

Building Research at the National Bureau of Standards 1968-1974 • NBS Building Science Series 75

Operation Breakthrough • ASTM E541 • CES • Gene A. Rowland

Executive Summary

This source, NBS Building Science Series 75, traces how the National Bureau of Standards moved from materials-testing work into performance-based evaluation and state-regulatory support between 1968 and 1974. The narrative below connects the direct source passages that follow, in the order the underlying events occurred.

- **Operation Breakthrough (1969→)**: HUD, seeking to industrialize housing, asked NBS to manage the evaluation program for 22 selected housing systems. NBS developed comprehensive performance criteria (the Guide Criteria), later called an “enduring technical achievement.” That work exposed gaps in existing building knowledge and fed a longer-range HUD-funded research program, and it also produced performance standards that, notably, were never folded into HUD’s Minimum Property Standards.
- **Parallel state-regulatory track (1967→)**: Independently, an NBS technologist’s chance encounter with state officials in Wisconsin led to the founding of NCSBCS in 1967, with Gene A. Rowland — a Wisconsin commissioner — as its first chairman. NBS’s Codes and Standards Section became the NCSBCS secretariat, and Rowland left his state post to lead that NBS section.
- **Why LEAP, CES, and model legislation exist**: By the early 1970s, NCSBCS and NBS recognized that 12,000+ fragmented local building-code jurisdictions were blocking “the two economies” (scale and technology) that industrialized building needed. Secretary of Commerce Maurice Stans asked for a plan to accelerate NBS’s state-support work, and three linked programs were funded: LEAP (laboratory accreditation), CES (consistent evaluation documentation), and model legislation.
- **LEAP → ASTM E541**: LEAP launched in January 1971 under James O. Bryson. Its four research reports were handed to ASTM, where Committee E32 turned them into ASTM E541 (1975) and Committee E36 pursued related lab-evaluation criteria. Massachusetts and Maryland piloted the LEAP approach directly.
- **CES and model legislation**: CES, headed by Robert D. Dikkers, produced model evaluation/approval/inspection documents adopted by several states. NBS and NCSBCS also drafted four model statutes (adopted by NCSBCS and used by states), while explicitly stating that NBS’s role stopped short of actual building regulation, which remains a state and local function.
- **The two tracks converge organizationally (1972)**: When the Department of Commerce created the Center for Building Technology in 1972, the former Operation Breakthrough group became the Office of Housing Technology (James Gross, chief), and the Codes and Standards Section — Rowland’s group — was elevated to the Office of Building Standards and Codes. The 1971 and 1972–74 organizational charts, quoted in full below, show this shift directly: informal branches becoming formal Offices. By the mid-1970s, Rowland, Gross, Pfrang, Kramer, and Achenbach all sat as chiefs within the same Center.

The sections below present this material as direct quotations from the source, organized topically and in the order summarized above, each with a page citation back to the original report and PDF.

Who’s Who — Quick Reference

Organizations	
NBS	National Bureau of Standards — the federal agency that produced this source document; became NIST in 1988.

HUD	U.S. Department of Housing and Urban Development — sponsored Operation Breakthrough and asked NBS for evaluation support.
NCSBCS	National Conference of States on Building Codes and Standards — the state body formed in 1967, for which NBS served as secretariat.
ASTM	American Society for Testing and Materials — Committee E32 processed LEAP's research into ASTM E541 (1975); Committee E36 worked on related lab-evaluation criteria.
LEAP	Laboratory Evaluation and Accreditation Program — NBS program launched January 1971, led by James O. Bryson.
CES	Coordinated Evaluation System — NBS/NCSBCS project headed by Robert D. Dikkers.
GSA / PBS	General Services Administration's Public Buildings Service — funded the PBS Performance Specification for Office Buildings, the other major performance document alongside Operation Breakthrough's.
People	
Gene A. Rowland	Wisconsin state official (1967) → Chief, NBS Codes and Standards Section → first chairman of NCSBCS → by 1972, Chief of the Office of Building Standards and Codes (later "Building Standards and Codes Services").
Harold B. Finger	HUD Assistant Secretary for Research and Technology — requested NBS's evaluation services for Operation Breakthrough; later assessed the program's success.
Dr. Edward O. Pfrang	NBS Operation Breakthrough program manager — later became Chief, Structures, Materials and Life Safety Division.
James O. Bryson	Led LEAP from its start in January 1971.
Robert D. Dikkers	Headed the CES project.
James Gross	Became Chief of the Office of Housing Technology — the successor to the former Operation Breakthrough group.
Samuel Kramer	NBS's Federal Building Coordinator during Operation Breakthrough — became Chief of the new Office of Federal Building Technology.

Direct Source Text — Operation Breakthrough, LEAP, ASTM E541, CES, Gene A. Rowland

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Operation Breakthrough — Origins

The Division in 1968 held a conference for the building community on the theme, “Performance of Buildings—Concept and Measurement; Man and His Shelter.” The conference and its proceedings not only advanced the performance concept but had the effect of spreading the word that the Division welcomed new challenges, especially those that would permit it to move from its traditional materials-testing preoccupation to performance standards for buildings.

Source: report p. 18 (PDF p. 28).

At HUD, meanwhile, Secretary George Romney was equally convinced that the rationalized and coordinated mass-production techniques of the automobile industry from which he had come could be transferred to homebuilding. Romney wanted to achieve a “break through” to innovative, industrialized housing. And so, “Operation Breakthrough.”

An Operation Breakthrough Request for Proposals distributed in the summer of 1969 yielded 632 proposals from a wide range of industrial and professional firms and consortia. From these proposals, 22 housing system producers were chosen to participate in the largest housing prototype demonstration program ever conducted in the United States.

HUD's new Assistant Secretary for Research and Technology, Harold B. Finger, told the Bureau in late 1969 that HUD, “in order to establish testing requirements, performance criteria, and the validity of testing procedures and results,” required the “advisory, consultative, and operating services of the National Bureau of Standards.” Pilot funding followed to enable NBS building researchers to begin work on Operation Breakthrough.

Source: report p. 19 (PDF p. 29).

NBS Manages the Evaluation Program

The Division had a clear idea of how to proceed. Its immediate objective was the development of a comprehensive set of performance criteria for the design and evaluation of the entire range of the 22 housing systems selected. A December 22, 1969, meeting between HUD, NBS, and the National Academy of Sciences indicated that the Division would manage the “evaluation program” for Operation Breakthrough and would develop the performance criteria necessary for evaluation — by February 1, 1970.

An interdisciplinary Operation Breakthrough team was formed, its members representing every Section and discipline within the Division. Dr. Edward O. Pfrang, then Chief of the Structures Section, was appointed program manager and Vannie E. Gray, a chemist, was named assistant manager.

It was decided to structure the criteria according to a matrix (707). One axis on the two-dimensional matrix represented the built elements and the other the attributes necessary to serve the user... Built elements were lettered and attributes were numbered. The built element “structure” (A) and the attribute “fire safety” (4) formed the intercept A-4.

Operation Breakthrough activities for a time tended to eclipse many of the Division's other research activities. The conduct of the entire evaluation effort — which was founded on the criteria — proved an absorbing, significant, and meaningful responsibility.

Source: report pp. 19–20 (PDF pp. 29–30).

Finger's Assessment / “Enduring Technical Achievement”

To Harold Finger the question of Breakthrough's success was beyond dispute. Three years after the program's launching Finger declared: “Our goal was to accelerate the rate of change, of improvement in housing, to encourage innovation in housing systems, in land planning, and in providing opportunities for all people to live in well-designed communities. In this short time we have accomplished much of what

we set out to do, and in many areas we have accomplished more than we expected. We have broken through many of the constraints to the improvements we are seeking.”

Finger ascribed to Operation Breakthrough a large measure of credit for the industrialized housing laws or general purpose building codes adopted by 20 States in the first years of Operation Breakthrough.

Certainly the development of performance criteria for Operation Breakthrough was considered an enduring technical achievement. These criteria were published in four volumes covering as many kinds of housing — single-family detached, single-family attached, multi-family low-rise, and multi-family high-rise. Entitled Guide Criteria for the Design and Evaluation of Operation Breakthrough Housing Systems (704) they have influenced building codes, standards used by HUD, and indeed the perspective at NBS with respect to performance and prescription.

The experience of working with new materials and techniques, the opportunity to challenge state-of-the-art technology, and most of all, the greater engagement in real-world problems afforded by Breakthrough, stimulated and redirected building research at Gaithersburg.

Source: report pp. 19–20 (PDF pp. 29–30).

Performance, Safety, Durability, and Livability

The performance criteria in addition to health and safety considerations also included issues of durability and livability. Durability and livability had to be addressed since the innovative systems in question had not undergone the test of time or marketplace. Moreover, Operation Breakthrough sought not only safe and healthful housing but housing of improved quality (715).

The Breakthrough team aimed at achieving at least that level of health and safety intended by the codes. “Targets of opportunity” having high payoff also were incorporated, an example being smoke detection. The Breakthrough criteria called for smoke detectors on a much broader scale than did most regulatory jurisdictions. In general, considerable attention was paid to life safety, the Breakthrough team believing that historically regulations placed too little emphasis on protecting housing occupants compared with the stress on protecting property.

It was necessary to identify and measure inherent but unexpressed attributes in conventional housing in order to ensure their presence in innovative housing. For example, for the first time attention was given to the fire safety of innovative materials and construction techniques for single-family residences. Never before had building codes prescribed fire endurance requirements for flooring and wall assemblies, or smoke generation limitations for interior finish materials, or smoke detectors.

Source: report pp. 20–21 (PDF pp. 30–31).

One of Two Major Performance Documents Generated at NBS

The Guide Criteria for the Design and Evaluation of Operation Breakthrough Housing Systems was one of two major performance documents generated at NBS. The other was the PBS Performance Specification for Office Buildings. The Public Buildings Service (PBS) in the General Services Administration funded the specification in an effort to achieve better government office buildings and to generally advance systems know-how in the building community. Arthur F. Sampson, PBS Commissioner, said in 1971: “This new approach to the design and construction process presents a challenge which must be accepted in order to ensure continuing excellence in Federal and private building construction.”

The specification was a product of the Building Systems Section which was headed by Robert Blake and which counted among its staff systems and performance thinkers, Michael Brill, Thomas E. Ware, and David B. Hattis (700). It was developed for three payment centers of the Social Security Administration. Earmarked for San Francisco, Philadelphia, and Chicago, the buildings' combined cost was estimated at \$110 million.

The performance specification envisaged buildings in part designed and constructed by conventional techniques and in part designed, manufactured, and assembled by coordinated (system) methods. Procurement provisions of the system portions are stated clearly in performance terms rather than in the particular technologies of pre-existing models. The specification is aimed at any or all of the following advantages: increased building quality, decreased building costs, and more efficient construction management techniques.

The specification addresses the volumetric portion of the building—the portion that houses the building's operational reason-for-being as distinct from ancillary spaces—seven of the major elements of the work space: structural frame, HVAC equipment (ductwork, and through a later PBS revision, air-handling equipment), electrical and telephone distribution, lighting fixtures, finished floors, finished ceilings, and partitions.

The performance specification changes the process of building and introduces a new participant—the executive architect. It is the executive architect's responsibility to define the roles of all participants and to maintain open lines of communication between them. The specification encourages the offsite manufacture of coordinated subsystems, this to replace the traditional in-situ, piece-by-piece assembly of the building.

Finally, it raises such ideas as life-cycle costing from conceptual to application levels. PBS undertook the development of bid equalization factors so that proposals with attractive first costs—but high maintenance and operating costs—would not necessarily win in the bidding. This is a stark departure from customary practice in an industry dominated by first costs. Moreover, as the cost dynamics in energy became felt, bid proposals were required to be energy sensitive as well as cost descriptive in relation to time.

Two of the three Social Security payment centers were completed by the mid-1970s and the third was under construction. PBS was also applying the specification to two more Social Security buildings in Baltimore with an estimated total cost of \$61 million. PBS found that the construction process was speeded up and that the office work environments which resulted were superior to those of conventional construction. Costs were within estimates but did not lend themselves to comparison with conventional construction because of the complicating life-cycle aspect.

Source: report pp. 21–22 (PDF pp. 31–32).

The challenges were met in the development of the PBS performance specification for office buildings and the criteria for HUD's Operation Breakthrough, both major ventures in the application of the performance concept.

Source: PDF p. 57.

Occupant Response Study

Questionnaires and other techniques developed by architects, psychologists, and sociologists were used to measure occupant response to Operation Breakthrough housing. A principal finding was the occupants' emphatic acceptance of industrialized housing, clear indication that the “pre-fab” stigma which marked the post-World War II era had all but disappeared.

Source: PDF p. ≈33.

NBS BUILDING SCIENCE SERIES 75 — CHAPTER 4

Working with the States

How the NBS–State Relationship Began

An NBS building technologist was in Madison, Wis., his day's business at the Forest Products Laboratory completed. It was 1967... The technologist, Charles T. Mahaffey, was in Madison on other business.

He met by chance an official of the NBS Office of Weights and Measures who that night was to meet with a group from the National Conference on Weights and Measures, and he was invited to attend the session as an observer.

The cordial but effective nature of meeting with the State representatives impressed Mahaffey. On his return to Gaithersburg he asked Dr. A. Allan Bates, then Chief of the Building Research Division (BRD), to consider formal interaction with the States on the subject of building regulation. Bates first wanted to determine if the States were interested. A telephone survey of 10 representative States was conducted; it revealed a distinct enthusiasm for the idea.

A month later officials of the States met in a two-day session with NBS staff members. The morning went well, but it was at a noon luncheon with NBS Director Allen V. Astin that the State representatives developed an approving attitude toward the National Bureau of Standards. Astin's low-key style and candid manner, but most of all his insistence that NBS's offer of help was on condition that the States assume the leadership role, offset worries over Federal pre-emption.

Source: report pp. 22–23 (PDF pp. 32–33).

Gene A. Rowland and the Formation of NCSBCS

Among the State representatives on hand was Gene A. Rowland, one of three Commissioners in the Wisconsin Department of Industry, Labor, and Human Relations. Rowland was keenly interested in the notion of interstate cooperation on building regulation; he asked the Governor of Wisconsin to host a meeting of all States. That meeting was held in the fall of 1967.

The 1967 Wisconsin meeting resulted in the formation of the National Conference of States on Building Codes and Standards (NCSBCS)... Two months later the BRD's Codes and Standards Section became the Secretariat to NCSBCS. At about the same time, Gene Rowland, having just completed the reorganization of the building codes section in Wisconsin's Industry, Labor, and Human Relations Department, left his State post to become Chief of the Codes and Standards Section at the Building Research Division. Rowland at the time was serving as NCSBCS' first chairman.

Source: report pp. 22–23 (PDF pp. 32–33).

The first annual meeting of NCSBCS was held at NBS on May 6–7, 1968. This meeting was for the purpose of establishing objectives, approving the proposed organizational structure, electing officers and committee members, and outlining NCSBCS' initial programmatic directions.

In 1969 the organization's constitution and by-laws were approved by 36 States at NCSBCS' second annual meeting, in Hollywood Beach, Fla. The next year all 50 States, the District of Columbia, and two territories through their respective governors' offices endorsed the concept and scope of NCSBCS and named delegates to the body.

Source: report p. 24 (PDF p. 34).

NCSBCS, Operation Breakthrough, and Regulatory Uniformity

While depicted as a forum for the discussion and resolution of problems, NCSBCS in the final analysis was designed to counter the proliferation of building code jurisdictions with their varying requirements. These jurisdictions numbered at least 12,000 with a potential of thousands more.

Not only do code requirements differ from one jurisdiction to another, but so do jurisdictional interpretations of common requirements. Additional differences are found in the administrative practices of regulatory agencies.

This situation was seen as an impediment to the realization of “the two economies”—an economy of scale and an economy of technology. So fragmented a regulatory overlay upon what otherwise might be a cohesive—and sizeable—market discouraged the development of innovative building products.

Source: report p. 24 (PDF p. 34).

NCSBCS influenced the passage of state-wide regulatory legislation as did the Operation Breakthrough program of the Department of Housing and Urban Development (HUD). Both HUD and NCSBCS had a telling influence on greater intrastate uniformity in the regulation of buildings, especially industrialized buildings.

Enhancing the climate for new technology has been the intent of the Bureau's service to NCSBCS. This service enables the States to describe more uniformly their regulatory requirements and to more accurately evaluate new construction materials and techniques, paving the way for the natural evolution of a market area sufficiently large and rewarding to stimulate industrial innovation. In turn, the consumer's choice range is widened. It is the consumer who is the ultimate beneficiary of an improved regulatory climate.

Source: report p. 24 (PDF p. 34).

The Origin of LEAP and CES

It was as the Bureau maintained this “relatively modest but high priority” program with the States that Secretary of Commerce Maurice Stans asked for a status report on the program and for suggestions on what might be done to “accelerate” it. The report, prepared by the Bureau, noted that NCSBCS had asked for support in the development of 1) laboratory accreditation procedures, 2) a coordinated system for evaluating and processing building innovations, and 3) model legislation on the regulation of buildings.

Funds were made available for all three. Thus were born the Laboratory Evaluation and Accreditation Program (LEAP), the Coordinated Evaluation System (CES), and the model legislation effort.

Source: report pp. 24–25 (PDF pp. 34–35).

LEAP — Full Text

The Laboratory Evaluation and Accreditation Program had as its backdrop a trend toward greater industrialization through State-level certification of manufactured buildings and toward interstate reciprocity in the certification of buildings and components. The caliber of the laboratories and agencies performing the evaluating and compliance assurance functions for manufactured buildings was subject to some question, however. A way of assessing the capabilities of these organizations on a uniform, interstate basis was needed if evaluations made by one State were to be confidently accepted by another.

NCSBCS in 1970 asked the Bureau to develop a program to accredit laboratories. The need for such a program was recognized and NBS initiated LEAP in January, 1971.

*LEAP under the leadership of James O. Bryson produced four research reports which NCSBCS and NBS turned over to ASTM for processing as national consensus standards. Two ASTM committees, E32 Criteria for Evaluating Agencies Concerned with Systems Analysis, Testing, and/or Compliance Assurance of Manufactured Buildings, and E36 Criteria for the Evaluation of Testing and/or Inspection Agencies, were established to process the documents. **The E32 Committee produced a standard which in time (1975) was to win consensus agreement — ASTM E541, Criteria for Evaluating Agencies Engaged in Systems Analysis and Compliance Assurance for Manufactured Building.** The E36*

Committee, meanwhile, pressed ahead with the development of generic criteria for the evaluation of testing laboratories.

Using LEAP evaluation criteria and methodology, pilot efforts were undertaken by the States of Massachusetts and Maryland to demonstrate the benefits of a LEAP approach to building regulation. The results of these demonstrations, along with the on-going deliberations of the ASTM committees, were expected to advance the industrialization of the building process as was the Coordinated Evaluation System (CES) project.

Source: report pp. 25–26 (PDF pp. 35–36).

CES — Full Text

The CES project was directed toward the fostering of regional or national markets through consistency of procedures and documentation. Headed by Robert D. Dikkers, CES was undertaken in response to two requests, one from NCSBCS and another from the Executive Office of the President. Its purpose was to develop, in conjunction with the States, consistent informational documents as a means of facilitating the acceptance of new technology (327).

Among the project's products was a four-volume preliminary report entitled Model Documents for the Evaluation, Approval and Inspection of Manufactured Building (172).

This and other output from the project were endorsed by NCSBCS and adopted for use by several States and a number of independent laboratories (342).

Source: report p. 26 (PDF p. 36).

Model Legislation

The National Conference of States on Building Codes and Standards and NBS agreed that model legislation in certain building-related areas was needed... NBS formed four balanced working groups to develop as many legislative models — a Manufactured Building Act, Mobile Home Act, State Building Code Act, and a Registration of Code Enforcement Officers Act... The models were endorsed by NCSBCS and all but the Registration of Code Enforcement Officers Act were included in the 1974 Suggested State Legislation package of the Council of State Governments, the Council believing that additional research was needed on the subject of registration. Several States have used the models in developing their own legislation.

NBS' work in support of NCSBCS has drawn it close to — but not into — the arena of building regulation. Building regulation is the function of the States and their political subdivisions.

Source: report p. 27 (PDF p. 37).

Breakthrough-Inspired Long-Range Research

Operation Breakthrough added to the ongoing research effort. In the course of preparing performance criteria and evaluating the 22 housing systems for Operation Breakthrough, researchers uncovered gaps in existing building knowledge (401, 404, 410, 417). These gaps were priority ranked by HUD and NBS, and a research program, formulated and funded by HUD, was set in motion to address the more serious deficiencies.

So-called “long-range” projects (projects requiring from two to four years to complete and therefore falling outside the Breakthrough immediacy) involved a number of technologies...

Among the Breakthrough-inspired research projects was one addressed to progressive collapse — a structural failure which, while local in origin, travels through all or much of the building (166)... Numerous HUD-supported studies were undertaken under the leadership of Dr. Norman F. Somes, and were pointed toward the development of design criteria to increase resistance to progressive collapse.

Source: report pp. 34–35 (PDF pp. 44–45).

Performance Standards — Result of Operation Breakthrough

As a result of Operation Breakthrough, HUD realized that the development of performance standards had to be expanded to accommodate the evaluation of special and innovative construction.

Building researchers generated performance standards that were the equivalent of HUD's Minimum Property Standards in their intent and requirements and provided a basis for the evaluation of innovative construction for home mortgage guarantee purposes. Drafts of these standards were iteratively reviewed by HUD and the National Conference of States on Building Codes and Standards (NCSBCS).

NCSBCS was enlisted in this effort on the theory that if the standards were adopted by the regulatory community, those standards bearing on health, safety, and welfare — the regulatory community's concern — could be dropped from the Minimum Property Standards. The Minimum Property Standards would retain the performance standards bearing on livability, durability, etc. — on issues outside the police-power concern for the public well-being but of direct pertinence to a mortgage guarantee program.

The performance standards were developed and delivered. They were not, however, made part of the Minimum Property Standards.

Source: report p. 36 (PDF p. 46).

Reorganization at NBS — Chapter 6, Full Text

As the Building Research Division broadened its disciplinary base, took on more varied projects, and assumed a more activist role in the transfer of technology, its organizational structure appeared less and less equal to the expanded task. A different kind of organizational unit — one more accommodating of a broad research approach — was sought for building technology at NBS, and much effort was exerted to bring this change about.

The Department of Commerce on June 12, 1972, issued Department Organization Order 30-2B creating a Center for Building Technology. Dr. Lawrence M. Kushner, Acting Director of NBS, pointed out that the new Center would provide the means for “cooperating with the States, local government, the building industry, and the consuming public in achieving greater benefit from the Bureau's long experience in building science and technology.”

The Commerce Department's organization order called for strong real-world connections. “The Center shall consult,” it said, “with industry, government agencies, professional associations, labor organizations, and such organizations as the National Conference of States on Building Codes and Standards...”

Dr. Edward O. Pfrang, who had headed the NBS' Operation Breakthrough effort, became the Chief of the new Structures, Materials and Life Safety Division. Paul R. Achenbach was the new chief of the Building Environment Division. Porter Driscoll was hired from HUD to head the new Technical Evaluation and Application Division.

The former Operation Breakthrough group was carried over to the new Center organization, becoming its Office of Housing Technology. James Gross became the Chief of this Office.

Two other Offices were created by upgrading the Codes and Standards Section to Office status (under Gene Rowland's direction) and by establishing an Office of Federal Building Technology for effective collaboration with the Federal agencies. During the Operation Breakthrough effort, the Building Research Division looked for stronger relationships with all Federal agencies concerned with building and the position of Federal building coordinator was created. The Office of Federal Building Technology was an outgrowth of this position. Samuel Kramer, who served the Division as its Federal Building Coordinator, became Chief of the Office of Federal Building Technology.

With its Center status, the new organizational structure meant an enhanced capacity to serve the building community. And it gave greater and more explicit status to two key building technology activities, elevating the subject of standards and codes to an importance commensurate with the expanded program to assist building regulation, and recognizing the growth in NBS' service to other Federal agencies having building responsibilities.

Source: report pp. 39–40 (PDF pp. 49–50).

Organizational Chart Text — Before and After (Pages 39–40)

1971 Building Research Division

- *Housing Technology*
- *Fire Research*
- *Materials Durability and Analysis*
- *Federal Building Research Coordinator*
- *Building Systems*
- *Scientific and Professional Liaison*
- *State Codes and Standards*
- *Sensory Environment Branch*
- *Environmental Engineering*
- *Building Transport Systems*
- *Applied Acoustics and Illumination*

1972–74 Building Technology

- *Office of Building Standards and Codes*
- *Office of Housing Technology*
- *Office of Federal Building Technology*
- *Structures, Materials and Life Safety Division*
- *Building Environment Division*
- *Technical Evaluation and Application Division*
- *Building Service Systems*
- *Scientific and Professional Liaison*

Source: organizational chart text, report pp. 39–40 (PDF pp. 49–50).

Gene Rowland Among Center Chiefs, Mid-1970s

By the mid-1970s the Center was confronted by emphatic research challenges, particularly over the need for resource conservation in building technology. Heading the management team charged with shaping a response to these challenges was Dr. Richard N. Wright, successor to Dr. James R. Wright who in early 1974 left the Center to become Deputy Director of the Institute for Applied Technology.

*Key team members were Harry Thompson, Center Deputy Director, and the Chiefs of the Center's principal organizational units: **Gene Rowland, Building Standards and Codes Services**; James Gross, Housing Technology; Samuel Kramer, Federal Building Technology; Dr. Edward O. Pfrang, Structures, Materials, and Safety; Paul R. Achenbach, Building Environment; and Porter Driscoll, Technical Evaluation and Application.*

Source: report p. 65 (PDF p. 75).

Other “Director of Operation Breakthrough” Names in the Committee Appendix

Mr. William L. Hooper (1972) — Director of Operation Breakthrough, Boise Cascade Urban Development Corporation, 525 School Street, S.W., Washington, D.C. 20024

Mr. Alfred A. Perry (Federal Observer / Liaison Representative for HUD) — Director of Operation Breakthrough, Office of Research and Technology, Department of Housing and Urban Development, Washington, D.C. 20410

Source: committee roster, PDF pp. ~114–116.

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