High Performance Earthquake Simulation at the University at Buffalo

UB Node of NEES

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Acknowledgements

- ◆ National Science Foundation
  - ▪ Dr. Joy Pauschke
  - ▪ Dr. Galip Ulsoy
  - ▪ Dr. Priscilla Nelson
- ◆ State of New York
- ◆ University at Buffalo
  - ▪ Dean Mark Karwan
- ◆ MTS
  - ▪ Dr. Omar Rood
  - ▪ Mr. Jeff Lundbeck

Major Components of UB-NEES

- ◆ New laboratory
- ◆ New hydraulic power supply
- ◆ New 6 DOF earthquake simulators (2)
- ◆ New dynamic actuators (3)
- ◆ New high capacity static actuators (2)
- ◆ New testing capabilities
  - One of the most versatile large scale earthquake engineering facilities

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Building and Equipment Summary

- ◆ Building expansion
  - 1200 m^2
- ◆ Strong floor
  - 320 m^2
- ◆ Reaction walls
  - 180 m^2
- ◆ Reaction mass: 10,000 T
- ◆ 6 dof simulators (2)
- ◆ 100 T dynamic actuators (3)
- ◆ 200 T static actuators (2)

- ◆ Hydraulic power supply
  - 6050 lpm
- ◆ Controllers
- ◆ Video recording network
- ◆ Data acquisition network
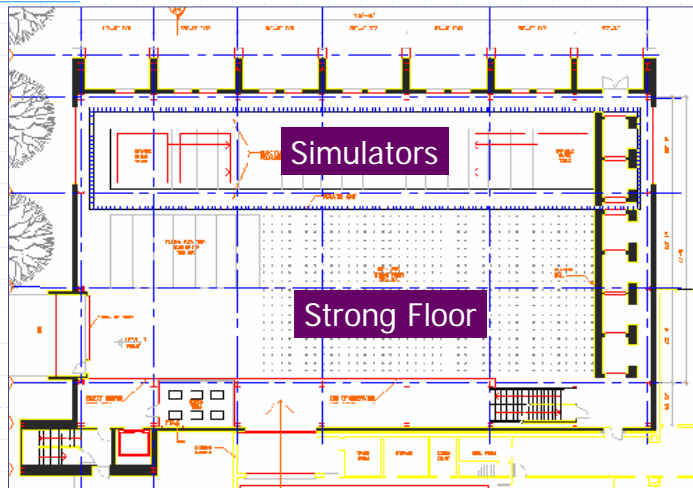- ◆ LAN for experimentation, data processing and simulation

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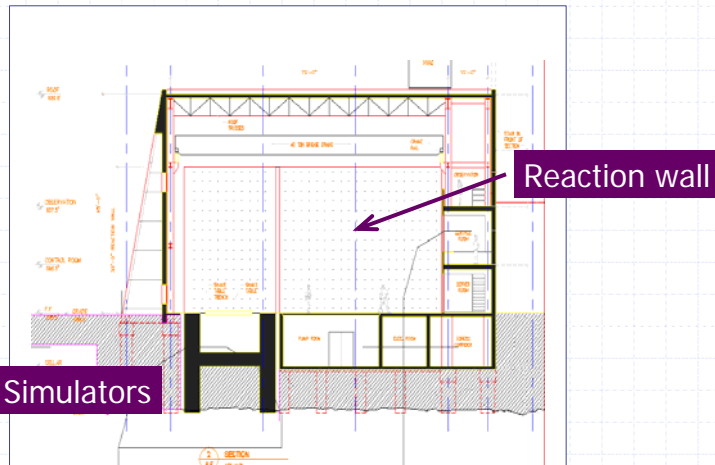
Ketter Hall Expansion

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Ketter Hall Expansion

Simulators

Strong Floor

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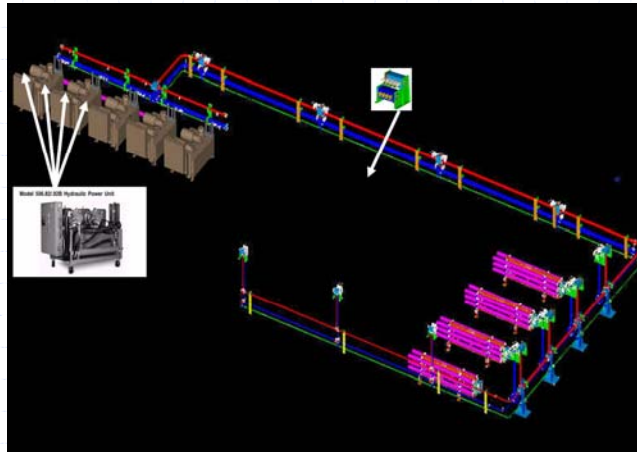# Ketter Hall Expansion

Reaction wall

Simulators

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Hydraulic Power Supply

- Four hydraulic pumps of 700 lpm each
- Surge tank and 14 no. 190 litre accumulators
- Continuous supply of 6050 lpm for 30 seconds of seismic motion
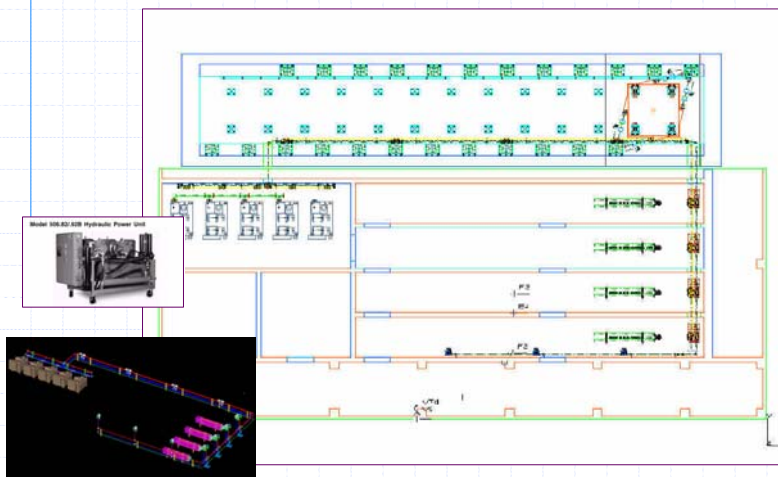- 6050 lpm of main distribution line

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Hydraulic Power Supply

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Hydraulic Power Supply

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Simulator Details

- Platform: 3.6 m x 3.6 m
- Platform weight: 8 T
- Maximum stroke
  - X, Y = 150 mm
  - Z = 75 mm
- Maximum velocity
  - X, Y = 1250 mm/s
  - Z = 500 mm/s
- Maximum acceleration
  - X , Y = 1.15 g
  - Z = 1.15 g

- Degrees of freedom: 6
- Maximum specimen weight:
  - 20 T nominal
  - 50 T maximum
- OTM capacity: 46 T-m
- Off-center loading moment: 15 T-m
- Working frequency range: 0.1 to 50Hz

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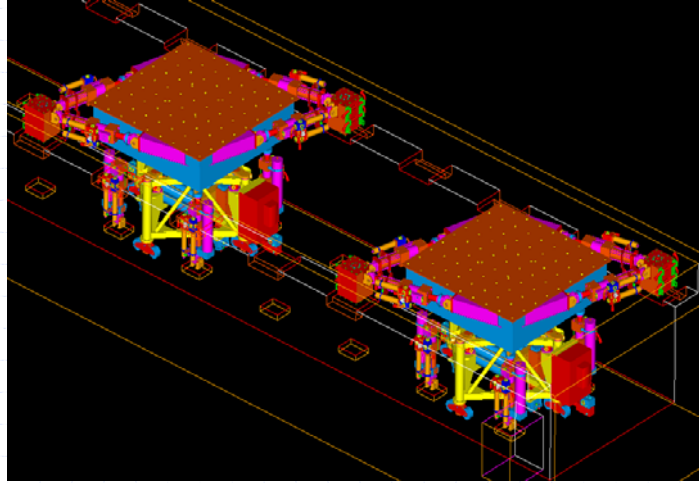University at Buffalo

Simulator Details

- Simulators are re-locatable in a trench
  - Place together
    - 40 T nominal
    - 100 T maximum
  - Place 30 m apart
    - Test large-span bridge structures
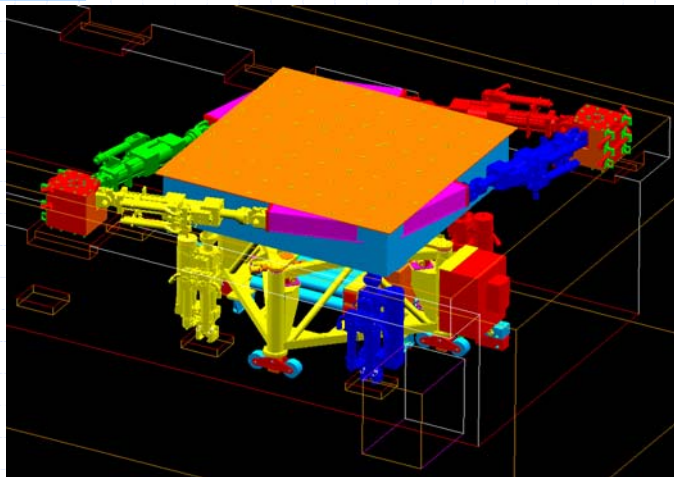 - Utilize adjacent strong wall for hybrid testing

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Simulator Details

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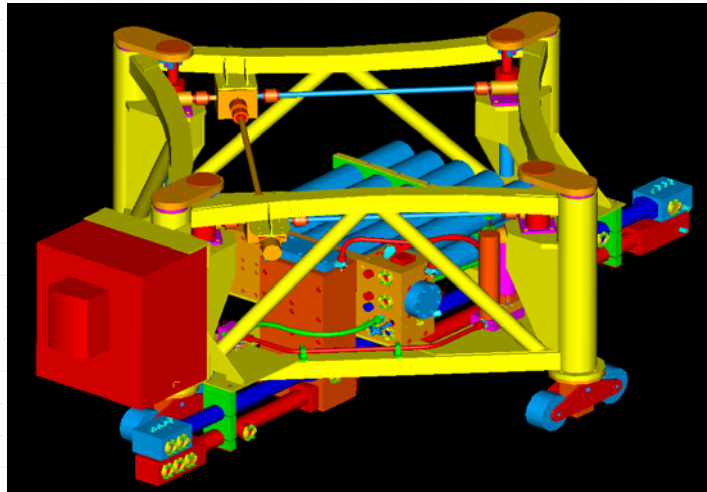
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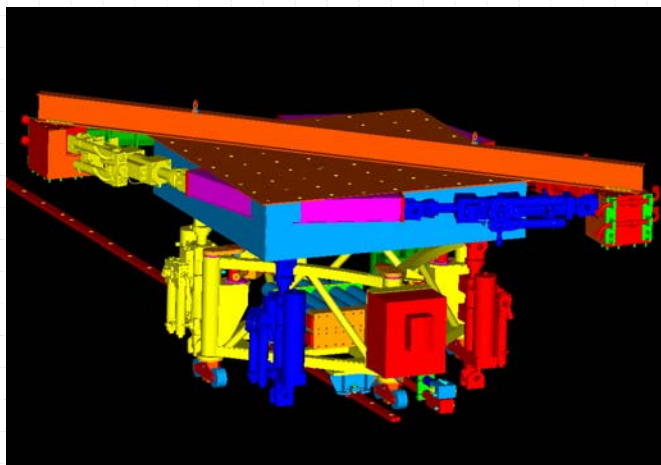University at Buffalo

Actuators

- Dynamic actuators (3)
  - 100 T tons
  - Dual 400 1500 lpm servovalves
  - 500 mm stroke
- Static actuators (2)
  - 200 T
  - 57 lpm servovalves
  - 500 mm stroke

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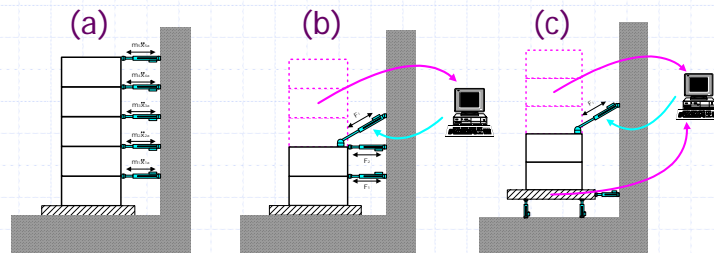University at Buffalo

Seismic Testing Capabilities

- Earthquake simulator testing
- Effective force method (a)
- Pseudo-dynamic testing (b)
- Real-time dynamic hybrid testing (c)

(a)   (b)   (c)

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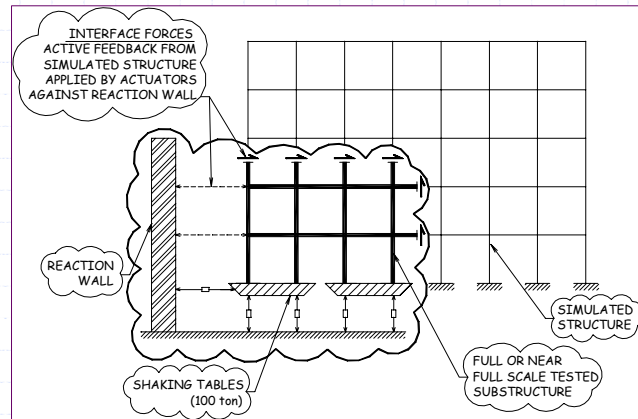University at Buffalo
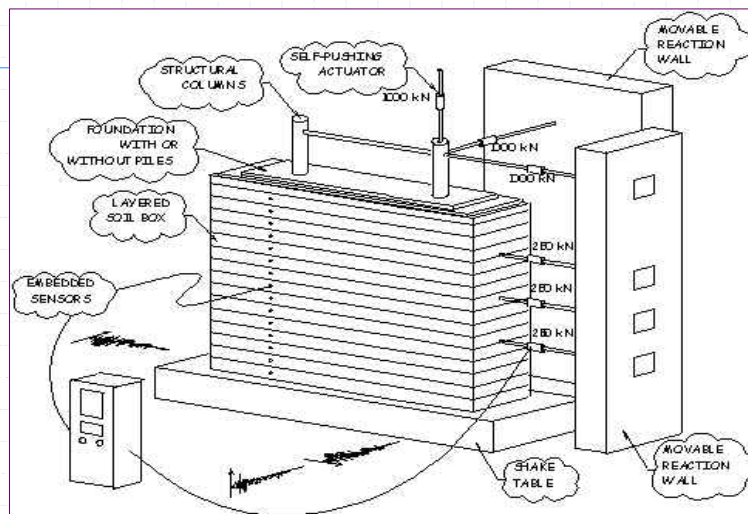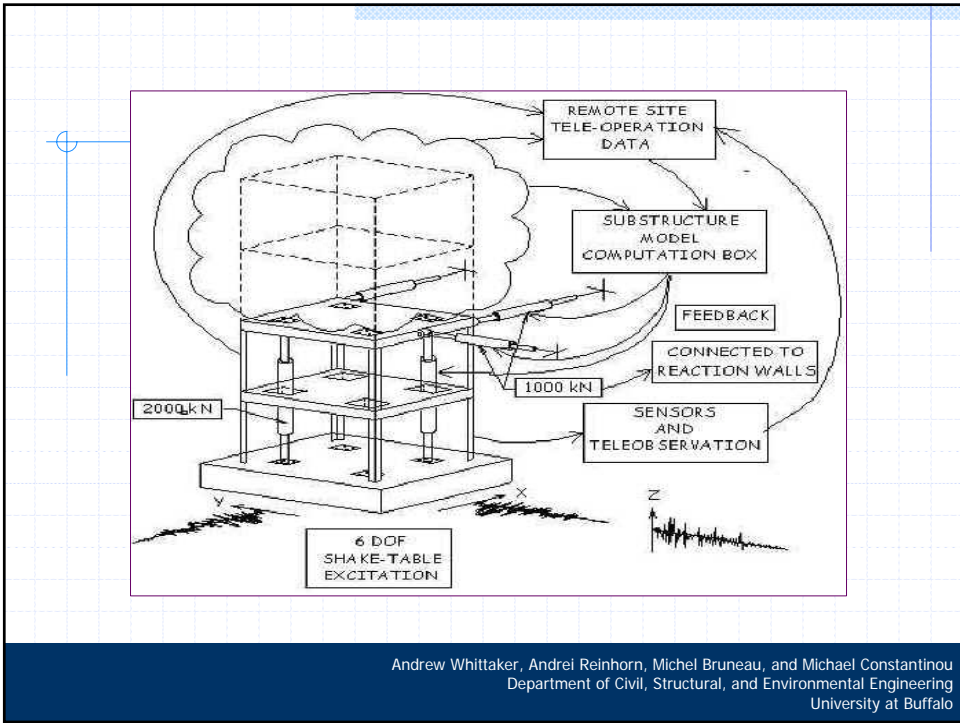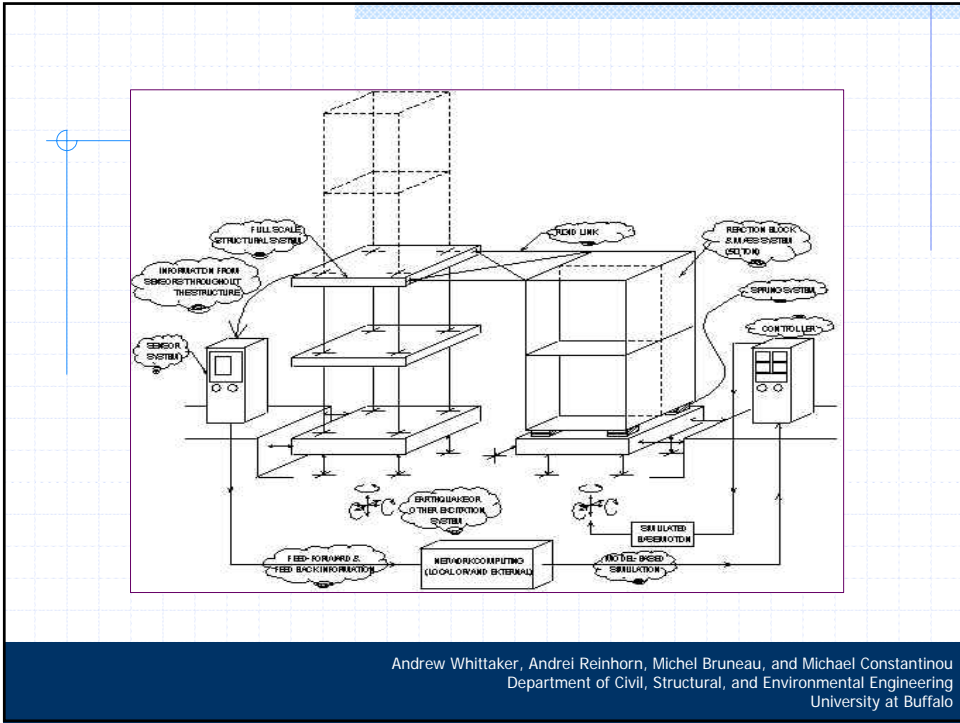
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Real-Time Dynamic Hybrid Testing

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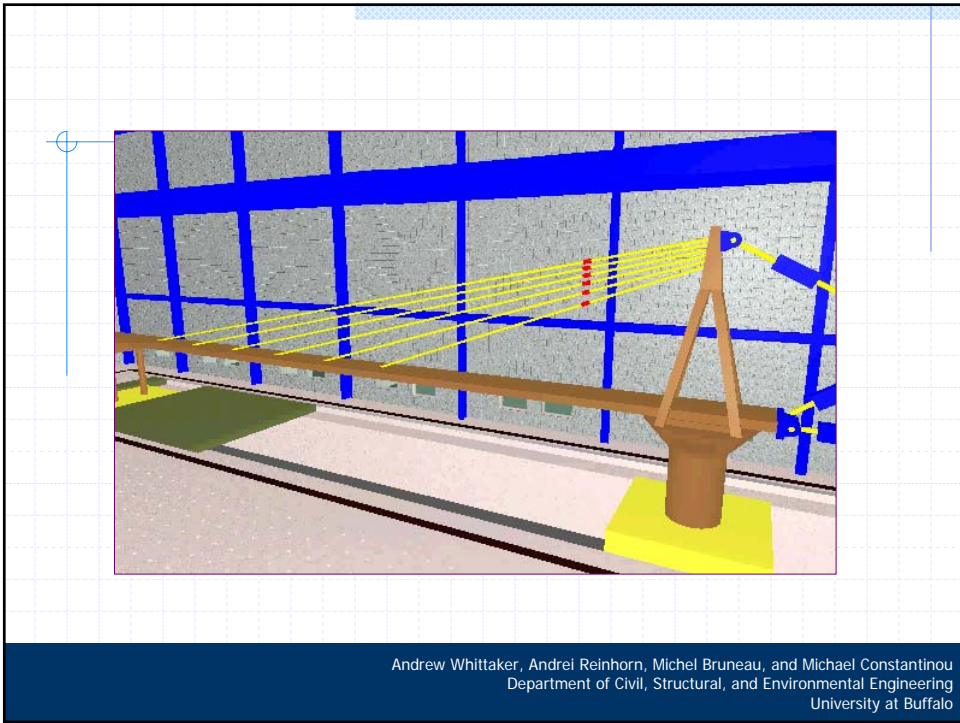University at Buffalo

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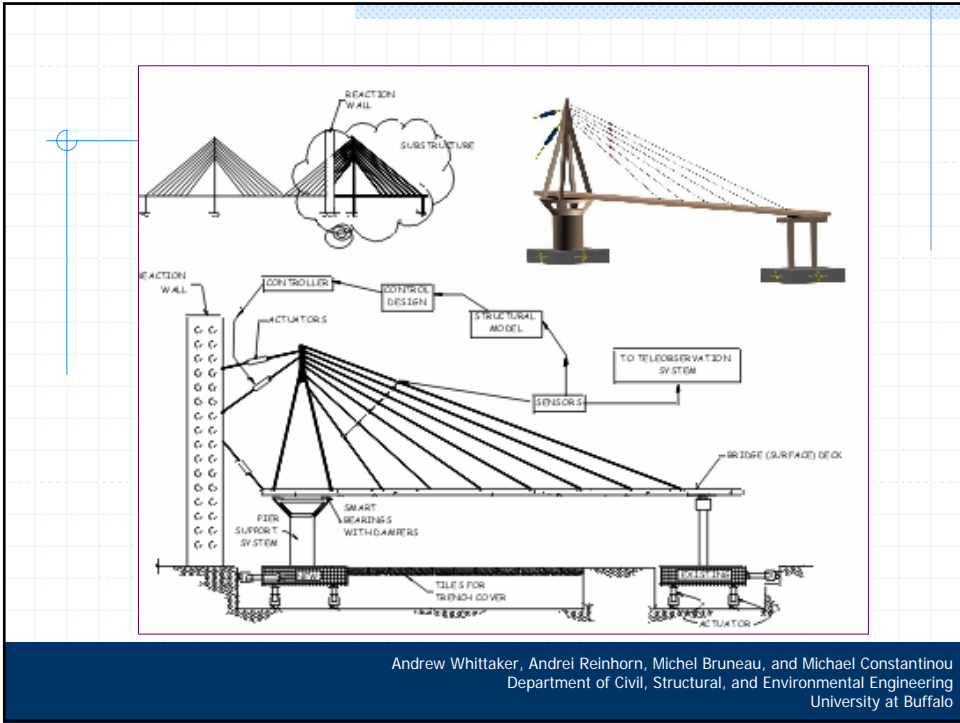University at Buffalo

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Closing Remarks

- ◆ NEES and NSF
  - The next-generation infrastructure for earthquake engineering research
- ◆ UB node of NEES
  - Expands national capabilities in earthquake engineering research
  - Complete and on-line in September 2004
  - Faculty are eager to see substantial use of UB-NEES by US and international research teams post September 2004

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http://nees.buffalo.edu
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