

1676-460,00-90H

NBSIR 74-618

**US/UK Joint Complementary Research  
Program in Building, (Wind Loads, Water  
Supply, Fire Detection),  
July 1973-June 1974**

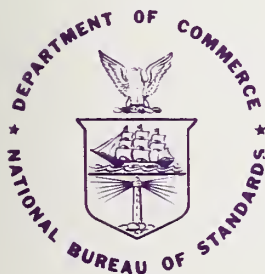
---

C. C. Raley  
I. A. Benjamin  
L. S. Galwin  
R. D. Marshall

Institute for Applied Technology  
National Bureau of Standards  
Washington, D. C. 20234

October 1974

Final



---

U.S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS



NBSIR 74-618

**US/UK JOINT COMPLEMENTARY RESEARCH  
PROGRAM IN BUILDING, (WIND LOADS, WATER  
SUPPLY, FIRE DETECTION),  
JULY 1973-JUNE 1974**

---

C. C. Raley  
I. A. Benjamin  
L. S. Galwin  
R. D. Marshall

Institute for Applied Technology  
National Bureau of Standards  
Washington, D. C. 20234

October 1974

Final

**U. S. DEPARTMENT OF COMMERCE, Rogers C.B. Morton, Secretary**  
**NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director**



TABLE of CONTENTS

Background . . . . .	1
Wind Loads on Buildings . . . . .	3
Design of Water Supply and Drainage Installations in Buildings . . . . .	7
Fire Detection in Buildings . . . . .	10
Appendices . . . . .	12



Building Research Establishment  
Department of the Environment  
Garston, Watford, WD2 7JR  
UNITED KINGDOM

Institute for Applied Technology  
National Bureau of Standards  
Washington, D. C. 20234  
UNITED STATES

### BACKGROUND

C. C. RALEY  
Coordinator of International Affairs  
Center for Building Technology  
Institute for Applied Technology

On July 21, 1971, a memorandum of understanding was signed by Mr. Peter E. WALKER, Secretary of State, Department of the Environment, United Kingdom, and Mr. George ROMNEY, Secretary of the Department of Housing and Urban Development, United States. It outlined a program for cooperation in matters concerning urban environment including housing and building technology. The goal of this program is to achieve the maximum exchange of documents and visits, and it can be extended to such other activities as expert consultations, long-term exchanges of professionals, and joint research projects. In carrying out this understanding, the two national coordinators may invite participation from other agencies, organizations or private groups within their respective countries.

The Building Research Establishment (BRE) and the Institute for Applied Technology (IAT), have long been acquainted with each other's work and have had a great deal of interaction. During the March 1971 visit of Dr. F. Karl WILLENBROCK, Director of IAT, with Mr. James B. DICK, Director of BRE, the subject of a joint program was discussed. With the signing of the memorandum of understanding, impetus was given to establishing a formal cooperative program between BRE and IAT's Center for Building Technology (CBT). As a result, CBT developed a number of research proposals which later were reduced to three specific projects by Mr. DICK and Dr. James R. WRIGHT, then Director of CBT.

On July 6, 1972, Mr. Harry E. THOMPSON, as Deputy Director, CBT, met with Mr. DICK in England to discuss formal implementation of the three projects under the title of the "Joint Complementary Research Program." This resulted in the preparation of three documents of agreement; the first two on wind and hydraulics were signed by BRE on July 27 and countersigned by CBT on August 3, 1972. The third, on fire detection, was signed on September 1 and countersigned on September 13, 1972. Copies of these documents are attached as appendices to this report.

During the second year of the program, fire studies were removed from CBT and consolidated in the Programmatic Center for Fire Research, IAT. Later, Dr. WRIGHT was appointed Deputy Director of IAT, from which position he continues to monitor US progress. Because of these changes the BRE/CBT program has evolved into a BRE/IAT program encompassing both Fire Research and Building Technology.

At the end of the program's second year, consideration was being given to establishing two additional projects, Heat Pumps, and Lighting Standards for Office Buildings, to coincide with the conclusion of the original projects.

Activities for the prior year are outlined in NBSIR 74-497, "US/UK Joint Complementary Research Program in Buildings (Wind Loads, Water Supply, Fire Detection), July 1972 - June 1973." The current status of the projects is outlined in the remainder of this report.



## WIND LOADS on BUILDINGS

R. D. MARSHALL  
Structures Section  
Center for Building Technology  
Institute for Applied Technology

### INTRODUCTION

The Center for Building Technology of the National Bureau of Standards and the Building Research Establishment have for the past two years conducted a joint complementary program of research into the effects of wind on buildings.

The primary goals of the program were the timely exchange of experimental data obtained in both full-scale and wind tunnel model studies, mutual assistance in the development of measuring techniques and methods of data analysis, and the exchange of certain pieces of research equipment. These goals remain essentially unchanged although both sides have initiated wind loads research projects which were unforeseen at the time this joint complementary program was conceived. These include the Post Office Tower Study on the part of BRE and the AID Philippine Study by NBS. It is anticipated that all the original program objectives will be completed by the end of Fiscal Year 1975.

### PROGRESS DURING FISCAL YEAR 1974

The principal items of accomplishment under this project during Fiscal Year 1974 are listed below, followed by a discussion of each item in the order of tabulation:

- (a) Visit to BRE by Dr. R. D. MARSHALL - December 1973;
- (b) Installation of electro-optical deflection system in Post Office Tower and subsequent system modifications;
- (c) Transmittal of Post Office Tower structural details to NBS;
- (d) Development of ambient pressure probe by NBS and wind tunnel and field tests by BRE;
- (e) Installation of eaves overhang on Aylesbury test house;
- (f) Continuing exchanges of information on instrumentation and test results, both wind tunnel model and full scale;
- (g) Visit to NBS by Mr. J. R. MAYNE - July 1974.

In line with the items for future collaboration identified at the end of Fiscal Year 1973, Dr. MARSHALL visited the BRE laboratories and field test sites in December 1973. During the course of this visit, discussions were held with members of the BRE staff concerning full-scale measurement techniques employed at the Aylesbury Test site and the analysis of pressure data and environmental wind data. Of particular interest was the new boundary-layer wind tunnel facility (then in the final stages of assembly) and the associated data acquisition and processing system. Discussions were also held with staff members concerning

probable and acceptable wind speeds in pedestrian areas and the response of tall structures to wind forces. A general talk was given to the BRE staff at the conclusion of this visit which covered ongoing wind loads research at NBS and two new projects sponsored by the Maritime Administration (MARAD) and the Agency for International Development (AID).

An important objective of the visit described above was the transfer of the NBS electro-optical deflection system to BRE and its subsequent installation in the Post Office Tower in London to monitor both mean and fluctuating deflections. The tower consists of a circular hollow shaft of reinforced concrete. The shaft extends 177 m above ground level and has an average diameter of approximately 7 m. Details of the structure and results of previous wind pressure and strain measurements are presented in BRE report CP 30/73. The tracking telescope was installed in the cable shaft on the fifth floor and the light source was installed at the level of the middle aerial gallery, approximately 105 m above the telescope. The system calibration was based on displacements of  $\pm 5$  cm at 91 m on the test range at NBS. Subsequent attempts to calibrate the system in place pointed up certain problems with both the light source and the circuitry which compensates for variations in light intensity at the objective lens of the telescope. Working with the second prototype at the NBS, a new light source was developed and used successfully with a revised compensation circuit. These modifications are currently being made to the system installed in the Post Office Tower. It is recognized that rotation of the telescope support may be significant and measurements of tilt at the level of the fifth floor will be attempted using 'electro-levels' which are on hand at BRE. In addition to measuring displacement and rotation, wind speed and direction at the top of the tower and accelerations at various levels will be recorded. Recording will be accomplished by means of a PEMCO 14-track analog recorder. Data will be converted to digital form for analysis. Mr. Peter SPARKS of BRE is in charge of the Post Office Tower study.

While full-scale measurements are being carried out on the tower, work is progressing on a theoretical model of the structural response. In line with this, structural details of the tower have been transmitted to NBS for use with existing computer programs. Wind loads will be based on the measured wind characteristics and pressure coefficients determined during the course of the study reported in CP 37/71 and CP 30/73.

Attempts to establish a suitable reference pressure in full-scale studies have always involved a considerable amount of uncertainty. The scheme used at Aylesbury consists of a chamber just below ground level to which all pressure transducers are referenced. The chamber is covered by a flat plate mounted flush with the ground surface and is vented to the atmosphere by a 2.5 cm hole in the plate. The chamber is located in an area which is usually free from wake effects caused by buildings and other obstructions. Reference pressures for the NBS studies in Montana, on the other hand, were obtained by means of a pitot-static probe mounted on a vane near the level of the anemometer. Two disadvantages of the pitot-static probe are clogging of the pressure ports with rainwater and a negative bias due to overshoot of the vane and the vertical component of velocity fluctuations. A probe with shielded pressure ports and omnidirectional characteristics was developed at NBS for use in field studies currently being carried out in the Philippines. Subsequent tests carried out by BRE staff members in one of the wind tunnels at the University of Bristol indicated that this probe registers ambient pressure for pitch angles as high as  $+ 10$  degrees. A comparison has been made with the ground surface technique at Aylesbury and the



three installations in the Philippines will provide a test of the probe's performance characteristics under rather difficult environmental conditions.

The experimental building at Aylesbury was modified in January 1974 by adding a 76 cm eaves overhang to the middle third of the roof. This overhang is identical to that on the first test house at the Great Falls, Montana, field site. Pressure measurements were taken for this configuration through the month of April and these records will be analyzed during the autumn of 1974. Test results for the Great Falls site, both full-scale and wind tunnel model, have been analyzed and published.

In addition to the specific items described above, exchanges continued through Fiscal Year 1974 on matters concerned with instrumentation, test results and methods of analysis. At the suggestion of BRE staff members, contact was made with Clark Masts Ltd. and three portable telescope masts were purchased for use in the MARAD project on port and harbor facilities. A pneumatically actuated mast was also purchased for use with the NBS Structures van. Consideration is being given by BRE to the use of flush-diaphragm transducers developed for the NBS/AID project in the Philippines. Results of performance tests on these transducers are currently being evaluated by BRE. Exchanges of full-scale test results continued through the year, the usefulness of these exchanges being enhanced by previous agreement as to methods of analysis and format for presentation of results.

Immediately following the International Symposium on Full-Scale Measurements on Tall Buildings and Other Structures, held at the University of Western Ontario, June 23-29, Mr. John MAYNE of BRE visited NBS. Accomplishments over the past year and plans for the forthcoming year were discussed. It was agreed that the exchanges carried out over this past year were highly beneficial to both sides and that all of the objectives identified for the year had been achieved.

#### PLANS FOR FISCAL YEAR 1975

Based on the exchanges accomplished over the past two years and the mutual agreement that June 1975 should be the target date for completion of this project, the following items have been identified as technical exchange activities for Fiscal Year 1975:

- (1) Certain analog tapes will be exchanged to verify analog to digital conversion and subsequent data processing.
- (2) Standard averaging times will be adopted for the calculation of mean reference speeds, and pressure coefficients will be based on the associated mean dynamic pressures. This will assist with comparisons of gust factors.

#### AREAS FOR FUTURE COLLABORATION

As indicated above, the Post Office Tower Study and the AID Philippine Study were initiated during the course of this joint complementary program. These studies will continue to yield vital information on the effects of wind on buildings and other structures after the completion of this current joint program. Much of this information will influence future revisions of the British Standard Code of Practice and American National Standard A58.1. It is recommended, therefore, that the benefits of this program to each side be critically

evaluated at the end of Fiscal Year 1975 and that consideration be given to its extension or, possibly, the initiation of a new joint program. It is hoped that both Dr. EATON and Mr. SPARKS will visit NBS during Spring 1975 for these discussions with NBS staff. It may be advantageous to consider separate program areas, one dealing with high-rise buildings and another limited to low-rise buildings and environmental wind effects.

DESIGN of WATER SUPPLY and DRAINAGE  
INSTALLATIONS in BUILDINGS

L. S. GALOWIN  
Chief  
Building Service Systems Section  
Center for Building Technology  
Institute for Applied Technology

INTRODUCTION

For a number of years the National Bureau of Standards and the Building Research Establishment have both been active in research into water supply and drainage in buildings. In 1972 it was proposed that a complementary research project should be started in this field and this was formalized by an agreement between the Directors of the two establishments. The detailed program of work proposed on this project was covered in a further document signed by Mr. P. R. ACHENBACH (NBS), Dr. J. E. SNELL (NBS) and Mr. A. F. E. WISE (BRE) in May 1972. Three distinct items of work were outlined in this document. These items (each discussed below) are:-

- A. Hydraulic design of drainage installations in buildings
- B. Design loads for plumbing systems
- C. Vacuum drainage systems

A. HYDRAULIC DESIGN OF DRAINAGE INSTALLATIONS IN BUILDINGS

PROGRESS DURING FISCAL YEAR 1974

A presently used criterion for satisfactory performance of gravity drainage systems is that water seals in the fixture traps are maintained under specified hydraulic loadings. The drain-waste-vent (DWV) system function requires that the sizing, spacing and configurations of drainage and vent piping must handle expected loads producing upsetting pressure fluctuations.

In the United States, two laboratory test projects were to be utilized, one at NBS, the full-scale typical town house; and the other at the Stevens Institute of Technology, a ten-story system. These test installations were designed with vent sizing in accordance with selected US criteria. Performance measurements are planned to be compared with those predicted by the BRE method utilizing a computer program. The required inputs for the computer program include data on (1) the pneumatic resistance of loaded stack branch fittings; (2) the discharge rates of the fixtures; (3) the hydraulic load pattern assumed. The joint effort by NBS and BRE requires particular data on fixture discharge rates obtained by NBS and data on fitting resistances obtained by BRE.

Detailed drawings and descriptions of two drain-waste-vent systems to be tested by NBS were sent to BRE and comments were provided on those aspects of design that BRE work shows are important.



BRE has developed a design procedure for the prediction of the maximum suction and has produced a computer program for the calculations involved. A description of this procedure and a flow chart for the program has been received by NBS. This design procedure relies on examination of the air flow through the drainage stacks and, if the resistance to air flow is known at each discharging branch, the air pressures in the stack are calculated. BRE will measure the resistance values for 100 mm branch fittings of US design. Some of these fittings have already arrived at BRE and, once NBS has provided information on flow rates from water closets of US manufacture, tests will be carried out with the appropriate branch flows. Information on the test methods, test equipment and detailed results obtained with UK fittings have been sent to NBS.

The design procedure above has been shown to give satisfactory agreement with the pressures obtained in various UK buildings. However, the application of this design procedure is limited since the procedure is based on certain simplified assumptions. An alternative design procedure of wider application has been developed in which the resistances of the components are derived from tests on a complete system. This design procedure also departs from the assumption of continuous flow and is based on a study of intermittent discharges in existing UK buildings. A description of this design procedure, together with a flow chart for the computer program, has been sent to NBS.

Results from tests on the innovative high-rise DWV system at Stevens Institute of Technology, monitored by NBS, were transmitted to BRE. Satisfactory performance of the system with reduced-size vents (RSV) above the lowest floor level was obtained. Certain configurations are necessary for the lowest level.

Preliminary tests on a five-story drainage stack explored correlations, under representative dynamic conditions, between traditional design criteria (air flow and pressure excursion) and the basic performance criteria (trap-seal retention, blow back and water rise). The results of the experimental design compare continuous and transient flow phenomena utilizing different hydraulic profiles for the same volume of water discharge, that is 'square-wave' versus 'sine-wave' loads.

NBS showed an interest in UK WCs which use a nine litre flush. Six examples of widely used UK WCs had been sent to NBS together with a dual flush pan which can be made to flush only 4.5 litres. Some of these WCs have been provided with a BRE measured discharge characteristic and it is hoped that a comparison can be made with corresponding NBS measurements.

#### PLANS FOR FISCAL YEAR 1975

NBS is to complete and transmit to BRE progress reports on drainage stack dynamics. These tests are to provide correlation between trap-seal reduction/blow back and trap-arm pressure with transient loading. These include trials comparing NBS and BRE experimental techniques for measuring pressure drop across loaded fittings with comparison of effects of transient versus continuous flows. The comparisons of results using BRE instrumentation in the same test runs in relation to the measurement of resistance across loaded stack-branch junction fittings are planned. These values are required to adapt the BRE computer program for DWV sizing for American systems. Such tests provide insight into the performance characteristics involved in development of computational methods for predicting performance.

Discharge characteristics for WCs of US manufacture will be provided by NBS and using these, BRE will determine resistance values for the 100 mm US fittings. These results are required for modification of the old BRE design procedure for US practice. Resistance values for use in the new procedure can only be obtained in full-scale trials and it is assumed these will be obtained from trials on the NBS test rig. Both BRE and NBS will use this data in the computer programs to predict single stack performance. Comparison between measured and computed performance characteristics for the tests conducted at Stevens Institute and NBS are to be made for single stack systems. The NBS reports concerning the Stevens Institute test results are expected to be transmitted to BRE by November 1974.

## B. DESIGN LOADS FOR PLUMBING SYSTEMS

### PROGRESS DURING FISCAL YEAR 1974

BRE organized a Seminar on water demand in buildings within CIB Commission W62 which included three papers on BRE work and one on work sponsored by BRE. Work is going on towards the production of two more papers on this subject by BRE. One covers the estimation of water demand and storage requirements for university laboratories and the other more general paper on the design of water supply systems for buildings.

### PLANS FOR FISCAL YEAR 1975

The two BRE papers on the above subjects will be completed and passed to NBS and also will be presented at the next meeting of CIB Commission W62.

## C. VACUUM DRAINAGE SYSTEM

There has been no exchange of information on this topic and BRE does not expect any further developments in the UK during the period of the complementary research project.

### PLANS FOR PROJECT TERMINATION

The three subjects of this complementary research project will continue at different levels of activity in NBS and BRE. The NBS effort on hydraulic design of drainage installations has been building up during the project. BRE effort, on the other hand, is now declining in this field since a British Code of Practice has been drafted covering UK conditions. However, work on other aspects of the topic is being expanded and work on design loads for plumbing systems will continue at BRE beyond the end of the project.

In view of the above, it is appropriate to concentrate on completion of the work proposals detailed in the agreement between Messrs. ACHENBACH, SNELL and WISE. The objectives should be largely achieved by the time the project is due to end. It would then be desirable to identify the aspects of work in these fields which offer most advantage for future complementary research projects.



## FIRE DETECTION in BUILDINGS

I. A. BENJAMIN  
Associate Director for Fire Technology  
Programmatic Center for Fire Research  
Institute for Applied Technology

### INTRODUCTION

The complementary research program on fire detection between NBS and BRE was initiated in July 1972. Work at NBS is on the development of criteria and test methods for establishing the level of performance of smoke detectors for use in residential occupancies, the ultimate aim being to reduce the toll of death and injury from fire in the home. The work in BRE is primarily concerned with reducing the false alarm rate in fire detectors.

There are about 10 false alarms for every real fire and about one-quarter of these are believed due to the environmental conditions present at the detector head. It is possible to reduce the false alarms rate by reducing the detector sensitivity but fires then tend to be larger when detected. The optimum detector operating conditions can only be reached if more is known about environmental factors which may cause false alarms. BRE is embarking on a substantial long-term program of measuring relevant ambient conditions in buildings in the absence of fire in order to obtain systematic data on the conditions which give rise to false alarms. This requires constructing special sensing equipment and data logging equipment which BRE has under development.

Out of this work have arisen the two objectives of the complementary program:

- (1) To share knowledge about fire detection by exchange of information through visitation of personnel between the facilities, correspondence exchange, and
- (2) To participate jointly in a program to develop information on environmental conditions conducive to false alarms.

### ACCOMPLISHMENTS FOR FISCAL YEAR 1974

The principal accomplishments under this program during Fiscal Year 1974 are listed below:

- (1) Visit to BRE by Mr. I. A. BENJAMIN of NBS in October 1973. The complementary fire detection research program was discussed with BRE counterparts at the Fire Research Station.
- (2) Mail exchange of information. BRE supplied NBS with a draft copy of the proposed European Standard on smoke detectors. In turn, NBS sent BRE copies of technical memoranda relating to residential smoke detector work at NBS.
- (3) Visit by Mr. R. BRIGHT and Mr. R. BUKOWSKI of NBS to BRE in April 1974. The principal contact at BRE was Mr. BURRY. Many items relating to smoke detection were discussed including the status of the NBS development of performance criteria and specifications for residential smoke detectors and BRE's development of the ambient conditions monitoring packages.



## PLANS FOR FISCAL YEAR 1975

The program plans for Fiscal Year 1975 envision a continuation of the original program objectives of exchange of visits and information as well as NBS participation in developing data on ambient environmental conditions conducive to false alarms. This latter objective is contingent upon receipt by NBS of one or more ambient conditions monitoring packages. When the monitoring packages are received at NBS, appropriate locations will be selected, the packages installed, and data collection begun. The data are to be reduced and analyzed at BRE.

## RECOMMENDED MODIFICATIONS IN PROGRAM SCOPE

The objectives should be left unchanged. Under the second objective add the following milestones:

- |     |   |                          |
|-----|---|--------------------------|
| (1) | Monitoring packages assembled and checked out by BRE                  | November 1974            |
| (2) | Packages received by NBS  | December 1974            |
| (3) | Packages installed, checked and in operation in U.S.                  | January 1975             |
| (4) | Interim review of acquired data in Fiscal Year 1975<br>Program report | July 1975                |
| (5) | Completion of one year in place                                       | January 1976             |
| (6) | Transmittal of data to BRE  | Continuous during period |
| (7) | Report on final data reduction by BRE                                 | April 1976               |

## PLANS FOR PROGRAM TERMINATION

A program termination date of one year after receipt and placement of the ambient conditions monitoring packages seems in order. This would allow accumulation of one year of data from US locations to be supplied to BRE for analysis. The packages could remain in place after the year is over and additional data collected or the packages could be moved to another location and data collected for another year. In either case, the data could be supplied to BRE for reduction, but this data reduction by BRE for NBS could continue outside the mechanism of the complementary program.

When the original program approaches its termination, BRE and the NBS Programmatic Center for Fire Research can investigate the possibility of expanding the complementary program efforts in fire through CIB and thus bring more than two countries into the program. It may be appropriate, at that time, to include other fire research efforts in addition to fire detection.

APPENDICES

Memorandum of Understanding . . . . .	i
Wind Loads on Buildings Agreement . . . . .	ii
Design of Water Supply and Drainage Installations in Buildings Agreement . . . . .	iv
Fire Detection in Buildings Agreement . . . . .	vi
Endorsement . . . . .	viii

## MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding between the Department of Housing and Urban Development (HUD) of the United States and the Department of the Environment of the United Kingdom outlines a program for cooperation in matters concerning the urban environment falling within their competence, such as physical planning, urban management, housing and building, technology, and community development. The goal of this program is to achieve the maximum exchange of experience in specified subject areas. The program will include an organized exchange of documents and visits and may be extended as mutually agreed to such other activities as expert consultations, the long-term exchange of scholars and professionals, or joint research projects. In carrying out specific activities under this Memorandum of Understanding, the Department of Housing and Urban Development may invite participation by other U.S. departments and agencies or private groups; the Department of the Environment may similarly invite participation by other agencies and organizations in the United Kingdom.

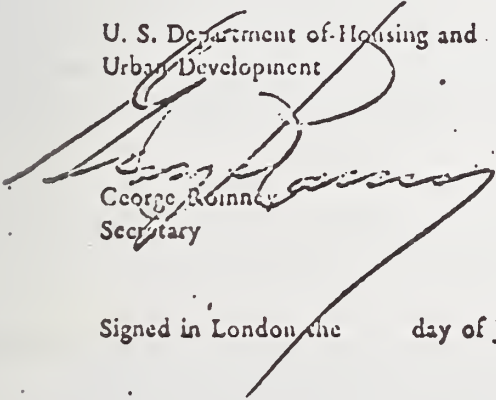
The general subject areas for initial cooperation may include, but are not limited to, community and regional planning, construction technology, housing management and financing, citizen participation, program evaluation techniques, policy and legislation. These general subject areas may be expanded, added to, or modified by mutual agreement. Further discussions and exchange of correspondence will further define these general areas, and it is specifically envisaged that joint projects of mutual interest, when proposed by either side and accepted by the other, will be undertaken.

The program will begin with the early exchange of views on the establishment of a mutually acceptable program. This first exchange will further define the interests of each country in the other's specific programs and legislation. Visits of experts and teams may be made thereafter without regard to reciprocity at the option of the visiting agency and subject to arrangements with the host agency. Each side will bear its own travel and related living costs under the program.

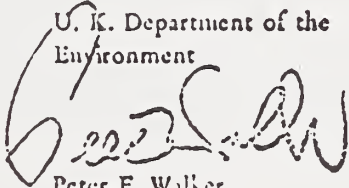
It is understood that the pace of the program outlined in this Memorandum of Understanding will be contingent upon the availability of funds and other resources on each side.

This Memorandum of Understanding will become effective when signed by authorized representatives of the Department of Housing and Urban Development of the United States and the Department of the Environment of the United Kingdom and will remain in effect for five years. It may be renewed by mutual agreement, and may be terminated at any time by either party on thirty days' notice.

U. S. Department of Housing and  
Urban Development

  
George Roinner  
Secretary

U. K. Department of the  
Environment

  
Peter E. Walker  
Secretary of State

Signed in London the            day of July 1971.

**BUILDING RESEARCH ESTABLISHMENT (DOE/UK)  
AND CENTER FOR BUILDING TECHNOLOGY (NBS/USA)  
JOINT COMPLEMENTARY RESEARCH PROGRAM(ME) \***

**Project title:** Wind Loads on Buildings

**Project outline:** Revised criteria and standards are required for the design of buildings for wind loading. Research in this area is also essential for the proper installation of materials, the cost of construction and protection of the user. Research will be carried out on buildings in low density and built-up areas. Both laboratories have worked on this subject and have common research objectives. In each case the basic requirement is to establish the validity of using wind tunnel studies for design by comparing wind tunnel data with measurements made on full-scale structures. Each laboratory has several full-scale experiments on hand and the scope for joint research is substantial.

Also, both laboratories have acquired or developed unique instrumentation and equipment for their research work. Sharing usage and experience in development of instrumentation and equipment will expedite results and provide more comprehensive research to both countries.

**Working arrangements:** Directors have agreed to nominate officers who will be responsible for developing and progressing the joint programme. This project will be initiated on 1 August 1972 and will be reviewed on 30 June of each year by each Director for continuation or revision of the project outline. It is expected that the project will be completed by July 1975. The manpower, funding and equipment necessary to conduct the complementary research will be provided by each organisation. Exchange visits by personnel are essential and will be encouraged.

---

\* Initiated in response to the Memorandum of Understanding between Mr George Romney, Secretary US Department of Housing and Urban Development and Mr Peter Walker, Secretary of State, UK Department of the Environment dated July 1971



LIAISON OFFICERS NOMINATED BY DIRECTORS:

Dr J B Menzies  
(Building Research Establishment)

Dr Richard Marshall  
(Center for Building Technology)

.....  
*J B Menzies*  
.....

DIRECTOR

BUILDING RESEARCH  
ESTABLISHMENT

Dated.....*27<sup>th</sup> July 1972*.....

.....  
*James R. Wright*  
.....

DIRECTOR

CENTER FOR BUILDING  
TECHNOLOGY

Dated.....*August 3, 1972*.....

**BUILDING RESEARCH ESTABLISHMENT (DOE/UK)  
AND CENTER FOR BUILDING TECHNOLOGY (NBS/USA)  
JOINT COMPLEMENTARY RESEARCH PROGRAM(ME) \***

**Project title: Design of Water Supply and Drainage Installations in Buildings**

**Project outline:** A sound method is required for the design of conventional drainage systems in buildings. Both laboratories have worked on this subject to provide theory and data. BRE has found it possible to develop and gain application in the UK of a simplified system - single stack drainage - that is now beginning to be applied in the USA. A computer program is available at BRE for sizing drainage and vent stacks on traditional as well as single stack systems.

Its adaptation for American conditions requires the determination of some further data on certain parameters by laboratory research. Once this information is available the computer program would be modified and applied to design installations for trials in USA, for example, on Operation BREAKTHROUGH sites.

The CBT has been developing empirical methods for determining the air demands of plumbing systems based on laboratory studies of reduced sized venting systems. This work will provide a basis for review and analysis of the BRE computer program.

The CBT has a new laboratory and field data collection facility offering the means for collecting many of the data needed in this program for fixtures, fittings and for drainage systems up to seven storeys in height. A ten-storey facility sponsored by HUD is currently under construction, this is designed to test the performance of alternative drainage system designs.

Both for water supply and drainage, sound theoretical framework and adequate field data are necessary for the specification of design loads and water storage requirements. Current procedures rely on a fixture unit method which has been

---

\* Initiated in response to the Memorandum of Understanding between Mr George Romney, Secretary US Department of Housing and Urban Development and Mr Peter Walker, Secretary of State, UK Department of the Environment dated July 1971

useful but is not rigorous and is known to lead to overdesign. Some research on the subject has been done in recent years to provide a sounder basis and this needs developing and extending for general use. BRE is organising an international seminar (on behalf of CIB Commission 62) in September 1972 to review this subject and discuss research needs. It is intended that this seminar will provide a basis for identifying priorities for collaborative research into this problem between BRE and CBT. It is expected that even though US and UK use quite different fittings and fixtures, a common theoretical framework may emerge for demand estimation and also for field test and measurement technology.

Working arrangements: Directors have agreed to nominate officers who will be responsible for developing and progressing the joint programme. This project will be initiated on 1 August 1972 and will be reviewed on 30 June of each year by each Director for continuation or revision of the project outline. It is expected that the project will be completed by July 1975. The manpower, funding and equipment necessary to conduct the complementary research will be provided by each organisation. Exchange visits by personnel are essential and will be encouraged.

LIAISON OFFICERS NOMINATED BY DIRECTORS:

Mr C J D Webster  
(Building Research Establishment)

Dr J E Snell  
(Center for Building Technology)

*J. B. Dick*

*James R. Wright*

DIRECTOR

DIRECTOR

BUILDING RESEARCH  
ESTABLISHMENT

CENTER FOR BUILDING  
TECHNOLOGY

Dated... 27<sup>th</sup> July 1972.....

Dated ... August 3, 1972 .....

**BUILDING RESEARCH ESTABLISHMENT (DOE/UK)  
AND CENTER FOR BUILDING TECHNOLOGY (NBS/USA)  
JOINT COMPLEMENTARY RESEARCH PROGRAM(ME)\***

**Project title: Fire Detection in Buildings**

**Project outline:** The development of criteria and test methods for establishing the level of performance of fire detectors is required for various types of building. Each year lives are lost and there is much property damage because of the lack of good fire detection systems in buildings. Both laboratories have worked in this area and have some common research objectives.

The work at CBT has been particularly concerned with detectors for use in the home. This CBT work is directed to detecting smoke and products of combustion from fires at a lower level of intensity than would be required for industrial systems.

The BRE has been concerned with defining how sensitive a detector system must be in order to do its job, and also how insensitive it must be to prevent too many false alarms occurring. As part of the programme BRE is embarking on a substantial long term programme of measuring relevant ambient conditions in buildings in the absence of fire in order to obtain systematic information on the conditions which give rise to false alarms. This requires the development of special sensing and data logging equipment.

Co-operation between laboratories will be achieved by close communication specifically on the CBT work on detectors for domestic use and the BRE work on the monitoring of ambient conditions since both countries have a deep interest in both programmes.

---

\* Initiated in response to the Memorandum of Understanding between Mr George Romney, Secretary, US Department of Housing and Urban Development and Mr Peter Walker, Secretary of State, UK Department of the Environment dated July 1971.



Working arrangements: Directors have agreed to nominate officers who will be responsible for developing and progressing the joint programme. This project will be initiated on 1 September 1972 and will be reviewed on 30 June of each year by each Director for continuation or revision of the project outline. It is expected that the project will be completed by July 1975. The manpower, funding and equipment necessary to conduct the complementary research will be provided by each organisation. Exchange visits by personnel are essential and will be encouraged.

LIAISON OFFICERS NOMINATED BY DIRECTORS:

Mr P E Burry  
(Building Research Establishment)

Mr Irwin Benjamin  
(Center for Building Technology)

..... *P. E. Burry* .....

..... *James R. Wight* .....

DIRECTOR

DIRECTOR

BUILDING RESEARCH  
ESTABLISHMENT

CENTER FOR BUILDING  
TECHNOLOGY

Dated. . . . . *1<sup>st</sup> September 1972* . . . . .

Dated. *SEPTEMBER 13, 1972* . . . . .

ENDORSEMENT

BUILDING RESEARCH ESTABLISHMENT (DOE/UK)  
INSTITUTE FOR APPLIED TECHNOLOGY (NBS/USA)  
JOINT COMPLEMENTARY RESEARCH PROGRAM(ME)\*

Project title: Design of Water Supply and Drainage Installations  
in Buildings

Dr. L. S. Galowin is herein nominated to act as the Liaison Officer for the Institute for Applied Technology in conjunction with the above mentioned Program. Mr. C. J. D. Webster will continue to serve in his capacity as Liaison Officer in the Building Research Establishment as outlined in the original agreement.

..... *J. B. Dick* .....

J. B. DICK

DIRECTOR

BUILDING RESEARCH  
ESTABLISHMENT

Dated... *29<sup>th</sup> July* ... *1974* ...

..... *James R. Wright* .....

J. R. WRIGHT

DEPUTY DIRECTOR

INSTITUTE FOR APPLIED  
TECHNOLOGY

Dated... *July 18* ... *1974* ...

---

\* Initiated in response to the Memorandum of Understanding between Mr. George Romney, Secretary, US Department of Housing and Urban Development, and Mr. Peter Walker, Secretary of State, UK Department of the Environment, dated July 1971.

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 74-618	2. Gov't Accession No.	3. Recipient's Accession No.
4. TITLE AND SUBTITLE US/UK Joint Complementary Research Program in Building, (Wind Loads, Water Supply, Fire Detection), July 1973 - June 1974		5. Publication Date October 1974	6. Performing Organization Code
7. AUTHOR(S) C. C. Raley, I. A. Benjamin, L. S. Galowin, R. D. Marshall		8. Performing Organ. Report No. NBSIR 74-618	
9. PERFORMING ORGANIZATION NAME AND ADDRESS NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, D.C. 20234		10. Project/Task/Work Unit No. 4633104	11. Contract/Grant No.
12. Sponsoring Organization Name and Complete Address (Street, City, State, ZIP) same as item 9.		13. Type of Report & Period Covered July 1973- Final June 1974	14. Sponsoring Agency Code
15. SUPPLEMENTARY NOTES			
16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.) <p>This is a status report of the progress achieved under the "Joint Complementary Research Program" sponsored by the Building Research Establishment (UK) and the Institute for Applied Technology (US), during the period July 1973 through June 1974. The program includes three projects: Wind Loads on Buildings, Design of Water Supply and Drainage Installations in Buildings, and Fire Detection in Buildings, each of which is discussed in the report.</p>			
17. KEY WORDS (six to twelve entries, alphabetical order, capitalize only the first letter of the first key word unless a proper name; separated by semicolons) Building technology; cooperation; fire safety; hydraulics; wind loads.			
18. AVAILABILITY <input checked="" type="checkbox"/> Unlimited <input type="checkbox"/> For Official Distribution. Do Not Release to NTIS <input type="checkbox"/> Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13 <input checked="" type="checkbox"/> Order From National Technical Information Service (NTIS) Springfield, Virginia 22151	19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED	21. NO. OF PAGES 23	
		20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED	22. Price \$3.25





