Public and Catholic District School Board Writing Partnerships

Technological Education

Course Profile

Construction Technology

Grade 12
College Preparation
TCJ4C

• *for teachers by teachers*

Course Profiles are professional development materials designed to help teachers implement the new Grade 12 secondary school curriculum. These materials were created by writing partnerships of school boards and subject associations. The development of these resources was funded by the Ontario Ministry of Education. This document reflects the views of the developers and not necessarily those of the Ministry. Permission is given to reproduce these materials for any purpose except profit. Teachers are also encouraged to amend, revise, edit, cut, paste, and otherwise adapt this material for educational purposes.

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Course Overview
Construction Technology, TCJ4C, Grade 12, College Preparation

Policy Document: *The Ontario Curriculum, Grades 11 and 12, Technological Education, 2000.*
Prerequisite: Construction Technology, Grade 11, College Preparation

Course Description

This course focuses on advanced residential construction, more complex construction systems, and the introduction of heavy construction related to commercial, industrial, and/or recreational construction. Students learn about tools, materials, equipment, and, methods used in the light and heavy construction industries; structural analysis and design; presentation and working drawings; and auxiliary systems. They also estimate materials and labour costs; study industry standards and building codes; consider health and safety issues; explore energy conservation, careers, and the impact of construction technology on society and the environment.

How This Course Supports the Ontario Catholic School Graduate Expectations

The design of this course allows for students, regardless of gender and race, to improve their skills and knowledge in the area of the construction industry and better themselves, their families, and the community. The students' development and continued growth in the Catholic faith can be measured by Catholic Graduate Expectations. The challenges that await the students upon graduation are varied and new. The personal development that they have experienced in the Catholic education system, aids in the decision making process so they can make enlightened and personal decisions with confidence.

The world and its possessions are gifts from God and as stewards of His word and world, we must make informed decisions being mindful of both the short and long term consequences on our environment, quality of life, and how this relates to our Catholic values as followers of Jesus Christ. The graduate now has the confidence and skills to become a contributing member of society.

Course Notes

- Teachers should be sensitive to the personal nature of the experience and support students in avoiding disclosure and discussion of sensitive issues.
- There is a need for a computer lab so students may complete the activities in the accompanying units.
- Teachers should be aware of the board's policy regarding trips and the clearing of visitors (guest speakers, etc.)
- Prior knowledge should be addressed to ensure all students have the opportunity for success.
- The course outline and evaluation should be discussed and agreed to prior to starting the units.
- Facility limitations may require that the activities not be completed as laid out in the overview and unit descriptions.
- Continuation of the Safety Passport System, or similar system, is encouraged for the safety of the student and the protection of the instructor (see Appendix 2.4.1).
- The unit dealing with restoration and renovation allows the instructor to use local buildings and churches as a resource for further education. Local historic societies and libraries can be valuable sources of information. Students' research and develop a product or service they could give back to the community.
- Since students will be visiting buildings, health and safety measures must be addressed prior to the field trips.

- The course content was laid out to provide the college destination student with the knowledge and confidence to further develop their personal and group problem-solving, decision making, and conflict resolution skills. All decisions in the construction industry have an effect on the person, neighbourhood and community and as Catholics, it is our obligation to make ethical decisions with an informed conscience.
- Exposure to career opportunities and course selection opportunities must be continually explored so the students final decision on a school and course is an informed one.

Units: Titles and Times

* Unit 1	Skill Building	30 hours
* Unit 2	Architectural Restoration and Renovation	40 hours
Unit 3	New Construction Technology	40 hours

* These units are fully developed in this Course Profile.

Unit Overviews

Unit 1: Skill Building

Time: 30 hours

Unit Description

This unit focuses on developing the necessary skills students require for post secondary education and careers in construction. Students explore and further develop their skills in computer applications, surveying, drafting, computer-aided drafting (AutoCAD), and cost estimating.
Students explore ethics and employability, potential careers and business opportunities, and available college programs that relate to the construction industry. Preparation for admission to college and university programs is particularly emphasized so that students are prepared to enter programs such as, Urban Planning, Engineering, Architecture, Landscape Architecture, Surveying, Environmental Management, Construction Engineering Technology, and Construction Estimating.

Unit Overview Chart

Activity	Time	Learning Expectations	Assessment Categories	Focus
1.1	15 hours	TFV.02, TF3.02, SP1.04, SP1.05 CGE 2b, 2c, 3b, 3c, 3f, 5b	Knowledge/ Understanding	Drafting/Computer-aided drafting programs
1.2	5 hours	TFV.03, TF2.02, TF2.04, TF2.05, SP1.03, SP2.08, SP2.10, IC1.01 CGE 2b, 2c, 3b, 3e, 4d, 5b, 7i	Thinking/ Inquiry	Material selection and possible consequences (financially and ethically)
1.3	5 hours	SPV.02, SPV.04, SPV.05, SP1.03, SP1.07, SP3.01, SP3.02, SP3.03, SP3.05, SP3.06 CGE 2b, 3c, 3e, 3f, 4f	Knowledge/ Understanding Thinking/ Inquiry	Organization of finances, flow charts and materials for a successful project
1.4	5 hours	SPV.05, SP1.03, SP3.07, ICV.01, ICV.02, ICV.04, IC3.01, IC3.02, IC3.03, IC3.04 CGE 1i, 2b, 2c, 3e, 3f, 5b, 5c, 5g, 7b, 7i	Knowledge/ Understanding Thinking/ Inquiry Communication Application	Students develop strategies for evaluating college/university programs and for developing resumes

Unit 2: Architectural Restoration and Renovation

Time: 40 hours

Unit Description

Students investigate aspects of design and construction having to do with the refurbishing, restoration, and renovation of older buildings. Study includes architectural and social history and traditional and current building techniques, tools, and materials. Students research, design, draw, and plan appropriate construction projects. From this planning, students complete interior and exterior work on, and for, buildings needing improvement. Students learn about educational and career opportunities in a broad range of fields including architecture, interior design, fine woodworking, carpentry, and landscape design. Student learning is assessed by means of report writing, research documentation, drawings, models, and full-scale construction. Throughout the unit an emphasis is placed on the environmentally conscious use of materials and the need to appreciate and preserve our architectural heritage.

Unit Overview Chart

Activity	Time	Learning Expectations	Assessment Categories	Focus/Tasks
2.1 Creating a Drawing	12 hours	TFV.02, TF2.04, SP1.04, SP1.05, SP2.08, SP2.09, SP3.02, IC1.01 CGE 1i, 2b, 3b	Knowledge/ Understanding Thinking/ Inquiry Communication Application	Select, photograph, and measure an existing building that has architectural or historical significance and draw floor plan(s) and elevation(s) using CAD
2.2 Researching a Period Style	4 hours	TFV.03, TFV.05, TF2.01, TF2.03, TF2.04 CGE 4b, 4c, 4g, 5a	Knowledge/ Understanding Thinking/ Inquiry Communication	Identify, research, and document the period style of the chosen house
2.3 Designing an addition	12 hours	TFV.01, TFV.02, TFV.04, TF1.01, TF1.02, TF2.03, TF2.04, TF2.06, TF3.02, SPV.01, SPV.02, SP1.01, SP1.02, SP1.03, SP1.04, SP1.05, SP2.05, SP3.08 CGE 3b, 4a, 4d, 5b	Application Communication Thinking/ Inquiry	Research, design, and produce plans for an appropriate addition to the chosen house
2.4 Fabricating building component(s)	12 hours	TFV.01, TFV.02, TFV.03, TFV.04, TF2.03, SPV.01, SP1.07, SP2.09, SP2.11, SP2.12, SP3.01, SP3.03, ICV.03, IC2.01, IC2.02 CGE 2b, 4b, 5d, 7b, 7i, 7j	Knowledge/ Understanding Application Thinking/ Inquiry	Design, draw, and construct a detail or component of the addition

Unit 3: New Construction Technology

Time: 40 hours

Unit Description

Students explore aspects of new residential, commercial, and industrial construction. They develop an understanding of how architectural styles have evolved and discover the effect that this has on our behaviour and development. Students experience the process of architectural design and learn how to create a better living environment. They develop skills in design process, problem-solving, drawing, model building, and fabrication using a variety of materials. A significant emphasis is placed on environmentally responsible design and wise use of materials. Students are introduced to a wide range of careers related to construction and design including engineering, urban planning, and architecture.

Unit Overview Chart

Activity	Time	Learning Expectations	Assessment Categories	Focus/Tasks
3.1 Investigating new materials and construction techniques	5 hours	TFV.03, TFV.05, TF2.01, TF2.02, TF2.03, TF2.04, SP1.03, SP2.08, SP2.09, SP2.10, SP2.12, SP2.13, IC1.01, IC1.03 CGE 2b, 2c, 2e, 3c	Knowledge/ Understanding Thinking/ Inquiry Communication	Research traditional, current, and emerging building materials and techniques, and experiment with applications in sketch form
3.2 Designing a new building	10 hours	TFV.01, TFV.02, TF1.01, TF1.02, TF2.06, SPV.01, SPV.02, SPV.04, SP1.01, SP1.02, ICV.02, IC1.05 CGE 2b, 3b, 4e	Knowledge/ Understanding Thinking/ Inquiry Communication Application	Identify an area of interest in the built environment Research, experiment, and sketch Develop innovative, environmentally responsible designs for use in this area of the built environment
3.3 Creating presentation drawings	10 hours	TFV.02, SPV.02, SP1.04, SP1.05, ICV.02, IC3.01 CGE5a, 5b, 5c, 7b	Application Communication Thinking/ Inquiry	Using sketches and CAD, students create scaled drawings of their structures
3.4 Fabricating a scale model	12 hours	TF2.01, TF2.03, TF2.04, SP2.11, SP3.01, IC2.02 CGE2b, 7i, 7j	Knowledge/ Understanding Application Communication	Using appropriate materials and techniques, students create scale models of their design concepts
3.5 Presentation and Critique	3 hours	TFV.03, TF1.01, SP1.06, SP2.12, ICV.01, ICV.02, IC1.01 CGE 4f, 5a, 5e, 5f, 7a	Thinking/ Inquiry Communication	Students present their design solutions and review and critique the designs of others

Teaching/Learning Strategies

Teaching/learning strategies include the following:

Brainstorming through group generation of initial ideas expressed without criticism or analysis;

Collaborative/Cooperative in small group learning providing high levels of student engagement and interdependence;

Conferencing through student-to-student and student/teacher discussion;

Design Process is applied in a problem-solving approach using a prescribed series of steps;

Inquiry is conducted through a problem-solving approach using prescribed processes involving a number of steps (e.g., SPICE model) Independent Study through an exploration and research of a topic interesting to students;

Construction activities in the development of products and services;

Report/Presentation using a variety of media both orally and in writing of the researched topics to the class;

Use of daily contact with the student to ensure they remain on task, and provide positive, and constructive feedback, or judgment, as required.

Assessment & Evaluation of Student Achievement

Students are assessed using the following strategies:

Diagnostic: occurs at the beginning of a term, a unit of study, or whenever information about prior learning is useful;

Formative: during learning; gives ongoing feedback to the student about the quality of learning and the effectiveness of instruction;

Summative: usually carried out at the end of a learning process and used for determining a grade.

Personal Communication

- journals/conferencing logs
- self-assessment
- student/teacher conferencing
- presentation

Paper-and-Pencil Tests

- unit tests/exams

Performance

- product research report
- construction projects (how they meet design expectations) drawing and sketching
- essay
- journal
- learning logs

Assessment Tools

- checklists
- marking schemes (e.g., tests, written assignments, presentations)
- rubrics
- anecdotal comments with suggestions for improvement

Seventy per cent of the grade is based on assessments and evaluations conducted throughout the course. Thirty per cent of the grade is based on a final evaluation in the form of an examination, performance, essay, and/or other method of evaluation.

Accommodations

The nature of these units and their activities allows for a wide range of course delivery methods. Accommodations are made to cover the needs of students identified with exceptionalities. Teachers should consult individual student's IEPs about required accommodations. Some accommodations that could be used are:

- Written, audio, and video taped materials in the form of notes, or samples of completed work, sketches, drawings
- Facilities for physically handicapped students (e.g., ramps, lowered tables, special tools, and protective wear) to provide an environment that is supportive both in academic content and physical set-up
- Large print texts, large screen monitors, and other adaptive devices that are appropriate
- Peer tutor;
- Word lists and definitions for students with special needs
- Alternative devices for note taking such as tape recorders, buddy or scribe
- Student demonstration of understanding using a variety of media (oral, audio, video etc.)
- Opportunities to explore a self-directed topic in depth
- Interaction with a mentor, where applicable

Information received from student's IEP must use student's strength to build understanding and confidence through adaptation of the activity and teaching/learning strategies.

Resources

Units in this Course Profile make reference to the use of specific texts, magazines, films, videos, and websites. Teachers need to consult their board policies regarding use of any copyrighted materials. Before reproducing materials for student use from printed publications, teachers need to ensure that their board has a Cancopy licence and that this licence covers the resources they wish to use. Before screening videos/films with their students, teachers need to ensure that their board/school has obtained the appropriate public performance videocassette licence from an authorized distributor, e.g., Audio Cine Films Inc. Teachers are reminded that much of the material on the Internet is protected by copyright. The copyright is usually owned by the person or organization that created the work. Reproduction of any work or substantial part of any work on the Internet is not allowed without the permission of the owner.

Print

Canadian Electrical Code. Rexdale, Ontario: Canadian Standards Association.

Canadian Home Workshop, Volumes 1–22. Markham, Ontario: Camar Publications. ISSN 1485-8509 – http://www.canadianhomeworkshop.com (1-905-475-8440)

Cantanese, A. J. and J.C. Snyder. *Introduction to Urban Planning*. Toronto: McGraw Hill, 1979. ISBN 0070102287

Clidero, Robert K. and Kenneth H. Sharpe. *Applications of Electrical Construction*. Don Mills, Ontario: General Publishing, 1979. ISBN 0-7725-1719-3

Expanding Your Horizons. McGraw-Hill Ryerson Limited, 1993. ISBN 0-07-551392-7

Hire Expectations – Employment Strategies for Canada's Youth. Canadian Federation of Independent Business, 1998. ISBN 0-9693268-4-X

The Home Depot. *Kitchen and Bath 1-2-3*. Des Moines, Iowa: Meredith Books, 1999.

The Home Depot. *Outdoor Projects 1-2-3*. Des Moines, Iowa: Meredith Books, 1998.

Hosie, R.C. *Native Trees of Canada*. Canada: Fitzhenry and Whiteside Ltd., 1979. ISBN 0-88-902-572-X

Kirchner, Harold B. *Wiring Installation and Maintenance*. Toronto: McGraw-Hill Ryerson, 1978. ISBN 0070828296

Kirklighter, Clois E. *Modern Masonry Brick, Block, Stone*. South Holland, Illinois: The Goodheart-Willcox Company, 1985.

Landers, Jack M. *Home Repair and Maintenance*. Tinley Park II: Goodheart-Willcox 1991. ISBN 0-87006-820-2

Lieper, Michael, Herve De Jordy, and Michael Schultz. *The Entrepreneurial Spirit*. Toronto: McGraw Hill Ryerson, 1991. ISBN 0-07-549931-2

Long, Frank J. *Intermediate Electricity*, 3rd ed. Toronto: General Publishing, 1985. ISBN 0773650296

Massey, Howard C. *Plumbers Handbook*, 2nd ed. Carlsbad, California: Craftsman Book Company, 1985. ISBN 091046093

Ontario Hydro Electrical Safety Code. Toronto, Ontario.

Ontario Job Futures and the Ontario Ministry of Training, Colleges and Universities. ISBN 0-7778-8799-1

Ontario Plumbing Code.

Plywood Handbook, Revised. Vancouver, British Columbia: Council of Forest Industries of British Columbia, 1980.

Stirling, Norman. *Fundamentals of Technical Drawing*. Canada: Gage Educational Publishing, 1984. ISBN 0-7715-0327x

Tech Prep Career Programs – A Practical Guide to Preparing Students for High-Tech, High-Skill, High-Wage Opportunities. Thousand Oaks, California: Corwin Press Inc., 1997. ISBN 0-8039-6510-9

Transitions – A Practical Guide to the Workplace. Canada: Collier MacMillan, Inc., 1989.

Wood, Robert W. *All Thumbs Guide to Home Plumbing*. Blue Ridge Summit, Pennsylvania: Tab Books, 1992. ISBN 0830625461

Fine Woodworking, Numbers 1–139. Newtown, Connecticut: The Taunton Press. ISSN 0361-3453 (1-800-477-8727)

Canadian Home Workshop, Volumes 1–22. Markham, Ontario: Camar Publications. ISSN 1485-8509

Websites

The URLs for the websites have been verified by the writer prior to publication. Given the frequency with which these designations change, teachers should always verify the websites prior to assigning them for student use.

– http://www.edu.gov.on.ca/eng/general/list/college.html, all colleges of technology in Ontario

– www.utoronto.cawww.ryerson.ca, and other university websites for careers and programs in Applied Science, Engineering, Landscape Architecture, Architecture, Urban Planning

– http://www.lafarge.ca La Farge Construction Materials, Technical Services Group, 7880 Keele St., Concord, Ontario, L4K 4G7. 1-800-523-2743

– http://www.scc.ca Publications of the Standards Council of Canada. Rexdale, Ontario.

– http://www.finehomebuilding.com Fine Homebuilding. Numbers 1-126. Newtown, Connecticut

– http://www.augusthome.com Shopnotes. Numbers 1-48. Des Moines, Iowa: August Home Publishing Company. ISSN 1062-9696, (Tel: 1-800-333-5854)

Video Resources

– www.icbo.org/gateway; this is a construction and safety video tape dealer

– www.ibhs.org; a resource for construction videotapes on loan

– www.fso.icbo.org/gateway/250x97.html–this is a resource for American Construction Training Series

Community Resources

Co-op placements, job shadows, speakers, local businesses, Municipal, Provincial and Federal Government Agencies, local clubs (gardening and landscape), Royal Botanical Gardens (Burlington), Public and University Libraries, School Libraries

Human Resources and Development Canada

Local Municipal Offices

Province of Ontario

Ministry of Municipal Affairs and Housing. *Ontario Building Code* (1997). Housing Development and Buildings Branch, 777 Bay Street, 2nd Floor, Toronto, Ontario, M5G 2E5

Local museums and historic societies

OSS Considerations

To prepare students effectively for the challenges that await them, Ontario's schools should offer an education program that promotes a high standard of achievement, that provides all students with the learning opportunities and support they need, and that is relevant to society's needs and expectations Today's technology programs challenge students to develop an understanding of the effects of technology on individuals and society.

Technological Education programs offer students an exciting and challenging opportunity to investigate areas of interest in postsecondary education.

Students work with computers and computer software that encourages and improves their ability to research, analyse, and present information. The course design allows for research into future employment opportunities, practical work experience, and taking responsibility for one's own decisions. The ability to understand a design problem, analyse its different aspects, work within a group or individually to brainstorm solutions, and then apply the correct answer to the problem, are skills that will be further tested in postsecondary education. Understanding their environment and protecting it for the next generations, is not an easy task and it is one these students will be asked to take up.

Technology courses have the ability to accommodate students of all abilities. The following Ontario Ministry of Education curriculum policy documents must be used in the development of technological education courses:

Ontario Secondary Schools, Grades 9 to 12, Program and Diploma Requirements, 1999.
Technological Education, Grades 11 and 12, 2000.

Through a wide range of teaching/learning strategies and accommodations, this course meets the needs of all students. The accommodations for exceptional students includes specialized support and assessments to facilitate individualized learning. Students of linguistic diversity are also accommodated through peer or individual help.

The career portion of this course allows students to learn about their interests, strengths, and aspirations. The activities allow students to research a variety of career opportunities and to learn to make appropriate educational choices as they relate to their high school courses, postsecondary requirements, and workplace options. Career exploration is made available to students with specific reference to Choices into Action: Guidance and Career Education Program Policy for Elementary and Secondary Schools, 1999.

Coded Expectations, Construction Technology, Grade 12, College Preparation, TCJ4C

Theory and Foundation

Overall Expectations

TFV.01 · apply the design process to develop solutions, products, processes, or services in response to complex challenges or problems in construction technology;

TFV.02 · explain advanced techniques, including computer applications, used to visualize, analyse, describe, and present designs of, and to construct, buildings and other structures (e.g., presentation and working drawings);

TFV.03 · describe the properties of natural and manufactured building materials, processes, and finishes;

TFV.04 · identify the building codes, regulations, and standards governing construction projects;

TFV.05 · describe appropriate building construction techniques; construction systems (electrical, mechanical, structural); and the building materials, tools, and equipment used in the construction industry.

Specific Expectations

The Design Process

TF1.01 – explain how a human need or want can be met through a new or improved product;

TF1.02 – apply the following steps of the design process to solve a variety of construction technology challenges or problems:

- identify what has to be accomplished (the problem);
- gather and record information, and establish a plan of procedures;
- brainstorm a list of as many solutions as possible;
- identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
- evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
- produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
- evaluate the prototype and determine the resources, including computer applications, required to produce it;
- communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
- obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution.

Building Materials and Methods

TF2.01 – describe the properties (physical, mechanical, structural, and thermal) of natural and manufactured building materials;

TF2.02 – describe the processes used to manufacture and prepare a variety of products (e.g., concrete and masonry, steel and metal products, gypsum, glass, plastics) used in the construction industry;

TF2.03 – describe the materials, and methods of applying them, used in various construction components (e.g., footings, foundations, floors, walls, roofs, windows, doors, millwork, interior and exterior finishes, hardware);

TF2.04 – identify a variety of building materials, construction techniques, architectural styles and details, and engineering features used in different construction projects;
TF2.05 – identify the insulation value of a variety of building materials;
TF2.06 – identify and explain the building codes, regulations, and standards applicable to construction projects.

Electrical, Mechanical, and Structural Systems
TF3.01 – describe the operating principles of basic electrical, plumbing, heating, ventilation, and air-conditioning systems used in construction projects;
TF3.02 – use the terminology, symbols, industry standards, codes, regulations, and conventions related to the electrical, mechanical, and structural systems of a construction project;
TF3.03 – describe the types of loads and structural support members for footings, foundations, floors, walls, roofs, framing systems, bearing walls, columns, beams, lintels, and other parts of construction systems;
TF3.04 – describe the loads and the weight of materials, forces, and stresses for a variety of construction projects.

Skills and Processes

Overall Expectations
SPV.01 · demonstrate an understanding of design process skills by applying them to a variety of construction projects;
SPV.02 · interpret technical data, building codes, regulations, standards, specifications, and other construction resources;
SPV.03 · describe advanced residential and heavy construction systems, and demonstrate the appropriate technical skills for using the tools, equipment, and materials required to build the various components of a construction project;
SPV.04 · demonstrate the mathematical skills required to calculate the estimated cost of a construction project and the heat loss or gain for the project;
SPV.05 · describe a construction company's personnel, documents, and management structure.

Specific Expectations
Design, Planning, and Communication Skills
SP1.01 – design (using effective brainstorming techniques), plan, and implement the best solutions for a variety of construction projects;
SP1.02 – apply design principles to, and identify good planning characteristics of, construction projects;
SP1.03 – research, document, and use resources applicable to construction projects such as technical data, charts, tables (e.g., on the strength, properties, and insulation values of materials), reports, zoning by-laws, and building codes, regulations, and standards;
SP1.04 – produce appropriate presentation and working drawings (including perspectives, floor plans, elevations, sections, and details), using traditional and computer-assisted methods, to meet client needs for a variety of construction projects;
SP1.05 – produce working drawings that accurately replicate the architectural features of a building;
SP1.06 – evaluate construction projects in relation to predetermined specifications;
SP1.07 – establish work schedules for a construction project;
SP1.08 – describe the electrical and mechanical system needs for construction projects, taking into consideration client needs and industry codes, regulations, and standards;

SP1.09 – design, and install when possible, the mechanical systems of a building project (including the electrical, plumbing, heating, ventilation, and air-conditioning systems) in accordance with building codes, regulations, and standards.

Building and Materials Application Skills

SP2.01 – evaluate commercial property with respect to important design considerations (e.g., location according to type and use of building, services, zoning restrictions, and building codes, regulations, and standards);

SP2.02 – identify the major considerations related to the footings for a construction project;

SP2.03 – identify the features included in a foundation plan for a construction project;

SP2.04 – describe the components of a floor structure and estimate the quantities of materials required;

SP2.05 – identify structural elements of various construction projects or systems and explain the methods of construction and their advantages and disadvantages (e.g., wood structure using post and beam construction vs. traditional framing; steel frame structure vs. reinforced and precast concrete and masonry structures);

SP2.06 – explain the mechanical systems used in a construction project;

SP2.07 – describe various systems that allow movement within industrial, commercial, and public buildings (e.g., elevators, stairs, ramps, escalators);

SP2.08 – compare a variety of types of windows and doors used in construction projects;

SP2.09 – compare different construction techniques, building materials, and finishes used in construction projects;

SP2.10 – identify new building materials, tools, equipment, and techniques used in the construction industry;

SP2.11 – complete a construction project using a variety of tools and equipment for calculating and laying out;

SP2.12 – explain the reasons for selecting the structure and materials for a particular project;

SP2.13 – calculate the correct sizes of the structural members (e.g., footings, floors, walls, roofs, beams, columns) required for a construction project.

Estimates, Specifications, and Management Skills

SP3.01 – prepare a materials list for a construction project;

SP3.02 – describe the units of measurement applicable to a variety of building products and materials used for complex construction projects;

SP3.03 – prepare a detailed, accurate estimate of the quantities of materials and costs of a building project, using conventional and computer-aided resources, charts, tables, technical data, and working drawings;

SP3.04 – calculate correctly heat gain, loss, or transfer and system capabilities in the design of heating, ventilating, and air-conditioning systems;

SP3.05 – describe a variety of types and sources of heating, cooling, and electrical systems;

SP3.06 – describe the organization, documents (e.g., work schedules, estimates), and management of a small construction company;

SP3.07 – identify and describe the roles of a variety of personnel involved in the construction industry (e.g., architects, engineers, lawyers, accountants, journey people, technicians, technologists, labourers);

SP3.08 – prepare documentation of all aspects of a construction project, including the process followed to obtain approval for a building permit and legal and contractual agreements with owners, architects, and subtrades.

Impact and Consequences

Overall Expectations

ICV.01 · explain the impact of the construction industry on the economy, on society, and on the environment;
ICV.02 · evaluate construction projects in terms of efficiency and needs;
ICV.03 · apply health and safety legislation; general shop and site safety rules; and rules specific to the safe use of materials, tools, and equipment;
ICV.04 · identify careers in construction technology and the skills, education, and training each requires.

Specific Expectations

Economic, Social, and Environmental Impacts

IC1.01 – describe natural and manufactured construction materials and the short- and long-term impact of their use on the environment;
IC1.02 – describe the economic and social impact of the activities of the construction industry;
IC1.03 – describe a number of ways of reducing negative environmental and social impacts through the choice of particular energy sources (e.g., alternative forms of heating such as the use of solar energy or heat pumps), materials, or products for construction projects;
IC1.04 – explain modifications to a building project that would improve its quality and value;
IC1.05 – identify factors to consider in community planning (e.g., population density, ecological and environmental factors).

Health and Safety

IC2.01 – identify hazards related to the materials, processes, and equipment used in a construction work environment;
IC2.02 – demonstrate safe shop practices when using hand and power tools, materials, and equipment;
IC2.03 – describe the basic health and safety needs of workers on construction sites;
IC2.04 – explain the need for, and apply where appropriate, health and safety laws and regulations;
IC2.05 – identify safety codes, regulations, and standards applicable to construction projects and the workplace;
IC2.06 – explain health and safety legislation and practices related to the construction industry such as the Workplace Hazardous Materials Information System (WHMIS), the Worker's Compensation Act, the Ontario Building Code, and local by-laws;
IC2.07 – handle hazardous materials in accordance with the Workplace Hazardous Materials Information Systems (WHMIS) guidelines.

Education, Training, and Career Opportunities

IC3.01 – identify career opportunities in a variety of sectors of the construction industry;
IC3.02 – describe the education and training required for employment in construction-related careers;
IC3.03 – identify postsecondary programs in construction technology and their admission requirements;
IC3.04 – explain the importance of lifelong learning for someone choosing a career in the construction field.

Ontario Catholic School Graduate Expectations

The graduate is expected to be:

A Discerning Believer Formed in the Catholic Faith Community who

CGE1a -illustrates a basic understanding of the **saving story** of our Christian faith;
CGE1b -participates in the **sacramental life** of the church and demonstrates an understanding of the centrality of the Eucharist to our Catholic story;
CGE1c -actively reflects on **God's Word** as communicated through the Hebrew and Christian scriptures;
CGE1d -develops attitudes and values founded on Catholic **social teaching** and acts to promote social responsibility, human solidarity and the common good;
CGE1e -speaks the **language of life**... "recognizing that life is an unearned gift and that a person entrusted with life does not own it but that one is called to protect and cherish it." (Witnesses to Faith)
CGE1f -seeks intimacy with God and celebrates **communion** with God, others and creation through prayer and worship;
CGE1g -understands that one's purpose or **call in life** comes from God and strives to discern and live out this call throughout life's journey;
CGE1h -respects the **faith traditions**, world religions and the life-journeys **of all people of good will**;
CGE1i -integrates faith with life;
CGE1j -recognizes that "sin, human weakness, conflict and forgiveness are part of the human journey" and that the cross, the ultimate sign of forgiveness is at the heart of **redemption**. (Witnesses to Faith)

An Effective Communicator who
CGE2a -listens actively and critically to understand and learn in light of gospel values;
CGE2b -reads, understands and uses written materials effectively;
CGE2c -presents information and ideas clearly and honestly and with sensitivity to others;
CGE2d -writes and speaks fluently one or both of Canada's official languages;
CGE2e -uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life.

A Reflective and Creative Thinker who
CGE3a -recognizes there is more grace in our world than sin and that hope is essential in facing all challenges;
CGE3b -creates, adapts, evaluates new ideas in light of the common good;
CGE3c -thinks reflectively and creatively to evaluate situations and solve problems;
CGE3d -makes decisions in light of gospel values with an informed moral conscience;
CGE3e -adopts a holistic approach to life by integrating learning from various subject areas and experience;
CGE3f -examines, evaluates and applies knowledge of interdependent systems (physical, political, ethical, socio-economic and ecological) for the development of a just and compassionate society.

A Self-Directed, Responsible, Life Long Learner who

CGE4a -demonstrates a confident and positive sense of self and respect for the dignity and welfare of others;
CGE4b -demonstrates flexibility and adaptability;
CGE4c -takes initiative and demonstrates Christian leadership;
CGE4d -responds to, manages and constructively influences change in a discerning manner;
CGE4e -sets appropriate goals and priorities in school, work and personal life;
CGE4f -applies effective communication, decision-making, problem-solving, time and resource management skills;
CGE4g -examines and reflects on one's personal values, abilities and aspirations influencing life's choices and opportunities;
CGE4h -participates in leisure and fitness activities for a balanced and healthy lifestyle.

A Collaborative Contributor who

CGE5a -works effectively as an interdependent team member;
CGE5b -thinks critically about the meaning and purpose of work;
CGE5c -develops one's God-given potential and makes a meaningful contribution to society;
CGE5d -finds meaning, dignity, fulfillment and vocation in work which contributes to the common good;
CGE5e -respects the rights, responsibilities and contributions of self and others;
CGE5f -exercises Christian leadership in the achievement of individual and group goals;
CGE5g -achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others;
CGE5h -applies skills for employability, self-employment and entrepreneurship relative to Christian vocation.

A Caring Family Member who

CGE6a -relates to family members in a loving, compassionate and respectful manner;
CGE6b -recognizes human intimacy and sexuality as God given gifts, to be used as the creator intended;
CGE6c -values and honours the important role of the family in society;
CGE6d -values and nurtures opportunities for family prayer;
CGE6e -ministers to the family, school, parish, and wider community through service.

A Responsible Citizen who

CGE7a -acts morally and legally as a person formed in Catholic traditions;
CGE7b -accepts accountability for one's own actions;
CGE7c -seeks and grants forgiveness;
CGE7d -promotes the sacredness of life;
CGE7e -witnesses Catholic social teaching by promoting equality, democracy, and solidarity for a just, peaceful and compassionate society;
CGE7f -respects and affirms the diversity and interdependence of the world's peoples and cultures;
CGE7g -respects and understands the history, cultural heritage and pluralism of today's contemporary society;
CGE7h -exercises the rights and responsibilities of Canadian citizenship;
CGE7i -respects the environment and uses resources wisely;
CGE7j -contributes to the common good.

Unit 1: Skill Building

Time: 30 hours

Description

This unit focuses on developing the necessary skills students require for postsecondary education and careers in construction. Students explore and further develop their skills in computer applications, surveying, drafting, computer-aided drafting (*AutoCAD*), and cost estimating.

Students explore ethics and employability, potential careers and business opportunities, and available college programs that relate to the construction industry. Preparation for admission to college and university programs is particularly emphasized so that students are prepared to enter programs such as, Urban Planning, Engineering, Architecture, Landscape Architecture, Surveying, Environmental Management, Construction Engineering Technology, and Construction Estimating.

Unit Synopsis Chart

Activity	Time	Learning Expectations	Assessment Categories	Tasks
1.1 Drafting and Computer Aided Drafting (*AutoCAD*)	15 hours	TFV.02, TF3.02, SP1.04, SP1.05 CGE 2b, 2c, 3b, 3c, 3f, 5b	Knowledge/ Understanding Application	Students practise drafting and computer drafting skills, manually and through *AutoCAD*
1.2 Construction Materials and Environmental Impact	5 hours	TFV.03, TF2.02, TF2.04, TF2.05, SP1.03, SP2.08, SP2.10, IC1.01 CGE 2b, 2c, 3b, 3e, 4d, 5b, 7i	Knowledge/ Understanding Thinking/Inquiry Application	Students evaluate different material selections with respect to their overall environmental impact and develop strategies for evaluating new materials
1.3 Cost Estimating and Project Management	5 hours	SPV.02, SPV.04, SPV.05, SP1.03, SP1.07, SP3.01, SP3.02, SP3.03, SP3.05, SP3.06 CGE 2b, 3c, 3e, 3f, 4f	Application	Students learn to organize the timing and sequence of a construction project and to estimate materials and labour costs
1.4 Ethics and Employability	5 hours	SPV.05, SP1.03, SP3.07, ICV.01, ICV.02, ICV.04, IC3.01, IC3.02, IC3.03, IC3.04 CGE 1i, 2b, 2c, 3e, 3f, 5b, 5c, 5g, 7b, 7i	Communication	Students develop strategies for evaluating college/university programs and for developing résumés and cover letters for prospective employers

Activity 1: Skill Building - Drafting and Computer-Aided Drafting and Illustration

Time: 15 hours

Description

Drafting and computer-aided drafting and design are integral to the construction industry today. This unit focuses on developing skills in computer drafting applications that students will need for postsecondary education and for careers in the construction industry. Students should be able to visualize their designs and create to scale presentation drawings of their ideas. Students further develop their skills in computer design software and computer-generated imagery by creating professional quality computer-generated plans and illustrations. Students also develop skills in sketching, drawing, and hand rendering site plans, architectural plans, and illustrations.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

CGE2b - read, understand and use written materials effectively;
CGE2c - present information and ideas clearly and honestly and with sensitivity to others;
CGE3b - create, adapt, and evaluate new ideas in light of the common good;
CGE3c - think reflectively and creatively to evaluate situations and solve problems;
CGE3f - examine, evaluate and apply knowledge of interdependent systems for the development of a just and compassionate society;
CGE5b - think critically about the meaning and purpose of work.

Strand(s): Theory and Foundation, Skills and Practices

Overall Expectations

TFV.02 - explain advanced techniques, including computer applications, used to visualize, analyse, describe, and present designs of, and to construct, buildings and other structures (e.g., presentation and working drawings).

Specific Expectations

TF3.02 - use the terminology, symbols, industry standards, codes, regulation, and conventions related to the electrical, mechanical, and structural systems of a construction project;
SP1.04 - produce appropriate presentation and working drawings (including perspectives, floor plans, elevations, sections, and details), using traditional and computer assisted methods, to meet client needs for a variety of construction projects;
SP1.05 - produce working drawings that accurately replicate the architectural features of a building.

Prior Knowledge & Skills

- working knowledge of scale, sketching, and drafting techniques
- mastery of some manual drafting techniques and possibly some aspects of computer-drafting programs in previous activities and in Grade 10 or 11
- mastery of the basic drawing setup, line draw, erase, grid, snap, zoom, text, offset, copy, and move commands
- mastery of basic drawing setup, border, and title block information

Planning Notes

- Arrange for a computer facility with *AutoCAD2000LT* or better. Teachers may choose to do this activity over the course of the semester, in conjunction with other units (particularly Unit 2: Restoration), or concentrate solely on the skill building activity (recommended for teachers who have not used *AutoCAD* previously). Ideally, it is recommended that teachers incorporate the computer drafting with an ongoing project so that students see first hand how generated plans are used.
- Provide *AutoCAD*, quick reference sheets for techniques, symbols, etc. used on site plans and illustrations.
- Teachers should provide scale rulers (triangle scales with metric and imperial measurements) for checking measurements.

Teaching/Learning Strategies

1. **Whole group – as a stand alone unit**
   - Discuss the importance of understanding computer-drafted plans and illustrations.
   - Share samples of professional site plans, working drawings, engineering drawings and artist renderings that have been completed using computer software programs (Local newspapers may have a new home section; if not, national newspapers carry new home news and plans, construction information, and drawings). Emphasize that computer-aided drafting simulates manual drafting just as word processing simulates hand writing.

   Individual or Small group – 2 students
   - Begin with exercises such as setting up pages and scales for drawings (this may be done in pairs).
   - Produce final rough plans and sketches using computer software.
   - Produce an overall site plan for an existing site.
   - Produce a floor plan from a sample supplied by the teacher.
   - Produce an elevation from a sample supplied by the teacher.
2. **Whole group – as part of an ongoing unit**
   - Where students have experience using *AutoCAD* software, begin with appropriate scale selection and page set up (refer to Unit 2: Restoration for information about project specifications).
   - Provide reference sheets and manuals on software.
   - Allow students to rough out work that will be drafted on computer to gather details for final drawings.

   Teachers will:
   Whole group
   - recommend a variety of appropriate scales for the final plan for ease of printing and to provide a sufficient amount of detail for the overall plan;
   - help students develop a strategy to start, save, and evaluate their computer-generated drawings;
   - focus student attention on design details and drawing conventions.

Assessment & Evaluation of Student Achievement

- Student plans and presentation drawings are assessed individually (Appendix 1.1.1).
- Accuracy of computer-generated draft plans is assessed.
- Students should demonstrate knowledge and understanding of how working drawings relate to model building and construction documents.

Accommodations

- Provide tilt top or raised desks and work areas to accommodate wheelchair access where applicable.
- Provide opportunities for enrichment (using symbols, creating quick-time movies using plans and drawings, and computer rendering plans and elevations).
- Enrichment opportunities may include creating a multi-media presentation of the design.

Resources

Middlebrook, M. and B. Smith. *AutoCAD 2000 for Dummies*. IDG Books Worldwide Inc., 1999. ISBN 0-7645-0558-0

Omura, G. *AutoCAD 2000, Instant Reference*. Sybex Inc., 1999. ISBN 0-7821-2497-6

Stirling, N. *Fundamentals of Technical Drawing*. Gage Educational Publishing, 1984. ISBN 0-7715-0327x

Gill, R.W. *Rendering with Pen and Ink*. London: Thames and Hudson Ltd., 1973. ISBN 0-500-68003-5

Sufley, T. *AutoCAD Lt: Fundamentals and Applications*. Illinois: The Goodheart-Willcox Co. Inc., 1997. ISBN 1-56637-322-0

Tait, D.M. and J.D. Vredevoogd. *Using AutoCAD in Your Job,* (2001).

Tutt, P. and D. Adler. *New Metric Handbook, Planning and Design Data*. Oxford: Butterworth Heinemann, 1979. ISBN 0-7506-0853-6

Local newspapers are an excellent source of new home plans and designs

New home building magazines offer a variety of floor plans to provide a basis for drafting

Murray State University provides a photo gallery of CAD generated illustrations at – www.cadinstitute.com

AutoDesk provides information about computer aided drafting and design programs – www3.autodesk.com

Excellent source of information on buildings, architecture at the University of Toronto – http://www.clr.toronto.edu/VIRTUALLIB/arch

– www.cad.msu.edu/ – courses offers student work gallery

Appendix 1.1.1

AutoCAD Drawing Checklist

Title Block

_____ includes drawing name
_____ includes date
_____ includes drawn by
_____ includes scale
_____ includes drawing border

Drawing Conventions

_____ lines are offset (not copied) accurately
_____ line types are appropriate to layer and drawing
_____ layers are used appropriately
_____ hatch lines are appropriate to material type (e.g., concrete)

Drawing Accuracy

_____ dimensions are accurate and have not been manually corrected
_____ dimensions are used appropriately (radius, centreline)
_____ scale is correct and suitable for the detail of the drawing
_____ lines intersect
_____ OSNAP is used to increase accuracy (snap to: midpoint, endpoint, intersection, centre, perpendicular)

Drawing Information

_____ text style and height are appropriate for drawing
_____ all symbols are accurate (electrical, centreline, etc.)

Activity 2: Construction Materials and Environmental Impact

Time: 5 hours

Description

This activity is designed to emphasize sustainable and responsible development. Although this activity has been referred to throughout the construction profiles in Grade 11, students need to understand the impact that materials, old and new, have on the environment and their community. Students gather information about a specific product and its development and use over the years by researching local papers, libraries, Internet, and magazine articles on current and future construction trends related to the construction industry and environmental is studied. This time of research and gathering of information allows the students to demonstrate their Catholic values when presenting to the class. Students present their findings in a report presentation using presentation software. The sharing of ideas allow the students to gain exposure to ideas and information that other students have researched and feel are relevant to the local and world communities' welfare.

Overuse and exhaustion of natural resources (e.g., wood) and their replacement with composite materials (plywood, particle board, etc.), insulation materials, thermal properties of different types of glass, glass over steel or wood, and the disposal of construction materials are explored. Specific topics should include the selection of environmentally appropriate materials, energy efficiency, water efficiency, and the development of new products.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

CGE2b - read, understand and use written materials effectively;
CGE2c - present information and ideas clearly and honestly and with sensitivity to others;
CGE3b - create, adapt, and evaluate new ideas in light of the common good;
CGE3e - adopt a holistic approach to life by integrating learning from various subject areas;
CGE4d - respond to, manage and constructively influence change in a discerning manner;
CGE5b - think critically about the meaning and purpose of work;
CGE5c - develop ones' God given potential and makes a meaningful contribution to society;
CGE7i - respect the environment and uses resources effectively.

Strand(s): Theory and Foundation, Skills and Practices, Impact and Consequences

Overall Expectations

TFV.03 - describe the properties of natural and manufactured building materials, processes, and finishes.

Specific Expectations

TF2.02 - describe the properties (physical, mechanical, structural, and thermal) of natural and manufactured building materials;
TF2.04 - identify a variety of building materials, construction techniques, architectural styles and details, and engineering featuring used in different construction projects;
TF2.05 - identify insulation value of a variety of building materials;
SP1.03 - research, document and use resources applicable to construction projects such as technical data, charts, tables (e.g., on the strength, properties, and insulation values of materials), reports, zoning by-law, and building codes, regulations and standards;
SP2.05 - identify structural elements of various construction projects or systems and explain the methods of construction and their advantages and disadvantages (e.g., wood structure using post and beam construction vs. traditional framing; steel frame structure vs. reinforced and pre-cast concrete and masonry structures);
SP2.08 - compare a variety of types of windows and doors used in construction projects;

SP2.10 - identify new building materials, tools, equipment and techniques used in the construction industry;
IC1.01 - describe natural and manufactured construction materials and the short and long term impact of their use on the environment;
IC1.03 - describe a number of ways of reducing negative environmental and social impacts through the choice of particular energy sources (e.g., alternative forms of heating such as the use of solar energy or heat pumps), materials or products for construction projects.

Planning Notes

- The intent of this unit is to expose students to a broad range of construction-related issues. Products and their composition, use, depletion, thermal properties, and environmental concerns are explored by individual students and then shared with the entire class so that all expectations may be met.
- Students should be aware of product development and the use of "green" measures when renovating or creating new structures. It is important that they have a fundamental understanding of their role as stewards of the environment.
- Teachers should allow students to present their research in a variety of ways allowing for further development of computer skills, audio-visual skills, or public speaking skills. Students may create a computer slide presentation, a short video, or a visual display which illustrates research, product information and the evolution and environmental impact of the use or overuse of the product and concludes with future changes which may occur.
- Teachers should prepare presentations that are computer generated so that students develop further skills using computers for drafting, cost estimating, and presentations.
- The student's presentation of material usage versus costs, etc can be used as an opportunity to discuss ethical purchases where the common good is placed ahead of the financial benefit.

Prior Knowledge & Skills

- familiarity with product changes and environmental impact of materials from previous units or in Grade 10 and 11 (see Planning Notes for additional help)
- communication skills (written, verbal, and computer-generated)

Teaching/Learning Strategies

1. **Whole group**
    - Discuss the use of common building materials that are used today. Discuss why wood (one of the only natural building materials) has not been replaced by man-made construction materials.
    - Discuss how materials have evolved both from a construction need point of view (cost, strength, availability) to an environmental impact (clear cutting trees, depletion of ozone, pollution) point of view.
    - Research the different types of products that are used in construction projects, narrowing down searches to specific products that are used heavily in construction today (e.g., wood, glass, aluminium, steel, concrete, insulation materials).
    - Reference Appendix 1.2.1 as checklists, if necessary.

2. **Individual**
   - Begin with research narrowing down topic choices (this may be done in pairs).
   - Choose one material, construction technique, or product to investigate.
   - Create a presentation showing the composition of the materials they might use on a project: weigh the relative cost compared to other products available; the history and use of the materials; the progression of man made materials from past to present; the use and overuse of the materials and its possible consequences, and a conclusion which outlines how the materials may change in the future.
   - Presentations must cover the overall environmental issues surrounding the use or overuse of the material, the history of the material chosen, the current use and future use or modification of the material, environmental concerns, and a conclusion which reflects on the suitability of the material from a "green" point of view or suggestions of how to make other materials more usable (affordable, easier to get, etc.).

   Teachers will:

   Whole group
   - recommend a variety of topics that are interesting and have significant environmental or social impact
   - share samples of the progression of the use of materials over time, e.g., insulation materials;
   - reinforce the idea of recycling, re-using and regenerating materials (discuss the recycling of rubber tires into products used in construction), reducing material waste (exact measurements allow fewer errors when cutting and using wood products), or re-planting disturbed natural areas when building developments (the need for regenerating the natural environment), as well as the depletion of natural materials and the advent of recycled or "high" tech materials;
   - discuss a variety of building materials used in different construction projects, why they were used, the potential long term problems or environmental effects that these products may cause;
   - discuss the insulation value of a variety of building materials and the evolution of insulation materials, their positive and negative impact on the structure and on the environment;
   - discuss the importance of sharing information on a broad range of topics so that students have an opportunity to learn about many aspects of the construction industry and heighten their awareness of the issues surrounding building material choices;
   - promote discussion on the ethical selection of materials versus cost savings.

Assessment & Evaluation of Student Achievement

- Students are assessed individually on final presentation work, the level of investigation, the detail of information provided, and the quality of the overall presentation, (see Appendix 1.2.1).
- Students should demonstrate knowledge of how the material's use has changed over time due to availability, cost, and environmental impact, etc. (see Appendix 1.2.1).

Accommodations

- Provide opportunities for enrichment: students may choose to do a multimedia presentation; a webpage; or a multi-faceted presentation (bringing in a guest speaker); quick-time movies using plans and drawings; and/or creating computer-rendered plans and elevations.
- Provide a checklist, outline, or advanced organizer to assist in completion of the assignment.

Resources

Print

CMHC. *Renovator's Technical Guide*. Canada Mortgage and Housing, 1998. ISBN 0-660-17439-1
Information on sustainable development.

Spence, W. P. *Encyclopedia of Construction Methods and Materials*. Toronto, Canada: Sterling Publishing Co., Inc., 2000. ISBN 0-8069-6851-6

Tutt, P. and D. Adler. *New Metric Handbook, Planning and Design Data*. Oxford: Butterworth Heinemann, 1979. ISBN 0-7506-0853-6

Wearne, P. *COLLAPSE When Buildings Fall Down*. Tv Books L.L.C., 1999. ISBN 1-57500-144-6

Websites

Excellent source of information on buildings, architecture and landscape architecture
– http://www.clr.toronto.edu/VIRTUALLIB/arch

Information on renovating and construction available at the Canadian Mortgage and Housing Department of the Ontario government at – www.cmhc.ca
This site includes information on asbestos, radon and other problem materials

Video Resources

Home Depot Stores

– www.buildinggreen.com – source for videos and CDs on construction and the environment

– www.constructionbook.com – video resource on environment and construction materials

– http://dmoz.org – resource for construction and education

– www.iokos.com – Green Building information

Appendix 1. 2.1

Research Checklist

Topic selection (TFV.03, TF2.02, SP2.10, TF2.05)

_____ identifies the material
_____ outlines its importance to the construction industry
_____ outlines where it is used most (residential, commercial, industrial)

Research (SP1.03)

_____ research shows a variety of sources used (Internet, library, texts)
_____ provides detailed product information
_____ product information includes history, composition, and current use of the product

Presentation (ICI.01, ICI.03)

_____ shows detailed product information
_____ includes insight into the use, misuse of the material
_____ discusses the important environmental aspects of the product's use
_____ describes how to reduce the negative environmental and social impact of the product
_____ discusses the short and long term implications of the product's use
_____ reflects on the future of the product (replacement by environmentally friendly or recycled product)

Conclusion (SP1.03, ICI.01)

_____ focuses on the future changes that may occur – feasibility, cost, environmental impact

Activity 3: Cost Estimating and Project Management

Time: 5 hours

Description

Whether students intend to further their education at college or decide to work in the construction industry, either as an employee as an owner of a company, estimating skills and an understanding of the management of construction projects is essential. Involvement, from the original idea to construction completion, is a valuable experience. Students develop skills that go beyond the drafting table, they personally develop through assuming leadership roles. Students demonstrate their Christian beliefs when making decisions alone or with others. They understand the process of generating rough sketches, working drawings, construction documents, and the development of comprehensive cost analysis and construction site management.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

CGE2b - read, understand and use written materials effectively;
CGE3c - think reflectively and creatively to evaluate situations and solve problems;
CGE3e - adopt a holistic approach to life by integrating learning from various subject areas;
CGE3f - examine evaluate and applies knowledge of interdependent systems for the development of a just and compassionate society;
CGE4f - apply effective communication, decision making, problem solving, time and resource management skills.

Strand(s): Theory and Foundation, Skills and Practices, Impact and Consequences

Overall Expectations

SPV.02 - interpret technical data, building codes, regulations, standard, specifications, and other construction resources;
SPV.04 - demonstrate the mathematical skills required to calculate the estimated cost of a construction project and the heat loss or gain for the project;
SPV.05 - describe a construction company's personnel, documents, and management structure;
SP1.03 - research, document, and use resources applicable to construction projects such as technical data, charts, tables (e.g., on the strength, properties, and insulation values of materials), reports, zoning bylaws, and building codes, regulations, and standards.

Specific Expectations

SP1.07 - establish work schedules for a construction project;
SP3.01 - prepare a materials list for a construction project;
SP3.02 - describe the units of measurement applicable to a variety of building products and materials used for complex construction projects;
SP3.03 - prepare a detailed, accurate estimate of the quantities of materials and costs of a building project, using conventional and computer-aided resources, charts, tables, technical data, and working drawings;
SP3.06 - describe the organization, documents, (e.g., work schedules, estimates) and management of a small construction company.

Prior Knowledge & Skills

- working knowledge of scale, sketching, and drafting techniques
- basic blue print reading and measurement learned from previous activities or in Grade 10 and 11
- basic math applications for estimating

Planning Notes

- This activity may be expanded into a full unit based on a renovation project. Students develop plans, prepare computer-generated working drawings, price out the work, and develop a timeline for construction and completion.
- Contact with mathematics and business studies teachers may be an asset in developing background materials, teaching math skills, initiating class discussions, or finding samples of completed work.
- If this activity is expanded to become a stand-alone unit, a real renovation project (one that is going to be undertaken or has been finished), such as a kitchen or bathroom, is ideal. Other types of projects could include a solarium, playhouse, or pool shed. All require plumbing, electrical work, framing, windows, fixtures, and finishing.
- Alternately, teachers may choose to do this activity over the course of the semester, in conjunction with other units (particularly Unit 2: Restoration, or other units where costing and time management are key issues), or concentrate solely on the skill-building activity itself.
- A new construction site visit would provide insight into how the site operates. A review of safety rules would be necessary. Alternately, having a construction superintendent visit the classroom to discuss a project that is on-going would also provide a foundation for student discussion.
- It is recommended that teachers incorporate the use of computer-generated plans and drawings so that students see first hand how computer-generated plans are used in the field.
- It is also recommended that students use computer software similar to that used in construction offices to generate estimates (spreadsheets, etc.).
- Teachers should provide scale rulers (triangle scales with metric and imperial measurements) for checking measurements.
- Teachers should use a construction project and work through the estimates with students so that they can see first hand how the process works.

Teaching/Learning Strategies

1. **Whole group**
    - Discuss the importance of understanding plans and working details.
    - Share samples of professional working drawings, construction documents, and building permits (review the permit process from concept to working drawings, permits, construction documents, and contracts, and final construction site supervision, work orders, and final payment) (Appendix 1.3.1).
    - Share samples of cost estimates for residential projects (Appendices 1.3.1 and 1.3.2).
    - Select a project to estimate and plan (see Planning Notes on project selection).
    - Organize students into three construction budget teams: (a) lowest price, (b) middle of the road price, and (c) highest quality work and materials.
2. **Small group – 2 students**
    - Two students would act as the project manager; developing a strategy for pricing (students develop a plan based on which price point they will attempt) and completing the work
    - Begin with exercises such as: setting up a project as a contractor, organizing pricing options, measuring and understanding the plan, and developing questions for clarification of material selection (Appendices 1.3.3 and 1.3.4).
    - If time permits, produce plans and sketches using computer software.
    - Depending on the size of the project and the size of the company, one student may be responsible for only one task or for the whole project. Students decide how complicated the project is and list the trades that would be necessary to complete the project.
    - Students develop a timeline for the project, taking into account factors such as weather, ordering materials, and client restrictions (such as working on weekends to speed up the project).

Teachers will:

Whole group

- recommend a strategy for setting up the materials and labour components of the project;
- help students set up charts which list all of the tasks, sub-trades necessary, and required scheduling to complete the project successfully;
- focus student attention on design details, material choices and alternatives, and environmentally friendly disposal of waste materials.

Assessment & Evaluation of Student Achievement

- Students are assessed individually on calculations and accuracy of measurements.
- Students should demonstrate knowledge of how the working drawings relate to the construction documents, and how the construction documents impact the final finished product (*AutoCAD* Drawing Checklist – Appendix 1.1.1).

Accommodations

- Allow for a variety of challenges, e.g., calculating, the cost of a small fence panel, or the cost of dry-walling, taping, and painting one wall of a kitchen or bathroom renovation.
- Provide opportunities for enrichment. Enrichment activities include creating options for customers, such as better energy efficiency, a variety of architectural detailing, and creative space planning.
- Ensure students needing mathematics or blueprint reading support receive peer/teacher support.
- Strive for quality rather than quantity of work as sometimes a reduced workload is required.

Resources

CMHC. *Renovator's Business Guide*. Canada Mortgage and Housing, 1998.

CMHC. *Glossary of Housing Terms*. Canada Mortgage and Housing Corporation, 1997. ISBN 0-660-16699-2

Cannon, K.F. and F.G. Hatley. *Building Construction Technology*. McGraw Hill Ryerson Ltd., 1982. ISBN 0-07-548036-0

Chilton, D. *The Wealthy Barber, The Common Sense Guide to Successful Financial Planning*. Toronto: Stoddart Publishing Co. Ltd., 1989. ISBN 0-7737-5318-4

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Washington, A.J. *Basic Technical Mathematics*, A.J. Addison-Wesley Publishing Co., 1997. ISBN 0-201-76642-6

Video

– www.home-construction-remodelling.com – site for home remodelling, estimating

– www.constructionvideos.com – video for construction project and remodelling

– www.hometechonline.com – video source for construction projects and estimating

– http://dmoz.org – resource for construction and engineering

– www.tsunh.edu/video – University of New Hampshire video library

Appendix 1.3.1

Estimating Guidelines

Estimating the cost of a project is one of the most essential aspects of running a successful construction business, whether it is a fence, high-rise, or highway construction company. The contractor needs to know how much the project should cost. Knowing the costs allows the contractor to stay on budget, check to see if unexpected costs arise, note when changes to the plans are made that need to be billed, and note when something is not going well at the construction site, e.g., material disappearing, not delivered, work is going too slowly, etc.

When estimating a large project a set of project specifications will accompany the plans. The project specifications outline the scope of the project, i.e., everything that the contractor will be expected to do during the contract, including posting company signs.

Estimating can be very simple or very frustrating based on a number of factors. It is very easy to estimate materials accurately so long as the following is done:

- Check that your own or the designer's measurements are accurate and that any plans and construction drawings are accurate (double check major dimensions)
- Read the plans carefully and make sure any questions that you may have are answered so that you fully understand the plans and the details
- Visit the site or get information about site details, access, and ease of delivering or storing materials
- Make a checklist of all of the things that will have to be done by you, the designer, or the owner so that you will know whether you will need to estimate time and costs for that task, getting building permits may take a considerable amount of time
- Make a list of all sub-trades that may have to be called in on the job, e.g., plumbers, electricians, dry-wallers, painters, etc.
- Calculate all materials that will be required and current costs for materials, including delivery charges
- Calculate any machinery that may have to be rented, or bought, or fuelled
- Calculate labour time and costs
- Double check all calculations - Mathematical errors can be very costly.
- Allow for a margin of error. Labour costs can increase if work is very detailed.
- Allow for the supervisor's time spent travelling (if that is included in costs) and time spent reviewing plans with the designer, the sub-trades, or the clients

Some important decisions may be left up to the contractor. The designer may make specific recommendations requiring consideration, e.g., price versus quality – $100.00 versus $500.00 toilet.

Changing the scope of work to reduce the price may require eliminating some items to reduce the cost, e.g., hot tub, number of windows.

Clients working on the project – How does client painting affect schedule and add interest to construction loan?

Common Errors in Estimating

- Errors in addition, subtraction, multiplication, and division
- Omission of items such as materials, labour, or overhead
- Errors in estimating the length of time (labour) to complete the job
- Errors in estimating quantities of materials and waste, e.g., cut materials
- Errors in transposing numbers from work-up sheet to summary sheet

Appendix 1.3.2

Typical Checklist for Construction of an Addition

Verify Location

_____ clearing vegetation
_____ stock pile top soil or dispose
_____ trees, brush removal
_____ power to site

Excavation

_____ dig basement
_____ removal of sub soil
_____ stock pile top soil

Footings

_____ footing forms
_____ stakes
_____ trenched footings
_____ footing size
_____ duplex nails

Determining Concrete Quantities

_____ length
_____ depth
_____ width
_____ are there footings of differing dimensions?

Concrete Quantities

_____ concrete is ordered by the Cubic Yard
_____ a cubic yard is 3 feet X 3 feet X 3 feet
_____ most batch plants deliver in quarter of a yard increments
_____ minimum delivery charge
_____ waiting time

Reinforcement

_____ rebar
_____ chairs
_____ tie wire

Doors

Sizes

_____ width – height – thickness
_____ exterior
_____ jambs
_____ interior
_____ casing
_____ locks

Windows (number of windows)

Sizes

_____ width then height
_____ casing
_____ apron
_____ window trim
_____ sill
_____ large sill for bay windows

Trim materials

Lengths available in one-foot increments. Some lengths have a premium price.

_____ base
_____ chair rail
_____ cleats to attach to wall
_____ paneling
_____ trim
_____ crown
_____ closet shelving and rods
_____ shelving for cabinets
_____ corners

Specialty Items

_____ lazy susan
_____ counter tops
_____ synthetic marble
_____ island or peninsula need material for backs
_____ oven units
_____ plastic laminates
_____ tile
_____ toilet, sink, bathtub, shower enclosure

List all items including towel racks, vanities, mirrors, knobs and fittings.

Appendix 1.3.2 (Continued)

Painting and Floor Coverings

Most subcontractors charge based on square footage of the job. Prices based on types of finishes

_____ stained woodwork
_____ painted woodwork

Extras

_____ more than one colour of paint
_____ high ceilings
_____ painting

Other items to consider

_____ types of window (divided lights)
_____ quality of finish
_____ coats of paint
_____ at least a primer and one finish coat

Determining quantities of paint. Cans labelled to give average coverage, some paints 'hide' better. Second coat usually uses less paint. Method of application affects rate of coverage.

_____ spray
_____ roller
_____ brush

Floor Coverings

Vinyl

_____ tile 45 sq. ft. per box
_____ roll goods 9, 12, 15 ft. wide rolls
_____ installed over 1/4" underlayment

Carpet

sold by the square yard or 12-, 15-foot wide rolls
_____ needs pad

Wood flooring

Ceramic tile
_____ need concrete backer board

Mechanical Systems

_____ plumbing
_____ heating
_____ electrical

Usually by subcontractor

Labour Costs

_____ starting off, labour equals cost of materials
_____ keep accurate records on past jobs.
_____ determine your costs for doing framing, placing concrete, roofing.
_____ verify actual expenses with estimated and adjust future estimates.

Appendix 1.3.3

Common Formulas used in Construction

Excavation
Volume = width × depth × length
$V = w \times d \times l$

Concrete
Volume = width × depth × length × percentage for spillage
$V = w \times d \times l \times \%$ for spillage

Sheet Material
Applies to drywall, plywood and any sheets that come in 4 ft. × 8 ft. sheets
Number of sheets = width × length (area to be covered) ÷ by area of sheet (4N × 8N = 32) 32 square feet
$S = w \times l \div 32$

Studs
Number of studs in a wall laid out 160 on centre = length of wall in feet
$S = 1$

Joists
Number of joists in floor laid out 160 on centre = run of the floor × 3 joists for every 4 ft. plus final rim joist and any doubles
$J = (\mathrm{L} \times \frac{3}{4}) + 1$

Board Feet
Larger quantities of wood are often ordered in board feet so that for larger quantities, the cost can be quickly figured out

$$\frac{\text{width (in.)} \times \text{thickness (in.)} \times \text{length (in.)} \times \text{number of boards}}{144} = \text{board feet}$$

e.g., one 8 ft. 2 × 4 = $\frac{2 \text{ in.} \times 4 \text{ in} \times 96 \text{ in}}{144} = 5.33$ board feet

Difference between board feet and dimensional lumber
Dimensional Lumber is used for many projects and is generally planed to smaller dimensions than the normal size

- 2 × 4 to 2 × 12
- sold in 2N foot lengths from 8N
- sold by piece

Lumber sold by the board foot is generally rough sawn in random widths
A board foot is a piece of limber 1 foot long × 1 foot wide × 1 inch thick
Board feet

- 1 foot long
- 1 foot wide
- 1 inch thick

Appendix 1.3.4

Estimating Sheet

Client Name: _____ **Date: _____**

Address: _____ **Job: _____**

Item	Quantity	Description	Unit Price	Amount
			Subtotal	
			G.S.T.	
			P.S.T.	
			Total Price	

Notes:

Activity 4: Ethics and Employability

Time: 5 hours

Description

This activity is designed to encourage students to become responsible and ethical employees and employers. Emphasis is placed on the student's Christian development, stewardship, respect for the environment, and the effective and appropriate use of resources. Students understand the responsibilities of an ethical employee and recognize the role of ethics in the workplace and community. Students illustrate how they have grown as individuals and as valuable members of the community. Students identify the requirements for part-time and full time employment in the construction industry.

Strand(s) & Learning Expectations

Ontario Catholic School Graduate Expectations

CGE2b - read, understand and use written materials effectively;
CGE2c - present information and ideas clearly and honestly and with sensitivity to others;
CGE3e - adopt a holistic approach to life by integrating learning from various subject areas;
CGE3f - examine, evaluate and apply knowledge of interdependent systems for the development of a just and compassionate society;
CGE5b - think critically about the meaning and purpose of work;
CGE5c - develop ones' God given potential and make a meaningful contribution to society;
CGE7b - accept accountability for one's own actions;
CGE7i - respect the environment and use resources effectively.

Strand(s): Skills and Practices, Impact and Consequences

Overall Expectations

SP1.03 - research document and use resources applicable to construction projects such as technical data, charts, tables (e.g., on the strength, properties, and insulation values of materials), reports, zoning by-law, and building codes, regulations and standards;
SP3.07 - identify and describe the roles of a variety of personnel involved in the construction industry (e.g., architects, engineers, lawyers, accountants, journey people, technicians, technologists, labourers);
ICV.01 - explain the impact of the construction industry on the economy, on society, and on the environment;
ICV.04 - identify careers in construction technology and the skills, education, and training each requires.

Specific Expectations

IC3.01 - identify career opportunities in a variety of sectors of the construction industry;
IC3.02 - describe the education and training required for employment in construction-related careers;
IC3.03 - identify post secondary programs in construction technology and their admission requirements;
IC3.04 - explain the importance of lifelong learning for someone choosing a career in the construction field.

Prior Knowledge & Skills

- familiarity with Internet searches
- identified careers from Grade 10
- communication skills

Planning Notes

- This unit reinforces the pursuit of postsecondary education and careers in the construction industry.
- Guest speakers from the industry would provide a personal viewpoint into construction-related careers.
- This unit should be delivered prior to students filling out university and college application forms so that they are exposed to the variety of programs that are available in the construction industry.
- Teachers should focus on presentations that are computer-generated so that students develop further skills using computers for drafting, cost estimating, and presentations.
- Christian ethics and values must be emphasized throughout the activity; teachers must be sensitive to the ethnic, racial, and religious composition of the classroom in order to be aware of individual student needs and beliefs.
- Using online internet career planning, such as – www.mazemaster.on.ca, can help students identify their interests and goals and focus on what they might consider doing when they graduate from secondary school. Where time or computer access is restricted, teachers may wish to allow students to work through the Mazemaster program or similar program, which helps students identify their interests, and which careers would suit their strengths and personality. It also gives information on training, education, and jobs.
- The modules on the Mazemaster are: Self-Assessment, Labour Market Information, Training and Education, Job Search Techniques, Self Employment, and Job Postings, which guide students through the maze of employment and training opportunities that are available. Workopolis.com gives students an opportunity to see what is available in the construction industry (such as: brick/stonemason, landscaping, building inspector, painter, cabinetmaker, carpentry, steam-fitter, plumber, crane operator, electrician, etc.) It provides access to any job related to the construction industry. The web site is useful in identifying what jobs are available, what requirements they have and how much they pay.

Teaching/Learning Strategies

1. **Whole group**
   - Discuss the career opportunities that are available in construction.
   - Help students develop awareness, understanding, and acceptance of self and others.
2. **Individual**
   - Begin with identifying postsecondary education construction career options.
   - Create a short oral presentation on a specific construction career opportunity.
   - Discuss the different college/university programs that may focus on that area.

Teachers will:

Whole group

- discuss the career plans and interests of members of the class so that information may be gathered that is pertinent to each individual student;
- discuss different career choices and the variety of opportunities that are available in the construction industry;
- discuss the importance of ethics; what ethics means in the industry and how Catholic values can be applied in the decision-making process;
- ensure students understand why ethics and moral responsibility are so important to their community;
- discuss the importance of sharing information on a broad range of careers so that students have an opportunity to learn about the various opportunities that are available in the construction industry.

Assessment & Evaluation of Student Achievement

- Students are assessed through conferencing and questioning by the instructor.
- Students are assessed individually on oral presentations and information gathered for their personal presentation (classroom questioning, written information, teacher conferencing).

Accommodations

- Provide opportunities for enrichment. (Students may choose to prepare a multimedia presentation, a webpage, a multi-faceted presentation, and arrange for a guest speakers.)
- Allow students to demonstrate understanding using a variety of delivery methods information (desk top publishing, audio, video etc.).
- Provide instructions both verbally and visually.
- Facilitate interaction with a mentor, where possible.

Resources

CMHC. *Renovator's Business Guide*. Canada Mortgage and Housing, 1998.

Cannon, K.F. and F.G. Hatley. *Building Construction Technology*. McGraw Hill Ryerson Ltd., 1982. ISBN 0-07-548036-0

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Hire Expectations – Employment Strategies for Canada's Youth. Canadian Federation of Independent Business, 1998. ISBN 0-9693268-4-X

Ontario Job Futures and the Ontario Ministry of Training, Colleges and Universities. ISBN 0-7778-8799-1

Tech Prep Career Programs – A Practical Guide to Preparing Students for High-Tech, High-Skill, High-Wage Opportunities. Thousand Oaks, California: Corwin Press Inc., 1997. ISBN 0-8039-6510-9

Transitions – A Practical Guide to the Workplace. Canada: Collier MacMillan Inc., 1989.

Websites

– www.Apprenticesearch.com – (40 regulated apprenticeship information sites

– www.careercruising.com – (must have a password provided by school guidance counsellors

– www.monster.ca

– www.mazemaster.on.ca – Internet career planner has excellent student–centred information on careers, trades, jobs, etc.

– www.esao.on.ca – WHMIS symbols and safe use of chemicals

– www.conferenceboard.ca/nbec

Employability skills 2000+ available at – www. workopolis.com

Video

– www.home-construction-remodelling.com – site for home remodelling, estimating

– www.constructionvideos.com – video for construction project and remodelling

– www.hometechonline.com – video source for construction projects and estimating

– http://dmoz.org – resource for construction and engineering

– www.tsunh.edu/video – University of New Hampshire video library

– http://dcsd.k12.nv.us – curriculum both written and video-taped on Ethics and Employability

Unit 2: Architectural Restoration and Renovation

Time: 40 hours

Unit Description

Students investigate aspects of design and construction having to do with the refurbishing, restoration, and renovation of older buildings. Study includes architectural and social history and traditional and current building techniques, tools, and materials. Students research, design, draw, and plan appropriate construction projects. From this planning, students complete interior and exterior work on, and for, buildings needing improvement. Students learn about educational and career opportunities in a broad range of fields including architecture, interior design, fine woodworking, carpentry, and landscape design. Student learning is assessed by means of report writing, research documentation, drawings, models, and full-scale construction. Throughout the unit an emphasis is placed on the environmentally conscious use of materials and the need to appreciate and preserve our architectural heritage.

Unit Synopsis Chart

Activity	Time	Learning Expectations	Assessment Categories	Focus/Tasks
2.1 "As found" house drawing	12 hours	TFV.02, TF2.04, SP1.04, SP1.05, SP2.08, SP2.09, SP3.02, IC1.01	Knowledge/ Understanding Thinking/Inquiry Communication	Select, photograph, and measure an existing building that has architectural or historical significance and draw floor plan(s) and elevation(s) using CAD
2.2 Researching a Period Style	4 hours	TFV.03, TFV.05, TF2.01, TF2.03, TF2.04	Knowledge/ Understanding Thinking/Inquiry Communication	Identify, research, and document the period style of the chosen house
2.3 Designing an addition	12 hours	TFV.01, TFV.02, TFV.04, TF1.01, TF1.02, TF2.03, TF2.04, TF2.06, TF3.02, SPV.01, SPV.02, SP1.01, SP1.02, SP1.03, SP1.04, SP1.05, SP2.05, SP3.08	Application Communication Thinking/Inquiry	Research, design, and produce plans for an appropriate addition to the chosen house
2.4 Fabricating building component(s)	12 hours	TFV.01, TFV.02, TFV.03, TFV.04, TF2.03, SPV.01, SP1.01, SP1.07, SP2.09, SP2.11, SP2.12, SP3, 01, SP3.03, ICV.03, IC2.01, IC2.02	Knowledge/ Understanding Application	Design, draw, and construct a detail or component of the addition

Activity 1: Creating an "As Found" House Drawing

Time: 12 hours

Description

Working in pairs, and with assistance from the teacher, students research a local building (house, or small commercial or public structure) that has architectural significance. The teacher arranges with the owner for the class to visit the building in order to photograph, sketch, and measure it. Using this information, each pair of students creates a set of architectural drawings for the chosen building. These drawings should be completed using a CAD program and must include floor plans and exterior elevations. The information gathered forms the basis for the unit and subsequent activities build on this first assignment. This activity provides opportunity for students to be involved directly and personally in an on-site investigation of the building and to develop problem-solving skills that will be applied throughout the unit.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Practices, Impact and Consequences

Overall Expectations

TFV.02 - explain advanced techniques, including computer applications, used to visualize, analyse, describe, and present designs of, and to construct, buildings and other structures (e.g., presentation and working drawings).

Specific Expectations

TF2.04 - identify a variety of building materials, construction techniques, architectural styles and details, and engineering features used in different construction projects;
SP1.04 - produce appropriate presentation and working drawings (including perspectives, floor plans, elevations, sections, and details), using traditional and computer-assisted methods, to meet client needs for a variety of construction projects;
SP1.05 - produce working drawings that accurately replicate the architectural features of a building;
SP2.08 - compare a variety of types of windows and doors used in construction projects;
SP2.09 - compare different construction techniques, building materials, and finishes used in construction projects;
SP3.02 - describe the units of measurement applicable to a variety of building products and materials used for complex construction projects;
IC1.01 - describe natural and manufactured construction materials and the short- and long-term impact of their use on the environment.

Prior Knowledge & Skills

- research skills using the Internet, local archives, publications, and other sources
- interactive and collaborative group skills
- communication skills – to interact with building owners, archivists, historians, local planning personnel, and others
- sketching and CAD knowledge and skills

Planning Notes

- Where appropriate, and with adequate supervision, students may make contact with building owners (municipal or other government agencies or family members, for example) in order to visit and investigate particular buildings that have notable local significance. In this case, more than one building would provide the focus for the unit activities for a class.

- The teacher should assess student experience and expertise, by means of diagnostic testing, before commencing activities in this unit. Demonstrations and lessons may then be presented in order to ensure that students have adequate instruction related to the techniques, processes, and equipment required to complete the project.
- The teacher should identify a number of buildings in the community suitable for this activity and contact the owners about their participation.
- The teacher should facilitate communication between a variety of experts/advisors (building owners, archivists, historians, architects, planners, etc.) and students who are involved in a particular activity.
- The teacher must familiarize themselves with local architectural and cultural history in order to advise students regarding suitable buildings and to direct them to appropriate information resources and experts.
- Guest speakers should be invited to address students on topics such as local architectural and cultural history and research techniques and resources
- Obtain permission for walking tours and field trips.
- Complete required paperwork for walking tours and field trips.
- It should be noted that, while students work in pairs during this activity, each student is involved in, and responsible for, specific, individual components of the final project.
- The teacher helps students organize the shared tasks to be performed throughout the activity. This may be done in the form of a production-planning chart.

Teaching/Learning Strategies

1. The teacher introduces the project challenge to the students. They are required to visit a building in order to complete preliminary research, which includes photographs, sketches, and measurements of the building. From this initial research, students create a set of architectural drawings for the building using a CAD program. Each set of drawings will include floor plans and exterior elevations.
2. The teacher and students discuss the project with the assistance of a guest speaker who has experience and knowledge in the fields of local architectural and cultural history.
3. The teacher may organize and lead a local walking tour to enable students to view examples of buildings that have architectural significance and beauty.
4. Students take a field trip to local archives, museums, or the historical society in order to take advantage of the knowledge of local experts.
5. Students, with the help of the teacher, research local architectural sites and examples in order to choose a suitable building.
6. Students, under the supervision of the teacher, communicate with the building owner to obtain permission to complete information gathering.
7. Once communication has been established and permission granted, students begin their preliminary research of the building, adding all documents obtained or created to their portfolio.

Assessment & Evaluation of Student Achievement

Task/Product	Tool	Purpose	Achievement Chart Categories
Skills Assessment	Observation	Diagnostic	Application
"As Found" House Portfolio	Checklist Anecdotal Comments Conferencing Marking Scheme	Formative – on-going through activity Summative at end of activity	Knowledge/Understanding Thinking/Inquiry Communication Application

Accommodations

- Ensure that students with special needs are provided for on field trips and walking tours.
- As enrichment, students may produce more detailed drawings (e.g., additional elevations, interior elevations, isometric, or perspective drawings), or may use computer-aided design drawings or 3-D illustration software to produce realistic illustrations or animation.

Resources

Mostafavi, Mohsen and Daved Leatherbarrow. *On Weathering: The Life of Buildings in Time*. Massachusetts: MIT Press, 1993. ISBN 0-262-63144-X

Rempel, J. *Building With Wood*. Toronto: University of Toronto Press, 1967. ISBN 0-8020-1476-3

Abhau, M. ed., with R. Copeland, and G. Greenberger. *Architecture In Education*. Philadelphia: Foundation for Architecture, 1992. ISBN 0-9622908-0-7

Phillips, S. *Old House Dictionary: An Illustrated Guide to American Domestic Architecture,* 1600–1940. Washington, D.C.: The Preservation Press, 1992. ISBN 0-89133-171-9

Fine Homebuilding Books. *Tricks of the Trades: Building Methods and Materials*. Connecticut: The Taunton Press, 1994. ISBN 1-56158-077-5

Scharff, R. *Workshop Math.* New York: Sterling, 1989. ISBN 0-8069-5802-2

Hoke, J.R., ed. *Architectural Graphic Standards*. Toronto: John Wiley & Sons, 1994. ISBN 0-471-01284-X

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Stirling, Norman. *Fundamentals of Technical Drawing*. Canada: Gage Educational Publishing, 1984. ISBN 0-7715-0327x

Hale, Jonathan. *The Old Way of Seeing*. Boston/New York: Houghton Mifflin Co., 1994. ISBN 0-395-60573-3

Muller, Edward J. *Architectural Drawing and Light Construction*. New Jersey: Prentice-Hall, Inc., 1985. ISBN 0-13-044561-4

Shoppell, R.W. *Turn-of the- Century Houses, Cottages and Villas*. Toronto: General Publishing, 1983. ISBN 0-486-24567-5

Magazines

Fine Homebuilding. Newtown, Connecticut: The Taunton Press. ISSN 1096 360-X
– www.finehomebuilding.com

Fine Woodworking. Newtown, Connecticut: The Taunton Press. ISSN 0361-3453
– www.finewoodworking.com

This Old House. Time Publishing Ventures, Inc.

– www.thisoldhouse.org

Old House Journal. Washington, DC: Hanley-Wood, Inc.
– www.oldhousejournal.com

Websites

– www.fbe.unsw.edu.au – resource site for AutoCAD tutorials

– www.acad.co.uk – AutoCAD services, projects for students, advice

– http://www.scc.ca – Publications of the Standards Council of Canada. Rexdale, Ontario

– http://www.finehomebuilding.com – Fine Homebuilding. Numbers 1–126. Newtown, Connecticut: The Taunton Press. ISSN 1096-360-X (1-800-477-8727)

– http://www.finewoodworking.com – Fine Woodworking. Numbers 1–139. Newtown, Connecticut: The Taunton Press. ISSN 0361-3453 (1-800-477-8727)

– http://www.finehomebuilding.com – Canadian Home Workshop. Volumes 1–22. Markham, Ontario: Camar Publications. ISSN 1485-8509

– http://www.augusthome.com – Shopnotes. Numbers 1–48. Des Moines, Iowa: August Home Publishing Company. ISSN 1062-9696 (Tel: 1-800-333-5854)

– http://www.augusthome.com – Woodsmith. Numbers 1–126. Des Moines, Iowa: August Home Publishing Company. ISSN 0164-4114 (Tel: 1-800-333-5075)

– www:Algonquincollege.com Algonquin College Web Page

– http://www.scc.ca – Publications of the Standards Council of Canada. Rexdale, Ontario.

– www.msbigday.com – Microsoft Free Seminar Series

– www.rubricbuilder.on.ca – An Ontario web site that assists teachers with the new assessment tool, rubrics.

– www.thisoldhouse.com

– www.hometime.com

– www.oldhousejournal.com

– www.taunton.com

Videos

This Old House, video sets

Hometime, video series

Taunton Press, video series

Community Resources

University Archives

Historical Societies

Architectural Organizations

Local Architectural Conservancy Advisory Committee (LACAC)

Activity 2: Researching a Period Style

Time: 4 hours

Description

Students gather information about the major period styles of architecture in Ontario and define each style by identifying its distinguishing characteristics. Each student, using the building from Activity 1, research, describe, and document information related to the building. By analysing the main architectural features of the building, each student identifies the period style that it best represents and presents a summary of their findings that includes sketches, photographs, and written documentation of the period style of the building.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Practices, Impact and Consequences

Overall Expectations

TFV.03 - describe the properties of natural and manufactured building materials, processes, and finishes; TFV.05 - describe appropriate building construction techniques; construction systems (electrical, mechanical, structural); and the building materials, tools, and equipment used in the construction industry.

Specific Expectations
TF2.01 - describe the properties (physical, mechanical, structural, and thermal) of natural and manufactured building materials;
TF2.03 - describe the materials, and methods of applying them, used in various construction components (e.g., footings, foundations, floors, walls, roofs, windows, doors, millwork, interior and exterior finishes, hardware);
TF2.04 - identify a variety of building materials, construction techniques, architectural styles and details, and engineering features used in different construction projects.

Prior Knowledge & Skills

- research skills (Internet and publications)
- interactive group skills
- freehand sketching

Planning Notes

- The teacher must familiarize themselves with features and examples of major architectural styles and must be able to direct students to appropriate information resources and experts.
- The teacher should facilitate a working relationship between "clients" or experts/advisors (building owners, archivists, historians, architects, planners, etc.) and the group of students who are involved in a particular activity.
- Guest speakers should be invited to address students on topics such as local architectural and cultural history and research techniques and resources
- It should be noted that, while students may work collaboratively during this activity, each student is involved in, and responsible for, an individual final project and presentation.

Teaching/Learning Strategies

1. The teacher reviews the project challenge to date. Any concerns or issues from the previous activity must be discussed so that students have no barriers to the next step.
2. Students research local architectural sites and examples in order to become familiar with a range of architectural styles and periods. Students add this information to their portfolios.
3. Students, using the building they have chosen in Activity 1, research, describe and document information about the building. By analysing the main architectural features of the building each student identifies the period style that it best represents.
4. Students present a summary of their findings, including sketches, photographs, and written documents to the class.

Assessment & Evaluation of Student Achievement

Task/Product	Tool	Purpose	Achievement Chart Categories
Skills Assessment	Observation	Diagnostic	Application
Production-Planning Chart	Checklist	Formative	Thinking/Inquiry Communication
Researching a Period Style Portfolio	Checklist Anecdotal Comments	Formative – on-going throughout activity	Knowledge/Understanding Thinking/Inquiry Communication
Presentation	Rating Scale Marking Scheme	Summative	Knowledge/Understanding Communication Application

Accommodation

- Ensure that students with special needs are provided for on field trips and walking tours.
- As enrichment, students may produce more detailed sketches and written descriptions of the research findings or may use computer-aided design drawings or 3-D illustration software to produce realistic illustrations.
- Advanced or creative photographic techniques may be utilized in the presentation of period details.

Resources

Rempel, J. *Building With Wood*. Toronto: University of Toronto Press, 1967. ISBN 0-8020-1476-3

Abhau, M., ed., with R. Copeland, and G. Greenberger. *Architecture In Education*. Philadelphia: Foundation for Architecture, 1992. ISBN 0-9622908-0-7

Phillips, S. *Old House Dictionary: An Illustrated Guide to American Domestic Architecture* (1600-1940). Washington, D.C.: The Preservation Press, 1992. ISBN 0-89133-171-9

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Karp, B. *Ornamental Carpentry on Nineteenth-Century American Houses*. Toronto: General Publishing Co. Ltd., 1981. ISBN 0-486-24144-0

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Bicknell, A.J. & Co. *Bicknell's Victorian Buildings*. Toronto: General Publishing, 1979 (reprint from 1878). ISBN 0-486-23904-7

McAlester, Virginia and Lee. *A Field Guide to American Houses*. New York: Alfred A. Knopf, 1991. ISBN 0-394-51032-1

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Brosseau, Mathilde. *Gothic Revival in Canadian Architecture*. Ottawa: Parks Canada, 1980.

Cameron, Christina and Janet Wright. *Second Empire in Canadian Architecture*. Ottawa: Parks Canada, 1980.

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Wright, Janet. *Architecture of the Picturesque in Canada*. Ottawa: Parks Canada, 1984.

Magazines

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Fine Woodworking. Newtown, Connecticut: The Taunton Press. ISSN 0361-3453 – www.finewoodworking.com

This Old House. Time Publishing Ventures, Inc.
– www.thisoldhouse.org

Old House Journal. Washington, DC: Hanley-Wood, Inc.
– www.oldhousejournal.com

Websites

– http://www.finehomebuilding.com
Fine Homebuilding. Numbers 1–126. Newtown, Connecticut: The Taunton Press. ISSN 1096-360-X (1-800-477-8727)

– http://www.finewoodworking.com
Fine Woodworking. Numbers 1–139. Newtown, Connecticut: The Taunton Press. ISSN 0361-3453 (1-800-477-8727)

– http://www.finehomebuilding.com
Canadian Home Workshop. Volumes 1–22. Markham, Ontario: Camar Publications. ISSN 1485-8509

– http://www.augusthome.com
Shopnotes. Numbers 1–48. Des Moines, Iowa: August Home Publishing Company. ISSN 1062-9696 (Tel: 1-800-333-5854)

– http://www.augusthome.com
Woodsmith. Numbers 1-126. Des Moines, Iowa: August Home Publishing Company. ISSN 0164-4114 (Tel: 1-800-333-5075)

– www:Algonquincollege.com – Algonquin College Web Page

– www.msbigday.com – Microsoft Free Seminar Series

– www.rubricbuilder.on.ca – An Ontario website that assists teachers with the new assessment tool, rubrics.

– www.thisoldhouse.com

– www.hometime.com

– www.oldhousejournal.com

– www.taunton.com

– www.doityourself.com

Videos

This Old House, video sets

Hometime, video series

Taunton Press, video series

Do It Yourself, Video Series

Community Resources

University Archives

Historical Societies

Architectural Organizations

Local Architectural Conservancy Advisory Committee (LACAC)

Local Historians and Authors

Activity 3: Designing an Addition

Time: 12 hours

Description

Using the building chosen in Activity 1, students research, design, and draw an addition to the structure, according to defined parameters that are consistent with, or complementary to, its architectural. Students must refer to, and have their work conform with, local building, plumbing, and electrical codes in the design of their addition. Students develop thinking and problem-solving skills as they use the design process to develop a suitable architectural concept. They refer to the previously developed research on period style related to their building, meet with a "client" (if possible), develop a design, produce scaled drawings (using CAD), and build a model of the final design concept. Students investigate architectural history, traditional and current building materials and techniques, space planning, and exterior and interior architectural design. This activity gives students an opportunity to investigate a variety of career fields including history, architecture, interior design, and landscape design.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes, Impact and Consequences

Overall Expectations

TFV.01 - apply the design process to develop solutions, products, processes, or services in response to complex challenges or problems in construction technology;
TFV.02 - explain advanced techniques, including computer applications, used to visualize, analyze, describe, and present designs of, and to construct, buildings and other structures (e.g., presentation and working drawings);
TFV.04 - identify the building codes, regulations, and standards governing construction projects;
SPV.01 - demonstrate an understanding of design process skills by applying them to a variety of construction projects;
SPV.02 - interpret technical data, building codes, regulations, standards, specifications, and other construction resources.

Specific Expectations

TF1.01 - explain how a human need or want can be met through a new or improved product;
TF1.02 - apply the following steps of the design process to solve a variety of construction technology challenges or problems:

- ❑ identify what has to be accomplished (the problem);
- ❑ gather and record information, and establish a plan of procedures;
- ❑ brainstorm a list of as many solutions as possible;
- ❑ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
- ❑ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
- ❑ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
- ❑ evaluate the prototype and determine the resources, including computer applications, required to produce it;
- ❑ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
- ❑ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution;

TF2.03 - describe the materials, and methods of applying them, used in various construction components (e.g., footings, foundations, floors, walls, roofs, windows, doors, millwork, interior and exterior finishes, hardware);
TF2.04 - identify a variety of building materials, construction techniques, architectural styles and details, and engineering features used in different construction projects;
TF2.06 - identify and explain the building codes, regulations, and standards applicable to construction projects;
TF3.02 - use the terminology, symbols, industry standards, codes, regulations, and conventions related to the electrical, mechanical, and structural systems of a construction project;
SP1.01 - design (using effective brainstorming techniques), plan, and implement the best solutions for a variety of construction projects;
SP1.02 - apply design principles to, and identify good planning characteristics of, construction projects;
SP1.03 - research, document, and use resources applicable to construction projects such as technical data, charts, tables (e.g., on the strength, properties, and insulation values of materials), reports, zoning by-laws, and building codes, regulations, and standards;
SP1.04 - produce appropriate presentation and working drawings (including perspectives, floor plans, elevations, sections, and details), using traditional and computer-assisted methods, to meet client needs for a variety of construction projects;
SP1.05 - produce working drawings that accurately replicate the architectural features of a building;
SP2.05 - identify structural elements of various construction projects or systems and explain the methods of construction and their advantages and disadvantages (e.g., wood structure using post and beam construction vs. traditional framing; steel frame structure vs. reinforced and precast concrete and masonry structures);
SP3.08 - prepare documentation of all aspects of a construction project, including the process followed to obtain approval for a building permit and legal and contractual agreements with owners, architects, and subtrades.

Prior Knowledge & Skills

- Research skills using the Internet, local archives, publications, and other sources
- Interactive and collaborative group skills
- Communication skills – to interact with building owners, archivists, historians, local planning personnel, and others
- Sketching and CAD knowledge and skills

Planning Notes

- The teachers should facilitate a working relationship between "clients" or experts/advisors (building owners, archivists, historians, architects, planners, etc.) and the group of students who are involved in a particular activity.
- Guest speakers can be invited to address students on a variety of construction-related careers, e.g., building inspector, architect, historian, carpenter, electrician, excavation contractor, etc.
- It should be noted that, while students may work collaboratively during this activity, each student is involved in, and responsible for, an individual final project and presentation.
- The teacher should assist each student in the identification of appropriate (or required) design parameters within which the student will create his or her concept.
- The teachers should prepare quick reference sheets for computer-design software programs.
- Photocopy design process criteria for students.
- The teachers must familiarize themselves with basic model-building techniques and materials.
- Models may be fabricated in significant detail, or plotted plans and elevations can be attached to Bristol board or illustration board to simplify the model-building process.

- If possible, arrange for a local model builder to visit the class or arrange a field trip to that person.
- The teacher must know and share with students the building code requirements relating to basic new construction.
- Develop an ever-growing resource of magazines, photographs, and other illustrations depicting homes (both new and old), architectural details, and construction elements.
- The teacher helps students organize the tasks to be performed throughout the activity. This may be done in the form of a production-planning chart and daily log.

Teaching/Learning Strategies

1. The teacher introduces the architectural design challenge to the students
2. The teacher and students discuss the goals of the activity and possible enrichment opportunities.
3. The teacher and students discuss the project. This may include the assistance of a guest speaker who has experience and knowledge in architectural styles and details or heritage architectural design.
4. The teacher reviews the set of parameters that have to be included in the design (e.g., specific rooms, square footage requirements, relationship of new and existing, specific materials, any special detailing, etc.).
5. The teacher supplies examples of professional scaled drawings for residential and small commercial or public buildings.
6. Students utilize a complete design process, from problem definition through research and concept sketches, to final submission and presentation of scaled drawings and model. See Appendix 2.3.1
7. Students communicate, with the teacher's knowledge, as needed, with building owners to obtain permission to complete information gathering.
8. The teacher and students evaluate the success of the activity by observing individual presentations of the completed projects.

Assessment & Evaluation of Student Achievement

Task/Product	Tool	Purpose	Achievement Chart Categories
Skills Assessment	Observation	Diagnostic	Application
Design Brief	Checklist Anecdotal Comments	Formative – on-going throughout the activity	Knowledge/Understanding Thinking/Inquiry Communication Application
Presentation	Rubric	Summative	Knowledge/Understanding Thinking/Inquiry Communication Application

Accommodations

- Students may be provided with a choice of project complexity.
- Ensure that students with special needs are provided for on field trips and walking tours.
- As an enrichment students may produce more detailed or additional drawings. They may, for example, produce isometric or perspective views, building section(s), landscape plans, and detail drawings.

Resources

Rempel, J. *Building With Wood*. Toronto: University of Toronto Press, 1967. ISBN 0-8020-1476-3

Abhau, M., ed., with R. Copeland, and G. Greenberger. *Architecture In Education*. Philadelphia: Foundation for Architecture, 1992. ISBN 0-9622908-0-7

Phillips, S. *Old House Dictionary: An Illustrated Guide to American Domestic Architecture* (1600-1940). Washington, D.C.: The Preservation Press, 1992. ISBN 0-89133-171-9

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Fine Woodworking. Newtown, Connecticut: The Taunton Press. ISSN 0361-3453 – www.finewoodworking.com

This Old House. Time Publishing Ventures, Inc. – www.thisoldhouse.org

Old House Journal. Washington, DC: Hanley-Wood, Inc. – www.oldhousejournal.com

Websites

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Fine Homebuilding. Numbers 1-126. Newtown, Connecticut: The Taunton Press. ISSN 1096-360-X (1-800-477-8727)

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– www.Algonquincollege.com – Algonquin College Web Page

– www.thisoldhouse.com

– www.hometime.com

– www.oldhousejournal.com

– www.taunton.com

– www.doityourself.com

– www.msbigday.com – Microsoft Free Seminar Series

Videos

This Old House, video sets

Hometime, video series

Taunton Press, video series

Do It Yourself, video series

Community Resources

University Archives

Historical Societies

Architectural Organizations

Local Architectural Conservancy Advisory Committee (LACAC)

Local Historians and Authors

Model Builders

Appendix 2.3.1

Sample Design Process*

Open Ended Problem Solving and the Design Process
Design is the act of inventing and innovating new products or services to satisfy needs or a change in needs. Design is a creative problem-solving activity. Like most creative processes, there are no correct procedures, but there are guidelines that assist the designer in ensuring the optimal solution is met. These guidelines are called the design process.

Students analyse at the beginning of the design process, a given set of conditions in order to identify a technological problem, challenge, or need. Students then work through a number of stages in order to arrive at a solution. Design processes include all stages in the development of a product. Although the design process may have distinctive stages, they are not followed in a rigid, step-by-step sequence. For example, students must evaluate their work at each stage of the process. As they do so, students may discover that they need to return to an earlier stage to make modifications or complete a particular step sooner than originally planned. A portfolio and/or a design report is used to document the design process.

Identification and Clarification of a Technological Problem
Students identify the technological problem and begin keeping a record of the design process. Students initially outline the broad aims of the project and describe in a general way what needs to be done to achieve those aims. Students may periodically revise the initial broad plan to reflect what is actually happening. Students need to translate the information given to them by the teacher into the sub-stages below. This provides an understanding of each sub-stage so students can independently complete the stage in later grades. Possible sub-stages for the design report are:

- context;
- problem situation;
- technological problem statement;
- performance specifications and constraints;
- planned sources of information.

Generation of Multiple Solutions
Students identify possible solutions for the technological problem and the resources required to achieve each proposed solution. Students determine the availability of required resources and record their findings. Students, during this stage, may discover they need to redefine the problem. Possible sub-stages for the design report include:

- brainstorming to generate ideas/solutions for the technological problem;
- selecting several ideas from the solutions generated in the brainstorming exercise (typically three);
- drawing rough sketches for these ideas;
- completing an analysis for each idea, i.e., indicate details on the rough sketches;
- identifying the materials and tools needed for each idea;
- making scale models of technological problem ideas to work out initial details of complexity and feasibility (scale models are not always required - they are used only if they help to clarify ideas).

Appendix 2.3.1 (Continued)

Selection of a Best Solution
Students establish evaluation criteria for the selection of a best solution. They consider such factors as: what materials, tools, and resources are available; the amount of time needed to carry out difficult procedures; and any relevant ergonomic and aesthetic requirements. Students choose the best solutions based on the results of these activities. They record the reasons for choosing a particular solution. Possible sub-stages for the design report include:

- establishing evaluation criteria for the best solution based on performance specifications, constraints, attribute analysis (details form rough sketches of ideas), and available materials;
- evaluating ideas according to the established evaluation criteria for the best solution by creating a chart to rate each idea;
- creating a working drawing of the idea selected as the best solution.

Production Plan
Students determine ways of producing the best solution and then construct a prototype of the product. Students produce a model-size prototype using production-type materials, where possible. Students first draft a revised or working drawing and develop a production plan. Students may modify their best solution while moving through the production phase to incorporate ideas that emerge during constructions. Students document all such changes. Possible sub-stages for the design report include:

- creating drawings of the selected ideas;
- calculating the materials needed to produce the selected idea and the associated costs;
- ordering supplies for the project;
- developing a critical path, incorporating key dates;
- completing the project, producing, in detail, the sequential steps used, and all modifications made.

Project and Process Evaluation
Students evaluate the project and their design report. They consider their own expectations and criteria and the reactions of their peers, teachers, and if applicable, their client.

Present the Results
The final project and design reports are presented to communicate the results.

*This design process is adapted from the work of Dr. Ann Marie Hill, Queens University.

Activity 4: Designing and Producing Building Components and Details

Time: 12 hours

Description

Based on the addition designed in Activity 3, students research, design, and produce/fabricate architectural components that could be used in this, or a similar, building. Examples include, but are not restricted to, mouldings and trim, wainscoting, custom doors and windows, built-in cabinetry, fireplace mantels, and stairway and porch components. The particular architectural style of each student's building dictates the essential design features, but the exact elements to be produced are determined by the specific application and the final design. The components could be used for new construction, or for a renovation or restoration project. This project provides an opportunity for students to develop a variety of design, drawing, and construction and fine woodworking skills and to employ a problem-solving design process in the development of architectural details. Depending on skill level, available space and other factors, students could work in pairs or small groups with each student having specific responsibilities.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes, Impact and Consequences

Overall Expectations

TFV.01 - apply the design process to develop solutions, products, processes, or services in response to complex challenges or problems in construction technology;
TFV.02 - explain advanced techniques, including computer applications, used to visualize, analyze, describe, and present designs of, and to construct, buildings and other structures (e.g., presentation and working drawings);
TFV.03 - describe the properties of natural and manufactured building materials, processes, and finishes;
TFV.04 - identify the building codes, regulations, and standards governing construction projects;
SPV.01 - demonstrate an understanding of design process skills by applying them to a variety of construction projects;
ICV.03 - apply health and safety legislation; general shop and site safety rules; and rules specific to the safe use of materials, tools, and equipment.

Specific Expectations

TF1.01 - explain how a human need or want can be met through a new or improved product;
TF1.02 - apply the following steps of the design process to solve a variety of construction technology challenges or problems:

- ❑ identify what has to be accomplished (the problem);
- ❑ gather and record information, and establish a plan of procedures;
- ❑ brainstorm a list of as many solutions as possible;
- ❑ identify the resources required for each suggested solution, and compare each solution to the design criteria, refining and modifying it as required;
- ❑ evaluate the solutions (e.g., by testing, modelling, and documenting results) and choose the best one;
- ❑ produce presentation and working drawings, sketches, graphics, mathematical and physical models, or a prototype of the best solution;
- ❑ evaluate the prototype and determine the resources, including computer applications, required to produce it;

- ❑ communicate the solution, using one or more of the following: final drawings, graphs, charts, sketches, technical reports, electronic presentations, flow charts, mock-ups, models, prototypes, and so on;
- ❑ obtain feedback on the final solution and repeat the design process if necessary to refine or improve the solution;

TF2.01 - describe the properties (physical, mechanical, structural, and thermal) of natural and manufactured building materials;
TF2.03 - describe the materials, and methods of applying them, used in various construction components (e.g., footings, foundations, floors, walls, roofs, windows, doors, millwork, interior and exterior finishes, hardware);
SP1.01 - design (using effective brainstorming techniques), plan, and implement the best solutions for a variety of construction projects;
SP1.02 - apply design principles to, and identify good planning characteristics of, construction projects;
SP1.07 - establish work schedules for a construction project;
SP2.09 - compare different construction techniques, building materials, and finishes used in construction projects;
SP2.11 - complete a construction project using a variety of tools and equipment for calculating and laying out;
SP2.12 - explain the reasons for selecting the structure and materials for a particular project;
SP3.01 - prepare a materials list for a construction project;
SP3.03 - prepare a detailed, accurate estimate of the quantities of materials and costs of a building project, using conventional and computer-aided resources, charts, tables, technical data, and working drawings;
IC2.01 - identify hazards related to the materials, processes, and equipment used in a construction work environment;
IC2.02 - demonstrate safe shop practices when using hand and power tools, materials, and equipment.

Prior Knowledge & Skills

- sketching and use of computer-aided design software
- research skills using the Internet, publications, and other sources
- experience in the safe use of woodworking tools and equipment
- an understanding of the design process
- safety passport (Appendix 2.4.1)
- interactive and collaborative group skills

Planning Notes

- The teacher should facilitate a working relationship between experts/advisors (archivists, historians, architects, carpenters, cabinet makers) and the group of students who are involved in a particular activity.
- Guest speakers can be invited to address students on a variety of construction-related careers (for example, cabinet maker, renovation or restoration contractor, architect, historian, carpenter, etc.
- It should be noted that, while students may work collaboratively during this activity, each student is responsible for individual components of the final project and presentation.
- The teacher should develop an ever-growing resource of magazines, photographs, and other illustrations depicting homes (both new and old), architectural details, and construction elements.
- There is almost limitless variation in the type of components that students could undertake, given the great range of architectural styles and individual needs.

- The teacher should collect as many examples of trim components and details as possible, as samples for students and as teaching aids. These may be constructed by the teacher or by students. These make a valuable resource and make it easier for students to identify the most appropriate components for their designs.
- Contact wooden trim manufacturers and request samples of all their products. Other sources for these examples are salvage yards and demolition sites.
- If the full-scale size of the project creates storage difficulties, students may construct the project in the form of a scale model using many of the same tools and processes.
- It should be noted that a group of students may work on an individual project with each student involved in the fabrication of some components of the project.
- Whenever possible, recycled materials should be used in the fabrication of components.
- Students may develop a photographic archive of architectural details that involve trim elements and prepare a portfolio of examples of components that reflect a broad range of architectural styles.

Teaching/Learning Strategies

1. The teacher introduces the design challenge to the students.
2. The teacher and students discuss the goals of the activity and possible enrichment opportunities.
3. The teacher and students discuss the project. This could be a guest lecture by a history or art teacher or someone from the local community who has particular interest in, and knowledge about, architectural history, architectural restoration, reproduction of details or fine woodworking.
4. The teacher and students review the set of parameters that have to be included in the design (e.g., period style, specific need or proposed use, relationship of new to existing, specific materials, special detailing, etc.).
5. The teacher supplies examples of professional scaled drawings of components and details for residential and small commercial or public buildings.
6. Students utilize a complete design process, from problem definition through research and concept sketches, to final submission and presentation of scaled drawings and prototype
7. If appropriate, students may work from existing drawings or those prepared by other students or professionals.
8. Students communicate, with teacher's permission, as needed, with building owners to obtain permission to complete information gathering.
9. The teacher should check cutting lists before the student proceeds.
10. Students use a variety of tools and equipment to fabricate the architectural components. Special attention must be given to the safe, competent use of tools (see Appendix 2.4.1 – Sample Safety Passport).
11. The teacher provides individual and group instruction on specific equipment as needed, and employs the safety passport.
12. The teacher and students assess the success of the activity through group presentations and discussions on all the components of the design and construction process.

Assessment & Evaluation of Student Achievement

Task/Product	Tool	Purpose	Achievement Chart Categories
Skills Assessment	Observation	Diagnostic	Application
Drawings	Checklist	Formative – on-going throughout activity	Knowledge/Understanding Thinking/Inquiry Application
Prototype	Checklist	Formative	Knowledge/Understanding Application
Design Report	Anecdotal comments	Formative	Thinking/Inquiry Communication
Presentation	Rubric	Summative	Knowledge/Understanding Thinking/Inquiry Communication

Accommodations

- Students with knowledge of sketching, computer-assisted drawing or with skill and experience in specific areas (wood turning, for example) from previous art and/or technology courses may be paired with students who are not yet proficient with these techniques.
- As an enrichment, students may produce more elaborate or additional scale drawings and architectural components. They may increase the manufacturing complexity by incorporating a variety of materials and assembly methods. Isometric or perspective drawings, or detail drawings could be produced and made available for other students and future projects.
- Students may follow a pre-designed production sequence.
- Teachers or other students may create some sample templates for use in duplicating some components, e.g., brackets or balusters. These are useful for students who require a less open-ended learning strategy.
- Groups of students may engage in an architectural scavenger hunt. The hunt takes a route through a neighborhood that contains outstanding examples of architecture. Each team has a list of architectural elements, examples of which are evident along the route. The team must find the element and record its location (street and address). An additional component to this trip could be the requirement that the details be sketched and/or photographed by group members.
- Ensure that students with special needs are provided for on field trips and walking tours.

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– www.msbigday.com – Microsoft Free Seminar Series

– www.hometime.com

–www.oldhousejournal.com

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– www.doityourself.com

Videos

This Old House, video sets

Hometime, video series

Taunton Press, video series

Do It Yourself, Video Series

Community Resources

University Archives

Historical Societies

Architects

Local Architectural Conservancy Advisory Committee (LACAC)

Local Historians and Authors

Restoration and Renovation Contractors

Cabinetmakers

Videos

Taunton Video Series, e.g., *Router Joinery*

Router Jigs and Techniques

Frame and Panel Construction

Wood Finishing

Turning Furniture Spindles

Turning Projects

Turning Wood

Appendix 2.4.1

Sample Safety Passport

This is a sample of a generic safety passport that may be adopted for use in a number of technology classrooms. The purpose of the safety passport is to ensure that students are fully aware of all safety features on each piece of equipment in the technical facility prior to using it independently. This process may be adapted to suit the needs of the teacher and student.

The general process is as follows:

1. The student records the date of the safety demonstration on the safety passport. It is initiated by the teacher, (see sample below) when a new piece of equipment, e.g., lathe, is introduced. The teacher demonstrates techniques for the safe operation of the machine and personal protective equipment, e.g., proper eye protection, securing loose hair, removing jewelry, protective clothing, etc. The student takes notes on the demonstration and records the information in a notebook along with the signed passport slip. If a student is absent on the day of a safety demonstration, a makeup opportunity must be provided.
2. Each student must complete a written (or oral) test on the safe operation of the machine tool, outlining all safety features that must be observed. The student must record the written tests in a notebook. These individual machine tests are designed to compliment any general facility safety rules. The student dates the "tested" column and the teacher initials this as complete when the test is completed satisfactorily. Next, students must demonstrate to the teacher that they have a thorough knowledge of the safety rules for the equipment and are able to demonstrate their competency on the equipment. Once the teacher has observed the required safe setup and operation of the equipment by a student, the teacher signs off that portion of their passport.
3. The teacher signs the final column of student's safety passport once the student has completed steps 1, 2, and 3. The student is now able to use that piece of equipment. Students must be able to provide the teacher with their signed passport for that equipment each time they wish to use it. A summary document of all the various permissions may be created by the student and signed by the teacher (as permissions are earned); these summary safety passports may be protected with page protectors or laminated for protection. See the sample summary passport below.

Sample Equipment Safety Passport

Student Name: _____

Equipment: _____

See notebook for the note on safe setup and operation of the equipment.

Attended Teacher Safety Instruction and Demonstration (and note recorded)		Passed Written or Oral Testing		Demonstrated Safe Setup and Operation of Equipment to Teacher		Granted Permission to use Equipment by Teacher	
Date of Lesson	Teacher Initial	Date Tested	Teacher Initial	Date of Demo	Teacher Initial	Date	Teacher Initial