APPENDIX DT

Detroit, Michigan (2006)

Vibrations and Crack Monitoring

Dowding_2007

Figure DT-1 – Photograph of the residential structure in Detroit, Michigan

Background

The test structure is an elderly, two-story wood-frame house with plaster and lath walls in Detroit, Michigan 48217. The structure, shown in Figure DT-1, at the edge of a residential neighborhood is located in close proximity to Interstate 75 and railroad tracks. The test structure was fitted with Vibra-Tech ground motion, air over pressure and crack displacement sensors as shown in Figure DT-2. Crack displacement and null sensors (Transtek series 200 LVDTs) were placed in the stairwell above the back doorway to the upstairs apartment of the test structure as shown in Figure DT-3. They were installed across an existing crack and on the adjacent un-cracked wall (null sensor).

Crack response is compared to long term trends in outdoor temperature and humidity in Figures DT-4. These comparisons show that the crack response is affected by a combination of outdoor temperature and humidity. Thunderstorm activity can also produce crack response. Figure DT-5 compares ground motion, air over pressure, and crack response time histories produced by a nearby lightening strike during a thunderstorm on 14 July 2006.

DETROIT, MI

This event produced crack response of approximately 210 μin (5.3 μm) that corresponds in time to the large measured air over pressure event and vertical ground particle velocity, likely caused by a nearby lightning strike. Records of response to wind gusts are presented in Micrometer Crack Response book (Dowding, 2008).

The magnitude of all measured crack responses are compared in Figure DT-6. The noise level of 35 μin (0.9 μm) is also noted on the chart. Climatological variation produces the largest crack response, with the exception of slamming the door directly below the crack. Occupant activity is a greater source of crack response than any external activity such as blasting and passing trucks.

Figure DT-7 presents time histories of the maximum recorded blast vibration event at the test structure during surveillance. Peak particle velocity for this maximum event is 0.083 ips (2.1 mm/s) with a dominant excitation frequency of 76 Hz. Excitation frequencies are considerably higher than the 5-20 Hz range of natural response frequencies. The blast induced crack respsonse was less than the noise level.

Reference:
Dowding, Charles H. *Report of Ground Vibration and Crack Displacement Monitoring at 12810 Sanders for Detroit Salt Company LLC*. Rep. *2007*.

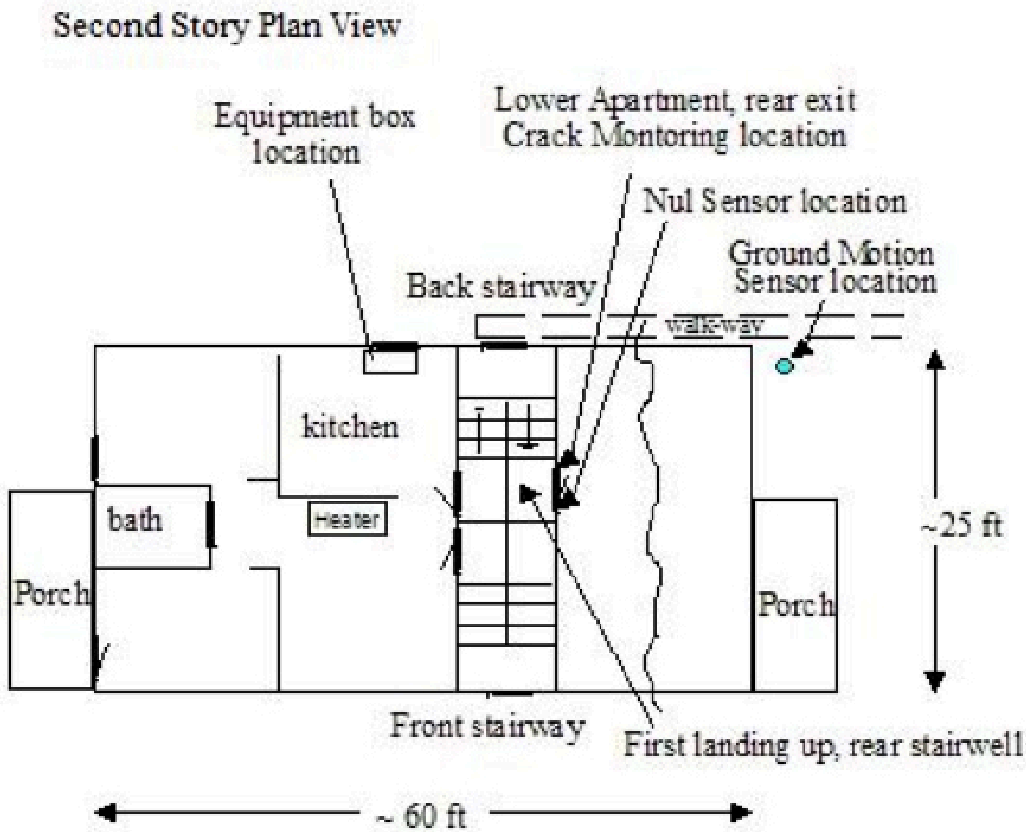

Figure DT-2 - Plan view of test structure and instrument locations

Figure DT-3 - Crack displacement sensor (left) and null sensor (right) installed in the stairwell above the back doorway to the upstairs apartment of the test structure.

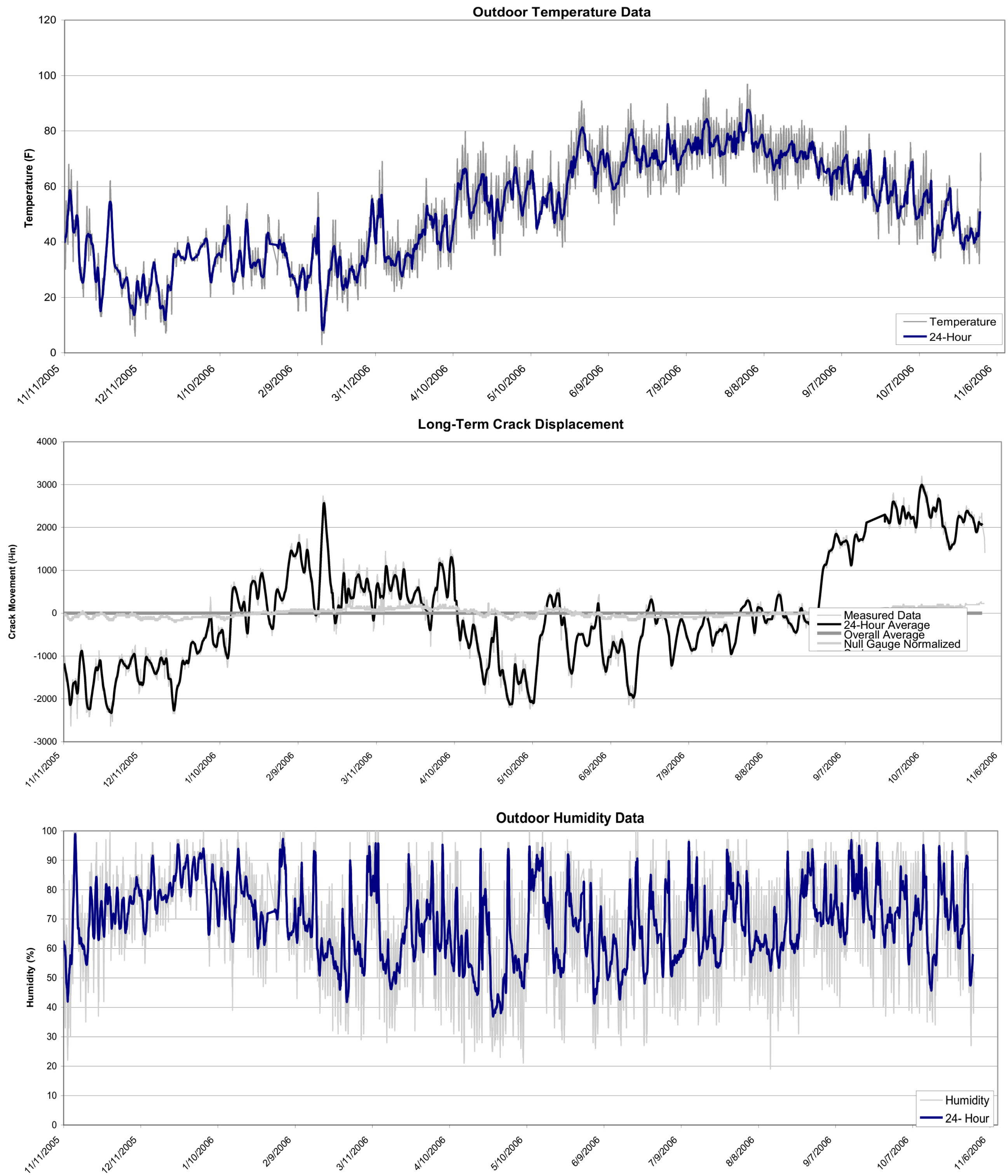

Figure DT-4 - Long-term crack response compared to outdoor temperature and humidity

Longitudinal Ground Particle Velocity

Transverse Ground Particle Velocity

Vertical Ground Particle Velocity

Air Overpressure

Crack Response

Null

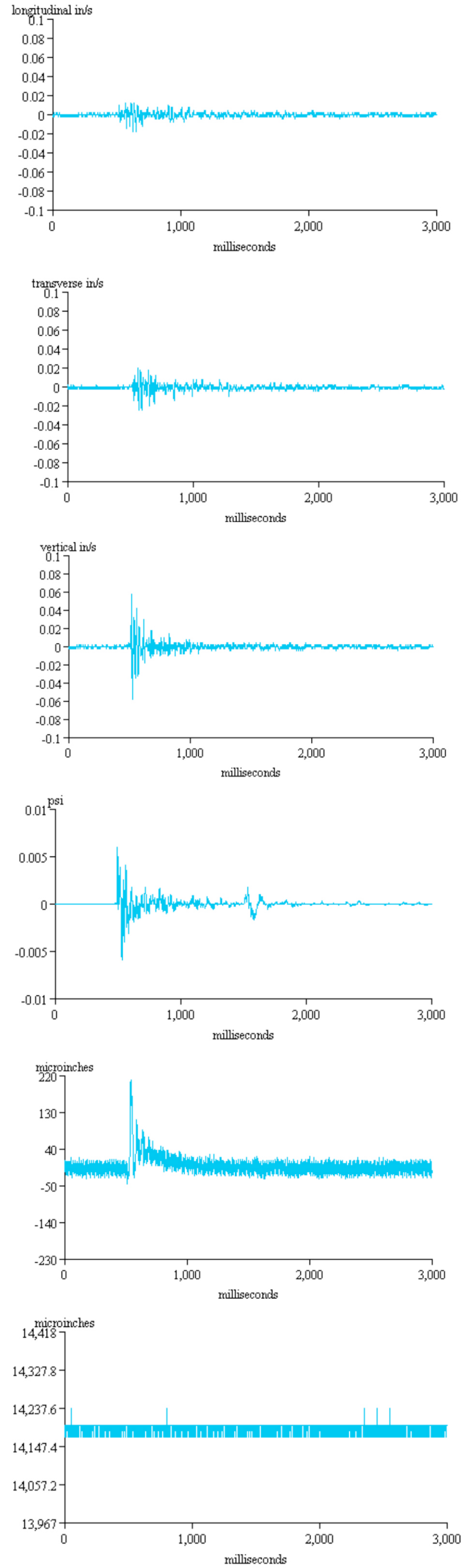

Figure DT-5 - Comparison of air overpressure, ground motion, and crack response recorded on 14 July 2006 at 17:06:55 from a suspected nearby lightning strike during a thunderstorm

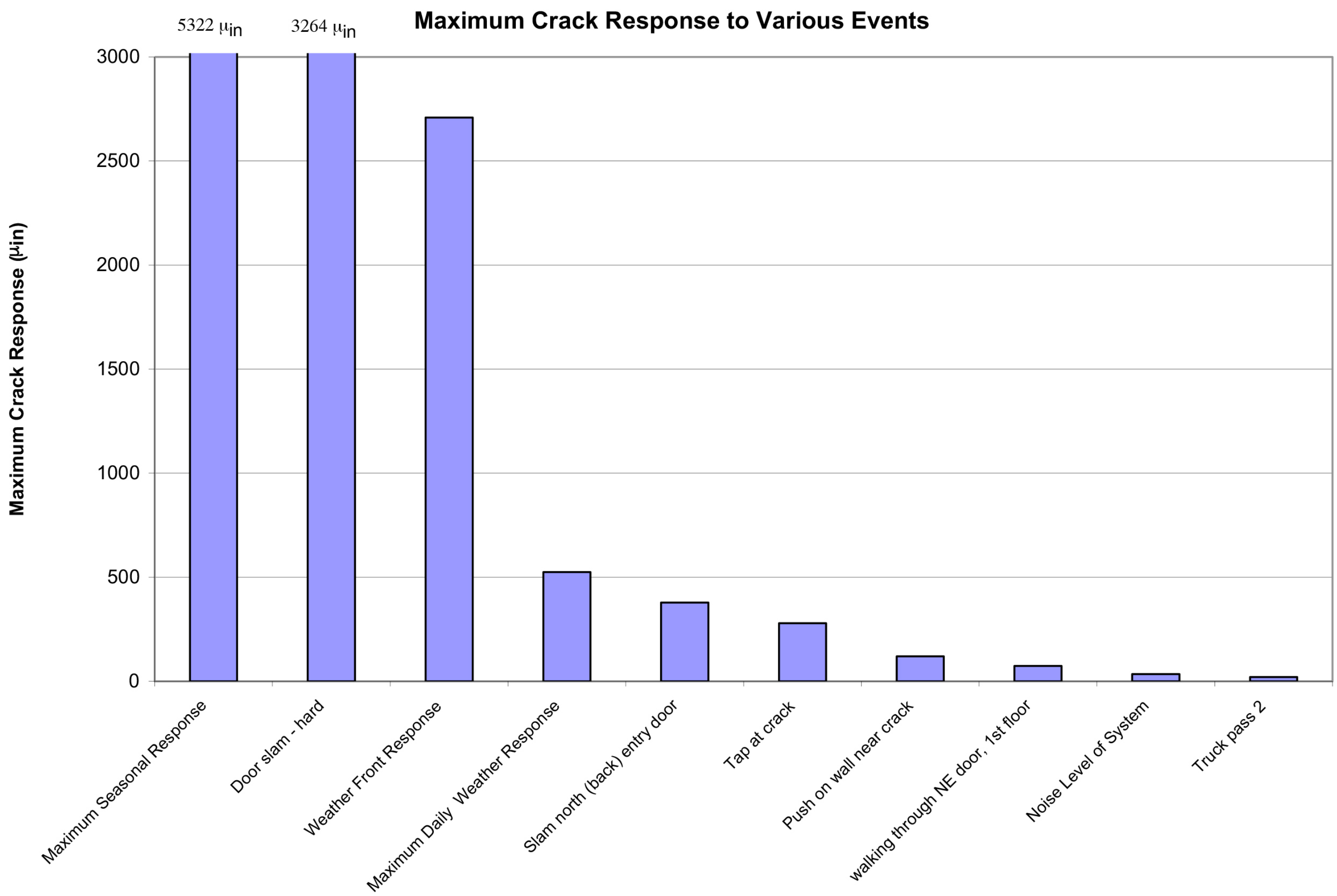

Figure DT-6 - Comparison of crack responses to various occupant activities and environmental conditions

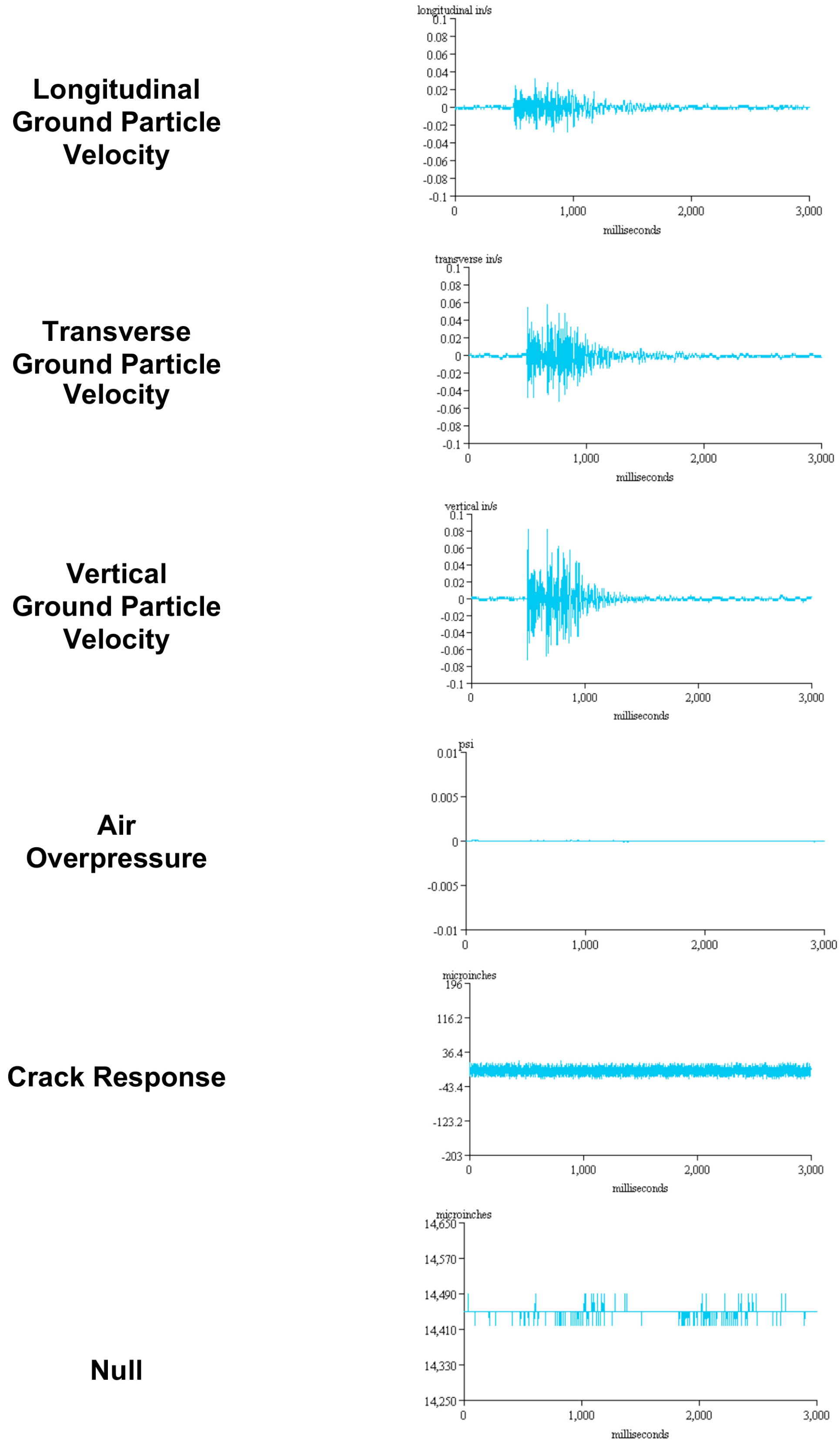

Figure DT-7 - Event record with the greatest ground motion recorded of 0.083 ips (2.1 mm/s) on 26 October 2006 that produced no crack response