IMTG
GIS Support Services Division

# CAD Standards for LAWA Projects

# Document History

| revision letter | release date | major changes | approved by |
|---|---|---|---|
| A | September 2012 | new version of standards | |
| B | June 2014 | General Review | |
| C | August 2014 | IMTG GIS Support Services Division | |

# Table of Contents

# About this book

The standards described in this document are provided to help LAWA staff, consultants and project partners prepare CAD files for use in LAWA projects.

By using these standards, LAWA will achieve a standardized approach to spatial data management and related record document(s) that will bring many benefits to both the organization and its staff. These benefits include, but are not limited to:

- consistent and more reliable data that will lead to more informed decision making
- closer integration with other LAWA information systems and LAWA spatial data users
- portability of staff skills
- greater interoperability with organizations outside of LAWA

## Relation to existing standards

These LAWA-specific standards are generally derived from version 5.0 of the United States National CAD Standard. More detailed topics such as layer guidelines also refer to the AIA standards.

## Who should read this book

This book is intended for all LAWA project partners, and especially for members of their staff who prepare CAD drawings for use within a project. It is provided to promote and support effective implementation of CAD drawing standards within the airport, for the full project life-cycle.

## How this book is organized

After the introduction, this book contains the following chapters and appendixes:

**Drawing organization**

Introduces the ideas of model and sheet files, and gives the title, length and description of each component of a standard file-reference

**Appearances and presentation**

Covers standards for lines, text, sheet organization, north arrow, drawing scale, and dimensioning.

**Layers**

Explains how layers are used for organization in AutoCAD and gives standards – based on AIA CAD guidelines – for identifying them

**Symbols**

Introduces the ideas of standardizing block entities

**Appendix A. File type codes per discipline**

List of valid file types per discipline

## Related documents

BIM, GIS, Survey, Metadata and EDI standards along with other documentation related to these standards are available on the LAWA website. LAWA Standard Documents and Guidelines

## Abbreviations

| | | |
|---|---|---|
| AEGIS | - | Airport Enterprise Geographical Information System |
| ANSI | - | American National Standards Institute |
| BIM | - | Building Information Modeling |
| CAD | - | Computer Aided Design and Drafting |
| CPPE | - | Capital Planning, Programming and Engineering |
| CSDGM | - | Content Standard for Digital Geospatial Metadata |
| DDMS | - | Document & Drawing Management System |
| EDI | - | Electronic Data Interchange |
| FAA | - | Federal Aviation Administration |
| FGDC | - | The Federal Geographic Data Committee |
| GIS | - | Geographic Information System |
| GISSSD | - | GIS Support Services Division |
| IMTG | - | Information Management Technology Group |
| ISO | - | International Organization for Standardization |
| LAWA | - | Los Angeles World Airports |
| LAX | - | Los Angeles International Airport |
| ONT | - | Ontario Airport |
| PMD | - | Palmdale Airport |
| SDSFIE | - | Spatial Data Standards for Facilities, Infrastructure, and Environment |
| VNY | - | Van Nuys Airport |

# Introduction

The standards cover the following aspects:

**Drawing organization**

How graphical information about a project is organized, including how the filenames for model files and the sheet files derived from them are built up.

Using agreed conventions makes it easy to identify the designer, location, discipline and subject of any file.

**Drafting conventions**

How information is presented in model files and sheet files, including standards for line width and color, fonts, and text orientation.

Using agreed drafting conventions helps ensure consistency through all related files, which makes it easier to compare and exchange information.

**Layer-structure**

How information (including blocks) is presented consistently on the appropriate layer.

Using agreed layers makes it easy to extraction and visualize information within a file or a set of files, and makes it easier to exchange files.

**Symbols**

Standard symbols used on CAD files throughout the airport environment.

Using agreed symbols helps ensure consistency, and reduces the effort required to create new files.

| | |
|---|---|
| ❖<br>❖ | All files and documents submitted to LAWA must be accompanied by a transmittal form holding all required metadata.<br>Transmittal forms along with other documentation related to these standards are available on the LAWA website. LAWA Standard Documents and Guidelines |

## Benefits of CAD Standards

Drawing up and implementing detailed standards for CAD files standards is intended to ensure a smooth flow of information at every stage of the project. Consistent, comparable files bring benefits that include the following:

- project partners can share information confidently and easily
- common format and comparable detail references are used for all projects within LAWA
- information is presented in the same place in each set of drawing files
- non-compliance and other errors can be quickly detected, reducing the need for change requests
- data can easily be translated between languages and file-formats; document storage and retrieval can be automated

## General principles

- except for some specialized schematics, the software used to produce CAD drawings is AutoCAD (a recent version)
- the unit of measurement used for CAD architectural drawings is the inch
- the unit of measurement used for CAD civil drawings is the U.S. foot
- project codes are defined by LAWA on a project per project basis
- all civil drawings must be created in NAD 83 California State Planes, Zone V, US Foot coordinate system
- all civil drawings will identify the survey epoch used, for example NSRS 2007, CORS 96, etc..
- all architectural drawings must use positive values for coordinates
- all spatial data must be created in “Model Space”
- all graphical elements must be in “Paper Space”

## Templates

Project partners and subcontractors who need to implement the CAD standards for LAWA projects can download templates to provide a working environment based on the LAWA CAD Standards. Each template (`.dwt` file) defines the layers for a specific discipline. Sample title blocks can also be downloaded.

# Standards in use at LAWA

## LAWA standards

This section provides an overview of LAWA specific standards, plus related federal, local, and national standards. LAWA standards have been created to improve productivity and reliable information exchange through the full life-cycle of geospatial data, CAD and BIM files along with related documents.

**LAWA Metadata Standards**

Metadata is structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource. Metadata is often called data about data or information about information.

**LAWA GIS Standards**

The LAWA GIS standards are directly based on the ANSI Spatial Data Standard for Facilities Infrastructure and Environment (SDSFIE), Release 2.60, extended in certain areas to handle specific information relevant to LAWA. *GIS Standards for LAWA Projects* presents the most important aspects of SDSFIE as it applies to LAWA.

**LAWA Survey Standards**

The LAWA Survey and Remote Sensing Standards are based on requirements laid out in Airport Circulars published by the FAA, adapted where necessary to suit LAWA-specific requirements.

**LAWA BIM Standards**

These guidelines focus primarily on adaptation of standards for practical and efficient application of BIM, particularly at the handover (Record - As-Built) stage of a project. Based on USACE_CAD-BIM_Technology Center: version 1.1 and National BIM standard (United States): version2

**LAWA EDI (Electronic Data Interchange) Standards**

This Standard provides a framework for all data requests and all hard copy or electronic data submittals to or from LAWA, thus ensuring a streamlined data exchange process

| | |
|---|---|
| ❖ | These standards along with other documentation related to these standards are available on the LAWA website. LAWA Standard Documents and Guidelines |

## National and International standards

### AIA CAD Layer Guidelines and the National CAD Standards (NCS)

The LAWA CAD standards are based largely on the AIA CAD Layer Guidelines and the National CAD Standards (NCS), adapted where necessary to suit LAWA-specific requirements.

### SDSFIE 2.6

The overall structure of LAWA current geospatial repository is based on SDSFIE 2.6.

SDSFIE organizes real world features such as runways, roads and water pipes into a hierarchical structure.

## Compliance

Having timely up to date, accurate, fully compliant data available to the LAWA community forms an integral part of planning within any project. The aim of these standards is to ensure a smooth data transfer of information into the LAWA geospatial data base and efficient data maintenance through the complete data lifecycle. Accordingly, the terms and conditions of a LAWA contract require compliance with these standards.

Failure to comply with these standards may result in organizations being back-charged for any financial costs incurred by LAWA for rectifying inconsistencies and errors

| | |
|---|---|
| ❖ | See EDI for standards governing data submitted to LAWA, this along with other documentation related to these standards are available on the LAWA website. LAWA Standard Documents and Guidelines |

The individual or organization submitting the files is also responsible for ensuring that all links between non-graphic data and graphic data, and all relationships between database tables, shall be preserved or automatically reconstructed when data is transferred to the LAWA GIS environment.

## Request of Variance

Compliance with the LAWA standards and data deliverables demands are the cornerstone of achieving trustworthy and relevant data.

Suggestions for improvements or extensions to these standards and demands are encouraged, to meet unforeseen requirements and as a way to improve effectiveness and clarify any ambiguities; any such deviation must be approved by LAWA, in advance and in writing. . Requests need to be submitted on the “Request for variance” form, this form along with other documentation related to these standards are available on the LAWA website. LAWA Standard Documents and Guidelines

## Exporting Revit (.rvt) files to CAD (.dwg)

When exporting Revit files to .dwg, special care must be taken to ensure that all LAWA CAD standards are maintained.

To assist in maintaining these standards, a Revit to CAD template is available upon request from LAWA

| | |
|---|---|
| ❖ | **Export views on sheets and links as external references**<br>Must be set as unchecked, all links in the Revit export to dwg shall be contained in one file with no references. |

# Drawing Organization

This section covers CAD model files and sheet files, naming conventions, and external reference files.

## Model Space and Paper Space (Sheet files)

AutoCAD has two distinct working spaces to create drawing objects, a model space and a paper space. All drawings for LAWA should have properly organized model and paper spaces:

- model space is for creating a model or drawing composed of geometric objects
- All data representing features must be drawn in the model space
- paper space is used for plots (sheet files) of drawings created in model space
- Paper space usually contains single or multiple viewports of a model, any specified scale and orientation, a title block, a north arrow, a legend, and a scale bar. Any descriptive text for a drawing (other than dimensions or object-related notes) must be placed in a paper space view.

## Naming Conventions

Naming conventions for electronic drawing files (model files and sheet files) allow users to identify the content and relevance of the drawing. They provide basic minimum information for organizing the files within a project directory and or entering them into an electronic document management system.

## Naming Conventions for Model Files

Model file names are made up of four mandatory elements, which must be used in the correct sequence. These names are structured to ensure consistency among different disciplines within the project.

- the first two elements are the unique project code and the discipline designator, followed by a hyphen
- the file type is a two-character code describing the content of the file
- a project-specific code identifying the coverage of the model file
- the extension (a period or stop followed by three letters) identifying the file format, for example *.dwg*

The combination of discipline designator and file type makes it possible to locate files and identify them consistently:

- A-DT identifies a model file showing detail information related to Architecture
- E-DT identifies a model file showing detail information related to Electricity

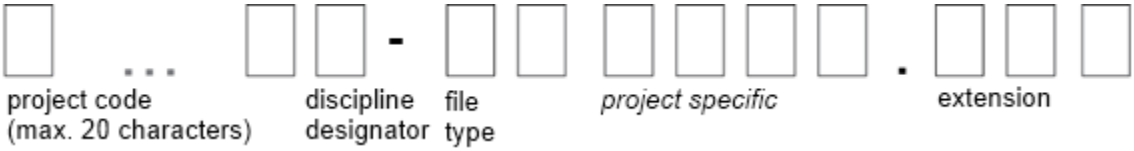



*Figure 1. Model file naming convention*

| *Model file names* | | |
|---|---|---|
| **component** | **length** | **comment** |
| project code | up to 20 | Project codes are developed by LAWA and provided to the contractors for each project. Agreed project codes must be used in all LAWA files, to guarantee unique, consistent file names. |
| discipline designator | 1 | Model files for LAWA projects use one letter for the discipline designator. The single character discipline designator must be followed by a hyphen, separating it from the file type code.<br>Allowable characters for the discipline designator in model files are listed in 0 Discipline designators for model files |
| file type code | 2 | This code identifies the content of the model file, for example DT (detail) or PR (profile). Using codes ensures consistency among different disciplines.<br>Allowable characters for the file type code are listed in Appendix A. |
| project specific | 4 | These four-character codes are defined per project, and generally identify a zone or area; for example, Floor 1, west quadrant.<br>Use lower case x as a placeholder for unused characters |
| extension | 3 | identifies the file format |

| *Discipline designators for model files* | | | |
|---|---|---|---|
| **discipline** | **designator** | **discipline** | **designator** |
| A | Architectural | O | Operations |
| B | Geotechnical | P | Plumbing |
| C | Civil | Q | Equipment |
| D | Process | R | Resource |
| E | Electrical | S | Structural |
| F | Fire Protection | T | Telecommunications |
| G | General | V | Survey/Mapping |
| H | Hazardous Materials | W | Civil Works |
| I | Interiors | X | Other Disciplines |
| L | Landscape | Z | Contractor/Shop Drawings |
| M | Mechanical | | |

## Examples

| P | R | O | J | E | C | T | 1 | A | - | F | P | F | 1 | x | x | . | d | w | g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| *project* | project reference (max. 20 characters) |
| *discipline* | architectural |
| *file type* | floor plan |
| *project-specific* | first floor |

| P | R | O | J | E | C | T | 3 | F | - | F | A | F | 2 | x | x | . | d | w | g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| *project* | project reference (max 20 characters) |
| *discipline* | fire protection |
| *file type* | fire alarm/detection plan |
| *project-specific* | second floor |

| P | R | O | J | E | C | T | 1 | C | - | A | F | S | 8 | x | x | . | d | w | g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| *project* | project reference (max 20 characters) |
| *discipline* | civil |
| *file type* | airfield plan |
| *project-specific* | sector 8 |

## Naming Conventions for Sheet Files

Sheet file names are made up of five mandatory elements, which must be used in the correct sequence. These names are structured to ensure consistency among different disciplines within the project.

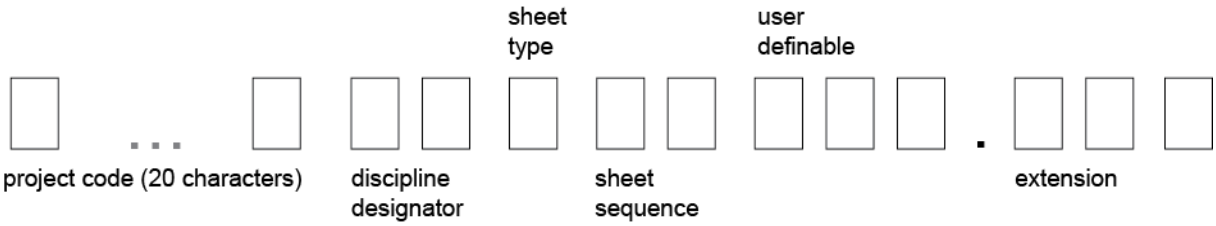



*Figure 2. Sheet naming convention*

| *Sheet file names* | | |
|---|---|---|
| **component** | **length** | **comment** |
| project code | up to 20 | Project codes are developed by LAWA PMD or their authorized representative and are provided to the contractors for each project. Agreed project codes must be used in all LAWA files, to guarantee unique, consistent file names. |
| discipline designator | 2 | The discipline designator for a sheet file name identifies the discipline in detail, and normally consists of two letters. Where a product file applies to a high-level discipline with a single-letter code, the second letter is replaced with a hyphen.<br>Allowable characters for the discipline designator in sheet files are listed in Appendix A. |
| sheet type code | 1 | A numerical character that identifies the type of information on the sheet.<br>See 0Sheet type designators |
| sheet sequence number | 2 | 01 to 99 – always two digits, with a leading zero if necessary |
| defined per project | 3 | These three-character codes are defined per project, and generally identify a zone or area. |

| *Sheet type designators* | |
|---|---|
| **Sheet Type** | **Designator** |
| General (symbols legend, notes, etc.) | 0 |
| Plans (horizontal views) | 1 |
| Elevations (vertical views) | 2 |
| Sections (sectional views) | 3 |
| Large Scale Views (plans, elevations, or sections that are not details) | 4 |
| Details | 5 |
| Schedules and Diagrams | 6 |
| User Defined | 7 |
| User Defined | 8 |
| 3D Representations (isometrics, perspectives, photographs) | 9 |

## Examples

| P | R | O | J | E | C | T | 1 | A | E | 1 | 0 | 2 | F | 1 | B | . | d | w | g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

*project* Project reference (max 20 characters)
*discipline* AE (Architectural, Elements)
*sheet type* 1 – plan (horizontal view)
*sheet sequence* 02
*project-specific* F1B – first floor, quadrant B

| P | R | O | J | E | C | T | 1 | F | A | 5 | 0 | 5 | F | 2 | C | . | d | w | g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

*project* Project reference (max 20 characters)
*project* FA (Fire protection, Fire Alarm/Detection Plan)
*sheet type* 5 – details
*sheet sequence* 05
*project-specific* F2C – second floor, quadrant C

| P | R | O | J | E | C | T | 1 | C | - | 1 | 1 | 6 | A | S | 8 | . | d | w | g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

*project* Project reference (max 20 characters)
*project* C- (Civil)
*sheet type* plan (horizontal view)
*sheet sequence* 16
*project-specific* AS8 – airfield sector 8

## Reference Files

Using reference files is recommended and promoted in LAWA projects, because:

- they make it possible to work with smaller files
- they allow different people to work on different project drawings (for example, drawings from different disciplines) at the same time
- every time a drawing using references file is loaded, the user sees the most recent version of the drawing

IMPORTANT Drawings using reference files must be stored in the same directory/ subdirectory as the files they refer to.

External references to other CAD files may be used to manage the content of a large CAD drawing as several smaller, more efficient drawings. The use of this procedure will reduce drawing size, increase performance, improve operator efficiency and make coordination of disciplines easier.

# Appearance and Presentation

This chapter covers standards for lines, text, sheet organization, north arrow, drawing scale, and dimensioning.

## Lines

Standards for line drawing cover:

- line weight
- line type (line style)
- line color

### Line weight

Using the correct line width makes drawings more readable, by making more important information stand out.

- wider lines draw attention to the part of the drawing where they are used, and place emphasis on certain elements
- screen or half-tone lines de-emphasize drawing elements
- The line weights to be used for each feature type in LAWA project drawings are available on the LAWA website. Typical use for line weights from Fine to XXXX Wide are described in the next table.

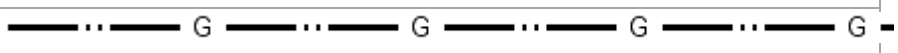
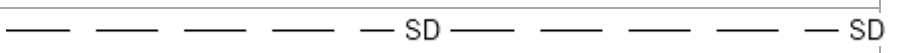
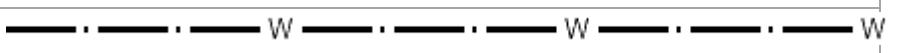
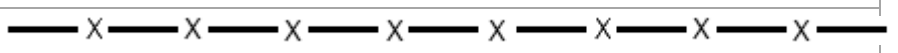
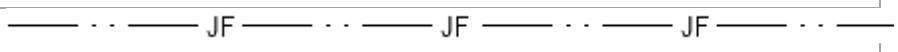
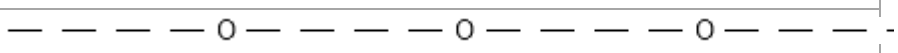
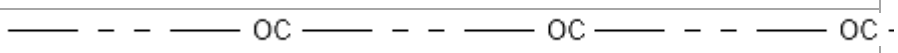
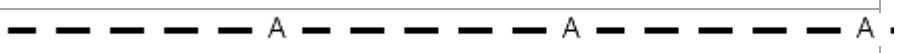
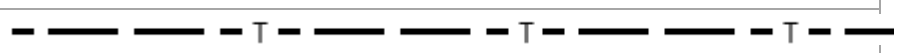
*Typical line weight usage*

| **line weight** | | **width (mm)** | **width (inch)** | **usage** |
|---|---|---|---|---|
| Fine | | 0.18 | 0.007 | Material indications, surface marks, hatch lines, patterns |
| Thin | | 0.25 | 0.010 | Dimension lines, leaders, extension lines, break lines, hidden objects, dotted lines, dashed lines, setback lines, center lines, grid lines, schedule grid lines |
| Medium | | 0.35 | 0.014 | Object lines, property lines, text, lettering, terminator marks, door and window elevations, schedule grid accent lines |
| Wide | | 0.50 | 0.020 | Titles, edges of interior and exterior elevations, profiling; cut lines, property lines, section cutting plane lines, drawing block borders |
| Extra wide | | 0.70 | 0.028 | Minor title underlining, schedule outlines, large titles, and |

| *Typical line weight usage* | | | | |
|---|---|---|---|---|
| **line weight** | | **width (mm)** | **width (inch)** | **usage** |
| | | | | object lines requiring special emphasis.<br>Match lines, large titles, footprints, title block borders, sheet borders, schedule outlines. |
| XX Wide | | 1.00 | 0.039 | Major title underlining and separating portions of designs. |
| XXX Wide | | 1.40 | 0.055 | Border sheet outlines and cover sheet line work |
| XXXX Wide | | 2.00 | 0.079 | Border sheet outlines and cover sheet line work |

## Line type (line style)

Line types for use in LAWA project drawings are available on the LAWA website, as AutoCAD templates `tsaec.rsc` and `tsaec.lin`. Sample line types are illustrated in the next table.

| *Samples of LAWA line types* | |
|---|---|
| electric line |  |
| gas line |  |
| sewer line |  |
| storm drain line |  |
| water line |  |
| fence line |  |
| jet fuel line |  |
| other line |  |
| oil company line |  |
| ACAMS |  |
| telephone line |  |
| traffic signal c. |  |

LAWA line types are based on the standard AutoCAD line types shown in the next table.

| *AutoCAD standard line types* | | |
|---|---|---|
| **Description** | **Example** | **AutoCAD Designator** |
| continuous |  | Continuous |
| dotted |  | ACAD_ISO07W100 |
| dashed |  | ACAD_ISO02W100 |
| dashed spaced |  | ACAD_ISO03W100 |
| dashed dotted |  | ACAD_ISO10W100 |
| dashed double-dotted |  | ACAD_ISO12W100 |
| dashed triple-dotted | N/A | ACAD_ISO14W100 |
| chain |  | ACAD_ISO08W100 |
| chain double-dashed | N/A | ACAD_ISO09W100 |

## Line color

The next table lists recommendations for line colors and widths. Note that exceptions may apply.

| *Examples of recommended line colors (screen values)* | | | |
|---|---|---|---|
| **color** | **color no.** | **line width (mm)** | **color (RGB)** |
| red | 1 | 0.18 | 255,0,0 |
| yellow | 2 | 0.25 | 255,255,0 |
| green | 3 | 0.35 | 0,255,0 |
| cyan | 4 | 0.35 | 0,255,255 |
| blue | 5 | 0.50 | 0,0,255 |
| magenta | 6 | 1.00 | 255,0,255 |
| white (or black) | 7 | 1.40 | 255,255,255 |
| grey | 8 | 0.35 | 128,128,128 |
| dark red | 14 | 0.70 | 153,0,0 |
| rust | 23 | 0.50 | 204,127,102 |
| brown | 36 | 1.40 | 127,63,0 |
| dark yellow | 54 | 0.70 | 153,153,0 |
| dark green | 94 | 0.70 | 0,153,0 |
| dark cyan | 134 | 0.70 | 0,153,153 |
| dark blue | 154 | 0.70 | 0,76,153 |
| dark magenta | 214 | 0.70 | 153,0,153 |
| dark gray | 250 | 0.25 | 51,51,51 |

| *Examples of recommended line colors (screen values)* | | | |
|---|---|---|---|
| **color** | **color no.** | **line width (mm)** | **color (RGB)** |
| med/dark gray | 251 | 0.35 | 91,91,91 |
| med/light gray | 252 | 0.50 | 132,132,132 |

## Text

Standards for text cover:

- text styles and fonts
- text size

### Text styles and fonts

Different text styles and fonts are used within all LAWA project drawings to identify different types of information.

The five approved text styles are:

- monotext (AutoCAD monotext font)
- proportional (AutoCAD Romans font, with a width factor of 0.8)
- slanted (AutoCAD Romans font with Obliquing Angle set to 21.8 deg to achieve the American Standard slope of 2 in 5
- filled (AutoCAD Swiss TrueType font, with the `TEXTFILL` system variable set to 1
  `arialbd.ttf` (Microsoft) can be used as an alternative
- outline (AutoCAD Sasb (Sans Serif-bold) PostScript font

| *Typical uses for text styles* | |
|---|---|
| **usage** | **text style** |
| schedules, title blocks and other aligned text fields with evenly spaced characters | monotext |
| general notes, labels, or title blocks with proportionally spaced characters | proportional |
| text that needs to stand out from other text around it | slanted |
| titles and cover sheets | filled |
| major titles such as cover sheet information, when using a pen plotter for final output | outline |


*Figure 3. Recommended AutoCAD fonts*

## Text sizes

All lettering in LAWA project drawings must be:

- of sufficient size (minimum height 0.20”) and weight, so that it can be easily read from a print that has been reduced to half the size of the original drawing

  Specific text height requirements apply to the title block, as described under Title BlockTitle Block on page 21.

- oriented to facilitate reading from the bottom or right hand edge of the sheet
- in capital letters only (uppercase)

Note that minimum text height also depends on paper size.

| *Minimum text height, based on paper size – all measurements in inches* | | | |
|---|---|---|---|
| **paper size** | **civil** | **engineering** | **architectural** |
| 11 x 17 | 0.0625 | 0.0625 | 1/16 |
| 24 x 36 or larger | 0.09375 | 0.09375 | 3/32 |

## Sheet organization

Sheet organization primarily involves sheet size and title block.

### Sheet Size

All LAWA project drawings shall be 24” x 36” (D-size). The sheet medium shall be 0.4 mm thick and double matted erasable.

Common sheet sizes for other types of drawing are shown in the next table.

*Sheet sizes*

| sheet size | dimensions (inches) | usage |
|---|---|---|
| A | 8.5 x 11.0 | Project book<br>Supplemental drawings<br>Mock-up sheets |
| B | 11.0 x 17.0 | Reduced drawings from "D" size<br>Supplemental drawings<br>Mock-up sheets |
| C | 17.0 x 24.0 | Small projects accommodating preferred plan scale |
| D+ | 24.0 x 36.0 | Projects accommodating preferred plan scale |
| E+ | 36.0 x 48.0 | Large projects accommodating preferred plan scale<br>Mapping and GIS. |

### Title Block

LAWA has its own distinctive project title block, including:

- LAWA company logo
- designer identification
- project identification
- drawing issue (issue date and revision level)
- management information (all relevant meta data)
- sheet title
- sheet identification

The title block is placed horizontally. A source file for the standard title block can be downloaded from the LAWA website.

Line heights for use in the title block are fixed:

- Line 1: letter height 0.140 inches
- Line 2: letter height 0.290 inches:
- Line 3: letter height 0.200 inches
- Line 4: letter height 0.200 inches

The general rules for line widths may not always apply in title blocks.

## North arrow

By default, the project North arrow symbol shall be placed beneath the extension of the top line of the title block. Exceptionally, the arrow may be placed where cartographically feasible.

## Drawing scale

Every sheet shall indicate the scale of the drawing, both as a ratio and as a graphical scale bar. In order of preference, graphical scale bars shall be placed:

1. beneath the extension of the top line of the title block
2. above the title block
3. where cartographically feasible

Where a single sheet includes drawings at different scales, for example a main drawing and a detail shown at a larger scale, every drawing must have its own scale indicators.

## Dimensioning

All useful measurements must be indicated as dimensions. The letter height used for dimensions must be easily readable from a print that has been reduced to half the size of the original drawing. Additionally:

- dimension figures shall be lettered parallel to and above the dimension line, and arranged to read from the bottom border or right hand border;
- within a single sheet, care must be taken to show each dimension only once, and in its proper location
- where dimensions cross the match-lines between two sheets, they shall be repeated on both sheets
- dimension styles for both architectural and site plan drawings have been created at various scales for AutoCAD. These dimension styles are included in the AutoCAD templates provided for the project.

# Guidelines for layers

Layers are a key organizational tool used in all LAWA projects for AutoCAD files:

- to separate graphic elements (lines, shapes, and text) according to the design discipline and feature type they represent
- to enforce line-type, color and other standards

Layer 0 is a neutral layer which should be kept 'clean', with status always thawed and on.

Layers must be identified according to the standards for LAWA projects.

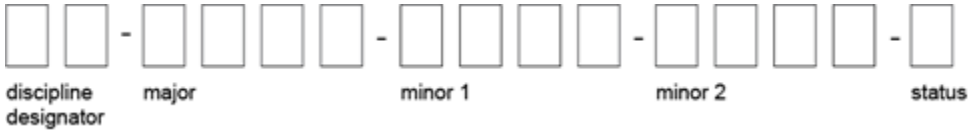
Detailed standard layer tables are available on the LAWA website.

## Layer Naming Convention

Layer names consist of distinct data fields, separated from one another by a hyphen. The full standard allows for five fields, but not all fields/characters have to be completed:

- where the second character of a discipline designator is not used, it is omitted
- where a Minor field or the Status field is not used, it is omitted
- where the last character or characters of a Minor field are not used, it is replaced by an underscore _
- exceptionally, the standards may define a minor 3, to be included in the layer name the same way as minor 1 and minor 2

The layers defined within these standards are based on the recommendations in *American Institute of Architects CAD Layer Guidelines*, as adopted by the NCS.




| *Layer name structure* | | |
|---|---|---|
| **component** | **length** | **comment** |
| discipline designator | 1 or 2 | The first character represents the discipline, and is mandatory.<br>The second character, which identifies the designator in more detail, is optional; the meaning depends on the first character. |

| *Layer name structure* | | |
|---|---|---|
| **component** | **length** | **comment** |
| major group | 4 | The major group normally identifies a building component or airport feature<br>The major group may also be used to identify:<br>– annotations (ANNO)<br>– drawing views (detail DETL, elevation ELEV or section SECT)<br>– demolition (STAT), used only in creating Existing Demolition model files |
| minor group 1 | 4 | Adding minor group 1 after the major group gives more detailed information about the layer. |
| minor group 2 | 4 | Adding minor group 2 after minor group 1 and the major group gives the most detailed information about the layer.<br>Minor group 2 is not always required. |
| status | 1 | Identifies the status of work or construction phase of the data contained on the layer.<br>Whether or not the status field is used depends on the project. |

## Examples

| E | - | L | I | T | E | - | S | I | G | N |
|---|---|---|---|---|---|---|---|---|---|---|

*designator* Electrical
*major/minor 1* taxiway guidance signs

| A | - | B | A | G | S | - | I | C | N | V | - | E |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

*designator* Architectural
*major/minor 1* inbound baggage conveyor
*status* to remain

| A | E | - | W | A | L | L | - | F | U | L | L |
|---|---|---|---|---|---|---|---|---|---|---|---|

*designator* Architectural elements
*major/minor 1* walls: full-height

| G | - | A | N | N | O | - | R | E | D | L | - | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| *designator* | General |
| *major/minor 1* | redlines |
| *status* | temporary |

| C | - | A | I | R | F | - | A | I | D | S | - | I | L | S | _ | - | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | |
|---|---|
| *designator* | Civil |
| *major/minors* | Airfield Instrument Landing System |
| *status* | future work |

## Layer assignment

In line with the AIA NCS, LAWA standards provide the following information for all discipline designators and layers used in LAWA projects:

- first character of a discipline designator
- layer name
- detailed description of each layer
- line style, line width (in mm), and color for each layer

The complete CAD layer assignment table is provided as a separate document.

To use other layers or designators, project partners must submit a “request for variance” form to the project manager. The proposed layers or designators may not be used in LAWA project drawings unless and until the project manager has approved them.

## Symbols/Blocks

A block in AutoCAD is a group of graphical elements logically or locationally combined to a single entity. Examples of logical blocks are windows, doors, graphic scale keys, furniture, etc. Locational blocks are made of all objects within a specified area.

The primary requirement of any type of block is that each graphical object in a block belongs to a proper layer listed in the AIA NCS. This means that each element comprising the block will, when fully exploded, be layered in conformance with established AIA NCS and LAWA standards.

# Appendix A. File type codes per discipline

Disciplines (plus the discipline codes) are listed here in alphabetical order, for ease of reference.

| *Discipline designators for model files* | |
|---|---|
| Architectural (A) | Landscape (L) |
| Civil (C) | Mechanical (M) |
| *Civil Works (W)* | *Operations (O)* |
| Electrical (E) | *Other disciplines* |
| *Equipment* | Plumbing (P) |
| Fire protection (F) | *Process* |
| General (G) | *Resource (R)* |
| Geotechnical (B) | Structural (S) |
| Hazardous materials (H) | Survey/Mapping (V) |
| Interiors (I) | Telecommunications (T) |

| P | R | O | J | E | C | T | 1 | A | - | F | P | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

Architectural

Floor plan

| Architectural (discipline A) | |
|---|---|
| **File type code** | **Definition** |
| 3D | Isometric 3D |
| AC | Area Calculations/Occupancy Plan |
| CP | Reflected Ceilinq Plan |
| DT | Detail |
| EL | Elevation |
| EP | Enlarqed Plan |
| FP | Floor Plan |
| LG | Legend |
| OP | Equipment Plan |
| RP | Roof Plan |
| SC | Section |
| SH | Schedule |
| XD | Existing/Demolition Plan |

| Civil (discipline C) | |
|---|---|
| **File type code** | **Definition** |
| AF | Airfield Plan |
| AM | Airfield Pavement Marking Plan |
| CP | Channel Plan |
| DT | Detail |
| EC | Erosion Control Plan |
| EL | Elevation |
| FU | Liquid Fuel Utilities Plan |
| GP | Grading Plan |
| IP | Installation Plan/Base Map |
| IW | Industrial Waste Water Plan |
| JP | Joint Layout Plan |
| KP | Staking Plan |
| LG | Legend |
| NG | Natural Gas Utilities Plan |
| PL | Project Location Map |
| PR | Profile |
| SC | Section |
| SH | Schedule |
| SP | Site Plan |
| SS | Sanitary Sewer Plan |
| ST | Storm Sewer Plan |
| TS | Transportation Site Plan |
| WA | Domestic Water Plan |
| XD | Existing/Demolition Plan |

| Electrical (discipline E) | |
|---|---|
| **File type code** | **Definition** |
| AL | Airfield Lighting Plan |
| AP | Auxiliary Power Plan |
| CP | Exterior Communication Systems Plan |
| DG | Diagram |
| DT | Detail |
| EU | Electrical Utilities Plan |
| GP | Grounding System Plan |

| Electrical (discipline E) | |
|---|---|
| **File type code** | **Definition** |
| LG | Legend |
| LP | Lighting Plan |
| PP | Power Plan |
| SH | Schedule |
| SS | Special Systems Plan |
| XD | Existing/Demolition Plan |
| PC | Power & Communication |

| Fire Protection (discipline F) | |
|---|---|
| **File type code** | **Definition** |
| DG | Diagram |
| DT | Detail |
| FA | Fire Alarm/Detection Plan |
| FP | Fire Suppression Plan |
| LG | Legend |
| LP | Life Safety Plan |
| SH | Schedule |
| XD | Existing/Demolition Plan |

| General (discipline G) | |
|---|---|
| **File type code** | **Definition** |
| BS | Border Sheet |
| KP | Keyplan |

| Geotechnical (discipline B) | |
|---|---|
| **File type code** | **Definition** |
| BL | Boring Location Plan |
| LB | Boring Log |
| LG | Legend |
| SH | Schedule |

| Interiors (discipline I) | |
|---|---|
| **File type code** | **Definition** |
| 3D | Isometric/3D |
| DT | Detail |
| EL | Elevation |
| EP | Enlarged Plan |
| LG | Legend |
| OP | Equipment Plan |
| RP | Furniture Plan |
| SC | Section |
| SH | Schedule |
| SP | Signage Placement Plan |
| WP | System/Prewired Workstation Plan |
| XD | Existing/Demolition Plan |

| Hazardous materials (discipline H) | |
|---|---|
| **File type code** | **Definition** |
| DT | Detail |
| EL | Elevation |
| LG | Legend |
| PP | Pollution Prevention Plan |
| SC | Section |
| XD | Existing/Demolition Plan |

| Landscape (discipline L) | |
|---|---|
| **File type code** | **Definition** |
| DT | Detail |
| EL | Elevation |
| IP | Irrigation Plan |
| LG | Legend |
| LP | Landscape Plan |
| SC | Section |
| SH | Schedule |
| XD | Existing/Demolition Plan |

| Mechanical (discipline M) | |
|---|---|
| **File type code** | **Definition** |
| 3D | Isometric/3D |
| DG | Diagram |
| DT | Detail |
| EL | Elevation |
| EP | Enlarged Plan |
| HP | HVAC Plan |
| HT | HTCW Utilities Plan |
| LG | Legend |
| MD | Machine Design Plan |
| MH | Material Handling Plan |
| PP | Piping Plan |
| QP | Equipment Plan |
| SC | Section |
| SH | Schedule |
| SP | Specialty Piping Plan |
| XD | Existing/Demolition Plan |

| Plumbing (discipline P) | |
|---|---|
| **File type code** | **Definition** |
| DG | Diaqram |
| DT | Detail Elevation |
| EP | Enlarqed Plan |
| LG | Legend |
| PP | Piping Plan |
| SH | Schedule |
| XD | Existing/Demolition Plan |

| Structural (discipline S) | |
|---|---|
| **File type code** | **Definition** |
| 3D | Isometric/3D |
| CP | Column Plan |
| DT | Detail |
| EL | Elevation |

| Structural (discipline S) | |
|---|---|
| **File type code** | **Definition** |
| EP | Enlarged Plan |
| FP | Framing Plan |
| LG | Legend |
| NB | Non-Building Structures Plan |
| NP | Foundation Plan |
| SC | Section |
| SH | Schedule |
| XD | Existing/Demolition Plan |

| Survey/Mapping (discipline V) | |
|---|---|
| **File type code** | **Definition** |
| AL | Existing Airfield Lighting Plan |
| CP | Existing Communication Plan |
| EU | Existing Electrical Utilities Plan |
| FU | Existing Liquid Fuel Utilities Plan |
| HP | Hydrographic Survey Plan |
| HT | Existing HTCW Utilities Plan |
| IW | Existing Industrial Waste Water Plan |
| LG | Legend |
| NG | Existing Natural Gas Utilities Plan |
| PB | Project Boundary |
| PR | Existing Profile |
| SC | Existing Section |
| SP | Survey and Mapping Plan |
| SS | Existing Sanitary Sewer Plan |
| ST | Existing Storm Sewer Plan |
| WA | Existing Domestic Water Plan |

| Telecommunications (discipline T) | |
|---|---|
| **File type code** | **Definition** |
| DG | Diagram |
| DT | Detail |
| LG | Legend |
| SH | Schedule |
| TP | Telephone/Data Plan |
| XD | Existing/Demolition Plan |