RESEARCH HIGHLIGHTS

Technical Series 99-106

WIND-DRIVEN RAIN STUDY FOR THE GOVERNOR'S ROAD PROJECT

Introduction

This project explored the ability to predict the rain wetting on a building facade in Dundas, Ontario, and assessed the potential performance and proposed cornice features of the building.

The action of wind-driven rain was simulated using a three dimensional modeling program for fluid dynamics, *Fluent 4.3*. The design probability distribution of wind speed, direction and rainfall intensity was based on meteorological records in two Ontario sites. The wind flow around the building as well as the raindrop trajectories on the building facade were calculated (see Figure 1).

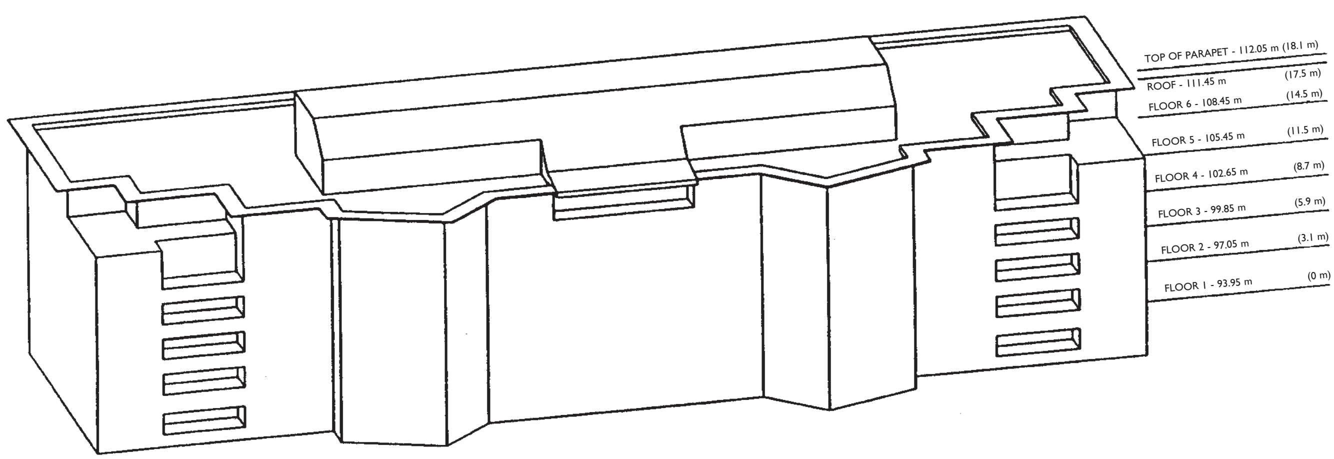
The simplified building geometry was modeled using AutoCad 13, eliminating any architectural details of little aerodynamic significance.

Implications for the Housing Industry

The weather data revealed that the southerly and easterly directions are most important for the point of view of wind-driven rain, and this was used for the main case study. Over a ten year period, the rainfall intensity was determined to be 11 mm/hour and the hourly wind speed to be 10.4 m/s at a 10 m height.

It was shown that the cornice has a positive effect by reducing the rainfall rate on the great majority of the building face. The only increase in rainfall rates due to the cornice occur for the back wall of a corner balcony, the mechanical penthouse roof and the floor of another balcony. This increase in rainfall was considered to be negative only for the one balcony floor, and was considered acceptable in the context of the overall

Figure 1: Detail of the Wind Flow (arrows) and typical raindrop trajectories (continuous lines)



The impact of the rain flow on the building envelope was determined for different zones of the main facade. Two design details were compared: the building with cornice protection, and without this protection.
By examining the wetting results for the two situations, the effectiveness of the cornice design was assessed.

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positive effect of the cornice. The information from this study led to the modification of some design features to reduce the negative effects. Upon learning of the simulated wetting patterns, the designers reconsidered some architectural features of the building design based on those predicted wetting patterns. The results can also be used to verify the quality of workmanship and details at the most vulnerable parts of the building. The study is a first step in developing more generic wetting analyis of residential buildings, which could provide designers a sophisticated tool to improve building configurations.

Results

The cornice effectiveness was analyzed by comparing the rainfall rate of the building without a cornice, with the actual building design with a cornice. These comparative factors were developed for multiple building zones. Cornice effectiveness factors (Fj) were defined as ratios between the local intensity factors—LIFs—both with and without cornices. These factors are estimated by relating the rainfall intensity in each building zone to the undisturbed rainfall intensity, and are useful in determining the effect of the cornice for every zone.

$$Fj = \frac{LIFj \text{ (without cornice)}}{LIFj \text{ (with cornice)}}$$

These (Fj) factors should be reviewed together with the LIF factors, as increases or reductions in rainfall rates are most significant when LIF values are large.

It was observed that the cornice reduced the rainfall rate in most of the building zones. Reduction factors between 1.1 and 2.5 can be expected for the main wall zones, with the upper wall zones, immediately beneath the cornice, being particularly well protected.

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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