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No. RW/PL-17 (14)/76-Vol. II *Dated the 16th June, 1983*

To

All Chief Engineers of States/Union Territories dealing with N.Hs and other Central Sector Bridge Works

Sub : Guidelines for repair of existing concrete bridges by shotcreting

Attention is invited to this Ministry's circular letter of even number dated 31.3.81 wherein "Guidelines for maintenance and repair of existing concrete bridges susceptible to being affected by corrosion" were issued.

2. The particular provisions with respect to repairs to damaged concrete given in para 51 (iii) have been further reviewed. Certain essential aspects of the procedure for repair by "shotcreting" are being outlined in the enclosed guidelines. These would be applicable for use not only in marine environments but also in any other situations where repairs to damaged/spalled concrete are found necessary. Para 5.1. (iii) of the aforesaid circular is, therefore, superseded by the provisions indicated in the enclosure.

3. The guidelines mentioned in the enclosure may be followed in conjunction with Indian Standard Recommended Practice for Shotcreting—IS : 9012- 1978 and the Equipments for Application of the same should comply with the requirements given in IS-6433-1972.

4. Suggestions to improve/augment the above guidelines based on experience are welcome.

Enclosure to letter No. RW/PL-17 (4)/76-Vol. II dt. 16.6.83

Guidelines for repairs of damaged/spalled concrete of exisiting concrete bridges by Shotcreting—Some important points to be borne in mind.

(i) In general Dry-Mix-Shotcrete which is also known by the trade name "Guniting" shall be applied for repair of concrete in bridge works.

(ii) Ordinary Portland cement conforming to I.S. 269-1976 shall be used in shotcreting.

(iii) Sand for shotcreting shall comply with the requirements stipulated in I.S. 383-1970 and graded evenly from fine to coarse as per Zone II grading. In general, sand should neither be too coarse to increase the rebound not too fine to increase the slump. Sand used should preferably have a moisture content between 3 to 6%.

(iv) For thick sections and where adequate guniting equipment is available, it may be advantageous to incorporate coarse aggregate in the mix. Coarse aggregate, when used, shall conform to grading given in Table I of I.S. 9012-1978.

(v) Water/cement ratio for shotcrete should fall within the range of 0.35 to 0.50 by mass, wet enough to reduce the rebound.

(vi) Drying shrinkage may be between 0.06% to 0.10%.

(vii) Test panels simulating actual field conditions should be fabricated for conducting preconstruction testing. The procedure for testing the cubes or cylinders taken from the panels stipulated in Clause 6 of I.S. 9012—1978 should be followed.

(viii) Cement mortar mix should be generally within the range of one part of cement to 3 to 4½ parts of sand. In case coarse aggregate is proposed to be included in the mix, its percentage may be normally kept as 20 to 40% of the total aggregate and the mix should be suitably designed.

(ix) It should be ensured from tests that a strength of about M 280 at 28 days is available for the mortar/concrete mix.

(x) The defective concrete should be cut out to the full depth till sound concrete surface is reached. Under no circumstances,

should the thickness of concrete to be removed be less than the clear cover to the main reinforcement. No square shoulders shall be left at the perimeter of the cut-out portion and all edges shall be tapered. Thereafter all loose and foreign materials should be removed and the surface shall be sand-blasted to make it rough to receive shotcrete.

(xi) The exposed reinforcement should be thoroughly cleaned free of rust, scales etc. by wire brushing. Wherever the reinforcements have been corroded, the same should be removed and replaced by additional reinforcement. Before application of shotcrete a coat of neat cement slurry should be applied on the surface of the reinforcement.

(xii) The additional reinforcement should preferably be welded to the existing reinforcement. In case the existing reinforcement is not weldable and provision of laps becomes necessary, the lapped reinforcing bars should not be tied together. They should be separated by at least twice the diameter of the bar wherever possible.

(xiii) Sufficient clearance should be provided around the reinforcement to permit encasement with sound shotcrete. Care has to be taken to avoid sand pockets behind the reinforcement.

(xiv) A thickness of 25 to 40 mm of shotcrete can normally be deposited in one operation. If, for some reason the total thickness is to be built up in successive operations, the previous layer should be allowed to set but not become hard before the application of the subsequent layer. It would always be necessary to apply shotcreting on a damp concrete surface.

(xv) It would be desirable to provide welded wire fabrics in the first layer of shotcreting. In case the damage to the concrete member is too deep, the specifications for shotcreting as well as requirement of placement of wiremesh has to be decided as per field conditions.

(xvi) The stipulations given in I.S. 9012-1978 regarding application of shotcrete should be scrupulously followed so as to keep the rebound to a minimum. The quality of shotcreting and workmanship should be such that the percentage of rebound mentioned in Clause 8.6 of the Standard can be adhered to. In no circumstances should the rebound material be reused in the work.

(xvii) Adequate care has to be taken regarding curing of the shotcrete. It would be desirable that green shotcrete is moistured for at least 7 days.

(xviii) Shotcreting work should not be done during windy or rainy conditions.