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NUMERICAL MODELING OF HYDRODYNAMIC IRRIGATION CHANNELS WITH PRESENCE OF SKEWED BOX-CULVERT

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Abstract

The box-culvert in irrigation channels, they are found at road crossings, control works such as gates and intake work. The importance of studying these structures lies in the hydrodynamic behavior of the channels in the rainy season, since they have been detected on free surface elevations due to blockages due to poor design. A numerical model was applied to estimate the hydrodynamic field in open channel with skewed box-culvert in irrigation channels in Mexico, for which purpose the calculation of the three-dimensional velocity field with presence of hydraulic control structures. The numerical method was developed using the Navier-Stokes equations in free surface flow, in cartesian coordinates; use the hypothesis of hydrostatic pressure and considering the postulates of Reynolds, the solve was done by an element finite method. A comparison of the model developed with the Flow3D software was made, where the results between the commercial and the developed model shown an RMSE (Root-Mean-Square Error) of 4.8. Three numerical scenarios were calculated including different alternatives and its behavior at the entrance, interior and exit of the water flow in the construction to determine which is the best option to be used on the skewed multi barrel crossings. In order to accomplish this, a variable slope channel and 1: 60 scale models of box culverts with 10, 22 and 45 degrees of skewness were used. The results observed in the multi-eyed box culverts were favorable, since the speed spans are low increase inside and outside of them, which favors the hydrodynamic behavior and minimize the accumulation of sediment into structure in the channel; another noteworthy fact is that at 45 skewed degrees there is a higher speed, which reduces an upstream hydraulic jump and favors circulation through reductions and control works.

Keywords: Open channel, free flow fluid, Navier-Stokes equations.