Revision: Issue 1
Date: 16th June 2014

Category Yellow

Universal Menswear Ltd.

Plot 234-238, 252-254, Adamjee EPZ, Narayanganj
(23.676969, 90.518717)
7th June, 2014

Structural Inspection Report

Authors: Salam Al Sabah & Victor Adamczyk
Checked by: Salam Al Sabah
Approved by: Salam Al Sabah

ACCORD on Fire and Building Safety in Bangladesh

ARUP

Executive summary

On Saturday, the 7th June 2014 Mr Salam Al-Sabah and Mr Victor Adamczyk of Arup carried out a visual structural survey of the **Universal Menswear Ltd** factory at the address and coordinates given on the cover of this report.

We met with Mr Humayun Ur Rahman the A.G.M.-Compliance, Mr Md. Billal Hossain the DGM-Admin, Maj (Retd) Md. Elias Hossain the DGM-Admin, HRD & Compliance, and Engineer Rabiul Islam Robin-Manager (Development). We inspected the accessible areas of the factory. All the building is currently occupied by Universal Menswear Ltd. During our inspection, access was provided to all floors. Floors in use are used for light factory operations such as sewing, cutting, finishing, and printing. Other areas contain offices, canteen, storage, and utilities.

The current management was responsible for running the factory since the start in 2012. The factory is owned by the company and employs 2600 workers working in two shifts, 1300 each. The lead brand is H&M.

A Building Permit Drawing (signed by the AEPZ authority on October 2011) was provided. A Soil Investigation report was also presented. The report was issued by Land Survey Team on August 2011 and signed by Engineer Debadi Biswas. The report conclusions were that piles may be provided for all borings. A set of structural drawings for the reinforced concrete piled foundation, substructure columns , and grade beams was also provided. An additional set of structural calculations and drawings for the steel superstructure was also provided. It was issued by Kirby Southeast Asia Co. Ltd. and signed by Engineer Md. Mizanur Rahman.

Executive Summary (Continued)

The factory is made from three main buildings. These are the four storey Building 1 - Factory Building, the single storey Building 2 - Raw materials Building, and the two storey Building 3 - Utilities Building. All buildings share the same construction, with piled foundation and steel superstructure. Lateral stability is achieved through moment frame action in one direction and cross bracing in the other.

Building 1 is made from three parts. The two ends of the building are four storey high and have a flat concrete roof slab on non-composite metal deck supported on primary and secondary steel beams. The middle part is two storey high with a metal roof sheeting over purlins. The single storey Building 2 has a metal roof with sheeting supported on purlins. Building 3 is made from two parts. The first is two storey high with a concrete first floor slab on non-composite metal deck supported on primary and secondary beams. The roof of the first part is a metal roof sheeting over purlins. The second part was originally build as per the Permit Drawings with only one storey. Its roof was a concrete slab on non-composite metal deck supported on primary and secondary beams. A later addition, that was not shown in the Permit Drawings, was made from steel column supporting steel trusses. The roof was metal roof sheeting over purlins. The column-truss connections appears to be non-engineered and to have limited moment capacity. The lateral stability system to additional construction is not clearly defined with absence of roof cross bracing, wall cross bracing and clear portal frame. Purlins appeared twisted as they suffer from lateral torsional buckling.

The ground floor of all these buildings is a reinforced concrete slab on grade.

There is a steel Link Bridge linking Buildings 1 and 2. In addition, there are three external steel stairs providing access and fire escape to the buildings.

Executive Summary (Continued)

In addition to the main buildings, there are two additional external rooms. These are the Guard Room and the Guard Accommodation Room. Both have a structure made from external brick walls reinforced concrete roofs. These rooms were shown on the Permit Drawings.

The buildings appear to be generally in good structural condition and there was good co-relation between the record structural drawings and the as built structure.

There was no visible evidence of overloading, distress, damage, excessive deflections or settlements of the building structures, with the exception of some ground bearing floor slabs, which are currently being repaired/replaced, and some access stairs which are further discussed in this report. The steel and concrete superstructures seem to function properly.

A high level and non exhaustive list of structural key concerns are:

- Generally, it appears fire protection to the primary steel structure of all inspected building has not been provided

- Building 1 – Garment Factory
  - Some cross bracing elements are missing and some connections were modified during construction
  - One lift core has been converted to storage at each floor level – this is a change from original design drawings
  - Cracking observed to brick perimeter walls

- Building 2 – Raw Materials
  - Building wall cross-bracing is not tight, relying on brick walls for lateral stability
  - Lateral support to tops of brick walls is not clearly defined

Executive Summary (Continued)

- Building 3 – Utilities
  - Footings to two sets of external stairs are settling
  - Water tank frame is tilting from uneven settlement
  - Additional roof structure added beyond the extent of original planning and design drawings
  - Significant settlement of ground floor slab and associated cracking observed – repairs currently underway.
  - Cracking to screed and repair attempts observed at mezzanine floor slab,

We see **no reason to suspend operations in the facility due to any structural concerns (subject to the required actions noted at the end of this report).**

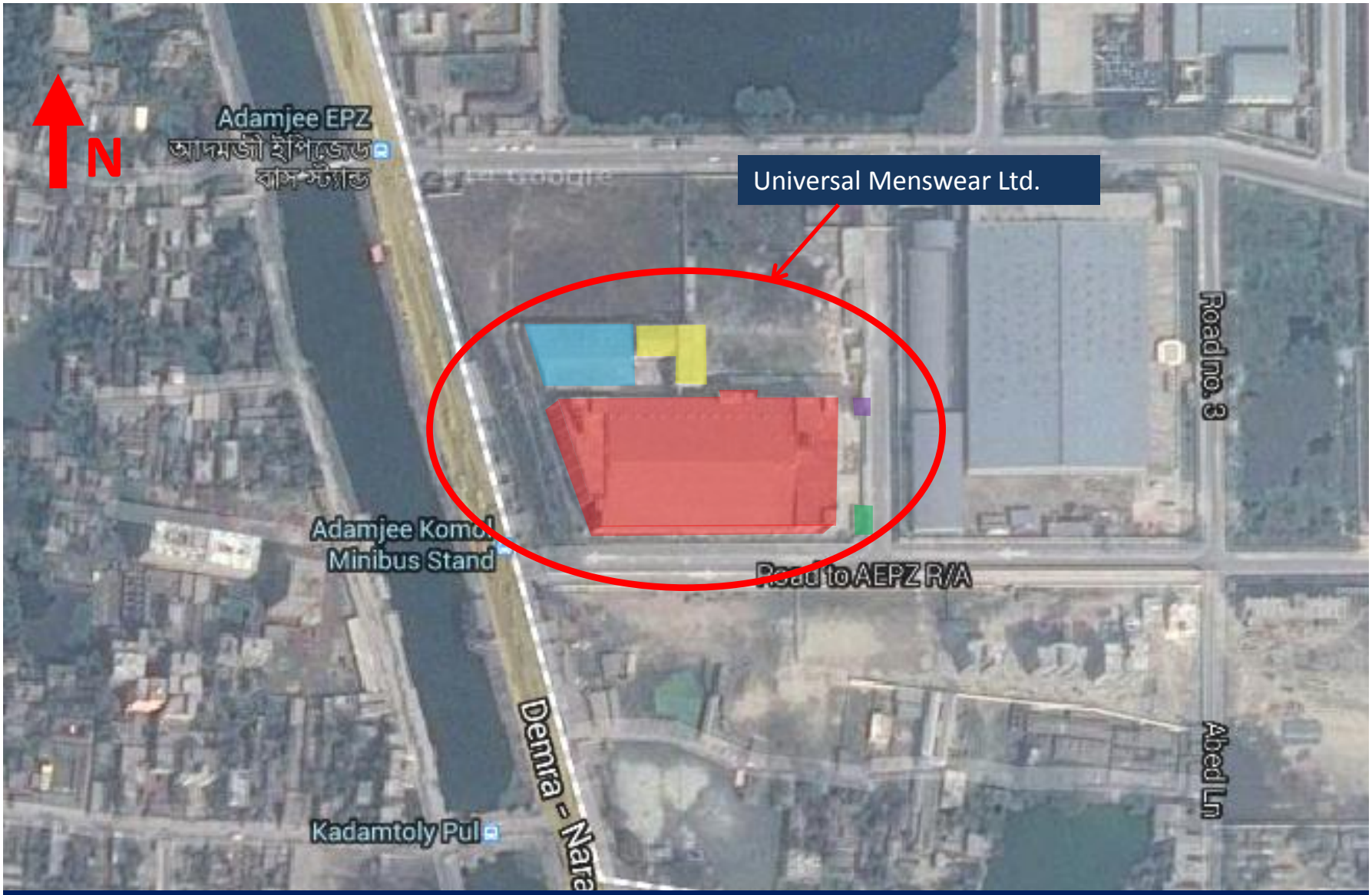
Further actions with associated priorities and timeframes are given at the end of this report.

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 in a major Seismic event.

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

Building Extents



Site Location: Universal Menswear Ltd.

Building Extents

ACCORD on Fire and Building Safety in Bangladesh

ARUP

Building 1 - Factory Building

Building 2 - Raw Material Store

Building Extents

ACCORD on Fire and Building Safety in Bangladesh

ARUP

Building 3 - Utilities

Guard Room

Building Extents

ACCORD on Fire and Building Safety in Bangladesh

ARUP

Accommodation for Guards

Building Extents

ACCORD on Fire and Building Safety in Bangladesh

ARUP

East Elevation

South Elevation

West Elevation

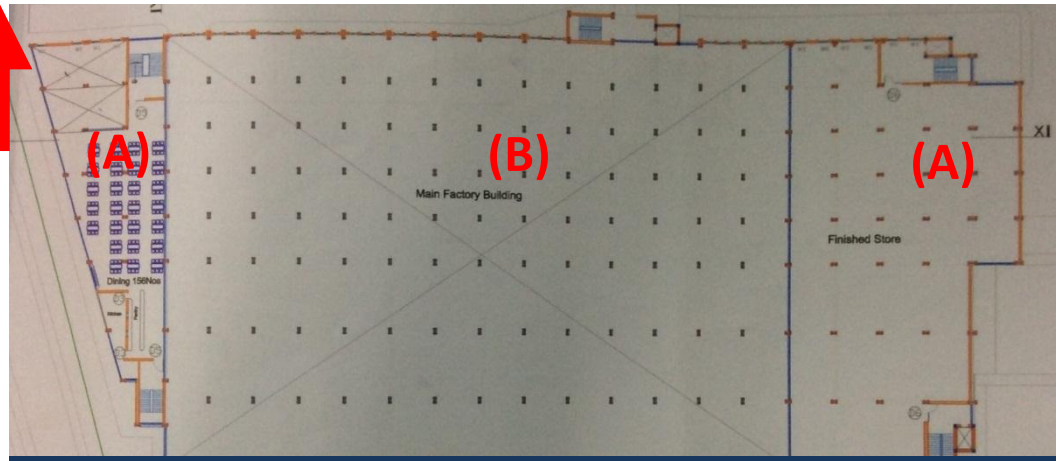
North Elevation

Building Extents-Building 1

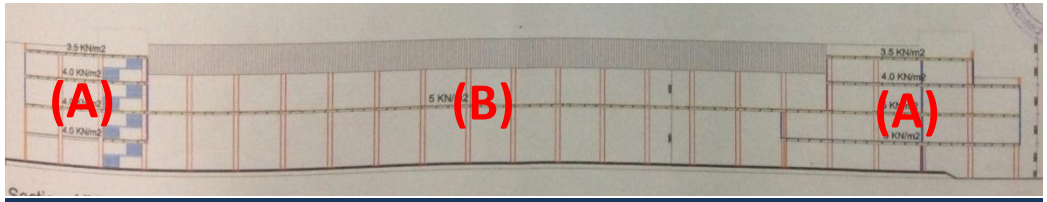
ACCORD on Fire and Building Safety in Bangladesh

ARUP

Structural Systems



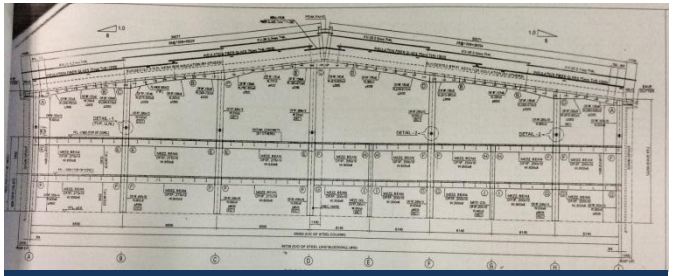
Floor Plan



Long Section

(A) Three suspended slabs between Ground Floor & the Roof

(B) One suspended slab between Ground Floor & the Roof



Cross Section

Structural System:
Building 1 is supported on piles and pile caps. Its superstructure comprises steel moment frames in one primary direction and cross bracing in the perpendicular direction.
The Ground Floor is a reinforced concrete slab on grade. Suspended floors comprise reinforced concrete slabs on permanent formwork, over primary & secondary steel beams.
The building roof generally consists of metal roof sheeting over metal purlins. At each end of the building, the roof comprises reinforced concrete slabs on permanent formwork, over primary & secondary steel beams.

Structural System – Building 1

ACCORD on Fire and Building Safety in Bangladesh ARUP

Primary structure seen from 2nd Floor

Reinforced concrete roof at east end of Building 1

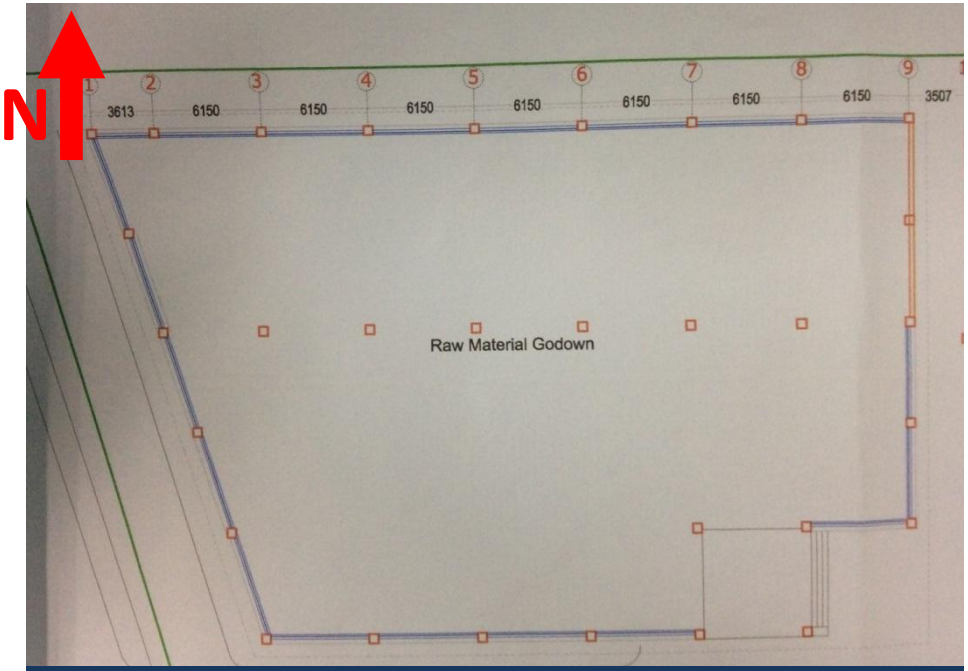
Primary structure seen from Ground Floor

Cross bracing to end bay

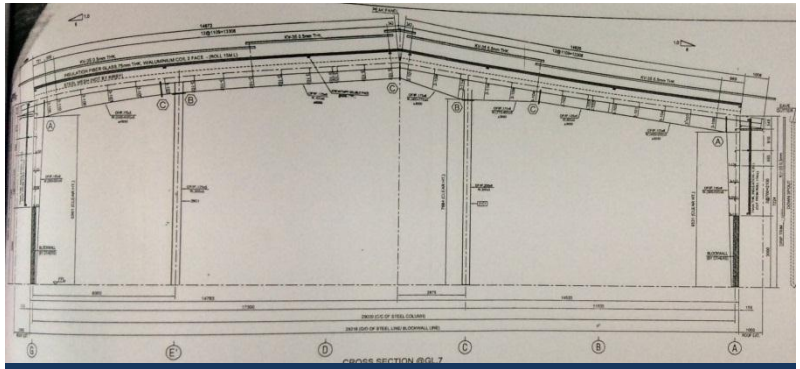
Structural System – Building 1

ACCORD on Fire and Building Safety in Bangladesh

ARUP



Floor Plan



Cross Section

Structural System:
Building 2 is supported on piles and pile caps. Its superstructure comprises steel moment frames in one primary direction and cross bracing in the perpendicular direction.
The Ground Floor is a reinforced concrete slab on grade. The building roof consists of metal roof sheeting over metal purlins.
Walls include a combination of brick & metal sheeting over metal girts.

Structural System – Building 2

ACCORD on Fire and Building Safety in Bangladesh ARUP

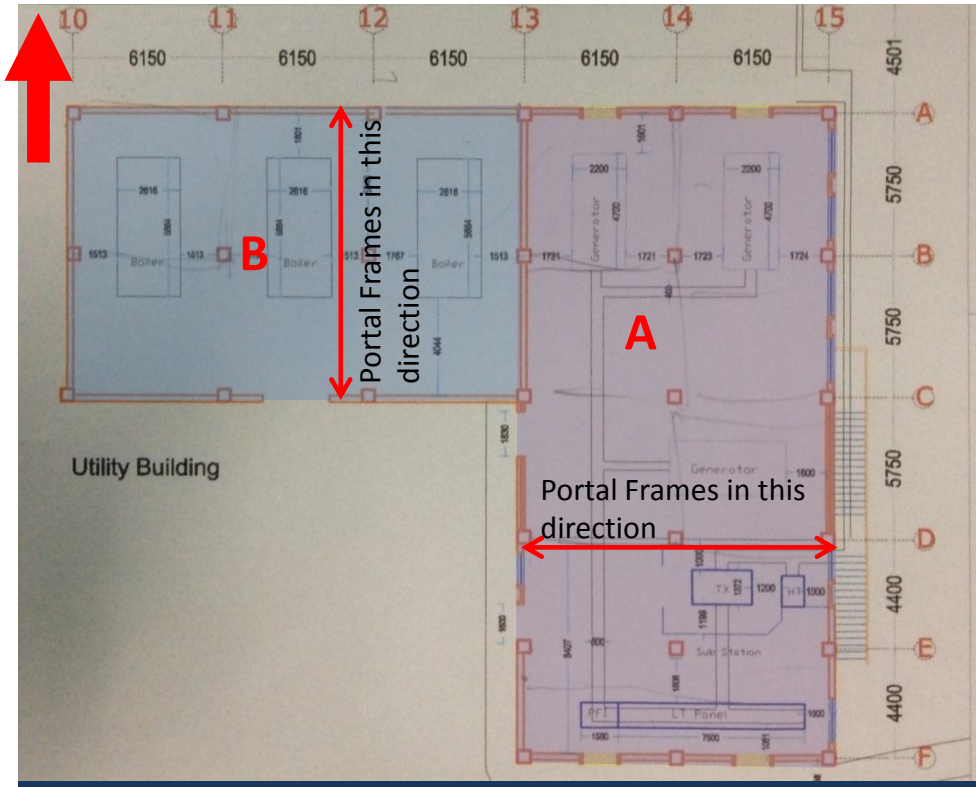
Portal Frames seen from building interior

Example cross bracing in building side wall

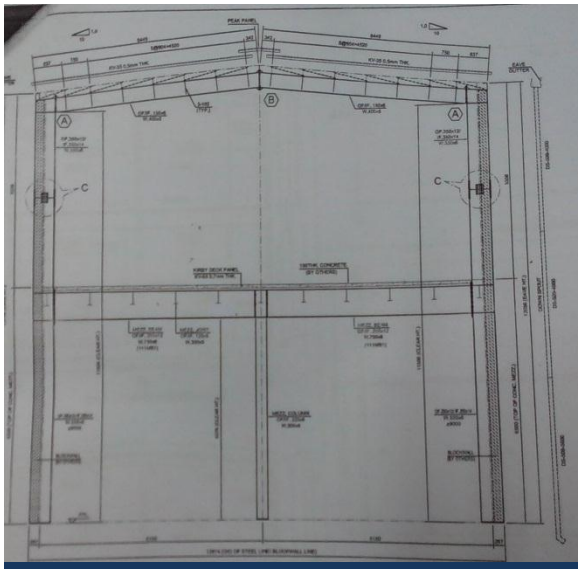
Structural System – Building 2

ACCORD on Fire and Building Safety in Bangladesh

ARUP



Floor Plan



Cross Section - Grid D

Structural System:

Building 3 is supported on piles & pile caps. Its superstructure has two parts (Part A & B), with steel portal frames in one direction and cross bracings in the perpendicular direction. The Ground Floor is a reinforced concrete slab on grade. The Level 1 suspended floor comprises a reinforced concrete slab on permanent formwork, over primary & secondary steel beams.

The building roof generally consists of metal roof sheeting over metal purlins, supported on rafters and trusses.

The structural system of the Roof at part B is not shown in the structural/permit drawings.

Structural System – Building 3

ACCORD on Fire and Building Safety in Bangladesh

ARUP

Primary structure seen at Ground Floor

Rafters to part A

Trusses to part B

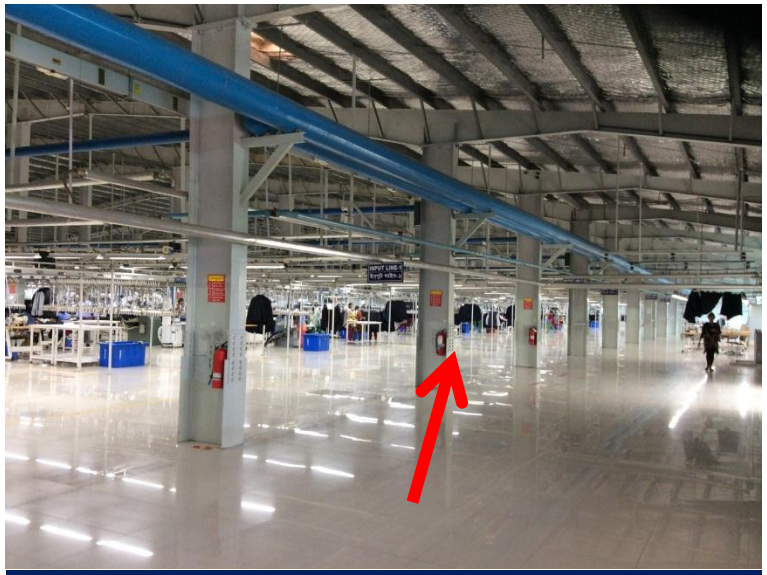
Truss supported on box section column, fabricated from individual sections

Structural System – Building 3

ACCORD on Fire and Building Safety in Bangladesh

ARUP

Observations – General



Building 1 – Factory floor

Building 3 – First Floor

- Generally, it appears fire protection to the primary steel structure of all inspected building has not been provided

Fire protection to the primary steel structure

ACCORD on Fire and Building Safety in Bangladesh ARUP

Observations – Building 1

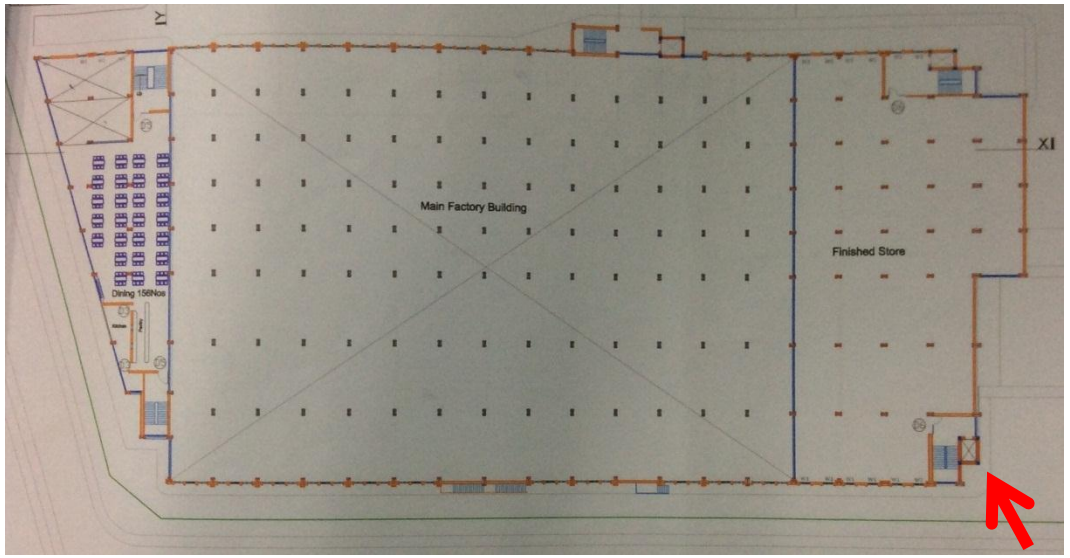
Garment Factory

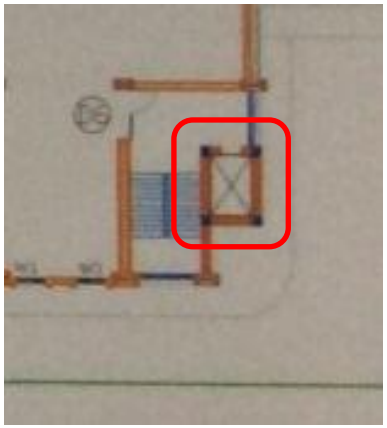
Example of modified cross bracing connection

Example of cross bracing omitted on account of door

- In a number of locations throughout Building 1, cross bracing elements were either missing, or had end connections which were cut, missing bolts or misaligned

Cross bracing elements missing or modified



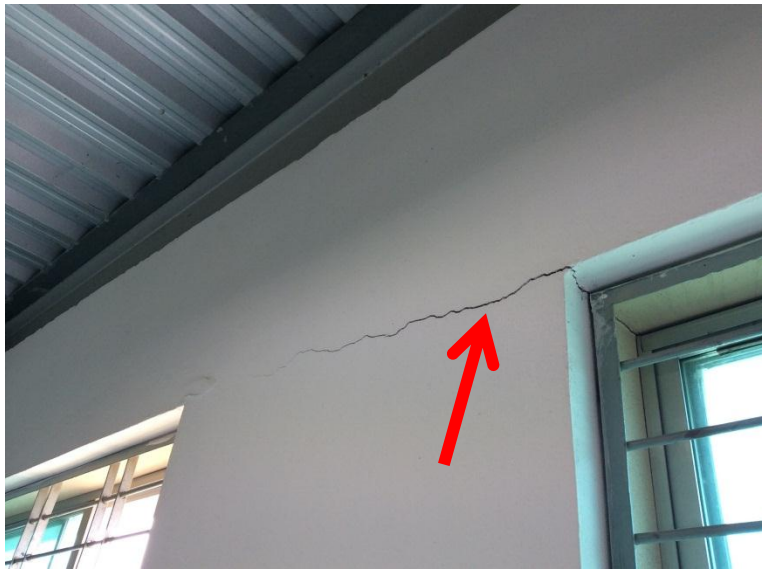


Lift core converted to storage

Lift core converted to storage at all building levels, using steel beams supporting RC floor slabs

ACCORD on Fire and Building Safety in Bangladesh ARUP

Examples of cracking to brick walls



Examples of cracking to brick walls

Cracking observed to brick perimeter walls

Observations – Building 2

Raw Materials

Loose wall cross bracing

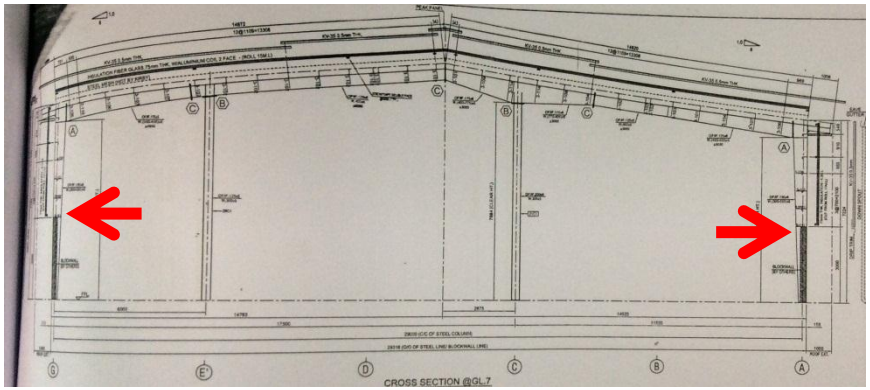
Loose wall cross bracing

Building wall cross-bracing is not tight

ACCORD on Fire and Building Safety in Bangladesh ARUP

As constructed, lateral support to tops of brick walls is not clearly defined

As constructed, lateral support to tops of brick walls is not clearly defined

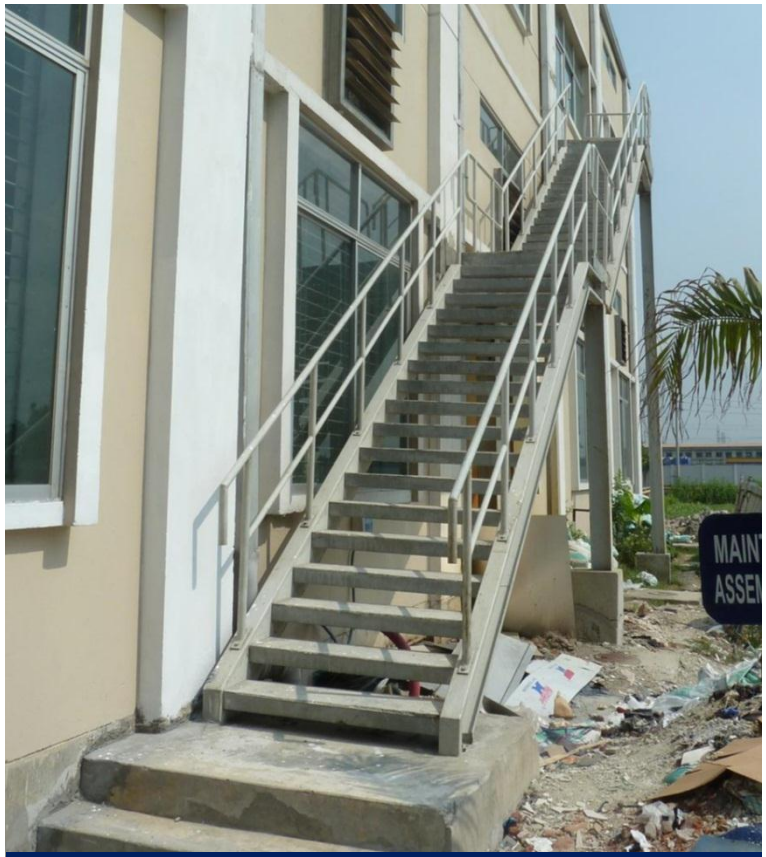


Unclear lateral support to tops of brick walls

ACCORD on Fire and Building Safety in Bangladesh ARUP

Observations – Building 3

Utilities



Settlement of ground beneath shallow footings to stairs

Failure of shallow footing to stairs

- Building footing system is piled, external stair footing system appears not to be piled
- Differential settlement and cracking of stair footings observed
- Subsequently, steel frames to stairs are deformed
- All external stairs to Buildings 1 and 3 are similarly affected

Footings to external stairs are settling

ACCORD on Fire and Building Safety in Bangladesh ARUP

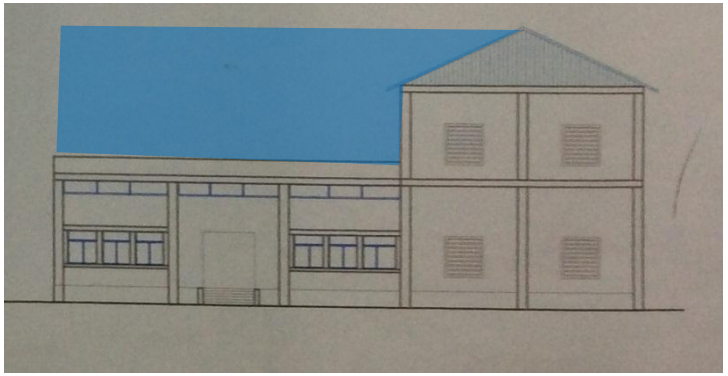
Temporary ties to restrain tank frame from toppling

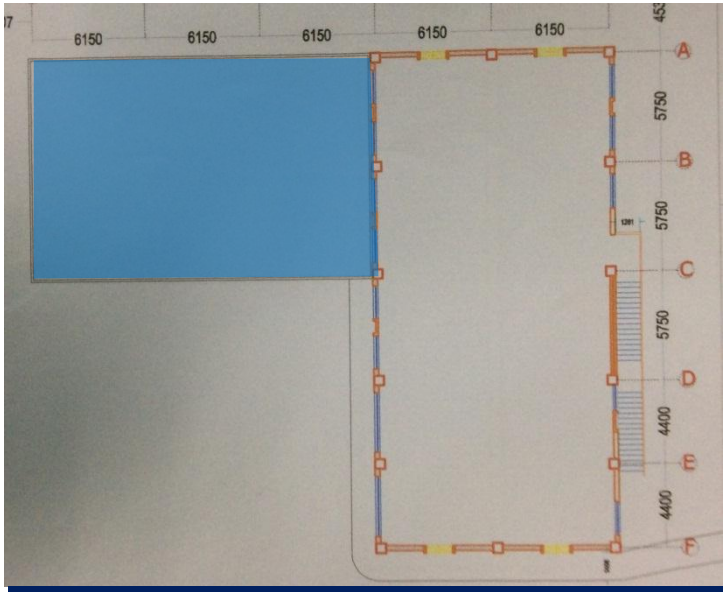
Shims used to support tank frame over settling ground floor slab

(A) Ground slab is settling unevenly, under weight of boiler and tank
(B) Shims have been installed beneath tank stand legs
(C) Steel ties have been installed, connecting tank frame to building primary frame

Water tank frame tilting from uneven settlement

ACCORD on Fire and Building Safety in Bangladesh ARUP



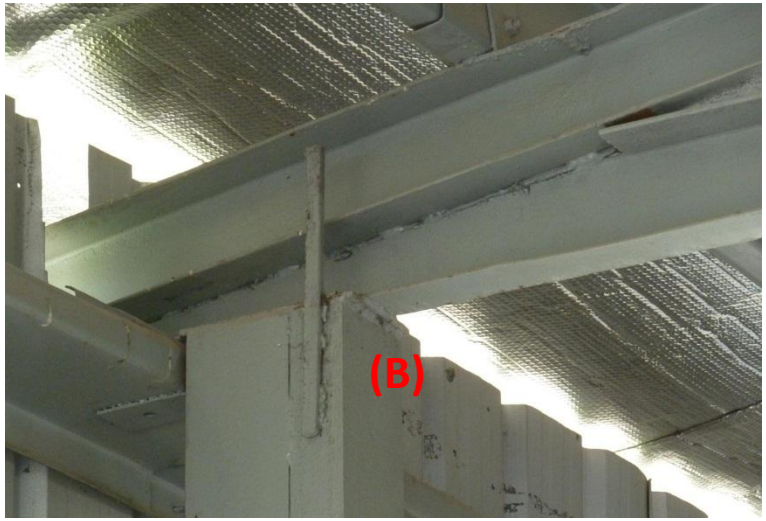


Additional roof over 1st floor

- An enclosed extension has been constructed over a portion the mezzanine floor
- Extension is not documented on permit drawings and engineering design drawings

Roof structure added beyond permit drawings

ACCORD on Fire and Building Safety in Bangladesh ARUP



(A) Lateral stability system to roof frame is not clearly defined – absence of roof cross bracing and wall cross bracing

(B) Unclear portal frame action, column-to-truss connection details appear non-engineered

(C) Purlin lateral torsional buckling observed

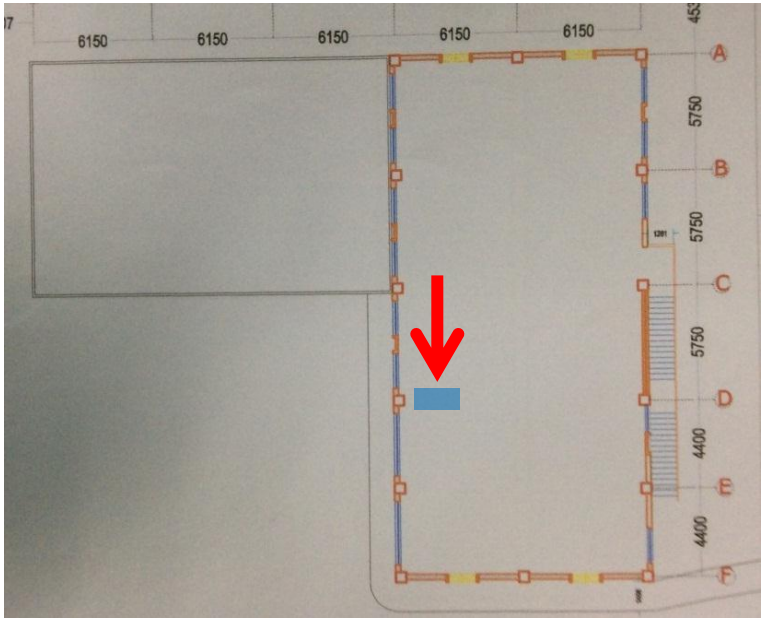
Roof structure added beyond permit drawings

ACCORD on Fire and Building Safety in Bangladesh ARUP

- Significant differential settlement and cracking of ground-bearing slab observed inside Building 3
- Piled foundation system to building superstructure appears unaffected
- Removal of slab was underway at time of inspection

Significant settlement of ground floor slab

ACCORD on Fire and Building Safety in Bangladesh ARUP



Approximate zone of investigation of cracking to mezzanine slab screed

- Local removal of screed over mezzanine floor slab was observed
- Screed removal was reportedly undertaken to check the extent of cracking in structural slab

Cracking to screed and repair attempts

ACCORD on Fire and Building Safety in Bangladesh ARUP

Priority Actions

Problems Observed
General

ITEM 1: Apparent lack of fire protection to the primary steel structure of all inspected buildings

Item 1 and actions

Apparent lack of fire protection to the primary steel structure of all inspected buildings

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• The requirement, if any, for fireproofing of primary steel structure to all buildings should be established by a Fire Engineering Specialist
Priority 3 (within 6-months)	• Fireproofing of steelwork should be installed in accordance with the Fire Engineering Specialist's requirements if required

Problems Observed

Building 1 (Garment Factory)

ITEM 1: Cross bracing elements missing or modified
ITEM 2: Lift core converted to storage
ITEM 3: Cracking observed to brick perimeter walls

Item 1 and actions

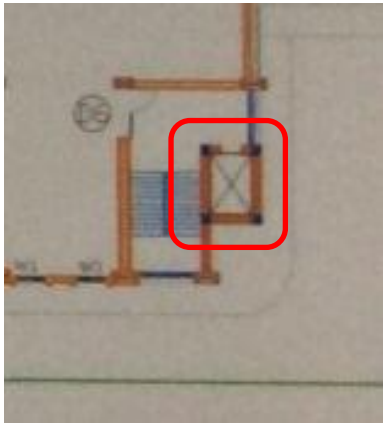
Cross bracing elements missing or modified

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building Engineer to assess the as-built bracing to BNBC and modify if required

Item 2 and actions

Lift core converted to storage

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building Engineer to assess the as-built construction to BNBC and modify if required • Building Engineer to carry out as-built survey of converted area and produce accurate complete as-built drawings



Item 3 and actions

Cracking observed to brick perimeter walls

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building engineer to record all cracking throughout factory compound and monitor on an on-going basis • If further cracking occurs Building Engineer to investigate and remediate as appropriate

Problems Observed

Building 2 (Raw Materials)

ITEM 1: Building wall cross-bracing is not tight
ITEM 2: Unclear lateral support to tops of brick walls

Item 1 and actions

Building wall cross-bracing is not tight

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building engineer to assess if the bracing in its current configuration achieves original design intent • Amend or adjust bracing if required

Item 2 and actions

Unclear lateral support to tops of brick walls

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building engineer to verify stability of brick walls according to BNBC and modify if necessary

Problems Observed
Building 3 (Utilities)

ITEM 1: Footings to external stairs are settling
ITEM 2: Water tank frame tilting from uneven settlement
ITEM 3: Roof structure added beyond permit drawings
ITEM 4: Significant settlement of ground floor slab
ITEM 5: Cracking to screed and repair attempts

Item 1 and actions

Footings to external stairs are settling

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• Building Engineer to assess safety of external stairs , and effects on main building structure • As appropriate, limit access and consider providing temporary propping system
Priority 3 (within 6-months)	• Building Engineer to implement a permanent solution to stairs footings settlement issue

Item 2 and actions

Water tank frame tilting from uneven settlement

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• Building Engineer to monitor uneven settlement • Building Engineer to assess effect of temporary ties on the permanent structure. Ties to be substituted by an alternative safe temporary system if deemed unsafe for the permanent structure
Priority 3 (within 6-months)	• Building Engineer to implement a permanent solution to slab settlement issue

Item 3 and actions

Roof structure added beyond permit drawings

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building engineer to prepare a set of as-built drawings for all structures linked to the factory's activities. Permit documentation and drawings also to be prepared • Building Engineer to assess stability of roof frame and capacity of connections under horizontal and vertical loading to BNBC and make all necessary alterations

Item 4 and actions

Significant settlement of ground floor slab

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building Engineer to continue providing a permanent solution to settlement issue

Item 5 and actions

Cracking to screed and repair attempts

Priority 1 (Immediate - Now)	• None required
Priority 2 (within 6-weeks)	• None required
Priority 3 (within 6-months)	• Building Engineer to consider local repairs to slab cracking

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.