GLOBAL FIT (BANGLADESH) LIMITED

Plot # 868/1, Block - A, Jangalia Para, Vawal Mirjapur, Gazipur Sadar, Gazipur-1700

(24.092802, 90.384984)

17 January 2024

1. Building Information

Office Building: This structure is a three-storied (G+2) RC building.

Production Shed (Shed-01): This structure is a single-storied prefabricated steel shed.

Warehouse (Shed-02): This structure is a single-storied steel shed.

Fire Pump Room: This structure is a single-storied RCC building.

Utility Building: This structure is a single-storied RCC building.

Toilet Block: This structure is a single-storied steel shed.

Wastage Shed (Shed- 04): This structure is a single-storied shed.

Security Post: This structure is a single-storied RC structure.

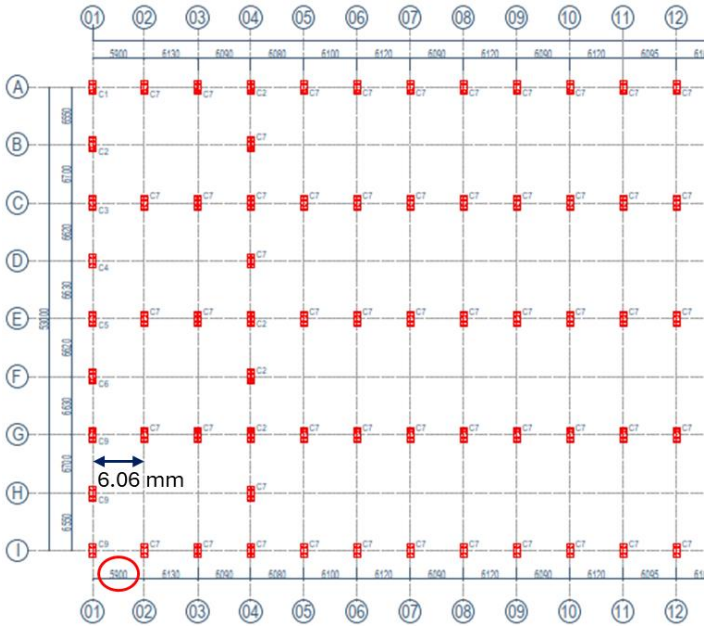
2. Observations:

Observation 1: Connection adequacy of the shed. (Production Shed)

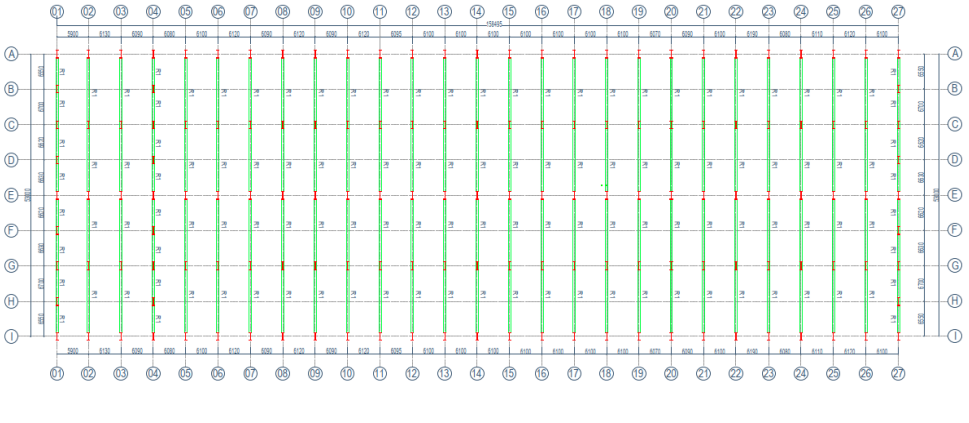
Connection between rafter to rafter

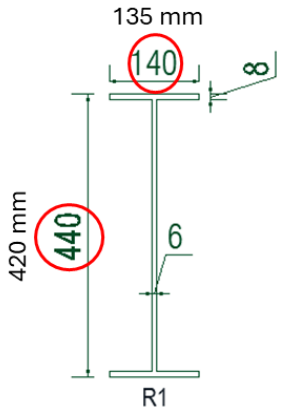
Description: The connection of the rafter is partially rigid. Full rigid connection was considered in the analysis. Building engineer is required to check the adequacy of the connection.

Observation 2: Mismatch in as-built drawings. (Production Shed)

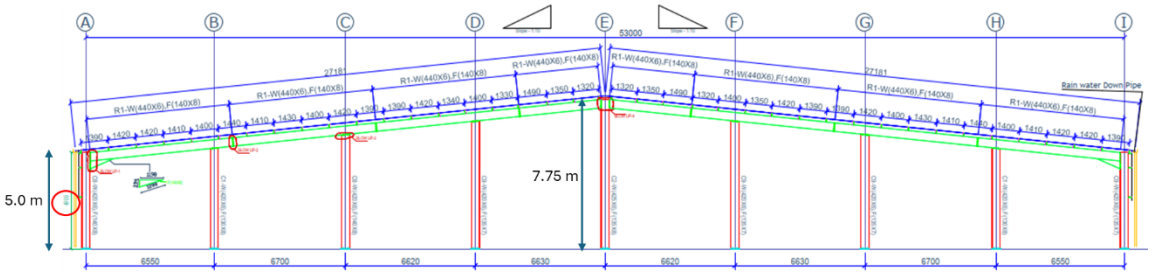


Mismatch in grid distance





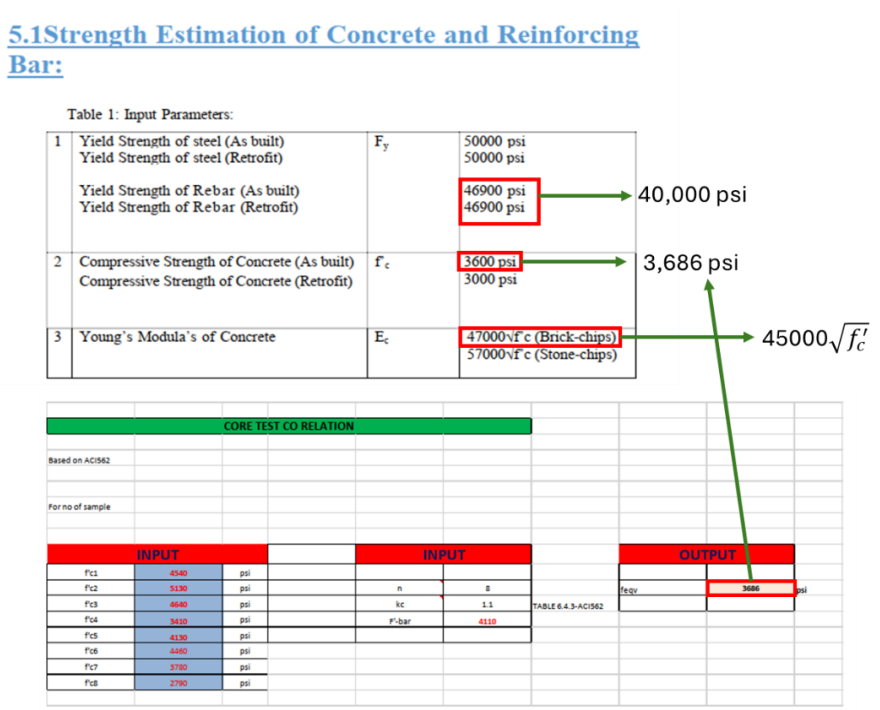
Mismatch in rafter size



Mismatch in eave and ridge height

Description: In the as-built drawing, the mismatch was found in the grid distance, rafter size, eave & ridge height. Grid distance between Grid 1 & 2 is found 6.06m, whereas the drawing shows 5.9m. All rafter sizes are shown W-440X6, F-140X8 but during inspection, rafter size was found W-420X6, F-135X8 on-site. Eave height is shown 4.91m in drawing but 5.0m was found on-site.

Observation-3: Inconsistency in design report. (Production Shed)



5.1Strength Estimation of Concrete and Reinforcing Bar:

Table 1: Input Parameters:

1	Yield Strength of steel (As built) Yield Strength of steel (Retrofit) Yield Strength of Rebar (As built) Yield Strength of Rebar (Retrofit)	F_y	50000 psi 50000 psi 46900 psi 46900 psi
2	Compressive Strength of Concrete (As built) Compressive Strength of Concrete (Retrofit)	f'_c	3600 psi 3000 psi
3	Young's Modula's of Concrete	E_c	47000√f'c (Brick-chips) 57000√f'c (Stone-chips)

40,000 psi

3,686 psi

$45000\sqrt{f'_c}$

CORE TEST CO RELATION

Based on ACI562

For no of sample

INPUT				INPUT			OUTPUT		
f'c1	4540	psi							
f'c2	5130	psi		n	8		feqv	3686	psi
f'c3	4640	psi		kc	1.1	TABLE 6.4.3-ACI562			
f'c4	3410	psi		f'-bar	4110				
f'c5	4130	psi							
f'c6	4460	psi							
f'c7	3780	psi							
f'c8	2790	psi							

The following summarized observations/conclusions/findings and key concerns appear to be noticeable regarding the structural condition of the existing Global Fit (BD) Limited.

- The column has been found adequate in capacity.
- The Beams has been found adequate in capacity.
- A foundation has been found adequate in capacity.

As per BNBC Standard

- **Serviceability:** All kind of serviceability checks are found within limit like deflection against earthquake and wind load, rotation is also within limit as we conducted modal analysis (dynamic analysis), drift ratio etc. as per BNBC 2006.
- **Structural Member:**
  - ✓ **Columns:** Demand Capacity Ratio of all columns is within limit. All of the columns have sufficient stiffness & strength.
  - ✓ **Beam:** All of the beams are found adequate in size and reinforcement for both flexure and shear.
  - ✓ **Slab:** Provided thickness and reinforcement of beam slab is adequate enough to resist code prescribed vertical load.
  - ✓ **Foundations:** RC column is supported by Isolated and Combined Footing. Provided foundation is adequate to resist vertical load (service condition that is un-factored load).

PART -8 DISCUSSION & CONCLUTION

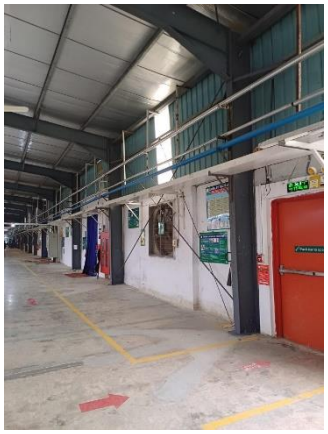
- Footing Capacity:
  All Footing has found adequate.
- RCC Column & Grade Beam Capacity:
  The axial, biaxial & shear capacity of all column has found adequate.
- Anchor Bolt Capacity:
  All Anchors bolt have found adequate capacity.
- Base Plate Capacity:
  All Base Plate have found adequate capacity.
- Steel Column Capacity:
  Steel columns have found adequate.
- Rafter Capacity:
  Rafters have found adequate
- Connection Adequacy Check:
  Connection has found within limit. adequate.

632	Taper	Taper	1.286	1
425	Taper	Taper	1.29	1
634	Taper	Taper	1.295	1
427	Taper	Taper	1.295	1
539	Taper	Taper	1.349	1
426	Taper	Taper	1.358	1
564	Taper	Taper	1.37	1
563	Taper	Taper	1.37	1
562	Taper	Taper	1.37	1
561	Taper	Taper	1.37	1
560	Taper	Taper	1.37	1
559	Taper	Taper	1.37	1
558	Taper	Taper	1.37	1
557	Taper	Taper	1.37	1
556	Taper	Taper	1.37	1

Description: As per the summarized observation & conclusion of the design report, beams and columns are shown as adequate. However, the PMM ratio of some members is more than the allowable limit. In the design report, the PMM ratio of the retrofitted structure is shown but no recommendation is provided for any retrofitting. The strength of retrofitted concrete is taken 3000 psi, but no test is carried out to verify the concrete strength.

As per the design report, the yield strength of rebar is 46,900 psi. Yield strength is required to be taken at 40,000 psi for structures constructed before 2005. Existing concrete strength is taken 3600 psi, but as per calculation concrete strength is found 3686 psi. Young's modulus of concrete with brick chip aggregate mentioned in the design report is not correct.

Observation 4: Apparently non-engineered wall bracing. (Production Shed)



Wall bracing

Lapping of deformed bar

Connection of deformed bar

Description: During the inspection, apparently non-engineered wall bracing was observed. 25 mm deformed bar was provided as wall bracing and lapping were provided at different locations of the rebars. The lapping length provided appears to be inadequate and the connections of the deformed bars are also poorly detailed.

Observation 5: Corrosion in steel member. (Production Shed)

Wall bracing

Description: During the inspection, corrosion was observed in the steel member.

Observation-6: Inconsistency in design report. (Office Building)

We had considered this as **Intermediate Moment resisting frame (IMRF)** for this project. (Ref. BNBC, Part-6, Sec1.3.2)

Strength Estimation of Concrete and Reinforcing Bar:

- **The grade of steel**, Concrete **used in the design of columns, slabs and beams are of** f_y **&** f'_c = Table 1: Input Parameters:

1	Yield Strength of steel	f_y	40,000 psi (As-Built) 60,000 psi (Retrofit)
2	Compressive Strength of Concrete for Column & Beam.	f'_c	2993 psi Column (As-Built) 2993psi G.Beam(As-Built) 2993psi F.Beam(As-Built) 2993psi Slab (As-Built) 3500 psi (Retrofit)
3	Young's Modula's of Concrete	E_c	45000√f'c (Bick's chip)

ACCEPTANCE CRITERIA FOR THE EVALUATION OF LINEAR ANALYSIS:

- **Code and Practice:**

For the present project, Guidelines of Bangladesh National Building Code (BNBC, 2006) have been used for analysis. For the reinforced concrete design, American Concrete Institute (ACI 318, 1999) code has been consulted as and when became necessary to complement the BNBC.

- **Load Definition and Input Parameters:**

Prior to structural analysis it is essential that the loads that may act upon the building during its lifetime be duly considered and incorporated in the analysis. The loads that may act upon the structure are as follows:

(ii) Live Load (L):

Live load is the gravity load due to non-permanent objects like machines, furniture, and human. Analysis has been carried out base on load recommended by BNBC (2006) for Buildings in Bangladesh and actual load acting on building. Following are the live load values used in the analysis.

Table 2: Typical Loading of Building considered for analysis

Floor	Type of Loading	Code Specified Load (Q_C) in psf. (As per BNBC)
FLOOR LOAD	Live Load	62.5
ROOF	Live Load	21
Floor finish		20

(iii). Wind load (W):

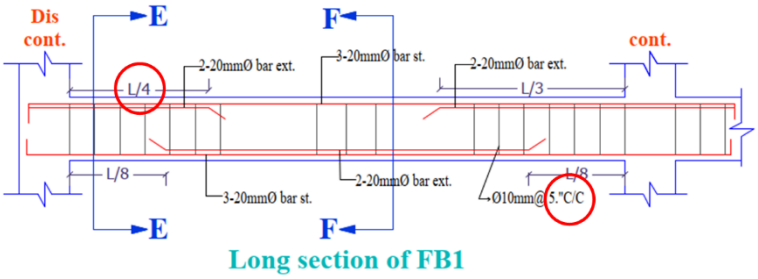
Bangladesh is typically a storm prone area where due consideration to the thrust due to storm must be given in the analysis and design of building and structures. Wind load due to storm is typically modeled as lateral thrust force causing sway or overturning of the building. Detailed specifications on wind loading on buildings are outlined in BNBC (2006). The present project is located in **Gazipur, Bangladesh.** For which the following basic parameters are used in wind load calculation,

Table 6.2.4
Minimum Roof Live Loads[1]

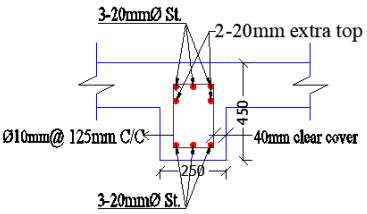
	Type and Slope of Roof	Distributed Load, kN/m²	Concentrated Load, kN
I	Flat roof (slope = 0)	1.5	1.8
II	1. Pitched or sloped roof (0 < slope < 1/3) 2. Arched roof or dome (rise < 1/8 span)	1.0	0.9
III	1. Pitched or sloped roof (1/3 ≤ slope < 1.0) 2. Arched roof or dome (1/8 ≤ rise < 3/8 span)	0.8	0.9
IV	1. Pitched or sloped roof (slope ≥ 1.0) 2. Arched roof or dome (rise ≥ 3/8 span)	0.6	0.9
V	Greenhouse, and agriculture buildings	0.5	0.9
VI	Canopies and awnings, except those with cloth covers	same as given in I through IV above based on the type and slope.	
Note : (1)	Greater of this load and rain load as specified in Sec 2.6.3 shall be taken as the design live load for roof. The distributed load shall be applied over the area of the roof projected upon a horizontal plane and shall not be applied simultaneously with the concentrated load. The concentrated load shall be assumed to act upon a 300 mm x 300 mm area and need not be considered for roofs capable of laterally distributing the load, e.g. reinforced concrete slabs.		

Inconsistency in material strength consideration

Inconsistency in live load consideration



Long section of FB1



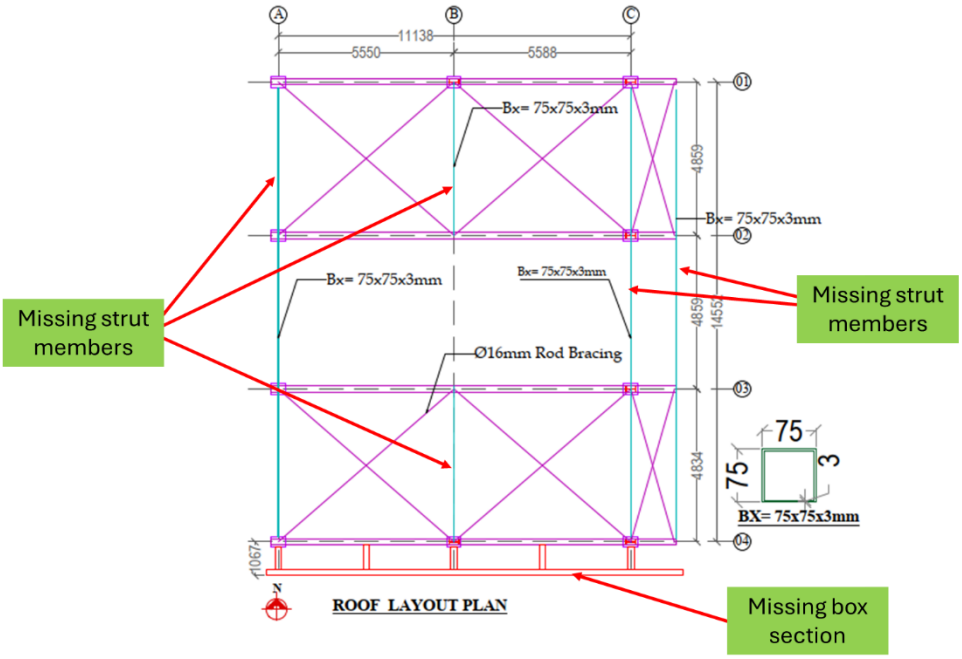
SECTION E-E

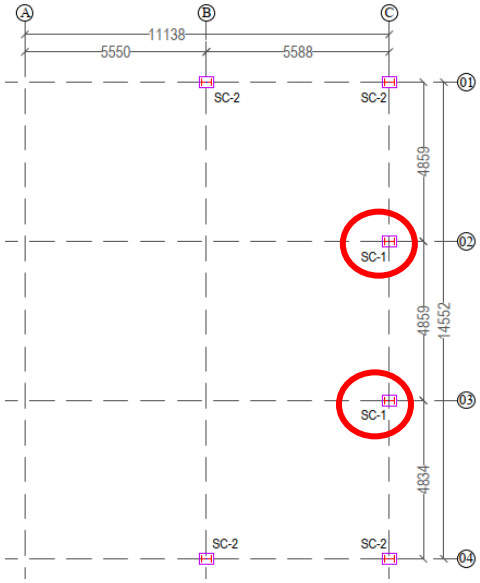
Inconsistency in structural system consideration

Description: As per design report, existing concrete strength for both beam and column is taken 2993 psi. Despite having concrete cores from slab, concrete strength of slab is taken same as equivalent concrete strength of columns. Since, construction drawing was not found on-site, design strength of columns and slabs cannot be verified. The building engineer is required to revise the material strength considerations for beams and slabs and give necessary justifications for not taking strengths of concrete cores obtained from slabs.

The strength of retrofitted concrete is taken 3500 psi, but no test is carried out to verify the concrete strength. In design report, roof live load is taken 1 kPa (21 psf) but as per BNBC 2006, roof live load is 1.5 kPa (31.5 psf). In design report, Intermediate moment resisting frame is considered but stirrup spacing of grade and floor beams doesn't comply with IMRF consideration of BNBC 2006.

Observation-7: Mismatch in as-built drawings. (Toilet Block)





STEEL COLUMN SCHEDULE		
ITEM	DIMENSION(mm)	SECTION
SC1	W-316 mmX5mm F-200mmX8 mm 150	150
SC2	W-312 mmX5mm F-150 mmX6 mm	

Description: During the inspection, the mismatch was found in the as-built drawing. Strut members are shown in the as-built drawing, but during the inspection, strut members were found missing on-site. A steel rafter supported by the cantilever rafters was found missing on-site. Sizes of steel column SC-1 is shown as W-316X5, and F-200X8 in the drawing, but column size was found W-316X5, and F-150X8 on-site.

Observation-8: Cut off flange found on steel column. (Toilet Block)

Description: During the inspection, cut off flange in a steel column was found at the Toilet Shed. The building engineer is required to investigate the cause of cutting off, prepare an investigation report, and repair the steel column accordingly.

Observation-9: Apparently non-engineered steel shed. (Wastage Shed)

Inadequate steel members

Poor steel rafter-column connection

Description: Apparently non-engineered lightweight steel shed. Lack of lateral stability, apparently inadequate steel members, and poorly detailed connections were found. During the inspection, corrosion was also found in the steel sections. The factory is required to replace the non-engineered shed with a properly engineered shed.

Observation-10: Mismatch in as-built drawing. (Warehouse)

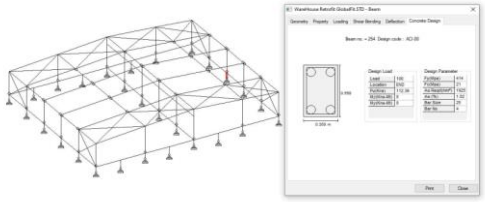
Mismatch in the as-built drawing

Description: Mismatch was found in the as-built drawing. The depth size of C1 was measured 390mm instead of 420mm and flange thickness was measured 6 mm instead of 8 mm.

Observation-11: Inconsistencies in design report. (Warehouse)

6.3 Short Column Adequacy Check from model:

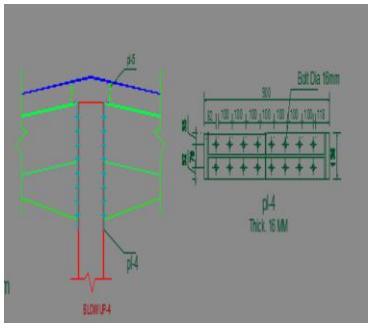
FOR SHORT COLUMN:

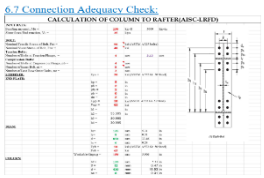


5.1Strength Estimation of Concrete and Reinforcing Bar:

Table 1: Input Parameters:

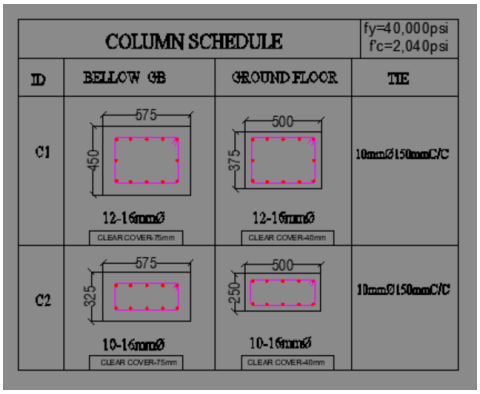
1	Yield Strength of steel (As built) Yield Strength of steel (Retrofit) Yield Strength of Rebar (As built) Yield Strength of Rebar (Retrofit)	F_y	50000 psi 50000 psi 46900 psi 46900 psi
2	Compressive Strength of Concrete (As built) Compressive Strength of Concrete (Retrofit)	f'_c	5022 psi 5022 psi
3	Young's Modula's of Concrete	E_c	47000√f'c (Brick-chips) 57000√f'c (Stone-chips)





Description: The steel strength is considered as 415 MPa in design analysis but in the material strength chapter it was considered as 323 MPa. Also, no test report was provided for the 415 MPa rebar. Also in the connection adequacy chapter, the type of connection is shown as not matched with the site condition.

Observation-12: Mismatch in as-built drawing. (Utility Building)



Mismatch in column dimension

Description: During the inspection it was observed that the C1 column width is 250 mm however in the drawing it shows 375mm.

3. Action Plan:

Observation	Action Plan	Timeline
Connection adequacy of the shed. (Production Shed)	Building engineer is required to check the connection adequacy of the shed and incorporate it in the design report.	within 6 weeks
	Carry out remedial work if required.	within 6 months
Mismatch in as-built drawings. (Production Shed)	The building engineer is required to survey the structure, collect information, and prepare accurate as-built drawings.	within 6 weeks
Inconsistency in design report. (Production Shed)	The building engineer is required to revise the design report and FEA model.	within 6 weeks
	Carry out remedial work if required.	within 6 months
Apparently non-engineered wall bracing. (Production Shed)	The building engineer is required to justify the application of the wall bracings and check the detailing of the connections.	within 6 weeks
	Carry out remedial work if required.	within 6 months
Corrosion in steel members. (Production Shed)	Building engineer is required to remove the rust and apply anti-corrosive paint.	within 6 weeks
Inconsistency in design report. (Office Building)	The building engineer is required to revise the design report and FEA model.	within 6 weeks
	Carry out remedial work if required.	within 6 months
Mismatch in as-built drawings. (Toilet Block)	The building engineer is required to survey the structure, collect information, and prepare accurate as-built drawings.	within 6 weeks
Cut off flange found on steel column. (Toilet Block)	The building engineer is required to investigate the cause of cutting off, prepare an investigation report, and repair the steel column accordingly.	within 6 weeks
	Carry out remedial work if required.	within 6 months
Apparently non-engineered steel shed. (Wastage Shed)	The building engineer is required to replace the non-engineered shed with a properly engineered shed.	within 6 months
Mismatch in the as-built drawing. (Warehouse)	The building engineer is required to survey the structure, collect information, and prepare accurate as-built drawings.	within 6 weeks
Inconsistencies in design report. (Warehouse)	Building engineer is required to prepare the design report following the provision of BNBC 1.9.	within 6 weeks
	Carry out remedial work if required.	within 6 months
Mismatch in the as-built drawing. (Utility Building)	The building engineer is required to survey the structure, collect information, and prepare accurate as-built drawings.	within 6 weeks