NATIONAL BUREAU OF STANDARDS REPORT

10 625

SUMMARY OF ACCOMPLISHMENTS IN BUILDING RESEARCH FISCAL YEAR 1971

Building Research Division
Institute for Applied Technology
National Bureau of Standards

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS REPORT

NBS PROJECT		NBS REPORT
42100–4210900	November 1, 1971	10 625

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INTRODUCTION

The project summaries contained in this report provide a brief account of the progress made in the research projects ongoing in the Building Research Division of the National Bureau of Standards during FY 1971.

Each summary contains a funding figure, a summary of output, and other particularized information including the name of the appropriate person to contact for additional information. Comments, suggestions and inquiries are welcomed (please contact individual project leaders). The summaries are arranged under the following Sections, Branches and Teams of the Building Research Division, each of which has the major responsibility for work in a particular areas:

Structures
Fire Research
Materials Durability and Analysis
Building Systems
Scientific and Professional Liaison
State Codes and Standards
Sensory Environment
Environmental Engineering
Building Transport Systems
Applied Acoustics and Illumination
Operation BREAKTHROUGH Team

This report has been prepared in response to a request from the Office of Management and Budget. Our distribution of this information is just one effort of the Building Research Division to improve communications between Federal agencies.

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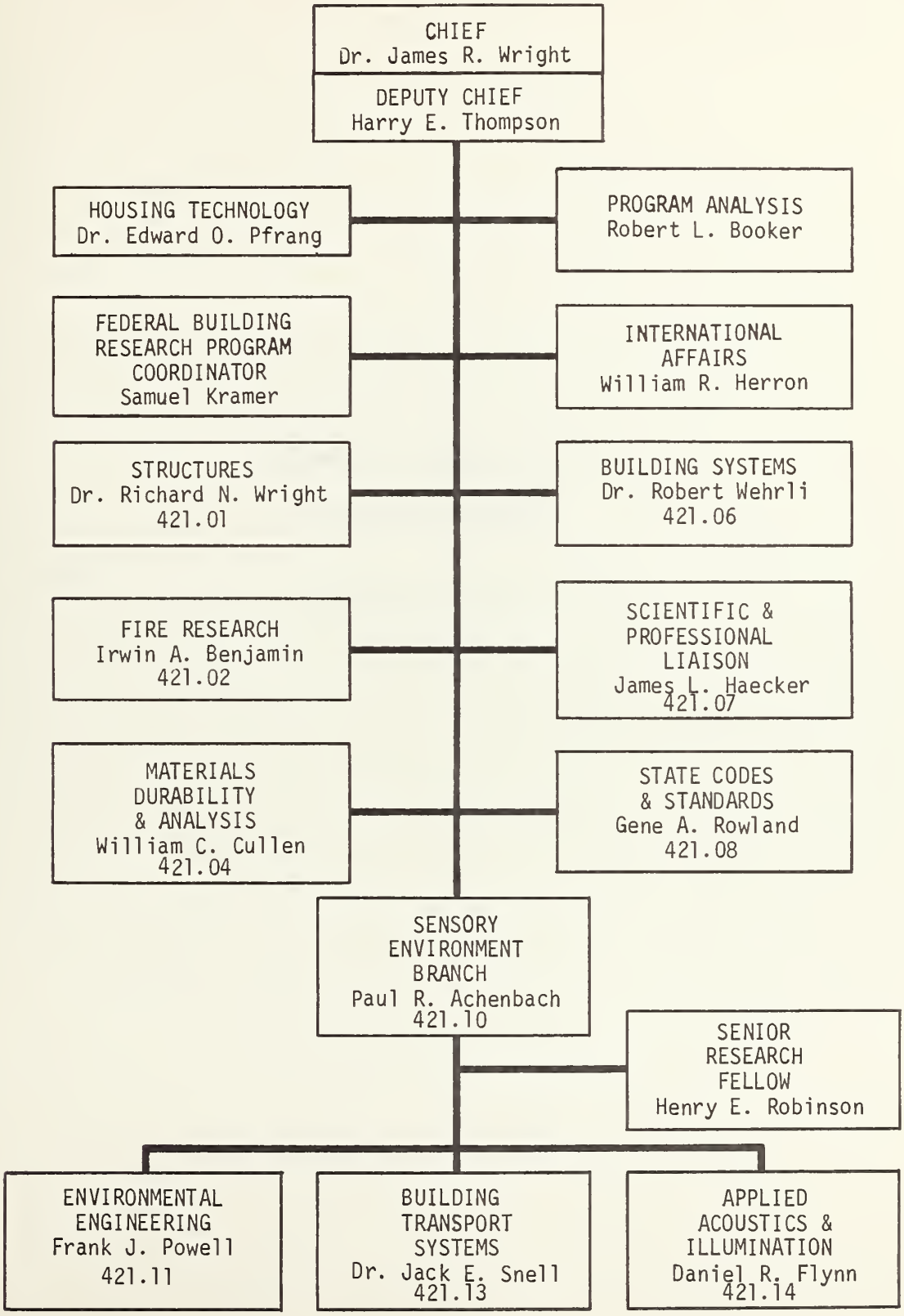
BUILDING RESEARCH DIVISION
INSTITUTE FOR APPLIED TECHNOLOGY
NATIONAL BUREAU OF STANDARDS



SUMMARY OF ACCOMPLISHMENTS

IN BUILDING RESEARCH

FISCAL YEAR 1971

PROJECT TITLE: Criteria for Structural Deflections

BACKGROUND: The Guide Criteria for static and dynamic deflections were developed on the basis of the present state of the art. To date, very little research has been devoted to this area; some of the presently used deflection limitations can be traced back to the 18th Centry. It is likely that more economical and more serviceable buildings could be achieved with more rational criteria for structural deflections.

RESEARCH OBJECTIVE: To develop performance-related criteria for structural deflections with a rational basis for performance levels. To develop techniques of evaluation, including instrumentation when necessary, in order that performance of structural elements in systems may be measured.

RESEARCH EFFORT: A study of the literature background for current deflection criteria is being conducted under contract with Washington University, St. Louis, Missouri. Two instrumentation systems are under development. One is concerned with the measurement of horizontal drift; the other is concerned with the measurement of vertical floor vibrations. A contract has been placed with Section 446.02 for the construction and testing of an instrumentation-grade electrical optical system for the measurement of drift. Surveys will be conducted of existing and planned structural systems to describe the mechanisms of drift and floor vibration. These systems will be rated for performance in terms of human comfort by a limited survey of user reactions and ratings of teams of technical experts. Physical testing will be conducted of laboratory elements of structures and prototype buildings in service. Long-range studies will be carried out of the performance of buildings in service. The accumulated data will be synthesized to determine the validity of existing deflection criteria and to develop improved criteria.

STATUS OR CONCLUSION: The literature survey, development of instrumentation, and planning of in-service and laboratory testing are ongoing.

Keywords:

Structures, Deflections
Vibrations, Wind,
Comfort

Initiation/Completion Dates:

September 29, 1970
September 29, 1973

Sponsorship:

HUD
$36.8K

Project Number(s):

4218381

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Published Descriptions:

None

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Design Standards for Composite Beams

BACKGROUND: Investigation was concerned with the flexural behavior of concrete-on-steel composite beams having partial sheer connection under static and fatigue loading. Analytical studies have been carried out using computer programs. Parallel to these studies, a series of experimental studies were undertaken to augment and substantiate the analytical studies.

RESEARCH OBJECTIVE: (1) To determine static and fatigue strength of stud shear connectors. (2) To develop an analytical means of estimating ultimate strength of concrete-on-steel composite beams having partial shear connection.

RESEARCH EFFORT: A study was made on partial interaction behavior of concrete-on-steel composite beams. Influence of longitudinal reinforcement in the concrete slab on distribution of shear force in shear connectors was also studied. Test results of four full-size beams designed to investigate the above-stated purposes were analyzed. Analytical study of these beams using the computer was also carried out.

STATUS OR CONCLUSION: It is anticipated that the study on partial shear connection problems will be completed in FY72. A report including design recommendations based on both experimental analytical studies will be published.

Keywords:

Beams, Composite Construction, Concrete, Steel, Shear Connector, Stud

Initiation/Completion Dates:

August 1968
June 1972

Sponsorship:

Building Research Division
$17.8K

Project Number(s):

4212115

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Published Descriptions:

NBS Report 10246

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Live Loads on Buildings

BACKGROUND: Gravity loads and fire criteria specified in current building codes are based on a small amount of data collected over twenty years ago and professional experience and judgement. This approach uses a single loading magnitude for structural stiffness and deflection criteria as well as strength and safety criteria. A better knowledge of loads as stochastic phenomena would permit different loadings for serviceability and safety resulting in greater reliability and cost effectiveness.

RESEARCH OBJECTIVE: Through the collection of data such as funiture and equipment (F & E), weight, room size and use, building type, etc., and effective probability (analytical) modeling, gain a better understanding of gravity live loads and fire loads for use by structural engineers to provide safe, cost-effective designs.

RESEARCH EFFORT: Concurrent development of analytical models and data collection techniques prior to the survey and continued modification of models and data collection techniques during the survey form a basic tenet of the program. This approach offers an excellent means of quickly evaluating the cost of gathering the data needed to develop and verify the models. Major emphasis is being placed on reducing the cost of the data collection process. Preliminary probability modeling indicates that estimates of F & E location and weight are adequate. This will result in a significant cost reduction when compared to previous surveys that measured the location and weighed all F & E.

STATUS OR CONCLUSION: The initial analytical models should be complete and the collection of data, survey of several buildings for static conditions to verify the models, should be started. Three models are contemplated: (1) stochastic descriptive, depicting existing conditions; (2) design loads to conservatively simplify the loads phenomena; and (3) a code loads model to further simplify loads for codification. Limited results from Model (1) should be available by the end of FY72.

Keywords:

Building, Live Loads, Fire, Gravity, Probability Modeling

Initiation/Completion Dates:

Continuing Projects

Sponsorship:

Building Research Division
American Iron and Steel Institute
$35K

Project Number(s):

4212116 and 4215361

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Published Descriptions:

None

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Paper Honeycomb Sandwich Panels (Army)

BACKGROUND: The military is and will be procuring thousands of ultra-lightweight structures suitable for air-drop at advanced bases. There is an urgent need for a procurement document which will insure the satisfactory performance of the sandwich panel material in these structures.

RESEARCH OBJECTIVE: The objective was twofold. First, the specification used by the military for paper honeycomb was to be updated. Second, the structural performance of some typical panel material was to be determined under several accelerated aging conditions and the data used in writing a procurement specification for sandwich panels.

RESEARCH EFFORT: The performance characteristics of all paper honeycombs being sold as conforming to Mil H 21040A, Type II, were determined using standard test methods. These results were incorporated in a new military standard for paper honeycomb.

Sandwich panels produced by four manufacturers were evaluated by several testing methods with the objective of determining the effect that the laminating process has on structural performance before and after accelerated aging. One series of tests on the full size panels (4'X8') was aimed at determining if a "proof" test is feasible as a quality control measure.

STATUS OR CONCLUSION: Most of the lab work is completed, although a new test frame for full-size panels is being designed and will be tested. The paper honeycomb data has been incorporated in Mil-H-21040B (Apr 71). The panel data is being used in writing a process-control specification.

Keywords:
Structural Sandwiches, Lightweight Structures, Paper Honeycombs, Laminated Structures, Composites

Initiation/Completion Dates:
Continuing Project

Sponsorship:

US Army Natick Labs
Natick, Massachusetts
$70.1K

Project Number(s):

4215424

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Published Descriptions:

NBS Report 10544

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Wind Loads on Structures

BACKGROUND: Project was initiated on 7-1-68 as a pilot project for research into the effects of wind on buildings and the establishment of design criteria to provide for these effects.

RESEARCH OBJECTIVE: To document the forces experienced by typical full-scale buildings under strong wind conditions and to correlate these observations with wind tunnel studies in which both the planetary boundary layers and building geometry have been modeled.

RESEARCH EFFORT: An array of meteorological towers was established to the north of Building 226 (prevailing wind direction) and several fast-response anemometers were installed. Pressure transducers were installed on the four walls and roof of Building 226 and simultaneous pressure-velocity records were obtained. Computer programs were developed to provide a statistical description of wind turbulence and concomitant surface pressure fluctuations. New techniques and equipment were developed to obtain wind speed and pressure measurements. The first phase of a companion wind tunnel study was completed.

STATUS OR CONCLUSION: Field studies are continuing on Building 226 and a site has been selected for future field studies of single-family dwellings. Preliminary results indicate good agreement between full-scale and model steady pressure coefficients.

Keywords:
Aerodynamics
Buildings
Wind Loads

Initiation/Completion Dates:
July 1, 1968
Continuing Project

Sponsorship:
BRD, $94.9*,
Tri-Services
$10K,
*Approximately half this amount was used to support ANSI A58 and UJNR activities.

Project Number(s):
4215113
4215430

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Published Descriptions:

Marshall, R.D. and Hsi, George, "Techniques for Measuring Wind Loads on Full-Scale Buildings," US-Japan Research Seminar on Wind Loads on Structures Honolulu, Hawaii, Oct 19-24, 1970

Campbell, J.R. and Cermak, J.E., "Wind Loading of National Bureau of Standards Bldg 226, Colorado State Univ Report, March 1971

PROJECT TITLE: Design for Earthquakes and Storms

BACKGROUND: AID-Washington sponsored a 15K feasibility study for Peru, Turkey and Philippine Islands as an initial effort to determine how socio-economic factors, local building codes, labor practices, materials and methodology might affect an NBS-recommended program to improve building resistance to natural phenomena.

RESEARCH OBJECTIVE: Critically examine the body of existing knowledge; identify those technological innovations which have been developed to overcome structural vulnerabilities and which might prove useful in strengthening structures within the context of the socio-economic and cultural restraints in the selected developing countries.

RESEARCH EFFORT: Research effort to be initiated in conjunction with recommendations of the initial feasibility study.
NOTE: AID-Lima has requested a research effort on stabilized blocks, to be made of local Peruvian soils.

STATUS OR CONCLUSION: Initial feasibility study should stimulate extensive follow-up work in structural testing, preparation of layman manuals for use in the field, educational films for local teaching, upgrading of design and construction codes and implementation of inspection and quality control procedures.

Keywords:
Design, Site, Seismic, Wind-Resistant, Low-Income Housing

Initiation/Completion Dates:
April 1971
June 30, 1972
Continuing Project

Sponsorship:
AID Washington
15K

Project Number(s):
4215432

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Published Descriptions
None

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Disaster Investigation

BACKGROUND: Every year the US suffers several disasters due to extreme environmental loads such as floods, hurricanes, tornadoes and earthquakes, together with a growing incidence of man-made disasters such as explosions and fires. The BRD has investigated these disasters over a period of 5 years on an ad-hoc basis. This project will formalize and make more effective the Division's capability to respond, report and recommend improved criteria for the design of buildings to better withstand extreme environmental loads.

RESEARCH OBJECTIVE: To investigate disasters using a BRD multidisciplinary team as appropriate to the situation. To prepare detailed reports setting forth findings and recommendations for the development of improved design criteria for buildings. To work with all other concerned agencies, governmental and professional, to see that these improved criteria are adopted and implemented.

RESEARCH EFFORT: Work was executed in connection with Hurricane Camille, the Lubbock tornado and the San Fernando earthquake. For the first two disasters, the work during this fiscal year was concerned with the preparation of the following reports:

"Hurricane Camille - Aug 1969," NBS Report 10393, Dec 4, 1970
"Hurricane Camille - Aug 1969," NBS Technical Note 569, Mar 71
"Lubbock Tornado," NBS Technical Note 558, March 1971

With the occurrence of the February 9, 1971, San Fernando earthquake, a large BRD team quickly commenced an on-site investigation of damages. This team was supplemented by consultants from universities and the state of California, in both the investigation and the preparation of reports. The first report of a series is a pictorial report of damage - "The San Fernando Earthquake, February 9, 1971," NBS Report 10556, March 1971. A second report is being prepared which will document in detail the damage caused to buildings and utilities.

STATUS OR CONCLUSION: The reports identify the areas in which further research is needed to quantify the recommendations for improved design criteria for buildings. Strenuous efforts are being made to secure from various sources the funds needed to execute this research for which high benefits would accrue to the nation.

Keywords:

Environment, Buildings, Disaster, Investigation Design, Criteria

Initiation/Completion Dates:

Continuing Project

Sponsorship:

Building Research Div.
OEP
OCD ,$36.1K,

Project Number(s):

4213569

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Published Descriptions:

NBS Report 10393
NBS Report 10556
NBS Technical Note 569
NBS Technical Note 558

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Live Loads in Postal Facilities

BACKGROUND: The Post Office Department is increasingly directing its efforts toward upgrading its mail handling activities with the tools of present day technology. It is expected that occupancy loads in postal facilities will continue to increase as more automatic equipment is developed and installed. Since present field data are inadequate for design of such structures for their expected useful life, the present design procedure must necessarily include very conservative load values.

RESEARCH OBJECTIVE: The program was initiated to study existing loads in a sample of postal mail handling facilities in various regions of the United States. Magnitudes and distributions of actual occupancy loads were investigated for the purpose of making engineering recommendations for values of loads to be used in the design of new facilities.

RESEARCH EFFORT: A total of over one million square feet of mail handling work space in postal facilities was surveyed for occupancy load data in this study. Seven major facilities located in different regions of the United States were surveyed (4 in FY 71) over their entire work floor areas. These 7 facilities ranged in height from 1 to 3 stories and supplied data which provide the basis for certain conclusions and recommendations pertaining to floor and ceiling load design values. Evaluation of the data included consideration of mail equipment, mail and personnel.

STATUS OR CONCLUSION: Project was completed in FY 71. Information on occupancy loading was reported in detailed arithmetic averages and summaries and in basic statistical parameters. Sponsor-requested exclusion of Christmas season observations (surveys) resulted in data treatment being augmented by engineering judgement in determining upper limit load values. Work accomplished is considered pioneering and worth being enlarged upon.

Keywords:

Postal Facilities
Floor Loads
Live Loads
Structural Design Loads
Mail Loads

Initiation/Completion Dates:

June 1968
July 1971

Sponsorship:

Post Office Department
$73.6K

Project Number(s):
4215418

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Published Descriptions:

NBS Reports No. 10347, 10505, 10488

PROJECT TITLE: Masonry Walls Subject to Axial Compression and Bending

BACKGROUND: The design of masonry structures is to a large extent empirical and does not rely extensively on the rational application of engineering principles. As a result, masonry design standards fail to recognize all the variables and in effect deprive the designer of the insight and flexibility provided by rational analysis.

RESEARCH OBJECTIVE: Objectives are to develop rational design criteria for masonry wall construction subjected to axial compression and bending loads. Current emphasis is directed to non-reinforced composite (brick and block) wall construction. In FY 70 experimental program was devoted to non-reinforced walls built with high-strength mortars.

RESEARCH EFFORT: Fabrication was completed on 95 masonry prisms (short wall sections) and 26 eight-foot high masonry walls. Construction consists of 4-inch brick, 6-inch block and 10-inch composite (brick and block). All specimens were constructed with type S (ASTMC270) mortar. Structural testing consisting of axial compression and bending loads was completed on 72 masonry specimens. In FY 72 remaining prism and wall sections will be tested. An additional 29 walls will also be fabricated and tested using compressive and flexural loading.

STATUS OR CONCLUSION: Test results will be analyzed on the basis of analytical procedures reported in BSS Reports 33 and 34. The test results will also be used to further develop the rational approach to evaluate both strength and slenderness effects in masonry walls.

Keywords:
Brick, Concrete block, Masonry, Mortar, Strength, Walls

Initiation/Completion Dates:

February 1970

June 1972

Sponsorship:

Tri-Services (Army, Air Force, Navy);
National Concrete Masonry Association;
Dow Chemical

$27.7K

Project Number(s):

4215431
4215360
4215362

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Published Descriptions:

Related previous research publications
BSS 33 (Dec 1970)
BSS 34 (March 1971)
ASCE Structural Division Journal, May 1971

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Design Standards for Masonry

BACKGROUND: Data on the properties of masonry structures are needed to establish satisfactory performance criteria and engineering standard requirements for various service conditions and for effecting economics in masonry construction.

RESEARCH OBJECTIVE: Development of new and improved test standards and design and construction standards relating to masonry construction.

RESEARCH EFFORT: Experimental programs in FY72 were carried out under projects 4215431, 4215360, and 4215362. Related program activity was carried out on the following committees: ACI 531, Concrete Masonry Structures; ANSI A41, Building Code Requirements for Masonry; ASCE Task Committee on Engineering Masonry; ASTMC12, Mortars for Unit Masonry; ASTM C15, Manufactured Masonry Units; and ASTM E6, Performance of Building Construction. Progress was made toward the development of new masonry standards and the revision of current masonry design standards.

STATUS OR CONCLUSION: In FY72 the experimental programs and committee and standard activities will be continued.

Keywords:

Codes, Design, Masonry, Mortar, Standards, Walls

Initiation/Completion Dates:

Continuing Project

Sponsorship:

Building Research Div
$25.6K

Project Number(s):

4212111

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Published Descriptions:
None

PROJECT TITLE:

Noncombustibility Test Development

BACKGROUND:

U. S. Coast Guard is actively supporting the use of a furnace test proposed by ISO and IMCO as an international standard for defining noncombustibility. This project provides technical background on the test methods used to measure noncombustible properties.

RESEARCH OBJECTIVE:

To investigate repeatability and reproducibility of proposed test method. To prepare and distribute test specimens. To evaluate the effects of furnace and procedural variables.

To evaluate heat released by materials by potential heat and French crucible tests.

RESEARCH EFFORT:

An interlaboratory test program was designed to investigate the repeatability and reproducibility of the proposed ISO/IMCO noncombustibility test method. Specimens were prepared and distributed. Experiments were conducted to evaluate the effects of furnace and procedural variables. Test furnaces were procured and distributed.

Potential heat measurements were made. The French crucible test for measuring the heat content of the volatile components of materials, was evaluated.

STATUS OR CONCLUSION:

Research is ongoing.

Keywords:
Noncombustibility
Fire Tests
Interlaboratory
ISO test

Initiation/Completion Dates:
May 1970
Continuing

Sponsorship:
DOT (USCG)
$21.6K

Project Number(s):
4219402

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Published Descriptions:
NBS Reports No.
10329
10330

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Field Fire Studies

BACKGROUND: This project covers fire studies inside and outside the laboratory, including research on fire growth and spread in full-scale structures. Studies outside the laboratory generally involve a specially instrumented mobile van.

Laboratory work is devoted to developing new test procedures to predict full scale fire performance.

RESEARCH OBJECTIVE: To provide ready capability for fire testing at any location. To extend laboratory studies to the fire performance of complete as-built field structures.

RESEARCH EFFORT: Extended capability of mobile van by additional instrumentation. Data was collected at fire tests at the Washington, D. C. laboratories, at burnout tests at the University of Maryland and at the U. S. Coast Guard facility at Mobile, Alabama.

Completed program on growth of fires in model enclosures as part of the CIB program; summarized in NBS Report 10471.

Completed round robin evaluation of the NBS-developed Smoke Density Chamber.

Performed flame spread tests and provided technical input as U.S. representative on ISO Fire Test Committee.

STATUS OR CONCLUSION: Research is ongoing.

Keywords:
Fire Tests
Field Studies
Mobile Laboratory
Data Logger
Building Fires
Burnout Tests

Initiation/Completion Dates:
July 1966
Continuing

Sponsorship:
BRD

$63.3K

Project Number(s):
4212229

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Published Descriptions:
NBS Reports No.
10373
10328
10364
10365
10471
10534

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Fire Endurance

BACKGROUND:
This project covers analytical and experimental studies on the effects of standard fire endurance tests on materials and construction assemblies.

RESEARCH OBJECTIVE:
To develop and refine the fire endurance test procedures through:
(a) analytical studies based on application of heat and mass transfer principles.
(b) experimental studies to measure engineering properties under real fire exposure conditions.

RESEARCH EFFORT:
Full scale corridor was constructed and used to study fire propagation. The use of carpeting was examined for a variety of test conditions.

Computer programs were developed to predict
(a) heat balance in corridor
(b) heat and mass transfer through fire-exposed walls
(c) effect of pressure difference (due to fire) on leakage through structural panels.

STATUS OR CONCLUSION: Research is ongoing

Keywords:
Fire Tests
Fire Endurance
Structures
Building Components
Flame Penetration

Initiation/Completion Dates:
July 1967
Continuing

Sponsorship:
BRD

$47.7K

Project Number(s):
4215122

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Washington, D.C. 20234
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Published Descriptions:
None

PROJECT TITLE:

Evaluation of Hazard Due to Smoke and Flame Spread in a Room.

BACKGROUND:

Flame spread and smoke generation criteria for interior finish materials are generally based on laboratory tests and fire experience. Controlled laboratory tests in full-size rooms are necessary to measure the contribution of interior finish materials under exposure to minor or low intensity residential fires.

RESEARCH OBJECTIVE:

To obtain knowledge on the burning behavior of minor fires, such as those which occur in wastebaskets or items of furniture. To develop one or two standard "minor fire" exposures. To evaluate wall, ceiling and flooring materials for flame spread and smoke in a minor-fire room environment. To provide better guides to OBT flame spread

RESEARCH EFFORT:

Measurements were made of the burning rates of combustibles in small and large wastebaskets, of the rate of heat transfer to the surrounding enclosure, and the temperature distribution of the flame and the ambient hot gases.

STATUS OR CONCLUSION:

Research is ongoing.

Keywords:

Fire Tests
Flame Spread
Wastebasket Fire
Smoke
Fire Criteria

Initiation/Completion Dates:

October 1970
Continuing

Sponsorship:

HUD
$41.6K

Project Number(s):

4218382

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Published Descriptions:

NBS Report No.
10557

PROJECT TITLE:

Fire Sensitivity of Frameless Buildings

BACKGROUND:

This project will explore the structural fire endurance of buildings constructed from light weight sandwich panels, in terms of their sensitivity to small scale fires.

RESEARCH OBJECTIVE:

To obtain knowledge on the burning behavior of minor fires, such as those which occur in wastebaskets. To develop one or two standard "minor fire" exposures for testing frameless building assemblies. To evaluate sandwich panel buildings for structural adequacy under minor fire exposure.

RESEARCH EFFORT:

Measurements were made of the burning rates of combustibles in small and large wastebaskets, of the rate of heat transfer to the surrounding enclosure, and the temperature distribution of the flame and the ambient hot gases.

STATUS OR CONCLUSION: Research is ongoing

Keywords:

Fire Tests
Flame Spread
Wastebasket Fire
Sandwich Panel

Initiation/Completion Dates:

June 1970
Continuing

Sponsorship:

ARMY (Natick Labs)

$39K

Project Number(s):

4219403

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Published Descriptions:

NBS Report No.
10557

PROJECT TITLE:

Tests of Structural Sandwich Panels

BACKGROUND:

This project involves the fire performance evaluation of a structural sandwich panel building. This light-weight, relocatable building is made of aluminum skins with paper honeycomb core, and is a replacement for the Quonset.

RESEARCH OBJECTIVE:

To evaluate the fire performance of the structural sandwich panel in terms of flame spread, smoke generated and flame penetration.

RESEARCH EFFORT:

Flame spread, smoke generation, flame penetration and full-scale fire endurance tests were conducted, and summarized in a final report.

STATUS OR CONCLUSION:

The panel is limited in its ability to prevent flamethrough under severe fire exposure. The panel is considered to be safe from the standpoint of flame spread along its exposed aluminum surfaces. The combustible paper honeycomb and the extruded vinyl cleats represent potential sources of heavy smoke development under fire exposure.

Keywords:
Fire Tests
Structures
Sandwich Panels
Flame Spread
Smoke

Initiation/Completion Dates:
March 1969
June 1971

Sponsorship:
NAVY
(Naval Facilities Engineering Command)
$16.1K

Project Number(s):
4215422

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Published Descriptions:
NBS Report No. 10469

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Shipboard Fire Research

BACKGROUND: Since the rate of heat release is an important factor in the buildup of fires, work was started on the development of a heat release rate calorimeter at NBS in 1962. Due primarily to problems of sensitivity and low time response as well as a shortage of personnel, this development was temporarily halted. A new instrumental concept was introduced and work was started again in 1970.

RESEARCH OBJECTIVE: The objective of this project is the development of fire tests to produce the information necessary to evaluate the performance of materials in a fire environment.

RESEARCH EFFORT: The magnitude of the effort in FY71 included approximately one half the time of the principal investigator, full time for a student trainee, and about 3 months of technical support. The operating mode of the calorimeter was changed by the additions of an auxillary burner and automatic control equipment to provide for a constant stack temperature and thereby eliminate the thermal inertia of the previous system. Under these conditions the measured flow to the auxiliary burner exactly compensates for the heat released by the specimen and thereby provides an accurate measurement of it. Measurements made on a variety of building materials indicate that the calorimeter now has adequate accuracy, sensitivity, and time response. An apparatus for measuring the time to ignition for building materials exposed to a flame was built and tested.

STATUS OR CONCLUSION: In FY72 the final refinements of the heat release rate calorimeter and the ignition test apparatus will be made, and their performance evaluations will be completed so that they can be made available for standard fire test methods. Work will commense on the development of mathematical models which should predict the results of the test and apply these results to real fire situations.

Keywords:
Fire, Heat Release Rate, Calorimeter, Ignition, Temperature, Irradiance, Thermal Conductivity

Initiation/Completion Dates:
Continuing

Sponsorship:
Naval Ship Systems Command

$92.6K

Project Number(s):
4215420

Project Leader and Contact Information:

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Published Descriptions:

"Development of a Heat Release Rate Calorimeter at NBS" by W.J. Parker and M.E. Long

Paper to be given at ASTM symposium Oct. 1971

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Study of ABS Pipe

BACKGROUND: ABS Plastic Pipe is being used in drain, waste, and vent pipe installations where the vertical pipe stacks are confined in a vertical pipe chase. Since ABS is combustible it may release smoke, gaseous products and heat inside the chase as it is consumed. Also, the consumption of the pipe in a room which is burning leaves a hole through which flames and hot gases can penetrate into the chase.

RESEARCH OBJECTIVE: The objectives of the test were to examine the potential hazard of an ABS Plastic Pipe installation in a vertical chase with a two hour fire-endurance rating and to determine the best way of making the lateral connection through the chase wall to prevent the passage of flames and hot gases.

RESEARCH EFFORT: Eight chases, each with a different drain, waste, and vent pipe installation, were subjected to the standard ASTM E119 fire exposure for up to 2 hours duration. Four chases were tested at the same time. The first four were tested in FY 1970 and the second set in the first month of FY 1971. It was concluded from these tests that four-inch ABS pipe in a protected chase with connecting three-inch ABS laterals penetrating the walls will not spread either fire or significant quantities of smoke from one floor to another during a two hour fire exposure provided that (1) the lateral passes into the chase at a downward angle of 45 degrees, (2) the lateral is enclosed in a steel sleeve at the point of penetration, (3) the penetration is in the lower one third of the room, (4) the chase is of 2 hour non combustible construction, (5) the top of the chase is sealed, and (6) the joints and openings where the laterals penetrate the chase wall are smoke tight during the first two hour period.

STATUS OR CONCLUSION: The project has been completed. A journal article, now in the editorial review process, will be submitted to "Fire Technology."

Keywords:

ABS, Building Fires, Fire Spread, Pipe Chase, Smoke, Temperature

Initiation/Completion Dates:

2/70 - 6/30/71

Sponsorship:

ABS Institute

$1 [illegible]

Project Number(s):

4215363

Project Leader and Contact Information:

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Published Descriptions:

NBS Report 10 342

PROJECT TITLE: Fire Endurance Testing of Aluminum Bulkhead and Ceiling Panels (SNAME)

BACKGROUND: Because of their intended use aboard ship, the fire endurance of ten aluminum bulkhead and ceiling assemblies were tested at NBS. In each case the aluminum was protected by layers of mineral wool, by marinite panels, or by both.

RESEARCH OBJECTIVE: The objective of the project was to determine the minimum amount of protection required to satisfy the specifications for a class A rating outlined in the IMCO Publication FP VI/17 annex II dated September 1967.

RESEARCH EFFORT: The aluminum bulkhead and ceiling assemblies were exposed to a furnace whose average temperature was made to follow the ASTM E119 standard time temperature curve. The assemblies were heavily instrumented with thermocouples for diagnostic purposes as well as to determine if and when the surface and core temperatures exceeded their maximum limits. All of the temperatures were plotted automatically making use of the newly developed computerized data handling system. Several changes in the design of the assemblies were indicated as a result of these tests.

STATUS OR CONCLUSION: All of the tests have been completed, all of the temperature data have been plotted, the final report is being written.

Keywords:
Fire Test, Temperature, Aluminum Bulkheads, Fire Endurance

Initiation/Completion Dates:
12/69-6/72

Sponsorship:
Society of Naval Architects and Marine Engineers (SNAME)

$12.7K

Project Number(s):
4213631

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Published Descriptions:
None

PROJECT TITLE: Aircraft Finish Materials

BACKGROUND: Previous summaries have described exploratory experiments on fire growth in model enclosures and an extensive investigation of smoke and gases produced by aircraft interior materials. While these data are helpful in evaluating potential hazards of various materials, the complex phenomena of flashover as it might relate to aircraft cabins is not well defined. In the context used here, flashover appears to involve gas phase combustion reactions from the products of thermal decomposition of solid organic materials within the cabin enclosure.

RESEARCH OBJECTIVE: To use carefully designed laboratory models as a means of producing flashover. These models should provide a practical approach to the analysis of the complex system while affording the opportunity to obtain precise quantitative data on combustion products and reactions.

RESEARCH EFFORT: A laboratory model was designed and assembled. Polyurethane polymer was pyrolized to obtain flashover using a high voltage arc as an ignition source.

STATUS OR CONCLUSION: Successful. Production of flashover in the laboratory model will allow investigation of other important variables, such as composition of pyrolysis gas mixture, source of ignition, and radiant energy flux density to sample specimen.

Keywords:

Aircraft Materials, Flashover, Pyrolysis, Combustion Products

Initiation/Completion Dates:

4/66 - continuing

Sponsorship:

Federal Aviation Administration
$25.4K

Project Number(s):

4219427

Project Leader and Contact Information:

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Published Descriptions:

None

PROJECT TITLE: Shipboard Machinery Room Fire Research

BACKGROUND: The engine crew normally sees and extinguishes fires in the engine room. When these men are replaced by automatic machinery, the possibility of fire will remain. Automatic detectors and extinguishers are currently used for unmanned spaces such as cargo holds.

RESEARCH OBJECTIVE: To test fire detectors and extinguishers for function in an engine room.

RESEARCH EFFORT: For detector tests, five fire detector systems were installed by the manufacturers in the engine space. The U. S. Coast Guard selected locations and we lit the fires and recorded the response of the fire detectors.

For extinguisher tests, 24 thermocouples and four gas sample lines were installed in the engine room. The fire was in the bilge; 1/2 inch of diesel fuel floating on the bilge water. We ignited the diesel fuel and recorded the data. The USCG closed off the space and operated the extinguishers.

Data from both tests were reduced and given to the U.S. Coast Guard.

STATUS OR CONCLUSION: U. S. Coast Guard has prepared a report on fire detectors and a first draft of a report on fire extinguishment systems for engine room use.

Keywords:

Fire Detectors, Fire Extinquishment, Engine Room, Ship

Initiation/Completion Dates:
May 1970
January 1971

Sponsorship:

Dept. of Transportation
U. S. Coast Guard
$19.3K

Project Number(s):
4219428

Project Leader and Contact Information:

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National Bureau of Standards
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Published Descriptions:

Report of Machinery Space Fire Detecting Tests, Phase II by D. J. Kerlin and D. E. McDaniel, DOT-USCG

PROJECT TITLE: Analysis of Fire Gases

BACKGROUND: Very little basic information is presently available on the mechanism of smoke formation, flame inhibition by halogenated inhibitors, or the role of inhibitors in polymer pyrolysis. A correlation of polymer structure and additives with pyrolysis products and smoke formation could lead to methods of reducing smoke and fire hazards.

RESEARCH OBJECTIVE: To establish the basic chemical mechanisms involved in polymer degradation and investigate the chemistry of diffusion flame inhibition.

RESEARCH EFFORT: Experimental studies are underway to identify the important chemical reactions including unstable species during pyrolysis of various polymeric materials. High energy molecular gas lasers are used to provide a well defined source of thermal radiation. Gas chromatographic and spectroscopic techniques are employed for identification of stable products and low temperature infrared matrix-isolation techniques for unstable products.

STATUS OR CONCLUSION: The analysis of stable reaction products evolved in the flash pyrolysis of polytetrafluoroethylene using a 130 watt CO_2 laser has been completed. Distinct modes of decomposition have been identified for pyrolysis in vacuum and inert atmospheres. A study correlating rates of heating and rates of evolution of HCl for poly(vinylchloride) insulated wire has been completed.

Keywords:

Combustion Products, Pyrolysis, Diffusion Flames, Flame Inhibition Flame Spectra, Laser Pyrolysis

Initiation/Completion Dates:

Continuing Project

Sponsorship:

Building Research Division
$60K

Project Number(s):

4219223

Project Leader and Contact Information:

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Phone: 921-3387

Published Descriptions:

Part of this work is described in NBS Report No. 10224

PROJECT TITLE:

Fire Resistance of Prestressed Concrete

BACKGROUND:

The use of prestressed concrete members in combustion had been limited by insufficient fire test data and design aids for estimating.

RESEARCH OBJECTIVE:

Phase I program - To develop design aids for evaluating the fire resistance of simply supported prestressed concrete beams.

RESEARCH EFFORT:

Research program was initiated in June 1971.
Test and analysis data developed by American and Foreign research centers being assembled for analysis.

STATUS OR CONCLUSION:

Contacts have been initiated with other research centers to use their most recent developments.

Keywords:
Fire Resistance,
Concrete,
Prestressed Concrete,
Beams, Girders, Design Aids.

Initiation/Completion Dates:

June 1971
Continuing

Sponsorship:

GSA-PBS

$2.9K

Project Number(s):

4219404

Project Leader and Contact Information:

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Published Descriptions:

None

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Fire Resistance of Ducts

BACKGROUND:

Currently NFPA Standard 90A governs the use of fire dampers to control the spread of fire in duct systems. The current requirements for fire dampers may be placing an added cost on building construction with only a marginal gain in fire safety.

RESEARCH OBJECTIVE:

To study the need for fire dampers and determine if these are design and construction parameters of a duct system that may be altered to substitute for a fire damper.

RESEARCH EFFORT:

The first phase investigation is to study the parameters governing fire penetration into a duct. In FY 71 a preliminary fire test of 5 ducts was run at the NBS facility. The results indicated that joint designs, joint spacing, hagar spacing, and duct thickness were significant parameters.

STATUS OR CONCLUSION:

In FY 72 the parameters governing fire penetration into a duct will be continued. A series of tests of duct joints and duct wall thickness will be run This is estimated to comprise 20 to 30 ducts. Instrumentation is concurrently being developed and improved.

Keywords:

Fire Safety,
Fire Dampers, Ducts,
Sheet Metal

Initiation/Completion Dates:

FY 1971 Continuing

Sponsorship:

American Iron and Steel Institute
$19.7K

Project Number(s):

4219360

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Published Descriptions:

Preliminary report of initial tests to sponsor.

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Miscellaneous Testing

BACKGROUND: For many years NBS has served as the testing organization for the U. S. Coast Guard.

RESEARCH OBJECTIVE: Evaluate fire resistance of materials proposed for shipboard applications.

RESEARCH EFFORT: Fire endurance tests were run on specimens 6 ft 3 in wide by 8 ft 0 in high on two different materials. The first was an asbestos-cement board manufactured in Scotland; the second was a similar material manufactured in England.

Heated tube and reheat tests on nine materials submitted for shipboard use were conducted.

STATUS OR CONCLUSION: The material manufactured in Scotland passed while the material manufactured in Great Britain failed.

Six materials passed and three failed on the nine materials submitted for shipboard use.

Keywords:

Fire Test, Marine Construction, Asbestos, Cement, Bulkhead

Initiation/Completion Dates:

Continuing

Sponsorship:

U. S. Coast Guard

$11.3K

Project Number(s):

4213646

Project Leader and Contact Information:

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Published Descriptions:

Test reports to sponsor

PROJECT TITLE: Performance of Roofing

BACKGROUND:

(1) A study of hail resistance of roofing materials was conducted because of considerable damage to roofs by hail storms in the U.S.A.

(2) Portions of the Owens-Corning (4216360) and rheological property study of roofing asphalts (4216447) were charged to 421 247.

(3) A glass transition point test method for asphalts was developed.

RESEARCH OBJECTIVE:

(1) Evaluation of hail resistance of asphalt shingles. Outside weathering of hail damaged shingles.

(2) Relationship between physical properties such as soft point, penetration, viscosity, sag and glass transition point determined for a series of roofing asphalts.

RESEARCH EFFORT:

(1) Considerable number of asphalt shingle samples submitted to hail gun test. These shingles now being weathered outdoors.

(2) A number of roofing asphalts from a wide variety of areas in the U.S. and Canada submitted to softening point, penetration, and viscosity tests; also a new glass transition point test.

(3) Field inspection of built-up roofs of various types, especially defective roofs.

STATUS OR CONCLUSION:

(1) Hail testing of asphalt shingles completed, outdoor weathering of hail damaged shingles in progress.

(2) Grayback report to be written on "Property Changes in Roofing Asphalts Subjected to ARMA Heat Test."

(3) Outdoor small-scale slippage tests being started on a variety of BUR systems.

Keywords:

Hail Resistance
Rheology
Roofing Asphalts
Roofing Membrane

Initiation/Completion Dates:

Continuing Project

Sponsorship:

Building Research Div.
$40K

Project Number(s):

4212247

Project Leader and Contact Information:

R. G. Mathey
B348, Building Research
National Bureau of Stds.
Department of Commerce
Washington, D.C. 20234
Phone: 921-3407

Published Descriptions:

Report "Hail Resistance of Asphalt Roofing Shingles" submitted to Division Editorial Committee for publication.

Several lectures given on this subject.

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Performance of Roofing

BACKGROUND: The frequency of roofing failure because of separation of part of the membrane system from the roof (called slippage) has increased in recent years in new military roof construction. Slippage can occur when the interply asphalt in BUR systems becomes very soft or fluid during periods of several days or longer of hot weather. Slippage oftens ruins roofs.

RESEARCH OBJECTIVE: To obtain data and information based on laboratory, outdoor exposure, and field experience on the causes of built-up roof slippage. To develop a criteria for design and a specification for material characteristics to alleviate such failures.

RESEARCH EFFORT: (1) The effect of the ARMA Heat Test on the rheological properties of a wide variety of roofing asphalts was determined. (2) A sag test was devised and used for bitumen and samples of ASTM Types I, II and III asphalts and coal tar were submitted to it. (3) A BUR slippage test at 70°C (158°F) was devised. Two ply membrane samples made from a variety of felts, and the bitumens in item (2) of different film thickness were conducted. (4) Large weathering platforms with different slopes were built and will be used for outdoor slippage tests on BUR systems resembling those in item (3).

STATUS OR CONCLUSION: Results from the research effort and field studies have yielded information and data enabling us to write specifications which should eliminate or considerably reduce chances of slippage occurring in new military BUR construction. A report is being written containing this information. Outdoor slippage tests on BUR samples will begin soon under 4216247

Keywords:

Asphalt, Sag, Built-Up Roofing, Slippage

Initiation/Completion Dates:

July 1, 1970

June 30, 1971

Sponsorship:

Tri-Service
$36K

Project Number(s):

4212447

Project Leader and Contact Information:

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Published Descriptions:

Talk on "Slippage in Roofing" given at Roofing Workshop, NBS, August 4, 1971. Report being written on "Slippage in Built-Up Roofing Systems"

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Roofing Design Criteria Research Program

BACKGROUND: Performance criteria of membrane roofing are needed by the roofing industry, particularly by the roofing material producers. These criteria are needed to design and produce roofing membranes. Currently there are inadequate standards and criteria available for manufacturers to develop roofing products that have the engineering properties to perform satisfactorily.

RESEARCH OBJECTIVE: To establish meaningful performance criteria for membrane roofing. The development of techniques to measure stresses that are developed in the roofing membrane. To provide data on probable stresses which may occur in various roof constructions and climates, to select and develop appropriate test methods which relate to stress resistance, to suggest criteria which can be incorporated into specifications for roof membrane designs based on experimental data.

RESEARCH EFFORT: A literature survey to be conducted of both published and unpublished literature. Field investigations will be made to identify and quantify, where possible, the natural and other forces which act alone or in combination with other forces on membrane roofing systems to cause problems. Laboratory studies will be carried out to measure the engineering and rheological properties on a large number of small scale roofing specimens that cover a wide range of types of roofing membranes. Laboratory studies will also include the testing of large scale roofing specimens in an environmental chamber under various conditions of temperature and humidity.

STATUS OR CONCLUSION: Over 300 small scale roofing membrane specimens were fabricated. A considerable number of tests were carried out on the tensile strength at various temperatures. Tests were developed to make these measurements. Both tensile and flexural fatigue tests were developed and testing has begun. A number of other tests needed to measure roofing membrane performance were identified and work has started to develop these tests.

Keywords:
Roofing; Built-up Roofing Roofing Felts; Engineering Properties; Roofing Membranes; Performance Criteria

Initiation/Completion Dates:
11/70 - 11/72

Sponsorship:
Owens Corning Fiberglas Corporation
$25.8K

Project Number(s):
4216360

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Published Descriptions:
None

PROJECT TITLE: Test Method for Hail Resistance of Asphalt Shingle Roofing

BACKGROUND: Data were needed on the hail resistance of asphalt shingle roofing with particular emphasis on the size of granule. Data were also needed in order to prepare performance criteria on the hail impact resistance of residential roofing for OPERATION BREAKTHROUGH.

RESEARCH OBJECTIVE: To develop measurement techniques to determine the comparative influence of protective granule grading on hail resistance as asphalt shingles. To evaluate hail damage and develop performance criteria for the hail impact resistance of roofing used on residential buildings.

RESEARCH EFFORT: Equipment was designed and developed to measure the speed of ice spheres prior to impact. An extensive literature survey was carried out to determine the speed, size, shape, angle of impact, etc. of hailstones that can be expected during a storm. Experimental tests were conducted on 58 roofing panels by impacting various sizes of ice spheres at speeds corresponding to those expected in a hail storm. Methods were developed for evaluating hail damage.

STATUS OR CONCLUSION: Project has been completed. A paper on the hail resistance of asphalt shingle roofing was prepared and is in editorial review. Performance criteria on the hail impact resistance of roofing for residential construction was proposed for the guide criteria for OPERATION BREAKTHROUGH.

Keywords:
Roofing; Asphalt Shingles; Hail; Impact; Storm Damage; Shingles

Initiation/Completion Dates:
6/69 - 6/30/71

Sponsorship:
3M Company

Building Research Div.
$46.5K

Project Number(s):
4216364
4212247

Project Leader and Contact Information:
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Published Descriptions:
Paper "Hail Resistance of Asphalt Shingle Roofing" is in Division editorial review.

PROJECT TITLE: Performance of Exterior Siding

BACKGROUND: The project is designed to develop test methods and techniques to predict the long-term in-service performance of exterior sidings on the basis of short-term tests. The test results are intended to provide a basis for specifying exterior siding materials for housing projects in order to improve the service life of this high maintenance cost item.

RESEARCH OBJECTIVE: To establish performance criteria for high maintenance cost items, i.e., exterior sidings.

RESEARCH EFFORT: A series of evaluative tests were performed on 12 systems including 63 colors of exterior siding including, solid vinyls, masonites and aluminum substrates. The tests used were natural & artificial weathering, salt spray, humidity resistance, abrasion, mar and adhesion resistance, cleanability, and impact resistance (hail gun). The effects of weathering were evaluated by color and gloss changes.

STATUS OR CONCLUSION: The results of the testing program have been used to establish limits for performance criteria. These performance criteria establish a basis for performance specifications to be used in procurement of cladding materials or systems for new construction or rehabilitation of existing structures by the Naval Facilities Engineering Command.

Keywords:
Siding, Exterior, Residential, Materials

Initiation/Completion Dates:
Initiate: Jan. 1969
Complete: July 1971

Sponsorship:
NAVFAC
$10.5K

Project Number(s):
4216416

Project Leader and Contact Information:
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Published Descriptions:
NBS Report in editorial review

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Test Methods for Coating Systems

Keywords:
Organic Coatings,
Test Methods,
Performance

BACKGROUND:
There is a continuing need to develop analytical test methods for the measurement of performance of organic coatings. The importance of test method development is evidenced by the fact that this work is supported by the joint-service paint project and is utilized in cooperative studies with ASTM Committee D-1.

Initiation/Completion Dates:
Continuing Project

RESEARCH OBJECTIVE:
Improvements in test methods result in improved specifications for organic coatings. The development of physical and chemical test methods is also essential for the characterization of performance and durability properties of coating systems.

Sponsorship:
Building Research Division
$50K

Project Number(s):
4212272

RESEARCH EFFORT:
I.R. Methods have been developed to separate, identify and quantitatively determine the polymer binders used in solvent type fillers and in modified latex paints. New methods of pigment analysis are being developed using AA and emission spectrophotometry. Physical test methods being studies for use in specification development have included abrasion resistance, water resistance, vapor permeability, and pigment volume concentration. Continuing cooperative methodology studies with ASTM Committee D-1 include biodeterioration, brushability, accelerated weathering, and soil removal.

Project Leader and Contact Information:
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Published Descriptions:
The analytical test method developed by this research has been incorporated into the specifications described in project no. 4212441

STATUS OR CONCLUSION:
The technological transfer of test method development studies will be included in improved coatings specifications, guide specifications, and ultimately in improved performance durability properties of organic coatings.

PROJECT TITLE: Characteristics of Protective Coating Systems

Keywords:
Organice Coatings, Performance, Specifications

BACKGROUND:

The Army, Navy and Air Force desired to establish a Paint Committee including an NBS representative which could investigate coating problems common to all. The project included the investigation to determine the performance and other characteristics of new organic coatings, to prepare specifications,to assist in the preparation of a coatings manual, and to provide consultative and advisory services.

Initiation/Completion Dates:
Continuing Project

RESEARCH OBJECTIVE:

Provide continuing technical support for joint-service investigations for the evaluation and development of performance standards for incorporating new technology and materials into specifications for surface protection. The ultimate objective will be improved coating performance and reduced maintenance by the proper selection and use of coating systems.

Sponsorship:
Army, Navy, Air Force
$52.1K

Project Number(s):
4212441

RESEARCH EFFORT:

Laboratory test methods were developed and utilized for the preparation and revision of three coatintgs specifications, TT-C-00555, TT-P-37, TT-P-001728. The IR method of resin analysis for solvent type fillers has been incorporated into a paper now in press. A five year study of exterior coatings on selected military family housing units was completed. The manual "Paints and Protective Coatings" was revised. The utilization of laboratory performance data with outdoor exposure performance data has provided a powerful tool for the evaluation of new organic coatings. Selected coatings were examined for compliance to specifications to assay the extent of quality control problems in areas of interest to the joint services.

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Published Descriptions:
NBS Report 10520
Federal Specifications for paints are available from the General Services Administration

STATUS OR CONCLUSION:

The coatings manual is widely used by the joint-services and other government agencies. The complete coatings laboratory is being utilized for the preparation of coatings specifications, guide specifications, the solution of quality control problems, and as a source of data to support the consultative and advisory services requested by the Military.

PROJECT TITLE: Durability and Analysis of Inorganic Building Materials

BACKGROUND:
This project was established in 1968 for the purpose of having competence within the BRD in the area of inorganic building materials. Prime areas of concern are concrete, gypsum and lime.

RESEARCH OBJECTIVE:
To gain a greater insight to the factors affecting the durability of inorganic building materials, especially from a physiocnemical standpoint.

RESEARCH EFFORT:
Properties of the gypsum plaster system has been studied by thermal analysis, scanning electron microscopy, and infrared spectroscopy, and this study has been extended to include the setting mechanism of gypsum. The influence of additives on the setting time and on the crystal morphology of the set gypsum is currently being investigated.

The durabilities of concrete specimens subjected to a 16-year weather exposure are being evaluated.

STATUS OR CONCLUSION:
It nas been observed that the crystal morphology of gypsum plaster can be changed by perturbing its setting time. Changing the crystal morphology nas a significant effect on the strength of set gypsum.

Keywords:
Cement,
Concrete,
Gypsum,
Lime

Initiation/Completion Dates:
8/71 continuing project

Sponsorship:
Building Research Division
$52.7

Project Number(s):
4216205

Project Leader and Contact Information:
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Published Descriptions:
NBS Report No. 10503
NBS Report No. 10512
Building Science Series 36

PROJECT TITLE: Update of Manufacturing Chemists Association's Outdoor Performance of Plastics

BACKGROUND: In 1966, specimens of 20 plastics were placed outdoors at Arizona, Florida, and Washington, D. C. weathering sites. Since then, at regular intervals, samples of each plastic have been sent to co-operating MCA laboratories for testing of physical properties. A series of reports on initial data has been issued.

RESEARCH OBJECTIVE: The objective of this project is to update the data from the earlier reports. Data has now been obtained on samples weathered outdoors for 48 months.

RESEARCH EFFORT: One sample of each plastic from the three weathering sites were sent to MCA member companies for testing of physical properties. These properties are tensile, flexure, color, gloss, and haze. The results of these tests were added to the original data. Plots of change-in-property vs. exposure time were generated by computer. These graphs were issued as a National Bureau of Standards Report.

STATUS OR CONCLUSION: The project is continuing and at the end of 60 months it will again be updated.

Keywords:
Weathering; Outdoors; Plastics; Performance; MCA

Initiation/Completion Dates:
1966
Continuing

Sponsorship:
Manufacturing Chemists Association (MCA)
$1.3K

Project Number(s):
4216365

Project Leader and Contact Information:

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Published Descriptions:

NBS Report
(Number pending)

PROJECT TITLE: Air Pollutants and Exposure Sites

BACKGROUND: The durability of building materials depends on their environment. Outdoor weathering has never been satisfactorily duplicated in the laboratory. Hence, NBS has set up a series of outdoor exposure sites representing climatic conditions from artic to tropical, rural to industrial.

RESEARCH OBJECTIVE: To evaluate building materials for various climatic regions and to develop tests and specifications for the proper selection of building materials for various climatic uses including use in heavily air polluted areas.

RESEARCH EFFORT: Various building materials and materials systems are tested before and after exposure to outdoor weathering under a wide range of climatic conditions. Comparison of observed changes with changes caused by laboratory aging conditions, i.e. weatherometer, etc. and evaluation of both materials and testing conditions. Parameters measured include color change, tensile strength, light transmission, impact, and thermal properties.

STATUS OR CONCLUSION: The results of this type of study should aid in the prediction of useful life and selection of proper materials for use in the building industry, benefiting both the builder and the consumer.

Keywords:
Durability, Weathering Exposure Sites, Air Pollutants

Initiation/Completion Dates:
July 1970
Continuing project

Sponsorship:
Building Research Division
$31.3K

Project Number(s):
4216207

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Published Descriptions:
NBS Report 10504

PROJECT TITLE: Sealants and Adhesives

BACKGROUND: In an attempt to explain the phenomenon of adhesion, several theories have been proposed. Proponents of the adsorption theory feel that, with proper preparation, no adhesive bond can fail and that all failures are cohesive with certain surface layers being transferred. Whether all failures of adhesives and sealants are cohesive in nature was one problem studied in this project. The weathering of sealants was also studied to obtain correlation between accelerated tests and actual field exposures.

RESEARCH OBJECTIVE: To evaluate the merits of various analytical chemical tools and techniques such as photon activation analysis, neutron activation analysis, and scanning electron mircroscopy in conducting surface studies to determine if all adhesive failures are indeed cohesive in nature, to correlate accelerated weathering tests of sealants using primarily weatherometers with aging and durability as observed in actual field applications and natural weathering.

RESEARCH EFFORT: Sealant pats were prepared on clean aluminum and cured as specified by manufactuers. The sealant was peeled and the aluminum surface studied using photon activation analysis and a scanning electron microscope. By irradiating sealant, aluminum from which sealant was peeled, and pure aluminum in the NBS LINAC, it was found the titanium present in many sealant samples, but not in aluminum could be used as a tracer for the sealant. Sealant was detected by activation analysis aluminum surfaces that was not detected with scanning electron microscopy at 10000x magnification. This would indicate the adsorption theory of adhesion may have some merit--what appears to be adhesive failure may actually be cohesive. The sealant weathering study involved placing pats and joints at the NBS exposure site. The joints were placed in the joint simulator at the site. Weathering results were compared with those obtained in weatherometer studies. Various weatherometer cycles were investigated to find rapid means of inducing observed field effects.

STATUS OR CONCLUSION: The adhesion study will be continued with other surface techniques such as electron spectroscopy for chemical analysis being investigated. The results thus far look very promising. The weathering of sealants will be continued in order to correlate accelerated weathering and field results. Our new weatherometer cycle consisting only of heat and UV exposure looks promising as a rapid test to induce cracking in some sealants

Keywords:
Activation Analysis, Surface Studies, Adhesion, Weathering, Durability, Sealants

Initiation/Completion Dates:
Continuing Project

Sponsorship:
Building Research Division
$25.2K

Project Number(s):
4216209

Project Leader and Contact Information:
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Published Descriptions:
No publications have yet resulted. A talk entitled "Application of Photon Activation Analysis to Studies of Adhesion" will be presented at the 162nd ACS meeting, Washington, D.C., September 1971

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE:

Bitumens and Plastics

BACKGROUND: Roofing bitumens represent the widest used roofing materials in the U.S. The industry is very dependent upon the petroleum industry but is too small to conduct appreciable research for best characterization of roofing bitumens. The plastics industry, on the other hand, is very large and represents an extremely diverse materials supply. Here, new materials result faster than they can be evaluated.

RESEARCH OBJECTIVE: To aid the roofing industry to specify and provide roofing bitumens that give predicted performance in roofs. To aid the consumer in specifying the roofing asphalt for roofs to meet his needs.

To keep abreast of the properties and performance of plastics and plastics systems used in building so that proper specifications for required performance can be given.

RESEARCH EFFORT: Rheological studies on roofing asphalts are being made to characterize the materials. Work toward a viscosity-temperature classification system for roofing bitumens is being conducted. New methods for measuring viscosity of these materials are being developed.

Thermal properties of plastics used in buildings are being made, i.e., DTA, TMA, TGA and coeff. of thermal expansion measurements. Aging and weathering studies are also being made in conjunction with project 4216207.

STATUS OR CONCLUSION: The studies on rheological properties of roofing bitumens should result in a new classification system for these materials and may lead to new specification requirements aiding both the producer and the consumer.

New specifications for certain building uses of plastics may result from the thermal studies now underway.

Keywords:

Bitumens, Plastics, Rheology, Thermal Properties, Roofing, Viscosity

Initiation/Completion Dates:

June 1967

Continuing project

Sponsorship:

Building Research Division
$45.3K

Project Number(s):

4216201

Project Leader and Contact Information:

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Published Descriptions:

None

PROJECT TITLE: Evaluation of Industrial-Type Protected Metal Building Sheets

BACKGROUND:
In order to update Guide Specifications, the military services need to obtain laboratory and weathering exposure data on the performance and durability of industrial-type protected metal building sheets.

RESEARCH OBJECTIVE:
The objectives of the project are being accomplished by 1) performing accelerated laboratory tests on representative samples of materials, 2) determining the weathering behavior of replicate specimens of these materials by exposing them at the seven NBS outdoor exposure test sites, and 3) conducting field surveys of existing buildings. The data from these three sources will be analyzed to determine what correlations exist between short-term laboratory tests and long-term service performance.

RESEARCH EFFORT:
Representative samples materials were obtained from manufacturers and specimens were put on exposure at the seven outdoor test facilities. Replicate specimens were tested in the laboratory, utilizing the following test methods: salt spray, single & twin carbon arc weatherometers, jet abrasion, and cyclic condensation. Gloss and color change measurements were made after testing.

STATUS OR CONCLUSION:
The laboratory test programs have been completed. To be done is the field survey and return to NBS of the samples undergoing natural weathering; upon the latter, correlation of natural and accelerated weathering can be made

Keywords:
Industrial Siding, Protected Metal

Initiation/Completion Dates:
July 1, 1969
June 30, 1972

Sponsorship:
Tri Service
$26K

Project Number(s):
4216446

Project Leader and Contact Information:
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Published Descriptions:
Summary report of the first year's activities on this project is contained in NBS Report 10269

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Building Joint Sealants

BACKGROUND: Present building design and practice has created a situation where water and air leakage through joints have become commonplace. Leakage through joints damages walls, floors, etc. and reduces efficiency of heating and cooling systems. Architects and others close to the problem recognize the urgent need for improved sealants, joint design, specifications and application methods.

RESEARCH OBJECTIVE: To obtain basic laboratory, exposure and field data on building joint sealants; to develop performance requirements and standard methods for purchase specifications. To issue new and updated guides for recommended practices to help designers select the proper sealant for any specific installation as related to joint design, anticipated joint movement, environmental conditions and expected level of performance.

RESEARCH EFFORT: Performance criteria are developed for all types sealants and for improved joint design. Criteria are for single family dwellings, apartments, office and industrial buildings, plazas, decks and related joint areas where water leakage must be stopped. Standard performance tests include rheological properties, application life, extrusion rate, stain, hardness at standard conditions and after heat aging, effect of heat aging on weight loss and cracking, effect of compression-extension cycling at high and low temperatures respectively, peel strength, water immersion and effect of UV radiation on sealant performance life. New formulations are received continuously to help guide improved standards development.

STATUS OR CONCLUSION: The joint sealant problem is continuous. During the year, project activities resulted in: (1) Upgrading Fed. Spec. TT-C-0598C; (2) Upgrading Fed. Spec. TT-S-001543a; (3) Development of a new specification TT-S-001657; (4) Publication of "Guide to Joints in Concrete Structures" ACI Tech. Report 67-31 (contributing author); (5) Completion of round robin study of peel strength test.

Keywords:

Sealants, Joints, Calkings, Leakage, Waterproofing, Glazing

Initiation/Completion Dates:

Continuing Project

Sponsorship:

Tri-Service
$30K

Project Number(s):

4212413

Project Leader and Contact Information:

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Published Descriptions:

Fed. Specifications (noted under Status) are available from the General Services Administration. "Guide to Joint Sealants for Concrete Structures" is available from American Concrete Institute.

PROJECT TITLE: Performance of Flooring

BACKGROUND:

A major problem in rehabilitation of WWII buildings is resurfacing worn and contaminated concrete floors. Recently, there has been greater interest in new construction, in which there is a need for seamless flooring or thin set terrazzo floors.

RESEARCH OBJECTIVE:

To study factors which determine the performance of flooring materials insofar as they affect the useful life of the finished floor. To investigate the performance characteristics of monolithic flooring systems to relate physical properties to performance. To compare and evaluate the performance of specialized flooring systems and to provide consultative and advisory service on specific flooring problems.

RESEARCH EFFORT:

A system for resurfacing contaminated concrete floors has been developed, based on a combination of grease barriers and mechanical bond, using metal lath or expanded metal. OCE specifications for resinous flooring have been reviewed and data on epoxy and polyester flooring used as a basis for suggested improvements in these specifications.

STATUS OR CONCLUSION:

NBS Report 10357 described research on resurfacing up to October 15, 1970. A final report with recommendations is being prepared. Another NBS report is being prepared on a review of specifications for resinous flooring, pertinent NBS data, and suggestions for improved specifications.

Keywords:

Bond, Floor Coverings, Performance Requirements, Resilient Types, Seamless Types, Specifications, Test Methods, Wear Resistance

Initiation/Completion Dates:

January 1966
Continuing Project

Sponsorship:

Tri-Service
$15K

Project Number(s):

4212488

Project Leader and Contact Information:

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Published Descriptions:

NBS Report No. 10357
Two other reports are in preparation

BUILDING RESEARCH DIVISION
Project Summary FY 1971

ROJECT TITLE: Field and Laboratory Investigation of Floor Assemblies

ACKGROUND:
Standards making bodies such as ASTM and ANSI increasingly recognize the need for performance and consumer standards for floor coverings. This type of standard is the basis for the GUIDE CRITERIA in Operation BREAKTHROUGH. In addition to performance test development, this project includes consultative and advisory service to government agencies, manufacturers, and consumers.

ESEARCH OBJECTIVE:
To develop performance criteria for floor systems. To write performance standards, specifications and codes. To disseminate information about flooring systems in the form of NBS reports and outside publications. To investigate properties of and test methods for floor coverings. To advise government agencies on flooring problems.

RESEARCH EFFORT:
As a result of research on wear and slip resistance testing, recommendations have been made for a cooperative test development program with ASTM Committees F-6 and D-21. One of the floor covering standards for wear testing. Research is continuing on tests for wear and slip resistance.

STATUS OR CONCLUSION:
Two manuscripts for publication as NBS Technical Notes have been written on the basis of work done on this project. One is entitled Durability and Maintenance as Related to the Economics of Finish Floors. The other is called Federal Specifications for Fooor Coverings and is a review of requirements and test methods in these specifications. A Third manuscript in preparation is Performance Tests for Finish Floors--State-of-the-Art.

Keywords:
Carpet, Floor Coverings, Performance Requirements, Resilient Types, Slip Resistance, Specifications Standards, Test Methods, Textile Types, Wear Resistance.

Initiation/Completion Dates:
January 1966
Continuing Project

Sponsorship:
RTS
$20.8K

Project Number(s):
4212273

Project Leader and Contact Information:
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Published Descriptions:
"Durability and Maintenance as Related to the Economics of Finish Floors" and "Federal Specifications for Floor Coverings," both NBS Technical Notes.

PROJECT TITLE: Porcelain Enamel Institute Research Associateship

BACKGROUND: The Porcelain Enamel Institute Research Associateship was established at the National Bureau of Standards in 1937 to develop standard methods of test for the porcelain enamel industry.

RESEARCH OBJECTIVE: The current objectives of the PEI Research Associateship are to develop methods of test for adherence of porcelain enamel to aluminum and direct-on-steel and to evaluate the weather resistance of porcelain enamels.

RESEARCH EFFORT: The electron microscope and electron microprobe were used to study the interface of various porcelain enamel-aluminum systems to gain a better understanding of the reactions taking place between the enamel and the aluminum. The various test methods for evaluating the adherence of conventional porcelain enamel on steel were studied and one was modified to make it applicable to porcelain enamels direct-to-steel. The color and gloss of the enamels exposed 30 years at Washington and 3-years at Gaithersburg, Miami, and Kure Beach were measured.

STATUS OR CONCLUSION: It has been found that different reactions occur at the enamel aluminum interface as the aluminum alloy, cleaning treatment of firing atmosphere are varied. Work is underway to determine which reactions are essential to good adherence. A draft of a method of testing the adherence of porcelain enamel direct-to-steel has been prepared. The weathering specimens were returned to the racks for additional exposure.

Keywords:
Adherence, Aluminum, Porcelain Enamel, Weathering, Direct-on-Steel

Initiation/Completion Dates:
Continuing Project

Sponsorship:
Porcelain Enamel Institute, Nat'l Bureau of Standards
$3.7K

Project Number(s):
9216371
9216208

Project Leader and Contact Information:
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Published Descriptions:
NBS Reports Nos. 10293, 10346, 10382, 10439, Study of Adherence of P/E to Al, Use of Elec. Microscope and Micro Probe, Proc. PEI Forum, An Instrumental Procedure for Evaluating Adherence of Porcelain Enamel Cover Coats Direct-to-Steel

PROJECT TITLE: PBS/NBS Building Systems

BACKGROUND: A graphic format was developed for the Performance Specifications and Contract Documents in 2 volumes and published in January 1971. Subsequently NBS agreed to write a supplement for GSA (PBS) which would make it possible to implement the specification in the procurement of Social Security Administration Payment Centers.

RESEARCH OBJECTIVE: Demonstration of cost, time, and quality benefits to the PBS in using performance specifications to procure building systems for the construction of government buildings.

RESEARCH EFFORT: Supplement is being prepared to "The PBS Specification for Office Buildings" which will make it applicable to Social Security Administration Payment Centers.

STATUS OR CONCLUSION: The supplement will be completed in 1971.

Keywords:
Performance Specification, Building Systems, Typical Office Attributes, Performance Procurement, Systems Building

Initiation/Completion Dates:
1/1/71--10/1/71

Sponsorship:
GSA (PBS)
$66.5K

Project Number(s):
4217416

Project Leader and Contact Information:
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Published Descriptions:
"The PBS Specification for Office Buildings" Jan. 1971, NBS Report No. 10527

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Urban Building Technology

BACKGROUND: In conjunction with Project 4217115, Technological Awareness, conducted research into user needs to identify those human activities in the building process and the building in use which are critical, inadequately supported and susceptible to technological improvement.

RESEARCH OBJECTIVE: This project seeks to develop methods by which information on user needs and material and environmental attributes can be generated, related, and stated for direct use in effecting the planning, programming, design, construction, and use of buildings at all scales from a single building to a region. As such, it continues to produce new concepts specifically in the areas of information systems and user needs.

RESEARCH EFFORT: Using the performance concept, existing documented information and expert opinion develop a process to derive user needs, a process to relate these to attributes of the built environment, and a process to generate performance statements. Using systems and information theory develop models of the existing building processes and building and use information system.

STATUS OR CONCLUSION: Monographs and papers have been written and lectures held to formulate new and innovative ideas. The Bouwcentrum Seminar report is ready to start the publication process.

Keywords:
Building Systems, User Need, Performance, Environmental Attributes

Initiation/Completion Dates:
1/69--continuing

Sponsorship:
NBS
$22.7K

Project Number(s):
4217111

Project Leader and Contact Information:
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Published Descriptions:
Monographs and papers have been written and lectures held to formulate new and innovative ideas. The Bouwcentrum Seminar report is ready to start the publication process.

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Medical Facility Design

BACKGROUND: The National Center for Health Services Research and Development requested that the Building Research Division undertake an evaluative project in investigating current designs of Intermediate Care Nursing Units.

RESEARCH OBJECTIVE: The objective of this research is to develop a model for use in evaluating different type Nursing Units.

RESEARCH EFFORT: An economic analysis will be performed on those cost factors effected by Nursing Unit and Patient Bedroom configuration. In addition to initial construction costs, other contributing costs over the Life Cycle of the structure will be considered. Using the systems approach, those physical aspects of the Nursing Unit having the greatest influence on patient well-being and on staff efficiency, will be identified and a model developed. This model will be used to compare three Nursing Unit Designs.

STATUS OR CONCLUSION: This project will be completed by November 1972. This project will aid hospital designers and future researchers by focusing attention on design considerations normally not considered significant.

Keywords:
Nursing Unit Design, Environmental Attributes, Building Systems, Health Delivery Services

Initiation/Completion Dates:
11/15/70 - 11/15/72

Sponsorship:
National Center for Health Services Research and Development
$45K

Project Number(s):
4217101
4217420

Project Leader and Contact Information:
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Published Descriptions:
None

PROJECT TITLE: Technological Awareness

BACKGROUND: In conjunction with Project 4217111, Urban Building Technology, conducted research into user needs to identify the sociological, economic and technological aspects of buildings in use and the building process which are likely to have future importance and their relationship to those aspects today.

RESEARCH OBJECTIVE: As a part of a continuing effort by the Building Research Division to explore new techniques, the Technical Awareness effort is devoted to forecasting socio/economic/technological resources, products, processes and change for use in building research management and planning. As such it has developed project pacing parameters intended for use in program control, and continues to investigate and report on new forecasting methods and to collect library source information.

RESEARCH EFFORT: To apply forecasting techniques to the use of buildings and spaces from single buildings to communities, and to the building process for the determination of sociological, economic and technological trends.

STATUS OR CONCLUSION: Library collection begun. Informal papers written, Project Pacing Parameters paper completed.

Keywords:

Information Analysis, Technological Forecasting, Sociology, Economics, Technology

Initiation/Completion Dates:
12/69
Continuing

Sponsorship:
NBS
$9K

Project Number(s):
4217115

Project Leader and Contact Information:
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Published Descriptions:

Informal papers have been written

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Precoordinated Building Components

BACKGROUND: Previously promulgated volumtary standards are the basis for this project's work in the "Precoordination of Building Components and Systems" for Committee A62 of the American National Standards Institute, Inc. (ANSI).

RESEARCH OBJECTIVE: The development of a basis for attaining both functional and dimensional compatibility and interchangeability of building components, and establishing guidelines for coordinating building systems is a means to achieve greater economy and utility in buildings.

RESEARCH EFFORT: The Building Research Advisory Board (BRAB) and the National Bureau of Standards (NBS) Building Research Division (BRD) serve as Co-Secretariats of ANSI Committee A62 for a period of one year. BRAB serves as administrative Secretariat responsible for organization, records, and efforts to obtain financial support. BRD is responsible for the preparation of technical material when funded by the ANSI Committee membership.

STATUS OR CONCLUSION:

The project is ongoing.

Keywords:

Standards, Building Systems, Module, Modular Coordination

Initiation/Completion Dates:

1/68

Continuing

Sponsorship:

ANSI, Nat'l Bureau of Stds.
$9.8K

Project Number(s):

4211155

Project Leader and Contact Information:

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Published Descriptions:

Building Science Series No. 32, "Basis for Industrialized Precoordination--Basis for Industrialized Building" was published. ANSI standard A62.8 completed.

PROJECT TITLE: Building Economics

Keywords:
Building Economics
Construction Cost
Management Sciences
Housing Technology

BACKGROUND: The Building Economics Program is supportive to questions of cost and construction alternatives in the presence of scarce resources within the national framework. They support the Building Research Division and other NBS functions as well as other Federal Agencies. Prior to FY '72, the Building Economics Program was largely cost centered. It is presently expanding to include economic evaluations.

Initiation/Completion Dates:
5/69

Continuing

RESEARCH OBJECTIVE:
The skills normally associated with economics, statistics, and management sciences will be employed to evaluate alternative approaches to the solution of building problems. These skills include labor economics, cost analysis, correlation and ratio analysis, econometric modeling, and statistical forecasting.

Sponsorship:
Building Research Division
$49.9K

Project Number(s):
4217112

RESEARCH EFFORT:
Develop cost control and economic analysis capability in support of BRD, Housing & Urban Development, Environmental Protection Agency, and other Federal Agencies. Establish an economic data base of United States construction activity. Compare U.S. (NBS) Building Economics role with other countries' national functions in this area.

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Published Descriptions:
None

STATUS OR CONCLUSION:
To be determined.

PROJECT TITLE: Industrial and Professional Studies

Keywords: Technical information; liaison

BACKGROUND: An apparent gap exists between the availability of technical information and its relation to the building construction process. The gap is widened because of the diversity of the participants in the building construction process and the inadequate methods for the transfer of information.

Initiation/Completion Dates:
July 1, 1970
July 1, 1971

RESEARCH OBJECTIVE: This project has been undertaken to narrow the gap through information interchange, problem definition, and communication between building researchers, decision makers in the building construction process, and the consumer.

Sponsorship:
Building Research Division
$101.5K

Project Number(s):
4212170

RESEARCH EFFORT: The project staff, by developing conferences and symposia, preparing technical information packages, and by implementing new communication techniques, effects the flow of information between various participants in the building construction process. This project is designed to identify problems within the building process and to seek a responsive solution through the application of technical resources and facilities of the Building Research Division. Twelve workshops for federal construction agencies have been held in addition to two national conferences concerned with building problems. Numerous audio visual packages and hard copy information packages, i.e. conference proceedings, brochures, and technical reports, have been prepared and distributed to the building community at large. Because much of the technical information prepared has a direct influence on the consumer's ability to make judgments about buildings and his environment, special emphasis is given to the preparation of consumer publications.

Project Leader and Contact Information:
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Published Descriptions:
None

STATUS OR CONCLUSION:
This project is ongoing.

PROJECT TITLE: Research Information System

BACKGROUND:

Information services presently consist of responses to requests for information on a customized basis. Responses are slow and usually lack a complete description of the document. With an expanding building industry, it is necessary that a system be devised for rapid identification of documents satisfying information needs.

RESEARCH OBJECTIVE:

The technical objectives are to effect the expeditious transfer of information in building research being conducted in various Federal Construction Agencies; to establish and maintain an information system for the dissemination of building research information to decision makers in the building process, including the consumer. The goal is to develop the information system to provide identification of information within 5 to 10 minutes, handling a volume of up to 25 letters per day, and to prepare a publications list for the Building Research Division twice a year.

RESEARCH EFFORT:

The approach is to establish computer aided information system which can provide rapid identification of documents by title and subject matter. A description of all Building Research documents will be stored in the computer. The system will provide rapid retrieval of desired information, identify documents containing it, and provide information about their availability. Descriptive information will include title, author, keyword, where available, price, etc. Retrieval will be made by use of keywords, or other parameters such as author, date of publication, title, etc. The computer will respond to and inquiry by printing out a description of the document satisfying the inquiry.

STATUS OR CONCLUSION:

By the end of FY71, the computer aided information system will be designed. Programs for inquiry and print out will be written. The data base will be defined and entry of Building Research documents into the data base will be underway.

Keywords:

Information
Information System
Building Research
Building Process

Initiation/Completion Dates:

July 1970
Continuing

Sponsorship:

Building Research Division
$4.9K

Project Number(s):

4212179

Project Leader and Contact Information:

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Published Descriptions:

None

PROJECT TITLE: National Conference of States on Building Codes and Standards

BACKGROUND: In 1967, several States met with NBS to discuss their needs relative to improvements in building regulatory systems. A formal organization was approved by the States in 1968 that included NBS as secretariat. Constitution and Bylaws were approved in FY69; Standing Committees were organized during FY70; major working programs were identified and initiated in FY71.

RESEARCH OBJECTIVE: To assist the several States establish statewide modern, performance oriented building regulatory systems that can serve as a basis for the future interstate compatibility of such systems. A principal project in the furtherance of this program is the development of criteria and methodology for assessing the capabilities of organizations to make reliable evaluations of and provide quality assurance for industrialized housing systems.

RESEARCH EFFORT: Assistance was given in devising a means by which a State might accredit organizations involved in evaluating, testing, and inspecting industrialized building products; in the development of ways for the States to effectively participate in standardization activities; in development of a measurement base for State use in the evaluation and acceptance of innovative building systems; in developing personnel training and recognition programs for State, county and local code enforcement officials; in the application of computer sciences to building code administrative practices. To assist the States in their acceptance of building system evaluating organizations, a team representing the several discipline areas of housing systems was established in a coordinated effort to generate the research documents indicating the criteria and methodology for determining the capabilities of such organizations.

STATUS OR CONCLUSION: Although this is a continuing program considerable progress has been made. All States, two territories and the Districit of Columbia are members of NCSBCS, and HUD has endorsed the States' program. Approximately 19 States have passed industrialized housing laws and many more have introduced enabling legislation. NCSBCS, with the assistance of NBS, is devising ways of establishing uniform standards for the evaluation of industrialized building systems, and for determining the capabilities of various organizations to make the evaluations with the goal of achieving an interstate acceptance of the systems.

Keywords:
Regulations, Innovation Evaluations, Codes, Standards, Evaluating Organization Criteria, NCSBCS

Initiation/Completion Dates:
January 1, 1968
Continuing Project

Sponsorship:
Building Research Division
$215.6K

Project Number(s):
4211152
4211161

Project Leader and Contact Information:
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Published Descriptions:
Constitution and Bylaws
Program Outline
Newsletters
Standing Committee Reports
Annual Conference Reports
State Building Code Profile

PROJECT TITLE: Regulatory Standards; Building Standards

BACKGROUND: The Building Research Division has long supported and participated in the development of voluntary and national standards and has supplied administrative and technical assistance, particularly in the field of safety standards. The activity funded here is primarily of an adminitrative nature.

RESEARCH OBJECTIVE: To further the development of product and safety standards related to construction, that represent a national consensus of all those with a substantial interest in the specific area of the standards.

RESEARCH EFFORT: The primary effort has been directed towards participation in the American National Standards Institute's (SNDI) Construction and Safety Technical Advisory Boards, the National Electrical Safety Code (C-2), the National Electrical Code (C-1), and the National Elevator Code (A-17), and other related standards committees. Participation in the activities of the Model Code Standardization Council has also been a factor. Input has been in the form of chairing or acting as secretary of specific standards writing committees and as representatives of NBS on the procedure type committees, such as ANSI Boards.

STATUS OR CONCLUSION: This has been an ongoing NBS assistance program for many years. However, critical reviews of this past activity, coupled with the impact of the growing interest in performance standards, suggest the need for a more selective emphasis in the future on user-oriented safety performance standards for use in building regulatory systems.

Keywords:

Building Standards, Performance Standards, Regulatory Standards, Standards Development

Initiation/Completion Dates:

Continuing Project

Sponsorship:

Building Research Division: $68.8K

Project Number(s):

4211159
4211160

Project Leader and Contact Information:

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Published Descriptions:

This activity results in the publication of recognized national standards by standards generating organizations such as ANSI.

PROJECT TITLE: Thermophysical Properties

BACKGROUND: This project has been and is concerned with the development of measurement methods, apparatus, and reference standards for accurate measurements of the thermal conductivity and heat transfer properties of materials and insulations. At the present time there is need for extension of measurement capability to cover temperature ranges considerably higher and lower than atmospheric temperatures, and to develop and furnish reference standards for use by other laboratories in checking or calibrating their measurements at these temperatures.

RESEARCH OBJECTIVE: To utilize, further develop, and extend, the capability of NBS to assist the nation's laboratories in making accurate measurements of the thermal conductivity and heat transfer properties of insulations, building and other materials, and of elements of buildings.

RESEARCH EFFORT: Major present effort has been directed toward development of a new design of guarded hot-plate apparatus for thermal conductivity measurements, both to replace present aged equipment and to enable needed extension of measurement capability. A basic concept for the new design has been developed, its characteristics and probable accuracy have been extensively examined mathematically and detailed physical design plans have been developed. A paper on the thermal conductivity of natural rubber from 134 to 314°K was prepared for publication, in collaboration with U.S. Army Natick Laboratories.

STATUS OR CONCLUSION: The apparatus mentioned represents a fundamental resource of NBS for leadership in the area of thermal insulation and reliable heat transfer coefficients needed for accurate evaluation of the heating and colling loads of buildings and of measures to conserve energy used for these purposes. Its influence will be wide because of its major use to assist other laboratories in checking or calibrating their own working equipment.

Keywords:
Thermal Conductivity, Heat Transfer Properties, Thermal Insulations, Thermal Conductivity Reference Specimens

Initiation/Completion Dates:
January 1966
Continuing Project

Sponsorship:
Building Research Division
$46.2K

Project Number(s):
4212231

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Published Descriptions:
None

PROJECT TITLE: Heat Flux Measurements

BACKGROUND: There is a need for simple, inexpensive method for measuring heat flux through building elements in place. Heat flow meters have been widely used for this purpose, but it is well known that the composition of the building element and the heat flow meter as well as the method of attachment can introduce significant errors in the accuracy of these meters.

RESEARCH OBJECTIVE: To study methods of measuring heat flux at the interior surfaces of buildings and to develop methods and instrumentation for in-situ measurements applicable in occupied buildings.

RESEARCH EFFORT: The collection of experimental data was completed in FY70. In FY71 the data were prepared for analysis, an analytic solution was developed for calculating errors in the use of heat flow meters and programmed for the computer. A report is being prepared. The Research Associateship was terminated.

STATUS OR CONCLUSION: A publication describing the results of this study will be completed early in FY72. It will be a significant guide in the proper application and use of heat flow meters.

Keywords:

Errors in Heat Flow Meters, Heat Flow Meters, Heat Flux Measurement, Instrumentation

Initiation/Completion Dates:

January 1968
June 1971

Sponsorship:

Dow Chemical Company
Research Associateship
$1.4K

Project Number(s):

4218373

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Published Descriptions:

None

PROJECT TITLE: Total Energy Systems

BACKGROUND: There are recognized shortages of reserves in natural gas and electrical generating capacity in many densely populated areas of the U.S., that will prevail for at least 3-5 years. At the same time the ecological impact of power generation, fuel combustion and other mechanical processes has become of critical importance. Means for more efficiently providing for electrical and heat energy requirements are being explored to alleviate both conditions.

RESEARCH OBJECTIVE: To explore through pilot installations the potential of total energy systems for energy conservation, improved control of noise and air pollution, and increased reliability of service in house and apartment complexes.

RESEARCH EFFORT: A feasibility study for the application of total energy systems to the eleven BREAKTHROUGH sites was submitted to HUD. Four sites were recommended and the Jersey City site was selected for a pilot installation for extensive field studies. A subcontractor was selected by the site planner for the design of the plant. A performance specification for a total energy system was prepared. A preliminary instrumentation plan was developed for the system and pre-installation test procedure for major components was drafted. Specifications for the engine-generators and switchgear were reviewed. Noise surveys and air pollution control requirements were developed for the Jersey City site. A contract was executive with Mechanical Technology Inc. to study acoustic and vibration patterns for the engine-generators both at the manufacturers plant and after installation.

STATUS OR CONCLUSION: The design and installation of the total energy plant at Jersey City will be completed in FY72. Field studies on thermal efficiency, diversity of thermal and electrical loads, technical design of the plant, system reliability, stability of electrical service, air pollution, acoustics and vibration, occupant acceptance, and repairs, maintenance, and costs will be carried our for a year or more, thereafter.

Keywords:

Central Utility Systems,
Energy Utilization,
Energy Use Research,
Total Energy Systems

Initiation/Completion Dates:

1970
Continuing Project

Sponsorship:

HUD
$220.3K

Project Number(s):

4213402

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Published Descriptions:
NBS Report 10313 - "A Performance Specification for a Total Energy Plant at Jersey City BREAKTHROUGH Site."
NBS Report 10402 - "Feasibility Study for Total energy Systems at BREAKTHROUGH Housing Sites

PROJECT TITLE: Long Range Research, Housing

BACKGROUND: A critical review of the Guide Criteria prepared for the HUD BREAKTHROUGH program revealed that the best state-of-the-art procedures for evaluation of building components and systems were heavily based on specification-type requirements, and that research on performance criteria could stimulate innovation in housing and produce housing more responsive to the users needs and welfare.

RESEARCH OBJECTIVE: To plan, conduct, and manage research and technology programs on building materials, components, systems, whole structures, construction techniques, and analytical procedures to improve and expand the Guide Criteria of HUD and the cadre of standards for housing in general.

RESEARCH EFFORT: A comprehensive compendium of research projects on housing, in excess of 100, covering twelve disciplines were developed and submitted to the sponsor. Two page summaries prepared on each project covering background, objective, scope, cost and time to perform, anticipated output, and benefits. A recommended program for support in FY72 was submitted. Five research projects related to structural deflections, fire and smoke hazards in rooms, thermal performance of whole buildings, design criteria for air conditioning, and environmental survey techniques were were initiated at NBS. The Building Research also assumed responsibility for monitoring five Type B contracts between HUD and private research organizations.

STATUS OR CONCLUSION: It is anticipated that the compendium of projects will be updated annually. It could serve as a broad gage plan for converting the Guide Criteria to a performance base over a period of years, and as a means for coordinating housing research in a national scale toward a more cost-effective basis.

Keywords:

Building Research, Housing Research, Housing Technology, Performance Criteria for Housing, Standards for Housing

Initiation/Completion Dates:

May 1970
Continuing Project

Sponsorship:

HUD
$432.5K

Project Number(s):

4213403 & subsidiaries
4218380 4218384
4218381 4218385
4218381 4218387
4218383 4214536

Project Leader and Contact Information:

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Published Descriptions:

Comprehensive Long-Range Research Plan for Housing. (Report to Sponsor)

Two interim reports to sponsor. Studies of Fire Development in a Room: Small Wastebasket Fires and Trash Barrel Fires.

PROJECT TITLE: Conservation in Energy in Buildings

BACKGROUND: The U.S. uses approximately 40% of the worlds annual energy consumption. The increasing demand for energy imposes great pressures on the available supplies. The concepts of conservation and optimism efficiency in energy utilization for buildings is one promising way to prevent the future demand for gas, oil, coal, and electricity from becoming excessive.

RESEARCH OBJECTIVE: Techniques, test development, and innovative approaches for reduction or energy consumption would be investigated. The principal building environmental factors to be studied are heating, cooling, moisture and air circulation control, and illumination as well as construction and design features. About a dozen means have been identified in which research and technical analysis could lead to a significant reduction in energy use in buildings.

RESEARCH EFFORT: An initial planning effort was carried out in FY71. Two circulars were developed for the Office of Consumer Affairs describing ways in which the home owner could reduce his use of fuel and ectrical energy for heating and cooling purposes.

STATUS OR CONCLUSION: The technology for reducing the heating and cooling loads of buildings by 30-50% could be developed in this program.

Keywords:

Building Energy Requirements, Conservation Energy, Efficient Energy Use, Electrical Loads, Energy Reserves, Heating and Air-Conditioning, Insulation of Buildings.

Initiation/Completion Dates:

April 1971

Sponsorship:

Building Research Division
$17.3K

Project Number(s):

4214105

Project Leader and Contact Information:

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Published Descriptions:

Special Publications of the Office of Consumer Affairs:
1. "Seven Ways to Reduce Fuel Consumption in Household Heating through Energy Conservation."
2. "Eleven Ways to Reduce Energy Consumption and Increase Comfort in Household Cooling."

PROJECT TITLE: Design Criteria for Heating and Air Conditioning

BACKGROUND: The requirements for heating and air conditioning as presently given in Operation Breakthrough Guide Criteria, and elsewhere, are based upon available information that is inadequate because of oversimplication. Criteria for indoor temperature is stated in terms of variation allowed at the thermostat location without recognition that the mass of the building affects the indoor thermal conditions, when outdoor conditions are continually changing, causing wide swings in temperature in other parts of the house.

RESEARCH OBJECTIVE: To examine in-depth the need for heating and air conditioning on the basis of hours per year for which a given level of indoor-habitability will not be realized. To utilize available sources of information and to develop criteria for use in housing programs, including physiological aspects, and also for use by designers to compute, select and provide proper indoor environmental conditions.

RESEARCH EFFORT: Four basic tasks must be completed before indoor-habitability indices are to be prepared for A-C criteria: (1) Determination of climatic data in the form of coincident hourly profiles for a typical year and for selected climatic zones, (2) Determination of building data for selected housing systems commonly in use in USA, (3) Determination of a suitable index for the indoor habitability based upon the calculated room temperature and humidity, assumed activity load, clothing condition, and air motion, and (4) A pilot study for generating the tables of indoor-habitability index for two selected cities and two selected type buildings. Work was started in all of these areas and considerable progress was made.

STATUS OR CONCLUSION: Building data analysis on Breakthrough building systems and prototype calculations to predict indoor temperature and humidity for the Jersey City climate are well under way. A survey of physiological indices on the thermal sensation has been completed and several of them were selected for the detailed analysis. A panel of consultants in the related fields was appointed.

Keywords:
Air Conditioning Criteria
Heating Criteria

Initiation/Completion Dates:
Continuing

Sponsorship:
H.U.D.
39.1 K

Project Number(s):
4218384

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Published Descriptions:

None

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Heating and Cooling Loads

BACKGROUND: Basic data is needed to improve NBS computer programs for estimating heating and cooling loads of buildings. In particular, data are lacking in the areas of conversion of heat gain to load, air infiltration and solar radiation effects.

RESEARCH OBJECTIVE: To develop a user oriented computer program for calculation of heating and cooling load and for estimation of energy usage based upon the dynamic thermal performance of a building.

RESEARCH EFFORT: Building response factors and experimental thermal response factors for wall heat conduction were developed. These factors were derived by a Wiener Filter Technique and a concept known as the equivalent thermal mass system. Several methods to determine the convolution type coefficients from the time series data on building heat gain and heat transmission data were studied.

STATUS OR CONCLUSION: For determining response factors the equivalent thermal mass system appears superior to the Wiener Filter Technique. Results of these studies were presented at the 5th Temperature Symposium and at the NBS-ASHRAE-APEC Symposium.

Keywords:
Energy Calculations
Computer Applications
Response Factors

Initiation/Completion Dates:
July 1969
continuing

Sponsorship:
Building Research Div.
25.7 K

Project Number(s):
4214239 (2239)

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Published Descriptions:
At printer: Proceedings of the First Symposium on the Use of Computers for Environmental Engineering Related to Buildings

Proceedings of the 5th Temperature Symposium

PROJECT TITLE: Thermal Environment

BACKGROUND: To provide a satisfactory indoor thermal environment in a building requires simultaneous consideration of the weather patterns for that location, the design of the building shell, the mechanical and electrical equipment within the building and the nature of the sensory response of humans. Research effort requires a multi-discipline approach.

RESEARCH OBJECTIVE: (1) To explore the relationships of the methods of physiology the human sensory response to indoor thermal environment. (2) To physically define and measure thermal environments for computer treatment. (3) To develop new methods and instruments for (1) and (2). (4) To develop thermal environmental criteria or standards of performance for the indoor environment of a building. (5) To provide experimental facilities for (1) to (5) at NBS.

RESEARCH EFFORT: (1) The present state of knowledge on Human Sensory Environment was reviewed. Some progress in computer treatment of physiological and engineering data (Fangers Comfort Equation) has been made, but the science of human thermal comfort is still largely empirical. Conceptual foundations need review, and new objective measurements to replace subjective data need to be developed. (2) The present state of the art in the physical evaluation of thermal environment was also reviewed. It does not permit a description of the human thermal environment with reference to both time and indoor space. Both in-house study and a small contract with a research medical doctor were implemented.

STATUS OR CONCLUSION: This project is the beginning of a BRD effort to simultaneous involve building science and the medical and physiological professions. With an objective foundation in modern temperature physiology to be generated in a new research unit, and with new methods and instruments for the physical evaluation of thermal environments, it is believed that an objective performance criteria could be developed.

Keywords:

Thermal Comfort, Temperature and Humidity Measurement, Human Physiology

Initiation/Completion Dates:

July 1970
continuing

Sponsorship:

Building Research Division
8.4 K

Project Number(s):
4214103

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Published Descriptions:

None.

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Thermal Performance of Whole Buildings

BACKGROUND: The main thrust of this effort is to determine by analytical and experimental means the heat transfer and thermal behavior and response of the fabric of buildings, in order to improve the quality of the indoor environment with the minimum expenditure of energy for heating and cooling.

RESEARCH OBJECTIVE: The first phase of the project is to develop mathematical solutions for determining the dynamic thermal performances of walls, roof, floors and windows. The second phase is to design, construct and instrument an experimental building for the investigation of its thermal performance under conditions of simulated dynamic changes in the outdoor air temperature.

RESEARCH EFFORT: A computer program known as NBSLD was developed for predicting thermal performance. A series of tests were completed on an experimental masonry building with considerable data gathered on several parameters such as fenestration location of insulation and indoor mass. In all tests measured values of temperature and heat transfer were compared with corresponding values predicted by the computer program using the response factor method. The design and instrumentation is proceeding for the tests of a full scale factory produced living unit, in the high-bay environmental laboratory. This unit is a 4-bedroom town house of lightweight construction. A comprehensive report of the work to date was drafted.

STATUS OR CONCLUSION: It was found that the combination of mass in the walls and roof facing the interior with insulation placed on the outside surfaces of the building was very effective in reducing and controlling the variation of the indoor air temperature. This desired effect was predicted by the Response Factor Method. In addition comparing cases of no insulation, insulation inside, and insulation outside, the temperature differences from floor to ceiling on the walls and of the indoor air were lowest when the insulation was placed on the outside of the building. The Response Factor computer program was experimentally validated for predicting the daily indoor air temperature profile as it is influenced by known outdoor temperature conditions and the effect of the mass and thermal resistance of the building.

Keywords:
Thermal Performance
Building Environment
Thermal Environment

Initiation/Completion Dates:
July 1969
continuing

Sponsorship:
Building Research Div.
H.U.D.
126.2 K

Project Number(s):
4214136
4218383

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Published Descriptions:

None

PROJECT TITLE: Air Distribution Studies

BACKGROUND: The Office of Civil Defense is concerned with the distribution of air due to natural ventilation, within survival shelters, as a means to provide ventilation without the use of power. Previous studies have been made of air distribution within shelters but these have not been definitive because of the difficulty of quantifying the velocity of air at low speeds.

RESEARCH OBJECTIVE: The primary objective is to study flow patterns of air produced by natural convection using a modeling approach. Variables such as ventilation ports and one or two simulated occupants are included. In order to carry this study out by a modeling approach, development of an experimental technique is required.

RESEARCH EFFORT: Previous results of NBS work were utilized to study air motion in single room shelters. A scale model of a shelter was made to study the parameters for dynamic similarity between the model and a full scale shelter. It was found that the use of high temperature water as the fluid in the model would produce results in the model which could then be used to predict air velocities and temperatures in the full scale case.

STATUS OR CONCLUSION: This project has been completed. A draft of the final report was completed. It is concluded that the water model approach is a useful technique for evaluation of natural convection problems. Air flow patterns of selected conditions were observed and recorded. Results show that the air is generally stratified except near the room boundaries.

Keywords:
Natural Convection
Modeling Natural Convection
Free Convection

Initiation/Completion Dates:
July 1969
June 1971

Sponsorship:
O.C.D.
D.O.D.
19.2 K

Project Number(s):
4214441

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Published Descriptions:
In preparation

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Heat Transfer of Underground Piping Systems

BACKGROUND: The present state-of-the-art does not allow preparation of engineering guideline for optimum designs of either uninsulated chilled water or heated pipes underground. Of particular interest is the effect of moisture in the ground on heat transfer rate.

RESEARCH OBJECTIVE: Develop a computer simulation of pipe, earth and ambient system for numerical analysis of the problem. Measure the performance of two or more underground pipe distribution systems during a period of one year. Analyze, correlate and compare analytic data and measurement data for final use in Engr. Design.

RESEARCH EFFORT: Experimental and theoretical studies on the heat gain of underground chilled water systems were undertaken. Experimental observations were made on a double pipe system connecting Pentagon building and FOB 2. A heated test pipe was installed in the ground at NBS to observe the time decay of the pipe heat loss. These observations were incorporated into a theoretical analysis so that the pipe heat transfer can be effectively and accurately predicted. Based upon this prediction method, criteria for the pipe insulation will be developed.

STATUS OR CONCLUSION: The chilled water system studies have been completed. The observed heat gain of the Pentagon system was well simulated by the calculation method developed for a double pipe heat transfer system. Insulation criteria for the chilled water system has been developed with respect to pipe sizes, depth, location and earth properties. The heated test pipe observations are being continued.

Keywords:
Underground Pipes
Heated Pipes
Chilled Water Systems

Initiation/Completion Dates:
July, 1969
continuing

Sponsorship:
Tri-Services
G.S.A.
V.A.
A.E.C.
$54.5K

Project Number(s):
4214443
4214444
4214448
4214449

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Published Descriptions:
Draft report on chilled water systems

PROJECT TITLE: Air, Moisture and Heat Transfer

BACKGROUND: Simultaneous transfer of air, moisture, and heat within a building and through building elements is of major importance for evaluating thermal loads, energy requirements, and building damage and deterioration caused by condensation. Design data, particularly in the area of air infiltration as a function wind velocity changes is needed.

RESEARCH OBJECTIVE: To improve, by experimentation, the technical information concerned with leakages of air into and out of buildings as this relates to the requirements for heating, cooling, humidifying and dehumidifying of air inside buildings.

RESEARCH EFFORT: Several mathematical modeling approaches to define and simulate the motion of air in a room as a result of natural ventilation were completed. Also the spectrum characteristics of wind and differential pressures across a building's external walls were studied to attempt a correlation of the dynamic characteristics of wind with air leakage. Two office modules of Building 226; one windward and another leeward, were instrumented for measurement of temperature, differential pressures and air leakage and data was gathered for correlation with simultaneous observations of outdoor wind data.

STATUS OR CONCLUSION: The dynamic air leakage data of two office modules was analyzed. The actual leakage was considerably greater than that predicted by the convection flow equations for flow through cracks using the observed mean differential pressure. A report discussing these findings was drafted.

Keywords:
Air Infiltration
Moisture Migration
Air Leakage

Initiation/Completion Dates:
July 1970
continuing

Sponsorship:
Building Research Div.
31.3 K

Project Number(s):
4214102

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Published Descriptions:
Draft papers and reports on this broad subject were prepared.

PROJECT TITLE: Aerobic Waste Treatment

BACKGROUND:

Because of the high cost of municipal waste treatment systems and because package plants are incapable of serving widely spaced residences, there is need for advanced technology to develop waste treatment systems for individual residences. The individual systems should produce an effluent at least equal to that of large secondary treatment systems, and possibly water of sufficient quality to be reused for sanitary flush systems, washing, plant watering, and even drinking.

RESEARCH OBJECTIVE:

To study methods of measuring performance of residential waste treatment systems; to develop apparatus, instrumentation and techniques for evaluation of aerobic waste systems, and to examine installation and operational problems of such systems.

RESEARCH EFFORT:

A research laboratory for waste water treatment was established in the Building Research Division. Instrumentation for standard procedures for measurement of biological oxygen demand, chemical oxygen demand, nitrite, phosphate, suspended solids, and microbiology were assembled. A study of the operational variables which require monitoring and control in a residential waste treatment system was carried out. Some work was done in the development of a standard sewage. A plan for future research was developed and an interim report prepared.

STATUS OR CONCLUSION:

This result should lead to standard test procedures for residential aerobic waste treatment systems and to field evaluation of prototype systems in actual use.

Keywords:

Aerobic Waste Treatment;
Innovative Plumbing Systems;
Performance Criteria;
Plumbing Research;

Initiation/Completion Dates:

January 1971
Continuing Project

Sponsorship:

Fairchild-Hiller Corp.
Research Associateship
$7.5K

Project Number(s):

4214370

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Published Descriptions:

None

PROJECT TITLE: Indoor Air Pollution

BACKGROUND: Control of air pollution has achieved a high national priority. Comparatively little attention, however, has been devoted to the indoor atmosphere where people spend most of their time. There are a number of important questions relating to indoor pollution which have not been answered such as: What protection does a building offer to outdoor pollution? What pollutants are found indoors and what is their source?

RESEARCH OBJECTIVE: To determine the type and composition of indoor air pollutants, both particulate and gaseous, and to develop methods for measuring them under laboratory and field conditions.

RESEARCH EFFORT: A simple mathematical model of an air conditioned building was developed to study the nature of the movement of externally and internally generated pollution. To use this model to predict the effect of change in indoor pollutant levels it is necessary to know the relative amounts of fresh air and recirculated air. A sulfur hexaflouride tracer technique is under investigation as a means of measuring these quantities.

Measurements of indoor and outdoor dust levels in the BRD building were made using paper tape high volume samplers. It is planned to augment these measurements by obtaining a record of diurnal variations using a particle counter to determine the number and size of particles.

Ammonium sulfate was identified as a constituent of indoor and outdoor dust at Gaithersburg, and lead was a consistent trace element.

STATUS OR CONCLUSION: Most pollutant measurements at present are of particulates. Equipment needs have been identified for extending measurement capability to trace amounts of gaseous pollutants.

Ammonium sulfate is not regarded as a health hazard, but its presence indoors indicates that a significant amount of indoor dust comes from outside.

The sulfur hexaflouride tracer technique has promise as a possible means of measuring large flow rates, which are now measured with shaped nozzles, orifices or Pitot static tube.

Keywords:

Air Pollution
Air Cleaning Systems

Initiation/Completion Dates:

July 1970
continuing

Sponsorship:

Building Research Div.
50.4 K

Project Number(s):

4214101

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Published Descriptions:

1. NBS Report 10591
2. Chap. IX, NBS Report on Air Pollution
3. ASHRAE Paper: Discussion on In/Out Pollution for Air Cond. Bldgs. by Hunt, Cadoff and Powell

PROJECT TITLE: Insulating Glass

BACKGROUND: Several government agencies are users of insulated glass units. Some of these units have a history of failure when subjected to weather conditions over a long time period. It would be highly desirable to have an accelerated method of testing these units to predict their future reliability.

RESEARCH OBJECTIVE: To develop a correlation between the reliability of insulated glass test units which are subjected to actual weathering conditions, and the reliability of similar units subjected to accelerated tests. To compare and analyze existing accelerated test methods and provide information for preparation of an ASTM test method.

RESEARCH EFFORT: A round-robin test series on specially constructed insulated glass units will be conducted. NBS will perform a reliability study on units under actual weathering conditions; six other participants will perform reliability studies on similar units subjected to various accelerated weathering tests. NBS will analyze round-robin test data, attempting to develop a correlation between reliabilities as determined in the actual and accelerated weathering tests, respectively. With these results in hand, accelerated test methods will be reviewed and analyzed, and recommendations for an optimal, standardized testing procedure will be developed. A Research Associate program with ASTM will be established.

STATUS OR CONCLUSION: Most of the preliminary accelerated testing by the other participants has been completed. NBS has accumulated approximately 2 months of one year of testing program of units under actual weathering conditions.

Keywords:
Glass
Thermal Glass
Insulating Glass

Initiation/Completion Dates:
April 1971
continuing

Sponsorship:
GSA (PBS)
2.0 K

Project Number(s):
42 14452

Project Leader and Contact Information:
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Published Descriptions:
"Needed: A Standard for Insulating Glass," Architectural Record, February 1971.

PROJECT TITLE: Standards for Refrigeration Components

BACKGROUND: The U. S. Army is a user of a large number of refrigeration and heating systems. There exists a continuing question of whether the performance of a particular system under development meets the needs required by the military for field service.

RESEARCH OBJECTIVE: This project is to evaluate and determine the performance of specially designed refrigerating and heating systems and related subsystems and components, under consideration by the U. S. Army Natick Lab, for suitability and standardization for military field use. In many instances test methods and procedures must be devised to measure system performance.

RESEARCH EFFORT: The effort involves a large series of performance tests on such prototype equipment as gasoline engine-driven refrigeration units, their components and other energy sources and the thermal performance tests and evaluations covering a range of sizes of insulated enclosures. Lab tests are done under a variety of environmental conditions to establish optimum application or redesign requirements.

STATUS OR CONCLUSION: Thermal and air leakage performance tests were completed on a redesigned refrigerated trailer. Thermal, air leakage and operational tests were completed on two ISO standard containers with self-contained refrigerating units. Shock drop tests were performed on two refrigerating units. Horsepower and capacity tests of 3 refrigeration compressors were completed. Drafts of reports of all the results, which are not already published, are under preparation.

Keywords:
Refrigeration
Test Methods
Performance Criteria
Standards

Initiation/Completion Dates:
July 1970
continuing

Sponsorship:
DOD
Army
104.5 K

Project Number(s):

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Published Descriptions:
NBS Report Numbers
10390, 10546 and 10547

PROJECT TITLE: Performance Characteristics of Plumbing Systems

BACKGROUND:

Research in plumbing in the U.S. has progressed very slowly for more than a decade because there was inadequate support for such programs by the industry and by government at various levels, and because the plumbing industry tended to base its practice on codes that were essentially static. Considerably more innovation occurred in European plumbing practice than in the U.S. The level of research activity at NBS was very low during this period.

RESEARCH OBJECTIVE:

To conduct laboratory and field studies and research on the hydraulics and pneumatics of plumbing systems, to develop performance tests and criteria for such systems, to determine plumbing load data having statistical validity, and to improve the climate for innovation and the technical performance base for plumbing codes and plumbing requirements.

RESEARCH EFFORT:

The new plumbing research facility was about 90% completed during the fiscal year, and plans and authorization completed for the remaining 10%. A publication describing the hydraulic performance evaluation of a single-stack drainage system was completed and submitted for editorial review. Another research report on the laboratory performance of a series of reduced-size venting systems was about 50% complete. Monitoring of two PL480 projects in plumbing was carried out, and consultative and advisory services of a technical nature were provided for three ANSI standards committees, an ASPE code committee, and a plumbing code review for NAPHCC. Cooperated with the New York State Urban Development Corp. in developing a field test procedure for plumbing systems in high-rise buildings.

STATUS OR CONCLUSION:

It is expected that the new plumbing research facility will be activated by Sept. 1. Studies will be undertaken immediately to extend the scope of the small-vent concept and to explore the performance of vacuum drainage, plastic pipe plumbing, and aerobic waste systems.

Keywords:

Criteria for plumbing
Hydraulic performance
Plumbing research
Plumbing systems
Waste disposal systems

Initiation/Completion Dates:

July 1966
Continuing project

Sponsorship:

Building Research Div.
$145.3K

Project Number(s):

4212135

Project Leader and Contact Information:

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Published Descriptions:

Laboratory Evaluation of the Hydraulic Performance of a Sovent Single-Stack Sanitary Drain-Waste-Vent System (in editorial review). Exhibit and slide presentation on "Performance in Plumbing. (1970 ASPE Convention).

PROJECT TITLE: Electrical Systems in Buildings

BACKGROUND: There is a need for studying electrical systems in buildings to gain greater economy in installation through industrialization and prefabrication; greater economy and effectiveness in artificial lighting; integration of electrical systems with other building components, and a reduction in energy use and peak demands by improved electrical load management.

RESEARCH OBJECTIVE: To develop performance criteria and test methods for electrical systems in buildings that will promote innovation in design, facilitate industrialization of building, greater economy and effectiveness in energy use, and reduction in peak demands.

RESEARCH EFFORT:
Activity in this project in FY 71 was very limited due to staff limitations.

STATUS OR CONCLUSION: This research should stimulate innovation and integration of electrical systems into industrialized building construction and provide guidance for more effective electric load management in buildings.

Keywords:
Electrical distribution,
Electrical demand,
Electrical load diversity
Artificial illumination
Performance criteria
Multifamily housing
Industrialized systems

Initiation/Completion Dates:
July 1969
Continuing

Sponsorship:
Building Research Division
$1.9K

Project Number(s):
421 4141

Project Leader and Contact Information:
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Published Descriptions:

None

PROJECT TITLE: Building Acoustics

BACKGROUND: The program involves investigation of (a) building acoustics parameters; e.g., sound transmission of wall partitions and floor/ceiling assemblies, flanking paths for noise in building systems, etc., (b) impact noise problems in building and coordination of field and laboratory measurements of sound transmission through building walls, floors and ceilings.

RESEARCH OBJECTIVE: The objectives include studies of the effects of noise, the development of improved methods of measuring the generation and transmission of noise, the development of correlations between noise exposure and subjective response, the development of performance criteria to enable standards setting in the noise area, and the development of improved noise control techniques and design information.

RESEARCH EFFORT: A psycho-acoustic room was installed and tested for compliance with the acoustic specifications. A program has been initiated, utilizing this room, to study the subjective response of people to complex noise.

A contract was let to undertake a joint NBS/industry program on the acoustical properties of doors and windows. Since these openings constitute the major paths for noise of exterior origin to enter buildings, the resultant data will be very valuable to architects and builders in improving the "sound-proofing" of homes, schools, hospitals, and offices. This program will be continued during FY 1972, at which time it should result in a very significant publication.

Two identical walls were tested for sound transmission loss. One was installed in an ASTM Standard Laboratory facility and the other was installed in a smaller test facility having the dimensions of a typical residence room. One was tested using the ASTM standardized laboratory measurement method and the other with ASTM field method. Agreement of the field and laboratory measurements were obtained by modification of the existing method for field measurements. Additionally, methods for multiplexing microphone signals and temporal averaging were investigated.

STATUS OR CONCLUSION:

Reports on these three areas will be published in Fiscal Year 72.

Keywords:

Sound Transmission, Noise Control, Noise Sources, Acoustic Criteria, Subjective Response.

Initiation/Completion Dates:
July 1966
Continuing project.

Sponsorship:
Building Research Division
$132.3K

Project Number(s):

4212266

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Published Descriptions:
None

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Noise Control in Building

BACKGROUND: The initial objectives were to develop design, construction, evaluation and performance standards for the control of noise in buildings. These broad objectives were redefined to center on the control of noise associated with heating, ventilating and air conditioning systems.

RESEARCH OBJECTIVE: Preparation of a detailed report to serve as a guide for writing acoustical performance specifications, or noise control standards for heating, ventilating and air conditioning systems. The purpose of the specifications, or standards, is to insure that the noise generated by heating, ventilating and air conditioning system does not adversely influence the acoustical environment to the extent that it interferes with the building users' performance of activities.

RESEARCH EFFORT: The general approach is to plan and execute studies and laboratory programs to develop information and techniques that will lead to the establishment of practical acoustical test methods and noise control standards. A comprehensive literature search was conducted to develop a background in, and become familiar with, the noise sources and noise control methods associated with heating, ventilating and air conditioning systems.

STATUS OR CONCLUSION: The report was completed and is presently in editorial review.

Keywords:

Noise Control, Noise Abatement, Heating, Ventilating, Air-Conditioning Systems

Initiation/Completion Dates:

July 1968
June 1971

Sponsorship:

Tri-Service
$15.2K

Project Number(s):

4214434

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Published Descriptions:

In editorial review

BUILDING RESEARCH DIVISION
Project Summary FY 1971

PROJECT TITLE: Truck Tire Noise Investigation

BACKGROUND: Public concern about rising noise levels is increasingly evident. Vehicular traffic (primarily trucks) is a significant contributor to the overall noise level. If a truck has a reasonably good muffler and is in a good state of repair, tire noise will predominate at speeds of 50 mph or greater. The development of a comprehensive physical data base will provide the groundwork for understanding the generation mechanisms by which tires produce noise.

RESEARCH OBJECTIVE: To identify and quantify the physical parameters which affect the noise generation characteristics of truck tires and to develop an information base that may lead to standardized tire-noise testing procedures and to highway noise reduction criteria, standards, and regulations.

RESEARCH EFFORT: An extensive data base is being established through a field study which is investigating the influence of tread design, tread depth (wear), pavement surface, vehicle speed, and loading on the noise generated by truck tires. In addition, the effect of tire location was studied including an evaluation of the reduction in overall noise that can be expected by mounting "noisy" tires inboard of "quieter" tires on a dual axle. The data base, when completed, will include: (1) peak A-weighted sound levels, (2) one-third octave band spectral data, and (3) directionality information in the form of equal sound level contour plots for vehicles equipped with various types of tires.

STATUS OR CONCLUSION: Approximately 60% of the field testing is completed. Peak A-weighted sound level data is complete for all tires tested thus far. These preliminary results have immediate implications for state lawmakers and enforcement agencies. The inventory of truck tire noise levels, which supplement the existing data on total vehicle noise, in conjunction with the developed testing procedures, can serve as a basis for meaningful vehicle noise regulations.

Keywords:
Acoustics
Noise Measurement
Noise (Sound)
Tire Noise
Transportation Noise
Trucks
Truck Tires

Initiation/Completion Dates:
May 1, 1970
Continuing Project

Sponsorship:
Department of Transportation

Office of Noise Abatement
$194.8

Project Number(s):
4214406

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Published Descriptions:
NBS Reports No. 10380, 10502 and 10567

PROJECT TITLE: Illumination

BACKGROUND: The quantity and quality of illumination required for an agreeable luminous environment must be based on visual performance. The identification and quantification of the parameters must be obtained through psychophysical techniques, followed by development of physical field measurement techniques.

RESEARCH OBJECTIVE: The basic visual performance data used in determination of levels of illumination required for different visual tasks is the Reference Visibility Function. A re-examination and determination of physical correlates for the Standard Visibility Function is currently underway. Glare is an important qualitative aspect of illumination that effects visual performance and/or results in an "uncomfortable" visual environment. An improved description and quantification of glare sources are needed.

RESEARCH EFFORT: The current Reference Visibility Function is defined as the contrast required to "just" perceive a luminous disk against a surround of lower luminance. This function obtained at the absolute threshold level is then extrapolated to suprathreshold (disks are clearly seen, but at different levels of clarity) by simple multiples. Is this simple extrapolation justified? A study has been started to investigate the visibility function at suprathreshold levels. Literature survey and a preliminary design of an experiment to investigate glare has been initiated.

STATUS OR CONCLUSION: Tentative results obtained with sinusoidal gratings indicate that the Reference Visibility Function at suprathreshold levels is not the monotonically decreasing function obtained at absolute threshold levels. Squarewave grating are currently being investigated. The results of the experiments conducted thus far indicate that a comprehensive study to cover a wider range of the variables effecting visibility of gratings is desirable.

Keywords:

Illumination, Reference Visibility Function, Glare

Initiation/Completion Dates:

January 1971
Continuing Project

Sponsorship:

Building Research Division

Project Number(s):

4214120

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Published Descriptions:

None

PROJECT TITLE: Visual Environment

BACKGROUND: Project formerly known as Colorimetry, dealt with all aspects of color. Scope now extended to include higher-level psychophysical and psychological aspects such as pleasantness (design applications) and noticeability (safety applications).

RESEARCH OBJECTIVE: In the long run, to understand all aspects of visual functioning other than simple sensitivity to level of illumination. Through FY 1971, to gather the facts of color and color-difference perception, account for the facts by theories and mathematical models, and apply the facts and models to help solve problems in esthetics, safety, information transmission (signs and signals), and color tolerances for products used in buildings and elsewhere.

RESEARCH EFFORT: Research on the perception of color differences and on the generation of models to predict the empirical facts has been carried out (for many years) in collaboration with the Committee on Uniform Color Scales of the Optical Society of America. On the applied end, knowledge of color appearance, color blindness characteristics, and color-difference perception has been put to use in recommendations for safety color codes (traffic signs and signals, marking hazardous equipment), the color coding of subway lines and of rocket launchers, specifications of school art supply colors, and the design of a "false color" rendering of X-ray photographs for detection of concealed weapons.

STATUS OR CONCLUSION: Work of the Optical Society of America (OSA) Committee on Uniform Color Scales is nearing a conclusion. One of its outputs is expected to be an improved formula for perceived color difference. It is anticipated that this formula may be adopted by some standardizing bodies, and, in any case, will be used widely in industry for the specification of color tolerances and degree of color contrast.

Keywords:

Color, Color Difference, Appearance, Esthetics, Conspicuity

Initiation/Completion Dates:

January 1971
Continuing project.

Sponsorship:

Building Research Division
$26.2K

Project Number(s):

4214138

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Published Descriptions:

Journal of the Optical Society of America, Vol. 60, 1970: July, p. 951-958 (Howett); October, p. 1407-1409 (Yonemura).

PROJECT TITLE: Environmental Protection Agency--Report to the President and the Congress

BACKGROUND: The Environmental Protection Agency is required under Title IV, the "Noise Pollution and Abatement Act of 1970," to study and report (to the Congress and the President) on noise and its effect on the public health and welfare.

RESEARCH OBJECTIVE: Preparation of four principal parts of a Report on the Problem of Noise Pollution: (1) Measurement, criteria, and control standards; (2) Effects of sonic boom and other impulsive noise on property; (3) Social impact of noise sources; (4) Economic impact of noise sources.

RESEARCH EFFORT: A professional staff of about six persons working mostly on a part-time basis, has (a) identified sources of accurately reported information on the noise problem, (b) selected pertinent information and useful data from the sources, (c) assembled the information and data into a written form suitable for a non-technical user.

STATUS OR CONCLUSION: Final drafts of four parts of the summary section of the Report are completed. Our effort on the comprehensive report, still in preliminary draft form, is scheduled for completion shortly after October 15, 1971. An Interim Report was completed and delivered to the sponsor in June 1971.

Keywords:

Noise Measurement, Sonic Boom Effects, Noise Effects on Society, Noise Effects on the Economy.

Initiation/Completion Dates:

April 1971.
Approximately Oct. 1971.

Sponsorship:

Environmental Protection Agency (EPA)
$21.3K

Project Number(s):

4214451

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Published Descriptions:

Interim report to the sponsor completed; final report in preparation.

PROJECT TITLE: Subjective Evaluation in Environmental Surveys

BACKGROUND: A critical aspect of the BREAKTHROUGH program concerns the subjective assessment of the environment by the user. At present, the "user's needs" are often indicated by the builders and architects responsible for design, and, in many instances, are implied instead of being expressly stated. In order to effectively determine the "user's needs," it is necessary to employ appropriate methods of data collection.

RESEARCH OBJECTIVE: This project is designed to specify a set of procedures that are appropriate for evaluating the home environment from the standpoint of the user.

RESEARCH EFFORT: Conducted a comprehensive literature survey of sources associated with user responses in environmental surveys. More than 200 relevant articles and approximately 50 books were identified from the fields of sociology, psychology, environmental and urban design, public opinion research, and consumer and marketing research. During the coming year these sources will be studied and critically evaluated. Contact will be made with architects and designers for inputs in connection with the critical evaluation. Following the critical evaluation, new surveying techniques will be developed and pilot tests of these techniques will be conducted.

STATUS OR CONCLUSION: A report on methods currently available for measuring user responses will be completed in the fall. A second report will provide a critical evaluation of the methods contained in the first report.

Keywords:

Evaluation, Housing, User Response, User Needs, Survey Methodology, Environmental Surveys

Initiation/Completion Dates:
October 1, 1970
Continuing Project

Sponsorship:

Department of Housing and Urban Development
4218385

Project Number(s):
4218385

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Published Descriptions:

None

PROJECT TITLE: Project FEEDBACK

BACKGROUND: Housing performance evalution based upon physical performance in use and its appraisal by consumers is particulary important when innovative systems and performance criteria are involved. The Department of Housing and Urban Development's Operation BREAKTHROUGH industrialized housing program provides a unique opportunity to evaluate innovative housing in use and to validate established performance criteria levels.

RESEARCH OBJECTIVE: To validate and upgrade critical HUD Guide Criteria by evaluating Operation BREAKTHROUGH Phase II Housing in use:

- Establish performance of Phase II housing;
- Determine user/consumer acceptance; and,
- Correlate performance evaluations (physical, consumer, producer, costs).

RESEARCH EFFORT: Operation BREAKTHROUGH Phase II. Such Phase II system types, innovations, and occupants will be sampled representatively over a 4-year period. Four classes of data and information will be generated, evaluated and synthesized:

- Physical performance of systems and relevant environment;
- Consumer acceptance, satisfaction, aggravation, etc.;
- Producer experience with Guide Criteria; and,
- System and component costs.

Primary research modes will be included, programmed actions, special problem research and emergency response actions.

STATUS OR CONCLUSION: Program plans and research design are virtually complete. Major field research and evaluation operations will be conducted during FY 72 and FY 73.

These data and evaluations will be relevant to:

- Guide Criteria development;
- Performance evaluation research;
- Housing system design modification and improvement; and,
- Code development.

Keywords:

Housing Research, Performance Evaluation, Consumer Acceptance, Industrialized Housing, Operation BREAKTHROUGH

Initiation/Completion Dates:

October 1970--
continuing project

Sponsorship:

BRD/HUD
BRD $17.4K
HUD $59.6K

Project Number(s):

4217119
4213404

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Published Descriptions:

None


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