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# Attached Garages and Indoor Air Quality

Canadians can spend an average of 90 per cent of their time indoors. Having clean indoor air is therefore critical for respiratory health.

Canada Mortgage and Housing Corporation (CMHC) and others have published material on how to provide good indoor air quality (IAQ). However, there is one source of pollutants that we are just discovering: automotive pollution from attached garages. This *About Your House* discusses the risks of attached garages and how to keep car-based pollutants out of your house.

Attached garages are convenient, and are a common part of suburban houses. The attachment could be to the side of the house, with a room over top of the garage, or even as a part of what traditionally is the basement (see figures 1, 2 and 3).

Automobiles give off pollution. Starting a car in a garage, even with the garage door wide open, can result in a higher concentration of combustion pollutants (for example, carbon monoxide) in the garage and house.

Driving a car into the garage and closing the door results in emissions of various chemicals over the next several hours as the engine and its fluids cool down. The pollutants in the garage air can be drawn into the house over time.

**CMHC publications on indoor air quality**

*Breathe Healthier Air in Your Home: A Consumer Guide to Residential Indoor Air Quality Investigations*

*The Clean Air Guide: How to Identify and Correct Indoor Air Problems in Your Home*

Consult the back page of this fact sheet for ordering details.

This is not just a theoretical problem. In a survey done by Health Canada in more than 100 houses in Windsor, Ontario, the results were very clear.

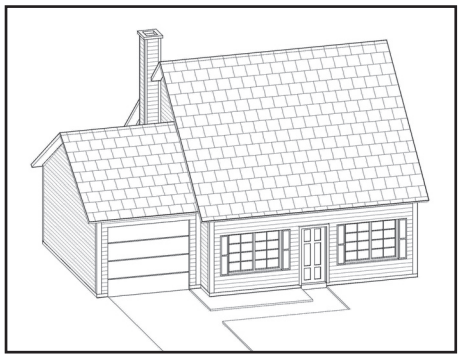

**Figure 1** Garage attached at the side of the house

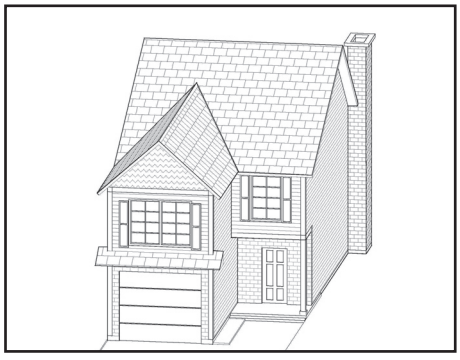

**Figure 2** Room over top of the garage

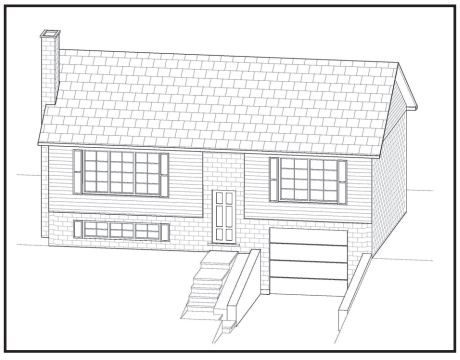

**Figure 3** Garage as part of the basement

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Houses with attached garages had measurable concentrations of benzene (a gasoline related pollutant) in their indoor air. Houses with no garages or detached garages had little or no benzene. This is true of a host of other airborne chemicals. The study revealed that pollutants in attached garages can find their way into the house.

There are also secondary sources of pollutants in garages, apart from car-based emissions. There are many gas-powered appliances, such as lawn mowers, chain saws and edging tools whose emission systems are not as good as those found in cars. Chemicals such as pesticides and herbicides are also sources of pollutants.

One disconcerting fact is that garage-to-house air movement is not obvious or straightforward. In the 1990s, when the first inexpensive carbon monoxide (CO) sensors became commercially available, many started going off without an evident source of carbon monoxide. Responders such as utilities and fire departments often wrote off the incidents as false alarms, prompted by over-sensitive CO detectors. However, research in Minnesota (Wilber & Klossner, 1997) showed that the time delay of CO entry to the house from the garage could be a factor. When a cold car engine starts up in the garage, even with the main garage door open, it can generate up to several hundred parts per million of carbon monoxide gas in the garage. Once the car has left and the garage door is closed, the garage may still hold a relatively high CO concentration for hours. Air leaking from the garage to the house can cause the CO level in the house to start climbing. After several hours, the house CO level is high enough to set off the CO alarm, but by then the garage is low in CO and is not recognized as a source.

## HOW GARAGE AIR GETS INTO YOUR HOUSE

It can be difficult to understand how and why garage air moves into the house. After all, there is at least one layer of drywall between the house and the garage, and a significant amount of insulation. The door from the attached garage to the house typically has weatherstripping and a spring to hold the door closed. So how does air enter?

Air can move through small cracks in the walls between the house and the garage, and through the top floor ceiling. There are many tiny holes and cracks that permit this air exchange to take place and they exist in all houses. It takes a sophisticated test with specialized tools, such as a blower door and leakage detection equipment, to find infiltration and exfiltration points.

Field tests by CMHC have discovered that the walls (and perhaps ceilings) between garages and the house can be as air leaky as the rest of the house. Some houses get most of their "fresh air" through the garage. One or two of those tested had so little leakage that there was no measurable air movement through the walls between house and garage. However, most garages have some air leaks, roughly in proportion to the size of the exterior wall.

But air movement into a house requires both a hole and a pressure difference. Does a pressure difference exist? Yes. CMHC measured the pressure difference across the house-garage wall and the house pressures are often lower than garage pressures, especially in winter. This is quite common in colder weather. Having exhaust fans or vented heating appliances also creates lower pressures inside the house, and garage air is drawn in through the leaks.

## PREVENTING GARAGE-TO-HOUSE TRANSFER IN NEW HOUSES

The best way to prevent garage air entry into the house is to make sure that there are no leaks between the garage and the house. In new construction, this should be easy. The builder should make the interface walls and ceilings as airtight as possible. This is more readily done if the builder knows that reducing pollution transfer from the garage is a priority.

The builder should:

1. Ensure the airtightness of the garage ceiling and walls that are

next to the house, before the insulation is installed and before installing drywall on the garage side.

2. Check all wall-to-wall junctions or wall-to-floor junctions and seal them. If the top of the basement wall is exposed in the garage, that header space can be notoriously leaky.
3. Diligently seal all penetrations from the house to the garage (wiring, central vacuum exhaust and so on).
4. Keep mechanical systems (furnaces, water heaters and so on) out of the garage. While most Canadian builders would not consider putting mechanical systems in the garage, it is common practice in parts of the U.S. The few Canadian houses that CMHC has tested (in B.C.) with heating systems located in the garage showed high levels of garage pollutants in house air.

## PREVENTING GARAGE-TO-HOUSE POLLUTION TRANSFER IN EXISTING HOUSES

It is much harder to prevent air movement from a garage to a house in an existing house. In a house already built, there will be leakage areas but they are usually hidden. They are not easy to locate and not easy to seal.

However, air-sealing the garage-to-house walls and ceilings may still prove worthwhile. If the garage side has no drywall, sealing air leaks may be simple. If the drywall is simply screwed on the wall and is otherwise unfinished, removing the drywall gives access to the interior spaces. Finishing the drywall itself with drywall compound and paint, as well as caulking all visible cracks and joints, may improve airtightness.

Another approach involves installing an exhaust fan to vent garage air outside. A good bathroom fan could be used. By operating the fan, the garage becomes depressurized relative to the house thereby preventing air movement from the garage to the house. This will not impact to any great extent on house heating costs but there will be an electrical cost to run a fan.

The use of a garage exhaust fan may lower the garage pressure enough for airflow through the holes to go from the house to the garage, rather than the garage to the house. Check the pressure difference by opening the door to the house just a crack and feeling for air movement from the house to the garage. A smouldering string can also be used to detect air movement. If air is moving into the garage, the pressure is in the right direction. This will assure that garage pollutants do not enter house air.

To avoid high electrical costs, choose an exhaust fan with low energy consumption. To further reduce fan usage, have the fan activated for a period (for example, one hour) after the garage door is used.

Continuous use of the exhaust fan is recommended if:

- There are a lot of noxious chemicals in the garage. Better yet, consider sending them to a hazardous waste disposal site.
- The garage is used to store or maintain older vehicles with higher emissions.
- There is a lot of coming to and going from the garage through the main garage door.

## WHAT TO DO

All buyers of new houses should confirm that their builder is aware of this issue and takes measures to do a good job of sealing air leakage paths. It is the only easy time to seal the air leakage points. An effective air sealing approach is far better than installing an exhaust fan after the fact.

Owners of existing houses have harder choices. If there is evident and annoying transfer of odours and drafts from the garage to the rooms next to the garage, the leaks should be located and sealed. If that task is too onerous or expensive, the garage exhaust fan solution could be considered.

Finally, if the attached garage is not used for vehicles (as is often true) and there are no other major chemical sources in that space, garage-to-house air movement should not be a significant problem.

## BIBLIOGRAPHY

Wilber, M.W., & Klossner, S.R. (1997). A study of undiagnosed carbon monoxide complaints. *Proceedings of Healthy Buildings/IAQ '97, 3.*