RESPONSE OF HUMAN BONE SYNTHETIC UNDER IMPACT LOADING USING EXPERIMENTAL METHOD

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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LIST OF SYMBOLS

v_o	Initial velocity
σ_m	Maximum stress
T	Kinetic energy
U_m	Strain energy
m	Mass
v	Velocity

LIST OF ABBREVIATIONS

DOE	Design of experiment
RSM	Response surface methodology
M	Material
E	Pendulum energy
SS	Sum of square
p	p-value
F	F-distribution
L	Linear
Q	Quadratic

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Bone is specialized tissue which, although apparently immobilized in a petrified state, has fundamental physiological functions. First, together with the intestine and kidney, it contributes to regulation calcemia. The mineral substance of bone is a calcium phosphate hydroxyapetite [Gary E. Wnek and Gary L. Bowlin, 2008]. The mechanical properties of the bone-implant interfaces as natural or synthetic are as important as their morphological and structural aspects. Mechanical testing of bone will help to assess the properties of bone.

Impact analysis is one of the Mechanical testing. Impact analysis is a technique that helps researchers to think through the full impacts of a proposed change. As such, it is a necessary part of the evaluation process for major decisions. It is very reliable to predict the damages that could occur [L. Jacques, 1993].

Design of experiment (DOE) is one of the methods to minimize possible errors during the experiment. Examples of DOE are Factorial Design, Taguchi and Response Surface Methodology (RSM). This project used Factorial Design as the design for the experiment based on the fact that number of factors less than 5, the factorial design is appropriate design to run the experiment systematically and for adequate analysis.

The general procedure to run this project can be explained in the simple flowchart as in Figure 1.1.

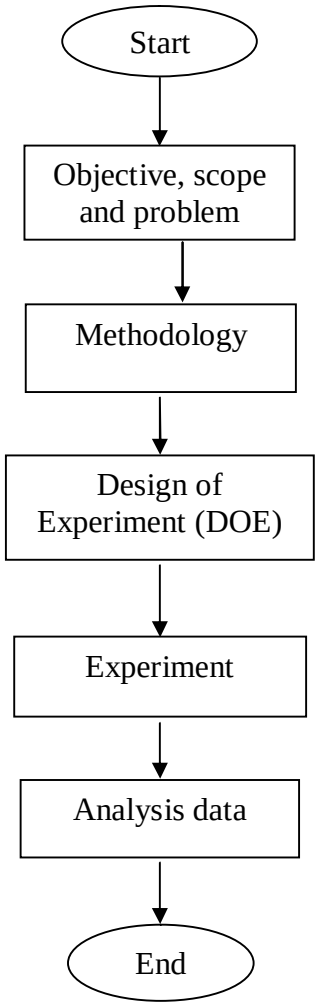

Figure 1.1: General flowchart

1.2 PROBLEM STATEMENT

Commercial bone synthetic has been extensively used in curing human bone defect and injuries. However, its real strength to external load, particularly sudden load is unknown. The knowledge of such strength is useful to find out the bone instability in case of unexpected load, even in micro domain especially during bone grafting period.

1.3 PROJECT OBJECTIVE

The project objectives are:

1.3.1 To investigate the response of bone synthetic under impact load.
1.3.2 To determine the factor that influent response of the bone synthetic.
1.3.3 To derive a mathematical formula that explains response of bone synthetic subjected to impact load.

1.4 PROJECT SCOPE

The scopes of this project are:

1.4.1 Special fixture for bone synthetic specimen will be designed in Solidwork and fabricated using the laser machine.
1.4.2 Response of bone synthetic will be compared with that of plastic and metal
1.4.3 Experimental plan will be designed in Statistica
1.4.4 Impact experiment will be carried out on the Zwick Roell equipment according to Statistica design
1.4.5 Deformed specimens will be investigated with optical microscope.
1.4.6 Response curve will be developed based on a mathematical model

1.5 ORGANIZATION OF THESIS

This thesis consists of five chapters. Chapter 1 is the introduction of the project. Chapter 2 presents some related literature. Chapter 3 is the methodology of the project. Chapter 4 presents the result and discussion of the project. Chapter 5 is the conclusion and recommendation of the project.

ABSTRACT

In this report, a method of identifying the absorb energy of bone synthetic is introduced. The method that has been used is impact loading testing. This method provides the properties of bone synthetic in term of the energy that can be slimed in it when subjected to dynamic load. The objective of this project is to investigate the response of bone synthetic under impact load. Experimental design technique was applied in performing the test. 3^k full factorial design was used for DOE and DOE table was generated in STATISTICA. The Izod impact load was used to apply load on the specimens and the load range considered were 1 J, 2.75 J and 10.8 J. The additive materials, plastic and metal were included in DOE to identify the material effect on the impact response, so-called absorb energy. Experimental data were analyzed in STATISTICA to develop mathematical model. Deformed specimens were investigated under optical microscope. Statistical analysis shows that the non-linear model is more accurate to predict impact response of bone synthetic. Micrograph indicates that failure pattern of bone synthetic is clear to that of plastic.

ABSTRAK

Di dalam laporan ini, kaedah untuk mencari tenaga yang di serap oleh tulang tiruan telah di perkenalkan. Kaedah yang di gunakan ialah eksperimen bandul. Kaedah ini akan memberikan ciri-ciri tulang tiruan dalam bentuk tenaga yang di pindahkan ke bahan tersebut dalam beban yang bergerak. Objektif utama projek ini adalah untuk mengkaji ciri-ciri tulang tiruan menggunakan beban yang bergerak. Eksperimen ini di jalankan dengan menggunakan teknik reka eksperimen. 3^k reka eksperimen telah digunakan untuk mereka eksperimen dan daftar fakta telah di olah dalam STATISTICA perisian. Jenis eksperimen Izod telah digunakan sebagai tenaga yang di beri kepada bahan dan beban yang dipertimbangkan adalah 1 J, 2.75 J dan 10.8 J. Bahan-bahan tambahan seperti plastic dan besi telah di masukkan ke dalam daftar fakta reka eksperimen untuk mengenalpasti kesan bahan terhadap reaksi hentakan yang di panggil tenaga yang di serap. Data yang diperoleh dari eksperimen akan di analisis dalam STATISTICA perisian untuk membentuk formula. Bentuk bahan akan di kaji menggunakan optikal mikroskop. Statistik analisis menunjukkan bahawa model tidak datar lebih tepat untuk menjangkakan tindakbalas hentakan tulang tiruan. Graf mikro menunjukkan bahawa bentuk rekahan tulang tiruan sama dengan bentuk rekahan plastic

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