



Effectiveness of Connections Type on Vibration Response of Steel Beam

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Received 23 May 2019; Accepted 18 September 2019

Abstract

In a steel structure, choosing the connections type are one of the most important parameters in design consideration. How a connection type affects the vibration of steel beams has been investigated in this paper. The most effective connection type in reducing beam vibration has been highlighted. The study was conducted using different finite element models to simulate each connection type. Firstly, the model was validated by comparing its results with the results obtained by the analytical approach. In the numerical model, a linear frequency analysis was performed to determine beam natural frequency, then it has been compared with the corresponding value obtained by the Euler-Bernoulli approximations for simply supported beams. After that, two analysis procedures have been executed, steady-state analysis and transient analysis. In the steady-state analysis, a harmonic load with different frequencies was applied to the beam mid-span, while an impulsive load has been applied in the transient analysis. The results indicate that the deflection could be reduced by 72%, furthermore steady vibration of the beam can be reduced by 81% with using one of the moment connections instead of the traditional shear connection.

Keywords: Vibration Analysis; Steel Beam; Finite Element Modeling; Steady State Analysis; Transient Analysis.

1. Introduction

The full potential of structure composing material is the main goal of structural engineers for a long time. The modern construction techniques led to use as the highest strength to weight performance as possible. A direct consequence of this new design trend is a considerable increase in problems related to unwanted floor vibrations. For this reason, the structural floors systems become vulnerable to excessive vibrations produced by impacts or other sources [1]. The main objective of this research is to present the effectiveness of connection type in reducing beam vibration. Where the incorrect choice of connection type in steel structure could be led to serviceability problem. Therefore, the most effective connection in reducing beam response to vibration has been highlighted in this work. The investigation was done through an extensive finite element modeling using ABAQUS software. Steady-state and transient analyses have been performed to measure the connection effect on beam response to vibration. The model was validated by comparing the beam natural frequency obtained from finite element simulation with the corresponding value obtained from the traditional analytical approach after that multi connections were simulated and its response to vibration was pointed out.

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 <http://dx.doi.org/10.28991/cej-2019-03091414>



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