# 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	
2.	1.0 credit from the	following list. Other courses may	1.0
be	e used, with Supervis	sor recommendation and Director	
ar	proval		

provan.	
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]	Research Methods for Building Engineering
CDNS 5403 [0.5]	Heritage Conservation and Sustainability
BLDG 5201 [0.5]	Advanced Building Characterization, Conservation and Rehabilitation
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

Тс	tal 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	

**Total Credits** 

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

#### **Requirements:**

1.	0.5 credit in:		0.5
	BLDG 5101 [0.5]	Introduction to Building Engineering	
lis		oncentration, from the following y be used, with Supervisor Director approval.	1.5
	BLDG 5103 [0.5]	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 appro	ved electives	0.5
4.	2.5 credits in:		2.5
	BLDG 5909 [2.5]	M.A.Sc. Thesis (in the area of the concentration)	

#### **Total Credits**

# M.A.Sc. Building Engineering

# with Concentration in Fire Safety (5.0 credits) **Requirements:**

1. 0.5 credit in:		0.5
BLDG 5101 [0.5]	Introduction to Building Engineering	
	oncentration, from the following be used, with Supervisor Director approval.	1.5
CIVE 5609 [0.5]	Fundamentals of Fire Safety	

5.0

Тс	otal Credits		5.0
		concentration)	
	BLDG 5909 [2.5]	M.A.Sc. Thesis (in the area of the	
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 5009 [0.5]	Engineering	

# 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

2. 1.5 credits in the concentration, from the following       1.5         list. Other courses may be used, with Supervisor       1.5         recommendation and Director approval.       ARCN 5100 [0.5]       Representation and Documentation in Architectural Conservation       1.5         ARCN 5100 [0.5]       Representation and Documentation in Architectural Conservation       1.5         ARCC 5401 [0.5]       Workshop: Technical Studies in Heritage Conservation       1.5         CDNS 5403 [0.5]       Heritage Conservation and Sustainability       1.5         BLDG 5201 [0.5]       Advanced Building Characterization, Conservation and Rehabilitation       1.5         BLDG 5202 [0.5]       Structural Assessment of Historic Buildings       1.5         BLDG 5203 [0.5]       Advanced Computational Modeling Strategies of Historic Buildings       1.5         CIVE 5609 [0.5]       Fundamentals of Fire Safety Engineering       0.5         3. 0.5 credit in approved electives       0.5       0.5         4. 2.5 credits in:       2.5         BLDG 5909 [2.5]       M.A.Sc. Thesis (in the area of the concentration)
list. Other courses may be used, with Supervisor recommendation and Director approval.ItsARCN 5100 [0.5]Representation and Documentation in Architectural ConservationARCC 5401 [0.5]Workshop: Technical Studies in Heritage ConservationCDNS 5403 [0.5]Heritage Conservation and SustainabilityBLDG 5201 [0.5]Advanced Building Characterization, Conservation and RehabilitationBLDG 5202 [0.5]Structural Assessment of Historic BuildingsBLDG 5203 [0.5]Advanced Computational Modeling Strategies of Historic BuildingsCIVE 5609 [0.5]Fundamentals of Fire Safety Engineering <b>3. 0.5 credit in</b> approved electives0.5
list. Other courses may be used, with Supervisor recommendation and Director approval.ARCN 5100 [0.5]Representation and Documentation in Architectural ConservationARCC 5401 [0.5]Workshop: Technical Studies in Heritage ConservationCDNS 5403 [0.5]Heritage Conservation and SustainabilityBLDG 5201 [0.5]Advanced Building Characterization, Conservation and RehabilitationBLDG 5202 [0.5]Structural Assessment of Historic BuildingsBLDG 5203 [0.5]Advanced Computational Modeling Strategies of Historic BuildingsCIVE 5609 [0.5]Fundamentals of Fire Safety Engineering
Iist. Other courses may be used, with Supervisor recommendation and Director approval.ARCN 5100 [0.5]Representation and Documentation in Architectural ConservationARCC 5401 [0.5]Workshop: Technical Studies in Heritage ConservationCDNS 5403 [0.5]Heritage Conservation and SustainabilityBLDG 5201 [0.5]Advanced Building Characterization, Conservation and RehabilitationBLDG 5202 [0.5]Structural Assessment of Historic BuildingsBLDG 5203 [0.5]Advanced Computational Modeling Strategies of Historic BuildingsCIVE 5609 [0.5]Fundamentals of Fire Safety
Iist. Other courses may be used, with Supervisor recommendation and Director approval.ARCN 5100 [0.5]Representation and Documentation in Architectural ConservationARCC 5401 [0.5]Workshop: Technical Studies in Heritage ConservationCDNS 5403 [0.5]Heritage Conservation and SustainabilityBLDG 5201 [0.5]Advanced Building Characterization, Conservation and RehabilitationBLDG 5202 [0.5]Structural Assessment of Historic BuildingsBLDG 5203 [0.5]Advanced Computational Modeling
Ist. Other courses may be used, with Supervisor recommendation and Director approval.ARCN 5100 [0.5]Representation and Documentation in Architectural ConservationARCC 5401 [0.5]Workshop: Technical Studies in Heritage ConservationCDNS 5403 [0.5]Heritage Conservation and SustainabilityBLDG 5201 [0.5]Advanced Building Characterization, Conservation and RehabilitationBLDG 5202 [0.5]Structural Assessment of Historic
Iist. Other courses may be used, with Supervisor         recommendation and Director approval.         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 5201 [0.5]       Advanced Building Characterization, Conservation and
Iist. Other courses may be used, with Supervisor recommendation and Director approval.ARCN 5100 [0.5]Representation and Documentation in Architectural ConservationARCC 5401 [0.5]Workshop: Technical Studies in Heritage ConservationCDNS 5403 [0.5]Heritage Conservation and
list. Other courses may be used, with Supervisor         recommendation and Director approval.         ARCN 5100 [0.5]       Representation and Documentation in Architectural Conservation         ARCC 5401 [0.5]       Workshop: Technical Studies in
list. Other courses may be used, with Supervisor recommendation and Director approval. ARCN 5100 [0.5] Representation and Documentation
list. Other courses may be used, with Supervisor

# M.Eng. Building Engineering (5.0 credits)

# Requirements - Coursework pathway:

	·····	
1. 1.0 credit in:		1.0
BLDG 5101 [0.5]	Introduction to Building Engineering	
BLDG 5103 [0.5]	Research Methods for Building Engineering	
2. 0.5 credit from Bu courses:	ilding Performance concentration	0.5
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 from Fire	e Safety concentration courses:	0.5
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	
4. 0.5 credit from He courses:	ritage Conservation concentration	0.5
ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation	
ARCC 5401 [0.5]	Workshop: Technical Studies in Heritage Conservation	
BLDG 5201 [0.5]	Advanced Building Characterization, Conservation and Rehabilitation	
BLDG 5202 [0.5]	Structural Assessment of Historic Buildings	
BLDG 5203 [0.5]	Advanced Computational Modeling Strategies of Historic Buildings	
BLDG 5301 [0.5]	Building Energy Management and Optimization	

	CDNS 5403 [0.5]	Heritage Conservation and Sustainability	
	CIVE 5609 [0.5]	Fundamentals of Fire Safety Engineering	
	1.0 credit in addition ready used to fulfil Ite	onal concentration courses, not ems 2-4 above	1.0
6.	1.5 credits in appro	oved electives	1.5
То	otal Credits		5.0
Re	equirements - Proje	ct pathway:	
1.	1.0 credit in:		1.0
	BLDG 5101 [0.5]	Introduction to Building Engineering	
	BLDG 5103 [0.5]	Research Methods for Building Engineering	
be		e following list. Other courses may or recommendation and Director	2.0
	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 5302 [0.5]	Building Services Engineering	
	BLDG 5104 [0.5]	Indoor Environmental Quality	
	BLDG 5201 [0.5]	Advanced Building Characterization, Conservation and Rehabilitation	
	BLDG 5202 [0.5]	Structural Assessment of Historic Buildings	
	BLDG 5203 [0.5]	Advanced Computational Modeling Strategies of Historic Buildings	
	BLDG 5301 [0.5]	Building Energy Management and Optimization	
	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 5609 [0.5]	Fundamentals of Fire Safety Engineering	
	MECH 5205 [0.5]	Building Performance Simulation	
	1.0 credits in appro	oved electives	1.0
4.	1.0 credit in:		1.0
	BLDG 5900 [1.0]	M.Eng. Project	
То	tal Credits		5.0
w	Eng. Building I ith Concentration redits)	Engineering on in Building Performance (5	.0
	, equirements - Cour	sework pathway:	
	1.0 credit in:	1000 C	1.0
	BLDG 5101 [0.5]	Introduction to Building Engineering	

			1.0
BLDG 5	101 [0.5]	Introduction to Building Engineering	
BLDG 5	103 [0.5]	Research Methods for Building Engineering	
list. Other of	ourses ma	concentration, from the following y be used, with Supervisor Director approval.	2.0
BLDG 5	104 [0.5]	Indoor Environmental Quality	

BLDG 5	5301 [0.5]	Building Energy Management and Optimization	
BLDG 5	5302 [0.5]	Building Services Engineering	
	5205 [0.5]	Building Performance Simulation	
3. 2.0 cre	dits in appr	oved electives	2.0
Total Cred	lits		5.0
Requirem	ents - Proje	ect pathway:	
1. 1.0 cre	dit in:		1.0
BLDG 5	5101 [0.5]	Introduction to Building Engineering	
BLDG 5	5103 [0.5]	Research Methods for Building Engineering	
list. Other	courses ma	concentration, from the following y be used, with Supervisor Director approval.	2.0
BLDG 5	5104 [0.5]	Indoor Environmental Quality	
BLDG 5	5301 [0.5]	Building Energy Management and Optimization	
BLDG 5	5302 [0.5]	Building Services Engineering	
MECH	5205 [0.5]	Building Performance Simulation	
3. 1.0 cre	<b>dits in</b> appr	oved electives	1.0
4. 1.0 cree	dit in:		1.0
BLDG 5	5900 [1.0]	M.Eng. Project	
Total Cred	lits		5.0
M Eng F	Building	Engineering	
-	-	on in Fire Safety (5.0 credits)	
Requirem	ents - Cour	rsework pathway:	
1. 1.0 cre			1.0
	5101 [0.5]	Introduction to Building Engineering	
	5103 [0.5]	Research Methods for Building Engineering	
2. 2.0 cree list. Other	dits in the c courses ma	Engineering concentration, from the following y be used, with Supervisor	2.0
2. 2.0 cree list. Other of recommen	dits in the c courses ma	Engineering concentration, from the following	2.0
2. 2.0 cree list. Other of recommen CIVE 56	dits in the o courses ma idation and	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety	2.0
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56	dits in the c courses ma idation and 609 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering	2.0
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56	dits in the c courses ma idation and 509 [0.5] 510 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I	2.0
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56	dits in the c courses ma dation and 609 [0.5] 610 [0.5] 612 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling	2.0
2. 2.0 cree recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56	dits in the occurses ma dation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 515 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials	2.0
2. 2.0 cree recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56	dits in the occurses ma dation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 515 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance	2.0
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56	dits in the of courses ma idation and 609 [0.5] 610 [0.5] 612 [0.5] 613 [0.5] 614 [0.5] 615 [0.5] dits in appr	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials	
2. 2.0 cree list. Other of recomment CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 3. 2.0 cree Requirem	dits in the of courses ma idation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 615 [0.5] dits in appr lits ents - Proje	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials	2.0 <b>5.0</b>
2. 2.0 cree list. Other of recomment CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 3. 2.0 cree Total Cred Requirem 1. 1.0 cree	dits in the of courses ma idation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 615 [0.5] dits in appr lits ents - Proje dit in:	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives	2.0
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 3. 2.0 cree Total Cred Requirem 1. 1.0 cree BLDG 5	dits in the of courses ma idation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 614 [0.5] 615 [0.5] 615 [0.5] 615 <b>[0.5]</b> 615 <b>[0.5]</b> 615 <b>[0.5]</b> 615 <b>[0.5]</b> 6115 <b>[0.5]</b> 6115 <b>[0.5]</b> 6115 <b>[0.5]</b> 6115 <b>[0.5]</b>	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives	2.0 <b>5.0</b>
<ol> <li>2. 2.0 cred list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56</li> <li>3. 2.0 cred Total Cred Requirem</li> <li>1. 1.0 cred BLDG 5 BLDG 5</li> </ol>	dits in the of courses ma idation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 614 [0.5] 515 [0.5] dits in appr dits in ents - Proje dit in: 5101 [0.5] 5103 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives External States of State	2.0 <b>5.0</b> 1.0
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 3. 2.0 cree Total Cred BLDG 5 BLDG 5 2. 2.0 cree list. Other of	dits in the of courses ma idation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 515 [0.5] 615 [0.5] 615 [0.5] 615 <b>in</b> appr fits ents - Proje dit in: 5101 [0.5] 5103 [0.5] 6103 [0.5] 6103 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives External States Stat	2.0 <b>5.0</b>
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 3. 2.0 cree Total Cred Requirem 1. 1.0 cree BLDG 5 BLDG 5 2. 2.0 cree list. Other of recommen	dits in the of courses ma idation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 515 [0.5] 615 [0.5] 615 [0.5] 615 <b>in</b> appr fits ents - Proje dit in: 5101 [0.5] 5103 [0.5] 6103 [0.5] 6103 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives Externational Statements Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives Externational Statements Externation to Building Engineering Research Methods for Building Engineering concentration, from the following y be used, with Supervisor	2.0 <b>5.0</b> 1.0
<ol> <li>2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56</li> <li>3. 2.0 cree</li> <li>Total Cred</li> <li>Requirem</li> <li>1.0 cree BLDG 5</li> <li>BLDG 5</li> <li>2. 2.0 cree</li> <li>list. Other of recommen CIVE 56</li> </ol>	dits in the of courses ma idation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 614 [0.5] 615 [0.5] dits in appr dits in appr dit in: 5101 [0.5] 5103 [0.5] dits in the of courses ma idation and	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives Engineering Introduction to Building Engineering Research Methods for Building Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety	2.0 <b>5.0</b> 1.0
<ol> <li>2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56</li> <li>3. 2.0 cree Total Cred BLDG 5</li> <li>2. 2.0 cree list. Other of recommen CIVE 56</li> </ol>	dits in the of courses ma dation and 509 [0.5] 510 [0.5] 512 [0.5] 513 [0.5] 514 [0.5] 614 [0.5] 615 [0.5] dits in appr dits in appr dits in appr dit in: 5101 [0.5] 5103 [0.5] dits in the of courses ma dation and 509 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives Engineering Concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering	2.0 <b>5.0</b> 1.0
<ol> <li>2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56</li> <li>3. 2.0 cree Total Cred BLDG 5</li> <li>2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56</li> </ol>	dits in the occurses main dation and           609 [0.5]           610 [0.5]           6112 [0.5]           612 [0.5]           613 [0.5]           614 [0.5]           615 [0.5]           dits in apprilits           ents - Projection           dit in:           6101 [0.5]           6105 [0.5]           dits in the occurses main dation and           609 [0.5]           610 [0.5]           610 [0.5]	Engineering Concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials Fire Behaviour of Building Engineering Fing Besearch Methods for Building Engineering Fire Supervisor Fire Safety Fire Safety Safety Fire Behaviour of Fire Safety Fire Safety Safety Fire Dynamics I Fundamentals of Fire Safety Fire Dynamics I Fire Dynamics I	2.0 <b>5.0</b> 1.0
2. 2.0 cree list. Other of recommen CIVE 56 CIVE 56 CIVE 56 CIVE 56 CIVE 56 <b>3. 2.0 cree</b> <b>7otal Cred</b> <b>8. Cree</b> <b>1. 1.0 cree</b> BLDG 5 BLDG 5 <b>2. 2.0 cree</b> list. Other of recommen CIVE 56 CIVE 56 CIVE 56	dits in the occurses maidation and           609 [0.5]           610 [0.5]           611 [0.5]           612 [0.5]           613 [0.5]           614 [0.5]           615 [0.5]           dits in appr           dits in the occurses maidation and           609 [0.5]           610 [0.5]           610 [0.5]           610 [0.5]           610 [0.5]           610 [0.5]           610 [0.5]           610 [0.5]           610 [0.5]           610 [0.5]           6110 [0.5]	Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Modeling Fire Dynamics II Design for Fire Resistance Fire Behaviour of Materials roved electives <b>Ext pathway:</b> Introduction to Building Engineering Research Methods for Building Engineering concentration, from the following y be used, with Supervisor Director approval. Fundamentals of Fire Safety Engineering Fire Dynamics I Fire Dynamics I Fire Modeling	2.0 <b>5.0</b> 1.0

2			
3.	1.0 credits in appr	roved electives	1.0
4.	1.0 credit in:		1.0
	BLDG 5900 [1.0]	M.Eng. Project	
Т	otal Credits		5.0
w (5	5.0 credits)	on in Heritage Conservation	
	equirements - Proj	ect pathway:	
1.	1.0 credit in:		1.0
	BLDG 5101 [0.5] BLDG 5103 [0.5]	Introduction to Building Engineering Research Methods for Building Engineering	
lis		concentration, from the following y be used, with Supervisor Director approval.	2.0
	ARCN 5100 [0.5]	Representation and Documentation in Architectural Conservation	
	ARCC 5401 [0.5]	Workshop: Technical Studies in Heritage Conservation	
	BLDG 5201 [0.5]	Advanced Building Characterization, Conservation and Rehabilitation	
	BLDG 5203 [0.5] CDNS 5403 [0.5]	Advanced Computational Modeling Strategies of Historic Buildings Heritage Conservation and	
		Sustainability	
3.	1.0 credits in appr	roved electives	1.0
4.	1.0 credit in:		1.0
	BLDG 5900 [1.0]	M.Eng. Project	
Т	otal Credits		5.0
	otal Credits equirements - Cou	rsework pathway:	5.0
R	equirements - Cour 1.0 credit in:		<b>5.0</b> 1.0
R	equirements - Cour 1.0 credit in: BLDG 5101 [0.5]	Introduction to Building Engineering	
R	equirements - Cour 1.0 credit in:		
R 1. 2.	equirements - Cour 1.0 credit in: BLDG 5101 [0.5] BLDG 5103 [0.5] 2.0 credits in the c	Introduction to Building Engineering Research Methods for Building Engineering concentration, from the following by be used, with Supervisor Director approval.	
R 1. 2.	equirements - Cour 1.0 credit in: BLDG 5101 [0.5] BLDG 5103 [0.5] 2.0 credits in the output of the courses main the courses	Introduction to Building Engineering Research Methods for Building Engineering concentration, from the following by be used, with Supervisor	1.0
R 1. 2.	equirements - Court 1.0 credit in: BLDG 5101 [0.5] BLDG 5103 [0.5] 2.0 credits in the off the courses many commendation and ARCC 5401 [0.5] ARCN 5100 [0.5]	Introduction to Building Engineering Research Methods for Building Engineering concentration, from the following y be used, with Supervisor Director approval. Workshop: Technical Studies in Heritage Conservation Representation and Documentation in Architectural Conservation	1.0
R 1. 2.	equirements - Cour 1.0 credit in: BLDG 5101 [0.5] BLDG 5103 [0.5] 2.0 credits in the off the courses main the off commendation and ARCC 5401 [0.5]	Introduction to Building Engineering Research Methods for Building Engineering concentration, from the following by be used, with Supervisor Director approval. Workshop: Technical Studies in Heritage Conservation Representation and Documentation in Architectural Conservation Advanced Building Characterization, Conservation and Rehabilitation	1.0
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R 1. lis re 3. To P R 1.	equirements - Court 1.0 credit in: BLDG 5101 [0.5] BLDG 5103 [0.5] 2.0 credits in the off commendation and ARCC 5401 [0.5] ARCN 5100 [0.5] BLDG 5201 [0.5] BLDG 5203 [0.5] CDNS 5403 [0.5] 2.0 credits in appro- tal Credits h.D. Building E equirements: 0.5 credit in: BLDG 5101 [0.5]	Introduction to Building Engineering Research Methods for Building Engineering concentration, from the following by be used, with Supervisor Director approval. Workshop: Technical Studies in Heritage Conservation Representation and Documentation in Architectural Conservation Advanced Building Characterization, Conservation and Rehabilitation Advanced Computational Modeling Strategies of Historic Buildings Heritage Conservation and Sustainability roved electives	1.0 2.0 2.0 5.0

	BLDG 5103 [0.5]	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		
	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		
Total Credits				

# 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		
	ncentration, from the following y be used, with Supervisor Director approval.	1.0	
BLDG 5103 [0.5]	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]	<b>Building Performance Simulation</b>		
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			

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

# Requirements:

1.	0.5 credit in:	
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BLDG 5101 [0.5] Introduction to Building Engineering 2. 1.0 credit in the concentration, from the following list. Other courses may be used, with Supervisor recommendation and Director approval. Fundamentals of Fire Safety CIVE 5609 [0.5] Engineering CIVE 5610 [0.5] Fire Dynamics I CIVE 5612 [0.5] Fire Modeling Fire Dynamics II CIVE 5613 [0.5] Design for Fire Resistance CIVE 5614 [0.5] CIVE 5615 [0.5] Fire Behaviour of Materials 3. 0.5 credit in: BLDG 6901 [0.5] Thesis Proposal (in the area of the concentration) 4. 0.0 credit in:

1.0

0.5

2.0

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

# **Total Credits**

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

# Requirements:

Total Credits				
	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]	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 [0.5]	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		
lis		ncentration, from the following y be used, with Supervisor Director approval.	1.0	
		Introduction to Building Engineering		
1.	0.5 credit in:		0.5	
	equirements.			

# Admission

0.5

### 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.

Note: a Regularly Scheduled Break as described for immigration purposes does not supersede the requirement for continuous registration in Thesis, Research Essay, or Independent Research Project as described in Section 8.2 of the Graduate General Regulations.

# **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 5103 [0.5 credit]

### **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 MEng Building Engineering, MASc Building Engineering, PhD Building Engineering.

#### 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

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