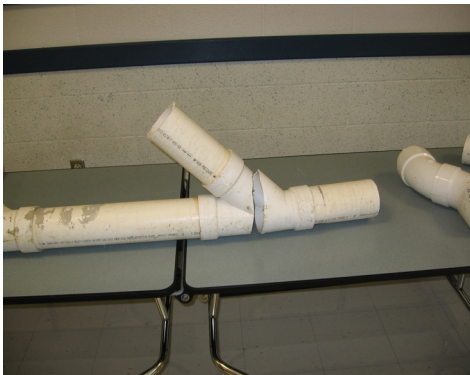


# PROJECT PROFILE

## FORENSIC EVALUATION OF FLOOR SLAB CRACKING AND GROUND HEAVE

D'Appolonia was retained by the Burgettstown School District to perform a forensic geotechnical evaluation for identification of the cause(s) of floor slab cracking and crawl space ground heave observed in the Burgettstown Elementary Center School in Burgettstown, Pennsylvania; to render professional opinions as to the potential for future damage; and to develop appropriate measures for correcting and mitigating damage. Our evaluation included review of design and construction documents; reconnaissance of the interior of the building interior, exterior and crawl space; a floor slab level survey; measurement of beam deflections in the crawl space; and sampling and testing of mine spoil from the crawl space and outside of the building.

The Burgettstown Elementary Center building was completed in 1997 on the site of a former strip mine that is cov-



Examples of damaged PVC pipe from building crawl space.

ered with 30 to 40 feet of spoil (waste rock and soil) from previous mining operations. The structure is supported above the mine spoil on a system of reinforced-concrete grade beams bear-



Cracking observed in school building floor.



Cracking observed in school building wall.

ing on drilled, reinforced-concrete caissons or piers extending to bedrock underlying the mine spoil. The interior floors of the building are concrete reinforced with welded-wire fabric and were poured on a corrugated-steel deck supported on a system of structural-steel beams that span between the caisson-supported concrete beams. Various utilities (plumbing, storm drains, sanitary sewer lines, electric conduits, and telecommunications conduits) were routed through the crawl space beneath the first floor slab.

Based upon our investigation of site conditions, we concluded that heave of



Cracking observed in exterior walls.

expansive shale caused damage to utilities in the crawl space below the first floor slab, which served to exacerbate the heave effects. Some of the damaged utility lines had already been replaced. Our study indicated that visible cracking of concrete building floors and masonry walls was not the result of heave, but due to differential displacements in and between building structural elements of varying stiffness, including rigid reinforced-concrete grade beams and relatively flexible structural steel members. We also concluded that exposure and heating of the ground in the crawl space under a boiler room in the building, leakage from storm/sanitary sewer drain lines, and poor surface drainage control contributed to the observed expansion/heave of the shale.

D'Appolonia developed the following suggested remedial measures:

- Remove reacted shale in affected crawl space areas.
- Coat excavated surfaces with bituminous material or a vapor barrier.
- Insulate the crawl space from boiler room heat.
- Relocate utilities that could potentially be affected by future expansion.
- Monitor the water main for leakage.
- Improve surface drainage around the building.
- Monitor the crawl space periodically for heave.



Portion of pyritic shale sample following laboratory free swell test.