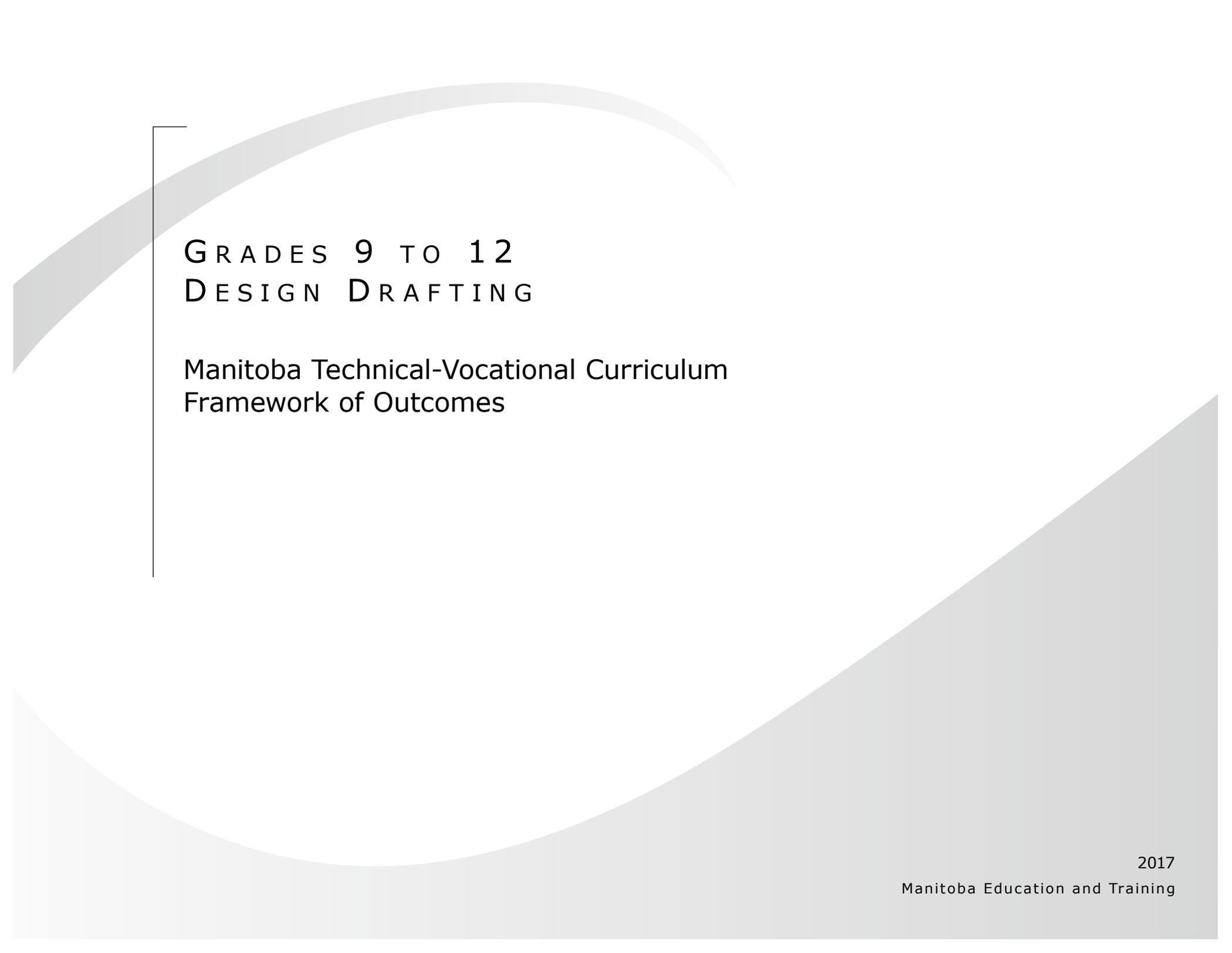




# **Grades 9 to 12 Design Drafting**

Manitoba Technical-Vocational  
Curriculum Framework  
of Outcomes





GRADES 9 TO 12  
DESIGN DRAFTING

Manitoba Technical-Vocational Curriculum  
Framework of Outcomes

Manitoba Education and Training Cataloguing in Publication Data

Grades 9 to 12 design drafting : Manitoba technical-vocational  
curriculum framework of outcomes

Includes bibliographical references

ISBN: 978-0-7711-8039-2 (pdf)

1. Drafters—Vocational guidance.
  2. Architectural drawing—Study and teaching (Secondary)—Manitoba.
  3. Engineering design—Study and teaching (Secondary)—Manitoba.
  4. Mechanical drawing—Study and teaching (Secondary)—Manitoba.
  5. Technical education—Manitoba—Curricula.
  6. Vocational education—Manitoba—Curricula.
- I. Manitoba. Manitoba Education and Training.  
604.20712

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Manitoba Education and Training  
Winnipeg, Manitoba, Canada

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This resource is available on the Manitoba Education and Training website  
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Available in alternate formats upon request.

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## ACKNOWLEDGEMENTS

Manitoba Education and Training gratefully acknowledges the contributions of the following individuals in the development of *Grades 9 to 12 Design Drafting: Manitoba Technical-Vocational Curriculum Framework of Outcomes*.

<b>Members of the 2017 Revision Team</b>	Tara Hamilton Duffield	Crocus Plains Regional Secondary School Brandon School Division
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	Otto Gebhardt	Red River College
	Crystal Lachance	Sisler High School Winnipeg School Division
	Gordon MacRae	Technical-Vocational High School Winnipeg School Division
	Richard Maslanka	Roseau Valley School Border Land School Division
	Ron McCutcheon	Steinbach Regional Secondary School Hanover School Division
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# TECHNICAL-VOCATIONAL EDUCATION OVERVIEW

In 2013, Manitoba Education released the document *Technical-Vocational Education Overview*, available at [www.edu.gov.mb.ca/k12/cur/teched/sy\\_tech\\_program.html](http://www.edu.gov.mb.ca/k12/cur/teched/sy_tech_program.html), to provide the philosophical and pedagogical underpinnings for curriculum development and the teaching of courses in the Senior Years Technology Education Program.

This overview presents educators with the vision and goals of technical-vocational education (TVE) in Manitoba. Topics include the following:

- curriculum revitalization and renewal
- curriculum framework and implementation
- articulation of programming
- assessment and reporting
- safety
- employability/essential skills and career development
- sustainable development

TVE clusters of courses are designed to encourage students to explore career options in designated trades and trained occupations and to address labour shortages in these areas. The TVE curriculum includes course clusters for both *designated trades* (trades designated for apprenticeship training and certification by Apprenticeship Manitoba) and *trained occupations* (not designated as trades).

The TVE curriculum is significantly different from other subject areas, such as industrial arts. It has distinctive qualities which, when respected, will provide students with a uniquely valuable experience that they cannot receive from any other curriculum.

TVE gives students the opportunity to learn, from an industry-certified teacher with industry experience, the theoretical and practical aspects of one specific trade or trained occupation in order to facilitate their transition from school to work or to post-secondary education in that trade or trained occupation, or into an associated trade or occupation. This transition is accomplished by having students complete an entire TVE cluster of courses in a setting that, as much as possible, emulates an actual workplace.

In the TVE curriculum, the emphasis is on hands-on learning activities. For instructional purposes, the sequence of learning outcomes and the learning outcomes included in each unit of study can vary based on the projects within the courses.

Cross-curricular learning outcomes, which include those in mathematics, science, and the interpretation of technical documents, are to be integrated into the authentic learning activities of the courses.

The TVE curriculum includes Grades 9 to 12 courses in a variety of areas, including design drafting.

## DESIGN DRAFTING OVERVIEW

*Grades 9 to 12 Design Drafting: Manitoba Technical-Vocational Curriculum Framework of Outcomes* identifies the goals, general learning outcomes (GLOs), and specific learning outcomes (SLOs) for nine design drafting courses. This framework is intended for use in all Manitoba schools teaching design drafting courses as part of the Senior Years Technology Education Program.

### Design Drafting as a TVE Cluster

*Grades 9 to 12 Design Drafting: Manitoba Technical-Vocational Framework of Outcomes* has been developed as a technical-vocational education (TVE) cluster of courses.

This curriculum prepares students for various careers associated with design drafting. Like all other TVE courses, design drafting courses should be taught only as part of a complete cluster, approved by Manitoba Education and Training.

This cluster of courses is designed to not only teach students how to use CADD software as an important tool within drafting, but to also understand the theory and function supporting designs that stem from architectural, mechanical, and civil backgrounds.

These design drafting courses prepare students for entry-level employment in architecture, mechanical engineering, civil engineering, and manufacturing companies, or for further education at college or university in drafting technology, architecture, interior design, landscape

architecture, urban design, or mechanical, civil, aerospace, chemical, biological, environmental, or electrical engineering.

Students completing the design drafting courses will be able to

- visualize the relationship between drawings and the objects they represent
- visualize the relationship between components and assemblies
- develop and prepare design sketches
- design to specifications and standards
- develop and prepare designs and technical drawings
- operate computer-assisted design and drafting (CADD) workstations
- write technical reports
- communicate aesthetically
- incorporate sustainable practices
- prepare construction specifications, costs, and material estimates
- apply mathematics and physics
- demonstrate an understanding of material properties
- demonstrate an understanding of manufacturing processes and construction methods
- solve problems
- work independently
- communicate and work with peers, clients, and industry professionals
- work to meet deadlines

Design drafting consists of two distinct disciplines.

- **Architectural Design Drafting**

Architectural design drafting focuses on residential architecture, which deals with the design of houses, cottages, small structures, and light commercial buildings. Residential architecture involves the design of structural, electrical, heating, cooling, and plumbing systems. Students will be introduced to civil engineering concepts, which deal with the design and construction of residential subdivisions and associated civil engineering infrastructure. Consideration must be given to construction specifications, building codes, material selection, and costs.

- **Engineering Design Drafting**

Engineering design drafting focuses on **mechanical engineering**, which deals with the broad areas of heat, energy, force, and motion, and their effects on a multitude of products. Mechanical engineers may be involved in the design of large industrial machinery, power plants, automobiles and aircraft, robots, biomedical devices and equipment, manufacturing processes, precision measurement and data acquisition equipment, and new materials, among others.

## 2017 Revisions to the Design Drafting Curriculum

During the 2016/2017 school year, a committee of design drafting teachers was struck to make revisions to the high school curriculum. The revisions were not extensive, and the course codes and names remain the same. Revisions included the following:

- **Design Drafting Essentials I 20S/20E/20M and Design Drafting Essentials II 30S/30E/30M** have been redesigned as a **pair of courses** to teach students the essential knowledge and skills in architectural and mechanical drafting. Teachers have the flexibility to focus on one or both of these topics in each course. However, by the end of both courses, students need to have had significant exposure to **both architectural and mechanical drafting** in order to be prepared to successfully complete the remaining courses in this cluster.
- **Applied Architectural Design Drafting 40S/40E/40M** has been revised to give teachers more flexibility to focus on **applied architectural and/or applied civil engineering** projects.

## Career and Employment Opportunities

Students who have completed the design drafting courses can seek entry-level employment as draftspersons in architectural, mechanical, or civil engineering, and manufacturing companies, or adapt their learning to other occupational streams. Draftspersons prepare designs, drawings, and related technical information in multidisciplinary teams or in support of engineers, architects, or industrial designers, or they may work independently. They are employed by architectural and engineering firms; consulting and construction companies; utility, resource, and manufacturing companies; all levels of government; and by a wide range of other organizations. Graduates can also seek employment in construction, manufacturing, and other industries.

Industry typically requires employees entering the design drafting fields to have post-secondary education. The design drafting courses provide a foundation for students to continue to build on in post-secondary education in architecture, engineering, interior design, urban design, landscape architecture, drafting technologies, and related fields. To facilitate the seamless transition from high school design drafting to a related college or university program, students will receive advanced credit with articulated post-secondary institutions, such as Red River College and Assiniboine Community College.

To prepare our students to enter industry or post-secondary programs, courses taught in design drafting will incorporate the latest computer-assisted design and drafting (CADD) technology and equipment.

For additional information and resources about design drafting occupations, see the following:

- National Occupational Classification ([www.hrsdc.gc.ca/eng/jobs/lmi/noc/](http://www.hrsdc.gc.ca/eng/jobs/lmi/noc/))
- Essential Skills Profiles ([www.hrsdc.gc.ca/eng/jobs/les/profiles/](http://www.hrsdc.gc.ca/eng/jobs/les/profiles/))

## Implementation of Design Drafting

To receive a Senior Years Technology Education diploma, a student must complete the minimum of eight departmentally developed credits from an approved TVE cluster, together with 16 compulsory credits and six optional credits.

The grade level in which the design drafting courses are offered is a local school-based decision. It is highly recommended that the sequencing of credits follow the sequence set out in this document.

Students entering design drafting will begin with the foundation courses and continue to explore design-related careers through the architectural and engineering streams. Projects may continue from one course to another.

## Strands in the Design Drafting Curriculum

The general and specific learning outcomes for each course belong to three distinct but related strands. As students move from Grades 9 to 12, the expectations within each strand will increase in complexity and depth and will move the students from sampling to transition to work or post-secondary education.



**Technology Fundamentals [Theory]:** Students develop foundational knowledge related to design drafting. Students will make connections to cross-curricular areas that include numeracy and literacy, sustainable development, and scientific literacy as it relates to the subject area. These are designated by the letter *F*.

**Technology Skills [Practical]:** Students develop the technological skills necessary to enter the industry. These are designated by the letter *S*.

**Professional Practice:** Students develop the knowledge, skills, and attitudes required to make a transition to post-secondary education or the workplace. Students will demonstrate an understanding of health and safety standards and issues. Students will develop the employability skills to successfully continue in the industry and explore career opportunities and the education and training required in the field of study. These are designated by the letter *P*.

## Qualifications of Design Drafting Teachers

Only vocationally certified teachers should teach TVE courses, including the ones in this design drafting cluster.

Vocational certification includes three components:

- **Post-Secondary Certification in a Drafting-Related Profession:** Design drafting teachers need to have formal post-secondary education in a program that includes drafting. Candidates may be graduates of professional engineering, architectural, or certified engineering technology programs.
- **Industry Experience:** Design drafting teachers need to have been employed, for at least six years, in a profession that includes drafting. This will enable them to share their industry experience with students.
- **Technical Vocational Teaching Certificate:** TVE teachers should have a technical vocational teaching certificate, obtained by completing Red River College's one-year Technical Vocational Teacher Education diploma

program. For information about this program, see [rrc.mb.ca/Catalogue/ProgramInfo.aspx?ProgCode=TECVF-DP&RegionCode=WPG](http://www.edu.gov.mb.ca/Catalogue/ProgramInfo.aspx?ProgCode=TECVF-DP&RegionCode=WPG)

Employing only vocationally certified teachers to teach TVE courses preserves the integrity of TVE programming by ensuring that teachers are able to share their first-hand experience working in design drafting. Students receive instruction from somebody who has been involved in that profession.

For further information, see “Professional Certification: Technical Vocational Teacher” on the Manitoba Education and Training website at [www.edu.gov.mb.ca/k12/profcert/certificates/vocational.html](http://www.edu.gov.mb.ca/k12/profcert/certificates/vocational.html).

## Comparison of TVE Design Drafting with Industrial Arts Drafting Design Technology

Like all TVE curricula, *Grades 9 to 12 Design Drafting: Manitoba Technical-Vocational Framework of Outcomes* has been developed to prepare high school students for a career. In the case of design drafting, students learn the knowledge, skills, and attitudes required to work in a career with design drafting as a major component. This includes such careers as professional engineer, architect, or certified engineering technologist. This curriculum has not been developed as a general interest cluster of courses in drafting. Schools interested in teaching such a cluster are invited to teach the Industrial Arts curricula, which can be found on the department’s website at [www.edu.gov.mb.ca/k12/cur/teched/ind\\_arts.html](http://www.edu.gov.mb.ca/k12/cur/teched/ind_arts.html).

Although the design drafting and industrial arts drafting design technology curricula share some common content, they have been developed for completely different purposes, and have significant differences in content. The chart on the following page summarizes some of the differences between design drafting (as a TVE cluster of courses) and drafting design technology (as an industrial arts cluster of courses).

## Comparison of TVE Design Drafting with Industrial Arts Drafting Design Technology

Frequently Asked Questions	TVE Design Drafting	Industrial Arts Drafting Design Technology
1. Is the purpose of the curriculum to facilitate students' transition to a career with design drafting as a major component?	Yes	No
2. Does the instruction try to emulate, as far as possible, a design drafting workplace?	Yes	No
3. Does the curriculum mandate employability skills such as punctuality and time management?	Yes	No
4. Is the teacher required to have post-secondary education in a drafting-related field such as professional engineering, architectural, or engineering technology?	Yes	No
5. Is the teacher required to have experience working in a drafting-related field?	Yes	No
6. Does the cluster prepare students for working in a drafting-related occupation?	Yes	No
7. Does the cluster focus on preparing students for entry-level employment in a drafting-related field after high school?	Yes	No
8. Is the teacher required to have a Manitoba general teacher certificate?	No	Yes
9. Is the teacher required to have a Manitoba technical vocational teaching certificate?	Yes	No
10. Do schools require special permission from Manitoba Education and Training to offer a cluster of courses?	Yes	No
11. Do schools have to offer all of the courses in the cluster?	Yes	No
12. Do the clusters focus on only one occupation?	Yes	No
13. Can schools offer hybrid clusters, made up of courses from several clusters?	No	Yes

## Design Drafting Goals and General Learning Outcomes

Curriculum goals outline the major curriculum components in addition to the general or across-the-curriculum learning goals for the subject area. The overall goals for design drafting are based on three broad components:

- process for design drafting
- cross-curricular knowledge and skills, sustainability, and emerging trends
- ethical and legal standards, health and safety practices, employability skills, and career development

The design drafting curriculum includes 12 course goals, which are broken down into general learning outcomes (GLOs), which are broken down into specific learning outcomes (SLOs).

Please note that some design drafting courses do not address all of these GLOs.

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### Process for Design Drafting

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**Goal 1:** Solve problems using the **design process**.

- GLO 1.1: Define design problems.
- GLO 1.2: Research and analyze information for design solutions.
- GLO 1.3: Synthesize information and ideas to create design solutions.

**Goal 2: Communicate** design solutions.

- GLO 2.1: Prepare computer models of design solutions.

GLO 2.2: Prepare working and presentation drawings and documents.

**Goal 3:** Use appropriate **materials and processes** of building/manufacturing.

- GLO 3.1: Describe materials used in design solutions.
- GLO 3.2: Describe building/manufacturing processes used in design solutions.

**Goal 4: Present** design solutions.

- GLO 4.1: Plan and organize presentations of design solutions.
- GLO 4.2: Use presentation production methods.
- GLO 4.3: Present/defend design solutions.

**Goal 5:** Describe and apply the **common tools and equipment** used in design drafting.

- GLO 5.1: Describe and use drawing and modelling tools and equipment.
  - GLO 5.2: Describe and use computer hardware and equipment.
  - GLO 5.3: Describe and use software.
- 

### Cross-curricular, Sustainability, and Emerging Trends

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**Goal 6:** Describe and apply the transferable **cross-curricular knowledge and skills** that relate to design drafting.

- GLO 6.1: Describe and apply mathematical concepts as they relate to design drafting.
- GLO 6.2: Read, interpret, and communicate information.
- GLO 6.3: Understand scientific concepts as they apply to design drafting.

**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting.

- GLO 7.1: Understand the impact of architectural/engineering design on the environment.
- GLO 7.2: Describe the impact of architectural/engineering design on human health and well-being.
- GLO 7.3: Recognize the economic impact of sustainable practices in architectural/engineering design.

**Goal 8:** Understand the **evolution** of design drafting, including its **technological progression and emerging trends**.

- GLO 8.1: Describe the evolution of design drafting, including its technological progression and emerging trends.

### **Safety and Health, Employability Skills, and Career Development**

**Goal 9:** Follow the **ethical and legal standards** in drafting.

- GLO 9.1: Incorporate the local and national building codes and standards as well as manufacturing and engineering standards into designs.
- GLO 9.2: Describe the ethical expectations of designers.

**Goal 10:** Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace.

- GLO 10.1: Demonstrate an awareness of rights, responsibilities, and safety procedures for specific tools, equipment, and working environments.
- GLO 10.2: Describe health and safety laws and regulations.

**Goal 11:** Demonstrate **employability skills** required in design drafting.

- GLO 11.1: Demonstrate fundamental employability skills.
- GLO 11.2: Demonstrate personal management skills.
- GLO 11.3: Demonstrate teamwork skills.

**Goal 12:** Describe **career opportunities** in design drafting.

- GLO 12.1: Describe post-secondary opportunities related to design drafting.
- GLO 12.2: Describe career opportunities available in design drafting across industries.

## Specific Learning Outcomes (SLOs)

*Grades 9 to 12 Design Drafting: Manitoba Technical-Vocational Curriculum Framework of Outcomes* identifies specific learning outcomes (SLOs) for use in all Manitoba schools teaching the Grades 9 to 12 design drafting courses as part of the Senior Years Technology Education Program. Specific learning outcome statements define what students are expected to achieve by the end of the course.

It is essential that students learn safety practices and employability skills; therefore, with a few exceptions, all SLOs related to safety and to employability skills are repeated from course to course.

Please note that SLOs are not identified for the goals and GLOs that are not addressed in a given course.

## Course Descriptions

Course titles, descriptions, and codes for the nine design drafting courses follow. For an explanation of the codes, refer to the *Subject Table Handbook: Technology Education: Student Records System and Professional School Personnel System*, available at [www.edu.gov.mb.ca/k12/cur/teched/sth\\_tech\\_ed.html](http://www.edu.gov.mb.ca/k12/cur/teched/sth_tech_ed.html) (Manitoba Education and Training).



8435 Design Drafting Essentials 1      20S/20E/20M

Design Drafting Essentials 1 is intended for students wishing to explore architectural/mechanical design drafting.

Curriculum content focuses on an introduction to architectural/mechanical design drafting. The emphasis will be on project-based learning activities. Students will present their design solutions to others.

Topics include the following:

- freehand sketching
- principles of design
- drafting standards
- materials and processes
- computer modelling
- architectural/mechanical basics

The course includes an introduction to safety, employability skills, career development, sustainability, and new and emerging technologies in design drafting.

8436 Design Drafting Essentials 2      30S/30E/30M

Design Drafting Essentials 2 is intended for students wishing to specialize in architectural/mechanical design drafting.

Curriculum content focuses on architectural/mechanical design drafting. Students will present their design solutions to others. The emphasis will be on project-based learning activities.

Topics include the following:

- freehand sketching
- principles of design
- drafting standards
- materials and processes
- computer modelling
- architectural/mechanical concepts
- architectural plan and elevation drawing
- mechanical multi-view drawings

The course includes an emphasis on safety, employability skills, career development, sustainability, and new and emerging technologies in design drafting.

8437 Architectural Design Drafting      30S/30E/30M

Architectural Design Drafting is intended for students continuing in the specialization phase of architectural design drafting.

Curriculum content focuses on the design of a residence. Students will present their design solutions to others.

Topics include the following:

- freehand sketching
- principles of design
- drafting and construction standards
- construction materials and processes

- computer modelling and selection of building components (e.g., wall, window, floor, roof, foundation)
- floor plan and elevation drawings
- interior design

The course includes an emphasis on safety, employability skills, career development, sustainability, and new and emerging technologies related to architectural design.

#### 8438 Engineering Design Drafting 30S/30E/30M

Engineering Design Drafting is intended for students continuing in the specialization phase of engineering design drafting.

Curriculum content focuses on engineering product design. Students will present their design solutions to others.

Topics include the following:

- freehand sketching
- principles of design
- drafting and engineering standards
- manufacturing materials, fasteners, standard components, and processes
- computer model parts, assemblies, and sub-assemblies
- part and assembly drawings

The course includes an emphasis on safety, employability skills, career development, sustainability, and new and emerging technologies related to engineering design.

#### 8439 Advanced Engineering Design Drafting 40S/40E/40M

Advanced Engineering Design Drafting is intended for students in the transition phase of engineering design drafting.

Curriculum content focuses on engineering product design and manufacturing. Students will present their design solutions to others.

Topics include the following:

- principles of design
- drafting, engineering, and manufacturing standards
- manufacturing materials, fasteners, standard components, and processes
- computer model parts, assemblies, and sub-assemblies for visualization, simulations, and finite element analysis
- part, assembly, and development drawings

Students will apply safety procedures and employability skills independently. Students will continue to develop their knowledge, skills, and attitudes in the areas of career development, sustainability, and new and emerging technologies in engineering design drafting and manufacturing.

**8648 Advanced Architectural  
Design Drafting** 40S/40E/40M

Advanced Architectural Design Drafting is intended for students in the transition phase of architectural design drafting.

Curriculum content provides for an overview of residential building systems. Students will present their design solutions to others.

Topics include the following:

- drafting and construction standards
- building materials and systems (e.g., foundation, electrical, HVAC)
- architectural technical drawings, including foundation, electrical, HVAC, and site plans, and section and detail drawings
- civil engineering concepts (structural, topographical)

Students will apply safety procedures and employability skills independently. Students will continue to develop their knowledge, skills, and attitudes in the areas of career development, sustainability, and new and emerging technologies in architectural design drafting.

**8649 Applied Architectural  
Design Drafting** 40S/40E/40M

Applied Architectural Design Drafting is intended for students transitioning to industry or post-secondary education from design drafting.

Teachers have the flexibility to focus on either applied architectural and/or applied civil engineering projects.

Curriculum content provides for the application of the design process for client-specific residential architectural and/or civil engineering construction projects. Communication with the client and construction professionals will determine the project scope and proposed design solution. Students will design and modify their proposal and create the required presentation and working drawings. Students will present their design solutions to others.

Students in the course will apply safety procedures and employability skills independently. Students will demonstrate their knowledge, skills, and attitudes in the areas of career and portfolio development, sustainability, and new and emerging technologies in architectural and civil design drafting.

**8669 Applied Engineering  
Design Drafting** 40S/40E/40M

Applied Engineering Design Drafting is intended for students transitioning to industry or post-secondary education from design drafting.

Curriculum content provides for the application of the design process for client-specific engineering and manufacturing projects. Communication with the client and engineering professionals will determine the project scope and proposed design solutions. Students will design and modify their proposal and create the required presentation

and working drawings. Students will present their design solutions to others.

Students will apply safety procedures and employability skills independently. Students will demonstrate their knowledge, skills, and attitudes in the areas of career and portfolio development, sustainability, and new and emerging technologies in engineering design drafting.

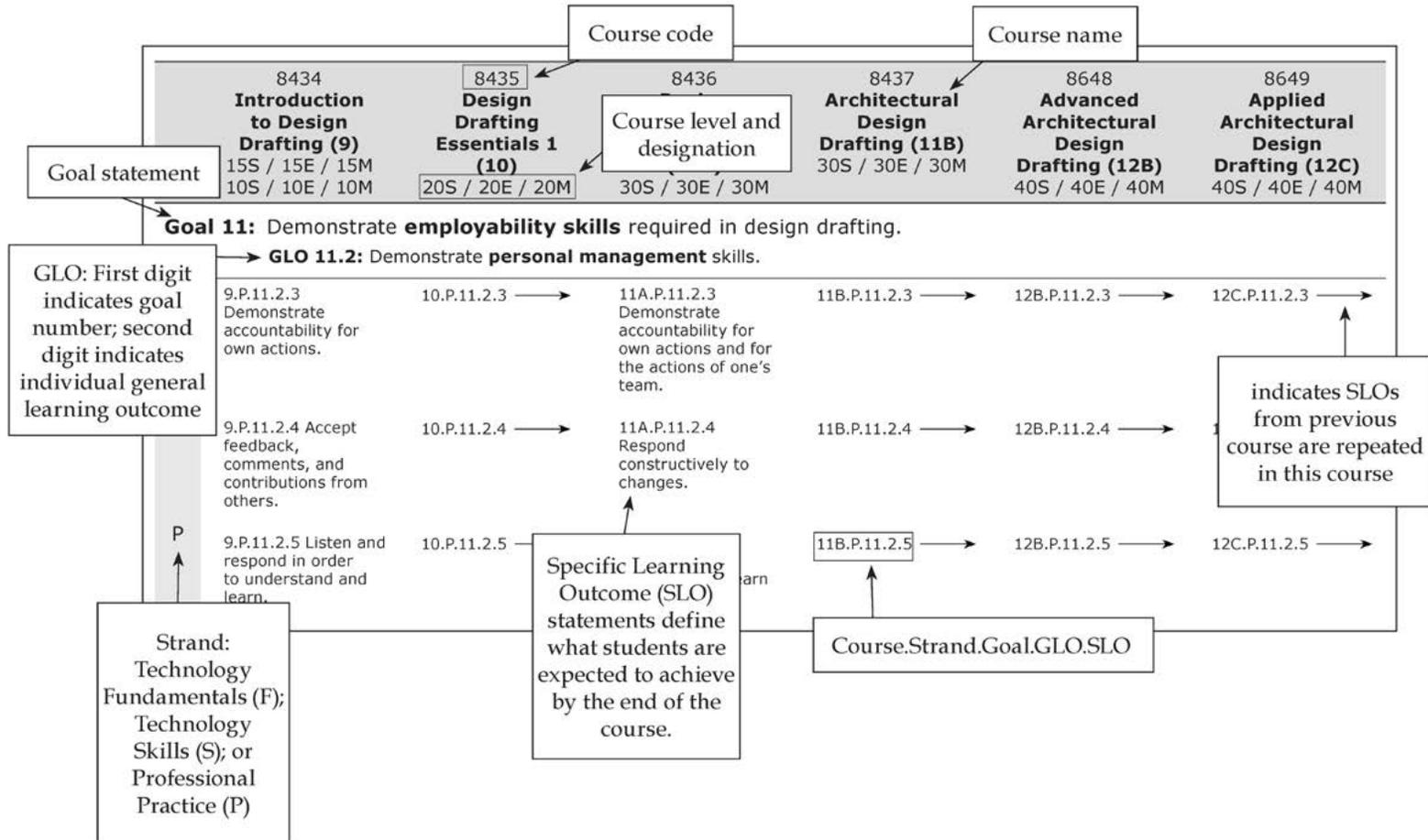
## Design Drafting Competitions

Competitions provide students with invaluable experience, both educational and related to their particular industry.

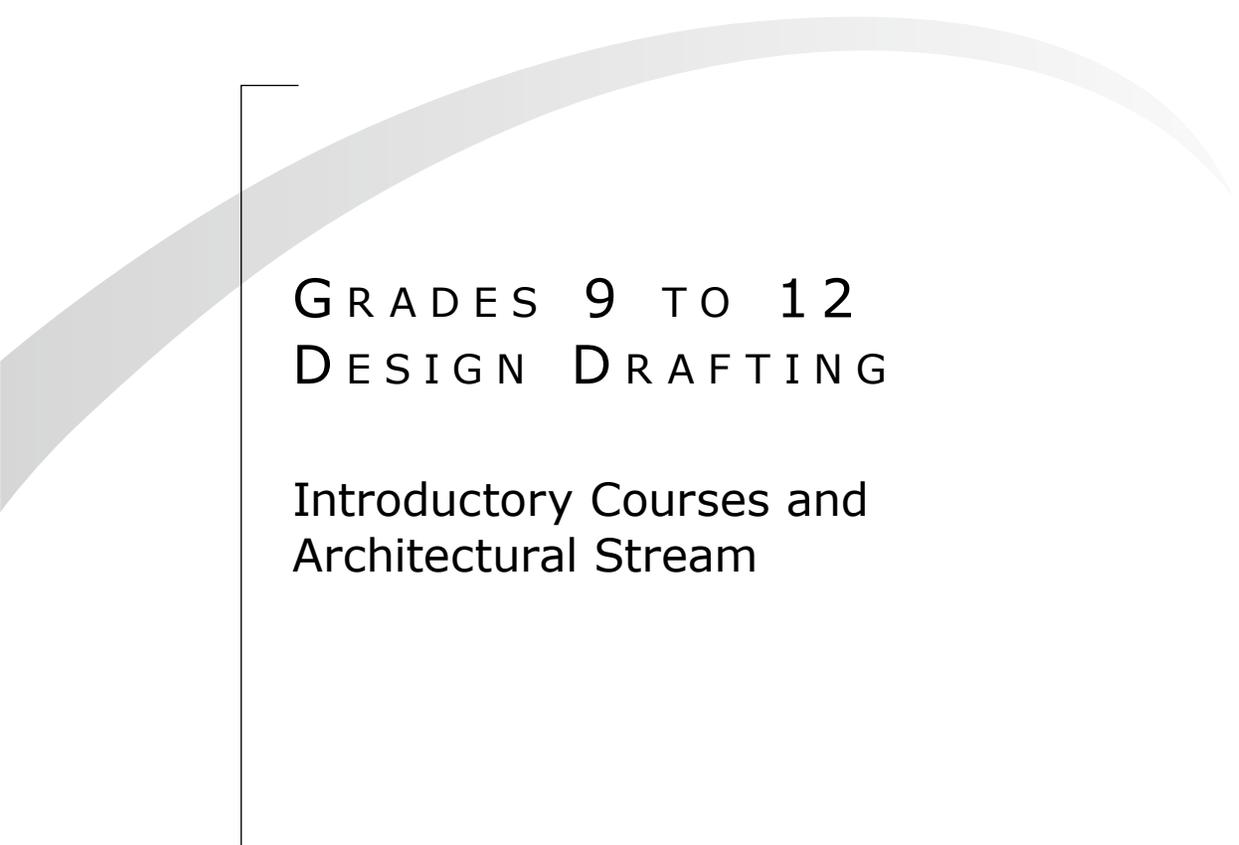
Students should be encouraged to participate and compete in architectural and engineering design drafting competitions, such as the following:

- F1 Challenge
- Discovery Project
- Industrial Design Competition (Carlton University)
- Skills Manitoba Cardboard Boat Race
- Skills Manitoba Wind Turbine Competition
- Engineering Week Spaghetti Bridge Competition

# Guide to Reading Design Drafting Goals and Learning Outcomes







GRADES 9 TO 12  
DESIGN DRAFTING

Introductory Courses and  
Architectural Stream



GRADES 9 TO 12 DESIGN DRAFTING:  
INTRODUCTORY COURSES AND ARCHITECTURAL STREAM  
GENERAL AND SPECIFIC LEARNING OUTCOMES BY GOAL

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**Goal 1:** Solve problems using the **design process**.

**GLO 1.1:** Define design problems.

F	9.F.1.1.1 Identify a structured model to solve basic problems.	10.F.1.1.1 Identify a structured model to solve basic problems.	11A.F.1.1.1 Describe a structured model to solve basic problems.	11B.F.1.1.1 Describe the feedback process in a structured problem-solving model.	12B.F.1.1.1 Describe the relationship between the design process and the creation and revision of construction documents.	12C.F.1.1.1 Collaborate with a client to define design problems.
	9.F.1.1.2 Identify design problems.	10.F.1.1.2 Identify design problems.	11A.F.1.1.2 Identify design problems (e.g., original or re-engineered design).	11B.F.1.1.2 Define design problems.	12B.F.1.1.2 Define design problems related to building systems (e.g., electrical, HVAC, site plan, wall systems).	
S	9.S.1.1.1 List the steps required to solve a design problem.	10.S.1.1.1 Use a structured model to solve architectural/mechanical problems.	11A.S.1.1.1 Use a structured model to solve architectural/mechanical problems.	11B.S.1.1.1 Use a structured model to solve, refine, and revise architectural problems.	12B.S.1.1.1 Use a structured model in the creation, refining, and revision of architectural drawings.	12C.S.1.1.1 Use a structured model to solve, refine, and revise architectural and/or civil engineering problems and to create construction drawings.

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2: Research and analyze information** for design solutions.

<b>F</b>	<p>9.F.1.2.1 List the factors (e.g., materials, cost, manufacturing processes) that influence design.</p>	<p>10.F.1.2.1 Demonstrate an awareness of architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical properties).</p>	<p>11A.F.1.2.1 Identify basic architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical properties).</p>	<p>11B.F.1.2.1 Identify different house types.</p>	<p>12B.F.1.2.1 Examine the impacts of building systems on architectural design.</p>	<p>12C.F.1.2.1 Evaluate solutions based on architectural design principles.</p>
	<p>9.F.1.2.2 Demonstrate an awareness of sustainability as it relates to design (e.g., materials used, social impact).</p>	<p>10.F.1.2.2 Identify factors (e.g., materials, cost, manufacturing processes) that influence design.</p>	<p>11A.F.1.2.2 Identify factors (e.g., materials, cost, manufacturing processes) that influence design.</p>	<p>11B.F.1.2.2 Identify architectural design principles, including work triangle, bathroom design, circulation, room shape, size and area, space zoning, layout, orientation, furniture layouts, and ergonomics.</p>	<p>12B.F.1.2.2 Consider the influence of building processes, material types and availability, costs, and the building code on design.</p>	<p>12C.F.1.2.2 Assess the factors that influence design (e.g., sustainability, universal design, client and municipal requirements, aesthetics).</p>

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2:** Research and analyze information for design solutions. *(continued)*

F	9.F.1.2.3 Demonstrate an awareness of universal design.	10.F.1.2.3 Discuss sustainability as it relates to design (e.g., materials used, social impact).	11A.F.1.2.3 Discuss sustainability as it relates to architectural/mechanical design (e.g., materials, processes).	11B.F.1.2.3 Consider the influence of building processes, materials, costs, and the building code on design.	12B.F.1.2.3 Compare various sustainable architectural building systems (e.g., HVAC, plumbing, electrical).	12C.F.1.2.3 Demonstrate an awareness of design drafting fundamentals and conventions as they relate to architectural and/or civil engineering drawings.
	9.F.1.2.4 Demonstrate an awareness of aesthetic principles.	10.F.1.2.4 Discuss universal design.	11A.F.1.2.4 Discuss universal design.	11B.F.1.2.4 Compare various sustainable architectural construction materials and processes (e.g., energy and resource consumption).	12B.F.1.2.4 Identify additional universal design principles.	
	9.F.1.2.5 Identify common research methods used in design.	10.F.1.2.5 Discuss aesthetic principles.	11A.F.1.2.5 Discuss aesthetic principles in architectural/mechanical design.	11B.F.1.2.5 Identify universal design principles as specified in building codes.	12B.F.1.2.5 Consider aesthetic principles in relation to building systems and site planning.	
		10.F.1.2.6 Identify common research methods used in design.		11B.F.1.2.6 Consider aesthetic principles (e.g., colour, balance, texture, form, proportion) in relation to interior and exterior residential design.	12B.F.1.2.6 Investigate the historical trends in urban design.	

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2:** Research and analyze information for design solutions. *(continued)*

<b>S</b>	<p>9.S.1.2.1 Research information to solve design problems.</p>	<p>10.S.1.2.1 Follow architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical principles) for design solutions.</p>	<p>11A.S.1.2.1 Incorporate architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical properties) into design solutions.</p>	<p>11B.S.1.2.1 Incorporate architectural design principles into design solutions (e.g., sketches, notes).</p>	<p>12B.S.1.2.1 Create and revise sketches and notes based on building system research.</p>	<p>12C.S.1.2.1 Develop a bubble diagram and sketches based on the design factors (e.g., sustainability, universal design, client and municipal requirements, and aesthetics).</p>
	<p>9.S.1.2.2 Include sustainable concepts in designs.</p>	<p>10.S.1.2.2 Research information to solve design problems.</p>	<p>11A.S.1.2.2 Research information to solve design problems.</p>	<p>11B.S.1.2.2 Incorporate architectural aesthetic principles, sustainable concepts, and universal design principles into design solutions.</p>	<p>12B.S.1.2.2 Extract site data using surveying devices.</p>	<p>12C.S.1.2.2 Reference specification tables to select building and infrastructure components.</p>
	<p>9.S.1.2.3 Include aesthetic principles in designs.</p>	<p>10.S.1.2.3 Include sustainable concepts in designs.</p>	<p>11A.S.1.2.3 Include sustainable concepts in architectural/mechanical designs.</p>	<p>11B.S.1.2.3 Gather measurement data about a residential construction project.</p>	<p>12B.S.1.2.3 Incorporate architectural aesthetic principles, sustainable concepts, and universal design principles into design solutions.</p>	<p>12C.S.1.2.3 Analyze and predict consequences of design modifications.</p>

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2:** Research and analyze information for design solutions. *(continued)*

S	9.S.1.2.4 Identify possible solutions for design problems.	10.S.1.2.4 Include universal design in solutions.	11A.S.1.2.4 Include universal design in architectural/mechanical solutions.	11B.S.1.2.4 Analyze and predict consequences of design modifications.	12B.S.1.2.4 Research sizes of appropriate structural members (e.g., nominal lumber, steel, truss joists, glulam).	12C.S.1.2.4 Research and reference information for residential construction and/or civil engineering from various sources.
		10.S.1.2.5 Include aesthetic principles in designs.		11B.S.1.2.5 Research and reference information for residential construction from various sources, including building codes, span tables, manufacturers' specifications, and site data.	12B.S.1.2.5 Analyze and predict consequences of design modifications.	
		10.S.1.2.6 Identify possible solutions for design problems.			12B.S.1.2.6 Research and reference information for residential building systems from various sources, including building codes, span tables, manufacturers' specifications, and site data.	

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2: Research and analyze information** for design solutions. *(continued)*

S					12B.S.1.2.7 Research existing site conditions.
					12B.S.1.2.8 Produce a drawing typical of civil engineering.

**GLO 1.3: Synthesize** information and ideas to create design solutions.

F	9.F.1.3.1 Demonstrate an awareness that the selection of design solutions is often influenced by factors (e.g., cost, materials, customer request).	10.F.1.3.1 Identify influences that can impact the decision-making process for design solutions.	11A.F.1.3.1 Identify influences that can impact the decision-making process for architectural/mechanical design solutions.	11B.F.1.3.1 Identify influences (e.g., cost, materials) that can impact the decision-making process for architectural design solutions.	12B.F.1.3.1 Identify influences (e.g., cost, materials, sustainability) that can impact the decision-making process for architectural design solutions.	12C.F.1.3.1 Identify influences (e.g., client and municipal requirements, cost, materials, building codes) that can impact the decision-making process for architectural design and/or civil engineering solutions.
	9.F.1.3.2 Identify techniques used for 2-D and isometric sketching.	10.F.1.3.2 Identify techniques used for 2-D and isometric sketching.	11A.F.1.3.2 Identify techniques used for 2-D, isometric, and perspective sketching.	11B.F.1.3.2 Identify sketching techniques related to specialized media (e.g., charcoal, paint, felt pen, pen and ink).	12B.F.1.3.2 Identify sketching techniques related to specialized media (e.g., charcoal, paint, felt pen, pen and ink).	

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.3: Synthesize** information and ideas to create design solutions. *(continued)*

F				11B.F.1.3.3 Describe the relationship between the plan view and the elevations.	12B.F.1.3.3 Identify timeline management techniques.	
	9.S.1.3.1 Select design solutions based on provided criteria and related research.	10.S.1.3.1 Select design solutions based on provided criteria and related research.	11A.S.1.3.1 Select design solutions based on provided architectural/mechanical criteria and related research.	11B.S.1.3.1 Select design solutions based on research into architectural topics (e.g., room layout, styles, trends, sizes, space zoning).	12B.S.1.3.1 Apply building systems to design solutions.	12C.S.1.3.1 Select design solutions based on research for client and municipal requirements.
S	9.S.1.3.2 Use freehand sketches and notes to solve basic design drafting problems.	10.S.1.3.2 Create freehand sketches to solve architectural/mechanical design problems.	11A.S.1.3.2 Create freehand sketches to solve architectural/mechanical design problems.	11B.S.1.3.2 Select construction systems (e.g., wall, floor, foundation, roof, doors, windows) based on research.	12B.S.1.3.2 Select building systems (e.g., HVAC, plumbing, electrical) based on research.	12C.S.1.3.2 Create freehand sketches using a variety of media to solve architectural design and/or civil engineering problems.
				11B.S.1.3.3 Create freehand sketches to solve architectural design problems.	12B.S.1.3.3 Create freehand sketches to solve architectural design problems.	
					12B.S.1.3.4 Select appropriate and cost-effective solutions to civil engineering problems.	
					12B.S.1.3.5 Produce a site-development proposal.	

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**Goal 2: Communicate** design solutions.

**GLO 2.1:** Prepare **computer models** of design solutions.

<b>F</b>	9.F.2.1.1 Identify the function of computer models (e.g., visualization, model to working drawing).	10.F.2.1.1 Identify the function of computer models (e.g., visualization, model to working drawing, assembly).	11A.F.2.1.1 Describe the function of computer models (e.g., visualization, model to working drawing, assembly).	11B.F.2.1.1 Describe the function of computer models (e.g., visualization, model to working drawing).	12B.F.2.1.1 Describe the function of computer models (e.g., visualization, model to working drawing).	12C.F.2.1.1 Assess client and municipal requirements and select the process for creating building systems using CADD software.
	9.F.2.1.2 Define geometric construction principles.	10.F.2.1.2 Define basic geometric construction principles (e.g., linear, angular, perpendicular, parallel, tangential).	11A.F.2.1.2 Define basic geometric construction principles (e.g., cylindrical, tangential, concentric, ogee).	11B.F.2.1.2 Describe the process of creating foundation, wall, and floor systems using CADD software.	12B.F.2.1.2 Describe the process of creating building systems using CADD software.	
		10.F.2.1.3 Identify basic architectural components, including walls, doors, windows, built-ins, fixtures, and stairs, and/or basic mechanical features of parts (e.g., fillets, chamfers, holes).	11A.F.2.1.3 Identify architectural components and materials, including foundation systems, roofs, and structural members, and/or mechanical features of parts and assemblies (e.g., cylinders, fillets, chamfers, holes, threaded and through holes, countersink, counterbore, spot face, basic fasteners).			

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.1:** Prepare **computer models** of design solutions. *(continued)*

S	9.S.2.1.1 Create models of design solutions.	10.S.2.1.1 Create basic architectural/mechanical models of design solutions.	11A.S.2.1.1 Create and use a computer model for visualization, to develop a working drawing, and to verify component assembly.	11B.S.2.1.1 Create a computer model using foundation, wall, and floor systems, window and door components, and standard parts.	12B.S.2.1.1 Modify computer models using building system components and standard parts.	12C.S.2.1.1 Create and modify computer models using building system components and/or civil infrastructure elements and following client and municipal requirements.
			11A.S.2.1.2 Apply basic geometric construction principles (e.g., cylindrical, tangential, concentric, ogee).	11B.S.2.1.2 Use a computer model for visualization and to create working drawings, including floor plans and elevations.	12B.S.2.1.2 Use a computer model for visualization and to create working drawings, including foundation, electrical, HVAC, and site plan drawings, and section (e.g., building and wall) and detail drawings.  12B.S.2.1.3 Identify existing site conditions.  12B.S.2.1.4 Identify structures within a site.  12B.S.2.1.5 Include utilities locations.	12C.S.2.1.2 Use a computer model for visualization and to create presentation and working drawings.

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**Goal 2: Communicate** design solutions. (*continued*)

**GLO 2.2: Prepare working and presentation drawings and documents.**

F	<p>9.F.2.2.1 Identify the differences between working and presentation drawings.</p> <p><b>Layout</b> 9.F.2.2.2 Identify the components (e.g., title block, border, view arrangements) of a drawing.</p>	<p>10.F.2.2.1 Identify the differences between working and presentation drawings.</p> <p><b>Layout</b> 10.F.2.2.2 Identify components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales) of an architectural drawing and/or the components (e.g., title block information, border with zones, view arrangements, engineering scale) of an engineering drawing.</p>	<p><b>Layout</b> 11A.F.2.2.1 Identify components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales) of an architectural drawing and/or the components (e.g., title block information, border with zones, view arrangements, parts lists, projection symbol) of an engineering drawing.</p> <p>11A.F.2.2.2 Identify architectural symbols (e.g., walls, doors, windows, foundation systems, roofs, structural members, stairs, materials) for floor plans and elevation drawings, and/or mechanical symbols (e.g., cylinders, fillets, chamfers, holes, threaded and through holes, countersink, counterbore, spot face, basic fasteners) for orthographic, auxiliary, and section drawings.</p>	<p><b>Layout</b> 11B.F.2.2.1 Identify components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales) of an architectural drawing.</p> <p>11B.F.2.2.2 Identify architectural symbols (e.g., walls, doors, windows, roofs, structural members, stairs, plumbing fixtures, materials) for floor plan and elevation drawings.</p>	<p><b>Layout</b> 12B.F.2.2.1 Identify architectural scales and revision columns for an architectural drawing.</p> <p>12B.F.2.2.2 Identify architectural symbols (e.g., building and wall) for foundation, electrical, HVAC, and site plan drawings, and section and detail drawings.</p>	<p>12C.F.2.2.1 Read and interpret construction standards and building codes.</p> <p>12C.F.2.2.2 Apply design drafting fundamentals and conventions to civil engineering drawings.</p>
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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

F	<p>9.F.2.2.3 Identify the standards related to working drawing view selection and placement.</p>	<p>10.F.2.2.3 Identify architectural symbols (e.g., walls, doors, windows, built-ins, fixtures, stairs) for floor plans and/or basic mechanical symbols (e.g., fillets, chamfers, holes) for orthographic projection drawings.</p>	<p><b>Line Work</b>          11A.F.2.2.3 Identify architectural line types (e.g., object, hidden, centre, construction, extension, dimension, break, section lines) and their intended uses (e.g., walls, doors, windows, foundation systems, roofs, structural members, stairs, materials), and/or mechanical line types (e.g., object, hidden, centre, construction, extension, dimension, leader, section, break, cutting plane, phantom, fold lines) and their intended uses (e.g., cylinders, fillets, chamfers, holes, threaded and through holes, countersink, counterbore, spot face, basic fasteners, flat patterns).</p>	<p>11B.F.2.2.3 Read and interpret tags and detailed schedule tables.</p>	<p>12B.F.2.2.3 Locate a residence on a site.</p>
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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

F	<p><b>Line Work</b> 9.F.2.2.4 Identify basic line types (e.g., object, hidden, centre, dimension, extension, section, cutting plane, break) and uses.</p>	<p><b>Line Work</b> 10.F.2.2.4 Identify basic architectural line types (e.g., object, hidden, centre, construction, extension, dimension lines) and their intended uses (e.g., walls, doors, windows, built-ins, fixtures, stairs), and/or basic mechanical line types (e.g., object, hidden, centre, construction, extension, dimension, leader lines) and their intended uses (e.g., fillets, chamfers, holes).</p>	<p><b>Dimensioning and Annotating</b> 11A.F.2.2.4 Differentiate between basic architectural and mechanical dimensioning standards.</p>	<p>11B.F.2.2.4 Recognize the need for auxiliary views when creating elevation drawings.</p>	<p>12B.F.2.2.4 Describe layout considerations (e.g., codes, function, aesthetics) for electrical and mechanical equipment.</p>
	<p><b>Dimensioning and Annotating</b> 9.F.2.2.5 Identify the purpose and rules of dimensioning.</p>	<p><b>Dimensioning and Annotating</b> 10.F.2.2.5 Identify dimensioning standards.</p>	<p>11A.F.2.2.5 Differentiate between basic architectural and mechanical notes and annotations.</p>	<p><b>Line Work</b> 11B.F.2.2.5 Identify architectural line types (e.g., object, hidden, centre, construction, extension, and dimension lines, break lines, phantom lines, hatch lines) and their intended use.</p>	<p><b>Line Work</b> 12B.F.2.2.5 Identify architectural line types (e.g., object, hidden, centre, construction, extension, and dimension lines, break lines, phantom lines, hatch lines) and their intended use.</p>

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

F	<p>9.F.2.2.6 Identify the purpose of notes and annotations.</p>	<p>10.F.2.2.6 Identify the purpose of notes and annotations (e.g., about materials, processes, finishes) in architectural and mechanical drawings.</p>	<p><b>Dimensioning and Annotating</b>          11B.F.2.2.6 Identify architectural dimensioning and annotation standards.</p>	<p><b>Dimensioning and Annotating</b>          12B.F.2.2.6 Identify architectural dimensioning and annotation standards.</p> <p>12B.F.2.2.7          Describe and apply civil engineering/surveying units.</p> <p>12B.F.2.2.8          Describe surveying terminology and techniques.</p>
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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

<b>S</b>	<p><b>Layout</b> 9.S.2.2.1 Use freehand sketches to arrange drawing layouts.</p>	<p><b>Layout</b> 10.S.2.2.1 Use the components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales) of an architectural drawing, and/or the components (e.g., title block information, border with zones, view arrangements, engineering scale) of a mechanical drawing.</p>	<p><b>Layout</b> 11A.S.2.2.1 Use architectural drawing components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales, revision columns) and/or mechanical drawing components (e.g., title block information, border with zones, view arrangements, parts lists, projection symbols).</p>	<p><b>Layout</b> 11B.S.2.2.1 Use the components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales, revision columns) of an architectural drawing.</p>	<p>12C.S.2.2.1 Produce a set of drawings and documents that meets drafting standards and follows building codes.</p>
	<p>9.S.2.2.2 Create working drawings following view selection (e.g., single, orthographic, section, auxiliary, isometric, oblique) and placement standards.</p>	<p>10.S.2.2.2 Create floor plans using architectural symbols (e.g., walls, doors, windows, built-ins, fixtures, stairs), and/or orthographic projection drawings using basic mechanical symbols.</p>	<p>11A.S.2.2.2 Create floor plans and elevation drawings using architectural symbols (e.g., walls, doors, windows, foundation systems, roofs, structural members, stairs, materials) and/or orthographic, primary auxiliary, and section drawings (e.g., full, half, offset section views) of parts and assemblies using mechanical symbols.</p>	<p>11B.S.2.2.2 Create floor plans and interior and exterior elevation working drawings using architectural symbols (e.g., walls, doors, windows, foundation systems, roofs, structural members, stairs, materials) to industry standard.</p>	<p>12B.S.2.2.2 Create working drawings, including foundation, electrical, HVAC, and site plan drawings, and section (e.g., building and wall) and detail drawings using architectural symbols to industry standard.</p>

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

S	<b>Line Work</b> 9.S.2.2.3 Select and use line types (e.g., object, hidden, centre, construction, extension, dimension lines) to construct a drawing to standards.	10.S.2.2.3 Apply basic geometric construction principles (e.g., linear, angular, perpendicular, parallel, tangential).	11A.S.2.2.3 Include materials notes in drawings.	11B.S.2.2.3 Create schedule tables (e.g., window, door, room finish).	12B.S.2.2.3 Create schedule tables (e.g., electrical, plumbing).
	9.S.2.2.4 Apply material symbols to full and half section views.	<b>Line Work</b> 10.S.2.2.4 Select and use basic line types for architectural/mechanical applications.	11A.S.2.2.4 Combine orthographic, section, auxiliary, detail, and isometric drawings into a set of architectural/mechanical working drawings.	<b>Line Work</b> 11B.S.2.2.4 Select and use line types for architectural applications based on standards.	12B.S.2.2.4 Revise drawings to ensure consistency, and organize and assemble a set of working drawings.
	<b>Dimensioning and Annotating</b> 9.S.2.2.5 Apply placement, styles, and rules of dimensioning.	<b>Dimensioning and Annotating</b> 10.S.2.2.5 Apply placement, styles, and rules of dimensioning following dimensioning standards.	<b>Line Work</b> 11A.S.2.2.5 Select and use line types for architectural and mechanical applications based on standards.	<b>Dimensioning and Annotating</b> 11B.S.2.2.5 Use industry standard dimensions and annotations.	<b>Line Work</b> 12B.S.2.2.5 Select and use line types for architectural applications based on standards.

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

S	9.S.2.2.6 Apply the placement, style, size of text, and leaders for notes and abbreviations.	10.S.2.2.6 Apply the placement, style, size of text, and leaders for notes and abbreviations following standards.	<p><b>Dimensioning and Annotating</b> 11A.S.2.2.6 Apply placement, styles, and rules of dimensioning following dimensioning standards.</p> <p>11A.S.2.2.7 Apply the placement, style, size of text, and leaders for notes and abbreviations following standards.</p>	<p><b>Dimensioning and Annotating</b> 12B.S.2.2.6 Use industry standard dimensions and annotations.</p>
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**Goal 3: Use appropriate materials and processes** of building/manufacturing.

**GLO 3.1: Describe materials** used in design solutions.

F	9.F.3.1.1 Explain the importance of materials notes on a drawing.	10.F.3.1.1 Describe the materials used in design solutions.	11A.F.3.1.1 Describe the properties of materials used in design solutions.	<p>11B.F.3.1.1 Identify materials and equipment used for foundation, wall, and floor systems, and windows and doors.</p> <p>11B.F.3.1.2 Identify material and equipment estimation techniques.</p>	<p>12B.F.3.1.1 Identify materials and equipment used for building systems.</p> <p>12B.F.3.1.2 Identify material and equipment estimation techniques.</p>	12C.F.3.1.1 Assess material and equipment selections based on client and municipal requirements.
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**Goal 3:** Use appropriate **materials and processes** of building/manufacturing. *(continued)*

**GLO 3.1:** Describe **materials** used in design solutions. *(continued)*

S	9.S.3.1.1 List materials used in design solutions.	10.S.3.1.1 List materials used in design solutions.	11A.S.3.1.1 List materials used in design solutions.	11B.S.3.1.1 Select materials and components for foundation, wall, and floor systems, and windows and doors.	12B.S.3.1.1 Select materials, components, and equipment for building systems.	12C.S.3.1.1 Select materials, components, and equipment for building systems and/or civil infrastructure projects.
	9.S.3.1.2 Include materials notes in drawings.	10.S.3.1.2 Include materials notes in drawings.		11B.S.3.1.2 Generate materials lists for foundation, wall, and floor systems, and windows and doors.	12B.S.3.1.2 Generate materials lists for building systems.	12C.S.3.1.2 Generate materials lists as required by clients and municipalities.

**GLO 3.2:** Describe **building/manufacturing processes** used in design solutions.

F	—	10.F.3.2.1 Demonstrate an awareness of the construction process and/or of the manufacturing process.	11A.F.3.2.1 Identify basic construction processes (e.g., wall and floor thickness) for residential designs and/or basic manufacturing processes (e.g., machining, casting) for mechanical designs.	11B.F.3.2.1 Identify and describe residential construction methods and principles for foundation, wall, and floor systems, and windows and doors.	12B.F.3.2.1 Identify and describe residential construction methods and principles for building systems.	12C.F.3.2.1 Assess residential construction methods and principles for building systems and/or civil infrastructure based on client and municipal requirements.
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**Goal 3:** Use appropriate **materials and processes** of building/manufacturing. *(continued)*

**GLO 3.2:** Describe **building/manufacturing processes** used in design solutions. *(continued)*

F		11A.F.3.2.2 Identify re-engineering concepts (e.g., improving function and form, adapting to a different function).	11B.F.3.2.2 Define project management.	12B.F.3.2.2 Demonstrate an awareness of residential project management.	12C.F.3.2.2 Identify project management considerations (e.g., timelines, material supplies, project management software) for residential construction and/or civil infrastructure projects.
S	—	—	—	—	—

**Goal 4: Present** design solutions.

**GLO 4.1: Plan and organize presentations** of design solutions.

F	9.F.4.1.1 Identify presentation methods (e.g., design briefs, sketches, drawings).	10.F.4.1.1 Identify presentation methods (e.g., design briefs, sketches, drawings).  10.F.4.1.2 Identify the rationale for presentations in the design process.	11A.F.4.1.1 Differentiate between architectural and mechanical presentation methods.	11B.F.4.1.1 Identify traditional and digital architectural presentation methods.	12B.F.4.1.1 Identify methods for presenting building systems.	12C.F.4.1.1 Describe the effectiveness of various presentation methods.
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**Goal 4: Present** design solutions. *(continued)*

**GLO 4.1: Plan and organize presentations** of design solutions. *(continued)*

<b>S</b>	9.S.4.1.1 Follow presentation methods (e.g., oral, written, graphic).	10.S.4.1.1 Follow presentation methods (e.g., oral, written, graphic, 3-D model).	11A.S.4.1.1 Follow presentation methods for design solutions (e.g., oral, written, graphic, physical or digital 3-D model).	11B.S.4.1.1 Select written and visual presentation methods for design solutions (e.g., oral, written, graphic, physical or digital 3-D model).	12B.S.4.1.1 Select presentation methods for building systems (e.g., oral, written, overlay graphic, physical or digital 3-D model).	12C.S.4.1.1 Select presentation methods based on client and municipal requirements.
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**GLO 4.2: Use presentation production methods.**

<b>F</b>	9.F.4.2.1 Identify the elements (e.g., rationale, functionality, research) of a design brief.	10.F.4.2.1 Identify the elements (e.g., rationale, functionality, research) of a design brief.	11A.F.4.2.1 Identify the elements (e.g., rationale, functionality, research) of a design brief.	11B.F.4.2.1 Differentiate among the formats and functions of technical reports, design briefs, and scope-of-work documents.	12B.F.4.2.1 Differentiate among the formats and functions of technical reports, design briefs, and scope-of-work documents.	12C.F.4.2.1 Assess written and visual presentation methods based on project complexity, budget, available time, and client and municipal requirements.
		10.F.4.2.2 Identify the function of 3-D models as presentation methods.	11A.F.4.2.2 Identify the techniques for creating working drawings from digital 3-D models.	11B.F.4.2.2 Differentiate among the formats and functions of visual presentation formats (e.g., presentation software, renderings, physical models).	12B.F.4.2.2 Differentiate among the formats and functions of visual presentation formats (e.g., presentation software, presentation sections, detailed views, physical models) for building systems.	12C.F.4.2.2 Identify techniques to create physical 3-D architectural and/or civil engineering models.

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**Goal 4: Present** design solutions. *(continued)*

**GLO 4.2: Use presentation production methods.** *(continued)*

F		11A.F.4.2.3 Identify the techniques to create 3-D physical models.				
S	9.S.4.2.1 Create sketches and design briefs to support design solutions.	10.S.4.2.1 Create design briefs to support design solutions.	11A.S.4.2.1 Create design briefs to support architectural/mechanical design solutions.	11B.S.4.2.1 Create design briefs to support architectural design solutions.	12B.S.4.2.1 Create written technical reports and scope-of-work documents supporting choice and placement of building systems.	12C.S.4.2.1 Choose written and visual presentation methods to communicate effectively with clients and/or other stakeholders.
		10.S.4.2.2 Communicate effectively using presentation software incorporating design elements (e.g., formatting, layout, font size).	11A.S.4.2.2 →	11B.S.4.2.2 →	12B.S.4.2.2 →	12C.S.4.2.2 →
		10.S.4.2.3 Create shaded 3-D computer models.	11A.S.4.2.3 Create floor plans and elevations from architectural computer models and/or orthographic and isometric views from mechanical computer models.	11B.S.4.2.3 Create visual presentations to support architectural design solutions.	12B.S.4.2.3 Create visual presentations supporting choice and placement of building systems.	12C.S.4.2.3 Create physical models.
		10.S.4.2.4 Create physical models.	11A.S.4.2.4 Create physical models.			

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**Goal 4: Present** design solutions. *(continued)*

**GLO 4.3: Present/defend design solutions.**

<b>F</b>	<p>9.F.4.3.1 Identify elements (e.g., clarity, conciseness) of effective verbal communication.</p>	<p>10.F.4.3.1 Identify elements (e.g., clarity, conciseness) of effective verbal communication.</p>	<p>11A.F.4.3.1 Identify elements (e.g., clear and concise communication, appearance and dress, enunciation and volume) of effective presentations.</p>	<p>11B.F.4.3.1 Describe elements (e.g., clear and concise communication, appearance and dress, enunciation and volume, body language) of effective presentations.</p>	<p>12B.F.4.3.1 Describe elements and communication techniques (e.g., appearance and dress, enunciation and volume, body language) of presentations for technical information.</p>	<p>12C.F.4.3.1 Assess and adapt the presentation and communication techniques (e.g., appearance and dress, enunciation and volume, body language) to the clients and/or other stakeholders.</p>
	<p>9.F.4.3.2 Demonstrate an awareness of competitions related to design drafting.</p>	<p>10.F.4.3.2 Demonstrate an awareness of competitions related to design drafting.</p>	<p>11A.F.4.3.2 Identify competitions related to design drafting.</p>	<p>11B.F.4.3.2 Discuss out-of-school student competitions related to architectural design drafting.</p>	<p>12B.F.4.3.2 Discuss out-of-school student competitions related to architectural design drafting.</p>	<p>12C.F.4.3.2 Revise solutions according to feedback from clients and/or other stakeholders.</p> <p>12C.F.4.3.3 Research out-of-school student competitions related to architectural design and/or civil engineering drafting.</p>
<b>S</b>	<p>9.S.4.3.1 Present design solutions to an audience (e.g., peer, teacher).</p>	<p>10.S.4.3.1 Present design solutions to an audience (e.g., peer, teacher).</p>	<p>11A.S.4.3.1 Present design solutions to an audience (e.g., peer, teacher) and reflect on feedback.</p>	<p>11B.S.4.3.1 Present design solutions to an audience (e.g., group) and reflect on feedback.</p>	<p>12B.S.4.3.1 Present technical design solutions to an audience (e.g., group), including the civil engineering components, and respond to questions and feedback.</p>	<p>12C.S.4.3.1 Present design solutions to clients and/or other stakeholders and respond to questions and feedback.</p>

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting.

**GLO 5.1:** Describe and use **drawing and modelling tools and equipment**.

F	9.F.5.1.1 Identify manual drafting tools and media.	10.F.5.1.1 Identify sketching tools and media.	11A.F.5.1.1 Identify basic sketching tools and media.	—	12B.F.5.1.1 Identify surveying tools and equipment.	12C.F.5.1.1 Identify specialized sketching tools and media (e.g., charcoal, paint, felt pen, pen and ink).
	9.F.5.1.2 Identify physical modelling tools (e.g., scissors, knives, saws).	10.F.5.1.2 Identify physical modelling tools (e.g., scissors, knives, saws).	11A.F.5.1.2 Identify physical modelling tools (e.g., scissors, knives, saws).			12C.F.5.1.2 Assess client project and select drawing and modelling tools and equipment.
	9.F.5.1.3 Identify measuring devices (e.g., rulers, tape measures, scales, calipers).	10.F.5.1.3 Identify measuring devices (e.g., rulers, tape measures, engineering, architectural, and metric scales, calipers).	11A.F.5.1.3 Identify basic measuring devices (e.g., rulers, tape measures, engineering, architectural, and metric scales, calipers).			
S	9.S.5.1.1 Use manual drafting tools and media (e.g., architectural, engineering, and metric scales, pencils, set squares, compass, t-squares, protractors).	10.S.5.1.1 Use sketching tools and media.	11A.S.5.1.1 Use sketching tools and media.	11B.S.5.1.1 Use sketching tools and media.	12B.S.5.1.1 Use surveying tools and equipment.	12C.S.5.1.1 Use specialized sketching tools and media.

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. *(continued)*

**GLO 5.1:** Describe and use **drawing and modelling tools and equipment**. *(continued)*

S	9.S.5.1.2 Use basic physical modelling tools (e.g., scissors, knives, saws, tape measures, calipers).	10.S.5.1.2 Use basic physical modelling tools (e.g., scissors, knives, saws, tape measures, calipers).	11A.S.5.1.2 Use basic physical modelling tools (e.g., scissors, knives, saws, tape measures, calipers).	11B.S.5.1.2 Use physical modelling tools (e.g., scissors, knives, saws).	12B.S.5.1.2 Use sketching tools and media.	12C.S.5.1.2 Use physical modelling tools (e.g., scissors, knives, saws).
				11B.S.5.1.3 Use measuring devices (e.g., rulers, tape measures, architectural and metric scales, calipers).	12B.S.5.1.3 Use physical modelling tools (e.g., scissors, knives, saws).	12C.S.5.1.3 Use measuring devices (e.g., rulers, tape measures, architectural, engineering, and metric scales, calipers).
					12B.S.5.1.4 Use measuring devices (e.g., rulers, tape measures, architectural and metric scales, calipers).	

**GLO 5.2:** Describe and use **computer hardware and equipment**.

F	9.F.5.2.1 Identify common computer hardware.	10.F.5.2.1 Identify common computer hardware.	11A.F.5.2.1 Identify basic requirements for a CADD workstation.	11B.F.5.2.1 Identify basic hardware problems (e.g., power, cords, device connections) and maintenance procedures.	12B.F.5.2.1 Identify function and use of rapid prototyping and 3-D scanning equipment.	12C.F.5.2.1 Assess client project and select computer hardware and equipment.
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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. *(continued)*

**GLO 5.2:** Describe and use **computer hardware and equipment**. *(continued)*

F	9.F.5.2.2 Identify basic hardware problems (e.g., power, cords, device connections).	10.F.5.2.2 Identify basic hardware problems (e.g., power, cords, device connections).	11A.F.5.2.2 Identify the uses of basic input devices (e.g., cameras, scanners) related to design.			
			11A.F.5.2.3 Identify the uses of basic output devices (e.g., printers, plotters) related to design.			
S	9.S.5.2.1 Operate common computer hardware (e.g., computer, three-button mouse, printers, monitors).	10.S.5.2.1 Operate common computer hardware (e.g., three-button mouse, printers, monitors).	11A.S.5.2.1 Operate input devices (e.g., digital camera, scanner).	11B.S.5.2.1 Operate input devices (e.g., digital camera, scanner).	12B.S.5.2.1 Operate input devices (e.g., digital camera, scanner, 3-D scanner).	12C.S.5.2.1 Use communication devices to interact with clients, industry experts, manufacturers, and suppliers.
			11A.S.5.2.2 Operate output devices (e.g., printers, plotters).	11B.S.5.2.2 Operate output devices (e.g., printers, plotters).	12B.S.5.2.2 Operate output devices (e.g., printers, plotters, rapid prototyping).	12C.S.5.2.2 Operate input devices (e.g., digital camera, scanner).
				11B.S.5.2.3 Troubleshoot computer and printer/plotter problems.	12B.S.5.2.3 Troubleshoot computer and printer/plotter problems.	12C.S.5.2.3 Operate output devices (e.g., printers, plotters).
						12C.S.5.2.4 Troubleshoot computer and printer/plotter problems.

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. (*continued*)

**GLO 5.3:** Describe and use **software**.

F	9.F.5.3.1 Identify industry standard CADD software.	10.F.5.3.1 Identify industry standard architectural and mechanical CADD software.	11A.F.5.3.1 Differentiate between industry standard architectural and mechanical CADD software.	11B.F.5.3.1 Identify industry standard architectural CADD software.	12B.F.5.3.1 Identify building system-specific software.	12C.F.5.3.1 Assess the project in order to select the required software.
	9.F.5.3.2 Identify office- and design-related software.	10.F.5.3.2 Identify office- and design-related software.	11A.F.5.3.2 Identify basic features of office- and design-related software.	11B.F.5.3.2 Discuss the application of office software in the design and presentation process.	12B.F.5.3.2 Discuss the application of office software in the design and presentation process.	
	9.F.5.3.3 Identify file management systems and practices (e.g., file organization, network navigation).	10.F.5.3.3 Identify information communication technologies (e.g., architectural and mechanical websites) related to design drafting.	11A.F.5.3.3 Identify information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to design drafting.			
S	9.S.5.3.1 Use industry standard CADD software.	10.S.5.3.1 Use industry standard architectural and mechanical CADD software.	11A.S.5.3.1 Use industry standard architectural and mechanical CADD software.	11B.S.5.3.1 Use industry standard architectural CADD software.	12B.S.5.3.1 Use industry standard architectural CADD software.	12C.S.5.3.1 Analyze and select software and tools necessary to complete the residential construction and/or civil engineering project.

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. *(continued)*

**GLO 5.3:** Describe and use **software**. *(continued)*

S	9.S.5.3.2 Use office- and design-related software.	10.S.5.3.2 Use office- and design-related software.	11A.S.5.3.2 Use basic features of office- and design-related software.	11B.S.5.3.2 Use office- and design-related software.	12B.S.5.3.2 Use office- and design-related software.	12C.S.5.3.2 Demonstrate use of electronic communications technology.
	9.S.5.3.3 Manage and organize project files.	10.S.5.3.3 Manage and organize project files.	11A.S.5.3.3 Manage project data using CADD software.	11B.S.5.3.3 Manage project data using CADD software.	12B.S.5.3.3 Manage project data using CADD software.	12C.S.5.3.3 Use information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to design drafting.
			11A.S.5.3.4 Manage and organize project files.	11B.S.5.3.4 Manage and organize project files.	12B.S.5.3.4 Manage and organize project files.	
			11A.S.5.3.5 Use and manipulate digital images, at a basic level, to obtain and record information (e.g., portfolio collection, research).	11B.S.5.3.5 Use and manipulate digital images to obtain and record information (e.g., portfolio collection, research).	12B.S.5.3.5 Use and manipulate digital images to obtain and record information (e.g., portfolio collection, research).	

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. (*continued*)

**GLO 5.3:** Describe and use **software**. (*continued*)

S		11A.S.5.3.6 Use information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to architectural/mechanical design drafting.	11B.S.5.3.6 Use information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to architectural design drafting.	12B.S.5.3.6 Use information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to architectural design drafting.	
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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting.

F	9.F.6.1.1 Identify metric and imperial systems of measurement.	10.F.6.1.1 Demonstrate an understanding of the metric and imperial systems of measurement.	11A.F.6.1.1 Demonstrate an understanding of the metric and imperial systems of measurement.	11B.F.6.1.1 Demonstrate an understanding of metric and imperial conversions.	12B.F.6.1.1 Identify standard drafting scales for technical drawings.	12C.F.6.1.1 Select mathematical methods to solve architectural and/or civil engineering design problems.
	9.F.6.1.2 Add and subtract fractions and decimals.	10.F.6.1.2 Add, subtract, multiply, and divide fractions, decimals, feet, and inches.	11A.F.6.1.2 Add, subtract, multiply, and divide fractions and decimals.	11B.F.6.1.2 Identify the buildable levels of precision used in architectural drawings.	12B.F.6.1.2 Identify the buildable levels of precision used in architectural drawings.	

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting. (continued)

F	9.F.6.1.3 Identify symbols related to imperial measurement (e.g., 2'-3").	10.F.6.1.3 Identify symbols related to imperial measurement (e.g., 2'-3").	11A.F.6.1.3 Identify the buildable levels of precision used in architectural and mechanical drawings.	11B.F.6.1.3 Identify metric site-grading data and convert to establish footing depth.	12B.F.6.1.3 Identify mathematical concepts (e.g., slope, ratio, proportion, angles) related to architectural drafting.
	9.F.6.1.4 Identify equivalent forms of fractions (e.g., $\frac{1}{8}'' = \frac{2}{16}''$ , lowest common denominator).	10.F.6.1.4 Identify equivalent forms of fractions (e.g., $\frac{1}{8}'' = \frac{2}{16}''$ , lowest common denominator).	11A.F.6.1.4 Identify equivalent forms of fractions (e.g., $\frac{1}{8}'' = \frac{2}{16}''$ , lowest common denominator).	11B.F.6.1.4 Demonstrate an understanding of straight-line interpolation.	
	9.F.6.1.5 Identify standard drafting scales (e.g., relationship between ratios and fractions).	10.F.6.1.5 Identify standard drafting scales (e.g., relationship between ratios and fractions).	11A.F.6.1.5 Identify standard drafting scales (e.g., relationship between ratios and fractions).		
	9.F.6.1.6 Identify the Cartesian coordinate system in relation to CADD.	10.F.6.1.6 Relate the Cartesian coordinate system to CADD.	11A.F.6.1.6 Recognize when numbers must have the same units before they can be calculated.		

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting. (continued)

F		11A.F.6.1.7 Identify symbols related to imperial measurement (e.g., 2'-3").				
		11A.F.6.1.8 Relate the Cartesian coordinate system to CADD.				
S	9.S.6.1.1 Extract data using measuring devices (e.g., rulers, tape measures, scales, calipers).	10.S.6.1.1 Use architectural and/or engineering units and formats of measurement.	11A.S.6.1.1 Use architectural and/or engineering units and formats of measurement.	11B.S.6.1.1 Select and use architectural (imperial or metric) units and formats of measurement to dimension architectural drawings.	12B.S.6.1.1 Apply slope, ratio, and proportion, and trigonometric and algebraic principles to solve architectural and civil engineering construction problems.	12C.S.6.1.1 Perform mathematical calculations, conversions, and measurements as required for the project.
	9.S.6.1.2 Calculate the length of geometric shapes.	10.S.6.1.2 Use ratios for scale drawing.	11A.S.6.1.2 Apply ratios (e.g., scale drawing, roof slope, tapers).	11B.S.6.1.2 Extract architectural data using measuring devices.	12B.S.6.1.2 Convert survey measurements to architectural measurements.	12C.S.6.1.2 Estimate material, equipment, and labour costs.
	9.S.6.1.3 Verify dimensions using estimation.	10.S.6.1.3 Extract architectural and/or mechanical data using measuring devices (e.g., rulers, tape measures, scales, calipers).	11A.S.6.1.3 Extract architectural and/or mechanical data using measuring devices (e.g., rulers, tape measures, scales, calipers).	11B.S.6.1.3 Establish footing depth using metric site-grading data.	12B.S.6.1.3 Research and calculate sizes of structural members (e.g., nominal lumber, steel, truss joists, glulam).	

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting. (continued)

S	9.S.6.1.4 Use ratios for scale drawing.	10.S.6.1.4 Calculate length and area.	11A.S.6.1.4 Calculate length and area.	11B.S.6.1.4 Perform straight-line interpolation calculations when reading span tables.	12B.S.6.1.4 Calculate volume for the sizing of HVAC systems (e.g., duct sizes, room volumes, window area).
		10.S.6.1.5 Calculate distance, area, and volume.	11A.S.6.1.5 Calculate distance, area, volume, and mass.	11B.S.6.1.5 Calculate the length and area of buildings and individual rooms.	12B.S.6.1.5 Calculate heating and cooling requirements.
			11A.S.6.1.6 Convert between metric and imperial linear units.	11B.S.6.1.6 Calculate volume for foundation systems (e.g., concrete, gravel).	12B.S.6.1.6 Estimate material, equipment, and labour costs.
			11A.S.6.1.7 Set CADD units to the appropriate precision.	11B.S.6.1.7 Estimate material costs.	

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.2:** Read, interpret, and communicate information.

F	9.F.6.2.1 Describe research and evaluation techniques.	10.F.6.2.1 Describe research and evaluation techniques.	11A.F.6.2.1 Differentiate between research and evaluation techniques.	11B.F.6.2.1 Identify sources of design information (e.g., building code, material specifications, aesthetic and design principles, restrictive covenants).	12B.F.6.2.1 Identify sources of technical information (e.g., building code, material and equipment specifications, span tables).	12C.F.6.2.1 Compare sources of design and technical information.
		10.F.6.2.2 Identify sources of technical information (e.g., building code, span tables, fastener tables).	11A.F.6.2.2 Identify sources of technical information (e.g., building code, span tables, fastener tables).			
S	9.S.6.2.1 Find, collect, and evaluate information (text, images, data, audio, and video) from given resources.	10.S.6.2.1 Find, collect, and evaluate information (text, images, data, audio, and video) from given resources.	11A.S.6.2.1 Gather and select information from oral, visual, material, print, or electronic sources.	11B.S.6.2.1 Organize and record design information from oral, visual, material, print, or electronic sources.	12B.S.6.2.1 Organize and record technical information from oral, visual, material, print, or electronic sources.	12C.S.6.2.1 Synthesize design and technical information from oral, visual, material, print, or electronic sources.
	9.S.6.2.2 Communicate using the language and terminology of design drafting.	10.S.6.2.2 Communicate using the language and terminology of architectural and/or mechanical design drafting.	11A.S.6.2.2 Read and interpret information from text, tables, charts, and graphs.	11B.S.6.2.2 Read and interpret design information from text, tables, charts, and graphs.	12B.S.6.2.2 Read, interpret, and apply technical information from text, tables, charts, and graphs.	12C.S.6.2.2 Read, interpret, and apply design and technical information from text, tables, charts, and graphs.

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.2: Read, interpret, and communicate** information. (continued)

S	11A.S.6.2.3 Communicate using the language and terminology of architectural and/or mechanical design drafting.	11B.S.6.2.3 Communicate using the language and terminology of architectural design drafting.	12B.S.6.2.3 Communicate using the language and terminology of architectural design drafting.	12C.S.6.2.3 Communicate using the language and terminology of architectural and/or civil engineering design drafting.
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**GLO 6.3: Understand scientific concepts** as they apply to design drafting.

F	9.F.6.3.1 Identify the factors that influence material use (e.g., strength, density, combustibility, buoyancy).	10.F.6.3.1 Identify the factors that influence architectural and/or mechanical material use (e.g., strength, density, combustibility, buoyancy).	11A.F.6.3.1 Identify the factors that influence architectural and/or mechanical material use (e.g., strength, density, combustibility, buoyancy).	11B.F.6.3.1 Identify the aesthetic characteristics and properties of materials used in the architectural design solutions (e.g., species of wood, manufactured versus natural materials, concrete finishing).	12B.F.6.3.1 Identify the scientific properties of materials used in architectural design solutions (e.g., strength, fire rating, properties of concrete, resistance to insect damage and decay, shrinkage, expansion).	12C.F.6.3.1 Compare and select materials based on aesthetic and scientific properties.
	9.F.6.3.2 Describe strengths of shapes.	10.F.6.3.2 Describe strengths of shapes.	11A.F.6.3.2 Describe strengths of shapes.			

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.3:** Understand **scientific concepts** as they apply to design drafting. (continued)

F	9.F.6.3.3 Demonstrate an awareness of the relationship between the model/drawing and physical object.	10.F.6.3.3 Demonstrate an awareness of the relationship between the model/drawing and physical object.	11A.F.6.3.3 Demonstrate an awareness of the relationship between the model/drawing and physical object.			
S	—	—	11A.S.6.3.1 Manipulate materials and shapes to assess their strengths.	—	—	—

**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting.

**GLO 7.1:** Understand the impact of architectural/engineering design on the **environment**.

F	9.F.7.1.1 Define sustainability as it relates to the environment.	10.F.7.1.1 Define sustainability as it relates to the environment.	11A.F.7.1.1 Demonstrate an awareness of the impact of sustainable practices on the environment.	11B.F.7.1.1 Identify environmental sustainability factors that influence architectural design solutions (e.g., building orientation, landscaping).	12B.F.7.1.1 Identify sustainable materials and building systems that affect architectural design solutions (e.g., electrical conservation, green construction, water conservation, cradle to cradle, alternative energy).	12C.F.7.1.1 Analyze sustainable factors, materials, and building systems that affect architectural and/or civil engineering design solutions.
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**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting. *(continued)*

**GLO 7.1:** Understand the impact of architectural/engineering design on the **environment**. *(continued)*

F	10.F.7.1.2 Identify environmental sustainability factors that influence architectural and/or mechanical design solutions.	11A.F.7.1.2 Identify environmental sustainability factors that influence architectural and/or mechanical design solutions.	11B.F.7.1.2 Demonstrate an awareness of the environmental factors that have an impact on the building design.	12B.F.7.1.2 Differentiate between traditional and sustainable building systems and their impacts on the environment.	12C.F.7.1.2 Differentiate between the effect of the environment on a project and the project on the environment.
			11B.F.7.1.3 Identify sustainable construction certifications (e.g., R-2000).	12B.F.7.1.3 Examine energy inventory for residential construction.	12C.F.7.1.3 Identify sustainable construction certifications (e.g., LEED).
S	—	—	11A.S.7.1.1 Incorporate environmental sustainability factors in architectural and/or mechanical design solutions.	11B.S.7.1.1 Incorporate environmental sustainability factors in architectural design solutions.	12B.S.7.1.1 Incorporate sustainable materials and building systems in architectural design solutions.
				12B.S.7.1.2 Use energy inventory software to calculate residential energy efficiency.	12C.S.7.1.1 Select sustainable factors, materials, and building systems that affect architectural and/or civil engineering design solutions, and incorporate them into design solutions.

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**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting. (*continued*)

**GLO 7.2:** Describe the impact of architectural/engineering design on **human health and well-being**.

F	9.F.7.2.1 Define sustainability as it relates to human health and well-being.	10.F.7.2.1 Define sustainability as it relates to human health and well-being.	11A.F.7.2.1 Demonstrate an awareness of the impact of sustainable practices on human health and well-being.	11B.F.7.2.1 Identify human health and well-being sustainability factors that influence architectural design solutions (e.g., building code [spacing on handrails], window area, colour selection, building orientation, ventilation).	12B.F.7.2.1 Identify human health and well-being sustainable materials and building systems that affect architectural design solutions (e.g., light quality, air quality, occupant safety, surface finishes, off-gassing).	12C.F.7.2.1 Analyze sustainable factors, materials, and building and civil systems, and/or civil infrastructure that affect human health and well-being.
		10.F.7.2.2 Identify sustainability factors that influence human health and well-being in architectural and/or mechanical design solutions.	11A.F.7.2.2 Identify sustainability factors that influence human health and well-being in architectural and/or mechanical design solutions.	11B.F.7.2.2 Demonstrate an awareness of the human health and well-being sustainability factors that have an impact on building design.	12B.F.7.2.2 Differentiate among various natural and synthetic materials, and sustainable building systems, and their impact on human health and well-being.	12C.F.7.2.2 Analyze the effect of a building and/or civil infrastructure on human health and well-being.
S	—	—	11A.S.7.2.1 Incorporate human health and well-being sustainability factors in architectural and/or mechanical design solutions.	11B.S.7.2.1 Incorporate human health and well-being sustainability factors in architectural design solutions.	12B.S.7.2.1 Incorporate human health and well-being sustainable materials and building systems in architectural design solutions.	12C.S.7.2.1 Select and incorporate human health and well-being sustainability factors, materials, and building systems in architectural and civil engineering design and/or civil infrastructure solutions.

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**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting. (*continued*)

**GLO 7.3:** Recognize the **economic impact** of sustainable practices in architectural/engineering design.

F	9.F.7.3.1 Define sustainability as it relates to the economy.	10.F.7.3.1 Define sustainability as it relates to the economy.	11A.F.7.3.1 Demonstrate an awareness of the impact of sustainable practices on the economy.	11B.F.7.3.1 Identify the economic sustainability factors that influence architectural design solutions (e.g., local versus imported products, cradle to cradle, recycled materials).	12B.F.7.3.1 Identify economic sustainable materials and building systems that affect architectural design solutions (e.g., solar, geothermal, wind, hydroelectric, renewable materials).	12C.F.7.3.1 Analyze economic sustainable factors that affect the selection of materials and building systems in architectural and civil engineering projects.
		10.F.7.3.2 Identify economic sustainability factors that influence architectural and/or mechanical design solutions.	11A.F.7.3.2 Identify economic sustainability factors that influence architectural and/or mechanical design solutions.	11B.F.7.3.2 Demonstrate an awareness of the economic impact of sustainability factors on architectural design solutions.	12B.F.7.3.2 Differentiate between traditional and sustainable building systems and their economic impacts.  12B.F.7.3.3 Identify sustainable site development practices.	12C.F.7.3.2 Analyze the economic impact of sustainability factors, materials, and building systems on architectural and civil engineering projects.
S	—	—	11A.S.7.3.1 Incorporate economic sustainability factors in architectural and/or mechanical design solutions.	11B.S.7.3.1 Incorporate economic sustainability factors in architectural design solutions.	12B.S.7.3.1 Incorporate economic sustainable materials and building systems in architectural design solutions.	12C.S.7.3.1 Select economic sustainability factors, materials, and building systems that affect architectural and civil engineering projects.

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**Goal 8:** Understand the **evolution** of design drafting, including its **technological progression and emerging trends**.

**GLO 8.1:** Describe the **evolution of design drafting, including its technological progression and emerging trends**.

F	9.F.8.1.1 Demonstrate an appreciation of traditional design drafting tools, equipment, materials, and drawings.	10.F.8.1.1 Demonstrate an appreciation of traditional design drafting tools, equipment, materials, and drawings.	11A.F.8.1.1 Describe the emerging technologies related to the tools, equipment, and materials of design drafting.	11B.F.8.1.1 Discuss emerging trends related to the tools and equipment of architectural design.	12B.F.8.1.1 Discuss emerging trends related to the role of designer/draftsperson and the use of construction documents in building.	12C.F.8.1.1 Demonstrate an appreciation of the changing role of the designer/draftsperson based on emerging trends and technologies.
	9.F.8.1.2 Demonstrate an appreciation of the impact of developing trends and emerging technologies on design drafting.	10.F.8.1.2 Demonstrate an appreciation of the impact of developing trends and emerging technologies on design drafting.	11A.F.8.1.2 Describe past and emerging trends (e.g., societal changes, styles) in architectural and/or mechanical design.	11B.F.8.1.2 Describe emerging styles and trends (e.g., building use, life of building, evolution of building, flexible housing, and home office) and their impact on architectural design.  11B.F.8.1.3 Research past/historical/contemporary examples of architectural design.	12B.F.8.1.2 Describe emerging styles and trends and their impact on the selection of materials and building systems.	12C.F.8.1.2 Describe emerging trends and their impact on the selection of materials and building systems in architectural design and/or civil engineering infrastructure.
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**Goal 9:** Follow the **ethical and legal standards** in design drafting.

**GLO 9.1:** Incorporate the local and national **building codes and standards as well as manufacturing and engineering standards** into designs.

P	9.P.9.1.1 Discuss the need for standards and codes in design drafting.	10.P.9.1.1 Discuss the need for standards and codes in design drafting.	11A.P.9.1.1 Discuss the need for standards and codes in design drafting.	11B.P.9.1.1 Identify the commonly used standards for architectural drafting.	12B.P.9.1.1 Identify the commonly used standards for architectural drafting.	12C.P.9.1.1 Select the appropriate standard for architectural drafting and/or civil engineering infrastructure projects.
	9.P.9.1.2 Follow ISO and ANSI standards to produce drawings.	10.P.9.1.2 Identify CAN/CSA, ISO, and ANSI standards for technical drawings, and/or building codes to create models.	11A.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.	11B.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.	12B.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.	12C.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.
		10.P.9.1.3 Identify the standards related to architectural and engineering working drawing view selection and placement.	11A.P.9.1.3 Identify the standards related to architectural and/or mechanical working drawing view selection, placement, and modification (e.g., removal of unnecessary hidden lines, addition of centre line, partial views).	11B.P.9.1.3 Follow building codes to create floor plans and elevations.	12B.P.9.1.3 Follow building codes to create working drawings including foundation, electrical, HVAC, and site plan drawings, and section (e.g., building and wall) and detail drawings.	12C.P.9.1.3 Interpret criteria from local and national building codes.

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**Goal 9:** Follow the **ethical and legal standards** in design drafting. *(continued)*

**GLO 9.1:** Incorporate the local and national **building codes and standards as well as manufacturing and engineering standards** into designs. *(continued)*

P	10.P.9.1.4 Demonstrate an awareness of the fact that drawings are legal and contractual.	11A.P.9.1.4 Demonstrate an awareness of the fact that drawings are legal and contractual.	11B.P.9.1.4 Demonstrate an awareness of variations in CADD standards (e.g., discipline specific, trade specific, organization).	12B.P.9.1.4 Use CADD standards (e.g., discipline specific, trade specific, organization) based on design project requirements.	12C.P.9.1.4 Select and use CADD standards (e.g., discipline specific, trade specific, organization) based on client and municipal requirements.
			11B.P.9.1.5 Describe the legal (e.g., permits, bylaws, building code, covenants) and contractual (e.g., contractor, material supplies) obligations of drawings.	12B.P.9.1.5 Describe the legal (e.g., permits, bylaws, building code, covenants) and contractual (e.g., contractor, material supplies) obligations of drawings.	12C.P.9.1.5 Produce architectural and/or civil engineering drawings to specifications required to obtain building permits.

**GLO 9.2:** Describe the **ethical expectations** of designers.

P	9.P.9.2.1 Practise ethical and responsible use of computer hardware and software.	10.P.9.2.1 Practise ethical and responsible use of computer hardware and software.	11A.P.9.2.1 Demonstrate an understanding of the legal implications of ethical design.	11B.P.9.2.1 Practise ethical and responsible use of computer hardware and software.	12B.P.9.2.1 Consider the ethical implications of compromise in making technical design decisions (e.g., costs, inadequate design).	12C.P.9.2.1 Apply ethical practices in producing contract documents.
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**Goal 9:** Follow the **ethical and legal standards** in design drafting. *(continued)*

**GLO 9.2:** Describe the **ethical expectations** of designers. *(continued)*

P	9.P.9.2.2 Appreciate the ethical responsibilities of producing accurate design drafting documents.	10.P.9.2.2 Demonstrate an understanding of the ethical responsibilities of producing accurate design drafting documents.	11A.P.9.2.2 Demonstrate an understanding of the ethical responsibilities of producing accurate design drafting documents.	11B.P.9.2.2 Consider the ethical implications of compromise in making design decisions (e.g., costs, inadequate design).
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**Goal 10:** Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace.

**GLO 10.1:** Demonstrate an awareness of **rights, responsibilities, and safety procedures** for specific tools, equipment, and working environments.

P	9.P.10.1.1 Demonstrate and value safe work practices and procedures.	10.P.10.1.1 →	11A.P.10.1.1 →	11B.P.10.1.1 →	12B.P.10.1.1 →	12C.P.10.1.1 →
	9.P.10.1.2 Demonstrate ergonomically correct procedures to avoid injury (e.g., stress, strain).	10.P.10.1.2 →	11A.P.10.1.2 →	11B.P.10.1.2 →	12B.P.10.1.2 →	12C.P.10.1.2 →
	9.P.10.1.3 Identify personal responsibility for health and safety.	10.P.10.1.3 →	11A.P.10.1.3 Demonstrate personal responsibility for health and safety.	11B.P.10.1.3 →	12B.P.10.1.3 →	12C.P.10.1.3 →

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**Goal 10:** Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace. *(continued)*

**GLO 10.1:** Demonstrate an awareness of **rights, responsibilities, and safety procedures** for specific tools, equipment, and working environments. *(continued)*

P	9.P.10.1.4 Identify and use the safety features of tools and equipment.	10.P.10.1.4 →	11A.P.10.1.4 Demonstrate the safety features of tools and equipment.	11B.P.10.1.4 →	12B.P.10.1.4 →	12C.P.10.1.4 →
	9.P.10.1.5 Follow emergency evacuation procedures.	10.P.10.1.5 →	11A.P.10.1.5 →	11B.P.10.1.5 →	12B.P.10.1.5 →	12C.P.10.1.5 →
	9.P.10.1.6 Use appropriate aids to minimize risk of injury.	10.P.10.1.6 →	11A.P.10.1.6 →	11B.P.10.1.6 →	12B.P.10.1.6 →	12C.P.10.1.6 →
	9.P.10.1.7 Use appropriate personal protective equipment.	10.P.10.1.7 →	11A.P.10.1.7 →	11B.P.10.1.7 →	12B.P.10.1.7 →	12C.P.10.1.7 →
	9.P.10.1.8 Locate first aid stations and fire extinguishers.	10.P.10.1.8 →	11A.P.10.1.8 →	11B.P.10.1.8 →	12B.P.10.1.8 →	12C.P.10.1.8 →
					12B.P.10.1.9 Demonstrate an awareness of external health and safety programs and certifications.	12C.P.10.1.9 →

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**Goal 10:** Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace. (*continued*)

**GLO 10.2:** Describe **health and safety laws and regulations**.

P	9.P.10.2.1 Describe the reporting process for injuries.	10.P.10.2.1 →	11A.P.10.2.1 →	11B.P.10.2.1 →	12B.P.10.2.1 →	12C.P.10.2.1 →
		10.P.10.2.2 Identify WHMIS symbols and terminology, and follow WHMIS guidelines.	11A.P.10.2.2 Identify WHMIS symbols and terminology, and follow WHMIS guidelines, including the location of MSDS sheets.	11B.P.10.2.2 →	12B.P.10.2.2 →	12C.P.10.2.2 →
		10.P.10.2.3 Comply with health and safety legislation and practices.	11A.P.10.2.3 →	11B.P.10.2.3 →	12B.P.10.2.3 →	12C.P.10.2.3 →

**Goal 11:** Demonstrate **employability skills** required in design drafting.

**GLO 11.1:** Demonstrate fundamental **employability skills**.

P	9.P.11.1.1 Explain the importance of employability skills.	10.P.11.1.1 →	11A.P.11.1.1 Describe the importance of employability skills in school, work, and daily life.	11B.P.11.1.1 →	12B.P.11.1.1 →	12C.P.11.1.1 →
	9.P.11.1.2 Ask questions to clarify written or oral instructions.	10.P.11.1.2 Ask questions to clarify written or oral communication.	11A.P.11.1.2 Listen and ask questions to clarify problems and instructions.	11B.P.11.1.2 →	12B.P.11.1.2 →	12C.P.11.1.2 →

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**Goal 11:** Demonstrate **employability skills** required in design drafting. *(continued)*

**GLO 11.1:** Demonstrate fundamental **employability skills**. *(continued)*

P	9.P.11.1.3 Identify sources of information and resources for design drafting.	10.P.11.1.3 →	11A.P.11.1.3 Locate, gather, and organize design drafting information using appropriate technology and information systems.	11B.P.11.1.3 →	12B.P.11.1.3 →	12C.P.11.1.3 →
	9.P.11.1.4 Identify problems and follow a problem-solving process.	10.P.11.1.4 Demonstrate an understanding of a problem-solving process for design drafting.	11A.P.11.1.4 Assess situations and identify problems and possible solutions.	11B.P.11.1.4 →	12B.P.11.1.4 →	12C.P.11.1.4 →

**GLO 11.2:** Demonstrate **personal management** skills.

P	9.P.11.2.1 Actively participate in a positive manner.	10.P.11.2.1 →	11A.P.11.2.1 Demonstrate interest, initiative, and effort.	11B.P.11.2.1 →	12B.P.11.2.1 →	12C.P.11.2.1 →
	9.P.11.2.2 Complete tasks within stated time frames.	10.P.11.2.2 →	11A.P.11.2.2 Manage time to complete tasks/projects within stated time frames.	11B.P.11.2.2 →	12B.P.11.2.2 →	12C.P.11.2.2 →

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**Goal 11:** Demonstrate **employability skills** required in design drafting. *(continued)*

**GLO 11.2:** Demonstrate **personal management** skills. *(continued)*

P	9.P.11.2.3 Demonstrate accountability for own actions.	10.P.11.2.3 →	11A.P.11.2.3 Demonstrate accountability for own actions and for the actions of one's team.	11B.P.11.2.3 →	12B.P.11.2.3 →	12C.P.11.2.3 →
	9.P.11.2.4 Accept feedback, comments, and contributions from others.	10.P.11.2.4 →	11A.P.11.2.4 Respond constructively to changes.	11B.P.11.2.4 →	12B.P.11.2.4 →	12C.P.11.2.4 →
	9.P.11.2.5 Listen and respond in order to understand and learn.	10.P.11.2.5 →	11A.P.11.2.5 Demonstrate a willingness to learn continuously.	11B.P.11.2.5 →	12B.P.11.2.5 →	12C.P.11.2.5 →
		10.P.11.2.6 Identify learning materials, resources, and opportunities.	11A.P.11.2.6 Appreciate the need for continuous learning in technologically dependent occupations.	11B.P.11.2.6 →	12B.P.11.2.6 →	12C.P.11.2.6 →

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**Goal 11:** Demonstrate **employability skills** required in design drafting. (*continued*)

**GLO 11.3:** Demonstrate **teamwork** skills.

P	9.P.11.3.1 Actively participate in the work of a group.	10.P.11.3.1 Demonstrate an understanding of the roles of members of a group.	11A.P.11.3.1 Be respectful toward, open to, and supportive of the thoughts, opinions, and contributions of others in a group.	11B.P.11.3.1 →	12B.P.11.3.1 →	12C.P.11.3.1 →
	9.P.11.3.2 Participate in the classroom/shop learning activities.	10.P.11.3.2 Actively participate in the work of a group.	11A.P.11.3.2 Contribute information and skills to achieve the goals of a group.	11B.P.11.3.2 →	12B.P.11.3.2 →	12C.P.11.3.2 →
		10.P.11.3.3 Participate in the classroom/shop learning activities.	11A.P.11.3.3 Contribute willingly to classroom/shop learning activities.	11B.P.11.3.3 →	12B.P.11.3.3 →	12C.P.11.3.3 →
			11A.P.11.3.4 Accept assistance from and offer it to others.	11B.P.11.3.4 →	11B.P.11.3.4 →	11B.P.11.3.4 →
						12C.P.11.3.5 Collaborate with peers and industry professionals.

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**Goal 12:** Describe **career opportunities** in design drafting.

**GLO 12.1:** Describe **post-secondary opportunities** related to design drafting.

P	9.P.12.1.1 Identify post-secondary paths for design drafting (e.g., requirements, educational institutions, programs).	10.P.12.1.1 Identify secondary (e.g., robotics, electronics, carpentry, art) and post-secondary (e.g., requirements, educational institutions, programs) paths related to design drafting.	11A.P.12.1.1 Identify post-secondary paths and articulation opportunities for design drafting (e.g., requirements, educational institutions, programs).	11B.P.12.1.1 Identify post-secondary paths and articulation opportunities for architectural design drafting (e.g., requirements, educational institutions, programs).	12B.P.12.1.1 Identify industry and association certifications related to architectural design drafting.	12C.P.12.1.1 Discuss the post-secondary application process (e.g., deadlines, forms, applications, scholarships).
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**GLO 12.2:** Describe **career opportunities** available in design drafting across industries.

P	9.P.12.2.1 Explore careers related to design drafting.	10.P.12.2.1 Explore architectural/engineering careers related to design drafting.	11A.P.12.2.1 Explore architectural/engineering careers related to design drafting.	11B.P.12.2.1 Explore architectural careers related to the design drafting industry.	12B.P.12.2.1 Explore architectural careers related to the residential construction industry.	12C.P.12.2.1 Explore careers related to architecture and civil engineering.
					12B.P.12.2.2 Identify information for transition from school to work.	12C.P.12.2.2 Finalize transition plan (school to work/post-secondary).

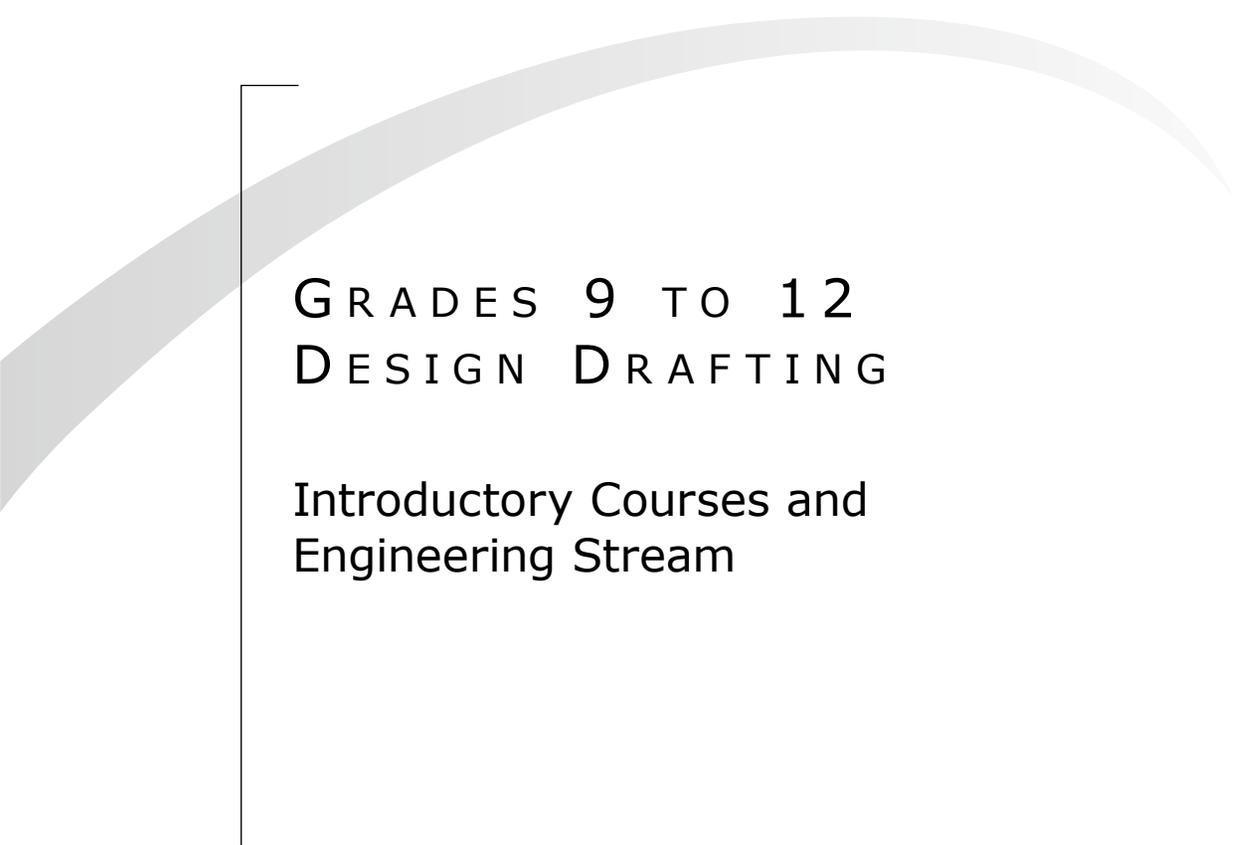
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**Goal 12:** Describe **career opportunities** in design drafting. *(continued)*

**GLO 12.3:** Create, maintain, and present a **portfolio**.

P	9.P.12.3.1 Collect samples for a design drafting portfolio.	10.P.12.3.1 Collect architectural/engineering samples for a design drafting portfolio.	11A.P.12.3.1 Collect architectural/engineering samples for a design drafting portfolio.	11B.P.12.3.1 Collect architectural samples for a design drafting portfolio.	12B.P.12.3.1 Organize and reflect on architectural samples for inclusion in a design drafting portfolio.	12C.P.12.3.1 Reflect on and include a complete set of architectural and/or civil engineering documents for a project in a design drafting portfolio.
						12C.P.12.3.2 Present a design drafting portfolio.





GRADES 9 TO 12  
DESIGN DRAFTING

Introductory Courses and  
Engineering Stream



GRADES 9 TO 12 DESIGN DRAFTING:  
 INTRODUCTORY COURSES AND ENGINEERING STREAM  
 GENERAL AND SPECIFIC LEARNING OUTCOMES BY GOAL

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**Goal 1:** Solve problems using the **design process**.

**GLO 1.1:** Define design problems.

F	9.F.1.1.1 Identify a structured model to solve basic problems.	10.F.1.1.1 Identify a structured model to solve basic problems.	11A.F.1.1.1 Describe a structured model to solve basic problems.	11C.F.1.1.1 Describe the feedback process in a structured problem-solving model.	12A.F.1.1.1 Describe the relationship between the design process and the creation and revision of engineering or manufacturing drawings.	12D.F.1.1.1 Collaborate with a client to define design problems.
	9.F.1.1.2 Identify design problems.	10.F.1.1.2 Identify design problems.	11A.F.1.1.2 Identify design problems (e.g., original or re-engineered design).	11C.F.1.1.2 Define design problems (e.g., original or re-engineered design).	12A.F.1.1.2 Define design problems related to manufacturing processes (e.g., machining, milling, injection moulding, casting).	
S	9.S.1.1.1 List the steps required to solve a design problem.	10.S.1.1.1 Use a structured model to solve architectural/mechanical problems.	11A.S.1.1.1 Use a structured model to solve architectural/mechanical problems.	11C.S.1.1.1 Use a structured model to solve, refine, and revise engineering problems.	12A.S.1.1.1 Use a structured model in the creation, refining, and revision of advanced engineering drawings.	12D.S.1.1.1 Use a structured model to solve, refine, and revise advanced engineering problems and to create buildable manufacturing drawings.

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**Goal 1:** Solve problems using the **design process**. (*continued*)

**GLO 1.2:** Research and analyze information for design solutions.

<b>F</b>	<p>9.F.1.2.1 List the factors (e.g., materials, cost, manufacturing processes) that influence design.</p>	<p>10.F.1.2.1 Demonstrate an awareness of architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical properties).</p>	<p>11A.F.1.2.1 Identify basic architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical properties).</p>	<p>11C.F.1.2.1 Identify engineering design principles, including aerodynamics, friction, motion, mechanical advantage, displacement, and ergonomics.</p>	<p>12A.F.1.2.1 Identify how engineering design principles affect the selection of the manufacturing process.</p>	<p>12D.F.1.2.1 Research and analyze the engineering principles (e.g., sustainability, universal design, aesthetics) and factors (e.g., client requirements, materials, cost, manufacturing process, availability) to solve engineering design problems.</p>
	<p>9.F.1.2.2 Demonstrate an awareness of sustainability as it relates to design (e.g., materials used, social impact).</p>	<p>10.F.1.2.2 Identify factors (e.g., materials, cost, manufacturing processes) that influence design.</p>	<p>11A.F.1.2.2 Identify factors (e.g., materials, cost, manufacturing processes) that influence design.</p>	<p>11C.F.1.2.2 Examine the factors (e.g., manufacturing processes, material properties, availability, cost, standard components) that influence design.</p>	<p>12A.F.1.2.2 Compare the factors (e.g., manufacturing processes, material properties, cost, availability, standard components) that influence design.</p>	

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2:** Research and analyze information for design solutions. *(continued)*

F	9.F.1.2.3 Demonstrate an awareness of universal design.	10.F.1.2.3 Discuss sustainability as it relates to design (e.g., materials used, social impact).	11A.F.1.2.3 Discuss sustainability as it relates to architectural/mechanical design (e.g., materials, processes).	11C.F.1.2.3 Examine sustainable engineering principles (e.g., energy, service life, recycling, resource consumption) to solve engineering problems.	12A.F.1.2.3 Compare sustainable engineering principles (e.g., energy, service life, recycling, resource consumption, social impact) to solve engineering problems.
	9.F.1.2.4 Demonstrate an awareness of aesthetic principles.	10.F.1.2.4 Discuss universal design.	11A.F.1.2.4 Discuss universal design.	11C.F.1.2.4 Examine universal design principles to include in engineering design solutions.	12A.F.1.2.4 Assess universal design principles to include in engineering design solutions.
	9.F.1.2.5 Identify common research methods used in design.	10.F.1.2.5 Discuss aesthetic principles.	11A.F.1.2.5 Discuss aesthetic principles in architectural/mechanical design.	11C.F.1.2.5 Consider aesthetic principles (e.g., colour, balance, texture, form, proportion) in relation to engineering design.	12A.F.1.2.5 Consider aesthetic principles (e.g., colour, balance, texture, form, proportion) in relation to engineering design.
		10.F.1.2.6 Identify common research methods used in design.			

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2:** Research and analyze information for design solutions. *(continued)*

<b>S</b>	<p>9.S.1.2.1 Research information to solve design problems.</p>	<p>10.S.1.2.1 Follow architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical principles) for design solutions.</p>	<p>11A.S.1.2.1 Incorporate architectural design principles (e.g., work triangle, bathroom design, circulation) and/or mechanical design principles (e.g., physical properties, fits, mechanical properties) into design solutions.</p>	<p>11C.S.1.2.1 Incorporate engineering design principles (e.g., aerodynamics, friction, motion, mechanical advantage, displacement, and ergonomics) into design solutions (e.g., sketch, notes).</p>	<p>12A.S.1.2.1 Select and incorporate engineering design principles into design solutions.</p>	<p>12D.S.1.2.1 Select and incorporate engineering principles (e.g., sustainability, universal design, aesthetic) and factors (e.g., client requirements, materials, manufacturing process, cost, availability) into design solutions.</p>
	<p>9.S.1.2.2 Include sustainable concepts in designs.</p>	<p>10.S.1.2.2 Research information to solve design problems.</p>	<p>11A.S.1.2.2 Research information to solve design problems.</p>	<p>11C.S.1.2.2 Create and revise sketches and notes based on engineering research.</p>	<p>12A.S.1.2.2 Create and revise sketches and notes based on engineering research.</p>	<p>12D.S.1.2.2 Create and revise sketches and notes based on engineering research and analysis.</p>
	<p>9.S.1.2.3 Include aesthetic principles in designs.</p>	<p>10.S.1.2.3 Include sustainable concepts in designs.</p>	<p>11A.S.1.2.3 Include sustainable concepts in architectural/mechanical designs.</p>	<p>11C.S.1.2.3 Incorporate materials and manufacturing processes into design solutions.</p>	<p>12A.S.1.2.3 Select and incorporate materials and manufacturing processes into design solutions.</p>	<p>12D.S.1.2.3 Research and reference information from various engineering and manufacturing sources.</p>

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.2:** Research and analyze information for design solutions. *(continued)*

S	9.S.1.2.4 Identify possible solutions for design problems.	10.S.1.2.4 Include universal design in solutions.	11A.S.1.2.4 Include universal design in architectural/mechanical solutions.	11C.S.1.2.4 Incorporate engineering aesthetic, sustainability, and universal design principles into design solutions.	12A.S.1.2.4 Select and incorporate engineering aesthetic, sustainability, and universal design principles into design solutions.	12D.S.1.2.4 Analyze and predict consequences of design modifications.
		10.S.1.2.5 Include aesthetic principles in designs.		11C.S.1.2.5 Research and reference information from various engineering sources (e.g., websites, manufacturer specifications, engineering tables, <i>Machinery's Handbook</i> ).	12A.S.1.2.5 Research and reference information from various engineering and manufacturing sources (e.g., websites, manufacturer specifications, engineering tables, <i>Machinery's Handbook</i> ).	
		10.S.1.2.6 Identify possible solutions for design problems.		11C.S.1.2.6 Predict consequences of design modifications.	12A.S.1.2.6 Analyze and predict consequences of design modifications.	

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**Goal 1:** Solve problems using the **design process**. (*continued*)

**GLO 1.3: Synthesize** information and ideas to create design solutions.

F	9.F.1.3.1 Demonstrate an awareness that the selection of design solutions is often influenced by factors (e.g., cost, materials, customer request).	10.F.1.3.1 Identify influences that can impact the decision-making process for design solutions.	11A.F.1.3.1 Identify influences that can impact the decision-making process for architectural/mechanical design solutions.	11C.F.1.3.1 Identify the decision-making process required to arrive at the best (compromised) design solutions (e.g., cost, materials).	12A.F.1.3.1 Identify the decision-making process required to arrive at the best (compromised) design solution (e.g., cost, materials, manufacturing process, recyclability, performance, ease of manufacture and repair).	12D.F.1.3.1 Identify the decision-making process required to arrive at the best (compromised) design solution for the client.
	9.F.1.3.2 Identify techniques used for 2-D and isometric sketching.	10.F.1.3.2 Identify techniques used for 2-D and isometric sketching.	11A.F.1.3.2 Identify techniques used for 2-D, isometric, and perspective sketching.	11C.F.1.3.2 Identify sketching techniques related to specialized media (e.g., charcoal, paint, felt pen, pen and ink).	12A.F.1.3.2 Identify sketching techniques related to specialized media (e.g., charcoal, paint, felt pen, pen and ink).	
S	9.S.1.3.1 Select design solutions based on provided criteria and related research.	10.S.1.3.1 Select design solutions based on provided criteria and related research.	11A.S.1.3.1 Select design solutions based on provided architectural/mechanical criteria and related research.	11C.S.1.3.1 Select design solutions based on engineering research (e.g., manufacturing processes, material properties, availability, cost, standard components).	12A.S.1.3.1 Select design solutions based on engineering and manufacturing research.	12D.S.1.3.1 Select design solutions based on engineering research and client requirements.

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**Goal 1:** Solve problems using the **design process**. *(continued)*

**GLO 1.3:** **Synthesize** information and ideas to create design solutions. *(continued)*

S	9.S.1.3.2 Use freehand sketches and notes to solve basic design drafting problems.	10.S.1.3.2 Create freehand sketches to solve architectural/mechanical design problems.	11A.S.1.3.2 Create freehand sketches to solve architectural/mechanical design problems.	11C.S.1.3.2 Create freehand sketches to illustrate refined engineering design solutions.	12A.S.1.3.2 Create and revise freehand sketches to illustrate the refined engineering design solution.	12D.S.1.3.2 Create freehand sketches using a variety of media to solve engineering design problems.
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**Goal 2: Communicate** design solutions.

**GLO 2.1:** Prepare **computer models** of design solutions.

F	9.F.2.1.1 Identify the function of computer models (e.g., visualization, model to working drawing).	10.F.2.1.1 Identify the function of computer models (e.g., visualization, model to working drawing, assembly).	11A.F.2.1.1 Describe the function of computer models (e.g., visualization, model to working drawing, assembly).	11C.F.2.1.1 Describe the function of computer models (e.g., visualization, model to engineering drawing).	12A.F.2.1.1 Describe the functions of computer models, including visualization, model to engineering drawing, simulations, model to computer-integrated manufacturing, and finite element analysis.	12D.F.2.1.1 Analyze research results and client requirements to select the process for modelling parts, sub-assemblies, and assemblies.
	9.F.2.1.2 Define geometric construction principles.	10.F.2.1.2 Define basic geometric construction principles (e.g., linear, angular, perpendicular, parallel, tangential).	11A.F.2.1.2 Define basic geometric construction principles (e.g., cylindrical, tangential, concentric, ogee).	11C.F.2.1.2 Define geometric construction principles related to engineering design.	12A.F.2.1.2 Define complex geometric construction principles related to engineering design.	

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.1:** Prepare **computer models** of design solutions. *(continued)*

F	<p>10.F.2.1.3 Identify basic architectural components, including walls, doors, windows, built-ins, fixtures, and stairs, and/or basic mechanical features of parts (e.g., fillets, chamfers, holes).</p>	<p>11A.F.2.1.3 Identify architectural components and materials, including foundation systems, roofs, and structural members, and/or mechanical features of parts and assemblies (e.g., cylinders, fillets, chamfers, holes, threaded and through holes, countersink, counterbore, spot face, basic fasteners).</p>	<p>11C.F.2.1.3 Identify basic engineering features of parts and assemblies (e.g., cylinders, fillets, chamfers, holes, standard components).</p> <p>11C.F.2.1.4 Describe the process of modelling basic parts, sub-assemblies, and assemblies.</p>	<p>12A.F.2.1.3 Examine engineering features for parts and assemblies (e.g., cylinders, fillets, chamfers, holes, standard components, knurl, taper, boss, ribs, webs).</p> <p>12A.F.2.1.4 Describe the process of modelling parts and the relationships of sub-assemblies to higher level assemblies.</p> <p>12A.F.2.1.5 Explain how developments (e.g., parallel and radial line developments and intersections) are used in 3-D product manufacturing (e.g., packaging, sheet metal products).</p>
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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.1:** Prepare **computer models** of design solutions. *(continued)*

S	9.S.2.1.1 Create models of design solutions.	10.S.2.1.1 Create basic architectural/mechanical models of design solutions.	11A.S.2.1.1 Create and use a computer model for visualization, to develop a working drawing, and to verify component assembly.	11C.S.2.1.1 Incorporate basic engineering features into computer model parts, sub-assemblies, and assemblies.	12A.S.2.1.1 Incorporate engineering features into computer model parts, sub-assemblies, and assemblies.	12D.S.2.1.1 Incorporate engineering features into computer model parts, sub-assemblies, and assemblies.
			11A.S.2.1.2 Apply basic geometric construction principles (e.g., cylindrical, tangential, concentric, ogee).	11C.S.2.1.2 Use a computer model to visualize design solutions and to create manufacturing drawings.	12A.S.2.1.2 Use a computer model to visualize design solutions, create manufacturing drawings, and perform finite element and motion analysis.	12D.S.2.1.2 Create and modify a computer model to visualize, analyze, and communicate design solutions.
				11C.S.2.1.3 Apply geometric construction principles.	12A.S.2.1.3 Apply complex geometric construction principles.	

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**Goal 2: Communicate** design solutions. (*continued*)

**GLO 2.2: Prepare working and presentation drawings and documents.**

<p>F</p>	<p>9.F.2.2.1 Identify the differences between working and presentation drawings.</p> <p><b>Layout</b> 9.F.2.2.2 Identify the components (e.g., title block, border, view arrangements) of a drawing.</p>	<p>10.F.2.2.1 Identify the differences between working and presentation drawings.</p> <p><b>Layout</b> 10.F.2.2.2 Identify components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales) of an architectural drawing and/or the components (e.g., title block information, border with zones, view arrangements, engineering scale) of an engineering drawing.</p>	<p><b>Layout</b> 11A.F.2.2.1 Identify components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales) of an architectural drawing and/or the components (e.g., title block information, border with zones, view arrangements, parts lists, projection symbol) of an engineering drawing.</p> <p>11A.F.2.2.2 Identify architectural symbols (e.g., walls, doors, windows, foundation systems, roofs, structural members, stairs, materials) for floor plans and elevation drawings, and/or mechanical symbols (e.g., cylinders, fillets, chamfers, holes, threaded and through holes, countersink, counterbore, spot face, basic fasteners) for orthographic, auxiliary, and section drawings.</p>	<p><b>Layout</b> 11C.F.2.2.1 Identify the components (e.g., title block information, border with zones, view arrangements, parts lists, revision blocks, general tolerance notes, projection symbol) of an engineering drawing.</p> <p>11C.F.2.2.2 Identify engineering symbols (e.g., cylinders, fillets, chamfers, holes, standard components) for orthographic, auxiliary, and section drawings.</p>	<p><b>Layout</b> 12A.F.2.2.1 Identify the components (e.g., title block information, border with zones, view arrangements, parts lists, revision blocks, general tolerance notes, projection symbol) of an engineering drawing.</p> <p>12A.F.2.2.2 Identify engineering symbols (e.g., cylinders, fillets, chamfers, holes, standard components, knurl, taper, boss, ribs, webs) for orthographic, auxiliary, and section drawings.</p>	<p>12D.F.2.2.1 Read and interpret drafting, engineering, and manufacturing standards.</p>
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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

F	<p>9.F.2.2.3 Identify the standards related to working drawing view selection and placement.</p>	<p>10.F.2.2.3 Identify architectural symbols (e.g., walls, doors, windows, built-ins, fixtures, stairs) for floor plans and/or basic mechanical symbols (e.g., fillets, chamfers, holes) for orthographic projection drawings.</p>	<p><b>Line Work</b>          11A.F.2.2.3 Identify architectural line types (e.g., object, hidden, centre, construction, extension, dimension, break, section lines) and their intended uses (e.g., walls, doors, windows, foundation systems, roofs, structural members, stairs, materials), and/or mechanical line types (e.g., object, hidden, centre, construction, extension, dimension, leader, section, break, cutting plane, phantom, fold lines) and their intended uses (e.g., cylinders, fillets, chamfers, holes, threaded and through holes, countersink, counterbore, spot face, basic fasteners, flat patterns).</p>	<p><b>Line Work</b>          11C.F.2.2.3 Identify engineering line types (e.g., object, hidden, centre, construction, extension, dimension, leader, section, break, cutting plane, phantom lines) and their intended uses (e.g., cylinders, fillets, chamfers, holes, standard components).</p>	<p><b>Line Work</b>          12A.F.2.2.3 Identify engineering line types (e.g., object, hidden, centre, construction, extension, dimension lines, break lines, phantom lines, hatch lines) and their intended use.</p>
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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

F	<p><b>Line Work</b> 9.F.2.2.4 Identify basic line types (e.g., object, hidden, centre, dimension, extension, section, cutting plane, break) and uses.</p>	<p><b>Line Work</b> 10.F.2.2.4 Identify basic architectural line types (e.g., object, hidden, centre, construction, extension, dimension lines) and their intended uses (e.g., walls, doors, windows, built-ins, fixtures, stairs), and/or basic mechanical line types (e.g., object, hidden, centre, construction, extension, dimension, leader lines) and their intended uses (e.g., fillets, chamfers, holes).</p>	<p><b>Dimensioning and Annotating</b> 11A.F.2.2.4 Differentiate between basic architectural and mechanical dimensioning standards.</p>	<p><b>Dimensioning and Annotating</b> 11C.F.2.2.4 Identify engineering dimensioning, tolerancing, and annotation standards.</p>	<p>12A.F.2.2.4 Select engineering line types.</p>
	<p><b>Dimensioning and Annotating</b> 9.F.2.2.5 Identify the purpose and rules of dimensioning.</p>	<p><b>Dimensioning and Annotating</b> 10.F.2.2.5 Identify dimensioning standards.</p>	<p>11A.F.2.2.5 Differentiate between basic architectural and mechanical notes and annotations.</p>	<p><b>Dimensioning and Annotating</b> 12A.F.2.2.5 Identify advanced engineering tolerancing, geometric dimensioning and tolerancing, fits, and annotation standards.</p>	

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

F	9.F.2.2.6 Identify the purpose of notes and annotations.	10.F.2.2.6 Identify the purpose of notes and annotations (e.g., about materials, processes, finishes) in architectural and mechanical drawings.			
S	<b>Layout</b> 9.S.2.2.1 Use freehand sketches to arrange drawing layouts.	<b>Layout</b> 10.S.2.2.1 Use the components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales) of an architectural drawing, and/or the components (e.g., title block information, border with zones, view arrangements, engineering scale) of a mechanical drawing.	<b>Layout</b> 11A.S.2.2.1 Use architectural drawing components (e.g., title blocks, border, sheet sizes, sheet layout, architectural scales, revision columns) and/or mechanical drawing components (e.g., title block information, border with zones, view arrangements, parts lists, projection symbols).	<b>Layout</b> 11C.S.2.2.1 Use engineering drawing components (e.g., title block information, border with zones, view arrangements, parts lists, revision blocks, general tolerance notes, projection symbols).	—

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

<b>S</b>	<p>9.S.2.2.2 Create working drawings following view selection (e.g., single, orthographic, section, auxiliary, isometric, oblique) and placement standards.</p>	<p>10.S.2.2.2 Create floor plans using architectural symbols (e.g., walls, doors, windows, built-ins, fixtures, stairs), and/or orthographic projection drawings using basic mechanical symbols.</p>	<p>11A.S.2.2.2 Create floor plans and elevation drawings using architectural symbols (e.g., walls, doors, windows, foundation systems, roofs, structural members, stairs, materials) and/or orthographic, primary auxiliary, and section drawings (e.g., full, half, offset section views) of parts and assemblies using mechanical symbols.</p>	<p>11C.S.2.2.2 Create orthographic, auxiliary, and section drawings (e.g., full, half, offset, revolved, removed, aligned, section views) of parts, sub-assemblies, and assemblies using engineering symbols.</p>	<p>12A.S.2.2.2 Create orthographic, auxiliary, and section drawings of complex parts, sub-assemblies, and assemblies using engineering symbols.</p>
	<p><b>Line Work</b>  9.S.2.2.3 Select and use line types (e.g., object, hidden, centre, construction, extension, dimension lines) to construct a drawing to standards.</p>	<p>10.S.2.2.3 Apply basic geometric construction principles (e.g., linear, angular, perpendicular, parallel, tangential).</p>	<p>11A.S.2.2.3 Include materials notes in drawings.</p>	<p>11C.S.2.2.3 Create schedule tables (e.g., tabular dimensions, fastener tables) and parts lists.</p>	<p>12A.S.2.2.3 Create pattern development (e.g., parallel and radial line developments and intersections) drawings for a 3-D object (e.g., packaging, sheet metal products).</p>

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

S	9.S.2.2.4 Apply material symbols to full and half section views.	<b>Line Work</b> 10.S.2.2.4 Select and use basic line types for architectural/mechanical applications.	11A.S.2.2.4 Combine orthographic, section, auxiliary, detail, and isometric drawings into a set of architectural/mechanical working drawings.	11C.S.2.2.4 Combine orthographic, section, auxiliary, detail, and isometric drawings into a set of working drawings.	12A.S.2.2.4 Create schedule tables and parts lists.
	<b>Dimensioning and Annotating</b> 9.S.2.2.5 Apply placement, styles, and rules of dimensioning.	<b>Dimensioning and Annotating</b> 10.S.2.2.5 Apply placement, styles, and rules of dimensioning following dimensioning standards.	<b>Line Work</b> 11A.S.2.2.5 Select and use line types for architectural and mechanical applications based on standards.	11C.S.2.2.5 Create a flat pattern drawing for a 3-D object (e.g., packaging).	12A.S.2.2.5 Revise drawings to ensure consistency and to organize and assemble a set of working drawings.
	9.S.2.2.6 Apply the placement, style, size of text, and leaders for notes and abbreviations.	10.S.2.2.6 Apply the placement, style, size of text, and leaders for notes and abbreviations following standards.	<b>Dimensioning and Annotating</b> 11A.S.2.2.6 Apply placement, styles, and rules of dimensioning following dimensioning standards.	<b>Line Work</b> 11C.S.2.2.6 Select and use line types for engineering applications based on standards.	12A.S.2.2.6 Combine orthographic, section, auxiliary, detail, and isometric drawings into a set of working drawings.

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**Goal 2: Communicate** design solutions. *(continued)*

**GLO 2.2: Prepare working and presentation drawings and documents.** *(continued)*

S		11A.S.2.2.7 Apply the placement, style, size of text, and leaders for notes and abbreviations following standards.	<b>Dimensioning and Annotating</b> 11C.S.2.2.7 Use industry standard engineering dimensioning, tolerancing, and annotation.	<b>Line Work</b> 12A.S.2.2.7 Select and use line types for engineering applications based on standards.	
				<b>Dimensioning and Annotating</b> 12A.S.2.2.8 Use advanced industry standard engineering tolerancing, geometric dimensioning and tolerancing, fits, and annotation.	

**Goal 3: Use appropriate materials and processes** of building/manufacturing.

**GLO 3.1: Describe materials** used in design solutions.

F	9.F.3.1.1 Explain the importance of materials notes on a drawing.	10.F.3.1.1 Describe the materials used in design solutions.	11A.F.3.1.1 Describe the properties of materials used in design solutions.	11C.F.3.1.1 Identify materials (e.g., ferrous and non-ferrous metals, woods, plastics) used in manufacturing parts.	12A.F.3.1.1 Compare materials (e.g., ferrous and non-ferrous metals, woods, plastics, composites) used in manufacturing parts.	12D.F.3.1.1 Analyze materials and standard parts based on research and client requirements.
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**Goal 3:** Use appropriate **materials and processes** of building/manufacturing. *(continued)*

**GLO 3.1:** Describe **materials** used in design solutions. *(continued)*

F				11C.F.3.1.2 Identify the use and material properties of standard parts.	12A.F.3.1.2 Compare standard parts based on use and material properties.	
S	9.S.3.1.1 List materials used in design solutions.	10.S.3.1.1 List materials used in design solutions.	11A.S.3.1.1 List materials used in design solutions.	11C.S.3.1.1 Select materials and standard parts for design solutions.	12A.S.3.1.1 Select and incorporate materials and standard parts into design solutions.	12D.S.3.1.1 Select materials and standard parts based on research and client requirements.
	9.S.3.1.2 Include materials notes in drawings.	10.S.3.1.2 Include materials notes in drawings.				

**GLO 3.2:** Describe **building/manufacturing processes** used in design solutions.

F	—	10.F.3.2.1 Demonstrate an awareness of the construction process and/or of the manufacturing process.	11A.F.3.2.1 Identify basic construction processes (e.g., wall and floor thickness) for residential designs and/or basic manufacturing processes (e.g., machining, casting) for mechanical designs.	11C.F.3.2.1 Identify basic manufacturing processes (e.g., machining, casting, drilling, threading) for engineering design.	12A.F.3.2.1 Identify manufacturing processes (e.g., grinding, polishing, reaming, knurling) for engineering design.	12D.F.3.2.1 Analyze manufacturing processes based on research and client requirements.
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**Goal 3:** Use appropriate **materials and processes** of building/manufacturing. *(continued)*

**GLO 3.2:** Describe **building/manufacturing processes** used in design solutions. *(continued)*

F		11A.F.3.2.2 Identify re-engineering concepts (e.g., improving function and form, adapting to a different function).	11C.F.3.2.2 Define project management.	12A.F.3.2.2 Identify project management considerations (e.g., timelines, material supplies, project management software, waste) for design solutions.	12D.F.3.2.2 Describe project management and production practices (e.g., LEAN, TQM, TPS).
S	—	—	11C.S.3.2.1 Select basic manufacturing processes for design solutions.	12A.S.3.2.1 Select manufacturing processes for design solutions.	12D.S.3.2.1 Select manufacturing processes based on research and client requirements.

**Goal 4: Present** design solutions.

**GLO 4.1: Plan and organize presentations** of design solutions.

F	9.F.4.1.1 Identify presentation methods (e.g., design briefs, sketches, drawings).	10.F.4.1.1 Identify presentation methods (e.g., design briefs, sketches, drawings).	11A.F.4.1.1 Differentiate between architectural and mechanical presentation methods.	11C.F.4.1.1 Identify traditional and digital engineering presentation methods.	12A.F.4.1.1 Identify presentation methods for engineered parts and products.	12D.F.4.1.1 Differentiate among the effectiveness of various presentation methods.
		10.F.4.1.2 Identify the rationale for presentations in the design process.				

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**Goal 4: Present** design solutions. *(continued)*

**GLO 4.1: Plan and organize presentations** of design solutions. *(continued)*

<b>S</b>	9.S.4.1.1 Follow presentation methods (e.g., oral, written, graphic).	10.S.4.1.1 Follow presentation methods (e.g., oral, written, graphic, 3-D model).	11A.S.4.1.1 Follow presentation methods for design solutions (e.g., oral, written, graphic, physical or digital 3-D model).	11C.S.4.1.1 Select written and visual presentation methods for engineering design solutions (e.g., oral, written, 2-D/3-D freehand sketch, graphic, physical, or digital 3-D model).	12A.S.4.1.1 Select presentation methods for engineered parts and products (e.g., oral, written, 2-D/3-D freehand sketch, overlay graphic, physical or digital 3-D model).	12D.S.4.1.1 Select presentation methods based on client requirements.
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**GLO 4.2: Use presentation production methods.**

<b>F</b>	9.F.4.2.1 Identify the elements (e.g., rationale, functionality, research) of a design brief.	10.F.4.2.1 Identify the elements (e.g., rationale, functionality, research) of a design brief.	11A.F.4.2.1 Identify the elements (e.g., rationale, functionality, research) of a design brief.	11C.F.4.2.1 Differentiate among the formats and functions of technical reports, design briefs, and scope-of-work documents.	12A.F.4.2.1 Differentiate among the formats and functions of technical reports, design briefs, and scope-of-work documents.	12D.F.4.2.1 Assess written and visual presentation methods based on project complexity, budget, available time, and client requirements.
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**Goal 4: Present** design solutions. *(continued)*

**GLO 4.2: Use presentation production methods.** *(continued)*

F		10.F.4.2.2 Identify the function of 3-D models as presentation methods.	11A.F.4.2.2 Identify the techniques for creating working drawings from digital 3-D models.	11C.F.4.2.2 Differentiate among the formats and functions of visual presentation formats (e.g., presentation software, renderings, physical models).	12A.F.4.2.2 Differentiate among the formats and functions of visual presentation formats for parts and assemblies (e.g., presentation software, presentation sections, detailed views, physical models).	12D.F.4.2.2 Identify the techniques to create 3-D engineering physical models.
S	9.S.4.2.1 Create sketches and design briefs to support design solutions.	10.S.4.2.1 Create design briefs to support design solutions.	11A.S.4.2.1 Create design briefs to support architectural/mechanical design solutions.	11C.S.4.2.1 Create design briefs to support engineering design solutions.	12A.S.4.2.1 Create written technical reports and scope-of-work documents supporting choice of parts and products.	12D.S.4.2.1 Choose written and visual presentation methods to communicate effectively with client.

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**Goal 4: Present** design solutions. *(continued)*

**GLO 4.2: Use presentation production methods.** *(continued)*

S	10.S.4.2.2 Communicate effectively using presentation software incorporating design elements (e.g., formatting, layout, font size).	11A.S.4.2.2 →	11C.S.4.2.2 →	12A.S.4.2.2 →	12D.S.4.2.2 →
	10.S.4.2.3 Create shaded 3-D computer models.	11A.S.4.2.3 Create floor plans and elevations from architectural computer models and/or orthographic and isometric views from mechanical computer models.	11C.S.4.2.3 Create visual presentations to support engineering design solutions.	12A.S.4.2.3 Create visual presentations supporting choice and placement of parts and products.	12D.S.4.2.3 Create physical models.
	10.S.4.2.4 Create physical models.	11A.S.4.2.4 Create physical models.	11C.S.4.2.4 Create animations from 3-D CADD models.	12A.S.4.2.4 Simulate motion in a 3-D CADD model.	

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**Goal 4: Present** design solutions. (*continued*)

**GLO 4.3: Present/defend design solutions.**

F	9.F.4.3.1 Identify elements (e.g., clarity, conciseness) of effective verbal communication.	10.F.4.3.1 Identify elements (e.g., clarity, conciseness) of effective verbal communication.	11A.F.4.3.1 Identify elements (e.g., clear and concise communication, appearance and dress, enunciation and volume) of effective presentations.	11C.F.4.3.1 Describe elements (e.g., clear and concise communication, appearance and dress, enunciation and volume, body language) of effective presentations.	12A.F.4.3.1 Describe elements and communication techniques (e.g., appearance and dress, enunciation and volume, body language) of presentations for technical information.	12D.F.4.3.1 Assess and adapt the presentation and communication techniques (e.g., appearance and dress, enunciation and volume, body language) for the client.
	9.F.4.3.2 Demonstrate an awareness of competitions related to design drafting.	10.F.4.3.2 Demonstrate an awareness of competitions related to design drafting.	11A.F.4.3.2 Identify competitions related to design drafting.	11C.F.4.3.2 Discuss out-of-school student competitions related to engineering design drafting.	12A.F.4.3.2 Discuss out-of-school student competitions related to engineering design drafting.	12D.F.4.3.2 Research out-of-school student competitions related to engineering design drafting.
S	9.S.4.3.1 Present design solutions to an audience (e.g., peer, teacher).	10.S.4.3.1 Present design solutions to an audience (e.g., peer, teacher).	11A.S.4.3.1 Present design solutions to an audience (e.g., peer, teacher) and reflect on feedback.	11C.S.4.3.1 Present engineering design solutions to an audience (e.g., group) and reflect on feedback.	12A.S.4.3.1 Present product design solutions to an audience (e.g., group) and respond to questions and feedback.	12D.S.4.3.1 Present design solutions to clients and respond to questions and feedback.

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting.

**GLO 5.1:** Describe and use **drawing and modelling tools and equipment**.

<b>F</b>	9.F.5.1.1 Identify manual drafting tools and media.	10.F.5.1.1 Identify sketching tools and media.	11A.F.5.1.1 Identify basic sketching tools and media.	11C.F.5.1.1 Identify sketching tools and media.	12A.F.5.1.1 Identify advanced sketching tools and media.	12D.F.5.1.1 Identify specialized sketching tools and media (e.g., charcoal, paint, felt pen, pen and ink).
	9.F.5.1.2 Identify physical modelling tools (e.g., scissors, knives, saws).	10.F.5.1.2 Identify physical modelling tools (e.g., scissors, knives, saws).	11A.F.5.1.2 Identify physical modelling tools (e.g., scissors, knives, saws).	11C.F.5.1.2 Identify physical modelling tools (e.g., drills, scroll saws, band saws, sanders, CNC router, 3-D printer).	12A.F.5.1.2 Identify physical modelling tools (e.g., drills, scroll saws, band saws, sanders, CNC router, 3-D printer).	12D.F.5.1.2 Select the drawing, modelling, and measuring tools and equipment based on own assessment of the project.
	9.F.5.1.3 Identify measuring devices (e.g., rulers, tape measures, scales, calipers).	10.F.5.1.3 Identify measuring devices (e.g., rulers, tape measures, engineering, architectural, and metric scales, calipers).	11A.F.5.1.3 Identify basic measuring devices (e.g., rulers, tape measures, engineering, architectural, and metric scales, calipers).	11C.F.5.1.3 Identify measuring devices (e.g., protractors, engineering and metric scales, calipers, micrometers).	12A.F.5.1.3 Identify advanced measuring devices (e.g., calipers, radius gauges, thread pitch gauges, thickness gauges, go-no-go gauges, feeler gauges, micrometers).	

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. *(continued)*

**GLO 5.1:** Describe and use **drawing and modelling tools and equipment**. *(continued)*

S	9.S.5.1.1 Use manual drafting tools and media (e.g., architectural, engineering, and metric scales, pencils, set squares, compass, t-squares, protractors).	10.S.5.1.1 Use sketching tools and media.	11A.S.5.1.1 Use sketching tools and media.	11C.S.5.1.1 Use sketching tools and media.	12A.S.5.1.1 Use sketching tools and media.	12D.S.5.1.1 Use specialized sketching tools and media (e.g., charcoal, paint, felt pen, pen and ink).
	9.S.5.1.2 Use basic physical modelling tools (e.g., scissors, knives, saws, tape measures, calipers).	10.S.5.1.2 Use basic physical modelling tools (e.g., scissors, knives, saws, tape measures, calipers).	11A.S.5.1.2 Use basic physical modelling tools (e.g., scissors, knives, saws, tape measures, calipers).	11C.S.5.1.2 Use physical modelling tools (e.g., drills, scroll saws, band saws, sanders, CNC router, 3-D printer).	12A.S.5.1.2 Use physical modelling tools (e.g., drills, scroll saws, band saws, sanders, CNC router, 3-D printer).	12D.S.5.1.2 Use the drawing, modelling, and measuring tools and equipment based on own assessment of the project.
				11C.S.5.1.3 Use measuring devices (e.g., protractors, engineering and metric scales, calipers, micrometers).	12A.S.5.1.3 Use advanced measuring devices (e.g., calipers, radius gauges, thread pitch gauges, thickness gauges, go-no-go gauges, feeler gauges, micrometers).	

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. (*continued*)

**GLO 5.2:** Describe and use **computer hardware and equipment**.

<b>F</b>	9.F.5.2.1 Identify common computer hardware.	10.F.5.2.1 Identify common computer hardware.	11A.F.5.2.1 Identify basic requirements for a CADD workstation.	11C.F.5.2.1 Identify basic hardware problems (e.g., power, cords, and device connections) and maintenance procedures.	12A.F.5.2.1 Identify function and use of advanced 3-D modelling hardware.	12D.F.5.2.1 Select the computer hardware and equipment based on own assessment of the project.
	9.F.5.2.2 Identify basic hardware problems (e.g., power, cords, device connections).	10.F.5.2.2 Identify basic hardware problems (e.g., power, cords, device connections).	11A.F.5.2.2 Identify the uses of basic input devices (e.g., cameras, scanners) related to design.	11C.F.5.2.2 Identify the uses of input devices (e.g., specialized mice, digitizing tablets) related to design.	12A.F.5.2.2 Identify function and use of advanced input devices (e.g., 3-D scanning equipment).	
			11A.F.5.2.3 Identify the uses of basic output devices (e.g., printers, plotters) related to design.	11C.F.5.2.3 Identify the uses of output devices (e.g., 3-D printers) related to design.	12A.F.5.2.3 Identify function and use of advanced output devices (e.g., rapid prototyping, CNC machines).	
<b>S</b>	9.S.5.2.1 Operate common computer hardware (e.g., computer, three-button mouse, printers, monitors).	10.S.5.2.1 Operate common computer hardware (e.g., three-button mouse, printers, monitors).	11A.S.5.2.1 Operate input devices (e.g., digital camera, scanner).	11C.S.5.2.1 Operate input devices (e.g., digital camera, scanner).	12A.S.5.2.1 Operate input devices (e.g., digital camera, scanner, 3-D scanner).	12D.S.5.2.1 Use communication devices to interact with clients, industry experts, manufacturers, and suppliers.

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. *(continued)*

**GLO 5.2:** Describe and use **computer hardware and equipment**. *(continued)*

S		11A.S.5.2.2 Operate output devices (e.g., printers, plotters).	11C.S.5.2.2 Operate output devices (e.g., printers, plotters).	12A.S.5.2.2 Operate output devices (e.g., printers, plotters, rapid prototyping).	12D.S.5.2.2 Operate input devices (e.g., digital camera, scanner).
			11C.S.5.2.3 Troubleshoot computer and printer/plotter problems.	12A.S.5.2.3 Troubleshoot computer and printer/plotter problems.	12D.S.5.2.3 Operate output devices (e.g., printers, plotters).  12D.S.5.2.4 Troubleshoot computer and printer/plotter problems.

**GLO 5.3:** Describe and use **software**.

F	9.F.5.3.1 Identify industry standard CADD software.	10.F.5.3.1 Identify industry standard architectural and mechanical CADD software.	11A.F.5.3.1 Differentiate between industry standard architectural and mechanical CADD software.	11C.F.5.3.1 Identify drafting and presentation components of industry standard engineering software (e.g., CADD, wind tunnel-simulation, CNC).	12A.F.5.3.1 Identify simulation and finite element analysis components of engineering software.	12D.F.5.3.1 Select software based on own assessment of the project.
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8434 <b>Introduction to Design Drafting (9)</b> 15S / 15E / 15M 10S / 10E / 10M	8435 <b>Design Drafting Essentials 1 (10)</b> 20S / 20E / 20M	8436 <b>Design Drafting Essentials 2 (11A)</b> 30S / 30E / 30M	8438 <b>Engineering Design Drafting (11C)</b> 30S / 30E / 30M	8439 <b>Advanced Engineering Design Drafting (12A)</b> 40S / 40E / 40M	8669 <b>Applied Engineering Design Drafting (12D)</b> 40S / 40E / 40M
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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. (*continued*)

**GLO 5.3:** Describe and use **software**. (*continued*)

F	9.F.5.3.2 Identify office- and design-related software.	10.F.5.3.2 Identify office- and design-related software.	11A.F.5.3.2 Identify basic features of office- and design-related software.	11C.F.5.3.2 Discuss features of office software in the design and presentation process.	12A.F.5.3.2 Discuss advanced features of office software in the design and presentation process.	12D.F.5.3.2 →
	9.F.5.3.3 Identify file management systems and practices (e.g., file organization, network navigation).	10.F.5.3.3 Identify information communication technologies (e.g., architectural and mechanical websites) related to design drafting.	11A.F.5.3.3 Identify information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to design drafting.	11C.F.5.3.3 →	12A.F.5.3.3 →	12D.F.5.3.3 →
S	9.S.5.3.1 Use industry standard CADD software.	10.S.5.3.1 Use industry standard architectural and mechanical CADD software.	11A.S.5.3.1 Use industry standard architectural and mechanical CADD software.	11C.S.5.3.1 Use drafting and presentation components of industry standard engineering software (e.g., CADD, wind tunnel-simulation, CNC).	12A.S.5.3.1 Use simulation and finite element analysis components of engineering software.	12D.S.5.3.1 Analyze and select software and tools necessary to complete the engineering project.
	9.S.5.3.2 Use office- and design-related software.	10.S.5.3.2 Use office- and design-related software.	11A.S.5.3.2 Use basic features of office- and design-related software.	11C.S.5.3.2 Use features of office software in the design and presentation process.	12A.S.5.3.2 Use advanced features of office software in the design and presentation process.	12D.S.5.3.2 Demonstrate use of electronic communications technology.

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**Goal 5:** Describe and apply the common **tools and equipment** used in design drafting. *(continued)*

**GLO 5.3:** Describe and use **software**. *(continued)*

S	9.S.5.3.3 Manage and organize project files.	10.S.5.3.3 Manage and organize project files.	11A.S.5.3.3 Manage project data using CADD software.	11C.S.5.3.3 Manage project data using CADD software.	12A.S.5.3.3 Manage project data using the file sharing and management features of CADD software.	12D.S.5.3.3 →
			11A.S.5.3.4 Manage and organize project files.	11C.S.5.3.4 Manage, organize, and share project files.	12A.S.5.3.4 Manage, organize, and share project files in a networked environment.	12D.S.5.3.4 →
			11A.S.5.3.5 Use and manipulate digital images, at a basic level, to obtain and record information (e.g., portfolio collection, research).	11C.S.5.3.5 Use and manipulate digital images to obtain and record information (e.g., portfolio collection, research).	12A.S.5.3.5 Use and manipulate digital images, at an advanced level, to obtain and record information (e.g., portfolio collection, research).	12D.S.5.3.5 →
			11A.S.5.3.6 Use information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to architectural/mechanical design drafting.	11C.S.5.3.6 Use information communication technologies (e.g., RSS feeds, blogs, technical websites, discussion boards) related to engineering design drafting.	12A.S.5.3.6 →	12D.S.5.3.6 →

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting.

F	9.F.6.1.1 Identify metric and imperial systems of measurement.	10.F.6.1.1 Demonstrate an understanding of the metric and imperial systems of measurement.	11A.F.6.1.1 Demonstrate an understanding of the metric and imperial systems of measurement.	11C.F.6.1.1 Demonstrate an understanding of metric and imperial conversions.	12A.F.6.1.1 Identify the buildable levels of precision used in engineering drawings.	12D.F.6.1.1 Select mathematical methods to solve engineering design problems.
	9.F.6.1.2 Add and subtract fractions and decimals.	10.F.6.1.2 Add, subtract, multiply, and divide fractions, decimals, feet, and inches.	11A.F.6.1.2 Add, subtract, multiply, and divide fractions and decimals.	11C.F.6.1.2 Identify the buildable levels of precision used in engineering drawings.	12A.F.6.1.2 Demonstrate an understanding of straight-line interpolation and extrapolation.	
	9.F.6.1.3 Identify symbols related to imperial measurement (e.g., 2'-3").	10.F.6.1.3 Identify symbols related to imperial measurement (e.g., 2'-3").	11A.F.6.1.3 Identify the buildable levels of precision used in architectural and mechanical drawings.	11C.F.6.1.3 Identify mathematical concepts (e.g., volume, density, mass, slope, ratio, proportion, angles) related to engineering drafting.	12A.F.6.1.3 Identify product estimation techniques, including material and labour costs.	
	9.F.6.1.4 Identify equivalent forms of fractions (e.g., $\frac{1}{8}'' = \frac{2}{16}''$ , lowest common denominator).	10.F.6.1.4 Identify equivalent forms of fractions (e.g., $\frac{1}{8}'' = \frac{2}{16}''$ , lowest common denominator).	11A.F.6.1.4 Identify equivalent forms of fractions (e.g., $\frac{1}{8}'' = \frac{2}{16}''$ , lowest common denominator).	11C.F.6.1.4 Identify material estimation techniques, including cost and quantity.		

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting. (continued)

F	9.F.6.1.5 Identify standard drafting scales (e.g., relationship between ratios and fractions).	10.F.6.1.5 Identify standard drafting scales (e.g., relationship between ratios and fractions).	11A.F.6.1.5 Identify standard drafting scales (e.g., relationship between ratios and fractions).	11C.F.6.1.5 Demonstrate an understanding of basic trigonometry.	
	9.F.6.1.6 Identify the Cartesian coordinate system in relation to CADD.	10.F.6.1.6 Relate the Cartesian coordinate system to CADD.	11A.F.6.1.6 Recognize when numbers must have the same units before they can be calculated.  11A.F.6.1.7 Identify symbols related to imperial measurement (e.g., 2'-3").  11A.F.6.1.8 Relate the Cartesian coordinate system to CADD.		
S	9.S.6.1.1 Extract data using measuring devices (e.g., rulers, tape measures, scales, calipers).	10.S.6.1.1 Use architectural and/or engineering units and formats of measurement.	11A.S.6.1.1 Use architectural and/or engineering units and formats of measurement.	11C.S.6.1.1 Perform metric and imperial conversions.	12A.S.6.1.1 Produce engineering models and drawings to a buildable precision.  12D.S.6.1.1 Perform mathematical calculations, conversions, and measurements as required for client project.

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting. *(continued)*

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting. *(continued)*

S	9.S.6.1.2 Calculate the length of geometric shapes.	10.S.6.1.2 Use ratios for scale drawing.	11A.S.6.1.2 Apply ratios (e.g., scale drawing, roof slope, tapers).	11C.S.6.1.2 Produce engineering models and drawings to a buildable precision.	12A.S.6.1.2 Use straight-line interpolation and extrapolation.
	9.S.6.1.3 Verify dimensions using estimation.	10.S.6.1.3 Extract architectural and/or mechanical data using measuring devices (e.g., rulers, tape measures, scales, calipers).	11A.S.6.1.3 Extract architectural and/or mechanical data using measuring devices (e.g., rulers, tape measures, scales, calipers).	11C.S.6.1.3 Perform mathematical calculations (e.g., volume, density, mass, slope, ratio, proportion, angles) related to engineering drafting.	12A.S.6.1.3 Estimate material, equipment, and labour costs.
	9.S.6.1.4 Use ratios for scale drawing.	10.S.6.1.4 Calculate length and area.	11A.S.6.1.4 Calculate length and area.	11C.S.6.1.4 Estimate the cost and quantity of materials.	12A.S.6.1.4 Research and calculate sizes of standard components (e.g., bolts, pins, gears).
		10.S.6.1.5 Calculate distance, area, and volume.	11A.S.6.1.5 Calculate distance, area, volume, and mass.	11C.S.6.1.5 Use algebra and trigonometry processes as required for engineering design drafting.	

8434 <b>Introduction to Design Drafting (9)</b> 15S / 15E / 15M 10S / 10E / 10M	8435 <b>Design Drafting Essentials 1 (10)</b> 20S / 20E / 20M	8436 <b>Design Drafting Essentials 2 (11A)</b> 30S / 30E / 30M	8438 <b>Engineering Design Drafting (11C)</b> 30S / 30E / 30M	8439 <b>Advanced Engineering Design Drafting (12A)</b> 40S / 40E / 40M	8669 <b>Applied Engineering Design Drafting (12D)</b> 40S / 40E / 40M
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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting. *(continued)*

**GLO 6.1:** Describe and apply **mathematical concepts** as they relate to design drafting. *(continued)*

S	11A.S.6.1.6 Convert between metric and imperial linear units.	11C.S.6.1.6 Extract engineering data using measuring devices.
	11A.S.6.1.7 Set CADD units to the appropriate precision.	

**GLO 6.2:** Read, interpret, and communicate information.

F	9.F.6.2.1 Describe research and evaluation techniques.	10.F.6.2.1 Describe research and evaluation techniques.	11A.F.6.2.1 Differentiate between research and evaluation techniques.	11C.F.6.2.1 Identify sources of design information (e.g., material specifications, aesthetic and design principles, ISO, SAE, <i>Machinery's Handbook</i> ).	12A.F.6.2.1 Identify sources of technical information (e.g., material specifications, ISO, SAE, <i>Machinery's Handbook</i> ).	12D.F.6.2.1 Compare sources of design and technical information.
		10.F.6.2.2 Identify sources of technical information (e.g., building code, span tables, fastener tables).	11A.F.6.2.2 Identify sources of technical information (e.g., building code, span tables, fastener tables).	11C.F.6.2.2 Read and interpret information from engineering tables (e.g., fits, screw thread, drill sizes).	12A.F.6.2.2 Read and interpret information from engineering tables (e.g., fits, screw thread, drill sizes).	

8434 <b>Introduction to Design Drafting (9)</b> 15S / 15E / 15M 10S / 10E / 10M	8435 <b>Design Drafting Essentials 1 (10)</b> 20S / 20E / 20M	8436 <b>Design Drafting Essentials 2 (11A)</b> 30S / 30E / 30M	8438 <b>Engineering Design Drafting (11C)</b> 30S / 30E / 30M	8439 <b>Advanced Engineering Design Drafting (12A)</b> 40S / 40E / 40M	8669 <b>Applied Engineering Design Drafting (12D)</b> 40S / 40E / 40M
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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.2: Read, interpret, and communicate** information. (continued)

S	9.S.6.2.1 Find, collect, and evaluate information (text, images, data, audio, and video) from given resources.	10.S.6.2.1 Find, collect, and evaluate information (text, images, data, audio, and video) from given resources.	11A.S.6.2.1 Gather and select information from oral, visual, material, print, or electronic sources.	11C.S.6.2.1 Organize and record design information from oral, visual, material, print, or electronic sources.	12A.S.6.2.1 Organize and record technical information from oral, visual, material, print, or electronic sources.	12D.S.6.2.1 Synthesize design and technical information from oral, visual, material, print, or electronic sources.
	9.S.6.2.2 Communicate using the language and terminology of design drafting.	10.S.6.2.2 Communicate using the language and terminology of architectural and/or mechanical design drafting.	11A.S.6.2.2 Read and interpret information from text, tables, charts, and graphs.	11C.S.6.2.2 Read and interpret design information from text, tables, charts, and graphs.	12A.S.6.2.2 Read, interpret, and apply technical information from text, tables, charts, and graphs.	12D.S.6.2.2 Read, interpret, and apply design and technical information from text, tables, charts, and graphs.
			11A.S.6.2.3 Communicate using the language and terminology of architectural and/or mechanical design drafting.	11C.S.6.2.3 Communicate using the language and terminology of engineering design drafting.	12A.S.6.2.3 Communicate using the language and terminology of engineering design drafting.	12D.S.6.2.3 Communicate using the language and terminology of engineering design drafting.

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**Goal 6:** Describe and apply transferable **cross-curricular knowledge and skills** that relate to design drafting.  
(continued)

**GLO 6.3:** Understand **scientific concepts** as they apply to design drafting.

F	9.F.6.3.1 Identify the factors that influence material use (e.g., strength, density, combustibility, buoyancy).	10.F.6.3.1 Identify the factors that influence architectural and/or mechanical material use (e.g., strength, density, combustibility, buoyancy).	11A.F.6.3.1 Identify the factors that influence architectural and/or mechanical material use (e.g., strength, density, combustibility, buoyancy).	—	—	—
	9.F.6.3.2 Describe strengths of shapes.	10.F.6.3.2 Describe strengths of shapes.	11A.F.6.3.2 Describe strengths of shapes.			
	9.F.6.3.3 Demonstrate an awareness of the relationship between the model/drawing and physical object.	10.F.6.3.3 Demonstrate an awareness of the relationship between the model/drawing and physical object.	11A.F.6.3.3 Demonstrate an awareness of the relationship between the model/drawing and physical object.			
S	—	—	11A.S.6.3.1 Manipulate materials and shapes to assess their strengths.	11C.S.6.3.1 Apply the scientific applications used in engineering design solutions (e.g., density, mass, malleability, combustibility, fluid dynamics, displacement, electricity).	12A.S.6.3.1 Apply the scientific applications used in engineering design solutions (e.g., gravity, mechanical advantage, vectors).	12D.S.6.3.1 Use materials and engineering processes based on aesthetic and scientific properties.

8434 <b>Introduction to Design Drafting (9)</b> 15S / 15E / 15M 10S / 10E / 10M	8435 <b>Design Drafting Essentials 1 (10)</b> 20S / 20E / 20M	8436 <b>Design Drafting Essentials 2 (11A)</b> 30S / 30E / 30M	8438 <b>Engineering Design Drafting (11C)</b> 30S / 30E / 30M	8439 <b>Advanced Engineering Design Drafting (12A)</b> 40S / 40E / 40M	8669 <b>Applied Engineering Design Drafting (12D)</b> 40S / 40E / 40M
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**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting.

**GLO 7.1:** Understand the impact of architectural/engineering design on the **environment**.

F	9.F.7.1.1 Define sustainability as it relates to the environment.	10.F.7.1.1 Define sustainability as it relates to the environment.	11A.F.7.1.1 Demonstrate an awareness of the impact of sustainable practices on the environment.	11C.F.7.1.1 Identify environmental sustainability factors that influence engineering design solutions (e.g., reusability and recyclability of materials, energy efficiency of manufacturing processes).	12A.F.7.1.1 Identify sustainable materials and manufacturing processes that affect engineering design solutions (e.g., electrical conservation, lean manufacturing, conservation of resources, cradle to cradle, alternative energy).	12D.F.7.1.1 Analyze sustainable factors, materials, and manufacturing processes that affect engineering design solutions.
		10.F.7.1.2 Identify environmental sustainability factors that influence architectural and/or mechanical design solutions.	11A.F.7.1.2 Identify environmental sustainability factors that influence architectural and/or mechanical design solutions.	11C.F.7.1.2 Appreciate the environmental factors that have an impact on product design and manufacturing.	12A.F.7.1.2 Differentiate between traditional and sustainable manufacturing processes and their impacts on the environment.	12D.F.7.1.2 Differentiate between the effects of various manufacturing processes on the environment.
S	—	—	11A.S.7.1.1 Incorporate environmental sustainability factors in architectural and/or mechanical design solutions.	11C.S.7.1.1 Incorporate environmental sustainability factors in engineering design solutions.	12A.S.7.1.1 Incorporate sustainable materials and manufacturing processes in engineering design solutions.	12D.S.7.1.1 Select and incorporate sustainable factors, materials, and manufacturing processes that affect engineering design solutions.

8434 <b>Introduction to Design Drafting (9)</b> 15S / 15E / 15M 10S / 10E / 10M	8435 <b>Design Drafting Essentials 1 (10)</b> 20S / 20E / 20M	8436 <b>Design Drafting Essentials 2 (11A)</b> 30S / 30E / 30M	8438 <b>Engineering Design Drafting (11C)</b> 30S / 30E / 30M	8439 <b>Advanced Engineering Design Drafting (12A)</b> 40S / 40E / 40M	8669 <b>Applied Engineering Design Drafting (12D)</b> 40S / 40E / 40M
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**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting. (*continued*)

**GLO 7.2:** Describe the impact of architectural/engineering design on **human health and well-being**.

F	9.F.7.2.1 Define sustainability as it relates to human health and well-being.	10.F.7.2.1 Define sustainability as it relates to human health and well-being.	11A.F.7.2.1 Demonstrate an awareness of the impact of sustainable practices on human health and well-being.	11C.F.7.2.1 Identify human health and well-being sustainability factors that influence engineering design solutions (e.g., ergonomics, coatings, sharp edges, pinch points).	12A.F.7.2.1 Identify human health and well-being sustainable materials and manufacturing processes that affect engineering design solutions (e.g., ergonomics, coatings, sharp edges, health and safety manufacturing, servicing, user and recycling implications).	12D.F.7.2.1 Analyze sustainable factors, materials, and manufacturing processes that affect human health and well-being.
		10.F.7.2.2 Identify sustainability factors that influence human health and well-being in architectural and/or mechanical design solutions.	11A.F.7.2.2 Identify sustainability factors that influence human health and well-being in architectural and/or mechanical design solutions.	11C.F.7.2.2 Appreciate the human health and well-being sustainability factors that have an impact on manufacturing processes.	12A.F.7.2.2 Differentiate among natural and synthetic materials, and sustainable manufacturing processes and their impact on human health and well-being.	12D.F.7.2.2 Analyze the effect of manufacturing processes on human health and well-being.
S	—	—	11A.S.7.2.1 Incorporate human health and well-being sustainability factors in architectural and/or mechanical design solutions.	11C.S.7.2.1 Incorporate human health and well-being sustainability factors in engineering design solutions.	12A.S.7.2.1 Incorporate human health and well-being sustainable materials and manufacturing processes in engineering design solutions.	12D.S.7.2.1 Select and incorporate human health and well-being sustainable factors, materials, and manufacturing processes in engineering design solutions.

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**Goal 7:** Demonstrate an awareness of **sustainability** as it pertains to design drafting. (*continued*)

**GLO 7.3:** Recognize the **economic impact** of sustainable practices in architectural/engineering design.

<b>F</b>	<p>9.F.7.3.1 Define sustainability as it relates to the economy.</p>	<p>10.F.7.3.1 Define sustainability as it relates to the economy.</p> <p>10.F.7.3.2 Identify economic sustainability factors that influence architectural and/or mechanical design solutions.</p>	<p>11A.F.7.3.1 Demonstrate an awareness of the impact of sustainable practices on the economy.</p> <p>11A.F.7.3.2 Identify economic sustainability factors that influence architectural and/or mechanical design solutions.</p>	<p>11C.F.7.3.1 Identify the economic sustainability factors that influence engineering design solutions (e.g., local versus imported products, cradle to cradle, serviceable and recycled materials).</p> <p>11C.F.7.3.2 Appreciate the economic impact of sustainability factors on engineering design solutions.</p>	<p>12A.F.7.3.1 Identify economic sustainable materials and manufacturing processes that affect engineering design solutions (e.g., solar, geothermal, wind, hydroelectric, renewable materials, rigorous prototyping).</p> <p>12A.F.7.3.2 Differentiate between traditional and sustainable manufacturing processes and their economic impacts.</p>	<p>12D.F.7.3.1 Analyze economic sustainability factors that affect the selection of materials and manufacturing processes.</p> <p>12D.F.7.3.2 Analyze the economic impact of sustainable factors, materials, and manufacturing processes on engineering design solutions.</p>
<b>S</b>	—	—	<p>11A.S.7.3.1 Incorporate economic sustainability factors in architectural and/or mechanical design solutions.</p>	<p>11C.S.7.3.1 Incorporate economic sustainability factors in engineering design solutions.</p>	<p>12A.S.7.3.1 Incorporate economic sustainable materials and manufacturing processes in engineering design solutions.</p>	<p>12D.S.7.3.1 Select economic sustainable factors, materials, and manufacturing processes that affect engineering design solutions.</p>

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**Goal 8:** Understand the **evolution** of design drafting, including its **technological progression and emerging trends**.

**GLO 8.1:** Describe the **evolution of design drafting, including its technological progression and emerging trends**.

F	9.F.8.1.1 Demonstrate an appreciation of traditional design drafting tools, equipment, materials, and drawings.	10.F.8.1.1 Demonstrate an appreciation of traditional design drafting tools, equipment, materials, and drawings.	11A.F.8.1.1 Describe the emerging technologies related to the tools, equipment, and materials of design drafting.	11C.F.8.1.1 Discuss emerging trends related to the tools and equipment of engineering design.	12A.F.8.1.1 Discuss emerging trends related to the role of designer/draftsperson and the use of working drawings in manufacturing.	12D.F.8.1.1 Demonstrate an appreciation of the changing role of the draftsperson based on emerging trends and technologies.
	9.F.8.1.2 Demonstrate an appreciation of the impact of developing trends and emerging technologies on design drafting.	10.F.8.1.2 Demonstrate an appreciation of the impact of developing trends and emerging technologies on design drafting.	11A.F.8.1.2 Describe past and emerging trends (e.g., societal changes, styles) in architectural and/or mechanical design.	11C.F.8.1.2 Describe emerging styles and trends (e.g., cradle to cradle, virtual design and testing, development of new materials, questioning existing design, creative thinking) and their impact on engineering design.  11C.F.8.1.3 Research past/historical/contemporary examples of engineering design.	12A.F.8.1.2 Describe emerging styles and trends and their impact on the selection of materials and manufacturing processes (e.g., nanotechnology, manufacturing in space, local manufacturing/cottage industries, serviceability, new trends in manufacturing).	12D.F.8.1.2 Describe emerging styles and trends and their impact on the selection of materials, manufacturing processes, and engineering design.
S	—	—	—	—	—	—

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**Goal 9:** Follow the **ethical and legal standards** in design drafting.

**GLO 9.1:** Incorporate the local and national **building codes and standards as well as manufacturing and engineering standards** into designs.

P	9.P.9.1.1 Discuss the need for standards and codes in design drafting.	10.P.9.1.1 Discuss the need for standards and codes in design drafting.	11A.P.9.1.1 Discuss the need for standards and codes in design drafting.	11C.P.9.1.1 Identify the commonly used standards for engineering drafting.	12A.P.9.1.1 Identify the commonly used standards for engineering drafting.	12D.P.9.1.1 Select the appropriate standard for engineering drafting projects.
	9.P.9.1.2 Follow ISO and ANSI standards to produce drawings.	10.P.9.1.2 Identify CAN/CSA, ISO, and ANSI standards for technical drawings, and/or building codes to create models.	11A.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.	11C.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.	12A.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.	12D.P.9.1.2 Produce technical drawings to CAN/CSA, ISO, and ANSI standards.
		10.P.9.1.3 Identify the standards related to architectural and engineering working drawing view selection and placement.	11A.P.9.1.3 Identify the standards related to architectural and/or mechanical working drawing view selection, placement, and modification (e.g., removal of unnecessary hidden lines, addition of centre line, partial views).	11C.P.9.1.3 Follow recognized engineering standards.	12A.P.9.1.3 Follow government regulatory guidelines.	12D.P.9.1.3 Interpret criteria from different government regulatory bodies.

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**Goal 9:** Follow the **ethical and legal standards** in design drafting. *(continued)*

**GLO 9.1:** Incorporate the local and national **building codes and standards as well as manufacturing and engineering standards** into designs. *(continued)*

P	10.P.9.1.4 Demonstrate an awareness of the fact that drawings are legal and contractual.	11A.P.9.1.4 Demonstrate an awareness of the fact that drawings are legal and contractual.	11C.P.9.1.4 Demonstrate an awareness of variations in CADD standards (e.g., discipline specific, trade specific, organization).  11C.P.9.1.5 Describe the legal (e.g., as enunciated by government regulatory guidelines, professional associations) and contractual (e.g., manufacturers, material suppliers) obligations of engineering drawings.	12A.P.9.1.4 Use CADD standards (e.g., discipline specific, trade specific, organization) based on design project requirements.  12A.P.9.1.5 Describe the legal (e.g., as enunciated by government regulatory guidelines, professional associations) and contractual (e.g., manufacturers, material suppliers) obligations of engineering drawings.	12D.P.9.1.4 Select and use CADD standards (e.g., discipline specific, trade specific, organization) based on client requirements.  12D.P.9.1.5 Produce engineering drawings to legal and manufacturable standards.
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**GLO 9.2:** Describe the **ethical expectations** of designers.

P	9.P.9.2.1 Practise ethical and responsible use of computer hardware and software.	10.P.9.2.1 Practise ethical and responsible use of computer hardware and software.	11A.P.9.2.1 Demonstrate an understanding of the legal implications of ethical design.	11C.P.9.2.1 Practise ethical and responsible use of computer hardware and software.	12A.P.9.2.1 Consider the ethical implications of compromise in making technical design decisions (e.g., costs, inadequate design).	12D.P.9.2.1 Apply ethical practices in producing contract documents.
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**Goal 9:** Follow the **ethical and legal standards** in design drafting. *(continued)*

**GLO 9.2:** Describe the **ethical expectations** of designers. *(continued)*

P	9.P.9.2.2 Appreciate the ethical responsibilities of producing accurate design drafting documents.	10.P.9.2.2 Demonstrate an understanding of the ethical responsibilities of producing accurate design drafting documents.	11A.P.9.2.2 Demonstrate an understanding of the ethical responsibilities of producing accurate design drafting documents.	11C.P.9.2.2 Consider the ethical implications of compromise in making design decisions (e.g., costs, inadequate design).
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**Goal 10:** Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace.

**GLO 10.1:** Demonstrate an awareness of **rights, responsibilities, and safety procedures** for specific tools, equipment, and working environments.

P	9.P.10.1.1 Demonstrate and value safe work practices and procedures.	10.P.10.1.1 →	11A.P.10.1.1 →	11C.P.10.1.1 →	12A.P.10.1.1 →	12D.P.10.1.1 →
	9.P.10.1.2 Demonstrate ergonomically correct procedures to avoid injury (e.g., stress, strain).	10.P.10.1.2 →	11A.P.10.1.2 →	11C.P.10.1.2 →	12A.P.10.1.2 →	12D.P.10.1.2 →
	9.P.10.1.3 Identify personal responsibility for health and safety.	10.P.10.1.3 →	11A.P.10.1.3 Demonstrate personal responsibility for health and safety.	11C.P.10.1.3 →	12A.P.10.1.3 →	12D.P.10.1.3 →

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**Goal 10:** Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace. *(continued)*

**GLO 10.1:** Demonstrate an awareness of **rights, responsibilities, and safety procedures** for specific tools, equipment, and working environments. *(continued)*

P	9.P.10.1.4 Identify and use the safety features of tools and equipment.	10.P.10.1.4 →	11A.P.10.1.4 Demonstrate the safety features of tools and equipment.	11C.P.10.1.4 →	12A.P.10.1.4 →	12D.P.10.1.4 →
	9.P.10.1.5 Follow emergency evacuation procedures.	10.P.10.1.5 →	11A.P.10.1.5 →	11C.P.10.1.5 →	12A.P.10.1.5 →	12D.P.10.1.5 →
	9.P.10.1.6 Use appropriate aids to minimize risk of injury.	10.P.10.1.6 →	11A.P.10.1.6 →	11C.P.10.1.6 →	12A.P.10.1.6 →	12D.P.10.1.6 →
	9.P.10.1.7 Use appropriate personal protective equipment.	10.P.10.1.7 →	11A.P.10.1.7 →	11C.P.10.1.7 →	12A.P.10.1.7 →	12D.P.10.1.7 →
	9.P.10.1.8 Locate first aid stations and fire extinguishers.	10.P.10.1.8 →	11A.P.10.1.8 →	11C.P.10.1.8 →	12A.P.10.1.8 →	12D.P.10.1.8 →
					12A.P.10.1.9 Demonstrate an awareness of external health and safety programs and certifications.	12D.P.10.1.9 →

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**Goal 10:** Demonstrate a knowledge of and ability to recognize and apply appropriate **health and safety** requirements and practices to maintain a safe workplace. *(continued)*

**GLO 10.2:** Describe **health and safety laws and regulations**.

P	9.P.10.2.1 Describe the reporting process for injuries.	10.P.10.2.1 →	11A.P.10.2.1 →	11C.P.10.2.1 →	12A.P.10.2.1 →	12D.P.10.2.1 →
		10.P.10.2.2 Identify WHMIS symbols and terminology, and follow WHMIS guidelines.	11A.P.10.2.2 Identify WHMIS symbols and terminology, and follow WHMIS guidelines, including the location of MSDS sheets.	11C.P.10.2.2 →	12A.P.10.2.2 →	12D.P.10.2.2 →
		10.P.10.2.3 Comply with health and safety legislation and practices.	11A.P.10.2.3 →	11C.P.10.2.3 →	12A.P.10.2.3 →	12D.P.10.2.3 →

**Goal 11:** Demonstrate **employability skills** required in design drafting.

**GLO 11.1:** Demonstrate fundamental **employability skills**.

P	9.P.11.1.1 Explain the importance of employability skills.	10.P.11.1.1 →	11A.P.11.1.1 Describe the importance of employability skills in school, work, and daily life.	11C.P.11.1.1 →	12A.P.11.1.1 →	12D.P.11.1.1 →
	9.P.11.1.2 Ask questions to clarify written or oral instructions.	10.P.11.1.2 Ask questions to clarify written or oral communication.	11A.P.11.1.2 Listen and ask questions to clarify problems and instructions.	11C.P.11.1.2 →	12A.P.11.1.2 →	12D.P.11.1.2 →

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**Goal 11:** Demonstrate **employability skills** required in design drafting. *(continued)*

**GLO 11.1:** Demonstrate fundamental **employability skills**. *(continued)*

P	9.P.11.1.3 Identify sources of information and resources for design drafting.	10.P.11.1.3 →	11A.P.11.1.3 Locate, gather, and organize design drafting information using appropriate technology and information systems.	11C.P.11.1.3 →	12A.P.11.1.3 →	12D.P.11.1.3 →
	9.P.11.1.4 Identify problems and follow a problem-solving process.	10.P.11.1.4 Demonstrate an understanding of a problem-solving process for design drafting.	11A.P.11.1.4 Assess situations and identify problems and possible solutions.	11C.P.11.1.4 →	12A.P.11.1.4 →	12D.P.11.1.4 →

**GLO 11.2:** Demonstrate **personal management** skills.

P	9.P.11.2.1 Actively participate in a positive manner.	10.P.11.2.1 →	11A.P.11.2.1 Demonstrate interest, initiative, and effort.	11C.P.11.2.1 →	12A.P.11.2.1 →	12D.P.11.2.1 →
	9.P.11.2.2 Complete tasks within stated time frames.	10.P.11.2.2 →	11A.P.11.2.2 Manage time to complete tasks/projects within stated time frames.	11C.P.11.2.2 →	12A.P.11.2.2 →	12D.P.11.2.2 →

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**Goal 11:** Demonstrate **employability skills** required in design drafting. *(continued)*

**GLO 11.2:** Demonstrate **personal management** skills. *(continued)*

P	9.P.11.2.3 Demonstrate accountability for own actions.	10.P.11.2.3 →	11A.P.11.2.3 Demonstrate accountability for own actions and for the actions of one's team.	11C.P.11.2.3 →	12A.P.11.2.3 →	12D.P.11.2.3 →
	9.P.11.2.4 Accept feedback, comments, and contributions from others.	10.P.11.2.4 →	11A.P.11.2.4 Respond constructively to changes.	11C.P.11.2.4 →	12A.P.11.2.4 →	12D.P.11.2.4 →
	9.P.11.2.5 Listen and respond in order to understand and learn.	10.P.11.2.5 →	11A.P.11.2.5 Demonstrate a willingness to learn continuously.	11C.P.11.2.5 →	12A.P.11.2.5 →	12D.P.11.2.5 →
		10.P.11.2.6 Identify learning materials, resources, and opportunities.	11A.P.11.2.6 Appreciate the need for continuous learning in technologically dependent occupations.	11C.P.11.2.6 →	12A.P.11.2.6 →	12D.P.11.2.6 →

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**Goal 11:** Demonstrate **employability skills** required in design drafting. (*continued*)

**GLO 11.3:** Demonstrate **teamwork** skills.

P	9.P.11.3.1 Actively participate in the work of a group.	10.P.11.3.1 Demonstrate an understanding of the roles of members of a group.	11A.P.11.3.1 Be respectful toward, open to, and supportive of the thoughts, opinions, and contributions of others in a group.	11C.P.11.3.1 →	12A.P.11.3.1 →	12D.P.11.3.1 →
	9.P.11.3.2 Participate in the classroom/shop learning activities.	10.P.11.3.2 Actively participate in the work of a group.	11A.P.11.3.2 Contribute information and skills to achieve the goals of a group.	11C.P.11.3.2 →	12A.P.11.3.2 →	12D.P.11.3.2 →
		10.P.11.3.3 Participate in the classroom/shop learning activities.	11A.P.11.3.3 Contribute willingly to classroom/shop learning activities.	11C.P.11.3.3 →	12A.P.11.3.3 →	12D.P.11.3.3 →
			11A.P.11.3.4 Accept assistance from and offer it to others.	11C.P.11.3.4 →	12A.P.11.3.4 →	12D.P.11.3.4 →
				11C.P.11.3.5 Collaborate with peers and industry professionals.	12A.P.11.3.5 →	12D.P.11.3.5 →

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**Goal 12:** Describe **career opportunities** in design drafting.

**GLO 12.1:** Describe **post-secondary opportunities** related to design drafting.

P	9.P.12.1.1 Identify post-secondary paths for design drafting (e.g., requirements, educational institutions, programs).	10.P.12.1.1 Identify secondary (e.g., robotics, electronics, carpentry, art) and post-secondary (e.g., requirements, educational institutions, programs) paths related to design drafting.	11A.P.12.1.1 Identify post-secondary paths and articulation opportunities for design drafting (e.g., requirements, educational institutions, programs).	11C.P.12.1.1 Identify post-secondary paths and articulation opportunities for engineering design drafting (e.g., requirements, educational institutions, programs).	12A.P.12.1.1 Identify industry and association certifications related to engineering design drafting.	12D.P.12.1.1 Discuss the post-secondary application process (e.g., deadlines, forms, applications, scholarships).
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**GLO 12.2:** Describe **career opportunities** available in design drafting across industries.

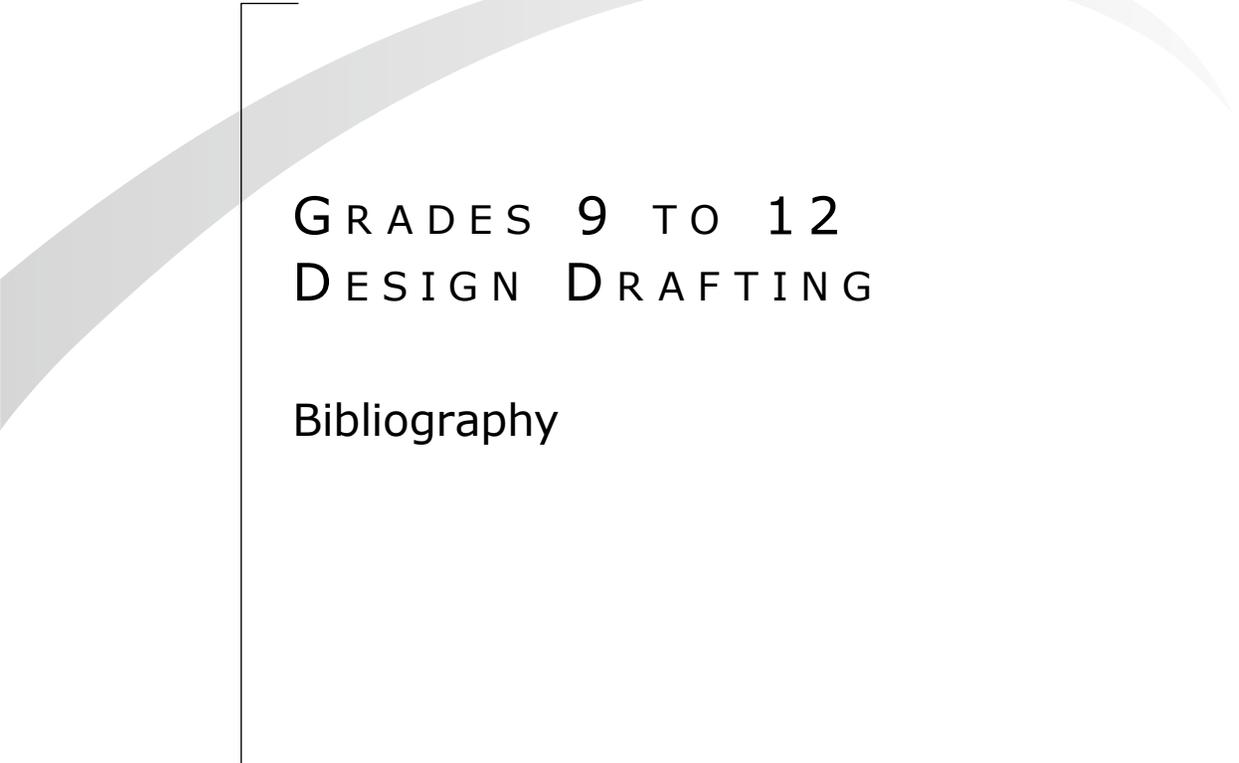
P	9.P.12.2.1 Explore careers related to design drafting.	10.P.12.2.1 Explore architectural/ engineering careers related to design drafting.	11A.P.12.2.1 Explore architectural/ engineering careers related to design drafting.	11C.P.12.2.1 Explore engineering careers related to the design drafting industry.	12A.P.12.2.1 Explore engineering careers related to the manufacturing industry.	12D.P.12.2.1 Explore engineering careers.  12D.P.12.2.2 Identify information needed for transition from school to work.
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8434 <b>Introduction to Design Drafting (9)</b> 15S / 15E / 15M 10S / 10E / 10M	8435 <b>Design Drafting Essentials 1 (10)</b> 20S / 20E / 20M	8436 <b>Design Drafting Essentials 2 (11A)</b> 30S / 30E / 30M	8438 <b>Engineering Design Drafting (11C)</b> 30S / 30E / 30M	8439 <b>Advanced Engineering Design Drafting (12A)</b> 40S / 40E / 40M	8669 <b>Applied Engineering Design Drafting (12D)</b> 40S / 40E / 40M
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**Goal 12:** Describe **career opportunities** in design drafting. *(continued)*

**GLO 12.3:** Create, maintain, and present a **portfolio**.

P	9.P.12.3.1 Collect samples for a design drafting portfolio.	10.P.12.3.1 Collect architectural/engineering samples for a design drafting portfolio.	11A.P.12.3.1 Collect architectural/engineering samples for a design drafting portfolio.	11C.P.12.3.1 Collect engineering samples for a design drafting portfolio.	12A.P.12.3.1 Organize and reflect on engineering samples for inclusion in a design drafting portfolio.	12D.P.12.3.1 Reflect on and include a complete set of engineering documents for a project in a design drafting portfolio.  12D.P.12.3.2 Present a design drafting portfolio.
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GRADES 9 TO 12  
DESIGN DRAFTING

Bibliography



## Introduction

Canada. Employment and Social Development Canada. *National Occupational Classification*. 18 Dec. 2013. <[www.hrsdc.gc.ca/eng/jobs/lmi/noc/](http://www.hrsdc.gc.ca/eng/jobs/lmi/noc/)> (2 Jan. 2014).

———. ————. *Essential Skills Profiles*. 11 Dec. 2013. <[www.hrsdc.gc.ca/eng/jobs/les/profiles/](http://www.hrsdc.gc.ca/eng/jobs/les/profiles/)> (2 Jan. 2014).

Manitoba Education. *Technical-Vocational Education Overview*. Winnipeg, MB: Manitoba Education, 2013.

Manitoba Education and Advanced Learning. *Subject Table Handbook: Technology Education: Student Records System and Professional School Personnel System*. Winnipeg, MB: Manitoba Education and Advanced Learning. Available online at <[www.edu.gov.mb.ca/k12/cur/teched/sth\\_tech\\_ed.html](http://www.edu.gov.mb.ca/k12/cur/teched/sth_tech_ed.html)>.

———. "Senior Years Technology Education Program." *Technology Education*. <[www.edu.gov.mb.ca/k12/cur/teched/sy\\_tech\\_program.html](http://www.edu.gov.mb.ca/k12/cur/teched/sy_tech_program.html)> (12 May 2014).

## Architectural

Allen, Edward. *How Buildings Work: The Natural Order of Architecture*. 3rd ed. Oxford, NY: Oxford University Press Inc., 2005.

Aubin, Paul F. *Mastering AutoCAD Architecture 2008*. Florence, KY: Autodesk Press, 2007.

Ching, Francis D. K. *Architectural Graphics*. 4th ed. New York, NY: John Wiley & Sons, Inc., 2003.

———. *Architecture: Form, Space, and Order*. 3rd ed. Hoboken, NJ: John Wiley & Sons, 2007.

———. *Building Construction Illustrated*. 4th ed. Hoboken, NJ: John Wiley & Sons, Inc., 2008.

CMHC. *New Canadian Wood-Frame House Construction*. Ottawa, ON: CMHC, 2005.

Crunden, Freda, and Maurice Cosyn. *Design for Residential Construction: A Project Oriented Approach*. Toronto, ON: McGraw Hill Ryerson, 1991.

DelPico, Wayne J. *Builder's Essentials: Estimating Building Costs for the Residential & Light Commercial Contractor*. Kingston, MA: Reed Construction Data Publisher, 2006.

Edwards, Brian, and David Turrent, eds. *Sustainable Housing Principles & Practice*. London, England: Taylor & Francis Group, 2000.

Eisenman, Sara. *Building Design Portfolios: Innovative Concepts for Presenting Your Work*. Beverly, MA: Rockport Publishers, 2006.

Frechette, Leon A. *Accessible Housing*. New York, NY: McGraw-Hill, 1996.

Grady, Wayne. *Green Home-Planning and Building the Environmentally Advanced Home*. Camden East, ON: Camden House, 1993.

- Grau, Philip, Edward J. Muller, and James G. Fausett. *Architectural Drawing and Light Construction*. Englewood Cliffs, NJ: Prentice Hall, 2008.
- Hopper, Leonard J. *Landscape Architectural Graphic Standards*. Hoboken, NJ: John Wiley & Sons, Inc., 2007.
- Knoll, Wolfgang, and Martin Hechinger. *Architectural Models: Construction Techniques*. London, England: B. T. Batsford Ltd., 1992.
- Koel, Leonard. *Carpentry*. 4th ed. Orland Park, IL: American Technical Publishers, Inc., 2003.
- Leggitt, Jim. *Drawing Shortcuts: Developing Quick Drawing Skills Using Today's Technology*. New York, NY: John Wiley & Sons, Inc., 2002.
- Lin, Mike W. *Architectural Rendering Techniques*. New York, NY: John Wiley & Sons, Inc., 1985.
- Lockhard, William K. *Drawing as a Means to Architecture*. Mississauga, ON: Crisp Learning, 1992.
- Manitoba Education, Citizenship and Youth. *Grade 10 Design Drafting Technology (20G): A Course for Independent Study*. Winnipeg, MB: Manitoba Education, Citizenship & Youth, 2008.
- Manitoba Education, Training and Youth. *Education for a Sustainable Future: A Resource for Curriculum Developers, Teachers, and Administrators*. Winnipeg, MB: Manitoba Education, Training and Youth, 2000.
- Mathewson, Casey C. M., ed. *Residential Designs for the 21st Century: An International Collection*. Buffalo, NY: Firefly Books Ltd., 2007.
- McGraw-Hill Information Systems Company. *Sweets Network: McGraw Hill Construction*. 2009. <<http://products.construction.com>> (24 Sept. 2009).
- McMorrhough, Julia. *Materials, Structures, Standards*. Beverly, MA: Rockport Publishers, 2006.
- Metzger, Phil. *Pencil Magic: Landscape Drawing Techniques*. Cincinnati, OH: North Light Books, 2004.
- Mills, Criss B. *Designing with Models: A Studio Guide to Making and Using Architectural Design Models*. 2nd ed. Hoboken, NJ: John Wiley & Sons, Inc., 2005.
- National Research Council Canada. *National Building Code of Canada 2005*. (Part 3 & 9). Winnipeg, MB: National Research Council Canada, 2005.
- Nuttgens, Patrick, and Richard Weston. *The Complete Architecture Handbook: From the First Civilizations to the Present Day*. New York, NY: Collins Design, 2006.

- Patterson, Terry L. *Architect's Studio Handbook*. New York, NY: McGraw-Hill, 2002.
- Pope, Tim, ed. *Canadian Electrical Code, Part 1: Safety Standard for Electrical Installations, CSA Standard C22.1-09*. 21st ed. Mississauga, ON: Canadian Standards Association, 2009.
- Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*. New York, NY: John Wiley & Sons, Inc., 2000.
- Rybczynski, Witold. *A Clearing in the Distance: Frederick Law Olmsted and America in the 19th Century*. New York, NY: Simon and Schuster, Inc., 1999.
- Strinholm, Ronald K., and Elmer W. Sundberg. *Building Trades Blueprint Reading: Residential*. Toronto, ON: Pearson Education Canada, 1982.
- Sutherland, Martha. *Model Making: A Basic Guide*. New York, NY: WW Norton & Company, 1999.
- Winkel, Steven R., David S. Collins, and Steven P. Jurosek. *Building Codes Illustrated for Elementary and Secondary Schools: A Guide to Understanding the 2006 International Building Code*. Hoboken, NJ: John Wiley & Sons, Inc., 2007.

## Engineering

- Autodesk. *AutoCAD Civil 3D 2008 Education Curriculum*. 2007. <[http://students2.autodesk.com/?nd=adsk\\_c3d2008\\_curriculum](http://students2.autodesk.com/?nd=adsk_c3d2008_curriculum)> (24 Sept 2009).
- Bird, John. *Basic Engineering Mathematics*. 4th ed. Burlington, MA: Newness Press, 2005.
- Brown, Walter C., and Clois E. Kicklighter. *Drafting for Industry*. Tinley Park, IL: Goodheart-Wilcox Publisher, 1995.
- Canadian Standards Association. *Dimensions and Tolerancing of Technical Drawings (CAN/CSA-B78.2-86)*. Mississauga, ON: Canadian Standards Association, 1986.
- Chen, W. F., and J. Y. Richard Liew, eds. *The Civil Engineering Handbook*. 2nd ed. Boca Raton, FL: CRC Press L.L.C., 2003.
- Childs, Peter R. N. *Mechanical Design*. London, England: Arnold Publishers, 1998.
- Daugherty, J. S., et al. *Sheet Metal Pattern Drafting and Shop Problems*. 4th ed. New York, NY: Glencoe/McGraw-Hill, 1975.
- Fogiel, Max. *Handbook of Mathematical, Scientific, and Engineering Formulas, Tables, Functions, Graphs, Transforms*. Winnipeg, MB: Research & Education Association, 1997.

- Giesecke, Frederick, et al. *Technical Drawing*. 12th ed. Upper Saddle River, NJ: Prentice Hall/Pearson Education, 2003.
- International Organization for Standardization. *ISO Standards Handbook: Technical Drawings, Vol. 1: Technical Drawings in General*. International Organization for Standardization, 2002.
- Jensen, Cecil H. *Interpreting Engineering Drawings*. 6th ed. Albany, NY: Delmar/Thomson Learning, 2002.
- Jensen, Cecil H., Jay D. Helsel, and Dennis Short. *Engineering Drawing and Design*. 7th ed. Whitby, ON: McGraw-Hill Science/Engineering/Math, 2007.
- Kalameja, Alan J. *AutoCAD 2007 Tutor for Engineering Graphics*. Florence, KY: Autodesk Press, 2006.
- Kutz, Myer Ed. *Mechanical Engineers' Handbook*. 2nd ed. New York, NY: John Wiley & Sons, Inc., 1998.
- Luzadder, Warren J., and Jon M. Duff. *Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production*. 11th ed. Upper Saddle River, NJ: Prentice Hall, 1992.
- Madsen, David A., et al. *Engineering Drawing and Design*. 3rd ed. Albany, NY: Delmar/Thomson Learning, 2004.
- Marrelli, Richard. *Geometric Tolerancing*. Encino, CA: Glencoe Pub. Co., 1984.
- Moss, Elise. *Autodesk Inventor R11 Fundamentals: Conquering the Rubicon*. Mission, KS: SDC Publications, 2006.
- Oberg, Erik, et al. *Machinery's Handbook*. New York, NY: Industrial Press Inc., 2000.
- Sclater, Neil, and Nicholas P. Chironis. *Mechanisms and Mechanical Devices Sourcebook*. 3rd ed. New York, NY: McGraw-Hill, 2001.
- Shih, Randy H. *Parametric Modeling with Autodesk Inventor 2009*. Mission, KS: SDC Publications, 2008.
- The American Society of Mechanical Engineers. *Dimensioning and Tolerancing ANSI Y14.5-1973*. New York, NY: ASME Publishers, 1988.
- Timings, Roger. *Engineering Fundamentals*. Woburn, MA: Newnes, 2002.
- Whyte, Walter S., and R. Paul. *Basic Surveying*. 4th ed. Burlington, MA: Elsevier Butterworth-Heinemann, 1997.
- Younis, Wasim. *Up and Running with Autodesk Inventor Simulation 2010*. Oxford, NY: Butterworth-Heinemann, 2009.

## Career Development

Human Resources and Skills Development Canada.  
*About the NOC 2011.* <[http://www5.hrsdc.gc.ca/  
NOC/English/NOC/2006/AboutNOC.aspx](http://www5.hrsdc.gc.ca/NOC/English/NOC/2006/AboutNOC.aspx)>  
(24 Sept. 2009).

Manitoba Education and Advanced Learning. *Career  
Development: Curriculum Documents.* <[www.  
edu.gov.mb.ca/k12/cur/cardev/curdocs.html](http://www.edu.gov.mb.ca/k12/cur/cardev/curdocs.html)>  
(2 Jan. 2013).

Parachute. *Passport to Safety.*  
<[www.passporttosafety.com/](http://www.passporttosafety.com/)>  
(31 Dec. 2013).

SAFE Work. *SAFE WORK Publications.* 2012.  
<<http://safemanitoba.com/resources/publication>>  
(3 Jan. 2013).







Printed in Canada  
Imprimé au Canada