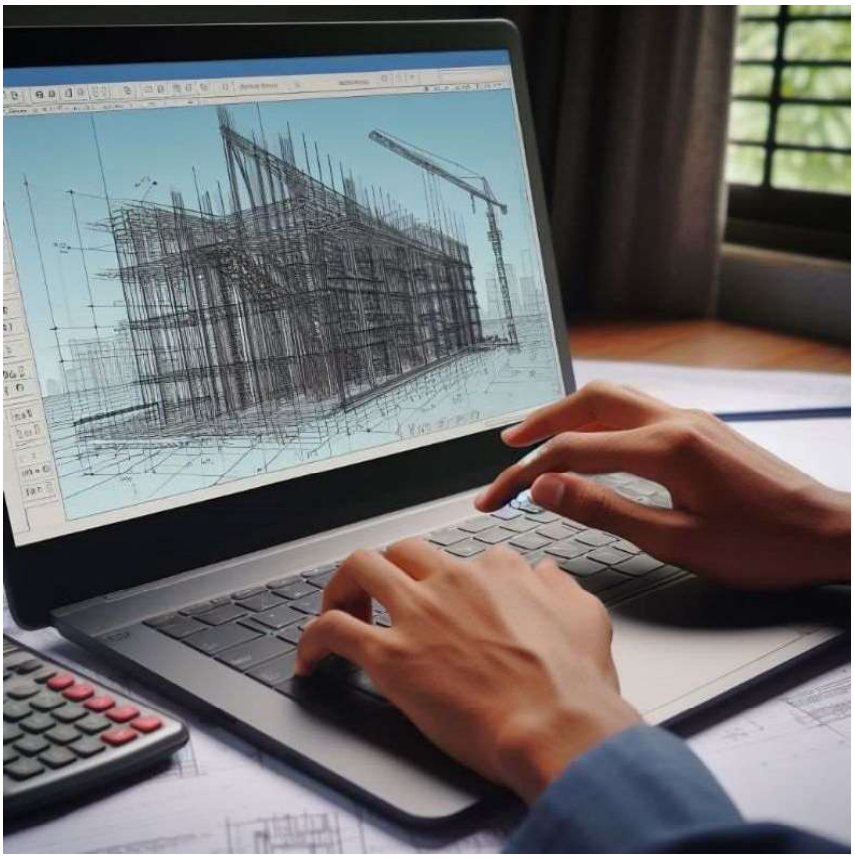
Manual I
Design Review on Structural Safety

For

The Project on Improvement of Design and Construction Quality for Resilience of Private Buildings (DCQR)



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Rajdhani Unnayan Kartripakkha (RAJUK)

JICA Expert Team for DCQR

Preface

By Chairman, RAJUK

Notes

楢府さん文章（2024.5.29_Addition to the manual on May 2024）利用

1. List of authors of the Manual I <design review on structural safety>

*** Rajdhani Unnayan Kartripakkha (RAJUK)**

Mehedi Hassan Khan (Mr.): Project manager on Output 1 on structure

Abdullah Al Mamun (Mr.): Project team member on Output 1 on structure

Masuk Ahmed (Mr.): Project team member on Output 1 on structure

Joton Debnath (Mr.): Project team member on Output 1 on structure

Rangon Mondal (Mr.): Project team member on Output 1 on structure

MD Shariar Siddioui (Mr.): Project team member on Output 1 on structure

Jannatun Nayma (Ms.): Project team member on Output 1 on structure

MD Eleous (Mr.): Project team member on Output 1 on structure

＊JICA Expert Team (JET)

Tatsuo Narafu (Dr.): Building administration/institutional framework 【Project Leader】

Yoichi Kubota (Mr.): Structural analysis/design

Shigenori Kita (Mr.): Structural specification and detailing

Rie Owada (Ms.): Coordination/training management

Suranjan Roy (Mr.): Local consultant

Engr. A. K. M. Saiful Bari, Peng (SB Consultant Ltd.)

Engr. Md. Faishal Hasan (SB Consultant Ltd.)

2. Authors of each section

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3. **List of reviewers** (proposal)

[redacted]

Dr. Raquib Ahsan, Professor of BUET, member of Advisory Committee for DCQR

Introduction

This manual and the checklist focus on Reinforced Concrete Structures

1. Objective of the Manual

*** Outline of the project of DCQR**

This manual is created for the project for Improvement of Design and Construction Quality for Resilience of Private Buildings (DCQR). The outline of the project is as below.

- Overall goal:
  Disaster risks in the jurisdiction of RAJUK is reduced
- Project purpose:
  Building design and construction quality for resilience of newly proposed private buildings approved by RAJUK in its jurisdiction is improved
- Expected Outputs:
  Output 1:
  RAJUK's application validating process on structure and fire safety of newly proposed private buildings is established and the capacity of RAJUK officers engaged in the process is strengthened.
  Output 2:
  Inspection by RAJUK officers and supervising processes by Certified Professionals for newly proposed private buildings are improved and the capacity of RAJUK officers engaged in the process is strengthened.
  Output 3:
  The awareness of the measures to improve building resilience among stakeholders (engineers, contractors, relevant associations and so on) is increased.

*** Objective of the Manual**

The Manual is created for the objective of capacity development of Output1 focusing on structural safety of reinforced concrete structure. The Manual is used for the Training of Trainers (ToT: RAJUK and JET collaborated to conduct training for trainers/lectures of RAJUK officials) and expected to be utilized for the Training of General staff (ToG: RAJUK trainers/lectures conduct training for officials other than the participants of ToT).

2. Policy of the trainings and list of materials

*** Policy of the trainings**

Output 1 states that it focuses on the capacity of RAJUK's application validating process/design review on structure and fire safety of newly proposed private buildings (in addition to the current application validating process on architectural design). Therefore, capacity of RAJUK officers engaged in the process needs to be strengthen. This Manual focuses on practical knowledge and skills on design review procedures rather than technical knowledge.

For the purpose, in addition to the Manual 1, a practical check list for structure design review and a complete set of structural design documents (an example of a typical structural design in Bangladesh) are created. In the ToT, lectures focus on how to use the check list in the design review procedures referencing the set of structure design documents.

*** List of the training materials**

- Manual 1: Design Review on Structural Safety: The basic material for the training which consists of Work flow (overview of building regulation, design review procedures in Bangladesh and so on), Technical documents (critical aspects of building in Bangladesh, overview of structural design and design review procedures, overview of "Design Report", basic knowledge on structural calculation software, and so on), possible enforcement measures, and annex.
- Structural design checklist focusing on basic items and critical items for Bangladesh
- a complete set of an example of structural design documents for practical training on how to use the checklist. The set of documents consists of "Design report", "approval sheet", architectural drawings, structural drownings, soil investigation report and several sheets of output of structural calculation

3. Procedures of creation of the Manuals and next steps forward

*** Baseline survey**

Prior to drafting of the Manual and relevant documents, following baseline surveys were conducted.

- Interview surveys

The interview surveys were conducted to six leading persons in Development Control wing, RAJUK on current situation of building safeties in Dhaka, causes and responsible people of the problems, and possible strategies to improve them.

- Questionnaire survey:

Questionnaire survey to 28 officers was conducted on educational background in Oct-Nov 2022, working experience, basic knowledge on structural design, view on safety of buildings including fire safety and construction work, and view of awareness of relevant people for safety of buildings. It shows that nearly half of them do not have experience of structure design and knowledge on structural design document is not enough.

*** Trial ToTs**

A series of the trial ToTs with participation of core member for structural design review listed below were conducted.

The 1st batch: for 3 days (Sep. 26, 28 and 29, 2022)

Number of participants: 4 participants and 1 observer (DPD)

The 2nd batch: for 3 days (February 7, 8, and 9, 2023)

Number of participants: 10 participants and 3 observers (PD, DPD and DPD of URP)

The 3rd batch: for 4 days (November 21, 27, 28 and December 5, 2023)

Number of participants: 5 participants and 1 observer (DPD)

The 4th batch: for 3 days (March 19, 20, and 21, 2024)

Number of participants: 7 participants and 2 observers (PD and DPD)

*** Creation of the Manual and relevant document**

According to the analysis of the baseline survey and the trial ToTs including discussions during them, RAJUK and JET agreed to create the materials for the training that the number of the items of the checklist should be limited to basic and critical issues considering common understanding that role of RAJUK review is cross check/double check (primary responsibility to design in accordance to the rule and BNBC2020 belongs to designers and their relevant engineers) and time for RAJUK officer to review the design is limited (refer to 1.4.1 Basic policy on structural design review).

*** Next steps forward**

The trainings of capacity development on structural design review are completely new challenge for RAJUK officers and proposed procedure on structural design review needs to be feasible and implementable for all the officials. Therefore, for the future, in accordance with development of the capacity of RAJUK officials, the check list is expected to be expanded both in number of items and in-depth contents.

*** Official ToTs**

Official ToTs with participation of core member (15 participants) for structural design review was conducted for 4 days (May 26, 27, 28, and 29, 2024).

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Yellow : by RAJUK

Annex

List of Abbreviations

ASD ＝WSD	Allowable Stress Design Method ＝Working Stress Design Method
IMF	Intermediate Moment Frame
LFD	Load Factor Design Method
OMF	Ordinary Moment Frame
SMF	Special Moment Frame
USD	Ultimate Strength Design Method

Following is the terminology relating to the structural design. (Reference: BNBC2020)

MOMENT RESISTING FRAME	A frame in which members and joints are capable of resisting forces primarily by flexure.
SHEAR WALL	A wall designed to resist lateral forces parallel to the plane of the wall (sometimes referred to as a vertical diaphragm or a structural wall).
DUAL SYSTEM	A combination of Moment Resisting Frames and Shear Walls or Braced Frames to resist lateral loads designed in accordance with the criteria of Sec 1.3.2.4.
SPECIAL MOMENT FRAME (SMF)	A moment resisting frame specially detailed to provide ductile behaviour complying with the requirements of Chapter 8 or 10 for concrete or steel frames respectively.
INTERMEDIATE MOMENT FRAME (IMF)	A concrete moment resisting frame designed in accordance with Sec 8.3.10.
ORDINARY MOMENT FRAME (OMF)	A moment resisting frame not meeting special detailing requirements for ductile behaviour.
ALLOWABLE STRESS DESIGN METHOD (ASD)	A method for proportioning structural members such that the maximum stresses due to service loads obtained from an elastic analysis does not exceed a specified allowable value. This is also called Working Stress Design Method (WSD).
STRENGTH DESIGN METHOD	A method of proportioning structural members using load factors and resistance factors satisfying both the applicable limit state conditions. This is also known as Load Factor Design Method (LFD) or Ultimate Strength Design Method (USD).
DEAD LOAD	The load due to the weight of all permanent structural and nonstructural components of a building or a structure, such as walls, floors, roofs and fixed service equipment.
LIVE LOAD	The load superimposed by the use and occupancy of a building.
CONCRETE	Mixture of Portland cement or any other hydraulic cement, fine aggregate, coarse aggregate and water with or without admixture.
CONCRETE, LIGHTWEIGHT	Concrete containing lightweight aggregate and an equilibrium density as determined by ASTM C567, between 1450 - 1850 kg/m^3.
CONCRETE, NORMALWEIGHT	Concrete containing only aggregate that conforms to ASTM C33.

Notation and Symbols

Ag	Gross area of concrete section, mm^2
Ash	Total cross-section area of transverse reinforcement (including cross ties) within spacing *s* and perpendicular to dimension *hc*, mm^2
Ast	Total area of nonprestressed longitudinal reinforcement (bars or steel shapes), mm^2
bw	Web width, or diameter of circular section, mm
d	Distance from extreme compression fiber to centroid of longitudinal tension reinforcement, mm
db	Bar diameter, mm
fc'	Specified compressive strength of concrete, Mpa (=N/㎟)
fy	Specified yield strength of (longitudinal) reinforcement, Mpa
fyt	Specified yield strength of transverse reinforcement, Mpa
hc	Cross-section dimension of column core measured to the outside edge of the transverse reinforcement composing area Ash, mm, center to center of confining reinforcement
ℓd	Development length in tension of deformed bar, deformed wire, plain and deformed welded wire reinforcement, mm
ℓdh	Development length in tension of deformed bar or deformed wire with a standard hook, measured from critical section to outside end of hook [straight embedment length between critical section and start of hook (point of tangent) plus inside radius of bend and one bar diameter], mm
ℓ_0	Minimum length, measured from joint face along axis of structural member, over which special transverse reinforcement must be provided, mm
s	Center-to-center spacing of items, such as longitudinal reinforcement, transverse reinforcement, wires, or anchors, mm
s_0	Maximum spacing of transverse reinforcement, mm

Chapter 1. Work flow

1.1. Overview of building regulation in Bangladesh

The building regulation is not very unfamiliar in Bangladesh. An act to provide for the prevention of haphazard construction of buildings and excavation of tanks which are likely to interface with the planning of certain area in Bangladesh. The name of this act is 'Building Construction Act1952'. According this law first building regulation started in Bangladesh. A lot of rules come out from this law as a derivatives. Among them most popular Dhaka Metropolitan building (construction, development, preservation and demolition) rules 2008 (DBCR2008) and Bangladesh National Building Code'2020 (BNBC2020). There are many organizations playing the role of regulatory authority, the RAJUK (Old name DIT) is the first organization to deal the issues related building regulation. The RAJUK has a fixed jurisdiction and mandate to implement the laws and rules of building regulation.

In Dhaka city for building plan approval we followed dhaka mohanogor imarot nirman bedhimala-2008 & Detailed Area Plan(2022-2035). As per imarot nirman bedemala & Detailed Area Plan there are two types of Land in rajuk jurisdiction area. a) Planned Area b) Unplanned area. If a land Oner's wants to construct a building his own land fast of all he needs land use Clearance both two type's of Land. In Land use Clearance basically given us which occupancy categories building can be construct in specific land, Total FAR (Floor Area Ratio) included Floor Area & Number of dwelling unit. Than farther process is applying for large and special projet(LSP) permission for specific condition. LSP needed for following conditions;

1. If building consist of more than 40 residential flat
2. If building consist of more than 7500sqm FAR including area.
3. If building type is market and consist of more than 5000sqm FAR including area.
4. If land is directly connected to national and Resonal highway.
5. Permission for brick field and industral building.
6. Any types of approval Radius including 250m distance between Historical building.
7. Any types of approval Radius including 250m distance between area of natural beauty.
8. Any types of approval Radius including 50m distance between any heels.
9. Any types of approval distance between 250m from river.

In other cases land owners can directly applying for building plan approval as per approved land used clearance. As per Imarot nirman bedhemala applying for plan approval needed only architectural drawing. After siddik Bazar incedent Rajuk decided that applying for every building plan approval after BC committee voting is complete than client Submit Structural, MEP design as per BNBC-2020. Now in Ecps software this process is ongoing.

1.2. Overview of design review

There are many standard guide lines for design of building in Bangladesh. For RAJUK area generally two rules are used i) DBCR2008 and ii) BNBC2020. From the beginning of establishment of RAJUK (old DIT) building owner need apply in RAJUK and submit design for construction approval. In thus purpose an architectural plan and design need to be submitted in RAJUK according to the DBCR2008. The officers of RAJUK check/review the architectural design and give permission the building construction without ensuring the otters design like structural, EMP, etc. The building design are mostly done by engineers and architects registered by professional board like IEB, IAB, etc.

1.3. Overview of procedure of design review on structural safety

Current procedure for structural and others design review

To introduce the structural and fire safety design review procedure first explain the existing construction procedure. The existing procedure is represented with flow diagram in the Figure1.

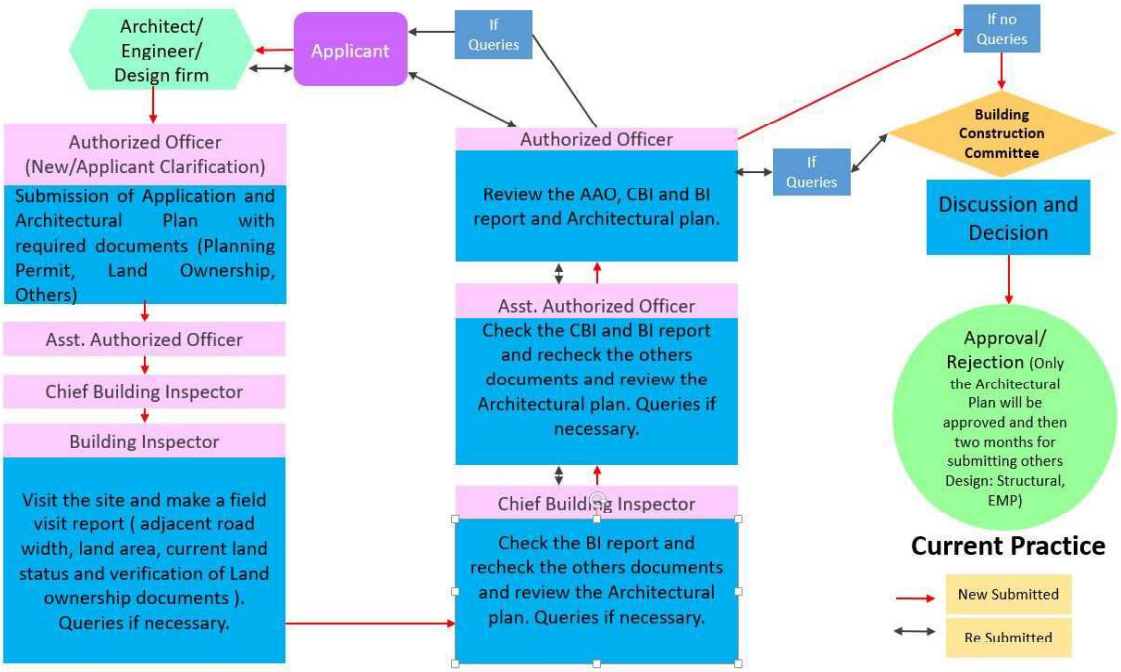


Figure 1: Existing Construction permit procedure.

Currently construction permit application process is online based (Electronic construction permit system; url http://www.ecps.gov.bd/). When an applicant wants to apply for construction permit then the applicant must have a registered account in ECPS (Electronic construction permit system).

Then the applicant along with the help of an architect successfully apply for construction permit with the required documents. The application first appears to the front desk officer (currently it's inactive). If the front desk officer finds it ok then he forwards this application to The Authorized Officer (AO) and consecutively to Asst. Authorized Officer (AAO), Chief Building Inspector (CBI) and lastly to Building Inspector (BI).

Building Inspector then visits the proposed site and check the submitted documents in application. Then the building inspector forwards the application to the CBI along with his written comments/ observations in the review section of the application. CBI and AAO do the same and forward the application to the Authorized Officer. The Authorized Officer then observes the findings of AAO, CBI and BI. Later if the Authorized officer finds everything is ok then the AO put the application for the next

building construction committee meeting and if there is any dispute in the application or requires any additional information then the AO sends the application back to applicant asking to submit the required information or correction.

There are many documents required for existing building construction permit.The followings are the lists of documents

1. National Identity
2. Photo
3. Up to date income tax
4. Land Ownership
    i. Updated land tax receipt
    ii. Duplicate Carbone receipt (DCR)
    iii. Mutation copy
    iv. Ownership deed
    v. Survey records(khatian, porcha, namjari jama vager prostab)
5. Indemnity bond *(it's an indemnity for Rajuk for any kind of failure during foundation construction, the construction company or the land owner will take all the liability for compensation or repairing).*
6. Undertaken (if required)
7. Others NOCs (If required)
8. Planning Permit
9. Large and Special Project permit (if required)
10. Architectural plan

Proposed procedure for structural and others design review

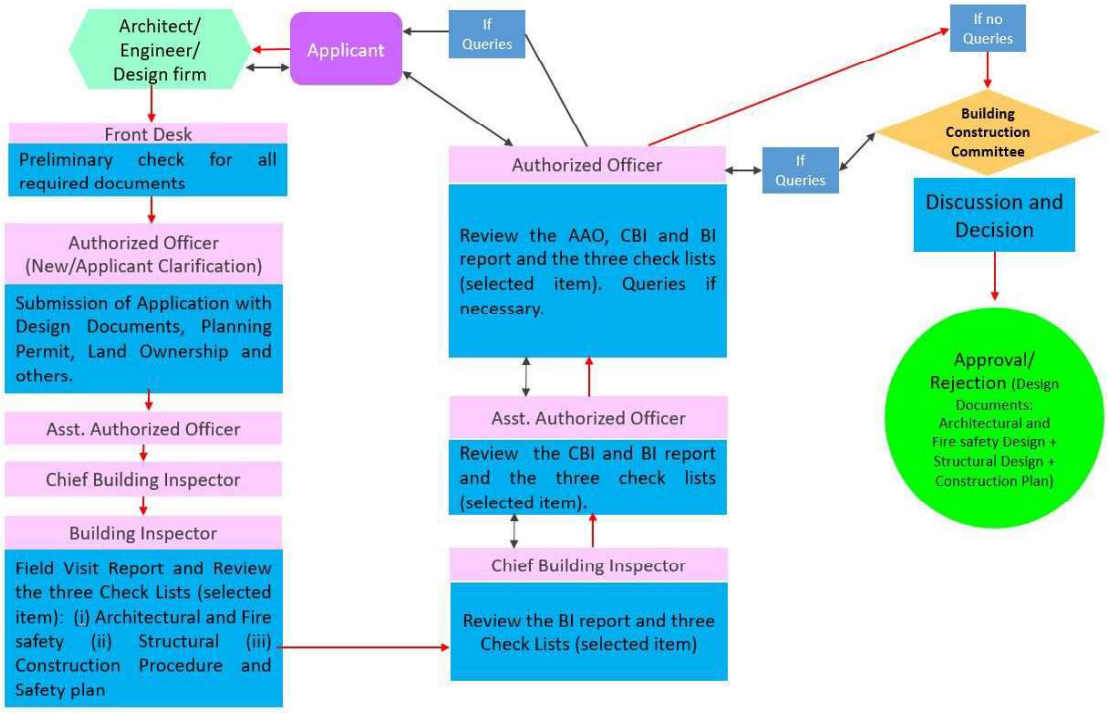


Figure 2: Proposed Construction permit procedure

The Design Documents consists of followings:

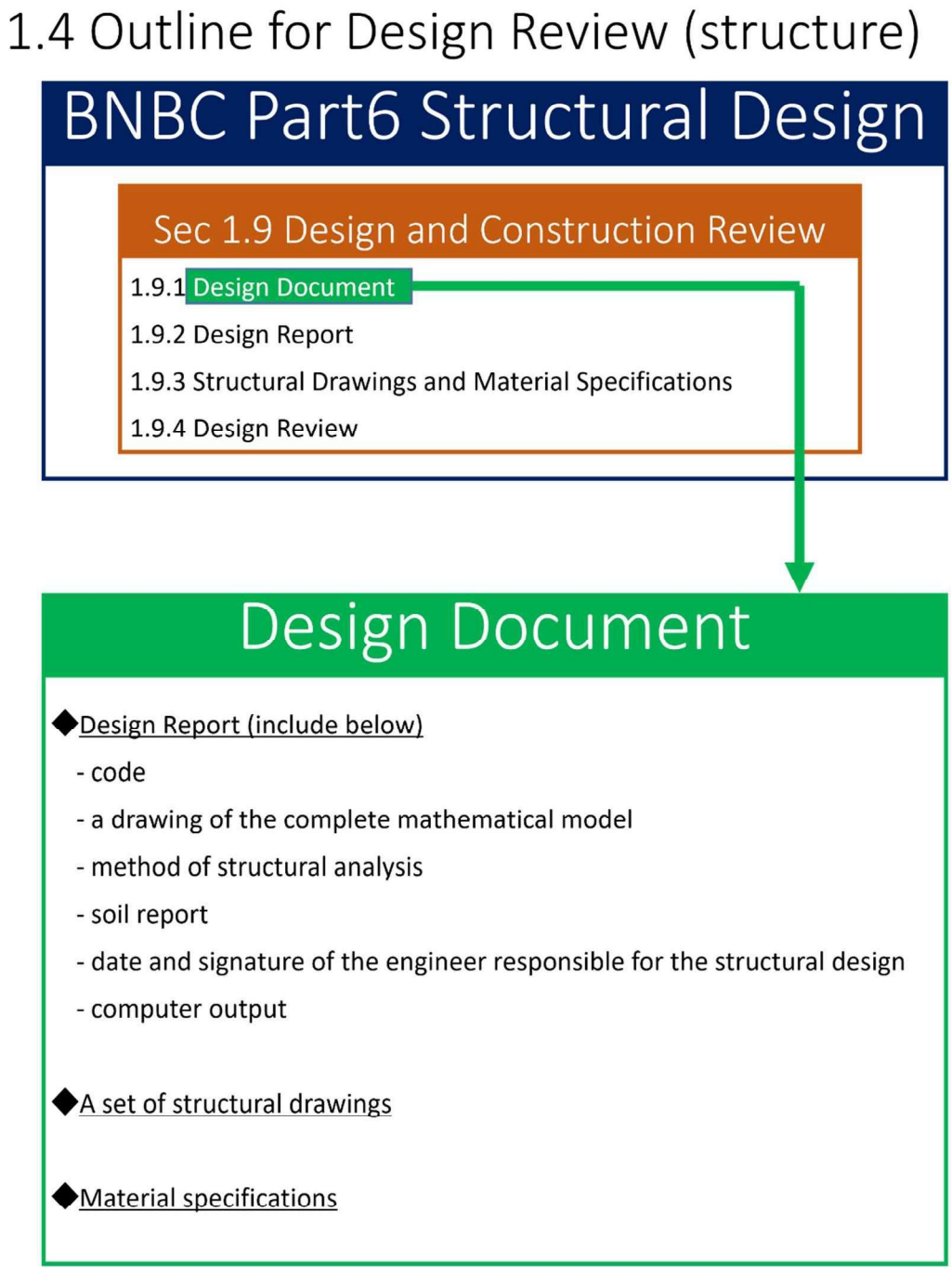
1. Design Report
2. Drawings
    a. Architectural
    b. Structural
    c. Electrical
    d. Plumbing
    e. Mechanical (if necessary)
3. Material Specifications
4. Construction Procedure and Safety plan report

There are three check lists for reviewing the design documents i) Architectural and fire safety design review ii) Structural design review and iii) Others. All check lists items are divided among the four officers (AO, AAO, CBI and BI) to expedite the procedure.

1.4. Procedures of design review on structural safety

Following is the outline of design document specified on BNBC 2020.

Related BNBC chapter & description is shown on the following page.



1.9 Design and Construction Review

Every building or structure designed shall have its design documents prepared in accordance with the provisions of Sec 1.9.1. The minimum requirements for design review and construction observation shall be those set forth under Sections 1.9.2 and 1.9.3 respectively.

1.9.1 Design Document

The design documents shall be prepared and signed by the Engineer responsible for the structural design of any building or structure intended for construction. The design documents shall include a design report, material specifications and a set of structural drawings, which shall be prepared in compliance with Sections 1.9.2 and 1.9.3 below for submittal to the concerned authority. For the purpose of this provision, the concerned authority shall be either persons from the government approval agency for the construction, or the owner of the building or the structure, or one of his representatives.

1.9.2 Design Report

The design report shall contain the description of the structural design with basic design information as provided below, so that any other structural design engineer will be able to independently verify the design parameters and the member sizes using these basic information. The design report shall include, but not be limited to, the following:

(a) Mention of this Code including relevant Part, Chapter and Section.

(b) Name of other referenced standards, and the specific portions, stating chapter, section etc. of these Code and standards including any specialist report used for the structural design.

(c) Methods used for the calculation of all applied loads along with basic load coefficients and other basic information including any assumption or judgment made under special circumstances.

(d) A drawing of the complete mathematical model prepared in accordance with Sec 1.2.7.1 to represent the structure and showing on it the values, locations and directions of all applied loads, and location of the lateral load resisting systems such as shear walls, braced frames etc.

(e) Methods of structural analysis, and results of the analysis such as shear, moment, axial force etc., used for proportioning various structural members and joints including foundation members.

(f) Methods of structural design including types and strength of the materials of construction used for proportioning the structural members.

(g) Reference of the soil report or any other documents used in the design of the structure, foundation or components thereof.

(h) Statement supporting the validity of the above design documents with date and signature of the engineer responsible for the structural design.

(i) When computer programs are used, to any extent, to aid in the analysis or design of the structure, the following items, in addition to items (a) to (g) above, shall be required to be included in the design report:

  (i) A sketch of the mathematical model used to represent the structure in the computer generated analysis.

  (ii) The computer output containing the date of processing, program identification, identification of structures being analysed, all input data, units and final results. The computer input data shall be clearly distinguished from those computed in the program.

  (iii) A program description containing the information necessary to verify the input data and interpret the results to determine the nature and extent of the analysis and to check whether the computations comply with the provisions of this Code.

  (iv) The first sheet of each computer run shall be signed by the engineer responsible for the structural design.

1.9.3 Structural Drawings and Material Specifications

The structural drawings shall include, but not be limited to, the following:

(a) The first sheet shall contain :

  (i) Identification of the project to which the building or the structure, or portion thereof belongs,

  (ii) Reference to the design report specified in Sec 1.9.2 above,

  (iii) Date of completion of design, and

  (iv) Identification and signature with date of the engineer responsible for the structural design.

(b) The second sheet shall contain detail material specifications showing:

  (i) Specified compressive strength of concrete at stated ages or stages of construction for which each part of structure is designed.

  (ii) Specified strength or grade of reinforcement

  (iii) Specified strength of prestressing tendons or wires

  (iv) Specified strength or grade of steel

  (v) Specified strengths for bolts, welds etc.

  (vi) Specified strength of masonry, timber, bamboo, ferrocement

  (vii) Minimum concrete compressive strength at time of post-tensioning

  (viii) Stressing sequence for post-tensioning tendons

  (ix) General notes indicating clear cover, development lengths of reinforcements, or any other design parameter relevant to the member or connection details provided in drawings to be followed, as applicable, and

  (x) Identification and signature with date of the Engineer responsible for the structural design.

(c) Drawing sheets, other than the first two, shall include structural details of the elements of the structure clearly showing all sizes, cross-sections and relative locations, connections, reinforcements, laps, stiffeners, welding types, lengths and locations etc. whichever is applicable for a particular construction. Floor levels, column centres and offset etc., shall be dimensioned. Camber of trusses and beams, if required, shall be shown on drawings. For bolt connected members, connection types such as slip, critical, tension or bearing type, shall be indicated on the drawing.

(d) Drawings shall be prepared to a scale large enough to show the information clearly and the scales shall be marked on the drawing sheets. If any variation from the design specifications provided in sheet two occurs, the drawing sheet shall be provided additionally with the design specifications including material types and strength, clear cover and development lengths of reinforcements, or any other design parameter relevant to the member or connection details provided in that drawing sheet. Each drawing sheet shall also contain the signature with date of the engineer responsible for the structural design.

1.9.4 Design Review

The design documents specified in Sec 1.9.1 shall be available for review when required by the concerned authority. Review shall be accomplished by an independent structural engineer qualified for this task and appointed by the concerned authority. Design review shall be performed through independent calculations, based on the information provided in the design documents prepared and signed by the original structural design engineer, to verify the design parameters including applied loads, methods of analysis and design, and final design dimensions and other details of the structural elements. The reviewing engineer shall also check the sufficiency and appropriateness of the supplied structural drawings for construction.

1.4.1. Basic policy on structural design review

1.4.1.1 Structural design by structural designer and reviews before application for construction permit

Structural designers have responsibility to conduct structural designs in accordance with BNBC as stipulated in Dhaka Construction Rules Article 21 (see below). For the purpose, structural designers should review the structural design to be compliant to the code by themselves. In addition, in case they work for consultant firms, managing/supervising engineers who are responsible to supervise services by technical staff of the firms, should review the structural designs. In case the building is large scale or others which needs high expertise to review the structural design, it is preferable to invite engineers of high expertise for the design review. Further, for owners who are conscious about structural safety, it is recommended to employ other independent engineers to conduct peer review to ensure safety (in several countries, this type of spontaneous peer review is practiced). In these ways, RAJUK should make effort to encourage owners, designers, and other relevant people to conduct several reviews to ensure compliance with the code before application for building permit to RAJUK. Current practice of design review in Japan is shown in Figure 1 for reference.

Dhaka Construction Rules Provision 21

Registered engineer appointed by applicants shall give structural design of the buildings according to the code and in proper scale.

Structural design review practice in Japan

Several mandatory structural design review schemes are introduced in Japan

- *General management by managing/ supervising engineers based on Kenchiku-shi Act #24*
- *Structural design review by structural design expert based on Kenchiku-shi Act #20-2*

For large buildings, structural calculation review by a third party is mandatory along with the review by regulatory authority based on Building Standard Act #6 (on the structural calculation. "Kozo tekihan")

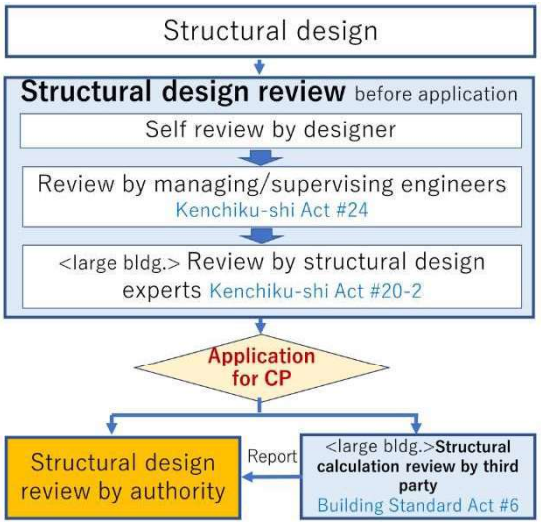


Figure 1 Structural design review practice in Japan

1.4.1.2 Role of review by RAJUK

1) Cross check and provision of opportunities of re-review by designers and relevant engineers

The role structural design review by RAJUK is to cross/double check the structural design (the primary check is responsibility of the designer and the relevant engineers as stated in the previous section). Considering this role, the design review by RAJUK should focus key issues mentioned in the following section (1.4.1.2 3)).

Points or parts on which the reviewer could not confirm the compliance to the codes (see below) should be notified to the designers for re-review. The designers must review the design again and report results to the reviewer. Through this procedure, the designer are reminded the responsibility to design compliant to the codes.

* Examples of parts or points to be notified to the designer

1) parameters in the description which seem not compliant to the codes,

2) parameters which could not be confirmed to be compliant to the codes by the review work,

3) consistency between parameters in the design documents and output of the structural calculation could not be confirmed by the reviewers

2) Types of review work by RAJUK officials

Types of review work proposed in this manual and the checklist can be categorized as follows.

* Clear description in the design documents

Key issues on the structural design need to be clearly described in the design documents. For the first step of the review process, RAJUK reviewer is to confirm that those issues are described in the design documents.

Examples of key issues listed in the proposed checklist:

- seismic zoning (Z) (#18)
- occupancy categories (#17)
- site class (#16)
- seismic design categories (#19)
- type of structural system (#32-33)

* Compliance with relevant provisions in BNBC

The next type is to confirm the description in the documents are compliant to the relevant provisions in BNBC.

Examples of items to be confirmed listed in the checklist:

- building height (#36)
- maximum story drift (#40-41)
- curing period (#48-49)
- concrete compression strength of column (#52-54)
- steel yield strength of longitudinal rebar (#62-63)

* Consistency between the design documents and output of the structural calculation

Structural design must be created based on result of structural calculation shown in Figure 2.

In order to confirm the consistency between the design documents and output of the structural calculation, several items of design documents need to be confirmed whether they are consistent with the computer software output.

Examples of items to confirm consistency in the proposed checklist:

- cross sectional area of longitudinal rebar of column (Ast) (#73-78)
- cross sectional area of longitudinal rebar of beam (#91-94)

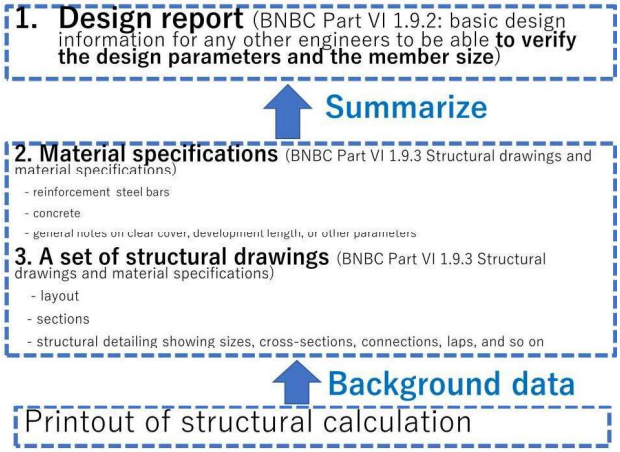


Figure 2 Relation among the documents relating the structural design

3) Selection of items for review

As RAJUK reviewer must review structural design in a limited time, items for review need to be limited (the structural designers bear responsibility to design compliant to the codes on all the design documants). For the situation, the items should be limited to key issues in structural design. This manual selects the items from the viewpoints as below.

- Basic items which dominate the structural design

In earthquake prone area like Dhaka, categories/factors relating to seismic design have strong influence to design of structural members. Examples of those are seismic zoning (Z), occupancy categories, importance factor (I), seismic design categories, type of structural system, and response reduction factor.

- Critical items which cause serious damage such as collapse of buildings

Most of current structural codes adopt the structural design policy “strong column-weak beam” to prevent serious damage such as collapse of buildings. Most of the codes allow failures in structural members in case of strong loads such as strong earthquake or strong wind. Under those situations, when columns fail, the total structure may collapse (Figure 3). Therefore, the structural design policy “strong column-weak beam” is adopted to design columns stronger than beams and several provisions are prepares in the code*. However, many buildings collapse because of failures in columns including the case of Rana Plaza in Bangladesh in 2013. The site investigations on damaged caused by large earthquakes clarify the followings are the main causes of failures in columns. In order to prevent collapse, items below in the checklist are selected for the review by RAJUK reviewers.

Possible causes which invite failures in columns

- Weak concrete strength caused by poor construction work such as pouring from high position, insufficient compaction, and inappropriate curing

- Concentrated overlap splice of longitudinal rebar which hinder compaction of concrete
- Inappropriate anchors of longitudinal rebar of beams to columns
- Absence of hoops in panel zones (joint of columns and beams)

Examples of items to prevent failures in columns

- Concrete: depositing/pouring (#38, 39), compaction (#40), and curing (#42, 43)
- Position of overlap splice (#58)
- Bending detailing of longitudinal rebar of beam (#90-93)
- Hoops in panel zone (#76-80)

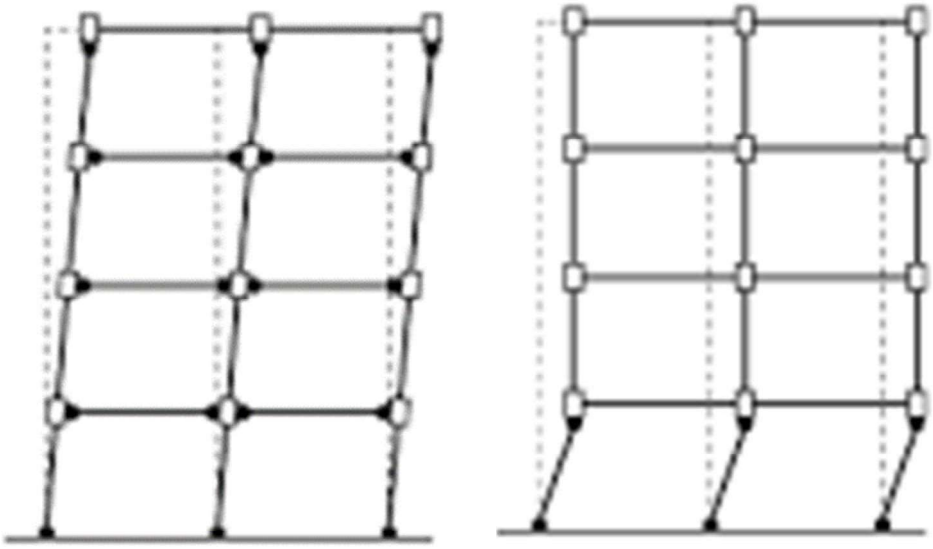


Figure 3 Black dots show failures. Left: failures in beams. The building could keep standing. Left: Failures occur in columns on the ground floor, which would invite total collapse

*Several provisions in BNBC2020 to support the “strong column-weak beam” policy

- Strength reduction factor (ϕ) in Part VI 6.2.3

  Tension-controlled section (beams or others): 0.90

  Ordinary compression-controlled section (columns and others) : 0.65

- Minimum flexural strength of columns in Part VI 8.3.52

  $\Sigma Mc \geqq 1.2\Sigma Mg$

  Mc: nominal flexural strength of columns

  Mg: nominal flexural strength of beams

Following is the contents of the sections on the Design Review flow. Details of each procedure are mentioned in the following sections (1.4.2 to 1.4.6). After obtaining the Land Use Clearance (LUC) from RAJUK, owners shall submit the application with all the necessary documents (RAJUK sheet, design report, a set of structural drawings and calculation sheet) to RAJUK. RAJUK officers/reviewers check the items by referring the Checklist.

*This manual and the checklist focuses on Reinforced Concrete Structures.

Out Line of 1.4.2 - 1.4.6
Procedures for Design Review (structure)