1. General Information

This recommended practice serves as a construction aid for the calculation of tunnel cross-section. It is particularly useful in difficult cases, such as a tunnel on a curve or when the distance between parallel tracks is large. To avoid tunnel entrances that appear overly wide, they should be positioned on straight or slightly curved tracks where increased clearances are not needed (see NEM 103).

The interior tunnel wall should be modeled for some distance within the tunnel entrance.

The size of the tunnel cross-section will vary depending on:

- - the mode of operation (with or without catenary),
- - the curve radius,
- - the length of the rolling stock used,
- - the distance between track centerlines.

This standard conforms with the following NEM standards:

NEM 102 - Track Clearance Diagram for Straight Track,

NEM 103 - Track Clearance Diagram for Curved Track,

NEM 112 - Track Separation.

When constructing a rectangular cross-section tunnel, allow additional side clearance for safety reasons as is the practice with most modern installations. In the case of the circular cross-section tunnel this additional clearance is built in as a result of the cross-section curvature.

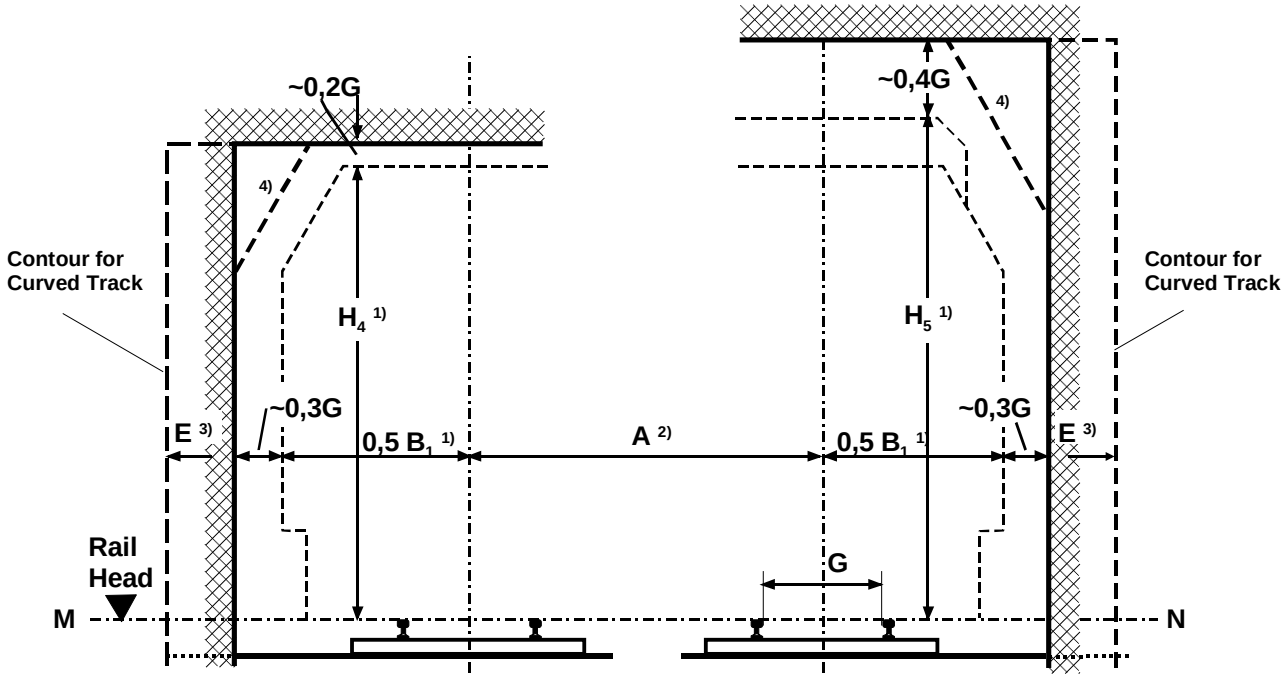
When used, it is advisable to lower the overhead line to the minimum height permitted by NEM 201.

Rectangular tunnel clearances are also applicable to bridge underpass construction.

The tunnel cross sections take into account the possible increased height brought about by NEM 114.

2. Descriptions

2.1 Tunnel with Rectangular Cross-section



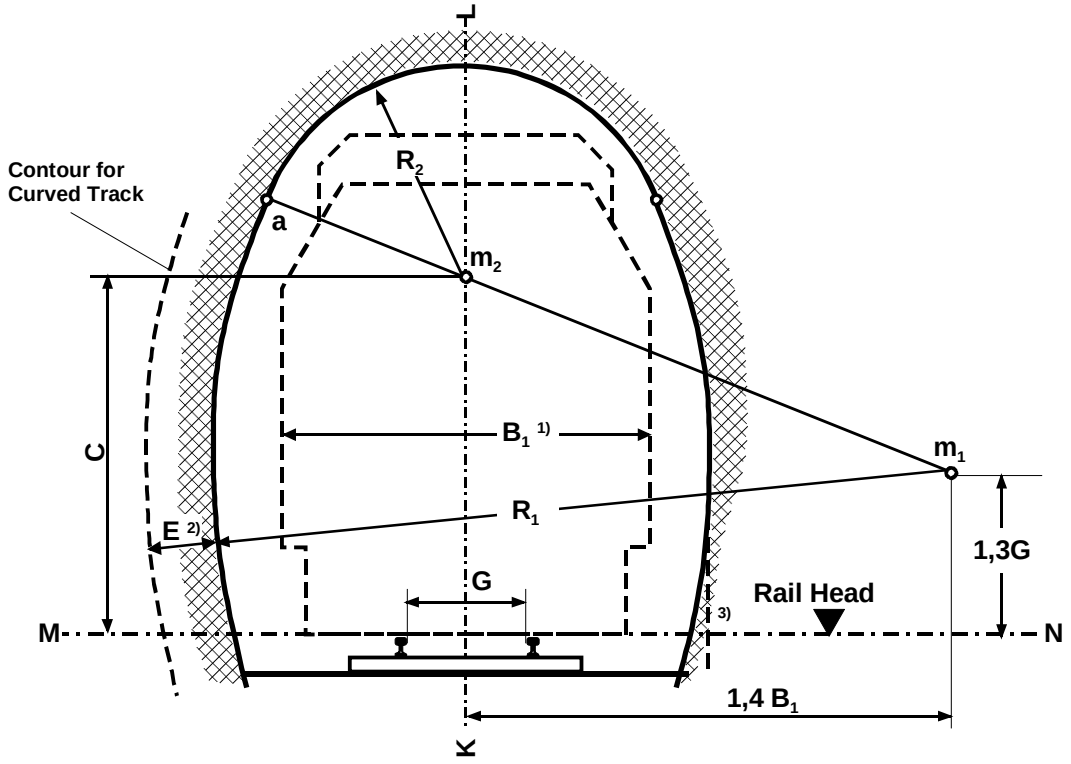
Notes:
1) Measurements ***B1***, ***H4*** and ***H5*** from NEM 102.
2) Track separation ***A*** from NEM 112.
3) Extension ***E*** from NEM 103.
4) The tunnel wall may be tapered in the upper corners.

Construction

1. The tunnel height is measured as shown in the design.
2. The tunnel width is governed by the width measure of ***B1*** (plus the track separation for multi-track tunnels in accordance with NEM 112) plus the additional side clearance 0.3*G.

   On curves, the tunnel width should be extended on both sides by the measurement E (NEM 103).

2.2 Single-track Tunnel with Circular Cross-section



Notes: 1) Measurements ***B₁*** from NEM 102.
2) Extension ***E*** from NEM 103.
3) The lower portion of the tunnel wall may drop perpendicularly to the ground.

Construction

1. Tunnel axis ***K*** - ***L*** and horizontal over rail head (SO) ***M*** - ***N*** derived from Column A measurements in NEM 112.
2. Points ***m₁*** and ***m₂*** are the radius points for determining the outline of the tunnel bore.

   Table of dimensions for ***C***:

Tunnel without catenary:	***C*** = 2.2*G
Tunnel with catenary:	***C*** = 2.8*G for straight track,
	C = 2.3*G for curved track.

3. For straight track: Draw a circular arc with radius $\mathbf{R_1}$ = 2*B1 around the point ***m₁*** (this outlines the lower portion of the tunnel wall below the horizontal intersecting point ***a***).

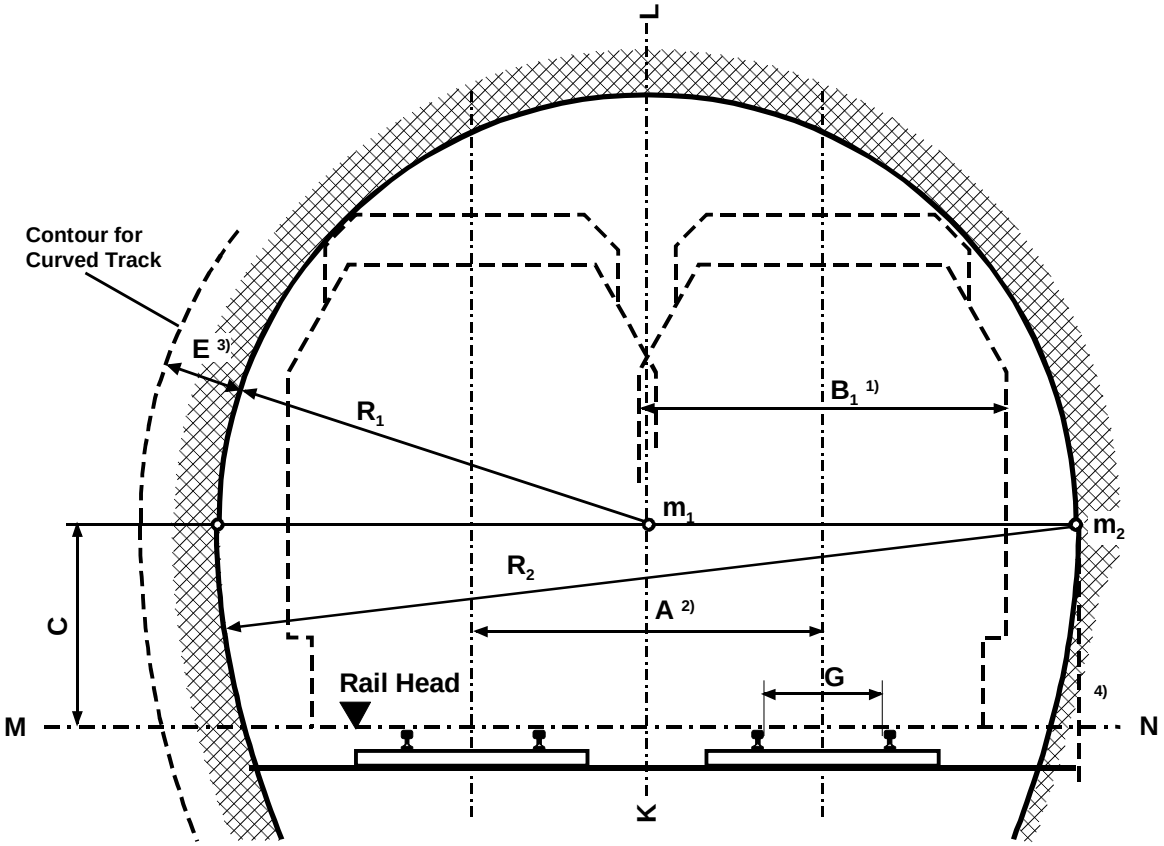
   On curves, measurement ***R₁*** should be increased by the measurement ***E*** (from NEM 103).

   Example for H0: *Curve radius 700, B_1 = 48, E = 7 mm*

   $R_1 = 2\ B_1 + E = 96 + 7 = 103$ mm

4. The profile of opposite sides of the tunnel should be a mirror image of one another.
5. Draw a circular arc with radius ***R₂*** (= distance from point ***m₂*** to point ***a***) around the point ***m₂*** (this outlines the upper portion of the tunnel wall above the horizontal line intersecting point ***a***).

2.3 Double-track Tunnel with Circular Cross-section



Notes: 1) Measurements ***B₁*** from NEM 102.
4) Track separation ***A*** from NEM 112.
3) Extension ***E*** from NEM 103.
4) The lower portion of the tunnel wall may drop perpendicularly to the ground.

Construction

1. Tunnel axis ***K*** - ***L*** and horizontal over rail head (SO) ***M*** - ***N*** derived from Column A measurements in NEM 112.
2. Point ***m₁*** on the tunnel axis and a horizontal line through ***m₁*** determine the tunnel outline

   Table of dimensions for ***C***:

Tunnel without catenary:	***C*** = 1.5*G for straight track,
	C = 1.7*G for curved track,
Tunnel with catenary:	***C*** = 1.8*G for straight track,
	C = 1.7*G for curved track.

3. For straight track: Draw a circular arc with radius ***R₁*** = 0.5*A + 0.6*B1 around the point ***m₁*** (this outlines the upper portion of the tunnel wall above the horizontal line at height C (point ***m₁***)).

   On curves, ***R₁*** should be increased by the measurement ***E*** (from NEM 103).

   Example for HO: *Curve radius (inner track) 700, A = 52, B1= 48, E = 7 mm*
   R1 = 0.5 A + 0.6 B, + E = 26 + 29 + 7 = 62 mm

4. Draw a circular arc with radius ***R2*** = 2*R1 around point ***m₂*** (this outlines the lower portion of the tunnel wall below the horizontal line at height C (through point ***m₂***)).

The profile of opposite sides of the tunnel should be a mirror image of one another.