TEST BUILDING LABs 101

This guide is intended to provide an overview of solutions available for living laboratory, test building labs, or structures commonly called test hut installations. What you choose to assess and test in your experiment is critical to select the appropriate sensors and installation methods. SMT provides a variety options to assess multiple aspects, which can be tailored to your application. Some common test hut parameters available at SMT include:

1. Moisture Profile
2. Temperature Profile
3. Differential Pressure Gradients
4. Thermal Performance
5. Window Performance
6. External Environmental Conditions

This guide serves to introduce basic sensors, monitoring parameters, and sensor applications relevant for research huts. Provided at the end of this guide is the **SMT Service Request Form**, which can be completed and forwarded to our team to help facilitate the process.

ESSENTIALS

Moisture and temperature monitoring are fundamental parameters appropriate for evaluating and comparing the performance of building materials and structures. SMT has a variety of options available for both temperature and moisture monitoring.

Moisture

Condensation formation and moisture presence is important for assessing material degradation, hygrothermal performance, and/or conditions for mould growth. SMT sensor options for monitoring moisture in structures include: bulk water detection, point moisture measurements, and indirect water content measurements.

Point Moisture Measurement sensors (PMMs) perform direct contact moisture measurements with excellent material interface connectivity. Options for shallow and deep internal measurements within envelope layers are available.

Moisture Detection Sensors (MDS) provides surface detection of water presence by adhering to the face of materials. Copper conductors are available; however, MDS continuously exposed to moisture will require stainless steel conductors. MDS tape is used in conjunction with PMMs for leak detection, moisture indications, and condensation sensing.

Embedded Moisture Sensors (EMS), also known as a Duff Gauges, indirectly measure moisture of materials not compatible with other measurement techniques, such as gypsum, concrete, masonry, etc. Sensors are embedded in the material and obtain relative moisture level of surrounding area through capillary absorption.

Temperature

Temperature distribution throughout the building envelope, roof, and air space can also provide valuable data on the wall's performance. With the exception of brass pins and MDS tape, SMT moisture sensors are fully integrated with thermistors for temperature compensation and monitoring. Additional temperature sensors for brass pins are recommended for temperature correction.

ADDITIONAL MONITORING

Branching into extensive measurements, specialized sensors can be incorporated into your experiments for added complexity and in-depth analysis. From thermal efficiency to solar radiation, SMT has a plethora of proven sensor options to differentiate your study from the average hut.

Pressure

Building science investigations can be supplemented with differential pressure monitoring for observing pressure drive, air tightness, stack effect, and condensation. SMT provides sensors for monitoring changes to pressure balances between envelope layers, cavities, and/or surrounding environment. Recently, SMT has been working with researchers to explore robust compact solutions for measuring air velocity directly.

SDP1000 differential pressure sensors are hysteresis free and feature offset capabilities, long term stability, and maintain excellent accuracy in low pressure applications. Two small tubes are used to connect the sensor to each location, making it ideal for mobile applications and situations were mounting orientation varies.

Thermal Performance

By collecting measurements related to energy transfer, dynamic thermal performance of an assembly can be investigated. Material degradation, environment and internal conditions, installation method, and material type all influences the thermal performance of a structure.

Thermal Efficiency Monitoring Kit (TEM Kit) developed by SMT provides an assessment of the thermal performance of structures with consideration to the existing ASTM standards. With minimal thickness and excellent sensitivity, this large area heat flux sensor provides real time data under varying conditions and establishes a dynamic thermal resistance. Sensors can be installed internally or externally on the surface of structures.

Window Performance

Solar radiation and moisture near the window are factors effecting a window's performance. **MDS tape** can be mounted on the stud track underneath the window to monitor for moisture presence.

SP-212 solar radiation sensors are stable and heated to minimize errors cause by dew, frost, and snow. SP sensors are calibrated for shortwave radiation and can be easily mounted on your hut.

External Conditions

SMT methods to monitor external conditions include relative humidity, condensation, and driving rain sensors.

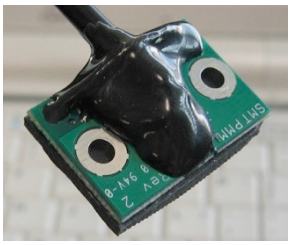
HTM2500 relative humidity sensors are accurate, reliable, and responsive. Applications include envelope cavity validation, air quality analysis, drying progress, and verification of equipment status. With excellent recovery after condensate exposure, HTM2500 instantly desaturates after long-term saturation. Rain shields are recommended for outdoor measurements.

Low profile condensations sensors detect the presence of condensation, frost, or ice through dielectric based capacitance sensing. Either side of the sensor can be activated for measurements. Integrated and external temperature options are available.

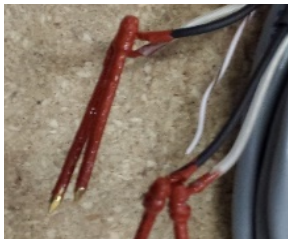
Driving rain gauges measure the amount of raining falling on the side of the building. Its effective management is critical for determining the durability of building enclosures. Options that integrate relative humidity, temperature, and solar radiation sensors are available.

SENSOR SNAPSHOT: FUNDAMENTAL AND ADDITIONAL

Moisture Detection Sensor
Bulk Water Detection



Point Moisture Measurement
Shallow Point Measurement



PMM: Brass Pins
Deep Point Measurement

Embedded Moisture Sensor
In-Direct: Moisture Content

Thermistors
Temperature

Differential Pressure
High and Low Sides

Heat Flux PHFS-09E
Interfaces with materials

HTM2500
External / Air Cavity

Solar Radiation
Roof/Windows

Condensation
Roof

Weather Station
Outdoor Environment

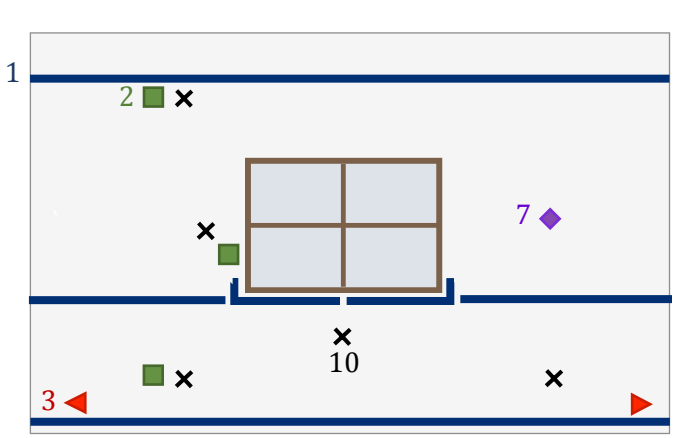
Rain Gauge
Outdoor Environment

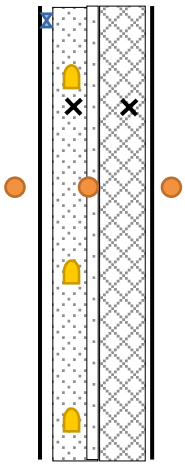
TAKING IT FURTHER

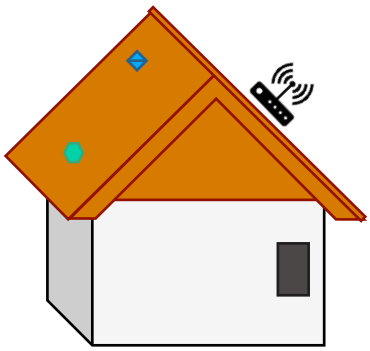
SMT is more than excited to help you bring your research to the cutting edge. Please include details in your project and SMT personnel will contact you to bring your ideas to reality.

SMT Research Ltd. – 103-1089 East Kent Ave N, Vancouver, BC V5X 0B2 – Tel: 778.373.2071 – Fax: 204.480.8573
Website: www.smtresearch.ca Email: info@smtresearch.ca

APPLICATION EXAMPLE: THE WORKS







	Recommended Locations[2] / Applications	Building Parameter	Sensor
1	Stud track under windows, external insulation behind finish, drainages, locations where condensation is expected	Bulk Water Detection	MDS
2	Interior surfaces, areas susceptible to thermal bridging, thermal interfaces etc.	Heat Flux[1]	TEM Kit
3	Joints, wood, materials, framing and sheathing layers, and locations susceptible to moisture absorption	Direct Point Contact Moisture	PMM
4	Exterior, interior, building envelope cavities, etc.	Relative Humidity / Temperature	HTM2500
5	Embedded in rigid insulation, stone, concrete, masonry	Indirect Moisture Level	EMS
6	Air cavities	Direct Air Flow	F450
7	Between two pressure zones	Differential Pressure	SDP1000
8	Roof, exterior walls, windows	Solar Radiation	SP-212
9	Roof, exterior walls	Condensation	COND
10	Throughout envelope, interior, exterior	Temperature	
11	In close proximity to the test hut	Weather	Weather Station
12	Outdoor wall of the test hut	Driving Rain	RG-01

[1] Heat flux requires two temperature sensors across the material being assessed

[2] Examples of sensor locations include:

- top, middle, and bottom
- interior surface, exterior surface, and within envelope layers
- areas with unique features, penetrations, etc.

Learn more about commercial and research monitoring at the following links below:

Windows	Walls	Foundations	Roofs

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SMT SERVICE REQUEST FORM: SENSORS

To get started on your living laboratory, review and send the below form with any relevant or known information. Include any additional drawings, pictures, or information relevant to your project. SMT personnel will review your inquiry and contact you shortly with a solution tailored to your application.

General

- ☐ Moisture
- ☐ Temperature
- ☐ Differential Pressure
- ☐ Thermal Performance
- ☐ Window Performance
- ☐ External Conditions
- ☐ Air Flow
- ☐ Other, please specify

SMT Sensors

- ☐ Moisture Detection Tape Sensor
  - ☐ Copper ☐ Stainless Steel
- ☐ Point Moisture Measurement
  - ☐ PMM ☐ Brass Pins
  - ☐ Extensions _____
- ☐ Thermistor
- ☐ Differential Pressure
- ☐ Relative Humidity
- ☐ Thermal Flux
- ☐ Solar Radiation
- ☐ Condensation
- ☐ Condensation with Thermistor
  - ☐ Integrated ☐ External
- ☐ Direct Air Flow
- ☐ Weather Station
- ☐ Driving Rain
  - ☐ RH/T ☐ Solar Radiation
- ☐ Custom, please specify

Number of Locations

- ☐ Walls x _____
- ☐ Windows x _____
- ☐ Roof x _____
- ☐ Foundations x _____
- ☐ Other x _____

Material Type

- ☐ Insulation
- ☐ Wood
- ☐ Concrete
- ☐ Glass
- ☐ Other, please specify

Multiple sensors per location?

☐ Yes ☐ No

If yes,

_____ per Wall

_____ per Window

_____ per Roof

_____ per Foundation

_____ per Other

Notes:

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SMT SERVICE REQUEST FORM: MONITORING

Please use the SMT Monitoring Request Form to help select a monitoring solution for you. Include any questions, comments, or technical information relevant to your application. Fill out this form and our experts at SMT will contact you shortly.

Duration

- ☐ Long Term
- ☐ Short Term

Datalogger System

- ☐ Wired
  - ☐ WiDAQ (8 inputs)
  - ☐ MultiSCAN (48 inputs)
- ☐ Wireless
  - ☐ A3 (8 inputs + RH/T)
  - ☐ A2 (4 inputs + RH/T)
- ☐ Cellular **(Analytics Required)**
  - ☐ C22 (4 inputs + RH/T)

Gateways

BiG

- Stand-alone monitoring center
- Real-time sensor display
- Data collection and visualization

TiG

- Embedded
- **Analytics Required**
- Dedicated data collection

If Wireless,

- ☐ TiG
- ☐ BiG

If Wired,

- ☐ TiG

If Cellular, N/A

Building Analytics

- ☐ Yes, _____ nodes per project
  - ☐ Basic (< 50 Nodes)
  - ☐ Silver (< 100 Nodes)
  - ☐ Gold (< 200 Nodes)
- ☐ No

Basic Package:

- Online Access
- Dashboard
- Sensor Browser/Editor
- Data Export
- Graphing
- Email/Phone Support

Silver and Gold Package:

- Basic Package Features
- Report Generation
- Alarm/Event Notification
- Image Manager
- Sensor Drawing Overlays
- Integrated Weather station

Analytics is **required for TiG** gateways and **cellular monitoring.**

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