

Arkay Knit Dyeing Mills Ltd.

Tongabari, Bangabandhu Road, Ashulia, Savar, Dhaka - Bangladesh.
(23.89747, 90.31463)

28 March 2022



Building information:

Building 1: is a 6-storied (G+Mz+5) reinforced concrete building including mezzanine floors.

Building 2: The building is separated into two units (Part A & Part B) where 2-storied (B+G+1) reinforced concrete building is Part A and 3-storied (G+2) reinforced concrete building is Part B.

Building 5: is a 3-storied reinforced concrete building.

Observations

Verify in-situ concrete strength

Main Production Building (Building-1)

Structural Dynamic Analysis

Key Item	Description of Key Item
Construction material and strength	The Factory Building, concrete compressive strength, $f'_c = 4000 \text{ psi}$ for column, footing, UGWR & shear wall (Stone chips) and $f'_c = 3500 \text{ psi}$ for slab (stone aggregates), beam, GB, OHWR and stair; yield strength of steel deformed bar, $f_y = 72500 \text{ psi}$ as per the provided material test reports by the Client.

Concrete material strength $f'_c = 4000 \text{ psi}$ (27.5 MPa) considered in the design report.

Equivalent strength calculation from cylinder test results have not been provided in the design report.

The cursory calculation indicates that some columns are marginally stressed above normal design limit considering the equivalent concrete strength from the cylinder test data as per BNBC. The building engineer is required to verify in-situ concrete strength of the building columns & foundation by taking 100 mm diameter cores (min. 4 nos) and review the design, load and stressed of column and foundations.

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CONCRETE LABORATORY

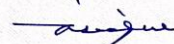
BRTC
 Bureau of Research
 Testing & Consultancy

BRTC No. : 1101-40305 /17-18/CE; Dt: 18/07/2017
 Sent by : Md. Saiful Islam, QC Manager (RMC), NDE RMC Ltd.
 Ref. No. : Letter; Dt: 17/07/2017
 Project : Palmal Group (Land Project), Ashulia, Savar, Dhaka
 Sample : Cylinder [Mix proportion(as quoted): Not Mentioned, Aggregate Type: Stone chips]
 Location : 3rd Floor Column
 Test : Compressive Strength [ASTM C39]
 Date of Test : 20/07/2017

TEST REPORT

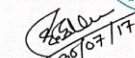
Sl. No.	Date of Casting as per the Letter	Specimen Designation/ Frog Mark	Specimen Area (sq. in)	Maximum Load (lb)	Crushing Strength (psi)	Average Crushing Strength	Mode of Failure
1	17/6/2017	-	12.67	55,263	4,362	4250 psi (29.3 MPa)	Combined *
2	(33 days test)	-	12.42	51,202	4,123	(299 kg/cm ²)	Combined *
3		-	12.42	53,007	4,268		Combined *

Note: Samples were received in unsealed condition. * Combined = Mortar and Aggregate failure.

Countersigned by:

 Dr. Abu Siddique
 Professor
 Department of Civil Engineering
 BUET, Dhaka-1000, Bangladesh

Authenticity of this page is verifiable from <http://verify.ce.buet.ac.bd> with the QR Code or ID

 9FXQ4WDMN

Test Performed by:

 Mohammad Faizus Salehin
 Assistant Professor
 Department of Civil Engineering
 BUET, Dhaka-1000, Bangladesh

Important Notes: Samples as supplied to us have been tested in our laboratory. BRTC does not have any responsibility as to the representative character of the samples required to be tested. It is recommended that samples are sent in a secure and sealed cover/packet/container under signature of the competent authority. In order to avoid fraudulent fabrication of test results, it is recommended that all test reports are collected by duly authorized person, and not by the Contractor/Supplier.

BUETCE 0046645

Cylinder test report. The cylinder test report does not satisfy the material design strength of column and foundation of f'_c -4000 psi (27.5 MPa) as per BNBC.

Base Point	Footing Type	Footing Thickness		CoL ID	Col. Size		Factored Load Pu (kN)	Vu kip	Conc. Strength F _c (ksi)	IV _c kip	F.S IV _c /V _u
		t (mm)	d (mm)		b (mm)	h (mm)					
41	F3	700	624	C4	825	450	2928	575	4	926	1.61
42	CF4A	850	774	C3	825	450	2700	587	4	1285	2.19
43	CF4A	850	774	C3	825	450	2702	588	4	1285	2.19
44	CF5A	800	724	C3	825	450	2654	578	4	1159	2.01
45	F9	900	824	C11	700	700	5137	1035	4	1477	1.43
46	CF4A	850	774	C11	700	700	4704	1020	4	1342	1.32
47	CF4A	850	774	C11	700	700	4425	959	4	1342	1.40
48	F9	900	824	C11	700	700	4606	928	4	1477	1.59
49	CF7	750	674	C11	700	700	4309	953	4	1089	1.14
50	CF5A	800	724	C7	825	525	4481	974	4	1191	1.22
51	F3	700	624	C4	825	450	2599	510	4	926	1.81
53	CF7	750	674	C1	700	450	1150	255	4	990	3.88
54	CF7	750	674	C3	825	450	2169	480	4	1039	2.16
55	CF5A	800	724	C6	825	525	4915	1068	4	1191	1.11
56	CF5A	800	724	C3	825	450	3319	723	4	1159	1.60
57	F6	750	674	C7	825	525	5137	1020	4	1069	1.05
13	CF6A	800	724	SW1	1417	250	1526	329	4	897	2.73
58	CF6A	800	724	SW1	1417	250	1360	293	4	897	3.06
59	CF6A	800	724	SW1	1417	250	1910	412	4	897	2.18
60	CF6A	800	724	SW1	1417	250	1763	380	4	897	2.36
61	CF7	750	674	C4	825	450	2262	501	4	1039	2.07
79	CF6A	800	724	SW1	1417	250	1419	306	4	897	2.93
81	CF6A	800	724	SW1	1417	250	1262	272	4	897	3.30

Table 7.8: Foundation Punching Capacity Checking (part 2)

Base Point	Footing Type	Footing Thickness		CoL ID	Col. Size		Factored Load Pu (kN)	Vu kip	Conc. Strength F _c (ksi)	IV _c kip	F.S IV _c /V _u
		t (mm)	d (mm)		b (mm)	h (mm)					
1	CF1	600	524	C1C1	700	900	3061	610	4	816	1.34
2	CF2	700	624	C3C3	825	900	4601	952	4	1091	1.15
3	CF3	750	674	C7C7	825	1050	5743	1180	4	1277	1.08
4	F4	750	674	C5	775	525	3134	620	4	1049	1.69
5	F4	750	674	C5	775	525	3044	602	4	1049	1.74
6	F4	750	674	C5	775	525	3050	604	4	1049	1.74
7	F2	600	524	C4	825	450	2418	467	4	716	1.53
8	F1	650	574	C2	700	450	1908	374	4	775	2.07
9	F8	850	774	C10	700	700	3898	796	4	1342	1.68
10	F5	750	674	C8	975	525	4144	836	4	1129	1.35
11	F8	850	774	C10	700	700	3816	780	4	1342	1.72

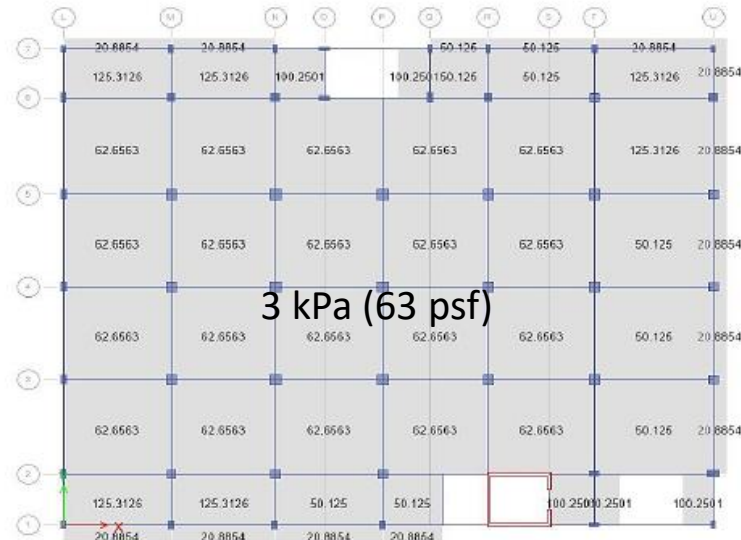
Base Point	Footing Type	Footing Thickness		CoL ID	Col. Size		Factored Load Pu (kN)	Vu kip	Conc. Strength F _c (ksi)	IV _c kip	F.S IV _c /V _u
		t (mm)	d (mm)		b (mm)	h (mm)					
12	F8	850	774	C10	700	700	4178	853	4	1342	1.57
13	F5	750	674	C9	700	700	3558	721	4	1089	1.51
14	F1	650	574	C2	700	450	1886	370	4	775	2.10
15	F3	700	624	C5	775	525	3101	606	4	935	1.54
16	F9	900	824	C10	700	700	4947	996	4	1477	1.48
17	F11	950	874	C13	825	825	5958	1211	4	1746	1.44
18	F11	950	874	C13	825	825	5443	1106	4	1746	1.58
20	F11	950	874	C13	825	825	5598	1138	4	1746	1.53
21	F6	750	674	C7	825	525	3651	725	4	1069	1.48
22	F7	900	824	C10	700	700	4530	924	4	1477	1.60
23	F7	900	824	C10	700	700	4487	915	4	1477	1.61
24	F7	900	824	C10	700	700	4447	907	4	1477	1.63
25	F10	900	824	C12	825	825	5630	1145	4	1598	1.40
26	F10	900	824	C12	825	825	5616	1142	4	1598	1.40
27	F10	900	824	C12	825	825	5512	1121	4	1598	1.43
28	F10	900	824	C12	825	825	5542	1127	4	1598	1.42
29	F10	900	824	C12	825	825	5416	1101	4	1598	1.45
30	F10	900	824	C12	825	825	5368	1092	4	1598	1.46
31	F10	900	824	C12	825	825	5863	1192	4	1598	1.34
32	F10	900	824	C12	825	825	5763	1172	4	1598	1.36
33	F10	900	824	C12	825	825	5985	1217	4	1598	1.31
34	F10	900	824	C12	825	825	5378	1093	4	1598	1.46
35	F10	900	824	C12	825	825	5282	1074	4	1598	1.49
36	F10	900	824	C12	825	825	5469	1112	4	1598	1.44
37	CF7	750	674	C11	700	700	4477	990	4	1089	1.10
38	CF4	850	774	C11	700	700	4293	930	4	1342	1.44
39	CF7	750	674	C3C3	825	900	4360	960	4	1218	1.27
40	CF3	750	674	C7C7	825	1050	5953	1223	4	1277	1.04
41	CF3	750	674	C7C7	825	1050	5665	1164	4	1277	1.10
42	CF7	750	674	C1C1	700	900	2627	580	4	1168	2.02
43	CF7	750	674	C4	825	450	2906	644	4	1039	1.61
44	CF4	850	774	C3	825	450	2745	597	4	1285	2.15
46	CF4	850	774	C3	825	450	3404	741	4	1285	1.73
47	CF5	800	724	C3	825	450	2654	578	4	1159	2.01
48	CF5	800	724	C3	825	450	2524	550	4	1159	2.11
49	CF4	850	774	C6	825	525	4336	941	4	1319	1.40
19	CF6	800	724	SW1	1417	250	2355	508	4	897	1.77
45	CF6	800	724	SW1	1417	250	2096	452	4	897	1.98
50	CF6	800	724	SW1	1417	250	1780	384	4	897	2.34
51	CF6	800	724	SW1	1417	250	1796	387	4	897	2.32

According to the design report punching stress of some footings are observed very close to 1. The building engineer is required to check the punching capacity of the foundation according to the in-situ concrete strength of building foundation.

Design report doesn't fully comply BNBC

Occupancy or Use	Uniform kN/m ²	Concentrated kN
Hotels	See Residential	
Libraries		
Reading rooms	2.90	4.50
Stack rooms	7.20 ^d	4.50
Corridors above first floor	3.80	4.50
Manufacturing ^a		
Light	4.00	6.00
Medium	6.00	9.00
Heavy	12.00	13.40
Garments manufacturing floor except stacking or storage area	4.00 ^b	—
Stacking or storage area of garments manufacturing industry	6.00 ^c	10.00 ^c
Marquees	3.60	—
Office Buildings		
File and computer rooms shall be designed for heavier loads based on anticipated occupancy		
Lobbies and first-floor corridors	4.80	9.00
Offices	2.40	9.00
Corridors above first floor	3.80	9.00
Penal Institutions		
Cell blocks	2.00	—
Corridors	4.80	—
Residential		
Dwellings (one- and two-family)		
Uninhabitable attics without storage	0.50	—
Uninhabitable attics with storage	1.00	—
Habitable attics and sleeping areas	1.50	—
All other areas except stairs and balconies	2.00	—
Hotels and multifamily houses		
Private rooms and corridors serving them	2.00	—
Public rooms and corridors serving them	4.80	—
Reviewing stands, grandstands, and bleachers	4.80 ^e	—

As per BNBC 2020 the minimum floor live load for the light garments manufacturing is 4 kPa.
3 kPa live load considered for the 3rd and 4th floor.

Figure 6.16: Assigned Live Load on 3rd Floor (part 2) (psf)Figure 6.18: Assigned Live Load on 4th Floor (part 2) (psf)

7.8 Torsional Irregularity Check

Torsional Irregularity check has been done form FEM model. Extreme torsional irregularity found at ground floor of the production building.

Table 7.9: Torsional Irregularity Checking in x-direction:

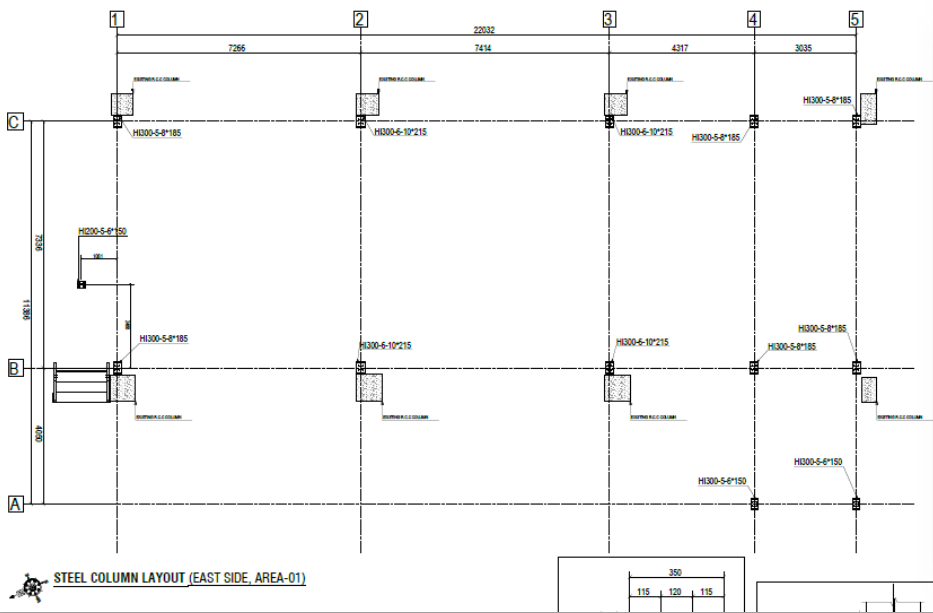
Story	Load Case	Direction	Max Drift (in)	Avg Drift (in)	Ratio	Torsional Irregularity Limit	Remarks
Roof	RSX	X	4.062	3.76	1.08	1.2	Okay
5F	RSX	X	4.939	4.458	1.11	1.2	Okay
4F	RSX	X	5.551	4.915	1.13	1.2	Okay
3F	RSX	X	7.112	6.176	1.15	1.2	Okay
2F	RSX	X	7.039	5.984	1.18	1.2	Okay
1F	RSX	X	7.883	6.623	1.19	1.2	Okay
GF	RSX	X	4.865	3.111	1.56	1.2	Not okay

Table 7.10: Torsional Irregularity Checking in y-direction:

Story	Load Case	Direction	Max Drift (in)	Avg Drift (in)	Ratio	Torsional Irregularity Limit	Remarks
Roof	RSY	Y	3.876	3.717	1.04	1.2	Okay
5F	RSY	Y	4.293	4.22	1.02	1.2	Okay
4F	RSY	Y	4.722	4.635	1.02	1.2	Okay
3F	RSY	Y	5.885	5.765	1.02	1.2	Okay
2F	RSY	Y	5.788	5.639	1.03	1.2	Okay
1F	RSY	Y	8.843	7.067	1.25	1.2	Not okay
GF	RSY	Y	4.287	2.509	1.71	1.2	Not okay

According to the design report external torsional irregularity found at ground floor of the building-1. But no remedial actions were suggested in the design report. Building engineer is required check the necessity and prepare proper remedial action for the torsional irregularities.

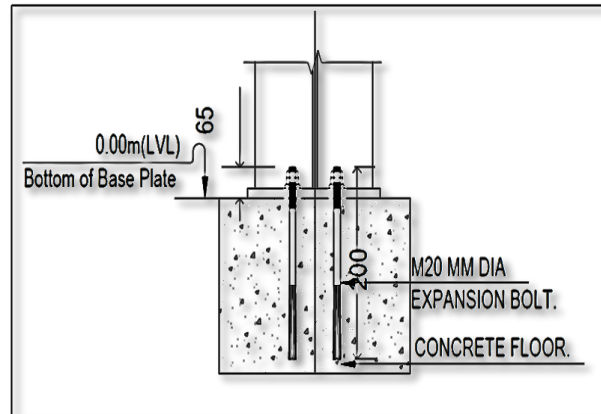
Punching shear adequacy check of the mezzanine column supported ground slab



Self supported steel mezzanine floor

Column layout plan of Steel Mezzanine floor

Columns of mezzanine floor supported on the ground slab of the Building 1. In design report the foundation adequacy of the mezzanine floor not included. Building engineer is required to check the punching shear capacity of the ground slab of the Building 1.



Connection of steel column of mezzanine floor and ground slab



Steel mezzanine floor column on ground slab

Improve roof drainage system



Water ponding at the roof of Building-1



Water ponding at the roof of Building-2



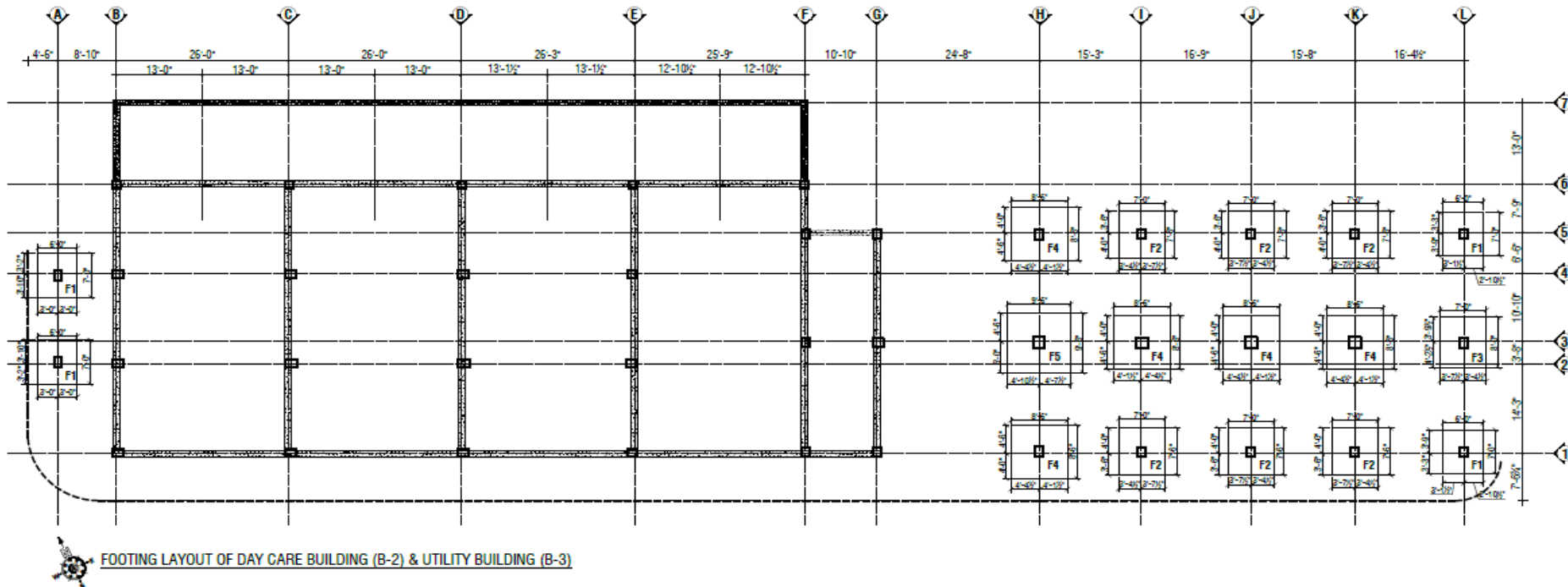
Inactive outlet at the roof of Building-2

Water clogging was observed on roof of the buildings due to leakage of pipeline & improper drainage system. Building engineer is required to improve the roof drainage system & to repair the leakage of pipeline.

Settlement check of foundation absent in the design report

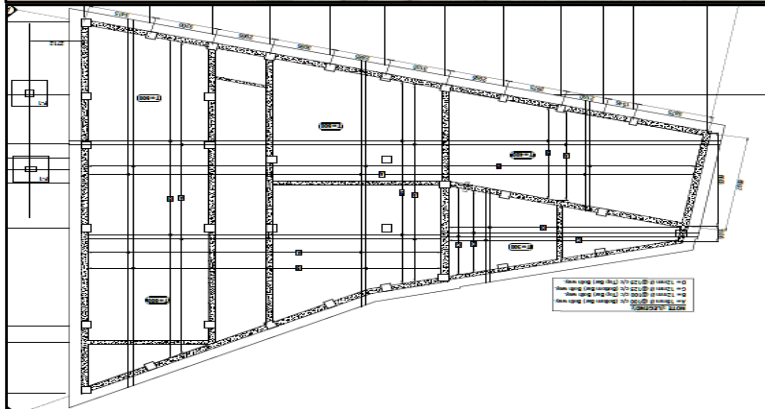
MAT foundation

Isolated footing



Different foundation system observed in the drawing. Settlement check of the shallow foundation not included in the design report. The building engineer is required to incorporate the settlement of the foundation system in the design report.

Torsional effect due to the irregular shape of the building



Building-5 : Irregular in shape

The building shape is geometrically irregular. Due to lateral forces, the building might be affected for torsional irregularities. In design report, extreme torsional irregularities found. Building engineer is required to suggest remedial action for the torsional irregularities.

9.1 Torsional Irregularity Check

Torsional Irregularity check has been done from FEM model. Extreme torsional irregularity found at both x and y-direction of the ETP Building.

Table 9.3: Torsional Irregularity Checking in x-direction

Story	Load Case/Combo	Direction	Max Drift	Avg Drift	Ratio
			mm	mm	
ST_Top	RSX Max	X	0.888	0.758	1.17
RL_10532	RSX Max	X	1.722	1.459	1.18
FL_6907	RSX Max	X	3.101	2.454	1.26

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ETP (Effluent Treatment Plant) Building (Building-5)

Structural Dynamic Analysis

TB_3067	RSX Max	X	0.316	0.16	1.97
TB_0	RSX Max	X	0.029	0.016	1.80

Table 9.4: Torsional Irregularity Checking in y-direction

Story	Load Case/Combo	Direction	Max Drift	Avg Drift	Ratio
			mm	mm	
ST_Top	RSY Max	Y	0.801	0.741	1.08
RL_10532	RSY Max	Y	1.963	1.636	1.20
FL_6907	RSY Max	Y	2.882	2.321	1.24
TB_3067	RSY Max	Y	0.526	0.266	1.97
TB_0	RSY Max	Y	0.302	0.152	1.99

Design report: Extreme torsional irregularities

Problems Observed

Building 1:

Item-1: Verify in-situ concrete strength.

Item-2: Design report doesn't fully comply BNBC.

Item-3: Punching shear adequacy check of the mezzanine column supported slab.

Building 1 & 2:

Item-4: Improve roof drainage system.

Building 2:

Item-5: Settlement check of foundation absent in the design report.

Building 5:

Item-6: Torsional effect due to the irregular shape of the building.

Priority Actions

Item No.	Observation	Recommended Action Plan	Recommended Timeline
01	Verify in-situ concrete strength. (Building-1)	Building engineer is required to verify in-situ concrete strength by taking 100 mm diameter cores from the column (min. 4 nos) and review the design, load and stressed of column and foundations.	6-weeks
02	Verify in-situ concrete strength. (Building-1)	Building engineer is required to check the punching capacity of the foundation according to the concrete strength from the cylinder test data.	6-weeks
03	Verify in-situ concrete strength. (Building-1)	Implement any remediation work where required.	6-months
04	Design report doesn't fully comply BNBC. (Building-1)	Prepare the floor live load plan as per BNBC.	6-weeks
05	Design report doesn't fully comply BNBC. (Building-1)	Building engineer is required check the necessity and prepare proper remedial action for the torsional irregularities.	6-weeks
06	Design report doesn't fully comply BNBC. (Building-1)	Implement any remediation work where required.	6-months

Item No.	Observation	Recommended Action Plan	Recommended Timeline
07	Design report doesn't fully comply BNBC. (Building-1)	Implement floor load plan.	6-months
08	Punching shear adequacy check of the mezzanine column supported ground slab. (Building-1)	Building engineer is required to check the punching shear capacity of the ground slab of the Building 1.	6-weeks
09	Punching shear adequacy check of the mezzanine column supported ground slab. (Building-1)	Implement the remedial works where required.	6-months
10	Improve roof drainage system. (Building-1 & 2)	Building engineer is required to improve the roof drainage system with adequate slope & repair the leakage of pipeline	6-weeks
11	Settlement check of foundation absent in the design report. (Building 2)	Building engineer is required to survey the structure and produce accurate as-built drawings.	6-weeks
12	Settlement check of foundation absent in the design report. (Building 2)	Implement any remediation work where required.	6-months

Item No.	Observation	Recommended Action Plan	Recommended Timeline
13	Torsional effect due to the irregular shape of the building. (Building-5)	Building engineer is required to suggest remedial action for the torsional irregularities.	6-weeks
14	Torsional effect due to the irregular shape of the building. (Building-5)	Implement any remediation work where required.	6-months

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 RSC.

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.