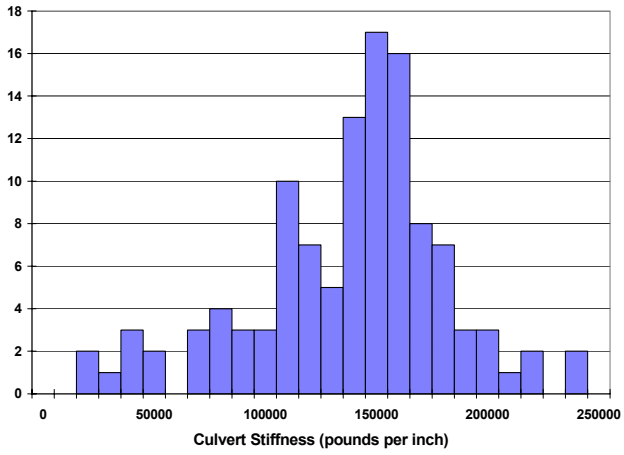
Freisland Ditch Culvert Rehabilitation Investigation

CNA Consulting Engineers conducted two types of nondestructive testing prior to culvert rehabilitation design: conventional hammer sounding to identify soft or “drummy” areas, and stiffness measurements with an innovative handheld shaker system.

About 115 stiffness measurements were made, using hardware and test methods developed for direct measurement of soil stiffness. The technique utilizes an 8-lb shaker to vibrate the culvert in a small area. Sensors built into the shaker simultaneously measure force and acceleration. The handheld shaker was pressed against the culvert with a force of 20 or 40 pounds. A Hewlett-Packard dynamic analyzer collected the sensor output, and integrated the acceleration to get velocity and displacement. The analyzer then computed the force to displacement ratio, i.e. the stiffness.

All stiffness measurements are less than 250,000 lb/in, with most between 100,000 lb/in and 200,000 lb/in. Culvert stiffness was lower near the open end of the culvert—measurements taken where there was no soil backfill produced the lowest stiffness. The stiffness at 41 locations more than three grid segments from the culvert ends ranged from 47,000 lb/in to 236,000 lb/in, with an average of 147,000 lb/in and a standard deviation of 33,000 lb/in. Seven locations were more than one standard deviation below average, indicating possible soft soil or voids. Five locations had more than one standard deviation above average, indicating large rocks or overcompaction around culvert.



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