CHAPTER SEVEN

7.0 SOIL RESISTANCE, YIELD DISPLACEMENT AND SOIL - PIPELINE INTERACTION

Soil and a pipeline can interact in two ways. The soil may interact with the pipeline through ground movement, as would occur in a landslide or earthquake fault rupture. Alternatively, the pipeline may interact with the soil, as in thermal expansion of the pipeline at a horizontal bend. In either case, the pipeline movement relative to the soil will cause the soil to strain and in doing so develop some resistance to the pipeline movement. It doesn't matter if the soil is "pushing" on the pipeline, or the pipeline is "pushing" into the soil. The purpose of soil-pipeline interaction modeling is to assess the stresses and strains that this interaction imposes on the pipeline. The safe design of pipelines depends on the stresses and strains in the pipeline not exceeding limiting values defined in the design codes.

The interaction between pipelines and soil is often represented by a Winkler beam model. This model considers the soil as four series of springs, each independent of each other, which provide linear elastic resistance proportional to the soil displacement. At some limiting soil displacement the elastic behaviour of the soil ceases and the deformation becomes perfectly plastic. The sets of springs represent the axial, lateral, vertical downward (bearing), and vertical upward (uplift) directions. Figure 7.1 presents the typical arrangement of the four series of springs. There is often some confusion on the use of the terms for the upward and downward springs. Many stress analysts refer to the "upward" spring as that being under the pipeline and the "downward"