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 - 5 mm
Permitted variation from design level of surface	+15mm - 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 filiers, 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

SPL ITEM 310 (3) WATERPROOFING FOR DECK SLAB

SPL 310 (3).1 Description

This work shall consist of applying the waterproofing on concrete decks slab in accordance with the requirements of these Specifications. The waterproofing system shall be a proprietary system specifically designed to waterproof the concrete bridge decks and shall be approved by the Engineer. The waterproofing system shall comprise of bituminous/rubberized bonding coat and rubberized asphalt membrane waterproofing with protective covers as required or other proprietary system approved by the Engineer. Surface preparation and application of waterproofing shall be strictly in accordance with the recommendations of the waterproofing manufacturer and with these Specifications.

SPL 310 (3).2 Material Requirements

The table below is recommended for quantities of waterproofing material. It should be noted that these quantities are not absolute but should also follow the recommendations of the manufacturer/supplier for waterproofing concrete decks with asphalt overlay.

Waterproofing Application on Concrete Deck

Material	Type	Rate of Application	Remarks
Bonding Coat			
a) Primer	Bituminous Rubberized Agent	0.3 kg/sq.m.	
b) Dressing	Bituminous Rubberized Agent	0.2 liter/sq.m.	
Waterproofing Layer	Rubberized Asphalt Membrane (Hot Applied Type)	0.4 kg/sq.m.	1.0 – 1.5mm thick

SPL 310 (3).3 Construction Requirements

a) Surface Preparation

Prior to the application of the bonding coat, the surface shall be clean, dry and free from any debris. Concrete decks shall also be free from laitance, loose aggregate and curing liquids, compounds and membranes.

b) Application

Waterproofing shall not be applied to any surface until the Contractor is prepared to follow the application with suitable approved protective covers and asphalt overlay within a sufficiently short time that the waterproofing membrane will not be damaged by workers or equipment, exposure or weathering, or any other cause. Damaged membrane or protective coating shall be repaired or replaced at the expense of the Contractor.

Care must be taken to confine all materials to the areas to be waterproofed and to prevent disfigurement of any other parts of the works by dripping or spreading of the waterproofing materials.

The bonding coat shall be applied strictly in accordance with the manufacturer's recommendations.

The waterproofing layer shall also be applied strictly in accordance with the manufacturer's recommendations.

SPL 310 (3).4 Method of Measurements

The quantity to be paid for shall be measured by the total area applied with waterproofing in square meter basis.

SPL 310 (3).5 Basis of Payment

The accepted quantities as provided in Section SPL 417.4, Method of Measurement will be paid at the Contract unit price shown 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 310 (3)	*Waterproofing Layer A* (For Pampanga Deck Slab)	*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 Cast-in- place Concrete Bored Piles are modified as follows:

400.1 Description

400.1.1 Scope

This work shall consist of the furnishing and concreting of bored 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 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

400.2.3.2 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

400.3.7 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.

400.3.16 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:

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) 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.

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 (16) a	Concrete Piles Cast in Drilled Holes 1000mm diameter	Linear Meter
400 (16) b	Concrete Piles Cast in Drilled Holes 1200mm diameter	Linear Meter
400 (16) c	Concrete Piles Cast in Drilled Holes 1500mm diameter	Linear Meter
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 412 (1).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 400 (23) b	High Strain Dynamic Pile Test For 1200 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	Linear Meter
401 (2) a	Steel Railing, Type A	Linear Meter
401 (2) b	Steel Railing, Type B	Linear Meter

SPL ITEM 401 (3) b BRIDGE NAME PLATES

SPL 401 (3) b.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) b.2 Material Requirements

Name plate of 1000 x 600mm 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) b.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) b.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) b.5 Basis of Payment

The accepted quantity as provided in Section SPL 401 (3) b.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) b	Bridge Name Plate	Each

ITEM 403 METAL STRUCTURES

Amend the whole text of this Item to read as follows:

403.1 Description

The work includes furnishing of all labor, materials and equipment required for performing all operations in the fabrication and installation of structural steel, bolts and other miscellaneous connector works as specified and shown on the Drawings. This work is constructed in reasonably close conformity with the lines, grades and dimensions shown on the Drawings.

Except as indicated in these technical Specifications, the work of this Contract shall be performed in accordance with Volume II of DPWH Standard Specifications. These specifications include amendments and additions to the following items that shall be applied in carrying out the work of this Contract.

Item 408: Steel Bridges
Item 409: Welded Structural Steel
Item 411: Paint
Item 712: Structural Metal, and

403.1.1 Standards Included in the Specifications

The Publications listed below form part of these Specifications to the extent indicated by the reference thereto.

(1) American Society for Testing and Materials (ASTM) Publications :

(2) American Welding Society (AWS) Publication:

403.1.2 Storage

The steel materials shall be carefully handled and stored on blocking, racks or platforms so as not to be in contact with the ground and from corrosion. Materials shall be kept free from dirt, oil, grease, and other foreign particles. Surfaces to be painted shall be carefully protected both in the shop and in the field. Threads shall be carefully protected from damage.

403.2 Material Requirements

403.2.1 General

All materials shall be of new stock, free from surface imperfections and shall conform to the applicable ASTM, or approved equal only.

- Structural steel for main girders shall conform to ASTM M270 (ASTM A709), grade 50W with minimum yield strength fy = 345 MPa; atmospheric corrosion resistant.
- Structural steel except at main girders shall conform to ASTM M270 (ASTM A709), grade 36W with minimum yield strength fy = 250 MPa; atmospheric corrosion resistant.
- Shear stud connectors for main bridge shall conform to ASTM A108 with minimum yield strength fy = 345 MPa (corrosion resistant).
- High strength bolts for main bridge shall conform to AASHTO M253, ASTM 490M (corrosion resistant).
- Unless otherwise shown on the drawings, standard bolts for main bridge shall conform to ASTM A307.

Tests are required under the ASTM Standards for steel to be used in the Works and shall be carried out in the presence of the Engineer and at least 4 days notice must be given to him prior to the dates proposed for such tests. Four calendar days notice on which fabricated steel work will be ready for inspection in the Contractor's yard.

403.2.2 Steel Material Requirements

(1) Steel Bridge

Materials shall conform to the requirements specified in Subsection 403.2.1. Connections in which details are not indicated shall be designed in accordance with the ASTM Specifications or approved equal only, latest edition, and shall be welded or bolted, except as shown otherwise on the Drawings.

Materials and parts necessary to complete each item, even though such work is not definitely shown or specified on the Drawings, shall be included. Miscellaneous bolts and anchors, supports, braces and connections necessary for completion of the works shall be provided.

Materials for steel plate, steel shape, welding material and high strength bolt shall be applied and shall be resistant to corrosion.

(2) Other Metal Work

Fabrication of other metal work shall conform to the material sizes and dimensions shown on the Drawings, and installation thereof shall be as indicated on the said Drawings and these Specifications or as directed by the Engineer.

- Material for anchor bolts shall be in accordance with ASTM Specification A325M.

- Slab drainage pipes shall be standard steel pipe in accordance with ASTM Specification A53, galvanized after fabrication in accordance with ASTM Specification A123.

(3) Tolerances

The Contractor shall, through appropriate planning and continuous measurements in the workshop and at the erection site ensure that the tolerances given in the Specifications are strictly observed. The Engineer will require any specific working procedures in case the Contractor's procedures appear not sufficient enough for security against exceeding the tolerances.

The Contractor is fully responsible for the calculation and provision of the necessary camber in the pre-assembled elements to obtain the correct levels in the completed bridge, duly considering the applied erection procedure and the sequence in the installation of the various dead load components.

The roadway levels given on the drawings or defined by the given inclination and curvature, are the required roadway levels to top of surfacing in bridge axis of the completed bridge, when loaded only with the dead loads of the installed and completed structure. In fixing the geometry of the superstructure, the Contractor shall make compensation for the difference between workshop temperature and the temperature at the job site in normal position (22°C to 32°C).

403.2.3 Submittal

403.2.3.1 Working Drawings

The Contractor shall submit working drawings for the whole of the steelwork to the Engineer for his review and approval. All working drawings shall show full detailed dimensions, sizes and cambers for all component parts of the structure and details of all miscellaneous parts such as pins, nuts, bolts, drains, etc. The size and extent of all welds shall be clearly shown on the shop drawings such that the work can be fabricated from these drawings without reference to the design drawings. The required grade of

steel for each individual fabrication shall be clearly indicated. All working drawings shall also show method of construction, spacing of bolts, welding, sectional areas and other details necessary for the works. Bolted or welded construction may be employed subject to approval, soundness and neatness of design. Where welds are used, either at works or on field, they shall, wherever possible, be continued and returned around any meeting face to ensure that the joints are completely sealed against corrosion.

The details of connections on working drawings shall be such as to minimize formation of pockets to hold condensation, water or dirt and a minimum gap between abutting angles and the like shall be provided wherever possible to eliminate any traps and facilitate maintenance painting.

No materials shall be ordered nor fabricated until such drawings are approved by the Engineer in writing.

The Contractor shall be responsible for all errors of detailing, fabrications and correct fitting for all structural members.

403.2.3.2 Fabrication Procedure

The Contractor shall submit to the Engineer the documents regarding his shop fabrication procedures inclusive of welders/welding procedures, technical qualifications, quality control/assurance, method of inspection, testing, and all shall be approved by the Engineer.

403.2.3.3 Erection Procedures

The Contractor shall submit program of work and methodology to illustrate steel erection, temporary staying and bracing and to give clarification on data submitted. These submittals shall include details of storage and handling of steel materials, camber control, geometric control, field connections, cutting, welding, bolted connection, field assembly, test, painting, erection equipment, crane way, temporary bent piers, and assembling yard preparation.

The Contractor shall also submit the details of welding equipment and welder's license and experience, such details shall include the type, voltage and amperage of the said equipment and subject to approval of the Engineer.

403.2.3.4 Proof of Compliance with the Specifications for Materials

Manufacturer's certificates shall always be submitted to the Engineer for his approval. The Contractor shall also submit the following test results as a proof that the materials he will be using comply with the requirement of these Specifications.

(1) Reports of Ladle Analysis for Steel

   (a) Mill test reports for main members
   (b) Fabricator's certificate for secondary members

(2) Reports for Tensile Properties and Bend Tests for:

   (a) Steel shapes

(b) Steel bars
(c) Steel plates

(3) Certificate of Conformance of:

(a) Structural steel tubing
(b) Steel bar grating
(c) Filler metal for welding

(4) Reports of Mechanical Properties of Shear Connectors

(5) Reports of Mechanical Tests for High Strength Bolts and Standard Bolts

403.2.3.5 Inspection Report

The Contractor shall likewise submit the result of inspection tests specified in Sub-section 403.3.5, Inspection and Test of Welding in these Specifications.

403.3 Construction Requirements

(A) Qualification

(1) Steel Fabricator

Steel fabricator shall have an experience in fabrication of structural steel for projects of similar type. Steel fabricator will require experience and technology in fabrication of 86 mm thick in flange and 2.85 meter web depth together with splicing and/or welding joints. A fabricator's shop shall have a suitable space with approximately 240 meter long for one unit of steel girders for shop assembly. The Contractor shall submit a written description of fabrication capability including facilities, personnel and list of similar completed projects, including testing and quality control capability and specifically the type and extent of quality control procedure which the fabricator intends to employ on this Project.

(2) Steel Erector

Steel erector shall have an experience in the erection of structural steel structure of similar size to the proposed structure. Steel erector will require experience and technology in erection of 65 m each 4 spans continuous steel girder bridge having 2.85 meter girder depth together with geometric control works. The Contractor shall submit a written description of structural steel erection capability including equipment, personnel, geometric control applications and a list of completed projects.

(3) Qualified Welder and Welding Procedures

The Contractor shall submit for Engineer's approval the welding procedure, welder's qualification and the test results of each type of welding to be performed.

Procedures shall be developed for welding all metals included in the work. The Contractor shall not start welding works until procedures, welders and tackers have been qualified and approved by the Engineer as specified herein. The

Contractor shall perform qualification testing by an approved testing laboratory, or by the Contractor's laboratory if approved by the Engineer. Cost of such testing shall be borne by the Contractor.

The Contractor shall qualify each welder and tacker assigned to work on this Project by test using equipment, positions, procedures, base metal and electrodes that will be encountered in his assignment. The Contractor shall furnish to the Engineer for approval a certification that each welder and tacker is qualified in accordance with the requirements of AWS D1.5-96, and welder shall have successful past experience with similar weld types (eg. using machine experiences of carbon gas arc semi-automatic welding machine and alternating current arc welding machine, and welding experience in thick members exceeding 80 mm) or approved equal only.

(B) Welding

(1) General

Item 409, Welded Structure Steel, DPWH Standard Specifications shall be applied to welded components.

Before the work is started, the welding procedure for each type of joint shall be approved by the Engineer and the Contractor shall make such trial welds and tests as the Engineer may require him to demonstrate the soundness of the proposed method.

(2) Welding Drawing

Prior to start of fabrication, a Welding Drawing shall be prepared and submitted by the contractor to the Engineer for review and approval. The drawing shall be prepared, signed and sealed by a suitably qualified professional engineer, having significant past experiences with similar projects, and shall include the following information:

- Procedures and program of welding sequence (for each component and for welding components together). After approval of this submittal, welding procedures and sequences shall be followed without deviation.
- All information on welding detailed procedures, and additives including any requirements for pre- and post-heating.
- Description of equipment to be used.
- Joint geometry for groove welds.
- Estimation and countermeasure for welding shrinkage.
- Environmental condition for welding in the field and equipment for windbreak under carbon gas-arc welding.
- Details on non-destructive testing methods to be used for specific typical joints.

- Repair procedures or possible treatment of complete welds by grinding with indication of grinding direction, etc..

- Fit-up requirements.

- Experience, qualification and licensing details for all welders to be employed. Successful past experience with similar weld types, plate thickness and plate material is required for all welders.

This Drawing shall be updated and maintained as required throughout the course of the project.

(3) Butt Welding Record of Main Girder

All butts welding of the main girder shall be recorded as follows:

- Date
- Welding location with girder number, joint number and flange or web
- Welder's name
- Welding procedures
- Actual joint geometry with base plate thickness, root opening and root alignment
- Environmental condition with wind speed, temperature and humidity
- Inspection method and result with inspector's signature
- Correction procedure

(4) Equipment

The welding machine shall be of modern type and with ample capacity to provide the required current to each welding point without appreciable fluctuations. Welding machine to be used shall be Carbon Gas Arc Semi-automatic Welding Machine, and Alternating Current Arc Welding Machine, or approved equal only. All shop/field welds shall be carried out by qualified welders under proper supervision. The work shall be properly prepared for welding and the correct sequence adhered to at all times.

(5) Welding Material

All arc-welding electrodes shall conform to the requirements of American Welding Society Specifications or approved equivalent.

(6) Welding Construction

Welded connection shall be permitted only where indicated on the approved working Drawings. Welding construction shall conform to the following:

(a) Surfaces to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign materials except that mill scale that withstands vigorous wire brushing may remain. Joint surfaces shall be free from fins

and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

(b) The work shall be position for flat welding whenever practicable.

(c) Environmental condition for welding in the field. Any welding works cannot do under environmental condition as follows:

- In case of rain expected during welding work;
- Joint wetted after rain;
- Humidity more than 80 percent; and
- Welding work is obstructed by wind.

(d) *Joint geometry for main girder welding.* Tolerances for joint geometry shall be under the following:

Root opening	+ 6mm to - 2mm
Root Alignment	± 6mm

(e) Control for heating works. Temperature shall be checked by thermometer during pre-heating and post-heating works.

(7) Tolerances

The members to be connected by welding shall be so prepared that they fit exactly together, without being forced into position.

The tolerances concerning gap between parts to be welded, eccentricity and departure from theoretical alignment, dimensions of the cross section of grooved welded joints, etc. shall conform to AWS D1.5 Bridge Welding Code, except that the gap between parts to be jointed by fillet welds shall not exceed 1 mm for fillet welds connecting flange to web and 5 mm for all other fillet welds. Tolerances of weld profiles shall correspond to section 3.6 of AWS D1.5.

(C) Fabrication

(1) General

The Contractor shall fabricate structural steel in the shop to the greatest extent possible for transporting in accordance with the Drawings.

Bolted or welded connection shall be provided whether constructed in the shop or in the field as shown on the Drawings or as approved by the Engineer. High strength bolts for all bolted connections shall be used unless otherwise shown on the Drawings or approved by the Engineer.

Connections shall be as shown on the Drawings or as approved by the Engineer. Holes shall be cut, drilled or punched at right angles to the surface of the metal and shall not be made or enlarged by burning.

All sharp edges and corners shall be ground to a minimum radius of 1 mm and all sharp irregularities, burrs, slag and spatters on welds shall be removed.

Contact surface between bases of bearing and column or other elements bearing directly upon such plates shall be ground or milled as necessary for full effective bearing. Edges for welding shall likewise be properly prepared.

An inspection shall be made to determine that the fabrication and the matching of the component parts are correct.

Jigs shall be used for the assembly of units as mush as possible to maintain appropriate position of mutual materials.

Approval of the Engineer shall be required when drilling temporary bolt holes or welding temporary support to the assembled structure.

Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. In order to maintain accurate finished dimensions and shape, appropriate reverse strain or restraints shall be provided as required.

Assembly and disassembly work shall be performed in the presence of the Engineer, unless waived in writing by the Engineer. Any error or defect disclosed shall be immediately remedied by the Contractor at his own expense.

Before disassembly for shipment, each piece of the structure shall be match-marked to facilitate erection in the field.

(2) Templates

All templates, jigs and other equipment necessary for the accurate fabrication of the work shall be provided by the Contractor at his own expense.

(3) Cutting of Steel

Edges may be cut by either planing, machining, flame cutting or shearing, but edges to be welded shall nevertheless comply with the welding sub-section of this Specification. Cut edges shall be free of gouges, burrs and other defects which are greater than 5 mm deep, or which would otherwise adversely affect the serviceability of the member. Occasional notches or gouges not more than 5 mm deep on otherwise satisfactory surfaces shall be removed by machining or grinding. Correction to defects shall be faired to the surface with a slope not exceeding 1 in 10.

Oxygen cutting of steel and weld metal shall be permitted provided a smooth and regular surface free from cracks and notches is secured, and provided that an accurate profile is secured by the use of a mechanical guide. Free-hand oxygen cutting shall be done only where approved by the Engineer.

In all oxygen cutting, the cutting flame shall be so adjusted and manipulated as to avoid cutting inside the prescribed lines. The surface roughness of oxygen cut surfaces shall be equivalent to or better than the standard classes of replicas of flame cut surfaces as existing on JIS B 0601.

Roughness exceeding allowable values and occasional notches or gouges not more than 2 mm deep, on otherwise satisfactory surfaces, shall be removed by machining or grinding. Cut surfaces and edges shall be left free of adhering slag. Corrections of defects shall be faired to the oxygen cut surface with a slope not exceeding 1 in 10. Defects of oxygen cut edges shall not be repaired by welding except with the express approval of the Engineer for occasional notches or gouges less than 5 mm deep. Such weld repair shall be made by suitably preparing the defect, welding with low hydrogen electrodes not exceeding 4 mm in diameter, observing the applicable requirements of the welding sub-section of this Specification, and grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

(4) Straightening

All material before being assembled shall be straightened or formed to the specified configuration by methods specified below.

Straightening or bending of either fabricated or un-fabricated steel, if necessary, shall be done by means of steady pressure applied by rolled or presses. Straightening and bending shall not be done by hammering or, unless the Engineer's approval has been obtained by heating. If straightening by heating is allowed, the steel shall in no case be heated to a higher temperature of 600°C as measured by indicating crayons, liquids or bimetal thermometers.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture. Depending on the location in the Work, the Engineer shall have the right to reject the metal or to direct that the defects be repaired in a manner that shall be approved by the Engineer. The cost of replacement of repair shall be borne by the Contractor.

(5) Holes of Bolts

All holes shall be drilled. Punching of holes shall not be permitted. Reamed and fitted holes shall be sub-drilled 3 mm less in diameter than that of the finished holes and reamed to size.

Reamed and fitted holes and drilled holes shall be made through steel templates or after assembly or by other approved means, to ensure complete matching between the plies of the joints.

All steel templates shall have hardened steel bushings in holes accurately dimensioned from the center lines of the connection. The center lines shall be used to accurately locate the template.

Reaming or drilling full-size holes for filed connections through templates shall be done after the templates have been located with the utmost care as to position and angle, and firmly bolted. Templates used for the reaming of holes in matching members, or of opposite faces of one member, shall be exact duplicates. Templates for connections which duplicate shall be so accurately located that like members are duplicates.

All finished holes shall be cylindrical and perpendicular to the member unless otherwise specified. All burrs and other defects shall be removed.

The diameter of the completed hole shall be 2 mm larger than the nominal diameter of the bolt unless otherwise specified except that for the inner plies of a structural connection fastened by high-strength bolts, the diameter of the hole shall not be larger than 3 mm larger than the nominal diameter of the bolt.

All matching holes shall register with each other so that a gauge or drift of 2 mm less in diameter than the hole shall pass freely through the assembled contact faces at right angles to them.

Burrs, fins and other defects shall be removed. Drifting to align holes shall be done in a manner that will not distort the metal or enlarge the hole.

(6) Marking for Final Assembly

Each part shall be carefully marked to facilitate final erection. Such marking shall be durable but shall not injure the material. Such marks shall not be injured, defaced or removed by any person. The marking of components shall be in accordance with that shown on the workshop drawings submitted.

(7) Shop Assembly

The Contractor shall carry out shop assemblage in his regular workshop.

Shop assemblage shall be understood as placing of prefabricated elements together to control the fit. The Contractor shall submit his proposal for shop assemblage for the approval of the Engineer. The shop assemblage shall verify that the individual elements have the shape to that the individual elements have the shape to fit exactly into adjoining elements. Also, the shop assemblage shall verify that the camber aimed at, or prescribed, actually exists, and that the geometry is generally correct.

The Contractor shall perform measurement of the structural members, and the results shall be recorded and submitted to the Engineer. The Contractor shall inform the Engineer that the shop assemblage of major components have been completed and measured, and the structure shall not be dismantled until the shop assemblage has been approved by the Engineer.

(D) Fabrication Tolerances

(1) Dimensional Tolerance for Structural Steel Work

Dimensions shall be measured by means of an approved calibrated steel tape at the time of inspection. Unevenness of plate work shall not exceed the limitation of the standard mill practice as specified in the American Institute of Steel Construction, "Manual of Steel Construction" or equivalent.

Where, in the opinion of the Engineer, there is evidence that the application of the following tolerances would adversely affect the serviceability of the structure, the Engineer shall have the right to reduce the tolerances.

Unless otherwise specified, the following tolerances shall apply:

(a) General

The tolerance on all structural dimensions shall be ± 2 mm.

(b) Straightening

A structural member before erection shall not deviate from straightness for the specified configuration by more than the following:

Struts	:	1/1000 of the length
Tubes	:	1/600 of the length
Plates	:	1/200 of the lesser dimension of the plate panel
Other members	:	1/500 of the length

(c) The length of member shall not deviate from the specified length by more than the followings:

For lengths 9 meters and under	:	+0 – 3 mm
For lengths over 9 meters	:	+0 –5 mm

(d) Twist

The twist of a member shall not be greater than the following:

Main girders and heavy columns	:	1/500 of the length
Other members	:	1/1000 of the length

(e) Camber

Reverse camber in any structural steel member in excess of 1/2000 of the span length shall cause rejection. The minimum dead load camber for any structural steel members shall be provided as shown on the Drawings or otherwise specified.

(f) Squareness of Ends

The deviation from squareness of ends (other than butt joints in compression) shall not exceed the following:

Members 800 mm deep and less	:	1 mm
Members over 800 mm deep	:	1 mm per 800 mm of depth to a maximum of 2 mm

(g) Butt Joint of Main Girders

Space of adjoin girders shall not deviate from designed root opening by more than – 2 mm to + 6 mm.

(h) Deviation of Web from Flange Centerline

The maximum deviation of the centerline of the web from the flange centerline in built up members shall not exceed 6 mm.

(i) Depth of Built up Members

The tolerance on the overall depth of a built up members shall not exceed the following:

Depth 900 mm and less	:	± 3 mm
Depth over 900 mm up to 1800 mm	:	± 4 mm
Depths over 1800		+ 5 mm

(j) Flatness of Web Plate

The deviation from flatness of girder web plates shall not exceed 1/200 of the lesser dimension of the web panel.

(k) Tilt and Warp of Flange Plate

The maximum combined warpage and tilt on the flanges of built up members shall not exceed 1/200 of the total width of the flange or 3 mm whichever is the greater.

(E) Inspection and Test of Welding

(1) Inspection of Welding

(a) General

All material and workmanship shall be subject to inspection by the Engineer during and after fabrication. To enable for the Engineer to arrange inspection, the Contractor shall give four (4) days notice in writing prior to the start of work in the shop, and no work shall be done before such period has elapsed.

Method of inspection which may be used includes the following:

- Visual inspections, including the use of penetrate dyes, acid etching and photography.
- Magnetic particle in accordance with ASTM E109 Specification
- Radiographic in accordance with AWS D1.1 Specification or equivalent JIS Z3104
- Ultrasonic in accordance with AWS D1.1 Specification or equivalent JIS Z3060

No work shall be dispatched from the shop until it has been inspected by the Engineer.

(b) Radiographic Inspection

Radiographs will be made either by x-ray or gamma ray in accordance with AWS D1.1 or equivalent, JIS Z 3104. The reinforcement on the weld that is to be radiographed shall be ground smooth and flush.

(c) Ultrasonic Inspection

Ultrasonic inspection shall be carried out in accordance with AWS D1.5 - 96 or equivalent JIS Z 3060.

Ultrasonic inspection shall be used on Flange/Web and Flange/Flange fillet welds and in any other areas directed by the Engineer.

Details of the extent of ultrasonic which will be undertaken are as follows:

Longitudinal fillet weld:

Top and bottom flange to web	=	25%
Horizontal stiffener to web	=	10%

Defects revealed by non-destructive tests will be compared with the standards for allowable porosity and fusion type defects set out herein. Where weld defects exceed the limits specified the weld will be rejected. If approved by the Engineer the Contractor shall carry out the corrective measure specified herein.

The Contractor shall program his work to the satisfaction of the Engineer in order to keep visits to a minimum.

The cost of providing welding inspections, and equipment and operators for non-destructive testing will be borne by the Contractor.

After the repair of any defective weld, further non-destructive tests of the corrected weld will be made at the Contractor's expense. The cost of any further corrective measures and subsequent non-destructive testing of the weld will be borne by the Contractor.

Inspection of welding shall be executed for the following work phases:

- Before Welding

  Inspect the scum, angle of bevel, roof clearance, cleaning of surface to be welded, quality of end tab, and drying of welding rod.

- During Welding

  Welding procedure, diameter of core and wire, type of flux, welding current and voltage, welding speed, welding rod position, length of arc, melting, cleaning of slag of each level under surface chapping, supervision of welding rod.

- After Execution of Welding

Assurance of bead surface, existence of harmful defects, treatment of crater, quality of slag removal, size of fillet, dimension of extra fill of butt welding, treatment of end tab.

(2) Testing of Welding

The Contractor shall retain a suitably qualified and experienced independent Testing Agency, acceptable to the Engineer, to perform non-destructive testing of welds as described below. This Agency shall submit reports regularly to the Engineer, who may also arrange other independent tests of the Work.

The test to be performed shall be as follows:

(e) All welds shall be visually inspected for size, contour and general conformance with good welding practice.

• Pit on head surface	(not allowed)
• Convexity of bead	(should be under 3mm against 25 mm bead length)
• Undercut	(should be under 3mm)
• Overlap	(not allowed)
• Crack	(not allowed)

(f) The following percentage of randomly selected welds shall be subjected to Magnetic Particle Testing in accordance with ASTM Specification E109:

- 50% of all fillet welds on flanges, including the main web to flange welds
- 10% of web to stiffener welds
- 20% of welds in diaphragms

(c) The following percentage of all butt welds shall be checked by Radiographic Inspection or Ultrasonic Inspection shown on welding Drawings.

- 100% of all flange butt welds
- 50% of each web butt weld, always including the 100 mm adjacent to each flange

Welds that fail to meet the requirements of these tests shall be repaired to the satisfaction of the Engineer, following which testing shall be repeated at the Contractor's expense. If the welds cannot be repaired to the satisfaction of the Engineer, they shall be rejected and removed from the Work.

(3) Corrections

In lieu of the rejection of an entire piece or member containing welding which is unsatisfactory or which indicates inferior workmanship, corrective measures may be permitted by the Engineer whose specific approval shall be obtained for making each correction. Defective or unsound welds or base steel shall be corrected either by removing and replacing the entire weld, or as follows:

(a) Excessive convexity or overlap shall be reduced by grinding.

(b) Undercut, lacking of weld shall be repaired with necessary reinforcement of weld after removal of any foreign material such as slag, dust, oil, etc.

(c) Any defects such as slag inclusions, incomplete fusion, or inadequate joint penetration, shall be completely removed, cleaned and rewelded.

(d) Cracks and pits in weld or base steel, shall be removed to sound steel throughout its length and 5 cm beyond each end of the crack, followed by welding. The extent of the crack, depth and length, shall be ascertained by the use of acid etching, magnetic particle inspection or other equally positive means.

The removal of welded steel shall be done by chipping, grinding, oxygen cutting, oxygen gauging, or air carbon arc gauging and in such a manner that the remaining welded steel or base steel is not nicked or undercut. Defective portions of the welding shall be removed without substantial removal of the base steel.

(F) Delivery to Site

The Contractor shall mark a number in accordance with shop drawings the materials tested and approved by the Engineer before delivery to the Site, and prepare a list showing number, size quality and quantities of materials.

All materials shall be delivered to the Site at such time or times as they are required for incorporation in the Works. Bolts and small or loose pieces shall be bagged and close crated. Bolts, nuts and washers shall be separately bundled for each size and each bundle clearly marked with the size and purpose of the bolts. The batch number of each bag of bolts shall be clearly marked to facilitate reference to the test certificates.

During delivery all component materials shall be adequately protected from damage and the Contractor shall be responsible for any damage which may occur. In particular, the Contractor shall adequately strut the bottom flange of plate girders.

All straps and chains used in lifting shall be adequately padded to prevent damage to the steelwork and its protective coating.

No fabricated steel shall leave at the Contractor's fabrication yard without inspection and approval by the Engineer or be placed in the Work without inspection and approval by the Engineer after delivery.

(G) Field Erection

(1) Installation Program

Prior to executing field erection, the Contractor shall prepare full calculation, detailed erection Drawings and comprehensive installation program including engineering supervision organization, field installation procedures, field welding procedures, application of material, application of machinery, inspection

procedures, scope and standards of quality testing, and submit to the Engineer for approval.

The erection Drawings shall be signed and sealed by responsible and qualified professional engineer. Supporting calculations for all major items of work such as crane reach and capacity, temporary girder supports, temporary bearings, temporary bent piers and incidentals and his methodology for each stage of erection shall accompany the erection Drawings.

Erection shall not commence until the Engineer has indicated that he has no further comments on the Contractor's proposals.

Steelwork shall be stored on timber bearers, clear of the ground and in such a way as to permit checking and to avoid excessive handling and damage to the steelwork or its protective coating.

Unless otherwise directed by the Engineer, all surfaces to be brought together to form a joint or splice shall be free of paint or any other applied finish, oil, dirt, loose rust, loose scale, burrs and other defects which would prevent solid seating of the parts or would interfere with the development of friction between them.

(2) Installation Requirements

(a) Setting of Anchor Bolt and Others

i. Anchor bolt shall be set in accurate position by using template.

ii. Setting method shall be proposed to the Engineer for his approval before setting starts.

iii. The thread of bolt shall be treated with appropriate method against rust and/or from any damage before tightening.

iv. Non-shrink grout shall be placed under base plate, well cured to obtain the sufficient strength before bearing load is applied to base plate.

(b) Temporary Bracing

i. Temporary bracing shall be installed as necessary to stay assemblies and assumed loads against forces due to transport, erection operations or other work.

ii. Temporary bracing shall be maintained in place until permanent work is properly connected and other construction installed as necessary for support, bracing or staying of permanent work.

iii. Extent and quality of temporary bracing shall be as necessary against wind and other loads, including seismic load not less than those for which permanent structure is designed to resist.

(c) Field Pre-assembly

All parts of steel girders shall be pre-assembled and inspected by the Engineer at the field into the largest practical sections, prior to erection. These sections shall then be erected and supported on temporary bents while the final splice connections are made. A suitable space for pre-assembly shall be provided at the field, including adequate means for proper and accurate alignment of sections for welding.

(d) Adequacy of Temporary Connections

During erection, temporary connection work shall be securely made by bolting and/or welding for all dead load, wind and erection stresses.

(e) Alignment

No permanent bolting or welding shall be done until the alignment of all parts with respect to each other shall be true within the respective tolerances required.

(f) Field Welding

i. Any shop paint or surfaces adjacent to joints where field welding is to be executed shall be wire brushed to remove paint/primer.

ii. Welding in the field shall be stopped under unsuitable weather condition.

iii. Field welding shall conform to the requirements specified in Sub-section B, Welding and Sub-section E, Inspection and Test of Welding of this Specification except as directed by the Engineer.

iv. Field welding shall be recorded as follows:

- Name of welder
- Date
- Location of welding
- Weather, temperature, humidity
- Welding method
- Welding material
- Welding condition

v. The Contractor shall correct immediately any defects in his welding work at his own expense and he shall inform right away the Engineer prior to the start of his corrections. His corrections shall be completed to the satisfaction of the Engineer.

(g) Bolting

Bolts shall be driven accurately into the holes without damaging the thread. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with the plane normal to the bolt axis, beveled washers shall be provided to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.

Unfinished bolts transmitting shear shall be threaded to such length that not more than one thread will be within the grip of the metal. The bolts shall be of the length that will extend entirely through. Bolt heads and nuts shall be drawn tight against the work with a suitable wrench not less than 80 mm long. Bolt heads shall be tapped with a hammer while the nut is being tightened.

After having been finally tightened, nuts shall be locked.

Alternately, bolts shall be tightened with a torque wrench to the appropriate torque for the bolt diameter.

(h) Bolted Connection (High Strength Bolts)

High Strength Bolts with associated nuts and end washers shall comply with AASHTO M253, ASTM 490M (corrosion resistant) and assemble with the Drawings and Item 403.3.10, DPWH Standard Specifications and shall incorporate load indicating devices acceptable to the Engineer.

High strength bolts shall be assembled with one hardened washer under the turned element (nut or bolt head). The washer shall be assembled with any convexity outwards. The inserting and tensioning of the high tensile bolts shall be so arranged that the close contact established by the service bolts in maintained at all times. The tensioning of high tensile bolts shall not commence until the joint has been inspected by the Engineer.

(i) Shear Stud Connectors

Shear stud connectors for main bridge shall have yield strength of fy=345 MPa and conforming to the requirements of ASTM A108 (corrosion resistant). Connection details between precast deck and upper flange are shown on the Drawings, and to the applicable requirements of AWS D1.5, Section 4, Part F, Plug and Slot Welds. Shear stud connectors shall be installed at the fabrication shop with proper and accurate location in accordance with approved shop Drawings.

(j) Correction of Errors

i. Correction of minor misfits by use of drift pins, and reaming, chipping or cutting will be permitted and shall be provided as part of erection work.

ii. Any errors to be corrected or adjusted, preventing proper assembly, shall be immediately reported to the Engineer, and such corrections or adjustment shall be made as necessary and approved by the Engineer.

iii. Cutting or alterations other than as approved will not be permitted.

(k) Erection

The Contractor shall submit for approval full and detailed descriptions and shop drawings of his proposed procedure referred to the construction sequences as shown on the Drawings together with his equipment and supporting calculations.

The Engineer's consent to the Contractor's erection procedure shall in no way affect the Contractor's responsibility under the Contract.

A full description of his proposed erection method shall include the following:

- sequence of erection
- use of temporary or permanent stanchions, beams and bracing
- connection
- erection camber diagrams to show the vertical position of the structure at each stage of the erection process
- design calculation to cover the various stages in the erection process
- type of equipment to be sued during erection

The erection procedures shall be such that at the datum temperature, when the bridge is complete and with full permanent load applied, the profiles of the roadways shall correspond to those given on the drawings.

Erection setting-out calculations shall take account of the load relationships between deck and girder as well as geometric controls.

Site workmanship, welding, and inspection during and after erection shall comply with the appropriate requirements of the preceding clauses of these specifications.

During erection, the Contractor shall take special care to avoid permanent distortion, the locking-in of secondary stress and impairment of the fatigue resistance of the permanent works.

Removal of temporary attachments by burning shall be on the waste side with ample allowance for finishing by grinding, this requirement applies equally to exposed and subsequently embedded parts.

The Contractor shall provide an adequate communication system between strategic points during erection, which shall be maintained at all times to the satisfaction of the Engineer.

The use of permanent fasteners as service fastenings during assembly or erection will not be permitted where such use is liable to cause damage to the protective treatment provided to the fastener. Any fastening so damaged shall be replaced at the Contractor's expenses.
Each structural unit shall be accurately aligned by the use of steel shims, or other approved methods so that no binding in any moving parts or distortion of any members occurs before it is finally fastened in place.

Operations, procedures of erection and bracing shall not cause any damage to works previously placed nor produce overstressing to any of the building parts or components. Damaged parts caused by such operations shall be repaired as directed by the Engineer at no extra cost to the Employer.

(3) Inspection

Inspection by the Engineer does not relieve the Contractor of his responsibility to provide the necessary inspection of his own work, and that of his subcontractors, to ensure compliance with Drawings and these Specifications.

The fabrication and erection facilities, materials and quality of workmanship of the Contractor and his subcontractors shall be made available for inspection by the Engineer at all times during the progress of work. The Engineer shall have the right to reject any work of the Contractor not complying and satisfying to the requirements as mentioned herein before.

403.4 Protective Coating

403.4.1 Galvanizing

(1) Preparation

All mild steel parts exposed to weather shall be hot-dipped galvanized after fabrication as shown on the Drawings or directed by the Engineer in accordance with the requirements of Item 411, DPWH Standard Specifications, or equivalent. Prior to galvanizing, the surface shall be cleaned of dirt, weld splatter, grease, slag, oil, paint or other deleterious matters. The steel surfaces shall be chemically desiccated and cleaned with abrasive blast or other suitable method as approved by the Engineer.

(2) Coating

The zinc coating shall consist of uniform layer of commercially pure zinc free from abrasions, cracks, blisters, chemical spots or other imperfections, and shall adhere firmly to the surface of the steel. The weight of zinc coating per square meter of actual surface shall not be less than 550 grams. Any surface damaged subsequent to galvanizing shall be given 2 coats of approved zinc rich paints.

403.4.2 Painting

(1) General

This work shall consist of the preparation of the steel surfaces, the application, and protection and drying of the painted surfaces, and the furnishing of all tools, tackle, scaffolding, labor and materials necessary for the entire work.

Unless otherwise specified or approved, surface preparation before painting shall be strictly in accordance with the recommendations of the paint manufacturer. These recommendations shall be confirmed in writing by the manufacturer, referring specifically to the details of this project.

This section shall not apply to all Anti-Corrosion Resistant Steel where painting is not necessary. The surface of all anti-corrosion resistant steel shall be thoroughly cleansed of all loose mill scale, rust and other foreign matters by means of sand blasting.

(2) Painting Plan and Certification

The Contractor shall in ample time before the commencement of the surface treatment, prepare and submit for approval a detailed program relating to the execution of the

works, in the workshop, at the field, etc., as well as the methods used, and the time schedule for the individual treatment. The program shall be subject to approval by the Engineer.

The Contractor shall submit to the Engineer, two (2) copies of certification stating that requirements pertaining to cleaning, surface preparation and painting of steel have been performed in accordance with the specifications.

(3) Shop Painting

All structural steel shall be given shop coat(s) of primer of the approved quality after fabrication and cleaning and prior to the delivery to Site.

All steel work shall be thoroughly dried and cleaned of all loose mill scale, rust and foreign matters by means of sand blasting or other suitable method approved by the Engineer before shop painting shall be applied. Each individual piece shall be painted prior to assembly. Portion where shop painting is proposed by the Contractor shall be approved by the Engineer. Portion where field welding or field contact with concrete is required, shall not be painted at the shop but it shall be painted in the field after welding has done as per direction by the Engineer.

(4) Field Painting

After erection, the Contractor shall thoroughly prepare and clean the entire surface of all structural steel from all dirt, grease, rust or other foreign matters. The entire surface of approved members shall then be field painted.

(5) Materials and Paint System

Contractor shall propose the suitable paint system for Engineer's approval. Paint to be applied on structural steel shall be anti-corrosive so that the steel may be well protected and become atmospheric corrosion resistant.

Reference Table for Paint Systems

System	Primer	Intermediate Coat	Top Coat
1	IOZ	EP	APU
3	PUZ	PU	APU
4	EPZ	EP	APU
5	EP	EP	APU
6	PUAL***	PU	APU
7	EM	EM	APU
8	OIL/ALK*	OIL/ALK*	OIL/ALK*

Legend:

IOZ = Inorganic Zinc Rich Primer
PUZ = Polyurethane Organic Zinc Rich
EPZ = Epoxy Organic Zinc Rich
EP = Epoxy
PUAL = Polyurethane Aluminum Primer
EM = Epoxy Mastic

OIL/ALK = Oil and Alkyd
PU = Polyurethane
APU = Aliphatic Polyurethane

Note:

*OIL/ALK paints include alternate inhibitive pigments to lead, such as zinc oxide, barium metaborate, zinc hydroxy phoshate, calcium boro silicate, calcium sulphanate, and zinc molybdate, which have been tested and are acceptable alternates.

*** PUAL can be used as a primer on bare steel or as a penetrating sealer on existing coatings. They should be specifically formulated for the intended use.

403.5 Measurement and Payment

403.5.1 General

Measurement and payment for steel girders in main bridge are divided into fabrication of materials and erection/installation of steel girders. These steel girders for payment includes the works of main girder, cross beam, stiffeners, bolts, stud, weld, seismic restrainer, paint and all incidental works for completion of structural steel components. The measurement of the steel girder works shall be made in terms of the weight in kilograms and shall be made for calculating the physical progress in order to monitor the Progress of the Project.

403.5.2 Unit Basis

(1) The weight of steel to be measured and paid for in kilogram shall be computed on the basis of the structural steel material only, including all plates, gussets and rolled sections. No reduction in weight shall be applied for bolt holes or weld preparation. The weight of welds, bolts, shear studs, paint, rubber pads, and any other miscellaneous items will not be considered for calculation of payment but shall be included in determining the unit price for the structural steel.

(2) Bearing shoe for steel plate girder shall be measured and paid for by the total number of bearing shoes properly and completely installed regarding of its type and dimensions shown on the Drawings and accepted by the Engineer

(3) The quantities to be paid for Fabrication and Field Erection shall be calculated based on the weight of the main structural steel girders, including only those components that are described in Sub-section 403.5.2 (1) above and are permanently welded to the main girder assemblies. Splice plates used for connections between the girders and pier diaphragms, cross-frames, and pier diaphragms and longitudinal and transverse restrainer assemblies shall also be included.

(4) The unit price for Fabrication shall be full compensation for all equipment, tools, transportation, incidentals, labor, materials, overhead and profit relating to the furnishing and fabrication of the specified components including but not necessarily limited to: shop welds (including the welding plan, testing and all other requirements for welding), bolts, shop drawing preparation and submission,

surface preparation and painting (including the painting plan, testing and all other requirements for painting), shear studs and testing.

(4) The unit price for Field Erection shall be full compensation for all equipment, tools, transportation, incidentals, labor, materials, overhead and profit relating to the erection of the specified components including but not necessarily limited to: field welds (including the welding plan, testing and all other requirements for welding), temporary supports, cranes and rigging, preparation and submission of erection drawings, installation and adjustment of profile, geometry adjustment, repair of areas damaged during erection, final touch-up painting and built and removal of temporary works used for erection.

403.6 Basis of Payment

(1) Furnishing and Fabrication of Structural Steel

For steel materials that are to be furnished and fabricated, the place designated for delivery shall be the project site. Payment for the item shall be deemed to be the full compensation for the "Furnishing and Fabrication" of all the materials, equipment, tools, labor, welds, bolts, stud, painting and scaffolding and any other incidental items of the works in accordance with the drawings and these specifications.

The following list is included in the cost of "furnishing and fabrication" of structural steel:

- Raw material cost in main and secondary steel girders with primer coating
- Associate material costs, studs, bolts, restrainers, weld, paint, tools, labor and equipment
- Shipping charge and marine transport cost
- Port charge, custom clearance, tax and duty
- Insurance
- Surface and or marine transport cost to fabrication shop
- Surface and or marine transport cost from fabrication shop to construction site
- Fabrication cost including pre-assembly, bolting, shop welds, shop coatings, equipment and facility costs in fabrication shop
- Administration and design/calculation costs
- Inspection and test cost, and
- Any other incidental cost

(2) Erection of Structural Steel

Payment for the erection shall be deemed to be the full compensation for the 'Erection of Steel Girders' of all the materials, equipment, tools, labor, and any other incidental works such as weld, bolt, stud, painting, temporary bearings, bent steel pier and false-works, and any other incidental items such as geometric control to erect the steel bridge components in accordance with the drawings and these specifications.

The following list is included in the cost of "Erection of Steel Girders":

- Crawler crane 150 ton; costs for transport, assembling, dismantle, operation and rent, etc.

- Steel bent pier; costs for construction/dismantling including its foundation, etc.
- *Field pre-assembling; cost for pre-assembling/dismantling of steel members* including preparation of base structure, unloading works, elevation adjustment work, welding, bolting, coating, and non-destructive test
- Girder erection works; costs for joint works of steel members including bolting and field welding, temporary bearing works, temporary support bracing at each work stages girder erections,
- Camber adjustment works
- Geometric controls
- Field welding and non-destructive tests
- Field paintings
- Installation/removal of scaffolding and safety net

Payment will be made under:

Pay Item No.	Description	Unit of Measurement
403 (3)	Structural Steel, furnished and fabricated	Kilogram.
403 (5)	Structural Steel, erected	Kilogram.
403 (8) a	Bearing Shoe for Steel Plate Girder Type 1	Each
403 (8) b	Bearing Shoe for Steel Plate Girder Type 2	Each
403 (8) c	Bearing Shoe for Steel Plate Girder Type 3	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 (mm)	Alternate U.S. Std.	CLASS 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) 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, or five-wire uncoated stress-relieved strands 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.

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) g	Prestressed Structural Concrete Members (AASHTO Girder Type V, L = 29.4 m)	Each
406 (1) h	Prestressed Structural Concrete Members (AASHTO Girder Type V, L = 29.55 m)	Each
406 (1) p	Prestressed Structural Concrete Members (PC Deck Slab, 280mm x 2000mm x 9650mm)	Square Meter

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 ± 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 ± 50mm, ± 70mm, and ± 165mm 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.

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.

b) 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) b	Elastomeric Bearing Pad (600x300x50mm), Duro 60	Each
407 (2) b	Expansion Joint (for ± 50mm Movement)	Linear Meter
407 (2) c	Expansion Joint (for ± 70mm Movement)	Linear Meter
407 (2) f	Expansion Joint (for ± 165mm Movement)	Linear Meter
407 (3) a	Restraining Bar, 32mm dia. x 1495mm	Each
407 (3) b	Restraining Bar, 32mm dia. x 1900mm	Each
407 (3) c	Restraining Cable, 65mm dia. x 4121mm (PC 7x15mm dia.)	Set
407 (3) d	Restraining Cable, 65mm dia. x 4224mm (PC 7x15mm dia.)	Set
407 (4)	G.I. Drain Pipe, dia.=150mm for Bridge Drainage	Linear Meter

SPL ITEM 407 (5) b PIER PROTECTION CONCRETE BLOCKS

SPL 407 (5) b.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) b.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) b.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) b.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) b.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) b	Pier Protection Concrete Blocks	Square Meter

SPL ITEM 420 (2) b REALIGNMENT OF RIVER/STREAM

SPL 420 (2) b.1 Description

This special Item shall consist of realignment of the upstream and downstream of river/stream in accordance with the lines, grades, elevations, limits and dimensions shown on the Drawing. Strictly close supervision by the Engineer is required during the actual excavation, shaping, trimming of river/stream bed and sloped surface, and backfilling and compaction works.

The Contractor shall submit to the Engineer for approval his realignment methodology and equipment to be used at a given time specified by the Engineer.

Realignment work shall commence upon receipt of written request from the Engineer.

SPL 420 (2) b.2 Equipment

Backhoe to be used for excavation under and above water level shall be recommended by the Contractor based on his methodology submitted and it shall be approved by the Engineer prior to commencement of excavation work.

Loader for hauling and disposal of excavated materials shall be as recommended by the Contractor and approved by the Engineer.

All recommended equipments shall be approved by the Engineer prior to the start of work in which such are intended to be used.

SPL 420 (2) b.3 Construction Requirements

Based on the Consultant's Drawings for realignment of river/stream, the Contractor is responsible for the actual verification in the field, the exact location, elevations and dimensions. The Contractor shall notify immediately the Engineer regarding the difference between the Drawings and the actual situation of the river/stream.

Upstream and downstream portion will be realigned by excavating the silted and shallow portion of the river by using the Contractor's recommended equipments which are approved by the Engineer. Excavated materials not intended for future use or for backfill and embankment shall be hauled and disposed immediately to the area wherein no possibility of materials to come back to the river during rainy season especially during heavy rains. Disposal area shall be as designated by the Engineer.

The excavated channel will be shaped and trimmed according to the designed slope, grade, elevation and dimensions shown on the Drawings. Channel surface shall be properly compacted as required by the Engineer.

All materials excavated and selected for backfill and embankment shall be hauled right away to the area they are intended to be used. The materials shall be spread properly and compacted according to the requirements specified by the Engineer.

The Contractor shall submit his actual realignment drawings and reports each week at the specified time and day given to him by the Engineer. The Engineer will thoroughly review the drawings and reports of the Contractor and in case there is discrepancy to the actual, the Engineer has the right to stop the realignment work. The work shall not be resumed unless written permission by the Engineer is given to the Contractor.

SPL 420 (2) b.4 Method of Measurement

a) The realignment work will be measured and paid for on a lump sum basis inclusive only of excavation, backfilling, shaping, trimming, compaction and hauling of excavated materials to designated disposal area. The Contractor is required to breakdown the inclusive works he rendered in the realignment operation with the corresponding cost. Costs included in the list but not rendered in the actual work will not be paid. Furthermore, excavation that goes beyond the construction limits will not be paid.

SPL 420 (2) b.5 Basis of Payment

The accepted quantity measured as prescribed in Section 420 (2).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 all labor, equipment, tools and incidentals necessary to complete the realignment work.

Payment will be made under:

Pay Item No.	Description	Unit of Measurement
SPL 420 (2) b	Realignment of River/Stream	Lump Sum

SPL ITEM 420 (4) b TEMPORARY CRANEWAY

SPL 420 (4) b.1 Description

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

The Contractor is required to design the temporary craneway 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 of temporary craneway and construction procedures to the Engineer for approval at a given time specified by the Engineer.

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

SPL 420 (4) b.2 Material Requirements

Steel H-Piles shall be in accordance with the requirements of AASHTO M 183. Other steel materials shall meet the requirements of Item 712, Structural Metal and Item 409, Welded Structural Steel.

SPL 420 (4) b.3 Construction Requirements

Prior to commencement of craneway construction, the Contractor at the given number of days specified by the Engineer, shall submit a detailed construction drawing of the craneway with structural analysis based on the latest topographic survey (S = 1/500) taken in the preconstruction survey stage. The Contractor may use the consultant's drawings for designing temporary craneway as his reference only. Applicable design live load for craneway design shall be MS-18 in AASHTO or gross weight of 80 tonne trailer whichever produces the severe effect for a member to be designed.

All piling works for the construction of temporary craneway shall strictly be in accordance with the piling requirements specified under Item 400, Piling, and shall be with close supervision by the Engineer and the Contractor's expert of said work.

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

It will be the sole responsibility of the Contractor to maintain and repair the craneway at his own expense during the entire construction period.

After the completion of the main bridge, the Contractor is responsible at his own expense for the removal of the craneway and the restoration of the river bank to its original position.

SPL 420 (4) b.4 Method of Measurement

Temporary craneway 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.

Damages inflicted on the craneway as a result of typhoon and floods shall not be a basis for claim of any manner against the Client and it is the obligation of the Contractor to restore and repair the damages at his own expense.

SPL 420 (4) b.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) b	Temporary Craneway (For Pampanga Bridge)	Linear Meter

SPL ITEM 420 (5) b TEMPORARY ACCESS ROAD (CAUSEWAY)

SPL 420 (5) b.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 and shall be in accordance with the lines, grades and dimensions shown on the Drawing. Proper maintenance and safety provisions shall be made and monitored for the completed access road to ease public traffic. The temporary access road will be placed at locations and elevations as indicated on the Drawings or as directed by the Engineer.

SPL 420 (5) b.2 Material Requirements

Materials for embankment of temporary access road shall be of the same kind, grade and sizes in accordance with the material requirements described in Item 104, Embankment as approved by the Engineer.

Materials shall comply with pertinent provisions for fill and construction of gravel roads specified in Item 201, Aggregate Base Course and shall be approved by the Engineer. The required thickness shall not be less than 200 mm as shown on the Drawing.

SPL 420 (5) b.3 Construction Requirements

The Contractor at a given number of days specified by the Engineer, shall submit his construction plans and information regarding the manner in which he intends to comply with the works and for the maintenance of the temporary access road and safety provisions, for the Engineer's review and approval prior to construction.

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

It will be the sole responsibility of the Contractor to maintain and repair the temporary access road at his own expense during the entire construction period.

If temporary access road is no longer be required and if directed by the Engineer, after completion of the main construction, the Contractor is responsible at his own expense for the removal of the temporary access road and the restoration of the area to its original position.

SPL 420 (5) b.4 Method of Measurement

Temporary 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) b.5 Basis of Payment

Temporary access road will be paid for as prescribed in Section 420 (5).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 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 materials used in the temporary access road as directed by the Engineer.

If temporary access road is no longer be required, and if directed by the Engineer, suitable materials used as fill, subbase or as surfacing for the temporary access road may be placed in the permanent road construction and paid for as embankment materials or as appropriate subbase or surfacing Item.

Payment will be made under:

Pay Item No.	Description	Unit of Measurement
SPL 420 (5) b	Temporary Access Road (For Pampanga Bridge Construction)	Linear Meter

SPL ITEM 420 (6) c TEMPORARY COFFERDAM FOR PIER CONSTRUCTION

SPL 420 (6) c.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) c.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) c.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) c.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) c.5 Basis of Payment

Temporary cofferdam will be paid for as prescribed in Section 420 (6).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) c	Temporary Cofferdam for Pier Construction (For Pampanga Bridge)	Each