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School of Architecture

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School of Architecture home page: <http://www.arch.rpi.edu>

Significant changes are occurring within the discipline and profession of architecture in the areas of globalization, interdisciplinary teamwork, and emerging technologies. Along with a strong creative focus, these issues are at the core of Rensselaer's undergraduate and graduate architecture programs. The school offers extensive international study programs in locations such as Italy, India, and China; a culture that encourages study and research between disciplines; a studio environment that supports the most ambitious applications of information-based design and technology while encouraging critical innovation. A strong permanent faculty of 15 professors and a complement of clinical and adjunct professors drawn from research and practices in New York, Boston, and Montreal center their instruction on design, which is the core of the undergraduate experience.

These same qualities characterize Rensselaer's several areas of graduate study in architecture. Apart from the professional masters degree that is designed for those with undergraduate degrees in other fields, the School offers several areas of master's level specialization: Architectural Acoustics, Building Conservation, Informatics and Architecture, Lighting, Building Systems Research, and Computation in Design. Each of these focuses on aspects of technology appropriate to Rensselaer and incorporates program elements of Rensselaer's nationally renowned Lighting Research Center, a preeminent laboratory for lighting research. The Doctor of Philosophy in Architectural Sciences is a multidisciplinary and interdisciplinary degree supporting research and scholarship across the many topics arising from the theory and practice of architecture and the built environment.

To both its undergraduate and graduate students, Rensselaer's School of Architecture offers an outstanding collection of resources and state-of-the-art facilities. Rensselaer's Architecture Library, the only branch library on the campus, is located at the physical center of the school and is a major student, faculty, and professional resource. This library contains over 30,000 books and periodicals, both domestic and foreign, as well as a loan collection of 90,000 slides on contemporary and historical buildings, structural design, building technology, city planning, and fine arts. It also holds a collection of maps and architectural drawings. The collection is growing to include microfiche and such electronic media as videos, and architecture-related software. (More information can be found at the library's web site: <http://www.rpi.edu/dept/library/html/architecture.>)

Specialized facilities and equipment that enhance school activities include a testing room with a Hemi-anechoic chamber, the Binaural Listening test station, specialized acoustics laboratory equipment and acoustics software, the Lee Harris Pomeroy '54 Advanced Visualization Lab; the Synthetic Environments Lab, the Laboratory of Human-Environment Interaction Research; the Electronic Studio 305; the Solar and Microclimate Laboratory, the School of Architecture Workshop, Field Study Facilities, Optical Tools, the Community Outreach Partnership Center in the Gurley Building, and various other laboratories. These are generally available to all students, although in some cases training may be required and some equipment is reserved for advanced students.

This combination of excellent programs and modern facilities endows all School of Architecture graduates with a distinctive creativity, pragmatism, independence, and a progressive outlook that makes them highly sought for not only architectural practice, but also for positions in their specific areas of specialization.

Degrees Offered

Architecture	B.Arch., M.Arch.
Building Conservation	M.S.
Architectural Sciences	M.S., Ph.D.
Concentration in Architectural Acoustics	
Concentration in Building Systems Research	
Concentration in Computation in Design	M.S.
Concentration in Informatics and Architecture (Computation in Design)	Ph.D.
Concentration in Lighting	
Informatics and Architecture	M.S.
Lighting	M.S.

Overview of Undergraduate Programs

The School of Architecture offers a four-year Bachelor of Science in Building Sciences and a five-year Bachelor of Architecture degree. The Bachelor of Architecture is a professional degree accredited by the National Architecture Accrediting Board. Approximately 60 students are admitted directly into the program each year.

As a professional school designed for those ready to begin serious architectural study in the first year, the School of Architecture's admissions decisions are based on three criteria: overall academic excellence, creativity demonstrated through work in the arts and other areas, and maturity and personal motivation. The School encourages visiting the campus and the Greene Building, home of the School of Architecture, along with a faculty interview. All undergraduate program applicants must also provide a portfolio. For portfolio requirements visit www.arch.edu/undergraduate.

Students who have completed some architecture course work at other schools may apply for transfer to Rensselaer. Upon acceptance, transfer students are placed at an appropriate level in the professional program based on a review of their transcript, course descriptions, and work portfolio.

Overview Graduate Programs

Rensselaer's School of Architecture offers both masters and doctoral level graduate programs.

Master's Programs

The School of Architecture offers a number of distinct master's degrees. The Master of Architecture I is a first professional degree. It is accredited by the National Architecture Accrediting Board for students already holding at least a baccalaureate degree in another field. This degree's course of study parallels much of the course and studio requirements for the Bachelor of Architecture program. Approximately 10 students are admitted to this program annually.

The remaining master's programs are advanced degrees in architecture, architectural sciences, and related fields. They include:

- Master of Architecture II
- Master of Science in Building Conservation
- Master of Science in Architectural Sciences (Concentration in Architectural Acoustics)
- Master of Science in Architectural Sciences (Concentration in Building Systems Research)
- Master of Science in Architectural Sciences (Concentration in Computation in Design)
- Master of Science in Architectural Sciences (Concentration in Lighting)
- Master of Science in Informatics and Architecture
- Master of Science in Lighting

Doctoral Programs

The Ph.D. in Architectural Sciences is a multidisciplinary and interdisciplinary degree supporting research and scholarship across the many topics arising from the theory and practice of architecture and the built environment. It is open to candidates with a professional degree in architecture and those with degrees in related design fields from science, engineering, and the humanities.

Although the discipline of architecture has a strong and complex knowledge base, its essential nature causes it to synthesize the knowledge produced in many other fields, from sociology and history to information technology and the performance of materials. The degree is aimed at producing a context for the advanced study and research between architecture and appropriate areas of science, engineering, and the humanities.

Those pursuing doctoral study in Architectural Sciences at Rensselaer may select from four areas of concentrations. They include:

- Ph.D. in Architectural Sciences (Concentration in Architectural Acoustics)
- Ph.D. in Architectural Sciences (Concentration in Building Systems Research)
- Ph.D. in Architectural Sciences Concentration in Informatics and Architecture (Computation in Design)
- Ph.D. in Architectural Sciences (Concentration in Lighting)

and also in emerging areas of specialization in aspects of architecture and technology.

Research Innovations and Initiatives

Communication acoustics

The School of Architecture faculty is renowned for its acoustic consulting expertise and academic research in many areas of communication acoustics such as advanced techniques for computational modeling of room acoustics. Examples of current research include modeling and perception of coupled acoustical spaces, including sound and vision, perception of early reflections due to scattering of sound by rough surfaces and the fine structure of reverberation, room sound coloration, acoustics of under-balcony environments, and telepresence questions involving cross-modal interaction between visual and acoustical stimuli, as well as interaction between tactile and aural stimuli.

Acoustics of concert halls and other performance venues and classrooms

The School of Architecture faculty is also renowned for its acoustic consulting expertise in designing performance venues and worship spaces. Architecture faculty and graduate students have traveled to the Bass Performance Hall in Fort Worth, Texas, to measure acoustical energy coupling with monaural and binaural receivers. A more recent emphasis is on classrooms where poor acoustics are detrimental to learning. Research and design in this area includes computer modeling and experimentation with scale models as well as measurement and analysis in existing facilities. Ease of Hearing in Various Classroom Geometries, a recently completed thesis project, involved modeling various geometries using acoustics prediction software. Other studies concern sound propagation and scattering using physical scale models diffusivity of reverberation, etc.

Auralization

The acoustical analog of visualization aims to recreate sound fields from computational models of spaces. Current core research includes the development of more accurate mathematical models for room acoustics, determination of accurate scattering and diffraction coefficients for performance-hall design and modeling, and subjective studies on the effect of sound quality on human performance, including productivity, ease of hearing, and hearing comfort.

Electronic enhancement of acoustical communication over large distances

This work focuses on the development of “acoustic telepresence systems” that will provide an unmatched auditory sense of presence across distances. This research is an essential aural counterpart to current research in computer-mediated visual technologies, with possible applications in teleconferencing, distance education, games, and virtual reality.

Active room acoustics and room tuning using electroacoustics

Electronic tuning can be very helpful in adapting the venue to the events taking place in it (music performances of different genres, conferences, etc.). Such dynamic tuning is very important to insure optimum acoustic quality in multipurpose spaces.

Measurement techniques for room acoustics

New measurement technologies can be used for more effective representation of sound fields, leading to a better understanding of physical phenomena and aiding acousticians in the design process.

Synthetic sensing and synthetic environments

Current research includes the experimental development of alternative sensory methods for individuals and the development and testing of immersive and augmented electronic environments for teleperformance and design collaboration. A guiding principle of the research is the complementary nature of media, computation, space, and the body rather than the substitution of human skills or spatial conditions with computer technology.

Computational acoustics and computer-mediated design processes

This research area is primarily concerned with Computer-Aided Design and the redefinition of the design process. The computer is envisioned as a medium for opening up new possibilities for architectural and urban design, rather than a tool for performing well-known tasks more quickly and cheaply. New design algorithms, new roles of computing in the client-designer-builder network, and new design processes are at the core of research in this area.

Product and transmission sound quality

The product sound quality approach is firmly based in psychoacoustics and psychology. Using jury evaluations the sound perception of humans is investigated with the ambition of finding new, psychoacoustically relevant sound metrics. The research includes simulation and modeling and setting targets for the design for sound quality for product applications such as automobile, household, etc., and the goal is to give sound to the work, the work in transmission sound quality focuses on the effect of transmission inaccuracies of speech systems, linear and nonlinear distortion in microphones and loudspeakers, and related applications.

Ultrasonic sensing

This research area is primarily concerned with finding cost-effective, fast and efficient methods of sensing the sonic environment using ultrasound for use with self propelled robots and other devices needing remote sensing for interaction with the environment.

Simulation, data, and design

Simulation in architecture must react not only to complex physical criteria, but also be sensitive to social, cultural, and political concerns not easily codified into a simulation algorithm. Research focuses on the development of new simulation methods that provide creative, legible, and interactive feedback to designers, planners, and others involved in architectural and urban design. Facilities specific to this research are the Lee Harris Pomeroy '54 Advanced Visualization Lab, the Synthetic Environments Lab, Studio 305, the Solar and Microclimate Laboratory, the School of Architecture Workshop, and Rensselaer's Libraries and Information Services.

Light and health

The Lighting Research Center continues to seek funding to expand research initiatives in the area of light of health. Investigations include the role of lighting in the mitigation of diseases and disorders such as Alzheimer's disease and Seasonal Affective Disorder (SAD) and the interaction of lighting with the human circadian and other biological systems. This research has far-reaching implications in the areas of medical research, photobiology, biotechnology, engineering, and related sciences.

Solid state lighting

Solid state lighting is one of the fastest growing areas in lighting technology today with wide implications for all areas of lighting including architecture, transportation, and information technology. The Lighting Research Center has developed core competencies in this area and works to expand research in solid state lighting development and application.

Energy policy

With the growing need for electricity nation-wide and increasing societal pressure to avoid building new generation plants and transmission lines, there is increasing need for research in the area of "demand/response" technologies. These technologies can be used to decrease electric demand at peak times quickly without negatively impacting employee comfort or productivity. Lighting plays a key role in this area, and the Lighting Research Center seeks funding for research to assist the development of demand/response technologies and policies.

Intelligent roadway systems

With the increasing complexity and congestion of roadways throughout the United States and the development of new communication and information technologies, lighting plays a key role in the transmission of information to drivers. The Lighting Research Center seeks funding to expand research into the development of lighting as part of intelligent roadway systems.

Faculty*

Professors

- Balfour, A.**—M.F.A. (Princeton University); architecture and urban history and society.
- Boyce, P.**—Ph.D. (University of Reading); human factors.
- Bronet, E.**—M.S. (Columbia University); architectural design, structures technology, interdisciplinary design. Past President, ACSA.
- Haviland, D.**—M.Arch. (Rensselaer Polytechnic Institute); building industry, management, economics.
- Goebel, J. M.A.**—M.Arch. (Staaliche Hochschule fur Music and Theater); music composition and performance.
- Kleiner, M.**—Ph.D. (Chalmers University of Technology, Sweden); architectural acoustics, sound quality of rooms, auralization and sonification, telepresence, product sound quality, audio and video systems, active control, noise and vibration control, signal processing, perceptual signal processing.
- Kroner, W.**—M.Arch. (Rensselaer Polytechnic Institute); resources and sustainable architecture, advanced building technologies, futurism, and architectural design.
- Leslie, R.**—M.Arch. (Rensselaer Polytechnic Institute); lighting, daylighting, environmental comfort technologies.
- Rea, M.**—Ph.D. (Ohio State University); vision science; lighting theory and applications.

Associate Dean

- Mistur, M.**—M.S. (Rensselaer Polytechnic Institute); architectural design, practice, technology. (Clinical)

Associate Professors

- Bell, D.**—M.Arch. (University of Virginia); architectural design, theory, and history.
- Dyson, A.**—M.Arch. (Yale University); architectural design, structures technology, multidisciplinary design theory and ecology.
- Krueger, T.**—M.Arch. (Columbia University); human-environment interaction, design.
- Massie, W.**—M.Arch. (Columbia University); architectural design, computer applications and emerging technologies, architectural practice.
- Narendran, N.**—Ph.D. (University of Rhode Island); remote source lighting, fiber-optic sensors, geometric and physical optics.
- Parsons, P.**—B.Arch. (Cornell University); architectural design, theory, and history.
- Warriner, K.**—B.Arch. (University of Florida); architectural and urban design and theory.
- Xiang, N.**—Ph.D. (Ruhr University, Bochum, Germany); architectural acoustics, acoustic signal processing.

Assistant Professors

- Lonsway, B.**—M.Arch. (Columbia University); architectural theory and electronic media.
- Torres, Rendell**—Ph.D. (Chalmers Tekniska Hoegkola, Gothenburg, Sweden); architectural acoustics; auralization of sound fields, subjective effects of room acoustics.
- Van Dessel, S.**—Ph.D. (University of Florida); emerging materials and material development, sustainable architectural technologies.

Clinical Professors

- Abbate-Gardner, C.**—M.Arch. (University of Rome); architectural and urban design, practice, and Italian studies.
- Ellinger, J.**—M. Arch. (Columbia University); design.
- Pattison, M.**—M.Ed. (Antioch/New England Graduate School, Organization and Management); Government, urbanism, urban planning and community development.

* Departmental faculty listings are accurate as of the date generated for inclusion in this catalog. For the most up-to-date listing of faculty positions, including end-of-year promotions, please refer to the Faculty Roster section of this catalog, which is current as of the May 2004 Board of Trustees meeting.

Oatman, M.—M.F.A. (University of Albany); B.F.A. (Rhode Island School of Design); drawing, design, painter and installation artist.

Riebe, D.—M.S. (Columbia University); architectural design, emerging technologies and practice. practicing licensed architect.

Emeritus Faculty

Pertuiset, N.—Hons. Dipl. Arch. and Theory (Architectural Association); architectural design and theory.

Quinn, P.—M.Arch. (University of Pennsylvania); theory and architectural design, institutional and community facilities.

Williams, G.—M.Arch. (Rensselaer Polytechnic Institute); architectural design and practice.

Adjunct and Visiting Faculty

Akashi, Y.—Ph.D. (Musashi Institute of Technology); human factors in lighting.

Bedford, S.—Ph.D. (Columbia University); architectural history, regulatory compliance.

Bierman, A.—M.S. (Rensselaer Polytechnic Institute); mesopic vision, color vision, lighting controls, measurement of lighting efficiency.

Boucher, D.—B. Arch. (Rensselaer Polytechnic Institute); partner, historic preservation, building conservation.

Boyer, K.—Ph.D. (McGill University); urban design, information technology gender and work.

Bullough, J.—M.S. (Rensselaer Polytechnic Institute); psychological and biological effects of light, lighting for transportation, technology transfer.

Byszewski, V.—D.Sc., Ph.D., M.S. (Warsaw University), Ph.D. (Polish Academy); lighting technology.

Carpentier, Jr., D.—B.A. Historic Preservation (Empire State College); historic preservation.

Carroll, P. T.—Ph.D. (University of Pennsylvania); history of American science and technology, industrial archeology.

Cawley, F.—B.F.A. and B. Landscape Architecture (Rhode Island School of Design); historic preservation, landscape architecture, and urban design.

Ebbing, C.—M.S.E.E. (SUNY at Buffalo); industrial acoustics, research special noise control.

Facca, A.—M.S. (University of Virginia); urban planner.

Figueiro, M.—M.S. Lighting, (Rensselaer Polytechnic Institute); architectural design and construction management.

Fleisher, S.—B.A. (Northeastern University); furniture design.

Foulks, W.—M.A. (Columbia University); restoration and preservation of historic buildings.

Freidman, D.—B.S. (Rensselaer Polytechnic Institute); historic buildings engineering practice.

Gilles-Smith, S.—M.A.U.D. (Harvard Graduate School of Design); landscape architecture.

Hartgen, K.—M.Arts (University at Albany); artifact preservation.

Hill, K.—M.Eng. (Cornell University); practicing structural engineer.

Hoffman, D.—B.F.A. (Carnegie Mellon University); theater, technical theater, stage design, stage lighting, theatrical engineering.

Holmes, O.—B.S. Mathematics (State University College Oneonta) B.S. Mechanical Engineering (Syracuse University), HVAC, building systems, energy management.

Kim, J.—M.Arch. (Princeton); information and public space in architecture.

Levin, R.—Ph.D. (Stanford University); lighting optics, lighting application, nonionizing radiation.

McColgan, M.—Ph.D. Physics (University of Alabama in Huntsville); B.S. Optics (University of Rochester); light pollution, outdoor lighting, optical modeling.

Miller, N.—B.S. (Massachusetts Institute of Technology); energy-efficient lighting for residential and commercial uses, lighting quality and human factors.

Miner, D.—M.S. (Columbia University); preservation law.

- Mintz, N.**—M.S. (Columbia University); urban design, historic preservation.
- Morante, P.**—B.S. Electrical Engineering (Norwich University); marketing and electric power markets.
- Morozov, P.**—M.Arch. (Rice University); design.
- Nelson, B.**—B.A., B.S. (Rensselaer Polytechnic Institute); professional practice, community planning, project management.
- Palenzuela, N.**—M.Arch. (University of Florida); design.
- Pepi, R.**—(Columbia University), architectural materials conservation and historic preservation.
- Pierpont, R.**—B.A., M.A. English (University at Albany); historic preservation.
- Reilly, S.**—B.Arch., B.S. (Rensselaer Polytechnic Institute), architectural design, practice, preservation technology.
- Rittelmann, R.**—M.Arch. (Rensselaer); research energy conservation in buildings and research laboratory design.
- Shaver, P.**—B.A. Liberal Arts (Syracuse University); American history, architectural history.
- Toatley, C.**—B.Arch. (Rensselaer); architectural theory and electronic media.
- Van Derlofske, J.**—Ph.D. (University of Alabama in Huntsville); illumination systems, optical design, optical computer modeling, prototype development.

Undergraduate Programs

The School of Architecture offers two distinct undergraduate degrees. The five-year Bachelor of Architecture (B.Arch.) curriculum centers on the design studio and culminates in a year-long research and design project. Computing, theoretical, technological, and historical issues are progressively integrated into the design projects beginning in the first year. Projects range in scale and form, but relate to issues in contemporary culture with a focus on globalization and urban contexts.

The second undergraduate curriculum is the four-year B.S. in Building Sciences, which prepares students for the broad range of building industry roles and opportunities. Rensselaer's excellence in science and technology permits specialization within the Building Sciences program. Students enrolled in the Bachelor of Architecture program may, anytime after the second year, apply for transfer to the four-year Building Sciences degree program. Rensselaer's Building Sciences students may also choose to concentrate in Information Technology as it relates to the building industry, energy efficiency in buildings, project and construction management, or lighting. In addition, independent studies are available in special topic areas. Another option is the interdisciplinary Product Design and Innovation dual degree program offered jointly between Building Sciences and the School of Humanities and Social Sciences' Department of Science and Technology Studies.

Each of these degree programs are described in detail below.

Students in both School of Architecture undergraduate programs are required to complete courses in the arts, sciences, humanities, and social sciences as part of the Institute core requirements. The core courses are structured to provide exposure and breadth to each of these areas.

In addition to Institute-wide academic regulations outlined earlier in this catalog, the following pertain to the bachelor's program in architecture:

- **Advancement in Design**—Students not passing a required design course may not advance to the next course in the design sequence. The architecture faculty will review students earning grades of D or lower in required design courses. A student earning a D or lower in any subsequent required design course must either repeat the course or take another course specified by the faculty before advancing to the next course in the design sequence. Students who fail to earn a grade of C or better in the repeated or specified course, or who earn a third grade of D or lower in design, may not continue in the design sequence. A student earning an F in any course must repeat the course.
- **Retention of Student Design Work**—All drawings and models done by students as part of the instructional program are the property of the Institute until they have been released by the instructor. The School of Architecture at its option, may retain certain works for academic purposes.

Baccalaureate Programs

Bachelor of Architecture (B.Arch.) Curriculum

This five-year undergraduate professional program is a first professional degree accredited by the National Architectural Accreditation Board. The program is for a limited number of qualified students committed to the study of architecture. These students are admitted directly to the professional degree program and begin studies in architecture in the first year.

The National Architectural Accreditation Board (NAAB) accredits the Rensselaer School of Architecture's Bachelor of Architecture program and its Master of Architecture program. The following statement is included in the catalog, pursuant to the requirement of the NAAB:

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accreditation Board, which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees; the Bachelor of Architecture and the Master of Architecture. A program may be granted a six-year, three-year, or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of preprofessional and undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

Rensselaer's B.Arch. program incorporates and interconnects the following important elements:

- **Design**—Design and the design studio form the core of all architecture degree programs. The design studio brings together the many aspects of architecture and presents a wide range of design issues, beginning with the development of the tools, skills, and judgments that underlie the production of architecture.

The skills area emphasizes that the hand is as important as the computer in the representation of ideas. The ability to freely manipulate space, surface, structure, and texture is central to the reformation of architecture. The tools component develops confidence in the technologies that form architecture and are essential support to creativity. Finally, the judgments aspect is developed through projects premised on the continual evolution of architecture as a manifestation of the social, economic, political, and technological forces within the culture. All design studios draw broadly on the exceptional range of urban and architectural contexts near the campus; from the historic towns in upstate New York to great cities of the region such as New York, Boston, Montreal, and Philadelphia.

In the design studio there are no singular, provable, or perfect answers to any of the problems presented. Students explore and develop their design proposals based on their growing knowledge of architecture and their emerging ability. The early semester-long studios introduce students to the full range of issues, skills, and judgments encountered in design and initiate and reinforce design as critical inquiry. The remaining studios focus on significant concerns in architecture. They are “vertical” in that they include students in different class years, and they present choices of project and faculty. Among these is the design development studio, in which a prior project is subjected to detailed structural, mechanical, construction materials, and professional practice considerations.

- **History and Theory**—A required five-course sequence presents the diversity of architectural works and ideas relative to the contexts within which architecture emerges and to key historical and theoretical issues in the field. Following this sequence, students may take additional advanced architectural history/theory electives as a part of their professional or free elective selections and are required to take at least one history elective from the listing of professional electives.
- **Technology and Building Science**—Technological issues are introduced from the beginning as essential to the conception and creation of architecture. New technologies can be the generative of form and inhabitable space. A series of six required technology courses consider both qualitative and quantitative views of building technologies. These include statics and strength of materials; basic structures and framing; design of wood, steel, and concrete structures; criteria for selecting building materials and systems; environmental systems, including heating, ventilation, air conditioning, plumbing, and electrical systems; sensory environment, including the luminous, acoustical, and tactile environments; codes and contract documents. Following this sequence, students may take additional advanced technology and building science electives as a part of their professional or free elective selections. Integration of technological considerations is central to many of the studios with a

focused emphasis on integrating building technologies and the act of creating in the required upper level design development studio.

- **Computing**—Computer proficiency is central to the future of architecture. From the first year, students are able to expand their knowledge and skill through course work with key computing concepts and applications—in some cases integrated within the design studios—and through independent experimentation in the many computer labs at the School and Institute. Apart from well-supported general-purpose labs, the School offers high-end multimedia environments within the many design studios. Students have access to the latest in three-dimensional design software, virtual reality programming tools, and video and multimedia production hardware and software to investigate the value of these technologies to critical design practice. Students may experiment with immersive 3-D, VR collaboration, or video and animation-based investigations of architectural and urban form. Advanced software from film production and VR-based manufacturing is available in an environment designed for digital collaboration.

These elements are provided through both required courses as well as many professional electives and topics in such areas as architectural and urban history and theory, technology, computing, building economics, community design, practice and management, architectural lighting, and acoustics in architecture. Professional degree students must complete at least 12 credits from these offerings by either building on a specific interest or by sampling the breadth and diversity inherent in the field. A minimum of four credits must be from a designated list of history electives. In addition to regularly offered electives (described in the back of this catalog), the faculty offers a number of topics or experimental courses as professional electives. Sample courses include, but are not limited to:

Advanced Structures Technology	Evolution of Housing in the 20th Century
Advanced Technologies Seminar	Extreme Drawing
American Building—17th–19th Centuries and 20th	Geometry in Architecture
Architectural Acoustics 1 and 2	History of Landscape
Architecture and Urban Design in the Italian Renaissance	Human Factors in Lighting
Bedford Technology Seminar	Lighting Design
Building Conservation 1 and 2	Lighting Technology
Building Design/Construction	Philosophies of Space in a Digital Culture
Building Engineering Design Seminar	Presentation [re] Presentation + Memory
Construction Industry Seminar	Preservation Theory
Design: Built Ecologies and Natural Systems	Recording Historic Structures
Digital Media Human Environment	Re-Painting the White Cube
Drawing Historic Structures	Seeing Digital
Electronic Media: Critical Visualization	Simulation
Electronic Media: Physical Design Processes	Sustainable Community Design
Emerging Materials and Material Development	Understanding Computer Mediated Design
	Workshop: Material Exploration and Fabrication

The five-year B.Arch. program concludes with an individually initiated, planned, and developed comprehensive project. Planning begins in the fourth year through an exchange of ideas with and a critique by a faculty adviser and review committee. The resulting proposals form published faculty statements of interest combined with the students' experiences and areas of special concern. These may emerge from a synthesis of previous work that applied gained knowledge to advanced issues or, alternatively, experiences to date may be used as a base from which to explore and to innovate. This final year begins with a short competition project in which all participate. An integrated design research phase then lasts the remainder of the first and throughout the second semester.

The final project is an opportunity to develop a point of view about architecture and its place in the world; to question conventions, habitual responses, and routine approaches to architectural design; and to investigate issues that the student sees as significant to architecture.

A sample template of the B.Arch. curriculum structure is provided below. Please note that special circumstances such as dual majors may involve some variation from this template.

Bachelor of Architecture Curriculum

First Year

Fall		Credit hours	Spring		Credit hours
IHSS-1970	Design, History, and Society ¹	4		Hum. or Soc. Sci. Elective	4
ARCH-2200	Design Studio (2)	4	ARCH-2210	Architecture Design 1(4).....	6
	Drawing (1)			Drawing (1)	
	Computing (1)			Computing (1)	
ARCH-2110	The Building and Thinking of		ARCH-2510	Materials and Design	2
	Architecture 1 ²	4	ARCH-2120	The Building and Thinking of	
MATH-1500	Calculus I.....	4		Architecture 2 ²	2
			PHYS-1050	Physical Principles of Design.....	4

Second Year

Fall		Credit hours	Spring		Credit hours
ARCH-2130	Contemporary Design Approaches ...	2	ARCH-2140	The Building and Thinking of	
ARCH-2220	Architecture Design 2 (5)	6		Architecture 3... ..	2
	Computing (1)		ARCH-2230	Architecture Design 3 (5).....	6
ARCH-2330	Structures 1 ³	4		Computing (1)	
	Hum. or Soc. Sci Elective	4	ARCH-2360	Environ. and Ecological Systems ³	4
ARCH-2350	Construction Systems	2		Math Elective ⁴	4

Third Year

Fall		Credit hours	Spring		Credit hours
	Hum. or Soc. Sci Elective	4	BIOL-1010	Introduction to Biology.....	4
ARCH-4240	Architecture Design 4 (Urban)	6	ARCH-4250	Architecture Design 5	6
ARCH-4330	Structures 2 ³	4	ARCH-4740	Building Systems and	
ARCH-4140	Modernity in Culture and			Environment ³	4
	Architecture	4	ARCH-4560	Materials and Enclosure.....	2

Fourth Year

Fall		Credit hours	Spring		Credit hours
ARCH-4690	Case Studies	4	ARCH-4040	Cities/Land	4
ARCH-4260	Architecture Design 6	6	ARCH-4300	Design Development	6
	Professional Elective	4	ARCH-4540	Professional Practice ⁵	2
	Elective.....	4		Elective.....	4

¹ IHSS-1970 will fulfill the Institute writing requirement.

² Four credits of the Hum. or Soc. Sci core requirements are embedded within The Building and Thinking of Architecture sequence: ARCH-2110 and ARCH-2120.

³ Four credits of the Institute core Science requirements are embedded within the technology sequence: ARCH-2330, ARCH-2360, ARCH-4330, and ARCH-4740.

⁴ In general, the recommended course is MATH-1620 offered only in the spring.

⁵ Taken in the same semester as ARCH-4300.

Fifth Year**Fall**

	Credit hours
ARCH-4990 B.Arch. Final Project 1 (3).....	6
Research/Methods (1)	
Competition (2)	
Hum. or Soc. Sci. Elective	4
Elective.....	4
Professional Elective	2

Spring

	Credit hours
ARCH-4990 B.Arch. Final Project 2	6
Science Elective.....	4
Professional Elective	4
Professional Elective	2

All undergraduate students should develop a plan of study with their faculty adviser. The degree requires 168 credit hours.

In regard to the above template, please note that studios are sequential with the exception of the Design Development studio, which may be taken any time after the completion of the urban studio (Architecture Design 4) and before B.Arch. Final Project 1. Students are required to complete eight credits in Math, 12 in Science, and 20 in Humanities and Social Sciences from an extensive list of course offerings (see Institute core requirements for greater detail). In addition, students have 12 credits of free electives which may be used to further focus on a concentrated area of study, pursue a minor or dual major, or as a means of further broadening exposure to a range of disciplines.

Discipline specific sequences embedded in the curriculum are detailed below.

Technology courses: ARCH-2330 Structures 1 is sequential and prerequisite to ARCH-4330 Structures 2; and ARCH-2360 Environmental and Ecological Systems is sequential and prerequisite to ARCH-4740 Building Systems and Environment.

ARCH-2200 Design Studio, ARCH-2210 Architecture Design 1, ARCH-2220 Architecture Design 2, ARCH-2230 Architecture Design 3, and ARCH-4240 Architecture Design 4 (Urban), and ARCH-2330 Structures 1, ARCH-2360 Environmental and Ecological Systems, ARCH-4330 Structures 2, ARCH-4740 Building Systems and Environment are prerequisites to the ARCH-4300 Design Development studio. ARCH-4740 Building Systems and Environment may be taken concurrently with the ARCH-4300 Design Development studio.

ARCH-2110 The Building and Thinking of Architecture 1, ARCH-2120 The Building and Thinking of Architecture 2 are prerequisites to ARCH- 2130 Contemporary Design Approaches.

Bachelor of Science in Building Sciences Curriculum

The four-year Bachelor of Science degree in Building Sciences prepares students for the broad range of roles and opportunities presented by the building industry. Students enrolled in the B.Arch. program may, anytime after the second year, apply for transfer to Building Sciences. The building sciences focus on the design and construction of building systems such as structures, enclosures, environmental systems, lighting, and acoustics, as well as their management, performance, and building diagnostics.

Students in the Building Sciences program declare a concentration and submit a plan of study at the end of the second semester. The plan of study must be approved and filed with the Building Sciences program director. For the first two semesters, students follow the same curriculum as the B.Arch. students. For the remaining six semesters, they take concentration electives in place of design courses. Concentrations include computer applications, lighting, construction management, and advanced technology assessment. The degree requires 126 credit hours.

Building Science Curriculum

First Year

Fall		Credit hours	Spring		Credit hours
ARCH-2110	The Building and Thinking of Architecture 1 ¹	4	ARCH-2120	The Building and Thinking of Architecture 2 ¹	2
ARCH-2200	Design Studio	4	ARCH-2210	Architecture Design 1	6
MATH-1500	Calculus I.....	4	PHYS-1050	Physical Principles of Design	4
IHSS-1970	Design, History, and Society ²	4	MATH-1520	Math. Methods in Mgmt. and Econ.	4
			ARCH-2510	Materials and Design	2

Second Year

Fall		Credit hours	Spring		Credit hours
	Hum. or Soc. Sci. Elective	4		Concentration Elective	4
	Professional Elective	2	ARCH-2360	Env. and Ecol. Systems ³	4
ARCH-2330	Structures 1 ³	4		Science Elective	4
MGMT-2100	Statistical Methods	4		Hum. or Soc. Sci. Elective	4

Third Year

Fall		Credit hours	Spring		Credit hours
	Concentration Elective	4	ARCH-4510	Construction Industry Seminar.....	2
ARCH-4330	Structures 2 ³	4	ARCH-4740	Bldg. Sys. and Env. ³	4
BIOL-1010	Introduction to Biology.....	4		Professional Elective	4
	Hum. or Soc. Sci. Elective	4		Concentration Elective	4

¹ Four credits of the Hum. or Soc. Sci. core requirements are embedded within The Building and Thinking of Architecture sequence: ARCH-2110 and ARCH-2120.

² IHSS-1970 will fulfill the Institute writing requirement.

³ Four credits of the Institute core Science requirements are embedded within the Technology sequence: ARCH-2330, ARCH-2360, ARCH-4330, and ARCH-4740.

Fourth Year Fall

	Credit hours	Spring		Credit hours
Concentration Elective	4		Concentration Elective	4
Hum. or Soc. Sci. Elective	4		Hum. or Soc. Sci. Elective	4
Elective.....	4		Elective	4
Professional Elective	4		Elective.....	4

The degree requires 126 credit hours. All undergraduate students should develop a plan of study with their faculty adviser.

Concentrations

All Building Science program concentrations require five four-credit-hour courses (or equivalent) that are approved by a concentration coordinator and the director of the Building Sciences program. Concentration options and their associated courses include:

Lighting

LGHT-4840	Human Factors in Lighting (4)
LGHT-4770	Lighting Technology (4)
LGHT-4230	Lighting Design (4)
LGHT-4790	Lighting Applications (4)
LGHT-4830	Light (4)

Building Systems and Products

MGMT-1100	Intro. to Management (4)
ARCH-4940	Adv. Ind. Projects in Arch. and Env. (4)
ARCH-4540	Professional Practice (2)
HVCC*	Construction Materials (2)
MGMT-4430	Marketing Principles (4)
ARCH-4940	Advanced Individual Projects in Arch. (2)

Construction Management

ARCH-4810	Advanced Technology Seminar (2)
MGMT-1100	Intro. to Management (4)
MGMT-4100	Operations Management I (4)
ARCH-4940	Adv. Ind. Projects in Arch. and Env. (4)
CIVL-2040	Professional Practice (3)
CIVL-4270	Construction Management (3)

Computer Applications

CSCI-1100	Computer Science I (4)
ARTS-1020	Media Studio: Imaging (4)
ARCH-4460	Electronic Media: Critical Visualization (4)
ARCH-4620	Intro. to Computation-Based Design and Programming (4)
ARCH-4940	Advanced Individual Projects in Arch. for Env. Design (CAD) (4)

Dual Major Programs

Dual majors are available to students interested in pursuing two majors simultaneously and who can develop an acceptable program of study that meets the requirements for both majors. There are many possibilities, with the most common options combining civil engineering or management with architecture. The interdisciplinary degree in Product Design and Innovation has been specifically developed for Building Science majors and is explained in detail under the heading Interdisciplinary Programs and Research found at the end of the School of Architecture section of this catalog.

Minor Programs

The School of Architecture offers minor options for both School of Architecture students and students majoring in other Rensselaer programs. These options are described below.

*This course is available at Hudson Valley Community College. Contact your adviser for further information.

Architecture

A minor in architecture is directed toward Rensselaer students interested in architecture as a sociocultural phenomenon and/or those envisioning a career in some segment of the building industry. The minor program provides an exposure to architecture—what it is, what it includes, its history, how it is accomplished; and to architects—who they are and how they think and work.

A minor consists of an approved 16-credit program. ARCH-2110 Building and Thinking of Architecture I is required but students may select the remainder of the courses to build a concentration in architecture that supports their own disciplinary interests.

Architectural History

The minor in architectural history is open to all Rensselaer students interested in the history of architecture as a sociocultural phenomenon that examines architecture as a cultural artifact. It consists of ARCH-2110 The Building and Thinking of Architecture I and upper division architectural history courses. Students who wish to obtain a minor in architectural history must receive approval of their course selections from the program adviser.

Lighting

The minor in lighting gives students the awareness and the confidence to extend their creative work through controlled use of light. The program covers human responses to light, both visual and nonvisual, and the means by which light is produced and controlled. Interactions of light with form, texture, and color are examined in the contexts of daylight, electric lighting, and their integration.

The program comprises 16 credits taken in the Lighting Research Center. Both fall semester courses must be taken before the spring semester courses, and the two spring semester courses must be taken concurrently. The courses required are: LGHT-4840 Human Factors in Lighting; LGHT-4770 Lighting Technology; LGHT-4230 Lighting Design; and LGHT-4790 Lighting Applications.

Special Undergraduate Opportunities

Study Abroad

International study is a defining aspect of Rensselaer's architectural education and the School of Architecture offers several international semester long programs of study. Offered in Italy, India, and China; these programs are fully integrated with the requirements of the undergraduate degree and have been established in three world cities that will challenge and help to define the future of architecture. Each of these programs is open, by competitive application, to students in their fifth semester and above. Only 20–25 students (B.Arch and M.Arch) are selected each year on the basis of academic accomplishment. In addition to a Rensselaer faculty member who directs these students, adjunct faculty in the host city or institution provide instruction. There is a program fee for participation in each of these programs, which are described briefly below.

- Italy—The Rome semester involves a design studio, an examination of the architectural development of Rome, courses in Italian language and culture, and travel throughout Italy. The program seeks to deepen appreciation of the city and the layers of its culture that have played a seminal role in the development of Western culture and architecture.
- India—The program is based in the School of Architecture CEPT at Ahmedabad, India, a highly respected school for the study of architecture and urbanism. It offers students the opportunity to travel, study, and apply the lessons learned from Indian architecture and Indian history and theory within the context of a major research center.

■ China—The semester in Shanghai is based at the School of Architecture at Tongji University, one of the great institutions of China. The program offers joint studios in design with Chinese faculty and students, and travel through central China augments additional courses in Chinese history and culture.

In addition the School of architecture offers occasional summer study abroad programs to places of special architectural interest. In recent years, these have included visits to Turkey and the Czech Republic.

Exchange Programs

Architecture students are eligible to apply for admittance into a student exchange program at the Swiss Federal Institute of Technology (ETH, Zurich). An agreement between Rensselaer and ETH provides for a year of study abroad. Other exchange and study abroad opportunities are also available.

Summer Studios

The school offers two six-week studios in the summer session that are open to accepted transfer and entering Master of Architecture students. With sufficient enrollment, an eight-week upper level vertical studio is offered for students enrolling in ARCH-2230 Architecture Design 3 through ARCH-4260 Architecture Design 6.

Co-op Experiences

A number of architecture students insert co-op work experiences into their program of study. Work opportunities are available in a wide range of situations, from architecture firms large and small to design groups in industry or institutions. Co-op experiences are an invaluable introduction to practice and strengthen the learning experience. Co-ops can usually earn credit toward the professional Intern Development Program (IDP) requirement.

Lectures and Exhibits

Architecture and architectural education advance through full engagement in the world of ideas. The school offers visiting faculty and lecturers and provides field trips, student travel funds, seminars, and exhibitions. Each semester a lecture, exhibition, seminar, and workshop program is created. The lecture and exhibition series presents the work of internationally recognized faculty and practitioners, providing students and faculty with exposure to current and critical ideas influencing the profession. Lectures and exhibitions are open to all Rensselaer students and the local professional community.

Graduate Programs

The School of Architecture offers several graduate degrees at the master's level. These include the Master of Architecture I as a first professional degree for students already holding at least a baccalaureate degree in any field of study.

Those who have accredited degrees in architecture and wish to pursue advanced studies related to architecture may seek a Master of Architecture, a Master of Science in Architectural Sciences, or a Master of Science as post-professional degrees in the School of Architecture. Master of Science and Master of Science in Architectural Sciences degrees are also available to applicants who have been enrolled in other related fields. The degrees offer the opportunity for advanced, focused, and intellectually rigorous study in architecture, building, and related sciences.

Included among these post-professional master's programs are the Master of Architecture (M.Arch.) II, Master of Science in Building Conservation, Master of Science in Architectural Sciences (Concentration in Architectural Acoustics), Master of Science in Architectural Sciences (Concentration in Building Systems Research), Master of Science in Architectural Sciences (Concentration in Computation in

Design), Master of Science in Architectural Sciences (Concentration in Lighting), Master of Science in Informatics and Architecture, and the Master of Science in Lighting.

As a degree limited to applicants who have gained a professional degree in architecture, the Master of Architecture II is distinct from the Master of Science in Architectural Sciences and Master of Science. For students entering this program with a five-year first professional bachelor's or master's degree, the M.Arch. II is one path to a terminal degree (for teaching). Either the M.Arch.II or the M.S. involves a minimum 30 credit hours of study.

Among its offerings, the School of Architecture provides some specialized seminars of particular benefit to most graduate students, except those studying lighting and building conservation. These include:

- **Research Design Seminar**—Covering the essential bases of research work, whether to assist with the development of a Ph.D. dissertation, masters thesis, or masters project, this course builds students' critical reading skills and ability to conduct a research project creatively and pragmatically. This course introduces students to external researchers who present work in progress and discuss and advise student projects.
- **Graduate Thesis Seminar**—Taken in a student's second term, this course provides graduate students from the Architectural Acoustics, Building Systems Research, Computation in Design, Lighting, and Informatics and Architecture research programs a forum for publicly presenting and discussing their work.

In addition to the Institute-wide academic regulations outlined in this catalog, the following pertain to graduate programs in architecture:

- **Academic Progress**—To earn the professional M.Arch. degree, students must maintain a B average in the following courses: Design Explorations (ARCH-6110, ARCH-6120 and ARCH-6130), Design Development (ARCH-4300), and Master's Thesis (ARCH-6990). Students whose cumulative averages for all course work drop below 3.0 will be reviewed for satisfactory progress. The architecture faculty, as part of its academic review process, will review professional M.Arch. students earning grades of C or below. A student earning a C or below in a subsequent required design course must either repeat the course or take another course specified by the faculty before advancing to the next course in the design sequence. Students who fail to earn a grade of B or better in the repeated or specified course or who earn a third C or lower in design may not continue in the design sequence.
- **Retention of Student Work**—All student drawings and models created as part of the instructional program are the property of the Institute until the instructor releases them. The School of Architecture, at its option, may retain certain works for academic purposes.

Doctoral Programs

Each of the Ph.D. in Architectural Sciences degree concentrations have different course requirements. In keeping with Rensselaer requirements, a candidate for the doctor's degree must complete a Plan of Study with satisfactory grades containing a minimum of 90 credit hours beyond the bachelor's degree or 60 hours beyond the master's degree. Within those 90 credit hours there must be at least 30 credit hours of coursework. To satisfy this requirement, at least half of the total credit hours, excluding dissertation, must contain the suffix numbers 6000-6990 with the further limitation that no more than 16 credit hours of 4000-4990 courses are to be allowed. (Undergraduate courses below the 4000 level may not be used for credit toward graduate degrees, although some may be required to make up missing prerequisites.)

Depending on the chosen concentration area and the agreed Plan of Study, candidates may either enter directly into the doctoral program or plan to complete a master's degree before beginning doctoral study. All candidates must successfully take a qualifying exam for entry into doctoral study. The Ph.D. manual

for Architectural Sciences is currently being edited. For the most up to date information, please contact the Director of the program.

Degree completion is possible in three years of full time study and the Institute requires, without exception, degree completion for full-time students within five years for those entering with a master's degree and within seven years for those entering with an undergraduate degree.

Those pursuing doctoral study in architecture at Rensselaer may select from four areas of concentration. They include:

- Ph.D. in Architectural Sciences (Concentration in Architectural Acoustics)
- Ph.D. in Architectural Sciences (Concentration in Building Systems Research)
- Ph.D. in Architectural Sciences Concentration in Informatics and Architecture (Computation in Design)
- Ph.D. in Architectural Sciences (Concentration in Lighting)

They may also concentrate on emerging areas of specialization in other aspects of architecture and technology.

Master's Programs

Master of Architecture I

The curriculum for this professional degree program largely overlaps the B.Arch program, albeit in an accelerated manner. It features a distinct individualized pedagogical core through an advanced history and theory course sequence. On average, this degree is completed in three and a half years (one summer plus three academic years).

This degree provides a balanced education in architectural design, history, theory, and technology. As with the undergraduate program, it centers on the design studio where projects address a multitude of design issues through multiple strategies ranging from the design of carefully crafted objects to architecture, landscape architecture, and urban design.

The National Architectural Accreditation Board (NAAB) accredits the Rensselaer School of Architecture's Master of Architecture three and a half-year program. The following statement is included in the catalog, pursuant to NAAB requirements:

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board, which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees; the Bachelor of Architecture and the Master of Architecture. A program may be granted a six-year, three-year, or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of preprofessional and undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

Applicants to this program must have a bachelor's degree, have earned a 3.0 cumulative average (on a 4.0 scale) and have within their undergraduate studies a course in free hand or life-study drawing. They must also have eight to 10 courses in humanities and social sciences, one year of mathematics with at least one course in calculus, one course in physics, and additional courses in the sciences. Course work in the arts and art history is also desirable. A portfolio of creative works and critical commentary on those works is required for admission. Application is made to the Office of Admissions. Students with previous architecture courses will be considered for advanced standing in this program. Enrollment in the initial summer studio is usually necessary to determine placement in the design sequence. For information regarding program tuition and financial aid, please refer to the Tuition and Financial Aid section of

this catalog.

Like the B.Arch. program, the M.Arch.I program incorporates and interconnects the important elements of design, history and theory, technology and building science, and computing. For a detailed description of Rensselaer's approach to these elements, please refer to the Bachelor of Architecture (B.Arch.) Curriculum section.

Also noted within the Bachelor of Architecture Curriculum description are the School's many professional electives and topics offerings in such areas as architectural and urban history and theory, technology, computing, building economics, community design, practice and management, architectural lighting, and acoustics in architecture. At the master's level, professional degree students must complete at least 16 credits from these offerings by building on a specific interest or sampling the breadth and diversity inherent in the field. A minimum of four of those credits must be from a designated list of history electives. In addition to regularly offered electives (described in the back of this catalog), the faculty offers a number of topics or experimental courses as professional electives. A sample of these courses can be found on page 111.

The M.Arch. I program concludes with an individually initiated, planned, and developed thesis. Planning begins in the third year and involves an exchange of ideas with and a critique by a faculty adviser and review committee. The resulting proposals are published statements of interest from the faculty combined with the students' experiences and areas of special concern. These may emerge from a synthesis of previous work applying gained knowledge to advanced issues, or alternatively, make use of experiences to date as a base from which to explore and to innovate. This final year begins with a short competition project in which all participate. An integrated design research phase then lasts the remainder of the first and throughout the second semester.

The thesis is an opportunity to develop a point of view about architecture and its place in the world, to question conventions, habitual responses, and routine approaches to architectural design, and to investigate issues that the student sees as significant to architecture.

To provide the clearest possible picture of the M.Arch.I curriculum structure, a sample template is provided below.

M.Arch.I Curriculum

Summer Session

The program begins with a 12-week summer session that provides full immersion in architectural design. The summer studio is small and characterized by intense and highly individualized student-faculty interaction. The graduate professional student uses the summer session to prepare for entry into design at the second-year level in the fall; it also provides an opportunity to evaluate his or her design capacity.

Summer Sessions 1 - 2 Credit hours

ARCH-2600	Graduate Design Studio	6
ARCH-2610	Graduate Architecture Design 1	6

First Year

Fall		Credit hours	Spring		Credit hours
ARCH-2110	The Building and Thinking of Architecture 1	4	ARCH-2120	The Building and Thinking of Architecture 2	2
ARCH-2620	Graduate Architecture Design 2 (5) Computing (1)	6	ARCH-2630	Graduate Architecture Design 3	6
ARCH-2330	Structures 1	4	ARCH-2360	Environ. and Ecological Systems	4
ARCH-2350	Construction Systems	2	ARCH-6110	Design Explorations 1	4

Second Year

Fall		Credit hours	Spring		Credit hours
ARCH-4360	Graduate Architecture Design 4 (Urban)	6	ARCH-4300	Design Development	6
ARCH-4330	Structures 2	4	ARCH-4740	Building Systems and Environment ..	4
ARCH-6120	Design Explorations 2 ¹	4	ARCH-4540	Professional Practice ²	2
ARCH-2130	Contemporary Design Approach	2	ARCH-4560	Materials and Enclosure	2
			ARCH-2140	The Building and Thinking of Architecture 3	2

Third Year

Fall		Credit hours	Spring		Credit hours
ARCH-6990	Thesis	6	ARCH-6990	Thesis	6
ARCH-6130	Design Explorations 3 ¹	4		Professional Elective	4
	Elective	4		Elective	4
ARCH-4140	Modernity in Culture and Architecture	4		Elective	4

The degree requires 112 credits.

¹ ARCH-6120 and ARCH-6130 address a variety of significant theoretical issues and are taught together. Topics alternate each year.

² Taken in the same semester as ARCH-4300.

In regard to the above template, please note that studios are generally sequential. ARCH-4300 Design Development studio should be taken after the completion of the ARCH-4360 Graduate Architecture Design 4 (urban) studio and before ARCH-6990 Thesis.

- Technology courses: ARCH-2330 Structures 1 is sequential and prerequisite to ARCH-4330 Structures 2; ARCH-2360 Environmental and Ecological Systems is sequential and prerequisite to ARCH-4740 Building Systems and Environment.
- ARCH-2600 Graduate Design Studio, ARCH-2610 Graduate Architecture Design 1 through ARCH-4360 Graduate Architecture Design 4; and the ARCH-2330 Structures 1, ARCH-2360 Environmental and Ecological Systems, and ARCH-4330 Structures 2 series are prerequisites to ARCH-4300 Design Development studio. ARCH-4740 Building Systems and Environment may be taken concurrently with ARCH-4300 Design Development studio.

A plan of study is required for all graduate students. The degree requires 112 credit hours. Admission with advanced standing can fulfill a significant number of these credits, especially for students who have been enrolled in undergraduate pre-architecture programs or non-accredited professional programs.

Masters Degrees—Advanced Programs

Applications to any of these programs should be directed to Rensselaer Admissions. Since a match between student interests and faculty research capabilities is an integral part of this program, applicants must include a focus-of-study proposal and, where appropriate, a portfolio of design and other creative work, with critical commentary, as part of the application.

Building Conservation

Applicants to the M.S. in Building Conservation are generally architectural or engineering practitioners who wish to build expertise in historic structures and building conservation. However, the program welcomes graduate students with related degrees and professional experience.

Master of Science in Architectural Sciences Degrees

Architectural Acoustics Applicants to the M.S. in Architectural Sciences (Concentration in Architectural Acoustics) are not required to submit a portfolio. A 30-credit, one year degree offering an intense program of advanced study in architectural acoustics, emphasizing the room acoustics of both large and small venues, such as automobile, household, etc. sound control and maximization of performance spaces. Applicants require a B.A. or B.S. in Architecture, Architectural Engineering, Music and Acoustics, or comparable fields.

Building Systems Research Applicants to the M.S. in Architectural Sciences (Concentration in Building Systems Research) are required to submit a portfolio and focused goal statement. This one year program combining faculty strength in energy efficient systems and technologies, new materials and applications, and whole systems integration.

Computation in Design Applicants to the M.S. in Architectural Sciences (Concentration in Computation in Design) are required to submit a portfolio related to the research interest. A 30-credit, one year program combining faculty expertise in the areas of computer-controlled design and fabrication, design and fabrication with new techniques and materials, and mediated human-environment interaction.

Lighting Applicants to the M.S. in Architectural Sciences should submit a portfolio or other examples of work and a statement of goals and objectives. They are also urged to complete two college-level math courses before applying to the program. This one-year program of study provides an education that cultivates both a scientific and artistic understanding of the many issues involved in the development of lighting and designing with light.

Master of Building Sciences Degrees

Informatics and Architecture Applicants to the M.S. in Informatics and Architecture must demonstrate familiarity with computing. Programming skills are helpful but not required. Where there is insufficient evidence of familiarity with any of these areas, prerequisite courses may be specified as conditions of admission.

Lighting Applicants to the M.S. in Lighting should submit a portfolio or other examples of work and a statement of goals and objectives. They are also urged to complete two college-level math courses before applying to the program.

M.Arch.II Applicants to this post-professional advanced degree program must hold a professional B.Arch or M.Arch degree. Students within this program develop a special individualized Plan of Study drawn from the School's various graduate offerings and must receive faculty guidance and approval.

For those accepted as candidates for these advanced Architecture master's programs, a thesis is normally required for degree completion. However in some subjects, and with faculty approval, degree requirements may be satisfied with either a research project or course work. The general institute criteria for the master's thesis can be found in the Academic Information and Regulations section of this catalog.

Master of Science in Building Conservation

The School of Architecture's M.S. in Building Conservation graduate program is a two-year, part-time course designed for mid-career professionals who are or intend to be involved in the care, repair, restoration, and adaptation of buildings, urban environments, and rural landscapes.

Both academically and geographically, Rensselaer is well-positioned to provide this course of study in historic resources conservation and management. The School of Architecture is noted for its technical emphasis and strong design concerns. Buttressing this foundation for the M.S. in Building Conservation are adjunct and clinical faculty drawn from a coterie of highly qualified preservationists in New York's historic Capital District, which includes some of the country's top preservation architects, planners, engineers, conservators, not-for-profit managers, and enlightened public officials. Potential institutional partners in the Building Conservation program include New York state agencies such as the Office of Parks, Recreation, and Historic Preservation and the Departments of State and Environmental Conservation; the Preservation League of New York State; the Hudson Mohawk Industrial Gateway; community-based organizations such as the Troy Rehabilitation and Improvement Program; Heritage corridor programs such as those in the Hudson and Mohawk River valleys; and local and county governments.

The Master of Sciences in Building Conservation program prepares students to assume responsible employment positions in the preservation, conservation, and management of historic resources. It also provides a thorough understanding of the theory and practice of historic preservation and building conservation. Students receive training in disciplines such as identification and analysis of specific building materials to structural stabilization, restoration, and reuse of historic structures; planning for wise development of entire urban and rural areas; and the legal, economic, and political factors that make these endeavors possible. In addition, they gain real-world, hands-on experience through extensive fieldwork and the program's close affiliation with regional architectural and engineering firms and with not-for-profit, state, and municipal, community-based, educational, and social service agencies.

The program is presented through alternate on-campus, two-day weekend sessions of class and fieldwork for two academic years (September–May) for a total of 30 weekends. It begins with a five-day residency and concludes with a three-day residency each year. This structure allows students to continue working, remain with their families, and pursue other interests while earning their degree. Students are generally expected to be architectural or engineering practitioners. However, the program welcomes graduate students with related degrees and professional experience.

To part-time students, the degree is offered every other weekend and is completed in four semesters over two years. Degree candidates follow the curriculum template outlined below in sequence. Teamwork is encouraged on campus, and students are required to complete 20–25 hours of home assignments between alternate weekend sessions. The M.S. in Building Conservation degree requires 32 credit hours and normally takes two years to complete. Students have access to such facilities as the objects conservation laboratories of the Metropolitan Museum of Art and Building Conservation Associates in New York City, a private museum of nineteenth century buildings in rural Rensselaer County, New York, and Rensselaer's Libraries and Information Services.

Building Conservation Curriculum

First Year

Fall		Credit hours	Spring		Credit hours
ARCH-4640	American Building—17th–19th Centuries	2	ARCH-4650	American Building—20th Century...	2
ARCH-6610	Preservation Theory	1	ARCH-6700	Recording Historic Structures.....	2
ARCH-4610	Building Conservation 1	2	ARCH-6670	Structural and Mechanical Systems ..	1
ARCH-6680	Researching Historic Structures.....	2	ARCH-6710	Preservation Design Studio 1	4
ARCH-6690	Drawing Historic Structures	1			

Second Year

Fall		Credit hours	Spring		Credit hours
ARCH-4630	Building Conservation 2	2	ARCH-4680	Traditional Trades and Craftsmanship.....	2
ARCH-4660	Historical Archeology.....	1	ARCH-6640	Historic Preservation Law	1
ARCH-4670	Industrial Archeology	1	ARCH-6620	Contemporary Preservation Practice ..	1
ARCH-6650	Architectural Materials Testing.....	2	ARCH-6720	Preservation Design Studio 2.....	4
ARCH-6630	Economics of Historic Preservation...	1			

The degree requires 32 credit hours.

Master of Science in Architectural Sciences (Concentration in Architectural Acoustics)

This program of advanced study focuses on the optimization of acoustical quality of performance spaces and other aurally sensitive environments. Research in this area improves understanding of how a space is designed to achieve the best acoustics for a given purpose. The program is geared toward students with a bachelor's degree who have interests in acoustics, music, architecture, and/or engineering. Rensselaer offers remonet numerous state-of-the-art facilities related to study in this area including a Hemi-anechoic testing room with a Binaural listening test station, the School of Architecture Workshop, and Rensselaer's Libraries and Information Services.

Individuals applying for admission to this program must have a bachelor-level degree (B.Arch., B.S., or B.A.) in Architecture, Engineering, Music, Physics, Mathematics, Computer Science, Acoustics, Electronic Media, Theater Technology, or other related fields. Those with other degrees or experience (e.g., who have worked in the field) and with keen interest in Architectural Acoustics will also be considered. Those receiving an M.S. in Building Sciences (Concentration in Architectural Acoustics) will be well prepared to enter the field at post-entry positions.

Architectural Acoustics Curriculum

Fall	Credit hours	Spring	Credit hours
ARCH-4840	Architectural Acoustics 1	ARCH-4850	Architectural Acoustics 2
ARCH-6460	Stagecraft and Theatre Design ¹	ARCH-6880	Sonics Research Laboratory 2
	or approved concentration elective	ARTS-6860	Applied Psychoacoustics
ARCH-6810	Research Design Seminar	ARCH-6900	Graduate Thesis Seminar
ARCH-6870	Sonics Research Laboratory 1	ARCH-6980	Master's Project or
ARCH-6940	Advanced Projects in Acoustics	ARCH-6990	Master's Thesis

Possible Concentration Electives include (but are not limited to):

ARCH-6940	Advanced Individual Projects (e.g., Ind. Study)	1–6 credits
ARTS-2310	Chorale: Performance Studies	2 credits
ARTS-6010	Computer Music Studio	4 credits
ECSE-4500	Probability for Engineering Applications	4 credits
ECSE-4510	Discrete Time Systems	3 credits
ECSE-4540	Introduction to Voice and Image Processing	3 credits
ECSE-4560	Signal Processing Design	3 credits
MANE-4610	Vibrations	3 credits
MANE-4830	Acoustics Engineering	3 credits

The degree requires 30 credit hours.

Master of Science in Architectural Sciences (Concentration in Building Systems Research)

The Building Systems Research program focuses on three major areas of inquiry: (1) measuring the impact of architectural design on human performance particularly creativity and productivity; (2) the design and testing of architectural innovations that improve the microclimate of buildings; and (3) research and design related to building systems and engineering. In the case of microclimate the program focuses its expertise on the luminous, thermal, and acoustical aspects of the microclimate. This area of building systems is particularly interested in the potentiality of dynamic design and its impact on the building's microclimate, energy efficiency, and spatial qualities.

Building Systems Research Curriculum

Fall	Credit hours	Spring	Credit hours
	Breadth Elective		Concentration Electives
	Concentration Elective	ARCH-4510	Construction Industry Seminar
ARCH-4810	Advanced Technology Seminar	ARCH-6900	Graduate Thesis Seminar
ARCH-4530	Systems Building Seminar	ARCH-6980	Master's Project or
ARCH-6810	Research Design Seminar	ARCH-6990	Master's Thesis
ARCH-6980	Master's Project or		
ARCH-6990	Master's Thesis		

The degree requires 30 credit hours.

Master of Science in Architectural Sciences (Concentration in Computation Design)

Advanced study in Informatics and Architecture involves a rethinking of architectural practice based on information technologies and their social, political, and cultural implications.

Computation in Design Curriculum

Fall	Credit hours	Spring	Credit hours
	Computer Science Elective 13		Computer Science Elective 24
	Electronic Media Elective4		Database Systems4
	Informatics Theory Elective4	ARCH-6900	Graduate Thesis Seminar2
ARCH-6420	Experimental Research Lab2	ARCH-6980	Master’s Project5
ARCH-6810	Research Design Seminar2		

The degree requires 30 credit hours.

Master of Science in Architectural Sciences (Concentration in Lighting)

The concentration in lighting within the Master of Science in Architectural Sciences allows students from a variety of disciplines to pursue a multidisciplinary graduate degree related to lighting practice. Geared toward the needs professionals either currently working or wishing to pursue careers in the lighting industry or design fields, this one-year, 30-credit degree exposes students to a wide range of topics within lighting including the physics of light, lighting technology, human factors, design, and application. It also allows students to concentrate their research or design work in a particular area of interest by pursuing a master’s project. Course content and curriculum in the lighting concentration is continually updated to include the latest advances in lighting research, technology, and design to assure that students receive a “cutting-edge” lighting education.

The M.S. in Architectural Sciences with a concentration in lighting is housed within the Lighting Research Center (LRC), the world’s largest university-based research and education institution dedicated to lighting, which includes an expert faculty and staff of lighting researchers and designers. The concentration in lighting includes 24 credits of formal course work taken over two semesters and a 6-credit culminating master’s project.

M.S. in Lighting Curriculum

Fall	Credit hours	Spring	Credit hours
LGHT-4230	Lighting Design4	LGHT-4940	Advanced Topics in Lighting4
LGHT-4830	Light4	LGHT-6760	Lighting Workshop I4
LGHT-4840	Human Factors in Lighting4	LGHT-6780	Lighting Leadership Seminar4
LGHT-6940	Lighting Project3	LGHT-6940	Lighting Project3

Note: Any student intending to continue to the Ph.D. program must fit ARCH-6810 Research Design Seminar (2 credits) into the Plan of Study before taking their candidacy exam.

The degree requires 30 credit hours.

Master of Science

Master of Science in Informatics and Architecture

Consider that “informatics” is the thoughtful study of the impacts of information technology on human lives and that “architecture” is one of the primary ways of relating to the environment. The study, then, of their combination can serve as an important juncture in understanding contemporary culture. Informatics and Architecture strives to broaden understanding of architecture as it relates to media culture, advanced building technology, and computation. Coursework requires the explicit integration of critical study and technological development. Students are asked to frame their ideas about design practices with progressive concerns for society, the environment, and the future of technological development. By engaging directly with the tools and techniques of computation, students can impact the future of research and practice in these burgeoning design areas. Students satisfy the degree

requirements either by completing a masters-level research thesis or design/research project. The research thesis option is open to students currently holding a master's degree or equivalent and who clearly articulate a research project proposal in their application.

The curriculum relies on a series of core courses developed to provide a critical foundation for the evolving discipline. These courses cover theoretical introductions, technological foundations, and research methods.

Informatics and Architecture Curriculum

Fall	Credit hours	Spring	Credit hours
	Concentration Elective	ARCH-6900	Graduate Thesis Seminar
ARCH-6420	Experimental Research Lab	ARCH-6990	Master's Thesis or
ARCH-6810	Research Design Seminar	ARCH-6980	Master's Project
ARCH-6400	Philosophies of Space in a Digital		Concentration Elective
	Culture		Concentration Elective
	Elective.....		

The degree requires 30 credit hours.

Electives

Students within this program pursue elective coursework from across the Institute, depending on their prior experience and intellectual objectives. Following is a sample of electives students have taken to fulfill their degrees:

- Computability and Complexity
- Computational Intelligence
- Economics of Information and Information Technology
- Electronic Media: Physical Design Processes
- Experimental Research Lab
- Gender, Science, and Technology
- History of American Technology
- Interactive Arts Programming
- Introduction to Artificial Intelligence
- IT Policy and Law
- Politics of Space in a Digital Culture
- Simulation of Large Scale Systems
- Technology and Social Theory
- Thinking Digital 3-D Computer Graphics Programming

Master of Science in Lighting

The School of Architecture, in association with the Lighting Research Center, offers a Master of Science in Lighting degree to students who complete a 48-credit, two-year curriculum. This post-professional program is based in the internationally renowned Lighting Research Center, the standard-setting research institute for the lighting industry. This program cultivates both a scientific and artistic understanding of the many issues involved in all aspects of the development of lighting and designing with light. It also offers an M.S. in Lighting to individuals without a first professional degree who wish to work in either lighting design or research. The first year curriculum provides a broad education that cultivates a scientific and artistic understanding of the interactions of all elements of lighting. The third semester offers opportunities to pursue individual projects under faculty guidance in the Lighting Workshop. The program concludes with a leadership seminar and thesis study. Graduates may seek leadership roles in

practice, or they may continue with further, more specialized, doctoral studies in other Rensselaer schools. The curriculum is normally completed in four semesters. Facilities and equipment specific to this program include various Rensselaer laboratories, field study facilities, optical tools, the Laboratory for Human-Environment Interaction Research, the School of Architecture Workshop, and Rensselaer's Libraries and Information Services.

M.S. in Lighting Curriculum

First Year

Fall		Credit hours	Spring		Credit hours
LGHT-4830	Light	4	LGHT-6760	Lighting Workshop	4
LGHT-6750	Lighting Research Design	4	LGHT-4840	Human Factors in Lighting	4
LGHT-6940	Advanced Individual Projects in Lighting	4	LGHT-4790	Lighting Applications (Adv. individual lighting projects)	4

Second Year

Fall		Credit hours	Spring		Credit hours
LGHT-4230	Lighting Design	4	LGHT-6780	Lighting Leadership Seminar	4
LGHT-6770	Lighting Workshop 2	4	LGHT-4770	Lighting Technology (Adv. topics in Lighting)	2
LGHT-6990	Master's Thesis	2	LGHT-6990	Master's Thesis	4
ARCH-6810	Research Design Seminar	2	ARCH-6900	Graduate Thesis Seminar	2

The degree requires 48 credit hours.

Master of Architecture

(Post –Professional Degree) Curriculum

Within the Master of Architecture programs, there is the opportunity to develop a curriculum specific to an applicant's interest if there is corresponding expertise in the faculty. This program includes 30 credits of project and course work (including a thesis) and normally requires three semesters to complete.

Fall

ARCH-6810	Research Design Seminar
ARCH-6990	Master's Thesis Electives

Spring

ARCH-6900	Graduate Thesis Seminar
ARCH-6990	Master's Thesis Electives

Fall

ARCH-6990	Master's Thesis
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This degree requires 30 credit hours.

Special Master's Opportunities

Study Abroad (M.Arch 1)

International study is a defining aspect of Rensselaer's architectural education and the School of Architecture offers several semester-long international programs of study. Offered in Italy, India, and China, these programs are open by competitive application to M.Arch.I students. Only 20–25 students (B.Arch and M.Arch) are selected each year on the basis of academic accomplishment. In addition to direction from a Rensselaer faculty member, adjunct faculty in the host city or institution provide instruction. There is a program fee for participation in each of these programs, which are described briefly on the next page.

- **China**—The semester in Shanghai is based at the School of Architecture at Tongji University, one of the great institutions of China. The program offers joint studios in design with Chinese faculty and students and travel through central China augments additional courses in Chinese history and culture.
- **India**—The program is based in the School of Architecture CEPT at Ahmedabad, India, a highly respected school for the study of architecture and urbanism. It offers students the opportunity to travel, study, and apply the lessons learned from Indian architecture and Indian history and theory within the context of a major research center.
- **Italy**—The Rome semester involves a design studio, an examination of the architectural development of Rome, courses in Italian language and culture, and travel throughout Italy. The program seeks to deepen appreciation of the city and the layers of its culture that have played a seminal role in the development of Western culture and architecture.

In addition, the School of Architecture offers occasional summer study abroad programs to places of special architectural interest. In recent years, these have included visits to Turkey and the Czech Republic.

For specific information regarding admission to the School of Architecture's graduate programs see the Admissions section of this catalog.

Doctoral Programs

Rensselaer's Ph.D. program in Architecture offers concentrations in Architectural Acoustics, Building Systems Research, Computation in Design, and Lighting. Thematic issues of interest are the impact of augmented and virtual reality systems, computational design systems; soft-computing and spatial databases, urban and architectural modeling and simulation, artificial cognition and spatial communication, spatial sound simulation and reproduction, and spatialized applications of computer vision.

A general template for developing individual programs of study and determining specific course requirements for these programs is as follows:

- Minimum time for degree: three years.
- Total credit hours for degree: 90
- 30 credit hours (which could be transferred from the master's degree) satisfy the basic Institute course requirements for the doctoral degree. All additional coursework is determined either by the area of specialization or in consultation with an adviser.
- In addition to the degree-specific and core requirements, individual plans of study are defined between student and adviser.

Significant cross disciplinary study is encouraged not only to build on advanced work in architecture and technology emerging in the School, but also to form a program of study that draws widely on Rensselaer's strength in other disciplines

Ph.D. in Architectural Sciences (Concentration in Architectural Acoustics)

Advanced study in Architectural Acoustics represents a unique opportunity for students to combine existing courses and research to provide an education that integrates scientific, computational, cognitive, and psychological research with experimental applications. The work will not only be multidisciplinary in scope but also application-oriented, relating closely to design and to the needs of practitioners and industry.

Architectural Acoustics is an interdisciplinary field of science tied intimately to the design and optimization of interior spaces, wherein the physical sound field of a space and its corresponding aural quality are primarily determined by architectural parameters such as shape, volume, and surface properties. The acoustical quality of a space is relevant not only for cultural settings (e.g., room acoustics) but also for any environment that values human health, performance, and productivity (e.g., effects of

noise). Architectural Acoustics is also necessary for the accurate and realistic simulation of virtual spaces, e.g., for prototyping, education, training, design, or experimental research with non-physical sound fields. Such virtual spaces can also lead to new developments of “sonic architecture” and time-variant sound-scapes.

Architectural Acoustics thus encompasses and links many traditionally disparate disciplines to design: physics, hearing perception, mathematics, computer modeling, engineering, music, psychological and physiological acoustics, cognitive science, and electro-acoustics. Thus the Ph.D. in Architectural Acoustics can also involve communication acoustics in its widest sense.

Examples of research topics of current interest are

- Training of auditory perception capabilities with regard to reverberation
- Sound quality of scattered sound
- New algorithms for the prediction of room acoustic transmission sound quality
- Improved methods for feature extraction in room acoustic measurement
- Physical scale modeling made simple
- Spatial properties of reverberation
- Product sound quality metrics and their relationship to the meaning of sounds
- Quantification of transmission sound quality of audio equipment

Ph.D. in Architectural Sciences (Concentration in Building Systems Research)

The Building Systems Research program focuses on three major areas of inquiry: (1) measuring the impact of architectural design on human performance, particularly creativity and productivity; (2) the design and testing of architectural innovations that improve the microclimate of buildings; and (3) research and design related to building systems and engineering. In the case of microclimate, the program focuses its expertise on the luminous, thermal, and acoustical aspects of the microclimate. This area of building systems is particularly interested in the potentiality of dynamic design and its impact on the building’s microclimate, energy efficiency, and spatial qualities.

Examples of research topics:

- To perform in-situ or laboratory tests on innovative Building Systems Research and its impact on human performance.
- To identify user preferences for individual control of microclimate system technologies.
- To determine the economic benefit/liabilities of innovative Building Systems Research and technologies.
- To research, design, and develop integrated systems that utilize emerging materials and technologies to achieve increased levels of building performance.
- To test the impact of integrated control systems that share control by central management systems and individual local control.

Ph.D. in Architectural Sciences Concentration in Informatics and Architecture (Computation in Design)

The Ph.D. is an advanced study in Informatics and Architecture involving a rethinking of architectural practice based on information technologies and their social, political, and cultural implications. Students are asked to frame their ideas about design practices with progressive concerns for society, the environment, and the future of technological development. By engaging directly with the tools and techniques of computation, students are given the opportunity to impact the future of research and practice in these burgeoning areas of design.

At a broader level Computation in Design involves a rethinking of design practice based on computational technologies. The field of study involves the full range of applications of computation and information technologies in the environment. The relationship of physical and digital spaces, the use of com-

putational techniques in the generation, development, representation, fabrication and installation of constructed environments and the integration of advanced technologies into the fabric of the environment are considered in relation to technical, social, cultural, and philosophical implications.

Above all, the program strives to broaden our student's understanding of architecture as it relates to media culture, advanced building technology, and computation. Coursework and advising requires the explicit integration of critical study and technological development—we believe that it is only through the thoughtful integration of these that important advances can be made in the field. Students are asked to frame their ideas about design practices with progressive concerns for society, the environment, and the future of technological development. By engaging directly with the tools and techniques of computation, students are given the opportunity to impact the future of research and practice in these burgeoning areas of design.

Ph.D. in Architectural Sciences (Concentration in Lighting)

Advanced study in Lighting is aimed at cultivating researchers who are able to create new knowledge and advance, in the broadest possible way, the field of lighting. Students in the program are supported by all the assets of the Lighting Research Center, the nation's preeminent center for research and education in lighting.

The goal of research in lighting is to integrate information from a diverse range of sources into a coherent idea and to work over a wide range of scales, from the details of a table lamp to the layout of a city. The advanced work applies both these skills to the means by which lighting and architecture are experienced; the concern is with human perception. Perception can vary in scale from specific details detected by an individual's sense of sight, hearing, touch, smell and taste, to broad impressions developed from the more integrated perceptions implicit in mental maps and societal impact. The plan of study is multidisciplinary, with input provided by the expertise available in the School of Architecture, the School of Science, the School of Engineering, and the Department of Cognitive Science. Also, as with Architectural Acoustics students, depending on their backgrounds, students may choose to do advanced work in Lighting within either the Ph.D. programs in Multidisciplinary Science or Multidisciplinary Engineering.

The program content focuses on vision, cognition, environmental psychology, and research design and methodology. Individuals will be able to concentrate in one research area, but some understanding in all areas will be required.

Research will be in areas such as:

- Transportation lighting,
- Human factors in lighting,
- Solid-state lighting,
- Light and health,
- Energy-efficiency and energy policy.

Candidates will be expected to have qualifications and experience in architecture or related fields.

Courses and Grade Requirements

Continuation in the graduate program requires satisfactory performance by the student. Satisfactory performance is not limited to the academic record, but includes other appraisals of the student's record and ability in areas such as teaching and research.

The minimum average of all grades used for credit toward an advanced degree must be B. If a student's grades fall below a B average, the Graduate School may request that the doctoral committee conduct a formal review to determine whether continuation is warranted. The student's adviser, with the consent

of the student's doctoral committee, may recommend to the Graduate School that a student whose performance is unsatisfactory be dropped from the graduate program. A student who has accumulated two failing grades will be dropped from the graduate program.

Applicant Requirements

Individuals applying for degree-seeking status must have official transcripts of previous college-level study sent directly from all institutions attended. Two faculty references or relevant employer references are required of all degree-seeking applicants. The faculty from a given area of concentration may waive the portfolio requirement. The Institute currently requires a minimum GRE score of 500 for any type as well as a minimum GPA of 3.0. The program director may ask for a waiver from these requirements for truly exceptional students.

Applicants whose native language is not English must have scores from the Test of English as a Foreign Language (TOEFL) submitted directly by the Educational Testing Service, Princeton, NJ. A minimum score of 570 is required. (For the electronic version of TOEFL, a minimum score of 230 is required.)

Interdisciplinary Programs and Research

Product Design and Innovation

The dual major program in Product Design and Innovation (PDI) is jointly offered by the Schools of Engineering, Architecture, and Humanities and Social Sciences. The PDI curriculum satisfies the requirements for the B.S. programs in both Building Sciences and Science, Technology, and Society (STS).

The PDI program prepares students to become innovative designers who will develop and design the advanced products and technologies for the coming century. Built around a design studio every semester, PDI combines the technical, aesthetic, and cultural sophistication of Rensselaer's building science curriculum with the insight and vision of the humanities and social sciences disciplines in the STS curriculum.

The core of PDI is the design studio that students take every semester, giving them a hands-on opportunity to bring together the two major curricula. The building science curriculum provides a fundamental education in building science and architectural design through basic and advanced courses in structures, environmental and construction systems, as well as physical and theoretical approaches in design. The STS curriculum provides a fundamental education in the economic, ethical, cultural, and political dimensions of product development and innovation, including numerous case studies of successes and failures that will give students the opportunity to learn what it takes to be effective design team leaders. On this basis, the design studios help students to explore and develop their creativity while a portfolio of design experiences continuously builds throughout all four years.

The design experiences range over a breadth of problems, from larger systemic problems to smaller focused ones, so students have a broad exposure to all the different applications of design practice. Some fall and spring semester studios are taught as a sequence to give students experience with the design process from conception to implementation. The studios also develop students' skills in using computers and other advanced tools and techniques, as well as in drawing, visualizing, communicating, and working together. In short, they provide everything necessary to put their creativity to work as leaders of design and innovation, whether it is in a multi-national business at the cutting edge of the global market or in a smaller business that creates an unusual solution to a local problem.

PDI Curriculum in Building Science and STS

First Year

Fall

	Credit hours
IHSS-1970 Design, History, and Society	4
MATH-1010 Calculus I	4
ARCH-2110 The Building And Thinking of Arch.1	4
ARCH-2200 Design Studio	4

Spring

	Credit hours
ARCH-2210 Architecture Design 1.....	6
STSH-296x Design, Culture, and Society.....	4
PHYS-1050 Physical Principles of Design	4
ARCH-2120 The Building And Thinking of Arch. 2	2
ARCH-2510 Materials and Design	2

Second Year

Fall

	Credit hours
IHSS-2500 PDI Studio 3 (Industrial Design) ¹	4
STSS-1110 Introduction to STS.....	4
ARCH-2330 Structures 1	4
ARCH-xxx Professional Elective	2
Science Sequence I ²	4

Spring

	Credit hours
ENGR-2050 Introduction to Eng. Design ³	4
ARCH-2360 Env. and Ecol. Systems	4
ARCH-2140 The Building And Thinking of Arch.3	2
BIOL-1010 Intro to Biology.....	4

Third Year

Fall

	Credit hours
STSH-496x Design Studio 5	4
STSS-4xxx STS Advanced Option ⁵	4
ARCH-4330 Structures 2	4
DSES-2010 Statistics	4
ARCH-4810 Advanced Technology Seminar	2

Spring

	Credit hours
ARCH-4960 Design Studio 6 ⁴	4
STSS-4800 Public Service Internship	4
ARCH-4740 Bldg. Sys. and Env.....	4
Math Elective	4

Fourth Year

Fall

	Credit hours
ARCH-4960 Design Studio 7 ⁴	4
STSS-4xxx STS Advanced Option ⁵	4
ARCH-xxxx Final Project	2
ARCH-4510 Construction Industry Seminar.....	2
Elective.....	4

Spring

	Credit hours
ARCH-4960 Capstone Design Studio with B.S. Final Project	4
STSS-4980 STS Senior Project ⁶	4
Elective.....	4
Math/Science Elective.....	4

The degree requires 132 credit hours.

Course Descriptions

Courses related to all Architecture curricula are described in the Course Descriptions section of this catalog under the department code ARCH.

¹ For PDI students, IHSS-2500 may be substituted for the second STS concentration option.

² The science sequence may be selected, with the assistance of the student's adviser, from among 1000-level introductory sequences in Biology, Chemistry, Geology, or Physics, including EARTH-1030, EARTH-1040.

³ Or other studio course as approved by advisers.

⁴ These special design studios meet jointly with ENGR-4960 Design Studios 6, 7.

⁵ Candidate courses include: STSS-4350, STSS-4960, STSH-4230; STSS-4110, STSS-4250, STSS-4310, STSS-4560, and STSS-4650.

⁶ The STS Senior Project can be combined with the Capstone Design Studio to make an eight-credit capstone studio project.