USER INTERFACE DESIGN FOR INTERACTIVE HYGROTHERMAL PERFORMANCE SIMULATION OF BUILDING ENVELOPES

Khee Poh Lam, Ph.D. **Ardeshir Mahdavi, Ph.D.**

ABSTRACT

The design of building envelopes involves simultaneous consideration of the formal attributes (e.g., geometry and construction configuration), semantic information (e.g., physical properties), and contextual variables (e.g., prevailing external environmental conditions). In developing computer simulation tools for this purpose, it is necessary to address the issue of how this information can be captured, represented, and transformed to effectively support the design decision-making process. This paper focuses on the user interface design for a hygrothermal performance simulation model. The following features will be discussed.

"Single-Screen" Graphic Input

A "single-screen" format for structuring data input is provided. It comprises a construction element editor, a construction graphics display, and a boundary condition specifier. This offers the user an immediate overview of the design parameters and data input requirements, which is supported by built-in data libraries such as those for weather and material specification. The construction element editor provides a graphically oriented interactive mode for configuring a component and is dynamically linked to the construction graphics display and a material library editor. This feature supports the rapid generation of alternative building envelope configurations.

Simulation Process Preferences and Control

Certain flexibility in user preference and control of the simulation process is implemented. For example, the time step for the transient simulation can be varied either at the beginning or "on-the-fly" during program execution. This functionality may be necessary to stabilize the simulation process for certain components that contain materials that are sensitive to moisture fluctuations, particularly when the discretized sublayers are small. The textual and/or graphic result output display can be toggled on or off during runtime, which will affect the computational speed of the simulation. The necessary functions to pause, continue, and terminate the simulation also are included.

Result Output Representation

The result output interface tracks the "real-time" simulation process and presents the results numerically and/or graphically. The graphic representation of temperature, water vapor pressures, and moisture distribution within the component sublayers, as well as cumulative moisture content for each constituent material, provides an effective visualization of the "behavioral pattern" of the component as the boundary conditions vary in time and enables the user to detect critical conditions that may arise. Simulation results can be saved on file according to the selected frequency of data recording, either

Khee Poh Lam is with the School of Architecture at the National University of Singapore. Ardeshir Mahdavi is with the Center for Building Performance and Diagnostics, Department of Architecture, Carnegie Mellon University, Pittsburgh, Pa.

on a daily or monthly basis. Such result files can subsequently be retrieved for review in "quick-time."