LITERATURE STUDY ON IMPACT ENERGY ABSORPTION (IEA) DEVICES

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I / we admit that have read this work and in my opinion / we this work was adequate from the aspect scope and quality to the meaning Bachelor of Mechanical Engineering (Structure and Material) Degree Program

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DECLARATION

"I declared that this thesis is result of my own research except as cited in the references"

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ABSTRACT

This report presents the literature study of Impact Energy Absorption (IEA) Devices. Since the society nowadays full with advance technologies especially in transportation vehicles, unexpected impact collisions may occur at any times and take over thousands of human life. A solution work out by the engineers and scientist was the used of impact energy absorber which were designed to minimize the impact force transfer to human body when unwanted collisions of vehicles occurs. This knowledge about (IEA) is now attracted greater concern and interest by the society. From the general review of the energy absorbers, IEA can be categorized into two categories concerned with structural and material. The IEA can be shaped into tubes, frusta, struts, honeycomb, and sandwich plates. In this report, it presents the analysis from the compression test of each shape above. The load versus displacement graph obtained to study the energy absorbed by the structure with different deformation modes which included inversion, splitting, axial crushing, lateral indentation and lateral flattening. The applications of the IEA device on the automobiles and road side barriers are included in this report. The details of the bumper test and crash test of the automobile are also included.

ABSTRAK

Laporan ini mengandungi pembacaan tentang 'Impact Energy Absorption (IEA) Devices'. Sejak pembangunan teknologi pada masa kini, terutamanya pada bahagian kenderaan, perlanggaran yang tidak diduga telah menambah dan merbahayakan kehidupan harmoni pada manusia. Cara penyelesaian telah dicadangkan oleh jurutera and ahli sains untuk mengecilkan tenaga yang pindah ke badan manusia semasa kecelakaan kenderaan berlaku. Ilmu ini dinamakan IEA. Alat penyerapan tenaga (energy absorber) telah makin diutamakan dalam masyarakat kini. Dalam penilaian terhadap alat penyerapan ini, difahamkan bahawa alat ini boleh wujud dalam pelbagai bentuk dan bentuk ini dianamakan tiub, 'struts','honeycomb','frusta',dan 'sandwich plate'. Bentuk-bentuk ini mengamalkan sifat penyerapan tenaga apabila tenaga kinetic dipindahkan ke bentuk-bentuk ini. Dalam banyak arah tenaga boleh dipindahkan ke bentuk-bentuk ini, contohnya arah 'axial','splitting','lateral indentation','lateral flattening',dan 'inversion'. Penilaian aplikasi bentuk-bentuk ini dalam kenderaan bermotor juga terkandung dalam laporan ini. 'Crash Test' oleh jenama kereta Porsche juga terkandung dalam laporan ini.

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P_{cr}	= Crushing Load, N
P_{mean}	= Mean Load occurs during the performance of Impact Energy Absorber, N
P_{max}	= Maximum Load, N
M	= Mass of the structure of vehicles, kg
KE	= Kinetic Energy, J
V	= Volume, m^3
P_{av}	= Mean Crushing Force, N
α	= Angle, Degree
F_{crush}	= Crushing Force, N
F	= Force, N
t	= Thickness, m
m	= Mass of the energy absorber, kg
P_d	= Designed energy absorber load, N

CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 Introduction in Impact Energy

As the results of advance of technologies, there is an increase of number in transporting vehicles which mainly made by metals. This has results the number of accident (unexpected collision) to be increase due to human error, vehicle error, road-surface error and also the weather changing. The collision may cause serious injury, fatality, properties lost, and etc. Due to these reasons, the society has now become more aware and concern about the safety aspects of the moving vehicles. These lead into the study and research on impact energy. Not only in transportation vehicles, but impact energy also occur in transportation (moving, carrying), lift system, oil and gas industries, impact of missile on target, and etc. These has results that impact energy studies become more and more popular among the others engineering fields.

Impact energy can be defined as the energy transferred from one object to another due to collisions. When a moving object crashed into another object, the kinetic energy from the moving object will transfer to the other object which collapse into each other. This is similar when the object fall down to the ground (or hit other objects on the ground), the energy will transfer from falling object to the ground. And yet, according

to Newton's 3rd law of motion, whenever a first body exerts a force F on a second body, the second body exerts a force –F on the first body, F and –F are equal in magnitude and opposite in direction. Hence, when there is a collision between each body, there will be a transfer of energy and reaction of force reacted to the bodies.

1.1.2 Impact Energy Absorption Devices (Impact Energy Absorbers)

Impact Energy Absorbers (IEA) is expendable mechanical structural elements which are brought into action in the event of an unwanted collision. They act as mechanical fuses to limit the loads that may act on the main structure immediately after a collision. They are also act as single shot devices and have to be replaced once they have damaged after serving their purpose. Some of the structural elements of the main structure may serve a secondary purpose as energy absorbers and be pressed into service in case the vehicle suffered more severe collisions. Similarly those elements whose principal purpose is energy absorption may serve as secondary purpose and as less important structural members.

1.1.3 Passive Safety and Active Safety

The terms "active" and "passive" are used in several seemingly-conflicting ways in the context of automobile safety. "Active safety" is often used to refer to crash avoidance and "passive safety" to crashworthiness. However, the terms may also be applied to the vehicle occupant's involvement in the function of the safety device or system. Under such nomenclature, active safety devices and systems are those which the vehicle occupant must act to make functional, as for example by fastening seat belt. Passive safety devices and systems are those such as air bags which operate without any input or action from the vehicle occupant. Terminological conflict can arise from the fact that passive safety devices and systems those requiring no input or action by the

vehicle occupant can themselves operate in an active manner. An example is active head restraints, which move to a position optimal for preventing neck injury when a collision is imminent. Vehicle safety professionals are generally careful in their syntax to avoid this sort of confusion. [1]

1.1.4 History of Impact Energy Absorption

Figure 1.1 shows the general timeline review on impact energy absorption

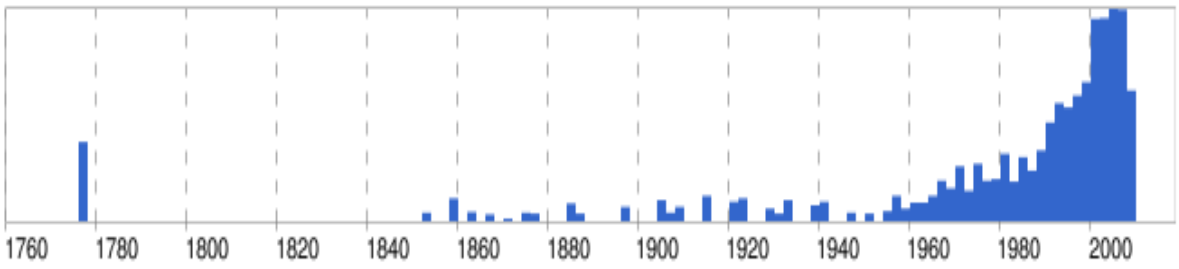

Figure 1.1: General Timeline review on impact energy absorption

Some of the comments/facts which show peoples care about impact energy absorption.

1970s - Ford Motor Co. has acquired a majority interest in a West Covina firm that has developed an energy absorbing system that could be used for more effective auto bumpers.

1980s - Extensible belts absorb energy during an initial part of the duration of an impact when the occupant is thrown forward.

1990s - A Bannon of Bloomfield Hills, Mich., has developed a vehicle impact absorption system.

- In the described configuration impact force is controlled by the overall thickness of the composite while energy absorption is mainly controlled by thickness of the Butyl rubber.

- Energy Absorption Systems Inc. in Chicago manufactures attenuators for the rear of trucks.

- Any damage that a helmet accumulates in a collision will reduce the energy absorption capability of the foam in subsequent collisions, thus making the helmet less functional and safe.

- Toyota passive safety structure sets new benchmark in passenger protection.

- People have absolutely no idea of the importance of these devices," says George Ebersole, president of Energy Absorption Systems Inc., a Chicago-based manufacturer of construction barriers and other traffic safety devices. "I find our industry now somewhat analogous to the people who were pioneers with seat belts and air bags."

2000s - The QuadGuard CEN crash cushion from Energy Absorption Systems, Inc. recently passed the three final tests required by EN1317-3, the European equivalent to NCHRP350, which qualifies the CEN as a re-directive, bi-directional family of crash cushions to 110 km/h, 100 km/h and 80 km/h.

- NASA Engineers Research Impact Dynamics.

- Germany, had developed an automobile impact energy absorption device.

- So if you want a bumper that can take a 6mph impact, then a 30 mph. impact will cause more injury to you because there is less energy absorption. by brianbwb-2009 August 6, 2009 7:36 PM EDT. [2]