ONE Simulations

Calculating the future


Datacentre


Marine and Offshore

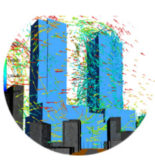

Process Industry


Research and Development


Car parks


Evacuation


Comfort


Wind and Weather


Sprinklers and Watermist


High Rise


Circulation


Tunnels

And much more...

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ONE Simulations
- Fluid dynamics
- Fire safety
- Environment
- Energy

ONE Simulations

Calculating the future

Who are we

ONE Simulations is an independent engineering company that specialises in advanced simulations in the fields of fluid dynamics, fire safety, the environment and energy. We excel in setting up realistic simulations that suit the requirements of our clients. We strive to find the right balance between the necessary detail and the (computational) costs. Furthermore, we ensure a thorough analysis and clear communication of the results.

The objective of ONE Simulations is to make advanced simulations accessible to a diverse target group.

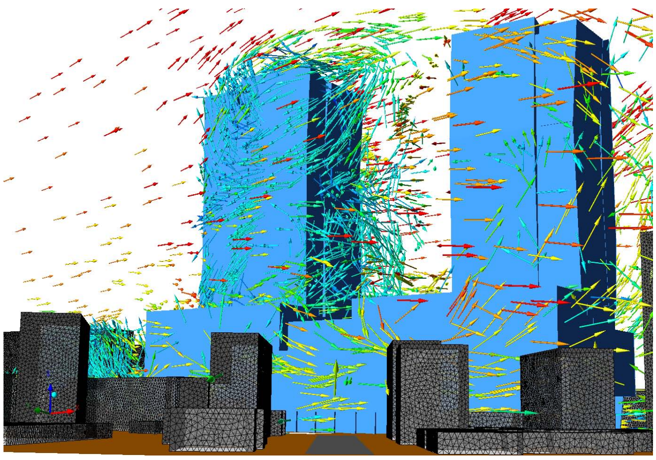
Computing capacity

The CFD simulations are carried out by our advanced computing facility consisting of multiple high performance computing servers interconnected by a dedicated high speed network.
In combination with our ANSYS CFX software this enables us to investigate your inquiry rapidly and accurately.
Our advanced hard- and software allows for difficult geometries in which complex physical processes take place, requiring fine hybrid grids and short time steps, while maintaining acceptable calculation times.

Why choose us

ONE Simulations is a specialised company that will work in close collaboration with you to translate advanced simulation results into applicable solutions. All in good agreement with the technical and economical feasibility of the project or development. Additionally, we possess a solid background knowledge of the regulations.
Thus providing the tools to offer you a profitable consult.

We form an important link in designing extraordinary projects which are expected to realise a specific performance.



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Kinaxixi
Luanda, Angola

Environment

Introduction

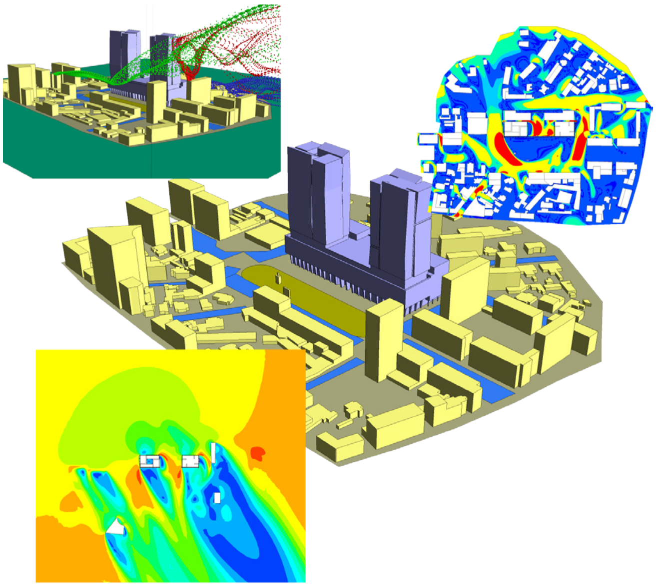
In Luanda, Angola, the large Mixed Use Development Complex Kinaxixi is under construction. The complex is composed of a shopping mall on the lower levels with a residence and office tower placed on top. A building like this can influence the local environment negatively. The project team consisting of EnerOne, 3 drivers and ONE Simulations was asked to quantify these effects.

Description

The influence of this MXD building on its surrounding environment is evaluated by ONE Simulations for three effects:

- Dispersion of diesel generators emissions
- Dispersion of water vapour emitted by cooling towers
- Wind comfort on the terrace and direct surroundings

Detailed spatial knowledge of the airflow, heat, humidity and emission dispersion in the surroundings is gained by CFD simulations. The surrounding buildings are included in the model, as shown in the figures on the right. Further surroundings (>300 meter radius) are modelled as terrain roughness to obtain the correct upstream flow pattern.

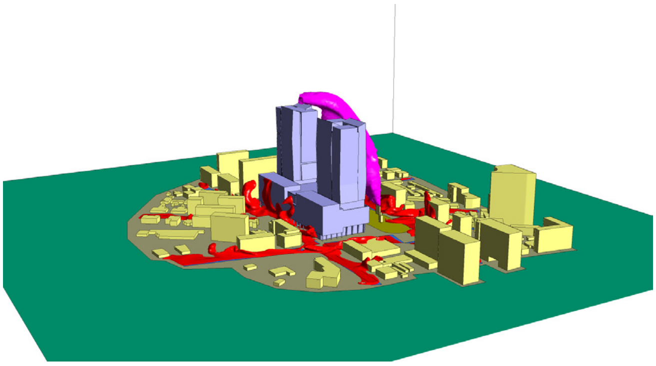


The simulation model with different types of result visualizatoin.

Objective

The impact of the generator and cooling tower were investigated for 4 wind directions at low wind speed (0.5 m/s), since this is the most pessimistic scenario. In more than 80% of the time higher wind speeds will occur in Luanda. The resulting pollutant concentrations from the systems were compared with the resulting concentration from local traffic. The effect of the generator and cooling tower on the local air quality is about 100 times less than that of the high density traffic.

The impact of the building on the local wind climate is investigated for 2 wind directions with 2 m/s at 10 meter height. The results show where the local wind velocity exceeds the normal wind velocity. This analyses indicates the expected local wind climate. In general the wind climate on ground level is not changed too much by the new buildings. The wind climate on the terrace can be uncomfortable with stronger winds.



3 dimensional visualization, in purple dispersion of emmision form the diesel generator plant and in red from the trafic.

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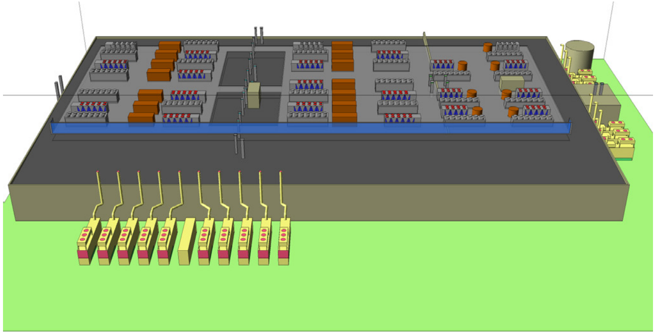
Datacentre roof
Equipment efficiency

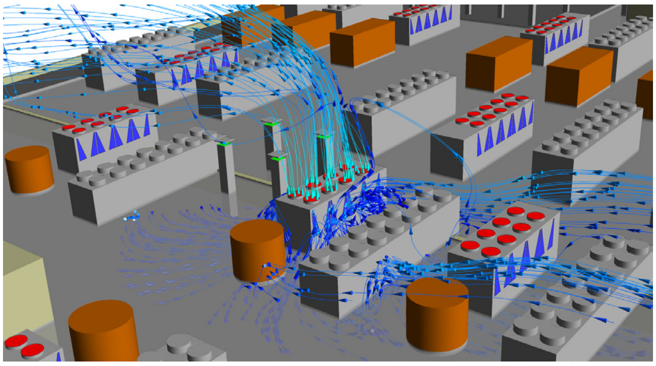
Fluid dynamics

Introduction

Datacentre cooling is essential for its operation reliability and should always be available during all different climate conditions. Cooling generation equipment is mostly installed on the roof of the facility, next to exhaust systems for generators, air handling units etc., all generating heat on top of the building.

Recent studies showed that heat dissipation from the different sources on the roof as well as solar irradiation does influence the efficiency of the cooling equipment on the roof, affecting negatively the cooling supply of the datacentre as well as the power demand of cooling equipment due to decreased system COP. Air inlet temperatures to chillers, hybrid dry coolers and cooling towers differ from normal design conditions due to these heating effects, thus causing the negative effects on datacentre cooling and related power systems.





Optimize roof layout

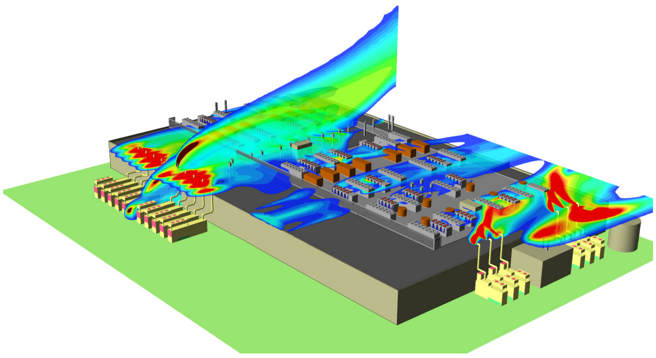
The increased inlet air temperature for the cooling equipment can be influenced by optimizing the roof design and layout. This effect can be minimized, resulting in a better cooling efficiency. The mutual influencing of roof mounted equipment and heating up effects of solar irradiation on the cooling performance can be clearly shown by performing CFD simulations, being computer calculations showing air flows, temperatures in a dynamic simulation.

By means of CFD the magnitude of the heating up effect can be assessed for different weather conditions, e.g. changing wind directions, velocities and solar irradiation. The CFD simulations calculate the resulting air inlet temperatures for all roof mounted cooling equipment, allowing the determination of resulting cooling performance on power demand as well as cooling output.

In addition of simulations on the basic situation, the effect of improvement measures can be assessed, thus optimizing the roof design as well as cooling and power performance. The CFD calculations can be used for optimizing costs and benefits of different improvement measures. By adding TCO calculations, the optimal set of measures can be determined, being measures on civil, mechanical and electrical level.

Overall energy efficiency

Initially the roof design and its equipment can be optimized, assessing the worst case weather scenario and its effect on maximum power demands and cooling supply. Next to this summer peak simulation, the influence of the heating up effect on the annual energy consumption (the EUE of the facility) can be determined. The improvement of cooling and power performance in peak situation also affects the annual energy consumption of roof mounted cooling equipment, influencing the facility's OPEX in quite high degree. This influence can be shown additionally as result of CFD simulations.



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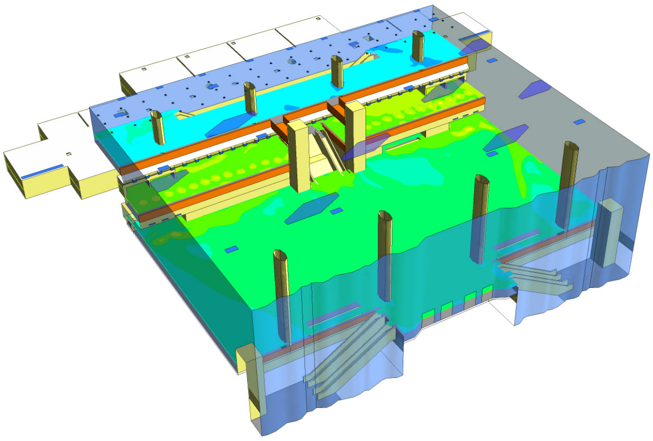
International Airport Luanda, Angola

Environment

Introduction

In Luanda, Angola, a new international airport will be built. Since the Angolan climate is hot and humid special attention is given to the air conditioning system. On request of the client and consultants the system performance is investigated by CFD simulations for the main entrance hall. The hall is about 15 m high and is surrounded by a double skin façade. The large glazed area results on a high thermal load by radiation and transmission.

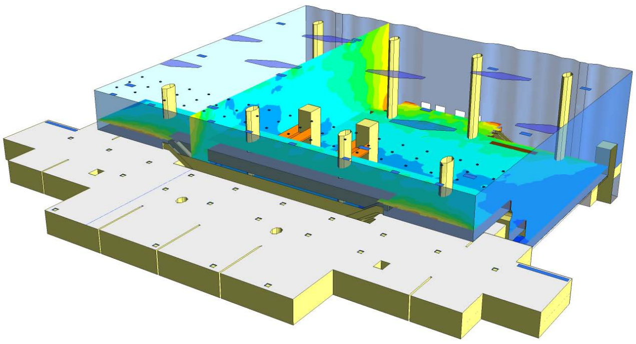
With the CFD simulations detailed information is provided regarding air speeds, temperatures, radiation intensity, humidity and many more parameters taking into account several physical phenomena. In such a simulation a geometry is supplied with a calculation grid wherein mass-, energy-, and momentum balances are solved. The resulting comfort factors PMV and PPD according NEN-EN-ISO 7730 are calculated.



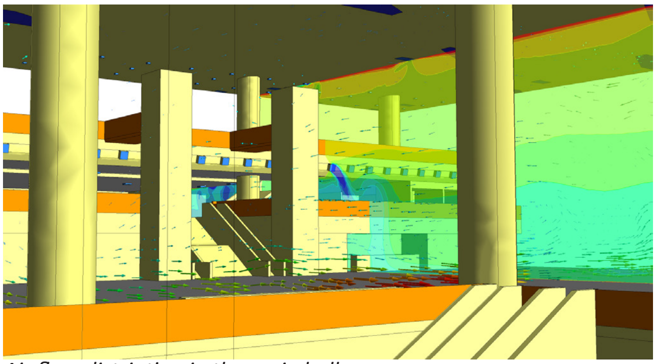
Resulting Predicted mean vote at occupant level.

Results

Using the CFD results the consultants have optimized the system design to achieve the requested indoor climate.
The CFD simulation results of the final proposed ventilation system indicate in general PMV (Predicted Mean Vote) values between -1 and 1, corresponding with a PPD (Predicted Percentage of Dissatisfied) of less than 10% at most locations. Occupants will experience a neutral internal climate. The biggest influence on the PMV comes from radiation from the sun.



Radiation intensity through the façade.



Air flow distriution in the main hall.

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Closed Car Parks
Performance verification

Fire safety

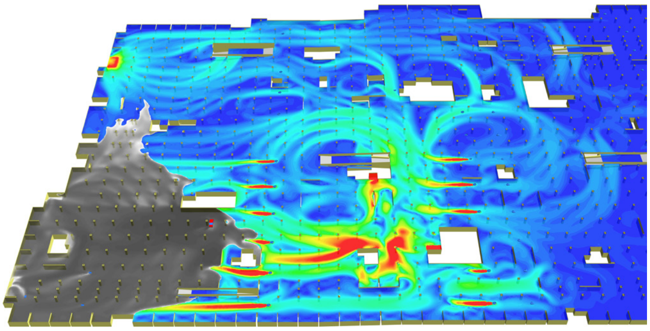
Simulation

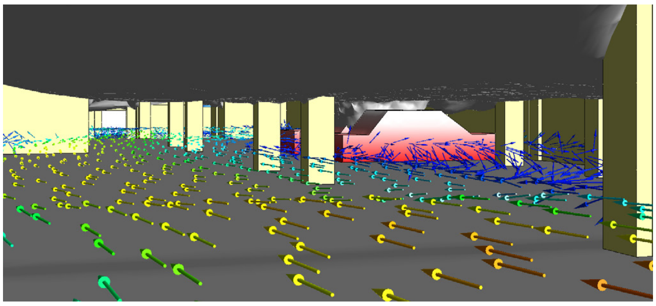
Enclosed car parks in general exceed the maximum building regulation fire compartment size . This oversize compartment is accepted because of the limited size of car fire but require additional measures to limit smoke and heat spread. Mainly consisting of ventilation requirements possibly in combination with sprinkler/watermist.

Due to the cars exhaust fumes car parks also require pollution control, since these can harm human health. Ventilation therefore should effectively ventilate the whole car park volume. This can be quite a challenge because a car park often includes numerous internal walls, columns, staircases and shafts which can result in possible non ventilated volumes.

Quick approval

In general we assist in communicating the performance objectives with the local authorities in a starting point document followed by the well-defined study and clear presentation of the results. Fire brigades and authorities can then easily check if the performance criteria are met and provide the planning permission.





System assessment

Enclosed car parks in general exceed the maximum building regulation fire compartment size . This oversize compartment is accepted because of the limited size of car fire but require additional measures to limit smoke and heat spread. Mainly consisting of ventilation requirements possibly in combination with sprinkler/watermist.

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System design

Besides analyzing and indicating the system performance we, as an independent company, can make you a conceptual system design that will meet the agreed performance.

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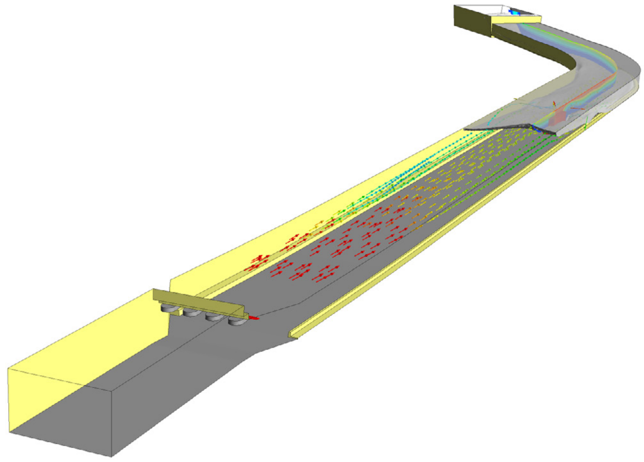
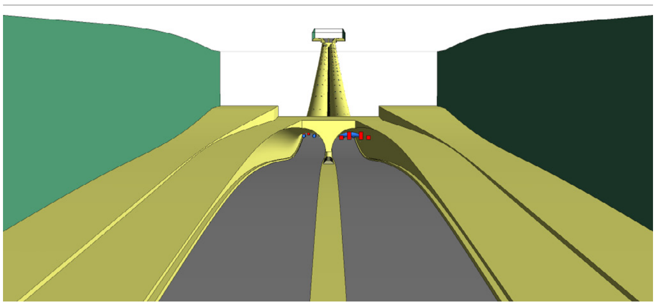
Tunnels
Equipement performance

Fluid dynamics

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.

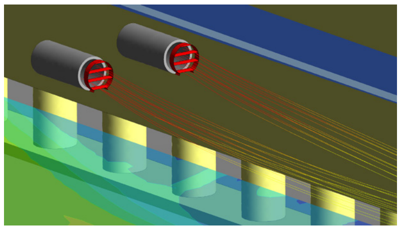
Possible structural damage or instability during and after the fire can be investigated by a **thermal load analyses**. The reduction of the thermal load when **sprinkler or water mist** systems are applied can well be incorporated in the CFD analyses to quantify the effect.

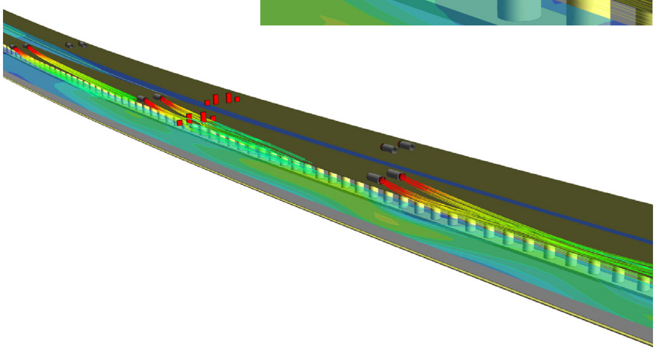
Evacuation simulations provide insight in the Required Save Evacuation Time (**RSET**), possibly for multiple scenario's and areas of the tunnel. A comparison of the ASET and RSET provides insight in the **fire safety level** of occupants.

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.





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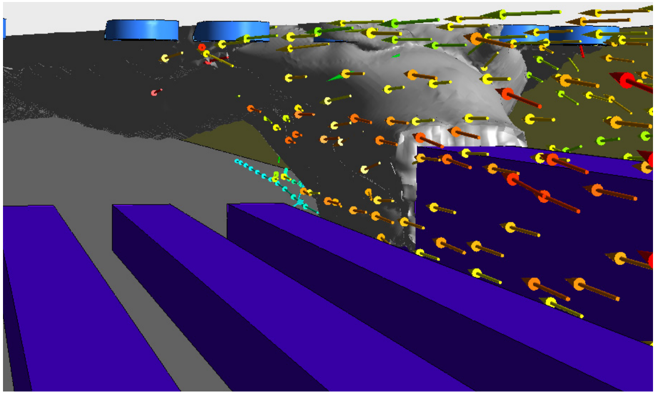
Al-Salam Street tunnel Abu Dhabi

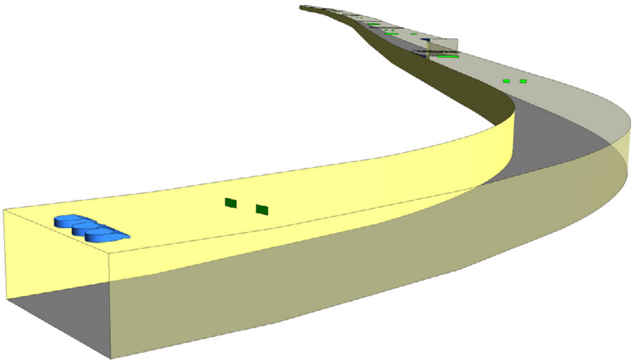
Fire safety

Facts

The Al-Salam Street tunnel enhances the traffic flow in the city centre of Abu Dhabi and connects new developments. The tunnel has a length of 2.2 km and is composed of 2 tubes separated by a closed wall. There are 4 driving lanes per tube, all in 1 driving direction.

The tunnel safety measures consist, amongst others, of a smoke control ventilation system, sprinkler system, and evacuation system. The ventilation system is composed of several exhaust/supply shafts and high thrust induction fans at the portals. The evacuation system is composed of doors to the other tube and structures at the shaft locations.





Research objectives

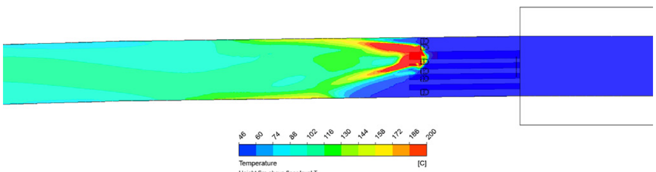
Two types of simulations were executed for this project, both for multiple fire scenarios.

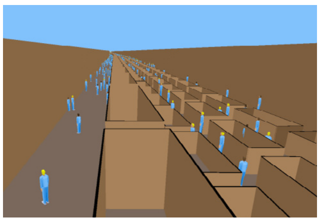
CFD simulations were used to verify the ventilation systems ability to prevent backlayering. Additionally, the conditions during evacuation were analysed. The visibility, temperature and radiant heat flux need to remain below specific tenability limits during the entire evacuation process.

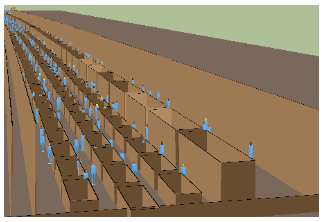
Evacuation simulations were used to calculate the required evacuation time. The calculated required evacuation time needed to be shorter than the available evacuation time as calculated by the CFD simulations.

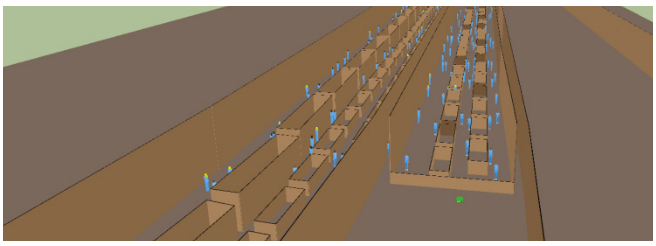
Achieved improvements

The simulations helped improving both the ventilation and evacuation system. The influence of the exact location of the thrust fans at the obtained air flow was investigated and an optimal position determined. For some scenario's the effect of wind on the performance of the ventilations system was also analyzed. The initial evacuation simulations showed bottlenecks at some specific locations inside the tunnel increasing the total evacuation time. Adding doors in this regions reduced the evacuation time resulting in a safer tunnel.









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Theatre Flower Lane
London, UK

Fire safety

Introduction

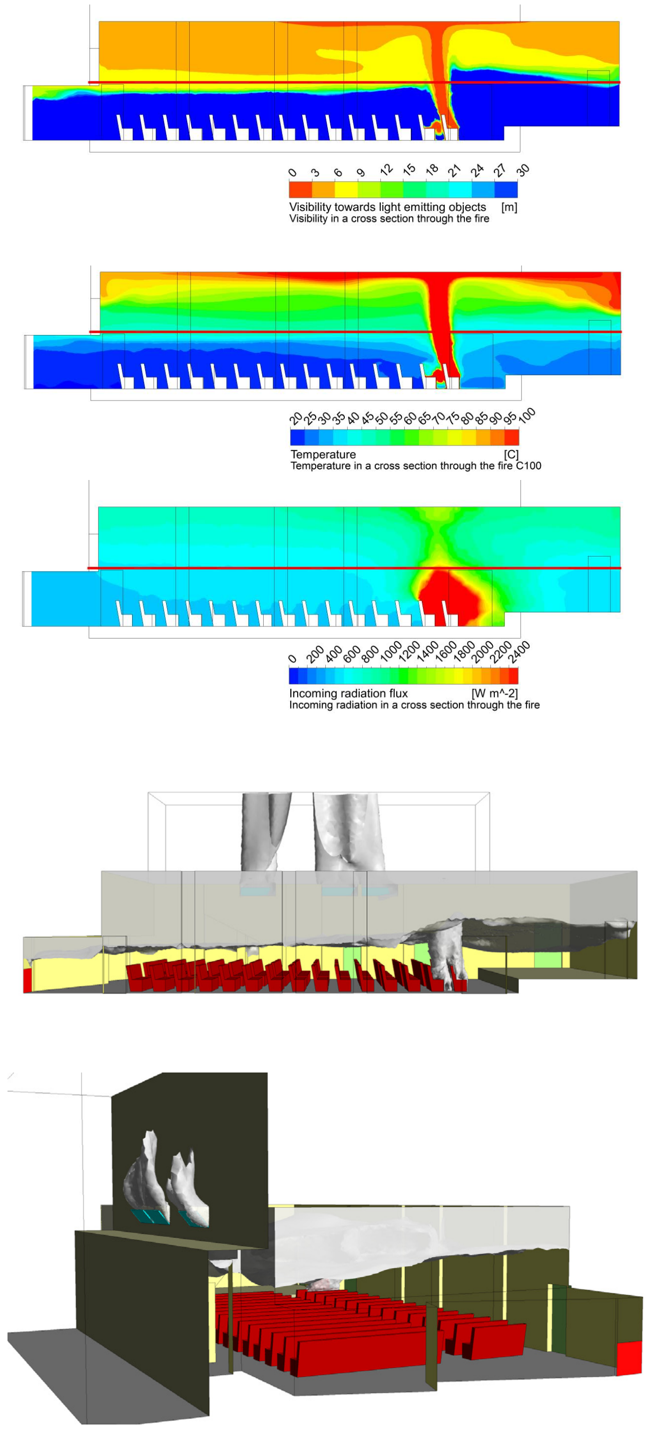
The community hall of the Flower Lane building in London, United Kingdom, is located in the basement and will be used as a theatre. People should be able to evacuate safely in case of fire, hence the room is foreseen with a smoke and heat ventilation system.

On request of designer the design of the smoke and heat ventilation system is validated by means of Computational Fluid Dynamics (CFD) simulations. The ventilation system should provide tenable conditions during the evacuation process. The simulation provides insight in the visibility, temperature and incoming radiation flux inside the community hall for a period of 360 s.

The fire ignites in the middle of the right front row of seats. The simulation does not account for the smouldering phase but starts when the fire enters the growth phase. This is a common and conservative approach.

A medium t-squared growing fire is applied for the growth phase, the time to 1 MW is 300 s. The heat release rate per unit area is 250 kW/m2. An average heat of combustion of 25 MJ/kg is applied. The mass optical density is 300 m2/kg, corresponding to general building contents as per PD7974-1 (1).

The smoke detectors in the room are modelled according the guidelines in the SFPE handbook. The automatic smoke vents will be opened in the simulation upon detection as calculated in the CFD simulation.



Several simulation results at 240 s after start of the simulation

Results

A movie of the smoke propagation in time is published at our youtube channel togheter with other interesting CFD results:

https://www.youtube.com/user/ONESimulations

Based on the CFD results the fire brigade was able to approve the proposed ventilation system.

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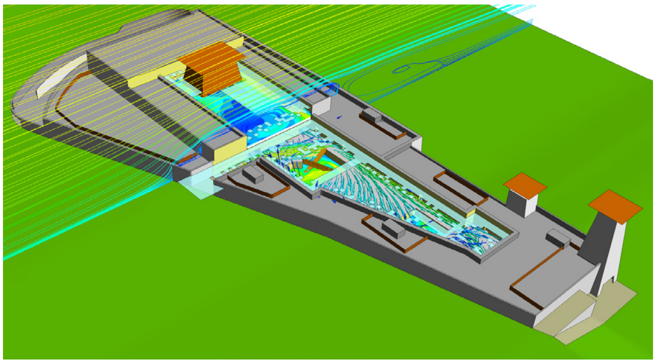
Portimão Shopping centre
Portimão , Portugal

Fluid dynamics

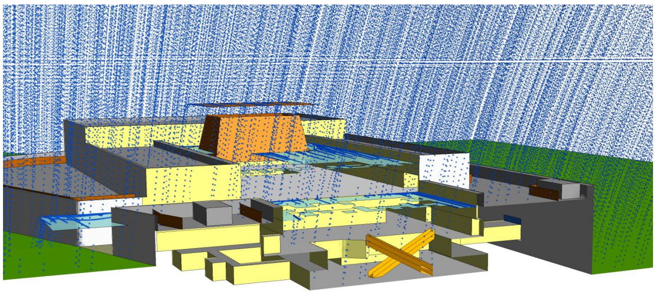
Introduction

This shopping centre in Portimão is a large 3 level building with an open structure, only partly sheltered by glass panels, and an open atrium in the centre. The building and its visitors are exposed to external conditions. The building must be suitable to be visited in different weather conditions. Therefore the owner, consultants and architects have requested multiple studies on the building.



Wind

The effect of the wind on the open areas of the building and the natural ventilation is investigated for multiple wind directions. It has been noted that winds through the building can occur due to pressure differences between the different entrances. Based on the studies special arrangements, such as air curtains, have been taken to limit the wind effect on the comfort of the ground floor and first floor level.

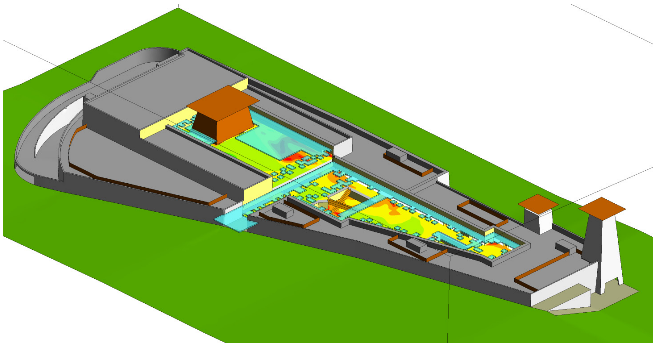


Rain

A rain impact study with different wind directions have been studied. The results of the studies have provided the designers with rain impact information per area on which the building indoor drainage is designed.

Indoor environment

The indoor environment is evaluated for a winter, moderate and summer day. Besides the wind effect on the experience of the indoor climate the radiation intensity and external temperature are of importance.



Crowd movement / evacuation

The crowd movement and evacuation capabilities are evaluated for the shopping centre. The simulation results provided detailed insights in visitors routing during normal and evacuation operation. Results are used to optimize the building accessibility.

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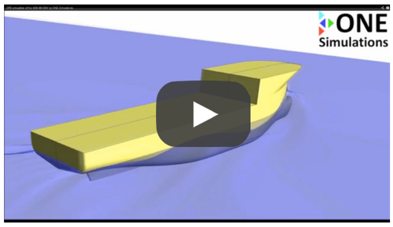
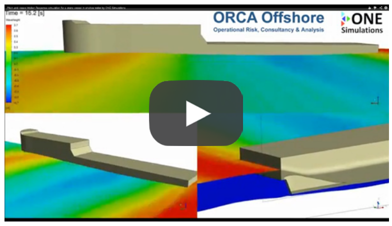
Fluid dynamics

CFD simulation of the NDS-60 OSV



Full scale CFD simulations are carried out in order to predict the hull performance for several speeds and drafts. The friction and pressure resistance of the hull is calculated and streamlines around the hull provided to our client Naval Dynamics (www.navaldynamics.com). The obtained data and streamlines can be used to optimize the hull shape for the purpose of the vessel.

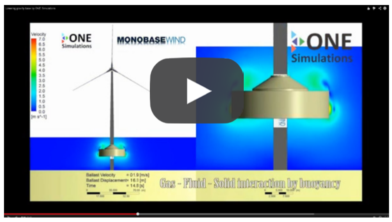
Pitch and Heave Motion Response



ORCA Offshore carried out lift dynamic motion analysis using the software tool MOSES from Ultramarine. One major challenge for this project was the limited bottom clearance of only 0.6 m. Furthermore, the seabed is formed from very soft mud which will have an unknown effect on the behaviour of the vessel. The standard diffraction calculation as used in MOSES cannot take this into account.

To verify the effect of the small keel clearance and the soft mud layer, several CFD (Computational Fluid Dynamics) simulations have been carried out by ONE Simulations. With a CFD simulation it is possible to calculate the motions of a rigid body in a dynamic environment composed of air, water and mud. The CFD simulations have been executed for several regular wave periods and calculate the Heave and Pitch Motion Response of the vessel, as well as the pressure on the skeg. A CFD simulation has also been used to calculate the Pitch Free Decay Period of the vessel in this specific environment.

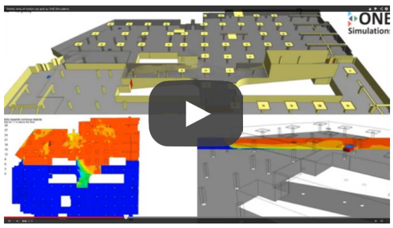
Lowering gravity base



One Simulations performed a simulation using Computational Fluid Dynamics for the lowering process of the gravety base. The simulation shows that the free falling base de-accellerates starting at about 10 m from the seabed before a smooth landing occurs.

More information: http://www.monobasewind.com/Engineering

Smoke exhaust system car park



This movie shows a sequence of results with 1 minute interval. The ventilation system is designed for smoke removal, furthermore the smoke spread is limited by fire doors.

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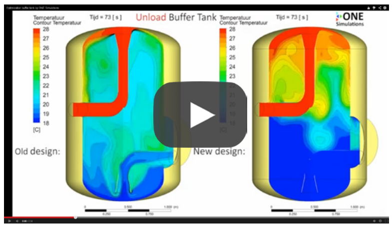
Youtube channel click here to watch

Fluid dynamics

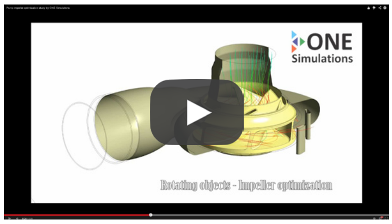
Optimization buffer tank

Optimization study for unloading and loading a buffer tank for the cooling system of a datacenter by means of CFD in collaboration with Cofely. The function of the tank is to guarantee the availability of chilled water for the equipment for a minimum time interval. So the servers will not be exposed to higher temperatures during a power failure. The performance of the buffer tank is depending on the temperature stratification. In collaboration with Cofely, several designs are verified in order to find the most suitable solution.



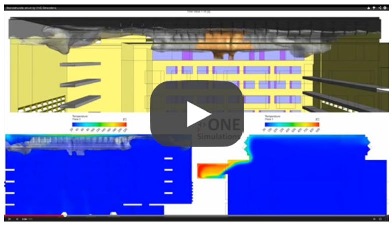
Pump impeller optimization

This study has been performed in collaboration with Holland Special Pumps in order to optimize the impeller. By the study the performance of the pump is analysed based on pressure losses, cavitation, flow patterns etc.



Fire simulation hospital atrium

Simulation of a fire in a top level room to determine the thermal load on the steel structure. The atrium roof is constructed of a glass structure supported by steel beams. The complete study included flash over analyses in the room, vertical fire spread by breaking windows and evacuation possiblities of the hospital rooms.

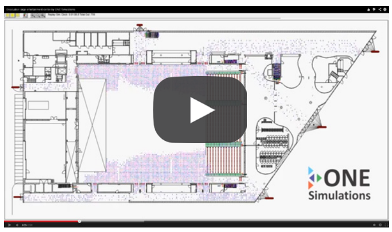


Evacuation of a road tunnel

The evacuation process is showed for the Al Salam road tunnel including the obstruction of cars, trucks and busses.

Evacuation large entertainment centre

This study shows the evacuation of a large entertainment centre (Heineken Music Hall). The simulation considers 6.364 persons divided over 4 building floors. In this movie the ground floor is shown. The model includes stairs, doors and stands. With use of simulations the effectiveness of the evacuation protocol has been analyzed for a large group of visitors.



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Selected reference list
Key projects

Fluid dynamics

Project	Location	Client
Portimão shopping mall	Portimão, Portugal	EnerOne
Airport main hall	Luanda, Angola	Confidential
Laboratory Synthon	Nijmegen, the Netherlands	BAM Techniek
Traffic control centre North West	Velsen, the Netherlands	Terberg
Second opinion CFD simulations	Multiple city's	Dutch local government
Venco campus	Eersel, the Netherlands	Venco groep
Dr. Struyckenstraat	Breda, the Netherlands	Rienks Engineering
Philipsgebouw	Hasselt, Belgie	Plakoni
Hospital AZ Alma	Eeklo, Belgie	Phirox
Cultural Centre 'De Werf'	Aalst, Belgie	De Werf te Aalst
IKEA	International	IKEA International
Kinaxixi	Luanda , Angola	Spacegroup
Douglas village shopping centre	Cork, Ireland	Arup
Prison facility Nieuwegein	Nieuwegein, the Netherlands	Smits van Burgst Beveiliging
Prison facility Dordrecht	Dordrecht, the Netherlands	Smits van Burgst Beveiliging
Prison facility Alphen a.d. Rijn	Alphen a.d. Rijn	Smits van Burgst Beveiliging
Prison facility Bonaire	Bonaire	RGD , the Netherlands
Prison facility Haren	Haren, Belgium	Denys
Shopping centre Rustenburg	Zaandam, the Netherlands	STE BV
Flow pattern plenum box	n/a	BarcolAir
Optimisation spray nozzle	n/a	FireDefender
Shopping centre Leidschenhage	Leidschendam, the Netherlands	Vector Brandveiligheid
Heineken Music Hall	Amsterdam, the Netherlands	Vector Brandveiligheid
Veller residential building	Barneveld, the Netherlands	Vector Brandveiligheid
JuBi	Den Haag, the Netherlands	HC groep
NDS 60 SSV	n/a	Tanangar Offshore
Nortrans AHTS OSV	n/a	Nordic Maritime Services
Jascon 25 crane vessel	n/a	ORCA-Offshore

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Selected reference list Europe

Fluid dynamics

Project	Location	Client
AEB (Waste Energy Company)	Amsterdam, the Netherlands	Tebodin
Airport bagage transport hall	Lisbon, Portugal	Airteam / ANA
AQUAradius	Hoofddorp, the Netherlands	RBG brandveiligheid
AZ Alma (hospital)	Eeklo, Belgium	Phirox
Bermondsey Spa	London, UK	PVE
Capgemini Leidsche Rijn	Utrecht, the Netherlands	bbn adviseurs
Central Park	Dublin, Ireland	Crossflow
Clothing warehouse (classified)	Classified	PelserHartman BV
Cultural Centre 'De Werf'	Aalst, Belgium	Phirox
Datacentre (classified) roof equipement layout	Classified	Cofely
Denizli Bus Terminal	Denizli, Turkey	Alarko
Dr. Struijkenstraat car park	Breda, the Netherlands	Rienks Engineering
EDP Head Quarters	Lisbon, Portugal	Airteam / Mota Engil
Focus beroepsacademie (school)	Barendrecht, the Netherlands	Vintis
HagaZiekenhuis (hospital)	Den Haag, the Netherlands	Imtech Building Services
Hatchery cells	n/a	Pas Reform
Heineken Music hall	Amsterdam, the Netherlands	Vector-fsc
JuBi	Den Haag, the Netherlands	HC groep
Kustwerk Katwijk	Katwijk, the Netherlands	HC groep
Laboritory Synthon	Nijmegen, the Netherlands	BAM Techniek
London Road	London, UK	PVE
Mater hospital	Dublin, Ireland	Crossflow
MG tower	Gent, Belgium	Somati
Oeiras Shopping centre	Oeiras, Portugal	EnerOne
Operating room kennemer gasthuis (hospital)	Haarlem, the Netherlands	Valstar Simonis
Optimization buffer tank	Classified	Cofely
Park Central Zone 13	Coventry, UK	PVE
Penitentiary complex Haren	Haren, Belgium	Denys
Penitentiary Nieuwegein	Nieuwegein, the Netherlands	Smits van Burgst
Penitentiary St. Eustatius	St. Eustatius, Dutch Caribbean	overnment Buildings Agency
Shangri-La Bosphorus hotel	Istanbul, Turkey	Alarko
South Acton	London, UK	Mendick Waring Ltd
Stadswerf	Amsterdam, the Netherlands	Municipality of Amsterdam
Traffic Control Centre North West Netherlands	Velsen, the Netherlands	Terberg
Uptown	Den Haag, the Netherlands	STE
Vencocampus	Eersel, the Netherlands	VENCO Groep
Westgate	Aldershot, UK	PVE

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Selected reference list Middle East

Fluid dynamics

Project	Country	City
Nad Al Sheba Racecourse	UAE	Dubai
Downtown Burj Dubai	UAE	Dubai
Al Raha Beach	UAE	Abu Dhabi
Majlis commercial development	Oman	Muscat
Business Park North & South building, business bay	UAE	Dubai
Aviation club hotel	UAE	Dubai
Sidra Medical & Research Centre	Qatar	Doha
West Bay hotel	UAE	Dubai
Al Hodaifi Tower	Qatar	Doha
Al Gurg Tower	UAE	Dubai
Al Salam tunnel	UAE	Abu Dhabi
Central Fish Markt	UAE	Abu Dhabi
Dafza	UAE	Dubai
Al Barsha	UAE	Dubai
Al Sadd	Qatar	Doha
Al Mawaleh	Oman	Muscat
Tilal	Oman	Muscat
Silverine Twin Towers	UAE	Dubai
Mohammed Bin Rashid Al Maktoum Academic Medical Center	UAE	Dubai
Telecommunicatioins Regulatory Authority Office Building	UAE	Dubai
Jaidah Commercial Development	Qatar	Doha
Barwa Commercial avenue	Qatar	Doha
Kingdom of Sheba Elevations	UAE	Dubai
U-Bora	UAE	Dubai
North Gate	Qatar	Doha
Prudential Tower	UAE	Dubai
Silver House	Oman	Muscat
Dana House	Oman	Muscat
Majlis Residential development	Oman	Muscat
Pentominium Tower	UAE	Dubai
Business Bay office tower	UAE	Dubai
Sofitel Resort-Palm Jumeirah	UAE	Dubai
Link Roads to the Pearl (Lusail Expressway), Tunnel ZT1 and ZT3	Qatar	Doha
Oman Arab Bank	Oman	Muscat
King Abdullah Financial District	Saudi Arabia	Riyadh
Lusail LRT stage 1 - IDA (SES) calculations	Qatar	Doha
Fadi Project	Saudi Arabia	Riyadh

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