



2015 PCI Big Beam

NMDE Design Partners

Proposal of Engineering Services

Prestressed/Precast Concrete Institute (PCI)

Who is PCI?

- ▶ Setting the standard in prestressed concrete since 1954
- ▶ Maintains current body of knowledge as industry standard for prestressed design
- ▶ Hosts annual PCI Big Beam Contest
 - Undergraduate/graduate prestressed concrete beam design



PCI Big Beam Competition Overview

► Design Constraints:

- Must work with PCI producer member (TPAC)
- Simply supported, 17' span prestressed concrete beam
- $P_{Cr} > 18.75$ -kips
- Beam must fail between live load of 30-kips and 37-kips

► Design Criteria:

- Total Cost
- Overall Weight
- Ultimate Deflection

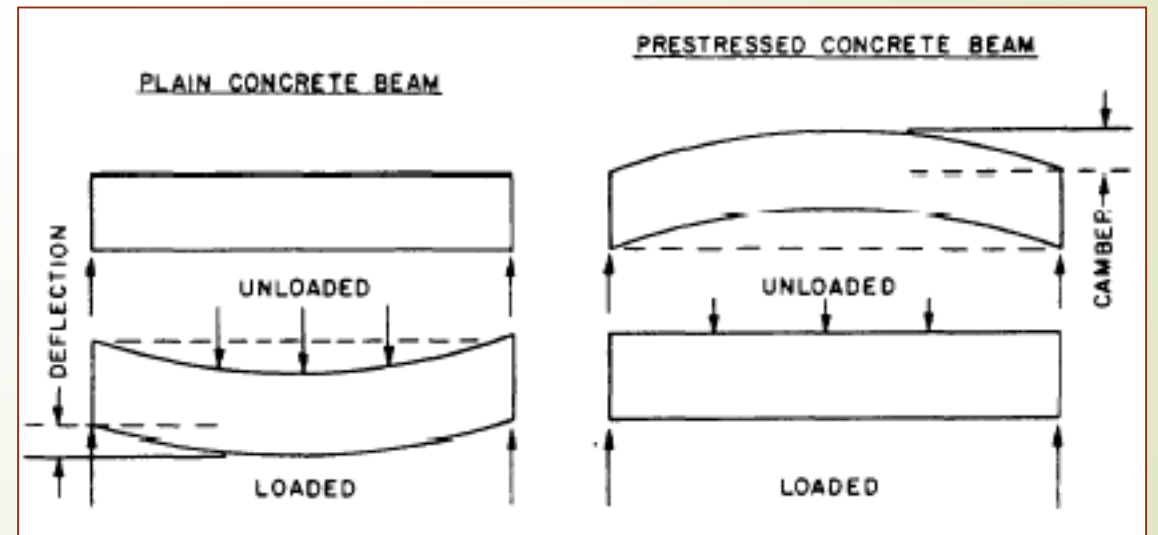


Why Prestressed Concrete ?

- Overcomes concrete's weakness in tension
- Constructability
- Prestressed Method:
 - 1. Stress reinforcement strands
 - 2. Tie together stirrup cage
 - 3. Cast concrete around tensioned cage
 - 4. After 72 – 96 hour cure time, strands are cut



<http://www.tekaz-prefaservis.cz/en/index.php>



<http://www.tpub.com/engbas/7-12.htm>

Prestressed Concrete Design – Technical Considerations

► Mix Design

- Determines: Young's Modulus and Compressive Strength
- Influences: Deflection and weight

► Cross Sectional Shape

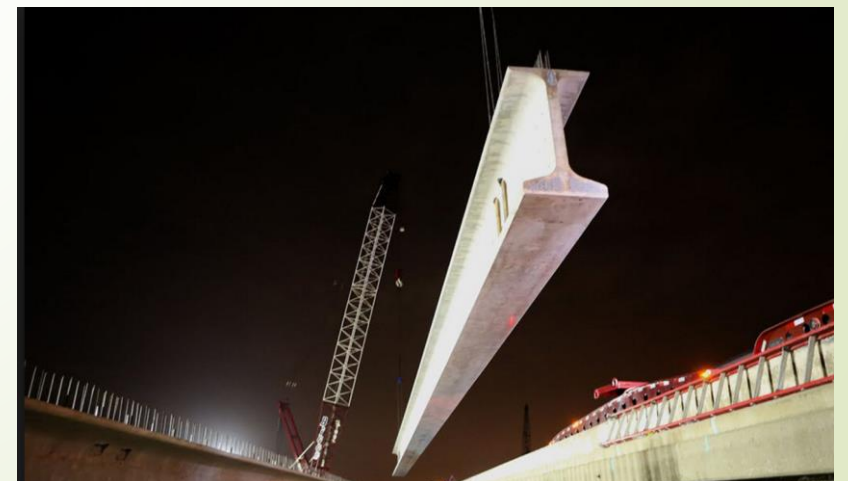
- Determines: Moments of Inertia
- Influences: Cost, deflection, and weight

► Reinforcement Selection

- Determines: Tensile capacity
- Influences: Ultimate flexural capacity and deflection



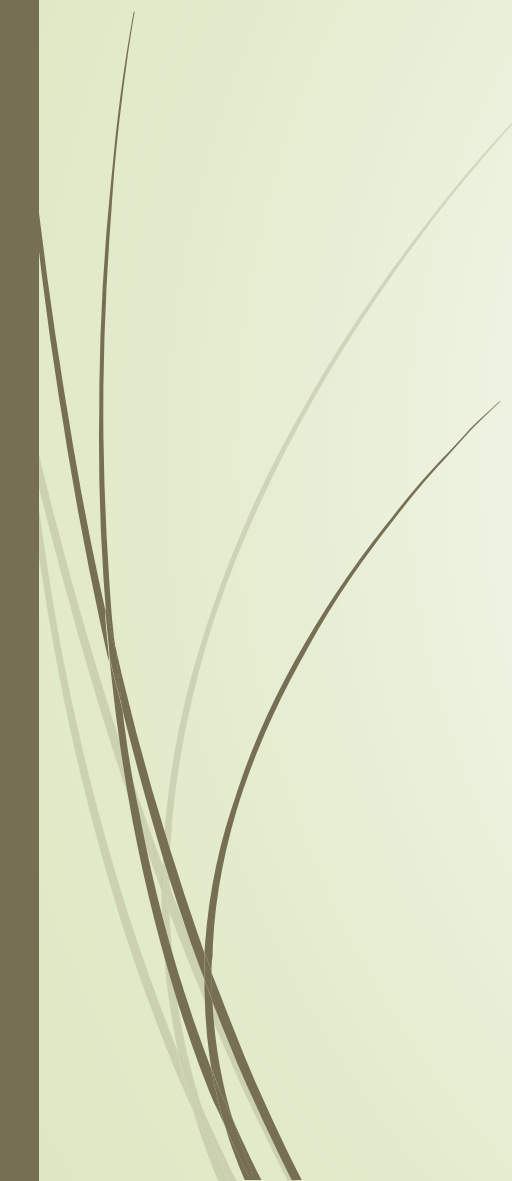
<http://www.allmix.co.uk/>



<http://www.wisegEEK.com/what-is-a-wide-flange-beam.htm#didyouknowout>

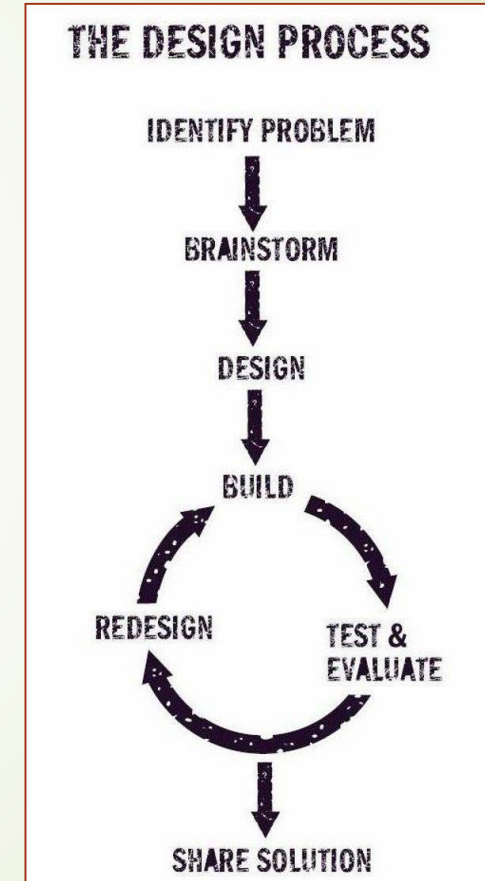


Scope of Work

- Task 1.0 – Pre-stressed Beam Design
 - Task 2.0 – TPAC Beam Manufacturing
 - Task 3.0 – Testing and Analysis
 - Task 4.0 – Project Management
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Task 1.0 – Prestressed Beam Design

- ▶ Sub Task 1.1: Evaluating Mix Designs
 - Compressive strength vs. cost vs. weight
- ▶ Sub Task 1.2: Evaluating Suite of Beam Cross Sections
 - Wide flange, rectangular, T-shaped
- ▶ Sub Task 1.3: Reinforcement Placement
 - 7-strand, ½" inch diameter
 - Placement optimized to maximize capacity
- ▶ Sub Task 1.4: Prediction of Results
 - Deflection, ultimate capacity, cracking moment



Task 2.0 – TPAC Beam Manufacturing

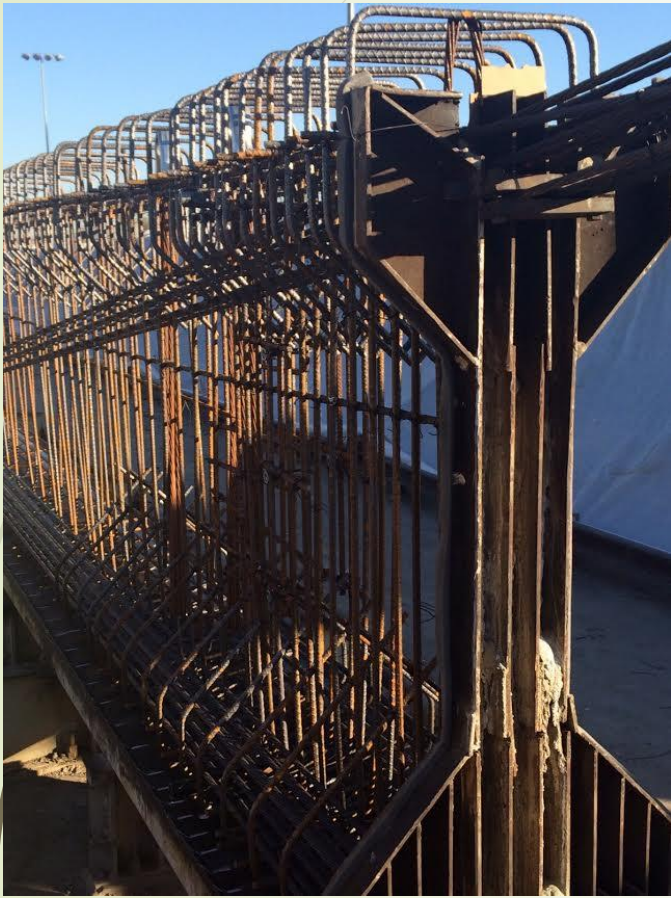


Figure 1: Prestressed Strands with RC stirrup cage



Figure 2: Casting Beds with Anchored Strands

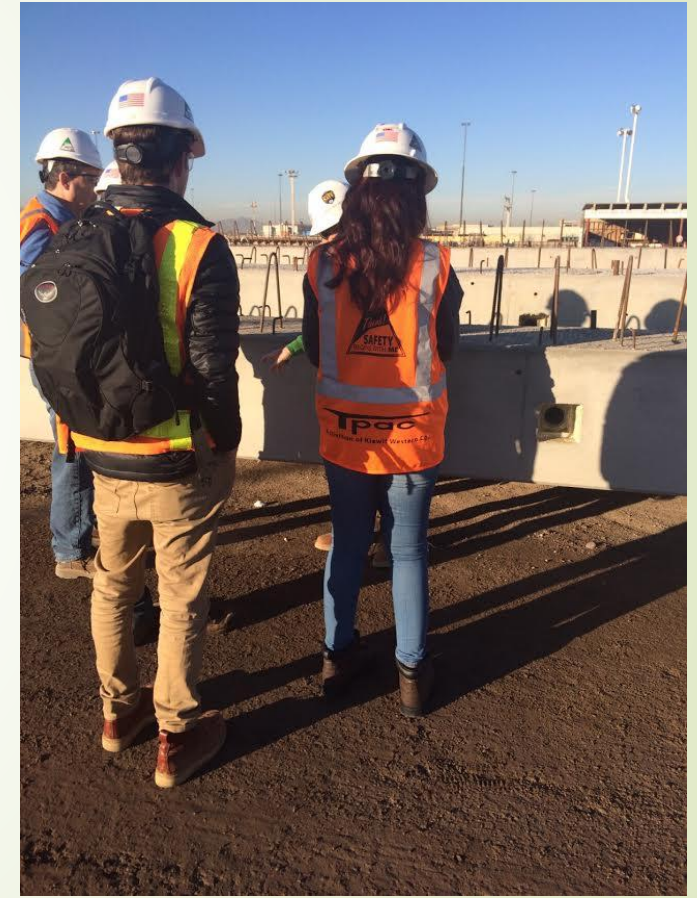


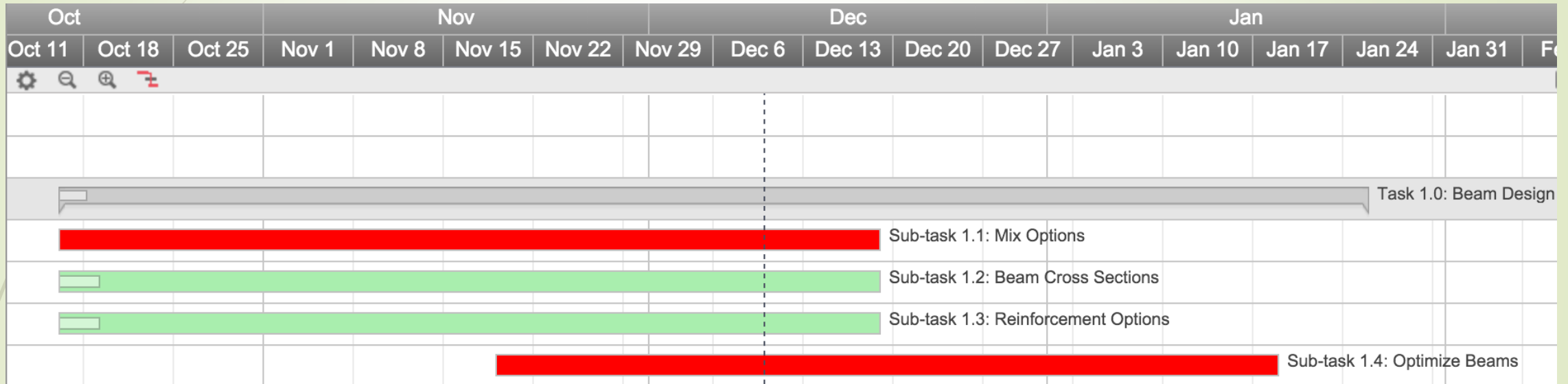
Figure 4: NAU PCI team and TPAC prestressed beam

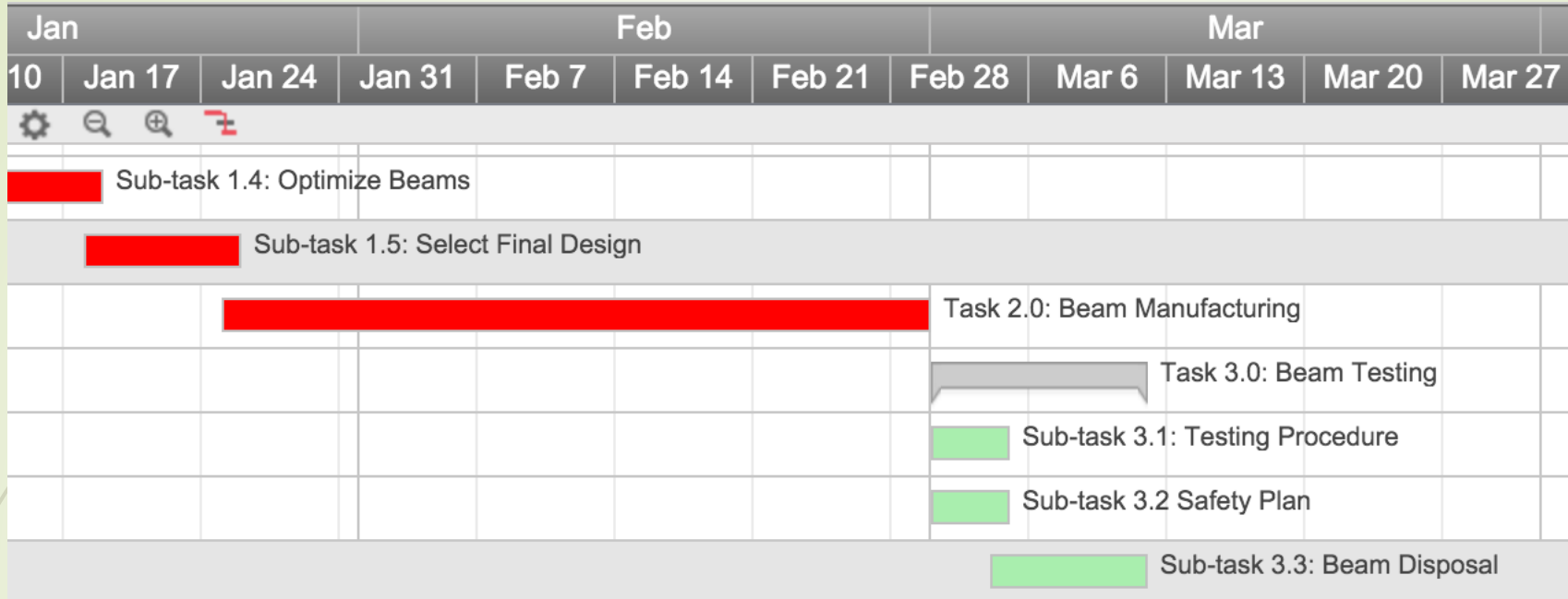
Task 3.0 – Testing and Analysis

- Beam Set Up
 - Set gages and safety equipment
- Testing
 - Apply load to failure
 - Record test with video
- Disposal
- Data Retrieval and Calculations
 - Analyze data from strain/force gages
 - Compare to predictions

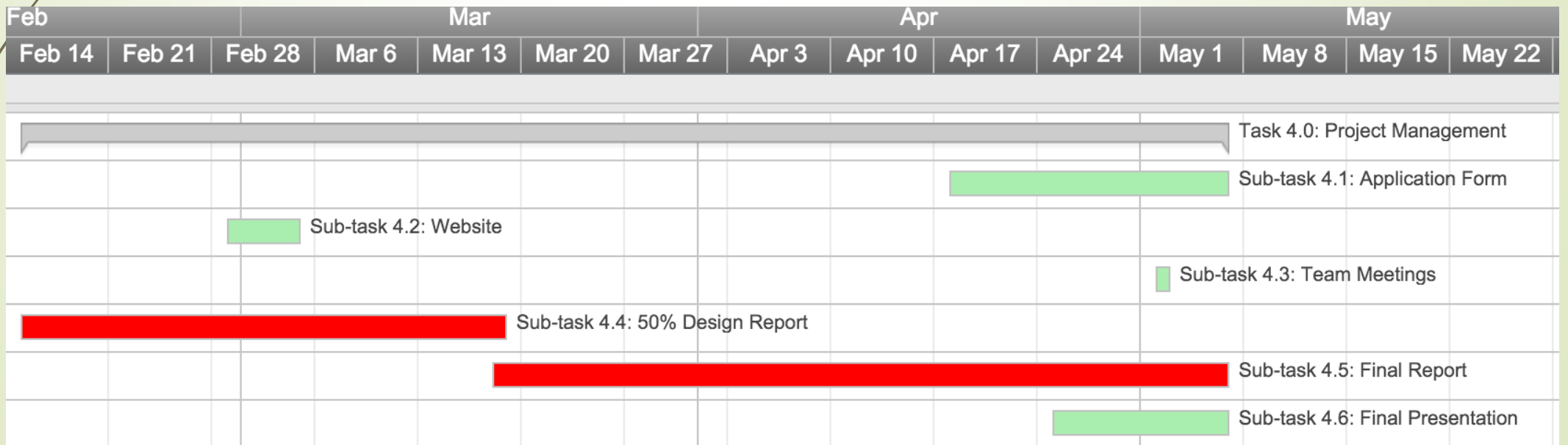


Project Schedule – Part 1





Part 2



Proposed Project Hours

PCI Big Beam Total Billable Hours				
Task	Hours SENG	Hours ENG	Hours AA	Hours INT
Task 1.0 Beam Design	60	94	25	123
Task 1.1 Deam Cross Sections	18	30	9	38
Task 1.2 Reinforcement Options	18	27	7	33
Task 1.3 Optimize Beam	9	22	7	40
Task 1.4 Select Final Design	15	15	2	12
Task 2.0 Beam Manufacturing	12	15	3	22
Task 3.0 Beam Testing	22	30	15	37
Task 4.0 Project Management	59	30	52	15
Total	153	169	95	197

Project Total:

614 hours

Billing and Project Cost

Billing Breakdown Table	
Position	Rate
Senior Engineer (SENG)	\$175
Project Engineer (ENG)	\$75
Administrative Assistant (AA)	\$60
Intern (INT)	\$50

Total Project Cost				
	Classification	Hours	Rate, \$/hr	Cost, \$
1.0 Personnel	SENG	153	175	26,775.00
	ENG	169	75	12,675.00
	AA	95	60	5,700.00
	INT	197	50	+ 9,850.00
	Total			= \$55,000
2.0 Travel	2 trips to Phoenix at 286 mi/trip		\$0.445 per mile	+ \$254.00
3.0 Project Total				= \$55,254.00

Questions?



University of
Phoenix Stadium,
Home of the
Arizona Cardinals

http://www.tpacaz.com/index.php?option=com_content&view=article&id=87&Itemid=7