

Construction Ph.D. Level Education

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A Ph.D. program in Construction Management requires a mastery of academics and practice in the broad area of Management and Science. It involves in-depth knowledge of specific areas of construction that involve skills in problem solving and the analysis of information; and the capacity to make original contributions to the field. To develop these abilities, a Ph.D. program in Construction Management has the following components: 1) Education in the various fields of Construction Management, 2) Detailed knowledge of a specialty or research concentration, and 3) A significant original contribution to the field. This corresponds to a layered model of graduate studies where students begin by developing a broad base of knowledge, and, building on that, progressively deeper understanding and skill in fields of increasing specialization: These principles: 1) Focus on preparing students for original research by developing a broad foundation followed by increasing specialization, and 2) Guide the design of a Ph.D. program in Construction Management. While a Ph.D. in Construction Management offers a structured curriculum to develop research capabilities and skills, the program is also flexible, in recognition that each individual student's program should be unique.

Key Words: Graduate Education, Ph.D., Curriculum, Competencies, Requirements

Introduction

A Ph.D. is a research degree. We believe those who receive a Ph.D. should be talented and enthusiastic organizational scholars. They should be able to critically evaluate existing research, translate and disseminate research knowledge to their students and their communities, and conduct their own original research adding to what we know and what we do in the construction management discipline. Therefore, students whose major field is construction management should always receive research-oriented training.

A primary form of that training could occur in one-to-one working relationships. From their first semester/quarter in a Ph.D. program, students should be encouraged to work closely with faculty members on current research projects, from which jointly authored papers are submitted and published in the field's top journals.

A program should also have high expectations that students should learn from and do well in their coursework. A Ph.D. program in construction management should require 18 semester/27 quarter hours of classes in the Construction Management major and 12 semester/18 quarter hours in research methods. Students should find that their content knowledge helps them to apply and crystallize what they learn about research methods. Likewise, programs should expect research methods courses to help students make better, more informed conclusions about existing construction management theory and research.

Finally, a Ph.D. program should also prepare students to excel in teaching. Although students should probably not be classroom instructors until after they pass one or more of their comprehensive exams, each student should be linked with individual faculty members as "teaching mentors." Through this mentoring program, students should learn how to put together a course syllabus, prepare and deliver lectures, create and grade assignments, construct and evaluate tests, and track student progress.

Description

A Ph.D. program should be student-centered. It is for this reason, that a program should be kept deliberately small - maintaining close to a 2:1 ratio of students to faculty. A Ph.D. program in Construction Management should offer a flexible set of courses to fit with student interests. It should allow exceptionally qualified students the opportunity to attend part-time and work part time. The Ph.D. student should be encouraged to follow his or her own research interests rather than be compelled to follow a particular faculty member's.

The maintenance of a construction management academic community is the mutual responsibility of students and faculty. Doctoral students are collaborators in the academic research enterprise. In addition to its formal curriculum and requirements, the following shared values and expectations should guide a Construction Management Ph.D. program.

The University is an open environment, not an environment for developing private work. Research work is measured by its impact on the broader scholarly community; therefore, without publication and dissemination, the research work would have limited impact. Students should maintain web pages to keep the Construction Management community, and as appropriate, the wider scholarly community, aware of their activities. Whenever possible, research papers should be distributed through technical reports and web publication. When it reaches professional quality, students should actively disseminate their research results by publication in the scholarly and scientific literature and presentation at the leading research conferences.

A Construction Management program is a community in which students participate by attending seminars and talks, and by presenting their own work to the community, as appropriate. Such activities extend students' and faculty's' understanding, and prepare students for job talks, for conference presentations, and full participation in the larger research community.

As new members of a profession or discipline, doctoral students participate in creating a sense of community through service to the School and beyond by, for example, serving on Committees, giving feedback to other students about their work, and helping coordinate Construction Management events.

Mentoring and apprenticeship is at the heart of the Construction Management Ph.D. learning process. Each student shall meet regularly with his or her academic Advisor. Weekly meetings with the Advisor are possible, and often typical.

Students should be involved in the world of research from the day they enter the Construction Management Program, and the admissions process should center on the quality and focus of an applicant's research interests. The life of the researcher is a continuous process of seeking new ideas, finishing tangible research products, and presenting them to others. Of course, these results should vary depending on the student's interests and stage of preparation.

Research is largely a collaborative process. Students are expected to actively engage in collaboration with faculty and fellow students, and to develop collaborative skills. All students of the Construction Management Ph.D. program are expected to maintain the highest standards of intellectual integrity and ethics. This includes respect for other researchers, full intellectual honesty in reporting on one's own work, correctly citing prior work, adhering to appropriate standards for research, presenting information on published experimental results, and avoiding conflict of interest or the appearance of conflict of interest.

Competencies

The mastery of a set of skills and competencies needed for success in Construction Management disciplines should be required. Normally students should develop the following vital skills through coursework and industry experience.

- The ability to design and implement research projects, including gathering, analyzing, and interpreting qualitative and quantitative data, including statistical data.
- The ability to clearly express oneself in scholarly, professional or scientific publications and in oral presentations.
- The ability to critically read and assess research.
- The ability to use and program computers at a level necessary for academic success.
- A program should take these competencies seriously, and, as discussed below, students are required to demonstrate this competency requirement as part of the Preliminary Exam process.

The Advisor and the Advisory Committee

On entering the program, each student should be assigned a temporary faculty Advisor. The Graduate Advisor reviews the breadth and disciplinary composition of the student's program of study. The Advisor should help the student design his or her coursework, and certify that the student has mastered the core set of competencies outlined above. Within the first two years, the student should choose a permanent faculty Advisor.

Monitoring Student Progress

Guidance by the Advisor is intended to provide students with feedback and expertise necessary for making normal progress towards the Ph.D. degree. Each semester/quarter, each student should prepare a statement describing his or her program and its direction, accomplishments for the current semester/quarter, and goals for the coming semester/quarter. The Advisor should review these reports, discuss students' progress with the student, and prepare a letter for each student reporting on what the faculty sees as the significance of the student's accomplishments and goals.

If a student is not making satisfactory progress, the Advisor should make specific recommendations to help the student return to good standing as part of the semiannual review. The quantitative standards should be:

- A 3.5 cumulative grade point average across all Graduate courses taken.
- Construction Management courses must be taken for credit with a cumulative 3.5 GPA in all Construction Management courses.
- Students may not accumulate more than one incomplete at a time, other than for reasons of illness or emergency (requiring written notification of the Graduate Advisor).

The student's Advisor should define qualitative standards such as "normal progress towards the degree," in writing each semester/quarter. The normative goal of the program is that students should complete the preliminary exam requirement in 8 semesters/12 quarters, and the Ph.D. dissertation in 12 semesters/18 quarters.

Failure to make normal progress towards the degree, as measured by these standards and processes, would result in a request to the Graduate Division that the student be placed on probation. The probation letter would state specific requirements that must be met for the student to return to good standing, and a reasonable timetable for meeting these requirements. Failure to meet these requirements in due time should result in dismissal from the program.

Coursework and the Preliminary Exam

In the first years of coursework, students gain a broad background in Construction Management, and then acquire an in-depth understanding of one Major and two Minor disciplines or research areas. The following principles and structures frame an educational process that meets most students' needs most of the time. In practice, these principles should be flexible, and most rules may be waived with the approval of the student's Advisor and interested faculty.

Because Construction Management is an inherently interdisciplinary field, the appropriate program for any one student needs to be worked out with his or her Advisor. Some fields, for example, are more structured, and a sequence of courses can be defined. Other fields are inherently less structured, and the student should be encouraged to draw on a wide range of faculty and campus resources within and outside of the Construction Management program. However, in the interests of equity and clarity, this paper presents the general outline of a likely

program that would challenge a student and result in reasonable progress toward the Ph.D. degree. Each student should actively work with his or her Advisor to develop the set of courses that should prepare him or her in both the broad area of Construction Management and their proposed Major and Minor specialties. Each student is strongly advised to consult with his or her Advisor as early as possible to start the process of planning his or her customized course curriculum.

In order to gain a broad foundation in Construction Management as well as detailed background knowledge sufficient to prepare the student to do research and master the competencies described above, each new student should:

- Enroll in required core Construction Management courses;
- Take the one of the continuing research seminars in the School closest to their research interests; and,
- Work with their Advisor to identify and take a set of advanced courses tailored to their interests from the Construction Management program and other departments on campus.

To gain a broad foundation in Construction Management, students who do not already have a Construction Management master's degree should take the core Construction Management courses. Ph.D. students are expected in their first semester/quarter to enroll in a continuing research seminar in the School closest to their research interests, and attend one of the continuing research seminars each semester/quarter. This requirement may be fulfilled by a research seminar in another department, with the approval of the student's Advisor, but students are still expected to actively participate in the intellectual activities of the Construction Management Program.

Mastery of three subject areas is required for the Preliminary Exam. The preparation is usually done by means of coursework in three areas, one Major and two Minor subject areas that draw upon, or is embedded within, many other disciplines and professions. Depending upon the student's focus, the process of specialization should normally require a mastery of at least one affiliated discipline. This subject area should develop the foundation for a possible dissertation research topic.

The Major subject area requires a coherent program of at least 12 semester/18 quarter units of graduate courses or the equivalent, with a GPA of 3.5 or better (Most students should take considerably more than 12 units in the Major area).

Each Minor subject area is usually composed of at least 6 semester/9 quarter units. Each Minor subject area must have an orientation different from the Major program, and the courses in the Minor must primarily contain material that does not overlap with the Major program. The student should maintain a minimum GPA of 3.0 in Minor fields, and only courses completed with a grade of B or above can count towards the course requirement.

Certification of the Competency Requirement

Usually students should acquire the competencies through coursework. Each student should confer with his or her Advisor about how to demonstrate mastery. The student's Advisor should certify that he or she has gained the core set of skills discussed above. However, if the Advisor is uncertain about the student's skills in any of these areas, it has the option to impose additional requirements or exams. Students may request a review of such decisions by the Head Graduate Program Coordinator or Department Chair.

Written Summary Report and Synthesis of Coursework

As part of the transition from coursework to the Dissertation, each student should prepare a written summary and synthesis of his or her work up to this point. The purpose of this is to give the Advisor an overview of the student's work, and to allow the student to reflect upon and synthesize his or her work up to this point. This is neither a Dissertation Proposal (see below) nor a comprehensive review of the literature (although it should contain references to the literature).

Upper division undergraduate courses may not count towards the Minor unit requirement, although they may be required as prerequisites. It is, rather, the student's analytical and synthetic reflections on how his or her work ties together, the nature and shape of the Major and Minor fields, how the fields fit together, and the important research issues. It should not duplicate the Dissertation Proposal, though it may serve as a prolegomenon to it. The Advisor may waive this requirement if it is satisfied that coursework has been well structured and the student's understanding of the field is well integrated.

This requirement reflects that students have the option to take a highly structured sequence of coursework that is designed to be cumulative, or to invent an interdisciplinary field consisting of courses without a cumulative content.

The Preliminary Exam

The intent of the Preliminary Exam is to ascertain the breadth of a student's knowledge and preparation. Three fields are considered necessary for that breadth. The student should be able to exhibit knowledge and understanding of the fundamental facts and principles inherent in his or her fields of study. The exam also enables the faculty to assess students' preparedness for a research career. The faculty examiners should look for evidence that students have the ability to think incisively and critically about both the theoretical and practical aspects of the field. In Construction Management, students are expected to present the topic for the Dissertation as part of the Preliminary Exam and answer questions about how they should pursue the research necessary to develop the selected topic.

A typical Preliminary Exam lasts approximately three hours. Usually, the student takes the Preliminary Exam within one semester/quarter of having completed the requirements. If the

student does not pass, the exam may be retaken one time. A student must be registered to take the Preliminary Examination.

The Preliminary Exam Committee

The Preliminary Exam Committee consists of four faculty members. At least two must be from the Construction Management program; at least one must be from another department, and up to two may be from another department. The chair and the designated outside member must be members of the Graduate Faculty.

The Dissertation Proposal

As part of the Preliminary Exam, the student prepares a Dissertation Proposal describing a plan for research that should be a significant original research contribution to the field of Construction Management. The written Dissertation Proposal normally includes:

- A concise problem statement that summarizes the central thesis.
- A motivation for the problem.
- A description of previous research in the area.
- A description of the relevance of preparatory coursework in the area.
- A summary of the course work done towards the Dissertation.
- A statement of how the student should attempt to investigate or support the thesis.
- A timetable for the student's Dissertation work, and (normally) a list of deliverables.

Summary of the Preliminary Exam Requirements

1. Meet the Graduate Division's eligibility requirements
2. Meet the Construction Management eligibility requirements
3. Form a Preliminary Exam Committee
4. Complete Dissertation Proposal
5. Pass the Preliminary Exam
6. The university regulations concerning the oral Preliminary Exam can be found in the *Graduate Advisor's Handbook*.

The Dissertation Committee

Shortly after passing the Preliminary Exam, the student forms a Dissertation Committee. The student's Ph.D. Advisor usually chairs the Committee. The Dissertation Committee will evaluate the Dissertation Proposal, and review and approve the final Dissertation. The Committee must include at least two regular Construction Management faculty members and one Graduate Faculty member from another department on campus.

The Dissertation Proposal

After passing the Preliminary Exam, the student completes (with any needed revisions) the Dissertation Proposal. After the Dissertation Committee approves the proposal, and no later than the end of the semester/quarter following the one in which the Dissertation Proposal is approved, the student files an Application for Advancement to Candidacy. In approving this Application, the Head Graduate Advisor approves the Dissertation Committee as well.

Residency

Students must have been in academic residence for at least four semester/six quarters to qualify for a Ph.D. In order for a semester/quarter to count as academic residence, a student must enroll for at least four semester/six quarter units of graduate-level courses (These 4/6 units do not necessarily satisfy the requirements for full-time study.).

The graduate division requires that students be registered during the semester/quarter in which the preliminary exam is taken. Construction Management also requires that students be registered in the semester/quarter in which the dissertation is approved in order to present his or her findings to the scholarly community. This second semester/quarter requirement may be waived if the student presents good reasons why residence would be difficult, with the concurrence of the student's Advisor and the Head Graduate Advisor.

The Ph.D. Advisor must be a member of the Graduate Faculty. The chair may be a faculty member outside of Construction Management, upon the approval of the Dean of the Graduate Division, but in such cases, a regular Construction Management faculty member should serve as a co-Advisor.

If the student's Advisor leaves the university after the student has begun the Dissertation requirements, the student should consult with the Ph.D. Committee as to what course of action to follow. In some cases, the student and the Committee may decide to pick a new Advisor; in other cases, the student and the Committee may decide to keep the student's original Advisor while choosing a regular Construction Management faculty member to co-advise.

The Ph.D. Dissertation

After receiving approval of the Dissertation Proposal, the student continues the Dissertation research and writing. During this period, the student should meet regularly with his or her Dissertation Chair and report regularly to the Dissertation Committee. Each semester/quarter, the student prepares a summary of progress, supported by copies of any writing that he or she may have done.

In accord with the standards of his or her specialization, the student is expected to publish the Dissertation and Major results of the Dissertation research. The Ph.D. Dissertation represents the

cumulative accomplishment of the Ph.D. process. The Ph.D. Dissertation must be an original and significant contribution to research. Results from Ph.D. Dissertations are published (except in extremely rare or exceptional circumstances).

To share new knowledge with colleagues and prepare for job interviews, Ph.D. students present the principal results of their Dissertation research and take questions and challenges from the community on the Dissertation work. The Dissertation Committee and other faculty members and students from the university community, both inside and outside Construction Management usually attend. This presentation informs the university community about the research that takes place in the Construction Management program and provides the student with valuable preparation for other research presentations (including job interviews). This presentation generally takes place in the last semester/quarter in residence or in the semester/quarter in which the Dissertation is filed. It should be scheduled so that as many interested people as possible can attend.

When the Dissertation is completed, it must be approved and signed by all the members of the Ph.D. Committee. Upon successful completion of the Dissertation and all prior requirements, the student should be awarded the Ph.D.

Summary of Requirements

Most students should complete the course requirements in about two years. After completing these requirements, a student who does not already possess a Construction Management degree may petition for a master's degree, and for permission to take the oral Preliminary Exam. The Construction Management degree requires that the student complete: (a) a program of 28 semester/42 quarter units of course credit, approved by the faculty, with an average grade of B or higher; and (b) a Thesis/Project approved under conditions designated by the faculty. However, because the program may be highly customized for each student, it is not possible to define a blanket timetable requirement other than the normative guideline described above. Thus, the student's Advisor should decide whether he or she is making adequate progress towards the degree, and communicate specific requirements and recommendations in writing each semester/quarter.

If the student has demonstrated sufficient mastery of the field, the student's faculty Advisor (in consultation with all interested faculties) should grant permission for the student to proceed to the oral Preliminary Exam. If the student has not demonstrated sufficient mastery of the field, the Committee may award the student a Construction Management degree, but not grant permission to take the oral Preliminary Exam or to complete the Ph.D. program.

Summary of the procedure for meeting the requirements once the coursework requirements have been fulfilled are:

1. Form the Dissertation Committee.
2. Complete the Dissertation Proposal.
3. Defend the Dissertation Proposal in an Oral Examination.

4. Have Dissertation Proposal approved by Dissertation Committee.
5. Complete and have the application for advancement to candidacy approved.
6. Meet the residency requirement.
7. Complete the Dissertation.
8. When required, make in public an oral defense of the Dissertation results.
9. Receive sign-off by all Dissertation Committee members.

The Ph.D. Dissertation represents the cumulative accomplishment of the Ph.D. process. The Ph.D. Dissertation must be an original and significant contribution to research. A Ph.D. program in Construction Management requires a mastery of academics and practice in the broad area of Management and Science. It involves in-depth knowledge of specific areas of construction that involve skills in problem solving and the analysis of information; and the capacity to make original contributions to the field.

What has been outlined in this paper corresponds to a layered model of graduate studies where students begin by developing a broad base of knowledge, and, building on that, progressively deeper understanding and skill in fields of increasing specialization. While a Ph.D. in Construction Management offers a structured curriculum to develop research capabilities and skills, the program is also flexible, in recognition that each individual student's program should be unique.