# PART C

# EARTHWORK

## PART C - EARTHWORK

### ITEM 100 CLEARING AND GRUBBING

100.1 Description

*The first sentence of this Section is modified as follows:*

This Item shall consist of the removal and satisfactory disposal of all materials including trees, stumps, roots, vegetations, logs, wastes, debris, top soil and protruding objects except those that are designated to remain in accordance with other items of the Specifications and where directed by the Engineer. The holes resulting from grubbing operations, where directed by the Engineer, shall be filled with approved materials which shall be deposited and compacted to the same dry density as that of the adjoining soil.

100.2 Construction Requirements

100.2.1 General

*This Sub-section is supplemented as follows:*

Clearing shall be extended to one (1) meter beyond the toe of the fill slopes, or rounding cut slopes, or outside edge of drainage facilities as the case maybe, for the entire length of the project, unless otherwise shown on the Drawings or as directed by the Engineer, with the exception of trees or brush under the jurisdiction of the Bureau of Forest Development and other trees and shrubs designated for preservation. These trees, shrubs or bushes designated to be remained in place shall be carefully trimmed as directed by the Engineer and shall be protected from scarring, debarking and other injuries during construction operations.

100.2.2 Clearing and Grubbing

*Add the following after paragraph (4):*

In areas covered by cogon, wild grass, talahib and other vegetations, top soil shall be cut with a depth of 20 to 30 centimeters below the original ground surface or as designated by the Engineer, and shall be disposed of outside the clearing and grubbing limits as indicated in the typical roadway section or to the disposal area directed by the Engineer.

100.2.3 Individual Removal of Trees or Stumps

*Add the following to read as second paragraph:*

The Contractor, prior to any tree cutting/removal operation shall prepare inventory of trees scheduled for cutting/removal for the Engineer's approval. Trees to be cut shall be submitted in tabulated form showing as much information for easy identification as follows:

- Station Limit
- Description/Name/Species of Trees
- Size, Diameter (in centimeter)

- Distance from the centerline of the road
- Location (Left/Right)

Upon Engineer's approval of the list, the Contractor shall make a request from the Local DENR (with the approved list attached) that such number of trees will be cut/removed for the improvement of the project road. No tree shall be cut/removed unless a "PERMIT TO CUT TREES" is issued by the DENR to the Contractor authorizing him to cut only such approved number of trees.

Trees cut shall be disposed of in a manner conforming to the requirements of Sub-section 100.2.2 and with the requirements contained in the DENR permit.

All fees relating to securing permit(s) shall be to the expense of the contractor.

Sizes of individual trees intended to be removed and relocated as indicated on the Drawings or as designated by the Engineer shall be removed and relocated by the Contractor with care.

100.3 Method of Measurements

*Delete paragraph (1) and replace with the following to read as:*

1. Area Basis: The work to be paid for shall be based on the total area cleared and grubbed which is calculated in hectares within the limits defined on the drawings or as directed by the Engineer including adjustment that may be made to satisfy certain site requirements.

2. The diameter of trees will be measured at a height of 1.4 m (54 inches) above the ground and trees less than 150 mm (6 inches) in diameter will not be measured for payment. In the measurement of trees by individual unit basis, the unit will be designated and measured in accordance with the following shedule of sizes:

| Diameter at height of 1.4 m | Pay Item Designation |
|---|---|
| 150 mm to 900 mm diameter | Small |
| Over 900 mm diameter | Large |

100.4 Basis of Payment

*The following paragraph shall be supplemented:*

Pay Item 100 (1), Clearing and Grubbing shall be paid in hectares and shall include the cost of removing all trees except those called for in Items 100 (3) and (4) located in the area designated to be cleared and grubbed. Removal of trees categorized as small and large in Items 100 (3) and 100 (4) shall be paid by the total number of trees removed.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 100 (1) | Clearing and Grubbing | Hectares |
| 100 (3) | Individual Removal of Trees | Each |

| | | |
|---|---|---|
| 100 (4) | Small (150mm – 900mm dia.)<br>Individual Removal of Trees<br>Large (Over 900mm dia.) | Each |

**ITEM 101 REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

101.2 Construction Requirements

101.2.2 Removal of Bridges, Culverts and other Drainage Structures

*This Sub-section is modified and supplemented with the following:*

a) Bridges

The Contractor shall dismantle, remove and dispose of the existing bridges to be demolished only after the detour structure is completed and traffic is diverted where required. The bridge substructure, if included in the demolition/removal, shall be razed 30 cm from stream bottom and those parts outside the stream shall be removed to a minimum of 60 cm below the proposed ground surface. Where such substructure to be removed are supported on piles, the piles shall be cut 50 cm below the stream bottom or as directed by the Engineer. Where such portions of existing bridges lie wholly or in part within the limits for new bridges, they shall be removed as necessary to accommodate the construction of the proposed structures. If substructures were shown to be retained, such shall be protected during the dismantling/demolition operation to prevent them from getting damaged. Any damage on portions shown to be retained shall be repaired and made good by the Contractor at his own cost and to the satisfaction of the Engineer. Disposal of materials from demolished bridges shall be at the direction and to the satisfaction of the Engineer. Materials required to be salvaged, shall be hauled and stored into stock area designated by the Engineer.

b) Box Culverts (if any)

Structures to be either removed or demolished at locations where box culverts are to be constructed shall be disposed of as directed by the Engineer. Materials to be salvaged in connection with the demolition/removal shall be hauled and stored as directed. Where existing concrete structures are to be demolished, such materials, if approved by the Engineer, maybe utilized for embankment purposes.

c) Reinforced Concrete Pipe Culverts (if any)

Where the removal of structures deals with removal and reinstallation/stockpile of RCP culverts and other drainage structures, the Contractor shall exert extra precautions to prevent damage to the pipes. RC pipes specified to be removed and reinstalled but were damaged during handling shall be replaced by the Contractor at his own expense. All materials to be removed which are not suitable for re-use shall be disposed of as directed by the Engineer, or maybe utilized for filling purposes if found suitable prior to the Engineer's approval.

All other structures removed which are not suitable for use on embankment purposes, shall be stockpiled but disposed away before they may obstruct the prosecution of the Project.

d) Other Drainage Structures

Existing slope protection structures such as hand-laid rock, gabions, and others necessary to be removed under this Specification shall be removed by suitable equipment chosen by the Contractor and approved by the Engineer. Hand-laid rock slope protection shall be demolished, excavated, broken into pieces, removed, hauled and disposed to area designated by the Engineer.

Existing gabions shall be removed by cutting the cages, removing the stones and gravels, hauling and stockpiling to area designated by the Engineer. Stones removed shall be properly stockpiled for future use.

e) Other structures to be removed

All other structures to be removed aside from (a), (b), (c) and (d) within the limits of construction as indicated on the Drawings or as directed by the Engineer which obstruct or interfere the prosecution of the works shall be removed, reinstalled, hauled and stockpiled as the case maybe in accordance with this specification or as directed by the Engineer.

101.2.4 Removal of Pavement, Sidewalks, Curbs, etc.

*Supplement the following paragraph to read as:*

Where new pavement structure is to be constructed to replace an existing but deteriorated portland cement concrete pavement or asphalt concrete pavement, the slab shall be broken, removed and disposed of as specified on the drawings or as directed by the Engineer.

The use of drop ball or weight shall not be allowed in breaking damaged or deteriorated portions of existing pavement. For asphalt pavement, it shall be removed with the use of motorized grader equipped with straight or articulated blade capable of breaking, scraping and demolishing the existing asphalt concrete pavement.

For concrete pavement, the slab shall be broken with the use of self-propelled hydraulic hammer equipped with interchangeable heads for specific purposes as demolition, breaking and punching. Where necessary, transverse boundaries must be saved full-depth with saw blades.

For existing gravel pavement, it shall be excavated by the Contractor to the desired thickness and elevations shown on the Drawings or as directed by the Engineer. All excavated materials shall be removed, hauled and disposed to area designated by the Engineer. If directed by the Engineer to reuse excavated materials, such materials shall be hauled and stockpiled to proper area designated by the Engineer.

In case where the Engineer instructed the Contractor to cut or remove existing facilities, or parts thereof, such as sewers, drains, water service, gas supply or other utility lines, the Contractor shall provide and maintain satisfactory bypass and/or protection service during the construction period. When only a portion of an existing structure is to be removed, care shall be taken not to impair the value of the retained portion. The use of equipment or devices which might damage the structures, facilities or property meant to

be preserved and retained will not be permitted. During demolition, the contractor shall ensure the safety of his work and the general public.

All materials having salvage value shall be carefully removed to avoid damage and shall be placed in neat piles at the locations to be determined by the Engineer within the construction site. If so provided or directed by the engineer, approved salvaged materials shall be used in the new work, with corresponding adjustment in cost. All other salvaged materials requiring hauling elsewhere (to other individual's use) shall be loaded into the his carrier with the Contractor providing the loading equipment.

All demolished materials not intended for reuse shall be removed or deposited off the site or to disposal area provided by the Contractor and approved by the Engineer.

*Add these Sub-sections to read as follows:*

101.2.5 Removal of Existing Fence

Existing fence, whether it is barbed wire or cyclone wire as directed by the Engineer to be removed, shall be dismantled and properly be rolled. All posts, concrete or wooden and its foundation shall be pulled by hand or by other mechanical devices. All removed fences, posts and foundation shall be hauled and disposed to the area designated by the Engineer.

CHB fence, post and foundation shall be demolished manually or by mechanical devices, removed, hauled and disposed to area designated by the Engineer.

Resulting holes, trenches and pits due to removal of fences, posts and foundation shall be backfilled and compacted properly as they may level to the original ground line.

101.2.6 Removal of Existing Guardrail

Existing guardrail, whether it is made of steel and concrete or combination of the two inclusive of posts and foundations as directed by the Engineer shall be demolished manually or by mechanical devices, removed, hauled and disposed to area designated by the Engineer. Steel guardrail material intended for reuse and relocation shall be carefully dismantled, removed and stockpiled to safety area designated by the Engineer. It must be covered and protected from corrosion.

Resulting holes and pits due to removal of guardrail, posts and foundations shall be backfilled and compacted properly as they may level to the original ground line.

101.3 Method of Measurement

*Substitute this Section to read as follows:*

Measurement for the removal of structures and obstructions encountered within the roadway limits shall be paid for on a lump sum basis.

Removal of existing PCC pavement shall be measured and paid for the total net area removed and disposed from the site. No deduction from the cost for the stones and gravels to be reused.

Items not included in the Bill of Quantities shall not be paid for directly, but shall be considered as subsidiary obligation of the Contractor under other Pay Items.

101.4 Basis of Payment

*Modify this Section with the following:*

The accepted quantities shall be paid for at the Contract unit price or Lump Sum price for each of the Pay Items listed in the Bill of Quantities, which price and payment shall be full compensation for removing and disposing of obstruction, including all materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in this item. The price shall also include backfilling, compacting and hauling of salvaged materials, storage or disposal as provided herein this Specification.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 101 (1) | Removal of Existing Structures and Obstruction | Lump Sum |
| 101 (3)a | Removal of Existing PCC Pavement | Square Meter |

**ITEM 102 EXCAVATION**

102.1 Description

102.1.1 Roadway Excavation

*This Sub-section is amended to read as follows:*

Roadway excavation will include excavation and grading of roadways, parking areas, intersections, approaches, slope rounding, benching waterways and ditches; removal of unsuitable material from the roadbed and beneath the embankment areas; and excavating selected materials found in the roadway as ordered by the Engineer for specific use in the improvement. Excavation at the cut sections of the roadway shall be carried down to at least 150 mm below the subgrade level to allow for the placement of selected fill as shown on the drawings. Prior to and after the placement of selected fill, the resulting surfaces shall be compacted to the requirement of Sub-section 105.3.3, Subgrade in Common Excavation.

Roadway excavation will be classified as "Common Excavation", Soft Rock Excavation", or "Hard Rock Excavation" as indicated in the Bill of Quantities and hereunder described.

1. Common Excavation shall consist of suitable material acceptable in accordance with the contract for use in the works and is capable for compaction in accordance with the DPWH Standard Specifications to form a stable fill having side slopes as indicated on the drawings.

2. Soft Rock Excavation shall consist of hard material of suitable size for deposition and compaction in accordance with the DPWH Standard Specifications and may

consist of broken stones or other comparable hard inert material which cannot be ripped by a properly equipped tractor with a drawbar power of 160 hp.

3. Hard Rock Excavation shall consist of hard material in masses (including individual rock boulders exceeding 1.0 $m^3$ in volume) which in the opinion of the Engineer necessitates the use of blasting or with the use of a bulldozer equipped with ripper with a 350 hp or more drawbar power.

4. The classification of earthwork material shall be subject to the approval of the Engineer.

102.1.2 Borrow Excavation

*Add the following paragraph:*

Irrespective of the source of borrow materials whether as indicated in the drawings, or as directed by the Engineer or from the Contractor's own source, it is understood that materials obtained from these sources are only of the desired quality passing the requirements of the Specifications. All preparatory works, problems of access and other related matters in connection with quarrying operations shall be the sole responsibility of the Contractor.

102.2 Construction Requirements

102.2.1 General

*The first paragraph is amended with the following:*

Prior to execution of any excavation works in areas where volume of earthwork will be quantified for payment purposes, the Contractor shall conduct his own survey and submit to the Engineer for checking and approval of the corresponding cross-section of the existing ground to serve as references for accurate measurement of quantities.

102.2.2 Conservation of Topsoil

*Add the following to this Sub-section:*

Except where otherwise specified on the drawings or as directed by the Engineer, the minimum depth of stripping of topsoil shall be 15 centimeters. Stripping of topsoil may not be required underneath the existing pavements to be replaced, unless otherwise instructed.

102.2.5 Presplitting

*Add the following sentence:*

Regardless of the variance allowed in the formation of the slope in rock excavations, only the volume within the limits indicated in the drawings, unless adjusted by the Engineer, shall be considered as pay quantity.

102.2.6 Excavation of Ditches, Gutters, etc.

*Add the following to supplement this Sub-section:*

Side ditches at cut sections, whether on rock or on common soil, shall be formed and shaped as shown on the drawings. At sections of fill where the original ground and toe of slope of the designed road meet and where the original ground slopes away from the intersection such that run off water does not accumulate but flow freely away from the roadbed, no drainage ditch will be necessary. However, if the ground slopes down towards the roadbed, the provisions of drainage ditches to convey run-off water away from the road will be necessary., whether or not indicated on the drawings. Whenever the longitudinal gradient of drainage ditches constructed on common soil exceeds the maximum allowed by the drawings or when the conditions exist, which in the opinion of the Engineer, will result to damage of the system through the action of erosion, the Contractor maybe required to provide the corresponding protection. Erosion control protection whenever required shall be constructed in accordance to the relevant provisions of Part G of the Specifications.

Excavation shall be included and govern by the provisions of Item 102. Structures to be constructed related to Erosion Control shall be measured and paid for in accordance with the relevant items in the Bill of Quantities under Parts G, H or Supplemental whichever is appropriate.

102.2.7 Excavation of Roadbed Level

*Add the following to this Sub-section:*

Tolerance for excavation are as follows:

Cut Slopes in Soils = plus or minus one hundred millimeters (+/- 100 mm)

Cut Slopes in Blasted Rock = plus or minus three hundred millimeters (+/- 300 mm)

102.2.8 Borrow Areas

*Add the following into this Sub-section:*

Material from borrow areas shall normally be used for the construction of embankment or for backfill when there is no suitable materials available from road excavation. Permission to use material from borrow areas shall first obtain an approval from the Engineer. Nevertheless, the total amount of material from roadway excavation, ditch and water course excavations, and structure excavation after deduction of the material declared unsuitable by the Engineer shall be considered available for use in the work regardless of haul distance. Any surplus material resulting from the Contractor having used materials from borrow materials to replace wasted material from roadway excavation, shall not be measured for payment.

No borrow material shall be taken nearer than 30 meters from the toe of the embankment or the top of the cuts unless called for in the widening of the cuts or authorized by the Engineer. Their distance from the work sites shall not be grounds for claims for extra payment or revision of the contract price.

In addition, no borrow material be obtained from any area within two hundred (200) meters downstream of the drainage structure without approval of the Engineer.

102.2.9 Removal of Unsuitable Materials

*Supplement the following paragraphs to this Sub-section:*

In general, whenever materials of doubtful characteristics are discovered in any area where excavation is being performed or at places where embankment will be formed which, in the opinion of the Engineer, constitutes materials unsuitable for use for backfill or embankment, such materials so discovered, shall not be used in the works until the Contractor has shown by laboratory test, with the approval of the Engineer that they satisfy the specifications requirements. If the test results show otherwise and if allowed by the Engineer to have this materials be treated or blended to produce the materials of the required quality, the Contractor may perform such treatment or blending to the complete satisfaction of the Engineer. Otherwise all materials declared unsuitable by the Engineer shall be disposed of in accordance with the relevant provisions of the Specifications. In all these cases, the Contractor, in electing to undertake the testing and blending operations, shall not be entitled to extra time account of the delay or additional compensation to take care of the additional expenses he incurred.

When any material including surplus or unsuitable materials from excavation are to be disposed of outside the right-of-way, the Contractor shall first obtain a written permit from the property owner of the proposed disposal site. He shall submit to the Engineer the said permit or a certified copy thereof together with a written release by the property owner absolving the Government from any and all responsibility in connection with the disposal of material at the sites.

102.3 Method of Measurement

*Add the following paragraph to this Sub-section:*

When in the opinion of the Engineer, the control of measurement of excavation cannot be exercised since the materials are being supplied simultaneously to other work for any reasons, the measurement shall be made for the actual truck loads of materials hauled away from the site. The full volume of materials in each truck shall be considered the truck capacity multiplied by an appropriate factor to account for the looseness. The factor shall be determined by dividing the density of the material in the truck by the density of the material at the source. The Contractor will not be required to actually provide truck loads for measurement. Each truck shall be filled so that the material at the side panel is no more than 30 mm below top of the panels and shall be heaped so that in the middle the material is at least 800 mm above the top of the panels. Trucks filled in this manner shall be considered truck loads.

102.4 Basis of Payment

The volume measured shall be paid for at the Contract unit price per cubic meter which payment shall constitute full compensation for all labor, equipment, tools and incidentals necessary to complete the excavation and disposal of the materials.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|

102 (1) Unsuitable Excavation Cubic Meter

**ITEM 103 STRUCTURE EXCAVATION**

103.1 Description

*The following paragraphs shall be added:*

For purpose of classification of structure excavation as basis for measurement and payment, bridge excavation shall be measured and paid differently from other structure excavations.

Structure excavation starts after the temporary cofferdam construction is completed. The excavation shall be done mechanically and will proceed until ten(10) centimeters (minimum) higher than the abutment and pier footing designed bottom elevation. The final excavation and trimming shall be done manually to conform to the level and lines indicated in the drawings. The bottom of the excavation works shall be free from irregular mounds or any foreign materials.

Structure excavation shall be limited to the excavation for bridges, box culverts, revetments, pipe culverts, retaining walls, headwalls, wingwalls, catch basins, manholes, drop inlets, and other structures for the whole or part of the structure as shown on the drawings. The work shall consist of excavation in earth or rock within the limits of the work as specified or shown on the drawings and backfilling of these structures with suitable material. The work shall also include disposal of surplus materials, all necessary draining, pumping, bailing, sheeting, shoring, the construction of cribs and cofferdams and their subsequent removal, and the removal of existing structures or parts thereof which obstruct or encroach upon the structural excavation.

Excavation for structures will be classified for measurement and payment as "Structure Excavation Above Ordinary Water Level (OWL)" as the case may be, and such classes shall include all materials and shall be the excavation above the OWL indicated on the drawings.

"Structure Excavation Below Ordinary Water Level" shall be the excavation below the OWL indicated on the drawings.

The water elevations shown on the Drawings are approximate only and any variation in elevation found during construction shall not be used as a basis for extra compensation for this Item.

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

103.2 Construction Requirements

103.2.2 Excavation

*In paragraph (1), supplement the following:*

Any excavation carried beyond the limits shown or described on the drawings or specifications or beyond the dimension resulting from adjustments made by the Engineer shall be backfilled with materials acceptable and as directed by the Engineer.

103.2.4 Cofferdams

*Add the following into this Sub-section:*

The Contractor shall, upon request of the Engineer, submit drawings required to show in detail the procedure and method of construction of the temporary facilities as means of support or protection to enhance or facilitate excavation under critical situations as when the presence of water or other natural phenomenon threaten the stability of the permanent structures to be constructed therein.

103.3 Method of Measurement

The quantities to be paid for shall be measured in cubic meter in original position of materials excavated in conformity with the lines, grades, elevations and dimensions shown in the Drawings and accepted by the Engineer.

103.3.3 Foundation Fill

The volume of foundation fill to be paid for shall be measured in cubic meter in final position of gravel material placed, compacted, completed and accepted by the Engineer.

103.3.5 Basis of Payment

*Item No. (4) is deleted and substituted with the following:*

Shoring, cribbing, and related protective works if required in the construction and not paid separately shall be considered subsidiary to the item for which they are constructed and utilized.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 103 (1) | Structure Excavation | Cubic Meter |
| 103 (2)a | Bridge Excavation Common, Above OWL | Cubic Meter |
| 103 (2)c | Bridge Excavation Common, Below OWL | Cubic Meter |
| 103 (3)a | Gravel Foundation Fill | Cubic Meter |
| 103(6) | Pipe Culverts and Drain Excavation | Cubic Meter |
| 103(7) | Granular Backfill for Pipe Culvert | Cubic Meter |

**ITEM 104 EMBANKMENT**

104.2 Material Requirements

*The following paragraphs shall be supplemented:*

All materials excavated from roadway, structures, drainage and ditches to the extent that they are suitable in the formation of embankment and backfill shall be utilized as such.

Selected material to be used for embankment shall be river run gravelly-sand as shown and specified on the drawing or as directed and approved by the Engineer.

*Modify the second sentence of the third paragraph to read as follows:*

The material shall have the plasticity index ranging from 6-11 as determined by AASHTO T90, a liquid limit of not more than 35 as determined by AASHTO T89 and a minimum soaked CBR of 7% at 95% MDD.

104.3 Construction Requirements

104.3.2 Methods of Construction

*Add the following paragraph:*

In places where the road has to be raised by embankment over the existing road, as shown on the Drawings or directed by the Engineer, the surface of the existing road shall be ripped, to a depth specified on the Drawings. It shall then be bladed, reshaped and compacted to the same or greater density as the material to be placed thereon provide a uniform foundation for the embankment material to follow.

The existing concrete pavement less than 100 centimeters below subgrade shall be broken down in such a way that it could be disposed of in a place designated by the Engineer.

104.3.3 Compaction

*Supplement the following after the last paragraph:*

Placing of fill shall be suspended if, in the opinion of the Engineer, there is no adequate compaction and grading equipment available on site in operating condition, to enable the fill to be shaped and compacted immediately upon placement.

104.3.5 Protection of Structures

*Add the following to this Sub-section:*

Any movement or displacement or whatever defect on the structures that may result due to improper method of backfilling and compacting shall be corrected by the Contractor at his own cost and shall not be entitled to any extra time on account of the delay incurred to correct the defect.

104.3.10 Foundation of Embankment on Existing Pavement

Prior to an execution of an embankment upon existing pavement, the Contractor shall scarify the existing pavement as directed by the Engineer. Gravel surfacing be scarified and thoroughly loosened to a minimum depth of 100 mm.

104.4 Method of Measurement

*This Section is modified and supplemented as follows:*

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 detained from any source including haulage.

Material from excavation per Item 102 which is used in embankment and accepted by the Engineer will be paid under Item 102, Excavation.

Any material coming from roadways, structures, drainage or ditches excavations which are suitable for use but are replaced by the Contractor with borrow materials without prior approval by the Engineer, shall not be measured for payment.

104.5 Basis of Payment

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 104 (1) | Embankment from Roadway Excavationl | Cubic Meter |
| 104 (3) | Embankment from Borrow Excavation | Cubic Meter |
| 104 (4) | Embankment from Borrow Excavation (For Bridges) | Cubic Meter |

**ITEM 105 SUBGRADE PREPARATION**

105.3 Material Requirements

105.3.3 Subgrade in Common Excavation

*Add to this item the following:*

a) Common excavation is considered to occur where the designed subgrade level cuts into the original ground (in most cases this is the existing road surface) and in earth cuts where the proposed road centerline deviates from the existing centerline wholly or in part of the existing roadway width.

b) All material within 30 centimeters below subgrade level, when moulded at the optimum moisture content, as determined by AASHTO T99 and at 95 percent of the maximum dry density, as determined by AASHTO T180, shall have the unsoaked CBR value of 15 in cut and 25 in fill.

c) The roadbed material in cut shall be moistured or dried to a uniform moisture content within + or –2% of optimum moisture and then thoroughly compacted to :

- 95% of the maximum density as determined by AASHTO T180 in case the roadbed will constitute the subgrade of the new pavement.

- 100% of the maximum dry density, as determined by AASHTO T180, in case the roadbed will constitute the subbase of the new pavement.

105.3.6 Subgrade on Existing Pavement

*Add the following paragraph:*

Where the existing deteriorated Portland Cement Concrete Pavement (PCCP) or Asphalt Concrete Pavement (ACP) to be replaced requires the formation of embankment to bring it to the required grade, the Contractor, if not specified on the drawings or upon instruction of the Engineer, shall scarify, reshape and recompact the surface to the required compaction density prior to the placement of embankment. Subsequent formation of fill up to the subgrade level shall satisfy the degree of compaction as prescribed under Sub-item 104.3.3 after which the subgrade shall be prescribed as outlined in Sub-item 105.3.5.

In both excavation and embankment formation, the areas covered by widened road sections and road shoulders are included in the same process of stabilization.

105.4 Method of Measurement

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

Insert the words "at or" between "ground" and "below" in paragraph (1).

*Add paragraphs (3) and (4):*

3) The preparation of the subgrade at locations where unsuitable materials have been excavated and disposed shall be measured in square meters which shall be calculated from surveys carried out defining the limits as delineated by the Engineer.

4) Should a leveling course is necessary to correct the irregularities of the prepared subgrade or for non-compliance to the maximum allowable tolerances prescribed in Sub-item 105.3.2, such course shall not be measured separately but is deemed to have been included in the Pay Item for Embankment.

105.5 Basis of Payment

Payment will be made under:

| *Pay Item No.* | Description | Unit of Measurement |
|---|---|---|
| 105 (1) | Subgrade Preparation (Common Materials) | Square Meter |

# PART D

# SUBBASE AND BASE COURSE

## PART D - SUBBASE AND BASE COURSE

### ITEM 200 AGGREGATE SUBBASE COURSE

200.2 Material Requirements

Aside from the first paragraph, this Sub-section is modified and supplemented with the following:

The sources of aggregate subbase are listed in the Soils and Materials Report to serve as guide of their locations. These include the results of tests conducted on them to determine their individual quality and characteristics.

The Contractor shall carry out all relevant tests required prior to their use and whenever such tests become necessary as determined by the Engineer.

Table 200.1 "Grading Requirements" is replaced by the following table, and must have a smooth grading curve.

**TABLE 200.1 – GRADING REQUIREMENTS FOR AGGREGATE SUBBASE**

| SIEVE DESIGNATION | | |
|---|---|---|
| **Standard (mm)** | **Alternate US Standard** | **Mass Percent Passing** |
| 50 | 2" | 100 |
| 25 | 1" | 55-80 |
| 9.5 | 3/8" | 40-70 |
| 2 | No. 10 | 20-45 |
| 0.425 | No. 40 | 10-30 |
| 0.075 | No. 200 | 5-15 |
| | | |

The portion passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and a plasticity index not greater than 12 as determined by AASHTO T89 and T90, respectively and sand equivalent value of not less than 40 as determined by AASHTO T176. When used for filling of shoulder as shown on the drawings, the plasticity index shall not be more than 8 and the liquid limit shall be 30% maximum.

The material shall have a soaked CBR value of not less than 25% determined in accordance with AASHTO T193. The CBR value shall be obtained at the maximum dry density by AASHTO T180, Method D.

The coarse aggregate material retained on a 4.75 mm (No. 4) sieve shall have a mass percentage of wear not exceeding 50 by the Los Angeles Abrasion Test as determined by AASHTO T96.

If fillers, in addition to that naturally present in the aggregate subbbase materials are necessary for meeting the grading requirements and/or for satisfactory bonding of material, it shall be uniformly blended with the subbase course material on the road. The material for such purpose shall be obtained from sources approved by the Engineer, shall be free from hard lumps and shall not contain more than 15 percent of material retained on the No. 4 sieve.

After each layer of subbase course material has been placed with blending material, when required, shall be thoroughly mixed to the full depth of the required layer by scarifying and blading. When and if directed by the Engineer, the materials shall be watered to prevent segregation of particle sizes and to obtain the moisture content required for compaction. When uniformity attained, the mixture shall be spread smoothly to the cross-section shown on the drawings.

200.3 Construction Requirements

200.3.3 Spreading and Compacting

*Delete the last paragraph of this Sub-section and substitute the following:*

The compacted dry density of each layer of the compacted subbase shall not be less than 98 percent of the maximum dry density determined according to AASHTO T180, Method D. The field density shall be determined according to AASHTO T191.

200.4 Method of Measurement

Aggregate subbase course will be measured by the cubic meter and the quantity to be paid for shall be the design volume compacted in-place as shown on the Drawings, and accepted by the Engineer in the completed subbase course.

200.5 Basis of Payment

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 200 (1) | Aggregate Subbase Course | Cubic Meter |

**ITEM 201 AGGREGATE BASE COURSE**

201.2 Material Requirements

*Aside from the first paragraph, this Sub-section is modified and supplemented with the following:*

The sources of aggregate base are listed in the Soils and Materials Report to serve as guide of their locations. These include the results of tests conducted on them to determine their individual quality and characteristics.

The Contractor shall carry out all relevant tests required prior to their use and whenever such tests become necessary as determined by the Engineer.

Unless otherwise specified and determined by the Engineer, Table 201.1 "Grading Requirements" is shown as follows

**TABLE 201.1 – GRADING REQUIREMENTS FOR AGGREGATE BASE**

| Sieve Designation | | Mass Percent Passing | |
|---|---|---|---|
| Standard mm | Alternate US Standard | Grading A | Grading B |
| | | | |
| 50 | 2" | 100 | |
| 37.5 | 1-1/2" | - | 100 |
| 25.0 | 1" | 60 - 85 | - |
| 19.0 | 3/4" | - | 60 - 85 |
| 12.5 | 1/2" | 35 - 65 | - |
| 4.75 | No. 4 | 20 - 50 | 30 - 55 |
| 0.425 | No. 40 | 5 - 20 | 8 - 25 |
| 0.075 | No. 200 | 0 - 12 | 2 - 14 |
| | | | |

If fillers, in addition to that naturally present, are necessary for meeting the grading requirements and/or for satisfactory bonding of material, it shall be uniformly blended with the base course material on the road unless otherwise specified or approved by the Engineer. The material for such purpose shall be obtained from sources approved by the Engineer. Filler shall be taken from sources approved by the Engineer, shall be free from hard lumps and shall not contain more than 15 percent of material retained on the No. 4 sieve.

201.3.3 Spreading and Compacting

*Delete the last paragraph of this Sub-section and substitute the following:*

The compacted dry density of each layer of the compacted base shall not be less than 98 percent of the maximum dry density determined according to AASHTO T180, Method D. The field density shall be determined according to AASHTO T191.

201.4 Method of Measurement

Aggregate base course will be measured by the cubic meter and the quantity to be paid for shall be the design volume compacted in-place as shown on the Drawings, and accepted by the Engineer in the completed base course.

201.4 Basis of Payment

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 201 (1) | Aggregate Base Course | Cubic Meter |

# PART E

# SURFACE COURSES

## PART E - SURFACE COURSES

### ITEM 300 AGGREGATE SURFACE COURSE

300.1 Description

This Item shall consist of a wearing or top course composed of gravel or crushed aggregate and filler material, whichever is called for in the Bill of Quantities, constructed on a prepared base in conformity with the lines, grades and typical cross-sections shown on the Drawings.

300.2 Material Requirements

Aggregate to be used under this Item shall be natural material, hard, durable particles or fragments of stone or gravel and sand or other fine mineral particles free from vegetable matter and lumps or balls that if compacted, it can readily form a firm and stable layer. When tested by AASHTO T11 and T27, the aggregate shall conform to the grading requirements tabulated hereunder:

| Sieve Designation | | Mass Percent Passing | | | |
|---|---|---|---|---|---|
| Standard mm | Alternate U.S. Standard | Grading A | Grading B | Grading C | Grading D |
| 25 | 1" | 100 | 100 | 100 | 100 |
| 9.5 | 3/8" | 50-85 | 60-100 | - | - |
| 4.75 | No. 4 | 35-65 | 50-85 | 55-100 | 70-100 |
| 2.00 | No. 10 | 25-50 | 40-70 | 40-100 | 55-100 |
| 0.425 | No. 40 | 15-30 | 25-45 | 20-50 | 30-70 |
| 0.075 | No. 200 | 5-20 | 5-20 | 6-20 | 8-25 |

The coarse aggregate material retained on the 2.00 mm (No. 10) sieve shall have a mass percent of wear by the Los Angeles Test (AASHTO T96) of not more than 45.

When tested by AASHTO T89 and T90, the fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and a plasticity index ranging from 4 to 9.

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

300.3 Construction Requirements

300.3.4 Surface Course Thickness and Tolerances

Thickness of aggregate surface course shall be in accordance with the thickness shown on the Drawings. The allowable tolerances shall be as follows:

| | |
|---|---|
| Permitted variation from design thickness of layer | +15mm<br>- 5 mm |
| Permitted variation from design level of surface | +15mm<br>- 5 mm |
| Permitted surface irregularity measured by | 5mm |

| | |
|---|---|
| 3-m straight edge | |
| Permitted variation from design crossfall or camber | +0.2 % |
| Permitted variation from design longitudinal grade over 25 m in length | +0.1 % |

300.4 Method of Measurement

The quantity to be paid for shall be measured by the cubic meter of aggregate surface course including all fillers, compacted in-place, completed and accepted by the Engineer. No allowance will be given for material placed outside the design limits shown on the cross-sections.

300.5 Basis of Payment

The accepted quantity as provided in Section 300.4, Method of Measurement shall be paid for at the Contract unit price shown in the Bill of Quantities. The price and payment shall constitute full compensation for furnishing, handling, placing and spreading, watering and compacting all materials, including all labor and equipment, tools and incidentals necessary to complete the Item.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 300 (1) | Gravel Surface Course | Cubic Meter |

**ITEM 302 BITUMINOUS TACK COAT**

302.1 Description

This Item shall consist of preparing and treating an existing bituminous or cement concrete surface with bituminous material in accordance with the design Drawings. The work is the preparation for the construction of a bituminous surface course.

302.2 Material Requirements

Bituminous material shall be either Rapid Curing (RC) Cutback or Emulsified Asphalt or whatever is called for in the design drawings or in the Bill of Quantities and it shall conform to the requirements of Item 702, Bituminous Material.

302.3 Construction Requirements

302.3.1 Surface Condition

Tack coat shall be applied only to surface which are dry or slightly moist. No tack coat shall be applied when the weather is foggy or rainy.

*Add these paragraphs for surface preparation:*

Prior to the application of the tack coat by pressure distributor of not less than 1000 liters/day, loose materials shall be removed from the surface. Mechanical sweepers, blowers and hand brooms shall clean the surface until it is free from dust. On a soil

surface or granular subbase, the clean surface shall be given a light application of water and allowed to dry to a surface dry condition before bituminous material is applied. No traffic is permitted on the surface after it has been prepared to receive the spray coat.

302.3.2 Equipment

Equipment shall conform in all respects to Subsection 301.3.2 of the DPWH Standard Specifications for Highways, Bridges and Airports, 1995, Volume II.

302.3.3 Application of Bituminous Material

*Modify this Subsection to read as follows:*

Unless shown on the Drawings or otherwise specified the Contractor shall submit to the Engineer the details of the material selected for tack coat before commencing the work. The Engineer may require trials to confirm the product's suitability. Bitumen heating shall be by method that does not introduce free stream or moisture to the material. The rate of application of Emulsified Asphalt shall be within the range of 0.2 to 0.7 liter/$m^2$, the exact rate as determined by the Engineer.

The Contractor shall take extra care so that the application of bituminous material is not in excess of the specified amount. If there's any excess in the amount, it shall be blotted by sand or removed as directed by the Engineer. Hand spraying device shall be used to all areas inaccessible by the distributor.

302.4 Method of Measurement

*Modify this Section as follows:*

The bituminous tack coat shall be measured by the metric tonne placed, completed and accepted by the Engineer.

302.5 Basis of Payment

The accepted quantity prescribed in Section 302.4, Method of Measurement shall be paid for at the Contract unit price shown in the Bill of Quantities. The price and payment shall be full compensation for furnishing and placing material, surface preparation, spraying, and including all labor, equipment, tools and other incidentals necessary to complete the Item.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 302 (1) | Bituminous Tack Coat | Metric Tonne |

**ITEM 310 BITUMINOUS CONCRETE SURFACE COURSE, HOT-LAID**

*Modify the whole text of this Item as follows:*

310.1 Description

This Item shall consist of constructing a bituminous concrete surface course composed of aggregates, mineral filler, and bituminous material mixed in a central plant, constructed and laid hot on the prepared base in conformity with the lines, grades, thickness and cross-sections shown on the design Drawings or established by the Engineer.

310.2 Material Requirements

The Contractor, at least three weeks prior to production, shall submit in writing a job-mix formula for each mixture supported by laboratory test data along with samples and sources of the components and viscosity-temperature relationships information to the Engineer for testing and approval. No substitution shall be made in the materials or mix without additional tests to show that the quality of bituminous concrete material is satisfactory.

310.2.1 Composition and Quality of Bituminous Mixture (Job-Mix Formula)

It shall be same as Subsection 307.2.1 of the DPWH Standard Specifications for Highways, Bridges and Airports, 1995, Volume II

310.2.2 Bituminous Material

It shall be either Medium Curing (MC) Cut-back Asphalt or Asphalt Cement, whichever is called for in the Bill of Quantities and shall conform to the requirements of Item 702, Bituminous Materials. The penetration grade, type and grade of bituminous material shall be as specified on the Drawings or by the Engineer.

310.2.3 Aggregates

Aggregates to be used shall conform to the requirements of Section 703.5, Aggregate for Bituminous Concrete of Item 703, Aggregates.

310.2.4 Mineral Filler

It shall conform to the requirements of Item 703A, Mineral Filler.

310.2.5 Hydrated Lime

It shall conform to the requirements of Item 701, Construction Lime.

*Add this Sub-section to read as follows:*

310.2.6 Material for Asphalt Mixture Wearing Course

Bituminous concrete material for asphalt mixture wearing course shall be the same as herein this specification. The required material for tack coat for this course shall be the same as those in Item 302, Bituminous Tack Coat having rate of application ranging from 0.20 to 0.70 liter per square mater. The exact rate shall be determined by the Engineer. The thickness of wearing course shall be in accordance with the design drawings.

310.4 Method of Measurement

a) The quantity to be measured and paid for bituminous concrete surface shall be the total net weight in metric tonnes of asphalt mixture provided as surface course, placed, compacted and accepted by the Engineer.

b) The quantity to be measured and paid for asphalt mixture wearing course shall be the total net area in square meter provided as wearing course, placed, compacted and accepted by the Engineer. The cost shall include the bituminous tack coat.

310.5 Basis of Payment

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 310 (1) | Bituminous Concrete Surface Course, Hot-Laid | Metric Tonne |
| 310 (2) | Asphalt Mixture Wearing Course Including tack coat, (t = 50mm) | Square Meter |

**ITEM 311 PORTLAND CEMENT CONCRETE PAVEMENT**

311.2 Material Requirements

311.2.11 Proportioning, Consistency and Strength of Concrete

*Supplement the following to this Sub-section:*

The Contractor shall submit design mixes obtained from samples made in accordance with Standard Method of Making and Curing Concrete Compression and Flexure Tests Specimen in the Laboratory for each strength required, stating the proposed slump and the proportioning weights of cement, saturated surface aggregates and water. These mixes shall be proven by preliminary tests thirty (30) days before concreting and shall show a 28-day strength of fifteen (15%) percent higher than the ultimate strength required. No substitution shall be made in the materials or mix without additional tests to show that the quality of concrete is satisfactory.

The proportion of aggregate to cement for concrete pavement shall be such that to produce a mixture which will work readily into the corners and around reinforcements, if any, with the method of placing concrete without permitting the materials to segregate or allow free water to collect on the surface. The combined aggregates shall be such compositions of sizes that when separated on the No.4 standard sieve, the weight passing the sieve (fine aggregate) shall not be less than thirty (30%) percent or greater than fifty (50%) percent of the total, except that these proportions do not necessarily apply to lightweight aggregates. The method of measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked anytime during work.

Aggregates shall be measured preferably by weight and to within one (1%) percent. Water shall be measured by weight or volume to within one and one-half (1 1/2%) percent. The water shall in no case, exceed 23 liters per bag (40 kg) of cement for all concrete with specified minimum flexural strength of 550 psi when tested by the third-

point method or 650 psi by the mid-point method and a compressive strength of 3,500 psi.

Job mix adjustment of water content shall be allowed only on permission of the Engineer, provided that cement is also added to keep the original water-cement ratio of the design mix.

311.3 Construction Requirements

311.3.1 Quality Control of Concrete

*Add the following paragraph at the end of this Sub-section:*

The Owner, his duly authorized representative or the Engineer shall have the right to order the test of any materials supplied by the Contractor entering into concrete pavement or reinforced concrete pavement whenever there is a reasonable doubt as to their suitability for the purpose. Such test shall be in accordance with the standards of the ASTM or AASHTO for testing materials noted elsewhere in the Specifications. Samples shall be provided by the Contractor without cost to the Owner. Expenses for testing and cost of transporting samples to the laboratory shall be borne by the Contractor. Copies or results of tests shall be furnished to the Owner promptly.

311.3.7 Mixing Concrete

*Add the following to this Sub-section:*

If mixing, transporting and depositing of concrete is done other than the procedure prescribed under this sub-clause is allowed by the Engineer, the Contractor shall remain to be solely responsible to observe and produce concrete with the same quality required in the Specifications.

No hand mixing shall be allowed during concreting operations except on emergency cases such as batching plant breakdown and shall stop at the first allowed construction joint. All concrete shall be machine mixed for at least 1½ minutes after all materials including water are in the mixing drum.

The batching plant shall be of an approved capacity and type which will insure a uniform distribution of materials throughout the mass. It shall be equipped with a device for accurately measuring and controlling the amount of mixing water in each batch. The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand and water to coat the inside of the drum without reducing the cement concrete of the mix to be discharged.

311.3.9 Placing Concrete

*Supplement this Sub-section with the following:*

Concrete shall be deposited on its final position in such a manner to require minimal re-handling or flowing without segregation. Placing of concrete shall be preferably done by the use of buggies, buckets or wheelbarrows. Unless truck mixers or non-agitating hauling equipment are equipped with means to discharge concrete without segregation

of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on a grade in such manner as to prevent segregation.

No chutes will be allowed except to transfer concrete from hoppers to buggies, wheelbarrows or buckets on which case the chutes shall exceed six (6) meters in aggregate length. Placing of concrete with a free drop or fall of more than 1.5 meters shall not be allowed except when sheet metal conduits, pipes or elephant trunks are employed.

When stoppages of concreting operations eventually occur for any reason, construction joints shall be placed horizontally or as directed by the Engineer and be provided with shear keys and dowels to develop bond. Construction joints shall be approved by the Engineer

The Contractor shall provide forms that will produce the placed concrete in a correct and aligned manner. Plywood, metal or surfaced lumber forms shall be used for all exposed concrete surfaces. Plastering in general shall not be allowed so that extra care shall be exercised by the Contractor.

Forms and shoring shall not be removed until the concrete has adequately set and stable enough to withstand the anticipated loadings, and in no case less than two (2) days after concreting. Removal of forms may be allowed earlier provided that test samples of concrete are taken and are shown to withstand safely dead and construction loads.

311.3.18 Protection of Pavement

*Modify this Sub-section with the following:*

The contractor shall protect the pavement and its appurtenances both against public traffic and traffic caused by its own construction equipments. This shall include watchmen to direct traffic, the erection of and maintenance of warning signs, lights, pavement bridges or crossovers, etc.

Any damage to the pavement from the opening of traffic for public use until final acceptance shall be repaired or replaced by the contractor without additional compensation.

311.3.21 *Opening to Traffic*

*Modify this Sub-section with the following:*

The Engineer will decide the opening of pavement to traffic after test specimens molded and cured in accordance with AASHTO T23 have attained the minimum strength requirements in Subsection 311.2.11. If such tests are not conducted prior to the specified age, the pavement shall not be opened to traffic until fourteen (14) days after the concrete was placed. Before opening to traffic, the pavement shall be cleansed thoroughly and all joints shall be sealed completely.

311. 3.22 Tolerance and Pavement Thickness

*Add the following to Sub-section 311.3.22 (2), Pavement Thickness:*

Outside and inner shoulders of super elevation equal or greater than seven percent (7%) should be paved with 15 centimeters thick Portland Cement Concrete Pavement (PCCP) between P.C. and P.T. or as shown on the drawings.

311.4 Method of Measurement

*Add at the end of the paragraph:*

"All reinforcing steel bars incorporated in the concrete pavement shall not be measured separately for payment, cost of which has been considered paid under this particular Item.

*Supplement the following to this Section:*

The area to be paid for under this Item shall be the number of square meters of concrete pavement placed and accepted in accordance with the drawings measured from the outside edge of width to the other edge by the length horizontally measured along the center line of each roadway or ramp. Any curb and gutter placed shall not be included in the area of concrete pavement measured for payment.

Shoulder paved for a superelevation of more than 7.0 % shall be measured one (1) meter from the outside and innerside edge by the length horizontally measured along PC to PT.

311.5 Basis of Payment

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

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 311 (1) b | PCC Pavement (Plain), t=250 mm | Square Meter |
| 311 (1) c | PCC Pavement (Plain), t=230 mm | Square Meter |
| 311 (2) | PCC Pavement (Reinforced), t=300 mm | Square Meter |

# PART F

# BRIDGE CONSTRUCTION

## PART F - BRIDGE CONSTRUCTION

### ITEM 400 PILING

*All provisions of this Item in connection with Pre-cast Concrete Piles and Cast-in- place Concrete Bored Piles are modified as follows:*

400.1 Description

400.1.1 Scope

This work shall consist of the furnishing, driving, splicing and cutting off of piles in accordance with these Specifications and in conformity with the Drawings and/or as designated by the Engineer. It also includes the construction of facilities for construction convenience, without which will either slow down the works or completely paralyze the operations relative to bridge construction.

400.1.2 Test Piles

Piles for pile driving tests which are shown on the Drawings shall conform to the requirements for piling as specified and designated by the Engineer. If ordered by the Engineer that driven test piles will not become part of the completed structure, test piles will be provided in addition to the permanent or regular piles. However, if so ordered by the Engineer to be part of the completed structure, test piles of the dimensions shown on the Drawings will be so correctly positioned, be properly driven to refusal or to such tip elevation or approximate bearing value as the Engineer may request. Test piles maybe cut-off at the elevation directed and approved by the Engineer. Piles driven by the Contractor for pile driving tests for his own use in determining the lengths of piles to be furnished maybe similarly located that they also maybe cut-off and become part of the completed structure provided that such test piles conform to the requirements for piling. Any driven pile, in which after serving the purpose as a test pile is found unsatisfactory for utilizations in structure, shall be removed if so ordered by the Engineer, or it shall be cut-off below the ground line and beams. Test piles shall generally be driven with the same equipment that is used for driving succeeding foundation piles.

In dynamic testing, when diesel hammers or other types of hammers are to be used for driving end bearing piles or friction piles, the bearing capacity shall be thoroughly checked by pile driving formula chosen by the Contractor and approved by the Engineer. The Contractor shall be in advance carry out test piling for calibration purposes so as to determine the energy developed by the hammer. The Contractor may elect one of the following methods for calibration.

a) By test driving piles of the same type successively with diesel hammer, or by driving two different piles with diesel hammer and gravity or single acting hammer according to detailed instructions given by the Engineer. The test shall be made at site with homogeneous soil conditions.

b) By driving test piles to a depth determined by the Engineer.

Calibration test shall be made at not less than two different sites until the results are satisfactory to the Engineer.

Calibration of diesel hammer may not be required if the hammer has been previously calibrated under similar soil conditions and for the same size and type of pile, provided that the calibration data is accepted by the Engineer.

*Add the following to supplement this Sub-section:*

400.1.2.1 Report

The report of the Test Pile shall include the following information:

A. General

1) Project identification
2) Project location
3) Test site location
4) Owner
5) Structural engineer
6) Geotechnical engineer
7) Pile contractor
8) Test boring contractor
9) Designation and location of nearest test boring with reference to location of the test pile and vertical control datum
10) Log of nearest test boring
11) Horizontal control datum
12) Vertical control datum

B. Pile Installation Equipment

1) Make, model, type, size, and recent service history of hammer
2) Weight of hammer and ram
3) Rated and actual stroke of ram
4) Rated energy of hammer
5) Rated capacity of boiler or compressor
6) Type, dimensions and stiffness values of cap-block and pile cushion
7) Weight and dimensions of drive cap
8) Detailed description and drawings of follower
9) Size of pre-drilling or jetting equipment
10) Type, size, length, weight and stress transmitting area of mandrel
11) Detailed specifications of any special arrangement for applying impact force.

C. Test Piles

1) Identification and location of test pile(s)
2) Working load of pile(s)
3) Type of pile(s)
4) Test pile material including basic specifications including strength
5) Tip and butt dimension of pile(s)
6) Date pre-cast test piles made
7) Concrete cylinder strengths when pile tested (approximate)
8) Description of internal reinforcement used in test pile (size, length, number of longitudinal bars, arrangement, spiral or tie steel)

9) Description, location, size, weight and where applicable catalogue data concerning splices
10) Condition of pre-cast piles including spalled areas, cracks, head surface and straightness of piles
11) Effective pre-stress
12) Which piles are vertical or batter
13) Degree of batter
14) Final elevation of test pile butt(s) referenced to fixed datum

D. Pile Installation

1) Date driven (installed)
2) Date concreted (cast-in place)
3) Volume of concrete or grout placed in pile
4) Grout pressure used
5) Description of pre-excavation or jetting (depth, size, pressure, duration)
6) Operating pressures for all hammers
7) Throttle setting-diesel hammer during testing
8) Fuel type diesel-hammer
9) Description of special installation procedures used such as piles cased off
10) Type and location of pile splices
11) Driving records
12) Final penetration resistance
13) Visual observations of stroke of ram during final driving and blow per drive of hammer
14) Penetration for last two series of five blows with the hammer
15) Penetration resistance during restrike
16) When cap-block replaced (indicate on log)
17) When pile cushion replaced (indicate on log)
18) Cause and duration of interruption in pile installation
19) Notation of every unusual occurrences during installation

E. Dynamic Testing

1) Description, calibration data and date of calibration of all components of the apparatus for obtaining dynamic measurements and apparatus for recording, reducing and displaying data
2) Data tested
3) Test pile identification
4) The modulus of elasticity, density, and wave speed of test pile and how it determined
5) Sequence in pile driving test, carried out such as end of initial driving and beginning of re-strike
6) Length of pile, as being driven, embedded, and below apparatus for obtaining dynamic measurements
7) Penetration resistance during dynamic testing
8) The range, average and standard deviation of the measurements of maximum and minimum compassion force
9) The range, average and standard deviation of the impact velocity data
10) The range, average and standard deviation of the measurements of maximum acceleration

11) The range, average and standard deviation of the measurements of final penetration of the pile
12) The range, average and standard deviation of the maximum and final energy data
13) Which one-dimensional wave theory was used for the analysis of the pile driving, give reference
14) The variables entered into the wave theory, such as damping, quake and resistance
15) When applicable, the computed soil resistance acting on the pile at time of testing and how it computed
16) Comments on the integrity of the pile

Data and force, velocity, acceleration, penetration and energy can be recorded at any point of interest during the pile driving. The standard deviation of these values should be calculated for a minimum of 20 consecutive hammer blows.

400.1.3 Static Load Test (For 1500mm Bored Piles)

A loading test shall consist of the application of a load equal to not less than twice the specified bearing capacity or as otherwise directed by the Engineer.

Test Procedure:

Static Load Tests shall be performed using procedures and equipment as set out in ASTM Specification D1143 – quick load test method. A load cell shall be utilized for all static tests – jack pressure alone is not sufficient. The requirements of ASTM D1143 shall take precedence over any conflicting requirements contained in the remainder of this clause, either in the Standard Specifications or the Special Provisions. The allowable pile capacity shall be assessed based on Davison's Failure Criterion with a factor of safety F.S. = 2.0. The maximum load to be applied during the test shall be two (2) times the specified allowable bearing capacity.

The Contractor shall submit to the Engineer detailed Drawings of the loading system and apparatus he intends to use at least 3 weeks in advance of the tests. The apparatus shall be so constructed as to allow the various increments of the load to be placed gradually without causing vibration to the test piles.

Suitable approved apparatus to determine the accurate loading on the pile and the settlement of the pile under each increment of load shall be supplied by the Contractor. The apparatus shall have a working capacity of three times the designed load for the pile being tested.

All pile load settlements shall be measured by adequate and accurate devices, such as gauge and shall be checked by means of an Engineer's level. Increments of deflection shall be read and recorded just after each load increment is applied and at 15 minute intervals thereafter. The safe allowable load shall be considered as 50 percent of the load applied, which after 48 hours of continuous application has caused not more than 6 mm of permanent settlement measured at the top of the pile.

The first load to be applied to the test pile shall be 60% of the pile designed load and first increment shall be up to the pile designed load. The load on the pile shall be increased to twice the designed load by applying additional loads in three equal increments. A minimum period of two (2) hours shall intervene between the applications

of each increment, except that no increment shall be added until a settlement of less than 0.1 mm is observed for a 15-minute interval under the previously applied increment. If there is doubt as to whether the test pile will support the test load, the load increments shall be reduced by 50 percent, at the discretion of the Engineer, in order that a more closely controlled failure curve may be plotted. The full test load shall remain on the test pile not less than 48 hours. The full test load shall then be removed and the permanent settlement shall be read and recorded.

When directed by the Engineer, load test shall then be continued beyond the double designed load in 10-ton of increments to failure or a maximum of 3 times the designed load.

The pile maybe considered failure when the total permanent settlement exceeds 6 mm.

400.2 Material Requirements

400.2.3 Concrete Piles

400.2.3.1 Pre-cast Concrete Piles

Pre-cast Concrete Piles shall be 450mm x 450mm with structural steel V-shape pile tip or as shown on the drawings. Concrete Class AA and reinforcing steel for piles shall meet all the requirements as provided under Item 405, Structural Concrete and Item 404, Reinforcing Steel respectively or as indicated on the Drawings.

400.2.3.2 Cast-in- place Concrete Bored Piles

Concrete for cast-in-place bored piles shall be Class AA1 with minimum compressive strength of 28 MPa as prescribed in Item 405, Structural Concrete. The maximum size of aggregate shall not exceed 25 mm. Bored pile ranges from 1200 mm to 1500 mm diameter as shown on the Drawings.

Reinforcing steel bars shall conform to the requirements of Item 404, Reinforcing Steel.

400.2.4 Steel Shells

Shells or steel casing for cast-in-place concrete bored piles, unless otherwise called for on the Drawings, shall have a minimum thickness of 5 mm conforming to AASHTO M 183.

400.2.5 Steel Pipes

Steel pipes which are being filled with concrete shall conform to the requirements of ASTM A 252, Grade 2, Welded and Seamless Pipe Piles. Closure plates for closed piles shall conform to the requirements of AASHTO M 183.

400.3 *Construction Requirements*

400.3.1 Location and Site Preparation

Piles shall be used where indicated on the Drawings or as directed by the Engineer. All excavations for the foundations on which piles are to be driven shall be completed

before the driving is began, unless otherwise specified or approved by the Engineer. After driving is completed, all loose and displaced materials shall be removed from around the piles by hand excavation, leaving clean solid surface to receive the concrete coping of the foundations.

400.3.2 Determination of Pile Lengths

The criteria for pile length and bearing capacity will be determined by the Engineer according to the results from test piling. The pile shall be driven to such depths, that the bearing load indicated on the Drawings are obtained. The criterion for pile length maybe one of the following:

a) Piles in sand and gravel shall be driven to a bearing value determined by the use of the pile driving formula or as decided by the Engineer.

b) Piles in clay shall be driven to the depths ordered by the Engineer. However, the bearing value shall be controlled by the pile driving formula if called for by the Engineer.

c) Piles shall be driven to refusal on rock or hard layer when so ordered by the Engineer.

The Contractor shall be responsible for obtaining the correct pile lengths and bearing capacities according to the criterion or criteria given by the Engineer.

400.3.3 Pile Driving

All piles shall be driven accurately to its vertical or to its batter position as shown on the drawings. All piles shall, after driving, be within 150 mm from the theoretical location underneath the pile cap or underneath the superstructure in the case of pile bents. All piles pushed up by the driving of adjacent piles or by any other cause shall be re-driven.

Piles shall be used in places where a recommended penetration of three (3) meters in firm materials is obtained or unless otherwise ordered by the Engineer. Where a soft upper stratum overlies a hard stratum, the piles shall penetrate the hard material a sufficient depth to fix the ends rigidly. The recommended penetration of three (3) meters shall be subject to change depending on the results of the pile test.

All pile driving equipment is subject to the Engineer's approval. The Contractor is responsible for sufficient weight and efficiency of the hammers to drive the piles down to the required depth and bearing capacity. Hammers shall be gravity hammers, single and double acting steam or pneumatic hammers or diesel hammers. Gravity hammers shall not weigh less than 60 % of the combined weight of the pile and driving head but not less than 2,500 kg. The fall shall be adjusted so as to avoid injury to the pile. The plant and equipment furnished for steam hammers shall have sufficient capacity to maintain, under working conditions, the pressure at the hammer specified by the manufacturer. The boiler or pressure tank shall be equipped with an accurate pressure gauge and other gauge shall be supplied at the hammer intake to determine the drop in pressure between the gauges. When diesel hammers are used, they shall be calibrated with test piling in accordance with pile driving test specified in Sub-item 400.1.2.

Water jets shall be used only when permitted in writing by the Engineer. When water jets are used, the number of jets and the nozzle volume and pressure shall be sufficient to erode freely the material adjacent to the pile. The jets shall be shut off at a depth not less than three (3) meters before final tip elevation is reached, and the piles shall be driven solely by hammer to final penetration as required by the Engineer.

Piles shall be supported in line and position with leads while being driven. Pile driving leads shall be constructed in such a manner as to afford freedom of movement of the hammer, and shall be held in position by guys or steel braces to insure rigid lateral support to the pile during driving. The leads shall be of sufficient length to make the use of a follower unnecessary, and shall be so designed as to permit proper placing of batter piles, if required. The driving of piles with followers shall be avoided if practicable and shall be done only under written permission from the Engineer.

The method used in driving piles shall not subject them to excessive and undue abuse producing crushing and spalling of the concrete, injurious splitting, and splintering. Manipulation of piles to force them into proper position, if considered by the Engineer to be excessive, will not be permitted.

The pile tops shall be protected by driving heads, caps, or cushions in accordance with the recommendations of the manufacturer of the hammer and to the satisfaction of the Engineer. The driving head shall be provided to maintain the axis of the pile in line with the axis of the hammer and provide a driving surface normal to the pile.

Piles shall be driven to refusal in rock or hard material when directed by the Engineer. Practical refusal shall be considered attained when the blow count is 6 for the last 10 mm of driving as determined by the Engineer.

400.3.6 Pre-cast Concrete Piles

Pre-cast piles shall be made in accordance with the designed drawings and the reinforcements shall be placed accurately and shall be secured rigidly in such manner as to insure its proper location in the completed pile. The concrete cover as measured to the outside face of ties shall not be less than 100 mm unless otherwise shown on the drawings.

The piles shall be casted separately, and if alternate piles are casted in a tier, the intermediate piles shall not be casted until 4 days after the adjacent piles have been poured. Piles casted in tiers shall be separated by tar paper or other suitable separating materials. The concrete in each pile shall be placed continuously. The completed piles shall be free from stone pockets, porous spots or other defects and shall be straight and true to the form specified. A 20 mm chamfer strip shall be formed on all corners. Form shall be mortar tight. Piles shall be cured in accordance with the requirements of Item 405, Structural Concrete.

Piles shall not be moved until the test indicates a compressive strength of 80 percent (80%) of the designed 28-day compressive strength and they shall not be driven until the tests indicate such compressive strength. Pile tips shall be of the design as called for on the Drawings or as directed by the Engineer.

400.3.7 Cast-In-Place Concrete Piles

Bored Piles

All provisions of this Section shall apply except where modified by procedures to conform to the prevailing practice in connection with the "Bored Piles" Method. Regardless of the procedure adopted, the construction of the bored piles shall be in strict conformity with the drawings.

All holes for cast-in-place bored piles shall be drilled up to the tip elevation as shown on the design Drawings.

Bored piles shall be of the type and sizes shown on the drawings and shall be in accordance with Item 400.2.3 herein this Specification. They shall not be changed or modified without the instruction or approval from the Engineer.

Reinforcing steel works shall conform to the requirements of Item 404, Reinforcing Steel.

Structural steel casing shall conform to the provision of Section 400.3.7(2) of the DPWH Standard Specifications unless otherwise shown on the drawings. Unless otherwise specified on the Drawings or directed by the Engineer, steel casing shall be driven to not less than 4 meters from the original ground surface.

The type of Slurry to be used shall be either "Bentonite" or "Supermud" or approved equivalent. The percentage and specific gravity of the material shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement. The level of the slurry shall be maintained at a height sufficient to prevent caving of the hole.

Prior to the execution of the works, the Contractor shall submit complete detailed methodology statements describing the procedure on how he intends to prosecute the various stages of his operations from the preparatory works up to completion stating among others, the required equipment, materials and the sequence of all activities.

Records and as-Built Drawings

Make complete boring record of each hole, upon completion of boring operation. The Contractor shall submit As-Built Drawings as may be required by the Engineer which accurately record the date, size, depth, location of all bored holes and local conditions encountered during the execution of the work.

The Contractor, when engaging the services of a Subcontractor, the latter shall have the complete outfit in terms of equipment and experienced qualified personnel, all subject to the approval of the Engineer who shall evaluate the same. The Subcontractor shall be qualified in all aspects as to his legal, technical and financial standings before he is considered for this specialized job. Nevertheless, the Contractor shall remain fully responsible and liable for the works and other acts of his Subcontractor in connection with the subcontracted works.

400.3.11 Cutting of Piles

*Modify the second paragraph with the following:*

Concrete piles shall, when approved by the Engineer, be cut off at such a level that at least 150mm of undamaged pile can be embedded in the structure or as shown on the

drawings. If a pile is damaged below this level, the Contractor shall repair the pile to the satisfaction of the Engineer. The longitudinal reinforcement of the piles shall be embedded in the structure to a length equal to at least 40 times the diameter of the main reinforcing bars or as shown on the drawings. The distance from the side of any pile to the nearest edge of the cap shall not be less than 200 mm.

400.3.12 Defective Piles

*Modify this Sub-section with the following:*

Any pile delivered with defects or damaged during driving or placed out of its proper location or driven below the elevation fixed by the Drawings or by the Engineer, shall be corrected at the Contractor's expense by one of the following methods approved by the Engineer for the pile in question:

a) The pile shall be withdrawn and replaced by a new and, when necessary, a longer pile.

b) A second pile shall be driven or cast adjacent to the defective pile.

400.3.16 Pile Records

*Modify this Sub-section with the following:*

The Contractor shall keep records of all piles driven or installed. A copy of the record shall be given to the Engineer within two (2) days after each pile is driven. The record form to be used shall be approved by the Engineer. The pile records shall give full information on the following:

Driven Piles:

1. Pile type and dimension
2. Date of casting and date of driving
3. Driving equipment: type, weight and efficiency of hammer, etc.
4. Depth driven and tip elevation.
5. Final set for the last 20 blows
6. For gravity and single-acting hammer: height of drop
7. For double-acting hammers: the frequency of blows
8. Details of any interruption in driving
9. Level of pile top immediately after driving and the level when all piles in the group are driven.
10. Details of re-driving.
11. Cut-off elevation and actual length of each pile section.

*Add herein these two (2) Sub-sections to read as follows:*

400.3.17 Granular Fill

After all foundation piles have been driven, cut-off to its desired top elevation, and have all necessary encasements, the designed elevation of the bottom of footing has been trimmed, excavated, filled and compacted, and made level. Placing of granular fill as

bedding will be provided with the required thickness as shown on the drawings or as directed by the Engineer.

400.3.18 Lean Concrete

Upon completion of granular fill, lean concreting if required will be executed to the desired thickness shown on the Drawings or as directed by the Engineer. However, it is necessary to check the actual elevation of the pouring guide prior to the commencement of concreting to avoid any possible mistakes.

400.4 Method of Measurement

1) Piles Furnished

The quantity to be paid for will be the sum of the lengths in meters of the piles of each type and size furnished and delivered to site and accepted by the Engineer. This will include all extensions that maybe necessary but excluding additional piles or test piles driven that maybe necessary to suit the Contractor's Method of Construction and were driven at his option.

Furnishing Length:

a) The quantity to be paid for the furnishing of Regular Pile will be the total length in meters of the pile driven as regular pile required in the design drawings plus an allowance of 1.25 meters inclusive of the least embedment to the structure.

b) The quantity to be paid for the furnishing of Test Pile will be the total length in meters of the pile driven as test pile required in the design drawings plus 1.25 meters chip-off portion plus an allowance of 2 meters.

2) Test Piles

The quantity to be paid for Test Piles will be measured by the total length in meters of the piles furnished and driven as test piles required in the design drawings inclusive of 1.25 meters chip-off portion and an allowance of 2 meters.

3) Piles Driven

The quantity to be paid for will be the sum of the lengths in meters of the piles of each type and size driven in the completed work and measured from the pile tip elevation to the bottom of pile caps, footings or bottom of concrete superstructure in the case of pile bents, and shall be accepted by the Engineer. This will not include additional piles or test piles driven that maybe necessary to suit the Contractor's Method of Construction and were driven at his option.

Unless otherwise provided for, pre-boring, jetting or other methods used to facilitate pile driving operations will not be measured directly but will be considered subsidiary to the pay items for which they were performed.

4) Cast-in-Place Concrete Piles

The quantity to be paid for will be the sum of actual lengths in meters of the piles cast and left-in place, completed and accepted by the Engineer. Lengths will be measured from the pile tip elevation to the bottom of cap or footing. Portions of piles cast deeper than the required due to over drilling shall not be measured for payment.

5) Pile Shoes

The quantity to be paid for pile shoes, including test pile shoes will be measured and paid for in the total number of pile shoes driven as shown on the Drawings. Pile shoes damaged or lost and replaced by the Contractor shall not be measured for payment. Pile shoes furnished by the Contractor at his own option and different from the required shall not be measured for payment.

6) Load Test

The quantity of load test to be paid for will be the number of tests completed and accepted by the Engineer. Load test made by the contractor to calibrate different types of hammers than the required will not be measured for payment.

400.5 Basis of Payment

The accepted quantities, measured as prescribed in Item 400.4, Method of Measurement shall be paid for at the Contract unit price for each of the particular items that are listed below and included in the Bill of Quantities, which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment tools and incidentals necessary to complete the work prescribed in these Item.

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 400 (3) | Steel H Piles, Furnished (BH-Steel Piles, 450mm x 260mm) | Linear Meter |
| 400 (4) b | Precast Concrete Piles (450 mm x 450 mm), Furnished | Linear Meter |
| 400 (10) | Steel H Piles, Driven (BH-Steel Piles, 450mm x 260mm) | Linear Meter |
| 400 (13) b | Precast Concrete Piles (450 mm x 450 mm), Driven | Linear Meter |
| 400 (15) b | Test Piles, (450 mm x 450 mm) Furnished and Driven | Linear Meter |
| 400 (15) c | Test Piles, Driven (BH-Steel Piles, 450mm x 260mm) | Linear Meter |
| 400 (16) a | Concrete Piles Cast in Drilled Holes 1000mm diameter | Linear Meter |
| 400 (16) c | Concrete Piles Cast in Drilled Holes 1500mm diameter | Linear Meter |
| 400 (19) b | Pile Shoes for 450 mm x 450 mm Piles | Each |
| 400 (21) | Static Pile Load Test for 1500 mm dia. Bored Pile | Linear Meter |

**SPL ITEM 400 (23) a HIGH-STRAIN DYNAMIC TESTING**

SPL 400 (23) a.1 Description

High-Strain Dynamic Testing is performed by obtaining and analyzing records of shaft force and velocity under weight impacts for evaluation of shaft load carrying capacity, structural integrity, and load movement and shaft-soil load transfer relationships.

Testing of drilled and cast-in-place shafts closely resembles in testing of driven piles during re-strike. The following are specifications and instructions for high-strain dynamic testing of drilled and cast-in-place foundation shafts.

The work shall consist of furnishing all materials, equipment and labor necessary for conducting high-strain dynamic tests on drilled and cast-in-place shafts (hereinafter each noted as test shaft). The Contractor will not be responsible for conducting the test, but he will be required to supply materials, equipment and labor as hereinafter specified and he is also responsible for the results of the test. High Strain Dynamic Testing is a non-destructive quick test and it is intended that the test shaft be left in a condition suitable for use in production. Unless otherwise specified, testing procedures shall conform to the ASTM D 4945-89 specification. The shaft used for the test will be instrumented and tested by others, as approved by the Engineer, meeting the requirements outlined in the ASTM D 4945-89 specification as well as those outlined below.

SPL 400 (23) a.2 Equipment and Materials Requirements

The contractor shall supply all labor, materials and equipment required to prepare the test shaft, dynamically load the shaft, and returns the shaft to a condition suitable for use in the finished structure. Equipment required to perform the test includes but is not limited to:

(a) If a permanent casing is not used as a feature to conduct the shaft, then a shaft top extension, consisting of a thin walled casing or equivalent shall be used to extent the shaft by length equal to two and a half (2-1/2) pile diameters. This top length, defined as the "test area" must be exposed and readily accessible by the testing Engineer at this time of the test. If the shaft top is below grade, then the contractor must have equipment available to remove surrounding soil (creating a safe working environment) so as to completely expose a test area of the shaft as described above. Windows on possible sides of the shaft may have to be cut off in the steel casing to reach the concrete.

(b) Means to ensure flat, level (axial to shaft) and soil concrete shaft top. Concrete should be on level with or above the casing.

(c) A drop weight in the range of one and half to two percent (1.5 – 2%) of the anticipated pile capacity, or as determined by the Engineer.

(d) A guide allowing variable drop heights typically between 2 to 3 m, or as determined by the Engineer.

(e) A shaft top cushion consisting of new sheets of plywood with total thickness between 2 to 6 inches (50 to 150 mm), or as determined by the Engineer.

(f) A steel striker plate with a thickness of at least 2 inches (50 mm) and an area between 70 to 90% of shaft top area but not less than the area of the impacting surface of the drop weight to be placed on top of the plywood cushion.

(g) If protruding reinforcing bars are present, the Contractor has the option to incorporate the reinforcing steel in the test area. Upon successful completion of the dynamic test, the surrounding concrete can then be removed as to make the pile suitable for use in the structure. If the Contractor selects not to incorporate the steel in such a manner as described above, then a steel beam or pipe (cross sectional area approximately 20% of the shaft cross sectional area) shall be supplied with sufficient length such that the ram impact will not interfere with the reinforcing bars. Steel striker plates and plywood cushion must also be sized so that they cover as much of the impact area as possible.

(h) One (1) kW of 200 Volt AC power.

(i) Surveyor's transit, laser light or equivalent for measurement of pile set under each impact.

SPL 400 (23) a.3 Dynamic Testing Firm

Testing is to be performed by an accredited Independent testing specialist from a firm with a minimum of four (4) years experience in dynamic load testing. The actual test shall be conducted and/or supervised by a Practicing Geotechnical Engineer with at least five (5) years of dynamic testing or who achieved basic level or better on the Foundation QA Examination for Providers of PDA Testing Services. Selection of the firm must be acceptable to the Engineer.

The independent dynamic testing firm must apply the following testing instrumentation in addition to that outlined in ASTM Specification D 4945-89 Section 5:

(a) Pile Driving Analyzer (PDA)
(b) Calibrated Strain Transducers
(c) Calibrated Accelerometers

Prior to performing the dynamic test, the testing Engineer must be provided with soil borings, shaft installation records, concrete properties (strength, etc.) and details regarding the anticipated dynamic loading equipment. The test Engineer is required to perform wave equation analyses (using GRLWEAP or equivalent) to determine the suitability of the proposed dynamic loading equipment and an acceptable range of ram drop heights so as not to cause damage in the shaft during the test.

SPL 400 (23) a.4 Construction Requirements

(a) The test shaft shall be constructed using the approved installation techniques.

(b) If a permanent casing is not required, then the upper length equal to two shaft diameters, noted as the "test area", must be cased in a thin wall tube or equivalent as noted above. Casing of this test area must be made as a continuation of the construction of the shaft. There should not be soil contamination or non-uniformities in the concrete located within or below the test area. Shaft top shall be made level to the casing and smoothed.

(c) Prior to testing time, the Contractor shall make the shaft test area length completely accessible to the testing Engineer.

(d) Prior to the test, four "windows" with an approximate size of 6 by 6 inches (150 by 150 mm) diameter opposite with each other will be located and removed from the casing if appropriate.

(e) In cases where casing is not present, the testing shall be smooth (by grinding) areas around the pile circumference such that proper gage attachment can be accomplished.

(f) Gages shall be attached by the testing Engineer to the exposed concrete or steel casing in a secure manner as to prevent slippage under impact.

(g) Shaft top should be examined to insure concrete is flushed with or above the casing.

(h) Apply plywood cushion and then striker plate to the shaft top. If reinforcing protrudes from the shaft top, it should be secured in such a manner as not to move under impact.

(i) At least two (2) hammer impacts should be applied to the pile top. First drop height should be minimal to allow the testing Engineer to assess the testing equipment, the driving system and pile stresses. Subsequent impacts can then be applied by utilizing higher drop heights.

(j) Upon completion of the test, it is the Contractor's responsibility to return the pile to acceptable production condition.

SPL 400 (23) a.5 Reporting of Results

It is the Testing Engineer's responsibility to submit a timely report of the testing results. In addition to the field results from at least one (1) CAPWAP analysis (Case Pile Wave Analysis Program) shall be submitted. CAPWAP analysis shall be performed by an Engineer that has achieved Advanced Level or better on the Foundation QA Examination for Providers of PDA Testing Services. The report must also provide the following:

(a) Wave Equation Analysis results obtained prior to testing.

(b) CAPWAP analysis result

(c) For each impact, the maximum measured force, maximum calculated tension force, transferred energy to the gage location, corresponding stresses, and the Case Method bearing capacity.

(d) Assessment of the test results both with respect to pile capacity and integrity.

SPL 400 (23) a.6 Method of Measurement

The quantity of designated size of piles on which high strain dynamic pile tests were carried out shall be measured and paid for in its total numbers inclusive of mobilization and demobilization of equipment, calibration, testing, recording, analyzing, and reporting.

SPL 400 (23) a.7 Basis of Payment

The quantities determined as provided under Section SPL 400 (23) a.6, Method of Measurement shall constitute full compensation for the cost of Pile Dynamic Testing, including tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| SPL 400 (23) a | High Strain Dynamic Pile Test For 1000 mm Bored Piles | Each |

**SPL ITEM 400 (24) PILE INTEGRITY TEST**

SPL 400 (24).1 Description

This Item shall consist of providing equipment and qualified personnel to conduct pile integrity tests to determine non-uniformities on cast-in-place piles, preparation of reports and recommendations, all as required in accordance with the Specification of ASTM 5882 (Integrity Testing Method).

SPL 400 (24).2 Execution of the Works

Pile Integrity Testing shall be performed only on piles designated by the Engineer.

The contractor shall hire/engage only services of Subcontractor qualified to perform the required job. The contractor shall inform the Engineer in writing the nominated subcontractor/s he proposes to hire including company profile and related job experience.

Nominated subcontractor shall have vast knowledge and experience with the type of test required and shall have appropriate equipment to perform the test. The method of test shall either be of the following method.

(a) Low Strain Pulse Echo Method

(b) Transient Response Method

The Contractor or his subcontractor shall be responsible for the preparation of pile surface prior to proceeding with the test to ensure reliable result. Contaminated concrete surface shall be chipped-off and cleaned of bentonite slurry, mud or other foreign materials before attaching the equipment.

The method and/or procedure in the conduct of testing shall be in accordance with the requirements of the type of test employed.

Report shall be prepared on every pile tested and any recommendations and/or measures to be taken shall be discussed in details.

SPL 400 (24).3 Method of Measurement

The quantity to be measured and paid for shall be the number of piles tested, completed and tested and accepted by the Engineer.

SPL 400 (24).4 Basis of Payment

The quantities determined as provided under Section SPL 412 (2).3, Method of Measurement shall be paid for at the Contract unit price of the test completed and accepted on each pile, which price and payment shall be full compensation for the provision of equipment, conduct of test required, preparation of reports, for all labor, tools and incidentals necessary to complete the item.

Payment shall be made only to those piles tested and reports submitted to the Engineer.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| SPL 400 (24) | Pile Integrity Test for Bored Piles (For Bored Piles, Various Diameter) | Each |

**ITEM 401 RAILINGS**

*Modify this Item to read as follows:*

401.1 Description

This Item shall consist of furnishing or fabricating and/or placing railings for bridges, and other structures, of concrete or steel materials or combination of the two materials according to its type as shown on the Drawings. Railings shall be constructed in conformity with the lines, grades and dimensions shown on the Drawings.

401.2 Material Requirements

All concrete materials to be used shall be Class C in accordance with the requirements of Item 405, Structural Concrete.

Reinforcing steel shall conform to the requirements of Item 710, Reinforcing Steel and Wire Rope.

Steel materials consisting of steel and iron plates, shapes, pipes and fittings and castings shall be in accordance with the requirements of Item 403, Metal Structures.

Paint materials shall conform to the requirements of Item 709, Paints.

401.4 Method of Measurement

The quantity to be paid for shall be the total net lengths of railings in linear meters measured from center to center of end posts according to its type, completely constructed and accepted by the Engineer.

401.5 Basis of Payment

The accepted quantity measured as provided in Section 401.4, Method of Measurement shall be paid for at the Contract unit price shown in the Bill of Quantities, which price and payment shall be full compensation for furnishing and placing materials, painting the erected railings, and it includes all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 401 (1) | Concrete Railing Type A (Concrete Post and Precast Beams) | Linear Meter |
| 401 (2) a | Steel Railing Type A | Linear Meter |

**SPL ITEM 401 (3) ć BRIDGE NAME PLATE**

SPL 401 (3) c.1 Description

The Item shall consist of providing name plate on the bridge and shall include the furnishing of materials, labor and equipment required to supply, construct or install, or to complete all the works as shown on the Drawings and as approved by the Engineer.

The wording and text for the bridge and monument name plates shall be submitted by shop drawing noting in full scale the wording and phrasing to be used. The Engineer, prior to plate fabrication, shall approve the submitted Drawing.

The following information shall at least be emerged on the plaque:

- Name of the bridge,
- Completion date,
- Name of client, contractors, and consultants
- Bridge features, and
- JBIC Loan No.

SPL 401 (3) c.2 Material Requirements

Name plates shall be from brass plates meeting the requirements of ASTM B36 with welded mold steel anchor bolt, wall, foundation and wording as directed by the Engineer. Prior to the installation of name plaque, the Contractor shall propose construction details to the Engineer for approval.

The wall and foundations of the monuments shall be of class C concrete in accordance with the requirements of Item 405, Structural Concrete.

Reinforcements shall be in accordance with the requirements of Item 404, Reinforcing Steel.

SPL 401 (3) c.3 Construction Requirements

The Contractor shall furnish the name plate and install 2 sets on the bridge as directed by the Engineer.

Concrete and reinforcement works shall follow the requirements prescribed in Item 405, Structural Concrete and Item 404, Reinforcing Steel respectively.

SPL 401 (3) c.4 Method of Measurement

Bridge Name Plates shall be measured for payment based on the *number of plates* installed in accordance with the requirements shown on the Drawings and approve by the Engineer.

Payment for bridge plate includes all the requirements such as plate, wall, and foundation; furnishing all materials, labor, equipment and incidentals necessary to complete the work. The payment includes cost for materials such as re-bar, concrete, pavement, excavation, backfill, grading, asphalt pavements, etc. to complete the work.

SPL 401 (3) c.5 Basis of Payment

The accepted quantity as provided in Section SPL 401 (3) c.4, Method of Measurement shall be full compensation for furnishing all materials and for all preparation, erection, surface treatment (galvanizing and painting) and installation of these materials, and for all shop drawings, labor equipment, tools, and incidentals to complete the Item.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| SPL 401 (3) c | Bridge Name Plate, 1000 x 600mm (For Talavera Bridge) | Each |

**ITEM 404 REINFORCING STEEL**

404.3 Construction Requirements

*Add herein this specification the following:*

404.3.7 Rebar Fabrication and Installation

Rebar fabrication and installation shall be done by a competent steelmen to ensure good workmanship. There should be a proper supervision for the "cutting and bending" of reinforcing bars, frequent checking of bar schedule and clearances, from the beginning until or up to where the re-bars are to be installed. Thus, covering shall always be confirmed also to the designed drawings.

404.3.8 Bar bending, Splicing and Placing

The Contractor shall submit to the Engineer for approval, the shop Drawings indicating the bending, cutting, splicing and installation of all reinforcing bars.

Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent unless permitted by the Engineer.

Bar splicing not indicated on the Drawings shall be subject to the approval by the Engineer.

Welded splices, if approved by the Engineer shall develop in tension at least 125% of the specified yield strength of the bars.

Not more than 50% of the bars at any section shall be spliced.

Unless otherwise shown on the Drawings, the clear distance between parallel bars in a layer shall not be less than 1.5 times the nominal diameter of the bar nor less than 1.5 times the maximum size of the coarse. The clear distance between layers shall not be less than 25 mm nor one bar diameter. The bars in the upper layer shall be placed directly above those in the bottom layer.

404.4 Method of Measurement

*Supplement the following paragraph:*

The quantity to be paid for shall be the calculated theoretical number of kilograms of reinforcing steel bars, mesh or mats as determined from the net length of the steel as shown on the drawings, incorporated in concrete and accepted. Reinforcing steel bars shall not be measured and paid separately where structures are paid in unit, as they are deemed to be included in the unit pay items of the structures.

The weight of plain or deformed bars or bar-mat will be computed from the theoretical weight of plain round bars of the same nominal size as shown on the following table:

| Bar Designation | Size (mm) | Unit Weight (kg/m) |
|---|---|---|
| # 2 | 6 | 0.222 |
| # 3 | 10 | 0.616 |
| # 4 | 12 | 0.888 |
| # 5 | 16 | 1.579 |
| # 6 | 20 | 2.466 |
| # 8 | 25 | 3,854 |
| # 9 | 28 | 4.833 |
| # 10 | 32 | 6.313 |
| # 11 | 36 | 7.991 |

404.5 Basis of Payment

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|

| | | |
|---|---|---|
| 404 (1) | Reinforcing Steel (Grade 40) | Kilogram. |
| 404 (2) | Reinforcing Steel (Grade 60) | Kilogram. |

## ITEM 405 STRUCTURAL CONCRETE

405.1 Description

405.1.2 Classes and Uses of Concrete

*The first paragraph of this Sub-section is amended as follows:*

Other than cement concrete pavement, concrete for bridge structures and except as otherwise stated in the Contract, the classes of concrete shall be designated as: Class A, B, C, P, Seal and Lean.

Lean concrete shall be used in thin layers underneath of footings, foundations and where shown on the drawings or as directed by the Engineer. Thickness shall be in conformance with the design Drawings.

As shown on the Drawings, the concrete class and strength for bridge shall be as follows:

| Concrete Class | Structural Member Using |
|---|---|
| | |
| Class A | Steel sheet pile cap |
| Class AA | Pre-cast Reinforced Concrete Piles |
| Class AA1 | Footings, pile cap, bored piles and approach slab |
| Class AA2 | Cast-in-place girders, slabs, diaphragms, wingwalls, backwalls, copings, columns, slabs, shear keys, curb and sidewalk parapet/railing |
| Class B | Rubble concrete/concrete blocks for slope protection |
| Class C | Thin Reinforced Section such as railings and railpost |
| Class PP | Prestressed concrete members such as AASHTO girders, precast deck slab panels, cast-in-place post-tensioned slab, voided slab, integral coping beams, diaphragm |

405.2 Material Requirements

405.2.3 Coarse Aggregates

Unless otherwise specified on the Drawings or as directed by the Engineer, the grading requirements for coarse aggregate shall be under Table 405.1 herein this Specification as follows:

**TABLE 405.1 – Grading Requirements for Coarse Aggregate**

| Sieve Designation | | Mass Percent Passing |
|---|---|---|
| Standard | Alternate | CLASS |

| (mm) | U.S. Std. | A | B | C | P | Seal | Lean |
|---|---|---|---|---|---|---|---|
| 63 | 2 1/2" | | 100 | | | | |
| 50 | 2 " | 100 | 95-100 | | | | |
| 37.5 | 1 1/2" | 95-100 | - | | | | 100 |
| 25 | 1" | - | 30-70 | 100 | 100 | | 95-100 |
| 19 | 3/4" | 35-70 | - | 100 | 90-100 | 100 | - |
| 12.5 | 1/2" | - | 10-30 | 90-100 | - | 90-100 | 25-60 |
| 9.5 | 3/8" | 10-30 | - | 40-70 | 20-55 | 40-70 | - |
| 4.75 | No. 4 | 0-5 | 0-5 | 0-15 | 0-10 | 0-15 | 0-10 |

405.4 Production Requirements

405.4.1 Proportioning and Strength of Structural Concrete

Add herein this Sub-section the following:

The maximum sizes of coarse aggregates shall be in accordance with the maximum sizes specified on the Drawings.

**Table 405.2 Composition and Strength of Concrete for use in Structures**

| Classes of Concrete | Minimum Cement Content | Maximum Water/ Cement Ratio | Consistency Range in Slump | Designated Size of Coarse Aggregate | Minimum Compressive Strength of 150x300 mm Concrete Cylinder Specimen @ 28 days |
|---|---|---|---|---|---|
| | Kg(bag**) | Kg/kg | Mm (inch) | Square Opening Std. | MN/m2 (psi) |
| A | 360 (9 bags) | 0.49 | 50 - 100 (2 - 4) | 38 - 4.75 (1 1/2" - No. 4) | 21 (3000) |
| A1 | 360 (9 bags) | 0.49 | 50 - 100 (2 - 4) | 20 - 4.75 (3/4" - No. 4) | 21 (3000) |
| AA | 380 (9.5 bags) | 0.42 | 50 - 100 (2 - 4) | 20 - 4.75 (3/4" - No. 4) | 28 (4000) |
| AA1 | 380 (9.5 bags) | 0.42 | 50 - 100 (2 - 4) | 25 - 4.75 (1" - No. 4) | 28 (4000) |

| | | | | | |
|---|---|---|---|---|---|
| AA2 | 380 (9.5 bags) | 0.42 | 50 - 100 (2 - 4) | 20 - 4.75 (3/4" - No. 4) | 28 (4000) |
| B | 320 (8 bags) | 0.54 | 50 - 100 (2 - 4) | 50 - 4.75 (2" - No. 4) | 17 (2500) |
| C | 380 (9.5 bags) | 0.49 | 50 - 100 (2 - 4) | 15 - 4.75 (1/2" - No. 4) | 21 (3000) |
| P | 440 (11 bags) | 0.34 | 80 - 100 (3.2 - 4) | 19 - 4.75 (3/4" - No. 4) | 38 (5500) |
| PP | As per design mix | 0.33 | 80 - 100 (3.2 - 4) | 20 - 4.75 (3/4" - No. 4) | 41 (6000) |
| Seal | 380 (9.5 bags) | 0.58 | 100 - 200 (4 - 8) | 25 - 4.75 (1" - No. 4) | 21 (3000) |
| Lean | 320 (8 bags) | 0.54 | 50 - 100 (2 - 4) | 50 - 4.75 (2" - No. 4) | 17 2500 |

** Based on 40 kg/bag

405.6 Basis of Payment

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 405 (1) a | Structural Concrete, Class "A" (fc'=21 MPa, For Heavily Reinforced Structure | Cubic meter |
| 405 (1) d | Structural Concrete, Class "A1" (fc'=21 MPa, For Small & Medium Bridges, PCDG Superstructures) | Cubic meter |
| 405 (1) e | Structural Concrete, Class "AA1" (fc'=28 MPa, For Long Bridge Substructures) | Cubic meter |
| 405 (1) f | Structural Concrete, Class "AA2" (fc'=28 MPa, For Long Bridge Superstructures) | Cubic meter |
| 405 (2) | Structural Concrete, Class "B" (fc'=17 MPa, For Plain and Lightly Reinforced Structures) | Cubic meter |
| 405 (3) | Structural Concrete, Class "C" (fc'=21 MPa, For Thinly Reinforced Member) | Cubic meter |
| 405 (6) | Lean Concrete (f'c = 17 MPa) | Cubic meter |

**ITEM 406 PRESTRESSED CONCRETE STRUCTURES**

*This Item is modified to read as follows:*

406.1 Description

This Item shall consist of precast prestressed concrete structures constructed in close conformity with the lines, grades and dimensions shown on the Drawings or established by the Engineer. It shall include the furnishing and installation of any appurtenant items necessary for the particular prestressing system to be used, including but not limited to ducts, anchorage assemblies and grout used for pressure grouting ducts.

406.2 Material Requirements

406.2.1 Concrete and Grout

a) Concrete

The material to be used for concrete shall conform to Item 405, Structural Concrete herein this Specification and it shall be class PP as shown in Table 405.2, Composition and Strength of Concrete for use in Structures.

b) Non-Shrink Grout

The epoxy resin grout to be used shall be a formulation specifically designed for bonding prestressing steel to polyethylene ducts and in providing an acceptable barrier to prevent corrosion of the prestressing steel. The type of epoxy resin proposed by the Contractor shall be approved by the Engineer.

The Contractor shall provide to the Engineer copies of manufacturer's literature describing the epoxy resin for use and examples of its application in previous projects.

The epoxy resin shall be formulated such that after injection into the duct, the resin does not harden (cure) until after all the prestressing steel is stressed and anchored for each precast concrete unit. As a minimum, the epoxy resin shall not cure for a minimum of four weeks after injection.

The epoxy resin shall have the following mechanical properties:

**Table 406.2.1 (b) Physical Properties after Hardening**

| Property | Required Value |
|---|---|
| Compressive Strength | 70 $N/mm^2$ |
| Tensile Strength | 23 $N/mm^2$ |
| Modulus of Elasticity | 5,800 $N/mm^2$ |
| Shear Adhesive Strength to Strand | 13 $N/mm^2$ |
| Durometer Hardness | 85 to 90 |
| Shrinkage Rate During Hardening | Below 1.0% |
| Heat Decomposition Temperature | Above 300 °C |

The Contractor shall either perform a pullout test of the proposed system or provide copies of certified pullout test results provided by the manufacturer and shall satisfy the Engineer that the requirements given below have been met by the system.

**Table 406.2.1 (c) Physical Properties after Hardening**

| Property | Required Value |
|---|---|
| 19 Wire Strand Diameter | 21.8 mm |
| Embedment Length of Strand | 100 cm |
| Minimum Pull Out Strength | 451 kN |
| Bond Strength | 4.7 $N/mm^2$ |

406.2.2 Prestressing Reinforcing Steel

Reinforcing steel shall conform to AASHTO M31 (ASTM 615), grades 40 and 60 deformed with minimum yield strength as follows:

| Rebar Grade | Yield Strength Fy (MPa) | Size (mm) |
|---|---|---|
| 40 | 276 (40 ksi) | 16 mm dia. and below, unless otherwise noted |
| 60 | 415 (60 ksi) | 20 mm dia. and above |
| | | |

406.2.3 Prestressing Steel

Prestressing steel shall be either twelve-wire, seven-wire, five-wire uncoated stress-relieved strands or whichever is called for in the design Drawings and it shall conform to AASHTO M203 (ASTM 416) with minimum ultimate strength of fy = 1860 MPa (270,000 psi).

PC stress bar shall be high tensile cold worked stress bar conforming to ASTM A722/ISO 6934 (SBPR 930/1180 with nominal tensile strength of 1176 MPa) as shown on the Drawing.

All prestressing steel shall be protected against physical damage and rust or other results of corrosion at all times from manufacture to grouting. Prestressing steel that has sustained physical damage at any time shall be rejected.

406.2.4 Packaging, Storing and Shipping

*Add this paragraph to read as follows:*

The Contractor must exercise extra care in handling prestressing steel, and any damage observed shall be replaced immediately at his own expense.

*Add this Subsection to read as follows:*

406.2.9 Structural Steel, Bolts and Welds

The structural steel, bolts and welds to be used shall be in accordance with the requirements given below:

a) For Bridge Nos. 11, 12 and 13

| Materials | Unit Weight |
|---|---|
| Steel plates and rolled shapes | AASHTO M183 (ASTM A36) |
| Bolts | AASHTO M164 (ASTM A325) |
| Welds | AWS D1.1 – 183, E70XX Series |

b) For Bridge No. 14 (Talavera River Bridge)

| Materials | Yield Strength fy (MPa) | Unit Weight |
|---|---|---|
| Structural Steel | 250 (Grade 36) | AASHTO M270 (ASTM A709) |
| High Strength Bolts | | AASHTO M253 (ASTM A490M) |
| Welds | | ANSI / AASHTO / AWS D1.5 Bridge Welding Code |

406.3 Construction Requirements

All prestressed concrete structure works shall be in accordance with the requirements of Item 405, Structural Concrete and Reinforcing Steel shall be placed in accordance with the requirements of Item 404, Reinforcing Steel, and may be subject to the modifications and amendments by the Engineer.

406.3.7 Pre-tensioning

*Add this paragraph at the end of this Section.*

No prestressing works shall be commenced without the consent and presence of the Engineer.

406.3.8 Placing of Concrete

*Add the following paragraphs at the end of this Section:*

Deflection of the structure during erection and after completion shall be controlled as described in the following:

The Contractor shall submit to the Engineer for approval the full details of camber calculation and deflection control method during erection and after completion of the bridge considering all factors such as:

1. Deflection due to the weight of concrete.

2. Deflection due to the prestressing force.

3. Deflection due the weight of pavement, sidewalks and railings, etc.

4. Deflection due to long creep and shrinkage in concrete.

The supports shall be placed at adequate locations to ensure the tendons to be placed in the right position along the prescribed curve.

During the concreting and within the 24 hours after concreting, the Contractor shall demonstrate that all PC cables and bars already installed before concreting are still completely free to move.

All ducts shall be checked for damage before concrete placing. Any damage found to ducts due to concrete placing, the Contractor shall be responsible for taking countermeasures with the Engineer's approval.

406.3.10 Post-tensioning

*This Sub-section is supplemented as follows:*

Tensioning of the prestressing reinforcement shall not be commenced until tests on concrete cylinders, manufactured of the same concrete and cured under the same conditions, indicate that the concrete of the particular structure to be prestressed has attained to its compressive strength of at least 28 MPa unless otherwise specified by the Engineer.

The proposed type of tendons which will be used in the post-tensioned designs and all necessary additional details including those for end anchorages, methods to be employed and procedures to be followed, shall be as approved by the Engineer. Portion of the tendons shall be draped longitudinal in parabolic portions. All tendons shall be placed so that their center of gravity will be at the position shown on the Drawings. The total post-tension force after losses required at mid-span shall be provided as called for in the various designs. The required forces after losses shall be obtained by applying initial tensile forces of sufficient magnitude to allow for all subsequent, including those for elastic shortening, shrinkage, creep, relaxation, friction, and efficiency of end anchorages. After securing the end anchorages, all tendons shall be pressure grouted in their conduits in accordance with

The Contractor shall submit full details of jacking force calculation, prestressing sequence and control method of each cable to the Engineer's approval not later than 2 months before any prestressing works will start. Post-tensioning works shall be carried out in the following manner:

1. Tensioning shall be carried out only in the presence of the Engineer or his representative unless written permission has been obtained to the Contractor.

2. Immediately before tensioning, the Contractor shall prove that all tendons are free to move between jacking points and that members are to accommodate the horizontal and vertical movements due to the application of prestress.

3. Unless otherwise described in related Specifications, concrete shall not be stressed until it has been reached to 41 MPa strength obtained from the result of average values of the concrete compression test using three cylinders. The test cylinders shall be made and tested in accordance with the concrete testing standards. The Contractor shall cast sufficient number of cylinders to demonstrate that the required strength of concrete is reached.

4. The Contractor shall add the forces described in approved tensioning method with an allowance for anchorage friction and jack losses. The total forces and calculated elongation shall be specified in the prestressing control system.

5. Immediately after tensioning, the stress in the prestressing tendons shall not exceed either 70 percent of their ultimate strength or 85 percent of yield strength whichever is lower. During stressing, the value shall not exceed either 80% of their ultimate strength or 90 percent of yield strength whichever is lesser.

6. The strength shall be stressed at gradual and steady rate. The force in the tendons shall obtained from readings on pressure gauges incorporated in the equipment. The average difference between calculated and measured elongation for a group of tendons in a structure should be as shown in the table below:

| Number of Tendons | Allowable Difference Between Calculated and Measured Elongation |
|---|---|
| 4 | 5% |
| 6 | 4% |
| More than 10 | 3% |

7. If the elongation cannot be reached, the jacking force may be increased to 80% of the ultimate strength or 90% of yield strength of the tendon whichever is lesser. If the difference between the measured and calculated elongation is still more than the allowed value, no further tensioning shall be made until the calculations and equipment are checked and the cause of the problem is determined. Stressing method and degree of stressing for tendons shall be modified with the Engineer's approval as necessary to provide the required pretensioning forces.

8. Unless otherwise specified on the Drawings, longitudinal main tendons shall be stressed from both ends. The pull-in at both ends shall be accurately measured and the required allowance shall be taken into consideration in the measured elongation.

9. Longitudinal stressing of the main tendons shall not from one end unless otherwise required on the Drawings or specified in the prestressing control system. Vertical and transverse stressing shall be made from one end.

10. When the prestressing has been applied according to the approved system, the tendons shall be anchored. The jack pressure shall then be released in such a way as to avoid shock to the anchorage or tendons.

11. If the pull-in of the tendons at completion of anchoring is greater than that of the approved by the Engineer, the load shall be released at a gradual and steady rate and tensioning is carried out fresh.

12. The Contractor shall submit, within the following day of the tensioning, full records and control graphs of all tensioning operations including the measured elongation, pressure gauge or load cell readings and the amount of the pull-in at each.

406.3.13 Handling

Extreme care shall be exercised by the Contractor in handling and moving the precast prestressed concrete girders and precast prestressed concrete slab. These girders and slabs shall be transported and maintained in an upright position and the points of

support and directions of the reactions with respect to the member shall be shall be approximately the same during transportation and storage as when the members are in their final position. If the Contractor deems it expedient to transport or store precast units in other than this position, it shall be done at his own risk after notifying the Engineer of his intention to do so.

Any precast prestressed concrete member shall not be transported until it has attained to its compressive strength equal to the specified design compressive strength of the concrete and has attained a minimum age of 14 days.

406.4 Method of Measurement

The quantity to be measured for payment shall be the actual number of Precast Prestressed Concrete Girders of designated types and sizes, installed in place, completed and accepted by the Engineer.

The quantities determined herein for precast prestressed concrete members shall include the furnishing of materials, fabrication, haulage and erection of precast PC members, preparation of the fabrication and storage yards with necessary equipment and facilities, concrete works, formworks, reinforcements, installation sheaths, prestressed concrete cables and anchorages, prestressing and all other related works and materials necessary to be included to complete the Item.

Prestressing steel and Prestressing Bar shall be measured by its total net weight in kilogram as shown in the Bill of Quantities. The weight of anchorage, sheath, grout, grid bars, cut-offs shall be excluded.

406.5 Basis of Payment

The accepted quantities as provided in Section 406.4, Method of Measurement shall be paid for at the Contract unit price shown in the Bill of Quantities, which price and payment shall be full compensation for furnishing and placing of all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 406 (1) a | Prestressed Structural Concrete Members (AASHTO Girder Type IV, L = 20 m) | Each |
| 406 (1) d | Prestressed Structural Concrete Members (AASHTO Girder Type IV, L = 25 m) | Each |
| 406 (1) j | Precast Prestressed Structural Concrete Members (AASHTO Girder Type VI, L = 35 m) | Each |
| 406 (1) l | Precast Prestressed Structural | Each |

| | | |
|---|---|---|
| | Concrete Members (AASHTO Girder Type VI, L = 39.40 m) | |
| 406 (1) m | Precast Prestressed Structural Concrete Members (AASHTO Girder Type VI, L = 39.55 m) | Each |

**ITEM 407 CONCRETE STRUCTURES**

*Modify this Item to read as follows:*

407.1 Description

This Item shall consist of the general description of the materials, equipment, workmanship, and construction requirements of concrete structure works conforming to the design, dimensions and details shown on the Drawings.

407.2 Material Requirements

407.2 (4) Elastomeric Bearing Pads

*Delete the sentence and replace with the following:*

Elastomeric bearing pad shall be 100% virgin chloroprene (neoprene) pads with durometer hardness 60 and shall be laminated and non-corrosive mild steel sheets. It shall conform to the requirements prescribed in DPWH Department Order No. 25, Series of 1997 "Revised DPWH Standard Specifications for Elastomeric Bearing Pad".

| | |
|---|---|
| Duro Hardness, Shore A (ASTM D-2240) | $60 \pm 5$ |
| Tensile Strength ASTM | D 412-175 kg/cm$^2$ (min) |
| Ultimate Elongation % | 350% (min) |
| Material | Neoprene |

407.2 (8) Expansion Joint

Expansion joint shall satisfy the requirements of bridge deck movement caused by temperature change, shrinkage, creep and traffic load. Its metal plates and angles shall be corrosion proof. It shall be water tight, durable, resistant to vehicle sliding, noiseless and smooth drive, capable of absorbing the vehicle load and the horizontal forces and it shall be easy to install.

a) Long Bridge

The expansion joint for long bridge shall be $\pm$ 50mm, $\pm$ 70mm, and $\pm$ 100mm movement with 10 mm thick epoxy mortar as called for and shown on the Drawings.

The steel components shall be manufactured in accordance with the requirements of ASTM A36. The rubber material shall be based on Neoprene rubber compound following to ASTM Test Method as follows:

| Physical Properties | Test Method | Required Specification |
|---|---|---|
| Hardness (Shore A) | D 2240 | 50 ± 5 |
| Tensile Strength (MPa) | D 412 | 13 Min. |
| Elongation at Break | D 412 | 400 Min. |
| Low Temperature Brittleness (30 min. at -40 °C) | D 746 | No Brittle |
| Compression Set (After 22 hours at 70 °C) | D 395 | 20 % Max. |
| Ozone Resistance, (After 72 hours at 40 °C, 20% strain 100 pphm) | D 1149 | No Crack |
| Oil Resistance in ASTM No. 3 oil (168 hours at 25 °C, volume charge | D 471 | 15% Max. |
| Flame Resistance | C 542 | Must not propagate flame |

Asphalt joint filler (transition strip) shall be applied having thickness and width shown on the Drawings. Asphalt sealant will also be used on the longitudinal bolt holes after final fixing of the joints.

b) Short Bridges

The expansion joint for carriageway of the short bridges shall be ± 40mm movement with 10 mm thick epoxy mortar as called for and shown on the Drawings. The steel components shall be manufactured in accordance with the requirements of ASTM A36. The rubber material shall be based on Neoprene rubber compound conforming to the physical properties, test method and required specification on the above table.

For bridge sidewalk of the short bridges, expansion joint shall be 30mm x 50mm premolded joint filler as shown on the Drawings.

Sealant shall be guaranteed against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion for a period of 5 years from the date indicated on the Acceptance Certificate of the Works.

Joint sealer for the sidewalk of bridges shall conform to AASHTO M 173 hot poured elastic type or equivalent and be installed as shown on the Drawings.

The expansion joint material shall have a 15-year warranty period. Damages on the joint within this period shall be replaced by the Contractor.

The Contractor is required to submit the manufacturer's brochure and specifications to the Engineer for approval.

*Add this Sub-section to read as follows:*

407.2 (11) Bridge Drainage

Bridge drain shall be of standard galvanized iron pipe with the diameter of 150 mm or as shown on the Drawing.

407.3 Construction Requirements

407.3.1 Handling and Placing Concrete: General

*Add the following paragraph:*

Prior to concreting works, it is necessary for the Contractor and the Engineer to closely work together to check all related elevations, installation of reinforcements and the stability of formworks and falsework to avoid unusual problems during and after the execution of work. Proper scheme during concrete placing shall be properly defined on the drawings and working platform must be provided as necessary. In the concreting scheme, the manpower, materials, and equipment set up will be properly indicated on the drawings in order to maximize the working efficiency at the same time maintaining the safety working environment.

407.3.10 Falsework Construction

*The following paragraphs shall be supplemented to read as:*

Falsework which includes formworks and scaffoldings shall be designed correctly by the Contractor according to his construction methodology and his falsework drawings shall be submitted to the Engineer for review and approval. Falsework shall be so designed in order to carry the maximum loads imposed on it and in order to prevent deformation, deflections and deviations due to loads and vibrations during concrete placing. No falsework construction shall start until the Engineer has reviewed and approved the design.

Inner forms surface shall be coated with the quality form oil prior to placing of concreting and must be mortar tight with sufficient strength and rigidity in order to maintain its shape according to Drawings after concreting work. Forms to be utilized must have a smooth surface in order to attain a true concrete surface finished product.

*Add the following paragraphs to read as follows:*

407.3.15 Expansion Joint Installation

Installation for expansion joints for both long bridges and short bridges shall be in accordance with the manufacturer's installation procedures.

The position of expansion joint and all anchor bolts cast into concrete shall be accurately determined from the template or other materials. During the placing and hardening of concrete or mortar under expansion joint components, relative movement shall be prevented between them and support to which they are being fixed.

407.4 Method of Measurement

a) Elastomeric Bearing Pad

The quantity to be paid for shall be measured by the total number of bearing pads of its dimensions and thickness shown on the Drawings, completely installed and accepted by

the Engineer. The payment includes the cost for anchorages, mortar bed, grouting and all other necessary works to complete the work.

b) Expansion Joint

The quantity to be paid for shall be measured by the total length in linear meters of its type and total movement shown on the Drawings, completely installed and accepted by the Engineer. The payment includes the cost for anchorages, provision of base, grouting, sealing and all other necessary works to complete the work.

c) G.I. Drain Pipe

The quantity to be paid for shall be measured by the total lengths of drain pipe installed. The payment includes cost for all appurtenances necessary to complete the work.

407.5 Basis of Payment

The accepted quantity as provided in Section 407.4, Method of Measurement shall be paid for at the Contract unit price shown in the Bill of Quantities which price and payment shall be full compensation for furnishing materials, labor, tools, equipment and other incidentals necessary to complete the particular work.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| 407 (1) c | Elastomeric Bearing Pad (600x350x50mm), Duro 60 | Each |
| 407 (1) e | Elastomeric Bearing Pad (600x400x50mm), Duro 60 | Each |
| 407 (2) a | Expansion Joint, (for ± 40 mm Movement) | Linear Meter |
| 407 (2) b | Expansion Joint (for ± 50mm Movement) | Linear Meter |
| 407 (2) g | Expansion Joint, 30mm x 50mm Premolded Joint Filler for sidewalk | Linear Meter |
| 407 (3) a | Restraining Bar, 32mm dia. x 1495mm | Each |
| 407 (3) b | Restraining Bar, 32mm dia. x 1900mm | Each |
| 407 (4) | G.I. Drain Pipe, dia.=150mm diameter for Bridge Drainage | Linear Meter |

**SPL ITEM 407 (5) c PIER PROTECTION CONCRETE BLOCKS**

SPL 407 (5) c.1 Description

This special item of work shall consist of placing, adjusting and jointing precast concrete blocks in accordance with the elevation shown on the Drawing. The purpose of placing concrete blocks around the pier is to protect the pier from damage due to the turbulence of floodwater. The concrete blocks shall be of its type, sections and dimensions shown on the Drawing.

SPL 407 (5) c.2 Material Requirements

Concrete to be used for concrete blocks shall be Class B in conformance to the requirements of Item 405, Structural Concrete.

Reinforcements shall be in conformance to the requirements of Item 404, Reinforcing Steel.

SPL 407 (5) c.3 Construction Requirements

Concrete blocks shall be precasted according to its designs, sections and types shown on the Drawing. All concrete and reinforcement works shall be in accordance with the requirements of Item 405, Structural Concrete and Item 404, Reinforcing Steel respectively.

Placing and jointing of concrete blocks of their types shall be in accordance with the arrangement shown on the design Drawing. Joints shall be properly connected by welding in accordance with the welding requirements described by the Engineer. Joints shall be coated with the required paint prescribed by the Engineer to protect them from rust.

SPL 407 (5) c.4 Method of Measurements

The quantity to be paid for shall be measured by the total area covered with concrete blocks in square meter basis.

Excavation, shoring, cribbing and other related work required for concrete block setting and hand-laid embankment will not be paid directly, but shall be considered as a subsidiary obligation of the Contractor under Pay Item 103 (2) a, Bridge Excavation, Common, A.O.W.L. and Item 103 (2) b, Bridge Excavation, Common, B.O.W.L.

SPL 407 (5) c.5 Basis of Payment

The quantities determined in Section SPL 414.4, Method of Measurement will be paid at the Contract unit price in the Bill of Quantities which price and payment shall be full compensation for furnishing material, labor, tools, equipment, and incidentals necessary to complete the Item.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| SPL 407 (5) c | Pier Protection Concrete Blocks (For Talavera Bridge) | Square Meter |

**SPL ITEM 420 (4) c TEMPORARY CRANEWAY**

SPL 420 (4) c.1 Description

This Item shall consist of the construction of Craneway Platform which may be bridge type structure that is necessary in connection with the construction of bridge.

The Bill of Quantities shows the quantity of these structures which will be constructed by the Contractor wherein he will affix his cost on a basis of payment as indicated.

The Contractor is required to design the Craneway Platform based on his methodology upon written request by the Engineer. He can use the designed drawings as reference for his planning and designing the structure. He then submit his design to the Engineer for approval.

Construction for craneway platform shall be started immediately after receipt of the written approval from the Engineer.

SPL 420 (4) c.2 Material Requirements

Timber shall be an aged coco-lumber of the same grade and sizes shown on the Drawings. Coco-lumber shall be sound, solid, free from defects such as decay or insect attack which will materially affects its strength.

Steel H-Pile shall consist of structural steel shapes of the sections indicated on the Plans. Other steel materials shall meet the requirements of Item 712, Structural Metal and Item 409, Welded Structural Steel.

SPL 420 (4) c.3 Construction Requirements

Construction of Craneway Platform shall be as directed and approved by the Engineer. The Contractor must construct the craneway platform properly and strong that it would give safety to the equipments using and to the workers as well during construction of bridge.

SPL 420 (4) c.4 Method of Measurement

Craneway Platform, Bridge Type shall be measured by the completed span in linear meter and shall include all materials, equipment and labor used to finish the structure as called for in the Bill of Quantities.

SPL 420 (4) c.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 420 (4).4, Method of Measurement shall be paid for at the Contract unit price shown in the Bill of Quantities. The payment shall constitute full compensation for furnishing and placing of all materials, undertaking proper maintenance and providing safety measures, as required in the Specifications or as directed by the Engineer, including all labor, equipment, tools and incidentals necessary to complete the structure including the subsequent removal upon completion of the permanent work.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| SPL 420 (4) c | Temporary Craneway (For Talavera Bridge) | Linear Meter |

**SPL ITEM 420 (5) c TEMPORARY ACCESS ROAD (CAUSEWAY)**

SPL 420 (5) c.1 Description

This Item shall consist of the construction of temporary access road of causeway type including the necessary embankment and placing of required stones and compaction. Proper maintenance and safety provisions shall be made and monitored for the completed detours to ease public traffic. The detours will be placed at locations and elevations as indicated on the Drawings or as directed by the Engineer.

SPL 420 (5) c.2 Material Requirements

Materials for embankment of access road shall be of the same kind, grade and sizes shown on the Drawings and approved by the Engineer.

Materials shall comply with pertinent provisions for fill and construction of gravel roads specified in this Specification and shall be approved by the Engineer.

SPL 420 (5) c.3 Construction Requirements

The Contractor shall submit to the Engineer construction plans and information regarding the manner in which he intends to comply with the works and for the maintenance of the detour road as access road and safety provisions, for the Engineer's review and approval prior to construction.

The construction of detour road/access road shall comply with applicable provisions for Gravel Road Construction in the Specifications or as had shown on the Drawings.

SPL 420 (5) c.4 Method of Measurement

Detour road/access road shall be measured for payment by linear meter and shall include all materials, equipment and labor used to finish the structure as called for in the Bill of Quantities.

SPL 420 (5) c.5 Basis of Payment

Detour road or access road will be paid for as prescribed in Item 420 (5).4, Method of Measurement which prices and payment shall constitute full compensation for furnishing and placing of all materials, undertaking proper maintenance and providing safety measures, as required in the Specifications or as directed by the Engineer, including all labor, equipment, tools and incidentals necessary to complete the work including the subsequent removal and disposal of the detour road or access road.

After a detour road or access road is no longer required, suitable material used as fill, subbase or as surfacing for the detour road or access road may be placed in the permanent road construction and paid for as embankment materials or as appropriate subbase or surfacing item.

Add the following Pay Items :

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| SPL 420 (5) c | Temporary Access Road (Causeway), For Talavera Bridge Construction | Lump Sum |

## SPL ITEM 420 (6) d TEMPORARY COFFERDAM FOR PIER CONSTRUCTION

SPL 420 (6) d.1 Description

This special Item shall consist of constructing temporary cofferdam to enclose the specified area for pier construction in accordance with the type and location shown on the Drawing.

The Contractor is required to design the temporary cofferdam based on his methodology upon written request by the Engineer. He can use the consultant's designed drawings as reference for his planning and designing the structure. He then submits his own design to the Engineer for approval at a given time specified by the Engineer.

SPL 420 (6) d.2 Material Requirements

Steel sheet piles to be used as inner and outer enclosures of cofferdam shall be Type IV in conformance to the requirements of AASHTO M 202 (ASTM A 328) or AASHTO M 223. The joints shall be watertight when the piles are in place.

All other steel materials required for the construction of cofferdam as listed in the design drawing shall be in accordance with the requirements of Item 712, Structural Metal.

SPL 420 (6) d.3 Construction Requirements

The Contractor shall submit together with his design drawing the construction methodology in constructing temporary cofferdam for pier construction. Steel sheet piles shall be driven to the required depth by the piling equipment recommended by the Contractor and approved by the Engineer.

Upon completion of driving the inner and outer steel sheet piles, the two driven sheet piles must be properly tied up by tie rods on steel waling as shown on the Drawing. To strengthen the position of cofferdam, two (2) steel H-posts must be driven at every corner portion of the outer steel sheet pile. To prevent water from coming into the cofferdam during and after pumping operation, the space between the two steel walling shall be filled with soil/sand then compacted by compaction equipment recommended by the Contractor and approved by the Engineer. Water shall be pumped out from the cofferdam by using the required pumping equipment recommended by the Contractor and approved by the Engineer. Dewatering of cofferdam shall be continuous operation until the existing river bed is exposed.

SPL 420 (6) d.4 Method of Measurement

The quantity to be paid for shall be measured by the total number of temporary cofferdams constructed, completed and accepted by the Engineer. Cost for pumping water is included.

SPL 420 (6) d.5 Basis of Payment

Temporary cofferdam will be paid for as prescribed in Section 420 (6) d.4, Method of Measurement which price and payment shall constitute full compensation for furnishing

and placing of all materials, undertaking proper maintenance and providing safety measures, as required and directed by the Engineer, including all labor, equipment, tools and incidentals necessary to complete the work including the subsequent removal and disposal of materials used in the temporary cofferdam as directed by the Engineer.

Payment will be made under:

| Pay Item No. | Description | Unit of Measurement |
|---|---|---|
| SPL 420 (6) d | Temporary Cofferdam for Pier Construction (for Talavera Bridge) | Each |