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CONDITION ASSESSMENT:

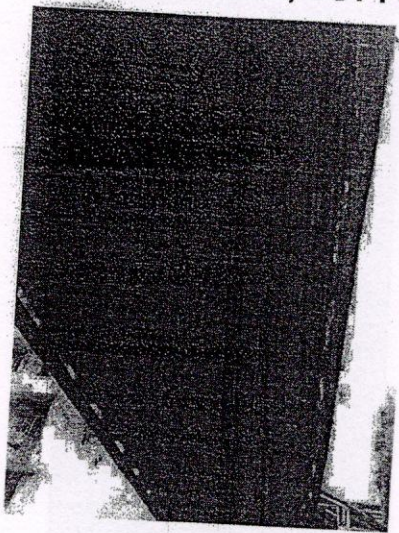
- 1) The cracks are formed in R.C. Parapet/railing.
- 2) Treads and risers of staircase are broken at various locations
- 3) Slab is not in good condition, steel in slab is exposed.

RECOMMENDATIONS & REPAIR METHODOLOGY FOR TIMES FOB D.N ROAD:

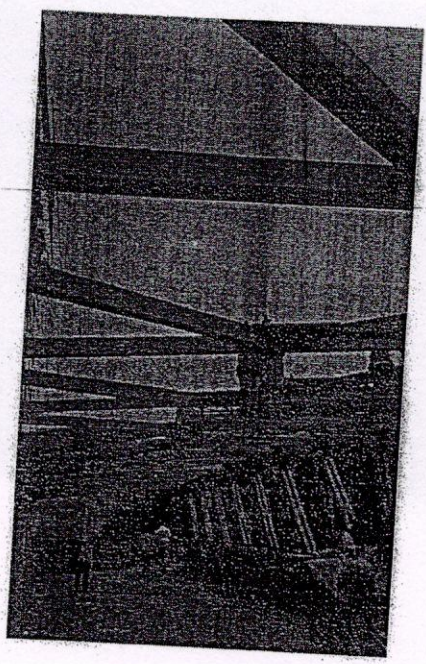
- 4) The NDT test for steel structures as per sheet no 8 need to be conducted on site for assessing residual strength of steel members. For concrete elements mainly the UPV, RBH, Carbonation, Half cell potentiometer, chemical analysis and Core tests to ascertain the strength and quality of concrete.
- 5) The proposed test locations and numbers are indicated in table.
- 6) A detailed methodology can be drawn up for retrofitting after the NDT proposal is accepted and report is available.
- 7) All broken treads and risers need to be replaced.
- 8) Other measures such maintenance of R.C. Parapet/railings and overall painting for anti corrosion shall be required



TIMES OF INDIA, CST FOB



SOFFIT VIEW OF FOB

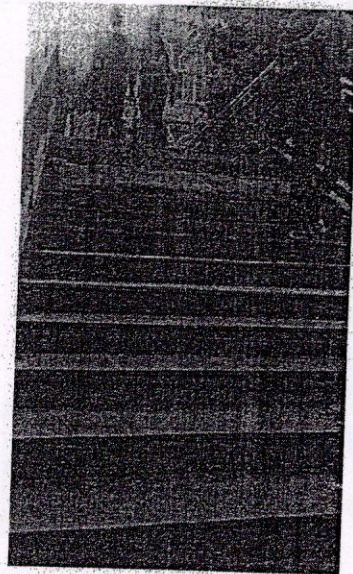


DECK LEVEL AT FOB

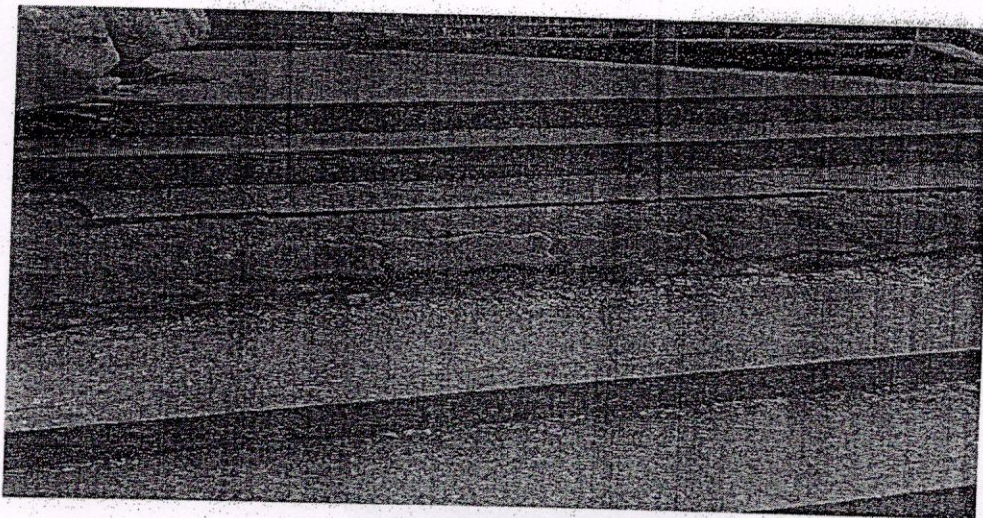


Structural Consultant Prof. D.D. Desai's Associated Engineering Consultants and Analysts Pvt Ltd.

TIMES OF INDIA, CST FOB



BROKEN TREADS AND RISERS OF FOB



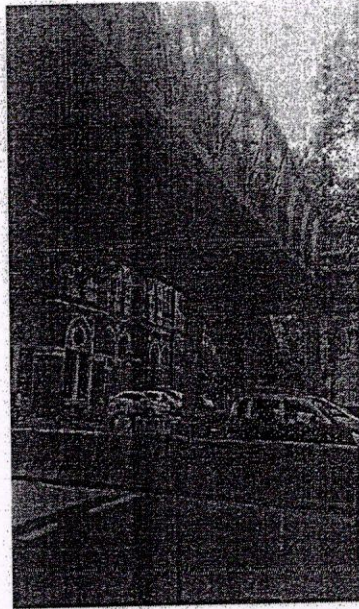
BROKEN TREADS AND RISERS

Structural Consultant Prof. D.D.Desais Associated Engineering Consultants and Analysts Pvt. Ltd.

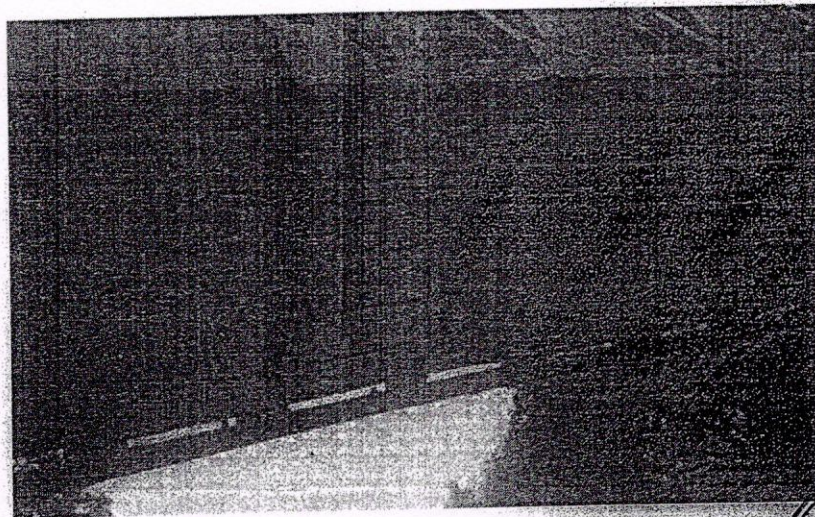


ETA
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TIMES OF INDIA, CST FOB



5.75m VERTICAL CLEARANCE



SOFFIT OF THE FOB

Structural Consultant Prof. D.D.Desais Associated Engineering Consultants and Analysts Pvt. Ltd.



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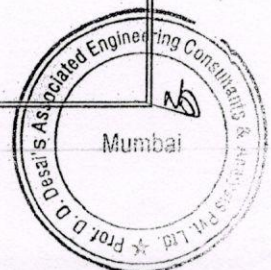
REPORT FOR NON DESTRUCTIVE TESTING ON
FOB AT 01 TIMES OF INDIA, C.S.T, MUMBAI

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PROJECT NO. : NDT-E205-01 (Rev-1)

DATE : July 12, 2017



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 - 2.2 REBOUND HAMMER TEST
 - 2.3 CARBONATION TEST
 - 2.4 THICKNESS MEASUREMENT OF STEEL MEMBERS BY ULTRASONIC GAUGE
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Rv/Pr



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3.0 TEST METHOD DESCRIPTION

3.1 ULTRASONIC PULSE VELOCITY (UPV) TEST

The test involves measurement of transit time of an ultrasonic pulse generated through the emitter and measured by the collector or by receiver. Since the thickness of the member is known or can be measured, the pulse velocity can be calculated from the simple formula $V=L/T$.

The test involves measurement of pulse velocity by either direct or semi-direct or indirect (surface) transmission method as mentioned in IS 13311 (Part 1): 1992. Direct method shall be used as far as possible, since that gives best results. Direct method shall be used as far as possible, since that gives best results. Wherever direct method is not possible due to very high member thickness the semi-direct or indirect methods of testing shall be used. The locations at which test is desired shall be identified by the engineer in-charge before the test, so as to prepare the surface for the test. It is desirable that the transducers shall be directly in contact with concrete whose surface is clean and free from moisture and dust. The reliability of the results might be affected significantly in case readings are taken from plaster and/or rough surfaces. The thickness of the member or the length of shortest direct path within concrete shall be measured before start of the test.

Any coupling agent like grease, petroleum jelly etc., shall be applied to the transducers and test surface to remove any entrapped air. The transducers shall then be placed against concrete in a direction depending on mode of transmission. The transit time shall be recorded onto the equipment. Repeated readings of the transit time shall be made until a minimum value is obtained and this should be the recorded value. Based on this, the ultrasonic velocity shall be calculated as described above.

3.1.1 INTERPRETATION OF RESULTS

The interpretation of results is conducted with reference to IS: 13311 (Part 1) the standard table of which is reproduced below. The results are enclosed in Table: 1. the method of testing is also mentioned along with specific remarks if any for a particular location. The pulse velocity through concrete usually gives a good indication of its quality. The pulse velocity is also affected by surface preparation, moisture content, temperature, percentage reinforcement etc., among other known factors.

TABLE 2A OF IS: 13311 (Part 1): 1992

PULSE VELOCITY (km/sec)	CONCRETE QUALITY GRADING
Above 4.5 km/sec	Excellent ✓
3.5 - 4.5 km/sec	Good ✓
3.0 - 3.5 km/sec	Medium
Below 3.0 km/sec	Doubtful



3.1.2 TEST LIMITATIONS

Test limitations for UPV testing are mentioned in IS: 13311 (Part-1), 1992. To mention briefly, the results are affected by age of concrete, percentage of reinforcement, method of testing, concrete composition etc.

Surface probing in general gives lower pulse velocity than in case of cross probing and also depending on number of parameters, the difference could be of the order of about 1 km/sec Velocity as per IS: 13311 Part 1 – 1992.

3.2 PRINCIPLE OF REBOUND HAMMER TESTING

When the plunger of rebound hammer is pressed against the surface of the concrete, the spring to control mass rebounds and the extent of such rebound depends upon the surface hardness of concrete. The surface hardness and therefore the rebound indices taken shall be related to the compressive strength of the concrete. The rebound distance is measured along a graduated scale and is designated as the rebound number or rebound Index. The test involves measurement of rebound number or rebound Index by placing rebound hammer at right angles to the surface of the concrete member as mentioned in IS 13311 (Part 2): 1992.

The test shall be conducted around all the points of observation on all accessible faces of the structural element. The point of impact shall be at least 20mm away from any edge or sharp discontinuity. The locations at which test is desired shall be identified by the engineer in-charge before the test, so as to prepare the surface for the test. For testing the selected surface shall be smooth and dry. Concrete surfaces shall be thoroughly cleaned before taking any measurement.

The reliability of the results might be affected significantly in case readings are taken from plaster and/or rough surfaces. The rebound number is affected by factors like type of cement and aggregate, surface preparation, moisture content, age of concrete and extent of carbonation of concrete. As per IS: 13311 (Part 2): 1992 the rebound indices are indicative of compressive strength of concrete to a limited depth from the surface.

3.2.1 INTERPRETATION OF RESULTS

The interpretation of results is conducted generally with reference to IS: 13311 (Part 2): 1992. The rebound hammer method provides a convenient and rapid indication of the compressive strength of concrete by means of established correlation between the rebound Index and the compressive strength of the concrete.

3.2.2 TEST LIMITATIONS

The test preliminary responds on surface hardness and may not provide complete information about strength of concrete. These tests are sometimes best suited for relative comparison between two different structures. Factors that influence the readings are mentioned in IS: 13311 (Part-2), 1992. To mention briefly, the results are affected by localized hardness, carbonation of concrete, surface smoothness, type of cement, type of the aggregates, moisture content of the concrete, concrete, age of concrete, concrete composition etc.



3.3 CARBONATION TEST

Carbonation test can be carried out using simple phenolphthalein test. Phenolphthalein spray is an indicator of pH value and as carbonation has its effect on pH of concrete, the change in colour indicates the extent of carbonation. The test is conducted by a drilling a hole or chip of the concrete surface to different depth up to cover concrete, spraying with phenolphthalein, and observing the colour change. Un-carbonated surface exhibits pink colour while carbonated concrete exhibits no change in colour. The depth of carbonation is estimated based on the change in colour profile. Phenolphthalein solution was sprayed on concrete member to observe for any carbonation in concrete.

3.4 MEASUREMENT OF THICKNESS BY ULTRASONIC GAUGE

This works on the principle of Ultrasonic waves, which travels in the material and gets reflected from the back surface. The spot where thickness has to be taken is made smooth by mechanical leaning. A couplant is applied between the Machine probe and the job which helps in transmitting the Ultrasonic waves within the material. The machine is calibrated prior to testing the readings are directly displayed on the LCD screen.

3.5 DYE PENETRATION TEST (DPT / LPT)

DPT is used to detect open to surface (surface breaking) defects like crack, voids, flaws, etc. It works on the principle of Capillary action.

The job is cleaned thoroughly to remove any surface contaminants, after which Dye penetrant is applied on the job surface. A dwell time of 10 mts. is given after which the excess penetrant from the surface is cleaned. After drying for 1 minute developer is applied on the job surface, which brings out the defect indication on the surface by blotting action. This technique is used extensively in engineering industries.

4.0 CONCLUSIONS

UPV Test

A total of 16 points were tested on FOB at 1 Times of India at C.S.T, Mumbai with UPV testing by DIRECT & INDIRECT method. Results are presented in Table 1. Most of the UPV readings are more than 4.0km/sec indicating GOOD quality of concrete. Only few locations show readings are in the range of 3.0 km/sec to 3.5 km/sec but since testing at this location is conducted by INDIRECT method the difference could be of the order of about 1 km/sec Velocity as per IS: 13311 Part 1 – 1992. In general, concrete quality is classified as GOOD.

Rebound Hammer Test

Rebound hammer testing was performed on same locations where UPV was performed. The results are mentioned in the Table: 1 attached with this report. A total of 10 readings were taken at each test location and an average of six readings was used for computation as per code. Most of the test results show concrete grade in the range of M20 to M30 based on rebound hammer test. Higher values may also be due to localized hardening/carbonation and subject to test limitations.

Carbonation Tests

Carbonation test was performed on 16 locations by spraying phenolphthalein on the concrete powder extracted from respective test locations. All test locations show possibility of carbonation as no change in colour was observed. The results are attached in Table: 1 of the report. The results are very likely due to exposure of concrete to weather.



Thickness Measurement of steel members of FOB


The thickness of members were measured as per location marked in sketch in Table-2 & necessary comparison may be done by consultant with original drawing for knowing reduction in thickness / further action of repair / strengthening of the structure as required.

Dye Penetration Test

The Dye penetration test was conducted on locations marked in sketch on Table-2. All these locations of steel members are found to be OK, i.e. without any surface defects like crack, flaws, voids, etc.

The entire testing was based on the following codes.
IS 13311 (PART 1): 1992 (UPV)
IS 13311 (PART 2): 1992 (RBH)
ASME Section-V: Dye penetration Test (DPT)

No other warranty, expressed or implied, is made. The findings provided in this report are based on the result of the individual locations tested and information made available to us.

For Geo Dynamics

Alpesh Kachhadkar
Manager (Technical)


For Geo Dynamics

Ravikiran Vaidya
Principal



TABLE-1

(UPV, RBH & CARBONATION TEST RESULTS)





PROJECT NO.: NDT-E205-01 (Rev-1)

UPV, RBH & CARBONATION TEST RESULTS

Sr No.	Member	Member ID Mark	Thk. (mm)	UPV results			Remarks	Rebound Hammer Results				Carbonation Results
				Time (µs)	Velocity (km/sec)			Overall Rebound Index	Selected Rebound Index	Average Rebound Index	Comp. Strength (N/mm ²)	
1	Column-1	1-2	300	76.4	3.927		Indirect Method	22.32,30.28,26.28	28.26,28	28.0	22.2	Evident
				84.2	3.563			28.28,28	28.3	22.6		
				110.2	2.722			28.20,28.30,28	28.30,28	28.3		
3	Beam Near staircase	1-2	300	88.4	3.394		Indirect Method	32.30,30.34,42	32.34,42	37.7	38.7	Evident
				110.2	2.722			42.40,42.40,38	40.40,38	37.7	38.7	
5	Column-2	1	828	184.2	4.495		Direct Method	32.38,32.30,28	32.30,30	30.3	25.9	Evident
				195.0	4.246			30.28,30,30,30	30.30,30	30.0	25.4	
				170.2	4.865			28.30,30,28,26	28.30,30	29.0	23.8	
7	Column-2	3	828	190.4	4.349		Direct Method	26.28,30,38,30	28.28,30	29.0	24.6	Evident
				185.4	4.466			30.32,30,28,30	30.29,30	29.5	24.6	
				192.5	4.301			30.32,30,28,30	30.28,30	29.0	23.8	
9	Column-3	2	828	184.6	4.485		Direct Method	30.32,30,28,30	30.30,28	29.7	24.9	Evident
				185.4	4.466			32.40,38,34,38	32.34,38	33.0	30.4	
				192.5	4.301			32.30,32,30,30	32.32,30	33.0	30.4	
11	Column-4	1	828	176.2	4.699		Direct Method	28.30,30,28,30	28.28,30	29.0	23.8	Evident
				184.6	4.485			28.30,30,28,26	28.30,28	29.3	24.3	
				192.5	4.301			28.30,30,28,26	28.30,28	29.3	24.3	
13	Column-4	3	828	210.2	3.939		Direct Method	32.34,28,26,28	28.30,28	29.7	24.9	Evident
				176.2	4.699			30.28,30,30,32	30.30,32	29.7	24.9	
				192.5	4.301			28.30,28,30,30	28.28,30	29.3	24.3	

UPV, RBH, HCP & CARBONATION TEST RESULTS

Sr. No.	Member	Member ID Mark	UPV results				Rebound Hammer Results				Carbonation Results
			Thk (mm)	Time (µs)	Velocity (km/sec)	Remarks	Overall Rebound Index	Selected Rebound Index	Average Rebound Index	Comp. Strength (N/mm ²)	
14	Column-5	1	828	211.3	3.919	Direct Method	28,20,30,28,30	30,28,30	29.0	23.8	Evident
		2	192.4	4.304	28,30,28,26,30		28,30,28	29.0	23.8		
15	Column-5	3	182.4	4.539	Direct Method	28,30,28,30,30	28,30,28	29.3	24.3	Evident	
		2	192.4	4.304		28,30,28,30,30	30,28,30	29.3	24.3		
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**THICKNESS MEASUREMENT BY ULTRASONIC GAUGE AND
DYE PENETRATION TEST RESULTS.**

TABLE-2

Sl. No.	Material	Thickness (mm)	Ultrasonic Gauge Reading (mm)	Dye Penetration Test Result
1	Aluminum	1.5	1.5	Pass
2	Steel	2.0	2.0	Pass
3	Brass	1.0	1.0	Pass
4	Copper	1.5	1.5	Pass
5	Cast Iron	2.5	2.5	Pass
6	Stainless Steel	1.5	1.5	Pass
7	Aluminum	1.5	1.5	Pass
8	Steel	2.0	2.0	Pass
9	Brass	1.0	1.0	Pass
10	Copper	1.5	1.5	Pass
11	Cast Iron	2.5	2.5	Pass
12	Stainless Steel	1.5	1.5	Pass