REPORT
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INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRECE LEVEL OVER HEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA

NOVEMBER 2020

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INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVER HEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA

NOVEMBER 2020

Report on	:	Investigation of distress in Basement floor& terrace level overhead tanks of Army Welfare Housing Organisation "Chanderkunj Army towers"at Silver Sand Island, Vytilla, Kochi, Kerala
Report for	:	M/s Army Welfare Housing Organization (AWHO) Vytilla, Kochi, Kerala.
Reference	:	Ref: SPI/621/2020-21 dated 15th October 2020
Period of Investigation	:	21st to 27th October 2020
Investigation carried out under the guidance of	:	Mr. Mohankumar Head-South Asia Region-NDT & RR Services Mr. Avinash J Technical Manager-NDT & RR Mr. Girish R Manager-NDT M/s Bureau Veritas (India) Pvt Ltd, Bengaluru
Investigation carried out by:		Mr. Mohanraj R Senior Engineer –NDT Mr. Varun K Engineer-NDT Mr. Ramesh Raju Senior Technician Mr. Sebin Thomas Das Engineer-NDT Mr. Ranjith Senior Technician M/s Bureau Veritas (India) Pvt Ltd, Bengaluru, Kochi & Chennai
Investigation carried out in the Presence of	:	Mr. Col MD Nair Project Director M/s Army Welfare Housing Organisation (AWHO)

CHANDERKUNJ ARMY TOWERS,
AWHO, VYTILLA, KOCHI

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Vice President

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Manager

Residential Welfare Association (RWA)
Managing committee, Chanderkunj Army towers
Kochi

Date of submission of report : 03rd December 2020

CONTENTS

A. INTRODUCTION

The existing **Army Welfare Housing Organisation "Chanderkunj Army Towers"** residential apartment building located at Silver Sand Island, Vytilla, Kochi, Kerala is a conventional RC framed structure with infilled masonry walls. The residential complex consists of three towers namely A, B & C.

The Tower B & C comprises of common basement, Stilt floor plus twenty eight upper floors with Helipad in Terrace and Tower A comprises of stilt floor plus fourteen upper floors. The residential blocks were reported to be constructed about 4 years back and since then most of the flats were occupied.

Off late, the concerned authorities of M/s Army Welfare Housing Organisation (AWHO) and Residential Welfare Association (RWA) were observed distress features such as Cracks, spalling of concrete, exposure of rebars, continuous leakage/seepage of water from RC retaining wall & slab in the basements of Tower B & C and dampness/ damp patches in container walls of overhead tanks of Tower A, B & C. Hence, a reference was made to M/s Bureau Veritas India Pvt. Ltd, Kochi to investigate the identified basement floor & overhead tanks and to suggest appropriate restoration & corrective measures.

In response to this, a detailed investigative study was carried out by M/s Bureau Veritas India Pvt. Ltd from 21st Oct to 27th Oct 2020 by conducting visual inspection, various Non-Destructive & Semi destructive tests to assess the quality/strength of concrete in RC members, Corrosion studies to assess the probability of corrosion in rebar's & laboratory tests to assess the Chloride content, Sulphate content & pH level in concrete samples. This report in brief, summarizes the outcome of the investigative study, recommended measures and conclusion thereon.

B. PHYSICAL OBSERVATIONS

Following are the physical observations made consequent to the detailed inspection of basement floor, stilt floor & overhead tanks of the Towers.

Ground and external side (Tower A, B & C)

- No visible signs of settlement in foundation system were observed in any part of the building.
- The tower B & C comprises of Common basement.

- Car parking was observed to be provided at podium level between the three towers A, B & C
- Screed concrete was observed to be provided for basement roof slab & drive way regions.

(Ref -road development drawing no: AR –WD-RED.117-015 rev no. 07)

- The entire drive way was observed to be constructed with paver blocks floor on well compacted subgrade, stone soling & water bound macadam and grit.

(Ref -road development drawing no: AR –WD-RED.117-015 rev no. 07)

- The drive way at Northwest corner nearer to ventilation duct, RCC concrete floor laid over well compacted subgrade, stone soling, water bound macadam, grit and PCC.

(Ref -road development drawing no: AR –WD-RED.117-015 rev no.07)

- Expansion joint was observed to be treated /provided/filled with L-shape 6mm plate in basement roof slab between tower –A, B & C and screed concrete provided region of the drive way.
- Rainwater trench with inner smooth finish of size 900mm x 500 mm was observed to be provided at all the three towers at a distance of 6 meter from retaining wall at podium level.
- Except at North West corner of tower -C, rainwater trench was observed to be provided at distance of one meter from retaining wall at podium level.
- Water Lake was observed at approximate distance of 600m to 800m at South face & west face from the compound wall. Further, lake was observed at approximate distance of 100m at Northwest corner face from the compound wall.
- Gardening was observed nearer to compound wall at a distance of 7 meter from retaining wall at North side opposite to Tower-B.
- Patch-up work was observed on drive way screed concrete at isolated locations.
- Dampness was observed on ramp side walls and pressure grouting treatment was observed to be provided for ramp side walls at isolated locations.
- The entrance portion of the ramp was observed to be covered with Galvanized sheet roof.

(Refer Photographs)

Basement floor (Tower B & C):

- Severe leakage / dampness were observed in peripheral retaining wall at isolated locations. Further these leakage regions were observed to be repaired by grouting technique. In spite of this leakages are still persist in these locations.

(Ref: Grouting adopted specification earlier was shared by customer)

- Pressure grouting treatment was observed to be carried out in RC slab to arrest the leakage at many locations

(Ref: Grouting adopted specification earlier was shared by customer)

- Leakage / dampness were observed in retaining wall at 1.5 meter level (first lift) from bottom at most of the locations.(height of retaining wall 3.62m)
- Dampness, Spalling of cover concrete and exposure of corroded rebars were observed in RC slab at various locations.
- Peeling of paint was observed in RC slab at various locations.
- Patch up repair works was observed in ceiling slab at various locations.
- Patch up repair works was observed on RC columns & beams at various locations.
- Cracks were observed in RC Column, Beam & corbel/bracket portion at few locations.
- Dampness, damp patches, leakages & peeling of paint were observed in retaining wall at isolated locations. However, it was observed to be more at North & North West corner of the retaining wall.
- Surface drainage system connected with network of pipelines (embedded in floor concrete) was observed in drive way area common sump to drive out seepage water from floor slab.

(Refer Photographs)

Over Head Tank (Tower A, B & C)

- Peeling of paint was observed in RC beams & slab at few locations.
- Patch up repair works was observed on RC beams & slab at various locations.
- Cracks were observed in RC beams at few locations.
- Dampness & dam patches were observed in RC beams & slab at few locations.

(Refer Photographs)

Note: At most of the locations patch up repair works were observed to be carried out. The material & methodology adopted to repair the distressed regions were not shared to us. Based on the existing distress and limited information about the treatment carried out, the distress mapping has been carried out.

C. PROBING TESTS

In order to assess the extent of distress & to assess the quality/strength of concrete in RC members of Basement, Stilt floor & Overhead Water tank following probing tests/studies were resorted to.

1. **Preparation of layout for distress mapping.**
2. **Semi-Destructive core test to assess in-situ strength of concrete in RC retaining wall.**
3. **Non-destructive tests to assess the quality / strength of in-situ concrete in RC members.**
   a. **Ultrasonic Pulse Velocity test on RC members.**
   b. **Rebound Hammer test on RC members.**
4. **Cover meter studies to assess the thickness of cover concrete provided to the rebars in RC members.**
5. **Half-cell potential difference test on RC members to assess the probability of corrosion.**
6. **Carbonation test on RC members to assess the loss of alkalinity in concrete.**
7. **Chemical Analysis on concrete samples to assess.**
   a) Chloride content
   b) Sulphate content
   c) Determination of pH value.

1. Preparation of layout for distress mapping.

A detailed physical measurement was carried to prepare the layout drawing of the identified floors & terrace level water tanks along with distressed mapping.

(Refer Sketch DWG.REF. No.01 to 08)

2. Semi-Destructive core test to assess in-situ strength of concrete in RC retaining wall.

In order to assess the compressive strength of in-situ concrete at basement floor RC retaining wall, Semi- destructive core test was resorted. Six numbers (6 nos.) of concrete core samples were extracted from RC retaining wall at random by using **Hilti -200** core cutting machine of German make for laboratory tests. The extracted core samples were subjected to compressive strength test after necessary trimming and capping as per the guidelines in **IS: 516-Part 4:2018**. The results of the test are tabulated in **Table-1**.

The compressive strength of in-situ concrete in the tested core samples extracted from identified Basement floor RC retaining wall is found to be in the range of **26.3 N/sq.mm to 31.1 N/sq.mm.**

Acceptance Criteria [As per clause 17.4.3 of IS: 456-2000-(RA-2011)]:
Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85% of the cube strength of the grade of concrete specified for the corresponding age and no individual core has a strength less than 75%.

3. Non-destructive tests to assess the quality / strength of in-situ concrete in RC members.

a. Ultrasonic Pulse Velocity test on RC members.

Ultrasonic Pulse Velocity test was conducted on RC members at random in Basement floor of Tower B & C, Stilt floor of Tower A and Over Head Tanks of Tower-A, B &C to assess the quality of in-situ concrete. The test was conducted using "PUNDIT Lab+" (Portable Ultrasonic Non-destructive Digital Indicating Tester) equipment from M/s. Proceq, Switzerland as per the guidelines in Indian Standard IS: 13311- (Part-I)-1992-(Reaffirmed in 2013). Direct & Indirect method of test was adopted at site. The results of the test are tabulated in **Table-2** and quality grading chart is appended in **Table-2A**.

The Ultrasonic Pulse Velocity test results indicate that the quality of concrete in the tested RC members as per Table-1 of IS: 13311- (Part-I)-1992-(Reaffirmed in 2013) are as follows.

a. Stilt floor – Tower-A

1. RC Columns fall under the category of **"Good"** concrete.
2. RC Beam fall under the category of **"Good"** concrete.

b. Basement – Tower-B

1. RC Columns fall under the category of **"Good"** concrete
2. RC Beams fall under the category of **"Medium to Good"** concrete.
3. RC Retaining Wall fall under the category of **"Medium to Good"** concrete.
4. RC Slabs fall under the category of **"Good"** concrete.

c. Basement – Tower-C

1. RC Columns fall under the category of **"Medium to Good"** concrete.
2. RC Beams fall under the category of **"Good"** concrete.
3. RC Slab fall in the category of **"Medium"** concrete.

d. Basement – Parking-1

1. RC Columns fall under the category of **"Good"** concrete.
2. RC Beams fall under the category of **"Good"** concrete.

e. Basement – Parking-2

1. RC Columns fall under the category of **"Medium to Good"** concrete
2. RC Beams fall under the category of **"Good"** concrete.
3. RC Slabs fall under the category of **"Medium to Good"** concrete.

f. Basement – Parking-3

1. RC Columns fall under the category of **"Good"** concrete.
2. RC Beams fall under the category of **"Good"** concrete.
3. RC Retaining Wall fall under the category of **"Medium to Good"** concrete.
4. RC Slab fall under the category of **"Good"** concrete.

g. Over Head Tank – Tower-A

1. RC Columns fall under the category of **"Good"** concrete
2. RC Beams fall under the category of **"Good"** concrete.
3. RC Wall fall under the category of **"Good"** concrete.
4. RC Slab fall under the category of **"Good"** concrete.

h. Over Head Tank – Tower-B

1. RC Columns fall under the category of **"Medium to Good"** concrete
2. RC Beams fall under the category of **"Good"** concrete.
3. RC Walls fall under the category of **"Medium to Good"** concrete.
4. RC Slab fall under the category of **"Medium"** concrete.

i. Over Head Tank – Tower-C

1. RC Columns fall under the category of **"Good"** concrete
2. RC Beams fall under the category of **"Good"** concrete.
3. RC Wall fall under the category of **"Medium"** concrete.
4. RC Slab fall in the category of **"Good"** concrete.

b. Rebound Hammer test on RC members.

Rebound Hammer Test was carried out on RC members at random in Basement floor of Tower B & C, Stilt floor of Tower A and Over Head Tanks of Tower-A, B &C to assess the surface hardness / strength of concrete nearer to surface. The test was conducted using Schmidt Rebound Hammer from M/s. Proceq Switzerland as per the guidelines in Indian Standard IS: 13311-(Part-2)-

1992(Reaffirmed in 2013).

The position of the hammer was vertically upwards and horizontal during the test. The results of the test are tabulated in **Table-3** the corresponding reference strength chart is tabulated in **Table-3A.** From the results of Rebound Hammer test, it is indicated that the estimated compressive strength of concrete nearer to surface in the tested RC members is found be as detailed below.

a. Stilt floor – Tower-A

1. RC Columns – Found to be in the range of **33 N/sq.mm** to **34 N/sq.mm.**
2. RC Beam – Found to be **31 N/sq.mm.**

b. Basement – Tower-B

1. RC Columns – Found to be in the range of **31 N/sq.mm** to **32 N/sq.mm.**
2. RC Beams - Found to be in the range of **30 N/sq.mm** to **32 N/sq.mm.**
3. RC Retaining Wall – Found to be in the range of **31 N/sq.mm** to **32 N/sq.mm.**
4. RC Slabs – Found to be in the range of **30 N/sq.mm** to **31 N/sq.mm.**

c. Basement – Tower-C

1. RC Columns –Found to be in the range of **30 N/sq.mm** to **33 N/sq.mm.**
2. RC Beams –Found to be in the range of **30 N/sq.mm** to **31 N/sq.mm.**
3. RC Slab –Found to be **32 N/sq.mm.**

d. Basement – Parking-1

1. RC Columns-Found to be in the range of **30 N/sq.mm** to **32 N/sq.mm.**
2. RC Beams-Found to be in the range of **29 N/sq.mm** to **31 N/sq.mm.**
3. RC Slabs –Found to be in the range of **28 N/sq.mm** to **29 N/sq.mm.**

e. Basement – Parking-2

1. RC Columns-Found to be in the range of **31 N/sq.mm** to **32 N/sq.mm.**
2. RC Beams –Found to be in the range of **29 N/sq.mm** to **33 N/sq.mm.**
3. RC Slabs –Found to be in the range of **30 N/sq.mm** to **32 N/sq.mm.**

f. Basement – Parking-3

1. RC Columns –Found to be in the range of **30 N/sq.mm** to **34 N/sq.mm.**
2. RC Beams – Found to be **31 N/sq.mm.**
3. RC Retaining Wall –Found to be in the range of **28 N/sq.mm** to **32 N/sq.mm.**
4. RC Slab –Found to be **32 N/sq.mm.**

g. Over Head Tank – Tower-A

1. RC Columns –Found to be in the range of **28 N/sq.mm** to **29 N/sq.mm.**
2. RC Beams –Found to be **28 N/sq.mm.**
3. RC Wall- Found to be **26 N/sq.mm.**

4. RC Slab- Found to be **31 N/sq.mm.**

h. Over Head Tank – Tower-B

1. RC Columns – Found to be **27 N/sq.mm.**
2. RC Beams – Found to be in the range of **26 N/sq.mm** to **30 N/sq.mm.**
3. RC Wall – Found to be in the range of **26 N/sq.mm** to **27 N/sq.mm.**
4. RC Slabs – Found to be **27 N/sq.mm.**

i. Over Head Tank – Tower-C

1. RC Columns –Found to be **28 N/sq.mm.**
2. RC Beams-Found to be in the range of **28 N/sq.mm** to **30 N/sq.mm.**
3. RC Wall –Found to be **26 N/sq.mm.**.
4. RC Slab –Found to be **27 N/sq.mm.**

Note: However, as per clause 8.1 of **IS: 13311-(Part-II)-1992-(Reaffirmed 2013)** the accuracy of strength estimation may vary by ±25%.

4. Cover meter studies to assess the thickness of cover concrete provided to the rebars in RC members

Cover meter studies were carried out on RC members at random in Basement floor of Tower B & C, Stilt floor of Tower A and Over Head Tanks of Tower-A, B &C in order to assess the thickness of cover concrete provided to the rebars. The test was conducted using **Profometer-5^{+}** from **M/s. Proceq, Switzerland** as per the guidelines **in BS: 1881(Part 204)-1998** & as per manufacturer's manual. The results of the tests were recorded & tabulated in **Table -4.**

From the results of the Cover meter studies, it is indicated that cover concrete provided to the rebars in tested RC Members is found to be as detailed below.
(The measured concrete thickness is including of plaster.)

a. Stilt floor – Tower-A

1. RC Columns – Found to be in the range of **35mm** to **40 mm.**
2. RC Beam – Found to be **28 mm to 33 mm.**

b. Basement – Tower-B

1. RC Columns – Found to be in the range of **40 mm** to **60 mm.**
2. RC Beams - Found to be in the range of **28 mm** to **38 mm.**
3. RC Retaining Walls – Found to be in the range of **35 mm** to **55 mm.**
4. RC Slabs – Found to be in the range of **25 mm** to **32 mm.**

c. Basement – Tower-C

1. RC Columns –Found to be in the range of **40 mm** to **60 mm.**
2. RC Beams –Found to be in the range of **28 mm** to **40 mm.**
3. RC Slab –Found to be **27 mm to 32 mm.**

d. Basement – Parking-1

1. RC Columns-Found to be in the range of **40 mm** to **65 mm.**
2. RC Beams-Found to be in the range of **30 mm** to **38 N/sq.mm.**
3. RC Slabs –Found to be in the range of **25 mm** to **35 mm.**

e. Basement – Parking-2

1. RC Columns-Found to be in the range of **52 mm** to **57 mm.**
2. RC Beams –Found to be in the range of **28 mm** to **35 mm.**
3. RC Slabs –Found to be in the range of **28 mm** to **34 N/sq.mm.**

f. Basement – Parking-3

1. RC Columns –Found to be in the range of **40 mm** to **58 mm.**
2. RC Beams – Found to be **25 mm to 35 mm.**
3. RC Retaining Wall –Found to be in the range of **25 mm** to **45 mm.**
4. RC Slab –Found to be **25 mm to 30 mm.**

g. Over Head Tank – Tower-A

1. RC Columns –Found to be in the range of **34 mm to 60 mm.**
2. RC Beams –Found to be **25 mm to 31 mm.**
3. RC Wall- Found to be **33 mm to 38 mm.**
4. RC Slab- Found to be **30 mm 35 mm.**

h. Over Head Tank – Tower-B

1. RC Columns – Found to be **33 mm to 43 mm.**
2. RC Beams – Found to be in the range of **30 mm** to **43 mm.**
3. RC Wall – Found to be in the range of **35 mm** to **45 mm.**
4. RC Slabs – Found to be **28 mm to 33 mm.**

i. Over Head Tank – Tower-C

1. RC Columns –Found to be **33 mm to 40 mm.**
2. RC Beams-Found to be in the range of **30 mm** to **36 mm.**
3. RC Wall –Found to be **53 mm to 58 mm.**
4. RC Slab –Found to be **33 mm to 40 mm.**

5. Half-cell potential difference test on RC members to assess the probability of corrosion.

Half-Cell Potential difference measurement test was carried out on RC members at random in Basement floor of Tower B & C, Stilt floor of Tower A and Over Head Tanks of Tower-A, B &C to assess the probability of corrosion in embedded reinforcing bars by using Copper-Copper-Sulphate-Half-Cell. The test was conducted using **CANIN** equipment from **M/s. Proceq, Switzerland** as per the guideline in **ASTM C876-15** & furnished by the manufacturer's manual. The results of the test are tabulated in **Table-5** and corresponding reference chart is appended in **Table–5A.**

The results of Half-cell potential difference measurement test indicate that the probability of corrosion in tested reinforcing bars of R C members are found to be as detailed below.

a. Basement- Tower-B

1. RC Columns- Found to be in the range of **"High probability of no corrosion to Uncertainty of corrosion"**
2. RC Slab- Found to be in the range of **"High probability of no corrosion to Uncertainty of corrosion".**

b. Basement- Tower-C

1. RC Columns – Found to be in the range of **"High probability of no corrosion to Uncertainty of corrosion".**
2. RC Column & Beam Junction – Found to be in the range of **"High probability of no corrosion to Uncertainty of corrosion".**
3. RC Beam – Found to be in the range of **"High probability of no corrosion".**

C. Basement- Parking-1

RC Slab-Found to be in the range of **"High probability of no corrosion".**

d. Basement- Parking-2

1. RC Beam –Found to be in the range of **"High probability of no corrosion".**
2. RC Slab – Found to be in the range of **"High probability of no corrosion".**

e. Stilt floor- Tower-A

RC Beam – Found to be in the range of **"High probability of no corrosion".**

f. Over Head Tank - Tower-A

RC Beam- Found to be in the range of **"High probability of no corrosion".**

g. Over Head Tank - Tower-B

RC Beam – Found to be in the range of **"High probability of no corrosion".**

h. Over Head Tank - Tower-C

RC Beam- Found to be in the range of **"High probability of no corrosion".**

6. Carbonation test on RC members to assess the loss of alkalinity in concrete.

Carbonation test was carried out on RC members at random in Basement floor of Tower B & C, Stilt floor of Tower A and Over Head Tanks of Tower-A, B &C by using phenolphthalein **indicator of 1gm dissolved in 70 ml ethyl alcohol & diluted to 100ml with distilled or deionized water** to assess the loss of alkalinity in cover concrete. The test was conducted as per the guidelines in **BS: 1881-Part (201).** The results of the test are tabulated in **Table-6.**

The results of the carbonation test indicate that the carbonation front in the tested RC members of Basement, Stilt floor & Over Head Tank is restricted to surface only. The measured depth of carbonation in the tested RC members is found to be in the range of **5 to 10mm.**

7. Chemical Analysis on collected concrete samples to assess.

a) Chloride content.

Chloride determination test is carried out on concrete samples collected from RC members of Basement floor, Stilt floor and Over Head Tanks at random to estimate the level of chlorides in the concrete as per the guidelines in **IS 14959(Part 2)-2001.**

The presence of higher amount of chlorides in concrete surrounding the reinforcement will result in corrosion of rebars. The quantity of chlorides in concrete is determined generally by chemical analysis. The results of the tests are tabulated in **Table-7.**

The results of chloride content test in concrete indicates that the level of chlorides in the tested RC members is found to be in the range of **0.028 kg/cum** to **1.12 kg/cum** as against the permissible limit of **0.6 kg/cum.**

b) Sulphate content

Sulphate determination test in concrete is carried out on concrete samples collected from RC members of Basement floor, Stilt floor and Over Head tanks at random to estimate the level of sulphates in the concrete as per the guidelines in **IS: 4032-1985 (RA 2019)** . The presence of higher amount of sulphates in concrete will result in reaction of calcium present in cement with sulphates, resulting in deterioration of concrete. The quantity of sulphates in concrete is determined generally by chemical analysis and is expressed in terms of percentage of sulphates by weight of concrete. The

results of the test are tabulated in **Table-7.**

The results of Sulphate content test on concrete indicates that the level of sulphate in RC members is found to be in the range of **0.09 % to 0.71 %** as against the permissible limit of **4%**

c) Level of pH

The level of pH value is carried out on concrete samples collected from RC members of Basement floor, Stilt floor and Over Head at random & tested as per the guidelines in **NCB 9th International Seminar Vol.3 Page 500 / IS: 2720 (Part 26): 1987 (Reaffirmed 2016).**

The level of pH in fresh concrete is generally in the range of 12 to 14. Due to carbonation, the pH value of concrete will be reduced considerably. When the pH value fall below about 10, the alkalinity of the concrete will not be adequate to protect the rebars against corrosion.

The results of the tests are tabulated in **Table-7.**

The pH value of the interior concrete in the tested RC members is found to be in the range of **10.20 to 12.30.**

D. INFERENCES.

Following are the inferences drawn, based on the detailed observations, results of probing tests.

1. From the observations of extracted concrete core samples, it is evident that the extracted Samples are uniform, homogeneous and free from voids / honeycombs. From the concrete core test results, it is inferred that the strength of concrete in the tested basement floor RC retaining walls were found to be satisfactory.
2. From the results of Non-destructive ultrasonic pulse velocity & rebound hammer tests, it Inferred that the quality of concrete in the tested RC members were found to be **satisfactory**.
3. From the results of Cover meter studies, it is inferred that the cover concrete provided to the rebar were **adequate** in most of the tested RC members except at isolated locations where over concrete was observed to be less..
4. From the results of Half-Cell Potential Measurement test, it is inferred that the probability of corrosion fall in the category of **"High probability of no corrosion to Uncertainty of corrosion" (i.e., Initial stage to Moderate stage)** in the tested RC members.
5. From the results of Carbonation test, it is inferred that the carbonation **is limited to surface concrete** only in the tested RC members.

6. From the results of chemical tests on concrete samples collected from RC members it is Inferred that the Chloride content in most of the tested samples is found to be with in the Permissible limit except for the concrete sample of column & slab of Basement floor at Tower –B, where the chloride content exceeds the permissible limit & Sulphate content is found to be with in the permissible limit. Further, the pH value of the tested concrete is found to be satisfactory.
7. Seepage of water in basement roof slab & retaining wall is essentially due to very high water table in the vicinity of the area .
8. Leakage & damp patches in peripheral retaining walls in basement floor are essentially due to in-effective water proof treatment at the junctions of the wall, the construction joint regions of the wall leading to ingress of water in to the basement through retaining walls. (Further, it is reported that, during rains leakage from retaining wall is severe).
9. Leakage & damp patches in peripheral retaining walls & roof slab at basement floor are essentially due to leakage of water from the ineffective joints i.e., between the screed concrete & paving block road.
10. Stagnation of water over roof slab is essentially due to improper slope provided towards disposal of rain water.
11. Dampness/damp patches in basement ceiling slab is essentially due to continuous leakage of water from the roof slab.
12. Peeling of paint may be due to dripping of water from ceiling slab at few locations.
13. Cracks in RC members of overhead water tanks may be due to corrosion of rebar's. Corrosion of rebar's is essentially due to carbonation of cover concrete & ingress of moisture in to RC members.

Based on the type of distress observed and results of probing tests, it is inferred that the distress in basement floors is in the form of cracks, dampness/damp patches, leakage & seepage etc., Further, the distress in RC members of the overhead water tank is in in the form of cracks. Cracks is mainly due to corrosion of rebars & corrosion is mainly due to ingress of moisture over a period of time. The distressed RC members of basement floor & Overhead water tanks as it stands calls for appropriate restoration /corrective measures to render it normal.

The existing cracks in RC members are restricted to plaster at most of the locations the cracks in RC slab is mainly due to shrinkage.

E. RESTORATION/CORRECTIVE MEASURES

Based on the above detailed studies & inferences drawn, appropriate recommendations are made:

1. **Treatment for peripheral RC retaining wall to prevent seepage of water**
2. **Treatment for corrosion distressed regions of RC slabs**
3. **Treatment for cracks in RC Ceiling slab**
4. **Treatment for dampness in bottom slab of water tanks.**

1. Treatment for peripheral RC retaining wall to prevent seepage of water

a. All existing Plaster / debonded cover concrete shall be completely removed by gentle chipping to expose hard / sound concrete.

b. V' groove of 10 mm shall be made along the lift interface/ crack/construction joint and filled with polymer modified mortar.

c. 12 mm dia holes, 75 mm deep shall be drilled along the crack/joint to fix PVC nozzles for grouting.

d. 10 mm dia PVC nozzles shall be fixed into the drilled holes using anchor grout as per specification.

e. Pressure grouting shall be done with a pressure of 3 to 4 Kg/sq.cm using low viscosity epoxy / modified poly-acrylic/acrylate resign gel injection grouting through the nozzles as per specification enclosed. The nozzles shall be cut in flush with the surface and plugged.

(Refer sketch DWG.REF.No.09)

Note:

The above treatment is shall be carried out from negative side. Since the observed distress such as dampness, damp patches &seepage in retaining walls are minor in nature, it is recommended to carry out the grouting & wait for two seasons.

If the problem still persists then, treatment shall be carried from the positive side (Since the cost implication is high in treating from positive side, it has been kept as the secondary option) as detailed below.

OPTIONAL

Treatment for peripheral RC retaining wall to prevent seepage of water from positive side

a. Existing landscaping/paver blocks/PCC/earth filling shall be removed completely without damaging the parent concrete of retaining wall to expose the distressed/damped portion of the retaining wall.

b. The exposed concrete surface shall be inspected and checked for any surface honeycombs, cracks/distress if any

c. The existing cracks & honeycombs in the retaining wall (if any) shall be grouted using Low viscosity epoxy /modified Poly-acrylic acrylate resign gel chemical as per manufacture's specification.

d. The entire concrete surface shall be providing with water proofing plaster mixed with silica fumes and polypropylene fibers.

e. 4 mm thick APP membrane shall be provided on the plastered surface with adequate torching as per manufacturer's specification.

f. Backfilling shall be carried using approved quality soil in layers to 95% degree of compaction.

g. 100mm thick screed concrete shall be provided over 100mm thick soling with adequate slope to drain off water and avoid water entering the treated regions.

2. Treatment for corrosion distressed regions of RC slabs

a. All loose plaster / cover concrete in the RC members shall be completely removed by gentle chipping to expose hard / sound concrete surface.

b. Exposed reinforcing bars shall be thoroughly cleaned with wire brush and emery cloth or by mechanical buffing wheel to remove rust, scales etc.

c. Exposed concrete surface shall be thoroughly cleaned with wire brush to remove color wash air and water jet to remove dust particles.

d. Two coats of anti-corrosive chemical shall be provided on the exposed and cleaned reinforcing bars as per manufacturer's specification.

e. A coat of corrosion inhibitor coating to be provided on cleaned concrete surface as per manufacturer's specification.

f. 20 mm thick polymer modified mortar plaster (with chicken mesh fixed with 'U' nails to concrete surface) shall be provided and finished in flush with the adjacent surface over a coat of primer as per manufacturer's specification and cured.

Note: If the thickness of structural grade polymer / latex modified mortar layer exceeds 20 mm, a layer of weld mesh 50 x 50 x 3 mm

(Refer sketch DWG.REF.No.10)

3. Treatment for cracks in RC Ceiling slab

The existing cracks in basement ceiling slab shall be treated by pressure grouting with low viscosity epoxy / monomer after treating the crack with epoxy putty along the crack and fixing PVC nozzles for pressure grouting at 300mm c/c along the crack as per specification.

4. Treatment for dampness in bottom slab of water tanks.

a. The existing plaster/debonded cover concrete shall be removed completely by gentle chipping to expose hard/sound concrete.

b. 12mm dia holes, 75mm deep shall be drilled 100mm c/c to fix PVC nozzles for grouting.

c. 10mm dia PVC nozzles shall be fixed to the drilled holes using anchor grout as per specification.

d. Pressure grouting shall be carried out through the nozzles with low viscosity epoxy/modified Poly-acrylic/acrylate region gel injection grouting as per specification. The nozzles shall be cut in flush with the surface & plugged.

F. GENERAL RECOMMENDATIONS

In addition to the above mentioned recommended measures, following are the general recommendations:

- Joint between ramp wall & paver block road at south face & east face shall be provided with elastomeric / water resistant sealant/bitumen to avoid water entering adjacent to wall.
- Corrosion activities shall be monitored in RC members periodically (i.e., at least once in a year).
- Periodic maintenance of the building shall be strictly adhered to for effective functioning and enhancing the life of the structure.

G. CONCLUDING REMARKS

Based on the detailed assessment study carried out on basement floor of tower B & C, stilt floor of tower A and terrace level overhead water tanks in tower A, B & C of the existing **"CHANDERKUNJ" Army Towers of Army Welfare Housing Organisation (AWHO) Residential Apartment Building"** located at Silver Sand Island, Vytilla, Kochi, Kerala India as it stands is found to be free from any major structural defects and quality & strength of concrete in the tested RC members are satisfactory.

However, various functional related distress features observed calls for appropriate treatment to avoid further deterioration and to improve the durability and longevity of the structure.

The existing distress is essentially due to inbuilt chlorides in few RC members, seepage in peripheral retaining wall, leakage in roof slabs, leakages through construction joints and moderate corrosion in RC members.

On carrying out the recommended remedial measures effectively under the guidance of experienced technical personnel by an experienced agency, the problem will be minimized

After carrying out the recommended remedial measures effectively it is mandatory to carry out periodic maintenance of the building as per standard practice.

K. VARUN
Engineer-NDT

GIRISH R
Assistant Manager-NDT

AVINASH J
Technical Manager-NDT & RR

****

APPENDIX

TABLES

TABLE -1

Project	:	"Army Welfare Housing Organizations" (AWHO) Silver Sand Land, Kochi
Core extracted from	:	Basement (Tower-B, C & Parking-1, 2 & 3),R C Retaining Wall
Date of core extraction	:	27th October 2020
Grade of concrete	:	M30*
Date of test	:	31st October 2020
Age of concrete	:	More than 28 days*
Capping material used	:	EP 10 HARDENER (PART A) AND EP 10 BASE (PART B) FROM M/s. Fosroc Conbextra.
Technical references	:	IS:516-Part 4:2018

Sl. No.	Member / Grid Identification*	Core Length** (l) (mm)	Core Dia (d) (mm)	Core Wt.** (Kg.)	Failure load (kN)	Corrected Core Comp. Strength# (N/sq.mm)	l/d Ratio	Correction factor for (l/d) ratio+	Corrected Cyl. Comp Strength (N/sq.mm)	Equivalent Cube Comp. Strength ++ (N/sq.mm)	Type of Failure
1	Dd / 20d-21d' (Parking-1,South Area)	75	68	0.599	89.9	26.23	1.103	0.901	23.64	29.6	Typical compressive failure
2	Vd / 13d-14d (Parking-2,North Area)	107	68	0.900	89.6	26.14	1.574	0.953	24.92	31.1	
3	Vd-Wd/1c-7d (Tower-C,North-West Area)	105	68	0.859	75.9	22.14	1.544	0.950	21.03	26.3	
4	Hd-Ld / 1d (Parking-3,West Area)	72	68	0.641	88.3	25.76	1.059	0.896	23.10	28.9	
5	12c / Kc-Lc(Tower B ,South area)	82	68	0.691	80.3	23.43	1.206	0.913	21.38	26.7	
6	5d-6d / Bd (Parking-3 ,South Area)	104	68	0.870	76.5	22.32	1.529	0.948	21.16	26.5	

Notes:

* As furnished by the client

** Core length and core weight after trimming and capping.

After applying correction factor for diameter of core which is less than 100 mm (i.e.Corrected Core Comp Strength, = Core Comp Strength * 1.06) as per IS:516-Part 4:2018 , Clause: 8.4.1

\+ For l/d ratio, correction factor = 0.11(l/d)+0.78 as per IS:516-Part 4 : 2018 , Clause: 8.4.2

++ Equivalent cube compressive strength = 1.25 x corrected cylinder compressive strength as per as per IS:516-Part 4 : 2018 , Clause: 8.4.2

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TABLE - 2
RESULTS OF ULTRASONIC PULSE VELOCITY TEST

Project	:	Army Welfare Housing Organization Chanderkunj Army Towers at Silver Sand Island, Vytilla, Kochi, Kerala.
Members tested	:	RC Columns, Beams, Walls & Slabs (With Plater)
Period of test	:	21st to 27th October 2020
Grade of concrete	:	M30*
Age of concrete	:	More than 28 Days*
Test instrument	:	Pundit Lab+ (Portable Ultrasonic Non- Destructive Digital Indicating Tester)
Make	:	M/s. Proceq, Switzerland
Test method	:	Direct & Indirect
Technical reference	:	1. IS: 13311-(Part-I)-1992-(Reaffirmed in 2013) Non-Destructive Testing of concrete, Methods of Test, Part-1 Ultrasonic Pulse Velocity. 2. Instrument manual furnished by M/s. Proceq, Switzerland

Sl. No.	Member / Floor Identification*	Grid Identification*	Average Pulse Velocity (Km/Sec)	Remarks
1	2	3	4	5
	Tower-B, Basement			**Table Refer – 2A for Quality Grading of in-situ concrete**
1	RC Column	Mb-1b	3.8	
2		Lb-8b	4.0	
3		Lb-11b	3.9	
4		Kb-12b	4.2	

* As furnished by the customer
* Refer sketch **DWG.REF.No. 01 to 04** for Floor / Member / Grid Identification.

1	2	3	4	5
Tower-B, Basement				
5	RC Column	Kb-5b	3.9	**Table Refer – 2A for Quality Grading of in-situ concrete**
6		Cb-9b	4.1	
7		Ab-Bb/3b	3.6	
8		Ab-1b	4.0	
9	Retaining Wall	Hb/10b-11b	3.6	
10		Hb-Eb/12b	3.0	
11		Cb-Bb/12b	3.6	
12	RC Beam	Mb/3b-10b	4.2	
13		Cb-Kb/1b	4.4	
14		Eb-Hb/1b-1b'	4.0	
15		Kb/11b-12b	3.7	
16		Hb/11b-12b	3.4	
17		Ab/5b-8b	4.0	
18	RC Slab	Kb-Lb/11b-12b	3.6	
19		Eb-Cb/11b-12b	3.8	
Tower-C, Basement				
20	RC Column	Ac-11c	3.3	
21		Cc-6c	3.6	
22		Ec/10c-11c	3.1	
23		Kc-8c	3.6	
24		Kc-12c	3.4	
25		Lc-2c	3.7	

1	2	3	4	5
Tower-C, Basement				**Table Refer – 2A for Quality Grading of in-situ concrete**
26	RC Column	Mc-3c	3.1	
27		Bc-8c	3.6	
28	RC Beam	Mc/10c-11c	3.9	
29		Hc/11c-12c	3.8	
30		Cc/2c-3c	4.2	
31	RC Slab	Cc-Ec/2c-3c	3.5	
Parking-1, Basement				
32	RC Column	Kd-19d	3.6	
33		Nd-24d	3.9	
34		Hd/12b-15d	4.0	
35	RC Beam	Kd-Nd/24d	3.8	
36		Nd/19d-20d	4.0	
37		Rd/12d-15d	3.8	
Parking-2, Basement				
38	RC Column	Qd-13d	3.6	
39		Jd-12d	3.4	
40	RC Beam	Jd/13d-14d	4.0	
41		Vd-Ud/12d	3.9	
42		Jd-Gd/12d-13d	4.0	

1	2	3	4	5
Parking-2, Basement				
43	RC Slab	Md-Jd/13d-14d	3.5	
44		Jd-Md/14d-Ab	3.7	
Parking-3, Basement				
45	RC Column	Ed-6d	4.1	
46		Hd-4d	4.2	
47		Ld-6d	3.9	
48		Vd-8d	3.6	
49	Retaining Wall	Hd-Ld/1d	3.4	
50		Rd-Ud/6d	3.7	
51		Wd/8d-9d	3.6	
52		Wd/10d-11d	3.5	
53		Bb-Cb/1b'	3.1	
54		Lb-Mb/1b'	3.1	
55		Rd-Sd/23d-24d	3.1	
56		Nd-Kd/26d	3.1	
57		Dd/18d-20d	3.4	
58	RC Beam	Rd-Sd/1c-6d	3.7	
59		Hd/4d-5d	3.7	
60		Ed-Hd/3d	3.6	
61	RC Slab	Bd-Ed/2d-3d	4.0	

Table Refer – 2A for Quality Grading of in-situ concrete

1	2	3	4	5
Tower-A, Stilt Floor				
62	RC Column	Ca-1a	4.0	
63		Ka-12a	4.1	
64	RC Beam	Ha/3a-6a	3.9	
Tower-A, Water Tank				
65	RC Column	Ka-11a	4.2	
66		Ka-12a	3.6	
67	RC Beam	Ha/11a-12a	4.0	
68		Ka/9a-11a	4.1	
69	RC Wall	Ha/6a-9a	3.9	**Table Refer – 2A for Quality Grading of in-situ concrete**
70	RC Slab	Ha-Ka/6a-9a	4.4	
Tower-B, Water Tank				
71	RC Column	Bb-10b	4.0	
72		Cb-10b	3.5	
73	RC Beam	Eb-Cb/10b	4.1	
74		Bb-Cb/10b-11b	4.4	
75	RC Wall	Eb-Hb/10b	3.7	
76		Cb-Eb/10b	3.1	
77		Cb/9b-10b	3.1	
78	RC Slab	Bb-Cb/9b-10b	3.4	

1	2	3	4	5
Tower-C, Water Tank				**Table Refer – 2A for Quality Grading of in-situ concrete**
79	RC Column	Bc-10c	3.8	
80		Cc-10c	3.9	
81	RC Beam	Bc/9c-10c	4.5	
82		Ec-Cc/9c-10c	3.9	
83		Ec-Hc/10c-11c	3.7	
84	RC Wall	Ec-Hc/10c	3.1	
85	RC Slab	Cc-Bc/9c-10c	4.1	

TABLE-2A
REFERENCE QUALITY GRADING CHART FOR ULTRASONIC PULSE VELOCITY TEST

Instrument : PUNDIT LAB + [Portable Ultrasonic Non-Destructive Digital Indicating Tester]

Make : M/s. Proceq, Switzerland

Pulse Velocity (Km/sec)	Concrete Quality Grading
Below 3.0	Doubtful
3.1 to 3.5	Medium
3.6 to 4.5	Good
Above 4.5	Excellent

Note: Concrete quality grading for different velocity criterion as reproduced from Table-2 of IS:13311-(Part-I)-1992-(Reaffirmed in 2013).

TABLE-3

RESULTS OF REBOUND HAMMER TEST

Project	:	Army Welfare Housing Organization Chanderkunj Army Towers at Silver Sand Island, Vytilla ,Kochi, Kerala.
Members tested	:	RC Columns, Beams, Walls & Slabs
Period of test	:	21st to 27th October 2020
Grade of concrete	:	M30*
Age of concrete	:	More than 28 Days*
Test instrument	:	Schmidt Hammer
Make	:	M/s. Proceq, Switzerland
Position of hammer	:	Horizontal & Vertically Upwards
Technical references	:	1. Indian Standard IS: 13311-(Part-II)-1992- (Reaffirmed in 2013) 2. Instrument manual furnished by M/s. Proceq, Switzerland

Sl. No.	Member / Floor Identification*	Grid Identification*	Average Rebound number+	Remarks
1	2	3	4	5
Tower-B, Basement				**Refer Table - 3A for estimated compressive strength of in-situ concrete**
1	RC Column	Mb-1b	43	
2		Lb-8b	43	
3		Lb-11b	43	
4		Kb-12b	44	
5		Kb-5b	44	

* As furnished by the customer

* Refer sketch **DWG. REF. No. 01 to 04** for Floor / Member / Grid Identification.

+ After applying the necessary correction factor for position of hammer.

1	2	3	4	5
Tower-B, Basement				
6		Cb-9b	43	
7		Ab-Bb/3b	44	
8		Ab-1b	43	
9	RC Retaining Wall	Hb/10b-11b	44	
10		Hb-Eb/12b	43	
11		Cb-Bb/12b	44	
12	RC Beam	Mb/3b-10b	42	
13		Cb-Kb/1b	43	
14		Eb-Hb/1b-1b'	42	
15		Kb/11b-12b	44	
16		Hb/11b-12b	42	
17		Ab/5b-8b	43	
18	RC Slab	Kb-Lb/11b-12b	42	
19		Eb-Cb/11b-12b	43	
20		Eb-Cb/1b-1b'	42	
21		Mb-Lb/5b-3b	43	
Tower-C, Basement				
22	RC Column	Ac-11c	44	
23		Cc-6c	43	
24		Ec/10c-11c	45	
25		Kc-8c	44	
26		Kc-12c	44	
27		Lc-2c	44	
28		Mc-3c	42	
29		Bc-8c	44	
30	RC Beam	Mc/10c-11c	43	

Refer Table - 3A for estimated compressive strength of in-situ concrete

1	2	3	4	5
Tower-C, Basement				**Refer Table - 3A for estimated compressive strength of in-situ concrete**
31	RC Beam	Hc/11c-12c	43	
32		Cc/2c-3c	42	
33	RC Slab	Cc-Ec/2c-3c	44	
Parking-1, Basement				
34	RC Column	Kd-19d	42	
35		Nd-24d	42	
36		Hd/12b-15d	44	
37	RC Beam	Kd-Nd/24d	43	
38		Nd/19d-20d	41	
39		Rd/12d-15d	42	
40	RC Slab	Fd-Kd/23d-25d	41	
41		Hd-Ld/12d-15d	40	
Parking-2, Basement				
42	RC Column	Qd-13d	43	
43		Jd-12d	44	
44	RC Beam	Jd/13d-14d	45	
45		Vd-Ud/12d	41	
46		Jd-Gd/12d-13d	44	
47	RC Slab	Md-Jd/13d-14d	44	
48		Jd-Md/14d-Ab	42	
49		Vd-Ud/14d-Ab	42	

1	2	3	4	
Parking-3, Basement				**5**
50	RC Column	Ed-6d	46	**Refer Table - 3A for estimated compressive strength of in-situ concrete**
51		Hd-4d	46	
52		Ld-6d	42	
53		Vd-8d	42	
54	RC Retaining Wall	Hd-Ld/1d	42	
55		Rd-Ud/6d	44	
56		Wd/8d-9d	41	
57		Wd/10d-11d	43	
58		Bb-Cb/1b'	44	
59		Lb-Mb/1b'	43	
60		Rd-Sd/23d-24d	41	
61		Nd-Kd/26d	40	
62		Dd/18d-20d	41	
63	RC Beam	Rd-Sd/1c-6d	43	
64		Hd/4d-5d	43	
65		Ed-Hd/3d	43	
66	RC Slab	Bd-Ed/2d-3d	44	
Tower-A, Stilt Floor				
67	RC Column	Ca-1a	45	
68		Ka-12a	46	
69	RC Beam	Ha/3a-6a	43	

1	2	3	4	5
Tower-A, Water Tank				**Refer Table - 3A for estimated compressive strength of in-situ concrete**
70	RC Column	Ka-11a	41	
71		Ka-12a	40	
72	RC Beam	Ha/11a-12a	40	
73		Ka/9a-11a	40	
74	RC Wall	Ha/6a-9a	38	
75	RC Slab	Ha-Ka/6a-9a	43	
Tower-B, Water Tank				
76	RC Column	Bb-10b	39	
77		Cb-10b	39	
78	RC Beam	Eb-Cb/10b	38	
79		Bb-Cb/10b-11b	42	
80		Bb/9b-10b	38	
81	RC Wall	Eb-Hb/10b	38	
82		Cb-Eb/10b	39	
83		Cb/9b-10b	39	
84	RC Slab	Bb-Cb/9b-10b	39	
85		Cb-Eb/10b-11b	39	
Tower-C, Water Tank				
86	RC Column	Bc-10c	40	
87		Cc-10c	40	
88	RC Beam	Bc/9c-10c	42	
89		Ec-Cc/9c-10c	42	
90		Ec-Hc/10c-11c	40	
91	RC Wall	Ec-Hc/10c	38	
92	RC Slab	Cc-Bc/9c-10c	39	

TABLE-3A
REFERENCE STRENGTH CHART FOR REBOUND HAMMER TEST

Test instrument : Schmidt Hammer

Make : M/s. Proceq, Switzerland

Type : N-34

Technical reference : 1. IS:13311-(Part-II)-1992-(Reaffirmed 1999) (Reaffirmed in 2004) and
2. Instrument manual furnished by M/s. Proceq, Switzerland

REBOUND NUMBER	ESTIMATED COMPRESSIVE STRENGTH RANGE (N/Sq.mm)
22 to 26	10 to 14
26 to 30	14 to 18
30 to 34	18 to 22
34 to 38	22 to 26
38 to 42	26 to 30
42 to 46	30 to 34

Note: Estimated compressive strength is worked out based on the Calibration Chart developed for the above test instrument in our laboratory.

TABLE -4
RESULTS OF COVERMETER STUDIES

Project	:	Army Welfare Housing Organization Chanderkunj Army Towers at Silver Sand Island, Vytilla, ,Kochi, Kerala.
Members tested	:	RC Columns, Beams, Walls & Slabs
Period of test	:	21st to 27th October 2020
Test instrument	:	Profometer-5+
Make	:	M/s. Proceq, Switzerland
Technical reference	:	BS: 1881-(Part 204) & Test Instrument Manual "Metal & Reinforcement Detector" from M/s. Proceq, Switzerland

Sl. No.	Member / Floor Identification*	Grid Identification*	Range of Cover Concrete (mm)**
1	2	3	4
Tower-B, Basement			
1	RC Column	Mb-1b	50-55
2		Lb-8b	50-55
3		Lb-11b	45-50
4		Kb-12b	40-45
5		Kb-5b	50-55

* As furnished by the customer
* Refer sketch **DWG.REF.NOS. 01 to 04** for Floor / Member / Grid Identification.

1	2	3	4
Tower-B, Basement			
6	RC Column	Cb-9b	55-60
7		Ab-Bb/3b	50-55
8		Ab-1b	55-60
9	RC Retaining Wall	Hb/10b-11b	45-50
10		Hb-Eb/12b	50-55
11		Cb-Bb/12b	35-40
12	RC Beam	Mb/3b-10b	30-35
13		Cb-Kb/1b	28-33
14		Eb-Hb/1b-1b'	30-34
15		Kb/11b-12b	28-33
16		Hb/11b-12b	29-34
17		Ab/5b-8b	33-38
18	RC Slab	Kb-Lb/11b-12b	25-30
19		Eb-Cb/11b-12b	25-30
20		Eb-Cb/1b-1b'	29-30
21		Mb-Lb/5b-3b	30-32
Tower-C, Basement			
22	RC Column	Ac-11c	55-60
23		Cc-6c	55-60
24		Ec/10c-11c	40-45
25		Kc-8c	50-55
26		Kc-12c	55-60
27		Lc-2c	50-55
28		Mc-3c	55-60
29		Bc-8c	50-55
30	RC Beam	Mc/10c-11c	35-40

1	2	3	4
Tower-C, Basement			
31	RC Beam	Hc/11c-12c	28-30
32		Cc/2c-3c	28-33
33	RC Slab	Cc-Ec/2c-3c	27-32
Parking-1, Basement			
34	RC Column	Kd-19d	58-63
35		Nd-24d	58-65
36		Hd/12b-15d	40-45
37	RC Beam	Kd-Nd/24d	33-38
38		Nd/19d-21d	35-38
39		Rd/12d-15d	30- 35
40	RC Slab	Fd-Kd/23d-25d	27-32
41		Hd-Ld/12d-15d	25-35
Parking-2, Basement			
42	RC Column	Qd-13d	53-57
43		Jd-12d	52-56
44	RC Beam	Jd/13d-14d	28-33
45		Vd-Ud/12d	30-35
46		Jd-Gd/12d-13d	28-33
47	RC Slab	Md-Jd/13d-14d	28-32
48		Jd-Md/14d-Ab	28-30
49		Vd-Ud/14d-Ab	28-34

1	2	3	4
Parking-3, Basement			
50	RC Column	Ed-6d	53-57
51		Hd-4d	53-58
52		Ld-6d	54-58
53		Vd-8d	40-45
54	RC Retaining Wall	Hd-Ld/1d	30-35
55		Rd-Ud/6d	42-45
56		Wd/8d-9d	35-40
57		Wd/10d-11d	35-40
58		Bb-Cb/1b'	34-42
59		Lb-Mb/1b'	25-28
60		Rd-Sd/23d-24d	30-38
61		Nd-Kd/26d	25-28
62		Dd/18d-20d	26-32
63	RC Beam	Rd-Sd/1c-6d	25-30
64		Hd/4d-5d	28-32
65		Ed-Hd/3d	32-35
66	RC Slab	Bd-Ed/2d-3d	25-30
Tower-A, Stilt Floor			
67	RC Column	Ca-1a	35-40
68		Ka-12a	37-40
69	RC Beam	Ha/3a-6a	28-33

1	2	3	4
Tower-A, Water Tank			
70	RC Column	Ka-11a	34-38
71		Ka-12a	45-60
72	RC Beam	Ha/11a-12a	26-31
73		Ka/9a-11a	25-30
74	RC Wall	Ha/6a-9a	33-38
75	RC Slab	Ha-Ka/6a-9a	30-35
Tower-B, Water Tank			
76	RC Column	Bb-10b	33-38
77		Cb-10b	38-43
78	RC Beam	Eb-Cb/10b	38-43
79		Bb-Cb/10b-11b	35-40
80		Bb/9b-10b	30-38
81	RC Wall	Eb-Hb/10b	35-40
82		Cb-Eb/10b	38-45
83		Cb/9b-10b	36-42
84	RC Slab	Bb-Cb/9b-10b	28-30
85		Cb-Eb/10b-11b	28-33
Tower-C, Water Tank			
86	RC Column	Bc-10c	35-40
87		Cc-10c	33-38
88	RC Beams	Bc/9c-10c	30-35
89		Ec-Cc/9c-10c	32-35
90		Ec-Hc/10c-11c	32-36
91	RC Wall	Ec-Hc/10c	53-58
92	RC Slab	Cc-Bc/9c-10c	33-40

TABLE -5

RESULTS OF HALF CELL POTENTIAL DIFFERENCE MEASUREMENT TEST

Project : Army Welfare Housing Organization Chanderkunj
Army Towers Silver Sand Island, Vytilla, ,Kochi, Kerala.

Members tested : RC Columns, Beams, Walls & Slabs

Period of test : 21st to 27th October 2020

Test Instrument : CANIN Corrosion Analyzer

Make : M/s. Proceq, Switzerland

Technical Reference : ASTMC 876-15 (Reapproved – 2015)

Sl. No.	Member Identification*	Grid Identification*	Half-cell Measurements Measured potential difference (mv)	*Remarks*
1	2	3	4	5
Tower-B, Basement				**Refer Table – 5A Reference Chart For Half-Cell Potential Difference Measurement Test**
1	RC Column	Lb-2b	-185 -176 -181 -191 -219 -214 -197 -236 -240	

* As furnished by the customer

* Refer sketch **DWG.REF.NOS. 01 to 04** for Floor / Member / Grid Identification.

1	2	3	4	5
Tower-B, Basement				**Refer Table – 5A Reference Chart For Half-Cell Potential Difference Measurement Test**
2	RC Column	Lb-5b	-143 -151 -133 -175 -149 -151 -127 -141 -146	
3	RC Slab	Mb-Lb/3b-5b	-125 -200 -204 -163 -229 -188 -187 -190 -185	
4		Eb-Cb/11b-12b	-112 -104 -122 -117 -111 -100 -118 -109 -106	
Tower-C, Basement				
5	RC Column	Hc/2c-3c	-145 -146 -127 -147 -133 -141 -138 -128 -145	

1	2	3	4	5
Tower-C, Basement				**Refer Table – 5A Reference Chart For Half-Cell Potential Difference Measurement Test**
6	RC Column	Ac-2c	-137 -210 -221 -156 -176 -205 -182 -190 -200	
7	RC Column & Beam Junction	Mc-1c	-207 -236 -142 -202 -219 -217 -210 -197 -205	
8	RC Beam	EC-Fc/1c	-104 -106 -85 -111 -135 -110 -112 -99 -97	
Parking-1, Basement				
9	RC Slab	Dd-Fd/18d-20d	-160 -150 -143 -155 -139 -147 -161 -159 -147	

1	2	3	4	5
Parking-1, Basement				**Refer Table – 5A Reference Chart For Half-Cell Potential Difference Measurement Test**
10	RC Slab	Rd-Sd/24d-26d	-149 -161 -171 -147 -154 -165 -151 -187 -169	
Parking-2, Basement				
11	RC Beam	Qd-Sd/12d	-170 -190 -207 -184 -208 -186 -154 -200 -198	
12	RC Slab	Ud/14d-14d'	-140 -130 -134 -145 -165 -145 -150 -133 -128	
Tower-B, Water Tank				
13	RC Beam	Bb/9b-10b	-80 -79 -93 -94 -110 -105 -98 -87 -109	

1	2	3	4	5
Tower-C, Water Tank				**Refer Table – 5A Reference Chart For Half-Cell Potential Difference Measurement Test**
14	RC Beam	Bc/9c-10c	-80 -71 -68 -48 -84 -70 -54 -75 -80	
Tower-A, Stilt Floor				
15	RC Beam	Ha/3a-6a	-74 -78 -90 -67 -69 -74 -91 -59 -69	
Tower-A, Water Tank				
16	RC Beam	Ka/9a-11a	-80 -61 -83 -63 -93 -98 -86 -97 -72	

TABLE – 5A

REFERENCE CHART FOR HALF CELL POTENTIAL DIFFERENCE MEASUREMENT TEST

Test instrument : Copper-Copper sulphate –Half cell

Make : M/s. Proceq, Switzerland

Technical reference : As per ASTM C 876 – 15(Reapproved 2015)

Sl. No.	Measured Potential Difference	Probability of Corrosion
1.	More negative than (-) 350 mV	High probability of corrosion/Advanced
2.	Between (-) 200 mV to (-) 350 mV	Uncertainty of corrosion/Moderate
3.	More positive than (-) 200 mV	High probability of No corrosion/Initial

*****

TABLE-6
RESULTS OF CARBONATION TEST

Project	:	Army Welfare Housing Organization Chanderkunj Army Towers at Silver Sand Island, Vytilla, Kochi, Kerala.
Members tested	:	RC Columns, Beams, Walls & Slabs
Period of test	:	21st to 27th October 2020
Chemical used for Carbonation test	:	Dilute Alcohol added with phenolphthalein indicator
Technical reference	:	BS: 1881 (Part 201) – 1986

Sl. No.	Floor /Member/Grid Identification*	Depth of Carbonation (mm)	Stipulation
1	2	3	4
Tower-B, Basement			**Carbonation Should Not Reach Reinforcement Level During Life Time Of The Structure**
1	RC Column, Lb-2b	5	
2	RC Column, Lb-5b	5	
3	RC Slab, Mb-Lb/3b-5b	5	
4	RC Slab, Eb-Cb/11b-12b	5	
Tower-C, Basement			
5	RC Column, Hc/2c-3c	10	

*As furnished by the client.
* Refer Sketch Dwg.Ref.No. **01 to 04** For Floor / Member / Grid Identification.

1	2	3	4
Tower-C, Basement			
6	RC Column, Ac-2c	5	
7	RC Column & Beam Junction, Mc-1c	8	
8	RC Beam, EC-Fc/1c	5	
Parking-1, Basement			
9	RC Slab, Dd-Fd/18d-20d	5	
10	RC Slab, Rd-Sd/24d-26d	5	
Parking-2, Basement			
11	RC Beam, Qd-Sd/12d	5	**Carbonation should not reach reinforcement level during life time of the structure**
12	RC Slab, Ud/14d-14d'	5	
Tower-B, Water Tank			
13	RC Beam, Bb/9b-10b	5	
Tower-C, Water Tank			
14	RC Beam, Bc/9c-10c	5	
Tower-A, Stilt Floor			
15	RC Beam, Ha/3a-6a	5	
Tower-A, Water Tank			
16	RC Beam, Ka/9a-11a	5	

TABLE-7
CHEMICAL TEST REPORT ON HARDENED CONCRETE SAMPLES

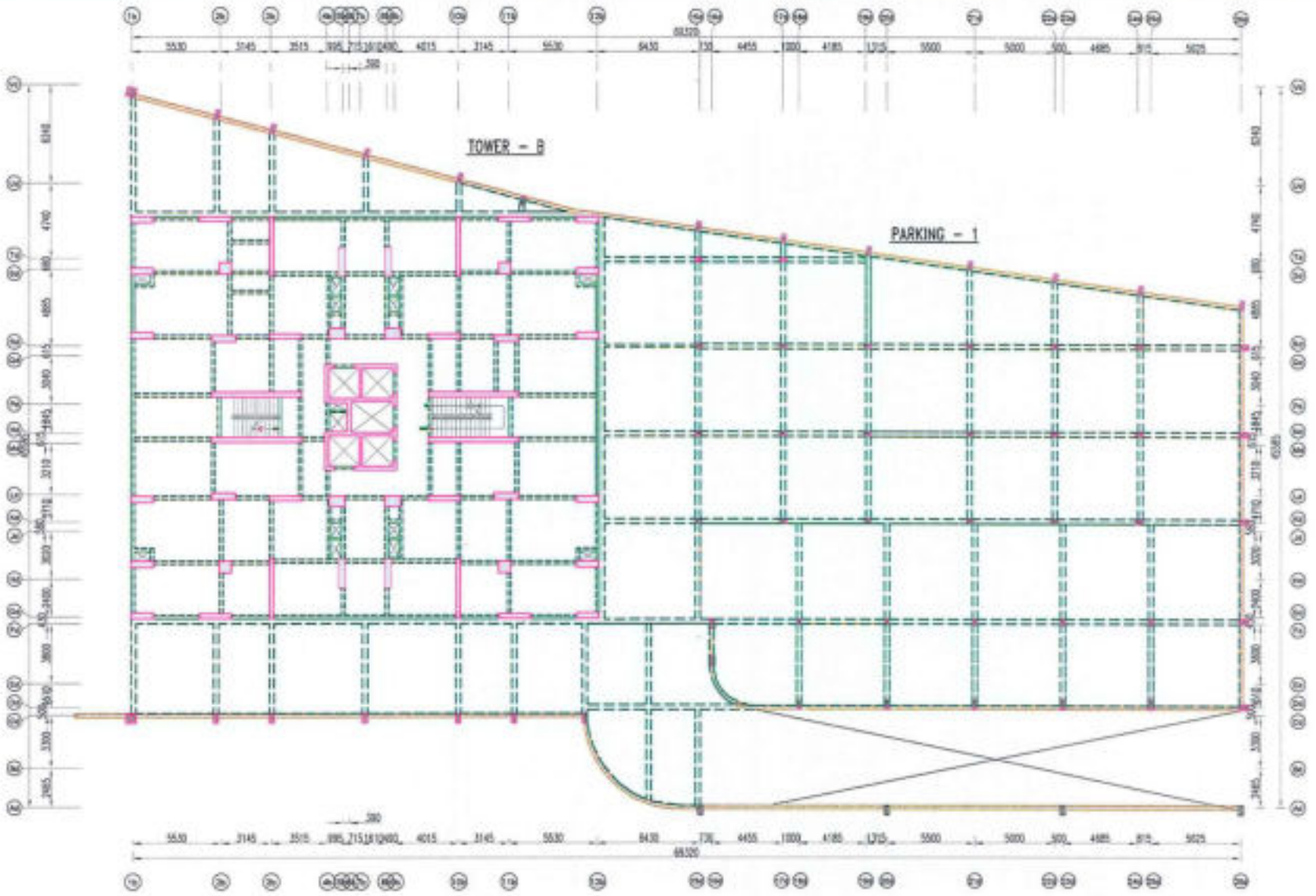
Project	:	Army Welfare Housing Organization Chanderkunj Army Towers at Silver Sand Island, Vytilla, Kochi, Kerala.
Members tested	:	RC Columns, Beams, Walls & Slabs
Period of test	:	21st to 27th October 2020
Condition of sample	:	Satisfactory
Test Method	:	1. IS: 14959 (Part II) 2001 (RA- 2007). 2. IS : 4032 : 1985 -RA 2019 3. IS: 2720(part 26) : 1987- RA 2016 4. NCB 9th International Seminar Vol.3 Page 500

Sl. No.	Location / Member / Grid Identification*	Name of Test		
		Chloride content - Acid Soluble (kg/cu.m)	Sulphate as (SO3) % by mass of cement in concrete mix	pH
Basement –Retaining wall				
1	Vd /13d-14d (North Area)	0.045	0.09	10.20
2	Vd-Wd /1c-7d (North – West Area)	0.040	0.11	11.89
3	Hd-Ld / 1d (West Area)	0.028	0.10	11.69
4	5d-6d / Bd (South Area)	0.096	0.35	12.08
Basement floor Tower –B				
5	RC slab (Mb-Lb/5b-3b)	1.12	0.71	12.09
6	RC column (Lb/2b)	1.12	0.23	12.17

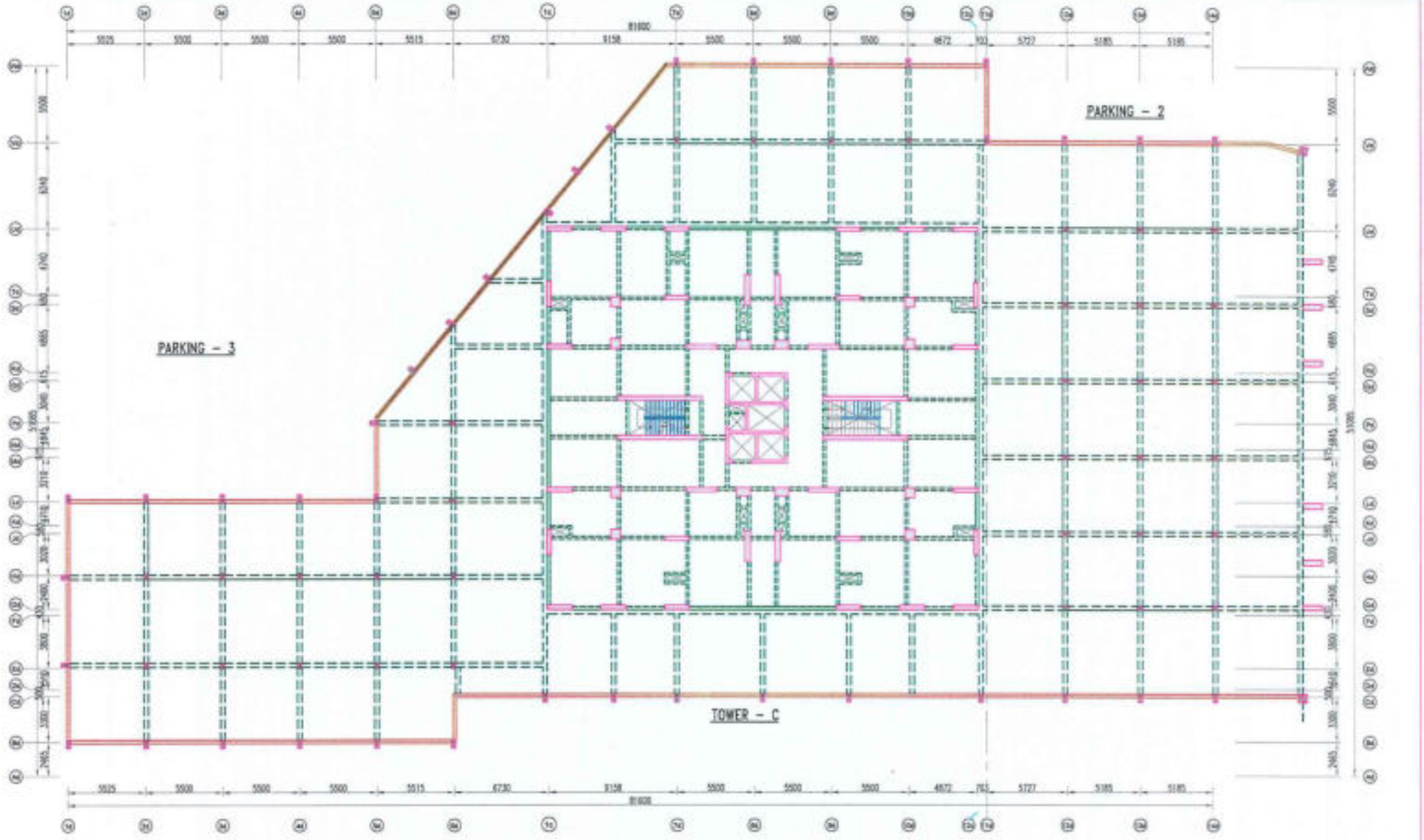
Sl. No.	Location / Member / Grid Identification*	Name of Test		
		Chloride content - Acid Soluble (kg/Cum)	Sulphate as (SO3) % by mass of cement in concrete mix	pH
	Basement floor Tower –C			
7	RC column (2c-3c/ Hc)	0.34	0.15	12.24
8	RC beam (Ec-Fc/1c)	0.26	0.11	12.19
	Parking Area –Basement floor			
9	Parking-1 RC slab (18d-20d/ Dd-Fd)	0.37	0.12	12.25
10	Parking-2 RC beam (Qd-5d/12d)	0.04	0.14	12.17
	Stilt floor Tower-A			
11	RC beam (4a-6a/Ha)	0.40	0.22	12.12
	Over Head Water Tank			
12	Tower-A RC column (Ka-11a)	0.045	0.14	12.17
13	Tower-B RC column (Cb-10b)	0.045	0.12	12.30
14	Tower-C RC beam (10C-11C/ between Cc-Ec)	0.079	0.22	12.15
Requirements as per IS:456-2000 (Reaffirmed in 2005)		For reinforced concrete or plain concrete containing embedded metal, max. acid soluble chloride content in concrete should not exceed 0.6 kg/cu.m.	Total water-soluble sulphate content as SO_3 should not exceed 4% by mass of cement in the concrete mix.	Not specified

* Refer sketch **DWG.REF.NOS. 01 to 04** for Floor / Member / Grid Identification.

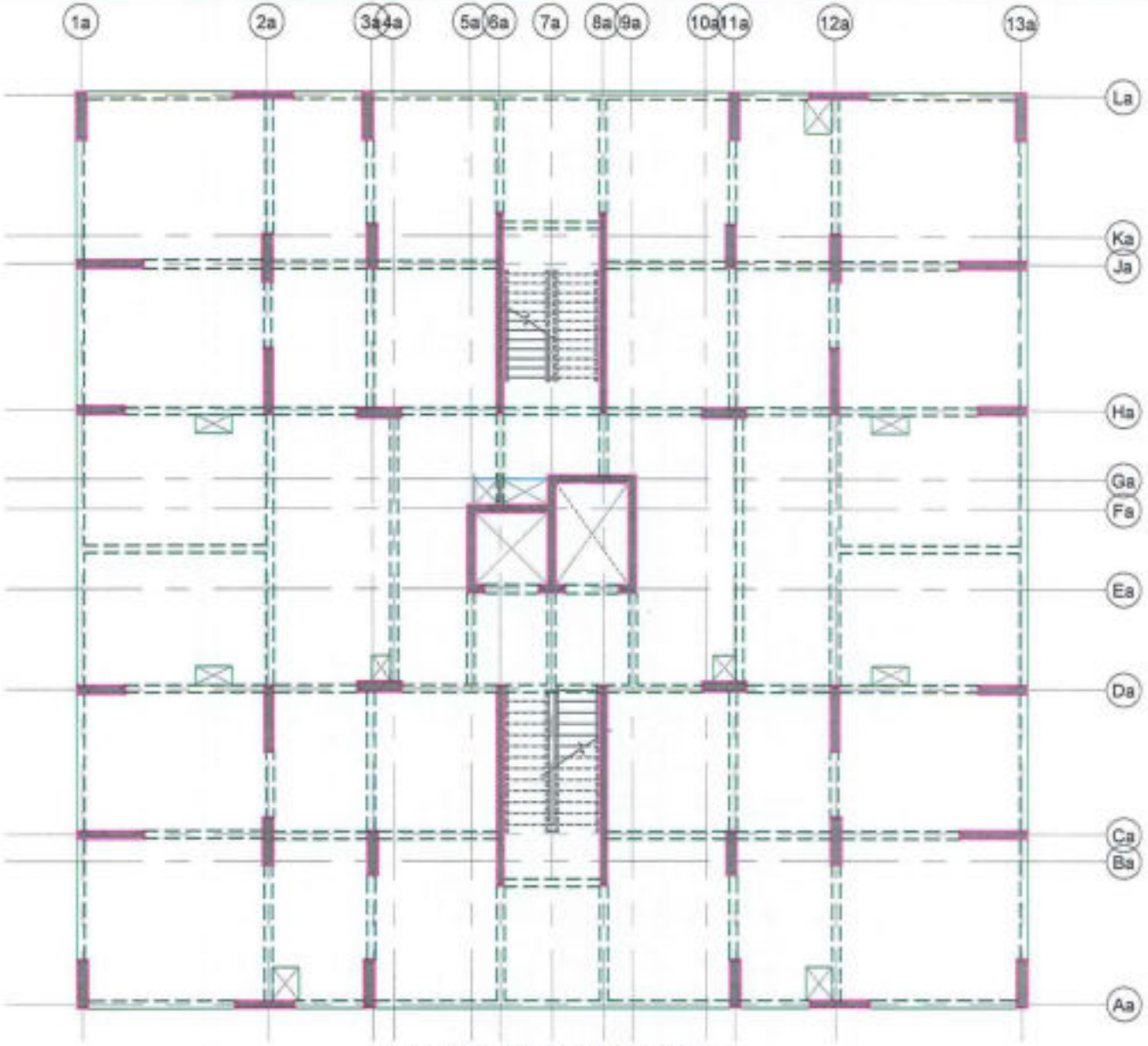
SKETCHES



CLIENT: M/s ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	TITLE: **EXISTING BASEMENT FLOOR RC COLUMNS, BEAMS AND RETAINING WALL LAYOUT**	DRAWN: PRABHU	CHECKED: RO	SCALE: NTS	DATE: 09-11-20
			APPROVED: AJ	DWG. REF. No : 01	REV.No. RO
PROJECT: INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA		CONSULTANT: BUREAU VERITAS (INDIA) PVT. LTD. # 1035, 13th Cross, Banashankari 2nd Stage, Bangalore - 560 070. Tel. : 080-26695200		CONTRACT NO: 4599751	

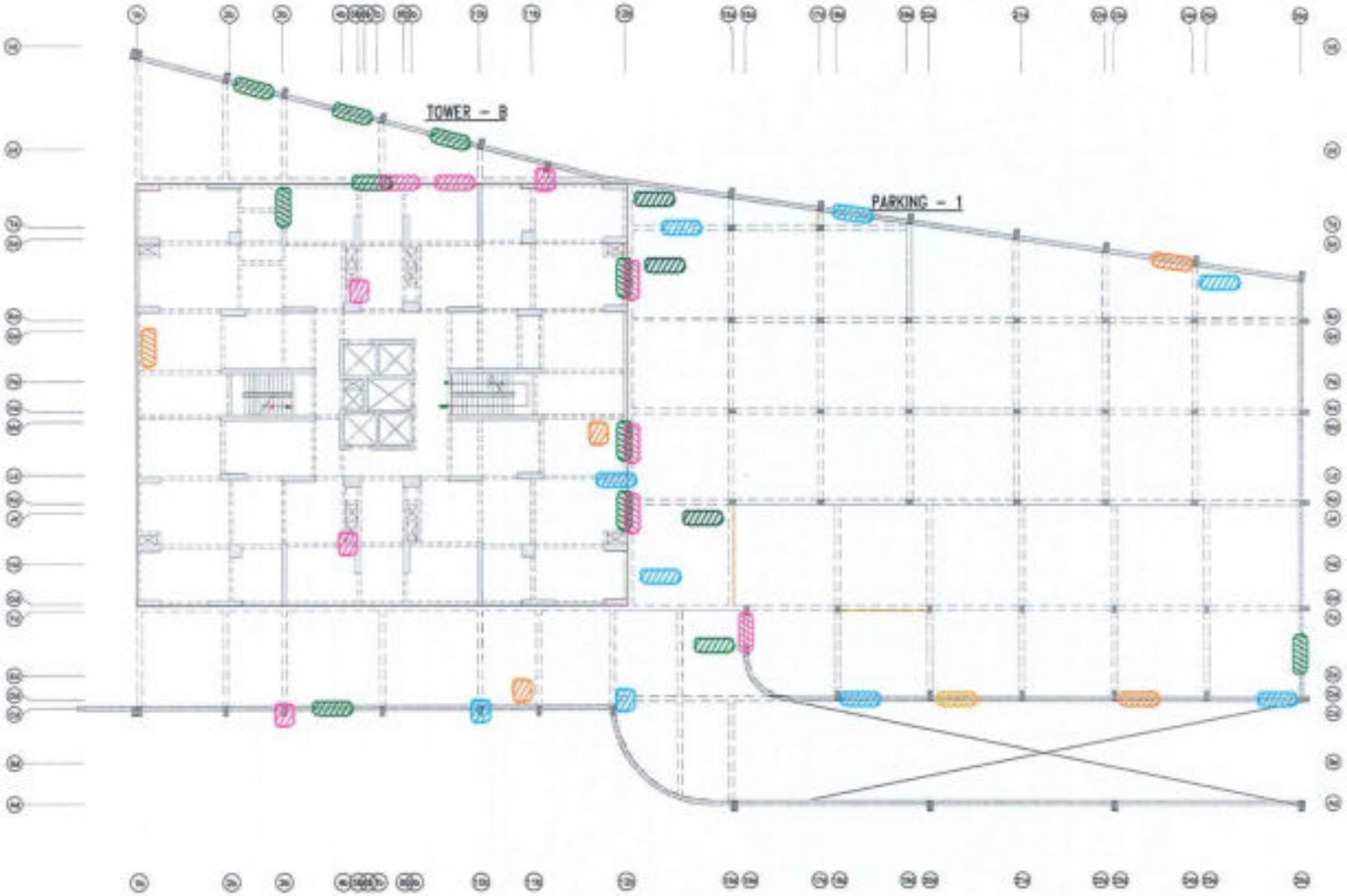


CLIENT: M/s ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	TITLE: **EXISTING BASEMENT FLOOR RC COLUMNS, BEAMS AND RETAINING WALL LAYOUT**	DRAWN: PRABHU	CHECKED: RG	SCALE: NTS	DATE: 09-11-20
			APPROVED: AJ	DWG. REF. No : 02	REV.No. R0
PROJECT: INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDRIKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA		CONSULTANT: BUREAU VERITAS (INDIA) PVT. LTD.		CONTRACT NO: 4599751	



TYPICAL EXISTING COLUMN BEAM LAYOUT OF TOWER - A

CLIENT: M/s ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	TITLE: **EXISTING BASEMENT FLOOR RC COLUMNS, BEAMS AND RETAINING WALL LAYOUT**	DRAWN: PRABHU	CHECKED: RG	SCALE: NTS	DATE: 09-11-20
			APPROVED: AJ	DWG. REF. No : 03	REV.No. R0
PROJECT: INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA		CONSULTANT: BUREAU VERITAS (INDIA) PVT. LTD.		CONTRACT NO: 4599751	



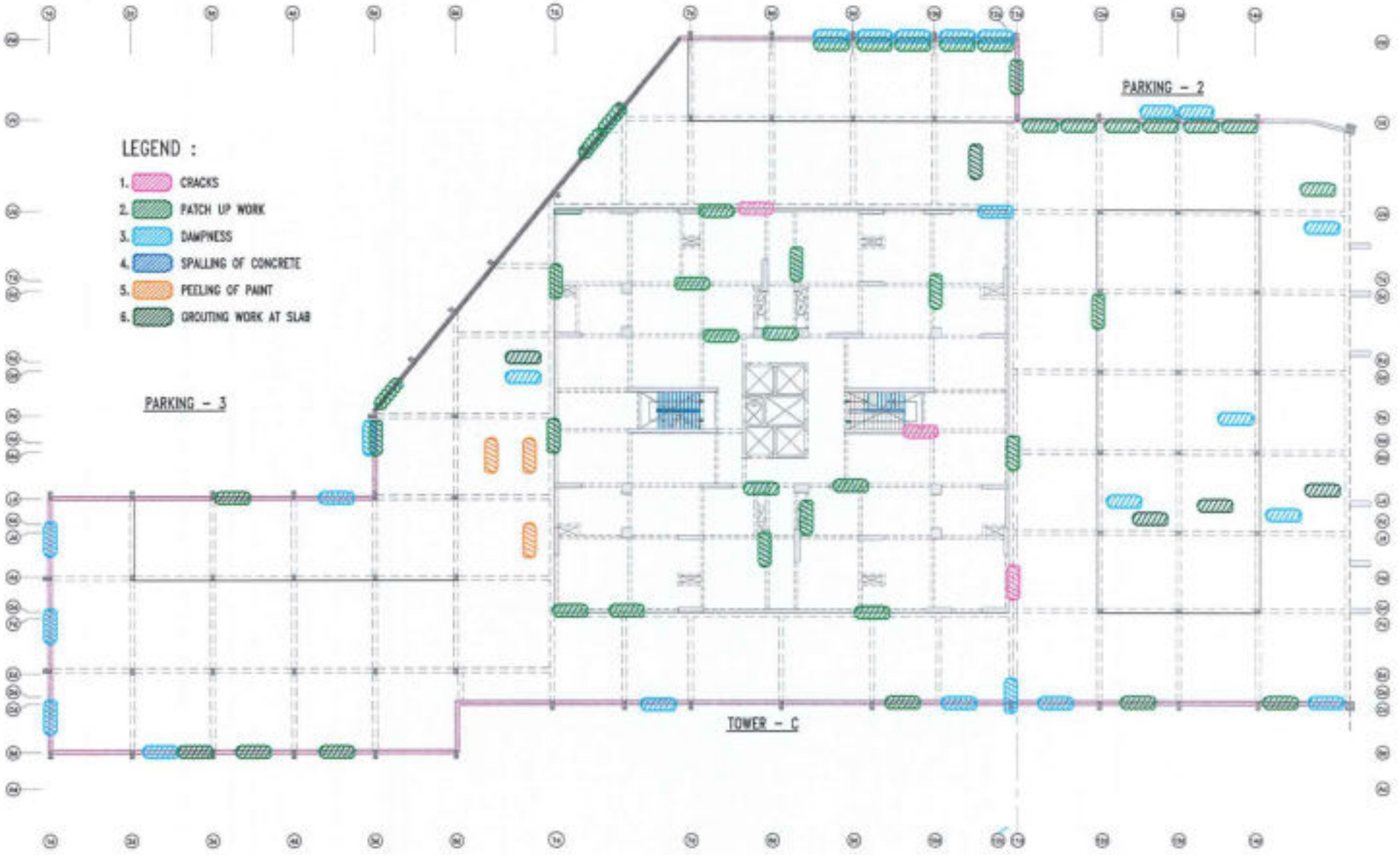
LEGEND :

1. CRACKS
2. PATCH UP WORK
3. DAMPNESS
4. SPALLING OF CONCRETE
5. PEELING OF PAINT
6. GROUTING WORK AT SLAB

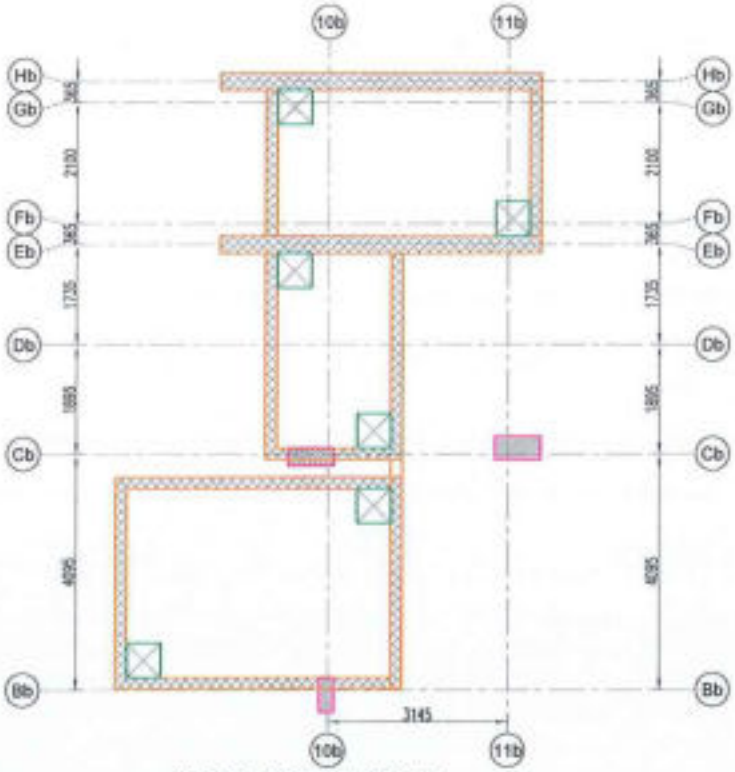
CLIENT: M/s ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	TITLE: **DISTRESS LAYOUT OF BASEMENT FLOOR**	DRAWN: PRABHU	CHECKED: RG	SCALE: NTS
			APPROVED: AJ	DWG. REF. No : 04
PROJECT: INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDIRAKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA		CONSULTANT: BUREAU VERITAS (INDIA) PVT. LTD.		CONTRACT NO: 4599751

DATE: 09-11-20

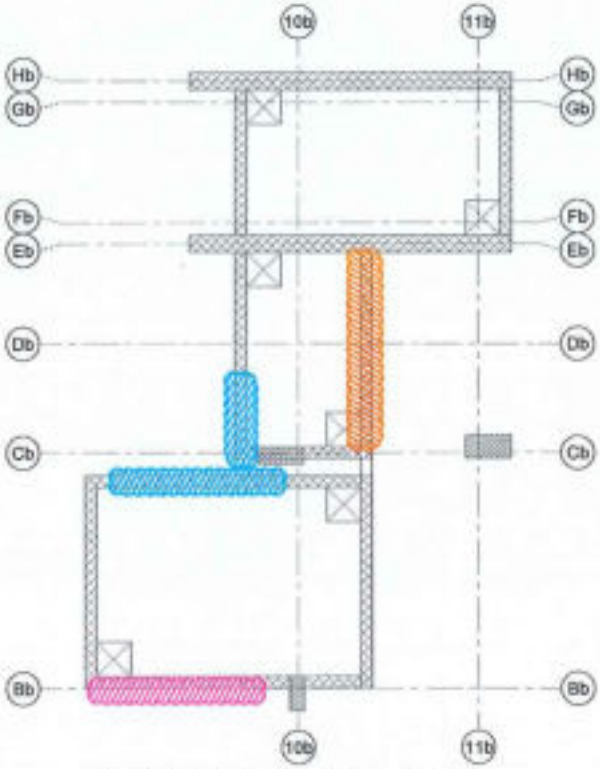
REV.No. R0



CLIENT: M/s ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	TITLE: **DISTRESS LAYOUT OF BASEMENT FLOOR**	DRAWN: PRABHU	CHECKED: RC	SCALE: NTS	DATE: 09-11-20
			APPROVED: AJ	DWG. REF. No : 05	REV.No. R0
PROJECT: INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDRIKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA		CONSULTANT: BUREAU VERITAS (INDIA) PVT. LTD.		CONTRACT NO: 4599751	



WATER TANK LAYOUT
(TOWER – B)

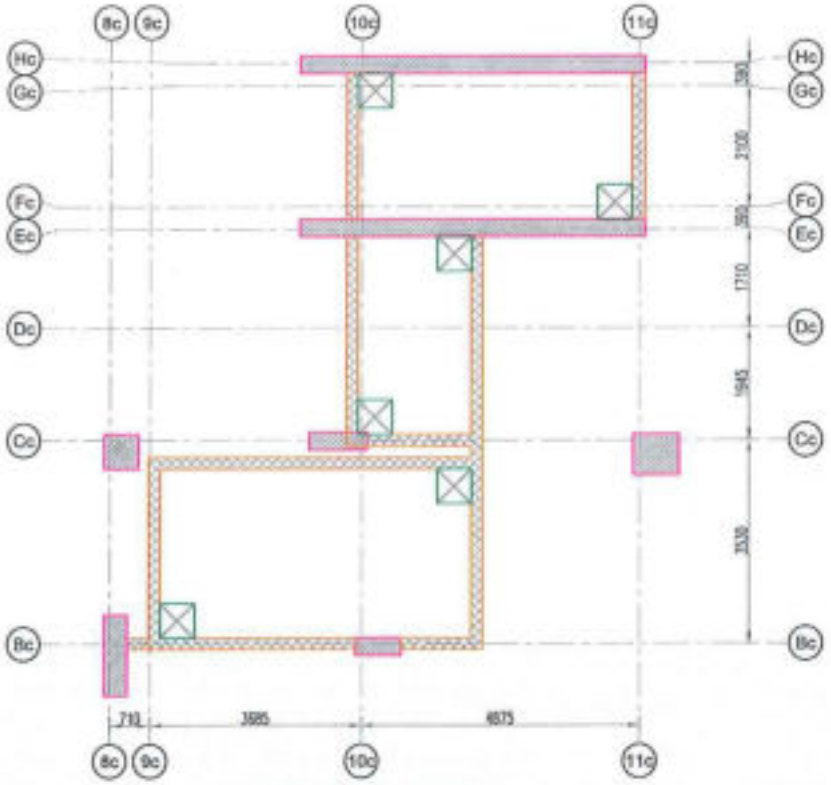


WATER TANK DISTRESS LAYOUT
(TOWER – B)

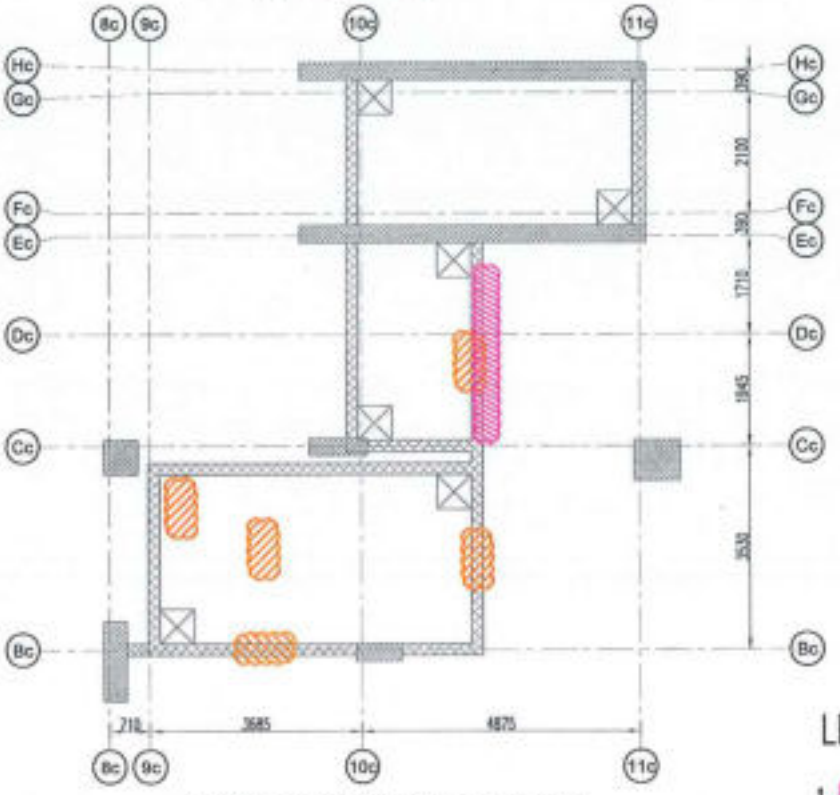
LEGEND :

1. CRACKS
2. DAMPNESS
3. PEELING OF PAINT

TITLE	**WATER TANK LAYOUT AND DISTRESS LAYOUT OF TOWER B**				
		DATE	REV	DESCRIPTION	
CLIENT	M/S ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	DRAWN: PRADEEP	CHECKED: KH/BG	SCALE: NTS	DATE: 17-11-2020
		DESIGNED:	APPROVED: AJ	DWG. REF. No. 06	REVN. R0
PROJECT	INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA	CONSULTANTS: BUREAU VERITAS (INDIA) PVT. LTD.			CONTRACT NO 4599751



WATER TANK LAYOUT
(TOWER - C)

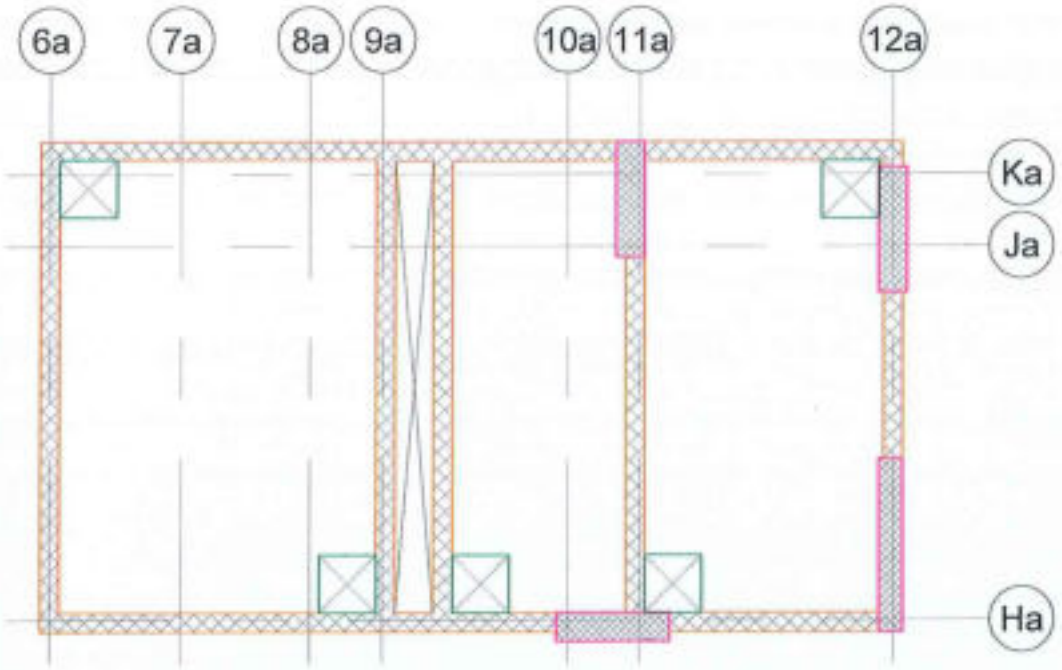


WATER TANK DISTRESS LAYOUT
(TOWER - C)

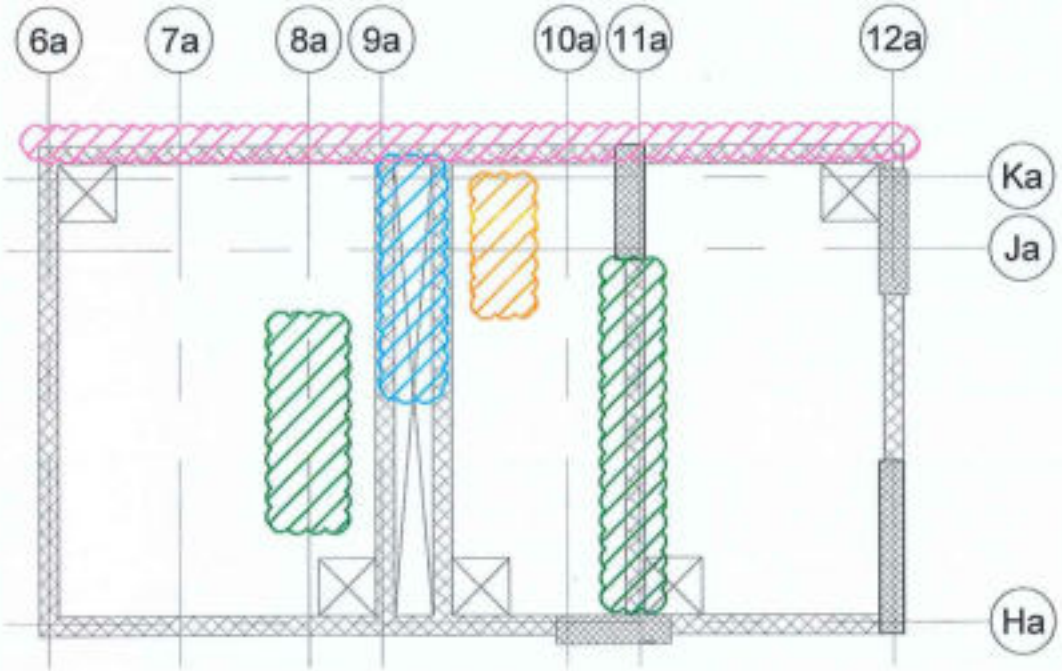
LEGEND :

1. CRACKS
2. PEELING OF PAINT

TITLE	**WATER TANK LAYOUT AND DISTRESS LAYOUT OF TOWER C**				
		DATE	REV	DESCRIPTION	
CLIENT	M/S ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	DRAWN: PRABHU	CHECKED: KR/BG	SCALE: NTS	DATE: 17-11-2020
		DESIGNED:	APPROVED: AJ	DWG. REV. No.: 07	REVISION: R0
PROJECT	INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA	CONSULTANTS: BUREAU VERITAS (INDIA) PVT. LTD.		CONTRACT NO: 4599751	



EXISTING LAYOUT OF WATER TANK TOWER – A

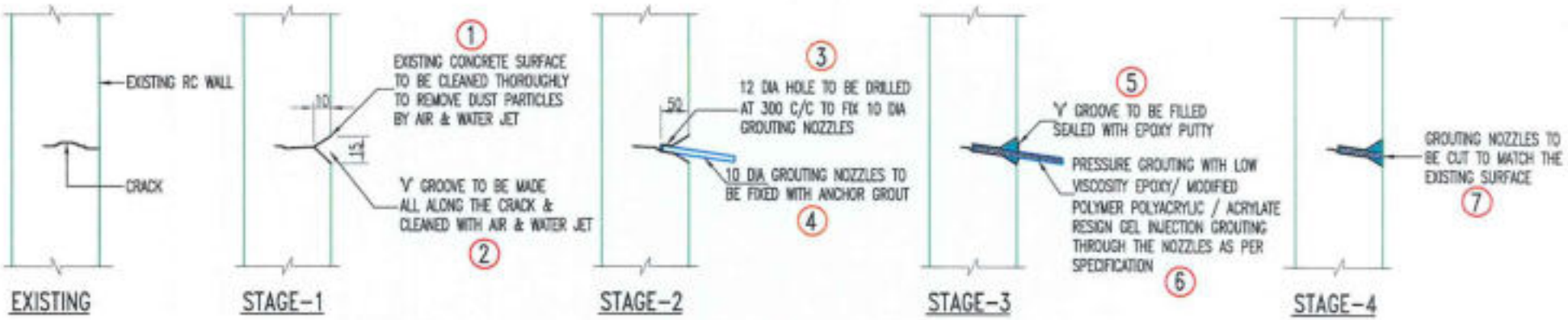


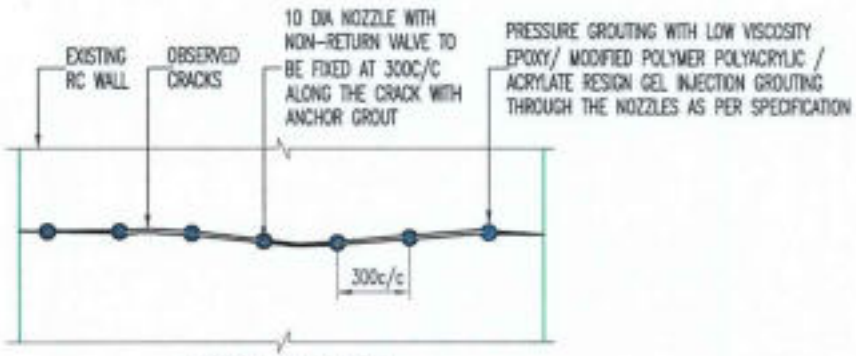
DISTRESS LAYOUT OF WATER TANK TOWER – A

LEGEND :

1. CRACKS
2. PATCH UP WORK
3. DAMPNESS
4. PEELING OF PAINT

TITLE	**WATER TANK LAYOUT AND DISTRESS LAYOUT OF TOWER C**				
		DATE	REV	DESCRIPTION	
CLIENT	M/S ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	DRAWN: PRADEEP	CHECKED: KR/BG	SCALE: NTS	DATE: 27-11-2020
		DESIGNED:	APPROVED: AJ	DWG. REF. No. 08	REVISION: R0
PROJECT	INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA	CONSULTANTS: BUREAU VERITAS (INDIA) PVT. LTD.		CONTRACT NO: 4599751	





FRONT ELEVATION

CLIENT
M/S ARMY WELFARE HOUSING ORGANISATION (AWHO)
VYTILLA, KOCHI, KERALA

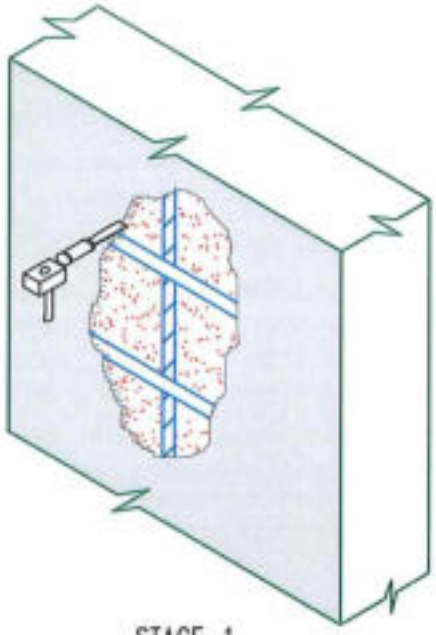
PROJECT
INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA

TITLE
TREATMENT FOR PERIPHERAL RETAINING WALL TO PREVENT SEEPAGE WATER

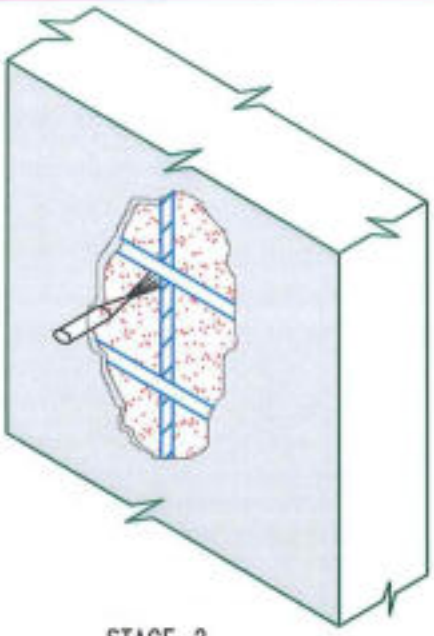
DRAWN: PRABHU	CHECKED: KR/RG	SCALE: NTS	DATE: 03-12-2020
	APPROVED: AJ	DWG. REF. No : 09	REV.No. R0

CONSULTANT
BUREAU VERITAS (INDIA) PVT. LTD.
155, 13th Cross, Banashankari 2nd Stage, Bangalore - 560 070.
Tel. : 080-26695200

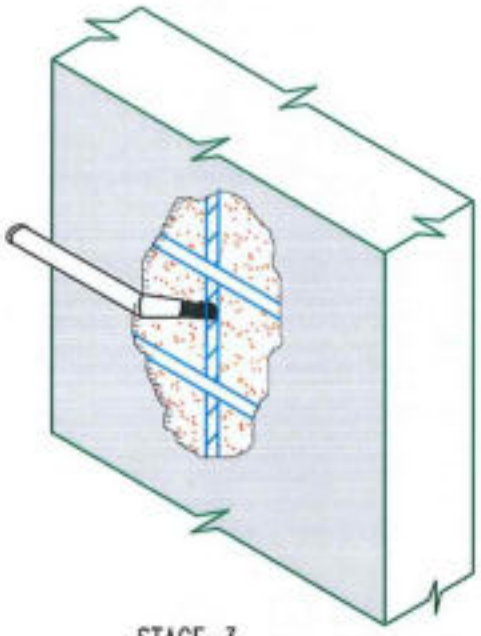
CONTRACT NO
4599751



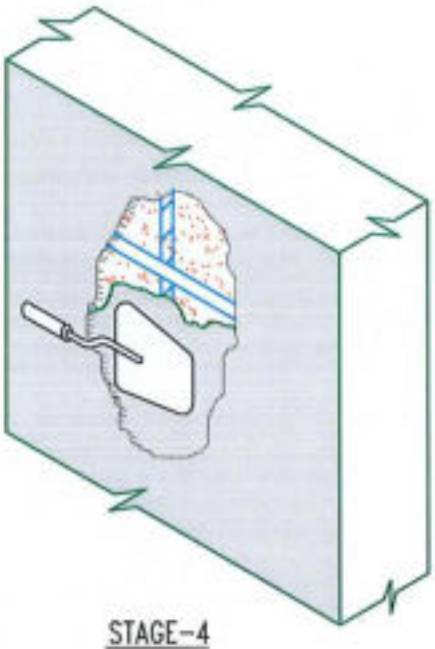
STAGE-1



STAGE-2



STAGE-3



STAGE-4

SEQUENCE OF OPERATIONS:

1. EXISTING LOOSE PLASTER/CONCRETE TO BE REMOVED THOROUGHLY BY CHIPPING, TO EXPOSE HARD CONCRETE.
2. EXPOSED REINFORCEMENT TO BE THOROUGHLY CLEANED USING WIRE BRUSH/EMERYCLOTH/BUFFING WHEEL/WATER JET.
3. TWO COATS OF ANTI-CORROSIVE CHEMICAL AND A COAT OF CORROSION INHIBITOR TO BE PROVIDED ON THE EXPOSED REINFORCEMENT AND CLEANED CONCRETE SURFACE RESPECTIVELY.
4. THE CONCRETE SURFACE TO BE FINISHED WITH POLYMER MODIFIED MORTAR IN FLUSH WITH ADJACENT SURFACE.

NOTE:

IF THE THICKNESS OF POLYMER MODIFIED MORTAR LAYER EXCEEDS 20mm, A LAYER OF WELD MESH 50X50X3mmSHALL BE PLACED AND FIXED TO CONCRETE USING CONCRETE NAILS

TITLE	**TREATMENT FOR CORROSION DISTRESSED REGIONS OF RC SLABS**					
		DATE	REV	DESCRIPTION		
CLIENT	M/S ARMY WELFARE HOUSING ORGANISATION (AWHO) VYTILLA, KOCHI, KERALA	DRAWN: PRABHU		CHECKED: KR/RG	SCALE: NTS	DATE: 27-01-2020
		DESIGNED:		APPROVED: AJ	DWG. REF. No. 10	REV. No. R0
PROJECT	INVESTIGATION OF DISTRESS IN BASEMENT FLOOR AND TERRACE LEVEL OVERHEAD TANKS OF ARMY WELFARE HOUSING ORGANISATION "CHANDERKUNJ ARMY TOWERS" AT SILVER SAND ISLAND, VYTILLA, KOCHI, KERALA	CONSULTANTS: BUREAU VERITAS (INDIA) PVT. LTD.			CONTRACT NO: 4599751	

CHANDERKUNJ ARMY TOWERS,
AWHO, VYTILLA, KOCHI

DRAWINGS AND TREATMENT SPECIFICATIONS FURNISHED BY THE CUSTOMER

SILPA Projects & Infrastructure (I) Pvt. Ltd.
3rd Floor, North Avenue, Paramara Road, Kochi-682 018
Tel:0484 2394002, 2396242, 9744722022 Fax:0484 2394002
www.silpa.in E-mail: mail@silpa.in, silpac@eth.net

Ref: SPI / 2088/2013-14

20 Jan 14

File

The Project Director
Army Welfare Housing Organisation
Prasana Vihar
Kochi

Through

M/s. Ajith Associates

Kind Attn : Col. M.D, Nair.

Sub : **Construction Of Residential Accomodation for AWHO at Silver Sandisland Vytilla,Kochi : Approval of waterproofing material & agency**

Ref : **CA No.AWHO/KOCHI/SSI/01/2012**

Dear Sir,

Enclosed herewith please find the brochure of 'Voltex' brand 'Bentonite Geotextile Waterproof' of 'CETCO India'. The material is as per the specification mentioned in the CA page no.197-198. The approved vendor for supply and installation for this material is M/s Athens Corporation, Athens House, Provident Fund Road, Kaloor.

It is requested to approve the material and the approved vendor for placing the purchase order.

Forwarded for your approval please.

Yours Faithfully,
For SILPA PROJECTS AND INFRASTRUCTURE (I) PVT LTD

PK PAUL
DIRECTOR

Encl : 1. Brochure of Voltex brand of CETCO Inda
2. Approval of agency by CETCO Inda

Voltex DS

BENTONITE GEOTEXTILE WATERPROOFING SYSTEM

DESCRIPTION

Voltex DS is a highly effective waterproofing composite of high strength geotextile and 4.8kg of sodium bentonite per square meter. The high swelling, low permeable sodium bentonite is encapsulated between a nonwoven and woven geotextile. A patented needle-punch process interlocks the geotextiles together forming an extremely strong composite that maintains the equal coverage of bentonite, as well as, protects it from inclement weather and construction related damage. Once backfilled, Voltex DS hydrates and forms a monolithic waterproofing membrane. Voltex DS contains zero VOC, can be installed in almost any weather condition to green concrete, and most importantly, has proven effective on both new and remedial waterproofing projects worldwide

APPLICATIONS

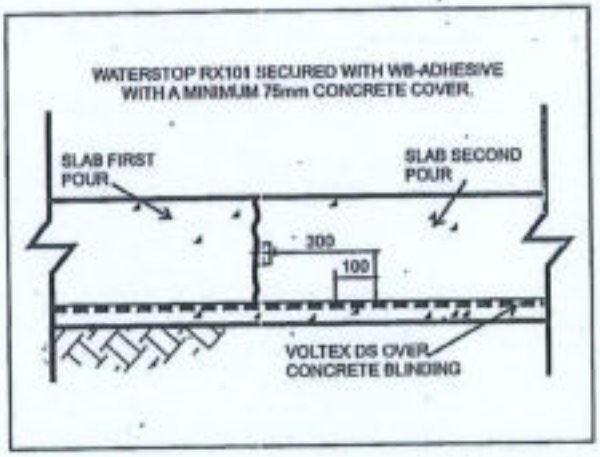
Voltex DS is designed for below-ground vertical and horizontal structural foundation surfaces. Typical applications include backfilled concrete walls, earth covered roofs, structural slabs, tunnels and property line construction. Property line construction applications include secant and contiguous piling, skin wall, metal sheet piling, shotcrete and stabilized earth retention walls. Applications may include structures under continuous or intermittent hydrostatic pressure.

INSTALLATION GENERAL

Install Voltex DS in strict accordance with the manufacturer's installation guidelines. Use accessory products as recommended. Install Voltex DS with the dark grey (woven) geotextile toward the concrete to be waterproofed. Install Waterstop-RX in all applicable horizontal and vertical concrete construction joints. Schedule waterproofing material installation to permit prompt placement of backfill material or concrete. For applications not covered herein, contact CETCO for specific installation guidelines.

UNDER CONCRETE FLOOR SLABS / RAFTS

Voltex DS is recommended for use under structural reinforced concrete slabs 150mm thick or greater on compacted earth, substrate, or 50mm PCC concrete. Install Voltex DS around all foundations (ground beams, pads, pile caps etc.)



Place Voltex DS over the properly prepared substrate with the dark grey (woven) geotextile side facing the concrete to be waterproofed (i.e. the white (non-woven) side should face the groundwater). Overlap all adjoining edges a minimum of 100mm and stagger ends to a minimum of 500mm. Staple or nail edges together as required to prevent any displacement before and during concrete placement.

Voltex DS should not extend into foundation bearing planes (i.e. pile caps, ground beams, pads etc.) but should completely envelop them.

Cut Voltex DS to provide a snug fit around all applicable penetrations (pipes, piles etc).

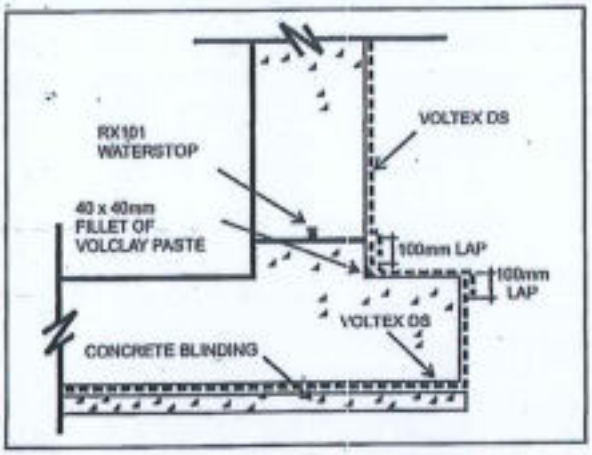
Detail all penetrations with a 40mm fillet of Bentoseal around the penetration on top of the Voltex.

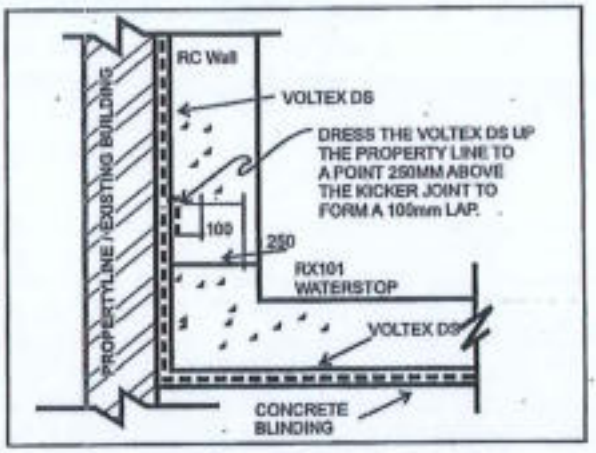
Where property line construction, such as secant/contiguous piling, metal sheet piling, skin wall, etc., is used as the outside concrete form, continue the underslab Voltex DS installation up the property line a minimum of 250mm above the top edge of the floor slab, foundation, or kicker level.

The extra 250mm is very important since there is no access to the outer edge after the concrete pour, and the top 100mm is to be kept free of concrete splashes to enable a clean lap later.

Voltex DS

BENTONITE GEOTEXTILE WATERPROOFING SYSTEM





BACKFILLED CONCRETE WALLS

Voltex DS can be applied to backfilled walls in two ways: mechanically fastening to cast concrete just prior to backfilling (post-applied), or preferably, by utilizing the peel-adhesion properties of the Voltex DS (pre-applied). The needle-punched geotextile fibers, which have been forced from the white (spun) side through the bentonite and dark grey (woven) side, will be trapped within the wet concrete, and allow the Voltex DS to remain firmly attached to the concrete after the formwork has been removed.

All through concrete tie holes, etc., must be filled, from the outside, using a proprietary non-shrink grout or similar, covered in a 'mushroom' of Bentoseal, either prior to Voltex DS (post-fix) application, or prior to backfilling (pre-fix/peel adhered application), where additional Voltex DS patching will be required.

Detail all pipe penetrations with Waterstop-RX 101 as a 'puddle flange' within the concrete, ensuring no less than 75mm concrete cover to all sides, and where penetrations pass through Voltex, ensure that Voltex DS is cut to provide a snug fit, and detail with a 40mm x 40mm fillet of Bentoseal, prior to backfilling.

Backfill material shall be compactable soils and free of construction debris. Backfill shall be clean, well grounded, and compacted every 300 mm to 85% modified proctor (as defined by ASTM 1557), and meet these general specifications:

- No rocks, stones or boulders larger than 50mm
- 90% minimum soil particles smaller than 5mm
- 10% maximum soil particles finer than 74 micron (200 mesh)

Terminate Voltex DS at ground level, etc., integrating the Voltex DS with a damp proof course/cavity tray (as per architects arrangement), by extending the DPC to overlap Voltex DS a minimum of 150mm. The Voltex/DPC lap should be enhanced by the inclusion of a 5mm x 50mm fillet of Bentoseal, centrally located.

PRE-APPLIED

Apply Voltex DS to timber formwork / shuttering, either horizontally or vertically, by nailing or stapling, following general application guidelines for lapping all adjacent edges 100mm, and staggering adjacent roll ends no less than 300mm (avoiding four-way laps), and additionally ensuring that laps face downwards, as applicable. The white (non-woven) side should be against the formwork, and the dark grey (woven) side should face the concrete to be waterproofed.

Extend Voltex DS the full depth of the formwork, so that the Voltex DS laps 100mm over the Voltex DS already cast into the slab edge and wall kicker, and allow no less than 150mm at the top of the formwork, to provide ground slab continuity later, if required.

Position formwork as required, and tie/space forms, penetrating Voltex DS as necessary. Normal concrete practice is sufficient in terms of striking times for formwork, but due care should be taken to ensure that Voltex DS remains bonded to green concrete.

Where a slab 'toe' exists, and underslab Voltex DS has terminated at the top edge of slab, additional Voltex DS will be required to link underslab/edge of slab Voltex DS with wall Voltex. Apply a 40mm x 40mm fillet of Bentoseal at the internal wall/slab corner, and place additional

Voltex DS

BENTONITE GEOTEXTILE WATERPROOFING SYSTEM

or greater. Do not install Voltex DS in horizontal split-slab, plaza deck and roof applications that will receive a poured concrete wear surface or other solid topping.

Voltex DS is not designed to waterproof expansion joints. Expansion joints require a properly engineered expansion joint sealant product manufactured by other companies.

SIZE & PACKAGING

Standard Voltex DS roll sizes are 1.1m x 5.0m (5.5m2) packaged 35 No. rolls per pallet (192.5m2). Average product weight varies with moisture content, and is between 6 and 7kg/m2. Voltex DS dimensions can be tailored to suit project requirements, keeping one dimension at 5.0m, and the other from 1.1m up to 40.0m. Larger rolls may be subject to special handling requirements.

ACCESSORY PRODUCTS

Voltex DS accessories include:

Bentoseal

Patented trowel grade sodium bentonite compound used as a detailing mastic around penetrations and corner transitions. Bentoseal is packaged in 14.25 liter tubs.

Waterstop-RX 101

Expanding bentonite-based concrete joint strip waterstop for use in non-moving concrete construction joints. Waterstop-RX 101 is manufactured in flexible strips.

TYPICAL SPECIFICATIONS

PROPERTY	TEST METHOD	TYPICAL VALUE
BENTONITE MASS PER UNIT AREA	ASTM D 3776 (mod)	4.88 kg/m2
PEEL ADHESION TO CONCRETE	ASTM D 903 (mod)	2.5 KN (per m width)
HYDROSTATIC PRESSURE RESISTANCE	ASTM D 5385 (mod)	70 m
PERMEABILITY	ASTM D 5084	1 X 10-9 cm/sec
GRAB TENSILE STRENGHT	ASTM D 4632	422 N
PUNCTURE RESISTANCE	ASTM D 4833	445 N
LOW TEMPERATURE FLEXIBILITY	ASTM D 1970	UNAFFECTED @-32°C

For more information on our full line of Waterproofing Systems visit our website at www.cetco.co.in

In Association with
Ashapura Volclay Ltd.
Jeevan Udyog Building,
3rd Floor, 278, D. N. Road, Fort
Mumbai 400 001 (India)
Tel. : +91-22-6665 1700
Fax : +91-22-2206 3288
www.cetco.co.in

February 2008 (Supersedes All Previous Versions)

Voltex DS over the slab 'toe' lapping 100mm over the edge of slab Voltex, and continue over the 'toe' terminating under the unbonded wall Voltex DS 'flap' at the back of the kicker.

POST-APPLIED

Apply Voltex DS vertically or horizontally against concrete, starting with a 100mm lap with the underslab/edge of slab Voltex DS (peel-adhered to concrete), using soft-washer fasteners, and following general application guidelines for lapping all adjacent edges 100mm, and staggering adjacent roll ends no less than 300mm, (avoiding four-way laps), and additionally ensuring that laps face downwards, as applicable. The dark grey side should be against the concrete, and the white (non-woven) side facing the installer.

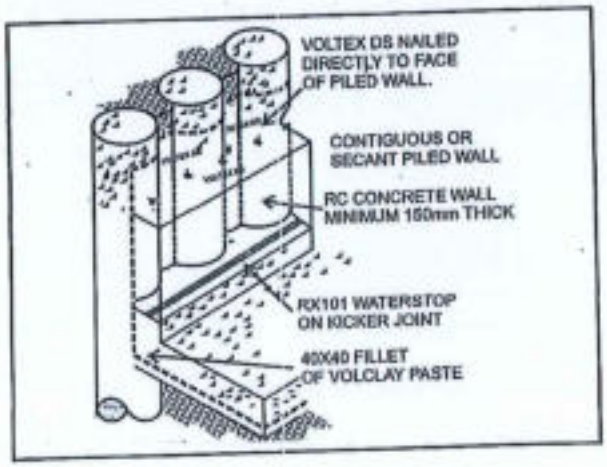
Detail all horizontal and vertical internal corners with a 40mm x 40mm fillet of Bentoseal, prior to Voltex DS application.

NOTE: Voltex DS is not recommended for masonry block walls.

PROPERTY LINE CONSTRUCTION

Voltex DS is used to waterproof various types of property line construction, including metal sheet piling, secant and contiguous piling, skin wall, shotcrete and stabilized-earth retention walls. Shotcrete can be applied directly against Voltex.

Concrete surfaces shall be free of large voids or projections. Voids, pits, and cracks in excess of 20mm, shall be parged to flush condition using cement grout or Bentoseal. Projections greater than 20mm shall be removed or smoothed flush. Generally, gradual undulating surfaces are acceptable, sudden changes in level, i.e. ridges and hollows, are not.



When working against property line, always start with the vertical installation, prior to installing Voltex DS under slab. Apply the bottom run of Voltex DS length ways/ horizontally against the property line, approximately 1,100mm from the substrate/ blinding level, allowing 150mm of Voltex DS to extend under slab.

On profiled property line (metal sheet piling, secant and contiguous piling, etc) the 150mm base 'flap' will need to be cut and splayed as necessary, to allow the material to lay flat.

Using soft-washer fasteners, and following general application guidelines for lapping all adjacent edges 100mm, and staggering adjacent roll ends no less than 300mm (avoiding four-way laps), and additionally ensuring that laps face downwards, as applicable, ensure that Voltex DS closely contours the application surface. For secant piling, locate fixings close to cleavages. On contiguous piling, ensure that soil columns between piles are cut back to no less than one third of the pile diameter, to create a fixing cleavage, and reduce the likelihood of soil dislodging behind the membrane.

Detail all through wall pipe/sleeve penetrations with Waterstop-RX101 as a 'puddle flange' within the concrete, ensuring no less than 75mm concrete cover to all sides.

LIMITATIONS

Horizontal installation surfaces shall be free of excessive* standing water, particularly where concrete underblinding is not utilized. (*Voltex DS can be installed in almost all inclement weather conditions, providing the quality/ accuracy of the installation is not affected e.g. Voltex DS floating, Waterstop RX submersed, etc).

If ground water contains strong acids, alkalis, or is of a conductivity of 2,500 umhos or greater, submit water samples to the manufacturer for compatibility testing. If contaminated groundwater or saltwater conditions exist, please contact manufacturer.

Voltex DS is not designed for unconfined above-ground waterproofing applications or below-ground masonry block foundation walls. Voltex DS is engineered for use under reinforced structural concrete slabs of 150mm thick

Gmail silpa usha <silpaushauj@gmail.com>

Pressure grouting method used.

1 message

PRAMOD KUMAR <pramodha2000@gmail.com> Mon, Oct 26, 2020 at 10:37 PM
To: silpa usha <silpaushauj@gmail.com>

1)In existing RCC surface /weak area and honey combs ,should be thoroughly checked to fix Nozzles, Drilling with 18mm bit by drilling machine up to length 36mm, fix nozzles of 18mm dia and seal around the pipe with Rapid setting Renderoc plug and allow to dry minimum 4 hours.

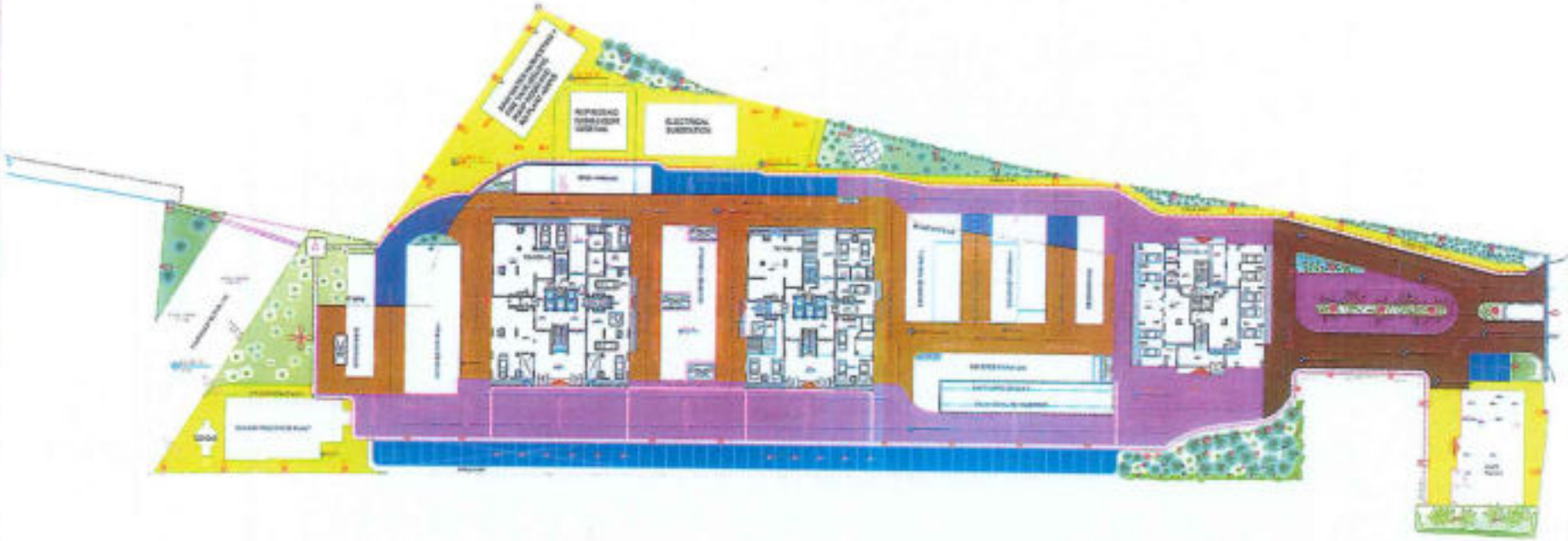
2)Pressure Grouting with CEBEX100 grout material at ratio of 225gm/50kg cement/20lit of water to be added up to flow able consistency. Thorough mixing and grout with pressure grouting machine upto honey combs get filled.

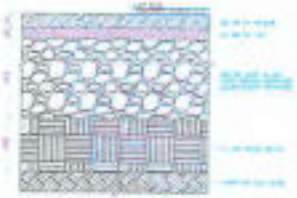
3) seal the nozzle with FOSROC RENDEROC PLUG to avoid mixture getting out.

4)Allow 4 hours to dry and cutting the projected nozzles and seal it with FOSROC CONPEXTRA GP2.

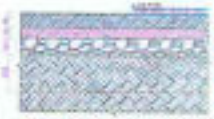
Make surface smooth with grinding machine after dry.

Rgds
Pramod

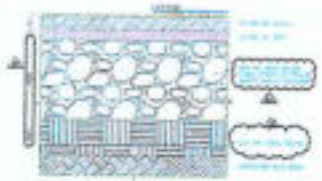




TYPICAL DETAIL (ROAD WITH PAVERS)



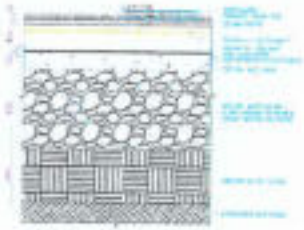
TYPICAL DETAIL (ROADS WITH PAVERS)



TYPICAL DETAIL (CAR PARK AREAS WITH PAVERS)

TYPICAL DETAIL (RDC ROAD)

TYPICAL DETAIL (PAVERS) (BASEMENT AREA)



TYPICAL DETAIL (RDC PAVERS WITH TRIMMER)

TYPICAL DETAIL (PAVERS TA/C IN BASEMENT PARKING AREAS)

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SPECIFICATIONS/
TECHNICAL LITERATURE

SPECIFICATION FOR ANTI CORROSIVE CHEMICAL

Type	:	Zinc based two parts epoxy-phenolic / Polyurethane coating suitable for application to ferrous surfaces.
Pot life	:	Shall not be less than 6 hrs. at 25 °C -35 °C
Consistency	:	Brushable to form a continuous formation
Requirements	:	Shall be applied directly on the prepared surface of ferrous metal to achieve intimate contact with the base metal
Wet film thickness (WFT)	:	135 microns (Min)
Dry film thickness (DFT)	:	40 microns (Min)
Surface preparation	:	Wire brushing / buffing wheel / solvent free from chlorides or any suitable means
Curing	:	45 minutes (air curing)
Source of Anticorrosive chemical	:	**"Concresive ZRi"** M/s. BASF Construction Chemicals India Pvt. Ltd., Bangalore **"CEMPATCH R"** M/s. Den Construction Chemicals India Ltd. **"Nito Zinc primer"** M/s. Fosroc Chemicals (India) Pvt. Ltd. **"Nito Zinc primer"** M/s. Krishna Conchem Products Pvt. Ltd. **"Colusal MK"** / **"Colusal 25"** M/s. MC Bauchemie (India) Pvt. Ltd. **"Sika Top Armatec 108 / Priazine R"** M/s. Sika India Pvt. Ltd. **or any equivalent**

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SPECIFICATION FOR CORROSION INHIBITOR

Type	:	Concrete penetrating corrosion inhibitors
Surface preparation	:	Surface should be free from oil, laitance, grease, loose particles, etc. by wire brushing/ sand blasting/ water jet.
Service condition	:	a. Shall resist carbon di oxide, chloride, sulphate and other dilute acids b. Shall penetrate concrete to a min. of depth 200 mm and resist corrosion of embedded rebars c. Shall be non-toxic and free from nitrate and Chromate
Application	:	Brushing / Spray gun
Application dosage	:	2 to 4 m^2/l or as per manufacturer specifications
Available sources	:	**"PROTECTOSIL CIT" from** M/s BASF Construction Chemicals India Pvt. Ltd., Bangalore **or any equivalent**

SPECIFICATION FOR WELD MESH

Reference	:	Indian Standard Specification IS: 1566-1982 reaffirmed in 2000
Wire diameter	:	5 mm
Size of openings	:	50 x 50 x 5 mm
Type	:	Spot welded non galvanised mesh
Ultimate tensile strength of wire	:	3800 kg/cm² min.
Elongation	:	20 percent min.

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SPECIFICATION FOR POLYMER MODIFIED MORTAR

Type	:	Structural grade polymer modified mortar
Material requirement	:	a. Ready to use / prepared of site polymer modified cementatious powder b. Polymer liquid c. Water conforming to IS: 456 – 2000 d. Acrylic bonding agent e. Polypropylene Fibers
Mix proportion	:	Mortar shall prepared be as per manufacturers recommendations with 125g of polypropylene fibers per 50 kg of dry mortar.
Consistency	:	Trowellable consistency
Surface preparation	:	Identified concrete surface shall thoroughly roughened by chipping, followed by water jet cleaning
Bonding agent	:	Surface shall be primed with acrylic bonding agent prior to application of mortar.
Recommended thickness	:	Not more than 12 mm per layer
Curing	:	Air curing
Flexural strength	:	Not less than 4.5 N/mm^2
Compressive strength	:	Not less than 15 N/mm^2 for 7 days Not less than 25 N/mm^2 for 28 days
Recommended prepared polymer **modified mortar**	:	**"Emaco S488C 1"** M/s. BASF Construction Chemicals India Pvt. Ltd. **"Ceupatch HM"** M/s. Dcc Construction Chemicals India Ltd. **"Dr. Fixit Super Latex"** M/s. Pidilite Industries Ltd. **"Renderoc S2"** M/s Fosroc Chemicals (India) Pvt. Ltd **"Sika Top 122.HS"** M/s. Sika India Pvt. Ltd. or any **equivalent**

SPECIFICATION FOR
STRUCTURAL GRADE LATEX MODIFIED MORTAR

Type	:	Structural grade latex modified mortar
Mixing	:	As per manufacturer's specification.
Consistency	:	Trowelable consistency
Setting time	:	Initial - 7½ hours maximum
		Final - 6 hours maximum
Compressive Strength:		Not less than 12.5 N/sq.mm in 3 day
		Not less than 14.0 N/sq.mm in 7 days
		Not less than 25.0 N/sq.mm in 28 days
Flexural strength	:	Not less than 6.5 N/sq.mm at 28 days
Tensile strength	:	Not less than 3.5 N/sq.mm at 28 days
Chemical Resistance	:	Cured mortar shall be impermeable to acids, gases, chloride ions, oxygen and water.
Priming	:	Cleaned substrate shall be primed as per manufacturer's specification.
Application	:	Wet on wet condition, primer shall not be allowed to dry
Working temperature	:	Above 10° C
Curing	:	Curing shall start immediately on finishing the surface and shall continue for 7 days minimum.

Available sources :

"Rheomix 141" from
M/s. BASF Construction Chemicals
India Pvt. Ltd., Bangalore

"Setcrete SBR"
M/s. Dun Construction Chemicals India Ltd.

"Nitobond SBR" from
M/s. Fosroc Chemicals India Ltd.

"Sika Latex" from
M/s. Sika Quaterete Pvt. Ltd., Bangalore

"Polyalk SB" from
M/s. Sunanda Speciality Coatings Pvt. Ltd.
Mumbai

or any equivalent

SPECIFICATION FOR ANCHOR GROUT

Connecting material	:	Fe-415 grade steel
Diameter of hole to be drilled in concrete	:	As detailed in sketch
Depth of embedment	:	As detailed in sketch
Anchoring medium	:	Quick setting polyester resin anchor grout
Curing time	:	24 hours minimum (air curing)
Source of resin grout available	:	"Masterflow 935" from M/s. BASF Construction Chemicals India Pvt. Ltd., Bangalore Lock fix 'S' from M/s. Fosroc Chemicals (India) Ltd. Bangalore or any other equivalent
Compressive strength of anchor grout	:	20 N/sq.mm in 5 hrs. @ 30 °C 75 N/sq.mm in 7 days
Type of equipment for drilling	:	Rotary-cum-Hammering action electrically operated drilling machine with masonry drill bits.
Source of equipment for drilling in concrete	:	Electrix (India) Pvt. Ltd. Bangalore BOSCH Ltd. Bangalore H.U.T.I India Ltd. Bangalore or any equivalent

SPECIFICATION FOR
EPOXY INJECTION / GROUTING

Reference	:	ASTM - 887 - 87 Type I, Grade I, Class B or C.
Type of Epoxy	:	Low viscosity solvent free prepacked resin and hardener, free flow epoxy system after mixing.
Viscosity	:	Mix viscosity 800 mPas maximum at 25° C.
Pot life	:	Not less than 45 minutes
Compressive strength after 7 days curing at 25° C	:	Not less than 75 N/Sq.mm
Injection equipment	:	Electrically operated or Compressed air driven injection pump with suitable syringe system, fitted with suitable pressure gauge.
Operating pressure	:	3 – 4 Kg/Sq.cm
Available sources	:	**"Conresive 1315"** from: M/s. BASF Construction Chemicals India Pvt. Ltd., Bangalore **"Quickmast 231"** M/s. Don Construction Chemicals India Ltd. **"Nitofil EPI.V"** from M/s. Fosroc Chemicals (India) Ltd., Bangalore **"KP 250"** from M/s. Krishna Concecem Products Pvt. Ltd., Mumbai **"Sikadur 52"** from M/s. Sika Qualcrete Pvt. Ltd., Bangalore **or any equivalent**

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SPECIFICATION FOR
WATER PROOF PLASTER
(With silica fumes and polypropylene fibers)

Thickness	:	20 mm
Mix Proportion	:	1 cement to 4 sand by weight
Water cement ratio	:	0.45 (maximum)
Admixture	:	Chloride free integral waterproofing Admixture conforming to IS:2645-1975 (Reaffirmed 1999) **"Rheomac 707"** from M/s. BASF Construction Chemicals India Pvt. Ltd., Bangalore **"Setseal tanking"** M/s. Don Construction Chemicals India Ltd. "Conplast X 421 IC" from M/s. Fosroc Chemicals (India) Ltd. **"Dichtament DM"** from M/s. MC-Bauchemie (India) Pvt.Ltd. **"Sika – 1"** from M/s. Sika Qualcrete Pvt. Ltd. **or equivalent**
Dosage of Admixture	:	As per manufacturer's specification.
Dosage of silica fume	:	5 % by weight of cement
Dosage of polypropylene fibre	:	125 gm/50 Kg. of cement
Curing period	:	14 days (minimum)

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SPECIFICATION FOR APP MEMBRANE

Type of membrane	:	Atactic Poly propylene (APP) modified bituminous membrane with polyster reinforced mat
Thickness of membrane	:	4 mm (min)
Type of application	:	Heat bonding (Torch-on)
Surface finish of membrane	:	a. Sand finish - If mortar / concrete is provided b. Two coats Aluminium paint—If the membrane is exposed directly to sun light
Primer (on cleaned substrate)	:	Compatible bituminous primer coat at the rate of 150 - 200 gm/sq.m (min)
Lap (Min.)	:	a) Side laps - 100mm b) End laps - 150mm
Tensile strength of membrane	:	Longitudinal - 700N (min) / 50 mm Transverse - 500 N (min) / 50 mm
Elongation of membrane		Longitudinal - 40 % Transverse - 50 %
Tear Resistance of membrane	:	Longitudinal - 150 N Transverse - 150 N
Lap strength of membrane	:	Longitudinal - 700 N / 50 mm Transverse - 500 N / 50 mm
Water Absorption of membrane		Less than 0.15%
Water vapour permeability	:	Absolutely impermeable
Available sources	:	**"Dr. Fixit Torchshield P4160"** M/s. Pidilite Industries Ltd.

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SPECIFICATION FOR SCREED CONCRETE

Reference	:	Indian Standard IS:456-2000 'Code of Practice for Plain and Reinforced Concrete'
Concrete	:	M-25 concrete 12 mm and down size aggregate mixed with integral water proofing compound.
Reinforcement	:	Nominal reinforcement / weld mesh / Polypropylene fibers to be provided as per drawing
Type of cement	:	Ordinary portland cement grade 43 conforming to IS: 8112 - 1989
Batching	:	Either by weigh batching or equivalent volume batching
Concrete admixture	:	Chloride free integral water proofing admixture conforming to IS:2645 - 1975 **"Rheomac 707"** from M/s. BASF Construction Chemicals India Pvt. Ltd., Bangalore **"Conplast X 421 IC"** from M/s. Fosroc Chemicals (India) Ltd. **"Dichtament DM"** from M/s. MC-Bauchemie (India) Pvt.Ltd. "Sika - 1" from M/s. Sika Quelcrete Pvt. Ltd. or any equivalent
Fibres	:	Polypropylene fibres from M/s. Naina Industries or equivalent
Dosage of admixture and quantum of fibres	:	As per manufacturer's specification
Curing period	:	14 days (min.)
Method of curing	:	By water ponding

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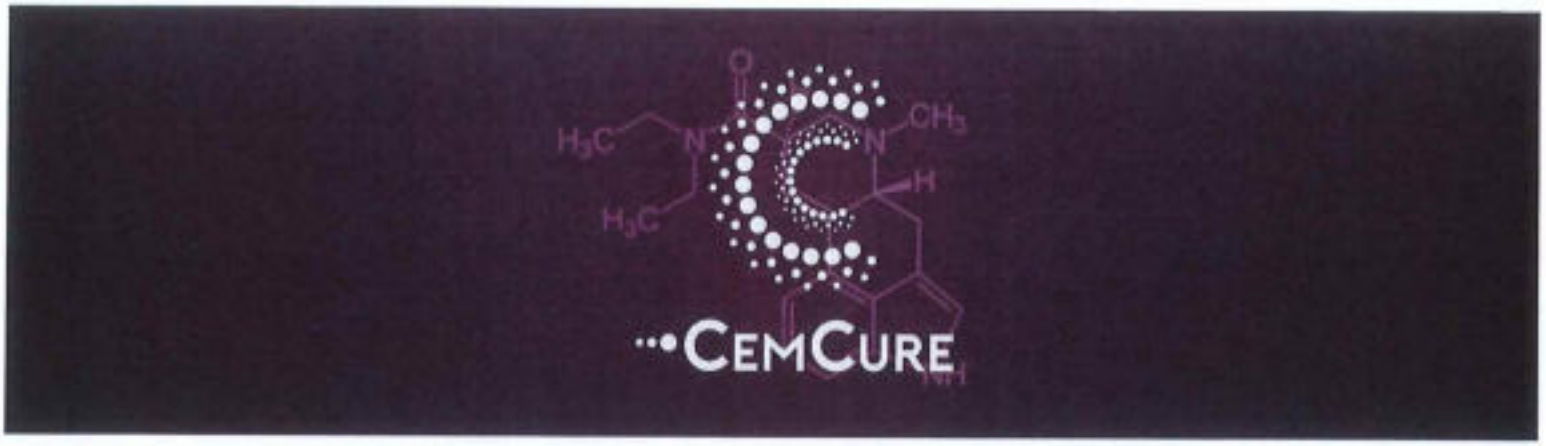


HIGHLY FLEXIBLE POLYACRYLIC / ACRYLATE RESIN INJECTION

CEMCURE SHIELD PLUG 2K

CEMCURE SHIELD PLUG 2K is two component water based modified polyacrylic / acrylate resign gel injection for negative and positive side chemical grouting. Resin grouts are used in general building, any civil engineering structures underground tunnels, dams, reservoir and channels.

It is used for both preventive waterproofing and repair waterproofing to overcome leakages. It can also used for consolidate rock and subsoil. it is chemical resistant after the polymerization, product will swell, when it contact with water to form a reliable plug.

FIELDS OF APPLICATION

- Basement,
- Underground tunnels,
- Dams,
- Reservoir
- Water channels
- Lift pits
- Lift pits,
- Swimming pools,
- Water tanks
- Leakage due to hydrostatic pressure
- To fill voids behind and consolidate buried structures for under ground injections.

FEATURES AND BENEFITS

- Outstanding flow properties due to low viscosity
- Water resistant
- Chemical resistant
- reversible and reactive swelling mass
- Suitable for Wet and Damp surface
- Swell, when it contact with water.
- Stabilized mass after injection

APPLICATION

Both the part 1 and 2 must first be prepared. The material is applied using high pressure 2 component hydro pneumatic air operated injection machine with the components fed separately in the ratio 1:1 by volume.

Mixing Instruction:-

Part – 1:-
is prepared by mixing the Component-1A (liquid) with the Component -1. Always use a mixing paddle when mixing. Mixed Component -1 may be kept for approx. 2 days, depending on the storage temperature.

Part - 2 :-
is prepared by mixing the Component- 2A (powder) with the Component -2. Mixed Component-2 may be kept for 2-5 days, depending on the storage temperature. For further details, lease consult the mixing instructions.

TECHNICAL DATA:-

Part - 1

- Appearance : Liquid
- Color : Greenish Purple
- pH Value : 5-6
- Specific Gravity : 1.05 + 5%

Part - 2

- Appearance : Liquid
- Color : Clear
- pH Value : 8 - 9
- Specific Gravity : 1.11 + 5%

Note:-** qty may varies depends upon condition of setting time usage as accelerator

Part - 1A

- Appearance : Liquid
- Color : Clear
- pH Value : 7-8
- Specific Gravity : 1.02 + 5%

Part - 2A

- Appearance : Powder
- Color : White
- pH Value : 3-4
- Specific Gravity : 1.02 + 5%

Coverage :- Depends upon site condition

PACKING: 20kg, 40kg & 100kg.

SHELF LIFE:-

12 months in original, unopened package.

STORAGE STORE:-

In dry area between +5°C and +35°C. Protect from heat, freezing and direct sunlight

CLEANUP INFORMATION: -

Clean tools and equipment with water immediately after use. Dried / polymerized material can only be removed mechanically.

CAUTIONS/LIMITATIONS

Store product under shade and protect from direct sunlight. Do not used the product in freezing temperature.

HEALTH AND SAFETY

Warning! Wear personal protective equipment (PPE) like:-clothing, gloves, eye and face protection. Cause eye and skin irritation. If eye or skin contact, get immediate medical attention. If swallowed, do not induce vomiting. Call a physician or poison control center. Never give anything by mouth to an unconscious person. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. Take off contaminated clothing and wash it before reuse. Dispose of unused, contents, container and other contaminated wastes in accordance with local, state, federal and provincial regulations. Keep container closed when not in use. Keep out of the reach of children.

CemCure

NO 35, OLD KHATHA NO.348, NEW KHATA NO.243, KRISHNARAJAPURAM, KRISHNARAJAPURAM HOBLI, BANGALORE - 560036.

CEMCURE.WPC@GMAIL.COM

WWW.CEMCURE.COM

8867722500

PHOTOGRAPHS

GENERAL VIEW OF THE BUILDING

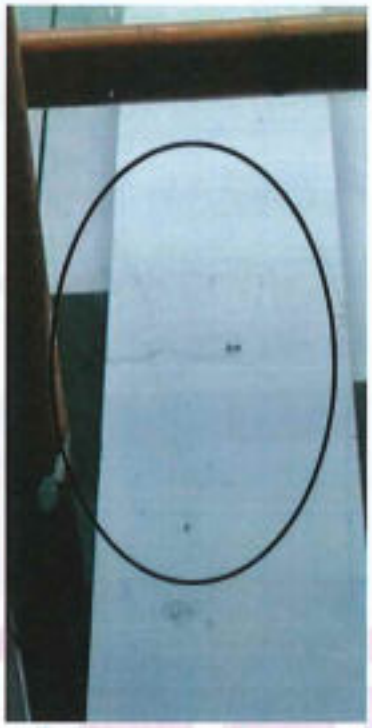
VIEW OF THE BASEMENT FLOOR & RAMP

CAR PARKING –I (BASEMENT FLOOR)

Dampness on RC Beam & Slab

Grouting on RC slab

Crack on RC beam



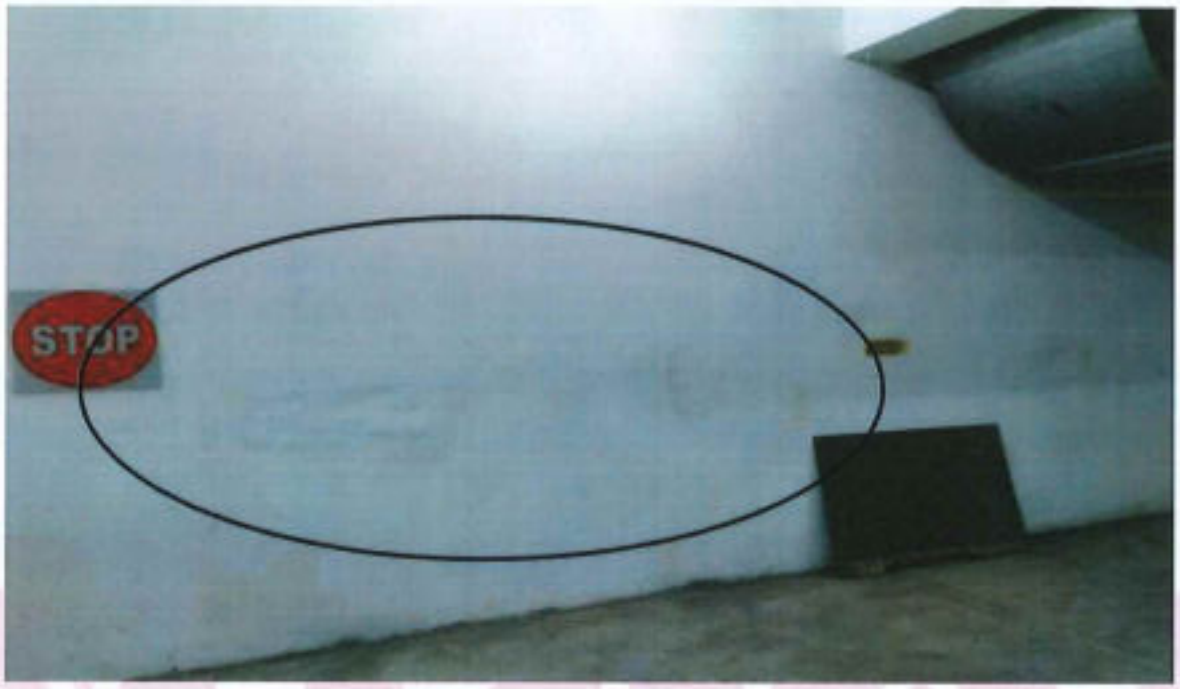
Dampness on column

Crack on RC column

CAR PARKING –II (BASEMENT FLOOR)

Grouting on RC slab

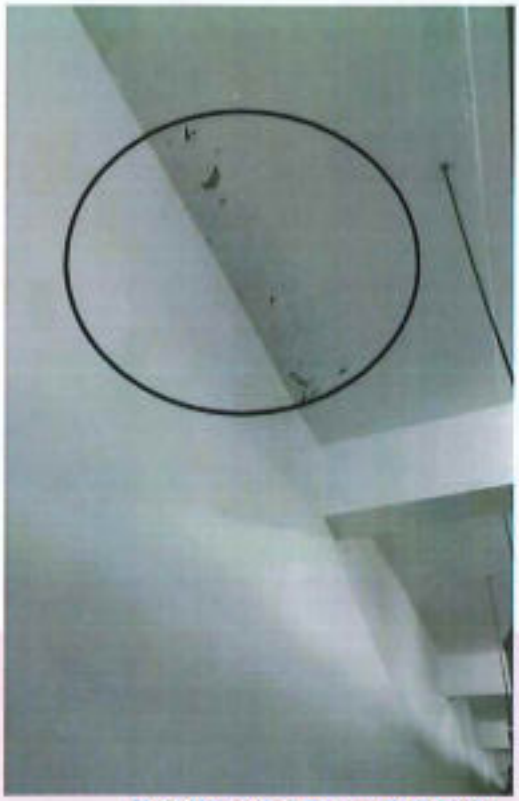
Minor leak & dampness on Retaining wall



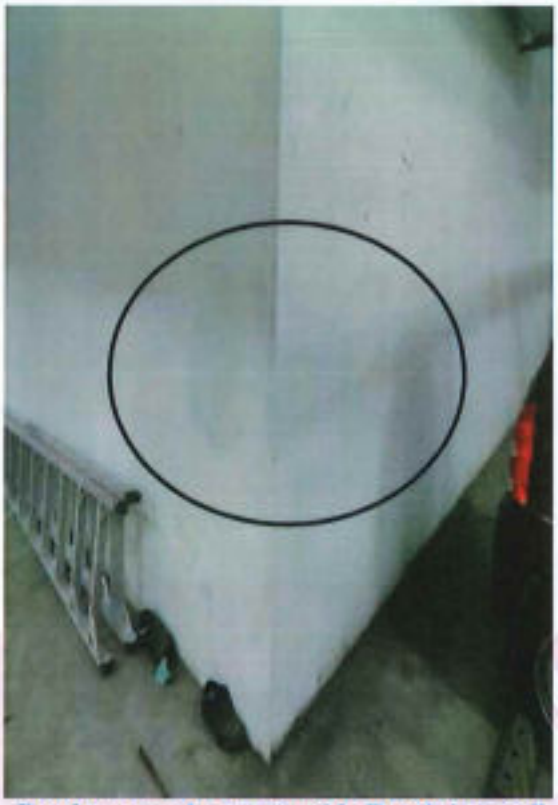
Patchup work on south side retaining wall

CAR PARKING –III (BASEMENT FLOOR)

Dampness on RC Slab

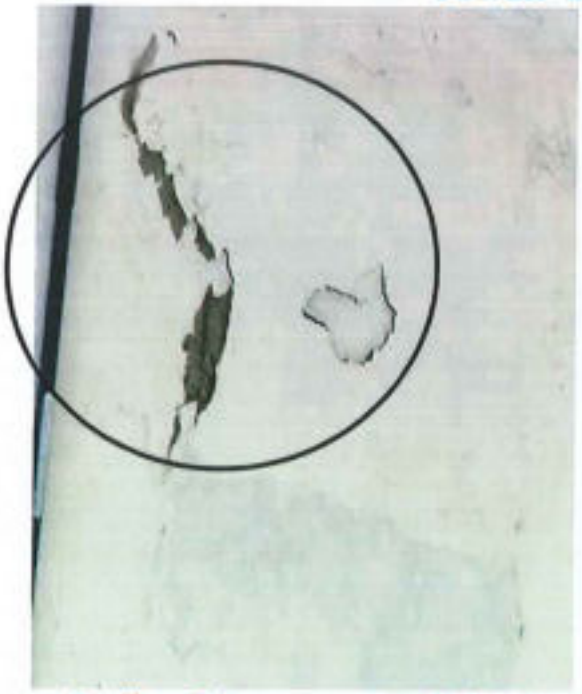


Peeeling of paint on RC Slab

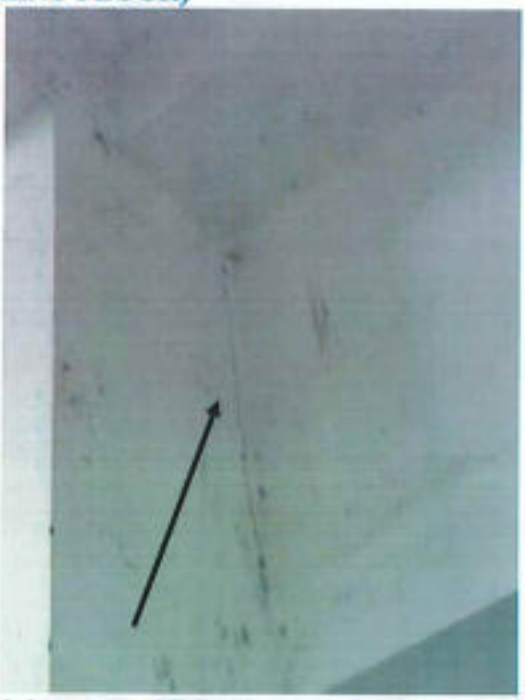


Patch-up work on west side Retaining wall

TOWER –B (BASEMENT FLOOR)



Spalling of cover concrete on RC slab



Crack between of RC column & RC beam junction

Minor Crack on corbel portion

Crack on RC beam bottom

TOWER –C (BASEMENT FLOOR)

Crack on staircase wall

Peeeling of paint on RC Slab

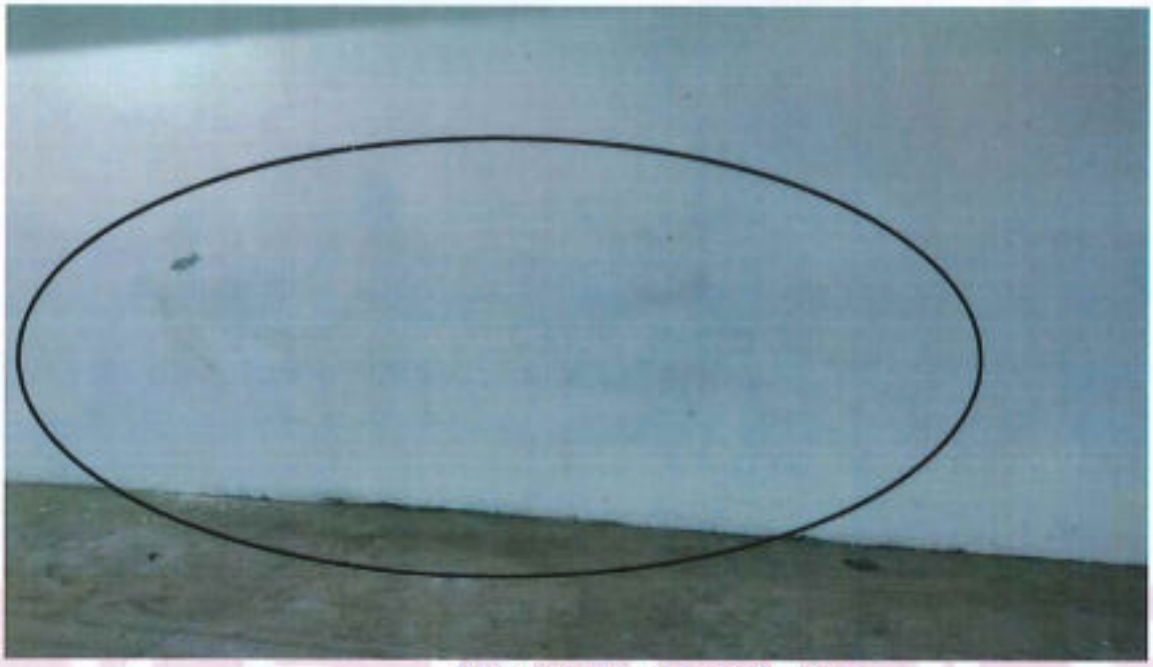
Patchup work on RC column

Dampness on retaining wall (south)

BASEMENT FLOOR (NORTH SIDE)

Dampness on Retaining wall

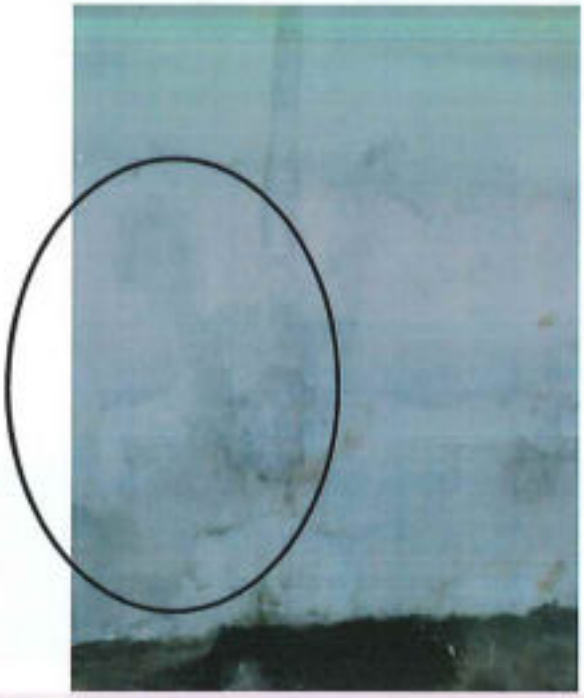
Grouting work on RC slab

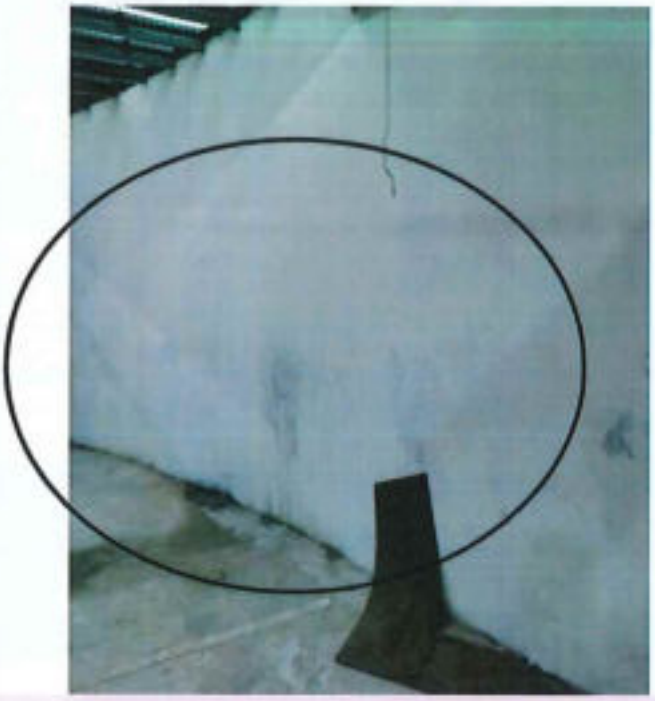


Patchup work on Retaining wall

BASEMENT FLOOR (NORTH & NORTHWEST SIDE RETAINING WALL)

Dampness, minor seepage and patchup on retaining wall





EXTERNAL & GROUND FLOOR

Gap between ramp wall and paver block

EXTERNAL & GROUND FLOOR

EAST FACE

SOUTH FACE

Gap between screed concrete and paver block (drive way area)

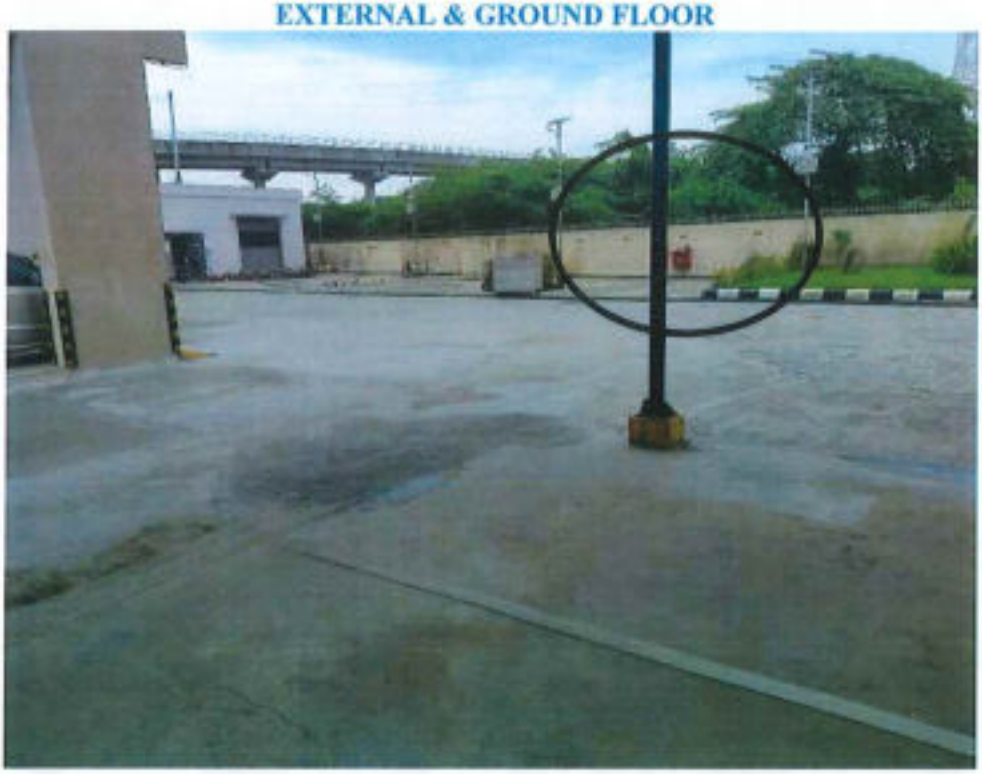
NORTH FACE

NORTH WEST FACE

EXTERNAL & GROUND FLOOR

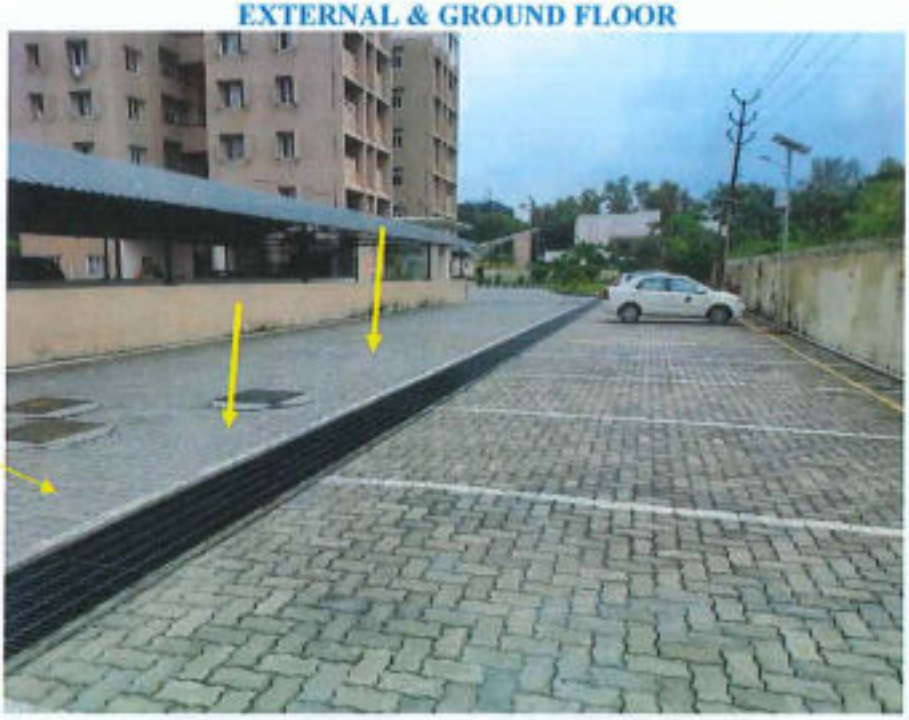
6mm metal plate (L –shape) provided at expansion joint region between parking area and tower –B & C

EXTERNAL & GROUND FLOOR

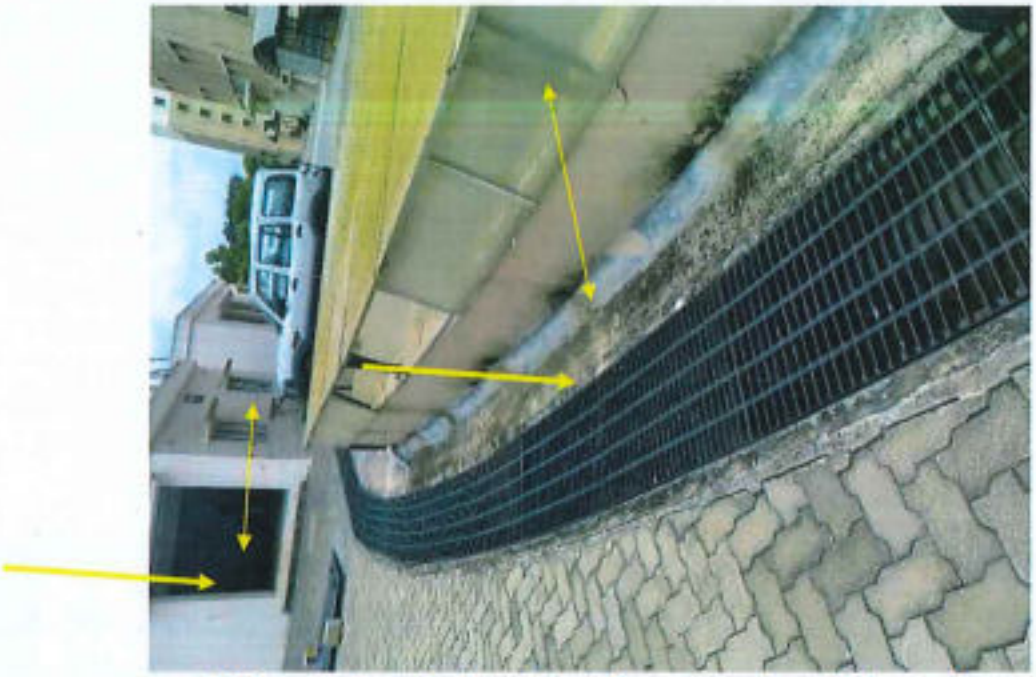


Gardening at North face

EXTERNAL & GROUND FLOOR



Rain water trench at south face away from retaining wall



Rain water trench at northwest face nearer to retaining wall

Extraction of concrete core sample in progress

Ultrasonic pulse velocity test in progress
(Typical view)

Rebound hammer test in progress
(Typical view)

Cover meter test in progress
(Typical view)

Half-cell potential difference measurement test in progress
(Typical view)

Carbonation test in progress
(Typical view)