

**PHILIPPINE BIDDING DOCUMENTS**

**PROCUREMENT OF  
VIRAC AIRPORT  
DEVELOPMENT PROJECT  
(Reblocking of Taxiway, Construction of  
CHB Perimeter Fence, and  
Construction of Drainage System)**

Government of the Republic of the Philippines

**BID NO. 24-010-02 ALPHA**

**Sixth Edition  
July 2020**

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# *Glossary of Terms, Abbreviations, and Acronyms*

**ABC** – Approved Budget for the Contract.

**ARCC** – Allowable Range of Contract Cost.

**BAC** – Bids and Awards Committee.

**Bid** – A signed offer or proposal to undertake a contract submitted by a bidder in response to and in consonance with the requirements of the bidding documents. Also referred to as *Proposal* and *Tender*. (2016 revised IRR, Section 5[c])

**Bidder** – Refers to a contractor, manufacturer, supplier, distributor and/or consultant who submits a bid in response to the requirements of the Bidding Documents. (2016 revised IRR, Section 5[d])

**Bidding Documents** – The documents issued by the Procuring Entity as the bases for bids, furnishing all information necessary for a prospective bidder to prepare a bid for the Goods, Infrastructure Projects, and/or Consulting Services required by the Procuring Entity. (2016 revised IRR, Section 5[e])

**BIR** – Bureau of Internal Revenue.

**BSP** – Bangko Sentral ng Pilipinas.

**CDA** – Cooperative Development Authority.

**Consulting Services** – Refer to services for Infrastructure Projects and other types of projects or activities of the GOP requiring adequate external technical and professional expertise that are beyond the capability and/or capacity of the GOP to undertake such as, but not limited to: (i) advisory and review services; (ii) pre-investment or feasibility studies; (iii) design; (iv) construction supervision; (v) management and related services; and (vi) other technical services or special studies. (2016 revised IRR, Section 5[i])

**Contract** – Refers to the agreement entered into between the Procuring Entity and the Supplier or Manufacturer or Distributor or Service Provider for procurement of Goods and Services; Contractor for Procurement of Infrastructure Projects; or Consultant or Consulting Firm for Procurement of Consulting Services; as the case may be, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.

**Contractor** – is a natural or juridical entity whose proposal was accepted by the Procuring Entity and to whom the Contract to execute the Work was awarded. Contractor as used in these Bidding Documents may likewise refer to a supplier, distributor, manufacturer, or consultant.

**CPI** – Consumer Price Index.

**DOLE** – Department of Labor and Employment.

**DTI** – Department of Trade and Industry.

**Foreign-funded Procurement or Foreign-Assisted Project** – Refers to procurement whose funding source is from a foreign government, foreign or international financing institution as specified in the Treaty or International or Executive Agreement. (2016 revised IRR, Section 5[b]).

**GFI** – Government Financial Institution.

**GOCC** – Government-owned and/or –controlled corporation.

**Goods** – Refer to all items, supplies, materials and general support services, except Consulting Services and Infrastructure Projects, which may be needed in the transaction of public businesses or in the pursuit of any government undertaking, project or activity, whether in the nature of equipment, furniture, stationery, materials for construction, or personal property of any kind, including non-personal or contractual services such as the repair and maintenance of equipment and furniture, as well as trucking, hauling, janitorial, security, and related or analogous services, as well as procurement of materials and supplies provided by the Procuring Entity for such services. The term “related” or “analogous services” shall include, but is not limited to, lease or purchase of office space, media advertisements, health maintenance services, and other services essential to the operation of the Procuring Entity. (2016 revised IRR, Section 5[r])

**GOP** – Government of the Philippines.

**Infrastructure Projects** – Include the construction, improvement, rehabilitation, demolition, repair, restoration or maintenance of roads and bridges, railways, airports, seaports, communication facilities, civil works components of information technology projects, irrigation, flood control and drainage, water supply, sanitation, sewerage and solid waste management systems, shore protection, energy/power and electrification facilities, national buildings, school buildings, hospital buildings, and other related construction projects of the government. Also referred to as *civil works or works*. (2016 revised IRR, Section 5[u])

**LGUs** – Local Government Units.

**NFCC** – Net Financial Contracting Capacity.

**NGA** – National Government Agency.

**PCAB** – Philippine Contractors Accreditation Board.

**PhilGEPS** - Philippine Government Electronic Procurement System.

**Procurement Project** – refers to a specific or identified procurement covering goods, infrastructure project or consulting services. A Procurement Project shall be described, detailed, and scheduled in the Project Procurement Management Plan prepared by the agency which shall be consolidated in the procuring entity's Annual Procurement Plan. (GPPB Circular No. 06-2019 dated 17 July 2019)

**PSA** – Philippine Statistics Authority.

**SEC** – Securities and Exchange Commission.

**SLCC** – Single Largest Completed Contract.

**UN** – United Nations.

# ***Section I. Invitation to Bid***



**Invitation to Bid for**

**VIRAC AIRPORT DEVELOPMENT PROJECT  
(REBLOCKING OF TAXIWAY, CONSTRUCTION OF  
CHB PERIMETER FENCE, AND CONSTRUCTION OF  
DRAINAGE SYSTEM)**

**Bid No. 24-010-02 ALPHA**

1. The Civil Aviation Authority of the Philippines, through the GAA CY 2018 DOTr Downloaded Projects intends to apply the sum of **FORTY-EIGHT MILLION THREE HUNDRED THIRTY-FIVE THOUSAND SEVEN HUNDRED TWELVE AND 48/100 (48,335,712.48)** being the Approved Budget for the Contract (ABC) to payments under the contract for **VIRAC AIRPORT DEVELOPMENT PROJECT (REBLOCKING OF TAXIWAY, CONSTRUCTION OF CHB PERIMETER FENCE, AND CONSTRUCTION OF DRAINAGE SYSTEM) (Bid No. 24-010-02 ALPHA)**. Bids received in excess of the ABC shall be automatically rejected at bid opening.
2. The Civil Aviation Authority of the Philippines now invites bids for the above Procurement Project. Completion of the Works is required **THREE HUNDRED (300) CALENDAR DAYS (inclusive of forty-five (45) unworkable/rainy days)** Bidders should have completed a contract similar to the Project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II (Instructions to Bidders).
3. Bidding will be conducted through open competitive bidding procedures using non-discretionary “*pass/fail*” criterion as specified in the 2016 revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184.
4. Interested bidders may obtain further information from the Civil Aviation Authority of the Philippines, BAC Office and inspect the Bidding Documents at the address given below from 08:00 AM to 05:00 PM from Monday to Friday.
5. A complete set of Bidding Documents may be acquired by interested bidders on **28 February 2024 until deadline of submission of bid** from given address and website/s below *and* upon payment of the applicable fee for the Bidding Documents, pursuant to the latest Guidelines issued by the GPPB, in the amount of **PHP 28,000.00 (inclusive of 12% VAT)**. The Procuring Entity shall allow the bidder to present its proof of payment for the fees by presenting the official receipt in person.



6. The Civil Aviation Authority of the Philippines will hold a Pre-Bid Conference<sup>1</sup> on **07 March 2024 @ 9:30 AM** through videoconferencing/webcasting via Jitsi/Zoom/Google Meet, which shall be open to prospective bidders.
7. Bids must be duly received by the BAC Secretariat through manual submission at the office address as indicated below on or before **19 March 2024 @ 9:30 AM**. Late bids shall not be accepted.
8. All bids must be accompanied by a bid security in any of the acceptable forms and in the amount stated in **ITB** Clause 16.
9. Bid opening shall be on **19 March 2024 @ 9:30 AM** at the given address below and/or Jitsi/Zoom/Google Meet. Bids will be opened in the presence of the bidders' representatives who choose to attend the activity.
10. The Civil Aviation Authority of the Philippines reserves the right to reject any and all bids, declare a failure of bidding, or not award the contract at any time prior to contract award in accordance with Sections 35.6 and 41 of the 2016 revised Implementing Rules and Regulations (IRR) of RA No. 9184, without thereby incurring any liability to the affected bidder or bidders.
11. For further information, please refer to:

**ENGR. LEANDRO R. VARQUEZ**

Head, BAC Secretariat

BAC Office

3<sup>rd</sup> Floor Supply, Procurement Building,

Civil Aviation Authority of the Philippines

MIA Road corner Ninoy Aquino Avenue

1300 Pasay City, Metro Manila

Telephone number – (+632) 8246-4988 loc.2236

Email: **bac@caap.gov.ph**

12. You may visit the following websites:

For downloading of Bidding Documents: **[www.caap.gov.ph](http://www.caap.gov.ph)**

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**CAPTAIN EDGARDO G. DIAZ**

Chairperson, BAC-ALPHA

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<sup>1</sup> May be deleted in case the ABC is less than One Million Pesos (PhP1,000,000) where the Procuring Entity may not hold a pre-bid conference.



## ***Section II. Instructions to Bidders***

## 1. **Scope of Bid**

The Procuring Entity, Civil Aviation Authority of the Philippines invites Bids for the **VIRAC AIRPORT DEVELOPMENT PROJECT (REBLOCKING OF TAXIWAY, CONSTRUCTION OF CHB PERIMETER FENCE, AND CONSTRUCTION OF DRAINAGE SYSTEM)**, with Project Identification Number: **Bid No. 24-010-02 ALPHA**.

The Procurement Project (referred to herein as “Project”) is for the construction of Works, as described in Section VI (Specifications).

## 2. **Funding Information**

2.1. The GOP through the source of funding as indicated below for GAA CY 2018 DOTR DOWNLOADED PROJECTS in the amount of **FORTY-EIGHT MILLION THREE HUNDRED THIRTY-FIVE THOUSAND SEVEN HUNDRED TWELVE AND 48/100 (48,335,712.48)**.

2.2. The source of funding is GOCC and GFIs, the Corporate Operating Budget.

## 3. **Bidding Requirements**

The Bidding for the Project shall be governed by all the provisions of RA No. 9184 and its 2016 revised IRR, including its Generic Procurement Manual and associated policies, rules and regulations as the primary source thereof, while the herein clauses shall serve as the secondary source thereof.

Any amendments made to the IRR and other GPPB issuances shall be applicable only to the ongoing posting, advertisement, or invitation to bid by the BAC through the issuance of a supplemental or bid bulletin.

The Bidder, by the act of submitting its Bid, shall be deemed to have inspected the site, determined the general characteristics of the contracted Works and the conditions for this Project, such as the location and the nature of the work; (b) climatic conditions; (c) transportation facilities; (c) nature and condition of the terrain, geological conditions at the site communication facilities, requirements, location and availability of construction aggregates and other materials, labor, water, electric power and access roads; and (d) other factors that may affect the cost, duration and execution or implementation of the contract, project, or work and examine all instructions, forms, terms, and project requirements in the Bidding Documents.

## 4. **Corrupt, Fraudulent, Collusive, Coercive, and Obstructive Practices**

The Procuring Entity, as well as the Bidders and Contractors, shall observe the highest standard of ethics during the procurement and execution of the contract. They or through an agent shall not engage in corrupt, fraudulent, collusive, coercive, and obstructive practices defined under Annex “I” of the 2016 revised IRR of RA No. 9184 or other integrity violations in competing for the Project.

## **5. Eligible Bidders**

- 5.1. Only Bids of Bidders found to be legally, technically, and financially capable will be evaluated.
- 5.2. The Bidder must have an experience of having completed a Single Largest Completed Contract (SLCC) that is similar to this Project, equivalent to at least fifty percent (50%) of the ABC adjusted, if necessary, by the Bidder to current prices using the PSA's CPI, except under conditions provided for in Section 23.4.2.4 of the 2016 revised IRR of RA No. 9184.

A contract is considered to be "similar" to the contract to be bid if it has the major categories of work stated in the **BDS**.

- 5.3. For Foreign-funded Procurement, the Procuring Entity and the foreign government/foreign or international financing institution may agree on another track record requirement, as specified in the Bidding Document prepared for this purpose.
- 5.4. The Bidders shall comply with the eligibility criteria under Section 23.4.2 of the 2016 IRR of RA No. 9184.

## **6. Origin of Associated Goods**

There is no restriction on the origin of Goods other than those prohibited by a decision of the UN Security Council taken under Chapter VII of the Charter of the UN.

## **7. Subcontracts**

- 7.1. The Procuring Entity has prescribed that subcontracting is not allowed.

## **8. Pre-Bid Conference**

The Procuring Entity will hold a pre-bid conference for this Project on the specified date and time and either at its physical address and/or through videoconferencing/webcasting as indicated in paragraph 6 of the **IB**.

## **9. Clarification and Amendment of Bidding Documents**

Prospective bidders may request for clarification on and/or interpretation of any part of the Bidding Documents. Such requests must be in writing and received by the Procuring Entity, either at its given address or through electronic mail indicated in the **IB**, at least ten (10) calendar days before the deadline set for the submission and receipt of Bids.

## **10. Documents Comprising the Bid: Eligibility and Technical Components**

- 10.1. The first envelope shall contain the eligibility and technical documents of the Bid as specified in **Section IX. Checklist of Technical and Financial Documents**.
- 10.2. If the eligibility requirements or statements, the bids, and all other documents for submission to the BAC are in foreign language other than English, it must be accompanied by a translation in English, which shall be authenticated by the appropriate Philippine foreign service establishment, post, or the equivalent office having jurisdiction over the foreign bidder's affairs in the Philippines. For Contracting Parties to the Apostille Convention, only the translated documents shall be authenticated through an apostille pursuant to GPPB Resolution No. 13-2019 dated 23 May 2019. The English translation shall govern, for purposes of interpretation of the bid.
- 10.3. A valid special PCAB License in case of Joint Ventures, and registration for the type and cost of the contract for this Project. Any additional type of Contractor license or permit shall be indicated in the **BDS**.
- 10.4. A List of Contractor's key personnel (e.g., Project Manager, Project Engineers, Materials Engineers, and Foremen) assigned to the contract to be bid, with their complete qualification and experience data shall be provided. These key personnel must meet the required minimum years of experience set in the **BDS**.
- 10.5. A List of Contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership, certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be, must meet the minimum requirements for the contract set in the **BDS**.

## **11. Documents Comprising the Bid: Financial Component**

- 11.1. The second bid envelope shall contain the financial documents for the Bid as specified in **Section IX. Checklist of Technical and Financial Documents**.
- 11.2. Any bid exceeding the ABC indicated in paragraph 1 of the **IB** shall not be accepted.
- 11.3. For Foreign-funded procurement, a ceiling may be applied to bid prices provided the conditions are met under Section 31.2 of the 2016 revised IRR of RA No. 9184.

## **12. Alternative Bids**

Bidders shall submit offers that comply with the requirements of the Bidding Documents, including the basic technical design as indicated in the drawings and

specifications. Unless there is a value engineering clause in the **BDS**, alternative Bids shall not be accepted.

### **13. Bid Prices**

All bid prices for the given scope of work in the Project as awarded shall be considered as fixed prices, and therefore not subject to price escalation during contract implementation, except under extraordinary circumstances as determined by the NEDA and approved by the GPPB pursuant to the revised Guidelines for Contract Price Escalation guidelines.

### **14. Bid and Payment Currencies**

14.1. Bid prices may be quoted in the local currency or tradeable currency accepted by the BSP at the discretion of the Bidder. However, for purposes of bid evaluation, Bids denominated in foreign currencies shall be converted to Philippine currency based on the exchange rate as published in the BSP reference rate bulletin on the day of the bid opening.

14.2. Payment of the contract price shall be made in Philippine Pesos.

### **15. Bid Security**

15.1. The Bidder shall submit a Bid Securing Declaration or any form of Bid Security in the amount indicated in the **BDS**, which shall be not less than the percentage of the ABC in accordance with the schedule in the **BDS**.

15.2. The Bid and bid security shall be valid until *[indicate date]*. Any bid not accompanied by an acceptable bid security shall be rejected by the Procuring Entity as non-responsive.

### **16. Sealing and Marking of Bids**

Each Bidder shall submit one copy of the first and second components of its Bid.

The Procuring Entity may request additional hard copies and/or electronic copies of the Bid. However, failure of the Bidders to comply with the said request shall not be a ground for disqualification.

If the Procuring Entity allows the submission of bids through online submission to the given website or any other electronic means, the Bidder shall submit an electronic copy of its Bid, which must be digitally signed. An electronic copy that cannot be opened or is corrupted shall be considered non-responsive and, thus, automatically disqualified.

### **17. Deadline for Submission of Bids**

The Bidders shall submit on the specified date and time and either at its physical address or through online submission as indicated in paragraph 7 of the **IB**.

## 18. Opening and Preliminary Examination of Bids

18.1. The BAC shall open the Bids in public at the time, on the date, and at the place specified in paragraph 9 of the **IB**. The Bidders' representatives who are present shall sign a register evidencing their attendance. In case videoconferencing, webcasting or other similar technologies will be used, attendance of participants shall likewise be recorded by the BAC Secretariat.

In case the Bids cannot be opened as scheduled due to justifiable reasons, the rescheduling requirements under Section 29 of the 2016 revised IRR of RA No. 9184 shall prevail.

18.2. The preliminary examination of Bids shall be governed by Section 30 of the 2016 revised IRR of RA No. 9184.

## 19. Detailed Evaluation and Comparison of Bids

19.1. The Procuring Entity's BAC shall immediately conduct a detailed evaluation of all Bids rated "*passed*" using non-discretionary pass/fail criteria. The BAC shall consider the conditions in the evaluation of Bids under Section 32.2 of 2016 revised IRR of RA No. 9184.

19.2. If the Project allows partial bids, all Bids and combinations of Bids as indicated in the **BDS** shall be received by the same deadline and opened and evaluated simultaneously so as to determine the Bid or combination of Bids offering the lowest calculated cost to the Procuring Entity. Bid Security as required by **ITB** Clause 15 shall be submitted for each contract (lot) separately.

19.3. In all cases, the NFCC computation pursuant to Section 23.4.2.6 of the 2016 revised IRR of RA No. 9184 must be sufficient for the total of the ABCs for all the lots participated in by the prospective Bidder.

## 20. Post Qualification

Within a non-extendible period of five (5) calendar days from receipt by the Bidder of the notice from the BAC that it submitted the Lowest Calculated Bid, the Bidder shall submit its latest income and business tax returns filed and paid through the BIR Electronic Filing and Payment System (eFPS), and other appropriate licenses and permits required by law and stated in the **BDS**.

## 21. Signing of the Contract

The documents required in Section 37.2 of the 2016 revised IRR of RA No. 9184 shall form part of the Contract. Additional Contract documents are indicated in the **BDS**.



## ***Section III. Bid Data Sheet***

# Bid Data Sheet

ITB Clause																												
5.2	<p>For this purpose, contracts similar to the Project refer to contracts which have the same major categories of work, which shall be:</p> <table border="1" style="width: 100%; margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Category</th> <th style="text-align: center;">ABC</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><b>1. Concreting of Roads or Other Structures or Drainage System</b></td> <td style="text-align: center;"><b>Php 48,335,712.48</b></td> </tr> </tbody> </table>	Category	ABC	<b>1. Concreting of Roads or Other Structures or Drainage System</b>	<b>Php 48,335,712.48</b>																							
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10.3	<p>Valid PCAB License or a valid special PCAB License in case of Joint Ventures, and registration for the type and cost of the contract for this Project.</p> <p><b>Medium A - License Category B</b> (Road, Highway Pavement, Railways, Airport Horizontal Structures, &amp; Bridges)</p> <p>No other contractor license or permit is required.</p>																											
10.4	<p>The key personnel must meet the required minimum years of experience set below:</p> <table border="1" style="width: 100%; margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Key Personnel</u></th> <th style="text-align: center;"><u>General Experience</u></th> <th style="text-align: center;"><u>Relevant Experience</u></th> </tr> </thead> <tbody> <tr> <td>Project (Civil) Engineer</td> <td style="text-align: center;">Five (5)</td> <td style="text-align: center;">Three (3) years in</td> </tr> <tr> <td>Geodetic Engineer</td> <td style="text-align: center;">years in</td> <td style="text-align: center;"><i>Concreting of</i></td> </tr> <tr> <td>Materials Engineer</td> <td style="text-align: center;">General</td> <td style="text-align: center;"><i>Roads or Other</i></td> </tr> <tr> <td>Construction Foreman</td> <td style="text-align: center;">Engineering</td> <td style="text-align: center;"><i>Structures or</i></td> </tr> <tr> <td>Construction Safety &amp; Health Officer</td> <td></td> <td style="text-align: center;"><i>Drainage System</i></td> </tr> </tbody> </table> <p><b>Use Annex “B” Forms 3, 4a, 4b &amp; 4c</b></p>	<u>Key Personnel</u>	<u>General Experience</u>	<u>Relevant Experience</u>	Project (Civil) Engineer	Five (5)	Three (3) years in	Geodetic Engineer	years in	<i>Concreting of</i>	Materials Engineer	General	<i>Roads or Other</i>	Construction Foreman	Engineering	<i>Structures or</i>	Construction Safety & Health Officer		<i>Drainage System</i>									
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10.5	<p>The minimum major equipment requirements are the following:</p> <table border="1" style="width: 100%; margin: 10px auto; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><u>Equipment</u></th> <th style="text-align: center;"><u>Capacity</u></th> <th style="text-align: center;"><u>Number of Units</u></th> </tr> </thead> <tbody> <tr> <td>Dump Truck</td> <td style="text-align: center;">12 cu.yd.</td> <td style="text-align: center;">Five (5)</td> </tr> <tr> <td>Backhoe with Excavator</td> <td style="text-align: center;">1.09 cu.m.</td> <td style="text-align: center;">Two (2)</td> </tr> <tr> <td>Transit Mixer</td> <td style="text-align: center;">5 cu.m. per trip</td> <td style="text-align: center;">Two (2)</td> </tr> <tr> <td>Concrete Vibrator</td> <td></td> <td style="text-align: center;">Two (2)</td> </tr> <tr> <td>Concrete Saw</td> <td style="text-align: center;">7.5 hp, 14” Blade Ø</td> <td style="text-align: center;">Two (2)</td> </tr> <tr> <td>Power Generator Set</td> <td></td> <td style="text-align: center;">Two (2)</td> </tr> <tr> <td>Welding Machine (Electric Driven, DC Output)</td> <td></td> <td style="text-align: center;">Two (2)</td> </tr> <tr> <td>Oxy-Acetylene Cutting Torch/ Welding Torch</td> <td></td> <td style="text-align: center;">Two (2)</td> </tr> </tbody> </table>	<u>Equipment</u>	<u>Capacity</u>	<u>Number of Units</u>	Dump Truck	12 cu.yd.	Five (5)	Backhoe with Excavator	1.09 cu.m.	Two (2)	Transit Mixer	5 cu.m. per trip	Two (2)	Concrete Vibrator		Two (2)	Concrete Saw	7.5 hp, 14” Blade Ø	Two (2)	Power Generator Set		Two (2)	Welding Machine (Electric Driven, DC Output)		Two (2)	Oxy-Acetylene Cutting Torch/ Welding Torch		Two (2)
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	<p>One Bagger Concrete Mixer One (1)</p> <p>Backhoe with Pavement Breaker 0.80 cu.m One (1)</p> <p>Payloader 1.50 cu.m One (1)</p> <p>Motorized Grader, G710A 140 hp One (1)</p> <p>Vibratory Single Smooth Drum Roller 10 MT, SD100DC One (1)</p> <p>Water Truck 16,000 L One (1)</p> <p>Unit Improvised Batching Plant One (1)</p> <p>Concrete Screeder 5.5HP One (1)</p> <p><b>Use Annex “B” Form 5</b></p>
12	No further instructions.
15.1	<p>The bid security shall be in the form of a Bid Securing Declaration or any of the following forms and amounts:</p> <p>a. The amount of not less than two percent (2%) of ABC, if bid security is in cash, cashier’s/manager’s check, bank draft/guarantee or irrevocable letter of credit;</p> <p>b. The amount of not less than five percent (5%) of ABC if bid security is in Surety Bond.</p>
19.2	Partial bid is not allowed. The infrastructure project is packaged in a single lot and the lot shall not be divided into sub-lots for the purpose of bidding, evaluation, and contract award.
20	<p>The Bidder with the Lowest Calculated Bid (LCB) that complies with and is responsive to all the requirements and conditions shall submit its</p> <p>a) Updated Valid PhilGEPS Certificate of Registration;</p> <p>b) Latest income and business tax returns filed through the Electronic Filing and Payment System (EFPS);</p> <p>c) Key personnel licenses;</p> <p>d) Updated status of all ongoing contracts, including contracts awarded but not yet started, issued by the government agency or private concerned;</p> <p>Failure to submit any of the post-qualification requirements on time, or a finding against the veracity thereof, shall disqualify the bidder for award. Provided, that in the event that a finding against the veracity of any of the documents submitted is made, it shall cause the forfeiture of the Bid Security in accordance with Section 69 of the IRR of RA 9184.</p>
21	<p>The following relevant project documents are required to be submitted by the successful bidder who submitted the LCRB as part of the Contract Agreement during its signing:</p> <p>a) Construction schedule</p> <p>b) Bar Chart &amp; S-curve</p> <p>c) PERT/CPM Network Diagram</p>

- d) Manpower schedule
- e) Construction methods
- f) Equipment utilization schedule

Construction safety & health programs approved by the Department of Labor & Employment (**VIRAC AIRPORT DEVELOPMENT PROJECT (REBLOCKING OF TAXIWAY, CONSTRUCTION OF CHB PERIMETER FENCE, AND CONSTRUCTION OF DRAINAGE SYSTEM))**)

## ***Section IV. General Conditions of Contract***

## 1. Scope of Contract

This Contract shall include all such items, although not specifically mentioned, that can be reasonably inferred as being required for its completion as if such items were expressly mentioned herein. All the provisions of RA No. 9184 and its 2016 revised IRR, including the Generic Procurement Manual, and associated issuances, constitute the primary source for the terms and conditions of the Contract, and thus, applicable in contract implementation. Herein clauses shall serve as the secondary source for the terms and conditions of the Contract.

This is without prejudice to Sections 74.1 and 74.2 of the 2016 revised IRR of RA No. 9184 allowing the GPPB to amend the IRR, which shall be applied to all procurement activities, the advertisement, posting, or invitation of which were issued after the effectivity of the said amendment.

## 2. Sectional Completion of Works

If sectional completion is specified in the **Special Conditions of Contract (SCC)**, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date shall apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

## 3. Possession of Site

3.1 The Procuring Entity shall give possession of all or parts of the Site to the Contractor based on the schedule of delivery indicated in the **SCC**, which corresponds to the execution of the Works. If the Contractor suffers delay or incurs cost from failure on the part of the Procuring Entity to give possession in accordance with the terms of this clause, the Procuring Entity's Representative shall give the Contractor a Contract Time Extension and certify such sum as fair to cover the cost incurred, which sum shall be paid by Procuring Entity.

3.2 If possession of a portion is not given by the above date, the Procuring Entity will be deemed to have delayed the start of the relevant activities. The resulting adjustments in contract time to address such delay may be addressed through contract extension provided under Annex "E" of the 2016 revised IRR of RA No. 9184.

## 4. The Contractor's Obligations

The Contractor shall employ the key personnel named in the Schedule of Key Personnel indicating their designation, in accordance with **ITB** Clause 10.3 and specified in the **BDS**, to carry out the supervision of the Works.

The Procuring Entity will approve any proposed replacement of key personnel only if their relevant qualifications and abilities are equal to or better than those of the personnel listed in the Schedule.

## **5. Performance Security**

- 5.1. Within ten (10) calendar days from receipt of the Notice of Award from the Procuring Entity but in no case later than the signing of the contract by both parties, the successful Bidder shall furnish the performance security in any of the forms prescribed in Section 39 of the 2016 revised IRR.
- 5.2. The Contractor, by entering into the Contract with the Procuring Entity, acknowledges the right of the Procuring Entity to institute action pursuant to RA No. 3688 against any subcontractor be they an individual, firm, partnership, corporation, or association supplying the Contractor with labor, materials and/or equipment for the performance of this Contract.

## **6. Site Investigation Reports**

The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the SCC supplemented by any information obtained by the Contractor.

## **7. Warranty**

- 7.1. In case the Contractor fails to undertake the repair works under Section 62.2.2 of the 2016 revised IRR, the Procuring Entity shall forfeit its performance security, subject its property(ies) to attachment or garnishment proceedings, and perpetually disqualify it from participating in any public bidding. All payables of the GOP in his favor shall be offset to recover the costs.
- 7.2. The warranty against Structural Defects/Failures, except that occasioned-on force majeure, shall cover the period from the date of issuance of the Certificate of Final Acceptance by the Procuring Entity. Specific duration of the warranty is found in the SCC.

## **8. Liability of the Contractor**

Subject to additional provisions, if any, set forth in the SCC, the Contractor's liability under this Contract shall be as provided by the laws of the Republic of the Philippines.

If the Contractor is a joint venture, all partners to the joint venture shall be jointly and severally liable to the Procuring Entity.

## **9. Termination for Other Causes**

Contract termination shall be initiated in case it is determined *prima facie* by the Procuring Entity that the Contractor has engaged, before, or during the implementation of the contract, in unlawful deeds and behaviors relative to contract acquisition and implementation, such as, but not limited to corrupt, fraudulent, collusive, coercive, and obstructive practices as stated in **ITB** Clause 4.

## **10. Dayworks**

Subject to the guidelines on Variation Order in Annex “E” of the 2016 revised IRR of RA No. 9184, and if applicable as indicated in the **SCC**, the Dayworks rates in the Contractor’s Bid shall be used for small additional amounts of work only when the Procuring Entity’s Representative has given written instructions in advance for additional work to be paid for in that way.

## **11. Program of Work**

11.1. The Contractor shall submit to the Procuring Entity’s Representative for approval the said Program of Work showing the general methods, arrangements, order, and timing for all the activities in the Works. The submissions of the Program of Work are indicated in the **SCC**.

11.2. The Contractor shall submit to the Procuring Entity’s Representative for approval an updated Program of Work at intervals no longer than the period stated in the **SCC**. If the Contractor does not submit an updated Program of Work within this period, the Procuring Entity’s Representative may withhold the amount stated in the **SCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program of Work has been submitted.

## **12. Instructions, Inspections and Audits**

The Contractor shall permit the GOP or the Procuring Entity to inspect the Contractor’s accounts and records relating to the performance of the Contractor and to have them audited by auditors of the GOP or the Procuring Entity, as may be required.

## **13. Advance Payment**

The Procuring Entity shall, upon a written request of the Contractor which shall be submitted as a Contract document, make an advance payment to the Contractor in an amount not exceeding fifteen percent (15%) of the total contract price, to be made in lump sum, or at the most two installments according to a schedule specified in the **SCC**, subject to the requirements in Annex “E” of the 2016 revised IRR of RA No. 9184.

## **14. Progress Payments**

The Contractor may submit a request for payment for Work accomplished. Such requests for payment shall be verified and certified by the Procuring Entity’s Representative/Project Engineer. Except as otherwise stipulated in the **SCC**, materials and equipment delivered on the site but not completely put in place shall not be included for payment.

## **15. Operating and Maintenance Manuals**

15.1. If required, the Contractor will provide “as built” Drawings and/or operating and maintenance manuals as specified in the **SCC**.



- 15.2. If the Contractor does not provide the Drawings and/or manuals by the dates stated above, or they do not receive the Procuring Entity's Representative's approval, the Procuring Entity's Representative may withhold the amount stated in the **SCC** from payments due to the Contractor.

## *Section V. Special Conditions of Contract*

# Special Conditions of Contract

GCC Clause	
2	Not applicable.
3.1	The <b>CIVIL AVIATION AUTHORITY OF THE PHILIPPINES</b> shall give possession of all parts of the Site to the Contractor upon receipt of the Notice to Proceed.
5	In addition to the Performance Security, winning bidder shall submit Contractor's All Risks Insurance (CARI) prior to signing of Contract.
6	None.
7.2	Fifteen (15) years.
10	No dayworks are applicable to the contract.
11.1	Not applicable.
11.2	Not applicable.
13	The amount of the advance payment shall not exceed 15% of the total contract price.
14	No further instructions.
15.1	<p>The date by which operating and maintenance manuals are required is upon completion of the project</p> <p>The date by which "as built" drawings are required is upon completion of the project.</p> <p>PDF/AutoCAD File of the "as built" plans shall include as attachment to the required hard copy of the same upon completion of the project.</p>
15.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is percent (2.00%) of the Contract price.



## ***Section VI. Specifications and Scopes of Work***

## **SCOPE OF WORK**

Name of Project: **VIRAC AIRPORT DEVELOPMENT PROJECT (REBLOCKING OF TAXIWAY, CONSTRUCTION OF CHB PERIMETER FENCE, AND CONSTRUCTION OF DRAINAGE SYSTEM)**

Location: Virac Airport, Virac, Catanduanes

Duration: Three Hundred (300) Calendar Days  
Inclusive of Forty-Five (45) rainy/unworkable days

The project covers the supply of labor, materials and equipment necessary for the **VIRAC AIRPORT DEVELOPMENT PROJECT (Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System)**. The details of work are best enumerated below, however, it is understood that the contract includes all works and services though not specifically mentioned herein, but are needed to fully complete the project shall be undertaken by the Contractor.

The following scopes of work shall be done in accordance with the approved plans, specifications and provisions of contract.

### **SPL 01 MOBILIZATION/DEMOBILIZATION**

This work includes mobilization and demobilization of the contractor's equipment necessary for performing the work required under the contract.

- a. Mobilization shall include all activities and associated costs for transportation of contractor's personnel, equipment, and establishment of offices, and other necessary facilities for the contractor's operations at the site.
- b. Demobilization shall include the disassembly of offices and other facilities on the site, as well as the removal and hauling of debris and rubbish materials.

### **SPL 02 CONSTRUCTION SAFETY AND HEALTH PROGRAM**

This item covers the provision of personnel protective equipment and devices intended for CAAP-Project Management Office (PMO) and resident engineer(s). The Contractor shall further take all necessary precautions against damage to the property of the airport and other facilities located at or adjacent to the worksite.

The Contractor shall at all times comply with any accident prevention, regulations and any safety regulations of local or national authorities or that are prescribed by CAAP.

The Contractor shall appoint a Safety Officer and Safety Aide to hold periodical safety meetings with the workers and with his own supervisors and foreman. In addition, the Contractor shall report in writing within twenty-four (24) hours to the PMO all the accidents involving the death of and/or injury to any person, resulting from the Contractor's operation.

### **SPL 03          PROVISION OF SURVEY INSTRUMENT**

The Contractor shall provide and maintain, as assistance to the PMO, the following survey instruments for inspecting and measuring the works of the project:

**a.      Total Station with AutoHeight and complete accessories 1 unit**

*GENERAL SPECIFICATIONS*

Display : Colored touch screen

Keyboard : Alpha numeric

Horizontal & Vertical Lock : Endless Drives

Operation time : up to 25 hours (combination of 2 battery)

AutoHeight Measurement : AutoHeight

Internal memory : 2 GB Flash

Memory card : SD card 1 GB

USB memory stick : 1 GB or 100,000 points or better

Operating System : Windows

Interfaces : RS232, USB device, Bluetooth, WLAN

Environmental Protection : IP66

Guide Light (EGL) : Working Range: 5 m to 150 m /

Position accuracy: 5 cm at 100 m

AC power cable 2-pole EU, to charger : 1

Battery int Li-Ion 11.1V/3500mAh : 2

Battery charger

### *Telescope*

Magnification : 30 x

Focusing range : 1.55 m / 5.08 ft

Field of view : 1°30' / 1.66 gon / 2.7 m at 100 m

Dust/Water/Humidity : IP66

Angular Measurement

Angular Accuracy : 3"

Minimum Angle Reading : 1"/5"

Distance resolution : 0:1" (0.1 mgon)

Quadruple axis compensation : Yes

Compensator range : +/-4

Circular level sensitivity : 6 / 2 mm

### *DISTANCE MEASUREMENT*

#### *Distance Range*

Prism : 3,500m

Non-prism : 500m



*Accuracy/Measurement time*

Single Prism

Precise+/Once : 1 mm + 1.5 ppm (typical 2.4 s)

Tracking/Continuously : 3 mm + 1.5 ppm (typical <0.15 s)

Averaging : 1 mm + 1.5 ppm

Long range mode : > 4 km: 5 mm + 2 ppm (typical 2.5 s)

Non-prism

0 m - 500 m : 2 mm + 2 ppm (typical 3 - 6 s)

> 500 m : 4 mm + 2 ppm (typical 3 - 6 s)

*ACCESSORIES*

*Tripod Setup Accessories*

Wooden Tripod, telescopic : 1

Tribrach Pro without optical plummet : 1

*Pole Setup Accessories*

Reflector pole, telescopic : 1

Circular prism w. holder + target : 1

Mini prism with pole : 1

*Miscellaneous Setup Accessories*

Data transfer cable : 1

*OTHER REQUIREMENTS:*

with Exclusive Manufacturer's Certificate

with Authorized Distributor's Certificate from Manufacturer

with Certified Manufacturer's Service Technician

with Local Service Center Certified by the Manufacturer

with Certified Manufacturer's Service Center in the Philippines

with one (1) year warranty on factory defects

with at least ten (10) years of experience in

supplying Survey Equipment

- b. GNSS Instrument including Base, Rover RTK and complete accessories 1 unit**

**• GNSS RECEIVER**

- Support GPS L1/L2/L5, BeiDou B1/B2/B3, GLONASS L1/L2/L3, Galileo E1/E5a/E5b/E6/AltBOC, QZSS L1/L2/L5, Navic L5, SBAS
- Advanced QUANTUMTM Generation III Technology WIFI/UHF/4G Module
- Up to 60° tilt IMU
- Smart Battery Design
- Low Power Consumption

*Signal Tracking*

at least 965 channels for simultaneously tracking satellite signals

*Positioning Specifications*

Static and Fast Static 2.5 mm + 0.5 ppm Horizontal

5 mm + 0.5 ppm Vertical

Long Observations Static	3 mm + 0.1 ppm Horizontal 3.5 mm + 0.4 ppm Vertical
Real Time Kinematic	8 mm + 1 ppm Horizontal 15 mm + 1 ppm Vertical
DGPS	<0.4 m RMS
SBAS	1 m 3D RMS
Standalone	1.5m 3D RMS

### *Communications*

1 x 7 pin lemo port (Combined Serial and USB function)

Baud rates up to 921600bps for serial

UHF modem1: Tx/Rx with full frequency range from 410-470 MHz2

Transmit power: 0.5-2 W adjustable

Range: 1-5 km3

WIFI: 802.11b/g/n

4G modem1

4G Bands: 800/900/1800/2100/2600 MHz 3G

Bands: 900/2100 MHz

2G Bands: 900/1800 MHz

Support GSM, Point to Point/Points and NTRIP

Position data output rates: 1 Hz, 2 Hz, 5 Hz, 10 Hz, 20 Hz

5 LEDs (indicating Power, Satellite Tracking, GPRS Status and Differential Data)

Bluetooth: V 4.0 protocol, compatible with Windows OS and Android OS

Calibration-free IMU integrated for Tilt Survey, up to 60° tilt with 2.5 cm accuracy

*Data Format*

Correction data I/O	RTCM 2.X, 3.X, CMR,CMR+
Position data output	ASCII: NMEA-0183 GSV, RMC, HDT, VHD, GGA, GSA, ZDA, VTG, GST; PTNL, PJK; PTNL, AVR; PTNL, GGK, ComNav Binary update to 20 Hz

*Environmental*

Operating temperature	-40 °C to + 65 °C
Storage temperature	-40 °C to + 85 °C
Humidity	100% non-condensing
Waterproof and dustproof	IP67, protected from temporary immersion to depth of 1 m
Vibration	MIL-STD 810 G standard, designed to Survive a 2 m drop onto concrete

*Electrical and Memory*

Input voltage	7-28 VDC
Power consumption	1.92 W4
Li-ion battery capacity	2 × 2000 mAh, up to 10 hours typically
Memory	at least 8 GB

*Software*

Field data collection software

**• DATA COLLECTOR**

- Android 8.1 Operating System
- MIL-STD 810 G and IP67 Certified
- 5"Sunlight Readable Touch Display
- 13 MP Camera with Autofocus
- Compact Design with Long Battery Life

*Overview*

CPU	at least 8 core 2.0GHz
System	at least Android 8.1
RAM	at least 4GB
ROM	at least 64GB
Camera	at least rear camera 13MP; front camera 5MP
Screen	at least 5 Inch HD highlight screen
Resolution	at least 1280*720
Touch	5-point capacitive touch screen
Signal tracking	GPS + BDS + GLONASS
Sensors	Geomagnetic, acceleration, light sensing distance
Buttons	Alphanumeric keyboard + 2 column keys + 1 power key

*Physical*

Size	207*84*20 mm
Weight	360g (Including battery)
Battery	7000mAh, can work at least 15 hours (With BT, WIFI on)

Charge	PE fast charge, less than 4 hours
TF	Support 128G extend TF card
Interface	USB-Type C, support fast charge, support OTG, Bottom charging contact to support dock charging
Working temperature	30°C ~ + 60°C
Storage temperature	-40°C ~ +80°C
IP	IP67
Shock and Vibration	MIL-STD 810 G standard, designed to survive a 1.5m drop onto concrete

#### *Communications*

BT	BT4.1 BLE
Wi-Fi	IEEE 802.11 a/b/g/n 2.4G 5G
4G	FDD-LTE B1/B3/B5/B7/B8 TDD-LTE B38/B39/B40/B41 TDSCDMA B34/B39 WCDMA B1/B2/B5/B8 GSM B2/B3/B5/B8 CDMA1x/CDMA2000 BC0/BC1
RFID	ISO14443A/B,ISO15693,NFC 0~5cm

### *Accessories*

AC adapter	1
USB cable	1
Hand strap	1
Battery	1

### **• UHF EXTERNAL DATALINK**

- Designed for GNSS RTK Survey Systems
- Change Channels From 410-470 MHz in the Field
- Channel Spacing at 12.5 kHz
- Support 9600/19200 Air Baud Rate
- 6 User-defined Power Levels From 2W to 30W
- Anti-reverse Power Protection
- Super-rugged IP67 Proof Level and Robust Reliability
- Work as TX/RX/Repeater Mode
- Support Industry Common UHF Protocols

### *General*

Frequency Range	410-470 MHz
Channel Spacing	12.5 kHz Channel Spacing
	$\pm 1.5$ ppm Stability
Work Mode	Half-duplex
Frequency Stability	1.5ppm
Modulation System	GMSK
Air Baud Rate	9600/19200 bps Selectable
Protocol Type	Transparent/South/Mac/TT450
Adjacent Channel Rejection Ratio	- 55 dB

Forward Error Correction	Yes
Sensitivity	-117dBm BER 10-5

*Electrical*

Power Supply	+10V ~ +14.5V DC
Transmit Current	1-2A (2W output power) 5-6A (30W output power)
Received Current	200mA (0.75W)
Transmit Power	2W/5W/10W/15W/20W/30W
Transmit Power Select	Low/High

*Environmental*

Operating Temperature	-40°C to +75°C
Storage Temperature	-50°C to +85°C
Humidity	100% no condensation
Dustproof and waterproof	IP67, protected from temporary immersion to depth 1m
Shock	Designed to survive a 2m drop onto concrete

*Physical*

Data Connector	1 Serial Port (7-pin Lemo) Baud rates 38400bps
Power Connector	2-pin Lemo port



RF External	50 Ohm, N-TYPE female
User Interface	-Power button (for powering receiver) -Channel button -Power selected button -Digital display
Size (with connector)	11cm × 18cm × 9.3cm
Weight	1.3 kg
Mount	Tripod Bracket, 5/8"-11 Range Pole

All survey instruments and tools shall be new and unused when initially put in place. Upon completion of the contract, all stated items shall be handed over to the End-user in good condition acceptable to the Engineer and shall become property of the End-user.

#### **SPL 04      TEMPORARY FACILITY**

##### **a. Staff House**

This item covers the Contractor’s provision of PMO Staff House on rental basis. The Facility shall be provided with air conditioning unit including the supply of kitchen utensils, gas and stove, beds and beddings, and dining sets for the exclusive use of CAAP-PMO in supervising the project. The Contractor shall be responsible for the payment of utility bills (water and electric) for the whole duration of the project.

##### **b. Service Vehicle**

This covers the provision of one rent to own service vehicle, brand new, latest model 4x4 pick-up, with air conditioning system, automatic transmission, power windows and locks, 2.5L diesel engine, with built-in 360 deg. camera view; for the exclusive use of CAAP Engineers supervising the project. Land Transportation Office (LTO) registration for the service vehicle will also be provided by the Contractor that are incorporated in the Contractor’s overhead cost throughout the duration of the project, but will not be considered as pay item.

The service vehicle including the Certificate of Registration and Official Receipt will be transferred and registered in the name of Civil Aviation Authority of the Philippines (CAAP) and will be turned over to the Aerodrome Development and Management Service (ADMS) in good running condition after the completion of the Project

**A. REBLOCKING OF TAXIWAY**

**1.00 SITEWORKS**

The work includes all materials, labor and equipment/tools to complete the removal/demolition and disposal of existing damaged pavement at taxiway indicated on the approved plans. It is the responsibility of the Contractor to transport all waste materials/ debris to proper disposal field. (Workmanship must be approved by the Project In-Charge assigned by CAAP)

Area of Taxiways

West Taxiway	:	1, 427.43 sq.m.
<u>East Taxiway</u>	:	<u>1,036.66 sq.m.</u>
TOTAL	:	2, 464.09 sq.m.

**200 AGGREGATE SUBBASE COURSE**

This item covers the furnishing, placing and compacting of aggregate subbase course on a prepared subgrade in accordance with the specification and shall conform to the lines, grades and cross section shown on the attached plans. The subbase course shall be composed of crushed/uncrushed coarse aggregate bonded with either soil or fine aggregates or both. (Materials to be used and workmanship must be approved by the Project In-Charge assigned by CAAP)

This item is identified in the following:

Area of Taxiways	:	2, 464.09 sq.m.
<u>Thickness of subbase</u>	:	<u>0.300 m.</u>
VOLUME	:	739.23 cu.m.

**311 PORTLAND CEMENT CONCRETE PAVEMENT**

This item covers the concrete paving of 0.25 meters thick Portland Cement Concrete Pavement on taxiway constructed on a prepared subbase in accordance with specified specifications and shall

conform to the lines, grades, thickness and paving joints shown on the approved plans. (Materials to be used and workmanship must be approved by the Project In-Charge assigned by CAAP)

This item is identified in the following:

Area of Taxiways : 2, 464.09 sq.m.  
Thickness of pavement : 0.250 m.  
VOLUME : 616.02 cu.m.

## **B. CONSTRUCTION OF CHB PERIMETER FENCE**

### **2.00 SITEWORKS**

This item covers the materials, labor and equipment for excavation, backfill and gravel bedding works as shown on the approved plans and in accordance with specifications and in conformity with the lines, grades and dimensions. The backfill shall be composed of selected common borrow (suitable) from the excavated materials. Hauling and disposal including any miscellaneous shall be the full responsibility of the contractor. This item covers the following:

1. Excavation Total Volume = 791.70 cu.m.
2. Backfill Total Volume = 684.57cu.m.
3. Gravel Bedding Total Volume = 85.0 cu.m.

### **3.00 CONCRETE WORKS**

This item covers the placement of reinforcing bars, forms, G.I. pipe embedded on concrete post and concrete pouring of lintel beams, column footings, columns and wall footings constructed on a prepared subbase with 50mm thick gravel bedding in accordance with the specifications and shall conform to the lines, grades, thickness and cross section shown on the approved plans. This item also consists of furnishing all materials, tools, and equipment including labor required in undertaking the proper application. Materials to be used and workmanship must be approved by the Project In-Charge assigned by CAAP. (Note: Follow the existing Terrain/ Slope)

1. Column Footing Total Concrete Volume = 41.58 cu.m.
2. Column Total Concrete Volume = 41.68 cu.m.

3. Wall Footing                      Total Concrete Volume = 39.93 cu.m.

4. Lintel Beam                      Total Concrete Volume = 34.73 cu.m.

### **3.00 MASONRY WORKS**

This item includes materials, labor and equipment required for the laying of 150 mm. thick CHB of covered area including cut, bend and installation of reinforcing steel bars, formworks and scaffolding as specified on the approved plans. CHB wall shall have mortar plaster (Costura finish) on both sides. (Materials to be used and workmanship must be approved by the Project In-Charge assigned by CAAP)

1. 150 mm. CHB                      Total Area of Fence = 1,538.54 sq.m.

Total Length of CHB Fence = 754 li.m.

### **4.00 STEEL WORKS**

This item includes materials, labor, equipment/tools and performance of all operations for steel works to complete the fabrication and installation of G.I. pipes with 8 strands of barbed wires as indicated on the approved plans. This item covers a total of 76 bays at 10.00 meters per bay. All G.I. pipes Sch. 40 shall be painted with epoxy primer before final coat is applied. The materials to be used must be approved by the CAAP Project-in-Charge. This item covers a total length of 754 linear meters.

## **C. CONSTRUCTION OF DRAINAGE SYSTEM**

### **5.00 SITEWORKS**

The work includes all materials, labor and equipment/tools for siteworks (excavation and disposal) including the provision of compacted gravel bedding of 75mm thickness as indicated on the approved plans. This item covers a total length of 1,689 linear meters.

### **6.00 CONCRETE WORKS**

This item covers the supply of materials, labor and equipment/tools needed for all concrete works which includes the provision of steel reinforcing bars and formworks necessary for the complete construction of drainage system at VPA in accordance with the approved plans and specifications.

1. Total Volume of Box Culvert = 1, 825.31 cu.m.

All scope of works for this item must be in accordance with the approved plans and specifications. Quality and types of materials must conform to specifications and must be approved by the project in-charge of the CAAP prior to installation.

The contractor shall be responsible in providing safety fence, personal protective equipment (PPE) for staffs and workers, and Safety Inspectors or Safety Engineers on site while construction is ongoing. Regular safety reports should be accomplished.

## **GENERAL PROVISIONS**

Provisions for staff house, service vehicles, laptops, printers, cameras, plotters, furniture and other materials, devices and equipment under Special Item or Temporary Facilities shall not include OCM & CP.

The contractor shall be responsible in providing safety perimeter fence or security fences, personal protective equipment (PPE) for staffs and workers on site while construction is ongoing. Safety reports should be prepared regularly.

The contractor shall be responsible for all laboratory, material testing, building and safety permits and survey instruments necessary in the project implementation. These expenses shall be incorporated in the contractor's overhead cost and shall not be considered as pay item.

# SPECIFICATIONS

## Section 105 Mobilization

**105-1 Description.** This item shall consist of work and operations, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

**105-1.1 Posted notices.** Prior to commencement of construction activities the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster “Equal Employment Opportunity is the Law” in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL “Notice to All Employees” Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

\*\*\*\*\*

**The Owner may include additional posted notices as required by local and State law.**

\*\*\*\*\*

**105-2 Basis of measurement and payment.** Based upon the contract lump sum price for “Mobilization” partial payments will be allowed as follows:

- a. With first pay request, 25%.
- b. When 25% or more of the original contract is earned, an additional 25%.
- c. When 50% or more of the original contract is earned, an additional 40%.

d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by 90-11, the final 10%.

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**Item Mobilization may be added to project at Owner’s discretion. Rather than paying Contractor 100% of mobilization on first pay request, many Sponsors have found a payment schedule to be an effective way to reimburse Contractor for mobilization and demobilization. It is not required but it is recommended that the final 10% of this bid item not be paid until the Contractor has cleaned up the project staging area. The payment schedule can be altered, e.g., on small projects may not be appropriate to have more than two (2) payments.**

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**END OF SECTION 105**

## Item P-152 Excavation, Subgrade, and Embankment

### DESCRIPTION

**152-1.1** This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans.

**152-1.2 Classification.** All material excavated shall be classified as defined below:

**a. Unclassified excavation.** Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature [ which is not otherwise classified and paid for under one of the following items ].

[ **b.** [ ] ]

[ Rock excavation. Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers. All boulders containing a volume of more than 1/2 cubic yard (0.4 m<sup>3</sup>) will be classified as "rock excavation." ]

[ Muck excavation. Muck excavation shall consist of the removal and disposal of deposits or mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials that will decay or produce subsidence in the embankment. It may consist of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment. ]

[ Drainage excavation. Drainage excavation shall consist of all excavation made for the primary purpose of drainage and includes drainage ditches, such as intercepting, inlet or outlet ditches; temporary levee construction; or any other type as shown on the plans. ]

[ Borrow excavation. Borrow excavation shall consist of approved material required for the construction of embankments or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas designated by the Resident Project Representative (RPR) within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport boundaries. ]

[ **Other.** ] ]



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**All material excavated shall be considered “unclassified” unless the Engineer specifies other classifications in the project specifications.**

**Add or delete the classifications not applicable for the project.**

\*\*\*\*\*

**152-1.3 Unsuitable excavation.** Unsuitable material shall be disposed in designated waste areas as shown on the plans. Materials containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material suitable for topsoil may be used on the embankment slope when approved by the RPR.

**CONSTRUCTION METHODS**

**152-2.1 General.** Before beginning excavation, grading, and embankment operations in any area, the area shall be cleared or cleared and grubbed in accordance with Item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the RPR. All unsuitable material shall be disposed of in waste areas as shown on the plans. All waste areas shall be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas shall be specified on the plans or approved by the RPR.

When the Contractor’s excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the RPR notified per Section 70, paragraph 70-20. At the direction of the RPR, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches (100 mm), to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches (100 mm) in their greatest dimension will not be permitted in the top 6 inches (150 mm) of the subgrade.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the RPR, who shall arrange for their removal if necessary. The Contractor, at their own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor’s operations during the period of the contract.

**a. Blasting.** [ Blasting shall not be allowed. ] [ Blasting will be permitted as directed by the RPR and in accordance with the following:

Blasting will be permitted only when proper precautions are taken for the safety of all persons, work, and property. All damage done to the work or property shall be repaired by the Contractor. The cost of repair is incidental to this item. All operations of the Contractor

in connection with the transportation, storage, and use of explosives shall conform to all federal, state and local regulations and explosive manufacturers' instructions, with applicable approved permits reviewed by the RPR. Any approval will not relieve the Contractor of their responsibility in blasting operations.

Where blasting is approved, the Contractor shall employ a vibration consultant, approved by the RPR, to advise on explosive charge weights per delay and to analyze records from seismograph recordings. The seismograph shall be capable of producing a permanent record of the three components of the motion in terms of particle velocity, and in addition shall be capable of internal dynamic calibration.

In each distinct blasting area, where pertinent factors affecting blast vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the RPR for approval. This plan must consist of hole size, depth, spacing, burden, type of explosives, type of delay sequence, maximum amount of explosive on any one delay period, depth of rock, and depth of overburden if any. The maximum explosive charge weights per delay included in the plan shall not be increased without the approval of the RPR.

The Contractor shall keep a record of each blast: its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location.

Blasting and explosive storage shall be in accordance with Section 70, paragraph 70-09 and all federal, state, and local safety regulations.

These records shall be made available to the RPR on a monthly basis or in tabulated form at other times as required. ]

**152-2.2 Excavation.** No excavation shall be started until the work has been staked out by the Contractor and the RPR has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and RPR shall agree that the original ground lines shown on the original topographic mapping are accurate, or agree to any adjustments made to the original ground lines.

[ Digital terrain model (DTM) files of the existing surfaces, finished surfaces and other various surfaces were used to develop the design plans.

[ Volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and generating Triangle Volume Reports. Electronic copies of DTM files and a paper copy of the original topographic map will be issued to the successful bidder. ]

[ Volumetric quantities were calculated using design cross sections which were created for this project using the DTM files of the applicable design surfaces and generating End Area Volume Reports. Paper copies of design cross sections and a paper copy of the original topographic map will be issued to the successful bidder. ]

Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within [ 0.1 foot (30 mm) ] of the stated elevations for ground surfaces, or within [ 0.04 foot (12 mm) ] for hard surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Contractor's verification identifies discrepancies in the topographic map, Contractor shall notify the RPR in writing at least [ two weeks ] before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area. ]

\*\*\*\*\*

**Delete bracketed DTM paragraphs if DTM not used.**

\*\*\*\*\*All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the RPR. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

The grade shall be maintained so that the surface is well drained at all times.

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the RPR. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

\*\*\*\*\*

**During the design phase, perform subsurface investigations to identify existing subsurface conditions to minimize the potential for unforeseen conditions arising during excavation such as the need for dewatering or removal of unsuitable materials.**

\*\*\*\*\*

**a. Selective grading.** When selective grading is indicated on the plans, the more suitable material designated by the RPR shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas until it can be placed. The more suitable material shall then be placed and compacted as specified. Selective grading shall be considered incidental to the work involved. The cost of stockpiling and placing the material shall be included in the various pay items of work involved.

**b. Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches (300 mm) below the subgrade or to the depth specified by the RPR. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be [ disposed of at locations shown on the plans. ] [ disposed off the airport. The cost is incidental to this item. ] This excavated material shall be paid for at the contract unit price per cubic yard (per cubic meter) for [ \_\_\_\_ ]. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans. Undercutting will be paid as [ unclassified excavation ] [ rock excavation ].

\*\*\*\*\*

**The Engineer shall specify the appropriate class of excavation. If rock or muck excavation is not included under paragraph 152-1.2, unclassified excavation should be specified.**

**The plans shall show details for draining pockets created in rock cuts.**

\*\*\*\*\*

**c. Over-break.** Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the RPR. All over-break shall be graded or removed by the Contractor and disposed of as directed by the RPR. The RPR shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the RPR determines as avoidable. Unavoidable over-break will be classified as “Unclassified Excavation.”

**d. Removal of utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished [ by someone other than the Contractor ] [ by the Contractor as indicated on the plans ]. All existing

foundations shall be excavated at least 2 feet (60 cm) below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the RPR. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as shown on the plans.

**152-2.3 Borrow excavation.** [ Borrow areas are not required. ] [ Borrow areas within the airport property are indicated on the plans. Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed by the RPR. All unsuitable material shall be disposed of by the Contractor as shown on the plans. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant. [ ] ]

[ There are no borrow sources within the boundaries of the airport property. The Contractor shall locate and obtain borrow sources, subject to the approval of the RPR. The Contractor shall notify the RPR at least [ 15 ] days prior to beginning the excavation so necessary measurements and tests can be made by the RPR. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant. [ ] ]

\*\*\*\*\*

**For on-site borrow areas, the Engineer must determine the acceptability of the borrow material before identifying the area on the plans.**

**For off-site borrow areas obtained by the Contractor, the RPR must determine the acceptability of the borrow material before its use on the project.**

**Address hazardous wildlife attractants when opening borrow sites on or near an airport. Add references and sources addressing standing water, permitting, approvals, and zoning. Reference AC 150/5200-33, Hazardous Wildlife Attractants on or near Airports.**

\*\*\*\*\*

**152-2.4 Drainage excavation.** Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the RPR. All necessary work shall be performed true to final line, elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

**152-2.5 Preparation of cut areas or areas where existing pavement has been removed.** In those areas on which a subbase or base course is to be placed, the top [ 12 inches (300 mm) ] of

subgrade shall be compacted to not less than [ 100 % ] of maximum density for non-cohesive soils, and [ 95% ] of maximum density for cohesive soils as determined by ASTM [\_\_\_\_]. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

\*\*\*\*\*

**For subgrade under flexible and rigid pavements, the Engineer shall specify the required compaction depth and density as determined from the geotechnical report and the FAARFIELD Airport Pavement Design compaction recommendations. The current version of FAARFIELD is available at: [www.faa.gov/airports/engineering/design\\_software/](http://www.faa.gov/airports/engineering/design_software/)**

**Specify ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds (27200 kg) or less and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27200 kg).**

**For soils with expansive characteristics, the maximum density should be determined in accordance with ASTM D698 regardless of aircraft weight.**

\*\*\*\*\*

**152-2.6 Preparation of embankment area.** All sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches (150 mm) and shall then be compacted per paragraph 152-2.10.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches (300 mm) and compacted as specified for the adjacent fill.

\*\*\*\*\*

**The Engineer shall include benching details on the plans based on the type of material, degree of consolidation of the material, and the degree of homogeneity of the material. The minimum width of the bench shall be sufficient to accommodate construction equipment.**

**The Engineer should consider the consolidation of embankments over 4 feet (1.2 m) and consider installation of monitoring equipment such as settlement plates and inclinometers for deep fills.**

\*\*\*\*\*

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

**152-2.7 Control Strip.** The first half-day of construction of subgrade and/or embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the RPR, that the

materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches (300 mm) upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the RPR. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the RPR.

**152-2.8 Formation of embankments.** The material shall be constructed in lifts as established in the control strip, but not less than 6 inches (150 mm) nor more than 12 inches (300 mm) of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the RPR. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each lift shall be within  $\pm 2\%$  of optimum moisture content before rolling to obtain the prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or manipulation alone to increase the rate of evaporation.

The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content to achieve the specified embankment density.

The [RPR][contractor] will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with [ ASTM D698 ] [ D 1557 ]. A new Proctor shall be developed for each soil type based on visual classification.

Density tests will be taken by the [RPR][contractor] for every [ 3,000 ] square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the RPR.

If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow AASHTO T-180 Annex Correction of maximum dry density and optimum moisture for oversized particles.

\*\*\*\*\*

**It is recommended that density tests be made for each 3,000 square yards (2500 square meters) of material placed per lift. Testing frequency should be determined by the Geotechnical Engineer. The Engineer may specify other frequencies as appropriate to the job size. If necessary to apply special controls to the moisture content of the soil during or after compaction to ensure strength because of the presence of expansive soils or other unusually sensitive soils), the Engineer must specify the appropriate moisture content. The moisture limitations shall be specified using acceptable moisture ranges as determined by ASTM D698 or ASTM D1557. Refer to FAA RD-76-66, Design and Construction of Airport Pavements on Expansive Soils, for additional guidance.**

**If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow the methods in the ASTM D698 or D1557; or AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles.**

**If nuclear density machines are to be used for density determination, the machines shall be calibrated in accordance with ASTM D6938.**

**Include testing frequencies per square yard for density and moisture acceptance tests.**

\*\*\*\*\*

Rolling operations shall be continued until the embankment is compacted to not less than [ 100% ] of maximum density for non-cohesive soils, and [ 95% ] of maximum density for cohesive soils as determined by ASTM [\_\_\_\_]. Under all areas to be paved, the embankments shall be compacted to a depth of [\_\_\_\_] and to a density of not less than [\_\_\_\_] percent of the maximum density as determined by ASTM [\_\_\_\_]. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

\*\*\*\*\*

**For subgrade under flexible and rigid pavements, the Engineer shall specify the required compaction depth and density as determined from the geotechnical report and the FAARFIELD Airport Pavement Design compaction recommendations. The current version of FAARFIELD is available at: [www.faa.gov/airports/engineering/design\\_software/](http://www.faa.gov/airports/engineering/design_software/)**

**Specify ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds (27200 kg) or less and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27200 kg).**



**For soils with expansive characteristics, the maximum density should be determined in accordance with ASTM D698 regardless of aircraft weight.**

\*\*\*\*\*

On all areas outside of the pavement areas, no compaction will be required on the top [ 4 inches (100 mm) ] which shall be prepared for a seedbed in accordance with [ Item T-901 ] [ T-906 ].

The in-place field density shall be determined in accordance with [ ASTM D1556 ] [ ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. ]. The [ RPR shall perform all density tests ] [ Contractor's laboratory shall perform all density tests in the RPR's presence and provide the test results upon completion to the RPR for acceptance ]. If the specified density is not attained, the area represented by the test or as designated by the RPR shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the embankment and the subgrade material shall be incorporated under the future paved areas. Stones, fragmentary rock, and recycled pavement larger than 4 inches (100 mm) in their greatest dimensions will not be allowed in the top 12 inches (300 mm) of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the RPR and the finer material shall be used to fill the voids forming a dense, compact mass. Rock, cement concrete pavement, asphalt pavement, and other embankment material shall not be disposed of except at places and in the manner designated on the plans or by the RPR.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding 2 feet (60 cm) in thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation 4 feet (1.2 m) below the finished subgrade.

[ There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in lifts, compacting, discing, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for excavation, borrow,

or other items. ] [ Payment for compacted embankment will be made under embankment in-place and no payment will be made for excavation, borrow, or other items. ]

**152-2.9 Proof rolling.** [ Not Used ] The purpose of proof rolling the subgrade is to identify any weak areas in the subgrade and not for compaction of the subgrade. [ Before start of embankment, ] [ and ] [ After compaction is completed, ] the subgrade area shall be proof rolled with a [ [ 20 ton (18.1 metric ton) ] Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to [ 80/100/150 psi (0.551 MPa/0.689 MPa/1.034 MPa) ] ] [ [ ] ton Proof Roller with tires spaced not more than 32 inches (0.8 m) on-center with tires inflated to [ 100/125/150 psi (0.689 MPa/0.861 MPa/1.034 MPa) ] ] in the presence of the RPR. Apply a minimum of [ ] coverage, or as specified by the RPR, under pavement areas. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch (25 mm) or show permanent deformation greater than 1 inch (25 mm) shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

\*\*\*\*\*

**The Engineer shall select the proof-rolling method and number of coverages.**

**Drawings should be checked to ensure that any supplementary information required by this paragraph has been shown and that there is no conflict between the drawings and the specifications.**

**When proof rolling not used, delete all text from Paragraph 152-2.9 and insert Not Used.**

\*\*\*\*\*

**152-2.10 Compaction requirements.** The subgrade under areas to be paved shall be compacted to a depth of [ 12 inches (300 mm) ] and to a density of not less than [ 100 ] percent of the maximum dry density as determined by ASTM [ D1557 ] [ D698 ]. The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of [ 12 inches (300 mm) ] and to a density of not less than [ 95 ] percent of the maximum density as determined by ASTM [ D698 ].

The material to be compacted shall be within  $\pm 2\%$  of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent retained on the  $\frac{3}{4}$  inch (19.0 mm) sieve, follow the [ methods in [ ASTM D698 ] [ ASTM D1557 ] ] [ procedures in AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles. ] Tests for moisture content and compaction will be taken at a minimum of [ ] S.Y. of subgrade. All quality assurance testing shall be done by [ the RPR. ] [ the Contractor's laboratory in the presence of the RPR, and density test results shall be furnished upon completion to the RPR for acceptance determination. ]

\*\*\*\*\*

The Engineer shall specify the required compaction depths and densities as determined from FAARFIELD Airport Pavement Design Report. The current version of FAARFIELD is available at: [https://www.faa.gov/airports/engineering/design\\_software/](https://www.faa.gov/airports/engineering/design_software/)

The Engineer shall specify ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds (27200 kg) or less, and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000 pounds (27200 kg).

If the material has greater than 30% retained on the 3/4-inch (19.0 mm) sieve, follow the methods in the ASTM D698 or D1557; or AASHTO T180 Annex for correction of maximum dry density and optimum moisture for oversized particles.

Include testing frequencies per square yard (square meter) for density and moisture acceptance tests.

\*\*\*\*\*

The in-place field density shall be determined in accordance with [ ASTM D1556 ][ ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938 within 12 months prior to its use on this contract. The gage shall be field standardized daily. ]

Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the RPR and the finished subgrade shall be maintained.

**152-2.11 Finishing and protection of subgrade.** Finishing and protection of the subgrade is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans. All ruts or rough places that develop in the completed subgrade shall be graded, re-compacted, and retested. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been accepted by the RPR.

**152-2.12 Haul.** All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling operations shall be repaired at the Contractor's expense.

The Contractor shall be responsible for providing, maintaining and removing any haul roads or routes within or outside of the work area, and shall return the affected areas to their former condition, unless otherwise authorized in writing by the Owner. No separate payment will be made for any work or materials associated with providing, maintaining and removing haul roads or routes.

**152-2.13 Surface Tolerances.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches (75 mm), reshaped and re-compacted to grade until the required smoothness and accuracy are obtained and approved by the RPR. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

- a. **Smoothness.** The finished surface shall not vary more than +/- 1/2 inch (12 mm) when tested with a 12-foot (3.7-m) straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot (3.7-m) straightedge for the full length of each line on a 50-foot (15-m) grid.
- b. **Grade.** The grade and crown shall be measured on a 50-foot (15-m) grid and shall be within +/-0.05 feet (15 mm) of the specified grade.

On safety areas, turfed areas and other designated areas within the grading limits where no subbase or base is to be placed, grade shall not vary more than 0.10 feet (30 mm) from specified grade. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

**152-2.14 Topsoil.** When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on the plans and the approved CSPP, and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the RPR, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

\*\*\*\*\*

**Refer to AC 150/5370-2, Operational Safety on Airports During Construction when developing the Construction Safety and Phasing Plan (CSPP).**

\*\*\*\*\*

Upon completion of grading operations, stockpiled topsoil shall be handled and placed as shown on the plans and as required in Item T-905. Topsoil shall be paid for as provided in Item T-905. No direct payment will be made for topsoil under Item P-152.

## METHOD OF MEASUREMENT

**152-3.1** Measurement for payment specified by the cubic yard (cubic meter) shall be computed by the [ average end areas of design cross sections ] [ the comparison of digital terrain model (DTM) surfaces ] for computation of neat line design quantities ]. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by cross-sections shown on the plans, subject to verification by the RPR.

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**The Engineer may edit method of volume calculations. The method of calculating volumes must meet or exceed the accuracy of the average end area method. The method of field verification should be described and must meet or exceed what is currently specified for the average end area method.**

\*\*\*\*\*

**152-3.1** [ The quantity of [ unclassified ] [ rock ] [ muck ] [ drainage ] excavation to be paid for shall be the number of cubic yards (cubic meters) measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed. ]

[ **152-3.2** The quantity of embankment in place shall be the number of cubic yards (cubic meters) measured in its final position. ]

[ **152-3.3** [ Stockpiled material shall be paid for on the basis of the number of cubic yards (cubic meters) measured in the stockpiled position. ] [ Stockpiled material shall not be measured for payment in the stockpiled position. ] ]

## BASIS OF PAYMENT

**152-4.1** [ Unclassified excavation ] [ Rock Excavation ] [ Muck Excavation ] [ Drainage Excavation ] [ Stockpiled Material ] payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

[ **152-4.2** For embankment in place, payment shall be made at the contract unit price per cubic yard (cubic meter). This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item. ]

[ **152-4.3** Stockpiled material shall be paid for on the basis of the number of cubic yards (cubic meters) measured in the stockpiled position. ]

Payment will be made under:

[ Item P-152-4.1 [ [ Unclassified ] [ Rock ] [ Muck ]  
[ Drainage ] [ Excavation ] [ Stockpiled  
material ] ]-per cubic yard (cubic meter) ]

[ Item P-152-4.2 Embankment in place - per cubic yard (cubic  
meter) ]

[ Item P-152-4.3 Stockpiled material - per cubic yard (cubic meter) ]

## Item 105 – SUBGRADE PREPARATION

### 105.1 Description

This Item shall consist of the preparation of the subgrade for the support of overlying structural layers. It shall extend to full width of the roadway. Unless authorized by the Engineer, subgrade preparation shall not be done unless the Contractor is able to start immediately the construction of the pavement structure.

### 105.2 Material Requirements

Unless otherwise stated in the Contract and except when the subgrade is in rock cut, all materials below subgrade level to a depth 150 mm or to such greater depth as may be specified shall meet the requirements of Section 104.2, Selected Borrow for Topping.

### 105.3 Construction Requirements

#### 105.3.1 Prior Works

Prior to commencing preparation of the subgrade, all culverts, cross drains, ducts and the like (including their fully compacted backfill), ditches, drains and drainage outlets shall be completed. Any work on the preparation of the subgrade shall not be started unless prior work herein described shall have been approved by the Engineer.

#### 105.3.2 Subgrade Level Tolerances

The finished compacted surface of the subgrade shall conform to the allowable tolerances as specified hereunder:

Permitted variation from	+	20 mm
design LEVEL OF SURFACE	-	30 mm
Permitted SURFACE IRREGULARITY		
MEASURED BY 3-m STRAIGHT EDGE		30 mm
Permitted variation from		
design CROSSFALL OR CAMBER	±	0.5 %
Permitted variation from	±	0.1 %
design LONGITUDINAL		
GRADE		
over 25 m length		

### **105.3.3 Subgrade in Common Excavation**

Unless otherwise specified, all materials below subgrade level in earth cuts to a depth 150 mm or other depth shown on the Plans or as directed by the Engineer shall be excavated. The material, if suitable, shall be set aside for future use or, if unsuitable, shall be disposed off in accordance with the requirements of Subsection 102.2.9.

Where material has been removed from below subgrade level, the resulting surface shall be compacted to a depth of 150 mm and in accordance with other requirements of Subsection 104.3.3.

All materials immediately below subgrade level in earth cuts to a depth of 150 mm, or to such greater depth as may be specified, shall be compacted in accordance with the requirements of Subsection 104.3.3.

### **105.3.4 Subgrade in Rock Excavation**

Surface irregularities under the subgrade level remaining after trimming of the rock excavation shall be leveled by placing specified material and compacted to the requirements of Subsection 104.3.3.

### **105.3.5 Subgrade on Embankment**

After the embankment has been completed, the full width shall be conditioned by removing any soft or other unstable material that will not compacted properly. The resulting areas and all other low sections, holes, or depressions shall be brought to grade with suitable material. The entire roadbed shall be shaped and compacted to the requirements of Subsections 104.3.3. Scarifying, blading, dragging, rolling, or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the cross-sections shown on the Plans.

### **105.3.6 Subgrade on Existing Pavement**

Where the new pavement is to be constructed immediately over an existing Portland Cement concrete pavement and if so specified in the Contract the slab be broken into pieces with greatest dimension of not more than 500 mm and the existing pavement material compacted as specified in Subsection 104.3.3, as directed by the Engineer. The resulting subgrade level shall, as part pavement construction be shaped to conform to the allowable tolerances of Subsection 105.3.2 by placing and compacting where necessary a leveling course comprising the material of the pavement course to be placed immediately



above.

Where the new pavement is to be constructed immediately over an existing asphalt concrete pavement or gravel surface pavement and if so specified in the Contract the pavement shall be scarified, thoroughly loosened, reshaped and recompactd in accordance with Subsection 104.3.3. The resulting subgrade level shall conform to the allowable tolerances of Subsection 105.3.2.

### **105.3.7 Protection of Completed Work**

The Contractor shall be required to protect and maintain at his own expense the entire work within the limits of his Contract in good condition satisfactory to the Engineer from the time he first started work until all work shall have been completed. Maintenance shall include repairing and recompactd ruts, ridges, soft spots and deteriorated sections of the subgrade caused by the traffic of the Contractor's vehicle/equipment or that of the public.

### **105.3.8 Templates and Straight-edges**

The Contractor shall provide for use of the Engineer, approved templates and straight- edges in sufficient number to check the accuracy of the work, as provided in this Specification.

## **105.4 Method of Measurement**

### **105.4.1 Measurement of Items for payment shall be provided only for:**

1. The compaction of existing ground below subgrade level in cuts of common material as specified in Subsection 105.3.3.
2. The breaking up or scarifying, loosening, reshaping and recompactd of existing pavement as specified in Subsection 105.3.6. The quantity to be paid for shall be the area of the work specified to be carried out and accepted by the Engineer.

**105.4.2** Payment for all work for the preparation of the subgrade, including shaping to the required levels and tolerances, other than as specified above shall be deemed to be included in the Pay Item for Embankment.

## **105.5 Basis of Payment**

The accepted quantities, measured as prescribed in Section 105.4, shall be paid for at the appropriate contract unit price for Pay Item listed below that is included in the

Bill of Quantities which price and payment shall be full compensation for the placing or removal and disposal of all materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
105 (1)	Subgrade Preparation (Common Material)	Square Meter
105 (2)	Subgrade Preparation (Existing Pavement)	Square Meter
105 (3)	Subgrade Preparation (Unsuitable Material)	Square Meter

## ITEM 200 – AGGREGATE SUBBASE COURSE

### 200.1 DESCRIPTION

This item shall consist of furnishing, placing and compacting an aggregate subbase course on a prepared subgrade in accordance with this Specification and the lines, grades and cross-sections shown on the Plans, or as directed by the Engineer.

### 200.2 MATERIAL REQUIREMENTS

Aggregate for subbase shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable subbase.

The subbase material shall conform to Table 200.1, Grading Requirements

**Table 200.1 – Grading Requirements**

Sieve Designation		Mass Percent Passing
Standard, mm	Alternate US Standard	
50	2"	100
25	1"	55 – 85
9.5	3/8"	40 – 75
0.075	No. 200	0 - 12

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and plasticity index not greater than 12 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve, shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion Tests as determined by AASHTO T 96.

The material shall have a soaked CBR value of not less than 25% as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density and determined by AASHTO T 180, Method D.

## 200.3 CONSTRUCTION REQUIREMENTS

**200.3.1 Preparation of Existing Surface.** The existing surface shall be graded and finished as provided under Item 105, Subgrade Preparation, before placing the subbase material.

**200.3.2 Placing.** The aggregate subbase material shall be placed at a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow. The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.

When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

**200.3.3 Spreading and Compacting.** When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150 mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate subbase shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of subbase material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothing, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the subbase material shall be compacted thoroughly with approved tampers or compactors.

If the layer of subbase material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a field density of at least 100 percent of the

maximum dry density determined in accordance with AASHTO T180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191.

**200.3.4 Trial Sections.** Before subbase construction is started, the Contractor shall spread and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m<sup>2</sup> shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for subbase, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

**200.3.5 Tolerances.** Aggregate subbase shall be spread with equipment that will provide a uniform layer which when compacted will conform to the designed level and transverse slopes as shown on the Plans. The allowable tolerances shall be as specified hereunder:

Permitted variation from design THICKNESS OF LAYER	± 20 mm
Permitted variation from design LEVEL OF SURFACE	+10 mm 20 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	20mm
Permitted variation from design CROSSFALL OR CAMBER	±0.3%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	±0.1%

**200.4 Method of Measurement.** Aggregate Subbase Course will be measured by the

cubic meter (m<sup>3</sup>). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course. No allowance will be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of subbase herein measured.

**200.5 Basis of Payment.** The accepted quantities, measured as prescribed in Section 200.4, shall be paid for at the contract unit price for Aggregate Subbase Course which price and payment shall be full compensation for furnishings and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
200	Aggregate Subbase Course	Cubic Meter

## ITEM 311 – PORTLAND CEMENT CONCRETE PAVEMENT

### 311.1 DESCRIPTION

This Item shall consist of pavement of Portland Cement Concrete, with or without reinforcement, constructed on the prepared base in accordance with this Specification and in conformity with lines, grades, thickness and typical cross-section shown on the Plans.

### 311.2 MATERIAL REQUIREMENTS

**311.2.1 Portland Cement.** It shall conform to the applicable requirements of Item 700, Hydraulic Cement. Only Type I Portland Cement shall be used unless otherwise provided for in the Special Provisions. Different brands or the same brands from different mills shall not be mixed nor shall they be used alternately unless the mix is approved by the Engineer. However, the use of Portland Pozzolan Cement Type IP meeting the requirements of AASHTO M 240/ASTM C 695, Specifications for Blended Hydraulic Cement shall be allowed, provided that trial mixes shall be done and that the mixes meet the concrete strength requirements, the AASHTO/ASTM provisions pertinent to the use of Portland Pozzolan Type IP shall be adopted.

Cement which for any reason, has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used. Samples of Cement shall be obtained in accordance with AASHTO T 127.

**311.2.2 Fine Aggregate.** It shall consist of natural sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles. Fine aggregate from different sources of supply shall not be mixed or stored in the same pile nor used alternately in the same class of concrete without the approval of the Engineer.

It shall not contain more than three (3) mass percent of material passing the 0.075 mm (No. 200 sieve) by washing nor more than one (1) mass percent each of clay lumps or shale. The use of beach sand will not be allowed without the approval of the Engineer.

If the fine aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 10 mass percent.

The fine aggregate shall be free from injurious amounts of organic impurities. If subjected to the colorimetric test for organic impurities and a color darker than the standard is produced, it shall be rejected. However, when tested for the effect of organic impurities of strength of mortar by AASHTO T 71, the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95 mass percent.

The fine aggregate shall be well-graded from coarse to fine and shall conform to Table 311.1

**Table 311.1 – Grading Requirements for Fine Aggregate**

Sieve Designation	Mass Percent Passing
9.5 mm (3/8 in)	100
4.75 mm (No. 4)	95 – 100
2.36 mm (No. 8)	-
1.18 mm (No. 16)	45 – 80
0.600 mm (No. 30)	-
0.300 mm (No. 50)	5 – 30
0.150 mm (No. 100)	0 – 10

**311.2.3 Coarse Aggregate.** It shall consist of crushed stone, gravel, blast furnace slag, or other approved inert materials of similar characteristics, or combinations thereof, having hard, strong, durable pieces and free from any adherent coatings.

It shall contain not more than one (1) mass percent of material passing the 0.075 mm (No. 200) sieve, not more than 0.25 mass percent of clay lumps, nor more than 3.5 mass percent of soft fragments.

If the coarse aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 12 mass percent.

It shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96.

If the slag is used, its density shall not be less than 1120 kg/m<sup>3</sup> (70 lb./cu. ft.). The gradation of the coarse aggregate shall conform to Table 311.2.

Only one grading specification shall be used from any one source.

**Table 311.2 – Grading Requirement for Coarse Aggregate**

Sieve Designation		Mass Percent Passing		
Standard Mm	Alternate U. S. Standard	Grading A	Grading B	Grading C
75.00	3 in.	100	-	-
63.00	2-1/2 in.	90-100	100	100
50.00	2 in.	-	90-100	95-100
37.5	1-1/2 in.	25-60	35-70	-
25.0	1 in.	-	0-15	35-70
19.0	¾ in.	0-10	-	-
12.5	½ in.	0-5	0-5	10-30
4.75	No. 4	-	-	0-5



**311.2.4 Water.** Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water will be tested in accordance with and shall meet the requirements of Item 714, Water. Water which is drinkable may be used without test. Where the source of water is shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials.

**311.2.5 Reinforcing Steel.** It shall conform to the requirements of Item 404, Reinforcing Steel. Dowels and tie bars shall conform to the requirements of AASHTO M 31 or M 42, except that rail steel shall not be used for tie bars that are to be bent and restraightened during construction. Tie bars shall be deformed bars. Dowels shall be plain round bars. Before delivery to the site of work, one-half of the length of each dowel shall be painted with one coat of approved lead or tar paint.

The sleeves for dowel bars shall be metal of approved design to cover 50 mm ( 2 inches), plus or minus 5 mm (1/4 inch) of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least 25 mm (1 inch) from the end of the dowel. Sleeves shall be of such design that they do not collapse during construction.

**311.2.6 Joint Fillers.** Poured joint fillers shall be mixed asphalt and mineral or rubber filler conforming to the applicable requirements of Item 705, Joint Materials.

Preformed joint filler shall conform to the applicable requirements of Item 705. It shall be punched to admit the dowels where called for in the Plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint.

**311.2.7 Admixtures.** Air-entraining admixture shall conform to the requirements of AASHTO M 154.

Chemical admixtures, if specified or permitted, shall conform to the requirements of AASHTO M 194.

Fly Ash, if specified or permitted as a mineral admixture and as 20% partial replacement of Portland Cement in concrete mix shall conform to the requirements of ASTM C 618.

Admixture should be added only to the concrete mix to produce some desired modifications to the properties of concrete where necessary, but not as partial replacement of cement.

### **311.2.8 Curing Materials**

Curing materials shall conform to the following requirements as specified;

a) Burlap cloth

- AASHTO M 182

- b) Liquid membrane forming compounds - AASHTO M 148
- c) Sheeting (film) materials - AASHTO M 171

Cotton mats and water-proof paper can be used.

**311.2.9 Calcium Chloride/Calcium Nitrate.** It shall conform to AASHTO M 144, if specified or permitted by the Engineer, as accelerator.

**311.2.10 Storage of Cement and Aggregate.** All cement shall be stored, immediately upon delivery at the Site, in weatherproof building which will protect the cement from dampness.

The floor shall be raised from the ground. The buildings shall be placed in locations approved by the Engineer. Provisions for storage shall be ample, and the shipments of cement as received shall be separately stored in such a manner as to allow the earliest deliveries to be used first and to provide easy access for identification and inspection of each shipment. Storage buildings shall have capacity for storage of a sufficient quantity of cement to allow sampling at least twelve (12) days before the cement is to be used. Bulk cement, if used, shall be transferred to elevated air tight and weatherproof bins. Stored cement shall meet the test requirements at any time after storage when retest is ordered by the Engineer. At the time of use, all cement shall be free-flowing and free of lumps.

The handling and storing of concrete aggregates shall be such as to prevent segregation or the inclusion of foreign materials. The Engineer may require that aggregates be stored on separate platforms at satisfactory locations.

In order to secure greater uniformity of concrete mix, the Engineer may require that the coarse aggregate be separated into two or more sizes. Different sizes of aggregate shall be stored in separate bins or in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.

**311.2.11 Proportioning, Consistency and Strength of Concrete.** The Contractor shall prepare the design mix based on the absolute volume method as outlined in the American Concrete Institute (ACI) Standard 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete".

It is the intent of this Specification to require at least 364 kg of cement per cubic meter of concrete to meet the minimum strength requirements. The Engineer shall determine from laboratory tests of the materials to be used, the cement content and the proportions of aggregate and water that will produce workable concrete having a slump of between 40 and 75 mm (1-1/2 and 3 inches) if not vibrated or between 10 and 40 mm (1/2 and 1-1/2 inches) if vibrated, and a flexural strength of not less than 3.8 MPa (550 psi) when tested by the third-point method or 4.5 MPa (650 psi) when tested by the mid-point method at fourteen (14) days in accordance with AASHTO T97 and T177, respectively; or a compressive strength of 31.0 MPa (4500 psi) for cores taken at fourteen (14) days and tested in accordance with AASHTO T24. Slump shall be determined using AASHTO T119.

The designer shall consider the use of lean concrete (econcrete) mixtures using local materials or specifically modified conventional concrete mixes in base course and in the lower course composite, monolithic concrete pavements using a minimum of 75 mm (3 inches) of conventional concrete as the surface course.

The mix design shall be submitted to the Engineer for approval and shall be accompanied with certified test data from an approved laboratory demonstrating the adequacy of the mix design. A change in the source of materials during the progress of work may necessitate a new design mix.

### 311.3 CONSTRUCTION REQUIREMENTS

#### 311.3.1 Quality Control of Concrete

1. **General.** The Contractor shall be responsible for the quality control of all materials during the handling, blending, and mixing and placement operations.
2. **Quality Control Plan.** The Contractor shall furnish the Engineer a Quality Control Plan detailing his production control procedures and the type and frequency of sampling and testing to insure that the concrete produces complies with the Specifications. The Engineer shall be provided free access to recent plant production records, and if requested, informational copies of mix design, materials certifications and sampling and testing reports.
3. **Qualification of Workmen.** Experienced and qualified personnel shall perform all batching or mixing operation for the concrete mix, and shall be present at the plant and job site to control the concrete productions whenever the plant is in operation. They shall be identified and duties defined as follows:
  - a. **Concrete Batcher.** The person performing the batching or mixing operation shall be capable of accurately conducting aggregate surface moisture determination and establishing correct scale weights for concrete materials. He shall be capable of assuring that the proportioned batch weights of materials are in accordance with the mix design.
  - b. **Concrete Technician.** The person responsible for concrete production control and sampling and testing for quality control shall be proficient in concrete technology and shall have a sound knowledge of the Specifications as they relate to concrete production. He shall be capable of conducting tests on concrete and concrete materials in accordance with these Specifications. He shall be capable of adjusting concrete mix designs for improving workability and Specification compliance and preparing trial mix designs. He shall be qualified to act as the concrete batcher in the batcher's absence.
4. **Quality Control Testing.** The Contractor shall perform all sampling, testing and

inspection necessary to assure quality control of the component materials and the concrete.

The Contractor shall be responsible for determining the gradation of fine and coarse aggregates and for testing the concrete mixture for slump, air content, water-cement ratio and temperature. He shall conduct his operations so as to produce a mix conforming to the approved mix design.

**5. Documentation.** The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and nature of any corrective action taken.

The Engineer may take independent assurance samples at random location for acceptance purposes as he deems necessary.

**311.3.2 Equipment.** Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of construction operations to be examined thoroughly and approved.

#### **1. Batching Plant and Equipment**

- a. General.** The batching shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, a hopper, and separate scale for cement shall be included. The weighing hopper shall be properly sealed and vented to preclude dusting operation. The batch plant shall be equipped with a suitable non-resettable batch counter which will correctly indicate the number of batches proportioned.
- b. Bins and Hoppers.** Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.
- c. Scales.** Scales for weighing aggregates and cement shall be of either the beam type or the spring less-dial type. They shall be accurate within one-half percent (0.5%) throughout the range of use. Poises shall be designed to be locked in any position and to prevent unauthorized change. Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy.
- d. Automatic Weighing Devices.** Unless otherwise allowed on the Contract, batching plants shall be equipped with automatic weighing devices of an approved type to proportion aggregates and bulk cement.

#### **2. Mixers.**

- a. **General.** Concrete may be mixed at the Site of construction or at a central plant, or wholly or in part in truck mixers. Each mixer shall have a manufacturer's plate attached in a prominent place showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.
- b. **Mixers at Site of Construction.** Mixing shall be done in an approved mixer capable of combining the aggregates, cement and water into a thoroughly mixed and uniform mass within the specified mixing period and discharging and distributing the mixture without segregation on the prepared grade. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and released it at the end of the mixing period. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed 90 seconds. The mixer shall be equipped with a suitable nonresettable batch counter which shall correctly indicate the number of the batches mixed.
- c. **Truck Mixer and Truck Agitators.** Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central-mixed concrete, shall conform to the requirements of AASHTO M 157.
- d. **Non-Agitator Truck.** Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation.

**3. Paving and Finishing Equipment.** The concrete shall be placed with an approved paver designed to spread, consolidate, screed and float finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement in conformance with the Plans and Specifications. The finishing machine shall be equipped with at least two (2) oscillating type transverse screed.

Vibrators shall operate at a frequency of 8,300 to 9,600 impulses per minute under load at a maximum spacing of 60 cm.

**4. Concrete Saw.** The Contractor shall provide sawing equipment in adequate number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions and at the required rate. He shall provide at least one (1) stand-by saw in good working condition and with an ample supply of saw blades.

**5. Forms.** Forms shall be of steel, of an approved section, and of depth equal to the thickness of the pavement at the edge. The base of the forms shall be of sufficient width to provide necessary stability in all directions. The flange braces must extend outward on

the base to not less than 2/3 the height of the form.

All forms shall be rigidly supported on bed of thoroughly compacted material during the entire operation of placing and finishing the concrete. Forms shall be provided with adequate devices for secure setting so that when in place, they will withstand, without visible spring or settlement, the impact and vibration of the consolidation and finishing or paving equipment.

**311.3.3 Preparation of Grade.** After the subgrade of base has been placed and compacted to the required density, the areas which will support the paving machine and the grade on which the pavement is to be constructed shall be trimmed to the proper elevation by means of a properly designed machine extending the prepared work areas compacted at least 60 cm beyond each edge of the proposed concrete pavement. If loss of density results from the trimming operations, it shall be restored by additional compaction before concrete is placed. If any traffic is allowed to use the prepared subgrade or base, the surface shall be checked and corrected immediately ahead of the placing concrete.

The subgrade or base shall be uniformly moist when the concrete is placed.

#### **311.3.4 Setting Forms**

**1. Base Support.** The foundation under the forms shall be hard and true to grade so that the form when set will be firmly in contact for its whole length and at the specified grade. (Any roadbed, which at the form line is found below established grade, shall be filled with approved granular materials to grade in lifts of three (3) cm or less, and thoroughly rerolled or tamped.) Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

**2. Form Setting.** Forms shall be set sufficiently in advance of the point where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. The forms shall not deviate from true line by more than one (1) cm at any point.

**3. Grade and Alignment.** The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. Testing as to crown and elevation, prior to placing of concrete can be made by means of holding an approved template in a vertical position and moved backward and forward on the forms.

When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

**311.3.5 Conditioning of Subgrade or Base Course.** When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross-section.

High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed.

Unless waterproof subgrade or base course cover material is specified, the subgrade or base course shall be uniformly moist when the concrete is placed. If it subsequently becomes too dry, the subgrade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.

**311.3.6 Handling, Measuring and Batching Materials.** The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work.

Stockpiles shall be built up in layers of not more than one (1) meter in thickness. Each layer shall be completely in place before beginning the next which shall not be allowed to “cone” down over the next lower layer. Aggregates from different sources and of different grading shall not be stockpiled together.

All washed aggregates and aggregates produced or handled by hydraulic methods, shall be stockpiled or binned for draining at least twelve (12) hours before being batched.

When mixing is done at the side of the work, aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, with chute, boot or other approved device, to prevent loss of cement, and to provide positive assurance of the actual presence in each batch of the entire cement content specified.

Bulk cement shall be transported to the mixer in tight compartments carrying the full amount of cement required for the batch. However, if allowed in the Special Provisions, it may be transported between the fine and coarse aggregate. When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1-1/2 hours of such contact. Cement in original shipping packages may be transported on top of the aggregates, each batch containing the number of sacks required by the job mix.

The mixer shall be charged without loss of cement. Batching shall be so conducted as to result in the weight to each material required within a tolerance of one (1) percent for the cement and two (2) percent for aggregates.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over than one (1) percent. Unless the water

is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be equipped with an outside tap and valve to provide checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

**311.3.7 Mixing Concrete.** The concrete may be mixed at the site of the work in a central-mix plant, or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time will be measured from the time all materials, except water, are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of AASHTO M 157, except that the minimum required revolutions at the mixing speed for transit-mixed concrete may be reduced to not less than that recommended by the mixer manufacturer.

The number of revolutions recommended by the mixer manufacturer shall be indicated on the manufacturer's serial plate attached to the mixer. The Contractor shall furnish test data acceptable to the Engineer verifying that the make and model of the mixer will produce uniform concrete conforming to the provision of AASHTO M 157 at the reduced number of revolutions shown on the serial plate.

When mixed at the site or in a central mixing plant, the mixing time shall not be less than fifty (50) seconds nor more than ninety (90) seconds, unless mixer performance tests prove adequate mixing of the concrete is a shorter time period.

Four (4) seconds shall be added to the specified mixing time if timing starts at the instant the skip reaches its maximum raised positions. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate attached on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his expense.

The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic metre, as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to ten (10) percent above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batches shall be so charged into the drum that a portion of the mixing water shall be entered in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period.



The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or non-agitating truck specified in Subsection 311.3.2, Equipment. The time elapsed from the time water is added to the mix until the concrete is deposited in place at the Site shall not exceed forty five (45) minutes when the concrete is hauled in non-agitating trucks, nor ninety (90) minutes when hauled in truck mixers or truck agitators, except that in hot weather or under other conditions contributing to quick hardening of the concrete, the maximum allowable time may be reduced by the Engineer.

In exceptional cases and when volumetric measurements are authorized for small project requiring less than 75 cu.m. of concrete per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.

Concrete mixing by chute is allowed provided that a weighing scales for determining the batch weight will be used.

Retempering concrete by adding water or by other means shall not be permitted, except that when concrete is delivered in truck mixers, additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements, if permitted by the Engineer, provided all these operations are performed within forty-five (45) minutes after the initial mixing operation and the water-cement ratio is not exceeded. Concrete that is not within the specified slump limits at the time of placement shall not be used. Admixtures for increasing the workability or for accelerating the setting of the concrete will be permitted only when specifically approved by the Engineer.

**311.3.8 Limitation of Mixing.** No concrete shall be mixed, placed or finished when natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

During hot weather, the Engineer shall require that steps be taken to prevent the temperature of mixed concrete from exceeding a maximum temperature of 90<sup>0</sup>F ( 32<sup>0</sup>C)

Concrete not in place within ninety (90) minutes from the time the ingredients were charged into the mixing drum or that has developed initial set shall not be used. Retempering of concrete or mortar which has partially hardened, that is remixing with or without additional cement, aggregate, or water, shall not be permitted.

In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete.

**311.3.9 Placing Concrete.** Concrete shall be deposited in such a manner to require minimal rehandling. Unless truck mixers or non-agitating hauling equipment are equipped with means to discharge concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade in such a manner as to prevent segregation. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

When concrete is to be placed adjoining a previously constructed lane and mechanical equipment will be operated upon the existing lane, that previously constructed lane shall have attained the strength for fourteen (14) day concrete. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three (3) days.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.

Concrete shall be deposited as near as possible to the expansion and contraction joints without disturbing them, but shall not be dumped from the discharge bucket or hopper into a joint assembly unless the hopper is well centered on the joint assembly. Should any concrete material fall on or be worked into the surface of a complete slab, it shall be removed immediately.

**311.3.10 Test Specimens.** As work progresses, at least one (1) set consisting of three (3) concrete beam test specimens, 150 mm x 150 mm x 525 mm or 900 mm shall be taken from each 330 m<sup>2</sup> of pavement, 230 mm depth, or fraction thereof placed each day. Test specimens shall be made under the supervision of the Engineer, and the Contractor shall provide all concrete and other facilities necessary in making the test specimens and shall protect them from damage by construction operations. Cylinder samples shall not be used as substitute for determining the adequacy of the strength of concrete.

The beams shall be made, cured, and tested in accordance with AASHTO T 23 and T 97.

**311.3.11 Strike-off of Concrete and Placement of Reinforcement.** Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two (2) layers, the bottom layer shall be struck off and consolidated to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation.

The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded.

Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

When reinforced concrete is placed in one layer, the reinforcement may be firmly positioned in advance of concrete placement or it may be placed at the depth shown on the Plans in plastic concrete, after spreading by mechanical or vibratory means.

Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale and loose or thick rust which could impair bond of the steel with the concrete.

**311.3.12 Joints.** Joints shall be constructed of the type and dimensions, and at the locations required by the Plans or Special Provisions. All joints shall be protected from the intrusion of injurious foreign material until sealed.

**1. Longitudinal Joint.** Deformed steel tie bars of specified length, size, spacing and materials shall be placed perpendicular to the longitudinal joints, they shall be placed by approved mechanical equipment or rigidly secured by chair or other approved supports to prevent displacement.

Tie bars shall not be painted or coated with asphalt or other materials or enclosed in tubes or sleeves.

When shown on the Plans and when adjacent lanes of pavement are constructed separately, steel side forms shall be used which will form a keyway along the construction joint.

Tie bars, except those made of rail steel, may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed, or in lieu of bent tie bars, approved two-piece connectors may be used.

Longitudinal formed joints shall consist of a groove or cleft, extending downward from and normal to, the surface of the pavement. These joints shall be effected or formed by an approved mechanically or manually operated device to the dimensions and line indicated on the Plans and while the concrete is in a plastic state. The groove or cleft shall be filled with either a premolded strip or poured material as required.

The longitudinal joints shall be continuous, there shall be no gaps in either transverse or longitudinal joints at the intersection of the joints.

Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width and line shown on the Plans. Suitable guide lines or devices shall be used to assure cutting the longitudinal joint on the true line.

The longitudinal joint shall be sawed before the end of the curing period or shortly thereafter and before any equipment or vehicles are allowed on the pavement. The sawed area shall be thoroughly cleaned and, if required, the joint shall immediately be filled with sealer.

Longitudinal pavement insert type joints shall be formed by placing a continuous strip of plastic materials which will not react adversely with the chemical constituent of the concrete.

**2. Transverse Expansion Joint.** The expansion joint filler shall be continuous from form to form, shaped to subgrade and to the keyway along the form.

Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used. The expansion joint filler shall be held in a vertical position.

An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete.

Finished joint shall not deviate more than 6 mm from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

**3. Transverse Contraction Joint/Weakened Joint.** When shown on the Plans, it shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement and shall include load transfer assemblies. The depth of the weakened plane joint should at all times not be less than 50 mm, while the width should not be more than 6 mm.

**a. Transverse Strip Contraction Joint.** It shall be formed by installing a parting strip to be left in place as shown on the Plans.

**b. Formed Groove.** It shall be made by depressing an approved tool or device into the plastic concrete. The tool or device shall remain in place at least until the concrete has attained its initial set and shall then be removed without disturbing the adjacent concrete, unless the device is designed to remain in the joint.

- c. **Sawed Contraction Joint.** It shall be created by sawing grooves in the surface of the pavement of the width not more than 6 mm, depth should at all times not be less than 50 mm, and at the spacing and lines shown on the Plans, with an approved concrete saw.

After each joint is sawed, it shall be thoroughly cleaned including the adjacent concrete surface.

Sawing of the joint shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on during the day or night, regardless of weather conditions. The sawing of any joint shall be omitted if crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. In general, all joints should be sawed in sequence. If extreme condition exist which make it impractical to prevent erratic cracking by early sawing, the contraction joint groove shall be formed prior to initial set of concrete as provided above.

4. **Transverse Construction Joint.** It shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 1.50 m of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has been mixed at the time of interruption to form a slab of at least 1.5 m long, the excess concrete from the last preceding joint shall be removed and disposed off as directed.

5. **Load Transfer Device.** Dowel, when used, shall be held in position parallel to the surface and center line of the slab by a metal device that is left in the pavement.

The portion of each dowel painted with one coat of lead or tar, in conformance with the requirements of Item 404, Reinforcing Steel, shall be thoroughly coated with approved bituminous materials, e.g., MC-70, or an approved lubricant, to prevent the concrete from binding to that portion of the dowel. The sleeves for dowels shall be metal designed to cover 50 mm plus or minus 5 mm (1/4 inch), of the dowel, with a watertight closed end and with a suitable stop to hold the end of the sleeves at least 25 mm (1 inch) from the end of the dowel.

In lieu of using dowel assemblies at contraction joints, dowel may be placed in the full thickness of pavement by a mechanical device approved by the Engineer.

### 311.3.13 Final Strike-off (Consolidation and Finishing)

**1. Sequence.** The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging and final surface finish. Work bridges or other devices necessary to provide access to the pavement surface for the purpose of finishing straight-edging, and make corrections as hereinafter specified, shall be provided by the Contractor.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as fog spray by means of an approved spray equipment.

**2. Finishing Joints.** The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material assembly, also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in Subsection 311.3.9, Placing Concrete.

After the concrete has been placed and vibrated adjacent to the joints as required in Subsection 311.3.9, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to over and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 20 cm (8 inches) from the joint. Segregated concrete shall be removed from in front of and off the joint. The front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

### **3. Machine Finishing**

**a. Non-vibratory Method.** The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without wobbling or other variation tending to affect the precision finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be

maintained ahead of the front screed in its entire length.

**b. Vibratory Method.** When vibration is specified, vibrators for full width vibration of concrete paving slabs, shall meet the requirements in Subsection 311.3.2, Equipment. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and method which will produce pavement conforming to the Specifications. All provisions in item (a) above not in conflict with the provisions for the vibratory method shall govern.

**4. Hand Finishing.** Hand finishing methods may only be used under the following conditions:

- a. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade.
- b. In narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical, hand methods may be used.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used.

The screed for the surface shall be at least 60 cm (2 feet) longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and constructed either of metal or other suitable material shod with metal.

Consolidation shall be attained by the use of suitable vibrator or other approved equipment.

In operation, the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

**5. Floating.** After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, either by hand or mechanical method.

**a. Hand Method.** The hand-operated longitudinal float shall be not less than 365 cm (12 feet) in length and 15 cm (6 inches) in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete, shall be worked with a sawing motion while held in a floating position parallel to the road center line, and moving gradually from one side of the pavement to the other. Movement ahead along the center line of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the side forms on each pass.

**b. Mechanical Method.** The mechanical longitudinal float shall be of a design approved by the Engineer, and shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustment of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward screed shall be adjusted so that the float will lap the distance specified by the Engineer on each transverse trip. The float shall pass over each areas of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.

**c. Alternative Mechanical Method.** As an alternative, the Contractor may use a machine composed of a cutting and smoothing float or floats suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on, and constantly in contact with the side forms. If necessary, following one of the preceding method of floating, long handled floats having blades not less than 150 cm (5 feet) in length and 15 cm (6 inches) in width may be used to smooth and fill in open- textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike off and consolidation are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a 3-m straight-edge or more in length. Successive drags shall be lapped one-half the length of the blade.

**6. Straight-edge Testing and Surface Correction.** After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 300 cm long straight-edge. For this purpose, the Contractor shall furnish and use an accurate 300-cm straight-edge swung from handles 100 cm (3 feet) longer than one-half the width of the slab. The straight-edge shall be held in contact with the surface in successive positions parallel to the road center line and the whole area gone over from one side of the slab to the other as necessary. Advances along the road shall be in successive stages of not more than one-half the length of the straight- edge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas



shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straight-edge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straight-edge and the slab conforms to the required grade and cross-section.

**7. Final Finish.** If the surface texture is broom finished, it shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation should be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than 1.5 mm in depth. Brooming shall be completed before the concrete is in such condition that the surface will be unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom. Brooms shall be of the quality size and construction and be operated so as to produce a surface finish meeting the approval of the Engineer. Subject to satisfactory results being obtained and approval of the Engineer, the Contractor will be permitted to substitute mechanical brooming in lieu of the manual brooming herein described.

If the surface texture is belt finished, when straight-edging is complete and water sheen has practically disappeared and just before the concrete becomes non-plastic, the surface shall be belted with 2-ply canvas belt not less than 20 cm wide and at least 100 cm longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the center line and with rapid advances parallel to the center line.

If the surface texture is drag finished, a drag shall be used which consists of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform gritty texture after dragging it longitudinally along the full width of pavement. For pavement 5 m or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 100 cm wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 15 cm wider than the layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1.5 mm in depth. Drag shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags be substituted.

Regardless of the method used for final finish, the hardened surface of pavement shall have a coefficient of friction of 0.25 or more. Completed pavement that is found to have a coefficient of friction less than 0.25 shall be ground or scored by the Contractor at his expense to provide the required coefficient of friction.

**8. Edging at Forms and Joints.** After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints, shall be worked with an approved tool and rounded to the radius required by the Plans. A well – defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during the use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed. All joints shall be tested with a straight t-edge before the concrete has set and correction made if one edge of the joint is higher than the other.

**311.3.14 Surface Test.** As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 3-m straight-edge or other specified device. Areas showing high spots of more than 3 mm but not exceeding 12 mm in 3 m shall be marked and immediately ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 3 mm when tested with 3 m straight-edge. Where the departure from correct cross-section exceeds 12 mm, the pavement shall be removed and replaced by and at the expense of the Contractor.

Any area or section so removed shall be not less than 1.5 m in length and not less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 1.5 m in length, shall also be removed and replaced.

**311.3.15 Curing.** Immediately after the finishing operations have been completed and the concrete has sufficiently set, the entire surface of the newly placed concrete shall be cured in accordance with either one of the methods described herein.

Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or the lack of water to adequately take care of both curing and other requirements, shall be a cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than ½ hour between stages of curing or during the curing period.

In all congested places, concrete works should be designed so that the designed strength is attained.

**1. Cotton of Burlap Mats.** The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that as laid they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mat shall be placed so that the entire surface and the edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mat shall be so placed and weighted down so as to cause them to remain in intimate contact with the

covered surface. The mat shall be maintained fully wetted and in position for 72 hours after the concrete has been placed unless otherwise specified.

**2. Waterproof Paper.** The top surface and sides of the pavement shall be entirely covered with waterproof paper, the units shall be lapped at least 45 cm. The paper shall be so placed and weighted down so as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimension but each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement, or at pavement width and 60 cm strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

**3. Straw Curing.** When this type of curing is used, the pavement shall be cured initially with burlap or cotton mats, until after final set of the concrete or, in any case, for 12 hours after placing the concrete. As soon as the mats are removed, the surface and sides of the pavement shall be thoroughly wetted and covered with at least 20 cm of straw or hay, thickness of which is to be measured after wetting. If the straw or hay covering becomes displaced during the curing period, it shall be replaced to the original depth and saturated.

It shall be kept thoroughly saturated with water for 72 hours and thoroughly wetted down during the morning of the fourth day, and the cover shall remain in place until the concrete has attained the required strength.

**4. Impervious Membrane Method.** The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it may be applied upon removal of the mass. The curing compound shall not be applied during rain.

Curing compound shall be applied under pressure at the rate 4 L to not more than 14 m<sup>2</sup> by mechanical sprayers. The spraying equipment shall be equipped with a wind guard. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surface exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed, but approved means shall be used to insure proper curing at least 72 hours and to prevent the intrusion of foreign material into the joint before sealing has been completed. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film be damaged from any cause within the 72 hour curing period, the damaged portions shall be repaired immediately with additional compound.

**5. White Polyethylene Sheet.** The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 45 cm. The sheeting shall be so placed and weighted down so as to cause it to remain intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

**311.3.16 Removal of Forms.** After forms for concrete shall remain in place undisturbed for not less than twenty four (24) hours after concrete pouring. In the removal of forms, crowbars should be used in pulling out nails and pins. Care should be taken so as not to break the edges of the pavement. In case portions of the concrete are spalled, they shall be immediately repaired with fresh mortar mixed in the proportion of one part of Portland Cement and two parts fine aggregates.

Major honeycomb areas will be considered as defective work and shall be removed and replaced at the expense of the Contractor. Any area or section so removed shall not be less than the distance between weakened plane joint nor less than the full width of the lane involved.

**311.3.17 Sealing Joints.** Joints shall be sealed with asphalt sealant soon after completion of the curing period and before the pavement is opened to traffic, including the Contractor's equipment. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign materials including membrane curing compound and the joint faces shall be clean and surface dry when the seal is applied.

The sealing material shall be applied to each joint opening to conform to the details shown on the Plans or as directed by the Engineer. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. The use of sand or similar material as a cover for the seal will not be permitted.

Preformed elastomeric gaskets for sealing joints shall be of the cross-sectional dimensions shown on the Plans. Seals shall be installed by suitable tools, without elongation and secured in place with an approved lubricant adhesive which shall cover both sides of the concrete joints. The seals shall be installed in a compressive condition and shall at time of placement be below the level of the pavement surface by approximately 6 mm.

The seals shall be in one piece for the full width of each transverse joint.

**311.3.18 Protection of Pavement.** The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection of and maintenance of warning signs, lights, pavement bridges or cross-overs, etc. The Plans or Special Provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic.

All boreholes after thickness and/or strength determinations of newly constructed asphalt and concrete pavements shall be immediately filled/restored with the prescribed concrete/asphalt mix after completion of the drilling works.

Any damage to the pavement, occurring prior to final acceptance, shall be repaired or the pavement be replaced.

### **311.3.19 Concrete Pavement – Slip Form Method**

If the Contract calls for the construction of pavement without the use of fixed forms, the following provisions shall apply:

**1. Grade.** After the grade or base has been placed and compacted to the required density, the areas which will support the paving machine shall be cut to the proper elevation by means of a properly designed machine. The grade on which the pavement is to be constructed shall then be brought to the proper profile by means of properly designed machine. If the density of the base is disturbed by the grading operation, it shall be corrected by additional compaction before concrete is placed. The grade should be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placing of concrete.

**2. Placing Concrete.** The concrete shall be placed with an approved slip-form paver designed to spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in conformance with the Plans and Specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accompanied with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur, and that necessary final finishing can be accomplished while the concrete is still within the forms. Any edge slump of the pavement, exclusive of edge rounding, in excess of 6 mm shall be corrected before the concrete has hardened.

The concrete shall be held at a uniform consistency, having a slump of not more than 40 mm (1-12/ inches). The slip form paver shall be operated with as nearly as possible a

continuous forward movement and that all operations of mixing, delivering and spreading concrete shall be coordinated so as to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

**3. Finishing.** The surface smoothness and texture shall meet the requirements of Subsections 311.3.13 and 311.3.14.

**4. Curing.** Unless otherwise specified, curing shall be done in accordance with one of the methods included in Subsection 311.3.15. The curing media shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

**5. Joints.** All joints shall be constructed in accordance with Subsection 311.3.12.

**6. Protection Against Rain.** In order that the concrete may be properly protected against rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times, materials for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood planks having a nominal thickness of not less than 50 mm (2 inches) and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper or plastic sheeting materials for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

### **311.3.22 Acceptance of Concrete**

The strength level of the concrete will be considered satisfactory if the averages of all sets of three (3) consecutive strength test results equal or exceed the specified strength,  $f_c'$  and no individual strength test result is deficient by more than 15% of the specified strength,  $f_c'$ .

Concrete deemed to be not acceptable using the above criteria may be rejected unless the Contractor can provide evidence, by means of core tests, that the quality of concrete represented by failed test results is acceptable in place. At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered deficient.

The location of cores shall be determined by the Engineer so that there will be at least impairment of strength of the structure. The obtaining and testing of drilled cores shall be in accordance with AASHTO T 24.

Concrete in the area represented by the cores will be considered adequate if the average strength of the cores is equal to at least 85% of, and if no single core is less than 75% of, the specified strength,  $f_c'$ .

If the strength of control specimens does not meet the requirements of this Subsection, and it is not feasible or not advisable to obtain cores from the structure due to structural considerations, payment of the concrete will be made at an adjusted price due to strength deficiency of concrete specimens as specified hereunder:

Deficiency in Strength of Concrete Specimens, Percent (%)	Percent (%) of Contract Price Allowed
Less than 5	100
5 to less than 10	80
10 to less than 15	70
15 to less than 20	60
20 to less than 25	50
25 or more	0

### 311.3.23 Opening to Traffic

The Engineer will decide when the pavement may be opened to traffic. The road will not be opened to traffic until test specimens molded and cured in accordance with AASHTO T 23 have attained the minimum strength requirements in Subsection 311.2.11.

If such tests are not conducted prior to the specified age the pavement shall not be operated to traffic until 14 days after the concrete was placed. Before opening to traffic, the pavement shall be cleaned and joint sealing completed.

### 311.3.24 Tolerance and Pavement thickness

- 1. General.** The thickness of the pavement will be determined by measurement of cores from the completed pavement in accordance with AASHTO T 148.

The completed pavement shall be accepted on a lot basis. A lot shall be considered as 1000 linear meters of pavement when a single traffic lane is poured or 500 linear meters when two lanes are poured concurrently. The last unit in each slab constitutes a lot in itself when its length is at least ½ of the normal lot length. If the length of the last unit is shorter than ½ of the normal lot length, it shall be included in the previous lot.

Other areas such as intersections, entrances, crossovers, ramp, etc., will be grouped together to form a lot. Small irregular areas may be included with other unit areas to form a lot.

Each lot will be divided into five (5) equal segments and one core will be obtained from each segment in accordance with AASHTO T 24.

It is the intent of this Specification that the pavement has a uniform thickness as called for on the Plans for the average of each lot as defined. After the pavement has met all surface smoothness requirements, cores for thickness measurements will be taken.

In calculating the average thickness of the pavement, individual measurements which are in excess of the specified thickness by more than 5 mm will be considered as the specified thickness plus 5 mm and measurement which are less than the specified thickness by more than 25 mm shall not be included in the average. When the average thickness for the lot is deficient, the contract unit price will be adjusted for thickness in accordance with paragraph (3 below).

Individual areas within a segment found deficient in thickness by more than 25 mm shall be evaluated by the Engineer, and if in his judgment, the deficient areas warrant removal, they shall be removed and replaced by the Contractor with pavement of the specified thickness at his entire expense. However, if the evaluation of the Engineer is that the deficient area should not be removed and replaced, such area will not be paid.

When the measurement of any core is less than the specified thickness by more than 25 mm, the actual thickness of the pavement in this area will be determined by taking additional cores at no less than 5 m intervals parallel to the center line in each direction from the affected location until a core is found in each direction, which is not deficient in thickness by more than 25 mm. The area of slab for which no payment will be made shall be the product of the paving width multiplied by the distance along the center line of the road between transverse sections found not deficient in thickness by more than 25 mm. The thickness of the remainder of the segment to be used to get the average thickness of each lot shall be determined by taking the average thickness of additional cores which are not deficient by more than 25 mm.

**3. Adjustment for Thickness.** When the average thickness of the pavement per lot is deficient, payment for the lot shall be adjusted as follows:

Deficiency in the Average Thickness per lot (mm)	Percent (%) of Contract Price Per Lot
0 – 5	100% payment
6 – 10	95% payment
11 – 15	85% payment
16 – 20	70% payment
21 – 25	50% payment
More than 25	Remove and replace/ No payment



No acceptance and final payment shall be made on completed pavement unless core test for thickness determination is conducted, except for Barangay Roads where the implementing office is allowed to waive such test.

**311.4 Method of Measurement**

The area to be paid for under this Item shall be the number of square meters (m<sup>2</sup>) of concrete pavement placed and accepted in the completed pavement. The width for measurements will be the width from outside edge to outside edge of completed pavement as placed in accordance with the Plans or as otherwise required by the Engineer in writing.

The length will be measured horizontally along the center line of each roadway or ramp. Any curb and gutter placed shall not be included in the area of concrete pavement measured.

**311.5 Basis of Payment**

The accepted quantity, measured as prescribed in Section 311.4, shall be paid for at the contract unit price for Portland Cement Concrete Pavement, which price and payment shall be full compensation for preparation of roadbed and finishing of shoulders, unless otherwise provided by the Special Provisions, furnishing all materials, for mixing, placing, finishing and curing all concrete, for furnishing and placing all joint materials, for sawing weakened plane joints, for fitting the prefabricated center metal joint, for facilitating and controlling traffic, and for furnishing all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
311 (1)	PCC Pavement (Plain)	Square meter
311 (2)	PCC Pavement (Reinforced)	Square meter

## Item P-501 Cement Concrete Pavement

### DESCRIPTION

**501-1.1** This work shall consist of pavement composed of cement concrete [ with reinforcement ] [ without reinforcement ] constructed on a prepared underlying surface in accordance with these specifications and shall conform to the lines, grades, thickness, and typical cross-sections shown on the plans. The terms cement concrete, hydraulic cement concrete, and concrete are interchangeable in this specification.

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**The Engineer shall specify with or without reinforcement. Item P-610, Cement Concrete shall be used for sign bases and other formed concrete structures.**

**The dimensions and depth of the concrete shall be as defined by the Engineer's pavement design performed in accordance with advisory circular (AC) 150/5320-6, Airport Pavement Design and Evaluation and FAARFIELD. The current version of FAARFIELD is available at: [www.faa.gov/airports/engineering/design\\_software/](http://www.faa.gov/airports/engineering/design_software/)**

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### MATERIALS

#### **501-2.1 Aggregates.**

**a. Reactivity.** Fine and Coarse aggregates to be used in PCC on this project shall be tested and evaluated by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and ASTM C1567. Tests must be representative of aggregate sources which will be providing material for production. ASTM C1260 and ASTM C1567 tests may be run concurrently.

(1) Coarse aggregate and fine aggregate shall be tested separately in accordance with ASTM C1260, however, the length of test shall be extended to 28 days (30 days from casting). Tests must have been completed within 6 months of the date of the concrete mix submittal.

(2) The combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

(3) If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) Concrete Research Division (CRD) C662 in lieu of ASTM C1567. If lithium nitrate admixture is used, it shall be nominal 30%  $\pm$ 0.5% weight lithium nitrate in water. If the expansion does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion is greater

than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

**b. Fine aggregate.** Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33 and the parameters identified in the fine aggregate material requirements below. Fine aggregate material requirements and deleterious limits are shown in the table below.

<b>Fine Aggregate Material Requirements</b>		
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 10% maximum using Sodium sulfate - or - 15% maximum using magnesium sulfate	ASTM C88
Sand Equivalent	[ 45 ] minimum	ASTM D2419
Fineness Modulus (FM)	$2.50 \leq FM \leq 3.40$	ASTM C136
<b>Limits for Deleterious Substances in Fine Aggregate for Concrete</b>		
Clay lumps and friable particles	1.0% maximum	ASTM C142
Coal and lignite	0.5% using a medium with a density of Sp. Gr. of 2.0	ASTM C123
Total Deleterious Material	1.0% maximum	

**c. Coarse aggregate.** The maximum size coarse aggregate shall be [\_\_\_].

Aggregates delivered to the mixer shall be clean, hard, uncoated aggregates consisting of crushed stone, crushed or uncrushed gravel, air-cooled iron blast furnace slag, crushed recycled concrete pavement, or a combination. The aggregates shall have no known history of detrimental pavement staining. Steel blast furnace slag shall not be permitted. Coarse aggregate material requirements and deleterious limits are shown in the table below; washing may be required to meet aggregate requirements.

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**Select maximum aggregate size (typically 1-1/2-inch, 1-inch, or 3/4-inch) based on what is locally available and considering freeze-thaw vulnerability.**

**Dust and other coatings may need to be removed from the aggregate by washing in order to meet material requirements.**

**On large projects and/or projects that span multiple construction seasons, additional aggregate tests may be necessary to validate consistency of aggregate produced and delivered for the project.**

**Some aggregates may contain ferrous sulfides and iron oxides which can cause stains on exposed concrete surfaces. In areas where staining has been**

a problem or is suspected, the Engineer should verify that producers and aggregate suppliers have taken steps to minimize the inclusion of any ferrous sulfides or iron oxides in aggregate to be used in the project.

If there is a concern that these may exist, a known indicator to identify staining particles is to immerse the aggregate in a lime slurry. If staining particles are present, a blue-green gelatinous precipitate will form within five (5) to 10 minutes, rapidly changing to a brown color on exposure to air and light. The reaction should be complete in 30 minutes. If no brown gelatinous precipitate forms, there is little chance of reaction in concrete. (Portland Concrete Association, Design and Control of Concrete Mixtures)

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### Coarse Aggregate Material Requirements

Material Test	Requirement	Standard
Resistance to Degradation	Loss: 40% maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss after 5 cycles: 12% maximum using Sodium sulfate - or - 18% maximum using magnesium sulfate	ASTM C88
Flat, Elongated, or Flat and Elongated Particles	8% maximum, by weight, of flat, elongated, or flat and elongated particles at 5:1 for any size group coarser than 3/8 (9.5 mm) sieve <sup>1</sup>	ASTM D4791
Bulk density of slag <sup>2</sup>	Weigh not less than 70 pounds per cubic foot (1.12 Mg/cubic meter)	ASTM C29
[ D-cracking (Freeze-Thaw) <sup>3</sup>	Durability factor ≥ 95	ASTM C666 ]

<sup>1</sup> A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

<sup>2</sup> Only required if slag is specified.

[ <sup>3</sup> Coarse aggregate may only be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated or which are over one (1) year old or which are for different gradations will not be accepted. ]

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**In areas where D-cracking is not a concern, delete the D-cracking (ASTM C666) and corresponding footnote in the above table.**

**Crushed granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite or trap rock are considered to meet the D-cracking test requirements but must meet all other quality tests specified in Item P-501.**

**In areas of freeze-thaw that have had problems with Chert popouts, prior to reducing the limit on Chert verify that aggregate sources are available that can meet specification. Very rare for sedimentary deposits to meet requirements less than 1%. Elimination of Chert may require that contractor utilize non sedimentary aggregates.**

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The amount of deleterious material in the coarse aggregate shall not exceed the following limits:

**Limits for Deleterious Substances in Coarse Aggregate**

<b>Deleterious material</b>	<b>ASTM</b>	<b>Percentage by Mass</b>
Clay Lumps and friable particles	ASTM C142	1.0
Material finer than No. 200 sieve (75 µm)	ASTM C117	1.0 <sup>1</sup>
Lightweight particles	ASTM C123 using a medium with a density of Sp. Gr. of 2.0	0.5
Chert <sup>2</sup> (less than 2.40 Sp Gr.)	ASTM C123 using a medium with a density of Sp. Gr. of 2.40)	[ 0.1 ] <sup>3</sup>

<sup>1</sup> The limit for material finer than 75-µm is allowed to be increased to 1.5% for crushed aggregates consisting of dust of fracture that is essentially free from clay or shale. Test results supporting acceptance of increasing limit to 1.5% with statement indicating material is dust of fracture must be submitted with Concrete mix. Acceptable techniques to characterizing these fines include methylene blue adsorption or X-ray diffraction analysis.

<sup>2</sup> Chert and aggregates with less than 2.4 specific gravity.

<sup>3</sup> The limit for chert may be increased to 1.0 percent by mass in areas not subject to severe freeze and thaw.

**d. Combined aggregate gradation.** This specification is targeted for a combined aggregate gradation developed following the guidance presented in United States Air Force Engineering Technical Letter (ETL) 97-5: Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements. Base the aggregate grading upon a combination of all the aggregates (coarse and fine) to be used for the mixture proportioning. Three aggregate sizes may be required to achieve an optimized combined gradation that will produce a workable concrete mixture for its intended use. Use aggregate gradations that produce concrete mixtures with well-graded or optimized aggregate combinations. The Contractor shall submit complete mixture information necessary to calculate the volumetric components of the mixture. The combined aggregate grading shall meet the following requirements:

(1) The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in paragraph 501-2.1d(4) below, the point thus determined shall fall within the parallelogram described therein.

(2) The CF shall be determined from the following equation:

$$CF = \frac{\text{(cumulative percent retained on the 3/8 in. (9.5 mm) sieve)}(100)}{\text{(cumulative percent retained on the No. 8 (2.36 mm) sieve)}}$$

(3) The WF is defined as the percent passing the No. 8 (2.36 mm) sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 94 pounds (42 kg) of cementitious material per cubic meter yard greater than 564 pounds per cubic yard (335 kg per cubic meter).

(4) A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary. The point determined by the plotting of the CF and WF may be adjusted during production  $\pm 3$  WF and  $\pm 5$  CF. Adjustments to gradation may not take the point outside of the parallelogram.

e. **Contractors combined aggregate gradation.** The Contractor shall submit their combined aggregate gradation using the following format:

**Contractor’s Combined Aggregate Gradation**

Sieve Size	Contractor’s Concrete mix Gradation (Percent passing by weight)
2 inch (50 mm)	*
1-1/2 inch (37.5 mm)	*
1 inch (25.0 mm)	*
3/4 inch (19.0 mm)	*
1/2 inch (12.5 mm)	*
3/8 inch (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (600 $\mu$ m)	*
No. 50 (300 $\mu$ m)	*
No. 100 (150 $\mu$ m)	*

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**Table remains blank until the Contractor submits the concrete mix.**

**Reference United States Air Force Engineering Technical Letter (ETL) 97-5: Proportioning Concrete Mixtures with Graded Aggregates for Rigid Airfield Pavements. The ETL is available at the following website:**

<https://www.wbdg.org/ffc/dod/supplemental-technical-criteria/tspwg-m-3-250-04-97-05>

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**501-2.2 Cement.** Cement shall conform to the requirements of ASTM [\_\_\_] Type [\_\_\_].

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**The Engineer shall specify all of the following that are acceptable for use on the project:**

**ASTM C150 - Type I, II, or V.**

**ASTM C595 - Type IP, IS, IL.**

**ASTM C1157 – Types GU, HS, MH.**

**Other cements may be specified with concurrence of the FAA.**

**Low alkali cements (less than 0.6% equivalent alkali, the low reactivity option in ASTM C595, or Option R in ASTM C1157) shall be specified.**

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**501-2.3 Cementitious materials.**

**a. Fly ash.** Fly ash shall meet the requirements of ASTM C618, with the exception of loss on ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total alkali content less than 3% per ASTM C311. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports can be used for acceptance or the material may be tested independently by the Resident Project Representative (RPR).

**b. Slag cement (ground granulated blast furnace (GGBF)).** Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

**c. Raw or calcined natural pozzolan.** Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 6%. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total available alkali content less than 3%.

[ **d. Ultrafine fly ash and ultrafine pozzolan.** UltraFine Fly Ash (UFFA) and UltraFine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

(1) The strength activity index at 28 days of age shall be at least 95% of the control specimens.

(2) The average particle size shall not exceed 6 microns. ]

**501-2.4 Joint seal.** The joint seal for the joints in the concrete pavement shall meet the requirements of [ Item P-604 ] [ Item P-605 ] and shall be of the type specified in the plans.

**501-2.5 Isolation joint filler.** Premolded joint filler for isolation joints shall conform to the requirements of ASTM D1751 or ASTM D1752 and shall be where shown on the plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the RPR. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the RPR.

**501-2.6 Steel reinforcement.** Reinforcing shall consist of [\_\_\_] conforming to the requirements of ASTM [\_\_\_].

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**The Engineer shall designate one of the following:**

**ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement**

**ASTM A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement**

**ASTM A775 Standard Specification for Epoxy-Coated Steel Reinforcing Bars**

**ASTM A934 Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars**

**ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete**

**ASTM A184 or A704 Bar mats**

**ASTM A1035 Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement**

**ASTM A884 Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement**

**Welded wire fabric shall be furnished in flat sheets only.**

**Delete this paragraph when not applicable to the project.**

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**501-2.7 Dowel and tie bars.** Dowel bars shall be plain steel bars conforming to ASTM A615 and shall be free from burring or other deformation restricting slippage in the concrete.

**a. Dowel Bars.** Before delivery to the construction site each dowel bar shall be epoxy coated per ASTM A1078, Type 1, with a coating thickness after curing greater than 10 mils. Patched ends are not required for Type 1 coated dowels. The dowels shall be coated with a bond-breaker recommended by the manufacturer. Dowel sleeves or inserts are not permitted. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the grout hardens.

**b. Tie Bars.** Tie bars shall be deformed steel bars and conform to the requirements of ASTM A615. Tie bars designated as Grade 60 in ASTM A615 or ASTM A706 shall be used for construction requiring bent bars.

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**After coordination with the FAA regarding need and eligibility of additional corrosion protection, the Engineer may require additional corrosion protection or resistance such as chromium dowel and tie bars meeting ASTM A1035; or stainless steel dowel and tie bars meeting ASTM A955.**

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**501-2.8 Water.** Water used in mixing or curing shall be potable. If water is taken from other sources considered non-potable, it shall meet the requirements of ASTM C1602.

**501-2.9 Material for curing concrete.** Curing materials shall conform to one of the following specifications:

**a.** Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class A, or Class B.

**b.** White polyethylene film for curing concrete shall conform to the requirements of ASTM C171.

**c.** White burlap-polyethylene sheeting for curing concrete shall conform to the requirements of ASTM C171.

**d.** Waterproof paper for curing concrete shall conform to the requirements of ASTM C171.

**501-2.10 Admixtures.** Admixtures shall conform to the following specifications:

**a. Air-entraining admixtures.** Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entraining agent and any water reducer admixture shall be compatible.

**b. Water-reducing admixtures.** Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D.

**c. Other admixtures.** The use of set retarding and set-accelerating admixtures shall be approved by the RPR prior to developing the concrete mix. Retarding admixtures shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating admixtures shall meet

the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

**d. Lithium Nitrate.** The lithium admixture shall be a nominal 30% aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon (1.2 kg/L), and shall have the approximate chemical form as shown below:

**Lithium Admixture**

Constituent	Limit (Percent by Mass)
LiNO <sub>3</sub> (Lithium Nitrate)	30 ±0.5
SO <sub>4</sub> (Sulfate Ion)	0.1 (max)
Cl (Chloride Ion)	0.2 (max)
Na (Sodium Ion)	0.1 (max)
K (Potassium Ion)	0.1 (max)

The lithium nitrate admixture dispensing and mixing operations shall be verified and certified by the lithium manufacturer’s representative.

**501-2.11 Epoxy-resin.** All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

**a.** Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

**b.** Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

**c.** Material for use for injecting cracks shall be Type IV, Grade 1.

**d.** Material for bonding freshly mixed Portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

**501-2.12 Bond Breaker.** [ Choke stone shall be an ASTM C33 Number 89 stone. ] [ Fabric shall meet the requirements of AASHTO M 288 Class I fabric with elongation not less than 50% at the specified strengths, with a weight not less than 14.5 oz/sy. A certificate of compliance (COC) shall be provided by the fabric manufacturer that the material may be used as a bond breaker. ] [ Liquid membrane forming compound shall be in accordance with paragraph 501-2.7. ] [ Not required. ]

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**The Engineer must select the bond breaker when concrete pavement will be placed directly above the lean concrete base. Coordinate with paragraph 501-.**

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## **CONCRETE MIX**

**501-3.1. General.** No concrete shall be placed until an acceptable concrete mix has been submitted to the RPR for review and the RPR has taken appropriate action. The RPR's review shall not relieve the Contractor of the responsibility to select and proportion the materials to comply with this section.

**501-3.2 Concrete Mix Laboratory.** The laboratory used to develop the concrete mix shall be accredited in accordance with ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix must be included in the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the RPR prior to start of construction.

**501-3.3 Concrete Mix Proportions.** Develop the mix using the procedures contained in Portland Cement Association (PCA) publication, "Design and Control of Concrete Mixtures." Concrete shall be proportioned to achieve a 28-day flexural strength that meets or exceeds the acceptance criteria contained in paragraph 501-6.6 for a flexural strength of [ ] psi per ASTM C78.

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**The Engineer shall specify a minimum contractual acceptance flexural strength for airport pavements sufficient to assure that the pavement achieves the design flexural strength prior to being placed in service. Note the design strength used in FAARFIELD structural analysis is approximately 5% higher than the construction acceptance strength e.g. if structural design strength is 650 psi (4482 kPa), then the construction acceptance strength would be approximately 620 psi (4275 kPa).**

**If local materials utilized consistently produce above the design strength limit with the minimum amount of cementitious material, the Engineer may allow a reduction in the minimum amount of cementitious material with approval of the FAA.**

**Due to variations in materials, operations, and testing, the average strength of concrete furnished by a supplier should be higher than the specified strength to ensure a good statistical chance of meeting the acceptance criteria throughout the duration of the job. The strength necessary to meet specification requirements depends on the producer's standard deviation of flexural test results and the accuracy that the value can be estimated from historic data for the same or similar materials.**

**For pavements designed to accommodate aircraft gross weights of 60,000 pounds (27215 kg) or less, this section may be modified to indicate that concrete shall be designed to achieve a 28-day compressive strength that meets or exceeds the acceptance criteria for a compressive strength of 4,400 psi (30337 kPa) per ASTM C39.**

**The use of materials that meet state highway specifications for airfield pavement construction materials is permitted at non-primary airports serving aircraft that do not exceed 60,000 pounds gross weight.**

**The use of State highway specifications for materials requires a Modification of Standards in accordance with FAA Order 5300.1. The project specification must include a copy of all referenced state specifications.**

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The minimum cementitious material shall be adequate to ensure a workable, durable mix. The minimum cementitious material (cement plus fly ash, or slag cement) shall be [\_\_\_\_] pounds per cubic yard ([\_\_\_\_] kg per cubic meter). The ratio of water to cementitious material, including free surface moisture on the aggregates but not including moisture absorbed by the aggregates shall be between 0.38 – 0.45 by weight.

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**A minimum total cementitious material content of 470 pounds per cubic yard (280 kg per cubic meter) should be specified. A higher minimum may be necessary to meet the specified strength when other cementitious materials are substituted or to meet durability requirements for severe freeze/thaw, deicer, or sulfate exposure.**

**The minimum total cementitious requirement should not be less than 517 pounds per cubic yard (310 kg per cubic meter) where severe freeze-thaw, deicer, or sulfate exposure is expected. The Engineer shall specify a maximum water/cementitious ratio of 0.45 unless a lower water/cementitious ratio is necessary for severe freeze/thaw, deicer, sulfate exposure, or other local conditions. A water/cementitious ratio of less than 0.38 shall be subject to approval by the Engineer and the FAA.**

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Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C78. At the start of the project, the Contractor shall determine an allowable slump as determined by ASTM C143 not to exceed 2 inches (50 mm) for slip-form placement. For fixed-form placement, the slump shall not exceed 3 inches (75 mm). For hand placement, the slump shall not exceed 4 inches (100 mm).

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**When the flexural design strength in paragraph 501-3.3 is to be accepted on the basis of compressive strength, the following procedure establishes the correlation between compressive and flexural strength for the concrete mix. Each concrete mix will require a separate correlation.**

**Cylinders/Beams**

**a. Fabricate all beams and cylinders for each mixture from the same batch or blend of batches. Fabricate and cure all beams and cylinders in accordance with ASTM C192, using 6 × 6-inch (150 × 150 mm) steel beam forms and 6 × 12-inch (150 × 300 mm) single-use cylinder forms.**

**b. Cure test beams from each mixture for 3, 7, 14, [ 28 ] and [ 90 ]-day flexural tests; three (3) beams to be tested per age.**

**c. Cure test cylinders from each mixture for 3, 7, 14, [ 28 ] and [ 90 ]-day compressive strength tests; three (3) cylinders to be tested per age.**

**d. Test beams in accordance with ASTM C78, cylinders in accordance with ASTM C39.**

**e. Using the average strength for each age, plot all results on separate graphs for each w/c versus:**

- 3-day flexural strength
- 7-day flexural strength
- 14-day flexural strength
- [ 28-day flexural strength ]
- [ 90-day flexural strength ]
- 3-day compressive strength
- 7-day compressive strength
- 14-day compressive strength
- [ 28-day compressive strength ]
- [ 90-day compressive strength ]

**f. From the above expected strengths for the selected mixture determine the following Correlation Ratios:**

**(1) Ratio of the 14-day compressive strength of the selected mixture to the [ 28 ] [ 90 ]-day flexural strength of the mixture (for acceptance).**

**(2) Ratio of the 7-day compressive strength of the selected mixture to the [ 28 ] [ 90 ]-day flexural strength of the mixture (for Contractor QC control).**

**g. If there is a change in materials, additional mixture design studies shall be made using the new materials and new Correlation Ratios shall be determined.**

**h. No concrete pavement shall be placed until the Engineer has approved the Contractor's mixture proportions. The approved water-cementitious materials ratio shall not exceed the maximum value specified.**

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The results of the concrete mix shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic yard (meter) basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition.

If a change in source(s) is made, or admixtures added or deleted from the mix, a new concrete mix must be submitted to the RPR for approval.

The RPR may request samples at any time for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

**501-3.4 Concrete Mix submittal.** The concrete mix shall be submitted to the RPR at least [ 30 ] days prior to the start of operations. The submitted concrete mix shall not be more than 180 days old and must use the materials to be used for production for the project. Production shall not begin until the concrete mix is approved in writing by the RPR.

Each of the submitted concrete mixes (i.e, slip form, side form machine finish and side form hand finish) shall be stamped or sealed by the responsible professional Engineer of the laboratory and shall include the following items and quantities as a minimum:

- Certified material test reports for aggregate in accordance with paragraph 501-2.1. Certified reports must include all tests required; reporting each test, test method, test result, and requirement specified (criteria).
- Combined aggregate gradations and analysis; and including plots of the fine aggregate fineness modulus.
- Reactivity Test Results.
- Coarse aggregate quality test results, including deleterious materials.
- Fine aggregate quality test results, including deleterious materials.
- Mill certificates for cement and supplemental cementitious materials.
- Certified test results for all admixtures, including Lithium Nitrate if applicable.
- Specified flexural strength, slump, and air content.
- Recommended proportions/volumes for proposed mixture and trial water-cementitious materials ratio, including actual slump and air content.
- Flexural and compressive strength summaries and plots, including all individual beam and cylinder breaks.

- Correlation ratios for acceptance testing and Contractor QC testing, when applicable.
- Historical record of test results documenting production standard deviation, when applicable.

### **501-3.5 Cementitious materials.**

**a. Fly ash.** When fly ash is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If fly ash is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

**b. Slag cement (ground granulated blast furnace (GGBF)).** Slag cement may be used. The slag cement, or slag cement plus fly ash if both are used, may constitute between 25 to 55% of the total cementitious material by weight.

**c. Raw or calcined natural pozzolan.** Natural pozzolan may be used in the concrete mix. When pozzolan is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 20 and 30% by weight of the total cementitious material. If pozzolan is used in conjunction with slag cement the maximum replacement rate shall not exceed 10% by weight of total cementitious material.

[ **d. Ultrafine fly ash (UFFA) and ultrafine pozzolan (UFP).** UFFA and UFP may be used in the concrete mix with the RPR's approval. When UFFA and UFP is used as a partial replacement for cement, the replacement rate shall be determined from laboratory trial mixes, and shall be between 7% and 16% by weight of the total cementitious material. ]

### **501-3.6 Admixtures.**

**a. Air-entraining admixtures.** Air-entraining admixture are to be added in such a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be [\_\_\_]. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

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**The Engineer must specify the appropriate air content for the exposure level for the project location at the maximum aggregate size specified in paragraph 501-2.1(c).**

**Recommended Air Content (Percent)**

Exposure Level	Maximum Size Aggregate				
	2 inch (50 mm)	1-1/2 inch (37.5 mm)	1 inch (25.0 mm)	3/4 inch (19.0 mm)	1/2 inch (12.5 mm)
Mild	2.0%	2.5%	3.0%	3.5%	4.0%
Moderate	4.0%	4.5%	4.5%	5.0%	5.5%
Severe	5.0%	5.5%	6.0%	6.0%	7.0%

1. Mild exposure - When desired for other than durability, such as to improve workability. Used where pavement will not be exposed to freezing or to deicing agents.
2. Moderate exposure - Service in a climate where freezing is expected but where the concrete will not be continually exposed to moisture or free water for long periods prior to freezing and will not be exposed to deicing agents or other aggressive chemicals.
3. Severe exposure - Concrete which is exposed to deicing chemicals or other aggressive agents or where the concrete may become highly saturated by continual contact with moisture or free water prior to freezing.

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**b. Water-reducing admixtures.** Water-reducing admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

**c. Other admixtures.** Set controlling, and other approved admixtures shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements. Tests shall be conducted with the materials to be used in the work, in accordance with ASTM C494.

**d. Lithium nitrate.** Lithium nitrate shall be added to the mix in the manner recommended by the manufacturer and in the amount necessary to comply with the specification requirements in accordance with paragraph 501-2.10d.

**CONSTRUCTION METHODS**

**501-4.1 Control Strip.** The control strip(s) shall be to the next planned joint after the initial 250 feet (75 m) of each type of pavement construction (slip-form pilot lane, slip-form fill-in lane, or fixed form). The Contractor shall demonstrate, in the presence of the RPR, that the



materials, concrete mix, equipment, construction processes, and quality control processes meet the requirements of the specifications. The concrete mixture shall be extruded from the paver meeting the edge slump tolerance and with little or no finishing. Pilot, fill-in, and fixed-form control strips will be accepted separately. Minor adjustments to the mix design may be required to place an acceptable control strip. The production mix will be the adjusted mix design used to place the acceptable control strip. Upon acceptance of the control strip by the RPR, the Contractor must use the same equipment, materials, and construction methods for the remainder of concrete paving. Any adjustments to processes or materials must be approved in advance by the RPR. Acceptable control strips will meet edge slump tolerance and surface acceptable with little or no finishing, air content within action limits, strength equal or greater than requirements of P501-3.3. The control strip will be considered one lot for payment (no sublots required for control strip). Payment will only be made for an acceptable control strip in accordance with paragraph 501-8.1 using a lot pay factor equal to 100.

**501-4.2 Equipment.** The Contractor is responsible for the proper operation and maintenance of all equipment necessary for handling materials and performing all parts of the work to meet this specification.

**a. Plant and equipment.** The plant and mixing equipment shall conform to the requirements of ASTM C94 and/or ASTM C685. Each truck mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades. The truck mixers shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 inch (19 mm) or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.

Equipment for transferring and spreading concrete from the transporting equipment to the paving lane in front of the finishing equipment shall be provided. The equipment shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

**b. Finishing equipment.**

**(1) Slip-form.** The standard method of constructing concrete pavements shall be with an approved slip-form paving equipment designed and operated to spread, consolidate, screed, and finish the freshly placed concrete in one complete pass of the machine so that the end result is a dense and homogeneous pavement which is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements.

**(2) Fixed-form.** On projects requiring less than [ 10,000 cubic yards (7650 cubic meters) ] of concrete pavement or irregular areas at locations inaccessible to slip-form paving equipment, concrete pavement may be placed with equipment specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the RPR. Hand screeding and float finishing may only be used on small irregular areas as allowed by the RPR.

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**The Engineer may reduce the quantity of concrete when fixed forms are allowed.**

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**c. Vibrators.** Vibrator shall be the internal type. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation or voids. The number, spacing, and frequency shall be as necessary to provide a dense and homogeneous pavement and meet the recommendations of American Concrete Institute (ACI) 309R, Guide for Consolidation of Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The Contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two times per day or when requested by the RPR.

Hand held vibrators may only be used in irregular areas and shall meet the recommendations of ACI 309R, Guide for Consolidation of Concrete.

**d. Concrete saws.** The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.

**e. Fixed forms.** Straight side fixed forms shall be made of steel and shall be furnished in sections not less than 10 feet (3 m) in length. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the RPR. The top face of the form shall not vary from a true plane more than 1/8 inch (3 mm) in 10 feet (3 m), and the upstanding leg shall not vary more than 1/4 inch (6 mm). The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by the RPR. The forms shall extend the full depth of the pavement section.

**501-4.3 Form setting.** Forms shall be set to line and grade as shown on the plans, sufficiently in advance of the concrete placement, to ensure continuous paving operation. Forms shall be set to withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms shall be cleaned and oiled prior to the concrete placement.

**501-4.4 Base surface preparation prior to placement.** Any damage to the prepared base, subbase, and subgrade shall be corrected full depth by the Contractor prior to concrete placement. The underlying surface shall be entirely free of frost when concrete is placed. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. [ Bond breaker shall be applied in accordance with 501-2.12. ]

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**The Engineer should ensure the plans show that the appropriate prepared base, subbase, and subgrade extend a width sufficient to support the paving machine track without any noticeable displacement of the paver. Typical widths up to 3 feet (1 m) are required to support the paver track.**

**The Engineer will determine if a bond breaker is required and insert the appropriate P-specification for the project.**

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**501-4.5 Handling, measuring, and batching material.** Aggregate stockpiles shall be constructed and managed in such a manner that prevents segregation and intermixing of deleterious materials. Aggregates from different sources shall be stockpiled, weighed and batched separately at the concrete batch plant. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Store and maintain all aggregates at a uniform moisture content prior to use. A continuous supply of materials shall be provided to the work to ensure continuous placement.

**501-4.6 Mixing concrete.** The concrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials are placed into the drum until the drum is emptied into the truck. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94 or ASTM C685.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is discharged from the truck should not exceed [ 30 ] minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. In no case shall the temperature of the concrete when placed exceed 90°F (32°C). Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified is not exceeded.

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**Depending on the location of the batch plant, this time can be adjusted. Batch plant location must be provided to ensure that the time limit is reasonable to allow for delivery and placement of concrete within the allotted time.**

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**501-4.7 Weather Limitations on mixing and placing.** No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

**a. Cold weather.** Unless authorized in writing by the RPR, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F (4°C) and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F (2°C).

The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50°F (10°C) at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.

When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150°F (66°C). The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.

Curing during cold weather shall be in accordance with paragraph 501-4.13d.

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**Information regarding cold weather concreting practices may be found in  
ACI 306R, Cold Weather Concreting.**

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**b. Hot weather.** During periods of hot weather when the maximum daily air temperature exceeds 85°F (30°C), the following precautions shall be taken.

The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90°F (32°C). The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.

The concrete placement shall be protected from exceeding an evaporation rate of 0.2 psf (0.98 kg/m<sup>2</sup> per hour) per hour. When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. If the Contractor's measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

Curing during hot weather shall be in accordance with paragraph 501-4.13e.

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**Information regarding hot weather concreting practices may be found in  
ACI 305R, Hot Weather Concreting.**

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**c. Temperature management program.** Prior to the start of paving operation for each day of paving, the Contractor shall provide the RPR with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. (Federal Highway Administration HIPERPAV 3 is one example of a temperature management program.) As a minimum, the program shall address the following items:

- (1) Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.
- (2) Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity; and anticipated evaporation rate using Figure 19-9, PCA, Design and Control of Concrete Mixtures.
- (3) Anticipated timing of initial sawing of joint.
- (4) Anticipated number and type of saws to be used.

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**Federal Highway Administration HIPERPAV 3 is one example of a temperature management program. The software is available at <http://www.hiperpav.com/>**

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**d. Rain.** The Contractor shall have available materials for the protection of the concrete during inclement weather. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

**501-4.8 Concrete Placement.** At any point in concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 feet (1 m). The finished concrete product must be dense and homogeneous, without segregation and conforming to the standards in this specification. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used. All concrete shall be consolidated without voids or segregation, including under and around all load-transfer devices, joint assembly units, and other features embedded in the pavement. Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches [ a flexural strength of 550 psi (3.8 MPa) ][ a compressive strength of 3,100 psi (21.4 MPa) ], based on the average of four field cured specimens per 2,000 cubic yards (1,530 cubic meters) of concrete placed. The Contractor must determine that the above minimum strengths are adequate to protection the pavement from overloads due to the construction equipment proposed for the project.

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**The Engineer shall choose flexural or compressive strength based on concrete mix requirement. The strength needed for construction traffic is dependent upon the loads it will be exposed to. The strength needed for a thin pavement at a small airport may be more than is needed for a thick pavement at a large airport. Coordinate the strength in 501-4.8, 501-4.17 and 501-4.18. Engineer must determine strength required to accommodate construction loads (e.g. hauling, placing, etc.) without damaging pavement, for each project. Strength needed can be adjusted during construction if contractor provides detailed engineering calculations supporting actual construction loads.**

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**The Contractor shall have available materials for the protection of the concrete during cold, hot and/or inclement weather in accordance with paragraph 501-4.7.**

**a. Slip-form construction.** The concrete shall be distributed uniformly into final position by a self-propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well-defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 9 inches (23 cm) for slipform and at the end of the dowels for the fill-in lanes. The spacing of internal units shall be uniform and shall not exceed 18 inches (0.5 m).

The term internal vibration means vibrating units located within the specified thickness of pavement section.

The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without, segregation, voids, or vibrator trails and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least one foot (30 cm). The frequency of vibration or amplitude should be adjusted proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

Not more than 15% of the total free edge of each 500-foot (150 m) segment of pavement, or fraction thereof, shall have an edge slump exceeding 1/4 inch (6 mm), and none of the free edge of the pavement shall have an edge slump exceeding 3/8 inch (9 mm). (The total free edge of 500 feet (150 m) of pavement will be considered the cumulative total linear measurement of pavement edge originally constructed as nonadjacent to any existing pavement; that is, 500 feet (150 m) of paving lane originally constructed as a separate lane will have 1,000 feet (300 m) of free edge, 500 feet (150 m) of fill-in lane will have no free edge, etc.). The area affected by the downward movement of the concrete along the pavement edge shall be limited to not more than 18 inches (0.5 m) from the edge.

When excessive edge slump cannot be corrected before the concrete has hardened, the area with excessive edge slump will be removed the full width of the slip form lane and replaced at the expense of the Contractor as directed by the RPR.

**b. Fixed-form construction.** Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars / dowel bars where these are specified.

Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.

Side forms shall remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.

Side forms shall be thoroughly cleaned and coated with a release agent each time they are used and before concrete is placed against them.

Concrete shall be spread, screed, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross-section with a minimum of handwork.

The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery. The equipment must be specifically designed for placement and finishing using stationary side forms. Methods and equipment shall be reviewed and accepted by the RPR.

Concrete for the full paving width shall be effectively consolidated by internal vibrators. The rate of vibration of each vibrating unit shall be sufficient to consolidate the pavement without segregation, voids, or leaving vibrator trails.

Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.

**c. Consolidation.** Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 2 inches (50 mm). Vibrators shall not be used to transport or spread the concrete. For each paving train, at least one additional vibrator spindle, or sufficient

parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) or over-consolidation (vibrator trails, segregation, or any other evidence) shall require the immediate stopping of the paving operation and adjustment of the equipment or procedures as approved by the RPR.

If a lack of consolidation of the hardened concrete is suspected by the RPR, referee testing may be required. Referee testing of hardened concrete will be performed by the RPR by cutting cores from the finished pavement after a minimum of 24 hours curing. The RPR shall visually examine the cores for evidence of lack of consolidation. Density determinations will be made by the RPR based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. When required, referee cores will be taken at the minimum rate of one for each 500 cubic yards (382 m<sup>2</sup>) of pavement, or fraction. The Contractor shall be responsible for all referee testing cost if they fail to meet the required density.

The average density of the cores shall be at least 97% of the original concrete mix density, with no cores having a density of less than 96% of the original concrete mix density. Failure to meet the referee tests will be considered evidence that the minimum requirements for vibration are inadequate for the job conditions. Additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete conforms to the above requirements.

**501-4.9 Strike-off of concrete and placement of reinforcement.** Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the plans and to an elevation that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown on the plans. When reinforced concrete pavement is placed in two layers, the bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screed. If any portion of the bottom layer of concrete has been placed more than 30 minutes without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable ASTM specification requirements.

**501-4.10 Joints.** Joints shall be constructed as shown on the plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the plans. Joints shall not vary more than 1/2-inch (12 mm) from their designated position and shall be true to line with not more than 1/4-inch (6 mm) variation in 10 feet (3 m). The surface across the joints shall be tested with a 12-foot (3 m) straightedge as the joints are finished and any irregularities in excess of 1/4 inch (6 mm) shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.



**a. Construction.** Longitudinal construction joints shall be slip-formed or formed against side forms as shown in the plans.

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.

**b. Contraction.** Contraction joints shall be installed at the locations and spacing as shown on the plans. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 inch (3 mm) wide and to the depth shown on the plans.

**c. Isolation (expansion).** Isolation joints shall be installed as shown on the plans. The premolded filler of the thickness as shown on the plans, shall extend for the full depth and width of the slab at the joint. The filler shall be fastened uniformly along the hardened joint face with no buckling or debris between the filler and the concrete interface, including a temporary filler for the sealant reservoir at the top of the slab. The edges of the joint shall be finished and tooled while the concrete is still plastic

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**An isolation joint is primarily used to separate structures with different foundations and pavements with different joint patterns. It does not provide for expansion by the material compressing, but rather allowing the joint to slip. There should rarely be an occasion to dowel an isolation joint since it defeats the purpose of the joint and does not permit isolation and slippage. A thickened-edge is the preferred load transfer method for isolation joints.**

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#### **d. Dowels and Tie Bars for Joints**

**(1) Tie bars.** Tie bars shall consist of deformed bars installed in joints as shown on the plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals shown on the plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth and within the tolerances in paragraph 501-4.10(f). When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. Tie bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed.

**(2) Dowel bars.** Dowel bars shall be placed across joints in the proper horizontal and vertical alignment as shown on the plans. The dowels shall be coated with a bond-breaker or

other lubricant recommended by the manufacturer and approved by the RPR. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

**(3) Placing dowels and tie bars.** Horizontal spacing of dowels shall be within a tolerance of  $\pm 3/4$  inch (19 mm). The vertical location on the face of the slab shall be within a tolerance of  $\pm 1/2$  inch (12 mm). The method used to install dowels shall ensure that the horizontal and vertical alignment will not be greater than 1/4 inch per foot (6 mm per 0.3 m), except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of lubricating oil or light grease before the concrete is placed. Dowels shall be installed as specified in the following subparagraphs.

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**Dowels and tie bars shall not be placed closer than 0.6 times the dowel bar or tie bar length to the planned joint line. If the last regularly spaced longitudinal dowel and/or tie bar is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar and/or tie bar length, but not closer than 6 inches (150 mm) to its nearest neighbor.**

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**(a) Contraction joints.** Dowels and tie bars in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires.

At the Contractor's option, dowels and tie bars in contraction joints may be installed by insertion into the plastic concrete using approved equipment and procedures per the paver manufacturer's design. Approval of installation methods will be based on the results of the control strip showing that the dowels and tie bars are installed within specified tolerances as verified by cores or non-destructive rebar location devices approved by the RPR.

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**Non-destructive rebar location devices include the MIT scanner, Pachometer, R-Meter, etc.**

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**(b) Construction joints.** Install dowels and tie bars by the cast-in- place or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels and tie bars shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms.

**(c) Joints in hardened concrete.** Install dowels in hardened concrete by bonding the dowels into holes drilled into the concrete. The concrete shall have cured for seven (7) days or reached a minimum [ compressive strength of 3100 psi ((21.4 MPa)) ][ flexural strength of 450 psi (3.1 MPa) ] before drilling begins. Holes 1/8 inch (3 mm) greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur. Spalling beyond the limits of the grout retention ring will require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of  $\pm 1/2$  inch (12 mm) of the dimension shown on the drawings. On completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole by means of a suitable metal or plastic grout retention ring fitted around the dowel.

**e. Sawing of joints.** Sawing shall commence, without regard to day or night, as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs and shall continue without interruption until all joints have been sawn. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing. Curing compound or system shall be reapplied in the initial saw-cut and maintained for the remaining cure period.

Joints shall be cut in locations as shown on the plans. The initial joint cut shall be a minimum 1/8 inch (3 mm) wide and to the depth shown on the plans. Prior to placement of joint sealant or seals, the top of the joint shall be widened by sawing as shown on the plans.

**501-4.11 Finishing.** Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, edging of joints, and then texturing. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Equipment, mixture, and/or procedures which produce more than 1/4 inch (6 mm) of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way. Fog (mist) sprays or other surface applied finishing aids specified to prevent plastic shrinkage cracking, approved by the RPR, may be used in accordance with the manufacturers requirements.

**a. Machine finishing with slipform pavers.** The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-

propelled non-rotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. Equipment, mixture, and/or procedures which produce more than 1/4 inch (6 mm) of mortar-rich surface shall be immediately modified as necessary to eliminate this condition or operations shall cease. Remove excessive slurry from the surface with a cutting straightedge and wipe off the edge. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

**b. Machine finishing with fixed forms.** The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

**c. Other types of finishing equipment.** Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the RPR's approval.

Bridge deck finishers shall have a minimum operating weight of 7500 pounds (3400 kg) and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

**d. Hand finishing.** Hand finishing methods will not be permitted, except under the following conditions: (1) in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade and (2) in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical.

**e. Straightedge testing and surface correction.** After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a 12-foot (3.7-m) finishing straightedge swung from handles capable of spanning at least one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 inch (3 mm) thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross-section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

**501-4.12 Surface texture.** The surface of the pavement shall be finished as designated below for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. The texture shall be uniform in appearance and approximately 1/16 inch (2 mm) in depth. Any imperfections resulting from the texturing operation shall be corrected to the satisfaction of the RPR.

**a. Brush or broom finish.** [ Shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface. ] [ Not used. ]

**b. Burlap drag finish.** [ Burlap, at least 15 ounces per square yard (555 grams per square meter), will typically produce acceptable texture. To obtain a textured surface, the transverse threads of the burlap shall be removed approximately one foot (30 cm) from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface. ] [ Not used. ]

**c. Artificial turf finish.** [ Shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf. The leading transverse edge of the artificial turf drag will be securely fastened to a lightweight pole on a traveling bridge. At least 2 feet (60 cm) of the artificial turf shall be in contact with the concrete surface during dragging operations. Approval of the artificial turf will be done only after it has been demonstrated by the Contractor to provide a satisfactory texture. One type that has provided satisfactory texture consists of 7,200 approximately 0.85-inch-long polyethylene turf blades per square foot. ] [ Not used. ]

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**The Engineer shall specify the type(s) of finishes to be used on project.**

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**501-4.13 Curing.** Immediately after finishing operations are completed and bleed water is gone from the surface, all exposed surfaces of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour during the curing period.

When a two-saw-cut method is used to construct the contraction joint, the curing compound shall be applied to the saw-cut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.

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**The Engineer shall delete cure types that may not be feasible in operating areas subject to aircraft jet blast.**

**The use of supplementary cementitious materials (for example, fly ash, slag cement) or set-retarding admixtures may delay the occurrence of bleed water.**

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**a. Impervious membrane method.** Curing with liquid membrane compounds should not occur until bleed and surface moisture has evaporated. All exposed surfaces of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall. Curing compound shall be applied by mechanical sprayers under pressure at the rate of one gallon (4 liters) to not more than 150 square feet (14 sq m). The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the RPR, a double application rate shall be used to ensure coverage. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved means. Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface.

**b. White burlap-polyethylene sheets.** The surface of the pavement shall be entirely covered with the sheeting. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted to remain in contact with the surface covered, and the covering shall be maintained fully saturated and in position for seven (7) days after the concrete has been placed.

**c. Water method.** The entire area shall be covered with burlap or other water absorbing material. The material shall be of sufficient thickness to retain water for adequate curing without excessive runoff. The material shall be kept wet at all times and maintained for seven (7) days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.

**d. Concrete protection for cold weather.** Maintain the concrete at a temperature of at least 50°F (10°C) for a period of 72 hours after placing and at a temperature above freezing for the remainder of the 7-day curing period. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather; and any concrete damaged shall be removed and replaced at the Contractor's expense.

**e. Concrete protection for hot weather.** Concrete should be continuous moisture cured for the entire curing period and shall commence as soon as the surfaces are finished and continue for at least 24 hours. However, if moisture curing is not practical beyond 24 hours, the concrete surface shall be protected from drying with application of a liquid membrane-forming curing compound while the surfaces are still damp. Other curing methods may be approved by the RPR.

**501-4.14 Removing forms.** Unless otherwise specified, forms shall not be removed from freshly placed concrete until it has hardened sufficiently to permit removal without chipping,

spalling, or tearing. After the forms have been removed, the sides of the slab shall be cured in accordance with paragraph 501-4.13.

If honeycombed areas are evident when the forms are removed, materials, placement, and consolidation methods must be reviewed and appropriate adjustments made to assure adequate consolidation at the edges of future concrete placements. Honeycombed areas that extend into the slab less than approximately 1 inch (25 mm), shall be repaired with an approved grout, as directed by the RPR. Honeycombed areas that extend into the slab greater than a depth of 1 inch (25 mm) shall be considered as defective work and shall be removed and replaced in accordance with paragraph 501-4.19.

**501-4.15 Saw-cut grooving.** If shown on the plans, grooved surfaces shall be provided in accordance with the requirements of Item P-621.

**501-4.16 Sealing joints.** The joints in the pavement shall be sealed in accordance with Item [ P-604 ] [ P-605 ].

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**The Engineer shall include the applicable specifications.**

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**501-4.17 Protection of pavement.** The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents until accepted by the RPR. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense.

Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least seven (7) days old, or for a longer period if directed by the RPR.

In paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for seven (7) days, the joints are protected, the concrete has attained a minimum field cured flexural strength of [ 450 psi (3100 kPa) ], and the slab edge is protected.

All new and existing pavement carrying construction traffic or equipment shall be kept clean and spillage of concrete and other materials shall be cleaned up immediately.

Damaged pavements shall be removed and replaced at the Contractor's expense. Slabs shall be removed to the full depth, width, and length of the slab.

**501-4.18 Opening to construction traffic.** The pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of [ 450 pounds per square inch (3100 kPa) ] when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints

shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion.

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**When the design strength in paragraph 501-3.3 is based on compressive strength, a strength of 3,100 psi (21400 kPa) shall be specified. Testing shall be in accordance with ASTM C39. See note with paragraph 501-4.8 for guidance on editing 501-4.17 and 501-4.18.**

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**501-4.19 Repair, removal, or replacement of slabs.** New pavement slabs that are broken or contain cracks or are otherwise defective or unacceptable as defined by acceptance criteria in paragraph 501-6.6 shall be removed and replaced or repaired, as directed by the RPR, at the Contractor's expense. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The RPR will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be have a diameter of 2 inches (50 mm) to 4 inches (100 mm), shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with a bonding agent, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the Owner. Repair of cracks as described in this section shall not be allowed if in the opinion of the RPR the overall condition of the pavement indicates that such repair is unlikely to achieve an acceptable and durable finished pavement. No repair of cracks shall be allowed in any panel that demonstrates segregated aggregate with an absence of coarse aggregate in the upper 1/8 inch (3 mm) of the pavement surface.

**a. Shrinkage cracks.** Shrinkage cracks which do not exceed one-third of the pavement depth shall be cleaned and either high molecular weight methacrylate (HMWM) applied; or epoxy resin (Type IV, Grade 1) pressure injected using procedures recommended by the manufacturer and approved by the RPR. Sandblasting of the surface may be required following the application of HMWM to restore skid resistance. Care shall be taken to ensure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the RPR. Shrinkage cracks which exceed one-third the pavement depth shall be treated as full depth cracks in accordance with paragraphs 501-4.19b and 501-19c.

**b. Slabs with cracks through interior areas.** Interior area is defined as that area more than 6 inches (150 mm) from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the Owner, when there are any full depth cracks, or cracks greater than one-third the pavement depth, that extend into the interior area.

**c. Cracks close to and parallel to joints.** All full-depth cracks within 6 inches (150 mm) either side of the joint and essentially parallel to the original joints, shall be treated as follows.

**(1) Full depth cracks and original joint not cracked.** The full-depth crack shall be treated as the new joint and the original joint filled with an epoxy resin.

**i. Full-depth crack.** The joint sealant reservoir for the crack shall be formed by sawing to a depth of 3/4 inches (19 mm), ±1/16 inch (2 mm), and to a width of 5/8 inch (16



mm), ±1/8 inch (3 mm). The crack shall be sawed with equipment specially designed to follow random cracks. Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent raveling or spalling. The joint shall be sealed with sealant in accordance with P-605 or as directed by the RPR.

**ii. Original joint.** If the original joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.

If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures.

Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.

**(2) Full depth cracks and original joint cracked.** If there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced.

**d. Removal and replacement of full slabs.** Make a full depth cut perpendicular to the slab surface along all edges of the slab with a concrete saw cutting any dowels or tie-bars. Remove damaged slab protecting adjacent pavement from damage. Damage to adjacent slabs may result in removal of additional slabs as directed by the RPR at the Contractor's expense.

The underlying material shall be repaired, re-compacted and shaped to grade.

Dowels of the size and spacing specified for other joints in similar pavement on the project shall be installed along all four (4) edges of the new slab in accordance with paragraph 501-4.10d.

Placement of concrete shall be as specified for original construction. The joints around the new slab shall be prepared and sealed as specified for original construction.

**e. Spalls along joints.**

**(1)** Spalls less than one inch wide and less than the depth of the joint sealant reservoir, shall be filled with joint sealant material.

**(2)** Spalls larger than one inch and/or deeper than the joint reservoir, but less than ½ the slab depth, and less than 25% of the length of the adjacent joint shall be repaired as follows:

**i.** Make a vertical saw cut at least one inch (25 mm) outside the spalled area and to a depth of at least 2 inches (50 mm). Saw cuts shall be straight lines forming rectangular areas surrounding the spalled area.

**ii.** Remove unsound concrete and at least 1/2 inch (12 mm) of visually sound concrete between the saw cut and the joint or crack with a light chipping hammer.

**iii.** Clean cavity with high-pressure water jets supplemented with compressed air as needed to remove all loose material.

**iv.** Apply a prime coat of epoxy resin, Type III, Grade I, to the dry, cleaned surface of all sides and bottom of the cavity, except any joint face.

**v.** Fill the cavity with low slump concrete or mortar or with epoxy resin concrete or mortar.

**vi.** An insert or other bond-breaking medium shall be used to prevent bond at all joint faces.

vii. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints.

(3) Spalls deeper than 1/2 of the slab depth or spalls longer than 25% of the adjacent joint require replacement of the entire slab.

**f. Diamond grinding of Concrete surfaces.** Diamond grinding shall be completed prior to pavement grooving. Diamond grinding of the hardened concrete should not be performed until the concrete is at least 14 days old and has achieved full minimum strength. Equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The depth of diamond grinding shall not exceed 1/2 inch (13 mm) and all areas in which diamond grinding has been performed will be subject to the final pavement thickness tolerances specified.

Diamond grinding shall be performed with a machine specifically designed for diamond grinding capable of cutting a path at least 3 feet (0.9 m) wide. The saw blades shall be 1/8-inch (3-mm) wide with sufficient number of flush cut blades that create grooves between 0.090 and 0.130 inches (2 and 3.5 mm) wide; and peaks and ridges approximately 1/32 inch (1 mm) higher than the bottom of the grinding cut. The Contractor shall determine the number and type of blades based on the hardness of the aggregate. Contractor shall demonstrate to the RPR that the grinding equipment will produce satisfactory results prior to making corrections to surfaces.

Grinding will be tapered in all directions to provide smooth transitions to areas not requiring grinding. The slurry resulting from the grinding operation shall be continuously removed and the pavement left in a clean condition. All grinding shall be at the expense of the Contractor.

## CONTRACTOR QUALITY CONTROL (CQC)

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**All federally funded projects over \$500K dollars where paving is the major work item must have a CQCP. It is strongly encouraged that a Contractor Quality Control Program (CQCP) be developed for all projects.**

**For projects that do not include a formal CQCP, this section can be edited to remove reference to a CQCP. However, QC testing is still required regardless of project size.**

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**501-5.1 Quality control program.** [ The Contractor shall develop a Quality Control Program in accordance with Item C-100. No partial payment will be made for materials that are subject to specific quality control requirements without an approved quality control program. ]

**501-5.2 Contractor Quality Control (CQC).** [ The Contractor shall provide or contract for testing facilities in accordance with Item C-100. The RPR shall be permitted unrestricted access to inspect the Contractor's QC facilities and witness QC activities. The RPR will advise the Contractor in writing of any noted deficiencies concerning the QC

facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected. ]

**501-5.3 Contractor QC testing.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to this specification [ and as set forth in the CQCP. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content. A QC Testing Plan shall be developed and approved by the RPR as part of the CQCP.

The RPR may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of concrete mixture which is rendered unfit for use due to contamination, segregation, or improper slump. Such rejection may be based on only visual inspection. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the RPR, and if it can be demonstrated in the laboratory, in the presence of the RPR, that such material was erroneously rejected, payment will be made for the material at the contract unit price ].

**a. Fine aggregate.**

(1) **Gradation.** A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) **Moisture content.** If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

(3) **Deleterious substances.** Fine aggregate as delivered to the mixer shall be tested for deleterious substances in fine aggregate for concrete as specified in paragraph 501-2.1b, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

**b. Coarse Aggregate.**

(1) **Gradation.** A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.

(2) **Moisture content.** If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

(3) **Deleterious substances.** Coarse aggregate as delivered to the mixer shall be tested for deleterious substances in coarse aggregate for concrete as specified in paragraph 501-2.1c, prior to production of the control strip, and a minimum of every 30-days during production or more frequently as necessary to control deleterious substances.

**c. Slump.** One test shall be made for each subplot. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

**d. Air content.** One test shall be made for each subplot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.

**e. Unit weight and Yield.** One test shall be made for each subplot. Unit weight and yield tests shall be in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

**f. Temperatures.** Temperatures shall be checked at least four times per lot at the job site in accordance with ASTM C1064.

**g. Smoothness for Contractor Quality Control.**

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**Note change in deviations on final surface course that require grinding, limited to deviations > 1/4 inch that trap water, intent here is to focus on areas that may cause issues with the safe operation of aircraft and to minimize grinding if it will not improve safety**

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The Contractor shall perform smoothness testing in transverse and longitudinal directions daily to verify that the construction processes are producing pavement with variances less than 1/4 inch in 12 feet, identifying areas that may pond water which could lead to hydroplaning of aircraft. If the smoothness criteria is not met, appropriate changes and corrections to the construction process shall be made by the Contractor before construction continues

The Contractor may use a 12-foot (3.7 m) “straightedge, a rolling inclinometer meeting the requirements of ASTM E2133 or rolling external reference device that can simulate a 12-foot (3.7m) straightedge approved by the RPR. Straight-edge testing shall start with one-half the length of the straightedge at the edge of pavement section being tested and then moved ahead one-half the length of the straightedge for each successive measurement. Testing shall be continuous across all joints. The surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between the two high points. If the rolling inclinometer or external reference device is used, the data may be evaluated using either the FAA profile program, ProFAA, or FHWA profile program ProVal, using the 12-foot straightedge simulation function.

Smoothness readings shall not be made across grade changes or cross slope transitions. The transition between new and existing pavement shall be evaluated separately for conformance with the plans.

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**Include detail for transition between new and existing pavement including smoothness and grade limitations.**

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**(1) Transverse measurements.** Transverse measurements shall be taken for each day's production placed. Transverse measurements shall be taken perpendicular to the pavement centerline each 50 feet (15 m) or more often as determined by the RPR. The joint between lanes shall be tested separately to facilitate smoothness between lanes.

**(2) Longitudinal measurements.** Longitudinal measurements shall be taken for each day's production placed. Longitudinal tests shall be parallel to the centerline of paving; at the center of paving lanes when widths of paving lanes are less than 20 feet (6 m); and at the third points of paving lanes when widths of paving lanes are 20 ft (6 m) or greater. When placement abuts previously placed material the first measurement shall start with one half the length of the straight edge on the previously placed material.

Deviations on the final surface course in either the transverse or longitudinal direction that will trap water greater than 1/4 inch (6 mm) shall be corrected with diamond grinding per paragraph 501-4.19f or by removing and replacing the surface course to full depth. Grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding. All areas in which diamond grinding has been performed shall be subject to the final pavement thickness tolerances specified in paragraph 501-6.6.

Control charts shall be kept to show area of each day's placement and the percentage of corrective grinding required. Corrections to production and placement shall be initiated when corrective grinding is required. If the Contractor's machines and/or methods produce significant areas that need corrective actions in excess of 10 percent of a day's production, production shall be stopped until corrective measures are implemented by the Contractor.

**h. Grade.** Grade will be evaluated prior to and after placement of the concrete surface.

Measurements will be taken at appropriate gradelines (as a minimum at center and edges of paving lane) and longitudinal spacing as shown on cross-sections and plans. The final surface of the pavement will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically [ and 0.1 feet (30 mm) laterally ]. The documentation will be provided by the Contractor to the RPR [ within 48 hours ] [ by the end of the following working day ].

Areas with humps or depression that that exceed grade or smoothness and that retain water on the surface must be ground off provided the course thickness after grinding is not more than 1/2 inch (12 mm) less than the thickness specified on the plans. If these areas cannot be corrected with grinding then the slabs that are retaining water must be removed and replaced in accordance with paragraph 501-4.19d. Grinding shall be in accordance with paragraph 501-4.19f. All corrections will be at the Contractors expense.

**501-5.4 Control charts.** The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, and air content. The Contractor shall also maintain a control chart plotting the coarseness factor/workability factor from the combined gradations in accordance with paragraph 501-2.1d.

Control charts shall be posted in a location satisfactory to the RPR and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and suspension Limits, or Specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the RPR may halt production or acceptance of the material.

**a. Fine and coarse aggregate gradation.** The Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Superimposed on the control charts shall be the action and suspension limits. Gradation tests shall be performed by the Contractor per ASTM C136. The Contractor shall take at least [ two ] samples per lot to check the final gradation. Sampling shall be per ASTM D75 from the flowing aggregate stream or conveyor belt.

**b. Slump and air content.** The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.

**c. Combined gradation.** The Contractor shall maintain a control chart plotting the coarseness factor and workability factor on a chart in accordance with paragraph 501-2.1d.

#### Control Chart Limits<sup>1</sup>

Control Parameter	Individual Measurements	
	Action Limit	Suspension Limit
Gradation <sup>2</sup>	*3	*3
Coarseness Factor (CF)	±3.5	±5
Workability Factor (WF)	±2	±3
Slump	+0.5 to -1 inch (+13 to -25 mm)	+1 to -1.5 inch (+25 to -38 mm)
Air Content	±1.5%	±2.0%

<sup>1</sup> Control charts shall developed and maintained for each control parameter indicated.

<sup>2</sup> Control charts shall be developed and maintained for each sieve size.

<sup>3</sup> Action and suspension limits shall be determined by the Contractor.

**501-5.5 Corrective action at Suspension Limit.** [ The CQCP shall indicate that appropriate action shall be taken when the process is believed to be out of control. The CQCP shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.

**a. Fine and coarse aggregate gradation.** When two consecutive averages of five tests are outside of the suspension

limits, immediate steps, including a halt to production, shall be taken to correct the grading.

**b. Coarseness and Workability factor.** When the CF or WF reaches the applicable suspension limits, the Contractor, immediate steps, including a halt to production, shall be taken to correct the CF and WF.

c. Fine and coarse aggregate moisture content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5%, the scale settings for the aggregate batcher and water batcher shall be adjusted.

d. Slump. The Contractor shall halt production and make appropriate adjustments whenever:

(1) one point falls outside the Suspension Limit line for individual measurements

OR

(2) two points in a row fall outside the Action Limit line for individual measurements.

d. Air content. The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:

(1) one point falls outside the Suspension Limit line for individual measurements

OR

(2) two points in a row fall outside the Action Limit line for individual measurements. ]

## **MATERIAL ACCEPTANCE**

**501-6.1 Quality Assurance (QA) Acceptance sampling and testing.** All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section, with the exception of coring for thickness determination, will be performed by the RPR. The Contractor shall provide adequate facilities for the initial curing of beams. The Contractor shall bear the cost of providing initial curing facilities and coring and filling operations, per paragraph 501-6.5b(1).

The samples will be transported while in the molds. The curing, except for the initial cure period, will be accomplished using the immersion in saturated lime water method. During the 24 hours after molding, the temperature immediately adjacent to the specimens must be maintained in the range of 60° to 80°F (16° to 27°C), and loss of moisture from the specimens must be prevented. The specimens may be stored in tightly constructed wooden boxes, damp sand pits, temporary buildings at construction sites, under wet burlap in favorable weather, or in heavyweight closed plastic bags, or using other suitable methods, provided the temperature and moisture loss requirements are met.

**501-6.2 Quality Assurance (QA) testing laboratory.** Quality assurance testing organizations performing these acceptance tests will be accredited in accordance with ASTM C1077. The quality assurance laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for acceptance sampling and testing must be

listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods will be submitted to the RPR prior to start of construction.

**501-6.3 Lot size.** Concrete will be accepted for strength and thickness on a lot basis. A lot will consist of a day's production not to exceed 2,000 cubic yards (1530 cubic meters) [ [ ] square yards ( [ ] square meters) ]. Each lot will be divided into approximately equal sublots with individual sublots between 400 to 600 cubic yards. Where three sublots are produced, they will constitute a lot. Where one or two sublots are produced, they will be incorporated into the previous or next lot. Where more than one plant is simultaneously producing concrete for the job, the lot sizes will apply separately for each plant.

**501-6.4 Partial lots.** When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot or for overages or minor placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

Where three sublots have been produced, they will constitute a lot. Where one or two sublots have been produced, they will be incorporated into the next lot or the previous lot and the total number of sublots will be used in the acceptance criteria calculation, that is, n=5 or n=6.

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**The Engineer will specify the lot size for a project based on the total quantity and the expected production rate. The lot size should not exceed 2,000 cubic yards (1,530 cubic meters). For projects where basis of payment is square yards (square meters), the Engineer will convert the lot size to an equivalent area that contains 2,000 cubic yards (1,530 cubic meters) or less.**

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### **501-6.5 Acceptance Sampling and Testing.**

#### **a. Strength.**

(1) **Sampling.** One sample will be taken for each subplot from the concrete delivered to the job site. Sampling locations will be determined by the RPR in accordance with random sampling procedures contained in ASTM D3665. The concrete will be sampled in accordance with ASTM C172.

(2) **Test Specimens.** The RPR will be responsible for the casting, initial curing, transportation, and curing of specimens in accordance with ASTM C31. Two (2) specimens will be made from each sample and slump, air content, unit weight, and temperature tests will be conducted for each set of strength specimens. Within 24 to 48 hours, the samples will be transported from the field to the laboratory while in the molds. Samples will be cured in saturated lime water.

The strength of each specimen will be determined in accordance with [ ASTM C39 ] [ ASTM C78 ]. The strength for each subplot will be computed by averaging the results of the two test specimens representing that subplot.

(3) **Acceptance.** Acceptance of pavement for strength will be determined by the RPR in accordance with paragraph 501-6.6b(1). All individual strength tests within a lot will be



checked for outliers in accordance with ASTM E178, at a significance level of 5%. Outliers will be discarded and the remaining test values will be used to determine acceptance in accordance with paragraph 501-6.5b.

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**The Engineer must make the appropriate selections in paragraph 501-3.3 based on whether the strength is based on flexural or compressive strength.**

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**b. Pavement thickness.**

(1) **Sampling.** One core will be taken by the Contractor for each subplot in the presence of the RPR. Sampling locations will be determined by the RPR in accordance with random sampling procedures contained in ASTM D3665. Areas, such as thickened edges, with planned variable thickness, will be excluded from sample locations.

Cores shall be a minimum 4 inch (100 mm) in diameter neatly cut with a core drill. The Contractor will furnish all tools, labor, and materials for cutting samples and filling the cored hole. Core holes will be filled by the Contractor with a non-shrink grout approved by the RPR within one day after sampling.

(2) **Testing.** The thickness of the cores will be determined by the RPR by the average caliper measurement in accordance with ASTM C174. Each core shall be photographed and the photograph included with the test report.

(3) **Acceptance.** Acceptance of pavement for thickness will be determined by the RPR in accordance with paragraph 501-6.6.

**501-6.6 Acceptance criteria.**

**a. General.** Acceptance will be based on the following characteristics of the completed pavement discussed in paragraph 501-6.5b:

- (1) Strength
- (2) Thickness
- (3) Grade
- (4) Profilograph smoothness [ Not used. ]
- (5) Adjustments for repairs

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**Add bracketed text when profilograph smoothness not used.**

**Profilograph smoothness and acceptance adjustment paragraphs only apply when the overall project is a new and/or reconstructed runway(s) and/or taxiway(s) greater than 500 feet (152 m) in length. Any changes to the profilograph smoothness acceptance limits requires a modification to**

**standards in accordance with FAA Order 5300.1, Modifications to Agency Airport Design, Construction, and Equipment Standards.**

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Acceptance for strength, thickness, and grade, will be based on the criteria contained in accordance with paragraph 501-6.6b(1), 501-6.6b(2), and 501-6.6b(3), respectively. [ Acceptance for profilograph smoothness will be based on the criteria contained in paragraph 501-6.6b(4). ]

[ Production quality must achieve 90 PWL or higher to receive full payment.

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**When the design strength in paragraph 501-3.3 is based on compressive strength, substitute compressive strength for flexural strength.**

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Strength and thickness will be evaluated for acceptance on a lot basis using the method of estimating PWL. Production quality must achieve 90 PWL or higher to receive full pavement. The PWL will be determined in accordance with procedures specified in Item C-110.

The lower specification tolerance limit (L) for strength and thickness will be:

**Lower Specification Tolerance Limit (L)**

<b>Strength</b>	0.93 × strength specified in paragraph 501-3.3
<b>Thickness</b>	Lot Plan Thickness in inches, - 0.50 in

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**The lower specification tolerance limits above are based on applying statistical analysis to FAA design assumptions, and there is no need to compensate for the above factor in the design process.**

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**b. Acceptance criteria.**

[ **(1) Strength.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 501-8.1.

**(2) Thickness.** If the PWL of the lot equals or exceeds 90%, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 501-8.1. ]

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**For small maintenance and repair projects:**

**Where the project has multiple small placements or the total project size is less than 2000 cubic yards (1530 cubic meters), the use of percent within limits (PWL) is not appropriate and acceptable material will be paid for by the cubic yard (square yard).**

**Replace the above bracketed PWL requirements with the following:**

**(1) Strength.** The strength for each subplot shall be computed by averaging the results of that subplot. When subplot strength equals or exceeds the strength as specified in paragraph 501-3.3, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 501-8.1.

**(2) Thickness.** If subplot thickness is not be less than 1/2 inch (12 mm) from plan thickness, the lot will be acceptable. Acceptance and payment for the lot will be determined in accordance with paragraph 501-8.1.

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**(3) Grade.** The final finished surface of the pavement of the completed project will not vary from the gradeline elevations and cross-sections shown on the plans by more than 1/2 inch (12 mm) vertically [ or 0.1 feet (30 mm) laterally ]. The documentation, stamped and signed by a licensed surveyor shall be in accordance with paragraph 501-5.3h. Payment for sublots that do not meet grade for over 25% of the subplot shall reduced by 5% and not be more than 95%.

**(4) Profilograph roughness for QA Acceptance.** [ The final profilograph shall be the full length of the project to facilitate testing of roughness between lots. The [ Contractor, in the presence of the RPR shall ] [ RPR will ] perform a profilograph roughness test on the completed project with a profilograph meeting the requirements of ASTM E1274 or a Class I inertial profiler meeting ASTM E950. Data and results shall be provided within [ 48 hrs ] of profilograph roughness tests.

The pavement shall have an average profile index less than 15 inches per mile per 1/10 mile. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must grind" bumps and the Profile Index for the pavement using a 0.2-inch (5 mm) blanking band. The bump template must span one inch (25 mm) with an offset of 0.4 inches

(10 mm). The profilograph must be calibrated prior to use and operated by a factory or State DOT approved, trained operator. Profilograms shall be recorded on a longitudinal scale of one inch (25 mm) equals 25 feet (7.5 m) and a vertical scale of one inch (25 mm) equals one inch (25 mm). Profilograph shall be performed one foot right and left of project centerline and 15 feet (4.5 m) right and left of project centerline. Any areas that indicate "must grind" shall be corrected with diamond grinding per paragraph 501-4.19f or by removing and replacing full depth of surface course. as directed by the RPR. Where corrections are necessary, a second profilograph run shall be performed to verify that the corrections produced an average profile index of 15 inches per mile per 1/10 mile or less. ]  
[ Not used. ]

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**Edit as required for project.**

**Profilograph roughness and acceptance paragraphs only apply when the overall project is a new and/or reconstructed runway(s) and/or taxiway(s) greater than 500 feet (152 m) in length.**

**Profilograph roughness is not applicable to aprons and should be used with caution on projects to rehabilitate runways and/or taxiways unless the project includes provisions to correct existing deficiencies.**

**Any changes to the profilograph roughness acceptance limits requires a modification to standards in accordance with FAA Order 5300.1, Modifications to Agency Airport Design, Construction, and Equipment Standards.**

**The Engineer must select who will provide the specified equipment and the timeframe for receiving the test data. The Airport should retain a copy of the profilograph roughness test and reports for inclusion in the Airport's Pavement Maintenance Management Program (PMP).**

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**(5) Adjustments for repair.** Sublots with spall repairs, crack repairs, or partial panel replacement, will be limited to no more than 95% payment.

**(6) Adjustment for grinding.** For sublots with grinding over 25% of a subplot, payment will be reduced 5%.

## **METHOD OF MEASUREMENT**

**501-7.1** Concrete pavement shall be measured by the number of [ cubic yards (cubic meters) ] [ square yards (square meters) ] of [ plain ] [ reinforced ] pavement as specified in-place, completed and accepted.

**BASIS OF PAYMENT**

**501-8.1 Payment.** Payment for concrete pavement meeting all acceptance criteria as specified in paragraph 501-6.6. Acceptance Criteria shall be based on results of strength [ , smoothness, ] and thickness tests. Payment for acceptable lots of concrete pavement shall be adjusted in accordance with paragraph 501-8.1a for strength and thickness; 501-8.1b for repairs; 501-8.1c for grinding; and 501-8.1d for smoothness, subject to the limitation that:

The total project payment for concrete pavement shall not exceed [ ] percent of the product of the contract unit price and the total number of [ cubic yards (cubic meters) ] [ square yards (square meters) ] of concrete pavement used in the accepted work (See Note 1 under the Price Adjustment Schedule table below).

Payment shall be full compensation for all labor, materials, tools, equipment, and incidentals required to complete the work as specified herein and on the drawings.

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**The Engineer shall specify a value ranging from 100% to 106%. When the total project payment for Item P-501 pavement exceeds the contract unit price, any Airport Improvement Program (AIP) or Passenger Facility Charge (PFC) funds used to pay the excess may require an amendment to the AIP grant or PFC application for the project.**

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**a. Basis of adjusted payment.** The pay factor for each individual lot shall be calculated in accordance with the Price Adjustment Schedule table below. A pay factor shall be calculated for both strength and thickness. The lot pay factor shall be the higher of the two values when calculations for both strength and thickness are 100% or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either strength or thickness is 100% or higher. The lot pay factor shall be the lower of the two values when calculations for both strength and thickness are less than 100%.

**Price Adjustment Schedule<sup>1</sup>**

<b>Percentage of Materials Within Specification Limits (PWL)</b>	<b>Lot Pay Factor (Percent of Contract Unit Price)</b>
96 – 100	106
90 – 95	PWL + 10
75 – 90	0.5 PWL + 55
55 – 74	1.4 PWL – 12
Below 55	Reject <sup>2</sup>

<sup>1</sup> Although it is theoretically possible to achieve a pay factor of 106% for each lot, actual payment in excess of 100% shall be subject to the total project payment limitation specified in paragraph 501-8.1.

<sup>2</sup> The lot shall be removed and replaced unless, after receipt of FAA concurrence, the Owner and Contractor agree in writing that the lot will remain; the lot paid at 50% of the contract unit price; and the total project payment limitation reduced by the amount withheld for that lot.

For each lot accepted, the adjusted contract unit price shall be the product of the lot pay factor for the lot and the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph 501-8.1. Payment in excess of 100% for accepted lots of concrete pavement shall be used to offset payment for accepted lots of concrete pavement that achieve a lot pay factor less than 100%; except for rejected lots which remain in place and/or sublots with adjustments for repairs.

**b. Adjusted payment for repairs.** The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots which contain repairs in accordance with paragraph 501-4.19 on more than 20% of the slabs within the subplot. Payment factors greater than 100 percent for the strength and thickness cannot be used to offset adjustments for repairs.

**c. Adjusted payment for grinding.** The PWL lot pay factor shall be reduced by 5% and be no higher than 95% for sublots with grinding over 25% of a subplot.

**d. Profilograph Roughness.** [ The Contractor will receive full payment when the profilograph average profile index is in accordance with paragraph 501-6.6b(4). When the final average profile index for the entire length of pavement does not exceed 15 inches per mile per 1/10 mile, payment will be made at the contract unit price for the completed pavement. ]

[ Not used. ]

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**Edit as required for project.**

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**e. Payment. Payment shall be made under:**

**Item P-501-8.1 Concrete Pavement.** [ per cubic yard (cubic meter) ] [ per square yard (square meter) ]

**Item P-620 Runway and Taxiway Marking**

**DESCRIPTION**

**620-1.1** This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Resident Project Representative (RPR). The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

**MATERIALS**

**620-2.1 Materials acceptance.** The Contractor shall furnish manufacturer’s certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint manufacturer’s surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the Resident Project Representative (RPR) prior to the initial application of markings. The reports can be used for material acceptance or the RPR may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the RPR upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the RPR.

**620-2.2 Marking materials.**

**Table 1. Marking Materials**

<b>Paint<sup>1</sup></b>				<b>Glass Beads<sup>2</sup></b>	
<b>Type</b>	<b>Color</b>	<b>Fed Std. 595 Number</b>	<b>Application Rate Maximum</b>	<b>Type</b>	<b>Application Rate Minimum</b>
*	*	*	*	*	*
*	*	*	*	*	*

<sup>1</sup> See paragraph 620-2.2a

<sup>2</sup> See paragraph 620-2.2b

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**Make the appropriate selections for paint type, color, Fed Std 595 number, application rates, and glass bead type and application rates and inserted into Table 1. Asterisks denote insert points.**

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**a. Paint.** Paint shall be [ waterborne ] [ epoxy ] [ methacrylate ] [ solvent-base ] [ and ] [ preformed thermoplastic ] in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595. [\_\_\_]



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The Engineer must specify paint type (s), colors and glass beads to be used for the project and populate that information above in Table 1. When more than one paint type is specified, the plans should clearly indicate paint type, paint color and bead type required for each marking.

Select type of paint.

Types: Waterborne, Epoxy, Methacrylate, solvent-base, or preformed Thermoplastic

For waterborne or solvent based paints, specify Type I, II, or III:

- Type I intended for locations where slower tracking is not a problem.
- Type II intended for locations where faster curing is desirable.
- Type III intended for locations that require a thicker, more durable coating.

1. Select paint color(s) from the following Table:

Paint Color	Fed Std. No 595 Color Number
White	37925
Red	31136
Yellow	33538 or 33655
Black	37038
Pink	1 part 31136 to 2 parts 37925
Green	34108

Waterborne or solvent base black paint should be used to outline a border at least 6 inches (150 mm) wide around markings on all light-colored pavements. Preformed thermoplastic markings shall have a non-reflectorized black border integral to the marking.

**Select appropriate application rates for type of paint and bead selected:**

**Application Rates for Paint and Glass Beads for Table 1**

Paint		Glass Beads		
Type	Application Rate Maximum	Type I, Gradation A <sup>1</sup> Minimum	Type III Minimum	Type IV <sup>1</sup> Minimum
Waterborne Type I or II	115 ft <sup>2</sup> /gal (2.8 m <sup>2</sup> /l)	7 lb/gal (0.85 kg/l)	10 lb/gal (1.2 kg/l)	--
Waterborne Type III	90 ft <sup>2</sup> /gal (2.2 m <sup>2</sup> /l)	7 lb/gal (0.85 kg/l)	8 lb/gal (1.0 kg/l)	
Waterborne Type III	55 ft <sup>2</sup> /gal (1.4 m <sup>2</sup> /l)		6 lb/gal (.8 kg/l)	5 lb/gal (.7 kg/l)
Solvent Base	115 ft <sup>2</sup> /gal (2.8 m <sup>2</sup> /l)	7 lb/gal (0.85 kg/l)	10 lb/gal (1.2 kg/l)	--
Solvent Base	55 ft <sup>2</sup> /gal (2.2 m <sup>2</sup> /l)	--	--	5 lb/gal (.7 kg/l)
Epoxy	90 ft <sup>2</sup> /gal (2.2 m <sup>2</sup> /l)	15 lb/gal (1.8 kg/l)	20 lb/gal (2.4 kg/l)	16 lb/gal (1.9 kg/l)
Methacrylate	45 ft <sup>2</sup> /gal (1.1 m <sup>2</sup> /l)	15 lb/gal (1.8 kg/l)	20 lb/gal (2.4 kg/l)	16 lb/gal (1.9 kg/l)
Methacrylate Splatter-Profile	24ft <sup>2</sup> /gal. (0.6 m <sup>2</sup> /l)	8 lb/gal. (0.1 kg/l)	10 lb/gal. (1.2 kg/l)	10 lb/gal (1.2 kg/l)
Temporary Marking Waterborne Type I or II	230 ft <sup>2</sup> /gal (5.6 m <sup>2</sup> /l)	No beads	No beads	No beads

<sup>1</sup>Glass bead application rate for Red and Pink paint shall be reduced by 2 lb/gal (0.24 kg/l) for Type I and Type IV beads.

The Engineer shall specify the time period in paragraph 620-3.5 in order to allow adequate curing of the pavement surface. The Engineer should contact the paint manufacturer to determine the wait period. A 24- to 30-day waiting period is recommended for all types of paint used for pavement marking. The final application should occur after the waiting period has passed. The final marking application must be at a rate equal to 100% of the full application rate with glass beads.

Markings may be required before paving operations are complete. The Engineer may wish to specify waterborne or solvent-based materials for temporary markings at 30% to 50% of the specified application rates. Glass beads will not adhere well at the low application rates for temporary markings.

**CAUTION: Prior to reopening pavements at Part 139 airports verify that all markings comply with Part 139 requirements. Temporary markings not in compliance with AC 150/5340-1 will require a NOTAM regarding any non-standard marking be issued. For example, temporary markings without beads.**

**When painting Porous Friction Course, the paint should be applied to the pavement in two coats from opposite directions. The first coat should be applied at a rate equal to 50% of the full application rate with no glass beads. The second coat should be applied from the opposite direction at a rate equal to 100% of the full application rate with glass beads.**

**Preformed thermoplastic pavement markings shall yield at least 225 mcd/m<sup>2</sup>/lux on white markings at installation and at least 100 mcd/m<sup>2</sup>/lux on yellow markings at installation.**

**Retroreflectivity shall be measured by a portable retroreflectometer according to ASTM E1710 and the practices in ASTM D7585 shall be followed for taking retroreflectivity readings with a portable retroreflectometer and computing measurement averages. A vehicle-mounted retroreflectometer may also be used.**

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[ Waterborne. Paint shall meet the requirements of Federal Specification TT-P-1952F, [ Type I ] [ Type II ] [ Type III ]. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. [ The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm<sup>-1</sup> with intensities equal to those produced by an acrylic resin known to be 100% cross linking. ]

[ Epoxy. Paint shall be a two component, minimum 99% solids type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 18% minimum (16.5% minimum at 100% purity).

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 14 to 17%.
- Epoxy resin shall be 75 to 79%.
- Organic yellow, other colors, and tinting as required to meet color standard.

(2) Epoxy content. Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D1652 shall be the manufacturer's target  $\pm 50$ .

(3) Amine number. Component B. When tested in accordance with ASTM D2074 shall be the manufacturer's target  $\pm 50$ .

(4) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(5) Daylight directional reflectance.

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

(6) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013-inch (0.33 mm) to four 3 × 6-inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 5 above. Evaluate for conformance with the color requirements.

(7) Volatile organic content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(8) Dry opacity. Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

(9) Abrasion resistance. Subject the panels prepared in paragraph 620-2.2b(6) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test

panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg)) of sand for the removal of the paint films.

(10) Hardness, shore. Hardness shall be at least 80 when tested in accordance with ASTM D2240. ]

[ **Methacrylate.** Paint shall be a two component, minimum 99% solids-type system conforming to the following:

(1) Pigments. Component A. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.
- Methacrylate resin shall be 18% minimum.

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum.

Organic yellow, other colors, and tinting as required to meet color standard.

- Methacrylate resin shall be 18% minimum.

(2) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(3) Daylight directional reflectance:

(a) White: The daylight directional reflectance of the white paint shall not be less than 80% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

(4) Accelerated weathering.

(a) Sample preparation. Apply the paint at a wet film thickness of 0.013-inch (0.33 mm) to four 3 × 6-inch (8 × 15 cm) aluminum panels prepared as described in ASTM E2302. Air dry the sample 48 hours under standard conditions.

(b) Testing conditions. Test in accordance with ASTM G154 using both Ultra Violet (UV-B) Light and condensate exposure,

72 hours total, alternating four (4) hour UV exposure at 140°F (60°C), and four (4) hours condensate exposure at 104°F (40°C).

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 3 above. Evaluate for conformance with the color requirements.

(5) Volatile organic content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(6) Dry opacity. Use ASTM E2302. The wet film thickness shall be 0.015 inch (0.38 mm). The minimum opacity for white and colors shall be 0.92.

(7) Abrasion resistance. Subject the panels prepared in paragraph 620-2.2c(4) to the abrasion test in accordance with ASTM D968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters (17.5 lb (7.94 kg)) of unused sand shall be used for each test panel. The test shall be run on two test panels Both baked and weathered paint films shall require not less than 150 liters (525 lbs (239 kg) of sand for the removal of the paint films.

(8) Hardness, shore. Hardness shall be at least 60 when tested in accordance with ASTM D2240.

**(9) Additional requirements for methacrylate splatter profiled pavement marking.** Pavement markings of this type shall comply with all above requirements for methacrylate paint, except as noted below:

(a) The thickness of the marking will be irregular ranging from 0.000 to 0.250 inches (0.00 to 6.4 mm), applied in a splatter pattern which comprises a minimum of 80% of the visible line (when traveling at 5 mph the line appears to be solid.).

(b) The hardness shall be 48 Shore D minimum. ]

[ Solvent-Base. Paint shall meet the requirements of Commercial Item Description [ A-A-2886B Type I, Type II, and Type III ]. ]

[ Preformed Thermoplastic Airport Pavement Markings. Markings must be composed of ester modified resins in conjunction with aggregates, pigments, and binders that have been factory produced as a finished product. The material must be impervious to degradation by aviation fuels, motor fuels, and lubricants.

(1) The markings must be able to be applied in temperatures as low as 35°F without any special storage, preheating, or treatment of the material before application.

(a) The markings must be supplied with an integral, non-reflectorized black border.

(2) Graded glass beads.

(a) The material must contain a minimum of 30% intermixed graded glass beads by weight. The intermixed beads shall conform to Federal Specification TT-B-1325D, Type I, gradation A and Federal Specification TT-B-1325D, Type IV.

(b) The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of one (1) lb (0.45 kg) ( $\pm 10\%$ ) per 10 square feet (1 sq m). These factory-applied coated surface beads shall have a minimum of 90% true spheres, minimum refractive index of 1.50, and meet the following gradation.

### Preformed Thermoplastic Bead Gradation

Size Gradation		Retained, %	Passing, %
U.S. Mesh	$\mu\text{m}$		
12	1700	0 - 2	98 - 100
14	1400	0 - 3.5	96.5 - 100
16	1180	2 - 25	75 - 98
18	1000	28 - 63	37 - 72
20	850	63 - 72	28 - 37
30	600	67 - 77	23 - 33
50	300	89 - 95	5 - 11
80	200	97 - 100	0 - 3

(3) Heating indicators. The material manufacturer shall provide a method to indicate that the material has achieved satisfactory adhesion and proper bead embedment **during application** and that the installation procedures have been followed.

(4) Pigments. Percent by weight.

(a) White:

- Titanium Dioxide, ASTM D476, type II shall be 10% minimum.

(b) Yellow and Colors:

- Titanium Dioxide, ASTM D476, type II shall be 1% minimum.
- Organic yellow, other colors, and tinting as required to meet color standard.

(5) Prohibited materials. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant federal regulations.

(6) Daylight directional reflectance.

(a) White: The daylight directional reflectance of the white paint shall not be less than 75% (relative to magnesium oxide), when tested in accordance with ASTM E2302.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 45% (relative to magnesium oxide), when tested in accordance with ASTM E2302. The x and y values shall be consistent with the federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

(7) Skid resistance. The surface, with properly applied and embedded surface beads, must provide a minimum resistance value of 45 BPN when tested according to ASTM E303.

(8) Thickness. The material must be supplied at a nominal thickness of 65 mil (1.7 mm).

(9) Environmental resistance. The material must be resistant to deterioration due to exposure to sunlight, water, salt, or adverse weather conditions and impervious to aviation fuels, gasoline, and oil.

(10) Retroreflectivity. The material, when applied in accordance with manufacturer's guidelines, must demonstrate a uniform level of nighttime retroreflection when tested in accordance to ASTM E1710.

(11) Packaging. Packaging shall protect the material from environmental conditions until installation.

**(12) Preformed thermoplastic airport pavement marking requirements.**

(a) The markings must be a resilient thermoplastic product with uniformly distributed glass beads throughout the entire cross-sectional area. The markings must be resistant to the detrimental effects of aviation fuels, motor fuels and lubricants, hydraulic fluids, deicers, anti-icers, protective coatings, etc. Lines, legends, and symbols must be capable of being affixed to asphalt and/or Portland cement concrete pavements by the use of a large radiant heater. Colors shall be available as required.

(b) The markings must be capable of conforming to pavement contours, breaks, and faults through the action of airport traffic at normal pavement temperatures. The markings must be capable of fully conforming to grooved pavements, including pavement grooving per advisory circular (AC) 150/5320-12, current version. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastics when heated with a heat source per manufacturer's recommendation.



(c) Multicolored markings must consist of interconnected individual pieces of preformed thermoplastic pavement marking material, which through a variety of colors and patterns, make up the desired design. The individual pieces in each large marking segment (typically more than 20 feet (6 m) long) must be factory assembled with a compatible material and interconnected so that in the field it is not necessary to assemble the individual pieces within a marking segment. Obtaining multicolored effect by overlaying materials of different colors is not acceptable due to resulting inconsistent marking thickness and inconsistent application temperature in the marking/substrate interface.

(d) The marking material must set up rapidly, permitting the access route to be re-opened to traffic after application.

(e) The marking material shall have an integral color throughout the thickness of the marking material. ]

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**Thermoplastic airport markings will be subject to an Engineering life-cycle cost analysis prior to inclusion in specifications.**

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**b. Reflective media.** Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D [ Type I, Gradation A ] [ Type III ] [ Type IV, Gradation A ].

Glass beads for red and pink paint shall meet the requirements for [ Type I, Gradation A ] [ Type IV, Gradation A ].

Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

\*\*\*\*\*

**The Engineer should insert all that will be used in the project. When more than one bead type is specified, the plans should indicate the bead type for each marking.**

**Federal Specification TT-B-1325D, Type I, gradation A shall be used when remarking on a frequent basis (at least every six months), and typically yield 300 mcd/m<sup>2</sup>/lux on white markings at installation and 175 mcd/m<sup>2</sup>/lux on yellow markings at installation.**

**Federal Specification TT-B-1325D, Type III. Initial readings typically yield 600 mcd/m<sup>2</sup>/lux on white markings and 300 mcd/m<sup>2</sup>/lux on yellow markings**

at installation and once in service, the reflectance values are approximately the same as Type I beads.

Federal Specification TT-B-1325D, Type IV, gradation A shall be used with TT-P-1952F, Type III paint. The glass beads are larger than either Type I or Type III, thus requiring more of the coating material to properly anchor. The Engineer should consult with the paint and bead manufacturer on the use of adhesion, flow promoting, and/or flotation additives.

Preformed thermoplastic pavement markings should yield at least 225 mcd/m<sup>2</sup>/lux on white markings at installation and at least 100 mcd/m<sup>2</sup>/lux on yellow markings at installation.

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## CONSTRUCTION METHODS

**620-3.1 Weather limitations.** Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the manufacturer's recommendations in accordance with paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the manufacturers' recommendations for application and dry time.

**620-3.2 Equipment.** Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

**620-3.3 Preparation of surfaces.** Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminants that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the RPR. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

**a. Preparation of new pavement surfaces.** The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the RPR to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

**b. Preparation of pavement to remove existing markings.** Existing pavement markings shall be removed by rotary grinding, water blasting, or by other methods approved by the RPR minimizing damage to the pavement surface. The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt

pavements, apply a fog seal or seal coat to ‘block out’ the removal area to eliminate ‘ghost’ markings.

**c. Preparation of pavement markings prior to remarking.** Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the RPR. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufactures application and surface preparation requirements must be submitted to the RPR prior to the initial application of markings.

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**Loose markings should always be removed prior to remarking, whether or not existing markings need to be removed is up to the Engineer and the Airport Operator. The type of removal method used depends upon whether you need to remove loose markings or all existing markings.**

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**620-3.4 Layout of markings.** The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans. [ The locations of markings to receive silica sand shall be shown on the plans. ]

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**Glass beads improve conspicuity and the friction characteristics of markings. At a minimum, the Engineer shall indicate the locations to receive glass beads per AC 150/5340-1, Standards for Airport Markings.**

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**620-3.5 Application.** A period of [\_\_\_] days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the RPR.

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**Select timeframe between placement of surface course or seal coat and application of the paint based on type of surface course or seal coat in the project and environment at the project location. The typical timeframe is 30-days for volatiles and moisture vapor to dissipate.**

\*\*\*\*\*

The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m), and marking dimensions and spacing shall be within the following tolerances:

**Marking Dimensions and Spacing Tolerance**

<b>Dimension and Spacing</b>	<b>Tolerance</b>
36 inch (910 mm) or less	±1/2 inch (12 mm)
greater than 36 inch to 6 feet (910 mm to 1.85 m)	±1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	±2 inch (50 mm)
greater than 60 feet (18.3 m)	±3 inch (76 mm)

The paint shall be mixed in accordance with the manufacturer’s instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

**620-3.6 Application--preformed thermoplastic airport pavement markings.**

[ Preformed thermoplastic pavement markings not used. ]

[ To ensure minimum single-pass application time and optimum bond in the marking/substrate interface, the materials must be applied using a variable speed self-propelled mobile heater with an effective heating width of no less than 16 feet (5 m) and a free span between supporting wheels of no less than 18 feet (5.5 m). The heater must emit thermal radiation to the marking material in such a manner that the difference in temperature of 2 inches (50 mm) wide linear segments in the direction of heater travel must be within 5% of the overall average temperature of the heated thermoplastic material as it exits the heater. The material must be able to be applied at ambient and pavement temperatures down to 35°F (2°C) without any preheating of the pavement to a specific temperature. The material must be able to be applied without the use of a thermometer. The pavement shall be clean, dry, and free of debris. A non-volatile organic content (non-VOC) sealer with a maximum applied viscosity of 250 centiPoise must be applied to the pavement shortly before the markings are applied. The supplier must enclose application instructions with each box/package. ]

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**The Engineer will make the appropriate selection for thermoplastic markings.**

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**620-3.7 Control strip.** Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the RPR. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking

equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

**620-3.8 Retro-reflectance.** [Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 reading shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

**Minimum Retro-Reflectance Values**

Material	Retro-reflectance mcd/m <sup>2</sup> /lux		
	White	Yellow	Red
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All materials, remark when less than <sup>1</sup>	100	75	10

<sup>1</sup> ‘Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance][not used]

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**Include tests of retro-reflectance at Part 139 airports, recommend testing at least 2 times per day. Enter Not Used at all other locations.**

\*\*\*\*\*

**620-3.9 Protection and cleanup.** After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the RPR. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes and regulations.

**METHOD OF MEASUREMENT**

**620-4.1a** The quantity of surface preparation shall be measured by [ the number of square feet (square meters) for each type of surface preparation specified in paragraph 620-3.3 ][ lump sum ].

**620-4.1b** The quantity of markings shall be paid for shall be measured [ by the number of square feet (square meters) of painting ] [ by lump sum ].

**620-4.1c** The quantity of reflective media shall be paid for by [ the number of pounds (km) ] [ lump sum ] of reflective media.

**620-4.1d** [ The quantity of temporary markings to be paid for shall be [ the number of square feet (square meters) of painting ] [ lump sum price ] performed in accordance with the specifications and accepted by the RPR. Temporary marking includes surface preparation, application and complete removal of the temporary marking. ] [ Temporary markings not required. ]

[ **620-4.1e** The quantity of preformed markings to be paid for shall be [ the number of square feet (square meters) of preformed markings ] [ lump sum ] ].

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**Separate pay items for surface preparation, marking, and reflective media is recommended, however on small jobs, lump sum pay items is acceptable.**

\*\*\*\*\*

**BASIS OF PAYMENT**

**620-5.1** This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item complete in place and accepted by the RPR in accordance with these specifications.

**620-5.1a** Payment for surface preparation shall be made at the contract price for [ the number of square feet (square meters) for each type of surface preparation specified in paragraph 620-3.3 ] [ lump sum ].

**620-5.2b** Payment for markings shall be made at the contract price for [ the number of square feet (square meters) of painting and the number of pounds (km) of reflective media ] [ by the number of square feet (square meters) of painting ] [ by lump sum ].

**620-5.3c** Payment for reflective media shall be made at the contract unit price for [ the number of pounds (km) of reflective media ] [ lump sum ].

**620-5.4d** Payment for temporary markings shall be made at the contract price for [ the number of square feet (square meters) of painting ] [ lump sum price ]. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item. [ Temporary markings are not required. ]

[ **620-5.5e** Payment for preformed markings shall be made at the contract price for [ the number of square feet (square meters) of preformed markings ] [ lump sum price ]. ]

Payment will be made under:

Item P-620-5.1a Surface Preparation [ per square foot (square meter) ][ lump sum ]

Item P-620-5.2b Marking [ per square foot (square meter) ] [ lump sum ]

Item P-620-5.3c Reflective Media [ per pound (km) ][ lump sum ]

Item P-620-5.4d Temporary runway and taxiway marking [ per square foot ][ per square meter ][ lump sum ].

[ Item 620-5.5e Preformed markings per [ the number of square feet (square meters) of preformed markings ][ lump sum price ]. ]

# **1. CIVIL / STRUCTURAL WORKS**

## **1.1. EXCAVATION, FILLING AND GRADING**

### **SCOPE OF WORK**

The work under this section of the Specifications consists of furnishing all items, materials, equipment, labor, plants, appliances, methods and all operations that may be necessary, and incidentals to complete excavation, filling, back-filling and grading in accordance with the Plans, and schedule if any, and subject to the terms and conditions of the Contract.

### **A. EXCAVATION**

The Contractor shall make all necessary excavation for foundations to establish grades indicated on drawings without extra compensation including all other excavations required and necessary for the proper prosecution of the work.

1. Cut slope for permanent excavations shall not be steeper than 1-1/2 horizontal to one vertical, and slopes for permanent fills shall not be steeper than 2 horizontal to one vertical unless a substantiating data which justify steeper slopes are submitted.
2. Deviation from the foregoing limitations for slopes shall be permitted only upon presentation of a soil investigation report acceptable to the supervising Engineer.
3. Trim the excavation to the required depth, lines and grades and other incidental excavations to level up the footing plus compacting tamping which are included in the building contract.
4. The materials to be excavated shall include any rock, earth and other materials of any nature and description encountered in obtaining the indicated lines and grades.
5. If the required safe bearing power of the soil is not obtained at the excavations shall be continued until such safe bearing power is reached.
6. Piers and walls shall be lengthened accordingly and likewise, the footings shall be revised to suit the new conditions for which the Contractor shall be paid at the unit price bid for concrete work.
7. No fill or other surcharge loads shall be placed adjacent to any building or structure unless such building or structure is capable of withstanding the addition loads caused by the fill or surcharges.
8. Footings or foundations which may be affected by the excavation shall be underpinned adequately, or otherwise, protected against settlement and/or against lateral movement.



9. Fills to be used to support the foundations shall be placed in accordance with accepted engineering practices. A soil investigation report and a report of satisfactory placement of fill, both, shall be acceptable to the supervising Architect or Engineer.
10. Additional payment for excavation will be computed per unit bid price and/or at established unit price for same as follows:

#### EXCAVATION, FILLING AND GRADING

- a) All materials of every nature and description, which in the Owner's opinion will require the use of air operated hammers, wedging, or drilling and blasting.
- b) For additional excavation to safe-bearing power soil as required in 5 based upon work required between indicated grades and authorized grades.

#### **B. UNAUTHORIZED EXCAVATION**

1. Where existing surface levels are lower than the sub-grade levels required for work, or where excess or authorized excavation takes place beyond the indicated lines and grades, the contractor shall fill the indicated line and grade at his expense under the following conditions.
2. Where the footings and foundations occur, use concrete fill of the same class as specified for footings and foundations.
3. Where slabs occur, use well compacted sand and gravel fill.

#### **C. EXCAVATION OMITTED**

1. When the nature of the soil is such that good-bearing or safe-bearing is found to exist at higher grades than the sub-grade levels indicated on the Plan, the supervising Architect or Engineer may decide to stop the excavation work at those higher grades.
2. Should the Owner so decide, it will be ordered in writing. This will be subject to reduction in the contract price in favor of the Owner at Unit Price Bid and or at established price based upon measurements taken between authorized higher grades and grades indicated on drawings. The same is true for omitted filling due to change of grade.
3. Footing shall not be placed on fill.

#### **D. PROTECTION, PUMPING AND MAINTENANCE**

1. The Contractor shall at all times protect the excavations and trenches from damages of rain water, spring water, backing of drains, and all other water.

2. He shall provide and operate all pumps or other equipment necessary to drain and keep excavations, pits, trenches and the entire sub-grade area free of water under any circumstances and contingencies that may arise.
3. He shall build all necessary enclosures, construct and maintain temporary drainage for this purpose. He shall provide all shoring, bracing and sheathing as required for safety, or necessary to support adjoining walls, walks, soils, streets, buildings, fences, and the like and for prosecution of the work, all these to be removed when work is completed, and or required by the Owner.

#### **E. BLASTING**

#### **F. INSPECTION**

No pouring of concrete shall be done by the Contractor unless the bearing surfaces has been inspected and approved by the Owner, and the authority to proceed has been received by the contractor.

#### **G. DRAINAGE SYSTEM AT SITE**

The Contractor shall provide, construct and maintain for the duration of the work, drainage system of the site approved and or as directed by the supervising Architect or Engineer.

#### **H. UTILITIES**

1. The Contractor shall protect and maintain all conduits, drains, sewer pipes and other utility services that are to remain on the property or in the building, or in the site, where required for the proper execution of the work.
2. The Contractor shall notify all corporations, companies, individuals, or the other authorities concerned with the above conduits, drains, water and sewer pipes, running to the property of the site, and protect relocate, remove, cap or discontinue all pipes, sewer, and other utility services, which interfere with the excavation in accordance with instruction and requirements of the above notified parties.

#### **I. FILLING AND GRADING**

1. All excavations shall be back-filled immediately as work permits after concrete walls and piers have attained full design strength and or as the Owner's Engineer directs.
2. After the forms have been removed from the footings, walls and piers, the materials taken from excavations (free from waste and objectionable matter) shall be used for back-filling around them.
3. These filling materials shall be made in layers not to exceed 15 centimeters and thoroughly tamped before the next fill is placed. Excess excavated materials shall be

placed and spread on the immediate premises as directed by the supervising Engineer, provided, however, that the Contractor shall not be required to remove such materials more than 50 meters from the building line.

4. Open tile drains around the building if any, shall be covered with crushed rock or gravel for a depth of 30 cm. and the same shall be graded from course to fine.
5. Open tile drains under floor slab (where so indicated on drawings) shall be covered with broken stones or gravel up to the bottom of the slab.
6. In spaces where slabs rest on ground, or on earth-fill as specified in paragraph 2, shall be labeled and accurately graded with 10 cm. thick of gravel and sand, and tamped thoroughly before concrete pouring is done.
7. All exterior grades shall be formed in accordance with the drawings and specifications, taking into account the requirements for landscaping work, if any, and giving due allowances for the top soil depth.
8. The Contractor shall grade the area included within clearing lines as defined "Clearing" under the General Conditions, and all such grading work should be included in the building Contract without extra or additional cost. Banks of graded areas shall have a slope of 3.8 cm. horizontal to one vertical distance.
9. Extra grading (cut or fill) beyond the \_\_\_meters and or due to change of grade shall be paid at the unit price bid for the same.

#### **J. TOP SOIL STRIPPING AND SPREADING**

For use when topsoil is salvaged for landscaping work.

1. Topsoil stripping operations shall start from the areas affected by the construction to limits indicated by the Owner and or as specified.
2. Topsoil shall be stripped to varying depths as approved by the Architect, but not beyond topsoil strata.
3. Topsoil shall be stripped by approved methods and stored where it will not interfere with the work.
4. This topsoil shall be evenly spreaded to the true contours and raked to even, smooth surfaces ready for seeding and planting.

#### **K. TEMPORARY EASEMENT**

The Contractor shall obtain the consent of adjoining property owners regarding the need for temporary easements or any other manner of physical encroachment at his own expense.

## **L. PAVEMENT**

The Contractor shall restore, without extra cost to the Government, any street pavements, concrete sidewalks and curb, and similar public structures that may be opened, removed or demolished in the performance of work under this Section in the manner prescribed by authorities having jurisdiction.

## **M. PROTECTION OF TREES**

The Contractor shall protect trees indicated to remain in place by boxing them, by using guys and the like, and or as indicated by the supervising Architect or Engineer.

## **N. PROTECTION OF ADJOINING PROPERTY**

The Contractor shall protect the excavation to be made below existing grade line so that the soil of adjoining property will not cave-in or settle and shall defray the cost of underpinning or extending the foundation of buildings on adjoining properties.

1. Before starting the excavation, the Contractor shall notify in writing the owners of the adjoining buildings not less than 10 days before such excavation is to be made and that the adjoining building will be protected by him.
2. The Owners of the adjoining properties shall be given access to the excavation for the purpose of verifying if their properties are sufficiently protected by the contractor making the excavation.
3. In case there is a party wall along a lot-line of the premises where an excavation is being made, the contractor at his expense preserve such party wall in as safe a condition as it was before the excavation was commenced and shall, when necessary, underpin and support the same by adequate methods.
4. Guards or fences shall be provided along open sides of excavation except that, in the discretion of the Engineer such guards or fence may be omitted from any side or sides other than those adjacent to streets or public passageways.

## **1.2.CONCRETE WORKS**

### **A. PLAIN AND REINFORCED CONCRETE**

#### **SCOPE OF WORK**

This Item shall consist furnishing, placing and furnishing concrete in buildings and related structures, flood control and drainage, and water supply structures in accordance with this Specifications and conforming to the lines, grades, and dimensions shown on the Plans.

#### **GENERAL REQUIREMENTS**

##### **1. Acronyms**

The following acronyms for applicable standards/ publications are referred to this Specification:

ASTM – American Society for Testing Materials  
ACI – American Concrete Institute  
POI – Pre Stressed Concrete Institute  
AWS – American Welding Society  
AISC – American Institute of Steel Construction

##### **2. Standard Specifications and Codes**

The work covered by this Section unless otherwise specified or detailed, shall be governed by the Building Code requirements for Reinforced Concrete (ACI 318), Standard Code for Arc and Gas Welding Society. The latest edition of all standards Specifications or Codes will be used.

##### **3. Coordination**

The concrete work shall be coordinated with the work of other trades allow reasonable time to set sleeves, inserts and other accessories which must be in position before concrete bases and pads of mechanical equipment shall be placed to comply with approved shop drawings for the equipment.

##### **4. Workmanship**

The Contractor shall be responsible for any additional cost which may result from concrete surfaces which are not finished to the required profile or elevation.

##### **5. Samples**

The Contractor shall submit samples of cement and aggregates proposed for use in the concrete work for approval, enumerating names, sources and description of materials.

## **MATERIAL REQUIREMENTS**

### **1. Portland Cement**

- a) Portland cement shall conform to the requirements of ASTM C-150 Type for normal Portland cement; Type-III for Highly Early Strength Portland Cement.
- b) Cement shall be any standard commercial brand in 40 kilograms per bag such as: Filipinas, Union, Republic Apo or other locally available equivalent.

### **2. Fine Aggregates**

Sand shall be clean, hard coarse river sand or crushed sand free from injurious amount of clay loam and vegetable matter and shall conform to ASTM C-33 or C330.

### **3. Coarse Aggregate**

Gravel shall be river run gravel or broken stones. The maximum size shall be 1/5 of the nearest dimension between sides of forms of the concrete, or  $\frac{3}{4}$  of the minimum clear spacing between reinforcing bars, or between re-bars and forms whichever is smaller.

### **4. Mixing Water**

Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkali, organic materials or other deleterious substances.

### **5. Admixture**

All air-entertaining admixtures if used shall conform to ASTM C-260. Water reducing admixtures, retarding admixtures, and water reducing and accelerating admixtures, if used, shall conform to the requirements of ASTM C-494.

## **STORAGE OF MATERIALS**

1. Cement and Aggregates shall be stored in such a manner as to prevent their deterioration or the intrusion of foreign matter
2. Cement shall be stored, immediately upon arrival on the site of the work, in substantial waterproof bodegas, with a floor raised from the ground sufficiently high to be free from dampness. Aggregates shall be stored in such manner as to avoid the inclusion of foreign matter.

## PLAIN CONCRETE

### General Requirements

1. Plain Concrete, other than fill, shall have a minimum ultimate compressive strength at 28 days of 140 kilograms per square centimeter or 2,000 pounds per square inch and material proportioning, and placing shall conform to the requirement of this section.
2. Concrete made with lightweight aggregate may be used with strengths less than 140 kg. per square centimeter if it has been shown by tests or experience have sufficient strength and durability.
3. The thickness of plain concrete walls may be 5 centimeters (2 inches) less than the required by 6.17 for plain masonry wall but in no case less than 18 centimeters and the ratio of unsupported height or length whichever is the lesser to thickness shall not be greater than 22.
4. Concrete shall consist of Portland Cement, fine aggregates, water, and where specified, Admixtures, proportioned mixed place, cured and finished as hereinafter specified.
5. The following special types of concrete shall be used where indicated on the detailed drawings or as specified.
  - a) Lean Concrete
  - b) Concrete with integral waterproofing
  - c) Highly early strength concrete may be used subject to the approval of the supervising Architect or Engineer.
6. All provisions of the Specifications shall apply the seven (7) day compressive strength equal to the 28 day strength required for normal concrete. Admixture used in concrete shall be produced by a reputable manufacturer and used in accordance with the manufacturer's printed directions.
  - a) **Plasticizing Admixture** – Concrete admixture shall be free from chlorides and shall conform to ASTM C-494-651. The admixtures shall be used in all concrete mixtures in accordance with the manufacturer's specifications.
  - b) **Calcium Chloride** – shall not be used under any circumstances.

### PROPORTIONING OF CONCRETE

1. The Contractor shall employ, at his own expense, an approved testing, laboratory which shall design the mix for each type of concrete required by the Specifications and drawings to obtain strength as determined at least 15% higher than required. Strength requirements shall be as noted on the drawings.

2. The adequacy of the mix design shall be verified by a test on a minimum of 6 cylinders, 3 tested at 7 days; 3 at 28 days, in accordance with ASTM C-192 and G-3 and by Slump Tests in accordance with ASTM C-143.
3. The testing laboratory shall submit 5 copies of the mix design and the test results to the Owner or his duly authorized representative for approval before any concrete is placed.
4. If any time during construction, the concrete resulting from the approved mix design proves to be unsatisfactory for the reason such as too much water, lack of sufficient plasticity to prevent segregation, honeycomb, etc. or insufficient strength, the Contractor shall immediately notify the testing laboratory and the supervising Engineer.
5. The laboratory shall modify the design, subject to approval by the supervising Architect or Engineer until a satisfactory concrete is obtained.
6. **Stone concrete** – Minimum compressive cylinder strength of concrete  $f_c'$  at 28 days area as follows:
  - a)  $f_c'$  27.58 Mpa for suspended beam, slab and columns
  - b)  $f_c'$  20.68 Mpa for footings and walls.
7. The **Water Content** shall not exceed 28 liters per 40 kilograms per bag cement, and the slump test shall not exceed 10 cm. in all cases unless otherwise changed by the supervising Architect or Engineer.
8. **Lean Concrete** – Lean concrete mix to be designated to produce concrete with 28 day strength of 13.79 Mpa, slump and size shall be subjected to approval depending where it is mixed.

#### **DETERMINING CONCRETE PROPORTIONS CONCRETE PROPORTIONS AND CONSISTENCY**

1. The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the form and around reinforcement without permitting the materials to segregate or excess free from water to collect on the surface.
2. The methods of measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked at any time during the work.



## **CONCRETE TEST**

### **1. Testing Laboratory**

- a) The Contractor shall employ at his own expenses, an approved Testing Laboratory which may shall make compression and Slum Tests and immediately submit 5 copies of the test reports to the supervising Architect or Engineer.
- b) Ready mixed concrete companies may use their own laboratories provided that testing is done with the supervision of the Owner or his authorized representatives.

### **2. Compression Slump Test**

Compression and Slump Tests shall be made every 50 cubic meters of concrete or fraction thereof; but not less than 1 set of tests shall be made from any one batch of concrete and all 3 tests shall be made from the same batch.

### **3. Compression Tests**

Make 3 standards 15 cm x 30 cm. cylinder and tests in accordance with ASTM C-31 and C-39. The one (1) cylinder at the age of 28 days and one (1) cylinder in reserve for 56 days test. If the 28 days test does not meet the requirements, make additional cylinder as required to check strength of concrete in the construction. These cylinders are to be cured in the field in the same manner as to the concrete in the construction is cured.

### **4. Slump Test**

For each representative quantity of concrete mentioned above, two slump tests shall be made in accordance with ASTM C-143.

### **5. Test Report**

The testing laboratory shall submit 4 copies of its test cylinder reports which are to include, as far as applicable, the following information:

- a) Location of the structure where the concrete is used, design number, concrete design strength, type and manufacturer of Portland cement.
- b) Amount of any Admixtures used, Slump Tests, date of sampling, cylinder application number, days cured in the field, and days cured in laboratory.
- c) Age at the time of testing, crushing stress, type of failure, who made the cylinders, who shipped the cylinders to the laboratory and whether concrete strength meets the specifications.

## **6. Inspection of Batch Plant Operation**

Inspection on a "Spot Check" basis required to insure the concrete delivery to the job complies with the Specifications and the design mix. The testing laboratory shall provide this service as directed by the Owner's supervising Engineer.

## **7. Additional Tests**

If, in the opinion of the supervising Engineer, based on cylinder strengths below specifications requirements or visual defects, concrete of poor quality has been placed, additional tests shall be made as directed by the Owner at the expense of the Contractor. Test may be Compression Test on core cylinder per ASTM C-42, and or Lead Tests as cut-lined in ACI 318, Section 202, or as specified.

## **MIXING CONCRETE**

The mixing and measuring equipment shall be approved by the supervising Architect or Engineer. Unless otherwise authorized, concrete shall be machine mixed at the site or by ready-mixed concrete.

### **1. Site Mixed Concrete**

Provide a batch mixer type equipped with accurate timing and measuring devices and operate in accordance with the manufacturer's recommendations:

### **2. Mixing Time**

- a) For each batch, after all solid materials are placed inside the mixing drum, and water is introduced before  $\frac{1}{4}$  of the mixing time has elapsed, shall not be less than 1 minute for mixers having a capacity of one (1) cubic meter or a fraction thereof for additional concrete.
- b) The concrete mixer shall revolve at no less than 14 or more than 20 revolutions per revolutions per minute. Speed greater than 20 revolutions per minute and less than 14 revolutionary per minute are usually found to be unsatisfactory.

## **READY MIXED CONCRETE**

1. All ready mixed concrete shall conform to the requirements of ASTM C-94, placed in forms within one (1) hour after adding water or not more than  $\frac{1}{2}$  hours if a retarder is used. It shall be kept constantly agitated during the transit period.
2. Pouring of concrete should not be started until after the forms and reinforcement for the whole unit are properly laid and installed, cleaned, inspected and approved.
3. Construction joints shall be rough-in and clean thoroughly before any pouring starts. Wet and slush surface with cement mortar.

## **HANDLING AND PLACING CONCRETE**

1. Immediately after the concrete is mixed, it shall be conveyed by the approved push cart or buggies to designated locations, and carefully deposited in such manner as to prevent the separation of ingredient or displacement of the reinforcements.
2. Keep temporary runways built in such a manner that runway supports will not bear upon reinforcement of fresh concrete. Conveying or hauling of concrete by the use of long inclined chutes or pipes shall not be permitted.
3. Dumping concrete into carts or buggies with a free fall of more than one (1) meter will not be permitted. Hardened splashes or accumulation of concrete on forms or reinforcements shall be removed before the work continues.
4. When placing more than 1.50 meters high, it shall be deposited through sheet metal or other approved conveyors.
5. As for practicability, the conveyers shall be kept full of concrete during the placing and their lower ends shall be kept buried in the newly placed concrete.
6. After the initial set of the concrete, the forms shall be jarred, and no strain' shall be placed on the ends of the projecting reinforcing bars. Foundation shall be free from water during concreting and construction joints shall be determined by the supervising Architect or Engineer.
7. Concrete in columns shall be placed in one continuous pouring operation and allowed to set 12 hours before caps are placed. Likewise, concrete in beams and slabs in superstructures shall be poured in one operation.

## **RE-TAMPING**

The contractor shall mix only such quantities that are required for immediate use. Mixture which has developed initial setting shall not be used. Concrete which has partially hardened shall not be re-tamped for use.

## **CURING AND PROTECTION**

1. All concrete work shall be protected from drying out after removal of forms by covering with waterproof paper, polyethylene sheeting burlap, with a coating of approved membrane curing compound having a moisture retention equal 90% based on ATM C-309 and C-156, applied in accordance with the manufacturer's instruction for use
2. Membrane curing compound shall not be used where the floor hardener, membrane waterproofing, damp-proofing, resilient floor tile or other floor or wall covering set in adhesive, concrete-fill or setting beds, paint, plaster or other applied finishing or surfaces treatment are to be subsequently applied.

3. Wet burlap as often as required to keep concrete wet throughout each day for as period of at least 7 days where normal Portland cement is used and 3 days where high early strength cement is used.

## **METAL REINFORCEMENT**

### **1. Steel Bars**

- a) Reinforcing bars shall conform to ASTM Specifications A-615. All mild steel for columns, shear wall, footings and footing beams shall be high grade deformed 413.7 Mpa.
- b) For 10 mm and smaller bars use intermediate grade deformed bars.  $F_y = 275.8$  Mpa
- c) If reinforcing bars are to be welded, these specifications shall be supplemented by requirements assuring satisfactory weld ability.
- d) Bar and rod mats for concrete reinforcement shall conform to ASTM Specifications A-184 and Wires for concrete reinforcement shall conform to ASTM A-82 Specifications.
- e) Welded wire fabric for concrete reinforcement shall conform to ASTM A-185 except that the weld shear strength requirements shall be extended to include a wire size differential up to and including six gauges.
- f) Wire and strand shall conform to ASTM A-416. Structural steel shall conform to ASTM A-26 and Steel pipe for composite column shall conform to ASTM Specification A-377.

### **2. Accessories**

Provide bar supports and other accessories necessary to hold reinforcing bars in the proper positions while concrete is being placed. Bar supports which come in contact with forms for concrete exposed to view in the finished structure shall be galvanized or stainless subject to approval.

### **3. Mill Certificate and Test**

- a) The Contractor shall furnish 2 copies of the manufacturer's certificate of mill tests al reinforcing steel.
- b) The Contractor shall, employ at his own expense an approved testing laboratory which shall conduct testing of all reinforcement sizes of each bulk under the supervision of the supervising Architect or Engineer.

### **4. Shop Drawing**

- a) Each reinforcing steel detail and placement drawings shall be submitted for approval. Any material fabricated before the final approval of the shop drawings will be done at the Contractor's risk, but no material shall be installed until final approval of the "Shop Drawings".
- b) All shop drawings shall be in accordance with the Manual Standard Practice for Detailing Reinforced Concrete Structure ACT-315.

## **5. Labeling**

Bars shall be properly labeled with weatherproof tags to facilitate identification.

## **PLACING OF REINFORCEMENT**

1. All reinforcement shall be placed according to the approved drawings. The Contractor shall provide sufficient bar supports, ties, anchors and other accessories to hold all bars securely in place.
2. Unless detailed on drawings, all stirrup shall be held in place by bar spacer. Reinforcing steel shall be cleaned of oil, grease, scale, rust or other coatings which will impair bond.
3. All bars shall be bent cold
4. All welded splices shall be done by certified welders having welder's certificate and shall be submitted and approved by the supervising Architect or Engineer before any welding works shall be started.
5. The welding of bars shall conform to AWS D -12.1 Recommended Practices for Welding Reinforcing Steel.

## **STORAGE OF MATERIALS**

Reinforcing steel bars shall be stored on supports above the ground level properly covered with roof or plastic materials for protection from direct effect of moisture and the considerable delay in use.

## **FORMS**

### **General Conditions**

1. Forms shall conform to the shape, lines and dimensions shown on the drawings. They shall be substantial and designed to resist the pressure and weight of the concrete.
2. Forms shall be properly tied and braced or shored so as to maintain their position and shape. Forms shall be sufficiently tight and strong to prevent leakage of mortar.
3. Where required by the Owner, Shop drawings of formwork, shall be submitted for approval before fabrication and erection of such formwork.
4. Provide temporary openings where necessary to facilitate cleaning and inspection before depositing concrete.
5. Before construction, all form materials are subject to approval. The type of form used shall be in accordance with the finish requirements as specified or as shown on the detailed drawings.
6. Forming shall start at the first floor level with new materials. Forms for exposed concrete may be reused only if the surface has not absorbed moisture and has not splintered, warped or peeled, subject to the approval of the supervising Architect or Engineer.
7. Forms shall be coated with non-staining form oil before setting reinforcement. The form oil shall not contain chemical that will impair the strength of the concrete.
8. Side forms of footings may be omitted and concrete be placed against the next excavation only when approved by the supervising Architect or Engineer.
9. All exposed corners shall be square. Extra care shall be exercised while stripping the forms. Corners shall be protected against chipping or other damages that may be caused by the working force.
10. Removal of forms or shoring is subject to approval by the supervising Architect or Engineer, and under no circumstances shall bottom form and shoring be removed until after the members have acquired sufficient strength to support their weight and the load thereon. Forms shall main in place for a minimum time as follows:

Columns, shear and bearing walls ----- 3 days  
Stairs (bottom forms) ----- 21 days  
Beams and Slabs (bottom form) ----- 21 days

### **OTHER FORMS**

Exposed exterior surfaces of building where Architectural finishing is required and as shown on detailed drawings, the following conditions shall be observed:

1. Forms shall be designed and constructed to facilitate early removal without damage to exposed surfaces of the concrete, free of offsets, and square corners true to lines and profiles as detailed.
2. Form ties will not be permitted through forms for surfaces which will be exposed. Formworks shall not be used twice unless otherwise approved by the supervising Architect or Engineer.
3. Exposed and Interior Surfaces treated plywood forms or moisture resistant plywood shall be laid vertically or horizontally in large are with joints so arranged and treated properly as required to provide smooth concrete surfaces.

### **FORMWORK ACCESSORIES**

Form ties shall be submitted for approval. It shall be so designed as to leave no metal closer than 19 mm to the surface of the concrete or to leave a hole greater than 22mm in diameter on the face of the concrete.

### **FINISHING OF FORMED SURFACE**

Remove forms and form tie ends then fill holes with 1:2 Portland cement mortar mixed to match the concrete. All defective areas below grade line not exposed to view shall be patched with Portland cement mortar mixed to match the concrete mixture as directed by the supervising Architect or Engineer.

1. *Exposed Exterior surfaces of the building where special finish is indicated* – Concrete shall be placed and finished as herein before specified and as required to provide even dense surface of uniform color, free from marks, aggregate, pockets, honeycomb or other imperfections so that after treatment of the finished surfaces will not be required.
2. Any concrete which is not formed on level of alignment, or shows defective surfaces shall be considered as not conforming with the expense of the Contractor, unless the Owner or his authorized representative grants permission to patch or otherwise correct the defective areas.
3. Permission to patch any such area shall not be a waiver of the right of the Owner to require complete removal of the defective works.
4. *Exposed Interior Finishes* – patch all defective areas and remove all fins, form joint marks, rough spots and other defects by rubbing with a suitable tools until such defects and rough areas are completely removed and surfaces free from imperfections so as to produce dense, smooth, uniform finish with desired texture and design.

5. Silicone water repellent shall be applied to all exterior exposed concrete surfaces above grade which are not to be painted.

### **INSERT, SLEEVE AND SIMILAR ITEMS**

1. All required flashing, reglets, seal, masonry ties, anchors, wood locks, nailing strips, ground, inserts, wire hangers, sleeves, drains, guard angles, (*insert for elevator guide supports where required*), provisions for floor hinges boxes, and concealed overhead door closer and all items specified, as furnished under this and other sections of the Specifications shall be in their final position at time concrete is placed and shall be properly located, accurately positioned and built-in to the construction and maintained securely in place.
2. Insert on hangers for ceiling construction specified under the plastering section shall be located only in bottom of concrete ribs or other concrete members crossed such ceiling construction.
3. Sleeves shall not be installed in beams, ribs, or column, except upon formal approval of the Architect or Engineer.
4. All stone-cut and V-cut lines, Sunk fillets, and the like, on concrete wall surface shall be integrated into the concrete with the corresponding removable mould on the forms before the concrete is poured and shall be finished straight and clean-cut in accordance with the size and shape as shown on full size details.

### **FINISHING OF SLAB**

1. Finish floor and roof slabs shall be level plane surfaces unless otherwise specified on the drawings, with a tolerance of 3 mm in 3.0 meters. Surfaces shall be slope towards the drains as required.
2. Resilient flooring, Ceramic Tile or Marble, base slabs which are to receive these finishes or other finishes requiring "Thin-Set" installation shall be floated and troweled with a steel trowel to provide a smooth surface as required to receive the flooring.
3. For roofing membrane waterproofing, the working processes is the same as that for Resilient Flooring except steel troweling which may be omitted.
4. Exposed concrete finish surface where no finishing applied as called for on the drawings shall be finished with a steel trowel as required to produce a hard, dense finish free from surface imperfections.
5. Dry materials should not be used on the surface to be finished. Apply hardener and sealer in accordance with the manufacturer's printed instructions.



## **WATERTIGHT CONCRETE**

1. All waterproofing on deck wherever called for in the plan shall be guaranteed to be absolutely water proofed and free from leaking for a period of two (2) years.
2. Should any leakage develop in these areas, they shall be made waterproof by approved waterproofing methods and materials and this shall be repeated if necessary until all leaks has been stopped.
3. Guarantee shall extend for a full two years after the last leak has stopped
4. All pipes or piping under slabs must be completed before the slabs are poured.

## **CONCRETE FLOORS ON FILL**

Concrete floor and steps on fill shall be laid on a prepared foundation which shall be placed as follows:

1. Earth or sand fill shall be laid to a uniform grade as shown on the detailed drawings; fill shall be placed in layers not to exceed 15 centimeters thick, for each layer being thoroughly wetted and rolled or tampered.
2. Earth or sand fill shall be made as soon as the concrete of the walls and foundations has set sufficiently to permit the filing load and pressure. On top of this fill shall be placed 10 cm. layer of gravel which shall be rolled or tampered.
3. All of these sand and gravel foundations specified above shall be kept wet for at least 30 days after rolling or tamping so as to allow settlement before the floors are placed.
4. Concrete floors shall be laid in alternate strips about one (1) meter in width by 6 meters minimum length, but following pattern shown on drawings. The construction joints shall coincide with the groove in case such items are called for in the cement finish. After the concrete has set, the form shall be removed and the remaining strips, laid.
5. All concrete shall be of such consistency as to require a tamping to bring the water to the surface. Tampering shall be done mechanically.
6. Concrete floor and steps on fill or in ground shall be reinforced if indicated in the drawings. The size and spacing of the reinforcing steel shall be in accordance with the drawing of Specifications.

## **HANDLING AND PLACING OF CONCRETE**

Concrete during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions:

1. The vibration shall be internal unless special authorization of the other method is given by the supervising Architect or Engineer or as provided herein.
2. Vibrators shall be of a type and design approved by the supervising Engineer. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute.
3. The intensity of vibration shall be as such as to visibly affect a mass of concrete of 25 mm, slope over a radius of at least 50 centimeters.
4. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms.
5. Vibrations shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrator shall be inserted into and withdrawn from the concrete slowly and gradually.
6. The vibration shall be sufficient duration and intensity to compact the concrete thoroughly but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.
7. Vibrators shall be thoroughly manipulated so as to work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms.
8. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly affected.
9. Vibration shall not be applied directly or through the reinforcement sections of layers of concrete which have hardened to a degree that the concrete ceases to be plastic under vibration.
10. It shall not be used to make concrete flow in the form over distances so great as to cause segregation and vibration shall not be used to transport concrete.

## **GRADATION OF AGGREGATES**

1. Fine and Coarse aggregates used in concrete, shall be tested in accordance with the requirements of the "*Standard Specifications for Concrete Aggregates*" ASTM 033-67m with a minimum frequency of one (1) set of 6 and one (1) set of 7 test per 1,000 cubic meter source, as follows:

2. At least one sample of fine and coarse aggregates used in concrete shall be tested in accordance with the requirements of the “*Standard Specifications for Concrete Aggregates*” ASTM 033-67 grading as follows:

**Coarse Aggregates**

Specific ..... Grading  
Gravity ..... Soundness  
Absorption ..... Abrasion  
Material finer than No. 200 sieve

**Fine Aggregates**

Grading .....Absorption  
Soundness.....Organic Impurities  
Material Finer than No. 200 sieve  
Mortar strength, 7 days  
Specific Gravity

**Coarse Aggregates (percent passing)**

38 mm sieve ..... 100%  
25 mm sieve ..... 95-100  
13 mm sieve ..... 25-50  
No. 4 sieve ..... 0-10  
No. 8 sieve ..... 0-5

**Fine Aggregates (percent passing)**

9 mm sieve ..... 100%  
No. 1 sieve ..... 90-100  
No. 8 sieve ..... 80-95  
No. 16 sieve ..... 50-85  
No. 30 sieve ..... 30-70  
No. 50 sieve ..... 10-45  
No. 100 sieve ..... 0-10

3. Aggregates failing to meet these specifications, but which have been shown by approved laboratory tests to produce concrete of the required quality may be used where authorized by the Architect or Engineer.
4. Aggregates shall be quarried or washed in fresh water and shall contain no more than one twentieth 1/20 of (1%) percent salt by weight.

## **STORAGE OF MATERIALS**

### **1. Portland Cement**

- a) Cement delivered in bags shall be stored immediately upon receipt at the work site in a weather proof structure which shall be air tight as practicable with suitable wooden floors which shall be elevated above the ground at a distance sufficient enough to prevent the absorption of moisture.
- b) Bags shall have guaranteed constant cement content and shall be provided with proper labels showing the number of consignment and the date of site delivery.
- c) The bag shall be stacked close together to reduce circulation of air but should not be stacked against outside walls but in such a way that they will be easily accessible for inspection and testing and shall be used in the order of their delivery.
- d) Cement that has been in storage longer than six months will be tested by standard mortar tested or other tests as deemed necessary by the Owner to determine its suitability and such cement shall not be used without the express approval of the Owner.
- e) Bags shall not be stored to a height greater than two (2) meters. All cement must be free from lumps or evident for deterioration.
- f) Cement delivered in bulk shall be stored in properly designated elevated airtight and waterproofed silos or bins, provided at the Contractor's expense. The silos shall be adequate in size to ensure continuity of work at all times.
- g) The site shall be kept perfectly dry. Bag cement shall be transported closed and effectively protected from weather by adequate coverings. Bulk cement shall be transported in closed container.

### **2. Aggregates**

- a) All aggregates shall be stored in bunkers provided with proper floors or tightly laid wood planes sheet metals, or other hard and clean surface. Fine and coarse aggregates of different sizes shall be stored in separate bunkers or piles in such a manner as to prevent aggregation, inclusion and contamination by dirt and other injurious foreign materials.
- b) Stockpiles of coarse aggregate shall be built in horizontal layers not exceeding 1.20 meters in depth to minimize segregation. Should the coarse aggregate become segregated, it should be re-mixed to conform to the grading requirements given herein before.

### **3. Reinforcing Steel Bars**

Reinforcing steel bars shall be transported and stored at the site in such a way as to prevent damage or deterioration of the steel by rust or coating with grease, oil, dirt and other objectionable materials. Storage shall be in separate piles or racks so as to avoid confusion or loss of identification after bundle are broken.

## **REBAR SPACING AND COVER**

### 1. Reinforcing Bars

Reinforcing bars shall be fixed one to the other by means of adequate steel wire ties to form rigid reinforcement cages or nets. The reinforcement shall be fixed in the form by approved concrete distance blocks, space bars, links and stirrups, and all to be provided at the Contractor's expense. Reinforcing bars shall be spaced according to the approved working drawings and the distance between bars shall not be less than those recommended in ACI-318.

### 2. Concrete Cover

The concrete to the gutter reinforcing bars shall be those recommended in ACI 318, unless otherwise specifically indicated on the drawings.

### 3. Anchorage Length

Plain bars shall be provided with end hook unless otherwise specified. The lengths of the anchorage of reinforcing bars shall be at least those recommended in ACI 318

### 4. Splices

Splices in bars shall be avoided as far as possible and shall be staggered in any one structural member. They shall conform to the recommendations in ACI 318. In no case shall splices be made at critical points of maximum stress.

## **PATCHING**

1. Immediately after the forms have been removed and work has been examined by the Owner, and his permission given, all loose materials shall be removed.
2. All holes, stone pockets and other surfaces which were in contact with forms treated with cement retarding materials shall be removed with wire brush or other approved method until a rough bonding surface of exposed aggregate is obtained.
3. Any surface considered by the supervising Engineer to be insufficiently roughened shall be further roughened by an approved mechanical means. Surfaces shall be thoroughly washed down with water.
4. Honey combed and other defective areas must be chipped out to solid concrete, the edge cut as straight as possible and at right angles to the surface of slightly undercut to provide a key at the edge of the patch.

5. Shallow patches may be filled with mortar similar to that used in the concrete. This should be placed in layers not more than 12 mm thick and each layer given a scratch finish to improve bond with the succeeding layer.

## **CONSTRUCTION JOINTS**

1. Once started, concreting shall be continued without interruption and shall only be stopped at properly indicated and prepared construction joints.
2. The position of construction joints shall be decided in advance so that the amount of concrete required to be placed at any one time does not exceed the capacity of the mixing plant.
3. In all cases where the positions of construction joints have not been indicated on the drawings, they must be approved by the Architect or Engineer.
4. Except where inclined joints are specified, all joints shall be formed to vertical or horizontal planes. Vertical joints shall be formed against a properly constructed stop-board.
5. As a general rule, joints in columns shall be made as near as possible to a beam haunching and joint in beams and slabs shall be made at positions shown on the drawings.
6. Construction joints shall be wire-brushed while the concrete is still green, roughened or hacked to expose the aggregate across the whole area of the joint.
7. Before fresh concrete is placed, the roughened surface shall be swept clean of all loose materials, thoroughly wetted and covered with a 12 mm thick layer of mortar composed of cement and sand in the same ratio as the cement and sand in the concrete mix.
8. Special care shall be taken to ensure that the first layer of fresh concrete is thoroughly rammed against the existing layer.
9. The cost of all measures necessary to form construction joints, whether shown on the Drawings or not, shall be deemed to be included in the Contractor's rates for concrete.

## **B. CONCRETE MASONRY**

### **GENERAL CONDITIONS**

The concrete masonry Contractor shall examine all drawings, specifications and all conditions that has relations and may affect his work and performance in the execution the Contract.

Where any deviation on the Plans and Specifications is to be made, the Owner shall be notified and his written approval shall be obtained before proceeding with the work.

### **SCOPE OF WORK**

The work covered by this Item shall include the following:

1. Furnishing of all necessary materials, tools, equipment, labor, and appliances necessary to complete the execution of the concrete masonry work as shown on the drawings and herein specified.
2. All preparations for masonry work necessary to receive and adjoin other work, including provisions for inserts and attachment as noted in the plans and specifications which shall be installed under the terms of work.
3. Coordination with all other trades in laying out and execution of the concrete masonry work. Giving the work his personal supervision and keeping a competent foreman on the job at all times.
4. Arranging for adequate bracing, forming and shoring required in conjunction with and in the course of constructing the concrete masonry although not provided for under other sections.
5. Furnishing of all reinforcing steel for concrete masonry work and their placement including those not provided for under other sections but necessary for proper prosecution of the work.
6. Arranging for the necessary storage space and protection for materials at the job site.
7. Providing assistance and facilities for all inspections by the Owner or his authorized representatives as required in the course of execution of the work.
8. Arranging for furnishing test specimens and samples of materials as may be required.

### **MATERIAL REQUIREMENTS**

The following materials to be used under this section of the specifications shall conform to the concrete masonry standards as indicated.

1. Cement to conform with ASTM C-150

2. Sand or fine aggregate shall be clear, sharp and well graded, and free from injurious amount of dust, lumps, shale, alkali, surface coatings and organic matter.
3. Lime: Hydrated lime shall conform with ASTM C-207
4. Quicklime shall conform with ASTM C-5 Specifications. Quicklime shall be slaked and then screened through a 16 mesh sieve.
5. After slaking, screening and before using, it shall be stored and protected for not less than 10 days. The resulting product shall weigh not less than 1330 kilogram per cubic meter.
6. Hollow load bearing masonry units shall be type I Class A or B unit conforming with ASTM C-90-70 and the Philippine Bureau of Standard No. 15-2, series of 1979.
7. Solid load bearing masonry units shall be class a units conforming to ASTM C-145. All load bearing masonry units shall have a minimum compressive strength of not less than 5.5 Mpa (800 psi) based on 5 individual units when tested in accordance with the methods set forth in ASTM C-140-70 or as tested by the Bureau of Research and Standard, DPWH.
8. Masonry units shall have been cured for not less than 14 days if steamed-cured, or 28 days if air-cured when placed in the structure.

## **CONCRETE HOLLOW BLOCKS**

1. For walls and partitions shown on the detailed drawings requiring concrete hollow blocks, the Contractor either uses of concrete or ceramic hollow blocks upon approval of the Architect or Engineer.
2. The load bearing of hollow blocks shall have a minimum compressive strength of 6.89 Mpa (1000 psi) computed from the average of five (5) units based on the average gross area, and a minimum of 5.41 Mpa (800 psi) for the individual unit respectively, all based on gross area.

### **Visual Inspection**

All units shall be sound and free from cracks or other defects that would interfere with the proper placing of the unit or impair the strength or permanence of the construction.

### **Sampling of Specimen**

In sampling blocks for the strength, absorption and moisture content determination, ten (10) individual units shall be selected from each lot of 10,000 units or fraction thereof and 20 individual units from each lot of more than 10,000 units.



## **Sampling**

For lots of more than 10,000 units, 10 individual units shall be selected from each 50,000 units or fraction thereof, contained in the lot. For non-bearing type of CHB, no sampling for test shall be required for less than 500 units to be used in the job.

## **Testing**

Units shall be tested in accordance with the standard method of testing Masonry units of the American Society of Testing Materials ASTM designation C-140 and or by the Bureau of Materials and Quality Control, DPWH. No blocks shall be used unless results of tests are known and duly approved by the supervising Architect or Engineer.

## **Reinforcement**

All units shall be laid with a mortar composed of one part Portland cement and three parts of sand. Reinforcement shall be done in accordance with the structural plans as to size, spacing and other requirements.

## **MORTAR AND GROUT**

Cement to be used for mortar and grout shall be: Type 1, 2, 3 or type 4 Portland cement conforming to ASTM C-150

1. Plastic cement shall have less than 12% of the total volume in approved types of plastic agents and shall conform to all the requirements for Portland cement per ASTM C-150, except the limitations in insoluble residue, air entrainment, and addition subsequent to calcination.
2. Mortar shall be freshly prepared and uniformly mixed in the proportion of 1 part Portland cement ¼ part maximum line putty or hydrated lime, loose sand not less than 1-1/2 and not more than 3 times the sum of the volume of cement and lime used, and shall conform to ASTM C-270.
3. Grout for pouring shall be of fluid consistency and mixed in the proportion by volume: 1 part Portland cement, 2-1/2 part minimum to 3 parts maximum damp loose sand where the grout space is less than 7.5 cm in its least dimension.
4. Grout for pouring shall be fluid consistency and mixed in the ratio by volumes; 1 part Portland cement, 2 parts minimum to 3 parts maximum damp loose sand, 2 parts coarse aggregate where the grout space is not more than 7.5 cm. in its least dimension.
5. Grout for pumping shall be fluid consistency and shall have not less than 7 bags of cement in each cubic meter of grout. Not mix design shall be approved by the supervising Engineer.

6. Fluid consistency shall mean; as fluid as possible for pouring without segregation of the constituent parts.
7. Aggregate for mortar shall conform to ASTM C-144.
8. Aggregate for grout shall conform to ASTM C-404

#### **ADMIXTURE**

1. The used of admixtures shall not be permitted in mortar or grout unless substantiating data is submitted to and approved by the supervising Architect or Engineer.
2. The use of Admixtures shall not be permitted in mortar without reducing lime content
3. Insert coloring pigments may be added but not to exceed 6% by weight of the cement.
4. The use of uncontrolled fire clay, dirt and other deleterious materials is prohibited.
5. Water to be used shall be fresh, clean and free from deleterious quantities of acids alkali and organic materials.

#### **REINFORCING STEEL**

1. The minimum requirements for deformed steel bars shall conform to ASTM A-305.
2. Wire reinforcement shall also conform with ASTM A-82.
3. Reinforcement shall be clean and free from loose, rust, scales and any coatings that will reduce bond.

#### **CONSTRUCTION**

##### **1. Workmanship**

- a) Masonry work shall not be started when the horizontal and vertical alignment of the foundation has a maximum total error of 25 mm OR 2.5 centimeters.
- b) All masonry work shall be laid true to line, level, plumb and neat in accordance with the plans and to the satisfaction of the Owner.
- c) Units shall be cut accurately to fit all plumbing ducts, openings electrical works, etc. and all holes shall be neatly patched.
- d) Extra care shall be taken to prevent visible grout mortar stain.

- e) No construction supports shall be attached to the wall except where specifically permitted by the supervising Architect or Engineer.

## **2. Masonry Unit**

- a) Masonry unit shall be sound, dry, clean and free from cracks when placed in the structure.
- b) All masonry units shall be stored on the job and kept off the ground and protected from the elements of weather.
- c) Wetting the units shall not be permitted except when hot dry weather exists causing the units to be warm to the touch, and then the surface only may be wetted with a light fog spray.
- d) Proper masonry units shall be used to provide for all window, doors, bond beams, lintels, plasters, etc., with a minimum of unit cutting.
- e) Where a masonry unit cutting is necessary, all cuts shall be neat and true line.
- f) Mixing of Mortar and Grout Mortar shall be mixed by placing  $\frac{1}{2}$  of the water and sand in the operating mixer, then add the cement, lime and the remainder of the sand and water.
- g) Mortar should be re-tampered with water as required to maintain high plasticity. Re-tampering on mortar boards shall be done only by adding water within a basin formed with mortar and the mortar re-worked into the water.
- h) Any mortar which is unused after 1 –  $\frac{1}{2}$  hours from the initial mixing time shall not be used.
- i) After all ingredients are in the batch mixer, they shall be mechanically mixed for not less than 3 minutes. Hand mixing shall not be employed unless specifically approved.

## **3. Bonding**

Concrete masonry units shall be laid with the thicker edge of the core up to provide a wider mortar bed.

- a) Both face core and ends of all blocks should receive a full bed of mortar.
- b) Cross web should be mortared.
- c) For bonding masonry to the foundation, the top surface of the concrete foundation shall be clean with laitance removed and aggregate exposed before masonry construction can be started.

- d) Where no bond pattern is shown, the wall shall be laid up in straight, uniform course with regular running bond.
- e) Intersecting masonry walls and partitions shall be bounded by the use of steel ties at 60 centimeter on.

#### **4. Reinforcement**

When the foundation dowel does not line up with a vertical core, it shall not be sloped more than one horizontal in six vertical.

- a) Dowels shall be grouted into a core in vertical alignment, even though it is an adjacent cell to the vertical wall.
- b) Reinforcing bars shall be straight except for bends around corners and where bends or hooks are detailed the plans.
- c) Reinforcing steel shall be lapped 30 bar diameters minimum where spliced bars shall be separated by one bar diameter or wired together.
- d) Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 192 diameter of the reinforcement.
- e) Horizontal reinforcing bars shall be laid on the webs of the units on continuous masonry courses, consisting of bond-beam or channel units, and shall be solidly grouted in place.
- f) Vertical reinforcing steel shall have a minimum clearance of 6 mm from the masonry, and not less than one bar diameter between bars.
- g) Wire reinforcement shall be completely embedded in mortar or grout. Joints with wire reinforcement shall be at least twice the thickness of the wire.
- h) Wire reinforcement shall be lapped at least 16 cm. at slices and shall contain at least one cross wire of each piece of reinforcement in the lapped distance.

#### **5. Grouting**

Reinforcing steel shall be secured in place and inspected before grouting starts.

- a) Mortar dropping should be kept out of the grout space.
- b) All grout shall be puddle or vibrated in place
- c) Vertical cells to be filled with grout shall have vertical alignment to maintain a continuous unobstructed core space.

- d) Cells containing reinforcement shall be solidly filled with grout and pours shall be stopped 3.8 centimeters below the top of a course to form a key at pour joints.
- e) Grouting of beams over openings shall be done in continuous operation.
- f) The tops of unfilled cell columns under a horizontal masonry beam shall be covered with metal latch or special units used to confine the front fill to the beam section.
- g) All bolts, anchors, or inserts in the wall shall be solidly grouted in place.
- h) Spaces around metal door frame and other built-in items shall be filled solidly with grout of mortar.

## **REJECTION**

In case the shipment fails to conform to the specified requirements, the Contractor may sort it, and new specimen shall be selected by the Owner or his supervising Engineer from the retained lot and tested at the expense of the Contractor. In case the second set of specimens fails to conform to the test requirements, the entire lot shall be rejected.

## **C. MASONRY FINISH**

### **CONSTRUCTION REQUIREMENTS**

#### **1. Curing**

The granolithic topping shall be cured at least 6 days before grinding or until such time when it has set sufficiently hard to permit machine grinding or rubbing with coarse sandstone grit without disclosing any surface aggregate.

#### **2. Surfacing**

- a) After curing all granolithic topping, surfaces shall be wetted and grinded with electric grinding machine to a smooth and even surface.
- b) Where it is not possible to use electric grinding machine, surface shall be hard-rubbed manually using No. 24 abrasive grit stone rubbing after which a light grouting of white Portland cement paste of creamy consistency as the matrix used in the topping.
- c) Grout shall remain on the surface until the time of final grinding and cleaning.

### **3. Finishing**

- a) Allow at least 72 hours after the granolithic surface have been grouted before removing the grout coat, cleaning and fine stone grinding by electric grinding machine using no coarser than No. 80 abrasive grit.
- b) Final grinding or rubbing of granolithic marble surface shall remove scratches and produce a true plane surface of uniform color and texture without objectionable irregularities of any description as that of the approved samples.
- c) *Cleaning, Waxing and Polishing.* Upon completion of final grading or rubbing of granolithic marble the Contractor shall apply two coats of natural wax penetrating type. Surface shall be allowed to dry and polished.

### **MEASUREMENT AND PAYMENT**

1. All granolithic marble finish indicated on the Plans and described herein shall be measured in square and lineal meter or part thereof for work completed and accepted to the satisfaction of the supervising Architect or Engineer.
2. The quantified area determined in the preceding section and provided in the Bill of Quantities shall be paid for at the Unit Bid or Contract Unit Price

### **(A) PEA GRAVEL WASHOUT FINISH**

#### **GENERAL CONDITIONS**

The Contractor shall furnish all materials, equipment, labor, and tools required in undertaking the proper application of pea gravel washout finish as shown on the Plans and in accordance with this Specifications.

#### **A-1 MATERIAL REQUIREMENTS**

- a) **Pea-Gravel** – pie-gravel specie shall be of well graded sizes consisting of 4 mm to 8 mm round variation wash river gravel.
- b) **Cement** – Portland cement shall conform to the Specification requirements of Hydraulic Cement. Use only one brand of cement throughout the pea-gravel washout finish mix.

#### **A-2 CONSTRUCTION REQUIREMENTS**

- a) All pea-gravel washout finish shall be done by men experienced and qualified to do this particular type of trade.

- b) The Contractor shall submit at least two (2) samples to the supervising Architect or Engineer for approval measuring 30 cm. x 30 cm. showing its color, texture and design patterns.

### **1. Surface Preparation**

- a) Walks, ramps, driveways and elsewhere indicated on the Plans as pea-gravel washout finish shall be properly sloped and rendered under bed.
- b) The under-bed mixture shall be spread to bring mortar under-bed to a level of 16 mm below the finish floor line.
- c) For concrete masonry walls, columns, etc., the surface to be applied shall be first rendered a scratch coat and made true to plane, leveled plumbed and squared then allowed to cure for seven (7) days

### **2. Mixture and Proportion**

- a) Pea gravel washout mix shall consist of one part Portland cement and two parts pea-gravel measured by volume or a proportion equivalent to 1:2.
- b) Mixtures shall be in approved containers to ensure that the specified materials are controlled and accurately measured. Mixture measured by shovel or shovel counts will not be permitted.
- c) Unless specified otherwise, pea-gravel washout mix shall be in the proportion by volume in approved mixing machines or mortar boxes.
- d) The aggregates introduced and mixed in such a manner that the materials will be uniformly distributed throughout the mass.
- e) A sufficient amount of water shall be added gradually and the mass further mixed until a mortar plasticity necessary for the purpose intended is obtained.
- f) Mortar boxes, pans, etc., where mixtures are mixed shall be kept clean and free from debris or dried mortar.

### **3. Application**

- a) Before work is started, the slope for drainage should be properly done and provided in the prepared under-bed.
- b) Concrete setting bed must be sufficiently rough and all loose particles or anything which will diminish bond shall be thoroughly cleaned off.

- c) The concrete under-bed must be kept wet for at least four (4) hours before the pea-gravel mix is applied.
- d) Pea-gravel mix shall be applied with pressure to obtain solid adhesion to the under-bed and setting bed.
- e) The finish surface shall be firmly, evenly, and monolithically applied.
- f) When the surface applied with pea-gravel mix has sufficiently set, the cement paste shall be removed by use of sponge or water spraying equipment used in this specially trade in order to expose the pea-gravel quarter face but still intact.

#### **4. Curing, Cleaning and Finishing**

As soon as possible as the pea-gravel are exposed to desire appearance the surface shall be covered with damp burlap other approved covers. At the proper time when surface are semi-dry and stable allowing the applied surface to cure.

#### **5. Protection**

- a) For proper curing, keep the pea-gravel washed finish moistened for a period of at least seven (7) days by thoroughly wetting the surface three (3) times a day and protecting it from the strong rays of the sun with burlap or layer of sand.
- b) Upon completion of the work and the surface has completely seasoned, wash with clean water and brush thoroughly to produce a clean and sparkling appearance and protected until work has been accepted.

### **A-3 METHOD OF MEASUREMENT**

All works done under this Item shall be measured in square meter or linear meter or part thereof for work completed and accepted to the satisfaction of the supervising Architect.

### **A-4 BASIS OF PAYMENT**

The quantity determined in the Method of Measurement shall be paid for at the unit price bid or contract unit price as stated in the Bill of Quantities, which price constitute full compensation including labor and materials, tools and incidentals to complete this item.

### **(B) BUSH HAMMERED FINISH**

#### **GENERAL CONDITIONS**

1. The Contractor shall furnish all materials, tools, plant, equipment and labor and other facilities and undertaking the proper application of Bush Hammered finish complete required as shown on the Plans and in accordance with this Specifications.



2. The Contractor shall submit for approval samples of each applied finish 30 cm. x 30 cm. of different shades to the Architect. Approved samples shall be kept for future reference.

## **B-1 MATERIAL REQUIREMENTS**

### **1. Cement**

Cement shall be ordinary gray Portland cement conforming to the specification requirement for Hydraulic cement. One (1) brand of Portland cement shall be used throughout the plaster mortar mix.

### **2. Adobe Aggregate**

Adobe aggregate shall be crushed and pulverized to an approved graded size improving its mixing ability as coarse aggregate.

## **B-2 CONSTRUCTION REQUIREMENTS**

### **1. Surface Preparation**

Wall surfaces to be rendered with bush hammered finish shall be scratching coated with plaster cement mortar and be made true to plane plumbed and squared. The scratch coat must be properly cured within seven days.

### **2. Adobe Mortar Mixture**

Adobe plaster shall be a mixture of Portland cement, crushed and pulverized graded adobe stones. It shall be uniformly mixed in the proportion by volume of one part Portland cement and two parts adobe aggregates or 1:2 proportions.

### **3. Application**

- a) Before any application work is commenced, all wood moulds for horizontal and vertical groove joints shall be first established and set. The scratch coat has to be seasoned for 7 days
- b) Surfaces to be applied with adobe plaster mortar shall be thoroughly moistened with fog spray.
- c) Adobe plaster mortar shall be floated to a true and even surface. It may also be floated / troweled to a hard fluted surface with series of grooves also known as corduroy finish.
- d) As soon as the plastered surface is hard enough to react hammering, the surface by hammering with an ax or hatchet leaving or exposing the natural appearance of the aggregate composition of mortar mixture.

#### **4. Workmanship**

- a) Bush hammered finish shall be level, plumbed squared and true to a tolerance of 3 mm in 3.0 meters without caves, cracks, blisters, pits, crazing, discolorations, projection or other imperfections.
- b) Plastering work shall be formed carefully around angles, contours and cants. Special care shall be taken to prevent sagging and consequent dropping of applications.
- c) There shall be no junction marks in the finish where one day work adjoins another.

#### **5. Curing and Protection**

Upon completion of the work all surfaces shall be cleaned with steel brush and water to remove loose particles leaving the cleaned surfaces in its natural appearance. When cleaned surfaces dries spray a coat of water repellent.

#### **B-3 METHODS OF MEASUREMENT**

Bush hammered finish shall be measure in square meter area and linear meter actually done completed and accepted to the satisfaction of the supervising Architect.

#### **B-4 BASIS OF PAYMENT**

The work quantified and determined in the preceding section or as provided in the Bill of Quantities shall be paid for at the Contract unit bid price which payment constitute full compensation including labor, materials and other incidentals necessary to complete this Item.

#### **(C) PEBBLE WASHOUT FINISH**

##### **GENERAL CONDITIONS**

The Contractor shall furnish all materials, labor tools, and equipment required in undertaking proper application of pebble washout finish as shown on the Plans and in accordance with this Specifications.

## **C-1 MATERIAL REQUIREMENTS**

### **a) Pebble**

Pebble shall be well graded stones sized ranging from No.4 to No. 10 rounded shape.

### **b) Cement**

Cement shall be Portland type hydraulic cement gray or whit specie depending on the tone or color scheme approved. Colored cement shall be powder type pigmented used to the desired shade and color of finish.

## **C-2 CONSTRUCTION REQUIREMENTS**

All pebble washout finish shall be done by men experienced and qualified to do this particular type of trade. The contractor shall submit at least two samples for each type of pebble washout finish to the Architect or Engineer for approval showing its color, texture and design patterns.

### **1. Surface Preparation**

- a) Surface to receive pebble washout finish shall be clean of all projection, dust, loose particles and foreign matters.
- b) It shall be thoroughly wetted with clean water before application of scratch coat mortar. When the surface has sufficiently set, scratch with hard broom.

### **2. Mixture**

- a) Pebble finish mortar mixture shall consist of one part Portland cement and two parts pebble measured by volume or a proportion equivalent to 1:2
- b) Mixtures shall be in approved containers to ensure that the specified materials are controlled accurately measured.
- c) Mixtures measured by shovel or shovel counts will not be permitted. Unless specified otherwise, pebble washout mix shall be in the proportion by volume in approved mixing machines or mortar boxes.
- d) The aggregate introduced and mixed shall be in such a manner that the materials will be uniformly distributed throughout the mass.
- e) A sufficient amount of water shall be added gradually and the mass further mixed until a mortar plasticity necessary for the purpose intended is obtained.
- f) Mortar boxes, pans etc., where mixtures are mixed shall be keep clean and free from debris or dried mortar.

### **3. Application**

- a) Before any application work started, the Contractor shall established all wood molding for vertical and horizontal groove lines after the scratch coat has seasoned for seven days in the case of masonry wall or concrete columns, beams and parapets etc.
- b) In the case of finish flooring application and the like the slope of drainage shall be properly provided and design pattern properly placed.
- c) The proposed under-bed shall be done to a level of 16 mm below the finish floor line to accommodate the pebble washout mix.
- d) The prepared surface to receive the pebble washout mix shall be kept damp for at least 4 hours before the application work is started
- e) Pebble washout finish mix shall be applied with pressure to obtain solid adhesion to the prepared surface. The applied surface shall be firm, even and monolithically applied, then allowed to set initially.
- f) When the applied surface has initially set to withstand the removal of the cement paste, spray evenly by spray apparatus to washout the cement paste on the outer surface so that the pebbles are partly exposed or,
- g) By means of paint brush of foam and water, or by means of spraying washing down the cement paste leaving the pebbles partially exposed in their natural texture appearance.

### **4. Workmanship**

- a) Pebble washout shall be leveled, plumbed, squared and true to line within a tolerance of 3 mm in 3.0 meters without caves cracks, blisters, pits, crazing, discoloration, projections or other imperfection.
- b) There shall be no visible junction marks in the finish surface where one day work adjoins another.
- c) Where required by the supervising Architect or Engineer, provide vertical and or horizontal groove joints.

## **5. Curing and Protection**

- a) When the pebble washout surface has finally set the surface shall be kept wet or moist for at least 6 days.
- b) After all other trade have been completed the pebbles washout finish surfaces shall be saturated with diluted hydrochloric acid and cleaned with steel brush
- c) Allow the clean surface to dry then apply a coat of silicon water repellent to protect the natural physical appearance of the pebble washout finish.

## **C-3 MEASUREMENT AND PAYMENT**

1. Pebble washout finish shall be measure in square meters, lineal meters or part thereof for work actually completed and accepted to the satisfaction of the supervising Architect or Engineer.
2. The work done under this Item as provided in the Bill of Quantities shall be paid for at the Contract Unit Bid which price and payments constitute full compensation including materials and labor and incidentals necessary to complete this Item.

## **(D) CEMENT PLASTER**

### **GENERAL CONDITONS**

The Contractor shall furnish all cement plaster materials, labor, tools and equipment required in undertaking cement plaster finish as shown on the Plans and in accordance with this Specifications.

### **D-1 MATERIAL REQUIREMENTS**

Manufactured materials shall be delivered in the manufacturer's original unbroken packages or containers which are labeled plainly with the manufacturer's name and trademark.

1. **Cement.** Cement shall be Portland Hydraulic Cement of any approved brand.
2. **Hydrated Lime** shall conform with the requirements as defined in Hydraulic Cement of any approved brand.
3. **Fine Aggregates.** Fine aggregates (sand) shall be clean, washed and sharp river sand, free from dirt, clay, organic matter or other deleterious substances

Sand derived from crushed gravel or stone may be used with the supervising Architect or Engineer's approval but in no case, shall such sand be derived from stone unsuitable for use as coarse aggregates.

## **D-2 CONSTRUCTION REQUIREMENTS**

### **1. Mixture**

- a) Mortar mixture for brown coat shall be freshly prepared and uniformly mixed in the proportion by volume of one part Portland Cement, three (3) parts sand and one fourth (1/4) part hydrated lime.
- b) Finish coat shall be pure Portland cement properly graded and mixed with water to approved consistency and plasticity.

### **2. Surface Preparation**

- a) After removal of forms, reinforced concrete surfaces shall be roughened to improve adhesion of the cement plaster.
- b) Surfaces to receive cement plaster shall be cleaned of all projections, dust, loose particles, grease and bond breakers.
- c) Before any application of brown coat is started, all surfaces that are to be plastered shall be wetted thoroughly with clean water to produce a uniformly moist condition.
- d) Brown coat mortar mix shall be applied with sufficient pressure starting from the lower portion of the surface to fill the grooved and to prevent air pockets in the reinforced concrete/masonry work and avoid mortar mix dropping.
- e) The brown coat shall be lightly broomed or scratch before surface has properly set and allowed to cure.
- f) Finish coat shall not be applied until after the brown coat has seasoned for 7 days and corrective measures had been done by the Contractor on surfaces that are defective.
- g) Just before the application of the finish coat, the brown coat surface shall be evenly moistened with clean water.
- h) Finish coat shall be floated first to a true and even surface, and then troweled in a manner that will force mixture to penetrate into the brown coat.
- i) Surfaces applied with finish coat shall then be smooth with paper or foam in a vertical motion to remove trowel marks, checks and blemishes.
- j) All cement plaster finish shall be 10 mm thick minimum on vertical concrete and or masonry walls.

Wherever indicated on the Plans to be “*Simulated Red Brick Finish*, the Contractor shall render brick design on plaster surface before brown coat had properly set and then allowed to dry.

**Cement shall not be directly applied to:**

- a) Concrete or masonry surface that had been coated with bituminous compound and,
- b) Surface that had been painted or previously plastered.

**3. Workmanship**

- a) Cement plaster finish shall be true to details and plumb. Finish surface shall have no visible junction marks where one day’s work adjoins the other.
- b) Where directed by the Architect or Engineer or as shown on the Plans vertical and horizontal groove joints shall be 25 mm wide and 10 mm depth.

**D-3 MEASUREMENT AND PAYMENT**

- 1. All cement plaster finish shall be measured in square meters or part thereof for work actually completed in the building.
- 2. The work quantified and determined as provided in the Bill of Quantities shall be paid for at the Contract Unit Price which price constitute full compensation including labor, materials, tools and equipment and incidentals necessary to complete this Item.

**(E) PLAIN CEMENT PLASTER FINISH**

**GENERAL CONDITIONS**

The Contractor shall furnish all materials, tools, equipment and labor required in undertaking the proper application of plain cement plaster finish as provided where plastering is noted the drawings and schedules. Plastering work shall be properly coordinated with the work of other trades.

- 1. The work of other trades shall be adequately from damages during the plastering operations. Finishing work shall be protected with a covering of heavy craft, waterproof paper or other approved protective covering with lapped and sealed joints.
- 2. Scaffolding shall be amply strong, well braced, tied securely and inspected regularly. Overloading of scaffolding will not be permitted.

## **E-1 MATERIAL REQUIREMENTS**

1. Portland Cement shall conform with the standard specifications of the ASTM 1-150, type-I, latest edition.
2. Hydrated lime shall conform with the standard specification of the ASTM C-6, latest edition.
3. Sand shall be hard, sharp, well washed, siliceous, clean and free from deleterious material.
4. Water shall be fresh, clean and free from organic matter, acids and alkali.

## **E-2 DELIVERY, STORAGE AND HANDLING**

Manufactured materials shall be delivered with unbroken packages or containers which are plainly labeled with the manufacturer's name and brand. All cement materials shall be kept dry until ready for use.

They shall be stored off ground, under cover and away from sweating walls and other damp surfaces.

## **E-3 MIXTURE**

1. Plaster materials, specified on a volume basis, shall be measured accurately in approved containers that will insure the specified proportion.
2. Measuring materials with shovels or shovel count will not be permitted
3. Mortar for brown coat shall be mixed in the proportion by volume of 1 part Portland cement 3 parts sand, an 1/4 part hydrated lime
4. Mortar for finish coat shall be the same as specified for brown coats, except that the proportions of sand shall be increased to not more than 4 parts.

## **E-4 APPLICATION**

1. All surfaces to receive plaster shall be cleaned of all projections, dust, loose particles, grease bond breakers and other foreign matter.
2. Plaster shall not be applied directly to concrete or masonry surfaces that have been painted or previously plastered.
3. Before the plastering work is started, masonry surfaces shall be wetted thoroughly with a fog spray of clean water to produce a uniformly moist condition.



4. Brown coat – shall be applied with sufficient pressure to fill the grooves in hollow block or concrete to prevent air pockets and secure a good bond.
5. The brown coat shall be lightly scratched and broomed. Each coat of cement plaster shall be kept moist for 48 hours after application and then allowed to dry.
6. Finish coat – shall not be applied until after the brown coat has seasoned for 7 days.
  - a) Dust before the application of the finish coat.
  - b) The brown coat shall again be evenly moistened with a fog spray
  - c) The finish coat shall be floated first to a true and even surface then troweled in a manner that will force the sand particles down into the plaster.
  - d) Plastered surfaces shall be smooth and free from rough areas, troweled marks, checks and blemishes.
  - e) Thickness of the plaster shall be 10 mm (3/8”) to 12 mm (1/2”) on vertical concrete and on masonry

#### **E-5 WORKMANSHIP**

Plaster work shall be finished level, plumb, square and true to line within a tolerance of 3 mm (1/8”) in 3.00 meters without waves, cracks, blisters, pits, crazing, discolorations, projection and other imperfections.

1. Plaster work shall be formed carefully around angles, contours, and well- up to screeds.
2. Special care shall be taken to prevent sagging and consequent dropping of mortar during applications.
3. There shall be no visible junction marks in the final coat where on day work adjoins the other.

#### **E-6 PATCHING, PAINTING AND CLEANING**

1. Upon completion of the building, and when directed, all loose, cracked, damage or defective parts shall be cut out and re-plastered in a satisfactory and approved workmanlike manner.
2. All painting and patching of plastered surfaces and plaster work abutting or adjoining any other finish work, shall be done in a neat and workmanlike manner.
3. Plaster drops or spatter shall be removed from all surfaces. Exposed plastered surfaces shall be left in a clean, unblemished condition ready to receive paint or other finish.

4. After the work has done, all protective coverings of cement finishes shall be removed from the floors. All rubbish and debris shall be removed from the building.

### **1.3. STRUCTURAL STEEL**

#### **SCOPE OF WORK**

The scope of work under this section consists of furnishing of all materials, labor, tools, equipment, and performance of all operations relative to the fabrication, delivery to site, erection and painting of structural steel trusses and purlins as shown on the plans.

#### **A. DESIGN CONDITIONS**

1. All structural work shall in accordance with AISC Specification for the Design, Fabrication and Erection of Structural and steel for buildings.
2. Materials , and parts necessary to complete each item through such work which is not shown or specified shall be included, such as miscellaneous bolts, anchor, supports, braces and connections etc.
3. Shop drawings as well as erection drawings shall be prepared and submitted by the contractor to the supervising Architect or Engineer for approval before any fabrication is made.

#### **B. SHOP DRAWINGS**

1. Shop drawings giving complete information necessary for the fabrication of the component parts of the structure, including the location, type and size of all rivets, bolts and welds, shall clearly distinguish between shop and field rivets, bolts and welds.
2. Shop drawings shall be made on conformly with the best modern practice and with due regard to speed and economy in fabrication and erection.

#### **C. MATERIALS**

1. All structural steel shapes and plates shall conform to ASTM A-36.
2. Light-gauge Cold-formed Structural Steel shall conform to pertinent specifications of the American Iron and Steel Institute (AISI).
3. Machine bolts shall conform to ASTM A-307. Each bolt shall be provided with standard nuts and washers.
4. Anchor Bolts – shall conform to ASTM A-141.

5. Cross Bracing with Turnbuckles shall conform to ASTM A-307.
6. Welding Electrodes – shall conform to AWS A-5.1 or A-5.5, E 70 Electrodes.

#### **D. FABRICATION**

1. Field fabrication shall be kept to a minimum. And shop fabrication shall be employed to the greatest extent possible with members shop fabricated as practicable with a minimum requirement for field connections.
2. Welding, shearing, gas cutting, chipping and all other works involved in the fabrication of structural steel shall be done with accuracy and of the highest quality of workmanship, within the allowable tolerance prescribed in the AISC specifications.

#### **E. WELDING**

1. The technique, appearance and quality of welds and the method of correcting defective work shall conform to the applicable provisions of “*Workmanship of the Standard Code for Welding in Building Construction of the American Welding Society*”
2. Welding of structural members in shop and on field, shall be done only by certified and experienced welder.
3. Surfaces to be welded shall be free from loose side, rust, grease, paint and other foreign materials that will impair the soundness of the weld.
4. Temporary weld and assembly attachments shall be kept to a minimum. All temporary attachment that are welded, shall be removed by a flame torch above the parent metal surface and ground to smooth surface by power grinding.
5. Note shall be made on the Plans and on the shop drawings of those joints or groups of joints in which it is especially important for the welding sequence and technique of welding to be controlled carefully, to minimize welding under restraint, and to avoid undue distortion.
6. Weld length called on the Plans and on the shop drawings shall be the net effective length.

## **F. CONNECTION AND HOLES**

Connections shall be as shown in the drawings and shall develop the full capacity of the members.

1. Surfaces or joints prepared for welded or high strength bolted connections shall comply with the cleanliness requirements of all joints surfaces and contact surfaces within friction types joints as specified in "Bolted parts" of the AISC Specifications.
2. Holes shall be punched or drilled at right angles to the surface of the metals and shall not be enlarged by burning.
3. Holes shall be clean-cut without rugged edges. Outside burrs resulting from drilling or reaming operations shall be removed with a tool which reaches a 1.588 mm level around the bolt holes.

## **G. QUALITY CONTROL PROCEDURES**

1. Quality control shall be practiced by the Fabricator to assure high quality in the work. In addition to the Fabricator's quality control procedures, materials and workmanship shall be subject to Inspection by qualified inspectors representing the Owner.
2. Fabricator shall cooperate harmoniously with the inspector to avoid interpretation in the work, when correction will be needed.

## **H. REJECTION**

1. Materials or workmanship not in reasonable conformance with the provisions of this Specification shall be rejected at any time during the progress of the work.
2. The Fabricator shall receive of all reports made by the Inspector authorized by the Owner and/or his supervising Architect or Engineer.

## **I. ERECTION**

1. The steel structures shall be erected plumb and true to line and grade. Bracings and supports shall be introduced whenever necessary to take care of all the loads to which the structure may be subjected. Such bracings shall be left in place as long as may be required for safety.
- 2.
3. Base plates and bearing plates shall be supported on steel wedges until the supported members shall have been aligned and plumb, following which the entire bearing are shall be grouted solid with non-shrink cement.

## **J. MARKING**

1. Shop fabricated members shall be marked prior to delivery to facilitate the erection of the members.
2. Markings shall be listed and given description and copies of which shall be furnished to the Owner.
3. Markings shall be neatly painted on the members with a distinctive color of enamel paint.

#### **K. SHOP PAINTING**

1. Steel works to be encased in concrete shall not be painted. All other steel works shall be given one coat of shop paint of red lead primer, applied thoroughly and evenly to dry surfaces, which have been cleaned, by brush, spray roller coating, floor coating or dipping at the selection of the Fabricator.
2. Steel work prior to painting and after inspection and approval shall be cleaned of loose mil scale, loose rust, weld slag or flux deposit, dirt and other foreign materials.
3. Oil and grease shall be removed by solvent. Parts of the steel work which shall be fielded, welded or connected shall not be painted. All steel work specified to have no shop paint shall likewise be thoroughly cleaned.

#### **L. FIELD PAINTING**

All the steel work after complete erection, shall be field painted with the type and color specified in the section of painting of this Specifications. Painting shall not be done on any steel surface that is thoroughly clean and dry.

## **1.4.ROOFFING WORKS**

### **CORRUGATED METAL ROOFING PRE-PAINTED METAL SHEET**

#### **SCOPE OF WORK**

This Item consist of furnishing all pre-painted metal sheet materials, tools and equipment, plant including labor required in undertaking the proper installation and complete as shown on the Plans and in accordance with the Specifications.

#### **A. MATERIAL REQUIREMENTS**

All Pre-Painted metal sheet and roofing accessories shall be oven baked painted true to profiles indicated on the Plans.

Pre-painted roofing sheets shall be fabricated from cold rolled galvanized iron sheets specially tempered steel for extra strength and durability. It shall conform to the material requirements defined in PNS 67:1985.

Profile section in identifying the architectural moulded rib to be used is: Regular corrugated Quad-rib, Tri-wave, Rig-wide, Twin rib, etc. Desired color shall be subject to the approval of the Architect.

1. Gutters, valleys, Flashings, Hips and Ridge roll shall be fabricated from gauge 24 (6 mm) thick cold rolled plain galvanized iron sheets specially tempered steel. Profile section shall be as indicated on the Plans.
2. Fastening hardware shall be of galvanized iron straps and rivets. G.I. straps are of .50 mm thick x 16 mm gauge 26 and standard G.I. rivets.
3. Base metal thickness shall correspond to the following gauge designation available locally as follows:

Base Metal Thickness	Designated Gauge
.40 mm thick	Gauge 28
.50 mm thick	Gauge 26
.60 mm thick	Gauge 24
.80 mm thick	Gauge 22

Length of roof sheets available in cut from 5 feet to 12') long. Long span length up to 8 meters. Special length by arrangements.

## **B. CONSTRUCTION REQUIREMENTS**

1. Before any installation begins, the Contractor shall ascertain that the top face of the purlins is in proper alignment.
2. Correct the alignment as necessary in order to have the top faces of the purlins on an even plane.
3. Sheets shall be handled carefully to prevent damage to the paint coating. Lift all sheets or sheet packs on to the roof frame with the overlapping down-turned edge facing towards the side of the roof where installation will commence, otherwise the sheets will have to be turned end to end during installation.
4. Start roofing installation by placing the first sheet in position with the down turned edge in line with other building elements and fastened to supports as recommended.
5. Place the down-turned edge of the next sheet over the edge of the first sheet, to provide side lap and hold the side lap firmly in place. Continue the same procedure for the subsequent sheets until the whole roofing area is covered and or adopt installation procedure provided in the instruction manual for each type of molded rib profile.
6. For walling applications follow the procedure for roofing but allow a minimum end lap of 10 cm. for vertical walling.
7. **End Lap.** In case handling or transport consideration requires to use two or more end lapped sheets to provide full length coverage for the roof run, install each line of sheets from bottom to top or from eave line apex roof framing. Provide 15 cm. minimum end lap.
8. **Anchorage.** Pre-painted steel roofing sheets shall be fastened to the wood purlins with standard length G.I. straps and rivets.
9. For Steel Frame up to 4.5 mm thick, use self-drilling screw No.12 by 4.0 cm long hexagonal head with neoprene washer.
10. For Steel Support up to 5 mm thick or more, use threaded cutting screw No. 12 by 4.0 cm long hexagonal head with neoprene washer.
11. For side lap fastener use self drills screw No. 10 by 1.6 cm. long hexagonal head with neoprene washer.

12. Valley fastened to lumber and for walling, use self drilling wood screw No. 12 by 2.5 cm. long hexagonal head with neoprene washer.
13. Valley fastened to steel supports, use self drilling screws, hexagonal head with neoprene washer, drill size is 5 mm diameter.
14. In cutting pre-painted steel sheets to place the exposed color side down, cutting shall be carried out on the ground and not over the top of other painted roofing product.
15. Power cutting or drilling to be done or carried out on pre-painted products already installed or laid in position, the area around holes or cuts shall be masked to shield the paint from hot fillings.
16. Storage and Protection. Pre-painted steel roofing, walling products and accessories should be delivered to the job site in strapped bundles.
17. Sheets and or bundles shall be neatly stacked in the ground and if left in the open it shall be protected by covering the stack materials with loose tarpaulin.

### **C. MEASUREMENT AND PAYMENT**

1. The work done under this item shall be measured by actual area covered or installed with pre-painted steel roofing and or walling in square meters and accepted to the satisfaction of the Architect or Engineer.
2. The area of pre-painted steel roofing and or walling in square meters shall be paid for at the Unit Bid Price or contract unit price which payment shall constitute full payment including labor, materials, tools and incidentals necessary to complete the work.

### **CLAY ROOF TILES**

#### **SCOPE OF WORK**

This Item consist of furnishing all plant, labor tools, equipment and clay roof tiles required to complete the roofing as shown on the Plans in accordance with this Specifications.

#### **A. MATERIAL REQUIREMENTS**

##### **1. Clay Roof Tiles**

Clay tiles shall be manufactured from red clay specie molded to custom pile patterns. It shall be kiln dried to improve natural aesthetic appearance and resistance to erosion and withstand any climate condition in the tropics. Where required and indicated to be glazed, color shall be approved by the Architect.



## **2. Sheating**

- a) Corrugated G. I. sub-roofing shall be 0.5 mm thick long span. Plywood sheating when used instead of G.I. shall be 12 mm thick marine plywood treated with two piles of felt paper asphalt impregnated.
- b) Wood Batten shall be 2.5 cm. x 5.0 cm. pressure treated lumber properly laid to fit clay roof tiles and accessories as indicated on the Plans.
- c) Fasteners shall be non-corrosive materials. Nails shall have large head sufficient length to give 19 mm penetration on wood batten and # 16 tie wires to be copper or brass as the case may be.

## **B. CONSTRUCTION REQUIREMENTS**

1. Before the work is started, the Contractor shall secure approved roof framing Plan and determine or evaluate actual site condition.
2. In case modification is necessary, the Contractor shall submit shop drawings to the supervising Architect or Engineer.
3. Batten roof shall be installed in straight lines, level squared and firm. It may rest on sheating and anchored rigidly by means of galvanized iron straps gauge 24 thick riveted on sheating, or nailed on top chord or jack rafter when it rests on plywood sheating.
4. The top chord or jack rafter shall have at least a minimum roof pitch of 25 degrees.
5. Plywood sheating shall be overlaid with two piles of felt paper, asphalt impregnated to control moisture. The batten shall be spaced to fit the clay roof tiles and accessories.
6. Gutter and valleys shall be set in place before wood battens are installed. Use gauge 24 plain galvanized iron sheet molded true to profile section indicated on the plans or as directed by the supervising Architect or Engineer.
7. For clay tiles on concrete roof slab provide and install pressure treated lumber 25 mm x 50 mm or metal strips properly aligned, level squared and firm.
8. Apply waterproofing on the slab surface to control moisture by cold process.
9. Laying of tiles shall start at the lower layer from right to left. See to it that the left anchorage of tile is placed near or close to hip truss as much as possible.
10. Continue to the next layer of clay roof tiles following the same procedure

11. After all clay roof tiles are laid out, mark the clay roof tiles at hips and valleys which are to be cut using straight edge or string as guide.
12. Where tiles join a hip stringer, provide waterproof elastic cement. Cement hip roll and ridge in lap and fasten with nails or tie wires as specified.
13. Fill voids at hip starters and ridge ends with mortar, color to match the tile.
14. Remove all debris and clean roof are for service.

### **C. METHODS OD MEASUREMENT**

This item shall be measured by actual roof area laid with clay roof tiles and accessories in square meters or part thereof, for work completed and accepted to the satisfaction of the Architect.

### **D. BASIS OF PAYMENT**

The accepted work quantified and provided in the Bill of Quantities shall be paid for at the Unit Bid Price which constitute full payment for furnishing all materials, labor, tools, equipment and other incidentals necessary to complete this item.

## **ROOF DRAINAGE**

### **SCOPE OF WORK**

This Item shall consist if furnishing all items, articles plant equipment, labor and materials and performing all methods necessary or required for the complete installation of all roof drains with strainers in accordance with all applicable drawings as shown on the approved plans and the provisions of this Specifications

### **A. GENERAL CONDITIONS**

1. Performing all operations or methods necessary and required for the complete installation of all Roof Drains with strainers, including connections to downspout, in accordance with all applicable drawings and details, and subject to the terms and conditions of the contract.
2. Should there be any conflict between the sizes of roof drains and downspout, the size of the latter shall govern.
3. The size of any roof drain with strainer shall follow the diameter of the corresponding roof leader or downspout to be installed.

### **B. CONSTRUCTION REQUIREMENTS**

## **1. Drainage**

- a) The contractor shall provide, fit or install all necessary drains with strainers where so shown or indicated on plans and or where the supervising Engineer directs.
- b) Each drain with strainers shall fit the size of the corresponding downspouts or conductor over which is to be installed and in accordance with the following schedule.
- c) Over each downspouts of cast iron body lacquer finish low “Dome” roof drain (rough brass strainer) 45 threaded outlet or side outlet respectively, secured to caming ring by screws.

## **2. Drain and Over flow Pipes**

- a) Concrete roof gutters or any other work which catches drains or collect rain water shall be provided with adequate drain overflow, pipes, one inch in diameter pipe spaced at 2.00 meters on centers and or as specified.
- b) Weep holes, where so indicated on plans, of the size and spacing shown, shall be provided by the contractor to allow the free flow of water to drain from one level over lower level or to outside all in accordance with the detailed drawings.

## **3. Downspout**

- a) All conductors or downspout encased in concrete unless otherwise shown in drawings shall be PVC pipe as specified in plans. Size of downspout shall be as shown or indicated on plans.
- b) Downspout of all floor drains indicated on reinforced concrete gutters shall be 75 mm in diameter except where specified other use and each shall branch from the adjacent main downspout if any as shown on plans.
- c) Any drain with strainers of approved quality, locally made, in accordance with full size details may be substituted subject to the written approval of the supervising Architect or Engineer.
- d) Should the series and type number specified herein be not suitable to a particular location due to concrete space limitations, any adaptation of the series specified of the same size, body material and finish may be substituted, subject to the approval of the supervising Architect or Engineer.
- e) Any other drain shown but not specified herein and necessary to leave the work complete, shall be provided and installed by the contractor suitable to the service required and fitted to the concrete limitations at the point of installation, based on or similar as specified herein or as directed by the supervising Architect or Engineer.

### **C. MEASUREMENT AND PAYMENT**

1. All roof drains strainers actually installed shall be measured and determined by the number of pieces or units ready for service as provided in the Bill of Quantities accepted to the satisfaction of the supervising Architect or Engineer.
2. The Item measured and determined shall be paid for at the Unit Bid Price which payment constitute full compensation of materials, labor and incidentals necessary to complete this Item.

## **1.5. WATERPROOFING**

### **SCOPE OF WORK**

This Item shall consist of furnishing all materials, labor, tools, equipment, plant and other facilities required as shown on the Plans and undertaking the proper application of integral and membrane waterproofing complete in accordance with this Specifications.

#### **A. MATERIAL REQUIREMENTS**

##### **1. Integral Waterproofing**

Integral waterproofing compound shall be cementitious powder pre-mix admixture or water base surface coat conforming with the standard Specifications set by the Bureau of Product Standards, Department of Trade and Industry.

##### **2. Membrane Waterproofing**

Membrane waterproofing shall be Osmo-seal powder; Liquid Elastomeric or Epoxy Solvent less waterproofing compound formulated for extra flexibility and resiliency to give lasting waterproof effect.

#### **B. CONSTRUCTION REQUIREMENTS**

1. Concrete mixture for decks, balconies, toilet and bathrooms, gutters, parapets, canopies and other areas indicated on the Plans to be integrally waterproofed shall be blended with integral waterproofing compound.
2. Only a minimum quantity of clean water shall be used in the concrete mixture to be sufficiently plastic and to obtain enough workability in placing concrete.
3. Concrete surface to be applied with membrane waterproofing shall have been integrally waterproofed, thoroughly set, dry, clean and free from foreign matters.
4. Surface shall be topped and plastered with double strength integral waterproofing compound pre-mix admixture of screened mixture: 1 part Portland cement, 3 parts clean and sharp sand and 2 packages integral waterproofing compound steel trowelled to smooth surface finish.
5. Concrete slab shall be properly graded to drain rainwater. A minimum pitch of 1 percent is satisfactory to drain water freely into the drain lines.
6. Drainage connection and weep-holes shall be set up to permit the free flow of water.
7. Any expansion and contraction joints shall be cleaned, primed, fitted with a backing rod and caulked with sealant.

8. Prepared surfaces shall be cured and kept wet by sprinkling water at regular intervals for a period of at least 3 days when smooth surface finish have actually set.
9. Allow cured surfaces to dry and remove all dust, dirt, debris and oil.
10. All loose areas shall be refitted and well secured. Repair cracks, breaks and open seams. Where required or as directed in the membrane waterproofing product instruction manual, prepared surface shall be prime coated.

### **C. APPLICATION PROCEDURES**

1. Prior to application, concrete surface shall be sound and cured without the use of curing compound.
2. Apply a coat of neutralizer to remove oil, dirt, and other contaminants.
3. Apply a coat of concrete primer on surfaces to be installed with membrane self-sealing type when required or as directed in the product instruction manual.
4. Stir thoroughly each container of membrane waterproofing before use.
5. Apply a coat of membrane waterproofing by brush, airless spray, notched trowel, squeegee or roller preferably 15 to 20 mils maximum thickness of wet coat.
6. Three applications is recommended and each coat is allowed a minimum of 24 hours curing time between each coat or as recommended in the product manufacturer's instruction manual.
7. Application of membrane waterproofing coat should not commence unless the ambient temperature is 4.44<sup>0</sup> C or higher and shall not proceed during inclement weather condition.
8. The waterproofing compound is combustible. Extra care shall be observed by persons having skin sensitiveness to wear protective gloves while applying.

#### **D. PROTECTION OF MEMBRANE WATERPROOFING SURFACES**

1. To have a bond between the membrane waterproofing and the slab, concrete topping shall be placed as the membrane dries after 48 hours of application.
2. If a bond is not required, the membrane shall be protected with asphalt asbestos board or asphalt felt paper until such time as topping and concrete covering is applied.
3. Prior topping or placing concrete cover, inspect the membrane for any damage and repair work as required.
4. Exposed membrane surfaces at basement shall be covered and protected by installing tightly butted asphalt impregnated protection boards with a minimum thickness of 6 mm and 12 m on all horizontal areas.
5. Use asphalt impregnated joint boards along all walls and cove areas.

#### **E. MEASUREMENT AND PAYMENT**

1. Integral and membrane waterproofing works rendered under this Item shall be measured in square meters for areas actually waterproofed as provided in the Bill of Quantities and accepted to the Owner satisfaction.
2. The areas provided with integral and membrane waterproofing measured in accordance with the preceding section shall be paid for at the Unit Bid Price which price and payment constitute full compensation for furnishing all materials, tools equipment, labor and incidentals necessary to complete this Item.

## 5. PLUMBING

### SCOPE OF WORK

This Item shall consist of furnishing all materials, tools equipment and fixtures required as shown on the Plans for the satisfactory performance of the entire plumbing system including installation in accordance with the latest edition of the National Plumbing Code, and these Specifications.

### A. MATERIAL REQUIREMENTS

All piping materials, fixtures and appliances fitting accessories whether specifically mentioned or not but necessary to complete this Item shall be furnished and installed.

#### 1. Plastic Pipes

- a) Unless otherwise specified or shown on drawings all tube pipes to be use in this project shall be plastic or synthetic materials.
- b) For rigid type of connections, the following shall be used: Polyvinyl Chloride (PVC); Chlorinated Polyvinyl Chloride (CPVC); Unplasticized Polyvinyl Chloride (uPVC); Acrylonitrile Butadiene Styrene (ABS); Polypropylene (PP) and Styrene Rubber Plastic (SR).
- c) For flexible connections either of the following shall be used: Polyethylene (PE) and Polybutylene (PB).
- d) The PE and PB tubes are in coil form available up to 150 meters long in coil form shall be used for underground water connections.
- e) Plastic pipe shall be of quality made by reputable manufacturers free from defects, and shall be true, smooth and cylindrical, their inner and outer surfaces being as nearly concentric, their inner and outer surfaces being as nearly concentric as practicable.
- f) They shall be in all aspect, sound and perfectly molded free from laps, pin holes or other imperfections and shall be neatly dressed with its end finished reasonably square to their axes.
- g) Pipes and fittings for sanitary and potable water lines as approved alternate shall be unplasticized Polyvinyl Chloride Pipes and fittings (Upvc)
- h) Pipes and fittings shall be made of virgin materials conforming to Specification requirements defined in ASTM D-2241 and PS 65: 1986.



- i) Fittings shall be molded type and designed for solvent cement joint connection for water lines and rubber O-ring seal joint for sanitary lines.

## **2. Septic Tank**

- a) The septic tank shall be provided as shown on the Plans including all pipe vents and fittings.
- b) Various construction materials such as concrete masonry work shall conform to the corresponding Items of this Specification.
- c) Inlet and outlet pipes shall conform to the latest edition of the National Plumbing Code.

## **3. Plumbing Fixtures and Fittings**

- a) All fittings and trimmings for fixtures shall be chromium plated and polished brass unless otherwise approved.
- b) Exposed traps and supply pipes for fixtures shall be connected to the roughing-in, piping system at the wall unless otherwise indicated on the Plans.
- c) Built in fixtures shall be watertight with provision of water supply and drainage outlet, fittings and trap seal.
- d) Unless otherwise specified, all plumbing fixtures shall be made of vitreous china complete with fittings.

## **4. Bathroom and Toilet Accessories**

- a) Shower head and fitting shall be movable, cone type with excutcheon arm complete with stainless steel shower valve and control lever. All exposed surface to be chromium finish.
- b) Grab bars shall be made of tubular stainless steel pipe provided with safety grip and mounting flange.
- c) Floor drains shall be made of stainless steel beehive type, measuring 10 cm x 10 cm. and provided with detachable stainless strainer, expanded metal lath type.
- d) Toilet paper holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent fixture and facing tiles.
- e) Soap holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent tile works.

- f) Faucets shall be made of stainless steel for interior use.
- g) Hose bibs shall be made of bronze cast finish.

## **5. Special Plumbing Fixtures**

- a) Kitchen sink shall be made of stainless steel self rimming, single compartment complete with supply fittings, strainer traps, dual control lever and other accessories.
- b) Laboratory sink shall be made of cast iron metal with white porcelain finish with single compartment, flat rim edge, 75 x 53 cm. complete with supply fittings, strainer, trap and other accessories,
- c) Scrub up sink shall be made of cast iron white porcelain finish with 3 compartment X – ray processing tank, drain plug, open sanding drain 19 mm inlet spud complete with stand and mounting accessories.
- d) Built in appliances such as urinal, lavatory and slope sink shall be installed as indicated on the Plans. Exposed surfaces to be tile wainscoating complete with fitting accessories required as practiced in this specialty trade.
- e) Squat Bowl(s) shall be vitreous china, wash down with integral foot treads, pail flush type. Color, make and type to be approved by the designing Architect.
- f) Grease Traps shall be made of cast bronze with detachable cover and mounting accessories.

## **6. Roof Drains, Overflow Pipes and Steel Grating**

- a) The Contractor shall provide fit and or install necessary drains with strainers where shown on the Plans.
- b) Each drain with strainer shall fit the size of the corresponding downspout or roof leader over which it is to be installed and in conformity with the following schedule.

## **7. Fire Protection System**

- a) Fire house cabinets shall be locally available consisting of 38 mm diameter valve hose rack 30 mm nipple rubber hose cable with square nozzle 38 mm diameter brass, chromium plated.
- b) Fire Standpipe system shall consists of risers and hose valves. Standpipe shall be extra strong black iron.

- c) Valves to be used shall be high grade cast bronze mounted with standing 79.40 kg. working pressure.
- d) Fire extinguisher shall be portable, suitable for Class A, B, C, fires, mounted inside the cabinet. Cabinet shall be full flush mounting door with aluminum trim for glass plate.
- e) Frame and box shall be made of gauge 14 galvanized iron sheets with white interior and red exterior baked enamel finish over the well prepared primer.
- f) Cabinet shall be wall mounted and size to accommodate the defined components.
- g) Yard hydrant where shown on the Plans shall match the Integrated Fire Department requirements. Outlet shall be single 63 mm diameter gate valves with chain connected caps.
- h) Built in appliances such as urinal, lavatory and slope sink shall be installed as indicated on the Plans. Exposed surfaces to be tile wainscoting complete with fitting accessories required as practiced in this specialty trade.

## **B. CONSTRUCTION REQUIREMENTS**

The Contactor before any installation work is started shall carefully examine the Plans and investigate actual structural and finishing work condition affecting all his work. Where actual condition necessitates a rearrangement of the approved pipe layout, the Contractor shall prepare Plan(s) of the proposed pipe layout for approval by the supervising Architect or Engineer.

### **1. Installation of Soil, Waste, Drain and Vent Pipes**

- a) **Soil Pipe** – all soil and drainage pipes shall be sloped at 2% or 2 cm. per 1.0 meter run but in no case flatter than one (1%) percent.
- b) **Horizontal lines** shall be supported by well secured heavy strap hangers.
- c) **Vertical lines** shall be secured strongly by hooks to the building frame a suitable brackets or chairs shall be provided at the floor from which they start.
- d) All main **Vertical Soil and Waste Stacks** shall be extended full size to and above the roof line to act as vents, except otherwise indicated on the Plans.
- e) **Vent Pipes** in roof spaces shall be run as close as possible to underside of roof with horizontal piping slope down to stacks without forming traps. Vertical vent pipes may be connected into one main vent riser above the highest vented fixtures.
- f) Where an end or circuit vent pipe from any fixtures is connected to a vent line serving other fixtures, the connections shall be at least 120 cm. above the floor on which the fixtures are located.

- g) Horizontal waste line receiving the discharge from two or more fixtures shall be provided with end vents unless separate venting of fixtures is note 1 on the Plan.
- h) All changes in pipe sizes such as soil and waste lines shall be made with reducing fittings or recessed reducers.
- i) All changes in directions shall be made by appropriate use of 45<sup>0</sup> degrees Y; half Y; long sweep; quarter bends or elbows for soil and waste lines where the change in direction of flow is form the horizontal to the vertical and discharges from water closet.
- j) Where it is becomes necessary to use short radius fittings in other locations, the approval of the supervising Architect or Engineer shall be obtained prior to installation of said fittings.
- k) **Cleanouts** at the bottom of each soil stack, waste stack, interior downspout, and where else indicated shall be the same size as the pipe lines.
- l) **Vent pipes** shall be flashed and made water tight at the roof with ferrule as the pipe lines.
- m) **Trap** – Each fixtures and place of equipment requiring connection to the drainage system except fixtures and continuous water shall be equipped with a trap. Each trap shall be placed as near to the fixtures as possible.

## 2. Water Pipes, Fittings and Connections

- a) The water supply piping shall be extended to all fixtures, outlets, and equipment from the gate valves installed in the branch near the riser.
- b) The cold water system shall be installed with a slope towards a main shutoff valve and drain. Ends of pipe and outlets shall be capped or plugged and left ready for future connections.
- c) All pipes shall be cut accurately to measurements and shall be worked into place without springing or forcing.
- d) All piping above the ground shall be run parallel with the lines of the building unless otherwise indicated on the Plan.
- e) All service pipes, valves and fittings shall be kept at sufficient distance from other work to permit finished covering not less than 12 mm from such work or from finished covering on the different service.
- f) No water piping shall be buried in floors, unless specifically indicated on the Plan. Changes in pipe directions shall be made with reducing fittings.

- g) Pipe drain indicated on the drawings shall consist of 12 mm globe valve with renewable disc and installed at low points on the cold water piping so that all piping shall slope 10 cm in 30 meters.
- h) All pipes to be threaded shall be reamed before threading. All screw joints shall be made with graphite and oil or with an approved graphite compound applied to make threads only.

### **3. Fire Standpipe System**

Fire standpipe system shall consist of risers and hose valve. Standpipe shall be extra strong black iron. Valves shall be of high grade cast bronze quality approved by the Underwriter's specifications.

### **4. Valves and Hose Bibs**

Valves shall be provided in all supplied fixture as herein specified.

- a) The cold water connections to the domestic hot water heater shall be provided with gate valves and the return circulation connection shall have gate and check valve.
- b) All connection to domestic hot water heaters shall be equipped with unions between valve and tanks.
- c) Valve shall not be installed with its stem below the horizontal elevation. All valves shall be gate valves unless otherwise indicated on the plans.
- d) Valves up to 50 mm diameter shall be threaded ends, rough bodies and finish trimmings, except those on chromium plated brass pipe.
- e) Valves 63 mm in diameter and larger shall have iron bodies, brass mounted and shall have either screws or flange ends.
- f) Hose bibs shall be made of brass with 12 mm inlet threads hexagonal shoulders and 19 mm male.

## **5. Fixtures, Equipment and Fastening**

- a) All fixtures and equipment shall be supported and fastened in a safe and satisfactory workmanship as practiced.
- b) All fixtures required to be wall mounted on concrete or concrete hollow block wall shall be fasten with brass expansion bolts.
- c) Expansion bolts shall be 6 mm diameter with 20 mm threads into solid concrete, fitted with tubing sleeves of proper length to acquire extreme rigidity.
- d) Inserts shall be rigidly secured, anchored and properly concealed and flushed into the walls.
- e) Bolts and nuts shall be horizontally mounted and exposed. It shall be provided with washers and chromium plate finish.

## **6. Pipe Hangers, Inserts and Supports**

- a) Pipe hangers shall be wrought iron malleable iron pipe spaced not more than 1.50 meters apart for horizontal runs of pipe.
- b) Chains, straps, perforated turn-buckles or other approved means of adjustment except the turn-turn-buckles may be omitted for hangers on soil or waste lines or individual toilet rooms to maintain stacks when spaced does not permit.
- c) Trapeze hangers may be used in lieu of separate hangers on pipe running parallel to and closed to each other.
- d) Inserts shall be cast steel of the type to receive machine bolt or nut after installation. Insert permit adjustment of the bolts in one horizontal direction and shall be installed before the pouring of concrete.
- e) Wrought iron clamps or collars to support vertical runs of pipe shall be spaced not more than 3.0 m apart or as indicated on the Plan.

## **7. Plates and Flashing**

- a) Plates to cover exposed pipes passing through floor finished, walls, or ceiling shall be fitted with chromium plated cast brass plates or chromium plated cast iron or steel plates on ferrous pipes.
- b) Plates shall be large enough to cover and close the hole around the area where pipes passes. It shall be properly installed to insure permanence.

- c) Roof areas penetrated by vent pipes shall be rendered water tight by lead sheet flashing and counter flashing. It shall extend at least 15 cm. above the pipe and 30 cm along the roof.

## **8. Protection and Cleaning**

- a) During installation of fixtures and accessories and until final acceptance, fixtures shall not be protected with strippable plastic or other approved means to maintain fixtures in perfect conditions.
- b) All exposed metal surface shall be polished clean and free of grease, dirt or other foreign materials after the completion.
- c) Upon completion, thoroughly clean all fixtures and accessories to leave the work in a polished condition.

## **9. Inspection, Warranty Test and Disinfection**

All pipes, fittings, traps, fixtures, appurtenances and equipment of the plumbing and drainage system shall be inspected and approved by the supervising Architect or Engineer to assure compliance with all requirements of applicable Codes and Regulations referred to in these Specifications.

## **10. Drainage System Test**

- a) The entire drainage and venting system shall have all the necessary openings which can be plugged to permit the entire system to be filled with water to the level of the highest stack vent above the roof.
- b) The system shall hold this water for a full 30 minutes during which time there shall be no drop greater than 10 mm.
- c) Where only a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system.
- d) If and when the Architect or Engineer decides that an additional test is needed, such as air to smoke test on the drainage system, the Contractor shall perform such test without any additional cost.

## **11. Water Test on System**

- a) Upon completion of the rough-in and before connecting fixtures, the entire cold water piping system shall be tested at a hydrostatic pressure 1-1/2 times the expected working pressure in the system during operation and remained tight and leak proofed.

- b) Where piping system is to be concealed, the piping system shall be separately in manner similar to that described for the entire system and in the presence of the Architect or Engineer or his duly designated representative.

## **12. Defective Work**

- a) All defective work, materials replaced and tested will be repeated until satisfactory performance is attained.
- b) Any material replaced for the satisfactory performance of the system made shall be at the expense of the Contractor.
- c) Caulking of screwed joints or holes will not be permitted.

## **13. Disinfection**

- a) The entire water distribution system shall be thoroughly flushed and treated with Chlorine before it is operated for human use.
- b) Disinfection materials shall be liquid Chlorine or Hypochlorite and shall be introduced in a manner approved as practiced for water distribution system.
- c) After contact period of not less than 16 hours, heavily chlorinated water shall be flushed from the system with portable water.
- d) Valves for the water distribution system shall be opened and closed several times during the 16 hours Chlorination treatment period.

## **14. As-Built Drawings**

- a) Upon completion of the work, the Contractor shall submit two sets of prints with all As-Built changes shown on the drawings in a neat workmanship manner.

Such points shall show changes or actual installation and conditions of the plumbing system in comparison with the original drawings.



## ***Section VIII. Bill of Quantities***

***Bill of Quantities, Summary of Bid Proposal & Detailed Estimate should be submitted together with the Annex “C” Form 4 to 7.***

***Non-attachment of Annex “C” Form 1 to 7 shall be automatically disqualified.***

{ATTACH COMPANY LETTERHEAD/LOGO}

**BILL OF QUANTITIES**

PROJECT: **VIRAC AIRPORT DEVELOPMENT PROJECT (Reblocking of Taxiway, Construction of CHB Fence, and Construction of Drainage System)**

LOCATION: **Virac Airport, Virac, Catanduanes**

ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE (Pesos)	AMOUNT (Pesos)
<b>SPL 01</b>	<b>MOBILIZATION/ DEMOBILIZATION</b>	<b>1.00</b>	<b>LOT</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>SPL 02</b>	<b>CONSTRUCTION SAFETY ABD HEALTH PROGRAM</b>	<b>1.00</b>	<b>LOT</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>SPL 03</b>	<b>PROVISION OF SURVEYING INSTRUMENT</b>	<b>1.00</b>	<b>LOT</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>SPL 04</b>	<b>TEMPORARY FACILITY</b>	<b>1.00</b>	<b>LOT</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				

<b>A.</b>	<b>REBLOCKING OF TAXIWAY</b>				
<b>1.00</b>	<b>SITWORKS</b>	<b>2,464.09</b>	<b>SQ.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>200</b>	<b>AGGREGATE SUBBASE COURSE</b>	<b>739.23</b>	<b>CU.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>311</b>	<b>PORTLAND CEMENT CONCRETE PAVEMENT</b>	<b>2,464.09</b>	<b>SQ.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>B.</b>	<b>CONSTRUCTION OF CHB PERIMETER FENCE</b>				
<b>2.00</b>	<b>SITWORKS</b>	<b>754.00</b>	<b>SQ.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>3.00</b>	<b>CONCRETE WORKS</b>	<b>157.92</b>	<b>CU.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>4.00</b>	<b>MASONRY WORKS</b>	<b>1,538.24</b>	<b>SQ.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>5.00</b>	<b>STEEL WORKS</b>	<b>3,892.32</b>	<b>KGS.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				

<b>C.</b>	<b>CONSTRUCTION OF DRAINAGE SYSTEM</b>				
<b>6.00</b>	<b>SITEWORKS</b>	<b>2,701.07</b>	<b>SQ.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				
<b>7.00</b>	<b>CONCRETE WORKS</b>	<b>1,825.31</b>	<b>CU.M.</b>		
	Pesos _____ Amount in Words _____ _____ and _____ centavos				

Signature: \_\_\_\_\_  
 Printed Name: \_\_\_\_\_  
 Position: \_\_\_\_\_  
 Name Company: \_\_\_\_\_  
 Date: \_\_\_\_\_

{ATTACH COMPANY LETTERHEAD/LOGO}

**SUMMARY OF BID PROPOSAL**

PROJECT: VIRAC AIRPORT DEVELOPMENT PROJECT (Reblocking of Taxiway, Construction of CHB Fence, and Construction of Drainage System)  
 LOCATION: Virac Airport, Virac, Catanduanes

ITEM NO.	QTY	UNIT	ESTIMATED DIRECT COST	MARK-UPS IN PERCENT		TOTAL MARK-UP		V.A.T.	TOTAL INDIRECT COST	TOTAL COST	UNIT COST
				OCM	PROFIT	%	VALUE				
[1]	[3]	[4]	[5]	[6]	[7]	[8]	[9] [5] x [8]	[10] 5%([5] + [9])	[11] [9] + [10]	[12] [5] + [11]	[13] [12] / [3]
<b>SPL 01</b>	<b>1.00</b>	<b>lot</b>									
<b>SPL 02</b>	<b>1.00</b>	<b>lot</b>									
<b>SPL 03</b>	<b>1.00</b>	<b>lot</b>									
<b>SPL 03</b>	<b>1.00</b>	<b>lot</b>									
<b>A.</b>											
1.00	2,464.09	sq.m.									
200	739.23	cu.m.									
311	2,464.09	sq.m.									
<b>B.</b>											
2.00	754.00	sq.m.									
3.00	157.92	cu.m.									
4.00	1,538.24	sq.m.									
5.00	3,892.32	kgs.									
<b>C.</b>											
6.00	2,701.07	sq.m.									
7.00	1,825.31	cu.m.									

Submitted by:

Signature: \_\_\_\_\_  
 Printed Name: \_\_\_\_\_  
 Position: \_\_\_\_\_  
 Name Company: \_\_\_\_\_  
 Date: \_\_\_\_\_

NAME OF PROJECT : <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>					
DESCRIPTION : Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System					
LOCATION : Virac Airport Virac, Catanduanes					
SUBJECT : <b>BILL OF QUANTITIES AND COST ESTIMATES</b>				QUANTITY	UNIT
				1.00	lot
ITEM	DESCRIPTION				
<b>SPL 01</b>	<b>MOBILIZATION AND DEMOBILIZATION</b>				
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY	TOTAL RATE
	Backhoe with Excavator (1.09cu.m.)	1.00	lot		
	Backhoe with Pavement Breaker (0.80cu.m.)				
	Payloader (1.5cu.m.)				
	Dump Truck (12cu.yd.)				
	Motorized Grader, (140 hp), G710A				
	Vibratory Single Smooth Drum Roller (10MT, SD100DC)				
	Water Truck (16,000 L)				
	Improvised Batching Plant				
	Transit Mixer (5 cu.m. per trip)				
	Concrete Vibrator				
	Concrete Screeder (5.5HP)				
	Concrete Saw (7.5 hp, 14" Blade Ø)				
	Power Generator Set				
	Welding Machine, (Electric Driven/DC Output)				
	Oxy-Acetylene Cutting Torch/Welding Outfit				
	One Bagger Concrete Mixer				
				<i>Equipment Cost</i>	.....
<b>C</b>	<b>MOBILIZATION AND DEMOBILIZATION EQUIPMENT COST</b>				
<b>D</b>	<b>MOBILIZATION AND DEMOBILIZATION DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% of TDC)					
2. CONTRACTOR's PROFIT (0% of TDC)					
<b>E. TOTAL OCM &amp; PROFIT</b>					
<b>F. VALUE ADDED TAX, (VAT)</b> 5.0% of (D + E)					
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT : <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>					
DESCRIPTION : Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System					
LOCATION : Virac Airport Virac, Catanduanes					
SUBJECT : <b>BILL OF QUANTITIES AND COST ESTIMATES</b>				QUANTITY	UNIT
				1.00	lot
ITEM	DESCRIPTION				
<b>SPL 02</b>	<b>CONSTRUCTION SAFETY AND HEALTH PROGRAM</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Safety Shoes	10.00	pairs		
	Working Gloves	10.00	pairs		
	Rain Coats	10.00	pcs.		
	Safety Hats	10.00	pcs.		
	Reflectorized Safety Vest	10.00	pcs.		
	First-aid Kit	5.00	sets		
			<i>Material Cost</i>	.....	
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Safety Officer	1.00	255		
	Safety Aide	1.00	255		
			<i>Labor Cost</i>	.....	
<b>A</b>	<b>CONSTRUCTION SAFETY AND HEALTH PROGRAM MATERIAL COST</b>				
<b>B</b>	<b>CONSTRUCTION SAFETY AND HEALTH PROGRAM LABOR CSOT</b>				
<b>D</b>	<b>CONSTRUCTION SAFETY AND HEALTH PROGRAM DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% of TDC)					
2. CONTRACTOR's PROFIT (0% of TDC)					
<b>E. TOTAL OCM &amp; PROFIT</b>					
<b>F. VALUE ADDED TAX, (VAT) 5.0% of (D + E)</b>					
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				1.00	lot
ITEM	DESCRIPTION				
<b>SPL 03</b>	<b>PROVISION OF SURVEYING INSTRUMENT</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Total Station with AutoHeight and complete accessories (see Scope of Work for detailed specifications)	1.00	unit		
	GNSS Instrument including Base, Rover RTK and complete accessories (see Scope of Work for detailed specifications)	1.00	unit		
				<i>Material Cost</i>	.....
<b>A</b>	<b>PROVISION OF SURVEYING INSTRUMENT MATERIAL COST</b>				
<b>D</b>	<b>PROVISION OF SURVEYING INSTRUMENT DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% of TDC)					
2. CONTRACTOR'S PROFIT (0% of TDC)					
<b>E. TOTAL OCM &amp; PROFIT</b>					
<b>F. VALUE ADDED TAX, (VAT)</b> 5.0% of (D + E)					
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_



NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				1.00	lot
ITEM	DESCRIPTION				
<b>SPL 04</b>	<b>TEMPORARY FACILITY</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Staff House, fully furnished, including electric and water utilities	9.00	months		
			<i>Material Cost</i>	.....	
<b>C</b>	<b>Equipment</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Service Vehicle (4x2 Pick-up, 2.5 liter diesel engine, latest model, with power windows and locks, and built-in 360deg. camera view) <i>(Rent to own)</i>	1.00	unit		
			<i>Equipment Cost</i>	.....	
<b>A</b>	<b>TEMPORARY FACILITY MATERIAL COST</b>				
<b>C</b>	<b>TEMPORARY FACILITY EQUIPMENT COST</b>				
<b>D</b>	<b>TEMPORARY FACILITY DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% of TDC)					
2. CONTRACTOR'S PROFIT (0% of TDC)					
<b>E. TOTAL OCM &amp; PROFIT</b>					
<b>F. VALUE ADDED TAX, (VAT) 5.0% of (D + E)</b>					
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				2,464.09	sq.m.
ITEM	DESCRIPTION				
<b>A.</b>	<b>REBLOCKING OF TAXIWAYS</b>				
<b>1.00</b>	<b>SITWORKS</b>				
	<i>Activity which requires labor only</i>				
	Excavation (Breaking and disposal of damaged concrete) <b>(616.02 cu.m.)</b>				
	Removal of existing aggregate base course <b>(739.23 cu.m.)</b>				
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Construction Foreman				
	Skilled Laborer				
	Common Laborer				
			<i>Labor Cost</i>	.....	
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY	TOTAL RATE
	Backhoe with Pavement Breaker (0.80cu.m.)				
	Payloader (1.5cu.m.)				
	Dump Truck (12cu.yd.)				
			<i>Equipment Cost</i>	.....	
<b>B</b>	<b>SITWORKS LABOR COST</b>				
<b>C</b>	<b>SITWORKS EQUIPMENT COST</b>				
<b>D</b>	<b>SITWORKS DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost			
2. CONTRACTOR'S PROFIT (0% - 8% of TDC)		of Estimated Direct Cost			
<b>E. TOTAL OCM &amp; PROFIT</b>		of D			
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)		
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT : <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>					
DESCRIPTION : Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System					
LOCATION : Virac Airport Virac, Catanduanes					
SUBJECT : <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT		
		739.23	cu.m.		
ITEM	DESCRIPTION				
<b>A.</b>	<b>REBLOCKING OF TAXIWAY</b>				
<b>200</b>	<b>AGGREGATE SUBBASE COURSE</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Aggregate Subbase Course (Delivered on Site)		cu.m.	.....	
			<i>Material Cost</i>	.....	
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Construction Foreman				
	Skilled Laborer				
	Common Laborer				
				<i>Labor Cost</i>	.....
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY	TOTAL RATE
	Motorized Road Grader (140 HP, G710A)				
	Vibratory Single Smooth Drum Roller (10MT, SD100DC)				
	Water Truck/ Pump (16,000 L)				
				<i>Equipment Cost</i>	.....
<b>A</b>	<b>AGGREGATE SUBBASE COURSE MATERIAL COST</b>				
<b>B</b>	<b>AGGREGATE SUBBASE COURSE LABOR COST</b>				
<b>C</b>	<b>AGGREGATE SUBBASE COURSE EQUIPMENT COST</b>				
<b>D</b>	<b>AGGREGATE SUBBASE COURSE DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost			
2. CONTRACTOR'S PROFIT (0% - 8% of TDC)		of Estimated Direct Cost			
<b>E. TOTAL OCM &amp; PROFIT</b>		of D			
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)		
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

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Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT : <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>				
DESCRIPTION : Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System				
LOCATION : Virac Airport Virac, Catanduanes				
SUBJECT : <b>BILL OF QUANTITIES AND COST ESTIMATES</b>			QUANTITY	UNIT
			2,464.09	sq.m.
ITEM	DESCRIPTION			
<b>A.</b>	<b>REBLOCKING OF TAXIWAY</b>	<b>2,464.09</b>	<b>sq.m.</b>	
<b>311</b>	<b>PORTLAND CEMENT CONCRETE PAVEMENT</b>			
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST
	Portland Cement (40kg per bag)		bags	
	Sand		cu.m.	
	Gravel (3/4")		cu.m.	
	25mmØ Plain Round Bar, 6 meters		pcs.	
	10mmØ DRSB, 6 meters		pcs.	
	#16 G.I. Tie Wire		kg.	
	Joint Sealant		tins	
	Backer Rod (22.5mmØ x 3.5m)		pcs.	
	Grease/ Tar		L	
	Red Oxide Paint		L	
	Steel Forms (0.25m width)		m	
	Form oil		L	
	Paint Brush 2"		pcs.	
	Manual Bar Cutter		units	
			<i>Material Cost</i>	.....
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY
	Construction Foreman			
	Skilled Laborer			
	Common Laborer			
			<i>Labor Cost</i>	.....
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY
	Improvised Batching Plant			
	Transit Mixer (5 cu.m. per trip)			
	Concrete Vibrator			
	Water Truck/Pump (16,000 gal)			
	Concrete Screeder (5.5HP)			
	Concrete Saw (7.5 hp, 14" Blade Ø)			
	Payloader (1.50cu.m.)			
			<i>Equipment Cost</i>	.....
<b>A</b>	<b>PORTLAND CEMENT CONCRETE PAVEMENT MATERIAL COST</b>			
<b>B</b>	<b>PORTLAND CEMENT CONCRETE PAVEMENT LABOR COST</b>			
<b>C</b>	<b>PORTLAND CEMENT CONCRETE PAVEMENT EQUIPMENT COST</b>			
<b>D</b>	<b>PORTLAND CEMENT CONCRETE PAVEMENT DIRECT COST</b>			
<b>INDIRECT COSTS</b>				
1. OCM (0% - 12% of TDC)				of Estimated Direct Cost
2. CONTRACTOR'S PROFIT (0% - 8% of TDC)				of Estimated Direct Cost
<b>E. TOTAL OCM &amp; PROFIT</b>				of D
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)	
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>				
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>				
<b>TOTAL ESTIMATED COST ( D + G ), P</b>				
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>				

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				754.00	sq.m.
ITEM	DESCRIPTION				
<b>B.</b>	<b>CONSTRUCTION OF CHB PERIMETER FENCE (76.00 bays)</b>				
<b>2.00</b>	<b>SITEWORKS</b>				
	<i>Activities which require labor only</i>				
	Excavation ( <b>791.70 cu.m.</b> )				
	Backfill ( <b>684.57 cu.m</b> )				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Gravel (3/4")		cu.m.		
			<i>Material Cost</i>	.....	
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Construction Foreman				
	Common Laborer				
			<i>Labor Cost</i>	.....	
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY	TOTAL RATE
	Backhoe with Excavator (1.09cu.m.)				
	Dump Truck (12 cu.yd.)				
			<i>Equipment Cost</i>	.....	
<b>A</b>	<b>SITEWORKS MATERIAL COST</b>				
<b>B</b>	<b>SITEWORKS LABOR COST</b>				
<b>C</b>	<b>SITEWORKS EQUIPMENT COST</b>				
<b>D</b>	<b>SITEWORKS DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost			
2. CONTRACTOR'S PROFIT (0% - 8% of TDC)		of Estimated Direct Cost			
<b>E. TOTAL OCM &amp; PROFIT</b>		of D			
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)		
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				157.92	cu.m.
ITEM	DESCRIPTION				
<b>B.</b>	<b>CONSTRUCTION OF CHB PERIMETER FENCE (76.00 bays)</b>				
<b>3.00</b>	<b>CONCRETE WORKS</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Portland Cement (40kg per bag)		bags		
	Sand		cu.m.		
	Gravel (3/4")		cu.m.		
	12mmØ DRSB, 6 meters		pcs.		
	10mmØ DRSB, 6 meters		pcs.		
	#16 G.I. Tie Wire		kgs.		
	1/2" x 4' x 8' Ordinary Plywood		pcs.		
	2" x 3" Form Lumber		bd.ft.		
	Assorted CWN		kgs.		
	Manual Bar Cutter		units		
	<i>Material Cost</i>			.....	
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Construction Foreman				
	Skilled Laborer				
	Common Laborer				
	<i>Labor Cost</i>			.....	
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY	TOTAL RATE
	One Bagger Concrete Mixer				
	Concrete Vibrator				
	<i>Equipment Cost</i>			.....	
<b>A</b>	<b>CONCRETE WORKS MATERIAL COST</b>				
<b>B</b>	<b>CONCRETE WORKS LABOR COST</b>				
<b>C</b>	<b>CONCRETE WORKS EQUIPMENT COST</b>				
<b>D</b>	<b>CONCRETE WORKS DIRECT COST</b>				
<b>E C T C O S T S</b>					
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost			
2. CONTRACTOR's PROFIT (0% - 8% of TDC)		of Estimated Direct Cost			
<b>E. TOTAL OCM &amp; PROFIT</b>		of D			
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)		
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				1,538.24	sq.m.
ITEM	DESCRIPTION				
<b>B.</b>	<b>CONSTRUCTION OF CHB PERIMETER FENCE (76.00 bays)</b>				
<b>4.00</b>	<b>MASONRY WORKS</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	6" Nonbearing CHB		pcs.		
	Portland Cement (40kg per bag)		bags		
	Sand		cu.m.		
	12mmØ DRSB, 6 meters		pcs.		
	10mmØ DRSB, 6 meters		pcs.		
	#16 G.I. Tie Wire		kgs.		
			<i>Material Cost</i>	.....	
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Construction Foreman				
	Skilled Laborer				
	Common Laborer				
			<i>Labor Cost</i>	.....	
<b>A</b>	<b>MASONRY WORKS MATERIAL COST</b>				
<b>B</b>	<b>MASONRY WORKS LABOR COST</b>				
<b>D</b>	<b>MASONRY WORKS DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost			
2. CONTRACTOR's PROFIT (0% - 8% of TDC)		of Estimated Direct Cost			
<b>E. TOTAL OCM &amp; PROFIT</b>		of D			
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)		
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				3,892.32	kgs.
ITEM	DESCRIPTION				
<b>B.</b>	<b>CONSTRUCTION OF CHB PERIMETER FENCE (76.00 bays)</b>				
<b>5.00</b>	<b>STEEL WORKS</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	2.7mm thk. Barbed Wire (135m per roll, 30kg)		rolls		
	50mmØ X 6m G.I. Pipe, Schedule 40		pcs.		
	50mmØ G.I. End cap		pcs.		
	10mmØ DRSB, 6 meters		pcs.		
	Welding rod E6011		kgs.		
	Oxygen		cyl.		
	Acetylene		cyl.		
	Red Oxide Paint		L		
	Epoxy Paint Reducer		gals		
	Epoxy Top Coat		gals		
	Paint Brush 2" with tray		pcs.		
			<i>Material Cost</i>	.....	
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Construction Foreman				
	Skilled Laborer				
	Common Laborer				
			<i>Labor Cost</i>	.....	
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY	TOTAL RATE
	Power Generator Set				
	Welding Machine, (Electric Driven/DC Output)				
	Oxy-Acetylene Cutting Torch/Welding Outfit				
			<i>Equipment Cost</i>	.....	
<b>A</b>	<b>STEEL WORKS MATERIAL COST</b>				
<b>B</b>	<b>STEEL WORKS LABOR COST</b>				
<b>C</b>	<b>STEEL WORKS EQUIPMENT COST</b>				
<b>D</b>	<b>STEEL WORKS DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost			
2. CONTRACTOR'S PROFIT (0% - 8% of TDC)		of Estimated Direct Cost			
<b>E. TOTAL OCM &amp; PROFIT</b>		of D			
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)		
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_



NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>		
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System		
LOCATION		: Virac Airport Virac, Catanduanes		
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY 2,701.07
				UNIT sq.m.
ITEM	DESCRIPTION			
<b>C.</b>	<b>CONSTRUCTION OF DRAINAGE SYSTEM (Airside) (1,689.00 li.m.)</b>			
<b>6.00</b>	<b>SITWORKS</b> <i>Activity which requires labor only</i> Excavation ( <b>4,051.61 cu.m.</b> )			
<b>A</b>	<b>Materials</b> Gravel (3/4")	QTY	UNIT	UNIT COST
			cu.m.	
			<i>Material Cost</i>	.....
<b>B</b>	<b>Labor</b> Construction Foreman Common Laborer	MANPOWER	DUR(days)	RATE/DAY
			<i>Labor Cost</i>	.....
<b>C</b>	<b>Equipment</b> Backhoe with Excavator (1.09cu.m.) Dump Truck (11.50 cu.m. capacity)	QTY	DUR(days)	RATE/DAY
			<i>Equipment Cost</i>	.....
<b>A</b>	<b>SITWORKS MATERIAL COST</b>			
<b>B</b>	<b>SITWORKS LABOR COST</b>			
<b>C</b>	<b>SITWORKS EQUIPMENT COST</b>			
<b>D</b>	<b>SITWORKS DIRECT COST</b>			
<b>INDIRECT COSTS</b>				
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost		
2. CONTRACTOR'S PROFIT (0% - 8% of TDC)		of Estimated Direct Cost		
<b>E. TOTAL OCM &amp; PROFIT</b>		of D		
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)	
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>				
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>				
<b>TOTAL ESTIMATED COST ( D + G ), P</b>				
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>				

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

NAME OF PROJECT		: <b>VIRAC AIRPORT DEVELOPMENT PROJECT</b>			
DESCRIPTION		: Reblocking of Taxiway, Construction of CHB Perimeter Fence and Construction of Drainage System			
LOCATION		: Virac Airport Virac, Catanduanes			
SUBJECT		: <b>BILL OF QUANTITIES AND COST ESTIMATES</b>		QUANTITY	UNIT
				1,825.31	cu.m.
ITEM	DESCRIPTION				
<b>C.</b>	<b>CONSTRUCTION OF DRAINAGE SYSTEM (Airside) (1,689.00 li.m.)</b>				
<b>7.00</b>	<b>CONCRETE WORKS</b>				
<b>A</b>	<b>Materials</b>	QTY	UNIT	UNIT COST	TOTAL AMOUNT
	Portland Cement (40kg per bag)		bags		
	Sand		cu.m.		
	Gravel (3/4")		cu.m.		
	1/2" x 4' x 8' Ordinary Plywood		pcs.		
	2" x 3" Form Lumber		bd.ft.		
	Assorted CWN		kgs.		
	12mmØ DRSB, 6 meters		pcs.		
	10mmØ DRSB, 6 meters		pcs.		
	#16 G.I. Tie Wire		kgs.		
	38mmØ x 3m PVC Pipe		pcs.		
	Manual Bar Cutter		units		
			<i>Material Cost</i>	.....	
<b>B</b>	<b>Labor</b>	MANPOWER	DUR(days)	RATE/DAY	TOTAL RATE
	Construction Foreman				
	Skilled Laborer				
	Common Laborer				
			<i>Labor Cost</i>	.....	
<b>C</b>	<b>Equipment</b>	QTY	DUR(days)	RATE/DAY	TOTAL RATE
	Improvised Batching Plant				
	Transit Mixer (5 cu.m. per trip)				
	Concrete Vibrator				
	Water Truck (16,000 L)				
	Concrete Screeder (5.5HP)				
	Concrete Saw (7.5 hp, 14" Blade Ø)				
	Payloader (1.50cu.m.)				
			<i>Equipment Cost</i>	.....	
<b>A</b>	<b>CONCRETE WORKS MATERIAL COST</b>				
<b>B</b>	<b>CONCRETE WORKS LABOR COST</b>				
<b>C</b>	<b>CONCRETE WORKS EQUIPMENT COST</b>				
<b>D</b>	<b>CONCRETE WORKS DIRECT COST</b>				
<b>INDIRECT COSTS</b>					
1. OCM (0% - 12% of TDC)		of Estimated Direct Cost			
2. CONTRACTOR'S PROFIT (0% - 8% of TDC)		of Estimated Direct Cost			
<b>E. TOTAL OCM &amp; PROFIT</b>		of D			
<b>F. VALUE ADDED TAX, (VAT)</b>		5.0%	of (D + E)		
<b>G. TOTAL ESTIMATED INDIRECT COST ( F + E ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

**SUBMITTED BY:**

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_

*Section IX. Checklist of Technical and Financial Documents*

# Checklist of Technical and Financial Documents

## I. TECHNICAL COMPONENT ENVELOPE

### *Class “A” Documents*

#### Legal Documents

- (a) Valid PhilGEPS Registration Certificate (Platinum Membership) (all pages) in accordance with Section 8.5.2 of the IRR;

#### Technical Documents

- (b) Statement of the prospective bidder of all its ongoing government and private contracts, including contracts awarded but not yet started, if any, whether similar or not similar in nature and complexity to the contract to be bid (*Annex “A” Form 1*); **and**
- (c) Statement of the bidder’s Single Largest Completed Contract (SLCC) similar to the contract to be bid, except under conditions provided under the rules (*Annex “A” Form 2*); **and**
- (d) Special PCAB License in case of Joint Ventures **and** registration for the type and cost of the contract to be bid; **and**
- (e) Original copy of Bid Security. If in the form of a Surety Bond, submit also a certification issued by the Insurance Commission **or** original copy of Notarized Bid Securing Declaration (*Annex “B” Form 1*); **and**
- (f) Project Requirements, which shall include the following:
  - a. Organizational chart for the contract to be bid (*Annex “B” Form 2*);
  - b. List of contractor’s key personnel (*e.g.*, Project Manager, Project Engineers, Materials Engineers, and Foremen), to be assigned to the contract to be bid, with their complete qualification and experience data (*Annex “B” Form 3*);
  - c. List of contractor’s major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership or certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be (*Annex “B” Form 5*); **and**
- (g) Original duly signed Omnibus Sworn Statement (OSS) **and** if applicable, Original Notarized Secretary’s Certificate in case of a corporation, partnership, or cooperative; or Original Special Power of Attorney of all members of the joint venture giving full power and authority to its officer to sign the OSS and do acts to represent the Bidder (*Annex “B” Form 6*).

#### Financial Documents

- (h) The prospective bidder’s computation of Net Financial Contracting Capacity (NFCC).

### *Class “B” Documents*

- (i) If applicable, duly signed joint venture agreement (JVA) in accordance with RA No. 4566 and its IRR in case the joint venture is already in existence **or** duly notarized statements from all the potential joint venture partners stating that they will enter into and abide by the provisions of the JVA in the instance that the bid is successful.

## **II. FINANCIAL COMPONENT ENVELOPE**

- (j) Original of duly signed and accomplished Financial Bid Form; **and**

### *Other documentary requirements under RA No. 9184*

- (k) Original of duly signed Bid Prices in the Bill of Quantities (*Annex “C” Form 1*) **and**
- (l) Summary of Bid Proposal (*Annex “C” Form 2*); **and**
- (m) Bill of Materials & Cost Estimates (*Annex “C” Form 3*); **and**
- (n) Summary Sheet indicating the Unit Prices of Construction Materials (*Annex “C” Form 4*); **and**
- (o) Summary Sheet indicating the Unit Prices of Labor (*Annex “C” Form 5*); **and**
- (p) Summary Sheet indicating the Unit Prices of Equipment (*Annex “C” Form 6*) **and**
- (q) Cash Flow by Quarter and Payment Schedule (*Annex “C” Form 7*).

# *Bidding Forms*

# *Other Bidding Forms*

## (ANNEX “A”)

ANNEX “A” FORM 1 .....	STATEMENT OF ALL ON-GOING CONTRACTS
ANNEX “A” FORM 2 .....	STATEMENT OF SINGLE LARGEST COMPLETED CONTRACT





{ATTACH COMPANY LETTERHEAD/LOGO}

Statement of single largest COMPLETED contract similar to the contract to be bid

Name of Project: \_\_\_\_\_

Location of Project: \_\_\_\_\_

Name of Company : \_\_\_\_\_

Address of Company: \_\_\_\_\_

Name of Contract	a. Owner's Name b. Address c. Telephone No.	Nature of Work	Contractor's Role		Contract Amount at Award	a. Date Awarded b. Date of Contract c. Contract Duration d. Date Started e. Date Completed
			Description	%		

Submitted by: \_\_\_\_\_  
(Print Name & Signature)

Designation: \_\_\_\_\_

Date: \_\_\_\_\_

## *Other Bidding Forms*

### (ANNEX “B”)

Annex “B” Form 1 .....	<b>Bid Securing Declaration</b>
Annex “B” Form 2 .....	<b>Organizational Chart of Contract to be Bid</b>
Annex “B” Form 3 .....	<b>Qualification of Key Personnel Proposed to be Assigned in the Project</b>
Annex “B” Form 4a .....	<b>Contractor's Letter-Certificate to Procuring Entity</b>
Annex “B” Form 4b .....	<b>Key Personnel's Certificate of Employment</b>
Annex “B” Form 4c .....	<b>Key Personnel (Format of Bio-Data)</b>
Annex “B” Form 6 .....	<b>List of Equipment Owned or Leased and/or under Purchased</b>
Annex “B” Form 7 .....	<b>Omnibus Sworn Statement</b>
Annex “B” Form 8 .....	<b>Performance Securing Declaration (Revised)</b>

**Bid Securing Declaration Form**

*[shall be submitted with the Bid if bidder opts to provide this form of bid security]*

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REPUBLIC OF THE PHILIPPINES)  
CITY OF \_\_\_\_\_) S.S.

**BID SECURING DECLARATION**  
**Project Identification No.: [Insert number]**

To: *[Insert name and address of the Procuring Entity]*

I/We, the undersigned, declare that:

1. I/We understand that, according to your conditions, bids must be supported by a Bid Security, which may be in the form of a Bid Securing Declaration.
2. I/We accept that: (a) I/we will be automatically disqualified from bidding for any procurement contract with any procuring entity for a period of two (2) years upon receipt of your Blacklisting Order; and, (b) I/we will pay the applicable fine provided under Section 6 of the Guidelines on the Use of Bid Securing Declaration, within fifteen (15) days from receipt of the written demand by the procuring entity for the commission of acts resulting to the enforcement of the bid securing declaration under Sections 23.1(b), 34.2, 40.1 and 69.1, except 69.1(f), of the IRR of RA No. 9184; without prejudice to other legal action the government may undertake.
3. I/We understand that this Bid Securing Declaration shall cease to be valid on the following circumstances:
  - a. Upon expiration of the bid validity period, or any extension thereof pursuant to your request;
  - b. I am/we are declared ineligible or post-disqualified upon receipt of your notice to such effect, and (i) I/we failed to timely file a request for reconsideration or (ii) I/we filed a waiver to avail of said right; and
  - c. I am/we are declared the bidder with the Lowest Calculated Responsive Bid, and I/we have furnished the performance security and signed the Contract.

IN WITNESS WHEREOF, I/We have hereunto set my/our hand/s this \_\_\_\_ day of *[month]* *[year]* at *[place of execution]*.

*[Insert NAME OF BIDDER OR ITS AUTHORIZED  
REPRESENTATIVE]*

*[Insert signatory's legal capacity]*

Affiant

**[Jurat]**

*[Format shall be based on the latest Rules on Notarial Practice]*

**CAAP-BAC-SF Annex “B” Form 2**

**Contractor’s Organizational Chart for the Project**

Submit Copy of the Organizational Chart that the Contractor intends to use to execute the contract if awarded to him. Indicate in the chart the names of the Key Engineering Personnel who will be assigned in the Project.

{ATTACH COMPANY LETTERHEAD/LOGO}

Attach the required Proposed Organizational Chart for the Contract as stated above.

Submitted by: \_\_\_\_\_

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

{ATTACH COMPANY LETTERHEAD/LOGO }

*Qualification of Key Personnel Proposed to be Assigned to the Project*

Name of Project: \_\_\_\_\_

Location of Project: \_\_\_\_\_

Name of Company: \_\_\_\_\_

Address of Company: \_\_\_\_\_

	Project Manager/Engineer	Material Engineer	Foreman	Construction Safety and Health Personnel	Other Position deemed required by the Applicant for this project
1. Name					
2. Address					
3. Date of Birth					
4. Employed Since					
5. Experience					
6. Previous Employment					
7. Education					
8. PRC License					

Note: Attached individual PRC License of the (professional) personnel.

Submitted by : \_\_\_\_\_  
(Signature over Printed Name)

Designation : \_\_\_\_\_

Date : \_\_\_\_\_

**CAAP-BAC-SF Annex “B” Form 4a**

{ ATTACH COMPANY LETTERHEAD/LOGO }

Date: \_\_\_\_\_

CAPTAIN EDGARDO G. DIAZ  
Chairman, Bids and Awards Committee  
Civil Aviation Authority of the Philippines  
Mia Road, Pasay City, M.M. 1300  
Tel: 944-2358

Subject: Contractor’s Letter-Certificate to Procuring Entity

Dear Sir:

Supplementing our Organizational Chart for the Contract, we have the honor to submit herewith, and to certify as true and correct, the following pertinent information:

That I/we have engaged the service of (Name of Employee), to be the (Designation) of the (Name of Project), who is a (Profession) with Professional License Certificate No.    issued on \_\_\_\_\_ and who has performed the duties in the construction of the project enumerated in the filled Annex “B” Form 5b.

That (Name of Employee) shall personally perform the duties of the said position in the above-mentioned project, if and when the same is awarded in our favor.

That (Name of Employee) shall employ the best care, skill and ability in performing his duties in accordance with the Contract Agreement, Conditions of Contract, Plans, Specifications, Special Provisions, and other provisions embodied in the proposed contract.

That (Name of Employee) shall be personally present at the jobsite all the time to supervise the phase of the construction work pertaining to his assignment as (Designation).

That (Name of Employee) is aware that he shall be authorized to handle only one contract at a time.

That in order to guarantee that (Name of Employee) shall perform his duties properly and be personally present in the Job Site, he is hereby required to secure a certificate of appearance for the Procuring Entity's Engineer at the end of every month.

That in the event that I/we elect or choose to replace (Name of Employee) with another Engineer, the Procuring Entity will be accordingly notified by us in writing at least twenty one (21) days before making replacement. We will submit to the Procuring Entity, for prior approval, the name of the proposed new (Designation), his qualification, experience, list of projects undertaken and other relevant information.

That any willful violation on my/our part of the herein conditions may prejudice my/our standing as a reliable contractor in future bidding of the Procuring Entity.

Very truly yours,

---

(Authorized Representative of Bidder)

CONCURRED BY:

---

(Name of Engineer)



**CAAP-BAC-SF Annex "B" Form 4b**

{ ATTACH COMPANY LETTERHEAD/LOGO }

Date: \_\_\_\_\_

CAPTAIN EDGARDO G. DIAZ  
Chairman, Bids and Awards Committee  
Civil Aviation Authority of the Philippines  
Mia Road, Pasay City, M.M. 1300  
Tel: 944-2358

Subject: Key Personnel's Certificate of Employment

Dear Sir:

I am (Name of Employee) a License \_\_\_\_\_ Engineer with Professional License No. \_\_\_\_\_ issued on (Date of Issuance) at (Place of Issuance).

I hereby certify that (Name of Bidder) has engaged my services as (Designation) for (Name of the Project), if awarded in their favor.

As (Designation), I know I will have to stay in the job site all the time to supervise and managed the Contract works to the best of my ability, and aware that I am authorized to handle only one (1) contract at a time.

I do not allow the use of my name for the purpose of enabling the above-mentioned Contractor to qualify for the Contract without any firm commitment on my part to assume the post of (Designation).

As (Designation), I supervised the following completed projects similar to the contract under bidding:

NAME OF PROJECT	OWNER	COST	DATE COMPLETED
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

At present, I am supervising the following project:

NAME OF PROJECT	OWNER	COST	DATE COMPLETION
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

In case of my separation for any reason whatsoever from the above-mentioned Contractor, I shall notify the \_\_\_\_\_ (*Name of the Procuring Entity*) at least twenty one (21) days before the effective date of my separation.

\_\_\_\_\_  
(Signature of Engineer)

SUBSCRIBED AND SWORN to before me this \_\_\_ day of \_\_\_\_\_, 20\_\_\_  
affiant exhibiting to me his/her Residence Certificate No. \_\_\_\_\_ issued  
on \_\_\_\_\_ at \_\_\_\_\_, Philippines.

\_\_\_\_\_  
Notary Public

Until 31 December 20.  
PRT No.: \_\_\_\_\_  
Issued at: \_\_\_\_\_  
Issued on: \_\_\_\_\_  
TIN No.: \_\_\_\_\_

Doc. No. \_\_\_\_\_  
Page No. \_\_\_\_\_  
Book No. \_\_\_\_\_  
Series of \_\_\_\_\_

**CAAP-BAC-SF Annex "B" Form 4c**

**KEY PERSONNEL**  
(FORMAT OF BIO-DATA)

Give the detailed information of the following personnel who are scheduled to be assigned as full-time field staff for the project. Fill up a form for each person.

1. Authorized Managing Officer / Representative: \_\_\_\_\_

2. Sustained Technical Employee:

Name: \_\_\_\_\_

Date of Birth: \_\_\_\_\_

Nationality: \_\_\_\_\_

Education and Degrees: \_\_\_\_\_

Specialty: \_\_\_\_\_

Registration: \_\_\_\_\_

Length of Service with the Firm:

\_\_\_\_\_ Year From \_\_\_\_\_ (months) \_\_\_\_\_ (year)

To \_\_\_\_\_ (months) \_\_\_\_\_ (year)

Years of Experience:

If Item 7 is less than ten (10) years, give name and length of service with previous employers for a ten (10) year period (attached additional sheet/s, if necessary):

Name and Address of Employer Length of Service

\_\_\_\_\_ year(s) from \_\_\_\_\_ to \_\_\_\_\_

\_\_\_\_\_ year(s) from \_\_\_\_\_ to \_\_\_\_\_

\_\_\_\_\_ year(s) from \_\_\_\_\_ to \_\_\_\_\_

Experience:

This should cover the past ten (10) years of experience. (Attached as many pages as necessary to show involvement of personnel in projects using the format below).

- a. Name: \_\_\_\_\_
- b. Name and Address of Owner: \_\_\_\_\_  
\_\_\_\_\_
- c. Name and Address of the Owner's Engineer (Consultant): \_\_\_\_\_  
\_\_\_\_\_
- d. Indicate the Features of Project (particulars of the project components and any other particular interest connected with the project): \_\_\_\_\_  
\_\_\_\_\_
- e. Contract Amount Expressed in Philippine Currency: \_\_\_\_\_
- f. Position: \_\_\_\_\_
- g. Structures for which the employee was responsible: \_\_\_\_\_  
\_\_\_\_\_
- h. Assignment Period:       from \_\_\_\_\_(months)       \_\_\_\_\_ (years)  
  to       \_\_\_\_\_ (months)       \_\_\_\_\_ (years)

\_\_\_\_\_  
Name and Signature of Employee

It is hereby certified that the above personnel can be assigned to the \_\_\_\_\_ Project, if the contract is awarded to our company.

\_\_\_\_\_  
(Place and Date)

\_\_\_\_\_  
(The Authorized Representative)

*List of Equipment, Owned or Leased and/or under Purchased Agreements, Pledge to the Proposed Project*

Name of Project: \_\_\_\_\_  
 Location of Project: \_\_\_\_\_

Name of Company: \_\_\_\_\_  
 Address of Company: \_\_\_\_\_

Description	Model/Year	Capacity/ Performance/ Size	Plate No.	Motor No./ Body No.	Location	Condition	Proof of Ownership/ Lessor or Vendor
<b>A. Owned</b>							
I.							
II.							
III.							
IV.							
V.							
<b>B. Leased</b>							
I.							
II.							
III.							
IV.							
V.							
<b>C. Under Purchased Agreement</b>							
I.							
II.							
III.							
IV.							
V.							

Submitted by : \_\_\_\_\_  
 Designation : \_\_\_\_\_  
 Date : \_\_\_\_\_  
 (Signature over Printed Name)

Omnibus Sworn Statement (Revised)

*[shall be submitted with the Bid]*

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REPUBLIC OF THE PHILIPPINES )

CITY/MUNICIPALITY OF \_\_\_\_\_ ) S.S.

**AFFIDAVIT**

I, [Name of Affiant], of legal age, [Civil Status], [Nationality], and residing at [Address of Affiant], after having been duly sworn in accordance with law, do hereby depose and state that:

1. *[Select one, delete the other:]*

*[If a sole proprietorship:]* I am the sole proprietor or authorized representative of [Name of Bidder] with office address at [address of Bidder];

*[If a partnership, corporation, cooperative, or joint venture:]* I am the duly authorized and designated representative of [Name of Bidder] with office address at [address of Bidder];

2. *[Select one, delete the other:]*

*[If a sole proprietorship:]* As the owner and sole proprietor, or authorized representative of [Name of Bidder], I have full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached duly notarized Special Power of Attorney;

*[If a partnership, corporation, cooperative, or joint venture:]* I am granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached [state title of attached document showing proof of authorization (e.g., duly notarized Secretary’s Certificate, Board/Partnership Resolution, or Special Power of Attorney, whichever is applicable)];

3. [Name of Bidder] is not “blacklisted” or barred from bidding by the Government of the Philippines or any of its agencies, offices, corporations, or Local Government Units, foreign government/foreign or international financing institution whose blacklisting rules have been recognized by the Government Procurement Policy Board, **by itself or by relation, membership, association, affiliation, or controlling interest with another blacklisted person or entity as defined and provided for in the Uniform Guidelines on Blacklisting;**

4. Each of the documents submitted in satisfaction of the bidding requirements is an authentic

copy of the original, complete, and all statements and information provided therein are true and correct;

5. [Name of Bidder] is authorizing the Head of the Procuring Entity or its duly authorized representative(s) to verify all the documents submitted;

6. *[Select one, delete the rest:]*

*[If a sole proprietorship:]* The owner or sole proprietor is not related to the Head of the Procuring Entity, Procurement Agent if engaged, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

*[If a partnership or cooperative:]* None of the officers and members of *[Name of Bidder]* is related to the Head of the Procuring Entity, Procurement Agent if engaged, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

*[If a corporation or joint venture:]* None of the officers, directors, and controlling stockholders of *[Name of Bidder]* is related to the Head of the Procuring Entity, Procurement Agent if engaged, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

7. *[Name of Bidder]* complies with existing labor laws and standards; and
8. *[Name of Bidder]* is aware of and has undertaken the responsibilities as a Bidder in compliance with the Philippine Bidding Documents, which includes:
  - a. Carefully examining all of the Bidding Documents;
  - b. Acknowledging all conditions, local or otherwise, affecting the implementation of the Contract;
  - c. Making an estimate of the facilities available and needed for the contract to be bid, if any; and
  - d. Inquiring or securing Supplemental/Bid Bulletin(s) issued for the *[Name of the Project]*.
9. *[Name of Bidder]* did not give or pay directly or indirectly, any commission, amount, fee, or any form of consideration, pecuniary or otherwise, to any person or official, personnel or representative of the government in relation to any procurement project or activity.

10. **In case advance payment was made or given, failure to perform or deliver any of the obligations and undertakings in the contract shall be sufficient grounds to constitute criminal liability for Swindling (Estafa) or the commission of fraud with unfaithfulness or abuse of confidence through misappropriating or converting any payment received by a person or entity under an obligation involving the duty to**

**deliver certain goods or services, to the prejudice of the public and the government of the Philippines pursuant to Article 315 of Act No. 3815 s. 1930, as amended, or the Revised Penal Code.**

**IN WITNESS WHEREOF**, I have hereunto set my hand this \_\_\_ day of \_\_\_, 20\_\_ at \_\_\_\_\_, Philippines.

*[Insert NAME OF BIDDER OR ITS AUTHORIZED REPRESENTATIVE]*

*[Insert signatory's legal capacity]*

Affiant

**[Jurat]**

*[Format shall be based on the latest Rules on Notarial Practice]*



# Bid Form for the Procurement of Infrastructure Projects

*[shall be submitted with the Bid]*

---

## BID FORM

Date : \_\_\_\_\_

Project Identification No. : \_\_\_\_\_

To: *[name and address of Procuring Entity]*

Having examined the Philippine Bidding Documents (PBDs) including the Supplemental or Bid Bulletin Numbers *[insert numbers]*, the receipt of which is hereby duly acknowledged, we, the undersigned, declare that:

- a. We have no reservation to the PBDs, including the Supplemental or Bid Bulletins, for the Procurement Project: *[insert name of contract]*;
- b. We offer to execute the Works for this Contract in accordance with the PBDs;
- c. The total price of our Bid in words and figures, excluding any discounts offered below is: *[insert information]*;
- d. The discounts offered and the methodology for their application are: *[insert information]*;
- e. The total bid price includes the cost of all taxes, such as, but not limited to: *[specify the applicable taxes, e.g. (i) value added tax (VAT), (ii) income tax, (iii) local taxes, and (iv) other fiscal levies and duties]*, which are itemized herein and reflected in the detailed estimates,
- f. Our Bid shall be valid within the a period stated in the PBDs, and it shall remain binding upon us at any time before the expiration of that period;
- g. If our Bid is accepted, we commit to obtain a Performance Security in the amount of *[insert percentage amount]* percent of the Contract Price for the due performance of the Contract, or a Performance Securing Declaration in lieu of the the allowable forms of Performance Security, subject to the terms and conditions of issued GPPB guidelines<sup>2</sup> for this purpose;

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<sup>2</sup> currently based on GPPB Resolution No. 09-2020

- h. We are not participating, as Bidders, in more than one Bid in this bidding process, other than alternative offers in accordance with the Bidding Documents;
- i. We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal Contract is prepared and executed; and
- j. We understand that you are not bound to accept the Lowest Calculated Bid or any other Bid that you may receive.
- k. We likewise certify/confirm that the undersigned, is the duly authorized representative of the bidder, and granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for the [Name of Project] of the [Name of the Procuring Entity].
- l. We acknowledge that failure to sign each and every page of this Bid Form, including the Bill of Quantities, shall be a ground for the rejection of our bid.

Name: \_\_\_\_\_

Legal Capacity: \_\_\_\_\_

Signature: \_\_\_\_\_

Duly authorized to sign the Bid for and behalf of: \_\_\_\_\_

Date: \_\_\_\_\_

# *Other Bidding Forms*

## (ANNEX "C")

<b>Annex "C" Form 1</b>	<b>.....Bill of Quantities</b>
<b>Annex "C" Form 2</b>	<b>.....Summary of Bid Proposal</b>
<b>Annex "C" Form 3</b>	<b>..... Bill of Materials &amp; Cost Estimates</b>
<b>Annex "C" Form 4</b>	<b>..... Summary of Unit Prices of Materials</b>
<b>Annex "C" Form 5</b>	<b>..... Summary of Unit Prices of Labor</b>
<b>Annex "C" Form 6</b>	<b>.....Summary of Unit Prices of Equipment</b>
<b>Annex "C" Form 7</b>	<b>.....Cash Flow by Quarter and Payment Schedule</b>

# CAAP-BAC-SF Annex "C" Form 1

{ATTACH COMPANY LETTERHEAD/LOGO}

## BILL OF QUANTITIES

PROJECT: \_\_\_\_\_

LOCATION: \_\_\_\_\_

ITEM NO.	DESCRIPTION	QTY	UNIT	UNIT PRICE (Pesos)	AMOUNT (Pesos)
	Pesos _____ Amount in Words _____ _____ _____ and _____ _____ centavos				
	Pesos _____ Amount in Words _____ _____ _____ and _____ _____ centavos				
	Pesos _____ Amount in Words _____ _____ _____ and _____ _____ centavos				
	Pesos _____ Amount in Words _____ _____ _____ and _____ _____ centavos				

TOTAL BID AMOUNT (Php) \_\_\_\_\_

TOTAL BID AMOUNT IN WORDS \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature: \_\_\_\_\_  
 Printed Name: \_\_\_\_\_  
 Position: \_\_\_\_\_  
 Name Company: \_\_\_\_\_  
 Date: \_\_\_\_\_



## CAAP-BAC-SF Annex “C” Form 3

{ATTACH COMPANY LETTERHEAD/LOGO}

BILL OF MATERIALS & COST ESTIMATES					
NAME OF PROJECT		:			
DESCRIPTION		:			
LOCATION		:			
				QUANTITY	UNIT
ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
<b>A</b>	<b>TOTAL MATERIAL COST</b>				
<b>B</b>	<b>TOTAL LABOR COST</b>				
<b>C</b>	<b>TOTAL EQUIPMENT COST</b>				
<b>D</b>	<b>TOTAL DIRECT COST</b>				
INDIRECT COSTS					
1. OCM (0% of TDC)					
2. CONTRACTOR'S PROFIT (0% of TDC)					
<b>E. TOTAL OCM &amp; CONTRACTOR'S PROFIT</b>					
<b>F. VALUE ADDED TAX, (VAT)</b> 5.0%					
<b>G. TOTAL ESTIMATED INDIRECT COST ( E + F ), P</b>					
<b>H. TOTAL ESTIMATED UNIT INDIRECT COST ( G / Quantity), P/Unit</b>					
<b>TOTAL ESTIMATED COST ( D + G ), P</b>					
<b>TOTAL ESTIMATED UNIT COST (Total Estimated Cost / Quantity), P/Unit</b>					

SUBMITTED BY:

Signature: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Position: \_\_\_\_\_

Name Company: \_\_\_\_\_

Date: \_\_\_\_\_









{ATTACH COMPANY LETTERHEAD/LOGO}

Name of Project : \_\_\_\_\_

Location of Project : \_\_\_\_\_

*CASH FLOW BY QUARTER AND PAYMENT SCHEDULE*

PARTICULAR	% W	1ST QUARTER	2ND QUARTER	3RD QUARTER	4TH QUARTER
ACCOMPLISHMENT					
CASH FLOW					
CUMULATIVE ACCOMPLISHMENT					
CUMULATIVE CASH FLOW					

Submitted by: \_\_\_\_\_

\_\_\_\_\_  
Name of the Representative of the Bidder

\_\_\_\_\_  
Position

\_\_\_\_\_  
Name of the Company

\_\_\_\_\_  
Date

*Other Bidding Forms*

(ANNEX “D”)

Annex “D” Form 1 ..... Authority of Signatory (Secretary's Certificate)

## CAAP-BAC-SF Annex “D” Form 1

### AUTHORITY OF SIGNATORY (SECRETARY’S CERTIFICATE)

I,, a duly elected and qualified Corporate Secretary of (Name of the Bidder), a corporation duly organized and existing under and by virtue of the law of the, DO HEREBY CERTIFY, that:

I am familiar with the facts herein certified and duly authorized to certify the same;

At the regular meeting of the Board of Directors of the said Corporation duly convened and held on at which meeting a quorum was present and acting throughout, the following resolutions were approve, and the same have been annulled, revoked and amended in any way whatever and are in full force and effect on the date hereof:

RESOLVED, that (Name of Bidder) be, as it hereby is, authorized to participate in the bidding of (Name of the Project) by the (Name of the Procuring Entity); and in that if awarded the project shall enter into a contract with the (Name of the Procuring Entity) and in connection therewith hereby appoints (Name of Representative), acting as duly authorized and designated representatives of (Name of the Bidder), and granted full power and authority to do, execute and perform any and all acts necessary and/or to represent (Name of the Bidder) in the bidding as fully and effectively as the (Name of the Bidder) might do if personally present with full power of substitution and revocation and hereby satisfying and confirming all that my said representative shall lawfully do or cause to be done by virtue hereof;

RESOLVED FERTHER THAT, the Board hereby authorized its President to:

- a. execute a waiver of jurisdiction whereby the (Name of the Bidder) hereby submits itself to the jurisdiction of the Philippine government and hereby waives its right to question the jurisdiction of the Philippine court;
- b. execute a waiver that the (Name of the Bidder) shall not seek and obtain writ of injunctions or prohibition or restraining order against the CAAP or any other agency in connection with this Project to prevent and restrain the bidding procedures related thereto, the negotiating and award of a contract to a successful bidder, and the carrying out of the awarded project.

WITNESS the signature of the undersigned as such officer of the said this.

—

(Corporate Secretary)

SUBSCRIBED AND SWORN to before me this day of, 20affiant exhibited to me  
his/her Community Tax Certificate No. \_\_\_\_\_ issued on \_\_\_\_\_  
\_\_\_\_\_ at, Philippines.

Notary Public

Until 31 December 20 \_\_\_\_\_

PRT No.: \_\_\_\_\_

Issued at: \_\_\_\_\_

Issued on: \_\_\_\_\_

TIN No.: \_\_\_\_\_

Doc. No. \_\_\_\_\_

Page No.: \_\_\_\_\_

Book No.: \_\_\_\_\_

Series of \_\_\_\_\_

