

CFD SIMULATION OF FULL-SCALE MULTI-SUBVORTEX TORNADOES

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A multiple-subvortex tornado is a tornado that contains two or more subvortices in the wind field. This type of tornado may appear to be one column from the outside view, but in close proximity it has different areas of contact with the ground. Due to the presence of multiple vortices, this type of tornado is likely to be more dangerous and destructive than single-vortex tornadoes. A number of real-world deadly/costly tornadoes have multiple subvortices. When several vortices co-exist, especially when they are close to each other, the wind effects on civil structures and failure mode/mechanism of civil structures will become more complicated. Although experimental testing in laboratory tornado simulators and numerical simulations based on CFD have been conducted in previous research, only small-scale tornadoes, mainly single-celled tornadoes, were studied and used to determine the design tornadic wind load. To understand the action of real-world tornadoes on civil structures and accurately predict the structural condition under impending tornadoes as well as effectively mitigate tornado-induced damage, the full-scale tornadoes with multiple vortices are simulated in this study. The multiple-subvortex tornadoes are generated by controlling the swirl ratio and the relationship between the number of vortices and swirl ratio is discussed. The results show that the inner flow structure of a multiple-subvortex tornado is distinct from a single-vortex tornado and the wind effects on structures are different between these two types of tornadoes.