

Thirty-four Strides Toward Earthquake-Resistant Structures

NIST's External Earthquake R&D Program

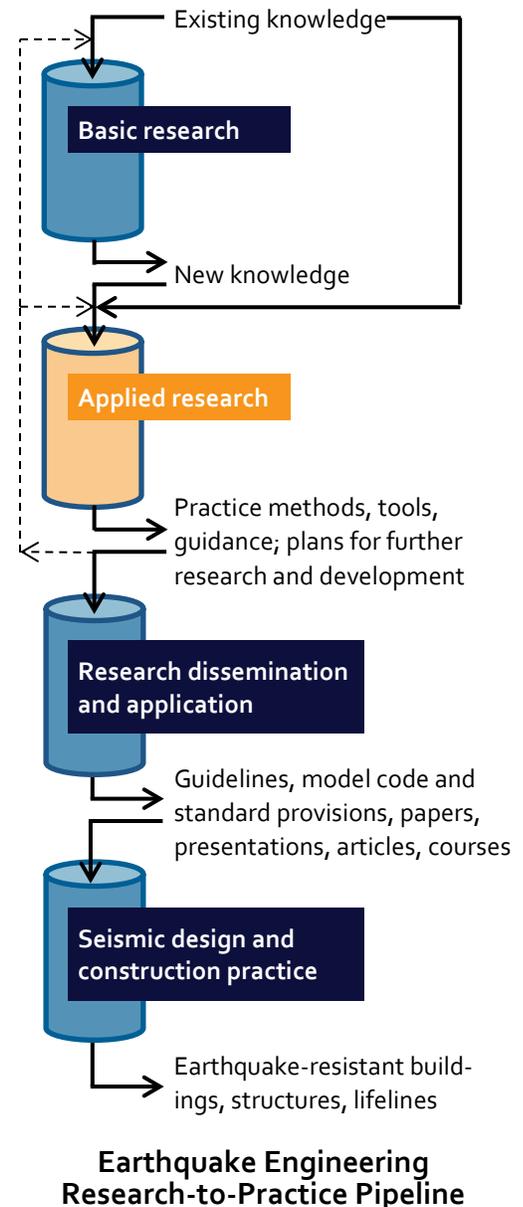
A unique and highly productive program of applied research and development (R&D) in earthquake engineering celebrated its fifth anniversary in September 2012. The National Institute of Standards and Technology (NIST), the lead Federal agency in the National Earthquake Hazards Reduction Program (NEHRP), launched this external R&D effort in 2007 through a 5-year contract with the NEHRP Consultants Joint Venture, a partnership between the Applied Technology Council (ATC) and the Consortium of Universities for Research in Earthquake Engineering (CUREE).

The need for such a program had been recognized several years earlier, when planning efforts organized by NIST warned of a widening gap between the findings of basic research in earthquake engineering and the practical application of those findings. The new program was designed to narrow this gap through problem-focused, practitioner-directed R&D projects. By the close of the contract period, the program had initiated 34 projects, 15 of which are still under way.

The role played by applied research, such as NIST's R&D projects, in integrating research findings into earthquake engineering is illustrated at right. New knowledge is generated through basic research supported by the National Science Foundation (NSF, a NEHRP agency), the U.S. Geological Survey (USGS, a NEHRP agency), and others. Applied R&D conducted by NIST, USGS, and others transforms this fundamental knowledge into methods, tools, and guidance that are of practical use. Dissemination of these resources to earthquake engineering practitioners is led by the Federal Emergency Management Agency (FEMA, a NEHRP agency) and other NEHRP agencies, by seismic code and standards developers, and by influential experts in industry and academia.

Tailor-Made for the Role

The NEHRP Consultants Joint Venture was structured expressly for moving research toward practice. It established a working partnership between CUREE, which represents many of the Nation's top university programs and researchers in earthquake engineering, and ATC, an organization that assembles and manages project teams composed of highly qualified engineering consultants from practice and industry, as well as researchers from academia. CUREE's member researchers develop new knowledge in earthquake engineering, and the expert practitioners enlisted by ATC lead advances in seismic design practice. As of June 2012, the program had created more than 300 consulting assignments. Approximately half of these positions had been filled by researchers, and



Topics of Selected NIST R&D Projects

Summarize the seismic design process for and issues concerning...

- Reinforced-concrete special moment (building structural) frames
- Steel special moment frames
- Concrete diaphragms (floor and roof slabs)
- Composite steel deck and concrete-filled diaphragms
- Concrete special structural walls and coupling beams
- Reinforced-concrete mat foundations
- Special steel concentric-braced frames

Plan an R&D program to...

- Solve the non-ductile-concrete building hazard
- Develop port and harbor seismic design guidance
- Improve the seismic resilience of lifelines
- Guide the future of nonlinear analysis in performance-based seismic design

Evaluate...

- Simplified consideration of nonlinear multiple-degree-of-freedom effects in structural analysis
- FEMA's P-695 methodology for quantifying building seismic performance factors
- Performance of reinforced-concrete buildings in the 2010 Chile earthquake
- Similarities and differences between U.S. and Chilean seismic code provisions and design practice
- Costs and benefits of seismic design in moderate-risk seismic zones
- Collapse indicators for existing reinforced-concrete buildings
- Use of high-strength reinforcement in concrete design
- Ground motion selection and scaling procedures

Develop...

- Online repository for 2010 Chile earthquake data
- Framework for advanced seismic design criteria in the model building code
- Improved soil-structure interaction practice
- Summarized and simplified guidance for nonlinear analysis

half by practicing engineers. These positions have contributed to the development of future leaders in the earthquake engineering workforce, with roughly one-fourth of the assignments performed by graduate students and young practicing engineers.

Widely Traveled Project Reports

NIST's external R&D program has addressed a variety of earthquake engineering issues and produced reports that are being disseminated in many settings. The box at left identifies many of the applied research topics that have been tackled by NIST's project teams. Some projects have focused on collecting, reviewing, and synthesizing research findings and seismic code requirements into concise design and construction guidance for practitioners (technical briefs). Others have involved the evaluation or development of proposed improvements to the seismic provisions of model building codes and standards or to seismic design practices. Planning the R&D programs needed to develop design guidance or resolve design problems has also been a focus of NIST's projects.

NIST's program has so far produced 16 final project reports. Many of these reports, such as the technical briefs, are being used directly by seismic design professionals. Findings and recommendations from other reports are being disseminated to practitioners and researchers via conference presentations and papers or through journal articles, book chapters, doctoral dissertations, continuing education courses, or professional associations. Some results are being incorporated into current R&D projects or into plans for future R&D supported by NSF, NIST, USGS, FEMA, or others. And significantly, many findings are being used in the ongoing process of improving the seismic provisions of national model building codes and standards.

The reports from all projects completed to date are available at www.nehrp.gov. Additional reports will be posted as the remaining projects are completed. NIST has begun a competitive process to establish a new contract that is similar to this successful effort.

For more information, visit www.nehrp.gov or send an email to info@nehrp.gov.


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