Accepted Manuscript


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PII: S2352-0124(16)30073-X
DOI: doi: 10.1016/j.istruc.2016.09.003
Reference: ISTRUC 146

To appear in:

Received date: 16 February 2016
Revised date: 19 August 2016
Accepted date: 8 September 2016

Please cite this article as: Gawande Shravan H., More Rudesh R., Effect of Notch Depth & Location on Modal Natural Frequency of Cantilever Beams, (2016), doi: 10.1016/j.istruc.2016.09.003

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# Effect of Notch Depth & Location on Modal Natural Frequency of Cantilever Beams

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*Abstract*— The dynamic characteristics of a beam with breathing notch is studied in this paper. A systematic approach has been adopted in the present investigation to develop theoretical expressions for evaluation of natural frequencies and mode shapes. A simple elastic cantilever beam with breathing notch located at different position is considered for the dynamic analysis. The notch depth and its location are the main parameters for the vibration analysis of beams.The notch depth and its position may affect the natural frequency. Hence, it is essential to study the effect of notch depth and its location on modal natural frequency of the beam for the decent performance and its safety. This paper emphasis on the examination of these changes, which are useful for identification of notch location.The cantilever beam made of mild steel is seleced for the study. In this work the comprehensive analysis of cantilever beam with & without notch has been done using analytical analysis and finite element method (FEM) and experimentally. An experimental set up was developed in which a cantilever beam with notch was excited by a hammer and the response was obtained using an accelerometer. The method presented describes the relation between the modal natural frequency with notch depth and its location. This paper contains the study of dynamic properties of cantilever beams subjected to free vibration under the influence of notch at different points along the length.

*Keywords*— Cantilever beam, Notch, Finite Element Method (FEM), NI Lab-view, Dynamics characteristics.

**NOMENCLATURE**

| | |
|---|---|
| $d$ | Depth of notch(mm) |
| $L$ | Length of the beam mm |
| $l$ | Notch location from fixed end (mm) |
| $l_c$ | Notch location from free end ( mm) |
| $A$ | Cross-sectional Area ($mm^2$) |
| $B$ | Width of the beam (mm) |
| $H$ | Height of the beam (mm) |
| $\rho$ | Mass Density ($Kg/mm^3$) |
| $E$ | Modulus of Elasticty (MPa) |
| $I$ | Second moment of Inertia ($mm^4$) |
| $Z$ | Dimensionless parameter |
| $\mu$ | Poisson's ratio |
| $K_J$ | Coefficient of torsional spring |
| $\omega_n$ | Natural frequency of free vibration of uncraked beam. |
| $\omega_c$ | Natural frequency of free vibration of notched beam. |
| $\lambda$ | Frequency parameter |
| $S$ | Crack depth ratio |

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