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# FE Model of Low Grade Rubber for Modeling Housing's Low-Cost Rubber Base Isolators

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**Abstract**

An accurate selection of strain energy function (SEF) plays a very important role for predicting the actual behavior of rubber material in the finite element analysis (FEA). The common method for selecting the SEF is by using the curve fitting procedure. However, the behavior of some typical rubbers, such as low grade rubbers (average hardness value of 47.2), cannot be predicted well by only using the curve fitting procedure. To accurately predict the actual behavior of such specifically nearly incompressible material, a series of FEA were carried out to simulate the actual behavior of four physical testing materials, namely the uniaxial, the planar shear, the equibiaxial, and the volumetric tests. This FEA is intended to examine the most suitable constitutive model in representing the rubber characteristics and behavior. From the comparisons, it can be concluded that the Ogden model provides a reasonably accurate prediction compared to the remaining investigated constitutive material models. Finally, the appropriate SEF, i.e. the Ogden model, was adopted for modeling a low-cost rubber base isolator (LCRBI) in the finite element analysis (FEA). The simple uniaxial compression test of the LCRBI is required for validating that the selected SEF works for predicting the actual behavior of LCRBI.

*Keywords:* Constitutive Model; Finite Element Analysis; Hyperelastic Material; Low Grade Rubber; Strain Energy Function; Curve Fitting.

## 1. Introduction

Hyperelastic material, such as rubber, has been applied in various kinds of industrial products such as seals, vehicles tires, hydraulic hoses, shock absorbers, vibration isolators or dampers, and others [1-10]. Generally, this material undergoes very large strain and performs highly nonlinear in stress-strain relationship. The characteristic of hyperelastic material has confirmed its unique behavior through a series experimental testing and describes its actual behavior through a proper selection of constitutive model [11-12]. The highly demand of rubber material in various applications, has required a good understanding for the engineers regarding the unique behavior of rubber material. Because of the complicated rubber characteristic, a critical issue in the nonlinear elastic theory is to apply the elastic law on the hyperelastic material, which is the primary goal in developing the powerful analysis tools [13].

Commonly, rubbers are considered as hyperelastic material that performs a highly-nonlinear large deformation. A number of constitutive models are available in many literatures to describe the actual rubber behavior by comparing one model to another. However, the critical issue in nonlinear hyperelastic material is how to determine the rubber parameters that govern the constitutive equations of hyperelastic material. Typically, three experimental tests must be conducted to define the rubber parameters for constitutive model. They involve the uniaxial tensile, planar shear, and

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