Wind-uplift Testing

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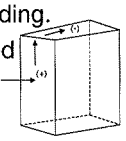
Uplift Pressure-

- As wind blows against a structure it pushes upwards towards the roof. The positive wind that hits the sides and corners of the building toping onto the roof creates negative pressure to the roofing assembly that could possibly pull it from the building.
- Negative pressure is defined on FM data sheet 1-28



ASCE 7

- The roofing industry has made many developments with regards to wind design and roofing system performance.
- We have the ability to calculate the uplift force that a given wind speed will create on the roofing system. Additional Factors affecting negative pressure include building height, geometry, ground roughness, occupancy type, and parapet wall height.
- These calculations are performed by using the American Society of Civil Engineers called ASCE-7, Minimum Design Loads for Buildings and Other Structures.
- The International Building Code (IBC) requires that buildings be designed in accordance with ASCE-7.

The 5 Wind Force Factors

1. Surrounding Terrain- wind will have a greater effect on buildings in open terrain vs. wind in a group of buildings similar in height.
2. Building Height and Geometry- Wind running up the wall of a tall building has a greater velocity than a lower story structure.
3. Presence of a parapet- The parapet protects the perimeter boundary of the roofing system, and reduces the uplift pressure on the membrane by moving the fastest wind above the membrane.

The 5 Wind Force Factors (cont'd)

4. Large Openings- i.e.. Cargo Bays cause problems for the roofing system because a wind, blowing into the opening has to "go" somewhere… when this happens, it can greatly increase the pressure on the roof because not only is the wind topping the roof edge and applying pressure, but the "wind" from inside is pushing up from the underside of the deck at the same time.
5. Occupancy Type- The building occupancy & importance of the structure for example large capacity or emergency buildings are taken into consideration as well.

Number of tests per roof

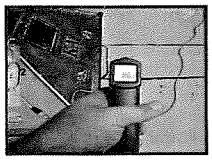
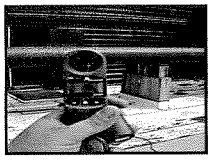
- A<= 10,000sf
- There should be a minimum of 3 tests per roof.
- One test at the corner, one at the perimeter, and one in the field of roof.
- Tests should be conducted throughout the roof rather than concentrated in one area.

Number of tests per roof (cont'd)

- 10,000sf <A<=60,000sf
- There should be a minimum of 5 tests per roof.
- One test at a corner, two at the perimeter, and two in the field of roof.
- Tests should be conducted throughout the roof rather than concentrated in one area.
- For a roof larger than 60,000 sf refer to FM Data Sheet 1-52

Testing conditions.

- Maximum wind velocity is 25 mph with a roof surface temperature between 40 and 100 degrees Fahrenheit.

- Water and ice may be used to lower the roof temperature.
- Walking around the chamber during testing can affect the uplift readings. All members of the testing party should be still once in position until the conclusion of testing.

Testing Increments

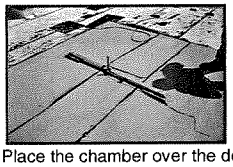
- Testing is conducted in increments of pressure starting at 15 psf, each increment is increased at 7.5 psf increments and held for one minute prior to proceeding to the next pressure increment.

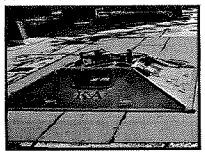
Roof types that can be tested

- Gravel surfaced built-up roofs
  (Gravel must be spud back in a 1' wide band, 5'X5')
- Smooth surfaced built-up roofs
- Modified bitumen roofs
- Fully adhered single ply roofs

Testing Procedure

- Place the deflection bar over the center of the test site.

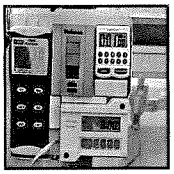




- Place the chamber over the deflection bar.
- Connect the cable from the deflection bar to the deflection gauge read out device.
- Zero the deflection gauge read out device, and timer.
- Assure that the Primary and Secondary Valve are completely open.

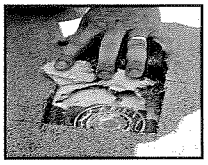
Testing Procedure (cont'd)

- Assure that the scale on the Manometer is set to inches H^2O.
- Zero the Manometer.
- Turn on the Vacuum Pump.
- Slowly turn the primary valve to increase the negative pressure. Fine tuning is accomplished through the usage of the secondary valve.
- Hold each pressure reading for one minute.
- Record the deflection in hundredths of an inch from the scale.



Testing Procedure (cont'd) and Negative pressure test failure

- In the event of a failure the previous pressure that was successfully held for 1 minute is considered the final pressure passed.
- In the event of a failure FM requires a destructive cut be made to determine the mode of failure within the roof system.



Negative pressure test failure (cont'd)

- Possible Modes of Failure
  1. Inadequately adhered roof covering
  2. Facer of the insulation or cover board delaminated
  3. Insulation board separated from the deck
  4. Fasteners pulled out of the deck, or insulation fractured around the stress plate.

Works Cited

Helene Hardy-Pierce, GAF/Elk Corporation
http://www.facilitiesnet.com/take5/details/Roofing-Uplift-and-Wind-Considerations--317

- Canon Fabrications-Negative Pressure/Uplift Chamber Manual
- FM Data Sheet 1-52 Field uplift Tests