Large Scale Culvert Testing at Queen's University

The GeoEngineering Laboratory at Queen's University West Campus has four specialized pipe test cells, and a large scale buried infrastructure test pit. The pipe test cells have been used on a range of buried pipe and culvert research projects. The large scale buried infrastructure test facility has a pit of 3-m (10-ft) depth, 8-m (25-ft) width, and 16-m (50-ft) length, Figure 1. A removable retaining wall is available to divide the pit into 25-ft by 25-ft square test areas, for structures that do not need the full size of the test pit.

The top of the test pit is at grade, so that vehicles can be driven in over test structures. Tests can use a high capacity float capable of supporting concrete blocks to develop HS20 single and double axle load configurations, Figure 2. The floor of the pit is close to the competent limestone below, in which are installed eight high capacity rock anchors. These restrain a reaction frame spanning the pit to support a 2000-kN (220-ton) hydraulic actuator, Figure 3. An axle beam has been designed and fabricated, Figure 3, to the geometry of standard AASHTO HS20 (or HS25) wheel loads on the ground surface. It can be used in either single or double axle configurations up to and exceeding fully factored HS25 loading. The actuator and reaction frame capacities of 440,000-lbf are more than 8 times the standard twin axle HS20 loading. The system is designed to bring any buried structure designed to reasonable factors of safety to collapse.

The laboratory has construction equipment available to handle soil placement, compaction, and excavation (see Figure 1 where placement and compaction operations are illustrated).

The laboratory is also designed to enable a variety of Trenchless Technologies to be studied. A 2m by 4m reaction pit on the East end of the large test pit houses a 2000kN actuator in a horizontal configuration to study construction using pipe bursting and splitting, pipe jacking and microtunneling. Other technologies that can be studied in the laboratory include pipe liners and directional drilling.

Figure 1 Test pit showing removable retaining wall and soil placement.

Figure 2 Vehicle load test on buried structure using the West half of the pit.

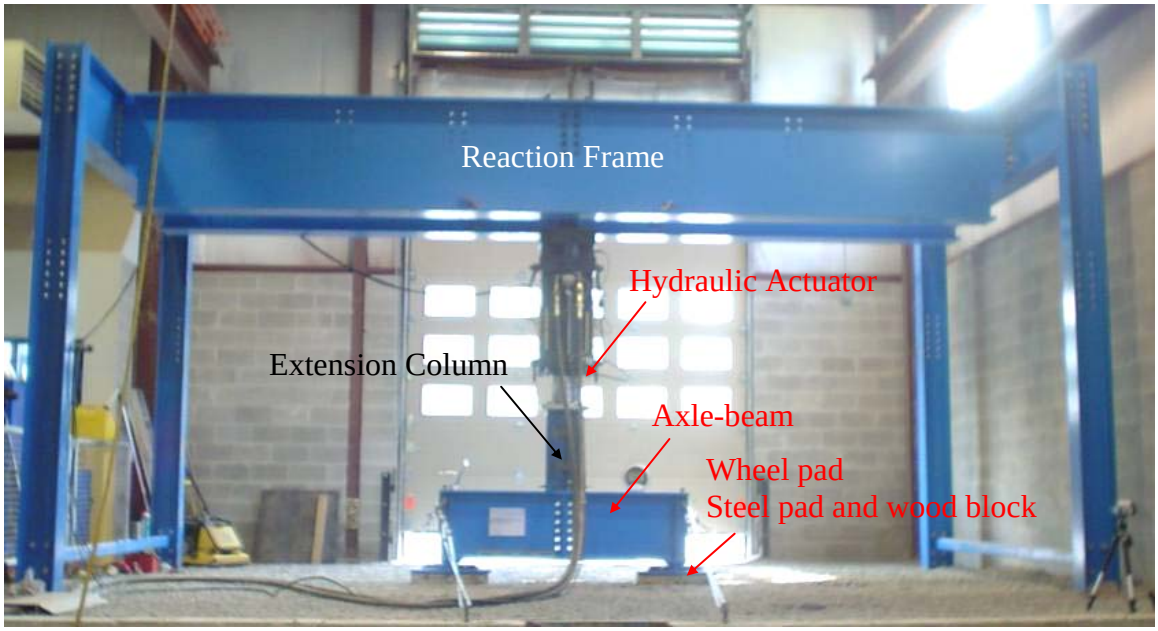

Figure 3 Actuator loading showing axle beam and reaction frame positioned for this test over the West half of the test pit.