State of the Art on Basic Methodologies for Crashworthy Design of Automotive Body Components Considering Axial Collapse Mode

Kiran Kumar Dama\textsuperscript{a}\ast, V Suresh Babu\textsuperscript{a}, R N Rao\textsuperscript{a}, Ismail Jani Shaik\textsuperscript{b}

\textsuperscript{a}Department of Mechanical Engineering, NIT, Warangal, Telangana State, INDIA
\textsuperscript{b}Sr. Design Engineer, Engineering Services, Ritza Technologies, INDIA

Abstract

The body structure of a passenger vehicle is one of the important functional groups of a vehicle. A crashworthy car body structure is so conceptualized as to absorb considerable amount of the impact energy by deforming in definite areas, and thereby reduce the deceleration experienced by its passengers to survivable levels. The non-deforming areas of the car body structure are designed as stiff survivable space for the passengers. Various criteria, such as deformation pattern, deceleration pulse of the vehicle, different bio-mechanical criteria defined for the passengers etc., can be used for assessing the crashworthiness of vehicles. Various methods have been developed and used over the years to analyze and optimize the crashworthiness of vehicles. This paper presents an overview of simplified design approaches for analyzing car body components for their behavior in crash events. This includes a brief summary of various collapse modes. Main characteristics of the axial collapse mode and simplified design approaches available for this mode, relevant for our research work, are also presented.

© 2017 Elsevier Ltd. All rights reserved.
Selection and Peer-review under responsibility of International Conference on Recent Trends in Engineering and Material Sciences (ICEMS-2016).

Keywords: Crashworthy Design Basic Methodologies; Vehicle Axial Collapse Mode; State of the art on Axial Collapse Mode;

1. Introduction

Crashworthiness of a vehicle can be defined as its ability to protect its passengers and other participants, like pedestrians and other vehicles, involved in an event of impact. The car body structure is one of the important vehicle

\ast Corresponding author. Tel.: +91-9160500411.
E-mail: kirandama@live.com

2214-7853 © 2017 Elsevier Ltd. All rights reserved.
Selection and Peer-review under responsibility of International Conference on Recent Trends in Engineering and Material Sciences (ICEMS-2016).
systems that helps in mitigating the impact loads. Therefore, appropriate design measures should be taken while designing the car body structure. A crashworthy car body structure is so conceptualised as to absorb considerable amount of the impact energy by deforming in definite areas, and thereby reduce the deceleration experienced by its passengers to survivable levels. The non-deforming areas of the car body structure are designed as stiff survivable space for the passengers. Various criteria, such as deformation pattern, deceleration pulse of the vehicle, different bio-mechanical criteria defined for the passengers etc., can be used for assessing the crashworthiness of vehicles.

2. Simplified Approaches for Crashworthy Design of Car Body Components

This section presents an overview of simplified design approaches for analysing car body components for their behaviour in crash events. These components are observed to deform in various collapse modes. Section 2.1 gives a brief summary of these collapse modes. Main characteristics of the axial collapse mode and simplified design approaches available for this mode, are presented in Sections 2.2.

2.1. Collapse Modes of Vehicle Body Components

The car body structure mainly consists of thin walled components, which act as energy absorbers as well as the structures maintaining integrity of the passenger compartment during an event of impact. Two basic collapse modes are mainly observed in these thin walled structures: axial and bending collapse, bending being the predominantly observed mode [10]. In their pure form, these modes are observed only in some specific structures, where the loading conditions are ideal for occurrence of the respective modes and due care is taken in designing these structures. All other structures are generally subjected to mixed collapse modes. Various analytical models have been developed for describing these basic collapse modes. Torsional mode of collapse is generally encountered in the thin walled structures of the passenger compartment. Due to the complexity involved in this mode, it is not yet clearly understood and therefore no specific analytical models exist for analysing this mode. However, in most cases, the effects of torsion are negligible, and can be considered only in the detailed design stage using FE method [10].

2.2. Axial Collapse

2.2.1. Main Features

The axial mode of collapse is the most effective collapse mode for absorbing impact energy. This collapse mode is generally observed in front and rear body structures when subjected to frontal and rear impacts. Depending on the following factors, different modes of axial collapse can be observed in the thin walled car body structures [2].

- Angle of impact
- End constraints
- Attachments to the structure
- Material of the structure
- Cross-sectional geometry of the structure

Figure 1 illustrates these modes, along with the corresponding force-deflection curves.

![Fig. 1. Modes of axial collapse](image)
دریافت فوری متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شب‌بام
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات