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10 June 2014

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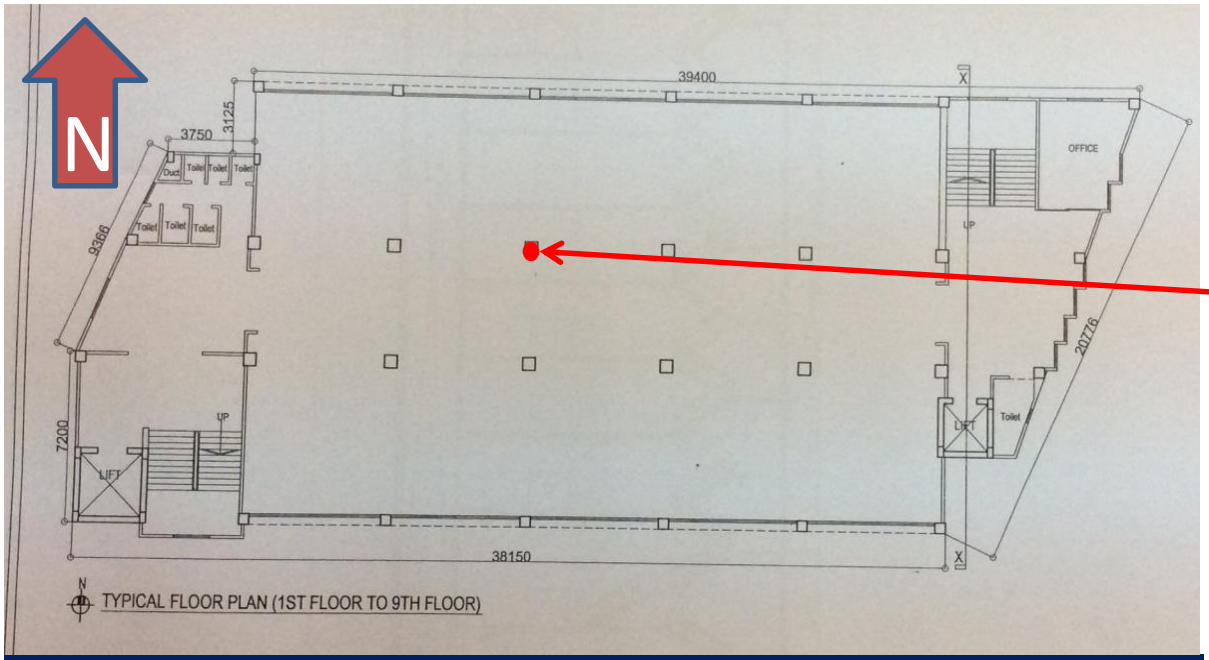
ARUP

Observations

Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment

Item 1 – Columns appear to be stressed to a high level



Main Factory Building

Column Test - Stone Aggregate

Outline calculations indicate that columns are stressed to a high level and require immediate review.

Building Engineer to perform detailed calculations including a Detail Engineering Assessment (see attached scope) and concrete tests to prove adequacy of column sizes, and (if required):

- **Reduce loads by vacating floors**
- **Reinforce columns**

Existing reinforcement in columns to be verified on site by Building Engineer

Design check required for the lateral stability of the Main Factory Building

Item 2 – Design check required for lateral stability of the building

Structural system mainly flat slab with column heads. Frame action due to absence of beams would be considered limited

Building Lateral Stability

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Design check required for the Punching Shear Capacity of the flat slab floors

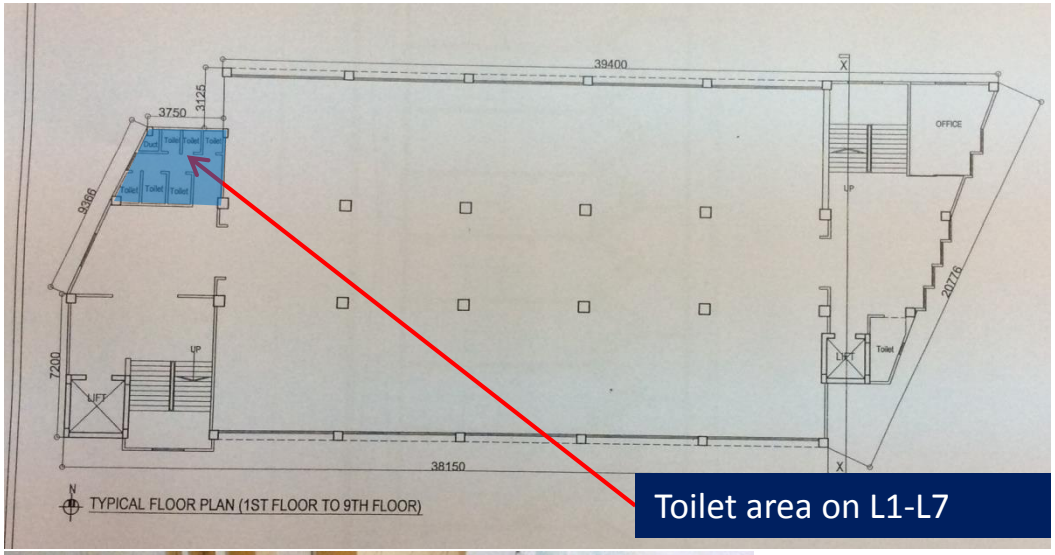
Item 3 – Design check required for punching shear capacity of flat slab floors

Structural system mainly flat slab floors with column heads. Punching shear capacity to be verified.

Flat Slab Floors – Punching Shear Capacity

Design check required for the loading from the toilet plinths

Item 4 – Design check required for the loading from the toilet plinths



Toilet area on L1-L7

Toilet block

Toilet plinths

N

Floor Build-up in Toilet Areas

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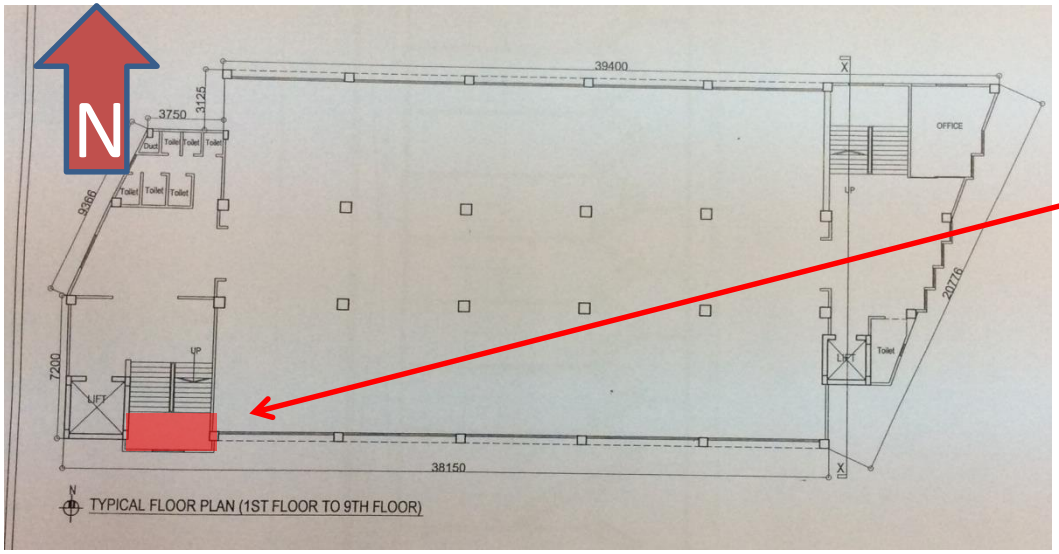
Design check required for the cantilever slab on the south west corner of the Building

Item 5 – Design check required for the cantilever slab on the south west corner of the Building



Cantilever Floor Slab

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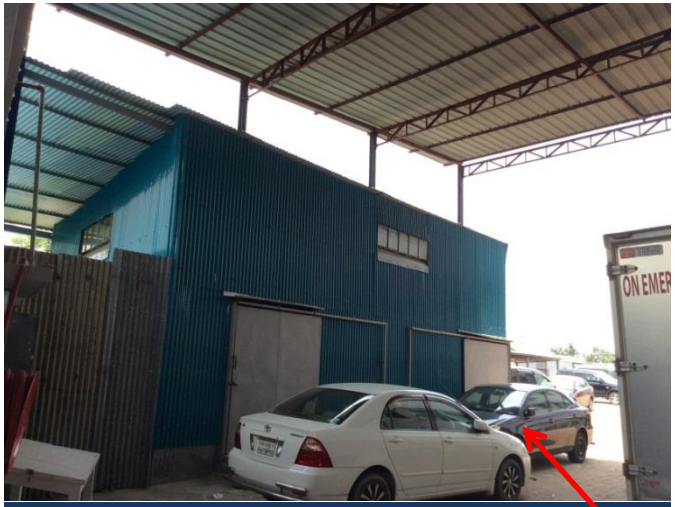
Design check required for the light steel roofs

Item 6 – Design check required for the light steel roofs



Steel Roof spanning between the Main Building and Childcare Building

Light steel roof to Storage Building

Steel roof of Utility Building

Steel roof of Main Building

Steel Roofs

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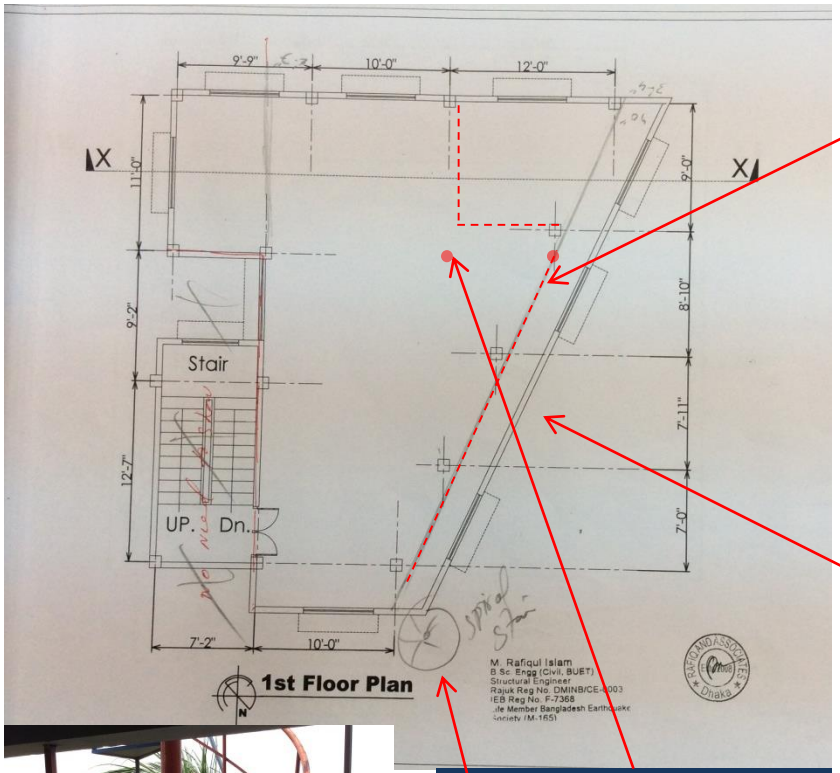
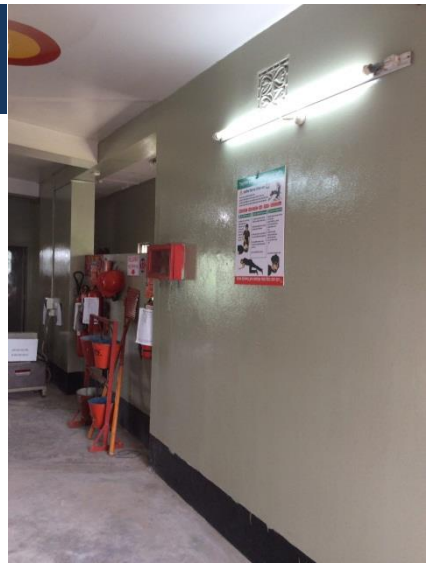
Inconsistencies between the Utility Building drawings presented and the as-built structure

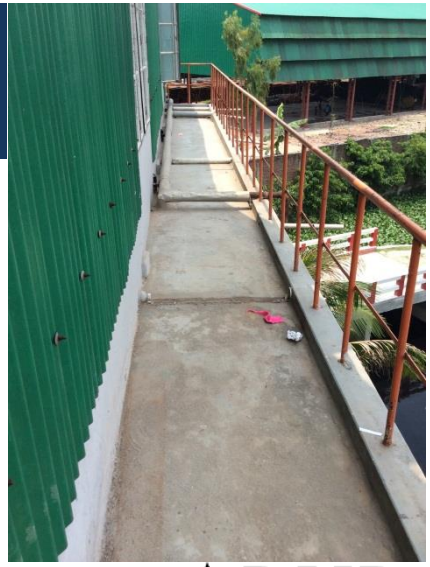
Item 7 – Inconsistencies between the Utility Building drawings presented and the as-built structure



Walls not indicated on drawings



Balcony not indicated on drawings



Approximate locations of as-built columns

Spiral staircase instead of indicated stairs

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Priority Actions

Problems Observed

ITEM 1: Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment

ITEM 2: Design check required for the lateral stability of the Main Factory Building

ITEM 3: Design check required for the Punching Shear Capacity of the flat slab floors

ITEM 4: Design check required for the loading from the toilet plinths

ITEM 5: Design check required for the cantilever slab on the south west corner of the Building

ITEM 6: Design check required for the light steel roofs

ITEM 7: Inconsistencies between the Utility Building drawings presented and the as-built structure

Item No.	Observation	Recommended Action Plan	Recommended Timeline
1	Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment	Maintain the current use of the floors and don´t change use or increase occupation, either of which could increase loading.	**Immediate - Now**
2	Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment	The Building Engineer is to review design loads and column stresses in all columns.	**Immediate - Now**
3	Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment	Verify insitu concrete stresses either by 100mm diameter cores or existing cylinder strength data for cores from 4 columns. Reinforcement quantities also to be confirmed.	**Immediate - Now**
4	Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment	A Detail Engineering Assessment is to be carried out to the scope attached.	**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. 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
5	Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment	Complete the Detail Engineering Assessment.	**6-weeks**
6	Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment	Produce and actively manage a loading plan for all floor plates within the factory giving consideration to floor capacity and column capacity.	**6-weeks**
7	Columns in the Main Factory Building appear to be stressed to a high level and require immediate review including preparation of a Detail Engineering Assessment	Continue to implement floor loading plan	**6-months**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
8	Design check required for the lateral stability of the Main Factory Building	The Building is tall and relatively narrow with flat slabs for all floors except the ground floor.	**6-weeks**
9	Design check required for the lateral stability of the Main Factory Building	The Building Engineer is to assess the capacity of the Building to resist lateral loadings as part of the Detail Engineering Assessment. (Refer to Item 1 actions)	**6-weeks**
10	Design check required for the lateral stability of the Main Factory Building	The Building Engineer is to implement any measures deemed necessary following the completion of the above assessment.	**6-months**
11	Design check required for the loading from the toilet plinths	The Building Engineer is to check the structural capacity of the floor slab in the area of the toilet plinths to transfer the loading back to the columns.	**6-weeks**
12	Design check required for the loading from the toilet plinths	Produce and actively manage a loading plan for all floor plates within the factory giving consideration to floor capacity and column capacity.	**6-weeks**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
13	Design check required for the cantilever slab on the south west corner of the Building	The Building Engineer is to check the structural capacity of the floor slab in the area indicated and confirm with calculations it's capacity to support both floor loadings and façade loadings.	**6-weeks**
14	Design check required for the light steel roofs as noted	No bracing noted in most of the light weight steel roofs and structures viewed on site.	**6-months**
15	Design check required for the light steel roofs as noted	The Building Engineer is to assess the adequacy of the structures to resist wind loading (pressure, suction & uplift). Bracing and other remedial measures deemed necessary to be implemented.	**6-months**
16	Inconsistencies between the Utility Building drawings presented and the as-built structure	Building Engineer to check, collect information and produce accurate and fully complete as-built documentation which is to include the correct sizing of all structural members as well as the reinforcement in each.	**6-months**