FHWA Fellowship: Eisenhower Deep Beam

Presented by:
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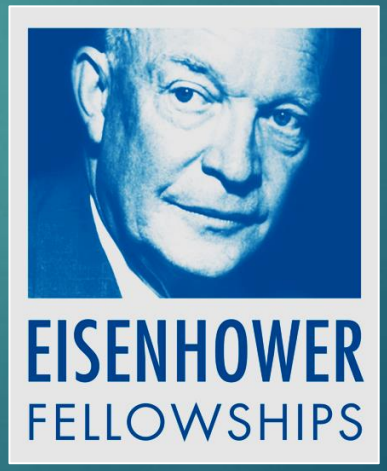
FHWA Requirements

- Project Proposal
- Abstract Submittal
- Poster Presentation
- Attendance at TRB conference in Washington D.C.
- Final Report of Findings



Project Description

- *Objective*: To quantify the amount of steel fibers necessary to supplement the conventional reinforcement required for deep beams by AASHTO
- Testing for crack width sizes
- To meet FHWA requirements

Propex Novocon 1050 Fibers From Google Images

Background

- What is a deep beam?
  - Has a low span-to-depth ratio
    - (a/d) < 2.0
- "Serviceability performance" is quantified as the rate of growth of the width of the maximum diagonal crack
- Demand for deep beam research

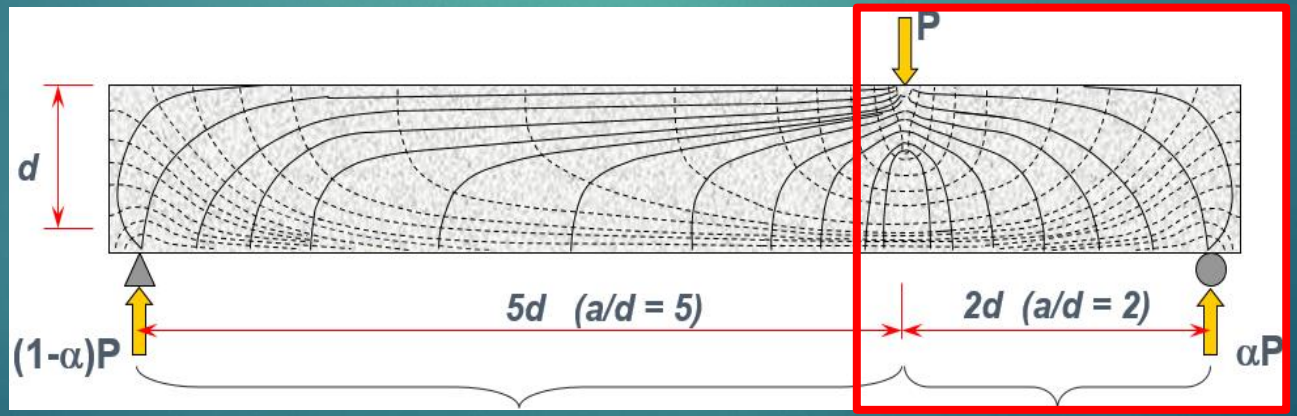
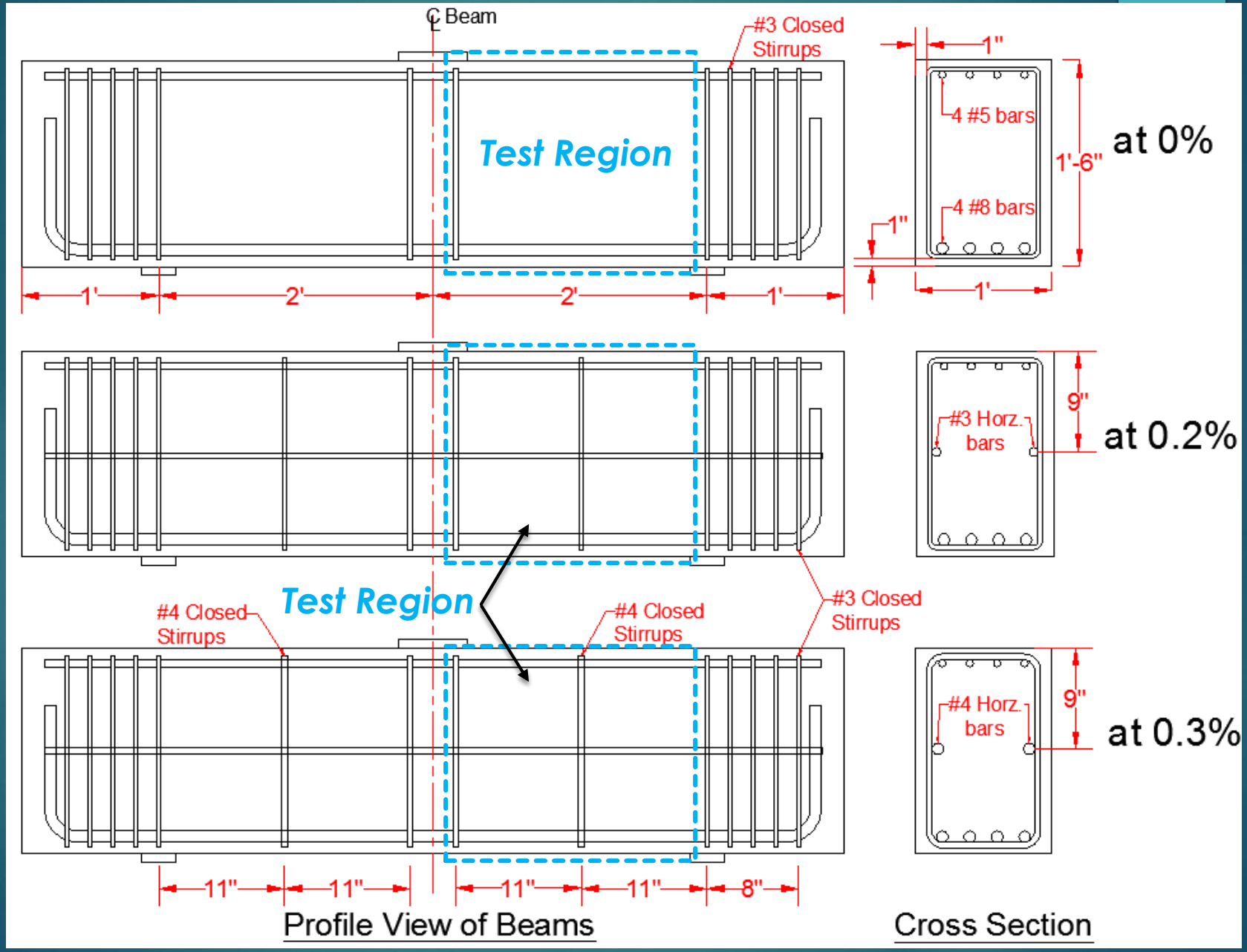


Image-Robin Tuchscherer, PhD, PE (PI)

Beam Designs



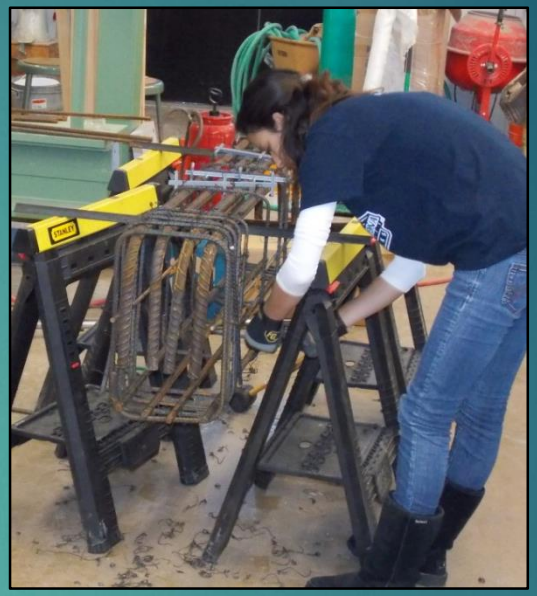
Design Variables

- The maximum diagonal crack width will be measured for all specimens at multiple load increments up to approximately 75% of their ultimate capacity

SPECIMEN	TRANVERSE REINFORCEMENT RATIO	FIBER PERCENTAGE
1	0.3% each way	0%
2	0.2% each way	
3	0% each way	
4	0.3% each way	0.5%
5	0.2% each way	
6	0% each way	
7	0.3% each way	1.0%
8	0.2% each way	
9	0% each way	

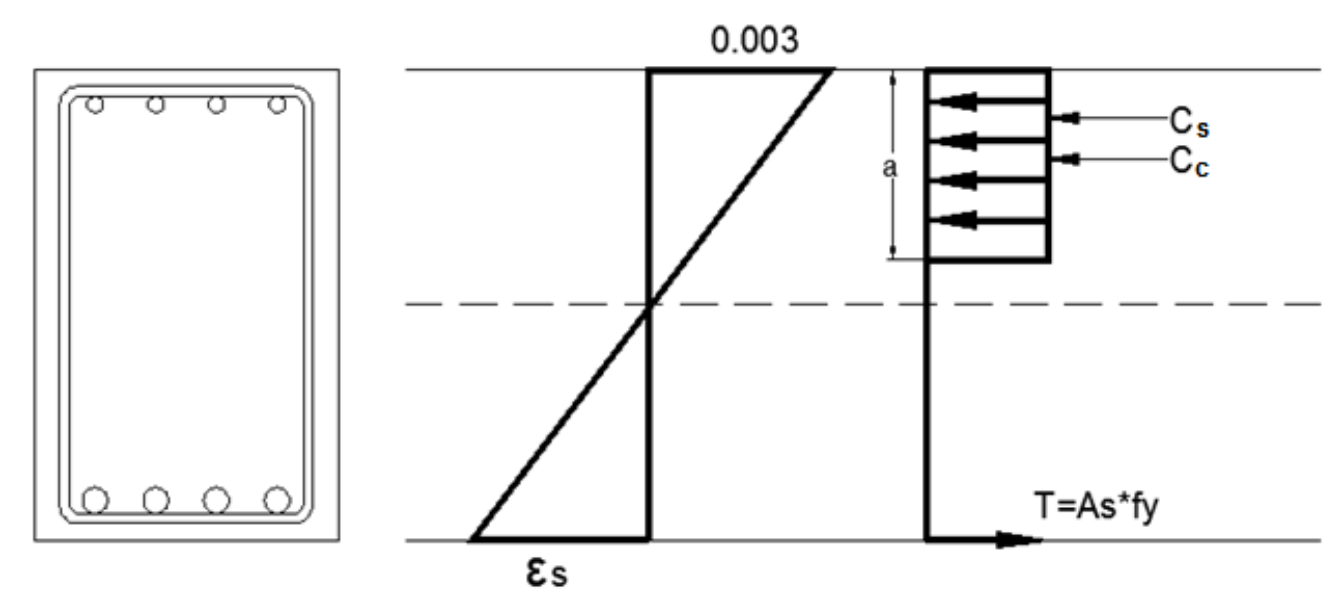
Fabrication

- Formwork
- Tie Rebar Cages
- Placement of Concrete
- Curing Process

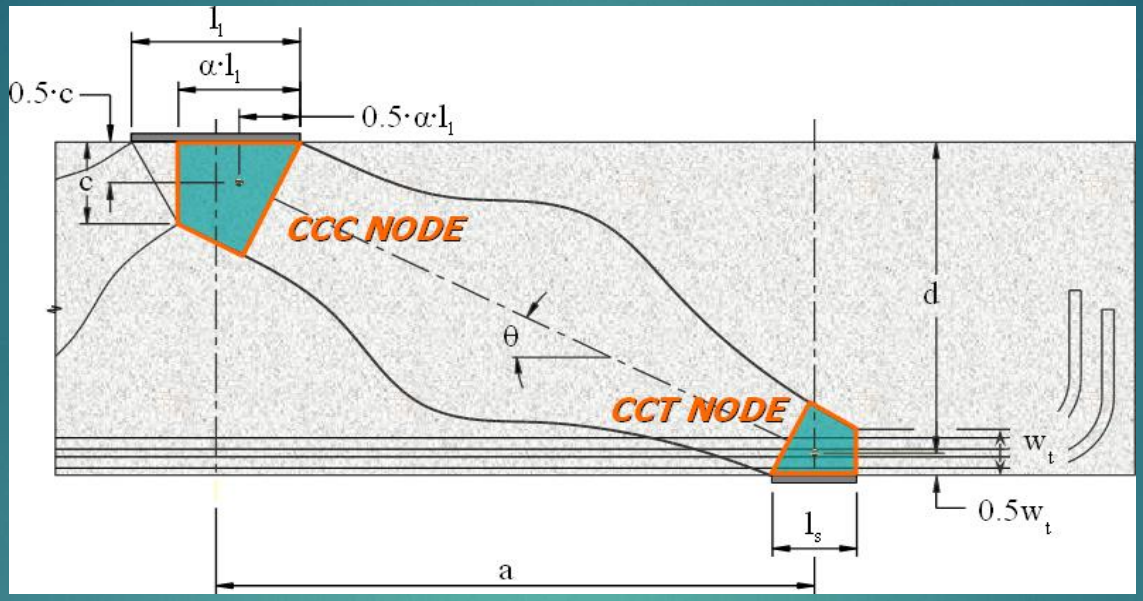


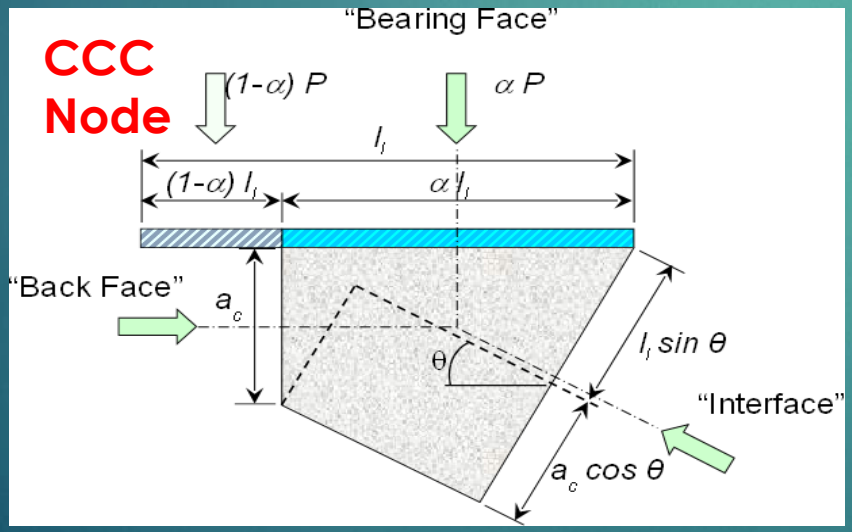
Beam Failure Analysis

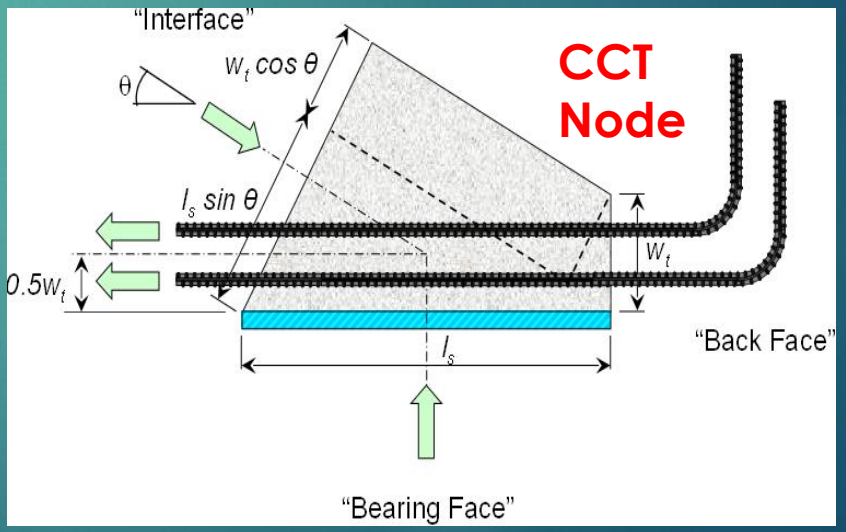
- Done before testing beams
- For determining the strength of a beam before a bending or flexural failure



Beam Failure Analysis







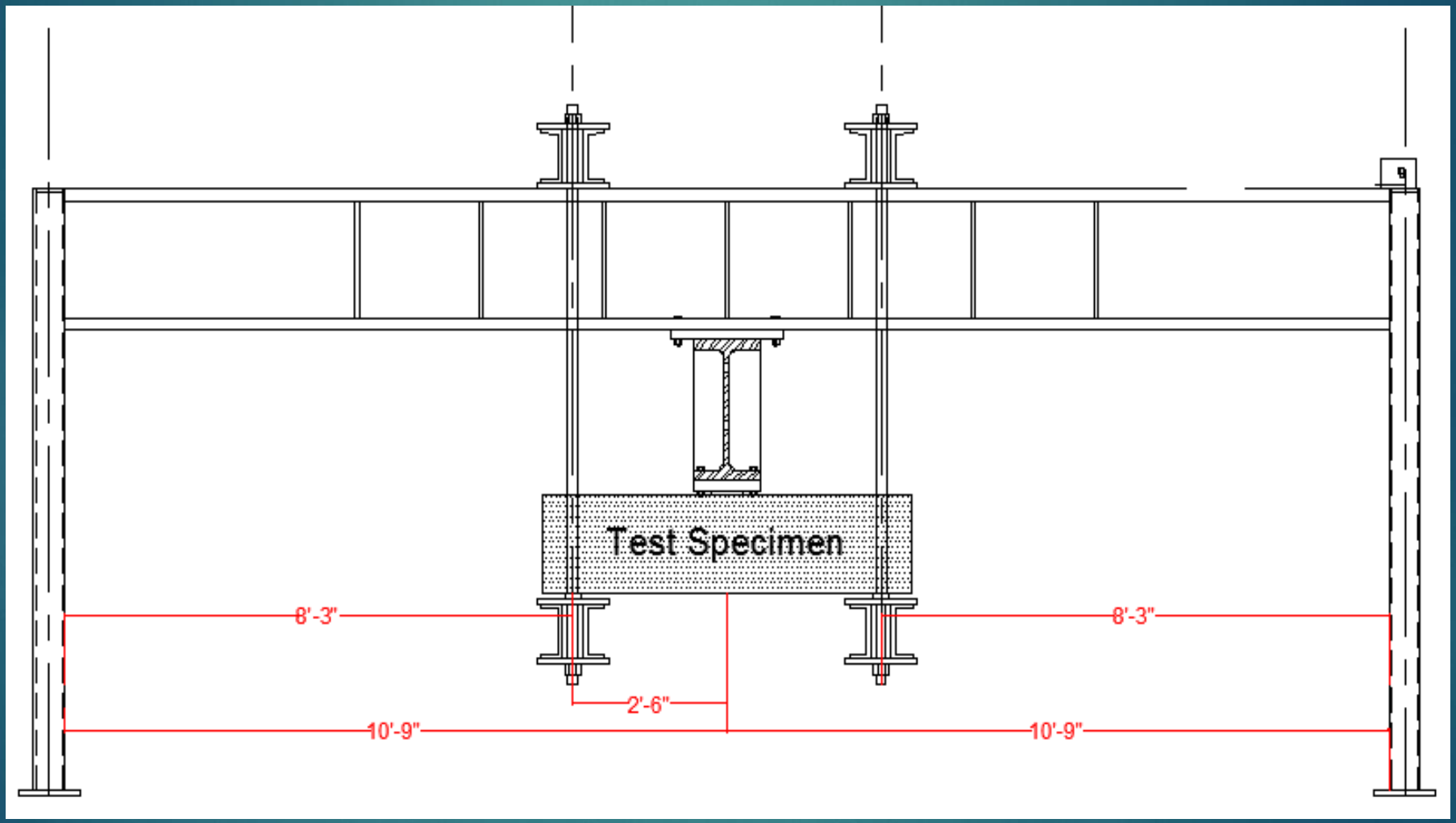
All Images-Robin Tuchscherer, PhD, PE (PI)

Testing and Analysis

- The lowest shear strength value determined was 106.97 kips

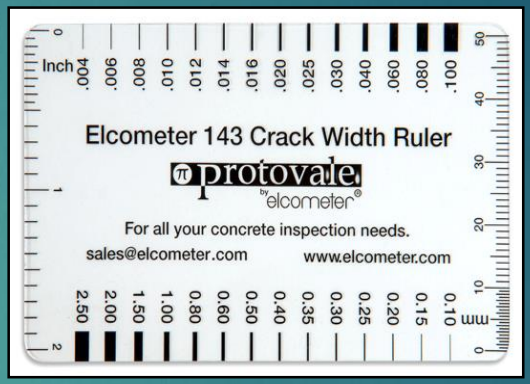
Shear Strength Equations	Resulting Shear Value, Vn
$Vn = f_{ce}*A_{nz}=0.85(1.0)(4.38ksi)(3")(12")$	133.93 kips
$Vn/\tan\theta = f_{ce}*A_{nz}=0.85(1.0)(4.38ksi)(2.98")(12")$	189.29 kips
$Vn/\sin\theta = f_{ce}*A_{nz}=0.85(0.75)(4.38ksi)(12")(5.02)$	168.20 kips
$Vn/\sin\theta = f_{ce}*A_{nz}=0.85(0.6)(4.38ksi)(5.02)(12")$	134.56 kips
$Vn = f_{ce}*A_{nz}=0.85(0.8)(4.38ksi)(3")(12")$	**106.97 kips**
$Vn/\tan\theta = fy*As = (60ksi)(3.16\ in^2)$	189.6 kips
$Vn/\sin\theta = f_{ce}*A_{nz}=0.85(0.6)(4.38ksi)(4.78)(12")$	127.98 kips

Testing-Setup



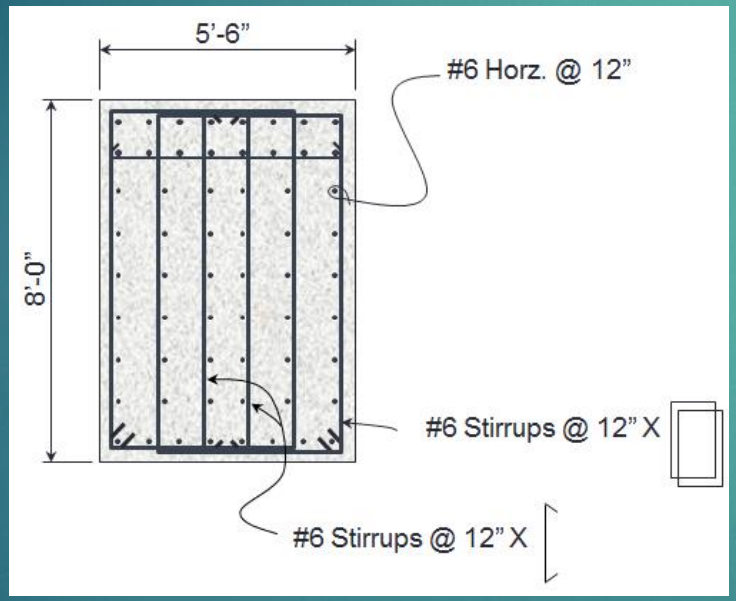
Testing-Setup

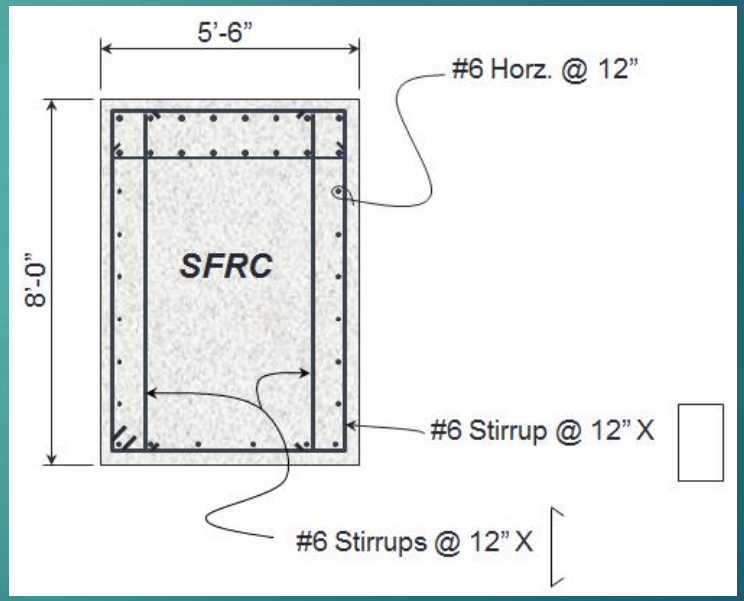
- Widths of any cracks created within the test region will be measured using a crack width ruler



Prediction

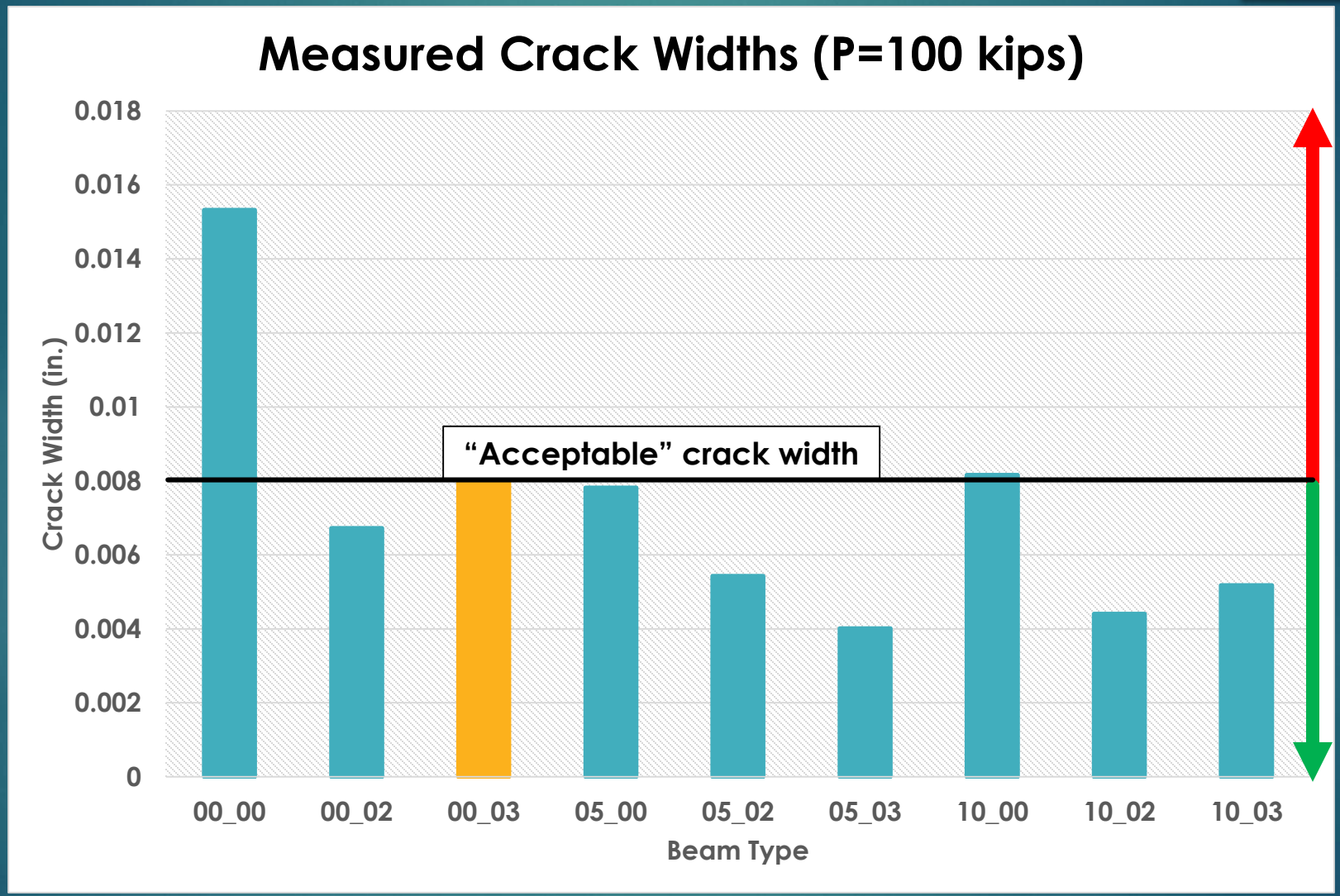
- The effect of incorporating steel fibers within a concrete mix design could potentially result in smaller crack widths and a reduction in the complexity of fabrication.





Images-Robin Tuchscherer, PhD, PE (PI)

Results



= AASHTO LRFD req'd stirrups

Results are good!

Summary of Project Costs

Personnel	Hours	Billable Rate, $/hr	Cost, $
Senior Engineer	45	$98.00	$4,410.0
Designer/Drafter	20	$36.00	$720.00
Construction Worker	80	$29.00	$2,320.00
Lab Technician	36	$36.00	$1,296.00
Analyst	30	$29.00	$870.00
		TOTAL	**$9,616**

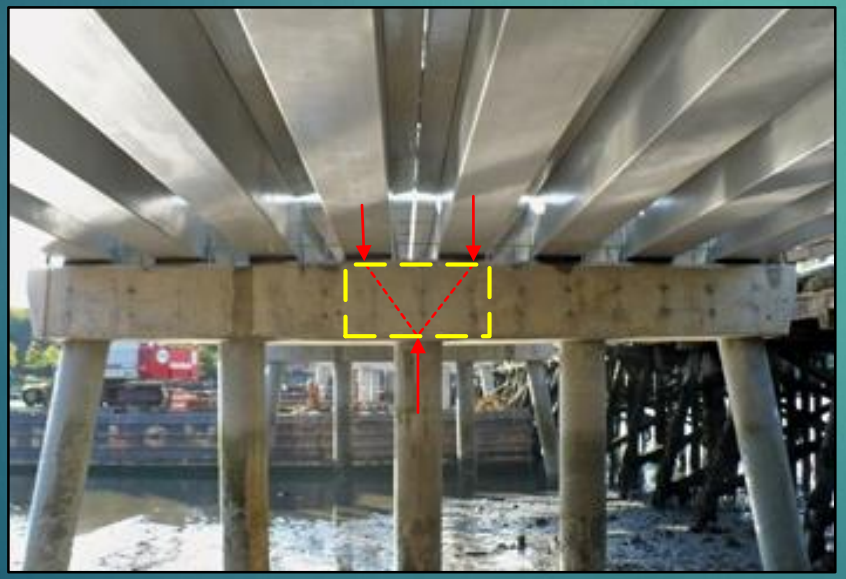
ITEM	COST
wood	$700.00
steel	$600.00
insulating blankets	$170.00
concrete vibrator (rental)	$130.00
concrete	$450.00
steel fibers	$460.00
Bolsters	$50.00
Lifting Inserts	$20.00
travel expenses	$1,500.00
TOTAL	**$4,080**

Total Cost of Project=

$13,696

Impacts

- Average lifespan= 50 years; Actual= 43 years
- Safety, serviceability, and longevity
- To potentially reduce costs of infrastructure repairs and bridge restoration; more economical



http://https://www.fhwa.dot.gov/publications/publicroads/11julaug/04.cfm/

http://reganwolfrom.wordpress.com/2010/05/05/disraeli-project-an-unnecessary-expropriation/

Acknowledgements

- Federal Highways Administration (FHWA)
- Dr. Robin Tuchscherer (Technical Advisor)
- Dr. Jun Ho (Project Manager)
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- Reinforced Concrete class-Fall 2013

ANY QUESTIONS ???