

CAD STANDARDS MANUAL

Edition Eight

Revised November 19, 2009

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PREFACE

This Computer Aided Drafting (CAD) manual is a compilation of standards and other information that pertains to the format of all CAD drawings created for Washington University (WU). The University requires that all Consultants and University staff adhere to the standards herein when creating drawings for Washington University or any of its programs.

This manual has been re-constructed from earlier versions to allow for new technologies that have resulted in more user-friendly CAD systems. The intent is to allow Consultants to utilize their own drafting standards and CAD systems while still allowing The University to utilize the drawings in its system without complications. The University does, however, require that a few minimum standards be met. This manual will define these requirements and will state which issues are mandatory. Deviations from stated requirements will result in drawings being rejected. Rejection of submitted drawings will not subject The University to liabilities related to failure to meet deadlines caused by non-compliance with this manual.

This manual is also part of the Professional Services Agreement between Washington University and its Consultants. The Professional Services Agreement contains other requirements that are beyond the scope of this document. Discrepancies that may be discovered between the two documents should be brought to the attention of the Washington University Project Manager who will issue a clarification. Deviation from the requirements herein must be approved in writing prior to drawing creation.

As stated in your Professional Services Agreement, construction documents prepared for The University are the property of The University. Therefore, each Consultant will be required to transfer electronic files to The University upon completion of the project. Consultants will be given reasonable time to prepare transferable media to be provided to the Project Manager.

1. LAYERING

A. Layer Naming Conventions

Washington University requires that all layer names be readily discernable as to the content of each layer. Numbered layering systems will not be acceptable under any circumstances. Examples of acceptable layer names might include 'F-IWALL' for Interior **W**ALLs on the **F**loor plan or 'C-ELEC' for **E**LECtrical items shown on the **C**eiling plans, etc.

2. GRAPHIC STANDARDS

A. Drawing Format

All drawings created for The University shall be in AutoCAD - 2006 format.

Consultants who are awarded work from Washington University will be provided certain standard data in electronic form (where available), to assist in creating drawings that are compatible with the Washington University system.

This disk will contain information such as Washington University standard Title Blocks that must be used on all University CAD drawings. The Project Manager may also provide other electronic data such as base drawings or as-built drawings for Consultants use. In such cases The University is doing so as a courtesy only.

Due to the ability of the recipient to manipulate CAD data, it is the policy of The University to disclaim any and all responsibility for said data and therefore each Consultant shall be fully responsible for field verification and/or drawing verification of all information provided by The University.

Furthermore, The University will not automatically update Consultants if base drawings or other provided data is changed or updated. It remains the responsibility of each Consultant to assure the accuracy of their product regardless of its origin.

All plans shall be set up with the north arrow oriented toward the top of the page, unless specifically approved in writing by the Washington University Project Manager.

B. Dimensioning

It is mandatory to utilize 'associative dimensioning' on all Washington

University drawings. All other dimension variables are subjective to the Consultants as long as they meet typical industry standards. Dimension style names shall be consistent between CAD files within a project.

C. Graphics

Blocks

To increase graphic uniformity, Consultants are requested to utilize 'blocks' whenever possible. The blocks shall contain graphics that are industry standards and that have been created on recent CAD systems that have minimized their file size.

All blocks and symbols shall be included in a 'legend' located on the drawings.

Any graphic entity that occurs repeatedly in drawings shall be made into a block. Insertion points for blocks shall be consistent with placement in the drawings. Use a logical insertion point (center of circle, bottom left corner of object, etc.). Keep names simple and descriptive. AutoCAD block names shall be unique within each Project. Nested blocks contain more than one block definition. Nested blocks are permitted but should be avoided whenever possible. Blocks shall conform to the *United States National CAD Standard Guidelines Version 3.1*.

Hatching

Hatching can play an important role in drawing readability. However, excessive hatching is discouraged in an effort to keep file size to a minimum. Do not use custom or old hatching programs that lead to excessive file size. Do not use polylines with increased width as a replacement for poche' or hatching.

Drawing Units:

Architectural CAD files shall be drawn using architectural (feet and inches). Civil engineering CAD files shall be drawn using decimal (feet and hundredths).

Drawing Accuracy:

All CAD drawings shall be drafted using precision input employing the most accurate source material available. For all drawing entities, zero tolerance is required, all lines meet at intersections, straight lines are straight; blocks are inserted properly without overlap, etc.

Consultants are responsible for the accuracy of all CAD drawings delivered to the University, regardless of the accuracy of the CAD drawings of previous projects furnished by the University as a convenience to the consultant.

Drawing Scale

Objects created in model space shall be drawn at 1:1 scale (ie. A 100 – foot wall will be drawn to 100 feet and a 36-inch column will be drawn to 36 inches).

The following types of CAD models may be drawn to any scale: schedules, riser diagrams, schematic diagrams and single line diagrams.

Drawing Origin and Registration

The origins of CAD files shall be defined at coordinates 0, 0, 0. This is typically the lower left of the building. For non-rectilinear buildings a logical origin point shall be established.

The origin point shall remain consistent between all CAD files in a Project. This is critical for correct registration of different CAD files when referenced together, aligning the various views of the facility. Registration of electronic data shall be maintained so the information will be usable in future applications.

Graphic Representation of Entities

- a. **Curved Entities:** Circles, arcs and ellipses shall be created as individual entities, not of line segments.
- b. **Entity Properties:** Entity properties such as color, line weight, and linetype shall be set BYLAYER, for purposes of clarity.

Line weight and color affect the use of CAD data in different ways. Line weight typically is most effective when working with plotted CAD files. Plots, or reproductions of plots, are typically monochrome.

Utilizing line weights can be an effective means of communicating important information about the facility and the design Project.

Color is most useful when displaying the CAD data on a computer screen. Colors allow users to readily identify systems and unique types of information.

Consultants shall select line weights and colors that promote effective

use of the CAD data, in both plotted and electronic **formats**.

Line Type Scale:

Line type scale shall be set so that each line type is recognizable, easily identified, and distinguishable to individuals who are working in the CAD files and in final plotted output.

Text Requirements

- A. Text shall be placed in the CAD file with enough space around it, to allow for legibility when the CAD file is plotted and reproduced.
- B. Text placed at an angle shall be readable from bottom or right edge of the plotted sheet. Typically text shall be placed at 0 or 90 degrees.
- C. Text placed along (aligned above or below) an object at an angle other than 0 or 90 degrees is acceptable.

Miscellaneous Drafting Practices

Superior drafting skills remain a very important role even with the advent of CAD systems. Please pay special attention to drafting techniques. Do not allow overlapping lines, large hatch patterns, etc., which would cause the files to be unreasonably large and/or 'messy'. Always purge drawings of excess data or unused layers, etc., prior to submission to The University.

Symbols

Graphic symbols, i.e. north arrows, detail symbols, partition type symbols, etc., are subjective to each Consultant as long as they meet industry standards. As previously noted, the north arrow should be oriented to the top of the page unless otherwise approved by the Washington University Project Manager.

All graphic symbols shall be included in a 'legend' located on the drawings.

A graphic scale bar shall be included on each plan in a readily visible location, preferably near the plan title, scale and north arrow. Location of the scale bar in the set binding is unacceptable.

Lineweights

Washington University plots its files using colors to plot specific lineweights. While Consultants are not required to use the WU standard

colors, we do require that each Consultant submit a document or plotter configuration file, separate from the drawings, that defines the appropriate plotting methods for future reference.

D. Standard Drawing Sizes and Title Blocks

All drawings created or scanned for Washington University will be placed on one of two sheet sizes. These sheet sizes are as follows:

- A) 30" x 42"
- B) 24" x 36"

The drawing limits should be set to reflect the appropriate sheet size. Title block 'scale' shall be 1:1 and shall be 'externally referenced' (X-ref) into each drawing at the exact scale factor. Sheet numbers or other sheet specific data should be included on the individual sheets and not part of the 'Xref' title blocks.

Scanned and vectorized drawings are to be placed on the same size sheet as the original. In the event that the original is not 24" x 36" or 30" x 42", the Project Manager at Washington University will advise the proper sheet size. Drawings submitted to Washington University shall not be 'divided' into separate drawings. If the Consultants have 'divided' the drawing for their use, the drawing must be combined before transmitting to The University.

Scanned and vectorized drawings should not contain the architect's or engineer's title blocks from the original drawing. All information from the original title block shall, however, be included on the newly created drawing in a small box located in the lower right corner inside of the WU title block.

Consultants shall use the standard Washington University title block. A space is provided for Consultant names and logos. Consultants are required to fill in each space on the title block that is provided for contact information.

Insertion points for all drawings shall be the lower left corner of the title block and will be at 0, 0,0.

E. Order of Drawings

Sets of drawings for all projects shall be organized and bound in the following order:

- Civil
- Landscape Architectural
- Architectural
- Interior Architecture
- Structural
- Mechanical
- Plumbing
- Electrical
 - Data/Telecom
- Fire Protection
 - Fire Alarm
- Other

Drawings within these classifications may be organized in industry standard order.

F. Sheet Numbering

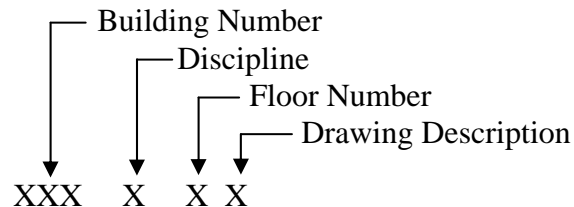
Consultants may number their drawings in their own standard format. However, each drawing must include the total number of sheets included in that discipline's set of drawings (i.e., A6 of 24).

G. File Naming Conventions

As with layers, drawings may be named in the Consultants standard format but each drawing must contain the Washington University building name and/or number at the beginning of the filename.

An example might be as follows: ACApln1.dwg (Bldg. name, plan, 1st floor)

For clarification, Washington University 'Space Survey' drawings are named as follows:



Example: 199A2PLN.dwg

3. TECHNICAL INFORMATION

A. File Format

All drawings created or scanned for Washington University will be 100% compatible with AutoCAD 2006 and shall be submitted in '.dwg' and '.ftp' format. Prior to submission to Washington University, all files should be compressed using 'WinZip' or another compatible program. Data will be accepted on CD-ROM or Consultant FTP site address.

Extraneous objects beyond the drawing extents shall be removed to ensure faster regens and more efficient manipulation of the CAD files.

CAD files shall be saved in a final state meeting the following requirements

- I. All xref files shall be bound to their respective local file.
- II. Electronic CAD documents shall reflect "as-built" conditions.
- III. All pertinent layers shall be on.
- IV. Blocks shall not be exploded.
- V. Drawings shall be purged.
- VI. Drawing shall be zoomed to extents.

All pertinent electronic support files shall be included with the submittal (example: Special Fonts, Hatch Patterns, Line Types, Color-dependent Plot Style Tablex (.ctb), .pc3 files etc.)

B. Labeling

All CD's shall contain the following label information:

- 1) Washington University Project #
- 2) Building or Project Name
- 3) Consultant name and contact information
- 4) Project phase
- 5) Content description
- 6) Date of submittal documents (dates of drawings, not the date the CD was created)

C. Use of X-ref's

External references (X-ref's) shall be used by the Consultants for attaching title blocks. Other uses such as details, plans, etc., are at the discretion of the Consultants.

X-ref files shall be located in the same directory as the main drawing files and shall contain no path information. X-ref files shall be 'bound' to the individual drawings prior to submission to The University. This requirement is intended to eliminate the need for the 'path' to the X-ref to be reconfigured and/or renamed after drawings are transferred into The University's system.

D. User Coordinate Systems (UCS)

AutoCAD provides for the use of multiple user coordinate systems. All drawings created for Washington University shall be created and edited with the UCS set equal to the World Coordinate System (default setting).

E. Model Space vs. Paper Space

All drawings shall be created and edited in model space.

F. Campus Grid System

All site plans created for The University shall include the Standard Campus Grid System to which all structures should be located in at least two directions. This grid will be provided upon request from the Washington University Project Manager.

Appendix A - Building Abbreviations

<u>Bldg. Name</u>	<u>Bldg. No.</u>
Academy Building	199
Alumni House	101
Anheuser Busch Building (Law)	250
Athletic Complex	123
Beaumont Residence Hall	163
Bixby Hall	104
Blewett Hall	240
Brauer Hall Phase 1 (SEAS)	206
Engineering Building Phase 2	207
Engineering Building Phase 3	208
Engineering Building Phase 4	209
Engineering Building Phase 5	210
Brookings Hall	105
Brown Hall	106
Bryan Hall	195
Busch Hall	107
Busch Lab	108
Charles F. Knight Executive Center	253
Compton Hall	109
Crow Hall	110
Cupples Hall I	111
Cupples Hall II	112
Cyclotron	113
Danforth Residence Hall	178
Danforth University Center	226
Dardick Residence Hall	329
Dauten Residence Hall	168
Duncker Hall	114
Eads Hall	115
Earth & Planetary Sciences	204
Eliot Hall	192
Environmental Health & Safety	225
Fraternity House 1	304
Fraternity House 2	305
Fraternity House 3	306
Fraternity House 4	307
Fraternity House 5	308
Fraternity House 6	312
Fraternity House 7	311
Gaylord Music Library	130
Givens Hall	131
Bldg. Name	Bldg. No.

Goldfarb Building	251
Graham Chapel	132
Gregg Residence Hall	321
Harbison House	174
Hitzeman Residence Hall	164
Hurd Residence Hall	165
January Hall	134
Jolley Hall	129
Kemper Art Museum	203
Koenig Residence Hall	330
Laboratory Sciences Building	254
Lee Residence Hall	162
Lien Garage	320
Lien Residence Hall (WUPD)	322
Life Sciences Building	243
Liggett Residence Hall	331
Lopata Hall	122
Louderman Hall	135
Mallinckrodt Center	193
McDonnell Hall	247
McMillan Hall	137
McMillen Hall	196
Millbrook Apartment (Unit 1)	218
Millbrook Apartment (Unit 2)	219
Millbrook Apartment (Unit 3)	220
Millbrook Apartment (Unit 4)	221
Millbrook Building	138
Millbrook Parking Garage	127
Monsanto Laboratory	139
Mudd Residence Hall	175
Music Classroom Building	252
Myers Residence Hall	166
Nemerov Residence Hall	323
Olin Library	141
Olin School of Business (Expansion)	125
Park Residence Hall	176
Plant Growth	140
Power Plant	142
Psychology Building	249
Radio Chemistry Building	144
Rebstock Hall	145
Ridgley Hall	146
Rublemann Residence Hall	161
Rutledge Residence Hall	169
Bldg. Name	Bldg. No.
Seigle Hall	228

Sever Hall	149
Shanedling Residence Hall	167
Shepley Residence Hall	177
Simon Hall	124
Small Group Housing #1 – Lopata House	324
Small Group Housing #2	325
Small Group Housing #3 – Village House	326
Small Group Housing #4	327
Snow Way Parking Garage	224
Steinberg Hall & Gallery	151
Stix International House	194
Tietjens Music Studio	242
Thomas Eliot House	328
Umrath Hall	153
Umrath Residence Hall	160
Urbauer Hall	116
Village East	217
Walker Hall	205
West Campus Parking Garage / Offices	413
West Campus Main Building	414
Wheeler Residence Hall	179
Whitaker Hall for Biomedical Engineering	202
Whittemore House	197
Wilson Hall	154
Wohl Center	171
Wohl Center Garage	246
Women’s Building	156

