## **Application of Frontal Solution Method in Dam-Reservoir Problem**

## Saba Golchin\*, Reza Attarnejad<sup>†</sup> and Shahram Vahdani<sup>††</sup>

<sup>\*</sup> PhD candidate at university of Tehran School of Civil Engineering, University of Tehran, Tehran, Iran E-mail: saba.golchin@ut.ac.

<sup>†</sup> Professor at university of Tehran School of Civil Engineering, University of Tehran, Tehran, Iran E-mail: attarnjd@ut.ac.

<sup>††</sup> Associate Professor at university of Tehran School of Civil Engineering, University of Tehran, Tehran, Iran E-mail: svahdani@ut.ac.

## ABSTRACT

Solution of the total equations of the phenomenon in time domain is the main target in the current study. The advantages of the method are high accuracy comparing with iterative methods, and possibility of handling the nonlinear affects. Deficiencies are due to high system requirement, the use of same formulation either Lagrangian or Eulerian which are suitable for the structure or reservoir respectively, and solving the variables with very different orders. The proposed method is to take advantage of frontal solution scheme. In this solution method some of the variables are gathered in a front, and solution is performed each time for successive fronts. The size of the front is different for each problem, but it is much less than total variables. Therefore, computational requirement is limited without losing accuracy. The hydrodynamic pressure variables are chosen to be located in front. Therefore some notable changes had to be made in formal scheme. In common version the choosing the variables and placing them in the front is done automatically. While in proposed application the hydrodynamic pressure variables are forced to be located in front. Other advantages are also achieved. Having the hydrodynamic pressure variables, the structure and reservoir are solved separately using their suitable formulations.

This paper studies two methods for analysis of the dam-reservoir system. The first method is based on using frontal method, while the other utilizes iterative schemes. A typical dam-reservoir system is performed by five different meshes. These analyses are compared from efficiency point of view. Frontal method requires less system requirement than iterative methods.

CPU time are calculated for two approaches. All the execution times are calculated on the same hardware to achieve an appropriate criterion for comparison purposes.

Compared to iterative scheme, CPU time is decrease in frontal method. As the number of the elements are increase, execution time is saved more in frontal method even up to 90 percent.

## REFERENCES

- [1] S. Golchin, R. Attarnejad and S. Vahdani, "Numerical uncoupling of domains in dam-reservoir problem", *Shock and Vibration*, Vol. **2018**, Article ID 4369240,11 pages, (2018).
- [2] B.M. Irons, "A frontal solution program for finite element analysis", *International Journal for Numerical Methods in Engineering*, Vol. 2, 5-32 pages, (2018).