



CAD Standards Manual
for
Construction Documentation

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INTRODUCTION

CAD STANDARDS

The purpose of this document is to serve as a specification for producing and delivering CAD drawings for Rutgers University–Institutional Planning and Operations (IPO) Construction Projects. The guidelines are intended to ensure the successful use and control of CAD systems and data throughout Rutgers University.

These requirements must be followed and met by in-house and outside A/E firms. The main A/E firm shall enforce these standards with their sub-consultant A/E firms. All submitted CAD drawings that do not conform to the following criteria shall be returned. The drawings are to be re-submitted once all requirements have been met. *(This CAD Standards Manual supersedes any previous standards pertaining to anything set forth in this document. This CAD Standards Manual may change without notice; use links below to ensure you have the current edition.)*

Before a project can be closed out and final payment from Rutgers University rendered, all specified materials must be submitted to the appropriate Rutgers University Project Manager or representative in accordance with the production standards and special instructions described throughout this document.

A signed copy of the CAD Standards Checklist found in **Section 1.0.0 (page 4)** of this document must also be submitted with the CAD drawings submitted during **Project Phases II, III, IV(a), IV(b), & V** of the project. When a CAD Standard Checklist has been signed and submitted, the A/E firm is assuring that all drawings submitted conform to the required standards and guidelines set forth in this document. To ensure/obtain the latest CAD Standards & all standard files mentioned in this document please see the links below.

To ensure you have the latest CAD Standards please visit the link below to verify:

<https://ipo.rutgers.edu/pdd/resources>

To download the latest CAD Standards & associated files please visit the link below:

<https://ipo.rutgers.edu/files/rucadstdzip>

SURVEY/GIS STANDARDS

All survey/civil/site work must follow *Rutgers Universities Survey & GIS Standards*. All drawings created under the Surveying & GIS Standards must also adhere to the CAD Standards. Failure to comply with any of the following standards shall be denied, returned & must be resubmitted.

To review the Surveying Standards please visit the link below:

<https://ipo.rutgers.edu/pdd/resources>

To review the GIS Standards please visit the link below:

<https://ipo.rutgers.edu/pdd/resources>

SITE UTILITY AS-BUILT CAD STANDARDS

All site work involving the installation, modification, and demolition of utility infrastructure must follow the *Site Utility As-Built CAD Standards for Standard Digital File (SDF) Submission Documentation*. All drawings created under the Site Utility As-Built CAD Standards must also adhere to the CAD Standards.

To review the Site Utility As-Built CAD Standards for Standard Digital File (SDF) Submission Documentation please visit the link below:

<https://ipo.rutgers.edu/pdd/resources/consultants-cad-submission-digital-file>

DESIGN STANDARDS

To review the latest Design Standards please visit the link below:

<https://ipo.rutgers.edu/pdd/university-design-standards>

1.0.0 CAD STANDARDS CHECKLIST

Drawings submitted for a Rutgers University project must be accompanied by the following checklist. When a checklist has been signed and submitted, the vendor (architect, engineer, contractor, etc.) is assuring that all materials adhere to the standards and guidelines set forth in this document.

2.0.0 CAD DRAWING PRODUCTION

2.1.0 FILE FORMAT and SETUP

- Electronic File Format & Submission
- Drawing Organization
- Layout / Plotting Settings
- Scale and Units
- Fonts and Text Styles
- Blocks
- Dimension Settings
- Border / Title Blocks
- Policy on Model Space and Paper Space
- Policy on External Reference Files (Xrefs)

2.2.0 LAYERING

- General Rules about Uses
- Attributes (Colors, Pens, Linetypes)

2.3.0 POLICY on CAD FILE TRANSLATION

- Full AutoCAD Compliance
- Translation Testing Recommended

3.0.0 ROOM NUMBERING ON FLOOR PLANS

4.0.0 PROJECT PHASE SUBMISSIONS (Check box that applies to this submission)

- | | |
|--|--|
| <input type="checkbox"/> Phase II – Schematic Design (PDF) | <input type="checkbox"/> Phase IV(b) – Addendum #1 (PDF) |
| <input type="checkbox"/> Phase III – Design Development (PDF) | <input type="checkbox"/> Phase IV(b) – Addendum #2 (PDF) |
| <input type="checkbox"/> Phase IV(a) – 50% Contract Docs (PDF) | <input type="checkbox"/> Phase IV(b) – Conforming Set (PDF & DWG Base Floor Plans) |
| <input type="checkbox"/> Phase IV(a) – 90% Contract Docs (PDF) | <input type="checkbox"/> Phase V – Signed Record Set (PDF) |
| <input type="checkbox"/> Phase IV(a) – 100% Contract Docs (PDF) | <input type="checkbox"/> Phase V – Record Set (DWG & RVT, if used) |
| <input type="checkbox"/> Phase IV(b) – Signed Bid Set (PDF, DWG, & RVT, if used) | <input type="checkbox"/> Other _____ |

Name (please print) _____

Signature: _____

Phone Number: _____ Date: _____

2.0.0 CAD DRAWING PRODUCTION

2.1.0 FILE FORMAT and SETUP

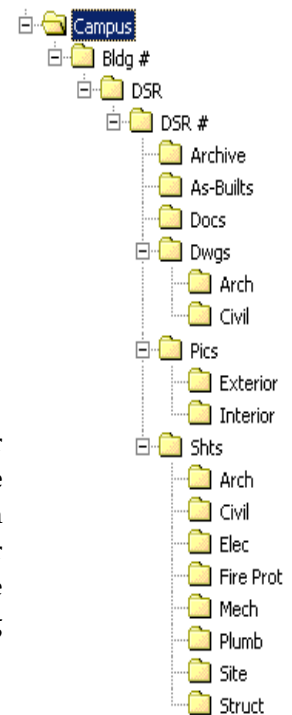
2.1.1 Electronic File Format & Submission

A **CAD Start Package** shall be supplied to all A/E Firms upon award of a project. Contact the Project Manager to receive this package (**or see page 3 for a direct link**). Upon completion of the Phase IV(b) “**Signed Bid Set**,” the A/E Firm shall submit a complete set of drawings in PDF (signed by A/E); DWG (AutoCAD Release 2019); and, if used, RVT (Revit 2019). Upon completion of the Phase IV(b) “**Conforming Set**,” the A/E Firm shall submit a complete set of drawings in PDF (signed by A/E) and DWG (only base Architectural Floor Plans with correct room numbers and descriptions). Upon completion of the Phase V “**Signed Record Set**” and the Phase V “**Record Set**,” the A/E Firm shall submit a complete set of drawings in PDF (signed by A/E); DWG (AutoCAD Release 2019); and, if used, RVT (Revit 2019). For all other submissions, **single-layered and unprotected PDF** versions of these drawings shall be provided. The drawings should be checked to verify that they conform to all the standards set forth in this document. The Bid Drawing Set and the Record Drawing Set shall be in PDF format with an electronic **A/E signature inserted on each sheet (not a digital signature RU-IPO will not accept digital signatures as they cannot be edited with University Architect signature, which is necessary for bidding purposes)**. All files shall be submitted on CD/DVD media in jewel box or USB/flash drive(s) in plastic sleeve (**See Section 4.0.0 for additional information**). An alternative method is to upload the files to the **FTP Server** or **BIM 360 Docs** (**See Project Manager to obtain access**).

Only **ONE Rutgers Project** per CD/DVD or USB/flash drive.

2.1.2 Drawing Organization

- a. All drawings shall be oriented in the same way with a true North arrow indicated on all plans and site drawings.
- b. **Xrefs** shall contain all the disciplines drawing entities that pertain to each drawing on their proper layer (etc.). The **Sheet** drawings shall contain all annotation, text, schedules, notes, markers (detail, elev., section etc.) drawing titles (**in paper space**) and dimensions (**in model space**).
- c. Drawings are to be organized and filed in the structure shown in **Diagram 1.0**, easily read and free of stray elements. All drawing elements must be laid out in the correct drawing order.
- d. Each base (xrefs) plan created of each floor must have Polylines drawn on a layer labeled **RM**. This layer shall consist of a tracing of every room using a **single continuous closed polyline** to the face of all walls that define that room. In addition, two (2) other continuous closed polylines must be drawn on a layer labeled **GROS** – one (1) to the inside face of the outermost building line and one (1) to the outside face of the outermost building line. (See drawing *sample_pline_02X.DWG* in the *RU_CAD_STD_ZIP.zip* for example.)
- e. All drawings must be purged completely to remove all unused blocks, dimension styles, layers, line types, plot styles, text styles, multi-line styles, etc.
- f. The A/E shall be responsible for preparation of the bid set of drawings; See **Section 4.0.0** for the current procedure on handling the Set Process for the Bid, Addenda, Conforming & Record Sets.



Dia. 1.0

2.1.3 Layout / Plotting Settings

- Paper size (set accordingly to border size).
- Plot Area – Extents
- Plot Offset – Centered
- Plot Scale – 1'-0" = 1'-0"
- Plot Style Table – (RU_Fac-Std.ctb only)

2.1.4 Scale and Units

All CAD drawings shall be drafted at full scale in architectural units, such that 1 drawing unit = equals 1 inch.

2.1.5 Fonts and Text Styles

Drafting Components	Text Style	Font File Name	Size
Notes, Dimensions, General Drafting, Room Names, etc.	Standard	Palatino Linotype	3/32"
Drawing Titles (Plan, Elevations, Sections, etc...)	Standard	Palatino Linotype	3/16"
Title Block – Project & Drawing Title Identification Boxes	Standard	Palatino Linotype	3/16"
Title Block – Lower Fields (bldg# etc.) Identification Box	Standard	Palatino Linotype	1/4"
Title Block – Rutgers Logos	Block R	Meta Pro	Varies

Only these fonts are approved for use, unless otherwise agreed to by Rutgers Institutional Planning and Operations. The only exceptions are fonts used in the A/E firm’s logos.

2.1.6 Blocks

Rutgers is currently not using or enforcing the use of any particular blocks or libraries. However, Rutgers requires that the following general rules be employed when handling block entities:

- a. All entities within a block must be created on layer 0.
- b. Drawing entities translated into AutoCAD blocks from non-AutoCAD systems must revert to layer 0 when exploded within AutoCAD.

2.1.7 Dimension Settings

Lines

p Dimension Lines

Color = **BYLAYER**
 Linetype = **BYLAYER**
 Lineweight = **BYLAYER**
 Extend = **1/8"**
 Baseline Spacing = **3/8"**
 Suppress 1 & 2 = **OFF**

Symbols and Arrows

Arrowheads

First & Second = **Architectural Tick**
 Leader = **Right Angle**
 Arrow Size = **1/8"**

Center marks

Mark = **On**
 Size = **3/32"**

Text

Text appearance

Text style = **Standard**
 Text color = **BYLAYER**
 Fill color = **None**
 Text height = **3/32"**
 Fraction height scale = **1.00**
 Draw frame around text = **None**

Fit

Fit options = **Either text or arrows (best fit)**
 Text placement = **Over dimension line, without leader**
 Fine tuning = **Draw dim line between ext lines**

Primary Units

Linear dimensions

Unit format = **Architectural**
 Precision = **1/16"**
 Fraction format = **Horizontal**
 Decimal separator
 Round off = **Off**

Measurement scale

Scale factor = 0

Extension Lines

Color = **BYLAYER**
 Linetype Ext #1&2 = **BYLAYER**
 Lineweight = **BYLAYER**
 Suppress = **OFF**
 Extend beyond dim lines = **1/8"**
 Offset from origin = **1/16"**
 Fixed length extension lines = **OFF**

Arc length symbol

Preceding dimension text = **On**

Radius dimension jog

Jog angle = **45**

Text placement

Vertical = **Above**
 Horizontal = **Centered**
 Offset from dim line = **1/16"**

Text alignment

Aligned with dim line = **On**

Zero suppression

0 Feet = **On**

Angular Dimensions

Units format = **Decimal Degrees**
 Precision = **0**

Zero suppression

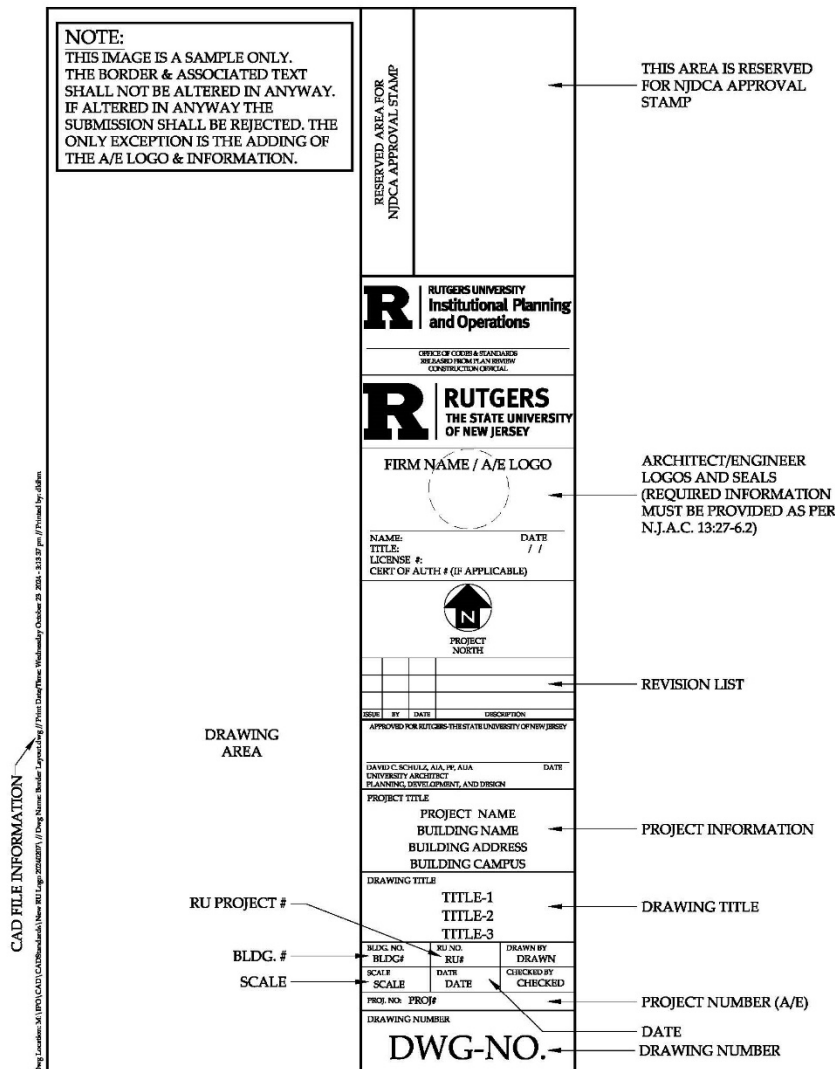
Leading = **Off**
 Trailing = **Off**

2.1.8 Border / Title Block

Rutgers University issues a standard border / title block that shall be used in all “Rutgers University Drawings” and which is to be xref’d into the sheet files. *The border & associated text shall not be altered; if altered in any way the submission shall be rejected.*

The border / title block contains attributes that must be filled out properly. These attributes are a separate block from the border, also included in the start package. Additionally, the full titles (logos) of the Project Architect and Engineer must be placed in the proper area. Along with the A/E Logo **the title block must contain the Name, License Number and Date of the licensed individual responsible for the corresponding discipline.** (Please see below for additional information.)

All Drawing Revisions must be properly noted in the revision list as depicting the number and date of revisions. They must be noted clearly and concisely and shall include at least 6 lines for revisions. Revisions on the drawing areas shall be clouded and tagged with a delta triangle stating which revision number it in relation to. The revision number in the triangle must coincide with its revision in the revision list.



This diagram is for reference only and not to scale, contents within the border or text may change without notice

2.1.8.1 Size

In an effort to maintain consistency in our permanent records of all University buildings, all construction documents sets must be formatted to print the same sheet size in one of the following standard paper sizes:

- Arch D - 24" x 36"
- Arch F - 30" x 42" (**preferred size**)

2.1.8.2 Drawing Title

The A/E title block and name of project shall be in a vertical format down the right-hand side of the drawing and shall contain the following:

- The Project Name shall match the title of the project on the project budget analysis sheet (PBA);
- The Project Number shall be cross-referenced to the budget number;
- The Building Number (to be provided by the Project Manager); and
- An area large enough for A/E's signature and seal.

2.1.8.3 Drawing Number

If the A/E does not have a standard drawing numbering system, the **United States National CAD Standard Latest Version** on sheet identification shall be used.

2.1.8.4 Title Sheet / Cover Sheet

A title sheet included in the **CAD Start Package** shall be included on all projects. Include an index of sheet numbers and drawing titles. This must also be provided in Microsoft Excel format to include drawing title, A/E sheet numbers, and drawing date. The title sheet shall have the following minimum information (**the layout can be altered to best suit the needs of the project**):

- Project name, campus, and address;
- Name, address, phone number, email address of the A/E and any consultants used on the project;
- Index of all drawings included in the Contract Documents;
- Location map indicating the location of the project on the particular campus or within the town where it is located. (Campus maps are available from the Project Manager);
- Key Plan
- List of symbols and abbreviations used in the Contract Documents. Abbreviations used on the drawings must be industry standard recognized abbreviations and must be consistent throughout the construction documents.
- All New Jersey Uniform Construction Code criteria and data.
- Scope of work description

2.1.9 *Policy on Model Space and Paper Space*

- **Model Space Only.** Both the drawing model and the drawing's title block are contained in the same model space environment within a single CAD file. The paper space environment is not used. **This method is not allowed and will not be accepted.**
- **Model Space and Paper Space Combined.** Each CAD file shall be set up to contain only one title block in paper space which references the building model(s) contained in model space. In cases where more than one border per CAD file is needed, tabs maybe created to accommodate multiple sheets.

2.1.10 Policy on External Reference Files (Xrefs)

- All xrefs shall be inserted into sheet file(s) as an **Attachment or Overlay using Relative Path as the Path Type**. Utilizing the file structure above (See **Diagram 1.0**) & setting the xref to Relative Path, the drawings can be moved as needed and still maintain their links, thus eliminating any further maintenance to re-link the xrefs.
- Xrefs can be bound and packaged. Binding an xref to a drawing makes the xref a permanent part of the design drawing. Keeping all files together as a package allows functionality in any situation. This method is allowed but is not preferred and needs to be approved prior to submitting the drawings.
- The **Rutgers Standard Border** shall be xref'd. The text/attributes shall be inserted into each sheet as an independent element. **The text block shall not be altered (exploded, rearranged, etc.) in any way.**

2.2.0 LAYERING

2.2.1 General Rules and Uses

Rutgers University has adopted the **AIA CAD Layer Guidelines Latest Edition** for layer naming only. See **Attributes (Colors & Pens)** for the explanation of colors & how they depict the lineweight.

2.2.2 Attributes (Colors & Pens)

1-Red being light (thinnest) to **7-White** being the darkest (heaviest). For ghosting/backgrounds **250-Dark Grey** being the darkest (heaviest) to **255-Lt. Grey** being light (thinnest). See Diagram below and **Sect 2.1.3 – “Plot Style Table”** for additional info.



COLOR #	COLOR	LINEWEIGHT
1	RED	0.0035
2	YELLOW	0.0098
3	GREEN	0.0138
4	CYAN	0.0209
5	BLUE	0.0315
6	MAGENTA	0.0417
7	WHITE	0.0472
8	GRAY	0.0039
9	LIGHT GRAY	0.0051
<hr/>		
250	GRAY	0.0157
251	GRAY	0.0138
252	GRAY	0.0118
253	GRAY	0.0098
254	GRAY	0.0079

2.3.0 Policy on CAD FILE TRANSLATION

2.3.1 *Error-free AutoCAD Drawing Deliverables:*

Rutgers University recognizes that many of its A/E Firms do not use the same CAD systems as the University. However, it is expected that A/E Firms who work with non-AutoCAD file formats will submit DWG formatted CAD files upon completion of the Bid Set and completion of the Record Drawing Set that are fully compliant with all of the standards outlined herein, and which have no significant loss of drawing entities or project data that can result from standard CAD file translation procedures.

All DWG files and CAD drawing entities submitted at the end of a project must be capable of being edited using standard AutoCAD drafting procedures. Non-compliance with this policy may result in the rejection of CAD files submitted at project closeout and delay of final project payment. DXF files may be submitted with advance written approval from **Rutgers University**.

2.3.1 *Translation Testing Recommended:*

It is strongly recommended that A/E firms which plan to translate their native CAD files into AutoCAD format conduct thorough file translation testing before the design development phase of the project. This will assure early detection of file conversion issues, if any, and allow for corrective measures to be taken before the documents are completed.

*If the A/E firm determines that they cannot produce translation/error-free drawings during any subsequent phase, then they must notify **Rutgers University** immediately. Failure to do so will make the A/E firm responsible for any/all subsequent changes at their own expense that accrued due to these errors.*

3.0.0 ROOM NUMBERING ON FLOOR PLANS

With over 800 buildings, in 1970 Rutgers adopted a standard method of handling room numbers which shall be adopted from the earliest possible point in the design process and carried throughout to completion. The A/E shall use the Rutgers Room Numbering System on all drawings. At the conclusion of the Design Development Phase, the A/E will work with **Institutional Planning and Operations, Office of Space Management** to develop room numbers consistent with the University system.

Doors shall be numbered with a system which reflects the room number to which the door allows access. For example, the door to room 104 should be labeled “104/1” or “104/A” or a similar system.

4.0.0 DRAWING SUBMISSION PROCESS

4.0.1 General Requirements

*This procedure shall be followed herein in accordance with this standard unless noted otherwise by **Rutgers University** in writing. Requirements for paper copy submissions of project phases can be found in the A/E Contract.*

Please note:

Square footage area numbers on drawings shall be clearly labeled as to what their intended purpose is (code review, GSF, net assignable, etc.). Calculations, polylines, etc. used to generate square footage shall be saved and turned over at submission phases to Rutgers University for internal use.

Design Phase (I, II, III & IV(a))

1. Drawings in PDF, DWG & RVT format are uploaded to **BIM 360 Docs** into its proper designated folder matching the current phase being submitted for review.

2. Along with the sets required a disc containing all the drawings in **DWG & RVT** format shall be submitted for review & compliance. This step is important in troubleshooting drawings issues (if any) early on in the project, mainly to avoid delays that can hinder the projects timeline.

Signed Bid Set (IV(b))

1. The 100% completed design drawings shall be submitted in (See Sect 2.1.0 for additional info):
 - A. **AutoCAD 2019 DWG & Revit 2019 RVT (if used) format** for compliance inspection & archiving.
 - B. **PDF format** for applying the **University Architect** digital signature and distribution. All prior revisions and deltas must be cleared and there will only be a single revision which reads: "For Bid/For Contract."
2. Additionally, specifications in **PDF format** signed by **A/E Firm** (if applicable) are considered part of the Bid documents and shall be sent to **IPO** for distribution to bidders.
3. The list of drawings in Microsoft Excel format (See Sect 2.1.8.4) shall also be submitted.

Distribution – Upon completion all "**Bid Set**" files are then distributed using one of the following methods:

1. Handed to the **Contractors** on a CD/DVD media or USB/flash drive(s) with all drawings & specs
2. Downloaded from the **IPO FTP Server**. (See Section 2.1.1)

The Contractor shall verify that all files are included and can be accessed. If there are any file(s) missing or cannot be accessed, the Contractor shall contact **Rutgers University Project Manager** for a new disk/file. Once all files have been verified, a transmittal shall be submitted back to the **Rutgers University Project Manager** before and/or on Bid Opening Meeting.

Addenda/Conforming Set (IV(b))

1. The updated files (**signed by A/E Firm**) shall be handled in the same manner as the "**Bid Set**" also for review and approval of the **University Architect**.
2. The required sets (drawings & specs) of the Addendum shall be sent to **IPO** on any media that best suits that addendum prior to bid opening.
3. After all Addenda drawings have been approved and compiled into the **Conforming Set**, the A/E shall submit that set in **PDF format**.
4. Additionally, the A/E shall submit DWG format base Architectural Floor Plans with correct room numbers and descriptions. Plans shall be accurate enough to show such things as distinctions in thickness of major walls and interior partitions. Plans shall also show all entrances and exits, stairways, elevators, service areas and major architectural features, such as window walls, plazas, ramps and loading docks. Dimensions need not be shown, and details not pertinent of the general layout should be omitted.
5. A room list in Microsoft Excel format shall be submitted which includes the room number, room description, and occupying department.

Record Set (V)

1. A/E must submit a legible marked-up copy of the General Contractors as-builts accompanied with updated signed electronic drawings in **PDF, AutoCAD 2019 DWG, & Revit 2019 RVT (if used) formats** with the changes incorporated (**Record Set**).