



Republic of the Philippines

Tourism Infrastructure & Enterprise Zone Authority

PROJECT SPECIFICATIONS

I. GENERAL CONDITIONS

The work to be undertaken shall include the furnishing of labor, materials, tools and equipment for the following:

Project : **TOURIST REST AREA**

Location : Magsaysay Boulevard, Real Street, Tacloban, Leyte

A. Scope of Work

The construction work must be executed strictly in accordance with the plans and specifications. The following principal items of work shall include but not limited to the following:

1. General Requirements
2. Earthworks
3. Concrete Works
4. Roofing Works
5. Masonry Works
6. Doors and Windows
7. Finishing Works
8. Painting Works
9. Plumbing Works
10. Electrical Works
11. Landscaping

The construction procedures shall be done in accordance with the DPWH Standard Specifications, and in full compliance with the approved plans and specifications.

All items not specifically mentioned in the specifications or noted on the plans but which are obviously necessary for the completion of the work shall be included.

II. FIELD OFFICE FOR THE ENGINEER

The Contractor shall construct field offices, laboratories and living quarters, including all the necessary air conditioning, electricity, water, and drainage and security services for the use of the Engineer and his staff for 24 h a day or provide the same on a rental basis until end of Contract. All offices, laboratories and living quarters shall be ready for occupancy and use by the Engineer immediately for rental basis; or if to be constructed within 3 months upon the commencement of the Works. Their location and final plan shall require the approval of the Engineer prior to the start of construction. It is the intent of this Specification to locate the field offices, laboratories and living quarters in Government owned lots so that the use by the Government of these facilities can be maximized even after the completion of the project. In the selection of construction site of the Engineer's Building/s and Recreational Facilities, first priority shall be on DPWH property lots, second is public school lots, third is public health lots, fourth is Local Government Unit (LGU) lots, and then other government

property lots. The proximity, access road and cost of development of the proposed site shall be properly evaluated. The construction of building/s and recreational facilities on property other than DPWH-owned shall be covered by an approved Memorandum of Agreement (MOA) between the concerned parties. The Implementing Office shall be allowed to use the other government lots for the construction of the field offices, laboratories and living quarters free of charge until the completion of the project and shall be turned over without cost, effective after completion or acceptance of the project from the Contractor. The transfer/turnover shall be supported by applicable document and shall be a requirement to support the issuance of project Completion Certificate of the Contractor. If no Government lot is available, and these structures are to be erected on private property, it is the responsibility of the Contractor to make the necessary arrangements for the negotiation with the property owner for the lease/rental of the lot. The field office shall display an appropriate sign that identifies the DPWH facility to the public in locating it. The field offices, laboratories, and living quarters, the improvements thereon, including appurtenances shall be removed or transferred if so required in the Contract upon completion of the project. All facilities provided by the Contractor shall be within the 5 km radius or preferably near the job site, where necessary and shall conform to the best standard for the required types. On completion of the Contract, the facilities provided by the Contractor including utilities shall revert to the Government including office equipment, apparatus, pieces of furniture, laboratory equipment, etc. unless otherwise specified in the Contract documents. The Contractor shall be responsible for raising the ground (if necessary), grading and drainage in the vicinity of each facility with suitable access 2 walkways, seeding and sodding of the ground around as directed and approved by the Engineer. Also, the Contractor shall construct a parking area for the compound near the buildings and a satisfactory access road to the parking areas. The whole area of the Engineer's compound shall be fenced with barbed wire (or equivalent) with necessary gates as directed by the Engineer.

III. OCCUPATIONAL SAFETY AND HEALTH

A. Description

This Item covers the implementation of construction safety in all stages of project procurement (design, estimate, construction and maintenance), requirements, provisions, and instructions for the guidance of the Engineer.

B. Construction Safety and Health Program (CSHP)

Every construction project shall have a suitable and approved Construction Safety and Health Program (CSHP) as required in all projects regardless of amount, funding source and mode of implementation which shall comply with the minimum safety and health requirements as specified in the Occupational Safety and Health Standards.

The required CSHP shall include but not limited to the following:

1. Composition of the Safety and Health personnel responsible for the proper implementation of CSHP.
2. Specific safety policies which shall be undertaken in the construction site, including frequency of and persons responsible for conducting toolbox and gang meetings.
3. Penalties and sanctions for violations of the CSHP.

4. Frequency, content and persons responsible for orienting, instructing and training all workers at the site with regard to the CSHP which they operate.

5. The manner of disposing waste arising from the construction.

C. Construction Safety and Health Personnel

At the start of the project, the Contractor shall establish construction safety and health committee composed of the following personnel:

1. Project Manager/Project Engineer

The Contractor must provide for a full time Project Manager/Project Engineer, who is tasked to observe, monitor and supervise if the enforcement of CSHP was being followed strictly and correctly.

2. General Safety Engineer/Officer

The General Contractor (under which are a number of subcontractors) must provide for a full time Officer, who shall be assigned as the CSHP to oversee and enforce full time the overall management of the CSHP. Furthermore, deployment of part-time or full-time safety man depending on the number of workers shall be complied in accordance with Rule 1033 of the Occupational Safety and Health Standards (OSHS) and applicable provisions under 26 Section 7.0, Safety Personnel of Department of Labor and Employment (DOLE) Department Order (D.O.) 13 Series of 1998.

3. Health Personnel

The Contractor's health personnel may be full time or part time certified first-aiders, registered nurse, physician and dentist depending on the total number of workers conforms to Section 8.0, Emergency Occupational Health Personnel and Facilities or DOLE D.O. 13, Series of 1998.

4. Safety Practitioner

The Contractor must provide a full time or part time Safety Practitioner, who shall initiate and supervise safety and health training for employees.

D. Supervision, Control and Monitoring

Overall supervision, control and monitoring of the implementation of CSHP for projects undertaken by administration/contracts shall be under the Implementing Office.

E. Construction Safety and Health Training

The Construction Safety and Health Seminar (COSH) shall be a 40 h training course as prescribed by the DOLE-Bureau of Working Conditions (BWC). All safety personnel involved in a construction project shall be required to complete such basic training course. The Contractor shall provide continuing construction safety and health training to all technical personnel under his organization. Continuing training shall be a minimum of 16 h per year for every full-time safety personnel.

F. Construction Safety and Health Reports

The Contractor shall be required to submit a monthly construction safety and health report to the DOLE Regional Office concerned. The report shall include a monthly summary of all safety and health committee meeting agreements, a

summary of all accident investigations/reports and periodic hazards assessment with the corresponding remedial measures/action for each hazard. In case of any dangerous occurrence or major accident resulting in death or permanent total disability, the concerned employer shall initially notify the DOLE Regional Office within 24 h from occurrence. After the conduct of investigation by the concerned construction safety and health officer, the employer shall report all permanent total disabilities to DOLE Regional Office on or before the 20th of the month following the date of occurrence of accident using the DOLE Employer's Work Accident Illness Report.

G. Personal Protective Equipment (PPE) and Devices

The Contractor shall furnish his workers with protective equipment for eyes, face, hands and feet, lifeline, safety belt/harness, protective shields and 27 barriers whenever necessary by reason of the hazardous work process or environment, chemical or radiological or other mechanical irritants of hazards capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical agent. All PPE and Devices shall be in accordance with the requirements of the OSHS and should pass the test conducted and/or standards set by the Occupational Safety and Health Center (OSHC). For General Construction Work, the required basic PPEs for all workers shall be safety helmet, safety gloves and safety shoes. Specialty PPEs shall be provided to workers in addition to or in lieu of the corresponding basic PPE as the work or activity requires. Workers within the construction project site shall be required to wear the necessary PPE at all times. Moreover, all other persons who are either authorized or allowed to be at a construction site shall also wear appropriate PPEs. Construction workers who are working from unguarded surfaces 6 m or more above water or ground, temporary or permanent floor platform, scaffold or where they are exposed to the possibility of falls hazardous to life or limb, must be provided with safety harnesses and life lines.

H. Signages and Barricades

Construction Safety Signages and Barricades shall be provided as a precaution and to advise the workers and the general public of the hazards existing in the worksite. Signages shall be posted in prominent positions at strategic location and as far as practicable, be in the language understandable to most of the workers employed. For road projects, it shall be in accordance with the DPWH Road Works Safety Manual.

I. Facilities

The Contractor shall provide the following welfare facilities in order to ensure humane working conditions:

1. Adequate supply of safe drinking water.
2. Adequate sanitary and washing facilities.
3. Suitable living accommodation for workers and as may be applicable for their families.
4. Separate sanitary, washing and sleeping facilities for men and women workers.

The services of a full time registered nurse, a full time physician, a dentist and an infirmary or emergency hospital with one (1) bed capacity when the number of

employees exceed 300. In addition, there should be one (1) bed capacity for every 100 employees in excess of three hundred (300).

J. Costing

The cost for the implementation of construction safety and health shall be integrated to the overall project cost under the prescribed pay item. In consideration of the cost involved of providing the necessary safety equipment and manpower for an effective implementation of safety in the workplace, the following shall be used as a guide:

1. Personal Protective Equipment (PPE) The PPEs shall be provided by the Contractor, and its cost shall be duly quantified and made part of the overall cost of Item B.7, Occupational Safety and Health. The use of PPEs shall conform to Section B.7.7 Personal Protective Equipment and Devices.

2. Clinical Materials and Equipment Clinical materials and equipment such as medicines, beds and linens, other related accessories shall be to the account of the Contractor implementing the project and shall be in accordance with the Occupational Health Services of OSHS.

3. Signages and Barricades The quantities and cost of signages and barricades necessary for a specific item of work shall be quantified and made part of that particular pay item of work. For general signages and barricades not included in specific pay item of work but necessary for promoting safety in and around the construction site, the quantities and cost shall be a separate pay item and included in the overall cost of Item B.7, Occupational Safety and Health.

4. Facilities Facilities such as portable toilets, waste disposal, sanitary and washing facilities, convenient dwellings and office, adequate lighting, and other facilities related to construction safety and health shall be in accordance with OSHS and previously approved guidelines of the Department and shall be quantified and the cost thereof be made a separate pay item under "Facilities for the Engineers" and "Other General Requirements" as required in the DPWH Standard Specifications.

5. Salaries Labor cost for the medical and safety personnel actually assigned in the field shall be included in the overall cost of Item B.7, Occupational Safety and Health. Manpower cost shall be established based on the cost of labor in the area. Duration of employment shall be based on project duration of the particular project. 29

6. Safety and Health Training Cost associated for the provision of basic and continuing construction safety and health training to all safety and technical personnel shall be made part of the indirect/overhead cost of the project.

K. Safety on Construction during Heavy Equipment Operation

In relation to heavy equipment operation in all construction sites, the following are required in the different phases of the project.

1. Pre-Construction

The Contractor must ensure that appropriate certification is obtained from DOLE duly accredited organizations for the following:

a. All heavy equipment operators assigned at the project site must be tested and certified in accordance with a standard trade test prescribed by Technical Education and Skills Development Authority (TESDA) in coordination with its accredited organization.

b. All heavy equipment must be tested and certified in accordance with the standards prepared by DOLE or its recognized organization prior to commissioning of said equipment.

2. During Construction

The Contractor must ensure that the following conditions are met or complied with:

a. For mobilization or transport of heavy equipment, load restrictions, height and width clearances as imposed by Department for all roads and bridges to be utilized during transport. Moreover, only duly certified operators are allowed to load and unload heavy equipment to low-bed trailer.

b. During erection and set-up of heavy equipment, existing hazards must be avoided. Standard checklist of steps and procedures must be observed. List of necessary equipment, tools and materials must be available and properly utilized.

c. In the interest of accident prevention, duly certified mechanics and operators shall conduct daily routine inspection of all heavy equipment deployed at the site in accordance with standards set by TESDA in coordination with the Association of Construction Equipment Lessors (ASCEL, Inc.). During routine inspection all equipment which do not comply with the minimum safety standards for equipment certification shall be immediately removed from the work site for restoration or repair until they meet said standards or requirements. The Contractor and the equipment owner shall maintain a separate logbook for data on maintenance, repair, tests and inspections for each heavy 30 equipment. Such logbook shall be used as a necessary reference during the conduct of equipment inspection.

3. Post Operation and Post Construction

The procedures for dismantling and demobilization of heavy equipment shall follow the same requirements as listed under provisions of mobilization or transport of heavy equipment and erection and set-up of heavy equipment.

L. Violations and Penalties

The Contractor if found violating safety rules and regulations shall be meted sanctions depending on the gravity of offense. The amount corresponding to non-compliance shall be deducted from the Contractor's billing.

M. Method of Measurement

Occupational safety and health program shall be measured by lump sum.

N. Basis of Payment

The accepted quantities, measured as prescribed in Section B.7.13, Method of Measurement shall be paid for at the Contract Unit Price or for the pay item listed below that is included in the Bill of Quantities. Such payment shall be full compensation for furnishing, maintaining and ensuring against loss of the equipment/tools.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
B.7	Occupational Safety and Health	Lump Sum

IV. PROJECT BILLBOARD / SIGNBOARD

A. General Requirements

The Contractor shall install two (2) Project Information Signs at/or near the beginning and the end of the project or upon the discretion of the Engineer.

The signs are prescribed separately by the Department of Public Works and Highways (DPWH) for government Infrastructure projects to inform the public of the implementation of the project and to advise the road users of the ongoing construction.

The new billboard design layout, dimension and letter sizes on white background, shall be depicted on a standard billboard measuring 1,220 mm x 2,440 mm using 12.50 mm thick marine plywood or tarpaulin of the same size posted on 5 mm marine plywood. For each building project, the billboard shall be installed in front of the project site. For each road/bridge/flood control project, two billboards shall be installed, one (1) at the beginning and one (1) at the end of the project.

For road projects with a length of 10 km or more, additional billboard shall also be installed at every five (5) km interval. Name(s) and/or picture(s) of any personages should not appear in the billboard.

No other billboards shall be allowed to be installed 100 m before and 100 m after all DPWH projects and in-between the project limits or within the road right-of-way. DPWH contractors shall not be allowed to place names of politicians or carry political billboard on their equipment.

The Contractor shall also install one (1) Billboard as per COA Circular No. 2013-004, Information and Publicity on Programs/Projects/Activities of Government Agencies.

Upon completion of the work, all signs installed shall be removed from the site.

B. Method of Measurement

All expenses incurred in the furnishing/installation/illumination of the signs shall be paid for each billboard installed.

C. Basis of Payment

The accepted quantities, measured as provided in Section B.5.2, Method of Measurement shall be paid for at the Contract Unit Price of the Pay Item listed below that is included in the Bill of Quantities. The unit price shall cover full compensation for all related services necessary to complete the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
B.5	Project Billboard / Signboard	Each

V. TEMPORARY FENCE (TEMPORARY ENCLOSURE)

A. Description

This work shall consist of furnishing, erecting, moving and removing chain link fencing and metal gates of the size and type shown on top of the temporary concrete barriers, and in sidewalk and roadway areas at the locations, as shown on the Plans or as directed by the Engineer.

B. Material Requirements

a. Barbed Wire

Barbed wire shall conform to the requirements of ASTM A121, Class I, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire. The barbed wire shall consist of two (2) strands of 12.5 gauge wire, twisted with two (2) points, 14 gauge barbs spaced 100 mm apart.

b. Chain Link Fence Fabric

Chain link fence fabric shall be fabricated from ten (10) gauge-galvanized wire conforming to AASHTO M 181, Chain Link Fence, and shall be of the type shown on the Plans. Before ordering the chain link fence fabric, the Contractor shall submit a sample of the material to the Engineer for testing and for approval.

c. Concrete Post

Concrete posts shall be made of Class A concrete in accordance with Item 900, Structural Concrete. The posts shall be cast to a tapered section as shown on the Plans and shall have a smooth surface finish.

d. Steel Post

Steel posts shall be of the sections and length as specified or as shown on the Plans. The posts shall be copper bearing steel and shall conform to the requirements of ASTM A702, Standard Specification for Steel Fence Post, Hot Wrought, for the grade specified.

e. Steel Reinforcement

Steel reinforcement for concrete posts shall be deformed steel bars conforming to the provisions of Item 902, Reinforcing Steel.

f. Hardware

Nuts, bolts, washers and other associated hardware shall be galvanized after fabrication as specified in ASTM A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. Construction Requirements

The Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment. The Contractor shall install fence posts on the concrete barrier in 38 mm diameter, 300 mm deep drilled or formed holes near each end of each section of the barrier. In addition, if the

concrete barrier is furnished in lengths exceeding 3 m, it will be necessary for the Contractor to provide an additional hole at the center of the section to permit the installation of an intermediate post. Line posts, corner and end posts on grade, and gate posts shall be installed in accordance with the Plans. Heights of the posts and fencing shall conform to the dimensions shown on the Plans. At locations where breaks in a run of fencing are required, or at interactions with existing fences, appropriate adjustments in post spacing shall be made to conform to the requirement for the type of closure indicated. When the Plans require that the posts, braces, or anchors be embedded in concrete, the Contractor shall install temporary guys or braces, as may be required to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. Unless otherwise permitted, no materials shall be installed on posts or strain placed on guys or bracing set in concrete until seven days elapsed from the time of placing the concrete. All posts shall be set vertically and to the required grade and alignment. Cutting off the tops of the posts will be allowed only with the approval of the Engineer and under conditions specified by the Engineer. The fence fabric of the size and type required shall be firmly attached to the posts and braces in the manner indicated. All fence fabric shall be stretched taut and installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of fence fabric not less than 50 mm nor more than 150 mm from the ground surface. Grading shall be performed where necessary to provide a neat appearance. Line posts shall be spaced equidistantly in the fence line at the spacing shown on the Plans or as directed by the Engineer. The end, corner, and intermediate posts shall be placed at the locations indicated on the Plans or where directed by the Engineer, and shall be braced as shown on the Plans. When chain-link fence is on a long curve, intermediate posts shall be evenly spaced so that the strain of the fence will not bend the line posts. All end, corner, and intermediate posts shall be set plumb in concrete bases of the depth and diameter shown on the Plans. The Contractor shall have the option of setting the line posts in concrete bases or using methods of driving and anchoring specified by the fence manufacturer and approved by the Engineer.

a. Chain Link Fencing with Top Rail

Posts shall be set so they are equidistant with a maximum of three (3) meters on center.

All top rails shall pass through the base of the post caps and shall form a continuous brace from end to end of each stretch of fence. Top rail lengths shall be joined with sleeve couplings with expansion sleeves provided at 30 m intervals. Top rails shall be securely fastened to end posts by means of approved rail end connectors. Horizontal braces shall be provided at all intermediate posts, midway between the top rail and ground as shown on the Plans.

Diagonal truss rods shall be installed with the horizontal braces as indicated in the Plans.

Fence fabric shall be installed approximately 50 mm above the ground level and securely fastened along the bottom and to all braces, top rails, line and pull posts, at the intervals indicated on the Plans. The fabric shall be secured to all end, corner, and gate posts with stretcher bars fastened to

the posts, with stretcher bands spaced at a maximum of 355 mm and in a manner permitting adjustment of the fabric tension.

If the Contractor selects the option of using pieces, roll-formed sections, the fence fabric shall be integrally woven into the fabric loops on the end, corner, pull and gate posts. The fabric shall be attached to the end, corner and line posts as shown on the Plans.

b. Chain Link with Top Tension Wire

The construction details specified in Chain-Link Fencing with top Rail shall apply with the following modifications:

- i. Top tension wire shall be installed as shown on the Plans or as directed by the Engineer.
- ii. All posts shall be spaced equidistant in the fence line on a maximum of 2.44 m on center, except that a 3 m spacing will be permitted on concrete barriers.
- iii. Additional pull posts shall be placed at locations indicated on the Plans. Brace assemblies shall be installed at each intermediate post as indicated on the Plans or Standard Sheets.

c. Vinyl Coated Chain-link Fencing on Plastic Coated Frame

The construction details specified on Chain-Link Fencing with Top Rail or ChainLink Fencing with Top Tension Wire shall apply with the following addition: If any of the resin-clad material specified under Item that has the protective resin coating is damaged that impairs its effectiveness to prevent corrosion of the base material, the Contractor shall repair such parts by applying one coat of an approved compound of color to match the original material.

d. Fence Gates

The Contractor shall construct metal fence gates of the type and size as indicated on the Plans, and in the location shown or ordered by the Engineer. Upon removal, fence gates shall become the property of the Contractor and shall be removed from the project site.

D. Method Of Measurement

This work under this Item shall be measured by lump sum of temporary fence installed as measured along the top of the fencing, including gates, center to center of end posts erected in place and accepted.

VI. STRUCTURE EXCAVATION

A. Description

This Item shall consist of the necessary excavation for foundation of buildings, culverts, underdrains, and other structures not otherwise provided for in the Specifications. Except as otherwise provided for pipe culverts, the backfilling of completed structures and the disposal of all excavated surplus materials, shall be in accordance with the Plans and this Specification.

This Item shall include necessary diversion of live streams, dewatering, pumping, draining, sheeting, bracing, and the necessary construction of cribs and cofferdams,

and furnishing the materials therefore, and the subsequent removal of cribs and cofferdams and the placing of all necessary backfill.

It shall also include the furnishing and placing of approved foundation fill material to replace unsuitable material encountered below the foundation elevation of structures.

No allowance shall be made for classification of different types of material encountered.

B. Construction Requirements

a. Clearing and Grubbing

Prior to starting excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Item 800, Clearing and Grubbing.

b. Excavation

i. General, All Structures

The Contractor shall notify the Engineer sufficiently in advance at the beginning of any excavation so that cross-sectional elevations and measurements may be taken on the undisturbed ground. The natural ground adjacent to the structure shall not be disturbed without permission of the Engineer.

Trenches or foundation pits for structures or structure footings shall be excavated to the lines and grades or elevations shown on the Plans or as staked by the Engineer. They shall be of sufficient size to permit the placing of structures or structure footings of the full width and length shown. The elevations of the bottoms of footings, as shown on the Plans, shall be considered as approximate only and the Engineer may order, in writing, such changes in dimensions or elevations of footings as may be deemed necessary, to secure a satisfactory foundation. 101 Boulders, logs, and other objectionable materials encountered in excavation shall be removed.

After each excavation is completed, the Contractor shall notify the Engineer to that effect and no footing, bedding material or pipe culvert shall be placed until the Engineer has approved the depth of excavation and the character of the foundation material.

ii. Structures Other than Pipe Culverts

All rock or other hard foundation materials shall be cleaned of all loose materials, and cut to a firm surface, either level, stepped, or serrated as directed by the Engineer. All seams or crevices shall be cleaned and grouted. All loose and disintegrated rocks and thin strata shall be removed. When the footing is to rest on material other than rock, excavation to final grade shall not be made until just before the footing is to be placed. When the foundation material is soft or mucky or otherwise unsuitable, as determined by the Engineer, the Contractor shall remove the unsuitable

material and backfill with approved granular material. This foundation fill shall be placed and compacted in 150 mm layers up to the foundation elevation.

When foundation piles are used, the excavation of each pit shall be completed before the piles are driven and any placing of foundation fill shall be done after the piles are driven. After the driving is completed, all loose and displaced materials shall be removed, leaving a smooth, solid bed to receive the footing.

iii. Pipe Culverts

The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe.

Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 300 mm or 4 mm for each 100 mm of fill over the top of pipe, whichever is greater, but not to exceed three-quarters of the vertical inside diameter of the pipe. The width of the excavation shall be at least 300 mm greater than the horizontal outside diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 150 mm in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, such unstable soil under the pipe and for a width of at least one diameter on each side of the pipe shall be removed to the depth directed by the Engineer and replaced with approved granular foundation fill material properly compacted to provide adequate support for the pipe, unless other special construction methods are called for on the Plans. 102

The foundation surface shall provide a firm foundation of uniform density throughout the length of the culvert and, if directed by the Engineer, shall be cambered in the direction parallel to the pipe centerline.

Where pipe culverts are to be placed in trenches excavated in embankments, the excavation of each trench shall be performed after the embankment has been constructed to a plane parallel to the proposed profile grade and to such height above the bottom of the pipe as shown on the Plans or directed by the Engineer.

c. Utilization of Excavated Materials

All excavated materials, so far as suitable, shall be utilized as backfill or embankment. The surplus materials shall be disposed of in such manner as not to obstruct the stream or otherwise impair the efficiency or

appearance of the structure. No excavated materials shall be deposited at any time so as to endanger the partly finished structure.

d. Trimming Works

The excavation shall conform to the lines, grades, cross sections and dimensions shown on the Plans. The Engineer shall order the removal of any soft spots, debris or organic material exposed when excavated areas shall have been trimmed to finished formation levels. Subgrade in earth shall be trimmed cut to an even surface free of loose material and compact as specified by the Engineer to the density prescribed in in the Plans.

i. Trimming and Finishing of Surfaces

Unless otherwise specified, all areas within the limits of clearing and outside the limits of earthworks shall be graded to an even surface. Ridges shall be trimmed and depressions shall be filled as necessary to produce a surface which will drain freely and is suitable for the operation of tractor mounted mowers. Batters in cut and fill shall be trimmed to shapes shown on drawings. Cut and fill batters shall be trimmed as specified in the Plans.

C. Method of Measurement

a. Structure Excavation

The volume of excavation to be paid for shall be the number of cubic meters measured in original position of material acceptably excavated as shown on the Plans or as directed by the Engineer, but in no case, except as noted, shall any of the following volumes be included in the measurement for payment:

- i. The volume outside of vertical planes 450 mm outside of and parallel to the neat lines of footings and the inside walls of pipe and pipe-arch culverts at their widest horizontal dimensions.
- ii. The volume of excavation for culvert and sections outside the vertical plane for culverts stipulated in (1) above.
- iii. The volume outside of neat lines of underdrains as shown on the Plans, and outside the limits of foundation fill as ordered by the Engineer.
- iv. The volume included within the staked limits of the excavation, contiguous channel changes, ditches, and the like, for which payment is otherwise provided in the Specification.
- v. Volume of water or other liquid resulting from construction operations and which can be pumped or drained away.
- vi. The volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed ground.
- vii. The volume of any material rehandled, except that where the Plans indicate or the Engineer directs the excavation after embankment has been placed and except that when installation of pipe culverts by the imperfect trench method specified in Subsection 1718.3.7, Imperfect Trench of Item 1718, Pipe Culverts and Storm Drains is required, the volume of material reexcavated as directed will be included.
- viii. The volume of excavation for footings ordered at a depth more than 1.5 m below the lowest elevation for such footings shown on the original Contract Plans, unless the Bill of Quantities contains a

pay item for excavation ordered below the elevations shown on the Plans for individual footings.

b. Shoring, Cribbing and Related Work

Shoring, cribbing and related work whenever included as a pay item in Bill of Quantities shall be paid for at the lump sum bid price. This work shall include furnishing, constructing, maintaining, and removing any and all shoring, cribbing, cofferdams, caissons, bracing, sheeting, water control, and other operations necessary for the acceptable completion of excavation included in the work of this Subsection, to a depth of 1.5 m below the lowest elevation shown on the Plans for each separable foundation structure.

c. Trimming Works

Trimming shall include all activities associated with the excavation of any material, the haulage of material, and trimming of batters that conform to the lines, grades, cross sections and dimensions shown on the Plans.

D. Basis Of Payment

The accepted quantities, measured as prescribed in Section 1702.3, Method of Measurement shall be paid for at the Contract Unit Price for each of the particular pay items listed below that is included in the Bill of Quantities. The payment shall constitute full compensation for the removal and disposal of excavated materials including all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this Item, except as follows:

- A.** Any excavation for footings ordered at a depth more than 1.5 m below the lowest elevation shown on the original Contract Plans shall be paid for as provided in the Part K of Volume I Requirements and Conditions of Contract, unless a pay item for excavation ordered below plan elevation appears in the Bill of Quantities.
- B.** Concrete will be measured and paid for as provided under Item 900, Structural Concrete. The quantity of structural concrete to be paid for shall be the final quantity placed and accepted in the completed structure. No deduction shall be made for the volume occupied by pipe less than 100 mm in diameter or by reinforcing steel, anchors, conduits, weep holes or expansion joint materials.
- C.** Any excavation or borrow excavation required in excess of the quantity excavated for structures shall be measured and paid for as provided under Item 1702, Excavation.
- D.** Shoring, cribbing, and related work required for excavation ordered more than 1.5 m below plan elevation shall be paid for in accordance with Part K.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1702 (1)a	Structure Excavation (Common Soil)	Cubic Meter
1702 (1)b	Structure Excavation (Soft Rock)	Cubic Meter
1702 (1)c	Structure Excavation (Hard Rock)	Cubic Meter
1702 (2)a	Excavation (Common Soil)	Cubic Meter
1702 (2)b	Excavation (Soft Rock)	Cubic Meter
1702 (2)c	Excavation (Hard Rock)	Cubic Meter
1702 (3)	Excavation ordered below Plan elevation	Cubic Meter
1702 (4)a	Shoring, cribbing and drain excavation (Shoring)	Lump Sum
1702 (4)b	Shoring, cribbing and drain excavation, (Cribbing/ Cofferdamming)	Lump Sum
1702 (5)a	Pipe culverts and drain excavation (Common Soil)	Cubic Meter
1702 (5)b	Pipe culverts and drain excavation (Soft Rock)	Cubic Meter
1702 (5)c	Pipe culverts and drain excavation (Hard Rock)	Cubic Meter
1702 (6)	Trimming Works	Square Meter

VII. EMBANKMENT

A. Description

This Item shall consist of the construction of embankment using suitable materials of various composition and compacted in accordance with this Specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

B. Material Requirements

a. Suitable Material

Embankments shall be constructed of suitable materials and materials meeting with the following requirements:

- i. Selected Borrow – soil of such gradation that all particles will pass a sieve with 75 mm square openings and not more than 15 mass percent will pass the 0.075 mm (No. 200) sieve, as determined by AASHTO T 11, Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing. The material shall have a plasticity index of not more than six (6) as determined by AASHTO T 90, Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils and a liquid limit of not more than 30 as determined by AASHTO T 89, Standard Method of Test for Determining the Liquid Limit of Soils.
- ii. Gravel fill shall consist of crushed, partially crushed, or naturally occurring granular material. The abrasion loss as determined by AASHTO T 96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and

Impact in the Los Angeles Machine shall not exceed 40 mass percent.

The gravel fill material grading requirements shall conform to Table 804.1.

Table 804.1 Grading Requirements

Sieve Designation		Mass Percent Passing
Standard, mm	Alternate US Standard	Grading A
63.5	2 ½"	100
50	2"	65 - 100
25.0	1"	50 - 85
4.75	No. 4	26 - 44
0.425	No. 40	16 max
0.075	No. 200	9 max

- iii. Rock fill material shall be hard, sound and durable material, free from seams, cracks, and other defects tending to destroy its resistance to weather. Specific gravity of rock fill materials shall be above 2.40.

b. Unsuitable Material

Materials that are not acceptable for use are the following:

- i. Organic soils such as peat and muck.
- ii. Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.
- iii. Soils with a natural water content exceeding 100%.
- iv. Soils with very low natural density, 800 kg/m³ or lower.
- v. Materials containing detrimental quantities of organic materials, such as grass, roots, sewerage, and other materials that cannot be properly compacted as determined by the Engineer.

C. Construction Requirements

a. General

Prior to placing of embankment materials, all necessary clearing and grubbing in that area shall have been performed in conformity with Item 800, Clearing and Grubbing.

Embankment construction shall consist of constructing embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or adjacent to any structures; the placing and compacting of approved material within areas where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits, and other depressions within the area.

Embankments and backfills shall contain no muck, peat, sod, roots or other deleterious matter. Rocks, broken concrete or other solid, bulky materials shall not be placed in embankment areas where piling is to be placed or driven.

Where shown on the Plans or directed by the Engineer, the surface of the existing ground shall be compacted to a depth of 150 mm and to the specified requirements of this Item.

Where provided on the Plans and Bill of Quantities the top portions of the roadbed in both cuts and embankments, as indicated, shall consist of selected borrow for topping from excavations.

b. Methods of Construction

Where there is evidence of discrepancies on the actual elevations and that shown on the Plans, a preconstruction survey referred to the datum plane used in the approved Plan shall be undertaken by the Contractor under the control of the Engineer to serve as basis for the computation of the actual volume of the embankment materials. 109

When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built $\frac{1}{2}$ of the width at a time, the existing slopes that are steeper than 3:1 when measured at right angles to the roadway shall be continuously benched over those areas as the work is brought up in layers. Benching will be subject to the Engineer's approval and shall be of sufficient width to permit operation of placement and compaction equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus excavated shall be placed and compacted along with the embankment material in accordance with the procedure described in this Section.

Unless shown otherwise on the Plans or Special Provisions, where an embankment of less than 1.2 m below subgrade is to be made, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing, scarifying, or steeping to a minimum depth of 150 mm except as provided in Subsection 802.2.2, Conservation of Topsoil. This area shall then be compacted as provided in Subsection 804.3.3, Compaction. Sod not required to be removed shall be thoroughly disc harrowed or scarified before construction of embankment. Wherever a compacted embankment containing granular materials lies within 900 mm of the subgrade, such old embankment shall be scarified to a depth of at least 150 mm whenever directed by the Engineer. This scarified material shall then be compacted as provided in Subsection 804.3.3, Compaction.

When shoulder excavation is specified, the shoulders shall be excavated to the depth and width shown on the Plans. The shoulder material shall be removed without disturbing the adjacent existing base course material, and all excess excavated materials shall be disposed of as provided in Subsection 802.2.3, Utilization of Excavated Materials. If necessary, the areas shall be compacted before being backfilled.

Embankment of earth material shall be placed in horizontal layers not exceeding 200 mm, loose measurement, and shall be compacted as specified before the next layer is placed. However, thicker layer may be

placed if vibratory roller with high compacting effort is used provided that density requirement is attained and as approved by the Engineer. Trial section to this effect must be conducted and approved by the Engineer. Effective spreading equipment shall be used on each lift to obtain uniform thickness as determined in the trial section prior to compaction. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Removal of water shall be accomplished through aeration by plowing, blading, discing, or other methods satisfactory to the Engineer.

Where embankment is to be constructed across low swampy ground that will not support the mass of trucks or other hauling equipment, the lower part of the fill may be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. Fill material shall be placed in a way it effectively displaces unsuitable material from within unstable area of the proposed embankment.

When excavated material contains more than 25 mass percent of rock larger than 150 mm in greatest diameter and cannot be placed in layers of the thickness prescribed without crushing, pulverizing or further breaking down the pieces resulting from excavation methods, such materials may be placed on the embankment in layers not exceeding in thickness the approximate average size of the larger rocks, but not greater than 600 mm.

Even though the thickness of layers is limited as provided above, the placing of individual rocks and boulders greater than 600 mm in diameter shall be permitted provided that when placed, they do not exceed 1,200 mm in height and provided they are carefully distributed, with the interstices filled with finer material to form a dense and compact mass. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth. Lifts of material containing more than 25 mass percent of rock larger than 150 mm in greatest dimensions shall not be constructed above an elevation 300 mm below the finished subgrade. The balance of the embankment shall be composed of suitable material smoothed and placed in layers not exceeding 200 mm in loose thickness and compacted as specified for embankments.

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until compaction complies with the requirements of Subsection 804.3.3, Compaction.

Hauling and leveling equipment shall be so routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

c. Compaction

i. Compaction Trials

Before commencing the formation of embankments, the Contractor shall submit in writing to the Engineer for approval his proposals for the compaction of each type of fill material to be used in the works. The proposals shall include the relationship between the types of compaction equipment, the number of passes required and the method of adjusting moisture content. The Contractor shall carry out full scale compaction trials on areas not less than 10 m wide and 50 m long as required by the Engineer and using his proposed procedures or such amendments thereto as may be found necessary to satisfy the Engineer that all the specified requirements regarding compaction can be consistently achieved. The compaction equipment shall be equivalent or higher than the required capacity prescribed in the Contract. Compaction trials with the main types of fill material to be used in the works shall be completed before work with the corresponding materials shall be allowed to commence. When embankment dimension is less than 10 m wide and 50 m long, the Engineer may waive the construction of compaction trials. 111 Throughout the periods when compaction of earthwork is in progress, the Contractor shall adhere to the compaction procedures found from compaction trials for each type of material being compacted, each type of compaction equipment employed and each degree of compaction specified.

ii. Earth

The Contractor shall compact the material placed in all embankment layers and the material scarified to the designated depth below subgrade in cut sections, until a uniform density of not less than 95 mass percent of the maximum dry density determined by AASHTO T 99, Standard Method of Test for Moisture Density Relations of Soils Using a 2.5 kg Rammer and a 305 mm Drop - Method C, is attained, at a moisture content determined by Engineer to be suitable for such density.

The Engineer shall, during progress of the Work, make density tests of compacted material in accordance with AASHTO T 191, Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method, AASHTO T 205, Soil - Field density test sets: Balloon density apparatus or other approved field density tests, including the use of properly calibrated nuclear testing devices. If, by such tests, the Engineer determines that the specified density and moisture conditions have not been attained, the Contractor shall perform additional work as may be necessary to attain the specified conditions.

At least one group of three (3) in-situ density tests shall be carried out for each 500 m² of each layer of compacted fill.

iii. Gravel Fill

Gravel fill shall be constructed below the original ground elevation. The maximum compacted thickness of any layer shall not exceed

150 mm. All subsequent layers shall be spread and compacted in a similar manner. Gravel fill shall be in accordance with the approved Plan and conform to the applicable requirements of earth embankment.

iv. Broken Concrete

Pieces of concrete not exceeding 20 cm in diameter can be mixed if approved by the Engineer. Any exposed rebar on broken concrete pieces shall be cut and disposed of properly.

v. Rock

Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with approved methods. Embankment materials containing rocks shall be deposited, spread and leveled the full width of the fill with sufficient earth or other fine material so deposited to fill the interstices to produce a dense compact embankment. In addition, one of the rollers, vibrators, or compactors shall compact the embankment full width with a minimum of three (3) complete passes for each layer of embankment.

d. Protection of Embankment During Construction

During the construction, the in-placed embankments shall be maintained in such condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments or otherwise shall be so constructed as to avoid damage to embankments by erosion.

e. Protection of Structure

If embankment can be deposited on one (1) side of adjoining structure, care shall be taken that the area adjacent to the structure shall not be compacted to the extent that it will cause damages against the structure.

When embankment is to be placed on both sides of a concrete structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure unless otherwise specified in the Plans.

Embankment shall not be placed in areas where the materials will be submerged in water. The area shall be pumped dry and any mud or loose material shall be removed.

f. Rounding and Warping Slopes

Rounding except in solid rock, the tops and bottoms of all slopes, including the slopes of drainage ditches, shall be rounded as indicated on the Plans. A layer of earth overlaying rock shall be rounded above the rock as done in earth slopes.

Warping adjustments in slopes shall be made to avoid injury in standing trees or marring of weathered rock, or to harmonize with existing landscape features, and the transition to such adjusted slopes shall be gradual. At intersections of cuts and fills, slopes shall be adjusted and

warped to flow into each other or into the natural ground surfaces without noticeable break.

g. Serrated Slopes

Cut slopes in rippable material (soft rock) having slope ratios between 0.75:1 and 2:1 shall be constructed so that the final slope line shall consist of a series of small horizontal steps. The step rise and tread dimensions shall be shown on the Plans. No scaling shall be performed on the stepped slopes except for removal of large rocks which will obviously be a safety hazard if they fall into the ditch line or roadway.

h. Earth Berms

When called for in the Contract, permanent earth berms shall be constructed of well graded materials with no rocks having a maximum diameter greater than 25% the height of the berm. When local material is not acceptable, acceptable material shall be imported, as directed by the Engineer.

i. Compacted Berm

Compacted berm construction shall consist of moistening or drying and placing material as necessary in locations shown on the drawings or as established by the Engineer. Material shall contain no roots, sod, or other deleterious materials. Contractor shall take precaution to prevent material from escaping over the embankment slope. Shoulder surface beneath berm will be roughened to provide a bond between the berm and shoulder when completed. The Contractor shall compact the material placed until at least 95 mass percent of the maximum density is obtained as determined by AASHTO T 99, Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg Rammer and a 305 mm Drop - Method C. The cross-section of the finished compacted berm shall reasonably conform to the typical cross-section as shown on the Plans.

ii. Uncompacted Berm

Uncompacted berm construction shall consist of drying, if necessary and placing material in locations shown on the Plans or as established by the Engineer. Material shall contain no roots, sod or other deleterious materials. Contractor shall take precautions to prevent material from escaping over the embankment slope.

i. Visual Inspection

Prior to final acceptance, the inspector shall visually inspect the entire section of the compacted embankment. If visual inspection shows that the course is not uniform or that the test values may not be representative of the entire section, additional tests may be performed and deficiencies shall be corrected by the Contractor. Deficiencies identified by visual inspection, such as laminations, dimensional deficiencies, soft areas, etc. shall be corrected before the section will be accepted. The section must be accepted prior to the placement of the next lift.

j. Dust Control

Adequate dust control must be maintained by the Contractor at all times during the earth-moving operations. Dust shall be controlled exclusively through the use of water unless otherwise indicated in the Contract documents or authorized by the Engineer.

k. Stockpiling

The Contractor shall not place stockpiles at locations where they are subject to erosion. The Contractor shall maintain erosion and drainage control near all stockpiles to the satisfaction of the Engineer and shall ensure that surface drainage does not adversely affect adjacent lands, watercourses or future reclamation sites.

Stockpiles shall not be situated at locations or by methods that will interfere or cause damage to any utilities such as power lines, telephone lines, pipelines, and underground utilities, among others.

Sites shall be cleared to the required dimensions. Topsoil and subsoil shall be separately excavated to the full depth or 300 mm, whichever is greater, and stockpiled separately.

Stockpiles shall not be situated within 30 m of a watercourse or permanent structure or within 4 m of adjacent property boundary unless otherwise permitted in writing by the property owner.

D. Method of Measurement

The quantity of embankment to be paid for shall be the volume of material compacted in place, accepted by the Engineer and formed with material obtained from an approved source.

The volume of embankment materials can be calculated using cross-sectional end area method or by the prismatic formula method with the assistance of computer aided design program.

Material from excavation per Item 802, Excavation which is used in embankment and accepted by the Engineer will be paid under Embankment and such payment will be deemed to include the cost of excavating, hauling, stockpiling and all other costs incidental to the work.

E. Basis Of Payment

The accepted quantities, measured as prescribed in Section 1704.4, Method of Measurement shall be paid for at the Contract Unit Price for each of the Pay 885 Items listed below that is included in the Bill of Quantities. The payment shall continue full compensation for placing and compacting all materials including all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1704 (1)a	Embankment (From roadway/structure excavation)	Cubic Meter
1704 (1)b	Embankment (From Borrow)	Cubic Meter
1704 (2)a	Selected Borrow for topping (Case 1)	Cubic Meter
1704 (2)b	Selected Borrow for topping (Case 2)	Cubic Meter
1704 (3)	Earth Berm	Cubic Meter
1704 (4)	Gravel Fill	Cubic Meter

VIII. TERMITE CONTROL WORK

A. Description

This Item shall consist of furnishing and applying termite control chemicals, including the use of equipment and tools in performing such operations in accordance with this Specification.

B. Material Requirements

Termite control chemicals or toxicants shall be able to immediately exterminate termites or create barriers to discourage entry of subterranean termites into the building areas. Chemical or toxicants to be used shall be in accordance with the governing laws and the manufacturer shall be accredited by the Department of Health through Food and Drug Administration (FDA). The toxicants may be classified into the following types and according to use:

Type I. Liquid Termicide Concentrate

This type of toxicant shall be specified for drenching soil beneath foundations of proposed buildings. The concentrate shall be diluted with water in the proportion of 1 L of concentrate material to 65 L of water or as specified by the manufacturer.

Type II. Liquid Termicide Ready Mixed Solution

This type of toxicant which comes in ready mixed solution shall be used as wood preservative by drenching wood surfaces to the point of run-off.

Type III. Powder Termicide

This type of toxicant shall be applied to visible or suspected subterranean termite mounds and tunnels where termites are exterminated through Trophallaxes method (exchange or nourishment between termites while greeting each other upon meeting).

C. Construction Requirements

Before any termite control work is started, thorough examination of the site shall be undertaken by the Contractor so that the appropriate method of soil poisoning can be applied.

The Contractor shall coordinate with other related trades through the Engineer to avoid delay that may arise during the different phases of application of the termite control chemicals.

This work shall be done by a trained personnel with a minimum two (2) years' experience for proper execution of the work of this Specification.

a. Soil Poisoning

There are two (2) methods usually adopted in soil poisoning which are as follows. Other methods as recommended by the manufacturers and approved by the Engineer may also be used.

i. Cordoning

This method is usually adopted when there is no visible evidence of termite infestation. Trenches in concentric circles, squares or rectangles are dug 150 mm to 220 mm wide and at least 1 m apart and applied with Type I working solution at the rate of 8 L/l.m within the cordoned area.

ii. Drenching

When soil show termite infestation, this method shall be applied. The building area shall be thoroughly drenched with Type I working solution at the rate of 24 L/m².

b. Surface preparation

All organic matter, construction debris, rubbish, etc. which could decrease effectiveness of treatment on areas to be treated shall be removed. Water logged foundations shall be treated after drying when the soil is absorbent. For low penetration and sloping sites, surface to be scarified shall be 75 mm deep. Cutting, excavation, leveling and grading shall be completed before starting treatment. Loosen, rake and level soil to be treated, except previously compacted areas under slabs and foundations.

c. Application

Before the application of soil treatment, the Contractor shall coordinate with the Engineer prior to excavating, filling, grading and concreting works.

At the time soil poisoning is to be applied, the soil to be treated shall be in friable condition with low moisture content so as to allow uniform distribution of the toxicant agents. Toxicant shall be applied at least 12 h prior to placement of concrete which shall be in contact with treated materials.

Treatment of the soil on the exterior sides of the foundation walls, grade beams and similar structures shall be done prior to final grading and planting or landscaping work to avoid disturbance of the toxicant barriers by such operations.

Areas to be covered by concrete slab shall be treated before placement of granular fill used as capillary water barrier at a rate of 12 L/m² with Type I working solution after it has been compacted and set to required elevation. Additional treatment shall be applied as follows:

1. In critical areas, such as utility openings for pipes, conduits and ducts, apply additional treatment at the rate of 6 L/l.m. in a strip 150 mm to 200 mm wide.

2. Along the exterior perimeter of the slab and under expansion joint, at the rate of 2.5 L/l.m. in a strip 150 mm to 200 mm wide in a shallow trench.

Apply an overall treatment under entire building slab, and moving strips adjacent to the building. Treat sidewalks or other such paved areas abutting the building for a distance not less than 1 m from the building. Apply along each side of foundation walls and at penetrations through slabs such as pipes, ducts, etc. apply at application rate of 5 L per linear meter around the perimeter of the building.

Post signs in areas of application to warn workers that soil termicide treatment has been applied. Remove signs when areas are covered by other construction.

d. Wood Protection

Where the application of wood preservative is necessary, the Contractor shall use Type II working solution as recommended by the manufacturer.

All wood materials not pressure treated as specified in Item 1003, Carpentry and Joinery shall be treated with Type II ready mixed solution as herein called for or as directed by the Engineer.

Wood treatment shall be applied after framing, sheathing, and exterior weather protection is completed but before the electrical and mechanical systems are installed.

e. Powder Termicide

When powder termicide is to be applied to eradicate subterranean termites, extreme caution and care shall be done at the time of application. It shall not be allowed to enter drains, waterways, streams or rivers. It shall not be used if rain is expected to occur within 48 h of application. All heating and air conditioning ducts, air vents, floor drains, and edible plants shall be covered prior to application of powder termicide.

f. Delivery, Storage and Handling

Deliver termiticides to the project site in sealed and labeled containers in good condition as supplied by the manufacturer. Store, handle and use termiticides in accordance with manufacturer's labels. Labels shall bear evidence of registration and Material Safety Data Sheet (MSDS) shall also be provided.

g. Safety Requirements

Formulate, treat and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Engineer and fit the filling hose with backflow

preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of the Contractor to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure 200 that proper protective clothing and equipment are worn and used during all phases of termiticide operation.

Disposal of used pesticide containers off the project site shall comply with the latest requirements of DENR Administrative Order for Revised Procedures and Standards for Management of Hazardous Waste, Material Safety Data Sheet (MSDS) shall also be strictly followed.

h. Warranty

Upon completion and acceptance of the work, the Contractor shall furnish the Engineer a written guarantee stating that termite control is guaranteed for a minimum period of three (3) years and annual inspections or as requested by the Engineer shall be done by both the Contractor and Engineer to ensure the quality of their work.

D. Method Of Measurement

Liquid termite control chemicals or toxicants shall be measured by actual number of liters used in the cordoning and drenching of lot areas and soil poisoning of granular fill or actual number of liters used in drenching wood surfaces, while powder chemical/toxicant shall be measured by kilograms applied to suspected subterranean termite mounds and tunnels. The quantity to be paid for shall be determined and accepted by the Engineer.

E. BASIS OF PAYMENT

The accepted quantities, measured as prescribed in Section 1000.4, Method of Measurement shall be paid for at the Contractor Unit Price for Termite Control Work which price and payment shall be full compensation for furnishing and applying termite control chemicals including the use of equipment and tools, labor and incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1000 (1)	Soil Poisoning	Liter
1000 (2)	Wood Preservative	Liter
1000 (3)	Powder Termicide	Kilogram

IX. STRUCTURAL CONCRETE

A. Description

a. Scope

This Item shall consist of furnishing, placing and finishing concrete in buildings and related structures, flood control and drainage, ports, and water supply structures in accordance with this Specification and conforming to the lines, grades, and dimension shown on the Plans.

b. Classes and Uses of Concrete

Five classes of concrete are provided for in this Item, namely: A, B, C, P and Seal. Each class shall be used in that part of the structure as called for on the Plans.

The classes of concrete will generally be used as follows:

Class A – All superstructures and substructures which include the important parts such as slabs, beams, girders, columns, arch ribs, box culverts, abutments, retaining walls, shearwalls, pedestal and footings.

Class B – Pier shafts, pipe bedding, slab on fill, gravity walls (unreinforced or with only a small amount of reinforcement), and other miscellaneous concrete structures.

Class C – Thin reinforced sections, railings, precast R.C. piles and cribbing and for filler in steel grid floors. Class P – Prestressed concrete structures and members.

Seal – Concrete deposited in water

B. Materials Requirements

a. Portland Cement

Cement shall conform to the requirements of the following cited Specifications for the type specified or permitted:

b. Concrete Aggregates

Concrete aggregates shall conform to ASTM C33M, Standard Specification for Concrete Aggregates, and lightweight concrete aggregates shall conform to ASTM C330M, Standard Specification for Lightweight Aggregates except that aggregates failing to meet these specifications, but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used under Method 2 of Subsection 900.3.2, Methods of Determining the Proportions of Concrete, when authorized by the Engineer in writing.

Except as permitted elsewhere in this Subsection, the maximum size of the aggregate shall be or not larger than $1/5$ of the narrowest dimensions between sides of forms of the member for which the concrete is to be used nor larger than $3/4$ of the minimum clear spacing between individual reinforcing bars or bundles of bars or pre-tensioning strands

1. Fine Aggregates

Fine aggregates shall consist of natural and crushed sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles. Fine aggregates 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 written 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 written approval of the Engineer.

If the fine aggregate is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate and ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate, the weighted loss shall not exceed ten (10) mass percent.

Fine aggregates 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 on strength of mortar by AASHTO T 71, Standard Method of Test for Organic Impurities in Fine Aggregate on Strength of Mortar (ASTM C87, Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar) the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95%.

The fine aggregate shall be well-graded and shall conform to Table Below:

Grading Requirements for Fine Aggregate

Sieve Designation (mm)	Mass Percent Passing
9.50	100
4.75	95 – 100
2.36	-
1.18	45 – 80
0.60	-
0.30	5 – 30
0.15	0 – 10

2. Coarse Aggregates

Coarse Aggregates 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 no more than one (1) mass percent of material passing the 0.075 mm comment 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 in accordance with AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or

Magnesium Sulfate and ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate, the weighted loss shall not exceed 12 mass percent.

Coarse Aggregates shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine (ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine).

If the slag is used, its density shall not be less than 1,120 kg/m³.

Gradation shall conform to next table.

Grading Requirements for Coarse Aggregate

Sieve Designation (mm)	Mass Percent Passing				
	Class A	Class B	Class C	Class P	Class Seal
63.00					
50.00	100	100			
37.50	95 – 100	-			100
25.00	-	35 – 70		100	95 – 100
19.00	35 – 70	-	100	-	-
12.50	-	10 – 30	90 – 100	-	25 – 60
9.50	10 – 30	-	40 – 70	20 – 55	-
4.75	0 – 5	0 – 5	0 – 15*	0 – 10*	0 – 10*

*Note: * The measured cement content shall be within plus (+) or minus (-) 2 mass percent of the design cement content.*

3. Aggregate Tests

Samples of the fine and coarse aggregates to be used shall be selected by the Engineer for tests at least 30 days before the actual concreting operations shall begin. It shall be the responsibility of the Contractor to designate the source or sources of aggregates to give the Engineer sufficient time to obtain the necessary samples and submit them for testing.

No aggregates shall be used unless official advice has been received that it has satisfactorily passed all tests, at which time written authority by the Engineer shall be given for its use.

c. 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 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.

If it contains quantities of substance that discolor it or make it smell or taste unusual or objectionable, or cause suspicion, it shall not be used unless service records of concrete made with it (or other information) indicated that it is not deleterious to the quality, shall be subject to the acceptance criteria as shown in Table 900.4 and Table 900.5 or as designated by the Engineer.

Table 900.4 Acceptance Criteria for Water Supply

Physical Property	Limit
Compressive strength, min. % control at 7 days	90
Time of Setting deviation from control, h:min ^A	from 1:00 earlier to 1:30 later

Note: ^AComparisons shall be based on fixed proportions for concrete or mortar mixtures. The control mixture shall be made with 100% potable or distilled water. The test mixture shall be made with the mixing water that is being evaluated.

Table 900.5 Chemical Limitation for Water

Chemical Property	Limits (parts per million, ppm), max.	Test Method
A. Chloride as Cl ⁽⁻¹⁾		
1. Prestressed concrete	500	ASTM C114
2. Other reinforced concrete in moist environments or containing aluminum embedments or dissimilar metals or with stay-in-place	1000	ASTM C114
B. Sulfate as SO ₄	3000	ASTM C114
C. Alkalies as (Na ₂ O + 0.658 K ₂ O)	600	ASTM C114
D. Total Solids by mass	50000	ASTM C1603

*Note: ASTM C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C1603 - Standard Test Method for Measurement of Solids in Water*

Non-potable water will be tested in accordance with, and shall meet the suggested requirements of ASTM C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

d. Metal Reinforcement

Reinforcing steel bars shall conform to the requirements of Subsection 902.2, Material Requirements of Item 902, Reinforcing Steel.

e. Admixtures

Air-entraining admixtures, if used, shall conform to ASTM C260M, Standard Specification for Air – Entraining Admixtures for Concrete. Air-entraining admixture shall conform to the requirements of AASHTO M 154, Standard Method of Test for Time of Setting of Hydraulic Cement Paste by Gillmore Needles. Chemical Admixtures, if used, shall conform to the requirements of ASTM C494M, Standard Specification for Chemical Admixtures for Concrete or AASHTO M 194, Standard Specification for

Chemical Admixtures for Concrete. Fly Ash, if specified or permitted as a mineral admixture and not exceeding 20% partial replacement of Portland Cement in concrete mix shall conform to the requirements of ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete. Chemical Admixture/s maybe added to the concrete mix to produce some desired modifications to the properties of concrete if necessary, but not as partial replacement of cement. If specified, monofilament polypropylene synthetic fibrin fibers, which are used as admixture to prevent the formation of temperature/shrinkage cracks and increase impact resistance of concrete slabs shall be applied in the dosage rate recommended by its manufacturer.

f. Storage of Cement and Aggregates

All cement shall be stored immediately upon delivery at the site in a 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 12 days before the cement is to be used. For a storage period of less than 60 days, stack the bags no higher than 14 layers, and for longer periods, no higher than seven (7) layers. As an additional precaution the oldest cement shall be used first. 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 (2) 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.

g. Curing Materials

Curing materials shall conform to the following requirements as specified;

1. Burlap cloth - AASHTO M 182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
2. Liquid membrane forming compounds - ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
3. Sheeting (film) materials - AASHTO M 171, Standard Specification for Sheet Materials for Curing Concrete

h. Expansion Joint Materials

Expansion joint materials shall be:

1. Preformed Sponge Rubber and Cork, conforming to AASHTO M 153, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled 151 PVC Expansion Joint Fillers for Concrete Paving and Structural Construction)
2. Hot-Poured Elastic Type, conforming to ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavement.
3. Preformed Fillers, conforming to AASHTO M 213, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types), ASTM D994M, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

C. Construction Requirements

The notation used in these regulations is defined as follows:

f_c' = compressive strength of concrete

a. Concrete Quality

All Plans submitted for approval or used for any project shall clearly show the specified strength, f_c' , of concrete of the specified age for which each part of the structure was designed.

Concrete that will be exposed to sulfate containing or other chemically aggressive solutions shall be proportioned in accordance with "Recommended Practice for Selecting Proportions for Concrete (ACI 613)" and Recommended Practice for Selecting Proportions for Structural Lightweight Concrete (ACI 613A)."

b. Methods of Determining the Proportions of Concrete

The determination of the proportions of cement, aggregate, and water to attain the required strengths shall be made by one of the following methods:

Method 1. Without preliminary test

Where preliminary test data on the materials to be used in the concrete have not been obtained, the water-cement ratio for a given strength of concrete shall not exceed the values shown in Table 900.6. When strengths in excess of 27.58 MPa are required or when lightweight aggregates or admixtures (other than those exclusively for the purpose of air entraining) are used, the required water-cement ratio shall be determined in accordance with Method 2.

Method 2. For combination of materials previously evaluated or to be established by trial mixtures.

Water-cement ratios for strengths greater than that shown in Table 900.6 may be used provided that the relationship between strength and water-cement ratio for the materials to be used has been previously established by reliable 152 test data and the resulting concrete satisfies the requirements of concrete quality. Where previous data are not available. Concrete trial mixtures having proportions and consistency suitable for the work shall be made using at least three (3) different water cement ratios (or cement content in the case of lightweight aggregates) which will produce a range of strengths encompassing those required for the work. For each water-cement ratio (or cement content) at least three (3) specimens for each age to be tested shall

be made, cured and tested for strength in accordance with ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen and ASTM C192, Standard Practice for Making & Curing Concrete Test Specimens in the Laboratory. The strength test shall be made at 7, 14 and 28 days at which the concrete is to receive load, as indicated on the Plans. A graph shall be established showing the relationship between water-cement ratio (or cement content) and compressive strength. The maximum permissible water-cement ratio for the concrete to be used in the structure shall be that shown by the curve to produce an average strength to satisfy the requirements of the strength test of concrete. Where different materials are to be used for different portions of the work, each combination shall be evaluated separately.

Table 900.6 Maximum Permissible Water-Cement Ratios for Concrete (Method No. 1)

Specified compressive strength at 28 days, MPa	Maximum Permissible water-cement ratio			
	Non-air-entrained concrete		Air-entrained concrete	
	Liters per 40 kg bag of cement	Absolute ratio by weight	Liters per 40 kg bag of cement	Absolute ratio by weight
17.24	25.77	0.642	22.22	0.554
20.70	23.11	0.576	18.66	0.465
24.13	20.44	0.510	15.99	0.399
27.58	17.77	0.443	14.22	0.354

c. Concrete Proportions and Consistency

The proportions of aggregates 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 with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface. 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.

d. Sampling and Testing of Structural Concrete

As work progresses, at least one (1) sample consisting of three (3) concrete cylinder test specimens, 150 mm x 300 mm, shall be taken from each 75 m³ of each class of concrete or fraction thereof placed each day. Samples from which compression test specimens are molded shall be secured in accordance with ASTM C172M, Standard Practice for Sampling Freshly Mixed Concrete. Specimens made to check the adequacy of the proportions for strength of concrete or as a basis for acceptance of concrete shall be made and laboratory-cured in accordance with ASTM C31M, Standard Practice for Making and Curing Concrete Test Specimen in the Field. Additional test specimens cured entirely under field conditions may be required by the Engineer to check the adequacy of curing and protection of the concrete. Strength tests shall be made in accordance with ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen. Compliance with the requirements of this Subsection shall be determined in accordance with the following standard methods of AASHTO:

Sampling of fresh concrete	: AASHTO R 60, Standard Practice for Sampling Freshly Mixed Concrete
Weight per cubic meter and air content (gravimetric) of concrete	: AASHTO T 121M, Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
Slump of Portland Cement Concrete	: AASHTO T 119M, Standard Method of Test for Slump of Hydraulic Cement Concrete

Tests for strength shall be made in accordance with the following:

Making and curing of concrete compressive specimen in the field	: AASHTO T 23, Standard Method of Test for Making and Curing Concrete Test Specimens in the Field (ASTM C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field)
Compressive strength of molded concrete Cylinders	: AASHTO T 22, Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens (ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens)

e. Proportioning and Strength of Structural Concrete

The concrete materials shall be proportioned in accordance with the requirements for each class of concrete as specified in Table 900.7, using 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. Other methods of proportioning may be employed in the mix design with prior approval of the Engineer. A change in the source of materials during the progress of work shall necessitate a new mix design. 154 The strength requirements for each class of concrete shall be as specified in Table 900.7.

Table 900.7 Composition and Strength of Concrete for Use in Structures

Class of Concrete	Minimum Cement Content Per m ³ 40kg/ (bag**)	Maximum Water / Cement Ratio (kg/kg)	Consistency Range in Slump (mm)	Designated Size of Coarse Aggregate Square Opening Std. mm	Minimum Compressive Strength of 150 mm x 300 mm Concrete Cylinder Specimen at 28 days, MN/m ²
A	364 (9.1 bags)	0.53	50 – 100	37.50 – 4.75	20.7
B	320 (8 bags)	0.58	50 – 100	50.00 – 4.75	16.5
C	380 (9.5 bags)	0.55	50 – 100	12.50 – 4.75	20.7
P	440 (11 bags)	0.49	100 max.	19.00 – 4.75	37.7
Seal	380 (9.5 bags)	0.58	100 - 200	25.00 – 4.75	20.7

Note: * The measured cement content shall be within plus or minus 2 mass percent of the design cement content.

** Based on 40 kg/bag

f. Consistency

Concrete shall have a consistency such that it will be workable in the required position and will flow around the reinforcing steel but individual particles of the coarse aggregates, when isolated, shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be gauged by the ability of the

equipment to properly place it and not by the difficulty in mixing and transporting concrete mix. The quantity of mixing water, which shall be determined by the Engineer and shall not be varied without his consent. Concrete as dry as it is practical to place with the equipment specified shall be used.

g. Strength Test of Concrete

As basis of acceptance, strength test shall generally be made with the frequency of not less than one (1) test [three (3) specimens] for each 75 m³. Each test shall be made from a separate batch. One each day concrete is delivered, at least one (1) strength test shall be made for each class of concrete. The age for strength tests shall be 28 days or, when specified in the Plan, the earlier age at which the concrete is to receive its full load or maximum stress. 155 Additional test may be made at earlier ages to obtain advance information on the adequacy of strength development where age-strength relationships have been established for the materials and proportions used. For structures designed in accordance with the ultimate strength design method, and for prestressed structures the average of any three (3) consecutive strength test of the laboratory cured specimens representing each class of concrete shall be equal to or greater than the specified compressive strength, f_c' and not more than 10% of the strength tests shall have values less than the specified strength. When the laboratory-cured specimens failed to conform to the requirements for strength, the Engineer shall have the right to order changes in the concrete sufficient to requirements. If the cured specimen had attained the intended minimum strength requirement, the removal of forms and falseworks may take place and shall conform to the requirements of Item 903, Formworks and Falseworks. When in the opinion of the Engineer, the strengths of the jobcured specimens may not likely be achieved, the Contractor may be required to improve the procedures for protecting and curing the concrete specimen, or when test of field-cured cylinders indicate deficiencies in protection and curing, the Engineer may require test in accordance with ASTM C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete or order load tests as outlined in the load tests of structures for that portion of the structure where the questionable concrete has been placed.

h. Batching

Measuring and batching of materials shall be done at a batching plant.

1. Portland Cement

Either sacked or bulk cement may be used. No fraction of a sack of cement shall be used in a batch of concrete unless the cement is weighed. All bulk cement shall be weighed on an approved weighing device. The bulk cement weighing hopper shall be properly sealed and vented to preclude dusting operation. The discharge chute shall not be suspended from the weighing hopper and shall be so arranged that cement will neither be lodged in it nor leak from it.

Accuracy of batching shall be within plus (+) or minus (-) one (1) mass percent.

2. Water

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 more than 1%.

3. Aggregates

Stockpiling of aggregates shall be in accordance with Subsection 900.2.6, Storage of Cement and Aggregate. All aggregates whether produced or handled by hydraulic methods or washed, shall be stockpiled or binned for at least 12 hours prior to batching. Shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. If the aggregates contain high or non-uniform moisture content, storage or stockpile period in excess of 12 hours may be required by the Engineer.

Batching shall be conducted as to result in a two (2) mass percent maximum tolerance for the required materials.

4. Bins and Scales

The batching plant shall include separate bins for bulk cement, fine aggregate and for each size of coarse aggregate, a weighing hopper, and scales capable of determining accurately the mass of each component of the batch.

Scales shall be accurate to 0.5% throughout the range used.

5. Batching

When batches are hauled to the mixer, bulk cement shall be transported either in waterproof compartments or between the fine and coarse aggregate. When cement is placed in contact with moist aggregates, batches will be rejected unless mixed within one and 1.5 h of such contact. Sacked cement may be transported on top of the aggregates.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped cleanly into the mixer without loss, and, when more than one (1) batch is carried on the truck, without spilling of material from one (1) batch compartment into another.

6. Admixtures

The Contractor shall follow an approved procedure for adding the specified amount of admixture to each batch and will be responsible for its uniform operation during the progress of the work. He shall provide separate scales for the admixtures which are to be proportioned by weight, and accurate measures for those to be proportioned by volume. Admixtures shall be measured into the mixer with an accuracy of plus or minus 3%.

The use of Calcium Chloride (CaCl_2) as an admixture will not be permitted.

i. Mixing and Delivery

Concrete may be mixed at the construction site, at a central point or by a combination of central point and truck mixing or by a combination of central point mixing and truck agitating. Mixing and delivery of concrete shall be in accordance with the appropriate requirements of AASHTO M 157, Standard Specification for Ready-Mixed Concrete except as modified in the following paragraphs of this Subsection, for truck mixing or a combination of central point and truck mixing or truck agitating. Delivery of concrete shall be regulated so that placing is at a continuous rate unless delayed by the placing operations. The intervals between deliveries of batches shall not be so great as to allow the concrete in place to harden partially, and in no case, shall such an interval exceed 30 min.

Volumetric measurement shall be used only if by weight batching plant is located more than 1 h travel from the project site.

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

For batch mixing at the construction site or at a central point, a batch mixer of an approved type shall be used. Mixer having a rated capacity of less than a one-bag batch shall not be used. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer except that an overload up to 10% 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 batch shall be so charge into the drum that a portion of the water shall enter 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 15 s of the mixing period. Mixing time shall be measured from the time all materials, except water, are in the drum. Mixing time shall not be less than 60 s for mixers having a capacity of 1.5 m³ or less. For mixers having a capacity greater than 1.5 m³, the mixing time shall not be less than 90 s. If timing starts, the instant skip reaches its maximum raised position, 4 s shall be added to the specified mixing time. Mixing time ends when the discharge chute opens.

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

The timing device on stationary mixers shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the Contractor will be permitted to continue operations while it is being repaired, provided he furnishes an approved timepiece equipped with minute and second hands. If the timing device is not placed in good working order within 24 h, further use of the mixer will be prohibited until repairs are made.

Retempering concrete will not be permitted. Admixtures for increasing the workability, for retarding the set, or for accelerating the set or improving the pumping characteristics of the concrete will be permitted only when specifically provided for in the Contract, or authorized in writing by the Engineer.

Mixing Concrete:

General All concrete batching plant prior to use shall be accredited by the DPWH-Bureau of Research and Standards.

1. Mixing Concrete at Site

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixers shall be restored or replaced when any part or section is worn 20 mm or more below the original height

of the manufacturer's design. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used.

When bulk cement is used and volume of the batch is 0.5 m³ or more, the scale and weigh hopper for Portland cement shall be separated and distinct from the aggregate hopper or hoppers. The discharge mechanism of the bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall also be interlocked against opening when the amount of cement in the hopper is underweight by more than one (1) mass percent or overweight by more than three (3) mass percent of the amount specified.

When the aggregate contains more water than the quantity necessary to produce a saturated surface dry condition, representative samples shall be taken and the moisture content determined for each kind of aggregate.

The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate. All water shall be in the drum by the end of the first quarter of the specified mixing time.

Cement shall be batched and charged into the mixer so that it will not result in loss of cement due to the effect of wind, or in accumulation of cement on surface of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

The entire content of a batch mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch except water shall be deposited simultaneously into the mixer.

All concrete shall be mixed for a period of not less than 90 s after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed.

Mixers shall be operated with an automatic timing device that can be locked by the Engineer. The time device and discharge mechanics shall be so interlocked that during normal operation no part of the batch will be charged until the specified mixing time has elapsed.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat inside of the drum without reducing the required mortar content of the mix. When mixing is to cease for a period of 1 hour or more, the mixer shall be thoroughly cleaned.

2. Mixing Concrete at Central Plant

Mixing at central plant shall conform to the requirements for mixing concrete at site.

3. Mixing Concrete in Truck

Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, water-tight, and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a

device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank is not required. Truck mixers may be required to be provided with a means of which the mixing time can be readily verified by the Engineer.

The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing, shall, unless otherwise directed be continued for not less than 100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

Mixing shall begin within 30 min after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface wet aggregate and when the temperature is above 32 °C, this limit shall be reduced to 15 min. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgement of the Engineer, the aggregate is sufficiently free from moisture, so that there will be no harmful effects on the cement.

When a truck mixer is used for transportation, the mixing time specified herein at a stationary mixer may be reduced to 30 s and the mixing completed in a truck mixer. The mixing time in the truck mixer shall be as specified for truck mixing.

4. Transporting and Delivery of Mixed Concrete

Mixed concrete may only be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturers of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable point for adequate placement and consolidation in place.

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling. 160 No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixers or agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1 h, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 30°C, or above, a time less than 1 h will be required.

The maximum temperature of concrete produced with heated aggregates, heated water, or both, shall at no time during its production or transportation exceed 32°C.

The Contractor shall have sufficient plant capacity and transportation apparatus to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and

finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 min. The methods of delivering and handling the concrete shall be such as that will facilitate placing of the minimum handling.

j. Handling and Placing Concrete: General

Concrete shall not be placed until forms and reinforcing steel have been checked and approved by the Engineer.

If lean concrete is required in the Plan or as directed by the Engineer prior to placing of reinforcing steel bar, the lean concrete should have a minimum compressive strength of 13.8 MPa.

In preparation for the placing of concrete, all sawdust, chips and other construction debris and extraneous matter shall be removed from inside the formwork. Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

No concrete shall be used which does not reach its final position in the forms within the time stipulated under "Time of Hauling and Placing Mixed Concrete".

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying concrete to the forms shall be permitted only on written authorization of the Engineer. The Engineer shall reject the use of the equipment for concrete transportation that will allow segregation, loss of fine 161 materials, or in any other way will have a deteriorating effect on the concrete quality.

Open troughs and chutes shall be of metal lined; where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement to avoid segregation.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure.

When placing operations would involve dropping the concrete more than 1.5 m, concrete shall be conveyed through sheet metal or approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower end shall be kept buried in the newly placed concrete. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement bars.

The concrete shall be placed as nearly as possible to its final position and the use of vibrators for moving of the mass of fresh concrete shall not be permitted.

1. Placing Concrete by Pneumatic Means

The equipment shall be so arranged that vibration will not damage freshly placed concrete. The capacity of equipment shall be 0.30 to 1.00 m³. Where