Revision: Issue 1
Date: 18th March 2015

Category Amber

DEA

Category Red if Key actions on Page 3 are not immediately progressed

NR Knitting Mills Ltd.

Enayetnagar, Bholail, Fatullah, Narayanganj.

(23.619090N, 90.478626E).

11th March 2015

Structural Inspection Report

Author: David Donnan
Reviewed by: Paddy Butler
Approved by: Richard Hill

ACCORD on Fire and Building Safety in Bangladesh

ARUP

Executive Summary

On 11th March 2015, Mr David Donnan of Arup carried out a visual structural survey of the **NR Knitting Mills Ltd.** factory at the address and co-ordinates given on the cover page of this report.

We met with Major Md. Rezzaul Hoque, Assistant General Manager (Admin & Compliance) of NR Group; Mr Md. Fazlul Kalim Molla, Senior Manager (Civil); Kabir Ahamed, Asst Eng; Fakhrul Akbar Khokon, Sr Executive Officer HR & Compliance; Engr. Armanul Kabir (ADEPT Consultants).

This factory comprises a single building, which is used for production. It is a 7 storey RC structure with a lightweight steel structure over a part of the roof level. A mezzanine floor was shown on the ground floor drawing, but this had been removed apart from the light steel framework. We were informed that there was no intention to replace the floor and use the area again.

The entire building is occupied by NR Knitting Mills Ltd. We were advised that the building was constructed in 1998.

We were presented with the following documentation.

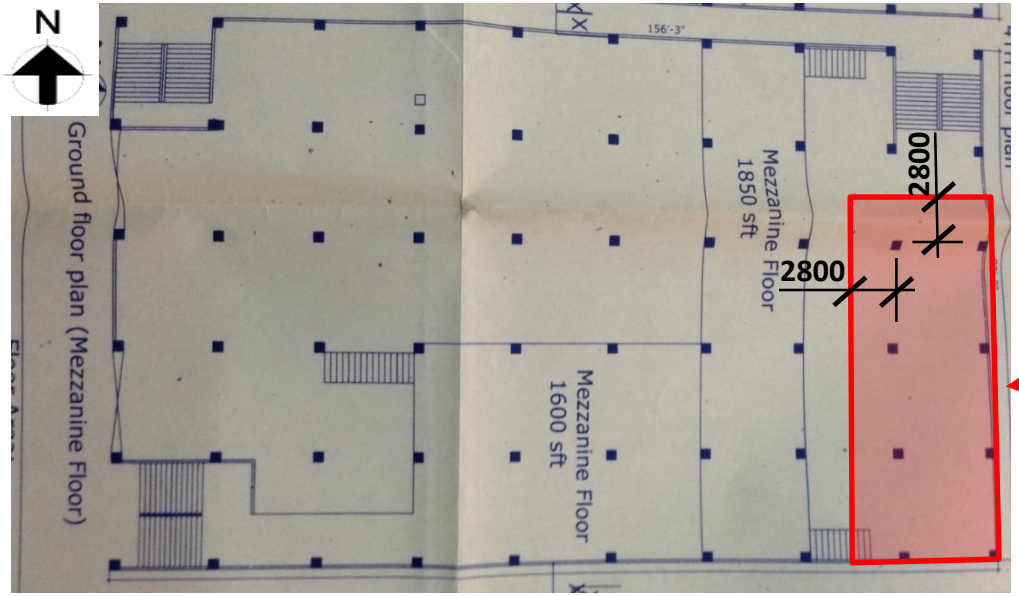
- Factory (Industrial) Permit by Assistant Inspector of Industrial Institution (Bangladesh Government) dated May 2004.
- Building Permit by Chairman of Local Authority / Engineer of Local Authority dated August 1998.
- Structural drawing – one drawing covered the whole building and included piles and pile caps.
- Architectural drawings – one drawing covered the whole building.
- Soils Test reports by Bhai Bhai Soil Foundation dated May 1998.

Executive Summary (continued)

The soils reports provided a range of possible options for the foundations. However, the drawings indicated piled foundations with pile caps and ground beams. This information could not be verified on site.

We have important and urgent concerns in relation to the column stresses in the building. Columns carrying the toilet areas at the east end of the building appear to be stressed to levels that require urgent review. The following **immediate** actions are required to be carried out:

1. The area indicated below is to be vacated and cordoned off at all levels.
2. A Detail Engineering Assessment for the building is to be carried out, the extent of which is outlined towards the end of this report.



Vacate and cordon off this area at all levels **immediately**, pending outcome of Detail Engineering Assessment

Executive Summary (continued)

If the building owners are not in a position to carry out these actions **immediately**, the building should be classified as **Category Red** and evacuated.

We would recommend that the Detail Engineering Assessment be completed **within 6 weeks** of receiving this report.

A high-level and non-exhaustive list of concerns are:

ITEM 1: Highly-stressed columns
ITEM 2: Punching shear stresses in flat slabs
ITEM 3: Discrepancies between drawings and on-site observations

Further actions with associated priorities and timeframes are given at the end of this report. Please note that these actions should be completed as soon as practically possible and certainly within the timeframe noted.

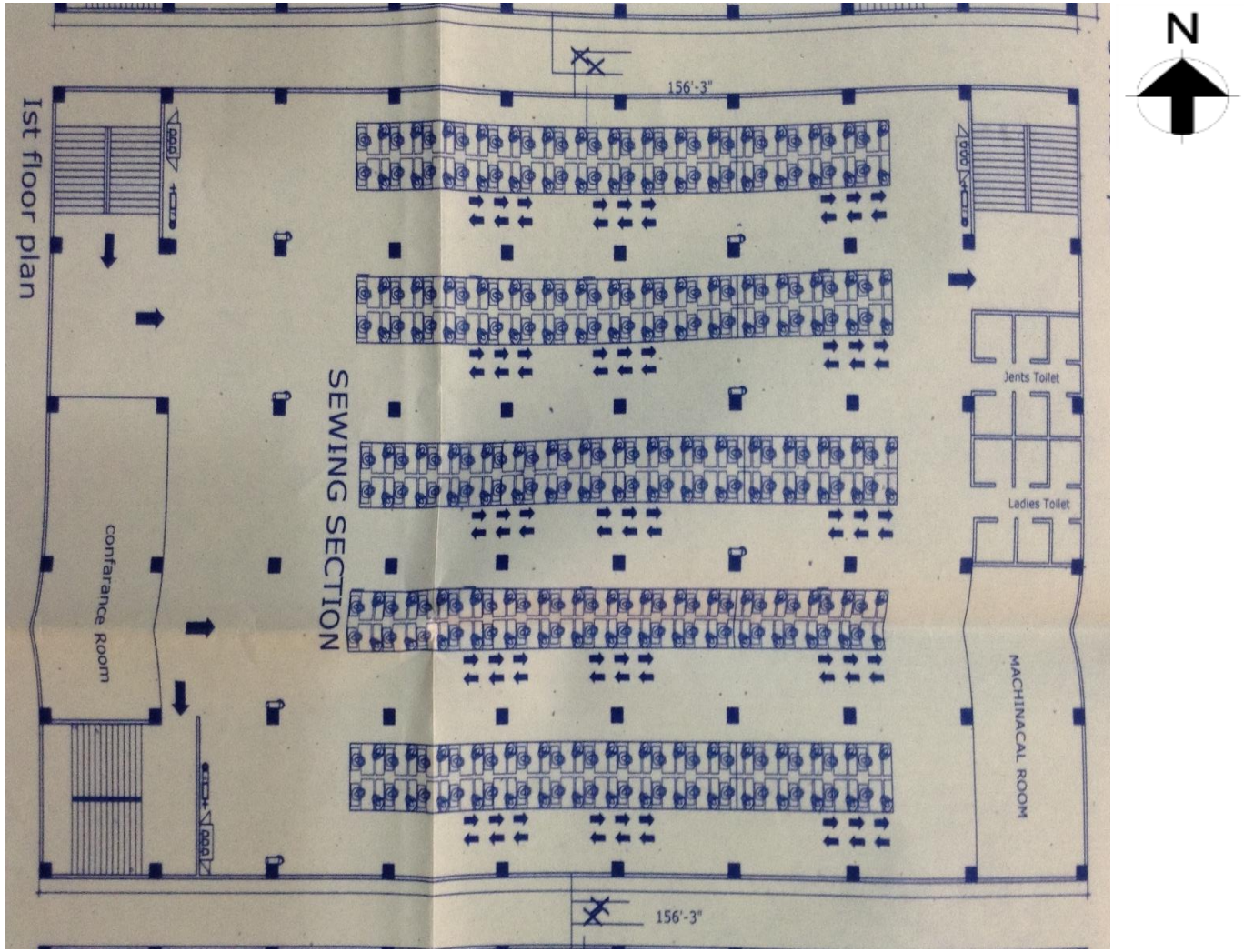
We have reviewed the property from an outline seismic perspective and would consider that the building, along with many others in the Dhaka region, to have a significant risk of damage in a major Seismic event.

Our Limitations and Assumptions are also noted at the end of this report.

Building Extents

NR Knitting Mills Ltd. – Factory Site Location

Building Extents



Typical Floor Plan (Extract from Structural Drawings)

Building Extents

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North Elevation

East Elevation

West Elevation

Building Extents

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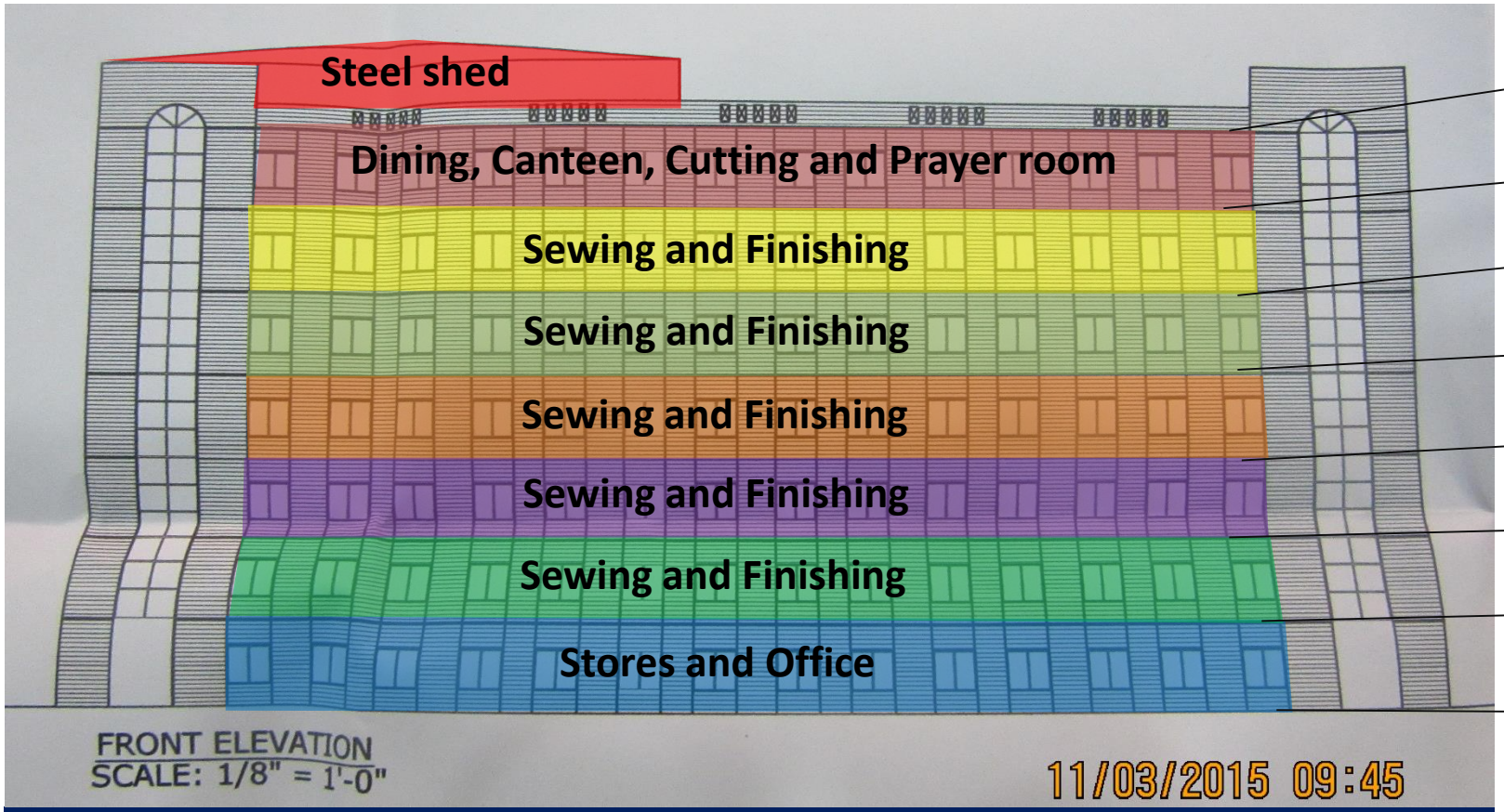

Current Use of Factory Floors

Building Extents

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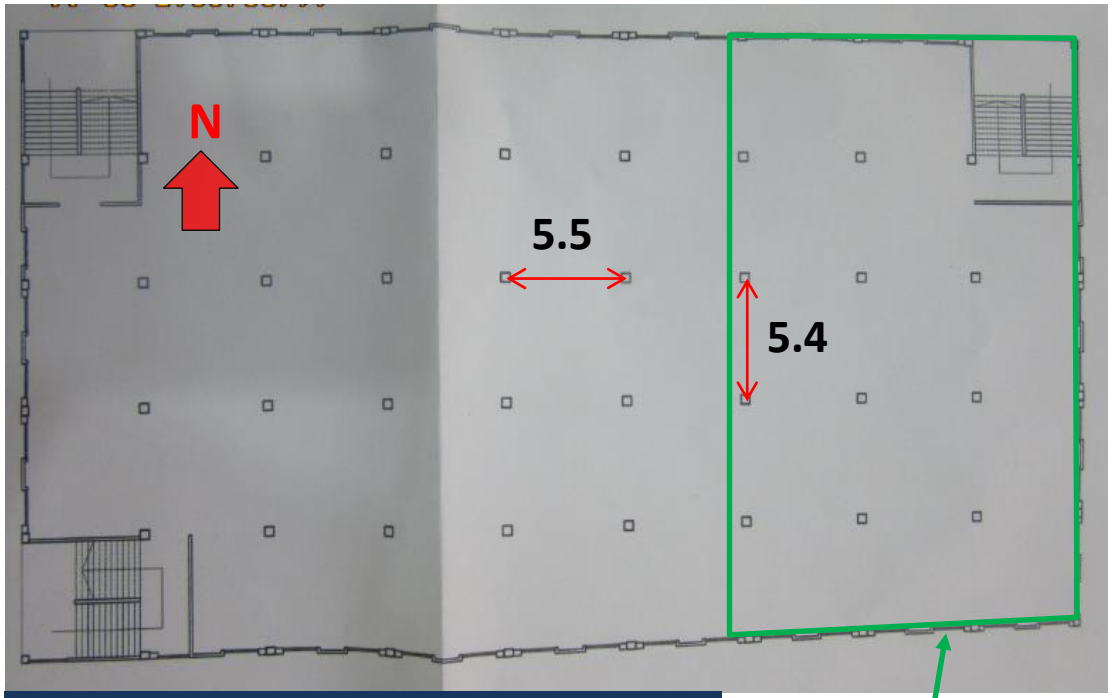
Structural System



Typical Grid

Extent of steel shed on 7th floor

7 storey RC building

Structural System:
- Ground & 1st floor: Beam & Slab
- 2nd floor & above: Flat slab

Grid:
- Typ. 5.4m x 5.5m

Stability System
- Ground & 1st floor: Moment frame
- 2nd floor & above: Flat slab with perimeter beams & brick infill walls

Columns:
- Internal: 400mm x 400mm
- Edge: 300mm x 400mm
- Corner: 300mm x 300mm

Beams (1st floor):
- Avg. 280mm W x 400mm D/std

Foundations:
- Not known

Column Aggregate
- Stone Chips up to soffit of 2nd floor
- Brick chips above 2nd floor

Structural system

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Beams and slab at ground and 1st floor

Flat slab from 2nd floor and above

Structural system

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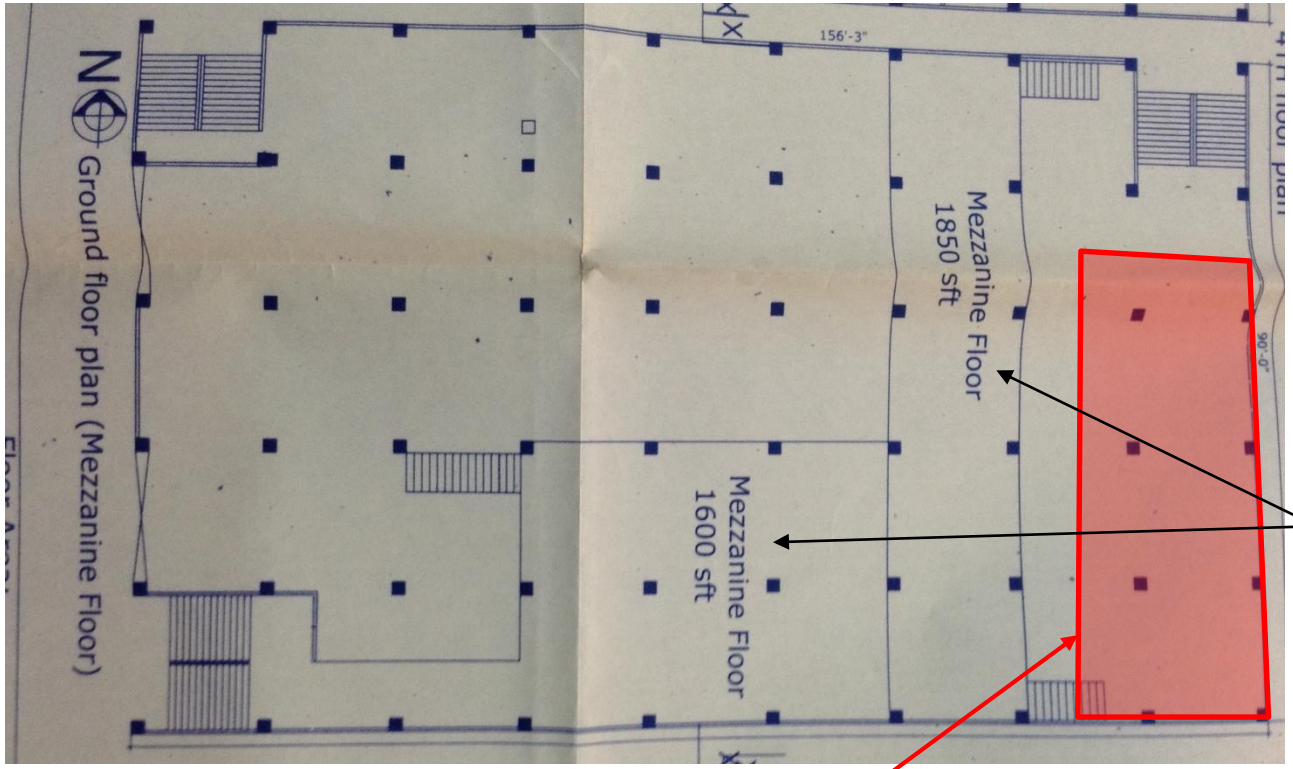
Observations

Highly-stressed columns



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Note:
We were informed that this mezzanine was constructed with a timber floor which was removed due to Accord Requirements, apart from the light steel framework.
We were informed that there was no intention to replace the floor and use the area again.

- Columns in this area are stressed to levels that require immediate review.
- Other columns appear to be stressed to levels in excess of normal design limits.

Observations

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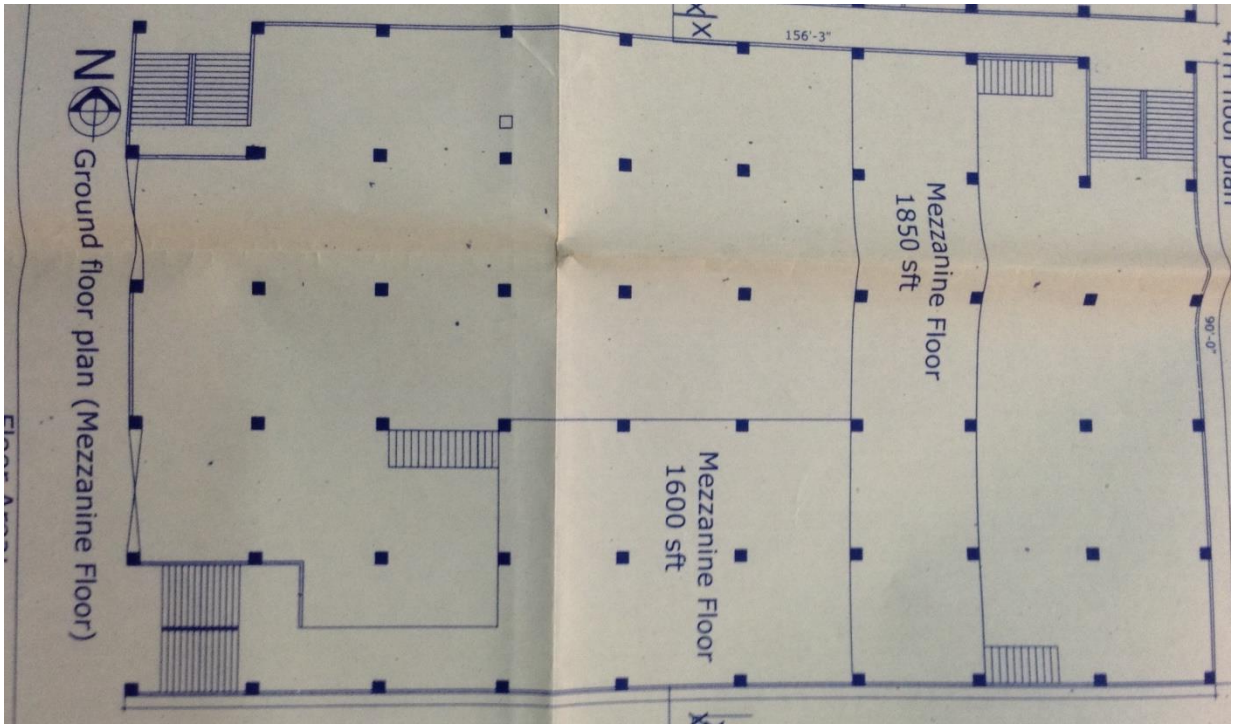
Punching shear stresses in flat slabs



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Flat slab at 2nd floor level and above – punching shear stresses appear to be in excess of normal design limits

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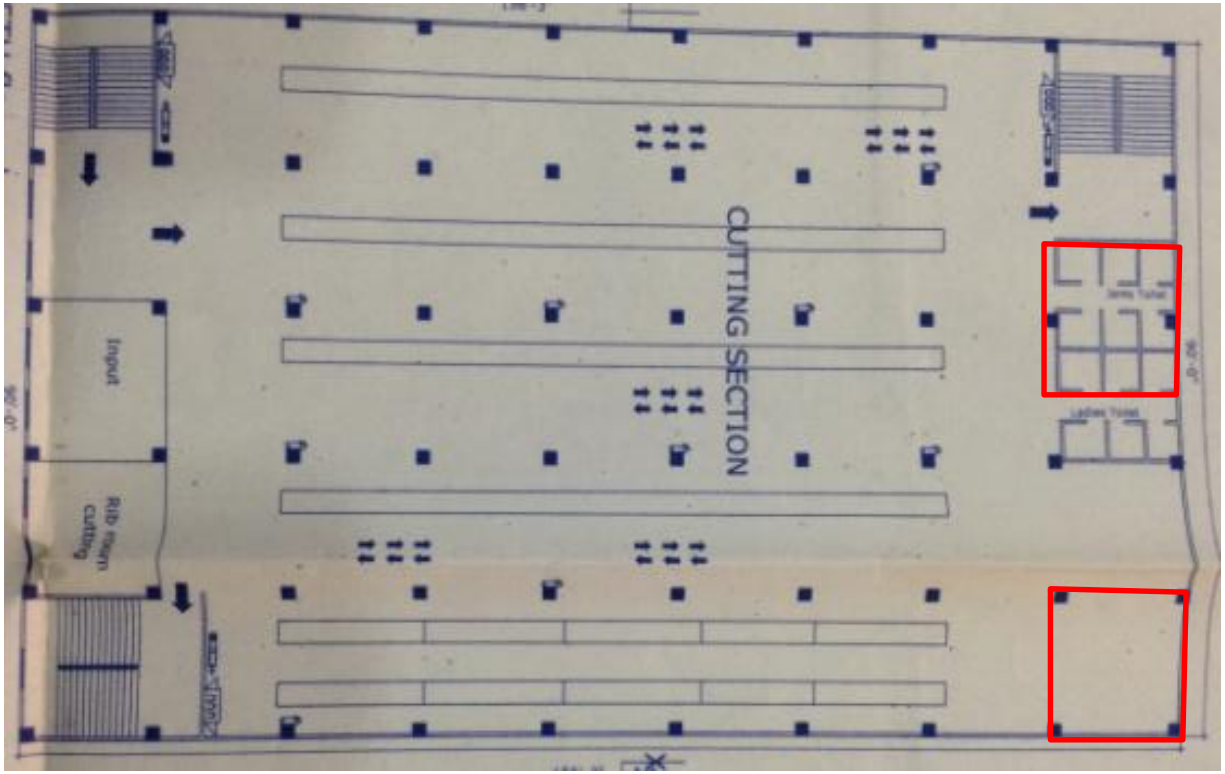
Discrepancies between drawings and on-site observations



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Toilet blocks as observed

Arrangements and location of the toilet blocks on the architectural drawing does not match with on-site observations

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Priority Actions

Problems Observed

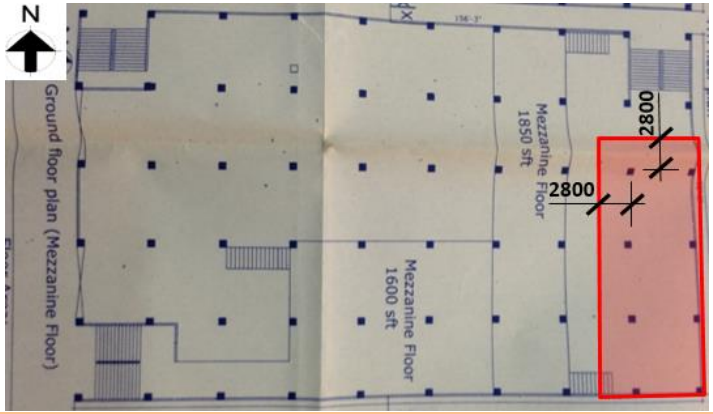
ITEM 1: Highly-stressed columns

ITEM 2: Punching shear stresses in flat slabs

ITEM 3: Discrepancies between drawings and on-site observations

Item 1 and actions

Highly-stressed columns



Priority 1

(Immediate - Now)

- Vacate and cordon off the area highlighted above at all levels **immediately.**
- Verify insitu concrete strength by 100mm dia. cores from min. 4 no. columns at ground floor level and min. 4 no. columns at 2nd floor level where aggregate changes to brick chips.
- A **Detail Engineering Assessment** of Factory to be commenced, see attached scope.

Priority 2

(within 6-weeks)

- Produce and actively manage a loading plan for all floor plates within the factory, giving consideration to floor capacity and column capacity.
- Detail Engineering Assessment to be completed.

Priority 3

(within 6-months)

- Continue to implement loading plan.

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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 2 and actions

Punching shear stresses in flat slabs

Priority 1 (Immediate - Now)	• None
Priority 2 (within 6-weeks)	• As part of Detail Engineering Assessment (see Item 1), verify insitu concrete strength by 100mm dia. cores from flat slabs at min. 4 no. floor levels. Cores to be taken near mid-span. • Input results into loading plan (see Item 1).
Priority 3 (within 6-months)	• Continue to implement loading plan.

Item 3 and actions

Minor drawing discrepancies

Priority 1 (Immediate - Now)	• None
Priority 2 (within 6-weeks)	• As part of Detail Engineering Assessment (see Item 1), Factory Engineer to carry out survey of as-constructed building.
Priority 3 (within 6-months)	• As part of Detail Engineering Assessment (see Item 1), Factory Engineer to produce accurate as-constructed drawings for the building.

Survey Limitations and Assumptions

This report is for the private and confidential use of Accord for whom it was prepared together with their professional advisors as appropriate. It should not be reproduced in whole or in part or relied upon by third parties for any use without the express written permission of Arup.

This report can be used in discussion with the supplier or factory owner as a means to rectify or address any observations made. The report is not comprehensive and is limited to what could be observed during a visual inspection of the building.

This Report is not intended to be treated as a generalised inspection and does not cover the deterioration of structural members through dampness, fungal or insect attack, nor does it deal with problems and defects of a non-structural nature. Other non structural aspects of the building such as fire safety have not been assessed in this survey.

Except as otherwise noted, drains and other services were not viewed or tested during our inspection and are therefore similarly excluded from this Report. We have not inspected any parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect.

External inspection of the façade walls has generally been carried out from ground level only by visual sighting. No opening up works were carried out (except as noted) and we rely on the Architects and Engineers drawings provided to us for our views on concealed parts of the structure and in particular foundations. Strengths of materials and components are untested and we recommend that the factory owners Building Engineer carries out insitu testing over and above those suggested to satisfy themselves with the material strengths and component details.

Recommendations, where given, are for the purpose of providing indicative advice only, are not exhaustive, relate solely to identifying key and obvious structural defects as identified in this presentation, and do not take the form of or constitute a specification for works. We take no responsibility for the works as constructed. This report does not interfere with the factory owners Building Engineers responsibility for the structural performance of this building, The Building Engineer remains fully responsible for the structural adequacy of the building.

This report does not comment in detail on the future seismic performance of the building and only highlights the fact that the building may experience significant damage or collapse in a seismic event along with many others in the Dhaka region.

The observations in this report are based on the Engineering Judgement of the lead surveyor/engineer at the time of the survey. We assume in making these observations that no covering up of faults defects, filling or plastering over cracking or significant repair work has been carried out by the building owner. Any future alteration or additional work by the building owner will void this report.