

Vertical CADD Standards

Version 1.3

November 18, 2020

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These Guidelines are intended for use with Bentley MicroStation Connect Edition.

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Related Documents

3D Execution Plan Template (MS Word File)

3D Design Review Checklist Template (MS Word File)

Level of Development (LOD) Master Format – UnniFormat (MS Excel File)

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1. Introduction

1.1. Overview

The Region of Peel's Public Works (PW) Department's policy mandates that all CADD submissions shall be submitted in Bentley MicroStation Connect (*.dgn) file format and conform to the structure and standards of the PW Department.

All CADD data supplied to Consultants by the Region of Peel shall be in MicroStation (.dgn) format.

The current platform for managing 2D CADD drawings in use within the PW Department is **MicroStation Connect** edition by Bentley Systems Incorporated.

It is not the intent of the Region of Peel to restrict Consultant's choice of CADD platforms, however, should a Consultant choose to use Autodesk's Autocad or a similar product, it will be the Consultant's responsibility to ensure that all deliverable 2D CADD data shall be provided in MicroStation format, as per the standards set out in this document. Where 3D design is required by the Region for project execution, it is the Region of Peel's intent to enable consultants to utilize their preferred 3D design software solutions for model and drawing development. However, the solution must be capable of producing 2D CADD deliverable outputs in MicroStation format, as per the standards set out in this document. Refer to Project Requirements and Conformance - 3D Design Development, for further details.

This document defines the scope and goals of The Region of Peel instructions and standards for the following topics:

- Project team accessibility
- CAD standards addressing preparation of construction drawings
- 3D Design delivery goals and guidelines
- Creation of graphical Bentley Drawings
- Workflow and communication
- Design review

Conformance to these instructions and the established National CADD Standard is essential to produce final drawings that are consistent in behavior, appearance, and content.

Communication is an integral component from discipline to discipline as well as in the format of our electronic files. Any existing information deemed necessary for use on this project should be input into the drawings using dimensional information as available, scanning or by digitizing.

It is particularly important to use the dimensional methods when the information needed relates to buildings and other structures.

All final Drawings submitted to the Region of Peel will be produced in **MicroStation Connect 2D**, utilizing Region of Peel Specific border(s) regardless of source 2D/3D vertical BIM applications that include **Autodesk Revit, Bentley AecoSim, OpenPlant Modeler, Bentley Raceway and Cable etc.**

1.2. Scope and Purpose

Scope and Goals: Coordinate and maintain drafting and CADD standards to comply with The Region of Peel/The National CADD Standard requirements for design and creation deliverable drawings.

The **Region of Peel Vertical CADD Standard** was developed to provide default standards governing CADD production and presentation both internally and externally. As there will always exceptions to rules, all issues outside the core principles of this document must be reviewed and approved by the Region of Peel prior to alterations, modifications that may compliment this document. No deviations shall occur without Region of Peel written approvals.

The Region of Peel utilizes Microstation Connect as their standard CADD platform. All CADD deliverables submitted in electronic format to the Region of Peel, will be provided in Microstation (As-Builts). All consultants, suppliers etc., will follow this CADD Standards Manual for the duration of their specific contract.

The Region of Peel has adopted the National CADD Standards (NCS) as the basis for its Vertical CADD Standard. It is beneficial for all Users to become familiar with the NCS and use it as reference only on any issues not covered within these Standards. The intent is to use the NCS as guideline on standards issues, and to comply with the NCS as much as possible to serve the Region's needs.

1.3. Document Security

All project work is to be maintained only on Consultant equipment using the standard practices of file storage for daily work. Should any consultants/contractors require digital data (digital drawings), they will be subjected to, and acceptance thereof, of the Consultant Electronic Media Release form.

2. Project Requirements and Conformance

2.1. Conformance

Conformance to these instructions, are essential to produce a final drawing(s) that is consistent in appearance and content. All project team members will follow and conform to **Region of Peel Vertical CADD Standards** for the preparation of contract deliverables.

2.2. CADD Software

Bentley software will be employed as the main CADD tool(s) for deliverable drawing development. Refer to Overview for more specific information.

2.3. Datum Requirements

All Civil based submitted CADD files will be spatially correct and/or geo-referenced to meet Region of Peel Geodetic Datums. These drawing types would include all discipline specific Site Plans, Plan and Profile drawings or any drawing that has critical datum specific data within.

Horizontal: Coordinates are based on 6 degree Universal Transverse Mercator (UTM) zone 17, Central Meridian 81 degrees west, North American Datum 1983 adjustment (NAD 83 ORG).

Elevations: GSC Datum, 1978 Southern Ontario Adjustment.

2.4. Design File Setup

All CADD documents will be complete with a **Default view and a Layout View per Region of Peel 2D Seed**. All referenced data within the **Default View** will always be at a 1:1 scale. For **Layout space**, Civil file types, as outlined in the Datum Requirements, will have all referenced data attached via the Default View at a scale of 1:1 and rotated to satisfy border placement at desired output scale. Only these file types will have the border referenced to a desired output scale.

All other discipline specific **Layout Views** will have the border attached at a 1:1 scale. All referenced data attached via the **Default View** will be at the desired output scale. Refer to **File Definitions and Relationships** for more information.

2.5. CADD Graphical Attributes

All CADD documents will be consistent with Region of Peel Vertical CADD Standards found on the Region of Peel website at: <https://www.peelregion.ca/>. These Standards are specific to Drawing criteria not limited to standard Dimensions, Cells, Linetypes, Layers, Text, Symbology etc.

2.6. CADD Seed Files

PEEL-2D_Seed.dgn/PEEL-3D_Seed.dgn – to be used for all Deliverable Files.

All 2D CADD and 3D design files (if working with Bentley 3D design verticals), are to be created using the appropriate Project Seed File(s). If a file is copied from another project, make sure all copied elements are contained within the Project Seed File and changed to the current Project Standards. If working with another 3D design solution, the 2D drawing content output must be compatible with the Seed Files and appropriate geometry translations must be developed to align 2D drawing deliverables with the structure in these seed files.

The Border File is client specific and will be referenced into each drawing. The border file name is **Peel Border - D.DGN** and is found in the supplied Standards data package along with all Region of Peel CADD specific Standard files. A standard plot configuration file/pen table combination will be supplied and utilized for all MicroStation plotting means to ensure drawing consistency.

2.7. 3D Design Development

When 3D design has been specified for project execution, the following guidelines shall be used to ensure proper planning and implementation is achieved:

- A project specific 3D Design Execution Plan shall be developed in collaboration with the Region's project team to outline specific requirements for the use of 3D Design on the project (3D Design Execution Plan Template, MS Word File).
- As a minimum, the following project uses for 3D Design will be implemented:
 - 2D drawing production from 3D design
 - 3D discipline design coordination
 - 3D design phase reviews
 - Quantity take-offs to support cost estimate reviews
 - 'As-Recorded' 3D model deliverable

2.8. 3D Discipline Coordination

To reduce major conflicts on the project, a process of visual and automated interference checks shall be employed. At a minimum interference checks for the following model elements shall be performed for all design phase submissions:

Discipline	To be checked against:		
Architectural -Structural	Process Mechanical	Building Mechanical	Electrical – I&C
Process Mechanical	-	Building Mechanical	Electrical – I&C
Building Mechanical	-	-	Electrical – I&C

3D coordination processes and reporting shall be outlined in the project-specific 3D Design Execution Plan and approved by Region of Peel Project Manager.

2.9. 3D Design Reviews

3D design review capabilities will be integrated into the project deliver approach. At a minimum, a federated project model will be provided to the Region at project milestones along with the supporting drawings, reports and specifications for review by Region project stakeholders. (Refer to 3D Design Review Checklist Sample, MS Word File)

3D design model deliverables will be used for communication and collaboration purposes during the design and construction phases. If any 3D design files are requested or used beyond the design phase, they will be for information purpose only and the sealed 2D contract drawings will take precedence.

Model review software shall be specified in the project-specific 3D Design Execution Plan and used for design phase reviews and general presentation of the federated 3D design. Further, support for a cloud hosted version of the federated 3D model, that is accessible via an internet browser, should be considered to enable open access to all project stakeholders.

Model review processes and file sharing schedule shall be outlined in the project-specific 3D Design Execution Plan and approved by Region of Peel Project Manager.

2.10. Quantity Take Off's to support Estimate Reviews

To support the collection of major project element quantities, the 3D design model shall be structured to identify and quantify the following elements and values;

- Structural Concrete: Element type, volume, and dimensions
- Structural Steel: CISC shape identification and length

- Process Piping: System, nominal diameter, material and length
 - Pipe fitting: Type and count by system
 - Inline components: Type, PAIDS Tag, and count by system
- Major Equipment – Type, PAIDS Tag, and count by system.

Additional model processes can be developed to support project-specific quantity take off requirements. Quantity reporting processes shall be outlined in the project specific 3D Design Execution Plan and approved by Region of Peel Project Manager.

2.11. 'As-Recorded' 3D Model Deliverable

3D design deliverables issued for Tender (IFT), Construction (IFC) and As-Recorded phases shall include at a minimum:

- Bentley iModel files of each 3D model
<https://www.bentley.com/en/i-models/creating-i-models/creating-i-models>
- Federated model review files in the agreed software format
- 3D model files in their native authoring format

3D design model file submissions are required as set out in the 3D Design Execution Plan and approved by Peel Region's Project Manager.

3D design files shall form the basis for all 2D drawings generated from the models. Therefore, the 3D design must be updated to reflect all changes required in the corresponding 2D drawings. This process of maintaining alignment between the 3D model and 2D drawings will be consistently applied from design through to As-Recorded deliverables. All Requests for Information (RFI), Change Orders (CO), or As-Recorded changes shall be captured in the 3D Design model to provide accuracy of the 3D and 2D design deliverables.

2.12. 3D Design Level of Development

3D design models shall be sufficiently detailed to convey design intent. Level of model development (LOD) shall provide accurate geometry to generate contract drawings and support the specified 3D design uses outlined in this standard and / or the project-specific 3D Execution Plan.

In general, any modeled element should be developed to LOD300 as set out in the BIMForum 2019 Guidelines (<https://bimforum.org/LOD>). However, it is understood that not all designed elements will need to be modelled in 3D and it may be acceptable that some elements meet

lower LOD requirements. To identify these elements, an exemption list shall be outlined in the 3D Execution Plan and approved by Peel Region's Project Manager.

Design elements that cannot be modelled to LOD300, with the level of detail and information outlined in this Standard, shall be noted in the exemption list and assigned a corresponding LOD or 'Not Modelled' designation. Refer to LOD UnniFormat (Separate MS Excel file) for use when a granular element LOD definition is required.

It is the intent of this standard to give projects the flexibility to define a 3D design LOD that aligns with the scope and complexity of the project while covering the intended 3D Design uses outlined for the project and stipulated in this standard.

Figure 2-1. Level of Development (LOD) Descriptions


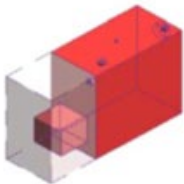



LOD 100	LOD 200	LOD 300	LOD 400	LOD 500
Conceptual	Approximate geometry	Precise geometry	Fabrication	As-built
				
The Model Element may be graphically represented in the Model with a symbol or other generic representation , but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square metre, etc.) can be derived from other Model Elements.	The Model Element is graphically represented in the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation.	The Model Element is graphically represented in the Model as a specific system, object, or assembly accurate in terms of quantity, size, shape, location, and orientation.	The Model Element is graphically represented in the Model as a specific system, object, or assembly that is accurate in terms of quantity, size, shape, location, and orientation with detailing, fabrication, assembly, and installation information .	The Model Element is a field verified representation accurate in terms of size, shape, location, quantity, and orientation.
	Non-graphic information may also be attached to the Model Element.	Non-graphic information may also be attached to the Model Element.	Non-graphic information may also be attached to the Model Element.	Non-graphic information may also be attached to the Model Element.

Figure 2-1 shows various Levels of Development for modeled elements. The LOD consists of a level of graphic detail and a level of information for each modeled element. To align with the 3D design uses outlined in this Standard, the following criteria should be utilized when developing 3D model content:

Level of detail:

- Accurate in Quantity, size and shape to align with the Design Basis components chosen for the project. Note: It is understood that Manufacturer specific components are not stipulated in tender packages and therefore, model elements may not be representative of the final installed components. In these cases, representative components chosen by the design team as the basis for design shall be modelled to LOD300 and used in the 3D design model.
- Accurate location and orientation as per project origin and referenced to geodetic coordinates described in this standard.

Level of Element Information:

- System flow stream identified per PAIDS standard
- Include Equipment Tag properties as per PAIDS standard.

2.13. General Drawing Setup and Units of Measure

The units of measure of the project are:

- Metre (m) coordinates and elevations.
- Millimetres (mm) for dimensions.

All sheet drawing files will be developed in the units specified above.

Border is referenced into the Default Workspace at the desired Drawing Scale.

All Deliverable Linework and Master File, Model File referencing is to be done in the Sheet Default Workspace.

Screening – Use Level Manager with ByLevel engaged for greyscale level.

2.14. Border Tag Sets

Once a border is attached to a sheet, Users will copy the outside shape extents into the active file. This procedure brings along a Tag Set (PEEL-Titleblock) that is tied directly to the sheet extents shape within the title block. Users will copy this shape 'In Place'. Once active, the User can turn off level **G-ANNO-TITL** from the referenced border file.

Color Code System for Checks, Modifications and Updates. Designers and Reviewers should adopt the following system when indicating revisions on hard copy plots or on electronic files.

ITEM

COLOR

Designer Approval (Checker)	Orange (Highlight)
Changes Completed (CADD)	Yellow (Highlight)
Questions (CADD)	Blue (Highlight)
Back Checked (Checker)	Green(Highlight)
Additions/Changes/Corrections	Red (Pen)
Deletes (Checker)	Green (Pen)
Notes/Instructions/Calcs	Black(Pen)GreyBackgroud
Remarks/Questions (CADD)	Blue (Pen)

2.15. Levels

All levels will be specific to Region of Peel Vertical CADD Standard (National CADD Standards **NCS** Based). All attributes used within CADD files will adhere to “ByLevel” associations, specifically colour, line weight and linestyles attributes. Therefore, Region of Peel Plot configs and Pen Tables will be utilized for output of deliverable documents.

2.16. Title Block Information

The following title block format shall be used on all drawings:

- First Line Facility
- Second Line Project Title
- Third Line Discipline
- Fourth Line Building Title/Sheet Title
- Fifth Line Additional Sheet Information

Example:

GE BOOTH WWTP
NEW PLANT 1 – CONTRACT X
DISCIPLINE
CONTROL ROOM PLAN AT EL. 200.00
ADDITIONAL SHEET INFORMATION

2.17. Border and Title Block

The project specific border/title block is as follows:

- **ANSI D size Border Drawing** – 863.6 mm X 559.8 mm (modified 34" x 22")

2.18. Annotation and Dimensioning

Annotation, dimensioning, patterns, general symbols and text styles will be according to Region of Peel Vertical CADD Standard. Do not drop dimensions! Please utilize Dimension Style (Peel Dim) and Text Styles (Peel-2.0, Peel-2.5, Peel-3.0, Peel-4.0 and Peel-5.0) included in the Peel Seed Files. Refer to Text Styles Section of this document.

2.19. Plotting to PDF

All drawing output will be to **Full Size** drawing (pdf). If required, reduce full size pdf to fit a 11" X 17" sheet for printing output. For Microstation, Users can utilize Print Organizer for batch pdf generation, employing a .pset as an output template. All .pdf's submitted for project work shall utilize Supplied Plot Configuration files and Pen tables that are set to a default 600 DPI for output.

Users shall plot all drawings for review or otherwise utilizing the .pdf plot driver (Peel_PDF.pltcfg), teamed with the proper pen table (Peel_PDF.TBL).

All engineering stamps will be applied upon approval of the Engineer & Architect and applied to each drawing per **Digital Sealing** practices. These submissions include Permitting, Issued for Tender (IFT) and Issue for Construction (IFC) unless otherwise requested.

Option

- ☒ Attached Cell Libraries
- ☒ Background Images
- ☒ Fonts
- ☒ Raster References
- ☒ Reference Files
- ☒ Rendering Data

The Region will require a proper As-built submission upon completion of project complete with digital files. This submission will include both the .PDF package in addition to the CADD files. CADD files will be packaged through the **MicroStation Packager** (Part of Microstation Connect). Packager maintains all reference files attached to the sheets, while including all data utilized for the project, to be compliant with the Region of Peel Vertical Standard, promoting project life-cycle management.

3. Drawing Numbering

3.1. File Naming, Drawing Number and Plan Number

File names and drawing numbers are assigned based on The Region of Peel standard. The Project number is issued by the Region. Drawing numbers will follow this format:

FFF-D-TLXX. dgn

Where:

FFF – Facility Code – 3 character (numeric) designation

D – Discipline Code - 1 character (numeric) designation

T – Type of Sheet – 1 character (numeric) designation

L – Level (Elevation) – 1 character (numeric) designation

XX – Variable - 2 character (alpha-numeric) designation.

3.2. Plan Number

Until drawings have been issued for Tender/Construction(IFC), Drawings will continue to show **XXXXXX-D** within the titleblock of the Microstation drawing. After Region of Peel review, the drawings be revised to include the assigned Region Plan Number **12345-D**. As an example:

50000-D_IFC.dgn, 50000-D_IFC.pdf

At this stage, drawing will continue to be named according the Drawing Number, maintaining all established cross referencing with said Drawing(s) Number. Each CAD file must be unique and will maintain all attached references and must be in true geodetic location.

Refer to the following sheets for a more in-depth illustration of Sheet and Master file naming conventions.

3.3. Discipline Order

Drawings shall be grouped by disciplines and ordered as presented in Table 3-1.

Table 3-1. Order of Disciplines

Designator	Description
G	General
C	Civil
L	Landscaping
S	Structural
A	Architectural
D	Process
P	Plumbing
M	Mechanical
E	Electrical
I	Instrumentation and Controls (I&C)
T	Telecommunications

3.4. Sheet Naming Convention

The sheet naming convention is shown in **Error! Reference source not found..**

3.5. Design Master File Naming Convention

The design Master File naming convention is shown in Figure 3-1.

REGION OF PEEL G.E. BOOTH WWTP Design Master - File Naming Convention																					
File Name Format T000976A-FFF-CSDSY-TLV.ext XXXXXXXXA- = Cima+ Project Number FFF = Facility or Process Code C = G.E. Booth Contract Number D = Discipline Designator C = Category S = Status T = Type LL = Level .ext = Extension																					
Facility / Process Code		Contract	Discipline Designator	Category		Status	Type	Level													
Project Number-	FFF-	C-	D-	C		S	T	LL													
Cima+ T000976A-	000 General 050 Site 055 Tunnel - Bob's Ct. 056 Tunnel - Casey's Ct. 057 Tunnel - Dennis' Dr. 058 Tunnel - Don's Pkwy. 059 Tunnel - Doug's Dr. 060 Tunnel - Glen's Dr. 061 Tunnel - Ed's Dr. 062 Tunnel - John's St. 063 Tunnel - Judy's Ct. 064 Tunnel - Julius Ave. 065 Tunnel - Mike's Blvd. 066 Tunnel - Otto's Alley 067 Tunnel - Pat's Ct. 068 Tunnel - Sam's Pl. 075 Storage Building 080 Guard House (Pre-Fabricated) 100 Preliminary Treatment 150 Primary Treatment 250 Aeration 325 Return Sludge Pumping Station 2 350 Secondary Treatment 450 Digestion 700 Solids 900 Advanced Treatment 999 Standard Details	1A 1B 2 3	G General C Civil L Landscaping S Structural A Architectural P Plumbing D Process M Mechanical E Electrical N Instrumentation	X 2D - Extraction - Master C Container Model R Review Model	N New Work E Existing Work D Existing to Demolish F Future Work T Temporary Work M Items to be Moved X Not in Contract 1 - 9 Phase Numbers	0 General (Legends, Notes) Schematics, Diagrams 1 Demolition Drawings 2 Plans 3 Elevations and Sections 4 Large Scale Views/Details 5 Details including Standard Details 6 Schedules 7 User Defined 8 User Defined 9 3D Representation (Isometrics, Perspectives, Photos, Images)	B3 Etc. B2 2nd Level Down B1 First Level Down 00 Ground Floor 01 First Level Up 02 Second Level Up 03 Etc. 04 05	Sequential: 01 = First in series in drawings sequence not to start with "00"													
<div>Example Filenames for Master/Models</div> <table><tr><th>Electronic File Name</th><th>Sheet Name on Deliverable</th><th>Drawing Description</th></tr><tr><td>T000976A-250-2-S-XN2B1.dgn</td><td>N/A</td><td>Aeration Facility Structural Basement Master Plan - Contract 2 - Microstation Master</td></tr><tr><td>T000976A-075-2-M-XN200.dwg</td><td>N/A</td><td>Storage Building Mechanical Ground Floor Plan - Contract 2 - Autocad Master</td></tr><tr><td>T000976A-075-2-S-XN301.dgn</td><td>N/A</td><td>Storage Building Structural Section 'A' - Contract 2 - Microstation Master</td></tr></table>										Electronic File Name	Sheet Name on Deliverable	Drawing Description	T000976A-250-2-S-XN2B1.dgn	N/A	Aeration Facility Structural Basement Master Plan - Contract 2 - Microstation Master	T000976A-075-2-M-XN200.dwg	N/A	Storage Building Mechanical Ground Floor Plan - Contract 2 - Autocad Master	T000976A-075-2-S-XN301.dgn	N/A	Storage Building Structural Section 'A' - Contract 2 - Microstation Master
Electronic File Name	Sheet Name on Deliverable	Drawing Description																			
T000976A-250-2-S-XN2B1.dgn	N/A	Aeration Facility Structural Basement Master Plan - Contract 2 - Microstation Master																			
T000976A-075-2-M-XN200.dwg	N/A	Storage Building Mechanical Ground Floor Plan - Contract 2 - Autocad Master																			
T000976A-075-2-S-XN301.dgn	N/A	Storage Building Structural Section 'A' - Contract 2 - Microstation Master																			

Figure 3-1. Design Master File Naming Convention

3.6. Sketch Drawing Number and Filename

At various stages of design, there may be a need to issue a sketch as part of the design process. Sketches are not considered project drawings. After tender, sketches will be issued based on changes/information, etc. These Sketches will reference back to the original contract document and include a reference to the deliverable file that it is referencing. Drawings will not be re-issued during the tending period, rather, only sketches will be provided. Therefore, it is of utmost importance for the CADD staff the confirm all changes/modifications/clarifications, etc., are captured in the model, extractions/dynamic view and deliverables

Sketch File names shall be as following example:

Sketch Title: **RFI-056-SK-01** (RFI #56, 1st Structural Sketch in series)

CAD File Name: **RFI-056-SK-01.dgn**

Sketches should be kept to a minimum and should be used in tandem with contract documents during the Tendering and Construction stages that include, **ADD** (Addendum), **FI** (Field Instruction), **RFI** (Request for Information, **CCO** (Contemplated Change Order), etc.

4. Revisions

The purpose of the following standards and procedures are to track changes to new and existing drawings. These apply to all drawings.

4.1. Revision Criteria

- All issued drawings shall adhere to the following revision numbering criteria. If there is no change to the drawing from one drawing issue to the next, but the purpose of the issue changes, that change triggers the revision value to increase. As an example:
- The drawing is issued for 60% review at revision C. There are no changes during review. The drawing would then be next issued at 90% at revision D.

4.2. Revision Description

All drawings being issued shall have the drawing border's 'Revision Description' area filled in with the 'Issued for' status, a description of the revision written horizontally (tag) beside the title block. As an example:

- ISSUED FOR TENDER

No previous issue information shall be removed from the drawing unless available space in the drawing border's 'Revision Description' area is required.

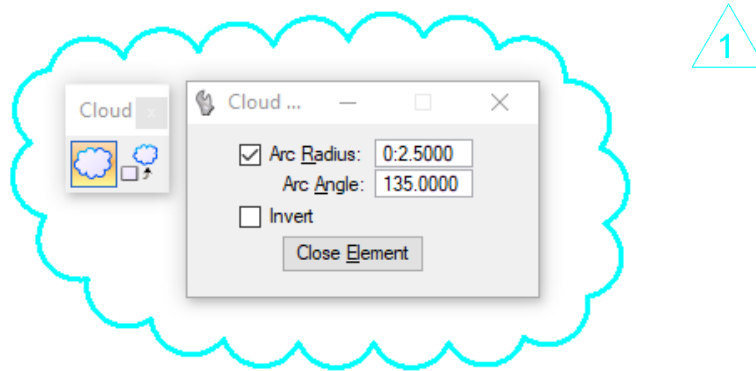
4.3. Revision Block Date Format

Date format on Revision block and drawing title shall be in MONTH for the general date. The revisions shall be in the **DD/MMM/YY** format.

4.4. Revision Triangles and Clouding

All changes on the drawing once tendered shall be flagged using clouding and revision triangles. Revision clouding from previous issues shall be removed from drawing prior to the next formal issue but the revision triangles will remain for all revisions. Users shall utilize the specific Clouding level isolated for this procedure: **G-ANNO-REV**.

All attributes are pre-set. Users can use the settings shown below or simply 'Smartmatch' or copy the example to the right of the attached border. Text size for the Revision Triangle is 2.5 mm per PEEL-2.5 text style.



4.5. Revision Numbering


For formal drawing issues before Tender and I.F.C. issue utilize alphabetical revisions starting with "A". All revisions following tender will be numerical starting with "0" with all previous to tender alphabetical revisions removed, as follows:

- A Issued for Review
- B Issued for 50% Client Review
- C Issued for 90% Client Review
- D Issued for 100% Client Review
- 0 Issued for Tender
- 1 Issued for Addendum NO. 2
- 2 Issued for Construction

5. Title Blocks

5.1. Title Block Data

Title blocks include: Project Information, Client Information, Subconsultant Information, Sheet Information, Revision Information, Package Information, and Production Data. For specific location of Title block tags/intelligent text, per the following examples shown in Figure 5-1

				
TITLE1 TITLE2 DISCIPLINE TITLE3 TITLE4				
Dwg No. XXX-XX-X-XXXX	Area	Project No. 17-2926		
Checked by X. CHECKER	Drawn by X. DRAWER	Plan No.		
Date OCTOBER 2018	Sheet XXX of XXX	XXXXXX-D		

<div style="border: 1px solid black; width: 80%; margin: 0 auto; padding: 10px;"> CONSULTANT LOGO </div>	

REVISIONS				
NO.	DATE	DESCRIPTION	BY	APVD
A	OCT 2018	ISSUED FOR REVIEW	X.X.	X.X.
B	OCT 2018	ISSUED FOR REVIEW	X.X.	X.X.
C	OCT 2018	ISSUED FOR REVIEW	X.X.	X.X.
D	OCT 2018	ISSUED FOR REVIEW	X.X.	X.X.
E	OCT 2018	ISSUED FOR REVIEW	X.X.	X.X.
F	OCT 2018	ISSUED FOR REVIEW	X.X.	X.X.

KEY PLAN (N.T.S.)

Figure 5-1. Examples of Title Block Data Formats

5.2. Sample Title Block

Figure 5-2 presents an example of “ANSI D” Size border.



Figure 5-2. "ANSI D" Size Border Example

6. Active Colour Table

The Microstation default colour table in Figure 6-1 **must** to be used so that the colours of reference file elements can be viewed correctly.

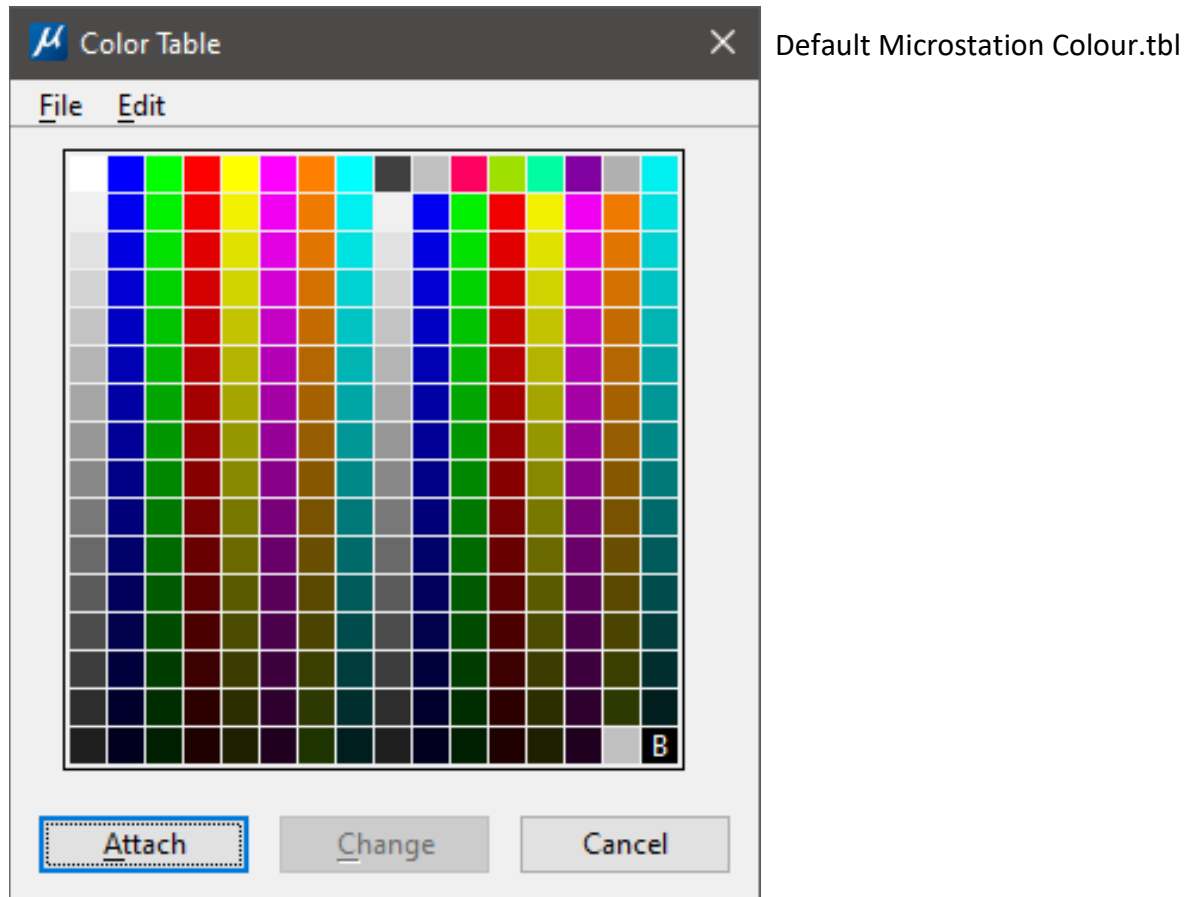


Figure 6-1. Colour Table

7. Working Units

Working units set the design file and accuracy. For reference file sharing, the scale and accuracy for all drawings must be equal. All projects in Metric Units (SI) unless prior approval has been given from the Region of Peel. All Civil based files will be dimensioned in meters (m). All other disciplined based drawings will be dimensioned in millimetres (mm) (except discipline specific Site Plans).

All drawings created from the Region of Peel Seed files will already have their geodetic location established. Any external files or files brought forward from legacy data shall be brought into this environment with no exceptions.

Design File Settings

Category

- Active Angle
- Active Scale
- Angle Readout
- Axis
- Color
- Fence
- Grid
- Isometric
- Locks
- Snap
- Stream
- Views
- Working Units**

Linear Units

Format: MU:SU

Master Unit: Meters Label: m

Sub Unit: Millimeters Label: mm

Accuracy: 0.1234 Custom

Advanced Settings

Resolution: 100000 per Distance Meter

Working Area: 9.0072E+07 Kilometers

Solids Area: 42.9497 Kilometers

Solids Accuracy: 4.29497E-07 Meters Edit

Focus Item Description

Select category to view.

OK Cancel

8. Reference Files

The reference file feature makes it possible to incorporate the work of other disciplines. By attaching other discipline work as a background and comparing it with the active design file

Reference files are design files that are actively linked to the working design. The attached files are not copied into the active design file, however, are displayed in the background. All Civil type drawings exist in true coordinates and should never be manipulated, scaled rotated, masked or copied. They cannot be modified, however, can have their displayed altered by either changing the ByLevel settings of the referenced file or by engaging level symbology overrides. Only in the Layout Space of the drawing may a Reference be Rotated, but by **View Rotation** only in order to satisfy drawing alignment by utilizing view rotation tools. Reference files should not be rotated, moved or scaled to satisfy aesthetic needs and **NOT** by the 'Rotate Reference' command found within the Reference Dialogue Box.

The effect and proper use of reference files will greatly reduce the time and effort required to prepare drawings. Using reference files also improved the coordination of the design/project wholly between disciplines and increases accuracy and consistency of the design. To ensure the success of using reference files, logical names and descriptions of each reference file should be employed.

9. Text Styles and Annotation

9.1. Text Styles

All project specific text (other than dimension text) must be placed on the appropriate Annotation level. All text shall be placed utilizing Arial Font specific to the Text Style.

All text within drawing files must be:

- Upper case
- Underline should not be used unless when being used within a cell specific to Sheet titles such as Plan, Section Elevation. Room names will also be underlined.
- All text sizes will be according to specific Text Styles. General Text shall be Peel-2.5 for all drawings. General Text should also be engaged when dimensioning for consistency.
- Text Styles shall always be employed as they govern justification, Line Spacing and any other attributes that control placement.

Figure 9-1 presents the text style standards.

9.2. Annotation

The Windows True Type font “Arial” shall be used for all annotation. Table 9-1 describes the standard text styles for use on all projects. In all cases the MicroStation style must include a height of “0” in the style definition so that appropriate scales and text sizes can be applied as needed. Adopting these text heights will help align CADD drawings with other project documentation (i.e. Word, Excel).

Table 9-1. Standard Text Style Definitions

Text Style	Used for	Font	Color	English Plotted Height	Point Sizes (MS Office)	Metric Plotted Height	Width
PEEL-2.5	Used for notes and all common text needs	Arial	ByLevel	0.098 in	7	3 mm	1.0
PEEL-4.0	Used for General and keyed Note Headers	Arial	ByLevel	0.157 in	14	4 mm	1.0
PEEL-5.0	Used for Title Blocks and to call out Objects	Arial	ByLevel	0.200 in	18	5 mm	1.0

GENERIC DRAWING TEXT
STYLE - PEEL-2.5
2.5mm, WT=1

ALTERNATIVE DRAWING TEXT
STYLE - PEEL-3.0
3.0mm, WT=1

GENERIC GENERAL/KEYED NOTE HEADER TEXT
STYLE - PEEL-4.0
4.0mm, WT=1

GENERIC VIEW LABEL/CALLOUT TEXT
STYLE - PEEL-5.0
5.0mm, WT=2

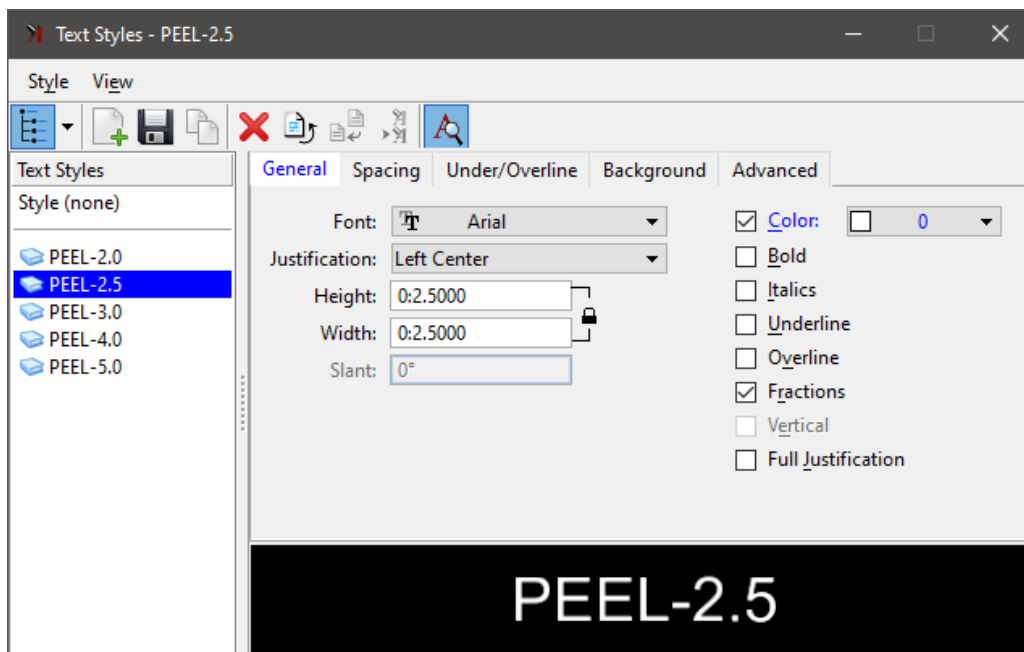


Figure 9-1. Text Style Standards

9.3. Note Rules

An example showing standards for notes is provided in Figure 9-2. The following rules shall be followed:

- Notes shall be located on the right side of the drawing.
- Capital letters shall be used for all notes and titles.
- Keyed notes may be used on plans.
- Keyed notes on sections and details shall not be used unless specified at the project level.
- Specification information shall not be duplicated by drawing notes, except where the information facilitates interpretation of the drawings. When possible, refer to notes on other drawings to avoid repetition.
- If single entities/lines of text: Start first string at least 6.3 5mm from border, left-justified note letter, then gap of at least 3.18 mm, then start new left-justified text string for body of note.
- If multi-line text: All text objects are contained inside its boundary. Try to keep the same spacing as above.

GENERAL NOTES

1. GENERAL NOTES APPLY TO ALL DRAWINGS WITHIN A PROJECT
2. ALL NOTES ARE INDICATED WITHIN NUMBERS, NOT LETTERS
3. THE TEXT STYLES FOR NOTE TITLE IS 'PEEL-4.0' AND SHOULD BE LEFT JUSTIFIED.
4. THE TEXT STYLE FOR THE BODY OF THE NOTES IS 'PEEL-2.5' AND ALSO LEFT JUSTIFIED
5. PROVIDE THE FOLLOWING SPACES:
 - 6mm FROM EACH SIDE OF THE BOUNDARIES
 - SINGLE SPACED BETWEEN CONTINUOUS STRINGS OF TEXT
 - DOUBLE SPACE BETWEEN NOTES IN MULTILINE TEXT BETWEEN (4.5mm) NOTES IN SINGLE LINE TEXT
 - A SINGLE 'TAB' SHALL SEPARATE THE POINT FOLLOWING THE NUMBER AND THE TEXT BODY ENTRY

GENERAL ARCHITECTURAL NOTES

1. GENERAL DISCIPLINE NOTES APPLY TO ALL DRAWINGS WITHIN THAT DISCIPLINE
2. TWO LINES OF TEXT MAY BE USED FOR HEADER IF NEEDED

GENERAL SHEET NOTES

1. GENERAL SHEET NOTES APPLY ONLY TO THE SHEET ON WHICH THEY APPEAR



SHEET KEYNOTES

1. SHEET KEYNOTES APPLY TO SPECIFIC DRAWING ELEMENTS ON THE SHEET THEY ARE LOCATED
2. A HEXAGON WILL BE USED TO DENOTE SHEET KEYNOTES

Figure 9-2. Example of Notes Format

Keyed notes shall follow the same rules as general notes except that they are indicated with a number value instead of a letter value.

For General Notes:

- Use text style "PEEL-4.0" for the title of general notes on a drawing. The title is underlined, and no symbol is used after the title.
- Use text style "PEEL-2.5" for all notes.
- General notes shall be indicated with numbers, not letters. The number designation is separate from the body of the note.

- Lines of general notes can consist of single entities of text or multi-line text. No period is used after each note's letter.
- General notes shall be single space and a double space exists between each new note.


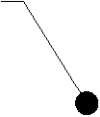
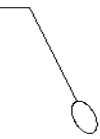
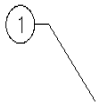



9.4. Leader Lines

All leaders can be found in specified locations based on the application platform. Use each leader style as appropriate for drawing clarity, as follow:

- The standard leader is the arrow.
- Use straight lines with appropriate termination.
- The line should be relatively short in length, and the line must point to the item being described by the note.
- Crossing dimension, extension, or other leader lines, as well as congested areas, should be avoided.
- If crossing dimension or extension lines is unavoidable, the leader shall be broken, not the dimension line.

Standard leader terminators are provided in Table 9-2**Error! Reference source not found..**

Table 9-2. Standard Leader Terminators

Name	Image	Description
Arrow		Most commonly used leader. This can be used anywhere.
Dot		Used to connect to a dimension that is too long to fit between dimension lines
Ellipse		Used to identify specific items. This is usually used to denote groups of piping or conduit.
Keynote		Used when an item needs to be tied back to a common text string (the Keyed Notes).
Loop		Used to identify specific items. This is usually used to denote groups of piping or conduit.
Tick		To be used only in tight spots where the filled arrow will not fit.
Tilde		Used to identify face of material

10. Dimensions

10.1. Dimension Styles

Figure 10-1 to Figure 10-5 provide general and discipline-specific dimension styles.

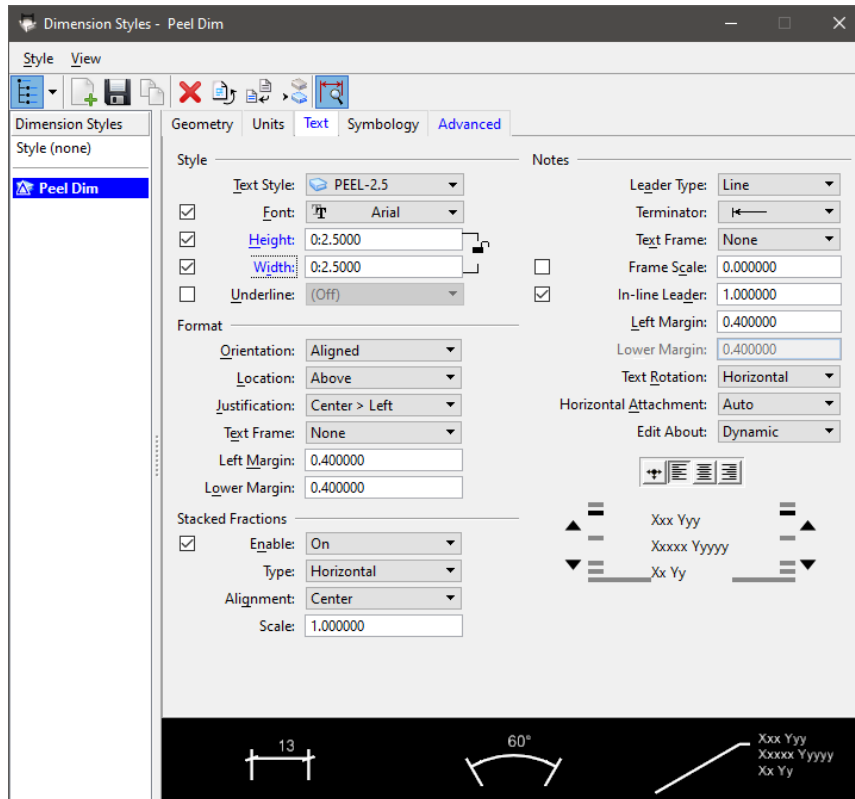


Figure 10-1. Dimension Text Style

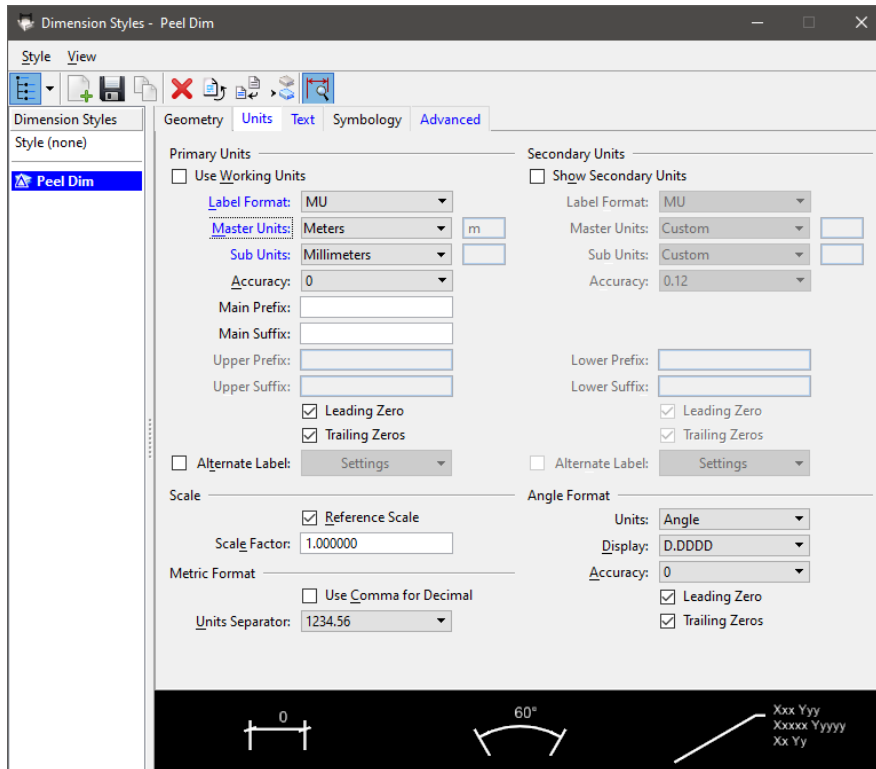


Figure 10-2. Dimension Style (Civil Discipline)

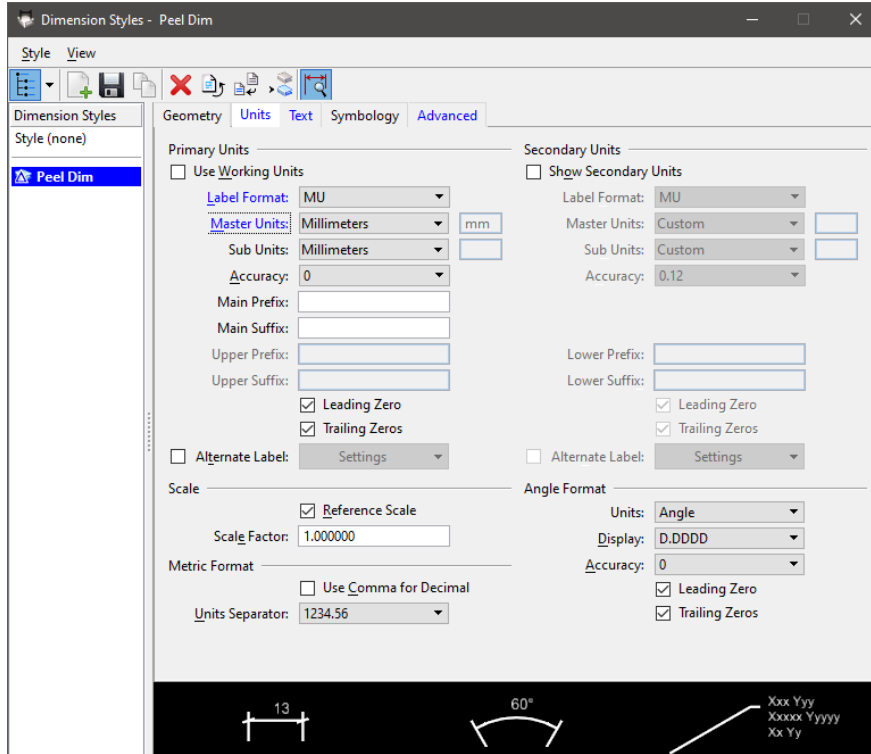


Figure 10-3. Dimension Style (All Other Disciplines)

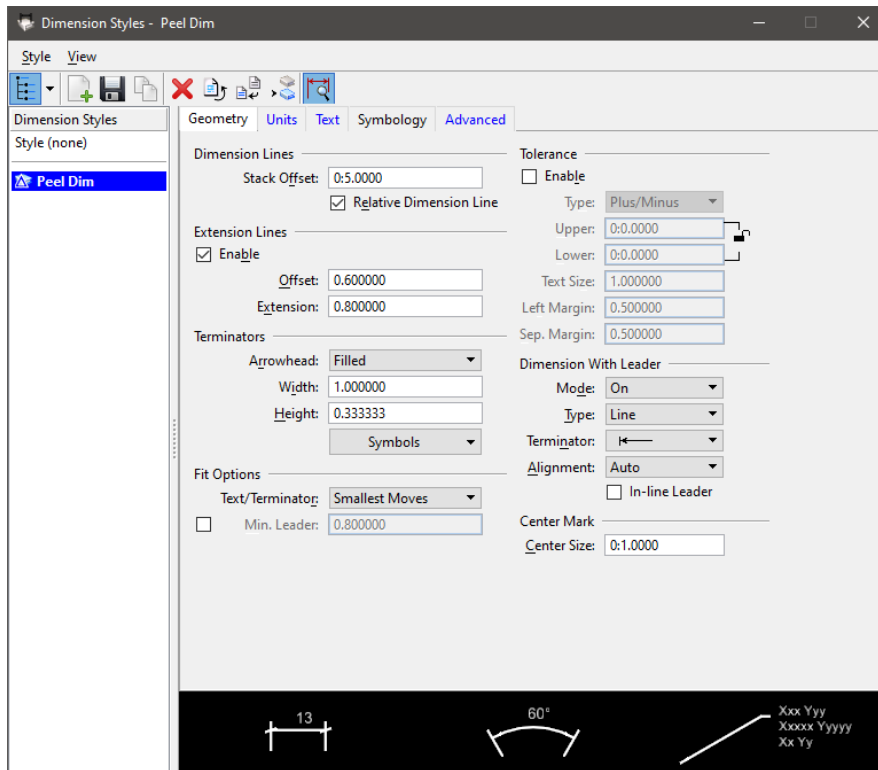


Figure 10-4. Dimension Style Geometry

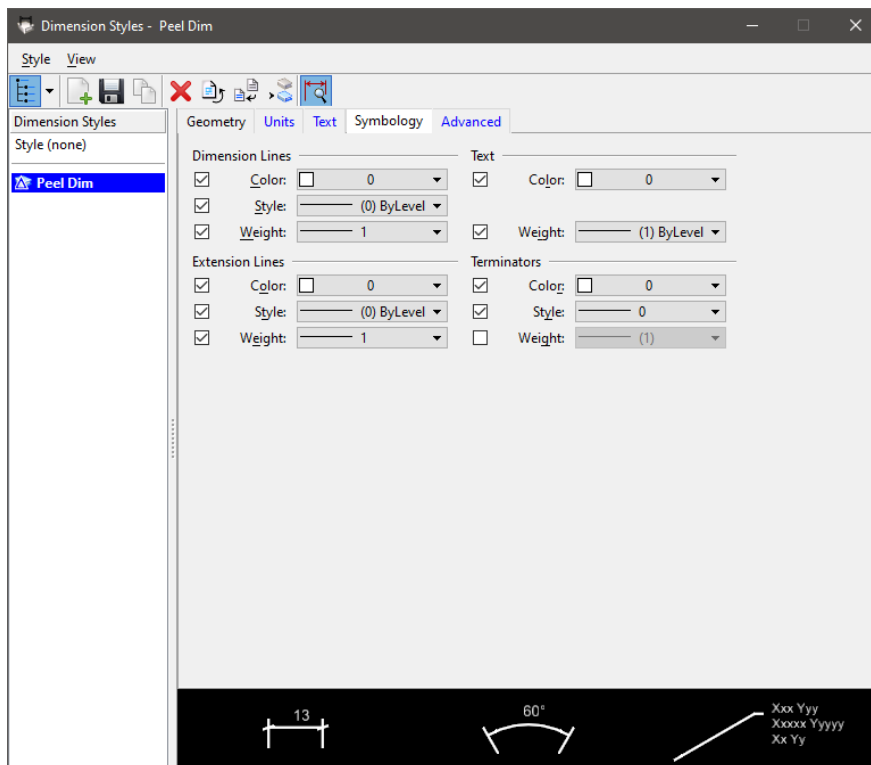


Figure 10-5. Dimension Style Symbology

10.2. Dimension Use Standards

The following provide guidelines for applying dimensions:

- Never drop dimensions!
- Dimensions less than 1 metre shall always be expressed in millimetres.
- Only in tight spots shall slashes be used instead of filled arrowheads.
- Metric dimensions shall be in millimeters. (There will be some exceptions, such as in Civil where meters are more appropriate because of the large distances. This shall always be noted on the drawing).
- When dimensions are taken from existing drawings, electronic files, or documents and used in new drawings, a note to field-verify shall be placed with the dimension or referred to in a general note. For example, “Contractor shall verify dimensions and conditions of existing construction before proceeding with his work.” Examples of where dimensions may be taken from include client-originated backgrounds, vendor equipment files, or drawings from major equipment suppliers, contractors, and surveyors.
- Dimensions “Not to Scale” shall be noted with notation NTS directly under the dimension text. Sections and details not drawn to scale shall be noted NTS below their title. Drawings not drawn to scale shall be noted “Not to Scale” in the title block.
- Avoid repetitious dimensioning. Where dimension lines continue, make sure only one line exists.
- Horizontal dimensioning slashes shall be oriented low end to high end and left to right. Vertical dimensioning slashes are to be oriented similarly as viewed from 90 degrees.
- Avoid adding leader lines to dimensions in already overcrowded areas.
- Avoid repeat dimensions or member sizes from view to view. Entering information in one place avoids possible errors in editing later. However, grid and datum dimensions on new sheets can be repeated if they will clarify important concepts to the contractor in the field.
- When possible, do not close dimension lines; That is, if you show an overall dimension, do not provide a complete string of dimensions below it.
- Show tolerance dimension when closure is necessary.
- Identify dimension datum point in all drawings.

10.3. Dimension Units

Dimension units are provided in Table 10-1.

Table 10-1. Dimension Units.

Name	Description	Unit Use
Peel-Dim	Meters – Decimal Style	Civil and Metric
Peel Dim mm	Millimeters – No Decimal	All other Disciplines

10.4. Dimension Settings

The following settings shall be used for applying dimensions:

- Dimension text shall be placed right-center-justified above the dimension line using the PEEL-2.5 text style. The text margin should be set to **1.6 mm**
- Secondary units are not shown unless required for multiple units of measure on a specific project.
- Angular dimensions shall be shown in degrees to 3 decimal points.
- Dimension lines use a stack offset of 9.5 mm.
- Dimension placement shall be aligned to the view and use automatic text location if available within the application.
- Use Reference Scale and Annotation Scale functionality in concert when dimensioning reference or master data within MicroStation
- Dimension tolerance settings for automatic generation of upper and lower plus/minus tolerances are typically off.
- Dimension Tool Settings can control the individual dimensioning components. The main settings for arrow-terminated dimensions are automatically display both left and right terminators, as well as left and right extension lines. The setting for the orientation of text should be standard, which indicates that text is placed horizontally in the dimension line. No prefix or suffix settings are used.
- Extension lines shall be set to Join with a connecting line when the dimension text falls outside the extension lines. The offset, the distance between the start of the extension line and the element, shall be set to 1.6mm. The extension, the distance the extension line extends beyond the dimension line, shall be set to 1.6 mm.

10.5. Methods Used for Dimensions

The following describe the standard methods that shall be used for applying dimensions:

- Location
 - Dimensions shall be associative, with line suppression for continuous dimension strings.
 - Locate dimensions outside the floor plan or other view being dimensioned, to minimize clutter and overlap with other graphics. Dimensions outside the view shall be located at the top and/or to the right side of the plans whenever possible.
 - Offset dimension lines 9.5mm.
 - When dimensions must be shown on the interior of a floor plan or other view, the dimensions shall be arranged in continuous strings for clarity and consistency.
- Types of Terminators
 - Terminators define the junction between a dimension line and the extension lines leading to the start and finish of the dimension. These terminators are in these forms: slash (slashes should always be parallel), *, arrowhead, dot, etc.
- Text Size and Location
 - Dimension text size shall match the size of the text in the drawing. Where possible, the dimension text shall be placed at the midpoint and on top of the dimension line.
 - Arrange dimensions from general to specific: dimension overall, then structural grid or floor-to-floor heights, then specific information such as window and partition locations/centerlines or heights of various building components.

An example of the use of dimensions is provided in Figure 10-6

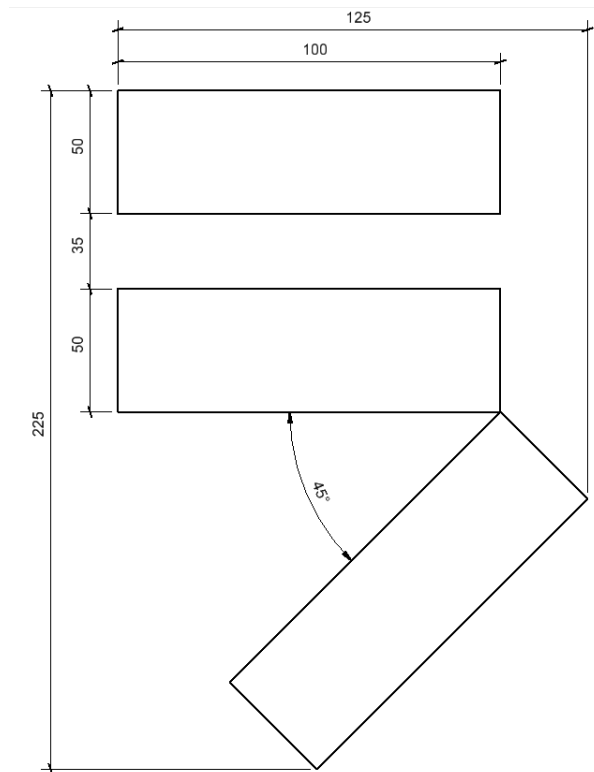


Figure 10-6. Example of Dimension Use

11. Hatching

Hatching is a series of dots, lines, or objects used in a pattern to identify the following:

- **Materials:** Types of walls (brick, fire, insulation, etc.). Also used in details and sections such as cross cuts, showing earth, gravel, concrete, etc. Basically, any material can have a specific hatch pattern.
- **Work areas:** Used to show sections of work to be completed or to be demolished. Hatch patterns can also be used on the key plan to denote a section of work to be completed.

If large areas need to be hatched, select smaller areas to keep readability at a maximum.

Default hatch patterns shall always be used, unless otherwise required by the clients such as civil applications where patterns are employed. If a client requires a pattern other than generic application patterns, the Region of Peel must approve prior to use.

12. Document/Sheet Set Organization

These are components of discipline sets. Each discipline is comprised of either common and/or unique types per discipline. Most have General, Plans, Elevations, Sections, Large-Scale Views, Details, Schedules & Diagrams, User Defined, and 3D Representations.

Each set will be comprised of the following:

- Cover/Title Sheet
- Vicinity Map, usually on Cover Sheet
- Location Map, usually on Cover Sheet
- Drawing Index Sheet with Drawings Revision Status
- Discipline Drawings (Refer to Table 11-1)/

Table 11-1. Discipline Drawing Subsets

Acronym	Discipline	Description
G	General	<u>General Informational</u> : List of sheets and symbols, code summary, symbol legend, orientation maps; <u>General Contractual</u> : Phasing, schedules, contractor staging areas, fencing, haul routes, erosion control, temporary and special requirements; <u>General Resource</u> : Photographs, soil borings
C	Civil	Structure removal and site cleaning; <u>Civil Survey (Site)</u> : Plats, topographic, dimension control; <u>Civil Grading</u> : Excavation, grading, drainage, retention ponds; <u>Civil Paving</u> : Roads, bridges, drives, and parking lots; <u>Civil Improvements</u> : Pavers, flagstone, exterior tile, furnishings, retaining walls, and water features; <u>Civil Transportation</u> : Waterway construction, wharves, docks, trams, railway systems, and people movers; <u>Civil Utilities</u> : Water sanitary sewer, storm sewer, power, and communications
L	Landscaping	Protection and removal of existing landscaping; <u>Irrigation</u> : <u>Planting</u> :
S	Structural	Protection and removal, Structural Site, Structural Sub-Structure, Foundations, Piers, Slabs and Retaining Walls. Structural Framing, Floor and Roofs
A	Architectural	<u>Architectural Site</u> : Protection and removal; <u>Architectural Elements</u> : General Architectural; <u>Architectural Interiors</u> : <u>Architectural Finishes</u> : <u>Architectural Graphics</u>
D	Process/Piping	TBA

Acronym	Discipline	Description
P	Plumbing	<u>Plumbing Site</u> : Extension and connections to civil utilities; Protection, termination and removal; <u>Process Piping</u> : Piping, valves, insulation, tanks, and pumps; <u>Process Systems</u> : Systems and equipment for thermal, electrical, materials handling, assembly and manufacturing, nuclear, power generation, chemical, refrigeration and industrial processes; <u>Process Electrical</u> : Electrical exclusively associated with a process and not the facility; <u>Process Instrumentation</u> : Instrumentation, measurement, recorders, devices and controllers (electrical and mechanical); <u>Plumbing</u> : Domestic water, sanitary and storm drainage, fixtures
M	Mechanical	<u>Mechanical Site</u> : Utility tunnels and piping between facilities; Protection, termination, and removal; <u>Mechanical HVAC</u> : Ductwork, air devices and equipment; <u>Mechanical Piping</u> : Chilled and heating water, steam; <u>Mechanical Instrumentation</u> : Instrumentation and controls
E	Electrical	<u>Electrical Site</u> : Utility tunnels, site lighting; Protection, termination, and removal; <u>Electrical Power</u> : <u>Electrical Lighting</u> : <u>Electrical Instrumentation</u> : Controls, relays, instrumentation and measurement devices
I	Instrumentation and Controls	TBA
T	Transportation	TBA

13. Discipline Codes

The list of discipline codes¹ presented in Table 13-1 represents the available options and should be referenced for all CAD-related activities, such as level and layer naming, file naming, and sheet naming.

Internally automated systems support the standardized codes shown in the table. Additional discipline codes may be adopted based on project needs, but they may not be fully supported by all internal systems, such as document management, procurement, or integrated design.

¹ Not all discipline codes are NCS compliant.

Table 13-1. Discipline Codes

Code	Description
A	Architecture
B	GeoTechnical
C	Civil
D	Process/Piping
E	Electrical
F	Fire Protection
G	General
H	Hazardous Materials
J	Life Safety
K	Packaging
L	Landscaping
M	Mechanical
I	Instrumentation and Controls
O	Operation
P	Plumbing
Q	Equipment (Machine Design)
R	Resources
S	Structural
T	Telecommunications
U	Industrial Planning
V	Survey/Mapping
W	Civil Works
Z	Contractor/Shop Drawings
NOTE M - Mechanical includes HVAC	

14. Document/Sheet Layout - Sizes

The table of sheet sizes shown in Table 14-1 represents a reference according to the NCS.

All Region of Peel Vertical projects shall use a full-size sheet of **ANSI D** (22"x34") size sheet based on appropriate units of measure. Half-size plotting shall be done on ANSI B (11"x17"). Sheet margin requirements are presented in Table 14-2

Table 14-1. ANSI Sheet Sizes

Type	Size	mm/Inches
A	Ansi A	215.9 mm x 279.4 mm
	Ansi A	8.5" x 11"
B	Ansi B	279.4 mm x 431.8 mm
	Ansi B	11"x17"
D	Ansi D	558.8 mm x 863.6 mm
	Ansi D	22" x 34"

Table 14-2. Sheet Margins

Margin	mm
Top, Bottom, Right	20 mm
Left	40 mm

15. Sketch Sheet Layout

Figure 15-1 represents an 8.5" x 11" border to be used for details and Sketches only. Also supplied with the Package will be an 11" x 17" border for Sketches only.



 		PROJECT TITLE 1 PROJECT TITLE 2 DISCIPLINE PROJECT TITLE 3 PROJECT TITLE 4			
		CONTRACT DRAWING NUMBER: XXX-XX-XXXX			
DATE: YYYY-MM-DD	DRAWN BY: DRAFTER	APPROVED BY: APPROVED	REVISION: 00	SCALE: 1 : XXX	STD. NO.: SK-XXX-X-XXXX PROJ. NO.

Figure 15-1. Sketch Sheet Layout

Ansi 'A' borders are specific for detail drawings, should they be required outside the contract documents package. Ansi 'A' (V-Vertical, H-Horizontal) and Ansi 'B' are specific to sketches. Sketches will be utilized during all Contract Document stages. Users will update the drawing accordingly and capture the changed data within the confines of a Sketch. This is to remove the need to regenerate full size drawings for small changes as contractors seldom have the use of a full size plotter on site as well as ease of .

15.1. Drawing Area

The drawing area is that portion of the sheet containing drawings, Keynotes, Key Plans, Schedules, and other graphic and text data necessary to illustrate the work. Should the drawing exceed the established Drawing Area, or the text on the drawing be too small to be legible, the users elect to utilize the similar 11"x17" Drawing Border in lieu of the 8.5"x11" border. Factors that may further influence the number and size of modules include sheet size, drawing scale, margins, title block area, client requirements and drawing legibility.

15.2. Key Plan

Location of Key Plan. Key Plans are needed to denote specific sections of work per sheet. A hatch pattern is typically used to show work in a specific area or Sector. Often the Key Plan can depict scope of work boundaries.

The Key Plan will usually consist of the following:

- Composite Plan
- The grid pattern for the building or plan
- Hatch pattern denoting area/scope of work.

15.3. North Arrows

Location of North Arrow. Might need to show a north and true north arrow if the site rotation is not north up. Location of North Arrow on Drawings, when possible, is pointing up and usually located on right side of sheet.

15.4. Graphical Scales and Titles

Graphical scales and titles are placed in the Non-Graphical Element Section

15.5. Schedules

If data must be placed in table formats, use the Schedule formats defined by the specific business group.

16. Cells

When engaging standards, use only Region of Peel Cell Libraries unless approved otherwise. Standard Cell libraries are included within the Region of Peel Vertical Standard CD/DVD.

The intent of cell libraries is to provide consistency across the entire design package by using duplicating standard symbols. Examples are provided in Figures 16-1 and 16-2.

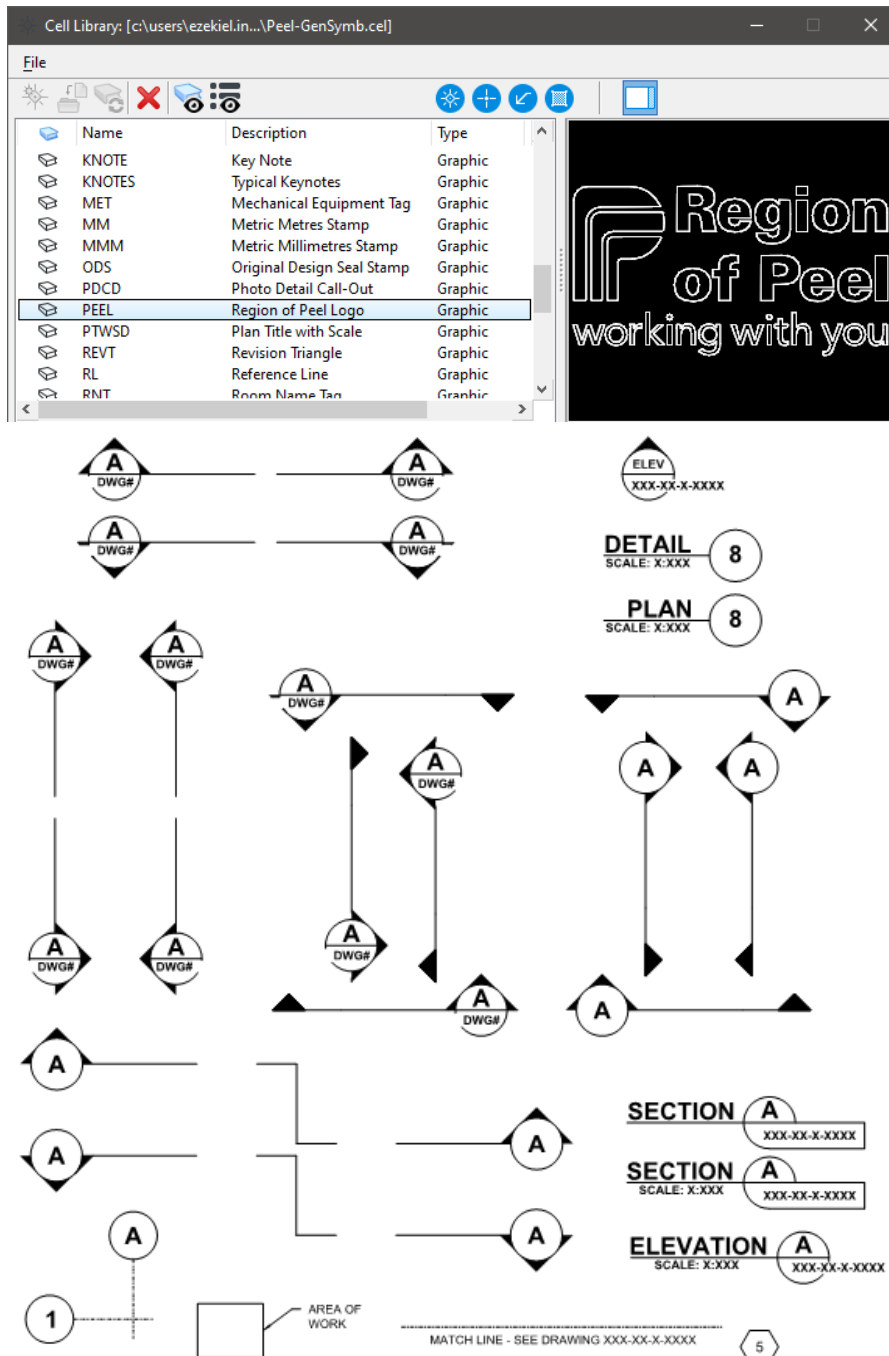


Figure 16-1. Examples of Cells

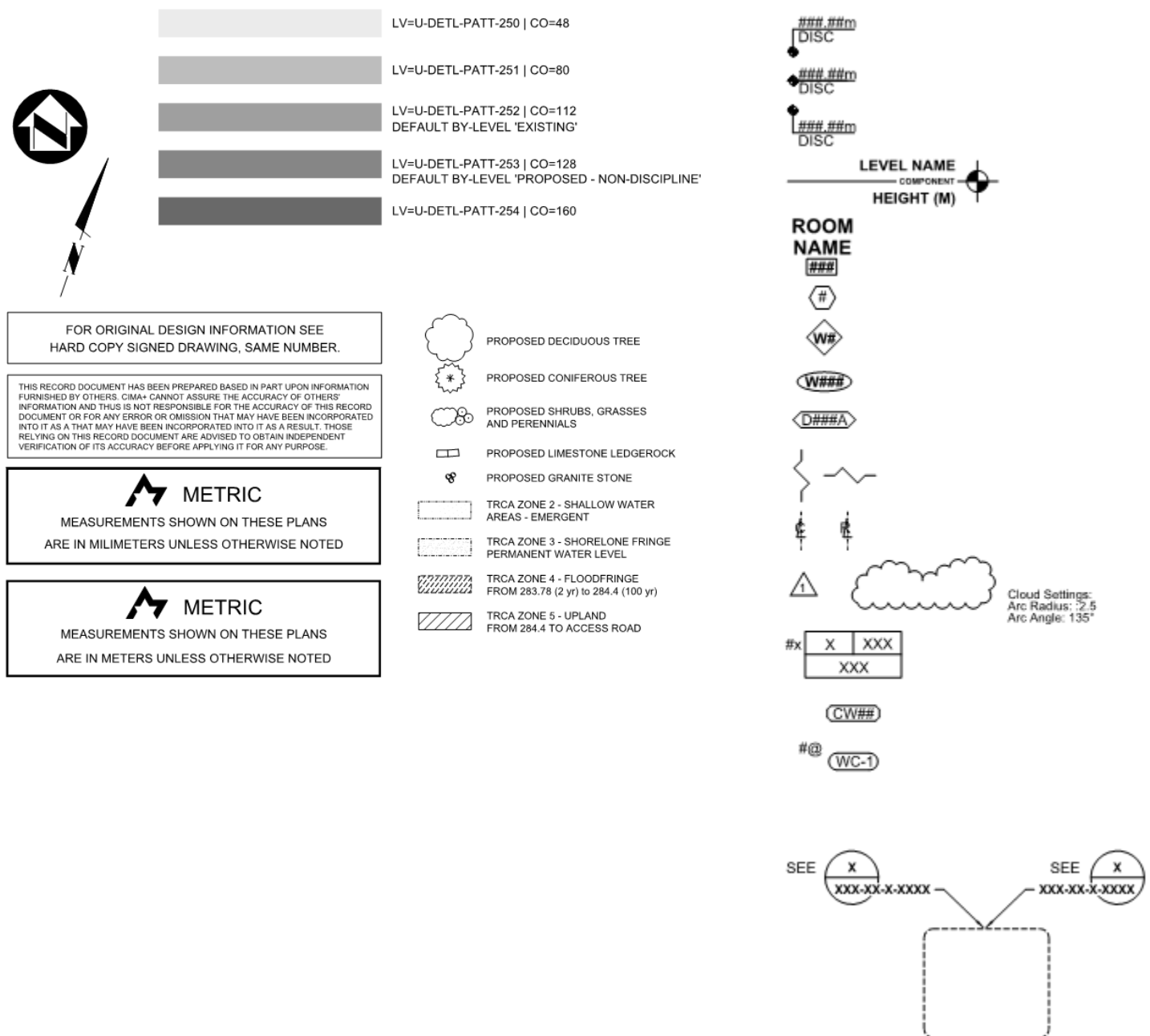


Figure 1-1. Examples of Cells (2)

17. File Definitions and Relationships

Figure 17-1 shows the relationship of master data stored within independent files, models, or model spaces, separated by discipline and referenced to a drawing layout or sheet.

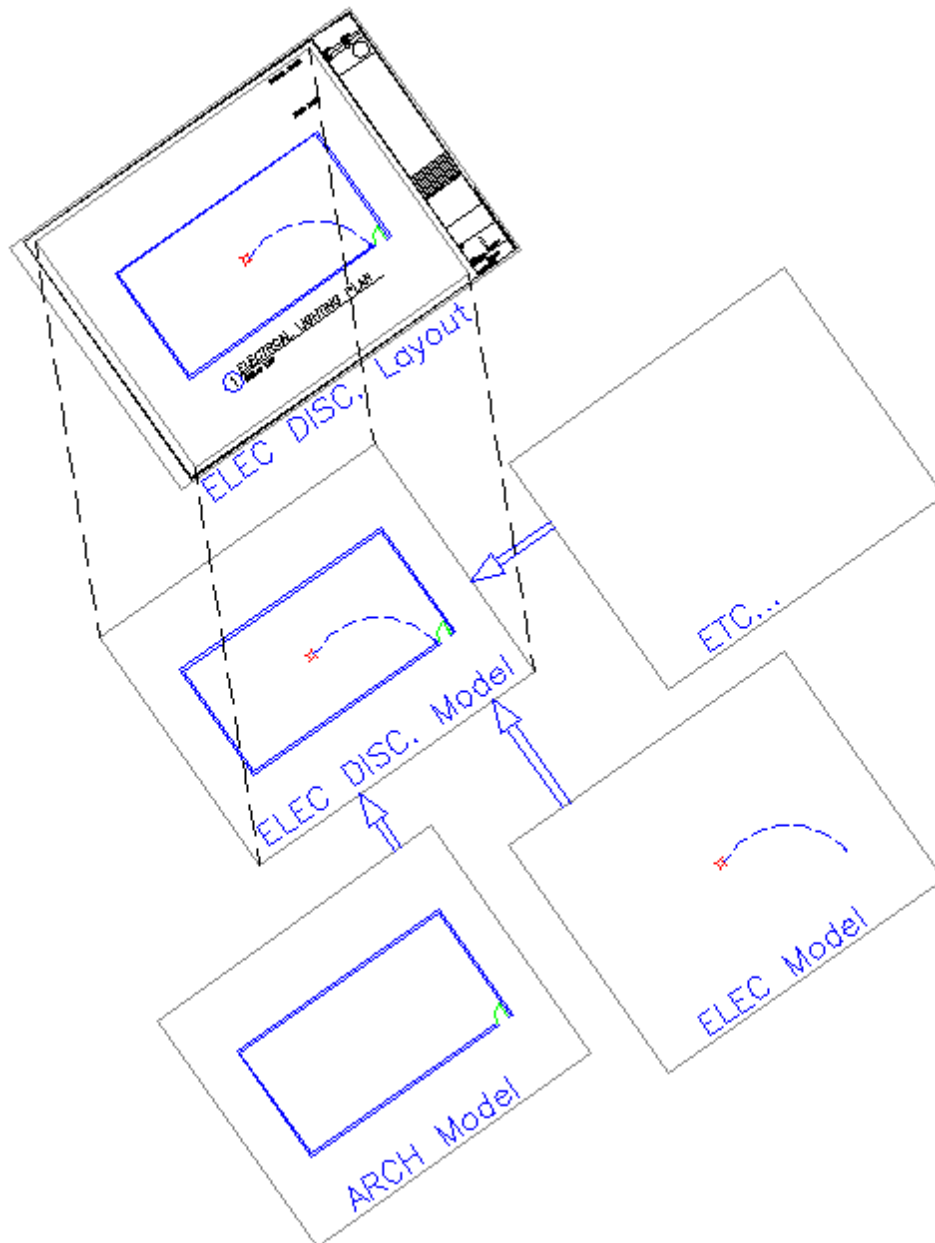


Figure 17-1. Illustration of Master Data Stored in Independent Files

17.1. Default Space & Model Definitions

The Default Space or Design Model refers to areas within CADD files that contain vector objects representing the main design data or a portion of design data. This is commonly referred to as master data and is generally separated and stored within individual files, or within the default space or 3D design models within a file. When working with 3D Model files it is important to separated design data adequately to ensure functional files sizes are maintained. At a minimum design data should be separated by discipline and then further as required.

17.2. Master Data Creation

Master data should be created and maintained from one location (file and default space) and referenced as necessary by other models, or from drawing layouts. Master data may include 2D-generated vector information, as well as 2D Views or extractions from 3D models. Master data should never be manually repositioned in the originating file. All master data should be created at true size, and at true position, which may be defined by the project as a state plane coordinate system or a plant/facility/area coordinate system.

17.3. Sheet Composition

CADD files also commonly include separate storage areas for drawing layout or sheet models that are intended to represent the construction drawing as it will be printed. The following guidelines represent the standard for composing construction drawings in the Microstation platform. It is understood that other 3D Design software solutions may handle Model and Sheet composition differently, however final 2D deliverables will need to follow the Microstation sheet composition structure described in this standard.

17.4. MicroStation Workflow

Sheet File

- Include information such as title blocks (inserted or referenced), key plans, notes, revision triangles and clouds, north arrow, text, dimensioning and patterning
- Reference the border/title block at the 1:1 for all drawings except those identified previously (Site Plans | Plan and Profile)
- Do not place extraneous information/Notes etc. outside of the border cut line.
- Apply appropriate clipping boundaries to each attachment.

17.5. Referencing

Referencing master data is critical for proper coordination between disciplines, as well as ensuring that the most up-to-date information is being used by the entire project team throughout design and construction drawing preparation. Common CADD applications support file/model referencing, and the guidelines below enable useful and streamlined referencing.

- Keep reference data portable. Do not reference files using a saved full path specification, regardless of the location of the file. Always use available project environment variables that have been defined when attaching reference files or models.
- Do not copy reference data directly into a construction drawing or another design model unless:
 - It will be used to represent an enhanced detail figure specifically for that drawing
 - It will be used as a template to create other, similar objects in the design model
- Position reference data within the default space at real world coordinates.
- Position the attached referenced border by moving it within the Default Space and scaling it to agreed upon scale. The **view** may be rotated to align properly to the screen (delta x,y) **Do not** rotate the reference files.
- Position multiple views to be shown on the same sheet by creating additional references between the sheet model and the design model (MicroStation) or by creating multiple view ports (MicroStation).
- Use clip boundary (MicroStation) or a view port (MicroStation) for limiting the amount of master data required for display within a drawing.
- Use a clip mask (MicroStation) or wipeout entity (MicroStation) to eliminate specific reference data from display within the drawing as needed. Master data that may not be appropriate for display includes redundant or unnecessary peripheral data that may cause confusion when reading the drawing.

17.6. Raster Data

Raster data is defined as files that are scans or images that represent either pictures of engineering documents, aerial photos, or other representative images of engineering information. These Raster data files can be in a variety of file formats in either black and white line art style or a full color photograph, that can be either completely scalable or not at all to scale. The mix of these characteristics depends on the specific information requirement necessary to represent the concept on the deliverable documents.

Typically, these raster data files are attached or inserted as references to the deliverable documentation, then sized or scaled to adequately represent the content. It is then possible to overlay what is called vector graphics or line art over the raster data to better describe the condition or trace over information represented in the raster data for clarity.

In some cases, the raster data is then removed, leaving only the vector graphics.

In some cases, the raster data and vector graphics will be worked as one unit, typically called a hybrid drawing.

18. Document/Sheet Conventions

18.1. MicroStation Units

The unit of measure of the project determines the format in which design information will be entered and displayed within the application.

Within MicroStation the unit definitions imply a system of measurement by inferring a base unit. Engineering or Architectural units shall be selected for all projects based on the readout differences. Specifically, Civil Site Plans, Plan and Profile drawings will utilize metres (m), where all other disciplines will utilize millimetres (mm) as their default units of measure. Peel dimensioning Style can be simply modified to satisfy this Unit change

Within MicroStation the unit of measure is defined using a unit label and a numeric definition, as shown in Table 18-1. Standard units are supported by default and the following list describes available options for project needs.

Table 18-1. MicroStation Unit Definitions

Label	Name (SI Metric Units)
mm	millimeter
cm	centimeter
dm	decimeter
m	meter
dam	dekameter
hm	hectometer
Km	kilometer
English Units (based on International Foot)	

18.2. Scales

The drawing scale is the ratio of measuring units expressing a proportional relationship between a drawing and the true size of the item it represents. The selection of the proper scale determines the readability of the drawing. The scale chosen should be large enough to allow the drawing to display its graphic, dimensional, and textual content clearly, without congestion or ambiguity. (Reference NCS UDS-06.00).

Definitions:

- Drawings shall be created at full size and plotted at the appropriate size for the project.
- Always plot the output PDF's to the sheet scale for full size output. Do not plot drawings to half-scale. Always reduce the full-size output .pdfs to a half size.
- Multiple scales shall not exist on a single drawing. If this cannot be avoided, use graphic scales to define each figure or design component requiring a different scale. Titleblock should read AS SHOWN where the scale callout is read.
- Graphic elements within the drawings, such as notes, leaders, dimensions, reference indicators, and other scale-dependent symbols must be sized according to the scale of the final plot.

Graphic Scales:

Figure 18-1 shows graphical representations of the scale normally appearing on drawing sheets. The use of a graphical scale bar, or scale text accompanying a detail title, is intended to denote distance and specify varying scales of a single drawing.

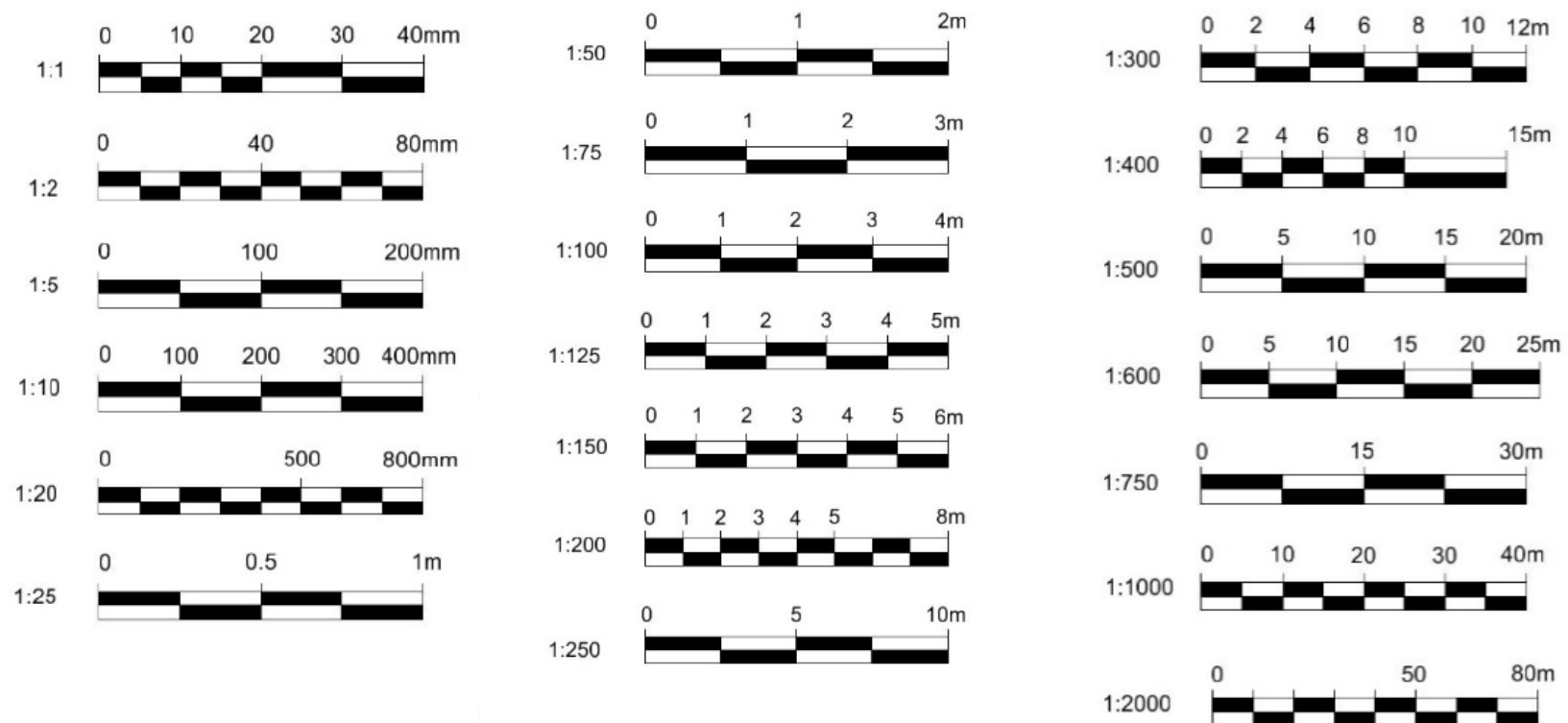


Figure 18-1. Drawing Sheet Scales

Common Scales Used on Construction Documents:

Table 18-2 represents the most common/traditional scales for purposes of information and illustration. It is not meant to be a complete list because special circumstances may require the use of non-traditional scales. (reference uds-04.11 for additional information. Refer to that section of the ncs.)

Table 18-2. Common Scales Used on Construction Documents

Metric	Value	Arch.	Value	Eng.		Value	Typical Uses
1:250000	250000	-	-	-		-	Site Plan
1:100000	100000	-	-	-		-	Site Plan
-	-	-	-	1"=5000'		60000	Site Plan
1:50000	50000	-	-	-		-	Site Plan
-	-	-	-	1"=2500'		30000	Site Plan
1:25000	25000	-	-	-		-	Site Plan
-	-	-	-	1"=1250'		15000	Site Plan
-	-	-	-	1"=1000'		12000	Site Plan
1:10000	10000	-	-	-		-	Site Plan
1:5000	5000	-	-	1"=500'		6000	Site Plan
-	-	-	-	1"=400'		4800	Site Plan
1:4000	4000	-	-	-		-	Site Plan
1:3000	3000	-	-	-		-	Site Plan
1:2500	2500	-	-	1"=200'		2400	Site Plan
1:2000	2000	-	-	-		-	Site Plan
1:1250	1250	-	-	1"=100'		1200	Site Plan
-	-	-	-	1"=60'		720	Site Plan
1:1000	1000	-	-	1"=50'		600	Site Plan
1:750	750	-	-	-		-	Site Plan
1:500	500	-	-	1"=40'		480	Site Plan
1:400	400	-	-	-		-	Site Plan
-	-	1/32"= 1'-0"	384	1"=30'		360	Site Plan
1:300	300	-	-	1"=25'		300	Site Plan
1:250	250	-	-	-		-	Site Plan
1:200	200	1/16"= 1'-0"	192	1"=20'		240	Floor Plans, Exterior Elevations, Building Sections, Overall Plans
-	-	3/32"=1'-0"	128	-		-	
1:150	150	-	-	-		-	
1:125	125	-	-	-		-	
1:100	100	1/8"=1'-0"	96	1"=10'		120	Floor Plans, Exterior Elevations, Building Sections, Sector Plans
-	-	3/16"=1'-0"	64	-		-	
1:75	75	-	-	-		-	

Metric	Value	Arch.	Value	Eng.		Value	Typical Uses
1:50	50	1/4"=1'-0"	48	1"=5'		60	Floor Plans, Exterior Elevations, Building Sections, Sub-sector Plans
1:30	30	3/8"=1'-0"	32	-		-	Interior Elevations
1:25	25	-	-	-		-	
1:20	20	1/2"=1'-0"	24	1"=2'		24	Enlarged Floor Plans, Wall Sections, Foundation, Footing, Others
1:20	20	3/4"=1'-0"	16	1"=2'		-	Enlarged Floor Plans, Wall Sections, Foundation, Footing, Others
1:10	10	1"=1'-0"	12	1"=1'		12	Wall Sections, Foundations, Footing, Intersections of walls and roof to walls, Connections, Others
1:10	10	1-1/2"=1'-0"	8	1"=1'		-	Wall Sections, Foundations, Footing, Intersections of walls and roof to walls, Connections, Others
1:5	5	3"=1'-0"	4	-		-	Door and Window Details, Cabinet Details, Intersections of roof to walls, Others
1:2.5	2.5	-	-	-		-	
1:2	2	6"=1'-0"	2	-		-	Door and Window Details, Cabinet Details, Intersections of roof to walls, Others
1:1	-	Full Size	1	-		-	Door and Window Details, Cabinet details, Intersections of roof to walls, Others

19. Line Work

19.1. Description of Use

- The intent of the drawing shall determine which elements of the drawing should receive major emphasis. These elements should stand out compared to items of lesser importance.
- Major construction lines (new work) shall be a medium continuous line, heavy enough to contrast with all other line work.
- Existing work to remain shall be indicated by a fine line, screening, or notation.
- Existing work to be removed shall be indicated using screening, a hatch pattern, or by notation.
- Existing work to be moved shall be indicated by a dashed line and notation.
- Existing work to be relocated shall be indicated by a dashed line and notation.
- Temporary work shall be indicated by a dashed line and notation.
- Future work shall be indicated using a thin phantom line, or by notation.
- Dimension lines, leader lines, arrowheads, etc. shall be simple and sharp, with the point placed so as to avoid misinterpretation. All arrowheads shall be filled.

19.2. Styles

Figure 19-1 shows line style examples. Standardized Microstation line styles, as shown below in , shall be used when possible. Other line styles may be utilized from the supplied library and mapped directly through the .dgnlib. Should a specific line style outside of the supplied standards be required, users will contact the Region of Peel for approval prior to implementing into their project work.

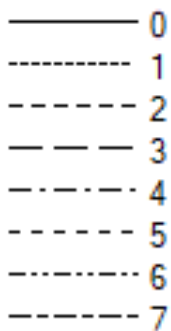


Figure 19-1. Example Line Styles

Common lines styles are shown in Table 19-1and complex line styles are shown in Table 19-2. Line weights are presented in Table 19.3.

Table 19-1. Common Line Styles

Line Style	Description
Hidden2	-----
Hidden	-----
Dashed	— — — — —
Center2	— — — — —
Dashed2	-----
Phantomx2	— — — — —
Centerx2	— — — — —

Table 19-2. Complex Line Styles

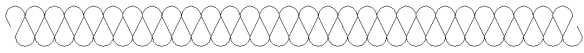


Line Style	Description
Batting	
Fenceline1	
Gas Line	— GAS — GAS — GAS —
Hydraulic	— X — X — X — X — X —
Welded	— x — x — x — x —
Pneumatic	— // — // — // —
Sonic	

Table 19-3. Line Weights

NCS Object Description	NCS Type
Material Indications, Surface Marks, Hatch Lines, Patterns	Fine
Dimension Lines, Leaders, Extension Lines, Break Lines, Hidden Objects, Dotted Lines, Dashed Lines, Setback Lines, Center lines, Grid Lines, Schedule Grid Lines	Thin
Object Lines, Property Lines, Text, Lettering, Terminator Marks, Door and Window Elevations, Schedule Grid Accent Lines	Medium
Title, Edges of Interior and Exterior Elevations, Profiling, Cut Lines, Property Lines, Section Cutting Plane Lines, Drawing Borders	Wide
Match Lines, Large Titles, Footprints, Title Block Borders, Sheet Borders, Schedule Outlines	Extra Wide
Major Title Underlining, Separating Portions of Design	XX Wide
Border Sheet Outlines	XXX Wide
Cover Sheet Line work	XXX Wide

19.3. Color

The ability to graphically segregate systems, components, or other objects into a range of colors for ease of use can be defined for two distinct uses:

- 2D/3D
- Types of modeling where certain limitations in existing palettes create a problem because of the inability to achieve the necessary segregation in colors.
- Presentation

Use of color to illustrate design characteristics for finished product.

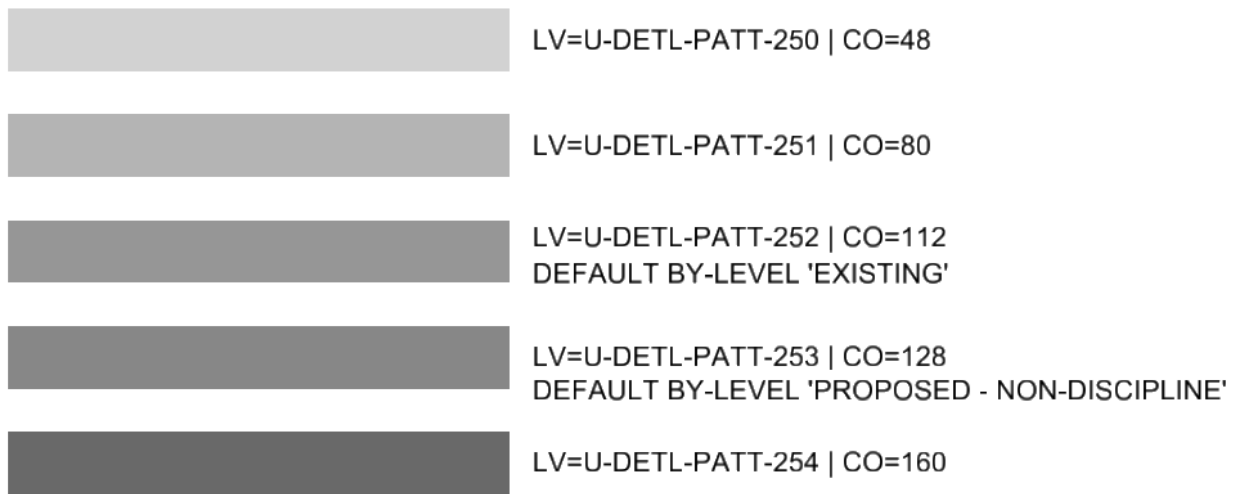
19.4. Screening

Screening involves the use of halftones to deemphasize portions of a design. Screening can be applied as necessary to any area or reference information not essential to the current design, and is often used to show:

- Architectural or Structural backgrounds on a Mechanical drawing – Colour Number 128
- Work by other trades or work done under separate contracts – Colour Number 80
- Existing objects or earlier phases of construction – Colour Number 112.

Screening tones are depicted in Figure 19-2.

Figure 19-2. Screening Tones



20. Level Standards

20.1. Level Standards

Layer/level naming conventions are shown in Figure 20-1.

BASE										OPTIONAL – Disc. - Comm. Modifiers / Status												
P	-	P	A	I	R	-	O	F	D	A	-	P	I	P	E	-	I	D	E	N	-	N
Discipline Designator	Separator	MAJOR (System)				Separator	MINOR (Component)				Separator	MINOR (Discipline Modifier)				Separator	MINOR (Common Modifier)				Separator	Status
REQUIRED						OPTIONAL																
P	-	P	A	I	R																	
P	-	P	A	I	R	-	N															
P	-	P	A	I	R	-	O	F	D	A												
P	-	P	A	I	R	-	O	F	D	A	-	P	I	P	E							
P	-	P	A	I	R	-	O	F	D	A	-	P	I	P	E	-	I	D	E	N	-	N
Modifier Use																						
DM = Discipline Modifier CM = Common Modifier S = Status Modifier N = Not available for level.						N					DM					N					N	
						CM					CM					CM					N	
					S					S					S					S		
P	-	P	A	I	R																	

Figure 20-1. Layer/level Naming Conventions

20.2. Description of Modules

Refer Figure 20-1 for details associated with creating new layer/level names².

² Reference NCS CLG-1 - 93

- Discipline Designators: Same as defined in Discipline Codes Section
- Identifies the discipline to be used (ex: M = Mechanical) Major (System): Identifies a major system type (ex: EXHS = Exhaust)
- Separators: Identifies the type of item used to separate each group. (ex: - = Dash)
- Minor (Components): Identifies a sub-type of the system often called a component. (ex: ACID = Acid)
- Minor (Discipline Modifiers): Identifies only items that can be used by certain disciplines (ex: PIPE = Piping)
- Minor (Common Modifiers): Identifies items that can be used by all disciplines (ex: IDEN = Identification)
- Status: Identifies the status or phase of the layer/level (ex: N = New)

20.3. Symbols

Symbols are objects that are managed and used by some or all of the disciplines. These symbols follow a basic pattern:

- All graphic content within the cell must reside on layer “0.” This allows a symbol to assume the attributes of the layer it is going to be inserted on.
- Text/Attributes must reside on a defined layer. This allows these objects to assume the correct layer assigned to the block’s text value.
- No other layers shall be assigned or used.
- Blocks shall be purged of all nonassigned entities.
- All line weights and colors are to be “ByLevel.”

Define Use of Symbols:

- Organization: Symbols shall be organized into libraries or library areas by discipline using descriptive names.³
- Symbol Definition: A symbol is a graphic representation of an object or of a material that represents something else by:
- Association

³ Symbols not organized according to NCS conventions.

- Resemblance
- Convention

Symbols used in drawings shall be scale-dependent, independent, or both.

Scale:

- Scale-dependent: Actual printed size of the symbol depends on the scale of the drawing or view of the model
- Scale-independent: Actual printed size of the symbol is consistent no matter what the drawing scale. Its size is related only to its clarity and interpretation.
- Symbols used in drawings are constructed of various line widths. The following list is an example of standardized line weights of symbols:
- Existing objects and material symbols shall be drawn with a thin line or can be screened
- New objects shall be drawn with a medium line
- Objects to be demolished or removed shall be drawn with a medium dashed line

Classification:

Block or cell content is comprised of the types shown in Figure 21-1:⁴

⁴ Reference NCS UDS-06.1 - 06.187

Identity	Valves	Fire Alarms	Light Fixtures	Elec. Outlets		
Line	Single	Double	Utility Lines			
Material Sec. Det. Elev	Earth	Concrete	Stone	Wood	Steel	
Object	Door	Door w/swing	Windows	Toilet fixtures	Furniture	
Reference	Elevation Indicators	Section Indicators	Detail Indicators	Drawing Block Titles	Graphic Scales	
Reference Continued	Window Identifier	Keyed Note Identifier	Leaders	Match Lines	Revision Clouds	North Arrows
Text	Text					
	Single or Multiple lines of text in block form					

Figure 21-1. Types of Symbols

22. Plotting

22.1. Output Tables

Figure 22-1 is a reproduction of the table presented in the NCS⁵ defining the relative appearance of line work on plotted drawings. It is the basis for the plotting configurations defined from this point forward.

Design Weight	Print Width
0	0.169 mm
1	0.375 mm
2	0.5 mm
3	0.625 mm
4	0.75 mm
5	0.875 mm
6	1 mm
7	1.125 mm
8	1.25 mm
9	1.375 mm
10	1.5 mm
11	1.625 mm
12	1.75 mm
13	1.875 mm
14	2 mm
15	2.125 mm

Figure 22-1. Relative Appearance of Line Work on Plotted Drawings

22.2. Raster Images

Raster images may be included on plots similar to that previously described under Raster Data, and also for the purposes of simple illustration or to represent a client logo on a border. Raster images cannot be screened back at plot time, and they do not inherit the line weight or color values related to plotted output.

Appropriate image quality and density should be determined for the required use. Refer to best practice documentation on image handling techniques and workflows and hardware- related constraints.

⁵ Reference UDS-04.14.
Region Vertical CADD Standards-V1.3 201116.docx
2020-11-18

Using raster images will certainly increase the relative size of the plot "file" output and may result in a much longer per-plot generating and processing time.

22.3. Screening Methodology

Screening or halftoning line work graphics may be necessary to emphasize certain aspects of a design, typically by screening the background objects "behind" or surrounding the desired subject.

Appropriate values within the pen tables used in plotting have been assigned to allow this to occur. It will be necessary to reassign the symbology of screened objects to the appropriate color index value defined in the tables for plotting. The values are a close approximation of a halftone that will still produce a first or second generation copy of the original and still retain the desired appearance. This in no way implies a guarantee that the document appearance will survive any combination of reproduction attempts on mixed hardware. The intent of screening is always to produce the appropriate appearance on original drawings. With the advent of the use of PDF and rasterize outputs, it is possible to create an electronic representation that may meet the requirements of a later generation of paper originals. Refer to documented best practices for signing and sealing electronic documents.

22.4. Black and White

The output tables are for reference only, to illustrate the relationships between the content generated in traditional CADD applications and the resulting plotted line thicknesses. For the most part, the user will have no active role in choosing the actual implementation of these values but may have a role in determining the choice of value used for certain symbols. The actual output will vary somewhat from device to device and may have slightly different actual values on the printed media.

All levels use a color, weight, and line style setting applied through a ByLevel assignment.

22.5. Color

The colors defined in the Plotted Output table represent strict NCS color standards and are presented only for reference. Projects will typically address color plotting needs using a WYSIWYG method, allowing for the use of color as necessary to differentiate designs for specific presentations.

Color output may vary between devices.

Three types of color plotting are supported in the current Standard:

- **NCS** - Limited available colors for use based on black, halftone/grey, gold, olive, green, forest green, blue, navy, purple, red, and magenta.

- Groups of colors are separated by black and halftone/grey color assignments.
- **WYSIWYG** – The use of standard palettes as defined by the delivered application. The onscreen colors will translate into the closest plotted representation of each color.
- Industry Standard Color Books or Palettes – The use of extended color palettes to achieve a wider range of plotted colors. The onscreen colors will translate into the closest plotted representation of each color.

22.6. Color Table

The color table was established to accommodate both 3D modeling and 2D drawing production. The following considerations for the color table should be followed:

- Begin with a Pantone color palette.
- Include a spectrum of earth tones and pastels.
- Provide a selection of earth tones to accommodate basic visualization requirements.
- Provide a range of pastel colors to allow on-screen distinction of objects such as complex piping layouts.
- Select colors that allow an overall color gradation on screen. Avoid expanding each range into colors that are too dark to differentiate.
- Preserve the primary colors.
- Preserve background color (black) and white.
- Support up to eight black lines for black and white plotting plus screening through pen table assignments.
- Use an algorithm to create the color divisions, such as:
- Start with primary color R255
- Select the darkest red that is still distinguishable from black by adjusting R settings to approximately R75
- Interpolate six new gradations in color between R255 and R75
- Copy eight colors and adjust saturation and intensity to pastel tones that show greatest contrast.
- Copy columns of the 16 colors above in 30-degree hue increments around the color wheel from -180 to +180
- Add black and white for background/foreground.

- Create 5 shades of white for greyscales (these appear at 48, 80, 112, 128 and 160).

23. Glossary

Term	Definition
Bentley iModel	Model exchange file format for use with all Bentley tools - https://www.bentley.com/en/i-models/creating-i-models/creating-i-models
CAD (computer-aided design):	Software used by architects, engineers, and drafters to create two-dimensional (2D) drawings or three-dimensional (3D) models. Also used as a software platform for some advanced design applications, including schematics and intelligent 3D modeling.
CAE (computer-aided engineering):	Broad term used by the electronic design automation (EDA) industry for the use of computers to design, analyze, and manufacture products and processes. CAE includes CADD and computer-aided manufacturing (CAM).
DEM (Drawing Extraction Manager):	MicroStation AecoSim tool for creating and managing extracted output from a 3D model (see Extraction).
Drawing Number:	This is the alpha-numeric code in the lower right corner of the title block.
Design Basis Components	Modelled elements used to relay design intent when manufacturer components are not specified, or optional named vendors are specified. These model elements are developed as LOD300 from industry standards or example manufacturer components and form the basis of the engineering design and layout with regards to size, shape, quantity and location.
Extraction:	Term used by MicroStation AecoSim to refer to geometry files that are automatically generated to represent a specific view of a 3D model. The resulting files contain 2D views from the model as it would be viewed from a specific location looking in a specific direction. For example, various symbology is assigned to elements in the forward view, reflected view, or beyond the cutting plane. Extractions from AecoSim are generated through the Drawing Extraction Manager (DEM).
Federated project model	A model file created for review and collaboration, based on the federation of all smaller discipline project files
GUI (Graphical User Interface):	Graphical rather than textual user interface to a computer. Term distinguishes the first interactive computer interfaces that were not graphical. Today's major operating systems provide a graphical user interface and applications that run on the operating system use elements of that interface, as well as unique additions.
Integration:	In the context of automation, a term referring to software applications that are tightly coupled. A "seamless" integration of two applications would mean that the user of the application would encounter no additional steps or breaks in data flow when working with the resulting data between the two applications.

Term	Definition
Interoperability:	In the context of automation, a term referring to software applications or data and/or data formats that work together. Generally an additional step is required to “convert” or transfer the data from one format to another.
LOD	Level of Development - Guideline for model element graphical detail and associated information properties - https://bimforum.org/LOD
MicroStation:	Bentley CADD platform. Required for all vertical Bentley applications, including AecoSim and OpenPlant products.
MicroStation Attribute:	A special type of text element that is associated with a block. The attribute has a definition and name, allowing information stored within the attribute to be searched, retrieved, modified or reported. Attributes are similar to MicroStation Tags (see Tags).
MicroStation Block:	A CADD concept that combines individual graphical elements such as lines and circles into a single entity for manipulation. Blocks are equivalent to MicroStation Cells (see MicroStation Cell).
MicroStation Cell:	A CADD concept that combines individual graphical elements such as lines and circles into a single entity for manipulation (see MicroStation block).
MicroStation Tag:	A special type of text element that is associated with another graphical object. The tag has a definition and name, allowing information stored within it to be searched, retrieved, modified or reported. Tags are similar to MicroStation Attributes (see Attributes).
Model File Name:	This 12-character name will apply to files containing Master Data as defined in section 4.2 of this document. This will include 2D floor plans, 3D building files and 2D extractions. It may also include sections, details and elevations if they are not drawn directly into the sheet file. The model file name is the name you see listed in the folder directory through Windows Explorer.
NCS (National CADD Standard):	A standard used in preparing and presenting design information in a CADD format. Adopted by the National CADD Standards Project Committee in 1997 from a council originally formed by the National Institute of Building Sciences. This standard is endorsed by the American Institute of Architects (AIA), the Construction Specifications Institute (CSI), the General Services Administration (GSA), the DOD Tri-Service CADD/GIS Technology Center, the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), the U.S. Coast Guard, and the U.S. General Services Administration (GSA). The foundations of the National CADD Standards (NCS) are the AIA CADD Layer Guidelines, the CSI Uniform Drawing System, and the Tri-Service CADD Standards.
PDF (Portable Document Format):	A file format that captures all the elements of a printed document as an electronic image that can be viewed, navigated, printed or forwarded. PDF files are viewed using Acrobat Reader, available from Adobe.

Term	Definition
PPTP (Point-to-Point Tunneling Protocol):	Communication protocol that allows corporations to securely extend their network through private “tunnels” over the public Internet.
Reference File:	CAD term used by MicroStation to refer to CADD files that are displayed for reference purposes from another file. Externally referenced files cannot be manipulated and generally represent data supplied by another engineering discipline, another phase of the project, or existing elements on the site (see XREF). File referencing can also apply to compound office documents such as Word, Excel, etc.
Screening:	A concept used in engineering construction drawing preparation to reduce emphasis on background information by using greyscale tones on black and white plots or color plots. May be used in different ways on different types of drawings. For example, structural drawings may screen back existing structures to emphasize new work. Mechanical sections may screen back Structural components to emphasize equipment and piping. Also referred to as halftones.
Sheet File Name:	This 11 (13 with hyphens) character name will apply to the plotted sheet or drawing. The sheet file should reference the title block and any pertinent model date files. The sheet file name is the name you see listed in the folder directory through Windows Explorer.
Sheet Number:	This is the literal number in a sequence of sheets (i.e. Sheet 2 of 98).
Symbology:	Term used within the context of the CAD/CAE environment to mean the specific color, line thickness, and pattern or style of the linework representing an object. For example, a uniformly dashed thin line is typically the symbology used to represent a centerline.
XREF (eXternal REference):	CAD term used by MicroStation to refer to CADD files that are displayed for reference purposes from another file. Externally referenced files cannot be manipulated and generally represent data supplied by another engineering discipline, another phase of the project, or existing elements on the site (see Reference File).
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