



# Frequently Asked Questions

## Soil suction Profiles for Slab-on-Ground Applications

Answers from the PTI DC-10 Slab-on-Ground Committee

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**Q** The design suction envelope is used to establish recommended  $y_m$  values for various conditions and soils. Section 3.6.3 of the PTI publication “**Design of Post-Tensioned Slabs-on-Ground**”, 3rd Edition with 2008 Supplement (herein referred to as 3rd Edition) discusses “**Differential Soil Movement**”. The text refers to the Post-Construction and the Post-Equilibrium Case under item 3 and 4 respectively. How does one determine the appropriate design suction envelope, and when should you use a “Post-Equilibrium” or “Post-Construction” envelope?

**A** The use of “Post-Equilibrium” versus “Post-Construction” design suction envelopes depends upon judgment of the geotechnical engineer. In general, Post-Construction envelopes should be considered for localities with a Thornthwaite Moisture Index ranging from  $-15$  to  $+15$ . The Post-Construction envelope assumes that the foundation is constructed when the site is in a condition of extreme dryness from a prolonged dry period or extreme wetness from a prolonged wet period. However, it is possible that extreme arid climates with high negative Thornthwaite Indices and extremely wet climates with high positive Thornthwaite Indices may from time to time experience periods of opposite extreme moisture conditions, but with generally much lower frequency than the range described above. It should be noted that the use of the Post-Construction envelopes will frequently result in significantly more expensive foundation designs than using the Post-Equilibrium envelopes.

The maximum change of suction at the ground surface for design purposes should **not exceed**  $1.5 pF$ .

### BACKGROUND

The following examples further illustrate these concepts.

### Guidance for Geotechnical Engineers Regarding Suction Profiles and $Z_A$

The figures show envelope limits for various moisture environmental conditions. These application examples of design suction envelopes are used in developing  $y_m$ . Note that the non-typical suction envelopes, that is, those without a typical trumpet shape as illustrated in Figure 3.16 of the 3rd Edition will require the use of computer program modeling using a program such as VOLFLO. Various depths of suction envelopes are demonstrated in Fig. 1 through 9; however, these will vary from site to site.

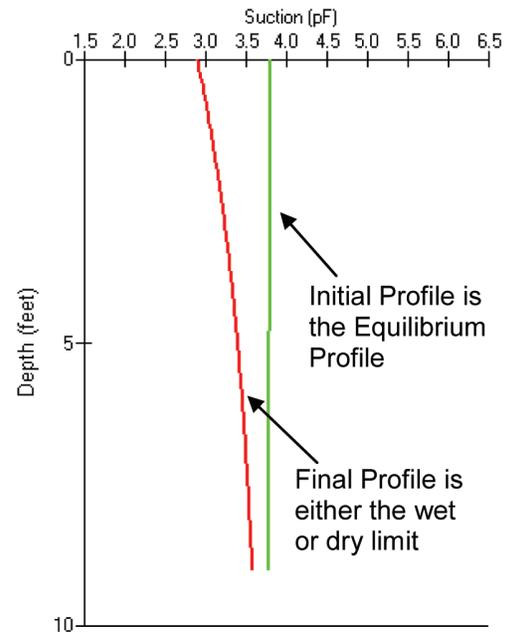


Fig. 1—Post-equilibrium suction envelope.

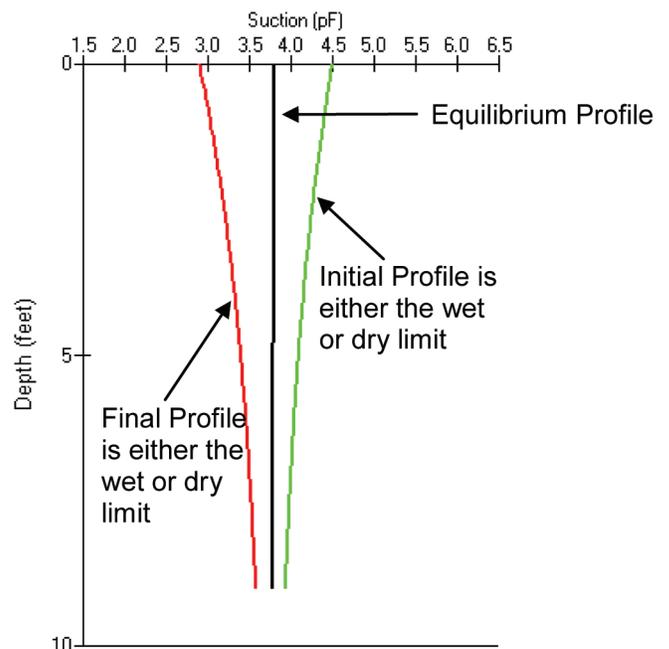


Fig. 2—Post-construction suction envelope.

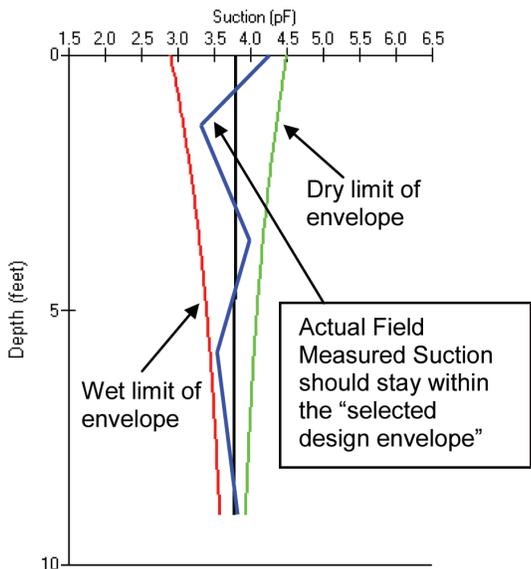


Fig. 3—Suction envelope with field suction profile.

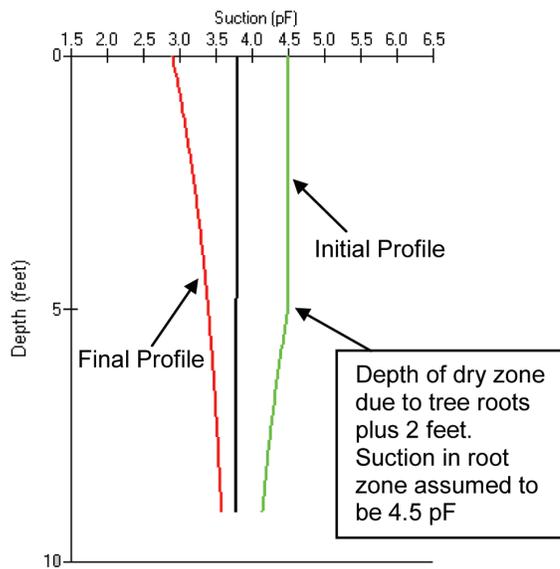


Fig. 6—Removed tree suction envelope.

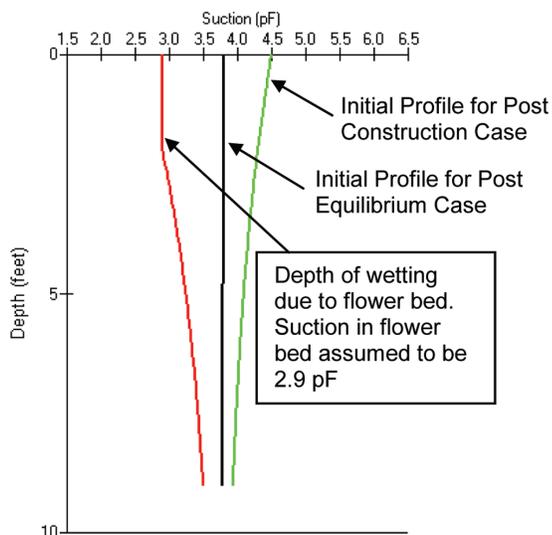


Fig. 4—Flower bed suction envelopes.

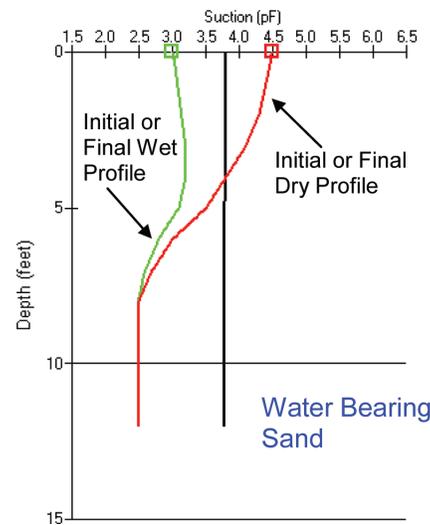


Fig. 7—Water bearing sand. Use suction envelope change to either wet or dry profile from equilibrium for Post Equilibrium Case. Use full wet to dry or dry to wet change for Post Construction Case.

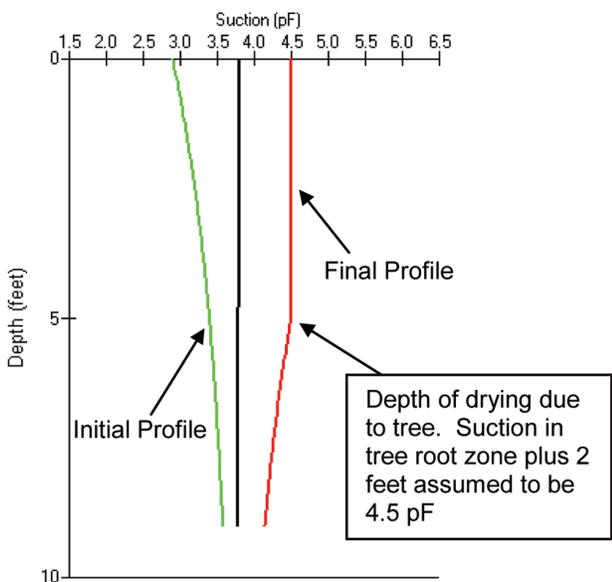


Fig. 5—Planted tree suction envelope.

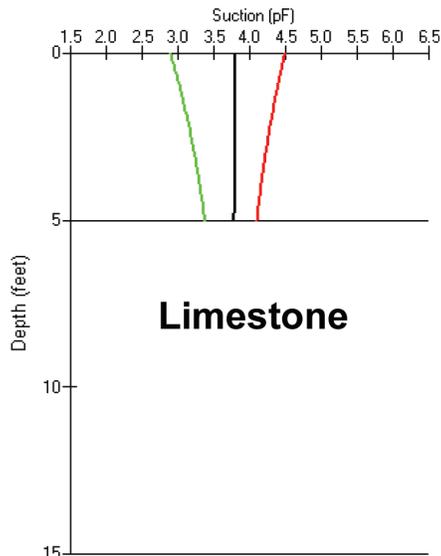


Fig. 8—Shallow limestone. Use suction envelope change to either wet or dry profile from equilibrium for Post Equilibrium Case. Use full wet to dry or dry to wet change for Post Construction Case.

The depth of the Movement Active Zone,  $Z_A$  as discussed in the 3rd Edition under 3.6.3 is illustrated in the diagrams (Fig. 1 through 9) for certain controlling conditions, such as shallow limestone or water bearing sand. Typical deep soil envelopes frequently have  $Z_A = 9$  feet, although unique suction envelopes may require different depths.

The following four cases reflect a western desert practice (Fig. 10 and 11).

### Water Injection—Moisture Conditioning

Testing should be performed for both moisture-conditioned and water-injected soils so that the assumed suction envelope is confirmed. Other acceptable tests calibrated to soil suction may be used to help evaluate the water injection and/or moisture conditioning process. Deep moisture conditioning or water injection is a process in which

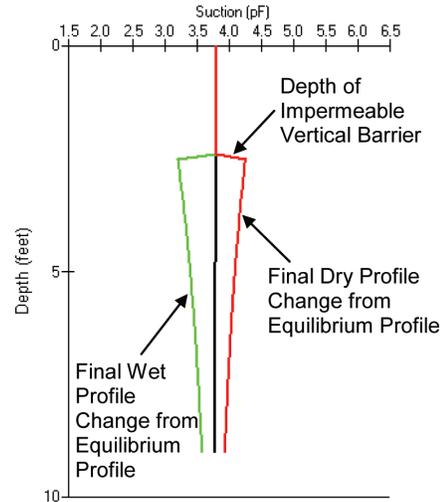
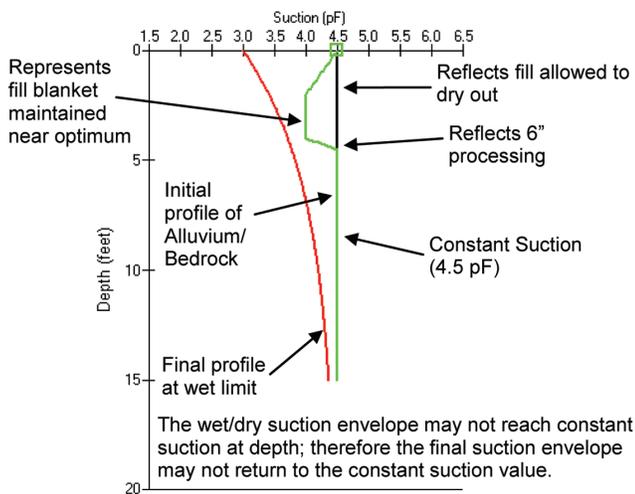
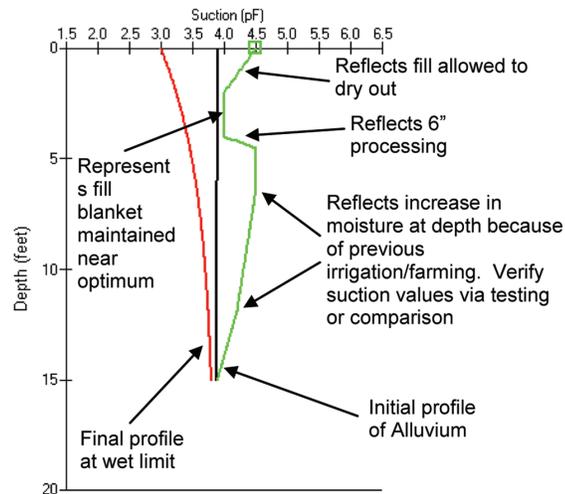


Fig. 9—Edge Barrier Envelope: Post Equilibrium Case.



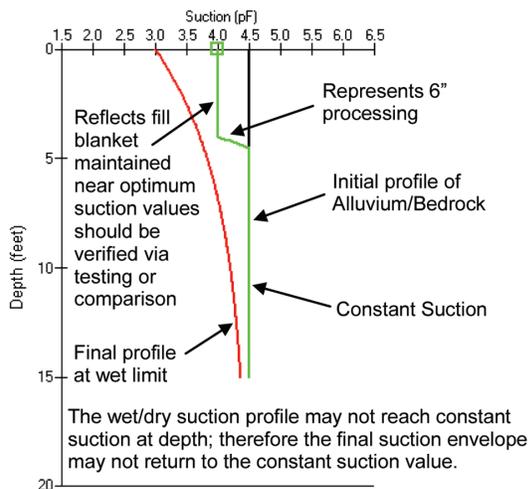
(a)

#### Case One



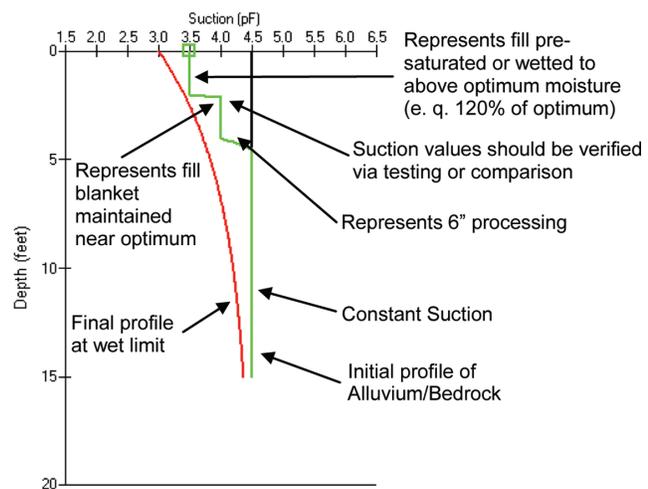
(b)

#### Case Two



(c)

#### Case Three



(d)

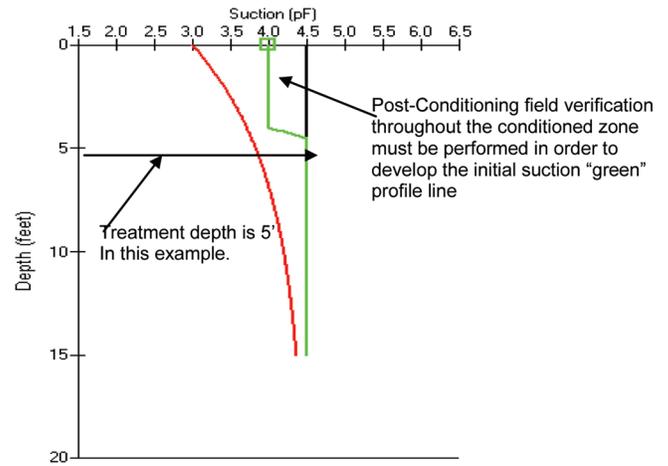
#### Case Four

Fig. 10—Post-Equilibrium Suction Envelopes (4-ft fill blanket over Alluvium/Bedrock): (a) Case One; (b) Case Two; (c) Case Three; and (d) Case Four.

Note: An overall suction change of 1.5 pF is reflected but the actual suction change could be as little as 0.75 pF. The overall suction change used by the designer should be based on experience backed by testing or comparison of known values.

a prescribed swell/suction/moisture condition is achieved to a prescribed depth in order to reduce the swell potential of the soil.

The design suction envelopes illustrated in this document are considered by the PTI DC-10 Slab-on-Ground Committee to represent the reasonable extremes for geotechnical design purposes. No guidance is provided in this document for values outside of these extremes. The development of design suction envelopes does not require site suction testing unless unusual conditions are present or for forensic studies.



**Fig. 11—Illustration of moisture conditioning-water injection envelopes. (Example shows injection/conditioning to 5 ft; however, site conditions will vary and may require much deeper treatment depths.)**