SIDD INSTALLATIONS

OLD VS. NEW

In the 1930's Professors Marston and Spangler of Iowa State University conducted extensive investigations relative to soil loads and the effect of various installations on the load supporting strength of concrete pipe. While they are to be commended for their work, current day installation procedures and the investigation of the various soil parameters relative to pipe response has given us greater insight to the load supporting strength of concrete pipe. This additional understanding is the cumulation of 20 years research which was initiated in 1970 through a coordinated effort with Northwestern University, the University of Massachusetts, the consulting firm Simpson Gumpert and Heger, and the Technical Committee of the American Concrete Pipe Association.

The results of this research, which is referred to as SIDD, while confirming much of the Marston and Spangler work in general, also quantified the soil related factors in terms of soils and compaction levels, recognizing how pipe is currently being installed. The initial work of Marston and Spangler in developing the support strength factors (i.e. effective bedding angle and lateral component of the soil load) assumed all pipe installed in a trench had no acting lateral component of soil pressure; Rankine K=0 and for pipe installed in an embankment only partial values of lateral forces were considered.

The current research, rather than assume values for an effective bedding angle and lateral components of the soil, specifically developed load response factors for the various soils and their force components for differing compaction levels. Such quantification not only enables the engineer to use the appropriate design factors in determining the required pipe strength, it also provides a measurable evaluation to confirm the pipe was installed according to those design parameters. In recognition of the difficulty to achieve compaction in the lower haunch area of the pipe, the new factors have allowed for poor compaction and voids 15° to 40° each side of the pipe invert. We do not mean to infer such voids will be the case, it is simply a conservative design factor that recognizes if poor compaction were to occur it would most likely be in the lower haunch area.

These new factors are currently included in AASHTO Bridge Design Standards, Section 17, and are presented in the ACPA publication Design Data 40. Also, the ASCE Direct Design Guide 15-93 has incorporated the results of this research in that design methodology.

These new installations and the design factors relative to those installations cover a wide range of backfill materials and compaction levels from a native dumped material having no applied compaction effort to a high quality material having a 95% standard proctor compaction.

In considering these new installations and design factors please keep in mind, voids under the haunches were conservatively included as were additional factors of safety ranging from 10% to 15% as compared with the exacting finite element design used to develop the four new standard installations. Such factors of safety were included in all of the new installations resulting in conservative design values for the four key performance modes of concrete pipe: shear, radial tension, moment, and crack control.

To briefly reiterate, while Marston and Spangler's work in the 1930's was most excellent, our current knowledge of soils-structure interaction and structural response provide a significant improvement to the early technology**.**