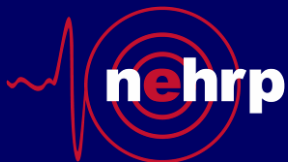


National Earthquake Hazards Reduction Program

... a research and implementation partnership

NIST Earthquake Mitigation Research Update

Advisory Committee on Earthquake Hazards Reduction
9 November 2011



FEMA

NIST
National Institute of
Standards and Technology

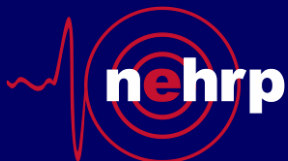


USGS
science for a changing world

national **earthquake** hazards reduction program

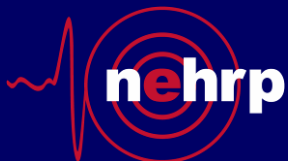
Program Accomplishments and Plans for FY2012

- Summary of project portfolio
- In-House NIST projects
- External projects
- Accomplishments
- Plans forward



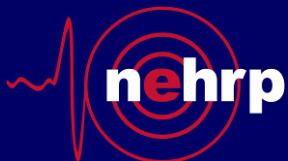
NIST Research Portfolio Summary

- Completed TechBriefs:
 - TO 14/ TB 5: *Concrete on Metal Deck Diaphragms*
 - TO 15/ TB 6: *Concrete Shear Walls*
- Completed Projects:
 - ATC-82/TO 9: *Selecting/Scaling EQ Ground Motions (97%)*
 - ATC-83/TO 10: *Soil-Structure Interaction (97%)*
 - ATC-76-1/TO 11: *Quantification of Building System Performance and Response Parameters*
 - ATC-90/TO 17: *Seismic Behavior and Design of Steel Beam-Columns (97%)*



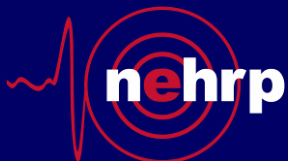
NIST Research Portfolio Summary

- Notable Active Projects:
 - ATC-89/TO 16: *Cost-Benefit Analysis of...EQ Resistant – Central US*
 - ATC-92/TO 19: *Chilean-US Seismic Provisions and Design Comparison*
 - ATC-93/TO 20: *Chilean Data Repository (DFSP)*
 - ATC-94/TO 21: *Seismic Performance of RC Buildings in Chilean Earthquake*



NIST Research Portfolio Summary

- New External Projects Underway - Late FY 2011:
 - TO 22: *Nonductile Concrete Frame Collapse Indicators*
 - TO 23: *Analysis, Modeling and Simulation for PBSE*
 - TO 24: *TechBrief: Mat Foundations*
 - TO 25: *Seismic Design of Concrete Buildings using High Strength Flexural Reinforcement*
 - *Research NIST Program for Implementing NRC Roadmap (BSSC)*
- Proposed External Projects – FY 2012:
 - *Two TechBriefs planned*
 - *Extramural laboratory testing (budget-dependent, see later discussion)*

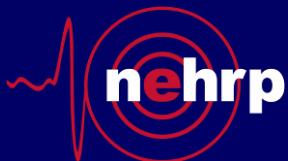


Snapshots



Completed External Projects

- ATC-76 1-4/TO 11 : *Quantification of Building System Performance and Response Parameters*
 - 100% draft submitted for NIST review – Jan. 2011
 - Harris worked with ATC to produce final document: conclusion reformatted – technical content maintained.
 - Final report published in April 2011
- ATC-83/TO 10: *Improved Procedures for Characterizing and Modeling Soil-Structure Interaction for Performance-Based Seismic Engineering*
 - 90% Draft Report produced in Aug. 2011; Workshop held in Aug. 2011
 - Harris working with ATC and PTC to reformat report: (1) develop consistent terminology for practitioners and (2) develop recommendations for NERHP PUC and ASCE 7 SSC consideration



Mature External Projects

- *ATC-84/TO 11: Improved Structural Response Modification Factors for Seismic Design of New Buildings, Phase 1*
 - *PTC currently producing 90% Draft Report*
 - *Workshop scheduled for Dec. 8, 2011*
 - *Toolkit to facilitate FEMA P695 analysis developed and in use by PTC*
- *ATC-90/TO 17: Seismic Behavior and Design of Deep, Slender Wide-Flange Structural Steel Beam-Column Members*
 - *Harris integrated with PTC (mostly AISC TC-9: TG-4 Moment Frame group members)*
 - *100% draft report submitted to NIST in Sept. 2011*
 - *Harris currently working with ATC to finalize report*

Mature External Projects

- *ATC 82/TO 9: Improved Procedures for Selecting and Scaling Earthquake Ground Motions for Performing Time-History Analyses*
 - *Objective: To develop guidance for selecting, generating, and scaling earthquake ground motions for effective use in performing response history analyses with validation.*
 - *User workshop: September 2011 (reviewed prefinal draft report)*
 - *Task Duration: 10/1/2010 – 9/30/2012*
 - *90% Draft Report – Currently under review*
 - *Final Draft Report – Submission to NIST by 11/30/2011*

Selected Active External Projects

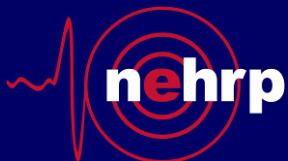
- *ATC-92/TO 19: Comparison of Chilean and U.S. Model Building Code Seismic Provisions and Seismic Design Practices*
 - *In progress, design documents and building codes/standards (en español) received from Chilean partners*
 - *Relevant strong ground motion records released two weeks ago*
 - *Evaluation to date reveals significant wall damage resulting from wall design and/or wall layout discontinuities*
 - *Typical comparison designs of the according to US practice just starting of Toledo building in Viña del Mar*

Selected Active External Projects

- *ATC-89 / TO 16: Cost-Benefit Analysis of Codes and Standards for Earthquake-Resistant Construction in Selected US Regions – Phase I*
 - **Memphis area selected**
 - **Project Review Panel identified typical structures for comparative design and cost evaluation:**
 - **3-story apartment building, wood**
 - **1-story large warehouse, tilt-up**
 - **1-story box retail, tilt-up**
 - **4-story office building, steel braced frame**
 - **5-story hospital, concrete shear wall**
 - **1-story reinforced masonry school building**
 - **Project task committee being finalized by ATC**

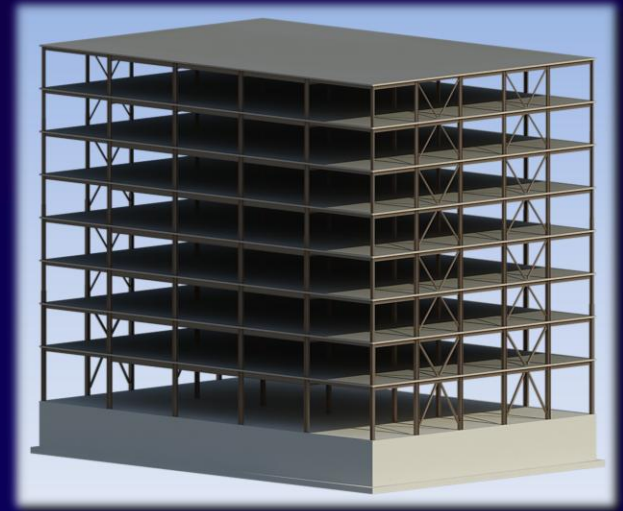
Selected Active External Projects

- TO 23: *Analysis, Modeling, and Simulation for Performance-Based Seismic Engineering*
 - **Objective:** To close the gap between state-of-the-art academic research and state-of-the-practice engineering applications on nonlinear analysis, structural modeling, and computer simulation.
 - **Task Duration:** 10/1/2011 – 9/30/2013 (New Start!)
 - **Expected Output/Outcome:**
 - Analysis Research Plan
 - First Volume of the Analysis Guideline



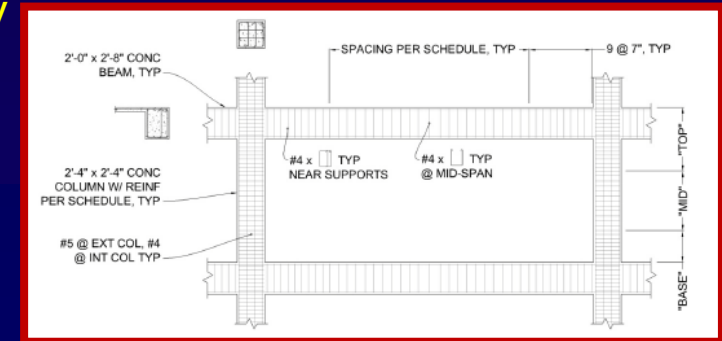
Selected Active Internal Projects

- *Assessment of First Generation Performance-Based Design Methods for New Concrete and Steel Buildings*
 - **Steel: 18 Buildings Designed per ASCE 7-10**
 - 4, 8, and 16-story SMF, SCBF, EBF
 - SDC D_{max} and D_{min}
 - **D_{max} assessment per ASCE 41**
 - Nearing completion
 - Some of this work used to update Chap. 5 provisions (in 41-06) to be balloted within the ASCE 41 Committee
 - **D_{min} assessment per ASCE 41 anticipated completion Dec. 2011**
 - Data analysis and report writing to commence in early 2012
 - **Peer review meeting for *steel assessments* being planned for Dec. 2011**



Selected Active In-House Projects

- *Assessment of First Generation Performance-Based Design Methods for New Concrete and Steel Buildings*
 - Reinforced Concrete: Designing a suite of RC moment frame buildings per ASCE 7-10 with evaluation against ASCE 41
 - Design space of 4, 6, 8, 16 and 20-story 2D frames; D_{min} and D_{max} SDC
 - 15 Haselton-designed frames used to fill out the population
 - Perimeter and space frames; different gravity tributary areas
 - Analysis will be conducted using OpenSEES and LSDYNA
 - Assessment per ASCE 41 to begin by year's end
 - Project completion in March 2012

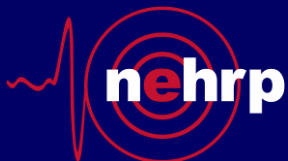


Selected Active In-House Projects

- *Nonlinear Seismic Analysis of Structures through Collapse Initiation*
 - Objective: To develop a simple methodology and guidelines for performing structural dynamic collapse analysis to support PBSE adoption
 - Selected Milestones:
 - Conduct “State-of-the-art” Review - 6/2012 (in progress)
 - Develop Simplified Tools to Analyze Collapse - 3/2013
 - Conduct Parametric Studies - 9/2013
 - Prepare Analysis Guidelines - 3/2014

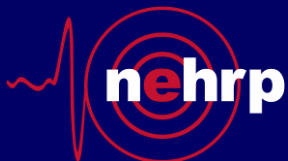
New In-House Projects

- Two Large Analytical-Experimental Projects:
 - *Seismic Response of Reinforced Concrete Walls*
 - *Seismic Behavior of Deep Steel Beam-Columns with Plastic Hinges*
 - Each starting in FY 2012 – supplements ongoing in-house research
 - Each involving significant laboratory testing by academic labs experienced in large scale structural testing
 - Laboratories selected by competitive RFP
 - Proposed significant funding for each testing program – scope hinges on 2012 budget



New In-House Projects

- *Seismic Behavior of Deep Steel Beam-Columns with Plastic Hinges*
 - Linkage with nearly complete external project ATC-90/TO 17
 - Project will provide much needed experimental information for beam-columns with low slenderness ratios subjected to large demands resulting in plastic hinging
 - Planned FY12 Outputs:
 - Technical report detailing current design and assessment provisions
 - RFP for experimental testing developed
 - Award by Sept. 2012



New In-House Projects

- *Seismic Response of Reinforced Concrete Walls*
 - (1) Reinforced Concrete Wall Models for Seismic Response
 - Aimed at improved and validated wall modeling capabilities for the engineering community
 - Partially driven by the Chilean experience
 - All analytical work using high fidelity FEA
 - Cooperative NSF project with Lehman & Lowes at UW
 - Ties with the experimental program

New In-House Projects

- *Concrete Walls cont'd:*
 - (2) Performance of Slender Reinforced Concrete Walls
 - Well-coordinated experimental program
 - ~20 wall tests to assess parameter sensitivity (slenderness, tension excursions, axial stress, confinement)
 - Work to be performed primarily by a University of Illinois SCEP PhD student working with Jeff Dragovich
 - Data used to:
 - ✓ Calibrate analytical work
 - ✓ Complement existing data
 - ✓ Code provisions to address the Chilean wall performance issues.

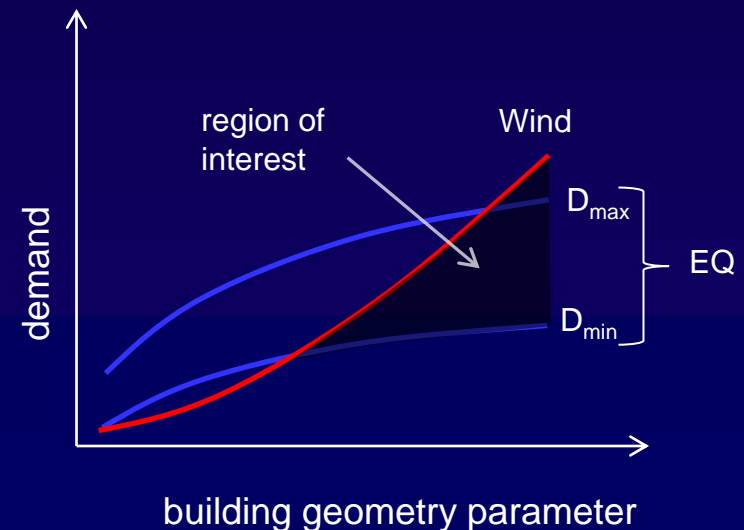
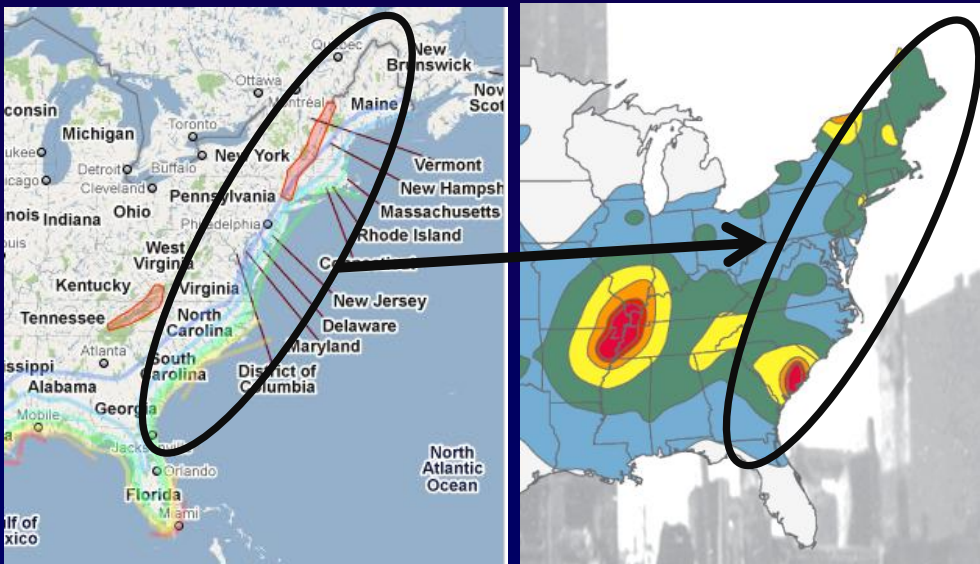


New In-House Projects

- *Seismic Design of Wind Load-Controlled Buildings*
 - Objective: Investigate the seismic performance of buildings whose design is controlled by wind loads
 - Project to commence in early 2012

Wind

Seismic



New In-House Projects

- *Lateral Force Distribution Procedures for Structural System Design*
 - Objectives:
 - Develop rules for the distribution of lateral forces based on structural irregularities – vertical and horizontal
 - Develop improved approximate period relationship
 - Work to begin mid-FY12



Active External Projects

- ATC-93/TO 20: *Ground Motion and Building Performance Data from the 2010 Chile Earthquake*
 - Develop a data repository to archive important information for building performance
 - Safe, secure, reliable
 - Provide an intuitive, searchable system (keyword, geospatial)
 - Leverage the NEES HUB data experience
 - Currently contains over 30,000 photos, ground motion data, 198 earthquake data for buildings, non-copyrighted documents
 - Significant step forward in post-earthquake data collection
 - Prototype for Disaster and Failure Studies Program data system - Started under NEHRP umbrella (Jeff Dragovich), now transitioned to Disaster and Failure Studies (Eric Letvin)



The Chile Earthquake Database: Ground Motion and Building Performance Data from the 2010 Chile Earthquake

[View Database](#) (HTML) →

0 Citation(s)
0 questions ([Ask a question](#))
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**NEES
Database**

Tags

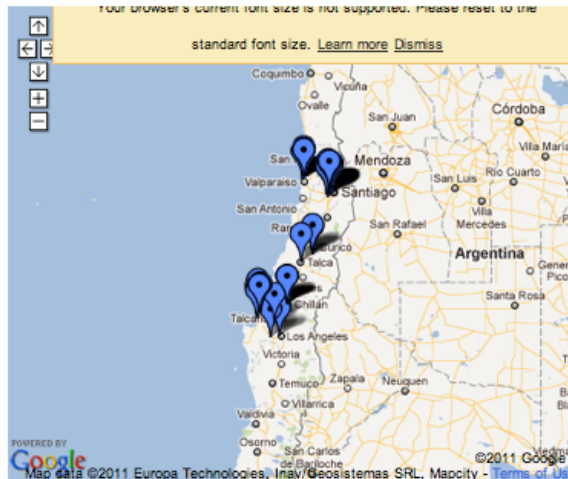
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The 2010 Maule, Chile earthquake was one of the seven largest recorded earthquakes in history (USGS, 2010). Because of the potential implications for U.S. design practices, several U.S. organizations sent reconnaissance teams to Chile, including the ... [See Related Content](#)

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Abstract



Background

The 2010 Maule, Chile Earthquake is one of the seven largest earthquakes recorded in history (USGS, 2010). Because of the potential implications for U.S. design practices, several U.S. organizations and companies sent reconnaissance teams to Chile, including the Earthquake Engineering Research Institute (EERI), The Los Angeles Tall Buildings Structural Design Council (LATBSDC), Applied Technology Council (ATC), and the American Society of Civil Engineers (ASCE). Engineers from the National Institute of Standards and Technology (NIST) accompanied the ASCE and EERI teams.

Typical Database Page

Map **Chile Earthquake Database : Essential Building Data**

Show entries First Previous Next Last Search:

Structure ID	Building Name	Main Building Photo	Address	City	Lat. [degrees]	Long. [degrees]	Earthquake Name	Photographs	Stories above Ground	Typ. Plan Shape	General Drawings
61	ANCONA		65, 7 NORTE, Vina del Mar	Vina del Mar	-	-	Maule.Chile.2010	Launch Gallery	9	rectangular	first_story_plan.pdf
61	ANCONA		65, 7 NORTE, Vina del Mar	Vina del Mar	-	-	Valparaiso.Chile.1985	Launch Gallery	9	rectangular	first_story_plan.pdf
121	BCO. CONCEPCION		112, ECUADOR, Vina del Mar	Vina del Mar	-	-	Valparaiso.Chile.1985	Launch Gallery	6	rectangular	first_story_plan.pdf second_story_plan.pdf
179	Condominio Alto Rio		776, Arturo Prat, Concepcion	Concepcion	-36.827949	-73.061822	Maule.Chile.2010	Launch Gallery	15	rectangular	PL-22-ELEV-5 (in Spanish).dwg PL-23-ELEV-8 (in Spanish).dwg
246	Condominio Bosque Mar			San Pedro de La Paz	-36.885822	-73.150838	Maule.Chile.2010	Launch Gallery	-	-	-
187	Condominio Los Reyes de Huechuraba			Santiago	-33.346823	-70.670983	Maule.Chile.2010	Launch Gallery	8	rectangular	-
241	Condominio Sol Oriente			Santiago	-33.475847	-70.600575	Maule.Chile.2010	Launch Gallery	-	-	-
108	CONJ. HAB. LIMACHE			Vina del Mar	-	-	Valparaiso.Chile.1985	Launch Gallery	7	-	-
175	CONJ. HAB. LIMACHE			Vina del Mar	-	-	Valparaiso.Chile.1985	Launch Gallery	5	rectangular	typical_plan.pdf
212	Conservador de Bienes Raices		620, 5 NORTE, Vina del Mar	Vina del Mar	-33.014033	-71.550671	Maule.Chile.2010	Launch Gallery	5	rectangular	-
206	Edificio Concepto & Estilo Concepcion		1255, Freire, Concepcion	Concepcion	-36.822137	-73.043744	Maule.Chile.2010	Launch Gallery	20	rectangular	-

Structure ID: Con Main Building Photo: Address: City: Lat.: Long.: Earthquake Name: Photographs: Stories above G: Typ. Plan Sha: General Drawings:

Show entries First Previous Next Last

Showing 1 to 11 of 11 entries (filtered from 306 total entries)

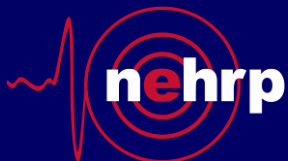
Codes and Standards Activities

Jay Harris:

- ASCE 7 *Seismic Subcommittee*, worked to complete seismic provisions and new commentary, plus Supplement 1 for balloting by main committee
- ASCE 41 *Steel Subcommittee* and AISC TC-9 *Ad-hoc committee on ASCE 41*, to develop updates to Chap. 5: *Steel* for balloting by main committee
- AISC *Committee on Manuals and Textbooks*, to produce the 14th Steel Design Manual, 2nd Seismic Design Manual (primary author Part 2: Analysis)
- NIST Representative, NEHRP *Provisions Update Committee* (PUC)

Jeff Dragovich:

- ASCE 41
- ACI 318-H
- ACI 369



Supplemental Information



national **earthquake** hazards reduction program

Improved Analytical Capabilities

- Applied for and was awarded 200,000 units of compute time on the Argonne National Lab *Surveyor* development computer (4096 cores). Currently porting OpenSEES MPI version for high-fidelity computing for wall models project.
- Procurement of 64 thread Windows HPC server for NEHRP to expand in-house computing capabilities. Networked off-hours machines will allow 120 core total for the *DragoCluster*.

All activities led by Jeff Dragovich ...



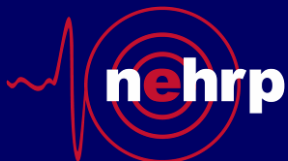
In-House Technical Publications

Kevin Wong:

- 1 NIST Technical Note (in review)
- 1 Journal Paper (in review)
- 3 Conference Papers

Matthew Speicher:

- Two conference papers written on current results from PBSE project(Harris and Speicher)
 - SEAOC 2011 Las Vegas
 - STESSA 2012 Santiago, Chile



Technical Publications

Jay Harris:

- Two conference papers written on current results from PBSE project(Harris and Speicher)
 - SEAOC 2011 Las Vegas
 - STESSA 2012 Santiago, Chile



In Summary

- Significant progress
- External projects
- Internal projects
- Committee and publications
- Important accomplishments and impact
- Busy days

