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A5_5 Storm Arwen vs. Noasis

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Abstract

We investigated how loud the Oasis tribute band, Noasis, would need to play *'Wonderwall'* in order to melt a snow drift blocking the door to the Tan Hill Inn after Storm Arwen. Playing at a volume of approximately $174dB$ for the song duration ($258s$) would provide enough power to heat the snow by $1°C$ and cause it to melt.

Introduction

The Oasis tribute band *Noasis* were playing a gig in the Tan Hill Inn, Britain's highest pub [1] when Storm Arwen hit the UK, bringing lots of snow. As a result, the band and revellers were stuck there for the next three nights, due to road blockages and snow blocking their exits. Here, we investigate how loud Noasis would have to play *'Wonderwall'* to melt the snow drift outside the front door of the pub. We assume all sound energy is converted into heat to melt the snow (at the same rate), and that the door can be opened inwards so all sound impinges on the snow. Also, that the band are playing directly at the snow drift, so the volume does not decrease with distance.

Theory

Figure (1) shows the snow drift at the door of the pub, where the measurements are taken to be standard measurements from [2]. We assume the length of the snow drift to be 3.0m. We make the following assumptions about the composition of the snow drift: snow ≈ ice, thus snow melting occurs $> 0°C$, and that only 10% of the snow's total volume is water-ice (the other component is air) [3]. We also assume a temperature change of $1°C$. The following equation can be used to determine the energy required to melt the snow:

$$\Delta Q = m_{snow} l_f + m_{snow} c_{(H_2 0)} \Delta T \qquad (1)$$

where l_f is the latent heat of fusion of water and $c_{H_2 0}$ is the specific heat capacity of water. The mass of snow (ice) to be considered is determined from the volume of the drift and the density of ice. By dividing ΔQ by the length of the song ($258s$), we get the power delivered to the snow for the song duration. Converting power into Decibels, Eq. (2) is used:

$$L_N = 10log_{10}(\frac{N}{N_{ref}}) \qquad (2)$$

where N is power (W), N_{ref} is a reference power of $10^{-12}W$ at $0dB$ and L_N is the volume in dB [4].

Results

The volume of snow was calculated as $2.264m^3$, however, we only need to consider 10% of this value (see Theory), thus the volume is $0.2264m^3$. Using an ice density of $917kgm^{-3}$ [5], gave the total mass of snow as $207.635kg$.

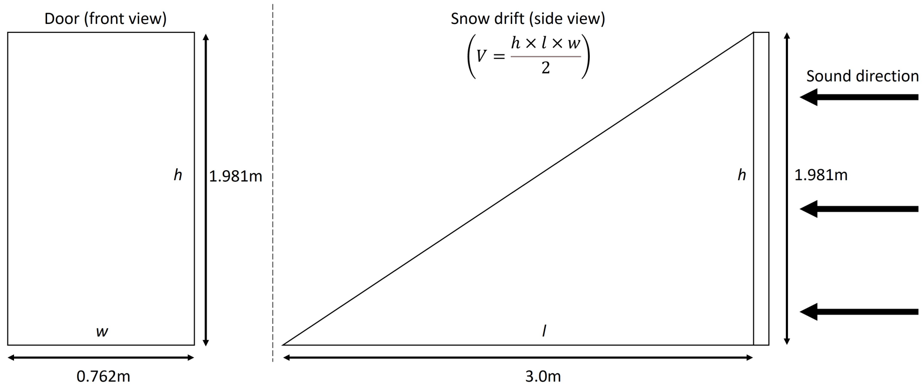

Figure 1: The diagram on the left shows standard measurements for a door in the UK. We assume the pub door to be this size. The schematic on the right shows the snow drift against the pub door with height equal to that of the door.

Water (ice) has l_f of $334kJkg^{-1}$ [6] and c_{H_20} of $4.184kJkg^{-1}K^{-1}$. Substituting all of these values into Eq.(1) gives ΔQ equal to $70.219MJ$. Dividing this by the song duration, $258s$, gives the power required, P, equal to $272.167kW$. Finally, converting this to dB using Eq.(2) requires the band to play at $174.348dB$, or approximately $174dB$.

Discussion

It can be seen that the volume required to melt the snow (assuming direct conversion of sound power to heat) is very large. For reference, a Boeing 747 engine at take-off is around $165dB$, and the human ear drum bursts at roughly $160dB$ [7]. In reality, achieving $174dB$ would be extremely damaging to those in the pub; the loudest sound possible is $\approx 194dB$, according to [8]. At this level, sound waves become deadly shock waves.

Conclusion

Visitors trapped inside the Tan Hill Inn alongside Noasis were safer waiting for Mountain Rescue, rather than asking the band to play at ear-drum-bursting noise levels in order to melt the snow. The assumptions made in this paper are also unrealistic as sound is not efficiently converted to heat, thus the volume required would likely be even louder, or they would have to play for longer.

References

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