Northeastern University

# NORTHEASTERN UNIVERSITY REQUIREMENTS FOR CLOSEOUT DELIVERABLES

## STANDARDS FOR PRODUCTION AND FORMAT

Facilities Archive / Project Controls | Northeastern University | 360 Huntington Ave, Boston
facilitiesarchive@northeastern.edu | 617/756-4622

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# INTRODUCTION

This document is a resource for project managers, architects, engineers, and contractors working on Northeastern University construction and renovation projects. The purpose of this document is to convey the requirements for project closeout documentation, and provide standards for creating and delivering documentation at the close of Northeastern University projects. Section 1 outlines the required document types due at closeout, and sections 2 through 6 describe standards for the creation and delivery of project deliverables.

Acknowledged that Northeastern University construction and renovation project deliverables may vary depending on size and type of work. For instance, some projects may not produce drawings in any format, or require regulatory approvals. However, all architects, engineers, and contractors must submit applicable deliverables as described within this document.

These requirements ensure that Northeastern University receives an accurate record of final project work, and also promotes a standard for consistency that ensures the long-term value and accessibility of construction project deliverables. Architects, Engineers, and Contractors must deliver required documentation (where applicable), and adhere to the standards described herein. If received documentation does not comply with the following standards, final payment may be delayed until documents conform to requirements.

There are 4 checklist templates to assist with deliverable submissions. Templates A-C provide summary lists of deliverable types, and standards for format. Appendix D must be completed and submitted with project drawing sets.

These guidelines are in accordance with the latest version of *U.S. National CAD Standards* and the *AIA CAD Layer Guidelines*, and Northeastern University guidelines, *Guidelines for Capital Project Design & Implementation, and NU MEP Design Standards.*

# DELIVERABLES

- Upload closeout to the appropriate folders in e-Builder, and/or deliver to the Northeastern University project manager.
- Complete and submit the Drawing Index (Appendix D) with all drawing sets.

## 1. Required Document Types

### 1.1. As-built and Record Drawings

#### 1.1.1. Definitions:

- As-Built: Definition for as-built drawings may differ depending on organization, but Northeastern University defines as-built drawings as drawings that are prepared at the end

of a construction project by the contractor. These are drawings / plans that show the work, as actually installed.

- Record Drawings: Record drawings are prepared by the architect and reflect on-site changes the contractor noted in the as-built drawings. They are often compiled as a set of on-site changes made for the owner per owner/architect contract. (see contract *Northeastern University Agreement Between Owner and Architect / Engineer*)

### 1.1.2. Requirements

- All drawings should be stamped and signed showing actual construction; drawings shall not show alternatives or different options. Mark drawings as "as-built."
- Submit each drawing separately as single sheet.
- Submit 3 sets of drawings in total, 1 set of CAD files, and 1 set of PDF files, and one set of TIFFF files.

### 1.1.3. General Production

- Drawings will be reviewed upon submission, and if all required documentation is not received, and/or submitted per requirements, project will not closeout and final payment will be delayed until documentation is received and approved.
- The Project Architect / Engineer should work with the contractor regarding the project CAD drawings; either to utilize these CAD files to produce as-built drawings, or pay the contractor to produce the project as-built CAD files. (see contract *Northeastern University Agreement Between Owner and Architect / Engineer,* Section 1.5.16)
- For Northeastern University in-house designed projects, coordinate with the Northeastern University project manager to determine if Northeastern University will produce the CAD as-built and if so then what allowance will be given for this from the contractor.

➡ For more details, see Exhibit One titled *Record Document Field Data* from the *Northeastern University Agreement Between Owner and Architect / Engineer*

## 1.2. Operations and Maintenance Manuals (O&Ms)

### 1.2.1. Definition

An Operations and Maintenance Manual contains the information required for the operation, maintenance, decommissioning and demolition of a building.

### 1.2.2. Requirements

- O&M manuals should be organized in separate sections for each related equipment.
- Each manual must contain: title page, table of contents, product data supplemented by text and/or drawings; warranties, bond and service contract issued.
- All O&Ms should include phone lists of subcontractors, suppliers, manufacturers' and representatives.
- Include a description of each unit and related component parts, including name of manufacturer, model number, serial number, and equipment tag number.
- Provide manufacturer information, maintenance procedures, and servicing schedule(s).
- Submit O&Ms in both hardcopy and PDF formats.
- PDF version must be organized in the same manner as the hardcopy.

## 1.3. Warranties

- Include warranties in O&Ms, and/or submit as separate document(s).

## 1.4. Specifications

### 1.4.1. Definition

Specifications are defined as detailed written descriptions of materials, equipment, systems, and required workmanship and other qualitative information pertaining to the work.

### 1.4.2. Requirements

- If specifications are submitted as a book, organize specifications following the latest Construction Specifications Institute (CSI) format and indexing.
- If specifications are submitted as a drawing, follow sheet identification standards described in section 3.

## 1.5. Final Commissioning Report

- Submit Final Commissioning Report, if applicable, in PDF.

## 1.6. Regulatory Approvals

➡ For full list of possible regulatory approvals, see Appendix A

- Submit regulatory approvals, as applicable, in PDF.
    - Asbestos / DEP Permits
    - Building Permits
    - Certificate of Inspection

- Assembly Permits
- Occupancy Permits

### 1.7. Land Survey

- If a land survey was done, submit in TIFF and PDF formats.

### 1.8. Environmental Reports

- If soil or other environmental reports were done, submit all geotechnical reports in TIFF and PDF format.

# CAD DRAWINGS

## 2. File Format Preparation

### 2.1. Version

- AutoCAD™ versions 2004 or higher are acceptable file formats for as-built project drawings. All drawings prepared for Northeastern University must be submitted in .dwg format.

### 2.2. General Production

- CAD files containing multiple drawing sheets must be broken down into separate drawings containing single sheets.
- All CAD drawings shall be purged of empty, unused, or non-essential drawing data prior to submittal. This includes all unused layers, linetypes, blocks, fonts and entities.
- All CAD drawing models should be drafted at full scale in architectural units, such that one drawing unit equals one inch.

### 2.3. Title Block Requirements

- Electronic drawing files must contain only one drawing and one title block per file.
- Title block information must include the following information:
  - A/E/C – consultant responsible for producing the drawings should be clearly identified.
  - Project Name - assigned by Northeastern University
  - Project Number – assigned by Northeastern University
  - Building – name of the building as per Northeastern University naming convention

## 2.4. Sheet Identification Requirements

- Drawing Title – describes the drawing content
- Sheet identification –follow the Sheet Identification Requirements in section 3
- Date – date of the drawing at final revision, as-built
- North Arrow showing orientation of drawing

## 2.5. Fonts and Text Styles

- Use only native CAD fonts, linetypes, and hatch patterns.
- Do not use custom fonts, linetypes, and hatch patterns, including any provided by 3rd party.
- Only use TrueType fonts such as Arial, Courier New, Times New Roman.
- Postscript fonts shall not be used.

## 2.6. External Reference Files (XREFs)

- Northeastern University will not accept CAD drawing submissions that reference external reference files (XREFS).
- All XREFS must be "bound" to the final drawing

## 2.7. Model and Paper Space Guidelines

- Place title blocks, schedules and general notes at full-scale in paper space whenever possible.
- Label scaled viewports with the appropriate scale in model space.
- Do not place or draw model-related blocks, tags and objects in paper space.
- Draw all model space objects at full scale.
- Scale objects using paper space viewports – zoom viewports to the appropriate scale.

## 2.8. Use Disclaimer Requirement

- All final as-built drawings / plans must include the following disclaimer:
  *"Warning: This document may contain sensitive and/or proprietary information and therefore must be treated as a confidential document. Acceptance of this document constitutes an agreement that this document and the information contained herein shall be maintained and transmitted in a confidential manner. No part of this document shall be reproduced, released or distributed without the express written permission of Northeastern University and any distribution to non-Northeastern University entities or persons must be subject to a written confidentiality agreement."*

## 2.9. Layering

### 2.9.1. General Layering Guidelines

- Use only the latest version of *US National CAD Standard* layer names.
- Use the minimum number of layers necessary to adequately separate entities in each drawing, and should not contain extraneous, redundant, or overly detailed layer names.
- Purge each drawing of unused layers prior to submittal. The drawing file should contain only those layers necessary for displaying and plotting the information and drawing entities contained in each drawing. To ensure that subsequent prints made from each CAD drawing match the original, unused or unnecessary layers must be purged from the drawing prior to delivery.
- The layer name format is organized as a hierarchy. This hierarchical structure allows for detailed levels of description as desired. Layer names consist of distinct data fields separated from one another by dashes.

### 2.9.2. Entity Properties

- Entity colors must be defined by layer, not by entity.
- Blocks must be created on layer 0 (zero).
- All attributes must be created on layer 0 (zero).

## 2.10. Layer Name Format

- Northeastern University follows a naming schema that is organized as a hierarchy. Layer names are defined using characters identifying disciplines, major and minor groups, and modifiers.

| AI | - | WALL | - | FULL | - | DIMS | - | N |
|---|---|---|---|---|---|---|---|---|
| Discipline Designator(s) | | Major Group | | Minor Group | | Minor Group | | Status |

- **Discipline Designator** indicates the category of subject matter contained on the specified layer or file name. The Discipline Designator is a one or two-character field. The first character is the discipline character, and the second character is an optional modifier.

| 1 LEVEL DISCIPLINE DESIGNATORS | | | |
|---|---|---|---|
| G | General | P | Plumbing |
| H | Hazardous Materials | D | Process |
| V | Survey / Mapping | M | Mechanical |
| B | Geotechnical | E | Electrical |
| C | Civil | W | Distributed Energy |

| | | | |
|---|---|---|---|
| L | Landscape | T | Telecommunications |
| S | Structural | R | Resource |
| A | Architectural | X | Other Disciplines |
| I | Interiors | Z | Contract / Shop Drawings |
| Q | Equipment | O | Operations |
| F | Fire Protection | | |

The optional second character is used to further define the discipline character. For example, AI-WALL *Architectural Interior, Wall*

For a complete list of 2 level Discipline Designators, refer to the latest version *US National CAD Standards*.

- **Major Group** is a four-character field that identifies a major building system. Major Group field codes are logically grouped with discipline designators. However, any Major Group may be used with prescribed Discipline Designator. For example, *A-Wall or I-Wall.*

  For complete list of Major Groups, refer to the latest version of *US National CAD Standards*.

- **Minor Group** is a four-character field used to further define the Major Group. For example, A-WALL-FULL *Architectural, Wall, Full*

  For complete list of Minor Groups, refer to the latest version of US National CAD Standards.

- **Status** field is an optional single-character field that identifies the data contained on the layer according to the status or construction phase of the work. Since drawings submitted at closeout are as-built, this field should be used to distinguish new construction from existing or phases of work that must be differentiated. For example, A-WALL-FULL-N *Architectural, Wall, Full, New Work*

| **STATUS FIELD CODES** | |
|---|---|
| A | Abandoned |
| D | Existing to demolish |
| E | Existing to remain |
| F | Future work |
| M | Items to be moved |
| N | New work |
| T | Temporary work |
| X | Not in contract |
| 1-9 | Phase numbers |

## 2.11. Drawing View Layer Names

- **DETL**, **ELEV**, and **SECT** are specialized codes used for layers that are organized primarily by drawing type, rather than by major building system. These field codes may also be used as Minor Group field codes to modify a major building system.

□□ indicate discipline and optional modifier

| LAYER NAME | DESCRIPTION |
|---|---|
| □□-SECT-MCUT | material cut by section |
| □□-DETL-MBND | material beyond cut |
| □□-DETL-PATT | textures and hatch patterns |
| □□-ELEV-IDEN | component identification numbers |
| □□-ELEV-OTLN | outline of object drawn |

## 2.12. Annotation Layer

- Annotation consists of text, dimensions, notes, sheet borders, detail references and other elements on CAD drawings that do not represent physical aspects of a building. Use of the Major Group ANNO allows all annotation to be placed in a defined group of layers.

  The Layer Names shown below provide examples for the use of Minor Group field codes for annotation.

□□ indicate discipline and optional modifier

| LAYER NAME | DESCRIPTION |
|---|---|
| □□-ANNO | Annotation |
| □□-ANNO-DIMS | Dimensions |
| □□- ANNO-IDEN | Identification tags |
| □□- ANNO-KEYN | Keynotes |
| □□- ANNO-LABL | Labels |
| □□- ANNO-LEGN | Legends, symbol keys |
| □□- ANNO -MARK | Markers, break marks, leaders |
| □□- ANNO-NOTE | Notes |
| □□- ANNO-REVC | Revision clouds |
| □□- ANNO-REVS | Revisions |
| □□- ANNO-SCHD | Schedules |
| □□- ANNO-SYMB | Reference symbols |
| □□- ANNO-TEXT | Text |
| □□- ANNO-TABL | Data tables |
| □□- ANNO-TITL | Drawing or detail titles |
| □□- ANNO-TTLB | Border and title block |

# SHEET IDENTIFFICATION

## 3. General Requirements

- Each sheet must have a corresponding image and .dwg file. **The sheet and the digital files must all follow the same naming convention.**

### 3.2 Sheet Identification

- The sheet identification format contains four alphanumeric characters in a specific sequence. The sheet identifier consists of three components: the discipline designator, the sheet type designator, and the sheet sequence number.
  Example SF-302

| A | A | | N | N | N |
|---|---|---|---|---|---|
| S | F | - | 3 | 0 | 2 |
| Discipline Designator(s) | | | Sheet Type Designator | Sheet Sequence Number(s) | |

- The **Discipline Designator** indicates the category of subject matter contained on the specified layer or file name. The Discipline Designator is an alpha one or two-character field. The first character is the discipline character, and the second character is an optional modifier. See section 2.2 for list.
- The **Sheet Type Designator** is a single numerical character that identifies the sheet type. All sheet types may apply to all discipline designators. It is not necessary to use all the sheet types for a project or within a discipline.

| SHEET TYPE DESIGNATORS | |
|---|---|
| 0 | General (symbols legend, notes, etc.) |
| 1 | Plans (horizontal views and combination Plan & Profile) |
| 2 | Elevations and Profiles (vertical views) |
| 3 | Sections (sectional views, wall sections) |
| 4 | Large-Scale Views (Scaled up reproductions of plans, elevations, Δ or sections that are not details) |
| 5 | Details |
| 6 | Schedules and Diagrams |
| 7 | User Defined (for types that do not fall in other categories, including typical detail sheets) |
| 8 | User Defined (for types that do not fall in other categories) |
| 9 | 3D Representations (isometrics, perspectives, photographs) |

- The **Sheet Sequence Number** is a two-digit number that identifies each sheet in a series of the same discipline and sheet type. Sequence numbering starts with 01; sheet number 00 is not permitted. The first sheet of each series is numbered 01, followed by 02 through 99.

# IMAGE FILE CREATION

## 4. Overview

- All image files must match in scale and content so that CAD = PDF = TIFF
- Ensure the drawings adhere to the guidelines presented in this document, including:
  - Title Block Requirements in section 2.3
  - Sheet Identification Requirements in section 2.4
  - Use Disclaimer Requirement in section 2.8
- Include a drawing index (see appendix D) containing filenames and sheet numbers for each submittal. This ensures the completeness of the drawing set and assists in archival procedures.
- Name each file with the following convention: the sheet number first, followed by the title of the drawing. (Example: A-1 First Floor Plan)

### 4.1. TIFF Image Creation Requirements

- Produce TIFFs using LZW lossless data compression. This ensures that the original data of each image will be perfectly reconstructed.
- **Resolution:** Create TIFF images using a resolution of 300ppi at original size. Ideally a 24x36 drawing should have a pixel ratio of 7200 x 10800.
- **Bit depth:** Use 8-bit depth for color and grayscale TIFF images.

### 4.2. TIFF Image Creation

- **Create a TIFF from CAD**, AUTODESK® AUTOCAD® recommends:
  - At the Command prompt, enter TIFFOUT.
  - In the Create Raster File dialog box, select a folder and enter a file name. Click Save.
  - The *.Tiff* extension is appended to the file name.
  - Select the objects you want to save.
- **Create a TIFF from PDF**
  - Click on File > Export to… > Image > TIFF
  - Save as TIFF

# BUILDING INFORMATION MODEL (BIM) STANDARDS

## 5. Overview

Northeastern University does not prescribe a project execution plan for BIM, however, if models are produced for a Northeastern University project, it should be submitted at project closeout with other deliverables. BIM standards continue to evolve, and while no one standard can be applied to all types of projects, there are basic standards to ensure consistency of project deliverables.

### 5.1. Guidelines

- Submit all BIM models as Revit file format.
- The *U.S. National CAD Standards-V6* recommends the following:
    - All model files within a project should share the same coordinate system.
    - All model files within a project should share coordinated units and unit tolerance.
    - All model files within a project should share the same basic level names and vertical reference datum.
    - Model(s) should be free of any unused or unnecessary views, links, references, or temporary content. All links or references should maintain portability and reusability (i.e. use relative paths and avoid embedding or binding content).
    - Model(s) should be free of any erroneous and/or duplicate geometry that cause errors in quantities (i.e. two identical chairs placed in the exact same location in the model may appear fine but will be an error in quantities). This also applies to content in aggregate where quantities should not be duplicated when derived from a collection of models that represent the building.
    - Model(s) should be free of excessive warnings or errors identified by the BIM software. Exceptions should be documented and distributed with model(s).
    - One composite model per building should be provided. Separate model files (i.e. discipline specific or separated by level, etc.) are insufficient when BIM is a deliverable. A holistic composite model is necessary even if the composite model is only used as a container for links and/or references (i.e. a means of packaging all related files for delivery).
    - Contract (Construction) Documents should be derived from the model(s). Avoid drafting 2D lines for modeled data but rather use 2D linework to embellish the model when necessary to convey intent. Sections and Details and other enlarged and more detailed views should utilize model content to the greatest extent possible.

# SUBMITTING ELECTRONIC PROJECT DELIVERABLES

## 6. Uploading Files to e-Builder Folders (preferred method)

- **All electronic drawing files must be accompanied with a drawing index (Appendix D).**
- Northeastern University utilizes the project management system, "e-Builder," to deliver capital projects for Northeastern University clients and its use is required of all vendors that provide services for capital projects.

Electronic project deliverables are to be uploaded into e-Builder as follows:

- Upload files into Documents > 07 Construction Closeout folder
  - Upload drawings into Documents > 07 Construction Closeout > 01 As-Builts folder
  - Upload Certificate(s) of Occupancy into Documents > 07 Construction Closeout > 02 Certificate of Occupancy folder
  - Upload specifications, final commissioning report, certificate of inspection(s), land surveys, and geotechnical reports into the Documents > 07 Construction Closeout > 03 Close-Out Documents.
  - Upload O&Ms into Documents > 07 Construction Closeout > 04 Operating Manuals folder.
  - If warranties are not included in the O&M manual, upload warranties into the Documents > 07 Construction Closeout > 05 Warranties folder.
- Permits may be uploaded into Documents > 06 Construction > 06 Permits.

### 6.1. Other Methods for Submitting Files

- **All electronic drawing files must be accompanied with a drawing index (Appendix D).**
- Project closeout electronic files may be emailed to FacilitiesArchive@Northeastern University.edu
- Project closeout electronic files may be loaded onto portable storage device and delivered to Northeastern University project manager.

# APPENDICES

A. Regulatory Approvals Checklist

B. Deliverables Checklist

C. Quality Assurance Checklist

D. Drawing Index

# A. REGULATORY APPROVAL CHECKLIST

## Boston Redevelopment Authority – BRA

- □ Letter of Intent
- □ Project Notification
- □ Boston Zoning Commission Approval
- □ Boston Civic Design Commission Approval
- □ BRA Board Approval
- □ Cooperation Agreement
- □ Certificate of Compliance for ISD
- □ Certificate of Consistency for ISD
- □ Project Impact Report
- □ Article 32 Groundwater Conservation

## Boston Transportation Department – BTD

- □ Transportation Access Plan Agreement (TAPA)

## Mass Environment Protection Agency - Mass DEP- Chapter 91 Waterfront

- □ Application
- □ Permit

## Mass Historical Commission – MHC

- □ Design Review/ Letter of Approval

## Mass Architectural Access Board – MAAB

- □ Variance documents

# B. DELIVERABLES CHECKLIST

REQUIRED DOCUMENTS

- ❑ As-built drawings
  - ❑ PDF
  - ❑ CAD
  - ❑ TIFF
- ❑ Operations and Maintenance Manuals (O&Ms)
  - ❑ PDF
  - ❑ Hardcopy
- ❑ Warranties
  - ❑ PDF
- ❑ Specifications
  - ❑ PDF – as book
  - ❑ TIFF, PDF, CAD – as drawing
- ❑ Final Commissioning Report, as applicable
  - ❑ PDF
- ❑ Regulatory Approvals, all as applicable
  - ❑ PDF
- ❑ Land Survey, as applicable
  - ❑ TIFF, PDF
- ❑ Environmental Reports, as applicable
  - ❑ PDF – as document
  - ❑ TIFF, PDF – as drawing

# B. QUALITY ASSURANCE CHECKLIST

ARCHITECTURAL DRAWINGS

- ❑ Format / Production Requirements [section 4]
- ❑ Title Block Requirements [section 2.3.]
- ❑ Sheet Identification Requirements [section 2.4.]
- ❑ Use Disclaimer Requirement [2.8.]

CAD PRODUCTION

- ❑ Multiple drawing sheets broken into separate drawings [section 2.2.]
- ❑ Fonts and Text Styles [section 2.5.]
- ❑ External Reference Files (XREFS) [section 2.6.]
- ❑ Model Space and Paper Requirements [section 2.7]
- ❑ Layering [section 2.9.]

SUBMITTING ELECTRONIC PROJECT DELIVERABLES

- ❑ e-Builder [section 6]

# C. DRAWING INDEX TEMPLATE

Drawing Index Template is located in e-Builder:

Documents \ PM Toolkit \ 07 Close Out \ 01 Documents \ Project Closeout Drawing Index Template

To have a template emailed to you, email facilitiesarchive@notheastern.edu

| | |
|---|---|
| **NU Project Name** | |
| **NU Project Number** | |
| **Firm** | |

| | | | | Check (X) all formats delivered | | |
|---|---|---|---|---|---|---|
| **Item #** | **Sheet #** | **Drawing Title** | **E-File Name** | **PDF** | **TIFF** | **DWG** |
| *1 of 35* | *A-1* | *Floor Plan* | *A-1 Floor Plan* | *x* | *x* | *x* |
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**NU Project Name**: Name of the project consistent with name assigned in e-Builder

**NU Project Number:** e-Builder number assigned to project

**Firm:** Name of your business / organization

**Item #:** Itemized total number of drawings in set, example, *2 of 40*, or *7 of 10*

**Sheet #:** the sheet identification number on the drawing, example, *A-1* or *MD-09*

**Drawing Title:** the description of drawing given as title, example, *Floor Plan* or *Wall Sections*

**E-File Name:** the title given to the file of corresponding drawing, example, *A-1 Floor Plan*

**Formats:** check (x) all formats that are being submitted