RENUDA
FLUID SOLUTIONS
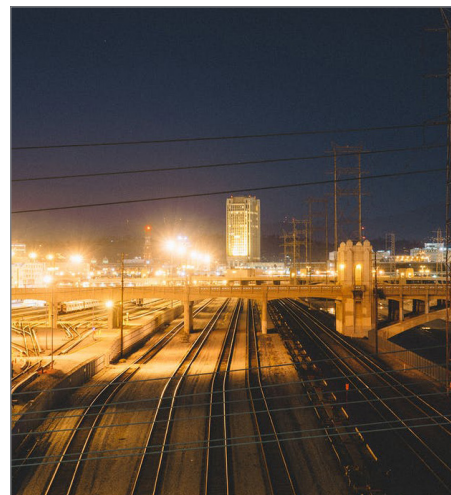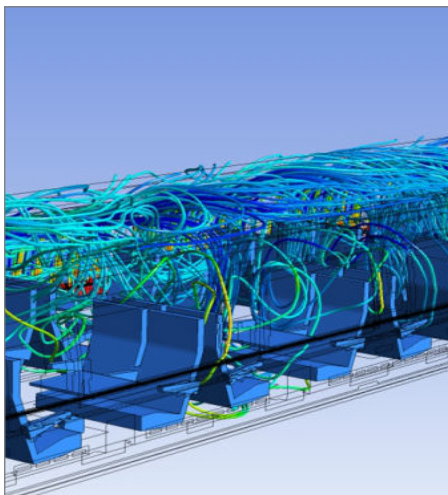
Improving ventilation in trains: SNCF

The Background

SNCF is a world leader in mobility for goods, people and logistics, present in 120 countries, with a total workforce of 250,000. Every day, 10 million passengers use SNCF's regional trains, buses, coaches, metros, tram-trains and self-service bicycles—in addition to parking facilities and car-sharing system solutions, district energy and power electronics.

SNCF aims to make passenger and freight transport seamless and easy. Since 2010, SNCF has conducted a research program on thermal comfort in order to better understand passengers' perception and improve specifications for new and refurbished trains. The surveys have shown that some passengers find the ventilation uncomfortable because of perceived high air velocity. This was the first reason given for discomfort during winter.

> **"Renuda's results have shown that numerical simulations are capable of predicting the flow field with a good degree of confidence"**
> *XPierre Hubsch, Process Department, ArcelorMittal Esch*

ArcelorMittal wanted to know if the reheating process could be achieved with less energy; to identify which alternative configurations would save energy; and to investigate the reasons for non-homogeneous temperature distributions in the beam blanks exiting the furnace.

SNCF therefore decided to investigate the ventilation flow in its TGV and TER trains with CFD simulations. The first simulations showed higher air velocity near the coach pillars between windows than in the rest of the carriages. To increase passenger thermal comfort, SNCF imagined alternative designs which would help make the airflow as uniform as possible along the coach for the same air flow rate.

SNCF required numerical simulations to build and test these new configurations with a view to identifying a working optimised prototype prior to experimental testing.

The Challenge

The first step was to investigate whether a hexagonal configuration, when compared to the current standard configuration, would address the winter ventilation issue on TGVs. If not, other configurations would be tested.

This required a numerical study to scale the new configurations for the TGV and validate the feasibility of the "winter" campaign.

The ideal configuration, then, needed to be tested to ensure uniform ventilation for both lower and upper decks on the TGV Duplex (double decker) trains.
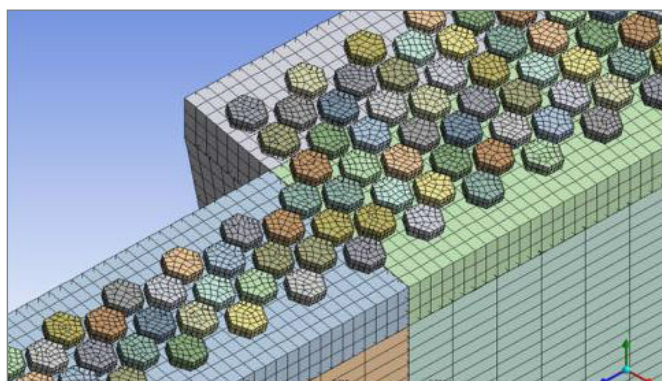
The Solution

Renuda undertook the project in 2 parts:

- The first part focused on modelling the performance of the current and optimised configurations in order to map the velocity profile of the air flow coming out of the grille:
  - Numerical models of a section of a TGV and ZTER passenger cars were built to design a method to interchange the ventilation ducting and grill geometries in simulations.
  - Simulations were then completed using numerous configurations on a simplified section of the two passenger cars (both at full scale but excluding passenger seats and other extraneous items).
  - Analysis showed that the global air flow in the carriage was similar to the air flow obtained in a current TGV. A comparison with the simplified model's results showed excellent agreement and justified the approach of using a simplified model to identify an optimised configuration.

Renuda's study identified a configuration that, for the same air flow rate, produced a uniform air velocity profile exiting the ventilation ducts. SNCF was confident that this optimised solution would improve the thermal comfort of passengers seating next to the window ventilation ducts. The next step in SNCF's R&D program was to experimentally test the optimised configuration.

> *"We chose Renuda because of their aerodynamic expertise, and the quality of their previous work."*
> *Sandrine Ségrétain,*
> *Project Manager in comfort research SNCF*

> *"I have worked with Renuda's consultants on various projects for over a year. They are very responsive and provide clear progress reports, which is very important for us."*
> *Nicolas Paradot, Aerodynamics Expert, SNCF*

How SNCF benefited

- SNCF achieved its objective of having a working optimised prototype prior to experimental testing.
- Renuda saved SNCF time; it was able to quickly identify that the hexagonal grid would not work for the TGV.
- It was more cost-effective for SNCF to have Renuda simulate numerous configurations rather than physically test alternative solutions. Renuda's simulations showed that it is very difficult to reduce maximum air velocity whilst maintaining the same flow rate.
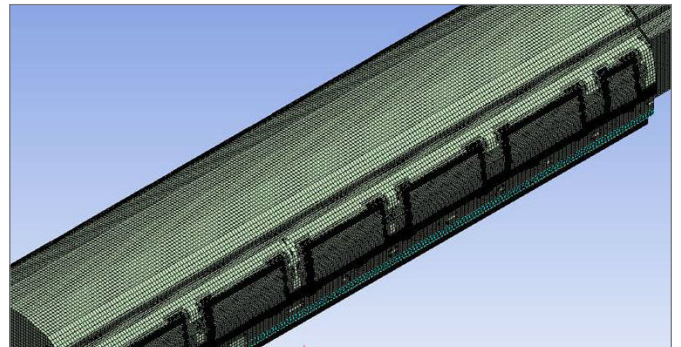
Why did SNCF choose Renuda?

- Quality of Work – SNCF was impressed with the quality of Renuda's work, based on previous projects that Renuda had successfully undertaken for SNCF:
  - Two studies on the impact of cross winds on the Paris to Marseilles line.
  - A study on the aero-acoustics of the front bogey on TGV.
- Relevant Experience – Renuda has undertaken a significant number of studies involving passenger compartments and thermal comfort, including one for ALSTOM modelling the impact of the human body on its surrounding environment and the complex interaction between the two.
- Specialist Knowledge – From these projects Renuda has an excellent understanding of modelling thermal comfort.
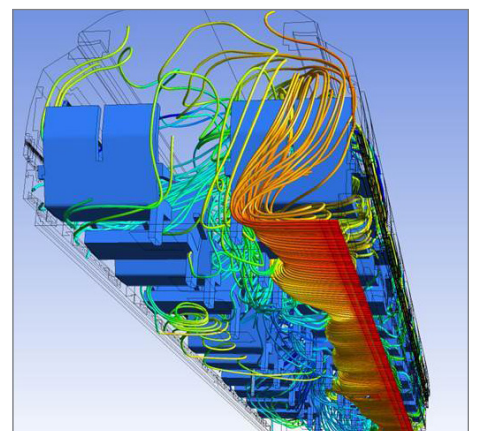
Contact Us

Renuda UK, France, Germany

📞 +44 (0)20 3371 1709

Please visit our website **www.renuda.com** for more information or contact us on **info@renuda.com**