Lifting Dharmadam Bridge

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Built in 1953, the third pier of Dharmadam Bridge, at 173/900km of National Highway 17, began sinking gradually after construction. This paper describes the lifting of the bridge and other repairS undertaken expeditiously, in order not to disrupt traffic inordinately.

The Dharmadam Bridge was constructed as far back as 1953. It consists of seven spans with a T-beam-and-slab superstructure; the spans vary from 6.93m to 14.40m. Due to paucity of steel, one of the RC deck slabs was placed on built-up girders at that time. The piers and abutments are in masonry, and the former are supported on open foundations.

The third pier from the Cannanore side started sinking gradually after construction. When measured in 1983, the sinking was about 270mm. Consequently, the spans looked depressed, creating an ugly angular inclined appearance.

The bridge serves as the main connection between Cannanore and Tellicherry, the most important towns of Cannanore District of Kerala. If this bridge were to collapse, the detour is so lengthy that the distance from Cannanore to Tellicherry would increase by about 10km via the diversion route.

The then PWD Minister as well as officials of the Ministry of Shipping and Transport (M.O.S.T), Government of India, suggested that the bridge be raised and repaired urgently so that through traffic would not be interrupted. A proposal to have a new bridge constructed upstream of the existing one, along the Tellicherry-Mahe Bypass, was in the offing but would take time to materialise.

It was, therefore. decided to prepare an estimate, making provisions for raising and levelling the two decks. including other repairs such as underpinning the piers wherever they showed signs of distress and guniting the entire bridge, deck and RC beams, as also for guniting the exposed built-up steel girders, acting as beams for one of the spans.

The estimate was sanctioned for Rs.2.55 lakh, in November 1983, by the M.O.S.T. When tenders were invited, a high rate of 220 percent over and above the estimate was quoted for the works by local agencies. Similar guniting work was done at 96/750km of National Highway 17 known as Kariangode Bridge and there also the rate quoted was above 220 percent. In order to reduce the rate and get the work done with the minimum of requirements. a decision was made to carry out the work departmentally at 170.42 percent of the above estimate, with the concurrence of State PWD Chief Engineer. National Highways, and Chief Engineer. Bridges, M.O.S.T.

Nowhere in the state was guniting equipment available and, hence, it had to be purchased from Calcutta departmentally and work started in right earnest to tackle the problem. Though the guniting job was easy. the problems of underpinning by placing concrete below water level, where the pier had developed cavities, and the raising of the two spans resting on the same pier were of utmost importance, which needed extreme care during execution. The fact that the bridge was more than 30 years old had also to be taken into account.

Preparatory work

The bottom and sides of the RC deck comprising T-beamand-slab were chipped off by hammer wherever peeling off was noticed and, simultaneously, the formation of the island for underpinning works was begun.

The total variation in the river was about 2m to 3m, close to the seamouths only about ¼ km away. As usual, piles were driven, and filling was done with clay and other materials. But half the filling was washed away the very next day, due to tidal action and, hence, the width of the ring bund around the pier was

increased and extra piles were driven for strengthening. Thus, five times the estimated amount was required to stabilise the island and start the work. When the island became stable and dewatering was done, underpinning was carried out by working day and night, after accounting for the tidal variation.

Lifting operations

Now, the most important item of lifting the span had to be tackled. Plans were made and discussions held when several suggestions were made. However, since this work of lifting caused distress in the RC T-beam-and-slab constructed 30 years ago and the reinforcement became exposed, care was needed in doing the work meticulously.

It was decided to have four sets of piles, each bunch totalling nine piles, Figures 1 and 2, three in a row, driven to refusal at the four corners of the pier outside the deck. Thus, a total of 36 teakwood piles of 200-mm diameter were driven to refusal. On a cluster of nine piles (three in a row, horizontal and three, perpendicular), the tops of three piles were connected at high-tide levels by placing steel rails so that the system could distribute the load uniformly, bracing the piles wherever necessary. The rails were first placed horizontally and again at right angles, to form a cluster. Over this, sleepers were placed to rest the jack on and topped by two old mild steel girders, ISMB 550mm x 190mm, which were strengthened and tested to take the load of the three Tbeams and deck slabs running right across the span The other ends of the girders were made to rest on the other side of the cluster of piles and on the jack. Thus, the girders were fixed on either side of the pier to lift the adjacent span.

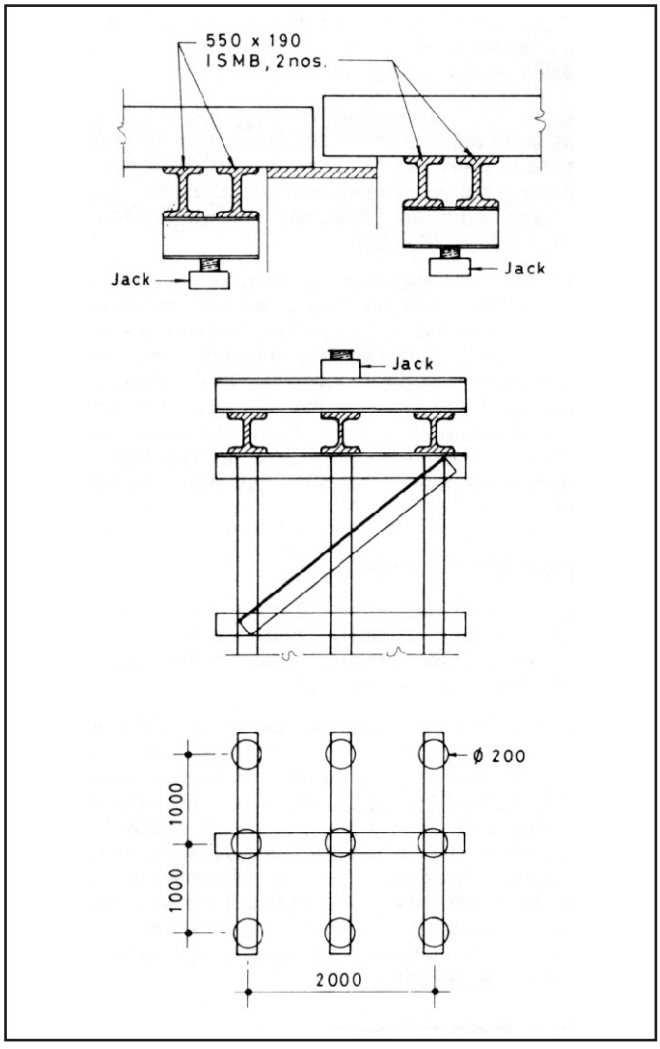

Figure 1. Lifting arrangements for piles and girders for Dharmadam Bridge

Since the 8.75-m long girders would be supported on the jack at either end and would transmit load to the rails and on to the pile, it was suddenly realised that there can be excessive deflection which may crack the deck during the process of lifting, as it is more than 30 years old.

To obviate any risk, a supporting structure was built on either side of the pier at the centre of the girder within the ring bund, by filling with sand bags, bringing it to the top of the tidal range and spreading railway sleepers. Over this, too, jacks were placed for supporting the girders at the centre, so as to avoid any possible deflection. In all, 16 jacks were used, — 4 electrically-operated, each of 100-t capacity and 12 hand-operated, each taking about 50t. These were far beyond the requirements. But only such jacks were used, which could prevent the risk of any unexpected tidal wave disturbing the sand bags on the islands and causing difficulty.

Initially, it was even difficult to find out as to which was the fixed end and which the moving end of the span, since it was constructed 30 years ago, and there was no maintenance. But, with great difficulty, the ends were located correctly, otherwise, the entire operation would have been of no use. The pier which had sunk had on it the moving ends of both the spans, and it was there that the lifting equipment was located.

The jack could raise the bridge by only about 150mm and, hence, two operations were needed to lift the entire depth. This entailed sufficient wedging arrangement to lift the span, place it on the wedge, and then remove the jack and replace it properly. Both for the jack and for supporting the three + three, two-span girders a steel stanchion was made. The latter was also for the full-lift portion so that it can be placed in position, with arrangements for expansion.

Having kept ready all these arrangements and expert workmen, the date for lifting was fixed. The time of 10 a.m. was decided upon for lifting, after traffic was blocked, so that the peak-hour traffic was over and school-going children and other public would be safe at their work in schools and offices. It would have been more suitable to work at night and complete the job without fanfare; however, it was thought fit to allow the public also to witness the operation.

At 10 a.m., traffic was stopped by the police. A large crowd had assembled on the banks of the river and at all the vantage points (some were in boats plying on the river), to see the operation. Before starting the work, the expansion joint was removed from the road between the spans on top.

At 10.30 a.m., the electric jacks were switched on and the manual jacks also were attuned; within half-an-hour the bridge was lifted by 140mm to the shouts and jubilation of the public. The operation was stopped and the stanchion was inserted; by 12 noon the second operation was started and both the spans were perfectly level by 12.30 p.m.

Thereafter, expansion joints on the road deck at top were properly filled and both heavy and light traffic began rolling over the bridge by 3 p.m., to the satisfaction of all present.

Guniting

The guniting of all the spans was started even earlier but, as the work progressed, more areas were found to have decayed; hence, the areas to be gunited increased nearly fivefold.

It is, however, not possible to assess correctly the areas which need guniting, especially in old bridges. Either the bridge has to be inspected from a boat, in which case proper assessment cannot be made or, better still, formwork should be hung from the span and some arrangements made to travel along and underneath the span, using a mechanical device which alone can provide a rough idea about the areas to be gunited. In the case of the Dharmadam Bridge, concrete was peeling off when sounded with a hammer; therefore, weld mesh was nailed to the old concrete surface before the gunite was applied.

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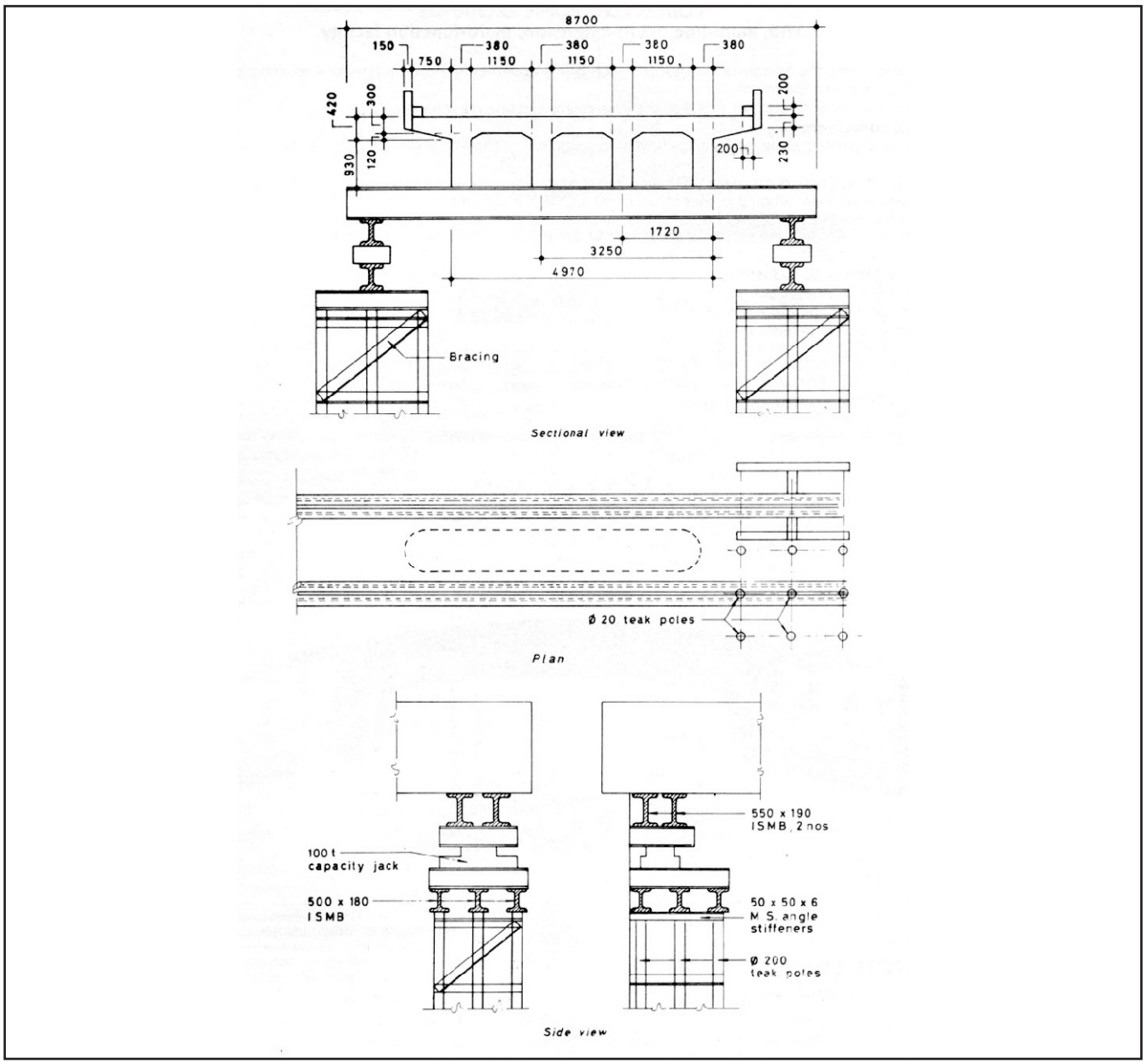

Figure 2. Views showing the lifting arrangements for Dharmadam Bridge. Four sets of piles, each totalling nine piles, three in a row, were used