Structural Inspection Report

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(23.794264N, 90.38766E)

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Executive summary

On 05th March 2014 Mr. Adrian Ryan and Mr. Cathal Mac an tSearraigh of Arup carried out a visual structural survey of the Cherry (Pvt) Ltd. factory at the address and coordinates given on the cover page of this report. We met with Mr. Md. Shahjahan Molla (Factory and Compliance Manager) and Mr. Humayun Kabir (Factory Director) and inspected accessible parts of the buildings.

The factory is located on one floor of the building (level 1). This 10 storey building over partial basement with an additional masonry and steel shed at roof level was constructed in phases and completed in 2004. Cherry Pvt have occupied the building since 2002. Other building occupants include Florence Fashion (Levels 10, 3, 4 & 5), Ultimate (Levels 7&8), Chandand Fashion (Level 6), and Joy Fashion (Level 2 & part of 1, Ground and Basement). There are multiple shop units at Level 0. Basement contains plant, dormitory, storage and weaving areas.

We were shown copies of
• Elevations and Plans approved by RAJUK (2000)
• A revised floor plan (Level 1) approved by Department of Customs and Commission on Rates (2001)
• A Soil Investigation reports dated April 2000 for the building.

Garment Factories inspected within the building generally consist of light factory spaces including offices, sewing, cutting, finishing, incoming and finished goods storage.
Executive Summary (Continued)

The information shown on the factory architectural layout plan provided is missing horizontal extensions to the building and does not reflect significant modification to the slab edge and column arrangements constructed at the South End of the building.

The soils report provides allows for use of either piled or isolated spread footings at the columns. No structural details for the foundation solution selected and partial basement were available for inspection.

**We do have some important concerns** that need to be addressed immediately, which give rise to our recommendation for **full evacuation of the building** and an immediate **Detail Engineering Assessment** (see actions below).

The principal reason for our concern is that columns appear to be stressed to levels that require immediate action and review. We would recommend that the Detail Engineering Assessment for this building be completed **within 6 weeks** of receiving the report.

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

- The addition of structures at roof level which use roof slabs as a transfer structures. This adds loading to highly stressed columns.
- Significant Horizontal extension of the building and signs of distress in same.
- Cracking of primary beams at a number of levels.
Executive Summary (Continued)

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
10 storey building with one basement (car park).

RAJUK approved drawings for a 10 storey building in February 2000.

Building completed in 2004.
Building Extents

- **10th Floor to Roof** – Florence Apparels Ltd.
- **9th Floor** – Ultimate Fashion Ltd.
- **8th to 7th Floor** – Chandan Fashion Ltd.
- **6th Floor** – Florence Apparels Ltd.
- **5th to 3rd Floor** – Florence Apparels Ltd.
- **2nd Floor** – Joy Fashion Ltd.
- **1st Floor** – Cherry Pvt. Ltd.
- **Ground Floor** – Retail / Market

Steel fabricated truss roof

Basement – Storage
Horizontal extensions to west face of building

River adjacent to west elevation
Concrete Frame
Prayer Room

Additional Canteen Area with Lightweight roof

Lightweight steel fabricated trussed roof supported by unreinforced brick walls

Vertical extensions to Building
Structural Systems
Main structure comprises R.C. beam and column frame with two way spanning R.C. slab.

Lightweight roof and masonry extensions at roof level.

Moment frame stability system.

10 storey building with one basement and 1 storey shed on top.

Max Observed Grid: 7.095 m x 5.790 m

Typical Internal Column: 530mm square

Down stand beam size: ≈410mm

Beam width: ≈320mm

Slab thickness: 155mm
Observations
Columns appear to be Highly Stressed
Columns appear to be highly stressed

Cursory calculations indicate column working stress is at high risk level. Floors to be evacuated as noted earlier

Engineer is to perform detailed calculations and concrete tests to prove column size and (if required):
- Reduce loads further by removing additional structures
- Reinforce columns
Vertical Extension
Vertical Extension Areas

Concrete Frame
Prayer Room

Additional Canteen Area with Lightweight roof

Lightweight steel fabricated trussed roof supported by unreinforced brick walls
Vertical Extension Areas
Horizontal Extension
Horizontal Extension
Horizontal extension on cantilever structure over river
Evidence of distress on cantilever e.g Façade Cracking
Typical Beams Carrying Increased Floor Areas
Typical Beams Carrying Increased Floor Areas

Column moved off Grid
Typical Beam size used as primary beam to support other floor beams
Cracking of beam evident

View A

Primary beam supporting secondary beams
Cracking of beam evident on a number of floors at both interface of beam and adjacent to column
Possible Foundation Settlement
Elevation of East Facade

- Basement under white painted structure
- No basement under freshly plastered section
- Cracking and step changes at ground floor
- Possible differential settlement of foundations

Foundation Settlement
View A: Approx. 400mm Step

View B
Differing Ground
Floor levels & Facade Render

Approx. Basement Extents
High Loading
High Loading

Loading on 9th Floor

6.3kPa

2.7kPa
Raised flooring in Toilet Blocks throughout building, up to a depth of 450mm

High loading on various floor plates
Particular concern on cantilever edges (+ façade load)

Sample of High Loading (Various Floors)
Priority Actions
Problems Observed

1. Columns appear to be highly stressed
2. Vertical extension on roof
3. Horizontal extension on west face
4. Typical Beams Carrying Increased Floor Areas
5. Foundation Settlement
6. High Loads
# Item 1 and actions

Highly stressed columns

<table>
<thead>
<tr>
<th>Priority 1</th>
<th>Priority 2</th>
<th>Priority 3</th>
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<tbody>
<tr>
<td><strong>(Immediate - Now)</strong></td>
<td><strong>(within 6-weeks)</strong></td>
<td><strong>(within 6-months)</strong></td>
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</table>
| • Remove all live loading from all floors  
  • A Detail Engineering Assessment of Factory to be commenced, see attached scope  
  • Verify insitu concrete stresses either by cores or existing cylinder strength data for columns or cores from 4 non-critical columns. | • Detail Engineering Assessment to be completed  
  • Provide calculations showing the structural adequacy of all columns, taking into account the loading plans and all built structure including additions beyond the original design. Provide concrete strength tests.  
  • Produce and actively manage a loading plan for all floor plates within the factory giving consideration to outcome of DEA. | • Carry out strengthening as required.  
  • Continue to implement load plan |
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. This 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

Undocumented vertical extension to roof area

<table>
<thead>
<tr>
<th>Priority 1</th>
<th>See Item 1</th>
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<table>
<thead>
<tr>
<th>Priority 2</th>
<th>Detailed Engineering Assessment to be completed as per Item 1</th>
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<tr>
<td>(within 6-weeks)</td>
<td>Create controlled loading plans for all floors, designating where storage can be placed and can not be placed.</td>
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<tr>
<th>Priority 3</th>
<th>Carry out strengthening as required.</th>
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<tr>
<td>(within 6-months)</td>
<td>Continue to implement load plan.</td>
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<tr>
<td></td>
<td>Building engineer to check, collect information and produce accurate and complete as-built documentation soonest.</td>
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</tbody>
</table>
Item 3 and actions

Undocumented horizontal extension on west face of building

**Priority 1**
(Immediate - Now)

- See Item 1

**Priority 2**
(within 6-weeks)

- Detailed Engineering Assessment to be completed as per Item 1
- Create controlled loading plans for all floors, designating where storage can be placed and can not be placed.

**Priority 3**
(within 6-months)

- Carry out strengthening as required.
- Continue to implement load plan.
- Building engineer to check, collect information and produce accurate and complete as-built documentation soonest.
Item 4 and actions
Typical Beams Carrying Increased Floor Areas

Priority 1
(Immediate - Now)
• See Item 1 above.

Priority 2
(within 6-weeks)
• Detailed Engineering Assessment to be completed
• Sections of plaster finish to beams to be removed to investigate if cracks penetrate to the structural beams.
• **Provide calculations showing the structural adequacy of typical beams supporting other beams**, taking into account the loading plans and all built structure including additions beyond the original design. Provide concrete strength tests for beams.

Priority 3
(within 6-months)
• Building Engineer to prepare Allowable Floor Loading Plans.
Item 5 and actions

Differential settlement of foundation

Priority 1
(Immediate - Now)

• None required.

Priority 2
(within 6-weeks)

• Detailed Engineering Assessment already instructed to be carried as per item 1. As part of this, confirm if building is founded on pads or piled foundations. Ensure building information is updated to reflect as-built.
• Building Engineer to confirm by calculations and records of site construction that foundation bearing is adequate.
• Building Engineer to verify integrity built structure under factory design loading.

Priority 3
(within 6-months)

• Monitor the differential movements of the cracks in the joint between basement and ground, to insure structural integrity of the structure.
# Item 6 and actions

High loads observed at various locations throughout building, particularly in cantilever areas and storage areas.

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</table>

- See Item 1 actions.

- Detailed Engineering Assessment to be completed as per item 1
- Create controlled loading plans for all floors designating where storage can be placed and can not be placed.

- Carry out strengthening as required.
- Continue to implement load plan.
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.