

Optimizing for Mill Housing Deflection With Analytical Equations

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Keywords: Mill Housing, Housing Deflections, Cold Rolling

ABSTRACT

Mill stretch is an important parameter in achieving accurate gauge control in rolling. Vertical mill housing deflections are an important component of total mill deflection. Horizontal mill housing deflections are important in controlling clearance between roll chocks and window liners. Building on prior work, improved analytical housing deflection equations have been derived by including the shear deflection component. Both vertical and horizontal deflections show good agreement with finite element analysis providing opportunities to optimize window setup, control, and housing design.

INTRODUCTION

Erzurum's Developments

In 1969, Erzurum developed a set of equations for mill housing deflections using the well-known Castigliano's Energy Method.¹ The equations determine the vertical and horizontal mill deflections given the mill housing geometry, the mill separation force, and the material properties. Erzurum's key contribution was to consider the deflection due to crossbeam bending. His equations were evaluated using two scaled down models of housings and strain gauges, however no results are published. Building on his work, similar mill deflection equations were developed with improvements and simplifications. Most importantly, crossbeam shear deflections were considered.

Frame Problems

This problem can be defined as a two-member frame problem.^{2,3} The indeterminate reaction can be resolved by matching slopes at the corner. Typical frame problems assume long, slender members, so only bending is considered. However, mill housings have short and thick members, making shear and extension deformation effects important.

Finite Element Analysis Verification

Finite element analysis (FEA) was used to validate the deflection equations. A variety of geometries and styles of housing were tested to validate assumptions and determine the range of validity of the equations.

COMPONENTS OF VERTICAL DEFLECTION

There are three basic components of vertical housing deflection to consider. These are post extension, crossbeam bending and crossbeam shear. Crossbeams refer to the horizontal members of the housing at the top and bottom. Posts refer to the vertical members of the housing on the left and right.