



الجامعة التقنية الشمالية
Northern Technical University

PhD in Building and Construction
Engineering/ Construction Materials

NORTHERN TECHNICAL UNIVERSITY
TECHNICAL ENGINEERING COLLEGE / MOSUL

الجامعة التقنية الشمالية
الكلية التقنية الهندسية / الموصل

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1. Vision and Mission Statement

Vision:

The department aims to become a global leader in advancing the frontier of knowledge and innovation in Construction Materials Engineering. We envision producing doctoral graduates who are at the forefront of research and development in the field, contributing significantly to the advancement of sustainable and resilient infrastructure worldwide. Our graduates will not only excel in academia but also lead transformative initiatives in industry, policy-making, and societal development. With a commitment to interdisciplinary collaboration and cutting-edge research methodologies, our doctoral program will nurture visionary researchers capable of tackling the most pressing challenges facing the built environment. The department's vision for the doctoral program is to be a catalyst for transformative change, driving innovation, and excellence in Construction Materials Engineering on a global scale.

Mission:

The mission of the doctoral program in Construction Materials Engineering is to cultivate exceptional scholars and researchers who will advance the frontiers of knowledge and innovation in the discipline. Our program aims to equip doctoral candidates with the advanced technical expertise, critical thinking skills, and research capabilities necessary to address complex challenges and pioneer groundbreaking solutions in the construction of infrastructure systems. Through rigorous theoretical inquiry, empirical investigation, and interdisciplinary collaboration, our doctoral students will explore novel methodologies, technologies, and materials to enhance the resilience, sustainability, and efficiency of built environments. Additionally, our program is committed to fostering a culture of creativity, innovation, and ethical leadership, empowering graduates to make meaningful contributions to academia, industry, and society at large.

2. Graduate Objectives

1. To confer doctoral degrees in Building Materials Engineering, producing graduates who are proficient in conducting original research, advancing knowledge, and addressing complex challenges in the field of building materials science and engineering.
2. To equip doctoral candidates with advanced competencies in scientific inquiry, experimental design, and field laboratory testing, enabling them to contribute significantly to the advancement of building materials research through innovative methodologies and empirical investigations.
3. To cultivate a cohort of doctoral scholars who are capable of staying abreast of scientific breakthroughs and emerging trends in the field of building materials, and who possess the expertise to develop novel solutions to local and global challenges related to the design, production, and utilization of building materials in diverse applications.

Overall, the goal of the PhD program in Construction Materials Engineering is to prepare doctoral graduates to become scholarly leaders, innovative researchers, and subject matter experts in the field, capable of making meaningful contributions to academia, industry, and society through their research, scholarship, and professional practice.

3. General objectives of the department:

1. To produce doctoral graduates equipped with advanced knowledge and expertise in the field of construction materials engineering, capable of conducting original and impactful research in both theoretical and applied aspects of the discipline.
2. To foster the development of critical thinking, problem-solving, and analytical skills among doctoral candidates, enabling them to address complex challenges and innovate novel solutions in the realm of building materials science and engineering.
3. To prepare doctoral students for leadership roles in academia, industry, and research institutions, by providing opportunities for interdisciplinary collaboration, scholarly publication, and professional development within the field of building materials engineering.
4. To contribute to the advancement of knowledge and technology in construction materials engineering through high-quality research,

innovation, and dissemination of findings that address global challenges such as sustainability, durability, and environmental impact.

5. To engage doctoral candidates in applied research projects and industry partnerships that translate theoretical knowledge into practical solutions, thereby bridging the gap between academic research and real-world applications in the field of building materials engineering.
6. To cultivate a culture of lifelong learning, continuous improvement, and ethical responsibility among doctoral graduates, emphasizing the importance of integrity, professionalism, and societal impact in their research and professional practice within the domain of building materials engineering.

4. Scientific and practical description:

- Conduct advanced research in the field of construction materials engineering, focusing on the development of innovative materials, construction techniques, and sustainable practices to address global challenges and local needs.
- Design and lead experimental investigations in laboratories and field settings to characterize the properties and performance of building materials, including both conventional materials and novel alternatives.
- Utilize advanced computational tools and modeling techniques to simulate the behavior of building materials under various conditions, optimize their performance, and predict long-term durability and resilience.
- Collaborate with interdisciplinary teams of researchers, engineers, architects, and stakeholders to integrate cutting-edge materials science into the design, construction, and maintenance of civil infrastructure.
- Develop and implement strategies for the efficient and sustainable use of resources in construction projects, including materials recycling, waste reduction, and energy-efficient construction practices.
- Contribute to the dissemination of research findings through scholarly publications, conference presentations, and knowledge transfer activities, fostering collaboration and exchange of ideas within the academic community and the industry.

5. Program Specification

Program code	Credits	Method
First semester	12	Full Time
Second semester	12	Full Time
Qualification Exam	S	
Research year, and the writing of the thesis	36	Full Time
Total	60	

The construction materials engineering program specification for a PhD degree outlines the advanced knowledge, research skills, and competencies required for individuals seeking to contribute to the advancement of the building and construction industry through rigorous academic inquiry and scholarly research. The program is designed to prepare doctoral candidates to conduct original research, engage in scholarly discourse, and make significant contributions to the theoretical understanding and practical application of building and construction techniques.

The key components of the PhD program specification may include:

- 1. Program Aims and Objectives:** The overarching goals of the program, such as to produce doctoral graduates who are capable of conducting innovative research, advancing knowledge in the field, and addressing complex challenges facing the building and construction industry.
- 2. Learning Outcomes:** A comprehensive list of the specific research skills, theoretical knowledge, and methodological competencies that doctoral candidates are expected to develop and demonstrate throughout the course of their studies.
- 3. Course Structure:** Details on the core and elective courses, seminars, workshops, and research colloquia that form the academic curriculum of the PhD program. This may include advanced topics in building materials science, structural engineering, construction management, sustainable design, and research methodology.
- 4. Research Requirements:** Information on the research requirements for the PhD degree, including the development and execution of a doctoral dissertation or thesis project that makes an original contribution to the field of building and construction techniques engineering.
- 5. Assessment Methods:** Description of the evaluation criteria and assessment methods used to evaluate doctoral candidates' research progress and scholarly contributions, including comprehensive

examinations, research proposals, dissertation defenses, and peer-reviewed publications.

6. **Resources:** An overview of the academic, research, and institutional resources available to support doctoral candidates in their scholarly pursuits, including access to laboratories, libraries, funding opportunities, and academic mentorship.

Overall, the Construction Materials Engineering Program Specification for a PhD degree serves as a roadmap for doctoral education and research, guiding both students and faculty in the pursuit of academic excellence and scholarly achievement in the field.

6. Program Goals

The program goals for a PhD in Construction Materials Engineering are refined to reflect the advanced scholarly pursuits and contributions expected from doctoral candidates:

1. Advancing the understanding and innovation of construction materials, methods, and technologies: Doctoral candidates will conduct in-depth research to push the boundaries of knowledge in building materials science and engineering, exploring novel materials, manufacturing processes, and sustainable technologies for construction applications.
2. Investigating and contributing to the development of construction codes, standards, and regulations: Doctoral candidates will engage in scholarly inquiry to examine existing construction codes and regulations, identify areas for improvement or innovation, and contribute to the development of new standards that enhance safety, sustainability, and efficiency in construction practices.
3. Communicating research findings and contributing to scholarly discourse: Doctoral candidates will develop advanced communication skills to effectively disseminate their research findings through scholarly publications, conference presentations, and professional collaborations, contributing to the advancement of knowledge and practice in the field of building and construction engineering.
4. Engaging in interdisciplinary research and collaboration: Doctoral candidates will collaborate with researchers, practitioners, and stakeholders across disciplines to address complex challenges and opportunities in the built environment, drawing on diverse

perspectives and expertise to generate innovative solutions and foster interdisciplinary dialogue and collaboration.

Overall, the goal of a PhD program in Construction Materials Engineering is to cultivate doctoral scholars who are capable of conducting original research, advancing the state-of-the-art in the field, and making meaningful contributions to academia, industry, and society through their scholarly work and leadership in the construction industry.

5. Student Learning Outcomes

- a) Mastery of advanced knowledge in construction materials and methodologies: Doctoral candidates should demonstrate a comprehensive understanding of the underlying principles, emerging trends, and innovative technologies in construction materials science and engineering, and their implications for sustainable, resilient, and high-performance built environments.
- b) Expertise in regulatory compliance and standards development: Doctoral candidates should possess a deep understanding of local, national, and international building codes, regulations, standards, and industry guidelines, as well as the ability to critically evaluate and contribute to the development of new codes and standards that address emerging challenges and opportunities in the construction industry.
- c) Advanced communication, collaboration, and interdisciplinary teamwork: Doctoral candidates should exhibit advanced communication skills, including the ability to articulate complex ideas, present research findings effectively to diverse audiences, and collaborate with stakeholders across disciplines and sectors to address complex challenges and opportunities in the built environment.
- d) Integration of safety and sustainability principles into research and practice: Doctoral candidates should demonstrate a commitment to safety, sustainability, and ethical responsibility in their research and professional practice, including the integration of green building materials, practices, and technologies, as well as the identification and mitigation of potential hazards and risks associated with construction activities.

Overall, the student learning outcomes for a PhD program in Construction Materials Engineering should prepare graduates to become scholarly leaders and innovators in the construction industry, equipped with the advanced knowledge, skills, and competencies to address complex challenges, drive innovation, and make significant contributions to the advancement of the field

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8. Academic Staff

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9.Credits, Grading and GPA

Credits The distribution of credits for a PhD in Building and Construction Engineering / Construction Materials Programme is typically structured as follows: 12 credits for the first semester, 12 credits for the second semester, 36 credits for the research year, and the writing of the doctoral thesis.

Grading: Before the evaluation, the results are divided into two subgroups: pass and fail. Therefore, the results are independent of the students who failed a course. The grading system is defined as follows:

GRADING SCHEME			
Group	Grade	Marks %	Definition
Success Group (70 - 100)	Excellent	90 - 100	Outstanding Performance
	Very Good	80 - 89	Above average with some errors
	Good	70 - 79	Sound work with notable errors
	Satisfactory	60 - 69	Fair but with major shortcomings
	Unsatisfactory	50 - 59	-----

Applicants for admission to the PhD in Building and Construction Engineering / Construction Materials Programme must pass a competitive examination, the successful completion of which is a condition for admission.

The academic backgrounds:

The academic backgrounds for applicants to the Ph.D. programme in Building and Construction Engineering / Construction Materials typically include:

- 1- Master's in Civil Engineering/structures.**
- 2- Master's in Construction Materials.**
- 3- Master's in Technical Engineering in Construction Materials Engineering.**

10. Curriculum/Modules

Syllabus of Ph.D. Courses of Building and Construction Engineering/ Construction Materials

1st semester

	Subject	اسم المادة	Hrs/Week		Units
			Theo.	Prac.	
1	Supplementary Cementitious Materials	مواد اسمنتية بديلة	3	-	3
2	Advanced Engineering Materials	مواد هندسية متقدمة	3	-	3
3	Mechanics of Composite Materials	ميكانيك المواد المركبة	3	-	3
4	Assessment and Rehabilitation of R.C. Structures (Elective 1)	تقييم واعادة تأهيل المنشآت الخرسانية	2	-	2
5	Dimensional Stability of Building Materials (Elective 2)	الاستقرار البعدي لمواد البناء	2	-	2
6	Technical Writing	الكتابة الفنية	2	-	1
Total				-	12

2nd semester

	Subject	اسم المادة	Hrs/Week		Units
			Theo.	Prac.	
1	Durability of Building Materials	ديمومة مواد البناء	3	-	3
2	Mechanical Behavior of Building materials	السلوك الميكانيكي لمواد البناء	3	-	3
3	Nanotechnology for Building materials	تكنولوجيا النانو لمواد البناء	3	-	3
4	Special Types of Concrete (Elective 1)	انواع خاصة من الخرسانة	2	-	2
5	Dimensional Stability of Building materials (Elective 2)	الاستقرار البعدي لمواد البناء	2	-	2
6	Technical Writing	الكتابة الفنية	2	-	1
Total				-	12

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Electives (1st & 2nd Semesters)

	Subject	اسم المادة	Hrs/Week		Units
			Theo.	Prac.	
1	Assessment and Rehabilitation of R.C. Structures	تقييم واعادة تأهيل المنشآت الخرسانية	2	-	2
2	Modeling and Neural Networks	النمذجة والشبكات العصبية	2	-	2
3	Dimensional Stability of Building Materials	الاستقرار البعدي لمواد البناء	2	-	2
4	Precast Concrete	الخرسانة مسبقة الصب	2	-	2
5	Special Types of Concrete	انواع خاصة من الخرسانة	2	-	2
6	Concrete Equipment	معدات الخرسانة	2	-	2
7	Finite Element Analysis	تحليل العناصر المحددة	2	-	2
8	Advanced Numerical Analysis	تحليلات عددية متقدم	2	-	2
9	Geomatics Applications	تطبيقات الجيوماتكس	2	-	2
	Total			-	

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Syllabus of Ph.D. Courses of Building and Construction Engineering/ Construction Materials

1st.Semester:

1- Supplementary Cementitious Materials

Subject		Hrs/Week	
		Theo.	Prac.
1	Introduction	3	-
2	Mechanism of Pozzolanic Reaction and its significances	6	-
3	Classification of Pozzolanic materials	6	-
4	Blast- Furnace Slag	9	-
5	Condensed Silica Fume	9	-
6	Metakaoline and Attapulgate	9	-
7	Fly Ash	3	-

2- Advanced Engineering Materials

Subject		Hrs/Week	
		Theo.	Prac.
1	Introduction	3	-
2	Metals and Alloys	9	-
3	Polymer Materials	12	-
4	Wood	9	-
5	Adhesives and Surface Coating	6	-
6	Paper and other Felt Products	6	-

3- Mechanics of Composite Materials

Subject		Hrs/Week	
		Theo.	Prac.
1	Overview of Types of Composite System	6	-
2	Ductile cement composite system	6	-
3	Mechanics of composite materials	6	-
4	Mechanical testing and characteristic	6	-
5	Inelastic analysis of cement composites using laminate theory	6	-
6	Tensile and flexural performance of hybrid cement composite	3	-
7	Flexural model for strain-softening and strain hardening composites	6	-
8	Back calculation procedures of material properties from flexural tests	6	-

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4- Assessment and Rehabilitation of Reinforced Concrete Structures (Elective1)

Subject		Hrs/Week	
		Theo.	Prac.
1	Evaluation of Existing Concrete Buildings: a. Preliminary Investigation b. Method for Material Evaluation c. Assessment of Loading Conditions d. Evaluation Methods and Report	10	-
2	Repairing of Damaged Concrete Structures: a. Causes b. Repair Methods	7	-
3	Strengthening of Concrete Structures a. Causes b. Strengthening Methods	7	-
4	Case Studies (examples)	6	-

5- Technical Writing (2 Hrs/week)

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Syllabus of Ph.D. Courses of Building and Construction Engineering/ Construction Materials

2nd semester

1- Durability of Building Materials

Subject		Time (3Hrs/Week)	
		Theo.	Prac.
1	Introduction	3	-
2	Deterioration of Concrete by Fire	9	-
3	Deterioration of Concrete by Chemical Reactions (Cation-Exchange Reaction)	9	-
4	Corrosion of Reinforcing Steel Embedded in Concrete	12	-
5	Durability of Timber	6	-
6	Durability of Plastics	6	-

2- Mechanical Behavior of Building Materials

Subject		Time (2Hrs/Week)	
		Theo.	Prac.
1	Stress and Strain: Introduction, Stress, Sign Convention, Transformation of Axes, Principal Stresses, Mohr's Stress Circles. Strains, Small Strains, Transformation of Axes, Mohr's Strain Circles.	6	-
2	Elasticity: Introduction, Isotropic Elasticity, Variation of Young's Modulus, Isotropic Thermal Expansion, Anisotropic Elasticity.	6	-
3	Tensile Testing: Introduction, Tensile Specimens, Stress–Strain Curves, Ductility, True Stress and Strain, Measurement of Force and Strain	6	-
4	Fracture Mechanics: Introduction, Theoretical Fracture Strength, Stress Concentration, Griffith Theory, Fracture Mechanics in Design, Compact Tensile Specimens.	9	-
5	Creep and Stress Rupture: Introduction, Creep Mechanisms, Temperature Dependence of Creep, Deformation Mechanism Maps, Cavitations, Rupture Versus Creep, Extrapolation Schemes.	9	-
6	Fatigue: Introduction, Surface Observations, Nomenclature, S–N Curves, Effect of Mean Stress, Stress Concentration, Design Estimates, Strains to Failure, Crack Propagation.	9	-

3. Nano Technology for Building Materials

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Subject		Time (2Hrs/Week)	
		Theo.	Prac.
1	Overview of Nanoscale and Nanoparticles	4	-
2	Nanotechnology in construction	4	-
3	Nanotechnology and cementitious materials	4	-
4	Specimen pretreatment and preparation for microscopy	4	-
5	Microscopic technique and Scanning Electron Microscopy	6	-
6	Image processing and analysis	4	-
7	X-Ray powder analysis diffraction for cement	4	-

4. Special Types of Concrete (Elective 1)

Subject		Time (2Hrs/Week)	
		Theo.	Prac.
1	Fiber Concrete	6	-
2	Ferrocement	6	-
3	Mass Concrete	6	-
4	Flowing Concrete	6	-
5	Self-Compacting Concrete (Fresh Properties)	6	-

5. Dimensional Stability of Building Materials (Elective 2)

6. Technical Writing (2 Hrs/week)