

IV.2.3 Recirculation

Between the exit portal and the neighbouring entry portal of two uni-directionally used tunnels a substantial air recirculation may take place, depending on the local geometry and wind direction. The same problem exists between exit portal and fresh air intake of a semi-transverse ventilation station. In short tunnels with high self-ventilation this may be of no concern, but in longer tunnels this effect should be reduced. Several model and full-scale tests [10, 21] gave the following findings:

No wind

1. With two tunnel portals at the same height and a distance between the neighbouring walls of 1 m, about 15 % of the outflowing tunnel air is sucked in as fresh air into the neighbouring entry portal. When the distance between the two neighbouring walls is increased to 4 m, the recirculation goes down to 2 %.
2. A division wall between two tunnel portals (1 m spaced) effectively reduces recirculation: with a wall-height equal to the tunnel height and a wall length of 5 or 10 m, the recirculation reduces to 4 % or 2 % respectively.
3. By elongating the exit tunnel portal 5 to 10 m, even less recirculation takes place relative to the case of a division wall.

Wind effects

Recirculation strongly increases when a wind pushes the outflowing tunnel air jet towards the neighbouring entry portal.

- In the case number 1 a side on wind with 1/2 or the same velocity as the outflowing jet brings the recirculation on the average to 30 % with a peak at 60 %.
When the two portals and the adjoining open road section are in a recess or in between walls, a side wind creates a vortex over the open road section, what also results in a high recirculation in both side wind situations.
- In the case number 2 with a division wall of 20 m or 40 m length the recirculation has a maximum of 40 % or 20 % respectively with an unfavorable side on wind, but practically no recirculation in all other wind directions.
- In the case number 3 where two tunnel portals are separated in the tunnel axis direction, wind effects can only be reduced, when the entry portal is in back of the exit portal. When the entry portal is in front of the exit portal, the tunnel air jet flows up to the entry portal and is taken in there quite strongly.