



ES 2502 B'18– Stress Analysis Term Project

American Ninja Warrior Obstacle Design

Introduction:

American Ninja Warrior (ANW) is a television show based on the Japanese show “Sasuke” in which competitors complete obstacle courses that test their strength, agility, and endurance. For this project, you and your team will be developing, designing, analyzing, and pitching an ANW obstacle of your own with the intent to sell that obstacle to the obstacle selection committee at ANW headquarters. When designing your obstacle, you should consider the ways in which you want to test the competitor (e.g. upper body strength, lower body strength, balance, agility, other). Your obstacle does not need to incorporate all of these physical feats, but you will be highlighting your design’s features in your pitch to the obstacle selection committee. If you have not seen the show, there are lots of clips on YouTube!

Design Requirements:

The main objective of the project is to give you and your team mates the opportunity to apply the skills you are learning in ES 2502 to a real world design challenge. As such, your final design will allow you to analyze concepts taught throughout the course including axial stress, pins, torsional shear stress, and bending stresses (both normal and shear). During the earlier stages of your project you will only be able to analyze individual stresses, but, as the project progresses and you incorporate new class content, your analysis will evolve so that you are able to analyze a complex combined loading scenario (i.e. all the loads at once).

Your obstacle needs to be designed for human use. So, the geometries and loads that you choose must be reasonable in that context. These values can be based on background research or personal experimentation. All research and experimentation must be documented in your submissions. A properly formatted bibliography and in text citations should be used to document your research. Photographs should be used to document your personal experiments.

Learning Outcomes:

This project is design to meet the following course objectives:

- Apply the fundamentals required for 2D and 3D stress analysis
- Demonstrate the effects of stress distributions over cross sectional areas
- Synthesize effects of different types of loading into combined loading scenarios
- Examine the ways in which the physics you analyze on paper is manifested in the physical world
- Develop project skills including teamwork skills and communication techniques

Assignment Staging:

The project assignments will be given in 4 stages. Each stage will have its own submission. All final submission dates are listed on the syllabus. The Term Project Due Dates Outline shows both submission dates and content exchange dates.



Teams and Team Roles For Submissions:

For this project you will be in a large group of 5-6 that will be subdivided into two groups of 2-3 students. These subgroups will work together in developing a single final submission for each project submission stage. You may wish to elect a project manager on your team and rotate that position for each submission. This person would be in charge to keeping track of deadlines, organizing meetings, etc.

The Term Project Due Dates Outline (below) graphically shows the group interactions for all 4 submissions.

Submission 1: Both subgroups will independently develop a proposal design including all necessary FBDs for their design. The large group will work together to develop a final design based off of the two small group designs. One written proposal will be created based on the final combined design. It may be practical for a few members to complete the writing, so if you do not complete the writing, you will be required to edit the writing. It is not requirement that all 6 members meet to combine ideas. It will be up to you as a team to determine what works best for your timing and the equal distribution of work among team members. You may use online methods to meet as a large group, but in person meetings with at least some members from each subgroup is likely to be the most effective method when combining your design ideas.

Submission 2: For this submission, subgroup A will take the lead completing the project tasks of analyzing the normal stress due to axial loading and the shear stress due to torsion. Subgroup B will be responsible for a complete and thorough review of the analysis. In addition to submitting the final product for submission 2, the full group will submit deliverables that demonstrate:

1. the original work completed by the project lead subgroup,
2. the quality of the review and the communication of the review from the reviewing subgroup, and
3. the ways in which the review changed the original work.

Submission 3: For this submission, the “technical lead” subgroup and “reviewing” subgroup will switch from their roles taken in Submission 2. If you were on the reviewing team last time, you are now on the project lead team and vice versa.

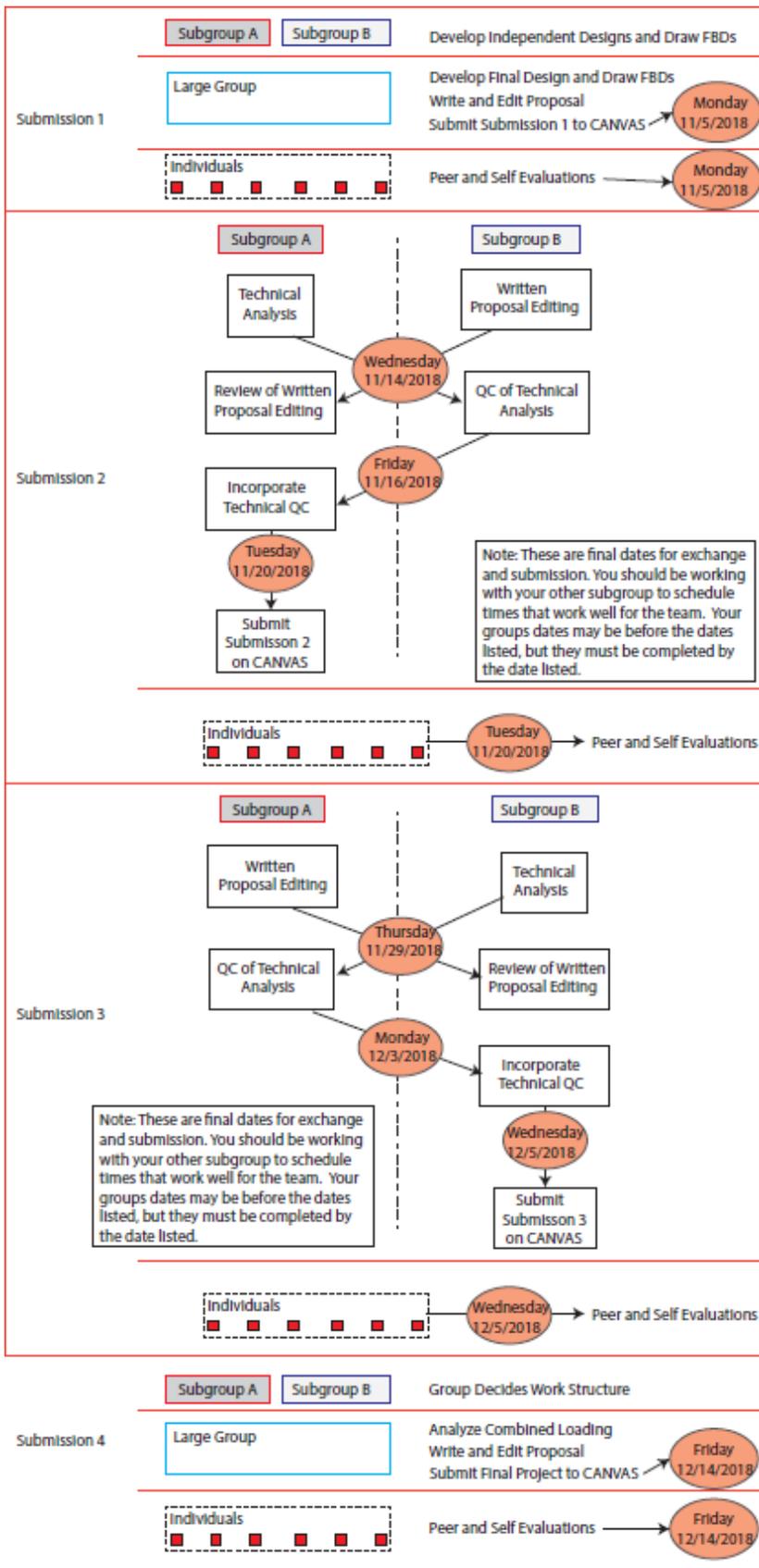
Submission 4: For the final submission, the entire large group can determine how they would like to divide the work. A written submission and poster is only required for the final synthesized project.

Peer and Self-Evaluations: For each submission, each team member must fill out the peer and self-evaluation form on CANVAS in order for the team to receive a grade for the submission. You will receive participation credit for filling out this survey (full credit for thoughtful completion). Late submissions will be accepted at partial credit.

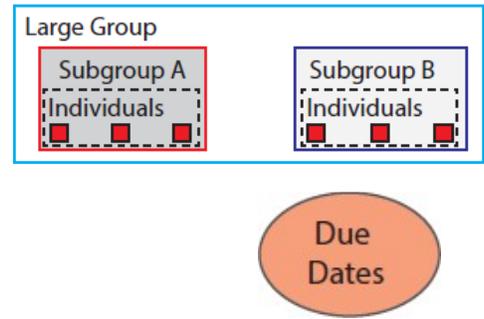
It is highly encouraged that you work with your team mates throughout the project to give them in person feedback on their performance in the group. These evaluations will be used as a way to assess each student’s individual contributions to each of the submissions.



The Term Project Due Dates Outline



Overall Team Structure



Deliverables:

The deliverables will be specified within each stage of the assignment. A template will be given to each team for each submission. There will be no template given for the final marketing poster. In general the deliverables for each submission are as follows:

- Submission 1
 - Original designs from each subgroup
 - Original FBDs from each subgroup
 - Final design and FBDs from large group
 - Written proposal from large group
 - Individual submissions of peer and self-evaluations
- Submission 2
 - Original stress analysis calculations conducted by subgroup A
 - QC review conducted by subgroup B
 - Documentation of changes to original calculations based on review
 - Final stress analysis calculations
 - Revised written proposal
 - Individual submissions of peer and self-evaluations
- Submission 3
 - Original stress analysis calculations conducted by subgroup B
 - QC review conducted by subgroup A
 - Documentation of changes to original calculations based on review
 - Final stress analysis calculations
 - Revised written proposal
 - Individual submissions of peer and self-evaluations
- Submission 4
 - Original calculations from the group
 - Final calculations from large group
 - Final written proposal from large group
 - Marketing poster
 - Individual submissions of peer and self-evaluations

Rubric:

Each stage will have a rubric provided. Be sure to use the rubric when working on your projects. These rubrics should be reviewed all team members while working on each submission.