

Application of Unstructured Mesh Modeling in Evolving SGE of an Airport at the Confluence of Multiple Rivers in a Macro Tidal Region

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Abstract : Among the various developing countries in the world like China, Malaysia, Korea etc., India is also developing its infrastructures in the form of Road/Rail/Airports and Waterborne facilities at an exponential rate. Mumbai, the financial epicenter of India is overcrowded and to relieve the pressure of congestion, Navi Mumbai suburb is being developed on the east bank of Thane creek near Mumbai. The government due to limited space at existing Mumbai Airports (domestic and international) to cater for the future demand of airborne traffic, proposes to build a new international airport near Panvel at Navi Mumbai. Considering the precedence of extreme rainfall on 26th July 2005 and nearby townships being in a low-lying area, wherein new airport is proposed, it is inevitable to study this complex confluence area from a hydrodynamic consideration under both tidal and extreme events (predicted discharge hydrographs), to avoid inundation of the surrounding due to the proposed airport reclamation (1160 hectares) and to determine the safe grade elevation (SGE). The model studies conducted using the application of unstructured mesh to simulate the Panvel estuarine area (93 km²), calibration, validation of a model for hydraulic field measurements and determine the maxima water levels around the airport for various extreme hydrodynamic events, namely the simultaneous occurrence of highest tide from the Arabian Sea and peak flood discharges (Probable Maximum Precipitation and 26th July 2005) from five rivers, the Gadhi, Kalundri, Taloja, Kasadi and Ulwe, meeting at the proposed airport area revealed that: (a) The Ulwe River flowing beneath the proposed airport needs to be diverted. The 120m wide proposed Ulwe diversion channel having a wider base width of 200 m at SH-54 Bridge on the Ulwe River along with the removal of the existing bund in Moha Creek is inevitable to keep the SGE of the airport to a minimum. (b) The clear waterway of 80 m at SH-54 Bridge (Ulwe River) and 120 m at Amra Marg Bridge near Moha Creek is also essential for the Ulwe diversion and (c) The river bank protection works on the right bank of Gadhi River between the NH-4B and SH-54 bridges as well as upstream of the Ulwe River diversion channel are essential to avoid inundation of low lying areas. The maxima water levels predicted around the airport keeps SGE to a minimum of 11m with respect to Chart datum of Ulwe Bundar and thus development is not only technologically-economically feasible but also sustainable. The unstructured mesh modeling is a promising tool to simulate complex extreme hydrodynamic events and provides a reliable solution to evolve optimal SGE of airport.

Keywords : airport, hydrodynamics, safe grade elevation, tides

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