

# 4 Level/Layer Assignments

## Levels/Layers

CADD levels or layers are analogous to overlays in manual drafting systems and serve to

separate graphic elements (lines, shapes, and text) according to the design discipline they represent (Figure 21).

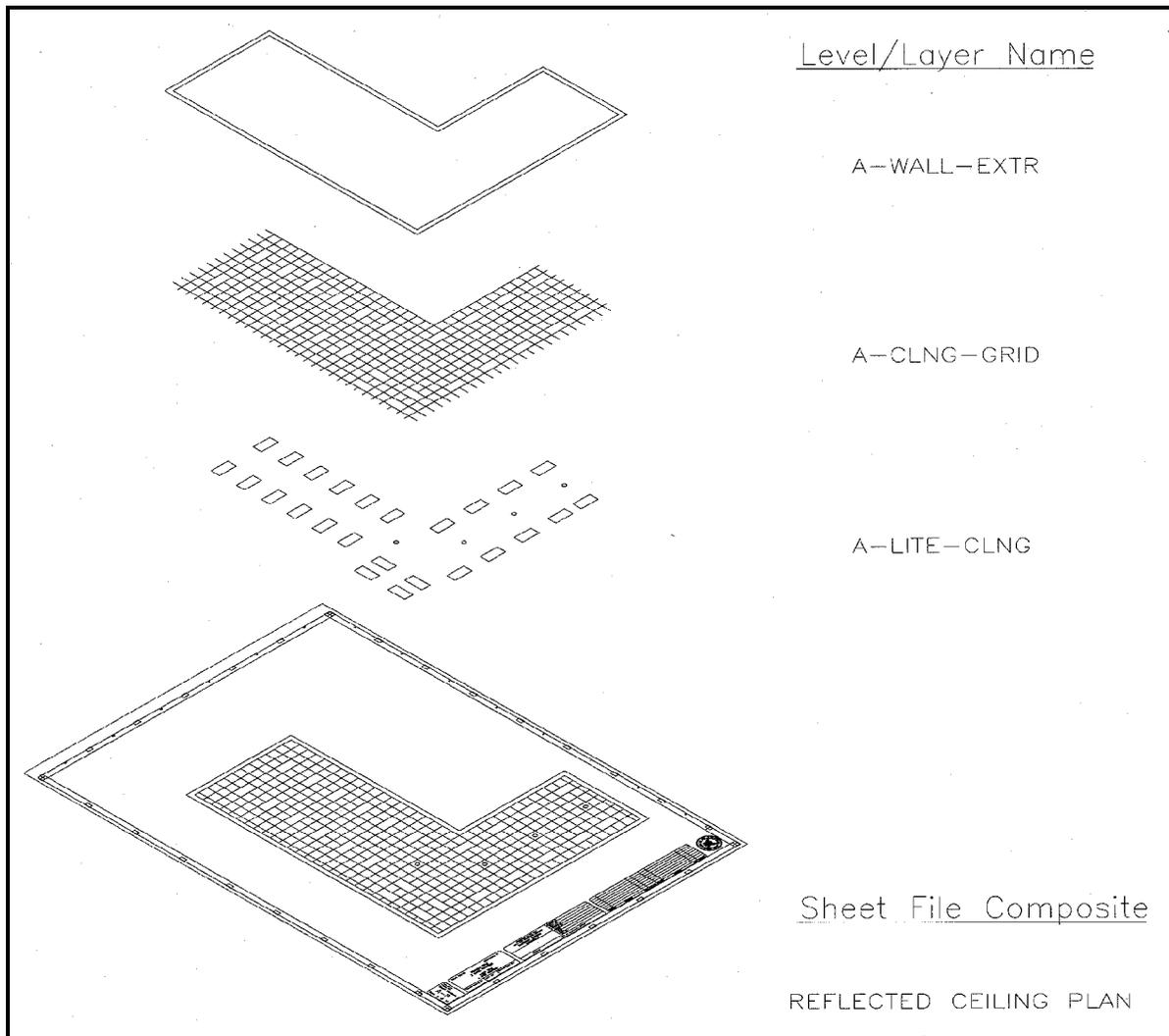


Figure 21. Typical levels/layers contained in a sheet file

The types of information represented by individual levels/layers can be grouped into two primary types: model-specific information and sheet-specific information (Figure 22).

- Model-specific information represents the physical form of a site, a building, or objects

composing a building. This information is often shared between drawings. Examples include walls, doors, light fixtures, and room numbers. Model-specific information may be either literal (e.g., walls) or symbolic (e.g., electrical outlets).

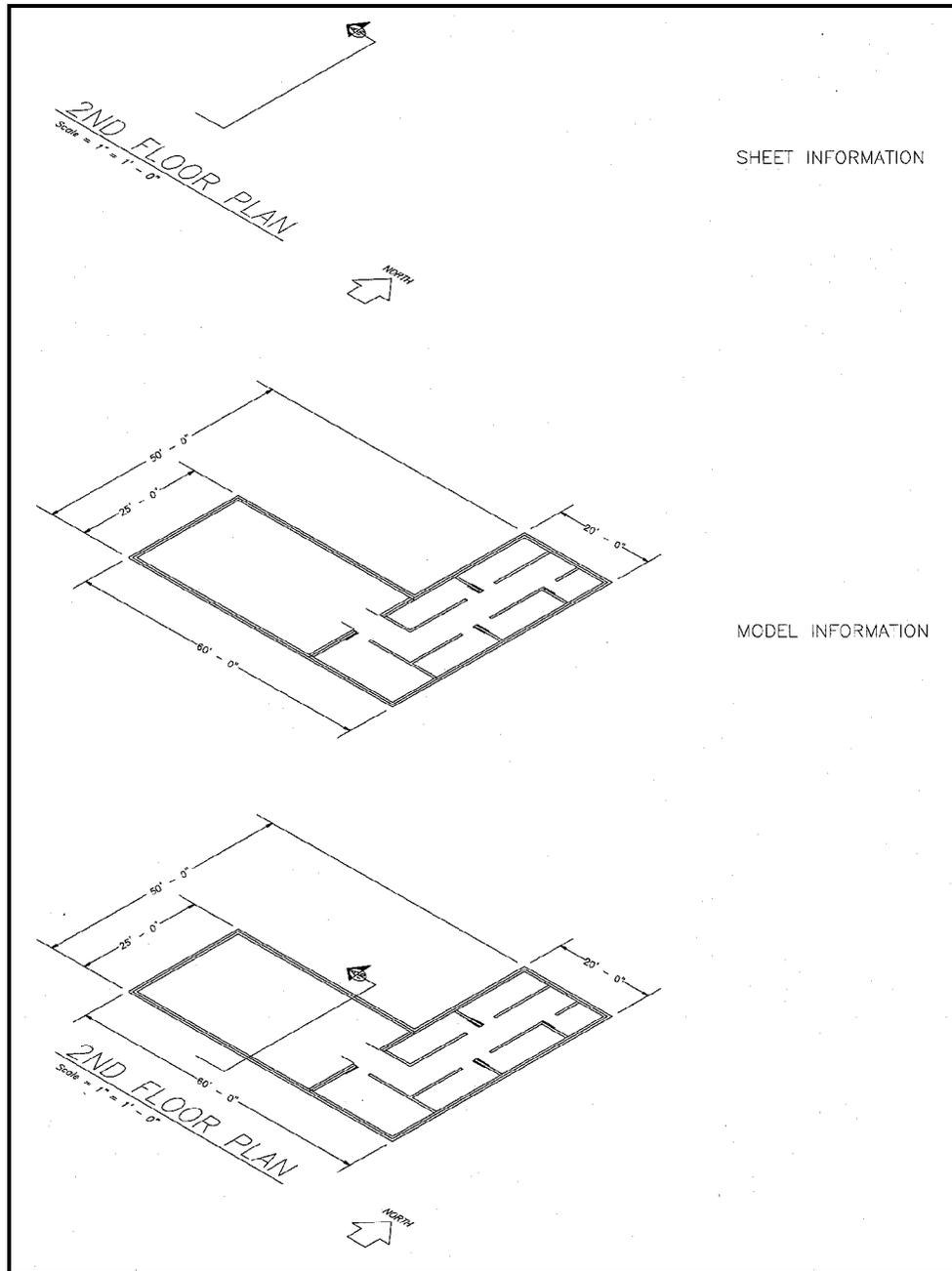


Figure 22. Sheet- and model-specific information

- Sheet-specific information may include notes, annotative symbols, and titles. This type of information is usually not shared between drawings.

**Note:** *Dimensions may occur on the model file or the sheet file. In small projects the dimensions are typically on the model file. In large projects, the dimensions should occur on the sheet file.*

To use and manipulate model-specific and sheet-specific information effectively, every level/layer must be defined (standardized) by its name and its use.

### Level/layer naming conventions

The reuse, not duplication, of graphic information reduces drawing time and improves project coordination. The level/layer is the basic tool used in CADD for managing graphic information. The levels/layers defined within these standards are based on the recommendations set forth in "CAD Layer Guidelines" (AIA 1997).

This manual offers two methodologies for level/layer naming: the Simplified Method and the Preferred Method (Figure 23). Because it can be used on large or small projects, the Preferred Method is recommended. Both methods consist of a two-character *Discipline Code* (e.g., "A-" for Architectural, "M-" for Mechanical, "QY" for Equipment - Security, etc.), followed by a four-character *Major Group* (e.g., "DOOR" for Doors, "LITE" for Lighting Fixtures, etc.). The Preferred Method adds an additional four-character *Minor Group* to further differentiate items within the Major Group (e.g., A-WALL-EXTR for exterior walls versus A-WALL-INTR for interior walls).

For very small projects where few levels/layers are required, the optional Simplified Method (where level/layer naming stops at the Major Group) may be used.

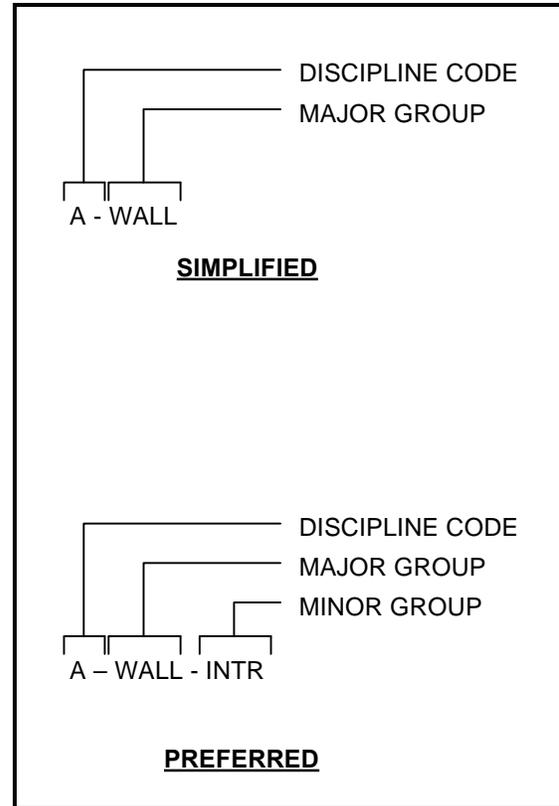


Figure 23. Level/layer naming format methods

**Note:** *Preferred level/layer names are presented in Appendix A. Simplified level/layer names are presented in Appendix C.*

### ISO format

ISO 13567-2 (ISO 1998) presents an international method for level/layer naming (Figure 24). This method consists of 10 mandatory alphanumeric characters, followed by 10 optional alphanumeric characters. The first two-character field, *Agent Responsible*, correlates to the AIA's Discipline Code. The following six-character field, *Element*, can map to a shortened version of the AIA's Major and Minor Groups (e.g., WALL-FULL becomes WALLFU, WALL-EXTR becomes WALLEX, etc.). The final two-character field in the mandatory level/layer name, *Presentation*, designates whether the level/layer information is Model information (i.e., model-specific information) or

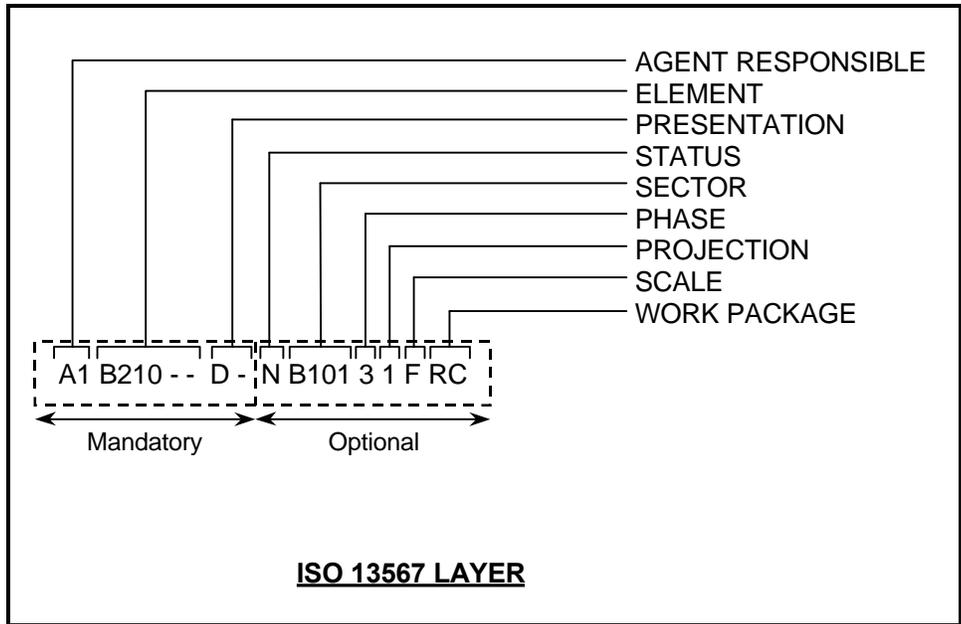


Figure 24. ISO 13567-2 level/layer naming method

Page/Paper information (i.e., sheet-specific information). Both Appendices A and C give a corresponding ISO Format level/layer name for both the Simplified and Preferred AIA Format level/layer names.

## Model Files

As mentioned in Chapter 2, model files represent full-size drawings of building elements, systems, or information (e.g., the mechanical HVAC system, the architectural floor plan, details, sections, etc.) and sheet files represent final plotted sheets. Model files are used as components in creating plotted sheet files. The information contained within a model file for a discipline may be referenced by other disciplines to create the particular model files or sheet files for that discipline.

A model file can be considered a "work in progress." For instance, a mechanical engineer may reference the architect's floor plan model file to begin development of the HVAC ductwork layout model file. Meanwhile, the architect can

continue developing the floor plan to meet new requirements. Any changes to the floor plan would be immediately accessible to the mechanical engineer. The viewing of real-time updates eliminates a great deal of frustration for other disciplines because it allows for on-the-spot rather than after-the-fact modifications.

### Level/layer assignment tables

The level/layer assignment tables in Appendix A present the following (Figure 25 presents an excerpt):

- The levels/layers assigned to each model file.
- The level number assigned to each level/layer name (MicroStation users only).
- An AIA and corresponding ISO format level/layer name for each level/layer.
- A detailed description for each level/layer.
- The presentation graphics associated with each level/layer. This includes the line style, line width, and color.

Discipline: Architectural Model File Type: Floor Plan							
Level #	Level/Layer Naming		Level/Layer Description	Graphics			
	AIA Format	ISO Format		Line Style	Line Width (mm)	AutoCAD Line Color/#	MicroStation Line Color/#
<b>General Information</b>							
1	A-ANNO-DIMS	A-----DIP-	Witness/extension lines, dimension arrowheads/dots/slashes, dimension text	0	V	V	V
2	A-ANNO-KEYN	A-----KEP-	Keynotes with associated leaderlines and arrowheads, ConDoc keynotes	0	V	V	V
5	A-ANNO-NOTE	A-----NOP-	General notes and general remarks	0	0.35	Y/2	Y/4
3	A-ANNO-NPLT	A-----NPP-	Construction lines, reference targets, area calculations, review comments, viewport windows	V	0.18	B/5	B/1
4	A-ANNO-PATT	A-----PAP-	Miscellaneous patterning, crosshatching, poche	0	0.18	Gr/8	Gr/9
6	A-ANNO-SYMB	A-----SYP-	Miscellaneous symbols	V	0.35	M/6	M/5
7	A-ANNO-TEXT	A-----TEP-	Miscellaneous text and callouts with associated leader lines and arrowheads	0	V	V	V
NA	A-ANNO-XREF	A-----XRP-	Reference files (AutoCAD users only, see Chapter 4)	NA	NA	NA	NA
<b>Floor Information</b>							
11	A-FLOR-FIXT	A-FLORFIM-	Floor-mounted/Free-standing miscellaneous fixtures (not including toilet fixtures)	0	0.25	G/3	G/2
12	A-FLOR-IDEN	A-FLORIDM-	Room name, space identification text	0	0.50	C/4	C/7
13	A-FLOR-LEVL	A-FLORLEM-	Level changes, shafts, ramps, pits, breaks in construction, and depressions	0	0.35	M/6	M/5
14	A-FLOR-NUMB	A-FLORNUM-	Room/space identification number and symbol	0	0.50	C/4	C/7
15	A-FLOR-OTLN	A-FLOROTM-	Floor outline/perimeter/building footprint	0	0.35	M/6	M/5
16	A-FLOR-PATT	A-FLORPAM-	Material patterns (e.g., paving, tile, carpet)	0	0.18	Gr/8	Gr/9
17	A-FLOR-RAIS	A-FLORRAM-	Access (raised) flooring	0	0.25	G/3	G/2
18	A-FLOR-RPRM	A-FLORRPM-	Room perimeter shape (Interior walls)	0	0.35	Y/2	Y/4
19	A-FLOR-SIGN	A-FLORSIM-	Signage	0	0.25	R/1	R/3
20	A-FLOR-SPCL	A-FLORSPM-	Architectural specialties, toilet room accessories (floor mounted only), display cases	0	0.25	G/3	G/2

Figure 25. Model file level/layer assignment table

**Annotation levels/layers.** Users should note that the first eight level/layers for every model file type (with the exception of detail model file types) are the same, the only difference being that the Discipline Code changes depending on the discipline for that model file type. The unique function of these eight annotation levels/layers is to contain model-specific information that might not be required by other disciplines. These levels/layers are as follows with \*\* representing a Discipline Code (e.g., A-, C-, QY, etc.):

- \*\*ANNO-DIMS  
Witness/extension lines, dimension arrowheads/dots/slashes and dimension text.
- \*\*ANNO-KEYN  
Keynotes with associated leader lines and arrowheads, ConDoc keynotes.
- \*\*ANNO-NOTE  
General notes and remarks.
- \*\*ANNO-NPLT  
Construction lines, reference targets, review comments, area calculations, and viewport windows.
- \*\*ANNO-PATT  
Miscellaneous patterning, crosshatching, poche.

**\*\*ANNO-SYMB**

Miscellaneous symbols.

**\*\*ANNO-TEXT**

Miscellaneous text and callouts with associated leader lines and arrowheads.

**\*\*ANNO-XREF**

An AutoCAD user-specific layer for use in attachment of external references (i.e., reference files).

**Status levels/layers.** Users should note that the last nine level/layers for every model file type (with the exception of detail and demolition model file types) are the same, the only difference being that the Discipline Code changes depending on the discipline for that model file type. The unique function of these nine Status levels/layers is to differentiate phases of work (e.g., new construction versus existing to remain items). When a project is started, the predominant portion of the work needs to be determined (i.e., will most of the items drawn be new work, demolition work, existing work, etc.). Once this determination is made, all levels/layers within that model file type (with the exception of the Status levels/layers) are used to draw those items. The Status levels/layers are then used to represent the minor phases of the design.

The Status levels/layers are as follows with \*\* representing a Discipline Code (e.g., A-, C-, QY, etc.):

**\*\*STAT-DEMO**

Existing to demolish.

**\*\*STAT-EXST**

Existing to remain.

**\*\*STAT-FUTR**

Future work.

**\*\*STAT-MOVE**

Items to be moved.

**\*\*STAT-NEWW**

New work.

**\*\*STAT-NICN**

Not in contract.

**\*\*STAT-PHS#**

Phase number (the # is replaced with 1-9).

**\*\*STAT-RELO**

Relocated items.

**\*\*STAT-TEMP**

Temporary work.

**Example:** A new addition to an existing building is to be designed. Since the majority of items designed in the model files will be New items, it is decided that all levels/layers (except for the Status levels/layers) will be used for new work. For items that are to be demolished, these items will be shown on the \*-STAT-DEMO level/layer. Similarly, existing to remain items would be shown on the \*-STAT-EXST level/layer.

**Note:** *The \*-STAT-NEWW level/layer would not be used since the non-Status levels/layers in the model file are used to represent these items.*

### **Border sheets**

As mentioned before, a model file contains information that can be referenced by other disciplines to create other model files or final sheet files. A border sheet model file contains border sheet linework, the title block, and project-specific symbols and text. Typically, each discipline will use the same border sheet and fill in sheet-specific information within the title block or revision block prior to printing the final sheet file (e.g., sheet number, designer names, etc.).

### **Seed files/prototype drawings**

To implement the standards without the aid of a "workspace" (Chapter 6), the most efficient means of creating model files is with a template file. Both AutoCAD and MicroStation allow the use of a template file (MicroStation seed file/AutoCAD prototype drawing). These files can contain established working units, preset drawing variables, or an established set of levels/layers. If a seed file/prototype drawing is developed for each model file, it is a simple matter for the architect/engineer to attach this file as a

The development of such a file eliminates the tedious aspect of setting variables and typing in level/ layer names every time a new drawing is started.

Both MicroStation and AutoCAD have similar methods for using seed files/prototype drawings. First, a new file or drawing (model or sheet) is created. Second, a seed file/prototype drawing is selected and attached (Figures 26 and 27). Based on the seed file/prototype drawing selected, the CADD program will set up all parameters and levels/layers contained in that seed file/prototype drawing.

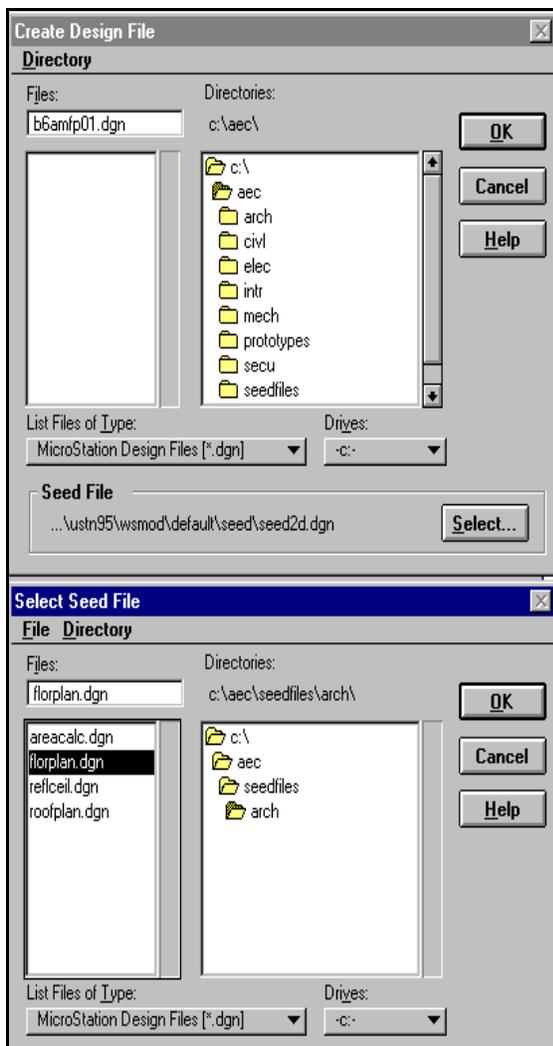


Figure 26. MicroStation design file creation and seed file selection dialog boxes

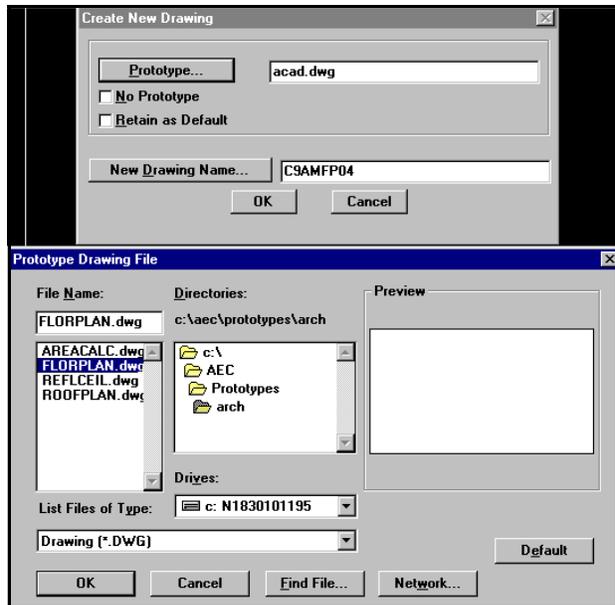


Figure 27. AutoCAD new drawing file and prototype drawing selection windows

**Note:** A seed file/prototype drawing for every model file within this standard does not have to be created at once. Rather, as particular model files are developed, seed files/prototype drawings can be saved at that time and stored away for later projects. Eventually, a complete library of seed files/prototype drawings will be developed and can be shared between other architects and engineers at a site.

### Reference files (XREFs)

Reference files (external references or XREFs) enable designers to share drawing information electronically, eliminating the need to exchange hard copy drawings between the design disciplines. With the use of reference files, the structural engineer need not wait for the architect to complete the architectural floor plans before beginning the structural framing plan model file. Nor does the engineer have to redraw the architect's structural walls on the structural framing plan model file.

Referencing electronic drawing information makes any future changes made by the architect apparent to the structural designer. This real-time access to the work of others ensures accuracy and consistency within a set of drawings and helps promote concurrent design efforts. No longer does one discipline have to wait until another discipline is nearly finished before they begin their drawings.

The use of reference files is a key component in the successful use of the level/layer assignments. To create either a model file or a final sheet file, multiple referenced model files may be required. Figure 28 shows how a simple Plumbing Piping Plan model file is developed using levels/layers referenced from the Enlarged Floor Plan model file. These referenced levels/layers show the current locations of walls, toilets, and sinks placed by the architect. The engineer uses this information to design the piping system required to service the plumbing fixtures. The architectural floor plan would then be detached and the Plumbing Piping Plan would be saved as a separate model file.

## Sheet Files

Sheet files are the final project sheets that are ready to be plotted. A sheet file is an assembly of referenced model files plus additional sheet-specific information (e.g., north arrows, scales, section cuts, title block information, etc.).

### Level/layer assignment tables

The level/layer assignment tables in Appendix B present the following (Figure 29):

- The levels/layers assigned to each sheet file.
- The level number assigned to each level/layer (MicroStation users only).
- An AIA and corresponding ISO format level/layer name for each level/layer.
- A detailed definition for each level/layer.

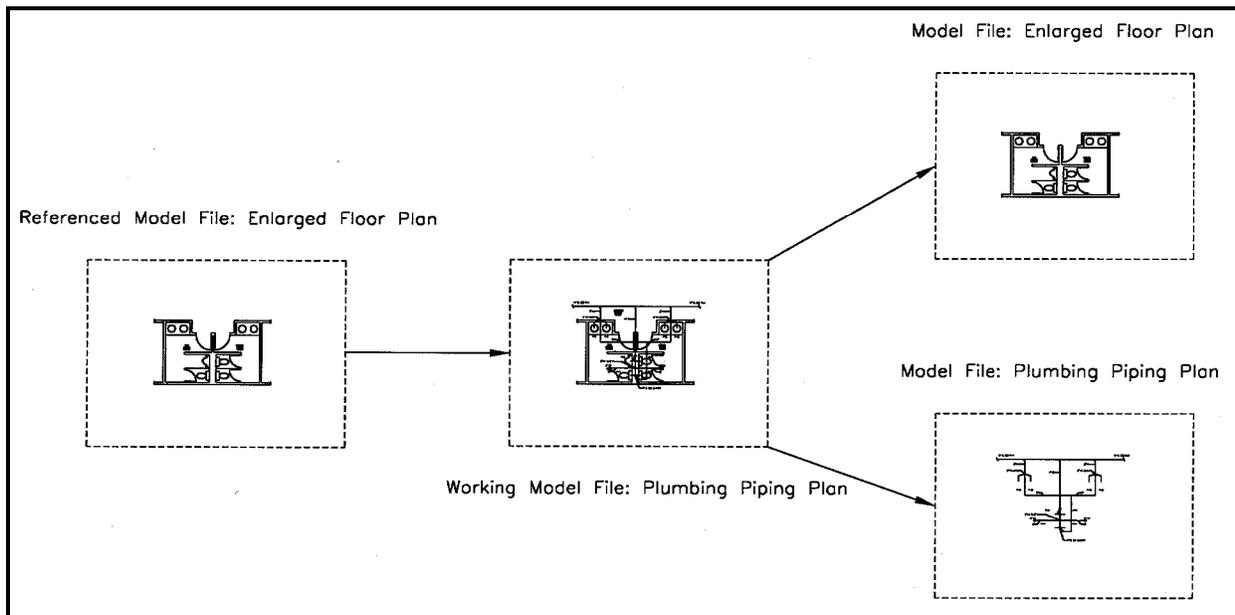


Figure 28. Using referenced model files to build a new model file without redundant effort

Discipline: Architectural							
Level #	Level/Layer Naming		Level/Layer Description	Graphics			
	AIA Format	ISO Format		Line Style	Line Width (mm)	AutoCAD Line Color/#	MicroStation Line Color/#
<b>General Information</b>							
1	A-ANNO-DIMS	A-----DIP-	Sheet-specific dimensions (includes witness/extension lines, dimension arrowheads/dots/slashes, dimension text)	0	V	V	V
2	A-ANNO-KEYN	A-----KEP-	Sheet-specific keynotes with associated leader lines and arrowheads, ConDoc keynotes	0	V	V	V
3	A-ANNO-LEGN	A-----LEP-	Legends and schedules	0	V	V	V
5	A-ANNO-NOTE	A-----NOP-	Sheet-specific notes and general remarks	0	0.35	Y/2	Y/4
4	A-ANNO-PATT	A-----PAP-	Sheet-specific patterning, crosshatching, poche (e.g., keyplan patterning)	0	0.18	Gr/8	Gr/9
6	A-ANNO-SYMB	A-----SYP-	Sheet-specific symbols (e.g., scales, north arrow, section cuts, detail bubbles, etc.)	V	0.35	M/6	M/5
7	A-ANNO-TEXT	A-----TEP-	Sheet-specific text and callouts with associated leader lines and arrowheads (e.g., title block text, legend and schedule text)	0	V	V	V
62	A-ANNO-REDL	A-----REP-	Redlines	0	0.25	R/1	R/3
63	A-ANNO-REVS	A-----RVP-	Revisions	0	0.50	C/4	C/7
NA	A-ANNO-XREF	A-----XRP-	Referenced model files (AutoCAD users only, see Chapter 4)	NA	NA	NA	NA

Figure 29. Sheet file level/layer assignment table

- The presentation graphics associated with each level/layer. This includes the line style, line width, and color.

Users should note that the first ten level/layers of the sheet file type for every discipline are the same, with the exception that the Discipline Code changes depending on the discipline for that sheet file type. The unique function of these ten Annotation levels/layers is to contain sheet-specific information. These levels/layers are as follows with \*\* representing a Discipline Code (e.g., A-, C-, QY, etc.):

**\*\*ANNO-DIMS**

Sheet-specific witness/extension lines, dimension arrowheads/dots/slashes, and dimension text.

**\*\*ANNO-KEYN**

Sheet-specific keynotes with associated leader lines and arrowheads, ConDoc keynotes.

**\*\*ANNO-LEGN**

Legends and schedules.

**\*\*ANNO-NOTE**

Sheet-specific general notes and remarks.

**\*\*ANNO-PATT**

Sheet-specific patterning, crosshatching, poche (e.g., keyplan patterning).

**\*\*ANNO-REDL**

Redlines, markups.

**\*\*ANNO-REVS**

Revisions, amendments, addenda, and modifications.

**\*\*ANNO-SYMB**

Sheet-specific symbols (e.g., north arrow, scales, etc.).

**\*\*ANNO-TEXT**

Sheet-specific text and callouts with associated leader lines and arrowheads.

**\*\*ANNO-XREF**

An AutoCAD user-specific layer for use in attachment of external references (i.e., reference files).

**Development of sheet files**

As mentioned previously, reference files are used in the construction of sheet files. The user opens the sheet file type from Appendix B that is appropriate to his/her discipline then references existing model files.

As an example, in order to create a final Plumbing Plan sheet file (Figure 30), the engineer would first open/create a new sheet file. The border sheet model file would be referenced first, and the engineer would continue to

reference other model files, such as the Architectural Floor Plan and the Plumbing Piping Plan. The engineer would have to "turn off" levels/layers within each referenced model file to achieve the desired sheet file. Finally, the ten sheet file levels/layers such as P-ANNO-TEXT would be used to fill in sheet-specific information (e.g., sheet number, designer name, etc.). Once the final sheet file is achieved, the resulting file is saved.

**Note:** Release 1.4 of the Tri-Service A/E/C CADD Standard included plotting matrix tables that showed the possible combinations of reference and active levels/layers used to create sheet files. These tables are available at the TSTC's Internet site at [tsc.wes.army.mil](http://tsc.wes.army.mil).

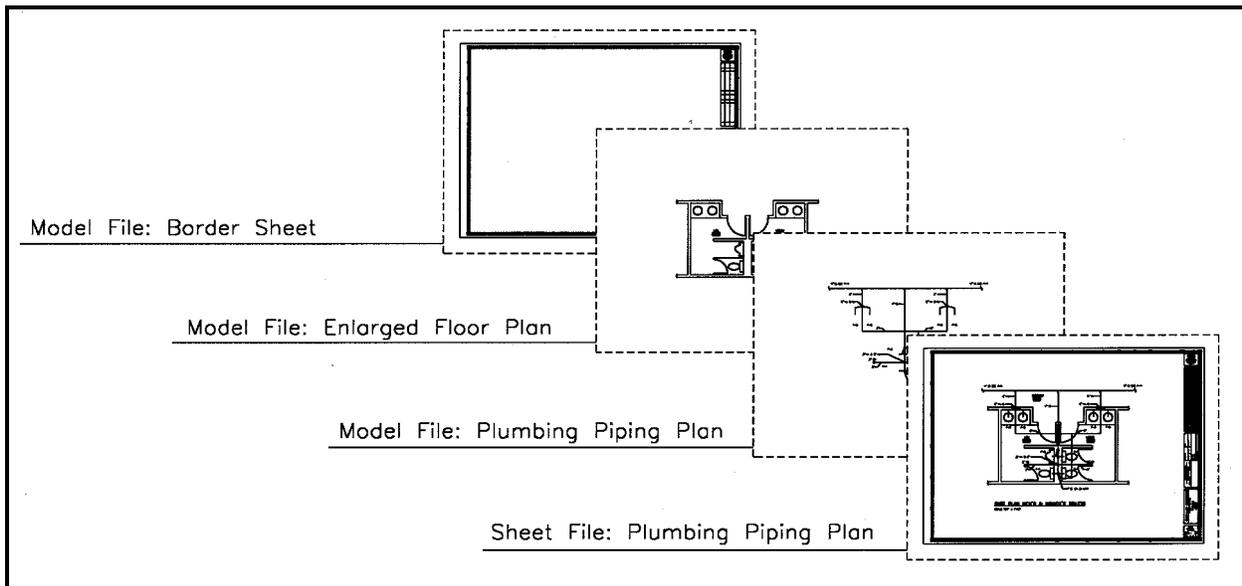


Figure 30. Using multiple referenced model files to build a sheet file without redundant effort