CFD Simulation of Airflow around a Hodoscope at UNAB's Marine Research Center

Roberto Renato Felipe Gómez Ramírez
Universidad Andrés Bello
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Abstract

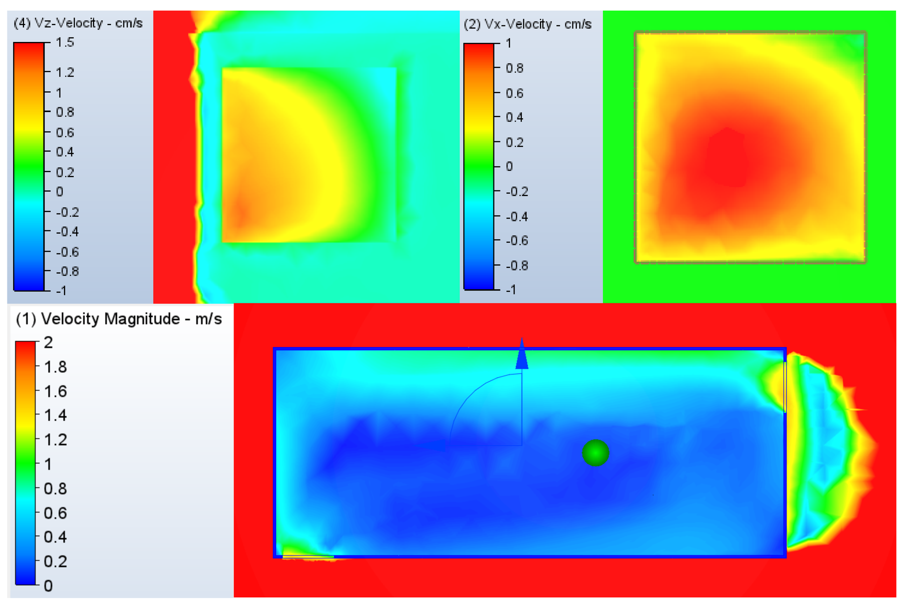
This work presents a computational fluid dynamics (CFD) study of the airflow and temperature distribution around a hodoscope installed inside a container at UNAB's Marine Research Center. The analysis was performed using Autodesk CFD software to simulate environmental conditions, including wind velocity, temperature, and relative humidity. The results indicate that wind velocities of approximately 1 m/s at the container windows could be replicated by fans to achieve similar ventilation conditions. However, airflow distribution inside the container exhibited fluctuations, particularly near the hodoscope, indicating a lack of a stable pattern. Additionally, temperature differences (21°C and 24°C) did not significantly impact airflow patterns.

Introduction

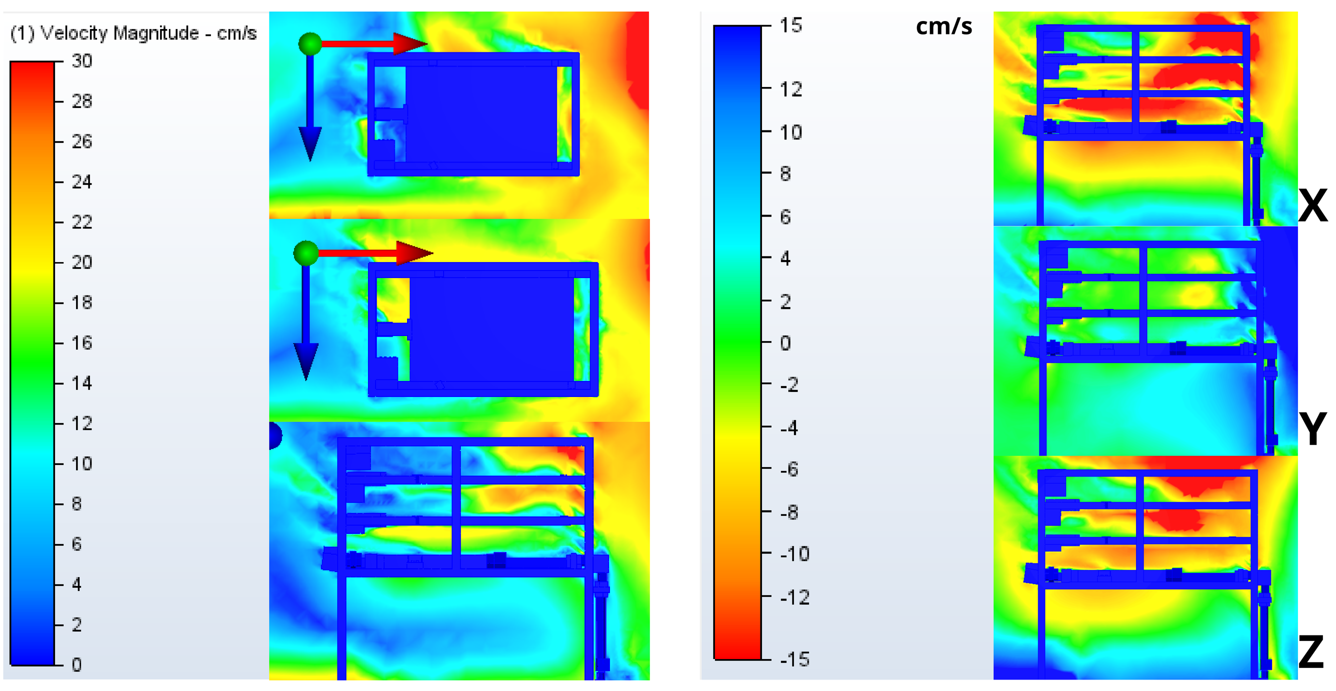
This study focuses on the computational analysis of airflow within an experimental container that will be located at the UNAB Marine Research Center near the coast in Quintay. The container houses a hodoscope intended for alpha ray detection. Efficient airflow management is critical to maintain stable operating conditions and ensure the accurate performance of the detection equipment.
Given the environmental factors of the coastal location, including varying wind conditions, the research aims to evaluate airflow behavior near the container windows and around the hodoscope's critical areas. This analysis provides valuable insights into potential ventilation strategies and supports the design and optimization of the system for long-term stability.

Results

- External Wind Velocity: Simulations showed that wind velocities of approximately 1 m/s at the container windows could be replicated by fans to achieve similar ventilation conditions.



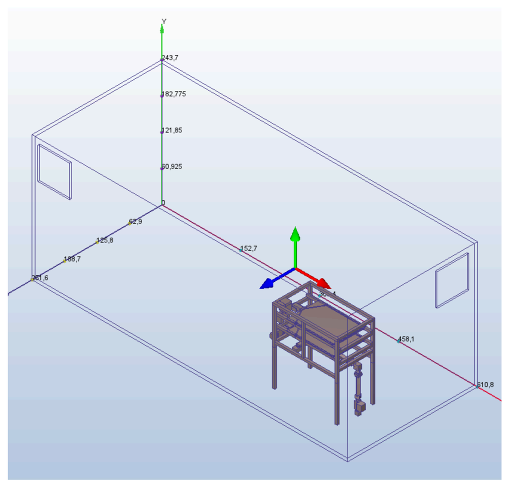
- Airflow Distribution: The aerodynamic effects inside the container indicated that the wind near the hodoscope exhibited fluctuations and lacked a stable pattern.

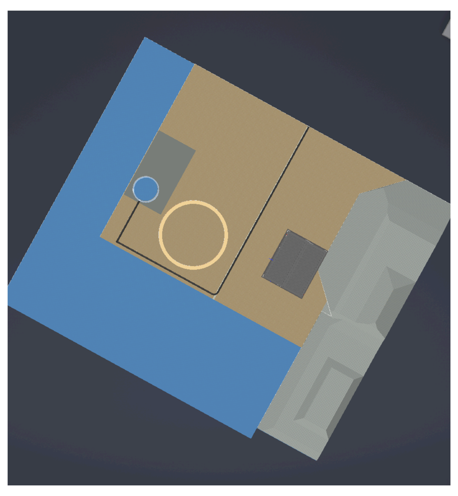


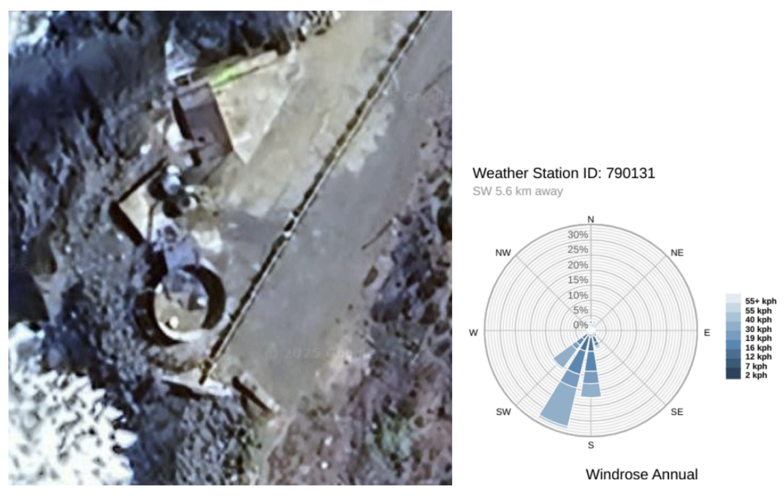
- Temperature Impact: No significant differences in airflow patterns were observed between the tested temperatures (21°C and 24°C).

Methodology

- Software: Autodesk CFD was utilized for simulations.
- Modeling: The container, including the hodoscope, was simplified to reduce computational load while maintaining critical features.
- Environmental Conditions: Average temperature (21°C), maximum temperature (24°C), 50% relative humidity, and prevailing wind directions were considered.
- Simulation Scenarios: External wind velocities were applied to assess their impact on airflow patterns within the container.

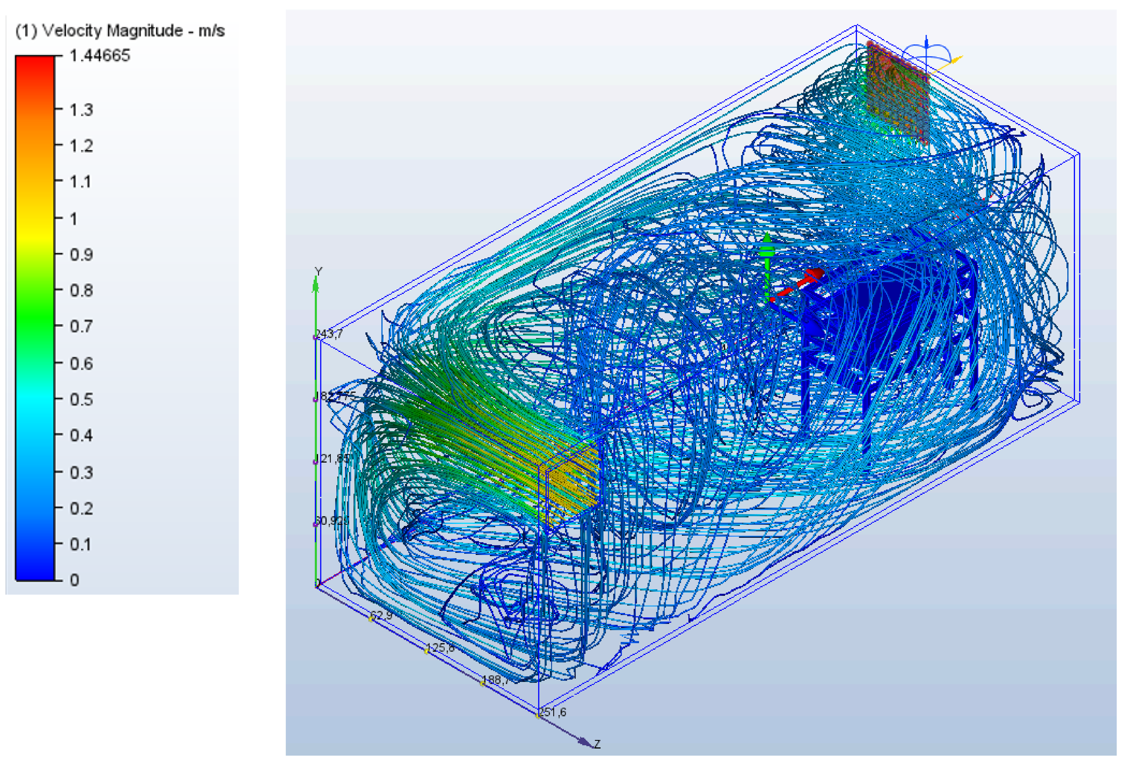

CFD Model.


Simulation Region.


Satellite view. (-33.194156253197534, -71.70289154410196)

Conclusions

The computational study provided valuable insights into the potential effects of installing ventilation fans near the hodoscope system. Simulations demonstrated that wind velocities of approximately 1 m/s at the container windows could be replicated by fans to achieve similar ventilation conditions. However, airflow distribution inside the container exhibited fluctuations, particularly around the hodoscope, suggesting a lack of a stable pattern. These findings contribute to understanding the system's ventilation dynamics and provide a basis for optimizing airflow management in real-world conditions.



Acknowledgments

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