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PALLET AND PACKAGING SOLUTIONS

Pallets and Hurricanes
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It has been quite hurricane season in 2017. We have all seen videos of hurricane damage this year. Many of those videos show the danger of flying debris. This reminded me of a request to me as Director of the Pallet and Container Research Lab at Virginia Tech back in 1993 after Hurricane Andrew (1992). During my tenure at Virginia Tech I have had many requests for assistance. However this one was unique.

I received a call from some state officials in Florida wanting to know what I knew about the **aerodynamic properties of wood pallets.** The good news is that pallets are the heroes after hurricanes, by helping to provide humanitarian aid to those affected by such violent storms and I could find no record of a pallet causing injury during such a storm.

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After some discussion with these public officials, the question was whether one could predict at what wind velocity, a stack of pallets would become unstable. That would cause one or more pallets would fly or fall from a stack. So I said, "Let me get back to you".
As is often the case with such questions the answer often lies within an analogy based on an understanding about how some other product or structure responds to similar situations

Stacks of pallets resemble buildings

So using a building analogy, I consulted the ASCE 7-95 "Minimum Design Loads for Buildings and Other Structures" published by the American Society of Civil Engineers. Based on the models for structural stability in wind

and assuming the mechanism of instability will be the horizontal shifting of one pallet relative to another, the following mathematical relationship can be used to predict the wind velocity "V" in miles per hour, that will push a 50 pound GMA style wood pallet across the top deck of another, parallel to the deck boards, with wind direction perpendicular to the stringers. (This would be the pallet orientation of most resistance to wind.)

$$V = \sqrt{\frac{F}{0.00256 K_Z \; K_{ZT} \; I \; G_F \; C_F \; A_F}}$$

Where:
F = 26.2 lbs.
K_Z = Velocity pressure exposure coefficient evaluated at height z (15 ft. or less) = 0.85 (table 6-3)
K_{ZT} = topographic factor (N/A) = 1
I = importance factor (i.e., consequence of pallet stack destabilization) = 0.87 (Table 6-2 and Table 1-1)
G_F = gust effect factor = 0.85 (Section 6.6.1)
C_F = force coefficient for wind loads on “other structures” = 1.35 (assuming H/D = 4.5 and Table 6-7)
A_F = area of the pallet side facing the wind (assuming 0.5 x 5.5” and 0.5 x 3.5” deck boards and 3.5 x 48” stringers and a notch of 1.5 x 9”) = 1.15 $ft.^2$

In this example the critical wind velocity to cause the pallet stack to become unstable is **102 miles per hour,** sustained or as a gust. Clearly this estimate will vary depending on many, many, factors and this has not been verified by testing. I could not predict, if or how far, a pallet would fly. But it was a start and the folks in Florida were "blown away" with this analysis. No pun intended.

So the message is; keep the pallet stacks out of the wind or weigh them down or otherwise secure them if a hurricane is approaching.

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