GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWINGS FOR ROAD BRIDGES

- ***40.0m Simply Supported Span, Cast-in-situ, 2-Webbed Prestressed Concrete Slab-Deck***

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REFERENCE 'NOTES'

1. The NOTES given in Drgs. No: "1/12 to 5/12 of 2-Webbed PSC-Slab-Deck cis 40.0m-SS Span" are applicable for the Superstructure covered by Drgs. No. 6/12 to 12/12 of 2-Webbed PSC-Slab-Deck cis 40.0m-SS Span, and must be followed strictly.
2. The above referred NOTES are in addition to the NOTES given in the said Drgs. No: 6/12 to 12/12.
3. All dimensions are in millimeters, unless stated otherwise.
4. No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
5. Any doubtful Dimensions/Descriptions shall be brought to the attention of the Engineer-in-charge for any corrections (if any) before execution of work.
6. Number of reinforcement bars shall not be counted from the Drawings. Only given spacing and/or specified numbers of bars, shall be provided.
7. All materials and workmanship shall be in accordance with these NOTES and those in the stated Drawings and shall be generally in accord with the applicable Specifications and relevant Standards/Codes of Practice specified therein and Sound Engineering Practice.
8. This Bridge Superstructure is designed for One Lane of IRC Class 70R Loading, Two Lanes of IRC Class A Loading, and One Lane of IRC Class A Loading, whichever governs, in addition to a Footpath Live Load corresponding to 500 kg/m^2 of Footpath area as per Clause 206.3 of IRC – 6 (2014). However, the precast Footpath slab has also been designed for a wheel Load of 4 Tonnes (distributed over a contact area of 300 mm dia.) as per clause 206.4 of IRC – 6 (2014), allowing 25% increase in stresses due to flexure.
9. The Contractor shall be responsible for constructing and maintaining all parts of the structure in stable, acceptable and serviceable condition, ensuring no part under construction is unduly stressed and unsafe.

10. **CONSTRUCTION SEQUENCE:**

Entire Deck (i.e. the Superstructure comprising the cast in situ Prestressed Concrete two webbed slab) shall preferably be concreted in one operation in one day for one span. If this is not possible, then the two webs shall be cast one after the other (each up to about 150 mm below the top throat) on one day (if possible) otherwise on two successive days, one after the other, along with the Cross Girders, and then the slab cast on the next day. This entire Deck must be cast in-situ on staging in span in no more than three Successive Days.

11. **CEMENT**

i. High strength Ordinary Portland Cement 53 Grade, conforming to IS: 12269 or 43 Grade conforming to IS: 8112, capable of achieving the required design concrete Strength and Durability, shall be used.

ii. Cement shall be obtained from approved Manufacturers only.

iii. Cement content in the Concrete Mix:

- for PRESTRESSED CONCRETE: not less than 400 kg/m^3 AND not more than 500 kg/m^3.
- for REINFORCED CONCRETE: not less than 350 kg/m^3 AND not more than 450 kg/m^3.

12. **COARSE AND FINE AGGREGATES:**

i. Maximum size of Coarse Aggregate used shall be 20mm. Fineness Modulus of Sand (Fine Aggregate) shall not be less than 2.3. Both these Aggregates shall be of Approved Quality, from Approved Sources, and of Approved Gradations, etc. conforming to IS: 383 (1970).

ii. In zones of congestion in the structural sections, if absolutely necessary, 12 mm. down sized Coarse Aggregates may be used (but the Mix shall then be re-designed to suit).

13. **ADDITIVES:**

i. To suitably improve workability and increase initial setting time of concrete and cement grout, Admixtures conforming to IS: 9103, and ASTM C–494 Type F water-reducing, high range admixtures, shall be permitted in appropriate dosages, subject to their satisfactory proven use.

14. **REINFORCEMENT:**

i. All reinforcing steel bars shall be High Yield Strength Deformed type and Thermo Mechanically Treated, having specified minimum 0.2 per cent proof stress of 500 MPa conforming to IS: 1786.

ii. Minimum lap-length of reinforcement bars shall be 65d where d is the dia. of the smaller diameter bar to be lapped (unless otherwise specified).

iii. Not more than 50 percent of reinforcement crossing a section shall be lapped at that location.

iv. All laps in reinforcement shall be properly staggered and minimum distance between the laps shall be 1.33 times the lap length.

v. Bending of reinforcement bars shall be as per IS 2502.

vi. Legend for reinforcement bar-marking

First two digits refer to "bar diameter" in mm.
Next two digits refer to "bar-shape" mark.
e.g. Bar designated as: 2005 means 20 mm dia bar of shape '05'

15. **WATER:**

Water for concrete and for its curing shall be of potable quality and presence of any salts, sugars and pollutants like chlorides, sulphates, algae, etc., shall be well within their limits specified in the relevant Specifications.

16. **CONCRETE AND CONCRETING:**

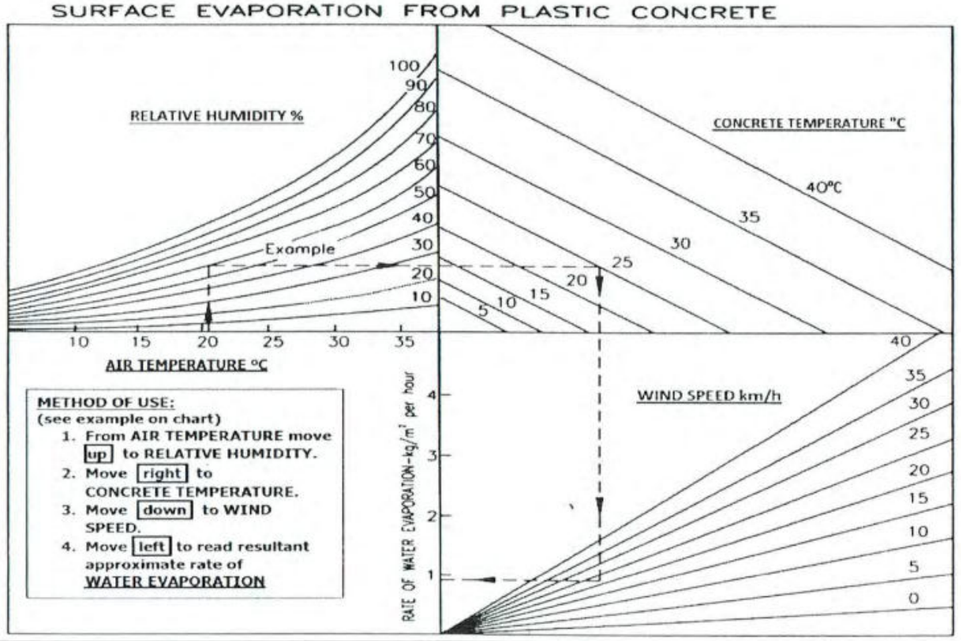
i. *WATER-CEMENT RATIO*, by weight, shall not exceed 0.40 for Reinforced Concrete, and 0.37 for Prestressed Concrete.

ii. *MINIMUM CLEAR CONCRETE COVER* to reinforcement bars shall be 40mm.

iii. *CONTROL OF SURFACE EVAPORATION*

Use the graphical Figure below to estimate and control the loss of water through surface evaporation in the laid concrete:

SURFACE EVAPORATION FROM PLASTIC CONCRETE



One or more of the following actions shall be taken to reduce the surface evaporation rate to no more than one kilogram of water per square metre of surface area per hour:

a) Construct Windbreakers to effectively reduce the wind velocity (to suit) in the area of concrete placement. The construction of windbreakers or enclosure should not proceed without approval of the Engineer with respect to their structural design relative to safety, stability, adverse loads, and vibrations in the falsework.

b) Install stationary Fog Sprayers upwind of the concreting operation to effectively increase the relative humidity in the area of concrete placement.

c) When necessary, effectively reduce the temperature of concrete (to suit) by cooling one or more of its components as well as lightly spray wet the shutters and the tied reinforcements. Ice, if added to the mix-water, shall be completely melted prior to using that water.

iv. *GRADES OF CONCRETE*

The structural concretes involved in this Bridge Deck shall be suitably designed as High Strength Concrete Mixes having 28 days minimum works Cube Crushing Strength in Compression on 150 mm Standard Cubes as follows:

• for Reinforced Concrete in – – Precast Footpath Slabs – Parapet Posts and their Bases – Road Kerbs	35 MPa (i.e. M-35 Grade Concrete)
• for the cast in situ (cis) Prestressed Concrete 2- webbed slab superstructure (i.e. for its Stems/Girders, Slab and Cross-girders)	45 MPa (i.e. M-45 Grade Concrete)

v. *CONSTRUCTION JOINTS:*

a) As far as possible the location of Construction Joints shall be as shown in the Drawings, but if not shown on the Drawings but found absolutely necessary, they shall be planned in advance and the placing of concrete carried out continuously from Joint to Joint.

b) A Construction Joint should not be located near the centroid level of the section as here transverse SHEAR stress is highest. The Joint should be nearly perpendicular to the principal lines of tensile stress and in general be located at points of minimum Shear and minimum Moment – as far as possible.

c) Where dowels, reinforcing bars, or other adequate ties are not shown at Construction Joints in the Drawings, 'keys' should be formed at reasonable spacing by embedding water-soaked beveled timbers while the concrete is still soft.

d) These keys should be sized as may be shown in the details, or as directed by the Engineer, and these key-forming timbers shall be removed when the concrete has initially set.

e) In resuming concreting work, the surface of the concrete previously placed shall first be thoroughly cleaned of dirt, scum, laitance, loosely projecting aggregates and any other soft material, using stiff wire brushes, and – if deemed necessary by the Engineer – by sand blasting.

f) The concrete surface shall then be thoroughly soaked with clean water (just before further concreting) and the free water, etc. air-blown away, and the cleaned concrete surface painted with a thin layer of cement slurry, and only then further concrete poured.

g) 'Wire-mesh' and other similar items do not provide a proper construction joint, and they shall not be used.

vi. *COLD JOINTS:*

a) When a planned 'continuous' placement of concrete in any structural member is interrupted or delayed, for any reason, for a period long enough for the previously partially placed concrete to take its initial set, the Engineer may declare such a joint as a Cold Joint and the Contractor shall immediately remove the previously partially placed concrete from the Forms.

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STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

Road Carriageway Width: 7.50m. plus 2 Footpaths each 1.50 m. wide	**Overall Deck Width: 11.00 m**
Effective Simply Supported Span (centre to centre of Bearings): **40.0 m.** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading

Drg. No.: **1/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE: **REFERENCE NOTES (5 Sheets): Sheet 1/5**

Designed by: Naresh P. Keshari, Engineer, DoR	*Mentored by:* Dr. V. K. Raina, Bridge Tech! Expert, DoR/ World Bank	Date: May 14, 2015
Drawn by: Bicky G. Shakha	*Accepted by:* Saroj K. Pradhan (DDG, DoR)	Revisions:
Checked by: Pradeep Bhandari, Engineer, DoR	*Approved by:* Madhab K. Karki (DG, DoR)	

Madhab Kumar Karki
Director General

b) *However*, where feasible, the previously partially placed concrete may instead be suitably and carefully hacked and its hacked end brought into 'low shear low moment' zone as far as possible, and given shear key depressions after bringing it nearly perpendicular to the principal lines of tensile stress (for example: brought to vertical or nearly vertical in a beam with principal bending reinforcement horizontal) and thereafter same treatment shall be given to it as to a Construction Joint and only then the concreting resumed (making sure all reinforcements are as per the approved Drawings and the Shuttering has been brought to line and plumb tightly).

vii. *CURING AND PROTECTION OF YOUNG CONCRETE:*

a) All structural concrete shall be cured for a period of time required to obtain the specified strength, but for not less than fourteen consecutive days (and nights) beginning immediately after 'initial setting' of concrete (which is when it loses its surface sheen).

b) Curing (Membrane–curing or Water–curing) of laid concrete shall be carried out as generally explained below:

c) ***Membrane–Curing the Concrete:***

c.1. Except for at Construction Joints and surfaces sealed by Forms, liquid membrane curing compound can be used (for curing the concrete) as follows:

c.2. On bridge deck top surface and other exposed surfaces, liquid membrane curing compound shall be applied soon after Initial Setting and as the Surface Sheen has disappeared and the concrete is still slightly damp (not wet).

c.3. On shuttered i.e. formed vertical surfaces, Forms shall be stripped as soon as practical (generally after 24 hours of casting) and liquid membrane curing compound applied immediately except in the areas that require rubbing or finishing during the curing period.

c.4. These areas shall be kept water-wet until their finishing is completed, whereafter the liquid curing membrane shall be uniformly applied on them also when their surface is damp.

c.5. White–pigmented liquid membrane curing compound shall be used for all surfaces where the structure temperature during curing period is likely to reach about 35°C or more.

c.6. For bridge decks which are to receive an asphaltic overlay, residual curing membrane (after curing) shall be removed prior to the overlaying.

c.7. Removal methods and results should be approved by the Engineer.

c.8. The membrane curing compound used shall be of longer lasting duration and in accordance with the requirements specified for curing membrane material, AASHTO M 148 or the equivalent IS Specification.

c.9. The curing membrane shall be applied in two applications one immediately following the other.

c.10. The rate of each application of curing compound shall be as prescribed by the manufacturer, with a spreading rate per application of at least one litre of liquid per five square metres of concrete surface.

c.11. If the concrete has dried up or has become dry, it shall be thoroughly wetted with water and the curing compound applied just as the surface film of water disappears and the surface is damp.

c.12. During curing operations any unsprayed surfaces shall be kept cured with watered Hessian cloth, and sprayed with the curing compound when Surface is damp (not wet).

c.13. Any curing membrane material on Construction Joints and/or on reinforcing steel shall be completely removed before the following concrete pour.

c.14. Hand operated spraying equipment shall be capable of applying constant and uniform pressure to provide uniform and even distribution of the curing membrane at the rates required.

c.15. The curing compound shall be kept thoroughly mixed at all times during usage/application.

c.16. No traffic of any kind shall be permitted on the curing membrane until the curing period is completed, design permitting.

d) ***Water–Curing the Concrete:***

d.1. All concrete surfaces, unless still sealed by unreleased Forms (which shall be kept from heating–up under ambient temperature) or submerged, shall be water-cured unless liquid membrane cured.

d.2. Water curing shall begin just after initial setting of concrete (which generally occurs by about 60 minutes of placement of un-admixtured concrete and by about 120 to 180 minutes of placement of admixtured concrete) and just after the surface water sheen has disappeared.

d.3. Surfaces water–cured shall be covered with wet sand, cotton mats, or double–thickness burlap (Jute/Hessian) sheets.

d.4. This Hessian material shall be placed tightly around and behind any projecting reinforcing steel in order to completely cover the fresh concrete surface.

d.5. The Hessian material shall be completely saturated with water and kept continuously saturated throughout the curing period.

d.6. After the initial saturation, unless water is kept running, all surfaces shall be covered with thick polythene sheeting or other approved impervious material in order to protect/prevent drying-up of concrete surface being cured continuously.

d.7. The sheeting shall be weighted down or secured well to prevent moisture–loss but the surfaces of the concrete shall be readily available for inspection of the Engineer (or his Representative).

d.8. The sheeting material shall be in good repair.

d.9. Sheeting that contains holes or is otherwise damaged shall be repaired or replaced immediately.

d.10. The Contractor shall be responsible for thoroughly inspecting and monitoring the concrete surfaces throughout the curing period to ensure continuous wet curing.

d.11. Additional water shall be poured on any areas where saturation is reduced.

d.12. Inspection of curing by the Contractor shall be conducted at least TEN times per day and night for the duration of the curing period – and even more often if ordered so by the Engineer.

d.13. The Engineer shall be advised of the curing inspection schedule and he (or his Representative) may accompany the workmen to verify the acceptability of curing.

e) 'COLD–WEATHER' CURING:

e.1. When concrete is placed and the air temperature is expected to drop below 5°C during the curing period, the Contractor shall provide suitable measures such as straw, additional burlap or other suitable blanketing materials and/or housing and artificial hot–air–curing to maintain the concrete temperature between 10°C and 32°C as measured on the surface of the concrete.

e.2. The surface of the concrete shall be kept moist and warm by the use of an approved warm moisture barrier such as warm wet Burlap/Hessian.

e.3. The moisture barrier should be maintained in intimate surface contact with the concrete during the entire curing period.

e.4. After the completion of the curing during the entire required curing period, the Contractor shall stop the curing and remove the protection in such a manner that rapid cooling of the concrete will be prevented.

e.5. When concrete is placed in 'cofferdams' and subsequently flooded with ground water, the above curing conditions may be waived, provided the surface of the water is not permitted to freeze/dry.

viii. *"CONCRETING" IN "ADVERSE WEATHER" CONDITIONS:*

a) ***'Concreting' in "Cold" Weather***

a.1. Concrete that freezes soon after placing, gains rather low strength and some permanent damage is certain to occur. Therefore, such concrete shall be removed and replaced immediately.

a.2. 'Planning for Protection of fresh concrete' during placement, and until it has attained the minimum properties required for the environment and the loading to which it will be exposed, shall be done well in advance of concreting and approved by the Engineer.

a.3. Appropriate equipment shall be made available in time for heating the concrete materials, for constructing enclosures and for maintaining favourable temperatures even after the concrete is placed.

a.4. Concrete shall never be placed on cold Forms and cold steel.

a.5. When the temperature of these items is below 5°C, the Contractor shall use means to raise their temperatures to above 10°C.

a.6. When faced with prolonged cold temperatures, all aggregates, or mixing water, or both, shall be heated to about 25°C to 32°C.

a.7. At temperature at least 10°C above freezing, it is seldom necessary to heat the Aggregates.

a.8. At temperatures below or at freezing, often only the Fine Aggregate is heated to produce concrete of the required temperature, provided the Coarse Aggregate is free of frozen lumps and the Temperature of Water for the Mix is at least 10°C.

a.9. If aggregate temperatures are above freezing, the desired concrete temperature usually can be obtained by heating only the mixing water.

a.10. Appreciable fluctuation in the mixing water temperature from batch to batch shall not be allowed.

b) ***'Concreting' in "Hot" Weather:***

b.1. No concrete shall be placed when the ambient air temperature at job site in shade is expected to exceed about 35°C during placement operations.

b.2. When the temperature of the 'concrete mixture' is expected to exceed about 25°C, a retarding admixture shall be included in the approved mix design since setting time tends to reduce at higher temperatures.

b.3. The temperature of the concrete mixture immediately before placement shall not exceed 32°C.

b.4. When the ambient air temperature is above 32°C, all Forms, reinforcing steel, and other contact surfaces shall be cooled to below 32°C until concrete is placed.

b.5. When such high ambient temperature conditions exist, the most appropriate solution is to resort to evening–night–&–morning–time concreting.

b.6. However, if the above stated precautions are taken to help lower the temperature of contact surfaces and the concrete mix–ingredients are also cooled (explained ahead), concreting can be carried out even during day hours provided the ambient air temperature in shade does not exceed 40°C.

b.7. Mixers, chutes, belts, hoppers, pump lines, and other production and placement equipment can be shaded, painted white, covered with (wet) burlap, or otherwise cooled to reduce the effect of the sun's heat.

b.8. Forms and reinforcing steel can be sprinkled with cold water and covered with wet burlap until controlled concreting commences.

b.9. Sprinkling the area with water spray, gainfully cools the contact surfaces and surrounding air and desirably increases its relative humidity.

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Road Carriageway Width: 7.50m. plus 2 Footpaths each 1.50 m. wide	**Overall Deck Width: 11.00 m**
Effective Simply Supported Span (centre to centre of Bearings): 40.0 m. Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading
Drg. No.: 2/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	
Drg. TITLE: REFERENCE NOTES (5 Sheets): Sheet 2/5	

Designed by: Naresh P. Keshari, Engineer,DoR	*Mentored by:* Dr. V. K. Raina, Bridge Techl Expert, DoR/ World Bank	Date: May 14, 2015
Drawn by: Bicky G. Shakha	*Accepted by:* Saroj K. Pradhan (DDG, DoR)	Revisions:
Checked by: Pradeep Bhandari, Engineer, DoR	*Approved by:* Madhab K. Karki (DG, DoR) Madhab Kumar Karki, Director General	

b.10. This not only reduces the 'temperature rise' of the concrete but also minimizes evaporation of water from the concrete during placement and after casting.

b.11. For slabs on ground, it is a good practice to dampen the sub-grade the evening before concreting.

b.12. There should be no standing water or puddles on the sub-grade or inside the Forms when the concrete is placed.

b.13. The mix water may be cooled by using shaved or crushed ice but only as much ice should be used as will be melted entirely before this water is added to the mix.

b.14. All water used for making ice and for cooling or sprinkling, and curing, must meet the same quality requirements as those for water used for Mixing of Concrete.

b.15. Of particular concern are the polluting sulphates and chlorides (salts) in the mix, which can adversely affect the cement and corrode the reinforcing steel, respectively. These must be kept below their specified limits.

b.16. Aggregates should be cooled by shading and sprinkling water (fog spray).

b.17. Transporting and placing concrete shall be done as quickly as practical during hot weather.

b.18. Delays contribute to loss of slump, a damaging increase in concrete temperature and loss of workability.

b.19. Enough workmen and equipment shall always be available to handle and place concrete immediately upon delivery.

b.20. Prolonged mixing, even at agitating speed of the Drum, shall be avoided since it might heat-up the mix and reduce workability.

b.21. If delays occur, the heat generated by continued mixing/agitating can be minimized by stopping the mixer and then agitating intermittently, but the delays shall be kept short.

b.22. Since concrete hardens more rapidly in hot weather, extra care in placing techniques is required to avoid Cold Joints.

b.23. For placement of Concrete in Walls, Shafts, Columns, etc., shallower layers may be required to assure proper consolidation and monolithicity with each previous lift, effective dissipation of heat of hydration and to prevent segregation of the mix.

b.24. Temporary sunshades and windbreakers help to minimize adverse effects of hot weather, winds, and surface evaporation.

ix. CAUTION AGAINST "PLASTIC-SHRINKAGE" CRACKING of Concrete AND USING EXCESSIVE DOSAGES OF ADDITIVES like 'RETARDER' and 'SUPER-PLASTICISER'

a) Plastic Shrinkage cracks develop prior to initial setting of concrete and can appear more prominently in slabs. If the rate of surface evaporation from the freshly laid concrete is faster than the rate of upward bleeding through it, the concrete surface tends to dry up, hence shrink, causing cracks in plastic concrete due to tension from this shrinking under such condition. These cracks travel downwards from the surface and their propagation is locked only upon 'initial setting' of concrete.

b) The longer the initial setting time, deeper will these cracks penetrate. Should they travel down to a significant depth of slab, then the slab can become a bunch of isolated concrete blocks separated by these cracks, and hence not be structurally monolithic with the rest of the Deck-section. Such deep-penetrating crack distress, in all probability, generally is not repairable by Epoxy filling of these cracks. The result may be a major Damage, requiring major rehabilitation.

c) Hence minimum doses of Retarders and Super-Plasticizers shall be used so as to keep the initial setting time to just the required minimum to allow the required 'workability' of concrete.

d) These cracks can be of random pattern (alligator-skin pattern) and/or may be somewhat parallel to each other and nearly perpendicular to the direction of wind that prevailed at the time of casting. Hence the field staff must look for these cracks before the concrete has initially set and , should these cracks occur, the plastic concrete should be quickly lightly 're-trowelled' on its surface (not re-vibrated) to close these cracks in time.

e) Reducing the ambient Temperature and increasing the ambient Relative Humidity (by Fog-spraying), lowering the Temperature of Concrete to less than 32°C (by cooling the Aggregates and the mix-water), and reducing the Dosage of Retarder and Super-Plasticizer, will help in controlling the endemically dangerous Plastic Shrinkage Cracking.

f) Concrete slabs which are correctly re-trowelled should not exhibit Plastic Shrinkage cracks because the action of floating and trowelling is a form of recompaction that tends to close them as fast as they form. (This trowelling can, however, aggravate sedimentation of solids in the mix and cause Plastic Settlement cracks – see ahead.)

g) Although the Plastic Shrinkage cracks can be wide at their start (even up to 2 mm), the width rapidly diminishes with depth. Nevertheless, in severe cases they may pass through the full depth of a slab, in contrast with most types of Plastic Settlement cracks.

If not noticed in the soffit of not-easily-accessible-slab-soffits, thorough wetting at the top of the slab may show them in case of full depth penetration. Taking cores can reveal them precisely.

h) Plastic Shrinkage cracks rarely reach the free ends of the slab (e.g. the edges of a slab) because these edges are free to move under plastic shrinkage. This is a very important way of differentiating them from long-term drying shrinkage cracks if the time of formation is unknown. However, Plastic Shrinkage cracks will form up to the ends of a slab which has been cast against a previous pour, especially if there is continuity of steel, because this acts as restraint.

i) The factors that determine rate of surface evaporation are: the temperature of the concrete, the air temperature, relative humidity, and wind velocity of the air adjacent to the concrete. The evaporation increases as the humidity decreases, as the wind velocity increases, as the air temperature decreases, and as the concrete temperature increases. Of particular interest is the fact that rapid evaporation is at least as big a problem in cold weather as in hot weather! Even when the relative humidity be 100 per cent in cold weather, there will be a large amount of evaporation if the concrete is warm! Of all the factors listed above, only the concrete temperature is easily controllable. There is a definite advantage to cool the concrete! It shall be placed as cool as practical in warm weather and should not be overheated in cold weather. If the concrete temperature is reduced to about 27°C to 15°C, much of the evaporation can be eliminated!

j) In hot weather, sometimes concreting during 4 p.m. on the previous day up to 12 noon on the next day may be resorted to for preventing formation of Plastic cracks and obtaining better quality concrete. But this will be effective only if it gives significantly lower concrete temperatures and lower wind velocity. The reduction of air temperature BUT not that of concrete (even with the increase in relative humidity) will not significantly reduce the Plastic Shrinkage cracking.

k) If it is not possible to eliminate the risk of Plastic Shrinkage cracks even by improved timely curing, then changes to the concrete mix must be considered. First, check that the concrete does not contain an admixture with high retarding effects. If it does, try to reduce it or replace it with the one that does not retard so much (rather than counter it by adding a compensating accelerator!). Second, consider the use of air entrainment. Air-entrained concrete exhibits less Plastic Shrinkage cracks than plain concrete. At first sight this might seem illogical because as air entrainment reduces the rate of bleeding it should increase the risk of Plastic Shrinkage cracks occurring at a given rate of evaporation. However, most commercially available air-entraining agents are 'detergents' and therefore reduce the surface tension caused by drying, and consequently reduce the shrinkage cracking.

l) The prevention and timely repair of Plastic Shrinkage cracks in slabs is particularly critical. This is because the cracks are wide at the top and can rapidly take in pollutants which may cause subsequent spalling and prevent the subsequent satisfactory application of sealing materials. Clearly wide cracks in slabs are not likely to be self-healing at the top and are likely to spall and allow ingress of pollutants.

x. CAUTION AGAINST POSSIBLE DAMAGE DUE TO "PLASTIC SETTLEMENT" CRACKING OF CONCRETE

a) Plastic Settlement cracks occur in not-yet-initially-set concrete when there is a relatively high amount of bleeding through it and some form of obstruction to the downward sedimentation of its solids (e.g. the reinforcement bars). These obstructions 'break the back of the settling concrete' over them as its solids fall downwards around them, fomenting formation of hollows under their 'belly'. Thus Cracks show directly over formwork-tie-bolts and over reinforcement near the top of the plastic concrete, reflecting their pattern. Such Cracks can also appear in narrow columns and walls where the said sedimentation is prevented by the resulting arching of the concrete due to downward passage for sedimentation and there may be further aggravation by the presence of horizontal bars.

b) Plastic Settlement Cracks can be prevented by reducing the bleeding and hence the sedimentation, and by reducing the obstructions to sedimentation.

c) Admixtures such as plasticizers reduce water demand and thus are the most effective way of reducing bleeding and sedimentation and hence the plastic settlement cracks. These can also be eliminated by light re-vibration (not re-trowelling) of the not-yet-initially-set concrete if they have formed, thus also filling back the under–belly hollows.

d) This light re-vibration shall not be applied too soon otherwise a second phase of bleeding can still cause Plastic Settlement cracks. The correct time can easily be determined by simple site trials: it will be the last time that a vibrating poker can be inserted into the concrete and removed without leaving a significant trace. Re-vibration is often the only way to eliminate plastic settlement cracks, particularly in deep sections. Trowelling the surface can actually aggravate these cracks as the pressure may only cause further settlement of solids!

xi. BEWARE OF CRACKS DUE TO "PLASTIC–SHRINKAGE" and "PLASTIC SETTLEMENT" IN CONCRETE WHILE IT IS STILL PLASTIC AND HAS NOT YET ATTAINED "INITIAL SET"

a) Plastic cracks by their very nature pass through the cement matrix and around aggregate particles; therefore they are very rugged and capable of transferring shear, providing there is sufficient reinforcement to maintain aggregate interlock. Consequently full structural repairs (using epoxy formulation) may not be necessary, though preferable....BUT only if the crack penetration is minor BECAUSE otherwise if deep penetration damage is done, EPOXYING WILL NOT restore full monolythicity (.....in which case the Deck-slab may have to be demolished, requiring major and very costly rehabilitational exercise). HENCE BEWARE OF PLASTIC CRACKING!!

b) If cracks follow the pattern of the top reinforcement it may be difficult at first to determine whether they are due to Plastic Shrinkage or Plastic Settlement. If it can be shown that the cracks 'pass through the slab' and follow the pattern of the steel, then they are almost certainly Plastic Shrinkage cracks that have been orientated by the steel!

c) Plastic cracks often form in the top face of sections e.g., Plastic Shrinkage cracks in slabs, and/or Plastic Settlement cracks on top of deep beams and walls. Thus they can be accessible, and this coupled with the fact that they form so early in the life of concrete, means that they may widen as thermal contraction and drying shrinkage take place. Consequently it may not be wise to fill plastic cracks with 'rigid' epoxy materials until it is certain that the long-term effects have subsided.

d) Plastic Settlement cracks over steel must be immediately and efficiently 'sealed' if the concrete is in an exposed state (to eliminate the risk of corrosion of the steel). Reduced bond strengths due to under-belly voids thus formed under steel bars are dangerous.

xii. ACCEPTABILITY CRITERIA OF CONCRETE CUBE CRUSHING TEST RESULTS FOR APPROVING THE CONCRETE THEY REPRESENT:

a) *The acceptability criteria of Standard Cube crushing test results* shall be that not more than 5% of works cubes fall below the specified minimum works strength. For this to be fulfilled, the Mean Strength of works cubes tested at 28 days age less 1.64 times the "*Standard Deviation*" should not be less than the required minimum 28 day works cube strength.

....cont'd

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

Road Carriageway Width: 7.50m. plus 2 Footpaths each 1.50 m. wide	**Overall Deck Width: 11.00 m**
Effective Simply Supported Span (centre to centre of Bearings): **40.0 m.** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading

Drg. No.: **3/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE: **REFERENCE NOTES (5 Sheets): Sheet 3/5**

Designed by: Naresh P. Keshari, Engineer,DoR	*Mentored by:* Dr. V. K. Raina, Bridge Techl Expert, DoR/ World Bank	Date: May 14, 2015
Drawn by: Bicky G. Shakha	*Accepted by:* Saroj K. Pradhan, (DDG, DoR)	Revisions:
Checked by: Pradeep Bhandari, Engineer, DoR	*Approved by:* Madhab K. Karki, (DG, DoR)	

Madhab Kumar Karki

b) ALTERNATIVELY (if the Standard Deviation for the concerned Concrete–Mix has not been established), the cube strength shall be accepted as complying with the strength requirement either "if none of the specimens tested falls below the minimum specified strength" or "if the average strength of the specimens is not less than the specified minimum, no individual test result falls below 85% of the minimum required works strength and the difference between the maximum and the minimum strengths of the test specimens is NOT GREATER THAN 20% of that average".

c) "In case of a dispute about the strength of concrete in a particular area of the cast concrete, three 50 mm dia. and 100 mm. long Standard concrete cores shall be drilled out from such an individual area and tested for their crushing compressive strength. These values shall then be rectified for concrete age and how the cores were cut, and the corresponding equivalent "cube" strengths worked out for each core. If their average exceeds 85% of required 28 days works cube strength and none falls below 75% of the required 28 days works cube strength, then concrete in such disputed area may be accepted – but of course subject to contractual conditions for poor work.

17. *PRESTRESS*

i. The Prestressing System assumed here can be SAI Prestressing System OR DYNAMIC Prestressing System AND each cable is either: 19JK13 OR 19DP13 type multistrand. An "alternative" equivalent and approved Prestressing system may be used instead so long as the effective Prestressing Force at each section, its eccentricity w.r.t. centroid of each section, and its Moments, Shears, etc. at each section of the Deck are retained unchanged, and the Detailed Design, Detailing and Drawings are duly submitted for checking and approval of the Department of Roads.

ii. Each Prestressing Cable shall be a multistrand cable comprising 19 Strands, each strand of 12.7 mm diameter, 7-ply low relaxation Class II High Tensile Steel Conforming to IS 14268 – 1995.

iii. Forming a 19 multistranded cable at site:

a) The monostrand is supplied (in large coils) in very long lengths.

b) Cut 19 lengths out of the long mono-strand, each length being equal to actual length of the concerned cable required between its stressing Jacks plus additional lengths beyond the Jacks to enable gripping the strands adequately by the Wedges of the Jacks.

c) Bunch together these 19 monostrands into a 'multistrand' holding them together by binding wire tightened around the bunch at about 1.0 m intervals.

d) Insert these cables in to their respective 90 mm ID Corrugated HDPE Ducts which are already placed to the required profile in the already concreted deck.

iv. Provisions for one 19JK13/19DP13 DUMMY CABLE, i.e. its Anchorages, HDPE Sheathing, and Profile details, have been provided in EACH of the two webbs (longitudinal girders) of the 2-webbed slab superstructure. Cable Profile details are shown in the attached relevant Prestressing Drawing. Prestressing these Dummy Cables may be required in the event of any exigency at site and/or emergency in future. These two Dummy Cables shall be installed only when needed and shall then be stressed only to the extent required but both must be stressed equally one immediately after the other in order to cause only least Temporary eccentric prestress on the Deck, and then Grouted.

v. a) Cross-sectional area of H.T.S. in ONE No: 12.7 mm dia. Strand = 98.7 mm²

b) Cross sectional area of H.T.S. in 19 strands = 19 × 98.7 = 1875.3 mm²

c) Breaking load i.e. Ultimate Tensile Force Per Strand = 183710 N (ref. Table: 3 of IS 6006 (1983)) i.e. 18726.81 Kg i.e. 18.72681 Tonne i.e. 18.72681 T.

d) Breaking load i.e. Ultimate Tensile Force of 19 strands of one Multistrand = 19 × 18.72681 =355.81 T

e) 0.1% Proof Load per Strand = 0.85 of Breaking Load per strand = 0.85 of 18.72681 T = 15.9178 T i.e. 15918 Kg i.e. 156155.6 N i.e. 156.156 KN

f) 0.1% Proof Load of 19 Stranded Multistrand here = 19 × 156.156 KN = 2966.964 KN i.e. 302.443 T

g) g.1 Jacking Force at each end of this Multistand as per Clause 8 of IRC-18 (2000) shall not exceed 90% of 0.1% Proof Load:
i.e. 0.9 × 302.443 = 272.1987 T
which is 0.765 of Breaking Load of 19 Strands

g.2 Hence Jacking Force normally should not exceed 76.5% of the Breaking Load

g.3 However, here we are using a Jacking Force of only 75% of the Breaking Load in the Design, which is 0.75 × 355.81 T = 266.86 T for a 19-Stranded Multistrand (19JK13, SAI system OR 19DP13, DYNAMIC System, see Note ahead).

g.4 In the very limit (if site exigency so requires) this Jacking Force in a 19JK13/19DP13 multistrand may be increased to a maximum of 270 T but NEVER MORE.

vi. a) The Prestressing Steel and Accessories shall be subject to Acceptance Tests prior to their actual use on the works. (Guidance may be taken from BS 4447). The Prestressing Jacks used shall be only those appropriate for tensioning simultaneously all the 19 strands of a multistranded Cable.

b) Appropriate "Prestressing Force Measurement Device" shall be part of the Multistrand Jack and shall be duly checked and calibrated for correctness and removal of zero–error, regularly, in consultation with the concerned Manufacturer.

vii. All Prestressing Cables shall be laid to smooth profiles using the specified profile ordinates given in the attached Prestressing Drawing. Short 12 mm dia. cross-bars shall be spot welded to the stirrup legs at approximately 2 m centers along the length of cables to give the necessary profile to the cables.

viii. At the time of installation of Cable-Sheathing (HDPE Ducts), the sheathing materials shall be examined for any possible punctures/cuts/etc. and the same shall be sealed with waterproof tape. The number of joints should be kept to the minimum, and each joint adequately sealed against the possibility of any ingress of any material and mortar. Joints in adjacent ducts should be staggered by at least 300 mm. Adequate concrete shield should exist between the adjacent ducts to prevent any accidental flow of grout from one duct to the other and the ducts shall be strictly maintained in their correct alignment and profile during the placing of concrete.

ix. Before commencement of prestressing, it should be ensured that all the Cables/Ducts are free of any clogs and that the structure–members are free to accommodate the horizontal and vertical movements due to application of prestress, and that there is enough space for the movement of the jack piston.

x. Each Cable shall be stressed from both its ends simultaneously, equally and gradually, and the extensions recorded at each suitable increment of Jacking Force.

xi. For tensioning a cable, the initial slack in it shall first be removed (taken-up) by applying a relatively small initial tension from each end as required to remove the slack. The initial tension required to remove this slack shall be taken as the starting point for measuring the cable elongations and the correction shall be applied as per clause 12.2.1.3 of IS: 1343 (1980).

xii. The Cable Elongations at their Jacking-Points, mentioned in the attached relevant Prestressing Drawing, are based on the assumption that the Modulus of Elasticity of Cable-steel, E_s, = 1.95×10^5 MPa (i.e. 1.988×10^6 kg/cm^2). However, if E_s of the actually supplied Cable-steel at site is slightly different, then the required Elongations at each end shall be re-worked out at site by multiplying the specified values by the ratio of (assumed E_s / actual E_s), and these shall then be the 'correct' specified extentions.

xiii. Sheathing (Ducting for housing the 19-multistranded Cables)

The sheathing for prestressing cables shall be corrugated "HDPE type", 90 mm ID (wall thickness 2.3 ± 0.3 mm as manufactured and 1.5 mm after loss of compression) and shall be tested as per IRC:18 (2000), Appendix 1.

xiv. For the above multistrands in HDPE sheathing, Wobble Friction Coefficient: K = 0.002 per meter, and Curvature Friction Coefficient: μ = 0.17 per radian, have been assumed in Design.

xv. Cable-Elongation at each end of each cable, given in the attached Prestressing Drawing, has already taken in to account the actual cable-length along its profile between the gripping points of the Tensioning Jacks placed nearest the Anchorages.

xvi. The effect of a 10 mm cable slip (anticipated at each Jacking–end) also has already been taken into account in evaluating the effective prestressing Force at each section along the Cable after and friction losses due to Curvature and Wobble.

xvii. a) Prior to concreting the Deck, INSERT 80 mm ID Plain HDPE Ducts into the 90 mm ID Corrugated HDPE Ducts (which have already been placed to the required cable profiles), protruding them suitably beyond the cable–Anchorages.

b) After concreting of the Deck is over, REMOVE these 80 mm ID Plain HDPE Ducts AND quickly blow oil-free compressed air through the emptied 90 mm ID Corrugated HDPE Ducts in order to flush them clean. Stand-by flushing equipment, capable of developing a pumping pressure of 20 Kg/cm² (2 MPa) and a sufficient capacity to flush out any blockages due to any accidental partial grout leaks in ducts, shall be kept available at site.

c) The 19-stranded multistrands may now be inserted in to their respective 90 mm ID corrugated HDPE Ducts already placed inside the Concreted Deck.

xviii. TENSIONING OF PRESTRESSING CABLES:

a) Normally, the specified required extensions shall be achieved at the specified Jacking Forces at stressing ends.

b) In case these required extensions are somehow not achieved at these specified Jacking Forces, the stressing (tensioning) shall be continued (where possible) till the required extensions are obtained but subject to the Jacking Force at Cable-ends NEVER exceeding 270T.

c) Should the required extensions be obtained at Jack Forces lower than the specified Jack Forces, then the stressing should be continued till the specified Jack Forces are reached but provided the "sum of the 'additional' extensions" so achieved is not more than 5% of the "sum of the 'specified' extensions".

d) Cables satisfying these provisions shall be locked (i.e. anchored).

e) However, if the Jack Forces are still lower than their specified values despite the 5% increase in the "sum of the 'specified' extensions", then the particulars of such cables shall be reported to the Designer for further instructions ('locking' but not 'grouting' these cables yet until receipt of instructions, just in case).

f) If for any cable, the required extension at any one end is not achieved despite the Jack Force in the cable at that end reaching 270 T (the maximum allowable Jacking Force), then the "total balance extension" should be attempted for at the other end BUT the Jacking Force SHALL NEVER EXCEED 270 T.

g) Also, for any cable, the extension at any one end shall not exceed the "sum total extension required for the cable at that end" by more than 5%.

h) Extensions should also be checked 24 hours after anchoring the cables to guard against the possibility of 'slow slipping', if any. If the average observed 'slow slip' at anchorages of a cable exceeds 3mm, the matter should be reported to the Designer for any further instructions.

i) All cables which satisfy the above provisions shall be grouted, taking care that the cables not yet stressed do not get accidentally blocked due any internal grout leak.

..... cont'd.

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

Road Carriageway Width: 7.50m. plus 2 Footpaths each 1.50 m. wide	**Overall Deck Width: 11.00 m**
Effective Simply Supported Span (centre to centre of Bearings): **40.0 m**. Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading

Drg. No.: **4/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE: **REFERENCE NOTES (5 Sheets): Sheet 4/5**

Designed by: Naresh P. Keshari, Engineer, DoR	*Mentored by:* Dr. V. K. Raina, Bridge Techl Expert, DoR/ World Bank	Date: May 14, 2015
Drawn by: Bicky G. Shakha	*Accepted By:* Saroj K. Pradhan, (DDG, DoR)	Revisions:
Checked by: Pradeep Bhandari, Engineer, DoR	*Approved by:* Madhab K. Karki, (DG, DoR)	

Madhab Kumar Karki
Director General

xix. Prestressing tendons shall never be heated or exposed to flame or to welding. Protruding Ends of tensioned strands of Grouted Cables, protruding beyond anchorages, shall only be saw-cut, not flame-cut. Recesses at anchorages (in the girder–ends) shall be filled and sealed with non-shrink cement mortar after the protruding strand–ends of tensioned, anchored and grouted cables are cut to suit.

xx. Prestressing cables shall be protected against any unacceptable rusting, damage due to 'pitting', and any greasing. The strands must be thoroughly cleaned with petrol at locations where Stressing Jacks and Wedges have to grip them.

xxi. SEQUENCE OF STRESSING AND STAGES OF PRESTRESSING:

a) The Sequence of Stressing of Cables shall be as indicated in the attached relevant Prestressing Drawing and the prestressing shall be accomplished in TWO STAGES: PS-I and PS-II as stated therein.

b) First Stage Cables i.e. PS-I cables shall be stressed in their indicated sequence when the last cubic meter of concrete in the deck-slab (laid last in concreting the "two-webbed slab" Deck) has attained a work's cube crushing compressive strength of at least 400 kg/cm^2 and is more than 10 days old (after the day of its casting).

c) Cables of PS-II shall be stressed in their indicated sequence when concrete in the deck slab has attained a works cube crushing compressive strength of at least 450 kg/cm^2 and is at least 28 days old (after the day of its casting).

d) The Sequence of stressing the cables in Stage-I Prestressing (i.e. in PS-I) and Stage-II Prestressing (i.e. in PS-II) is shown in the attached relevant Prestressing Drawing.

e) After successfully stressing the PS-I Cables the deck becomes self supporting between its ends. The Contractor may now carefully release the Staging supporting the Deck.

f) The Dirt-walls of the two Abutments shall be constructed after successfully Prestressing and Grouting the cables of the Decks supported by the Abutments.

xxii. After completion of stressing and anchoring a cable, the Jack Force shall be released in such a way so as to avoid shock to the anchorage and the cable.

xxiii. Complete record of all Prestressing and Grouting shall be carefully maintained at site.

xxiv. An appropriately experienced Technical representative of the Supplier of Prestressing system shall carry out and supervise all Prestressing and Grouting Operations at site and ensure, monitor and certify their correctness.

18. GROUTING THE DUCTS OF SUCCESSFULLY TENSIONED CABLES:

i. Prestressing steel shall be bonded by the Grout to the concrete by filling the void space between the duct and the tendon with cement grout.

ii. For this purpose each cable shall normally be Grouted within 5 days of completion of its successful tensioning unless specific requirements require delaying it till certain other cables are first successfully stressed. HOWEVER, in the present case, all the PS-I and PS-II cables may be grouted (one after the other) immediately after the last of these cables has been successfully stressed (when the concrete in the Deck is about 30 to 35 days old).

iii. The Grout shall consist of Ordinary Portland Cement, Water, and an Expansive Admixture approved by the Engineer. All grout shall pass through a screen with 2 mm maximum clear openings prior to being introduced into the grout–pump. No admixtures containing chlorides and nitrates shall be used. Water shall be of potable quality and free of any salts and sugars (as per Specifications) and shall be added to the mixer first, followed by cement and the admixture.

iv. The Grout shall be mixed in mechanical mixing equipment of a type that will produce uniform and thoroughly mixed colloidal grout. The water content shall not be more than 24 litres per 50 kg sack of cement. Retempering of grout shall not be permitted. Grout shall be continuously kept agitated until it is pumped in.

v. Grouting Equipment shall be furnished with a pressure gauge having a full-scale reading of upto 20 Kg/cm^2 (2 MPa) and it shall be capable of grouting at a pressure of at least 10 Kg/cm^2 (1 MPa).

vi. Prior to placing the shuttering, the Contractor should demonstrate to the satisfaction of the Engineer that all ducts are unobstructed and, if the prestressing reinforcement has been placed, that the Cable–steel is free and not bonded in the duct.

vii. If the expansive Admixture (generally an Aluminium compound) is used to expand the Grout, it shall be added strictly as per Manufacturer's instructions. The ducts shall be completely filled, from the low end, with grout, under NOT MORE THAN 7 kg/cm^2 pressure. Grout shall be pumped through the duct and continuously wasted at the outlet until no visible slugs of water or air are seen. All vents shall then be closed, and the grouting pressure at the injection–end raised to 10 kg/cm^2 and held for a minimum of 10 seconds before closing the hole in the cable–anchorage at the injection–end.

viii. If some delays in Grouting are unavoidable (e.g. due to sequence of construction planned), temporary protection against corrosion shall be provided by ventilating the Ducts with dry/hot air, since any humid conditions contribute considerably to acceleration of corrosion of cable–steel.

19. BEARINGS

i. "POT" and "POT–PTFE" BEARINGS shall be used. Their Material specifications, Design, Acceptance Criteria and Installation shall be generally in accordance with IRC: 83 part 3 (2002), the AASHTO Design Specifications, and Sound Engineering Practice.

ii. The Bearings shall be obtained from approved and experienced Manufacturers.

iii. Installation of Bearings shall be carried out under the expert supervision of the Manufacture's Technical Representative.

iv. The Design of Bearings shall be based on the Design Loads, Rotations, etc., given in the appropriate Table in the attached relevant Drawing.

v. Detailed Shop Drawings shall be prepared by the Manufacturer, which shall be checked and duly approved before the Bearings are manufactured and installed.

vi. The Grout/Bedding Mortar, where used, shall be high strength free flowing Non Shrink Grout.

vii. All Bearings shall be placed in truly horizontal plane only and to true line and direction (unless shown differently), as generally indicated in the attached relevant Drawing.

viii. IMPORTANT NOTE:

a) The Superstructure in a span can be lifted upwards at each of its ends (work only at one end at a time) by operating the appropriate – capacity LIFTING JACKS applied under the end-crossgirder at that end as indicated in the attached relevant Drawing.

b) Each of these Lifting Jacks shall have a Safe Lifting Capacity of 200 Tonnes.

c) All Hydraulic Lifting Jacks shall be connected to a common oil-bath manifold so that – in the event of any emergency while lifting, e.g. Washer-burst, etc., in a Jack – the oil being pumped shall automatically recirculate and cause to lower all the Jacks simultaneously and equally, in unison.

d) All Jacks must be operated simultaneously, equally, and in unison

ix. Pier Caps and Abutment Caps MUST also be structurally dequately designed for the Reactions from the said Lifting Jacks.

x. A conditions–free warranty of at least 10 years after opening of the Bridge to the traffic shall be furnished by the Contractor and the Manufacturer/Supplier of the Bearings.

xi. ALL Bearings shall be placed in their final and correct positions (as per details shown in the attached relevant Drawing) over the R.C. Pedestals before casting the Deck (i.e. superstructure) in-situ.

20. EXPANSION–CONTRACTION JOINTS

i. These Movement Joints shall be provided in the deck as Specified and shown in attached relevant Drawing. These shall be of Approved Quality and shall be fitted under the expert supervision of the Manufacturer at the appropriate ambient Temperature as per Design.

ii. A conditions–free warranty of at least 10 years after opening of the Bridge to the traffic shall be furnished by the Contractor and the Manufacturer/Supplier of these Expansion–Contraction Joints.

21. WEARING COURSE

Asphaltic concrete wearing course, 75mm thick at roadway crown, gradually reducing to 50mm at the road kerbs, shall be provided over the Deck Slab.

22. EARTHQUAKE EFFECTS

The Horizontal Seismic coefficient assumed is 0.27 (i.e. 0.27G) accompanied by a Vertical Seismic coefficient of + or – 0.135G.

23. LIST Of the ATTACHED RELEVANT DRAWINGS PERTINENT TO THE ABOVE NOTES

Drg. No:	'TITLE' of DRAWING
1/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REFERENCE NOTES (5 Sheets): Sheet 1/5
2/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REFERENCE NOTES (5 Sheets): Sheet 2/5
3/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REFERENCE NOTES (5 Sheets): Sheet 3/5
4/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REFERENCE NOTES (5 Sheets): Sheet 4/5
5/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REFERENCE NOTES (5 Sheets): Sheet 5/5
6/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	GENERAL ARRANGEMENT DRAWING AND DIMENSIONS
7/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	DETAILS OF PRESTRESSING CABLES
8/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REINFORCEMENT DETAILS IN ANCHORAGE ZONES (TYP.)
9/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REINFORCEMENT DETAILS OF DECK SLAB, PRECAST R.C. FOOTPATH SLAB, ROAD KERB, PARAPET POST AND ITS BASE
10/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	REINFORCEMENT DETAILS OF LONGITUDINAL WEBS & CROSS GIRDERS
11/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	BAR BENDING SCHEDULE
12/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span	ADDITIONAL DETAILS

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

Road Carriageway Width: 7.50m. plus 2 Footpaths each 1.50 m. wide	**Overall Deck Width: 11.00 m**
Effective Simply Supported Span (centre to centre of Bearings): 40.0 m. Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading

Drg. No.: 5/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span

Drg. TITLE: REFERENCE NOTES (5 Sheets): Sheet 5/5

Designed by: Naresh P. Keshari, Engineer, DoR	*Mentored by:* Dr. V. K. Raina, Bridge Techl Expert, DoR/ World Bank	Date: May 14, 2015
Drawn by: Bicky G. Shakha	*Accepted by:* Saroj K. Pradhan (DDG, DoR)	Revisions:
Checked by: Pradeep Bhandari, Engineer, DoR	*Approved by:* Madhab K. Karki (DG, DoR)	

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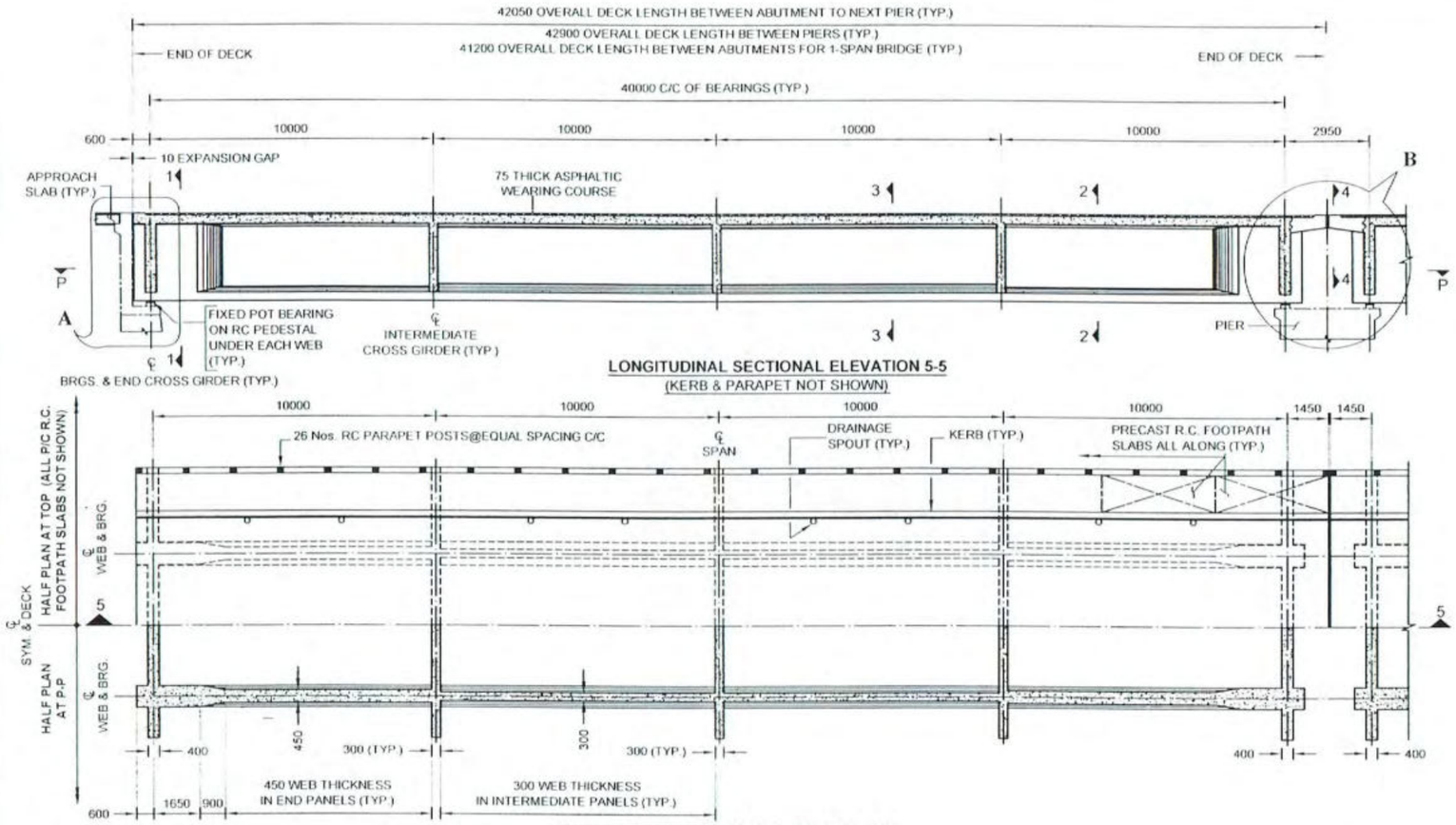


NOTES:

1. All dimensions are in millimeters, unless stated otherwise.
2. No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
3. This drawing shall be read in conjunction with Drgs. No: 1/12 to 5/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.
4. **Entire 2-Webbed slab deck shall be cast in situ on staging in span and Prestressed as a whole as explained in Drg. No: 5/12 and 7/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.**
5. Road Kerbs and Parapet Posts shall be cast in situ after all cables have been stressed.
6. **Longitudinal Cantilevering portions of Deck-Slab (over piers), shown shaded, shall be cast after all cables have been stressed.**
7. **For Expansion Joint Details see Drg. NO: 12/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.**

QUANTITIES IN ONE COMPLETE SUPERSTRUCTURE IN ONE SPAN

S.N.	Item	Quantity
1	Structural Concrete	M45 in PSC Deck = 267.73 cu.m. M35 in Precast RC Footpath Slabs, Parapet Posts and their bases and Road Kerbs = 34.30 cu.m.
2	Untensioned reinforcement bars, HYSD, TMT, minimum 0.2% proof stress 500 MPa (Fe 500).	38.82 Tonnes
3	Prestressing multistranded cables, each comprising 19 mono-strands, each mono-strand of 12.7 mm dia. 7-ply low relaxation Class-II HTS (Breaking load per mono-strand = 183.71 KN); Total length of the 19 multi-stranded cables (weighing@14.73 Kg/m) = 616.6 m. (Total length of the 12.7 mm dia. mono-strand, weighing@0.77526 Kg/m = 11716 m).	9.1 Tonnes
4	Sheathing (ducting for housing 19-multistranded cables), corrugated "HDPE" type, 90mm internal dia. (wall thickness 2.3 ± 0.3 mm as manufactured and 1.5mm after loss of compression)	675 m
5	Anchorages for 19-stranded multistranded cables.	32 sets
6	**Expansion Joint:** See Details in Drg. No: 12/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS-Span.	
7	**Bearings** POT Fixed Bearing: Free to Rotate in all directions, and Fixed in position	POT Fixed Bearing = 2 Nos.
	POT-PTFE Free Bearing: Free to Rotate in all directions, Free sliding in Longitudinal Direction of Bridge, Fixed in Position in Transverse Direction of Bridge.	POT-PTFE Free Bearing = 2 Nos.
8	Asphaltic Wearing Course, Average Thickness 62.5mm.	316 sq.m.
9	75mm dia. GI Pipe (Parapet Railings).	253 m
10	Drainage spouts each 450mm long, 100mm dia. GI Pipe.	16 Nos.

NOTES: i) Exact Quantities shall, however, be calculated by the concerned Engineer for Costing Purposes.
ii) Total Weight of entire Superstructure in one Span = 856 Tonnes

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

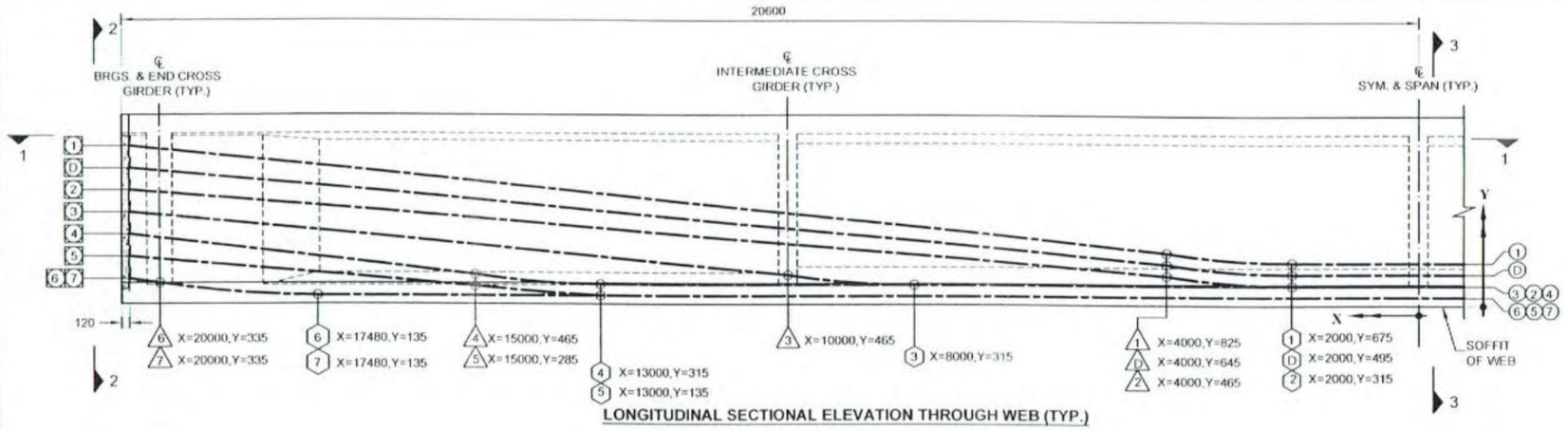
Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	**Overall Deck Width 11.00 m**
Effective Simply Supported Span (center to center of Bearings): **40.0 m** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : **6/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

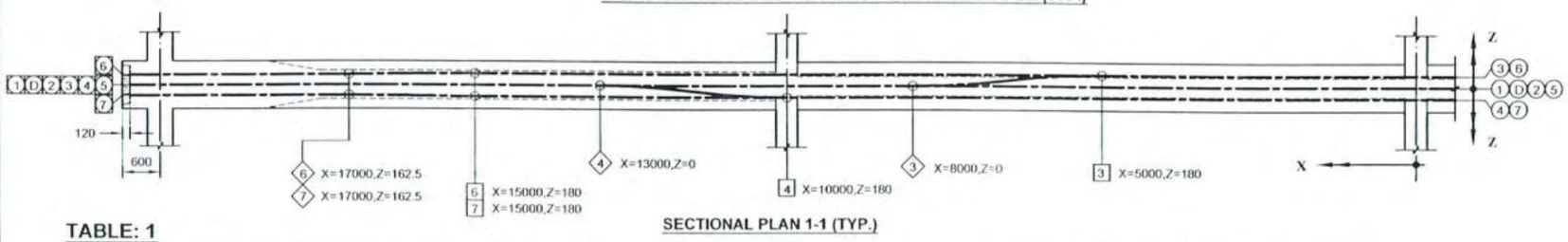
Drg. TITLE : **GENERAL ARRANGEMENT DRAWING AND DIMENSIONS**

Designed by : Naresh P. Keshari, Engineer, DoR	***Mentored by :*** Dr. V.K. Raina, Bridge Techl Expert, DoR/World Bank	Date : May 14, 2015
Drawn by : Bicky G. Shakha	***Accepted by :*** Saroj K. Pradhan (DDG, DoR)	Revision :
Checked by : Pradeep Bhandari, Engineer, DoR	***Approved by :*** Madhab K. Karki (DG, DoR)	

Madhab Kumar Karki
Director General



LONGITUDINAL SECTIONAL ELEVATION THROUGH WEB (TYP.)



SECTIONAL PLAN 1-1 (TYP.)

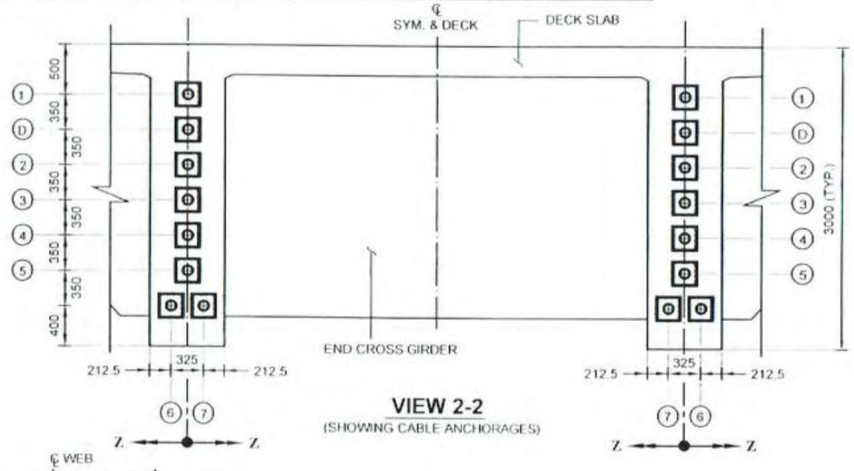
TABLE: 1

HORIZONTAL DISTANCE "X" FROM MID SPAN SECTION	AT X=20480		AT X=20000		AT X=18000		AT X=16000		AT X=14000		AT X=12000		AT X=10000		AT X=8000		AT X=6000		AT X=4000		AT X=2000		AT X=0	
CABLE NUMBER	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z	Y	Z
①	2500	0	2451	0	2248	0	2045	0	1841	0	1638	0	1435	0	1232	0	1028	0	825	0	675	0	675	0
Ⓓ	2150	0	2106	0	1924	0	1741	0	1558	0	1376	0	1193	0	1010	0	828	0	645	0	495	0	495	0
②	1800	0	1761	0	1599	0	1437	0	1275	0	1113	0	951	0	789	0	627	0	465	0	315	0	315	0
③	1450	0	1405	0	1217	0	1029	0	841	0	653	0	465	0	315	0	315	139	315	180	315	180	315	180
④	1100	0	1044	0	813	0	581	0	370	0	315	40	315	180	315	180	315	180	315	180	315	180	315	180
⑤	750	0	709	0	540	0	370	0	205	0	135	0	135	0	135	0	135	0	135	0	135	0	135	0
⑥	400	162.5	335	162.5	153	162.5	135	171	135	180	135	180	135	180	135	180	135	180	135	180	135	180	135	180
⑦	400	162.5	335	162.5	153	162.5	135	171	135	180	135	180	135	180	135	180	135	180	135	180	135	180	135	180

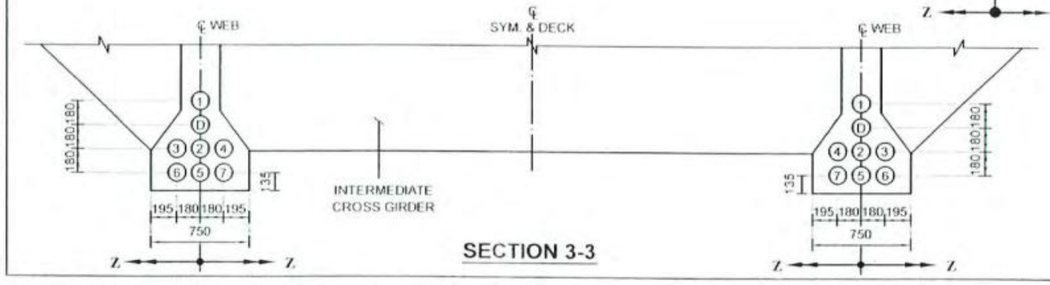
NOTES: 'X' = HORIZONTAL DISTANCE FROM MID SPAN SECTION
'Y' = VERTICAL DISTANCE TO CENTERLINE OF CABLE ABOVE SOFFIT OF WEB
'Z' = HORIZONTAL DISTANCE TO CENTERLINE OF CABLE FROM CENTERLINE OF WEB

TABLE: 2

CABLE NO.	ANCHORAGE TYPE	NO. OF STRANDS	REQUIRED EXTENSION AT EACH END (mm.)	EMERGENCE ANGLE (Degrees)	REQUIRED JACKING FORCE AT EACH END (Tonne)	STAGE OF PRESTRESSING
①	19JK13 OR 19DP13 OR EQUIVALENT (SEE NOTES)	19	151	5.803	266.86	PS-I
②		19	151	4.631	266.86	
③		19	148	5.369	266.86	
④		19	146	6.609	266.86	
⑤		19	150	4.850	266.86	
⑥		19	147	7.711	266.86	PS-II
⑦		19	147	7.711	266.86	
Ⓓ		-	-	5.217	-	EMERGENCY



VIEW 2-2
(SHOWING CABLE ANCHORAGES)



SECTION 3-3

NOTES:

1. All dimensions are in millimeters, unless stated otherwise.
2. No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
3. **This drawing shall be read in conjunction with all relevant NOTES given in Drgs. No:1/12 to 5/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span - specially those dealing with Prestressing.**
   NOTE: Cables marked 'D' are the Dummy Cables.
4. This drawing shall also be read in conjunction with Drgs. No: 6/12 & 8/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.
5. **The sequence of stressing of multistranded cables shall be as follows :**
   (i) PS-I Cables (i.e. cables of 1st stage of Prestressing)
   - Stress Cable No: 1 in one web;
   - Then stress Cable No: 1, followed by Cable No: 2, in the second web;
   - Then stress Cable No: 2, followed by Cable No: 3, in the first web;
   - Then stress Cable No: 3, followed by Cable No: 4, in the second web;
   - Then stress Cable No: 4, followed by Cable No: 5, in the first web;
   - Then stress Cable No: 5 in the second web.

   (ii) PS-II cables (i.e. cables of 2nd stage of Prestressing)
   - Stress Cable No: 6 in the first web;
   - Then stress Cable No: 6, followed by Cable no: 7, in the second web;
   - Then stress Cable No: 7 in the first web.
6. **During Stressing of PS-I Cables:**
   After successfully stressing Cables No: 1 to 4 in each of the two webs, and just before stressing the remaining cables of these PS-I Cables: **Lightly Hammer and Loosen** the wooden wedge packings from under the soffits of the two webs of the deck **simultaneously** - BUT ONLY JUST - to ensure that the deck has now hogged upwards clear of its supporting staging between its ends. (This will confirm that the Prestress applied so far has fully countered and taken up the self weight of the Superstructure which, therefore, is resting only at its ends and not on the staging any longer and hence the accompanying Decompression of staging columns is complete).
7. **CAUTION: The shown Profiles of Prestressing Cables shall be Strictly followed without any compromise, whatsoever. Where absolutely necessary, the Untensioned Reinforcement Bars/Meshes may be suitably slightly repositioned to suit.**
8. Vertical Ordinates 'Y' and Horizontal Distances 'Z' of Cable-Profiles given in this Drg., are to Center-lines of the Cables from soffit of Web and from Vertical Centerline of Web, respectively. Account should be taken of the RADIUS of the Cable-duct in welding the 12 mm dia. Cross-bars to the Stirrup-legs for profiling the Cables.

LEGEND:

- ○ — INDICATES CABLE NUMBER
- ⬡ — INDICATES START OF CURVE IN ELEVATION
- △ — INDICATES END OF CURVE IN ELEVATION
- □ — INDICATES START OF CURVE IN PLAN
- ◇ — INDICATES END OF CURVE IN PLAN
- ⊏ — INDICATES END OF CABLE

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

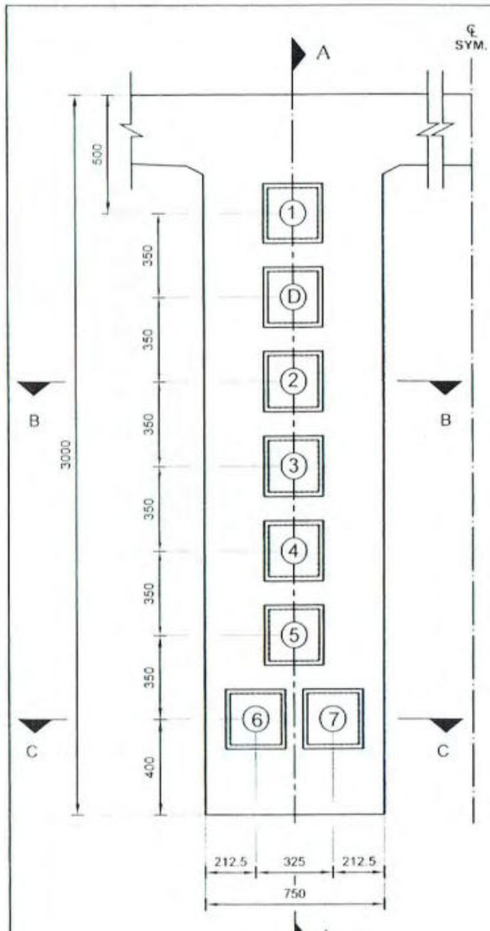
Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	**Overall Deck Width 11.00 m**
Effective Simply Supported Span (center to center of Bearings): **40.0 m** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : **7/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE : **DETAILS OF PRESTRESSING CABLES**

Designed by : Naresh P. Keshari, Engineer, DoR	***Mentored by :*** Dr. V.K. Raina, Bridge Techl Expert, DoR/World Bank	Date : May 14, 2015
Drawn by : Bicky G. Shakha	***Accepted by :*** Saroj K. Pradhan, (DDG, DoR)	Revision :
Checked by : Pradeep Bhandari, Engineer, DoR	***Approved by :*** Madhab K. Karki, (DG, DoR)	

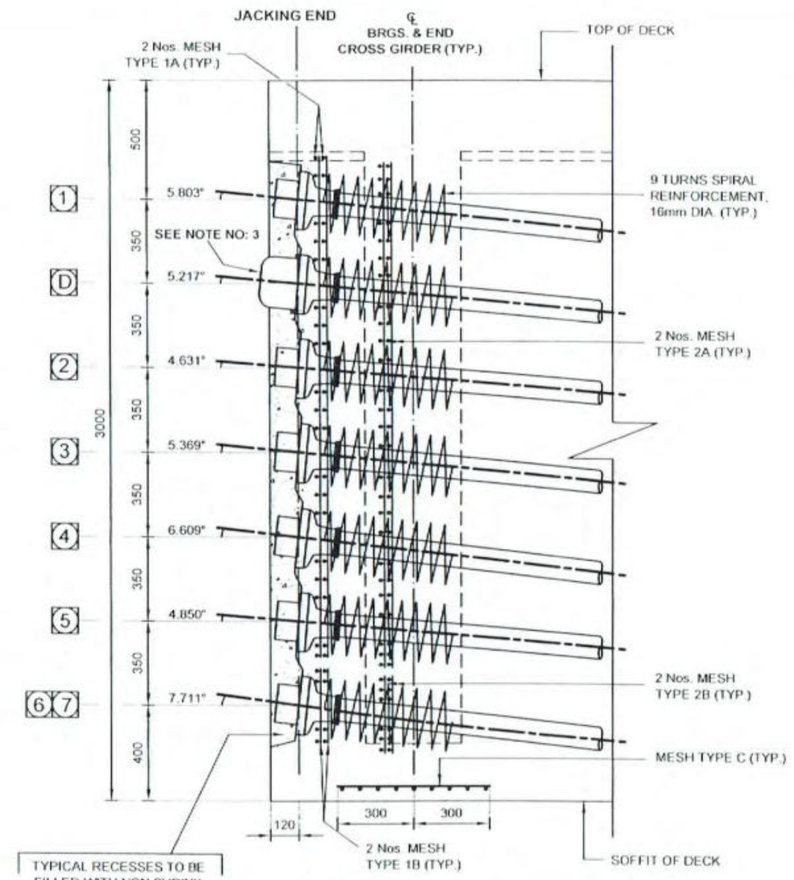
Madhab Kumar Karki



END VIEW OF WEB OF DECK (TYP.)

120MM INSIDE FROM FACE

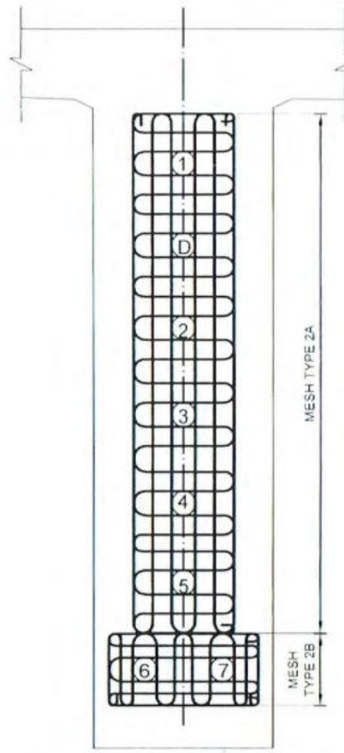
(END CROSS GIRDER NOT SHOWN)



TYPICAL RECESSES TO BE FILLED WITH NON SHRINK CEMENT MORTAR AFTER ALL CABLES SUCCESSFULLY STRESSED AND GROUTED AND PROTRUDING CABLE ENDS SAW-CUT, SEE NOTE NO: 3

SECTION A-A (TYP.)

(ALSO SHOWING INCLINATIONS OF CABLE-AXES TO HORIZONTAL AT ANCHORAGES)

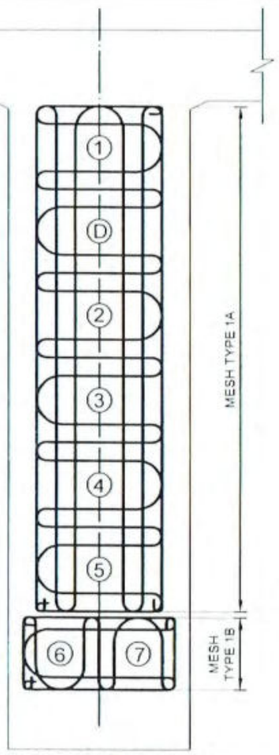


MESHES TYPE 2A & 2B

BAR DIA. 12mm

(FRONT ELEVATION)

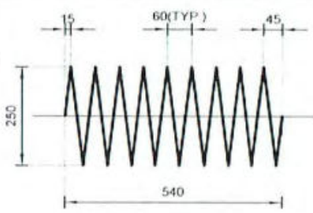
(TYP.)



MESHES TYPE 1A & 1B

BAR DIA. 12mm

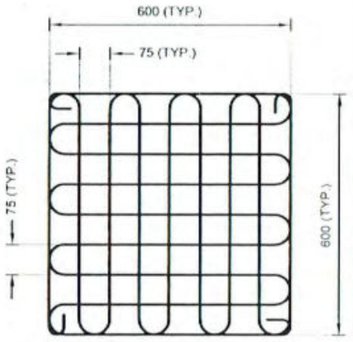
(FRONT ELEVATION) (TYP.)



TYPICAL DETAIL OF SPIRAL REINFORCEMENT (9 TURNS) IN FRONT OF EACH ANCHORAGE

BAR DIA. 16mm

(TYP.)



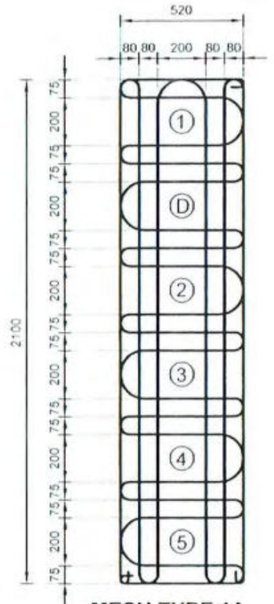
PLAN OF MESH TYPE C PLACED ABOVE LOCATION OF BEARINGS

BAR DIA. 10mm

(TYP.)

NOTES:

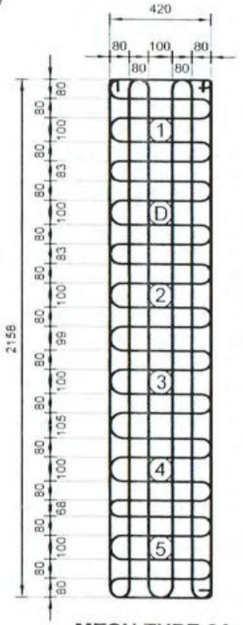
1. All dimensions are in millimeters, unless stated otherwise.
2. No dimension shall be scaled from the Drawings; only written dimensions shall be followed
3. **This drawing shall be read in conjunction with all relevant NOTES given in Drgs. No:1/12 to 5/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span - Specially those dealing with Prestressing.**
   NOTE: Cables marked 'D' are the Dummy Cables and shall be installed when needed. Their Anchorages should be capped suitably (to prevent ingress of foreign material) and should be marked as 'DUMMY' for future recognition.
4. This drawing shall also be read in conjunction with Drgs. No: 6/12 & 7/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.
5. CAUTION: **The specified Profiles of Prestressing Cables shall be Strictly followed without any compromise, whatsoever. Where absolutely necessary, the Untensioned Reinforcement Bars/Meshes may be suitably slightly repositioned to suit.**



MESH TYPE 1A

BAR DIA. 12mm

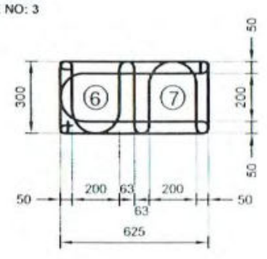
(FRONT ELEVATION) (TYP.)



MESH TYPE 2A

BAR DIA. 12mm

(FRONT ELEVATION) (TYP.)

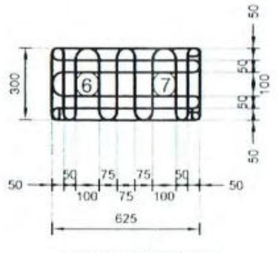


MESH TYPE 1B

BAR DIA. 12mm

(FRONT ELEVATION)

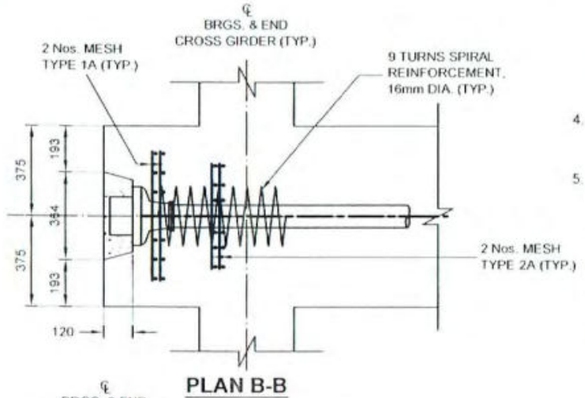
(TYP.)



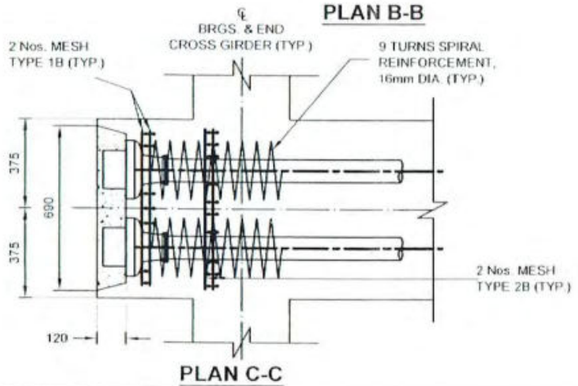
MESH TYPE 2B

BAR DIA. 12mm

(FRONT ELEVATION) (TYP.)



PLAN B-B



PLAN C-C

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

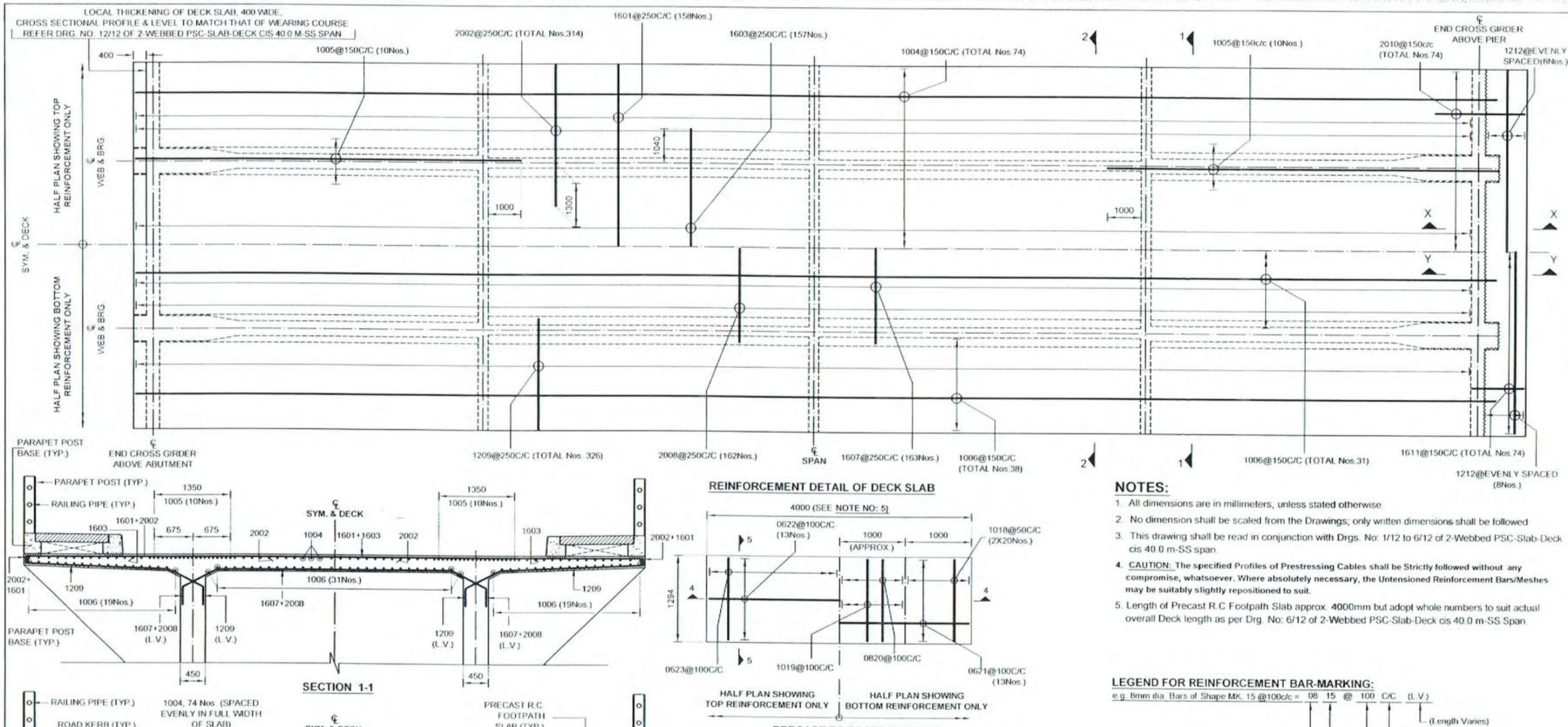
Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	**Overall Deck Width 11.00 m**
Effective Simply Supported Span (center to center of Bearings): **40.0 m** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : **8/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

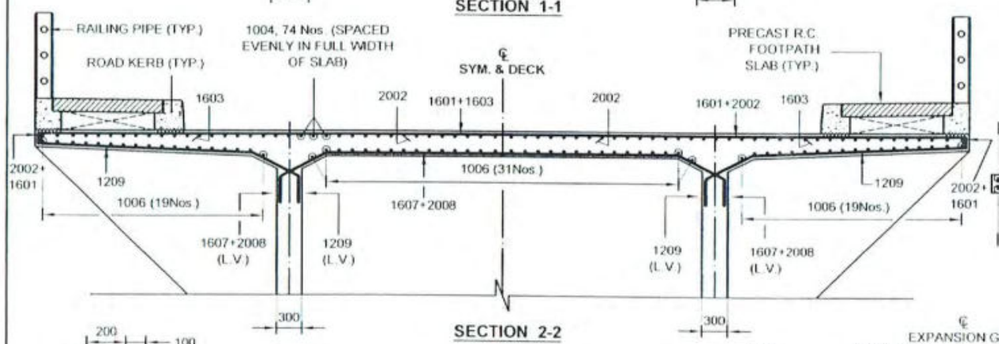
Drg. TITLE : **REINFORCEMENT DETAILS IN ANCHORAGE ZONES (TYP.)**

Designed by : Naresh P. Keshari, Engineer, DoR	***Mentored by :*** Dr. V.K. Raina, Bridge Techl Expert, DoR/World Bank	Date : May 14, 2015
Drawn by : Bicky G. Shakha	***Accepted by :*** Saroj K. Pradhan (DDG, DoR)	Revision :
Checked by : Pradeep Bhandari, Engineer, DoR	***Approved by :*** Madhab K. Karki (DG, DoR)	

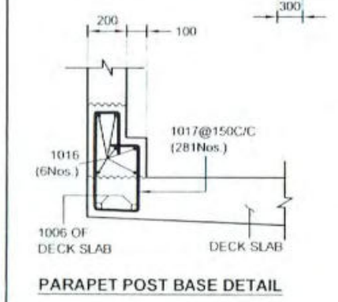
Madhab Kumar Karki
Director General



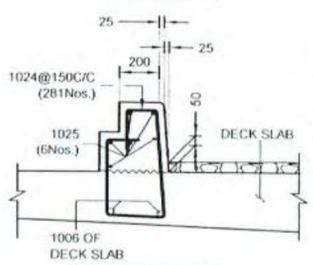
SECTION 1-1



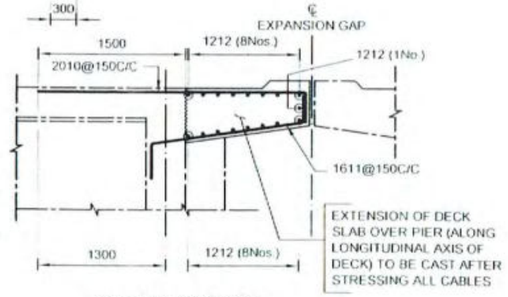
SECTION 2-2



PARAPET POST BASE DETAIL



ROAD KERB DETAIL



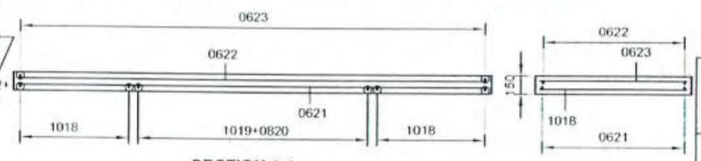
SECTION X-X & Y-Y

REINFORCEMENT DETAILS OF EXTENSION OF DECK SLAB OVER PIER (ALONG LONGITUDINAL AXIS OF DECK)
(OTHER REINFORCEMENTS NOT SHOWN)

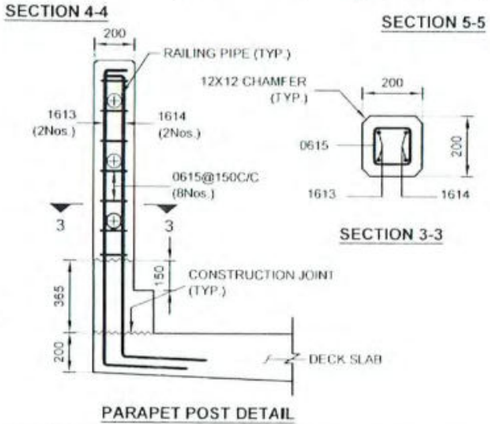
REINFORCEMENT DETAIL OF DECK SLAB

PRECAST RC FOOTPATH SLAB

(SUITABLY ANCHORED M.S. HOOKS SHALL BE PROVIDED FOR LIFTING & HANDLING)



SECTION 4-4 SECTION 5-5



PARAPET POST DETAIL

SECTION 3-3

NOTES:

1. All dimensions are in millimeters, unless stated otherwise.
2. No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
3. This drawing shall be read in conjunction with Drgs. No: 1/12 to 6/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.
4. CAUTION: **The specified Profiles of Prestressing Cables shall be Strictly followed without any compromise, whatsoever. Where absolutely necessary, the Untensioned Reinforcement Bars/Meshes may be suitably slightly repositioned to suit.**
5. Length of Precast R.C Footpath Slab approx. 4000mm but adopt whole numbers to suit actual overall Deck length as per Drg. No: 6/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span.

LEGEND FOR REINFORCEMENT BAR-MARKING:

e.g. 8mm dia. Bars of Shape MK. 15 @100c/c = 08 15 @ 100 C/C (L.V.)

- (Length Varies)
- Center to Center
- Spacing of Bars in mm
- Bar Shape Mark
- Dia. of Bar in mm

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

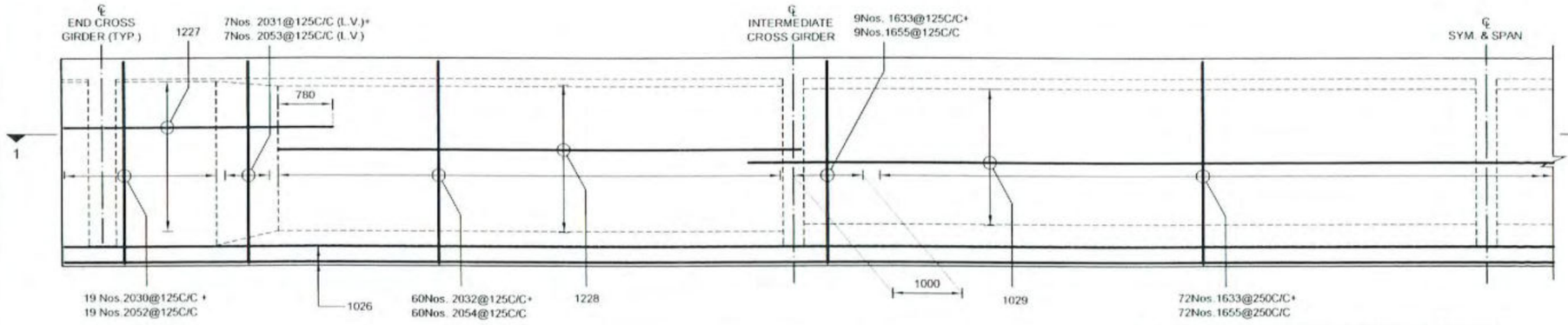
STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	**Overall Deck Width 11.00 m**
Effective Simply Supported Span (center to center of Bearings): **40.0 m** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : **9/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE : **REINFORCEMENT DETAILS OF DECK SLAB, PRECAST R.C. FOOTPATH SLAB, ROAD KERB, PARAPET POST AND ITS BASE**

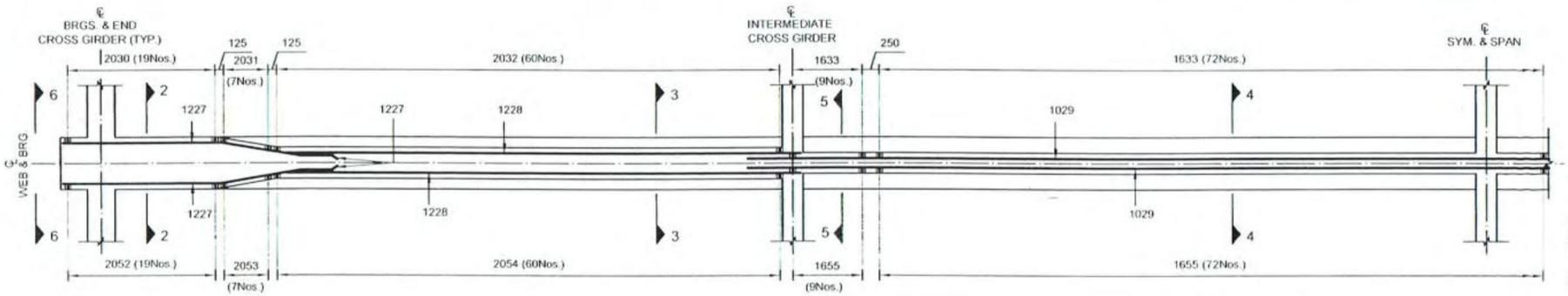
Designed by : Naresh P. Keshari, Engineer, DoR	***Mentored by :*** Dr. V.K. Raina, Bridge Techl Expert, DoR/World Bank	**Date :** May 14, 2015
Drawn by : Bicky G. Shakha	***Accepted by :*** Saroj K. Pradhan (DDG, DoR)	**Revision :**
Checked by : Pradeep Bhandari, Engineer, DoR	***Approved by :*** Madhab K. Karki (DG, DoR)	Madhab Kumar Karki



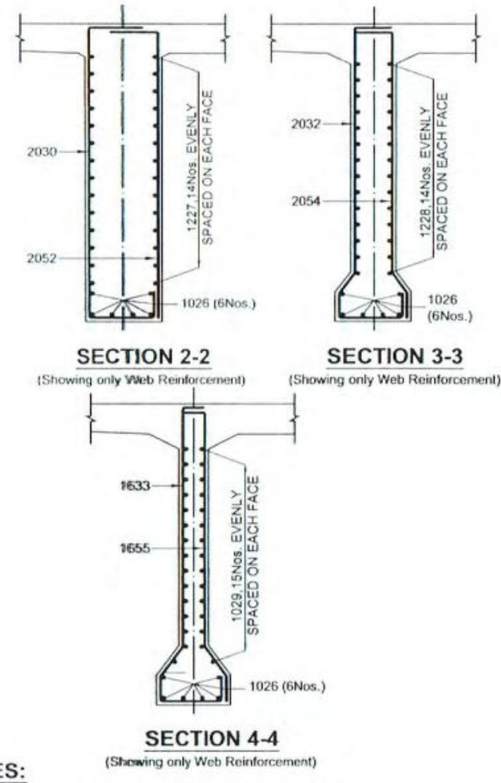
LONGITUDINAL SECTIONAL ELEVATION OF WEB

(SHOWING ONLY WEB REINFORCEMENT)
EDGE THICKENING OF DECK SLAB NEAR EXPANSION JOINTS NOT SHOWN

Bars 2010 and 1611 (See Section X-X & Y-Y in Drg. No: 9/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span) shall be provided as Dowels from Deck Slab & End Cross Girder, respectively (Over Piers) but are not shown here.



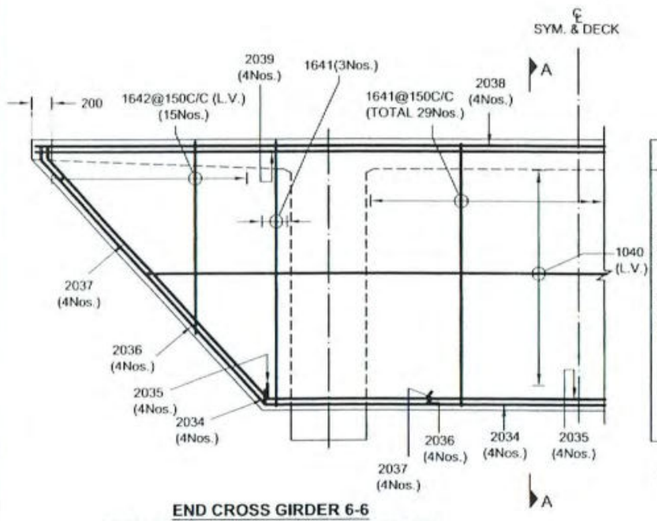
SECTION 1-1



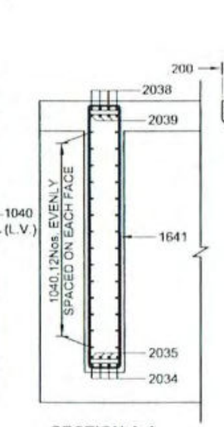
SECTION 2-2
(Showing only Web Reinforcement)

SECTION 3-3
(Showing only Web Reinforcement)

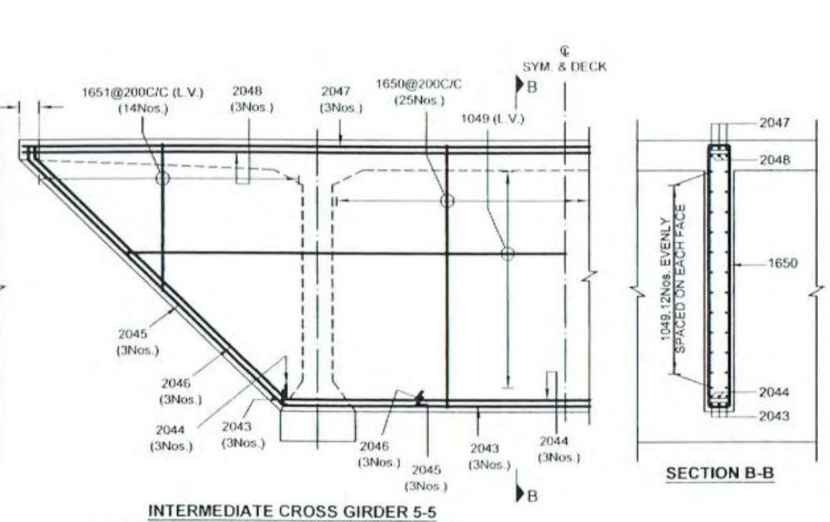
SECTION 4-4
(Showing only Web Reinforcement)



END CROSS GIRDER 6-6
(SHOWING ONLY CROSS GIRDER REINFORCEMENT)



SECTION A-A



INTERMEDIATE CROSS GIRDER 5-5
(SHOWING ONLY CROSS GIRDER REINFORCEMENT)

SECTION B-B

NOTES:

1. All dimensions are in millimeters, unless stated otherwise.
2. No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
3. This drawing shall be read in conjunction with Drgs. No:1/12 to 6/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span.
4. **CAUTION: The specified Profiles of Prestressing Cables shall be Strictly followed without any compromise, whatsoever. Where absolutely necessary, the Untensioned Reinforcement Bar/Meshes may be suitably slightly repositioned to suit.**
5. Where bar length actually at site is less than that required in the structure, the same shall be made up by lapping of bars of same dia. (lap length generally 65 times dia.) such lap lengths have not been accounted for in the bar bending schedule shown in Drg. NO: 11/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span.

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

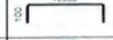
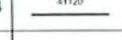
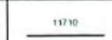
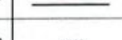
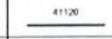
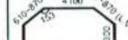
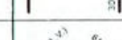
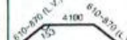
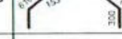
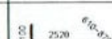
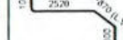
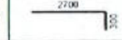
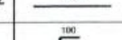
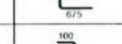
STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

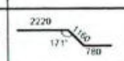
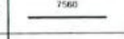
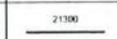
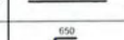
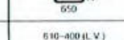
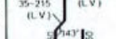
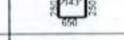
Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	**Overall Deck Width 11.00 m**
Effective Simply Supported Span (center to center of Bearings): **40.0 m** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : **10/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE : **REINFORCEMENT DETAILS OF LONGITUDINAL WEBS & CROSS GIRDERS**

Designed by : Naresh P. Keshari, Engineer, DoR	***Mentored by :*** Dr. V.K. Raina, Bridge Techl Expert, DoR/World Bank	**Date :** May 14, 2015
Drawn by : Bicky G. Shakha	***Accepted by :*** Saroj K. Pradhan (DDG, DoR)	**Revision :**
Checked by : Pradeep Bhandari, Engineer, DoR	***Approved by :*** Madhab K. Karki (DG, DoR) Madhab Kumar Karki, Director General	

S.No:	Bar Mark	Shape of Bar (Not to scale) Dimensions are in mm	Dia. of Bar (mm)	Length of each Bar (mm)	No. of Bars	Total Length of Bars (m)	Weight (kg)
1	1601		16	11100	158	1753.8	2771.4
2	2002		20	4350	314	1365.9	3372.6
3	1603		16	7080	157	1111.6	1756.5
4	1004		10	41120	74	3042.9	1878.3
5	1005		10	11710	40	468.4	289.1
6	1006		10	41120	69	2837.3	1751.4
7	1607		16	-	163	1007.3	1591.8
8	2008		20	-	162	1001.2	2472.1
9	1209		12	-	326	1193.16	1060.6
10	2010		20	3000	74	222.0	548.1
11	1611		16	2140	74	158.4	250.2
12	1212		12	10920	17	185.6	165.0
13	1613		16	2245	104	233.5	369.0
14	1614		16	2245	104	233.5	369.0
15	0615		6	550	416	228.8	50.8
16	1016		10	41970	12	503.6	310.9
17	1017		10	1420	562	798.0	492.6
18	1018		10	1300	880	1144.0	706.2
19	1019		10	1300	396	514.8	317.8
20	0820		8	1300	374	486.2	192.1
21	0621		6	3830	308	1179.6	262.1
22	0622		6	3830	308	1179.6	262.1
23	0623		6	1300	858	1115.4	247.9
24	1024		10	1605	562	902.0	556.8
25	1025		10	41970	12	503.6	310.9
26	1026		10	41120	12	493.4	304.6

S.No:	Bar Mark	Shape of Bar (Not to scale) Dimensions are in mm	Dia. of Bar (mm)	Length of each Bar (mm)	No. of Bars	Total Length of Bars (m)	Weight (kg)
27	1227		12	4160	112	465.9	414.2
28	1228		12	7560	112	846.7	752.6
29	1029		10	21300	60	1278.0	788.9
30	2030		20	4450	76	338.2	835.1
31	2031		20	-	28	121.1	299.0
32	2032		20	4200	240	1008.0	2488.9
33	1633		16	4075	180	733.5	1159.1
34	2034		20	6350	8	50.8	125.4
35	2035		20	6350	8	50.8	125.4
36	2036		20	4990	16	79.8	197.1
37	2037		20	4890	16	78.2	193.2
38	2038		20	10920	8	87.4	215.7
39	2039		20	10920	8	87.4	215.7
40	1040		10	-	48	421.4	260.1
41	1641		16	6100	70	427	674.8
42	1642		16	-	60	136.80	216.2
43	2043		20	5750	9	51.8	127.8
44	2044		20	5750	9	51.8	127.8
45	2045		20	4940	18	88.9	219.6
46	2046		20	4900	18	88.2	217.8
47	2047		20	10920	9	98.3	242.7
48	2048		20	10920	9	98.3	242.7
49	1049		10	-	72	612.40	378.0

S.No:	Bar Mark	Shape of Bar (Not to scale) Dimensions are in mm	Dia. of Bar (mm)	Length of each Bar (mm)	No. of Bars	Total Length of Bars (m)	Weight (kg)
50	1650		16	5800	75	435.0	687.4
51	1651		16	-	84	319.0	504.1
52	2052		20	3550	76	269.8	666.2
53	2053		20	-	28	97.30	240.2
54	2054		20	3425	240	822.0	2029.6
55	1655		16	3175	180	571.5	903.1
56	MESH TYPE 1A		12	24246	4	97.0	86.2
57	MESH TYPE 1B		12	5398	4	21.6	19.2
58	MESH TYPE 2A		12	25611	4	102.4	91.1
59	MESH TYPE 2B		12	7548	4	30.2	26.8
60	MESH TYPE C		10	11774	4	47.1	29.1
61	SPIRAL REINFORCEMENT (9 TURNS EACH)		16	7100	32	227.2	359.0

NOTES:

1. All dimensions are in millimeters, unless stated otherwise.
2. No dimension shall be scaled, only written dimensions shall be followed.
3. This drawing shall be read in conjunction with Drgs. No: 1/12 to 10/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.
4. Dimensions, Reinforcement Bars and Quantities shown pertain to superstructure in One Span of 42050 mm overall Deck Length and these shall be worked out for other overall deck lengths to suit.
5. Where Bar Length available at site is less than that required in the structure, the same shall be made up by lapping of bars of same dia. (lap length generally 65Ø). Such lap lengths have not been accounted for in the bar bending schedule here.
6. The schedule of reinforcement shown here is indicative only, and is given purely for assisting the site Engineer, and does not pretend to be complete in all respects. The site Engineer should check and rectify it to suit.
7. L.V. = Bar "Length Varies".
8. Length of a Bar as shown is along its centerline.

GOVERNMENT OF NEPAL
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DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	**Overall Deck Width 11.00 m**
Effective Simply Supported Span (center to center of Bearings): **40.0 m** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : **11/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE : **BAR BENDING SCHEDULE**

Designed by : Naresh P. Keshari Engineer, DoR	***Mentored by :*** Dr. V.K. Raina Bridge Techl Expert, DoR/World Bank	**Date :** May 14, 2015
Drawn by : Bicky G. Shakha	***Accepted by :*** Saroj K. Pradhan (DDG, DoR)	**Revision :**
Checked by : Pradeep Bhandari Engineer, DoR	***Approved by :*** Madhab K. Karki (DG, DoR)	

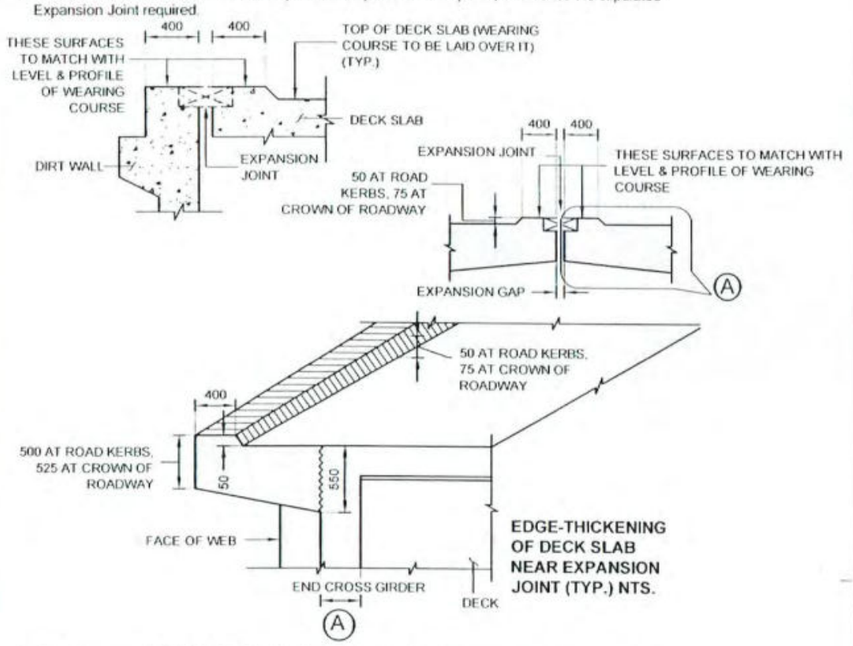
Madhab Kumar Karki
Director General

EXPANSION JOINTS

1. Necessary pockets shall be left in Deck-Slab and Dirt Wall (of Abutment) for fixing Expansion joint/Armour Angles.

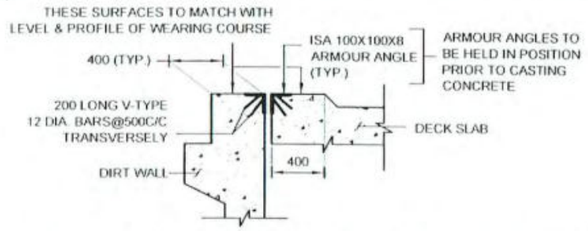
2. Stipulated Expansion Joint WABO STRIP SEAL SE-200 or WABOFLEX SR 2A or equivalent to cater for 50 mm total movement shall be provided in the Deck over 'Abutment with Free Bearings' and over 'Pier with Free and Fixed lines of Bearings'.

3. Over Abutment with **FREE BRGS.**: Expansion Gap of 50mm required, and hence the stipulated Expansion Joint required.



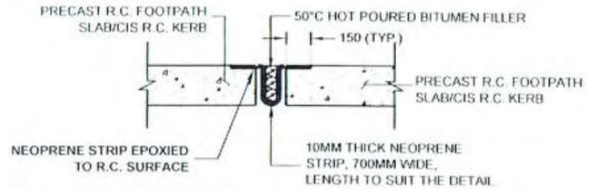
EDGE-THICKENING OF DECK SLAB NEAR EXPANSION JOINT (TYP.) NTS.

4. Over Abutment with **FIXED BRGS.**: Nominal Expansion Gap of 10mm required, No Expansion Joint required, only strengthen the facing concrete edges (of Deck Slab and Dirt Wall) by Armour Angles ISA 100X100X8 each duly anchored back into concrete with 200mm long V-type 12mm dia. bars@500 c/c transversely (This NOTE also applicable to the facing Deck-ends over a Pier with fixed Brgs. under both Deck-ends).



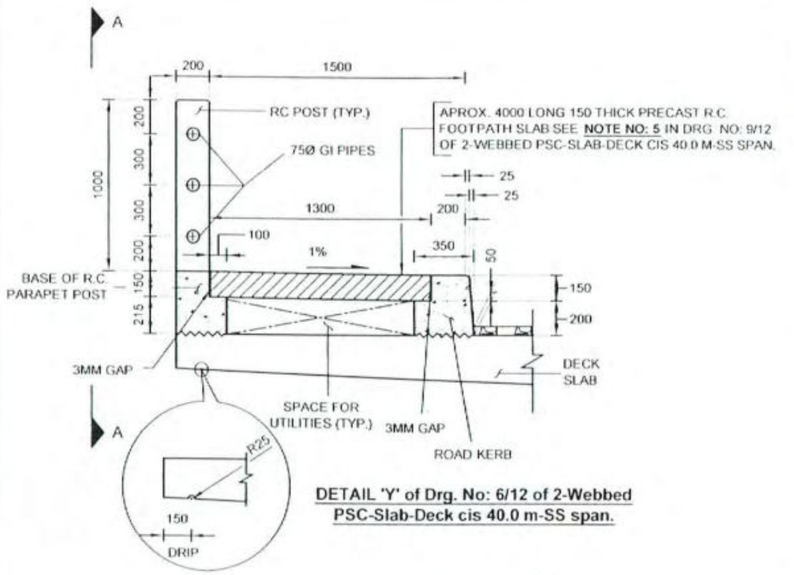
5. The Expansion Joint as well as the Armour Angles shall run along the width of road carriageway between road-side faces of the Road Kerbs (i.e. shall be 7.50m long).

6. Where the Superstructures from the two sides of a Pier rest on it on Free Brgs., each, (i.e. a Pier having two lines of Free Brgs.), the Expansion Joint shall be WABO STRIP SEAL SE-400 or WABOFLEX SR 4A or equivalent (to cater for 100 mm total movement). In such case the expansion joint arrangement between the Precast R.C. Footpath Slabs and between cis Kerbs across the expansion gap shall be as follows.

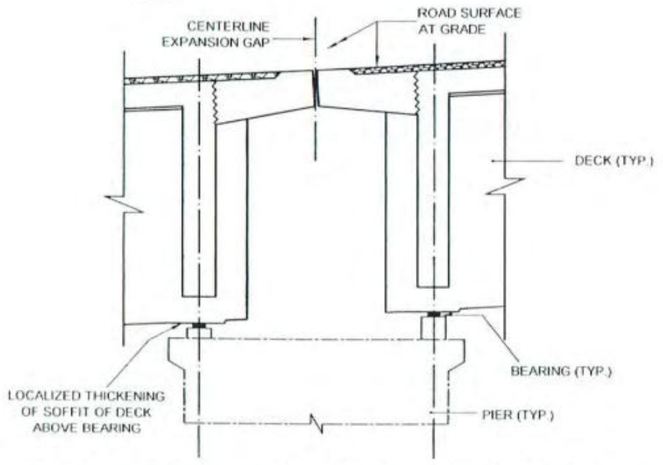


APPROACH SLAB

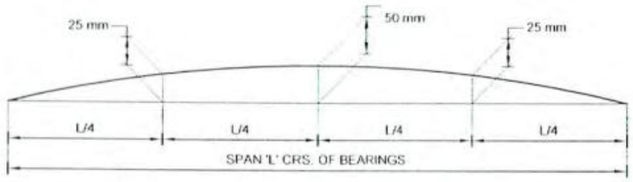
1. 3.5m long, 7.5m wide Approach Slab shall be provided behind each Abutment as generally shown in Drg. No: 6/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.These shall be cast on fully compacted backfill over suitable PCC leveling course.
2. Approach Slab shall be 300mm thick in M35 Grade concrete.
3. Reinforcement at its Top and at its Bottom, each, shall be 12mm dia. bars@150c/c both ways.
4. Suitable arrangement for Footpaths shall be provided on each side of Approach Slab taking due account of connections to Utilities.
5. Asphaltic Wearing Course shall be laid over the Approach Slabs matching the level & profile of wearing course on the adjacent Bridge Deck.



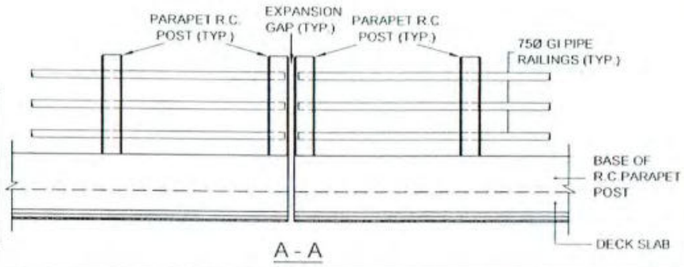
DETAIL 'Y' of Drg. No: 6/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.



INSTALLATION OF BEARINGS WHEN SUPERSTRUCTURE IS AT GRADE (TYP.)



LONGITUDINAL CAMBER PROFILE TO BE GIVEN TO SOFFIT OF DECK (TYP.)



A - A

DATA FOR BEARINGS

Load Condition	Items		POT FIXED Bearing: Free to Rotate in all Directions, and Fixed in Position	POT-PTFE Free Bearing: Free to Rotate in all Directions, Free sliding in Longitudinal Direction of Bridge, Fixed in Position in Transverse Direction of Bridge
Under No Live Load	V	NO EQ.	214 Tonnes	214 Tonnes
		EQ.	242 Tonnes	242 Tonnes
	H_L	NO EQ.	11 Tonnes	11 Tonnes
		EQ.	128 Tonnes	12 Tonnes
	H_T	NO EQ.	0	0
		EQ.	58 Tonnes	58 Tonnes
	Θ	NO EQ.	Negligible	Negligible
		EQ.	Negligible	Negligible
	Δ		-	80 mm
Under Maximum Live Load	V	NO EQ.	286 Tonnes	286 Tonnes
		EQ.	347 Tonnes	347 Tonnes
	H_L	NO EQ.	20 Tonnes	15 Tonnes
		EQ.	141 Tonnes	21 Tonnes
	H_T	NO EQ.	0	0
		EQ.	71 Tonnes	71 Tonnes
	Θ	NO EQ.	Negligible	Negligible
		EQ.	Negligible	Negligible
	Δ		-	80 mm

NOTES:

i) Here the Deck being a "Slab-&-Two-Web" type, the case of 'Minimum Live Load' clearly falls in between 'Max Live Load' and 'No Live Load' cases and hence is not given.

ii) At POT-PTFE Free Bearings assumed value for μ=0.05 (Ref. IRC:6-2014, Cl.211.5.1.1)

"V" = Vertical Load
"H_L" = Longitudinal Horizontal Force
"H_T" = Transverse Horizontal Force
"Θ" = Rotation About Bridge Transverse Axis
"Δ" = Longitudinal Movement
"EQ." = Earthquake

ASPHALTIC WEARING COURSE

This shall be Provided between Road-Side faces of Road-Kerbs, its thickness: 75 mm at crown reducing linearly to 50 mm at Road-Side faces of Road-Kerbs.

NOTES:

1. All dimensions are in millimeters, unless stated otherwise.
2. No dimension shall be scaled from the Drawings, only written dimensions shall be followed.
3. This drawing shall be read in conjunction with Drgs. No: 1/12 to 11/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS span.

GOVERNMENT OF NEPAL
MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT
DEPARTMENT OF ROADS, BRIDGE BRANCH

STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES

Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	**Overall Deck Width 11.00 m**
Effective Simply Supported Span (center to center of Bearings): **40.0 m** Prestressed Concrete Deck (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : **12/12 of 2-Webbed PSC-Slab-Deck cis 40.0 m-SS Span**

Drg. TITLE : **ADDITIONAL DETAILS**

Designed by : Naresh P. Keshari, Engineer, DoR	***Mentored by :*** Dr. V.K. Raina, Bridge Techl Expert, DoR/World Bank	***Date :*** May 14, 2015
Drawn by : Bicky G. Shakha	***Accepted by :*** Saroj K. Pradhan (DDG, DoR)	***Revision :***
Checked by : Pradeep Bhandari, Engineer, DoR	***Approved by :*** Madhab K. Karki (DG, DoR)	

Madhab Kumar Karki