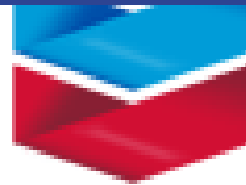


Soil Gas Behavior Beneath a Residential Building

Paul D. Lundegard

UNOCAL 76

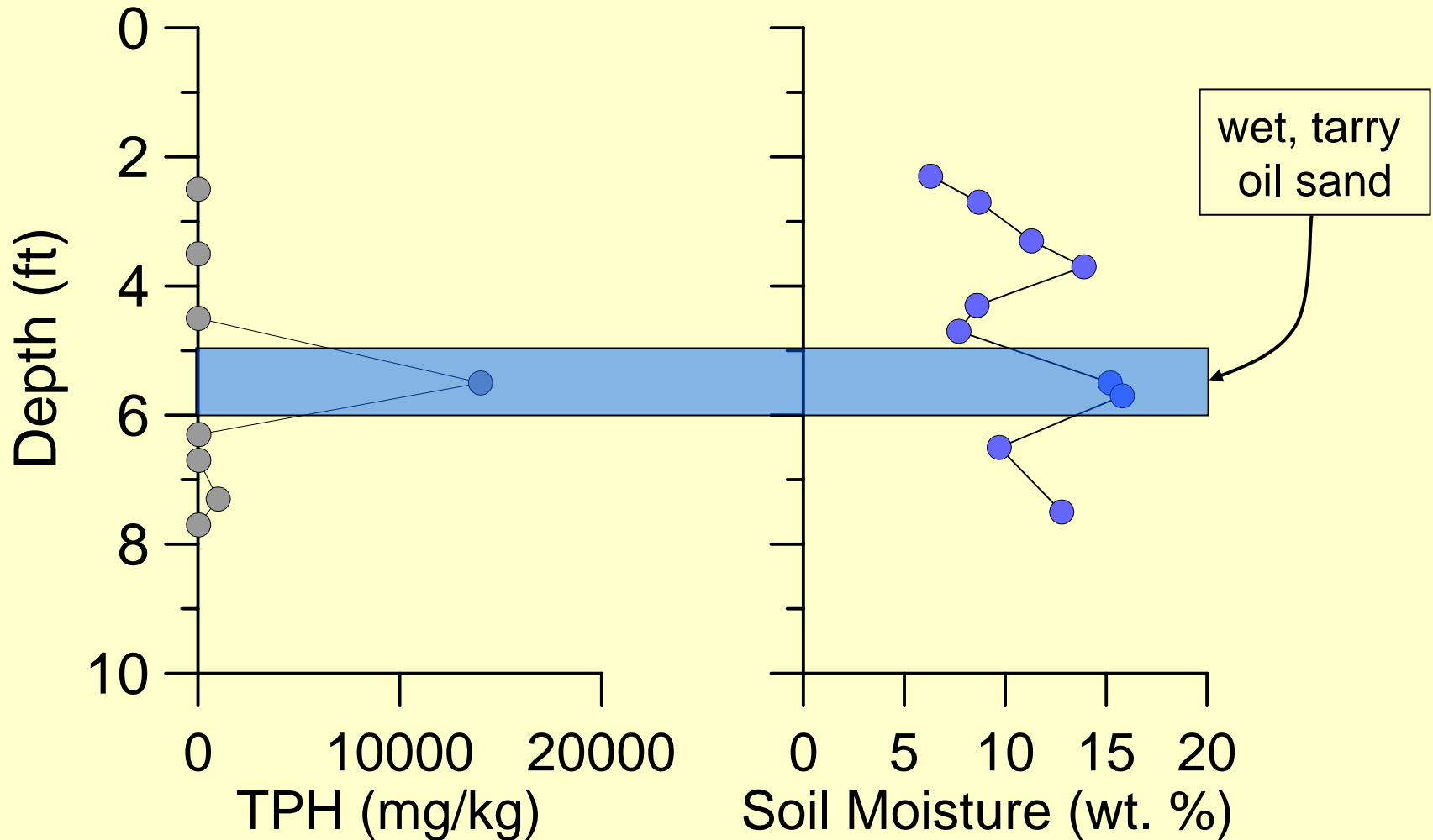


Sub-Slab Natural Ventilation

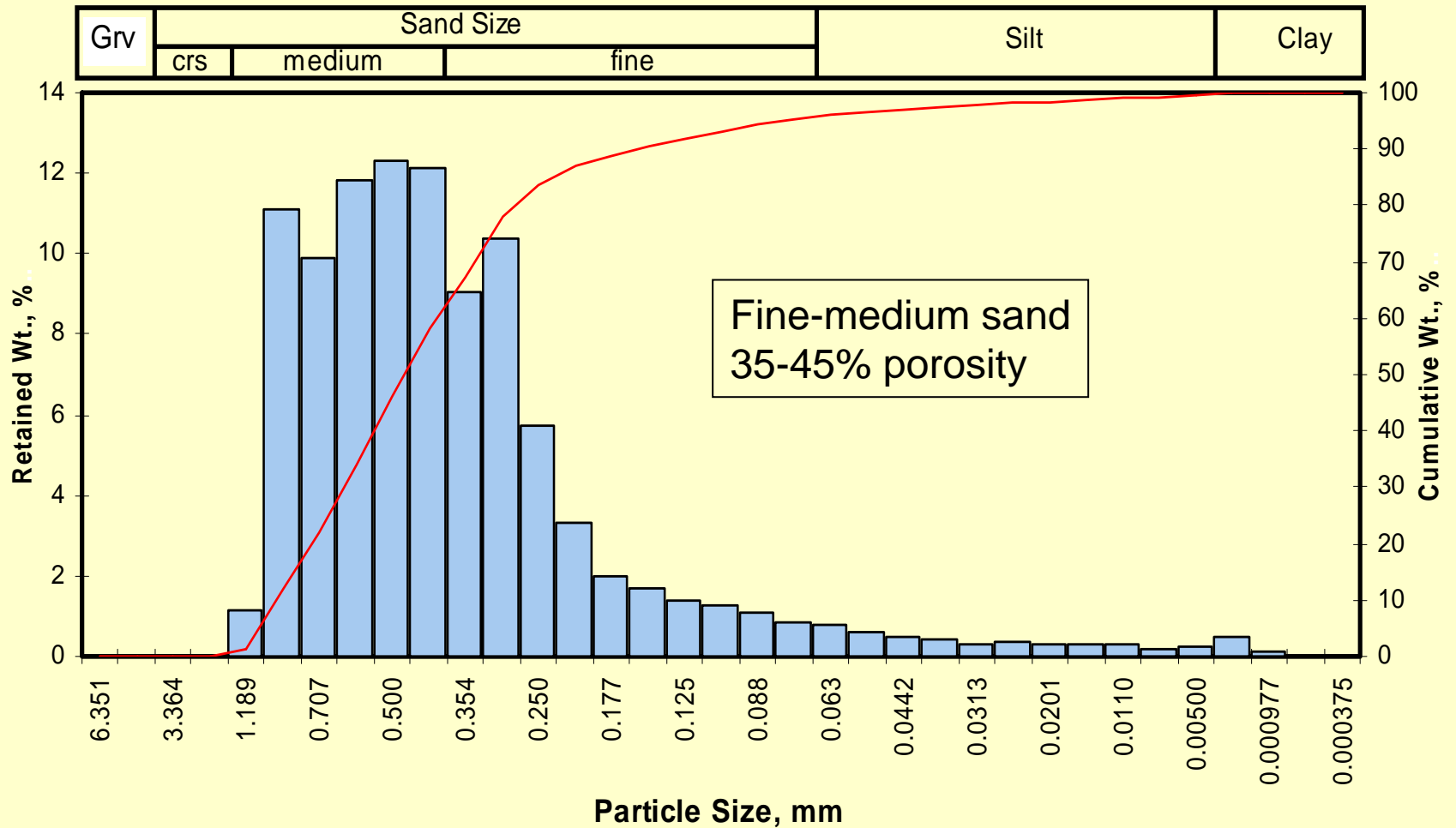


- Single Story
- 1980 ft²
- Slab-on-grade
- Heating only
(no AC)
- Unoccupied

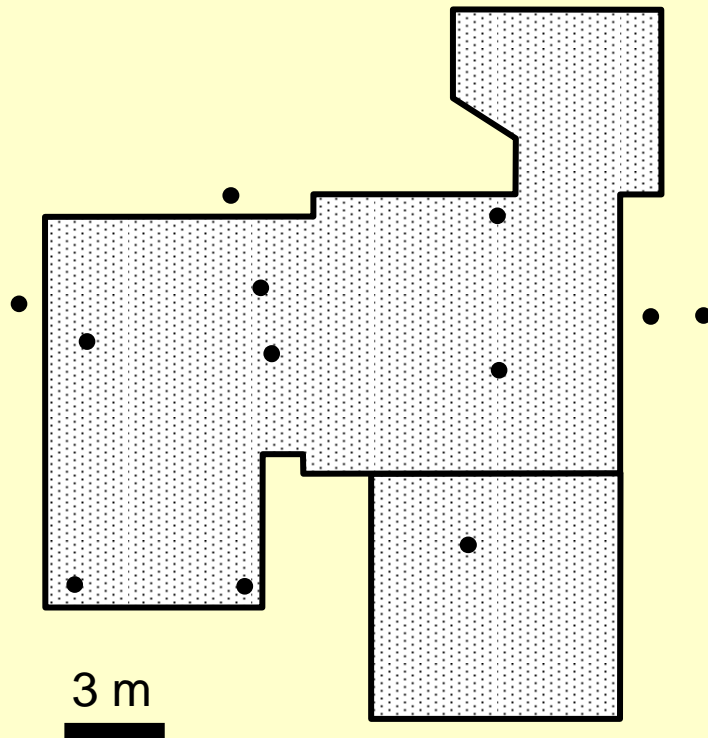
TPH and Soil Moisture



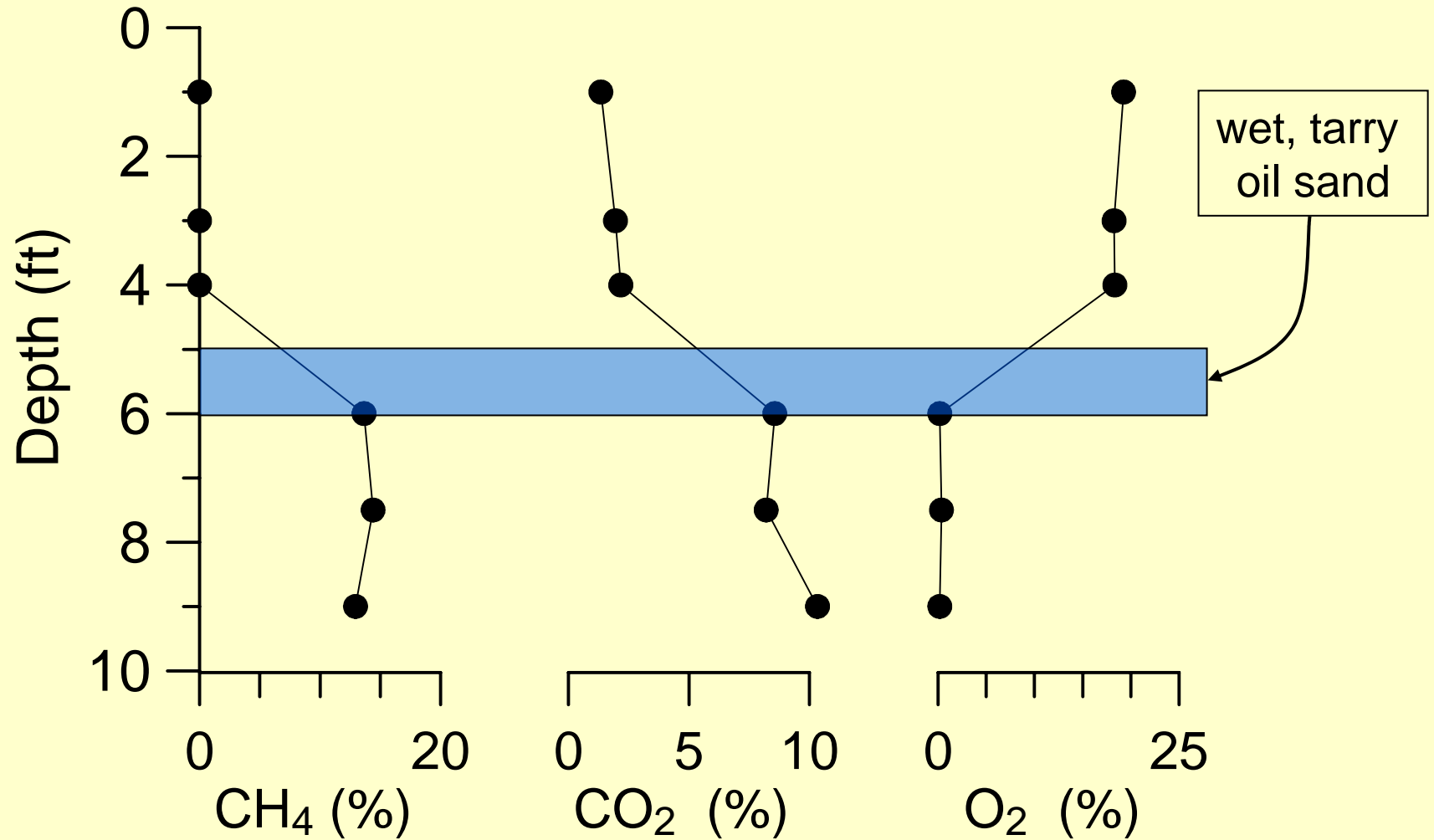
Soil Character



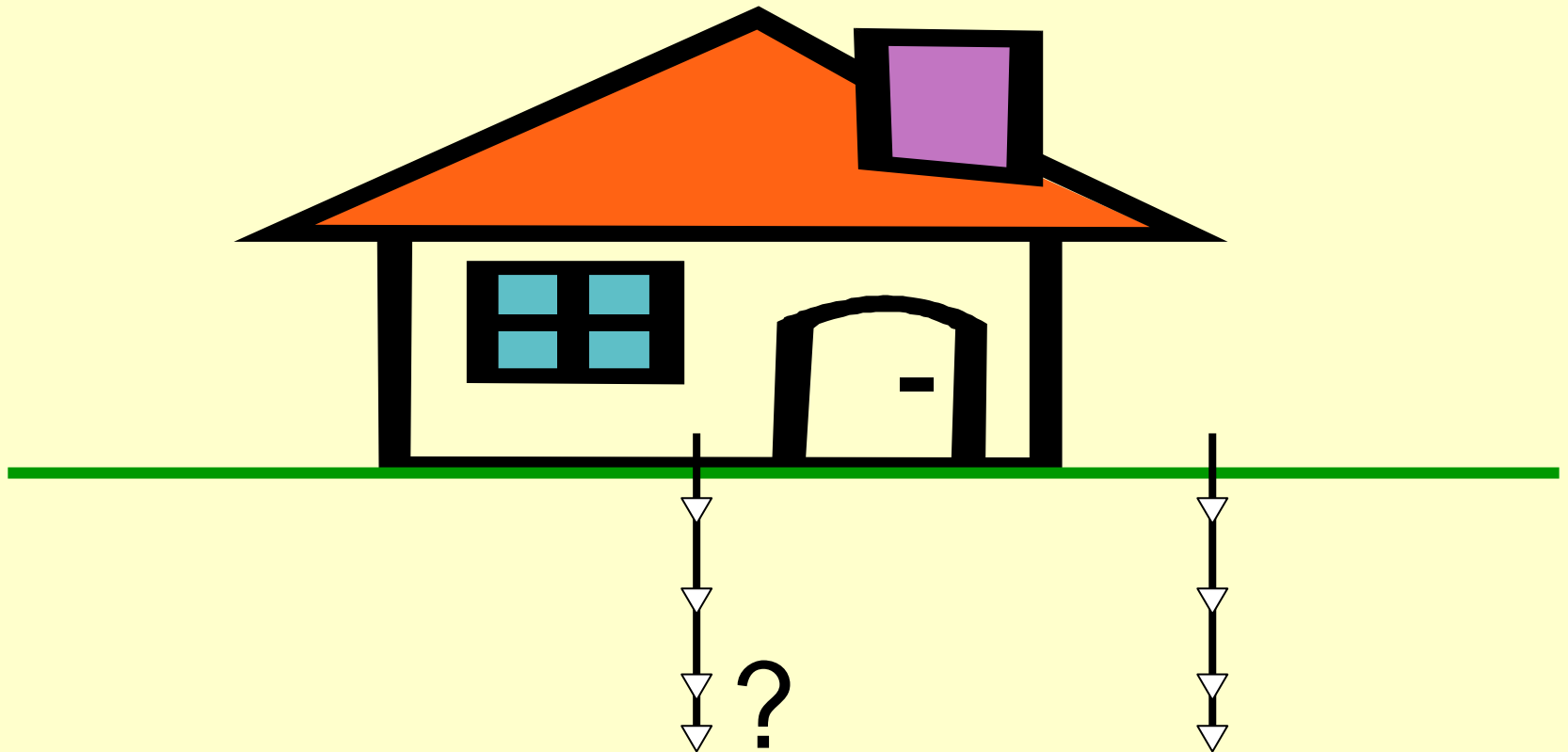
Soil Gas Profiles



Typical Soil Gas Profile

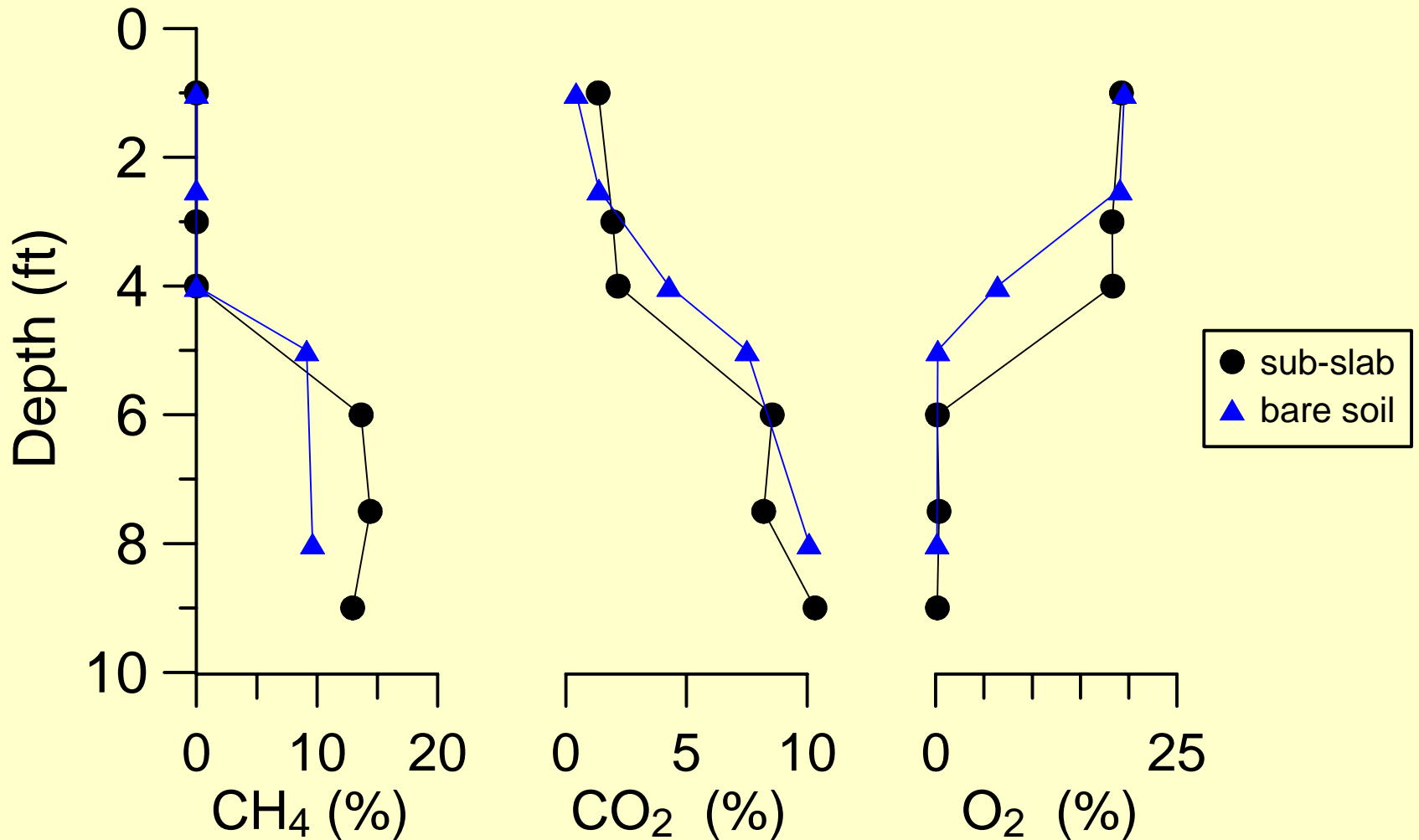


Sub-Slab vs. Near-Slab Profiles

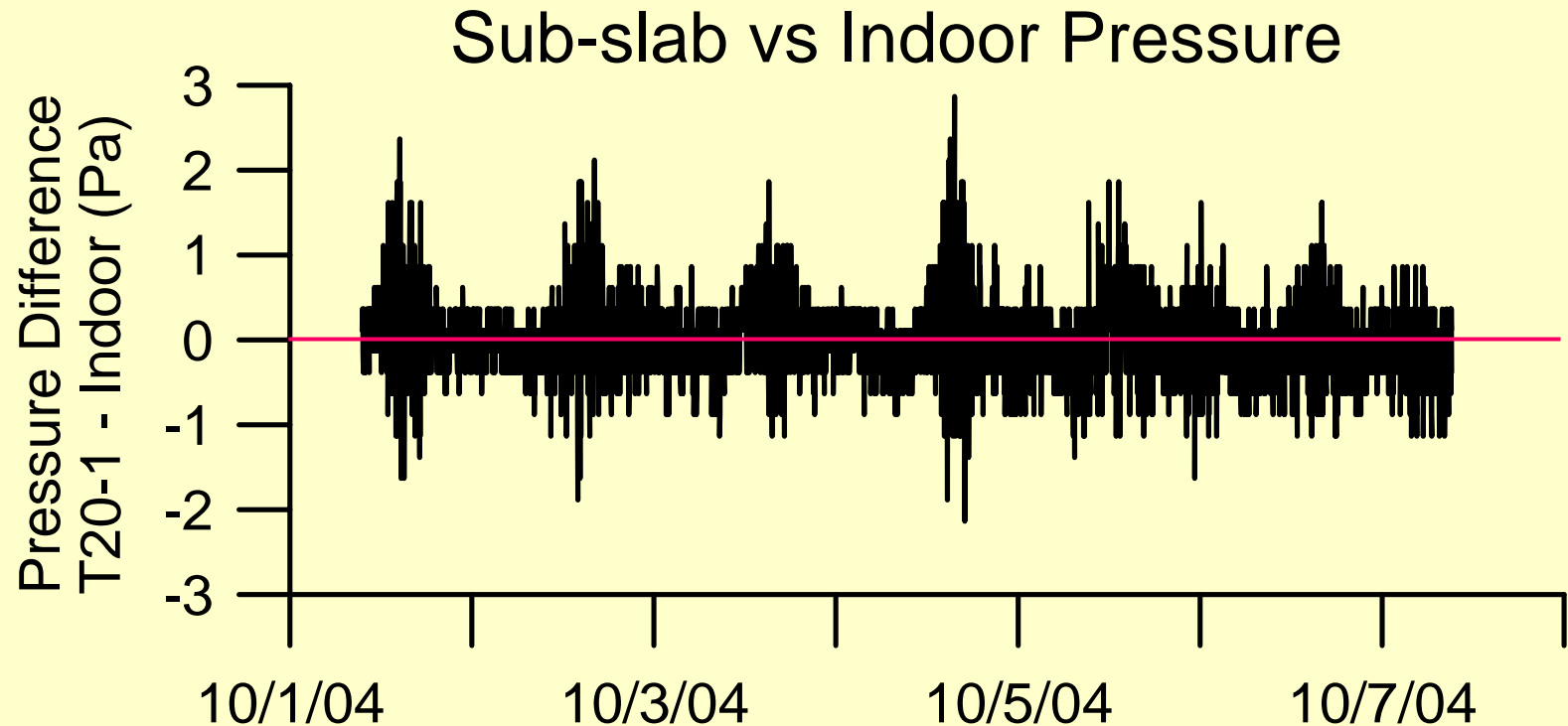


Sub-slab vs. Near Slab

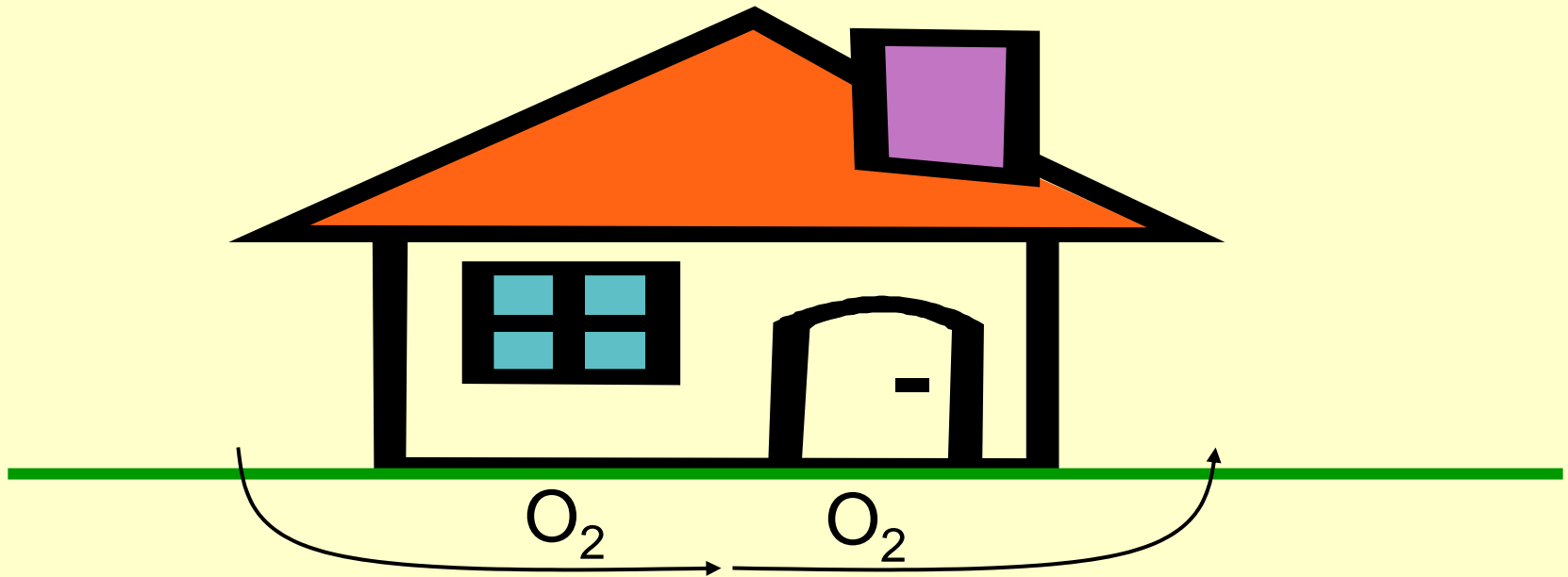
House #3



Cross-Slab Pressure Gradients

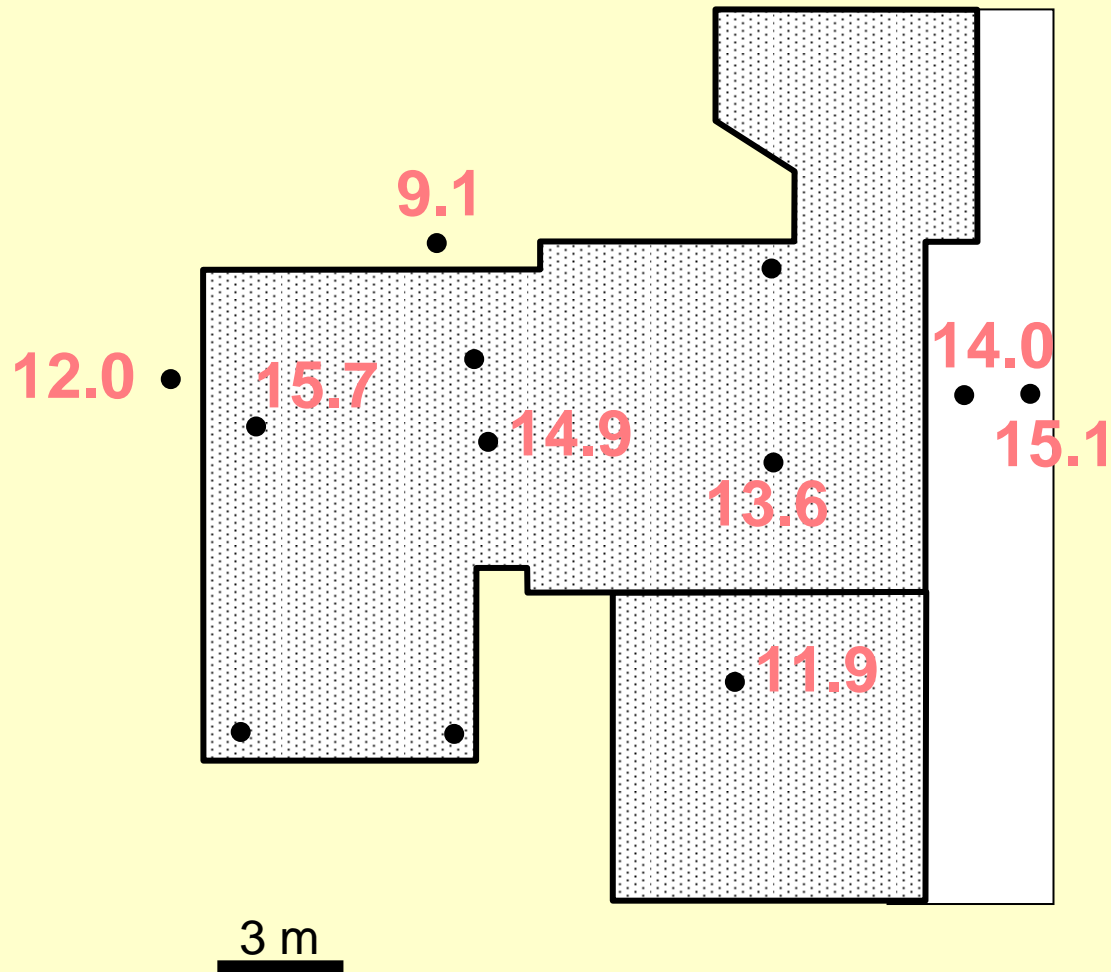


Natural Sub-Slab Ventilation



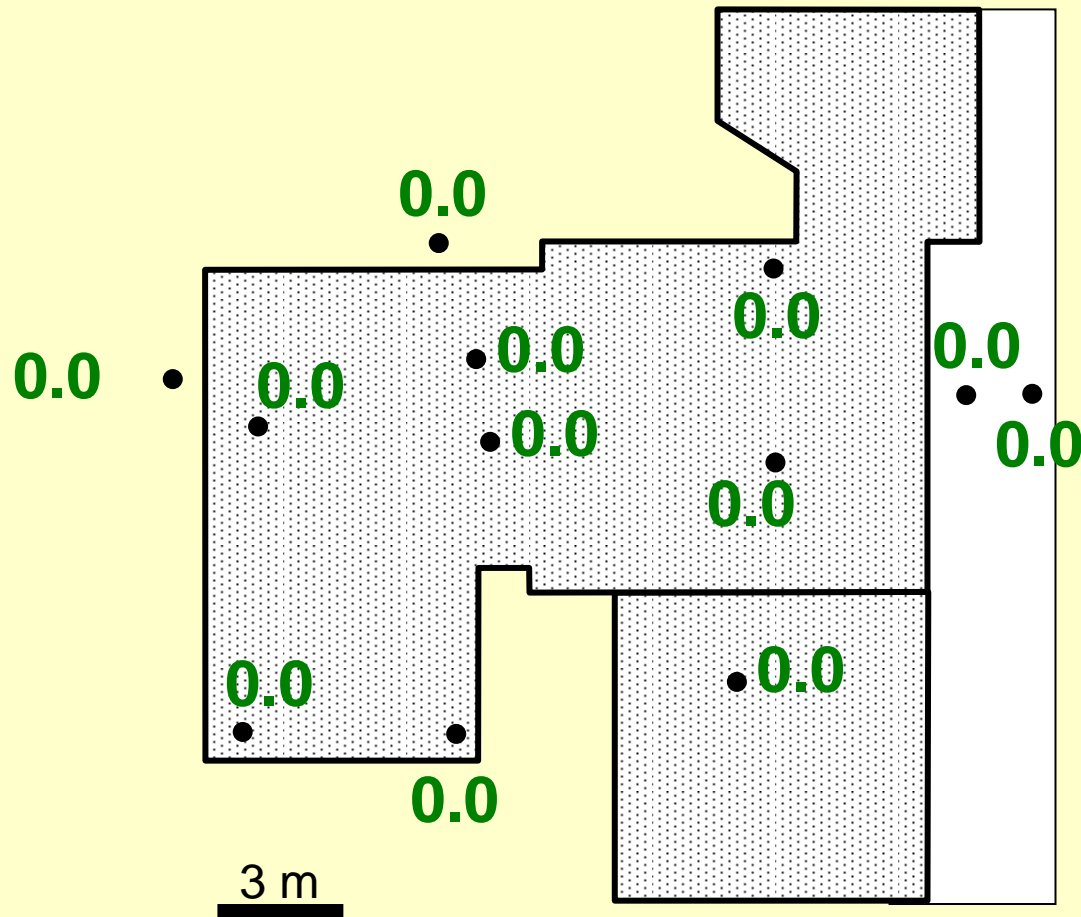
Sub-Slab Methane (%)

(5-6 foot depth)



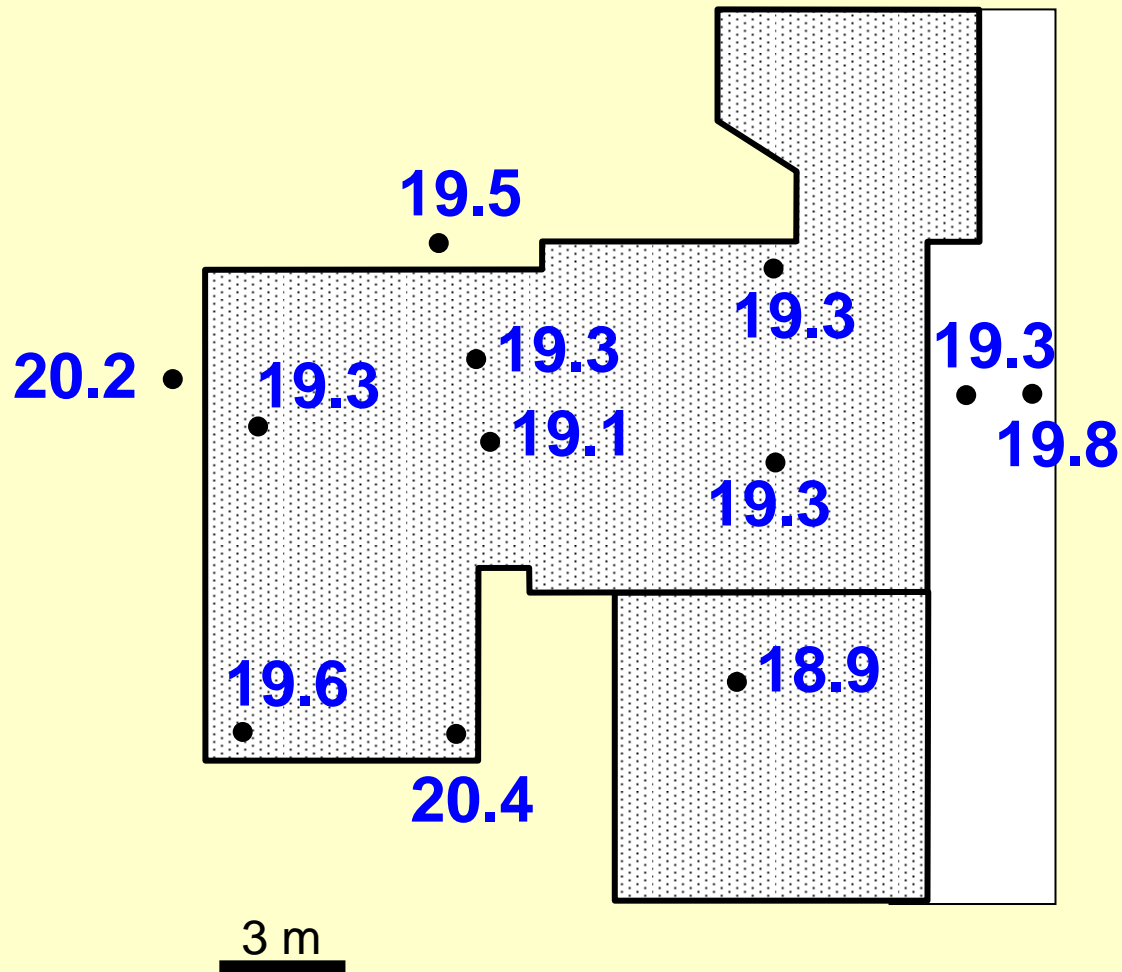
Sub-Slab Methane (%)

(1 foot depth)



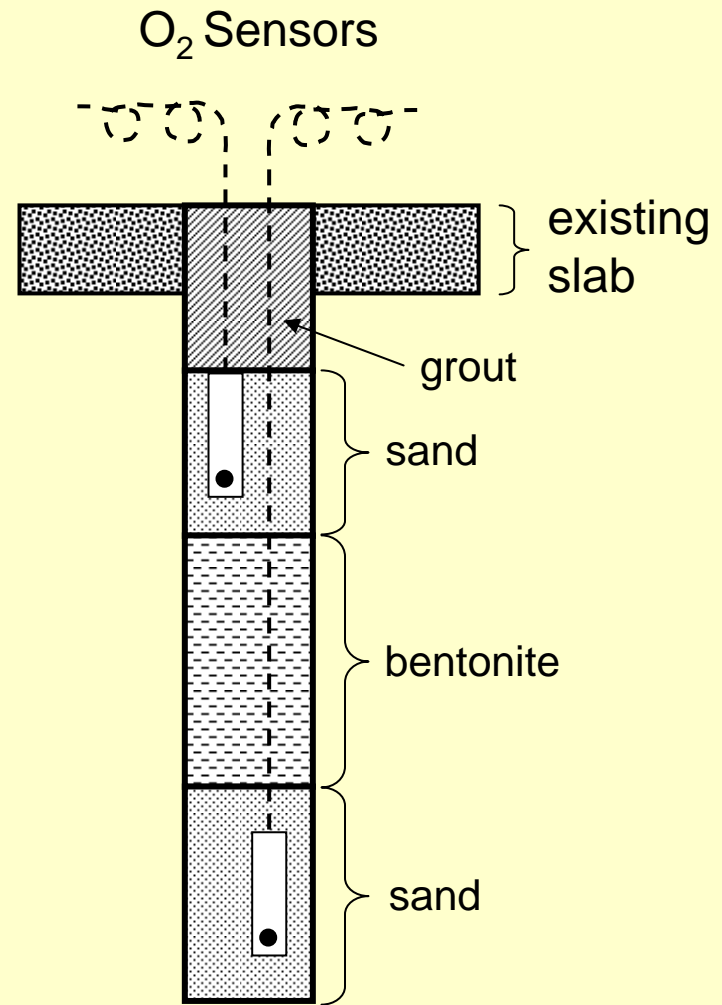
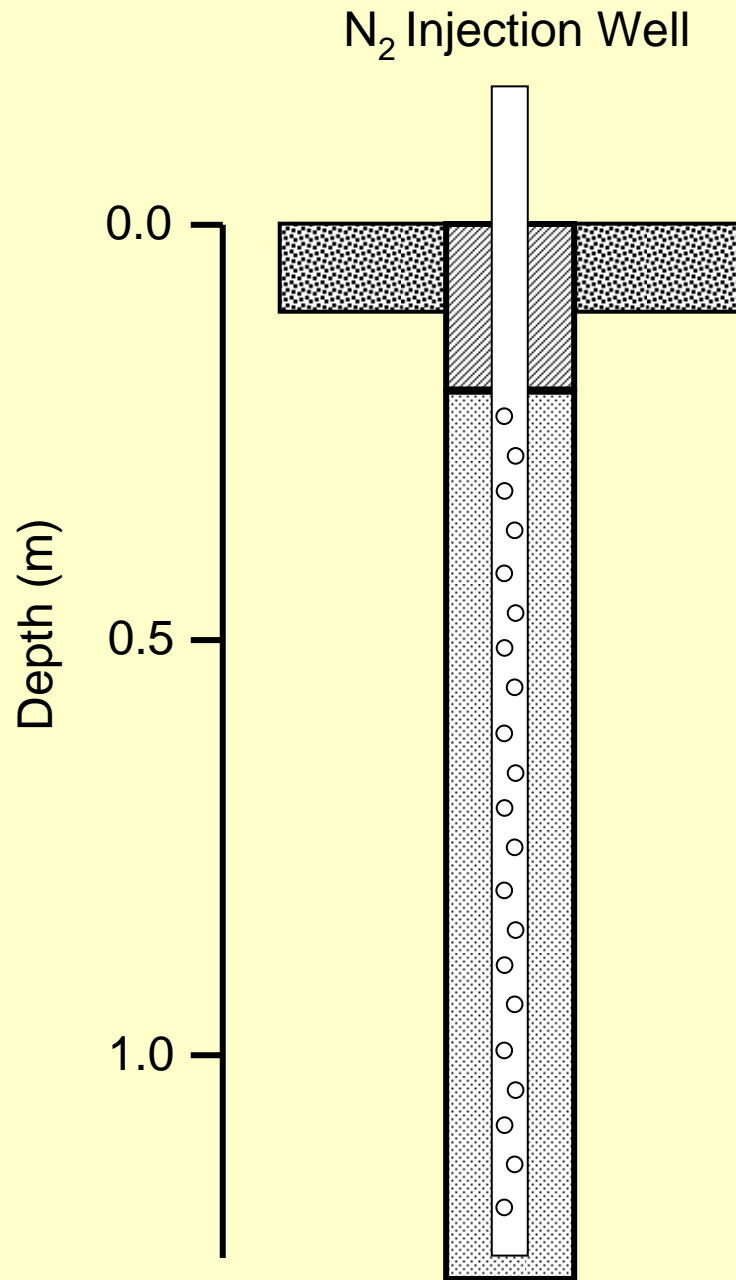
Sub-Slab Oxygen (%)

(1 foot depth)

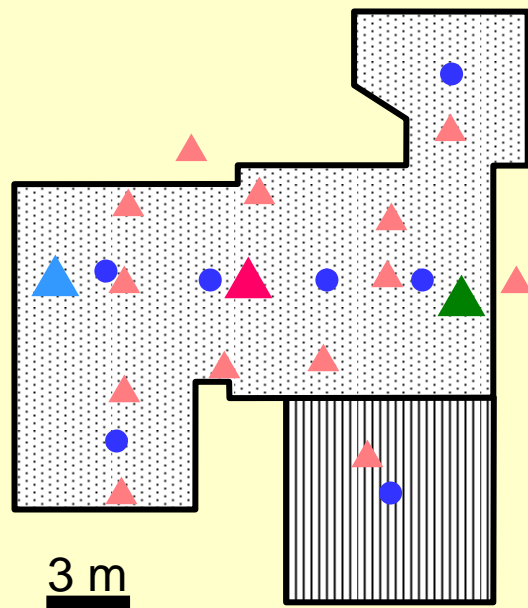


Sub-Slab Nitrogen Flood



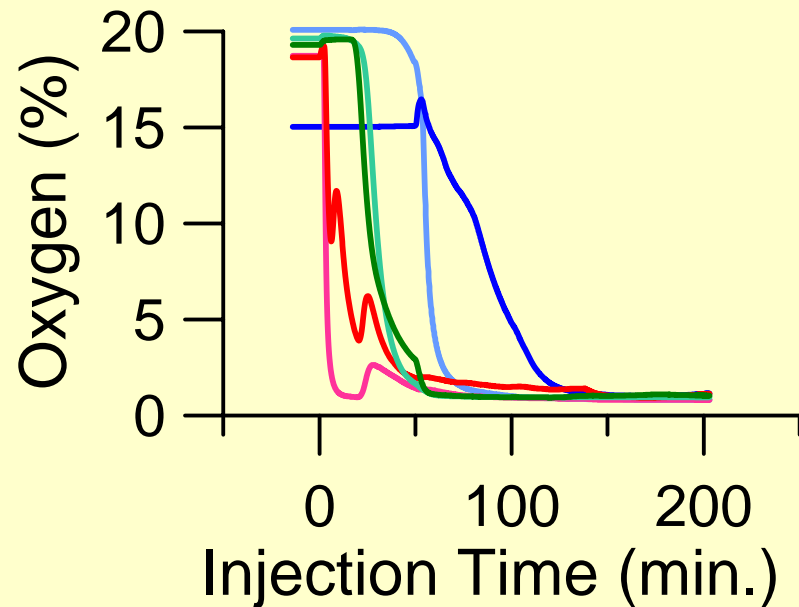


Sub-Slab O₂ Transport Experiment

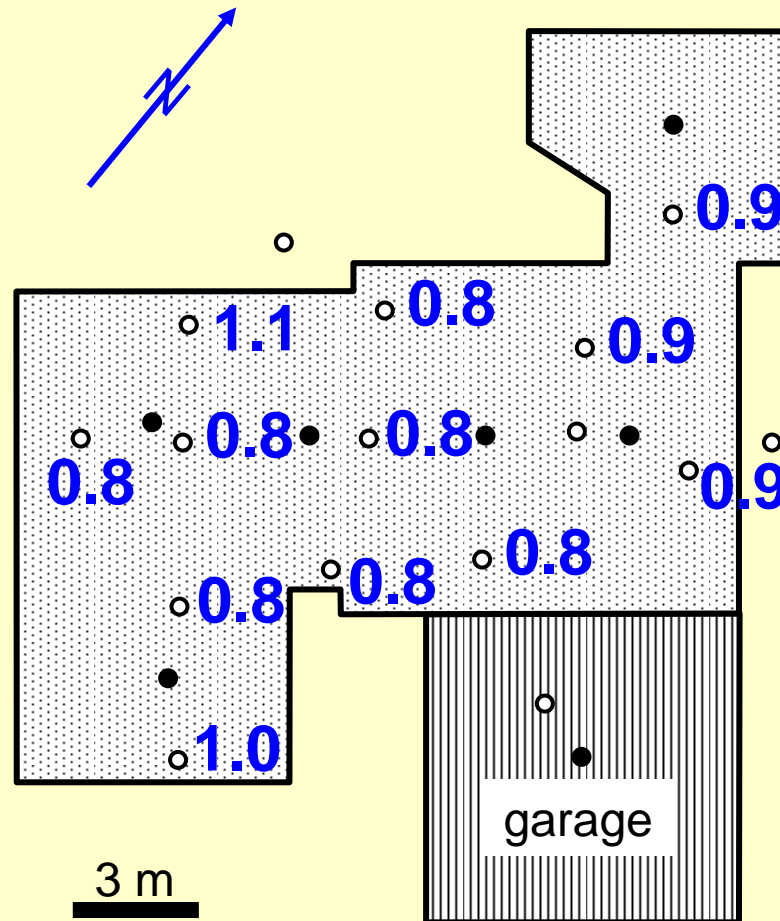


- N₂ injection
- ▲ O₂ sensor

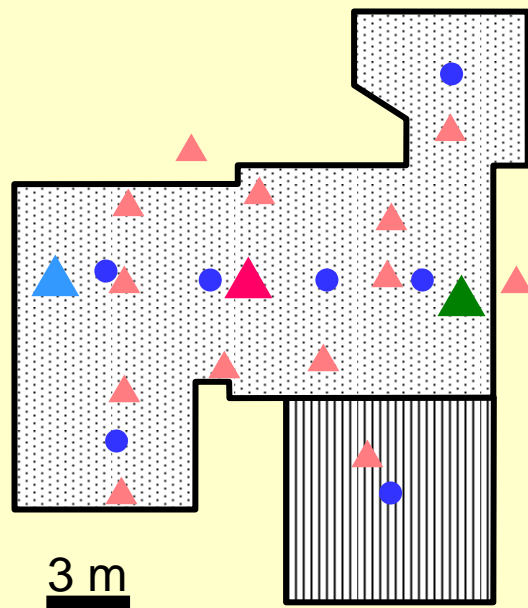
Oxygen Displacement with N₂



% Oxygen After N₂ Flood

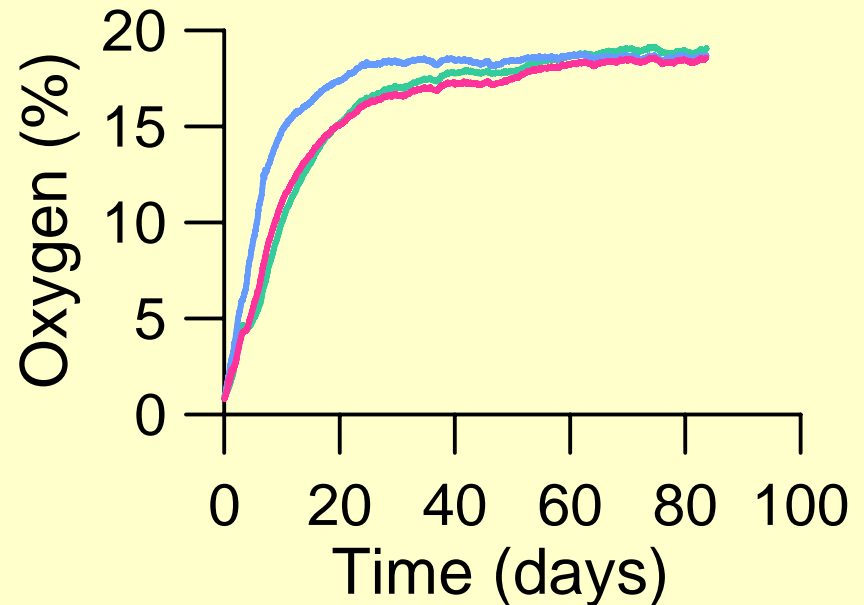


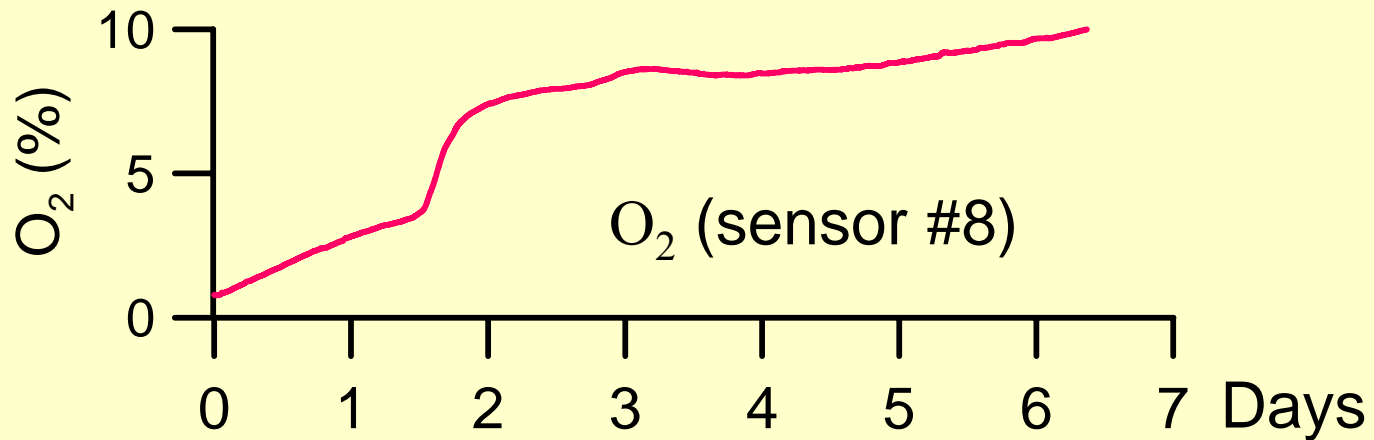
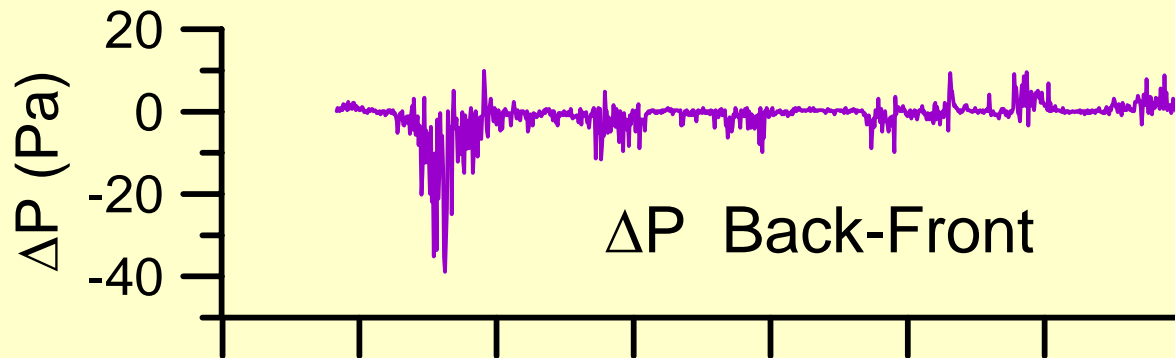
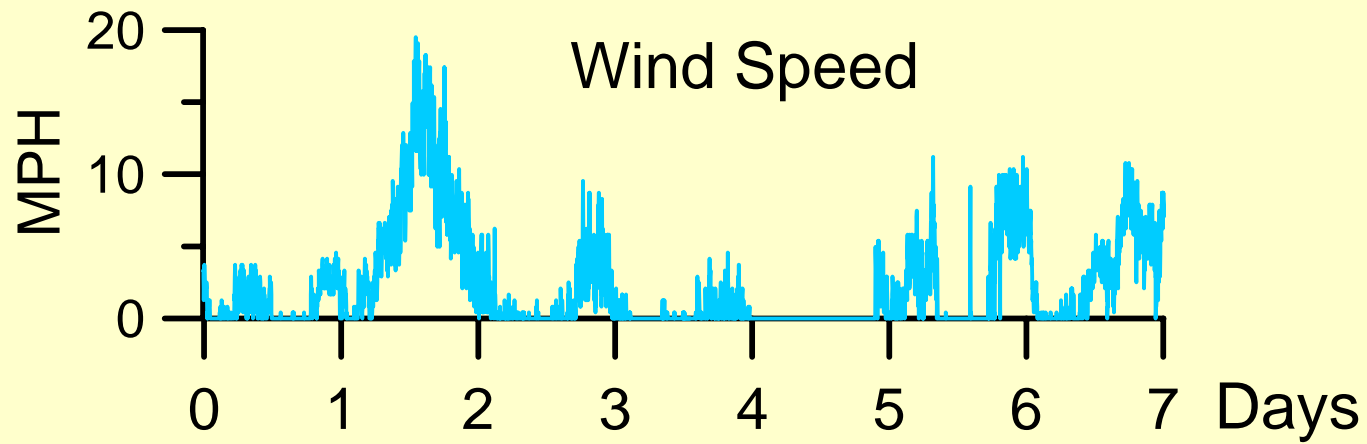
Sub-Slab O₂ Transport Experiment



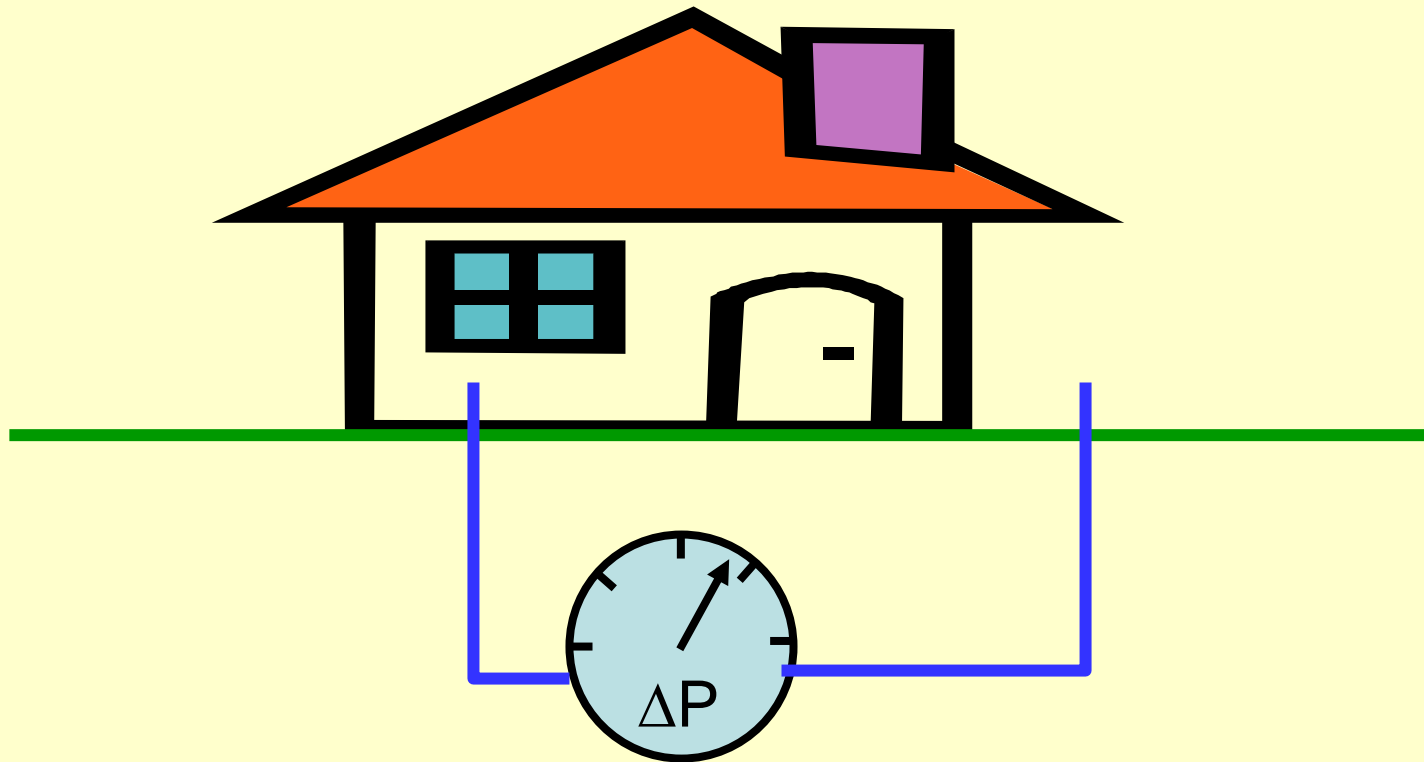
- N₂ injection
- ▲ O₂ sensor

Sub-slab O₂ Recovery





Building Underpressurization



0-50 Pa - range (*Nazaroff et al., 1985*)

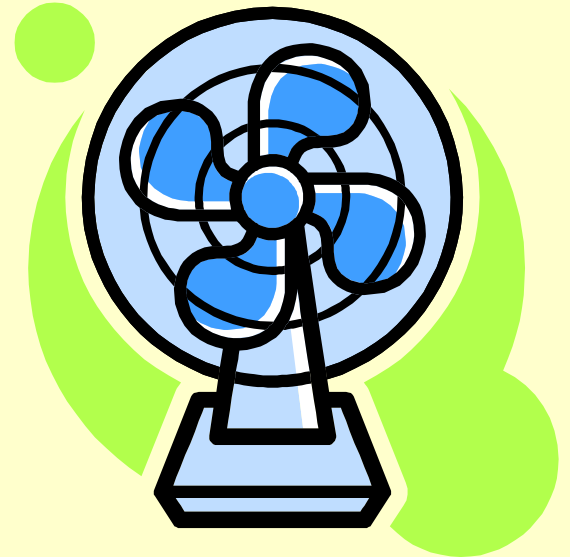
0-5 Pa - typical values (*Robinson et al., 1997*)



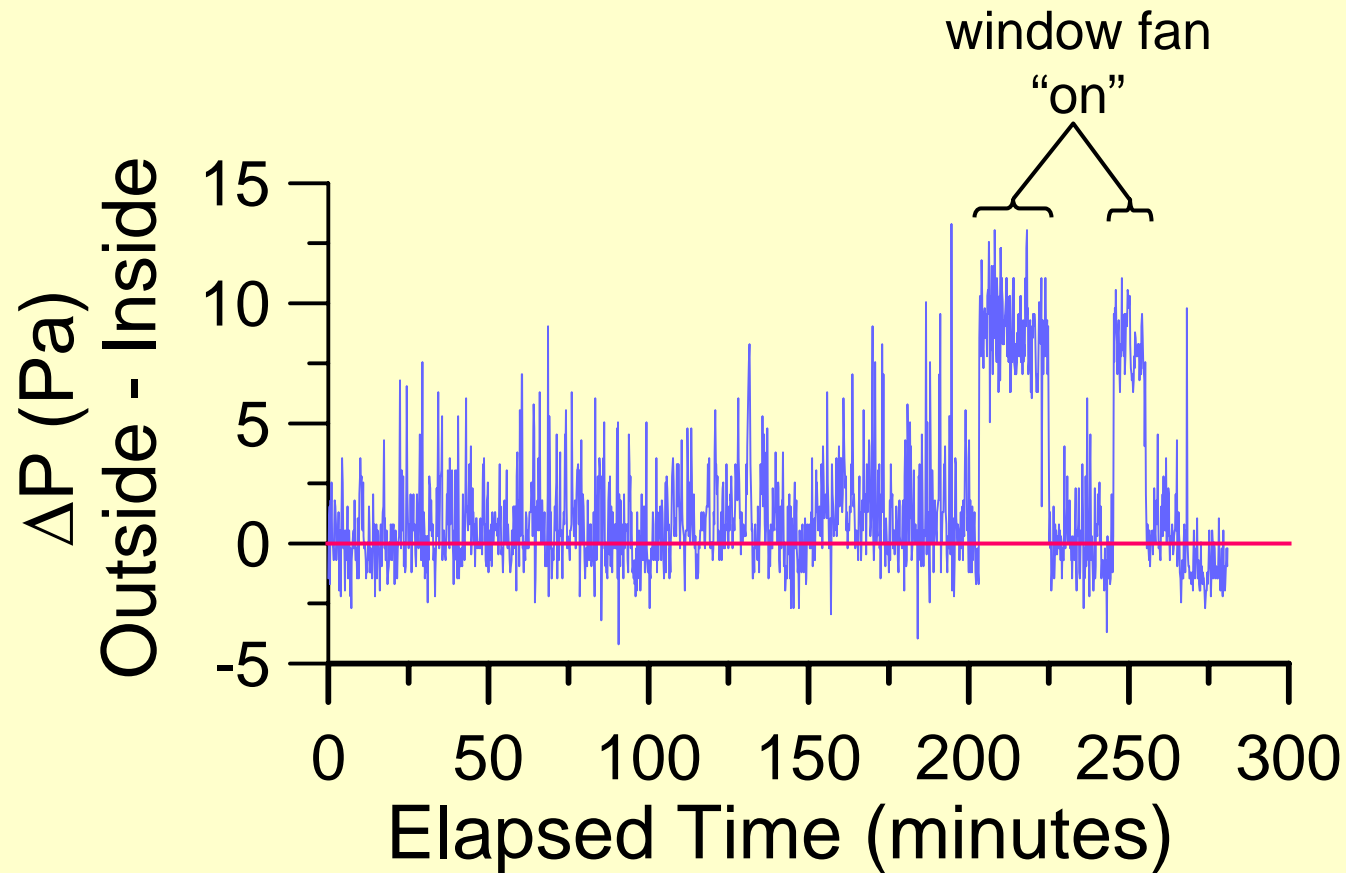
1 Inch H₂O = 250 Pa

House Underpressure Tests- Outside Pressure-Inside Pressure

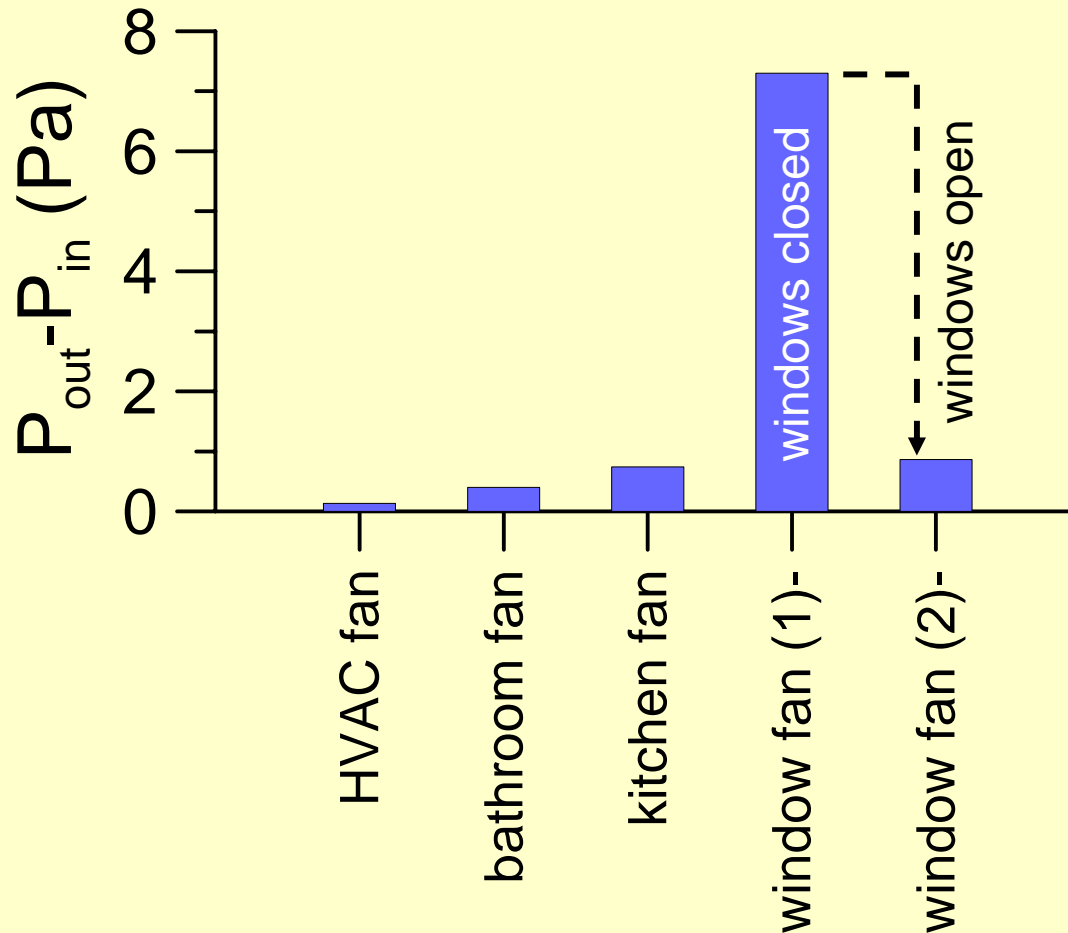
- Base conditions (closed windows and doors)
- Bathroom ventilation fan
- Kitchen stove ventilation fan
- HVAC fan
- Window fan



House Underpressure Tests

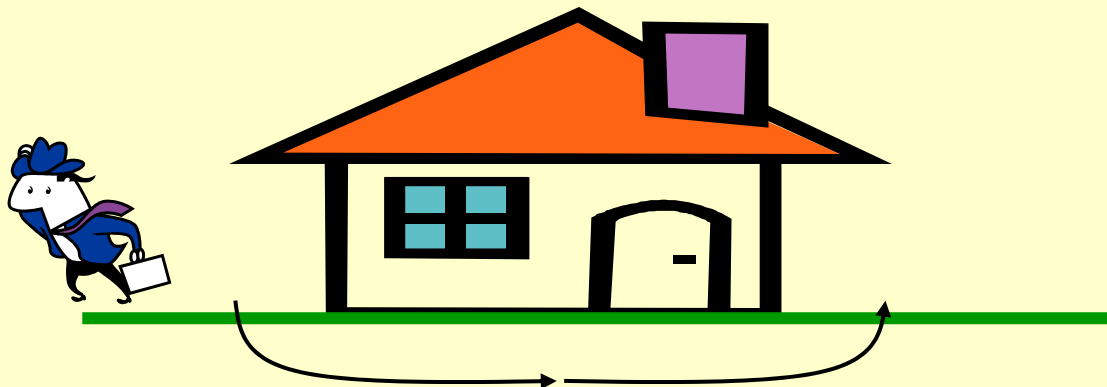


Underpressure Test Results



Site Specific Findings

- Sub-slab soil gas profiles are well predicted by near-slab profiles.
- Cross-slab pressure gradients are small and average ~ 0 .
- Sub-slab soil is naturally ventilated and kept aerobic.
- Wind-induced pressure gradients and diffusion play a role in the sub-slab ventilation process.
- House underpressurization is less than 1 Pa.



Comparison with Benzene Profile

