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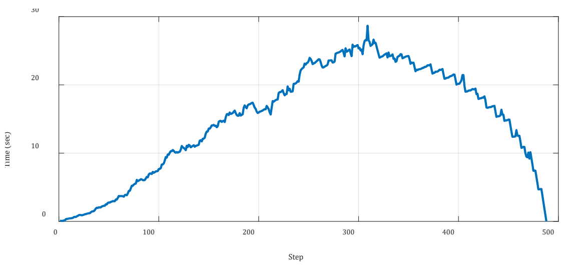
Incremental Computation of Stiffness Matrix for Assembly Sequence Optimization

*Junhwa Lee[1)] and Siripong Petpradit[2)]

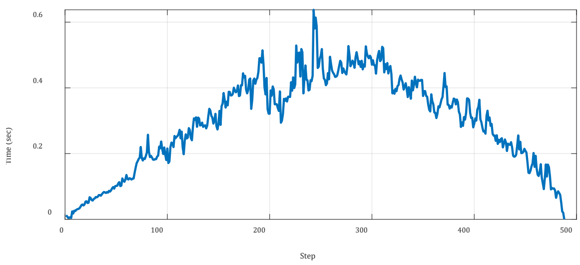
[1), 2)] *Department of Civil Engineering, Pukyong National University, Busan 48513, Korea*
[1)] *lee@pknu.ac.kr*

ABSTRACT

Truss structures consist of straight members connected by hinges and are widely used in modern engineering due to their efficient load distribution. The hinged joints allow each member to carry only axial forces, either in tension or compression, which ensures effective load transmission throughout the structure. During construction, the sequence of member assembly has a significant impact on substructure stiffness, particularly in vulnerable modes such as the primary bending mode. An incorrect assembly sequence or poorly placed temporary supports may reduce stiffness, which in turn increases the risk of collapse. This study introduces a caching-based technique that incrementally updates the stiffness matrix. The method reduces computational time by incorporating the effects of newly added members into cached substructure stiffness matrices. Validation through various truss assembly scenarios shows that the proposed approach achieves notable gains in computational efficiency compared to traditional methods.



(a) Conventional method



(b) Proposed method

Fig. 1 Computational time at each step

[1)] Assistant Professor
[2)] Graduate Student