Environmental Loads: Wind, Rain and Sun

Books and Research Reports

Canada Mortgage and Housing Corporation
Simulation of Wind Driven Rain and Wetting Patterns on Buildings
Ottawa: Canada Mortgage and Housing Corporation
1994
"Three conditions must exist simultaneously for rain penetration to occur: 1) water on the surface of the building; 2) a force (such as gravity, kinetic energy, capillarity or wind pressure) to drive the water through the wall; and 3) a leakage path in the wall through which the water can penetrate. Eliminating any one of these conditions will eliminate rain penetration. Conventional approaches to rain penetration have focused on eliminating openings or eliminating the forces. It has always been assumed that it is not possible to control the rain on the surface of a building. However, this research project looks at the interaction of wind and rain and suggests that there may be some means of limiting the amount of water that impinges upon a building. This project included components: 1) a demonstration of the feasibility of physically modeling wind-driven rain in a wind tunnel to show how wetting affects buildings; 2) a study, using a model that allows comparisons with field experience, of the effects of wind direction and wind speed on wetting patterns; and 3) an exploratory investigation of the effects of building height and architectural features on wetting patterns."
Available at: CMHC

Canada Mortgage and Housing Corporation
An Exploratory Study of the Climatic Relationships Between Rain and Wind
Ottawa: Canada Mortgage and Housing Corporation
1994
"Rain penetration caused by wind pressures is a significant building performance problem. A better understanding of the interaction between wind and rain may lead to improved building design. The objectives of the study focused primarily on two issues: 1) whether there is a significant relationship between wind speed and rainfall rate; and 2) whether the wind directions associated with wet hours are significantly different from the directionality of all winds. A secondary objective was to explore the applicability of the existing Driving Rain Wind Pressure (DRWP), used in the Canadian Standards Association's 'Windows' Standard, CAN/CSA-A440-M90, to the problems of the building envelope."
Available at: CMHC

Canada Mortgage and Housing Corporation
Wind-Rain Relationships in Southwestern British Columbia
Ottawa: Canada Mortgage and Housing Corporation
2007
"Building envelope failures in Southwestern British Columbia have brought to light the strong influence of wind-driven rain on building envelopes. This study examines wind and rainfall data

collected throughout the year from 12 meteorological stations: four on Vancouver Island and eight in the Lower Mainland. Results indicate that prominent wind directions during rain, as well as maximum wind speed, vary with location. Furthermore, all stations exhibited a marked difference in the wind direction and frequency of higher wind speeds for wet hours versus all hours."
Available at: CMHC

Cornick, S.M., W.A., Dalgliesh, et al.
MEWS Project - Task 4-Environmental Conditions Final Report
: Institute for Research in Construction, National Research Council Canada
2002
"This report summarized the methods developed for classifying for US and Canadian climates with respect to moisture loading. Hourly weather data for approximately 400 Canadian and US locations were collected. The data spans 30 or more years. Data for the 40 cities, 27 American and 13 Canadian, were analyzed and converted into the appropriate format for the Advanced Hygrothermal Model (AHM). A method for calculating a moisture index based on two independent indices, the wetting index and the drying index was developed characterizing the locations in the 40 city set. From the candidate list five cities were selected: Wilmington NC, Seattle WA, Ottawa ON, Winnipeg MB, and Phoenix AZ for detailed analysis. Climates were classified according to their potential for moisture loading. Five groups were defined: Zone 1, Zone 2, Zone 3, Zone 4, and Zone 5. A provisional contour map showing isopotentials for Canada and the United States was created."
Available at: http://irc.nrc-cnrc.gc.ca/pubs/fulltext/rr/rr113/

Crocker C.R.
Canadian Building Digests, CBD-126
Ottawa: National Research Council of Canada, Division of Building Research
1970
"The service life of materials is greatly influenced by the environment in which they are required to serve. In most cases, the limits of the environmental conditions are known, but the variations that exist because of orientation often have a profound effect on the durability of sealants, mortar, masonry and other wall components. It is the purpose of this Digest to indicate the effects of orientation, particularly as it relates to temperature and moisture." [It is important when reading this publication to acknowledge the many advancements that have taken place with sealants and other wall components since 1970.]
Available at: BCIT, VPL, UBC, NRC-IRC

Institute of Research in Construction
A Guide to the Wind Design of Mechanically Attached Flexible Membrane Roofs
Ottawa: National Research Council
2005
"Mechanically attached flexible membrane roofs are used on more than half of North American commercial buildings. Proper design is critical to ensuring good performance of this type of roof against wind uplift and to preventing failure. This publication provides extensive new information to help designers achieve good design. The information is based on ten years of NRC research, critical input from industry experts and the development of a new dynamic wind uplift testing

protocol. A comprehensive appendix includes excellent examples of wind load calculations."
Available at: BCIT, NRC-IRC, HPO

Articles

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Available at: BCIT, UBC

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