Additional example on the use of Taylor's Chart to find the TRUE factor of safety for a given slope

Determine the factor of safety for a 9.14 m high fill slope. The slope angle is 30º. The fill is constructed with soil having the following properties: Total unit weight, γ = 18.8 kN/m^3; Effective cohesion, c′ = 23.9 kPa and effective friction angle, ϕ' = 20º

Solution:
First assume a common factor of safety of 1.6 for both cohesion and friction angle so that $F_c = F_\varphi = 1.6$. Since $F_\varphi = 1.6$, the developed friction angle, ϕ_d, can be computed as follows:

$$\phi_d = \arctan\left(\frac{\tan\phi'}{F_\phi}\right) = \arctan\left(\frac{\tan 20°}{1.6}\right) = 12.8°$$

For φ_d = 12.8º, and β = 30º, the value of the stability number N_s from Taylor's chart is approximately 0.065. Thus, from the stability equation:

$$F_c = \frac{c'}{N_s \gamma H}$$

$$0.065 = \frac{23.9}{(1.6)(18.8)(H)}$$

or $$H = \frac{23.9}{(1.6)(18.8)(0.065)} = 12.2 \text{ m}$$

Since computed height H = 12.2 m is greater than the actual height of 9.14 m, the value of the common safety factor must be greater than 1.6. Assume $F_c = F_\varphi = 1.9$ and recompute as follows:
If $F_\varphi = 1.9$, then ϕ_d = 10.8º and N_s from the chart is approximately 0.073.

The recomputed value of H is as follows:

$$H = \frac{23.9}{(1.9)(18.8)(0.073)} = 9.16 \text{ m}$$

The height of 9.16 m is virtually identical to the correct height of 9.14 m. Therefore, the minimum factor of safety with respect to shearing strength is approximately 1.9.