CAD Standards

Fermilab

Facilities Engineering Services
Section

The primary objective at Fermilab is that operations be conducted in a safe, deliberate and controlled manner. The role of the FESS/Engineering (FESS/E) procedures is to provide the best knowledge available in order to accomplish the task.

This CAD Standard Manual provides a compilation of the FESS/Engineering policies and procedures specific to the utilization of in-house projects and projects developed by outside A/E Consultants.

This CAD Standard Manual provides guidance for the A/E Consultant services and is intended as a supplement to the A/E subcontract. In all cases the A/E subcontract shall take precedence over the procedures in this standard.

To better align with DOE Order 413.3, the following conventions have been revised:

TITLE I is now Preliminary Design

TITLE II is now Final Design

1.0   INTRODUCTION

1.1   Purpose:

The following CAD standards were developed by the Facilities Engineering Services Section's Engineering Department (FESS/E) at Fermilab. The CAD Standards apply to all design, engineering, and construction related (conventional) facilities projects.

Although FESS/E does not intend to stifle the creativity of individual CAD designers, there is a need to maintain uniformity in the creation of quality design documents. To that end, all CAD drawings should be generated and shall be supplied in DWG format, as supported by Autodesk's AutoCAD® desktop software. Furthermore, the base building drawing files, especially on retrofitting existing buildings, should be kept in tack with the appropriate viewport scale setting representing the area of work. In this way, the final overall electronic drawing will represent an As-Condition/Record Set.

This document sets forth the minimum requirements to be implemented for all facilities projects, regardless whether projects are completed in-house or work is performed by an outside Architectural and Engineering (A/E) consultant.

1.2   Contact Information:

Inquiries should be directed to:

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P.O. Box 500, MS-214
Batavia, IL 60510-0500

630.840.3856
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1.3   Reference:

The following policies/procurers complement the CAD Standards and should be utilized.

A/E Consultant Handbook
FESS Engineering Design Guide
BIM Guide
GIS Standards

2.0 GENERAL REQUIREMENTS

A number of standard sheet sizes and title blocks have been developed to match the nature of various drafting projects completed at Fermilab. The FESS/E Project Coordinator shall define the appropriate sheet size.

2.1 Sheet Sizes:

All "A", "B", "D", and "E" size CAD drawings were created as blocks (DWG) and templates (DWT). Naming convention is as follows:

A-Size Drawing Sheet:

Sheet Size:	"A" Size, 8-1/2" x 11"
Binding:	Along left edge
Template and Block Name:	STD-ASHT
Scale Factor:	Same as drawing DIMSCALE

B-Size Drawing Sheet:

Sheet Size:	"B" Size, 11" x 17"
Binding:	Along left edge
Template and Block Name:	STD-BSHT
Scale Factor:	Same as drawing DIMSCALE

D-Size Drawing Sheet:

Sheet Size:	"D" Size, 22" x 34"
Binding:	Along left edge
Template and Block Name:	STD-DSHT
Scale Factor:	Same as drawing DIMSCALE

E-Size Drawing Sheet:

Sheet Size:	"E" Size, 34" x 44"
Binding:	Along left edge
Template and Block Name:	STD-ESHT (STD-AE-ESHT to be used by A/Es)
Scale Factor:	Same as drawing DIMSCALE

The standard title blocks have attributes which allow the title block information to be entered as the title block is inserted. All title blocks shall be inserted 1 to 1 scale in paper (layout) space at coordinate 0,0,0 in AutoCAD® World UCS.

2.2   Title Block Information:

Project Titles:
The project title and project number shall be determined by FESS/E Project Coordinator regardless whether projects are done in-house or by an A/E and entered into the engineering's project database, see Section III.

CDR and PDR Drawing Numbers:
Conceptual Design and Project Definition Reports are numbered sequentially with all disciplines combined. Conceptual and Project Design Report numbers have a prefix that read "**CDR-**" and "**PDR-**" respectively. Advanced Conceptual Design work is considered Preliminary Design, formally known as Title 1 Design.

Preliminary Design and Final Design Drawing Numbers:
Preliminary and Final Design drawings are numbered sequentially within each of the following categories and are arranged in the order as shown below.

Prefix	Category
G-	**Genera**l *(Title Sheet)*
C-	**Civil** *(Includes erosion control drawings)*
D-	**Demolition**
A-	**Architectural**
AF-	**Furniture** *(Can be combined with Arch.)*
SC-	**Structural Concrete**
SS-	**Structural Steel**
M-	**Mechanical**
P-	**Plumbing**
FA-	**Fire Alarm & Detection**
FP-	**Fire Protection** *(Sprinkler/Suppression)*
E-	**Electrical & Special**
EC-	**HVAC Controls** *(Can combined w/ Elec.)*

Consideration:
Preliminary Design drawings shall have the text "**Preliminary Design**" affixed between the Project Number and Drawing Number on the standard D and E sized sheets.

Drawing Title:
Drawings that should be named the same shall have a suffix labeling SHEET 1, OR SHEET 2, Etc. The preferred abbreviation for Sheet is "**SHT**.".

2.3   Font Type:
The typical font types utilized are SWISS BOLD for the titles and ARIAL for notes, text, and dimensions. See Section VI for font size.

2.4   Cover Sheet:

Numbering:
The cover sheet shall be "**CDR-1**" for Conceptual Design Reports, "**PDR-1**" for Project Definition Reports and **G-1** (See Section III titled Electronic Naming Convention & Filing) for Preliminary Design and Final Design drawings.

Contents:
Cover sheets are placed on the standard drawing sheet, with a completed title block.

ITEM	CDR or PDR*	PRELIMINARY DESIGN	FINAL DESIGN
Project Title Bold Typeface (Swiss Bold)	SC	SC	SC
Project Number Bold Typeface (Swiss Bold)	SC	SC	SC
Location Plan	MC	MC	SC
Vicinity Plan	MC	MC	SC
List of Drawings	SC	SC	SC
General Notes	N/A	N/A	MC

SC   = Shall Contain
MC   = May Contain
N/A   = Not Applicable

> ***Note**: CDR and PDR do not require cover sheets.*

Consideration: FESS/E Project Coordinator may elect to replace the cover sheet on smaller projects with a sketch detailing the vicinity plan with the appropriate site access/entrances incorporated into the Exhibit A.

3.0. ELECTRONIC NAMING CONVENTION AND FILING

Each electronic drawing will have an electronic name consisting of a discipline specific prefix followed by the drawing number.

3.1 FESS Engineering Project Numbering

Project numbers are associated by areas around site.

|	
2-1-XXX	Central Laboratory (Wilson Hall)
2-3	Cross Gallery
2-4	Central Laboratory Site Work
2-5	Footprint Area Upgrades
3-2	General Site Work, Topography
3-3	Survey Facilities
3-5	Site Utilities
3-6	Master & Kautz Road Sub Stations
3-7	Power & Communication Distribution
4-1	Linear Accelerator
5-1	Booster Accelerator
5-2	Booster Prototype
5-3	Booster Utilities
6-1	Main Ring
6-2	Antiproton Source
6-3	D-Zero Experimental
6-4	20 GeV Rings
6-5	150 GeV Rings
6-6	Main Injector
6-7	NuMI
6-8	C-0 Test Hall Area
6-10	Muon Campus
7-1	Switchyard
8-1	Meson Enclosure & Buildings
8-2	Neutrino Enclosures & Buildings
8-3	Pion Laboratory (High Intensity Lab)
8-4	Proton Enclosures & Buildings
8-5	Tagged Photon Laboratory
8-6	KTeV Experimental
10-1	Industrial Complex
10-2	Village Area Complex
10-3	Industrial Center Building
10-4	Receiving & Storage (North Support)
10-5	Central Computing Facility (FCC)
10-6	Science Education Center Facility
10-8	Office, Technical, & Education
11-2	Central Utility Plant Building
12-1	Energy Conservation
13-1	Misc. (Roof Vents, Sprinkler Repl)
13-2	Pre-cast Concrete (Shield Blocks)
14-1	Interiors
15-1	Off Site Experiments (NOvA)

Last digits
Chronologic
Order

XX-XX-XXX

Project No.
Area
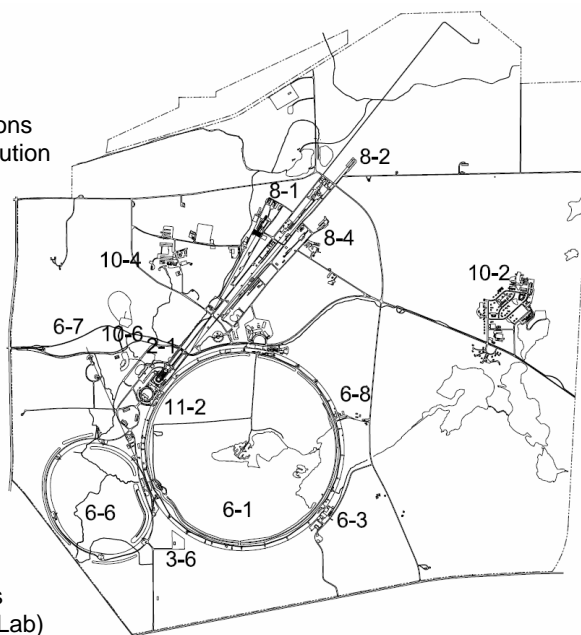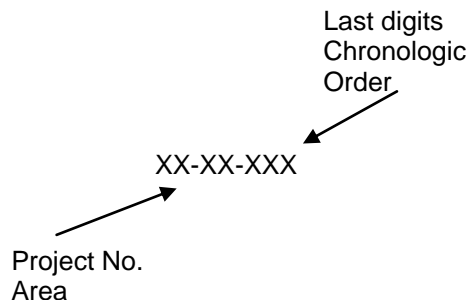
3.1.2 FESS Operations Numbering Format

50 Series	Existing Conditions (Village Power Overhead, Feeders, Etc.)
60 Series	Maintenance (Utility Breaks, Building Equipment Locations)

3.2 Prefix

The prefix should follow the same convention as prefix used for drawing numbers as described in Section II.

Prefix	**Category**
G	General
C	Civil
D	Demolition
A	Architectural
AF	Furniture
SC	Structural Concrete
SS	Structural Steel
M	Mechanical
P	Plumbing
FA	Fire Alarm
FP	Fire Protection
E	Electrical & Special
EC	HVAC Controls
*SK	Sketch

The prefixes can be combined for smaller projects, but should not exceed a total of five characters. In cases where this is impractical, the lead discipline's prefix should be used for all electronic drawing names.

NOTE: Sketches can be utilized for preliminary concepts/designs and for project change orders and proposals. Sketches for project change orders should be incorporated into the design documents as a single revision or as-built at the completion of the project.

3.3   Suffix:

The suffix should consist of a drawing number and project number. The first drawing in each sequence will be 1.

<u>EXAMPLES – Electronic naming conventions for Project No. 2-3-18.</u>

C1-2-3-18.DWG	First Civil drawing
C2-2-3-18.DWG	Second Civil drawing
A1-2-3-18.DWG	Architectural drawing
AS1-2-3-18.DWG	Combined Architectural/Structural Drawing
FP1-2-3-18.DWG	Fire Protection Drawing No. 1
FP2-2-3-18.DWG	Fire Protection Drawing No. 2

<u>EXAMPLE – Electronic "As-Built" (Record Drawing)</u>

FP1_AB-2-3-18.DWG   Fire Protection Drawing No. 1

Prefix

Suffix

File Extension – Native to AutoCAD
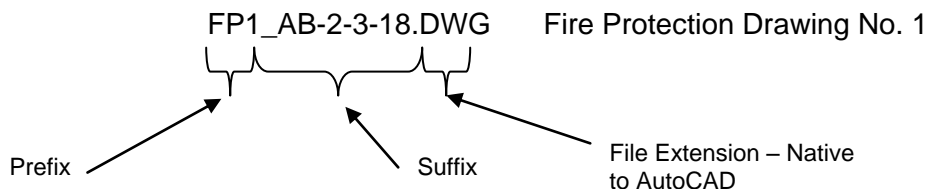
3.4   Project Filing:

All current project electronic drawing files should be stored in the Active Project area. The subdirectory (subfolder) Active Projects area is located on Fermilab's server in the FESS/Eng directory (folder). All project specifications shall be filed in the project directory (folder) as well.
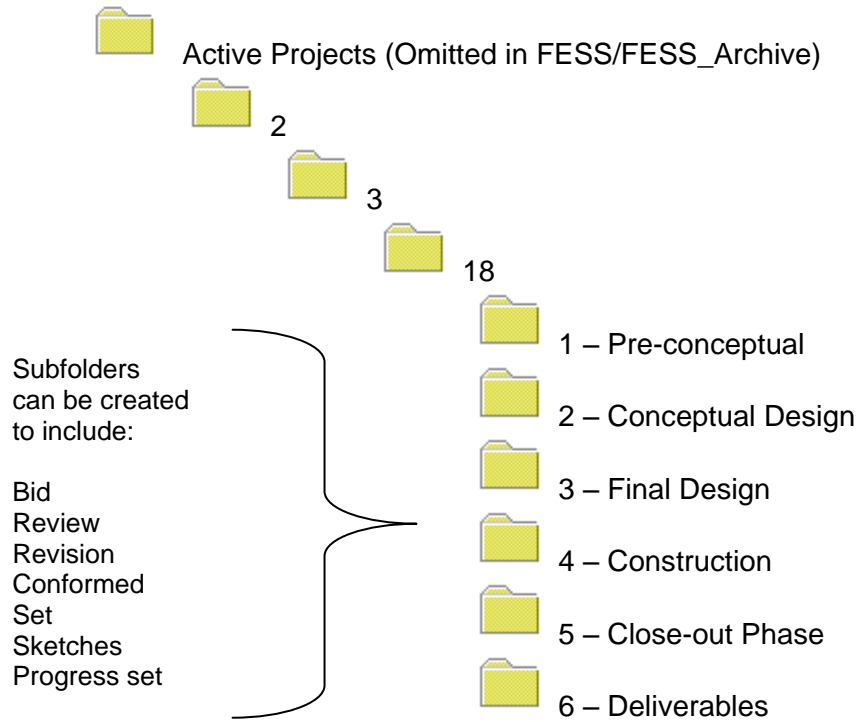
All completed project drawings, regardless whether electronically or manually drawn, shall be stored in the archived area. A list containing project number, project name, each drawing description, and appropriate FIMS (building identification number) number shall be provided to the Record Document Coordinator(s) in order that the Project Database can be updated. Additionally, the FESS/E Project Engineer and/or Record Document Coordinator(s) have permissions to store the drawing files in the archive area.   The archive area is located on Fermilab's server in the FESS/FESS_Archive directory (folder).

Reference Section 7.2.1 for submittal of final set.

Below is an example of a filing structure for Project Number 2-3-18 in Engineering's Active Projects and the FESS/FESS_Archive areas.

FESS/Eng and FESS/FESS_Archive

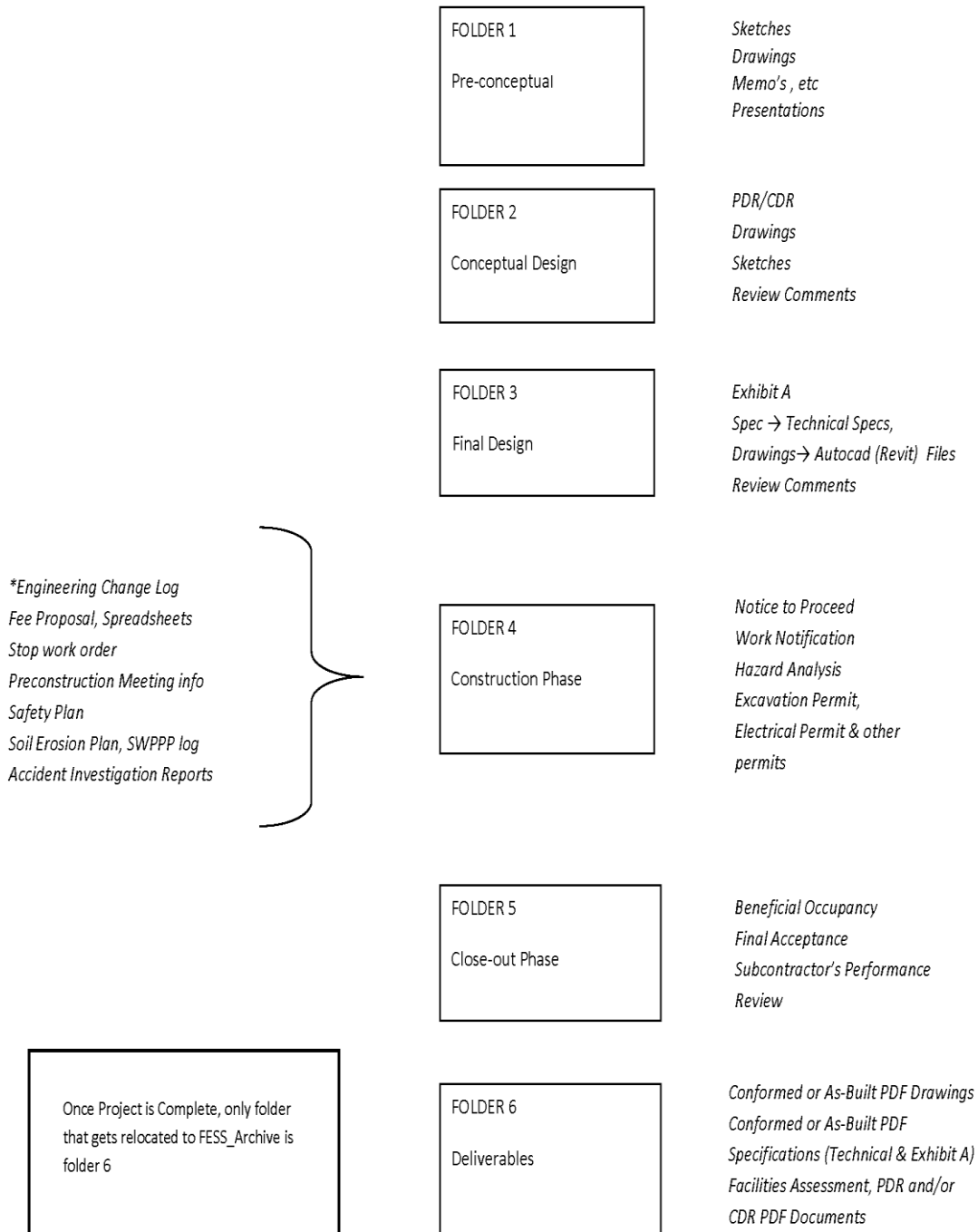Active Projects (Omitted in FESS/FESS_Archive)

2

3

18

1 – Pre-conceptual

2 – Conceptual Design

3 – Final Design

4 – Construction

5 – Close-out Phase

6 – Deliverables

Subfolders
can be created
to include:

Bid
Review
Revision
Conformed
Set
Sketches
Progress set

FOLDER 1

Pre-conceptual

Sketches
Drawings
Memo's , etc
Presentations

FOLDER 2

Conceptual Design

PDR/CDR
Drawings
Sketches
Review Comments

FOLDER 3

Final Design

Exhibit A
Spec → Technical Specs,
Drawings→ Autocad (Revit) Files
Review Comments

*Engineering Change Log
Fee Proposal, Spreadsheets
Stop work order
Preconstruction Meeting info
Safety Plan
Soil Erosion Plan, SWPPP log
Accident Investigation Reports

FOLDER 4

Construction Phase

Notice to Proceed
Work Notification
Hazard Analysis
Excavation Permit,
Electrical Permit & other
permits

FOLDER 5

Close-out Phase

Beneficial Occupancy
Final Acceptance
Subcontractor's Performance
Review

Once Project is Complete, only folder that gets relocated to FESS_Archive is folder 6

FOLDER 6

Deliverables

Conformed or As-Built PDF Drawings
Conformed or As-Built PDF Specifications (Technical & Exhibit A)
Facilities Assessment, PDR and/or CDR PDF Documents

*Denotes Subfolder

3.5   SLED Filing:

All single line electrical drawings (SLED) should be stored in the Archive area. A list containing project number, project name, each drawing description, and appropriate FIMS (building identification number) number shall be provided to the Record Document Coordinator(s). The archive area is located on Fermilab's server in the FESS/FESS_Archive directory (folder).

A.   The naming convention should begin with E for Electrical and the number sheet. In the title block should reference the FIMS number of a given building.

B,   File Naming Convention and File Format. For Example:

Wilson Hall has a FIMS No. of 001, therefore the single line electrical drawing would begin as:

E-1_001.pdf
E-2_001.pdf
E-3_001.pdf
E-4_001.pdf

C.   File Format deliverables should be in a postscript or PDF format.

4.0.   LAYER NAMING CONVENTIONS

Each new AutoCAD® drawing will have a core group of layers common to all disciplines. The intent is to consolidate the number of layers as well as prevent unnecessary repetition. All layers within model space should be at "by-layer".

4.1   Core Layers:

Layer Name	Color #	Description
TITLE BLOCK	7	*This layer will contain the standard title block, north arrow, graphic scales, Section and Detail Marks, and Titles for Plans, Sections and Details.*
COLLINE	2	*This layer will contain column lines and column grid lines.*
DIM	1	*This layer will contain all dimensioning information and dimensioning notes.*
TEXT	3	*This layer will contain all text information for the drawing that is not included on the DIM layer.*
HATCH	1	*This layer will contain all hatch and material designations.*
TITLES *Sections*	7	*This layer will contain Project Titles, Section and Detail marks, and Titles for Plans, and Details.*
CL	1	*This layer will contain center lines.*
EXIST	12	*This layer will contain existing equipment (See definitions for discipline layers with existing entities).*
V-PORT		This layer will contain viewport border number 1
XREF	7	External reference drawings should be contained on this layer.

4.2   Discipline Specific Layering:

Disciplines will have a unique set of layers. The layer names will be a discipline identification prefix followed by a layer description. The layer naming format is based on the 1997 American Institute of Architects (AIA) Layer Guidelines

Description of discipline work
(Major Group)

X – XXXXX-XXXXX

Discipline

Minor Group
(Not Required)
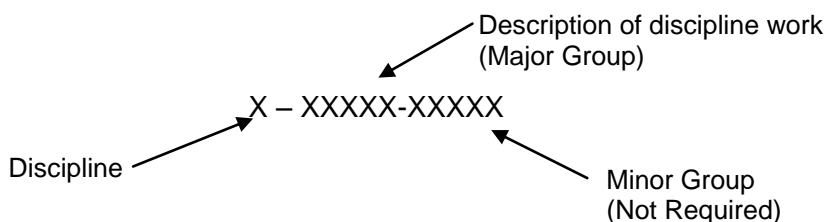
EXAMPLES – Layering:

Layer Name	Color	Description
C-ROAD	6	*Roads and hardstands*
C-TEXT	3	*Civil text/notes and general notes*
D-EQUIP	7	*Equipment to be demolished, dashed line*
A-SHELL	7	*Basic building exterior walls*
A-DOOR	2	*Door swing and door*
A-DOOR-IDEN	7	*Tag and text for door type*
A-WALL-EXTR	7	*Building/Enclosure exterior walls*
A-TEXT	3	*Arch. text/notes and general notes*
SC-FOOT	7	*Concrete foundation walls/footings*
SC-SLAB	7	*Concrete floor/basement slab*
SC-TEXT	3	*Concrete text/notes & general notes*
SS-BEAMS	5	*Structural overhead beams*
SS-COLUMNS	5	*Structural vertical columns*
SS-TEXT	3	*Structural notes/general notes*
M-DUCTS	7	*Mechanical ductwork*
M-TEXT	3	*Mechanical text/notes*
P-FIXTURE	6	*Plumbing fixtures*
P-TEXT	3	*Plumbing text/notes*
FA-DEVICES	4	*Fire Alarm devices*
FP-PIPE	6	*Fire Protection pipe*
FP-TEXT	3	*Fire Protection text & notes*
E-LTS	6	*Electrical lighting*
E-RECPT	7	*Electrical power receptacles*
E-TEXT	3	*Electrical text and notes.*
EQ-SYSTEM		*For partition furniture*
EQ-FURN		*Free Standing Furniture (tabled, chairs, etc)*

An "**X**" should be placed after the discipline code of the prefix to show that the layer is existing entities and will be plotted as a half tone. An example of this might be **CX-ROADS**, **FPX-PIPE**, etc. . The typical color for existing is 9 or 12.

5.0   COLOR AND LINE WEIGHT MAPPING

All standard A, B, D and E size drawings should be plotted utilizing the Fermi Pen Style ctb file.

The following tables reflect Fermilab's CTB files:

5.1   Pen Settings for Sheets D and E:

Screen Color	No.	Line Width	Color	Screening
Red	1	.1800	Black	100%
Yellow	2	.1800	Black	100%
Green	3	.3000	Black	100%
Cyan	4	.3000	Black	100%
Blue	5	.8000	Black	100%
Magenta	6	.5000	Black	100%
White	7	.8000	Black	100%
Dark Gray	8	.5000	Black	100%
Light Gray	9	.1800	Black	60%
Medium Red	10	.1800	Black	60%
Light Red	11	.3000	Black	60%
Dark Red	12	.3000	Black	40%
Light Red	13	.8000	Black	60%
Dark Red	14	.5000	Black	60%
Medium Red	15	.8000	Black	40%
Dark Maroon	16	.1000	Black	100%

5.2   Pen Settings for Sheets A and B:

Screen Color	No.	Line Width	Color	Screening
Red	1	.0900	Black	100%
Yellow	2	.0900	Black	100%
Green	3	.1500	Black	100%
Cyan	4	.1500	Black	100%
Blue	5	.4000	Black	100%
Magenta	6	.2500	Black	100%
White	7	.4000	Black	100%
Dark Gray	8	.2500	Black	100%
Light Gray	9	.0900	Black	60%
Medium Red	10	.0900	Black	60%
Light Red	11	.1500	Black	60%
Dark Red	12	.1500	Black	40%
Light Red	13	.4000	Black	60%
Dark Red	14	.2500	Black	60%
Medium Red	15	.4000	Black	40%
Dark Maroon	16	.1000	Black	100%
Varies	17	.255	Black	100%

6.0   SCALES, TEXT AND DIMENSIONING

The following outlines the standard for font heights and styles. This document does not necessarily pertain to presentation documents and may deviate from this standard.

6.1   Scales

The scale factor for Paper Space drawings should have a DIMSCALE of 1, independent of the Viewport scales.

The Scale Factor for Model Space drawings shall be equal to the DIMSCALE value as follows:

Architectural Plotting Scale Factor	Normal Scale Scale	Civil Plotting Factor	Normal Scale Scale	Fermi System Factor
1/32"=1'-0"	384	1"=5'	60	5
1/16"=1'-0"	192	1"=10'	120	10
3/32"=1'-0"	128	1"=20'	240	20
1/8"=1'-0"	96	1"=30'	360	30
3/16"=1'-0"	64	1"=40'	480	40
1/4"=1'-0"	48	1"=50'	600	50
3/8"=1'-0"	32	1"=100'	1200	100
1/2"=1'-0"	24	1"=200'	2400	200
3/4"=1'-0"	16	1"=400'	4800	400
1"=1'-0"	12	1"=600'	7200	600
1 1/2"=1'-0"	8	1"=800'	9600	800
3"=1'-0"	4	1"=1200'	14400	1200

LTSCALE
The "LTSCALE" should be 0.375 or 0.5 times the Scale Factor for all Model Space images to be used in paper space.

6.2   Text Styles

Text: The font "Arial" shall be used for all standard text and dimensioning.

Titles: The font "Swiss Bold" shall be used for all highlighted text.

<u>Font Height:</u>   Font Heights shall be as follows:

6 pt. = 1/16 in. or 0.0625" multiplied by the drawing scale factor
8 pt. = +/-3/32 in. or 0.08333" multiplied by the drawing scale factor
10 pt. = +/-3/32 in/0.104167" multiplied by the drawing scale factor
12 pt. = 1/8 in. or 0.125" multiplied by the drawing scale factor
14 pt .= 5/32 in. or 0.15625" multiplied by the drawing scale factor
18 pt. = 3/16 in. or 0.1875" multiplied by the drawing scale factor
24 pt. = 1/4 in. or 0.25" multiplied by the drawing scale factor
36 pt. = 3/8 in. or 0.375" multiplied by the drawing's scale factor
60 pt. = 3/4 in. or 0.625002 multiplied by the drawing's scale factor

The minimum text height for a project will be determined by the Project Coordinator. Generally, 10pt is the smallest size that should be used if full or half size drawings will be the final product. Typically, CDR drawings are reduced to 11"x17". For readability, 12 pt is the smallest size that should be used for E-sized drawings reduced to 11"x17".

<u>Width Factors:</u>
Width Factor for the Swiss font shall be 1.0.
Width Factor for the Arial font shall be 1.1.

<u>Oblique Angle:</u>
Oblique angle for the Swiss and Arial fonts should be 0 degrees.

6.3   Dimensioning

All dimensioning should be done in Paper (Layout) Space. The base model space drawing should be kept clean of text and dimensions.

TIP: *If you move the viewport, or pan the view, use DIMREGEN to get your dimension back to its proper location. Occasionally, you may need to use DIMREASSOCIATE to re-associate the dimensions to their objects. In addition, one can lock the viewport in change properties*

7.0. STANDARD DRAWING TECHNIQUES

Several Section, Detail, Elevation, and Plan Marks have been developed to provide for consistency among drawings. The use of Paper Space and Model Space is strongly recommended for ALL new drawings.

7.1 Section, Details, and Titles

Section Marks: A Section is cut on plans, elevations and building sections. Sections are referenced by letters placed in the top half of the ellipse, and the sheet that the section is cut on is placed in the bottom half of the ellipse. A dash is placed in the bottom of the mark if the Section is on the same sheet that it is cut on.

Section Mark (Typical)

Reference Drawing No. (Typical)
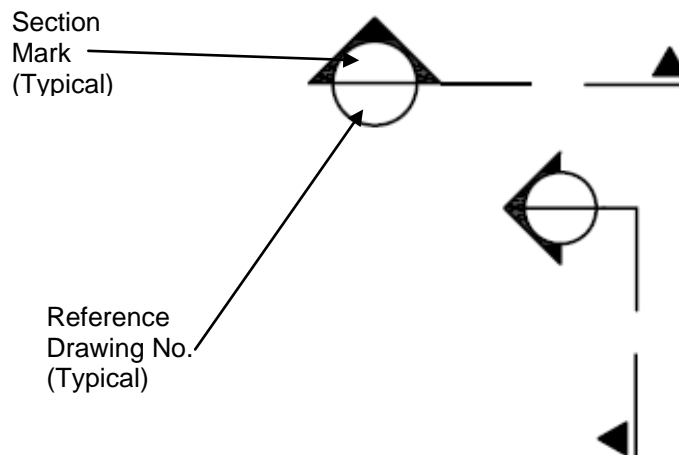
Typical Section Marks

Note: The Autodesk Revit Template Section Marks are slightly different then above. Reference the Autodesk (Fermi) Revit Template.
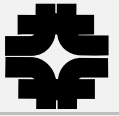
Detail Marks:
Place a "-" in the lower portion of the circle if the Detail is on the same sheet.
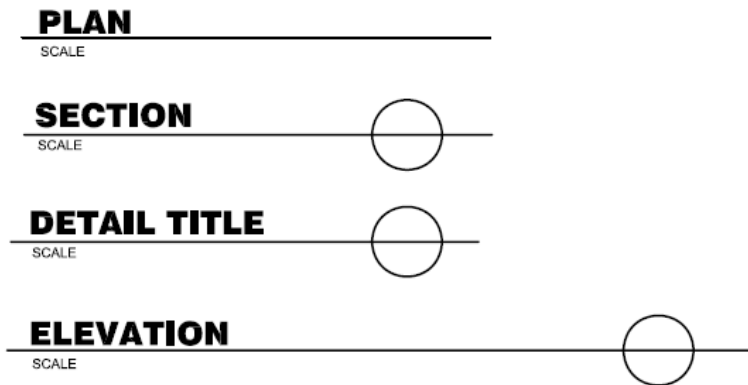
Circle the area that is being detailed with a dashed line; draw a line between the dashed line and either end of the Detail mark.
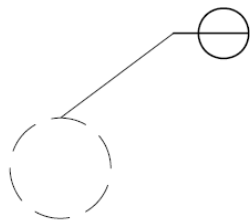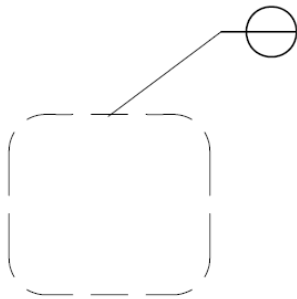
Typical Detail Marks

<u>Plan, Section, and Detail Titles:</u> To maintain clarity, titles should convey more than simply "Plan" or "Section" or "Detail" to assist in clarity. Examples of this would be "PLAN AT EL: 772'-4"" or "ELEVATION LOOKING NORTH".

Blocks for Section marks, Detail marks and titles attributed for proper labeling are provided at:
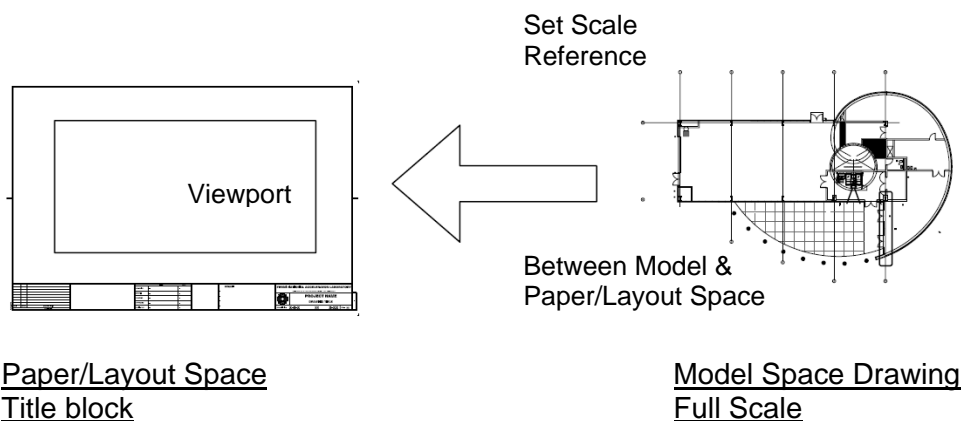
ftp://fess-ftp.fnal.gov/public/BIM-CAD%20Standard%20Blocks%20Tempates/

North arrows and graphic scales are also provided at:

ftp://fess-ftp.fnal.gov/public/BIM-CAD%20Standard%20Blocks%20Tempates/

7.2   Paper Space (Layout), Model Space, and XREF

All new drawings should be drawn using Paper Space and Model Space.   The Fermilab's Title blocks are drawn in 1 to 1 scale.   The title blocks drawings shall be prepared in paper (layout) space.   Other features such as North arrows, general plan notes, keyplans, or other items that are repetitive throughout the drawing set may be included in paper (layout) space.   Discipline drawings shall be prepared in model space at full scale.   Drawing elements such as floor plans, details, elevations, sections, schedules, etc. should all be included in model space.

Set Scale
Reference

Viewport

Between Model &
Paper/Layout Space

Paper/Layout Space
Title block

Model Space Drawing
Full Scale

7.2.1 FINAL SET: At the completion of project, two different electronic files shall be furnished to Fermilab.

> **7.2.1(a)   XREFS***:* External reference and image files are strongly encouraged for base architectural sheets.   All line work in Base Sheets shall BY LAYER.   These sheets should include the entire building, without text and dimensions. By creating base sheets of buildings, they can be utilized in future projects and provide the lab with an "as-condition" or as current of a floor layout as possible.   Save xref files without directory/folder path and in the same directory as the discipline DWG files, so that when a discipline specific DWG file is open, the external reference file automatically loaded within the DWG file.
>
> **7.2.1(b) PDF:** A complete project in PDF File format, typically from Paper Space/Layout, reflecting the printed bid copy.   (Do not use the wipe-out command – PDFs do not print correctly).
>
> **7.2.1(c)   GIS:** When required by the project team, utilities created in AutoCAD shall be converted into GIS – Reference the GIS Standard for guidance.

8.0   FERMI COORDINATE SYSTEM

The Fermi Site Coordinate System formally known as DUSAF shall be used to establish civil construction control points. Civil and Location maps should use this convention.

<u>***Note***</u>*: The FERMI Coordinate system is rotated such that the site Project North is from true North.*

Project North is rotated at base point: x=100,000 and y=100,000
                                                    @ 38d16'48.01429"

8.1   Definitions

<u>Fermi Coordinate System</u>: The FERMI Coordinate System is a Cartesian coordinate system using the A-0 point of the Fermilab Main Ring as x=100,000.00, y=100,000.00. Units are in feet. In most cases, the Fermilab drawings are oriented with Project North pointing to the right of the sheet. The FERMI system places the positive "Y" axis also pointing North to the right side of the sheet (This is referred to as Northing.)   The positive "X" axis or Easting axis is pointing down.

Further information can be obtained at the following website:

http://ppd.fnal.gov/align/beams-doc-1148.html

8.3   Working with Fermi Coordinates

The following will help users effectively work within the Fermi coordinate system.

Fermi Coordinate system is a Cartesian grid system using the point A-0 of the Fermilab Main ring as x=100,000.00, y=100,000.00. Units are in feet. In most cases the Fermilab drawings are oriented with Project North pointing to the right of the sheet. The Fermi Coordinate system places the positive "Y" axis also pointing North to the right side of the sheet. This is referred to as Northing by the Fermilab Alignment (survey) group. The positive "X" axis or Easting axis is pointing down.

Working with AutoCAD and Fermi Coordinate System:
AutoCAD allows the operator to rotate its Cartesian coordinate system. Changing the user coordinate system (UCS) rotation only changes the axes, it does not move or rotate objects. To work within the Fermi Coordinate System with Fermilab's standard drawing sheet orientation you must rotate the "Z" axis 270 degrees.

The AutoCAD® standard "world" UCS orients positive "X" to the right of the screen. Entities with positive "X" and "Y" values will reside in the upper right-hand quadrant. Rotating the UCS to the Fermi Coordinate System orientation will change an entity's values to negative "X" and positive "Y". With the Fermi coordinate system, the positive "X" positive "Y" is the global lower right-hand quadrant.

Inserting Blocks and Text: To insert blocks with normal orientation while in the Fermi coordinate system, they must be inserted with a rotation angle of 90 degrees. Similarly, to be inserted properly, horizontal text must also have a 90 degree rotation angle. Otherwise, switch the UCS to "world" before entering text.

Dimensioning: While in the FERMI coordinate system, interchange vertical and horizontal for proper orientation.

It is possible to change to the "world" UCS at any time while editing a drawing, making text, insertion of blocks, and dimensioning much simpler. Rotation angles are now normal to AutoCAD®'s standard setup.   The limitations of switching to the "World" USC is that the drawing entities will have positive "X", but negative "Y" values. Mostly, this restricts entering entities with keyboard real number values and other information from the drawing database.

Scale: The default FERMI unit is the decimal foot. (Example: to offset a line 35 feet, enter 35. Offsetting 8 inches requires the decimal equivalent, or .667, 8/12). When using FERMI or any decimal units, the basic AutoCAD® unit, which is an inch, represents one foot. Dimensioning with the decimal option (not the civil setting) gives understandable dimensioning assuming feet and decimal feet.   If Architectural dimensioning is desired, the 35 feet offset lines would dimension as, incorrectly,
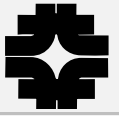
2'-11". To solve this, set the DIMVAR "DIMLFAC" equal to 12.

Settings: The DIMSCALE or scale factor and the LTSCALE is 1/12 of what is normally use for the plot scale. For example, a 1"=200'-0" civil drawing would use 200 for the scale factor not 2400, or a 1/8"=1'-0" architectural scale drawing would use 8 not 96. Plot file input for the above would be 1=200 and 1=8, respectively.

9.0   AMENDMENTS AND REVISIONS

Reference the FESS/E Standard Operating Procedure for further clarification. Project Coordinators will assign an Amendment or Revision number(s).

9.1   Definitions

Amendment: A change to the subcontract documents, which occurs before the bids have been received (opened). Amendments are issued during the bid period.

Revision: A change to the subcontract documents, which occurs after the bids are received and after the subcontract has been awarded and executed. Revisions are issued during Title III, construction period.

Conformed Set: Once the bid is awarded, a revised set of drawings and specifications can be issued to the subcontractor incorporating the amendments and revisions.

9.2   Procedures

Amendment: When a drawing has been changed, those items that have been modified, i.e., changed, added, or deleted, are to be clouded. A number shall be placed inside a triangle with the triangle either touching the cloud or connecting to the cloud with a leader line. Clouds and triangles on a drawing with a previous amendment are to be removed before making the new amendment with new clouds and triangles. Do not cloud a new drawing that has been issued for an amendment. In addition, add the new drawing to the title sheet and Addendum A of the Exhibit A. Add the data in the revision block of the sheet's title block indicating Amended per Amendment No. X.

Revision: When a drawing has been changed, those items that have been modified, i.e., changed, added, or deleted, are to be clouded. A revision number shall be placed inside a triangle with the triangle either touching the cloud or connecting to the cloud with a leader line. Clouds and triangles on a drawing with a previous revision are to be removed before making the new revision with new clouds and triangles. Do not cloud a new drawing that has been issued for a revision. Add the revision data in the revision block of the sheet's title block.

Revisions can be drawn on sketches and should be numbered SK-XXX. As revisions progress, the numbers are sequential and the letter identifies the discipline. These numbers should be entered into the Engineering Change Request Proposal database for each particular project.