Modifying Ship Air-Wake Vortices for Aircraft Operations

Takeoffs and landings would be safer.

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Columnar-vortex generators (CVG) have been proposed as means to increase the safety of takeoffs and landings of aircraft on aircraft or helicopter carriers and other ships at sea. According to the proposal, CVGs would be installed at critical edge locations on ships to modify the vortices in the air wakes of the ships. The desired effects of modifications are to smooth airflows over takeoff and landing deck areas and divert vortices from takeoff and landing flight paths.

With respect to aircraft operations, the wake flows of primary interest are those associated with the bow and side edges of aircraft-carrier decks and with superstructures of ships in general (see Figure 1). The bow and deck-edge vortices can adversely affect airplane and helicopter operations on carriers, while the superstructure wakes can primarily affect operations of helicopters.

The concept of the CVG is not new; what is new is the proposed addition of CVGs to ship structures to effect favorable modifications of air wakes. Figure 2 depicts a basic CVG, vertical and horizontal CVGs installed on a simple superstructure, and horizontal CVGs installed on the bow and deck edges. The vertical CVGs would be closed at the deck but open at the top. Each horizontal CVG would be open at both ends. The dimensions of the CVGs installed on the aft edges of the superstructure would be chosen so that the portion of the flow modified by the vertical CVGs would interact synergistically with the portion of the flow modified by the horizontal CVG to move the air wake away from the takeoff-and-landing zone behind the superstructure.

The deck-edge CVGs would be mounted flush with, and would extend slightly ahead of the bow of, the flight deck. The overall length of each tube would exceed that of the flight deck. Each deck-edge CVG would capture that portion of the airflow that generates a deck-edge vortex and would generate a columnar vortex of opposite sense to that of the unmodified vortex. The vortex generated by the CVG could be dispersed at its base, thereby removing unwanted turbulence in the path of an approaching airplane. The deck-edge CVGs would promote smooth flow over the entire flight deck. In the case of a Nimitz-class aircraft carrier like that of Figure 1, there would be a CVG on each of the outer edges of the two left portions of the flight deck and a single CVG on the right side of the flight deck. The forwardmost CVG on the left side would take the generated vortex underneath the angled flight deck.

A CVG could also be installed on the bow of the flight deck to smooth the flow of air onto the flight deck. In the case of wind incident on the deck from an azimuth other than straight ahead, the vortex generated by the bow CVG could, perhaps, be used to feed the CVG(s) of the leeward side edge of the flight deck.

This work was done by John E. Lamar of **Langley Research Center**. *Further information is contained in a TSP (see page 1).*
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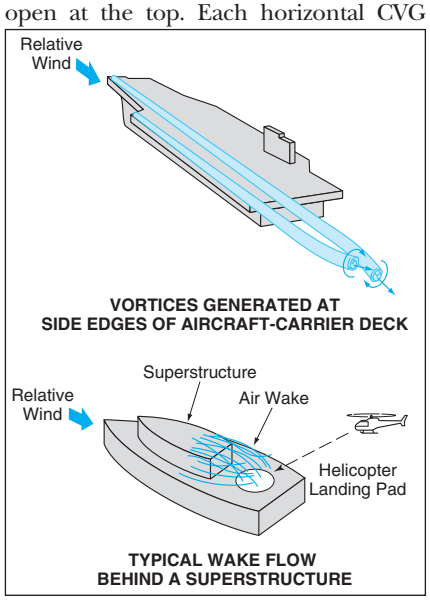

Figure 1. **Air Wakes** of ship structures can adversely affect operations of aircraft.

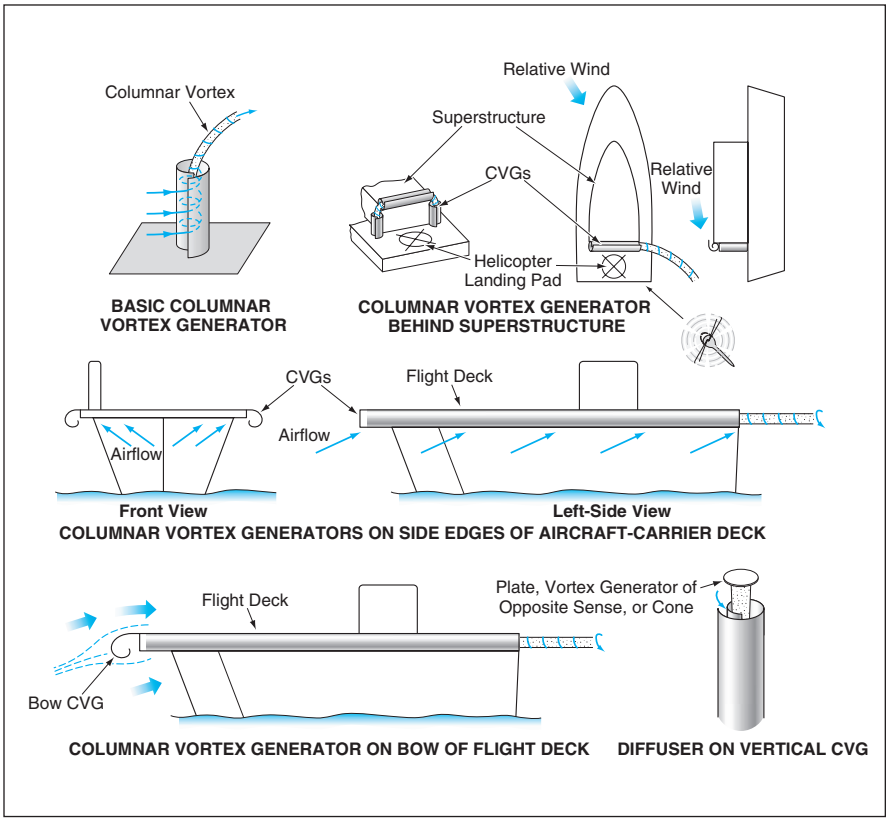

Figure 2. **Columnar-Vortex Generators** would modify air wakes to provide smoother flows and divert vortices from paths of aircraft.