

#### **1.4.2. Receiving application for Construction permit and examination of application documents**

When Authorized Officer (AO) received an application for construction permit, he must examine whether all the necessary documents are attached using the following checklist below. If not, he shall ask the applicant to submit all the remaining documents, After receiving the application from Authorized Officer (AO), Building Inspector (BI) visits the proposed site and make field visit report and check the application documents. BI and Chief Building Inspector (CBI) review the land related documents. If he finds all are ok, then he forwards it to Assistant Authorized Officer (AAO). Then AAO again checks these documents with the planning permit certificate and the consistency of these with all other Non Objection Certificates (NOCs). The Authorized Officer and Assistant Authorized Officer check the architectural drawing with respect to Dhaka Metropolitan building (construction, development, preservation and demolition) rules 2008, planning permit. The followings are the issues generally reviewed:

- a. Size, Shape, adjacent roads, road's width and area of the proposed plot (there must be consistency in between draft survey map, BI's site visit map, approved layout plan for planned housing area and the submitted proposed layout plan).
- b. FAR (Floor area ratio) value, MGC (Maximum ground coverage), GC (ground coverage), each floor area, overall FAR calculation.
- c. Beside FAR calculation the following parameters are also checked (Layout plan, ground floor plan, floor plan, roof floor plan. The proposed basement floor in the view of BC rules 2008, planning permit and BNBC 2020).
- d. Setback, entry size, driveway, ramp, car parking, number of parking, guard room, electromechanical room, driver's toilet at ground floor, stair width, lift lobby, lift size, landing, lobby size, smoke free wall and door, number of units, Room kitchen toilet size, door opening direction, window size, balcony, sun shade, fire protective special equipment (fire rated shutter, door, fire pump, hydrants etc.), scaling, car lift/ elevator are also checked.

For DCQR, confirm all the documents were submitted (e.g., using the table below)

Check sheet for submitted documents (If documents are available, mark as )

Type of Document	If available, mark as <input checked="" type="checkbox"/>	Details			
★ Approval sheet	<input type="checkbox"/>	Building specification	Floor Plan	Elevation Plan	Sectional plan
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
● Design report	<input type="checkbox"/>	Declaration of Responsibility and compliance	Structural Calculation sheet	Out put	-
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
● Soil report	<input type="checkbox"/>	Site class	Ave. shear wave vel	Ave. SPT	Ave. undrained shear strength
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
★ Architectural drawing	<input type="checkbox"/>	Floor plan	Elevation	Cross-section of building	-
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
● Structural drawing	<input type="checkbox"/>	specifications	Lay-out plan	Cross-section list of members [Column,beam, wall slab]	Detailed bar arrangement (beam column joint)
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
▲ Mechanical drawing	<input type="checkbox"/>	Fire			
		<input type="checkbox"/>			
▲ Electrical drawing	<input type="checkbox"/>	Fire			
		<input type="checkbox"/>			
▲ Plumbing drawing	<input type="checkbox"/>	Fire			
		<input type="checkbox"/>			

★ : Documents required for both Structure and Fire safety

● : Documents required for Structure safety

▲ : Documents required for Fire safety



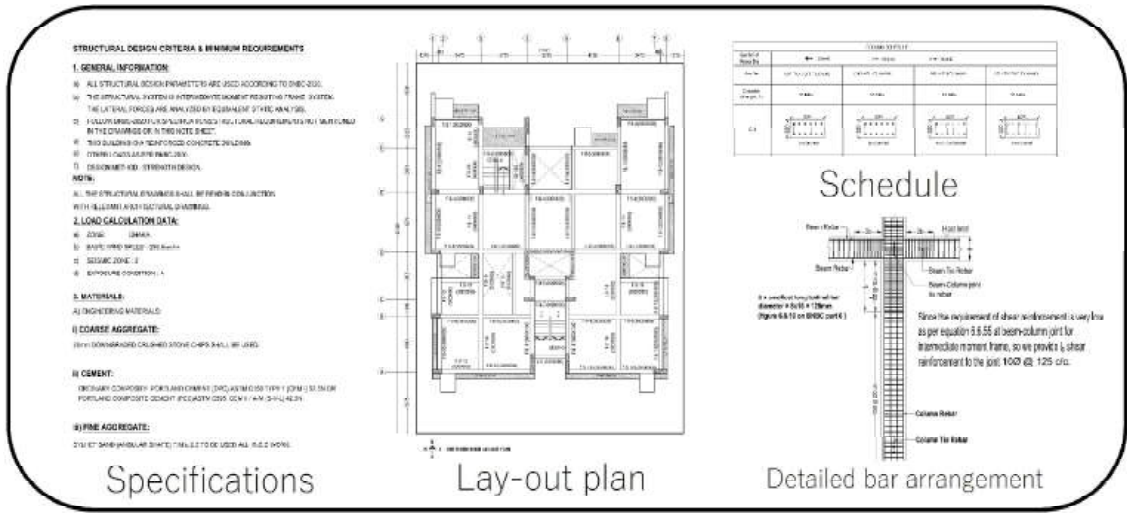


Floor plan

Elevation

Cross-section

An example of Architectural drawing



**STRUCTURAL DESIGN CRITERIA & MINIMUM REQUIREMENTS**

**1. GENERAL INFORMATION:**

- A. ALL STRUCTURAL DESIGN PARAMETERS ARE USED ACCORDING TO DIBC CODE.
- B. THE STRUCTURAL SYSTEM IS INTERMEDIATE MOMENT RESISTING FRAME SYSTEM.
- C. THE LATERAL FORCES ARE ANALYZED BY EQUIVALENT STATIC ANALYSIS.
- D. COLUMN MOMENTS ARE DEVELOPED BY USING THE MOMENT DISTRIBUTION METHOD.
- E. THIS BUILDING IS NON-TYPICAL CONCRETE COLUMN.
- F. DESIGNER HAS REVIEWED ALL DRAWINGS.
- G. DESIGNER HAS REVIEWED ALL DRAWINGS.

**NOTES:**

- A. ALL STRUCTURAL DIMENSIONS SHALL BE GIVEN IN METERS.
- B. ALL DIMENSIONS SHALL BE GIVEN IN METERS.

**2. LOAD CALCULATION DATA:**

- A. DEAD LOAD: 15 kN/m<sup>2</sup>
- B. LIVE LOAD: 5 kN/m<sup>2</sup>
- C. SEISMIC ZONE: II
- D. WIND SPEED: 40 m/s

**3. MATERIALS:**

- A. ENGINEERING MATERIALS:

**B. COARSE AGGREGATE:**

- A. CRUSHED GRANITE OR OTHER EQUIVALENT SHALL BE USED.

**C. CEMENT:**

- A. PORTLAND CEMENT SHALL BE USED WITH A MINIMUM OF 42.5 MPa.

**D. FINE AGGREGATE:**

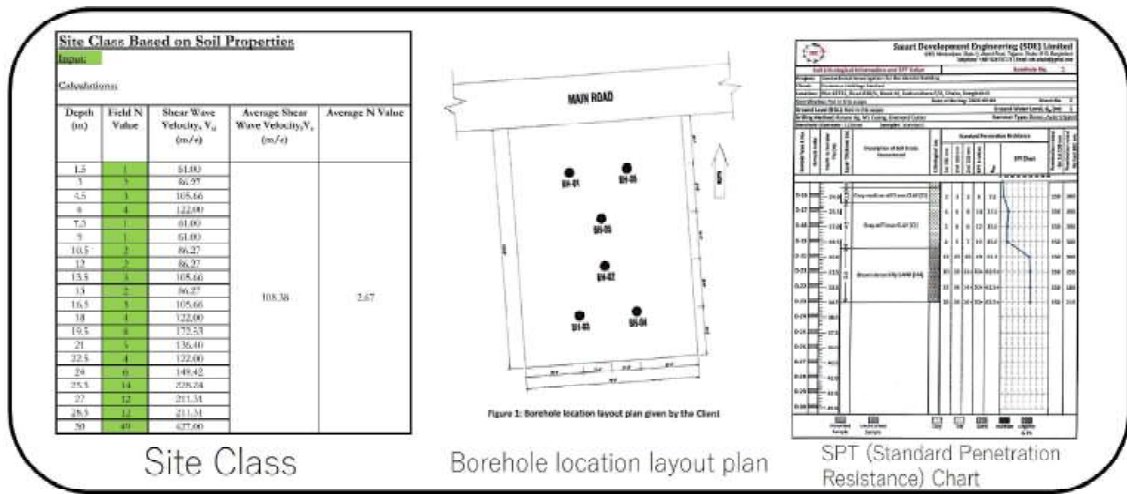
- A. ALL SANDS SHALL BE USED WITH ALL SIZES PERmissible.

Specifications

Lay-out plan

Detailed bar arrangement

An example of Structural drawing



**Site Class Based on Soil Properties**

Depth (m)	Field N Value	Shear Wave Velocity, $V_s$ (m/s)	Average Shear Wave Velocity, $V_s$ (m/s)	Average N Value
1.5	1	81.00		
3	2	86.97		
4.5	3	105.66		
6	4	122.00		
7.5	5	81.00		
9	6	81.00		
10.5	7	86.97		
12	8	86.97		
13.5	9	105.66		
15	10	86.97		
16.5	11	105.66		
18	12	122.00		
19.5	13	172.23		
21	14	136.40		
22.5	15	122.00		
24	16	148.42		
25.5	17	208.24		
27	18	211.34		
28.5	19	211.34		
30	20	217.00		
			108.36	2.67

Site Class

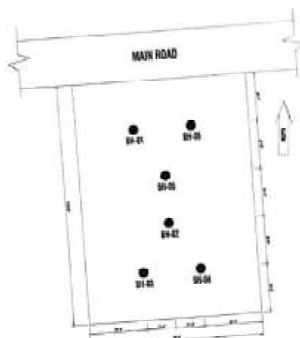
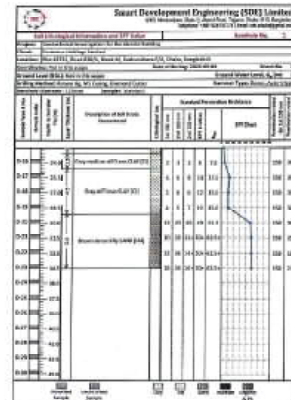


Figure 1: Borehole location layout plan given by the Client

Borehole location layout plan



SPT (Standard Penetration Resistance) Chart

An example of Subsoil investigation report  
(Site class, Average of shear wave velocity, etc.)

### 1.4.3. Preparation of Checklist for design review by filling necessary cells in the Checklist

Preferably, structural design reviewers examine all the design documents. However, due to the limited time available, only the main items of the design documents are subject to review. Therefore, structural design review is carried out only for the items indicated in the checklist. (The design engineers is responsible on all the design) The structural design checklist is/will be filled by RAJUK officers (=reviewers). However, in order to improve efficiency, it might be better if some of the items in checklist are filled in by the structural design engineers.

Fill out here

		Cells filled out by RAJUK/designers					Reference			
1	2	3	4	5	6	7	8	9	10	
Check	Item	code	code	Describe the Contents of Definitions	Date issued page or file	Date issued	Date issued	Date issued	Date issued	
Building overview	Building occupancy type	01	01	Residential building	01	01	01	01	01	
	Total floor area	02	02	4500 sqm	02	02	02	02	02	
	Ground floor area	03	03	527.00sqm	03	03	03	03	03	
	Type of structure	04	04	RC	04	04	04	04	04	
	Number of stories	05	05	11 (G+10)	05	05	05	05	05	
Declaration	Declaration of the designer (responsibility for the design)	06	06	A.A.B (initial)	06	06	06	06	06	
	Code and Standards	07	07	BS6000	07	07	07	07	07	
Design method	Design method	08	08	Strength design	08	08	08	08	08	
	Earthquake analysis method	09	09	Pushover static analysis	09	09	09	09	09	
Software	Design software used	10	10	ETABS v16.2.1	10	10	10	10	10	
	SOIL	11	11	Groundwater B/A, Brak	11	11	11	11	11	
Prescriptive	1. Average shear wall thickness	01	01	160mm	01	01	01	01	01	
	2. Average depth of slab	02	02	160mm	02	02	02	02	02	
	3. Average depth of slab	03	03	160mm	03	03	03	03	03	
	4. Average depth of slab	04	04	160mm	04	04	04	04	04	
Other conditions	1. Seismic zone	01	01	II	01	01	01	01	01	
	2. Seismic zone	02	02	II	02	02	02	02	02	
	3. Seismic zone	03	03	II	03	03	03	03	03	
	4. Seismic zone	04	04	II	04	04	04	04	04	
	5. Seismic zone	05	05	II	05	05	05	05	05	

[Column 3 and 4]  
Fill out the contents by referring the submitted documents

[Column 5]  
Fill out the Reference No. or page according to the submitted documents

ex.  
D-5: Design Report page 5  
A-05: Architectural Drawing No.05  
S-G05: Structural Drawing No.05 of General Note

### 1.4.4. Design Review using the Checklist

The checklist includes the criteria, BNBC reference chapter, Manual page and URP list to help reviewers for expediting the review process.

All the items are categorized into two groups (Level 1 and Level 2) below by RAJUK for practical use of the Checklist.

Level 1: mandatory items (100 items) --- ex. checked by inspector

Level 2: sampling items (25 items) --- ex. checked by assistant authorized officer or authorized officer

Get In. Filled out. by RAJUK/Designers

[Column 2]

Criteria : Numerical value shown in green cells (sampling cells)

[Column 6, 7, and 8]

Criteria : BNBC2020 , Manual, and URP checklist

Sl. No.	Item	Confirm		Describe the Details of the Configuration	Data source (type of No.)			Remarks
		yes	no		BNBC	Manual	URP	
1	Columns are shown in the design report (check construction)	yes	no		0.34 (0)			
2	Select one of the column models designed in the design report and describe it (see Fig. 4.2.1.1)	yes	no	EP-022	0.34 (0)			
3	Column models shown in the structural drawings. The following is a review of this column	yes	no		0.34 (0)			
4	Assessment of nature of column above - Check the dimensions: 300mm x 300mm	yes	no	300mm x 300mm	0.34 (0)			
5	As per the below - See Fig. 4.2.1.1	yes	no					
6	Assess the compressive ratio of column above from computer output - Check the IL: 4.1, 3.0%	yes	no	3.0%	0.34 (0)			25.08
7	Longitudinal ratio of column above from structural drawing at store 4 - Check the ratio of longitudinal ratio & diameter (L/D): 14.75 (0)	yes	no	14.75 (0)	0.34 (0)			25.08
8	Reinforce the total cross-sectional area of longitudinal ratio above from structural drawing - Check the IL: 16.48 (0)	yes	no	16.48 (0)				
9	Reinforce the total cross-sectional area of longitudinal ratio above from structural drawing - Check the IL: 16.48 (0)	yes	no	16.48 (0)				
10	Reinforce the compressive ratio of reinforcement ratio of column, % between longitudinal and structural drawing - Check the IL: 16.48 (0)	yes	no					
11	Check the ratio of the following: 0.34 (0.34) or 0.34 (0.34) or 0.34 (0.34) - Check the IL: 16.48 (0)	yes	no					
12	Quantity ratio of column above	yes	no	0.308	0.34 (0)			00
13	Quantity ratio to confirm below Quantity ratio 0.34	yes	no					00
14	Area of section - Check the IL: 100 (0)	yes	no	100	0.34 (0)			00
15	Spacing of the end 500 area - Check the IL: 100 (0)	yes	no	100mm	0.34 (0)			00
16	Spacing of the middle area - Check the IL: 100 (0)	yes	no	100mm	0.34 (0)			00.00
17	Spacing of the boundary joint - Check the IL: 100 (0)	yes	no	100mm	0.34 (0.34)			00.00
18	As per the below - See Fig. 4.2.1.1	yes	no					
19	Spacing of end area - 3.0 times of diameter of longitudinal ratio - 100mm (100mm) or 100mm (100mm) - 100mm (100mm) or 100mm (100mm) - 100mm (100mm) or 100mm (100mm) - Spacing of end area	yes	no					
20	Spacing of end area - 3.0 times of diameter of longitudinal ratio - 100mm (100mm) or 100mm (100mm) - 100mm (100mm) or 100mm (100mm) - 100mm (100mm) or 100mm (100mm) - Spacing of end area	yes	no					

By using above and Manual, confirm the consistency of the contents between design documents and criteria

### 1.4.5. Inquiry on incompliant/unclear/skeptical issues to the applicants

The reviewer, RAJUK, verifies the checklist whether there are any errors in the contents. If there is any discrepancy between the contents of the checklist and the design documents or related standards, the reviewer shall require the engineer to make correction or clarification to such discrepancies.

**How to contact the designer (ECP2 system or email)? What kind of format should be used?**

[Column 9]  
Write reviewer's  
questions/unclear points here

		Data filled out by RAJM/designers					Reference			
1	2	3	4	5	6	7	8	9	10	
Criteria	Type	comply	not comply	Description of the Deficiencies	INTL. STANDARDS OR BS	LOCAL STANDARDS	REMARKS	APPLICABLE	APPROVED	APP P
Building envelope	Building envelope type -Describe what you selected and how it is being used	Y	N	Residential building	2-1			Sec 1.2.2 Table 1.1	Approved	-
	Total Floor area -Describe (i) and (ii) (4.14)	Y	N	455.41sf	4-01			-	-	-
	Ground Floor area -Describe (i) and (ii) (4.14)	Y	N	321.33sf	4-01			-	-	-
	Age of structure -Describe (i) and (ii) (4.14)	Y	N	NC	2-2.9 (2-02.1-1)			-	-	-
Site Elevation	Number of stories -Describe (i) and (ii) (4.14)	Y	N	11 (3rd-9th)	2-7, 4-01.13			-	-	-
	Site Elevation -Describe (i) and (ii) (4.14)	Y	N	34.5ft	2-7.13, 4-14			-	-	-
Declaration	Declaration of the designer (responsibility for the design) -Describe (i) and (ii) (4.14)	Y	N	A. K. M. Saikat (Sr)	3-1.2			Sec 1.3.1(3)	Approved	-
SOIL AND FOUNDATION	SOIL AND FOUNDATION -Describe (i) and (ii) (4.14)	Y	N	SHALLOW	2-8 (2-02.1-1)			Sec 1.4.1(5)	-	-
	Design method -Describe (i) and (ii) (4.14)	Y	N	Strength design	2-18 (2-02.1-1)			Sec 1.3.2(4)	-	-
Geotechnical Analysis methods	Geotechnical Analysis methods -Describe (i) and (ii) (4.14)	Y	N	Terzaghi's settlement analysis	2-22 (2-02.1-1)			Sec 2.3.7 (2-16.1)	-	-
	Settlement -Describe (i) and (ii) (4.14)	Y	N	EMAS v16.2.1	2-22			Sec 1.3.2(1)	Approved	-
Soil Parameters	Soil report confirmation -Describe (i) and (ii) (4.14)	Y	N	Kemathara A/S, Dhaka	2-18.10			Sec 2.3.2(4)	Approved	1.6.11
	Soil Average Shear Wave Velocity -Describe (i) and (ii) (4.14)	Y	N	Various locations	2-18 (2-11) report			Sec 2.3.2.2 Section 2.12	Approved	1.4
	Soil Average SPT value (in-situ) -Describe (i) and (ii) (4.14)	Y	N	12.47 (16.1)	2-18 (2-11) report			Sec 2.3.2.2 Table 2.12	Approved	1.18
	Soil Average Moisture Content (Standard) -Describe (i) and (ii) (4.14)	Y	N	No description	2-18 (2-11) report			Sec 2.3.2.2 Table 2.12	Approved	1.18
Site Conditions	Soil type is selected according to Figure 2.34 -Describe (i) and (ii) (4.14)	Y	N	SH	2-16			Sec 2.3.2.2 Table 2.12	Approved	1.18
	Seismic category is selected according to Table 2.11 -Describe (i) and (ii) (4.14)	Y	N	3	2-15.10			Sec 1.3.3 Table 1.1	Approved	-
	Seismic zone is selected according to Figure 2.34 -Describe (i) and (ii) (4.14)	Y	N	2	2-15 (2-02.1-1)			Sec 2.3.4.2 Figure 2.15	Approved	1.11
	Soil Seismic Coefficient is selected according to Table 2.14 -Describe (i) and (ii) (4.14)	Y	N	0	2-19			Sec 2.3.4.2 Table 2.14	Approved	1.11
	Seismic Zone Coefficient "Z" is selected according to Table 2.14, 2.2.15 -Describe (i) and (ii) (4.14)	Y	N	0.3	2-16.10			Sec 2.3.4.2 Table 2.14, 2.15	Approved	1.11
	Importance factor is selected according to Table 2.11 -Describe (i) and (ii) (4.14)	Y	N	1.00	2-15.10			Sec 2.3.5.1 Table 2.11	-	1.18

Ask designer  
questions/unclear points

### 1.4.6. Reviewing answers on inquiry from the applicants

Once all the discrepancies are corrected or clarified to be appropriate by the designer and checklist and design documents are found to be consistent, the structural design review is considered to have passed. The reviewer must take full responsibility if he/she makes design review passed with deficiencies or errors on the items in the checklist.

Get the explanation/comments from the designer and then RAJUK confirms the contents, fill out column 3, 4 and 5.

		Data Filled out by RAJUK/Designers					Reference			
1	2	3	4	5	6	7	8	9	10	
Item	Item	yes/no	yes/confirm	Describe the contents of the Confirmation	Date source used or No	Date source	IBC/CSIS/Other	Local code	SP/ P. C.	Other
Building overview	Building occupancy type -Describe (i. ex) Residential building	☑	☐	Residential building	0-1	☐				
	TOTAL Floor area -Describe (i. ex) 4000 sqm	☑	☐	4000 sqm	0-11	☐				
	Ground Floor area -Describe (i. ex) 1000 sqm	☑	☐	1000 sqm	0-11	☐				
	Floor of Storey -Describe (i. ex) R/C, 30m	☑	☐	30	0-1, 0-2, 0-3, 0-4, 0-5	☐	☐			
	Number of storey -Describe (i. ex) 10 storey	☑	☐	10 storey	0-1, 0-2, 0-3, 0-4, 0-5	☐	☐			
Declaration	Declaration of the designer (responsibility for the design) -Refer to designer's name, ex) A.K.R. Sultana	☑	☐	A.K.R. Sultana	0-1, 2	☐				
	Codes and Standards -Describe (i. ex) IBC/CSIS	☑	☐	IBC/CSIS	0-4, 0-5, 0-6, 0-7, 0-8, 0-9, 0-10, 0-11	☐	☐			
Design method	Design method -Describe (i. ex) ULS, ASD	☑	☐	Strength design	0-10, 0-11, 0-12	☐	☐			
	Earthquake Analysis methods -Describe (i. ex) Equivalent static analysis	☑	☐	Equivalent static analysis	0-11, 0-12	☐	☐			
Software	Software -Describe (i. ex) ETABS v10.2.1	☑	☐	ETABS v10.2.1	0-11	☐				
	Soil Investigation	Soil report Confirmation -Describe (i. ex) Soil Investigation R/L, Shale	☑	☐	Investigation R/L, Shale	0-1, 0-2	☐			
1) Average Shear Wave Velocity -Describe (i. ex) Vs=185 (30-100) (m/s)		☑	☐	Vs=185 (30-100) (m/s)	0-10, Soil Report	☐				
2) Average Rf value in top 30m -Describe (i. ex) Rf=2.47 (2) (m/30m)		☑	☐	Rf=2.47 (2) (m/30m)	0-10, Soil Report	☐				
3) Average Undrained Shear Strength -Describe (i. ex) No description (see software input)		☐	☑	No description	0-10, Soil Report	☐				
4) Soil Class based on Soil properties as selected according to Table 0.10 - Refer to (i. ex) 2		☑	☐	SC	0-10	☐				
Site Conditions	5) Seismic category as selected according to Table 0.11 - Describe (i. ex) I	☑	☐	I	0-10, 10	☐				
	6) Seismic Zone as selected according to Figure 0.2.24 - Describe (i. ex) 2	☑	☐	2	0-10, 0-10 (2nd)	☐	☐			
	7) Seismic Design Category as selected according to Table 0.10 - Describe (i. ex) D	☑	☐	D	0-10	☐				
	8) Seismic Zone Coeff (Z) as selected according to Table 0.2.14, 0.2.15 - Describe (i. ex) 0.2	☑	☐	0.2	0-10, 10	☐				
	9) Importance factor as selected according to Table 0.2.11 - Describe (i. ex) 1.00	☑	☐	1.00	0-10, 10	☐				

After RAJUK confirms the Checklist (No. 1-125) all okay, its application is completed and approved.

#### [Summary of 1.4.3 to 1.4.6]

RAJUK reviews design documents based on the Checklist. If there are unclear points, RAJUK makes inquiries to the designer directly. After RAJUK confirms the items of Checklist (No.1-125) all OK, its application is completed and approved.

\*RAJUK only takes responsibilities for No.1-125. The rest would be under the responsibility of designers.

#### **1.4.7. Approval by Building Construction Committee (BCC)**

As per the provision laid out in section 3(2) of the Building Construction Act-1952 the government may constitute a committee by a notification to exercise the power of an Authorized Officer in such area as may be specified in the notification. As per this provision the building construction committee is formed to examine and scrutinize Construction Permit applications.

#### **Formation of BC Committee in RAJUK**

	<b>No. Of Committee</b>	<b>Committee members</b>	<b>Quorum No.</b>
BC Committee up to 07(seven) story buildings	24	<ol style="list-style-type: none"><li>1. Zonal Director (Committee Chairman)</li><li>2. Civil Engineer</li><li>3. Architect</li><li>4. Town Planner</li><li>5. Authorized Officer of concerned sub-zone (Committee Member-Secretary)</li></ol>	03
BC Committee 08(Eight) story and above buildings	02	<ol style="list-style-type: none"><li>1. Member (Planning/Development Control) (Committee Chairman)</li><li>2. Director (Development Control-1/Development Control-2)</li><li>3. Civil Engineer</li><li>4. Architect</li><li>5. Town Planner</li><li>6. Representative of Concerned City Corporation</li><li>7. Authorized Officer of concerned sub-zone(Committee Member-Secretary)</li></ol>	04

### **The General Terms of References and Work Procedure of BC Committee**

1. Committee has to organize a meeting at least one per month.
2. The term of committee shall be a period of 03(three) years commencing on the day of notification.
3. The quorum for a 01(One) to 07(Seven) storied buildings BC committee meeting is 03(Three) and for 08(Eight) storied and above buildings BC committee meeting is 04(Four).
4. Committee has to submit a report about quality and transparency of its work to concerned meeting in ministry in every 06(six) months.
5. All committee decisions have to be anonymous.

### **Disposal of Application**

Subject to the submission of correct and completed application for the construction permit and after preliminary assessment of the application by Building Inspector, Chief Building Inspector and Assistant Authorized Officer an application has been brought forward to a Building Construction Committee. The committee members check the file and put their comments and vote. An application may approve if all participatory members put positive vote, otherwise the application may reject or send back to applicant for correction.

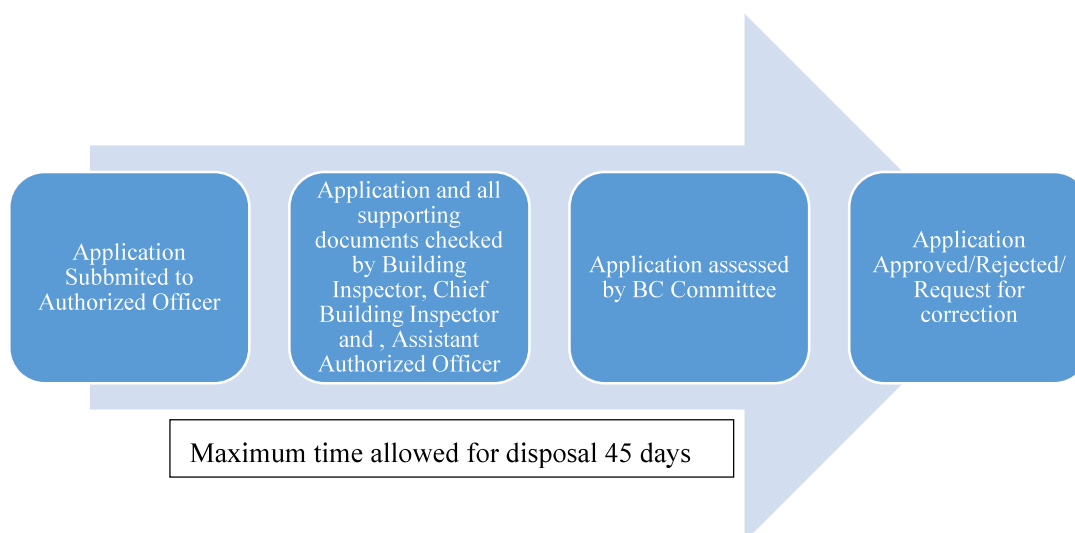


Figure: A simple process map of construction permit application disposal system in RAJUK

#### **1.4.8. Issuance of Construction Permit**

When a construction permit application is placed in Building construction committee and all the committee members find it ok then they vote yes for approval. After everyone's voting The Authorized Officer himself sign the architectural drawing electronically using dongle and send it to others for signing. Later when everyone's signature is completed then the Authorized Officer issues a construction permit approval letter in Electronic construction permit system (ECPS) and send it to applicant via ECPS. The applicant is notified with system generated sms/email that the construction permit application is approved. Then the applicant can download both the construction permit approval letter and approved architectural drawings from ECPS.

## Chapter 2. Technical documents

### 2.1. Overview of the relevant laws, rules, and code

The lists of related law, rules and Code:

- i. The building construction Act'1952
- ii. The Town Improvement Act'1953
- iii. Dhaka Metropolitan building (construction, development, preservation and demolition) rules 2008
- iv. Bangladesh National Building Code'2020

<Reference>

Summary of Part 6 of BNBC 2020 (table of contents).

Part 6: Structural Design

Chapter 1: Definitions and General Requirements

Chapter 2: Loads on Buildings and Structures

Chapter 3: Soils and Foundations

Chapter 4: Bamboo

Chapter 5: Concrete Material

Chapter 6: Strength Design of Reinforced Concrete Structures

Chapter 7: Masonry Structures

Chapter 8: Detailing of Reinforced Concrete Structures

Chapter 9: Prestressed Concrete Structures

Chapter 10: Steel Structures

Chapter 11: Timber

Chapter 12: Ferrocement Structures

Chapter 13: Steel-concrete Composite Structural Members

## 2.2. Critical aspects of buildings in Bangladesh

The older reinforced concrete buildings (hereinafter RC buildings) in Bangladesh have some problems like below. In the newly RC buildings, design and construction should be carried out in a way that eliminates these problems.

- the use of plain bars instead of deformed bars
- straight anchorage of beam longitudinal bars in the beam-column joints
- high axial load on the columns
- very low strength of concrete (ex. less than  $10\text{N/mm}^2$ )
- insufficient lap-length of rebars
- poor hooking in ties and stirrups, etc.

Figure 2.2.1 shows the vulnerable spot of RC buildings in Bangladesh.

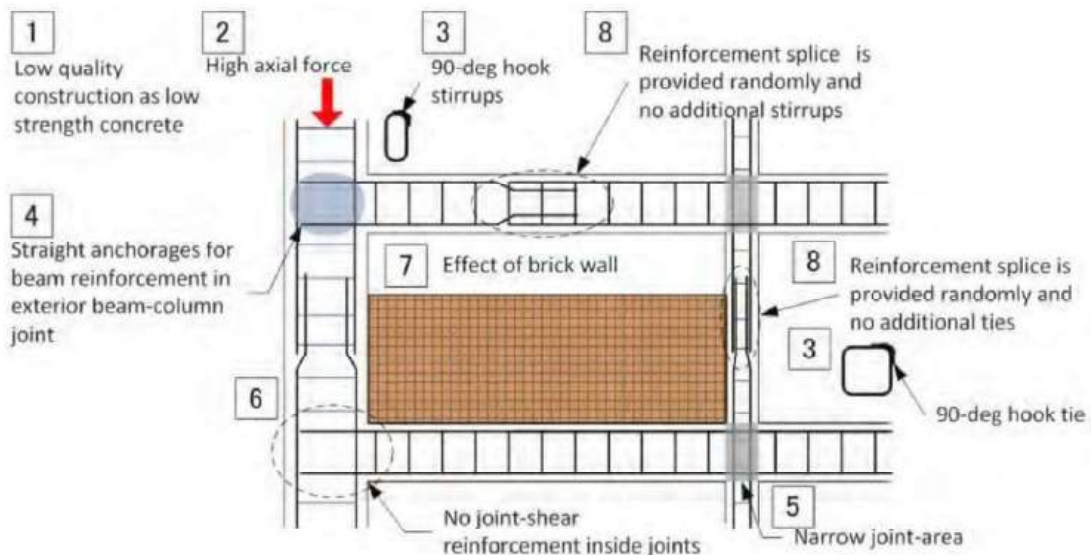


Figure 2.2.1 vulnerable spot of RC buildings in Bangladesh

(source: CNCRP report)



### Rana Plaza Collapse in 2013

Source: JAEE NEWSLETTER, December 2019 Vol.8, [Number3](#)

#### ■ 2023 Turkey-Syria Earthquake

Source: Journal of Architecture and Building Science, August 2023

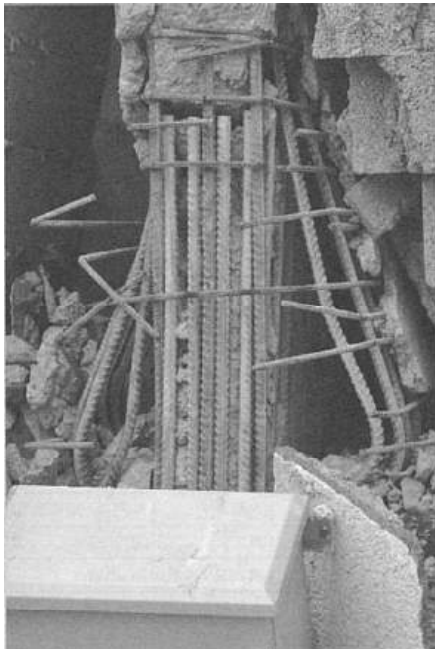


Photo 1

Lap joints on column leg (Example of overcrowded reinforcement that does not secure adhesion.)



Photo 2

Pancake collapse building

## 2.3. Overview of structural design procedures and design review procedures for earthquake resistant design

### 2.3.1 Overview of structural design procedures and design review procedures

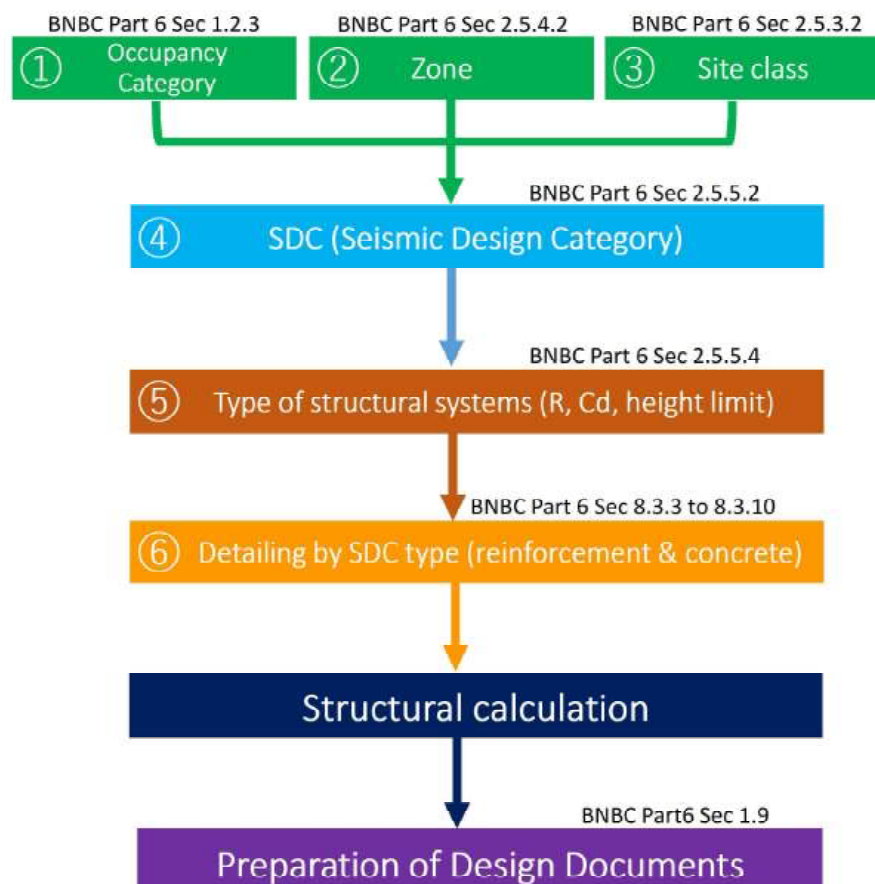
Following is a flow chart for structural design review. More details are shown on the next page together with the Checklist Items No. [1-125] related to each item.

To start the structural design, buildings are first classified in **(1) Occupancy Category**, **(2) Zone**, and **(3) Site Class**. Next, they are assigned to appropriate **(4) Seismic Design Category (SDC B, C or D)** and **(5) Structural type (with height limit)**. Finally, **(6) Detailing (reinforcement and concrete) by SDC** shall be considered as follows:

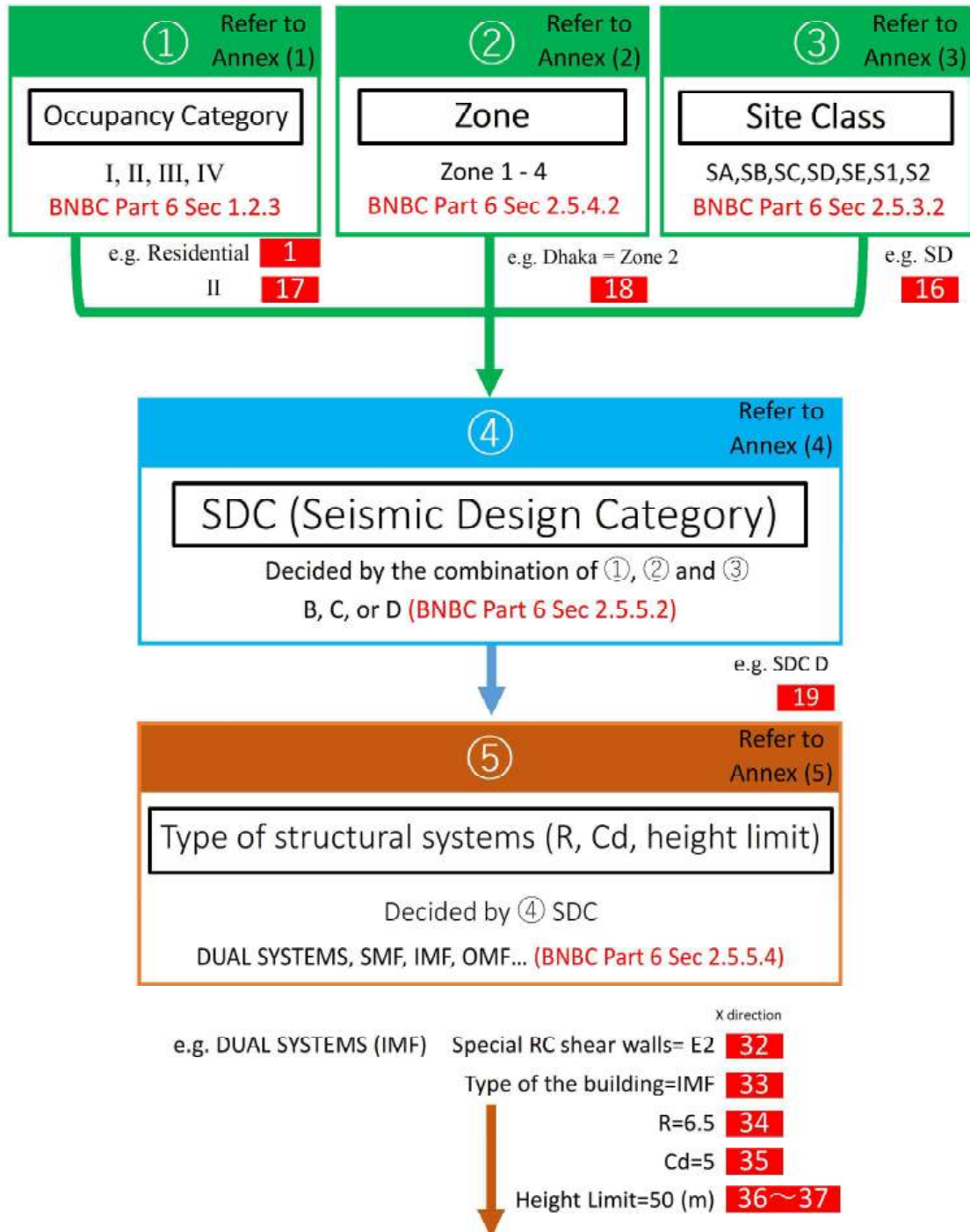
SDC D → follow SMF provisions in addition to OMF and IMF provisions	*higher SDC	the most stringent seismic design detailing
SDC C → follow IMF provisions in addition to OMF provisions	-	-
SDC B → follow OMF provisions	*lower SDC	the least stringent seismic design detailing

\*Structures in lower SDCs are permitted to design with detailing provisions of higher SDCs  
(Part6 Sec 8.3.2 (e) )

## 2.3 Process for Design Review (structure)



The number in red square (■) indicates the number in the Checklist.



The number in red square ( ■ ) indicates the number in the Checklist.

⑥	Refer to Annex (6)
<b>Detailing (reinforcement and concrete) by SDC</b>	
SDC D : BNBC Part 6 Sec 8.3.3 to 8.3.8 (special seismic detailing) SMF	
SDC C : BNBC Part 6 Sec 8.3.10 (intermediate seismic detailing) IMF	
SDC B : BNBC Part 6 Sec 8.3.9 (ordinary seismic detailing) OMF	

e.g. Strength of concrete ■ 52~61

Strength of steel ■ 62~65

Lap splice for column ■ 66

Lap splice for beam ■ 67

Reinforcement of column (hoop/tie spacing of the end area, middle area, and beam-column joint) ■ 81~85

Reinforcement of beam (development length and extension of longitudinal rebar. Stirrup spacing of the end area and middle area) ■ 95~102

The number in red square (   ) indicates the number in the Checklist.

## Structural Calculation

### Design policy and calculation method

Design: determined by structural type, codes & standards, modeling, etc.

Calculation method: ASD/WSD, USD

Software: ETABS, etc.

e.g. Floor area [Total floor area, ground floor]	<span style="background-color: red; color: black; padding: 0 2px;">2~3</span>
Structure [RC]	<span style="background-color: red; color: black; padding: 0 2px;">4</span>
Number of stories	<span style="background-color: red; color: black; padding: 0 2px;">5</span>
Height	<span style="background-color: red; color: black; padding: 0 2px;">6</span>
Declaration of the designer	<span style="background-color: red; color: black; padding: 0 2px;">7</span>
Codes and Standards [BNBC2020]	<span style="background-color: red; color: black; padding: 0 2px;">8</span>
Applied calculation method [Strength Design]	<span style="background-color: red; color: black; padding: 0 2px;">9</span>
Analysis method [Equivalent static analysis]	<span style="background-color: red; color: black; padding: 0 2px;">10</span>
Design software [ETABS]	<span style="background-color: red; color: black; padding: 0 2px;">11</span>

The number in red square (■) indicates the number in the Checklist.

## Structural Calculation

### Load calculation and designing detailing/reinforcement

Software input: setting loads, designing shape and cross-sectional member & reinforcement by following BNBC 2020 and specification.

e.g. Zone factor [ $Z=0.2$ ] ■ 20

Importance factor [ $I_e=1$ ] ■ 21

Dead load ■ 22

Live load ■ 23

Seismic load ■ 24

Wind load ■ 29~31

Building period [ $T$ ] ■ 25

Normalized acceleration response spectrum [ $C_s$ ] ■ 26

Design spectral acceleration [ $S_a$ ] ■ 27

Seismic design base shear [ $V$ ] ■ 28

Building irregularities

-Vertical ■ 38

-Horizontal ■ 39~43

The number in red square (■) indicates the number in the Checklist.

## Preparation of Design Documents

### Preparation of RAJUK Sheet and Design Documents

Designers shall prepare RAJUK sheet, design report, specifications (including concrete pouring), a set of drawings (architecture, structure and EMP) as well as calculation sheet.

After obtaining LUC (Land Use Clearance), owners submit all the above documents to RAJUK for application.

**BNBC Part 6 Sec 1.9**

e.g. Soil report	12
$\bar{V}_s$	13
$\bar{N}$	14
$\bar{S}_u$	15
Concrete pouring	44~47
Curing	48~49
Cover	50
Concrete classification	51
Column	68~80
Beam	86~94
Shear Wall	103~114
Slab	115~119
Foundation	120~125

### 2.3.2 Structural design checklist

■ Design Check List (No. 1~125) No. 32 20240829

100 items are mandatory (white cells).

25 items are sampling (green cells ★ marked).

Building Name	
Site Location	
Engineer	Na
RAJUK	Na
	Na
	Na
	Na

1		2	3		
Element	No.	Item	confirm	not confirm	Det
Building overview	1	Building occupancy type →Describe what you checked. ex) Residential building	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	2	Total floor area →Describe it. ex) 4353.41m <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	3	Ground floor area →Describe it. ex) 527.03m <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	4	Type of Structure →Describe it. ex) RCC, Steel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	5	Number of stories →Describe it. ex) 10 stories and 1 base	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	6	Building Height →Describe it. ex) 34.5m	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Declaration	7	Declaration of the designer (responsibility for the design) →Write designer's name. ex) A. K. M Saiful Bari	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Codes and Standards	8	Codes and Standards →Describe it. ex) BNBC2020	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Design method	9	Design method →Describe it. ex) USD, WSD	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Earthquake Analysis methods	10	Earthquake Analysis methods →Describe it. ex) Equivalent static analysis	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Ex
Software	11	Design software Name →Describe it. ex) ETABS v16.2.1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Soil Properties	12	Soil report Confirmation. →Describe the site. Ex) Basundhara R/A, Dhaka	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	13	Vs: Average Shear Wave Velocity →Describe it. ex) Vs=108.38<180 (m/s)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	14	N: Average SPT value in top 30m →Describe it. ex) N=2.67<15 (blows/30cm)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	15	Su: Average Undrained shear Strength →Describe it. ex) No description (non-cohesive layer)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Site Conditions	16	S: Site Class based on Soil properties is selected according to Table6.2.13. →Describe it. ex) SD	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	17	Occupancy category is selected according to Table6.1.1. →Describe it. ex) II	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	18	Seismic Zone is selected according to Figure6.2.24. →Describe it. ex) 2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	19	SDC: Seismic Design Category is selected according to Table6.2.18. →Describe it. ex) D	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	20	Seismic Zone Coefficient "Z" is selected according to Table6.2.14, 6.2.15. →Describe it. ex) 0.2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	21	I: Importance factor is selected according to Table 6.2.17. →Describe it. ex) 1.00	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Name	Date
Name	Date
Name	Date
Name	Date
Name	Date

Cells filled out by RAJUK/designers					Reference			
4	5				6	7	8	9
Describe the Contents of the Confirmation	Data source page or No.	Data source			BNBC2020 Part VI	Manual page	URP P-S	Remarks
	D-Design Report A-Architectural Drawing S-Structural Drawing	DESIGN REPORT	Architectural DRAWING	Structural DRAWING				
Residential building	D-7	<input type="radio"/>			Sec 1.2.3 Table 6.1.1	Annex (1)	-	
4353.41m <sup>2</sup>	A-01		<input type="radio"/>		-	-	-	
527.03m <sup>2</sup>	A-01		<input type="radio"/>		-	-	-	
RC	D-7,9 S-G02 1-d)	<input type="radio"/>		<input type="radio"/>	-	-	-	
10 stories and 1 base	D-7 A-01, 18	<input type="radio"/>	<input type="radio"/>		-	-	-	
34.5m	D-7, 18 A-14	<input type="radio"/>	<input type="radio"/>		-	-	-	
A. K. M Saiful Bari	D-1, 2	<input type="radio"/>			Sec. 1.9.2(h)	Chapter 1 1.4	-	
BNBC2020	D-8 S-G02 1-a)	<input type="radio"/>		<input type="radio"/>	Sec. 1.9.2(a), (b)	-	-	
Strength design	D-19 S-G02 1-f)	<input type="radio"/>		<input type="radio"/>	Sec. 1.9.2(c)	-	-	
Equivalent static analysis	D-21 S-G02 1-b)	<input type="radio"/>		<input type="radio"/>	Sec 2.5.7- 2.5.12	-	-	
ETABS v16.2.1	D-21	<input type="radio"/>			Sec. 1.9.2(i)	Chapter 1 1.4	-	
Basundhara R/A, Dhaka	D-15, 20	<input type="radio"/>			Sec. 1.9.2(g) Sec. 2.5.3	Annex (4)	118, 123	
V <sub>s</sub> =108.38<180m/s	D-15 Soil Report	<input type="radio"/>			Sec. 2.5.3.2 Table 6.2.13	Annex (3)	118	
N=2.67<15m/s	D-15 Soil Report	<input type="radio"/>			Sec. 2.5.3.2 Table 6.2.13	Annex (3)	118	
No description	D-15 Soil Report	<input type="radio"/>			Sec. 2.5.3.2 Table 6.2.13	Annex (3)	118	
SD	D-15	<input type="radio"/>			Sec 2.5.3.2 Table 6.2.13	Annex (3)	118	
II	D-15, 18	<input type="radio"/>			Sec 1.2.3 Table 6.1.1	Annex (1)	-	
2	D-15 S-G02 2-c)	<input type="radio"/>		<input type="radio"/>	Sec 2.5.4.2 Figure 6.2.24	Annex (2)	117	
D	D-15	<input type="radio"/>			Sec 2.5.5.2 Table 6.2.18	Annex (4)	122	
0.2	D-15, 18	<input type="radio"/>			Sec 2.5.4.2 Table 6.2.14, 15	Annex (2)	117	
1.00	D-15, 18	<input type="radio"/>			Sec 2.5.5.1 Table 6.2.17	-	119	

The entry in the red box above is an example.

Element	No.	Item	confirm	not confirm	De	
Loads etc.	22	Total Dead Load →Describe it. ex) 53041.2kN	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	23	Total Live Load →Describe it. ex) 9484.0kN	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	24	W : Seismic weight W=Dead Load+Live Load× (25%, 50%, 100%, or higher) →Describe it. ex) W=55412.25kN	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	25	T(a) : Building period →Describe it. ex) T=0.694678957	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	26	Cs : Normalized acceleration response spectrum →Describe it. ex) Cs=3.375	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	27	Sa : Design spectral acceleration. Sa=2/3×Z1/R×Cs →Describe it. ex) Sa=0.069	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	28	V : Design base shear. V=Sa×W →Describe it. ex) V=3823.5kN	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	29	Wind Loads	Basic Wind Speed →Describe it. ex) 65.7m/s (=236.5km/h=146.9mph)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	30		Importance Factor (Table 6.2.9) →Describe it. ex) 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	31		Gust Effect Factor →Describe it. ex) 0.85 If building period greater than 1.0 second, the Gust Effect Factor shall be calculated.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Structural System	32	Seismic Force-Resisting System is selected according to Table 6.2.19. →Describe it. ex) DUAL SYSTEMS (IMF) E2 Special reinforced concrete shear walls	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	33	The type of Moment Resisting Frame (SMF, IMF, or OMF) →Describe it. ex) IMF	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	34	R : Response Reduction Factor is selected according to Table 6.2.19. →Describe it. ex) R=6.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	35	Cd : Displacement Amplification Factor is selected according to Table 6.2.19. →Describe it. ex) Cd=5	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	36	Height limit is selected according to Table 6.2.19. →Describe it. ex) 50m	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	37	★Building height is lower than the height limit above.	<input checked="" type="checkbox"/>		Sat	
Building Irregularities	38	Vertical Stiffness Irregularity check (mentioned/not) Soft story occurs when lateral stiffness is less than 70% of that in the story above.	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	39	Horizontal (a) Torsional Irregularity check (mentioned/not) Irregular : $\Delta_{max}/\Delta_{ave} > 1.2$ Extreme : $\Delta_{max}/\Delta_{ave} > 1.4$	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	40	Drift check Storey drift →As a representative, describe the maximum value of the X-direction (positive force). ex) 0.003139 (6F)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	41	★The maximum storey drift above is lower than the value of Table 6.2.21 (ex. lower than 0.020hsx). hsx is the story height below level x.	<input checked="" type="checkbox"/>		Sat	
	42	(b) Reentrant Corner check ( $A/L > 0.15$ ) (mentioned/not)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	43	(c) Diaphragm discontinuity check (mentioned/not) Irregular : $A_{axn}$ (= cutout or open areas) $> 1/2XY$ (= 50 percent of the gross enclosed area of the diaphragm)	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Concreting Procedure	44	Concrete Maximum permissible free fall height of concrete depositing/pouring →Describe it. ex) 1.5m	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	45	★The maximum free fall height above is lower than 1.5m (lower is better).	<input checked="" type="checkbox"/>		Sat	
	46	A compaction method such as using mechanical vibrators	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	47	Precautions for form work such as follow PWD schedule	<input checked="" type="checkbox"/>	<input type="checkbox"/>		

Describe the Contents of the Confirmation	Data source page or No. D:Design Report A:Architectural Drawing S:Structural Drawing	Data source			BNBC2020 Part VI	Manual page	URP P-S	Remarks
		DESIGN REPORT	Architectural DRAWING	Structural DRAWING				
53041.2kN	D-15	<input type="radio"/>			Sec 2.2	-	96	
9484.0kN	D-15	<input type="radio"/>			Sec 2.3	-	99-105	
W=55412.25kN	D-15	<input type="radio"/>			Sec 2.5.7.3	-	-	
T=0.694678957	D-18	<input type="radio"/>			Sec 2.5.7.2	-	128	
Cs=3.375	D-15	<input type="radio"/>			Sec 2.5.4.3	-	121	
Sa=0.069	D-15	<input type="radio"/>			Sec 2.5.4.3	-	121	
V=3823.5kN	D-15	<input type="radio"/>			Sec 2.5.7.1	-	-	
65.7m/s	D-13 S-G02 2-b)	<input type="radio"/>		<input type="radio"/>	Sec 2.4.4 Table 6.2.8	-	138	
I	D-13	<input type="radio"/>			Sec 2.4.5 Table 6.2.9	-	139	
0.85	D-13	<input type="radio"/>			Sec 2.4.8	-	158	
E2:Special reinforced concrete shear walls	D-7,18 S-G02 1-b)	<input type="radio"/>		<input type="radio"/>	Sec 2.5.5.4 Table 6.2.19	Annex (5)	120, 124	
IMF	D-7 S-G02 1-b)	<input type="radio"/>		<input type="radio"/>	SMF: Sec 8.3.3-8 IMF: Sec 8.3.10 OMF: Sec 8.3.9	Annex (6)	-	
R=6.5	D-18	<input type="radio"/>			Sec 2.5.5.4 Table 6.2.19	Annex (5)	120, 124	
Cd=5	D-18	<input type="radio"/>			Sec 2.5.5.4 Table 6.2.19	Annex (5)	120, 124	
50m	D-7	<input type="radio"/>			Sec 2.5.5.4 Table 6.2.19	Annex (5)	120, 124	
Satisfactory	-							
-	D-49	<input type="radio"/>			Sec 2.5.5.3.2 (i)	-	126	
-	D-44	<input type="radio"/>			Sec 2.5.5.3.1 (i)	-	126	
0.003139 (6F)	D-47	<input type="radio"/>			Sec 2.5.14.1 Table 6.2.21	-	136	
Satisfactory	-							
-	D-51	<input type="radio"/>			Sec 2.5.5.3.1 (ii)	-	126	
-	D-51	<input type="radio"/>			Sec 2.5.5.3.1 (iii)	-	126	
1.5m	S-G06			<input type="radio"/>	Sec 5.10 or Indian Standard IS- 456:2000	-	-	
Satisfactory	-							
-	S-G06			<input type="radio"/>	Sec 5.10 or Indian Standard IS-456:2000	-	-	
-	S-G06			<input type="radio"/>	Sec 5.16	-	-	

The entry in the red box above is an example.

Element	No.	Item	confirm	not confirm	De	
Curing (days)	48	Column/Beam/ Shear wall/Slab	The curing period →Describe it. ex) 21 days	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	49		★The curing period is subject to the following. - General : More than 7 days at 10°C or higher. - High early strength : More than 3 days at 10°C or higher. - others : follow Sec 5.11.3.	<input checked="" type="checkbox"/>		Sat
Cover	50	Column/Beam/ Shear wall/Slab	The cover thickness (mentioned/not)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Concrete	51	classification	Normal weight concrete is used. In the case of lightweight concrete, follow the regulations of lightweight concrete. Below is a regulation for normal weight concrete.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Concrete Compressive Strength f'c	52		Concrete compressive strength (f'c) of column from design report →Describe it. ex) 31N/mm <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	53	Column	Concrete compressive strength (f'c) of column from structural drawing →Describe it. ex) 31N/mm <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	54		★Confirm the consistency between design report and structural drawing. - f'c' of design report = f'c' of structural drawing	<input checked="" type="checkbox"/>		Sat
	55	Beam	Concrete compressive strength (f'c) of beam. Confirm the consistency between design report and structural drawing. →Describe it. ex) 24.13N/mm <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	56	Shear Wall	Concrete compressive strength (f'c) of shear wall. Confirm the consistency between design report and structural drawing →Describe it. ex) 31N/mm <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	57	Slab	Concrete compressive strength (f'c) of slab. Confirm the consistency between design report and structural drawing. →Describe it. ex) 24.13N/mm <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	58		★f'c' is subject to the following. - IMF, OMF : 20 N/mm <sup>2</sup> or more (17 N/mm <sup>2</sup> or more for 4th floors and below) - SMF : 21 N/mm <sup>2</sup> or more - For the corrosive environment or other severe exposure conditions : 25 N/mm <sup>2</sup> or more	<input checked="" type="checkbox"/>		Sat
	59		Concrete compressive strength (f'c) of foundation. Confirm the consistency between design report and structural drawing. →Describe it. ex) Pile=21N/mm <sup>2</sup> , Pile cap=31N/mm <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	60	Foundation	The type of foundation →Describe it. ex) cast in situ pile	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
61		★f'c' is subject to the following. - Footing : ≥20N/mm <sup>2</sup> - Cast-in-situ pile : ≥18N/mm <sup>2</sup> - Driven pile : ≥25N/mm <sup>2</sup>	<input checked="" type="checkbox"/>		Sat	
Steel yield Strength	62	fy (longitudinal rebar)	Steel yield strength (fy) of longitudinal rebar. Confirm the consistency between design report and structural drawing. →Describe it. ex) 414N/mm <sup>2</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	63		★fy is subject to the following. - IMF, OMF : 550N/mm <sup>2</sup> or less - SMF : 420N/mm <sup>2</sup> or less	<input checked="" type="checkbox"/>		Sat
	64	fyt (transverse rebar)	Steel yield strength (fyt) of transverse rebar. Confirm the consistency between design report and structural drawing. →Describe it. ex) 414N/mm <sup>2</sup> If fyt is not described, the value of fy is adopted.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
	65		★fyt is subject to the following. - IMF, OMF : 550N/mm <sup>2</sup> or less - SMF : 700N/mm <sup>2</sup> or less	<input checked="" type="checkbox"/>		Sat
	Lap splices	66	Column	The position of the lap splices (ℓd) of column. (mentioned/not)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
67		Beam	The position of the lap splices (ℓd) of beam. (mentioned/not)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Describe the Contents of the Confirmation	Data source page or No. D: Design Report A: Architectural Drawing S: Structural Drawing	Data source			BNBC2020 Part VI	Manual page	URP P-S	Remarks
		DESIGN REPORT	Architectural DRAWING	Structural DRAWING				
21 days	S-G06			○				
Satisfactory					Sec 5.11	-	-	
-	D-9 S-G05	○		○	Sec 8.1.7	-	8, 12 17, 63	
-	S-G02			○	Sec 5.1.1	-	-	
31N/mm <sup>2</sup>	D-9	○						
31N/mm <sup>2</sup>	S-G02			○				
Satisfactory								
24.13N/mm <sup>2</sup>	D-9 S-G02	○		○	Sec 5.5.4 Sec 8.1.7.8 Sec 8.3.3.3	Annex (6) A-8, 11, 17	64, 67 73, 84	
31N/mm <sup>2</sup>	D-9 S-G02, S-S16	○		○				
24.13N/mm <sup>2</sup>	D-9 S-G02	○		○				
Satisfactory								
pile=21N/mm <sup>2</sup> pile cap=31N/mm <sup>2</sup>	pile: D-9, S-S04 pile cap: S-G02	○		○				
cast in situ pile	S-S04			○	Sec 3.6.1 Table 6.3.5	-	67	
Satisfactory								
fy=414N/mm <sup>2</sup>	D-9 S-G02	○		○	Sec 6.2.4 Sec 8.3.3.4(b)	Annex (6) A-11, 17	68, 74, 85	
Satisfactory								
fyt=414N/mm <sup>2</sup>	D-9 S-G02	○		○	Sec 6.2.4 Sec 8.3.3.4(c)	Annex (6) A-11, 17	68, 74, 85	
Satisfactory								
-	S-G04, S-G06			○	Sec 8.2.3 Sec 8.2.12.2 Sec 8.3.4.2 Sec 8.3.5.3 Sec 8.3.5.4 Sec 8.3.10.5	Annex (6) A-7, 8, 13 20, 22, 23	65, 66 69, 75 76, 81 82	
-	S-G04, S-G06			○				

The entry in the red box above is an example.