Structure Response of the Abandoned German Village Building

West Desert Test Center
Dugway Proving Ground

Structure response of the abandoned German Village building to gun testing was conducted on March 10, 2004 at the proposed AGS location. Airblast pressures, ground, and structure motions were monitored at the building during eleven gun tests using propellant charge weights between 5.5 and 53.6 lbs and two different gun configurations shown in Figure 1.

Fig. 1 Guns used in testing showing the German Village structure to the east

The purpose of the structure response study was to compute whole-structure and mid-wall strains induced in the building during gun testing using a typical range of charge weights anticipated for future AGS gun testing and compare strains with typical failure strains in materials similar to those of the structure. Structure instrumentation orientation is shown in Figure 2 and instrumentation shown in Figure 3.

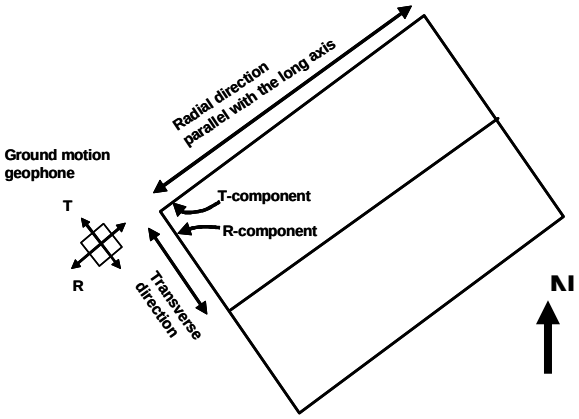

Fig. 2 Components of ground and wall motions

Structure response data indicated that the levels of motion in the whole structure (as noted in the upper corner, S2, relative to the lower corner, S1) and mid-walls were very small and near the lower resolution of the instrumentation. The most active wall was the southwest shown in the radial component and southwest mid-wall as shown in Figure 2. The vertical structure motions were so small that the influence of vertical ground motions generated during testing can be ignored as damage potential to structures from wall strains are only influence by horizontal motions in the T and R directions.

The worst-case event producing the highest amplitude of upper structure and mid-wall responses was used to estimate strains in the walls. Airblast and mid-wall time-histories for this event are shown in Figure 4. This test provided the largest levels of upper structure (0.10 ips in the horizontal radial) and southwest mid-wall (0.14 ips) response.

Maximum mid-wall bending strains were computed based on these worst-case mid-wall displacements using a wall height or height between sensors of 21.9ft (or 263 in.) and an assumed maximum wall thickness of 6 in. (or half-wall of 3 in.). The mid-wall strains were 0.172 micro-strains in the northwest wall and 0.338 micro-strains southwest wall.

Maximum dynamic tensile strain from global wall displacements was calculated to be 1.6 micro-strains for propellant charge weights of 53.6 lbs (the highest charge weight planned for the new test range) and less.

These low levels of strains produced in the German Village structure during gun testing are far below possible dynamic tensile failure strains for similar construction materials (red fire brick and mortar). The lowest threshold to dynamic failure strains for mortar and red fire brick range from 100 to 700 micro-strains, respectively. Therefore, it is not possible that gun testing near the German Village using similar charge weights will contribute to structure cracking or the degradation of the structure beyond the normal aging process.

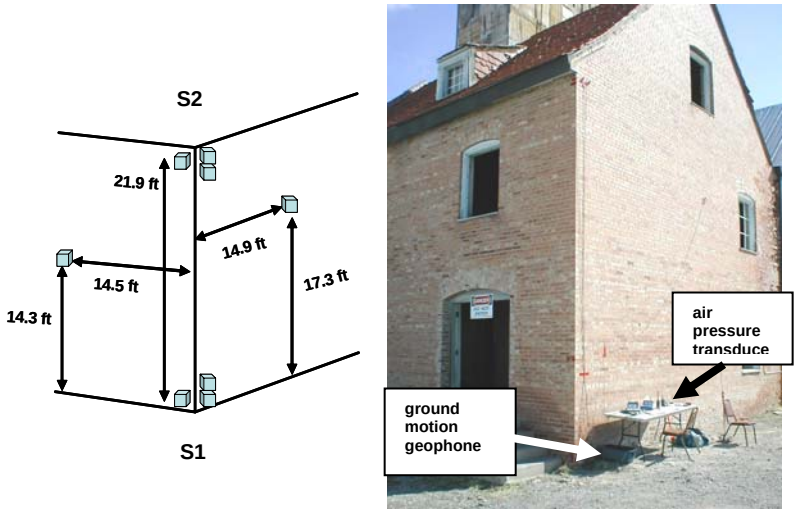

Fig. 3 Structure response instrumentation (left) showing the location of horizontal and vertical single axis motion geophone and mid-walls and (right) location of ground motion geophone and air pressure transducer

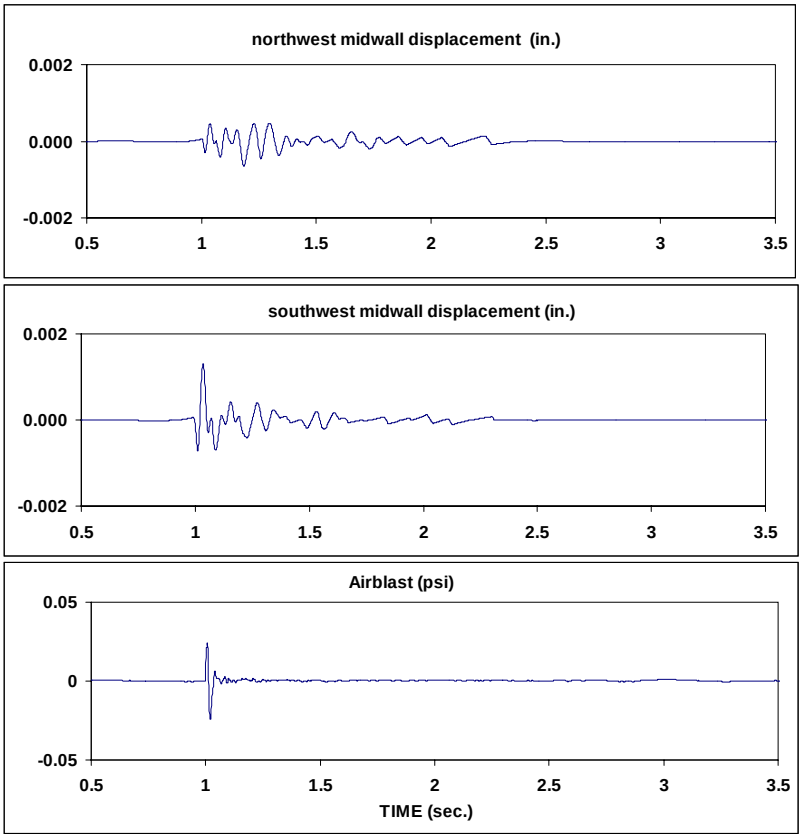

Fig. 4 Mid-wall displacement time-histories compared with airblast pressure time history