

# Consultancy Products

## Fire Design and Risk Analyses

The specialties of HOJ Consulting comprise among others services within the headlines of "fire design" and "risk analyses".



### Fire design

The services include among others, fire design of:

- Tunnels
- Concrete structures
- Other structures and other materials
- Fire safety concepts  
Development and description of concepts and integration of design, operation, safety measures, and emergency planning into an overall safety concept
- Development of fire design requirements for projects - as part of internal or external specifications
- Fire safety engineering/ Performance-based fire design according to the framework given in ISO/TR 13387
- Qualitative fire design reviews  
Quantitative analysis of design  
Assessment of fire design
- Modelling of effect of risk reducing measures: structural, electrical, mechanical measures. active and passive systems preventive and mitigation measures etc.
- Modelling of fires  
Development of heat, temperature and smoke
- Fire, smoke and heat spread  
Planning of CFD studies and other assessments of fire, smoke and heat spread  
Application of fire, smoke and heat spread in the design process.
- Planning of ventilation studies, interaction with ventilation studies, and use of result of ventilation studies in the design process.
- Application of studies of material behaviour during fires in the design process

Micro-, meso-, and macro-level behaviour of concrete (components), steel, and other (construction) materials

- Structural behaviour during fires  
Loss of strength and stiffness as well as deformations and interaction with ground and other structures.
- Evaluation of structural design measures: structural lay-out, concrete mix, added fibres, fire protection or other passive protection.
- Fire design as part of an overall design process taking into account also other aims of the design process, e.g. constructability, durability and low environmental impact.
- Planning and preparation of fire tests  
Small-scale test of material behaviour  
Small-scale test of structural components  
Large scale tests of structural components or structures  
Tests of fire development or smoke spread  
Large scale test under realistic conditions
- Use of fire tests as part of the design process  
Selection of design options  
Documentation of suitability of design
- Study of escape from fires  
Analytical and computerised simulation models
- Planning of safety measures related to escape  
Signs, communications, alarms,  
Escape ways and - doors
- Emergency planning and planning of safety measures related to assisted rescue and to fire fighting

### Risk Analysis

The services include among others:

- Risk of related to a contract
- Risk of tender (tender evaluation)
- Risk related to construction
- Risk related to operation
- Risk related to decommissioning

The risk analyses can be carried out with the purpose of:

- Communication of the risk to other parties
- Documentation that the risk is lower than a specified maximum (or similar)
- Risk analysis as part of the design and decision process

The risk analysis can be related to

- Tunnels for railways, roads, metros etc.
- Bridges and other particular parts of the infrastructure

- Open railways, roads, and other types of infrastructure
- Industrial plants and other relevant systems

The type of risk to be studied can be defined as, for example

- Individual risk to users
- Risk of economic loss
- Risk of loss of the operation
- Risk of societal loss, etc

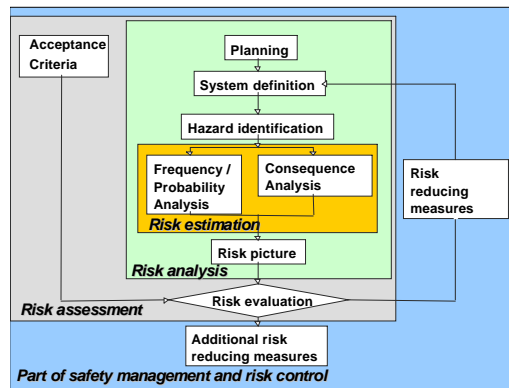
The structure and the level of detail of the risk analyses will have to be adapted to the specific purpose of the risk analysis

Risk analysis procedures:

- Safety review of systems
- Benchmarking of system
- Qualitative identification of hazards and critical items and evaluation of significant hazards
- Modelling of risk analysis
- Quantification of probabilities and consequences or semi quantified risk analysis
- Evaluation of the risk based on the predefined evaluation criteria.
- Evaluation of risk reducing measures

In more detail the risk analysis may include the following:

- Establishment of risk policy and evaluation criteria
- Definition of the system and boundaries
- Identification of hazards
- Qualitative and semi-quantitative methods
  - System analysis
  - Hazard and operability analyses
  - Hazard analysis
  - What-if analyses
  - Failure Mechanism and Effect analyses
  - Cause consequence analyses
- Establishment of scenarios
  - Evaluation of scenarios
  - Worst case studies
- Application of expert judgment and experience in the risk analyses
- Inclusion of human reliability, risk of errors and human behaviour in the risk analyses
- Quantitative studies
- Statistical studies and creation of basis for risk analyses
- Scenarios studies
- Simulation of system behaviour.
- Logical trees: Fault trees, Event trees etc.
- Assessment of risk, based on criterion lines or based on evaluation of cost efficiency, cost-benefit considerations etc.
- Integration of risk aversion principles in the risk evaluation



Specific models has been developed and applied for risk analyses with similar nature, for example:

- Operational risk in road tunnels
- Operational risk in rail tunnels
- Transport of dangerous goods through tunnels
- Construction risk analyses for tunnel construction, etc.
- Contract risk analyses
- Integrated approach including safety, durability and environmental requirements

The models can be established in order to achieve a transparent and uniform structure of the risk analyses and can be part of a general harmonisation

### **Analysis of operational risk in road tunnels**

The risk analyses of road tunnels shall be well adapted to the needs, the phase of the project and the local conditions. The analyses can use a stepwise approach with detailed of selected items. The analyses will typically include the following:

- Description of the tunnel and traffic system
- Determination of the decision goals, the acceptance criteria and general principles.
- Establishment of the risk related basis including the available statistics and information about accidents and incidents in tunnels and on roads
- Benchmarking of the tunnel design and identification of critical factors
- Hazard analysis and qualitative risk analysis
- Evaluation of human factors
- Quantitative modelling of risk influencing factors and critical aspects for the specific tunnel
- Quantitative risk analysis of fatalities, injuries, damage to structure and environment
- Evaluation of risk and identification and recommendation of risk reducing measures
- Support of decision making
- Communication and coordination of the results of risk analyses to other stake holder, for example as part of the emergency planning process.

The risk analyses can be carried out for the tunnel owner in order to document the safety in the tunnel and can be an integrated part of the design process.



HOJ Consulting GmbH

Gersauerstrasse 78  
CH-6440 Brunnen  
Switzerland

Tel +41 41 820 3376