CAD Industry Skills and Standards

CAD INDUSTRY STANDARDS are important because the standards ensure consistency among architects, drafters, builders, CAD designers, government agencies, and businesses. How can a CAD drawing be printed anywhere, by anyone, and it will look the same no matter who prints it? The answer is CAD standards.

Objective:

Identify CAD standards organizations and describe CAD/CADD skill standards.

Key Terms:

American Institute of Architects (AIA) CAD Layer Guidelines
American National Standards Institute (ANSI)
appendices
Building Information Modeling (BIM)
BIM implementation
CAD standards
International Organization for Standardization (ISO)
plotting guidelines
Uniform Drawing System (UDS)
United States National CAD Standards (NCS)

CAD Standards Organizations and CAD/CADD Skills

CAD standards are a collection of specific guidelines, for CAD/CADD production, that encompass drawing requirements, illustrative appearances, formulation techniques, operating procedures, and record-keeping methods. These standards allow work to be shared between

multiple companies and industries who use the same formatting rules. CAD utilizes international, national, and industry-specific standards.

CADD STANDARDS AND ORGANIZATIONS

There are some basic standards that most CAD users follow, as well as industry standards set by different organizations.

Basic Standards

In our technical, fast-paced world, standards are constantly being created and revised. However, the reasons for implementing CAD standards remain the same. The following topics relay the importance of standards shared between national and international companies.

Uniformity

A variety of industries use CAD drawings. Within a CAD drawing or document, there are multiple options for font sizes, date formats, metric or imperial measurements, etc. If an architect, an engineer, and a title company representative must view the same document, a set format standard allows the person from each industry to open, view, and understand the needed information.

Template Creation

When multiple organizations use the same formats, templates can be used to start a drafting project. These templates have preset fonts, illustrative tools, and other preset formats. This saves time and money.

Universal Readability

If a designer needs to work from previous files or drawings, the material should be understandable. By using the same standards, a designer can read, modify, and share drawings without a problem.

Layout

When plotting or printing a drawing, a drafter needs to know the specifications of line weights, scale, and other details. When using a shared CAD standard, a drafter knows exactly where to find these specifications.

Time

Beside the ease of using preset templates, there is an additional benefit. A consistent format for individual drafts saves time. Most designers create work to be shared by multiple parties. Changing the specifications, based on each individual company, would take hours (and maybe days) of unnecessary work.

Training

CAD design can be a unique and creative art form, but a set of known rules ensures that everyone can view and appreciate a designer's creation. Working in layers of data, a trainee could easily be overwhelmed with conflicting input from training resources. With one set of rules, training becomes much simplified.

Sharing Between Firms

As stated earlier, CAD standards allow a work product to be used by multiple organizations and industries. It is also a bonus for clients. If a firm employs an in-house CAD engineer, they might possibly hire an outside company for specific CAD enhancements. If these two CAD designers used differing standards, the specialized CAD company would lose the firm as a client.

Office Procedures

The simple act of naming a computer file can create a problem. If there is not a set standard for the naming of files, then locating a desired file could be difficult. Specific formatting and saving methods allow easy access to computer files.

FIGURE 1. Standards are necessary for clear communication between construction team members.

Standards Organizations

National and international standards are applied to CAD and other aspects of business operations. To set up and initiate these rules, industry- and country-related organizations create guidelines for easy access to a set of known standards. The following is a list of the most used organizational guidelines.

ANSI

The **American National Standards Institute (ANSI)** is an organization that provides a forum for standards used by a wide variety of American interests, including companies, government agencies, non government organizations, standards developers, and consumers. These standards are voluntarily set, through the direction of industry leaders.

ISO

The **International Organization for Standardization (ISO)** is a global organization that promulgates standards for industrial, commercial, and public use. The majority of the voluntary standards relate to manufacturing and industry, while others relate to digital technolo-

gies and IT. The 162 members of ISO are national standards bodies. They share knowledge and develop standards to ensure quality, safety, and efficiency. Standards were originally set to ensure that every company, engaged in international trade, followed the same safety and product specifications. The list of standards has since expanded to include multiple industrial norms, including CAD.

NCS

The **United States National CAD Standard (NCS)** is an organization that centralizes data from The American Institute of Architect's CAD Layer Guidelines, the Construction Specification Institute's Uniform Drawing System (UDS), and the National Institute of Building Sciences BIM Implementation Plotting Guidelines. The NCS coordinates publications from the building design and construction industry to promote clear communication among owners, designers, and construction teams.

AIA

The **American Institute of Architects (AIA) CAD Layer Guidelines** are a portion of the U.S. National CAD Standard (NCS) that establish levels of layers in CAD drawings. This set of guidelines outlines the name format and provides exhaustive lists for more than twenty types of layers. This includes layers for:

- Distributed energy
- Real estate
- Survey/mapping
- Architectural
- Structural
- Fire protection
- Electrical
- Plumbing
- Mechanical
- Telecommunications

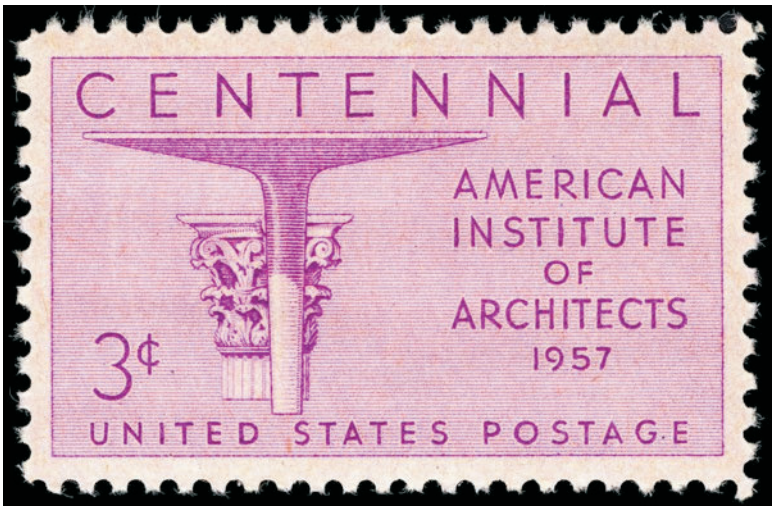


FIGURE 2. AIA is a professional organization for architects in the U.S., located in Washington, DC. This is a 1957 U.S. postage stamp commemorating the AIA's centennial.

UDS

AIA's **Uniform Drawing System (UDS)** is a system of specific guidelines for organizing, managing, and presenting construction drawings (sheets). The UDS includes eight modules:

- Drawing Set Organization: provides consistency in the way that a set of construction drawings is organized. Sheet identification is a key element. Sheets are identified with a discipline designator (e.g., P = Plumbing, E= Electrical), a sheet type designator (e.g., 2= Elevation, 6=Schedules & Diagrams), and a sheet sequence number.

- Sheet Organization: encompasses sheet size and location, drawing, title block, and production reference areas and their content.
- Schedules: provide that information organized in every schedule is consistent in format. Parts of a schedule are the heading, a mark column, an item description column, and a distinguishing feature column.
- Drafting Conventions: are the rules that pertain to drawing details: orientation, layout, symbols, material indications, line types, dimensions, drawing scale, diagrams, notation, and cross-referencing.
- Terms and Abbreviations: is a standardized resource for construction terms and abbreviations. Consistency is crucial for clear communication among the architect, the owner, the contractor, and the consultant. This module provides consistent standards and spelling, a searchable list, and notes on common use.
- Symbols: This reference list of standards is organized by symbol, symbol type and description, MasterFormat division, number, and three digit extension number.
- Notations: Construction documents include drawings and specifications. Text providing information, identification, and instruction may be added to a construction drawing. Those notes and the terms that they contain should be consistent with terms used in the specs. This module provides standards to ensure that consistency. The standards also provide ways to link notes to specifications.
- Code Conventions: The first stage in the regulatory process is to identify and analyze applicable building regulations. Then, those regulations need to be incorporated into construction documents. This module provides standards for expediting code review by designers and plan review authorities.

BIM

Building information modeling (BIM) is a 3D digital file of a building's physical characteristics. BIM files allow architects, engineers, and construction (AEC) professionals to share the same document and 3D model as they plan, design, construct, and manage buildings and infrastructures. A **BIM implementation** is a set of guidelines to expedite the workflow within NCS and BIM regulations.

Plotting guidelines

Plotting guidelines are rules that specify grayscale, color, and line-width tables for drawings.

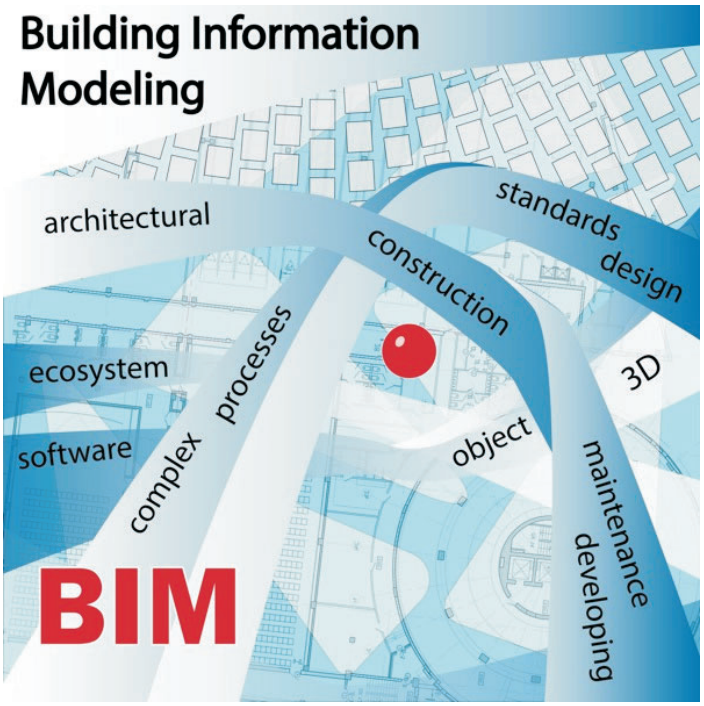


FIGURE 3. BIM (building information modeling) helps industries adhere to CAD standards. Benefits of BIM include improved building design, information streamlining, accurate cost estimation, sustainable building design, and more.

Appendices

Appendices are resource lists that provide additional information at the end of a document. In NCS guides, an appendix provides additional reference documents, such as a template-disclosure statement for projects claiming substantial or partial conformance with the NCS. It may also contain the consensus rules followed by NCS committees to update the standard.

CAD/CADD SKILLS

A drafter creates technical drawings, makes corrections, and revises drawings. A drafter functions as an assistant to the other members of the design team, working under their direction and supervision. CAD/CADD designers are skilled drafters who have additional training in specialized subjects, such as mechanical systems, architecture, electrical lighting, etc. Designers possess expert knowledge of the requirements of their designated field. They work independently with minimal oversight.

Basic Skills

All CAD designers began their career as drafters. The following are some unique skills you would need as a CAD drafter or designer.

Draft Creation

A drafter's main function is to create a drawing or other graphic representation of a building, mechanical device, or other structure. The technical drawing determines how the project should be created. As a drafter, you need to be able to visualize the end result. You should be able to:

- Produce simple X-assembly drawings using Block and Xref techniques.
- Produce section drawings using Hatched Section lines.
- Produce drawings dimensioned in various styles.
- Produce isometric drawings using the isometric grid system settings.

Software Knowledge

Understanding basic software functions (saving a file, changing font, looking up a file) is important, since CAD is setup like most user-friendly software programs. Also, you should be able to:

- Use attributes to add information to symbols.
- Use Inquiry, Help, Undo, and other commands (to manage the drawing session).
- Work with basic wire frames, 3D models, and 3D surfaces.

Prototype Drawings

Many times, you may have to create or study the drawings of a prototype. This will give the basic layout and specifications on how to create the final product. Understanding the guidelines and parameters of a prototype are necessary for developing a usable draft.

Design Specifications

Following required specifications is crucial when working with drawings that become real-life objects. You should:

- Use layers, line-types, and color for clarity and to show function in drawings.
- Produce scaled prints by understanding and using Paper Space (some companies still print from Model Space).
- Draw accurately, follow typed input, and use the various User Coordinate Systems.
- Pay close attention to measurements, ratios, and scale. When creating a tool or machine, even the tiniest fractions matter.

Self-Created Shortcuts

Many times, there are multiple items used over and over. You should be able to:

- Prepare a set of title blocks in standard sizes (for use with all drawings).
- Create symbol libraries.

Analytical Skills

Some science, math, and commonsense skills come in handy. You should be able to:

- Accurately apply mathematical methods and techniques in various applications: contextual sciences, theoretical mathematics, physics, and natural sciences.
- Use academic technology, including finding, evaluating, and utilizing appropriate information sources.
- Use critical and analytical thinking.

Advanced Skills

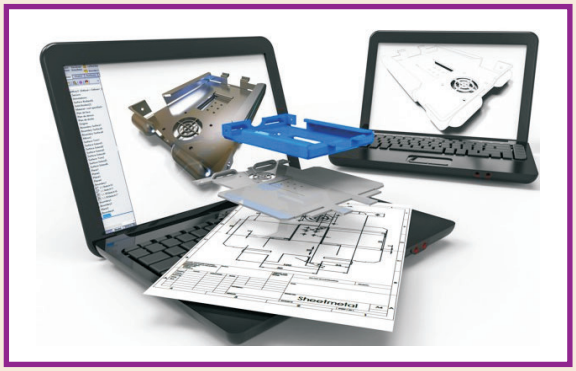
As you progress in your career, advanced CAD operations will become necessary. Advanced CAD skills include an ability to:

- Use sheet set manager.
- Use, create, edit, and insert tables and fields commands.
- Use and manipulate layering systems.
- Create and use templates.
- Create, codify, insert, and purge symbols and symbols libraries.

FURTHER EXPLORATION...

ONLINE CONNECTION: CADD Skill Standards

If you are pursuing a career in drafting and design, you must use AutoCAD software proficiently. Use of AutoCAD software can bump your portfolio to the front of the line in a competitive job market. As opportunities arise, AutoCAD skills may help you to secure work as a freelance CAD operator. Staying current with your CAD operator skills is essential. New software versions come to market often. To learn more about CAD operator skills, see the CCAD's AutoCAD Tutorials at http://www.ccadinc.com/autocad-tutorials.html.



CADD software is used for design work in numerous industries including the sheet metal industry example shown here.

- Create, edit, insert blocks with attributes, and define attributes.
- Perform object linking and embedding (OLE) operations.
- Edit CAD user variables.
- Prepare, attach, work with, manage, bind, and edit external references (Xref).
- Convert raster images.
- Perform advanced editing and dimensioning techniques.
- Use special plotting techniques.
- Use remote and Internet file management.
- Work with wire frame, surface model, and solid model techniques.
- Create texture mapping, renderings, lighting, shadows, dynamic viewing, and automated slides.

Summary:

In the world of drafting/CAD/CADD, something new is always on the horizon. CAD standards and CAD skill standards, though not as exciting to talk about as the latest 3D printing technology or spacecraft design, help make those more exciting activities possible. Standards provide consistency of product, save all project personnel time, make training easier, and make outsourcing more efficient.

Checking Your Knowledge:

1. What is a CAD standard?
2. List four organizations that create drafting/CAD/CADD standards.

3. List and briefly describe five basic drafting/CAD/CADD skills.
4. List and briefly describe five advanced drafting/CAD/CADD skills.
5. What makes drafting/CAD/CADD standards important?

Expanding Your Knowledge:

CADD standards and the associated skill standards have evolved over time. Conduct research about the history of the CADD standards. Important ideas include: What are the important issues to consider when creating a CADD standard? Who is affected by a CADD standard? Then, call or visit local companies that work with CADD and ask them how the standards and skill standards help them or affect them. Go online to your local community college and find out how the CADD skill standards are being taught.

Web Links:

America's Favorite Architecture
https://en.wikipedia.org/wiki/America%27s_Favorite_Architecture

StandardsCanada—Why Are Standards Important?
https://www.youtube.com/watch?v=EWDrXOrguII

Why CAD Standards Are Important: Yoshi Honda, U.S. CAD
https://www.youtube.com/watch?v=s23FQ2PwwDU

Why CAD Standards Are Still Important
https://www.3dcadworld.com/10-reasons-cad-standards-important/