Energy-Efficient Building Facades: Case Study Comparisons of External Screen-Wall Shading Systems

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ABSTRACT

Historically, building façades were adapted to the demands of the local climate—small windows and thermally massive building materials in temperate climates, large openings and lightweight materials in tropical climates. With the invention of air conditioning, buildings no longer needed to respond to local conditions, rather, the envelope became a sealed barrier between highly variable external conditions and a highly controlled, unchanging, comfortable internal environment.

Our increasing concerns about environmental degradation and the sustainability of our way of life has led to desires to design buildings and urban communities that enhance occupants' health and comfort, reduce building operating costs, and conserve resources. One of the principal strategies to reducing building energy demands and providing comfortable interior environments is an efficient building envelope system.

This presentation will illustrate the integrated design of a number of different types of external screen-wall façade systems and the impact they can have on the overall building energy efficiency of the project when used and designed appropriately. This presentation will illustrate the analysis and design process used as well as the resulting façade systems and project by comparing the slightly different vented, screen-wall systems designed for four different projects, each located in a different U.S. climate and each with different internal use.

- *The Seattle Justice Center—illustrates a mechanically controlled, externally vented, double-glazed skin façade system with operable blind shading located in the cavity. The project is complete and the façade system is currently being monitored to assess actual performance against predicted performance.*
- *60 Oxford St. Harvard—represents a fixed, dense slatted external shade system set off an operable window system (but in addition, preliminary design analysis for an externally vented, double-glazed skin façade system with operable blind shading illustrates local climatic benefits/design constraints between the Seattle and Boston climates). This project is currently under construction with targeted completion of July 2004.*
- *UC San Diego Pharmaceutical Sciences—highlights a fixed, planar, open-jointed, fritted glass shade screen to exposed, west-facing windows. This project is targeted for design completion and start of construction in June 2004.*
- *LA CalTrans Headquarters—illustrates a close-coupled fixed, planar, open-jointed, integrated PV shade screen and natural ventilation system. This project is currently in design.*

Through these case studies, the presentation will illustrate an integrated façade design process and analysis methodology for appropriate levels of analysis and understanding of façade system options performance. This process then allows for early assessment (as well as continued refinement) of the façade systems impact on total building energy performance and sustainability.

The presentation proposes both a design process/analysis methodology and the tools used to understand different façade system performances:

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- *significantly reduce or eliminate direct solar radiation during peak cooling hours*
- *harness solar gains (to natural heating advantage) in winter in appropriate climates*
- *control direct solar radiation for the different façade orientations with respect to potential impact on local thermal comfort*
- *maximize occupant view and connection to the outdoors*
- *maximize daylight transfer and penetration while controlling potential for glare*

It also proposes the resultant implications/impacts on

- *greater possibility to first use the local outdoor climate and natural processes for supplemental heating, cooling, and lighting;*
- *to then complement these natural systems with the use of low-energy supplemental systems (e.g., underfloor air distribution, radiant heating/cooling systems) without compromising standards of thermal and visual comfort;*
- *thus reducing building energy demands and providing comfortable interior environments.*