13.42 Final Project

Spring 2005

Out: Thursday, April 14, 2005

Due: Tuesday, May 10, 2005

This year's final project is part research and part conceptual design and analysis. The project will be a group effort with groups of three students assigned randomly based on the topic you are interested in. There will be two topics to choose from: one related to ships and one related to offshore platforms. The options are similar in basic structure, but have different design considerations to be made and challenges to overcome.

Preliminary Instructions:

a) Six groups of three students will be assigned randomly.

b) There will be a choice of two project topics, where three groups will do each project topic. **Submit your preference by e-mail to Prof. Techet (ahtechet@mit.edu) and Cara LaPointe (lapointe@mit.edu) by Friday 15 April at Noon**. Final assignments will then be determined and sent out over the weekend.

c) Each topic should be researched using outside sources, such as library, internet, etc. When using on-line sources consider their origin and be sure to assess the validity of the material as best as possible – also cite internet sources in the reference section at the end of your report. The knowledge and experience gained throughout 13.42 should be used to do any required quantitative analysis for each topic to support your qualitative discussion of design optimization.

d) Parts of project: Research topic, some analytic assessment, some discussion of design optimization.

e) Each group will prepare a written report on the order of 15 pages and give a 15 minute oral presentation (using visual aid such as Powerpoint) in class on Tuesday 10 May. Expect 5-10 minutes of questions after your presentation.

Class will start at 8:30 am on that day to facilitate completing all of the presentations in one session. There will be no class Thursday May 12th.

f) There are no predetermined answers for this project. You will be graded on the thoroughness of your research, quality of your analysis, and innovativeness of your design recommendations and presentation. All team members are expected to participate in some way during the final presentation.

Topic 1: Environmental loading design criteria of offshore floating Liquid Natural Gas (LNG) terminals.

a) Research the extreme event wave loading design criteria which are used in the design of various types of offshore platforms (e.g. high sea states, hurricanes, 100 year waves, etc.). Address questions such as: What are the primary design criteria used? Who establishes these criteria (e.g. ABS (American Bureau of Shipping), offshore industry, etc)? How were these criteria developed? How often/how are they updated? How good are they?

b) Specifically looking at the 100 year wave: Explain the significance of the 100 yr wave and how it is determined? Is it different for different regions of the ocean? How many 100 yr waves have been seen in the last 40 years? Discuss the benefits/drawbacks of using it as a design criterion – possibly using an example of how it would be applied in practice. Is this a sufficient maximum loading criterion?

c) Based on existing offshore platform designs, suggest what type of platform might be appropriate for an offshore LNG terminal. (Feel free to come up with your own design, but be prepared to defend it.) Outline the basic design requirements and sketch your proposed design and use the appropriate design criteria as established in part (a) to analyze this design.

d) Consider various locations on the East Coast of the US (such as Cape Canaveral, Fl., Savannah, Ga., Hatteras, NC, Annapolis/DC area, Manhattan, NY, Boston, Ma.) and discuss why you would or would not locate an LNG terminal in these areas based on seasonal weather and sea condition considerations and practicality.

Topic 2: Nonlinear Wave-Ship Interactions and Design of High Speed Vessels

a) Research nonlinear wave-ship interaction effects including effects such as slamming, drift, and damping. Why is it challenging to analyze these interactions meaningfully using linear systems theory? What methods are used to consider such effects during the design process. Assess the state of the art for resolving such forces and non-linear ship motions.
b) For a basic ship, set up the basic governing equations of motion – considering linear forcing as well as non-linear effects discussed in part (a).
c) What tools are used to analyze these problems (e.g. what software, theories)? How do these tools "solve" problems related to non-linear forces on ships and non-linear ship motions? How are these solutions/theories typically integrated into a design process?
d) Consider at a new high speed ship design, such as a high speed ferry or a USN High Speed Vehicle (HSV). The aim of these vessels is fast transport of cargo and/or people at speeds up to or greater than 50 knots. Take one prototypical vessel, of your choosing, and use it as the basis for your discussions. What design criteria and analysis are applied to designs of this type—taking into account human factors, ship handling and structural issues given the extreme loading conditions at high speeds. Offer suggestions for possible improvements on the design if applicable. Consider both hydrodynamic forces and basic structural issues in your discussion.

For both options consider viscous and non-viscous hydrodynamic forces. Your discussions should include a combination of theoretical and physical reasoning, as well as a bit of your own engineering intuition and experience.