



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

STANDARD SUPERSTRUCTURE DRAWINGS FOR ROAD BRIDGES

- ***20.0m Simply Supported Span,
RC Deck with Precast RC Beams***



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Published by:
The Bridge Branch on behalf of Government of Nepal
Ministry of Physical Infrastructure and Transport

Copies can be purchased from:
The Bridge Branch
Department of Roads
Kathmandu, Nepal

PRICE: Rs. /-

REFERENCE 'NOTES'

- The NOTES given in Drgs. No. "1/10 to 4/10 of RC Deck with Precast RC Beams 20.0 m-SS Span" are applicable for the Superstructure covered by Drgs. No: 5/10 to 10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span, and MUST be followed strictly:
- The above referred NOTES are in addition to the NOTES given in the said Drgs. No: 5/10 to 10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- All dimensions are in millimeters, unless stated otherwise.
- No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
- Any doubtful Dimensions/Descriptions shall be brought to the attention of the Engineer-in-charge for any corrections (if any) before execution of work.
- Number of reinforcement bars shall not be counted from the Drawings. Only given spacing and/or specified numbers of bars, shall be provided.
- 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, in that order.
- 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/m² 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.
- 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. CEMENT

- 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.
- Cement shall be obtained from approved Manufacturers only.
- Cement content in the Concrete Mix for Reinforced Concrete shall not be less than 350 kg/m³ and not more than 450 kg/m³.

11. COARSE AND FINE AGGREGATES:

- 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).
- 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).

12. ADDITIVES:

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.

13. REINFORCEMENT:

- 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.
- 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).
- Not more than 50 percent of reinforcement crossing a section shall be lapped at that location.
- All laps in reinforcement shall be properly staggered and minimum distance between the laps shall be 1.33 times the lap length.
- Bending of reinforcement bars shall be as per IS 2502.
- 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'

14. WATER:

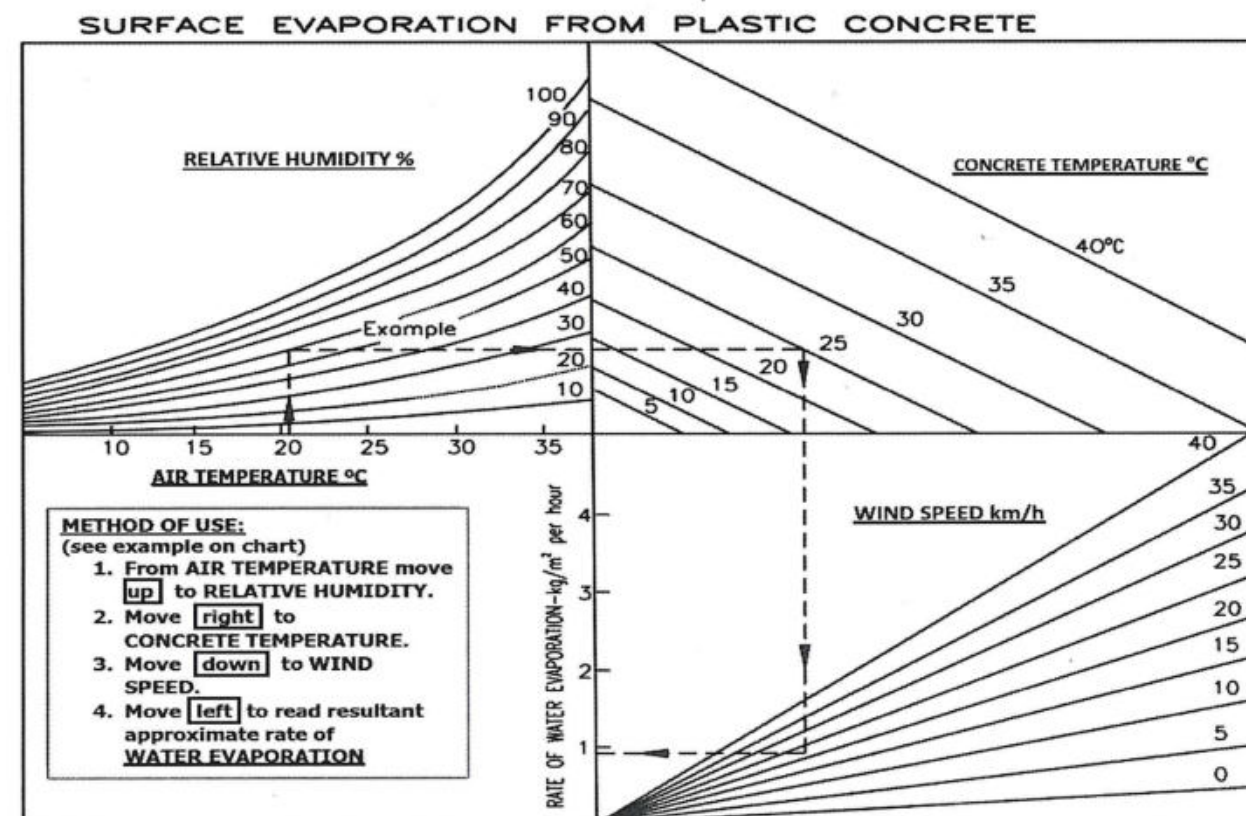
Water for concrete and for its curing shall be of potable quality and presence of any salts, sugars and pollutants like chlorides, sulphates, algae, etc., shall be well within their limits specified in the relevant Specifications.

15. CONCRETE AND CONCRETING:

- WATER-CEMENT RATIO, by weight, shall not exceed 0.40 for Reinforced concrete.
- MINIMUM CLEAR CONCRETE COVER to reinforcement bars shall be 40mm.
- CONTROL OF SURFACE EVAPORATION

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



- 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.
- Install stationary Fog Sprayers upwind of the concreting operation to effectively increase the relative humidity in the area of concrete placement.
- 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 the Precast r.c. beams and the cast in situ (cis) Reinforced Concrete Deck Slab and Cross Girders	35 MPa (i.e. M-35 Grade Concrete)
• for the Reinforced Concrete in- – Precast Footpath Slabs – Parapet Posts and their Bases – Road Kerbs	35 MPa (i.e. M-35 Grade Concrete)

v. CONSTRUCTION JOINTS:

- 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.
- 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.

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

vi. COLD JOINTS:

- 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.
- 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).

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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 (center to center of Bearings) : 20.0 m RC Deck with Precast RC Beams (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading
Drg. No.: 1/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	

Drg. TITLE: REFERENCE NOTES (4 Sheets): Sheet 1/4

Designed by: Amit K. Varna Engineer, DoR	Mentored by: Dr. V. K. Raina Bridge Techl Expert, DoR/ World Bank	Date: July 14, 2015
Drawn by: Prabina Joshi	Accepted By: Saroj K. Pradhan (DDG, DoR)	Revisions:
Checked by: Naresh P. Keshari Engineer, DoR	Approved by: Madhab K. Karki (DG, DoR)	

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-admixed concrete and by about 120 to 180 minutes of placement of admixed 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.

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.

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- 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 monolithicity (.....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.
- 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".

....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 (center to center of Bearings) : 20.0 m RC Deck with Precast RC Beams (no SKEW)		LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading	
Drg. No.: 3/10 of RC Deck with Precast RC Beams 20.0 m-SS Span			
Drg. TITLE: REFERENCE NOTES (4 Sheets): Sheet 3/4			
Designed by: Amit K. Varna Engineer, DoR	Mentored by: Dr. V. K. Raina Bridge Techl Expert, DoR/ World Bank	Date: July 14, 2015	
Drawn by: Prabina Joshi	Accepted By: Saroj K. Pradhan (DDG, DoR)	Revisions:	
Checked by: Naresh P. Keshari Engineer, DoR	Approved by: Madhab K. Karki (DG, DoR)		

- 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.

16. CONSTRUCTION SEQUENCE:

- Each precast (p/c) reinforced concrete (r.c.) beam shall be cast in a pre-casting yard. (The pre-casting yard shall be located either on the river-bank near one of the Abutments or at a strategically located centralised pre-casting yard.)
- Adequately cure each p/c r.c. beam for not less than 14 days (and nights) (beginning immediately after 'initial' setting of concrete) on its casting bed. When "the minimum works cube crushing strength of concrete in it" reaches 280 kg/cm², it may be lifted carefully (using its two Lifting Hooks placed near its two ends, as generally shown in Drg. No: "10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span") without causing any jerks and sudden movements, and placed in the stacking yard (storage area).
- When at least 21 days old, these p/c r.c. beams (two outer beams and one central beam in each span) shall only then be lifted, one by one, carefully and gradually, and placed in their final positions in a span, on their Bearings.
- Adequately designed, supporting Structural Steel Stanchions shall then be raised under each beam (tightly touching their soffits) at one-third Span locations, as generally indicated in Drg. No: "10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span". Each of the two supporting stanchions under each of the three p/c r.c. beams in a span (six Stanchions in all in a span) shall be adequately designed (by the Contractor) for safety and stability for the axial downward load specified in Drg. No: "10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span". These supporting Stanchions shall be positively "engaged" tight with the beams by adequately hammering-in the Steel Wedge Plates indicated in Drg. No: "10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span". The wedge plates shall be thoroughly tightened to positively support the beams but only just, taking care that the beams do not get lifted but are only positively supported. The idea is to make each simply supported beam to behave now like a "3-Span Continuous beam" until after item vi. below. Also, Cross-brace all the six Stanchions in a span - both longitudinally as well as transversely for overall stability.
- Now erect the Shuttering for casting the Cross-girders and the Deck-slab. Tie the reinforcement for the Cross-girders and the Deck-slab and cast their concrete. The weights of this Shuttering and of the wet concrete just poured in the Span for the Cross-girders and the Deck-slab, is coming only on the three naked p/c r.c. beams and the Stanchions under each p/c r.c. beam, each naked beam behaving like a "3-Span Continuous naked beam", causing corresponding Reactions in the Stanchions and the Bearings under them.
- Adequately cure the "just cast" Deck-slab and Cross-girders for not less than 14 consecutive days (and nights). When "the minimum works cube crushing strength of concrete in the Deck-slab and Cross-girders reaches 300 kg/cm² and it is not less than 21-days old, carefully dismantle the Stanchions now, one by one. WITH THIS DONE, the statical status of the Deck is now "Composite" (comprising 3 p/c r.c. beams acting in unison with the cast-in-situ (cis) Deck-slab and Cross-girders), all working together as "one composite" section, on a simply supported span between centers of Bearings.
- Removal of the supporting Stanchions at this stage is equivalent to applying the Reactions (that were coming on them) in downward direction on the simply-supported Composite Deck, their Moments, Shears, etc., acting on higher section properties of the fully composite Deck

section, not on the smaller naked beam sections. This methodology reduces the stresses in concrete and reinforcement significantly compared with "if no Stanchions were used", and hence leads to considerable economy in quantities.

- Now the Super-imposed Dead Loads (i.e. Road Kerbs, Railing Posts, Railings, p/c foot-path slabs, Expansion Joints, Wearing Course and the Utilities) can be laid. After this the Deck is ready for service.

CAUTION: After the Deck has been in service for about 90 days, in the case of NEOPRENE BEARINGS follow NOTE NO: 17.ix. given below.

17. BEARINGS

- NEOPRENE BEARINGS shall be used. Their Material specifications, Design, Acceptance Criteria and Installation shall be generally in accordance with IRC: 83 part 2, the AASHTO Design Specifications, and Sound Engineering Practice.
- The Bearings shall be obtained from approved and experienced Manufacturers.
- Installation of Bearings shall be carried out under the expert supervision of the Manufacturer's Technical Representative.
- The Design of Bearings shall be based on the Design Loads, Rotations, etc., given in the appropriate Table in the attached relevant Drawing.
- Detailed Shop Drawings shall be prepared by the Manufacturer, which shall be checked and duly approved before the Bearings are manufactured and installed.
- Neoprene Bearings shall be bonded to their r.c. pedestals by appropriate Epoxy Adhesive. (The Grout/Bedding Mortar, where used, shall be high strength free flowing Non Shrink Type.)
- 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.
- In case the contractor wishes to change the type of Bearings from Neoprene to POT Bearings (POT Fixed and POT-PTFE Free), then the magnitudes of Vertical loads, Horizontal forces and movements, etc. tabulated in Drg. No: "10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span" will all change and the same will then have to be re-worked out and the design of POT-Bearings done accordingly. The Substructure and Foundations shall then be designed according to the correctly re-worked out Loads, Forces and Movements, etc.
- IMPORTANT NOTE:**
 - After the Superstructure in a span has been constructed and is about three months old, each end of that Superstructure, (one end at a time) shall be momentarily 'lifted up by about 6 mm' carefully and gradually (using appropriate capacity Lifting Jacks - preferably the Freyssi Flat Jacks with their Saucer Plates placed under the end-cross-girder at that end at locations shown in the attached relevant Drawing) and quickly but gradually lowered back on to its Neoprene Bearings. (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).
 - Each of these Lifting Jacks shall have a safe lifting capacity of at least 100 Tonnes.
 - All Jacks must be operated simultaneously, equally, gradually and in unison.
 - Because of such "momentary lifting-up and then lowering-back the Deck", the Neoprene Bearings spring back and hence need to be designed only for the residual Deformations that will be caused in them after the superstructure is already 3 months old. This reduces the

cost of these Bearings and helps economise on the size of Neoprene Bearings.

- Pier Caps and Abutment Caps MUST also be structurally adequately designed for the Reactions from the said Lifting Jacks, transmitted at their designated locations.
- 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.
- ALL Bearings in a span shall be placed in their final and correct positions (as per details shown in the attached relevant Drawing) over the R.C. Pedestals before placing the Precast Beams in that span.

18. EXPANSION-CONTRACTION JOINTS

- These Movement Joints shall be provided in the deck as Specified and shown in attached relevant Drawing.

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

Drg. No:	'TITLE' of DRAWING
1/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	REFERENCE NOTES (4 Sheets): Sheet 1/4
2/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	REFERENCE NOTES (4 Sheets): Sheet 2/4
3/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	REFERENCE NOTES (4 Sheets): Sheet 3/4
4/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	REFERENCE NOTES (4 Sheets): Sheet 4/4
5/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	GENERAL ARRANGEMENT DRAWING AND DIMENSIONS
6/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	REINFORCEMENT DETAILS OF DECK SLAB, CROSS GIRDERS, PRECAST R.C. FOOTPATH SLAB, ROAD KERB, PARAPET POST AND ITS BASE
7/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	REINFORCEMENT DETAILS OF LONGITUDINAL PRECAST BEAM OUTER BEAM
8/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	REINFORCEMENT DETAILS OF LONGITUDINAL PRECAST BEAM CENTRAL BEAM
9/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	BAR BENDING SCHEDULE
10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span	ADDITIONAL DETAILS

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.

- 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.

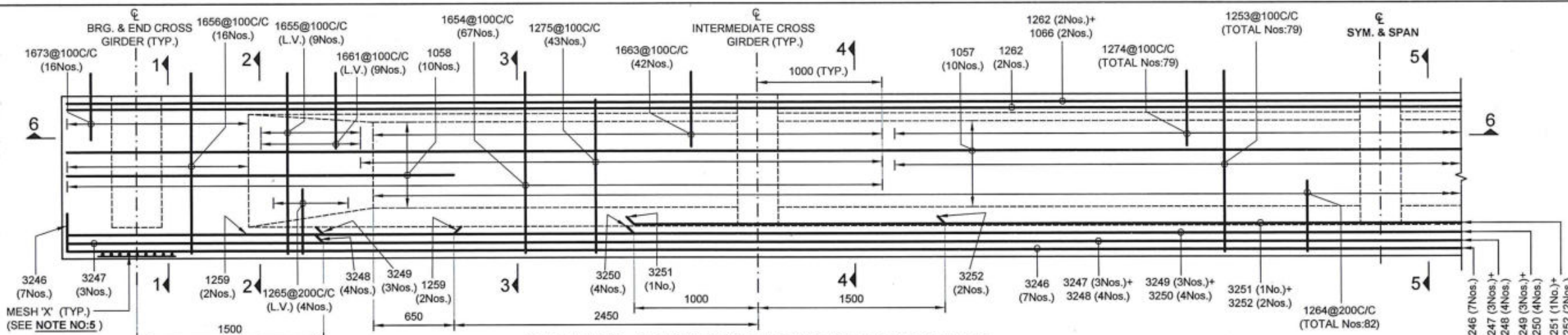
19. WEARING COARSE

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

20. EARTHQUAKE EFFECTS

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

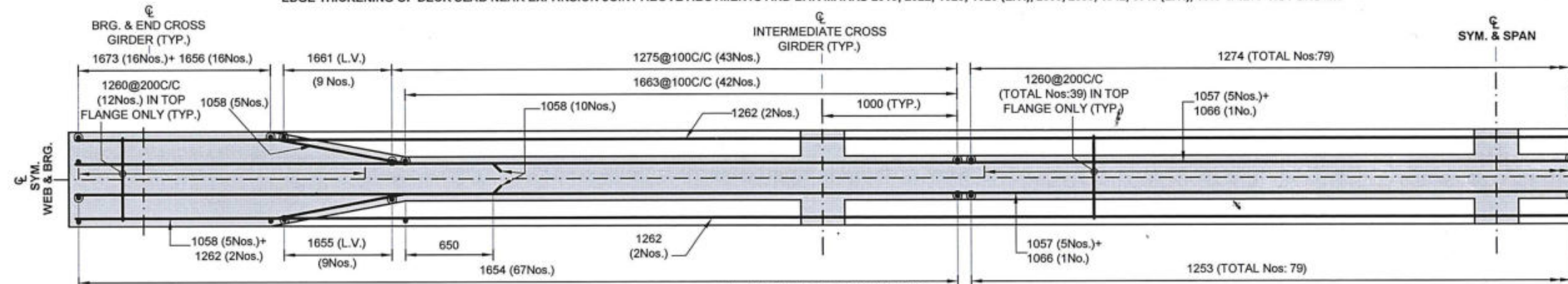
GOVERNMENT OF NEPAL MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT DEPARTMENT OF ROADS, BRIDGE BRANCH		
STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES		
Road Carriageway Width: 7.50m. plus 2 Footpaths each 1.50 m. wide	Overall Deck Width: 11.00 m	
Effective Simply Supported Span (center to center of Bearings) : 20.0 m RC Deck with Precast RC Beams (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs, and Footpath Loading	
Drg. No.: 4/10 of RC Deck with Precast RC Beams 20.0 m-SS Span		
Drg. TITLE: REFERENCE NOTES (4 Sheets): Sheet 4/4		
Designed by: Amit K. Varma Engineer, DoR	Mentored by: Dr. V. K. Raina Bridge Techl Expert, DoR World Bank	Date: July 14, 2015
Drawn by: Prabina Joshi	Accepted By: Saroj K. Pradhan (DDG, DoR)	Revisions:
Checked by: Naresh P. Keshari Engineer, DoR	Approved by: Madhab K. Karki (DG, DoR)	



SECTIONAL ELEVATION OF OUTER PRECAST BEAM

SHOWING ONLY PRECAST BEAM REINFORCEMENT

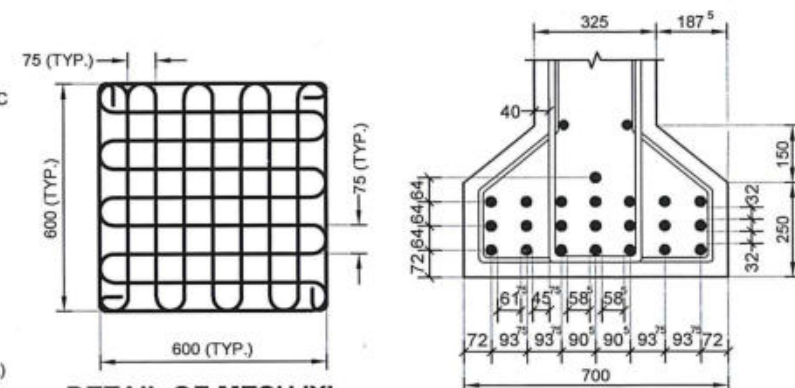
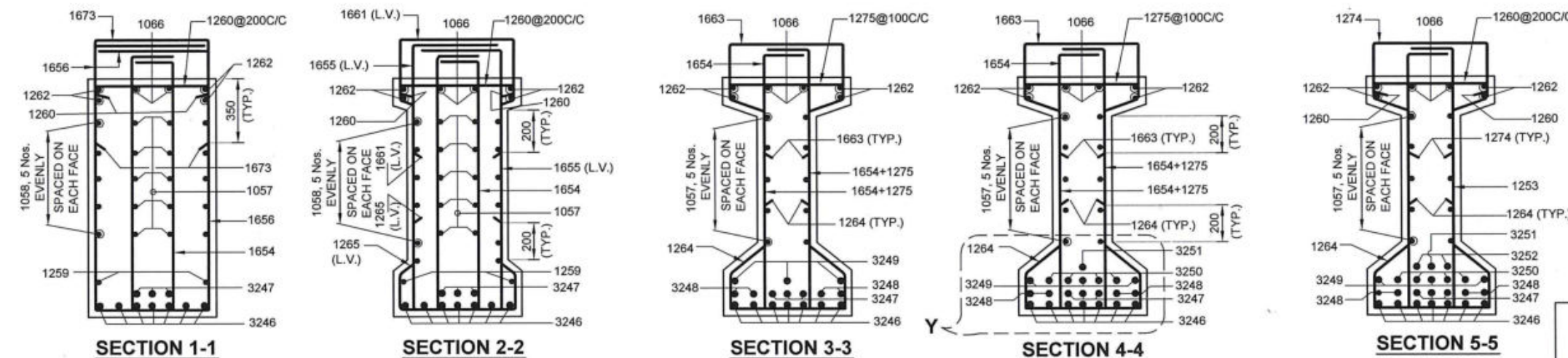
EDGE THICKENING OF DECK SLAB NEAR EXPANSION JOINT ABOVE ABUTMENTS AND BAR MARKS 2019, 2022, 1028, 1029 (L.V.), 2033, 2036, 1042, 1043 (L.V.), 1667 & 1260 NOT SHOWN



PLAN AT SECTION 6-6

LONGITUDINAL MAIN REINFORCEMENT OF BEAM AND BAR MARKS 2019, 2022, 1028, 1029 (L.V.), 2033, 2036, 1042, 1043 (L.V.) & 1667 NOT SHOWN

BAR MARKS 1260, 1275, 1274, 1663, 1661 (L.V.) & 1673 SHALL BE SUITABLY BUT VERY SLIGHTLY STAGGERED WITH RESPECT TO BAR MARKS 1253, 1654, 1656 & 1655 (L.V.) TO AVOID CONGESTION

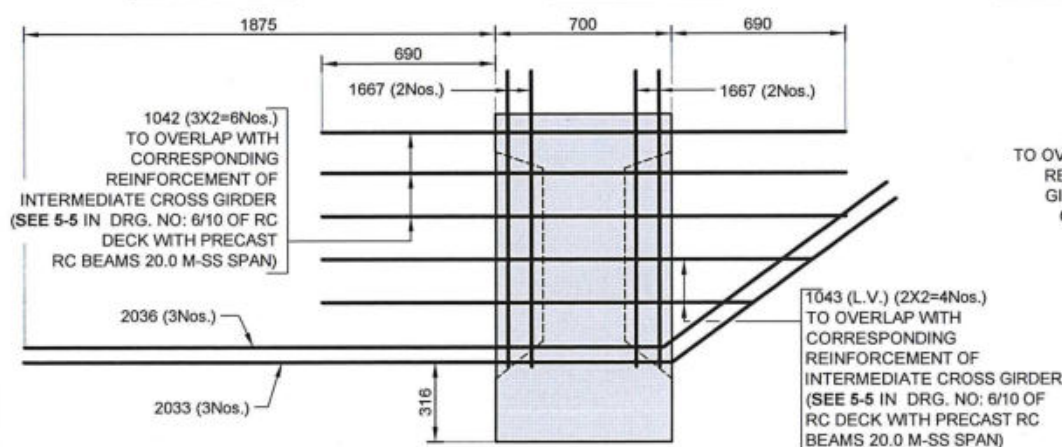


DETAIL OF MESH 'X'

(SEE NOTE NO: 5)

BAR DIA. 10MM (TYP.)

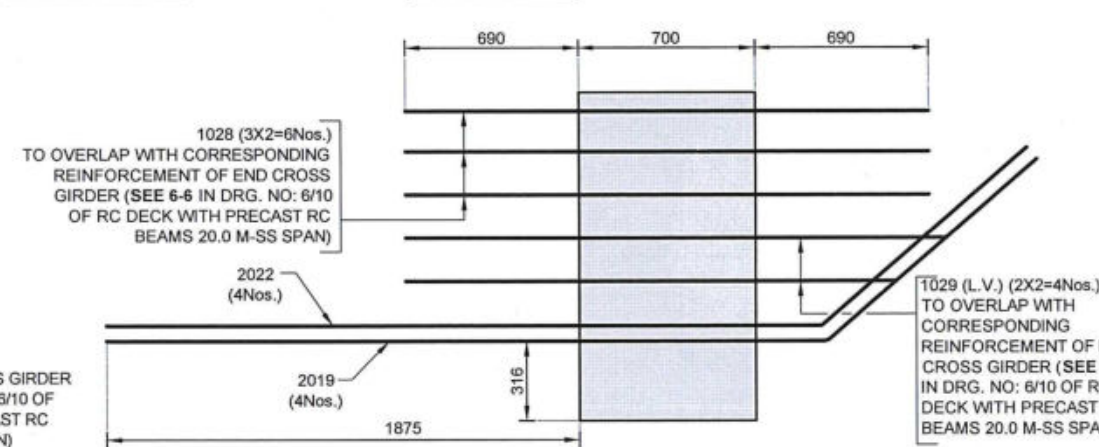
DETAIL 'Y'



REINFORCEMENT DOWELLING OUT OF STIFFENERS OF PRECAST BEAM

(AT INTERMEDIATE CROSS GIRDER LOCATIONS) (TYP.)

LONGITUDINAL MAIN REINFORCEMENT OF BEAM NOT SHOWN



REINFORCEMENT DOWELLING OUT OF PRECAST BEAM

AT END CROSS GIRDER LOCATIONS (TYP.)

(TO OVERLAP WITH CORRESPONDING REINFORCEMENT OF END CROSS GIRDER)

LONGITUDINAL MAIN REINFORCEMENT OF BEAM NOT SHOWN

NOTES:

- All dimensions are in millimeters, unless stated otherwise.
- No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
- This drawing shall be read in conjunction with Drgs. No: 1/10 to 6/10, 8/10 to 10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- 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 65 times dia.) such lap lengths have not been accounted for in the bar bending schedule shown in Drg. No: 9/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- Mesh 'X' shall be provided in each Precast Beam (above the 'Bearing locations') as shown.
- Bars dowelling out of Precast Beams for overlapping with corresponding reinforcement of Intermediate and End Cross Girders of the Deck may be temporarily bent up suitably (using GI Pipe) for convenience of handling. These shall be bent back to suit their overlapping with corresponding bars in the Cross Girders at the time of casting the Cross Girders.
- Necessary Spacer bars between main reinforcement bars shall be provided for supporting and ensuring correct spacing of main reinforcement bars.
- For Construction Sequence refer to **NOTE NO: 16** in Drg. No: 4/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- In each Outer Beam:
 - Bar Mark 1260 (2x12+39=) 63 Nos. thus
 - Bar Mark 1275 (2x43=) 86 Nos. thus

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): 20.0 m
RC Deck with Precast RC Beams (no SKEW)

LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : 7/10 of RC Deck with Precast RC Beams 20.0 m-SS Span

Drg. TITLE : REINFORCEMENT DETAILS OF LONGITUDINAL PRECAST BEAM
OUTER BEAM

Designed by :
Amit K. Varma
Engineer, DoR

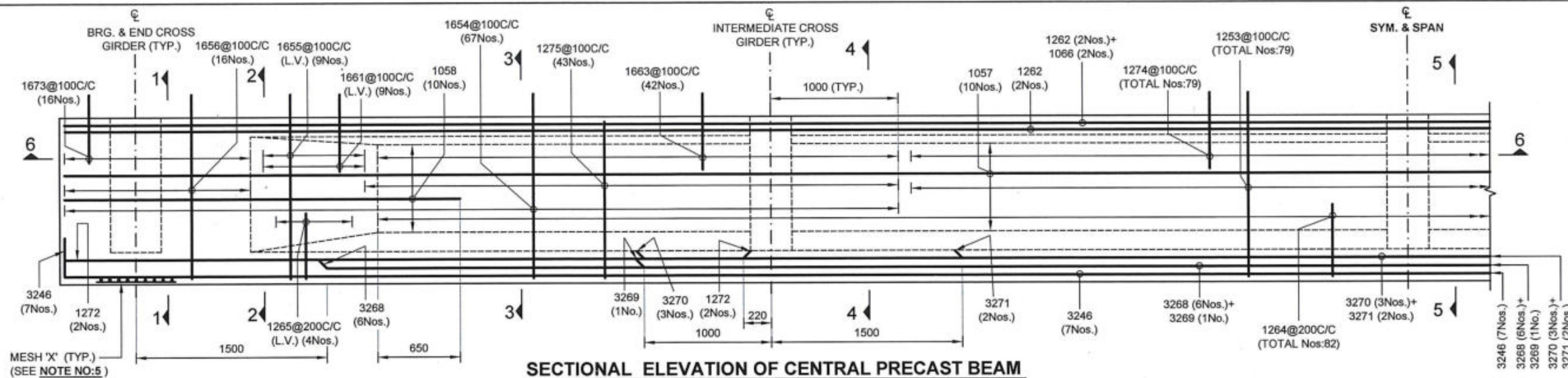
Mentored by :
Dr. V.K. Raina
Bridge Techl Expert, DoR
Date: July 14, 2015

Drawn by :
Prabina Joshi

Accepted by :
Saroj K. Pradhan
(DDG, DoR)

Checked by :
Naresh P. Keshari
Engineer, DoR

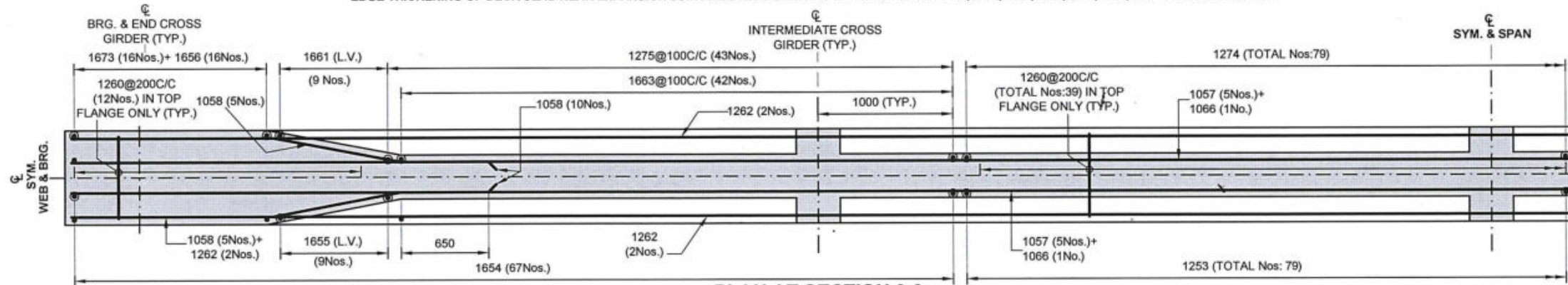
Approved by :
Madhab K. Karki
(DG, DoR)



SECTIONAL ELEVATION OF CENTRAL PRECAST BEAM

SHOWING ONLY PRECAST BEAM REINFORCEMENT

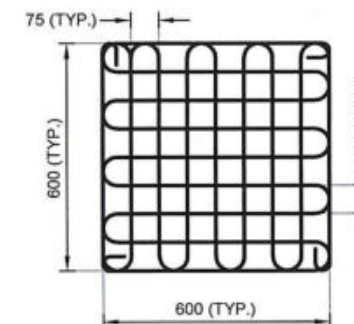
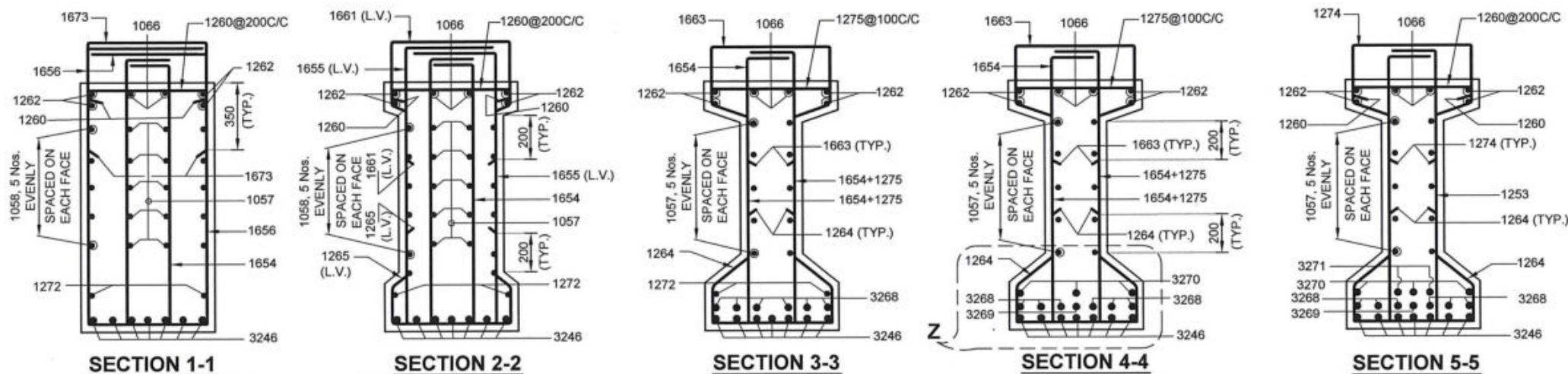
EDGE THICKENING OF DECK SLAB NEAR EXPANSION JOINT ABOVE ABUTMENTS AND BAR MARKS 2018, 2021, 1028, 2032, 2035, 1042, 1667 & 1260 NOT SHOWN



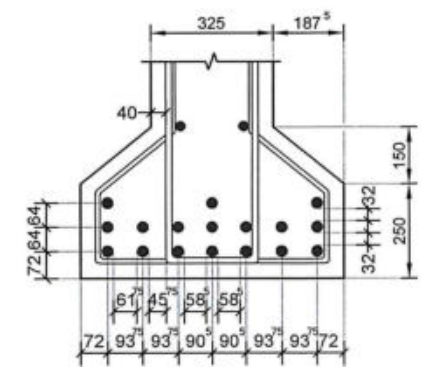
PLAN AT SECTION 6-6

LONGITUDINAL MAIN REINFORCEMENT OF BEAM AND BAR MARKS 2018, 2021, 1028, 1042, 2032, 2035 & 1667 NOT SHOWN

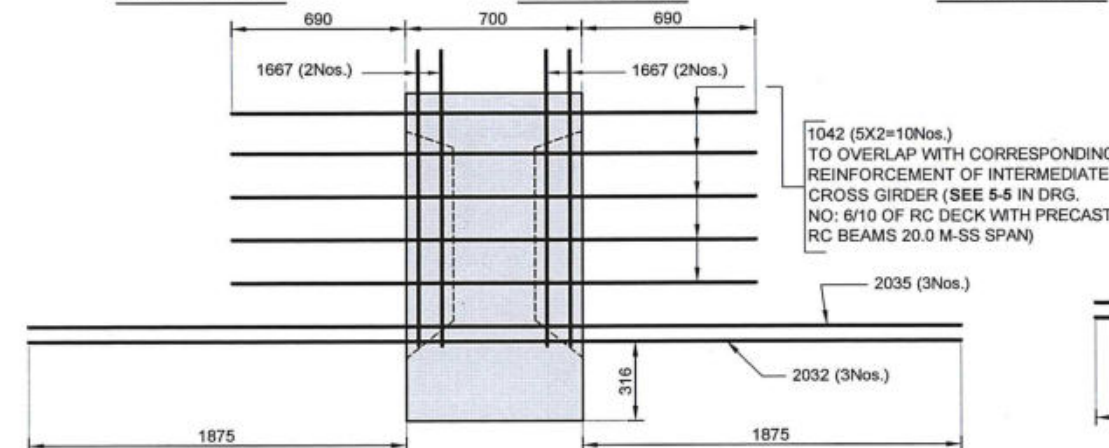
BAR MARKS 1260, 1275, 1274, 1663, 1661 (L.V.) & 1673 SHALL BE SUITABLY BUT VERY SLIGHTLY STAGGERED WITH RESPECT TO BAR MARKS 1253, 1654, 1656 & 1655 (L.V.) TO AVOID CONGESTION



DETAIL OF MESH 'X'
(SEE NOTE NO: 5)
BAR DIA. 10MM (TYP.)

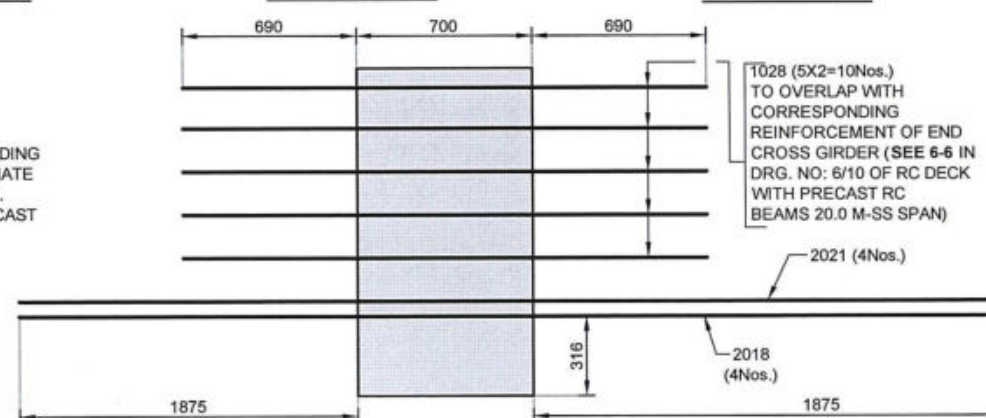


DETAIL 'Z'



**REINFORCEMENT DOWELLING OUT OF STIFFENERS OF PRECAST BEAM
(AT INTERMEDIATE CROSS GIRDER LOCATIONS) (TYP.)**

LONGITUDINAL MAIN REINFORCEMENT OF BEAM NOT SHOWN



**REINFORCEMENT DOWELLING OUT OF PRECAST BEAM
AT END CROSS GIRDER LOCATIONS (TYP.)**

(TO OVERLAP WITH CORRESPONDING REINFORCEMENT OF END CROSS GIRDER)
LONGITUDINAL MAIN REINFORCEMENT OF BEAM NOT SHOWN

NOTES:

- All dimensions are in millimeters, unless stated otherwise.
- No dimension shall be scaled from the Drawings; only written dimensions shall be followed.
- This drawing shall be read in conjunction with Drgs. No: 1/10 to 7/10, 9/10 to 10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- 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 65 times dia.) such lap lengths have not been accounted for in the bar bending schedule shown in Drg. No: 9/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- Mesh 'X' shall be provided in each Precast Beam (above the 'Bearing locations') as shown.
- Bars dowelling out of Precast Beams for overlapping with corresponding reinforcement of Intermediate and End Cross Girders of the Deck may be temporarily bent up suitably (using GI Pipe) for convenience of handling. These shall be bent back to suit their overlapping with corresponding bars in the Cross Girders at the time of casting the Cross Girders.
- Necessary Spacer bars between main reinforcement bars shall be provided for supporting and ensuring correct spacing of main reinforcement bars.
- For Construction Sequence refer to **NOTE NO: 16** in Drg. No: 4/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- In Central Beam:
 - Bar Mark 1260 (2x12+39=) 63 Nos. thus
 - Bar Mark 1275 (2x43=) 86 Nos. thus



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): 20.0 m RC Deck with Precast RC Beams (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : 8/10 of RC Deck with Precast RC Beams 20.0 m-SS Span

Drg. TITLE : REINFORCEMENT DETAILS OF LONGITUDINAL PRECAST BEAM

CENTRAL BEAM

Designed by : Amit K. Varma Engineer, DoR	Mentored by : Dr. V.K. Raina Bridge Techl Expert, DoR/World Bank	Date : July 14, 2015
Drawn by : Prabina Joshi	Accepted by : Saroj K. Pradhan (DDG, DoR)	Revision :
Checked by : Naresh P. Keshari Engineer, DoR	Approved by : Madhab K. Karki (DG, DoR)	

CIS RC DECK, RAILING POSTS & ITS BASES, PRECAST RC FOOTPATH SLABS, ROAD KERBS, INTERMEDIATE AND END CROSS GIRDERS							
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	107	1187.70	1876.86
2	1077		10	11100	106	1176.60	726.30
3	1602		16	6500	106	689.00	1088.79
4	1078		10	11100	107	1187.70	733.15
5	1003		10	21120	74	1562.88	964.74
6	1004		10	21120	74	1562.88	964.74
7	1076		10	6720	18	120.96	74.67
8	1605		16	2245	52	116.74	184.48
9	1606		16	2245	52	116.74	184.48
10	0607		6	570	208	118.56	26.35
11	1008		10	21120	12	253.44	156.44
12	1009		10	1420	284	403.28	248.94
13	1010		10	1300	504	655.20	404.44
14	1011		10	1300	180	234.00	144.44
15	0812		8	1300	168	218.40	86.28
16	0613		6	3540	156	552.24	122.72
17	0614		6	3540	156	552.24	122.72
18	0615		6	1300	432	561.60	124.80
19	1016		10	1605	284	455.82	281.37
20	1017		10	21120	12	253.44	156.44
21	2020		20	2310	16	36.96	91.26
22	2023		20	2200	16	35.20	86.91
23	2024		20	10920	8	87.36	215.70
24	2025		20	10920	8	87.36	215.70
25	1626		16	3240	80	259.20	409.60
26	1627 (L.V.)		16	---	40	87.60	138.43
27	1030		10	2370	40	94.80	58.52
28	1031 (L.V.)		10	---	24	34.92	21.56
29	2034		20	2260	18	40.68	100.44
30	2037		20	2140	18	38.52	95.11
31	2038		20	10920	9	98.28	242.67
32	2039		20	10920	9	98.28	242.67
33	1640		16	3015	78	235.17	371.63

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)
34	1641 (L.V.)		16	---	60	120.90	191.05
35	1044		10	2370	60	142.20	87.78
36	1045 (L.V.)		10	---	36	49.32	30.44

PRECAST RC BEAMS (OUTER AND CENTRAL BEAMS), INTERMEDIATE STIFFENERS AND BARS DOWELLING OUT OF PRECAST BEAMS NEAR ITS ENDS							
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)
37	3246		32	21680	21	455.28	2877.82
38	3247		32	21120	6	126.72	801.00
39	3248		32	17000	8	136.00	859.65
40	3249		32	17000	6	102.00	644.74
41	3250		32	12000	8	96.00	606.81
42	3251		32	12000	2	24.00	151.70
43	3252		32	7000	4	28.00	176.99
44	1253		12	3515	237	833.06	740.49
45	1654		16	3527	402	1417.85	2240.56
46	1655 (L.V.)		16	---	54	219.78	347.31
47	1656		16	4640	96	445.44	703.91
48	1057		10	21120	30	633.60	391.11
49	1058		10	3130	60	187.80	115.93
50	1259		12	3110	8	24.88	22.12
51	1260		12	700	189	132.30	117.60
52	1275		12	3200	258	825.60	733.87
53	1661 (L.V.)		16	---	54	95.04	150.19
54	1262		12	21120	12	253.44	225.28
55	1663		16	1960	252	493.92	780.52
56	1673		16	1640	96	157.44	248.79
57	1274		12	1960	237	464.52	412.91
58	1264		12	1840	246	452.64	402.35
59	1265 (L.V.)		12	---	24	38.64	34.35
60	1066		10	21120	6	126.72	78.22
61	1667		16	3015	36	108.54	171.52
62	3268		32	17000	6	102.00	644.74

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)
63	3269		32	12000	1	12.00	75.85
64	3270		32	12000	3	36.00	227.56
65	3271		32	7000	2	14.00	88.49
66	1272		12	5340	4	21.36	18.99
67	2018		20	4450	8	35.60	87.90
68	2019		20	3955	16	63.28	156.25
69	2021		20	4450	8	35.60	87.90
70	2022		20	3935	16	62.96	155.46
71	1028		10	2080	44	91.52	56.49
72	1029 (L.V.)		10	---	16	35.44	21.88
73	2032		20	4450	9	40.05	98.89
74	2033		20	3910	18	70.38	173.78
75	2035		20	4450	9	40.05	98.89
76	2036		20	3890	18	70.02	172.89
77	1042		10	2080	66	137.28	84.74
78	1043 (L.V.)		10	---	24	48.24	29.78
79	MESH 'X'		10	5887 (2 such)	6 MESHES	70.64	43.61

NOTES:

- All dimensions are in millimeters, unless stated otherwise.
- No dimensions shall be scaled; only written dimensions shall be followed.
- This drawing shall be read in conjunction with Drgs. No: 1/10 to 8/10 of RC Deck with Precast RC Beams 20.0 m-SS Span.
- Dimensions, Reinforcement Bars and Quantities shown pertain to Superstructure in one Span of 21200 mm overall Deck Length
- 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 65 Ø), Such lap lengths and Spacer Bars have not been accounted for in the bar bending schedule shown here.
- 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.
- L.V. = Bar "Length Varies"
- Length of a Bar as shown is along its centerline.

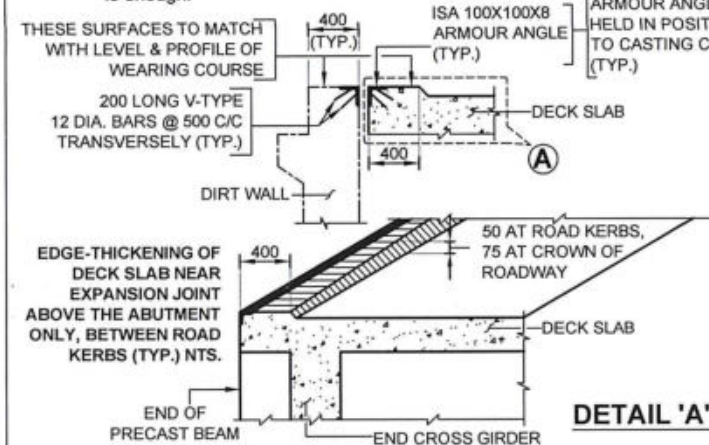
GOVERNMENT OF NEPAL MINISTRY OF PHYSICAL INFRASTRUCTURE AND TRANSPORT DEPARTMENT OF ROADS, <u>BRIDGE BRANCH</u>		
STANDARD SUPERSTRUCTURE DRAWING FOR ROAD BRIDGES		
Road Carriageway Width: 7.50m plus 2 Footpaths each 1.50 m wide	Overall Deck Width 11.00 m	
Effective Simply Supported span (center to center of Bearings): 20.0 m RC Deck with Precast RC Beams (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading	
Drg. No : 9/10 of R.C. Deck with Precast RC Beams 20.0 m-SS Span		
Drg. TITLE : BAR BENDING SCHEDULE		
Designed by : Amit K. Varma Engineer, DoR	Mentored by : Dr. V.K. Raina Bridge Techl Expert, DoR/World Bank	Date : July 14, 2015
Drawn by : Prabina Joshi	Accepted by : Saroj K. Pradhan (DDG, DoR)	Revision :
Checked by : Naresh P. Keshari Engineer, DoR	Approved by : Madhab K. Karki (DG, DoR)	

EXPANSION JOINT

- (i) Expansion movement of Superstructure at its each end (Neoprene Bearings at each end being identical)
- due to total Temperature Rise/Fall of $45^{\circ}\text{C} = \pm 6 \text{ mm}$
 - due to Residual Shrinkage of concrete after 90 days of casting Deck Slab = -1.75 mm
- (ii) Assuming Expansion Joints are installed after not less than 90 days of casting Deck Slab, then:
- total expansive movement at each end of Span = $6-1.75 = 4.25 \text{ mm}$
say 5 mm
 - &
 - total contraction movement at each end of Span = $-6-1.75 = -7.75 \text{ mm}$
say -8 mm

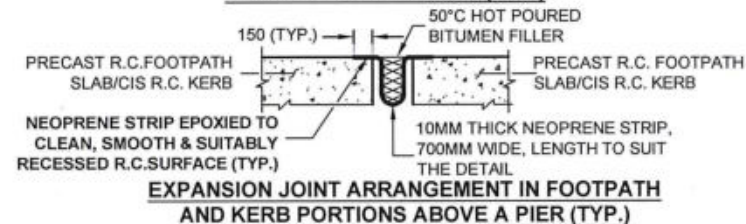
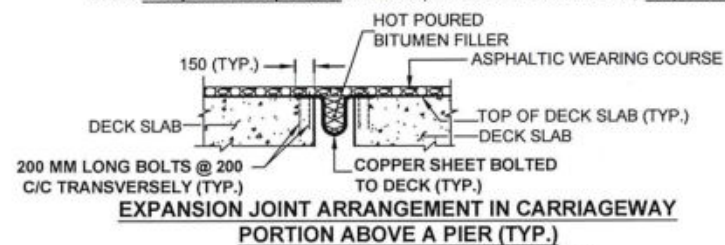
(iii) Hence Expansion Joint Arrangement above Abutment (TYP.):

- Provide 10 mm initial Gap between Dirt wall and End of Deck.
- This Gap can reduce to $(10-5) = 5 \text{ mm}$ and increase to $(10+8) = 18 \text{ mm}$
- Hence no Special Expansion Joint needed above Abutments, just strengthening of the facing edges of the Dirt wall and the Deck by ARMOUR ANGLES-as shown below is enough.



(iv) And Expansion Joint Arrangement above Pier (TYP.):

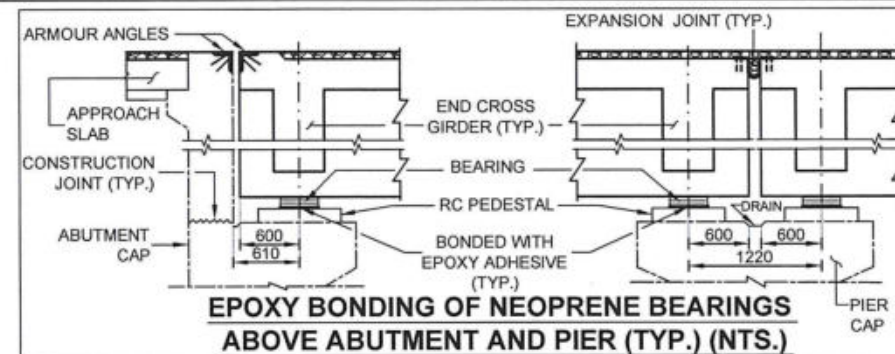
- Provide 20 mm initial Gap between the ends of the two Decks (facing each other) above a Pier.
- This gap can reduce to $(20-5-5) = 10 \text{ mm}$ and increase to $(20+8+8) = 36 \text{ mm}$.
- Hence provide following arrangement of Expansion Joint in the carriageway portion and in the Footpath+Kerb portions of the Superstructure above a Pier, respectively (TYP.):



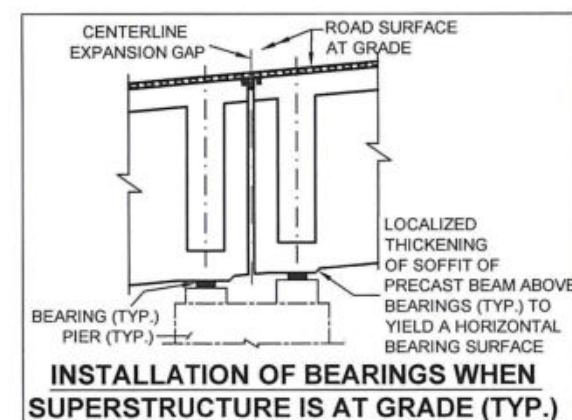
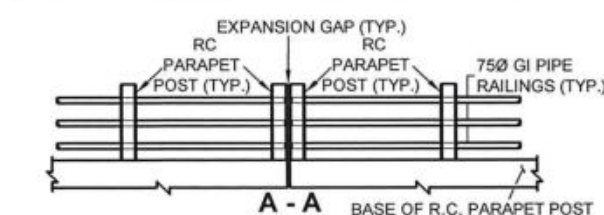
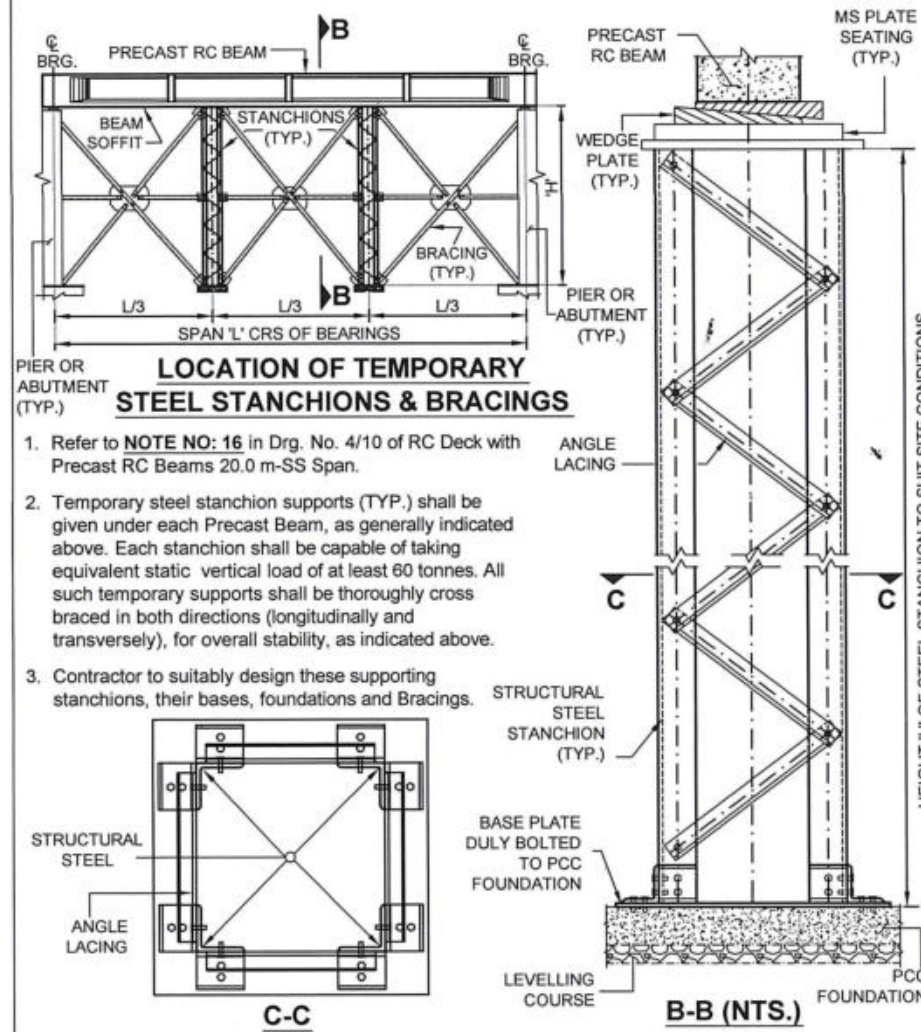
CAUTION: See NOTE NO: 3 (i) and 3 (ii) in this Drg.

APPROACH SLAB

- 3.5m long, 7.5m wide Approach Slab shall be provided behind each Abutment as generally shown in Drg. No: 5/10 of RC Deck with Precast RC Beams 20.0 m-SS Span. These shall be cast on fully compacted backfill over suitable PCC levelling course.
- Approach Slab shall be 300mm thick in M35 Grade concrete.
- Reinforcement at its Top and its Bottom, each, shall be 12mm dia. bars @ 150 c/c both ways.
- Suitable arrangement for Footpaths shall be provided on each side of an Approach Slab taking due account of connections to Utilities.
- Asphaltic Wearing Course shall be laid over the Approach slabs matching the level & profile of wearing course on the adjacent Bridge Deck.



TEMPORARY STEEL STANCHION SUPPORTS



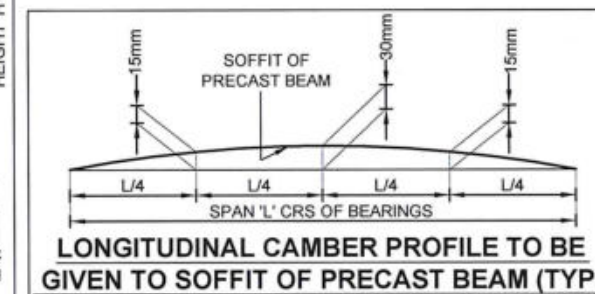
DATA FOR EACH NEOPRENE BEARING

Load Condition	Items	Under	On each Neoprene Bearing
Under No Live Load	V	NO EQ.	60 Tonnes**
		EQ.	76 Tonnes
	H _L	NO EQ.	*
		EQ.	15+* Tonnes
	H _T	NO EQ.	0
		EQ.	15 Tonnes
Under Maximum Live Load	θ	NO EQ.	0.00511 Radian
		EQ.	0.00546 Radian
	Δ		11 mm
	V	NO EQ.	115 Tonnes
		EQ.	139 Tonnes
	H _L	NO EQ.	6+* Tonnes
Under Minimum Live Load		EQ.	20+* Tonnes
	H _T	NO EQ.	0
		EQ.	17 Tonnes
	θ	NO EQ.	0.00672 Radian
		EQ.	0.00728 Radian
	Δ		11 mm
Under Minimum Live Load	V	NO EQ.	45 Tonnes
		EQ.	30 Tonnes
	H _L	NO EQ.	0.31+* Tonnes
		EQ.	14+* Tonnes
	H _T	NO EQ.	0
		EQ.	15 Tonnes
	θ	NO EQ.	0.00411 Radian
		EQ.	0.00385 Radian
	Δ		11 mm

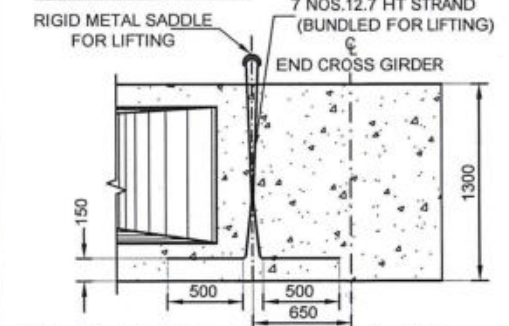
* equals 'Shear Rating of Brg. times Design Movement in it'

** One side placement of temporary SIDLs increases reaction per bearing due to reaction factor.

"V" = Vertical Load
 "H_L" = Longitudinal Horizontal Force
 "H_T" = Transverse Horizontal Force
 "θ" = Rotation About Bridge Transverse Axis
 "Δ" = Longitudinal Movement for Design purpose
 "EQ." = Earthquake
 NOTE: See NOTE NO. 5



LIFTING HOOKS



- Lifting Hook shall be provided at each end of the Precast Beam for lifting and placing it in position. (Just prior to casting the Deck Slab, these Hooks shall be cut flush with top of beam.)
- Each Lifting Hook comprises 7 Nos. monostrands each of 12.7mm dia. 7-ply low relaxation Class II High Tensile Strands bundled together.
- A Precast Beam may be lifted using High Tensile Steel Strand Lifting Hooks as shown. However, the Contractor may lift the Precast Beam using other but suitable alternative method. Lifting of the beam, from its two ends, by whichever method must be rehearsed at the site to ensure successful lifting and handling of the Precast Beam.

ASPHALTIC WEARING COURSE

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

NOTES:

- Identical Neoprene Bearings (as above) shall be provided under each end of each Precast Beam.
- The Neoprene Bearings shall be designed as per latest AASHTO LRFD Specifications.
- (i) In case the Contractor wishes to change the type of Bearings from Neoprene to POT bearings (POT Fixed and POT-PTFE Free), then the above noted magnitudes of Vertical loads, Horizontal forces and movements etc. will all change and the same will then have to be re-worked out and the design of POT-Bearings done accordingly.
 (ii) In that case, the details of the Expansion Joints, given in this Drawing, will also change and the same must then be designed accordingly.
 (iii) The Substructure and Foundations also shall then be designed according to the correctly re-worked out Loads, Forces and Movements etc.
- If the plan size of a Bearing so demands, the plan size of the bottom bulb of each Beam above the Bearings may be locally suitably increased (possibly into a diamond shape in plan) and reinforced accordingly.
- For BEARINGS: See NOTE NO: 17 in Drg. No: 4/10 of RC Deck with Precast RC Beams 20.0 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): 20.0 m RC Deck with Precast RC Beams (no SKEW)	LIVE LOAD: IRC 1 Lane of 70R or 1 or 2 Lanes of Class A, whichever governs and Footpath Loading

Drg. No : 10/10 of RC Deck with Precast RC Beams 20.0 m-SS Span

Drg. TITLE : ADDITIONAL DETAILS

Designed by : Amit K. Varma Engineer, DoR	Mentored by : Dr. V.K. Raina Bridge Techl Expert, DoR/World Bank	Date : July 14, 2015
Drawn by : Prabina Joshi	Accepted by : Saroj K. Pradhan (DDG, DoR)	Revision :
Checked by : Naresh P. Keshari Engineer, DoR	Approved by : Madhab K. Karki (DG, DoR)	