Civil Engineering Technology Program Standard

The approved program standard for all Civil Engineering Technology programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario Colleges of Applied Arts and Technology (MTCU funding code 61003)

Ministry of Training, Colleges and Universities
January 2004
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Inquiries regarding specific Civil Engineering Technology programs offered by colleges of applied arts and technology in Ontario should be directed to the relevant college.

This version replaces the program standard released in June 1996. Inquiries regarding this program standard should be directed to the address noted above.

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I. Introduction

This document is the Program Standard for all Civil Engineering Technology programs of instruction leading to an Ontario College Advanced Diploma delivered by Ontario colleges of applied arts and technology (MTCU funding code 61003). This version replaces the one released in June 1996.

Development of System-Wide Program Standards

In 1993, the Government of Ontario initiated program standards development with the objectives of bringing a greater degree of consistency to college programming offered across the province, broadening the focus of college programs to ensure graduates have the skills to be flexible and to continue to learn and adapt, and providing public accountability for the quality and relevance of college programs.

The Colleges Branch of the Ministry of Training, Colleges and Universities has responsibility for the development, review, and approval of system-wide standards for programs of instruction at Ontario colleges of applied arts and technology.

Program Standards

Program standards apply to all similar programs of instruction offered by colleges across the province. Each program standard for a postsecondary program includes the following elements:

- **Vocational standard** (the vocationally specific learning outcomes which apply to the program of instruction in question),

- **Generic employability skills standard** (the generic skills learning outcomes which apply to all programs of instruction offering similar credentials), and

- **General education standard** (the requirement for general education in postsecondary programs of instruction).

Collectively, these elements outline the essential skills and knowledge that a student must reliably demonstrate in order to graduate from the program.

Individual colleges of applied arts and technology offering the program of instruction determine the specific program structure, delivery methods, and other curriculum matters to be used in assisting students to achieve the outcomes articulated in the standard. Individual colleges also determine whether additional local learning outcomes will be required to reflect specific local needs and/or interests.
The Expression of Program Standards as Learning Outcomes

Learning outcomes represent culminating demonstrations of learning and achievement. They are not simply a listing of discrete skills, nor broad statements of knowledge and comprehension. In addition, learning outcomes are interrelated and cannot be viewed in isolation of one another. As such, they should be viewed as a comprehensive whole. They describe performances that demonstrate that significant integrated learning by graduates of the program has been achieved and verified.

Expressing standards as learning outcomes ensures consistency in the outcomes for program graduates, while leaving to the discretion of individual colleges curriculum matters such as the specific program structure and delivery methods.

The Presentation of the Learning Outcomes

The learning outcome statement sets out the culminating demonstration of learning and achievement that the student must reliably demonstrate before graduation.

The elements of the performance for each outcome define and clarify the level and quality of performance necessary to meet the requirements of the learning outcome. However, it is the performance of the learning outcome itself on which students are evaluated. The elements are indicators of the means by which the student may proceed to satisfactory performance of the learning outcome. The elements do not stand alone but rather in reference to the learning outcome of which they form a part.

The Development of a Program Standard

In establishing the standards development initiative, the Government determined that all postsecondary programs of instruction should include vocational skills coupled with a broader set of essential skills. This combination is considered critical to ensuring that college graduates have the skills required to be successful both upon graduation from the college program and throughout their working and personal lives.

A program standard is developed through a broad consultation process involving a range of stakeholders with a direct interest in the program area, including employers, professional associations, universities, secondary schools, and program graduates working in the field, in addition to students, faculty, and administrators at the colleges themselves. It represents a consensus of participating stakeholders on the essential learning that all program graduates should have achieved.
Updating the Program Standard

The Ministry of Training, Colleges and Universities will undertake regular reviews of the vocational learning outcomes for this program to ensure that the Civil Engineering Technology Program Standard remains appropriate and relevant to the needs of students and employers across the Province of Ontario. To confirm that this document is the most up-to-date release, contact the Ministry of Training, Colleges and Universities at the address or telephone number noted on the inside cover page.
II. Vocational Standard

All graduates of Civil Engineering Technology programs of instruction must have achieved the 14 vocational learning outcomes listed in the following pages, in addition to achieving the generic employability skills learning outcomes and meeting the general education standard.

Preamble

The program standard for the Civil Engineering Technology Program includes a foundation of vocational skills that are achieved concurrently with the generic employability skills and general education standards. Graduates will have completed a program that is based on applied mathematics and scientific and engineering theory, principles, and practices.

Through successful achievement of the vocational standard, the generic employability skills standard, and the general education standard, graduates, as entry-level practitioners, have the knowledge, skills, and attitudes that are necessary to perform their roles according to recognized civil engineering practices. This enables graduates to evaluate assignments, establish objectives, set parameters, and determine and implement appropriate procedures and actions. Graduates are able to adhere to applicable laws, to exercise due diligence in the workplace, to adhere to health and safety practices, and to work in accordance with labour-management principles and practices. Graduates are prepared to assume responsibility for their work and may work independently or interdependently as part of a civil engineering or multi-disciplinary team.

For graduates of the Civil Engineering Technology Program, there are employment and career opportunities in a variety of areas of business, industry, government, and public organizations. The graduate could find employment in careers including design of processes, infrastructure, or systems; interpretation or preparation of specifications, drawings, or instructions; sales and marketing; purchasing operations; maintenance; field and customer service; estimating; quality management; production control; and management and supervision of projects and training.

With experience and ongoing learning, graduates will be able to enhance their professional competence and expand their scope of practice. There may be opportunities for graduates to pursue further educational or occupational qualifications; through apprenticeship or through articulation agreements between the colleges, universities, or professional organizations, graduates may be granted credits towards a degree and/or certification. Students should contact individual colleges for further details of a college's articulation agreements with other institutions or professional associations.
Synopsis of the Vocational Learning Outcomes
Civil Engineering Technology Programs

The graduate has reliably demonstrated the ability to

1. assemble, analyse, and appropriately apply civil engineering data from existing graphics,* reports, and other documents.

2. coordinate and facilitate the collection, processing, and interpretation of technical data* related to civil engineering projects.*

3. communicate information effectively and accurately by analysing, translating, and producing civil engineering documents.

4. monitor that all work is completed in compliance with the rights and conditions of contractual obligations; applicable law,* standards, bylaws, and codes; and the accepted principles and practices* of civil engineering.

5. schedule and coordinate civil engineering projects* and monitor the quality and quantity of work.

6. assist in planning, designing, inspecting, supervising, and constructing civil engineering projects.*

7. evaluate the methods employed and the use of equipment and materials involved in the implementation and completion of civil engineering projects.*

8. use electronic technology to support civil engineering projects.*

9. apply the principles of mathematics* and science* to analyze and solve technical problems* related to civil engineering projects.*

10. manage and maintain systems for civil engineering project records, logs, and inventories.

11. assist in the assessment of the political, social, and environmental impacts of civil engineering projects.*

* Please see Glossary of Terms
12. take into account the interdependence of the architectural, structural, mechanical, and electrical disciplines relating to civil engineering projects.*

13. facilitate liaison among the project stakeholders* involved in the design and implementation of civil engineering projects.*

14. develop and use personal and professional strategies and plans to enhance professional growth and competence.

Note: The learning outcomes have been numbered as a point of reference; numbering does not imply prioritization, sequencing, nor weighting of significance.

* Please see Glossary of Terms
The Vocational Learning Outcomes

1. The graduate has reliably demonstrated the ability to

assemble, analyse, and appropriately apply civil engineering data from existing
graphics,* reports, and other documents.

Elements of the Performance

• Participate as a member of the project team to establish the scope of the project in
consultation with the project stakeholders*
• Determine the type of data required
• Identify the most appropriate source(s) for data
• Select, retrieve, validate, organize, and summarize data by using paper-based and
computerized techniques
• Explain the selection and use of data
• Assist in the preliminary analysis of data by using systematic approaches to problem
solving and decision making in accordance with recognized standards and practices

* Please see Glossary of Terms
2. The graduate has reliably demonstrated the ability to coordinate and facilitate the collection, processing, and interpretation of technical data* related to civil engineering projects.*

Elements of the Performance

- Assist with the development of appropriate strategies for the collection of technical data*
- Select, operate, and supervise the use of a variety of data collection equipment
- Measure, record, and evaluate technical data in accordance with recognized industry standards
- Ensure that data collected are within expected parameters of accuracy
- Process and document civil engineering data by using computers and appropriate software correctly
- Collect and interpret data relevant to potential and actual relationships between civil engineering projects* and their physical environment (e.g., air, water, soil)
- Determine if the data is compatible with existing hardware and software for the end user

* Please see Glossary of Terms
3. The graduate has reliably demonstrated the ability to communicate information effectively and accurately by analysing, translating, and producing civil engineering documents.*

Elements of the Performance

• Assemble relevant information and data
• Establish criteria; organize and prepare documents according to industry standards
• Employ appropriate techniques to produce documents for civil engineering projects*
• Evaluate and modify documents in a variety of formats
• Present civil engineering data and contribute to the making of recommendations to project stakeholders*
• Prepare and present project-related documents including formal technical reports in oral and written formats
• Select and use relevant information to construct models for civil engineering projects using paper-based and computer-assisted techniques
• Use correct terminology
• Transfer digital information effectively in required format and to specified standards

* Please see Glossary of Terms
4. *The graduate has reliably demonstrated the ability to*

monitor that all work is completed in compliance with the rights and conditions of contractual obligations; applicable law,* standards, bylaws, and codes; and the accepted principles and practices* of civil engineering.

**Elements of the Performance**

- Assist in the review and preparation of typical contracts for compliance with legal principles and the tendering processes
- Adhere to applicable environmental, and health and safety-related legislation and practices
- Take into account environmental sustainability issues
- Select equipment, materials, and practices that comply with relevant law,* legislation, standards, codes, and bylaws
- Apply standard business and administrative principles and practices
- Prepare estimates and assist in the preparation of tender and construction documents
- Understand and use ethical practices as outlined by professional associations
- Take into account labour-management principles and practices

* Please see Glossary of Terms
5. *The graduate has reliably demonstrated the ability to*

schedule and coordinate civil engineering projects* and monitor the quality and quantity of work.

**Elements of the Performance**

- Assist in establishing the phases of the project and their component activities
- Assist in reviewing the criteria applicable to each phase of work
- Monitor project schedules
- Recognize and interpret required data using appropriate statistical data analysis tools
- Perform quantity surveys and cost estimates
- Observe, record, assess, and report work activity
- Conduct and/or coordinate quality assurance* sampling and testing
- Evaluate reports, minutes, logs, diaries, and relevant technical data*
- Identify and seek assistance to resolve problems related to materials, scheduling, resources, and budgets in order to complete civil engineering projects*
- Monitor adherence to occupational health and safety regulations

* Please see Glossary of Terms
6. *The graduate has reliably demonstrated the ability to*

   assist in planning, designing, inspecting, supervising, and constructing civil engineering projects.*

**Elements of the Performance**

- Assist in establishing the technical criteria necessary to design and construct civil engineering projects*
- Review the technical criteria used in the design, layout, and construction of civil engineering projects*
- Identify and seek assistance to resolve technical problems* in the design, layout, and construction of civil engineering projects*
- Recognize own role within the project team to plan, implement, and evaluate civil engineering projects*
- Take into account appropriate project management principles and methods
- Assist in selecting appropriate criteria to design, inspect, and construct civil engineering projects*
- Monitor the financial resources, human resources, and time-lines of civil engineering projects
- Use organizational and time-management strategies to support civil engineering projects*
- Review failure and accident reports and make appropriate recommendations
- Create deficiency lists and recommend solutions
- Consider health and safety factors in design and construction

* Please see Glossary of Terms
7. The graduate has reliably demonstrated the ability to

   **evaluate the methods employed and the use of equipment and materials involved in the implementation and completion of civil engineering projects.***

**Elements of the Performance**

- Review and explain the specifications, limitations, use, and safety aspects of equipment, and construction materials
- Ensure operational safety and accuracy of equipment
- Perform and/or supervise quality-assurance* sampling and testing; interpret results; and make necessary adjustments or changes
- Ensure that equipment is used according to manufacturer's recommended directions
- Contribute to overall project safety
- Ensure the proper handling and use of materials
- Consider and report on the costs/benefits of methods employed

* Please see Glossary of Terms
8. The graduate has reliably demonstrated the ability to

use electronic technology to support civil engineering projects.*

Elements of the Performance

• Keep abreast of changes in technology that affect civil engineering
• Use electronic systems to select, store, and retrieve information
• Use electronic communications effectively to access and share information
• Apply knowledge of computers and application software to solving civil engineering problems
• Manage civil engineering data by using computers and appropriate software correctly
• Use electronic technology to assist in various phases of civil engineering projects*

* Please see Glossary of Terms
9. *The graduate has reliably demonstrated the ability to*

apply the principles of mathematics* and science* to analyse and solve technical problems* related to civil engineering projects.*

**Elements of the Performance**

- Use mathematical and scientific analyses to identify and solve technical problems*
- Apply standardized mathematical and scientific formulas and techniques accurately
- Perform civil engineering calculations correctly
- Apply mathematical and scientific principles to assist in the analysis, design, and construction of civil engineering projects
- Use mathematical and scientific terminology correctly and to the required degree of accuracy in written and oral communication

* Please see Glossary of Terms
10. *The graduate has reliably demonstrated the ability to*

manage and maintain systems for civil engineering project records, logs, and inventories.

**Elements of the Performance**

- Collect, organize, and apply project-related information
- Establish and implement an appropriate system to store and retrieve information
- Keep ongoing, accurate project records, minutes, diaries, and accounts of civil engineering projects* according to established formats, policies, and procedures
- Use collected and stored information accurately and effectively to assist in decision making, reporting, and quality assurance*
- Monitor, report, and correct deficiencies and non-compliance with project specifications
- Monitor, report, and resolve quality and cost deviations
- Apply principles of cost control and accounting to do budget forecasts and project estimates
- Apply principles of information management and materials management

* Please see Glossary of Terms
11. *The graduate has reliably demonstrated the ability to*

assist in the assessment of the political, social, and environmental impacts of civil engineering projects.*

**Elements of the Performance**

- Recognize legislative requirements for impact studies
- Coordinate, monitor, interpret, and report to appropriate authorities the results of impact studies and assessments
- Identify the project stakeholders* and obtain their input about civil engineering projects*
- Provide feedback to project stakeholders*
- Identify and attempt, where possible, to reduce the negative political, social, and environmental impacts of civil engineering projects*
- Consider the principles of sustainable development, combining environmental stewardship and economic performance, in project work

* Please see Glossary of Terms
12. *The graduate has reliably demonstrated the ability to*

   *take into account the interdependence of the architectural, structural, mechanical, and electrical disciplines relating to civil engineering projects.*

**Elements of the Performance**

- Take into account theory and research of relevant disciplines when assisting in designing, implementing, and evaluating civil engineering projects*
- Participate as a member of a multi-disciplinary team to design, implement, complete, and evaluate civil engineering projects*
- Recognize the role of the civil engineering technologist* as a member of the project team

* Please see Glossary of Terms
13.  The graduate has reliably demonstrated the ability to facilitate liaison among the project stakeholders* involved in the design and implementation of civil engineering projects.*

Elements of the Performance

• Identify and keep informed the key project stakeholders*
• Support the roles, rights, and responsibilities of project stakeholders*
• Facilitate interaction among project stakeholders* by using effective individual and group interpersonal skills
• Facilitate and participate in job-site and project-related off-site meetings
• Report, in written, graphics,* and oral formats, the results of job-site and project-related off-site meetings
• Use appropriate interpersonal skills and terminology suited to the situation and project stakeholders*
• Promote project direction as a team member

* Please see Glossary of Terms
14. The graduate has reliably demonstrated the ability to develop and use personal and professional strategies and plans to enhance professional growth and competence.

Elements of the Performance

- Apply a systematic approach to decision making
- Keep abreast of changes in the civil engineering field
- Use appropriate self-management techniques (e.g., time management, stress management)
- Recognize the importance of ongoing professional development
- Apply team work and interpersonal knowledge and skills to improve work relationships
- Act reliably, flexibly, and tactfully, and use good judgement in all interpersonal situations
- Listen effectively and respond appropriately to feedback
- Integrate the need for self-evaluation and commitment to lifelong learning
- Seek assistance to resolve problems beyond own knowledge and skills
- Recognize the importance of professional associations and the value of obtaining professional designations and certification
Glossary of Terms

**Accepted Principles and Practices** – the knowledge, skills, and attitudes used in civil engineering that are based on applied theory and research, experience, and the profession's standards and ethical guidelines.

**Civil Engineering Projects** – the product of and the technical steps and phases required to design, plan, implement, and evaluate geotechnical, structural, survey, hydraulics, transportation, urban, building, infrastructure, and subdivision work.

**Documents** – graphics, reports, field notes, cost estimates, specifications, and contract documents.

**Geomatics** – a field of scientific and technical activities which, using a systemic approach, integrates all the means used to acquire and manage spatially referenced data as part of the process of producing and managing spatially based information (Gagnon and Coleman, 1990: 378).

**Graphics** – a model or pictorial representation of information, including field notes, sketches, drawings (e.g., design, plan/profile, as-built plans) and maps (e.g., geotechnical, hydrographic, contours, topographic), and urban and subdivision plans. Graphics can be paper-based or computer-assisted.

**Law** – all governing federal, provincial, and municipal law, legislation, and regulations.

**Mathematics** – the study of space and numbers as applied to civil engineering projects. Mathematics includes algebra, calculus, geometry, trigonometry, linear equations, logarithmic functions, graphs, ratios and proportions, and basic statistics.

**Project Stakeholders** – any group or individual who has a vested interest in the civil engineering project including the clients, suppliers, purchasers, community, consultants, contractors, project personnel, management team, municipal authorities, and the public.

**Quality Assurance** – the control and improvement of civil engineering projects by sampling, testing, calibrating, monitoring, correcting, and enhancing performance, materials, and equipment. Quality assurance is based on the potential, specifications, and limitations of materials, equipment, and human resources.

**Science** – systematic theory and research of material facts. Sciences useful for civil engineering work include physics, geodesy, photogrammetry, astronomy, and cartography.

**Technical Data** – information referring to field, survey/geomatics, and laboratory data.
Technical Problems – specialized difficulties affecting the project including those related to statics, dynamics, thermal dynamics, work, energy, power, motion, and friction.

Technologist – the technologist approaches the solution of problems in applied science and engineering technology with a comprehensive understanding of a specific field of technology. The technologist evaluates assignments, establishes objectives, defines problems, and decides upon procedures and actions for their accomplishment or resolution. (taken from the National Standards-Civil Technologies, 1994: 1)

References

III. Generic Employability Skills Standard

All graduates of Civil Engineering Technology Programs must have achieved the thirteen generic employability skills learning outcomes listed on the following pages, in addition to achieving the vocational learning outcomes and meeting the general education standard. In the generic employability skills learning outcomes, an explanation of the outcome is also provided to help ensure clarity.
Synopsis of the Generic Employability Skills Learning Outcomes
Civil Engineering Technology Programs

*The graduate has reliably demonstrated the ability to*

1. communicate clearly, concisely, and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audiences.

2. reframe information, ideas, and concepts using the narrative, visual, numerical, and symbolic representations which demonstrate understanding.

3. apply a wide variety of mathematical techniques with the degree of accuracy required to solve problems and make decisions.

4. use a variety of computer hardware and software and other technological tools appropriate and necessary to the performance of tasks.

5. interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.

6. evaluate her or his own thinking throughout the steps and processes used in problem solving and decision making.

7. collect, analyze, and organize relevant and necessary information from a variety of sources.

8. evaluate the validity of arguments based on qualitative and quantitative information in order to accept or challenge the findings of others.

9. create innovative strategies and/or products that meet identified needs.

10. manage the use of time and other resources to attain personal and/or project-related goals.

11. take responsibility for her or his own actions and decisions.

12. adapt to new situations and demands by applying and/or updating her or his knowledge and skills.

13. represent her or his skills, knowledge, and experience realistically for personal and employment purposes.
The Generic Employability Skills Learning Outcomes

1. *The graduate has reliably demonstrated the ability to*

   communicate clearly, concisely, and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audiences.

**Explanation**

Communicating in a clear, concise, and correct manner requires producing the written, spoken, or visual material that best suits the situation. Graduates will have developed their ability to analyze their audiences to identify what is required and to match those needs with the means that is most appropriate. They will have produced material according to the style and conventions required, and they will have checked their products for accuracy and clarity. Finally, graduates will have used the tools available to them to create and correct their written, spoken, and visual messages.

**Elements of the Performance**

- Plan and organize communications according to the purpose and the audiences
- Choose the format (e.g., memo, illustration, video, multimedia presentation, diagram) appropriate to the purpose
- Incorporate content that is meaningful and necessary
- Produce material that conforms to the conventions of the chosen format
- Use language and style suitable to the audience and purpose
- Ensure that the material is free from mechanical errors
- Use the computer technology that will enhance the production of materials
- Evaluate communications and adjust for any errors in content, structure, style, and mechanics
2. *The graduate has reliably demonstrated the ability to*

reframe information, ideas, and concepts using the narrative, visual, numerical, and symbolic representations which demonstrate understanding.

**Explanation**

Responding to messages from many sources requires the ability to receive and to comprehend what has been received. One way to demonstrate that comprehension is to reframe, or restate in other forms, the original message. This requires graduates to have developed the skills to read, listen to, and observe messages contained within narrative and visual form. It also requires the ability to construct unique narrative and visual representations that are consistent with the original messages.

**Elements of the Performance**

- Develop and use strategies to read, listen, and observe effectively
- Clarify what has been read, heard, and observed
- Reproduce original information in other formats (e.g., written and spoken summaries; tables, figures, charts, diagrams, maps, drawings, photographs, and computer-generated graphics; terms represented by numbers; and values represented by letters or signs)
- Use technology, where appropriate, to aid in reframing
- Evaluate the representation for consistency of meaning with the original
- Acknowledge the use of material from other sources according to the conventions of the medium used
3. The graduate has reliably demonstrated the ability to

apply a wide variety of mathematical techniques with the degree of accuracy required to solve problems and make decisions.

Explanation

Using mathematics effectively in everyday situations requires the ability to apply a wide variety of mathematical skills accurately. Graduates will have demonstrated their ability to apply the concepts of number and space to situations which include quantities, magnitudes, measurements, and ratios. They will have developed their ability to identify the need for mathematics, to apply mathematical techniques (concepts, conventions, strategies, and operations) and to check the results of their applications. This will require graduates to be flexible and creative and to be confident in their mathematical skills and abilities.

Elements of the Performance

- Recognize situations that require mathematics
- Assess potential mathematical strategies (including models, geometric representations or formulas, elementary algebraic equations, descriptive statistical methods, and mathematical reasoning) for suitability and effectiveness
- Decide on the degree of accuracy required for answers
- Estimate probable answers
- Execute mathematical operations necessary to implement selected strategies
- Use calculators or appropriate technological tools to perform mathematical operations accurately
- Check for errors in numerical answers and the appropriate fit between problems and answers
- Express answers clearly
- Transfer the use of mathematical strategies from one situation to another
4. The graduate has reliably demonstrated the ability to

use a variety of computer hardware and software and other technological tools appropriate and necessary to the performance of tasks.

Explanation

Using computers and other technologies as tools to increase productivity and to enhance tasks requires graduates to have the confidence and ability to use the tools well. Graduates will have demonstrated the ability to recognize when computers and other technologies contribute to completing tasks, solving problems, performing research, and creating products. They will use the technological tool most appropriate to the task and use it accurately. Finally, they will have gained confidence in continuing to learn about and cope with new technologies in the future.

Elements of the Performance

• Use basic operating system functions competently (e.g., load software, store and retrieve data)
• Determine which tasks can best be handled by computers and other technology
• Select suitable software, equipment, and tools for the task
• Use the software, equipment, and tools effectively, correctly, and ethically
• Deal with equipment and software problems and errors in a logical and systematic manner
• Transfer concepts, knowledge, and skills from one technology to another
• Evaluate one’s own use of hardware, software, and technological tools
5. *The graduate has reliably demonstrated the ability to*

   interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.

**Explanation**

Working in teams or groups in either a work or personal context requires the ability to assume responsibility for collective duties and decisions. It also requires interacting effectively with the members of the group. Therefore, in achieving this outcome, graduates will have demonstrated their ability to understand and complete the various tasks required of them as group members. They will also have demonstrated their ability to understand and respond to others.

**Elements of the Performance**

- Identify the tasks to be completed
- Establish strategies to accomplish the tasks
- Identify roles for members of the team/group
- Clarify one’s own roles and fulfill them in a timely fashion
- Treat other members of the group equitably and fairly
- Contribute one’s own ideas, opinions, and information while demonstrating respect for those of others
- Employ techniques intended to bring about the resolution of any conflicts
- Regularly assess the group’s progress and interactions and make adjustments when necessary
6. *The graduate has reliably demonstrated the ability to*

   evaluate her or his own thinking throughout the steps and processes used in problem solving and decision making.

**Explanation**

Solving a range of complex problems and dealing with a variety of tasks require the thinking skills and strategies that will allow graduates to identify what has to be done and to select and implement the most suitable approach. In applying thinking skills and strategies, graduates will have understood the limits as well as the potential of their own thought processes. As well, in attempting various strategies, they will have explored styles of thinking that may be new to them. This will allow graduates to understand the way they think and how they approach decisions and problems.

**Elements of the Performance**

- Clarify the nature and extent of problems or required directions
- Explore various thinking skills and strategies that could be used
- Identify limits as well as the potential of one’s own thought processes
- Choose and apply thinking skills and strategies (e.g., inductive and deductive thinking; creative and intuitive thinking; inquiry; critical thinking; and reflection)
- Evaluate results of the thinking skills and strategies used in problem solving and decision making
- Appreciate the benefits of the use of alternative types of thinking
7. The graduate has reliably demonstrated the ability to

collect, analyze, and organize relevant and necessary information from a variety of sources.

Explanation

Making decisions and completing tasks often requires information that can be used as support. Graduates, therefore, must be able to access current, relevant, and useful information and to organize that information in understandable ways. In achieving this outcome, graduates will have developed and used strategies to locate and gather a wide range of information, most particularly through technological means. They will have learned how to select pertinent information and to sort it so that it can be displayed in useful formats like databases and spreadsheets. This information can then be used to support decisions and to assist in the completion of tasks.

Elements of the Performance

- Identify the nature of information required
- Investigate sources of information (including people, text, databases, and the Internet)
- Gather information from the most appropriate sources using various data collection techniques, including technology
- Examine the information and select what is relevant, important, and useful
- Employ a variety of techniques to organize the information (e.g., spreadsheets, databases, graphs, charts)
- Draw conclusions about how the information can be used
- Evaluate the processes used
- Cite sources according to the conventions of the medium used
8. The graduate has reliably demonstrated the ability to evaluate the validity of arguments based on qualitative and quantitative information in order to accept or challenge the findings of others.

Explanation

With the wealth of numerical and non-numerical information available, graduates must be able to interpret, understand, and draw conclusions about what others have produced. Graduates will have used their mathematical abilities to question the validity of statistics and other numerical claims. Graduates also will have used their language and critical thinking skills to analyze the assumptions and evidence that others use to support more qualitative arguments and conclusions. As a result, graduates will have developed the ability to question and make decisions about what they read, hear, and observe.

Elements of the Performance

• Identify conclusions and claims made by others
• Detect any fallacies, biases, misrepresentations, and assumptions and judge their relevance to supporting arguments
• Check for accuracy and credibility of claims or arguments
• Be prepared to defend acceptance or rejection of claims or arguments
9. *The graduate has reliably demonstrated the ability to*

   create innovative strategies and/or products that meet identified needs.

**Explanation**

Creating strategies and products that are original and innovative will require graduates to develop their creative thinking skills to find alternative ways to address situations. Graduates will have developed the confidence to use old information in new ways; to see unique relationships; and to practice the lateral, divergent, and intuitive thinking that will yield new approaches.

**Elements of the Performance**

- Analyze needs
- Generate creative ideas for strategies and products that will meet needs
- Choose alternatives to pursue based on needs and criteria of projects/plans
- Create strategies/products
- Evaluate strategies/products according to meeting needs
10. The graduate has reliably demonstrated the ability to

manage the use of time and other resources to attain personal and/or project-related goals.

Explanation

Achieving task-related goals in their personal and professional lives requires graduates to use their time, money, space, and other, often limited, resources as efficiently as possible. Graduates will have developed their ability to plan and predict ways of achieving goals. They will have developed and used tools intended to assist in the process. Finally, they will have attempted to follow their plans and use the tools, assessing regularly how realistic the goals, plans, and processes are and adapting when it is necessary.

Elements of the Performance

- Define reasonable and realistic goals
- Use planning tools (e.g., budgets, schedules) to achieve goals
- Monitor the process and goals and respond to changes
- Use resources (e.g., money, space, time) efficiently to accomplish tasks
- Re-evaluate goals and the use of resources and make appropriate adjustments
11. *The graduate has reliably demonstrated the ability to*

   **take responsibility for her or his own actions and decisions.**

**Explanation**

Making decisions, taking positions, and completing tasks require graduates to be accountable for actions taken and to defend their convictions. Graduates will have demonstrated their ability to evaluate what they do and why they do it. They will have taken into consideration their individual values, beliefs, and opinions and the effects these have on their actions. Not only will graduates be able to justify their decisions, they will be able to advocate positively on behalf of themselves.

**Elements of the Performance**

- Review the results of one’s actions and decisions
- Reflect on the processes and practices used
- Identify any errors and make corrections
- Identify successes for adaptation to other situations
- Account for how one’s own values and beliefs affect actions and decisions
- Evaluate and act upon constructive feedback
- Be prepared to defend decisions made and actions taken
12. The graduate has reliably demonstrated the ability to

adapt to new situations and demands by applying and/or updating her or his knowledge and skills.

Explanation

Transferring skills from one context to another enables graduates to be lifelong learners. Graduates will have developed the confidence to know that their current skills are applicable to a range of changing, novel, and unexpected situations. They will have demonstrated their ability to reflect on what they can do, match those skills to the new demands, and apply previous skills or develop the additional ones that will make them as effective in the new situations.

Elements of the Performance

• Assess current skills, knowledge, and learning styles
• Identify skills and knowledge required for new situations
• Adapt current skills and knowledge to new situations
• Identify new skills and knowledge required
• Choose the most appropriate learning and working styles to acquire new skills and knowledge
• Evaluate success of the processes and actual adaptations
13. The graduate has reliably demonstrated the ability to represent her or his skills, knowledge, and experience realistically for personal and employment purposes.

Explanation

Preparing for changes in their personal and professional lives requires graduates to assess and present their accomplishments and abilities. In achieving this outcome, graduates will have developed their ability to reflect on what they have done and learned. They will also have summarized their abilities in ways that are attractive and useful to potential recipients. These ways may include portfolios and resumes. Finally, graduates will have developed the skills to present themselves and their accomplishments personally and with confidence.

Elements of the Performance

- Summarize one’s own skills, knowledge, and experience realistically
- Choose formats (e.g., resume, portfolio, interview) which best display skills, knowledge, and experiences according to the situations
- Evaluate responses to the representations and make any adjustments
IV. General Education Standard

All graduates of Civil Engineering Technology programs must have met the general education requirement described on the following pages, in addition to achieving the vocational and generic employability skills learning outcomes.

The General Education Requirement for Ontario College Diploma and Ontario College Advanced Diploma Programs

Graduates will have been engaged in learning that exposes them to at least one discipline outside their main field of study and increases their awareness of the society and culture in which they live and work. This will typically involve students taking three to five courses (or the equivalent) designed discretely from vocational learning opportunities. This learning would normally be delivered using a combination of required and elective processes.

The general education requirement is an integral component of the Civil Engineering Technology Program Standard, along with the vocational and generic employability skills learning outcomes.

The general education requirement is to be met consistent with the following guiding principles:

1. General education in the colleges shall identify and deal with issues of societal concern in a manner relevant to the lives of students. General education courses are to be structured in such a way as to guide students through the historical context of such issues, their theoretical bases, and application to contemporary life.

2. All general education courses offered in the colleges are to be designed to benefit one or more of the three aims: learners’ personal growth and enrichment, informed citizenship, and working life.

3. An essential component of the mission of Ontario’s colleges is the encouragement and support of continuous learning. This commitment to lifelong learning is to be reflected in each of the general education courses offered in the colleges.
General education appropriate for Ontario colleges is defined as those postsecondary learning experiences that enable learners to meet more effectively the societal challenges which they face in their community, family, and working life. General education in the colleges provides learners with insight into the enduring nature of the issues being addressed and into their particular relevance to today and the future. This education is intended to encourage and support continuous learning and is designed to address one or more of the following goals and associated broad objectives established for general education.

Goals and Broad Objectives

1. Aesthetic Appreciation

*understand beauty, form, taste, and the role of the arts in society*

**Broad Objectives**

- develop critical awareness of arts in society
- perceive and evaluate the role of the arts
- heighten critical appreciation through development and application of personal and formal judgement factors

2. Civic Life

*understand the meaning of freedoms, rights, and participation in community and public life*

**Broad Objectives**

- develop knowledge of the structure and function of governments in Canada: legislative, judicial, and administrative arms; roles of elected officials and public servants; and a personal awareness of citizen responsibility
- develop historical understanding of major issues affecting Canadian politics and a critical awareness of related public policy
- develop awareness of international issues and their effects, and the place of Canada in international communities
- develop awareness of the history, significance, and organization of the voluntary sector in community life
3. **Cultural Understanding**

*understand the cultural, social, ethnic, and linguistic diversity of Canada and the world*

**Broad Objectives**

- develop an understanding of cultural identity by linking personal history to broader cultural study
- develop an understanding of the diversity of cultures and subcultures represented in Canadian society and of their interactions within the Canadian society
- develop intercultural understanding through reasoned reflection on various cultures’ responses to universal human issues

4. **Personal Development**

*gain greater self-awareness, intellectual growth, well-being, and understanding of others*

**Broad Objectives**

- consider one’s expectations and values and analyze their impact on personal goals
- apply an understanding of the individual and human development to personal life and relationships
- integrate the concept of well-being into one’s lifestyle
- understand oneself as a learner and articulate one’s own learning style

5. **Social Understanding**

*understand relationships among individuals and society*

**Broad Objectives**

- develop informed understanding of social organization and institutions and of ongoing issues in relationships between individuals, groups, and societies
- develop informed understanding of social trends, social change, and social problems and of implications for social and personal response
- develop informed understanding of contemporary social problems and issues
6. Understanding Science

*appreciate the contribution of science to the development of civilization, human understanding, and potential*

**Broad Objectives**

- develop an understanding of the history, philosophy, contributions, perspectives, and limitations of the sciences
- develop an understanding of the scientific method and its uses in measuring quantifiable entities and confirming laws of nature

7. Understanding Technology

*understand the interrelationship between the development and use of technology and society and the ecosystem*

**Broad Objectives**

- relate implications of current transformations in technological knowledge and development to our physical and biological world
- develop awareness of ethical positions on enduring issues regarding the place of the human species in the physical and biological world

8. Work and the Economy

*understand the meaning, history, and organization of work; and working life challenges to the individual and society*

**Broad Objectives**

- set personal expectations for efficiency, effectiveness, ethics, and rewards and reconcile them with the changing work environment
- apply knowledge of the organization and structure of work, its institutions, and history; and of social and cultural attitudes to work
- develop an understanding of the changing nature of work and the economy