Case Study: Use of Alternate Vapour Flow Media for Vapour Management Systems in New Building Construction

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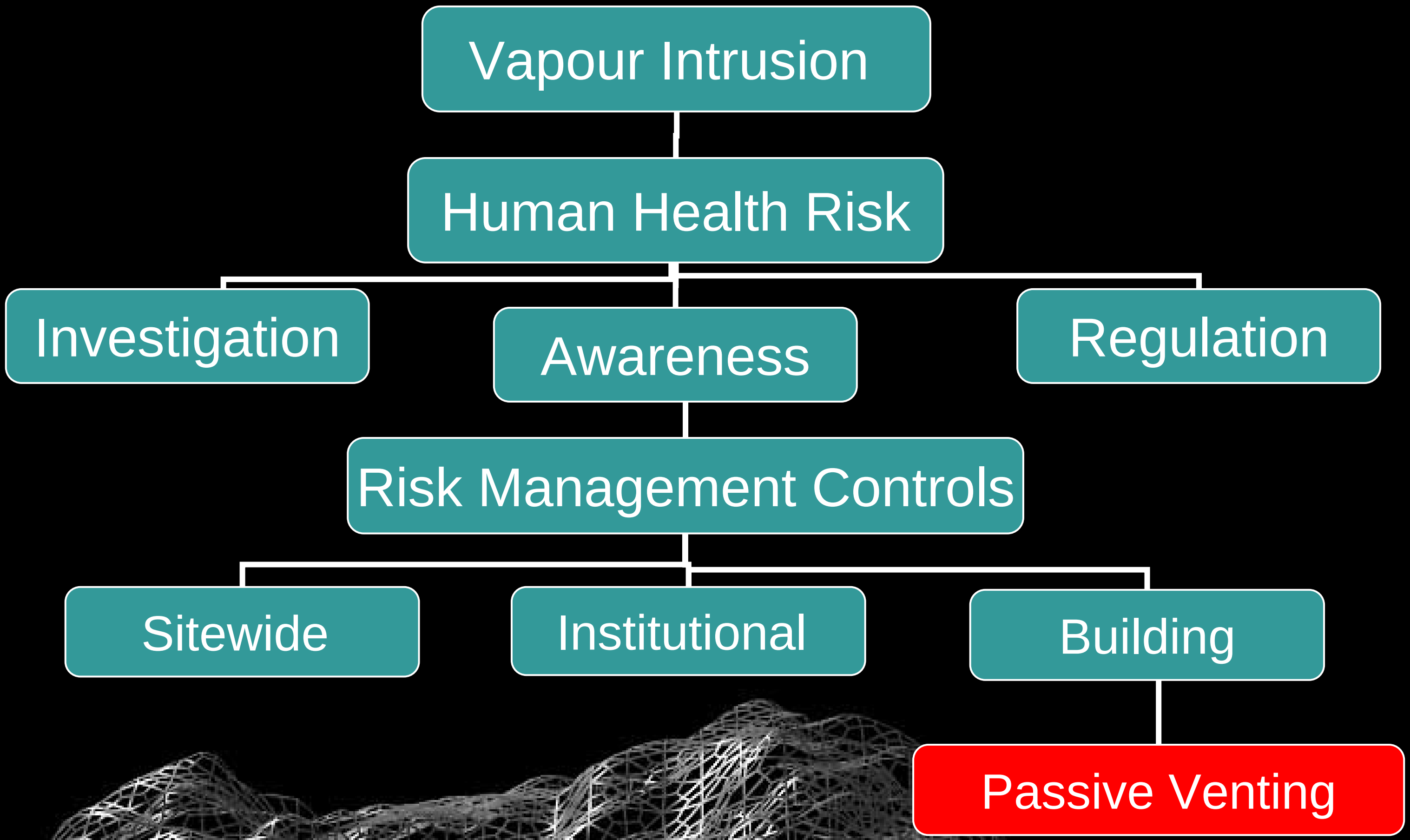
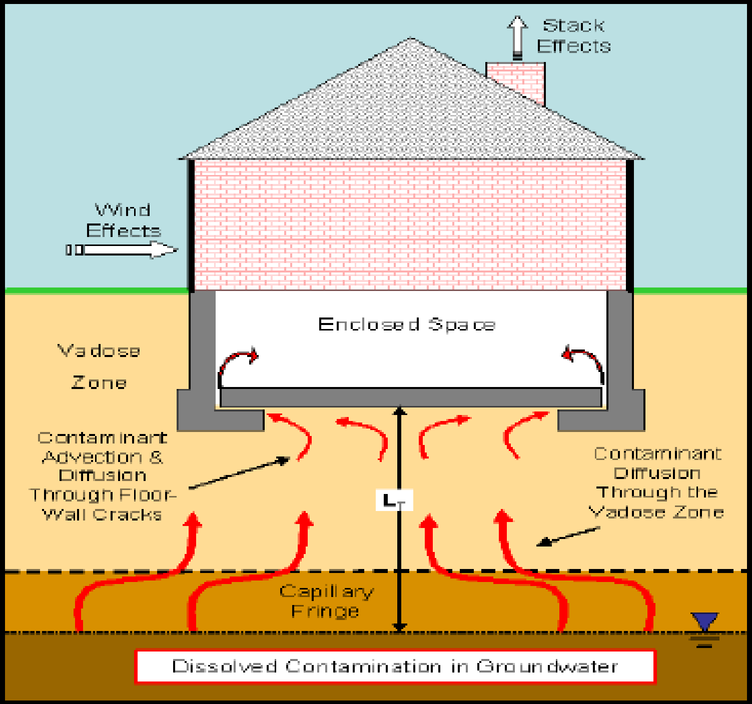
Overview


Vapour Intrusion
Human Health Risk
Investigation
Awareness
Regulation
Risk Management Controls
Sitewide
Institutional
Building
Passive Venting

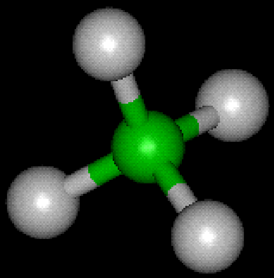
What is Vapour Intrusion?

- Soil gas migration from subsurface to overlying and/or adjacent buildings
- Common Sources
  - Landfills
  - Service stations
  - Dry cleaning facilities
- Transport
- Preferential Pathways



Provided by ITRC, January 2007

Methane Properties



- CH_4
- Simplest hydrocarbon (alkane)
- Gas at room temperature
- Less dense (lighter) than air
- Forms explosive mixtures with air (5 – 15% Gas)
- Colourless
- Odourless
- Simple asphyxiant

Regulatory Considerations

- City of Calgary - no written policy
- Alberta Environment – no written policy
- Calgary Health Region – internal guideline
  - Subsurface soil gas response:
    - [CH4] > 2% LEL (1000 PPM) - further Investigation
    - [CH4] > 10% LEL (5000 PPM) - mitigation
  - Indoor methane concentration response
    - [CH4] > 0.1% LEL (50 PPM) - further investigation
    - [CH4] > 1% LEL (500 PPM) - mitigation
  - Two Stage In-building Alarm System
    - Alarm # 1 > 5% LEL (2500 PPM) - alert occupants
    - Alarm # 2 > 10% LEL (5000ppm) - evacuation

Case Study – Background Information

- Brownfield development in Calgary
  - industrial and commercial land use
- Site area: ~ 100 ha
- 20-30 buildings proposed
  - Area: 50,000 ft^2 to 150,000 ft^2
- Former gravel pit backfilled with fine-grained material
- Elevated levels of methane identified in subsurface

Case Study – Mitigation

- Installation of a permeable trench along the perimeter of the site boundary
- Isolation of utility infrastructure
- Methane building management
- Methane monitoring program

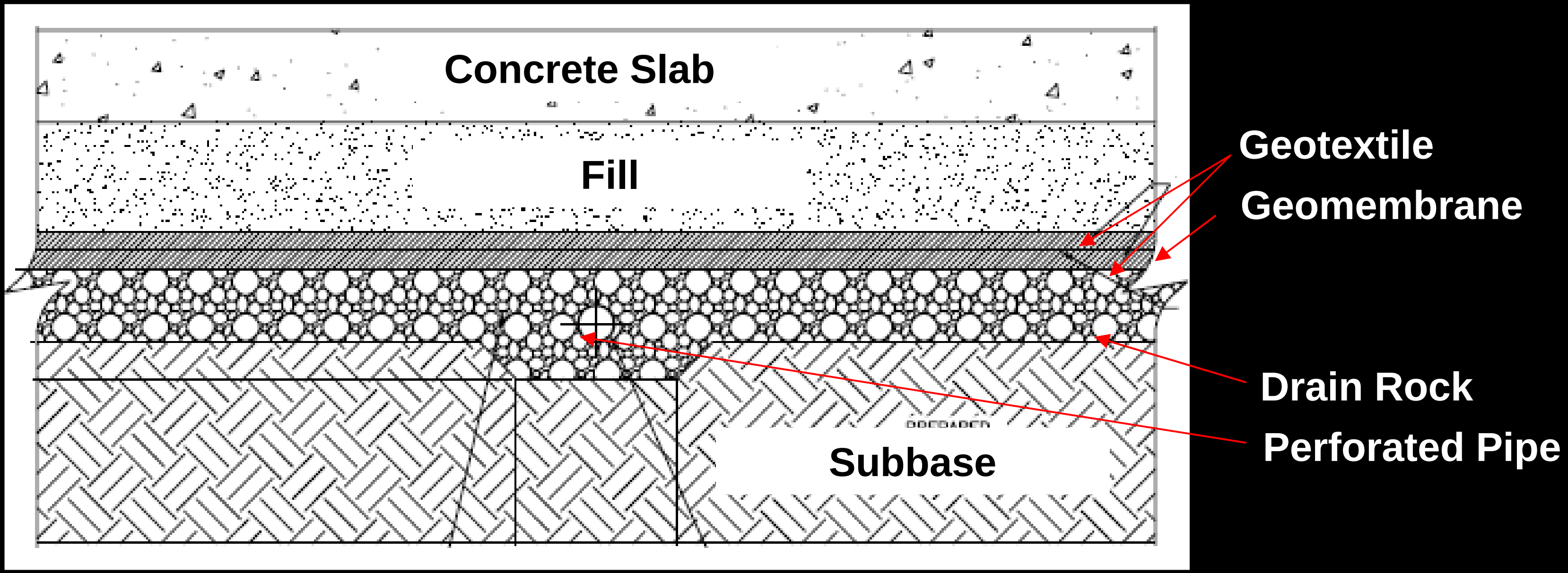
Case Study - Methane Building Management

- Purpose:
  - To reduce the potential for methane gas to accumulate to harmful levels inside the buildings

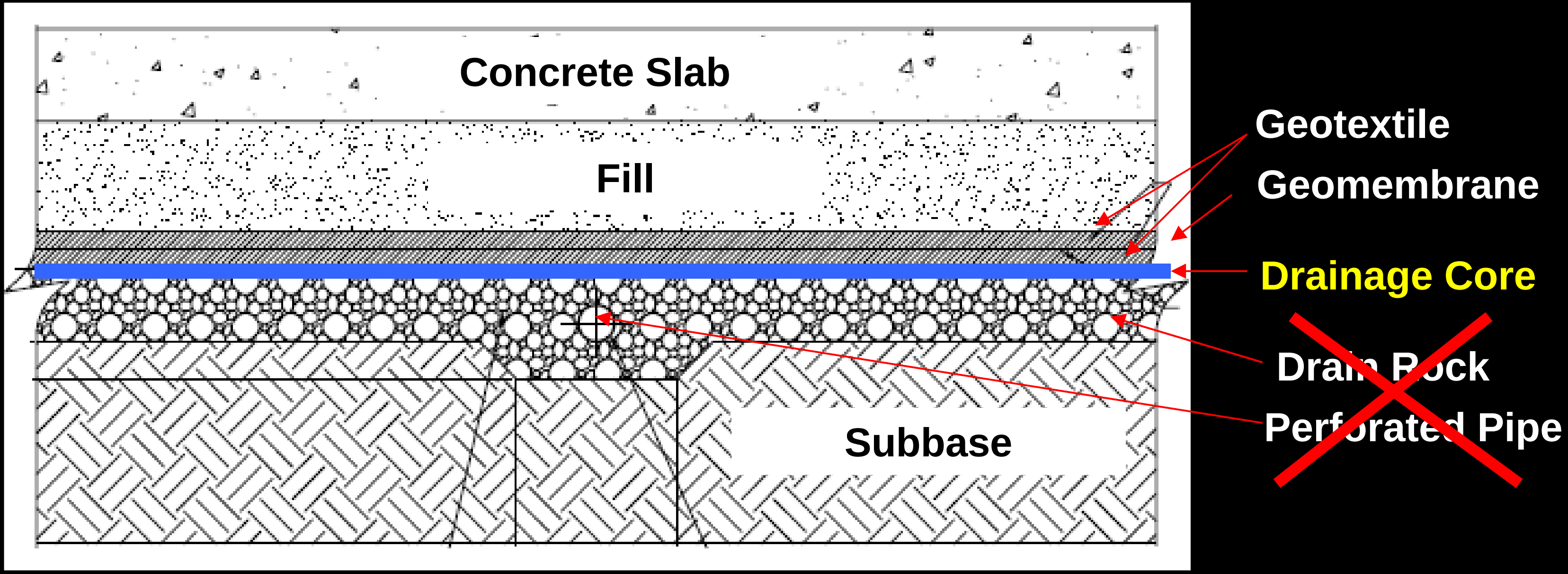
Case Study - Methane Building Management

- System principles
  - Passive vapour management system that can be activated
  - Automated, continuous in-building monitoring
  - Manual monitoring
    - short term and long term
  - Emergency response plan

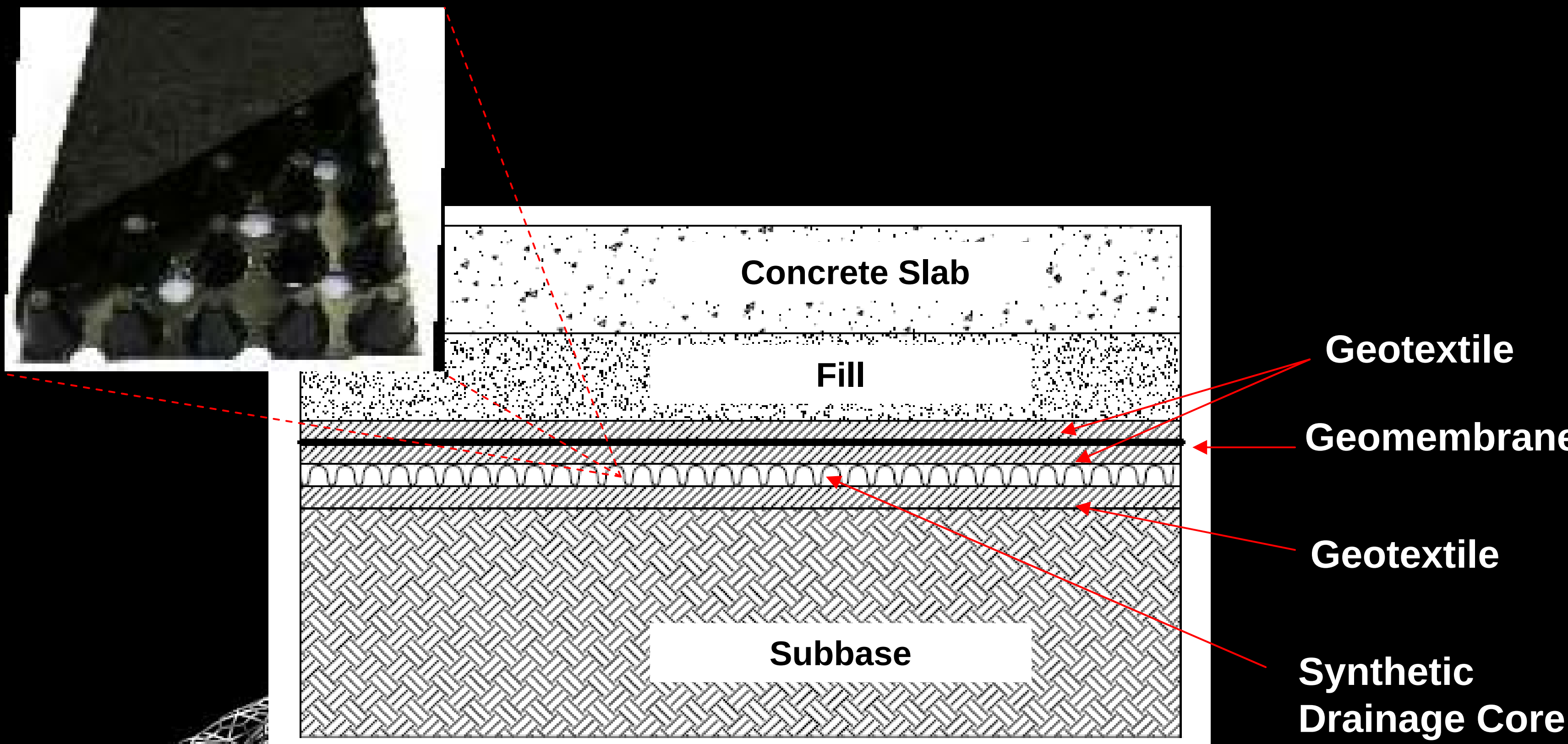
Case Study - Typical Vapour Management System



Case Study - Alternate Vapour Management System



Case Study - Alternate Vapour Management System (cont'd)



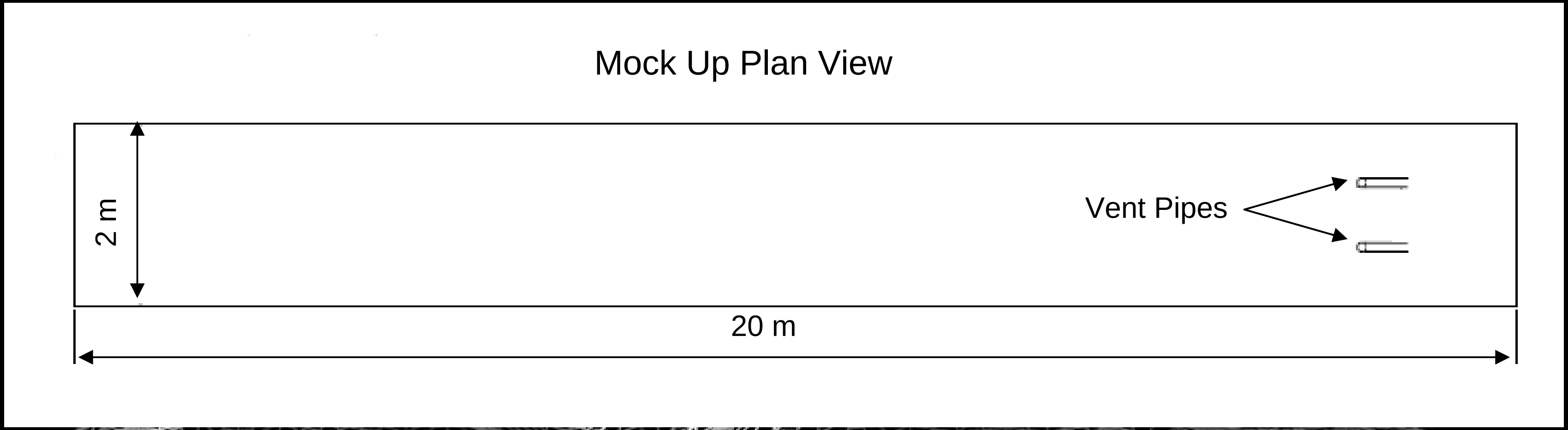
Case Study - Alternate Vapour Management System (cont'd)

Case Study - Pilot Testing

- Purpose:
  - How effective is a synthetic drainage core at facilitating air flow beneath a building concrete slab?
  - Determine linear flow of air through a typical VMS design (40 mm drain rock)
  - Compare with two configurations of synthetic drainage core
  - Compare with typical fill material (20 mm crush)

Case Study - Pilot Testing (cont'd)

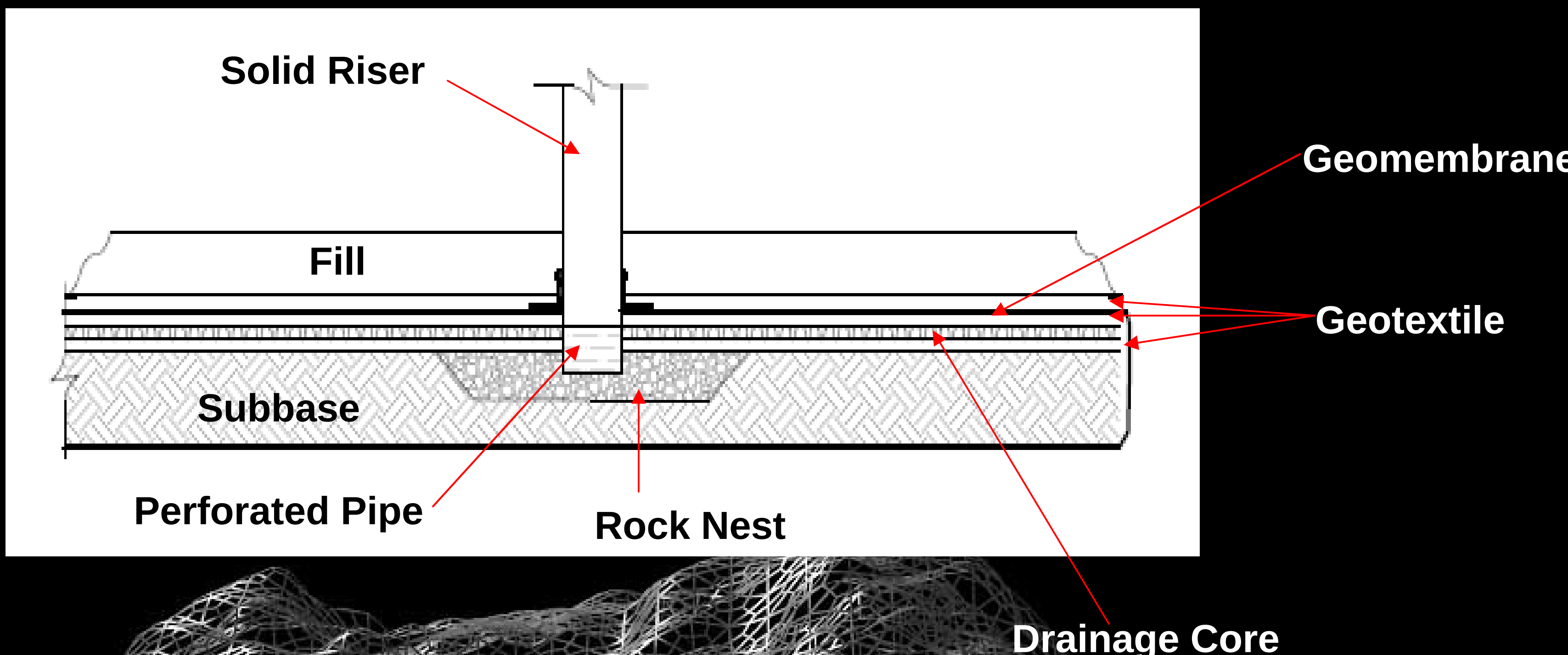
- 4 plots:
  - Dimensions: 20m x 2 m
  - Rock nests located at one end of the plots
  - Perforated pipes connected to solid pipes from rock nests, acting as risers
  - Completely enveloped in PVC to minimize short-circuiting
  - Numerous vacuum fan configurations investigated



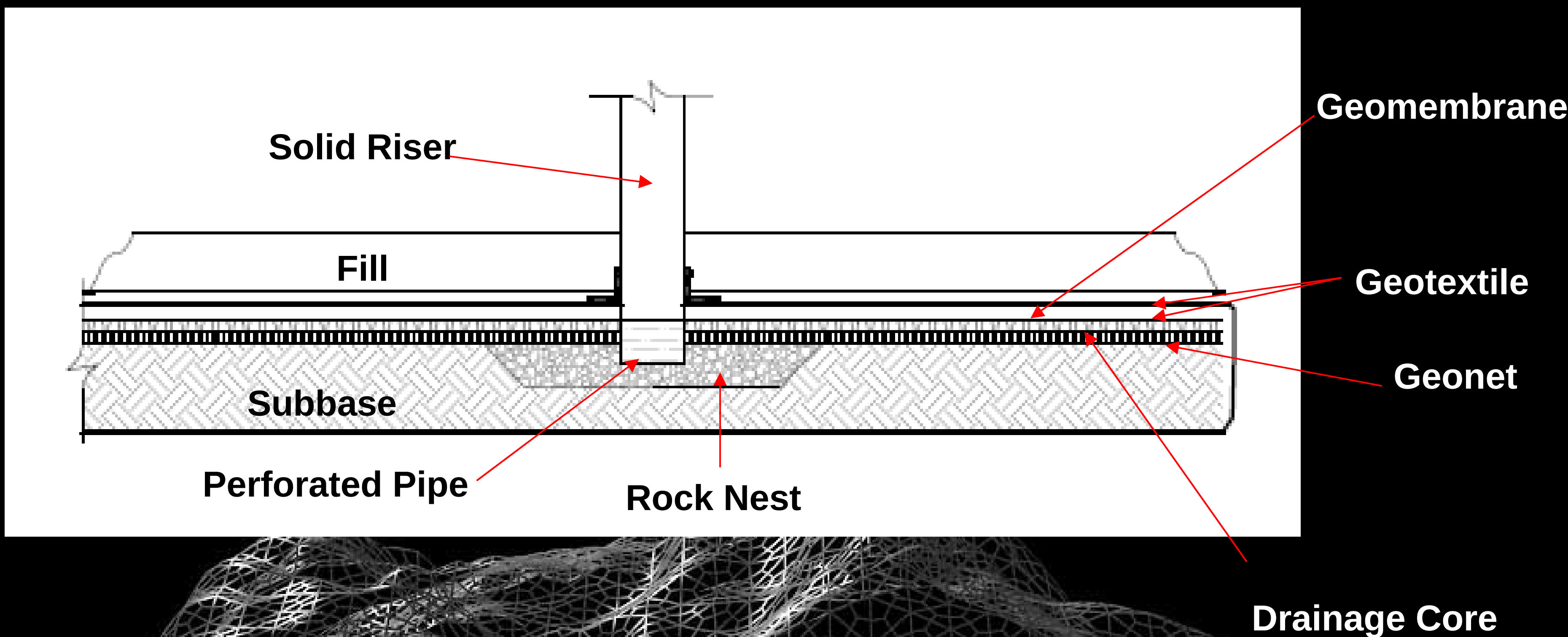
Case Study - Pilot Testing: Construction Details

- Using full size equipment, as in typical building construction (i.e., bobcat, vibratory compactors)
- Measure air flow and vacuum at select locations
- Inspect synthetic drainage core material to evaluate damage from compaction loads

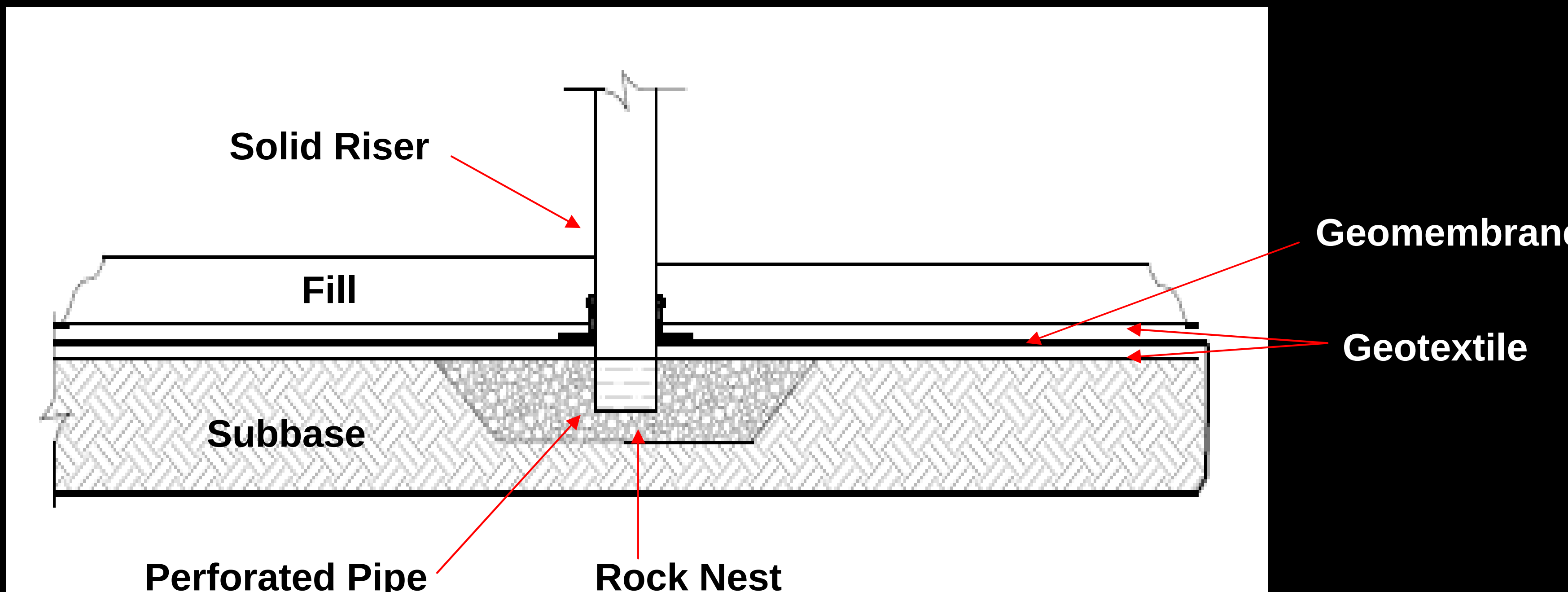
Pilot Test – Plot 1:
Synthetic Drainage Core/Geotextile



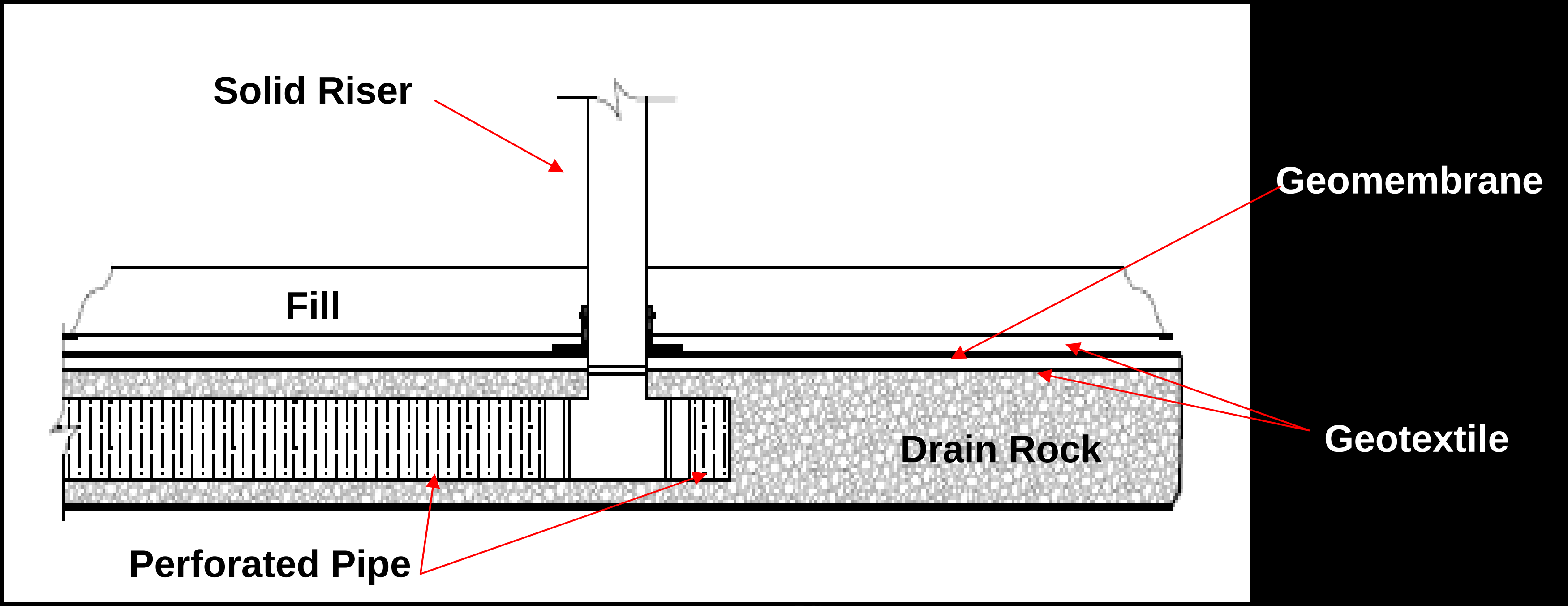
Pilot Test – Plot 2
Synthetic Drainage Core/Geonet



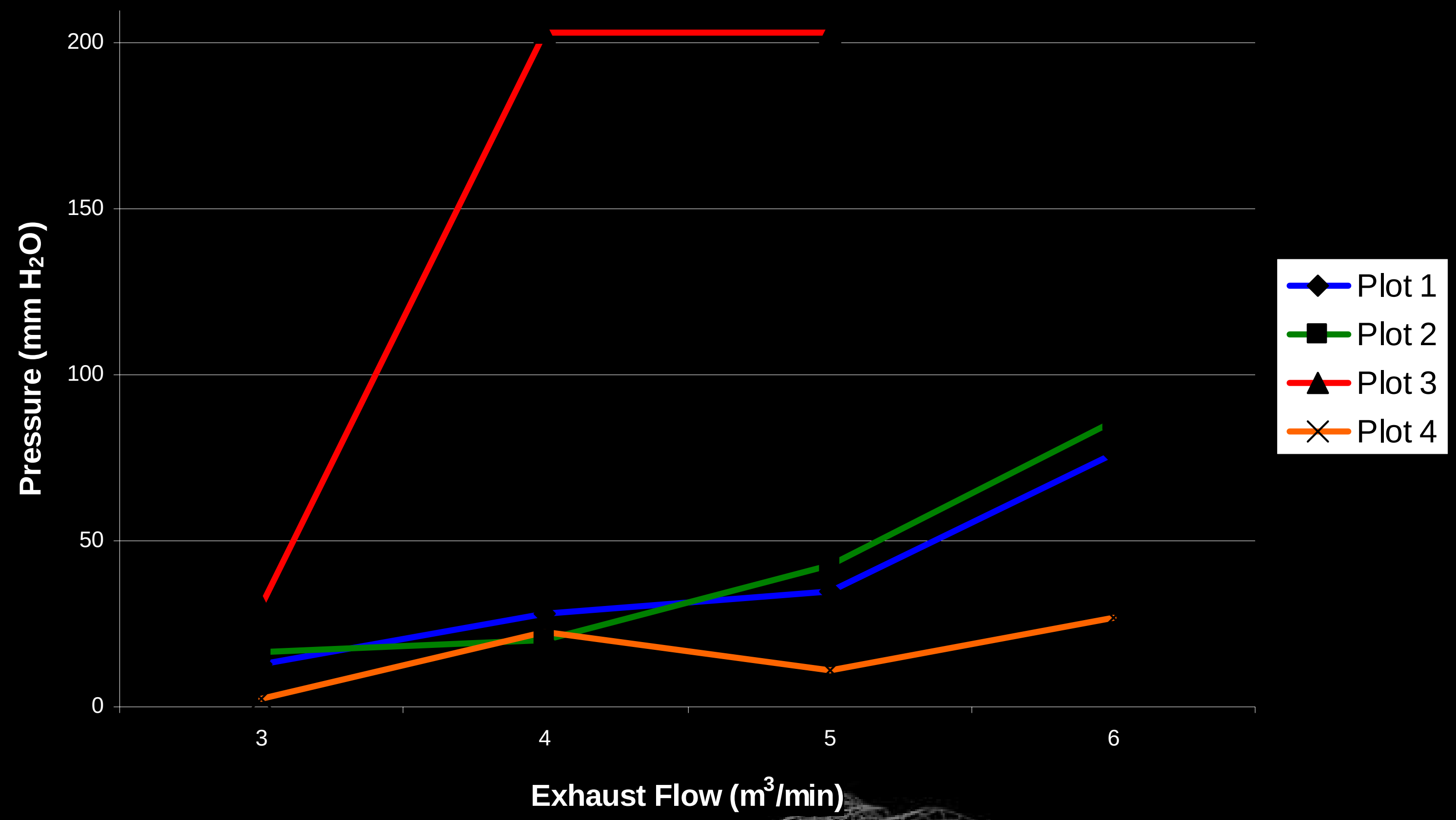
Pilot Test – Plot 3
Typical Fill (20 mm Crush)



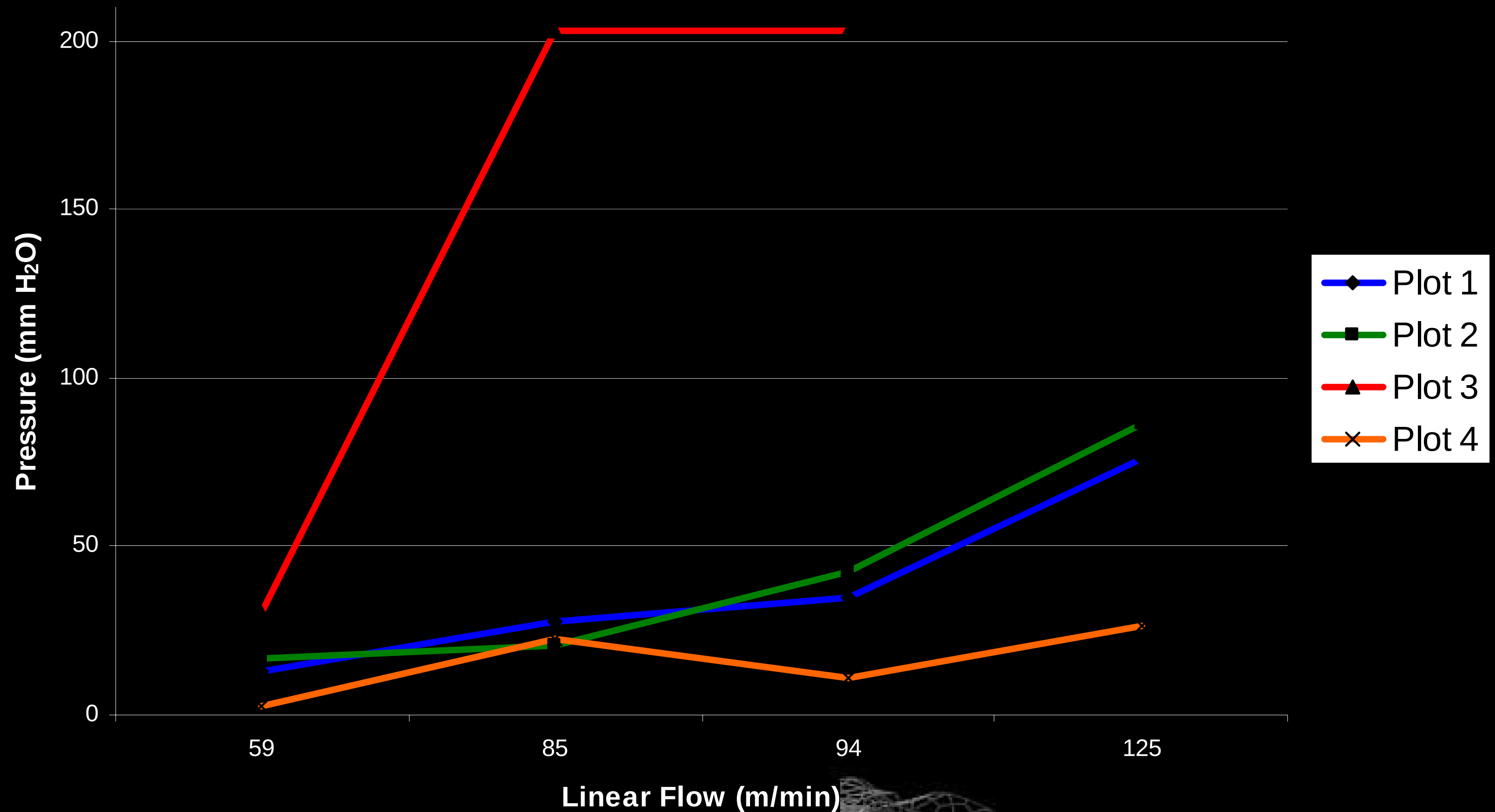
Pilot Test – Plot 4
Typical VMS/40 mm Drain Rock



Comparison of Plots



Comparison of Plots



Conclusions - Resistance

- Plot #4 (40 mm drain rock)
  - Greatest flow volume with the least amount of resistance
- Plot #1 (Synthetic drainage core/Geotextile)
  - Approximately 3.0 to 3.5 times more resistance at the same flow rate as Plot #4
- Plot #2 (Synthetic drainage core/Geonet)
  - Approximately 3.5 to 4.0 times more resistance at the same flow rate as Plot #4
- Plot #3 (20 mm crush)
  - Resistance at orders of magnitude greater than Plot #4

Conclusions - Use as an Alternate VMS Design

- Synthetic drainage core will provide similar air flows when used in a passive VMS
- If activation of the VMS is required, larger fans would be required to ensure adequate flow beneath the building sub-slab

Cost Comparison

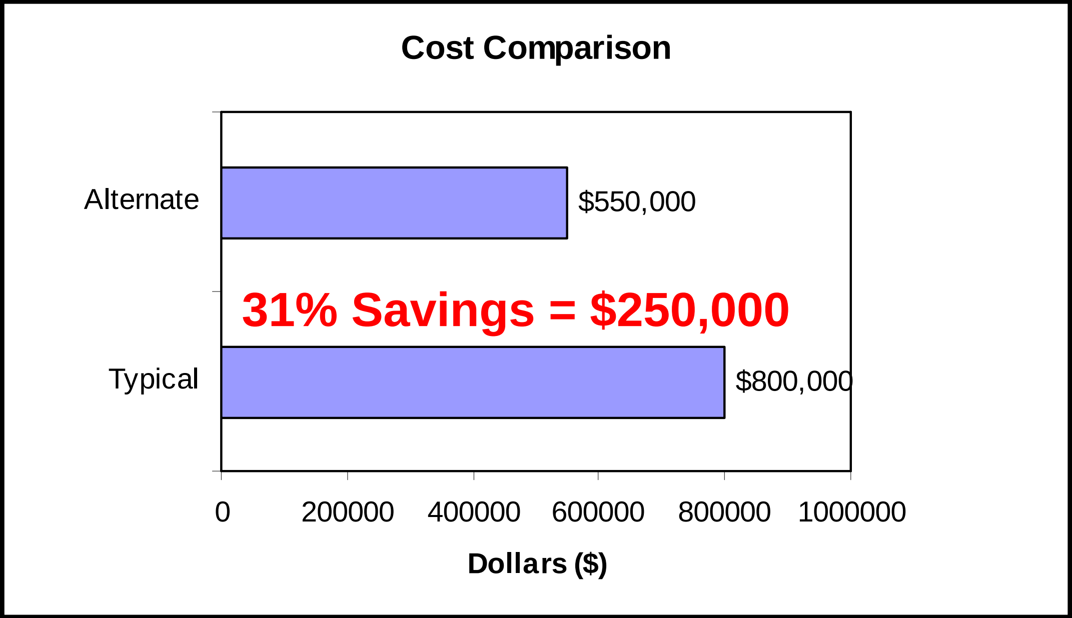
- Cost Variables
  - Building area
  - Building design (slab-on-grade, crawlspace)
  - Number of penetrations
- Unit Prices
  - Typical Vapour Management System
    - \$7.00 - \$9.00/ ft^2
  - Alternate Vapour Management System
    - \$5.00 – \$6.00/ft^2

Client quoted between 20%-50% Cost Savings!!!

Cost Comparison (cont'd)

Example:

- ~100,000 ft^2 commercial building
- slab on-grade design
- Costs based on contractor quoted prices for building construction in 2008



Alternate Vapour Management System

Advantages

- Less materials
- Reduced labour
- Reduced schedule
- Cost effective
- Greater stability
- Reduced earthworks

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Disadvantages

- Reduced flow
- Increased resistance
- Increased O & M costs if activation required
- More easily damaged during installation

Questions?

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