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Analyzing wind performance at the pedestrian waterfront along South America's Pacific coast through urban design morphology modeling.

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Extreme weather events, like storms and tornadoes, are becoming more frequent due to climate change, resulting in wind gusts over 150 km/h in South America's waterfront areas. These conditions threaten lives and urban heritage. For decades, high-rise developments in these locations have followed similar design patterns, obstructing or channeling wind flow in outdoor spaces. This built environment poses challenges for climate-sensitive urban design. To address these issues, it is essential to understand how different urban layouts affect wind performance. This study aims to evaluate the wind performance of urban design morphology in the waterfront of Viña del Mar, a prominent tourist city on South America's Pacific coast. Two geometric arrangements are analyzed: a new circular and a traditional linear. Both designs have heights of up to 25 floors and use the same construction materials. The method involves modeling wind performance using Computational Fluid Dynamics (CFD) during two sample periods: summer (December) and winter (June). The data was extrapolated from a weather station in Viña del Mar to the Con-Con site. According to the wind rose data, the main wind directions for analysis are North-West and South-East. The results connect theoretical wind performance around buildings and the modeling outcomes, highlighting phenomena such as Venturi effects, vortex formation, and wind shadow lengths. Findings reveal that the permeability of urban facades varies between the two layouts. Increasing the distance between buildings reduces the length of wind shadows in linear arrangements. Conversely, circular building arrangements lead to higher wind speeds in outdoor areas facing the windward side.