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Structural Audit on Badlapur Skywalk

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I. GENERAL

The structural audit is a crucial assessment process aimed at evaluating the health and integrity of a structure to ensure its safety, durability, and functionality. This report provides a comprehensive evaluation of the structure under consideration, identifying potential risks, defects, and areas requiring maintenance or repair.

Conducted in accordance with established standards and guidelines, the audit involves visual inspections, non-destructive testing (NDT), and a detailed analysis of structural elements, including structural steel, columns, Deck slab, Staircase, Flooring and Roof. The findings of this report are intended to assist in decision-making for necessary interventions to extend the structure's lifespan and enhance safety.

The structure under inspection, the Badlapur (East-West) Skywalk, is a composite structure constructed by the Mumbai Metropolitan Region Development Authority (MMRDA) circa 2009-2011, located in Badlapur. The skywalk is currently under BADLAPUR MUNICIPAL COUNCIL (KBMC)'s management.

This technical report provides a summary and outcome of this testing and evaluations work, and also provides suggestions for steps to be taken in future. It should be noted here that as per the finalized scope of this project, the retrofitting and rehabilitation, and the recommendation thereof [is] not a part of this project." However, based on the detailed visual inspection and NDT conducted along the length and breadth of the structure, some suggestions towards re-analysis, repair and replacement are given here.

1.1 Scope of the Project

The scope of this project covers all the essential activities required to assess the structural condition, safety, and stability of the Badlapur Skywalk. The study aims to identify existing defects, determine the causes of deterioration, and propose suitable maintenance or repair measures to ensure the skywalk remains safe and serviceable for public use.

The main scope includes

1. Collection of Data:
- Gathering existing drawings, design details, and previous maintenance records of the skywalk.
- Recording site conditions and structural layout through field visits.

2. Visual Inspection:
- Identifying physical defects such as cracks, corrosion, spalling, deflection, or leakage.
- Assessing the general condition of structural members like beams, columns, slabs.

3. Non-Destructive Testing (NDT):
- Conducting tests such as rebound hammer test, ultrasonic pulse velocity test, and carbonation depth test to evaluate material quality and strength.

4. Structural Assessment:
- Comparing field results with standard codes and design specifications.
- Evaluating the load-carrying capacity and remaining life of the structure.

5. Recommendations and Reporting:
- Preparing a detailed report with observations, test results, conclusions, and suggestions for repair, retrofitting, or maintenance.

The scope of this project is limited to the structural components of the Badlapur Skywalk and does not include architectural or aesthetic modifications. The outcome will assist local authorities in ensuring long-term durability and public safety of the structure.

1.2 Objective of the Project

The main objective of this project is to evaluate the structural health, safety, and serviceability of the Badlapur Skywalk through a systematic structural audit process. The project focuses on identifying structural defects, assessing material strength, and suggesting appropriate repair or maintenance measures to ensure the continued safe use of the skywalk.

The specific objectives are as follows:

1. To conduct a comprehensive visual inspection of the Badlapur Skywalk to identify visible signs of deterioration such as cracks, corrosion, or deformation.
2. To perform non-destructive testing (NDT) and evaluate the strength and quality of the construction materials.
3. To analyze the structural stability and load-carrying capacity of various components of the skywalk.
4. To determine the causes of damage or distress and assess the remaining service life of the structure.
5. To prepare a detailed audit report including observations, analysis, conclusions, and recommendations for repair, retrofitting, or preventive maintenance.
6. To enhance awareness about the importance of periodic structural auditing for public infrastructure safety and sustainability.

The project ultimately aims to ensure that the Badlapur Skywalk remains structurally sound, durable, and safe for public use, while promoting a culture of preventive maintenance in civil engineering practices.

II. LITERATURE REVIEW

Literature review is a summary and evaluation of existing research, studies, reports, and technical papers related to your project topic. It helps you understand what work has already been done by other researchers or engineers and how your project is related or different from them.

2.1 Introduction

Structural auditing of pedestrian bridges and skywalks is a well-established practice in civil engineering aimed at evaluating safety, serviceability, and remaining life of structures. The literature emphasizes that periodic audits are essential for early detection of defects and to plan timely maintenance, particularly for urban infrastructure exposed to heavy pedestrian use and harsh environmental conditions.

2.2 Studies on Common Distress Mechanisms

Research and field reports consistently identify a set of common distress mechanisms in reinforced concrete and steel pedestrian structures: concrete cracking, spalling, chloride- induced corrosion of reinforcement, section loss in steel members, joint deterioration, and fatigue at connections. Many studies link these problems to inadequate drainage, exposure to de-icing salts or pollutants, design detailing that traps moisture, and lack of routine maintenance.

2.3 Inspection Methods and Best Practices

Literature describes a combination of visual inspection, non-destructive testing (NDT), and instrumentation as the most effective audit approach. Visual inspections remain the first step for mapping defects, while NDT techniques — e.g., rebound hammer, ultrasonic pulse velocity, cover meter and half-cell potential (for corrosion evaluation) — provide quantitative information about material condition without damaging the structure. Several papers recommend combining complementary NDT tests to reduce uncertainty and to calibrate in-situ results with laboratory testing where possible.

2.4 Structural Assessment and Load Evaluation

A recurring theme is the comparison of as-built/observed conditions with original design assumptions and current code requirements. Literature stresses checking load-carrying capacity of critical members, deflection behaviors under service loads, and connection integrity. Many authors advocate modest structural analyses (hand calculations or simplified finite element models) supplemented by measured data when available to assess residual capacity and safety margins.

2.5 Durability, Corrosion and Material Performance

Durability research highlights how environmental exposure, concrete cover, porosity, and carbonation influence reinforcement corrosion and long-term performance. Studies suggest preventive measures — adequate concrete cover, protective coatings, improved drainage, and cathodic protection in severe cases — and recommend life-cycle-based maintenance planning rather than ad-hoc repairs.

2.6. Repair, Strengthening and Maintenance Strategies

The literature offers a range of repair and strengthening solutions appropriate to pedestrian structures: patch repairs for spalling, protective coatings and corrosion inhibitors, steel plate bonding or fiber-reinforced polymer (FRP) laminates for strengthening, and local reconditioning of bearings and joints. Authors emphasize selecting solutions based on the root cause of distress, expected remaining life, and cost-effectiveness.

2.7. Case Studies and Lessons Learned
Multiple case studies of skywalks and pedestrian bridges demonstrate that early detection and scheduled maintenance dramatically reduce life-cycle costs and improve safety. Case reports often include before-and-after NDT results, strengthening design choices, and monitoring protocols that confirm the effectiveness of interventions.

2.8. Gaps in Existing Research
Despite extensive guidance, gaps remain in standardized thresholds for intervention based on combined NDT results, long-term performance data for some modern strengthening materials (e.g., newer FRPs), and region-specific studies that factor local climate and pollution. There is also a need for more practical guidelines for municipal bodies with limited budgets.

2.9. Recommended Types of References to Include in the Report
- Recent journal articles and conference papers on pedestrian bridge inspections and NDT. Technical manuals and NDT method guides.
- Case study reports on skywalk/footbridge audits and retrofits.
- National design and maintenance codes and standards (for reference to load and material requirements).

III. PROJECT METHODOLOGY

The methodology adopted for the Structural Audit of the Badlapur Skywalk consists of a systematic sequence of steps designed to assess the structural health, safety, and serviceability of the skywalk. Each stage is carried out in accordance with relevant codes and standard engineering practices to ensure accurate evaluation and reliable results.

1. Data Collection and Review

- Collection of available structural drawings, design details, previous inspection records, and maintenance history.
- Verification of design loads, materials used, and construction methodology.
- Site visit to understand the existing conditions and layout of the skywalk.

2. Visual Inspection

- Conducting a detailed walk-through survey of the entire skywalk structure.
- Identifying visible signs of distress such as:
- Cracks, spalling, corrosion of reinforcement, leakage, rust stains, and deformation.
- Photographing and mapping the defects for documentation and analysis.
- Categorizing defects based on severity (minor, moderate, or critical).

3. Non-Destructive Testing (NDT)

To assess the in-situ strength and quality of materials without damaging the structure, the following NDT methods are carried out:
- Rebound Hammer Test: To determine surface hardness and estimate compressive strength of concrete.
- Ultrasonic Pulse Velocity Test: To evaluate internal concrete quality and detect voids or cracks.
- Cover Meter Test: To measure the concrete cover over reinforcement.
- Half-Cell Potential Test: To assess the probability of corrosion in steel reinforcement.
- Carbonation Test: To determine the depth of carbonation and its effect on durability.

4. Structural Analysis and Assessment

- Evaluation of collected data and test results to assess overall structural integrity.
- Comparison of current condition with design standards and code requirements (IS 456:2000, IRC codes, etc.).
- Estimation of remaining service life based on material condition and observed deterioration

5. Reporting and Recommendations

- Preparation of a comprehensive audit report including:
- Observations and photographs

- Test results and interpretations
- Structural analysis and conclusions
- Suggested repair, retrofitting, and preventive maintenance measures
- Prioritization of critical repairs to ensure user safety.

6. Follow-up and Monitoring
- Proposing a periodic inspection schedule for future monitoring.
- Suggesting preventive maintenance strategies to enhance durability and service life.

This methodology ensures a thorough and scientific evaluation of the Badlapur Skywalk. The findings help the municipal authority make informed decisions regarding repairs, strengthening, and long-term maintenance planning.

3.1 Timeline (August 2025 – March 2026)

Table 3.2 Major Project Timeline from August 2025 to March 2026

Sr. No.	Activity / Phase	Description	Duration / Time Period
1	Project Planning and Literature Review	Understanding project objectives, collecting background data, and reviewing previous research on structural auditing and NDT methods.	Week 1 – Week 2
2	Data Collection and Site Reconnaissance	Gathering drawings, past records, and conducting initial visits to study site layout and conditions.	Week 3
3	Visual Inspection	Detailed survey of the skywalk to identify visible defects and distress patterns.	Week 4
4	Non-Destructive Testing (NDT)	Performing tests such as Dye Penetration Test, Ultrasonic Pulse Velocity, and Carbonation Test.	Week 5 – Week 6
5	Data Analysis and Structural Assessment	Evaluating test results, comparing with code requirements, and assessing overall structural health.	Week 7 – Week 8
6	Preparation of Audit Report	Compiling data, photographs, analysis results, and drafting conclusions and recommendations.	Week 9
7	Review and Final Submission	Reviewing the report, incorporating guide's feedback, and preparing the final submission.	Week 10

3.2 Experimental Program Structural Audit of Badlapur Skywalk

1. Objectives of the Experimental Program

- Quantify in-situ material strength and durability of concrete and steel.
- Detect and map corrosion, voids, cracks, and other defects.
- Measure serviceability (deflection) and load response of critical members.
- Provide laboratory verification (core tests, chloride, carbonation) where required for repair design.
-

2. Scope of Tests (Field + Laboratory)

Field (NDT & measurements):

- Visual mapping & photographic log
- Rebound Hammer Test (surface strength estimation)
- Ultrasonic Pulse Velocity (UPV) (internal condition)
- Concrete Cover Measurement (Cover Meter)
- Half-Cell Potential (corrosion probability)
- Carbonation Depth (phenolphthalein spray)
- Crack width measurement (feeler gauges / microscope)
- Deflection measurement (dial gauge / LVDT) under service loads
- Bearing & joint inspection (movement, condition)
- Visual steel inspection for protection, section loss estimation (where exposed)
-

Laboratory (destructive / chemical):

- Core extraction & compressive strength test (3–7 cores depending on condition)

- Chloride content (titration) on selected cores/powder samples
- Carbonation confirmation (mortar powder pH) if needed
- Petrographic / microstructural examination (optional, for unusual deterioration)
-

3. Equipment & Instruments

- Digital camera, measuring tape, marking materials
- Rebound Hammer (EN/IS compliant)
- Ultrasonic Pulse Velocity tester (transducers with gel)
- Cover Meter / GPR (where available)
- Half-Cell Potential kit (reference electrode, voltmeter)
- Dial gauge / Digital LVDT with tripod and magnetic base
- Phenolphthalein solution and spray bottle for carbonation test
- Core drilling rig (wet coring) and core box
- Portable grinder (for surface prep), grinder for exposing reinforcement if needed
- Chloride titration kit or send to accredited lab
- Personal protective equipment (PPE) — helmets, harness, gloves, safety shoes
-

4. Detailed Test Procedures (Field)

1. Visual Inspection & Mapping

Walk-through, record all defects with location tags, severity, and photographs; prepare defect log and sketches.

2. Rebound Hammer

Clean surface, take readings at prepared flat locations, avoid edges and repair patches; record temperature & surface condition; convert rebound number to estimated compressive strength using accepted correlation.

3. UPV

Use direct/indirect method depending on accessibility. Maintain good coupling and follow manufacturer's calibration. Record pulse velocity (m/s) and compare with reference values.

4. Cover Meter

Scan element surface; mark reinforcement grid and estimate cover at selected locations.

5. Half-Cell Potential

Prepare area (wetting surface), connect reference electrode (copper/copper sulphate), take potential readings and map corrosion probability (ISO/ASTM criteria).

6. Carbonation

Drill shallow pits or expose concrete surface, spray phenolphthalein; measure depth of uncoloured zone (carbonated depth).

7. Deflection Test

Fix dial gauge/LVDT to a stable reference; measure initial reading; measure under existing live load and after simulated incremental loading (if permitted). Record recovery after unloading.

8. Crack Measurement & Monitoring

Measure width, length, and direction; install tell-tales or crack gauges for periodic monitoring.

9. Core Extraction

Select locations based on NDT results and visual distress. Use wet coring, cure cores as per standard, transport to lab for compressive strength, water absorption, chloride analysis.

5. Laboratory Procedures

i. Compressive Strength on Cores: Trim to standard length-diameter ratio, test per relevant code (IS/ASTM); correct for core size and age.
ii. Chloride Content: Powder from concrete at cover depth; determine % by weight of cement or concrete.
iii. Carbonation / pH: powder analysis or indicators.

6. Acceptance Criteria & Interpretation

i. Compare measured concrete strength with design strength (allow for age and variability).
ii. Deflection: allowable limits per IS/IRC (e.g., span/250 for total deflection — adapt to member type).
iii. Half-Cell Potential: interpret using standard thresholds (e.g., more negative values indicate high probability of corrosion).
iv. Chloride threshold: compare with critical chloride threshold for corrosion (typical guideline: %Cl by weight of cement; local codes to be referenced).
v. UPV/Rebound: use combined interpretation — low UPV + low rebound suggests degraded concrete; calibrate with core tests.

7. QA / QC and Calibration

i. Calibrate NDT instruments before testing (record calibration certificates).

ii. Use experienced personnel for half-cell and UPV tests.
iii. Cross-validate NDT results with at least one core test for reliability.
iv. Maintain chain-of-custody and labelling for all cores and lab samples.
v. Maintain weather log and ambient conditions during tests.

8. Safety & Site Access
i. Obtain municipal/site permission before coring or any intrusive works.
ii. Ensure traffic management and pedestrian safety during on-site tests.
iii. Use harnesses/edge protection for work at height.
iv. Electrical safety for powered tools and instruments.

9. Notes & Recommendations
i. Use combined interpretation (visual + multiple NDTs + cores) rather than single-test decisions.
ii. Prioritize safety-critical defects for immediate remedial action.

3.3 Details & Scope of Investigation
The Scope of the work stipulated for strength evaluation of existing structure is tabulated below. The field work of NDT was carried out 26^{TH} AUG 2025 the details of this investigation are given below.

Sr. No.	NAME OF TEST	BROAD PURPOSE OF THE INVESTIGATION	NO. OF TESTS
1	Ultrasonic thickness gauge test (UT):	To measure the reduced thickness of corroded steel components	50
2	Dye penetration test (DPT)	To detect cracks in steel components, particularly at welded joints	100

Table 3.4 Field Work Of NDT

It may please be noted that the detailed structural design of strengthening, if required, is not contemplated in the report. This report is aimed at providing general information regarding the strength and existing status of RCC members. The information presented in the report shall provide the necessary data from which the detailed structural audit for the purpose for which it is intended can be worked out.
The work in general was carried out in accordance with the following Indian standard specifications.

IS – 12889 – Code of Practice for Method for Liquid Penetrant Inspection of Welds
IS – 15388 – Non-Destructive Testing-General Principles.

3.4. Ultrasonic Thickness Gauge Test (UT):
An ultrasonic thickness gauge measures the reduced thickness of corroded steel components by utilizing the properties of sound waves to detect changes in material thickness.

How It Works:
1. Sound Wave Propagation:
An ultrasonic thickness gauge sends high-frequency sound waves (usually in the range of 0.5 to 20 MHz) through the steel material.
The sound waves travels through the steel until it encounters the opposite surface. Some of the sound

wave energy is reflected back, and the rest continues through the material.

2. Reflection and Echo:

The gauge records the time it takes for the sound wave to travel through the steel and return (echo).

The time interval between the transmitted and reflected pulses is used to calculate the thickness of the material.

3. Reduced Thickness Due to Corrosion:

In corroded steel components, the thickness is reduced because corrosion has eaten away at the material's surface.

The ultrasonic thickness gauge measures the time delay between the transmitted and reflected sound waves. Since the sound wave travels faster through the material, the thickness measurement is influenced by any reduction in the steel's cross-section.

By comparing the current measured thickness with the original thickness (using calibration with known standards), the gauge can detect and quantify the amount of corrosion and material loss.

4. Calibration and Accuracy:

To ensure accurate readings, the gauge must be calibrated to account for the speed of sound in the specific steel material. This calibration is done using a reference standard with a known thickness. The speed of sound varies slightly between different grades and conditions of steel, so calibration is critical for precise thickness measurement.

5. Detection of Corrosion:

The ultrasonic thickness gauge can identify areas of steel that have reduced thickness due to corrosion. If there is a significant reduction in thickness (e.g., a loss of more than 10% to 20% of the original thickness), it indicates corrosion.

Continuous monitoring can help track corrosion progression over time and provide data for maintenance and safety assessments.

B. DYE PENETRATION TEST (DPT)

The dye penetration test (DPT) is a useful method for detecting cracks in steel components, particularly in welded joints, due to its ability to reveal surface-breaking defects. Here's how the test specifically identifies cracks in these contexts:

IV. REPAIR

The repair and maintenance of structural components are critical to ensuring safety, functionality, and durability. Below is a general methodology that can be applied to assess, repair, and maintain various structural elements:

Assessment and Classification of Deterioration

1. Visual Inspection: Conduct a thorough visual inspection to identify signs of wear, corrosion, or damage.
2. Testing: Use Non-Destructive Testing (NDT) techniques to evaluate the degree of deterioration, particularly at joints and welds.
3. Classification:

i. Mild Deterioration: Minor corrosion or damage without significant loss of material strength.

ii. Severe Deterioration: Substantial material loss or structural weakening requiring strengthening or replacement.

4.1 Repair Methodology

1. Surface Preparation

- Remove old paint, rust, and other contaminants using suitable methods such as sandblasting or wire brushing.
- Clean all surfaces thoroughly to ensure proper adhesion of repair materials.

2. Repair Strategies

Mild Deterioration:

- Apply protective coatings such as anticorrosive paints.
- Perform minor repairs to restore the structural integrity.

Severe Deterioration:

- Strengthen affected members with additional plates or angles.
- Replace severely damaged components.

3. Welding and Joint Repairs

- Inspect welds and joints for defects.
- Remove and redo defective welds to restore joint integrity.

4.2. Specific Element Repairs

4.2.1 Staircases

- Repair or replace damaged steps, riser plates, and handrails.
- Replace damaged floor/step tiles.
- Strengthen or replace structural members as needed.
- Apply protective coatings to steel components.

4.2.2. Superstructure

- Remove cladding to inspect hidden areas.
- Repair corroded or weakened members and joints.
- Apply anticorrosive paint to all exposed surfaces.

4.2.3. Piers

- Surface Preparation: Remove rust, old paint, and contaminants using sandblasting, wire brushing, or chemical cleaning.
- Clean the surface thoroughly to ensure proper adhesion of repair materials.

4.2.4 Corrosion Protection:

- Apply anti-corrosive primer to cleaned steel surfaces.
- Repaint with high-quality, weather-resistant paint systems in multiple coats to provide durable protection.

4.2.5 Strengthening and Reinforcement:

- Weld or bolt additional plates, angles, or channels to strengthen weakened members.
- Replace severely corroded or deformed members with new ones of similar specifications.

4.2.6 Weld and Connection Repairs:

- Remove defective welds and re-weld using appropriate techniques and materials.
- Tighten or replace loose or damaged bolts and rivets.
- Ensure all connections meet design specifications and standards.

4.2.7 Structural Modifications:

- Install additional bracings or stiffeners to improve lateral and torsional stability if required.
- Replace or retrofit joints with modern connection techniques for enhanced performance.

4.2.8 Protective Measures:

- Install cathodic protection systems to mitigate corrosion in highly exposed or submerged areas.
- Provide drainage arrangements to prevent water accumulation on or around steel components.

4.2.9 Roofing

Replace damaged or missing roofing sheets with new ones of similar specifications.

4.2.10. Flooring

Replace damaged tiles or flooring material to ensure safety and uniformity.

4.2.11 Miscellaneous Components

- Railings: Clean, Repair or replace missing or damaged sections.
- Expansion Joints: Clean, repair, or replace damaged joints to ensure proper functionality.
- Drainage System: Install or repair drainage to prevent waterlogging and structural damage.

4.2.12. Lighting Systems:

Replace damaged or non-functional light fixtures, switches, and control systems.

Upgrade to energy-efficient lighting solutions, such as LED lights, where feasible.

4.3 Observation

4.3.1 Important photographs showing defects and disorders in the structure

EAST SIDE SKYWALK

STAIRCASE 1(VIEW OF STAIRCASE)



Observation: -
1. Staircase columns corroded. ACP cladding damage.
2. Bracings highly corroded.
3. Staircase roof sheet damage.

PIER 1 TO PIER 2: -



(VIEW OF PIER, DECK SLAB, FLOOR AND ROOF)

Observation: -
1. Pier 1- Surface corrosion detected on exposed steel members.
2. ACP Cladding damaged of deck slab, girder beam corroded.

PIER 2 TO PIER 3: -



(VIEW OF PIER, DECK SLAB, FLOOR AND ROOF)

Observation: -

1. Pier 2- Surface corrosion detected on exposed steel members.
2. Flooring tiles damaged near expansion joint. Cleaning required.

PIER 3 TO PIER 4: -

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 3- Surface corrosion detected on exposed steel members.
2. Flooring tiles damaged near expansion joint.

PIER 4 TO PIER 5: -

(VIEW OF PIER, FLOOR)

Observation:

1. 9Pier 4- Surface corrosion detected on exposed steel members.
2. Flooring tiles damaged.
3. Cleaning required.

PIER 5 TO PIER 6: -

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 5- Surface corrosion detected on exposed steel members.
2. Deck slab (ACP cladding) damaged.
3. Flooring tiles damaged.

PIER 6 TO PIER 7: -

(VIEW OF PIER, DECK SLAB, FLOOR AND ROOF)

Observation: -

1. Pier 6&7- Surface corrosion detected on exposed members.

PIER 8 TO PIER 9: -

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 9- Major surface corrosion detected on exposed steel members.
2. Flooring damaged.

PIER 9 TO PIER 10

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 10- Surface corrosion detected on exposed steel members due to inadequate maintenance.
2. Flooring damaged.

STAIRCASE 4

(VIEW OF STAIRCASE)

Observation:

1. Surface corrosion detected on exposed steel members.
2. Uneven tread and raiser.

WEST SIDE SKYWALK
STAIRCASE 1:



(VIEW OF STAIRCASE)

Observation: -

1. Surface corrosion detected on exposed steel members.
2. Uneven tread and raiser.
3. Flooring tiles damaged.

PIER 1 TO PIER 2: -

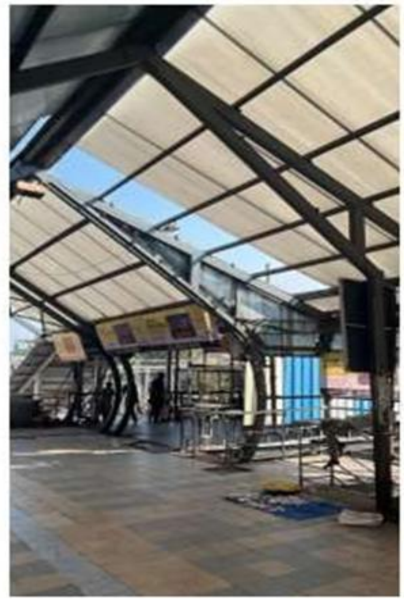
(VIEW OF PIER, DECK SLAB, ROOF)



Observation: -

1. Pier 1- Surface corrosion detected on exposed steel members.
2. ACP Cladding damaged.
3. Roof sheet damaged.

PIER 2 TO PIER 3: -



(VIEW OF PIER, FLOOR, ROOF)

Observation: -

1. Pier 2&3- cleaning required.
2. Flooring damaged. Cleaning required.
3. Roof damaged majorly.

PIER 3 TO PIER 4: -

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 4- cleaning required.
2. Deck slab (ACP Cladding) damaged.
3. Flooring damaged. cleaning required.

PIER 4 TO PIER 5: -


VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 5- Surface corrosion detected, cleaning required.
2. Flooring damaged. cleaning required.

PIER 5 TO PIER 6: -


(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 6- cleaning required.
2. Flooring damaged.

PIER 6 TO PIER 7: -

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 7- Surface corrosion detected, cleaning required
2. Flooring damaged. cleaning required.

(VIEW OF PIER, DECK SLAB)

Observation: -

1. Pier 19- Surface corrosion detected on exposed steel members.
2. Observed runner beam and deck sheet corroded.

PIER 7 TO PIER 8: -

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation: -

1. Pier 8- Surface corrosion detected, cleaning required
2. Flooring damaged. cleaning required.

PIER 8 TO PIER 9: -

(VIEW OF PIER, DECK SLAB, FLOOR)

Observation:

1. Pier 9- Surface corrosion detected, cleaning required
2. Flooring damaged. cleaning required.

PIER 9 TO PIER 10: -

(VIEW OF PIER, DECK SLAB, FLOOR, ROOF)

Observation: -

1. Pier 10- Surface corrosion detected, cleaning required
2. Cleaning required.

PIER 10 TO PIER 11: -

(VIEW OF PIER, DECK SLAB, FLOOR, ROOF)

Observation: -

1. Pier 11- Surface corrosion detected, cleaning required.
 Cleaning required.

STAIRCASE 2: -

(VIEW OF STAIRCASE)

Observation: -

1. Flooring tiles damaged majorly.
2. Uneven tread and riser.

1. The FOB/skywalk is currently in a repairable condition, with some minor but slightly critical repair works required.
2. The cantilever beams supporting the roof have been observed to exhibit corrosion. At certain locations, ACP cladding was removed to inspect the condition (refer to the drawing for details).
3. Columns at certain locations are found to be heavily corroded and require immediate repair.
4. Roof sheets at a few locations are damaged and need to be repaired.
5. The flooring, particularly at the staircase areas, is damaged and requires repair.
6. The protective wall of the column is damaged at certain locations and requires necessary repairs (refer to the drawing).
7. The railing along the FOB/skywalk is observed to be damaged at certain locations and needs to be repaired or replaced to ensure safety.
8. The expansion joints are found to be filled with dust and garbage. These shall be cleaned thoroughly and a clear gap shall be maintained for proper functioning.
9. There is no drainage arrangement observed over the FOB, as such, it is required to provide a new drainage arrangement by providing the water spout and runner &down take pipe arrangement.

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Common IS Codes for Structural Audit:

1. IS 456:2000 – Code of Practice for Plain and Reinforced Concrete
2. IS 800:2007 – General Construction in Steel – Code of Practice
3. IS 1893 (Part 1):2016 – Criteria for Earthquake Resistant Design of Structures
4. IS 875 (Parts 1–5) – Code of Practice for Design Loads (Dead, Live, Wind, etc.)
5. IS 3370 (Parts 1–4) – Concrete Structures for Liquid Retaining Applications
6. IS 1343:2012 – Prestressed Concrete (if the structure is prestressed)
7. IS 2062:2011 – Hot Rolled Steel for Structural Purposes
8. IS 15988:2013 – Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings
9. IRC: SP:51 or IRC:6 – For pedestrian bridges/walkways,
10. IS 13311 (Part 1 & 2) – Non-Destructive Testing of Concrete (for UPV and Rebound Hammer tests)

IS Code Commentaries & Technical Manuals

These aren't books exactly, but essential technical references used alongside audit reports:

- IS 456:2000 – Plain & Reinforced Concrete – Code of Practice (with Commentary)
- IS 15988:2013 – Seismic Evaluation and Strengthening of Existing Buildings
- IS 13311 (Part 1 & 2):1992 – NDT of Concrete (Rebound Hammer, Ultrasonic Pulse Velocity)
- IRC SP:35 – Inspection and Maintenance of

Bridges
- CPWD Maintenance Manual (2020 Edition)