

PENNDOT e-Notification



Bureau of Design
Bridge Quality Assurance Division

PAPIER

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Revised Criteria for Spread Footings Founded on Rock

In the current version of PAPIER (Version 1.1), the intact rock modulus, E_o , (entered via the RCK command) is compared against the modulus of elasticity of the footing concrete, E_c , in compliance with Section 11.6.3.2 of the DM-4 for the purpose of determining the bearing pressure distribution. If E_o is less than E_c , the program considers the rock to be "soft" and an equivalent uniform bearing pressure distribution is used, whereas if E_o is greater than E_c , the program considers the rock to be "hard" and a linear bearing pressure distribution is used.

While not explicitly stated in Section 11.6.3.3 of the DM-4, the PAPIER program further uses the "soft" versus "hard" rock classification when applying overturning (stability) provisions. For "hard rock", the resultant reaction must be within the middle three-fourths of the base, while for "soft rock", the resultant must be within the middle one-half. (This is LRFD criteria, LFD criteria is middle one-third for "soft rock" and middle one-half for "hard rock".)

BQAD has recently made the decision that using the comparison of E_o to E_c is not a valid means of determining the bearing distribution and overturning requirements for a footing primarily because very few rocks in Pennsylvania have documented intact rock modulus values greater than concrete. The DM-4 will be revised accordingly.

The PAPIER program will be revised in the next release to eliminate the comparison of E_o to E_c in determining the bearing pressure distribution and overturning provisions. Instead, if the RCK command is used to describe the bearing stratum for a footing, then "rock" criteria will be used, whereas if the SOI command is used to describe the bearing stratum, "soil" evaluation criteria will be followed.

WORK-AROUND

As a temporary work-around, enter a value for the intact rock modulus that is greater than the modulus of elasticity of the footing concrete, which is computed internally in the program using the following equation — $E_c = 33000 (w_c)^{1.5} (f'_c)^{0.5}$ [ksi, English units] based on a normal concrete weight of 0.145 kcf and the user input concrete strength in units of ksi. While the resulting settlement computations will be less than if based on the actual rock modulus, settlement of footings founded on rock is not typically a concern anyway. Should settlement of a rock foundation be a concern, then two separate PAPIER runs should be made.

Direct any questions concerning the above issues to:

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