

Abloom Design Ltd

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10th June 2014

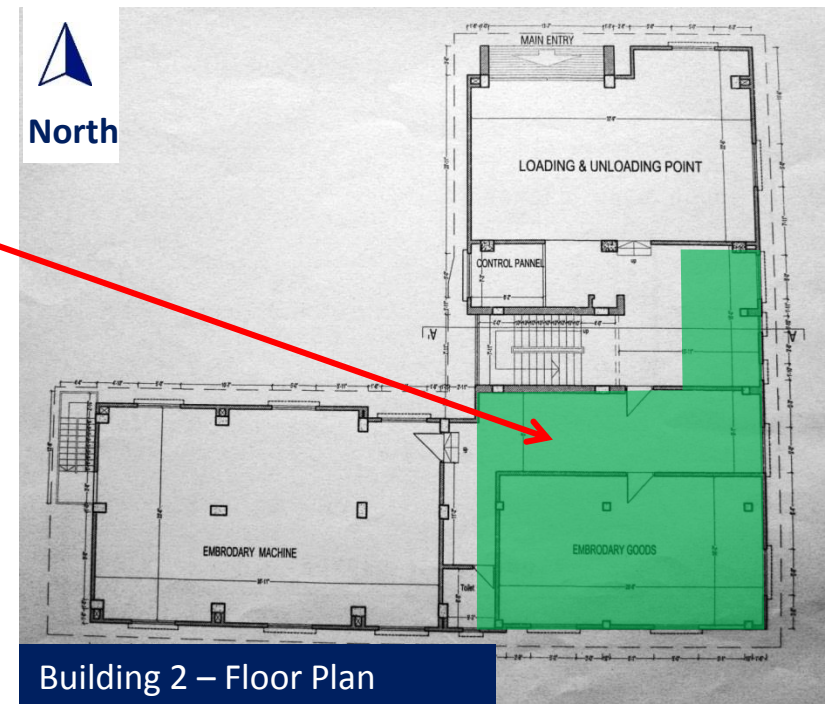


Executive Summary

We do have important and urgent concerns in relation to Building 2 and Building 1. Columns within Building 2 appear to be stressed to levels that require immediate review. In addition, columns within Building 1 are stressed in excess of the normal design limits and a significant number of discrepancies are evident between the drawings and the as-built structure. Detail Engineering Assessments for Building 2 and Building 1 should be carried out immediately to the requirements of the scope attached and addressing the concerns as noted within this report and this needs to be addressed immediately and completed within 6 weeks of receiving this report. In addition, the following **immediate action in relation to Building 2** is required:

Immediate Action;
Imposed loading in the area highlighted, including personnel, equipment and storage loads, is to be cleared at all floor levels with immediate effect.

If the building owners are not in a position to complete this action immediately, the factory building should be re-classified as **Category Red** and evacuated in its entirety.



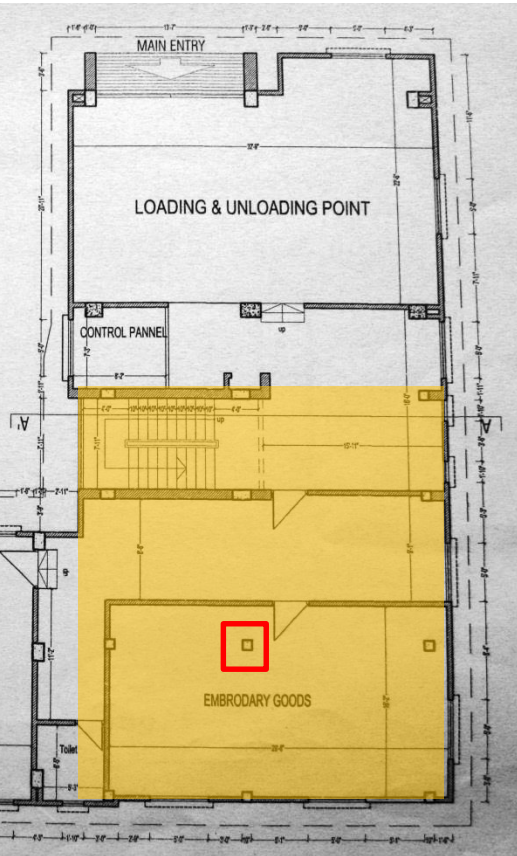
Observations

Columns in Building 2 appear to be stressed to a high level and require review including immediate action

Cursory calculations indicate that the working stress in the columns of Building 2 is at a level which requires immediate review. **Area of Building 2 to be vacated immediately (Refer to Page 4 of this report)** and Detail Engineering Assessment required.



Tested Column



Building 2 – Ground Floor Plan

- Construction of Building 2 commenced in November 2006 and was completed in February 2009.
- Building 2 is built around and above an existing single-storey structure.
- Other than strengthening works to the four stair core columns and foundations, there is no information – structural or other – relating to the original building.
- The year of construction of the original building is not known.
- Brick aggregate was noted in the Ground Floor columns.
- Four steel reinforcement bars (two per face) were observed at ground floor level using the ferros scanner.
- There is a discrepancy between the structural drawings and the constructed building in relation to the footprint of the building above the original building.



Tested Column

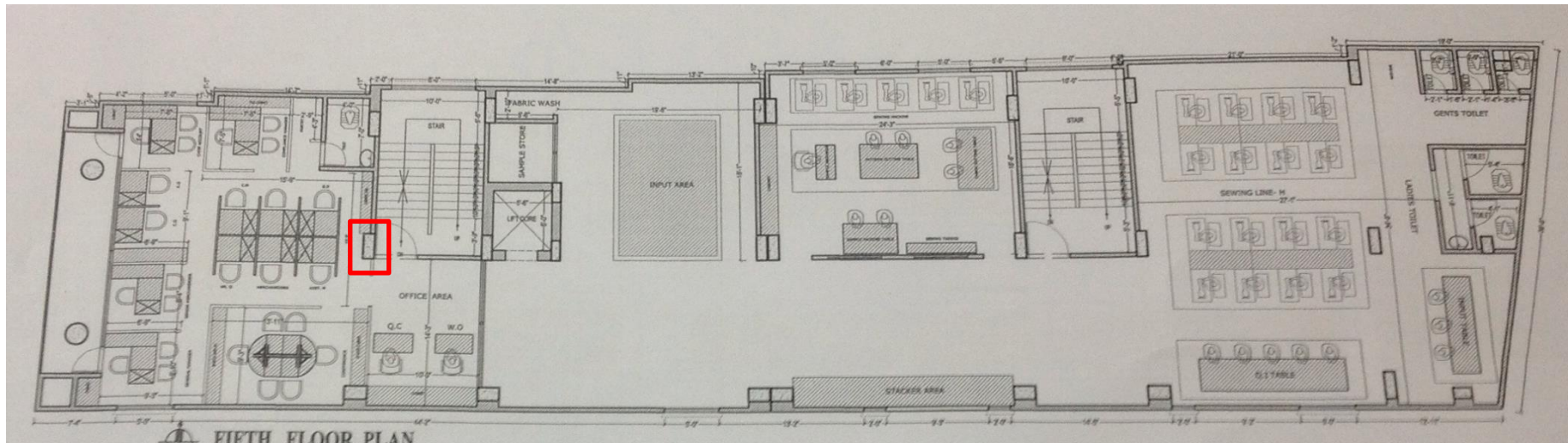


Original structure



**Columns in Building 1 appear to be stressed
in excess of normal design limits**

Cursory calculations indicate that the working stress in the columns at Ground Floor level of Building 1 is above normal design limits.



Building 1 – Ground Floor Plan

- Construction of Building 1 commenced in June 2005 and was completed in December 2008.
- Stone aggregate is called up on the drawings and was observed in the Ground Floor columns.
- High yield steel reinforcement is called up on the drawings and was observed at Roof level.
- Reinforcement quantities observed at Ground Floor level using the ferros scanner agree with the column schedule.



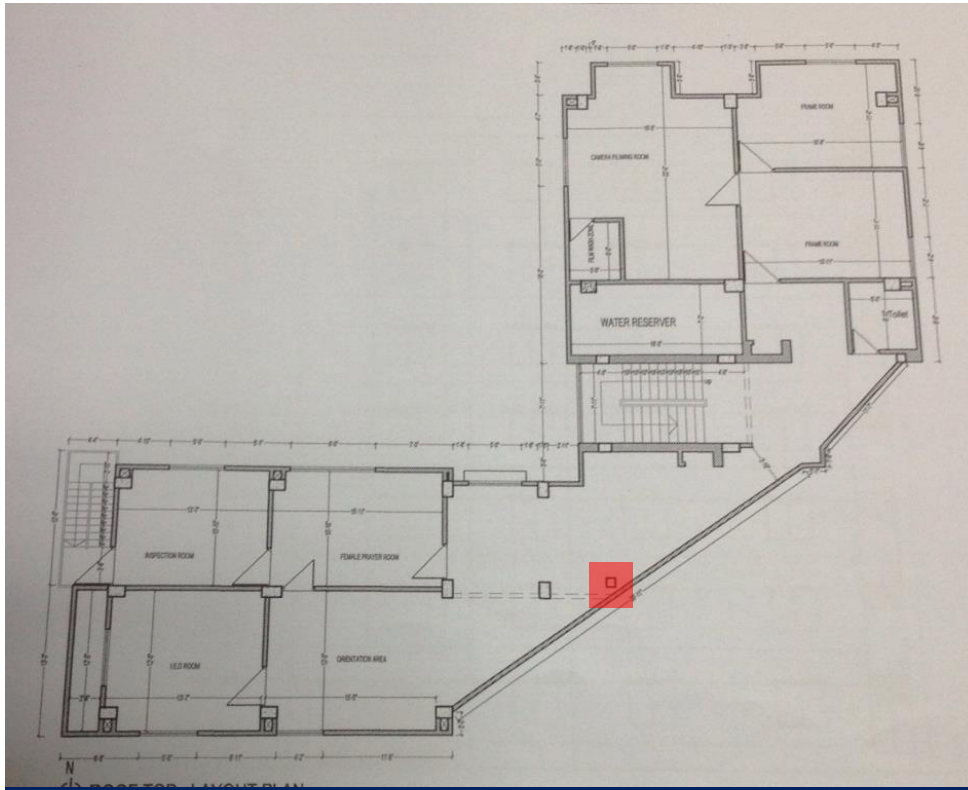
Tested Column



HY rebar at Roof level

Concerns over the structural adequacy of the columns in Building 2, particularly at 5th and 6th Floor levels

There are concerns over the structural adequacy of the columns in Building 2, particularly at the upper floor levels. Detail Engineering Assessment required.



Building 2 – 6th Floor Plan

Exposed column



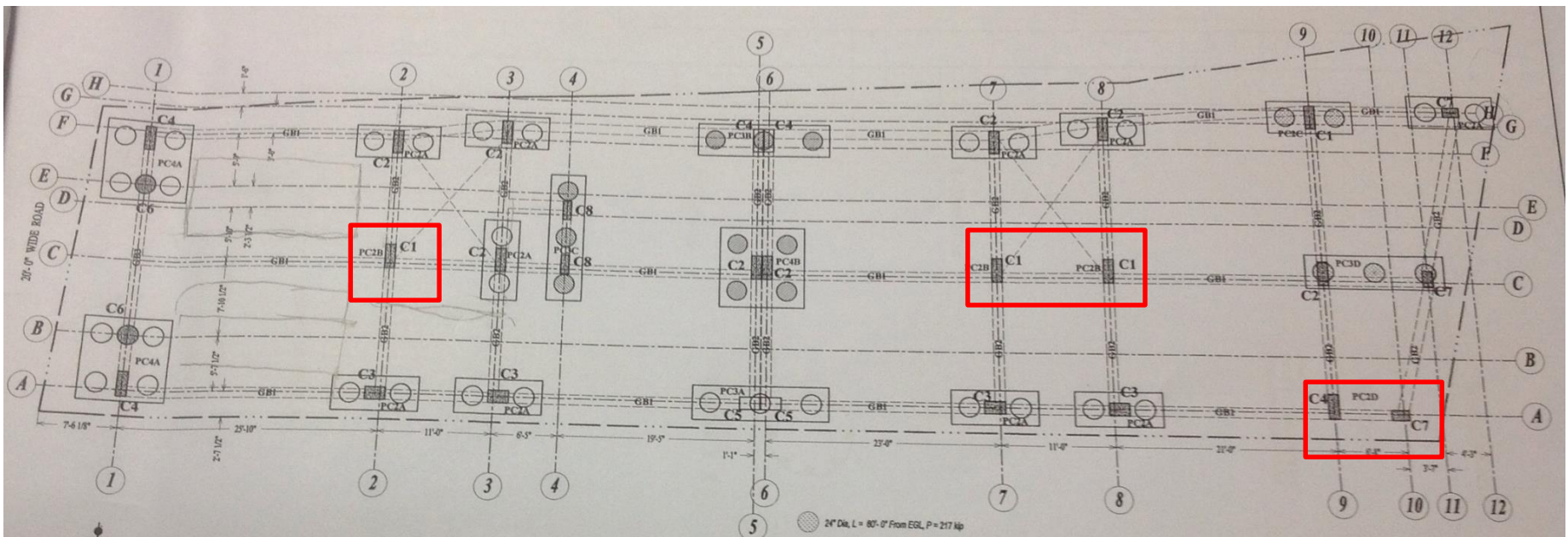
Exposed Column G.L. E / 2

Hairline cracks were noted to column head. This prompted the removal of plaster, which appeared to reveal the concrete column finishing approximately 500mm short of the slab and bricks used thereafter.

**Detail Engineering Assessment required
due to missing or incorrect design
documentation for Buildings 1 and 2.**

An original set of construction drawings for Building 1, dated 22nd March 2005 and prepared by Engineer Md. Anwarul Islam, and an undated set of as-built structural drawings for Building 2, prepared by Engineer Pijush Kanti Dey of Design Source, were presented. Local authority-approved permit drawings for Buildings 1 and 2, both dated 9th November 2004, were also provided. There are a number of important inconsistencies between these drawings and the constructed building, for which design checks / clarification is required. A non-exhaustive list of issues include:

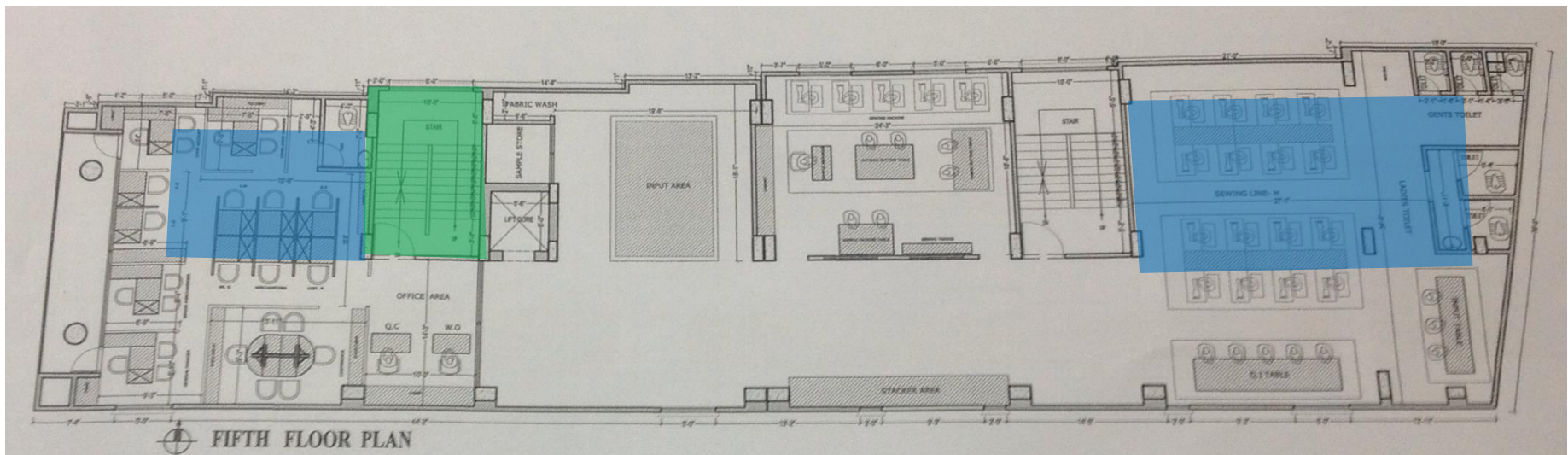
- Piled foundations for critical columns are missing from the Foundation Layout Plan for Building 1. Supporting documentation for a transfer structure below Ground level between adjacent foundations, supposedly developed for these columns (as suggested by the Engineer. Md. Ali Hossain Majumder), is also missing;
- The stair / lift core to the western-half of Building 1 extends three storeys above the existing Roof level – this is not shown on the structural drawings;
- Two maintenance rooms, which occupy approximately 25% of the Roof area of Building 1, are not shown on the structural drawings;
- There are no structural drawings for the Mezzanine floor above Ground Floor level, which occupies approximately 70% of the footprint of Building 1 – it is not clear how the load is transferred to foundations;
- Cantilevers to the North elevation of Building 1 are not shown on the structural drawings;
- Building 2 has a building permit for a six-storey building, not seven as constructed;
- There is no information on the structural drawings about the single-storey original building around and above which Building 2 is built, other than strengthening works to the 4 stair core columns and foundations;
- Inconsistencies in building footprint and column layout for Building 2 – the 4th and 5th Floor slabs are not reduced, as is suggested on the structural drawings, only the 6th Floor and Roof slabs, and the observed profile of the slab on plan at the upper levels is not as per the drawings;
- Inconsistencies in construction type for Building 2 – the structural drawings appear to indicate beam and slab construction, whereas flat slab was observed at 5th and 6th Floor levels;
- The two steel bridge structures which link both buildings are not shown on the structural drawings.



Building 1 – Piled Foundation Layout Plan

Foundations missing at key column locations. Supporting documentation for a transfer structure below Ground level which spans between adjacent foundations, as suggested by Engr. Md. Ali Hossain Majumder, was not provided.





Building 1 – Roof Plan

Maintenance Rooms

Western Stair core



Maintenance Room to West of Building 1 at Roof level



Maintenance Room to East of Building 1 at Roof level



Two additional floors to stair core to West of Building 1



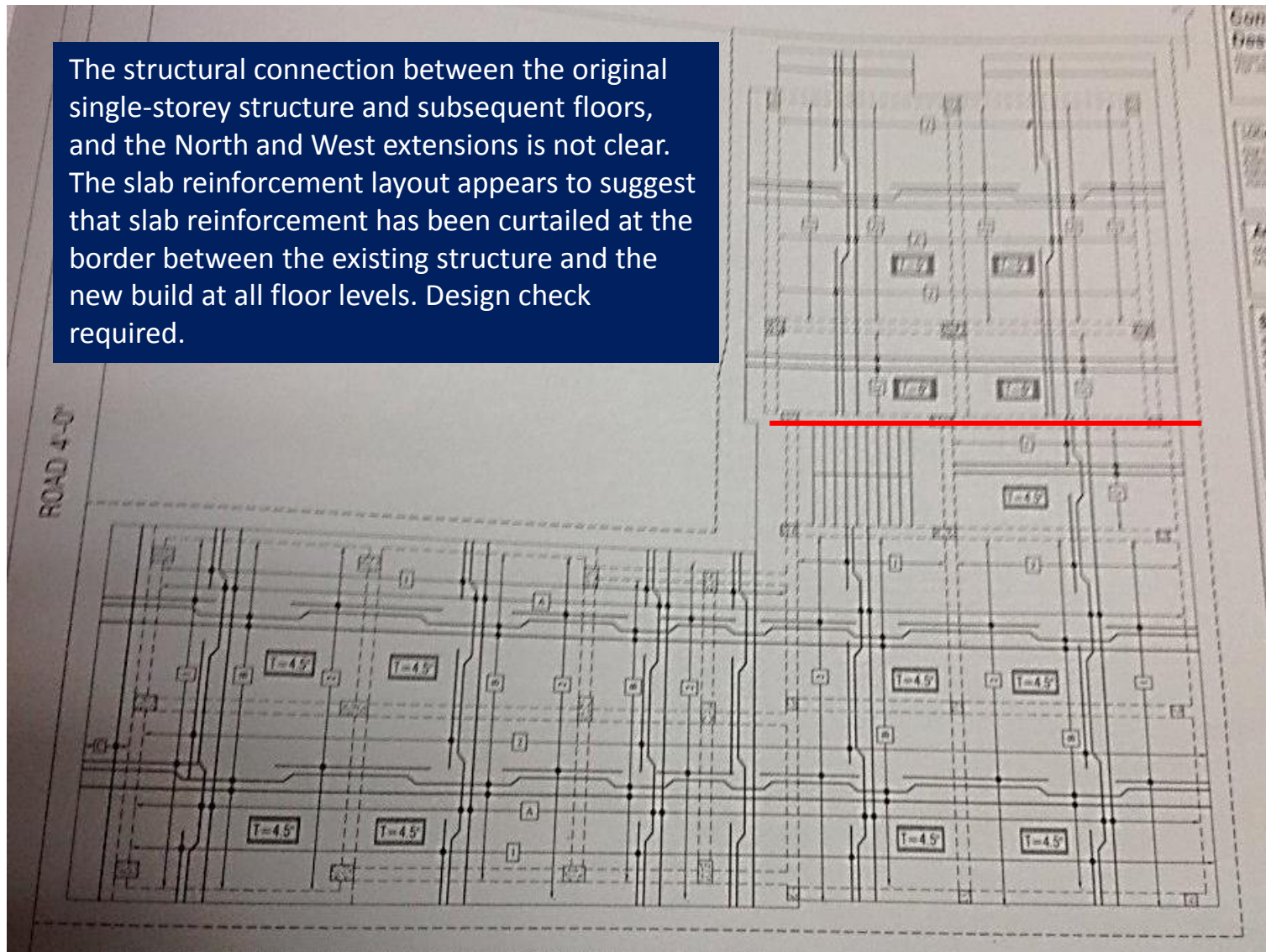
Building 2 – Typical Floor Plan

- Original single-storey building on and around which Building 2 is built
- New sections to the North and West of the original building which now comprise Building 2
- Columns and foundations to original stair core which have undergone strengthening works – shown on drawings
- Non-constructed escape stair



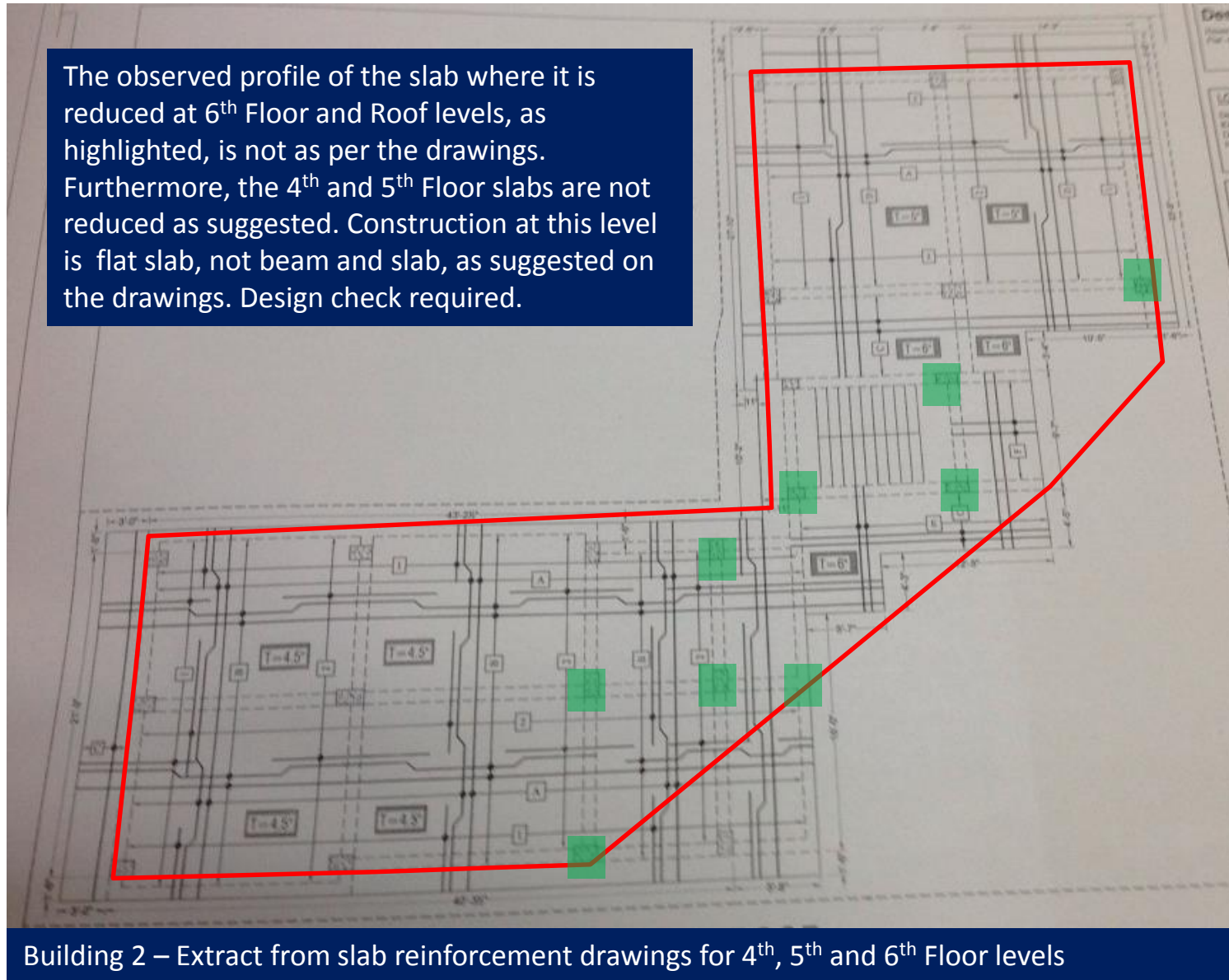
There is no information on the structural drawings about the single-storey original building, highlighted above, around and above which Building 2 is built, other than strengthening works to the four stair core columns and foundations. It is not clear why all columns and foundations in the existing single storey building were not strengthened.

The structural connection between the original single-storey structure and subsequent floors, and the North and West extensions is not clear. The slab reinforcement layout appears to suggest that slab reinforcement has been curtailed at the border between the existing structure and the new build at all floor levels. Design check required.



Building 2 – Slab reinforcement layout for 1st, 2nd & 3rd Floor levels

The observed profile of the slab where it is reduced at 6th Floor and Roof levels, as highlighted, is not as per the drawings. Furthermore, the 4th and 5th Floor slabs are not reduced as suggested. Construction at this level is flat slab, not beam and slab, as suggested on the drawings. Design check required.



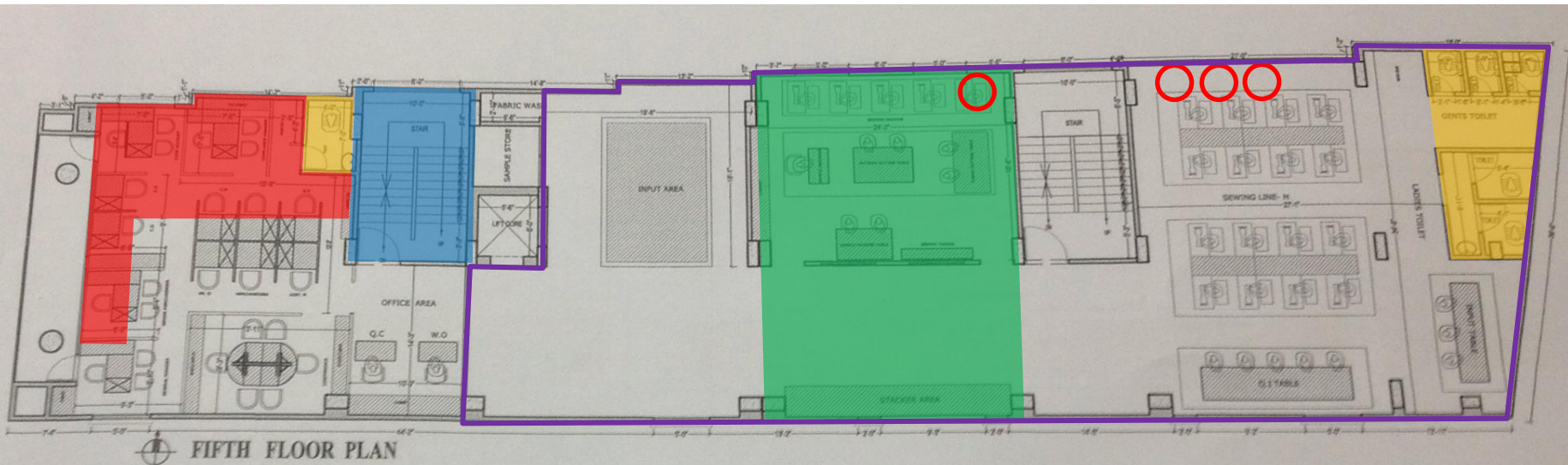
Actual slab footprint at 6th Floor & Roof



Column locations

Heavy floor loading and lack of loading plans for Buildings 1 and 2

Heavy loading was observed in the fabric storage area at 1st Floor level of Building 2. Further areas of high loading were noted at the water tanks at roof level and 6th floor level of Buildings 1 and 2, respectively, and at the storage areas to Mezzanine and 7th floor levels of Building 1 and to 5th and 6th Floor levels of Building 2.



Building 1 – Typical Floor Plan

2m high RC water tank above West stair core of Building 1

1000L water tanks at Roof level of Building 1

Finished Goods Store at 7th Floor of Building 1

Accessories Store at 7th Floor of Building 1

295mm average toilet floor build-up to at all suspended floor levels of Building 1

Outline of Fabric Storage at Mezzanine Floor of Building 1





Water tank above stair core of Building 1



1000L capacity Gazi water tanks to Roof of Building 1



Finished Goods Store to 7th Floor of Building 1



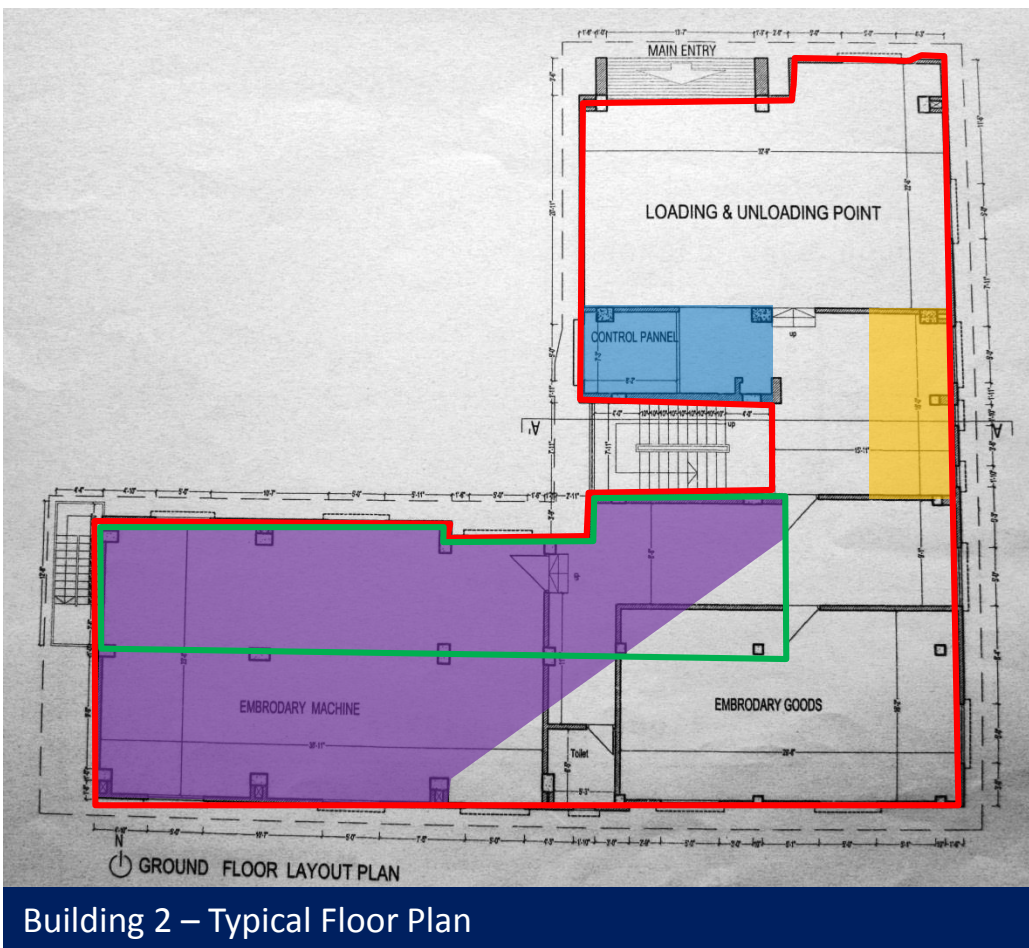
Accessories Store to 7th Floor of Building 1



Toilet floor build-up to all floors of Building 1



Fabric Storage to Mezzanine Floor of Building 1



Building 2 – Typical Floor Plan

- 2m high RC water tank adjacent to stair core of Building 2
- Storage area at 6th Floor of Building 2
- Storage area at 5th Floor of Building 2
- 315mm average toilet floor build-up at 2nd, 3rd, 4th and 5th floor levels of Building 2
- Outline of Yarn Storage at 1st Floor of Building 2





Storage area at 6th Floor of Building 2



Storage area at 5th Floor of Building 2



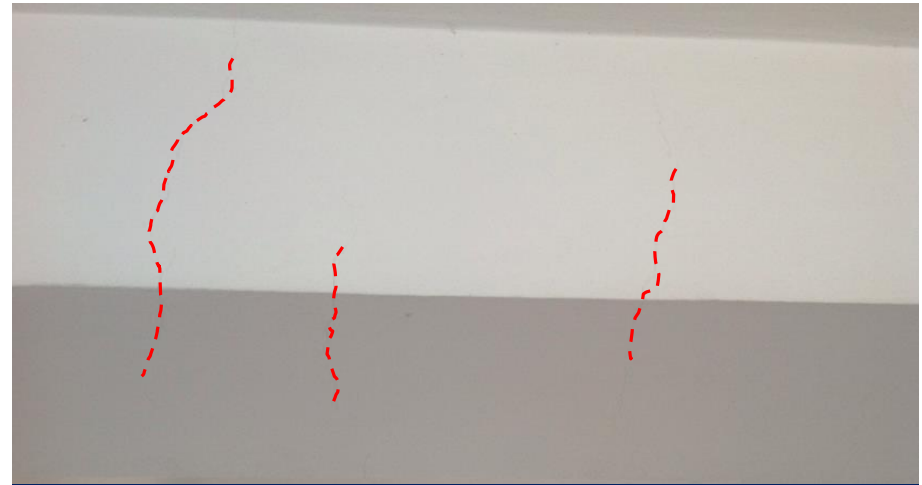
Yarn Store at 1st Floor of Building 2

Hairline cracking to soffit and edges of beams in Building 1

Hairline cracking was observed to a number of beam edges and soffits at most floor levels of Building 1. It is not clear whether the cracking extends to the concrete.



Hairline cracking to beam edges and soffits



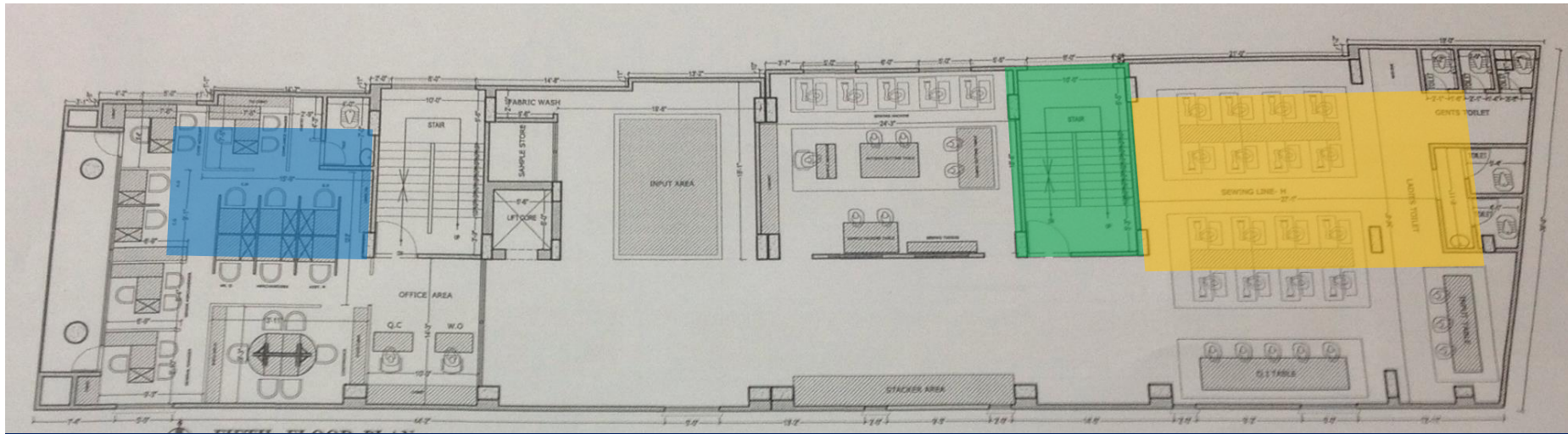
Hairline cracking to beam edges and soffits



Hairline cracking to beam edges and soffits

Apparently non-engineered roof structures on roof of Building 1

There are a number of lightweight roof structures, located at the Maintenance Rooms and the eastern stair core of Building 1. These appear to be non-engineered and may not be adequate to resist design uplift forces and lateral loads.



Building 1 – Roof Plan



Roof to Maintenance Room



Lightweight roof to stair core



Roof to Maintenance Room

Priority Actions

Problems Observed

ITEM 1: Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment.

ITEM 2: Columns in Building 1 appear to be stressed in excess of normal design limits.

ITEM 3: Concerns over the structural adequacy of the columns in Building 2, particularly at 5th and 6th Floor levels.

ITEM 4: Detail Engineering Assessment required due to missing or incorrect design documentation for Buildings 1 and 2.

ITEM 5: Heavy floor loading and lack of loading plans for Buildings 1 and 2

ITEM 6: Hairline cracking to soffit of beams in Building 1

ITEM 7: Apparently non-engineered roof structures on roof of Building 1

Item No.	Observation	Recommended Action Plan	Recommended Timeline
1	Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment	Area of Building 2 highlighted on page 4 of this report to be immediately cleared of all personnel, equipment and storage at all floor levels.	Immediate - Now
2	Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment	Engage a Building Engineer to review design, loads and column stresses in all columns in Building 2.	Immediate - Now
3	Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment	Building Engineer to verify insitu concrete stresses either by 100mm diameter cores or existing cylinder strength data for cores from 4 columns, and to verify steel reinforcement and grade of reinforcement used.	Immediate - Now
4	Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment	A Detail Engineering Assessment of the as-constructed factory Building 2 is to be commenced, see attached Scope.	Immediate - Now

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. This 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 Elevation 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
5	Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment	Detail Engineering Assessment of Building 2 to be completed and structural remedial measures to be carried out as required.	6-weeks
6	Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment	Building Engineer to produce and actively manage a loading plan for all floor plates within Building 2 giving consideration to floor capacity and column capacity.	6-weeks
7	Columns in Building 2 appear to be stressed to a high level and require review including immediate action as detailed on page 4 of this report and preparation of a Detail Engineering Assessment	Continue to implement floor loading plans.	6-months

Item No.	Observation	Recommended Action Plan	Recommended Timeline
8	Columns in Building 1 appear to be stressed in excess of normal design limits. Note; Refer to Priority Item 4 which requires the preparation of a Detail Engineering Assessment for Building 1	Factory Engineer to review design, loads and column stresses in Building 1.	6-weeks
9	Columns in Building 1 appear to be stressed in excess of normal design limits. Note; Refer to Priority Item 4 which requires the preparation of a Detail Engineering Assessment for Building 2	Verify insitu concrete strengths (using min. 4 no. 100mm dia. Cores) and existing reinforcement for all columns.	6-weeks
10	Columns in Building 1 appear to be stressed in excess of normal design limits. Note; Refer to Priority Item 4 which requires the preparation of a Detail Engineering Assessment for Building 3	Produce and actively manage a loading plan for all floor plates within Building 1 giving consideration to floor capacity and column capacity.	6-weeks
11	Columns in Building 1 appear to be stressed in excess of normal design limits. Note; Refer to Priority Item 4 which requires the preparation of a Detail Engineering Assessment for Building 4	Continue to implement load management plan	6-months

Item No.	Observation	Recommended Action Plan	Recommended Timeline
12	Concerns over the structural adequacy of the columns in Building 2, particularly at 5th and 6th Floor levels – due to possible use of brick at upper column level	Building Engineer to review all columns, including an inspection of the completed construction, as part of the Detail Engineering Assessment (refer to Item 1) and to prepare a schedule of remedial works, as required.	Immediate - Now
13	Concerns over the structural adequacy of the columns in Building 2, particularly at 5th and 6th Floor levels – due to possible use of brick at upper column level	Detailed Engineering Assessment to be completed.	6-weeks
14	Concerns over the structural adequacy of the columns in Building 2, particularly at 5th and 6th Floor levels – due to possible use of brick at upper column level	Building Engineer to implement any actions / supervise any remedial works as identified following the review.	6-weeks

Item No.	Observation	Recommended Action Plan	Recommended Timeline
15	Detail Engineering Assessment required due to missing or incorrect design documentation for Buildings 1 and 2	A Detail Engineering Assessment (DEA) of the as-constructed Building 1 and Building 2 (refer to Item 1) is to be commenced, see attached Scope. The DEA's should address all areas where drawings provided differ to the as constructed buildings.	Immediate - Now
16	Detail Engineering Assessment required due to missing or incorrect design documentation for Buildings 1 and 2	Building Engineer to survey all areas of Buildings 1 and 2 as part of the Detail Engineering Assessments.	6-weeks
17	Detail Engineering Assessment required due to missing or incorrect design documentation for Buildings 1 and 2	Building Engineer to produce / complete calculations to justify structure where structure differs from drawings.	6-weeks
18	Detail Engineering Assessment required due to missing or incorrect design documentation for Buildings 1 and 2	Detail Engineering Assessment of Buildings 1 and 2 to be completed.	6-weeks
19	Detail Engineering Assessment required due to missing or incorrect design documentation for Buildings 1 and 2	Building Engineer to collect information and prepare a full set of accurate "as-constructed" drawings for both buildings.	6-months

Item No.	Observation	Recommended Action Plan	Recommended Timeline
20	Heavy floor loading and lack of loading plans for Buildings 1 and 2. Refer to Items 1 & 4 which require preparation of Detail Engineering Assessments for Buildings 1 and 2	Building Engineer to review loading in the yarn store, temporary storage areas, water tanks and toilet floor build-up, and to check that the different floor constructions have been adequately designed to accommodate these loadings. Note; this design check to be carried out as part of the Detail Engineering Assessments.	6-weeks
21	Heavy floor loading and lack of loading plans for Buildings 1 and 2. Refer to Items 1 & 4 which require preparation of Detail Engineering Assessments for Buildings 1 and 2	Building Engineer to advise on any necessary alterations as a result of the investigation and to supervise these works.	6-months
22	Hairline cracking to soffit of beams in Building 1	Building Engineer to investigate if cracks are only in the plastering.	6-weeks
23	Hairline cracking to soffit of beams in Building 1	Design check of beams to be carried out as part of the Detail Engineering Assessment.	6-weeks
24	Hairline cracking to soffit of beams in Building 1	Building Engineer to advise on load reduction and repair and strengthening of the beams if required. Cracks to be monitored on an on-going basis.	6-months
25	Apparently non-engineered roof structures on roof of Building 1	Engage a Building Engineer to review the design of the lightweight roof structures noted above, and confirm adequacy to withstand wind loading pressure, suctions and uplift forces, including connections and bracing.	6-weeks
26	Apparently non-engineered roof structures on roof of Building 1	Building Engineer to implement any actions / supervise any remedial works as identified following the review.	6-months