PCI BIG BEAM COMPETITION

SARAH RZESZUT
CHRISTOPHER CHAPMAN
DEMIAN PERERA
HAITHAM MURAD

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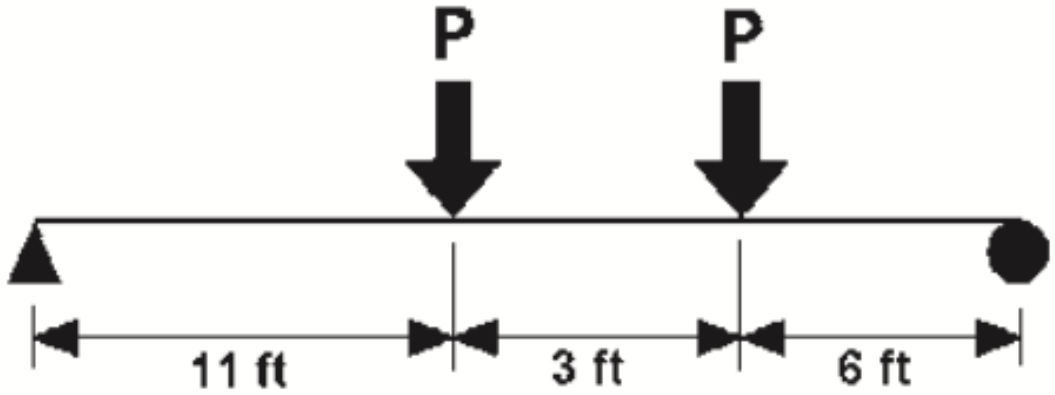
CENE 476 PROJECT PROPOSAL

PROJECT UNDERSTANDING

Purpose:

- Analyze, design, and test a prestressed concrete beam



Stakeholders:

- Student team
- NAU
- PCI
- TPAC

PROJECT UNDERSTANDING

Technical Aspects and Considerations:

- Rules for the competition
  - 20 foot long beam
  - Crack after 20 kips
  - Break between 32-40 kips

Potential Challenges:

- Mix selection
- Beam type selection
- Reinforcement selection
- Transportation of beam

TASK 1: PRELIMINARY RESEARCH

1.1 Three Stages of Design Prestressed Concrete Beam

- Release or transfer
- Cracking load
- Ultimate strength

1.2 Preliminary Designs

- I beam
- T beam
- Box

1.3 Decision Matrix

- Determine decision matrix criteria based off PCI scoring

PCI
Precast/Prestressed Concrete Institute

TASK 2: PRELIMINARY BEAM DESIGN

2.1 Initial Beam Designs

- Design 8-12 beam options with different depths and cross sections

2.2 Decision Matrix

- Mix selection
- Beam selection
- Reinforcement selection

TASK 3: FINAL DESIGN AND ANALYSIS

3.1 Shear Design

- Number of stirrups and spacing

3.2 Reinforcement

- Increases the compressive strength

3.3 Loss Calculations

- Camber due to prestressing

3.4 Cracking Load

- Tensile stress exceeds tensile strength

3.5 Max Load at Midspan

- Strength of the beam

3.6 Max Anticipated Deflection

- Anticipated deflection when the beam experiences the max load at midspan

TASK 4: PREDICTIONS

4.1 Response 2000

- Generates the diagrams for shear, bending moment deformation, and deflected shapes
  - Cracking load
  - Max load at midspan
  - Max anticipated deflection

TASK 5: SHOP DRAWINGS

5.1 AutoCAD

- Plan view
- Dimensions
- Cross section
- Spacing of stirrups
- Review of drawings
- Revisions of drawings

5.2 Reinforcement Details

- Must be identified in drawings
- Sizing, spacing, and clear cover must be stated

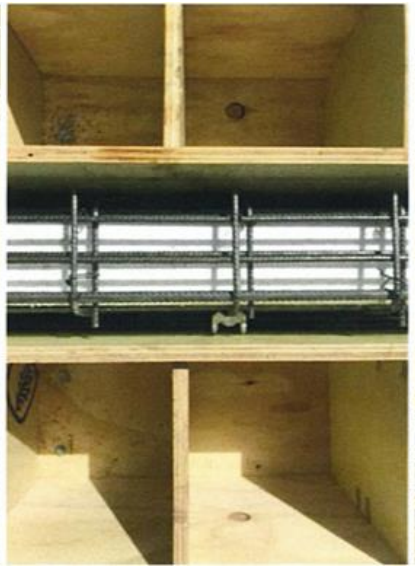
TASK 6: CASTING OF BEAM

6.1 Form Work

- TPAC will be doing the form work for the beam
- Plan around TPAC's schedule

6.2 Curing of Beam

- The beam will take a few weeks to a month for the concrete to cure

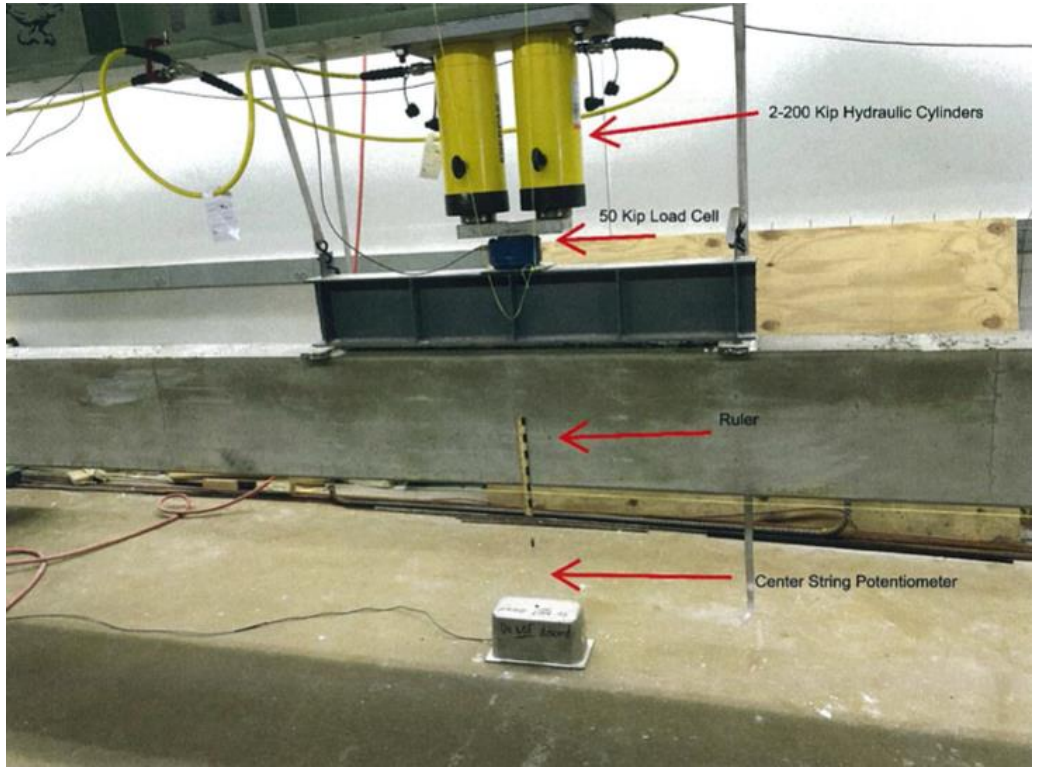

TASK 7: TESTING OF BEAM

7.1 Prepare for Testing

- Collaboration with Dr. T.
- Calibrate the equipment before the test take place
- Properly apply for time in concrete lab

7.2 Test Beam

- Hydraulic press will be used to apply loads and analyze the deflections/failing capacities of the beam



TASK 8: PROJECT MANAGEMENT

8.1 Report

- UGRADS - 30%, 60%, 90%, and final
- PCI - Final

8.2 Website

8.3 Video

8.4 Meetings

- Team meetings
- Weekly meetings with TA
- Bi-weekly meetings with grader

TASK 9: PROJECT IMPACTS

- Social
- Environmental
- Economic

EXCLUSIONS

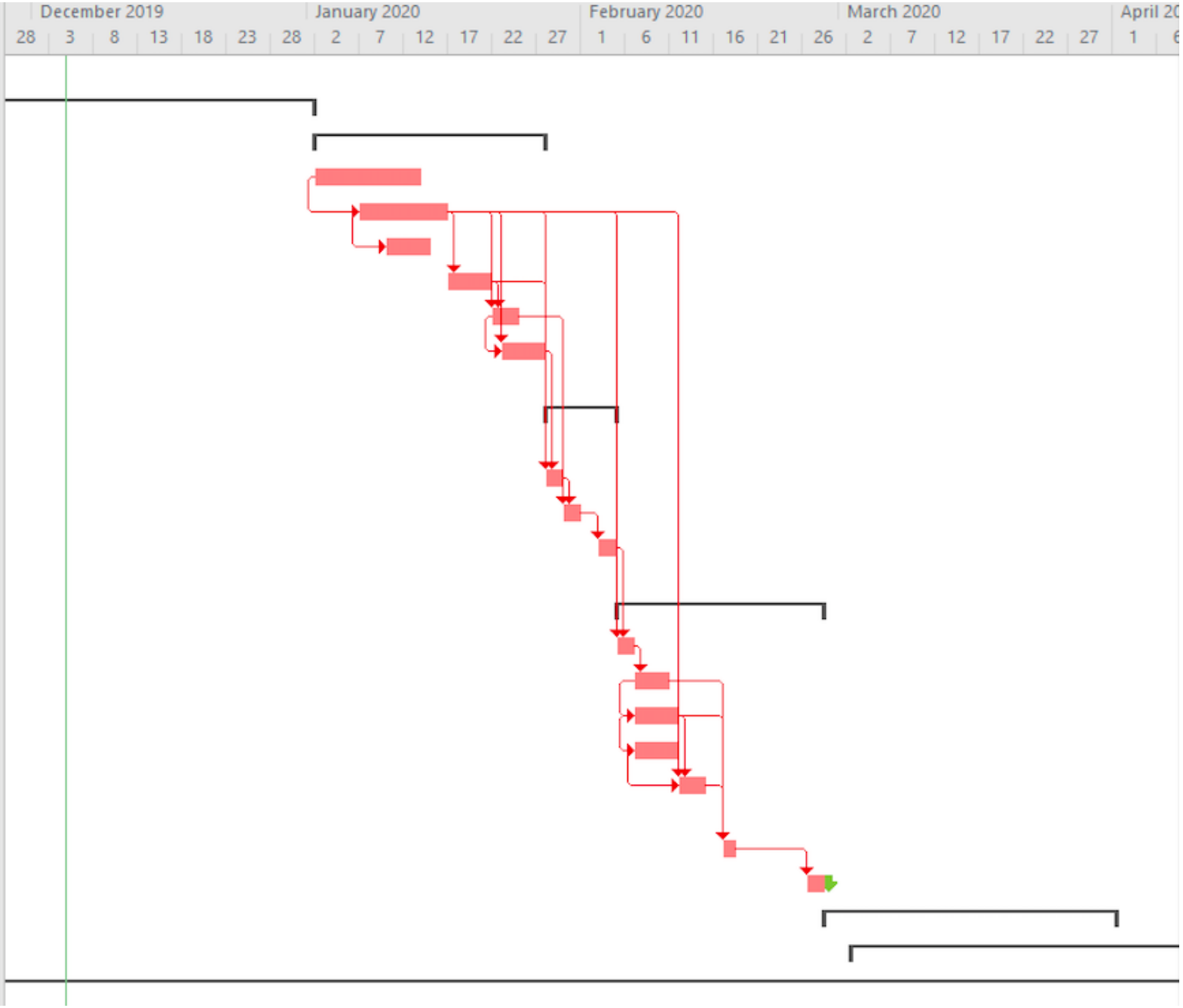
- Mix design
- Steel testing

Tpac

Architectural and Structural Precast Concrete

An **EnCon** Company

	Task Name	Start	Finish
1	**Task 1: Research**	**Wed 10/23/**	**Mon 11/11/1**
11	**Task 2: Preliminary Beam Design**	**Tue 11/12/1**	**Wed 1/1/20**
14	**Task 3: Final Design and Analysis**	**Thu 1/2/20**	**Mon 1/27/20**
15	Task 3.1: Shear Design	Thu 1/2/20	Mon 1/13/20
16	Task 3.2: Reinforcement Design	Tue 1/7/20	Thu 1/16/20
17	Task 3.3: Loss Calculations	Fri 1/10/20	Tue 1/14/20
18	Task 3.4: Cracking Load	Fri 1/17/20	Tue 1/21/20
19	Task 3.5: Max Load at Midspan	Wed 1/22/2(	Fri 1/24/20
20	Task 3.6: Max Anticipated Deflection	Thu 1/23/20	Mon 1/27/20
21	**Task 4.1: Response 2000 Predictions**	Tue 1/28/20	Tue 2/4/20
22	Task 4.1.1: Cracking Load	Tue 1/28/20	Wed 1/29/20
23	Task 4.1.2: Max Load at Midspan	Thu 1/30/20	Fri 1/31/20
24	Task 4.1.3: Maximum Anticipated Deflection	Mon 2/3/20	Tue 2/4/20
25	**Task 5.1: Shop Drawings**	Wed 2/5/20	Fri 2/28/20
26	Task 5.1.1: Elevation View	Wed 2/5/20	Thu 2/6/20
27	Task 5.1.2: Dimensions	Fri 2/7/20	Mon 2/10/20
28	Task 5.1.3: Cross-Section Details	Fri 2/7/20	Tue 2/11/20
29	Task 5.1.4: Stirrup Spacing	Fri 2/7/20	Tue 2/11/20
30	Task 5.1.5: Reinforcement Details	Wed 2/12/20	Fri 2/14/20
31	Task 5.1.6: Review of Drawings	Mon 2/17/2(	Tue 2/18/20
32	Task 5.1.7: Revisions of Drawings	Wed 2/26/2(	Fri 2/28/20
33	**Task 6: Casting of Beam**	**Fri 2/28/20**	**Wed 4/1/20**
36	**Task 7: Testing of Beam**	**Mon 3/2/20**	**Thu 4/9/20**
39	**Task 8: Project Management**	**Fri 9/13/19**	**Mon 4/20/20**



STAFFING AND PERSONNEL

Project Time Estimate Breakdown						
Task	SENG Hours	ENG Hours	LAB Hours	INT Hours	AA Hours	Total Hours per Task
Task 1: Research	14	46	0	77	12	149
Task 2: Mix	1	16	16	20	0	53
Task 3: Design and Calculation	2	10	0	20	0	32
Task 4: Predictions	1	12	0	16	3	32
Task 5: Shop Drawings	2	13	8	22	5	50
Task 6: Casting of Beam	0	11	0	15	0	26
Task 7: Testing of Beam	0	9	6	12	0	27
Task 8: Project Management	33	113	39	155	38	378
Total Hours	53	221	63	325	58	720

COST OF ENGINEERING SERVICES

1.0 Personnel	Classification	Total Hours		Billing Rate $/hr		Personnel Cost
	SENG	53		257		$ 13,642
	ENG	221		132		$ 29,172
	LAB	63		44		$ 2,744
	INT	325		28		$ 9,009
	AA	58		33		$ 1,940
				Total Personnel Cost		$ 56,507
2.0 Travel	Classification	Units (miles)	No. of visits	Unit Cost (/mile)	Cost	
	meetings w/ gary @ town hall	2	20	0.445	$	18
	TPAC site visit	300	3	0.445	$	401
				Total Travel Expenses		$ 418
3.0 Supplies	Classification	Units	Item Total	Unit cost	Cost	
	Mix	DONATED				
	Stirrups					
	Fabricating equip.					
4.0 Subcontracting	Classification	Tasks		Unit Cost	Cost	
	TPAC	Beam Casting		NONE/DONATED		
		Beam Delivery				
					Total Overall Cost	$ 56,925

ANY QUESTIONS?

THANK YOU FOR LISTENING