



National Research Council Conseil national de recherches
Canada Canada

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SPECIAL INTEREST GROUP FOR THE DYNAMIC EVALUATION OF ROOFING SYSTEMS

I. Summary

On Nov. 16, 1994, members of the roofing community met at the National Research Council of Canada and agreed that a means of evaluating the effect of dynamic loads on roofing systems was necessary. Thus, a Special Interest Group on Dynamic Evaluation of Roofing Systems (SIGDERS) will be created. SIGDERS will combine the efforts of the National Research Council of Canada with those of the Roofing Industry to build a facility and develop a protocol to evaluate the performance of roofing systems under dynamic loads.

The aim of SIGDERS is to carry out generic, pre-competitive research of benefit to all its members. Although the exact deliverables will be discussed at the committee level, it is understood that actual dynamic loads failures should be duplicated and that any design manual or technical guide be in written for the general public. The members will include manufacturers of roofing systems, membranes and fasteners, building owners and managers, and contractor associations.

An annual fee of \$6000 (Canadian funds) for two years will be required to participate in SIGDERS. This R&D expenditure as well as all other related expenditures are tax deductible. At the end of SIGDERS, any remaining money will divided equally and returned to its members. Members of SIGDERS will automatically be eligible as members of the Task Groups.

II. Introduction

Current standards for roof attachment systems are developed based on static loading conditions. Existing test procedures for roof certification, such as the well-known FM (Factory Mutual) and UL (Underwriters Laboratories), are also limited to static loading conditions. Unfortunately, field wind conditions are dynamic. Thus, it is necessary to evaluate systems under dynamic loads.

The Institute for Research in Construction has initiated a project, “*Dynamic Evaluation of Roof Attachment Systems*”, that aims to evaluate mechanically attached roof systems under dynamic wind loading. Test procedures and computer models will be developed. The analyses and the test results will be combined to produce a **Design Manual** for the

roofing industry. The numerical model and the wind-tunnel-derived, unsteady wind loads may also be utilized to produce a more detailed computer based design tool to complement the Design Manual. There are five major tasks: (1) Material characterization (2) Construction of a dynamic test facility for the evaluation of roofing systems (3) Development of a computer model (4) Wind tunnel and Laboratory measurements and (5) Development of a Design Manual. Progress has already been made on Task 1 and the results will be presented at the Ninth International Wind Engineering Conference in January 1995.

To undertake systematic laboratory measurements and develop a protocol to evaluate roofing systems under dynamic loading, it is proposed that a joint research program be initiated. This partnership between industry, end-users and NRC will be of benefit to all involved in the roofing area. To ensure that the views of the roofing community are fully reflected in this program, a special interest group would be formed. This group would be called *Special Interest Group on Dynamic Evaluation of Roofing Systems (SIGDERS)*.

The focus of this group is to produce design and test procedures to evaluate and certify roofing systems under dynamic loads. The National Research Council of Canada is uniquely poised to assume the leading role in dynamic loading effects on roofing systems because the resources and expertise of at least two institutes will be involved. IRC, Institute for Research in Construction (formerly known as the Division of Building Research) is well known for its roofing related research. IRC, also has an established reputation for assisting in the development of standards. For example, five papers were presented by IRC at the ASTM meeting in Montreal, QC in June 1994 (Roofing Research and Standards Development, 3rd Volume, ASTM STP 1224). Moreover, IRC has already committed 70% of the funds required to build this facility. IAR, the Institute for Aerospace Research is well known for wind engineering research and its 9m by 9m wind tunnel is the largest commercially-accessible wind-tunnel in North America. The IAR has twenty years experience in roofing research and development, having developed a widely-used design manual for loose-laid roofing systems. This manual was based on wind tunnel measurements and mathematical analysis. This successful approach is now being extended to singly-ply roofing systems. Together, a unique blend of expertise will be available to the members of this partnership.

III. Objectives

Based on the discussions held on Nov. 16, 1994, the objectives are designed such that deliverables can be made after one and two years. Also, those attending the meeting felt that could easily develop in to a five year project. However, all agreed that it was best to make this judgment during the second year. It is understood that the objectives listed below may be modified and added to by the steering committee.

- . To build a facility for the dynamic evaluation of roofing systems. The initial facility will be based on the UEAtc guidelines.
- . Evaluate the validity of the UEAtc test protocol.
- . Develop a North American protocol which is fast, inexpensive and replicates field conditions. Moreover, it would be beneficial for many establishments to be capable of carrying out the evaluations.

- . Evaluate the effects of heat aging on the resistance to dynamic loads.
- . Evaluate the effects of rain on the resistance to dynamic loads.
- . Evaluate the effect of testing temperature.
- . Develop a Design Manual for the roofing community.
- . Develop a CGSB and ASTM standard for the dynamic evaluation of roofing systems.

III. Membership Fee and Duration of Joint Research Program

Six thousand dollars (\$6000) Canadian funds, payable in equal payments of \$3000 made semi-annually, will constitute the membership fee. It is anticipated that a total of 24 months will be required to complete the facility and establish the initial protocol for the dynamic evaluation of roofing systems. At the end of SIGDERS, any remaining money will be divided equally and returned to its members. Membership privilege includes being part of the Task Groups.

IV. Task Groups and Steering Committee

A maximum of five (5) Task Groups will be initiated. Each Task Group will be allowed to nominate one representative to the Steering Committee. The Steering Committee will not exceed a total of seven (7) people with voting privilege. It is anticipated that the structure of the committee will be such that there will be a member from the various groups associated with the roofing industry. In other words, there will be **one** representative from each of the following: roofing contractors, roofing manufacturers, roofing fasteners, building owners, building managers, IRC (roofing research) and IAR (wind engineering research). It is proposed that Ralph M. Paroli be a non-voting member of the Steering Committee.

It will be the responsibility of the Steering Committees to develop milestones and deliverables. Moreover, the Committee will provide (through the assistance of NRC) minutes of the semi-annual meetings and annual financial reports to all its members.

IV. Benefits to the Members of SIGDERS

Members would profit in several ways, including:

- providing advice in establishing the facility, test protocols and development of standards aimed at evaluating roofing systems under dynamic loads.
- participating in the Task Groups of SIGDERS.
- providing input in the development of the Design Manual and related standards.
- participating in the semi-annual reviews and receive the associated interim technical reports. Technology transfer is our goal, however, a two year moratorium (negotiable) would be in effect prior to publication.
- having access to IRC's and IAR's technical staff. Members would be briefed on IRC's other roofing-related research developments.

- receiving a \$1500 discount for evaluating roofing systems with this protocol. Furthermore, members will be entitled to a 25% discount for the measurement of the glass transition temperature, T_g , of roofing membranes.

V. Description of Proposed Facility and Initial Protocol

The following description is proposed to initiate discussion. Obviously, this is subject to change once the SIGDERS steering committee and Task Groups are established.

This unique North American facility will investigate complete roofing systems with dimensions up to 20 ft long by 5 ft wide. Simultaneous wind induced suctions cycles and wind flow generated gusts will be simulated under laboratory conditions. In parallel, a thermal chamber will be built allowing scientist to quantify wind interaction with thermal stress. This lab service will facilitate the certification of roofing systems in accordance with UEAtc standard - *“Guideline for technical approvals of mechanically fastened roof waterproofing systems”*.

VI. Personnel

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