University at Buffalo's NEES Equipment Site

Overview – Equipment, Access and Site Support

Andrei M Reinhorn
Director SEESL and PI UB-NEES Equipment Site

Department of Civil, Structural and Environmental Engineering
Welcome to SEESL

A large scale **STRUCTURAL DYNAMICS** LABORATORY

The FLAGSHIP LABORATORY in MCEER experimentation network

The largest NSF supported expansion in George E Brown Jr. NETWORK FOR EARTHQUAKE ENGINEERING SIMULATION (NEES)

Most VERSATILE laboratory in NEES
Overview Equipment Site

- **Host Laboratory:** SEESL
- **UB-NEES = nees@buffalo**
- **Location and Layout**
- **Equipment and Basic Configurations**
- **Examples of assemblies**
- **Collaboration and networking**
- **Organization Chart: Personnel**

- **Services**
What is SEESL

The largest Laboratory of the Department of Civil Structural and Environmental Engineering (CSEE)

- 1975: Founded as “Structural Engineering Laboratory”
- 1981: Enhanced with a strong floor, after move to a new building
- 1983: Upgraded to Earthquake Engineering capabilities by adding a 5-DOF shake table
- 1986 - present: Served as the flagship lab for the (National) Multidisciplinary Center for Earthquake Engineering Research - (N)MCEER
- 2000-2004: Upgraded to current size by adding the Network for Earthquake Engineering Simulation capabilities ($21.2M investment)
- 2004 – present: Provides multiple services to CSEE, to MCEER, to NEES, to OTHER AGENCIES and to INDUSTRIES
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What is UB-NEES

UB-NEES is a service of SEESL provided to the Earthquake Engineering Community under guidance and sponsorship of NSF through the NEESinc organization.

UB-NEES service includes specialized equipment and personnel providing research support, collaborative environment, education and training, maintenance and management.
Overview Equipment Site

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Original SEESL in Ketter Hall

- 3,000 sq.ft. strong floor
- 5 dof shake table
- Two reaction frames
- 15-ton overhead crane
- Humidity Controlled Rooms (Hot and Cold)
SEESL – NEES Expansion

- 13,000 sq. ft. expansion
  - 600 sq. ft. for control and server rooms
  - 800 sq. ft. of elevated observation space
  - 1,500 sq. ft. of renovated space
- 3,400 sq. ft. strong floor
- 1,800 sq. ft. reaction wall
- 115 ft. long shake table trench
- 40-ton overhead crane
Funding for the Development of the New SEESL-UB-NEES Facility

The Development of the New SEESL-UB-NEES Facility Was Supported Through Collaborative Sources of Funding

- The National Science Foundation Under Awards:
  - CMS-0086611 ($4.6M)
  - CMS-0086612 including the LAN Supplement ($6.6M)
- The State University (of NY) Construction Fund ($6.0M)
- The UB-School of Engineering ($3.2M)
- The UB-Department of CSEE (>0.8M)

Total Investment: ~$21.2M
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Relocatable Shake Tables

- Two 6-DOF Shake Tables (3.6x3.6m)
- 50 metric ton capacity (each) (100 ton combined)
- Relocatable in the 115 ft. trench
- Fully in phase or independent operation up to 100Hz
- Controllers
  - Conventional Control Techniques
  - MTS Adaptive Control Techniques
Relocatable Shake Tables

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Relocatable Shake Tables
Large Dynamic and Static Actuators and Controllers

- 3 x 100 tons Dynamic Actuators (0-100Hz, 1.25 m/sec, 800 gpm valves)
Hydraulic Supply and Distribution System

- 4 x 900HP Hydraulic Pumps Operating at 3000psi
  (Space for a 5th Pump)
- Integrated Accumulators and Distribution System
- 1600 gpm System Flow Capacity
Models available

In storage
“Protective Systems” Model

6 (7) stories model
12’ x 3’ x 18’ (21’)
40-48 kips weight
Material: steel
20 years old
Used in “active control systems”
tests
Used in “semi-active controlled
systems” tests
Used in “base isolated systems”
structures

Reinhorn, A.M., Soong, T.T., Lin, R.C., Wang, Y.P.,
Fukao, Y., Abe, H., and Nakai, M. "1:4 Scale
Model Studies of Active Tendons Systems and
Active Mass Dampers for Aseismic Protection",
Report NCEER-89-0026, NCEER/SUNY/Buffalo,
1989.*
2:5 Scale “P.R.China” Model

5 stories model

P.C. Roussis and M.C. Constantinou, “FIVE-STORY TEST STRUCTURE WITH DAMPING SYSTEM” Department of Civil, Structural and Environmental Engineering, University at Buffalo, Buffalo, NY
May 2004
Truss Bridge Model

Bridge Deployed on Twin Shake Tables for Tuning and Synchronization

1:4 scale model
36’ long

Report in Progress
“Suspended Ceiling” Frame

Suspended Ceiling Test Frame
16’ x 16’ x 6’
In process to be adopted as ASTM standard

More Details in Lab Manual
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# Possible Assemblies

<table>
<thead>
<tr>
<th>Equipment/Resources</th>
<th>(A) Shake Table #1 Simulator</th>
<th>(B) Shake Table #2 Simulator</th>
<th>(C) Coupled Shake Tables #1 &amp; #2 Simulator</th>
<th>(D) Large Scale Quasi Static System</th>
<th>(E) Pseudo-Dynamic and Dynamic System</th>
<th>(F) Real Time Dynamic Hybrid Testing System</th>
<th>(G) Geotechnical Laminar Box Testing System</th>
<th>(H) Nonstructural Components Simulator</th>
<th>(I) Shake Table #0 Simulator</th>
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<tbody>
<tr>
<td>Check System</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<td>Reaction Wall (RxnW) (Non-NEES)</td>
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<td>Strong Floor (S.F.) (Non-NEES)</td>
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<td>Flex Test Controller (NEES)</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Hybrid Controller (NEES)</td>
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<td>X</td>
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<tr>
<td>Data Acquisition (NEES &amp; Non-NEES)</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Instrumentation (NEES &amp; Non-NEES)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
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<tr>
<td>3D Optical Coordinate Tracking System (NEES)</td>
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<td>X</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>Video/Digital Cameras (NEES)</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Geotechnical Laminar Box (NEES)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>5DOF Shake Table #0 (Non-NEES)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* Special long stroke dynamic actuators

X: Equipment/Resources Required in Testing

Optional and Alternative Equipment/Resources Used in Testing
Tandem Shake Tables
2-D Large Scale Geotechnical Laminar Box
Development of a National Seismic Testing Facility at UB as “NCS” Nonstructural Components Simulator

http://nees.buffalo.edu
Layout of NCS
Development of a National Seismic Testing Facility at UB as “NCS” Nonstructural Components Simulator

http://nees.buffalo.edu
Platform of NCS

(a) 

(b)
NCS
New testing capabilities

- Effective Force Method
- Pseudo-dynamic testing
- Real Time Dynamic Hybrid Testing-RTDHT - (new development)
Typical Applications of RTDHT

- Building and Cable Stayed Bridge Segments With RTDHT Using Two Shake Tables, the Reaction Wall and Large Actuators
Real-Time Dynamic Hybrid Testing (RTDHT)

- Integrated Use of Shake Tables, Actuators, Reaction Wall, Strong Floor and Computational Resources (Unique to UB)
- Inertia Effects in the Physical Model—Different from Real-Time Pseudo Dynamic Testing
- Force-Based Substructure and Actuators in Force Control Necessitated by the Above
- Parallel computer built for this type of testing technique
**Substructure response**

- **First floor**
  - Calculated
  - Measured

- **Second floor**
  - Hybrid test
  - Analytical
FLOOR PANTOGRAPH

West

FB-Actuator Beam
W460x97 (W18x65)
with Modifications

Static Hydraulic Actuator
1960 kN (440 kip) Capacity

Link - Length 1.2 or 1.6
X-Sec Vanes

Loading Beam (LB) W610x217
(W24x146)

Pantograph Diagonals - Set 1
HSS 203x102x12.7 (8x4x3/4)

317
4737
324

2432
902

902

394
1451

4023

1016
838
1022
1219
349

Strong Floor

Strong Floor Holes

10312

Pantograph Center HSS 203x152x12.7 (8x6x3/4)
FLOOR PANTOGRAPH

- Lateral Bracing
- Loading Beam
- Actuator
- Link XL1.2
- Pantograph
- Foundation Beam
Unbonded Braces: Shake Table and Floor (MCEER)

Floor Test

Shake Table
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Telepresence and Collaboration Rooms

- Room K140: The telepresence room completed January 2004 provides for:
  - Video Conferencing
  - Audio and Video Streaming
  - Webcast Capabilities
  - Data Streaming
  - Data Visualization
  - Tele-operations
  - Tele-observations

- Room K133b Collaboration room completed September 2004 provides for:
  - Services for Visiting Researchers
  - Discussion Room
UB-IT Infrastructure for Networking, Data Acquisition and Telepresence

- Server Systems (Windows and Linux) for File, Print, Domain Admin.
- Data Acquisition Systems >300 Channels
- MTS Table and Actuator and Control Systems
- UB-NEES Hybrid Control Systems
- UB-NEES Telepresence and Collaboration Room Systems
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END

Details of Equipment - Components

Shake tables, Reaction Walls, Strong Floor, Power supplies, Actuators, Controllers

More in Lab Manual
Observation systems
Observation Systems

• Instrumentation
  – Conventional – gages, motion, load
  – Specialized –
    – Imaging system
    – Multi-axis load cells
    – MEMS array (strips)

• Data acquisition systems
  – Fixed vs portable
  – Multiple types

• Video and video assemblies
Welcome to the University at Buffalo’s NEES Equipment Site

The University at Buffalo’s (UB) Structural Engineering and Earthquake Simulation Laboratory (SEESL) is hosting a key equipment site, NEES@Buffalo, in a nationwide earthquake engineering “collaboratory” – the National Science Foundation’s “George E. Brown, Jr. Network for Earthquake Engineering Simulation” (NEES). In this network, earthquake engineers and students located at different institutions are able to share resources, collaborate on testing, and exploit new computational technologies.

The SEESL facility has following capabilities which are available to NEES and non-NEES participants:

- Three Earthquake Simulators, known also as Shake Tables:
  - Two relocatable 7.0m x 7.0m platforms with six-degrees-of-freedom, 50 ton payload each
  - One 3.0m x 2.0m with five-degrees of freedom, 30 tons payload
- A two stories bi-axial Shaking Table system used as Non-structural Component Simulator
- A 175 m² Strong Reaction Wall for reactions to horizontal loading devices (actuators) for large scale testing
- A 340 m² Strong Testing Floor for vertical reactions and tie downs of large scale models
- A bi-axial Laminar Box for 1.0 g self testing
- Reconfigurable assemblies of Static and Dynamic Servo-controlled Actuators with advanced control systems (RTS, Flextest, etc.)
- A High Performance Hydrotic Power Supply with flow exceeding 6000 liters per minute (1600 gallons per minute)
- High speed wide band Local and Wide Area Gigabit Networks interfaced and supported by with NEESSE services
- Tele-presence & Tele-operations capabilities for local and wide area collaborations in real time
- Advanced Dynamic, Pressure-dynamic, and Static Testing Capabilities including a generic advanced procedure “Real-Time Dynamic Hybrid Testing (RTDHT)”

A detailed description of the facility, its components, and procedures of use can be found in the Lab Manual.

What’s New

NEES@Buffalo

The NEES@Buffalo project will involve the laminar box filled with saturated sand at a relative density of 40-60%. The first test denoted by LG-1 involves a level ground deposit subjected to shaking, and the second experiment denoted by SG-1 involves a gently sloping ground at a slope of about 2 to 3 degrees.

For More Information on NEES@Buffalo project, please go to NEES@Buffalo project section of this website

NSF Site Visit

The UB-NEES Site is hosting a two day NSF Site Visit on Wednesday and Thursday September 20th and 21st. The 8-member site visit team will be led by Dr. Jay Rauchle, the NEES Program Director. The objective of the site visit is to assess the progress of site operations and the quality of performance, to date, and the plans for the future based upon an analysis of strengths, weaknesses, opportunities and threats (SWOT) with respect to the NEES equipment site, as part of NEES operations.

UB-NEES Training Workshop:

For More Information on UB-NEES Training Workshop, please go to UB-NEES Training Workshop section of this website

http://nees.buffalo.edu
Access

Lab manual  
Access Plan  
Safety Plan  
Fees Schedule  
Work Schedules  
Contracting Information
Access plan

- Comprehensive plan developed prior to Oct 1, 2004 and is in effect now
- Plan posted on website for all users
- Plan contains:
  - Description of equipment availability free and fees based
  - Project planning requirements
  - Advisement contacts
  - Business requirements – time, fees, insurance, etc
  - Scheduling
  - Safety – plan, training, certifications
Access plan

The Department of Civil, Structural and Environmental Engineering at the University at Buffalo has an extensive earthquake simulation, structural, and geotechnical engineering testing facility that is a key node in a nationwide earthquake engineering "collaboratory" - the National Science Foundation’s "George E. Brown, Jr. Network for Earthquake Engineering Simulation" (NEES). The entire lab facility consists of four main laboratory rooms, two earthquake laboratories, identified below as Testing Area 1 and Testing Area 2, a Revolving Area and a Fabrication Area, located side by side within Ketter Hall. In addition to these laboratories, Ketter Hall also houses many of the Civil and Structural Engineering faculty offices and a number of smaller laboratories in structural and geotechnical engineering used for research and instruction. Figure 1 presents a plan drawing of the laboratory facilities.

Facilities Navigation List

- Major Equipment
- Physical Facility Information
- Lab Manual and Calibration Records
- Safety Plan
- Software Interfaces
- Site Access Rules and Policies (Access Plan)*
- Recharge Rates and User Fee Policies*
- Room And Equipment Schedules
  ** Not open in new window

Figure 1: Plan Drawing of Laboratory Facilities
Safety plan

• Comprehensive plan developed prior to Oct 1, 2004 and is in effect now

• Plan posted on [website] for all users

• Plan contains:
  – Self training [material]
  – Requirements for certifications (safety equipment, self study, physical tours, examination)
  – Monitoring requirements (floor officer, re-certification, refreshing, discussions, etc)
  – Risk management Plan
  – Indemnification Policies
  – Inspections and Audits
Safety Plan

- Safety Committee
- Safety Apparel;
  - Wearing hardhats
  - Safety shoes
  - Long pants
  - Safety glasses,
  - ear protection
  - gloves
  - Safety harnesses
- Buddy System;

- Test Plans and Pretest Activities;
  - Plans Approval
  - Pretest meeting
- Test Operations;
  - audible alarm
  - flashing amber
  - witness tests from
  - 3rd floor observation deck.
- Laboratory and Test Equipment
- Supervision and Monitoring;
  - Restricted areas
Safety Plan

Facilities
Introduction
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- Room and Equipment Schedules
* not open in new window
Fees Schedule

• Comprehensive schedule developed prior to Oct 1, 2004 and is in effect now. Continuously updated

• Schedule posted on website for all users

• Schedule contains:
  – NEES and non-NEES fees
  – Evaluation sheet for recharge fees
  – Contact information if help is needed
# Fees Structure

## Budget Worksheet for Operations and Maintenance Usage Fees for SEESL:

### Fees for Labor / Technical Assistance- per day (minimum 1/2 day)

<table>
<thead>
<tr>
<th>Item</th>
<th>Sponsored Research-Non-NEES</th>
<th>Sponsored Research-NEES*</th>
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</thead>
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<tr>
<td><strong>PERSONNEL</strong></td>
<td><strong>Research Fees</strong></td>
<td><strong>Research Fees</strong></td>
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<tr>
<td>Daily</td>
<td>Days</td>
<td>Hourly</td>
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<tr>
<td>Engineering aid*</td>
<td>190</td>
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</tr>
<tr>
<td>Expert Student (grad) Consultant</td>
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<tr>
<td>Lab Technician (Majewski)</td>
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<tr>
<td>Lab Specialist (Mechanic, or Instrumentation)</td>
<td>350</td>
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</tr>
<tr>
<td>Development engineer / operator (Pitman, Hanley, Albrechinski)</td>
<td>460</td>
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</tr>
<tr>
<td>Expert Testing (Faculty) Consultant</td>
<td>1010</td>
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### Fees for Equipment Usage

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Full Usage</th>
<th>Idle</th>
<th>Occupancy</th>
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<tbody>
<tr>
<td><strong>TESTING SYSTEMS</strong></td>
<td><strong>Basic</strong></td>
<td><strong>Sub-Tot</strong></td>
<td><strong>Basic</strong></td>
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<td>Shake Table 1 or 2 (6-DOF)</td>
<td>1750</td>
<td>0</td>
<td>875</td>
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<td>Shake Table 2 with reaction wall (6-DOF)</td>
<td>1800</td>
<td>0</td>
<td>900</td>
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<td>Shake Table 1 and 2 (6-DOF)</td>
<td>3500</td>
<td>0</td>
<td>1750</td>
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<td>Extension Frame (single table)</td>
<td>350</td>
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<td>175</td>
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<td>Laminar Box (6m high or less)</td>
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<td>700</td>
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<td>Non Structural Components Simulator (NCS)</td>
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<td>0</td>
<td>700</td>
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<td>Shake Table 5-DOF</td>
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<td>Shake Table (Small)</td>
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<td>Bearing Testing Machine (large)</td>
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<td>Bearing Testing Machine (small)</td>
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<td>Reaction Frame (large)</td>
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<td>150</td>
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<td>Reaction Frame (small)</td>
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<td>Reaction Wall</td>
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<td>150</td>
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<td><strong>TEST APARATUS</strong></td>
<td><strong>Full Usage</strong></td>
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<td><strong>Occupancy</strong></td>
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<td>110 ton - UTM - MTS</td>
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<td>Axial - Torsion MTS apparatus</td>
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<td><strong>ACTUATORS with CONTROLLERS</strong></td>
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<td><strong>Amplification</strong></td>
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<td>Actuators-dynamic high capacity &gt;=100 tons</td>
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<td>120</td>
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<td>Actuators-dynamic medium capacity 20-100 tons</td>
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<td>60</td>
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<tr>
<td>Actuators-dynamic small capacity &lt;20 tons</td>
<td>200</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Actuators-static high capacity &gt;=140 tons</td>
<td>300</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>Actuators-static medium capacity 30-140 tons</td>
<td>200</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Actuators-static small capacity &lt;20 tons</td>
<td>100</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td><strong>HYDRAULIC EQUIPMENT</strong></td>
<td><strong>Full Usage</strong></td>
<td><strong>Idle</strong></td>
<td><strong>Occupancy</strong></td>
</tr>
<tr>
<td>Hand Pumps</td>
<td>40</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Servovalves substitutions</td>
<td>40</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Hydraulic manifolds - substitutions</td>
<td>90</td>
<td>0</td>
<td>45</td>
</tr>
<tr>
<td><strong>CONTROLLERS</strong></td>
<td><strong>Full Usage</strong></td>
<td><strong>Idle</strong></td>
<td><strong>Occupancy</strong></td>
</tr>
</tbody>
</table>
Schedules

• Project-time comprehensive schedules provided on website

• Floor layout provided on website

• Collaboration room schedules on website
PROJECT DEVELOPMENT AND EXECUTION

• Planning
• Fabrication
• Assembly / Installation
• Instrumenting
• Test execution
• Data management
• Retesting (?)
• Demolition and Disposal
Planning

- **Scaling – Similitude**
- Motion Protocols
  - Types of testing
  - Sequencing
- Design of Assemblies
- Design of Interfaces to Equipment
- Preliminary Analysis of Set-up
- Design of Instrumentation
- Preparation of Test Set-Up Drawings
- Submit to Equipment Site (ES) PI for review
PROJECT DEVELOPMENT AND EXECUTION

- Planning
- **Fabrication**
- Assembly / Installation
- Instrumenting
- Test execution
- Data management
- Retesting (?)
- Demolition and Disposal
Fabrication

- In-house vs contracting
- Interfaces
- Plans to be reviewed by ES – PI
PROJECT DEVELOPMENT AND EXECUTION

- Planning
- Fabrication
- Assembly / Installation
- Instrumenting
- Test execution
- Data management
- Retesting (?)
- Demolition and Disposal
Assembly / Installation

- Anchor design
  - Use largest static loads equivalent to max. dynamic
  - Connect to interface blocks, plates …
  - Anchors data in Lab Manual
- Staging of assembly
- Rigging plan
- In-house vs contracting out
- Personnel requirements
- All plans to be reviewed and approved by Site PI
- Risk management plan to be submitted to Site PI
Bare frame
Fail-safe devices: Diagonal braces
Fail-safe device: Overhead crane
PROJECT DEVELOPMENT AND EXECUTION

- Planning
- Fabrication
- Assembly / Installation
- **Instrumenting**
- Test execution
- Data management
- Retesting (?)
- Demolition and Disposal
Instrumenting

- Process of installation of sensors and connections from specimen to data acquisition
- Made by the investigator with assistance of lab personnel (usually 30-70% split)
- Calibrate all instrumentation
  - Although instrumentation is calibrated, it should be recalibrated in place
  - Account for the wiring
  - Verify directivity and compatibility
  - Test protocol must include instrumentation check during project execution (i.e., check-sum, etc)
PROJECT DEVELOPMENT AND EXECUTION

- Planning
- Fabrication
- Assembly / Installation
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Test Execution

• Test protocol – a series of events which cover verifications as well as actual testing
  – For example: include white noise tests between episodes of earthquakes, or various load histories, or…….
## Test Execution

### Table 1 Test protocol

<table>
<thead>
<tr>
<th>Test Number</th>
<th>Test Label</th>
<th>Scale</th>
<th>Ground Motion</th>
<th>PGA (g)</th>
<th>Note</th>
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<tbody>
<tr>
<td>#1</td>
<td>WHN1</td>
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<td>White Noise</td>
<td>0.05</td>
<td>System Identification</td>
</tr>
<tr>
<td>#2</td>
<td>LA22_15</td>
<td>15%</td>
<td>LA22yy</td>
<td>0.138</td>
<td>Elastic Range</td>
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<tr>
<td>#3</td>
<td>WHN2</td>
<td></td>
<td>White Noise</td>
<td>0.05</td>
<td>System Identification</td>
</tr>
<tr>
<td>#4</td>
<td>LA22_30</td>
<td>30%</td>
<td>LA22yy</td>
<td>0.276</td>
<td>Elastic Range</td>
</tr>
<tr>
<td>#5</td>
<td>WHN3</td>
<td></td>
<td>White Noise</td>
<td>0.05</td>
<td>System Identification</td>
</tr>
<tr>
<td>#6</td>
<td>LA22_45</td>
<td>45%</td>
<td>LA22yy</td>
<td>0.46</td>
<td>First story braces buckle</td>
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<tr>
<td>#7</td>
<td>WHN4</td>
<td></td>
<td>White Noise</td>
<td>0.05</td>
<td>System Identification</td>
</tr>
</tbody>
</table>
PROJECT DEVELOPMENT AND EXECUTION

• Planning
• Fabrication
• Assembly / Installation
• Instrumenting
• Test execution
• Data management
• Retesting (?)
• Demolition and Disposal
Data Management

• Managing the information collected from tests
• Documenting and archiving data developed during test

Presented latter in this workshop
PROJECT DEVELOPMENT AND EXECUTION

- Planning
- Fabrication
- Assembly / Installation
- Instrumenting
- Test execution
- Data management
- Retesting (?)
- Demolition and Disposal
Retesting

- Operation required only if quality of information is not reliable
  - Retest specimen after a non-destructive test
  - Retest the instrumentation (recalibrate) after a destructive test
  - Build new specimen if none of the above apply
- Operation is unpredictable but has high probability of occurrence
- Can be part of Risk management plan
PROJECT DEVELOPMENT AND EXECUTION

• Planning
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• Assembly / Installation
• Instrumenting
• Test execution
• Data management
• Retesting (?)
• Demolition and Disposal
Demolition and Disposal

Alternatives

- In-house by researchers and lab personnel
- Outside contractor

Selection of one of the above based on:
- Safety
- Manpower and tools
- Costs to be supported by projects (fees structure available)
- Timely execution (financial penalties apply in case of delays)
Demolition and Disposal

Note:

- The specimens used in this lab are large and need to be handled by cranes and rigging equipment.
- Operation is dangerous to people and can be handled only by trained personnel.
- Safety and risk management should be at top of planning list.
- This task should be carefully budgetted.
Lab Resources
Personnel
Collaboration services
Data services
Test assistance services

TRY US !!!
Thank You!

Questions?