Chapter One

Introduction

A bridge is a structure connecting two sections of land so that people and vehicles can cross from one side to the other over an obstacle (a river, roads, a valley, or a stream) and to shift the load from the upper deck to the foundation at ground level through bearings. Currently many bridges are made of reinforced concrete, prestressed concrete, timber, steel etc, and these are built with different technique according to the modern technology.

Types of concrete and composite bridges that have been built are:-

1- Arch bridges,
2- Reinforced slab bridges,
3- Girder and slab bridges,
4- Box girder bridges,
5- Integral bridges,
6- Cable stayed bridges, and
7- Suspension bridges.

Bridge is more economical and time efficient compare to a ferry or a longer road route. Even to build a bridge requires a lot of cost of material, labor, machinery, engineering, insurance; maintenance, renovation and replacement of a damage component, but the efficiency of a bridge dominate its time life cost.

❖ Bridge component

A bridge structure is divided into an upper part (the superstructure), which consists of the slab, the floor system, and the main truss or girders, and a lower part (the substructure), which are columns, piers, towers, footings, piles, and abutments. The

superstructure provides horizontal spans such as deck and girders and carries traffic loads directly. The substructure supports the horizontal spans, elevating above the ground surface.

1.1 Problem statement

Since decades, we have seen that many bridges being built to avoid a traffic jam or to cross over river, stream or sea. Bridges are commonly constructed using concrete or steel, while bridge deck and column or pier is constructed using concrete. By the moment designation of bridge by an engineer are influenced by a factor of increasing in load , because of the increasing in daily traffic , usage of bridge standard to comply of abridge safety and effect due to earthquake and erosion from the environment.

In recent years, many bridges around the world are not performing are they should. In some cases, bridges are carrying significantly more traffic loads than originally intended. How ever in many others, the problem is because of durability. The new awareness of the need to design durable bridges has led to remarkable changes of attitude towards bridge design.

It is important for every bridge engineer to analyze and design bridges that will provide safety, durability and serviceability for public.

Accomplishing this task will require a very good understanding of behavior and a good knowledge of parameters that affecting a bridge deck due to loads. The most important one is that the bridge deck is analyzed to assure it meet the design standard , design of bridge deck is required to meet an acceptable deflection and cracking to insure that the bridge deck is secure to use .

Analysis using software or computer application is most suitable because the result is more effective. By the powerful computer software technology, structures can be analyzed and tested on a computer before the prototype is built. Currently models that

can be used to analyze the bridge deck are grillage analysis, orthotropic plate analysis, beam - shell and 3D finite element models.

All models used can be analyzed using finite element software. It is very useful to apply the methods to the complex structures accurately. There are a lot of models to analyze bridge and it is the aim of the project to determine the most suitable model to analyze bridge deck.

1.2 Objective of the study

The objective of this study is to conduct a finite element analysis of bridge decks to compare between (beam - shell) with (3D solid) finite element models. Both models will be analyzed to determine the value of:

1- Maximum bending moment,
2- Maximum twisting moment or(torsional moment),
3- Maximum shear force, and
4- Maximum support reaction.

1.3 Scope of the study:

The scopes of the study are:

1. Analysis of beam and slab bridge deck made of concrete,
2. Analysis of bridge deck using SAFE finite element software, and
3. Only two modeling methods bare studied :
   - 3.1 3D solid model, and
   - 3.2 Beam and shell model.

1.4 Research Methodology

The study of bridge deck analysis undergoes 5 main phases .Phases involves were very important to insure that the study meet the objective of the research. The phases are as stated in Fig (1.1):

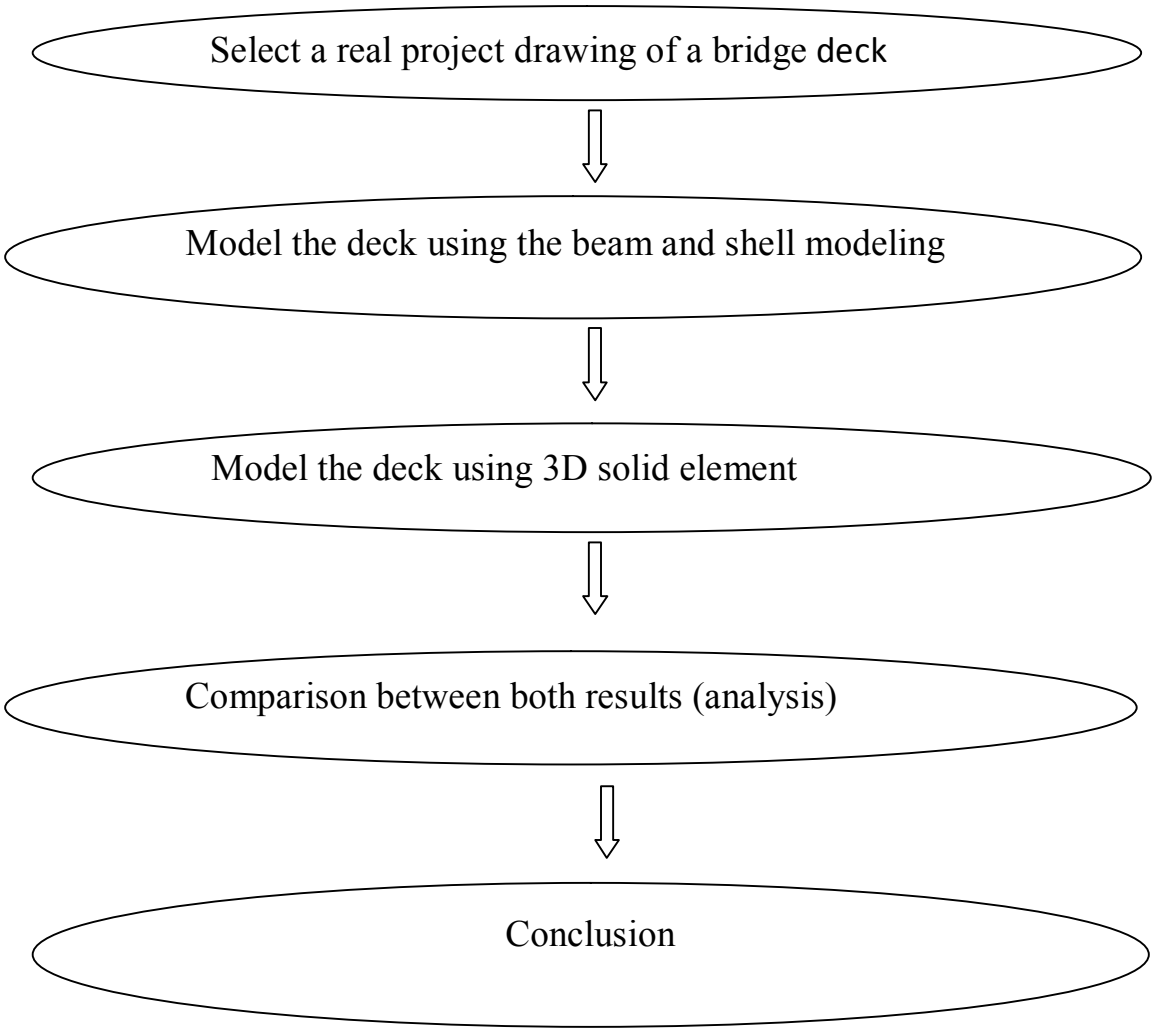

Fig. (1.1)*: Flowchart of research design*

1.5 Thesis organization:

This thesis is composed of the following chapters;

Chapter One:

Includes general introduction and bridge definitions. Also shows the objective of this research and gives overview of chapters' organization.

Chapter Two:

Includes literature review which provides general overview for the different types of bridge deck, and previous studies.

Chapter Three:

Includes different methods and techniques of analysis of bridges, and the type of loads applied to super –structures of bridge and application of HA and HB loads.

Chapter Four:

Reviews the modeling and analysis of case studied, design consideration, and load cases.

Chapter Five:

Reviews the analysis and discussion of results.

Chapter Sex:

This chapter contains the conclusions and recommendations.

Appendices:

Appendix (A); Save Program output data.