Montex Fabrics Ltd

Nayapara, Kashimpur, Gazipur, Dhaka, Bangladesh.
(23.98935, 90.31814)
03 & 26 February & 16 March 2020

Category Amber

DEA

Structural Inspection Report

Observations & Actions

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Reviewed by Md. Moshiur Rahman and Maruf Zindanee
Approved by Mohammed Shafiq Uddin

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Executive Summary

On 03 & 26 February & 16 March 2020 Maruf Zindanee, Md. Kamruzzaman Mahfuz, Sourav Datta, Md Latifur Rahman Siddique, Md. Niamul Islam of **Stichting Bangladesh ACCORD Foundation** carried out a visual structural survey of **Montex Fabrics Ltd.** at the address and coordinates given on the cover page of this report.

We met with Mr. Mohammad Shameem Ahmed (Head of HR Admin & Compliance), Mr. Suman Roy (Asst. Manager-Civil) , Engr. Muhammad Ali (Sr. Manager Maintenance) and many more.

Montex Fabrics Ltd. comprise of nine structures: Building 1, Building 1 extension, Service Utility, Security Building, Garments Building, Building 7, Building 7A, Building 9, Boiler Building. All the structures are owned by **Montex Fabrics Ltd.** We were allowed access & inspected all the areas of the buildings mentioned above.

Building 1 is a six storied (G+5) reinforced concrete structure including a mezzanine floor on ground floor. This building is being used for both light garments manufacturing and storage including dyeing, finishing, warehouse, office, sewing, inspection room. At rooftop there was a reinforced concrete water tank. This building has been constructed between August 2007 to August 2009. The Production has been started from December 2009.

Building 1-extension is a seven storied (G+6) reinforced concrete structure including a mezzanine floor on ground floor. This building is being used for light garments manufacturing including office, sample, sewing, Idle machine, prayer room. This building has been constructed between April 2013 to May 2016. The Production has been started from June 2016.

The Building 1 and Building 1-extension is separated by an expansion joint. These buildings are accessible in floors.

Executive Summary (Continued)

Building 2- Service Utility is a four storied (G+3) reinforced concrete structure. The building is being used for utility purpose including generator, compressor & dinning. The building has been constructed between August 2013 to end of 2016 and occupied from early of 2017.

Building 4- Security Building is a five storied (G+4) reinforced concrete structure. The building is being used for both utility & storage purpose including accessories store, maintenance store, security rest room & dinning. At rooftop, there is a water tank. The building has been constructed between April 2013 to April 2014.

Building 6- Garments Building is a six storied (B+G+5) reinforced concrete building with a basement floor. The building is being used for both light garments manufacturing and storage purpose including dyeing, chemical store, finishing, sewing storage and training room. At rooftop, there was RCC water tank. This building has been constructed between July 2007 to end of 2009. The Production has been started from end of 2009. A Detail Engineering Assessment has been carried out for this building which was accepted from RCC. Retrofitting works were on going at the time of inspection.

Building 7 is a six storied (G+5) reinforced concrete building which is divided into two parts by an expansion joint. The building is being used for light garments manufacturing including dyeing and ETP at ground floor level. Details of floor used has been shown in building extent section. There is a connecting bridge at 4th floor level of south part of Building-7 with another building. The building has been constructed in between 2007 to 2008. A Detail Engineering Assessment has been carried out for this building which was accepted from RCC. Retrofitting works were on going at the time of inspection.

Executive Summary (Continued)

Building 7A is three storied (B+G+2) reinforced concrete building with a basement floor. There is a mezzanine floor in ground floor. This building is being used for utility purpose including Fire Pump room, Fire control room, WTP, Workshop, office, prayer, store. This building has been constructed between 2013 to 2014 and occupied from 2014.

Building 9 is two storied (G+1) steel building. There is a mezzanine on ground floor. This building is also used for utility purpose including generator, air filter, panel room, boiler at roof there was generator cooler. The building has been constructed between August 2013 to end of 2016 and occupied from early of 2017.

Building 10 is single storied steel building using for boiler & utility purpose.

During the inspection, we were provided with the following documents for review :

- A permit layout drawing for Building 1, Building 1-Extension and Building 6 approved by LGED Gazipur, dated 14/03/2007, 22/04/2013 & 19/07/2009 respectively.
- A permit layout approved by Department of Inspection for Factories and Establishments (DIFE) for Building 1, Building 1-Extension and Building 6 dated 24/03/2014 & 09/08/2015.
- A set of structural drawings, architectural drawings and load plans for all the buildings. 2 kPa Live load considered on most of the buildings.
- Geotechnical investigation reports for Building 1, 1-extension, 7, 7A prepared by "Geoscape" dated November-December 2019. For Building 2 & 6 geotechnical investigation report prepared by "RCC lab" dated February-April 2018 and for Building 9 report prepared by "Survey 2000" dated August 2014.

Executive Summary (Continued)

- Detailed Engineering Assessment (DEA) report for Building 1, 1-Extension, Building 4, Building 6, Building 7A & Building 9. Human Properties Ltd prepared DEA for Building 1, 1-extension, 7A. Desinscape Ltd prepared DEA for Building 6, 7.
- Design report for Building 2 & 4 prepared by Designscape. Design report of building 9 prepared by Origin Engineering
- Concrete core test report for Building 7 (sample from column, beam & slab), Building 4 (sample from column, beam & slab), Building 1 (sample from grade beam) & Building 6 (Sample from column, beam & slab).
- Concrete cylinder test report for Building 9.
- Tensile test report of Rebar for Building 1, 1-extension, 2, 4, 6, 7 & 9.

We have checked the column capacity considering the prepared live load (mentioned in the design reports) and the observed strength of concrete based on aggregate type and provided test report.

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

Building 1:

Item 1: High stress levels in columns that require immediate review
Item 2: Recommendation of DEA report.
Item 3: Crack on beam column Joint.
Item 4: Spalling of concrete at 3rd floor toilet area.

Building 1-extension:

Item 5: Review of the DEA report.

Executive Summary (Continued)

Building 4:
Item 6: Damaged beam & column.
Item 7: Discrepancies in as-built drawings.
B**uilding 6:**
Item 8: High stress levels in columns that require immediate review.
Item 9: Overloading on floor.
Building 7:
Item-10: Mismatches in the drawing and missing core cutting location.
Item-11: Non-engineered shed at roof.
Building 7A:
Item 12: Columns to be stressed above normal design limits.
Item 13: Discrepancies between as built drawing and onsite condition.
Item 14: Non-engineered Rooftop Shed.
Item 15: Damaged column.
Building 9:
Item 16: Bolt missing in connection.
Item 17: Irregular bracing system.

We see no reason to suspend operations in the Building due to structural concerns (subject to the required immediate actions noted in this report).
However, we have important and urgent concerns in relation to the adequacy of structural elements in this factory. Preliminary calculations suggest that column stresses in Building 1 & 6 are high.

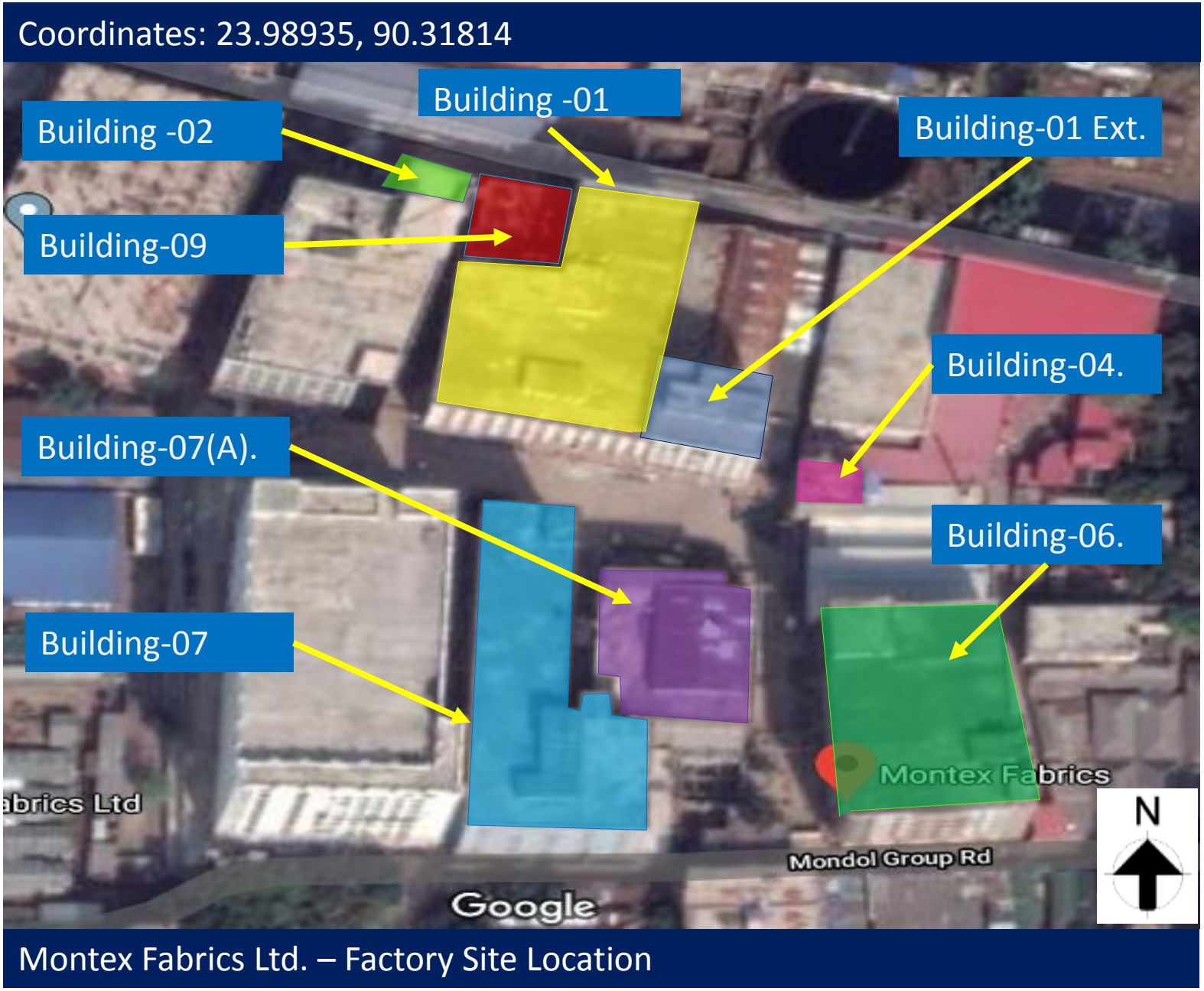
Executive Summary (Continued)

Further actions with associated priorities and time frames 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 time frame noted.

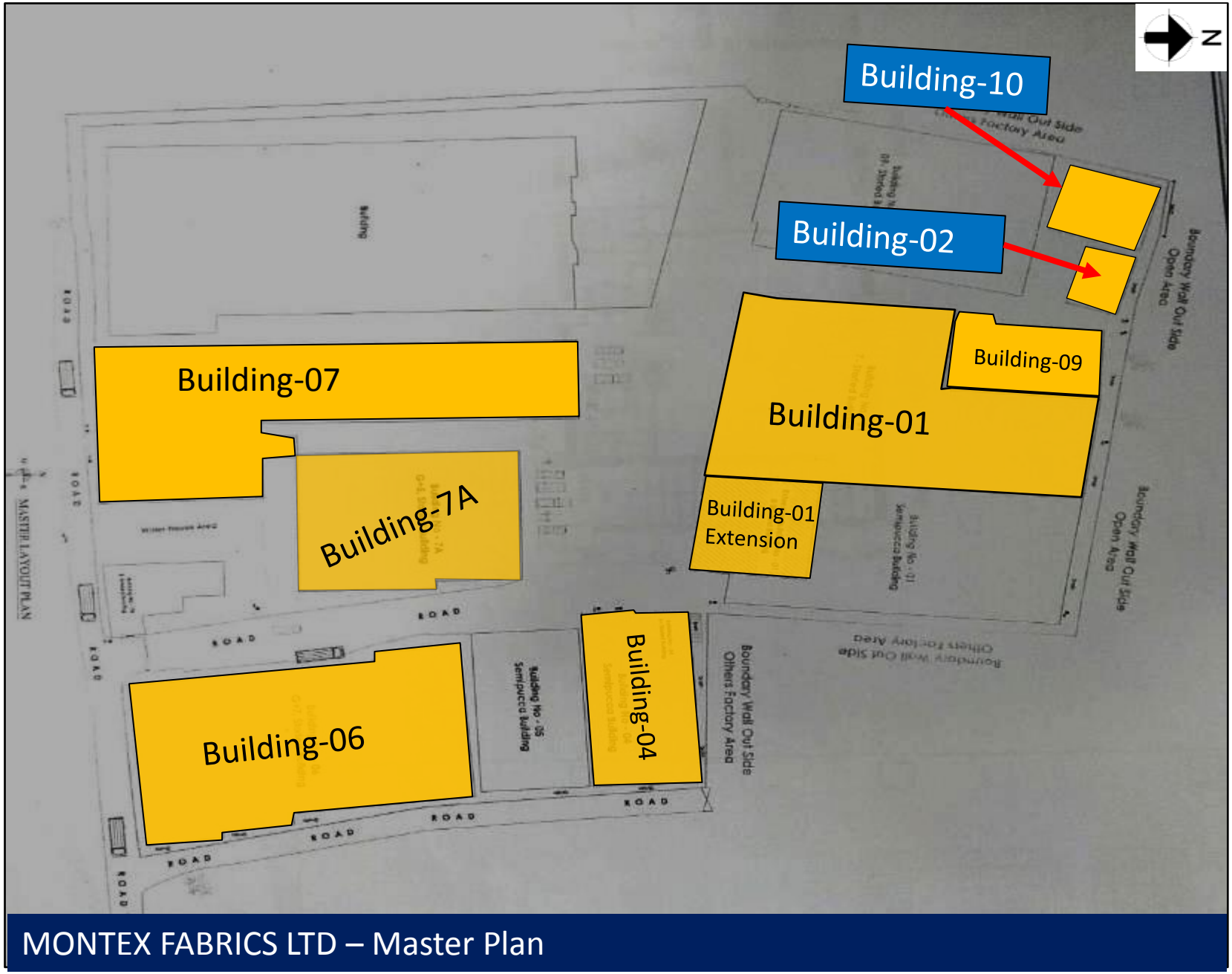
We have reviewed the property from an outline seismic perspective and would consider that the building, along with many others in the Dhaka region, to be at significant risk in a major Seismic event.

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

Building Extents

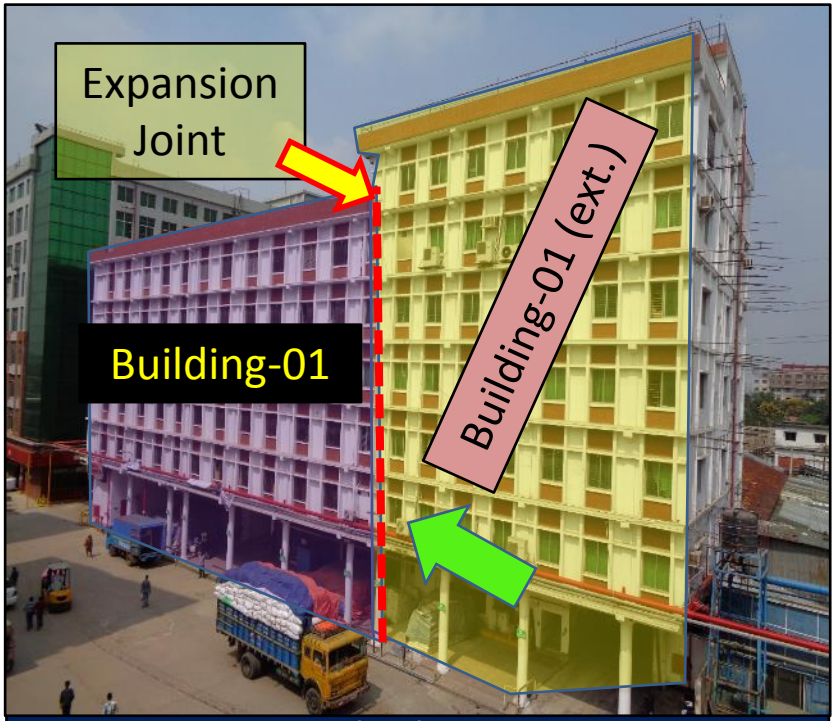


Building Extents



MONTEX FABRICS LTD – Master Plan

Building Extents



South Elevation

East Elevation

Building Extents – Building-01 & Building-01 (Extension)

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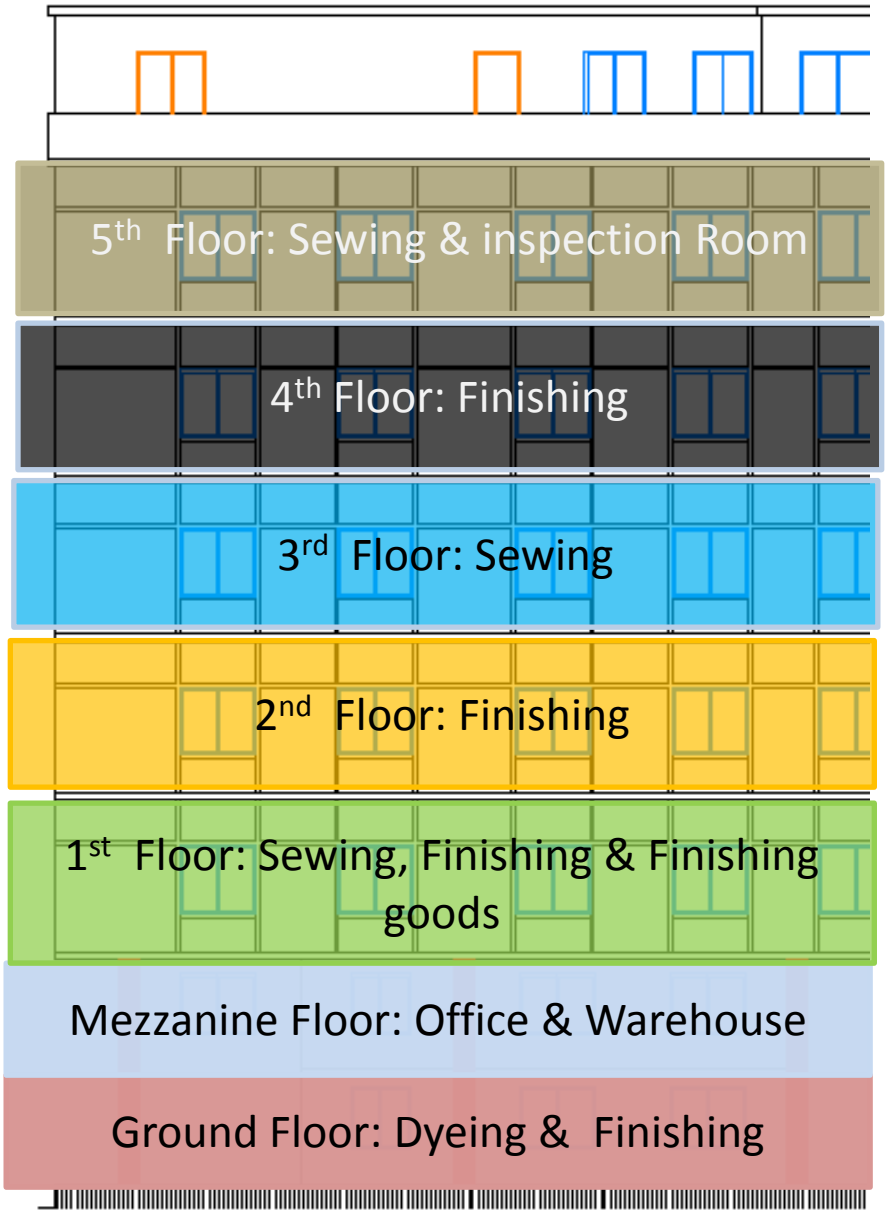
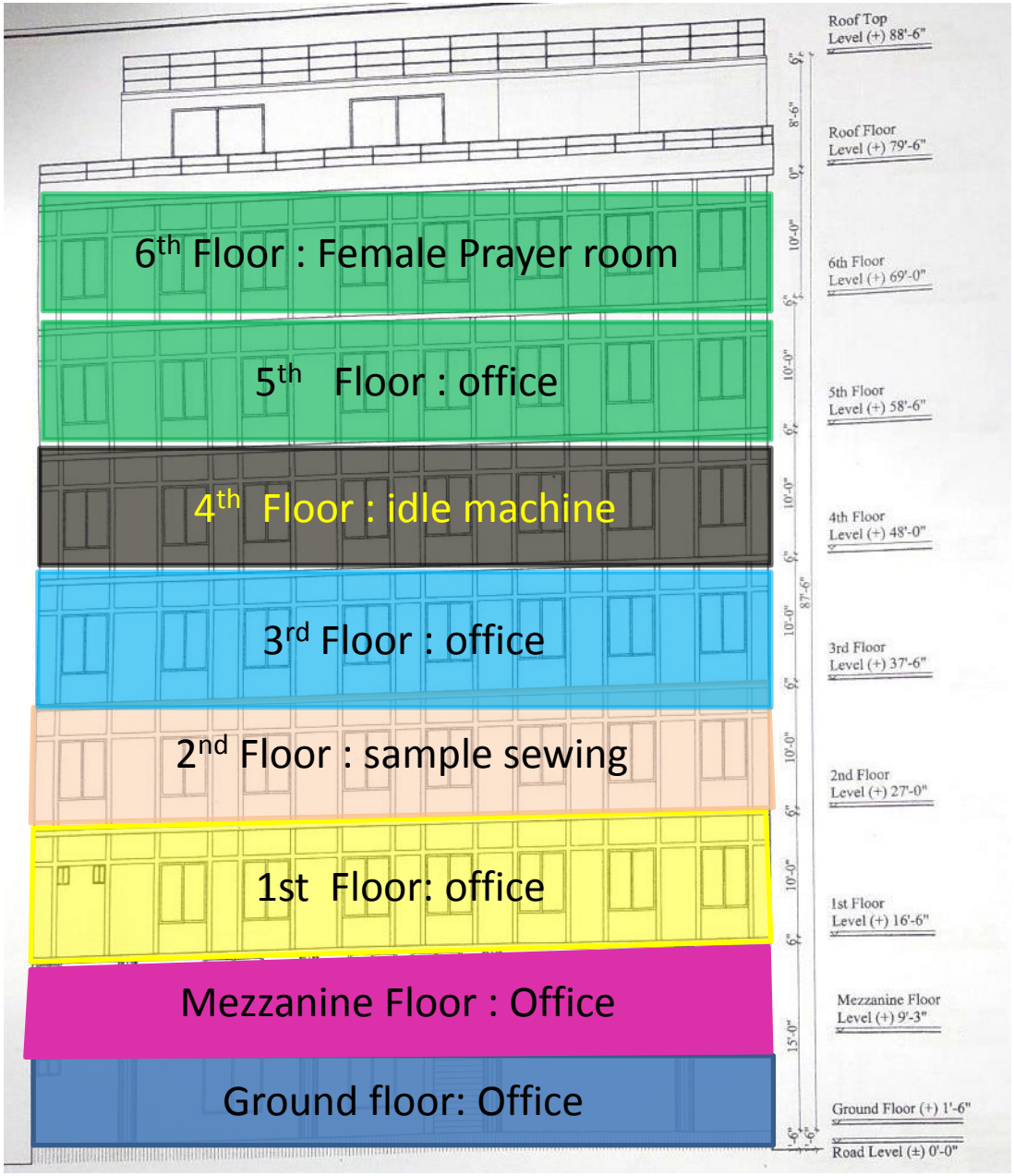


Building Extents – Building-01



Building Extents –Building-01 (Extension)

South & East Elevation

South Elevation

Building Extents: Building 2

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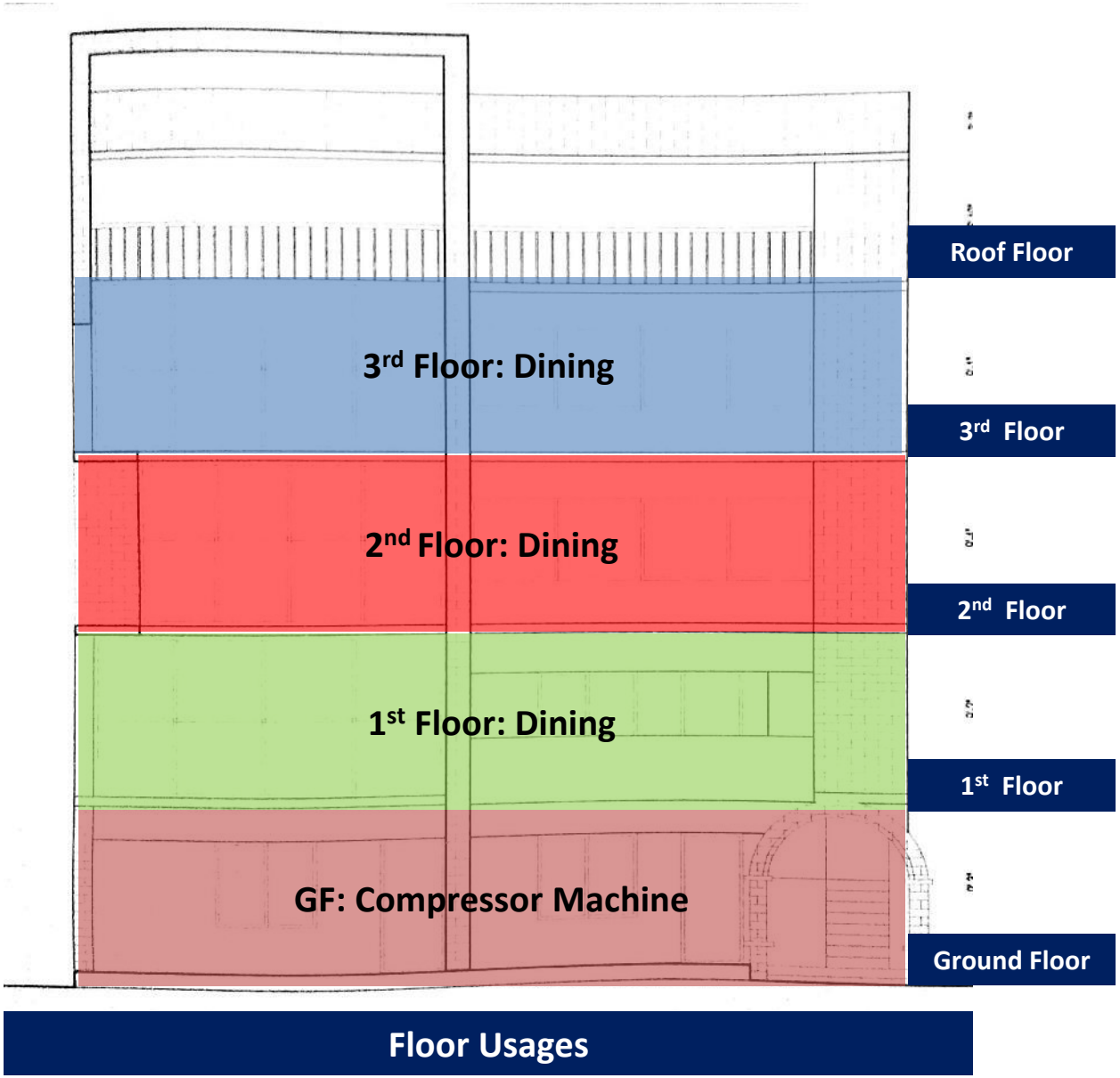

Building Extents: Building 2

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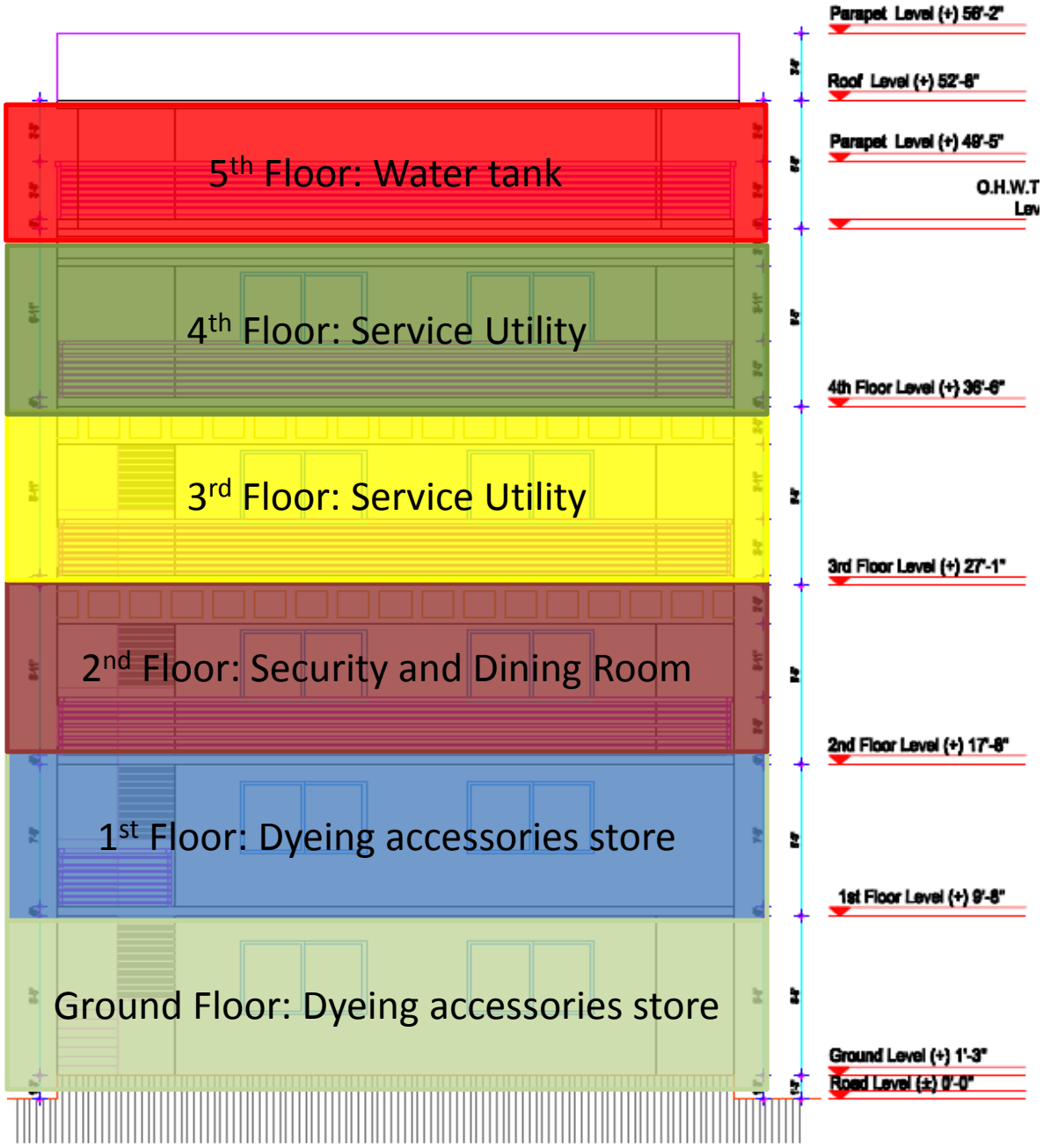
East Elevation

North Elevation

Building Extents- Building-04



Building Extents- Building-04

South Elevation

West Elevation

Building Extents – Building-06

Building Extents- Building 06

South Elevation

East Elevation

Building Extents: Building-7 (Part-1)

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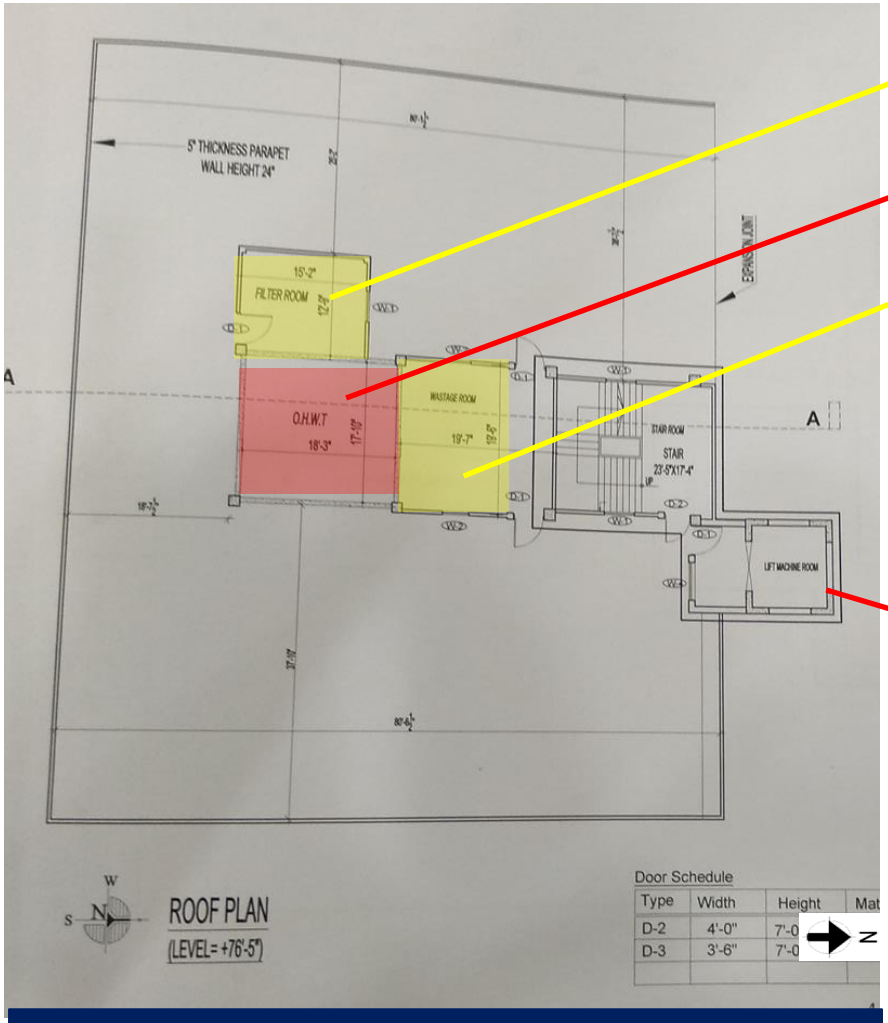

Roof Layout Plan

RC Water Tank & Temporary shed

Lift, Stair core & shed

Building Extents: Building-7 (Part-1)

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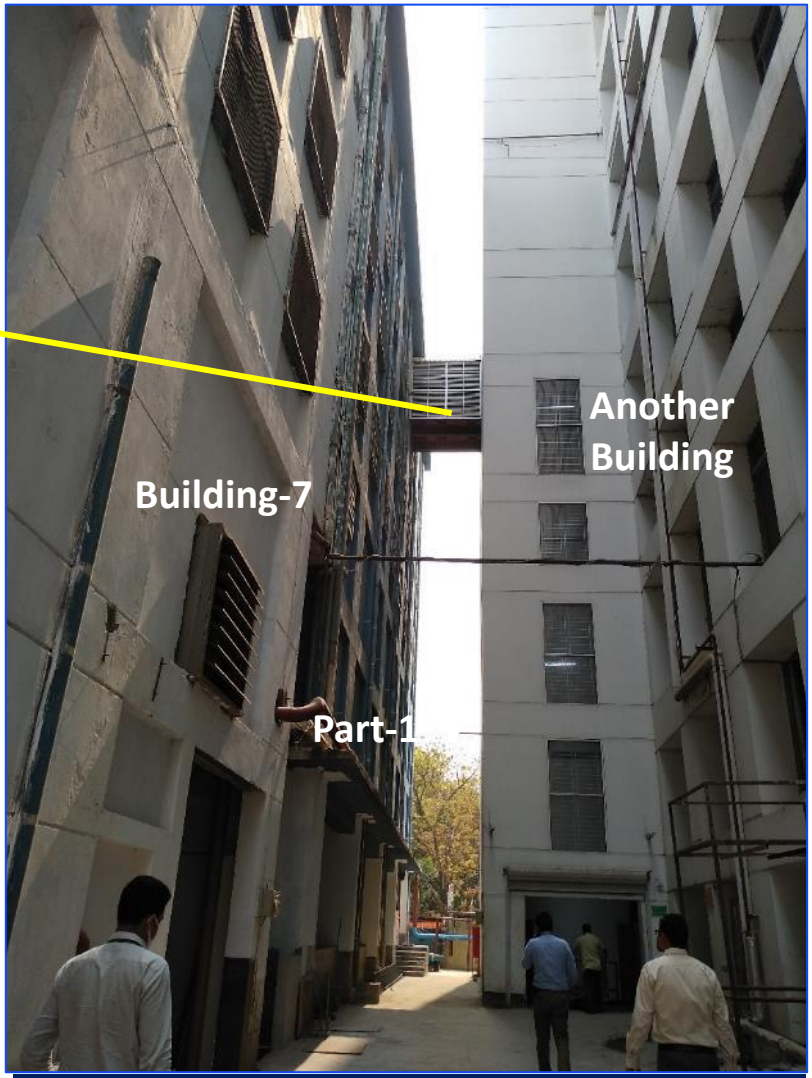
Connection Bridge

Connection Bridge



Connection Bridge

Building Extents: Building-7 (Part-1)

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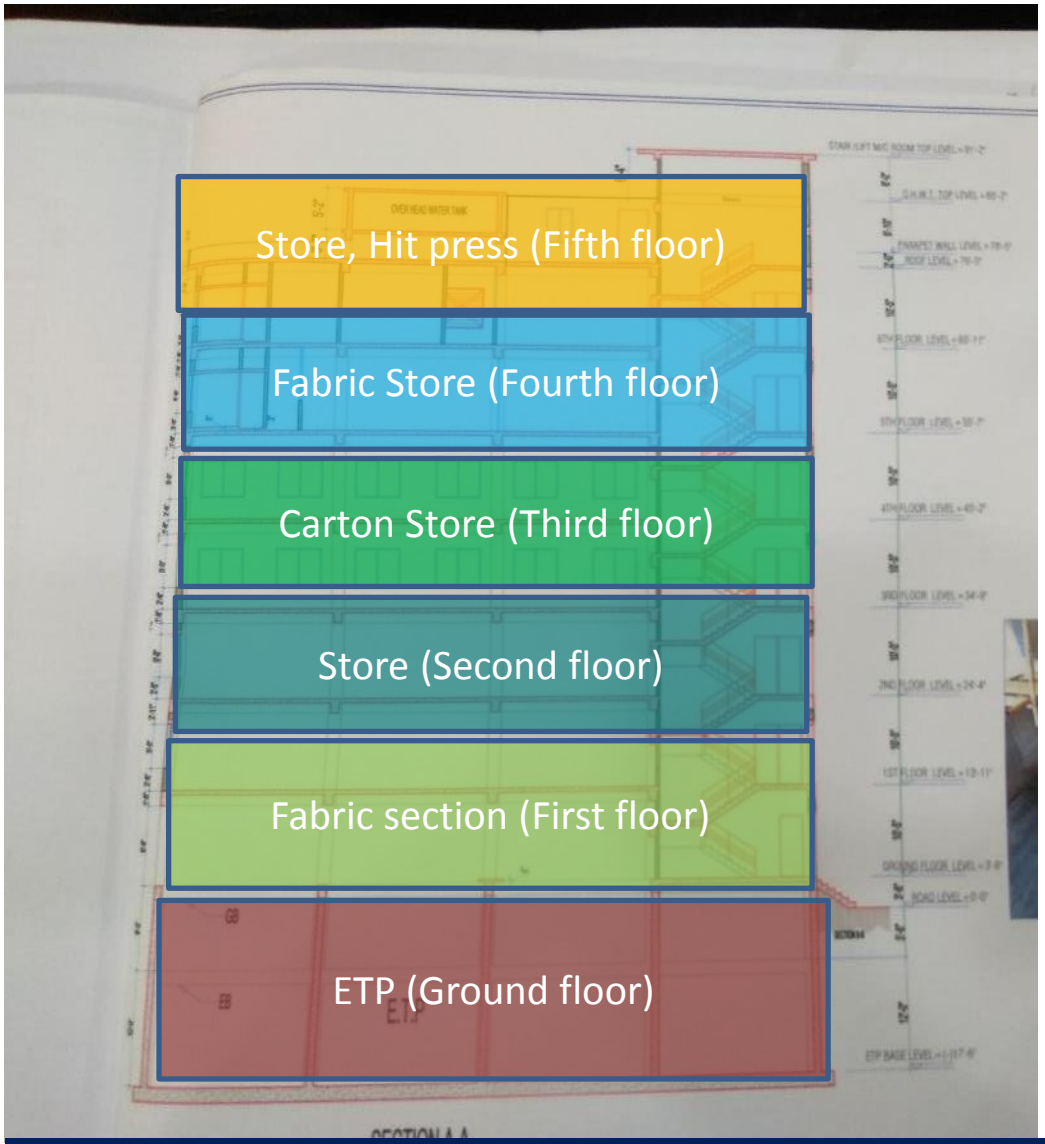
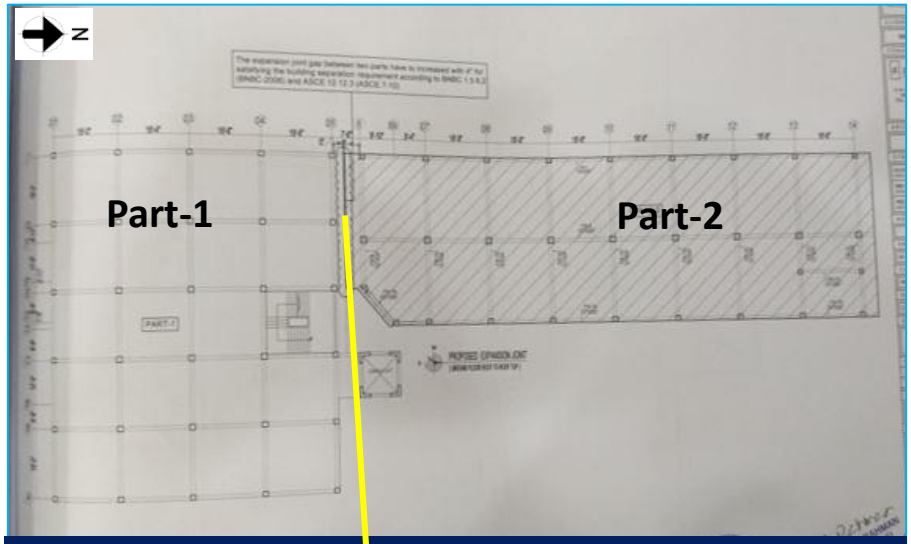


Floor Usages

Building Extents: Building-7 (Part-1)



Layout

Movement Joint

Movement Joint

Building Extents: Building-7

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East & North Elevation

North & West Elevation

Building Extents: Building-7 (Part-2)

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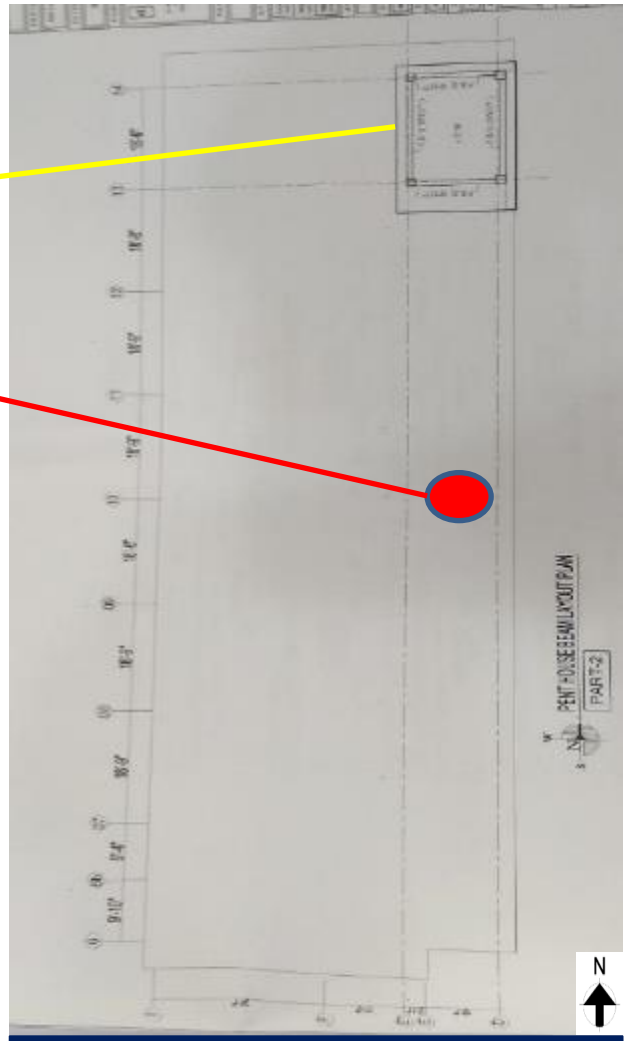
Stair Core and Plastic Water Tank

2,000 liters

Plastic Water Tank



Roof Layout Plan

Building Extents: Building-7 (Part-2)

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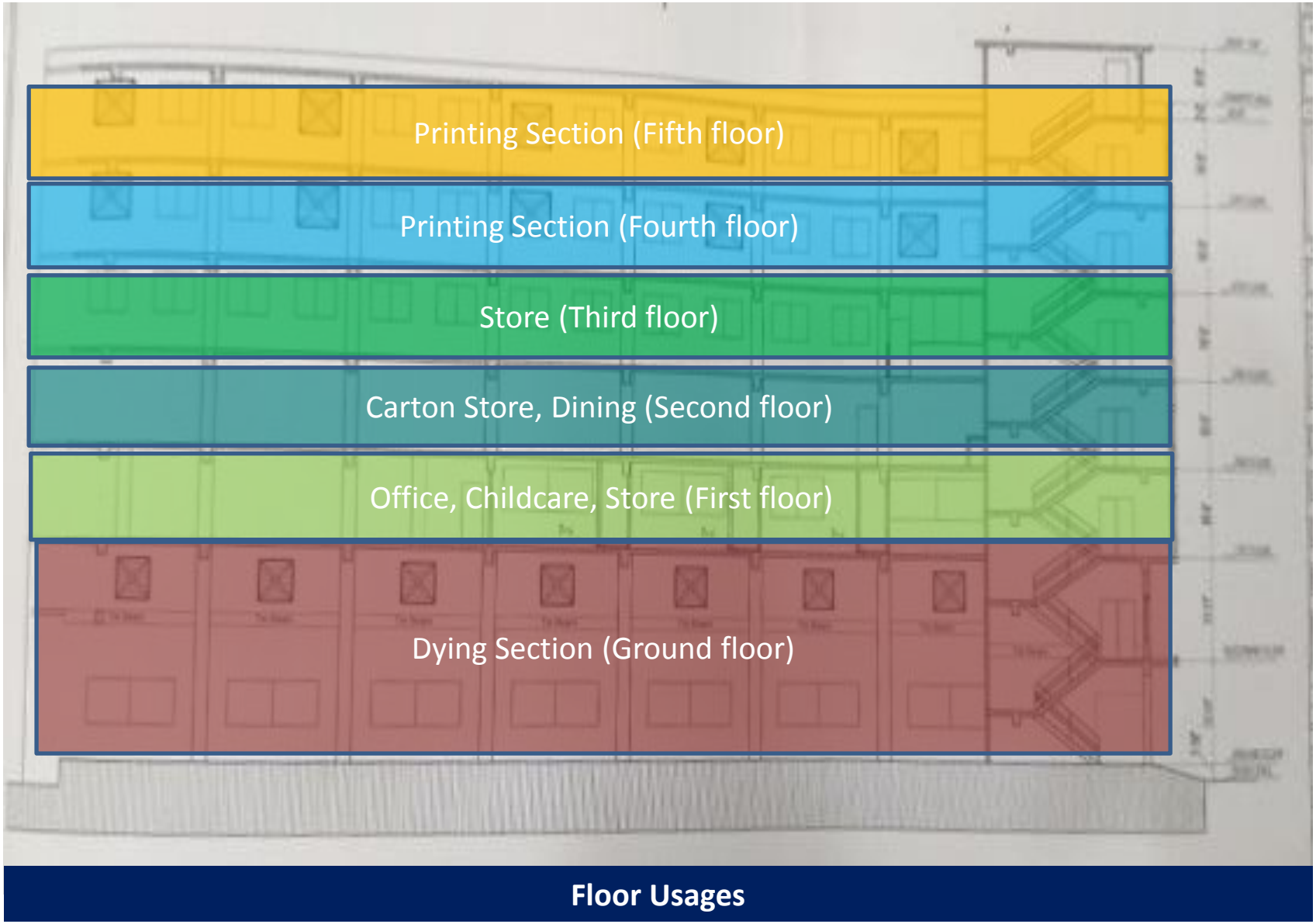

Floor Usages

Building Extents: Building-7 (Part-2)

South and East Elevation

East and North Elevation

Building Extents: Building 7A

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North Elevation

East Elevation

West Elevation

Building Extents: Building 7A

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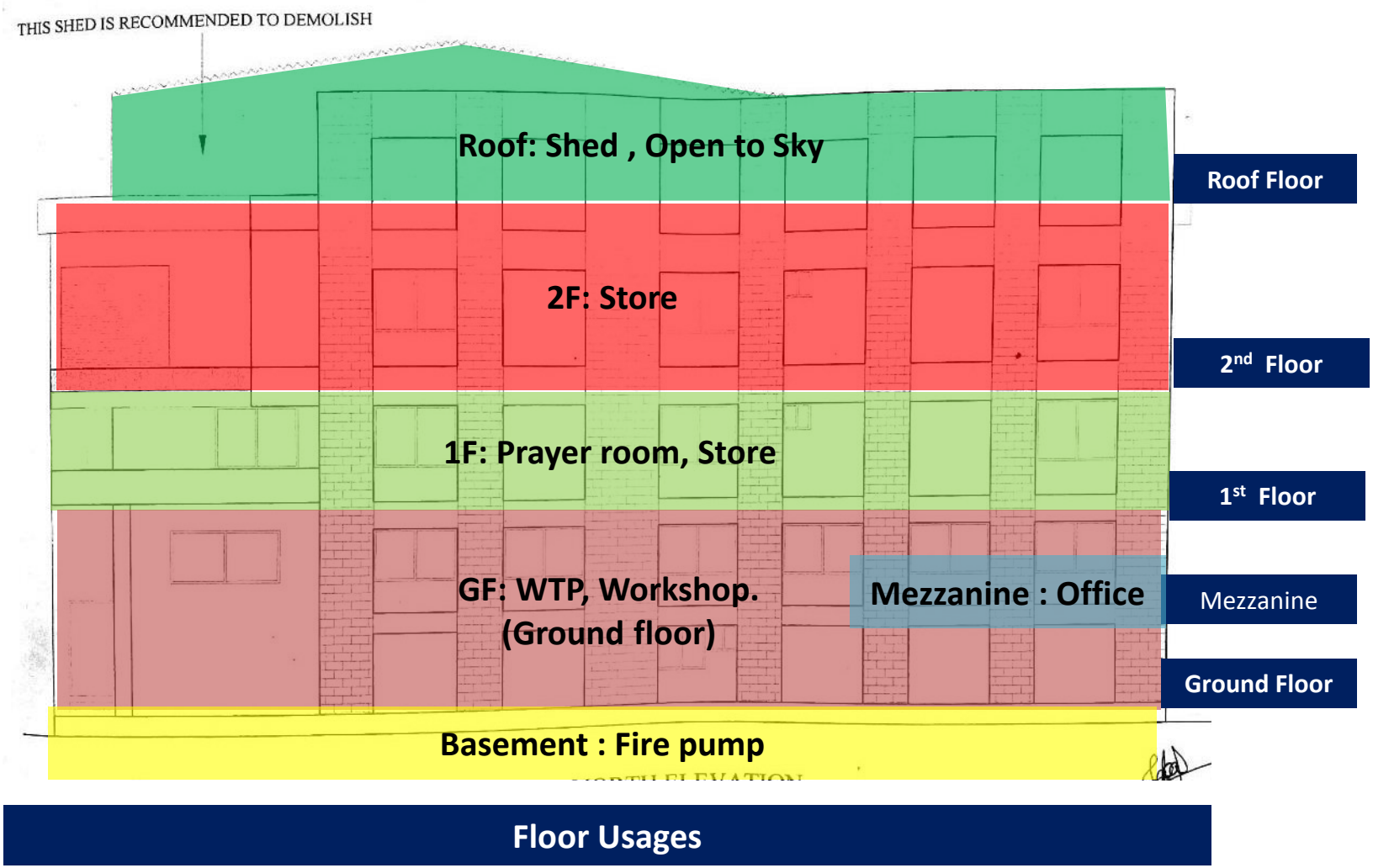

Building Extents: Building 7A

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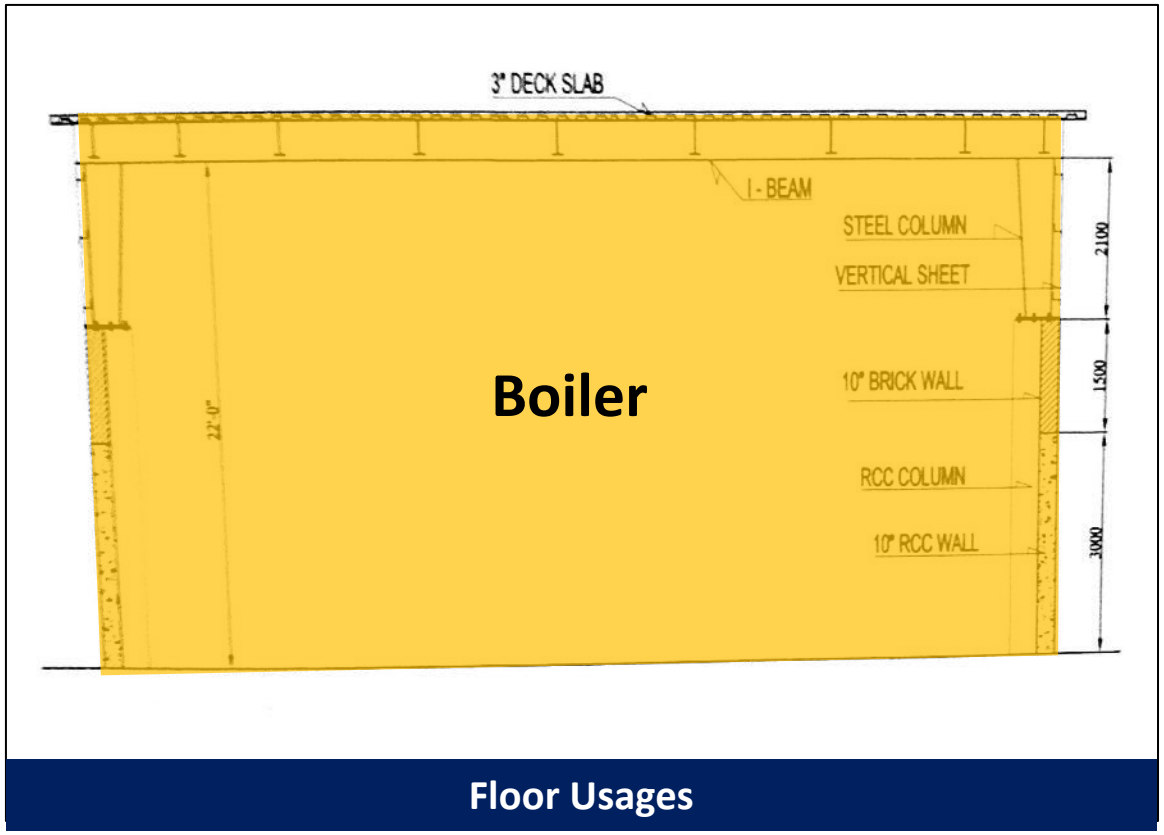
East Elevation

East Elevation

Building Extents- Building-09

South & East Elevation

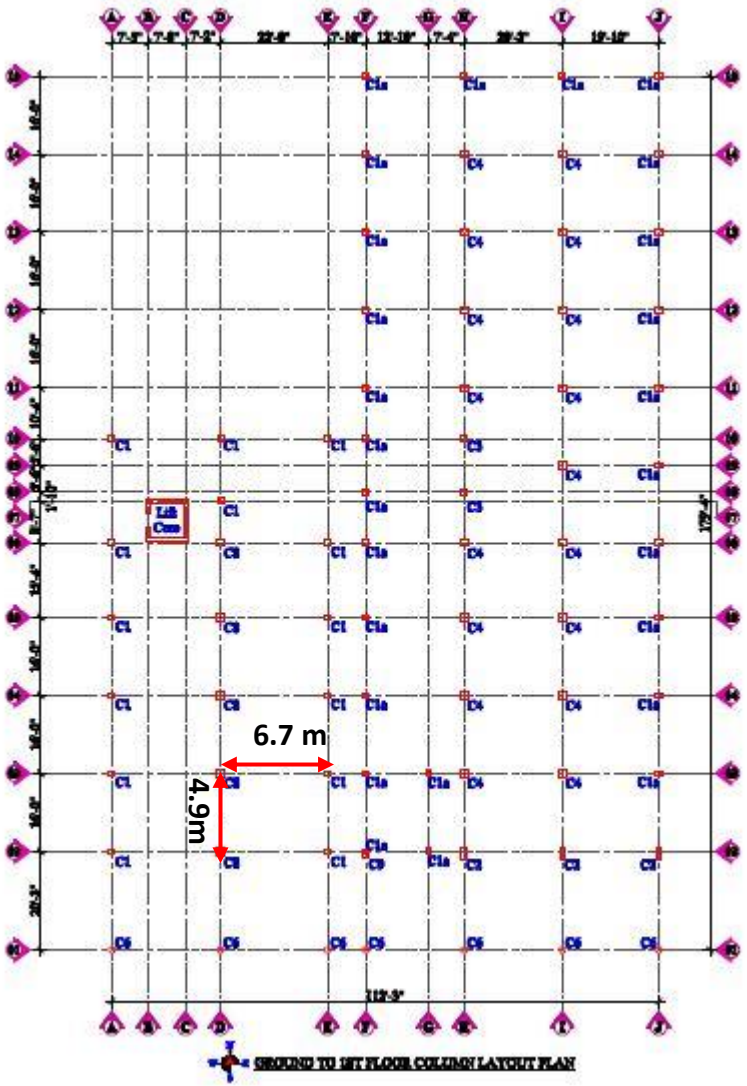
Building Extents: Building 10



Floor Usages

Building Extents: Building 10

Structural System



Column Layout Plan

Framing System:
RC beam and column framing system with two way spanning slab.

Stability System:
Moment resisting frame.

Maximum Grid: As shown in figure.

Column sizes (Varies):
300 mm X 375 mm
450 mm X 450 mm
Circular 400 mm diameter

Beam Size (Typical):
Longitudinal & Transverse-
250 mm (w) x 300 mm (d/s)

Slab thickness:
150 mm (excluding finishes)

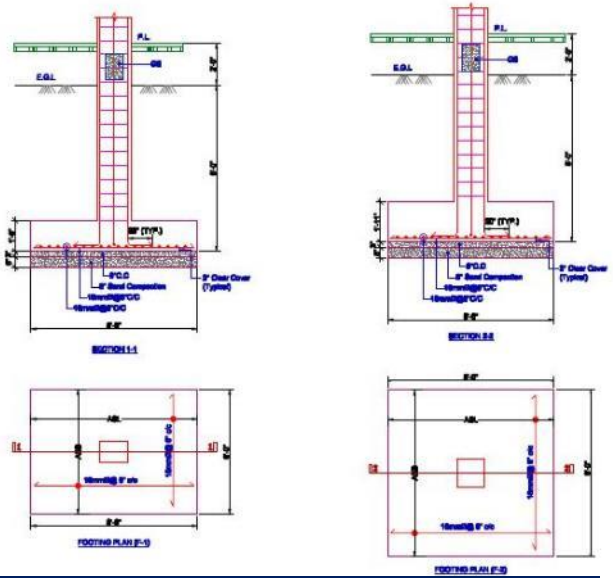
Aggregate Type: Stone Chips.

Floor to Ceiling Height:
3.33 m (Avg.)

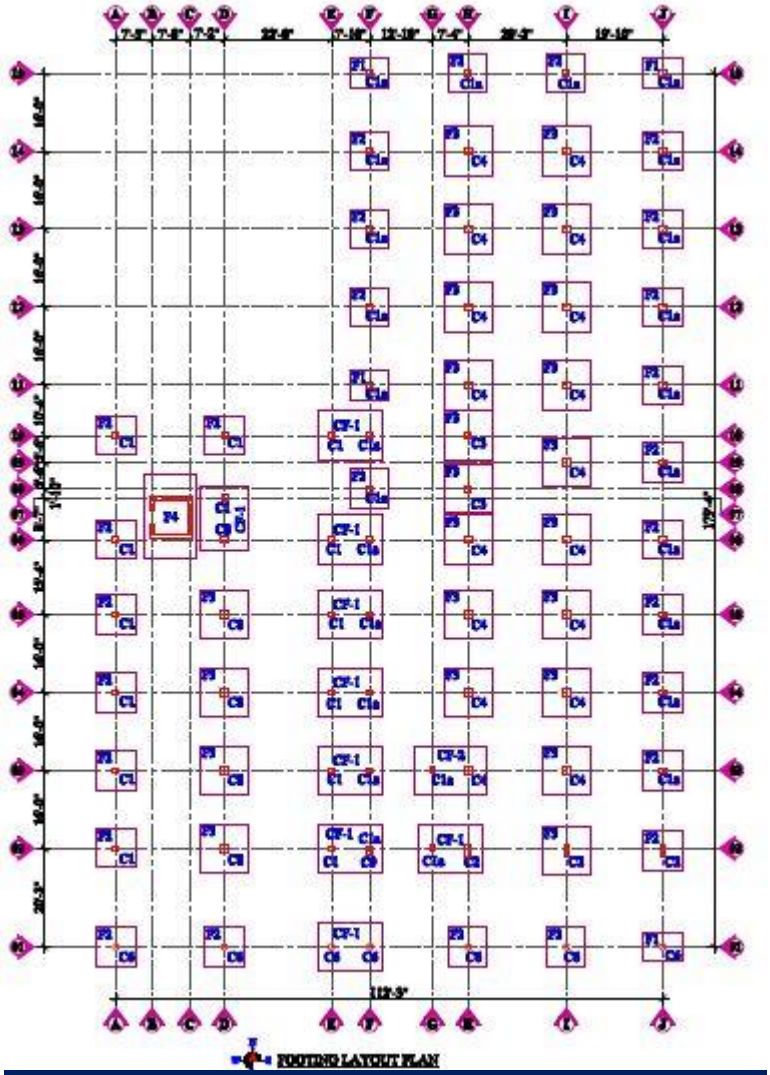
Foundations:
Isolated column footing (from drawing).

Structural System: Building-1

Typical beam and Column framing system

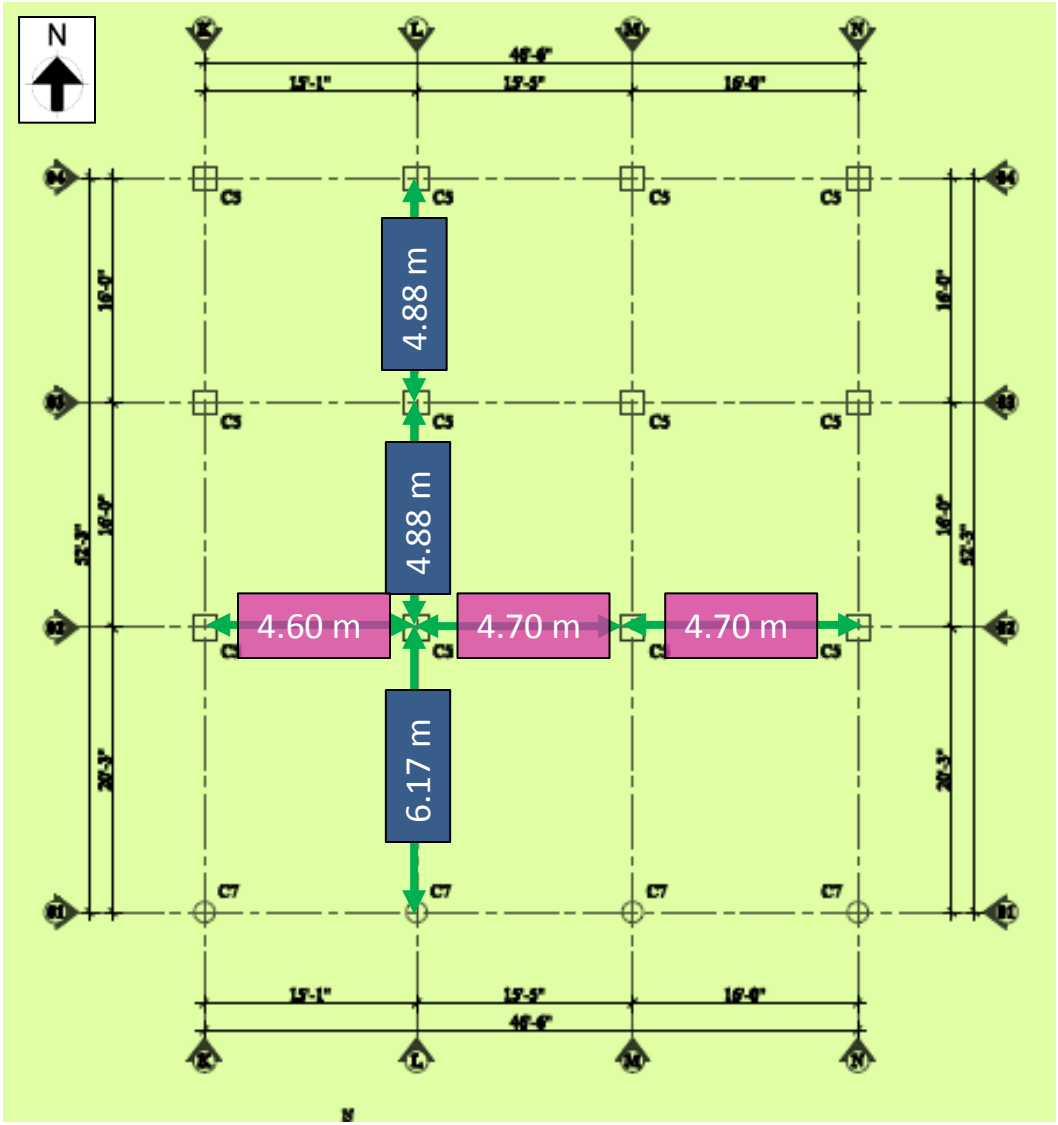


Typical footing section



Foundation layout plan

Structural System: Building-1



Column layout plan

Structure System-RC Part:

Beam column framing system with two-way spanning slab.

Stability system:

Moment resisting.

Typical Grids:

4.88 m X 4.70 m (minimum)

6.17 m X 4.88 m (maximum)

Column Size:

500 mm X 500 mm

375 mm × 375 mm

450 mm dia.

Beam Size:

Typical Beam size:

320 mm X 350 mm (d/s)

Floor slab thickness:

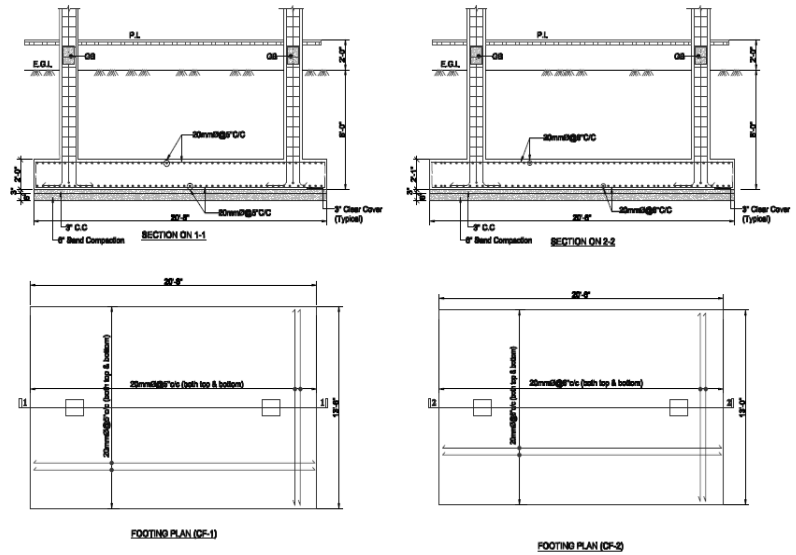
150 mm (excluding finish).

Foundations: Combined footing (as per drawing)

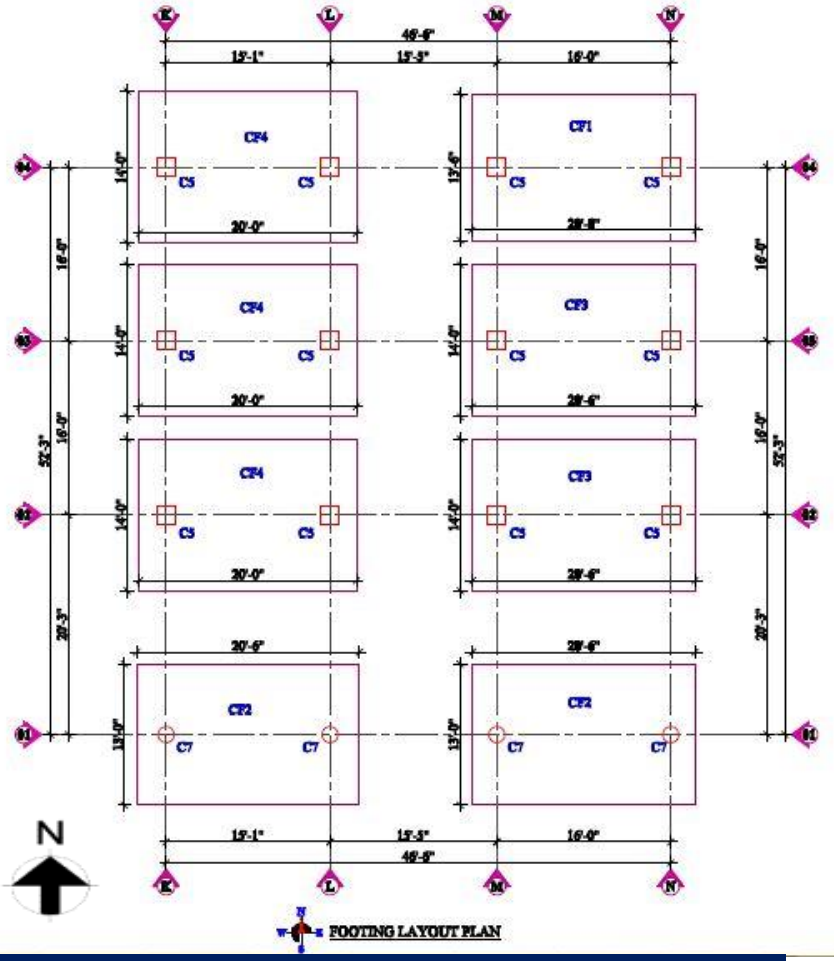
Aggregate Type: Brick chips (Column)

Structural System – Building 1-Extension

Typical beam column framing system

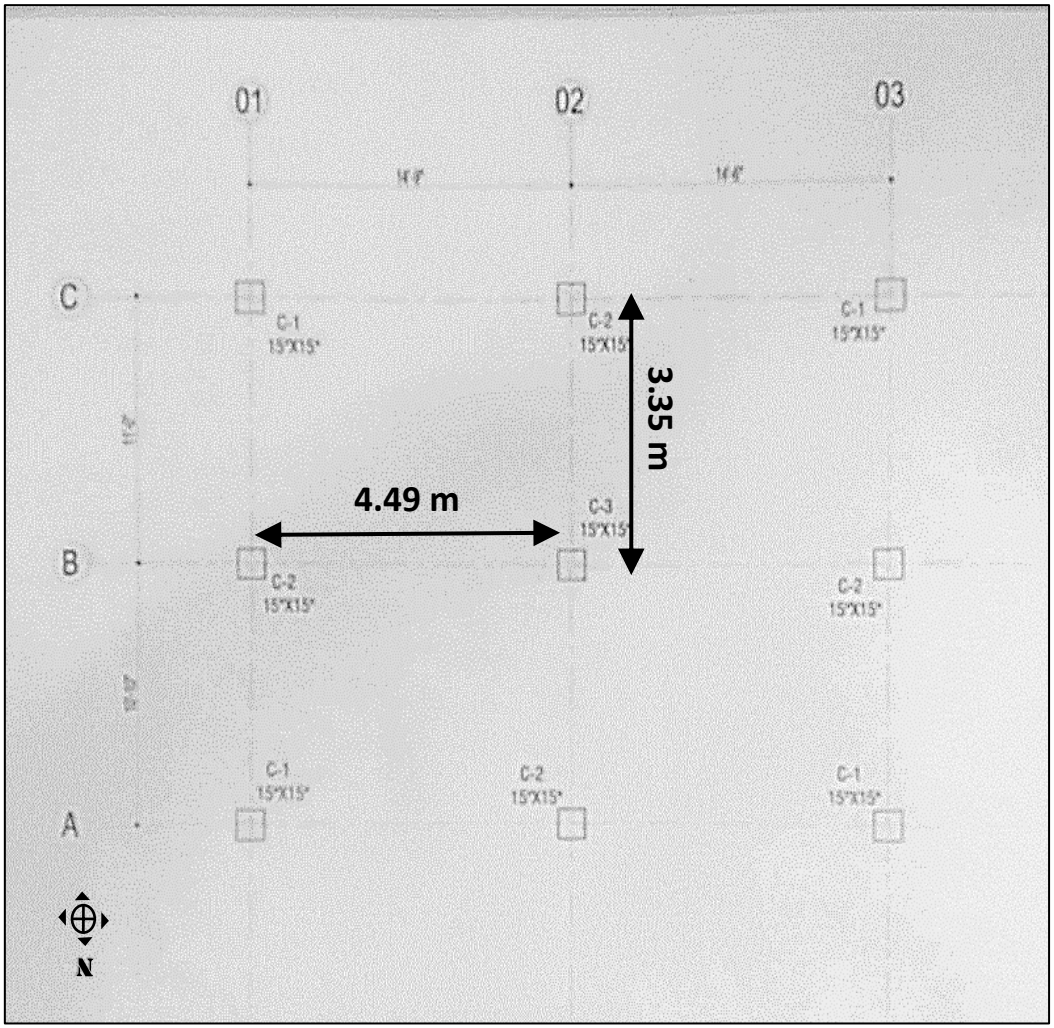


Typical footing section



Foundation layout plan

Structural System – Building 1-Extension



Column Layout Plan

Framing System:
RC beam and column frame with 2 way spanning slab.

Stability System:
Moment resisting frame.

Maximum Grid: As Shown in figure

Typical Column size:
381 mm x 381 mm

Typical Beam Size:
300 mm (w) x 230 mm (d/s)

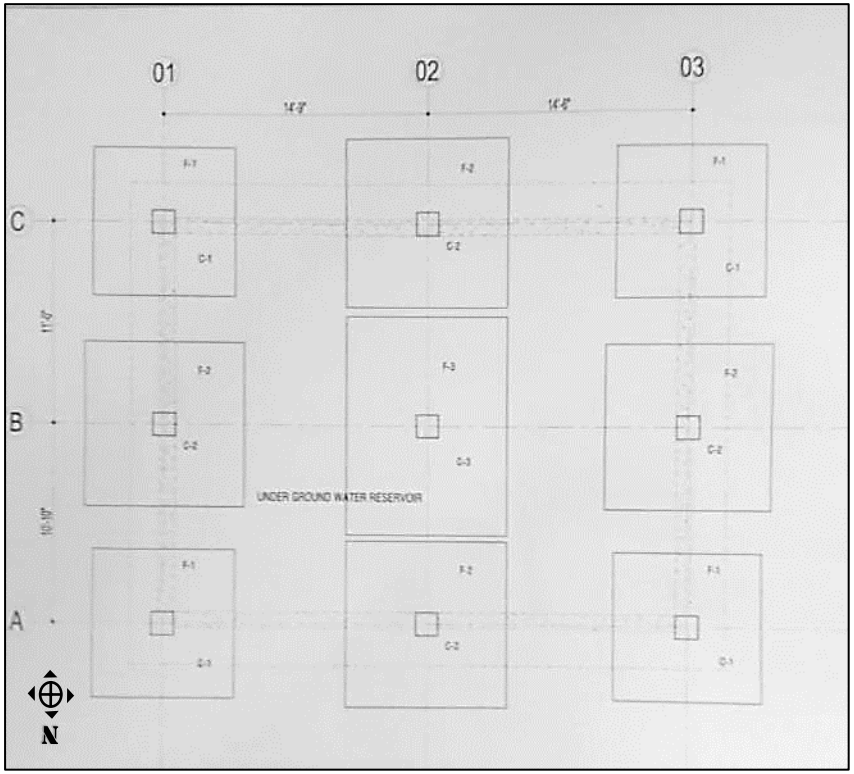
Slab thickness:
150 mm (excluding finishes)

Aggregate Type: Brick Chips

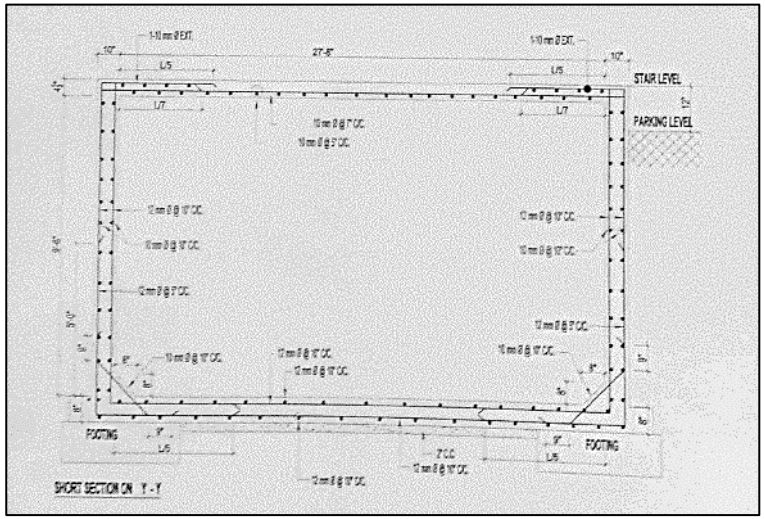
Floor to Ceiling Height:
2.85 m avg.

Foundations:
Isolated Footing (as per drawing)

Structural System: Building 2



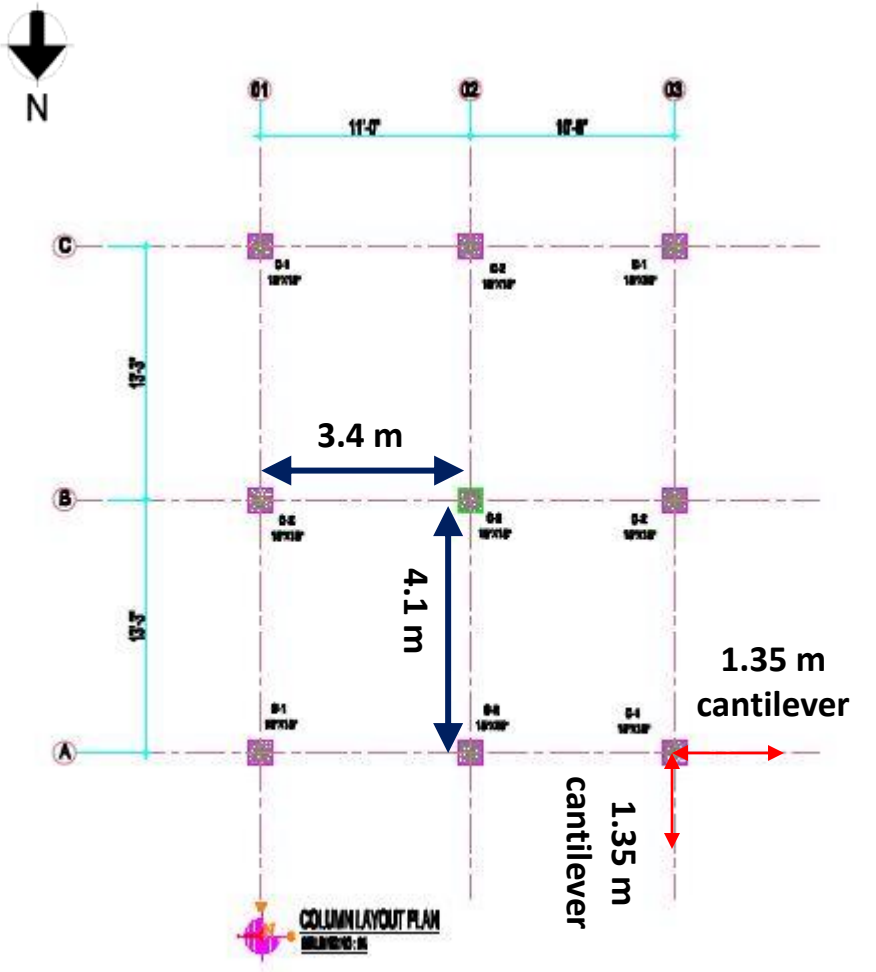
Foundation Layout (Isolated Footing)



UGWR Section

Beam-column frame system

Structural System: Building 2



Column Layout Plan

Framing System:
RC beam and column framing system with two way spanning slab.

Stability System:
Moment resisting frame.

Maximum Grid: As shown in figure.

Column sizes:
375 mm X 375 mm

Beam Size (Typical):
Longitudinal & Transverse-
250 mm (w) x 150 mm (d/s)

Slab thickness:
140 mm (excluding finishes)

Aggregate Type: Stone Chips

Floor to Ceiling Height:
3.3 m (Avg.)

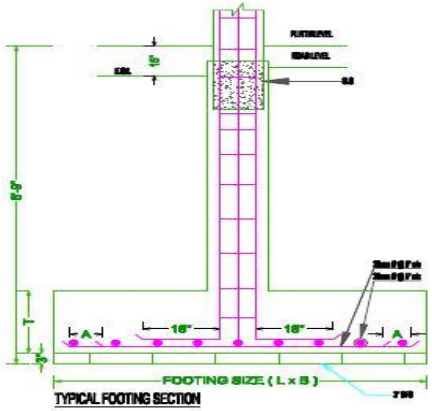
Foundations:
Isolated column footing (as per drawing)

Structural System: Building-4

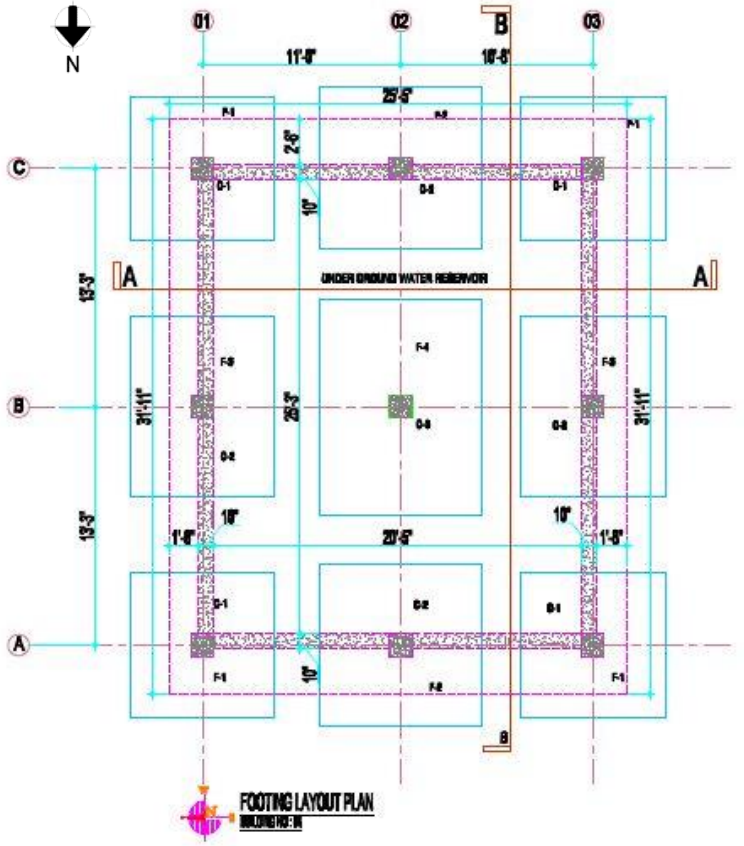
Typical beam and Column framing system

FOOTING SCHEDULE

FOOTING	FOOTING SIZE (L x B)	FOOTING DEPTH T	A	LONG DIRECTION	SHORT DIRECTION
F1	6'-0" X 6'-0"	18"	7"	20mm Ø @ 5" c/c	20mm Ø @ 5" c/c
F2	9'-0" X 9'-0"	18"	7"	20mm Ø @ 5" c/c	20mm Ø @ 5" c/c
F3	6'-0" X 18'-0"	18"	7"	20mm Ø @ 5" c/c	20mm Ø @ 5" c/c
F4	9'-0" X 12'-0"	24"	7"	20mm Ø @ 5" c/c	20mm Ø @ 5" c/c
U.G.W.R. BASE	25'-5" X 31'-11"	See Details in U.G.W.R.			

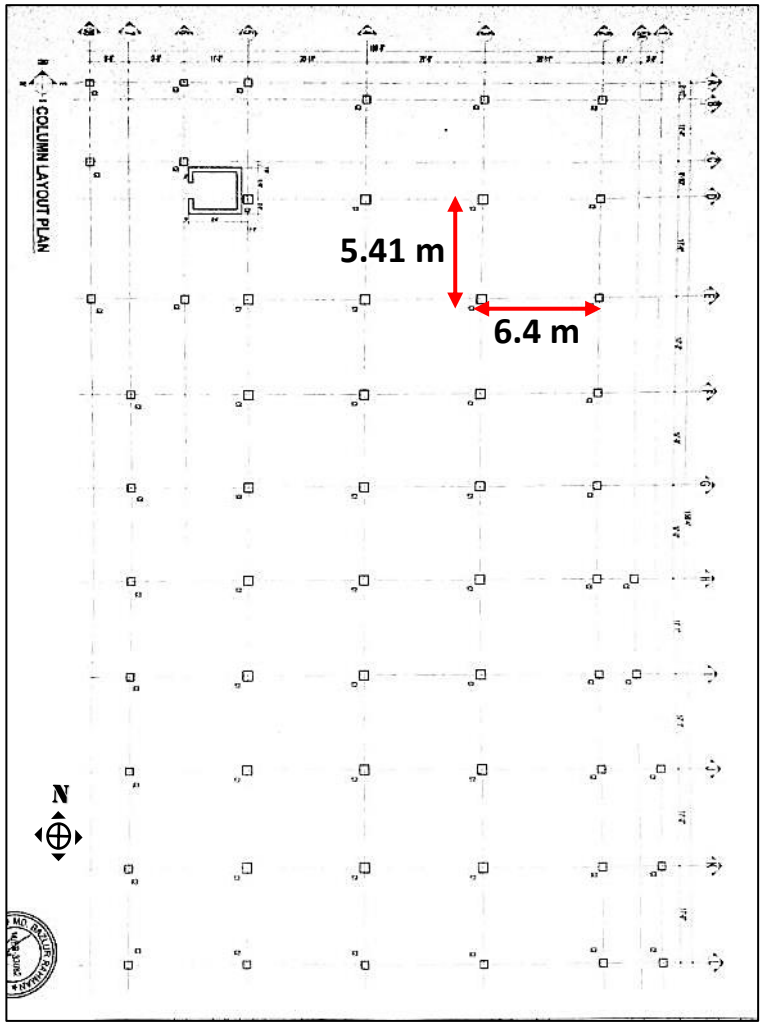


Typical footing section



Foundation layout plan

Structural System: Building-4



Column Layout Plan

Structural System:
RC beam and column frame with two-way slabs and shear walls.

Stability System:
Moment resisting frame and shear walls.

Maximum Grid : 5.41 m x 6.4 m

Floor to Ceiling Height:
Ground Floor: 5.85 m,
Other floor: 3.34 m.

Column sizes:
Internal: 500 mm x 500 mm (C1)
Peripheral: 406 mm x 406 mm (C2)

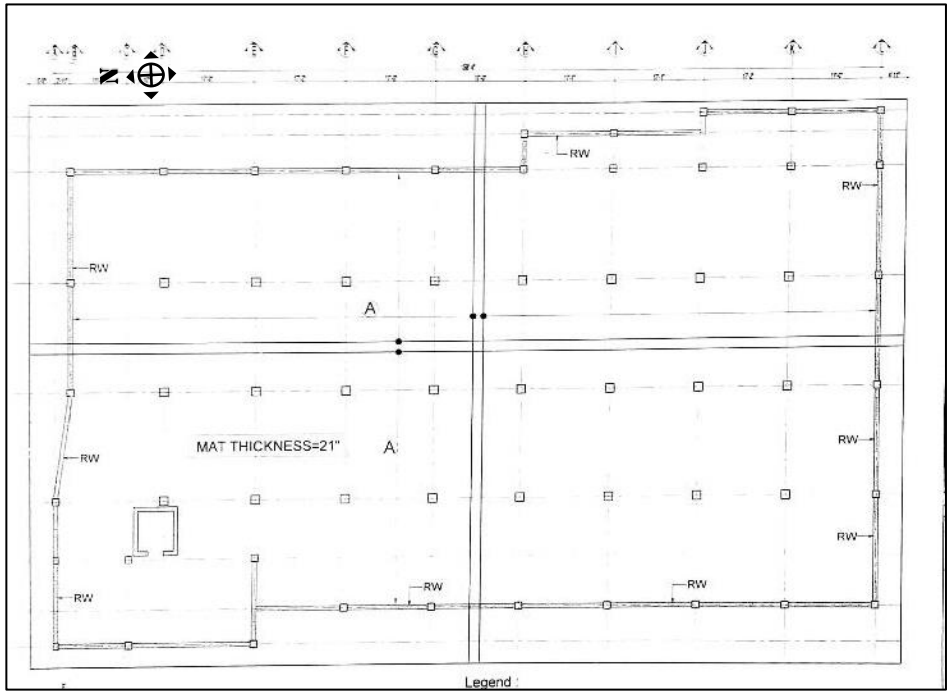
Beam Size (Typical):
Longitudinal: 300 mm x 405 mm (d/s)
Transverse: 300 mm x 300 mm (d/s)

Slab thickness:
152 mm (excluding finishes)

Aggregate Type: Stone Chips

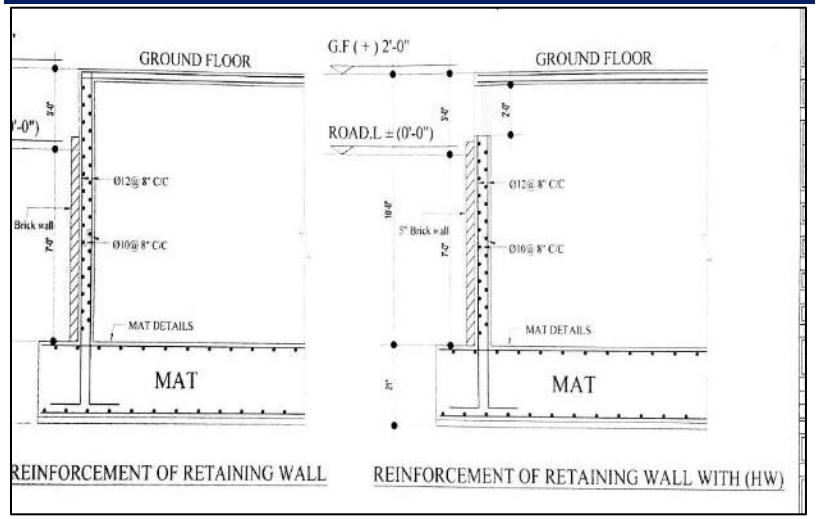
Foundations: Mat Foundation (drawing)

Structural System: Building 6



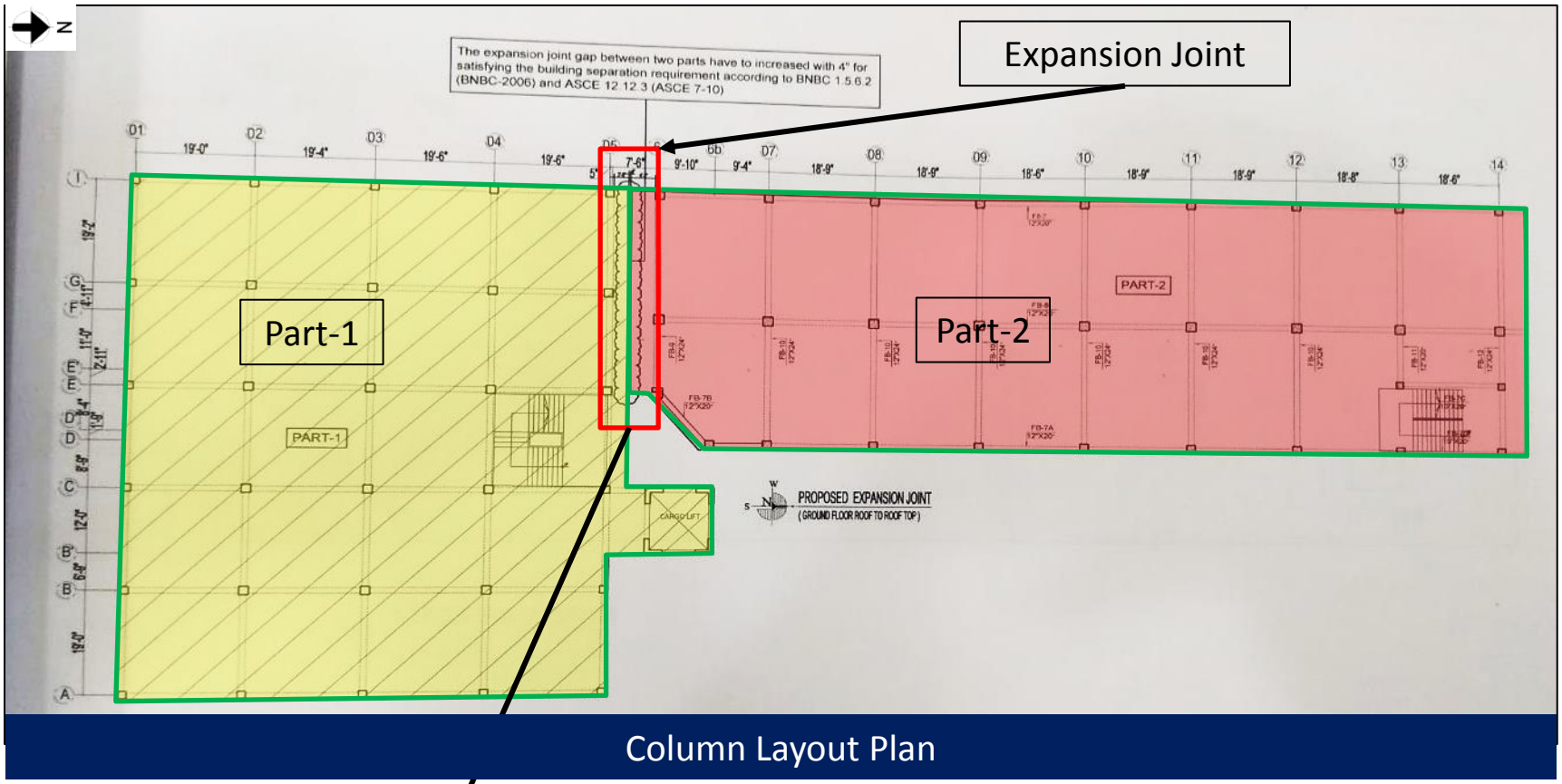
Foundation Layout (MAT foundation)

Beam-column frame system



Section of Retaining Wall

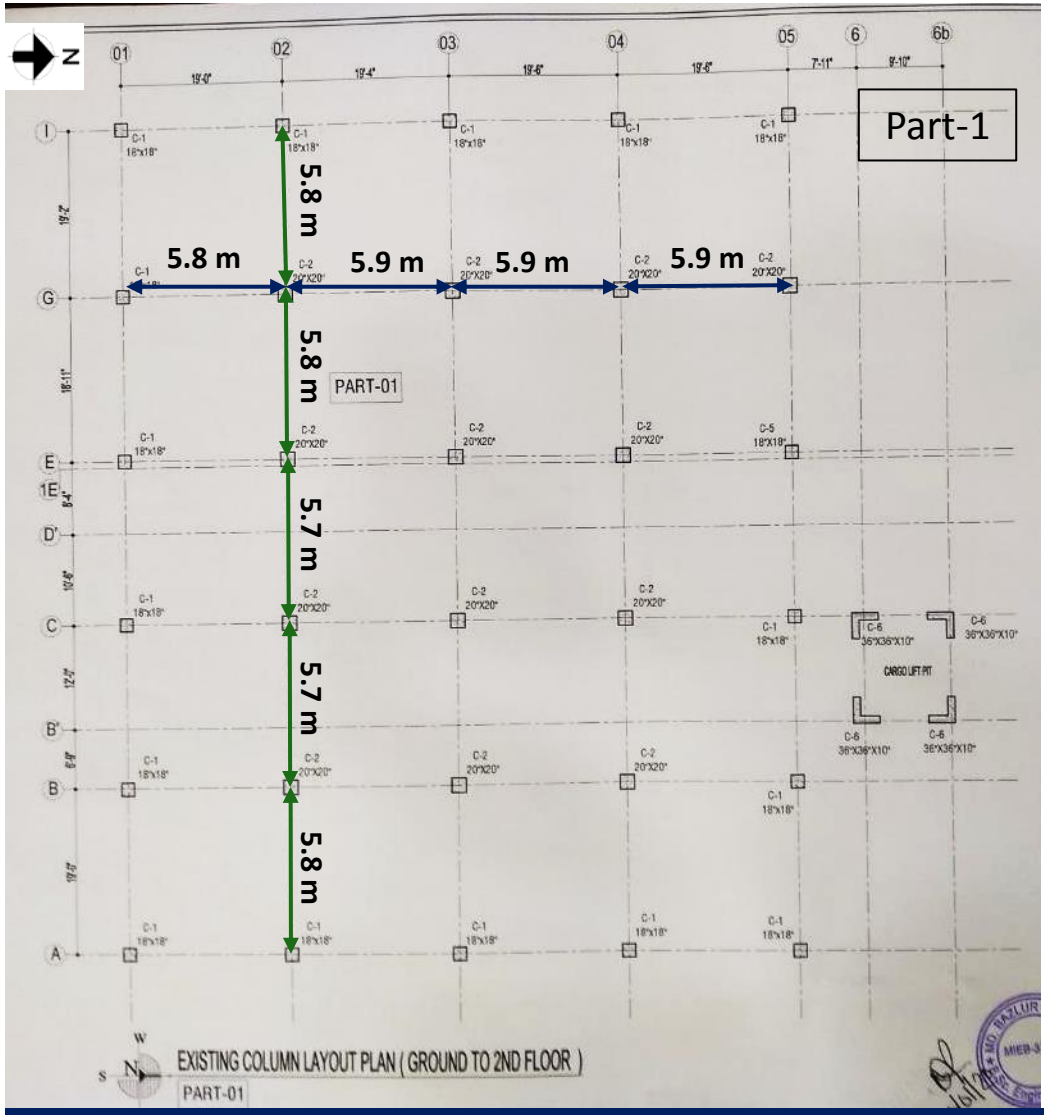
Structural System: Building 6



Column Layout Plan

Expansion Joint location between Part-1 & Part-2

Structural System: Building- 7



Column Layout Plan

Framing System:
RC beam and column frame with 2 way spanning slab.

Stability System:
Moment resisting frame.

Grid: As shown in figure.

Column sizes (Varies):
Edge & Corner- 450 mm X 450 mm
Internal- 500 mm X 500 mm.

Beam Size (Typical):
Longitudinal & Transverse-
300 mm (w) x 350 mm (d/s)

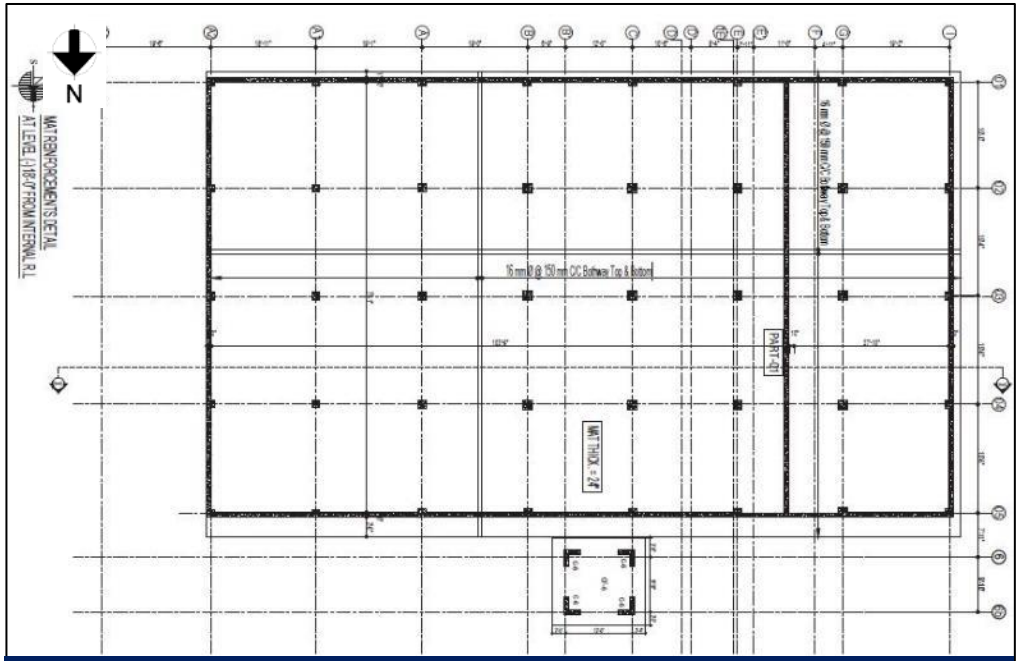
Slab thickness:
150 mm (excluding finishes)

Aggregate Type: Stone Chips

Floor to Ceiling Height: 3.18 m

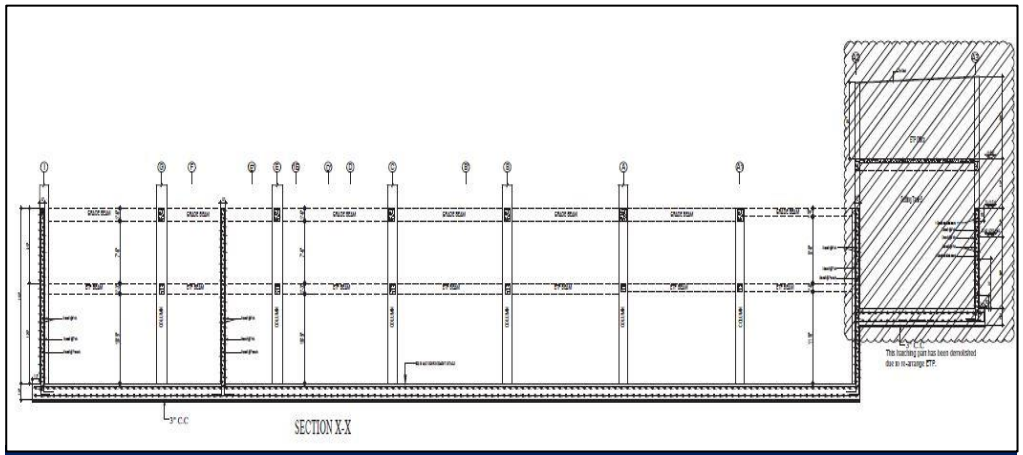
Foundations:
MAT Foundation (as per drawing).

Structural System: Building- 7 (Part-1)



MAT Foundation Reinforcement Details

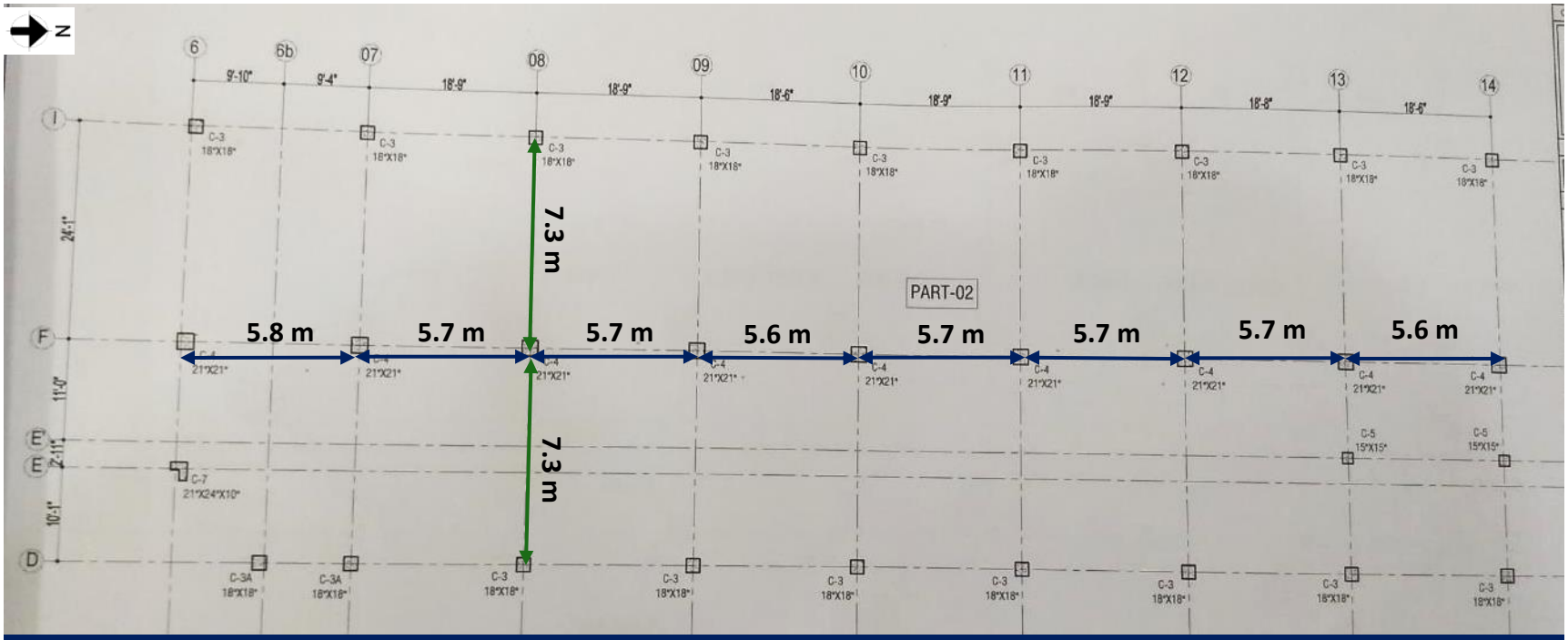
Beam-column frame system



Sectional Details of MAT foundation

Beam-column frame system

Structural System: Building- 7 (Part-1)



Column Layout Plan

Framing System:
RC beam and column frame with 2 way spanning slab.

Stability System:
Moment resisting frame.

Grid: As shown in figure.

Column sizes:
Edge & Corner- 450 mm X 450 mm
Internal- 525 mm X 525 mm.

Slab thickness: 150 mm (excluding finishes)

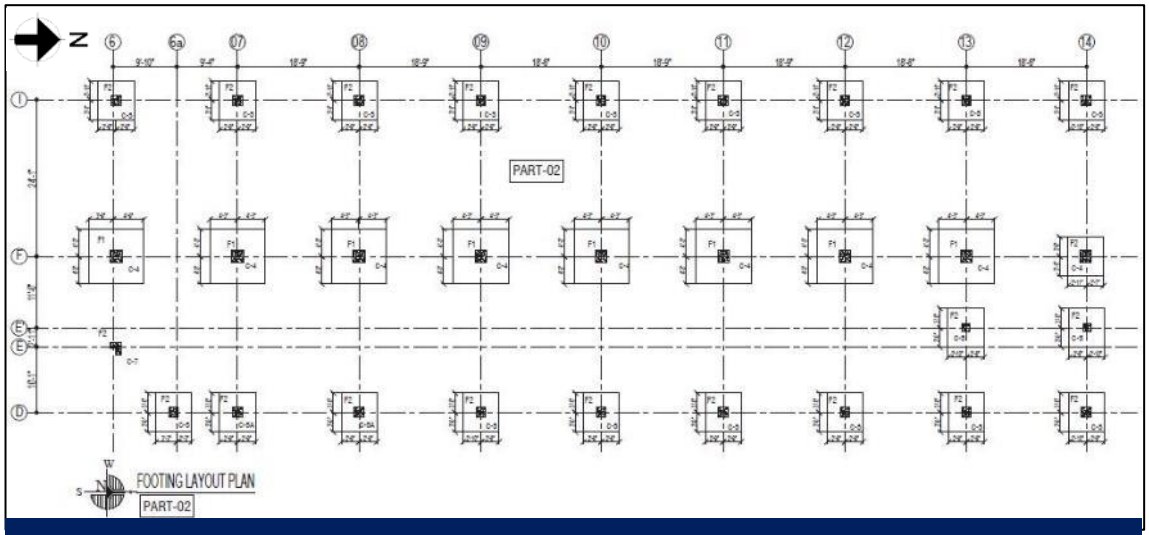
Beam Size (Typical):
Longitudinal: 250 mm (w) x 350 mm (d/s)
Transverse: 250 mm (w) x 450 mm (d/s)

Aggregate Type: Stone Chips

Floor to Ceiling Height:
Ground Floor- 7.3 m & Typical Floor-3.2m

Foundations:
Isolated Footing (as per drawing).

Structural System: Building- 7 (Part-2)



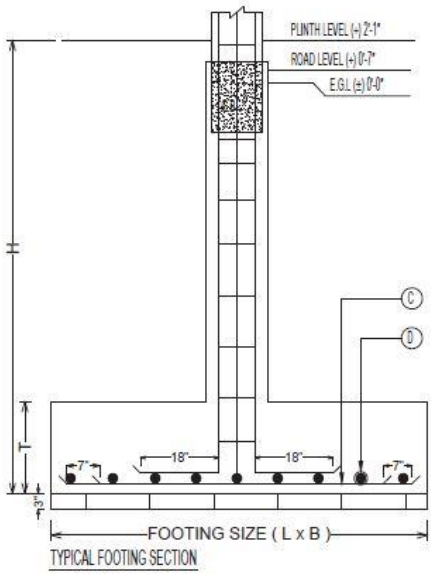
Foundation Layout (Isolated Footing)

Beam Column Frame

Beam Column Frame

FOOTING SCHEDULE

FOOTING NO-	FOOTING INFORMATION			REINFORCEMENTS	
	Size (A x B)	Depth (H)	Thickness (T)	Short Direction (C)	Long Direction (D)
F1	8'-6" X 8'-6"	8'-0"	15"	(C) 20mm Ø @5" o/c	(D) 20mm Ø @5" o/c
F2	6'-0" X 5'-6"	7'-3"	18"	(C) 20mm Ø @5" o/c	(D) 20mm Ø @5" o/c



Footing details

Structural System: Building- 7 (Part-2)

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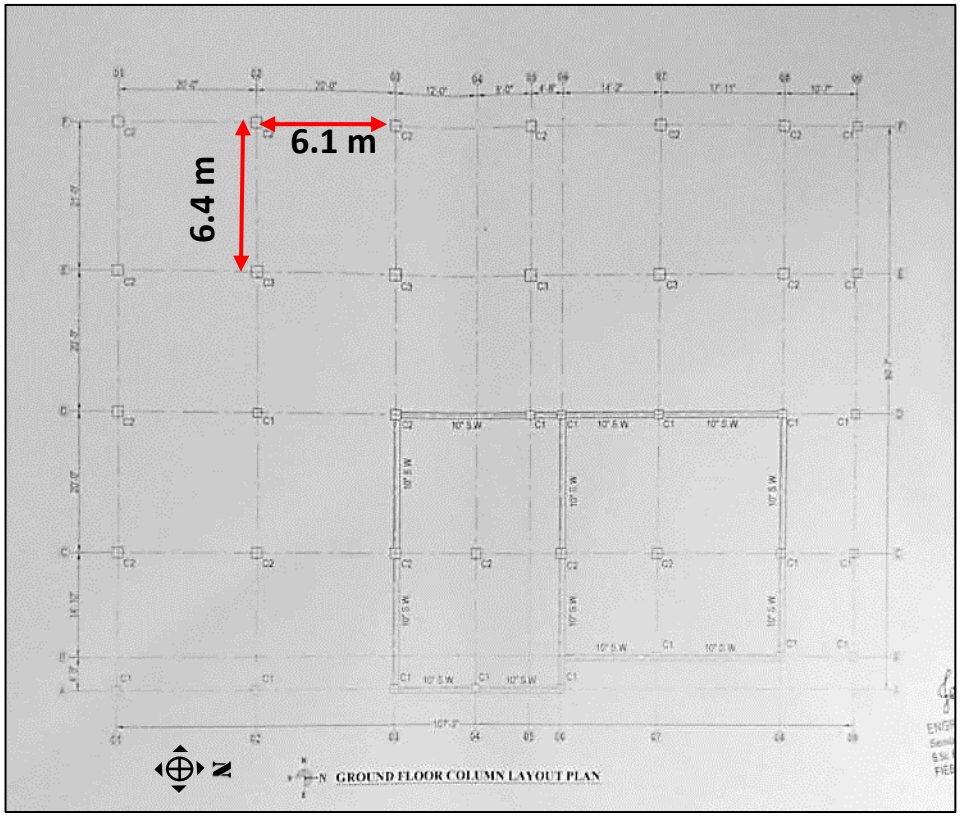


Column Layout Plan

Structural System:
RC beam and column frame with two-way slabs

Stability System:
Moment resisting frame above

Maximum Grid : 6.1 m x 6.4 m

Floor to Ceiling Height:
Ground floor: 4.72 m,
Other floor: 3.00 m.

Column sizes:
381 mm x 381 mm (C1)
457 mm x 457 mm (C2)
510 mm x 510 mm (C3)

Beam Size (Typical):
300 mm x 457 mm (d/s)

Slab thickness: 152 mm

Aggregate Type: Stone Chips

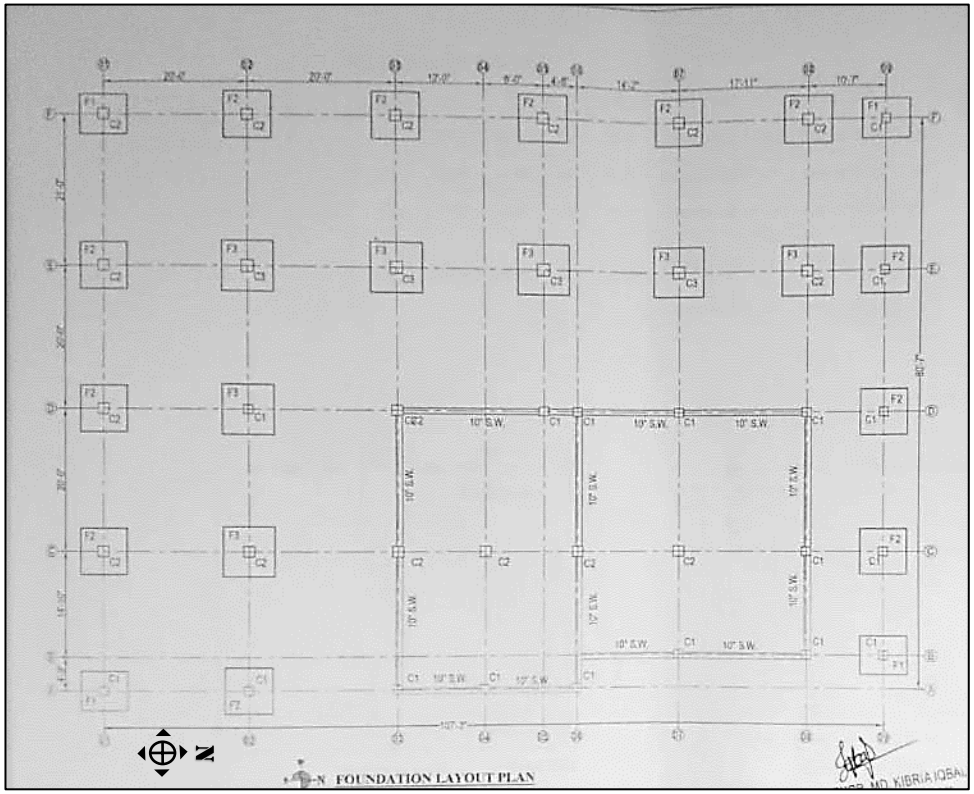
Foundations:
Isolated footing (as per drawing).

Structural System: Building 7A

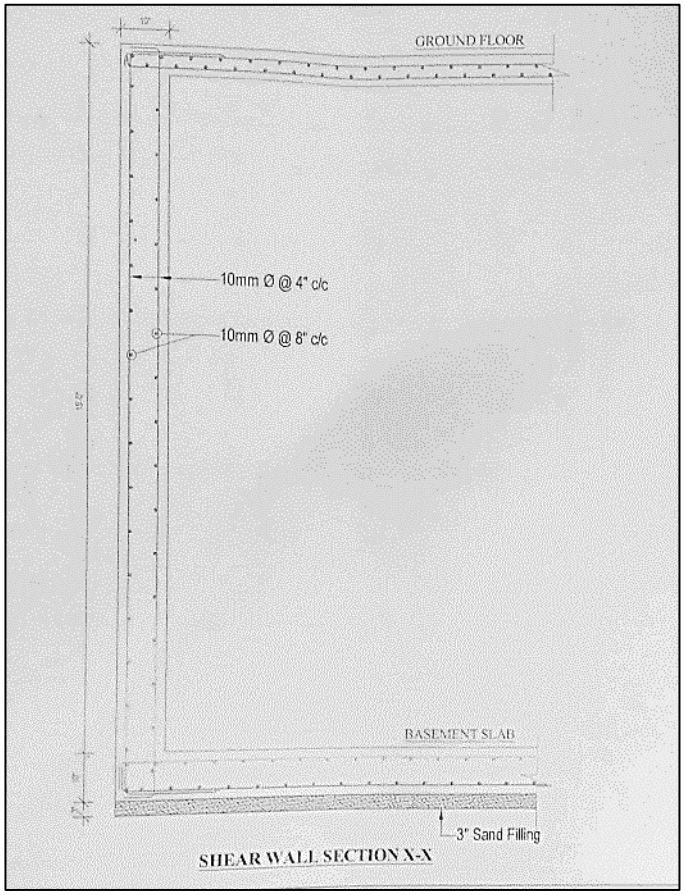
Inside rooftop shed

Beam-column frame system

Structural System: Building 7A

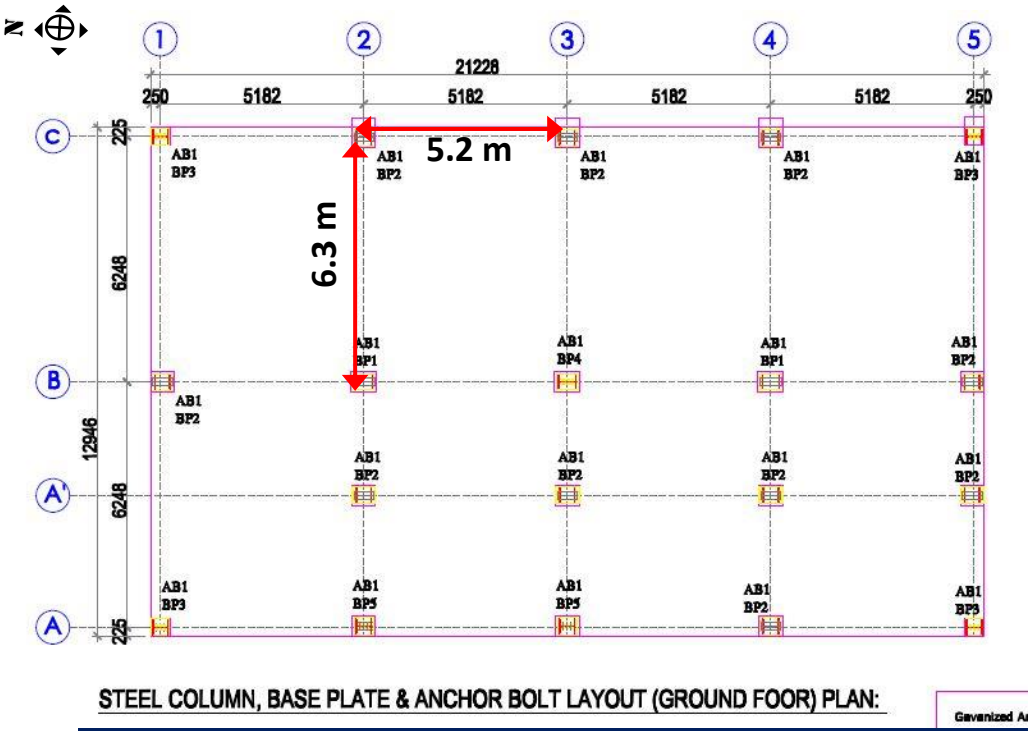


Foundation Layout (Isolated Footing)



UGWR shear wall section

Structural System: Building 7A



Steel Column Layout Plan

Framing System:
Prefabricated steel beam-column framing system.

Stability System:
Moment resisting system in long direction with tie beams.

Maximum Grid : As Shown in figure

Column sizes (mm):
W- 450 X 16, F- 375 X 20
W- 400 X 16, F- 300 X 16

Beam Size (Typical):
MB: W- 600 x 8; F- 250 x 12
Joist: W- 400 x 8; F- 200 x 10

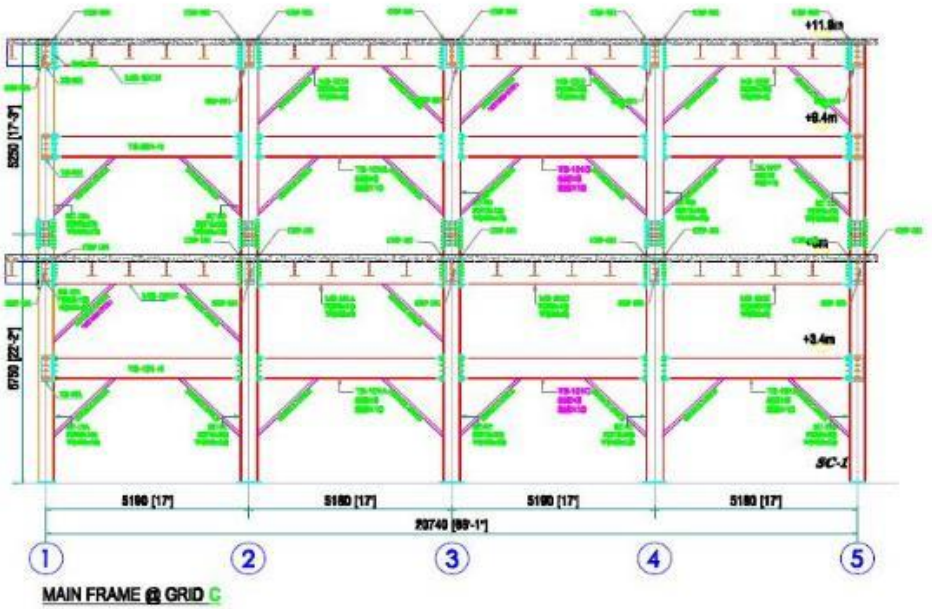
Connection: Bolted & Welded

Floor to Ceiling Height:
6.75 m (G.F), 5.25 m (1st F.)

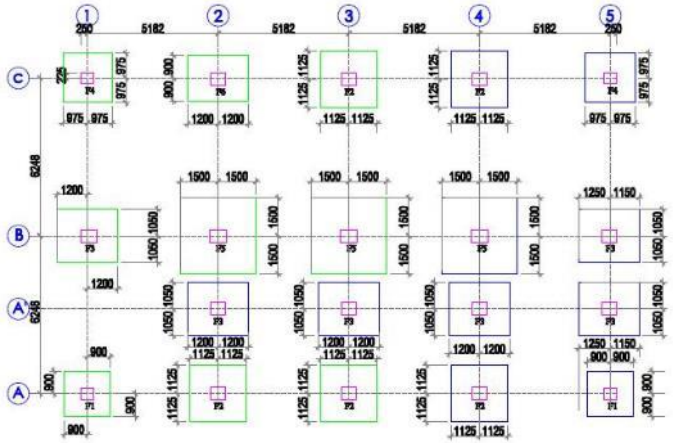
Foundations:
Isolated footing (as per drawing).

Structural System: Building 9

Typical beam column framing system



Typical framing system



Foundation Layout (Isolated Footing)

Structural System: Building 9

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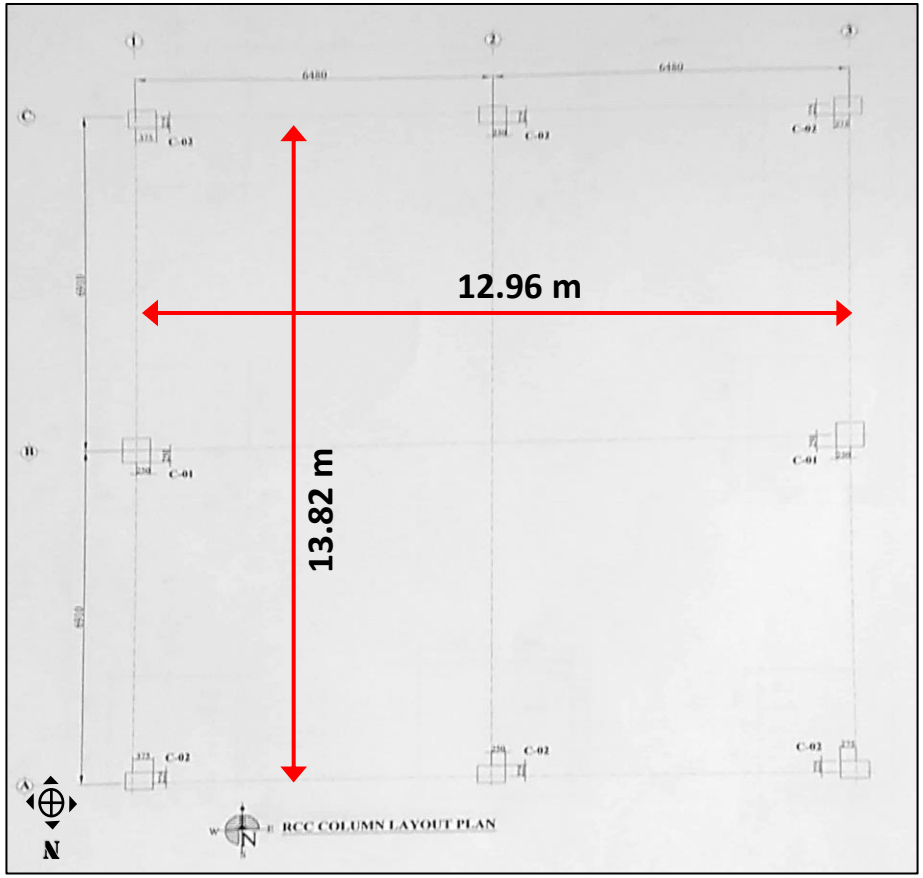
Knee bracings & tie beams

Typical bolted connection

Structural System: Building 9



Column Layout Plan

Framing System:
RC column and shear wall with steel column beam rafter framing system on top

Stability System:
Concrete shear walls and Steel Vertical Bracings on top

Maximum Grid: As Shown in figure

Column sizes (mm):
RC: 575 x 575
Steel short column:
W-440 x 12; F- 400 x 20 (As per drawing)

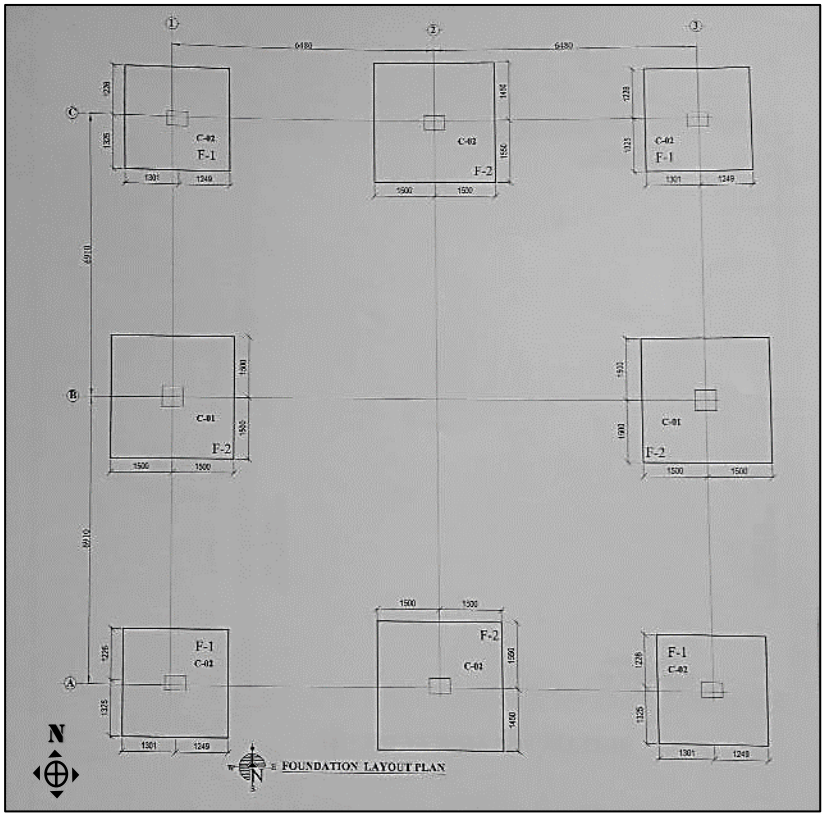
Beam Size (Typical):
MB: W- 1032 x 10; F- 400 x 16
Joist: W- 362 x 5; F- 150 x 6

Aggregate Type: Stone Chips

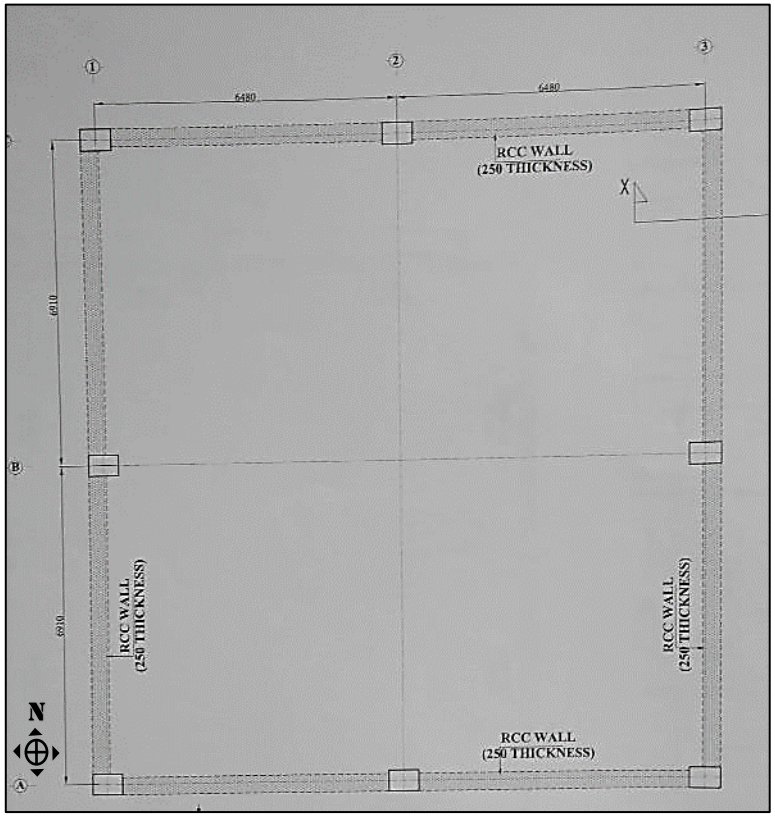
Floor to Ceiling Height: 7.5 m

Foundations:
Isolated footing (as per drawing).

Structural System: Building 10



Foundation Layout (Isolated Footing)



Shear Wall layout

Structural System: Building 10

Vertical bracings

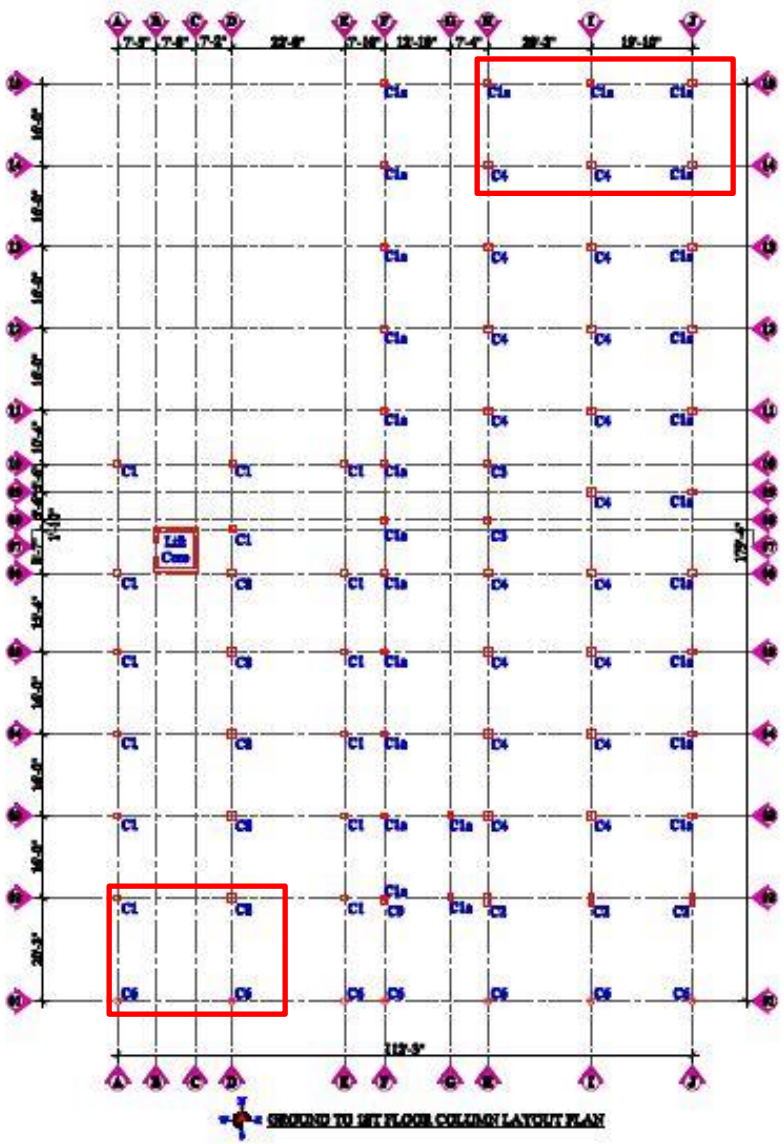
Steel beam-rafter framing system on top

Structural System: Building 10

Observations

High stress levels in columns that require immediate review

Observations: Building-1



Column Layout Plan

Live load considered 2 kPa.

Toilet partition wall load with floor build up

Observations: Building-1

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RECOMMENDATION|AFTER STRUCTURAL ANALYSIS

32. **Foundation performance:** The thickness and bearing of the footing has been found inadequate to rest the punching share stress & bearing capacity So, the foundation is inadequate to carry the building load. There is no visible sign of foundation settlement.

Recommendation: Since the footings are failed by bearing and punching, so retrofitting footings are recommended.

32. **Column performance:** Column members of the building are inadequate to withstand the structure. Demand Capacity Ratio of the columns exceed limit on structural analysis considering 3Kpa (63psf) live load along with code prescribe lateral load. Beams size and reinforcement is adequate to transfer the slab load. The slab thickness is adequate to resist punching shear.

Recommendation: Retrofitting of Columns are required.

3. **Serviceability:** All the sectional dimensions of the key structural elements of the building are found to be insufficient with respect to the requirements of code. Visually there is no sign of pronounced deflection or other deformities that would indicate insufficiency regarding the building's serviceability. The concrete quality is moderate level as per test result and the failure type for columns were combined. Overall state of the building is found to be satisfactory.

Recommendation: Retrofitting of Columns are required.

Recommendation of DEA report

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Table 4.1: The results of average core strength of samples are given below:

Grade Beam:

Equivalent Concrete Core Strength by ACI-562				
Individual Concrete Core Strength (f'_c) (psi)	Grid	Average Core Strength (f'_c) (psi)	No of Core (Nos)	f'_{ceq} (psi)
1710	C/13-14	2863.71	6	2168.3
1230	B-C/14			
4680	A/10-11			
4360	A-B/11			
4230	C-D/11			
3640	D/10-11			

The equivalent specified strength f_{ceq} was calculated using the following Equation as per ACI562;

Equivalent strength of concrete from core test report. Samples are taken from grade beams.

Preliminary calculations indicate high stresses in the columns based on the concrete strength (from core test report) and prepared load plan. However, as per the provided DEA report, most of the columns are inadequate and column strengthening has been suggested. The building engineer is required to review design, load & column stresses in the areas identified above based on in-situ concrete strength which must be confirmed by concrete core test from lower tier of building columns.

Observations: Building-1

Recommendation of DEA report

Observation : Building-1

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RECOMMENDATION AFTER STRUCTURAL ANALYSIS

32. Foundation performance: The thickness and bearing of the footing has been found inadequate to rest the punching share stress & bearing capacity So, the foundation is inadequate to carry the building load. There is no visible sign of foundation settlement.

Recommendation: Since the footings are failed by bearing and punching, so retrofitting footings are recommended.

32. Column performance: Column members of the building are inadequate to withstand the structure. Demand Capacity Ratio of the columns exceed limit on structural analysis considering 3Kpa (63psf) live load along with code prescribe lateral load. Beams size and reinforcement is adequate to transfer the slab load. The slab thickness is adequate to resist punching shear.

Recommendation: Retrofitting of Columns are required.

3. Serviceability: All the sectional dimensions of the key structural elements of the building are found to be insufficient with respect to the requirements of code. Visually there is no sign of pronounced deflection or other deformities that would indicate insufficiency regarding the building's serviceability. The concrete quality is moderate level as per test result and the failure type for columns were combined. Overall state of the building is found to be satisfactory.

Recommendation: Retrofitting of Columns are required.

32. Performance in respect of lateral loading: It was found from analytical model that the story drifts and top floor deflection value lies within allowable limit for the performance of anticipated lateral loading.

Recommendation: No recommendation to be made.

32. Vertically Extension: The building was assessed with a simplified model-based calculation which revealed that the building possesses insufficient strength regarding anticipated gravity load.

Recommendation: No Vertical extension is allowed.

Therefore, the entire structural elements are inadequate under BNBC-2006 standard loading condition (3 KN/m2). Retrofitting of few Columns and Footings are required.

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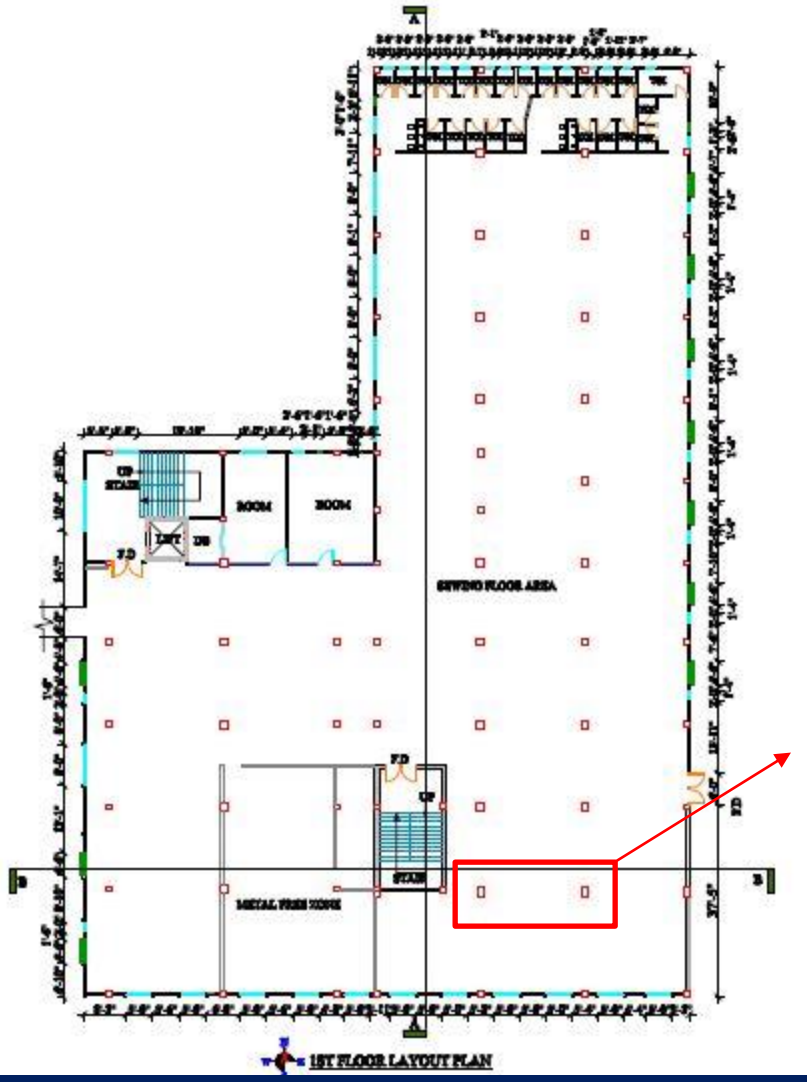
As per DEA recommendation foundations are inadequate due to punching shear and bearing pressure. Columns are also inadequate. Retrofitting suggested to the inadequate members.

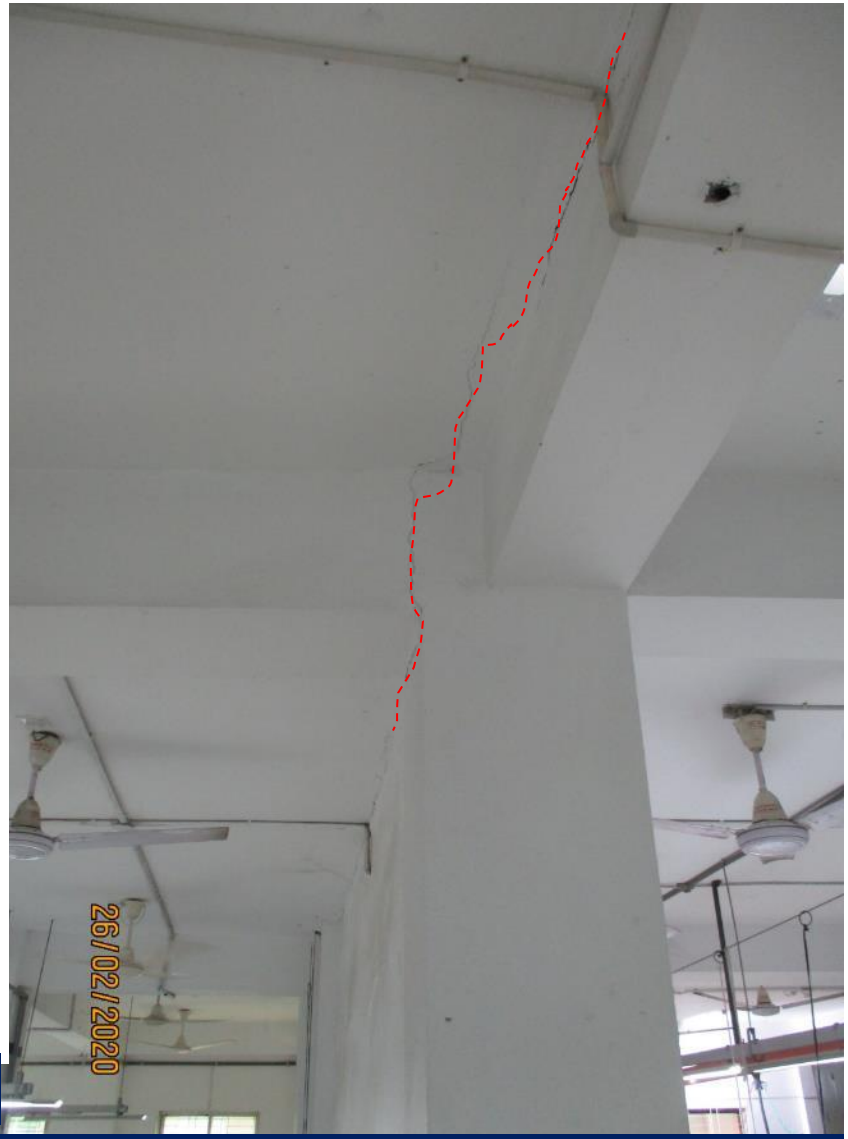
Observations: Building-1

Crack on beam column Joint

Observation : Building-1



1st floor layout plan

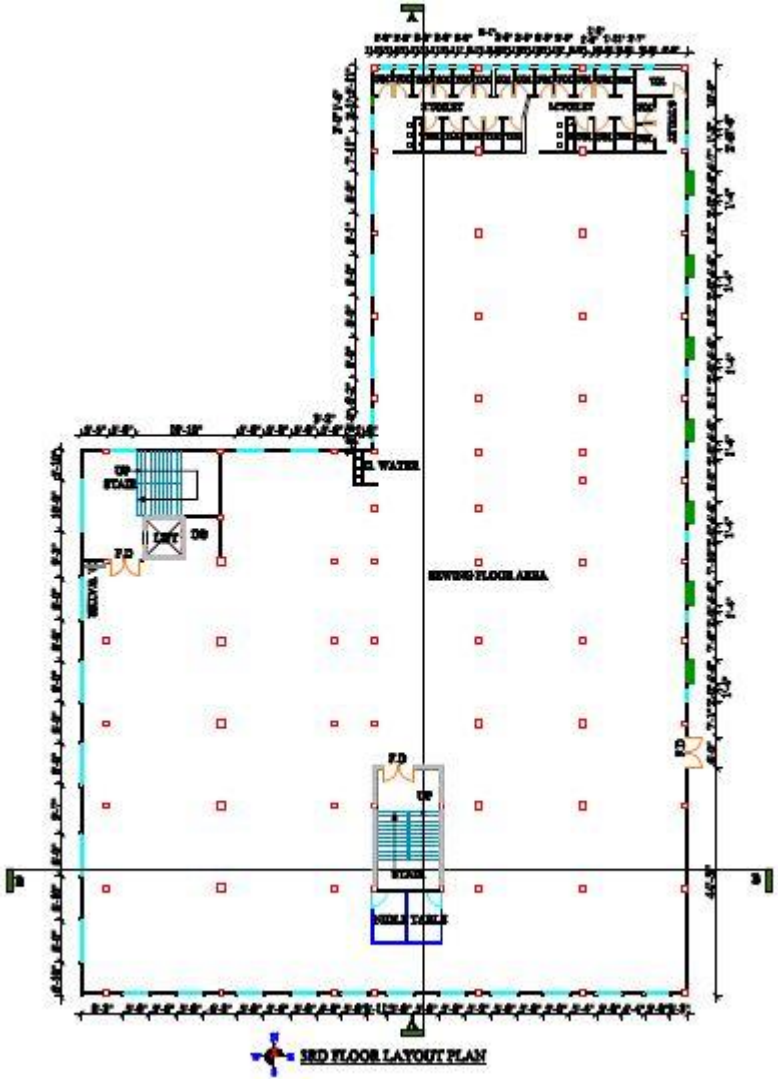


Cracks were observed on beam-column joint. Building engineer is required to investigate the cracks and carry out suitable repair work as per recommendation of investigation report.

Observations: Building-1

Spalling of concrete at 3rd floor toilet area

Observation : Building-1



3rd floor layout plan

Spalling of concrete was observed on 3rd floor toilet zone. Building engineer is required to carryout civil works in a safe manner to the lose concrete.

Observations: Building-1

Review of the DEA report

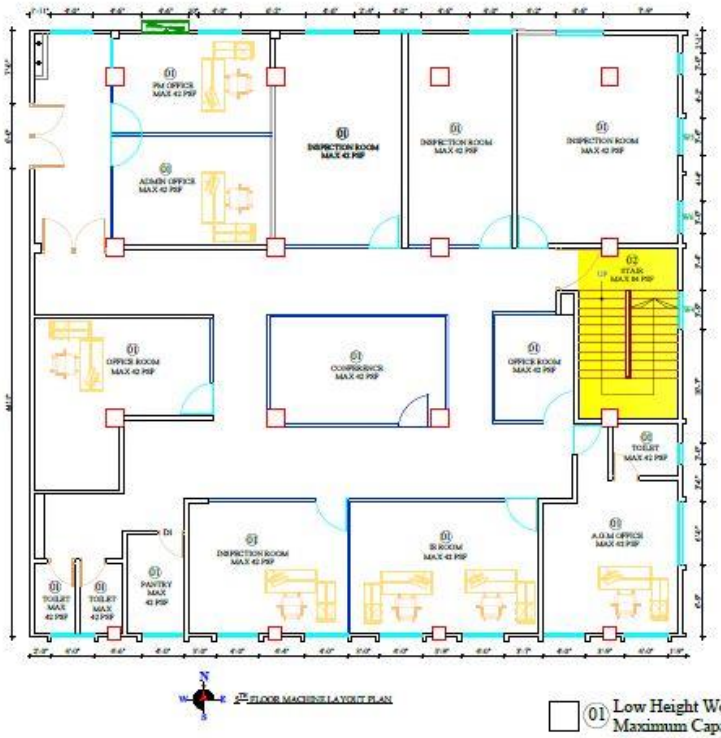
Observation : Building 1-extension

6.2.2 LIVE LOAD CALCULATION

According to BNBC live load is the load superimposed by the use or occupancy of the building not including the environmental loads such as wind load, rain load, earth quake load or dead load. Table: 6.2 describes the live load values considered for modeling the structure, which are referenced from Alliance Standard.

Table 6.2: Live load for various floors of the structure

Floor ID	Use of floor	Load Value (psf)
Ground Floor	Washing Section & Storage Area	-
Mezzanine Floor	Office Room & Storage Area.	42.00
1st Floor	Prayer Room & Storage Area.	42.00
2nd Floor	Cutting & Iron Section, Storage Area	42.00
3rd Floor	Sewing Section	42.00
4th Floor	Packing & Iron Section, Storage Area	42.00
5th Floor	Sewing Section	42.00
Roof Floor	Open Space & Storage Area	32.00



Sl No	Type	Color	Item	Max Load in Psf	Description
1	Working Area		Office Room	42 PSF	Office Accessories
2	Working Area		Inspection Room	42 PSF	Office Accessories

As per BNBC minimum floor live loading not followed for RMG building. 2kPa live load considered in DEA report and live load plan.

Observation : Building 1-extension

Equivalent Concrete Core Strength

Individual Concrete Core Strength (f'c) (psi)	Average Core Strength (f'c) (psi)	No Of Core(Nos)	Kc Value	Standard Deveadtion(v)	Coefficient Of variation	f'ceq (psi)
1710	3104.2	12	1.06	1142	0.37	2367.9
1230						
4680						
4360						
4230						
3640						
2750						
2560						
2020						
2360						
3800						
3910						

For equivalent concrete strength, Concrete core from both Building 1 and Building 1-extension are considered in DEA report.

RECOMMENDATION AFTER STRUCTURAL ANALYSIS

1. Foundation performance: Total foundation system has been found adequate to carry the building load in bearing, punching.

Recommendation: Since the footings are failed by bearing and punching and one-way shear, so no retrofitting is required.

2. Column performance: Total 28nos of column members has been failed by demand capacity ratio. Maximum column members of the building are adequate to withstand the structure. Demand Capacity Ratio of the columns exceed limit on structural analysis considering 3KPa (63psf) live load along with code prescribe lateral load. Beams size and reinforcement is adequate to transfer the slab load. The slab thickness is adequate to resist punching shear.

Recommendation: Retrofitting of Columns are required.

3. Serviceability: All the sectional dimensions of the key structural elements of the building are found to be insufficient with respect to the requirements of code. Visually there is no sign of pronounced deflection or other deformities that would indicate insufficiency regarding the building's serviceability. The concrete quality is moderate level as per test result and the failure type for columns were combined. Overall state of the building is found to be satisfactory.

Recommendation: Retrofitting of Columns are required.

As per DEA report some columns are overstressed and suggested for retrofitting.

Observation : Building 1-extension

Damaged beam & column

Observation : Building-4

Damaged Beam-Column

Damaged Beam

Damaged Column

Damaged beam-column observed on 3rd floor. Building engineer is required to carry out suitable repair works also check the capacity of the damaged structural members.

Observations: Building-4

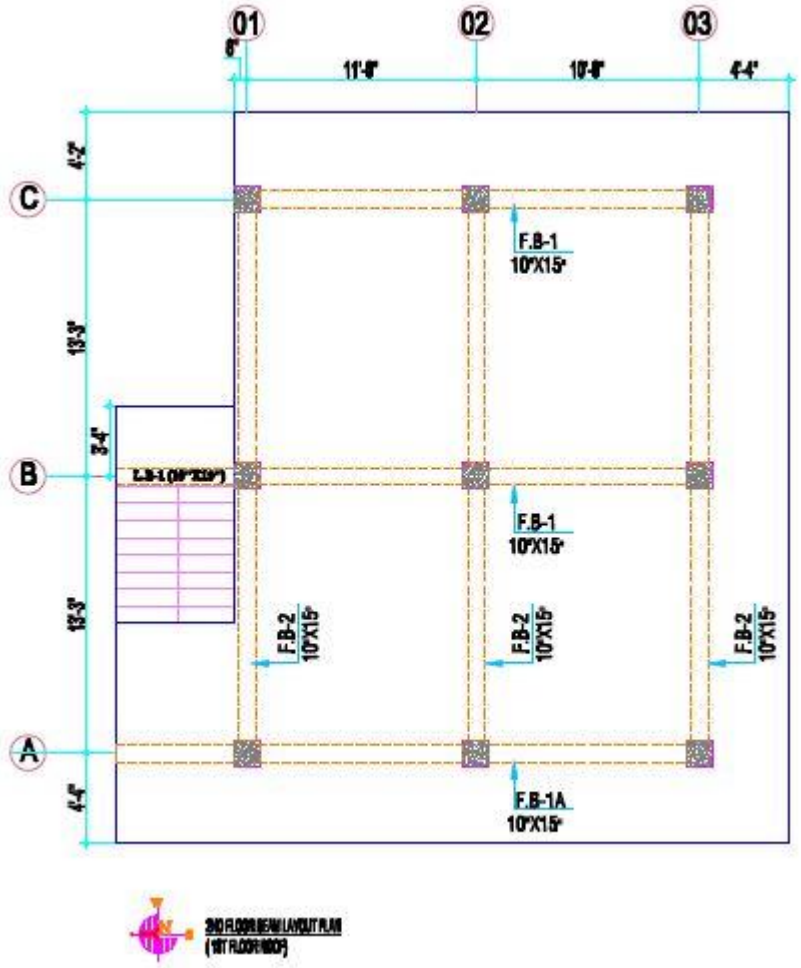
Discrepancies in as-built drawings

Observation : Building-4

COLUMN SCHEDULE								
COLUMN	BELOW PL	GROUND FLOOR	1ST FLOOR	2ND FLOOR	3RD FLOOR	4TH FLOOR	O.H.W.T	TIE BAR
SIZE	17"X17"	15"X15"	15"X15"	15"X15"	15"X15"	15"X15"	15"X15"	
C1	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	10mmØ @ 6"/10"/6" C/C
SIZE	17"X17"	15"X15"	15"X15"	15"X15"	15"X15"	15"X15"	15"X15"	
C2	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	14-22mm Ø CLEAR COVER = 1.5"	10mmØ @ 6"/10"/6" C/C
SIZE	17"X17"	15"X15"	15"X15"	15"X15"	15"X15"	15"X15"	15"X15"	
C3	16-22mm Ø CLEAR COVER = 1.5"	16-22mm Ø CLEAR COVER = 1.5"	16-22mm Ø CLEAR COVER = 1.5"	16-22mm Ø CLEAR COVER = 1.5"	16-22mm Ø CLEAR COVER = 1.5"	16-22mm Ø CLEAR COVER = 1.5"	16-22mm Ø CLEAR COVER = 1.5"	10mmØ @ 6"/10"/6" C/C

As per column schedule all rebars are 22 mm diameter but onsite some of the rebars were found 20 mm & 16 mm diameter.

Observations: Building-4

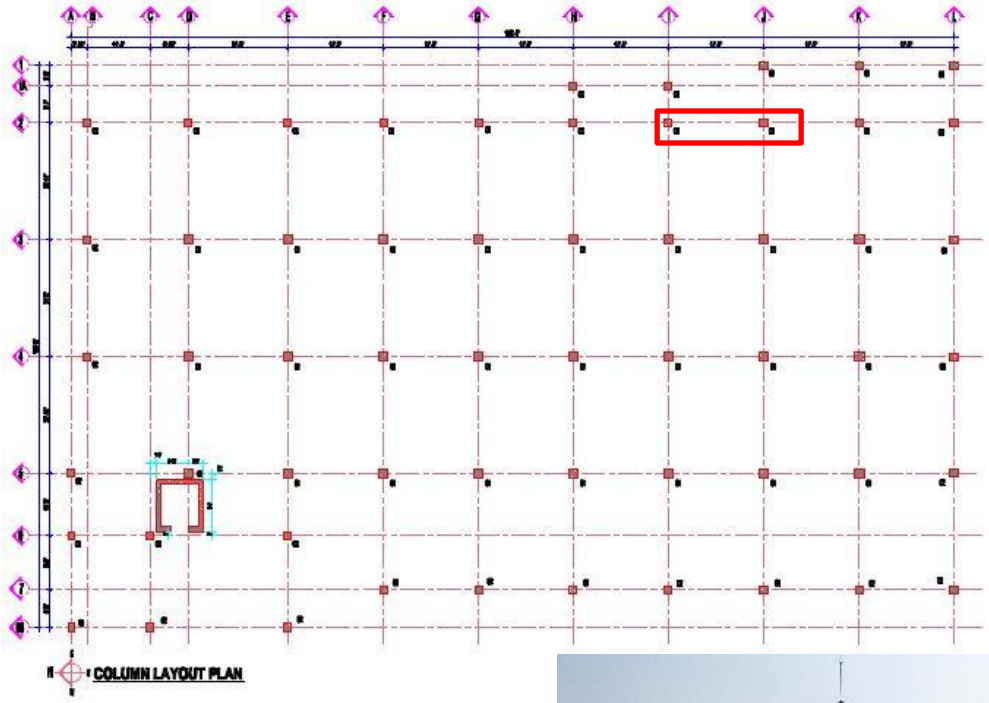


Down stand of the beam was measured 150 mm, but drawings shows 235 mm.

Observations: Building-4

High stress levels in columns that require immediate review

Observation : Building-6



Input Parameters:

Table 1 Input Parameters:

1	Yield Strength of steel	f_y	40000 psi
2	Cylinder Strength of Concrete for Column	f'_c	2430 psi
3	Cylinder Strength of Concrete for Beam & Slab	f'_c	4080 psi
4	Young's Modula's of Concrete(Stone Chips)	E_c	$57000\sqrt{f'_c}$

Equivalent concrete strength of column from concrete strength

Loading from OHWT

Observed live load more than 2 kPa

Preliminary calculations indicate high stresses in the columns based on the concrete strength (from core test report) and observed load plan. Moreover, as per the provided DEA report, most of the columns are inadequate and column strengthening has been suggested. The building engineer is required to review design, load & column stresses in the areas identified above as per building code.

Observation : Building 6

Overloading on floor

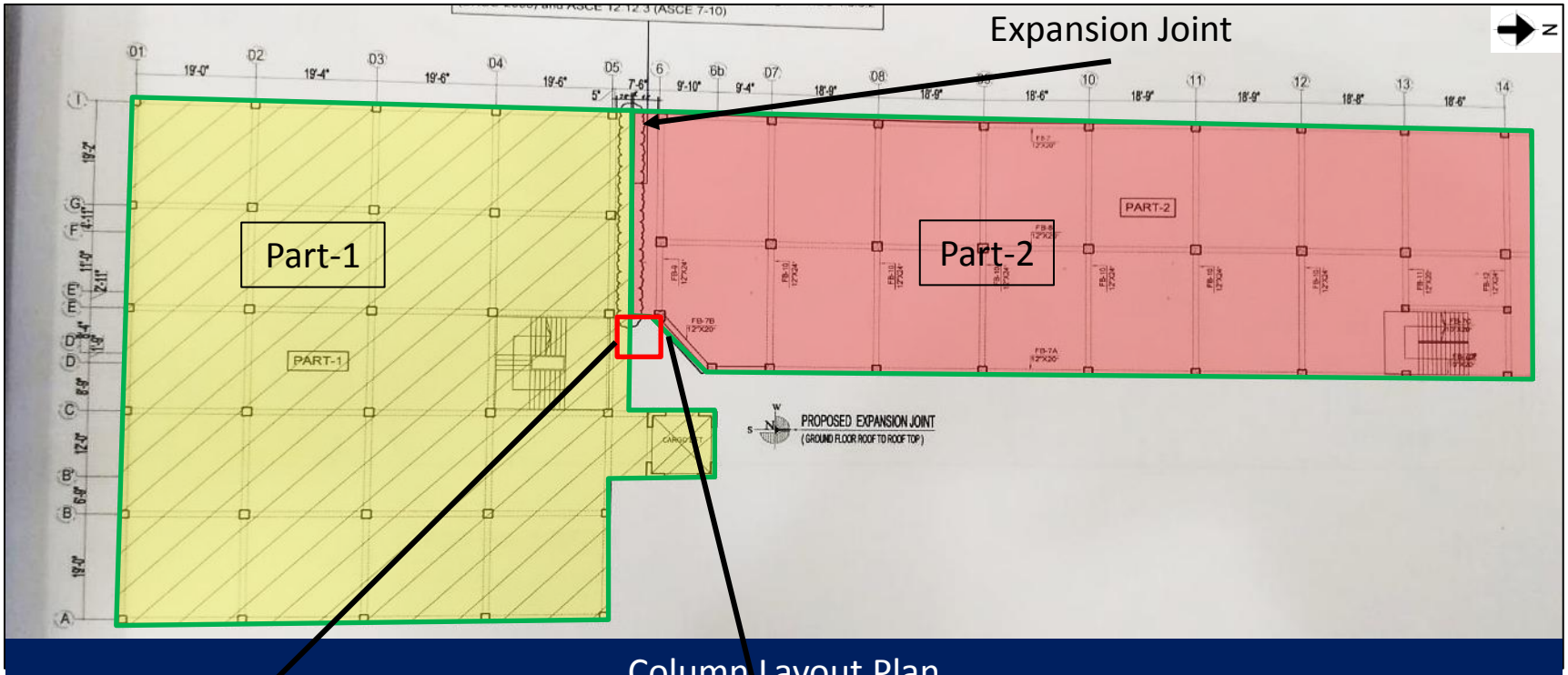
Observation : Building-6

Loading was observed above 2 kPa on floors. Building engineer is required to maintain loading below 2 kPa on floors until completion of all required remedial works from engineering assessment.

Observation : Building-6

Mismatches in the drawing and missing core cutting location

Observations: Building-7



Column Layout Plan

Undocumented lift

A lift was found in between Expansion Joint of part-1 & 2. Which is not shown in as-built drawing. Separation of part-1 & part-2 is not clear on that location.

Observations: Building-7

Retrofitting works

During inspection, the retrofitting works were ongoing. Detail Engineering Assessment (DEA) of building-7 was accepted from (Remediation Coordination Cell) RCC.
Prepared DEA need to be revised as per as-built condition mentioned in previous slide and submit to RSC for further review.

All core location could not be verified as per core cutting layout. All core cutting location need to be exposed and revised the core layout plan as per site condition.

Core

Observations: Building-7

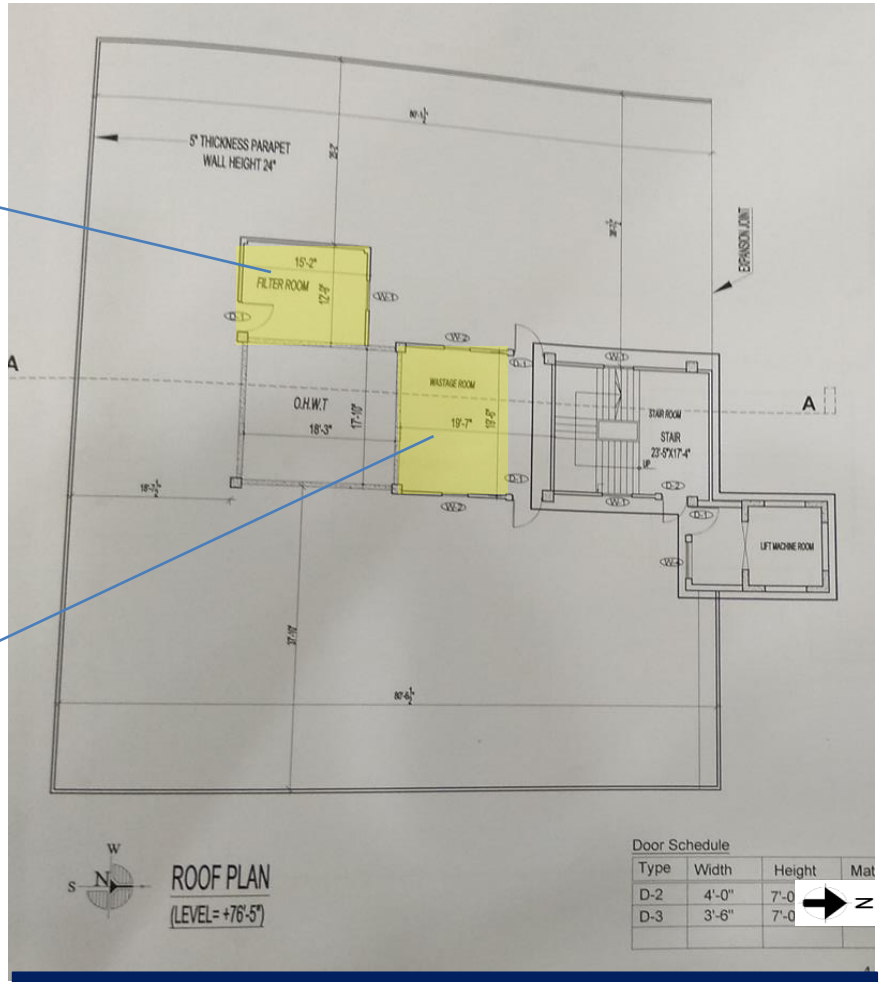
Non-engineered shed at roof

Observation : Building-7 (Part-1)

Non-engineered shed was found at roof level. The connections of the truss/rafter with wall are non-engineered.

Rafter supported on brick wall

Truss supported on brick wall



Roof Layout Plan

Observations: Building-7 (Part-1)

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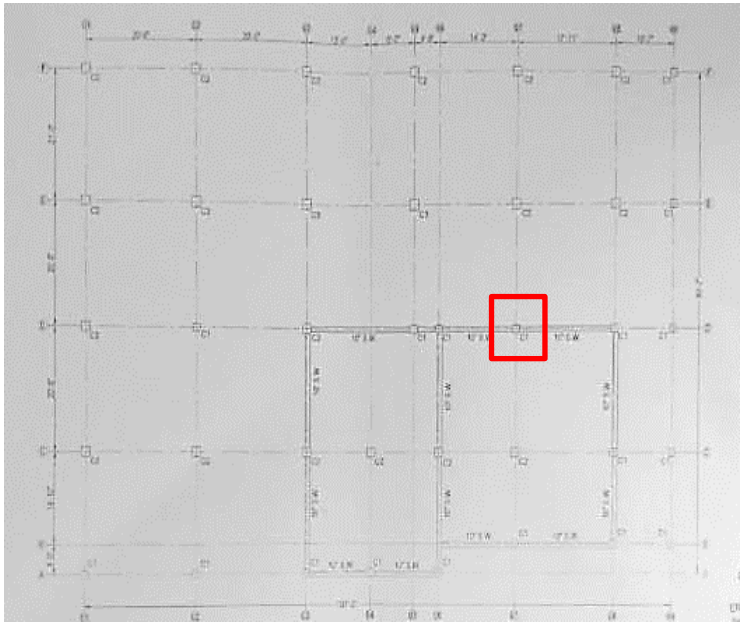
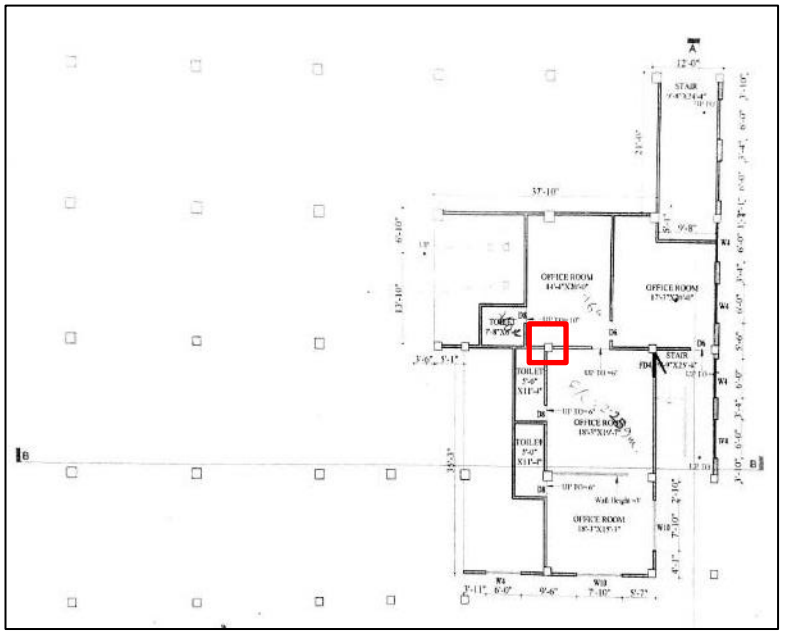
Columns to be stressed above normal design limits

Observations: Building 7A



Column Layout



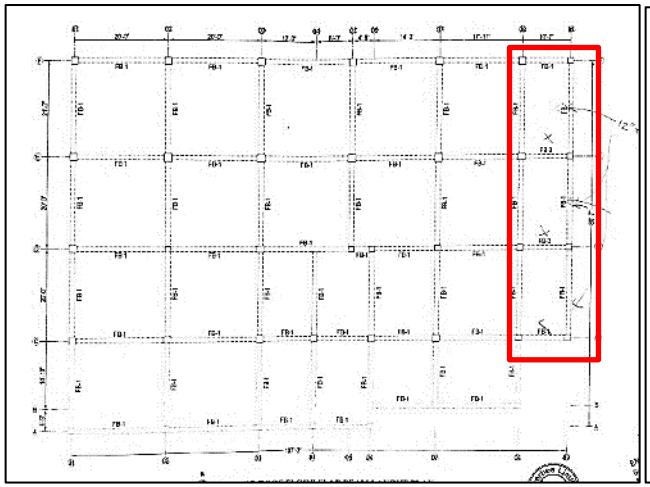
Column Shown in Mezzanine floor area

Cursory Calculation indicate that the working stress of the highlighted column at ground floor level appear to be stressed in excess of normal design limits

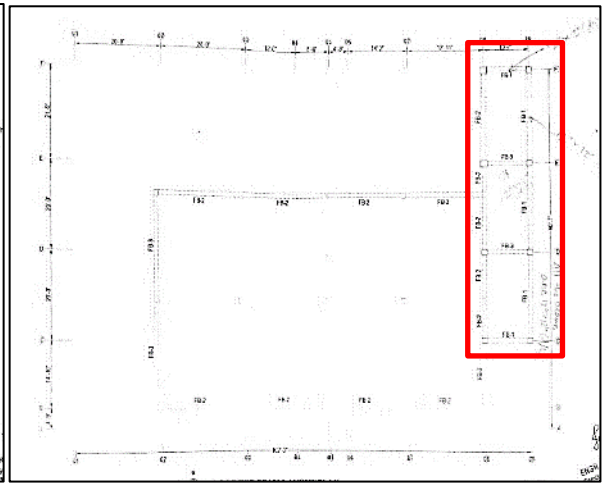
Observations: Building 7A

Discrepancies between as built drawing and on-site condition

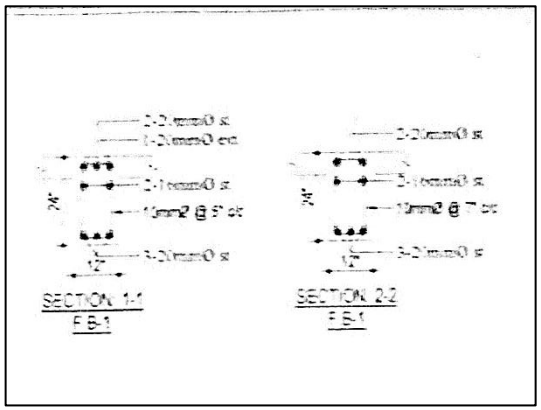
Observations: Building 7A



2nd floor beam layout



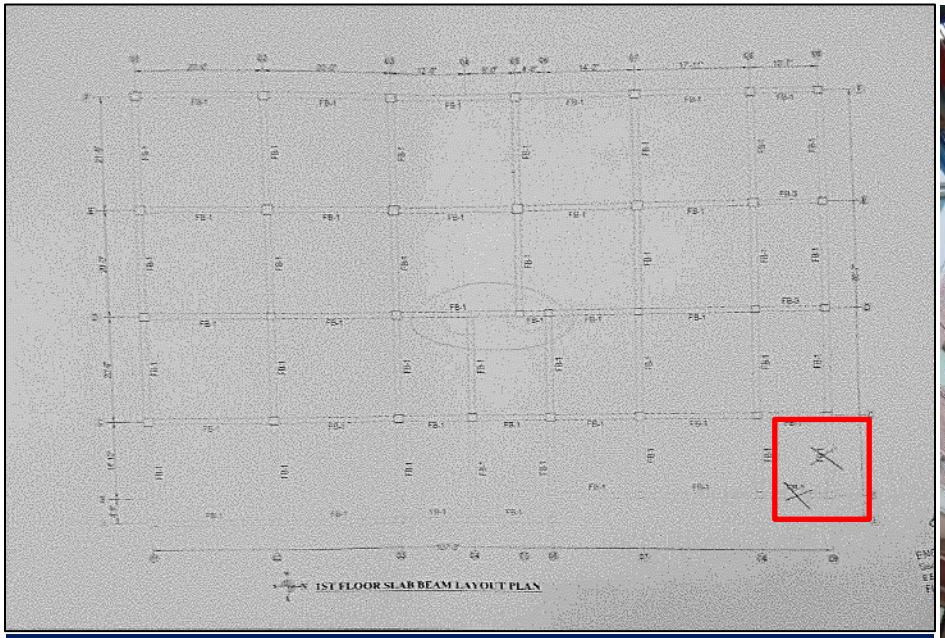
Roof floor beam layout



FB1 Beam Section

In the marked area of 2nd floor and roof, the down-stand of beam was measured 300 mm whereas as per drawings it should have been 450 mm (18 inches). Also, beam (FB-3) in the 2nd floor marked area were missing.

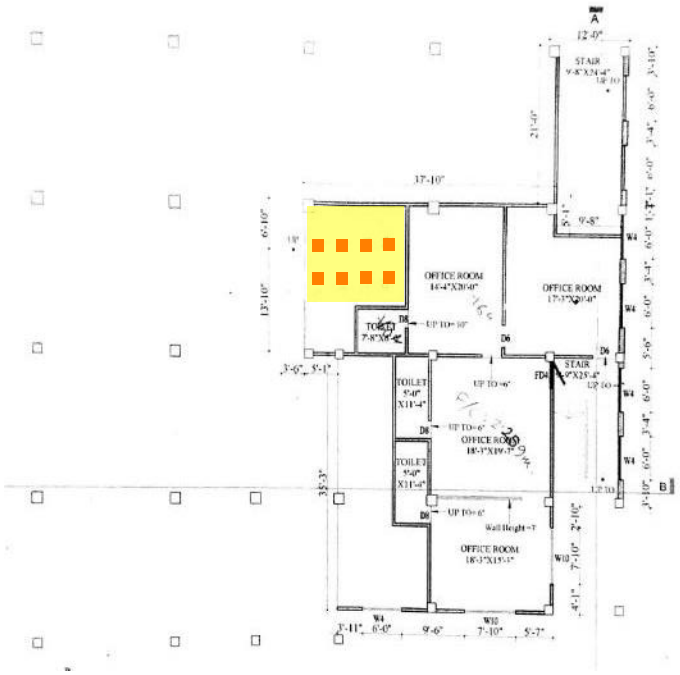
Observations: Building 7A



1st floor beam layout

Marked beams in the 1st floor beam layout were missing

Observations: Building 7A

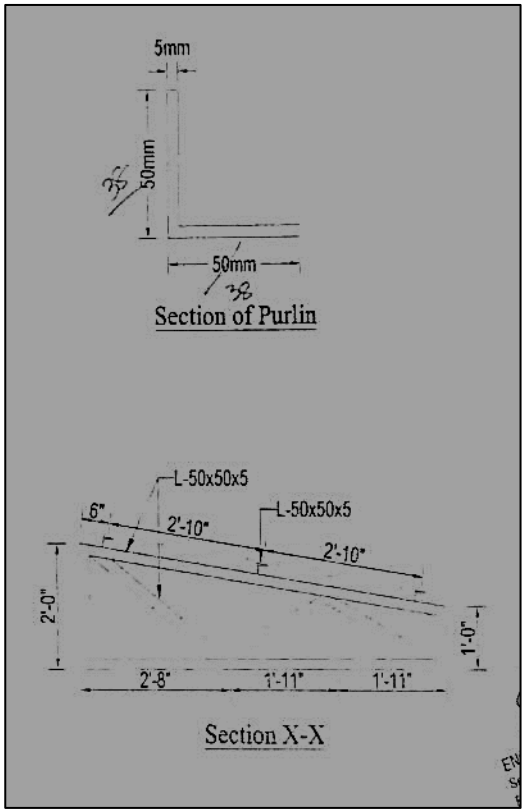


Undocumented mezzanine floor

Columns observed in the mezzanine area

An undocumented RC mezzanine floor portion was observed in between ground floor and 1st floor. Foundation details of additional columns are unknown.

Observations: Building 7A



As per the drawing, the angles in canopy are supposed to be 50 mm but during inspection, angles were measured 38 mm.

Observations: Building 7A

Non-engineered rooftop Shed

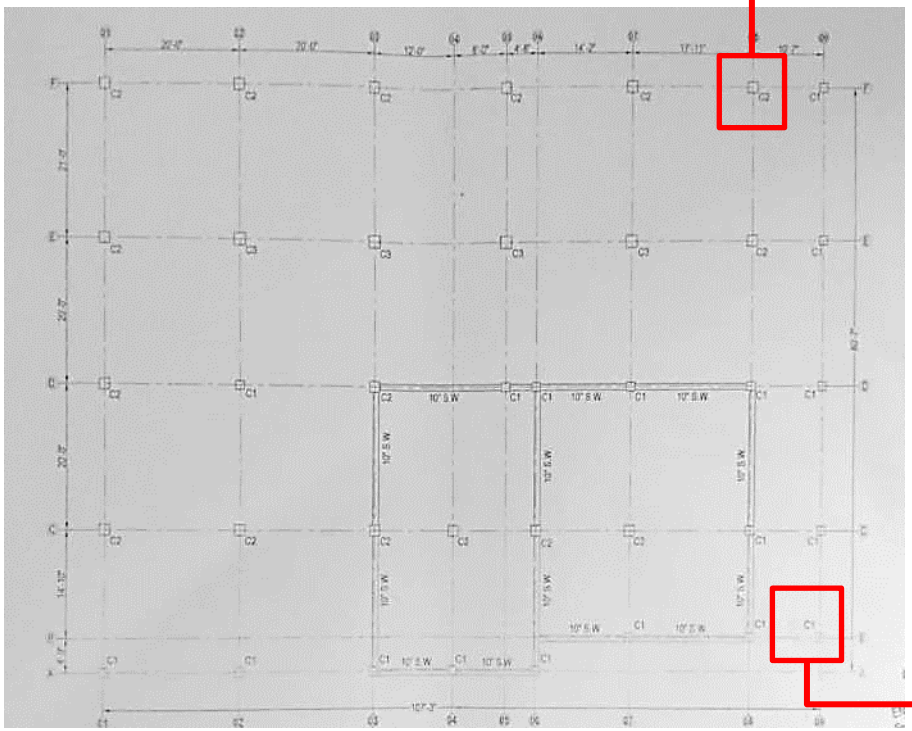
Observations: Building 7A

There is a rooftop shed on top of the building which is undocumented.The roof trusses are constructed with rebars and angles. Also As per as built drawings, the rooftop shed is required to be demolished but on site rooftop shed was found intact.

Observations: Building 7A

Damaged column

Observations: Building 7A



Column Layout

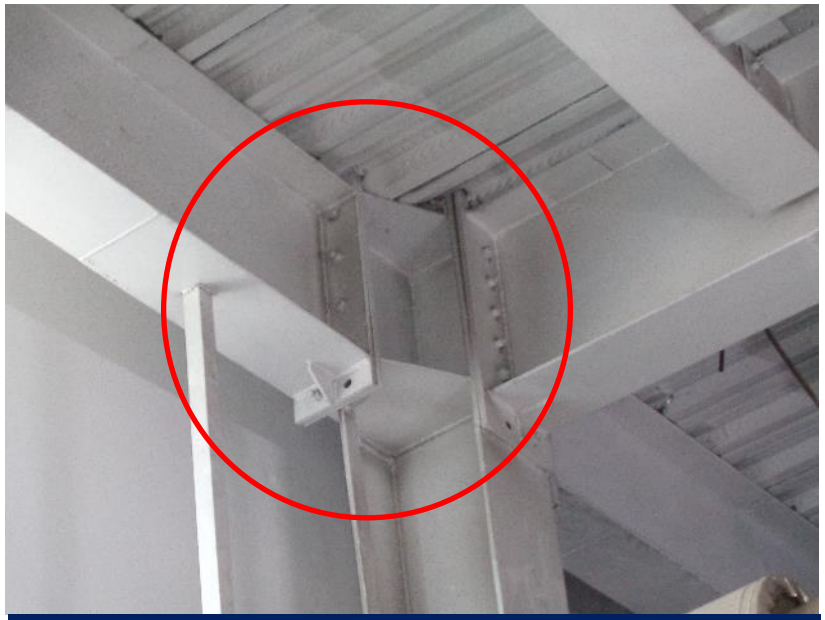
Column damage

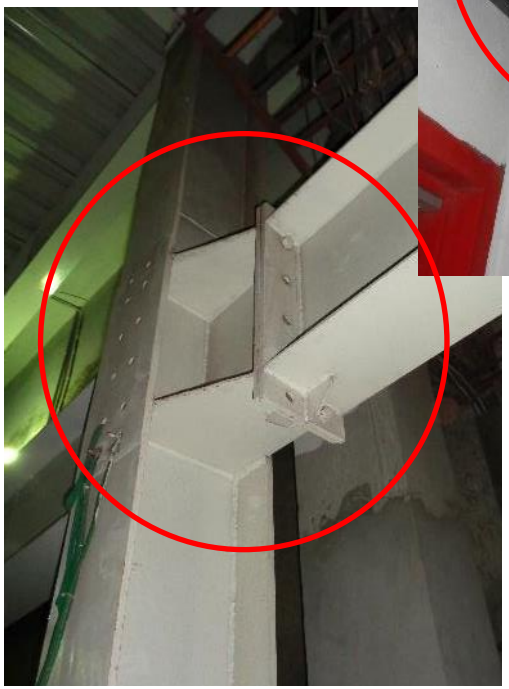
Column on Grid F-8 in the 2nd floor was found damaged due to fire door installation. Also, Column on grid B-09 in the ground floor was found damaged.

Observations: Building 7A

Bolt missing in connection

Observation : Building-9



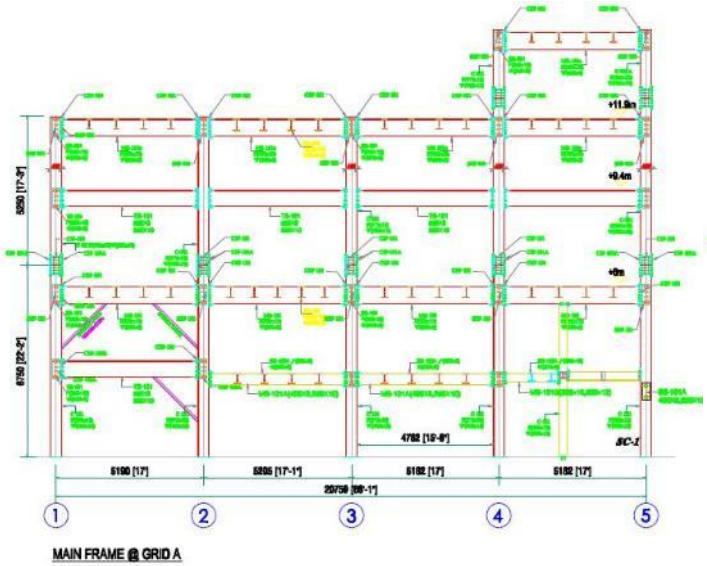


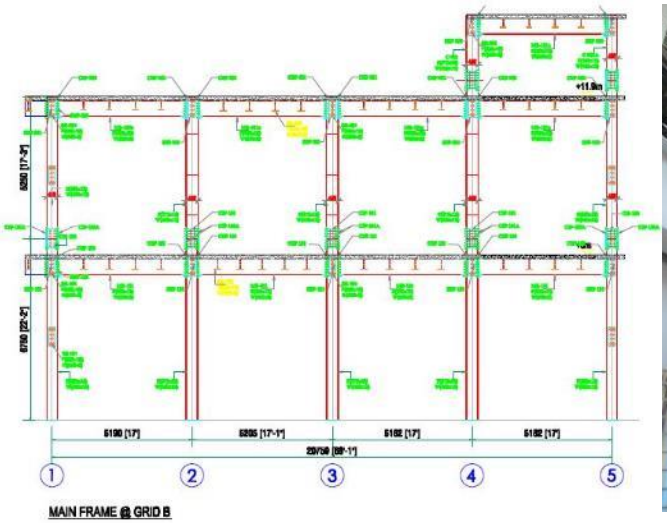
Bolts were missing in several location of the building. Building engineer is required to identified the location and reinstall the missing bolts as per specification.

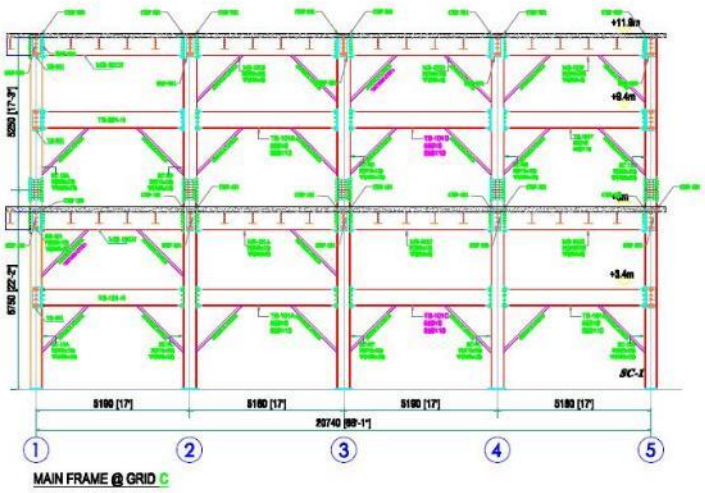
Observation : Building-9

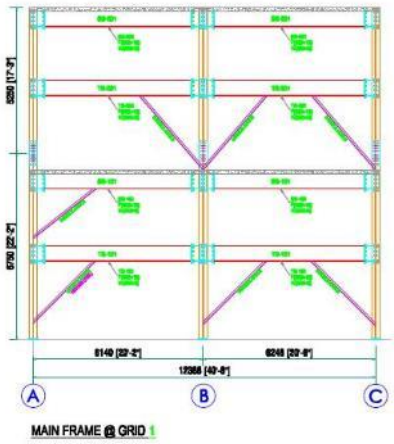
Irregular bracing system

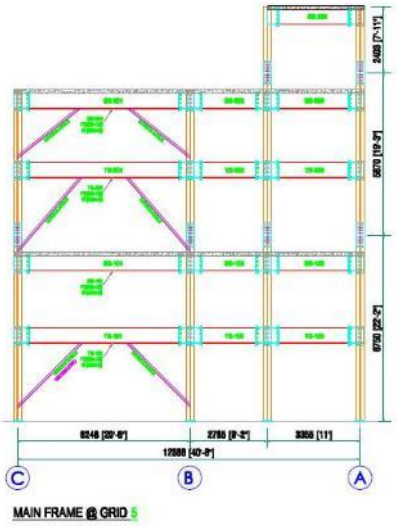
Observation : Building-9











Irregular bracing system observed in the building. Building engineer is required check the existing bracing system for lateral stability.

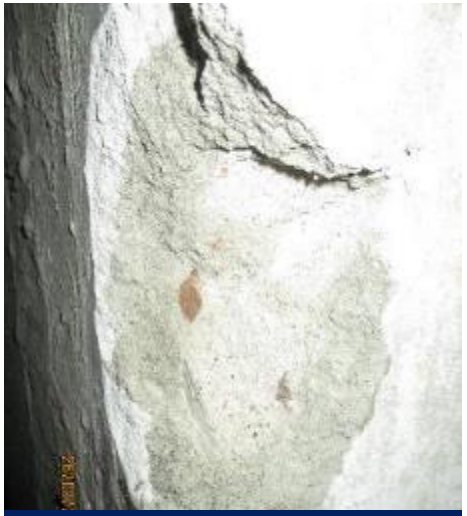
Observation : Building-9

Test Carried out

Stone chips (Building 6)

Brick chips (Building 4)

Brick chips (Building 1-extension)



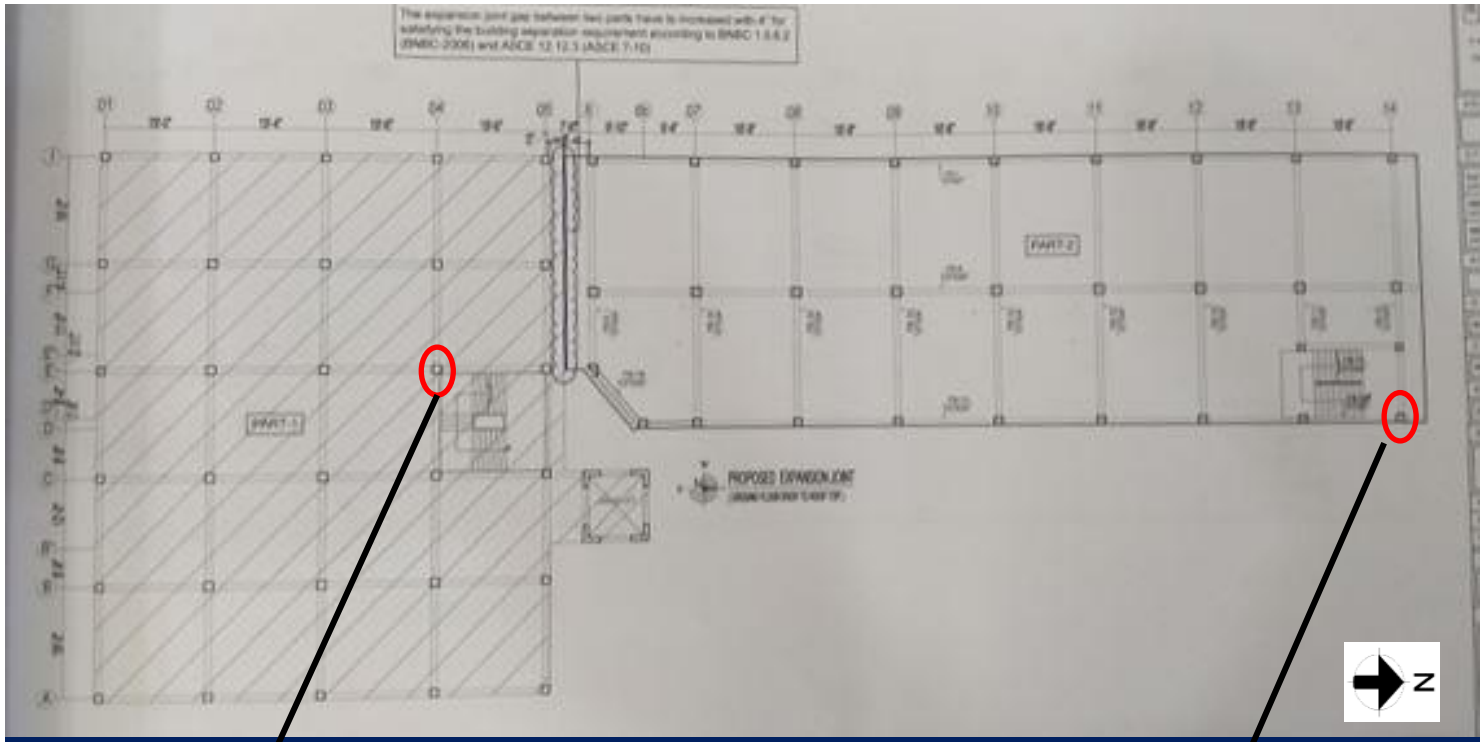
Stone chips (Building 1)

Test Carried Out

Column Layout

Stone chips (Building 7A)

Test Carried Out



Column layout (Building 7)

Stone Aggregate

Stone Aggregate

Test Carried out

Problems Observed

Building 1:

Item 1: High stress levels in columns that require immediate review

Item 2: Recommendation of DEA report.

Item 3: Crack on beam column Joint.

Item 4: Spalling of concrete at 3rd floor toilet area.

Building 1-extension:

Item 5: Review of the DEA report.

Building 4:

Item 6: Damaged beam & column.

Item 7: Discrepancies in as-built drawings.

Building 6:

Item 8: High stress levels in columns that require immediate review.

Item 9: Overloading on floor.

Building 7:

Item-10: Mismatches in the drawing and missing core cutting location.

Item-11: Non-engineered shed at roof.

Building 7A:

Item 12: Columns to be stressed above normal design limits.

Item 13: Discrepancies between as built drawing and onsite condition.

Item 14: Non-engineered Rooftop Shed.

Item 15: Damaged column.

Building 9:

Item 16: Bolt missing in connection.

Item 17: Inconsistency in drawings & bracing system.

Item 1 and actions

High stress levels in columns that require immediate review (Building-1)

Priority 1

(Immediate - Now)

- Factory Engineer to review design, loads, column and foundation stresses.
- A Detail Engineering Assessment to be commenced, see the attached Scope.

Priority 2

(within 6-weeks)

- Verify in situ concrete stresses either by 100 mm diameter cores (min. 4 nos.) from lower tier columns.
- Produce and actively manage a loading plan for all floor plates considering the floor, column and foundation capacity.
- Detail Engineering Assessment to be completed.

Priority 3

(within 6-months)

- Continue to implement load plan.
- Carry out any remedial works where necessary

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 ACCORD DEA guideline , ACCORD standard for Assessment of Structural Integrity of Existing RMG Factory Buildings in Bangladesh (Tripartite Document), the latest version of these document should be referenced. These 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 Elevation 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 ACCORD DEA guideline , ACCORD standard 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 see ACCORD DEA guideline & ACCORD standard more details.
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 ACCORD DEA guideline & ACCORD standard (http://bangladeshaccord.org/factories/resource-centre/).

Item 2 and actions

Recommendation of DEA report. (Building-1)

Priority 1 (Immediate - Now)	• Not Required
Priority 2 (within 6-weeks)	• Address all the issues noted on ITEM 1 and complete the DEA review. • Follow all the recommendations of the DEA report.
Priority 3 (within 6-months)	• Carry out any remedial works from DEA report where necessary.

Item 3 and actions

Crack on beam column Joint. (Building-1)

Priority 1 (Immediate - Now)	• Building engineer is required to carry out the investigation and suggest remedial works. • Building engineer is required to check whether temporary support is required or not.
Priority 2 (within 6-weeks)	• Carry out suitable repair works as per investigation report.
Priority 3 (within 6-months)	• Not Required.

Item 4 and actions

Spalling of concrete at 3rd floor toilet area. (Building-1)

Priority 1 (Immediate - Now)	• Not Required
Priority 2 (within 6-weeks)	• Building engineer is required to carryout civil works in a safe manner to the lose concrete.
Priority 3 (within 6-months)	• Not Required.

Item 5 and actions

Review of the DEA report. (Building 1-Extension)

Priority 1 (Immediate - Now)	• Not Required
Priority 2 (within 6-weeks)	• Building engineer is required to review the existing DEA report following BNBC-2006. Incorporate all the observations.
Priority 3 (within 6-months)	• Carry out remedial works where necessary.

Item 6 and actions

Damaged beam & column. (Building-4)

Priority 1 (Immediate - Now)	• Building engineer is required to carry out suitable repair works.
Priority 2 (within 6-weeks)	• Building engineer is required to check the capacity of the damaged structural members.
Priority 3 (within 6-months)	• Not Required.

Item 7 and actions

Discrepancies in as-built drawings. (Building-4)

Priority 1 (Immediate - Now)	• Not Required.
Priority 2 (within 6-weeks)	• Building engineer is required to survey the structure and prepared as constructed drawings. • Confirm the rebar diameter of the structure.
Priority 3 (within 6-months)	• Not Required.

Item 8 and actions

High stress levels in columns that require immediate review. (Building-6)

Priority 1

(Immediate - Now)

- Factory Engineer to review design, loads, columns and foundation stresses.
- A Detail Engineering Assessment to be commenced, see the attached Scope.

Priority 2

(within 6-weeks)

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

Priority 3

(within 6-months)

- Continue to implement load plan.
- Carry out any remedial works where necessary

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 ACCORD DEA guideline , ACCORD standard for Assessment of Structural Integrity of Existing RMG Factory Buildings in Bangladesh (Tripartite Document), the latest version of these document should be referenced. These 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 Elevation 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 ACCORD DEA guideline , ACCORD standard 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 see ACCORD DEA guideline & ACCORD standard more details.
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 ACCORD DEA guideline & ACCORD standard (http://bangladeshaccord.org/factories/resource-centre/).

Item 9 and actions

Overloading on floor. (Building-6)

Priority 1 (Immediate - Now)	• Maintain loading below 2 KN/m2.
Priority 2 (within 6-weeks)	• Produce and actively manage a loading plan for all floor plates within the Factory Building considering floor capacity and column capacity. • Detail Engineering Assessment to be completed.
Priority 3 (within 6-months)	• Continue to implement load plan.

Item 10 and actions

Mismatches in the drawing and missing core cutting location. (Building-7)

Priority 1 (Immediate - Now)	• Not Required.
Priority 2 (within 6-weeks)	• The building engineer to update the Detailed Engineering Assessment (structural design) report including the software analysis file for further review. • All core cutting location need to be exposed and revised the core layout plan as per site condition. • Update and actively manage the floor loading plans based on the column and floor capacity of the building.
Priority 3 (within 6-months)	• Complete remedial works after complete the DEA review. • Continue to implement load plan.

Item 11 and actions

Non-engineered shed at roof (Building-7: Part-1)

Priority 1 (Immediate - Now)	• Not Required.
Priority 2 (within 6-weeks)	• Building engineer to check the connection & capacity of the lightweight roof structure against lateral loading. • Or replace the existing shed with an engineered structure.
Priority 3 (within 6-months)	• Not Required.

Item 12 and actions

Columns to be stressed above normal design limits.(Building 7A)

Priority 1

(Immediate - Now)

- Not Required.

Priority 2

(within 6-weeks)

- Factory Engineer to review design, loads and columns stresses in area identified in observations.
- Verify in situ concrete stresses either by 100mm dia. cores or existing cylinder strength data for [the identified columns] or [100mm dia. cores from 4 columns].

Priority 3

(within 6-months)

- Produce and actively manage a loading plan for all floor plates within the factory considering floor capacity and column capacity.

Item 13 and actions

Discrepancies between as built drawing and on-site condition.(Building 7A)

Priority 1 (Immediate - Now)	• Not Required.
Priority 2 (within 6-weeks)	• Factory Engineer to survey the structure and prepare accurate as-built drawings.
Priority 3 (within 6-months)	• Not Required.

Item 14 and actions

Non-engineered Rooftop Shed (Building 7A)

Priority 1 (Immediate - Now)	• Not Required.
Priority 2 (within 6-weeks)	• Factory Engineer to analyze the lateral stability of the rooftop shed and take necessary steps as per analysis report.
Priority 3 (within 6-months)	• Not Required.

Item 15 and actions

Damaged column. (Building 7A)

Priority 1 (Immediate - Now)	• Not Required.
Priority 2 (within 6-weeks)	• Factory Engineer to properly repair the damaged elements.
Priority 3 (within 6-months)	• Not Required.

Item 16 and actions

Bolt missing in connection. (Building 9)

Priority 1 (Immediate - Now)	• Not Required.
Priority 2 (within 6-weeks)	• Install the missing bolts as per specification.
Priority 3 (within 6-months)	• Not Required.

Item 17 and actions

Irregular bracing system. (Building 9)

Priority 1

(Immediate - Now)

- Not Required.

Priority 2

(within 6-weeks)

- Building engineer is required to check the adequacy of existing bracing system for lateral stability.

Priority 3

(within 6-months)

- Not Required.

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 ACCORD.

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 in situ 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.