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## Introduction

### The purpose of the standard

The ASU Construction Drawings CAD Standard provides specifications on delivering as-built CAD drawings for ASU construction projects managed by the Capital Programs Management Group or the Office of the University Architect. The standard will ensure consistency with Arizona State University's current and future construction needs and are consistent from one project to another.

Consultants must adhere to all sections of this standard before construction projects can be closed out and final payment rendered by ASU.

### Standard overview

The ASU Construction Drawings CAD Standard documents the requirements of as-built CAD drawings that will be submitted during the closeout portion of ASU CPMG and OUA construction projects. The ASU Construction Drawings CAD Standard consists of three interrelated sections:

- **Section one: Delivery format.**
  - This section outlines the acceptable delivery options and formats that can be used for approved as-built CAD drawings and associated files.
- **Section two: CAD drawing file standards.**
  - This section outlines the details that should be included in submitted as-built CAD drawings and associated files.
- **Section three: Submittal requirements.**
  - This section outlines the procedures and requirements for preparing and submitting as-built CAD drawings and associated files to Facilities Development and Management Asset Management Group.

All questions and communications regarding using the Construction Drawings CAD Standard shall be directed to the ASU project manager.

### Updates

The ASU Construction Drawings CAD Standards will be updated as the requirements and procedures of ASU and the Arizona Board of Regents change.

### Questions and comments

Contact Paul Molter, manager, FDM and Assets Management, for questions or comments about this standard.

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## Section one: Delivery format

### Delivery options

ASU desires to collect construction drawing as-built information in a manner that can be easily integrated into the data update process supported by ASU's CAD environment. Use CAD drawing files as a delivery option.

## Delivery format

The content of electronic drawings must match the delivered original hard copy set. A digital copy of each sheet in the as-built construction drawings must be submitted to ASU using AutoCAD® 2010 or newer software with the file extension .DWG.

ASU shall not accept drawings in the Drawing Interchange Format or any format other than .DWG. If any drawing translators are used before submittal, the results of such translation shall be 100 percent complete. It is the responsibility of the design professional to cross-check translated drawings for errors and omissions.

## Section two: CAD drawing file standards

For every hard-copy utility system as-built plan submitted to ASU, an electronic CAD drawing file deliverable, such as a DWG, must also be delivered. It must follow the standards outlined in this document.

To establish consistency in the delivery, analysis and implementation of all survey control, as-built data, including utility systems, ASU CPMG has established guidelines for all survey deliverables, [CPM 319: Survey Requirements](#).

To support the electronic DWG submittal, the ASU Construction Drawings CAD Drawing File Standards were developed based on the [U.S. National CAD Standards — Version Four](#) as a standard for the discipline designators and as a baseline for major and minor group designators. ASU has updated the discipline designators and may have adjusted the values for the major and minor groups to meet ASU's needs. For additional detail beyond what is outlined below, please [contact ASU FDM Asset Management](#) before making any changes to these standards.

## User coordinate system, model and paper space usage

All CAD drawing files must be submitted with the defined User Coordinate System or geographic location set to state plane coordinates, Arizona Central Zone 0202, NAD 1983, International Feet.

All AutoCAD files shall have a world file associated with them. The world file must have the required coordinate and projection system as outlined below:

- NAD\_1983\_StatePlane\_Arizona\_Central\_FIPS\_0202\_Feet\_Intl.
- Projection: Transverse\_Mercator.
  - False\_Easting: 700000.0.
  - False\_Northing: 0.0.
  - Central\_Meridian: -111.9166666666667.
  - Scale\_Factor: 0.9999.
  - Latitude\_Of\_Origin: 31.0.
  - Linear Unit: Foot — 0.3048.
- Geographic Coordinate System: GCS\_North\_American\_1983.
  - Angular Unit: Degree (0.0174532925199433)
  - Prime Meridian: Greenwich — 0.0.
  - Datum: D\_North\_American\_1983.
    - Spheroid: GRS\_1980.
    - Semimajor Axis: 6378137.0.
    - Semiminor Axis: 6356752.314140356.
    - Inverse flattening: 298.257222101.

No rotation or scaling of the information is permitted. If the file must be rotated to fit the sheet correctly, use the DVIEW TWIST command not to disturb the coordinate base values. In addition, all drawings

should be checked to ensure the UCS set in the model space matches the viewport set within the paper space.

All CADD line work shall be drawn in model space at a scale of 1:1. Dimensions and labels shall also be in model space, with the text sized appropriately to plot at the correct text style. Title blocks, notes and details shall be inserted into paper space. A paper space viewport can be created in the title block to let the model show through. The model space drawing can then be reduced or enlarged to the appropriate scale.

## File naming

Each .DWG file should be named using the following format:

- Sheet number-project number-date, where the date is in YYYY-MM-DD format.

For example, sheet CU-1-01, named per the standards below, should not be in a file called CU1.dwg but in a file called CU-1-01-projectnumber-yyyymmdd.dwg. The CPMG assigns project numbers. A project name can be substituted if a project number does not exist.

If more than one sheet is contained in one file, then the file should be composed to only have one sheet per file and then name each accordingly.

## Sheet naming

As summarized below, the U.S. NCS identifies sheets with the following components:

- **Discipline designator** — one alphabetical character field and a hyphen or two alphabetical characters representing the discipline are required, such as C equals Civil and CU equals Civil Utilities.
- **Sheet type designator** — one numerical character identifying the information on the sheet is required, such as 1 equal plans.
- **Sheet sequence number** — consists of one or two numerical characters identifying the sheet as a subset member, such as 01-99, and is required.

<b>CU</b>	<b>-</b>	<b>1</b>	<b>-</b>	<b>01</b>
Discipline designator		Sheet type designator		Sheet sequence number

The ASU Construction Drawings CAD sheet naming standard should follow the sheet naming values below.

Table one: CAD drawing file sheet naming values	
Component	Valid values
Discipline designator	<ul style="list-style-type: none"> <li>• A: Architectural.</li> <li>• E: Electrical.</li> <li>• M: Mechanical — thermal or natural gas.</li> <li>• T: Telecommunications.</li> </ul>
Sheet type designator	<ul style="list-style-type: none"> <li>• 0: General — symbols legend, notes, etc.</li> <li>• 1: Plans — 2D horizontal views.</li> <li>• 5: Details.</li> <li>• 7: User-defined when the others above don't apply.</li> </ul>
Sheet sequence number	<ul style="list-style-type: none"> <li>• 01–99.</li> </ul>

**Note:** Multiple utility systems layers in the same discipline can be included on one sheet, such as water and sewer.

## Title block

The title block should be placed in a paper scale, with its insertion point inserted at a coordinate location of 0, 0, 0, and at a scale of 1:1. Once inserted, the title block attributes provided in the table below must be populated at a minimum.

Table two: Title block standard	
Attribute name	Description
Project information	
Project number	Assigned by the CPMG.
Project name	Assigned by the CPMG.
Firm name	Representing the drawing author.
Building name	Specify only if the project name does not include this information and the project is building-specific.
Building number	
Drawing information	
Drawing title	Indicating the drawing content, such as the water system detail.
Project number	Assigned by the CPMG and referenced on all sheets.
Drawing number	Drawing and sheet number.
Date of drawing	The original date of the drawing, including significant revision dates.
Drawing scales	Representing the intended plot of the drawing with a title block.
North arrow	
Electronic file name	Name of the drawing file.
Effective date	The effective date of the drawing file.

## Layering standard

Below is a list of ASU's in-house drawing standards:

- All drawings should be in full scale, such as 1'-0"=1'-0".
- Do not use blocks that cannot be edited when inputting the drawing. This applies to user-defined blocks and not the pre-defined blocks indigenous to AutoCAD.
- For site utilities, use the Utility Systems CAD Standards.
- Elevations do not need to concur with any in-house drawing requirements. The DP's in-house standards are acceptable for elevation documents.

The ASU Construction Drawings CAD Layering standard should follow table three's layer names and properties.

If the project requires additions to the standard layering convention due to the uniqueness of the project, then [contact FDM Asset Management](#).

Table three: Layer standards			
Layer name	Description	Color	Line type
<b>Architectural and structural</b>			
KP_GRID	Construction grids: Includes construction lines used to define further building elements, such as center lines and major axis lines. Lines of symmetry should be a phantom line type, like 6-magenta.	2	Continuous
KP_COL	Columns.	144	Continuous
KP_EXT-WALL	Exterior walls.	252	Continuous
	Exterior windows, walks and exterior features.	40	Continuous
KP_INT-WALL	Interior walls.	102	Continuous
	Interior masonry walls.	252	Continuous
	Interior windows, counters and interior features.	40	Continuous
KP_SOFT-WALL	Cubicle and workstation furniture.	30	Continuous
KP_DOOR	All doors.	40	Continuous
KP_STAIR	Stairs and elevators, including ramps.	134	Continuous
KP_STAIRDIR	Lines, arrows and text showing the direction of the stairway, like UP and DN.	254	Continuous
KP_BATH	Restroom fixtures, toilet partitions, sinks and drinking fountains.	214	Continuous
KP_FLDR	Floor drain.	214	Continuous
KP_FHC	Firehouse cabinets.	242	Continuous
KP_HATCH	Walls.	40	Continuous
	Earth.	10	Continuous
	Water.	117	Continuous
KP_RMNO	Room numbers.	254	Continuous
KP_RMNAME	Room use.	254	Continuous
KP_SQFT	Room net assignable square feet.	254	Continuous

Table three: Layer standards			
Layer name	Description	Color	Line type
Reflected ceiling layers			
RCP_GRID	Ceiling grid.	52	Continuous
RCP_FIXT	Light fixtures.	2	Continuous
RCP_HVAC	Heating, ventilation and air conditioning equipment.	4	Continuous
RCP_PA	Special systems such as public address systems, audio, etc.	6	Continuous
FS_EXIT	Exit signs	5	Continuous
FS_SYM	Smoke detectors, fire alarm equipment and exit signs.	1	Continuous
FS_TEXT	Fire safety text.	2	Continuous
FS_SPRINKLE	Sprinkler systems.	5	Continuous
Mechanical layers			
MECH_AIR_DEVICE	HVAC system.	3	Continuous
MECH_CHR	Cold water returns.	4	Continuous
MECH_CHS	Cold water supply.	4	Continuous
MECH_DIM	Dimensions.	2	Continuous
MECH_DUCT	Ductwork.	3	Continuous
MECH_EQUIP	Equipment.	4	Continuous
MECH_FILL	Fill.	30	Continuous
MECH_HI_DUCT	Ductwork.	3	Continuous
MECH_HWR	Hot water return.	1	Continuous
MECH_HWS	Hot water supply.	1	Continuous
MECH_PIPE	Piping.	1	Continuous
MECH_TXT	General text.	2	Continuous
MECH_THERM_CENTRL	Thermostats.	1	Continuous
Plumbing layers			
PLUM_HW	Hot water lines.	1	Continuous
PLUM_CW	Cold water lines.	5	Continuous
PLUM_SWR	Sewer.	6	Continuous
PLUM_FIXT	Fixtures.	3	Continuous
PLUM_ACID	All process piping on layers of befitting material is transported through pipes. All process piping layers in cyan, such as pipes carrying acids on later ACID.	4	Continuous
PLUM_FIRESPR	Fire sprinkler lines.	2	Continuous
Electrical layers			
ELEC_TELE	Telecommunications.	4	Continuous
ELEC_COMP	Computer.	4	Continuous
ELEC_FAL	Fire alarms.	1	Continuous
ELEC_120	All 120V power.	3	Continuous
ELEC_120PLUS	All circuits greater than 120V.	2	Continuous
ELEC_INTCOM	Intercom.	5	Continuous
ELEC_SX	Switches and lighting fixtures.	254	Continuous
ELEC_SS	Special systems, including security systems.	6	Continuous

Table three: Layer standards			
Roof plan			
Layer name	Description	Color	Line type
KP_RDR	Roof drains, overflow drains, scuppers and slope lines.	4	Continuous
SLAR	Slope arrows.	254	Continuous
RVENT	Roof vents.	1	Continuous
PVENT	Plumbing and exhaust vents.	1	Continuous
MECH	Mechanical equipment.	6	Continuous
HVAC	HVAC.	6	Continuous
SKLITE	Skylights.	2	Continuous
WALK	Walking surfaces.	254	Continuous
SMHATCH	Smoke hatches.	5	Continuous
ACCHATCH	Access hatches.	5	Continuous
SPEQ	Antennae and other special equipment.	3	Continuous
Sites			
CM_BLDG	Buildings.	3	Continuous
CM_WALK	Sidewalks.	34	Continuous
CM_MSTR	Miscellaneous structures.	5	Continuous
CM_FNCE	Walls and fences.	2	Continuous
CM_C&G	Curb and gutters.	4	Continuous
CM_IRRI	Irrigation.	5	Continuous
CM_VEG	Vegetation, including plants, trees, shrubs and all landscaping.	3	Continuous
CM_PARK	Parking.	2	Continuous
CM_SITELITE	Site lighting.	254	Continuous
CM_FNT	Fountains and any special features.	5	Continuous

## Layer “0”

The layer “0” should only be used when creating blocks — symbols — so that the blocks will take on the properties of the active layer when inserted into a drawing. The layer “0” must otherwise not be used. Drawings with as-built objects in layer “0” will be returned for correction, delaying the project closeout process.

## Annotation layers

Text size must be legible and appropriate to the graphic information presented and the intended plotted scale of the drawing. All text must be in uppercase throughout the drawing.

## External references and images

ASU will not accept the submission of any CAD drawing that contains the following:

- Referenced images such as .jpg, .bmp, .tiff, .png, etc.
- Unbound references to external source drawing files — Xrefs.

All external references to drawing files should be inserted into the single drawing file before delivery to ASU.



### CAD drawing support files

ASU will not accept the submission of any additional CAD supporting files except for the following:

- CSV, if used as an annotation as a linked file option.
- Submittal checklist.

## Section three: Submittal requirements

### Submittal checklist

This checklist must accompany CAD drawing files delivered at a closeout of a construction project. When a checklist has been signed and submitted, the vendor — architect, engineer, contractor, etc. — assures that all materials adhere to the standards and guidelines outlined in the ASU Utility Systems CAD standard.

Date of submittal: \_\_\_\_\_

Project number: \_\_\_\_\_

Project name: \_\_\_\_\_

Utility systems: \_\_\_\_\_

Firm name: \_\_\_\_\_

### File format and setup

- Electronic file format.
- Policy on project coordinate system and world file.
- Title blocks.
- Policy on model space and paper space.
- Policy on Xrefs.

### Layering

- Standard layer list.
- Layer name formatting.
- Annotation and attribution.
- Layer properties, such as styles and colors.

### CAD file naming conventions

- Standard for the file name.

Printed name of accountable vendor representative: \_\_\_\_\_

Signature of accountable vendor representative: \_\_\_\_\_

Phone number: \_\_\_\_\_

Date: \_\_\_\_\_

### **File transmittal**

All electronic materials — .dwg, .csv and .pdf — must be compressed into a zip file and delivered using the file submittal procedures. The submission file must include a zip file name in an XX-XXX-XXX-ABCDEF.zip, where the XX-XXX-XXX is the project number, and the ABCDEF is the project name.

The zip file should contain the following materials:

- Associated CSV files, if applicable.
- Completed submittal checklist in a PDF format.
- Construction drawing as-built DWG files.

All submittal documentation forwarded to ASU should be submitted in a timely fashion, coinciding with the needs of the project and the planning, design and construction staff. The delivery of as-built submittal documentation should be timed appropriately to ensure ASU receives the most accurate information available.