

DESIGNING TRUSSES FOR ROOF TOP GARDENS

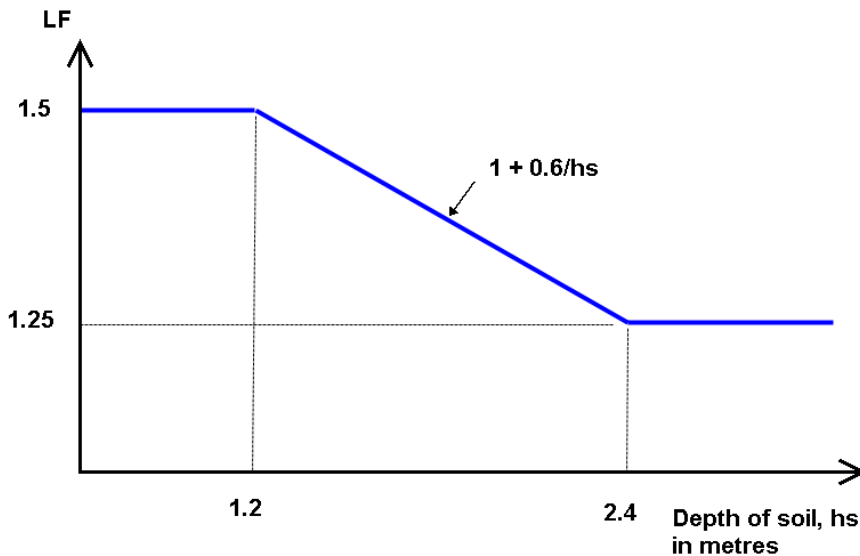
Introduction

There has been a trend in recent years for homeowners in the city to convert the bare roof tops into roof top gardens. This, as you can imagine, requires the roof trusses to be designed to carry soil, superimposed earth, plants and trees on top of traditional dead, snow and floor loads. Therefore NBC 2005 has provided the designers with the loading requirements for these roofs.

The additional loads imposed on the roof top gardens are classified as dead loads. However, due to the variability of this dead load, NBC 2005 provides a different principal load factor for Strength Limit States as follows:

Principal Load Factor

Sentence 4.1.3.2. 7): The load factor 1.25 for *dead load*, D, in Table 4.1.3.2 for soil, superimposed earth, plants and trees shall be increased to 1.5, except that when the *soil* depth exceeds 1.2 m, the factor may be reduced to $1 + 0.6/h_s$ but not less than 1.25, where h_s is the depth of *soil* in metres supported by the structure. The graph below shows how the principal load factor varies with the depth of soil



It is important to note, however, that Sentence 4.1.3.2.7 addresses only the Factored Loads and not specified loads, which affect Serviceability Limit States.

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Therefore when a roof contains a garden, additional specified dead load due to soil must be applied to the truss top chord and the factored dead load, derived from soil, shall be computed using factors in the following Table while standard dead load is factored using the standard principal load factor of 1.25.

Soil Depth (h_s)		Load Factor	
m	ft	($h_s - m$)	($h_s - ft$)
$0 \leq h_s \leq 1.2$	$0 \leq h_s \leq 3.94$	1.5	1.5
$1.2 < h_s < 2.4$	$3.94 < h_s < 7.87$	$1 + 0.6/h_s$	$1 + 1.97/h_s$
$2.4 \leq h_s < \infty$	$7.87 \leq h_s < \infty$	1.25	1.25

Duration of Load (DOL) Factor

Duration of load factor is determined using specified dead load, D, (includes soil load) and other variable loads as provided in Sentence 4.3.2.3 of CSA O86. Accordingly, load duration factor, K_D is computed using the following formula:

$K_D = 1.0 - 0.50 \log (P_L/P_S) \geq 0.65$. Where P_L = Specified long term load and P_S = Specified standard term load based on S and L loads (determined using importance factors =1.0) acting alone or in combination. The following are possible combinations: S, L, (S+0.5L), (0.5S+L).

It should be noted that K_D will vary per load case since the ratio P_L/P_S varies with load case.

Simplified Calculation of applied Soil Load

Where designers are not set up to use software designed to handle soil loads, it is acceptable for designers to convert specified soil load to standard dead load by increasing the soil load by 20% and adding the increased specified soil load to standard dead load.

This approach simplifies the remaining calculations but overdesigns deflection and underestimates uplift and overturning loads. Designers must be carefully to examine designs where uplift and overturning loads are critical.