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REVISION STATUS: Version 1.1.

Date: 11/10/24

The revision to the Wind Load Analysis Report for Accent Productions is prompted by the client's request to clarify discrepancies between their tests and the CFD results. They want an investigation into the reasons behind the differing performance outcomes. Additionally, the client has asked for specific recommendations on rope selection based on force considerations. These updates aim to ensure the report meets the client's accuracy and practical application requirements.

Please note that all modifications have been made in response to information recently provided to KORA by Accent Productions on October 9, 2024. All revised pages have been labelled as "*EDITED PAGE*," and the edited content highlighted specifically including pages P6, 7, 8 and 10.

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Wind Load Analysis Report: Stage Cover Performance for Accent Productions.

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Preliminary Design Report

Stage Cover Wind Load Analysis
Client: Barrie Hutton

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1. Introduction

This Wind Load Analysis Report has been prepared by KORA for Accent Productions. The purpose of this document is to present the results of simulations conducted to evaluate wind loads on the stage cover structure. It includes an analysis of wind and wall forces, along with the design considerations for stability. Additionally, the report outlines key recommendations, including the force required to resist lift and an analysis of the trailer stage's weight under varying wind conditions.

2. Wind Load Analysis

This section presents a comprehensive examination of wind loads as they pertain to the design of the stage cover. We will explore key concepts related to wind loading, provide calculated wind forces based on industry standards, and analyze the impact of structural elements such as mesh windows and doors on wind resistance and overall stability.

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2.1. Calculated Wind Forces

The simulations were configured using Autodesk CFD 2024. The wall forces calculated provided accurate force measurements based on the simulated wind conditions. The client suggested that the maximum tested wind speeds are $40\ Km/h$ with gusts up to $60\ Km/h$. The client has also suggested that at this point the cover can behave in an unsafe manner; Hence, KORA have decided to test the device in the range of $10 - 60\ Km/h$. The wind speeds were set at 1.00 m from the opening region of the stage.

Initial testing revealed that the stage cover model (with the door open) achieved convergence at 19.1875°C after approximately 300 simulations. Consequently, all data presented in this report is based on highly accurate simulations. Figure 1 shows the direction of the modelled forces concerning the structure and Figure 2 and Figure 3 contain graphs with the six iterations of wind speeds (10,20,30,40,50,60) Km/h against the force in Newtons on the vertical axis with the varied door configurations.

An important note regarding the creation of the CFD simulation is that it was designed to prevent air from escaping beneath the parts of the structure in contact with the mounting surface. While this assumption results in higher static pressure on the internal walls of the structure, it does not accurately reflect real-world conditions, where wind can escape underneath the structure. This escape of air can significantly reduce the static pressure and affect the overall accuracy of the model

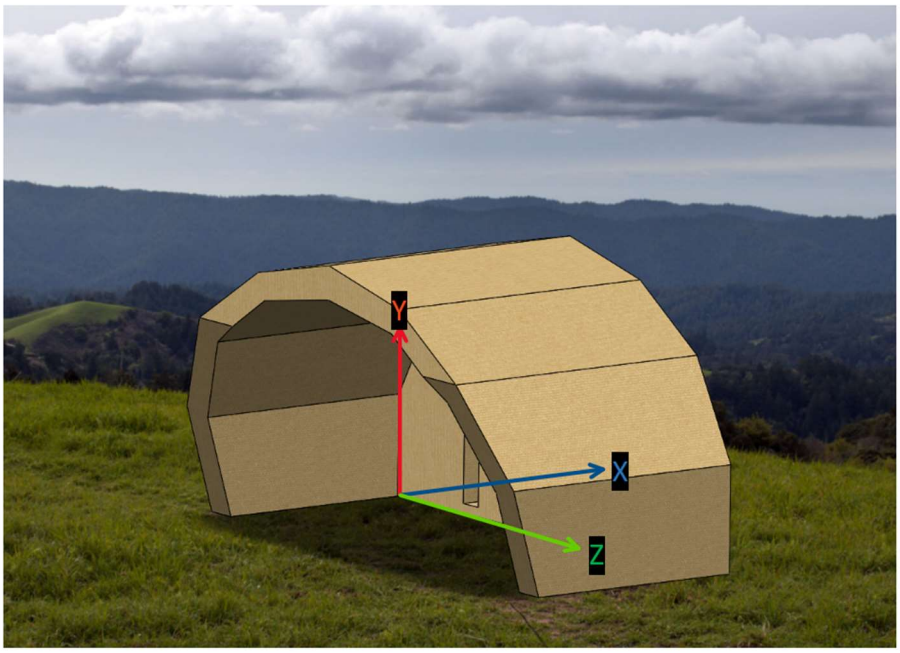

Figure 1. Axis directions relevant to structure.

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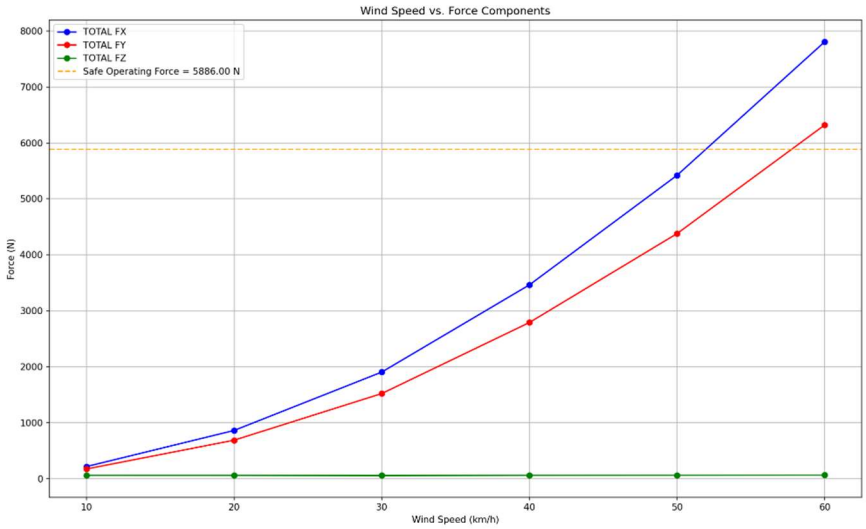

Figure 2. Wind speeds (door open) plotted with force.

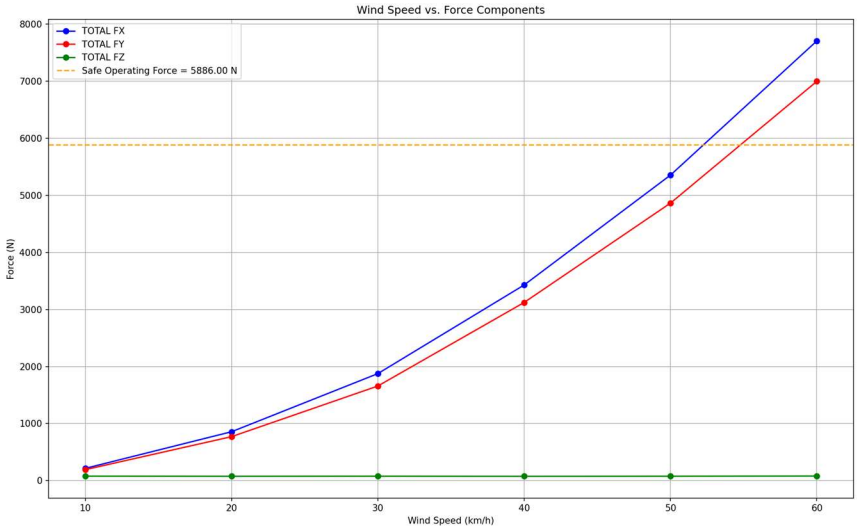

Figure 3. *Wind speeds (door closed) plotted with force*

The wall calculations align with both the client's predictions and the potential limits of the stage cover. The 'safeness' gauge (yellow dotted line) is based on the suggested mass of the trailer stage (800kg) being the sole factor holding the stage cover down. It also assumes the attachment method is rated to withstand over 5886N of force, which is 25% less than the force required to lift the stage and cover. The vertical force (FY) and horizontal force (FX) breach the safety gauge when the wind force reaches 60 km/h. As expected, due to the symmetrical design, the lateral force (FZ) remains unchanged across all wind speeds.

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2.2. Impact of Mesh Windows and Door

A comparison plot was derived to ease the comparison between the door's position. Forces FZ and FY were averaged and then plotted against one another in Figure 4.

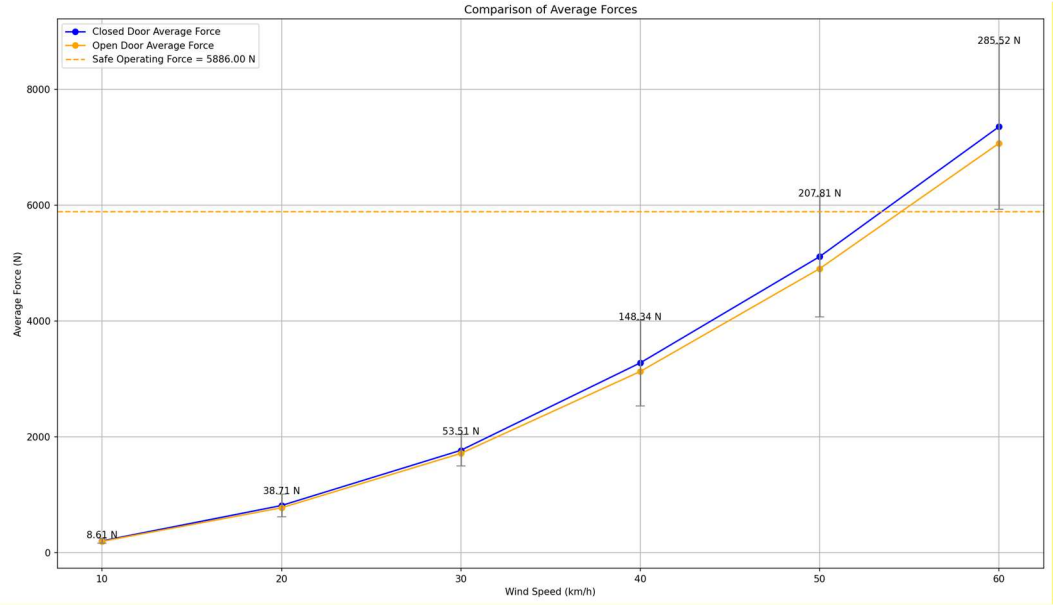

Figure 4. Graph highlighting the differences in forces applied to the structure upon different door configurations. Error bars labelled with force differences for comparison at each wind milestone.

Reflecting on Figure 4 we can see that with the door closed, at the last 'safe' speed (under the safety gauge), the structure is 3.36% closer to the point the structure has been deemed unsafe; We can also see that the difference is exaggerated the larger the wind load.

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3. CFD Simulations visualization

This section of the report can be used to better understand the load forces calculated in section 2. All visualization was done at 60Km/h to make the effects as clear as possible.

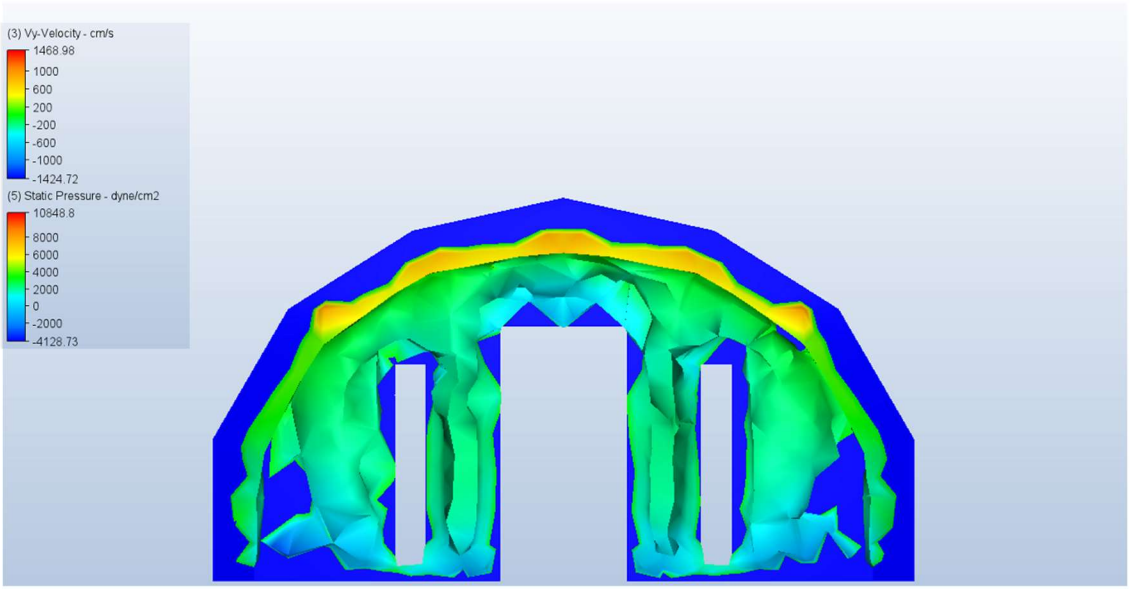

Figure 5. Static pressure viewed from the front of the structure coloured with windspeed in the vertical direction.

The clustering of pressure bubbles observed in Figure 5 corroborates the load calculations in Section 2. The fastest vertical airflow occurs at the bridge of the structure, followed by the main wall. This also aligns with the minimal lateral force generated at any wind speed, demonstrating how the symmetrical shape evenly dissipates the fluid load.

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4. Recommendations

4.1. Force Required to Resist Lift and

Figure 2 shows that the force required to mitigate hazards at the maximum operational speed (50 km/h) is 5241.2 N with the rear door open and 5353.6 N with it closed. KORA recommends that Accent Productions use a holding system with a load capacity of 8000 N to ensure the stage cover remains secure and performs safely at wind speeds of 0-50 km/h.

To secure the structure at the specified tie-down points rated for high loads (Figure 6), we recommend using nylon or polyester ropes with a diameter of 1 inch (25.4 mm) for their durability and performance. This conclusion is summarized in the risk matrix (Table 1).

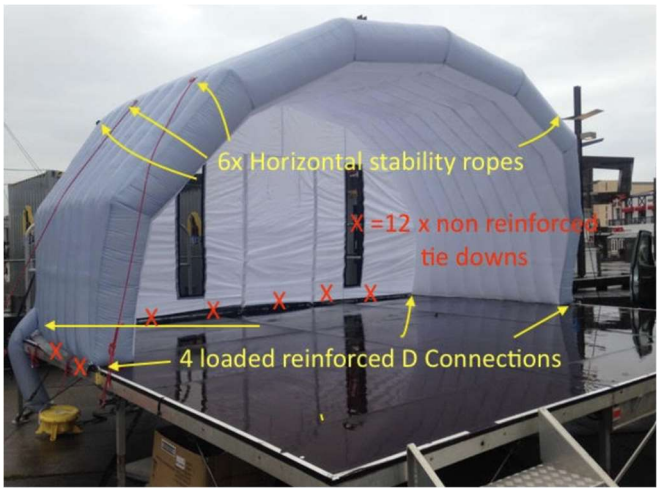

Figure 6. Figure supplied by the client.

	10 km/h	20 km/h	30 km/h	40 km/h	50 km/h	60 km/h	60+ km/h
Door open	Safe	Safe	Safe	Safe	Limit	Over Limit	Over Limit
Door closed	Safe	Safe	Safe	Safe	Limit	Over Limit	Over Limit

Table 1. Risk matrix for wind load on the structure.

Any decisions made by Accent Productions based on this report should be grounded in precise measurements of the wind speed at the entrance of the structure.

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KORA will retain copies of the project deliverables, including source data files, on its servers for 12 months following project completion. Requests for data access beyond the initial 12-month period will incur a service fee.

KORA would like to thank Accent Productions for the opportunity to undertake this project and looks forward to collaborating again in the future.

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