

The Particular Technical Specifications

The Particular Technical Specifications contain Clauses/Sub-Clauses applicable to this particular contract that supplement or amplify the requirements of the **Standard Technical Specifications of MPWT**. Special Provisions, as contained in Particular Technical Specifications, are to be read in conjunction with Standard Specifications. Where there are ambiguities between the contents of Standard Specifications and Particular Specifications, the Particular Specifications shall prevail.

1. FACILITIES FOR THE EMPLOYER AND ENGINEER PAKADING.

Amend Division 104 of MPWT Specification: Facilities for the Engineer and employer as follows

Division 104.01:

Replace the current text with the following:

The following facilities shall be arranged for the Engineer:

- Provision of office for 15 persons as follows:
- one large common space
- one individual office type A
- one meeting room,

for a total surface of about 200m².

Additional common areas include Kitchen, Toilet, Store and Reception area, reasonably equipped for common use.

Division 104.02.1: Furniture

Replace the current text with the following:

Furniture shall be as follows, or as agreed by the Engineer:

	Open Space	Office	Meeting room
Desk with locking drawers	8	1	
Conference Table for seating of 12			1
Occasional table	1	1	
Swivel chair on rollers	8	1	
Straight chair	12	3	16
Filing cabinet	8	2	
Whiteboard / flipchart with markers	1		1

Miscellaneous items which can reasonably be expected as curtains, table-lamps, waste-paper baskets, coat hangers, shelves, racks shall also be provided by the Contractor.

Division 104.02.3: Equipment

Replace the current text with the following:

Facilities provided by the contractor include:

- one A3/A4 integrated color printer copier, scanner, type Canon Image Runner Advance DX C37251 or equivalent
- cleaning services,
- security services,
- consumables such as stationary, potable water, A4/A3 paper, toilet paper, cleaning products.
- No beverages and food shall be provided.

Division 104.05: Accommodation for the Engineers staff and Employer

Add to this division as follows:

The contractor shall provide **3 single quarters** equipped as stated in Table 1 of Division 104.05.02 for single quarters.

The contractor shall provide **a mess hall for common use**, including a kitchen, dining and seating space, as well as bathrooms.

Replace table 2 of 104.05.02 (2) in accordance with the following:

• Electric boiler (150 l)	1
• Electric stove, 4 plate with integral oven	1
• Electric refrigerator (350 l)	1
• Electric freezer (200l)	1
• Kitchen exhaust fan and hood	1
• Air-conditioner (2.5 kW)	2
• Kitchen sink (large double unit)	1
• Washing machine	1
• Laundry trough	1
• Electric iron and ironing board	1
• Kitchen cupboard fitted units	1
• Kitchen table	1
• Kitchen chair	4
• Dining table (modular to seat 4)	2
• Dining chair	10
• Ceiling fan	2
• Free standing fan	2
• Chilled water dispenser	1
• Sofa	2
• Lounge chairs	2
• Lower table	1
• 42"-inch colour TV, with satellite or cable	1
• Bath / shower combination	2
• Bathroom shelves	2
• Internet connectivity (WIFI or LAN)	

104.-19: Transport for the employer

(1) the Contractor shall cover the cost of drivers, fuel and maintenance for **2 cars** during the project implementation.

2. SOLAR POWERED STREET LIGHTING:

Lighting performance shall be in accordance with Specifications division 612.

The solar power unit shall include:

- Dual Solar Panels of Mono-Crystalline- or Multi-Crystalline Silicon Solar Cells, The power output of the module under STC should be a minimum of 75W
- Battery, Minimum 12.8V, 30 AH capacity Lithium Ferro Phosphate battery. Autonomy of 3 days or Minimum 36 operating hours per permissible discharge with fully charged Lithium-Ferro Phosphate Battery.
- Battery pack should have proper 'Battery management System' (BMS) for cell balancing, over charge and over temperature protection. Battery should conform to the latest international standards.
- System Controller, controlling that Electronics operate at an appropriate voltage suitable for proper charging of the battery, no Load current consumption should be less than 20 mA. The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp. The elements containing the electronics should be capable of easy access for installation and replacement. The system should have two indicators, green and red. The green indicator should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged.

2.1. ELECTRONIC PROTECTIONS

- i. Adequate protection is to be incorporated under "No Load" conditions e.g. when the lamp is removed and the system is switched 'ON'.
- ii. The system should have protection against battery overcharge and deep discharge conditions.
- iii. The System should have protection against short circuit conditions.
- iv. Protection for reverse flow of current through the PV module(s) should be provided.
- v. Adequate protection should be provided against battery reverse polarity.
- vi. Load reconnect should be provided at 80% of the battery capacity status.

2.2. STRUCTURE

- i. A corrosion resistant metallic frame structure should be fixed on the pole to hold the SPV module.
- ii. The frame structure should have provision so that the module can be oriented at the suitable tilt angle.
- iii. The pole should be Hot dip galvanized pipe
- iv. IV. Pole height 5 m above the ground level and 1 m below the ground or in accordance with suppliers' specifications
- v. The pole should have the provision to hold the solar panels and the luminaire.
- vi. The battery shall be either included in the luminaire enclosure, which should be water proof (IP 65) and corrosion resistant or outside the luminaire enclosure in a vented, acid proof and corrosion resistant, hot dip galvanized metallic box (IP 65) with anti-theft locking arrangement for outdoor use.

The Solar Power supply shall be inclusive of all foundation works, Cables, Ground & Accessories. All necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.

3. ADDITIONAL ITEM: BULLNOSE

Bullnose, in the context of roads, refers to a specific type of feature used in road design and construction. Here are some common uses of bullnose on roads:

Safety Enhancement: Bullnose is often installed at the end of barriers, guardrails, or parapets to improve safety. The rounded shape of the bullnose reduces the risk of vehicles snagging or getting impaled in case of an impact, minimizing the severity of accidents and injuries.

Pedestrian Safety: Bullnose can be used at intersections or pedestrian crossings to create a safer environment for pedestrians. The rounded edge of the bullnose helps to guide pedestrians safely across the road and reduces the risk of tripping or injury.

Traffic Calming: Bullnose can be strategically placed on roads to help control traffic speed and reduce the risk of accidents. By creating a visual and physical barrier, bullnose encourages drivers to slow down, particularly at curves or intersections where speeding may be a concern.

Aesthetic Enhancement: Bullnose can also serve aesthetic purposes, especially in urban areas or scenic routes. The smooth, rounded design adds a decorative element to the road infrastructure, enhancing the overall visual appeal of the surroundings.

Intersection Design: Bullnose is commonly used in intersection design to facilitate smoother turns and transitions for vehicles. By providing a rounded corner, bullnose allows vehicles to navigate intersections more efficiently, reducing the likelihood of collisions and traffic congestion.

Overall, bullnose serves various practical and safety-related purposes in road design and construction, ranging from enhancing safety and traffic flow to improving aesthetics and accessibility. Its versatility makes it a valuable feature in creating road infrastructure that is both functional and visually appealing. For understanding typical sketch of Bullnose is shown below: -



Figure 3-1: Bullnose

4. ADDITIONAL ITEM: SOLAR ROAD STUDS

Solar road studs, also known as solar road markers or solar cat eyes, are small devices installed on roads or pavements to provide guidance, warning, and visibility, especially during low-light conditions or at night. Here are some common uses of solar road studs:

Road Marking: Solar Road studs are often used to mark lanes, edges, and centrelines of roads, providing clear guidance to drivers, especially in areas with poor visibility or adverse weather conditions.

Traffic Management: Solar Road studs can be used in traffic management schemes to delineate lanes, merge lanes, exits, and entrances on highways, expressways, and other roadways, reducing confusion and improving traffic flow.

Safety Enhancement: Solar Road studs enhance safety by providing visual cues to drivers, alerting them to changes in road alignment, upcoming hazards, pedestrian crossings, and other potential dangers, thereby reducing the risk of accidents.

Pedestrian Crossings: Solar Road studs can be used to mark pedestrian crossings, zebra crossings, and other pedestrian pathways, improving visibility for both pedestrians and drivers and promoting pedestrian safety, especially at night.

Bicycle Lanes: Solar Road studs can delineate bicycle lanes and paths, increasing visibility and safety for cyclists, especially in areas where bicycle lanes are integrated with vehicular traffic.

Parking Lots: Solar Road studs can be installed in parking lots and garages to mark parking spaces, aisles, and driveways, improving visibility and guiding vehicles safely in and out of parking areas, especially at night.

Speed Control: Solar Road studs can be used in speed control measures, such as speed humps, speed tables, and rumble strips, to warn drivers to slow down, promoting compliance with speed limits and reducing the risk of speeding-related accidents.

Emergency Situations: Solar Road studs can be used to guide emergency vehicles, such as ambulances, fire trucks, and police cars, along designated routes, providing clear visual markers even in blackout conditions or when other road signage is obscured.

Environmental Benefits: Solar Road studs are powered by renewable solar energy, reducing the reliance on traditional grid electricity and minimizing carbon emissions, making them an environmentally friendly option for road lighting and marking.

Overall, solar road studs serve multiple purposes in road infrastructure, enhancing safety, visibility, and efficiency for both motorists and pedestrians, especially in low-light conditions or at night. Typical Solar Road Stud is shown in fig. below:



Figure 4-1: Solar Road Stud

5. ADDITIONAL ITEM: FLASHING SIGNAL SYSTEM

In highway infrastructure, solar-powered keep right and hazard marker signs serve important functions in guiding and alerting drivers to potential hazards or changes in road conditions. Here's how they are typically utilized:

Keep Right Signs: These signs are strategically placed along highways and roadways to indicate to drivers that they should keep to the right side of the road, especially in areas where lanes merge, diverge, or where construction work is being carried out. The solar-powered feature ensures visibility of the sign even during low-light conditions or at night, enhancing safety for motorists.

Hazard Marker Signs: Hazard marker signs are used to warn drivers of potential dangers or obstacles on the road ahead. These hazards could include sharp curves, steep grades, narrow bridges, pedestrian crossings, animal crossings, or other hazards. By incorporating solar-powered illumination, these signs remain visible and effective even in dimly lit or night time conditions, helping drivers to anticipate and navigate hazards safely.

Highway Maintenance and Construction Zones: Solar-powered keep right and hazard marker signs are commonly deployed in highway maintenance and construction zones to guide drivers safely through temporary traffic configurations, lane closures, or detours. These signs help maintain traffic flow and reduce the risk of accidents or confusion among drivers navigating through work zones.

Roadway Alignment: Solar-powered keep right signs may also be used to indicate roadway alignment, particularly in areas where the road curves or changes direction. By alerting drivers to upcoming curves or bends in the road, these signs enhance safety and reduce the likelihood of accidents due to excessive speed or unexpected changes in road direction.

Visibility Enhancement: The use of solar power ensures that these signs remain illuminated without the need for external power sources or wiring. This enhances their visibility and effectiveness, particularly in rural or remote areas where access to electricity may be limited or impractical.

Environmental Considerations: Solar-powered signs are environmentally friendly, as they rely on renewable energy sources and do not produce greenhouse gas emissions. This aligns with sustainability goals and reduces the ecological footprint of highway infrastructure projects.

Solar-powered keep right and hazard marker signs play a crucial role in highway safety by guiding and alerting drivers to potential hazards, changes in road conditions, and regulatory requirements. By enhancing visibility and providing clear guidance, these signs contribute to safer and more efficient travel on highways and roadways. Typical Flashing Signal System is shown in fig below: -

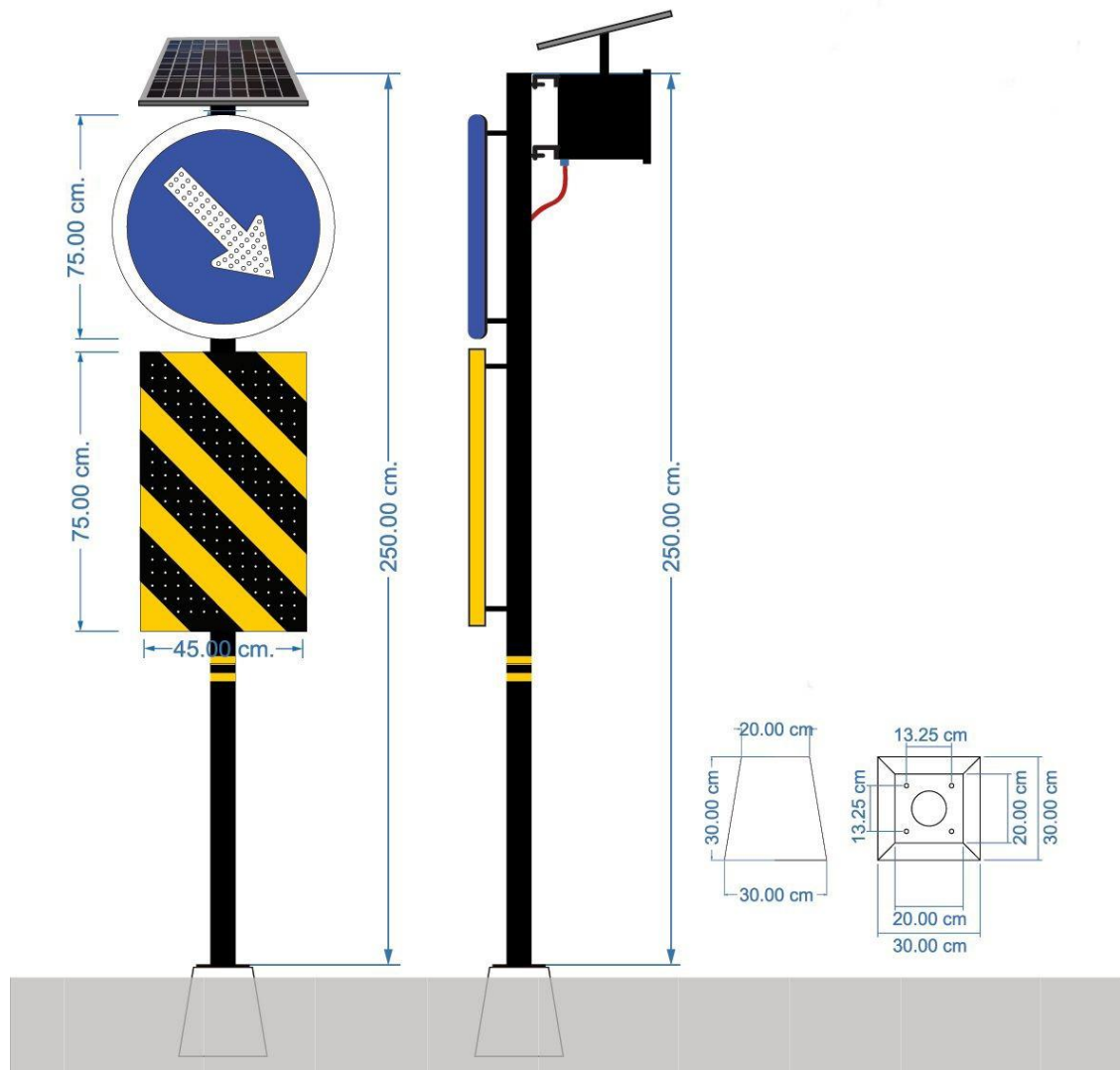


Figure 5-1: Flashing Signal System

6. IN ADDITION OF SECTION 504, BORED PILE

In addition of 504.03.5 Temporary Casing Method

Please read at the beginning

- When concreting is carried out for a pile, a temporary casing should be installed to sufficient depth so as to ensure that fragments of soil from the sides of the hole do not drop into the concrete as it is placed. When the bore hole is stabilized using drilling mud, the temporary casing is not required except near the top.
- The metal casing shall be of sufficient thickness and strength to hold its original form and show no harmful distortion while driving or when adjacent casings are driven.
- Bored cast in-situ piles in soils which are stable, may often be installed with only a small casing length at the top. A minimum of 2 m length of top of bore shall invariably be provided with casing

to ensure against loose soil falling into the bore. In cases in which the side soil can fall into the hole, it is necessary to stabilize the side of the bore hole with drilling mud, or a suitable steel casing.

- d. Materials inside the casing shall be removed progressively by air lift, grab or percussion equipment or other approved means.
- e. Where bored cast in-situ piles are used in soils liable to flow, the bottom of the casing shall be kept sufficiently in advance of the boring tool to prevent the entry of soil into the casing, leading to formation of cavities and settlements in the adjoining ground. The water level in the casing should generally be maintained at the natural ground water level for the same reasons. The joints of the casing shall be made as leak-tight as possible to minimize inflow of water or leakage of slurry during concreting.
- f. The diameter of the boreholes shall not be more than the inside diameter of the liner when the liners are installed before boring. When the liners are installed after boring, the diameter of the boreholes shall not be more than the outside diameter of liner + 2 mm, unless otherwise approved by Engineer.

6.1. IN ADDITION, 504.03.6 PERMANENT CASING METHOD

Please read at the beginning

- a. Permanent steel liner shall be provided at least up to designed/anticipated “maximum scour level”. The minimum thickness of steel liner shall be 6 mm.
- b. Permanent steel liner shall be provided for the full depth of the pile in the following situations where:
 - i) The surrounding soil is marine clay
 - ii) Soft soil is present
 - iii) Surrounding soil has sulphate content equal to or more than 1 %
 - iv) Surrounding water has sulphate content equal to or more than 2500 ppm
 - v) Leakage of sewage is expected

6.2. IN ADDITION TO 504.03.12 CONCRETE PLACEMENT, CURING AND PROTECTION

Please read at the beginning

Use of Tremie for Placing Concrete in Pile Bore

The concrete should invariably be poured through a tremie with a funnel, so that the concrete can be properly deposited in the hole without segregation. For concreting done by tremie, the following requirements which are particularly applicable shall be ensured.

- a) The hopper and tremie should be a leak proof system.
- b) Diameter of tremie shall be not less than 200 mm for use with 20 mm diameter down aggregate.
- c) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it or with a steel plate with adequate charge to prevent mixing of concrete and water. However, the plug should not be left in the concrete as a lump.
- d) The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal of the pipe. The tremie should be always full of concrete.

- e) The pile should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile, to prevent laitance from being entrapped within the pile.
- f) All tremie tubes shall be thoroughly cleaned after use.
- g) For concrete placed through tremie, there is no need to add 10 percent extra cement.
- h) Concreting of piles shall be carried out continuously. In exceptional cases of interruption of concreting the tremie shall not be taken out of the concrete under any circumstances. The tremie pipe shall be raised and lowered slowly from time to time to prevent it from getting stuck in the concrete while ensuring its lower end does not come out of concrete. The concreting shall be resumed before final setting time of concrete, which shall be established before the start of the piling operation. For achieving longer setting time of the concrete, super plasticizers having retarding properties/retarders can be used. If any of these requirements are not met, the pile shall be rejected.

6.3. IMPORTANT CONSIDERATIONS, INSPECTION/PRECAUTIONS FOR “BORED CAST IN-SITU PILES”

- a) While concreting uncased piles, voids in concrete shall be avoided and sufficient head of concrete is to be maintained to prevent inflow of soil or water into the concrete. It is also necessary to take precautions during concreting to minimize the softening of the soil by excess water. Uncased cast in-situ piles shall not be allowed where mudflow conditions exist.
- b) The drilling mud such as bentonite suspension shall be maintained at a level sufficiently above the surrounding ground water level throughout the boring process, to ensure the stability of the strata which is being penetrated until the pile has been concreted.
- c) The bores shall be washed by bentonite flushing to ensure clean bottom at two stages viz. after completion of boring and prior to concreting after placing of reinforcement cage. Flushing of bentonite shall be done continuously with fresh bentonite slurry till the consistency of inflowing and outflowing slurry is similar.
- d) For very long or large diameter piles, use of retarding plasticizer in concrete is desirable.
- e) For large diameter piles, it may be essential to conduct non-destructive pile integrity tests to evaluate integrity of the pile
- f) Where possible, it may be desirable to grout the base of pile with cement slurry under suitable pressure after concrete in the pile attains the desired strength. For this purpose, conduit pipes with easily removable plugs at the bottom end, should be placed in the bore along with reinforcement cage before concreting.
- g) Removal of Concrete above Cut-off Level
- h) It is desirable that the concrete above cut-off level, is removed before the concrete is set. This may be done manually or by specially made bailer or other device. Such removal of concrete helps in preventing the damage of the good concrete below the cut-off level, which results from chipping by percussion method.

- i) The removal of concrete shall be within ± 25 mm from the specified cut off level, preferably on the minus side. After removal of such concrete, the concrete shall be compacted with rammer with spikes or vibrated.

6.4. REMOVAL OF CONCRETE ABOVE CUT-OFF LEVEL

It is desirable that the concrete above cut-off level, is removed before the concrete is set. This may be done manually or by specially made bailer or other device. Such removal of concrete helps in preventing the damage of the good concrete below the cut-off level, which results from chipping by percussion method.

The removal of concrete shall be within ± 25 mm from the specified cut off level, preferably on the minus side. After removal of such concrete, the concrete shall be compacted with rammer with spikes or vibrated.

In case the concrete is not removed before setting, a groove shall be made on outer perimeter by rotary equipment before chipping by percussion method.

The reinforcement in the pile shall be exposed for full anchorage length to permit it to be adequately bonded into the pile cap. Exposing such length shall be done carefully to avoid damaging the rest of the pile.

6.5. IN ADDITION OF SECTION 504.03.13, TOLERANCES

Permissible Tolerances for Pile Caps

- | | |
|---|-------------------------------|
| a) Variation in dimensions | : +50 mm, -10 mm |
| b) Misplacement from specified position in plan | : 15 mm |
| c) Surface irregularities measured | : 5 mm with 3 m straight edge |
| d) Variation of level of top of piles | : ± 25 mm |

PILE TESTS (To be added immediately before 504.03.14)

A. Initial Load Test

- i. The number of initial tests shall be determined by the Engineer taking into consideration the bore log and soil profile, design length, pile diameter and design pile capacity.
- ii. Minimum 1 number of test over the dedicated "Test Pile" shall be conducted for every location of bridge.
- iii. Initial load test for vertical axial load capacity on "Test Piles" of the same diameter and length as of the design/working pile, shall be carried out after 28 days design strength is achieved. The testing shall be done as per the procedure laid down in ASTM D1143 using "quick load compression test method" except that the test shall be taken to plunging failure or three times design load or 1,000 tonnes whichever occurs first as it is stated under "Clause No. 503.03.15". The initial load test shall be cyclic load test for piles deriving strength from end bearing and side friction. The maintained load test can also be performed for determination of total value of safe load.

B. Routine Load Tests

- i. Routine load test shall be carried out at actual locations of foundations of bridges to re-confirm or modify the allowable loads. However, results of routine load tests shall not be used for upward revision of design capacity of piles.
- ii. Minimum 1 number of "Routine Load Test" over the "Working Pile" at "Abutment" and 1 number of "Routine Load Test" over the "Working Pile" at "Pier" for every location of bridge.

- iii. The “High Strain Dynamic Pile Load Test” shall be conducted under “Routine Load Test” as per procedure stipulated in ASTM D4945 in line with the guidelines given under “Clause No. 504.03.16”

6.6. IN ADDITION TO 504.03.15 SONIC TESTING

Please read at the beginning

- a) Since the proposed diameter of “working pile” is 1200 mm, so minimum 4 numbers of “Sonic Logging Tubes” shall be fitted along the periphery of the pile reinforcement cage at equal interval for doing the “Cross-hole Sonic Logging Test (CHSLT)” following the procedure stipulated in ASTM D6760.
- b) The “Cross-hole Tomography” from the test records (namely “Waterfall Diagram” including “Increase in FAT” and “Loss of Energy”) shall be made separately for every working pile”.
- c) The “length of pile shaft” and the “Integrity/Quality of Concrete of Pile Shaft” shall be clearly stated with detailed clarification based on the CHSLT results.

7. IN ADDITION OF SECTION 505

7.1. RE-USE OF FORMWORK

When the formwork is dismantled, its individual components shall be examined for damage and damaged pieces shall be removed for rectification. Such examination shall always be carried out before their use again. Before re-use all components shall be cleaned of deposits of soil, concrete or other unwanted materials. Threaded parts shall be oiled after cleaning.

All bent steel props shall be straightened before re-use. The maximum permissible deviation from straightness is 1/600 of the length. The maximum permissible axial loads in used props shall be suitably reduced depending upon their condition. The condition of the timber components, plywood and steel shuttering plates shall be examined closely for distortion and defects before re-use.

7.2. SPECIALISED FORMWORK

Specialised formwork such as slip form, floating caisson and travelling form, wherever used shall be designed and detailed by competent agencies and a set of complete working drawings and installation instructions supplied to the Engineer. In case proprietary equipment is used, the supplier shall furnish drawings, details, installation instructions etc. in the form of manuals along with the formwork.

8. IN ADDITION OF SECTION 508, PRESTRESSING

8.1. CUTTING OF PRESTRESSING STRANDS

Cutting and trimming of wires or strands shall be done by suitable mechanical or flame cutters. When a flame cutter is used, care shall be taken to ensure that the flame does not come in contact with other stressed steel. The flame cutting of wire or strand shall be carried out at least 75 mm beyond the point where the tendon will be gripped by the anchorage or jacks.

In post tensioned members, the ends of prestressing steel projecting beyond the anchorages, shall be cut after the grout has set.

8.2. CLEANING

Tendons shall be free from loose rust, oil, grease, tar, paint, mud or any other deleterious substance.

Cleaning of the steel may be carried out by immersing in suitable solvent solutions, wire brushing or passing through a pressure box containing carborundum powder. However, the tendons shall not be brought to a polished condition.

8.3. STRAIGHTENING

High tensile steel wire and strand shall be supplied in coils of sufficiently large diameter, such that tendons shall retain their physical properties and shall be straight as they unwind from the coil. Tendons of any type that are damaged, kinked or bent shall not be used.

The packing of prestressing wire/strand shall be removed only just prior to forming of cable for placement. Suitable stands shall be provided to facilitate uncoiling of wires/strands without damage to steel. Care shall be taken to avoid the possibility of steel coming into contact with the ground.

8.4. SHEATHING DUCT JOINTS

The sheathing and all joints shall be water tight and shall withstand a pressure of 1.1 times the grouting pressure and maximum grouting head due to grout. Any temporary opening in the sheathing shall be satisfactorily plugged and all joints between sheathing and any other part of the prestressing system, shall be effectively sealed to prevent entry of mortar, dust, water or other deleterious matter. Sheathing shall be neatly fitted at joints without internal projection or reduction of diameter.

Enlarged portions of the sheathing at couplings or anchorages shall be of sufficient length to provide for the extension of the tendons.

Special attention shall be paid to the junction at the anchorage end, where the sheathing must be tightly fitted on the protruding trumpet end of anchorage and thereafter sealed preferably with tape, to make it water-proof.

9. IN ADDITION OF SECTION 513.02.2.1, STRIP SEAL JOINT

Strip seal expansion joint shall comprise the following:

9.1. EDGE BEAM

This shall be either extruded or hot rolled steel section including continuously shop welded section with suitable profile to mechanically lock the sealing element in place throughout the normal movement cycle. Further, the configuration shall be such that the section has a minimum thickness of 10 mm all along its cross section (flange and web). Thickness of lips holding the seal shall not be less than 6 mm. The minimum height of the edge beam section shall be 80 mm. The minimum cross sectional area of the edge beam shall be 1500 mm²

9.2. ANCHORAGE

The edge beams of single strip/box seal joints shall be anchored in the concrete with rigid loop anchorage. The anchor loops shall be connected to the edge beam by means of anchor plate welded to the edge beam. Total cross sectional area of anchor loop on each side of the joint shall not be less than 1600 mm² per metre length of the joint and the centre to centre spacing shall not exceed 250 mm. The thickness of anchor plate shall not be less than 0.7 times the diameter of anchor loop or 12 mm whichever is higher. The anchor loop at the edge profiles should be at right angles to the joint. Planned deviations of this direction are allowable only for the range of 90° ± 20°. The anchoring reinforcement of the construction must lie parallel to the anchor loops.

9.3. SEALING ELEMENT

This shall be a preformed/extruded single strip of such a shape as to promote self-removal of foreign material during normal joint operation. The seal shall possess high tear strength and be insensitive to oil, gasoline and ozone. It shall have high resistance to ageing. The specially designed proprietary type of locking system of seal in the housing of edge beam shall be such as to ensure 100% water tightness as well as ease of installation and replacement. Mechanical fastening of sealing element with edge beam shall not be permitted. Sealing element shall be continuous over the entire joint.

10. IN ADDITION OF SECTION 602.02.01, STONE PITCHING

The size of stone shall be as large as possible and no stone shall weigh less than 40 kg.

10.1. FILTER MEDIUM

The material for the filter shall consist of coarse sand, gravel or stone. One or more layers of graded materials, to act as a filter medium, shall be provided underneath the pitching, to prevent loss of the embankment material and build-up of uplift head on the pitching.

10.2. CONSTRUCTION OPERATIONS

Before laying the pitching, the side of banks shall be trimmed to the required slope and profiles by means of lines and pegs at intervals of 3 m. Depressions shall be filled and thoroughly compacted.

The filter granular material shall be laid over the prepared base and compacted to the thickness specified on the drawings by means of suitable equipment.

The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.

The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.

In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible.

When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size wedged in with hammers to ensure tight packing.

When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

11. IN ADDITION OF SECTION 520: STEEL STRUCTURES

11.1. GENERAL

The work under this Section shall consist of the supply, fabrication, delivery to the site and erection, of steel structures in the Project, in strict accordance with the MPWT Specifications and Drawings or as established and directed by the Client/Engineer.

Unless otherwise specified in the Drawings or elsewhere the fabrication and erection of the steel superstructure shall conform to the requirements as specified below:

- ▶ Grade of Structural Steel shall be Grade 345 with Specified Minimum Yield Strength of 345 MPa, and Minimum Tensile Strength of 450 MPa, as per AASHTO M270M (Equivalent ASTM Designation A709M).
- ▶ Welding requirements shall in all respects conform to the relevant sections of AWS D1.5, Bridge Welding Code

11.2. INSPECTION

The Engineer has the authority to inspect, examine and test materials, workmanship, and performance of any part of the works at the manufacturer's works or the site of fabrication. The Contractor shall furnish:

- ▶ Copies of mill orders at the time orders are placed with the manufacturer.
- ▶ Certified mill test reports: a production certification before the start of fabrication using material covered by these reports.
- ▶ A production certification from the manufacturer.
- ▶ The chemical analyses and physical test results for each heat of steel used in the work and for steels with specified impact values, including the results of Charpy V-notch impact tests in the certified mill test reports.

The Contractor shall furnish all facilities for the inspection of material and workmanship at the place of fabrication and the Engineer, his representatives or their delegate shall be allowed free access to all parts of the premises upon request. The Inspectors will be appointed by the Client/Engineer but all expenses for this inspection work including fees, transportation cost and per diem, shall be paid by the Contractor and shall be deemed to be included in the unit prices for relevant Pay Items in BOQ.

11.3. TOLERANCES FOR STEEL STRUCTURES

All fabrication shall be executed accurately to the shapes and dimensions shown on the Drawings, and, unless otherwise indicated on the Drawings, shall be within the tolerances listed below. 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.

Deviation of web from flange connection line:

The maximum deviation of centerline of the web from the flange connection line of Girder and the flange centerline of the cross beams shall not exceed 6mm.

The following tolerances shall be applied to fabrication of steel girder bridges and erection of bridges:

Item		Condition	Tolerance (mm)
Trial Assembly	Overall Bridge length, Span length, L(m)	-	$\pm (10+L/10)$
	Distance between CL of main girders, main structure, B(m)	$B \leq 2$	± 4
		$B > 2$	$+ (3+B/2)$
	Assembled height of main girder, H(m)	$H \leq 5$ $B > 5$	± 5 $\pm (2.5+H/2)$

	Camber, L(m)	$L \leq 20$	-5 to + 5
		$20 < L \leq 40$	-5 to + 10
		$40 < L \leq 80$	-5 to +15
		$80 < L \leq 200$	-5 to +25
	Verticality of main girder, d1 (mm)	H=Height of main girder (mm)	$3+H/1000$
	Cross point difference at bridge edge of main girder	-	10
	Horizontal alignment, L(m)	$L \leq 100$	$5+L/5$
		$L > 100$	25

11.4. ERECTION

The Contractor shall submit to the Engineer a proposal detailing the construction sequence based on the construction sequence shown in the drawings. The submission shall incorporate detailed methodology, erection drawings of the proposed construction sequence, together with the corresponding complete and checked erection design calculation in every erection step to obtain the correct elevation in the completed bridges. The proposed documents shall be submitted at least twelve (12) weeks prior to the commencement of construction of the superstructure of new bridge for the Engineer's approval.

The erection drawings shall show all temporary works necessary including the temporary support arrangements, sheet piling, the bearings, supports and incidentals, and include full method statements for each stage of the erection. A detailed scheme shall be prepared showing stage-wise activities, with complete drawings and working instructions. This should be based on detailed stage-wise calculations taking into account specifications and capacity of erection equipment machinery, tools and tackles to be used and temporary working loads as per respective codal provisions. The scheme shall also take into account site conditions such as hydrology, rainfall, flood timings and intensity, soil and subsoil conditions in the river bed and banks, maximum water depth, temperature and climatic conditions and available working space.

All components of the bridge shall be got checked for their adequacy to take care of temporary forces to which they are subjected during erection so as to ensure safety of the structure at all stages of erection.

The Contractor shall be responsible for the detailed design of the erection plan, equipment, and temporary works and be responsible for ensuring the structural adequacy and stability of all items during entire erection.

12. ADDITIONAL ITEMS: SEISMIC ARRESTER/RESTRAINER

12.1. GENERAL

The function of this system is to prevent Superstructures from being displaced from Substructures because of any exceptional forces like massive earthquakes, massive water current forces on bridge superstructure due to unprecedented rain etc. Bridge Arresters/Restrainers are expected to ensure that the relative displacement between the Superstructure and Substructure does not exceed the girder seating length.

Usual bearings of various types (metallic, elastomeric, pot, etc.) can be designed to have the capacity of sustaining lateral forces of about 25-30% of their vertical load carrying capacity. For larger lateral forces, because of some unforeseen situations, it is more suitable and economical to provide resistance to these forces separately by some other structural element, which is provided here in the form of Seismic Arrester/Restrainer. It has been designed as an additional safety measure in the event of failure of bearings.

In many earthquakes it was noticed that the Superstructure was dislodged and had fallen onto the ground or was damaged due to loss of support caused by large displacements of bearings or due to out-of-phase

displacement of Substructures. To counteract such failures the following counter measures such as seismic arresters/restrainers are provided for preventing dislodgement of superstructure at pier/abutment cap level. It provides adequate support for superstructure on pier/abutment cap.

Seismic Arrester shall be provided at top of Abutment Cap & Pier Cap. It generally consists of concrete of same grade as Abutment Cap & Pier Cap, or as mentioned in respective Drawing. Properly designed reinforcement shall be provided in the concrete portion of Seismic Arrester, which shall be mentioned in the Drawing. Between the face of Seismic Arrester and Precast Girder Elastomeric Pad has been provided to absorb the shock between Girder & Arrester during impact. Relevant Drawing should be followed for the detailed dimensions and reinforcement detailing.

12.2. MATERIALS

- a) **Concrete:** Concrete for Seismic Arrester shall conform to the requirements of Section 507 of MPWT Standard Technical Specifications
- b) **Reinforcement:** Reinforcement for Seismic Arrester shall conform to the requirements of Section 506 of MPWT Standard Technical Specifications
- c) **Elastomer Pad:** Elastomer Pad for Seismic Arrester shall conform to the requirements of Section 509 of MPWT Standard Technical Specifications.

13. ADDITIONAL ITEMS: LINK SLAB (DECK SLAB CONTINUITY)

13.1. GENERAL

The expansion joints in bridge deck always pose problems. The joint deteriorates very fast, requiring constant attention and maintenance. Accumulation of debris in the joint restrains the expansion of the deck, causing undesirable forces in the deck and damage to the structure. Water leaking through the joints is a major cause for the deterioration of the bridge girder bearings and supporting structure. The water, thus, penetrated causes corrosion to the ends of steel girders or the strands of the Prestressing Girders. Hence, possible omission or reduction of expansion joints in the bridge deck will reduce the problems mentioned above. Moreover reduction of expansion joints will also reduce the maintenance problem to a great extent. Reduction of expansion joints can be achieved by constructing the Deck Slab continuous over the over the support, which is generally called Deck Slab Continuity or Link Slab. As the basic structural configuration is simply supported Girder & Deck Slab bridge, it is required to adopt some special construction technique. Methodology to be followed during construction of Link Slab:

- 1) A length of deck slab equal to 5% (De-bonding Zone) of total length plus another 2.5% (Transition Zone) of total length of span (both from central line of Piers towards each span) to be left un-cast with the reinforcement from the cast portion extending out, as shown in the relevant Drawings.
- 2) Vertical/Shear Reinforcement projecting from Precast Girder in the de-bonded zone is not to be provided to avoid any bonding between the Link Slab & Precast Girder.
- 3) Shuttering is to be set-up to cast the link slab.
- 4) A nominal 6mm thick bitumen sheet or equivalent shall be placed over precast surface of Girder and Diaphragm etc. to separate the link slab from the precast Girder.
- 5) The reinforcement for link slab shall be laid and lapped suitably along with the already laid reinforcement of the Deck Slab cast. Regarding this respective Drawing should be followed.
- 6) Concrete shall be poured in placed and compacted using vibrators using vibrators etc. This concrete should be only poured after the already cast Deck Slab concrete has achieved minimum 80% of its anticipated strength or minimum 10 days of age, whichever occurs later.

- 7) Proper water proofing at top of link slab needs to be provided to protect concrete from water infiltration

13.2. MATERIALS

- a. **Concrete:** Concrete in Link Slab portion shall conform to the requirements of Section 507 of MPWT Standard Technical Specifications.
- b. **Reinforcement:** Reinforcement in Link Slab portion shall conform to the requirements of Section 506 of MPWT Standard Technical Specifications.

14. ADDITIONAL ITEMS: ALUMINUM MONUMENT SIGNS

The aluminum monument signs will be installed in each bridge as shown in the picture below:

