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The Construction of a New Bridge across Panadura Ganga

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Introduction

The bridge at Moratuwa across Panadura ganga on the Colombo-Galle Road was found insufficient to cater for the ever increasing traffic flow during the last few decades. It was also found that most of the steel members of the existing bridge were severely corroded and the bridge would not be able to serve very long. Therefore the construction of a new bridge got under way in the recent past although the idea had been in the minds of the concerned authorities for a long period. Three sites were originally proposed as suitable locations for the new structure. One of them was at the site of the existing bridge and another at Egoda-Uyana. The third proposed site was at Galetotupola situated in between Moratuwa and Panadura. Egoda-Uyana site was the selected one as preliminary investigations carried out by the Department of Highways revealed that the total cost of construction of the bridge and the approach road would be the lowest at this particular location.

The construction work of this bridge was entrusted the State Development Construction Corporation at an estimated cost of ten million rupees, which includes the approach roads.

Consisting of ten spans, each 62′ 7″ long, this bridge can be considered as one of the longest in the country. The width of the bridge was chosen to be large enough to accommodate four ten feet wide lanes, which would be advantageous in heavy flows of traffic. Along with the two sidewalks, each seven feet wide, the overall width of the bridge will be 54′. The soffit level has been taken to be at approximately 12′ above the ordinary water level so as to provide room for fishing boats. Although the construction work commenced in November 1976, the work was initially carried out only at the Moratuwa end. Later work was started from the Panadura end too, and at present the foundation stage has reached completion. It is expected to complete construction work by December 1979.

2. Construction

At the Moratuwa end a temporary access road was formed by filling sea sand and a crawler mounted Priestman crane (capacity 7 tons) was used for concreting of cylinders and excavation. But unfortunately at the Panadura end the river was too deep to obtain such access and therefore a crane mounted on a pontoon was used.

2.1 Foundation and Substructure
(see Fig. 1.)

The foundations of all piers and the two abutments are 10′ 10″ diameter cylinders which are anchored to the bedrock. Each wingwall is founded on a 7′ diameter cylinder. To retain earth at the two abutments, precast concrete sheet-piles measuring 12″ × 8″ are driven between the abutment and wingwall cylinders.

A coffer-dam was formed by driving steel sheet piles and filling with sand to position cutting edges in order to sink foundation cylinders. After placing reinforced concrete cutting edges, 21″ thick cylinders were cast using steel moulds 4′ 6″ high. A concrete mix of 1:2:4 (2″) was used for this purpose and sinking was done by excavating the inside with a mechanical grab. Throughout the sinking process great care was taken to avoid any tilting.

It was possible to sink the cylinders upto a depth of about 25′ without using any external loads as the self weight of the concrete shell itself was sufficient to overcome the skin friction. Beyond this depth the sinking process was slow due to surface friction, hence cylinders were loaded with kentledge of 100 tons. When the addition of kentledge did not help in sinking a cylinder, the layer of clay below the cutting edge was removed by divers. At certain instances partial dewatering was done in order to cause a flow of water into the cylinder which reduced the skin friction. Air jetting was carried out at the outer surface to minimise the skin friction of a cylinder which was very difficult to be sunk even by loading. The maximum depth encountered in cylinder sinking was 40′ (in cylinder No. 22) and the minimum was 22′ (in cylinder No. 1), the former being towards Panadura end which was due to the dipping of the rock strata. Once a cylinder was sunk down the rock, the soft rock layer was removed by divers. The removal of soft layer and thorough cleaning was done in order to form the bottom concrete plug on firm rock surface. After cleaning the bottom, 8 Nos. of 1″ diameter mild steel dowels were driven to the bedrock and the bottom concrete plug was laid using a

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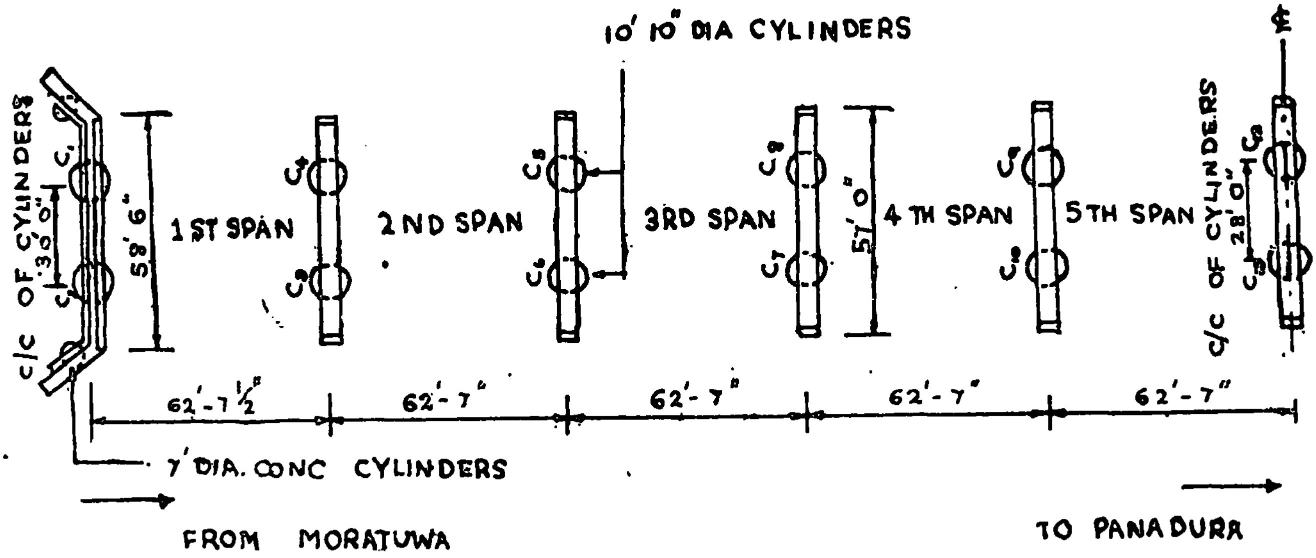


LAYOUT OF CYLINDER POSITIONS

mix of 1:2:4(¾"). Complete dewatering was not possible in some cylinders and in such cases part of the bottom concrete plug was laid under water with a special type of concrete bucket (skip bucket) using a mix of 1: 1½ : 3 (¾") before dowelling. After a few days such a cylinder was dewatered and the dowels were driven to the bed-rock through the concrete and the balance part of the bottom-plug (1 : 2 : 4 (¾")) was laid.
(see fig. 2)

From the bottom plug level, the cylinders were filled with saturated sand upto the top-plug level. Eighteen numbers of 1" diameter tor-steel dowels connect the top plug with the cylinder shell. The dowels are driven at an angle in order to facilitate transfer of load from column to the cylinder shell. The thickness of the top-plug concrete (1 : 2 : 4 (¾") was 4" and its level was taken at 1½' below the ordinary water level.

The columns and the pier capping beam were cast as shown in fig. 3a. The pier-capping beam is supported on two columns which are directly positioned on cylinder top-plugs. The column height for each pier was taken so as to give a longitudinal camber in the super-structure. The maximum column height was 4.81' at the centre pier and the minimum was 3.69' at the first pier on each end. The abutment and the wingwall capping beams were directly located on the cylinder top-plugs as shown in Fig. 3b. Acrow steel shuttering was used in the conventional manner for columns and capping beams. For the pier-capping beam the formwork was supported on a rolled-steel joist (16"×6"), placed on the cylinder top-plug on either side of a column. A concrete mix of 1 : 1½: 3 (¾") was used for the capping beams which were cast in one operation.

2.2 Prestressed Concrete Beams

The final preparation of a prestressed concrete beam consisted of the following stages of work:

(i) Transporting of standard 53' precast, pretensioned beams and 4' 6" long end-blocks from Ratmalana concrete yard. (Thirty beams are required for each span).

(ii) Joining the two end-blocks to each standard 53' unit to form 62' 6" long P.S.C. beams. The 53' unit and the two end-blocks are properly aligned and the 3" gap in between is filled with a concrete mix of 1 : 1½: 3(¾").

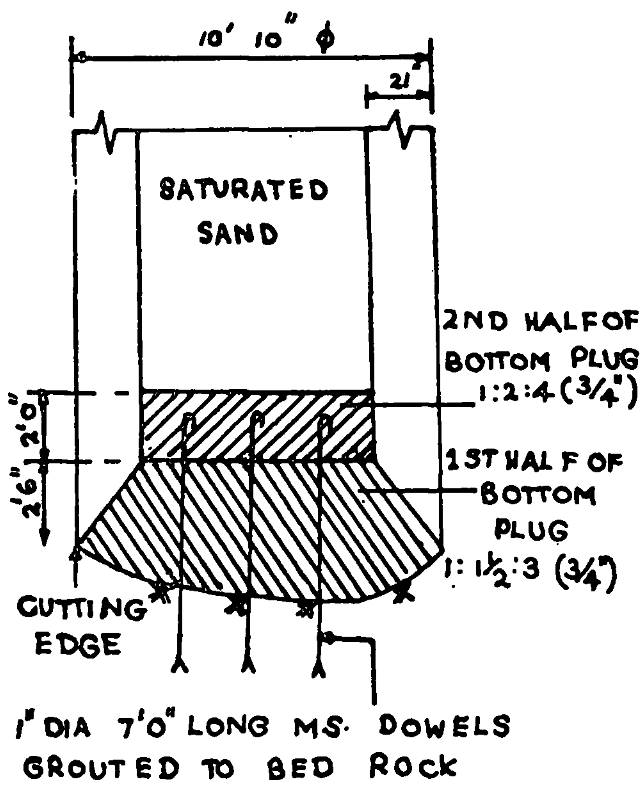
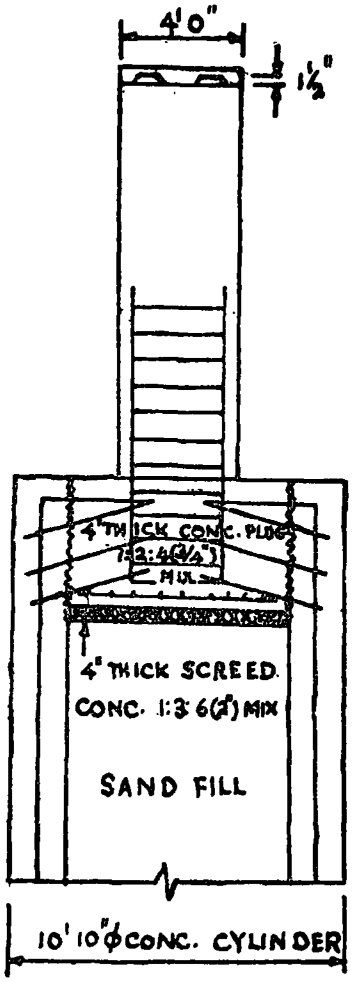
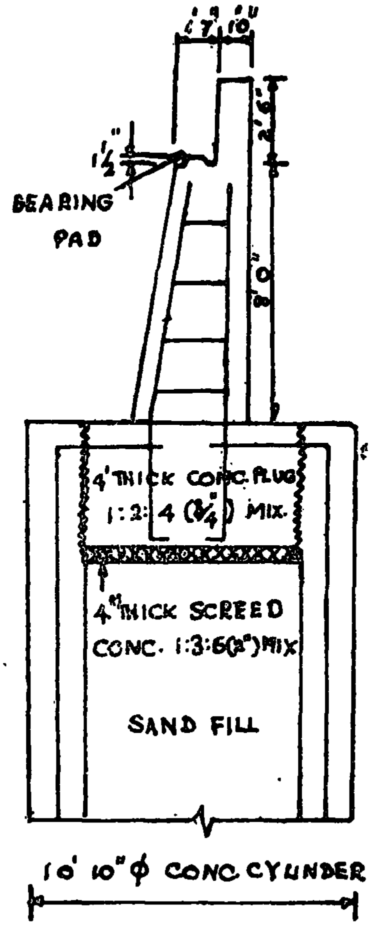


FIG 2



DETAIL OF PIER

FIG 3a



DETAIL OF ABUTMENT

FIG 3b

(iii) Stressing of Beams. A cable consisting of 12 numbers of 0.276 in diameter, high tensile steel wires is used for post-tensioning. This cable is inserted into the beam and the end-blocks through the duct-tube provided. After seven days of casting, sufficient strength is attained in the joint and then each wire is separately stressed to 77 ton/sq. in. A total extension of 4 13/16" including an allowable total slip of ½" should be achieved. There were various difficulties in getting the required extension as some of the jacks produced a slip of more than ½". The slip was high when the anchoring of the high tensile steel wires was done with a jack by itself. The slip could be minimised by manually anchoring the wires. Although spacer grills were used to keep the twelve high tensile steel wires apart, it was difficult to extend the latter when they touched each other. It was not easy to extend the wires to the required amount when the cable got twisted while manually inserting in the duct-tube. This effect was minimised by introducing a cone at the inserting end of the twelve wires.

(iv) After stressing, the cable is grouted and the ends are covered with a concrete mix of 1:1½:3(¾").

2.3 Superstructure

Launching and Deck-concreting.

As the weight of each P.S.C. beam is about 6 tons, two cranes were used to place them on the span.

After placing 30 beams on each span, 1" diameter tor-steel tie-rods are inserted at a pitch of 1' 6" and the space between beams is concreted to form a composite section. 9" diameter polythene displacers filled with a light material such as saw-dust are placed between the beams before concreting in order to minimise the weight of the deck. The deck is concreted in two stages. The middle portion of the span is concreted first and the rest is completed after the first concrete attained the required strength.

Work is in progress and it is expected to complete the construction of the bridge as well as the approach roads in the near future. Further progress will be reported in a future article.

Acknowledgements

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ශ්‍රී ලංකාවේ දිගම කොන්ක්‍රීට් පාලම්වලින් එකක් වන කොළඹ, ගාලු පාරේ පානදුර ගඟ හරහා ඉදි වන නව පාලමේ නිර්මාණ කටයුතු පිළිබඳව මෙම ලිපියෙන් විස්තර කරයි. මහා මාර්ග දෙපාර්තමේන්තුව වෙනුවෙන් රාජ්‍ය සංවර්ධන හා නිර්මාණ නීතිගත සංස්ථාව විසින් භාරගෙන ඇති මෙම වැඩ කටයුතු 1976 නොවැම්බර් මාසයේදී ආරම්භ වුනු අතර 1979 දෙසැම්බර් මාසයේ දී අවසන්වීමට නියමිතය. දිග අඩි 62' 7" බැගින් වන සමාන පරායණයන් දහයකින් සමන්විත වන මෙහි පළල අඩි 10 බැගින් වන මාර්ග 4 ක් සහ අඩි 7 බැගින් වන පදික වේදිකා 2 ක් සඳහා ඉඩ සලසා ඇත.

මෙහි දෙකෙළවර බැමිවලට සහ සියලුම අතර මැදි කුලුණුවලට අත්තිවාරම වී ඇත්තේ විෂ්කම්භය අඩි 10' - 10'' වූ කොන්ක්‍රීට් සිලින්ඩරය. පාෂාණ තට්ටුව වෙත බස්සවා ඇති මෙම සිලින්ඩරවල පතුල ඊට හොඳින් සවිවන සේ නිර්මාණය කර ඇත.

දැනට ඉදිවෙමින් පවතින පාලම් තට්ටුව එකකට එකක් ලංව පිහිටන සේ තබන ලද අඩි 62' - 6'' දිගැති සම්මත ආකාරයේ පෙරසවි කොන්ක්‍රීට් බාල්ක 30 කින් (එක් පරායනයක් සඳහා) යුක්තය.

இக்கட்டுரை இலங்கையில் உள்ள மிக நீளமானதும் கொழும்பு, காலி வீதியில் பாணந்துறை ஆற்றுக்கு மேலாக அமைக்கப்படுவதுமான புதிய பாலத்தைப் பற்றி விவரிக்கின்றது. இவ்வேலைத்திட்டம் பெருந் தெருக்கள் திணைக்களத்துக்காக அரச அபிவிருத்தி நிர்மானக் கூட்டுத்தாபனத்தினால் 1976ம் ஆண்டு நவம்பர் மாதம் ஆரம்பிக்கப்பட்டு, 1976ம் ஆண்டு மார்கழி மாதம் பூர்த்தியடையும் நிலையில் உள்ளது. இப்பாலம் 62'–7" அடி நீளமான பத்து இடைகளையும் ஒவ்வொன்றும் 10 அடி அகலமான நான்கு தெருக்களையும் இருபக்கங்களிலும் 7' அகலமான நடைபாதைகளையும் கொண்டது.

இப்பாலத்துக்கான இரு கரைக்கட்டுக்கள் மற்றும் எல்லா இடைத்தூண்களும் கற்படுக்கையில் அத்திவாரமிடப்பட்ட 10'–10" அடிவட்டத்தைக்கொண்ட கொங்கிறீட் உருளைகளின் மேல் அமைக்கப்பட்டுள்ளன. தற்போது அமைப்பு நிலையில் இருக்கும் மேல் தளம், ஒவ்வொரு இடைவெளிக்கு 30 வீதம் பக்க வாட்டில் அடுக்கப்பட்ட 62'–6" தீ அடி நீளமான நிலையான கொங்கிறீட் கட்டங்களை கொண்டுள்ளது.