PCI Big Beam Final Presentation

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Lander Porter, Kaylynn Calvin, Jonah Simminger, David Lucas Macaraeg

Introduction of Project

- Design a 17’ prestressed concrete beam
- Predict behavior at service and factored load
- Compare against tested beam
- Compete with other schools

Client: Precast/Prestressed Concrete Institute

Technical Advisor: Ben Dymond

Sponsor: TPAC in Phoenix, Arizona

- ❑ Prestressed concrete members are strengthened by tensioned strands that compress the beam
- ❑ Resists cracking
- ❑ Supports higher stresses
- ❑ Counteracts tensile forces under load

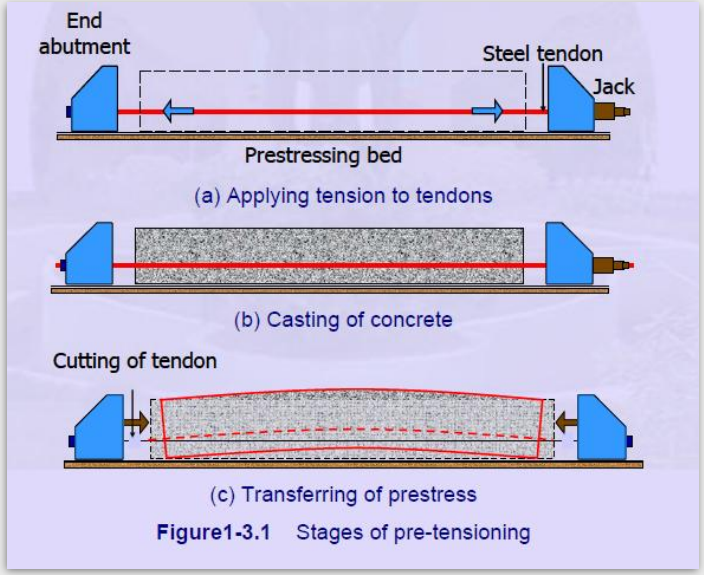


Figure 1: Stages of Pre-Tensioning [1]

Competition Guidelines

- Two 10-kip service loads & two 16-kip factored loads
- No cracking at service load
- Failure after factored load
- Judging based on strength, cracking, deflection, cost, weight, and report quality

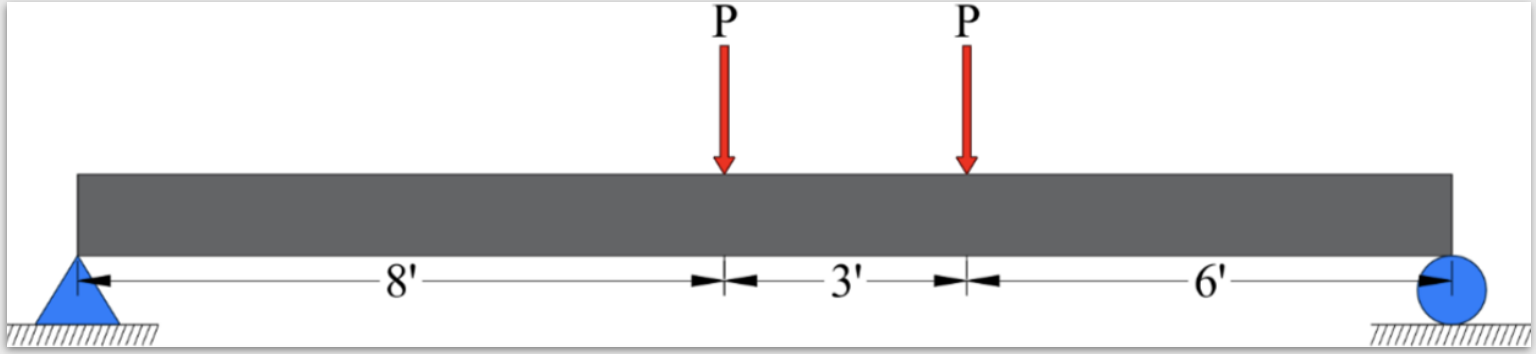


Figure 2: Competition Loading Diagram

Scope of Services

Task 1: Research & Preparation

- **Task 1.1: Technical Research**
- **Task 1.2: Material Testing plan**

Task 2: Beam Analysis & Design

- **Task 2.1: Analysis of Load and Material**
  - Task 2.1.1: Calculate Beam Initial Conditions
  - Task 2.1.2: Select Concrete Mix for Design

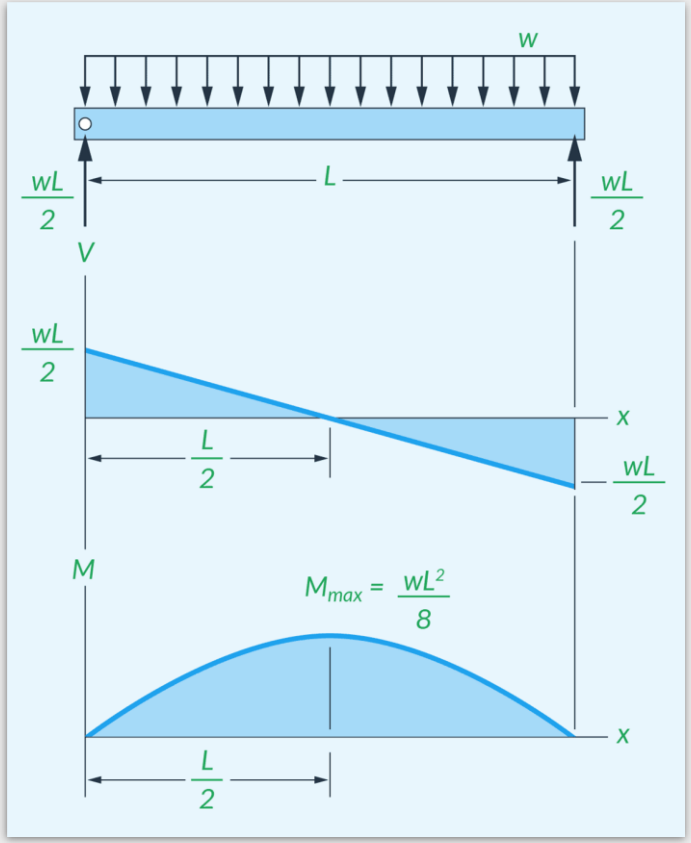


Figure 3: Shear and Moment Diagram Example [2]

Task 2: Beam Analysis & Design (Cont.)

- **Task 2.2: Create Analysis Spreadsheet**
- **Task 2.3: Design Decision Matrix**
- **Task 2.4: Select Best Design**
  - Task 2.4.1: Determine Cross-Section Dimensions
  - Task 2.4.2: Design Prestressing Layout
  - Task 2.4.3: Refine Beam Dimensions
  - Task 2.4.4: Evaluate Performance Against Design Criteria
  - Task 2.4.5: Refinement of Final Beam Design

Figure 4: Mathcad Logo [3]

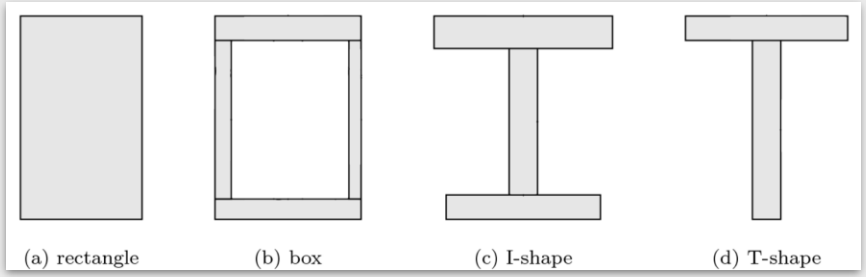


Figure 5: Cross-Section of Concrete Beam [4]

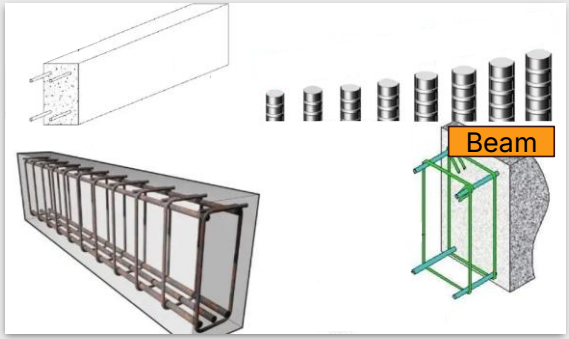


Figure 6: Cross-Section of Concrete Beam [5]

Task 3: Engineering Shop Drawings

- **Task 3.1: Create Shop Drawings**
- **Task 3.2: Internal Review**
- **Task 3.3: External Review**

Task 4: Fabrication & Engineer's Site Visit

- **Task 4.1: Beam Fabrication & Observation**
- **Task 4.2: Cylinder Testing & Beam Predictions**
  - Task 4.2.1: One-Day Test
  - Task 4.2.2: Seven-Day Test
  - Task 4.2.3: Fourteen-Day Test
  - Task 4.2.4: Twenty-One-Day Test
  - Task 4.2.5: Day of Testing Test
- **Task 4.3: Final Beam Predictions**

Figure 7: Pre-tension Casting Bed [6]

Figure 8: Cylinder Test [7]

Task 5: Delivery & Setup

- **Task 5.1: Transportation**
- **Task 5.2: Testing Preparation**

Task 6: Beam Testing

- **Task 6.1: Load Testing on Beam**
- **Task 6.2: Analyze Test Results**

Figure 9: Example of Beam Testing [8]

Task 7: Finalize Report & Submit to PCI

- Compile all testing data
- Prepare the beam-testing video for PCI
- Submit the final report and video May 8, 2026

Task 8: Project Impacts

- Evaluate the projects contributions to engineering practice and society
- Proportions of global, societal, economic, and environmental implications.

Figure 10: Project Impact Considerations [9]

Task 9: Deliverables

- **Task 9.1: 30% Project Progress Report and Presentation**
  - Task 1 - Task 2
- **Task 9.2: 60% Project Progress Report and Presentation**
  - Task 2 - Task 4
- **Task 9.3: 90% Project Progress Report and Presentation**
  - Task 4 - Task 7
- **Task 9.4: Final Project Report and Presentation**
- **Task 9.5: PCI Competition Report**

Task 10: Project Management

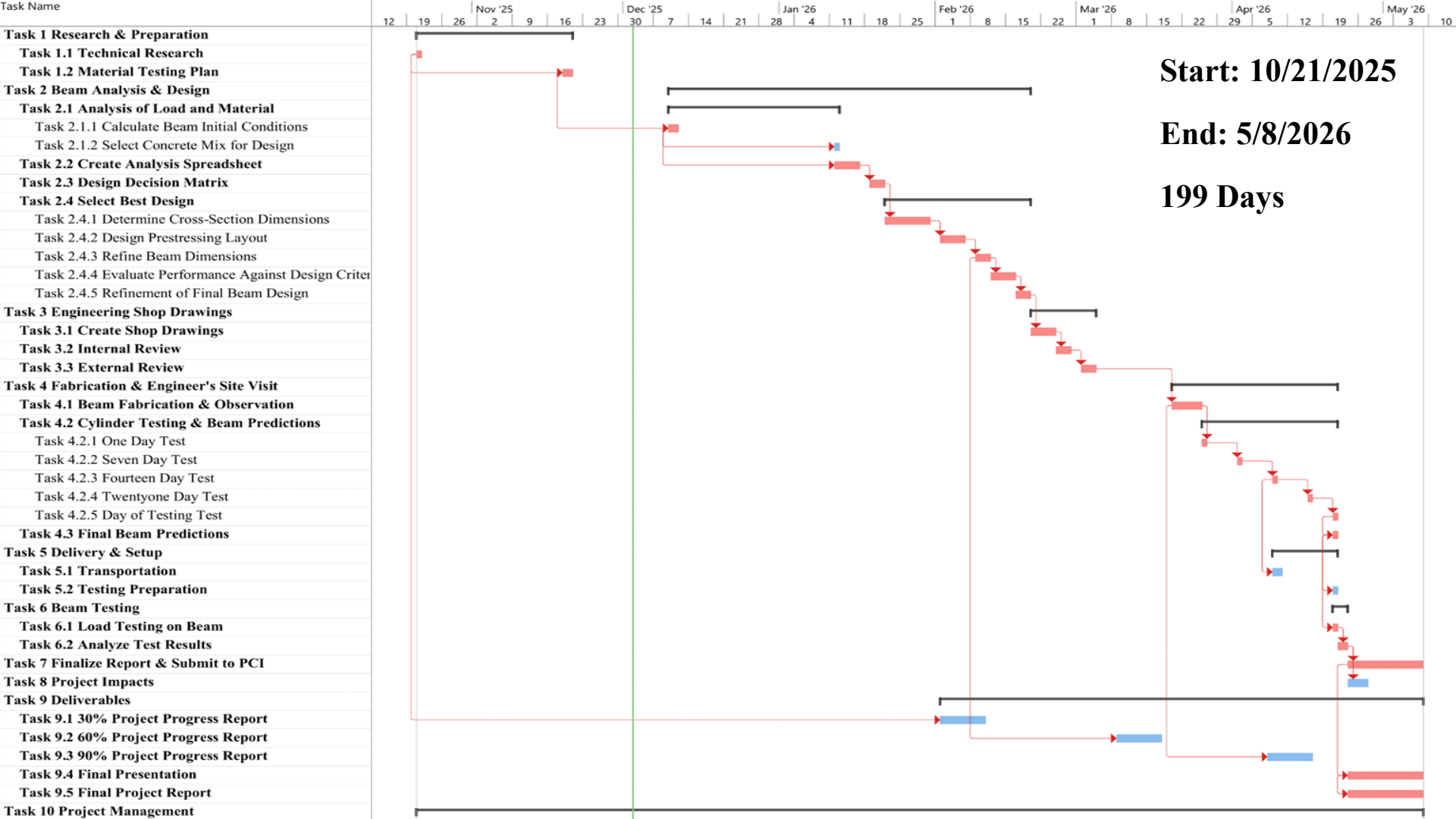
- **Task 10.1: Meetings**
  - Hold weekly meetings with the Technical Advisor before progress report are due. Record and store meeting minutes for documentation
- **Task 10.2: Tracking Project Progress**
  - Continuously update the team schedule, track tasks and subtasks to meet milestones on time and maintain quality
  - Manage resources throughout project

Figure 11: PCI Logo [10]

Exclusions

- Operation of TPAC's production equipment or fabrication of unrelated precast products
- Administrative or logistical tasks not directly tied to this competition beam
- Long-term performance monitoring and non-competition laboratory testing

Figure 12: Tpac Logo [11]


Task Name
Nov '25
Dec '25
Jan '26
Feb '26
Mar '26
Apr '26
May '26
12 19 26 2 9 16 23 30 7 14 21 28 4 11 18 25 1 8 15 22 1 8 15 22 29 5 12 19 26 3 10
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Task 1.1 Technical Research
Task 1.2 Material Testing Plan
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Task 4.3 Final Beam Predictions
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Task 5.1 Transportation
Task 5.2 Testing Preparation
Task 6 Beam Testing
Task 6.1 Load Testing on Beam
Task 6.2 Analyze Test Results
Task 7 Finalize Report & Submit to PCI
Task 8 Project Impacts
Task 9 Deliverables
Task 9.1 30% Project Progress Report
Task 9.2 60% Project Progress Report
Task 9.3 90% Project Progress Report
Task 9.4 Final Presentation
Task 9.5 Final Project Report
Task 10 Project Management
Start: 10/21/2025
End: 5/8/2026
199 Days

Project Staffing Roles

- **Senior Engineer (SENG)**
  - Licensed PE and SE in Arizona with an emphasis in structural analysis and design
  - 17 years of experience in prestressed concrete
- **Structural Engineer (STEG)**
  - Licensed PE in Arizona
  - 8 years of experience in structural design and preparation of shop drawings
- **Engineering Intern (INT)**
  - Enrolled in an ABET-accredited Civil Engineering program
  - 2 years of internship experience
- **Lab Technician (LBT)**
  - 1 year of laboratory experience

Project Staffing Plan

Task Name	SENG	STEG	INT	LBT	Total Hours
Task 1 Research & Preparation	*0*	*10*	*20*	*0*	*30*
Task 1.1 Technical Research		*5*	*10*		
Task 1.2 Material Testing Plan		*5*	*10*		
Task 2 Beam Analysis & Design	*20*	*145*	*82*	*0*	*247*
Task 2.1 Analysis of Load and Material		*20*	*12*		
Task 2.2 Create Analysis Spreadsheet	*5*	*20*	*10*		
Task 2.3 Design Decision Matrix	*5*	*15*	*5*		
Task 2.4 Select Best Design	*10*	*90*	*55*		
Task 3 Engineering Shop Drawings	*5*	*30*	*20*	*0*	*55*
Task 3.1 Create Shop Drawings		*25*	*10*		
Task 3.2 Internal Review	*5*	*5*	*5*		
Task 3.3 External Review			*5*		
Task 4 Fabrication & Engineer's Site Visit	*10*	*6*	*16*	*17*	*49*
Task 4.1 Beam Fabrication & Observation	*2*	*2*	*5*		
Task 4.2 Cylinder Testing & Beam Predictions	*2*	*2*	*6*	*17*	
Task 4.3 Final Beam Predictions	*6*	*2*	*5*		

Figure 13: PCI Big Beam Staffing Plan

Task 5 Delivery & Setup	*5*	*5*	*10*	*5*	*25*
Task 5.1 Transportation		*5*	*5*		
Task 5.2 Testing Preparation	*5*		*5*	*5*	
Task 6 Beam Testing	*6*	*0*	*8*	*0*	*14*
Task 6.1 Load Testing on Beam	*2*		*3*		
Task 6.2 Analyze Test Results	*4*		*5*		
Task 7 Finalize Report & Submit to PCI	*5*	*15*	*40*		*60*
Task 8 Project Impacts	*1*	*2*	*5*	*2*	*10*
Task 9 Deliverables	*8*	*14*	*104*	*0*	*126*
Task 9.1 30% Project Progress Report	*1*	*2*	*16*		
Task 9.2 60% Project Progress Report	*1*	*2*	*16*		
Task 9.3 90% Project Progress Report	*1*	*2*	*16*		
Task 9.4 Final Presentation	*1*	*2*	*16*		
Task 9.5 Final Project Report	*4*	*6*	*40*		
Task 10 Project Management	*5*	*24*	*24*	*24*	*77*
Task 10.1 Meetings	*4*	*20*	*20*	*20*	
Task 10.2 Tracking Project Progress	*1*	*4*	*4*	*4*	
Total Hours	*59*	*234*	*284*	*46*	*693*

Figure 14: PCI Big Beam Staffing Plan (Continued)

Project Cost Estimate

	Unit	Quantity	$/unit	Cost
1.0 Personnel				
SENG	HR	59	$ 275	$ 16,225
STEG	HR	234	$ 140	$ 32,760
INT	HR	284	$ 65	$ 18,460
LBT	HR	46	$ 70	$ 3,220
Total Personnel	HR	693		$ 70,665
2.0 Travel				
Milage Rate	MILE	288	$ 0.15	$ 43
Sedan Rental	DAY	1	$ 40.00	$ 40
Total Travel				$ 83
3.0 Supplies				
Lab Rental+Consumables	DAY	6	$ 100	$ 600
Software Licensing	WEEK	16	$ 93	$ 1,488
Forklift and Operator	HR	2	$ 300	$ 600
Total Supplies				$ 2,688
4.0 Subcontract				
TPAC	LS	1	$ 10,000	$ 10,000
Combined Total				$ 83,436

Figure 15: Cost Estimate for Engineering Services

Citations

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[10] "PCI Big Beam Competition," 2024. [Online]. Available: https://www.pci.org/bigbeam/.

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Thank you!

Any questions?