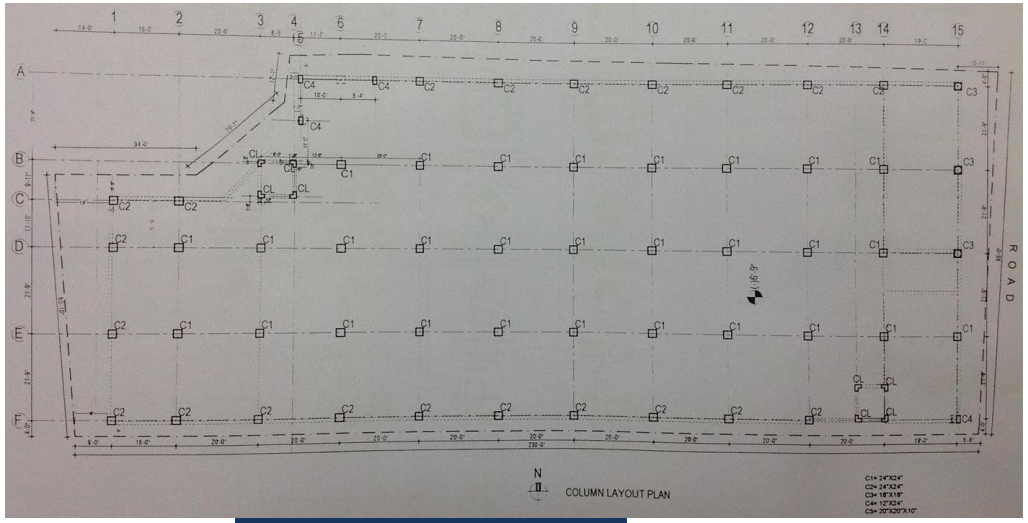
Russel Garments Ltd.

Osman Tower, 56/1, S.M. Maleh Road, Narayanganj, Dhaka
(+23.61549E, 90.50383N)
20 April 2014

ACCORD on Fire and Building Safety in Bangladesh ARUP

Building Observations

Columns appear to be stressed in excess of normal design limits



Typical column layout

Tested Basement Floor Column – Stone Chips

Preliminary calculations indicate that working stress is at a high level for all columns.

A Detailed Engineering Assessment of the building is required (See attached Scope). Building engineer is to perform detailed calculations based on as constructed dimensions, loadings. Use material data from concrete tests to prove column size and in addition to the immediate actions noted in this report, if required:

-Reduce loads by vacating floors and removing undocumented structures, partition walls and floor finishes.
-Reinforce columns

Column Stresses

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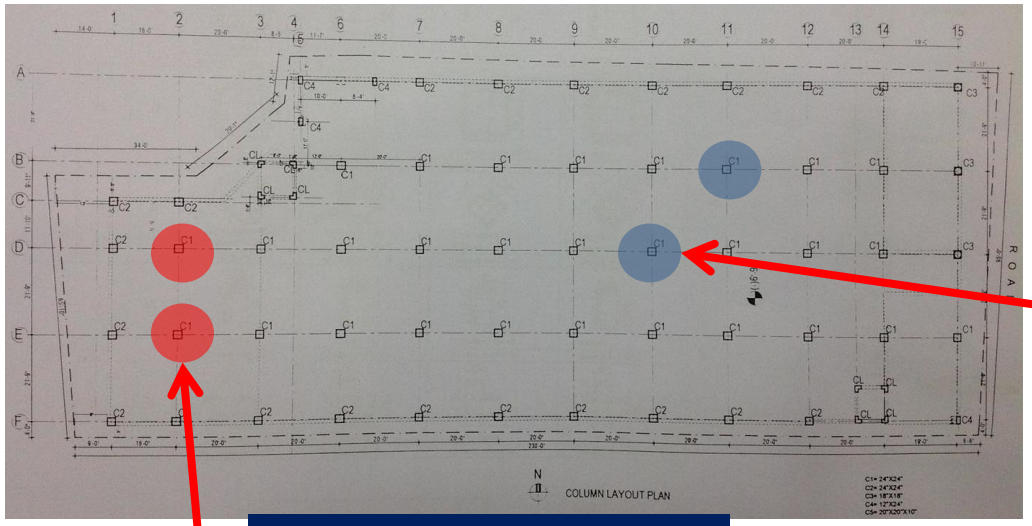
Cracking in slab finishes



Locations of cracking

2nd floor slab

Ground floor slab

Ground Floor Slab

2nd Floor Slab

Cracks to be reviewed by removing floor finishes to investigate if they extend into structure.

There was a toilet nearby with heavy buildup – engineer to confirm that this has been allowed for in design.

Cracking in slab finishes

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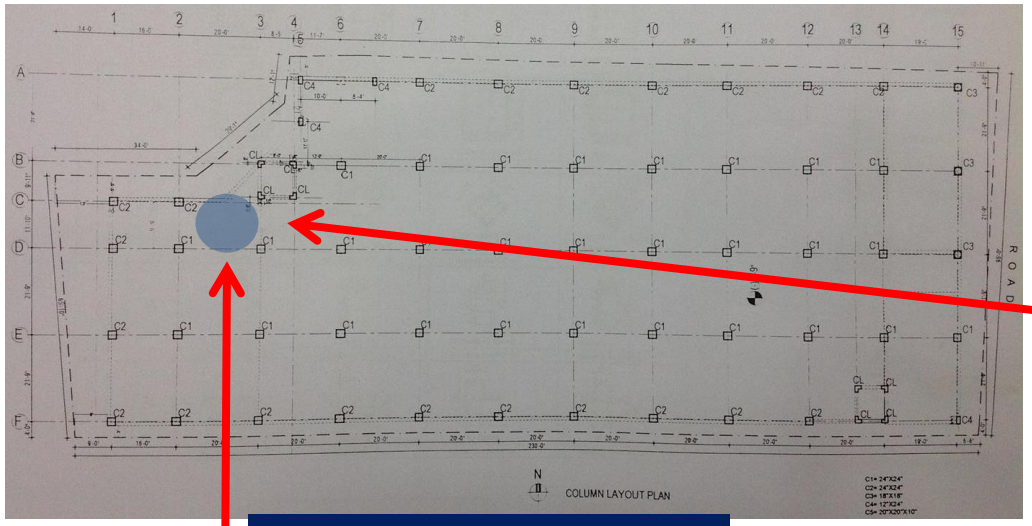

Locations of cracking

Ground floor slab

Heavy plant on plinth

Ground Floor Slab

Ground Floor Slab

Cracks to be reviewed by removing floor finishes to investigate if they extend into structure.

Cracking in slab finishes

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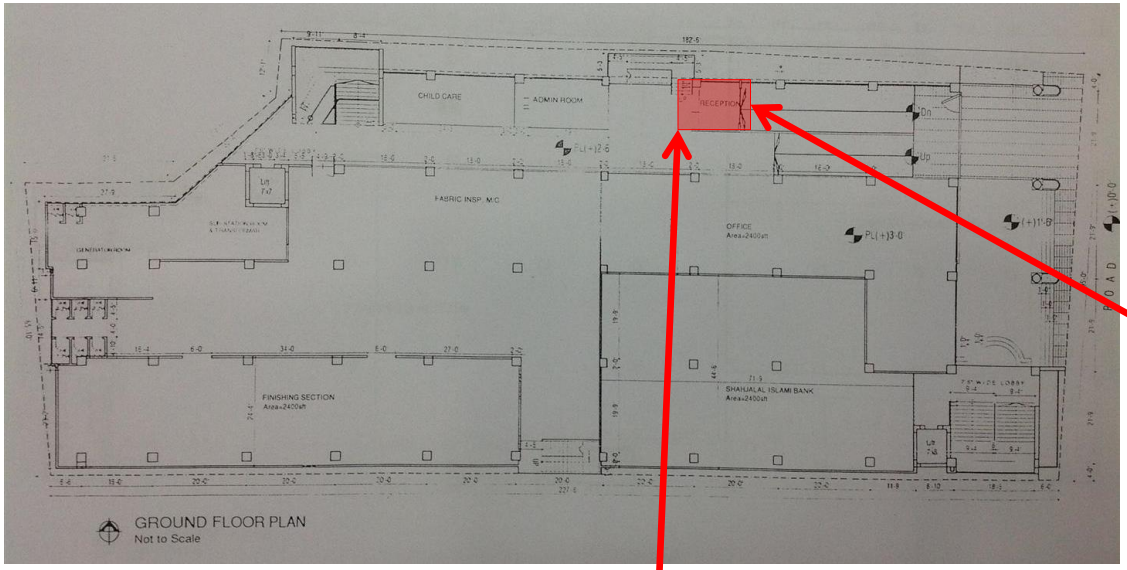
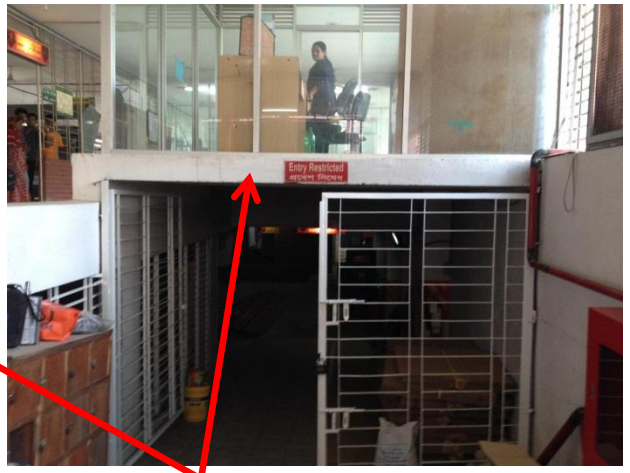
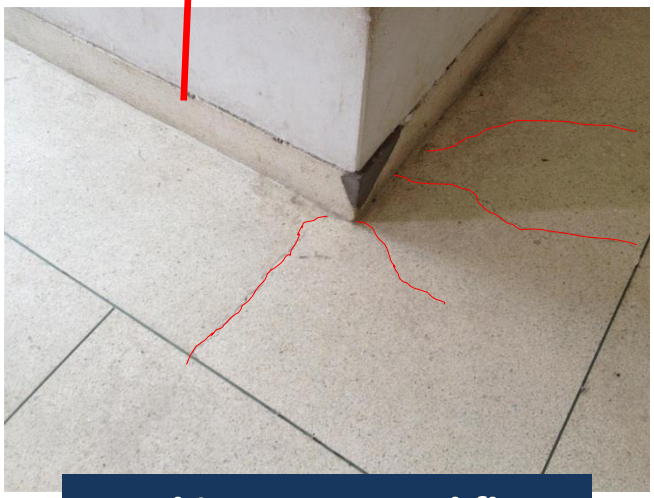
Defects to ramp structure





Mezzanine

Load path for mezzanine structure over ramp is not logical and signs of distress in ground floor slab are evident.



Cracking to ground floor slab.

Column built off edge of ramp slab (support?)

Defects to ramp structure

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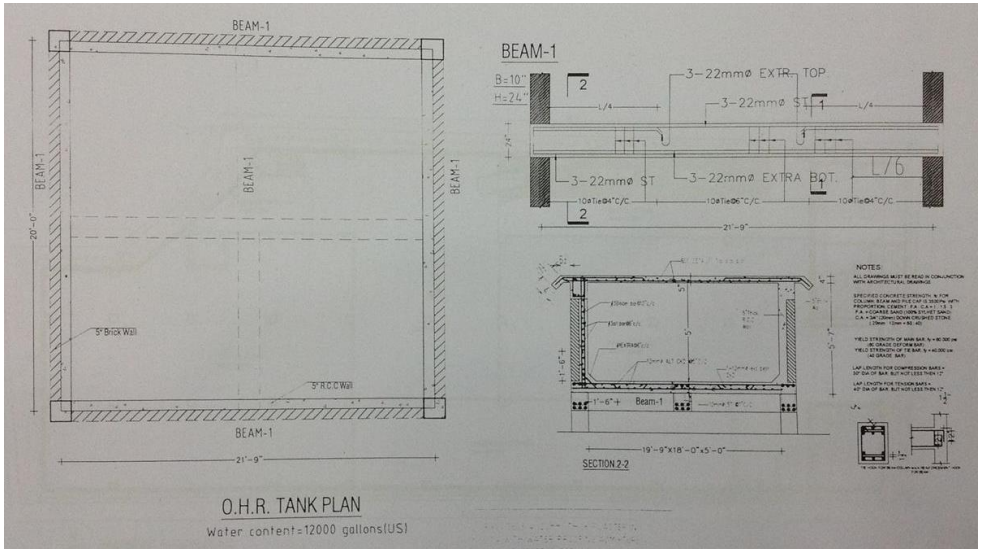
Tank at roof level

Tank currently under construction on roof is bigger than shown on structural drawings.



Tank at roof level

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Additional floor

East Elevation

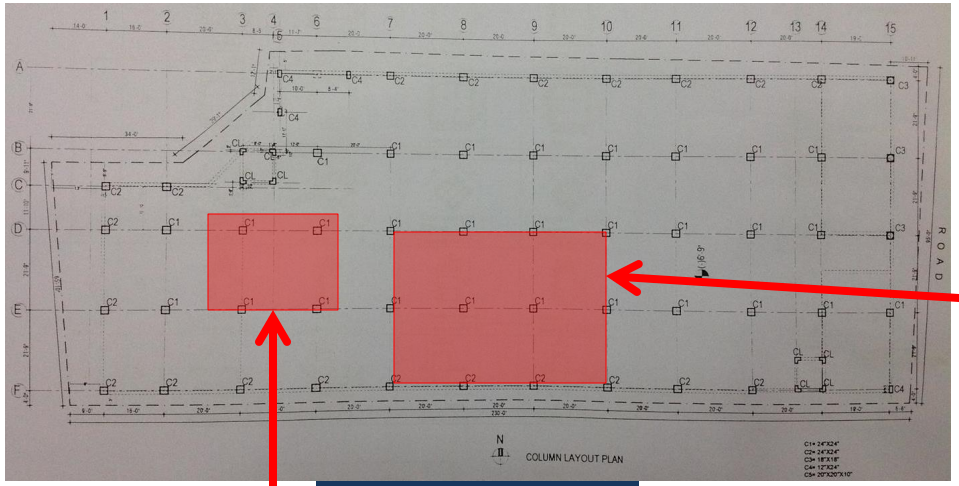
Uppermost floor not documented within the structural drawings provided.

No structural information suitable for construction was provided for any structure above the 9th floor. This includes the 10th floor slab, the columns above the 9th floor, the overhead water tank, the stair core over runs and the lift core over runs.

The permit drawings also did not account for the uppermost floor.

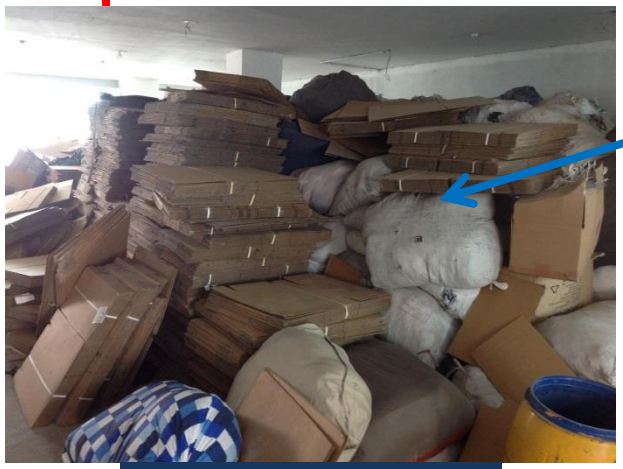
Additional floor

Localised areas of high loading



Typical Floor Plan

Ground Floor Storage Area



8th Floor Storage Area

Uncontrolled stacking of materials.

Areas of high loading on suspended structure. Floor load management system incomplete as no loading plans or loading height limits displayed.

Localised areas of high loading

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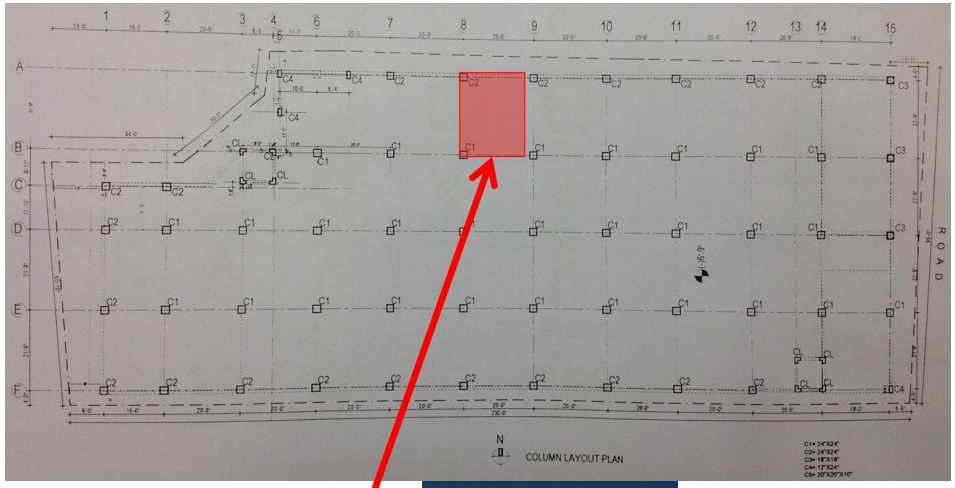
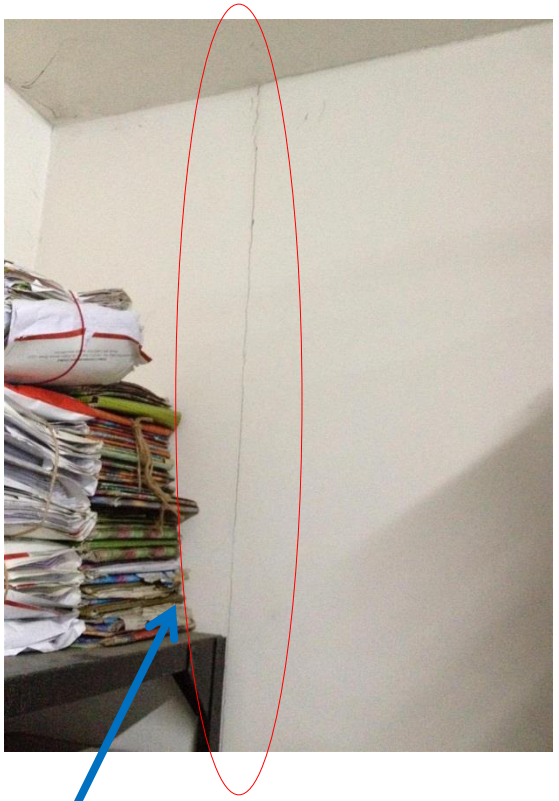


1st Floor Plan



Uncontrolled stacking of materials in bank leading to cracking of infill brickwork wall.

Localised areas of high loading

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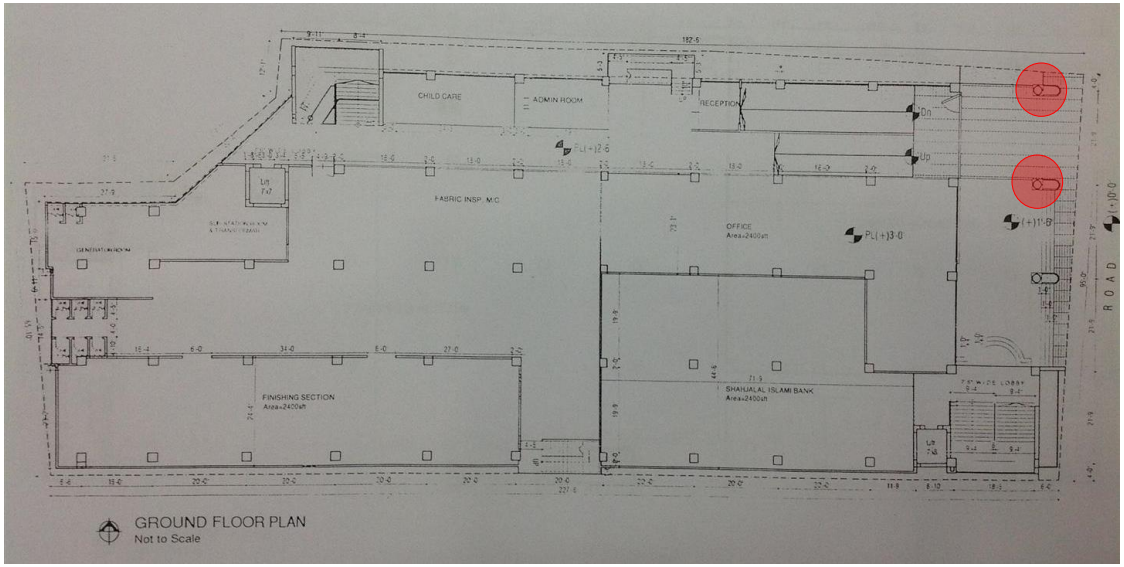
Columns susceptible to impact loading



Columns at front entrance are susceptible to impact loading from vehicles.

Columns susceptible to impact loading

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Priority Actions

Problems Observed

Item 1; Columns appear to be stressed in excess of normal design limits

Item 2; Cracking in slab finishes

Item 3; Defects to ramp structure

Item 4; Tank at roof level

Item 5; Additional floor

Item 6; Localised areas of high loading

Item 7; Columns susceptible to impact loading

Item No.	Observation	Recommended Action Plan	Recommended Timeline
1	Column Stresses	Pending verification of column capacity by the building engineer remove storage loads on all floors from ground level to level 7 such that the maximum height of stacked material is 0.5m. Remove all construction and storage loading from level 8, 9 and 10. Ensure loading on all suspended floors does not increase.	**Immediate - Now**
2	Column Stresses	Do not complete fit out of levels, 8, 9 and 10 or recommence construction of the level 10 water tank	**Immediate - Now**
3	Column Stresses	Verify insitu concrete stresses either by cores (min 100mm diameter) or existing cylinder strength data for all the columns from a minimum of 4 non-critical columns.	**Immediate - Now**
4	Column Stresses	Accurately determine as built reinforcement grade, size, quantity and distribution.	**Immediate - Now**
5	Column Stresses	Building engineer to review design, loads and columns stresses for all columns.	**Immediate - Now**
6	Column Stresses	A Detail Engineering Assessment (DEA) of the factory to be commenced. DEA to focus on vertical structure loading and available member capacity. See attached scope.	**Immediate - Now**
7	Column Stresses	Produce and actively manage a loading plan for all floor plates within the factory giving consideration to floor capacity and column capacity	**6-weeks**
8	Column Stresses	Detail Engineering Assessment to be completed.	**6-weeks**
9	Column Stresses	Carry out strengthening as required.	**6-months**
10	Column Stresses	Continue to implement load plan.	**6-months**

Detail Engineering Assessment

This Schedule develops a minimum level of information, Analysis and testing expected as part of a Detail Engineering Assessment.
The Building(s) have been visually assessed and it is deemed necessary that a detailed engineering assessment be carried out by a competent Engineering Team employed by the factory Owner.
This Request should be read in conjunction with the BUET developed Tripartite Guideline document for Assessment of Structural Integrity of Existing RMG Factory Buildings in Bangladesh (Tripartite Document), the latest version of this document should be referenced. T his document also gives guidance on required competency of Engineering Team.

We expect that the following will be carried out:

1. Development of Full Engineering As-Built Drawings showing Structure, loading, elements, dimensions , levels, foundations and framing on Plan, Section and Elevational drawings .
2. The Engineering team are to carry out supporting calculations with a model based design check to assess the safety and serviceability of the building against loading as set out in BNBC-2006. Lower rate provisions can be applied in accordance with the Tripartite Guidelines following international engineering practice, justification for these lower rate provisions must be made.
3. A geotechnical report describing ground conditions and commenting on foundation systems used/proposed.
4. A report on Engineering tests carried out to justify material strengths and reinforcement content in all key elements studied.
5. Detailed load plans shall be prepared for each level showing current and potential future loading with all key equipment items shown with associated loads.
6. The Engineering team will prepare an assessment report that covers the following:
    - As-Built drawings including
        - Plans at each level calling up and dimensioning all structural components
        - Cross sectional drawings showing structural beams, slabs, floor to floor heights, roof build-ups and Basic design information of the structure
    - Highlight any variation between As-built compared to the designed structure
    - Results of testing for strength and materials
    - Results of geotechnical assessment and testing/investigation
    - Details of loading, inputs and results of computer modelling
    - Commentary on adequacy/inadequacy of elements of the structure
    - Schedule of any required retrofitting required for safety or performance of Structure

Any proposals for Retrofitting to follow guidance developed in the Tripartite Document.

Item No.	Observation	Recommended Action Plan	Recommended Timeline
11	Cracking in slab finishes	Remove finishes to investigate if cracking extends into structure.	**6-weeks**
12	Cracking in slab finishes	If the cracks do extend into structure engineer to review current loading and usage of adjacent areas with respect to what was assumed in design.	**6-weeks**
13	Cracking in slab finishes	If necessary remove heavy plant in substation room on ground floor and toilet build-up on all floors deemed overloaded.	**6-weeks**
14	Cracking in slab finishes	Building engineer to design strengthening as required.	**6-weeks**
15	Cracking in slab finishes	Implement any strengthening specified by the building engineer.	**6-months**
16	Cracking in slab finishes	Any cracks found should be repaired.	**6-months**
17	Cracking in slab finishes	Continue to monitor building for signs of cracking on on-going basis and take appropriate action.	**6-months**
18	Defects to ramp structure	Building engineer to review design of ramp structure, mezzanine floor and adjoining ground floor structure and design strengthening as required to support the codified design loading.	**6-weeks**
19	Defects to ramp structure	Implement strengthening specified by the building engineer.	**6-months**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
20	Tank at roof level	We understand that the construction of the water tank has ceased and this should continue to be the case.	**6-weeks**
21	Tank at roof level	Engineer to review adequacy of supporting elements to carry water tank, including slab and beams at roof level, and supporting columns down to basement level.	**6-weeks**
22	Tank at roof level	Redesign tank to ensure slab and column capacity not exceeded.	**6-weeks**
23	Additional floor	Engineer to provide detailed calculations to prove adequacy of members supporting the undocumented structures throughout the building.	**6-weeks**
24	Additional floor	If necessary supporting structures should be retrofitted in order to increase capacity or load should be reduced by removing structure.	**6-weeks**
25	Additional floor	Drawings to be updated to reflect as-constructed building.	**6-months**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
26	Localised areas of high loading	Engineer to produce loading plans to be displayed at each floor level. Consideration to be given to all applied loads (imposed loads and super imposed dead loads), floor capacity and column capacity.	**6-weeks**
27	Localised areas of high loading	Factory manager to actively manage floor usage in accordance with the loading plans.	**6-weeks**
28	Columns susceptible to impact loading	Place temporary warning /protection (e.g. traffic cone, sand filled barrels as deemed appropriate by building engineer) at 1m from column faces.	**Immediate - Now**
29	Columns susceptible to impact loading	Building engineer to design appropriate impact protection for critical column within loading dock.	**6-weeks**
30	Columns susceptible to impact loading	Construct and maintain protection to critical column and continue to assess likelihood of vehicle impact to critical elements.	**6-months**