Building Engineering

This section presents the requirements for programs in:

- M.A.Sc. Building Engineering
- M.A.Sc. Building Engineering with Concentration in Building Performance
- M.A.Sc. Building Engineering with Concentration in Fire Safety
- M.A.Sc. Building Engineering with Concentration in Heritage Conservation
- M.Eng. Building Engineering
- M.Eng. Building Engineering with Concentration in Building Performance
- M.Eng. Building Engineering with Concentration in Fire Safety
- M.Eng. Building Engineering with Concentration in Heritage Conservation
- Ph.D. Building Engineering
- Ph.D. Building Engineering with Concentration in Building Performance
- Ph.D. Building Engineering with Concentration in Fire Safety
- Ph.D. Building Engineering with Concentration in Heritage Conservation

Program Requirements

M.A.Sc. Building Engineering (5.0 credits)

Requirements:

1.	0.5 credit in:		0.5
	BLDG 5101 [0.5]	Introduction to Building Engineering	
be		e following list. Other courses may sor recommendation and Director	1.0
	ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation	
	ARCC 5401 [0.5]	Workshop: Technical Studies in Heritage Conservation	
	BLDG 5301 [0.5]	Building Energy Management and Optimization	
	BLDG 5302 [0.5]	Building Services Engineering	
	BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering	
	CDNS 5403 [0.5]	Heritage Conservation and Sustainability	
	BLDG 5201 [0.5]	Advanced Building Characterization, Conservation and Rehabilitation Heritage	
	BLDG 5203 [0.5]	Advanced Computational Modeling Strategies of Historic Buildings	
	CIVE 5609 [0.5]	Fundamentals of Fire Safety Engineering	
	CIVE 5610 [0.5]	Fire Dynamics I	
	BLDG 5202 [0.5]	Structural Assessment of Historic Buildings	
	CIVE 5612 [0.5]	Fire Modeling	
	CIVE 5613 [0.5]	Fire Dynamics II	
	CIVE 5614 [0.5]	Design for Fire Resistance	

To	otal Credits		5.0
	BLDG 5909 [2.5]	M.A.Sc. Thesis (in the area of the concentration)	
4.	2.5 credits in:		2.5
3.	1.0 credit in appro	ved electives	1.0
	MECH 5205 [0.5]	Building Performance Simulation	
	CIVE 5615 [0.5]	Fire Behaviour of Materials	

M.A.Sc. Building Engineering with Concentration in Building Performance (5.0 credits)

Requirements:

Total Credits 5.0			
BLDG 5909 [2.5]	M.A.Sc. Thesis (in the area of the concentration)		
4. 2.5 credits in:		2.5	
3. 0.5 credit in appro	ved electives	0.5	
MECH 5205 [0.5]	Building Performance Simulation		
BLDG 5302 [0.5]	Building Services Engineering		
BLDG 5301 [0.5]	Building Energy Management and Optimization		
BLDG 5104 [0.5]	Indoor Environmental Quality		
BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering		
2. 1.5 credits in the concentration, from the following list. Other courses may be used, with Supervisor recommendation and Director approval.			
BLDG 5101 [0.5]	Introduction to Building Engineering		
1. 0.5 credit in:		0.5	
•			

M.A.Sc. Building Engineering with Concentration in Fire Safety (5.0 credits)

Requirements:

Total Credits		5.0
BLDG 5909 [2.5]	M.A.Sc. Thesis (in the area of the concentration)	
4. 2.5 credits in:		2.5
3. 0.5 credit in appro	ved electives	0.5
CIVE 5615 [0.5]	Fire Behaviour of Materials	
CIVE 5614 [0.5]	Design for Fire Resistance	
CIVE 5613 [0.5]	Fire Dynamics II	
CIVE 5612 [0.5]	Fire Modeling	
CIVE 5610 [0.5]	Fire Dynamics I	
CIVE 5609 [0.5]	Fundamentals of Fire Safety Engineering	
	concentration, from the following y be used, with Supervisor Director approval.	1.5
BLDG 5101 [0.5]	Introduction to Building Engineering	
1. 0.5 credit in:		0.5

M.A.Sc. Building Engineering with Concentration in Heritage Conservation (5.0 credits)

Requirements:

1. 0.5 credit in:		0.5
BLDG 5101 [0.5]	Introduction to Building Engineering	

	concentration, from the following ay be used, with Supervisor	1.5	CDNS 5403 [0.5] CIVE 5609 [0.5]	Heritage Conservation and Sustainability Fundamentals of Fire Safety	
ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation			Engineering	4.0
ARCC 5401 [0.5]	Workshop: Technical Studies in		already used to fulfil It	onal concentration courses, not tems 2-4 above	1.0
	Heritage Conservation		6. 1.5 credits in appr	roved electives	1.5
CDNS 5403 [0.5]	Heritage Conservation and Sustainability		Total Credits		5.0
BLDG 5201 [0.5]	Advanced Building		Requirements - Proje	ect pathway:	
	Characterization, Conservation and		1. 1.0 credit in:		1.0
	Rehabilitation Heritage		BLDG 5101 [0.5]	Introduction to Building Engineering	
BLDG 5202 [0.5]	Structural Assessment of Historic Buildings		BLDG 5102 [0.5]	Introduction to Research Methods	
BLDG 5203 [0.0]	Advanced Computational Modeling Strategies of Historic Buildings			ne following list. Other courses may sor recommendation and Director	2.0
CIVE 5609 [0.5]	Fundamentals of Fire Safety Engineering		ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation	
3. 0.5 credit in appr	<u> </u>	0.5	ARCC 5401 [0.5]	Workshop: Technical Studies in	
4. 2.5 credits in:		2.5	AROO 040 1 [0.0]	Heritage Conservation	
BLDG 5909 [2.5]	M.A.Sc. Thesis (in the area of the concentration)		CDNS 5403 [0.5]	Heritage Conservation and Sustainability	
Total Credits		5.0	BLDG 5302 [0.5]	Building Services Engineering	
M.Eng. Building	Engineering (5.0 credits)		BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering	
Requirements - Cou	ursework pathway:		BLDG 5104 [0.5]	Indoor Environmental Quality	
1. 1.0 credit in:		1.0	BLDG 5201 [0.5]	Advanced Building	
BLDG 5101 [0.5]	Introduction to Building Engineering			Characterization, Conservation and	
BLDG 5102 [0.5]	Introduction to Research Methods		DI DO 5000 [0 5]	Rehabilitation Heritage	
2. 0.5 credit from B courses:	uilding Performance concentration	0.5	BLDG 5202 [0.5]	Structural Assessment of Historic Buildings	
BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering		BLDG 5203 [0.5]	Advanced Computational Modeling Strategies of Historic Buildings	
BLDG 5104 [0.5]	Indoor Environmental Quality		BLDG 5301 [0.5]	Building Energy Management and Optimization	
BLDG 5301 [0.5]	Building Energy Management and Optimization		CIVE 5609 [0.5]	Fundamentals of Fire Safety	
BLDG 5302 [0.5]	Building Services Engineering		CIVE 5610 [0.5]	Engineering Fire Dynamics I	
MECH 5205 [0.5]	Building Performance Simulation		CIVE 5610 [0.5] CIVE 5612 [0.5]	Fire Dynamics I Fire Modeling	
	ire Safety concentration courses:	0.5	CIVE 5613 [0.5]	Fire Dynamics II	
CIVE 5609 [0.5]	Fundamentals of Fire Safety		CIVE 5614 [0.5]	Design for Fire Resistance	
01)/5 5040 [0.5]	Engineering		CIVE 5609 [0.5]	Fundamentals of Fire Safety	
CIVE 5610 [0.5]	Fire Dynamics I		017 2 0000 [0.0]	Engineering	
CIVE 5612 [0.5]	Fire Modeling Fire Dynamics II		MECH 5205 [0.5]	Building Performance Simulation	
CIVE 5613 [0.5] CIVE 5614 [0.5]	Design for Fire Resistance		3. 1.0 credits in appr	roved electives	1.0
CIVE 5615 [0.5]	Fire Behaviour of Materials		4. 1.0 credit in:		1.0
	eritage Conservation concentration	0.5	BLDG 5900 [1.0]	M.Eng. Project	
courses:	-	0.5	Total Credits		5.0
ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation		M.Eng. Building with Concentrati	Engineering on in Building Performance	(5.0
ARCC 5401 [0.5]	Workshop: Technical Studies in Heritage Conservation		credits)		
BLDG 5201 [0.5]	Advanced Building		Requirements - Cour	rsework patnway:	
	Characterization, Conservation and Rehabilitation Heritage		1. 1.0 credit in:	Introduction to Duilding Engineer	1.0
BLDG 5202 [0.5]	Structural Assessment of Historic		BLDG 5101 [0.5]	Introduction to Building Engineering	
0 0202 [0.0]	Buildings		BLDG 5102 [0.5]	Introduction to Research Methods concentration, from the following	2.0
BLDG 5203 [0.5]	Advanced Computational Modeling Strategies of Historic Buildings			y be used, with Supervisor	2.0
BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering		. seeenadon dilu		

	BLDG 5103 [0.5]	Advanced Research Methods for		CIVE 5614 [0.5]	Design for Fire Resistance	
	DI DO 5000 10 51	Building Engineering		CIVE 5615 [0.5]	Fire Behaviour of Materials	
	BLDG 5202 [0.5]	Structural Assessment of Historic Buildings		1.0 credits in app	proved electives	1.0
	BLDG 5301 [0.5]	Building Energy Management and		4. 1.0 credit in:		1.0
	BEBG 3301 [0.3]	Optimization		BLDG 5900 [1.0]	M.Eng. Project	
	MECH 5205 [0.5]	Building Performance Simulation		Total Credits		5.0
3.	2.0 credits in appr	roved electives	2.0	M.Eng. Building	Engineering	
To	otal Credits		5.0	with Concentrat (5.0 credits)	ion in Heritage Conservation	
	equirements - Proj	ect pathway:		,	:44h	
1.	1.0 credit in:		1.0	Requirements - Pro	ject patnway:	1.0
	BLDG 5101 [0.5]	Introduction to Building Engineering			Introduction to Duilding Engineering	1.0
	BLDG 5102 [0.5]	Introduction to Research Methods		BLDG 5101 [0.5] BLDG 5102 [0.5]	Introduction to Building Engineering Introduction to Research Methods	
lis	st. Other courses ma ecommendation and		2.0	2. 2.0 credits in the list. Other courses ma	concentration, from the following ay be used, with Supervisor	2.0
	BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering		recommendation and ARCN 5100 [0.5]	Representation and Documentation	
	BLDG 5202 [0.5]	Structural Assessment of Historic Buildings		ARCC 5401 [0.5]	in Architectural Conservation Workshop: Technical Studies in	
	BLDG 5301 [0.5]	Building Energy Management and Optimization		BLDG 5103 [0.5]	Heritage Conservation Advanced Research Methods for	
	MECH 5205 [0.5]	Building Performance Simulation			Building Engineering	
3.	1.0 credits in appr	•	1.0	BLDG 5201 [0.5]	Advanced Building	
	1.0 credit in:		1.0		Characterization, Conservation and	
	BLDG 5900 [1.0]	M.Eng. Project		BLDG 5203 [0.0]	Rehabilitation Heritage Advanced Computational Modeling	
To	otal Credits		5.0	DEDG 3200 [0.0]	Strategies of Historic Buildings	
	l.Eng. Building	Engineering ion in Fire Safety (5.0 credits)		CDNS 5403 [0.5]	Heritage Conservation and Sustainability	
		,		3. 1.0 credits in app	roved electives	1.0
	equirements - Cou	rsework pathway:		4. 1.0 credit in:		1.0
1.	1.0 credit in:		1.0	BLDG 5900 [1.0]	M.Eng. Project	
	BLDG 5101 [0.5]	Introduction to Building Engineering		Total Credits		5.0
_	BLDG 5102 [0.5]	Introduction to Research Methods	2.0	Requirements - Cou	irsework nathway:	
		concentration, from the following be used, with Supervisor	2.0	1. 1.0 credit in:	noowork paniway.	1.0
	commendation and			BLDG 5101 [0.5]	Introduction to Building Engineering	
	CIVE 5609 [0.5]	Fundamentals of Fire Safety		BLDG 5102 [0.5]	Introduction to Research Methods	
		Engineering		2. 2.0 credits in the	concentration, from the following	2.0
	CIVE 5610 [0.5]	Fire Dynamics I			ay be used, with Supervisor	
	CIVE 5612 [0.5]	Fire Modeling		recommendation and	• • • • • • • • • • • • • • • • • • • •	
	CIVE 5613 [0.5]	Fire Dynamics II		ARCC 5401 [0.5]	Workshop: Technical Studies in	
	CIVE 5614 [0.5]	Design for Fire Resistance		ADON 5400 (0.51	Heritage Conservation	
	CIVE 5615 [0.5]	Fire Behaviour of Materials		ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation	
3.	2.0 credits in appr	roved electives	2.0	BLDG 5103 [0.5]	Advanced Research Methods for	
To	otal Credits		5.0	BLDG 5103 [0.5]	Building Engineering	
R	equirements - Proj	ect pathway:		BLDG 5201 [0.5]	Advanced Building	
1.	1.0 credit in:		1.0		Characterization, Conservation and Rehabilitation Heritage	
	BLDG 5101 [0.5]	Introduction to Building Engineering		DI DC 5203 [0.0]	Advanced Computational Modeling	
	BLDG 5102 [0.5]	Introduction to Research Methods		BLDG 5203 [0.0]	Strategies of Historic Buildings	
lis	st. Other courses ma	concentration, from the following be used, with Supervisor	2.0	CDNS 5403 [0.5]	Heritage Conservation and Sustainability	
re	commendation and	• •		3. 2.0 credits in app	•	2.0
	CIVE 5609 [0.5]	Fundamentals of Fire Safety Engineering		Total Credits		5.0
	CIVE 5610 [0.5]	Fire Dynamics I				
		-				
	CIVE 5612 [0.5] CIVE 5613 [0.5]	Fire Modeling Fire Dynamics II				

R	equirements:		
1.	0.5 credit in:		0.5
	BLDG 5101 [0.5]	Introduction to Building Engineering	
be		e following list. Other courses may sor recommendation and Director	1.0
	BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering	
	ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation	
	ARCC 5401 [0.5]	Workshop: Technical Studies in Heritage Conservation	
	CDNS 5403 [0.5]	Heritage Conservation and Sustainability	
	BLDG 5301 [0.5]	Building Energy Management and Optimization	
	BLDG 5302 [0.5]	Building Services Engineering	
	BLDG 5201 [0.5]	Advanced Building Characterization, Conservation and Rehabilitation Heritage	
	BLDG 5202 [0.5]	Structural Assessment of Historic Buildings	
	BLDG 5203 [0.5]	Advanced Computational Modeling Strategies of Historic Buildings	
	CIVE 5609 [0.5]	Fundamentals of Fire Safety Engineering	
	CIVE 5610 [0.5]	Fire Dynamics I	
	CIVE 5612 [0.5]	Fire Modeling	
	CIVE 5613 [0.5]	Fire Dynamics II	
	CIVE 5614 [0.5]	Design for Fire Resistance	
	CIVE 5615 [0.5]	Fire Behaviour of Materials	
	MECH 5205 [0.5]	Building Performance Simulation	
3.	0.5 credit in:		0.5
	BLDG 6901 [0.5]	Thesis Proposal	
4.	0.0 credit in:		
	BLDG 6909 [0.0]	Ph.D. Thesis	
To	otal Credits		2.0

Ph.D. Building Engineering with Concentration in Building Performance (2.0 credits)

Requirements:

1.	0.5 credit in:		0.5
	BLDG 5101 [0.5]	Introduction to Building Engineering	
lis		ncentration, from the following y be used, with Supervisor Director approval.	1.0
	BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering	
	BLDG 5104 [0.5]	Indoor Environmental Quality	
	BLDG 5301 [0.5]	Building Energy Management and Optimization	
	BLDG 5302 [0.5]	Building Services Engineering	
	MECH 5205 [0.5]	Building Performance Simulation	
3.	0.5 credit in:		0.5
	BLDG 6901 [0.5]	Thesis Proposal (in the area of the concentration)	
4.	0.0 credit in:		0.0

BLDG 6909 [0.0]	Ph.D. Thesis (in the area of the
	concentration)

Total Credits	2.0

Ph.D. Building Engineering with Concentration in Fire Safety (2.0 credits)

Requirements:

Total Credits		
BLDG 6909 [0.0]	Ph.D. Thesis (in the area of the concentration)	
4. 0.0 credit in:		
BLDG 6901 [0.5]	Thesis Proposal (in the area of the concentration)	
3. 0.5 credit in:		0.5
CIVE 5615 [0.5]	Fire Behaviour of Materials	
CIVE 5614 [0.5]	Design for Fire Resistance	
CIVE 5613 [0.5]	Fire Dynamics II	
CIVE 5612 [0.5]	Fire Modeling	
CIVE 5610 [0.5]	Fire Dynamics I	
CIVE 5609 [0.5]	Fundamentals of Fire Safety Engineering	
	oncentration, from the following y be used, with Supervisor Director approval.	1.0
BLDG 5101 [0.5]	Introduction to Building Engineering	
1. 0.5 credit in:		0.5
Requirements.		

Ph.D. Building Engineering with Concentration in Heritage Conservation (2.0 credits)

Requirements:

Total Credits		2.0
BLDG 6909 [0.0]	Ph.D. Thesis (in the area of the concentration)	
4. 0.0 credits in:		0.0
BLDG 6901 [0.5]	Thesis Proposal (in the area of the concentration)	
3. 0.5 credit in:		0.5
BLDG 5103 [0.5]	Advanced Research Methods for Building Engineering	
ARCC 5401 [0.5]	Workshop: Technical Studies in Heritage Conservation	
ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation	
CDNS 5403 [0.5]	Heritage Conservation and Sustainability	
BLDG 5203 [0.0]	Advanced Computational Modeling Strategies of Historic Buildings	
BLDG 5202 [0.5]	Structural Assessment of Historic Buildings	
BLDG 5201 [0.5]	Advanced Building Characterization, Conservation and Rehabilitation Heritage	
	oncentration, from the following y be used, with Supervisor Director approval.	1.0
BLDG 5101 [0.5]	0 0 0	
1. 0.5 credit in:		0.5

Admission

M.A.Sc., M. Eng. Building Engineering

The normal requirement for admission to the M.A.Sc. and M.Eng. in Building Engineering is a bachelor's degree in an engineering or related program, with at least a B+ average. Applicants to the M.A.Sc. are required to include a research proposal statement.

Ph.D. Building Engineering

The normal requirement for admission to the Ph.D. Building Engineering is a master's degree in an engineering or related program, with at least a A- average. Applicants are required to include a research proposal statement.

Students registered in the M.A.Sc. Building Engineering program at Carleton University may be permitted to transfer into the Ph.D. program without completing the master's program, provided they meet the following conditions:

- completion of 2.5 credits of master's-level courses with a minimum average of A-,
- · demonstration of exceptional research potential,
- formal application for admission to the PhD program no later than the fourth semester of initial registration in the M.A.Sc. program, and
- permission from the Director of the Building Engineering programs.

Regulations

See the General Regulations section of this Calendar.

Regularly Scheduled Break

For immigration purposes, the summer term (May to August) for the M.Eng. Building Engineering (coursework and project pathways) is considered a regularly scheduled break approved by the University. Students should resume full-time studies in September.

Building Engineering (BLDG) Courses BLDG 5101 [0.5 credit] Introduction to Building Engineering

Broad introductory and multi-disciplinary coverage of building engineering, with particular emphasis on building performance, heritage conservation, fire safety, and structures. Core competencies including research skills, communication of building engineering topics. Advanced methods for building design and restoration in the architectural, engineering, and construction field.

BLDG 5102 [0.5 credit]

Introduction to Research Methods

Broad introduction to theory and application of research methods in engineering. Key areas include conducting literature reviews; field, laboratory, and computational techniques; and designing, conducting, and presenting research.

Prerequisite(s): Enrolment in M.Eng. Building Engineering.

BLDG 5103 [0.5 credit]

Advanced Research Methods for Building Engineering

Broad set of technical and non-technical research skills to design, conduct, and publish research focused on building engineering. Key areas: defining research problems; literature reviews; methods to conduct research; inferential statistics; measurement and error analysis; design of experiments; presenting and publishing in scientific venues.

Prerequisite(s): enrollment in MASc Building Engineering, PhD Building Engineering, or BLDG 5702.

BLDG 5104 [0.5 credit]

Indoor Environmental Quality

Indoor environmental quality (air quality, thermal, visual, and acoustic comfort); physical and chemical parameters for characterization. Types and sources of indoor air pollution and discomfort; measurement techniques. Heating, ventilation, air conditioning, lighting practices and issues. Modeling of and design for indoor environmental quality.

Precludes additional credit for ENVE 4106. Also offered at the undergraduate level, with different requirements, as ACSE 4106, for which additional credit is precluded.

BLDG 5201 [0.5 credit]

Advanced Building Characterization, Conservation and Rehabilitation Heritage

Supporting concepts and techniques for the identification, documentation, and conservation of heritage and existing buildings; advanced workshops by experts from key disciplines and practice areas in heritage conservation. Includes: Experiential Learning Activity Also listed as CIVE 5603.

BLDG 5202 [0.5 credit]

Structural Assessment of Historic Buildings

General concepts related to conservation of heritage structures; materials, construction techniques and structural components; classical structural analysis approaches; seismic behaviour, damage and collapse mechanisms of historic buildings; modern conservation criteria and practical implementation of repair or strengthening strategies.

Also listed as CIVE 5202.

BLDG 5203 [0.5 credit]

Advanced Computational Modeling Strategies of Historic Buildings

Introduction to conservation engineering; commonly used construction materials in historic buildings and their constitutive laws; Graphical and numerical methods to analyze masonry arches; Theory and application of discrete element method and its applications to assess masonry buildings.

Also listed as CIVE 5210.

BLDG 5301 [0.5 credit]

Building Energy Management and Optimization

Fault detection and diagnostics; preventive and predictive maintenance; predictive and adaptive control of indoor climate; advanced sensing technologies for the built environment; analysis and modelling using data from buildings; data mining; linear and generalized linear models; optimization methods; model selection and validation; inverse modelling.

BLDG 5302 [0.5 credit] Building Services Engineering

How buildings are designed and operated. The materials provide foundational knowledge to understand building services: mechanical, electrical, plumbing systems with associated controls.

Precludes additional credit for ENVE 4107. Also offered at the undergraduate level, with different requirements, as ACSE 4107, for which additional credit is precluded.

BLDG 5900 [1.0 credit] M.Eng. Project

Includes: Experiential Learning Activity

BLDG 5906 [0.5 credit] Directed Studies

Supervised by a faculty member, students enrolled in this course will undertake a research project. A final report will be evaluated in determining the course grade.

Prerequisite(s): Open only to students in a Building Engineering Master's program.

BLDG 5909 [2.5 credits] M.A.Sc. Thesis

BLDG 6901 [0.5 credit] Thesis Proposal

BLDG 6906 [0.5 credit] Directed Studies

Supervised by a faculty member, students enrolled in this course will undertake a research project. A final report will be evaluated in determining the course grade.

Prerequisite(s): Open only to students in the Building Engineering Ph.D. program.

BLDG 6909 [0.0 credit] Ph.D. Thesis