

Hazards, Risk, and Resilience Preliminary Exam Procedures

The purpose of this document is to outline the standard operating procedure for the Civil Engineering PhD Preliminary Exam for students specializing in Hazards, Risk, and Resilience. Presently, the faculty who administrate this program are:

- Jeremy Bricker, jeremydb@umich.edu
- Estéfan Garcia, fegarcia@umich.edu
- Seth Guikema, sguikema@umich.edu
- Sabine Loos, sloos@umich.edu
- Seymour Spence, smjs@umich.edu

Overview. The preliminary exam is a two-part examination to test a student's potential to be successful as a Ph.D. student. The preliminary exam has the following objectives:

1. Assess the ability of the student to propose an interesting problem relevant to hazards, risk, and resilience for Ph.D. research;
2. Assess the student's understanding the breadth of knowledge in the proposed area of research, and the ability to identify knowledge gaps;
3. Test the student's grasp of appropriate methods to assess the research question(s) or hypothesis(es) that they pose for the research problem being evaluated; and
4. Evaluate written and oral communication skills, quality of presentation, and the ability to respond to questions.

Exams are held biannually, typically in the first week of January and the second and third weeks of May. The preliminary exam is an oral exam lasting for 90-minutes that includes a 20-minute slide presentation of a short research proposal. The research proposal must be submitted two weeks before the exam. The presentation is followed by a question-and-answer session with three or more faculty members, one of whom is the student's dissertation advisor. At the conclusion of the question-and-answer session, the student will be excused, and the faculty committee members will deliberate and vote on the outcome of the exam.

Eligibility. Students should register for the exam when they judge themselves to be ready to take the exam and after consultation with their dissertation advisors. Students should understand there is an assumption that they will be familiar with the content of the core graduate courses in the Hazards, Risk, and Resilience program (listed starting on page 6 of this document), whether these courses were taken by the student at the University of Michigan or as equivalent courses elsewhere. Students should also expect a free-ranging discussion to ensue during the question-and-answer period with the exam committee, with follow-up questions that may be posed to evaluate the student's understanding of natural hazards, risk, and resilience related to

the student's research proposal. Faculty members for their committee will be drawn from the entire Hazards, Risk, and Resilience group and Civil and Environmental Engineering (CEE) more broadly as appropriate, and not just from the faculty most closely aligned to their proposed research areas. Therefore, Students should prepare their proposals and exam presentations for an audience of CEE faculty who are not specialists in their intended dissertation research area.

Registration and Preparation. Eligible students must register their intent to take the preliminary exam to the CEE department's Student Services Office. The online registration form is announced to students via email in the first two weeks of each Fall and Winter term. The deadline to register is the last day of September for the January prelim exam, and the last day of January for the May prelim exam. Student attendance at a prelim exam information session hosted by the hazards, risk, and resilience specialization Director in October (for January prelims) or February (for May prelims) is also mandatory if this is offered. A full timeline of important dates is included on the next page.

At least two weeks before the scheduled exam date, students are responsible for submitting an electronic document to the Student Services Office with the following:

1. A two-page biosketch using an amended version of the standard NSF format. A template for the biosketch is appended to this document on page 12.
2. A research proposal that includes the following elements:
 - a. the purpose and significance of the research;
 - b. key-related research, summarized from a review of relevant literature, with identified knowledge gaps;
 - c. a research question or hypothesis to be investigated;
 - d. a proposed research methodology;
 - e. an explanation of how the proposed research is relevant to the field of natural hazards, risk, and resilience; and
 - f. a timeline, or Gantt chart, of proposed tasks.

The research proposal should be formatted in 11-point Arial or Times New Roman font, with single spacing, one-inch margins on all sides, and a **length of five pages**, not including figures, citations, or bibliography.

The research proposal should be original work prepared by the student following their arrival at UM. The student may develop the topic of the proposal in consultation with their advisor, but the work should be substantially their own. At the information session, the student should state what their intended proposal topic will be (i.e., a working title for their proposal), and certify that their topic is original and has not been appropriated from a prior proposal submission of their own, or of another member of their advisor's research group. Students should consult the hazards, risk, and

resilience specialization Director with any questions regarding the suitability of their research proposal topic.

Schedule. The schedule for students to complete the requirements for preliminary exams to be taken in January and May, and for faculty to administer the exams during those same periods, is shown in the table below.

Student action (deadline)	January prelim exam	May prelim exam
Student registers for exam	September 30	January 31
Student attends prelim exam information session and submits working title for preliminary proposal	October 16-31 (TBD)	February 15-28 (TBD)
Student submits research proposal and biosketch	December 15	April 15
Student presentation and Q&A with exam committee	January 3-7 (TBD) ** subject to Rackham candidacy deadline **	May 8-21 (TBD)
Student notified of exam outcome	Within three days after exam was taken	Within three days after exam was taken
Faculty action (deadline)	January prelim exam	May prelim exam
Hazards, risk, and resilience specialization Director hosts information session and confirms suitability of students' proposal topics	October 16-31 (TBD)	February 15-28 (TBD)
Hazards, risk, and resilience specialization Director presents draft committee assignments to faculty at Hazards, risk, and resilience specialization group meeting	November 1-15	March 1-15
Faculty confirm participation as prelim examiners	November 30	March 31
Faculty examiners review submitted research proposals	December 16 – January 2	April 16 - May 7
Faculty examiners attend prelim exams and evaluate students	January 3-7 (TBD) ** subject to Rackham candidacy deadline **	May 8-21 (TBD)

Faculty examiners report outcomes to Graduate Chair and Student Services Office	Within three days after exam was taken	Within three days after exam was taken
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Examiners. Three or more faculty members are selected by the Hazards, Risk, and Resilience specialization Director, in consultation with the Hazards, Risk, and Resilience specialization faculty, to act as examiners for each student. These three faculty members, including the student’s dissertation advisor, will serve as the student’s prelim exam committee.

Eligible examiners are any CEE faculty holding at least a 25% CEE appointment. This includes tenure-system faculty (i.e., tenured and tenure-track), professors of practice, and research professors and lecturers of any rank. CEE faculty are expected to equally serve on committees regardless of appointment fraction, except when on sabbatical.

The Student Services Office will notify students whom their faculty examiners will be in the month before the scheduled exam. *There is an expectation that any CEE faculty member can serve as an examiner on the committee of Hazards, Risk, and Resilience Ph.D. student. Students should prepare their research proposals and their slide deck presentations with this expectation in mind. Students should be prepared to explain their research proposal at a level that any CEE faculty member can follow, including faculty who are outside of the student’s anticipated area of research specialization.*

It is expected, and strongly encouraged, that most preliminary examinations will be attended by all participants in-person, with the student and the faculty examiners meeting in a GGB or EWRE conference room for the student’s presentation and oral examination. However, accommodation will be made for remote participation if any of the faculty examiners, or the student, is unable to attend the exam in-person, due to scheduling constraints or other unavoidable circumstances.

Grading. Students are evaluated on a four-point scale ranging from strongly agree (4) to strongly disagree (0) in each of the following areas:

1. Student is well versed in the proposed area of study and its knowledge gaps.
2. Student has made a convincing argument for the importance of the research.
3. Student has proposed a sound methodology for conduct of the research.
4. Student has prepared a high-quality proposal and presentation to committee.
5. Student has good communication skills and effectively answers questions.

A grading rubric for faculty examiners is appended to this document. The scores of the three faculty examiners (excluding the student’s advisor) are summed and averaged to yield a score ranging from 0 to 20. A score of 15 or higher is generally

considered a passing grade for the student to immediately advance to Ph.D. candidacy. After discussion of the student's exam performance among the prelim committee members, the faculty examiners will vote on whether the outcome is pass or fail, with the majority vote prevailing. These three examiners will produce a written report to the CEE Graduate Chair (with copy to the CEE Student Services Office), indicating if the student has passed or failed the preliminary exam, with specific reasons for the decision and feedback to be shared with the examinee.

Communication of Results. The student's dissertation advisor will inform the student of the prelim outcome immediately following the exam. The Student Services Office will subsequently email the exam result, with the committee's feedback, to the student, copying the student's advisor, the Hazards, Risk, and Resilience specialization Director, and the CEE Graduate Chair.

Retaking the Prelim. If the student fails the exam, one retake is permitted. Students must re-register within the aforementioned deadlines for a future available exam date with a different group of faculty examiners; i.e., there is no requirement that the same group of examiners be seated for the exam retake. The student may prepare and present a research proposal that is substantively similar to the previous submission. However, it is strongly recommended that the student carefully consider the feedback provided from the faculty committee that was seated for the student's prior exam and address all concerns that were identified that prevented the student from advancing to candidacy on the first attempt.

Hazards, Risk, and Resilience Core Subjects

A recommended list of topics is presented below for examinees to review, in preparation for a preliminary examination on a research proposal presented by the student that is thematically aligned with one or more the following program subjects.

Disaster Loss Modeling

(expectation for typical courses taken: CEE 501)

- Knowledge of the disaster risk modeling framework, including hazard, exposure, and physical vulnerability
- Knowledge of hazard simulation
- Knowledge of exposure assessment
- Knowledge of fragility curve development
- Knowledge of vulnerability curve development
- Knowledge of damage, financial loss, and fatality estimation
- Knowledge of the interaction between loss modeling and social vulnerability
- Knowledge of alternative metrics of loss, including recovery, access, welfare

Risk Analysis

(expectation: IOE 561/ISD 523)

- Knowledge of risk perception and factors influence risk perception
- Knowledge of risk and resilience conceptualizations and definitions
- Knowledge of Bayesian probability and Bayesian updating
- Knowledge of event trees and decision trees
- Knowledge of fault trees and external events in fault trees
- Knowledge of schedule and budget risk estimation and management
- Knowledge of infrastructure risk analysis methods
- Knowledge of terrorism risk analysis methods, particularly game theoretic methods and concepts
- Knowledge of risk governance approaches and concepts.

Machine Learning, Probability, and Statistics

(expectation: CEE 554)

- Knowledge of probability theory and its application in hazard modeling and risk and resilience analysis
- Knowledge of parameter estimation methods for fitting distributions with data
- Knowledge of machine learning methods, including at least spline-based, tree-based, neural-network-based methods, ensembling, boosting, and bagging
- Knowledge of holdout validation testing and regularization
- Knowledge of ethical and bias issued in statistical and machine learning methods

Spatial Analytics

(expectation: CEE 501)

- Knowledge of Geographic Information Systems (GIS) and their use for analyzing and integrating spatial data
- Knowledge of spatial autocorrelation, variogram analysis, and spatial hotspot identification
- Knowledge of hierarchical and multiscale modeling and their application to spatial analysis
- Knowledge of spatial regression models and spatial machine learning models

Social Vulnerability

(expectation: SEAS 567)

- Knowledge of social vulnerability and adaptation and their different dimensions
- Knowledge of and ability to compare and contrast perspectives on vulnerability and adaptation
- Knowledge of needs, challenges, and opportunities for reducing vulnerability and increasing adaptation
- Knowledge of and ability to design vulnerability assessments and adaptation plans
- Knowledge of the literature on social vulnerability and its use in hazard assessment
- Knowledge of methods to quantify vulnerability including index-based approaches

Evaluation Category	Score	Comments
<p>Research Context: Student understands the state of the art – what is known and not known – and has identified a need for original knowledge to be developed.</p>	<p>4 – strongly agree</p> <p>3 – somewhat agree</p> <p>2 – neither agree nor disagree</p> <p>1 – somewhat disagree</p> <p>0 - strongly disagree</p>	
<p>Research Significance: Student has convincingly explained why the research is important, and how it is related to the environmental engineering discipline.</p>	<p>4 – strongly agree</p> <p>3 – somewhat agree</p> <p>2 – neither agree nor disagree</p> <p>1 – somewhat disagree</p> <p>0 - strongly disagree</p>	
<p>Research Methodology: Student has stated a hypothesis, outlined a research approach, and indicated how the environmental engineering body of knowledge applies to the research problem.</p>	<p>4 – strongly agree</p> <p>3 – somewhat agree</p> <p>2 – neither agree nor disagree</p> <p>1 – somewhat disagree</p> <p>0 - strongly disagree</p>	
<p>Presentation: Student has crafted a well-organized proposal and slide deck, with polished content and thoughtfully chosen</p>	<p>4 – strongly agree</p> <p>3 – somewhat agree</p>	

visuals to aid in following the presentation.	2 – neither agree nor disagree 1 – somewhat disagree 0 - strongly disagree	
Communication: Student demonstrates effective written and oral communication skills, and is able to acknowledge and answer questions insightfully.	4 – strongly agree 3 – somewhat agree 2 – neither agree nor disagree 1 – somewhat disagree 0 - strongly disagree	

Biosketch Template: Insert Name Here

Maximum of two pages. Use size 11 or 12 font throughout using one of the following typefaces: Arial, Courier New, Palatino Linotype, Times New Roman, or Computer Modern. Margins on all sides must be at least one inch. Remove all instructions in blue text prior to submission.

a. Professional Preparation. (listed in chronological order)

Institution, Major, Degree, Year

b. Professional and Research Positions. (listed in reverse chronological order)

c. Publications.

PUBLICATIONS AUTHORED / CO-AUTHORED BY EXAMINEE (if applicable)

List up to 5 publications most closely related to the proposed project. Each publication identified must include the names of all authors, in the same sequence that they appear in the publication; the article title; journal name or book title; volume number; page range; and year of publication. If the document is available electronically, the website address also should be identified.

PUBLICATIONS RELATED TO PRELIMINARY EXAM NOT AUTHORED BY EXAMINEE

Use the same formatting guidelines as above. List up to 5 publications related to the research proposal to be presented by the student.

d. Synergistic activities.

Enter up to five activities that relate to furthering your skills as a graduate researcher and scholar. One of the activities can be a list of courses taken at the current and/or prior institutions that are relevant to the knowledge base and methodologies for the proposed research.

e. Collaborators and other affiliations.

1. Collaborators. List all persons in alphabetical order, including their current organizational affiliations, who are currently, or who have been collaborators or co-authors with the student, on a project, book, article, report, abstract, or paper during the 48 months preceding the submission of the proposal. Also include those individuals who are currently or have been co-editors of a journal, compendium, or conference proceedings during the 24 months preceding the submission of the proposal. If there are no collaborators or co-editors to report, this should be so indicated.

2. Graduate advisor. Name(s) of student's graduate advisor(s) and departmental affiliation(s).