Real-Time Monitoring for Leak Locating with Wireless Moisture Content Sensors in Non-combustible Construction

SMT
Structure Monitoring Technology

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Wall Monitoring

Vancouver, BC
luxury residential rental building
Constructed 2004

189 suites, 14 of which are townhouses

The interiors of the townhouses were renovated to address damaged components just inside the exterior concrete walls:

2011: First townhouse renovation - Pilot
2012: First phase of the general renovation program
2013: Second phase of the general renovation program.

Wall Monitoring

Work completed to reduce the amount of condensation forming on the interior surfaces of the exterior walls and windows:

- foam insulation on the inside of concrete exterior walls
- Set back furring studs off concrete
- Improved supply and exhaust air systems
- aluminum fins on the interior of most window
- baseboard heaters below windows
- Insulation at some ceilings

Some recommendations were not implemented immediately, rather walls were monitored.

Wall Monitoring

Other potential water sources existed, including cracks/open joints in exterior walls, window leaks and the roofs.

Sense Engineering and SMT assisted with a monitoring program to check for other sources of moisture and the effectiveness of interior modifications.

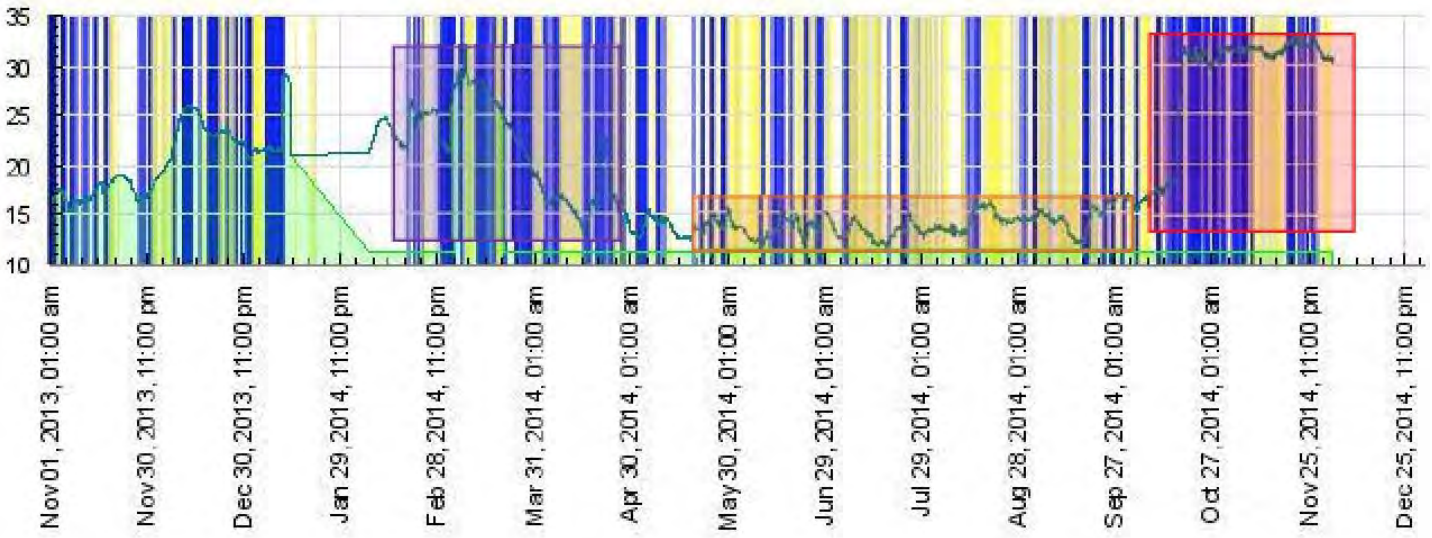
Wall Monitoring

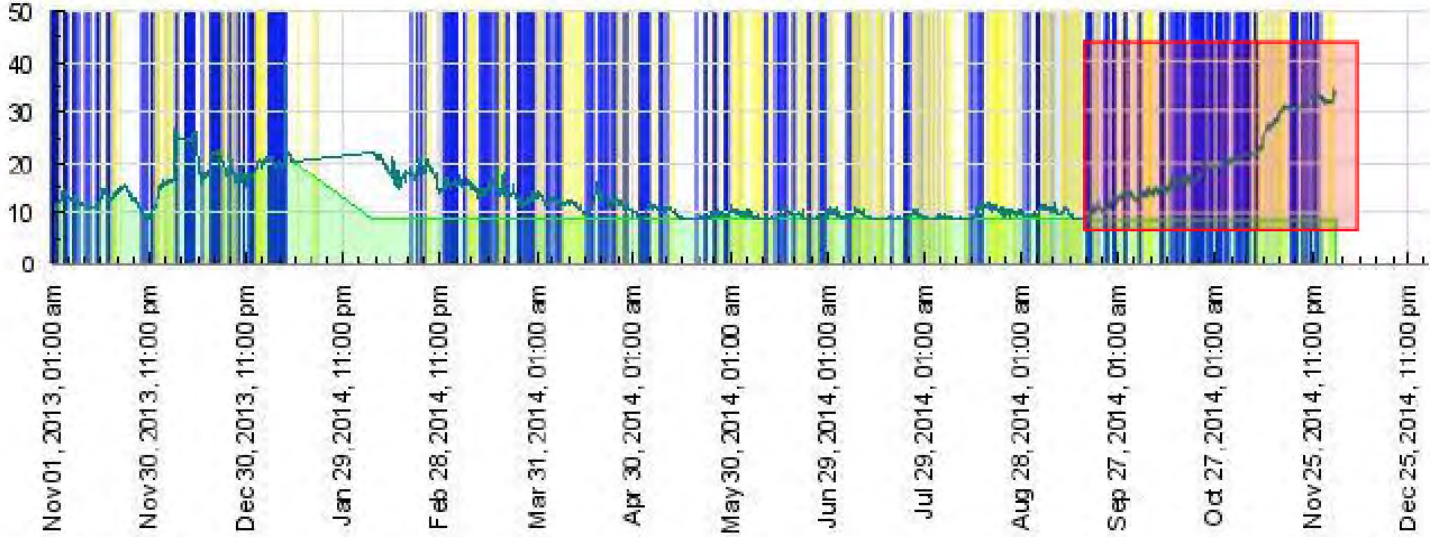
Wall Monitoring

Wall Monitoring

Townhouse 108

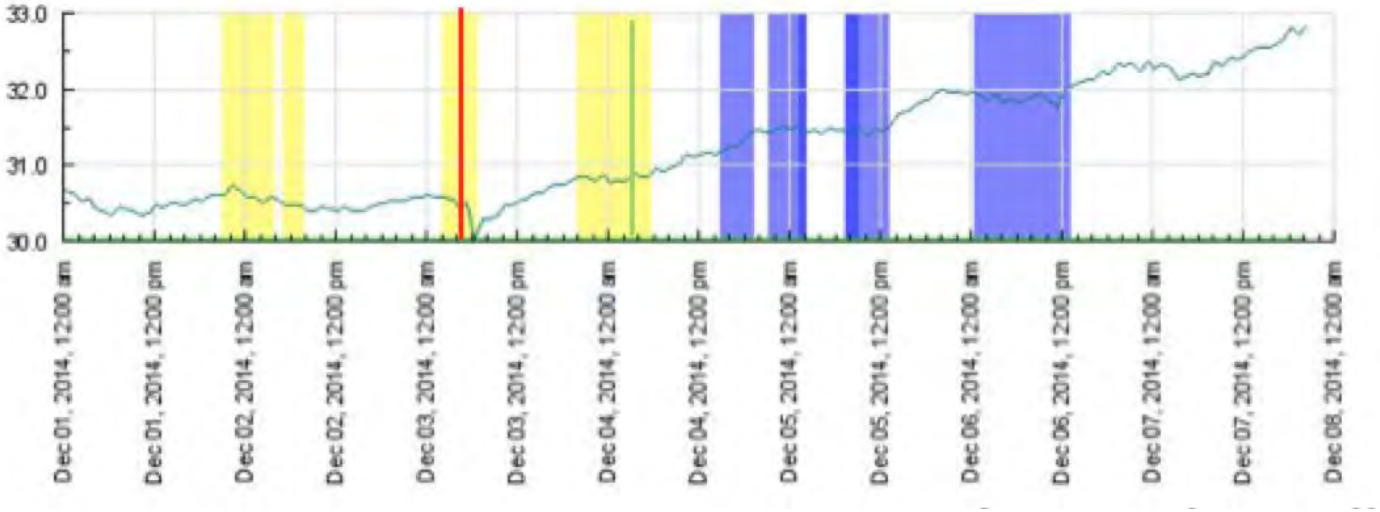
Figure 3: Sensors having elevated moisture content in the 2nd floor of Townhouse 108.

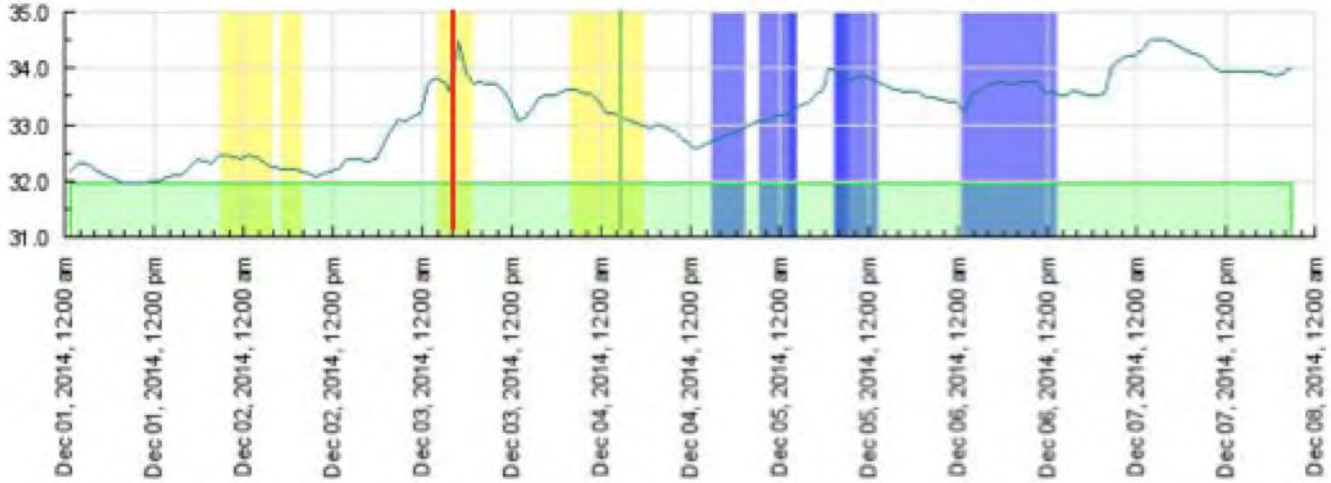




Townhouse 108

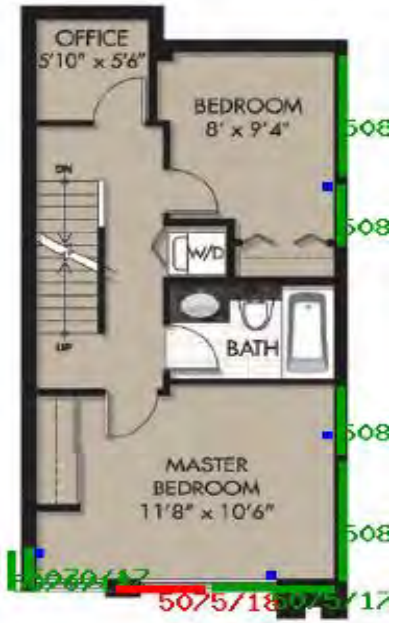
Figure 3: Sensors having elevated moisture content in the 2nd floor of Townhouse 108.





Red line indicates the approximate time of the wall water test.
The green line indicates the approximate time of the roof planter test.

Townhouse 903



Sensors having elevated moisture content in the 2nd floor of Townhouse 903.

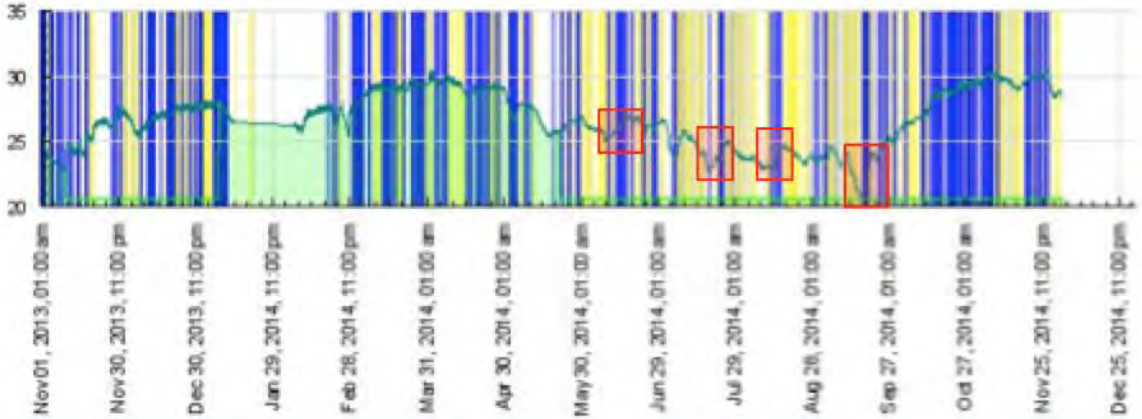


Figure 7: Moisture readings at right side of north-east master bedroom window in townhouse 903. Red boxes indicate where there appears to be a strong correlation with rainfall and sudden increases in moisture in the wall. There is a general accumulation trend in the winter when the wall cannot dry out.

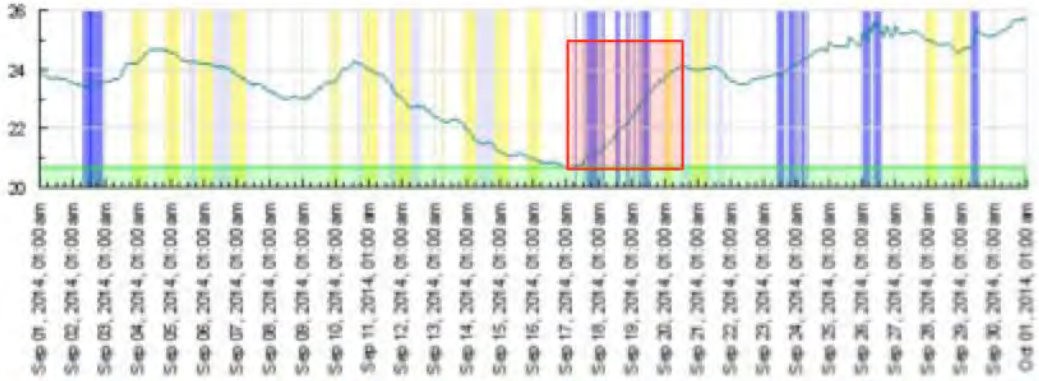
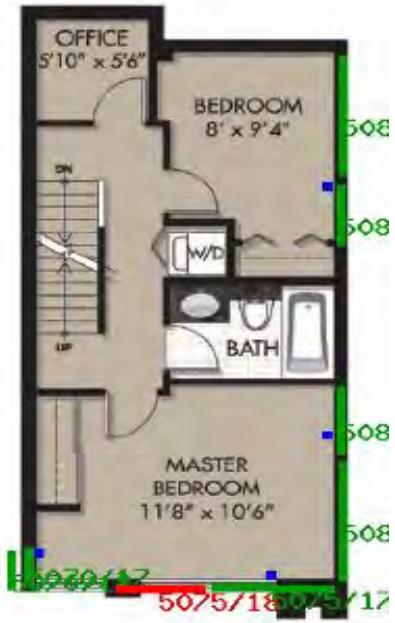
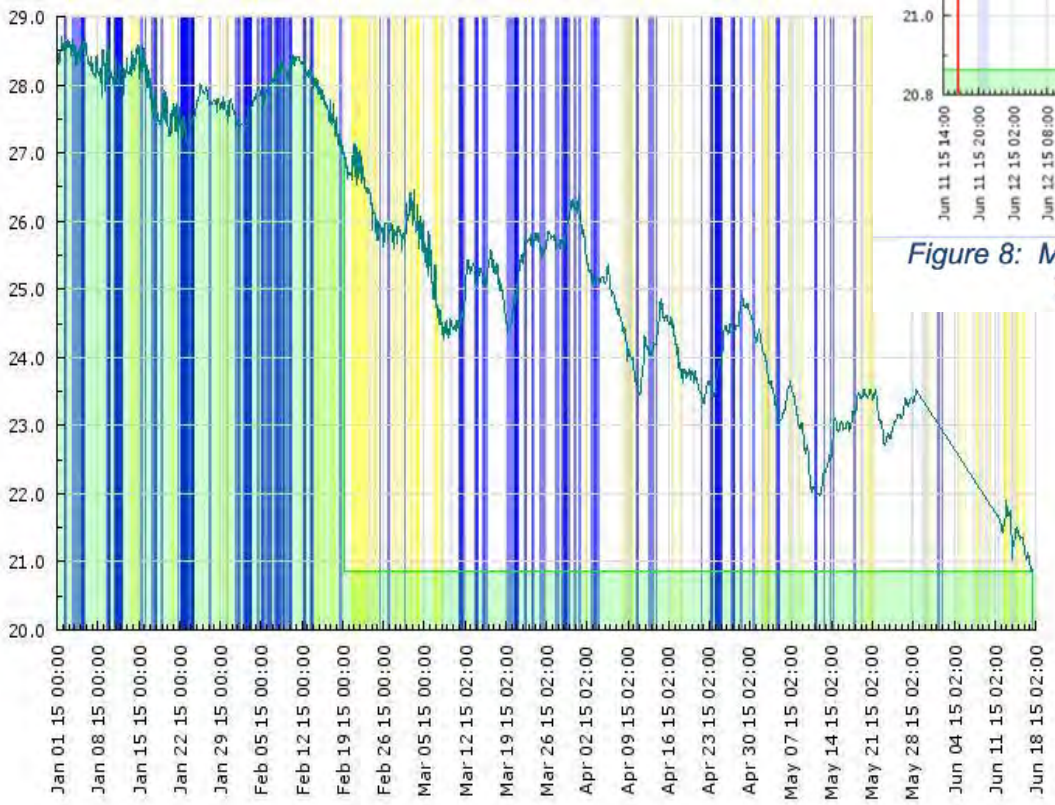


Figure 8: Snapshot of moisture readings at the master bedroom of Townhouse 903 following rainfall on September 7, 2014. Temperatures were generally above 15°C during this period, making condensation on windows and insignificant moisture source.

Townhouse 903



Sensors having elevated moisture content in the 2nd floor of Townhouse 903.



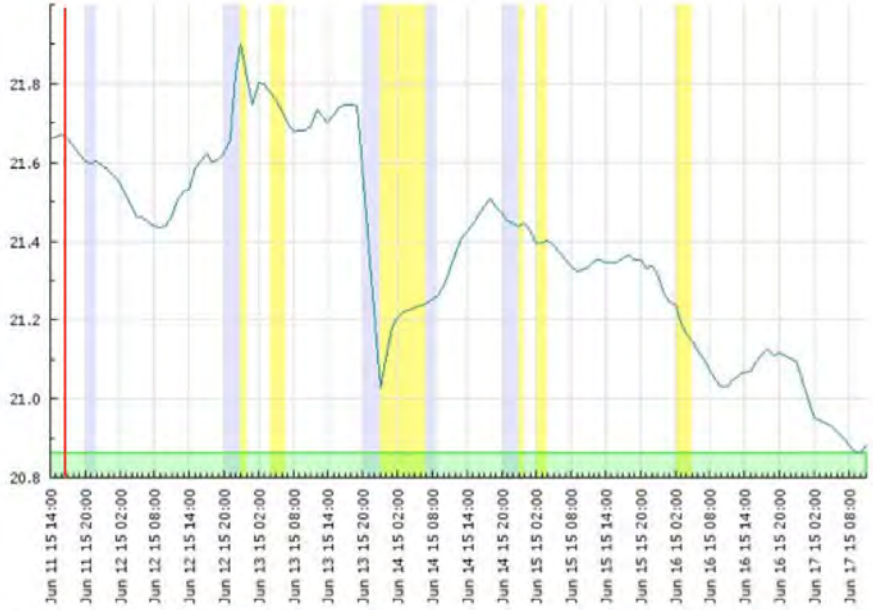


Figure 8: Moisture readings at right side of master bedroom window in Townhouse 903 immediately after water testing.

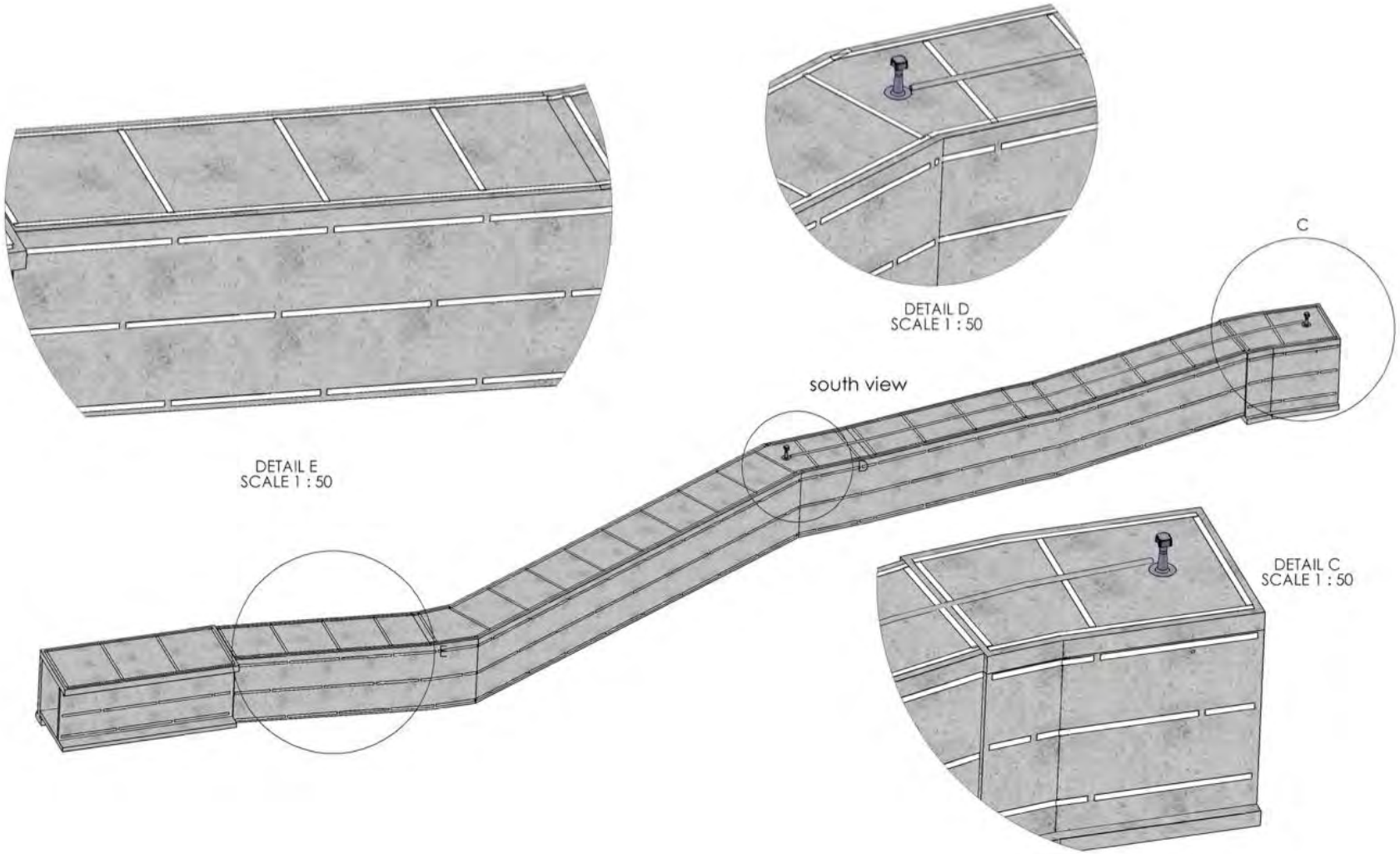
CONCLUSIONS

- Exterior water was entering from some roofs and some joints in exterior concrete.
- Condensation continued to occur on corner and end suite windows.

CASE STUDY:

Pedestrian Tunnel

Leak Detection in a Pedestrian Tunnel



Staggered Horizontal Sensor Grid

Precast Segments

Bentonite, Mechanically Fastened

Waterproofing, Drainage, and Insulation

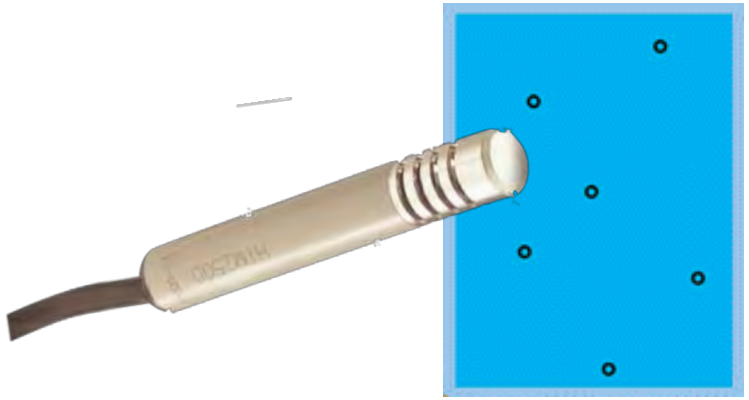
Sequencing

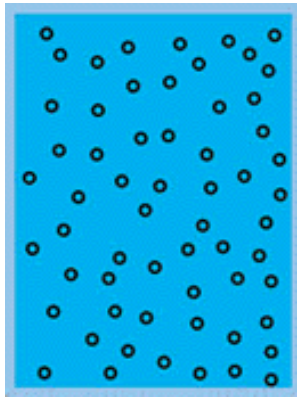
Square Grid on Tunnel Roof

Electronics Installation

End of Presentation

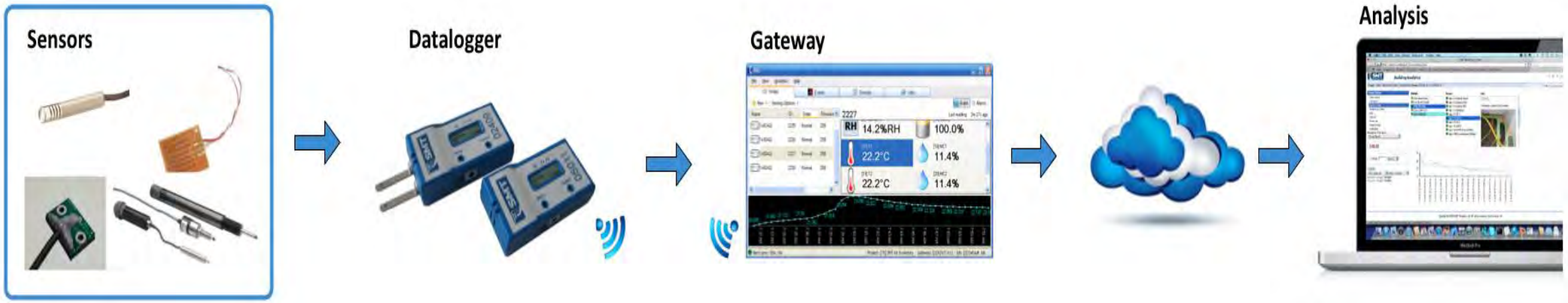
Relative Humidity versus moisture content





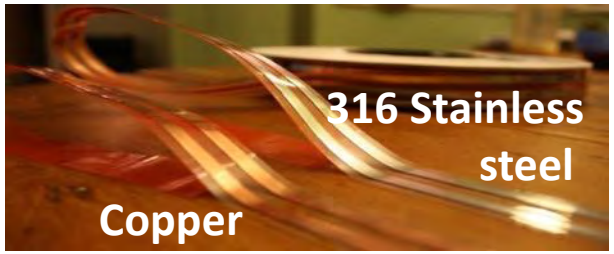
RH Air	20%	40%	60%	80%	95%	H_2O →		
MC Wood[1]	4.5%	7.7%	11%	16%	24%	30%	35%	>40%
MC Gypsum	0.1%	0.5%	0.75%	1%	2%	4%	>6%	
MC Sandstone	<0.5%	<0.75%	<1%	1.75%	2%			

System Overview



SMT has a complete suite of sensors, data acquisition, gateways, and cloud based analytics for any project.

Linear Moisture Sensor



Detects the presence of moisture
Has a wide coverage area
Has limited accuracy

WALL

ROOF

FLOOD