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# Influence of the Connecting Condition on the Dynamic Buckling of Longitudinal Impact for an Elastic Rod

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**Abstract**

The stress wave propagation law and dynamic buckling critical velocity are formulated and solved by considering a general axial connecting boundary for a slender elastic straight rod impacted by a rigid body. The influence of connecting stiffness on the critical velocity is investigated with varied impactor mass and buckling time. The influences of rod length and rod mass on the critical velocity are also discussed. It is found that greater connecting stiffness leads to larger stress amplitude, and further results in lower critical velocity. It is particularly noteworthy that when the connecting stiffness is less than a certain value, dynamic buckling only occurs before stress wave reflects off the connecting end. It is also shown that longer rod with larger slenderness ratio is easier to buckle, and the critical velocity for a larger-mass rod is higher than that for a lighter rod with the same geometry.

**Keywords**

Elastic rod, longitudinal impact, connecting boundary, stress wave, dynamic buckling, critical velocity

## 1. Introduction

Buckling analysis of a straight rod under an axial load is the basis of research on structural stability. The theoretical system of elastic static buckling for a straight rod is now relatively well established compared to the dynamic case. Due to the time parameter involved, the dynamic impact buckling for a rod is more complicated than the static buckling. The impact boundary, the connecting boundary and the mechanical properties are key factors to affect the buckling condition for a given rod. One of the main goals for dynamic buckling research is to identify the buckling condition which includes critical buckling time, critical velocity, critical buckling length and critical load; another is to explore the post buckling mode. The simple time-varying axial load [1], constant load [2,3,4] and step-load [ 5] have been separately applied on the fixed or simply supported rod to study the critical conditions [1,4,5] and post buckling mode