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On the anti-rolling performance of a coastal train using vortex generators

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ABSTRACT

High-speed trains running along coastal railway lines are susceptible to extreme weather conditions such as strong crosswinds, which pose safety risks such as vehicle overturning. Effective mitigation of similar driving risks is a key focus in the field, and passive flow control methods hold engineering potential due to their reliability and simplicity. This study presents a method to enhance a coastal train's anti-rolling performance under crosswinds using vortex generators (VGs). An efficient VG array design is proposed by comparing VGs of different heights and angles, aiming to delay flow separation on the roof and suppress trailing vortices on the leeward side of the train. While taller VGs have a more pronounced effect on changing the boundary layer momentum, they also result in higher device drag forces. A height-to-boundary layer thickness ratio (h/δ) of approximately 0.4 is deemed to be a balanced choice. The train's rolling moment exhibits the greatest decrease when the angle between the VG and synthetic flow is 40 degrees.

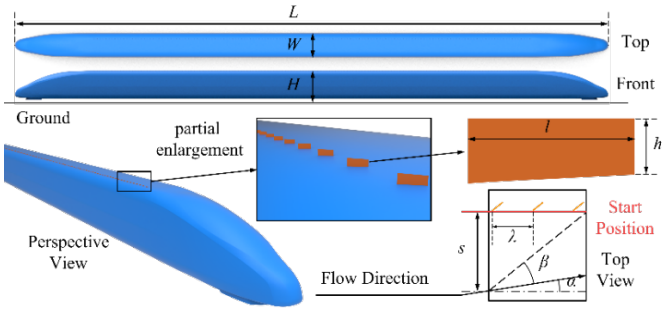

Fig. 1 Computational meshes for high-seed train with VGs

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