LABORATORY SESSION 1

Project 1 Attempt A - Balsa Beam Design and Test

PART 1 - Students' handouts -

RECAP FROM WEEK 1:

1. **Lab Safety**
2. **Team Formation**

Add names of your team members in this handout:
1-
2-
3-
x-

Announcements:

1. *Bring a minimum of one laptop or tablet per Team to every lab to access the handouts. We recommend one device per student for optimum interaction.*

2. *Bring a minimum of **one printed copy** of the particular week's Student's Handouts per Team. Handouts will be available on Moodle the day before your lab.*

3. *Students must utilize e-Learning to survive in this subject.*

4. *Your report is to be submitted as a word file through Moodle. You should seek advice from your instructor before making your Team's submission meaning show them your report before submitting.*

These notes are based on originals developed by Tim McCarthy, Richard Dwight and Cameron Lam, later updated by Carey Freeth, Josip Horvat, Tim McCarthy and Bruce Fowler.

They have been updated and are used by Khaled El-Akruti in 2017 and by Sana Amir in 2023.

SUMMARY OF TASKS

Task 1: Team formation
Please see Team work handouts

Task 2: Ice Breaker/Team building Activity: Brief review. For details please see Team work handouts.

Task 3: Project 1A: Beam design - Planning **(20 minutes)**

Your Team is required to design a beam structure to carry the equivalent of a central mass of 2.5kg over a clear span of 400mm. The deflection at the centre of the beam must be in the range of $1\text{mm} \leq \boldsymbol{\delta} \leq 6.5$ mm.

Task 4: Project 1A: Beam design - Building **(20 minutes)**

When ready, give your instructor a written Material Request (a shopping list!) covering the Balsa sheet and square sections quantities they require. Use the standard form in the Student's Handout (See ATTACHMENT 2). Fabrication should begin as early as possible to allow glue to dry.

Please read the Classroom Health and Safety section!

Task 5: Project 1A: Beam design - Testing of beam to be done in week 2 **(30 minutes)**

Task 5 is to be done in week 2 during first 30 minutes.

Your Team is allowed an absolute maximum of 10 minutes to set up and test your beam. The Tutor will briefly demonstrate this to the first team - suggest you watch!

Submission:

1. **Teams will submit this report as a word file through Moodle Assignment, by 11:59 pm on the day of your next lab class in Week 3.**
2. **Further details of the tasks are provided in the second part of this handout. READ THEM!**

Note:

1. **All meetings should be documented coherently and attached as Appendix A in their Project 1A Design and Reflection Report.**
2. **Teams must add a completed copy of the Team Ground Rules Form as Appendix B to the Project 1A Design and Reflection Report.**
3. **All Teams to agree on a time and place to complete this first Team Meeting after class - before you leave!**

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LABORATORY SESSION 1(b)

Project 1 Attempt A - Balsa Beam Design and Test

PART 2 - Students' handouts

Task 3: Planning and Designing Your Beam

Your Team is required to design a beam structure to carry the equivalent of a central mass of 2.5kg over a clear span of 400mm. The central deflection under this load must be more than 1mm but less than 6.5mm. The load will be applied over an area in the middle of the beam as shown below –

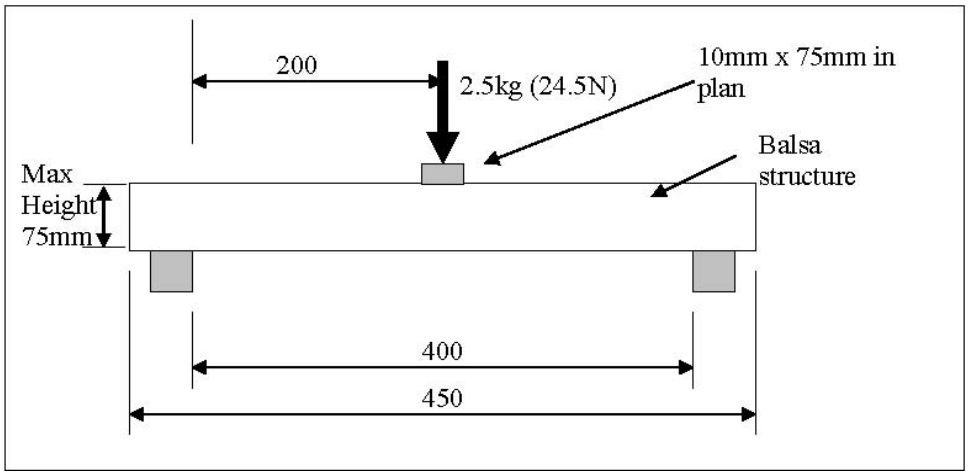

Figure 1 Longitudinal View of Beam

Procedure

1. Brain storm design ideas: Consider at least **two** different concepts. Keep notes for your report.
2. Make a list of the material you require and submit this to the tinstructor for supply. Complete the Materials Request Form (See ATTACHMENT 2: from the Lab session 1 Student Notes)

Each team is allowed -

- 1 balsa sheet 4.7x50.5x457
- up to a maximum 4 of the 914mm long balsa rectangular sections subject to the following restriction: 3.1x6.3x 914mm max 2, 4.7x6.3x914mm max 2, and 1.5x6.3x914mm max 4.

For example the following materials list is valid: 1of 4.7x50.5x457 plus 2 of 3.1x6.3x914 plus 2 of 1.5x6.3x914mm because this list has one sheet plus a total of 4 rectangular sections.

3. Get a feel for how strong the material is (without breaking it!).
4. In the interests of Sustainability, try to design the lowest mass structure that meets the engineering criteria.

Task 4: Building Your Beam

When ready, give your Tutor your written Material Request covering the Balsa sheet and rectangular sections quantities they require. Use the standard form in the Student's Handout (See ATTACHMENT 2: from the Week 1 Students Notes). Fabrication should begin as early as possible to allow glue to dry.

Procedure

1. Build your structure taking care when cutting.
2. Use the glue sparingly. ***Use up the already open glue bottles first.***
3. ***Wear safety glasses when using the glue and cutting balsa pieces.***
4. ***Wear plastic gloves when using the glue***

5. ***All cutting is done on the cutting boards provided***
6. You will need to share cutting resources with other teams. Cut the rectangular sections in half (approx 457mm lengths) if they are to span the whole of the gap. (You need some extra length at either end to go over the supports which are 400mm apart).
7. Take photos of the building process as you go - but do not waste time!

Classroom Health and Safety

Three safety risks are identified for this project -

1. *Handling of glue*
   Putting too much pressure on the glue tube results in the tube bursting, potentially ending up in the eyes of the handler of his/her team-mates. This can result in a serious eye injury. Such incidents typically happen when opening the new glue tube or when the nozzle gets blocked by the set glue (tube not closed properly). To avoid this happening -
   - NEVER apply excessive pressure to the glue tube. If the glue does not come out easily, consult the tutor.
   - The Glue nozzle will be cut open for you. Inspect it before each use. If it is not open, ask your tutor.
   - ALWAYS wear safety glasses and gloves when handling the glue.
   - Be mindful of your team-mates. They may get injured by you handling the glue. Always point the nozzle away from people around you.
2. *Cutting balsa pieces*
   Use the small saws where possible. A sharp blade can also be used for cutting balsa pieces. Fingers can get cut and blade may snap, potentially resulting in eye injury. To avoid this -
   - Always use the safety rule when cutting the balsa sheet, keeping your fingers in the groove to \ protect them from the blade.
   - Keep your fingers well away from the blade at all times (at least the length of the blade).
   - ALWAYS wear safety glasses when cutting.
   - Make sure your team-mates are at safe distance (at least a metre) to prevent injuring them.
   - Always cut in a direction away from your fingers.
3. *Use of testing rig*
   A weight of 2.5 kg will be used to apply a force on the beam. It may fall, potentially hurting your feet. To avoid this -
   - Wear sturdy closed-type shoes. You are not allowed to be in the class in thongs or similar shoes.
   - Keep your feet away from the lever at all times.

Task 5: Testing Your Beam (WEEK 2, Laboratory session 2)

Your Team is allowed an absolute maximum of 10 minutes to set up and test your beam. The instructor will briefly demonstrate this to the first team - suggest you watch!

Procedure

1. Take photos during the Testing phase. Suggest -
   - take one wide angle photo showing their beam set up ready to test - make sure their team label is clearly visible,
   - take one close up shot of the beam under load showing the reading on the dial gauge, and,
   - if the beam fails, take one shot of the failed/collapsed/twisted/whatever beam.
   - include these photos in your Report in the Comparison of Results and Reflections sections.
2. Throughout the exercise, document your discoveries and how you overcame unexpected problems.
3. Complete your Team's part of the Results Table on the whiteboard. You are expected to reproduce this table using the Table Template provided at the end and include it in your report.
4. Make sure a member from your team posts your Team's photos onto the Moodle laboratory Class Forum with their Team label (ie Team A, Team B etc) clearly showing - by 5pm the day after your lab.

Guidelines for preparing your Project 1A Report

The report you submit in Week 3 accounts for 5% of the overall marks for this subject. It is a team report and normally each member in the team will be awarded the same mark but if there is issues with the lack of equal contribution by some group members then certain measures will be taken that may reduce the mark of members group members. The reflection report **must show clear evidence of team work** and the contributions from each member.

Use the Report Structure list provided below. Teams should use these headings for their reports. Teams should assess their own work by using the Assessment Marking Sheet (See the version provided in Moodle) before submitting their report.

Anything missed will result in lost marks. *Please properly proofread your report before submitting!*

Report structure:

The report should contain the following -

1. Assignment cover sheet with name and student number for each team member.
2. Assessment sheet with Team information (Team number and names). Place, time and date of design exercise.
3. Title page and Contents page
4. Statement of purpose of this report
5. Results of brainstorming and rationale for chosen concept
6. Brief description of your beam, including a drawing with dimensions
7. Results for your beam and results for the rest of the teams
8. A comparison of the results of your beam to the others (WHAT happened)
9. Reflection (WHY it happened) - most of the marks go for this section
10. Mapping of what you have done in the subject so far with the learning outcomes mentioned in the Subject outline. Include a short commentary for each.
11. Conclusion
12. References used (evidence of further reading)
13. Appendix A: Minutes of team meetings (evidence of teamwork)
    Appendix B: A completed copy of your Team Ground Rules Contract Form

What is a Reflection?

A good "Reflection" for this report would contain the following -

1. Reflection on the fabrication and design aspects. What were the most difficult or fiddly bits that took most time? Can you avoid this in the second attempt?
2. Reflection on the performance of your beam relative to the others. WHY did some beams perform better than others?
3. What improvements would you make to your design if you were to repeat the experiment?
4. Reflect on your understanding of how beams behave. Try to identify what relevant knowledge you had prior to the experiment, what you gained during the exercise and what gaps you have identified. What can you do about filling those gaps before the second attempt? What additional literature did you read to support your responses?
5. An analysis of how agreement was achieved in your team on final design. How good was you decision making process? Took too long? Not enough debate? Did you consider enough options?

ENGG102 Project 1A Beam Design and Reflection Report: Assessment sheet

Lab session number: _____ Instructor's name: _____

Team Number: _____ Date and time of exercise: _____

Names and ID Numbers: _____

Aspect	Comment	Mark
Appendix A: Minutes of Team Meetings (evidence of teamwork)	**Minus 2 marks if Minutes of Team Meetings (more than one!) are not included with this Report**	
Appendix B: A completed copy of your Team Ground Rules Contract Form	**Minus 2 marks if a copy of your Team Ground Rules Contract Form is not included with this Report**	
Structure of report, team information etc (as per "what report should contain")	0.5 mark for each item 3-12 (see Report structure provided above)	/5
Overall Presentation	Neatness Spelling Grammar Diagrams Professionalism	/10
Brainstorming and rationale: List 2 distinct proposals Reasons for selection of prototype	Must show evidence of developing at least two distinct design ideas and variations/improvements to one.	/5
Description of beam Drawing/sketches with dimensions	Describe the principle behind the design. Accurate line drawings or neat and clear sketches with all important dimensions (should enable tutor to build the same structure)	/20
Results including comparison with other team(s) WHAT happened!	Comparison table of all results. Discussion of results with commentary on table and main factual findings. Describe the main failure mechanisms.	/10
Reflections – identify some reasons for the performance of your beam and other teams. WHY it happened! Consider the various aspects of the task (fabrication, material use). Discuss how it might be improved, what knowledge might be needed, & design criteria considered.	To achieve top marks (35-40/40) in this section your report must demonstrate clear and insightful reflection considering own solution and others in the class. Demonstrates further reading and critical analysis. To achieve 25-35/40 your report must describe the performances of your solution and some others. Itemisation of knowledge gaps and some critique of designs. To achieve 0-25/40: Describes own solution with limited reference to other beams.	/40
Mapping of learning outcomes	Identifies all the relevant outcomes from subject outline and discusses how well each is addressed.	/5
Conclusion	1 or 2 paragraphs that draw appropriate conclusions from evidence presented in report. Include the main results, both numerical and qualitative.	/5
Total		/100

Submission:

1. **Teams will submit this report as a word file through Moodle, by 11:59pm on the day of their next laboratory class in Week 3.**
2. **Reports MUST have a completed assignment cover sheet giving the name and student number of each team member.**
3. **One student per team is to submit the report. That student will receive the feedback and must share it with other teammates.**

These notes are based on originals developed by Tim McCarthy, Richard Dwight and Cameron Lam, later updated by Carey Freeth, Josip Horvat, Tim McCarthy and Bruce Fowler.

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ENGG102 Project 1A Beam Design and Testing: Table of Results

Team	**Type** eg beam or Plank? Box, I beam, Channel, Flat or Truss?	**Deflection** mm	**Met Criteria** Yes OR No	**Material Used** (4.7 x 50.5 Sheet 3.1 x 6.3 rectangle 4.7 x 6.3 rectangle 1.5 x 6.3 rectangle	**Volume** mm^3	**Fabrication Effort** eg High, Medium or Low	**Comments** eg Performance relative to type Performance relative to volume Performance relative to fabrication effort Apparent failure mode? What else did you observe?
1							
2							
3							
4							
5							
6							
7							
8							
9							

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ATTACHMENT 1:

Project : Title……..

TEAM ATTENDANCE FORM –
Make a copy of the information for each group member

Lab day: Time: Room: Lab session number:

Instructor's name:

Team letter: Name Email address Phone No. Best day for group meeting

Team members: 1.……

2. ……

3.……

Date, time and place of first team meeting to develop the report.:……

Actions list and person responsible:

..

Project 1 Attempt A Balsa beam design and test

TEAM ATTENDANCE FORM

Lab day: Time: Room: Lab session number:

Instructor's name:

Team number: Name Email address Phone No. Best day for group meeting

Team members: 1. ……

2. ……

3. ……

Date, time and place of first team meeting to develop the report.:……

..

Project 1 Attempt A Balsa beam design and test

TEAM ATTENDANCE FORM

Lab day: Time: Room: Lab session number:

Instructor's name:

Team number: Name Email address Phone No. Best day for group meeting

Team members: 1. ……

2. ……

3. ……

Date, time and place of first team meeting to develop the report.:……

ATTACHMENT 2:

Material Request List (complete and give to your tutor)

Task 4: Project Title…….

Tutorial Number.....**Team Number**.....**Tutor's Name**..... **Date**.....

Please supply the following Balsa Beam construction materials -

1. Material 1……

Section dimensions and length -.....
Quantity -.....

2. Material 2…….

Section dimensions and length -.....
Quantity -.....

Section dimensions and length -.....
Quantity -.....

Section dimensions and length -.....
Quantity -.....

Materials collected by -.....

Please note -

1. Material supplies are limited so please do not delay in collecting your order.
2. It is your responsibility to choose your materials wisely. Returns or refunds will not be considered.
3. Replacements for breakages and any additional Material Requests will be considered only at the discretion of the management.

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ATTACHMENT 3:

Sample meeting report: Key things to document are – WHAT Action was decided, WHO is going to do it and WHEN does the Action need to be completed.

University of Wollongong UNIVERSITY of WOLLONGONG **MEETING REPORT**	**Job No. : CM501** **Page 1 of** **Report Date: 7/10/2007** **Prepared by: C Lam**
Project: Richie Rich – Crude Piping	**Contract Ref: N/A**
Purpose: Progress	**Internal**
Place: Engineering Faculty RM 1.105	**Meeting Date: 02/10/2007**
Attendance: **Name: Position: Company: UOW** **Emillio Peterson Estimator** **Tony Roche Project Engineer** **Jenny Thompson Workshop Supervisor** **Charlie Lamb Workshop Engineer/QA** **Apologies: None**	**Minutes Issued To:** **All Attendees & C Cook**

AGENDA/SUMMARY OF ACTIONS

ITEM	SUBJECT	ACTION	DATE
1	**Crude Piping**		
	• Order from Richie Rich/Job number to be established.	T.R./C.L.	05.10.07
	• Schedule/Priorities from T.S. Richie Rich	T.R./C.L.	05.10.07
2	**Project Details**		
	• Lump Sum Price = $1,629,349.00 plus tundish		
	• 4 months delivery = 12,434 m/hrs		
	• 60 hrs per week working hours		
	• All materials free issue from Richie Rich (except pipe supports)		
	• Materials will be transported from Richie Rich on Backload from diesel pipe work delivery. Backload to be charged to Richie Rich.	T.R./C.L.	
	• Tundish to be fabricated from 2mm galvanized sheet, touch up welds.	TR./JT./EP./ C.L.	
	• Project budget very tight – need to look at all improvement opportunities.		
3	**Workshop Improvements**		
	• Workshop and yard drawing issued for mark up for proposed lay down areas and work stations.	JT./T.R./C.L	08.10.07
	• Remove any materials or equipment from yard not required to allow more room for storage and ease of movement.	J.T.	
	• Use slewing crane for unloading and loading.	J.T.	
	• Review if more pipe clamps required.		12.10.07
	• Produce pipe cutting list.		
	• Set up cutting rack outside.	JT/TR/CL	
	• Review if pipe storage racks are required and fab.	J.T.	12.10.07
	• Pipe end caps from Richie Rich.	J.T.	
	• Use step deck trailer for other work so flat top can be loaded with pipes directly after painting.	T.R. J.T.	10.10.07 05.10.07
4	**Resources**		
	• Review Painting.Com ability to complete existing work and upcoming pipe work.		
	• Review availability/cost/quality of pipe fitters from Anthony Kim.	T.R./E.S.	
5	**General Items**		
	• Pipe cradles to be used for transport to site.	J.T.	05.10.07
	• Priority list of materials to be generated.	T.R/C.L	
	• Traceability & NDE	C.L.	12.10.07
	Next Meeting: Thursday 11th October 2007 at 2pm		

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ATTACHMENT 4:

ENGG102 Team Ground Rules and Contract Form

For a team to be effective it is a requirement that all team members understand their responsibilities to one another. It can be useful to discuss and agree certain project ground rules.

All team members agree to -

1. Come to class and team meetings on time.
2. Come to meetings with assignments and other necessary preparations done.
3. Respect one another.
4. Help each other when the need arises.

Additional Rules -

5.....
.....

6.....
.....

7.....
.....

If a team member fails to meet these ground rules, other members are expected to take the following actions -

Step 1: (agreed action amongst the team and write it here)

……
…….....
.....

If not resolved -

Step 2: Bring the issue to the attention of the instructor. If agreed, actions to be taken -

.....
.....

If still not resolved -

Step 3: Meet your Subject coordinator as a group.

Lab session Number:..... Team:.....

Member signatures:

1.....

2.....

3.....

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