

PENNSTATE



Architectural Engineering Graduate Student Handbook

2008-2009

Linda M. Hanagan, Ph.D., P.E.
Graduate Program Coordinator
104 Engineering A
University Park, PA 16802
Voice: (814) 863-2084
Fax: (814) 863-4789
Email: RMistrick@psu.edu

Lori Smith, Graduate Records Assistant
Voice: (814) 865-6664
Email: LoriSmith@psu.edu

August 2008

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1 Architectural Engineering

Graduate Program - General Information

1.1 GRADUATE PROGRAMS OFFERED

There are four formal programs leading to graduate degrees in Architectural Engineering: (1) the Master of Science in Architectural Engineering (M.S.); (2) the Master of Engineering in Architectural Engineering (M. Eng.); (3) the Integrated Bachelor and Master of Architectural Engineering Degree Program, which is reserved for Penn State undergraduates (M.A.E.); and (4) the degree of Doctor of Philosophy with a major in Architectural Engineering (Ph.D.).

The M.S. offers an introduction to research, and the Ph.D. offers research competence. The M.Eng. and M.A.E. degrees offer students the opportunity to gain advanced knowledge for application in professional engineering practice.

Requirements for each of these programs are discussed in detail in separate sections of this document. The immediate sections that follow pertain to all of the graduate programs except the Integrated Master of Architectural Engineering Degree, which is a degree that is integrated with the Penn State Bachelor of Architectural Engineering degree and is covered under separate guidelines.

1.2 REQUIREMENTS OF THE GRADUATE SCHOOL AND THE DEPARTMENT

All graduate students in the Department of Architectural Engineering are required to adhere to the requirements of the Graduate School, as found in the latest [Graduate Bulletin for Graduate Degree Programs](#). The requirements of the Graduate School, however, are minimum requirements and the policies, procedures, and regulations listed below are additional and more specific requirements for graduate students pursuing formal programs in Architectural Engineering. Advisers will call pertinent regulations to the attention of their advisees, but students should understand that it is their personal responsibility to see that all requirements from both the Graduate Bulletin and this Department Handbook are satisfied.

All Architectural Engineering graduate students are required to attend ten approved guest lecture presentations prior to graduation. Approved lectures include, Bowers Lectures, CE lectures, ME lectures,

selected guest lectures of AE student societies (AE Graduate Student Association, ASHRAE, IES, SSAE, SPACE). This list will be expanded upon recommendation of the faculty. Lecture announcements will be distributed via email to graduate students and/or printed on posted announcements throughout the department.

1.3 NEW STUDENTS

All incoming students will be required to participate in a kick-off orientation/mixer at the beginning of the first semester of graduate study.

Immediately upon arriving on campus, a student should obtain an access account and communicate via email with the Graduate Program Officer during the first week of graduate study. Students should frequently check their email since this media will be used to communicate with students on a regular basis.

New students should also become familiar with the Engineering Library and its resources at: <http://www.libraries.psu.edu/eng/>

1.4 COURSE CREDIT LOAD

Full-time students and students receiving fellowships should register for 12-15 credits per semester. All students (US and International) receiving assistantships should register as follows:

<u>Category</u>	<u>Credits</u>
1/4-time Assistantship	9-14
1/2-time Assistantship	9-12
3/4-time Assistantship	6-8

Students may apply to the Graduate School for one credit beyond this limit, provided they have the approval of their advisor, work supervisor and the Head of the Department.

International students with student visas must maintain full-time academic status as determined by their type of assistantship, or must be registered for at least 9 credits if not supported by an assistantship during both the Fall and the Spring semesters.

1.5 ADDING AND/OR DROPPING OR AUDITING COURSES

Courses taken formally as an audit are not included in the minimum number of credits required for assistantships or for satisfying visa requirements for international students. The Graduate Faculty of the Department strongly discourages retroactively switching a course from a "for-credit" to audit basis or

initiating "late drop" procedures and receiving WF, WN or WP.

Students wishing to add or drop courses must consult their advisors before taking any action. Students on assistantships should not change their schedules to reduce or increase their course credits beyond the limits indicated in the previous section. Students adding or dropping courses should refer to the Schedule of Classes for the procedures and fees. A limited tuition refund may apply for courses that are dropped.

1.6 SPECIAL COURSES

AE 596, 597, 600 (610) 601 (611)

Graduate students registering for the above courses should consult with their advisor to insure they are registering for the correct course. Failure to select the correct course may require the student to pay "retroactive fees" and perhaps additional course-credit fees.

AE 596 Individual Studies

This course covers creative projects. AE 596 SHOULD NOT be used for M.S. or Ph.D. thesis research. Instructors or advisors may award a grade of A, B, C, D, F or R for this course. (See Graduate Bulletin.)

AE 597 Special Topics

This course is a trial or experimental course, A grade of A, B, C, D or F is awarded. (See Graduate Bulletin.)

AE 600 (610 off-campus) Thesis Research

This course should be used to register for M.S. and Ph.D. thesis research. Instructors usually award a grade of R (for research, which assumes adequate effort) for this course, but may award a grade of A, B, C, D, or F for up to 6 credits for M.S. students and 12 credits for Ph.D. students (see Graduate Bulletin.) An R need not be changed later to a quality grade. A quality grade must be reported no later than the end of the following semester.

AE 601 (611 off-campus) Ph.D. Thesis Preparation

ONLY Ph.D. STUDENTS CAN REGISTER FOR AE 601 AND ONLY AFTER THEY HAVE PASSED THEIR COMPREHENSIVE EXAM AND MET THE TWO-SEMESTER RESIDENCY REQUIREMENT. Ph.D. students cannot register for any other course when they register for AE 601. Prior to graduation, the Graduate School reviews students' transcripts. Students registering for AE 601 when they have not

satisfied the above requirements will be asked to retroactively change their registration, pay retroactive fees and possible additional course-credit costs before they will be permitted to graduate.

It is vital that graduate students consult their advisors prior to each semester's registration to insure they are registering for the correct course.

1.7 GRADES

A +/- grading system is used in both graduate and undergraduate level courses. Grades with plus and minus include, A 4.0; A-, 3.67; B+, 3.33; B, 3.0; B-, 2.67; C+, 2.33. A minimum grade-point average of 3.00 for work done at the University is required for all graduate degrees.

1.8 CONTINUOUS REGISTRATION

After passing the comprehensive exam, all Ph.D. students must maintain "continuous registration", which requires them to register for AE 601 or conventional courses for the Fall and Spring semesters at a course load appropriate for their assistantship or visa requirements. If Ph.D. students use university facilities during the Summer, or plan to take their oral or comprehensive exams during the summer, they must be registered (see Graduate Bulletin).

M.S. students must also maintain "continuous registration" until the thesis is approved.

1.9 PRIVILEGES AND BENEFITS OF GRADUATE STUDENTS

All Masters and Doctoral students are:

1. Provided with a desk within office space controlled by the department. Students who do not plan to use department office space should notify the Graduate Program Officer. (Note: M.Eng. students will be provided with a desk only if space is available within the department.)
2. Eligible to apply for financial assistance (grant-in-aid and stipend). (Note: M.Eng. students do not qualify for graduate assistantships).
3. Eligible for services at the Ritenour Health Center.
4. Provided access to the services of the University Placement Office.
5. Eligible to participate in the programs offered by the Graduate Student Association.
6. Eligible to join undergraduate student organizations except those with constitutions limiting membership to undergraduates.

1.10 OBLIGATIONS AND RESPONSIBILITIES

All graduate students must:

1. Maintain scholarship satisfactory to the department.
2. Make progress in their degree program that is acceptable to the department.
3. Assume full responsibility for knowing the regulations and pertinent procedures of the Graduate School.
4. Comply with department policies related to the use of department facilities such as computers, printers and copiers.
4. Comply with regulations governing the use of automobiles by all students.
5. Meet standards of conduct outlined as outlined below

"By virtue of their maturity and experience, graduate students are expected to have learned the meaning and value of honesty before entering the Graduate School. However, to insure the maintenance of a high level of moral integrity, each student and faculty member is expected to assume personal responsibility for the encouragement and promotion of the highest ethical and moral standards. It is the particular responsibility of each department and each staff member to set up conditions of operation, which will encourage the student to strive for these high ideals on the one hand and will assure the detection of violations on the other. A violation is regarded as a serious offense, raising grave doubt that the guilty student is worthy of continued membership in the Graduate School community."

1.11 USE OF DEPARTMENT COMPUTERS AND PRINTERS

Graduate students are provided access to department computers, printers and copiers to permit them to conduct their funded work activities (instructional or research). All computer use must abide by established University policies:

Graduate students are provided with \$40 of free printing each semester for use on their own coursework. Page charges are incurred based on the printer that is used. Students may add additional money to their personal printing accounts at the Engineering Copy Center.

Students who are on research and teaching assistantships will be required to charge printing conducted in support of these activities to a separate account. These accounts will be charged to the department or to a research budget. All graduate students must ensure that any charges to department

and research budgets are for those purposes. No personal printing should be charged to these accounts.

Graduate students are not permitted to attempt to circumvent, in any way, the print charges imposed on them for the use of the department printing facilities. If a student finds a printer that is not charging copies to their account, the student should contact Mr. Paul Bowers and refrain from making excessive copies during the time that the printing system is malfunctioning.

1.12 GRADUATE STUDENTS WITH A TEACHING OR RESEARCH ASSISTANTSHIP, OR WAGE PAYROLL POSITION

A large number of graduate students are appointed as graduate assistants. They are assigned tasks in teaching, research, or other activities that are educationally significant. These appointments are made by department at the recommendation of the faculty.

Although graduate assistants may assist with research, they should be distinguished from Research Assistants, who are full-time members of the staff with rank equivalent to Instructors.

Graduate students with a teaching or research assistantship must comply with Graduate School regulations governing the duties of their appointment (See Graduate Degree Programs Bulletin). For example, note that "appointments for graduate assistants are for eighteen weeks of activities per semester." Typically this means that students are asked to report at least one week prior to the first day of classes and work through the finals week and/or the following week. Work may also be required during the week of Spring Break. A student is responsible for clarifying all planned absences from the University, including arrival and departure dates, with their work supervisor prior to making plans related to these activities.

On rare occasions, a student may be offered a wage payroll position within the department that provides an hourly wage and no tuition benefits. To work in such positions, international students must submit an "Application For Permission To Work On-Campus" to the Office of International Students, and may work up to a maximum of 20 hours/week.

2 Master of Science Degree Program Information

2.1 DEGREE REQUIREMENTS

The following are the requirements for the Master of Science degree in Architectural Engineering:

1. Complete a minimum of 30 graduate credits (minimum 24 credits of course work, at least 12 of which must be at the 500-level, and a minimum of 6 credits of thesis research). 20 of these credits must be earned on the University Park Campus. These credits must be completed with a grade point average of 3.00 or higher.

2. All M.S. students must participate in new student orientation activities.

3. All M.S. students must attend ten approved guest lecture presentations prior to graduation. Approved lectures include, Bowers Lectures, CE lectures, ME lectures, selected guest lectures of AE student societies (AE Graduate Student Association, ASHRAE, IES, SSAE, SPACE). This list will be expanded upon recommendation of the faculty. Lecture announcements will be distributed via email to graduate students and/or printed on posted announcements throughout the department.

3. As a general rule, 400-level courses normally offered to 3rd-year students in the 5-year undergraduate program at Penn State cannot be included in the 30-credit minimum.

5. A thesis proposal must be written by the student and submitted for approval to the advisor and a faculty committee. The proposal is also presented during a meeting of the student's thesis committee. A copy of the proposal and approval sheet shall be sent to the Graduate Program Officer by the advisor. (See Appendix C for guidelines and approval sheet.)

6. All M.S. students must attend 10 approved lectures during the time period of their program.

2.3 SELECTING AN ADVISOR

For the student's first semester, a member of the Graduate Faculty will serve as a temporary advisor until the student has chosen a thesis advisor. Students are expected to locate an advisor in their area of specialization (see Table 1 below) before beginning their second semester. The student should inform the Graduate Program Officer of the name of their advisor.

Students should feel free to discuss possible advisors with the faculty in their area of specialization and the Graduate Program Officer.

TABLE 1. AE Faculty and their option areas

Construction	Structures
Dr. Michael J. Horman	Dr. Richard A. Behr
Dr. John I. Messner	Dr. Thomas E. Boothby
Dr. David R. Riley	Dr. Linda M. Hanagan
Illumination	Dr. Bohumil Kasal
Dr. Richard G. Mistrick	Dr. Andres Lepage
Dr. Kevin W. Houser	Dr. Ali M. Memari
Mechanical and Energy Sys.	Prof. M. Kevin Parfitt
Dr. William P. Bahnfleth	
Dr. James D. Freihaut	
Dr. Jelena Srebric	

2.4 CONTINUOUS REGISTRATION

M.S. students need to maintain "continuous registration" until the thesis is approved.

2.5 MASTER OF SCIENCE PROGRAM APPROVAL FORM

The purpose of the M.S. Program Approval Form (Appendix B) is to insure that students have selected an advisor and begin a program of study and research tailored to their interests. Every M.S. degree student must prepare the Masters Approval Form in consultation with his/her academic advisor. The M.S. Program Approval Form must be submitted no later than the end of the first semester. The Masters Approval Form identifies courses the student intends to take and describes the topic of the thesis in the M.S. program. The Graduate Program Officer will review the Masters Approval Form for completeness and conformance with program guidelines. If, at a later time, the student and advisor wish to add or delete courses or change the emphasis of the thesis, they have the authority to do so, but a revised Masters Approval Form must be submitted to the Graduate Program Officer.

Students failing to submit the Masters Approval Form by the end of the first semester will be advised that such action constitutes "Unsatisfactory Scholarship" which can be grounds for dismissal from the University.

2.6 M.S. THESIS COMMITTEE

M.S. students must assemble a committee consisting of a minimum of three faculty members with expertise in areas related to the proposed thesis project to serve as their M.S. Thesis Committee. At least two of these members must be from the AE department, but an outside member is not required.

2.7 M.S. THESIS PROPOSAL

A candidate for the M.S. degree must provide a short written and oral presentation of the thesis proposal to the student's committee.

1. Written Requirements. The candidate's written thesis proposal should consist of the following:

Introduction

Literature review

Research hypothesis

Proposed research activity

Tools necessary to undertake the proposed research

Anticipated schedule

The objective of this proposal is to:

- ◆ Clearly demonstrate that the candidate has identified and sufficiently narrowed the thesis research topic through a concise statement of the thesis hypothesis.
- ◆ Clearly demonstrate that the candidate is familiar with related work reported in the literature.
- ◆ Clearly demonstrate that the candidate is aware of and has mastery of the analytical/experimental tools necessary to successfully undertake the proposed thesis research.
- ◆ Provide a basis upon which to evaluate the final thesis research.
- ◆ Provide a basis for committee approval of the proposed work.
- ◆ This written proposal must be provided to the candidate's committee in advance of the oral presentation.

2. Oral Requirements: The candidate will make a formal oral presentation to his/her committee on the thesis problem and the proposed approach to its solution. The use of audio-visual aids in this presentation is encouraged. The intent of this presentation is to provide valuable feedback to the student to assist him/her in completing the work.

2.8 M.S. THESIS

A candidate generally registers for a minimum of 6 credits of AE 600 and submits a thesis following the procedures specified by the Graduate School. The formatting guidelines are outlined in the following document:

<http://www.gradsch.psu.edu/enroll/thesisguide.html>

The research thesis must be a research topic resulting in work that is publishable in a professional journal. It is permissible, provided the committee approves, to have a thesis composed of parts (published or unpublished) provided a comprehensive introduction is provided. It should also have a conclusion placing the parts in perspective to the whole and making recommendations for future research.

The M.S. thesis may be written in the form of a conference paper with supporting information provided in Appendices, with the approval of the student's advisor.

The thesis must receive at least three approval signatures. One of these signatures must be that of the Department Head or the Graduate Program Officer. The Architectural Engineering *M.S. thesis must also include a Biographical Sketch.*

2.9 ORAL PRESENTATION OF THESIS

All Masters degree students will present the results of their thesis research at a meeting consisting of their advisor, the thesis committee and other members of the faculty and graduate student body. The format and content of the presentation will be similar to that used at technical meetings. Accomplishing this task in a satisfactory fashion is a requirement for graduation. ***It is the student's responsibility to inform the Graduate Program Officer a minimum of 1 week in advance of the defense with details of time, location, thesis title, and names of the committee members.*** The Grad officer will then make sure the event is publicly announced. In order to emphasize the importance of complying with this requirement, the Graduate Officer will not sign graduation clearance forms if the defense is held without proper notification of the Graduate Officer.

2.10 GRADUATE SCHOOL AND DEPARTMENT COPY OF AN M.S. OR Ph.D. THESIS

The final copy of the thesis is retained in the Thesis Office until after the degree conferral date, at which time it is sent to the Bindery in Pattee Library and to the Engineering Library for circulation.

A final bound copy (created by the "BINDERY" in the Pattee Library) of the thesis must be given to the Department Head Secretary in 104 Engineering "A" Building to be filed in the Department Library. Graduation requirements are not met until the Department's bound copy has been received.

As a courtesy, most students also present their advisor with both a bound and an unbound copy of their thesis (for reference and reproduction purposes).

2.11 THESIS GUIDE

The Graduate School Thesis and Publications Office provides a Thesis Guide (Web site referenced earlier), which is designed to provide generation formatting information and answer most questions for a graduate student who is writing a thesis.

3 Master of Engineering Degree

Program Information

3.1 MASTER OF ENGINEERING PROGRAM GOALS

The goals of this program are to provide the highest quality professional education in Architectural Engineering.

3.2 SELECTING AN ADVISOR

Each student is assigned to an academic advisor, a member of the graduate faculty in their area of interest, prior to their first semester of graduate school. A student may transfer this position to another faculty member later in their program by submitting a Change of Advisor form to the Graduate Program Officer. The student's advisor assists the student in constructing a program of courses that meets the educational objectives of the student along with all department requirements. During the first semester of graduate study, each M.Eng. student must submit a M.Eng. Program Approval form, which lists the courses the student expects to take to fulfill the 30-credit coursework requirement. This form must be amended in future semesters if a student's program changes for any reason.

3.3 PROGRAM REQUIREMENTS

Requirements for graduation are the following.

- ◆ All M.Eng. students must participate in the new student orientation activities.
- ◆ Each student must complete at least 30 credits, of which at least 18 must be at the graduate level (500-level). [Note – this requirement applies to any M.Eng. student who began the program in Fall 2007 or later. Prior to Fall 2007, this requirement was only 12 credits.] Students must follow the approved program of study provided in one of the four emphasis areas, or receive approval to substitute courses on the course list. A limited number of courses may be substituted for those listed in the approved programs. Students must provide valid justification for all proposed changes (such as lack of availability, previous successful completion of a similar course, greater benefit to a student's degree program, etc.).

As early as possible during the first semester of study, a student should consult with his/her advisor and submit the Master of Engineering Program Approval form, which lists the courses that are expected to make up a student's degree program. Students must file an amended plan in subsequent semesters if changes to this program are required. All changes to a student's

approved program must be approved prior to enrollment in any course.

- ◆ The courses on a student's approved M.Eng. program list must be completed with a grade point average of 3.0 or better to receive the M.Eng. degree.
- ◆ Each M.Eng. student must attend a minimum of 10 department lectures and document these on the appropriate form.
- ◆ The University requires that M.Eng. students submit a formal capstone paper as part of their degree requirements. This paper should demonstrate comprehensive knowledge of the field of study, and may be take the form of an in-depth design study, technical paper, or other engineering or research activity. Each MAE student should coordinate this activity with their adviser, or another graduate faculty member in their area of study and submit a M.Eng. capstone project proposal form prior to beginning the work. The student should register for AE 596 – Independent Study (3 credits) when work on this activity will be conducted (late in their program of study). The student must submit both the paper and a copy of the M.Eng. Paper Approval Form to the Graduate Program Officer prior to graduation. The form must be signed by the faculty member who reviewed the paper, indicating that the paper is of sufficient quality to fulfill this requirement.

The student will receive notice from the Graduate Program Officer regarding final acceptance of the paper, or informing the student of required changes or modifications that must be made prior to acceptance of the paper. The department will retain a final copy of the paper.

3.4 MASTER OF ENGINEERING CHECKLIST

- _____ Semester 1 - Submit M.Eng. Program Approval Form
- _____ Prior to graduation: Attend a minimum of 10 approved lectures on Architectural Engineering topics. These must be documented on the Architectural Engineering Lecture Confirmation Form.
- _____ In the first week of AE 596, Submit the M.Eng. Paper Proposal For
- _____ Prior to graduation: Submit M.Eng. Paper Approval Form and a copy of the paper to the Graduate Program Officer.
- _____ Prior to graduation: complete the 30 credits of courses on the M.Eng. Program Approval Form with a 3.0 GPA or better.

4 Doctor of Philosophy (Ph.D.) Program Information

4.1 Ph.D. PROGRAM GOALS

The goal of the Ph.D. program is to produce outstanding engineers who have demonstrated their abilities through the following:

1. Independent Research: Each Ph.D. candidate must demonstrate an ability to plan and carry out independent and original research. This work must show a high degree of maturity and creativity and contribute to the knowledge base in Architectural Engineering.
2. Depth of Study: Each Ph.D. candidate must develop a depth of understanding in one of the four basic areas of the department:
Building Construction,
Building Illumination Systems
Building Mechanical and Energy Systems
Building Structural Systems.

This is normally established through work on the M.S. degree and will be developed further within the Ph.D.

In the area of research, a student is expected to attain a level of understanding far above that normally acquired through typical course work. This depth is developed not only through an organized series of courses but through extensive independent study and research.

3. Breadth of Study: At all times, the concept of the Architectural Engineer as an individual who possesses a breadth of understanding of the building and building processes must be maintained. Some of this breadth will come from formal classes while the remainder of it will come from self study, active participation in a wide range of department lectures and activities, a personal interest in buildings, and interaction with fellow students.

4.2 ADVISOR

Each student, upon entering the doctoral program, is assigned to an academic advisor. The advisor selected will generally be the member of the graduate faculty who is best aligned with the student's area of academic interest, or will be the faculty member who is the student's supervisor for an assistantship. When a student decides on a faculty member with whom they plan to work on their Ph.D. dissertation, that person should then become their academic advisor. A Change of Advisor Form should be completed and submitted to the Graduate Program Officer. The advisor assists the student in constructing a program of

courses that meets the educational objectives of the student along with all department requirements; however, the Ph.D. committee will ultimately determine a student's program of courses.

4.3 ENGLISH COMPETENCY

A candidate for the degree of Doctor of Philosophy is required to demonstrate high-level competence in the use of the English language, including writing, speaking, and presenting as part of the language and communications requirements for the Ph.D. The Architectural Engineering Department, in conformance with Penn State University policy, assesses these three aspects of English competence. To ensure the highest level of student performance in this area, the Department assesses English competency at all levels of a Ph.D. student's program. The student should view these requirements as a highly beneficial component of their doctoral studies.

Competence must be formally attested by the program before the doctoral comprehensive examination will be scheduled. (International students should note that passage of the minimal TOEFL requirement does not demonstrate the level of competence expected of a Penn State Ph.D. graduate.)

The main elements of the policy are detailed below.

4.3.1. Testing International Students on Entry into Graduate Program

All international students who have not completed an academic program in a U.S. university are required to take the Penn State American English Oral Communicative Proficiency Test if they have not previously taken the Test of Spoken English (TSE). The Penn State test is administered by the Center for English as a Second Language at Penn State. Results from this test (or the TSE) will be used by the Department to determine measures for improving English competency of international students as they commence their graduate studies at Penn State.

All international students who have not taken the TSE must take the Penn State American English Oral Communicative Proficiency Test during the orientation week prior to their first semester at the University. If the performance level of the student is below the highest proficiency code (Test Score of 250), then the student will be required by the AE Department to take one of the following courses during the first semester: SPCOM 115G, SPCOM 117G, or SPCOM 118G.

4.3.2. First Year English Proficiency Examination

All Ph.D. students, domestic and international, will undergo an assessment of English competency during their first year. This assessment will typically occur in November of that year, to permit students to take English courses during their second semester and first summer session.

This assessment will include tests of writing, speaking and presentation skills. The assessment will be conducted by an AE Department English Proficiency Committee consisting of three members of the AE graduate faculty who are from different option areas within the Department, and who do not have an advisee currently taking the exam. The AE Department English Proficiency Committee will be assigned by the AE Graduate Program Officer, with the approval of the AE Department Head. English competency testing will consist of three parts.

a. Writing. The student will be asked to write an essay on a topic selected by the faculty. This essay will typically be 3-5 double-spaced pages in length. The written document will be judged on its organization, logical arguments in support of the student's statements, inclusion of relevant details, spelling, and style in the use of language, grammar and punctuation. The student will have three hours to complete this writing assignment in a monitored setting. The students may provide a neat and legible hand-written solution or may use MS-Word in completing this essay.

b. Presentation. At a later, scheduled date (generally within 2 weeks of the writing exercise), the student will make a formal oral presentation related to the short essay topic or another topic selected by the faculty committee. The presentation must be between 10 minutes \pm 1 minute in length. The presentation will be judged for its clarity, adaptation to the audience, organization, appropriate use of visual aids, and effectiveness of delivery. The quality of the presentation should be comparable to that of a paper presented at a technical session of a professional society meeting. The student's presentation may use Powerpoint or overhead transparencies.

c. Speaking. A second purpose of the oral presentation portion of the English Competency Test is to evaluate the oral skills of the student in spoken English. Following the presentation in item "b" above, the examination committee will question the student for approximately 10 minutes on issues related to the presentation to further evaluate the student's ability to understand questions and formulate intelligible and appropriate responses using the English language.

At the end of the English Proficiency Exam, each member of the examination committee will assess the student's English competency in three categories: writing, formal presentation and oral discussion. These assessments will be used to certify the areas in which the student has attained English competency and to recommend measures for improving their English competency for students judged to be deficient in one or more areas. Guidelines and recommended coursework for achieving English Competency are provided later in this document.

4.4.3. Further Opportunities for Enhancement of English Competency

The student's doctoral dissertation committee will also assess a student's English competence at other points in the student's doctoral program. These points will include the Doctoral Comprehensive Exam (written and oral) and the Dissertation Proposal. The format of the Comprehensive Exam gives faculty additional opportunities to assess a student's reading, writing, formal presentation and oral discussion skills, and his/her readiness to proceed with writing, presenting and defending the dissertation. Students whose work exhibits clear difficulties with either spoken or written English in either the comprehensive exam or the thesis proposal will be required to take additional English courses to improve their English proficiencies. The first draft of a student's dissertation proposal will be an important evaluative measure of the student's English writing abilities. Poor performance on the comprehensive exam or on the doctoral dissertation proposal will necessitate additional English coursework so that writing and/or speaking deficiencies can be removed before the student attempts to write his/her doctoral dissertation. Decisions on these matters will be the responsibility of the student's doctoral committee.

4.3.4 Expectations

It is expected that candidates for the Architectural Engineering Ph.D. be able to communicate effectively in daily academic/job-related settings, and in more formal professional conference settings. The expectations for comprehensible speech are as follows:

- Accurate pronunciation, with only occasional instances of clearly non-native accent or intonation patterns, especially for engineering-specific terminology.
- Appropriate grammatical constructions, with only minor non-native influences.
- Near native-like flow of speech, with only occasional non-native pauses, accentuation, or intonation.

For professional conference presentation settings, speaking proficiency expectations also include the following:

- Strong clarity of purpose for the presentation.
- Appropriate adaptation to an audience.
- Effective organization.
- Effective and appropriate visual aids and delivery style.

Expectations for written material include demonstration of clear competence on both rhetorical and syntactic levels. Ph.D. students are expected to be able to do the following:

- Effectively address a writing task.
- Organize and outline written material.
- Use appropriate details to support a thesis.
- Be consistent in the use of language.
- Demonstrate syntactic variety and appropriate word choice.
- Effectively observe grammar, punctuation, and spelling conventions in English.

4.3.5. Improving the English Competency of Students with Deficiencies

If the expected level of competence is not demonstrated at either the First Year English Proficiency Test or at one of the later doctoral program evaluation points, the doctoral student will be required to enroll in one or more courses offered at the University to improve their English skills. The AE Department English Proficiency Committee, in consultation with the Graduate Program Officer, will determine the required courses for which a student must register when a student's English skills fall below the Department's standards from the following list:

i. Oral Language Skills

SPCOM 114G Basic English as a Second Language
SPCOM 115G English as a Second Language:
Speaking and Listening

ii. Presentation Skills

SPCOM 100A Effective Speech, Public Speaking

SPCOM 312 Informative Technical and Presentational Speaking

iii. Writing Skills

SPCOM 116G English as a Second Language: Reading and Writing
ENGL 202C Effective Writing: Technical Writing
ENGL 198G Writing in the Disciplines

4.3.6 Attainment of English Competence

If the doctoral student completes and passes the course(s) required by either the AE Department English Proficiency Committee or the student's doctoral committee with a B grade or better, then the student will be certified as having attained English competence. If the student fails to achieve a B or better, then the student must retake the course (or another comparable course). The AE Department's policy to evaluate English competence at multiple points within a student's doctoral program means that a student who attains first-year English competence through either the exam or coursework could still be required to take additional English coursework later in their doctoral program if English performance at a later evaluation point does not meet the recommended standards as set forth and evaluated by his/her doctoral committee.

No student will be permitted to schedule his/her candidacy exam until he/she has completed the courses needed to fulfill the English proficiency requirements established at both the student's Penn State American English Oral Communicative Proficiency Test, and at the Department's First Year English Proficiency Exam. No student will be permitted to schedule his/her final oral examination until he/she has fulfilled all English proficiency requirements established by his/her doctoral committee at either the comprehensive examination or at the dissertation proposal stage. Students who do not make sufficient progress towards achieving competency in English jeopardize the renewal of their graduate assistantship funding and/or their continued enrollment in the Penn State University Architectural Engineering Doctoral Program.

4.3.7 Summary of English Proficiency Testing

The overall objective of the English Proficiency program implemented by the Department of Architectural Engineering is to ensure that all doctoral students in the Department exhibit the high level of competence in the use of the English language necessary to complete their doctoral dissertations and enable them to become successful members of the research, academic and building industry communities. Students are evaluated at a number of different points

throughout their AE doctoral program to ensure they have the English skills necessary to succeed in their doctoral studies and in their future careers.

4.4 BECOMING A DOCTORAL CANDIDATE AND THE CANDIDACY EXAM

Becoming a Doctoral Candidate

Regular graduate students who wish to become doctoral candidates must be approved for candidacy by the graduate faculty of the department. The approval is based on:

- a) the academic record of the student,
- b) a candidacy examination given by the department, and
- c) evidence of research capability based on advisor recommendations.

Therefore, it is essential that a new student begin working with an advisor as soon as possible.

Candidacy examination

Potential candidates are strongly encouraged to undertake the candidacy evaluation at the earliest possible time. The purpose of the candidacy evaluation is to assist in determining whether or not the student is competent to pursue a Ph.D. program and to provide the doctoral committee with a basis for recommending a program of study. This requires that the student:

- a) Has become associated with some member of the graduate faculty to a sufficient degree to allow evaluation of the potential candidate's ability to do independent research.
- b) Has earned a minimum of 18 course credits in graduate work (taken at PSU or accepted from another institution recognized by the AE Graduate Faculty) beyond the baccalaureate degree.
- c) Has fulfilled other pertinent requirements of the Graduate School as stated in the Graduate Catalog and the Manual for Graduate Students.
- d) Has demonstrated sufficient intellectual capacity and maturity to progress successfully through the coursework and other organized aspects of the Ph.D. program.
- e) Has demonstrated the ability to perform original and independent work required for research and design activities.

The candidacy examination is required to evaluate the student's competence to pursue a Ph.D. degree in Architectural Engineering and to provide the student's doctoral committee with a basis for recommending a course plan. The candidacy examination must be completed during, or immediately following, the two semesters of residency beyond the MS in order to identify any deficiencies and to discourage the marginal student from further effort in the Ph.D. program. The decision for or against candidacy is based on the student's performance on this exam and is reported to the Graduate School where it is entered on the student's record.

The candidacy exam is generally administered annually early in the Fall semester.

The form of the exam will consist of a six-hour written test. The exam will consist of a two-hour open book/notes breadth portion and a four-hour open book/notes depth portion in one of 4 specialty areas. An oral exam will also be scheduled for each student so that specific questions, often based on, but not limited to, the written exam may be directed to each student.

Written exam

The material covered in the depth portion of the candidacy examination is to be at the terminal B.A.E. (B.S.) level. While the materials may be based on the baccalaureate degree, the *faculty expects competency and maturity acquired in graduate study*. The faculty expects candidates to possess knowledge and understanding of architectural engineering principles, to be able to recall them quickly and to synthesize them accurately. The faculty also expects the candidates to be able to express themselves verbally with clarity and persuasion. Descriptions of the breadth portion of the test, the four specialization areas, and typical reference texts are shown below.

Candidacy Exam Breadth Coverage. Students will be required to work problems in the 3 areas outside their depth specialization.

AE 308 - Introduction to Structural Analysis. Algebraic and graphical methods of analysis of determinate members, deflections; introduction to indeterminate methods.

AE 310 - Fundamentals of Heating, Ventilation, and Air Conditioning. Fundamental principles, and engineering procedures for the design of heating, ventilating, and air conditioning systems, including energy utilization and constraints.

AE 311 - Fundamentals of Electrical and Illumination Systems for Buildings. Fundamental principles, systems, and planning concepts for electrical and illumination systems in modern buildings.

AE 372 - Introduction to the Building Industry. Introduction to the building industry; owner, designer, contractor responsibilities; contract documents, bidding procedures; types of construction contracts; project management; insurance; labor relations.

Candidacy Exam Depth Coverage

1. BUILDING CONSTRUCTION

AE 472 – Building Construction Management. Components of building industry; related responsibilities; building trades relationships; building construction contracts and bidding procedures; building construction sequences; industrialization; projects.

AE 475 - Building Construction Engineering I. Project planning, mobilization, supervision, execution; methods and inspection of architectural and structural operations in buildings; coordination of trades; offsite testing and fabrication.

AE 476 - Building Construction Engineering II. Construction of mechanical and electrical systems in major buildings, including fire protection, sound control, elevators; trade coordination; manufacturers' developments; computer application.

2. BUILDING ILLUMINATION SYSTEMS

AE 461 - Basic Building Illumination Practice. Theory and application of lighting to buildings; electric light sources, luminaries, and related equipment; branch circuiting and control; illumination design standards and procedures.

AE 464 - Advanced Illumination Systems Design. Advanced work in light distribution, interreflections, vision, color; energy management; economics; and outdoor lighting systems; electrical code requirements for lighting systems; emergency lighting; ballast theory; and principles of dimming controls.

3. BUILDING MECHANICAL AND ENERGY SYSTEMS

AE 454 - Advanced Heating, Ventilating, and Air Conditioning. Engineering design and performance analysis procedures for complex commercial systems, including energy conservation techniques; design project.

AE 455 - Advanced Heating, Ventilating, and Air Conditioning Design. Design of several different systems for a course project building; control strategy; economic comparisons using life cycle cost techniques.

4. BUILDING STRUCTURAL SYSTEMS

AE 401 - Structural Design of Buildings. Application of principles of engineering mechanics to layout, analysis, design, and detailing of structural elements in wood and steel of simple buildings.

AE 402 - Structural Design of Buildings. Plain and reinforced concrete; design, analysis, and detail of beams, slabs, columns, and walls.

AE 430 - Indeterminate Structures. Classical methods of analysis for beams, frames, arches, and secondary stresses as applied to buildings; introduction to modern methods.

Oral Exam

The purpose of the oral portion of the exam (approximately 60 minutes long) is to provide an additional form of evaluation and to reveal the student's depth of understanding of basic concepts relative to his/her ability to answer specific questions. The student's ability to express ideas and concepts verbally under questioning will also be assessed. The oral exam is scheduled within 2 weeks of the written exam.

Results of the Exam

Based on the student's performance on the criteria provided above, one of the following recommendations must be submitted by the Graduate Program Officer:

1. Full admission to Ph.D. candidacy. The recommendation of at least 2/3 of the department's Graduate Faculty present at the oral exam is required. The recommendation for admission to candidacy may include the stipulation that specific courses be included in the student's "committee approved" program of study.

2. Rejection as a doctoral candidate. A negative decision of the Graduate Faculty may yield the recommendation that the student be reexamined, that the student first be enrolled in the M.S. program or that the student withdraw from the department.

The decision to accept or deny admission to doctoral study in Architectural Engineering will be based on:

1. Results of the written exam.
2. Results of the oral exam.
3. Advisor's recommendation, grades, and the quality of work performed for the student's research or teaching assistantship.

Depending on the results of the above, selected students that do not pass the candidacy evaluation MAY be allowed to retake the entire exam the next time it is offered, if the faculty needs an additional opportunity to evaluate the student. These students will be allowed to retake the candidacy exam only once, and not all students will be permitted to retake the exam.

4.5 THE DOCTORAL COMMITTEE

When a graduate student has passed the candidacy examination, a Ph.D. Committee should be formed IMMEDIATELY. In this way, the student will receive proper guidance early in his/her program. The candidate and the advisor should discuss possible committee members. The committee must have a minimum of four members. At least three members must be from Architectural Engineering and one must be from outside the department and have no project or financial ties to the AE department or the committee chair. Names of the proposed committee should be forwarded to the Graduate Program Officer for action. The Graduate Officer may act on the suggested committee members or may discuss possible changes prior to requesting that the Graduate School form the committee. The Graduate School will appoint the committee and notify all persons concerned. At this point, the student's program is under the complete control of the Ph.D. Committee. The function and organization of the doctoral committee are as follows:

Chairperson and Thesis Advisor

The chairperson is responsible for the administrative aspects of the doctoral program and for coordinating the committee's activities. The chairperson convenes all meetings of the committee. The chairperson's duties also include:

- 1) directing the research program.
- 2) assisting the student in selecting and scheduling courses.
- 3) supervising and releasing:
 - the research proposal

- the final draft of the thesis for defense
- the final copy of the thesis that will be sent to the Graduate School

Meetings of the Doctoral Committee

Planning Meeting

The Ph.D. candidate and committee will meet immediately (within 30 days) after the doctoral committee is formed. The objective of the meeting is as follows:

- 1) listen to brief comments by the student regarding his/her academic record and work or educational experience.
- 2) define a tentative series of courses to be taken by the student.
- 3) define a tentative time schedule.

A written record of the meeting will be sent to the Graduate Program Officer.

The committee should meet as a body at least once a year to review the status of the student's program of study and research. Alternatively, the student can meet individually (at least once a year) with each committee member for these purposes. If there is a substantial change in the student's program of study or research objective, the committee will meet to discuss this change, and a written record of this meeting (describing the changes) will be sent to the Graduate Program Officer.

Other Meetings

The committee will also meet to review the thesis proposal, to administer the comprehensive exam, and to conduct the final oral exam.

4.6 THESIS PROPOSAL

1. Written Requirements. The candidate will prepare a comprehensive written thesis proposal consisting of the following:

- Introduction
- Literature review
- Research hypothesis
- Proposed research activity
- Tools necessary to undertake the proposed research
- Anticipated schedule

The objective of this proposal is to:

- ◆ Clearly demonstrate that the candidate has identified and sufficiently narrowed the thesis research topic through a concise statement of the thesis hypothesis.
- ◆ Clearly demonstrate that the candidate is familiar with related work reported in the literature.
- ◆ Clearly demonstrate that the candidate is aware of and has mastery of the analytical/experimental tools necessary to successfully undertake the proposed thesis research.
- ◆ Provide a basis upon which to evaluate the final thesis research.
- ◆ Provide a basis for committee approval of the proposed work.
- ◆ This written proposal will be presented to the candidate's doctoral committee in advance of an oral presentation at a meeting of the committee and prior to the comprehensive exam.

2. Oral Requirements: The candidate will make a formal oral presentation to his/her doctoral committee on the thesis problem and the approach to its solution. This presentation shall precede the comprehensive exam. The use of audio-visual aids in this presentation is encouraged.

4.7 COMPREHENSIVE EXAMINATION

The purpose of the examination is to demonstrate that candidates are qualified to undertake the research phase of the program. This requires that students:

- 1) have substantially completed, with a minimum grade point average of 3.00, a program of courses approved by their committee (approximately two semesters before the thesis defense).
- 2) have spent at least two semesters in a twelve-month period as a registered student during which time they were engaged in full-time academic work at the University Park Campus.

The comprehensive exam should cover the minor field of study (if elected) and specific areas of Architectural Engineering that relate to the student's program, as designated by the student's Ph.D. Committee. The comprehensive exam will consist of a 16 hour written examination administered by the student's doctoral committee. The committee will also conduct an oral

exam in a timely fashion. A student must receive a favorable vote of at least three-fourths of the members of the Ph.D. Committee for this requirement to be met.

The comprehensive exam is scheduled by the Graduate School upon request by the Graduate Program Officer. The chairperson of the doctoral committee notifies the Graduate Program Officer when a student has substantially completed the coursework requirement and a comprehensive examination should be scheduled. The student must be registered at the time the comprehensive exam is taken. It is the responsibility of the Ph.D. committee chairperson to complete all procedures and see that all requirements are met. It is the responsibility of the Ph.D. student to ascertain that the committee chairperson performs these duties in a timely and accurate manner.

Copies of all transactions between the Ph.D. committee chairperson and the Graduate School shall be forwarded to the Graduate Program Officer.

4.8 DOCTORAL FINAL ORAL EXAMINATION AND THESIS DEFENSE

The purpose of this examination is for students to defend their Ph.D. dissertation. In the interim between successful completion of the comprehensive examination and the final oral examination, the following regulations apply:

1. A request for scheduling the oral examination should be made to the Dean of the Graduate School by the Graduate Program Officer upon request from the chairperson of the Ph.D. committee, following the guidelines set forth above and in the Graduate Bulletin. Note that at least two weeks written notice is needed to schedule a final oral examination.
2. A candidate must be registered and maintain student status until passing the final oral examination and the thesis is accepted by his/her Ph.D. Committee. This may be satisfied by registering (at least two semesters per calendar year) for AE 601 and AE 611, which are for Ph.D. thesis preparation and are non-credit.
3. When a period of more than five years has elapsed between passing of the comprehensive examination and the completion of the program, the student is required to pass a second comprehensive examination before the final oral examination can be scheduled.
4. The final oral examination may not be scheduled until at least three months have elapsed after the comprehensive examination was passed, although the Dean of the Graduate School may grant a waiver in the case of an outstanding student.

5. The final oral examination will be administered by the student's Ph.D. Committee and will be a defense of the student's dissertation. The student must receive a favorable vote of at least three-fourths of the members of his/her doctoral committee. The final oral exam will be publicized and members of the academic community will be encouraged to attend.

4.9 COURSE CREDITS

The Ph.D. degree is based upon the achievement of a high level of competency in the area of specialization as demonstrated through a combination of course work, independent study, and research. This competency must be demonstrated through successful completion of the comprehensive examination and the Ph.D. thesis. As a guideline for coursework, it is expected that a student will take a minimum of thirty non-thesis course credits beyond the MS degree, with at least 24 at the 500 level. Penn State AE's proceeding directly to the Ph.D. are expected to take at least 45 non-thesis course credits beyond the B. AE. The exact number of courses may exceed these guidelines if the committee believes that more courses are necessary for the student to achieve the required mastery of the subject matter.

In all cases, no more than 9 course credits may be obtained through individual study, AE 496 or AE 596. Further, because of the interdisciplinary nature of Architectural Engineering, it is anticipated that a significant number of course credits will be completed in other engineering departments. The student's doctoral committee is responsible for establishing the coursework and other study that will lead to the desired level of competency. The committee is also responsible for the evaluation of both competency and thesis quality. As a component of the thesis research, the student is to complete AE 6XX thesis credits as defined by the committee, with no more than 6 credits permitted prior to approval of the thesis proposal.

4.10 THE Ph.D. THESIS

Approval Procedure

The Ph.D. dissertation will be reviewed by each member of the student's doctoral committee. At least three fourths of the committee must approve and sign the thesis. The thesis must also bear the signature of either the Department Head or Graduate Program Officer.

Graduate School and Department Copy of a Ph.D. Thesis

The final copy of the thesis is retained in the Thesis Office until after the degree conferral date, at which time it is sent to the Bindery in Pattee Library and to the Engineering Library for circulation. Doctoral theses are shipped to University Microfilms International for microfilming and are subsequently returned to the library for binding and circulation.

A final bound copy (created by the "BINDERY" in Pattee Library) of the thesis must be given to the Department Head Secretary in 104 Engineering "A" Building to be filed in the Department Library. Graduation requirements are not met until the Department's bound copy has been received.

As a courtesy, most students also present their advisor with both a bound and an unbound copy (for ease of reproduction) of their thesis.

Thesis Guide

The Graduate School Thesis and Publications Office provides a Thesis Guide which is designed to provide guidance and answer questions for a graduate student writing a thesis. When you start your thesis, you should pick up the latest copy in 211 Kern Building.

4.11 OTHER REQUIREMENTS

All first semester graduate students are required to participate in the departmental orientation activities, and to attend a minimum of 10 lectures on a variety of topics during prior to their comprehensive exam.

4.12 TIME LIMITATIONS AND SCHEDULE

The Department records the progress of each student in meeting the requirements through the use of a checklist on which completion dates are recorded. This checklist summarizes the sequence and time schedule of the requirements. A copy of the Ph.D. Degree Clearance Sheet is included in Appendix E.

A student is required to complete his/her program within 8 years from the date of acceptance as a candidate as established by the Graduate School.

4.13 DEGREES RECEIVED WHEN THE FIRST GRADUATE DEGREE IS THE Ph.D.

For students who proceed directly from the B.A.E degree to the Ph.D., a Masters degree will not be awarded. Only students with a five-year undergraduate Architectural Engineering degree from an approved program may proceed directly to the Ph.D. program.

Appendix A

Forms

Department of Architectural Engineering
Master of Science
MASTER'S APPROVAL FORM

From: _____ Date : _____
(M.S. Candidate's Name)

To: a) Graduate Program Officer, Department of Architectural Engineering
b) Advisor

Professor _____ has agreed to serve as my advisor.

PART 1. PROPOSED TOPIC OF THE M.S. THESIS: _____
_____. When the topic has matured, a thesis proposal must be prepared. (See Appendix D of Graduate Student Handbook)

PART 2. PROPOSED COURSE OF STUDY.

	COURSE NO.	COURSE TITLE	SEM	C R E D I T S
1.	_____	_____	_____	_____
2.	_____	_____	_____	_____
3.	_____	_____	_____	_____
4.	_____	_____	_____	_____
5.	_____	_____	_____	_____
6.	_____	_____	_____	_____
7.	_____	_____	_____	_____
8.	_____	_____	_____	_____
9.	_____	_____	_____	_____
10.	_____	_____	_____	_____
11.	_____	_____	_____	_____

APPROVAL OF ADVISOR:

- 1) I have worked with the candidate in developing the program and recommend its approval. I believe that the proposed work can be accomplished by the candidate within the normal Master's program time limits (one calendar year for a full-time student, or three semesters and a summer for a graduate assistant). The experimental equipment is
 on hand, funding arrangements have been made, or
 no experimental work is required

- 2) This course of study is approved as appropriate to the candidate's objective and background.

(Date) (Signature of Student) (Signature of Advisor)

Received by the Graduate Program Officer _____
(Date)

Approved for completeness: _____
(Graduate Program Officer)

Department of Architectural Engineering
M.S. and Ph.D. THESIS PROPOSAL APPROVAL FORM

For: _____
(Candidate's name)

To: a) Advisor
 b) Graduate Program Officer

Proposed Thesis Topic: _____

Thesis Committee Approval:

Name	Signature	Date
_____ (Advisor)	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

**The Pennsylvania State University
Department of Architectural Engineering**

M. Engr. DEGREE CLEARANCE SHEET

Name: _____ Admitted: _____

- _____ 1. 18 or more credits of approved 5XX level courses.
- _____ 2. 30 credits of approved 4XX and 5XX level courses.
- _____ 3. Copy of the Master of Engineering Paper submitted to the AE Department along with the Master of Engineering Paper Approval Form
- _____ 4. Architectural Engineering Lecture Confirmation Form has been submitted (confirming that the student has attended 10 approved lectures during their graduate program).
- _____ 5. All keys have been returned.

Advisor Signature: _____

Date: _____

Grad Program Secretary Signature: _____

Date: _____

Dept. Head Secretary Signature: _____

Date: _____

Key Administrator Signature: _____

Date: _____

Send completed form to the Graduate Program Officer.

Department of Architectural Engineering
MASTER OF ENGINEERING PAPER PROPOSAL FORM

Student: _____

Semester Scheduling AE 596: _____

Paper Title: _____

Description of the Work:

AE Faculty Reviewer for Paper (signature below indicates agreement to work with the student on the listed project):

Faculty Reviewer:

Name

Signature

Date

(Faculty Reviewer)

Graduate Program Officer:

Department of Architectural Engineering
MASTER OF ENGINEERING PAPER APPROVAL FORM

Student: _____

Paper Title: _____

Please submit this form along with a copy of the paper. This copy will be retained by the AE Department for its records.

AE Faculty Reviewer for Paper (signature below indicates acceptance of this paper to meet the Master of Engineering Paper Requirement):

Faculty Reviewer:

Name

Signature

Date

(Faculty Reviewer)

Accepted:

Yes _____

No _____

Graduate Program Officer:

**The Pennsylvania State University
Department of Architectural Engineering**

M.S. DEGREE CLEARANCE SHEET

Name: _____ Admitted: _____

- _____ 1. 12 or more credits of approved 5XX level courses.
- _____ 2. 24 credits of approved 4XX and 5XX level courses.
- _____ 3. 6 credits of thesis AE 600
- _____ 4. Satisfactory Oral Presentation of the M.S. research.
- _____ 5. At least 3 signatures on the M.S. thesis approval sheet.
- _____ 6. One copy of the thesis, unbound and signed, sent to the graduate school and one bound and signed copy delivered to the AE Department Head Secretary
- _____ 7. Thesis copies submitted above contain Biographical Sketch
- _____ 8. Architectural Engineering Lecture Confirmation Form has been submitted (confirming that the student has attended 10 approved lectures during their graduate program).
- _____ 9. All keys have been returned.

Advisor Signature: _____

Date: _____

Grad Program Secretary Signature: _____

Date: _____

Dept. Head Secretary Signature: _____

Date: _____

Key Administrator Signature: _____

Date: _____

Send completed form to the Graduate Program Officer.

**The Pennsylvania State University
Department of Architectural Engineering**

PhD DEGREE CLEARANCE SHEET

Name: _____ Admitted: _____

Advisor: _____ Student ID Number: _____

- _____ 1. PhD English Proficiency requirement satisfied
- _____ 2. Candidacy Exam successfully completed
- _____ 3. Ph.D. Thesis Proposal successfully completed
- _____ 4. Comprehensive Exam, written and oral exams successfully completed
- _____ 5. Coursework credits satisfied
- _____ 6. Final Oral Exam, thesis defense
- _____ 7. Residency requirement met
- _____ 8. One copy of the thesis, unbound and signed, sent to the graduate school and one copy bound and signed delivered to the department.
- _____ 9. Architectural Engineering Lecture Confirmation Form has been submitted (confirming that the student has attended 10 approved lectures during their graduate program).
- _____ 10. All keys and equipment have been returned.

Advisor Signature: _____

Date: _____

Grad Program Secretary Signature: _____

Date: _____

Dept. Head Secretary Signature: _____

Date: _____

Key Administrator Signature: _____

Date: _____

Send completed form to the Graduate Program Officer.

Appendix B

Penn State Guidelines for the Responsible Conduct of Research

Guideline RAG16 THE RESPONSIBLE CONDUCT OF RESEARCH

Contents:

- Purpose
 - Policy Guidelines
 - Approval Procedures
-

PURPOSE:

The Pennsylvania State University is committed to fostering integrity in the conduct of research. All members of the research community, including faculty, research staff, students, fellows, adjunct faculty, and visiting researchers, are expected to adhere to the highest ethical and professional standards as they pursue research activities to further scientific understanding.

The goal of the Guidelines is to offer a set of values, principles, and standards to guide decision-making and conduct throughout the research process. It is not intended to provide a set of rules that prescribe how researchers should act in all situations. Rather, the Guidelines are intended to increase awareness of research integrity and outline the University's expectations for ethical behavior amongst all researchers.

The Guidelines discussed are not mutually exclusive. There are many circumstances when many of them apply to a single project or activity. The risks of non-adherence to the Guidelines can be both personally and institutionally great. Potential consequences of non-adherence are outlined in the University policies that form the foundation for these Guidelines.

GUIDING PRINCIPLES:

The Code of Conduct prescribes standards of work performance and ethical conduct expected of all persons engaged in research at The Pennsylvania State University based upon the following guiding principles:

- a. Research is the pursuit of truth in the advancement of knowledge
- b. Researchers should, in all aspects of research-
 - i. Demonstrate integrity and professionalism;
 - ii. Observe fairness and equity;
 - iii. Disclose and appropriately manage all conflicts of interest;
 - iv. Ensure the rights, safety, and dignity of those associated with research; and
 - v. Comply with all legal, regulatory, and ethical requirements established by the University, regulatory bodies, funding sources, and professional organizations.
- c. Research methods and results should be open to scrutiny and debate.

I. DATA MANAGEMENT AND DATA INTEGRITY:

Data integrity depends on the proper and ethical collection, representation, and retention of data. Falsification or fabrication of one's own data and unacknowledged use of data generated by others are unacceptable behaviors and constitute misconduct. The University maintains ownership of all data collected from research conducted at the University, under the auspices of the University, or with University resources, subject to restrictions stipulated in University-approved agreements with sponsors and other third parties.

Guidelines:

- a. Accept primary responsibility for data collection, proper attribution, recording, storage, retention, and disposal or transfer to University Archives, as appropriate.
- b. Scrupulously record data in a form that is easily accessible for analysis and review and, if the research is supported by external funding, readily identifiable with and traceable to the sponsored project.
- c. Maintain the privacy of data as required by confidentiality agreements and regulations.
- d. Make data immediately available to scientific supervisors and collaborators, as confidentiality agreements permit.
- e. Post-publication, share data with other interested researchers who seek to verify and/or complement existing research.
- f. Maintain research data intact, preferably in original form, in accordance with University or sponsor's retention requirements or for a sufficient amount of time to allow for analysis of published results by other researchers, optimally a minimum of five years after publication.

II. RESPONSIBLE AUTHORSHIP:

Authorship is the process by which the results of original research are translated to published form to facilitate the communication of new knowledge to the professional community. Thus, the integrity of the scholarly record is of paramount concern to the research community. See University Policy [RA13](#).

Guidelines:

- a. Attest to the originality of work.
- b. Assign credit appropriately in publications by citing relevant work of others.
- c. Discuss and resolve issues of authorship before beginning a study or as they arise during a study.
- d. Assign appropriate credit in publications to all those who have contributed significantly to the research process, including research staff, students, and support staff. See PSU Policy [RA13](#) for further clarification on coauthorship.
- e. Confirm that all coauthors willingly agree to be listed as coauthors of publications and to assume responsibility for the accuracy and integrity of their contributions.
- f. Actively involve all coauthors in reviewing and verifying any and all parts of the manuscript.
- g. Identify a primary author to be responsible for the validity of the entire manuscript and for assuring that all contributions are appropriately recognized.
- h. Avoid honorary authorship, which is the practice of subscribing authorship to an individual who has not made a substantial contribution to a manuscript. Instead, utilize alternative forms of acknowledgment as allowed by the publication venue.
- i. Include information in the publication on the sources of financial support for the research. Be cautious of financial sponsorship that prohibits the naming of the sponsor in publication.

III. DISSEMINATION OF RESEARCH:

The University strongly upholds principles of academic freedom, and as an institution serving the public, encourages every effort to ensure that research conducted under the auspices of the University can be freely pursued and disseminated. Researchers are urged to be aware of overtly commercialized research that attempts to place boundaries on academic freedom to pursue research for the good of society and to make research results available to

the general public. However, the nature of some research, particularly industrial and defense-related research, does present some circumstances where it may be appropriate and necessary for restrictions to be placed on dissemination. Where such situations are warranted, researchers should practice caution and abide by the following guidelines.

Guidelines:

- a. Conduct classified research only in the Applied Research Laboratory.
- b. Maintain the secrecy of classified research.
- c. Maintain the confidentiality of proprietary information that has been provided to enable research.
- d. Refrain from publishing or otherwise disseminating research related to inventions until appropriate disclosure filings are made to protect your intellectual property.
- e. Abide by export control regulations that can place legal restrictions on the ability to publish or present.
- f. Refrain from disseminating research that may result in future harm to the public.

IV. PUBLICATION PRACTICES:

Timely communication of research results is the primary method for the public dissemination of new knowledge, which is necessary for fostering growth in a professional field. As such, researchers have the responsibility to communicate research results to the scholarly community. Both the reputation and the growth of a profession depend upon three key values: 1) openness in communication, 2) honesty in reporting results and methods, and 3) fairness in apportioning credit. All investigators are obligated to uphold these values.

Guidelines:

- a. Include sufficient information in publications to enable others to replicate the results or otherwise scientifically validate the research.
- b. Avoid simultaneous submission of the same abstract or manuscript to multiple journals.
- c. Avoid fragmentary publication or multiple publications of highly similar research findings based on the same data set.
- d. Acknowledge any sources of financial support for the research and disclose any conflicts of interest in publications.

V. PEER REVIEW:

Peer review is an essential part of the research process. Peer review helps ensure that research has been carried out in an effective manner and will make a significant, timely contribution to the field. Researchers of all fields may find themselves in the position to offer peer review, and the obligation should be thought of as an additional way to contribute to the profession. The review process must be conducted according to the highest professional standards to ensure continuing widespread confidence in the peer review system.

Guideline:

- a. Review only manuscripts and grant applications on a subject matter of personal expertise and return a thoughtful review.
- b. Disclose real or perceived conflicts of interest. Identification of a conflict of interest may require a decision to remove oneself from the review process.
- c. Base a review objectively within the context of published information. Offer positively constructive comments rather than confrontational remarks.

- d. Retain the confidentiality of all manuscript and grant application contents, as both contain privileged information.

VI. COLLABORATIVE RESEARCH:

Collaborative research affords many opportunities to significantly expand research in response to more detailed questions by sharing expertise and resources. Researchers are encouraged to partake in collaborative research within the institution as well as across institutions, keeping in mind that all of the guidelines for research put forth are applicable to collaborative projects. Noncompliance by any single individual contributing to collaborative research may have negative repercussions for the entire research team.

Guidelines:

- a. Ensure all those involved confirm their compliance with applicable regulations and policies of all institutions and professional standards.
- b. Abide by export control regulations that can place legal restrictions on the ability to publish or present.
- c. Ensure collaborators adhere to all grant management regulations and contractual obligations.
- d. Discuss and agree to authorship guidelines for the project.
- e. Advise collaborators of institutional policies for intellectual property and requirements for protecting privileged work invented in the course of the collaboration.
- f. Disclose all real or perceived conflicts of interest with collaborators prior to embarking on collaboration.

VII. FINANCIAL CONFLICT OF INTEREST:

Conflict of interest occurs when a researcher uses his/her position, relationships, and reputation for personal gain or for the profit of a family member. Real or perceived conflict of interest can be detrimental to the research process in that it may lead some researchers to inappropriately influence a research study or results. The existence of a financial relationship does not necessarily lead to inappropriate actions. Consequently, it is important for researchers to disclose all relevant financial relationships. See University Policies [RA05](#), [RA12](#), [HR91](#), and [RA20](#).

Guidelines:

- a. Disclose all potential significant conflicts of interest to:
 - a. the University Conflict of Interest Committee prior to the submission of proposals or initiation of sponsored projects or at least annually or as changes in status occur.
 - b. funding agencies when submitting funding applications.
 - c. journal editors when submitting manuscripts for publication or acting as a peer reviewer.
 - d. meeting organizers prior to delivering a scholarly presentation.
 - e. the Institutional Review Board, when applicable.
- b. Attempt to eliminate significant conflicts of interest and appropriately manage those that cannot be eliminated.

VIII. CONFLICT OF COMMITMENT:

Conflict of commitment occurs when demands on time and/or effort made by non-institutional entities or persons interfere with primary professional responsibilities to the University. Avoiding irresponsible conflicts of commitment is essential for supporting credibility and accountability, providing sound stewardship of University resources, increasing trust among members of the University community, protecting researchers and the University

from litigation, and for maintaining mission focus and academic freedom. The University allows and encourages extra-university research activities as long as such activities support the mission of the University and do not compete with the University. To avoid the appearance of unethical conflicts of commitment, researchers should disclose all potential conflicts to academic supervisors. See University Policy [RA12](#).

Guidelines:

- a. Attempt to effectively manage time and effort commitments that may detract from University obligations.
- b. Disclose all potential conflicts of commitment that arise from activities such as consulting, external teaching, privately-funded research, and start-up companies.

IX. FISCAL RESPONSIBILITY:

Accurately managing research funds contributes to the fiscally sound and ethically responsible conduct of research. Managing project budgets and effort responsibly contributes to the legitimacy of the overall research project. See University Policies [RA01](#), [RA03](#), [RA04](#), [RA06](#), and [RA08](#).

Guidelines:

- a. Understand that grants, contracts, and gifts are awarded to the University, rather than to individuals employed by the University.
- b. Effectively manage research-appropriated funds to ensure all costs incurred on a project are reasonable, allowable, and allocable.
- c. Comply with all terms and conditions imposed by the financial sponsor.
- d. Initiate all required approvals for budgetary and programmatic changes that may be necessary during a project.
- e. Comply with University purchasing and travel policies as well as all sponsor regulations.
- f. Submit effort certifications for all projects annually, but review effort assignments monthly to avoid unallowed expenses for federally funded projects in particular.

X. RESPONSIBILITIES OF RESEARCH SUPERVISORS:

Mentoring young researchers in the technical as well as ethical aspects of research is a significant responsibility. Research supervisors have the rewarding and unique opportunity to inform, instruct, and set an example for the responsible conduct of research. However, researchers should be cognizant of ethical issues related to the supervision of research trainees such as the potential abuse of power over those who are dependent for financial, academic, and emotional support; conflicts of commitment between the productivity of the supervisor's research and the trainee's academic progress; and financial conflicts of interest created by assigning research trainees to projects in which the supervisor stands to gain financially.

Guidelines:

- a. Ensure the scientific integrity of all work stemming from one's research group.
- b. Provide supervision, guidance, and example to trainees to further their academic, technical, and professional development.
- c. Provide oversight of experimental procedures including study design and data collection, validity, reporting, and retention.
- d. Instruct graduate students, post doctoral fellows, and other research assistants on all relevant regulations, university policies, and university procedures for research with humans, animals, and/or hazardous materials.

- e. Ensure the proper fiscal management and conduct of the project.
- f. Oversee the preparation and submission of technical reports and any other required deliverables.

XI. RESEARCH WITH HUMAN PARTICIPANTS:

The conduct of research with human participants is highly regulated and is guided by ethical considerations. First and foremost, researchers should be cognizant of the fact that research with human participants is a privilege, not a right stemming from Academic Freedom. Researchers are obligated to conduct research with human participants in such a way as to minimize any risks or harm to participants. The Institutional Review Board (IRB) review and approval process is in place to ensure that all research with human participants adheres to this mandate. See University Policies [RA14](#) and [RA22](#).

Guidelines:

- a. Minimize risk to participants and ensure that research is justified by maximizing potential benefits.
- b. Obtain informed consent of participants throughout the duration of the research as appropriate.
- c. Ensure the safety and privacy of all participants, as well as the confidentiality of all information.
- d. Employ additional safeguards when vulnerable populations are involved.
- e. Obtain written IRB approval for research prior to contact with human participants.
- f. Adhere to all relevant federal regulations.

XII. RESEARCH WITH ANIMAL SUBJECTS:

Research involving animals must be humane and meet normative standards of conduct. Animal researchers are duty-bound to conduct their research ethically and humanely. Researchers should be cognizant of the fact that the use of animals in research is a privilege, not a right stemming from Academic Freedom. See University Policy [RA15](#).

Guidelines:

- a. Ensure all research associates working with animals are adequately evaluated according to the Animal Care and Use Occupational Health and Safety program, trained and supervised.
- b. Identify how the research will benefit animals or human kind.
- c. Minimize the number of animals involved in a research study to include only the number necessary to ensure the integrity of the research.
- d. Design protocols to avoid or minimize discomfort, distress, and pain, using appropriate pain medication where appropriate.
- e. Obtain written approval of research from the Institutional Animal Care and Use Committee (IACUC) prior to the commencement of any research or teaching with animals.
- f. Adhere to the IACUC-approved protocol throughout the study.
- g. Conduct all research activities in accordance with University policy, the Animal Welfare Act, the Public Health Service Policy on Humane Care and Use of Laboratory Animals, the Guide for Care and Use of Laboratory Animals, and U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Teaching, Research, and Training.

XIII. RESEARCH INVOLVING HAZARDOUS MATERIALS AND POTENTIAL SAFETY HAZARDS:

Research involving biohazardous, radioactive and other hazardous materials, such as chemicals, if, improperly handled, has the potential to pose a threat to researchers, the Penn State community, and society at large. Additionally, other potential safety hazards may exist in the research environment and measures need to be in-place to prevent injury or negative impacts. It is essential that an organizational structure for safety be established and followed so that safe processes are integral with daily activities. See University Policy [SY01](#).

Supervisor Responsibilities:

All supervisors (department chairs, faculty, and other employees with direct oversight of University activities) have specific responsibilities to provide for the health and safety of those supervised.

- a. Be thoroughly informed of appropriate University and Departmental safety policies, rules and procedures and how they specifically apply to your responsibilities and authority.
- b. Ensure all employees and students understand and abide by relevant safety and health policies, rules, regulations, and procedures.
- c. Provide and maintain required safety equipment, devices and personal protective equipment and apparel. Ensure proper usage.
- d. Provide instruction and assistance in the proper operation of equipment or materials that may be potentially hazardous.
- e. Encourage reporting of health and safety concerns. Take prompt, corrective action when unsafe conditions, practices or equipment are reported or observed.
- f. Conduct a thorough investigation in all work-related injuries, illnesses and accidents, submit appropriate recommendations on all accident reports, and follow through to ensure corrective measures have been implemented.
- g. Coordinate or conduct inspections to maintain safe and healthful conditions, and address any deficiencies that are identified.
- h. Provide for health and safety training.

Guidelines for Use Involving Biohazardous Materials:

The Institutional Biosafety Committee (IBC) and Environmental Health and Safety (EHS) exist to ensure compliance with regulations pertaining to the use of these materials. See University Policy [SY24](#).

- a. Submit any research or teaching involving the use of genetically modified materials (recombinant DNA); infectious agents; human blood, tissues, or unpreserved body fluids; Select Agents, or USDA regulated agents to the Institutional Biosafety Committee for review and written approval prior to conducting the activities.
- b. Ensure all laboratory work areas have current and protocol appropriate inspections by Environmental Health and Safety.
- c. Ensure all research personnel are properly trained and supervised for handling biologic and chemical materials to which they may be exposed.
- d. Dispose of all biological hazards and chemical materials according to established regulations.
- e. Conduct all research activities in accordance with relevant University policies, federal regulations, and state laws.

Guidelines for Use of Radioactive Materials:

The University Isotope Committee (UIC) and Environmental Health and Safety (EHS) exist to ensure compliance with radiation rules and procedures. See University Policy [SY14](#).

- a. Obtain written authorization from the University Isotope Committee prior to beginning research utilizing radioactive materials.
- b. Acquire all radioactive research materials through Environmental Health and Safety.
- c. Ensure the proper containment of radioactive materials being utilized in work areas.
- d. Ensure all research associates and technicians working with radioactive materials are properly trained by EHS.
- e. Immediately report radioactive material spills or exposure to the environment.
- f. Dispose of all radioactive materials according to established regulations.
- g. Conduct all research activities in accordance with all relevant University policies, federal regulations, and state laws.

Guidelines for Use of Radiation-Producing Equipment:

The use of radiation-producing equipment such as x-rays poses a potential serious hazard to those individuals exposed. It is also regulated by federal and state agencies. See Policy [SY15](#).

- a. Consult with EHS as early as possible prior to ordering or installing any radiation-producing equipment.
- b. Arrange to have newly installed systems inspected by EHS for required labeling, safety devices, radiation levels, and evaluation of the system location to assure user and non-user safety.
- c. Prepare written operating procedures for the use of all radiation-producing instruments and review them with the user(s).
- d. Inform EHS prior to the transfer of the equipment or when a system is permanently removed from service and is to be either disposed of or used for parts.
- e. Contact EHS for guidance on proper disposal.

CONCLUDING STATEMENT:

The responsible conduct of research is essential for promoting public trust in research and in the University. The University expects that all research and other scholarly activities be conducted according to the highest ethical standards and guidelines. The personal and institutional consequences associated with unethical conduct can be significant. The risks of non-adherence to the guidelines stated here can include fines, loss of privileges to conduct particular types of research, loss of funding or the inability to apply for certain types of funding in the future, damaged reputation, disbarment from a federal agency, and dismissal from the University. As is stated in Policy [RA10](#), the University will take all necessary actions to ensure the integrity of research and scholarly work.

Effective Date: December 3, 2003
Date Approved: December 1, 2003
Date Published: December 2, 2003

