Establishment of Cover Depth Requirement for Utility Pipes in Arterial Roads

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Abstract

Pipelines are a safe and economical means of transporting water, gas, sewage and other fluids. They are usually buried in the ground to provide protection. Among those utilities, water lines play a vital role in supplying water to the public. These lines are mainly located under the carriageway of major roads. Therefore, a failure of a critical pipeline is extremely serious and has major consequences in terms of economic loss, social impacts and environmental issues.

The failure modes of the pipeline differ depending on the level of applied external loads, operational conditions and pipe geometry (i.e., diameter and thickness etc.). Among them, the external loads which mainly come from a live loading increase rapidly due to the growth of traffic. With the higher growth of traffic, the existing capacities of roads have exceeded and hence required widening. Further, when the roads are widening, the existing shoulders automatically turn to lanes, causing the existing cover depths of pipes are inadequate to cater new loading. Due to this reason, the highway authorities now have persuaded to shift the utility lines under the shoulder /foot walk when widening or reconstructing of any road and the highway authorities allocated significant amount from rehabilitation budget for utility shifting. Hence it is essential to establish criteria to decide the safe cover depths for utility lines. This research is an attempt to develop a criterion to find the safe depth of cover for locating underground water lines based on various Traffic loading conditions.

As a first step, the stresses acting on pipes under specified depths were found by using “CIRCLY” mechanistic pavement design software. The different pavement layer properties (i.e. thickness, elastic modulus, poison ratio) and Design Equivalent standard axles (DESA) were given as inputs. Then the stresses were obtained for different depths and DESA values.

The second step was the modelling of the pipe using “Solid Works” software. Polyethylene (PE) type pipe (diameter of 110 mm) was used for modelling as it is widely used for water distribution in urban areas. The stresses were given separately for the analysis of the pipe. Then

the fatigue analysis was done in order to obtain the number of cycles to fail the pipe in each depth and in each DESA.

Finally, a graph was developed which ease in finding the safe depth of locating pipes for various design traffic loadings.

Key words: Pipelines, Fatigue analysis, Safe depth

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