

Final Project Guidelines

Probabilistic Analysis of a Structure

SUMMARY:

This document is intended to provide guidelines for your final project in the Decision and Risk Analysis class. The topic of the project is a full probabilistic analysis of a structure. You are asked to evaluate the probability of failure of a structure of your choice, and identify the possible failure modes.

If you would like to work on something other than this, you can discuss alternative ideas with the Professor and the mentor. Any idea is welcome provided that you use material from the class.

1. GUIDELINES

This is the list of steps to follow to perform a full probabilistic analysis of a structure:

1. *Select the structure of interest:* You can select any structure of your choice (e.g., building or bridge). Make sure you include a detailed description of the selected structure in your report and explain the reasons that led you to your selection.
2. *Identify the components of the structure and how they interact with each other:* Find the trusses, beams and frames that make up your structure. Floor plans and technical drawings can help you for this step. Come up with a simplified skeleton that is a good approximation for your structure. How do the different components interact with each other?
3. *Identify the loads on the structure:* What types of loads will be acting on the structure? Estimate the dead loads from the self weight of structural members and fixtures that are permanently attached. Estimate the live load resulting from the occupancy of the structure. How can you model these loads on your elements (e.g., point, distributed)? You can also consider additional types of loads (e.g., snow loads, earthquake loads).
4. *Identify the associated uncertainties:* What are the quantities in your problem that are characterized by uncertainties? Uncertainties can be found both in the capacity of your structure (e.g., material and geometric properties of the components) and in the demand (e.g., variability in the load). Find a suitable way to model these uncertainties (i.e., identify proper distribution for the random variables in your problem).
5. *Obtain the probability of failure of the structure:* Perform a fragility analysis of your structure using the material seen in class. Obtain a fragility curve and identify which components are most likely to fail.
6. *Discuss your results/provide insight:* Discuss the results that you have obtained in Step 5. If you want, you can investigate scenarios that would provide additional insight. For example, what are the expected losses associated with the failure of your structure? What kind of preventive measures can you take to reduce the probability of failure and/or the losses?

2. PROJECT DELIVERABLES

Week 2: Structure layout (Deliverable: Brief report)

- Identify the components of the structure
- Draw a simplified skeleton of the structure
- Identify the connections among elements (boundary conditions)

Week 3: Loads (Deliverable: Brief report)

- Identify dead loads and live loads for your structure
- Identify additional loads, if any (e.g., snow, earthquake)
- Draw the free body diagrams of components
- Identify how the load is transmitted among elements

Week 4: Uncertainties (Deliverable: Brief report)

- Assess the variability in material and geometric properties
- Assess the variability in the loads
- List the assumed random variables and associated distributions

Week 5 - Lecture: First presentation (Deliverable: Powerpoint presentation)

- Summarize the findings of weeks 1-3

Week 5 - Mentor: Structural analysis (deterministic) results (Deliverable: Powerpoint presentation)

- Accurately describe your problem and how you performed the structural analysis of your structure
- Do the results make sense?

Week 6 - Lecture: Reliability analysis (probabilistic) results (Deliverable: Powerpoint presentation)

- Accurately describe your problem and how you performed the reliability analysis of your structure
- Do the results make sense? What else can be added?

Week 6 - Mentor: Open discussion (Deliverable: Powerpoint presentation - optional)

- Discuss any issues in preparation for the final presentation

Week 7: Final presentation (Deliverable: Final Powerpoint presentation and final report)

The brief reports are due before the start of the week's lecture (post on Ed).

Comments on the brief reports (if any) will be shared within a week of the submission deadline.

Comments on the Powerpoint presentations of Weeks 5-6 will be shared during the lecture/mentor sessions.

Project deliverables will not be graded except for the Final Powerpoint presentation and the final report.