

Guidelines for DEA Documents submission

This guideline for the DEA documents submission has been prepared by RSC to assist DEA engineers in preparing complete DEA submissions, below is the guideline that provides the general requirements which we expect in a DEA.

1. AS-BUILT DRAWINGS:

As-built drawings should be generated in order to concisely record the general arrangement of the building and size and location of the structural elements. It should include the title, date, revision (if any), and signature of the designated concern engineer. All drawings should be prepared on A3 paper for submission, and all soft copy (CAD & PDF) drawings should be submitted along with Detail Engineering Assessment (DEA).

a. As-built architectural drawing set should include but not be limited to, the following:

- Master layout plan
- Floor wise layout plan (showing plan at each level with all walls, openings, expansion joints, stairs, elevators, floor build-up, false slab, water tank, helipad, tower, location of corridors, etc.)
- Machine layout plan (showing usage, location, and weight of major equipment)
- Details of walls, door & window schedules, floor build-up, false slab
- Building elevations (four sides)
- Building sections (both directions)

b. As-built structural drawing set should include but not be limited to, the following:

- The first sheet shall contain:
 - (i) Identification of the project to which the building or the structure, or portion thereof belongs
 - (ii) Date of completion of drawing
 - (iii) Identification and signature with date of the engineer responsible for the structural design
- 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, 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 drawing/design.
- Drawing sheets, other than the first two, shall include following:
 - (i) Structural detail and layout plan of foundation, column, beam, shear wall, slab, rafter's, joists, purlin, flange brace & strut, bracing, truss, connections etc.) whichever is applicable for a particular construction
 - (ii) For bolt connected members, connection types such as slip, critical, tension or bearing type, shall be indicated on the drawing
 - (iii) For weld connected members, welding types, lengths and locations etc. shall be indicated on the drawing
 - (iv) Lapping, bends, and development length, stiffener details shall be indicated on the drawing
 - (v) Floor levels, column centers and offset etc., shall be dimensioned
 - (vi) Each drawing sheet shall also contain the signature with date of the engineer responsible for the structural design
 - Drawings shall be prepared to a scale large enough to show the information clearly and the scales shall be marked on the drawing sheets.

2. ENGINEERING TESTS:

a. Concrete.

Existing concrete strength should be determined using 100mm diameter concrete core to estimate strength capacity of all key structural elements. Areas where samples are to be taken from should be discussed with RSC and marked on the drawing. The number of core specimens required to estimate the concrete strength is determined based on Engineer's assessment. However, a minimum of four 100mm (4in) diameter cores should be taken to determine the strength of the concrete.

All samples are to be tested at Bureau of Research Testing & Consultation (BRTC), Bangladesh University of Engineering and Technology (BUET) or University Grants Commission of Bangladesh (UGC) approved Universities. Follow ACI 562 in conjunction with ACI214.4R to evaluate concrete strength from core test results. Reliance on rebound hammer result will not be accepted.

The use of Cut and Pull Out (CAPO) testing can be considered in conjunction with core testing with the use of the correlation testing of concrete with reference to the aggregate type.

b. Reinforcement.

The strength and type of reinforcement used in RC element should be determined by lab test. Scanning of reinforced concrete element should be performed in order to determine the size/quantity/spacing of the reinforcement provided.

All soft copies of the test result should be submitted along with DEA.



c. Subsoil Investigation Report

The subsoil investigation report must be submitted. Existing foundation shall be verified, and adequacy shall be checked. Sufficient on site opening up to be carried out to test or investigate the foundation system, bearing levels, bearing capacities and condition of the representative sample of elements below ground for size, corrosion and condition.

Conduct a subsoil investigation at the close vicinity of the structure if required to determine the bearing capacities for existing building¹.

All sample locations are required to be mentioned in the layout plan. All soft copies of the test result should be submitted along with the DEA.

3. LOADING:

The structural assessment of the building should be initially considered based on the existing loading on the structure as observed during the survey. The assessment should consider the self-weight of all structural and non-structural elements (dead load) and all observed super imposed dead loads including render, finished, floor build-ups, ceilings, equipment, water tanks etc.

Imposed loading on all floors (except roof) should be taken as a minimum of 2kN/m² as agreed by the Tripartite for existing building¹. The imposed loading on all floors for interim² and new building³ should be taken using BNBC 2006 and BNBC 2020 respectively. However, if the imposed loads observed on site exceed this value (floor usage, storage etc.), the higher values should be used. Point loads due to heavy equipment should be considered where appropriate.

For load combination BNBC 2020/BNBC 2006 /RSC Technical Guidelines (Standard) Article: 8.12.1 should be the followed as per RSC Technical Guidelines (Standard).

4. LOAD PLANS:

Load Plans for every floor shall be prepared that reflect the actual use of the factory including actual material and work product loads as typically stored at maximum density. Load plans will clearly show measured aisle widths and extent of loading areas. Load plans, duly approved by the Engineering Team shall be posted by the factory owner at each floor level. Storage areas shall be clearly marked to indicate maximum allowable stored height of typical stacked materials. Each piece of factory equipment, such as generators, washing machines, and dryers, should be weighed and the load plan should include plan dimensions.

In the case of structural member deficiencies, an interim load plan must be prepared and followed until the remediation work is completed.

¹ Existing Buildings Building: which are constructed and occupied prior 24 November 2013.

² Interim Construction or Building: Buildings which are constructed and occupied from 24 November 2013 prior 11 February 2021.

³ New Construction or Building: Buildings which are constructed and occupied with approved design from the appropriate building approval authority from 11 February 2021.



5. ANALYSIS:

A structural model of the building should be developed using an international recognized computer analysis package. A non-exhaustive list of suitable software is listed below:

- i. ETABS
- ii. STAAD.Pro
- iii. SAP 2000
- iv. SAFE
- v. Any other software used

The analysis based on as-built drawing should consider the vertical and lateral stability of the structure in accordance with BNBC 2006, as amended by the Tripartite Document and BNBC 2020.

Final analysis must show structural adequacy of all the members using concrete compressive strength/rebar strength of composite section (Old/new concrete/rebar)

All soft copies of the analysis should be submitted along with DEA.

6. REPORT:

The 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 this basic information. The design report shall include, but not be limited to, the following:

- **Contents:** The table of contents should include all main and sub content including all chapters' headings and page numbers.
- **Executive summary:** An executive summary should be written in an organized way such that readers can rapidly become acquainted with the content incorporated in the report. It usually contains a brief statement of the structure, background information of structure, preliminary assessment findings, concise analysis output and key findings.
- **Introduction:** An introduction should include project background, scope of work, site visit, objectives, the construction history, type of building materials, number of stories, height of structures, building type, floor areas, building framing structural system, floor usages, occupying year, foundation types, etc.
- **Codes and standards:** This section should include Design codes (ACI, AISC), design method (USD, LRFD), load combinations (BNBC 2020, BNBC 2006, NTPA, ACCORD), analysis type (Static and dynamic), special considerations, etc.
- **Field investigation observations:** In this section, the building engineer should comment on the source of the as-built drawing and any changes/alterations from the construction drawings. The visual observations of the building like crack, damage, vibration, dampness, settlement, tilting, corrosion etc. should be addressed. The in-situ field investigation like foundation excavation, rebar confirmation through scanning/strip cutting, core test location, etc should be incorporated. All the pictorial evidence should be attached in the appendix.
- **Material properties:** The section shall be including of evaluated of concrete strength, rebar strength, steel member strength, bearing capacity of the soil, concrete mix design and all related calculations. All test reports shall be attached in the Appendix.



- **Parameters of the analysis:** Gravity load includes self-weight of the structure, floor finishes, partition walls, build up, false slab loads and live loads. And lateral loads include wind and seismic loads. Detailed hand/excel calculations must be included in the report. Manual hand/excel calculated base shear of lateral forces shall be compared with the model generated base shear.
- **Analysis of the structural performance:** Adequacy check for all structural members such as foundations, columns, beams, slab, rafters, connections, purlin, compression strut, etc. are to be carried out in the report whichever is applicable for a particular structure. All serviceability checks according to BNBC 2006/BNBC 2020 should be included in this section. Where remediation is required, after retrofitting condition, structural performance should be checked.
- **Conclusion and recommendations:** In conclusion, an overall summary of structural analysis is to be drawn. Comment regarding each structural members (e.g., footing, columns, beams, slabs, connections, etc.) performance and all findings are recommended to add whether they are adequate or not adequate with the imposed loading condition. Recommendations should be provided for the observations identified in the assessment. It is recommended to suggest remedial action for the overstressed members. Also, recommendations are required for load management plan and load limit, safety guidelines, vertical extension and horizontal expansion, structural integrity monitoring system, corrossions, etc. are required to be clearly described. All required remediation drawings shall be attached in the appendix.
- **Appendices:** All used appendices must be added at the end of the report.
- **References:** All used references must be added at the end of the report.

LIST OF DOCUMENTS REQUIRED FOR DEA CONSULTANCY WORK

Following documents are required to be submitted by consulting firms to qualify for doing DEA:

- i. Trade license (Firm should have a minimum of 5 years' experience in structural design work)
- ii. TIN certificate of the firm
- iii. Company profile
- iv. List of projects completed
- v. List of qualified personnel
- vi. Lead engineer CV (must have at least 10 years of experience in structural design work)

LIST OF DOCUMENTS THAT SHOULD BE SUBMITTED ALONG WITH DEA

- i. Hard copy of DEA report and drawings signed by responsible engineer meeting RSC standard, scan report, core test and reinforce test report, soil test report and everything else that is required for DEA
- ii. Retrofitting drawings and calculations with proper reference
- iii. Soft copy of the DEA report, analysis file, drawings, test reports, scan report and everything else that is required for DEA
- iv. CV of the engineer who signed on the DEA
- v. Trade license of the consulting firm (starting year and current year)
- vi. Company profile of the consulting firm

