Wind Load Reduction Effect of Exterior Porous Skin on Facade Performance

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Abstract : Building envelope design is one of the most popular design fields of architectural profession in nowadays. The main design trend of such system is to highlight the designer's aesthetic intention from the outlook of building project. Due to the trend of current façade design, the building envelope contains more and more layers of components, such as double skin façade, photovoltaic panels, solar control system, or even ornamental components. These exterior components are designed for various functional purposes. Most researchers focus on how these exterior elements should be structurally sound secured. However, not many researchers consider these elements would help to improve the performance of façade system. When the exterior elements are deployed in large scale, it creates an additional layer outside of original façade system and acts like a porous interface which would interfere with the aerodynamic of façade surface in micro-scale. A standard façade performance consists with 'water penetration, air infiltration rate, operation force, and component deflection ratio', and these key performances are majorly driven by the 'Design Wind Load' coded in local regulation. A design wind load is usually determined by the maximum wind pressure which occurs on the surface due to the geometry or location of building in extreme conditions. This research was designed to identify the air damping phenomenon of micro turbulence caused by porous exterior layer leading to surface wind load reduction for improvement of façade system performance. A series of wind tunnel test on dynamic pressure sensor array covered by various scale of porous exterior skin was conducted to verify the effect of wind pressure reduction. The testing specimens were designed to simulate the typical building with two-meter extension offsetting from building surface. Multiple porous exterior skins were prepared to replicate various opening ratio of surface which may cause different level of damping effect. This research adopted 'Pitot static tube', 'Thermal anemometers', and 'Hot film probe' to collect the data of surface dynamic pressure behind porous skin. Turbulence and distributed resistance are the two main factors of aerodynamic which would reduce the actual wind pressure. From initiative observation, the reading of surface wind pressure was effectively reduced behind porous media. In such case, an actual building envelope system may be benefited by porous skin from the reduction of surface wind pressure, which may improve the performance of envelope system consequently.

Keywords : multi-layer facade, porous media, facade performance, turbulence and distributed resistance, wind tunnel test
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