Tunnels: Design and Construction. Profile

1 Purpose and scope

Profiles indicated in Underbygning/Prosjektering og bygging/Profiler og minste tverrsnitt must be used as a basis for the design of new tunnels.

2 Normal profile

The normal tunnel profile is described in Normalprofil for tunneler

3 Theoretical blast profile

The theoretical blast profile of tunnels is the profile that indicates the blast limits for the tunnel, cf. Normalprofil for tunneler

a) Between the limits for the theoretical blast profile and the normal profile, space must be set aside for stabilisation measures, including water and frost protection. This distance must be assessed on an individual basis, but is normally in the region of 400-600 mm.

In the bed, the theoretical blast profile is determined by the thickness of the superstructure, the selected substructure and the crossfall requirements for the tunnel bed, as well as by deep blasting, where applicable. Requirements for tunnel substructure are described in Underbygning i tunnel. Requirements for superstructure are described in Overbygning/Prosjektering.

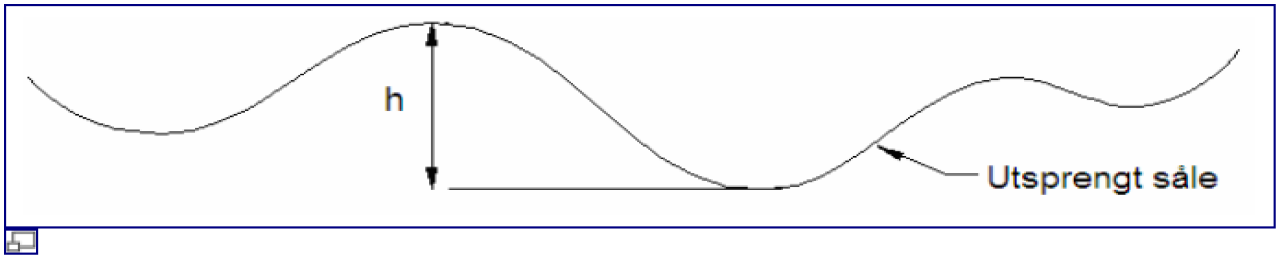
b) The raw-blasted bed must have a crossfall of at least 5% towards the main ditch.

The following requirements apply to ballasted track:

c) Vertical height difference between lowest and highest excavated point of the tunnel bed must not exceed height h, where h for speed V is stated as:

- For V = 160 km/h: h = 0.5 m
- For 160 km/h < V = 250 km/h: h = 0.25 m

If height h must be reduced, this entails assessing whether measures such as blasting/chipping away nodules of rock, and/or filling in any hollows are appropriate; see Figur 1.



Figur 1: Height difference between lowest and highest point of the tunnel bed

The height limit requirement is related to the fact that wavelengths with high amplitudes may occur in the rails. For conventional excavation methods, the material processed is approximately 5.50 m. If the difference in height becomes too great, the variation in elasticity of the track in the tunnel bed can result in too high a wavelength amplitude. This may result in violent resonance movements in trains (including their superstructure) at high speeds, and also means that track can degenerate more quickly. This aspect applies when the height of the ballast layer under the

sleepers is normal.

An alternative is to increase the thickness of the ballast layer by 20–30 cm, but this would require larger tunnel cross-sections.

The values for the heights apply to all nodules of rock, and are measured along the full length of the tunnel. This means that the requirement must be complied with between all adjacent nodules at every point in the tunnel, and thereby also between every randomly selected nodule along the length of the tunnel.

In order to accomplish this, and in order to comply with the requirement, depending on local conditions, a dedicated reference line may be selected (which can be the bottom edge of sleepers, the top edge of sleepers, or the top of the rail head).