Civil Engineering

Program Requirements
Study at the master's level can be pursued through either a thesis leading to a M.A.Sc., a project option leading to a M.Eng., or a course work option leading to a M.Eng. Requirements are stated in terms of Carleton University credits.

M.A.Sc. Civil Engineering (5.0 credits)
Requirements - Master's degree by thesis (5.0 credits)
1. 2.5 credits in courses
2. 2.5 credits in:
3. Participation in the graduate student seminar series:
   - CIVE 5901 [0.0] Master's Seminar
4. Successful oral defence of the thesis
Total Credits 5.0

M. Eng. Civil Engineering (5.0 credits)
Requirements - Master's degree by project (5.0 credits)
1. 4.0 credits in courses
2. 1.0 credit in:
   - CIVE 5900 [1.0] Civil Engineering Project
Total Credits 5.0

Requirements - Master's degree by course work (5.0 credits)
1. 5.0 credits in courses
Total Credits 5.0

Ph.D. Civil Engineering (10.0 credits)
Requirements are stated in terms of Carleton University credits.

Requirements:
1. 2.0 credits in courses
2. Participation in the graduate student seminar series:
   - CIVE 6901 [0.0] Ph.D. Seminar
3. Successful completion of written and oral comprehensive examinations in subject areas determined by the student's advisory committee:
   - CIVE 6902 [0.0] Ph.D. Comprehensive Examination
4. Successful completion of a thesis proposal examination
5. 8.0 credits in:
   - CIVE 6909 [8.0] Ph.D. Thesis
6. Successful oral defence of the thesis. The examination board for all theses will include an external examiner, and, when possible, professors from both departments.
Total Credits 10.0

Note
• Subject to approval of his/her advisory committee, a Ph.D. student may take, or be required to take, courses in other disciplines.

Graduate Courses
In all programs, the student may choose graduate courses from either university with the approval of the adviser or the advisory committee. Graduate courses are listed below, grouped by subject area. Course descriptions may be found in the departmental section of the calendar concerned. All courses are of one term duration. The codes given in parentheses are those used by the University of Ottawa. Courses beginning with "CIVE" and 'ENVE' are offered at Carleton University and those beginning with "CIVJ" and 'ENVJ' are offered at the University of Ottawa. Not all courses listed are necessarily offered during one academic year. Courses taken outside the Institute will not count towards the degree requirements unless approved by the adviser or the advisory committee and the program's Associate Chair (graduate affairs). In all programs, at least one half of the course work must be taken from the Institute.

Geotechnical Engineering

Geotechnical Engineering
- CIVE 5209 (CVG 7100) Geotechnical Case Studies
- CIVE 5300 (CVG 7101) Advanced Soil Mechanics
- CIVE 5500 (CVG 7104) Earth Retaining Structures
- CIVE 5501 (CVG 7105) Advanced Foundation Engineering
- CIVE 5502 (CVG 7106) In-Situ Geotechnique
- CIVE 5503 (CVG 7107) Numerical Methods in Geomechanics
- CIVE 5505 (CVG 7109) Geotechnical Earthquake Engineering
- CIVE 5800 (CVG 7305) Topics in Geotechnique
- CIVE 5801 (CVG 7306) Topics in Geotechnique
- CIVE 5802 (CVG 7307) Topics in Geotechnique
- CIVE 5803 (CVG 7308) Topics in Geotechnique
- CIVE 5804 (CVG 7309) Topics in Geotechnique
- CIVJ 5000 (CVG 5100) Deep Foundations
- CIVJ 5006 (CVG 5106) Site Improvements
- CIVJ 5008 (CVG 5108) Pile Dynamics
- CIVJ 5105 (CVG 5175) Numerical Methods for Geotechnical Engineering
- CIVJ 5106 (CVG 5161) Mechanics of Unsaturated Soils
- CIVJ 5107 (CVG 5177) Offshore Geotechnique
- CIVJ 5108 (CVG 5178) Ice Mechanics
- CIVJ 5109 (CVG 5109) Geotechnical Hazards

Structural Engineering
- CIVE 5101 (CVG 7120) Solid Mechanics
- CIVE 5102 (CVG 7121) Advanced Elasticity
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<tr>
<td>CIVE 5103 (CVG 7122)</td>
<td>Finite Element Analysis 1</td>
<td>CIVE 5206 (CVG 5150)</td>
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<td>Earthquake Engineering and Analysis</td>
<td>CIVE 5209 (CVG 5153)</td>
<td>Wind Engineering</td>
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<td>CIVE 5105 (CVG 7124)</td>
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<td>CIVE 5306 (CVG 5153)</td>
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<td>CIVE 5106 (CVG 7137)</td>
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<td>CIVE 5301 (CVG 5155)</td>
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<td>CIVE 5107 (CVG 5321)</td>
<td>Nonlinear Analysis and Design of Advanced Earthquake-Resistant Structures</td>
<td>CIVE 5303 (CVG 5156)</td>
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<td>CIVE 5200 (CVG 7138)</td>
<td>Masonry Behaviour and Design</td>
<td>CIVE 5307 (CVG 5157)</td>
<td>Elements of Bridge Engineering</td>
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<td>CIVE 5203 (CVG 7125)</td>
<td>Theory of Structural Stability</td>
<td>CIVE 5308 (CVG 5158)</td>
<td>Random Vibrations</td>
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<td>Advanced Steel Structures</td>
<td>CIVE 5309 (CVG 5159)</td>
<td>Long Span Structures</td>
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<td>CIVE 5311 (CVG 5312)</td>
<td>Durability of Concrete Structures</td>
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<td>CIVE 5208 (CVG 7130)</td>
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<td>CIVE 5312 (CVG 5313)</td>
<td>Seismic Analysis and Design of Concrete Structures</td>
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<td>CIVE 5507</td>
<td>Blast Load Effects on Structures</td>
<td>CIVE 5609 (CVG 7170)</td>
<td>Fundamentals of Fire Safety Engineering</td>
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<tr>
<td>CIVE 5600 (CVG 7131)</td>
<td>Project Management</td>
<td>CIVE 5610 (CVG 7171)</td>
<td>Fire Dynamics I</td>
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<tr>
<td>CIVE 5601 (CVG 7140)</td>
<td>Engineering, Statistics, and Probabilities</td>
<td>CIVE 5611 (CVG 7173)</td>
<td>People in Fires</td>
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<tr>
<td>CIVE 5605 (CVG 7143)</td>
<td>Design of Steel Bridges</td>
<td>CIVE 5612 (CVG 7174)</td>
<td>Fire Modeling</td>
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<tr>
<td>CIVE 5606 (CVG 7144)</td>
<td>Design of Concrete Bridges</td>
<td>CIVE 5613 (CVG 7172)</td>
<td>Fire Dynamics II</td>
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<td>CIVE 5607 (CVG 7145)</td>
<td>Introduction to Bridge Design</td>
<td>CIVE 5614 (CVG 7175)</td>
<td>Design for Fire Resistance</td>
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<tr>
<td>CIVE 5705 (CVG 7300)</td>
<td>Topics in Structures</td>
<td>CIVE 5615 (CVG 5320)</td>
<td>Fire Behaviour of Materials</td>
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<tr>
<td>CIVE 5706 (CVG 7301)</td>
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<td>CIVE 5810</td>
<td>Topics in Fire Safety</td>
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<td>CIVE 5707 (CVG 7302)</td>
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<td>Transportation Engineering</td>
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<td>CIVE 5303 (CVG 7103)</td>
<td>Pavements and Materials</td>
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<td>Topics in Structures</td>
<td>CIVE 5304 (CVG 7150)</td>
<td>Intercity Transportation</td>
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<td>CIVJ 5201 (CVG 5142)</td>
<td>Advanced Structural Dynamics</td>
<td>CIVE 5305 (CVG 7151)</td>
<td>Traffic Engineering</td>
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<td>Advanced Structural Steel Design</td>
<td>CIVE 5306 (CVG 7152)</td>
<td>Highway Materials</td>
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<td>CIVE 5307 (CVG 7153)</td>
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<tr>
<td>CIVJ 5203 (CVG 5145)</td>
<td>Theory of Elasticity</td>
<td>CIVE 5308 (CVG 7154)</td>
<td>Highway Geometric Design</td>
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<td>CIVJ 5302 (CVG 5146)</td>
<td>Numerical Methods of Structural Analysis</td>
<td>CIVE 5309 (CVG 7155)</td>
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<td>CIVJ 5204 (CVG 5147)</td>
<td>Theory of Plates and Shells</td>
<td>CIVE 5401 (CVG 7156)</td>
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<td>CIVJ 5305 (CVG 5148)</td>
<td>Prestressed Concrete Design</td>
<td>CIVE 5402 (CVG 7159)</td>
<td>Transportation Terminals</td>
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<tr>
<td>CIVJ 5304 (CVG 5149)</td>
<td>Structural Stability</td>
<td>CIVE 5403 (CVG 7158)</td>
<td>Airport Planning</td>
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**Fire Safety Engineering**

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<td>CIVE 5609 (CVG 7170)</td>
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**Transportation Engineering**

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<td>CIVE 5402 (CVG 7159)</td>
<td>Transportation Terminals</td>
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<td>CIVE 5403 (CVG 7158)</td>
<td>Airport Planning</td>
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CIVE 5404 Introduction to Infrastructure Management
CIVE 5805 (CVG 7310) Topics in Transportation
CIVE 5806 (CVG 7311) Topics in Transportation
CIVE 5807 (CVG 7312) Topics in Transportation
CIVE 5808 (CVG 7313) Topics in Transportation
CIVE 5809 (CVG 7314) Topics in Transportation

**Water Resources Engineering**
CIVJ 5501 (CVG 5111) Hydraulic Structures
CIVJ 5502 (CVG 5112) Computational Hydrodynamics
CIVJ 5503 (CVG 5119) Computational Hydraulics
CIVJ 5506 (CVG 5120) Water Resources Systems
CIVJ 5509 (CVG 5123) Advanced Topics in Hyrology
CIVJ 5605 (CVG 5124) Coastal Engineering
CIVJ 5601 (CVG 5125) Statistical Methods in Hydrology
CIVJ 5602 (CVG 5126) Stochastic Hydrology
CIVJ 5603 (CVG 5127) Hydrologic Systems Analysis
CIVJ 5604 (CVG 5128) Water Resources Planning and Policy
CIVJ 5606 (CVG 5131) River Engineering
CIVJ 5503 (CVG 5160) Sediment Transport
CIVJ 5504 (CVG 5162) River Hydraulics

**Environmental Engineering**
Environmental Engineering
ENVE 5001 (CVG 7160) Biofilm Processes
ENVE 5003 (EVG 7143) Advanced Ultraviolet Processes
ENVE 5004 (EVG 7144) Advanced Wastewater Treatment
ENVE 5101 (EVG 5101) Air Pollution Control
ENVE 5102 (CVG 7161) Traffic-Related Air Pollution
ENVE 5103 (CVG 7162) Air Quality Modeling
ENVE 5104 (EVG 7104) Indoor Environmental Quality
ENVE 5105 (EVG 7105) Atmospheric Aerosols
ENVE 5106 (EVG 7106) Atmospheric Chemical Transport Modelling

ENVE 5201 (EVG 7201) Geo-Environmental Engineering
ENVE 5203 (EVG 5203) Hazardous and Radioactive Wastes
ENVE 5204 (EVG 7134) Resource Industry Waste Management
ENVE 5205 (EVG 7132) Sludge Treatment and Disposal
ENVE 5301 (EVG 7301) Contaminant Hydrogeology
ENVE 5302 (CVG 7163) Case Studies in Hydrogeology
ENVE 5303 (EVG 7303) Multiphase Flow in Soils
ENVE 5401 (EVG 7401) Environmental Impacts of Major Projects
ENVE 5402 (EVG 7402) Finite Elements in Field Problems
ENVE 5701 (EVG 6301) Topics in Environmental Engineering
ENVE 5702 (EVG 6302) Topics in Environmental Engineering
ENVE 5703 (EVG 6303) Topics in Environmental Engineering
ENVE 5704 (EVG 6304) Topics in Environmental Engineering
ENVE 5705 (EVG 6305) Topics in Environmental Engineering
ENVJ 5101 (CHG 4301) Air Pollution Control Process
ENVJ 5700 (CVG 5139) Environmental Assessment of Civil Engineering Projects
ENVJ 5900 (CVG 5130) Wastewater Treatment Process Design
ENVJ 5901 (CVG 5132) Unit Operations of Water Treatment
ENVJ 5902 (CVG 5138) Advanced Water Treatment
ENVJ 5903 (CVG 5331) Sludge Utilization and Disposal
ENVJ 5905 (CVG 5137) Water and Wastewater Treatment Process Analysis
ENVJ 5906 (CVG 5133) Solid Waste Disposal
ENVJ 5907 (CVG 5134) Chemical Analysis for Environmental Engineering
ENVJ 5908 (CVG 5179) Anaerobic Digestion
ENVJ 5909 (CVG 5180) Biological Nutrient Removal
ENVJ 5911 (CVG 5232) Unit Operations of Water Treatment Lab
ENVJ 5912 (CVG 5238) Advanced Water Treatment Processes Lab

**Studies and Seminars**
CIVE 5901 (CVG 7314) Master's Seminar
CIVE 5906 (CVG 6108) Directed Studies 1
CIVE 6906 (CVG 6109) Directed Studies 2
Admission

The normal requirement for admission to a master's program is a bachelor's degree with at least high honours standing in civil engineering.

1. Graduates from engineering programs other than civil engineering, or Honours science programs with a mathematics content equivalent to the civil engineering program will have to take a minimum of four qualifying undergraduate civil engineering courses in their area of graduate specialty.

2. Graduates from other science programs will have to take all the core engineering undergraduate mathematics courses in addition to the requirements specified in (1) above.

The undergraduate courses required will be specified in the Certificate of Admission.

Undergraduate civil engineering courses will not be accepted towards a graduate degree. Graduate students may still be required to take undergraduate courses for credit to fulfill the admission requirements.

No more than one half of the program credit requirements or that stipulated in the regulations of the university in which the student is registered, whichever is less, can be transferred at admission.

Accelerated Pathway

The accelerated pathway in Civil Engineering is a flexible and individualized plan of graduate study. Students in the final year of Bachelor of Engineering in Civil, Environmental, or Architectural Conservation and Sustainability Engineering with demonstrated excellent aptitude for graduate studies and research may qualify for this option.

Students with a CGPA of 10.0 or higher, going into their final year of undergraduate study, and intending to apply to a Master's degree in Civil Engineering in the following academic year should consult with both the Undergraduate and Graduate Associate Chairs to determine if the accelerated pathway is appropriate for them and to confirm their selection of courses.

Upon approval for the accelerated pathway, students will replace a maximum of 1.0 credit of their engineering electives with 5000 level CIVE or ENVE courses. Students will receive advanced standing for the approved 5000 level courses in which they receive a grade of A- or higher.

Admission

The normal requirement for admission into the Ph.D. program is a master's degree with thesis in civil engineering. Students who have been admitted to a master's program may be permitted to transfer into the Ph.D. program if they demonstrate:

1. outstanding academic performance by completing at least 2.5 credits of course work with a CGPA of A- or higher, and

2. significant promise for advanced research and the ability to defend their Ph.D. proposal in the first year of their Ph.D. program.

Regulations

See the General Regulations section of this Calendar.