APPENDIX PN

Pineville, North Carolina (2006-2007)

Quarry Blasting

Aimone-Martin 2007

Figure PN-1 - Photograph of the one-story house with instrumented interior drywall crack

Background

The house shown in Figure PN-1 was monitored with the hybrid combination of the ITI ACM system and LARCOR standard vibration monitoring seismograph (AMA et al, 2002). This combination allows recording of vibratory response time histories of both crack and structural response to either ground motions or air over-pressures as well as well as long-term, climatological crack response. See App. KI for a detailed description of the hybrid ACM-seismograph system used in these studies. Figures in this appendix were copied directly from Aimone-Martin and Rosenhaim (2007).

The exterior wall of the slab on grade wood-frame one-story house was covered with brick as shown in Figure PN-1. The exterior façade and interior walls were monitored along with an interior gypsum drywall crack. The locations of these sensors are shown in Figures PN-2 through PN-5.

Vibratory time histories of the upper (S2) and lower (S1) corner and mid wall (MW) displacement, airblast, and ground motions (GV) parallel to the plane containing the crack for a 2/05 blast are shown in Figure PN-6. These ground motions produce structural responses, which in turn drive the crack response. The differential displacement between S1 and S2 is also shown in Figure PN-7 to illustrate the wall strains that induce crack response.

Response of the crack to climatological effects for the full study is compared to the time histories of temperature and humidity in Figure PN-8. Humidity was high between the 1000 and 2000 hour marks of the study. The crack had a large response during this time as the wood frame absorbed moisture which contributed to the opening of the crack. Figure PN-9 then compares the long-term, climatological response for a few days surrounding the 2/05 blast with vibratory crack response time histories.

Quarry blasting some 760 m (2500 ft) away produced a maximum PPV of 2.667 mm/s (0.105 ips) (average 0.044 ips) and a maximum airblast of 125 dB (average 116 dB) on 2/05. This maximum ground motion produced a zero-peak crack response 3.6μm (141.55 μ-in). This is 0.014 (1.4%) of the maximum weather response (peak-peak) during the study.

Additional Consideration

In addition to the crack's response to ground motion from blast vibrations, it also responded to ground swelling and settlement during a frontal rainfall period in November. This effect is illustrated in Figure PN-10. As a soil anchor point swelled 0.015 in., the structure responded and caused the crack width to decrease by 8000 μ-in.

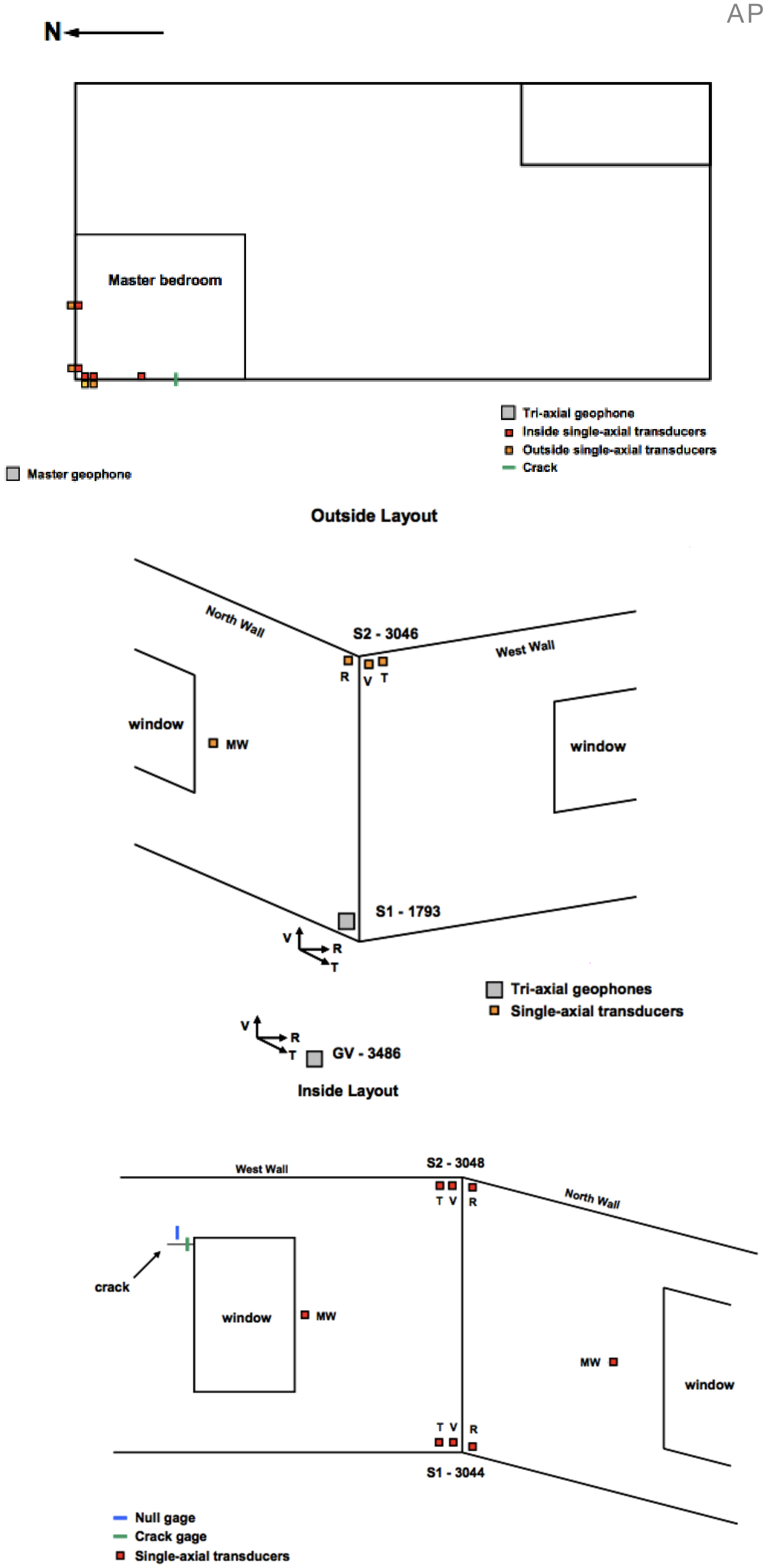

Figure PN-2 - Locations of Structural Response and Ground Motion Transducers


Figure PN-3 - Photographs of Exterior Sensors



Figure PN-4 - Photographs of Interior Sensors

Figure PN-5 - Photograph of interior drywall crack and sensors.

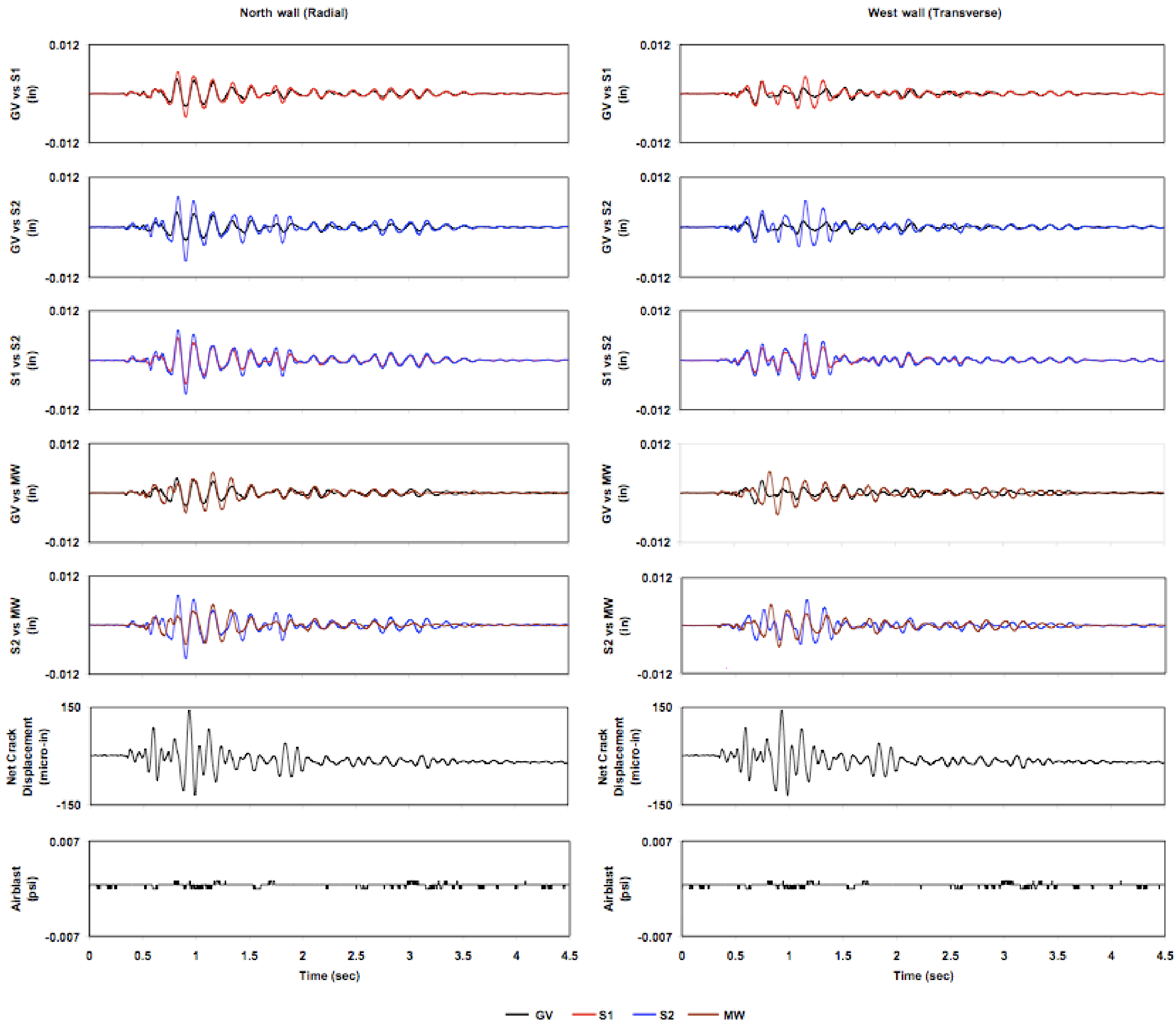

Figure PN-6 - Comparative Time History Plots fo 2/05 blast

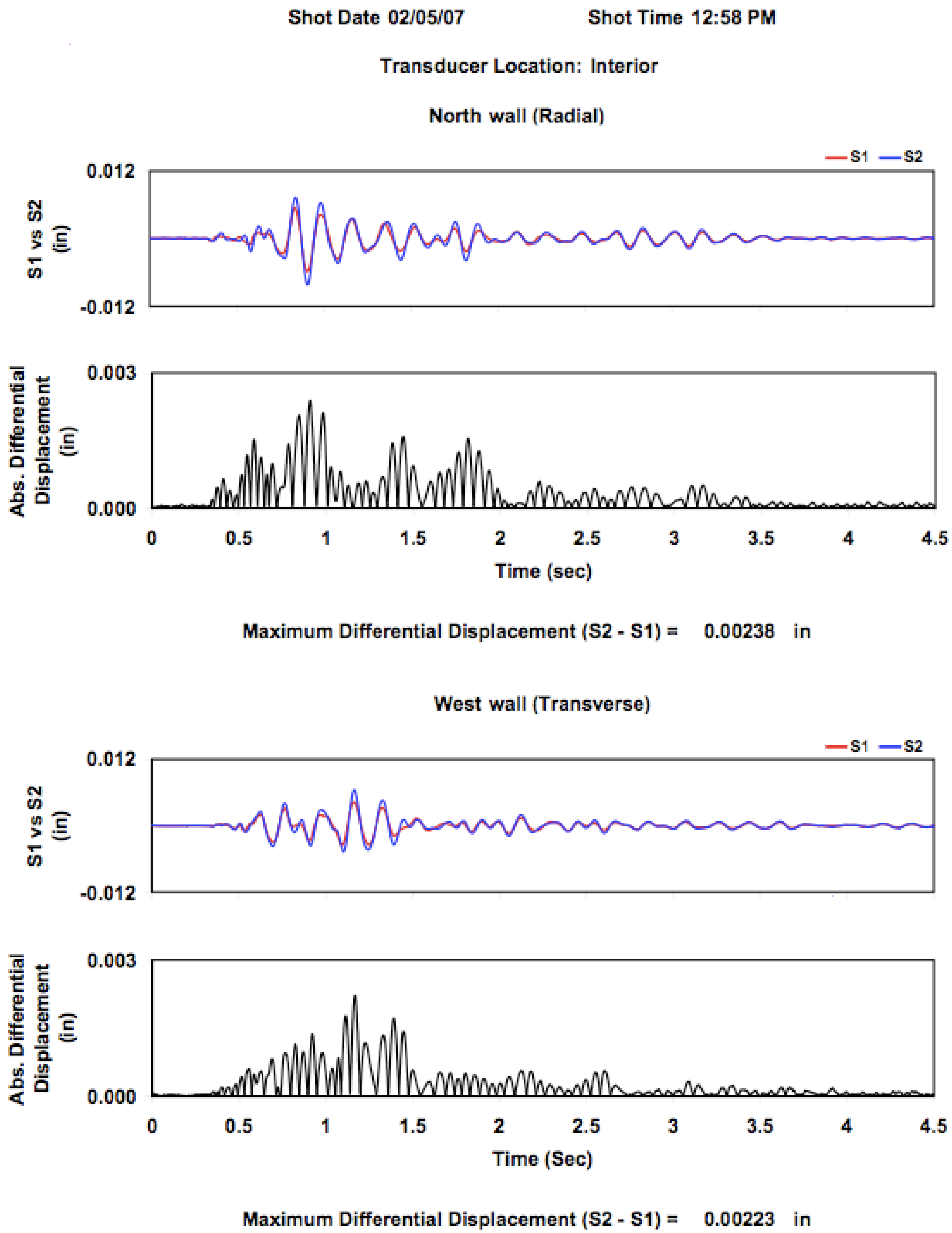

Figure PN-7 - Differential Time History Plots

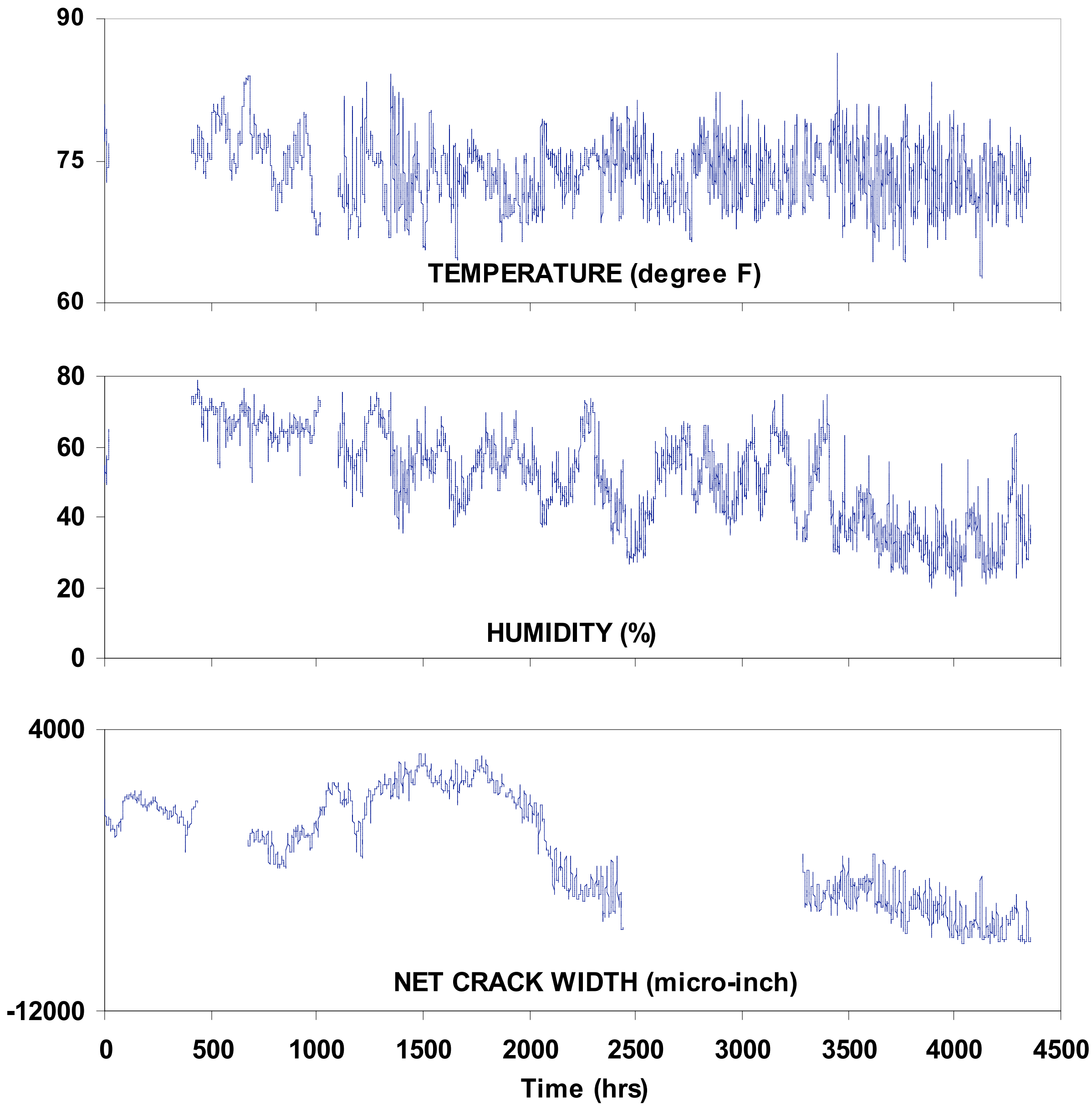

Figure PN-8 - Variations in ambient temperature, humidity and corresponding crack displacement for entire study period

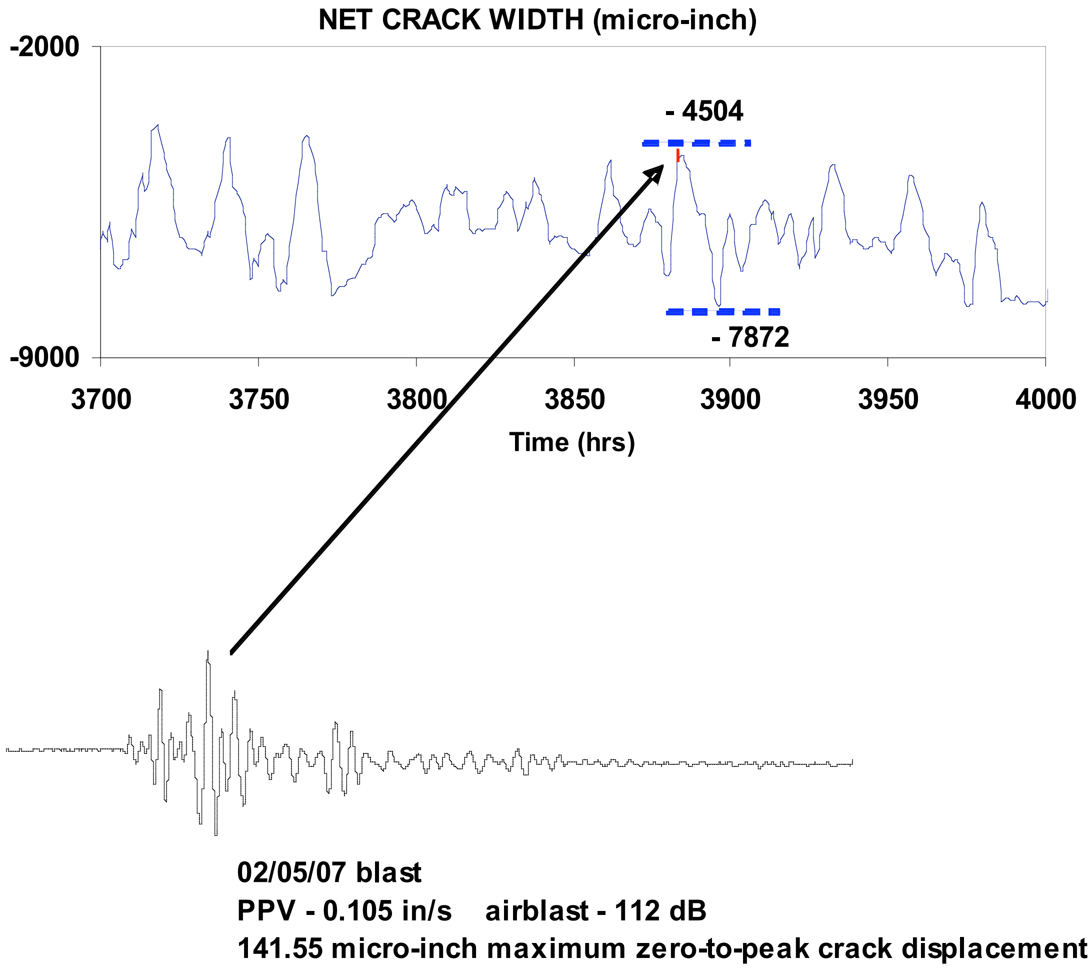

Figure PN-9 - Comparison of static changes in crack width from weather and blast-induced dynamic crack motion for the blast on 02/05/07 (blast-induced crack time history is enlarged below)

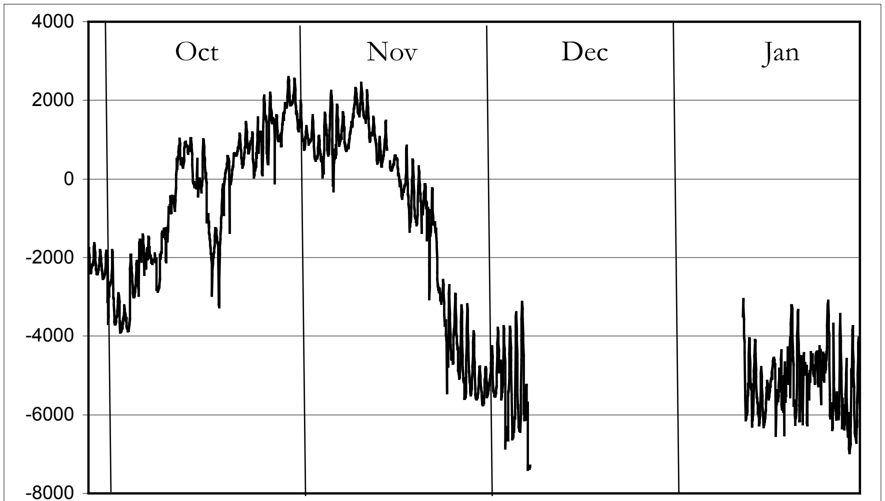

Figure 1 - Crack Displacement [micro-in.]

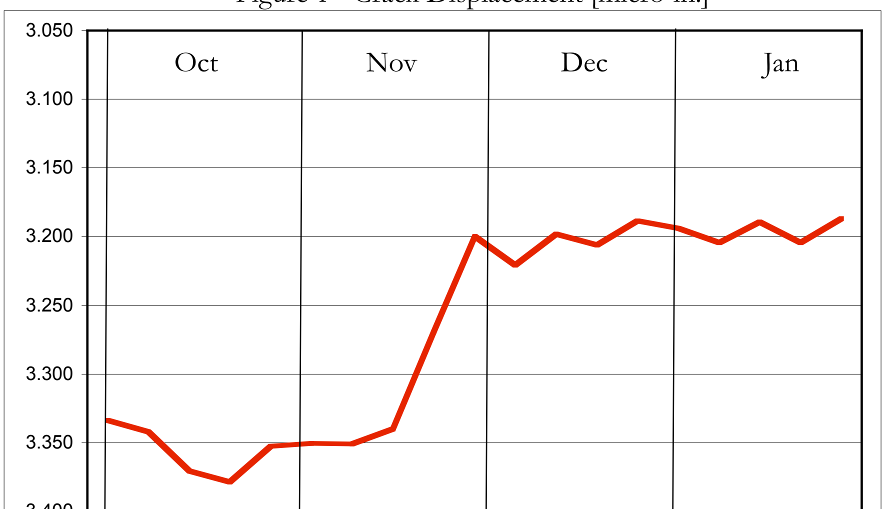

Figure 2 - Anchor Displacement in Soil [in.]

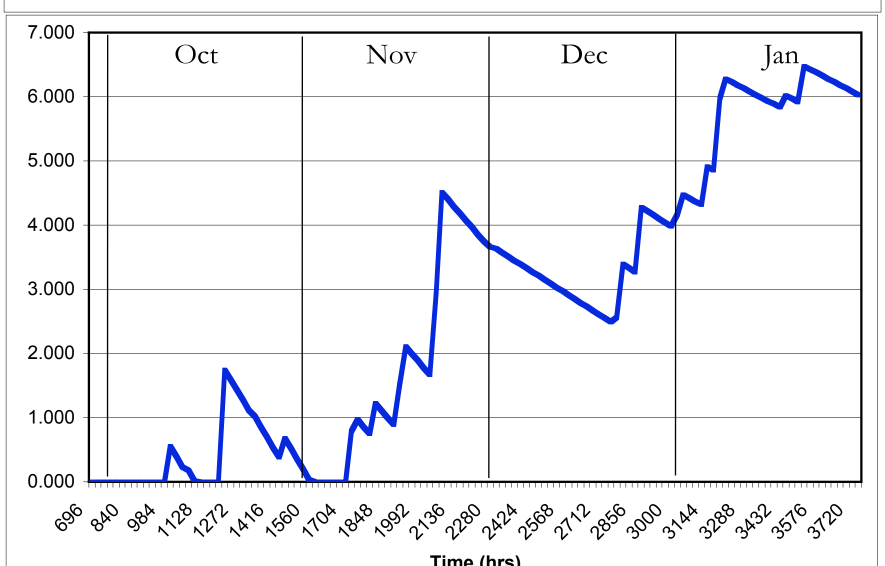

Figure PN-10 - Comparison of precipitation that causes ground swelling and induced crack development