

April 2, 2026

Development Review Committee
City of St. Petersburg
One Fourth Street North
St. Petersburg, Florida 33701

To Whom it May Concern:

I am a seasonal resident of St. Petersburg and Tierra Verde. I'm also a retired but licensed structural engineer. I am very concerned about the proposed marina buildings for boat storage that are partially enclosed, and the ability to withstand multiple types of pressures. This is a potentially dangerous type of facility given what we know in our field of structural dynamics. If there is anything in this letter that you find in question, I strongly recommend you retain a licensed structural engineer to review and confirm this information as these are not opinions, these are basics of structural engineering.

I trust the Committee has both the authority and the obligation to require a higher standard of engineering justification for a project that poses this level of risk to the surrounding community. I requested structural information from the developer, but they did not respond. In the absence of this, I have included substantial structural information that the Zoning Commission needs to take very seriously.

The Core Engineering Problem: Partially Enclosed Structures in Hurricane Winds

The fundamental danger of the proposed towers lies in their configuration. A structure that is open on one or more sides, as any boat rack tower must be to allow forklift access, is classified under the governing engineering standard, ASCE 7-22 (Minimum Design Loads and Associated Criteria for Buildings and Other Structures), as a "partially enclosed" structure. This classification is not a technicality. It carries one of the most serious design penalties in the building code for hurricane zones.

When hurricane-force winds strike a partially enclosed structure, wind enters through the open face and has nowhere to escape through the enclosed sides and roof, even if vents are placed intermittently along different sides. The interior of the structure rapidly pressurizes, a phenomenon called the "ballooning" effect, and this internal pressure acts outward simultaneously on the roof, the enclosed walls, and every structural connection in the building. Research published by the Natural Hazards Center documents that an opening on the windward wall of only five percent of the wall area is sufficient to allow full internal pressurization, effectively doubling the forces acting to lift the roof and push the side walls outward. The open bays of this type of structure represent a far greater percentage than five percent.

The American Society of Civil Engineers quantifies this hazard through the Internal Pressure Coefficient (GC_{pi}), defined in ASCE 7-22 Table 26.13-1. For an enclosed building, this coefficient is ± 0.18 . For a partially enclosed structure — the category that applies here — it rises to ± 0.55 . This means the internal pressure loads on a partially enclosed structure are more than

three times those on an enclosed building of identical dimensions facing identical winds. Engineers at Simpson Strong-Tie, in published technical guidance on open-front structures, explicitly recommend using the ± 0.55 coefficient for any structure with a dominant open face and confirm that positive internal pressure will build up due to the solid walls on the remaining three sides.

These internal pressures do not replace external wind pressures; they add to them. The net uplift on the roof is the sum of both. For a structure at 72 feet of elevation in Exposure Category D, the highest wind exposure category under ASCE 7-22, applicable to everywhere in coastal St. Petersburg, combined roof uplift pressures can exceed 130 to 150 pounds per square foot under design hurricane wind speeds. That is more than the weight of most structural roofing systems, applied outward.

The Problem of Height: Wind Pressure Increases with Elevation in this Structure

The proposed towers are 72 feet tall. This height is not incidental to the risk, it is substantially additive to it. ASCE 7-22 requires that wind load calculations account for the velocity pressure exposure coefficient (K_z), which increases with height above ground. In Exposure Category D, a structure at 72 feet experiences approximately 40 to 50 percent higher wind pressure than the same structure at ground level. The boats stored on the uppermost rack levels, already the most dangerous location in the event of structural failure, are also subjected to the highest wind loads of any part of the structure.

Height also introduces a second critical hazard called vortex shedding. When steady wind flows past a tall, uniform structure, vortices form and shed alternately from each side, creating a repeating pattern of lateral suction forces perpendicular to the wind direction — the Kármán vortex street, documented extensively in structural engineering literature including a landmark paper in *Physics Today* by P.A. Irwin (2010). If the frequency at which these vortices shed matches the natural resonant frequency of the structure, the structure begins to oscillate, with each cycle adding energy to the motion. Research published in the *Eastern-European Journal of Enterprise Technologies* (Nuzhnyj and Bilyk, 2024) confirms that vortex shedding effects are negligible for structures below approximately 40 to 50 feet, but increase significantly for structures above 65 feet. The proposed towers, at 72 feet, fall precisely in this critical range.

Standard simplified wind load calculations under ASCE 7-22 do not capture vortex shedding effects. Structures of this height and configuration requires formal dynamic analysis, modal analysis, gust factor calculations for flexible structures, or physical wind tunnel testing, to determine whether resonant oscillation is a design-governing concern. There is no indication that Greenleaf has performed or submitted any such analysis as they did not provide any in their application.

The Two-Tower Problem: Aerodynamic Interference

The proposed development includes not one but two towers in close proximity. Published research in the journal *Engineering Structures* (Qin et al., 2022) documents that twin-tower configurations experience substantially different wind loading than single isolated structures. Three specific interference effects are of concern here.

First, the downwind tower will experience highly turbulent and gusty airflow from the wake of the upwind tower, a phenomenon called wake buffeting, which significantly increases the dynamic load fluctuations on the second structure beyond anything standard code calculations predict. Second, when wind blows parallel to the gap between the two towers, it accelerates through the gap in a venturi effect, increasing local wind speeds and pressures on the interior-facing surfaces of both towers. Third, under certain wind directions, both towers may oscillate together — either in phase or out of phase — with each tower motion reinforcing the forces on the other through the shared ground and foundation system.

The ASCE 7-22 simplified design methods are explicitly developed for single, isolated structures. They are not validated for two proximate towers of this size in a coastal exposure. This is not a minor technical refinement; it is a fundamental limitation of the standard that requires supplemental analysis. No such analysis has been submitted in the developer's information.

This Is Not a Hypothetical Risk — It Has Happened Repeatedly

I am not asking the Committee to accept theoretical risk assessments alone. The catastrophic failure of high-rise boat rack storage towers in hurricanes is a documented, recurring event in Florida history.

During Hurricane Wilma in 2005, three large steel boat rack storage facilities collapsed in South Florida, each holding thousands of boats. One of the documented collapses occurred at Marina 1's dry stack storage facility in Deerfield Beach. The structures that failed were made of steel and were not materially different in concept from what is now being proposed in St. Petersburg. Boaters who experienced these collapses consistently report the same sequence: the roof fails first under combined external uplift and internal pressure, the walls lose their lateral support, and the entire structure comes down — releasing its cargo of boats as a debris field.

In 2008, Hurricane Ike — while making landfall in Texas — produced hurricane-force winds across Ohio. A licensed structural engineer who surveyed the damage afterward documented in the Eng-Tips professional engineering forum that multiple three-sided and partially open structures failed in winds of 70 to 90 miles per hour. In one specific case, a three-sided structure with a monoslope roof had its roof lift off, travel approximately five feet, and crash down on recreational vehicles parked inside. The design wind speeds for coastal St. Petersburg under ASCE 7-22 exceed 140 miles per hour — nearly double the wind speeds that destroyed these Ohio structures. The performance gap between what partially enclosed structures can endure and what a Florida coastal hurricane delivers is vast.

The Insurance Institute for Business and Home Safety (IBHS), after conducting full-scale wind testing of open and semi-open attached structures, found that 80 percent of such structures surveyed after Hurricane Charley in 2004 suffered partial or total destruction. Equally important, as these structures come apart, their components become wind-borne debris that damages neighboring properties. A boat rack tower does not fail quietly, it fails violently, and everything stored in it becomes a problem.

Storm Surge, Rain Loading, and Compounding Hazards

Wind is not the only threat during a Gulf Coast hurricane. The Tampa Bay area is consistently identified by NOAA and FEMA as one of the highest storm surge risk zones on the Gulf of Mexico, due to the bay's funnel shape and shallow water. A Category 3 or 4 direct strike, as in 2024, produces storm surge of 10 to 15 feet or more at coastal St. Petersburg locations. Storm surge introduces foundation threats that compound the wind hazard: hydrodynamic lateral loading in the direction of wind, upward buoyancy forces on the foundation slab, and scour erosion around and beneath the foundation piles that can cause sudden bearing capacity failure mid-storm. Tierra Verde Marina reported up to 4 feet of water on their property.

There is also a well-documented failure mechanism specific to boat rack structures that deserves the Committee's attention. During hurricanes, rainfall rates can reach six inches per hour or more. Recreational boats stored in open or partially open rack structures collect this rainwater in their cockpits and bilges. If bilge pumps lose power, as they commonly do during major storms, a single 30-foot boat can accumulate thousands of pounds of water within hours. Multiplied across dozens of boats on upper rack levels, this creates a progressive overloading scenario that has been directly cited as a contributing cause of rack collapses during Hurricane Wilma. It is a hazard that standard structural dead and live load calculations do not account for, and there is no indication the developer has addressed it.

Florida Building Code Section 3109 and the FDEP Coastal Construction Control Line program require that structures near the coast be designed to resist forces associated with the 100-year storm event, including surge, wave uplift, and scour. I respectfully ask the Committee to confirm that the developer's submission includes a complete foundation design certified by a Florida-licensed Professional Engineer that accounts for all of these combined loading conditions.

The Debris Hazard to Our Community

I want to be direct about what failure of these structures would mean for the surrounding neighborhood, as I lived a few houses away from the marina. Each boat stored in these towers is a heavy object — recreational vessels typically weigh between 5,000 and 30,000 pounds, and some exceed that range. Stored at heights of up to 70 feet and released suddenly by structural collapse in a hurricane, these vessels do not simply fall straight down. They are carried, tumbled, and thrown by hurricane-force winds. Fiberglass hull fragments, outboard motors, aluminum outriggers, fuel tanks, and steel rack framing all become ballistic debris.

Florida International University's Wall of Wind research facility, the premier institution for full-scale hurricane structural testing in the United States, has documented through years of Category 4 and 5 simulation testing how rapidly structural failures cascade and how widely debris is projected under those conditions. The proximity of the proposed towers to residential neighborhoods, public roadways, and other marine facilities means that the debris radius from a structural failure during a major hurricane would encompass areas where people and property are at risk.

The NCSEA (National Council of Structural Engineers Associations) notes in its hurricane guidance that when hurricane winds are able to enter a partially enclosed structure, they cause a rapid increase in internal pressures that causes further damage to the structure, which in turn

creates wind-borne debris. That debris then causes further damage to neighboring buildings. The towers being proposed would not merely fail in place; they would become the origin point of a debris cascade threatening a broad area of the community.

What I am Asking the Committee to Require

I am not asking the Committee to prohibit boat storage. I am asking for the standard of engineering rigor that a project of this risk profile demands before a permit is issued. Specifically, I request that the Committee condition any approval on the following:

The developer must submit a complete wind load analysis prepared by a Florida-licensed Professional Structural Engineer, explicitly addressing the partially enclosed building classification under ASCE 7-22 Section 26.2 and applying the $GC_{pi} = \pm 0.55$ internal pressure coefficient to all structural elements. This analysis must use the Directional Procedure under ASCE 7-22 Chapter 27, not simplified methods, and must account for the full Exposure Category D velocity pressure profile at all heights from grade to 72 feet.

The developer must submit a dynamic wind analysis addressing vortex shedding and resonance risk. Given the height of the proposed structures and their coastal open-terrain exposure, this requires at minimum a gust factor calculation using the flexible structure methodology under ASCE 7-22 Chapter 26, or physical wind tunnel testing at a recognized facility such as FIU's Wall of Wind.

The developer must submit a twin-tower aerodynamic interference analysis demonstrating that the mutual wind loading effects of the two proximate towers have been evaluated and accounted for in the structural design.

The developer must submit a debris hazard assessment quantifying the potential trajectory and kinetic energy of structural components and stored vessels in the event of partial or total structural failure at each rack level.

The developer must submit a foundation design certified by a Florida-licensed PE demonstrating adequate resistance to the combined loading of design wind, storm surge hydrodynamic forces, buoyancy uplift, and foundation scour under the 100-year storm event as required by Florida Building Code Section 3109.

All structural calculations must be peer-reviewed by an independent Florida-licensed Professional Engineer with demonstrated expertise in hurricane wind engineering, with no professional or financial relationship to the developer or the engineer of record.

Alternatively, if the developer cannot demonstrate code compliance and adequate safety through the above submissions, I ask the Committee to deny the permit and direct the developer toward a fundamentally safer design — such as a fully enclosed hurricane-rated structure, a lower-height facility, or ground-level dry storage — that does not present the same combination of risks.

Conclusion

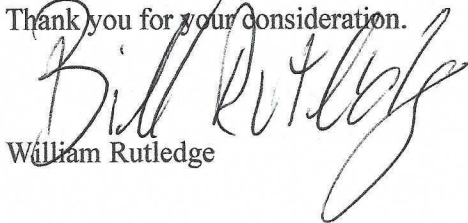
The engineering record on partially enclosed tall structures in coastal hurricane zones is clear and consistent. These structures are vulnerable to internal pressure amplification that multiplies wind

loads by a factor of three or more, to height-related wind pressure increases, to vortex-induced resonance, to storm surge combined loading, and to progressive collapse initiated by rain accumulation in stored boats. Structures of this type have failed in real hurricanes in Florida, at wind speeds far lower than what the Tampa Bay coastal zone is designed to withstand.

The Florida Building Code exists precisely to prevent foreseeable failures of this kind. The city has both the legal authority and the professional obligation to require that the marina demonstrate, through rigorous independent engineering analysis, that the proposed structures can safely withstand the design hurricane conditions for this location — before, not after, a permit is issued.

I respectfully urge the Development Review Committee to take this letter seriously, to scrutinize the developer's engineering submissions with the rigor this risk profile demands, and to protect our community by requiring genuine compliance with the governing standards before any approval is granted. As a side note, I spent a lot of time on the metrics of these issues, but I ask the Commission to use simple common sense: these specific structures don't belong in a well known hurricane zone.

Thank you for your consideration.


William Rutledge