Analysis of wrinkles and bridging of geomembranes leading to practical guidance

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ABSTRACT: The purpose of this presentation will be to summarize results from theoretical analyses that provide guidance for practical decisions to address problems posed by wrinkles and bridging during geomembrane installation.

An analysis of the parameters that govern the formation of geomembrane wrinkles will be summarized. The parameters include the coefficient of thermal expansion of the geomembrane, the bending modulus of the geomembrane, the mass per unit area of the geomembrane, and the interface friction angle between the geomembrane and the underlying material. The analysis shows that, while the coefficient of thermal expansion of the geomembrane governs the amount of increase in length of the geomembrane, the bending modulus of the geomembrane (and to a lesser degree the interface friction) govern the height of the wrinkles. HDPE, PVC and bitumen have a high coefficient of thermal expansion, but only HDPE geomembranes exhibit high wrinkles. Bituminous geomembranes do not exhibit wrinkles because they have a low coefficient of thermal expansion thanks to glass-fiber reinforcement; and PVC geomembranes do not exhibit high wrinkles because they have a very low bending modulus. This analysis provides guidance for geomembrane selection.

An analysis of the flattening of geomembrane wrinkles under pressure by the impounded liquid will be summarized. This analysis provides a relationship between liquid pressure and the yield stress at the tip of the wrinkle. This analysis provides guidance for wrinkle acceptance or elimination.

An analysis of the geomembrane stress generated by the loading of a geomembrane bridging an angle between two planar surfaces of the supporting medium will be summarized. This analysis shows that the relevant parameters are the value of the angle, the interface friction angle between the geomembrane and the underlying material, and the distance between the geomembrane and the supporting medium angle when the load is applied (by ballasting or by the liquid or solid material being stored). This analysis provides guidance to determine whether a certain amount of bridging is acceptable or should be eliminated.