Teaching Innovation Projects

Volume 9 | Issue 1 | 2020

Replacing Final Exams with Open-Ended Course Projects in Engineering Education

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Recommended Citation:

Goorts, K. (2020). Replacing final exams with open-ended course projects in engineering. *Teaching Innovation Projects*, 9(1), 1-18. <https://doi.org/10.5206/tips.v9i1.10328>

ABSTRACT

Over the last twenty years, assessment methods in Engineering education have shifted to focus on evaluating desired learning outcomes. Both Mills and Treagust (2003) and Olds, Moskal, and Miller (2005) credit the paradigm shift to accreditation procedures that report program inputs and document achievement of learning objectives. High-stakes final exams have been, and still are, widely used in Engineering education as the primary means to evaluate student learning (Flores, Veiga Simão, Barros, & Pereira, 2015). Although considered objective and efficient for large class sizes, Knight (2002) points to shortcomings associated with final exams including ineffectiveness at evaluating certain types of outcomes and a distorting effect on the taught curriculum. However, overcoming these shortcomings is possible through project-based learning and open-ended course projects.

Project-based learning is a form of experiential learning that gives students the opportunity to apply theoretical concepts while developing higher-order skills (e.g., critical thinking, synthesis, and evaluation) and soft-skills (e.g., communication, management, and teamwork; Mills & Treagust, 2003). Based on three different experiences with large-scale open-ended projects, Daniels, Faulkner, and Newman (2002) conclude that the use of course projects enhances student learning while better preparing them for their future careers. Flores et al.'s (2015) findings support this notion by demonstrating that students perceive assessment methods that require active involvement as more fair and effective.

This workshop aims to increase awareness around the importance of assessment and highlight that high-stakes final exams, although widely used, have a number of flaws that may bias evaluation and impact student learning. The workshop's main goal is to introduce project-based learning as an alternative to final exams and develop skills to identify where and how instructors can use open-ended course projects effectively.

KEYWORDS

open-ended course projects; project-based learning; Engineering assessments

LEARNING OUTCOMES

By the end of this workshop, participants will be able to:

- Describe the influence of test-based assessment methods on student learning.
- Use research evidence to explain the limitations of final exams in assessing student learning.
- Recognize situations where instructors can use open-ended course projects in the place of final exams to address higher-order learning outcomes and achieve meaningful learning among students.

ANNOTATED BIBLIOGRAPHY

Daniels, M., Faulkner, X., & Newman, I. (2002). Open ended group projects, motivating students and preparing them for the 'real world'. In *Proceedings of the 15th Conference on Software Engineering Education and Training (CSEE&T)* (pp. 128-139).
<https://dx.doi.org/10.1109/CSEE.2002.995205>

By bringing together the findings from three different experiences with large scale open-ended group projects, this study suggests that open-ended group projects are a means to developing and enhancing student learning and skills while better preparing them for their future careers. The authors discuss the choices involved with designing and managing open-ended course projects as well as possible measures for success. Reflecting on their experiences, they highlight a number of benefits from a learner's perspective, as well as challenges from an implementation perspective.

The workshop uses this source when developing a definition for an open-ended group project and identifying some of the key challenges.

Flores, M. A., Veiga Simão, A. M., Barros, A., & Pereira, D. (2015). Perceptions of effectiveness, fairness, and feedback of assessment methods: A study in higher education. *Studies in Higher Education*, 40(9), 1523-1534. <https://dx.doi.org/10.1080/03075079.2014.881348>

Flores et al. investigate assessment methods in higher education with a focus on undergraduate students' perception of key issues such as effectiveness, fairness, and feedback. A study involving over 350 students found the most frequent methods of assessment include written tests, oral presentations, and project work. Furthermore, the study shows that students assessed by methods that require their active involvement view the assessment as fairer and more effective. The authors discuss the influence of assessment and how it dictates the way students spend their time and what they see as important in learning.

The workshop relies on this source to emphasize the importance of assessment and provides supporting information for the jigsaw activity on perceptions of final exams.

Knight, P. T. (2002). Summative assessment in higher education: Practices in disarray. *Studies in Higher Education*, 27(3), 275-286. <https://dx.doi.org/10.1080/03075070220000662>

This article reviews learning and assessment in higher education and distinguishes between feedout assessment systems (i.e., those used for grades and classification) and feedback assessment systems (i.e., those intended to evoke information to help further learning). With a focus on final exams, Knight identifies what is lacking from most feedback assessment systems, as well as challenges with feedout systems. Through this, Knight highlights the need for systems of formative assessment that engage students with feedback about their work in order to achieve desired learning outcomes.

The workshop refers to this source when motivating the need for alternative assessment systems and discussing the impact of assessment methods on student learning.

Liu, O. L., Frankel, L., & Roohr, K. C. (2014). Assessing critical thinking in higher education: Current state and directions for next-generation assessment. *ETS Research Report Series*, 2014(1), 1-23. <https://dx.doi.org/10.1002/ets2.12009>

Liu, Frankel, and Roohr provide comprehensive definitions of assessment and critical thinking, and highlight the challenges associated with designing assessments to evaluate critical thinking. After reviewing the common methods for assessing critical thinking, namely multiple-choice items and constructed response questions, the authors propose a new approach.

This workshop refers to this source when discussing the challenges associated with evaluating critical thinking. It supports the notion that higher-order skills such as critical thinking are essential to student learning and require innovative methods of assessment.

Mills, J. E., & Treagust, D. F. (2003). Engineering education: Is problem-based or project-based learning the answer? *Australasian Journal of Engineering Education*, 3(2), 2-16.

This source discusses how the needs of today's Engineering graduates have transformed and yet little has changed in Engineering education practices over the last 50 years. The authors highlight six critical issues within Engineering education and claim that adopting project-based or problem-based learning methods addresses most of these issues. Their findings suggest project-based or problem-based learning motivates students and they demonstrate enhanced teamwork and communication skills. Although the authors observe a reduction in the rigorous understanding of fundamentals, the students' ability to apply knowledge in practice increases.

The workshop shares effectiveness of project-based learning to motivate participants to start using open-ended course projects.

Olds, B. M., Moskal, B. M., & Miller, R. L. (2005). Assessment in engineering education: Evolution, approaches and future collaborations. *Journal of Engineering Education*, 94(1), 13-25. <https://dx.doi.org/10.1002/j.2168-9830.2005.tb00826.x>

Olds et al. investigate the current state of assessment in Engineering education in the United States. Noting the paradigm shift in accreditation from reporting programs and resources (i.e., inputs) to demonstrating the achievement of learning objectives through assessment and evaluation (i.e., outputs), the authors provide comprehensive reviews of common methodologies used in the evaluation of Engineering courses. In addition, the authors also discuss less common methods that are likely to prove useful.

The workshop uses this source to compile a list of common assessment methodologies in Engineering education.

ADDITIONAL REFERENCES

- Brown, S., & Glasner, A. (1999). *Assessment matters in higher education: Choosing and using diverse approaches*. Buckingham, UK: SRHE and Open University Press.
- Falchikov, N. (2005). *Improving assessment through student involvement: Practical solutions for aiding learning in higher and further education*. New York, NY: RoutledgeFalmer.
- Hulls, C., Rennick, C., Bedi, S., Robinson, M., & Melek, W. (2015). The use of an open-ended project to improve the student experience in first year programming. *Proceedings of the Canadian Engineering Education Association Conference (CEEAA)*. McMaster University, Hamilton, ON.
- Martinez-Rodrigo, F., Herrero-De Lucas, L. C., de Pablo, S., & Rey-Boue, A. B. (2017). Using PBL to improve educational outcomes and student satisfaction in the teaching of DC/DC and DC/AC converters. *IEEE Transactions on Education*, 60(3), 229-237.
<https://dx.doi.org/10.1109/TE.2016.2643623>
- Smith, G. (2007). How does student performance on formative assessments relate to learning assessed by exams? *Journal of College Science Teaching*, 36(7), 28-34.
- Wankat, P. C., & Oreovicz, F. S. (2015). *Teaching engineering (2nd ed.)*. West Lafayette, IN: Purdue University Press.

WORKSHOP CONTENT AND ORGANIZATION

DURATION (min)	SUBJECT	ACTIVITY	PURPOSE
5	Introduction and Outcomes	<p>Interactive Presentation: Open by polling the audience (by show of hands) on who has written and/or enjoyed final exams. Introduce yourself to the participants and summarize the workshop outline and key learning outcomes.</p> <p>Distribute workshop handout (Appendix A-D), which includes worksheets for the activities.</p>	To engage participants and make them aware of the workshop outline and learning outcomes.
10	Impact of Assessment	Pop Quiz: Transition into the activity with a statement about the importance of assessment. Direct participants to the quiz (Appendix B) in the handout	To illustrate the impact assessment style has on learning. The pop quiz represents how

		<p>and instruct them that they have two or three minutes to score as many points as possible. After the quiz, initiate a discussion with the participants to glean their impressions.</p> <p>Key discussion topics should include:</p> <ul style="list-style-type: none"> • Which questions were answered (i.e., did they skip the long question worth few points)? • Who actually read about Jill and her pet rabbit Jack? • How well do their grades reflect their higher order skills such as critical thinking (Q3 was targeted to assess critical thinking)? <p>Draw parallels to traditional course assessment methods where possible.</p> <p>Quiz Answers (for information only) Q1: 100 minutes Q2: 60 years old Q3: Sally with Johnny and Billy with Jane Q4: 35 apples Q5: 3 pies</p>	<p>assessment guides student learning and timed tests may not permit evaluation of particular learning skills.</p> <p>To address workshop outcome 1.</p>
10	Assessment and Learning	<p>Short Presentation: Provide the definition of assessment and discuss common assessment procedures in Engineering (Olds et al., 2005). Note the difference between assessment and evaluation, where evaluation is the process of interpreting assessment results.</p> <p>Convey the importance of assessment by referring to literature supporting the claim that assessments:</p> <ol style="list-style-type: none"> 1. Used for evaluating learning outcomes. 2. Influence/guide student learning. 	<p>To convince participants of the important role assessment plays in Engineering education. Show supporting research to motivate the need for thoughtful assessment.</p> <p>To address workshop outcome 1 and provide context for workshop outcome 2.</p>

		<p>Discuss the role of assessment in evaluating critical thinking (Liu et al., 2014). Refer to change in accreditation as a driving factor and note the common discrepancy between the assigned numeric grade and actual learning (refer back to the quiz for support).</p> <p>Discuss the impact of assessment on student learning (Flores et al., 2015; Knight, 2002). Grades motivate most students, which means they focus their time on the tasks that will help them score the highest. Students concentrate on becoming test smart, which may distort the curriculum.</p>	
20	Final Exams?	<p>Jigsaw: Introduce final exams as the most common assessment method. Note, the two main characteristics of final exams (i.e., heavily weighted and cumulative) and highlight the direct implications this method of assessment has on evaluation of learning outcomes and guiding student learning (i.e., heavy weighting means a large impact on grades and particular attention from students).</p> <p>Introduce Jigsaw activity to investigate common perceptions on final exams (Appendix C).</p> <p>Create up to 4 groups (i.e., student, instructor, institution, industry) and prompt discussion regarding perceptions on final exams. Discuss within group and then form new groups with at least one member from each original group to share perspectives. The facilitator should mingle throughout and create a summary list.</p>	<p>To identify perceptions on final exams from various stakeholder perspectives.</p> <p>To understand the main advantages and key limitations associated with traditional final exams.</p> <p>To address workshop outcome 2.</p>

		<p>Discussion Prompts (included in handout):</p> <ul style="list-style-type: none"> • I like/dread final exams because... • For evaluating learning, final exams are... • Compared to other methods, final exams ... 	
20	Introduction to Course Projects	<p>Interactive Presentation: Identify six critical issues with current education system (Mills & Treagust, 2003). Frame these issues within context of final exams:</p> <ol style="list-style-type: none"> 1. Preparing for final exams does not develop necessary skills (i.e., critical thinking). 2. Focusing on content and fundamental knowledge as tested by exams overlooks application and design ability. <p>Introduce project-based learning and discuss how this method addresses most of the issues. Summarize the benefits of the project-based approach in the context of learning and assessment (Daniels et al., 2002).</p> <p>Brainstorm in a large group the challenges with open-ended group projects (focus on projects used in place of final exams) and list them on the board.</p> <p>Present two recent successful implementations and summarize key tips for successful projects. Possible examples include Hulls et al. (2015) and Martinez-Rodrigo et al. (2017).</p>	<p>To introduce course projects as an active learning strategy and method of evaluation.</p> <p>To provide theory on advantages and highlight key issues with implementation.</p> <p>To provide tips on effective implementation techniques and highlight successful examples.</p> <p>To address workshop outcome 3.</p>
15	Evaluating Course Projects	<p>Think-Pair-Share: Direct participants to two sample course project outlines (Appendix D) and have them identify features that will likely work well and</p>	<p>To apply theory and analyze different course projects.</p>

		others that may cause concern. Provide the participants time to think individually, discuss results with a neighbour, and finally share as group.	Practice identifying key aspects of successful course projects. To address workshop outcome 3.
10	Summary and Conclusion	<p>Interactive Presentation: Reiterate how the kind of assessment can influence student learning, recap shortcomings of final exams, and highlight key benefits for using course projects in place of final exams from both a student and instructor perspective.</p> <p>Frame key learning outcomes as questions and consider leveraging an online polling software to measure participants learning and identify areas to expand upon.</p>	<p>To recap the importance of assessment methods and their impact on learning. Compare and contrast the use of course projects in place of final exams.</p> <p>To measure learning towards all three learning outcomes.</p>
Total Time: 90 minutes			

PRESENTATION STRATEGIES

This workshop focuses on developing skills to identify suitable scenarios where open-ended course projects may replace of final exams to improve evaluation and promote higher-order learning. Participants achieve the key learning outcomes using a combination of interactive lectures, group activities, and discussions that rely on research studies and draw upon the participant's personal experiences and perceptions of assessment. This workshop consists of three major components: illustrating the importance of assessment type and its influence on student learning, linking perceptions of final exams to advantages and shortcomings, and introducing project-based learning as an alternative to traditional final exams. The content in this workshop focuses primarily on Engineering education; however, the concepts may be transferrable to any of the STEM fields.

Part 1: Importance of Assessment

In the first component, the facilitator can use the pop-quiz activity to demonstrate the importance of assessment. By completing this timed test, participants think about their previous experiences with writing tests/exams and can continue to reflect on them throughout the workshop. The pop-quiz provided in the handout purposefully includes questions of varying difficulty and relies on a range of assigned grade weights (as is common in many forms of assessment). This sets the stage for post-quiz discussion on topics such as which questions participants answered or skipped, and how the grades indicate learning. Following the pop-

quiz, the facilitator can present research supporting the key message and complimenting the discussion.

Part 2: Perceptions of Final Exams

After appreciating the important role assessment plays in student learning, the participants reflect on their own perceptions of high-stakes final exams through a 'jigsaw' activity. To gain a broader understanding, the facilitator divides participants into groups to represent various stakeholders (i.e., students, instructors, institution, and industry). First, the participants work in their stakeholder groups. Then, the facilitator shuffles the groups so that at least one representative of each stakeholder is present in each new group. Each stakeholder shares the perceptions with their new group members. The workshop facilitator should immerse themselves in the group discussions and generate a list on the board of recurring ideas and perceptions. Following the activity, use the group discussion to highlight the advantages and disadvantages of final exams.

Part 3: Project-based learning

The third component focuses on presenting open-ended course projects as an alternative to final exams. The facilitator provides a short presentation on project-based learning to give contextual background and highlight the advantages of course projects. To address the shortcomings, participants brainstorm as a large group some of the challenges and obstacles one might face when implementing a course project. Having identified challenges, the facilitator presents examples of successful implementations along with tips for success. This leads to the third activity, which gives participants the opportunity to apply this information by evaluating two different sample course project outlines. In this 'think-pair-share' activity, participants will review the sample outlines individually before discussing their opinions with a partner. The activity ends with a facilitator-led group discussion on the key aspects that are likely to work well and potential implementation issues.

This workshop addresses the idea of replacing final exams with open-ended course projects from a neutral lens by including advantages and disadvantages of both methods. The facilitator should support this view and acknowledge that the selection of assessment methods is highly circumstantial and depends on many factors ranging from content and learning objectives to class sizes and teaching support. Group discussion is a key part of this session and although the topics are not anticipated to be controversial, the facilitator should state that participants are free to disclose as much or as little as they are comfortable with. The facilitator should welcome questions and comments throughout the workshop and particularly at the end of each of the three components.

Preparation Notes:

- Identify and reserve a workshop space equipped with a whiteboard and projector to suit expected number of participants. An ideal number of participants is 16 to 24 for the proposed learning activities; however, the facilitator can modify activities slightly for as few as 9 participants.

- Collect two sample implementations of course projects or use Hulls et al. (2015) and Martinez-Rodrigo et al. (2017) for illustration and discussion in Part 3.
- Collect two course project descriptions (or use those provided) for the think-pair-share activity.
- Prepare a presentation that follows the content and activities. This presentation should consist of mini-presentations to cover the introduction, assessment and learning, introduction to course projects, and summary subjects. Transition slides between the mini-presentations are encouraged to introduce the pop-quiz, jigsaw, and think-pair-share activities. Prior to preparing the presentation, review the literature listed in the reference summaries, understand the content and organization table, and refer to the handout provided.
- Prepare copies of the handout for the participants.

APPENDIX A: Handout

Replacing Final Exams with Open-Ended Course Projects

Learning Outcomes:

By the end of this workshop, you will be able to:

- Describe the influence that test-based assessment methods have on student learning.
- Use research evidence to explain the limitations of final exams in assessing student learning.
- Recognize situations where instructors can use open-ended course projects in the place of final exams to address higher-order learning outcomes and achieve meaningful learning among students.

Part 1: Assessment Matters

"Assessment is the act of collecting data or evidence that can be used to answer curricular questions"

(Olds et al., 2005).

- Assessment is important, as it is the primary tool for evaluating student learning with respect to desired learning outcomes but also because the assessment methods or procedures can directly influence student learning.
- Common assessment methods in Engineering include assignments, subject quizzes, midterm exams, projects, reports, laboratory exercises, and final exams.

Part 2: Examining the Final Exam

- Final exams are widely used in Engineering assessment and are often cumulative in nature and heavily weighted.
- Since they are heavily weighted...
 1. the final grades are strongly correlated with exam performance.
 2. students spend significant amount of time preparing for them.
- Since they are cumulative...
 1. they are often used to evaluate overall learning objectives for the course.
 2. they may encourage learning of all course material as opposed to specific topics.
- Advantages of exams: promote hierarchy by assigning grades, efficient for large class sizes, and objective grading.
- Shortcomings of exams: limited ability to evaluate soft skills, punishes mistakes without seeking to improve learning, and persuades students to learn for the purpose of assessment (Flores et al., 2015).

Part 3: Opening the Door to Open-Ended Course Projects

- Project-based learning is a form of experiential learning instructors can apply within a course or curriculum wide.
- Reasons to use Project-based learning:
 1. Directed towards application of multidisciplinary knowledge and integration of technical concepts.
 2. Representative of reality: communication, time and resource management, and teamwork skills.
 3. Incorporates problem analysis, synthesis of information, and evaluation of possible solutions.
- Challenges related to project-based learning include subjective grading with no 'right' answer, issues of equal learning and carrying weak students in group work, suitability for large class sizes and reduction in knowledge of fundamental concepts.
- Tips for a successful project (Hulls et al., 2015, Flores et al., 2015, Daniels et al., 2002):
 1. Make students aware of assessment criteria and share a consistent message about performance expectations.
 2. Include feedback they can use to recognize their level of understanding, offer steps for improvement.
 3. Limit the number of educational goals in order to manage time and ensure fair assessment.
 4. Be comfortable dealing with ambiguity and addressing a wide spectrum of issues.
 5. Consider telescoping report (build upon project using assessment throughout the term).

APPENDIX B: Activity 1 - Pop Quiz

Instructions: Read the paragraph about Grandma Ruth's famous apple pie. Use the background information at the bottom of the page to answer the following questions.
You have 2 minutes to score as many points as possible.

Grandma Ruth's Famous Apple Pie:

Grandma Ruth has four grandchildren named Billy, Sally, Johnny, and Jill. One day Ruth took her grandchildren to an orchard to pick apples for her famous apple pie. Each pie requires 5 apples, 10 minutes of preparation, and 30 minutes to bake. She then cools them on the sill for 1 hour before they are finally ready for eating.

1. How long does it take before one of Ruth's famous apple pies is ready for eating?
(2 points)
2. How old was Ruth when Billy was born?
(3 points)
3. Ruth's famous apple pies sold fast that she returned to the orchard for more apples. This time, Ruth decided to split her grandchildren into two teams in order to pick more apples. List two teams you think Ruth should use to pick the most apples and explain why you feel these teams are the most appropriate.
(1 point)
4. How many apples did Billy, Sally, and Johnny pick all together?
(5 points)
5. How many famous apple pies can Ruth bake with Sally and Johnny's apples?
(4 points)

Background Information

Ruth: Ruth is 78-years old

Billy: Billy is 18-years old and picked twice as many apples as Sally. Billy is the tallest and can reach the apples near the top of the trees.

Sally: Sally is older than Billy but only picked 10 apples. Sally is the same height as Johnny and can reach the middle of the trees.

Johnny: Johnny picked half as many apples as Sally. Johnny is very strong and can lift Sally to reach the apples at the top of the trees.

Jill: Jill is the youngest and the shortest. She did not pick any apples because she was busy chasing her pet rabbit Jack who is great at finding the freshest apples on the ground.

APPENDIX C: Activity 2 - Perceptions of Traditional Exams Jigsaw Activity

We look to answer the question: *"What are the current perceptions on traditional final exams?"*

In groups, we will consider four different perspectives: Student, Teacher, Institution, and Industry.

Step 1: As a group with a single perspective (i.e., student perspective), add 3-5 points in the appropriate box.

Step 2: After switching groups, share your perspective and fill in the remaining boxes with the perspectives shared from other participants.

Discussion Prompts:

- *I like/dread final exams because...*
- *For evaluating learning, I feel final exams are...*
- *Compared to other assessment methods, final exams are...*

Student's Perspective	
Teacher/Instructor's Perspective	
Institutional Perspective	
Industry Professional's Perspective	

APPENDIX D: Activity 3 - Analyzing Course Projects Think-Pair-Share Activity

Compare the sample course project outlines to identify features that will likely lead to success and aspects that may cause concern.

SAMPLE COURSE PROJECT 1

Purpose

The purpose of this project is to apply stiffness method concepts and related course materials to solve a practical structural analysis problem. By the end of the project, you will have completed a building layout, assessed loading conditions, and conducted a 3D structural analysis of a steel-framed structure.

Project Statement

To address the increasing need for student space on campus, a university is seeking proposals for a new building on south side of campus. The building will focus on the creation of additional student social, activity, dining, and recreation space, to help facilitate a greater sense of community and to improve student experience. The proposed site for the building is an existing parking lot as shown in Figure 1. To meet accessibility and clearance requirements, the building footprint must fit within a 20 x 40 metre area as seen in Figure 2. The maximum height of the building is 15 metres.

Figure 1: University campus

Figure 2: Proposed site for student building

Deliverables

Project Proposal (due June 2)

- Detail the proposed layout and loading considerations. (Memo format, maximum 2 pages)

Client Presentation (due July 10)

- Present key aspects of the building design and analysis program.

- 5-10-minute presentation to classmates.

Technical Report (due July 24)

- Discuss key aspects of the analysis, program, structural design, and layout.
- Technical report format, maximum 20 pages, attach MATLAB code.

Evaluation

The project will be evaluated based on the following criteria:

- Layout
 - The building layout should be well thought out, clearly justified in the deliverables, and meet the needs as outlined in the project statement.
- Loading
 - The applied loads should be determined based on occupancy and use and be consistent with the Ontario Building Code. Loading assumptions should be reasonable, conservative, and clearly stated in the deliverables.
- Analysis
 - The structural analysis should be accurate and performed efficiently using your own MATLAB program. The program should have a formalized method for data input and post-processing and be verified using the provided sample building. Key aspects of the program should be included in the presentation and technical report.
- Design
 - Typical members should be designed using standard steel sections. Design checks should be included. Internal member forces and support reactions for selected members should be included in the form of sketches, bending moment diagrams, shear force diagrams, etc.

The following grading scheme will be applied for the deliverables:

- Project Proposal: 15% (building layout, loading assessment, conciseness of memo)
- Client Presentation: 10%
- Technical Report: 75% (code development, accuracy of analysis, comprehensiveness of report)

Notes:

1. Project proposal is to be submitted in hard copy by the deadline. Late submissions will not be accepted.
2. Presentation materials should be submitted 24 hours prior to the presentation time.
3. Technical report may be submitted in hard copy or electronically by the deadline.
4. MATLAB code and associated files must be attached to the report and submitted by the deadline.

SAMPLE COURSE PROJECT 2

A final project worth 40% of the final grade is required for this course. The grading for this project will be based on weighting factors as defined by these three criteria:

- Difficulty of the problem: 0.25
- Versatility of the code: 0.25
- Quality of the report: 0.25
- Oral Presentation: 0.25

The project will consist of analyzing a three-dimensional steel-framed structure, developing the appropriate input properties, element libraries, solution algorithms, and post-processing. Portions of the programs will be developed by you, individually, throughout the term, as a part of your homework. The project should be an individual effort, and all the programs should be developed individually. No group work.

The framed structure, designed by you, must be 4 stories tall with plan dimensions of 100 feet by 60 feet. Commercial space and parking should be provided on the ground floor with office space on the upper floors.

The final report should not exceed 20 pages and describe the problem and analysis results. Presentations will take place on the last day of class.