21. Lateral Support for Buried Pipelines.

a. General.

1) This section discusses the importance of lateral support for buried flexible pipelines. The topics include when it should be considered and how to determine in the field when special design is required to compensate for low E', modulus of soil reaction.

b. Guidelines.

1) Type of pipes. Lateral support plays a significant role in the design of flexible pipes, such as Steel and PVC. Semi-flexible pipes, such as ductile iron, also rely on the lateral support to some extent. The behavior of rigid pipes such as clay or concrete is independent of lateral support.

2) Lateral support. Flexible and semi-flexible pipes rely on the lateral support to resist external loading. If adequate side support is not available the pipe may undergo excessive deflection, which may lead to total collapse. The side support is a function of the backfill material placed at the sides of the pipe, its degree of compaction, and also the type and stiffness of in-situ soil.

3) Modulus of soil reaction, E'.

a) The contribution of lateral support to external load carrying capacity of pipelines is estimated by the modulus of soil reaction, E'. The soil modulus characterizes the stiffness of the soil at the sides of the flexible pipeline. The E' value of the backfill material is related to its type and degree of compaction. The Ductile Iron Pipe Research Association (DIPRA) handbook provides recommended values of E' for different types of soils. Howard, A.K., "Modulus of Soil Reaction (E') Values for Buried Flexible Pipe" Engineering and Research Center, Bureau of Reclamation, Denver, CO., 1976, provides a comprehensive review of E' values. Hartley, A.M., Duncan, J.M., "E' and Its Variation With Depth", ASCE Journal of Transportation Engineering, Vol. 113, No. 5, September 1987, provides depth-dependent E' values for design of flexible pipes.

b) In general, E' of the in-situ material should be estimated in the field by conducting standard penetration tests, cone penetrometer or dilatometer tests. Based on the results of these tests, the type and degree of compaction of in-situ soil is estimated and the literature cited above can be referenced to estimate the E' value of the in-situ soil.

c) Use the smaller of the two E' values in the design. Alternatively, a finite element analysis may be completed using the corresponding E' values for in-situ and backfill soil.

4) Compensation for low E'. If the in-situ soil is very soft, having a standard penetration test blow count of four (4) or less, it will have a low E' value. There are two methods to compensate for the low E' value.

a) Higher-class (thicker) pipe may be used to reduce the required lateral support.

b) High quality and well-compacted backfill material may be used all around. The width of the backfill material at the sides of the pipe may be increased to reduce the amount of pressure transmitted to the in-situ soil. This method can only be analyzed by a finite element analysis.