# Drafting Standards and Skills



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## Health & Safety Standards

### Standard 1: Safety and Health in a Drafting Environment

Students will demonstrate the skills required to maintain a safe and healthy working environment in drafting settings, including the management of tools and equipment, proper use of personal protective equipment (PPE), and adherence to workspace ergonomics.

Aligned Industry Recognized Credentials: OSHA 10 – Construction, AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Identify, describe, and demonstrate the effective use of Safety Data Sheets (SDS) to meet documentation requirements.
2. Locate emergency equipment, first aid kit, and emergency action and response plan, including labels and signage that follow OSHA Hazard Communication Program (HAZCOM).
3. Demonstrate safe dress and use of relevant safety gear, personal protective equipment (PPE) and jobsite ergonomics, e.g., safety equipment, gloves, proper footwear, knee pads, earplugs, eye protection, and breathing apparatus.
4. Demonstrate safe body mechanics, including appropriate lifting techniques and ergonomics aimed at minimizing injury.
5. Describe procedures used to manage emergency situations, defensive measures, and accidents, including identification, reporting, response, evacuation plans, and follow-up procedures.
6. Demonstrate safety practices and procedures to be followed when working with and around electricity, e.g., ground fault circuit interrupter (GFCI) and frayed wiring.
7. Demonstrate safe handling, storing, disposing of, and recycling hazardous, flammable, and combustible materials, according to Environmental Protection Agency (EPA), OSHA, and product specifications.
8. Demonstrate the safe use, storage, and maintenance of equipment in the lab, shop, and classroom, e.g., the OSHA Lockout/Tagout Program (LOTO).
9. Comply with appropriate fire protection regulations, local permit regulations, and state/federal regulations.
10. Identify and describe potential consequences for non-compliance with appropriate health and safety regulations.

## Technical & Integrated Academic Standards

### Standard 2: Role of Drafting Professionals in Society

Students will examine the role of drafting professionals in society, analyze the evolution of drafting and its technological advances, and evaluate the impact of current drafting practices on the construction industry.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Explain the impact of Massachusetts General Laws and regulations on the construction industry and identify key regulations, compliance requirements, and licensing standards that influence building design.
2. **Interpret** local, national, and international building codes and standards, such as the International Building Code (IBC) and National Building Code (NBC), to ensure designs meet requirements for safety, structural integrity, and accessibility.
3. **Analyze** recent technological advancements and techniques in drafting that have led to significant improvements in construction outcomes, project efficiency, accuracy, and collaboration.
4. **Evaluate** how drafting professionals contribute to sustainable design practices and consider the environmental impact of construction projects, including sustainable drafting techniques, analyzing green building projects, and proposing environmentally friendly design solutions.

### Standard 3: Fundamentals of Drafting

Students will apply general drafting standards, develop various views, and utilize the design process to create accurate and well-documented technical drawings.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Select and use the appropriate tools for drafting tasks, leading to higher-quality and more precise work.
2. Annotate a drawing by using basic systems of measurement to convey dimensions and details clearly.
3. Convert between English and metric systems (ISO) of measurement to ensure consistency in measurements and designs.
4. Identify the alphabet of lines to create standardized and easily understandable drawings.
5. Prepare title blocks and other drafting formats to manage and reference drawings throughout the design and construction process.
6. Catalog and use number system for documentation and file management to prevent errors and lost documents.
7. Demonstrate methods used to record revisions to track changes and make sure the latest version of the drawing is used.
8. Produce and inspect prints, plots, and reproductions to ensure they are to the appropriate scale and accurately match the intended dimensions of the original drawing.
9. Create orthographic views to represent the dimensions and shape of an object.
10. Create auxiliary views to display features not visible in standard orthographic views, enhancing the completeness of the technical drawing.
11. Create detail views to focus on specific areas of a drawing where complex or intricate details require closer examination.
12. Create isometric views to provide a three-dimensional representation of an object, aiding in visualization and spatial understanding.
13. Demonstrate placing views considering first and third angle projection standards to ensure consistency and clarity in how views are oriented and interpreted.
14. Identify and utilize 1-, 2-, and 3-point perspectives to represent objects in depth and enhance the realism of the drawing.
15. Identify key elements that impact design, such as functionality, aesthetics, and manufacturability, to create well-rounded and feasible design solutions.
16. Evaluate a problem and develop a solution using the design process, including research, ideation, prototyping, and testing.
17. Interpret detail prints or technical processes to understand and implement design specifications accurately.

### Standard 4: Project Management

Students will develop skills in project management within the drafting and design industry, focusing on cost estimation, scheduling, and effective project execution.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Explain key project management concepts, including scope, schedule, budget, and resources.
2. Identify the roles and responsibilities of project managers and team members.
3. Prepare detailed procedural documentation for project workflows, including drafting and design processes.
4. Estimate project costs, including materials, labor, and overhead to create accurate budget forecasts.
5. Develop project schedules using tools such as Gantt charts and critical path method (CPM).
6. Monitor and adjust schedules to ensure timely project completion.
7. Identify potential risks and their impact on project outcomes.
8. Develop risk management plans and mitigation strategies.
9. Manage stakeholder expectations and resolve issues that arise during the project.
10. Assess project performance against goals and objectives and make necessary adjustments to ensure project success and continuous improvement.
11. Maintain accurate records of design changes, project specifications, and other relevant documentation.

### Standard 5: Conventional Drafting Techniques and Skills

Students will demonstrate conventional drafting techniques by creating accurate and detailed free-hand technical sketches, applying proper dimensioning practices, and effectively using measurement tools essential to drafting professionals.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Demonstrate lettering using block style to ensure clarity and legibility in technical sketches.
2. Identify and apply measurement tools, such as engineering, architectural, civil engineering, fractional, metric, and decimal inch scales.
3. **Utilize precision measurement instruments to mea**sure parts including vernier calipers and micrometers.
4. Apply general notes and/or annotations to a drawing to provide essential information and clarify details for accurate interpretation.
5. Translate customer needs into sketches and diagrams.
6. Sketch a basic concept and/or object proportionately to provide a realistic representation of objects, including detailed measurements and annotations.
7. Apply correct dimension line terminators to enhance accuracy.
8. Apply size and location dimension practices to ensure all parts of the drawing are represented accurately.
9. Create and interpret maps using conventional drafting techniques, including plotting geographical features and layouts.
10. Apply the use of dimensioning types to allow for flexibility and precision, e.g., ordinate, leader, baseline, datum, chain, and tabular.
11. Identify and utilize standard symbols to communicate effectively with all stakeholders.
12. Apply aligned and unidirectional standardized methods to ensure information is clear to all stakeholders.

### Standard 6: Computer Aided Drafting (CAD) and Design

Students will apply skills in CAD and BIM software tools, including the creation of detailed CAD drawings and 3D models and apply key BIM concepts to enhance design visualization, coordination, and project management.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Develop and customize CAD templates to establish standardized drawing setups and ensure consistency across projects.
2. Set up layers and levels to organize drawing elements effectively.
3. Configure dimension types, including units, precision, scale, and style, to ensure accurate and clear representation of measurements.
4. Apply appropriate tools and techniques to create clear and functional drawings based on design requirements.
5. Create and edit geometric shapes, e.g., lines, circles, rectangles, arcs, polygons, rays, etc.
6. Produce 2D isometric drawings, switch between standard isometric planes using ISODRAFT, and apply appropriate drawing and tracking tools that align with the corresponding isometric axes.
7. Draw and edit open and closed polylines.
8. Explain the significance of creating a block on layer zero (0).
9. Demonstrate transferring information between drawing files.
10. Edit existing CAD drawings modifying object properties to correct errors or update design details.
11. Manipulate CAD drawings by moving, scaling, rotating, and modifying elements to refine the design.
12. Demonstrate modifying leaders/multileaders.
13. Create and edit dimensions and apply dimension styles.
14. Extract and analyze CAD data, including mass, volume, and area, to support engineering analysis and decision-making.
15. Use CAD software to develop detailed and accurate 3D representations of complex designs.
16. Utilize various modeling techniques to ensure precision and detail in 3D models.
17. Generate and export CAD files in formats such as PDF, DXF, STL, IGES, and STEP for effective sharing, printing, and system integration.
18. Explain the basic principles of BIM and its benefits over traditional CAD methods.
19. Use BIM software, e.g., Autodesk Revit, to create and manage integrated 3D building models, incorporating architectural, structural, and MEP components.
20. Apply BIM data to generate construction documentation, perform energy analyses, and manage project information throughout the building lifecycle.
21. Create and interpret digital maps using CAD or GIS software, integrating spatial data with design elements for enhanced project analysis and planning.

### Standard 7: Mechanical Drafting

Students will demonstrate skills in creating accurate and detailed technical drawings used in engineering and manufacturing.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Identify and use sheet metal terminology and gauges.
2. Develop basic sheet metal patterns and shapes using radial line and parallel line development.
3. Produce accurate flat patterns suitable for precision bending operations.
4. Identify various welding techniques and processes.
5. Differentiate between types of welded joints and their applications.
6. Apply standard welding symbols to accurately represent welds in technical drawings.
7. Identify different manufacturing processes used in metalworking and fabrication, e.g., casting, forging, molding, extruding, machining, metal fabrication, and welding procedures.
8. Create detailed drawings of individual mechanical components.
9. Produce drawings that illustrate how components fit together in an assembly.
10. Develop layout drawings showing the arrangement of parts and components.
11. Use standards, handbooks, and other resources to include necessary specification details in drawings.
12. Implement dual dimensioning to meet both product and manufacturing requirements.
13. Understand and use common tolerancing terms.
14. Apply tolerances while considering the impact of stack-ups on assembly.
15. Calculate clearance and interference fit tolerance of mating parts using tables, e.g., RC, LN, FN, LT, and LC.
16. Apply tolerance to dimensions using unilateral, bilateral, and limits.
17. Use geometric tolerance symbols to specify precision and fit.
18. Identify and apply datum symbols to reference points in a drawing.
19. Identify and apply surface (finish) control to part surfaces.
20. Identify and describe mechanical components including breaks, joints, couplings, bearings, clutches, belts, chains, gears, and cams.
21. Differentiate between fasteners such as screws, nuts, rivets, springs, keys, pins, and washers.
22. Specify thread details for accurate component design, including thread nomenclature, series, classifications, and fits and forms.
23. Identify basic electric/electronic components and symbols used in drafting.
24. Differentiate between various types of electro-mechanical drawings and their uses, e.g., schematic, wiring diagram, circuit diagram, and cable/harness drawings.

### Standard 8: Architectural Drafting and Design

Students will identify different building types, recognize architectural styles, and create a variety of construction drawings using appropriate references and standards, including the use of architectural drafting software.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Distinguish between the characteristics and requirements of commercial, residential, and industrial buildings.
2. Identify and differentiate between various architectural styles.
3. Analyze technical data, such as building codes and material specifications, to determine its effect on architectural designs and plans.
4. Develop construction drawings utilizing appropriate references, including building codes, ADA standards, and Architectural Graphic Standards in drafting.
5. Develop a plot plan that incorporates civil engineering concepts and site layout.
6. Develop floor plans that effectively organize service, sleeping, and living areas.
7. Produce a foundation plan including footings and other foundational elements.
8. Develop interior and exterior elevation drawings.
9. Create section drawings to illustrate vertical cuts through a building.
10. Produce detailed drawings of framing, windows, doors, and other architectural elements.
11. Develop a roof plan showing the layout and design of the roof structure.
12. Incorporate detailed schedules for doors, windows, and finishes in the drawings.
13. Interpret drawings related to electrical, plumbing, fireplace, exhaust, and HVAC systems.
14. Design and layout stairs, including calculation of risers and treads.
15. Compile a complete set of drawings for a single building or residence.
16. Identify common material sizes and lengths and understand how these constraints affect design decisions.

### Standard 9: Sustainability

Students will demonstrate the ability to incorporate sustainability principles into architectural drafting and design by applying environmentally responsible practices, selecting sustainable materials, and utilizing energy and resource-efficient strategies in their designs.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Implement sustainable practices in architectural designs to contribute positively to the environment and society.
2. Integrate LEED criteria into architectural designs, including strategies for energy efficiency, water conservation, sustainable materials, and indoor environmental quality.
3. Assess the lifecycle of materials and their impact on sustainability and use certification programs like LEED as a reference.
4. Design systems and select fixtures that promote water efficiency, such as low-flow fixtures and rainwater harvesting systems.
5. Integrate drought-resistant landscaping into site plans to conserve water.
6. Develop strategies for minimizing construction waste, including modular design and efficient material use.
7. Create drawings that ensure good indoor air quality through proper ventilation and the use of low-VOC materials.
8. Design for maximum natural light to reduce reliance on artificial lighting and enhance occupant well-being.
9. Develop site plans that consider environmental impact, preserve natural habitats, and reduce site disturbance.
10. Incorporate climate-responsive design elements, such as orientation and shading, to improve energy efficiency.
11. Comply with building codes and regulations related to sustainability.

### Standard 10: Advanced Architectural Drafting and Design

Students will use advanced software tools to perform complex architectural and civil design tasks with precision and professionalism, applying advanced architectural and civil engineering principles to calculate structural loads, determine heat loss, and identify key elements of civil design.

* Aligned Industry Recognized Credentials: AutoCAD Certified User or ADDA Certified Drafter

#### Skills:

1. Use structural analysis software to calculate dead, live, snow, and wind loads on residential structures, ensuring accuracy and adherence to safety standards.
2. Employ software tools to develop detailed architectural plans, including plot plans, floor plans, elevation drawings, and sections, integrating civil engineering principles and design requirements.
3. Identify and calculate the tributary areas of structural elements to assess load distribution.
4. Analyze and trace the path of loads from various structural elements through the building to the foundation.
5. Survey, design, and optimize parking lot layouts, incorporating elements like traffic flow, space efficiency, and regulatory compliance.
6. Develop an estimate of the costs associated with the redesign of the parking lot.
7. Assess the heat loss of a designed residential house to ensure efficient energy use and comfort.
8. Create graphical representations of structures or landscapes to support detailed architectural and civil design analysis and presentation.
9. Identify and describe materials and their properties used in civil design, such as concrete, steel, and soil.
10. Recognize common symbols used in civil design drawings and documentation.
11. Identify zoning, environmental, and other regulations and guidelines that impact civil design and development.
12. Identify and understand the use of common surveying instruments.
13. Utilize bearings, distances, and coordinates for plotting and mapping in civil design.
14. Survey land or bodies of water to measure or determine design features.
15. Integrate utilities, accesses, and contours into designs according to size and specifications described in codes and regulations.
16. Calculate the acreage for sites and developments as part of the design and planning process.

## Employability Standards

### Standard 11: Employability Skills

Students will understand and demonstrate the roles of professional communication, critical thinking, problem-solving, professionalism, teamwork, and collaboration within the professional drafting industry.

#### Skills:

1. Demonstrate the ability to effectively communicate ideas, design concepts, and technical information to team members, clients, and stakeholders.
2. Analyze complex problems, develop solutions, and make decisions based on technical data.
3. Demonstrate attention to detail by checking and verifying drawings, calculations, and designs.
4. Demonstrate adaptability to changes in project requirements, technology, and industry practices.
5. Apply the concept of teamwork to a residential project to improve outcomes.

## Entrepreneurship Standards

### Standard 12: Entrepreneurship

Students will be able to describe opportunities for entrepreneurship and be able to evaluate the value proposition of business ownership in the drafting industry.

#### Skills:

1. Describe a business model of a company that employs drafting professionals.
2. Evaluate the licensing, regulatory, and tax implications of self-employment and business ownership as a drafting professional compared to W-2 employment.

## Digital Literacy Standards

### Standard 13: Digital Literacy

Students will demonstrate skills in both common and professional drafting software, showcasing digital literacy skills necessary to excel as competitive professionals in the drafting industry.

#### Skills:

1. Describe the use of online resources in licensing and professional development as a professional draftsperson.
2. Demonstrate the use of common scheduling, resource management, and customer relationship software systems.
3. Apply the use of digital tools and cloud-based platforms to facilitate real-time collaboration, integration of various design aspects, and seamless communication among project stakeholders.
4. Locate and utilize online resources that support effective practices, while adhering to principles of safe and ethical digital content creation and consumption.
5. Implement strategies for utilizing digital tools and technology to enhance business operations and drive success in the drafting industry.