REPORT OF FINAL PROJECT

BACHELOR OF MECHANICAL ENGINEERING (HONS.)

FACULTY OF MECHANICAL ENGINEERING

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TRUSS OPTIMIZATION

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PREFACE

The ever-increasing demand on engineers to lower production costs to withstand competition has prompted engineers to look for rigorous methods of decision making, such as optimization methods, to design and produce products both economically and efficiently. Optimization techniques, having reached a degree of maturity over the past several years, are being used in a wide spectrum of industries, including aerospace, automotive, chemical, electrical, and manufacturing industries. With the advent of computer technology and CAD, optimization method are being used to enhance the creative process of conceptual and detailed design of engineering systems.

This thesis presents the optimization techniques and applications where emphasize is given to the analysis of truss structures. Although there are many other methods and techniques of engineering optimization, this thesis only uses the techniques of Sequential Unconstrained Optimization, Unconstrained Optimization, and One Dimensional Optimization. These techniques are incorporated in a computer program, which uses the Fortran Compiler. In addition, the Finite Element Method is used to calculate structural analysis. Finally, several case studies mainly in two and three-dimensional truss are conducted to enhance the presentation of the material.

CHAPTER 1

INTRODUCTION TO OPTIMIZATION

Optimization is the act of obtaining the best result under given circumstances. Furthermore, the motivation of optimization is to exploit the available limited resources in a manner that maximizes utility. In design, construction, and maintenance of any engineering system, engineers have to take many technological and managerial decisions at several stages. The ultimate goal of all such decisions is either to minimize the effort required or to maximize the desired benefit. A growing realization of scarcity of the raw materials resulted in a demand for lightweight and low cost structures. This demand emphasizes the need for weight and cost optimization of structures. Therefore, optimization can be defined as the process of finding the conditions that give the maximum or minimum value of a function. The conditions have to fulfill certain design constraints for safety purposes.

There are broad applications of optimization in solving any engineering problem. Few examples are:

1. Design of aircraft and aerospace structures for minimum weight.
2. Design of civil engineering structures such as frames, foundations, bridges, towers, chimneys, and dams for minimum cost.
3. Optimum design of linkages, cams, gears, machine tools, and other mechanical components.
4. Design of pumps, turbines, and heat transfer equipment for maximum efficiency.
5. Optimum design of control systems.