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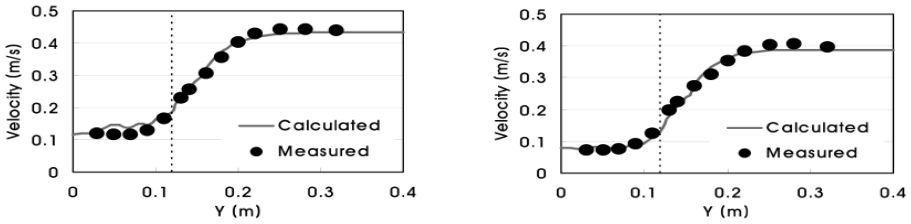
Application of Depth-Averaged 2D Numerical Model for Evaluation of the Vegetal Resistance in a Natural River

APPLICATION OF DEPTH-AVERAGED 2D NUMERICAL MODEL FOR EVALUATION OF THE VEGETAL RESISTANCE IN A NATURAL RIVER

Ji-Sung Kim[1], Keuk-Soo Kim[2], Won Kim[3], and Hyoseop Woo[4]

The purpose of river management was mainly restricted to flood defense and water use in Korea, so the trees in a river which increase the water level in a flood season due to their obstruction had been removed. Recently, concern about the environmental and aesthetic value of river, such as ecosystem and amenity, has increased owing to change of paradigm in river management. Actually, Korean government permitted tree planting in a river floodplain in 2000. "The standard about planting and managing trees and woodlands in a river"-proposed in 1999, was revised partially in 2007. In total, 29 planting plans in relatively wide rivers were evaluated by Korea Institute of Construction Technology from 2000 until 2007. The existing revised criterion, in which the density or interval, diameter and height of trees were regulated, is still restrictive and makes the planting activities passive. Therefore, it should be necessary that the methodology with which the flow resistance due to trees can be evaluated quantitatively and practically is developed.

In this study, FESWMS FST2DH model was used to analyze the changes in the flow characteristics with and without the flow resistance due to the natural plants in the Nakdong river, Korea. The additional flow resistance acting on each tree is calculated using the drag-force concept and the lateral momentum transfer between planted and non-planted zone could be satisfactorily reproduced by parabolic turbulence model in this depth-averaged 2-D numerical model. For model validation, the simulated velocities were compared with the measured data, showing a good agreement for the densities of the trees considered in the experimental investigations of Tsujimoto and Kitamura (1995).



(a) Δs= 0.028m (b) Δs= 0.02m

Figure 1 Validation of FESWMS FST2DH mode

The traditional method using a proper Manning's *n* coefficient gives reasonable solutions only to evaluate the conveyance, but the calculated approach velocities at each tree were different

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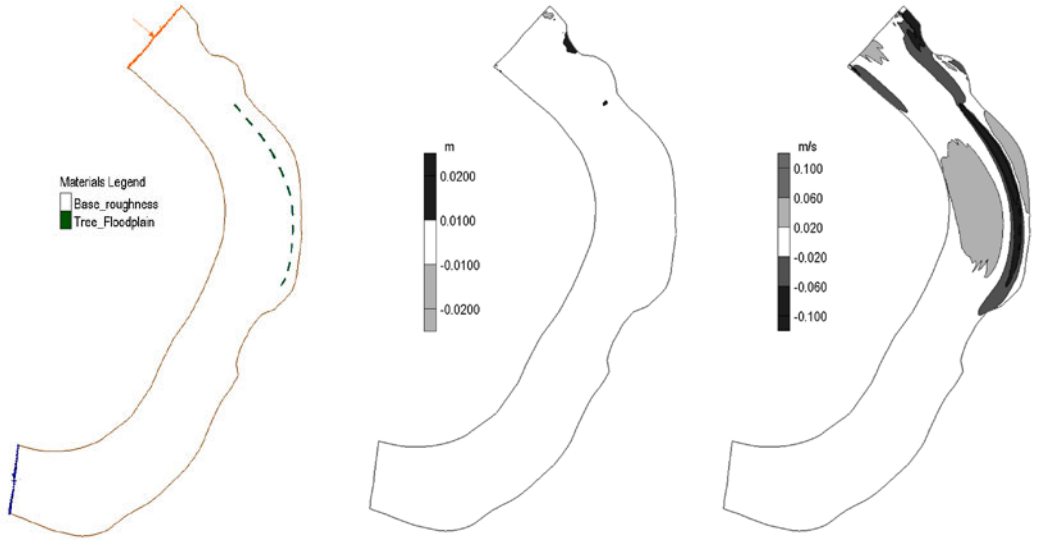
from values through the drag-force approach. This means that the possibility of tree-overturning may be under- or over-estimated in a flood event. The proposed procedure could be widely used to evaluate the hydraulic effects of vegetal resistance in practical engineering.



(a) Location of planting (b) difference in stage (c) difference in velocity

Figure 2 Comparisons between drag force and conventional approach.

REFERENCES

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