GH Haewae Co. Ltd.

Sector-8, Plot-19-24, CEPZ, Chittagong, Bangladesh
(22.28172N 91.77527E)

22 APRIL 2014

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Observations
Main Building 1

Slot made in wall on Level 1

Partly removed wall requires engineering assessment

Lintel beam detail on level 1

Column Strength

- No evidence of steel sections inside the columns.
- The corbel details supporting the primary steel beams indicate that the columns in the 5-storey building may well be just conventionally reinforced concrete columns.
- Ferro-scanning of the columns also indicated rebar inside rather than solid steel section.

- Outline check on column stresses based on concrete only and with a minimum reinforcement of 1.25%.
- Based on this, the columns under design loads (3kPa) would exceed the allowable stresses.

- A full Detail Engineering Assessment for Main Buildings 1 and 2 is strongly recommended including a thorough load-take down, core sampling and testing of the concrete in the columns, exposing of bars in some columns to establish the bar diameter and to establish the stress level.

Tested Ground Floor Column – Stone Chips

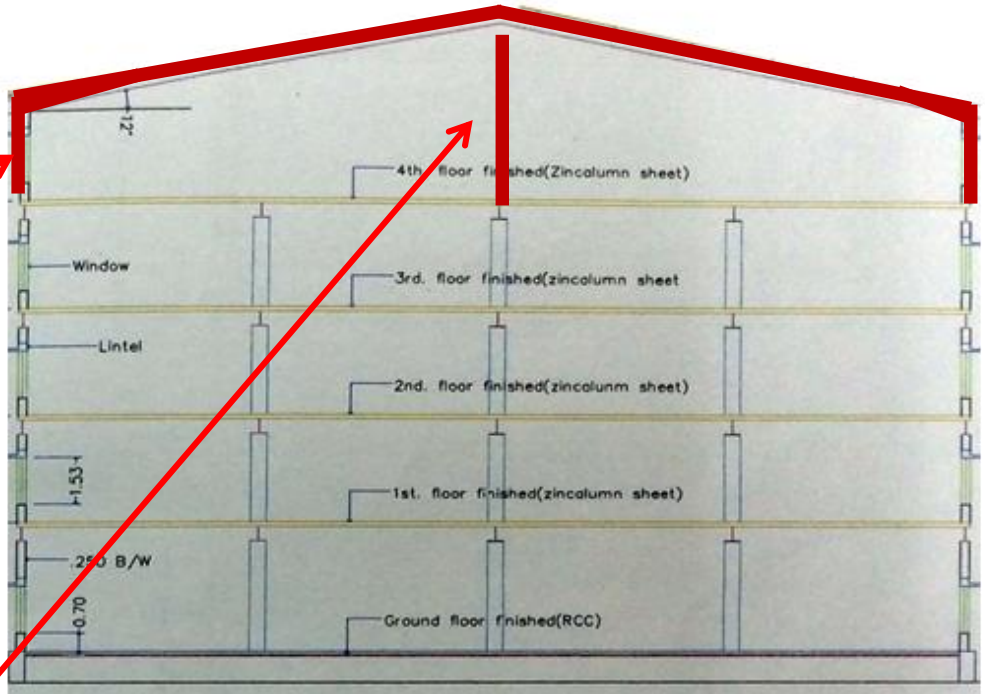
Column Strength

Stability system of 5-storey building

- In Building 1 it appears that the primary steel beams are not rigidly connected to the columns (pinned connections on corbels). Hence no frame-action is provided.
- In the transverse direction, the secondary beams are not connected to the columns but only to the primary beams. Again no frame action is provided.
- The stability seems to rely entirely on the brickwork infill around the perimeter. The Detail Engineering Assessment should therefore include stability calculations to justify the current system. It should be noted that the infill walls include a number of window openings which diminish their ability to act as shear panels.
- The roof structure consists of a portal frame, but this provides lateral stability between 4th floor and roof only.

Column Strength

5-storey building



- Stability of the 4th floor to roof structure is provided in the cross direction by portal frame action, i.e. moment connection between roof beams and perimeter columns.
- In the longitudinal direction, external walls provide lateral rigidity.

Stability system not clear

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Non-engineered steel shed on 3rd floor (roof of building extension)

5-storey building

Non-engineered steel shed used for storage

Absence of bracing: horizontal and vertical

Small “formwork” props

Non-engineered steel shed on extension roof

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Management of floor loads

5-storey building

Storage load on 1st floor

Water tanks on roofs

Management of Floor Loads

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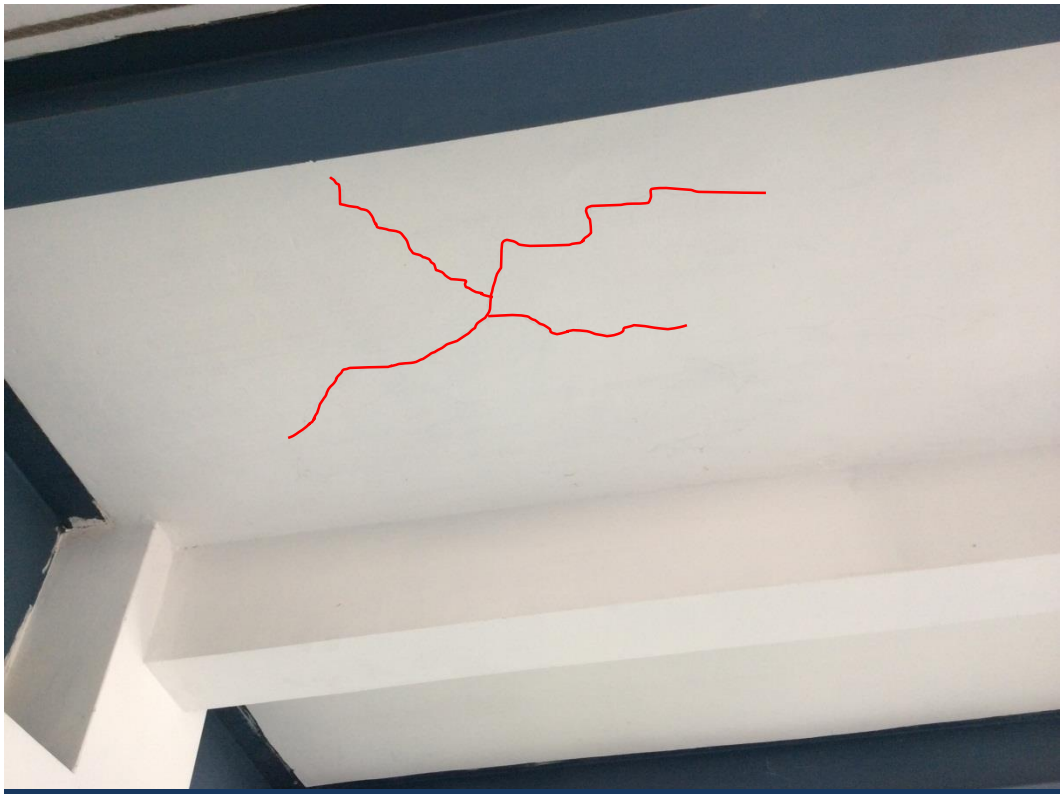
Cracking in slab soffits and brick walls

5-storey building



Cracking in soffit 3rd floor

Cracking in wall at ground floor

Cracking in soffit and wall

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Fire protection to steel structure not known

5-storey building

Fire protection to steel structure not known

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Observations
Main Building 2

Fire protection to steel structure not known

Fire protection to steel structure not known

Cracking in façade wall

Cracking and signs of repairs on 1st floor

Cracking on ground floor

Cracking in façade wall

RC water tank

2 storey sewing shed

Damage on concrete water tank and steel roof due to water leakage

Water tank

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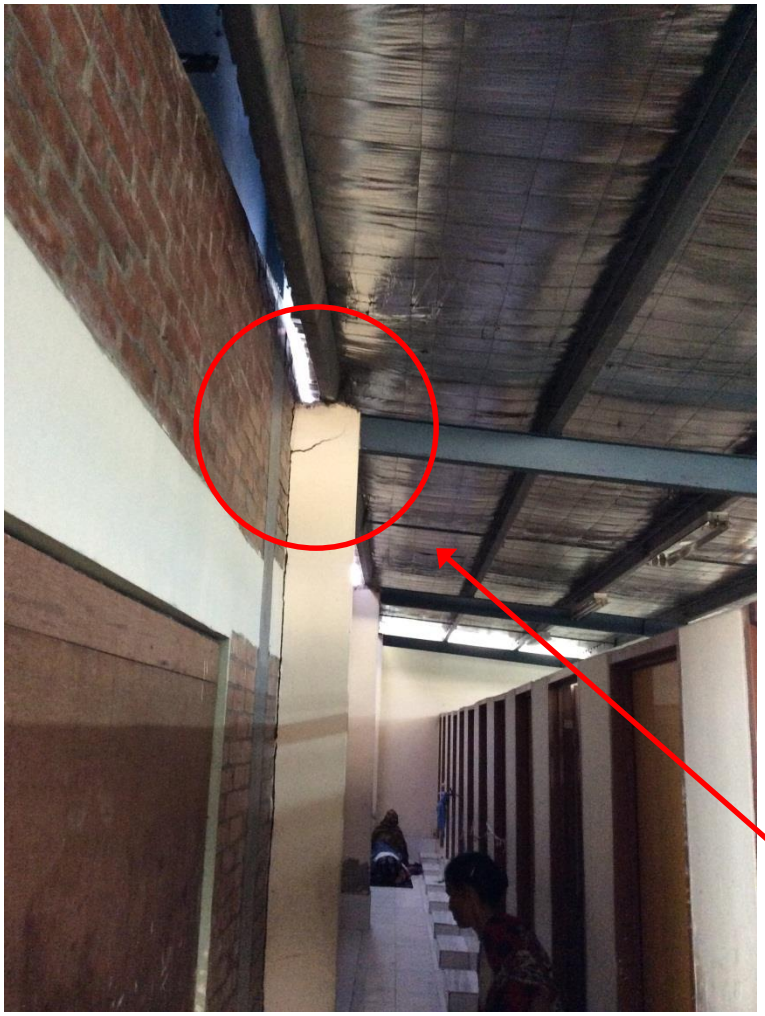
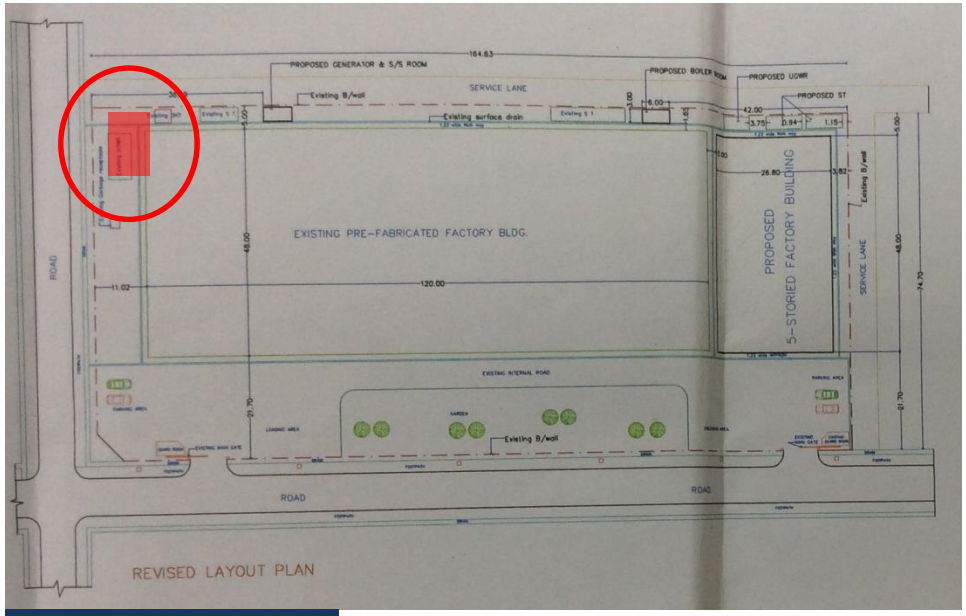
Extension shed for toilets





Location of shed

Crack at top of column in shed for toilets, possibly due to poor detailing and possibly due to lateral forces trying to activate a frame action at a point where no moment connection has been considered.

Extension shed for toilets

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No clear movement joint

Centre column is used for both systems.

Roof and floor structure seem to have been deliberately separated from each other as the roof column runs passed the first floor. However, the two structures are not separated from each other everywhere, having bearing elements in common.

No visible movement joint between the two supposedly independent structures. The external brick wall provides stability in the longitudinal direction for both the roof and the 1st floor slab.

No clear movement joint

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Observations
General

Missing structural drawings and discrepancies from as-built structures

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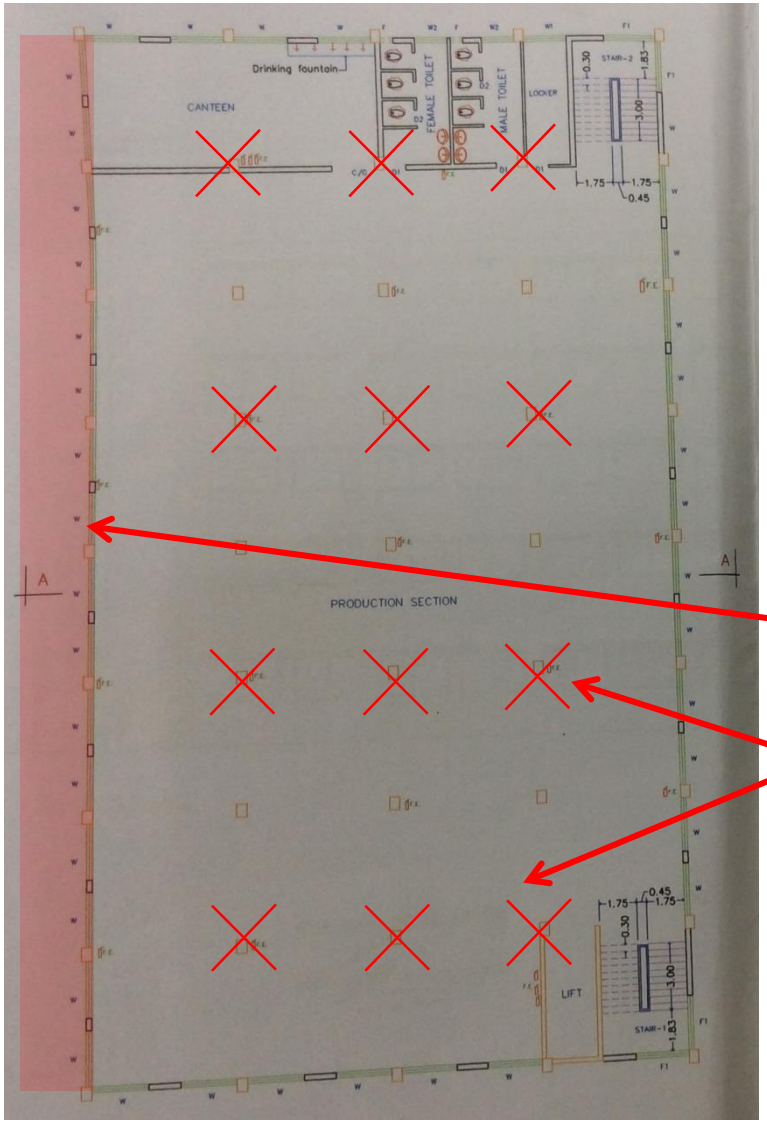

Missing structural drawings for all buidings

Architectural drawings available for 5 storey building only

Discrepancies between drawings and as-built situation (not exhaustive):

- Bay from ground to 2nd floor missing on the architectural drawings.
- Drawings show too many columns on plan. The internal column spacing for a typical floor is 6 x 12m, not 6 x 6m.
- We measured the bay width in the transverse direction to be 6m instead of 6.7m.

Missing structural drawings and discrepancies

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Non-engineered steel sheds

Canteen: missing bracing

Shed around main buildings: missing bracing and poor detailing.

Non-engineered steel sheds

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Actions

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Problems observed

1. Slot in wall on 1st floor (Building 1)
2. Non-engineered steel shed on 3rd floor (Building 1)
3. Concrete water tank: damage to bearing elements (adj. to Building 2)
4. Crack at top of column in toilet shed (Building 2)
5. Fire protection to steel frame not known (Buildings 1 and 2)
6. Lack of structural documentation
7. Cracking in brick walls (Buildings 1 and 2)
8. Non-engineered single-storey sheds
9. Cracking to the underside of 3rd floor (Building 1)

Item No.	Observation	Recommended Action Plan	Recommended Timeline
1	Slot in wall in 5-storey main building on 1st floor	Building Engineer to open up wall and assess its safety.	**Immediate - Now**
2	Slot in wall in 5-storey main building on 1st floor	If wall is not needed, cut back the entire wall to the underside of the slab above.	**Immediate - Now**
3	Slot in wall in 5-storey main building on 1st floor	If there are reasons for the wall to be kept, provide any necessary additional support on the unsupported side.	**Immediate - Now**
4	Non-engineered steel shed and access ladder on 3rd floor above the building extension between Buildings 1 and 2	Building Engineer to prepare engineering calculations, including connection details, for the shed structure and its support.	**Immediate - Now**
5	Non-engineered steel shed and access ladder on 3rd floor above the building extension between Buildings 1 and 2	Engineering calculations to be completed.	**6-weeks**
6	Non-engineered steel shed and access ladder on 3rd floor above the building extension between Buildings 1 and 2	Provide steel bracing for stability as required from calculations.	**6-weeks**
7	Non-engineered steel shed and access ladder on 3rd floor above the building extension between Buildings 1 and 2	Provide support members as required from calculations.	**6-weeks**
8	Non-engineered steel shed and access ladder on 3rd floor above the building extension between Buildings 1 and 2	Provide as-built drawings for shed structure, incorporating any remedial works carried out.	**6-months**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
9	Damaged structural elements supporting the high-level RC water tank outside the sewing shed.	Building Engineer to assess the structure supporting the water tanks.	**Immediate - Now**
10	Damaged structural elements supporting the high-level RC water tank outside the sewing shed.	Carry out all structural repairs to the support structure arising from engineering assessment.	**6-weeks**
11	Damaged structural elements supporting the high-level RC water tank outside the sewing shed.	Take measures to prevent any further damage to the support structure in the future.	**6-months**
12	Crack at the top of a concrete column in the women's toilet area (extension building to the 2-storey sewing shed at the far end / first floor level)	Building Engineer to assess beam/column connection and crack in column.	**6-weeks**
13	Crack at the top of a concrete column in the women's toilet area (extension building to the 2-storey sewing shed at the far end / first floor level)	Stability system of the extension building to be established as part of the Detail Engineering Assessment (see Item 6).	**6-months**
14	Crack at the top of a concrete column in the women's toilet area (extension building to the 2-storey sewing shed at the far end / first floor level)	Provide horizontal and vertical cross-bracing as required to provide a proper stability system. Carry out all structural works arising from assessment.	**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 checks 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
15	Fire protection to steelwork not known (Buildings 1 and 2)	Building engineer to review adequacy of fire protection to steelwork	**6-weeks**
16	Fire protection to steelwork not known (Buildings 1 and 2)	Any required remediation work to be completed	**6-months**
17	Lack of structural documentation	Detail Engineering Assessment (in accordance with the scope set out in the following slide) for Buildings 1 and 2 to be commenced, with particular attention to full structural analysis of bearing elements (slab, beams, columns, foundations), stability and as-built drawing information.	**Immediate - Now**
18	Lack of structural documentation	Detail Engineering Assessment to be completed.	**6-weeks**
19	Lack of structural documentation	Implement actions arising from assessment.	**6-months**
20	Lack of structural documentation	Floor load plans to be developed and implemented.	**6-months**
21	Cracks in the brick walls at ground floor (Buildings 1 and 2)	Cracks in the brick walls to be repaired (grouted) to make sure the walls continue to act as stability elements.	**Immediate - Now**
22	Cracks in the brick walls at ground floor (Buildings 1 and 2)	Assess the role of brick walls in the building's stability as part of the Detail Engineering Assessment (see Item 6).	**6-weeks**
23	Cracks in the brick walls at ground floor (Buildings 1 and 2)	Carry out any works identified in the Detail Engineering Assessment to ensure the building's stability.	**6-months**

Item No.	Observation	Recommended Action Plan	Recommended Timeline
24	Non-engineered steel sheds are unlikely to be able to withstand strong wind events	Building Engineer to assess sheds in terms of lateral stability and resistance to uplift.	**6-weeks**
25	Non-engineered steel sheds are unlikely to be able to withstand strong wind events	Provide structural calculations.	**6-weeks**
26	Non-engineered steel sheds are unlikely to be able to withstand strong wind events	Steel structures to be upgraded as required to support code vertical and wind loads, or they should be vacated and removed.	**6-months**
27	Cracking on the underside of 3rd floor slab (Building 1)	Monitor cracks on slab. Conduct regular inspection of cracks. Investigate if cracks are only in the plastering.	**6-months**
28	Cracking on the underside of 3rd floor slab (Building 1)	If cracks grow larger, remove all items above the slab and close working areas below the affected areas. Building Engineer to investigate, repair and strengthen the slab.	**6-months**