Frequently Asked Questions

Slab-on-Ground Construction

Answers from the PTI Slab-on-Ground Committee July 1999 · Issue No. 1

Q The perimeter load P includes both dead load and live load, by definition. In the edge lift swell mode an increase in P results in a decrease in moment. So shouldn't P include only dead load in the edge lift condition?

A The PTI method, since its inception, has always been based on both dead load and live load for the perimeter load P in both swell modes. The basis for the PTI method is both analytical and empirical. The equations offered in the PTI publication have been derived from observations of slab behavior and slab deformation computations that considered the slab loading as defined in the publication. While it may seem logical to remove the live load in the edge lift condition, it may result in unnecessarily conservative edge lift moments. The committee recommends that designers conform to the current definition of P that includes both dead and live load for both swell modes. However, designers are permitted to use dead load and sustained (or true longterm) live load, or to use dead load only, whichever they judge to be the more responsible.

Q The 2nd Edition of "Design and Construction of Post-Tensioned Slabs-on-Ground" states that perimeter loads P between 600 and 1500 plf were used to develop the PTI method (Section 4.2(C)(3)(c), p.13). What do we do when the edge load is in excess of 1500 plf?

A This section was added in the 2nd Edition to caution the user that the research which is the basis for the equations in the PTI publication was limited to slabs with perimeter loads not exceeding 1,500 plf. Based on the past two decades of PTI method application to multi-story buildings (e.g., two to four-story wood-framed buildings) with perimeter loads exceeding 1,500 plf, the committee believes that the PTI method will yield reasonable results for perimeter loads somewhat in excess of 1,500 plf. The committee is aware of the successful performance of slabs designed by the PTI method with perimeter loads up to 2,500 plf. Engineering judgment however, should be used for perimeter loads exceeding 1,500 plf.

Q The 2nd Edition states that the PTI method can be used for y_m values up to 4 inches (Section 4.2(B)(3), p.10). For values substantially over 4 inches, another procedure such as finite element, should be considered. What is "substantially"?

A The statement in the 2nd Edition is there because the original research extended only to y_m values of 4 inches. However, based upon discussions with those involved in the original research, the committee feels that the structural equations in the 2nd Edition can be extrapolated to y_m values beyond 4 inches, and values greater than 4 inches may be appropriately used. The committee is also of the opinion that the incremental effect on designs for values above 4 inches is less significant than for low y_m values. Another design method, such as finite element, may of course be used under any circumstances. However, engineering judgment should also be used when applying alternate procedures because of the potential differences in support assumptions, etc., from those used in the original PTI method research. The PTI method does not prohibit the use of y_m values greater than 4 inches, it simply advises caution and the consideration of alternate design procedures.

Q There is a discontinuity in center lift moments at e_m=5 ft. The moment for e_m slightly greater than 5 ft. is often substantially less than the moment with e_m exactly equal to 5 ft. Is this an error?

A The 2nd Edition of the PTI publication provides a transition to resolve the discontinuity. "…calculations of center lift moments based on values of e_m greater than 5 ft. should not be less than those generated for the 5 ft. threshold." (last paragraph of Section 4.2(B)(2), p. 10). The discontinuity is not an error. This condition is only encountered in the center lift swell mode. It is primarily caused by contact between the tip of the elastically deforming "cantilevered" slab edge and the soil. The moment equations predict the reduction of center lift actions as a result of soil support. Also, the curve fitting process used to arrive at the moment equations influences the discontinuity.

Q When I convert a ribbed foundation to a uniform thickness foundation, do I use the same prestress force and tendon location as in the ribbed slab?

A No, the intent of the uniform thickness conversion is for the average compressive stress in the ribbed foundation to be maintained in the uniform thickness foundation. This will result in an increase in total prestress force in the uniform thickness foundation, since its cross-sectional area will invariably be larger than the equivalent ribbed slab. The committee recommends, at the present time, that the tendons be located at the concrete centroid in the uniform thickness foundation. These matters are not directly addressed in the 2nd Edition. The committee is currently working on a clarification that will be part of future editions of the PTI publication.

Q What are the lower and upper levels of soil expansivity for which the PTI expansive soil method should be used?

A a) Lower level. For a plasticity index (PI) less than 15 (or Expansion Index less than 20, i.e. "Very Low"), the soils are relatively stable. Ribbed slabs are not necessary on soils with a PI less than 15. The Uniform Building Code requires special design consideration for foundation slabs built on soils with an EI greater than 20. When the bearing capacity is greater than 1,500 psf, the committee currently recommends prestress levels adequate to provide crack control and slab thickness adequate to distribute gravity loads to the soil (see 2nd Edition, Chapter 2). For soil bearing strength less than 1,500 psf, the committee recommends use of the compressible soils method (2nd Edition, Section 6.13(C)). The committee recognizes that designed post-tensioned slabs-on-ground may not be competitive with non-designed (prescriptive) slabs on relatively stable soils, however the committee believes that they are competitive with designed slabs (such as BRAB Type II slabs or those designed by the WRI method).
b) Upper level. See the discussion of large y_m values (greater than 4 inches) in the third question on this FAQ sheet.

Q Why does the 2nd Edition base the design on the minimum rib depth when more than one rib depth is actually constructed, as in a deeper perimeter rib (Section 4.2(C)(2)(a)(ii), p.12)? Doesn't it make sense to use some sort of average depth, or average moment of inertia, when two or more rib depths are actually constructed? The computer program marketed by PTI for the design of slabs-on-ground allows the use of two different rib depths.

A The committee sympathizes with the logic of computing the gross moment of inertia for the slab and ribs of two depths. The computer study used in the development of the method, however, assumed a uniform moment of inertia across the full width of the foundation, implying that all ribs are the same depth. Further, the maximum design moments (M_L and M_S) depend on the rib depth. The predominant deformation shapes for center lift and edge lift caused by climatic soil swell typically result in bending about an axis parallel to the slab edge. Ribs normal to the slab edge are the resisting structural members, and each rib should carry the proper fraction of the moment. Calculating an average cross-sectional stiffness using two beam depths may result in an inadequate capacity for the smaller ribs. The committee is studying the effects of variable moments of inertia. Until the results of that study are finalized, the committee recommends that the minimum stiffening rib depth be used in design, as stated in the 2nd Edition. Designers who choose to use the moment of inertia of the entire cross-section, including the slab and ribs of two depths, must carefully evaluate the stress distribution to the slab and beams on each specific project.

Q The values for C_Δ in Table 6.2 seem very restrictive for prefabricated roof trusses. Why?

A The committee is aware of significant problems (drywall cracking, wall/ceiling joint separations, resultant litigation) in residential wood-framed structures with prefabricated roof trusses when the trusses are rigidly attached to non-bearing partitions between the truss supports. In that case, even a small relative vertical movement between the two ends of the trusses can cause unsightly gypsum wallboard cracking as a result of wall-ceiling joint separations. The committee considers the large C_Δ values in Table 6.2 to be a warning signal to designers that this condition exists and must be mitigated. As a preferable alternative to designing for the large C_Δ values for prefabricated roof trusses, joinery details can be provided between the trusses and the intersecting non-bearing partitions which permit relative movement without inducing stresses into the partitions. In that case, a smaller C_Δ value may be used based upon the appropriate material listed in Table 6.2.

Q In the equations for Activity Ratio (Ac) and Cation Exchange Activity (CEAc) on (p. 41) I am confused about the denominator. Is the clay percentage based upon the full sample size or just the part of the sample which passes the #200 sieve?

A The denominator of these equations is intended to represent the percentage, by weight, of the amount passing the #200 sieve which is of clay size (smaller than 2_μ or 0.002mm), not the percentage of the total sample weight. Perhaps a clearer way to state the equation is as follows:

$$\text{Percent Clay} = \left[\frac{\text{Weight of Material Passing \#200 Sieve That is} <0.002\text{mm}}{\text{Weight of Material Passing \#200 Sieve}}\right] \times 100$$

For example, assume a total sample weight of 100 grams, of which 60 grams passes a #200 sieve, and of that 60 grams, 30 grams is smaller than 0.002 mm. The Percent Clay is [30/60]x100=50%.

The percentage of clay which appears in the tables for y_m in Appendix A.3 should be calculated in the same way, i.e., based upon the weight of the sample passing the #200 sieve rather than the total sample weight.

In a related matter, the committee would also like to point out that the numerator of the equations for CEC and CEAc in Section A.4.2 on p. 57 of the 2nd Edition is incorrectly shown as PI when it should be PL.

POST-TENSIONING INSTITUTE
1717 W. Northern Avenue, Suite 114 · Phoenix, Arizona 85021
(602) 870-7540 · FAX (602) 870-7541 · www.post-tensioning.org