Al Muslim Apparels Ltd. (New Building)

C. S Dug No. 04 & 12, Nishchintapur, Zirabo, Ashulia, Savar, Dhaka

(23.9245265889, 90.308980602)

6 March 2024

RSC RMG SUSTAINABILITY COUNCIL

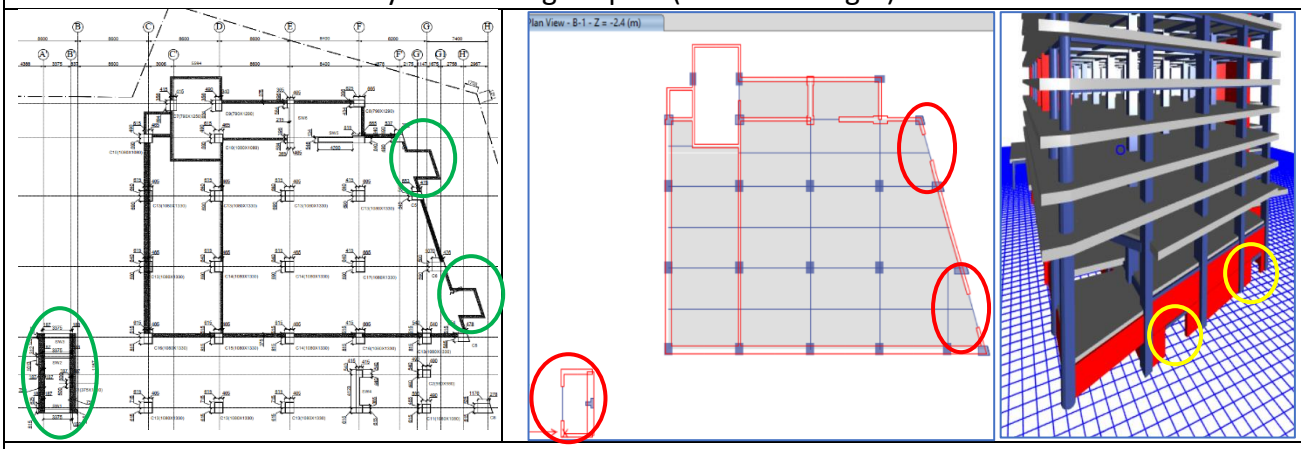
Level 5, Shanta Forum, 187, 188/B,
Bir Uttam Mir Shawkat Sarak, Tejgaon,
Dhaka- 1208, Bangladesh
PABX : +880 2 41081863-6
www.rsc-bd.org

1. Building Information

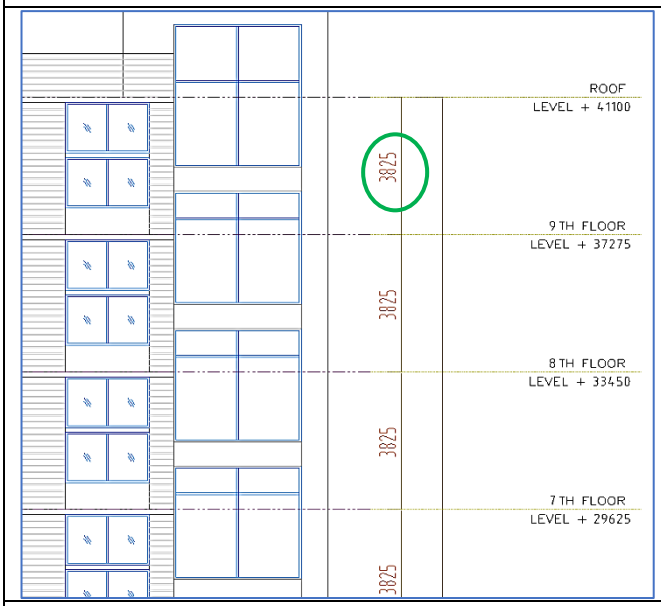
1) Main Building: The building is existing partial four-storied and proposed for eleven-storied (B+G+9) reinforced concrete building.

2. Observations

Observation-1: Inconsistency in the design report (Main Building-2).



The green marked RC walls are not properly incorporated in the analysis model. In the analysis model discontinuous RC wall observed which does not match the provided structural drawing.



Story Data

Story	Height m	Elevation m	Master Story
MR Top	1.9	45.373	No
Stair top	2.85	43.473	No
Roof	3.048	40.623	No
9th Floor	3.825	37.575	No
8th Floor	3.825	33.75	No
7th Floor	3.825	29.925	No
6th Floor	3.825	26.1	No
5th Floor	3.825	22.275	No
4th Floor	3.825	18.45	No
3rd Floor	3.825	14.625	No
2nd Floor	3.825	10.8	Yes
1st Floor	5.475	6.975	No
GF	3.9	1.5	No
B-1	3.2	-2.4	No

Building elevation height is mismatching with the analysis model and provided drawing. The 9th floor height considered 3.048m in analysis model and 3.825m considered in the provided drawing.

2.3 Classification of The Building

Occupancy Classification –

Occupancy, G : Industrial Buildings.

Subdivision, G2 : Moderate Hazard Industries.

(BNBC 2.1.11).

Fire Resistance Classification –

Fire Zone 2 : Industrial Buildings.

(Table 3.2.4)

Occupancy Category of the Building for Wind and Earthquake Loads:

Occupancy Category : IV

(BNBC 2020 Part VI: Table:6.1.1).

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Table 2.3 :Base Shear (BNBC 2020-Manually Calculated)

Site Class	***SD***
Zone	***3***
Occupancy Category	***iii***
Building Height (in Meter)	**33.23 m**
Seismic Design Category	***D***
Structure Type (for C_t & m)	***All others Structural System***
Response Reduction Factor, R	***Intermediate Moment Frames with Special Shear Wall***

In the section 2.3 occupancy category was considered as IV (4) but in the lateral loading calculation it has been considered as III (3).

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Table 2.3 :Base Shear (BNBC 2020-Manually Calculated)

Site Class	*SD*
Zone	*3*
Occupancy Category	*iii*
Building Height (in Meter)	**33.23 m**
Seismic Design Category	*D*
Structure Type (for C_t & m)	***All others Structural System***
Response Reduction Factor, R	***Intermediate Moment Frames with Special Shear Wall***

2.6 Structural System

Selection of structural system normally depends on site class, seismic zone & seismic design category as per BNBC-2020.
From section 2.1 & 2.5 of this report, we have found that seismic zone -II & Site Class – SC for this structure.
As per BNBC-2020 (Table-6.2.18) Seismic design category for this structure is C. Reference from BNBC added below.

Table 6.2.18: Seismic Design Category of Buildings

Site Class	Occupancy Category I, II and III				Occupancy Category IV			
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
SA	B	C	C	D	C	D	D	D
SB	B	C	D	D	C	D	D	D
SC	B	C	D	D	C	D	D	D
SD	C	D	D	D	D	D	D	D
SE, S_1, S_2	D	D	D	D	D	D	D	D

Considering the above factors, **Intermediate Reinforced Concrete Moment Resisting Frames (IMRF) with Special Shear wall** is adopted for this structure.
(BNBC-2020, Sec. 1. 3. 2 & Table-6.2.19).

In the section 2.6 the seismic zone -II (2), Site Class – SC, and seismic design category C were considered but in the seismic calculation (section 2.8.4) the seismic zone -III (3), Site Class – SD, and seismic design category D have been considered.

Time Period, T = Ct(h)m	0.645
Site coefficient, S (Table-6.2.16, BNBC-2020)	1.35
Damping Correction factor, η	1 (5% damping)
TB (Table-6.2.16, BNBC-2020)	0.2
TC (Table-6.2.16, BNBC-2020)	0.8
Here, TB < T < TC, Hence, CS value will be as follows below	
Normalized acceleration response spectrum., CS = 2.5 Sη	3.375
Response modification coefficient, R	6.5
Spectral Acceleration, Sa = (2/3) (*ZI*/*R*) Cs	0.1212
Seismic Weight, W (kip) =	58095
Seismic Base Shear, V (kip) = Sa W	7041

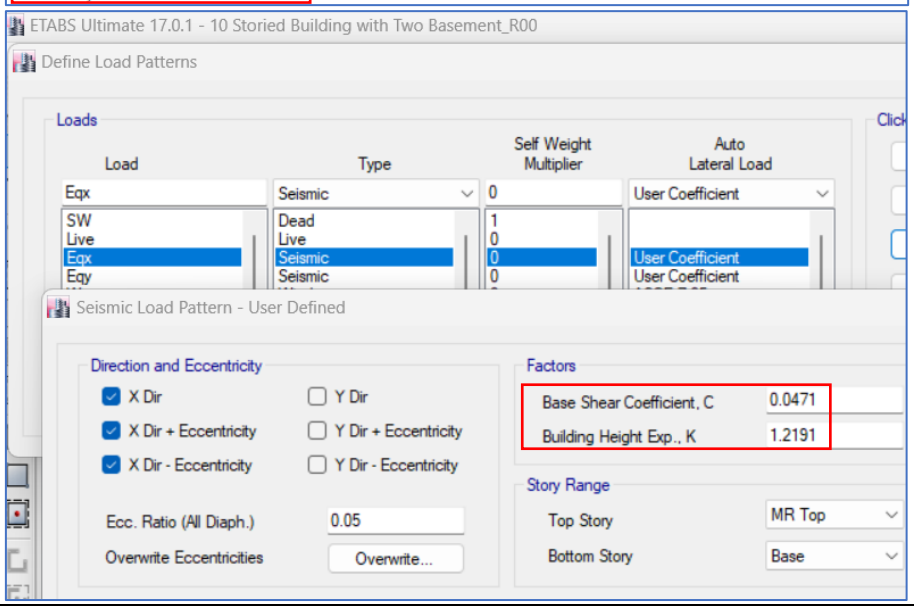
Calculation of Building Height Exp. Value, K

K = 1 when T ≤ 0.5s

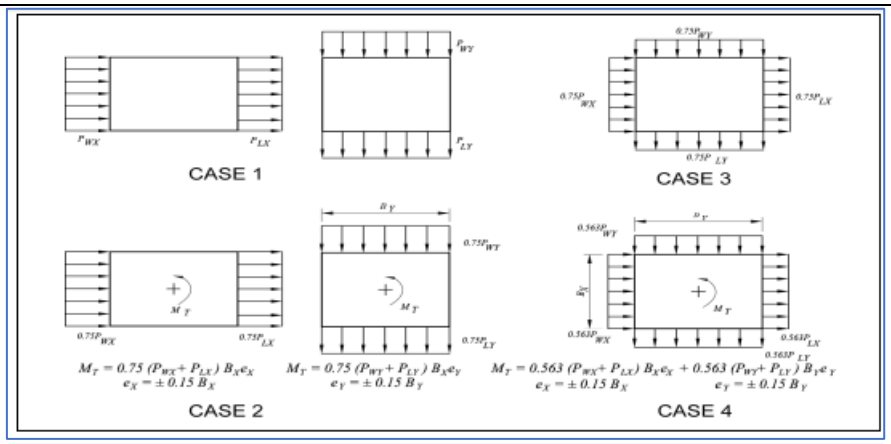
K = 2 When T ≥ 2.5s

when 0.5s < T< 2.5s, Value of **K** will be determined by linear interpolation (Sec-2 BNBC-2020).

Hence, Value of K = 1.088



In the analysis model seismic parameters assignment mismatching with the design report calculated base shear coefficient C and building height exp. K.

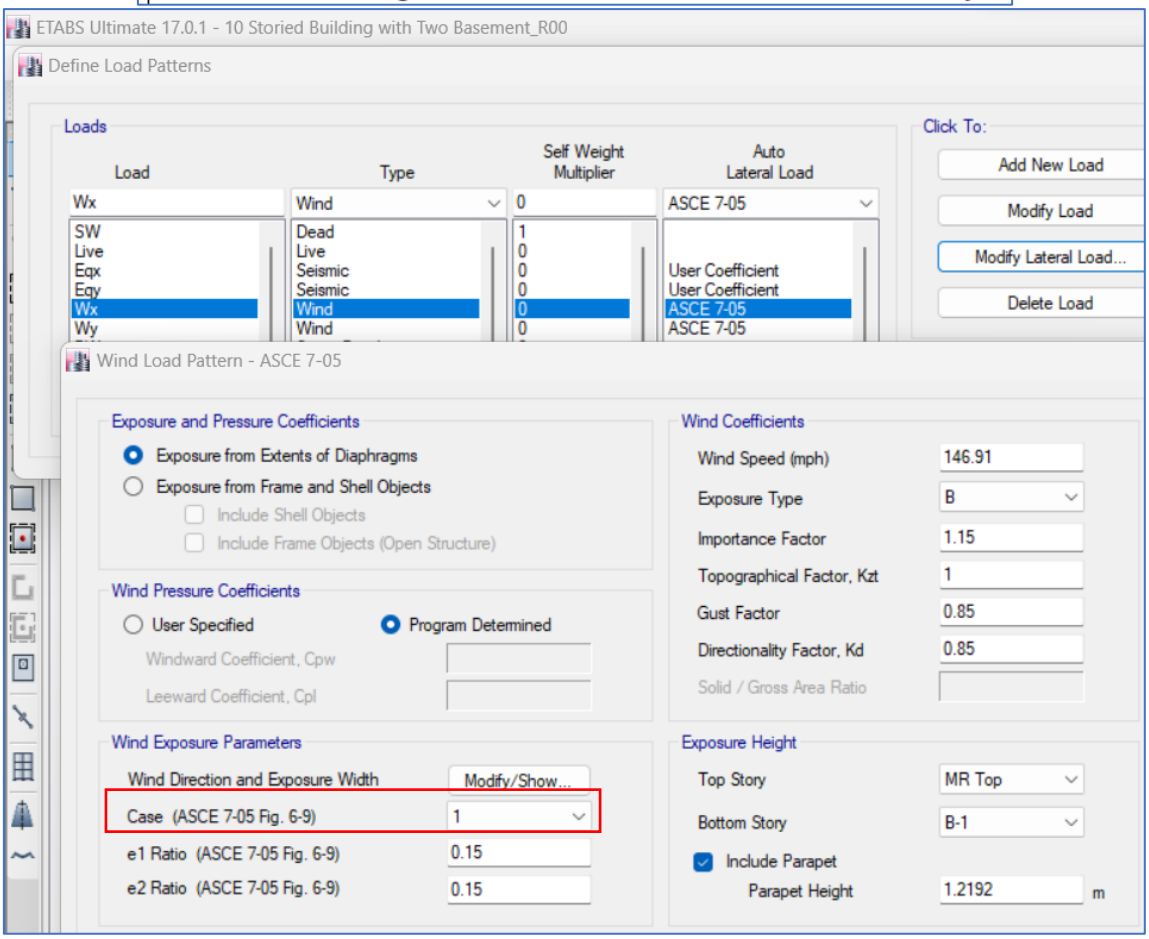


Case 1. Full design wind pressure acting on the projected area perpendicular to each principal axis of the structure, considered separately along each principal axis.

Case 2. Three quarters of the design wind pressure acting on the projected area perpendicular to each principal axis of the structure in conjunction with a torsional moment as shown, considered separately for each principal axis.

Case 3. Wind loading as defined in Case 1, but considered to act simultaneously at 75% of the specified value.

Case 4. Wind loading as defined in Case 2, but considered to act simultaneously at

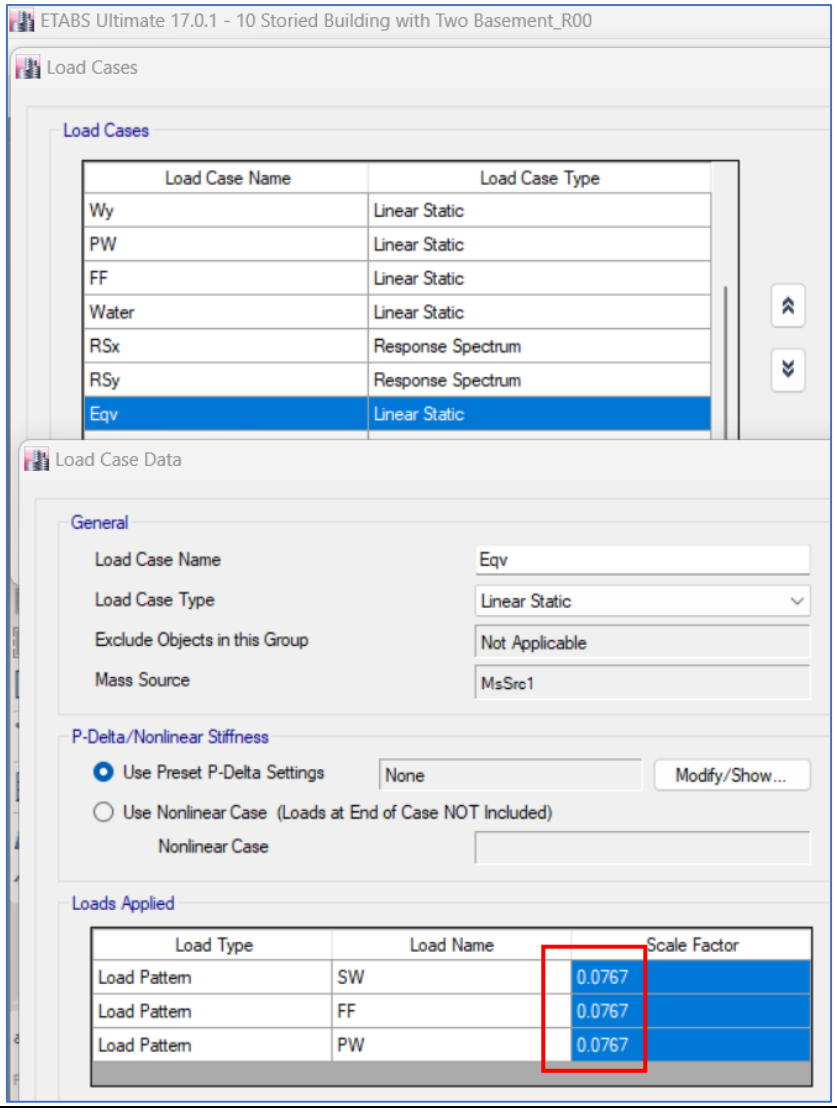


All four load cases (BNBC 2020 Fig-6.2.9) were not considered in considered in the analysis file (only one set load case considered).

2.5.13.2 Vertical earthquake loading, E_v

The maximum vertical ground acceleration shall be taken as 50 percent of the expected horizontal peak ground acceleration (PGA). The vertical seismic load effect E_v may be determined as:

$$E_v = 0.50(a_h)D \qquad (6.2.56)$$



Vertical earthquake loading factor, as per BNBC 2020 section 2.5.13 and provided design report the calculated Ev factor does not match with the assignment of analysis model.

2.6 Structural System

Selection of structural system normally depends on site class, seismic zone & seismic design category as per BNBC-2020.
From section 2.1 & 2.5 of this report, we have found that seismic zone -II & Site Class – SC for this structure.
As per BNBC-2020 (Table-6.2.18) Seismic design category for this structure is C. Reference from BNBC added below.

Table 6.2.18: Seismic Design Category of Buildings

Site Class	Occupancy Category I, II and III				Occupancy Category IV			
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 1	Zone 2	Zone 3	Zone 4
SA	B	C	C	D	C	D	D	D
SB	B	C	D	D	C	D	D	D
SC	B	C	D	D	C	D	D	D
SD	C	D	D	D	D	D	D	D
SE, S_1, S_2	D	D	D	D	D	D	D	D

Considering the above factors, **Intermediate Reinforced Concrete Moment Resisting Frames (IMRF) with Special Shear wall** is adopted for this structure.
(BNBC-2020, Sec. 1. 3. 2 & Table-6.2.19).

8.3.3.4 Reinforcement in special moment frames and special structural walls

(a) Requirements of Sec 8.3.3.4 shall apply to special moment frames, special structural walls and all components of special structural walls including coupling beams and wall piers.

(b) Deformed reinforcement resisting earthquake-induced flexural and axial force, or both, shall comply with ASTM A706 Grade 420. Alternatively only BDS ISO 6935-2 Grades 300, 350, 400 and 420 or ASTM A615 Grades 275 and 420 reinforcement shall be permitted if:

2.7 Material

2.7.1.1 Concrete:

Compressive Strength of Concrete:

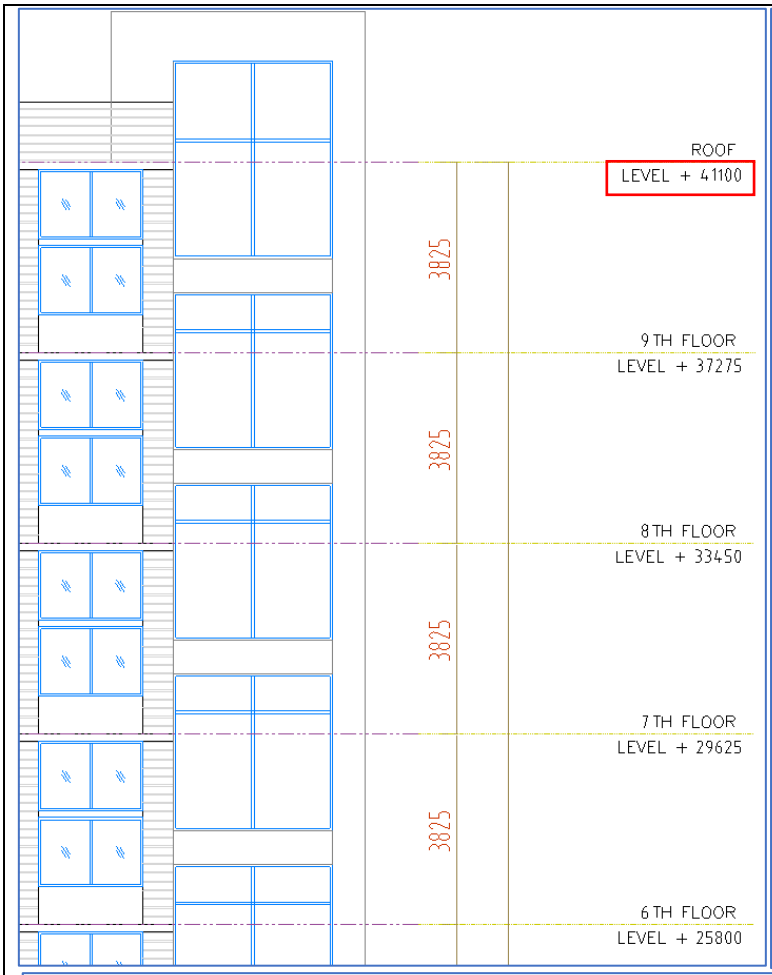
Compressive Strength of Concrete is considered f'_c = **4500** psi for all foundations Shear Wall & columns.
Compressive Strength of Concrete is considered f'_c = **4000** psi for Beam.
Compressive Strength of Concrete is considered f'_c = **4000** psi for Slab.

Reinforcing bar:

High strength deformed bar with Min[m] Yield Strength, f_y = 500 Mpa (72,500 psi) conformed to one of the following ASTM specifications.

i) A615-40M, ii) A616-40M, iii) A617-40M, & iv) A706-40M

Inappropriate yield strength consideration. In the design report the structural system is considered dual system IMF with Special Shear wall. So, re-bar design strength shall be within 420 MPa (BNBC 2020 section-8.3.3.4) but in the design report minimum yield strength was considered 500 MPa.



2.9.1 Load Combination:

- R.C.C structural members have been checked that t required to resist the most unfavorable effect of the as per **BNBC-2020** are shown below:

1	1.4D
2	1.2D + 1.6Lf + 0.5Lr
3	1.2D + 1.6Lr + Lf
4	1.2D + 1.6Lr + 0.8WX (+)
5	1.2D + 1.6Lr + 0.8WX (-)
6	1.2D + 1.6Lr + 0.8WY (+)
7	1.2D + 1.6Lr + 0.8WY (-)
8	1.2D + Lf + 0.5Lr + 1.6WX (+)
9	1.2D + Lf + 0.5Lr + 1.6WX (-)
10	1.2D + Lf + 0.5Lr + 1.6WY (+)
11	1.2D + Lf + 0.5Lr + 1.6WY (-)
12	1.2D + Lf + EX (+) + 0.3EY (+) + Ev
13	1.2D + Lf + EX (+) + 0.3EY (-) + Ev
14	1.2D + Lf + EX (-) + 0.3EY (+) + Ev
15	1.2 D + Lf + EX (-) + 0.3EY (-) + Ev
16	1.2D + Lf + EY (+) + 0.3EX (+) + Ev
17	1.2D + Lf + EY (+) + 0.3EX (-) + Ev
18	1.2D + Lf + EY (-) + 0.3EX (+) + Ev
19	1.2D + Lf + EY (-) + 0.3EX (-) + Ev
20	0.9D + 1.6 WX (+)
21	0.9D + 1.6 WX (-)
22	0.9D + 1.6 WY (+)
23	0.9D + 1.6 WY (-)

2.5.8 Dynamic Analysis Methods

Dynamic analysis method involves applying principles of structural dynamics to compute the response of the structure to applied dynamic (earthquake) loads.

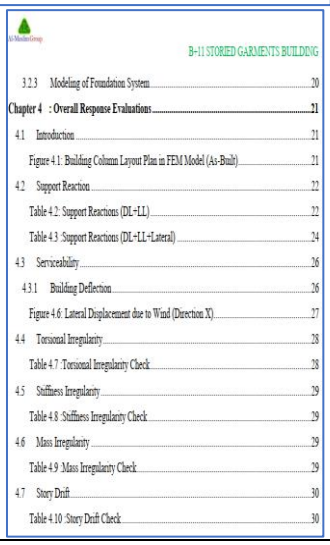
2.5.8.1 Requirement for dynamic analysis

Dynamic analysis should be performed to obtain the design seismic force, and its distribution to different levels along the height of the building and to the various lateral load resisting elements, for the following buildings:

(a) Regular buildings with height greater than 40 m in Zones 2, 3, 4 and greater than 90 m in Zone 1.

(b) Irregular buildings (as defined in Sec 2.5.5.3) with height greater than 12 m in Zones 2, 3, 4 and greater than 40 m in Zone 1.

For irregular buildings, smaller than 40 m in height in Zone 1, dynamic analysis, even though not mandatory, is recommended.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Dynamic analysis need to be considered, in the design report static analysis was considered to design the building. The building height is more than 40m and in the seismic zone II so as per BNBC 2020 2.5.8.1.a. dynamic analysis shall be considered.

Also, for structural configurations all irregularity checks (BNBC 2020 table 6.1.4 & 6.1.5) and foundation adequacy checks were not incorporated in the design report.

Description: In the provided design report, inconsistencies were observed in the structural configurations, geometry of the structure, seismic & wind load parameters, special re-bar detailing, analysis considerations, and member design review.

The building engineer is required to check lateral load parameters & design considerations and update the design report as per BNBC section 1.9.1.

Observation-2: Design concrete strength verification from existing cylinder test data (Main Building-2)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY (BUET)
DEPARTMENT OF CIVIL ENGINEERING
CONCRETE LABORATORY

BRTC No. : 1102-70376 /22-23/CE; Dt: 18/9/2022
Sent by : [illegible], Sr. Project Manager (Construction), Al-Muslim Apparels Ltd.
Nabdintapur, Ashulia, Dhaka
Ref. No. : [illegible]
Project : Mat Foundation of Ten Storied Main Building for Al-Muslim Apparels Ltd. At 12 Nabdintapur, Ashulia, Savar, Dhaka
Sample : Concrete Cylinder [Aggregate Type: Stone chips]
Location : Mat Foundation [Mix proportion(as quoted): 1:1.25:2.50]
[Admixture Added (as per letter): Not mentioned]
Test : Compressive Strength Test of Concrete Cylinder (ASTM C39)
Date of Test : 11/9/2022

TEST REPORT

SL No.	Date of Casting as per the letter	Specimen Designation/ Frog Mark	Specimen Area	Maximum Load	Crushing Strength	Average Crushing Strength	Mode of Failure
			(sq. in)	(lb)	(psi)		
1	6/8/2022	Al-Muslim	12.30	78,884	6,413	—	Combined*
2	(33 days test)	Al-Muslim	12.67	95,655	7,888		Combined*
3		Al-Muslim	12.80	102,502	8,313		Combined*

* Combined = Mortar and Aggregate Failure

Note: Samples were received in unsealed condition.

Countersigned by: Dr. A. B. M. Badruzzaman, Professor, Department of Civil Engineering, BUET, Dhaka-1000, Bangladesh

Test Performed by: Dr. Hasib Mohammed Ahsan, Professor, Department of Civil Engineering, BUET, Dhaka-1000, Bangladesh

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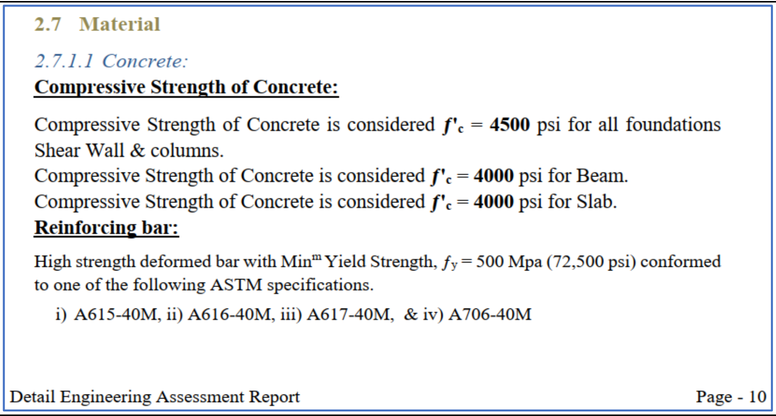

2.7 Material

2.7.1.1 Concrete:

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Compressive Strength of Concrete is considered f'_c = **4500** psi for all foundations Shear Wall & columns.
Compressive Strength of Concrete is considered f'_c = **4000** psi for Beam.
Compressive Strength of Concrete is considered f'_c = **4000** psi for Slab.

Reinforcing bar:

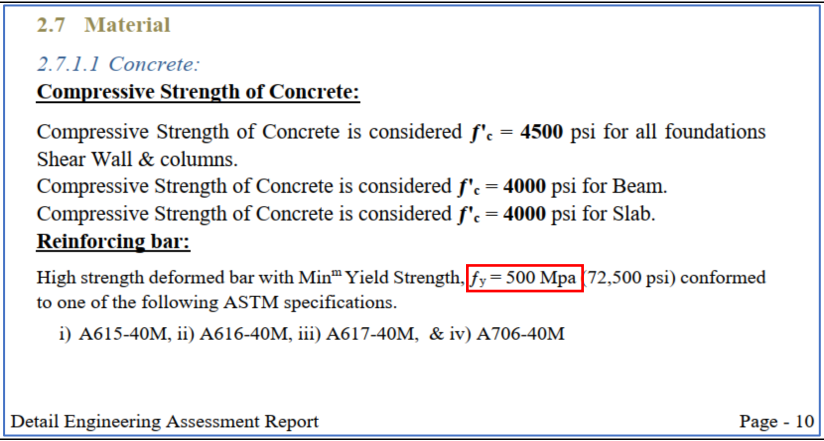
High strength deformed bar with Min^{m} Yield Strength, f_y = 500 Mpa (72,500 psi) conformed to one of the following ASTM specifications.

i) A615-40M, ii) A616-40M, iii) A617-40M, & iv) A706-40M

Detail Engineering Assessment Report — Page - 10

Description: During the inspection, 20 sets of cylinder test report (Foundation = 6 sets, Column = 4 sets, Wall = 2 set, Wall & Column = 3 sets, and Beam- Slab = 5 sets) were provided.
The building engineer is required to check and confirm the design strength by reviewing the existing cylinder test data according to the BNBC.
If the existing cylinder test data does not satisfy the BNBC 5.12, confirm the concrete strength by taking 100 mm diameter core (minimum 4 no's.) from lower tier columns. Submit the test report and necessary calculations along with design report to the RSC.

Observation-3: Design re-bar strength need to be verified (Main Building-2).



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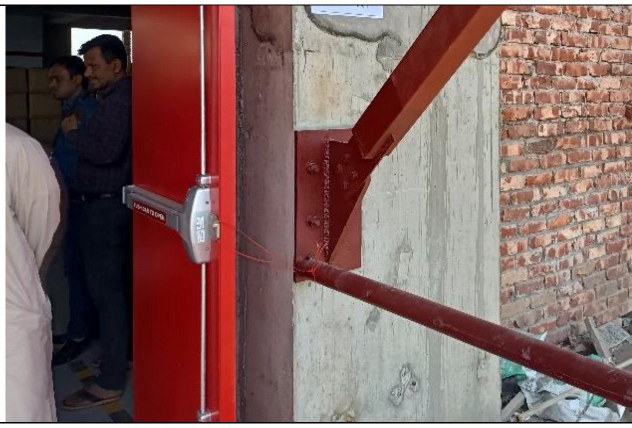
i) A615-40M, ii) A616-40M, iii) A617-40M, & iv) A706-40M

Detail Engineering Assessment Report — Page - 10

Description: In the design report, re-bar strength is considered 500 MPa but no re-bar test report were provided. The building engineer is required to confirm the re-bar grade.

Observation-4: Lack of information in the provided drawing (External Steel Stair, Main Building-2).



Description: The steel column splice and bracing connections were not observed in the provided drawing. The building engineer is required to prepare as-built drawings reflecting the on-site condition.

3. Action Plan:

Observation	Action Plan	Timeline
Inconsistency in the design report (Main Building-2)	The building engineer is required to check lateral load parameters & design considerations and update the design report as per BNBC section 1.9.1.	within 6 weeks
	Carry out remedial work where required.	within 6 months
Design concrete strength verification from existing cylinder test data (Main Building-2)	The building engineer is required to check and confirm the design strength by reviewing the existing cylinder test data according to the BNBC. If the existing cylinder test data does not satisfy the BNBC 5.12, confirm the concrete strength by taking 100 mm diameter core (minimum 4 no's.) from lower tier columns.	within 6 weeks
Design re-bar strength need to be verified (Main Building-2)	The building engineer is required to confirm the re-bar grade.	within 6 weeks
Lack of information in the provided drawing (External Steel Stair, Main Building-2)	The building engineer is required to prepare as-built drawings reflecting the on-site condition.	within 6 weeks