Modeling & Analysis of Deck Bridge with Pre-stress Deck Bridge Under IRC Loading Conditions

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Abstract - Bridge is a structure which is used to connect physical obstacles without closing the way underneath such as a body of water, valley, or road, for the purpose of providing passage over the obstacle. In this research work, we have used STAAD PRO & SAP 2000 software which is based on the application of Finite Element Method. In this study, a comparative study based on different types of bridges that is simple girder deck with various configurations like with & without prestress. All over 4 models have been prepared for the consideration of the study. Analysis results indicate the effect of girder deck Bridge on performance of structure. In this comparative analysis it is clearly stated that Pre-stressed bridge is more stable in resisting load.

I. INTRODUCTION

A bridge deck is the portion of a bridge that acts as the roadway in the support of vehicular or pedestrian traffic. While deck parts like trusses, girders, rails, arches, posts and cantilevers assume a number of forms and types, there are relatively few bridge deck types given the utilitarian nature of the component. Deck types are defined by the materials from which they are made and the manner in which those materials are fit together.

The Finite Element Method involves subdividing the actual structure into a suitable number of sub-regions that are called finite elements. The intersection between the elements is called nodal. This has been considered to analyze the bridge having same IRC loading and Span 30 m for critical load. After analyzing these critical loads, the results will be compared in terms of forces, deflection, weight and most importantly cost of each type to determine the most stable and economical section.

II. LITERATURE SURVEY

General

Mosheb Kaloop. al. (2019) This paper aims to evaluate the behavior of Dorim-Goh bridge in Seoul, Korea, under static and dynamic loads effects by ambient trucks. The prestressed concrete (PSC) girders and reinforcement concrete (RC) slab of the bridge are evaluated and assessed. A short period monitoring system is designed which comprises displacement, strain and accelerometer sensors to measure the bridge performance under static and dynamic trucks loads. The statistical analysis is used to assess the static behavior of the bridge and the wavelet analysis and probabilistic using Weibull distribution are used to evaluate the frequency and reliability of the dynamic behavior of the bridge. The results show that the bridge is safe under static and dynamic loading cases. In the static evaluation, the measured neutral axis position of the girders is deviated within 5% from its theoretical position. The dynamic amplification factor of the bridge girder and slab are lower than the design value of that factor. The Weibull shape parameters are decreased, it which means that the bridge performance decreases under dynamic loads effect. The bridge girder and slab's frequencies are higher than the design values and constant under different truck speeds.

Phamvan Hung. al. (2019) this paper presents the design proposal of the prestressed concrete slab (PSCS) track used for highway-railroad grade crossings in Vietnam. A new type of highway-railroad grade crossings is being proposed to replace the traditional panel crossings made by reinforced concrete, asphalt concrete and rubber. Numerical simulation was carried out to analyze the structural behavior of the PSCS. The results show that the structural proposal of the PSCS meets the requirements of stability and strength under the standard loads of truck and train engines recommended in Vietnamese specifications.

David Hester al. (2019) This article proposes a bridge damage detection method using direct rotation measurements. Initially, numerical analyses are carried out on a one-dimensional (1D) simply supported beam model loaded with a single moving point load to investigate the sensitivity of rotation as a main parameter for damage identification. As a result of this study, the difference in rotation measurements due to a single moving point load obtained for healthy and damaged states is proposed as a damage indicator. A relatively simple laboratory experiment is conducted on a 3-m long simply supported beam structure to validate the results obtained from the numerical analysis. The case of multi-axle vehicles is investigated through numerical analyses of a 1D bridge model and a theoretical basis for damage detection is presented. Finally, a sophisticated 3D dynamic finite element model of a 20-m long simply supported bridge structure is developed by an independent team of researchers and used to test the robustness of the proposed damage detection methodology in a series of blind tests. Rotations from an extensive range of damage scenarios were provided to the main team who applied their methods without prior knowledge of the extent or location of the damage. Results from the blind test simulations demonstrate that the proposed methodology provides a reasonable indication of the bridge condition for all test scenarios.

Sunil Yadav al. 2019 Concrete slab is an important two dimensional or planar element, used in all types of structures such as floors and roof covering. Bubble Deck slab is a futuristic method which can effectively eliminate all the concrete from middle of slab by replacing it with High Density Polyethylene Balls (HDPE) and provides thermal insulation. In this technique, the reinforcement mesh acquires, allocates and attached the balls at exact position and also stabilizes the lattice. By this technique structural weight can be reduced from 25% to 50.The main aim of this study to comparatively study of Bubble Deck slab and conventional slab under cost analysis, load bearing capacity .i.e. strength and efficiency too and also families and create awareness to all. The advantages of this technique are less energy consumption - both in production, transport and carrying out, less emission - exhaust gases from production and transport, especially CO2.

III. OBJECTIVES

The objectives of the research are outlined below:

To analysis model of the girder deck Bridge in STAAD-Pro & SAP 2000.

4.2 METHODOLOGY

Following steps are required in a sequence for proper completion:

Preparation of geometry of Bridge in STAAD PRO & SAP 2000

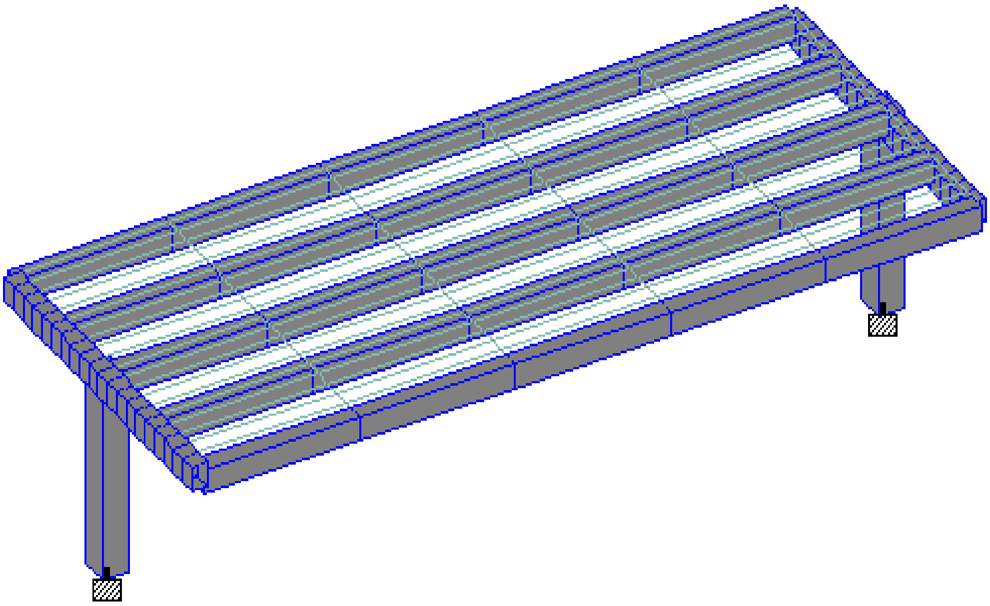

Figure 4.1 Ordinary Beam Bridge Using Staad Pro

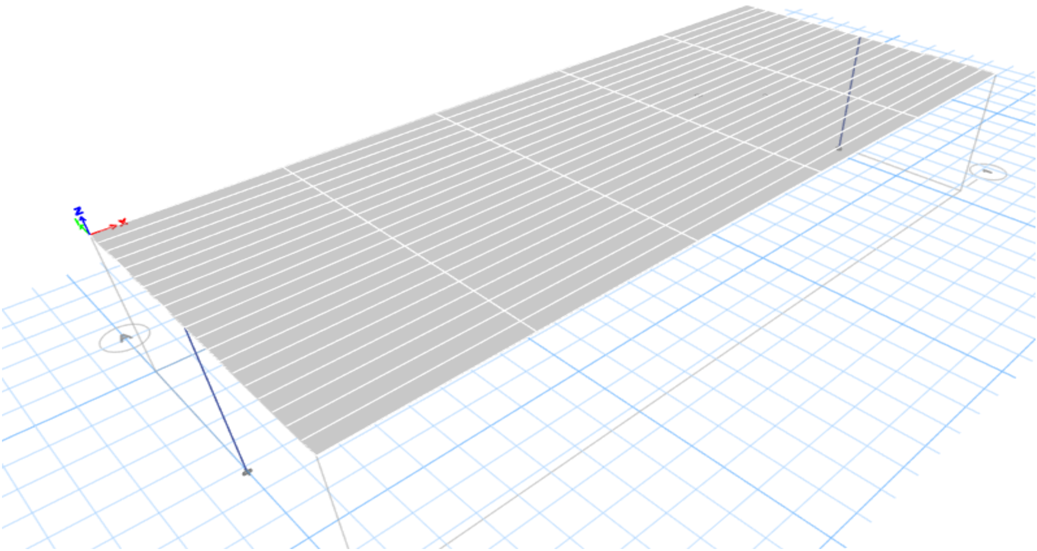

Figure 4.2 Ordinary Beam Bridge Using SAP 2000

IV. RESULTS

5.2.1 Maximum Displacement Comparison Graph Ordinary Beam Using Staad Pro & SAP 2000

Table 5.9 Maximum Displacement Summary

	Ordinary Deck using Staad pro	Ordinary Deck Prestress using Staad pro	Ordinary Deck using SAP	Deck Foam Concrete Prestress SAP
	X mm	X mm	X mm	X mm
Max X	7.116	7.215	7.114	7.214
	Ordinary Deck using Staad pro	Ordinary Deck Prestress using Staad pro	Ordinary Deck using SAP	Deck Foam Concrete Prestress SAP
	Y mm	Y mm	Y mm	Y mm
Max Y	38.742	38.742	38.743	38.743
	Ordinary Deck using Staad pro	Ordinary Deck Prestress using Staad pro	Ordinary Deck using SAP	Deck Foam Concrete Prestress SAP
	Z mm	Z mm	Z mm	Z mm
Max Z	29.672	29.69	29.673	29.68

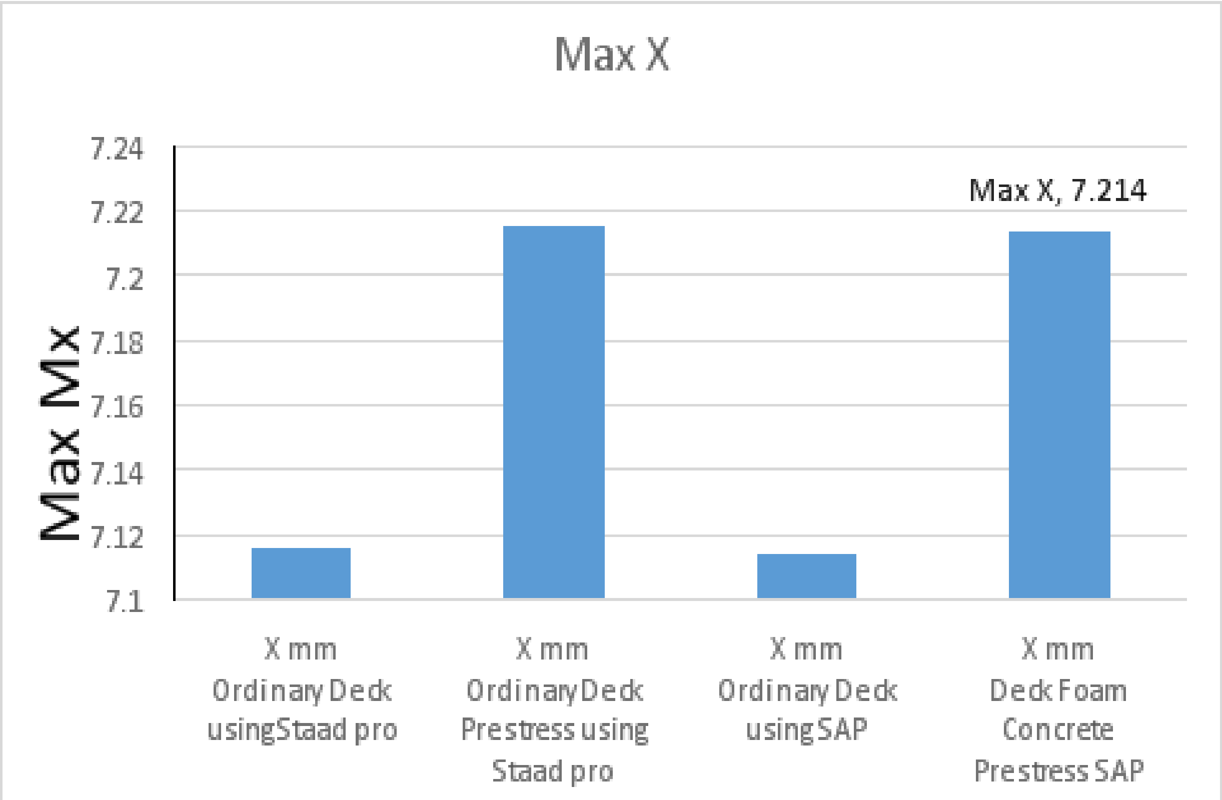

Figure 5.10 Maximum Displacement Comparison X Direction

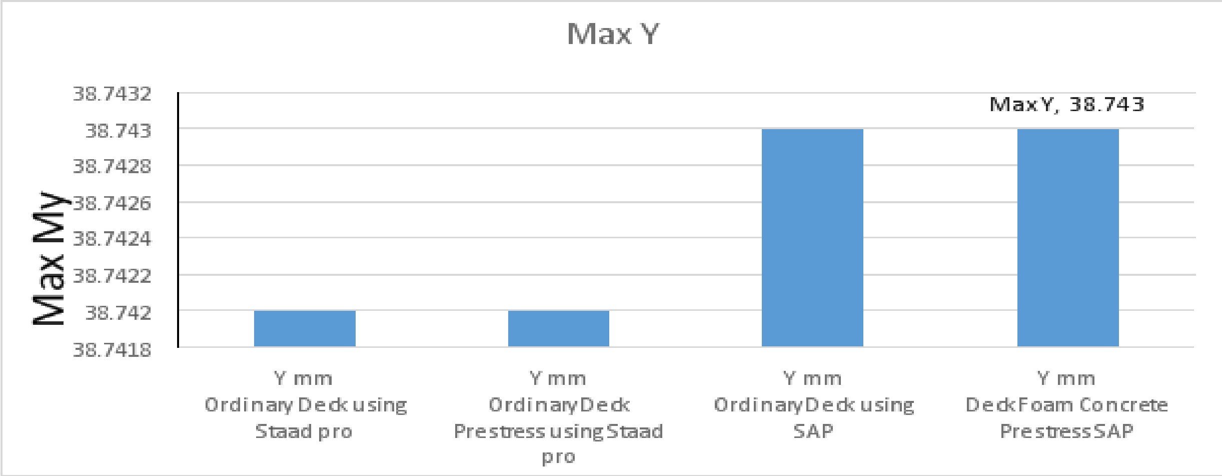

Figure 5.11 Maximum Displacement Comparison Y Direction

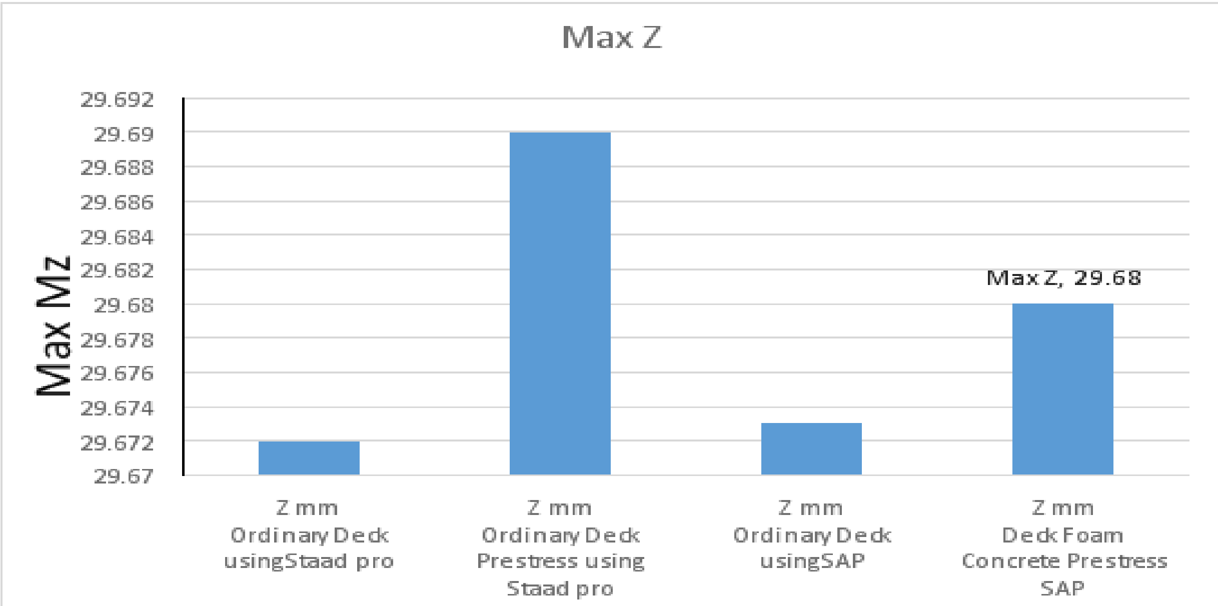

Figure 5.12 Maximum Displacement Comparison Z Direction

5.2.2 Forces& Bending Moment Comparison Graph Ordinary Beam Using Staad Pro & SAP 2000

Table 5.10 Maximum Forces& Bending Moment Comparison Summary

	Ordinary Deck using Staad pro	Ordinary Deck Prestress using Staad pro	Ordinary Deck using SAP	Deck Foam Concrete Prestress SAP
	Fx kN	Fx kN	Fx kN	Fx kN
Max Fx	8447.702	8442.541	8447.701	8442.542
	Fy kN	Fy kN	Fy kN	Fy kN
Max Fy	3298.134	3288.322	3298.135	3288.323
	Fz kN	Fz kN	Fz kN	Fz kN
Max Fz	2491.052	2497.729	2491.054	2497.727
	Mx kNm	Mx kNm	Mx kNm	Mx kNm
Max Mx	1207.316	1204.502	1207.314	1204.502
	My kNm	My kNm	My kNm	My kNm
Max My	4202.252	4202.252	4202.252	4202.254
	Mz kNm	Mz kNm	Mz kNm	Mz kNm
Max Mz	14848.575	14813.312	14848.573	14813.302

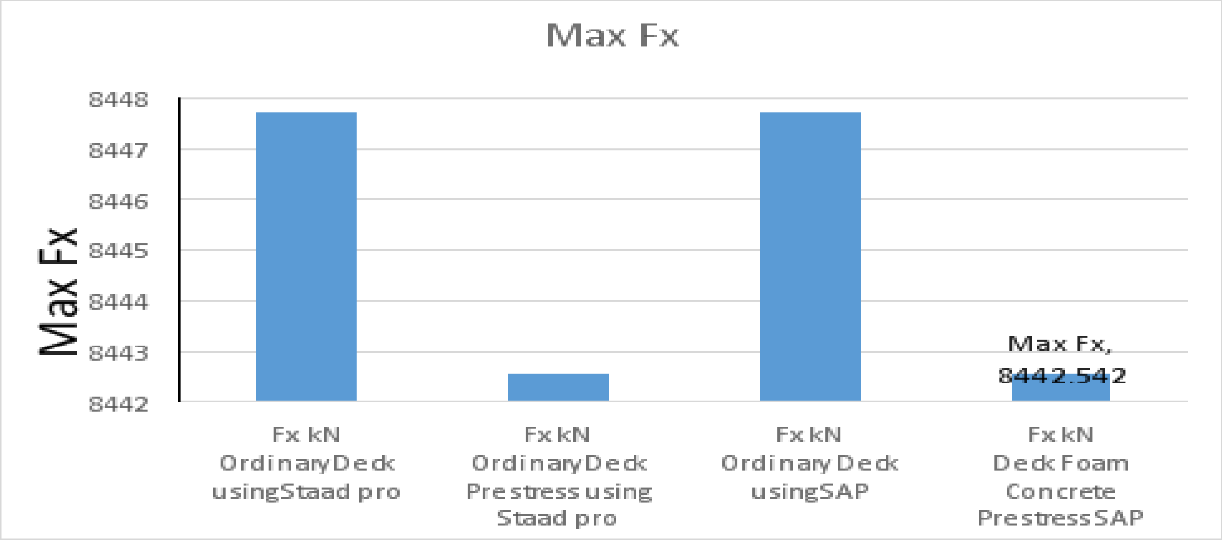

Figure 5.13 Maximum Force Comparison X Direction

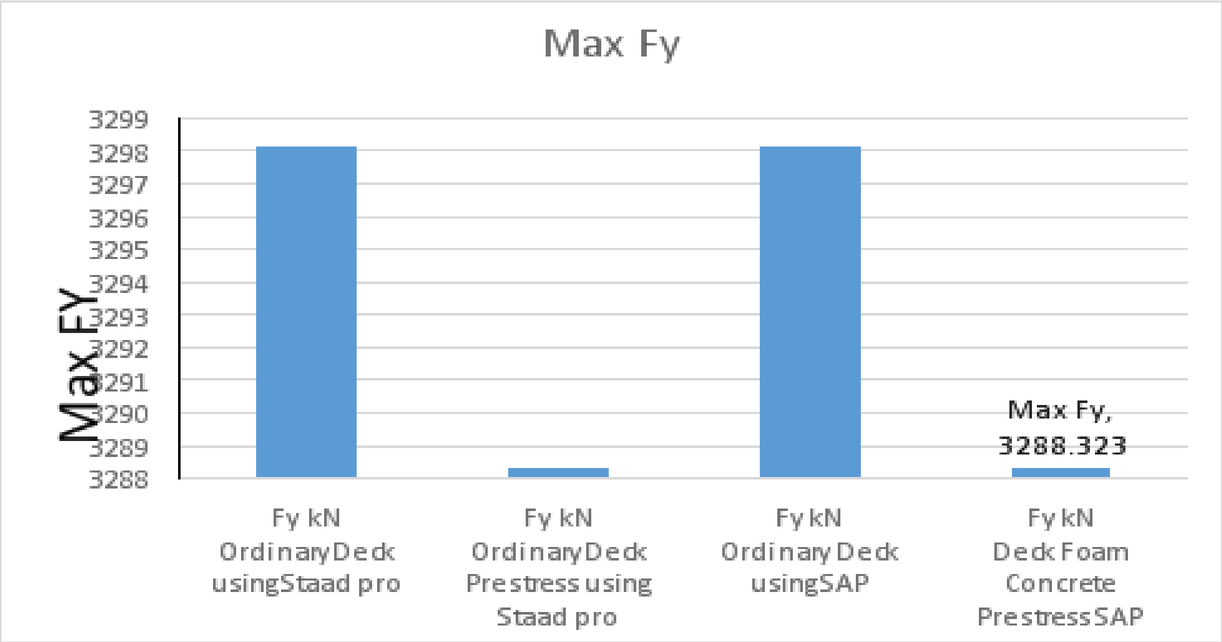

Figure 5.14 Maximum Force Comparison for Y Direction

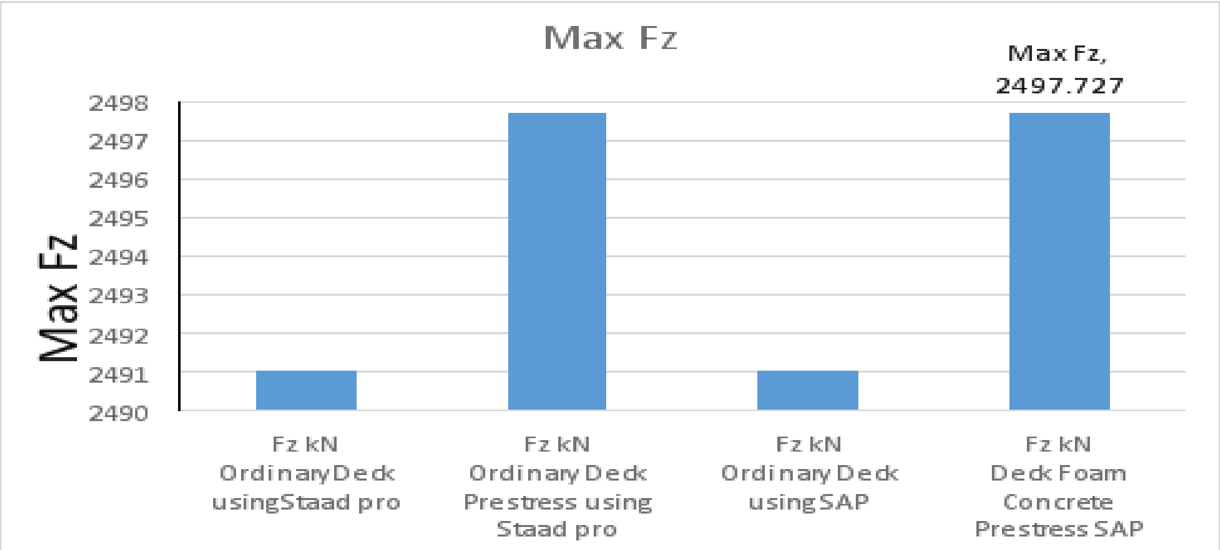

Figure 5.15 Maximum Force Comparison for Z Direction

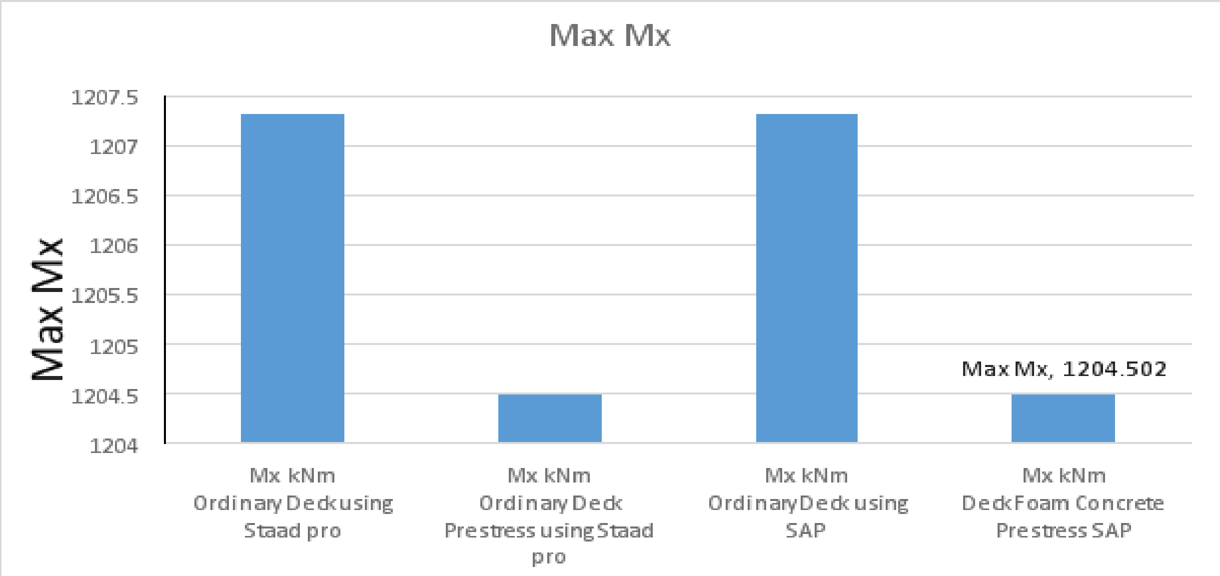

Figure 5.16 Maximum Bending Moment Comparison for X Direction

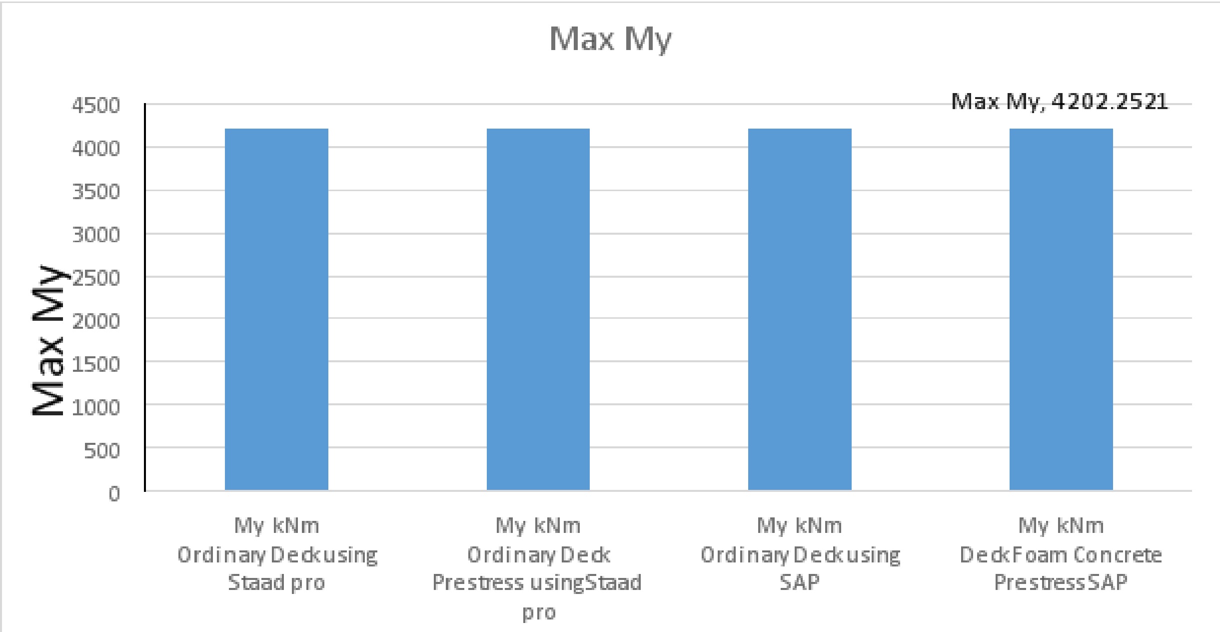

Figure 5.17 Maximum Bending Moment Comparison for Y Direction

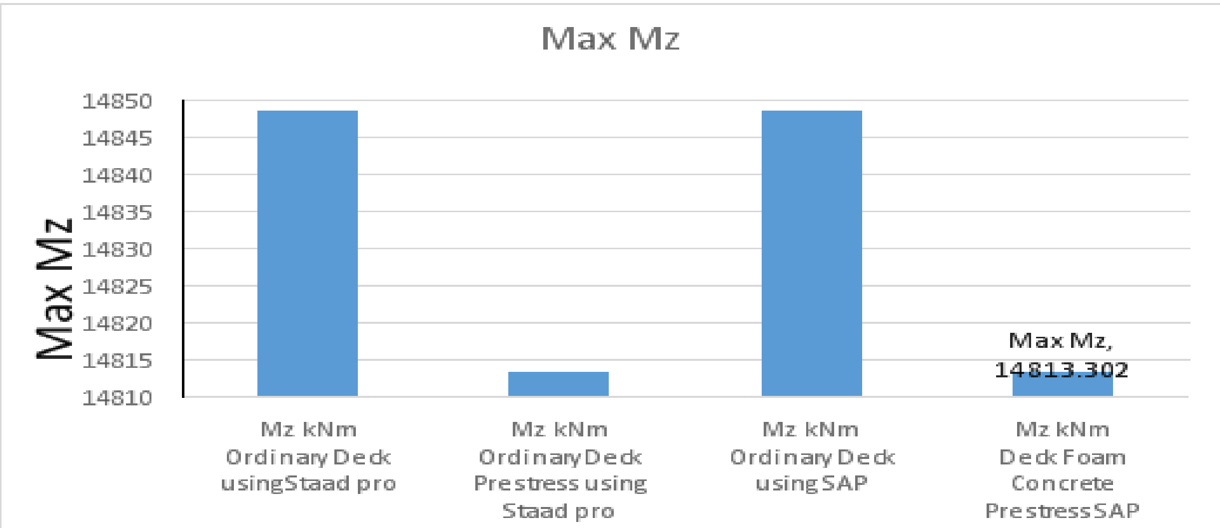

Figure 5.18 Maximum Bending Moment Comparison for Z Direction

V. CONCLUSIONS

Findings of the project can be concluded as below:

1. Deck Slab has larger variations in terms of forces, moments & displacements in comparison with ordinary deck.
2. Deck Slab with prestressed concrete decks lower variationsin terms of forces, moments & displacements, in comparison with plain beam deck.
3. In both the software i.e .STAAD and SAP 2000 the results are similary only minitude diffrenceses in the value of forces, moments & displacements in comparison with ordinary deck Slab with Deck Slab with Presstress Concrete.

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