Protective coating for the second Thane Creek bridge superstructure

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The first Thane Creek bridge had started showing signs of corrosion damage in 1982. While steps were taken to repair and strengthen this bridge, the public works department (PWD) of Maharashtra, was keen to ensure that the second Thane Creek bridge has better resistance to corrosion damage. The specifications incorporated many additional protective measures, one of which included a specialised coating to the superstructure. The paper discusses the coating system, application procedure, and the quality control system, in brief.

Experience worldwide has shown that despite the best protective measures reinforced and prestressed concrete structures located in marine and polluted environment suffer damage due to corrosion. Chloride ingress into concrete is the main cause for corrosion initiation.

Taking into consideration the experience of the first Thane Creek bridge, a number of additional protective measures have been incorporated in the design and construction of the second Thane Creek bridge. All these were briefly presented in an article published earlier in this Journal'. For example, only the box type superstructure was acceptable to the designers, taking into consideration the durability aspects. The box girders avoid concentration of prestressing cables, reinforcement and prestressing forces that generally takes place in the bottom bulbs of I-girders, due to which possibilities of transverse cracking are eliminated. Each carriageway consists of a single-cell box girder, the depth of which varies parabolically from 7m (above pier location) to 3.5m (at mid span). Only seven expansion joints were proposed in a total length of 1.83 km. Provision of minimum number of these joints is expected to minimise maintenance problems and improve riding quality. The construction was carried out with balanced cantilever method. Cast-in-place segments were added on either side above pier with the help of cantilever construction equipment. Finally, a key segment was cast to establish continuity of the unit. The details of the superstructure are given in Table 1.

The north carriage of the bridge has already been completed and is opened to traffic. The south carriageway is nearing completion.

Table 1: Salient details of superstructure

1.	Length	:	1,837.09 in
2.	Width of bridge	:	25.68 m (2 carriageways 11 m each + central median verge 1.2 m + 2 walkways 0.60 in each)
3.	No. of spans	:	23
4.	Details of span		
	Units from Vashi end		
	- 1 unit of 3 spans (61.95 +80.935 + 62.575) m	:	205.46 m
	- 4 intermediate units of 4 spans (53.5 + 107 + 107 + 53.5) = 321 m	:	1284.00 m
	- 1 unit of 4 spans at Bombay end (55.43 + 103.30 + 107.10 + 81.8) = 347.63 m	:	347.63 m
	Total length of 23 spans	:	1837.09 m
5.	Navigational spans		
	No. of spans	:	2 (each of 107 m on centres)
	Navigational clearance	:	9.14 m (above M.H.W.S.R.L. of +3.19 in)
6.	Superstructure	:	Prestressed concrete single cell box girder of varying depth; one box girder for each carriageway

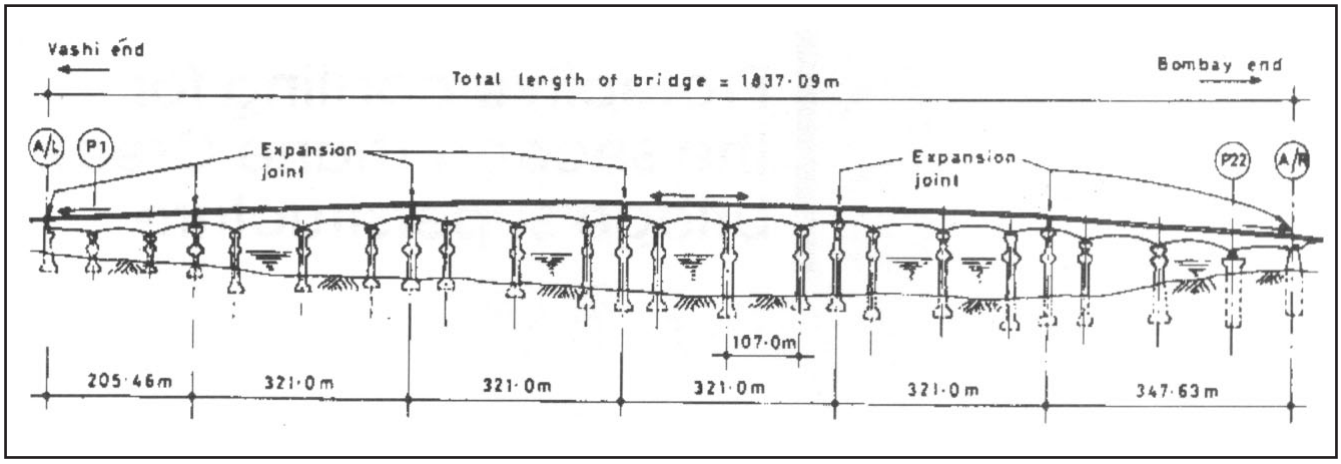

Figure 1. Longitudinal section of the second Thane Creek bridge

Coating system

Integrated epoxy-polyurethane coating system consisting of four coats of hi-build epoxy and a finish coat of UV-resistant aliphatic polyurethane was adopted after due evaluation and comparison with conventional epoxy systems.

The finished coat of polyurethane is to be provided only on outermost vertical faces of the bridge as these faces are likely to be affected by direct sunrays.

Salient features of coating system

The integrated coating system comprises of the following coats:

1.	Primer coat	:	Epoxy-resin (Redoxide as major pigment)
	Dry film thickness	:	50-60 microns
	Hardner	:	Polyamide based
2.	Middle coat	:	Epoxy resin (Micaceous iron oxide as major pigment)
	Dry film thickness	:	110-120 microns
	Hardner	:	Polyamide based
3.	Top coat	:	Epoxy resin (Titanium dioxide as major pigment)
	Dry film thickness	:	95-105 microns
	Hardner	:	Polyamide based
4.	Finish coat	:	Polyurethane (aliphatic)
	Dry film thickness	:	30-40 microns
	Hardner	:	Isocyanate based

Primer coat

Properties of coating system

The properties of the coating system confirm to the following.

1. Salt spray test (ASTM-B-117)
2. Adhesion test (ASTM-D-3359-83)
3. UV-resistance test (ASTM-D-3361-81)
4. Water absorption test (ASTM-D-570)
5. Permeability test (IS-3085)
6. Chemical resistance properties : Resistant against dilute acids, alkalies, DM water and urea.

Application procedure

Staging

The application for the north carriageway required innovative scaffolding design, since it was already opened to one-way traffic of 40,000 p.c.u. per day. It meant that interrupting the traffic even for a minute, would not be acceptable during the application. Further, with the existing electric poles placed at a regular interval of 10m, a continuous on-rail staging system was not possible. Hence, a gantry with removable girder system was devised with optimum weight.

A leading bridge consultant was exclusively retained to design and provide the scaffolding system and support.

Surface preparation

Mild sandblasting (sweep blasting) with fine quartz was used

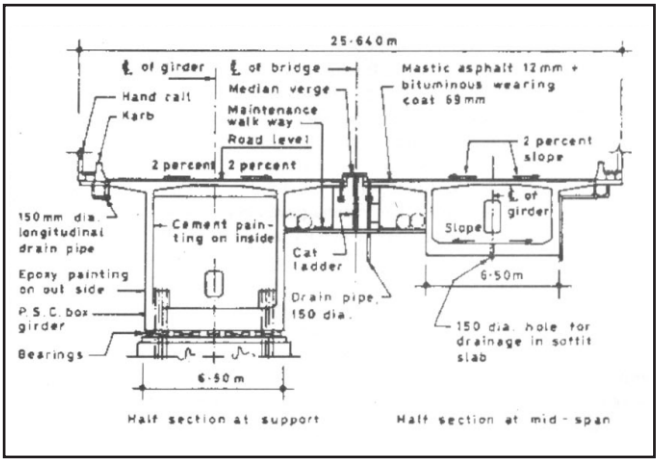

Figure 2. A cross section of the superstructure

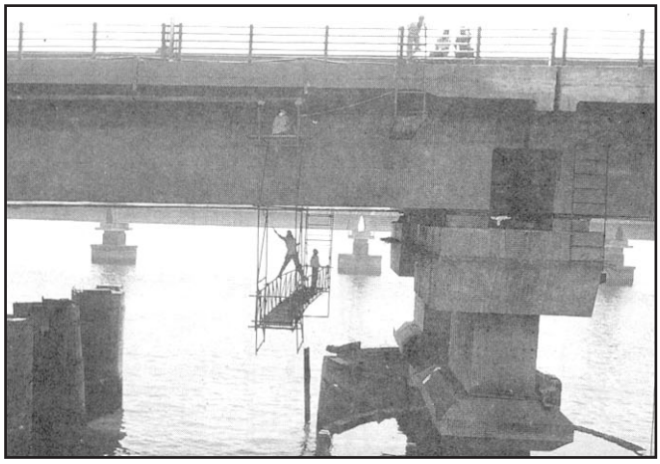

Figure 3. Application of protective coating in progress

for thoroughly preparing the cured concrete surface (after 28-day curing period was over) taking all the care to maintain consistency in surface preparation.

Total removal of demoulding agents and loose particles was ensured by sweepblasting prior to the application of primer coat. Presence of oily residues, grease, etc. impairs the bonding of the epoxy coating to the concrete substrate; hence it is essential to ensure their total removal.

Spray coating

Special type of air-assisted, airless spray guns were used for coating all the four systems. Main feature of this equipment was the particle size of the droplets which was between 70-90 microns. This attributed for uniform film thickness even on uneven surface. In view of the absence of a stream of compressed air accompanying the paint particles, and because the droplet size was generally larger, the problem of bouncing back was minimised. This was of great advantage since the exposed surface faced strong wind pressure during coating. The primer, middle coat, top coat and finish coat of aliphatic isocyanate cured polyurethane were coated keeping a time interval of minimum 24 hours between them.

Internal concrete surface of box girder is painted with 3 coats of waterproof cement-based paints.

Quality control

The material testing, surface preparation, application and coating integrity were monitored on continuous basis by the Central Electrochemical Research Institute, Karaikudi whose services as consultant were sought by PWD, Maharashtra for the purpose.

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References

1. BORKAR, A.G. and TAMBE,S.R., Second Thane Creek bridge -An overview, The Indian Concrete Journal, September 1994, Vol.68, pp.445-449.

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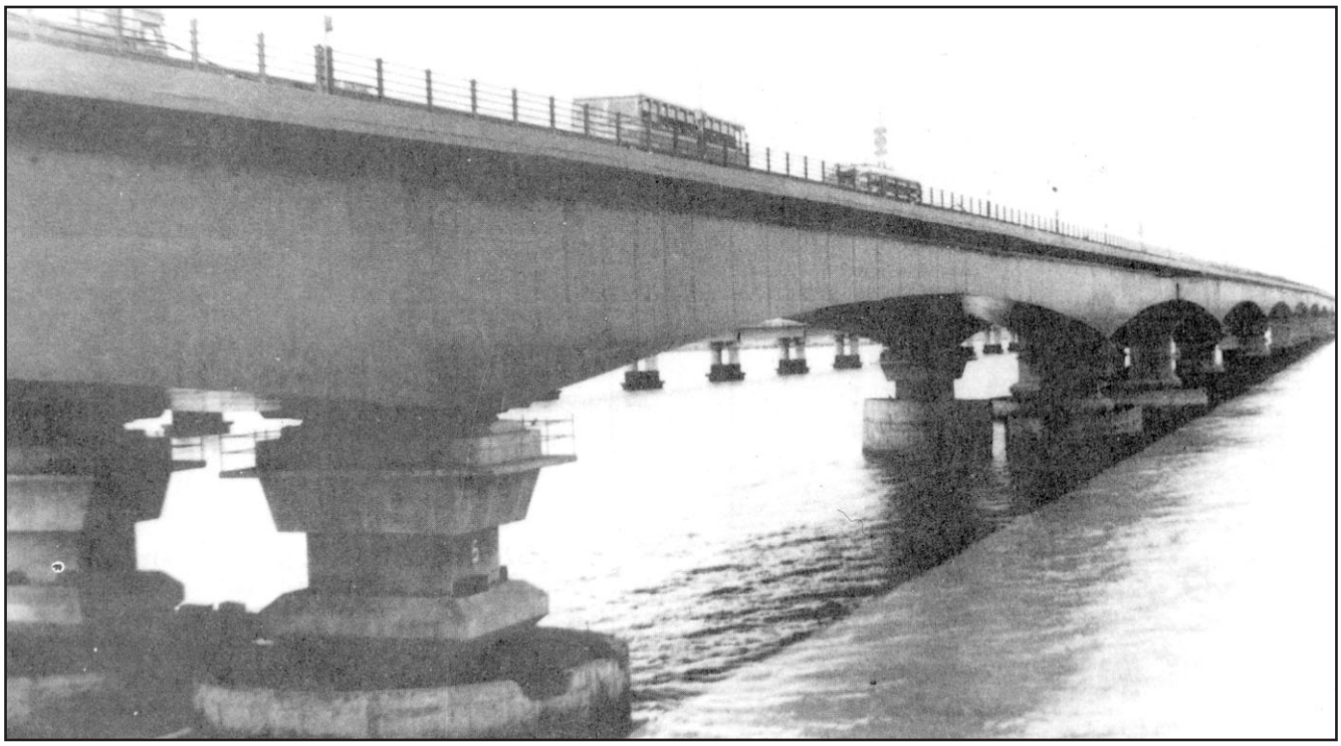

Figure 4. A view of the completed Thane Creek bridge