



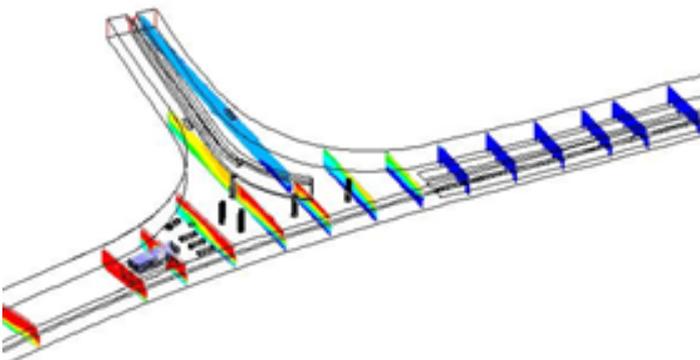
# Thermal analysis to determine the fire safety of structure

Computational Fluid Dynamics & Finite Element Method

## INTRODUCTION

- What is the expected fire scenario?
- How will a structure behave during a fire?
- When will a structure lose its integrity?

With over 65 years of experience in fire science, EFECTIS can answer these questions. The development and spread of a fire, its intensity and the resulting temperatures are computed with Computational Fluid Dynamics (CFD). The effects on steel and concrete structures are determined by Finite Element Method (FEM). This synergy in modelling leads to fire safe results, optimised designs and reduction of costs, where simple models or EN Eurocodes do not suffice.

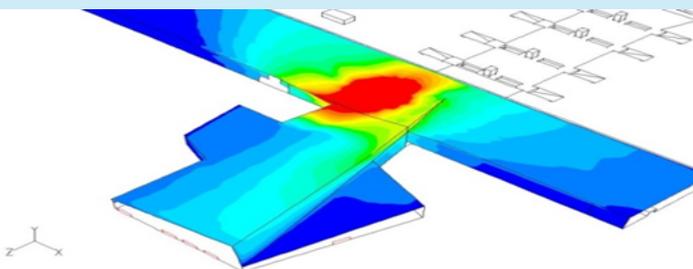


*A car fire in a tunnel modelled via CFD*

## COMPUTATIONAL FLUID DYNAMICS

It is a never ending challenge, offering satisfying solutions without limiting the design. That is where CFD software provides the answer. Requirements may change and application areas can vary, but by utilizing software models, realistic, yet conservative scenarios are created to determine the thermal conditions.

Ultimately, calculation outputs such as local temperature and heat flux indicate the possible weak points of the structure. With this knowledge tailored solutions can be offered that justify both the safety and the design.



*Temperature on the ceiling of a train station*

## 4D APPROACH

Using the 4D approach helps us to optimise results in both efficiency and outcome. The steps are:

### *Designing the geometry*

- Interconnected compartments

### *Determining the boundary conditions*

- Thermal properties
- Ventilation conditions

### *Defining the fire scenario*

- Fire load and size
- Duration
- Location

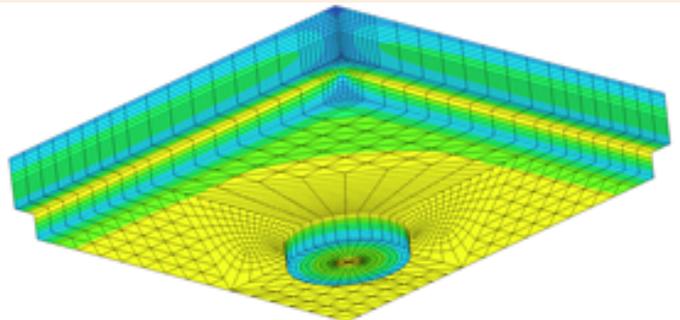
### *Data collection from calculation*

- Gas and solid temperature
- Heat flux on surface
- Velocity
- Extinction coefficient of smoke
- CO, CO2 and other species in air
- Smoke propagation

Using the 4D approach makes finding optimized solutions without compromising safety easier than ever.

## FINITE ELEMENT METHOD

Once the fire scenario is determined, the next step is to find out if the structure of concrete or steel can withstand the fire loads. This thermal analysis is done using a Finite Element Method. With FEM all possible structural complications can easily be analysed.

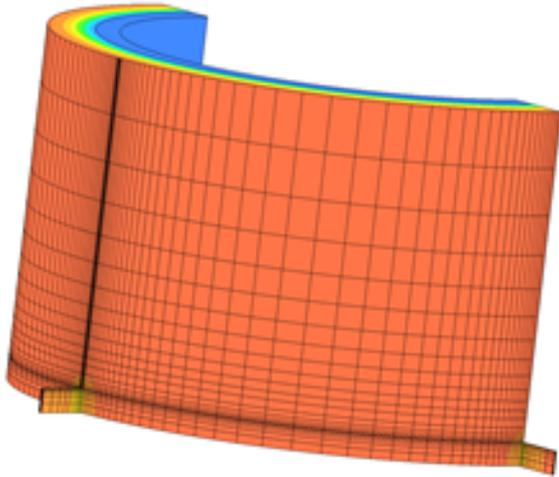


*Thermal analysis of steel section*

## REDUCE STRUCTURAL COSTS

With the help of FEM, thermal analysis can be used to determine the structural behaviour in case of a fire or high temperature loads. It can also evaluate how long a structure can withstand fire loads while satisfying the strength and/or serviceability criteria specified by the standard. EFECTIS uses TNO DIANA software for accomplishing these goals.

By providing optimized solutions for fire safety EFECTIS can help to reduce structural costs.



*Thermal analysis of a concrete section*

## YOUR STRUCTURE, OUR EXPERTISE

Our services cover the modelling of following structures:

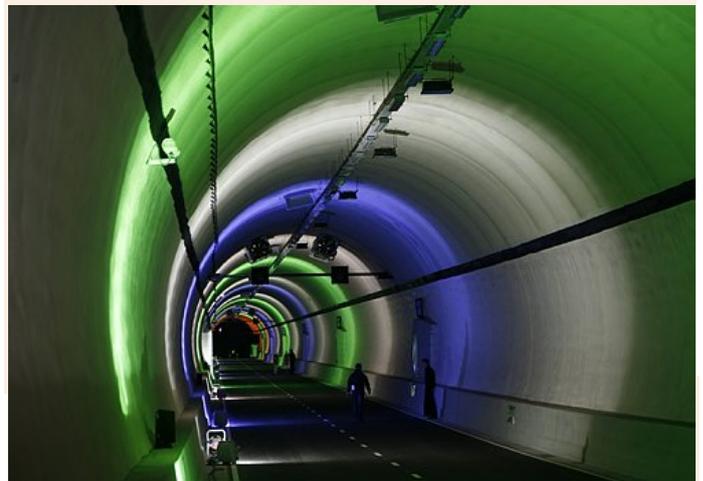
- Tunnels
- Car parks
- Train and subway stations
- Residential buildings
- Theatres and concert halls
- Offshore platforms
- Pipelines

## WHY CHOOSE EFECTIS

Over 65 years of experience in the field of fire engineering and testing makes EFECTIS leading in knowledge of concrete and steel behaviour during fire.

The model type, the temperature dependent thermal properties of materials during fire and calibration of data with the test results makes the analysis of CFD and FEM reliable and precise.

The knowledge of all the parameters mentioned above makes EFECTIS a trustworthy partner in the fire safety industry. This is why we are your first choice when it comes to CFD and FEM based thermal analysis.



*Being the author of two market specific test procedures both tunnels\* and Oil&Gas\*\* paves the way forward for the industry in fire safety.*

*This is why Efectis should be your first choice when it comes to CFD and FEM based thermal analysis.*

\*2008-Efectis-R0695

\*\*EFTP-002:2016



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Efectis is the Expert in fire science, engineering, design and modelling, risk analysis, testing, inspection and certification.

Efectis covers all fire safety capabilities and know-how in testing and modelling around the world with offices and laboratories located in France, the Netherlands, Spain, Turkey, North Africa and the Middle-East area.