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Construction and Building



Interagency Program For Technical Advancement In Construction and Building



**Report of the Subcommittee on Construction and Building
Committee on Technology
National Science and Technology Council**

1999 CONSTRUCTION AND BUILDING

INTERAGENCY PROGRAM FOR TECHNICAL ADVANCEMENT IN CONSTRUCTION AND BUILDING

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Executive Summary

The National Science and Technology Council (NSTC), Subcommittee on Construction and Building (C&B) was organized in 1994 to coordinate and focus the work of 14 federal agencies in enhancing the competitiveness of U.S. industry, public and worker safety and environmental quality through research and development. The Subcommittee works in cooperation with U.S. industry, labor and academia for improvement of the life cycle performance, sustainability, efficiency, effectiveness and economy of constructed facilities.

At the start, C&B formulated, in consultation with industry, national construction goals to guide federal agencies and industry in the focus and coordination of the \$500 million annual federal R&D relevant to the industries of construction. Collaborative R&D has been planned and conducted with residential, commercial/institutional, industrial and public works sectors. A notable collaboration, the High Performance Construction Materials and Systems Program (CONMAT), involves 13 materials associations has planned a \$2 billion, 10-year program of R&D; and developed \$250 million in ongoing projects jointly funded by industry and government.

While C&B coordinates federal R&D in collaboration with the industries of construction, most such R&D is conducted as part of agencies' programs and not through the subcommittee. To enhance private sector/federal agency collaboration C&B sponsored the Construction Industry Collaborations Workshop to advise industry on interests, capabilities and mechanisms for research collaborations.

Industry has pointed out, in response to C&B's encouragement of greater private sector investment in R&D for construction, that barriers to innovation must be

reduced to justify private sector investments. A large part of C&B's collective federal activities has been focused on such barrier removal. C&B or its member agencies have:

- Organized and funded with state and local governments and industry a project Streamlining the Building Regulatory Process. The project will enhance economic development, public safety and environmental quality by bringing better management and practices to the regulation of the siting, design, and construction of all types of buildings throughout the United States. The project is producing model practices, based on more than 100 case studies of successful innovations in regulatory practices, expected to reduce the duration and costs of regulatory processing in many jurisdictions by 60 percent.
- Provided technical and financial support for development of the private sector evaluation centers including:
 - ▲ the National Evaluation Service - Building Innovation Center (NES-BIC) for an authoritative assessment of safety, functional and environmental qualities for national and international acceptance of innovative building products and services;
 - ▲ the Highway Technology Evaluation Center (HITEC) for information on and evaluation of products, materials, services, equipment, and systems for highways;
 - ▲ the Environmental Technology Evaluation Center (EvTEC) - for promotion of environmental management technologies; and
 - ▲ the Civil Engineering Innovative Technology Evaluation Center (CEITEC) - for the evaluation of a wide spectrum of technologies with particular attention to public works and military technologies.



In response to national needs and interests of the housing sector, beginning in FY97 C&B organized the Partnership for Advancing Technologies in Housing (PATH), which became a Presidential initiative announced in 1998. PATH brings together government and industry to develop, demonstrate and deploy housing technologies, designs and practices that can significantly improve the energy efficiency and quality of new and existing houses without raising the costs. The Department of Housing and Urban Development and the Department of Energy are leading the PATH program.

Recognizing the need for advanced infrastructure systems to meet the needs of citizens and businesses for the 21st century, C&B worked with the Civil Engineering Research Foundation (CERF) to form a Partnership for Advancing Infrastructure and its Renewal (PAIR). PAIR is a partnership of government, private sector and academic programs to develop innovative technologies needed to advance the nation's physical infrastructure consisting of transportation, energy, telecommunications, water supply and sewage, as well as key public institutional resources such as schools,

hospitals and prisons. To build consensus for PAIR, C&B and CERF held two workshops in 1998, one dealing solely with transportation and the other covering energy, telecommunications, water supply and sewage.

These are major efforts but do not span the needs for collaborations with the industries of construction to advance competitiveness all industries and everyone's quality of life. Additional cooperative programs initiated in fiscal year 1998 are:

- improving the functionality, safety, efficiency and sustainability of building service systems through research with the industrial sector's Construction Industry Institute and a Mechanical and Electrical Systems Council and;
- determining relations between the workplace environment and worker productivity.

C&B also has studied baseline data and measures of progress for the National Construction Goals and produced reports on the first two goals—reduction in delivery time and reduction in operation, maintenance and energy costs.

C&B's workplan for fiscal years 1999 and 2000 includes:

- aggressive implementation of PATH and PAIR;
- continuation and strengthening of CONMAT;
- continuation and strengthening of Streamlining the Building Regulatory System;
- supporting the development of the Mechanical and Electrical Systems Council;
- cooperating with the Construction Industry Institute in breakthrough research and
- documenting relations between the workplace environment and worker productivity, health and safety, and defining opportunities for improvement.

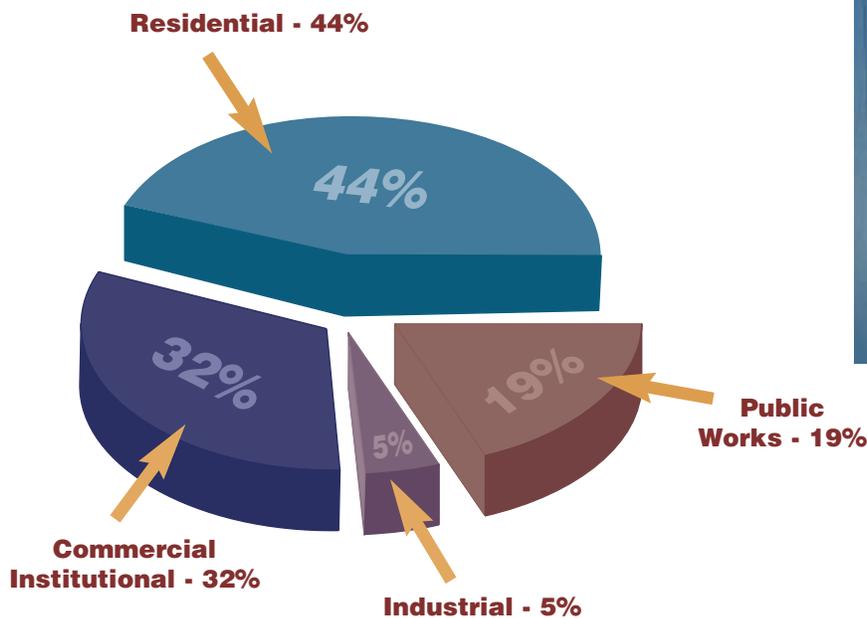
The President's Office of Science and Technology Policy endorses this workplan and encourages the agencies comprising C&B to support it vigorously.

1

The U.S. Construction Industry

Construction is one of the nation's largest industries. In 1997, new construction was \$618 billion (1)*; with renovation, maintenance and repair added, the total volume of construction was about \$995 billion, 12.3 percent of the GDP. Since constructed facilities shelter and support most human activities, their quality and economy is vital to the competitiveness of all industries and everyone's quality of life. Federal construction represents 10 percent of U.S. construction. Buildings use one-third of all energy used in the United States.

* Numbers in parentheses denote references listed on page 34.



2

National Construction Goals

Background

In 1994 the Construction and Building Subcommittee studied research priorities expressed by the construction industry in proposals to the Advanced Technology Program of the Department of Commerce. Two priority thrusts—better-constructed facilities and health and safety of the construction workforce, were defined for focus of research, development and deployment (RD&D) in the construction and building area. Under these thrusts, seven goals were proposed and reviewed with a focus group of industry leaders convened by the Civil Engineering Research Foundation in April of that year. The focus group strongly endorsed the goals, which became known as the National Construction Goals.

The C&B program plans to make technologies and practices necessary for achieving the goals under these thrusts available for general use in the construction industry by 2003.

Goals - Rationale

50 Percent Reduction in Delivery Time

Reduction in the time from the decision to construct a new facility to its readiness for service is vital to industrial competitiveness and project cost reduction. During the initial planning, design, procurement, construction and commissioning process, the need of the client for the facility is not being met. Needs evolve over time so a facility long in delivery may be non-competitive when it is finished, and the investments in producing the facility cannot be recouped until the facility is operational. The need for reduction in time to project completion is often stronger in the case of renovations and repairs of existing facilities because of interruption of ongoing business. Owners, users, designers and constructors are among the groups calling

for technologies and practices reducing delivery time.

50 Percent Reduction in Operation, Maintenance and Energy Costs

Operation and maintenance costs over the life of the facility usually exceed its first cost and may do so on an annualized cost basis. To the extent that prices for energy, water, sewage, waste, communications, taxes, insurance, fire safety,

activities of its occupants. Improved productivity of the occupants (or for an industrial facility, improved productivity of the process housed by the facility) is the most important performance characteristic for most constructed facilities.

50 Percent Fewer Occupant Related Illness and Injuries

Buildings are intended to shelter and support human activities, yet the



Absolute measurements of thermal resistance of insulation of varying thicknesses and densities being made using the NIST guarded hot plate.

plant services, etc. , represent costs to society in terms of resource consumption, operation and maintenance costs also reflect the environmental qualities of the constructed facility. Therefore, reductions in operation, maintenance and energy costs benefit the general public as well as the owners and users of the facility.

30 Percent Increase in Productivity and Comfort

Industry and government studies have shown that the annual salary costs of the occupants of a commercial or institutional building are of the same order of magnitude as the capital cost of the building. Indeed, the purpose of the building is to shelter and support the

environment and performance of buildings can contribute to building users' illnesses and injuries such as avoidable injuries caused by fire or natural hazards, slips and falls and legionnaires' disease from airborne bacteria and illnesses associated with a workplace environment (sick building symptoms). Injuries can occur as a result of building damage or collapse from fire, earthquakes, or extreme winds as well as improper or poor building design. Sick building symptoms include irritation of eyes, nose and skin; headache; and fatigue. If improvements in the quality of the indoor environment reduce days of productive work lost to sick days and impaired productivity, annual nationwide savings could reach billions of dollars. Criminal violence in buildings is

a safety issue, which can be addressed in part by building design. Reductions in illnesses and injuries will increase users' productivity and lower costs of medical care and litigation.

50 Percent Less Waste and Pollution

Improvement of the performance of constructed facilities that shelter and support most human activities provides major opportunities to reduce waste and pollution at every step of the delivery process, from raw material extraction to final demolition and recycling of the shelter and its contents. Examples are decreased energy use and greenhouse gas emissions and reduced water consumption and wastewater production. Waste and pollution also can be reduced in the construction process; construction wastes are estimated at 20 to 30 percent of the volume of landfills.

50 Percent More Durability and Flexibility

Durability denotes the capability of the constructed facility to continue (given appropriate maintenance) to function at its initial level of performance over its intended service life. Flexibility refers to the owner's capability to adapt the constructed facility to changes in use or users' needs. High durability and flexibility contribute strongly to the life cycle quality of constructed facilities.

50 Percent Reduction in Construction Work Illnesses and Injuries

A factor affecting international competitiveness is the cost of injuries and diseases among construction workers. Although the construction workforce represents about 6 percent of the nation's workforce, it is estimated that the construction industry pays for about one-third of the nation's workers' compensation. Workers' compensation



Constructed wetlands project prior to flooding—part of a 1200-acre bottomland wet prairie located near Alton, Illinois

insurance premiums range from 7 to 100 percent of payroll in the construction industry. Construction workers die as a result of work-related trauma at a rate that is 2 1/2 times the annual rate for workers in all other industry sectors (13.6 deaths per 100,000 construction workers, as compared to 5.5 deaths per 100,000 workers in all other industry

sectors). Construction workers also experience a higher incidence of non-fatal injuries than workers in other industries.

Industry Perspective

In December 1994 a White House - Construction Industry Workshop was



Dust collection system used during the removal of lead paint from an overpass

held to explore the perspective of the construction industry on the National Construction Goals. The workshop noted that the five sectors of the construction industry: residential, commercial, industrial, institutional, and public works differ in the participants involved, methods of financing, legal factors, project timing, the desire for or acceptance of innovation, the importance of first cost or operating cost, market forces, and customer involvement. Consequently, they differ in their ranking of relative importance of the proposed goals. For example, the residential construction industry specifically identified reduced first cost (directly coupled to reduced delivery time) as its most important goal. Other sectors, however, considered operation, maintenance and energy costs as the most important goal.

Meeting the goals will require advances in technology, demonstration of those

advances, elimination of barriers to innovation, and leadership to bring about the important non-technical changes called for by industry.

Strategy

The C&B program plans to make technologies and practices necessary for achieving the goals under these thrusts available for general use in the construction industry by 2003. The baseline for measuring progress against the goals is average practice in 1994. Therefore, reliable baselines and measurement tools are being developed. Reports (2), (3) containing detailed baseline information on the first two goals—reduction in delivery time and reduction in operation, maintenance and energy costs—have been produced.

Achieving the National Construction Goals will require the federal government to work in cooperation with state

and local governments and the private sector to:

- reduce non-technical barriers to innovation,
- conduct research programs to respond to the needs of the industry, and
- provide the measurement methods and data to enable the industry to use innovative products and techniques.

The strategy adopted by C&B is to work with industry to develop partnerships focusing on specific sectors of construction such as housing and physical infrastructure. C&B will also hold government-industry workshops to document industry needs and then develop R&D programs that contribute to meeting those needs. With the help of C&B, government agencies will coordinate their work and, where appropriate, collaborate directly with the private sector.



Evaluation of seismic performance of a pre-cast beam column using NIST's computer controlled tri-directional test facility.

3

Collaborative R&D Planning

Sector Planning Meeting — Residential

The National Association of Home Builders Research Center (NAHBRC) served as secretariat of the residential sector portion of the effort to plan the effort needed to achieve the National Construction Goals. The residential sector group designated two goals as high priority: reducing cost (through innovative technology and cycle time reduction) and improving durability. Durability improvement is a natural complement to reducing production cost. Working to improve the durability of the existing housing stock will increase the effective supply of housing by prolonging its service life, thereby relieving the upward pressure on prices.

In December 1996, NAHBRC organized a Residential Sector/Federal Agency Workshop attended by over 30 representatives of private sector organizations and federal agencies. The group reaffirmed and prioritized the following strategic approaches to meeting the two high priority goals:

1. Establish and maintain an information infrastructure responsive to the needs of builders, designers, subcontractors, manufacturers, code officials and consumers.
2. Develop and implement improved methods for assessing and increasing durability of specific types of building products.
3. Improve the efficiency of the housing production process.
4. Improve the efficiency of the regulatory and new product approval systems.
5. Develop an improved understanding of the performance of conventionally-built light-frame structures.



6. Foster the development and commercialization of innovative products and systems.

7. Expand markets and marketability.

The NAHB Research Center published a report (4) summarizing this planning effort in March 1997.

The residential sector planning effort has resulted in the Presidential initiative PATH (Partnership for the Advancement of Technology in Housing). See page 13 for more information.

Sector Planning Meeting — Public Works

The American Public Works Association (APWA) served as the lead organization in helping to develop an implementation strategy for facilitating innovation in the public works sector. In June 1996, APWA convened a strategic planning meeting of federal agencies, private sector manufacturing companies, construction companies, consulting engineers, academic and federal laboratories and professional associations. Prior to the

meeting a survey of APWA members showed that local public works leaders do not view the federal government as a direct source of information on the adoption of new construction technology. They obtain most of their information from trade publications and association meetings.

Round table discussions at the meeting identified two main elements of an implementation strategy: partnerships and communication. Two types of partnerships were envisioned: public/private partnerships, bringing together government agencies with private sector companies to minimize the adversarial relationship which sometimes develops in construction projects; and practitioner/researcher partnerships bringing end users, manufacturers and researchers into regular contact. For these partnerships to work and for practitioners to be knowledgeable about research results, it was agreed that more effective and ongoing channels of communication between the various elements in the public works construction industry should be created.



The APWA has entered into formal partnerships with various organizations and private companies to encourage direct communication and develop specific laboratory technologies for the public works marketplace. In addition, a number of the C&B member agencies have exhibited at the APWA Annual Congress and participated in the technology programs.

Sector Planning Meeting — Commercial/Institutional

The commercial and institutional sectors of the industry do not have a single organization that is recognized as representing a broad spectrum of their interests. Furthermore, many designers, constructors, equipment manufacturers and operators participating in these



U.S. Courthouse, Foley Square NY – Constructed by GSA

sectors do not restrict their businesses to these sectors. In July 1996, the National Institute of Building Sciences (NIBS) agreed to convene a workshop to address the National Construction Goals as they relate to the planning, designing, operating, and maintaining of commercial and institutional facilities. Representatives of the building community, including owners, design professionals, contractors, lenders, insurers, labor and regulators attended the workshop.

The workshop addressed each of the National Construction Goals identifying barriers, needed actions and implementation responsibilities. The report of the workshop (5) noted the following general observations and recommendations:

- Improvements in the application of currently existing technology are important.
- Federal construction should stimulate the industry to think and act cooperatively.
- Planning should: utilize life-cycle based decision making from project inception; integrate worker safety plans into construction methods; call for waste separation and onsite recycling; incorporate environmental considerations into the construction process; and address occupant and worker health and security.
- Greater standardization of the model building codes and code interpretation is needed and the code approval process should be improved.
- A range of new financial strategies which reward environmental performance and early completion should be developed.
- Multilingual education and training programs should be more available.

Sector Planning Meeting — Industrial

The Construction Industry Institute (CII), whose members include major design and construction companies; large corporations in the chemical, process and refining area; and federal agencies, focuses its efforts on project management in the industrial, commercial, institutional, and public works and utilities sections of the construction industry.

In June 1997, the Research Committee of CII sponsored a workshop to identify for the federal laboratories that conduct construction-related research the needs of the private sector, and to introduce to the private sector the capabilities of the federal laboratories to lay a foundation for future cooperation and collaboration. Participants included representatives of private companies, federal agencies, and universities. Workshop brainstorming sessions identified more than 50 potential research subjects. From these the following 12 highest priority research topics were selected:

- global standards development and implementation;
- uniform rational and predictable product approval process;
- integrated project information to the field;
- remediation of hazardous materials and sites;
- model-based design process to reduce cycle time;
- using production line techniques in construction;
- construction worker aids/ tools/ robotics;
- behavior modification for safe work practices;

- technology transfer and implementation;
- communication of best safety practices in construction;
- information exchange protocols;
- improved communication of business owners' needs to engineering/construction; firms for mutual profit from technology.

For each of these topics the workshop report (6) identified the main products of the research, by whom they are needed, the expected benefits, reasons for government involvement and potential participants and sponsors.

C&B member agencies are continuing to work with the CII Strategic Planning Committee in the development of their Vision 2020 for the industrial sector.

CONMAT

In 1994 CERF coordinated the development of a plan for the deployment of high-performance construction materials. This plan (6) led to the formal establishment, in 1995, of the industry-led CONMAT Council, a key element of the CONMAT program. The mission of the Council is to expedite innovation and construction-related research and deployment projects through a coordinated and integrated industry effort with close communication among trade associations, private and public laboratories, academic groups and government agencies. Many C&B member agencies engaged in materials and construction-related research provided financial support for the formation of the CONMAT Council. CERF provides the secretariat to the CONMAT Council, which is composed of representatives from 13 materials groups covering, aluminum, coatings, fiber-reinforced polymer composites, concrete, geosynthetics, masonry, plastics, roofing materials, smart materials



devices and monitoring systems, stainless materials and systems, steel and wood. Seven C&B agencies are liaison members of the council.

The CONMAT program now has approximately 50 projects under way representing an investment of over \$250 million and has plans for a \$2 billion program over next 10 years. In June 1996, the CONMAT Council, CERF, ASTM and the National Institute of Standards and Technology held a planning workshop for a National Partnership on Computer Integrated Knowledge Systems (CIKS) Network for High Performance Construction Materials and Systems. CIKS is now under development with an initial focus on high performance concrete.

Collaborations Workshop

In April 1996, C&B and the Army Corps of Engineers sponsored the Construction Industry Collaborations Workshop as a first step in identifying ways to improve collaborative mechanisms between the public and private sectors of the construction industry.

Workshop participants discussed a variety of mechanisms including

- use of government facilities and capabilities and the role of government as consultant/assistance provider;

- commercialization of government laboratory technologies;
- joint research agreements;
- jointly sponsored research centers; and
- research consortia and large-scale industry wide network programs.

Cooperative Research and Development Agreements (CRADAs) are an important partnership tool when protection of intellectual property is required. In CRADAs, private sector partners may contribute research staff, equipment, facilities and funds. Government partners may contribute research staff, equipment, facilities and funds (to other federal partners only). CRADAs can protect confidential information to the extent permitted by law. CRADAs can protect research results from Freedom of Information Act requests for up to five years and provide for exclusive licensing rights to resulting inventions.

The report of the workshop (8) provides information on capabilities of federal laboratories and a federal agency point of contact on 66 collaboration success stories covering safety, information systems, high performance materials and systems and automation.

4

Barrier Removal

Streamlining the Building Regulatory System

Delays and costs of complying with a multiplicity of federal, state and local building regulations, some of which may conflict, are most often cited by industry as inhibitors to private sector investment in innovation. The regulatory process is considered both a barrier to the use of innovative products and practices in construction projects and a major factor in increasing costs and obsolescence of constructed facilities.

As an element of the U.S. Innovation Partnership between federal and state governments, and with major support from the federal agencies of the C&B Subcommittee, the National Conference of States on Building Codes and Standards (NCSBCS) has organized a program designed to develop and gain the adoption of a package of model reforms. When adopted by federal, state, regional or local governments, these reforms are expected to reduce by as much as 60 percent the amount of regulatory processing time it takes to move projects from the initial step of zoning approval through to the last step of issuance of the certificate of occupancy. The program—called streamlining the nation's building regulatory process—will enhance public safety, economic development, and environmental quality.

In January 1997, NCSBCS issued a national call for the public and private sectors to submit case studies of existing streamlined processes and procedures that reduce regulatory overlap. Currently more than 100 case studies have been received. Executive summaries of most of those case studies are now available on the NCSBCS Web site (<http://www.ncsbc.org/>). With the cooperation of the Council of State Community Development Agencies (COSDA) 13 task groups, each covering

a different regulatory area, have begun screening the case studies and turning some of them into model processes. The NCSBCS consensus-based Regulatory Affairs Committee is analyzing the models for completeness and consistency. A 55 member National Streamline Implementation Committee (NSIC), composed of a consortium of public and private sector organizations and federal agencies representing the major stakeholders in the Nation's building process, has been formed. The NSIC is developing and implementing strategies to gain the adoption of each of the model processes by the most appropriate levels of government. Annual reports on the project (9) (10) have been published.

More information can be found on the project web-site, www.ncsbc.org/streamline/welcomestream.btm.

Evaluation Centers

C&B and its member agencies have provided technical and financial support to CERF for development of four private sector evaluation centers.

The National Evaluation Service - Building Innovation Center (NES-BIC) is a new evaluation service designed to expedite the introduction of innovative technologies into the building marketplace. It represents the culmination of a multiyear planning effort, by the Partnership for Building Innovation (PBI). Facilitated by CERF, PBI brought together a diverse group of industry leaders concerned with the quality and speed of entry of new building technology into the marketplace.

This new service, administered by NES in cooperation with CERF, provides independent technical evaluations for all types of building technologies that can be used by innovators, designers, owners or facility operators to gain credible

performance information. The Center is governed by a management board recommended by the National Evaluation Service Board of Directors representing manufacturers, building owners, insurers, designers/architects, contractors builders, testing organizations, standards developers and home builders. The NES-BIC website is www.cerf.org/nesbic.

Contact: Mr. John Kwon
Phone: 202 842-0555
Fax: 202 789-5345
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The Highway Technology Evaluation Center (HITEC) provides information on and evaluation of products, materials, services, equipment, and systems for highways.

Contact: Mr. David Reynaud
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E-mail: dreynaud@cerf.asce.org

The Environmental Technology Evaluation Center (EvTec) was established to promote the acceptance of environmental management technologies.

Contact: Mr. Will Kirksey
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The Civil Engineering Innovative Technology Evaluation Center (CEITEC) evaluates a wide spectrum of technologies with particular attention to public works and military technologies.

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5

Partnership for Advancing Technology in Housing

Partnership Formation

In 1997, the Office of Science and Technology Policy through the C&B Subcommittee formed a working group of representatives of some of the C&B agencies (HUD, DOE, NIST, EPA, DOD, FEMA and OSHA) to examine the need for improvements in the housing industry.

In December 1997 HUD Secretary Andrew Cuomo hosted a planning meeting for the Partnership for Advancing Technology in Housing (PATH). He was joined by DOE Secretary Federico Pena and Presidential Science Advisor, Dr. John Gibbons, in welcoming 35 representatives from the housing and related industries. Enthusiastic support for PATH was expressed by many of the industry representatives. HUD hosted a second meeting in March 1998 to discuss PATH's 1998-1999 Program Plan.

HUD and DOE have been designated the lead federal agencies for the partnership. The government's primary role in the partnership is to act as catalyst and facilitator, and to help remove unnecessary regulatory barriers to innovation. Private industry will develop and deploy the technologies for the next generation of U.S. housing. Industry welcomes this approach and is committed to working with the partnership to achieve PATH goals.

PATH's primary goal is to accelerate the creation and widespread use of advanced technologies to radically improve the quality, durability, environmental performance, energy efficiency and affordability of our nation's housing.

Specifically, during the next decade the partnership aims to accelerate development of innovative housing components, designs and production methods and reduce the time needed to move technologies to market by more than half while increasing confidence in the safety and durability of these technologies. By the year 2010 PATH will:

- reduce the monthly cost of new housing by 20 percent or more;
- cut the environmental impact and energy use of new housing by 50 percent or more and reduce energy use in a least 15 million existing homes by 30 percent or more;
- improve durability and reduce maintenance costs by 50 percent; and
- reduce by at least 10 percent the risk of loss of life, injury, and property destruction from natural hazards and decrease by at least 20 percent residential construction work illnesses and injuries.

PATH's program plan specifies three objectives:

- increase utilization of advanced technologies in today's new and existing homes;
- strengthen the housing technology infrastructure of the United States; and
- stimulate development of new technologies that will create the next generation of U.S. housing.

The PATH web site, www.pathnet.org, describes PATH and federal programs that support PATH goals. The site is linked to the National Association of Home Builders Research Center Homebase Services web site <http://www.nabbrc.org/xhomebase.htm> which provides access to many innovative technologies that have less than 5 percent market share and that contribute to the PATH goals. The homebase site also describes some "best practices" used in home construction.



In May 1998, President Clinton formally announced the formation of PATH to bring together government and industry to develop, demonstrate and deploy housing technologies, designs and practices that can significantly improve the energy efficiency and quality of new and existing housing without raising costs. That same month Vice President Gore, in a speech to the National Association of Home Builders, said of PATH “by working together, we’re going to build in America homes that are safer and more affordable, more durable, more energy efficient, more comfortable. And we’re going to do it through the power of innovation and through the power of the marketplace.”

Housing Related Programs in Federal Agencies

National Homeownership Partnership (HUD)

HUD coordinates the National Homeownership Partnership. The goal of the Partnership created by President Clinton is to lift the homeownership rate to an all-time high. Sixty-two national private and public organizations are members of the Partnership including the National Association of Home Builders, the Manufactured Housing Industry, Fannie Mae, the American Institute of Architects, the Council of American Building Officials and the Mortgage Bankers Association. As part of their efforts, the partners have committed to working on “a public-private effort to accelerate adoption of technological innovation in the homebuilding industry.” The Partnership has voted to support and work closely with PATH.

ENERGY STAR (EPA/DOE)

EPA with the cooperation of DOE, runs the ENERGY STAR program, which provides recognition, marketing and technical assistance to builders that agree to build energy efficient homes. This is a voluntary program through which builders are to provide energy-efficient buildings consistent with ENERGY STAR guidelines. Qualifying buildings are permitted to be marketed as “ENERGY STAR” homes.



Building America (DOE)

DOE’s Building America program involves a series of consortia composed

of product manufacturers and builders jointly funded by industry and government to apply systems engineering to the development and adoption of new products, building designs and processes. Four industry teams have been established representing a variety of material and product manufacturers as well as designers and builders. Innovative technologies are identified using a systems engineering approach and then prototypes as well as full subdivisions are developed. Goals are to reduce energy use and waste as well as first costs.

Disaster Resistant Communities (FEMA)

Under Project Impact: Building a Disaster Resistant Community, FEMA challenges the nation to undertake actions that protect families, businesses and communities by reducing the effects of natural disasters. The goal of Project Impact is to reduce the personal and economic costs of disasters by bringing together community leaders, citizens and businesses to prepare for and protect themselves against the ravages of nature. This effort is an investment that enhances and strengthens the economic structure and long-term stability of a community regardless of when a

disaster strikes. The FEMA disaster mitigation website is

<http://www.fema.gov/mit/>

6

Partnership for the Advancement of Infrastructure and its Renewal

The Partnership for the Advancement of Infrastructure and its Renewal (PAIR) is being organized as a partnership of existing and future government, private sector, and academic programs to develop the innovative technologies needed to revitalize and advance the nation's physical infrastructure. "Infrastructure" comprises transportation, energy, telecommunications, water supply, and sewerage, as well as key public institutional resources such as schools, hospitals and prisons. PAIR is forging an unprecedented public-private sector partnership in research and development and technology transfer to renew existing infrastructure and expedite delivery of new, advanced facilities to support infrastructure systems for the 21st century. The aim of these systems is to be more functional, reliable, economical, environmentally friendly, durable and safe.

In April 1998, C&B, the Department of Transportation, and Civil Engineering Research Foundation organized a workshop for national transportation leaders to address the critical need for innovation for renewal of the transportation infrastructure. A second workshop was convened in June 1998 to focus on innovations for telecommunications, energy infrastructure and water supply and sewerage. At both workshops, participants concurred that PAIR is a key element in the accelerated use of innovation, particularly advanced materials and processes in new construction, repair, retrofit and maintenance of the physical infrastructure.



Testing a scale model of a dam and spillway at the Army Corps of Engineers Waterways Experimental Station. Flood control is an important component of the Nation's infrastructure.

PAIR's four interrelated objectives, which were discussed at the workshops, are:

- nurturing a national constituency that is committed to infrastructure renewal;
- identifying and creating private and public sector R&D partnerships that will aggressively develop and utilize advanced materials and processes;
- identifying and reducing those barriers that impede the rapid commercialization of innovative technologies with emphasis on advanced materials and processes; and
- recognizing, stimulating and showcasing innovative projects that will address critical infrastructure needs.

White papers (11) (12) have been developed that describe the need for and vision of a public/private sector umbrella partnership to accelerate innovation in the construction, maintenance and repair of our Nation's physical infrastructure. One white paper addresses transportation issues (PAIR-T) and the other addresses the full scope of the infrastructure. Key near-term objectives for PAIR are to develop a detailed implementation plan and develop increased public awareness of PAIR to broaden programmatic and financial support. This will include the development of a web site.

7

Subcommittee Plans for Fiscal Years 1999 and 2000

Partnership for Advancing Technology in Housing

C&B provides the secretariat for the PATH federal agency-working group and, as such, works in collaboration with the industrial consultant of PATH to provide personnel and technical support from the federal agencies.

C&B coordinates the federal R&D effort in all sectors of construction and building and therefore, will help to identify Federal R&D that is in support of the PATH goals. C&B will stimulate and encourage federal agencies to provide supporting technology for industry partners in response to their expressed needs.

Expertise on the performance of innovations that will be used in pilot projects is located in different federal agencies. C&B will help to identify those experts

and benefits of current and new technologies and ensure that the pilot home developers have information they need.

C&B agencies will also explore and promote industry/government collaborations that will respond to the research needs of the housing industry. Cooperative research and development agreements (CRADAs) between Federal agencies and private industry are effective in focusing research efforts on the needs of industry and provide an excellent means of transferring new technology to practice.

Streamlining the Building Regulatory System (NCSBCS)

C&B will continue to provide financial support for the NCSBCS project on streamlining the building regulatory system. NCSBCS will complete the development of a matrix delineating the

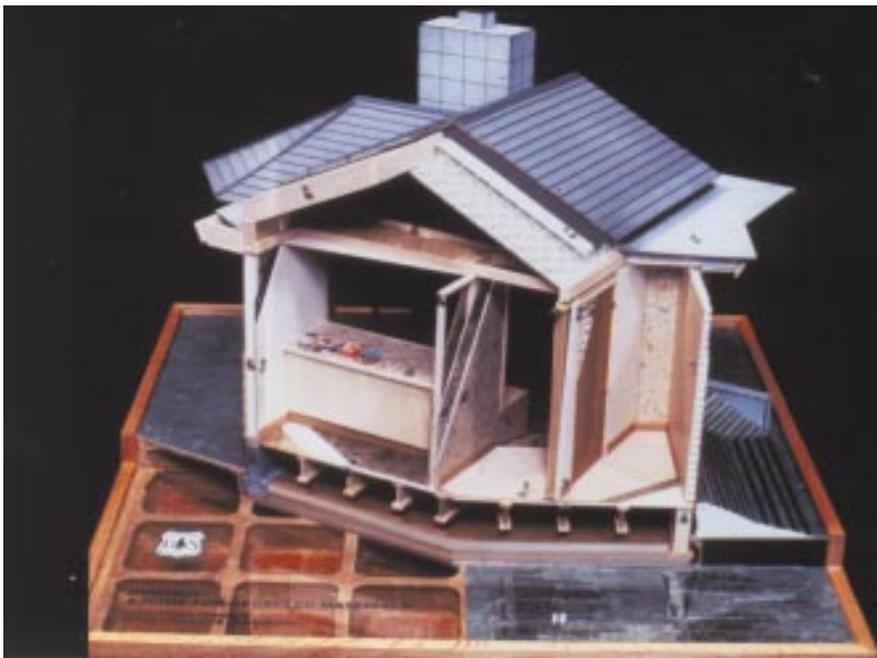
regulatory areas covered by the project, areas where case studies have been received and areas where model processes are available. In addition to turning existing case studies into model processes, the program will develop streamlined models in those areas of regulatory overlap and duplication that have not yet been successfully addressed.

NCSBCS will develop a streamlining model guidebook, which will include a legislative guide for state and local governments. The guidebook and the NCSBCS web site will make available the matrix, executive summaries of all the case studies, and guidance on the option and use of all models produced in this project. NCSBCS's working with public and private groups to develop training seminars in the use of model regulatory procedures such as the one developed for the state of Oregon.

NCSBCS will assist in PATH demonstration projects by offering the inventory of streamlined regulatory processes and their experience to building regulators in communities where PATH demonstration projects are planned.

Partnership for Advancing Infrastructure and its Renewal (PAIR)

C&B plans to support the development of PAIR. CERF will act as secretariat. The initial effort will focus on developing detailed roadmap/implementation plans for transportation physical infrastructure and educational facilities, and develop increased public awareness of PAIR to broaden programmatic and financial support. This will include the development of a web site.



This model house depicts the use of new recycled wood and paper products for housing. Use of recycled products has the potential to conserve resources, reduce landfills and provide additional create jobs.

CONMAT

CONMAT, which provides an excellent mechanism to align federal R&D with industry programs for advanced construction materials and systems, will play a key role in PAIR. For example, high performance concrete that is more easily placed will result in reduced inspection and maintenance costs associated with repair, and fiber-reinforced polymer composites promise to allow vehicular bridges to be factory produced reducing delivery time and worker accidents.

C&B agencies will provide continuing financial support for the operation of the CONMAT Council and will explore opportunities for cooperative research with Council members. C&B will advise the Council on C&B activities and will help to coordinate federal R&D in high performance materials with the needs of industry members of the Council. C&B will also identify federal construction projects that could provide opportunities to demonstrate the use of high performance materials.

Mechanical and Electrical Systems

C&B will provide financial support to the American Society for Mechanical Engineers to establish the Forum on Innovation in Buildings' Mechanical and Electrical Systems in support of the National Construction Goals. The focus will be on facilitating research, technology transfer and cooperative interactions between organizations and individuals concerned with innovations in mechanical and electrical systems in buildings. A holistic approach to the design and operation of buildings will be taken to enhance building efficiency, the occupant's safety and quality of life, and the building owner's satisfaction. Prospects are good for achieving



Ocean Lakes High School, Virginia Beach, Virginia.

private/public cooperation similar to the CONMAT Council.

Construction Industry Institute

C&B member agencies will participate in CII's continuing development of its vision and strategic plan for industrial facilities and in CII's research that supports the mission of C&B or an individual agency.

Workplace Environment, Worker Productivity and Summit on Building Performance

C&B will support a study on the relationship between workplace environment and worker productivity by the National Research Council's Board on Infrastructure and the Constructed Environment. Initially this study will involve completing a thorough literature search

on the subject. Research agendas then will be developed in collaboration between industry, government and academe. C&B member agencies will support, conduct and participate in research consistent with agency missions.

As a result of the commercial/institutional sector's interest in the goal of increased productivity and comfort, annual National Building Performance Summits have been held in Washington, D.C. , to advance the dialogue on the positive relationship between the high performance workplace and its impact on productivity and profitability. Sponsors of the summits are the American Institute of Architects, the Building Owners and Managers Association, the International Facility Managers Association, and Johnson Controls Inc. C&B agencies participate in the summit.

Baseline Measures for the National Construction Goals

Reports on baselines and measures of progress for two of the National Construction Goals—namely, reduced delivery time and reduced operation, maintenance and energy costs—have been completed. The reports provide a wealth of data on which to base improvements, but show that no single figure can be used as a baseline for each of the goals, mainly because of the major differences between building sectors. C&B will continue to develop baselines and measures of progress for the National Construction Goals to assist in planning, research and implementation.

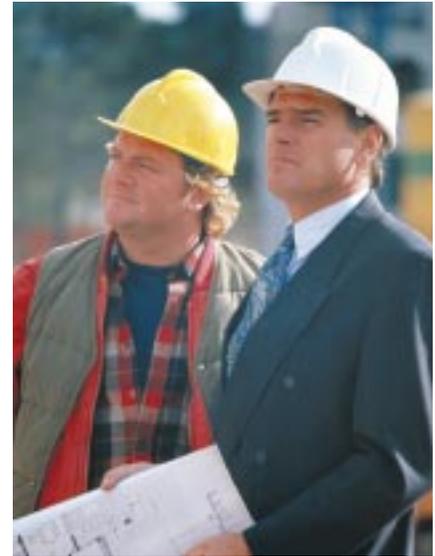
Coordinating of Federal Research and Development in Construction and Building

C&B will continue to coordinate federal agency research, development and deployment programs dealing with the design, construction and operation of constructed facilities. In addition to

examining the fiscal aspects of federal RD&D programs, C&B discusses draft plans for future agency programs. This interaction provides an opportunity to identify areas suitable for collaboration between agencies. In addition C&B will coordinate the federal collaborations with industry to plan and conduct research addressing the National Construction Goals.

Working with the Private Sector

Most agencies in C&B work directly with the private sector. Examples include: DOE's work with Fusion Lighting Inc. to demonstrate new sulfur lamp; NIST's work with the BACnet consortium on building energy controls; and HUD's work with the National Association of Homebuilders Research Foundation and the American Iron and Steel Institute on steel stud construction methods. The Collaborations Workshop report, referred to earlier, documented many successful examples of past collaborative work.



The workshops and meetings to find out the needs of each building sector, reported in Chapter 3, represent C&B's initial work with the private sector. C&B members not only participated in those meetings and subsequent conference calls, but now are assessing their own programs in light of the strategic plans developed by the sectors to identify how the expected results of their programs will fulfill the needs of the private sector.

Private sector representatives are invited to speak at monthly C&B meetings to discuss their interests and needs. Recent speakers have included Liza Bowles of the National Association of Homebuilders Research Center, John Bernaden of Johnson Controls, Knute Ringen of the Center to Protect Workers Rights, Robert Wible of the National Conference of States on Building Codes and Standards and Kenneth Herold of the International Institute for Interoperability.



Beam-column test on an under-reinforced 14 in. diameter, 9 ft. long concrete filled tube. This test was one of a series performed at the Florida Department of Transportation Laboratory with funding support from the National Science Foundation.

8

Federal Agencies Participating in the Construction and Building Subcommittee

Department of Agriculture (Forest Service)

Department of Commerce, Co-chair (National Institute of Standards and Technology)

Department of Defense (Army Corps of Engineers)

Department of Education (National Library of Education)

Department of Energy, Co-chair

Department of Health and Human Services (National Institute for Occupational Safety and Health and National Institutes of Health)

Department of Housing and Urban Development

Department of Labor (Occupational Safety and Health Administration)

Department of Transportation (Federal Highway Administration)

Department of Veterans Affairs

Environmental Protection Agency

Federal Emergency Management Agency

General Services Administration

National Science Foundation

Individual Agency Programs and Contacts

The following section describes the mission and relevant activities of each federal agency participating in the Subcommittee on Construction and Building. A contact person is given for each agency.

U.S. Department of Agriculture



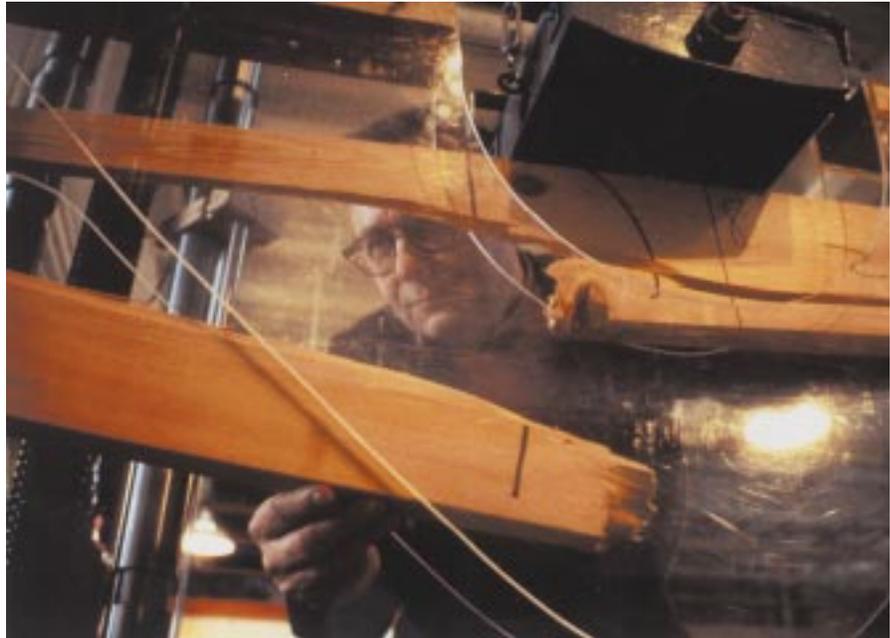
Forest Service
Forest Products Laboratory
Madison, WI 53705
www.fpl.fs.fed.us

Mission:

The USDA Forest Service's natural resource stewardship responsibilities include ensuring the wise and efficient use of our nation's forests. As part of that responsibility, the Forest Service conducts research to develop technology that helps meet America's growing demand for forest products, conserve our nations forests and improve the environmental sensitivity of forest products manufacturing. Within that framework, a Forest Service research initiative is aimed at increasing the use of recycled wood and paper in housing.

Major Activities Contributing to the Construction and Building Program:

- Develops processing technologies that increase efficiency, minimize environmental impacts and improve utilization of wood wastes.
- Provides the technical basis for performance characteristics of wood products used in housing.
- Identifies test procedures and criteria for development of codes and standards for new wood products.
- Determines economic feasibility and impacts of emerging technologies in the wood products sector.
- Facilitates implementation of new technologies of construction materials.



The USDA Forest Products Laboratory develops new options to utilize low-grade and undervalued trees to help improve the economy of rural America.

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Department of Commerce



National Institute of Standards
and Technology
Gaithersburg, MD 20899
www.nist.bfrl.gov/

Mission:

The National Institute of Standards and Technology's Building and Fire Research Laboratory's mission is to enhance the competitiveness of U.S. industry and public safety by developing performance prediction methods, measurement technologies and technical advances needed to assure the life cycle quality and economy of constructed facilities.

Major Activities Contributing to the Construction and Building Program:

- Develops a computer-integrated construction environment by demonstrating measurements and standards for seamless integration of work processes in the office and the work-site.
 - Provides measurements and data to accelerate the use of high performance concrete in buildings and infrastructure facilities.
 - Delivers state-of-the-art criteria and evaluation tools for a model performance guide for housing stimulating innovative building systems and components.
 - Demonstrates measurements and standards for open cybernetic building systems that combine environmental control, fire protection and physical security
 - Provides performance prediction methods and measurements to industry in the development and deployment of next generation fire safe materials and composites.
- Demonstrates the utility of state of the art fire safety engineering tools in delivering more cost-effective safety systems in industrial facilities.
 - Provides measurement and predictive methods for reducing the effects of fire, earthquakes and wind.
 - Provides quantitative methods for evaluation of sustainable technologies for constructed facilities.
 - Provides a knowledge base and methods for service life prediction of coatings, roofing and structural composites.
- Develops scientific and engineering bases and predictive tools for industry to provide advanced fire measurements and fire fighting techniques

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Calibrated HotBox. Environmental and climatic chambers are used to develop standard tests to evaluate the dynamic performance of full-scale walls up to 3m by 4.6m under cyclic temperatures ranging from -40°C to 65°C .

Department of Defense

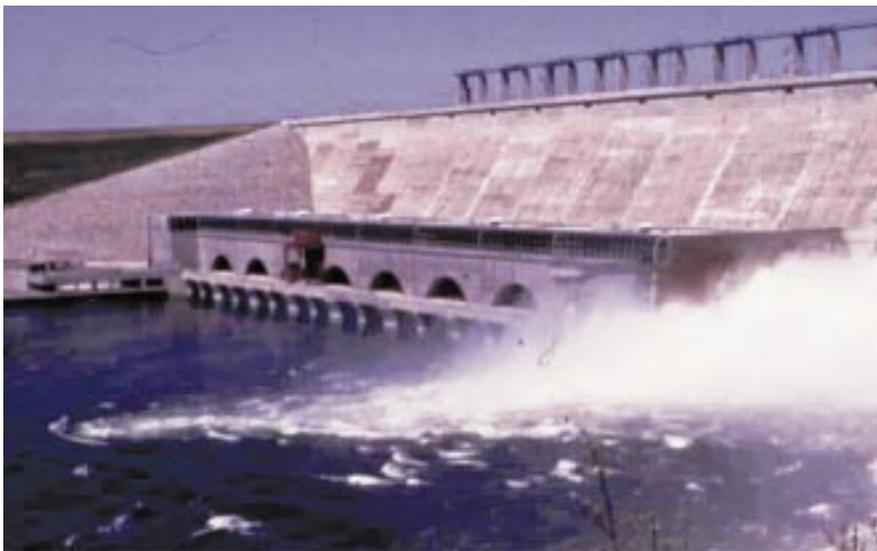


Defense Research and Engineering
Washington, D.C. 20301
www.usace.army.mil/functions/cw/www.usace.army.mil/cemp/mainmp.btm

Civil Works Research & Development Program

Mission:

The Army Civil Works R&D program provides solutions to problems related to the Army Corps of Engineers Civil Works (CW) missions, including flood damage reduction, inland and coastal navigation, environmental quality, hydropower, water supply, emergency management and other water resources management-related issues. The CW R&D is primarily user driven and the effort is essentially a “problem solving” process by which the Corps systematically examines new ideas, approaches and techniques, with a view toward improving the efficiency of its planning, design, construction, operations and maintenance activities.



Civil Works Hydroelectric Dam

Major Activities Contributing to the Construction and Building Program:

Research in seven areas contribute to the C&B program goals:

- high-performance materials and systems,
- structural and geotechnical engineering,
- innovative design and construction technologies,
- earthquake engineering,
- geospatial technology,
- construction technology transfer and
- coastal and hydraulic structures.

Military Research and Development Program

Mission:

The primary goal of the DoD civil engineering research program is to support



Military airfield

the national security objectives of the nation by conducting research to enhance the life-cycle performance of the infrastructure required to provide an efficient and cost effective power projection platform for the armed forces.

Major Activities Contributing to the Construction and Building Program:

Research in four focus areas contribute to the C&B program goals:

- conventional facilities
- airfield and pavements
- ocean and waterfront facilities/operations
- sustainable facilities

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Department of Education



National Library of Education
Washington D.C. 20208
www.ed.gov/offices/OERI/index.html

Mission:

The mission of the Library shall be to become a principal center for the collection, preservation and effective utilization of the research and other information related to education and to the improvement of educational achievement; to strive to ensure widespread access to the Library's facilities and materials, coverage of all education issues and subjects and quality control; to have an expert library staff; and to use modern information technology that holds the potential to link major libraries, schools and educational centers across the United States into a network of national education resources.

Major Activity Contributing to the Construction and Building Program:

Through the management and oversight of the National Clearinghouse for Educational Facilities NLE:

- provides for the identification, collection, storage and dissemination of all information about primary and secondary school facilities;
- provides toll free technical assistance in helping practitioners on state and local levels to solve facility problems;
- supports training and information exchange among users; and
- maintains a comprehensive on-line information system.

Contact:

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South Vermillion Middle School media center.

Department of Energy



Office of Building Technology, State and Community Programs and the Federal Energy Management Program
Washington, D.C. 20585

Mission:

The building sector, including both residential and commercial buildings, currently uses 33 quadrillion Btu's of primary energy annually. This is 36 percent of total U.S. energy consumption, and includes two-thirds of all electricity used in the United States. Federally owned facilities represent approximately 4 percent of U.S. non-residential building stock. The mission of Office of Building Technology, State and Community Programs (BTS) is to limit the expected increase in building sector energy consumption by improving energy efficiency and expanding the use of renewable energy in buildings. Energy efficiency has and will continue to be major part of the U.S. response to the global agreements on Climate Change. As a result, Climate Change is a major influence in the current portfolio of activities.

Major Activities Contributing to the Construction and Building Program:

BTS conducts a comprehensive research program designed to develop, demonstrate and, if appropriate, commercialize advances in energy performance of major building components including thermal insulation systems, windows and heating and cooling equipment. Building America is a major R&D activity where industry teams are developing, analyzing and demonstrating systems-engineering approaches to new housing.

Additionally, BTS conducts a program that focuses on the activities of

market-pull and market transformation of energy efficient buildings systems. This includes many of the activities recently authorized by Energy Policy Act and the Climate Change Action Plan. For example, "Rebuild America" is a program directed at upgrading the energy performance of the existing stock of commercial buildings. The "Design Tools" program focuses on the market delivery of tools that will allow for full consideration of energy options in the design of our future buildings.

Within its regulatory and voluntary programs, BTS develops and promotes building energy codes and appliance and equipment standards.

Through its Office of Federal Energy Management, DOE leads the federal government's drive for increased energy efficiency and renewable energy utilization in its own facilities and vehicle fleets.

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R&D team leader
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Houses such as this, that will comprise the 330 houses in the Prairie Crossing Environmental Community, near Libertyville, Illinois, use about 50 percent less energy for heating and cooling than similar sized houses in neighboring communities.

Department of Health and Human Services



National Institute for Occupational
Safety and Health
Centers for Disease Control
Atlanta, GA 30333
www.cdc.gov/niosh/homepage.html

Mission:

The National Institute for Occupational Safety and Health (NIOSH) is the federal institute responsible for conducting research on the causes and prevention of occupational diseases and injuries in the workplace. NIOSH is also responsible for developing prevention strategies and interventions to reduce diseases and injuries in the workplace. Created under the Occupational Safety and Health Act of 1970, P.L. 91-596, NIOSH is also mandated to develop controls and solutions to reduce workplace exposures, evaluate the hazards of worksites at the request of employers or employees and transfer health and safety information and technology through training as well as educational and technical materials to workers and health professionals; make recommendations for preventing disease, injury and disability; and develop an effective national workplace health and safety agenda. To this end, the Director of NIOSH directed the development of the National Occupational Research Agenda (NORA), which outlines 21 high priority research areas that focus national efforts on high priority industries, such as construction. Each of these research priorities pertains to construction safety and health.

Major Activities Contributing to the Construction and Building Program:

- Identifies current and emerging occupational hazards of construction workers through the collection and analysis of pertinent data and outreach programs.



Asphalt paving process is studied to determine evaluate worker exposure to asphalt fumes.

- Conducts research to identify the causes of occupational injury and illness in construction, utilizing laboratory facilities, on-site analysis in cooperation with internal external partners, including industry and labor as well as university and other private sector resources.
- Develops and demonstrates the technology or other intervention necessary to reduce the exposure of construction workers to occupational hazards.
- Disseminates the results of its research through field demonstrations, publications, presentations, educational materials, patents and cooperative ventures with construction contractors as well as those who supply the construction industry with materials, equipment and professional services.

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Marie Haring Sweeney, Ph. D.
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Department of Housing and Urban Development



Policy Development and Research
Washington, D.C. 20410
www.bud.gov/

Mission:

The Office of the Assistant Secretary for Policy Development and Research is responsible to the Secretary of Housing and Urban Development for overall Departmental policy, program evaluation and research. The Division of Affordable Housing and Technology conducts research and analysis on the production and supply of housing and on the physical and technical aspects of community development. The Division addresses all physical, structural, developmental technology, regulatory and related issues needed to support the Department's commitment to ensure decent, safe and sanitary housing in a suitable living environment for all Americans.

Major Activities Contributing to the Construction and Building Program:

- Research and policy analysis to expand affordable housing opportunities for low and moderate-income families by reducing the initial and operating cost of housing and to expand the affordability of new and rehabilitated housing supplied by



Panelized housing construction: improving energy efficiency and durability through industrialized housing technology.

both the private and publicly-assisted market.

- Technical, developmental and related regulatory research to assist in the physical redevelopment of communities.
- Research to develop new legislative and regulatory tools to ensure that new development provides equitable access to jobs and housing for lower-income and minority families.
- Research that permits the integration of other major administration objectives such as environmental protection and hazard prevention into the

programs of the Department and into housing production without sacrificing housing affordability and viable urban redevelopment.

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Department of Labor



Occupational Safety and Health
Administration
Washington, D.C. 20210
www.osha.gov/index.html

Mission

The mission of the Occupational Safety and Health Administration (OSHA) is to save lives, prevent injuries and protect the health of America's workers. To accomplish this, federal and state governments must work in partnership with the more than 100 million working men and women and their six and a half

million employers who are covered by the Occupational Safety and Health Act of 1970 (OSH Act). OSHA and its state partners have approximately 2,100 inspectors, plus discrimination investigators, physicians, educators, standards writers and other technical and support personnel spread over more than 200 offices throughout the country.

Because construction is such a hazardous occupation, the OSHA Directorate of Construction was created in 1995 to improve health and safety in the construction industry. The Directorate works with construction industry management and labor to implement proactive strategies for worker protection that make safety and health part of workplace culture.

Major Activities Contributing to the Construction and Building Program

- Sets standards to reflect construction industry safety performance and the need for worker protection.
- Conducts worksite inspections to enforce standards.
- Provides training to construction safety and health enforcement personnel to improve inspections. Training is also provided to industry personnel through training grants and agreements with local educational institutions, including community colleges.
- Investigates accidents to determine industry-wide causative factors that need to be reduced or eliminated.
- Establishes cooperative programs and partnerships with companies to benchmark good safety practices and recognize those contractors who are role models for the industry.
- Coordinates federal activity to assure a government leadership role in promoting health and safety programs through responsible construction project ownership.

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Rofer using fall protection.

Department of Transportation



Federal Highway Administration
McLean, VA 22101
www.fhwa.dot.gov

Mission:

The Department of Transportation (DOT) was established to assure the coordinated, effective administration of the transportation programs of the federal government, and to develop national transportation policies and programs conducive to the provision of fast, safe, efficient and convenient transportation at the lowest cost consistent therewith.

The Federal Highway Administration, Federal Railroad Administration, Federal Aviation Administration, Federal Transit Administration and United States Coast Guard are the primary offices involved with programs related to the nation's transportation infrastructure.

Major Activities Contributing to the Construction and Building Program:

- Research on high performance materials for renewal engineering will provide stronger, longer-lasting structures and facilities.
- Research on diagnostics and analysis will develop nondestructive testing and monitoring technology for futuristic transportation systems.

- Research on reduction of intermodal hazards will help provide emergency response to transportation interruptions caused by earthquakes, floods, wind storms and other natural forces and restore lifelines.
- Research related to bridges, pavements, and geotechnology will improve quality and durability.

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Geosynthetic Reinforced Soil Bridge Pier Load Test

Department of Veterans Affairs



Office of Construction Management
Washington, D.C. 20420
www.va.gov/facilities.htm

Mission:

VA is dedicated to constructing quality facilities for serving veterans in medical centers, outpatient clinics, nursing homes, domiciliaries, regional office buildings and cemeteries. VA's Office of Facilities Management implements planning, design, construction and real estate programs in support of the department's missions, with a strong commitment to customer service. CM also promotes maximizing VA-owned assets through creative development initiatives.

Major Activities Contributing to the Construction and Building Program:

- Updates, consolidates, and automates design and construction standards.
- Develops criteria for operating in and responding to natural disasters.
- Create design guides to improve quality, control cost and increase user satisfaction.
- Manages traditional and alternate methods of design and construction, emphasizing the use of design programs to minimize the need for change.
- Reviews project designs for function, efficiency and flexibility.
- Maintains a cost database for planning alternatives, budgeting and cost management during design and construction.



Veterans Administration Medical Center, Houston, TX

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U.S. Environmental Protection Agency



Washington, D.C. 20460
www.epa.gov

Mission:

The mission of the U.S. Environmental Protection Agency (EPA) is to preserve and improve the quality of the environment, protect human health and safeguard the productivity of natural resources on which all human activity depends. To achieve these goals, the Agency is committed to reduced risks to humans, the environmental and natural resources using the best available science and innovative technologies.

Major Activities Contributing to the Construction and Building Program:

- Provides leadership in the identification, characterization and mitigation of indoor air pollutants. Develops technologies for the prevention of indoor air pollution.
- Promotes energy conservation and efficient energy use through voluntary actions such as the ENERGY STAR Labeling program, the ENERGY STAR New Home Program and the ENERGY STAR New Home program.
- Promotes sustainable development through the Green Buildings Initiative, the Environmental Technology Initiative and community-based, in-place environmental management.

- Promotes the safe and sustainable reuse of idled and underused industrial and commercial facilities through the Agency's "Brownfields Initiative."
- Promotes efficiency and streamlines environmental regulation through the Agency's Common Sense Initiative.
- Provides leadership in the nation's environmental science, research, training and assessment.

Contact:

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ENERGY STAR partner, Joyal Construction, uses signage to alert buyers that their Creekwood subdivision in Florida is building to ENERGY STAR guidelines.

Federal Emergency Management Agency



Federal Center Plaza
500 C Street, SW
Washington, D.C. 20472
www.fema.gov/mit/

Mission:

To reduce loss of life and property and protect our institutions from national and man-made hazards by leading and supporting the nation in a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery.

Major Activities Contributing to the Construction and Building Program:

- Builds preparedness by ensuring adequate plans are in place for the continuation of essential government functions during an emergency.
- Protects effective land-use planning, building codes and other means to minimize the effects of disasters such as floods, hurricanes and earthquakes. FEMA provides technical assistance, nationwide flood hazard mapping and training and grants directed at reducing the impact of natural disasters to government agencies throughout the country.
- Coordinates the federal response to disasters that exceed the capabilities of state and local governments, and assists communities to recover.
- Operates the U.S. Fire Administration, which supports the nation's fire service and emergency medical services communities.
- Operates the Federal Insurance Administration, which makes flood insurance available to residents of communities that agree to adopt and enforce sound floodplain management practices.



Successes and failures in residential buildings observed after Hurricane Georges. A concrete building with no structural damage is seen in the center. At the top right is a wood frame building that is completely destroyed around a center room that was constructed of masonry.

A major FEMA initiative that challenges the nation to undertake actions that protect families, businesses and communities by reducing the effects of natural disasters is Project Impact: Building a disaster-resistant community. The goal of Project Impact is to reduce the personal and economic costs of disasters by bringing together community leaders, citizens and businesses to prepare for and protect themselves against the ravages of nature. This effort is an investment that enhances and strengthens the economic structure and long-term stability of a community regardless of when a disaster strikes.

Contact:

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General Services Administration



Public Building Service
Washington, D.C. 20405
www.gsa.gov/pbs/pbs.htm

Mission:

The General Services Administration (GSA) is the federal business manager responsible for space acquisition and management, retail and wholesale supply sales, fleet management, travel and transportation management, telecommunications and information management.

The Public Buildings Service (PBS) serves as the federal government's chief buildings planner, developer, owner and real property asset manager. PBS manages over 8,400 buildings that provide more than 290 million square meters.

Major Activities Contributing to the Construction and Building Program:

- The capital construction program (including projects in both planning and design/construction phases) is \$4 billion to 5 billion per year, with approximately \$0.7-1.5 billion for new designs.
- PBS establishes facilities design criteria for the facilities it constructs. Its research activities involve the deployment or showcasing of innovative technologies that advance its program interests and limited studies of building performance issues in support of its criteria development. Current research issues include investigating the influence of the environment on workplace productivity; physical security, particularly with regard to window glazing technology and progressive collapse; and sustainable development, including energy efficient design and green building technologies.



The border station in Calexico, located 125 miles east of San Diego, sets a standard of excellence as a landmark facility that vigorously reinforces the ceremonial aspect of crossing an international border.

- GSA wants top-quality designs for all its federal building projects involving new construction, major modernization, and repairs. PBS's Design Excellence Program encourages the design community to pursue its projects by stressing creativity and exploring the use of innovative technologies. It also streamlines the way GSA hires architects and engineers, substantially cutting the cost of competing for GSA design contracts. Emphasis is placed on the unique aspects of the particular project, design philosophy, possible approaches in carrying out the project and project management.
- Energy consumption in PBS facilities has been reduced 17 percent from 1985 levels and is more than 40 percent below the federal average. PBS also partners with utilities' demand side management programs. These save energy and dollars, as well

as providing rebates, which are reinvested in other projects.

- PBS is investigating new project management/construction management practices to insure that delivered projects are of high quality and achieve the function objectives.

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National Science Foundation



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Mission:

The National Science Foundation (NSF) is created to promote and advance scientific and engineering progress in the United States. NSF funds research and education in most fields of science and engineering through grants, contracts and cooperative agreements to colleges, universities and other institutions. Civil infrastructure systems research (which includes the Construction and Building Program) is one of the Foundation-wide initiatives.

Major Activities Contributing to the Construction and Building Program:

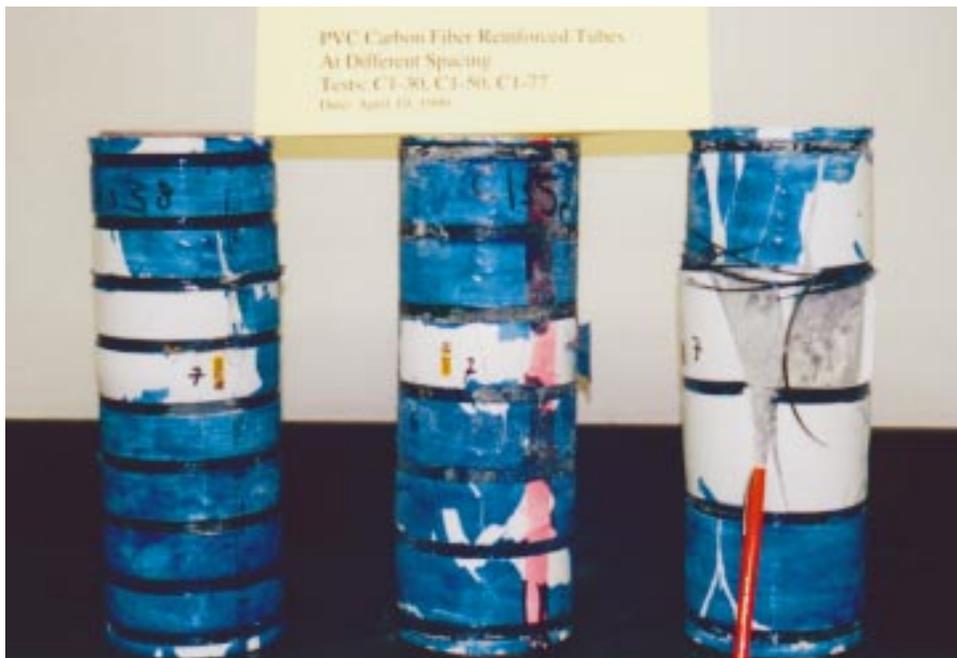
The NSF program is composed of four program elements:

- Deterioration science examines how materials and structures break down and wear out, improving our understanding of deterioration and design, and how to build and maintain structures that are more durable, safer and more environmentally sound.
- Assessment technologies determines durability, safety and environmental conditions of structures and facilities. Research can lead to nondestructive evaluation techniques, improved sensor technologies and self-correcting materials.
- Renewal engineering extends and enhances the life of civil infrastructure systems and components that would otherwise continue to deteriorate.
- Institutional effectiveness and productivity recognizes the importance of

those factors affecting the decision processes underlying the provision and management of civil infrastructure on the economic and social productivity of society. This activity will lead to better decisions that maximize the impact of civil infrastructure investments on the productivity and economic and social well-being of the public.

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Concrete columns encased with PVC-carbon fiber reinforced polymer (FRP) tubes after failure. The PVC tubes are strengthened by externally wrapping them with 8 mm wide FRP strips at different spacing. This NSF funded research project is being performed by the University of Alabama in Huntsville.

9

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Notes

