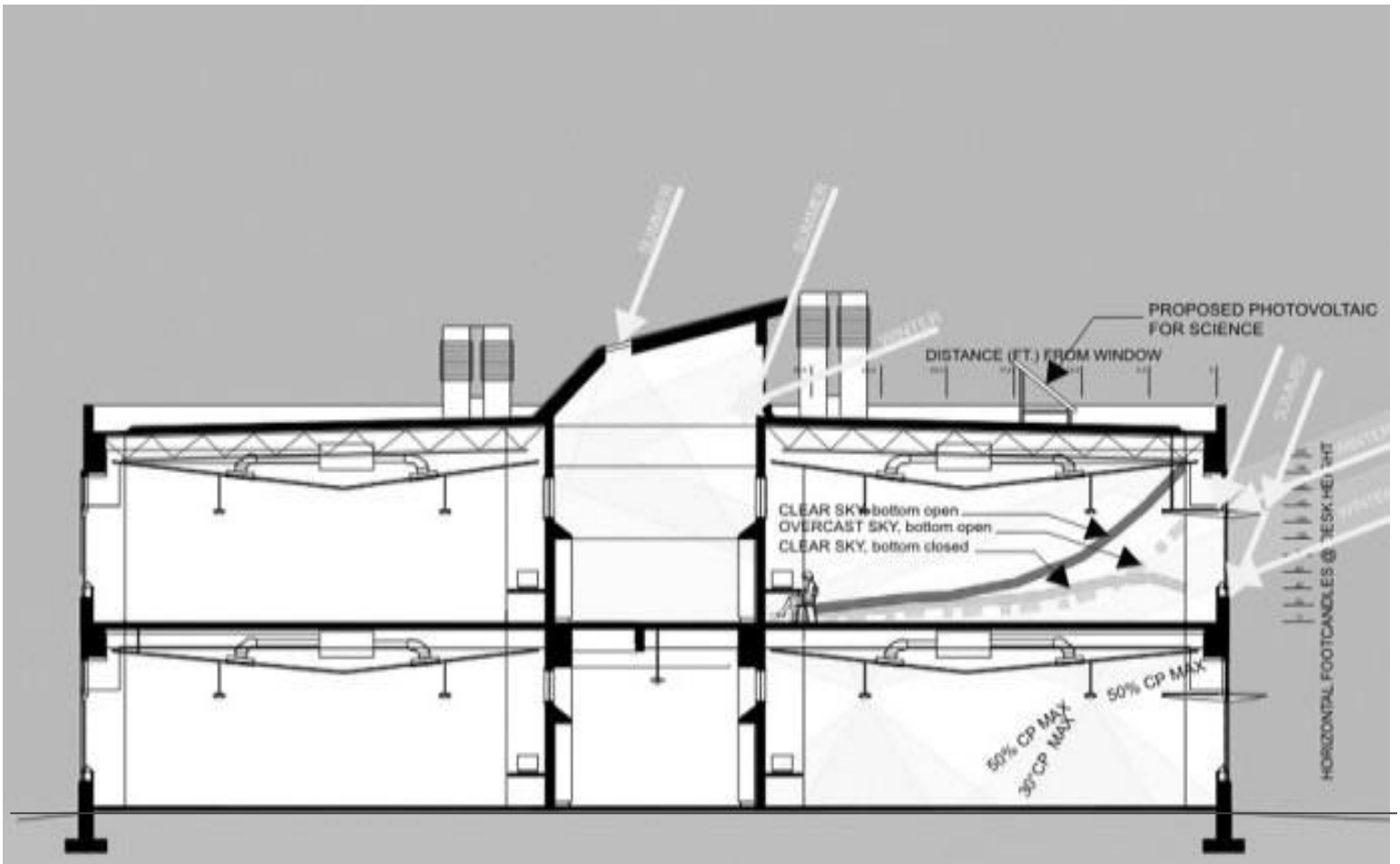
Graduate Certificate in Energy & Technology in Architecture (ETA)



School of Architecture | College of Design | NC State University

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College of Design | School of Architecture

Introduction

Building operations consume about 40% of the fossil fuels and account for about 40% of the carbon emissions. When embodied energy is accounted for, these percentages rise closer to 50%. There are few opportunities with greater near-term potential for reducing fossil fuel consumption and carbon emissions than the thoughtful design of buildings. Properly designed energy and other systems have the potentials to substantially enhance building performances and reduce carbon emissions. Preparing the next generation of architects and engineers to meet the challenge of our changing world is absolutely crucial.

Program Intent

The intent of this certificate program is to provide students the opportunity to focus their elective studies in the area of energy and technology in architecture. This is accomplished through courses and design studio(s) that are focused on building energy systems along with other building systems. The program's aims are:

- to provide educational opportunities for architecture graduate students who wish to acquire knowledge and skills in the design and operation of building systems at site and building levels, with an emphasis on energy and materials.
- to advocate for the importance of energy efficiency over the entire life cycle of a building.
- to make our students more competitive in the fields of architectural practice, building engineering, and construction.

Market for Graduates

The sustainable energy sector will present significant career opportunities for decades to come. Skilled professionals specialized in sustainable building energy and technology areas will be in high demand.

- There has been an increasing demand from the client side for sustainable projects. As an indicator of this trend, many clients request that their buildings to be LEED certified. (While it is a good sign that clients want LEED certification, LEED by itself is wholly inadequate to address the stringent issues of genuine sustainability, which is why we need more intensive educational opportunities for our students in the building design field.)
- There has been an increasing demand from architectural and engineering firms for designers with the expertise in sustainable design. More and more architectural, engineering, and contracting firms have established energy and technology research units within their organizations and require that their employees be LEED accredited.
- There has been an increasing number of architectural schools in this country and across the world that offer building energy and technology related courses and/or studios. It is crucial for our university to establish such a program to stay competitive in this realm.

Interdisciplinary Focus

There has been a large gap among the disciplines in building design. Major components of the building systems—architectural assemblies, mechanical, electrical, and structural systems—tend to be dealt with separately in design education and practice, and the coordination between these disciplines are often limited to systems error checking. In a successfully designed project, building systems, materials, and products must be integrated to create a unified whole that achieves the desired functional purpose. This program will provide unique interdisciplinary opportunities, both at the curricular level and the research level, between college of Design and other engineering units - Civil, Electrical, Mechanical, Material science (e.g., Textile), NC Clean Energy Technology Center, etc., and between academia and building design industries or organizations, such as architecture, engineering, general contracting, real estate companies and public policy agencies.

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Faculty Participants

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Traci Rider, Assistant Professor

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DEPARTMENT OF HISTORY

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COLLEGE OF TEXTILES

Hechmi Hamouda, Professor
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NC Clean Energy Technology Center

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Academic Requirements for Participants
There are three paths to gaining the certificate.

1. Master of Architecture Student pursuing a final project:
   It is strongly recommended, but not required, that M.Arch students aiming to complete the certificate should plan to undertake the final project under the chairmanship of one of the Certificate faculty. These students take an advanced studio in energy or technology (to be approved by the certificate coordinator) – 6hrs; two advanced seminars from the certificate menu (2 x 3 hrs); ARC 697 Final Project Research (3 hrs), for a total of 15 credit hours, plus the final project.

2. Master of Architecture student not pursuing a final project:
   These students take an advanced studio in energy or technology (to be approved by the certificate coordinator) – 6hrs; and three advanced seminars from the certificate menu (3 x 3 hrs), for a total of 15 credit hours.

3. Non-degree seeking students, or graduate students in another discipline:
   These students take five advanced seminars from the certificate menu (5 x 3 hrs), for a total of 15 credit hours.

The following charts outline how the Graduate Certificate in Energy & Technology in Architecture fits into each of the three M.Arch tracks.

M.ARCH TRACK I WITH FINAL PROJECT

FALL	SPRING
ARC 500 Architectural Design: Professional Studio (6 hrs)	ARC 503 Advanced Architectural Design (6 hrs)
ETA Focus Elective **(3 hrs)**	ARC 561 The Practice of Architecture (3 hrs)
ETA Focus Elective **(3 hrs)**	Graduate Elective (3 hrs)
Total = 12 hours	**Total = 12 hours**

FALL	SPRING
ARC 503 **Advanced Architectural Design** **(focused on Energy & Technology)** **(6 hrs)**	ARC 598 Final Project Studio in Architecture (6 hrs)
ARC 697 **Final Project Research in Architecture** **(3 hrs)**	Graduate Elective (3 hrs)
Graduate Elective (3 hrs)	Graduate Elective (3 hrs)
Total = 12 hours	**Total = 12 hours**
	Total hours = 48

The above course of study would be undertaken by students seeking a first professional M.Arch degree (Track I) with a Final Project under the chairmanship of one of the certificate faculty. This degree is for students with a four-year undergraduate pre-professional degree in architecture BEDA degree (or equivalent) that is part of a NAAB-accredited professional program. **Courses *without* the gray background** in this table are required for the students who intend to receive a Master of Architecture with a Graduate Certificate in Energy and Technology.

M.ARCH TRACK I WITHOUT FINAL PROJECT

FALL	SPRING
ARC 500 Architectural Design: Professional Studio (6 hrs)	ARC 503 Advanced Architectural Design (6 hrs)
ETA Focus Elective **(3 hrs)**	ARC 561 The Practice of Architecture (3 hrs)
ETA Focus Elective **(3 hrs)**	Graduate Elective (3 hrs)
Total = 12 hours	**Total = 12 hours**

FALL	SPRING
ARC 503 **Advanced Architectural Design** **(focused on Energy & Technology)** **(6 hrs)**	ARC 503 Advanced Architectural Design (6 hrs)
ETA Focus Elective **(3 hrs)**	Graduate Elective (3 hrs)
Graduate Elective (3 hrs)	Graduate Elective (3 hrs)
Total = 12 hours	**Total = 12 hours**
	Total hours = 48

The above courses of study would be undertaken by students seeking a first professional M.Arch degree (Track I) without doing a Final Project. This degree is for students with a four-year undergraduate pre-professional degree in architecture BEDA degree (or equivalent) that is part of a NAAB-accredited professional program. **Courses *without* the gray background** in this table are required for the students who intend to receive a Master of Architecture with a Graduate Certificate in Energy and Technology.

M.ARCH TRACK II (Final Project Required)

FALL	SPRING
ARC 503 **Advanced Architectural Design** **(focused on Energy & Technology)** **(6 hrs)**	ARC 598 Final Project Studio in Architecture (6 hrs)
ETA Focus Elective **(3 hrs)**	**ETA Focus Elective** **(3 hrs)**
ARC 697 **Final Project Research in Architecture** **(3 hrs)**	Graduate Elective (3 hrs)
Graduate Elective (3 hrs)	Graduate Elective (3 hrs)
Total = 15 hours	**Total = 15 hours**
	Total hours = 30

The above course of study is for students who have completed a NAAB-accredited professional degree in architecture, either a B.Arch, M.Arch or D.Arch. **Courses *without* the gray background** in this table are required for the students who intend to receive a Master of Architecture with a Graduate Certificate in Energy and Technology. The required certificate courses total 15 hours, plus the recommended final project under the chairmanship of one of the certificate faculty.

M.ARCH TRACK III WITH FINAL PROJECT:

FALL	SPRING
ARC 403 Architectural Design Fundamentals: Environment (6 hrs)	ARC 404 Architectural Design Fundamentals: Form (6 hrs)
ARC 211 Natural Systems and Architecture (3 hrs)	ARC 232 Structures and Materials (3 hrs)
ARC 241 Introduction to World Architecture (3 hrs)	ARC 242 History of Western Architecture (3 hrs)
ARC 450 Architectural Drawing (3 hrs)	ARC 251 Digital Representation (3 hrs)
Total = 15 hrs	**Total = 15 hrs**

FALL	SPRING
ARC 405 Architectural Design Fundamentals: Technology (6 hrs)	ARC 503 Advanced Architectural Design (6 hrs)
ARC 331 Architectural Structures I (3 hrs)	ARC 332 Architectural Structures II (3 hrs)
ARC 432 Architectural Construction Systems (3 hrs)	ARC 414 Environmental Control Systems (3 hrs)
ARC 441 History of Contemporary Architecture (3 hrs)	ARC 561 The Practice of Architecture (3 hrs)
Total = 15 hrs	**Total = 15 hrs**

FALL	SPRING
ARC 500 Architectural Design: Professional Studio (6 hrs)	**ARC 503 Advanced Architectural Design (focused on Energy & Technology) (6 hrs)**
ETA Focus Elective (3hrs)	**ARC 697 Final Project Research in Architecture (3 hrs)**
ETA Focus Elective (3hrs)	Graduate Elective (3 hrs)
Total = 12 hours	

FALL	SPRING
ARC 598 Final Project Studio in Architecture (6 hrs)	
Graduate Elective (3 hrs)	
Graduate Elective (3 hrs)	
Total = 12 hours	
	Total hours = 96

The above option would be for students obtaining the M.Arch degree (Track III). This is a first professional degree for students without previous academic preparation in architecture. **Courses *without* the gray background** in this table are required for the students who intend to receive the first professional Masters of Architecture with a Graduate Certificate in Energy and Technology. The required certificate courses total 15 hours, plus the recommended Final Project.

ETA Required Coursework

ARC 503 Advanced Architectural Design (focused on Energy & Technology, 6 hrs)
OR two additional elective courses from the list below for non-degree seeking students
ETA Elective course selected from the list below (3hrs)
ETA Elective course selected from the list below (3hrs)
ETA Elective course selected from the list below (3hrs)
OR ARC 697 Final Project Research (3 hrs)

Approved ETA Focus ARC503 Studios
ARC 503 Advanced Architectural Design – Collaborative Design Studio: Architecture + Engineering [David Hill]
ARC 503 Advanced Architectural Design – Airport Design [Wayne Place]
ARC 503 Advanced Architectural Design – High-rise Building Design [Wayne Place]
ARC 503 Advanced Architectural Design – Production for Architecture [Dana Gulling]

Approved ETA Focus Elective Courses
SCHOOL OF ARCHITECTURE
ARC 520 Sustainable Architecture [Traci Rider]
ARC 521 Daylighting and Passive Energy Systems for Architecture [Jianxin Hu]
ARC 522 Building Energy Efficiency and Renewable Energy [Soolyeon Cho]
ARC 523 Building Energy Modeling and Simulation [Soolyeon Cho]
ARC 524 Building Energy Optimization [Soolyeon Cho]
ARC 530 Tectonics & Craft [Frank Harmon]
ARC 534 Design of Architectural Details [Pat Rand]
ARC 535 Experiments in Architectural Prototypes [David Hill]
ARC 536 Materials for Design [Pat Rand]
ARC 537 Digital Materials Translations [David Hill]
ARC 538 Manufacturing Architecture [Dana Gulling]

AT LEAST TWO SEMINARS MUST BE TAKEN IN THE SCHOOL OF ARCHITECTURE. FOR THE THIRD SEMINAR, STUDENTS MAY, WITH THE APPROVAL OF THE CERTIFICATE COORDINATOR, TAKE ONE OR MORE OF THE FOLLOWING COURSES FROM OTHER DEPARTMENTS AND COLLEGES; FINAL APPROVAL FOR ENROLLMENT WILL BE DETERMINED BY THE DEPARTMENT OFFERING THE COURSE.

CE 504 Airport Planning and Design
ECO 620 Special Problems in Ecology
HI 540 American Environmental History
HI 585 History of American Technology
ID 500 Advanced Industrial Design (Series)
ID 511 Industrial Design Materials and Processes I
ID 512 Industrial Design Materials and Processes II
ID 532 Advanced Concepts in Product Engineering
ID 570 Advanced Industrial Design-Textiles (Series)
ID 582 Special Topics in Industrial Design
ISE 514- Manufacturing Product Engineering
MAE 514 Noise and Vibration Control
MAE 589 Special Topics in Mechanical Engineering
MSE 556 Composite Materials
MSE 576 Technology Evaluation and Commercialization Concepts
MSE 577 Technology Evaluation and Strategy
MSE 578 High Technology Entrepreneurship

ETA Certificate Course Structure:

Energy-Focused Courses

- ARC 503 Advanced Architectural Design – Collaborative Design Studio: Architecture + Engineering
- ARC 503 Advanced Architectural Design – Airport Design
- ARC 520 Sustainable Architecture
- ARC 521 Daylighting and Passive Energy Systems for Architecture
- ARC 522 Building Energy Efficiency and Renewable Energy
- ARC 523 Building Energy Modeling and Simulation
- ARC 524 Building Energy Optimization

Material/Tectonic-Focused Courses

- ARC 503 Advanced Architectural Design – High-rise Building Design
- ARC 503 Advanced Architectural Design – Production for Architecture
- ARC 530 Tectonics & Craft
- ARC 536 Materials for Design
- ARC 537 Digital Materials Translations
- ARC 538 Manufacturing Architecture
- ARC 534 Design of Architectural Details
- ARC 535 Experiments in Architecture Prototypes

Note: Certificate students are required to take at least one course in each of the above two categories to achieve the learning outcomes defined for the program.

Objectives and Outcomes

1. By the time they complete this certificate program, graduates should be able to:

- analyze how climate and architectural form affect daylighting and energy performances in buildings
- develop strategies to optimize architectural solutions by reducing loads and increasing energy efficiency
- apply simulation tools to evaluate design options and to demonstrate the effects of climate, building form and energy efficiency measures on building performances
- define the performance qualities of architectural materials and develop a working knowledge of resources relevant to various architectural materials
- define the performance objectives of architectural details and develop a working knowledge of basic construction methods and material manufacturing processes
- identify the roles of material, construction, and manufacturing in proposing architectural design solutions relevant to aesthetics, function, east of construction, durability and cost.

Additional Opportunities
Students in this concentration will become part of an academic and professional community that offers a broad range of extracurricular activities. These include visiting lecturers and colloquia.

Application Process
Applicants must complete an application form to be considered for the certificate program (example attached).

To qualify for admission to the Graduate Certificate in Energy & Technology in Architecture, students must be enrolled in, or have completed, a professional program in architecture. Students must have at the time of application a 3.00 grade point average in their professional degree program.

Graduate Certificate Completion
To receive a Graduate Certificate, a student must complete 15 hours of coursework, and have a minimum 3.00 grade point average (GPA) on all certificate course work. All grades on courses taken towards the certificate program in courses numbered 400 and above are included in the GPA. Courses at the 300 level and below are not eligible for certificate credit and subsequently do not affect the graduate GPA.

The minimum grade to receive certificate credit can be no lower than a grade of B-. GCP students who take letter-graded 400-, 500- and 700-level courses do not have the option of taking the courses for "credit only" if they intend for the course to be part of their GCP. Transfer credit from other institutions is not allowed for GCP. All course work must be registered for through NC State University. All GCP requirements must be completed within four (4) calendar years, beginning with the date the student commences courses applicable to the GCP, unless a more restrictive time limit has been established by the program or academic college/school. A student may obtain more than one certificate. Each certificate must have at least nine (9) credit hours that are unique to it.

Note: Academic success might have a strong bearing on admission to a degree program, but completion of a certificate program in no way guarantees entry into a graduate degree program, which is done through a separate application process.

Graduate Student Certificate Plan Data Entry

Student ID _____	Student Name _____

Student Program Related Information	
Admit Term _____	(Enter semester and year)
Academic Load (for Graduate School office use only) LTHalftime	
Academic Program (for Graduate School office use only in the case of NDS students) GCERT	
Expected Graduation Term (if known) _____	(Optional field – enter semester and year)

Student Plan & Sub-plan Related Information (choose code/description from drop-down lists below)
Academic Plan _ Select One _____
Academic Sub Plan (dynamically populates if a Distance Education sub plan exists for the plan chosen above) * Please change the option below to a dash if you do not wish to choose a Distance Education subplan. _____ - _____ _____

_____ _____

Director's Signature Date

***NOTE**: If you are viewing this PDF in a browser and the Sub Plan drop-down above is not dynamically populating, please download it to your computer (right-click, Save or right-click, Save Page As) and open it with Adobe Reader or Adobe Acrobat.*

Graduate Certificate - Courses and Learning Objectives

Energy and Technology in Architecture

Applicant Name_____Student ID _____

Courses Completed

All studios and/or seminars taken to achieve the Energy-Focused learning outcomes:	**All studios and/or seminars taken to achieve the Material/Tectonic-Focused learning outcomes:**
e.g. ARC 521 Daylighting and Passive Energy (J.Hu) – Fall 2013 ….	e.g. ARC 503 Studio – High-rise building (W. Place) – Spring 2013 …

Learning Objectives Assessment

Column 1 - Learning Objective: ***Student should be able to***	**Column 2 - Title of the course addressing the learning objective**	**Column 3 - Relevant content and/or project completed within the course**
Energy objective 1: To analyze how **climate and architectural form** affect daylighting and energy performances in buildings	e.g. ARC 590-004 Daylighting and Passive Energy Systems for Arch.	e.g. Project 3: LEED V4 Daylight Credit Assessment by Computer Simulation
Energy objective 2: To develop **strategies** to optimize architectural solutions by reducing loads and increasing energy efficiency		
Energy objective 3: To apply **simulation** tools to evaluate design options and to demonstrate the effects of climate, building form and energy efficiency measures on building performances		
Material/Tectonic objective 1: To define the performance qualities of architectural **materials** and develop a working knowledge of resources relevant to various architectural materials		.
Material/Tectonic objective 2: To define the performance objectives of architectural **details** and develop a working knowledge of basic construction methods and material manufacturing processes		
Material/Tectonic objective 3: To identify the **roles** of material, construction, and manufacturing in proposing architectural design solutions relevant to aesthetics, function, east of construction, durability and cost.		