

# CHAPTER I

## INTRODUCTION

### 1.1. Research Background

Leaf spring is one of the classical components of suspension systems that still exist in present use, especially in heavy loaded vehicles such as trucks. In Thailand, the design process of leaf spring is not directly related to the consideration of ride comfort. Most manufacturers mass produced the product, by using detail drawings created by their customers. Nowadays, general light trucks available in commercial are used as multi-purposed transports as they are sometimes treated as normal passenger cars whose ride comfort of passengers are also concerned. In this research, the relation between ride comfort/discomfort level and some parameters of suspension parts; i.e., leaf spring is examined and investigated experimentally in order to propose methods or guidelines of leaf spring design for manufacturers related to ride comfort in light commercial vehicles.

General manufacturing of leaf spring, a conservative vehicle suspension part that has been used widely until present, usually begins with the design process which performed using specifications relating to their usage. Few main leaf spring parameters, using in design are mentioned in the "Spring Design Manual" the handbook that was published and approved by SAE International [1]. The manual provides useful background as well as design guidelines for designing leaf spring to meet the essential requirements. However, the conventional method usually employs some prototype testing which might takes time before the final design is satisfied. Nowadays, the modern computational methods are used widely and have been adapted as tools to facilitate the tasks. Due to the fact that leaf spring is a complicated-to-analyze element in a vehicle suspension as it combines some nonlinearities, arising from its mechanism and from other relevant components in the installation. It also has significant effect on vehicle performance and ride quality. For such the reasons, the very precise model is necessary to be carefully made as it can reflect very close-to-nature characteristic which

is meaningful in the analysis and interpretation when investigation is performed within the computational environment.

## **1.2. Research Objective**

The purpose of this research is to develop a method for ride comfort prediction of a light commercial vehicle, related to the design parameters of leaf spring. The experimental verified leaf spring model was used to investigate such a relationship so that the study can be developed and contributed to a new method of leaf spring design, in such a manner that the precise value of ride comfort level is evaluated by the leaf spring parameters in a predictive way. The main objectives can be stated clearly as follows,

1. To build a leaf spring model that includes hysteresis leaf spring parameters which can be used in the design process
2. To investigate and verify the leaf spring model by the leaf spring test rig
3. To investigate significance of nonlinear leaf spring model on ride comfort of a light truck

## **1.3. Scope of the Research**

1. In this study, all investigations were performed based on the assumptions or conditions applied to the light commercial vehicles (i.e., passenger cars and small pick-up trucks)
2. The suspension components, involving in this study are one semi-elliptic leaf spring, one damper, and one shackle.
3. Ride comfort evaluation is based on ISO 2631 standard

## **1.4. Obtained Results**

1. Relationship between ride characteristic of vehicle and design parameters of suspension system is achieved.

2. New verified criteria of automotive suspension components design, based on predicted value of ride comfort is proposed.

3. Approved simple method of automotive ride comfort investigation in the field experiment.

### 1.5. Research Operating Structure

The structure of research operation is divided into three phases as follows,

#### Phase 1

1. Study of past research and theory relating to ride comfort evaluation and applications

2. Revision of ride characteristic of vehicles and suspension systems

3. Study of data analysis and data processing for ride comfort investigation

#### Phase 2

1. Set up data collection system and related equipment i.e., accelerometers, data logger

2. Perform the preliminary testing

3. Practice Ride evaluation method with collected data, based on ISO Standard

#### Phase 3

1. Study of leaf spring characteristic.

2. Build up quarter car model and sub-system, representing suspension properties of leaf spring.

3. Investigate the effect of suspension parameters on ride comfort from simulating model.

### 1.6. Outline of the Thesis

This thesis contains seven chapters. Chapter 1 is a comprehensive introduction of the thesis. Chapter 2 focuses on literature review to describe past studies on related topics. In this chapter, the principal concepts such as ride comfort and fundamental theories are also introduced. Chapter 3 will summarize the methodology of the whole thesis including the research construction and relevant analyzing tools. Chapter 4

consists of the content of the preliminary study on field testing. Some results will also be presented in this chapter. Chapter 5 reviews the leaf spring modeling description and its verification process. Chapter 6 is a major part of the thesis. It provides details on parametric study of suspension model's parameter and the effects on ride comfort. Chapter 7 reviews the summary, final conclusion and further recommendation of this research.