

Strength Testing and Analytical Modeling of Reinforced Autoclaved Aerated Concrete Lintels

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Supporting programs: EPSCoR & Honors**

Autoclaved Aerated Concrete

○ What is AAC?

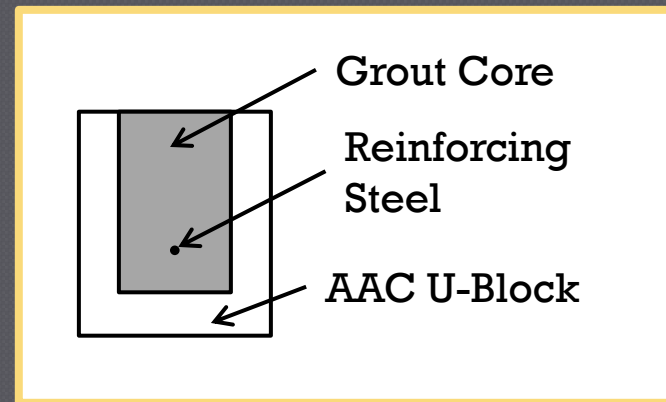
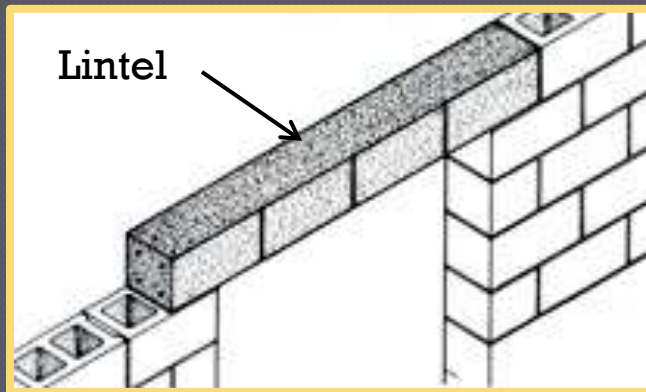
- Lightweight, cellular
- Made of cement, sand, lime, water, and expansive agents
- Steam cured
- Autoclaved at 150 psi

Autoclaved Aerated Concrete

- High-quality building material
 - Fire resistance
 - Low-density
 - High thermal efficiency
 - Acoustic damping

Masonry Lintels

- Lintels horizontally span wall openings (such as doors and windows)
- Carry load from the wall above and distribute it across the opening
- Standard grouted U-block construction with longitudinal steel



Previous Research at UW

○ Nathan Stroud

- Strength testing of AAC lintels
- Evaluated strength contribution of AAC blocks

Research Goals

◉ Additional construction

- 1, 6ft beam
- 1, 8ft beam

◉ Testing

- Four-point bending

◉ Predict behavior

- Displacement
- Design

Construction

○ Construction of lintels

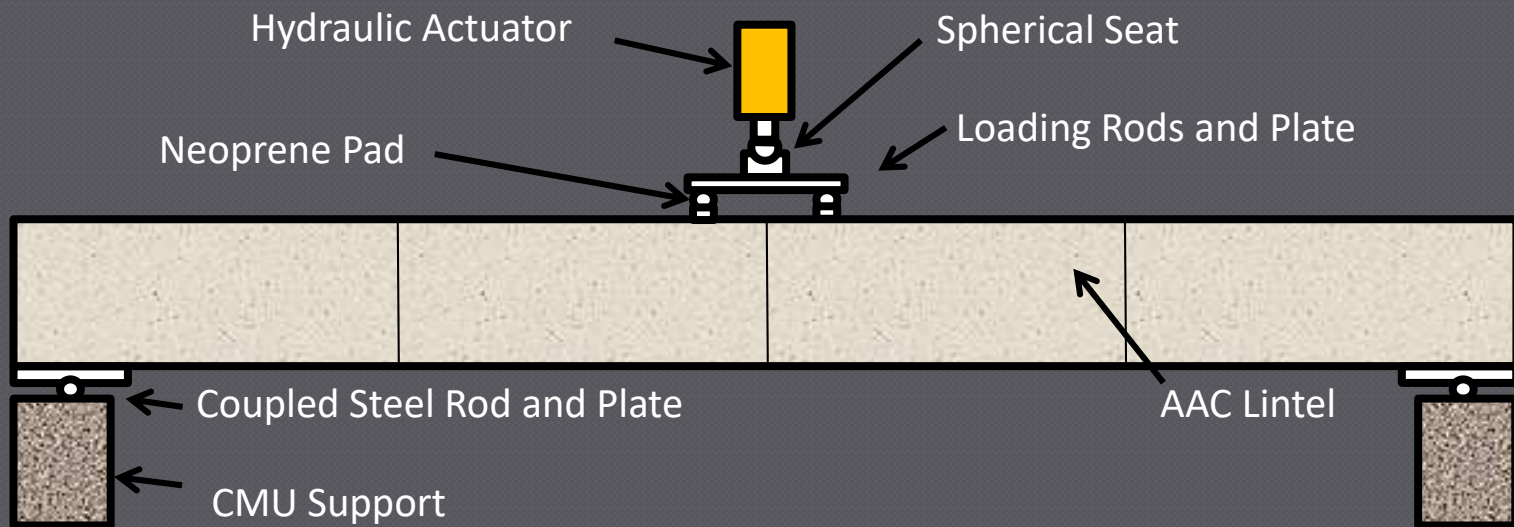
- Thin-set mortar
- Grout mixing
- AAC U-block preparation
- Curing



Testing

○ Four point bending

- Force applied and displacement measured



Testing

- Masonry class demonstration



Testing

○ Basic concrete beam behavior

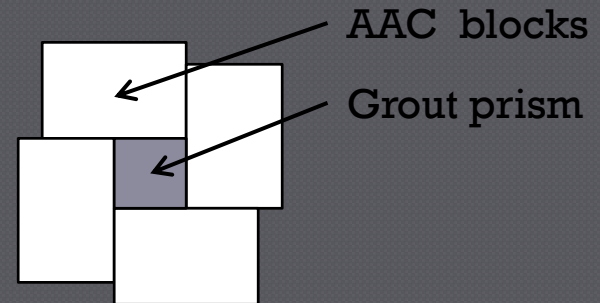
- Initial cracking
- Loss of grout
- Reinforcing steel



Companion Material Testing

○ Grout Prisms

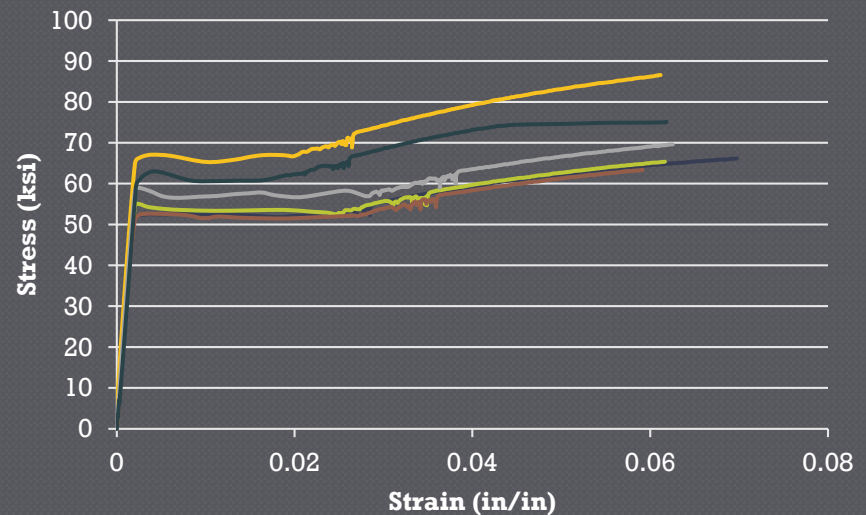
- Replicate water absorption
- Tested for compressive strength



○ Reinforcing Steel

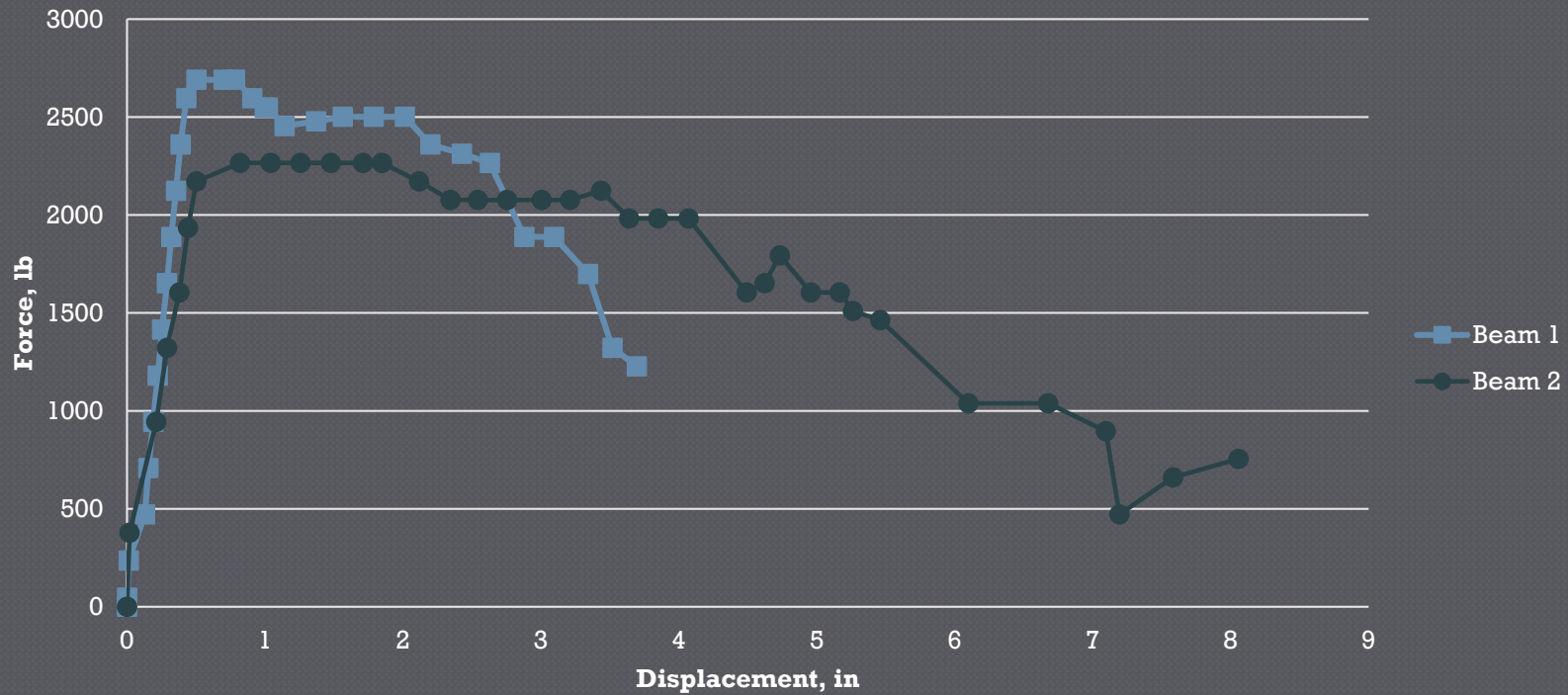
- Strain gauges
- Tested for tensile strength
- Grade 50 and 60

Steel Reinforcing Stress Strain Curve



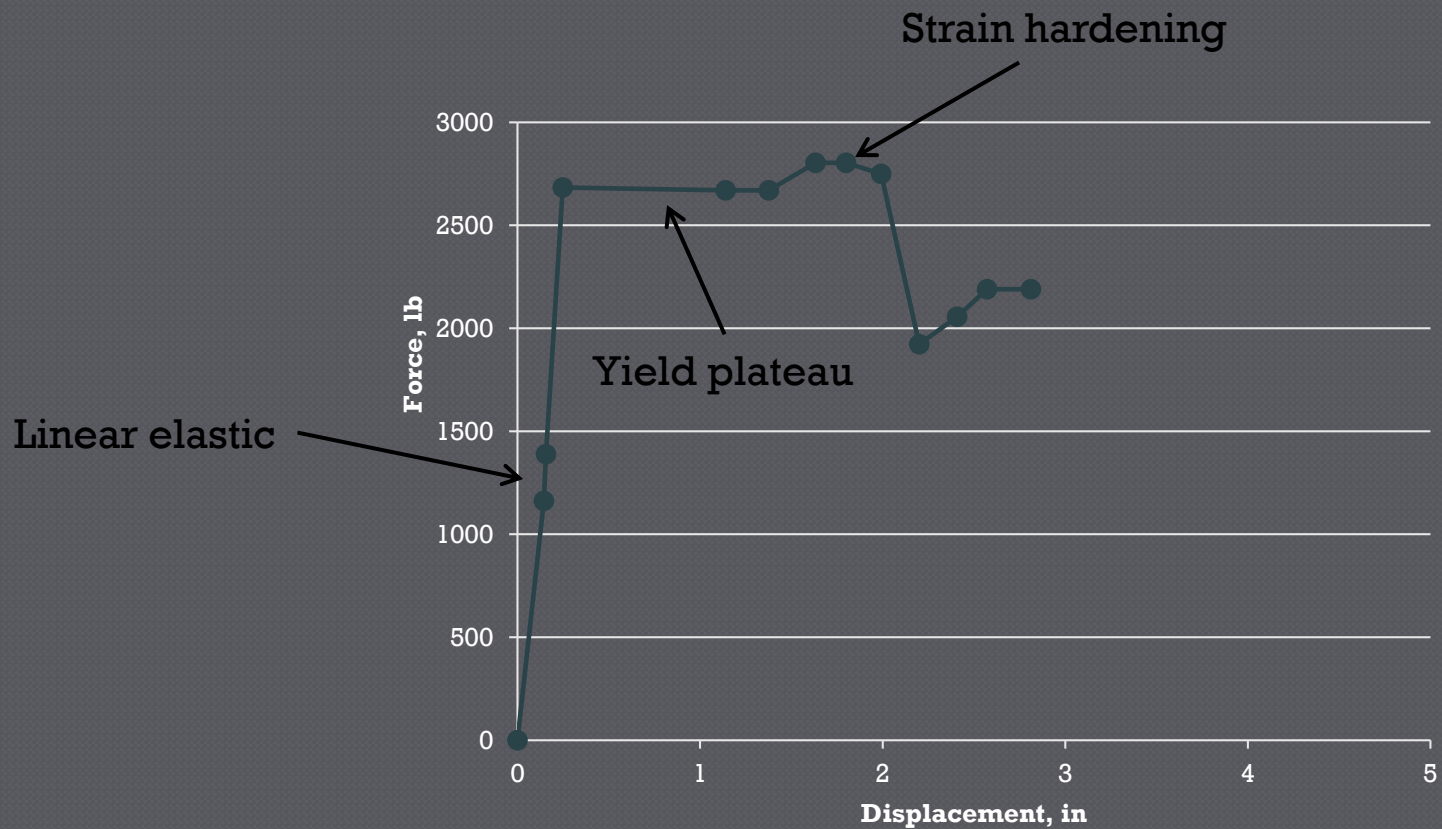
Analysis

Force displacement data



Analysis

Reinforcing steel yields



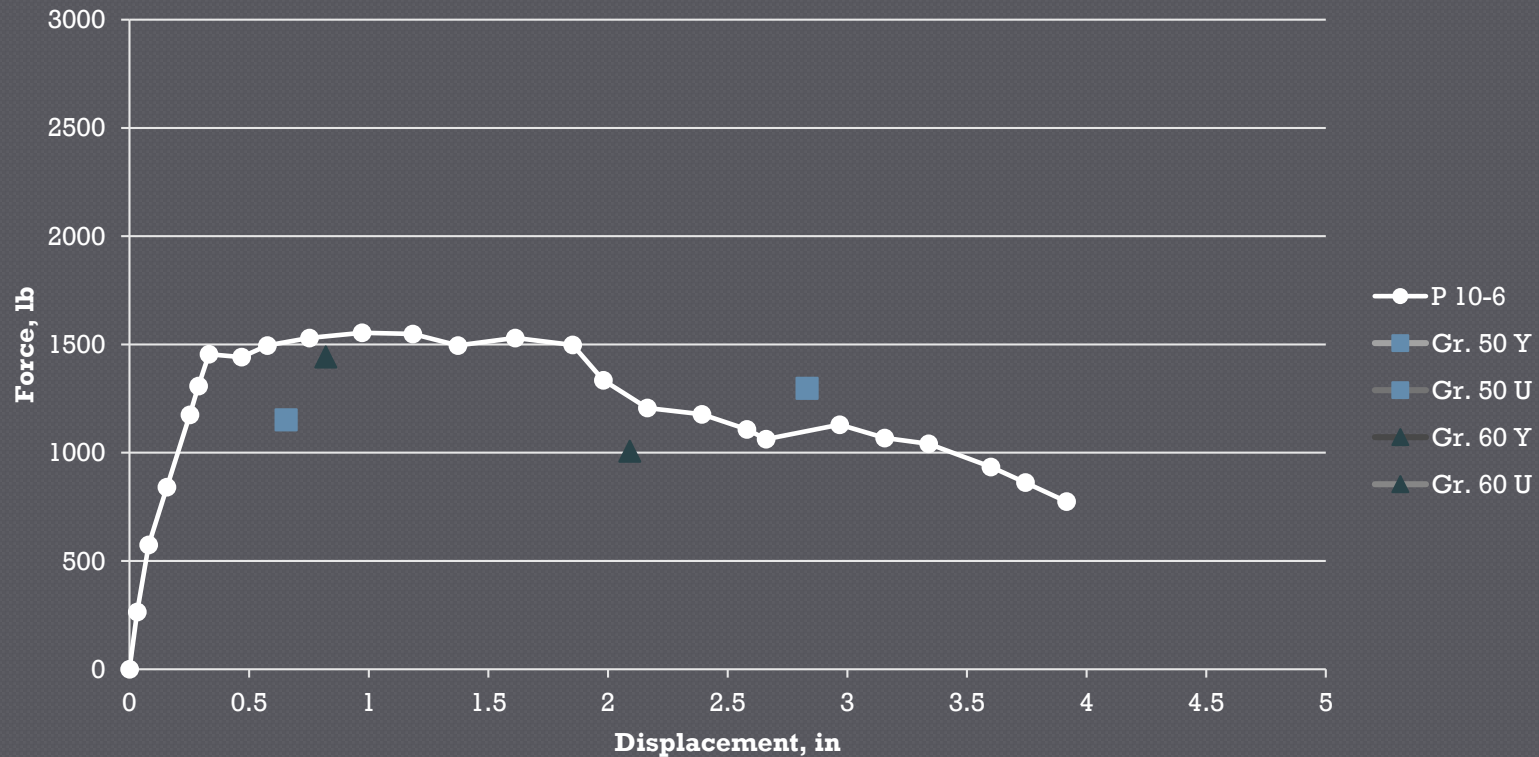
Modeling

- Moment curvature analysis
- Predict displacement
 - Yield and Ultimate
 - Grade 50 and 60 steel
- Assumptions
 - Reinforcing steel yields
 - Plastic hinge length

$$\Delta = \frac{PL^3}{3EI_{cr}} + (\Phi_{ult} - \Phi_y)l_p \mathbf{L}$$

Results

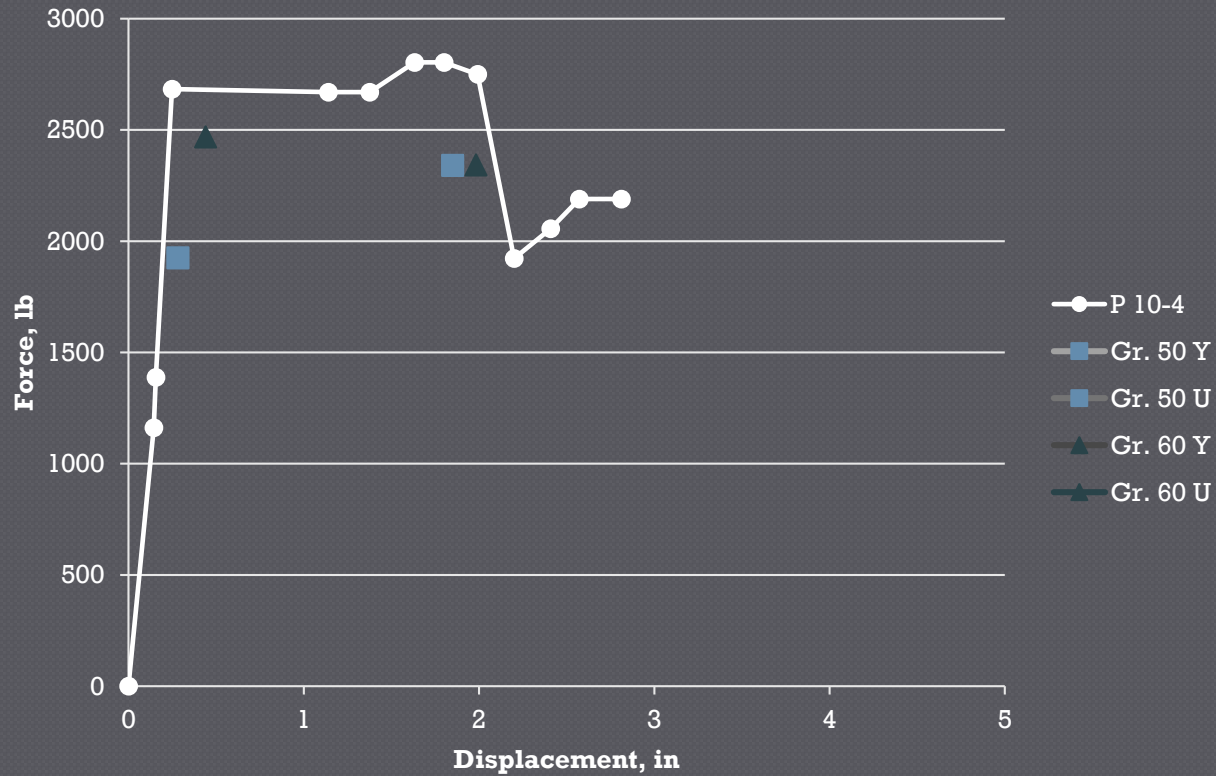
Force-Displacement Behavior and Predictions



$$\Delta = \frac{PL^3}{3EI_{cr}} + (\Phi_{ult} - \Phi_y) l_p \mathbf{L}$$

Results

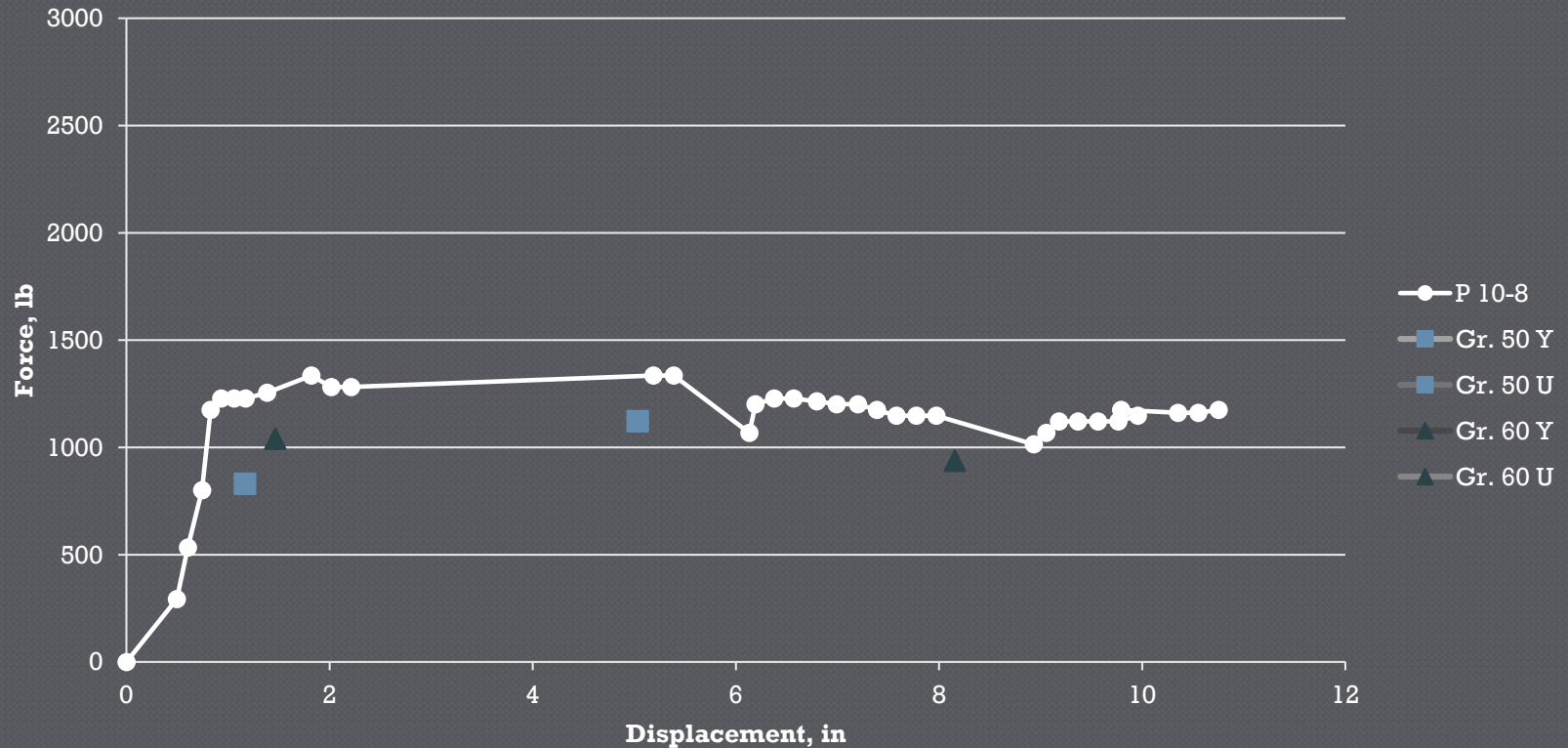
P 10-4



$$\Delta = \frac{PL^3}{3EI_{cr}} + (\Phi_{ult} - \Phi_y)l_p \mathbf{L}$$

Results

P 10-8



$$\Delta = \frac{PL^3}{3EI_{cr}} + (\Phi_{ult} - \Phi_y) l_p \mathbf{L}$$

Conclusions

- Plastic Hinge Length
 - Varied between 10% and 20%
- Reinforcing Steel
 - Grade 60
- Actual Capacity vs Predicted Capacity
 - Greater actual capacity
 - Neglected AAC contribution

Thanks

- ◉ NSF EPSCoR
- ◉ Dr. Jennifer Tanner Eisenhauer

Questions?
