Mother Color Ltd.

160, Shashongaon, Enayetnagar, Fatullah, Narayangonj, Bangladesh
(23.627807N, 90.474703E)

12 APRIL 2014

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ARUP

Observations

Out-building
Vertical column cracks

Vertical cracks observed in concrete outbuilding at first floor level. IMMEDIATE ACTION REQUIRED:

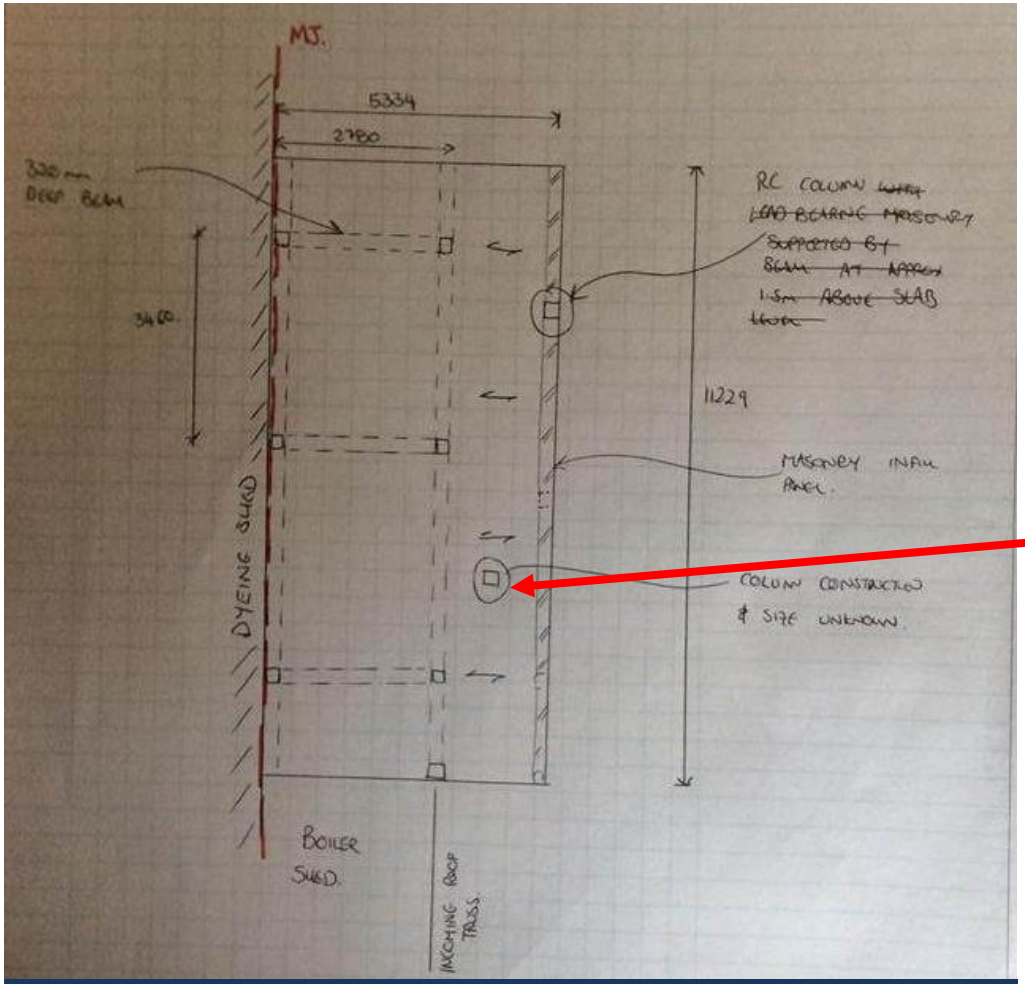
- Water tank to be drained.
- Floor beams at first floor and roof level to be propped through to ground floor.

Generally the undocumented out-building has two-way spanning slabs supported on downstand beams.

An off-grid column has been constructed between the ground and first floor, connected directly to the slab. The construction of this column could not be confirmed.

An Engineering Assessment should be carried out for this building, to assess the column design and whether the off-grid column will punch through the slab. See photos overleaf.

Vertical columns cracks – concrete out-building



Ground floor column layout, showing first floor downstand beams over.

This column stops at underside of first floor

Concrete outbuilding – engineering assessment

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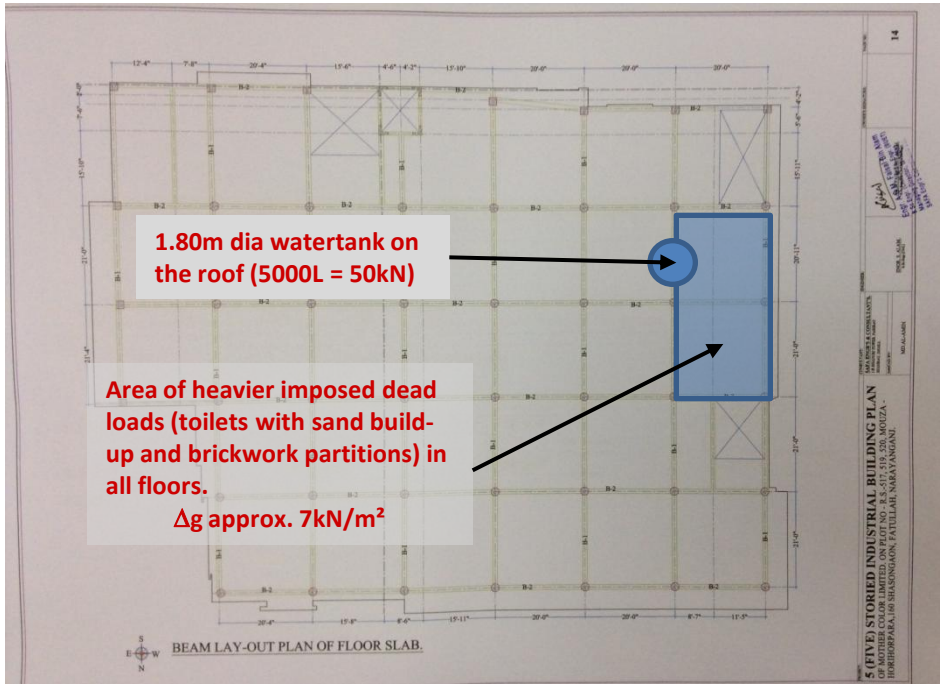
Main Building:
Highly-stressed columns at Ground Floor



Column Checks:

Whilst the reinforcement drawings for the columns presented at the meeting show 20 bars of D18 to D25, the Ferroscanner has confirmed only 16 bars for the circular columns at ground floor. This matches the number of bars sticking out at roof level where bar diameter is also 16mm.

Highly Stressed Column near toilets

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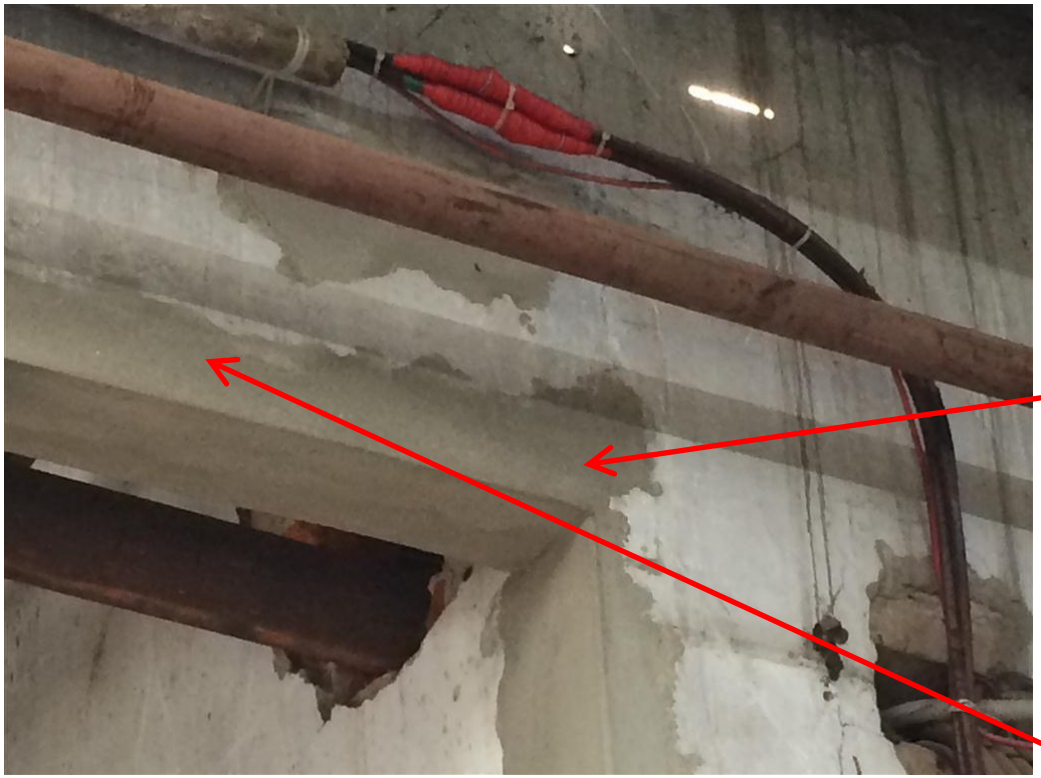
Dyeing shed
Lintels over openings

Lintels in dyeing shed

Openings in dyeing sheds appear to have no lintels. Engineer to design suitable lintel to span between masonry walls.

IMMEDIATE ACTION REQUIRED:

Finishes to be removed to confirm whether lintel has been provided. If not, opening to be propped to prevent bricks falling and injuring building users.



Load-bearing masonry wall

Dyeing shed – lintels may be inadequate

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IMMEDIATE ACTION REQUIRED:

Opening to be propped to prevent bricks falling and injuring building users.

Dyeing shed – lintels may be inadequate

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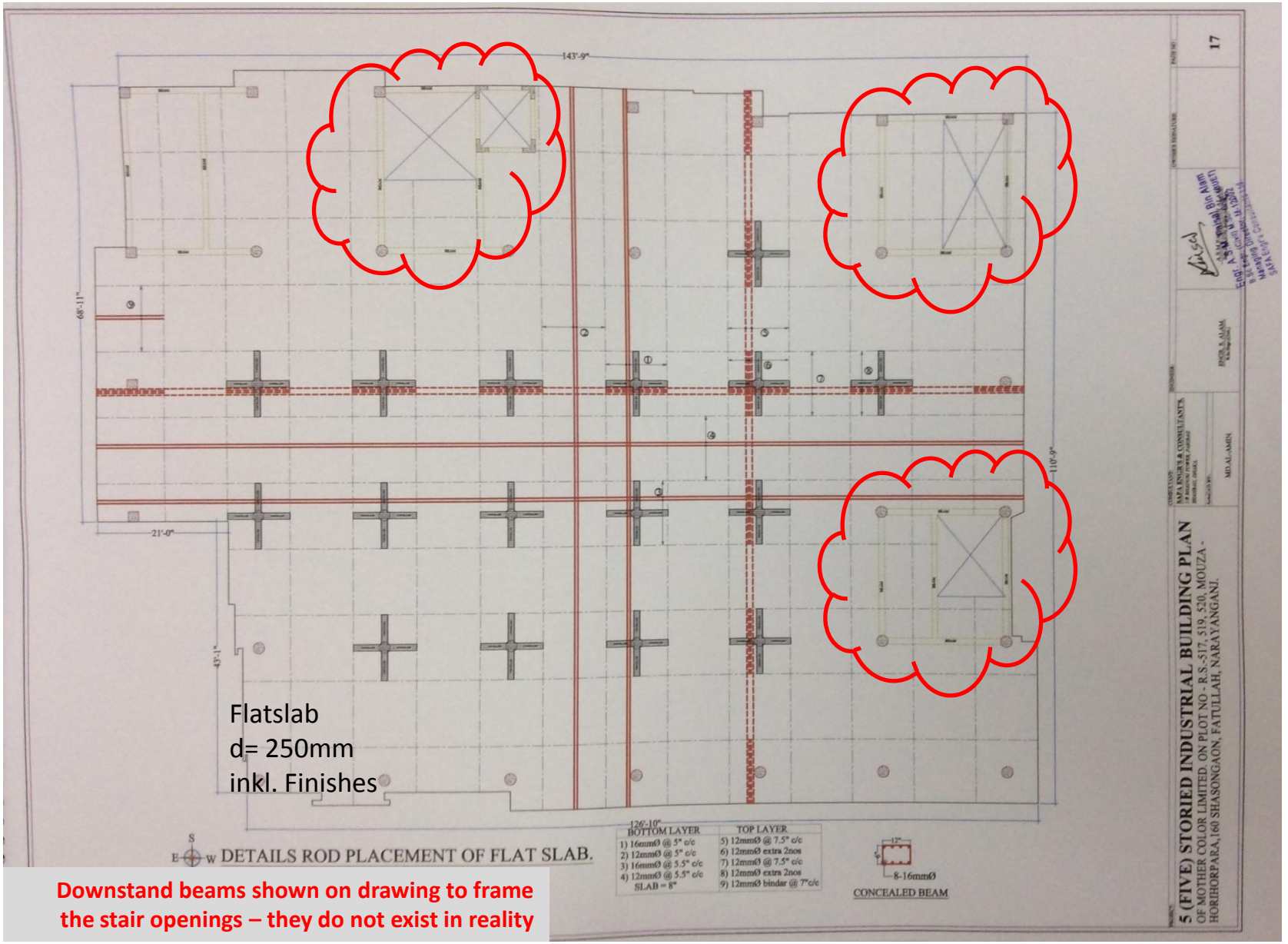
Main Building:
Missing beams to frame the stair openings (at all levels with flat slabs)



Downstand beams shown on drawing to frame the stair openings – they do not exist in reality

Slab above 1st Floor and 2nd Floor

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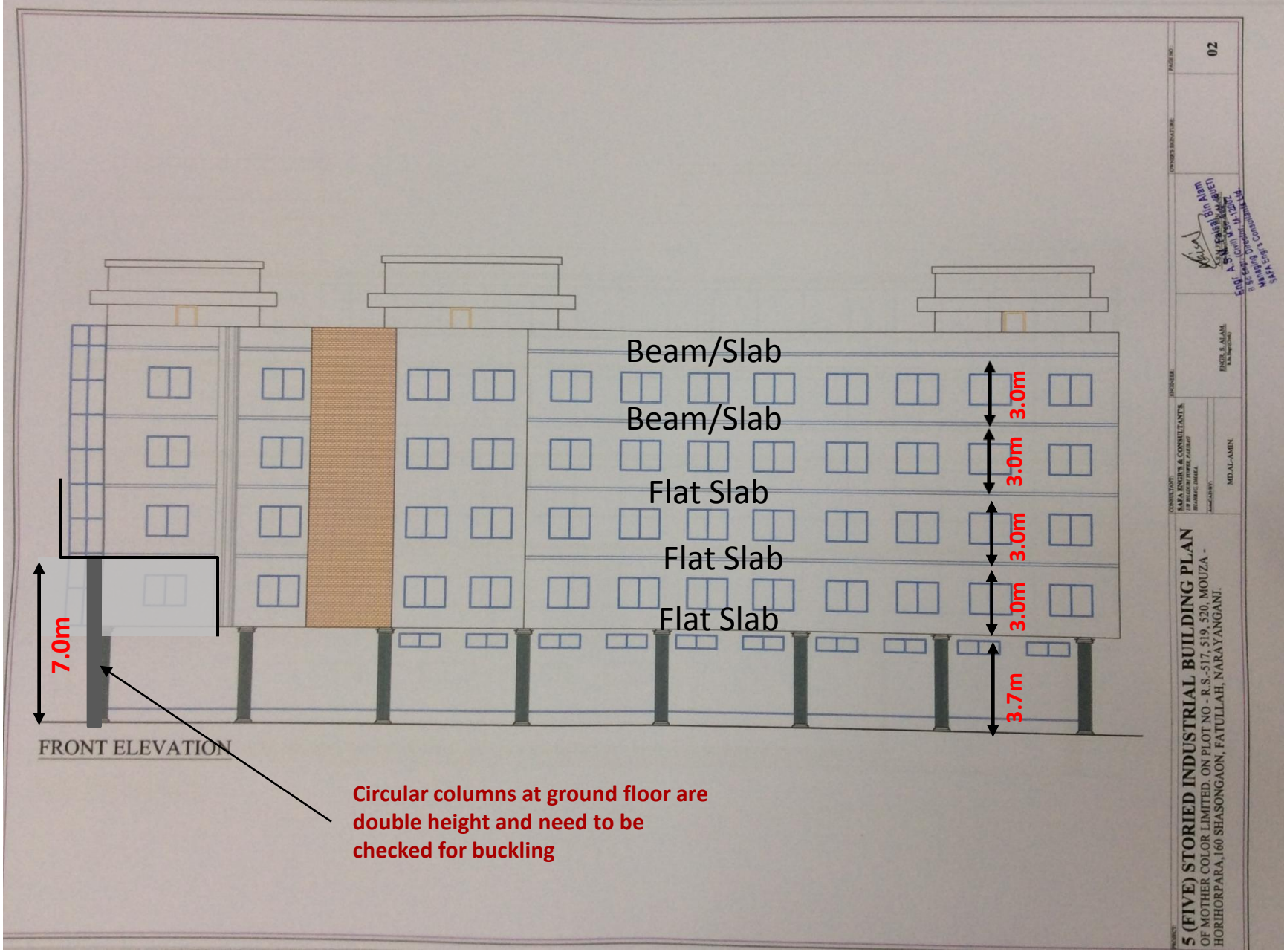
Double-height columns at entrance area



Double-height columns at entrance area

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Dyeing Shed
Cracks in brick walls

Cracks in masonry infill panels

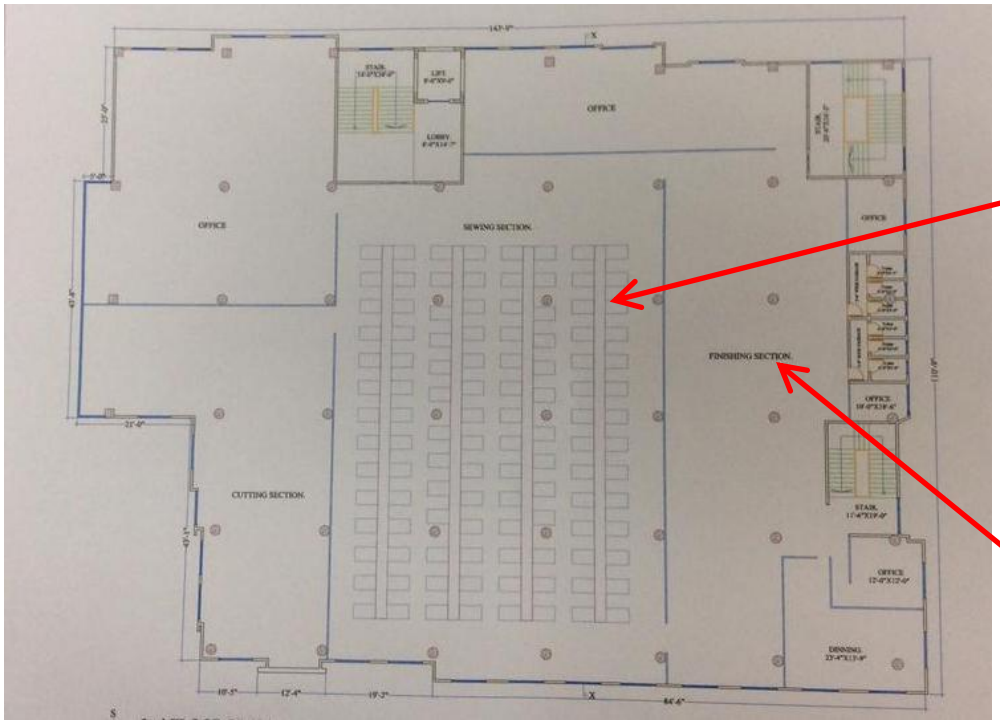
Engineer to assess the lateral stability of the masonry panels and whether the stability of shed under lateral loads has been compromised.

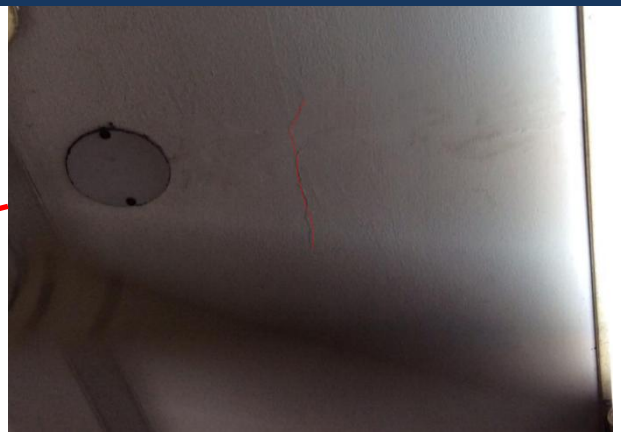
Wall should be repaired to prevent on-going maintenance issues.

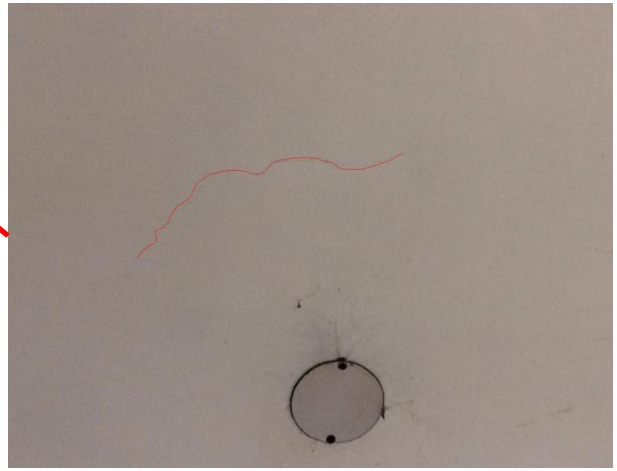
Dyeing shed - Masonry panel cracks

Main Building
Slab Cracking

Beam cracks to be reviewed by removing plaster to confirm whether cracks extend into structure.







Cracking in slabs

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Knitting shed
Steel roof design

- A steel tube has been positioned at mid-span of each truss, apparently to provide further vertical support. Building engineer to assess whether prop has sufficient capacity (it has no horizontal restraint at the top in one direction) and whether there are adequate foundations.
- Truss design to be checked to assess whether it can support the applied loading. Truss design should take into account the fact that the purlins do not line up with truss nodes, thereby applying additional bending to the top chord (steel angle).
- Roof purlins bear directly on masonry wall at the back. Restraint to be checked.

Knitting shed – steel roof

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Knitting shed sheds have no roof bracing elements. Stability system of these sheds appears incomplete. In-plane bracing may be required.

Connections between roof trusses and concrete columns could not be inspected. Engineer to assess whether connections are designed to resist wind uplift forces.

Knitting shed - Stability system

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Dyeing Shed
Steel roof design

Dyeing sheds have no roof bracing elements. Stability system of these sheds appears incomplete. In-plane bracing in roof may be required.

Stability system – Dyeing shed

Connections between roof trusses and concrete columns could not be inspected. Engineer to assess whether connections are designed to resist wind uplift forces.

Roof connections – Dyeing shed

Structural Documentation

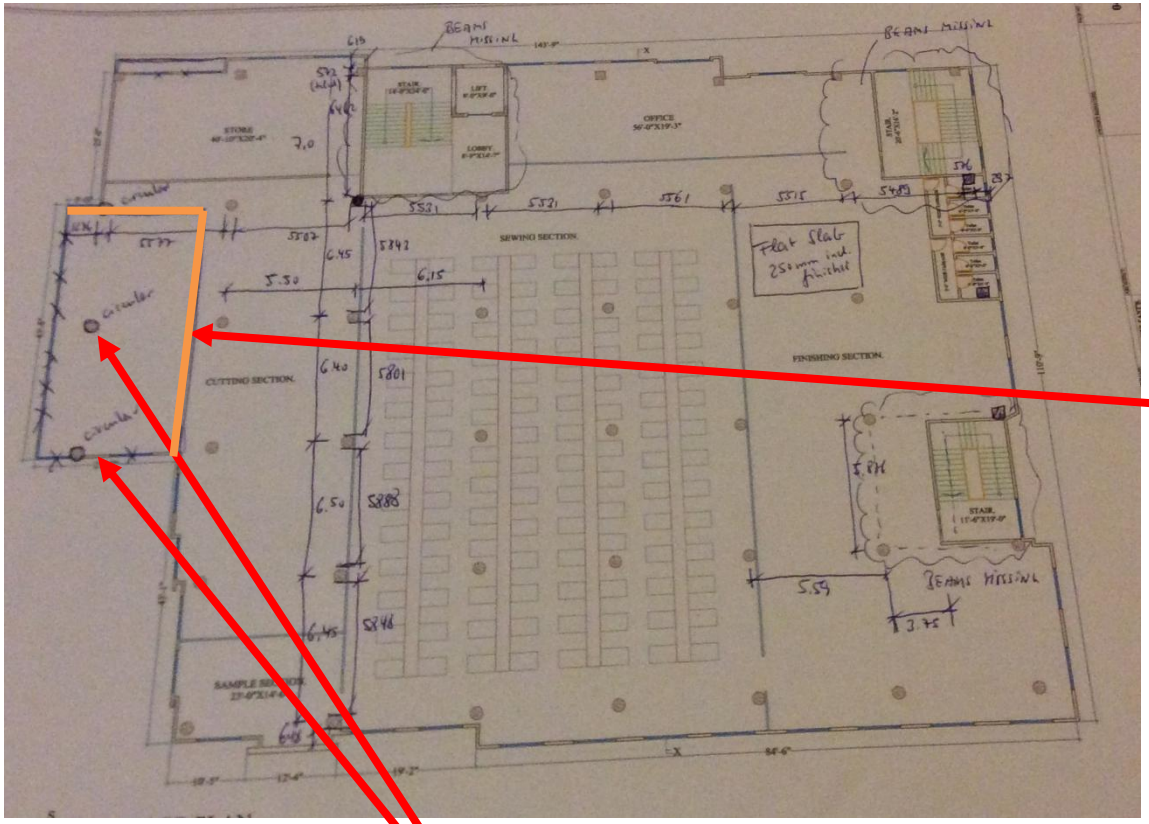
Generally drawings for the main building only were presented.

No permit drawings were shown.

No dates on drawings. Hence it is not clear whether the drawings were produced before or after construction.

- The reinforcement stated on the drawing could not be confirmed by Ferroscanning, which showed significantly less reinforcement in the column.
- The drawings give reinforcement details for columns up to 9th floor whilst the building currently has only five levels. **No more floors are to be built pending the outcome of the Detail Engineering assessment.**
- Slab edges on the floors are not shown correctly – particularly on the first floor drawing (area above entrance)
- Column shapes are different in reality to what is shown on the drawing for the edge columns along the short faces of the buildings
- Beams shown on 1st and 2nd floor layout around the stair cores are missing in reality

No Record of Relevant Structural Documentation



Slab edge at first floor is not as shown on drawing. Columns are unrestrained at first floor. Engineer to confirm that column has sufficient capacity to carry applied loading

Columns are circular in reality, not square

Inconsistencies between the record drawings and as-built frame.

Engineer to produce as-built drawings that accurately reflect frame construction

Documentation Issues – Main Building

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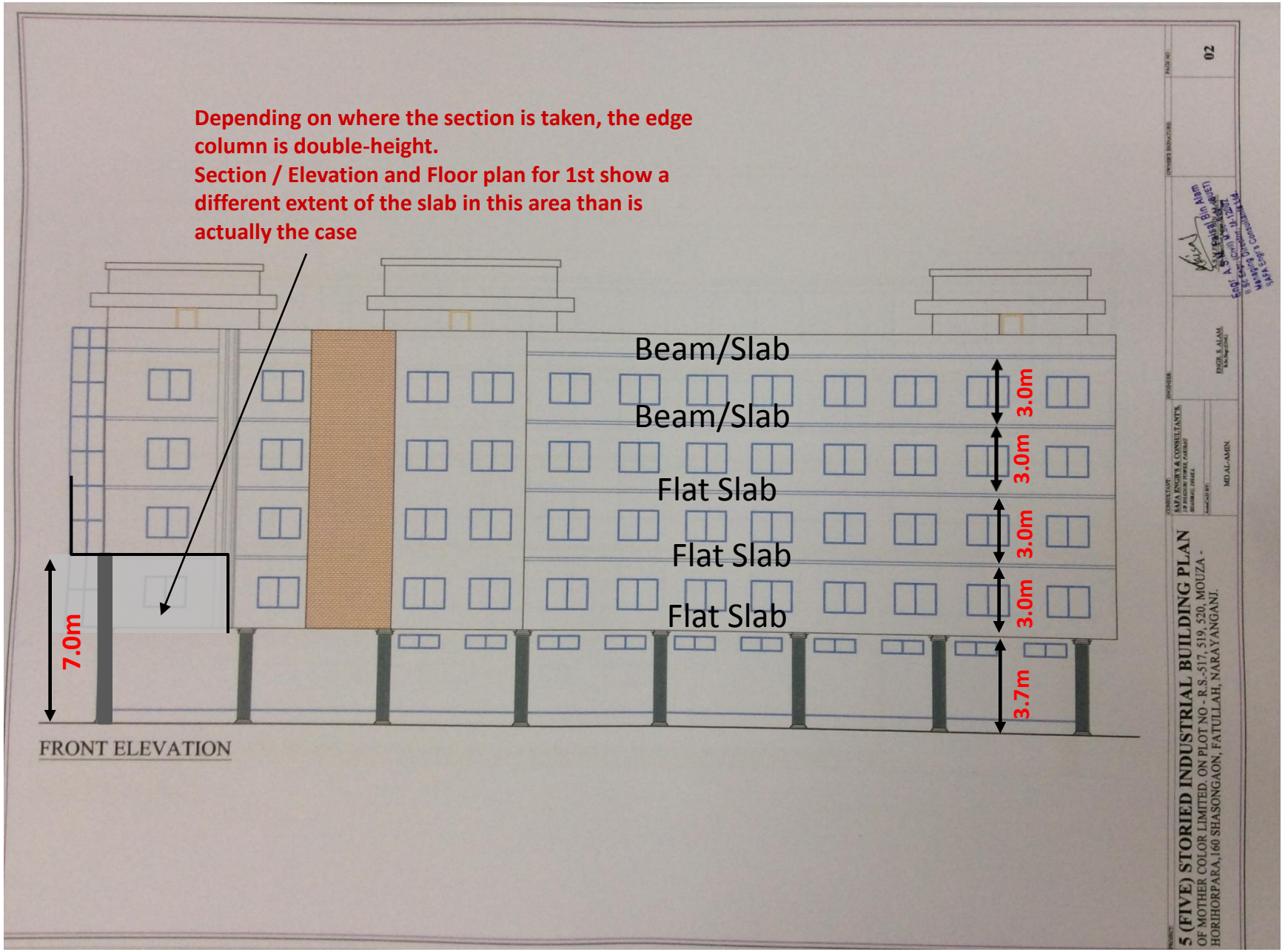

Longitudinal Cross Section

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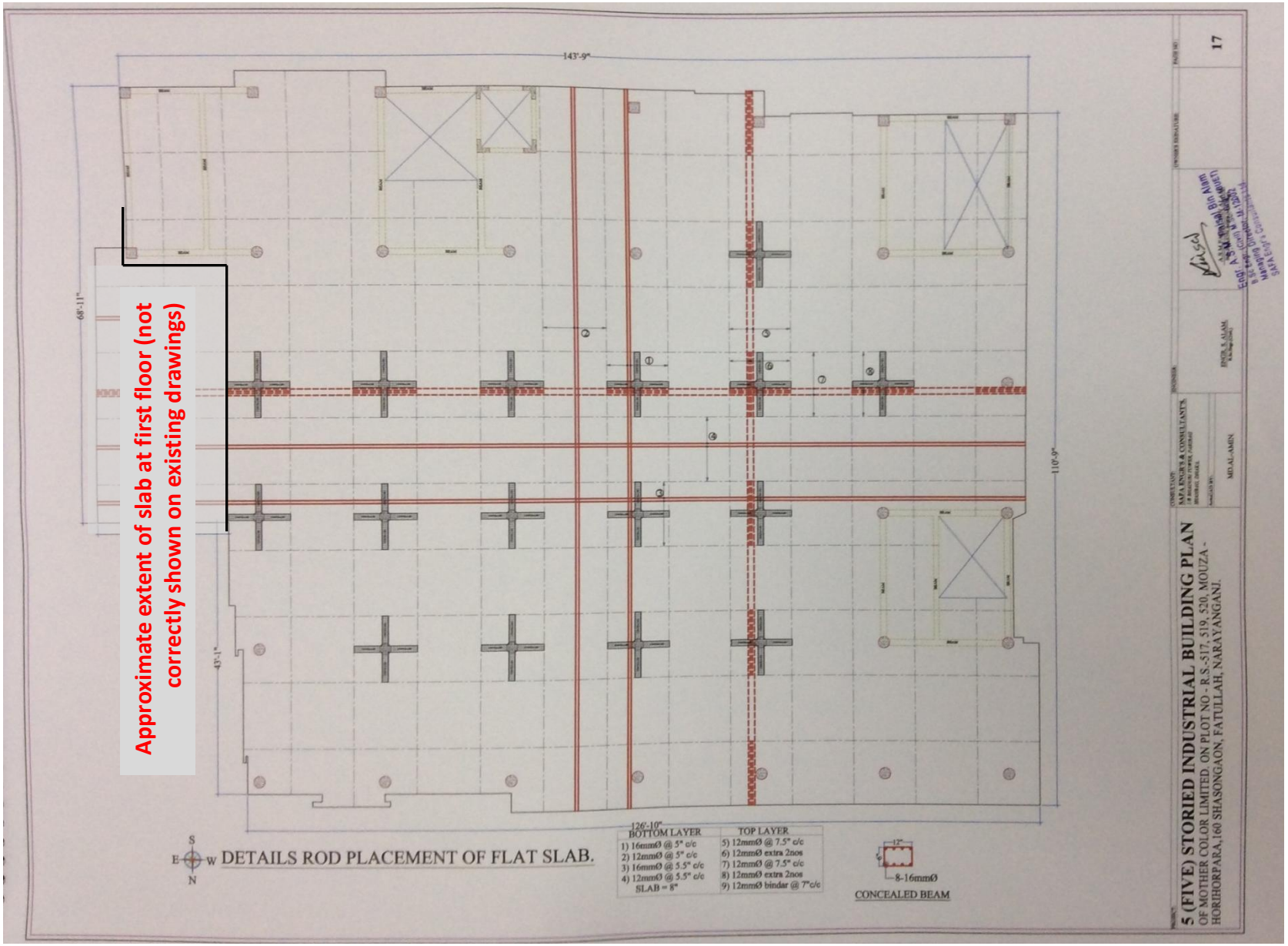

Slab above Ground Floor

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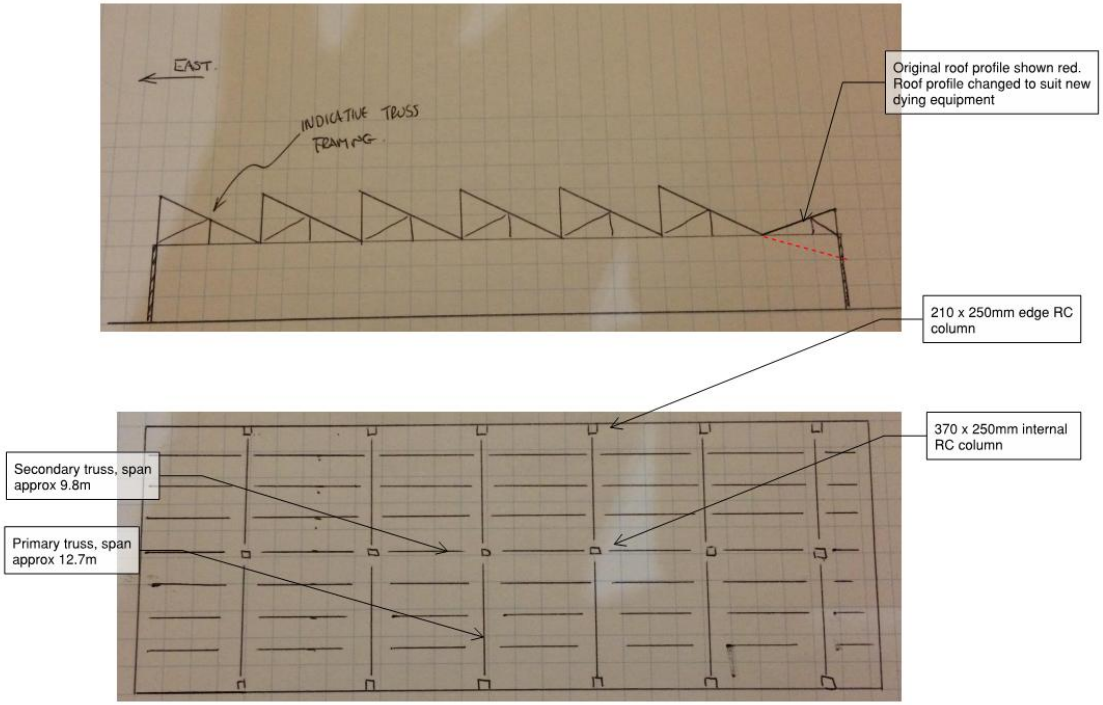

No drawings available for dyeing shed.

Engineer to provide calculations to confirm that structure and foundations are capable of resisting applied loads.

Documentation Issues – dyeing shed

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No drawings available for knitting shed, outbuilding, boiler house, gatehouse

Knitting shed

Boiler House

Gatehouse

Outbuilding

Documentation Issues – Ancillary buildings

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Priority Actions

Problems Observed

1. Cracked columns in out-building behind dyeing shed
2. Highly-stressed Columns at Ground floor in main building
3. Inadequate lintel beams above large openings in dyeing shed
4. Flat slab design of 1st and 2nd floors in main building
5. Double-height columns at external entrance area to be checked for buckling
6. Substantial masonry cracking in the dyeing shed
7. Hairline cracks in some areas to underside of 3rd floor in the main building
8. Horizontal stability of steel shed roofs
9. No record of relevant Structural Documentation

Item No.	Observation	Recommended Action Plan	Recommended Timeline
1	Out-building - Substantial cracks in three 1st floor columns	Water tank on the roof to be drained.	**Immediate - Now**
2	Out-building - Substantial cracks in three 1st floor columns	Floor beams at first floor and roof level to be propped through to ground floor.	**Immediate - Now**
3	Out-building - Substantial cracks in three 1st floor columns	Verify insitu concrete stresses by 100mm diameter cores from min. 4 columns.	**Immediate - Now**
4	Out-building - Substantial cracks in three 1st floor columns	Building Engineer to review concrete structure in terms of loadings, including punching shear for slab over lone column.	**Immediate - Now**
5	Out-building - Substantial cracks in three 1st floor columns	Engineering Review to be completed.	**6-weeks**
6	Out-building - Substantial cracks in three 1st floor columns	Produce and actively manage a loading plan for all floor plates and roof of the out-building, giving consideration to floor capacity and column capacity.	**6-weeks**
7	Out-building - Substantial cracks in three 1st floor columns	Carry out remedial works as required.	**6-months**
8	Out-building - Substantial cracks in three 1st floor columns	Continue to implement load plan.	**6-months**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
9	Main Building - Check column stresses and verify concrete strengths in ground floor columns	Factory Engineer to review design, loads and column stresses in area highlighted above.	**Immediate - Now**
10	Main Building - Check column stresses and verify concrete strengths in ground floor columns	Verify insitu concrete stresses by 100mm diameter cores in min. 4 no. non-critical columns	**Immediate - Now**
11	Main Building - Check column stresses and verify concrete strengths in ground floor columns	A Detail Engineering Assessment of Main Building to be commenced, see attached scope	**Immediate - Now**
12	Main Building - Check column stresses and verify concrete strengths in ground floor columns	No more construction in this building, pending outcome of DEA.	**Immediate - Now**
13	Main Building - Check column stresses and verify concrete strengths in ground floor columns	Produce and actively manage a loading plan for all floor plates within the factory giving consideration to floor capacity and column capacity.	**6-weeks**
14	Main Building - Check column stresses and verify concrete strengths in ground floor columns	Detail Engineering Assessment to be completed	**6-weeks**
15	Main Building - Check column stresses and verify concrete strengths in ground floor columns	Carry out strengthening as required.	**6-months**
16	Main Building - Check column stresses and verify concrete strengths in ground floor columns	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
17	Dyeing Shed - Inadaquate lintels over large openings	Openings to be propped to prevent bricks falling off and injuring building users.	**Immediate - Now**
18	Dyeing Shed - Inadaquate lintels over large openings	Lintel to the back of the building to be checked to verify the material (brick or concrete). If brick then immediate propping required.	**Immediate - Now**
19	Dyeing Shed - Inadaquate lintels over large openings	Suitable lintels to be designed by qualified engineer and installed above opening.	**6-weeks**
20	Inadequate lintel beams above large openings in dyeing shed	Openings to be propped to prevent bricks falling off and injuring building users	**Immediate - Now**
21	Inadequate lintel beams above large openings in dyeing shed	Lintel to the back of the building to be checked to verify the material (brick or concrete). If brick then immediate propping required	**Immediate - Now**
22	Inadequate lintel beams above large openings in dyeing shed	Suitable lintels to be designed by qualified engineer and installed above opening	**6-weeks**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
23	Flat slab design of 1st and 2nd floors in main building	As part of Detail Engineering Assessment (see Item 2), structural calculations to be carried out for the flat slab without the downstand beams around stair cores, to assess bending stresses and shear stresses in the slab and punching checks. Loads to be taken into account according to norms and incl. all partition walls and finishes observed on site	**6-weeks**
24	Flat slab design of 1st and 2nd floors in main building	Carry out strengthening as may be required arising from results of calculations.	**6-months**
25	Main Building - Check the double-height ground floor perimeter columns in the external entrance area for potential buckling	As part of Detail Engineering Assessment (see Item 2), structural calculations to be prepared for the double-height columns using concrete strength identified from core samples and loads according to as-built load take-down calculations	**6-weeks**
26	Main Building - Check the double-height ground floor perimeter columns in the external entrance area for potential buckling	Carry out strengthening as may be required.	**6-months**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
27	Dyeing Shed - Cracks in brick walls	Building engineer to assess whether masonry panels have sufficient horizontal restraint to prevent collapse.	**6-weeks**
28	Dyeing Shed - Cracks in brick walls	Implement any remedial works arising from assessment.	**6-months**
29	Main Building - Hairline cracks in beams on the underside of 3rd floor	Sections of plaster finish to beams to be removed to investigate if cracks penetrate the building structure	**6-weeks**
30	Main Building - Hairline cracks in beams on the underside of 3rd floor	Building Engineer to carry out design check on beams to following investigation	**6-months**
31	Main Building - Hairline cracks in beams on the underside of 3rd floor	Implement any actions arising from design check.	**6-months**
32	Steel Sheds - Horizontal stability of roof structures.	Building engineer to check whether steel/concrete connections have been designed for wind uplift forces.	**6-months**
33	Steel Sheds - Horizontal stability of roof structures.	Building engineer to carry out a stability analysis and provide additional stability system if necessary.	**6-months**
34	No record of relevant Structural Documentation	As part of Detail Engineering Assessment for Main Building (see Item 2), Building Engineer to provide as-built drawings for this building.	**6-weeks**
35	No record of relevant Structural Documentation	Building engineer to collect information for all other buildings, and provide as-built drawings.	**6-months**