

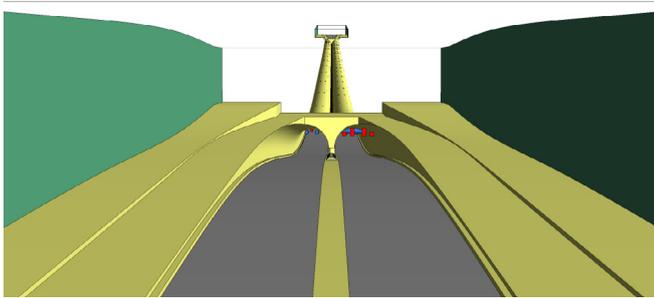


Tunnels

Equipement performance

Introduction

There are many types of tunnels with varying uses. Nevertheless, tunnels are always a confined space which require special measures for its daily usage and in case of hazards. Simulations assist with the design of tunnels and in particular its safety measures. Most commonly simulations are used to analyze the fire safety level and/or air quality.



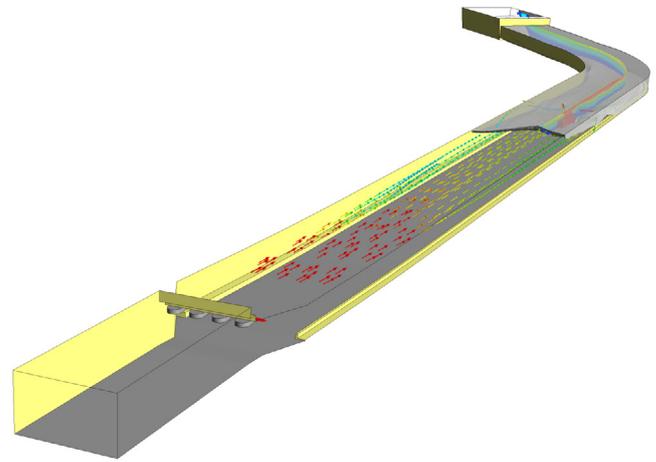
Tunnel fire safety

The specific fire safety strategy for a tunnel is a combination of the local regulations, the owner demands and its use. This can result in requirements for evacuation, smoke control, sprinkler systems, structural damage control, etc.

With CFD simulations the ventilation design can be verified and the **smoke/heat propagation** in case of fire calculated in great detail. Mainly the temperature, radiant heat and resulting visibility are investigated indicating the conditions to which **evacuees** and **fire brigade** are exposed. For road tunnels the general objective for longitudinal ventilation is to prevent **backlayering**, for other control systems different objectives can apply. When analyzing the smoke propagation in time the Available Safe Evacuation Time (**ASET**) and possibilities for the fire brigade to **approach** the seat of the fire can be investigated.

Possible structural damage or instability during and after the fire can be investigated by a **thermal load analyses**. The reduction of the thermal load when **sprinkler or water mist** systems are applied can well be incorporated in the CFD analyses to quantify the effect.

Evacuation simulations provide insight in the Required Safe Evacuation Time (**RSET**), possibly for multiple scenario's and areas of the tunnel. A comparison of the ASET and RSET provides insight in the **fire safety level** of occupants.



Air quality

During daily use the tunnel air quality must be maintained at any time. CFD simulations calculate the air flow through the tunnel in great detail, accounting for thrust fans, pollution sources from traffic and all kind of resistances such as wall resistance, portal losses and other shape factors. The resulting concentrations of pollutants such as CO or particulate matter can be evaluated.

Polluted air leaving the tunnel through its portals can also have an impact on its environment. The dispersion of polluted air through this environment and the effect of different portal designs or other measures can very well be investigated with CFD.

