Confused Spaces & the Building Envelope: A Case Study

BY DANIEL MARTIS, PENG, LEED® AP

IN MOST BUILDINGS, the separation from indoor and outdoor space is easy to identify. A wall, floor or ceiling makes a clear distinction between the warm, toasty indoors and the cold, blustery outdoors. If parts of the building envelope are not installed or do not function, the distinction between indoors and outdoors, called the building envelope, can get fuzzy. This becomes a "confused space" requiring some analysis to understand where it belongs. Confused spaces are often found in parking garages, crawl spaces and attics, areas that can blur the line between indoors and outdoors.

A Confused Space

Morrison Hershfield recently completed an assessment and repairs to a confused service space in the parking garage of a high-rise condominium in Thornhill. The service space is situated above suspended ceiling tiles on the P1 level, and contains a multitude of plumbing and HVAC equipment for the swimming pool and hot tub directly above. The service space was heated, keeping the pool floor above it nice and warm. Insulation was installed above the ceiling tiles, acting as the building envelope, and separating the space from the unheated parking garage below.

The service space contained ductwork for the pool dehumidifier (some call it the "Dry-o-tron") that kept the pool room from getting too muggy. The ductwork took air from the pool down to the dehumidifier in a room on P1 level, and sent it back still warm, but much drier. Refer to Figure 1 below showing a section through the pool, service space and parking garage.

Every winter, icicles would form on parts of the ceiling tiles, and with the arrival of spring, soaked ceiling tiles would fall to the garage floor. No one understood why this was happening. The space was confused – it wasn't really outside or inside.

The Building Envelope

The building envelope is a wall, ceiling or floor that serves the following four functions to keep the indoors separate from outdoors:

1) A thermal barrier – keeping heat from moving from one side to another.

2) An air barrier – keeping inside and outside air separate.

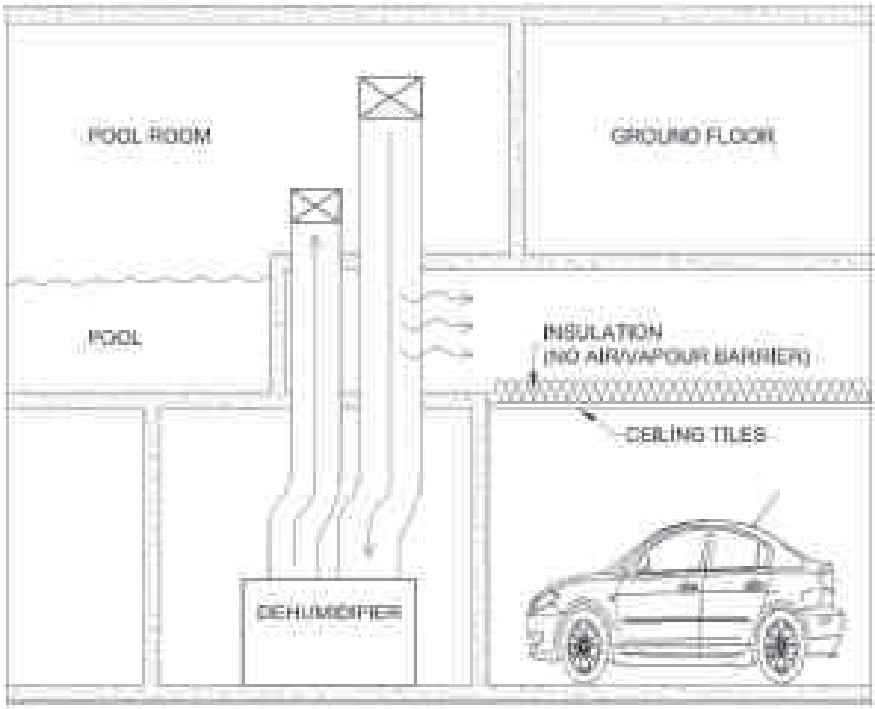


Figure 1. Section showing the pool, dehumidifier and suspending ceiling in parking garage.

3) A vapour barrier – keeping water vapour (found in air) from moving from one side to another.

4) A weather barrier – keeping the inside dry.

In this confused space, the plane of the suspended ceiling tiles acted as the building envelope. Considering the four functions of the building envelope shown above, the suspended ceiling tiles do the following:

1) They were insulated with fibreglass batts, meaning there was a thermal barrier.

2) No air barrier was present.

3) No vapour barrier was present.

4) The ceiling was in the garage, meaning a weather barrier wasn't necessary.

Ductwork ran through the service space, drawing warm, humid air from the pool room and sending it to the dehumidifier in the parking garage. This warm, humid air was at about 27°C, and had a dewpoint of about 20°C. Any surface below 20°C that came in contact with this air would form condensation. The warm, humid air from the pool leaked out of joints in the ductwork into the service space. The ceiling tiles in this space were exposed to the cold parking garage (at about –5°C during winter) meaning condensation and frost formed on the tiles.

The service space was confused, because there was no way to keep this warm, humid air separate from the cool, dry parking garage. The air barrier and vapour barrier were missing.

The Solution

We recommended several measures to solve this problem. First, joints in the ductwork were sealed to keep most of the warm, humid air where it belonged, though we expected some would still leak out. We also constructed a wall to keep ductwork in a warm space. The wall was built with an air barrier, and a vapour barrier, to keep the ductwork separate from the cold ceiling tiles of the parking garage. Refer to Figure 2 showing the new wall.

Most importantly, an intelligent ventilation system was installed to keep the humidity under control in the space around the ductwork. A system of sensors measured temperature and humidity in the area around the ductwork, as well as in the parking garage. An exhaust fan would come on only if the service space got too humid, and the parking garage air was relatively dry. This would draw in the dry air of the garage to lower the humidity.

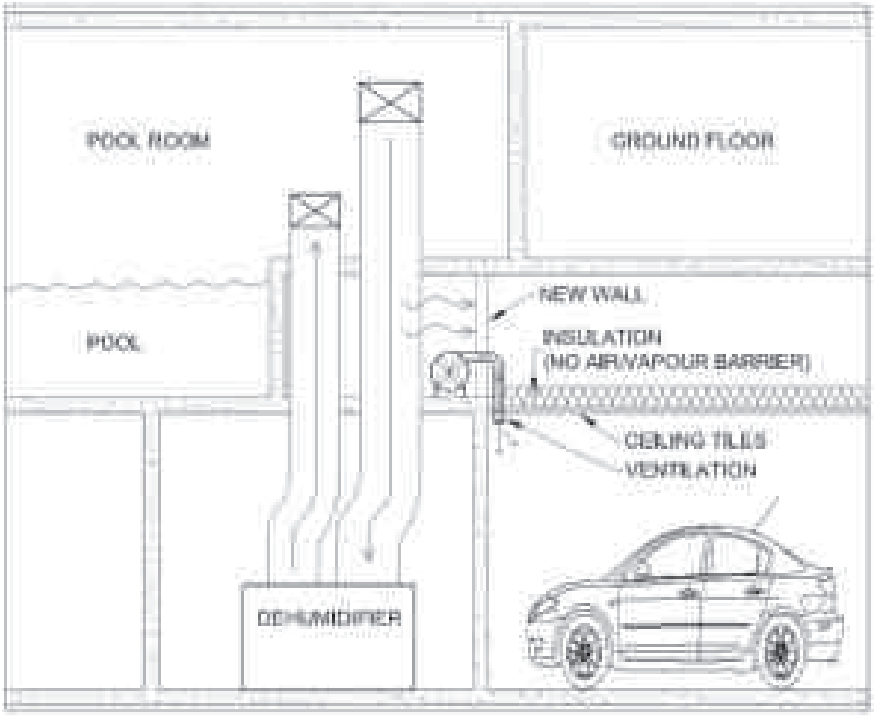


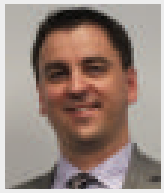
Figure 2. Same as above, showing location of new wall and ventilation equipment.

The space was no longer confused. A building envelope, complete with thermal, air and vapour barriers separated indoors from outdoors.

The Take Away

Confused spaces happen when the separation between indoors and outdoors gets blurred. Many condominiums can have confused spaces around swimming pools, in parking garages or in attics. These spaces need a complete building envelope to make the distinction between indoors and outdoors. The greater the difference in temperature and humidity, the greater the risk of something going wrong.

Working with your building envelope consultant is key to ensuring these spaces work as intended. ❖



Daniel Martis, P.Eng., LEED® AP is principal, project manager, Morrison Hershfield Limited.