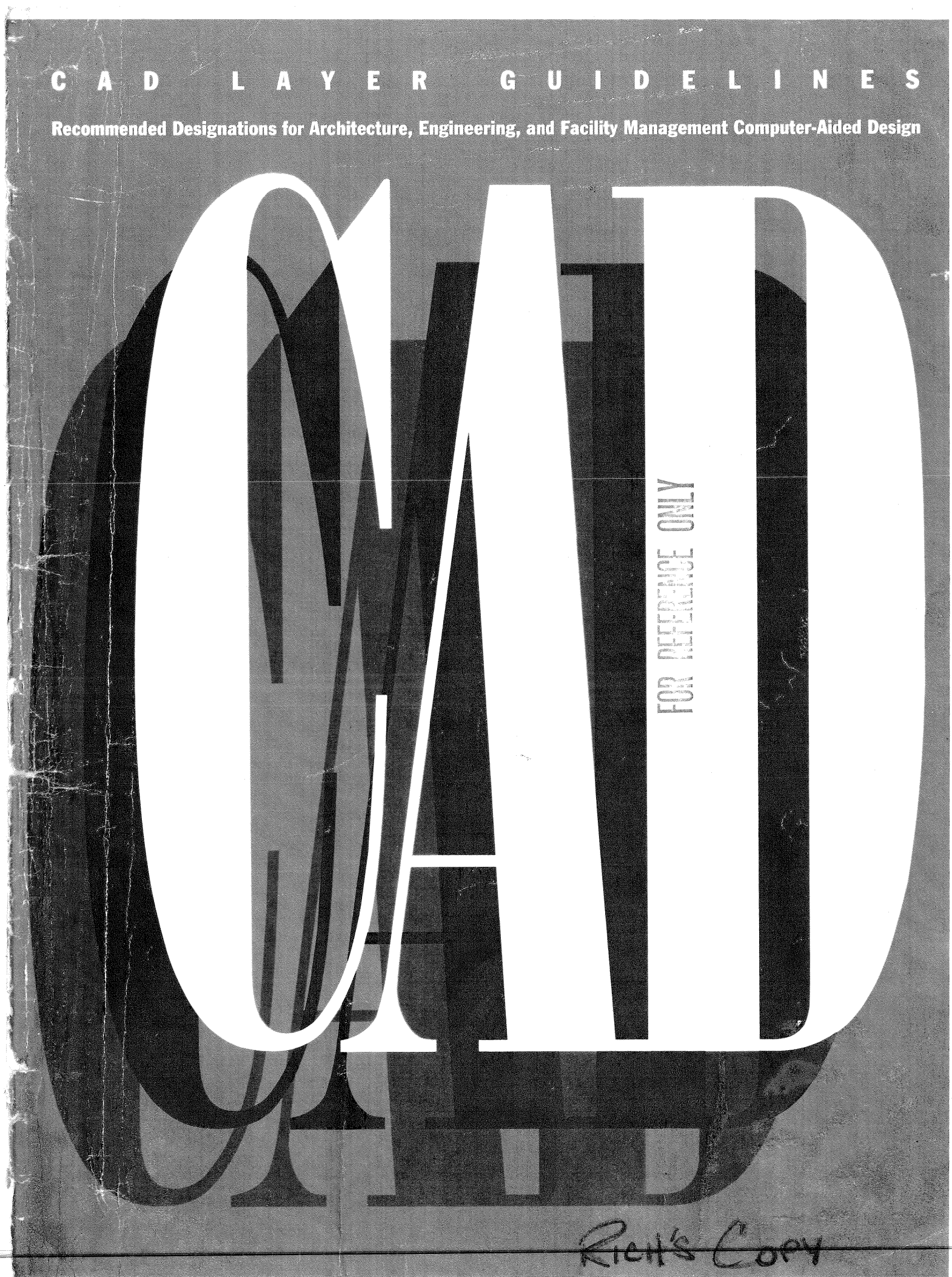
CAD LAYER GUIDELINES

Recommended Designations for Architecture, Engineering, and Facility Management Computer-Aided Design



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CAD LAYER GUIDELINES

Recommended Designations for Architecture, Engineering, and Facility Management Computer-Aided Design

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Prepared by
The Task Force on CAD Layer Guidelines

Sponsored by
The American Institute of Architects
The American Consulting Engineers Council
The American Society of Civil Engineers
The International Facility Management Association

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Contents

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THE TASK FORCE ON CAD LAYER GUIDELINES

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INTRODUCTION

Effective use of computer-aided design (CAD) in architecture, engineering, and facility management depends on sharing graphic information. Floor plan drawings developed by architects need to be available as backgrounds for mechanical and electrical plans. Symbols and details developed for one project need to be reusable for future projects. And increasingly, clients are requesting copies of drawings in electronic form for use in ongoing facility management. To realize the benefits of shared graphics in the building design professions, standards are needed for organizing information in CAD drawings. In particular, a standard approach is needed for the use of CAD layers, the basic method most CAD systems use to group information for display, editing, and plotting purposes.

To address this issue, four professional associations and three government agencies organized the Task Force on CAD Layer Guidelines in September 1988. The sponsoring organizations were as follows:

American Institute of Architects
International Facility Management Association
American Consulting Engineers Council
American Society of Civil Engineers
United States Army Corps of Engineers
Naval Facility Engineering Command
Department of Veterans Affairs

The task force began work in September 1988 with the objective of establishing CAD layer designations for architecture, engineering, and facility management. In June 1989 the task force released a draft of the CAD Layer Guidelines for public review and comment. The draft was reviewed by over 500 architects, engineers, facility managers, and CAD vendors using a variety of CAD systems. Over 100 responses were received, all of which were extremely useful in completing the final document.

This document is intended to serve as a guideline rather than a tight standard. In a field that is changing as rapidly as computer-aided design, rigid specifications would constrain imaginative applications and future development. On the other hand, the total absence of a standard would result in chaos and unrealized potential for sharing graphic information. The document therefore strives for a balance, providing a general framework for practice while allowing and encouraging expansion and modification.

This release of the CAD Layer Guidelines is intended as the first step in an ongoing process. As architecture, engineering, and facility management adapt to CAD technology, it will be important for the guidelines to continue to evolve.

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1. INTRODUCTION TO CAD LAYERS

Computer-Aided Design Terms

Computer-aided design, like many rapidly developing technical fields, has introduced new concepts faster than our ability to adopt terms and definitions. To aid discussion and understanding of the concepts dealing with CAD layers, the following working definitions are provided for terms used in this document:

CAD An acronym for computer-aided design. Some people prefer CADD for computer-aided design and drafting or CAD standing for computer-aided drawing.

File A collection of information stored under a single name on a computer.

Entity A geometric element or an item of data on a CAD drawing. Examples of entities include lines, arcs, circles, text, and symbols.

Symbol A collection of CAD entities stored under a single name and available for use on other drawings. Some systems use the term *block* or *cell* instead of symbol.

Attribute Text or numeric data attached to a symbol or entity on a CAD drawing. Examples of attributes include a model number associated with a furniture symbol or a door type code associated with a door symbol. Some systems allow attributes to be associated with any graphic element. Other systems support attributes only for symbols.

CAD layer An attribute of an item on a CAD drawing commonly used for classification and to control visibility and manipulation. The term *level* is used by some systems instead of *layer*.

Reference file A file or drawing that can be displayed as a background but that cannot be edited.

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CAD Layer Applications

Almost all computer-aided design systems support the concept of layers, a method for grouping graphic information for display or plotting purposes. By accommodating the reuse of information, layers reduce drafting time and improve project coordination. Applications of layers include the following:

Facilitating drawing coordination and the sharing of information between drawings and disciplines.

Allowing several drawings sharing common information to be combined in one CAD file to reduce drawing effort and improve consistency.

Accommodating the sharing of information common to several floors of a multistory building.

Accommodating alternative design schemes or project phases within individual drawings.

Controlling visibility of classes of objects to facilitate editing of drawings, thus improving CAD system response time and reducing visual clutter.

Controlling appearance characteristics such as color or line type.

Layer Names versus Layer Numbers

There are two basic methods used in CAD systems to designate layers: layer names and layer numbers.

With systems that use alphanumeric layer names, users can typically control layers by using wild card characters such as typing "E*" to identify all electrical layers.

Systems that use numeric layer designations typically limit the total number of layers to 64, 128, or 256. Some systems using numeric layer designations support a concept of reference files that allows for several drawings to be combined for viewing and plotting, thus expanding the number of possible layer combinations.

There are several problems associated with using numeric layer designations. Although 256 layers are sufficient to accommodate almost any project, the total list of layers needed for the diversity of architecture, interior design, structural engineering, mechanical engineering, electrical engineering, facility management, landscape architecture, civil engineering, and dozens of supporting disciplines is more than 1,000. This exceeds the capacity of most systems with numbered layers. Furthermore, designating specific numeric layers as an industry standard would greatly restrict the flexibility to add future layers at logical locations in the number sequence. For example, if layers 20–28 were defined for walls and 30–38 for doors, only one additional wall layer (29) could be added to the wall series in the future.

For these reasons, the task force decided to leave the designation of layer numbers to individual users. Vendors of CAD systems with layer numbers are urged to implement layer names, or at least to facilitate translation between numbered layers and named layers. This topic is discussed further in Sections 5 and 7.

Drawing Intelligence Issues

Although layers can be used to support "bill of materials" reports, attributes provide a much better method for carrying nongraphic data. Attributes provide significantly more flexibility than layer designations and can be used without hindering the control of display and output. For these reasons, the CAD Layer Guidelines do not attempt to use layers to carry "drawing intelligence," but leave these functions to CAD attributes.

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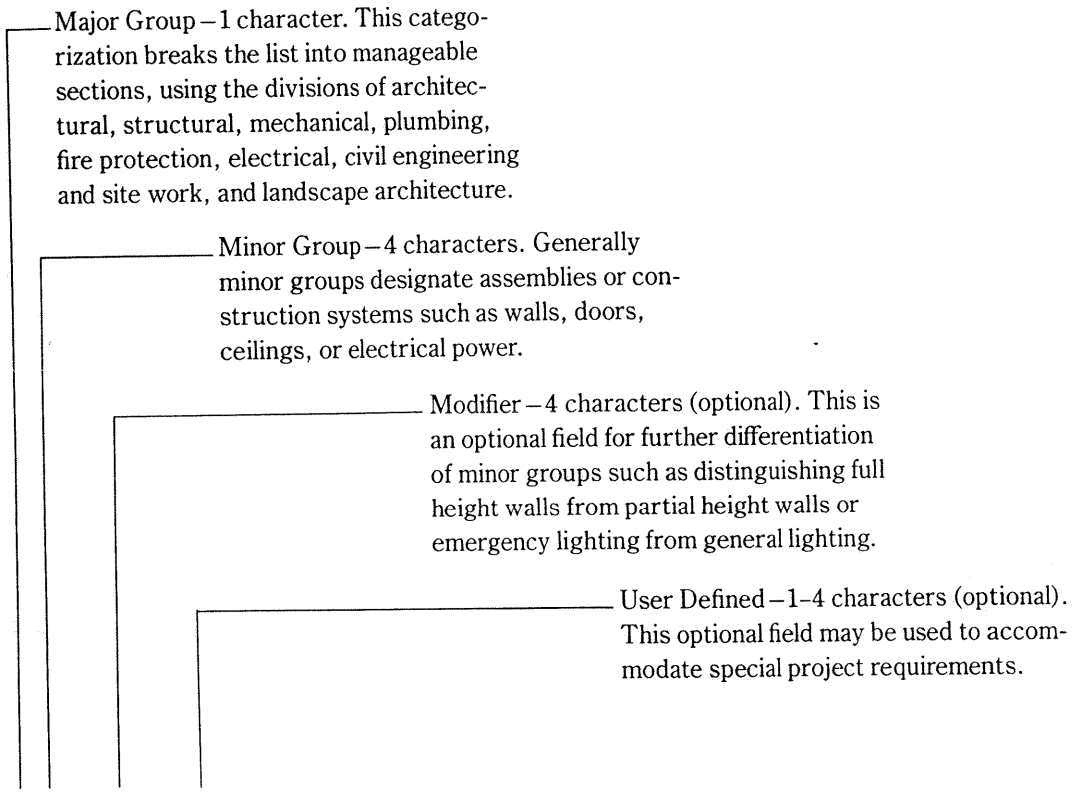
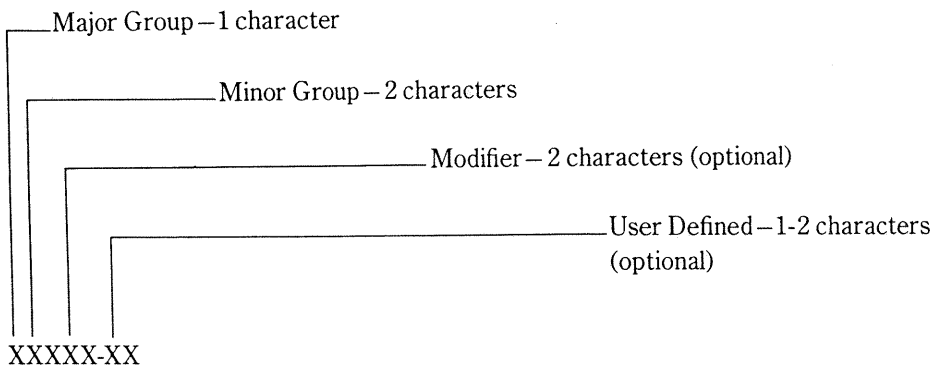
Figure 2.1 Long and Short Formats

Long Format



Examples	A-WALL	Walls
	A-DOOR-IDEN	Door Numbers

Short Format



Examples	AWA	Walls
	ADORID	Door Numbers

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Building and Drawing Information Layers

Layer names for each major group are divided into two sections: building information layers and drawing information layers.

Building information generally represents the physical form of the site, building, or objects in the building. This information is often shared between drawings. Examples include walls, doors, light fixtures, and room numbers. Building information may be either literal (such as walls) or symbolic (such as electrical outlets). Cross-hatching and identification labels such as room numbers are also grouped with building information, using the modifiers "PATT" and "IDEN" since this information is often shared between drawings.

Drawing information adds annotation, dimensions, and cross references and usually is not shared between drawings. Examples include notes, dimensions, annotative symbols, and tabulations. Drawing information layers are organized by drawing type and type of information rather than by construction system. For example:

A-PFLR-TTLB	APFTT	Sheet Title Block and Name
A-PFLR-DIMS	APFDI	Architectural Floor Plan Dimensions
A-PCLG-DIMS	APCDI	Architectural Reflected Ceiling Plan Dimensions

Layers for Elevations, Sections, Details, and Three-Dimensional Drawing

Special groups of layers within each major group are defined for elevations, sections, and details:

*-ELEV	*EL	Elevations
*-ELEV-OTLN	*ELOT	Building Outlines
*-ELEV-PATT	*ELPA	Textures and Hatch Patterns
*-ELEV-IDEN	*ELID	Component Identification Numbers
*-SECT	*SE	Sections
*-SECT-MCUT	*SEMC	Material Cut by Section
*-SECT-MBND	*SEMB	Material beyond Section Cut
*-SECT-PATT	*SEPA	Textures and Hatch Patterns
*-SECT-IDEN	*SEID	Component Identification Numbers
*-DETL	*DE	Details
*-DETL-MCUT	*DEMC	Material Cut by Section
*-DETL-MBND	*DEMB	Material beyond Section Cut
*-DETL-PATT	*DEPA	Textures and Hatch Patterns
*-DETL-IDEN	*DEID	Component Identification Numbers

The modifier "-ELEV" can also be added to any minor group layer (A-WALL, A-DOOR, etc.) to identify information only seen in 3D views. This facilitates integrating three-dimensional CAD "models" with two-dimensional plan drawings. For example:

A-WALL	AWA	Walls (in Plan View)
A-WALL-ELEV	AWAEL	Wall Surfaces (3D Views)

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Mechanical

Long Format Layer Name	Short Format Layer Name	Layer Description
		Building Information Layers
M-BRIN	MBR	Brine Systems
M-CHIM	MCH	Prefabricated Chimneys
M-CMPA	MCM	Compressed Air Systems
M-CONT	MCO	Controls and Instrumentation
M-DUST	MDU	Dust and Fume Collection System
M-ENER	MEN	Energy Management System
M-EXHS	MEX	Exhaust System
M-FUEL	MFU	Fuel System Piping
M-HVAC	MHV	HVAC System
M-HOTW	MHO	Hot Water Heating System
M-CWTR	MCW	Chilled Water Systems
M-MACH	MMA	Machine Shop Equipment
M-MDGS	MMD	Medical Gas Systems
M-PROC	MPR	Process Systems
M-REFG	MRE	Refrigeration Systems
M-SPCL	MSP	Special Systems
M-STEM	MST	Steam Systems
M-TEST	MTE	Test Equipment
M-ELEV	MEL	Elevations
M-SECT	MSE	Sections
M-DETL	MDE	Details

Mechanical (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
		Drawing Information Layers
M-SHBD	MSH	Sheet Border and Title Block Line Work
M-PPIP	MPP	Piping Plan
M-PDUC	MPD	Duct Plan
M-PEXD	MPE	Exhaust Duct Plan
M-PHVA	MPH	HVAC Plan
M-PSTM	MPS	Steam Piping Plan
M-PWCH	MPW	Chilled Water Piping Plan
M-PMED	MPM	Special Medical Process – Piping Plan
M-PCON	MPC	Controls Plan
M-P***	MP*	Other Mechanical Plans
M-ELEV	MEL	Elevations
M-SECT	MSE	Sections
M-DETL	MDE	Details
M-SCHD	MSC	Schedules and Title Block Sheets

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Electrical

Long Format Layer Name	Short Format Layer Name	Layer Description
		Building Information Layers
E-LITE	ELI	Lighting
E-POWR	EPO	Power
E-CTRL	ECT	Electric Control Systems
E-GRND	EGR	Ground System
E-AUXL	EAU	Auxiliary Systems
E-LTNG	ELT	Lightning Protection System
E-FIRE	EFI	Fire Alarm Systems
E-COMM	ECO	Telephones and Communication Systems
E-DATA	EDA	Data Systems
E-SOUN	ESO	Sound or PA System
E-TVAN	ETV	TV Antenna System
E-CCTV	ECC	Closed Circuit TV
E-NURS	ENU	Nurse Call System
E-SERT	ESR	Security System
E-PGNG	EPG	Paging System
E-DICT	EDI	Central Dictation System
E-BELL	EBE	Bell System
E-CLOK	ECL	Clock System
E-ALRM	EAL	Miscellaneous Alarm System
E-ELEV	EEL	Elevations
E-SECT	ESE	Sections
E-DETL	EDE	Details

Electrical (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
		Drawing Information Layers
E-SHBD	ESH	Sheet Border and Title Block Line Work
E-PLIT	EPL	Lighting Plan
E-PPOW	EPP	Power Plan
E-PCOM	EPC	Communication Systems Plan
E-PAUX	EPA	Auxiliary Systems Plan
E-PROF	EPR	Electrical Roof Plan
E-P***	EP*	Other Electrical Plans
E-LEGN	ELE	Legend of Symbols
E-1LIN	E1L	One Line Diagrams
E-RISR	ERI	Riser Diagram
E-ELEV	EEL	Elevations
E-SECT	ESE	Sections
E-DETL	EDE	Details
E-SCHD	ESC	Schedules and Title Block Sheets

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4. MASTER LAYER LIST WITH MODIFIERS

General Information

The layer list is divided into eight major groups. Within each group, building information layers are listed first, followed by drawing information layers.

The following modifiers may be used with any building information layer:

Long Format Layer Name	Short Format Layer Name	Layer Description
*-****-IDEN	***ID	Identification Tag
*-****-PATT	***PA	Cross-hatching and Poche
*-****-ELEV	***EL	Vertical Surfaces (3D Drawings)
*-****-EXST	***EX	Existing to Remain
*-****-DEMO	***DE	Existing to Be Demolished or Removed
*-****-NEWW	***NW	New or Proposed Work (Remodeling Projects)

For example, A-WALL-DEMO would be used to designate walls to be demolished.

The following modifiers may be used with any drawing information layer:

Long Format Layer Name	Short Format Layer Name	Layer Description
*-****-NOTE	***NO	Notes, Call-outs and Key Notes
*-****-TEXT	***TE	General Notes and Specifications
*-****-SYMB	***SY	Symbols, Bubbles, and Targets
*-****-DIMS	***DI	Dimensions
*-****-PATT	***PA	Cross-hatching and Poche
*-****-TTLB	***TT	Title Block Sheet Name and Number
*-****-NPLT	***NP	Nonplot Information and Construction Lines
*-****-PLOT	***PL	Plotting Targets and Windows

Read-Me Layer

The following layer is common for all major groups:

X-RDME	XRD	Read-Me Layer, Not-to-Be-Plotted, Information on File Organization

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Architecture, Interiors, and Facilities (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
A-FURN	**AFU**	**Furniture**
A-FURN-FREE	AFUFR	Freestanding Furniture (Desks, Credenzas, etc.)
A-FURN-CHAR	AFUCH	Chairs and Other Seating
A-FURN-FILE	AFUFI	File Cabinets
A-FURN-PNLS	AFUPN	Furniture System Panels
A-FURN-WKSF	AFUWK	Furniture System Work Surface Components
A-FURN-STOR	AFUST	Furniture System Storage Components
A-FURN-POWR	AFUPO	Furniture System Power Designations
A-FURN-IDEN	AFUID	Furniture Numbers
A-FURN-PLNT	AFUPL	Plants
A-FURN-PATT	AFUPA	Finish Patterns
A-FURN-ELEV	AFUEL	Furniture (3D Views)
A-CLNG	**ACL**	**Ceiling Information**
A-CLNG-GRID	ACLGR	Ceiling Grid
A-CLNG-OPEN	ACLOP	Ceiling and Roof Penetrations
A-CLNG-TEES	ACLTE	Main Tees
A-CLNG-SUSP	ACLSU	Suspended Elements
A-CLNG-PATT	ACLPA	Ceiling Patterns
A-ROOF	**ARO**	**Roof**
A-ROOF-OTLN	AROOT	Roof Outline
A-ROOF-LEVL	AROLE	Level Changes
A-ROOF-STRS	AROST	Stair Treads and Ladders
A-ROOF-RISR	ARORI	Stair Risers
A-ROOF-HRAL	AROHR	Stair Handrails, Nosings, and Guard Rails
A-ROOF-PATT	AROPA	Roof Surface Patterns (Hatching)
A-ROOF-ELEV	AROEL	Roof Surfaces (3D Views)

Architecture, Interiors, and Facilities (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
A-AREA	**AARE**	**Area Calculation Boundary Lines**
A-AREA-PATT	AARPA	Area Cross-hatching
A-AREA-IDEN	AARID	Room Numbers, Tenant Identifications, and Area Calculations
A-AREA-OCCP	AAROC	Occupant or Employee Names
A-ELEV	**AEL**	**Interior and Exterior Elevations**
A-ELEV-OTLN	AELOT	Building Outlines
A-ELEV-FNSH	AELFN	Finishes, Woodwork, and Trim
A-ELEV-CASE	AELCA	Wall-Mounted Casework
A-ELEV-FIXT	AELFI	Miscellaneous Fixtures
A-ELEV-SIGN	AELSI	Signage
A-ELEV-PATT	AELPA	Textures and Hatch Patterns
A-ELEV-IDEN	AELID	Component Identification Numbers
A-SECT	**ASE**	**Sections**
A-SECT-MCUT	ASEMC	Material Cut by Section
A-SECT-MBND	ASEMB	Material beyond Section Cut
A-SECT-PATT	ASEPA	Textures and Hatch Patterns
A-SECT-IDEN	ASEID	Component Identification Numbers
A-DETL	**ADE**	**Details**
A-DETL-MCUT	ADEMC	Material Cut by Section
A-DETL-MBND	ADEMB	Material beyond Section Cut
A-DETL-PATT	ADEPA	Textures and Hatch Patterns
A-DETL-IDEN	ADEID	Component Identification Numbers

Table continues

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Structural (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
S-ABLT	**SAB**	**Anchor Bolts**
S-COLS	**SCO**	**Columns**
S-WALL	**SWA**	**Structural Bearing or Shear Walls**
S-METL	**SME**	**Miscellaneous Metal**
S-FRAM	**SFR**	**Framing Plan (Beams, Joists)**
S-FRAM-BEAM	SFRBE	Beams
S-FRAM-JOIS	SFRJO	Joists
S-FRAM-DECK	SFRDE	Structural Floor Deck
S-ELEV	**SEL**	**Elevations**
S-ELEV-OTLN	SELOT	Building Outlines
S-ELEV-PATT	SELPA	Textures and Hatch Patterns
S-ELEV-IDEN	SELID	Identification Numbers
S-SECT	**SSE**	**Sections**
S-SECT-MCUT	SSEMC	Material Cut by Section
S-SECT-MBND	SSEMB	Material beyond Section Cut
S-SECT-PATT	SSEPA	Textures and Hatch Patterns
S-SECT-IDEN	SSEID	Identification Numbers
S-DETL	**SDE**	**Details**
S-DETL-MCUT	SDEMC	Material Cut by Section
S-DETL-MBND	SDEMB	Material beyond Section Cut
S-DETL-PATT	SDEPA	Textures and Hatch Patterns
S-DETL-IDEN	SDEID	Identification Numbers

Structural (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
		Drawing Information Layers
S-SHBD	SSH	Sheet Border and Title Block Line Work
S-SHBD-TTLB	SSHTT	Project Title Block and Project Name
S-SHBD-LOGO	SSHLO	Project or Office Logo
S-PFND	SPF	Foundation Plan
S-PSFR	SPS	Structural Framing Plan
S-PCOL	SPC	Column Plan
S-P***	SP*	Other Structural Plans
S-ELEV	SEL	Elevations
S-SECT	SSE	Sections
S-DETL	SDE	Details
S-SCHD	SSC	Schedules and Title Block Sheets
S-****-NOTE	S**NO	Notes, Call-outs, and Key Notes
S-****-TEXT	S**TE	General Notes and Specifications
S-****-SYMB	S**SY	Symbols, Bubbles, and Targets
S-****-DIMS	S**DI	Dimensions
S-****-PATT	S**PA	Cross-hatching and Poche
S-****-TTLB	S**TT	Sheet Name and Number
S-****-NPLT	S**NP	Nonplot Information and Construction Lines
S-****-PLOT	S**PL	Plotting Targets and Windows

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Mechanical (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
M-REFG	**MRE**	**Refrigeration Systems**
M-REFG-EQPM	MREEQ	Refrigeration Equipment
M-REFG-PIPE	MREPI	Refrigeration Piping
M-SPCL	**MSP**	**Special Systems**
M-SPCL-EQPM	MSPEQ	Special Systems Equipment
M-SPCL-PIPE	MSPPI	Special Systems Piping
M-STEM	**MST**	**Steam Systems**
M-STEM-CONP	MSTCO	Steam Systems Condensate Piping
M-STEM-EQPM	MSTEQ	Steam Systems Equipment
M-STEM-LPIP	MSTLP	Low Pressure Steam Piping
M-STEM-HPIP	MSTHP	High Pressure Steam Piping
M-TEST	**MTE**	**Test Equipment**
M-ELEV	**MEL**	**Elevations**
M-ELEV-OTLN	MELOT	Building Outlines
M-ELEV-PATT	MELPA	Textures and Hatch Patterns
M-ELEV-IDEN	MELID	Identification Numbers
M-SECT	**MSE**	**Sections**
M-SECT-MCUT	MSEMC	Material Cut by Section
M-SECT-MBND	MSEMB	Material beyond Section Cut
M-SECT-PATT	MSEPA	Textures and Hatch Patterns
M-SECT-IDEN	MSEID	Identification Numbers
M-DETL	**MDE**	**Details**
M-DETL-MCUT	MDEMC	Material Cut by Section
M-DETL-MBND	MDEMB	Material beyond Section Cut
M-DETL-PATT	MDEPA	Textures and Hatch Patterns
M-DETL-IDEN	MDEID	Identification Numbers

Mechanical (continued)

Long Format Layer Name	Short Format Layer Name	Layer Description
		Drawing Information Layers
M-SHBD	MSH	Sheet Border and Title Block Line Work
M-SHBD-TTLB	MSHTT	Project Title Block and Project Name
M-SHBD-LOGO	MSHLO	Project or Office Logo
M-PPIP	MPP	Piping Plan
M-PDUC	MPD	Duct Plan
M-PEXD	MPE	Exhaust Duct Plan
M-PHVA	MPH	HVAC Plan
M-PSTM	MPS	Steam Piping Plan
M-PWCH	MPW	Chilled Water Piping Plan
M-PMED	MPM	Special Medical Process – Piping Plan
M-PCON	MPC	Controls Plan
M-P***	MP*	Other Mechanical Plans
M-ELEV	MEL	Elevations
M-SECT	MSE	Sections
M-DETL	MDE	Details
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M-****-NPLT	M**NP	Nonplot Information and Construction Lines
M-****-PLOT	M**PL	Plotting Targets and Windows

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