Consideration on Effectiveness of the MFS to Linear Notch Mechanics

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It is well known that the method of fundamental solutions (MFS) based on the collocation method has simple program architecture, but the stability of accuracy depends on each problem in case of high stress concentration factor(SCF). One of the authors has been improving the source loads of the MFS program [1] [2] to calculate the stress at the notch tip correctly. We compared the accuracy by using conventional point loads and the accuracy by the equally dispersed point loads (EDPL). It is found that the improved MFS gives the good accuracy even if SCF >5 under some conditions. The index on the balance of force was also proposed and was found to be effective to confirm the accuracy of the maximum stress. On the view of product design, the maximum elastic stress in a notched body is not a unique parameter that controls the failure of the product. Therefore, we should use the proper measures of severity in a notched body in order to predict the strength of real objects from the strength of specimens. This idea is called linear notch mechanics which was proposed by Nisitani. To utilize linear notch mechanics to evaluate the failure behavior, we should calculate two parameters correctly. One is the maximum stress at the notch tip and the other one is the gradient of the stress near the notch tip. When the measures of severity are the same in a specimen and a real object under the condition of small-scale yielding, the same elastic-plastic fields are assured and the same phenomena occur in both. In this study, we give some examples which shows that the MFS is better than FEM to calculate those two parameters correctly.

References

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[2] W. Fujisaki, Assurance of Accuracy on High SCF of Double Holes Problems by the Method of Fundamental Solutions, Recent Studies in Meshless & Other Novel Computational Methods, Tech Science Press, 57-69, 2010.