

The BEGhut Natural Exposure & Test Facility

The Building Engineering Group (BEG) at the University of Waterloo (UW) operates a full-scale natural exposure and test building dubbed the Beghut. Building envelope assemblies can be inserted in the Beghut and their performance assessed through monitoring, testing, and observation. This facility facilitates the testing of full-scale assemblies under real time, under South Western Ontario climatic conditions. The weather conditions are representative of most of the North eastern United States and Central and Eastern Canada. Our experience with operating a test house for hygrothermal studies is unmatched in North America.

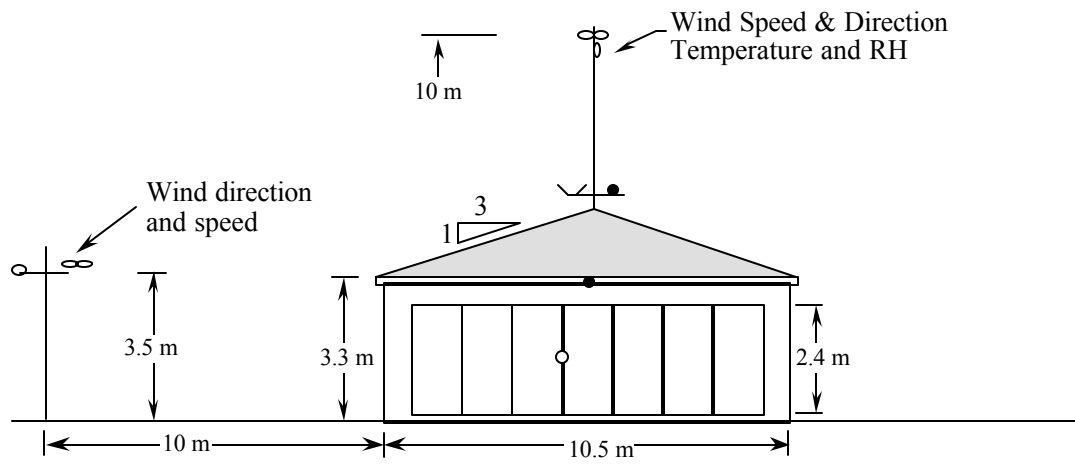
The method of construction used in the Beghut allows for six panels in each side (24 total) each of approximately 1.2 m width and 2.4 m height to be installed and removed at any time. Special panels, which occupy two (2.4 x 2.4 m) or three (2.4 x 3.6 m) normal panel slots can also be accommodated. Each panel is isolated from the Beghut structure and neighbouring panels by special insulating air- and vapour-tight separators.

This facility is a square building approximately 10.5 m x 10.5 m in plan and 3.0 m high on the interior. The walls are oriented in the four cardinal directions. The roof is peaked to the centre with a slope of 1-in-3. A pipe mast rising from the central peak of the roof supports a weather station at 10 m above grade.

The test hut is sited on relatively flat land and is fully exposed to winds from most directions. The roof overhang is sized to avoid shading from the sun under all conditions. The small overhang and the drip-edge in lieu of eavestroughs provides very little direct protection from rainfall.

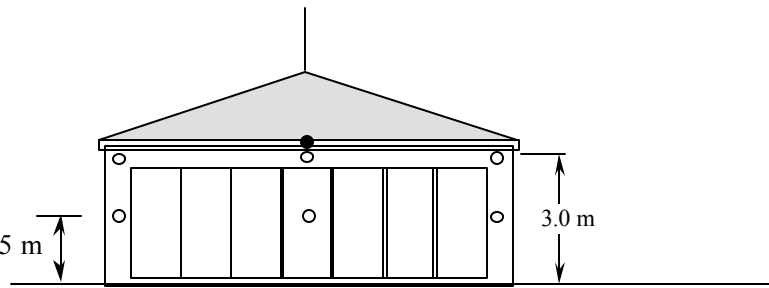
The structure is of wood post-and-beam construction with a trussed roof. The foundation consists of a 1.2 m high, 250 mm thick unreinforced concrete wall on a 500 mm wide, 300 mm deep strip footing. The floor is a 100 mm thick concrete slab-on-grade placed on a polyethylene moisture barrier and 150 mm of granular fill. The corner columns and ring beam are sheathed with plywood, insulated with 150 mm fiberglass batts, and clad with aluminum siding. The roof is insulated to RSI 5.4 and conventionally constructed from prefabricated trusses. The roof system comprises asphalt shingles, building paper, and plywood sheathing, with an additional ice and water shield extending 600 mm up from the eaves.

An air-to-air heat pump heating and air conditioning unit and supplementary humidification units control the interior climate to 21 C and 50% relative humidity all year. Floor-mounted diffusers and fans ensure even distribution of the conditioned air.

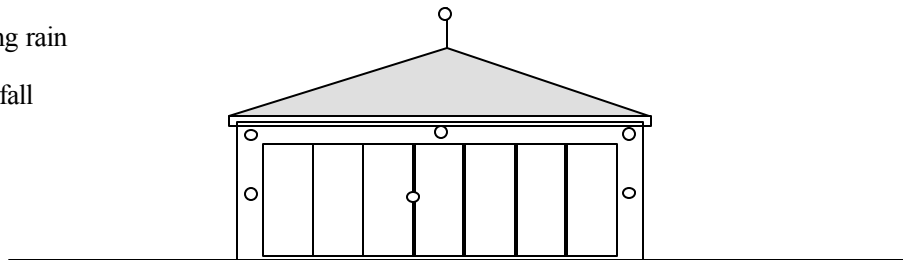


South Elevation

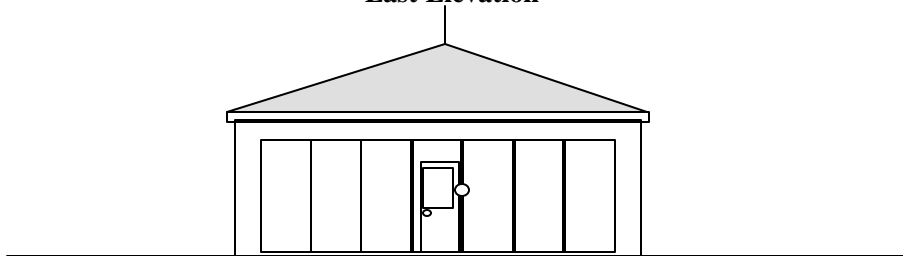
- Legend**
- Solar radiation (horiz)
 - Solar radiation (vert)
 - Driving rain
 - ∩ Rainfall



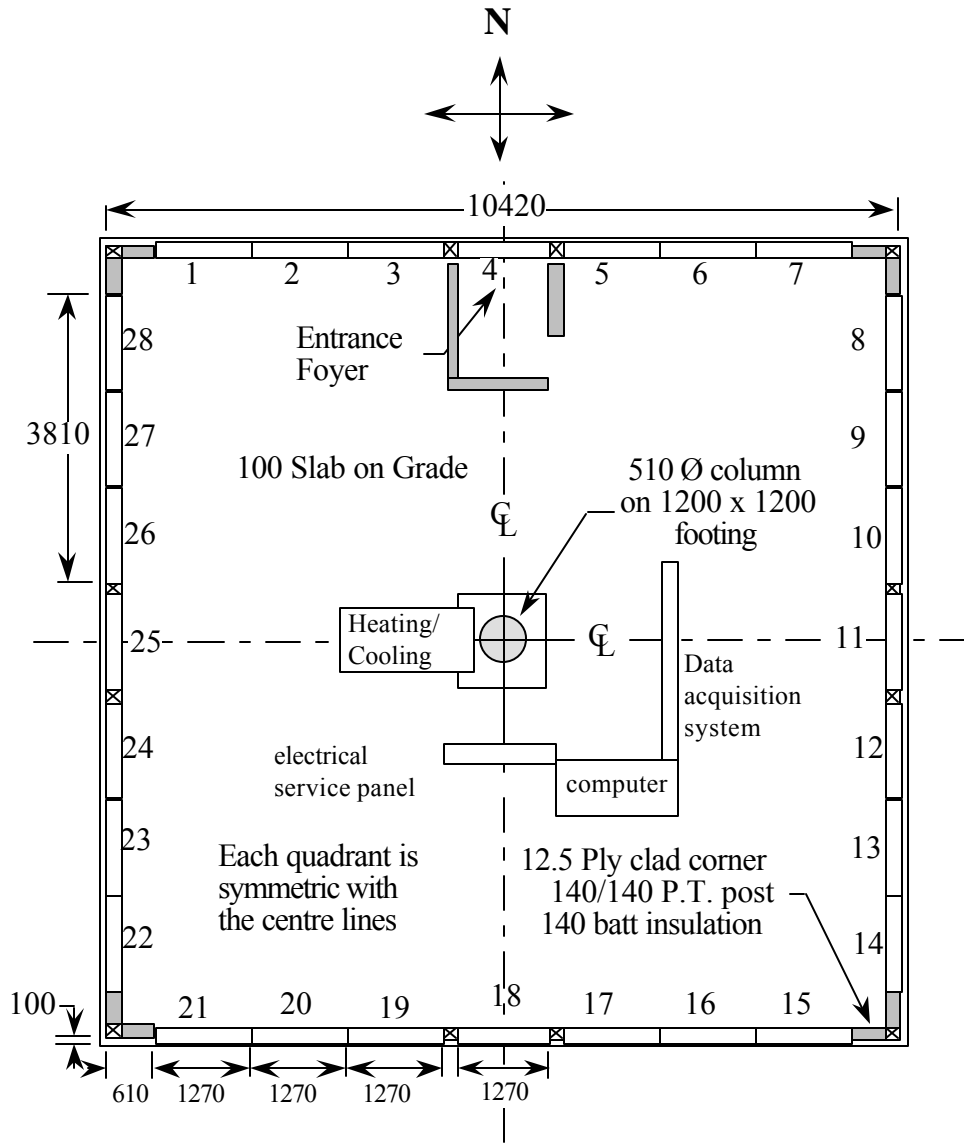
West Elevation



East Elevation



North Elevation



The Beghut contains 28 wall panels. One panel is reserved for the entrance door (#4)

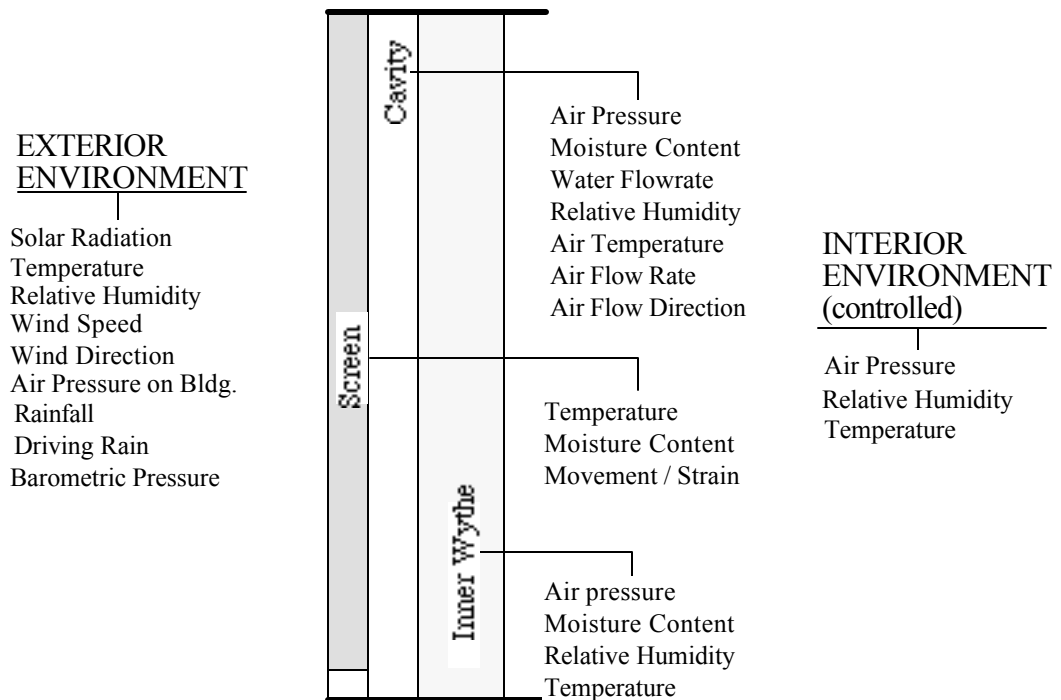
All panels are nominally 1270 wide and 2465 high.

Note: All dimensions in mm

Plan of Beghut

Measurement Capabilities

To provide meaningful quantitative analysis of building enclosure assembly performance undergoing natural exposure testing the most important exterior and interior environmental and wall parameters must be measured at frequent intervals. The figure below schematically presents those parameters that can be measured at the Beghut. We have often developed our own instrumentation for special uses, such as low pressure measurement, low velocity measurement, in-situ brick moisture content measurement, driving rain, and wall drainage measurement.



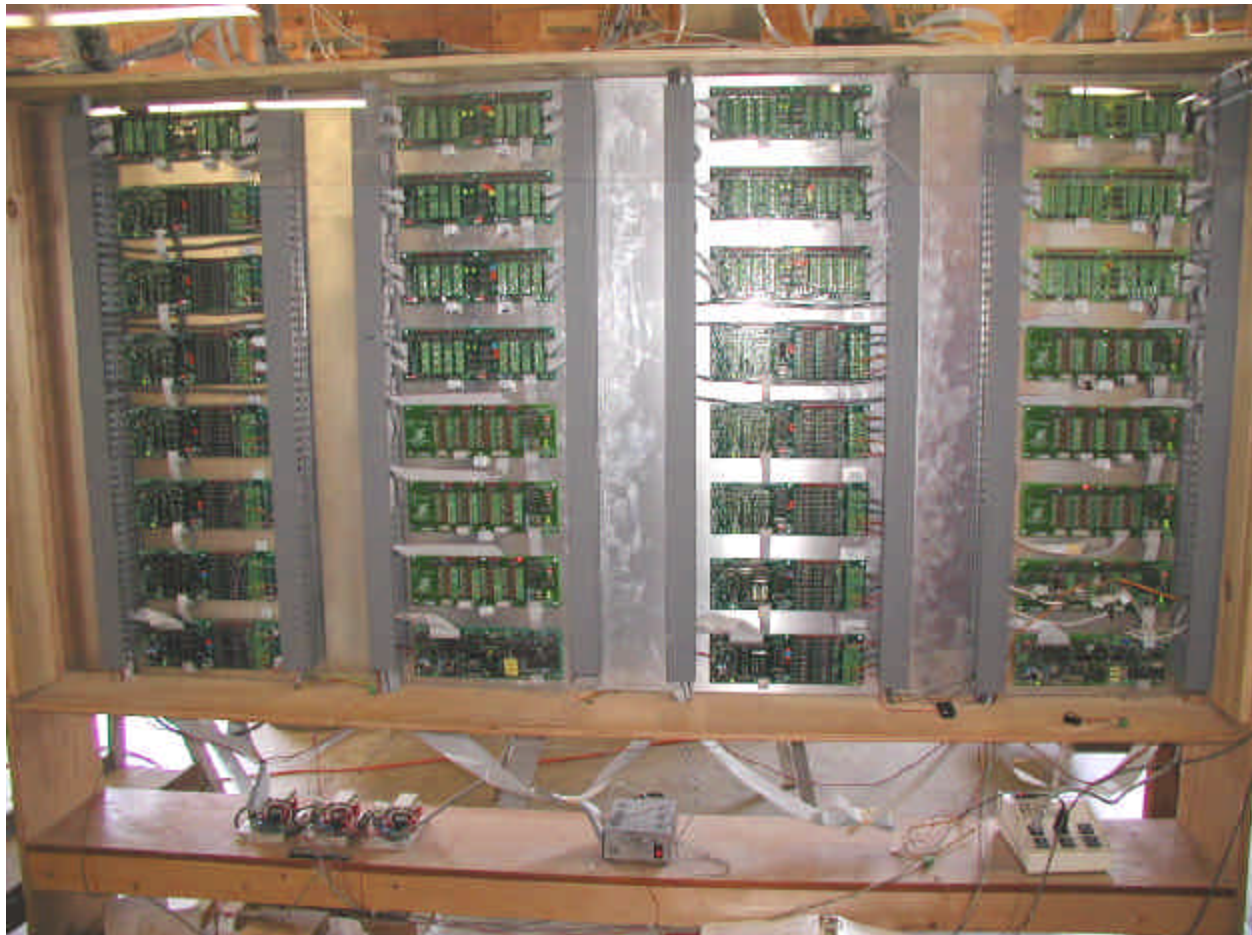
Measurement Parameters in a Typical Screened Wall

The data acquisition (DAQ) system presently comprises two fixed analog-to-digital converters with multiplexers that allow a total of 648 channels to be measured. All channels are normally scanned every five minutes and the data is averaged and saved at 15 to 60 minute intervals. Total throughput of up to 30 channels per second are possible but, except for dynamic wind pressure measurements, speed is typically not a concern. A separate mobile 32 channel system is used for high speed pseudo-simultaneous pressure measurements within and through test panels. Air velocity within vented cavities is also usually measured in an adhoc manner with either the roving DAQ system or the fixed system at slower rates.

The exterior weather elements (temperature, relative humidity, solar radiation on a horizontal and reflected onto a vertical surface, driving rain on each panel, and falling rain) are recorded. The weather

data from the nearby Environment Canada - University of Waterloo Class A weather station is also used.

Periodic testing for in-situ air leakage, microbiological growth, and water penetration can be (and have been) readily conducted at any time during or after the monitoring period. These tests have the virtue of measuring performance after an assembly has been subjected to real environmental conditions and, generally, after a considerable length of time. Because the Beghut was designed to allow for easy testing and measurement, the accuracy and repeatability of results will normally be much better and much less expensive to obtain than if the same assemblies were part of an in-service building.



Fixed Data Acquisition System



Test House View from South – Vinyl, EIFS, Durisol and Brick clad walls over steel stud, wood stud, and ICF backup are shown in this view



Masonry Construction (A), Wall Instrumentation in Place (B) and Wall Assembly (C)



Views of West Face showing Driving Rain Gauges and both Local Weather Towers



Beghut Ready to Receive a New Test Panel – Note Driving Rain Gauge



Destructive Disassembly and Careful Inspection at End of Test Period Often Yields Interesting and Useful Results



The Base Detail Can be designed to Collect Drainage Normally Directed to the Exterior



Masons Install a Brick Veneer after Instrumented Panels are Installed