

Flipped IN-CLASS Lesson Plan Template

Topic or concept:

Internal forces

Basic objectives for preparatory work:

- Defining internal loads concept wrt external loads
- Identifying on a single-loaded concentrate force structure the 2 sections
- Estimate internal loads on a single-loaded concentrate force structure

Advanced objectives for classwork & after class work:

4 classes (1st class: multi-loaded concentrated forces, 2nd class: uniform distributed forces, 3rd class: distributed forces, 4th class: any combination of forces), for each class work and after class work will be:

◦ Class work

- Identifying in a multi-loaded structure the different sections
- Estimate the internal loads in a multi-loaded structure
- Draw internal loads diagrams

◦ After class

- Practice on similar exercises to class exercise,
- Localize and evaluate the peak internal loads

Each class, 75 mins, will follow the same schedule:

| | Time planned | Activity and rationale | Resources needed |
|---------------------------|--------------|--|---|
| Beginning of class period | 5 mins | Time open to question on the prep-phase, <i>guided or based on the quizzes answers from preparatory activities</i> | None |
| | 5 mins | Exercise solve by teacher based on preparatory activities. <i>Aiming at clarifying misconceptions and add info.</i> | Lecture prep – board (several colors of pencil is required for draws clarification) |
| | 5 mins | Quiz (cahoot-like) | Computer or smartphone |
| Middle of period | 5 mins | Présentation of a New problem related to class topic (see LAO above) and highlights on its differences with former exercises. | Video + slides |
| | 5 mins | Pair work to analyze the problem and identify the internal cut, and sections: <i>No calculation is expected</i> | |
| | 5 mins | Collective analyze of the problem to clarify misconceptions. | board (several colors of pencil are required for draws clarification) |
| | 10 mins | Pair work to solve the problem and estimate the internal loads acting on every sections | |
| | 5 mins | Collective correction of the problem. | board (several colors of pencil is required for draws clarification) |
| | 15 mins | 1 exercise assigned to each group of 5-6 students | Video + slides |
| | 5 mins | Flash correction of exercises | Video + slides |
| End of period | 10 mins | RSQC (Recall, Summarize, Question, Review, Comment). Students solidify understanding in preparation for doing advanced work at home. | Board + Video + slides |

Flipped AFTER CLASS Work Plan Template

| Advanced learning objective | Activity and rationale | Instructions to students |
|---|--|--|
| <ul style="list-style-type: none"> - Practice on similar exercises to class exercise, - Draw internal loads diagrams - Localize and evaluate the peak internal loads | <ul style="list-style-type: none"> - Training: analyze, and solve the problem to draw internal loads diagrams, and find peaks. <i>This phase provides training, and helps to appropriate, or consolidate new materials studied during class.</i> <ul style="list-style-type: none"> o Exercise 1: annotated exercise with internal sections, analytics solutions on each section, and peak values given o Exercise 2: annotated exercise with only peak values given. o List of similar exercises advised with numerical values annotated. | <p>The aim of this after-class phase is to recall last class, improve, and make them your own concepts studied during class:</p> <ul style="list-style-type: none"> - Training: <ul style="list-style-type: none"> o Solve exercises 1, and 2 without looking at the annotations. o Compare your solutions to the annotated solutions. o If you noted mistakes, try to understand and practice on similar exercises as listed |
| <ul style="list-style-type: none"> - | <ul style="list-style-type: none"> - Practicing: solve the problems, draw the diagrams, and quantify and localize the peaks. <i>This provides practice in problem-solving.</i> <ul style="list-style-type: none"> o Problem 1: Completely annotated but the annotations contains 5 mistakes. Find the mistakes and provide a corrected version of the annotated exercise. o Problem 2: Partially annotated but the annotations contains mistakes. Find the mistakes and provide a corrected version of the annotated exercise and complete the exercise annotation. o Problem 3: Solve and explain each step. | <ul style="list-style-type: none"> - Practicing: <i>Exercises (5 of each) will be randomly collected</i> <p>Solve and annotate problems 1, 2 and 3. You may work together; just be sure that YOU can solve and annotate problems independently as the exam will be similar to this work.</p> |

GUIDED PRACTICE CLASS 1¹

Class: ME 2510
Time estimate to complete: 1h – 1.5h

Date assigned: 10/20/2019
Date due: 10/26/2019

Overview/Introduction

The previous lessons of the ME 2510 introduced the concepts of external loads (forces and moments) applied to a structure. External loads might be related to applied external actions, or induced by joints to whom the structure is connected. Since the 2nd Newton's law (the equilibrium equations) is verified, the induced loads can be defined with respect to applied ones.

Indeed, external loads determination is required as this leads into internal loads which are related to internal stress and strain of the structure. Studying the reliability or the weaknesses of structure, and in a further step optimizing and designing them, requires to first estimate the internal loads.

The aim of this lesson, 2 weeks long, is to introduce internal loads, to learn how to estimate them, and to localize and quantify their peaks.

Learning Objectives

Basic objectives

- Defining internal forces concept,
- Defining the internal bending moment concept,
- Modeling an equilibrium between external and internal loads,

Advanced objectives

- Analyze a single-loaded concentrate force structure the 2 internal sections problem,
- Solve a single-loaded concentrate force structure the 2 internal sections problem,
- and calculate the internal loads at specific locations.

Preparatory Activities and Resources:

1. Look at the video "4 types of internal forces": <https://www.youtube.com/watch?v=d1fjGy8tas0>
2. Read text book² Chap. 7, pp. 343-345.
3. Answer on canvas Quizz internal_forces-Q1 to evaluate your understanding. If the results is lower than 80%, go back to step 1, and then 2.
4. Look at the video "Introduction to internal forces": <https://www.youtube.com/watch?v=SKE7-IEO4go>
5. Train on text book, example 7.1 p. 346. Practice it without looking at the correct answer and then compare your result to the solution.
6. Practice on canvas on Quiz internal_forces-Q2, repeat it until all your answers are correct
7. Answer on canvas on Quiz internal_forces-Q3, you will be notified of your score without knowing which answer is wrong (if some are), and you will be allowed to repeat once.

Questions?

Remember that you can contact me during my office hours, or by email for any questions.

¹ Only Class one has a specific guided practice, Class n ($n \in \{2, 3, 4\}$) guided practice are indeed the "flipped after class" of class $n-1$

² Engineering Mechanics, Statics, R.C. Hibberler, Pearson Ed.,

ADVANCED PRACTICE

This is given for students to complete after the class meeting in which they work together.

| | |
|----------------|--|
| Class: | ME 2010 |
| Date assigned: | Practice exercises and Homework on Monday, Practice exercises Thursday |
| Date due: | Thursday, noon for practice assigned on Monday, Monday noon of the following, for practice assigned on Thursday and homework assigned on Monday. |

Time estimate to complete this assignment: 1h for each class (2) for the practice part, and 2h for the homework assigned once a week: total of 4h a week

Learning Objectives

Advanced objectives

- 1- Analyze & solve a problem and calculate the internal loads applied within the structure,
- 2- Draw the 4 internal loads diagram,
- 3- Identify, localize, and calculate the peak internal loads within the structure

Activities & deliverables

1. Practice problem can be downloaded on canvas
 - a. Problem 1:
Completely annotated but the annotations contains 5 mistakes.
Find the mistakes and provide a corrected version of the annotated exercise.
Complete quiz internal_forces_W1(or 2)-Q1. One try only
 - b. Problem 2:
Partially annotated but the annotations contains mistakes.
Find the mistakes and provide a corrected version of the annotated exercise and complete the exercise annotation.
Complete quiz internal_forces_W1(or 2)-Q2. One try only
 - c. Problem 3:
Solve the problem.
Complete quiz internal_forces_W1(or 2)-Q3. One try only
and answer the and explain each step. Give detailed, action-oriented instructions for completing the assignment. Make sure to also include a reflective component.
2. Homework
Complete homework, staple every pages together and title this assignment: **"Internal_forces_W1(or 2)"** along with you name and due date.
This assignment is due in class on Monday 1 week after the homework has been assigned.
Give detailed, action-oriented instructions for completing the assignment.
 - Neatness and logical flow in your solutions is required.
 - Analytical expression is expected before any numerical calculation.
 - A Free Body Diagram must be drawn before solving each problem
 - Every information must be provided to clearly justify each step. Lack of justification may lead to consider results as false.

Resources:

1. Statics: Lesson 56 - Introduction to Internal Forces, M, N, V:
<https://www.youtube.com/watch?v=AJC3TNdC-f0>
2. https://ecourses.ou.edu/cgi-bin/ebook.cgi?doc=..&topic=st&chap_sec=08.1&page=theory
3. Statics Lecture 26: Internal forces -- Shear Force and Bending Moment Functions and Diagrams:
<https://www.youtube.com/watch?v=fRTZyTAo0ts>

Questions?

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