

ENCLOSURE DESIGN: GUIDING PRINCIPLES

The starting point in the design of a building enclosure should be a consideration of what climate it is intended to exclude (e.g., climatic region: cold-dry, hot,-wet, arid) what micro-climatic conditions are expected (due to site, orientation, and height), and what type of climate it is intended to enclose (e.g., museum, apartment, factory). Together with the client's expectations and resources, these lead naturally to the specification of the required level of enclosure performance and durability (e.g. service life). The designer(s) must then balance the design with the available resources (money, labour, materials, time, etc.).

Regardless of the durability and performance requirements, or of the available resources, certain principles of design should be followed.

Be sure to have defined a complete load transfer path, including all connections, to the ground for all loads. This means for roofs to foundations, from floors to walls to foundation and from window or canopy to walls to foundations. The most common problem noted is that of no design for connection of secondary components to the structure (e.g. windows to wall). The most common primary structural system performance problem experienced is that of too much flexibility caused by excessive slenderness.

Control rain penetration by proper siting, building shape, and surface features.

Deflection, drainage and drying are the proven approaches to rain control. Orient and site the building to deflect rain if possible, use surface features, drips and flashing to redirect water off the building and away from critical joints. Define the approaches taken in writing!

Where possible, use a drained-screened systems to control rain penetration. The ability of the design to drain water in the likely as-built condition should be a high priority. Remember that the enclosure system includes joints and elements. *Drawings must show all flashings, laps, drainage planes. Slopes and drip edges should be dimensioned.*

If you choose a mass system, ensure that the amount of mass (storage and drying capacity) and its absorptance is matched to its exposure and the climate. Deflect as much rain from the building as possible with good details and consider the of the system.

If you must use a perfectly sealed system, pay extra attention to surface drainage, joints, and buildable details. Quality control is essential on site, and maintenance important.

Control air flow by using an effective air barrier. A strong, stiff, durable and, above all, continuous air barrier can be placed anywhere within the assembly. Consider inspection, repair, and replacement. The buildability of the air barrier is critical; all joints and interfaces in three dimensions must be tight and remain so.

The air barrier system should be labelled (i.e., its function and the specific materials) on drawings.

Insulate the structural components of the assembly. Place as much thermal mass inside the insulation as practical without violating other principles. Always consider the size and

effect of thermal bridges. The durability of most materials (e.g. air barrier) will benefit by being placed inside of the insulation. Thermal mass is useful in almost all permanently occupied buildings.

Design the enclosure to accommodate movements and construction tolerances.

Movement joints or flexible materials should be designed and provided wherever movements could be expected. Use dry (not caulked) joints when possible. Include realistic construction tolerances and provide a design that allows for them.

Movement joints must be indicated and dimensioned on drawings.

Control diffusion by providing appropriate layers of vapour resistance throughout the assembly. A specific vapour barrier plane is often not required. Vapour barriers rarely solve problems on their own, and can cause them. Reduce the risk of condensation within walls by making it difficult for vapour to enter the assembly and relatively easy to leave. Vapour barriers should be located close to the warm side of the wall. Beware of inward vapour drives in air conditioned buildings and warm weather -- some vapour resistance inside of absorbent exterior cladding is beneficial.

Provide a moisture-tolerant design by balancing wetting, drying, and storage potentials.

Despite the previous measures, always presume that some wetting will occur. Assess the susceptibility of each material to moisture damage relative to its vulnerability (i.e., its potential for getting wet). Provide as much drying capacity as possible. Consider the benefits of providing moisture storage.

Control unwanted solar gains. Provide exterior shade and solar control glazing to control glare and excessive solar heating. Interior shading *does not* control solar heat gain well. West-facing glass causes the worst complaints and overheating. Almost twice as much energy falls on a south wall in the winter than in the summer.

Consider the enclosure as part of the building system. The enclosure and the HVAC system should not be considered in isolation. Resources expended on the enclosure will often displace resources expended on HVAC. How will the building provide heating, air conditioning, humidity control, fresh air, and filtration? Control interior conditions to levels that the chosen enclosure design can tolerate (e.g., ventilate to control RH).

Consider the future. Attempt to design an enclosure that allows for repairs, improvements, changes in use, additions, and deletions. What is the likely life-cycle of the building? How will it be demolished, retrofit, recycled?