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Design of Various Concepts of Structure of Platform for Multi-purpose Industrial Application

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ABSTRACT

Various industrial heavy equipment, which are assembled and manufactured at one place, are needed to be transported and kept in super-structure buildings. This paper deals with designing a conceptual design of a moving platform which is used for assisting lifting such engine equipment where the platform will be powered by combination of motors and electro-hydraulic power units as being heavy loads. The entire platform assembly is divided into three sub-assemblies; one platform is having a long travel of 18 m, and above that platform will be a platform which will be lifted to a height of 6 m with the help of a set of telescopic cylinder if equipment have to be kept at certain height and can travel in cross direction with the help of guided wheels. While the top platform, which is the final sub-assembly, will rotate in a particular angle with the help of manual mechanism with certain maximum rpm provided so that an assistant can rotate and direct the equipment when it is needed to be placed at a certain height. The main aim of the paper is to design the structural components of the platform like frames and their structure selection for high stiffness.

Keywords: *base platform, heavy equipment, moving platform, structural design*

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INTRODUCTION

Technological improvement in industrial engineering is being carried out on a large-scale basis as the demand for machinery is increasing day by day so as to preserve their inventory. Very large super-structure buildings made of crossed structures of I-frames and C-frames have to be done. These machineries have to be kept in different areas at different heights of super structures [1]. These equipment have to be kept with great precision and have to be taken up at certain height with minimal speed and with no jerk being applied. Based on the design requirements, we will consider a super-structure building of 25 m length, 6 m height and 8 m width, respectively. The configuration of design of moving platform to be studied will be followed.

i. Main platform which is mounted above the base platform to travel in vertical direction up to 6 m of height with the help of electro-hydraulic mechanism.
ii. Top platform is mounted above the main.
iii. So, the basic structural as well as supporting members of the platform are frames of each platform, hydraulic jack probably telescopic for such a high-lifting purpose, and bevel gears for revolving the mechanism in a proper angle.

For designing the frame of the revolving platform, the spider web system is adopted rather to have a high stiffness rather than conventional rob slabs, because the author here deals with the comparison of two-way reinforcement with normal slab, which is more effective and resistant to vibration. For this, the author discusses about different structural iterations carried out to get the best possible iterations and corresponding high stiffness. The author actually deals with selecting and optimizing topology of a 3-D printed product, which, in this project, has been used to develop high stiffness and low-weight product [2]. For designing hydraulic jack, the concern telescopic jack is used in industries for heavy lifting of loads. The telescopic cylinders are nothing, but the concentric arrangement of the cylindrical tubes with decreasing diameter at one of the ends is ultimately used for lifting the heavy loads. Adjustable oil-driven jack is an extraordinary structure of jack, which gives an uncommonly long-yield travel from an exceptionally reduced withdrew length. Static examination of the adjustable hydraulic-powered jack segments, for the diverse stacking conditions, can be performed by utilizing the business-limited component bundles if the heaps on the structure are legitimately characterized [3]. The strategies utilized for this structure work could give huge information and expertise to youthful plan designers, and this chamber item might be promptly accessible to industrialist for fabrication [4]. The guidelines are used for designing and analysing the rails on which the multi-directional and multi-degree of freedom vehicles describe the weight and section selection of the rail depending on the load acting. Different properties such as weight (kg/m), mass moment of inertia and different structural properties are studied [5].

METHODOLOGY

Based on the above literature, the proposed design requirement for the three platforms mounted over each other is as follows (Table 1):

Table 1. *Proposed requirement for moving platform and its sub-platforms.*

Duty	To facilitate handling of engine and assists working personnel involved in test activities.
Location	Outdoor. Supported on cross beams provided in loading frame columns.
Motion	Rotational movements shall be manual (gear train). Long travel and cross-travel movements shall be motorized. Lift shall be electro-hydraulic.
Speed	Long travel – Macro: 3 m/min and Micro: 60 mm/min. Cross travel – Macro: 3 m/min and Micro: 60 mm/min. Lift – Macro: 1 m/min and Micro: 60 mm/min
Hand rails	Hand rails and toe guards shall be provided around the outer edges of main and low bed platform. Removable-type hand rail shall be provided.
Noise level	Less than 85 dB

a) The circular rotary platform of diameter 3 m at the top capable of rotating 30° in clockwise and anticlockwise directions with 40 kN load on it and a live load of 5 kN/m^2 is acting on it.
b) The circular rotary platform shall be attached to a main platform of size 5 m × 5 m. The main platform shall have arrangement to lift for a height of 6 m and cross travel for a distance of 1.5 m on both directions.
c) The main platform shall be attached to a low-level platform of size 8.0 m × 17.0 m. It shall have arrangement to long travel for a distance of 18 m to clear the deflector pit during the testing.

Concept 1

Figure 1 shows the CAD model of one of the concepts modelled in Autodesk inventor.

The platform is divided in sub-platforms as follows:

Base platform: The base platform is sized 8 m × 17 m in area, with 12 wheels and fixed swing bracket being arranged to travel 18 m of distance in to-and-fro directions, respectively. The detailed CAD model is shown in Figure 2.

In the above CAD, the skeletal frames of the base platforms are assembled by welding two units of **ISMC 250** standards frames, respectively, instead of using box rectangular frames. The advantage of this type of the frame assembly is that it gives good positioning of neutral axis to bear high loads and less stress concentration at the corners, as shown in Figure 3. The weight of the structure along with the wheels assumes the material used is mild steel with 7850 kg/m^3.

Concept 2

In the proposed design of the assembly, we have mounting wheels that will support the hydraulic jacks at the bottom of the base platform. In the upcoming concept, we removed the base part of the main platform sub-assembly and we just shifted the entire assembly of the main platform at the top of the main frame directly as shown in Figure 4. By doing so, we will be placing one more telescopic cylinder at the base, which were trio in the earlier conceptual design that is actually arranged in an equilateral triangle. Additionally, we will be adding a bent-chequered plate. Following is the relevant CAD model preparation as shown in Figures 4–6.

Concept 3

In the upcoming concept, we will be completely changing the rotating platform arrangement assembly in which we will bevel using a slotted roller assembly to revolve the platform in purely and accurately 60° rotation assemblies. The main advantage of this assembly is that the structure weight of the assembly is decreased accordingly and the height in expandable, on the other hand, will be a disadvantage to the assembly because the height of the platform has decreased, respectively, and due to which can bring certain restriction in engine mounting, while the rest of the assembly remains the same as Concept 1. Following is the assembly as shown in Figures 7–9.

Components of Revolving Platform

The efforts for revolving the gear are reduced by using deep groove ball bearing (SKF 6215). In this mechanism, the rotary motion of the bevel is transferred to the adjacent bevel gears (Figures 10–12).

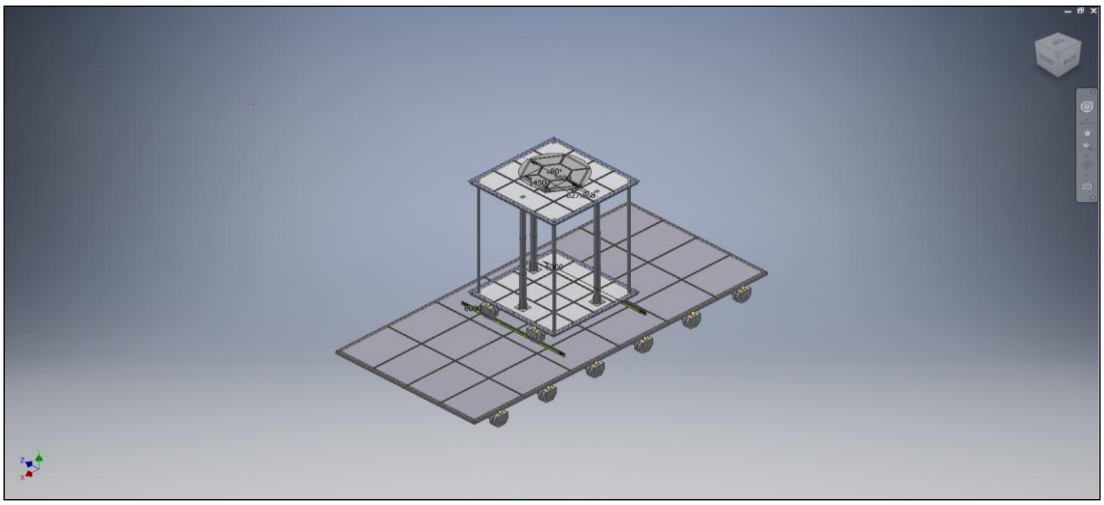

Fig.1. *Layout of assembly of wheel platform.*

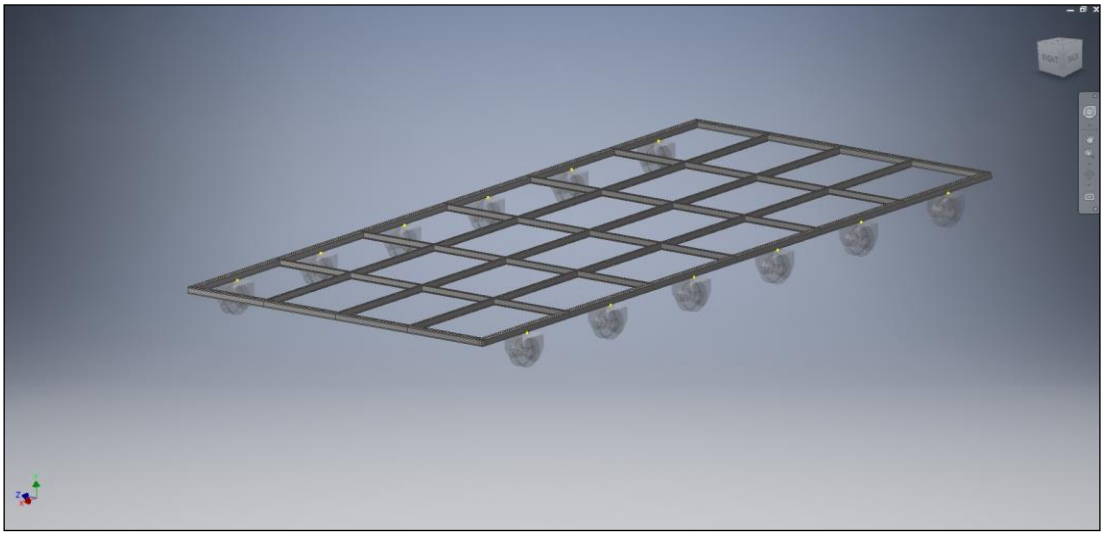

Fig. 2. *Skeletal structure of the base platform.*

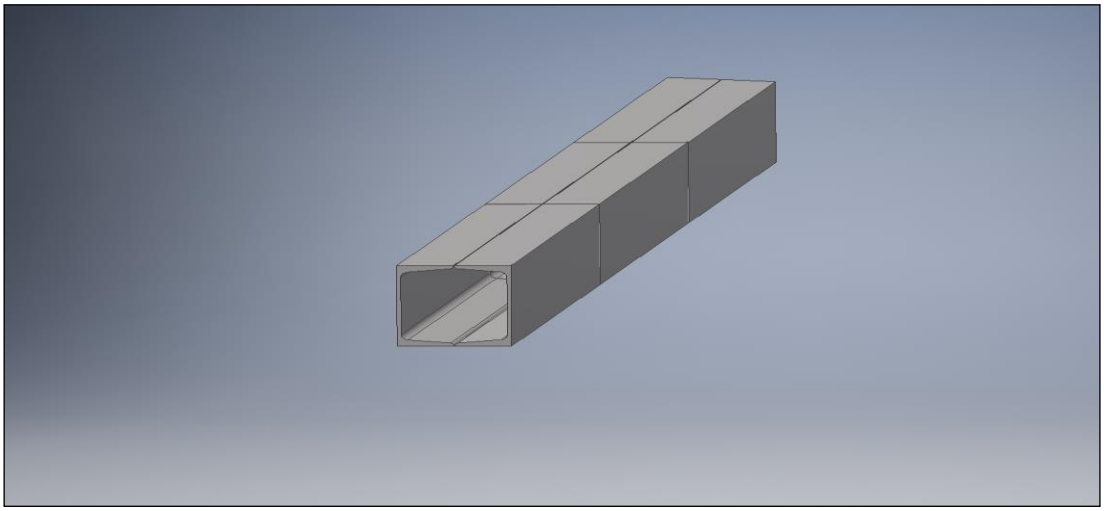

Fig. 3. *Frame assembly of the base structure for the platform.*

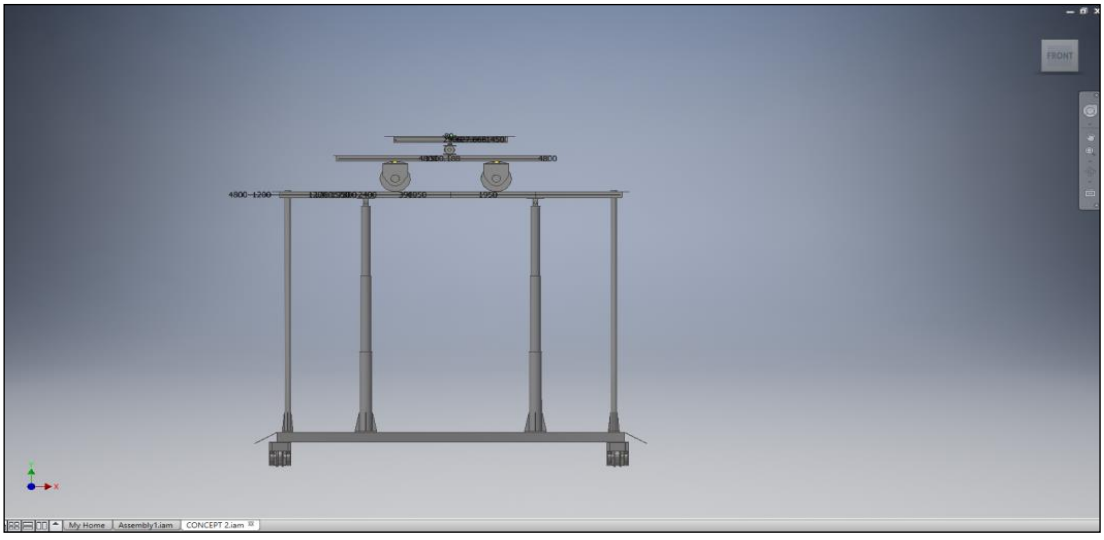

Fig. 4. *Plan view of the entire assembly for Concept 2.*

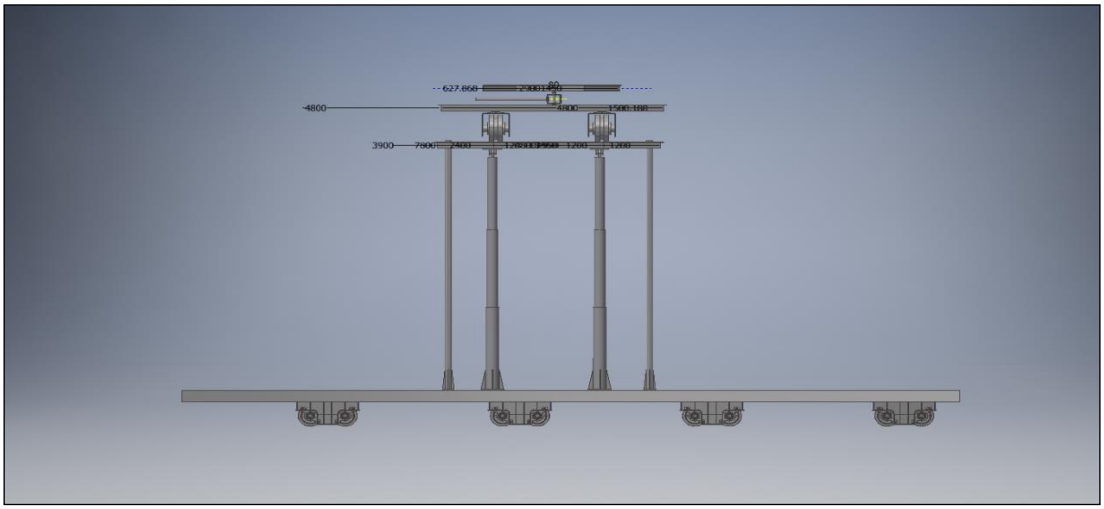

Fig. 5. *Elevation view of Concept 2.*

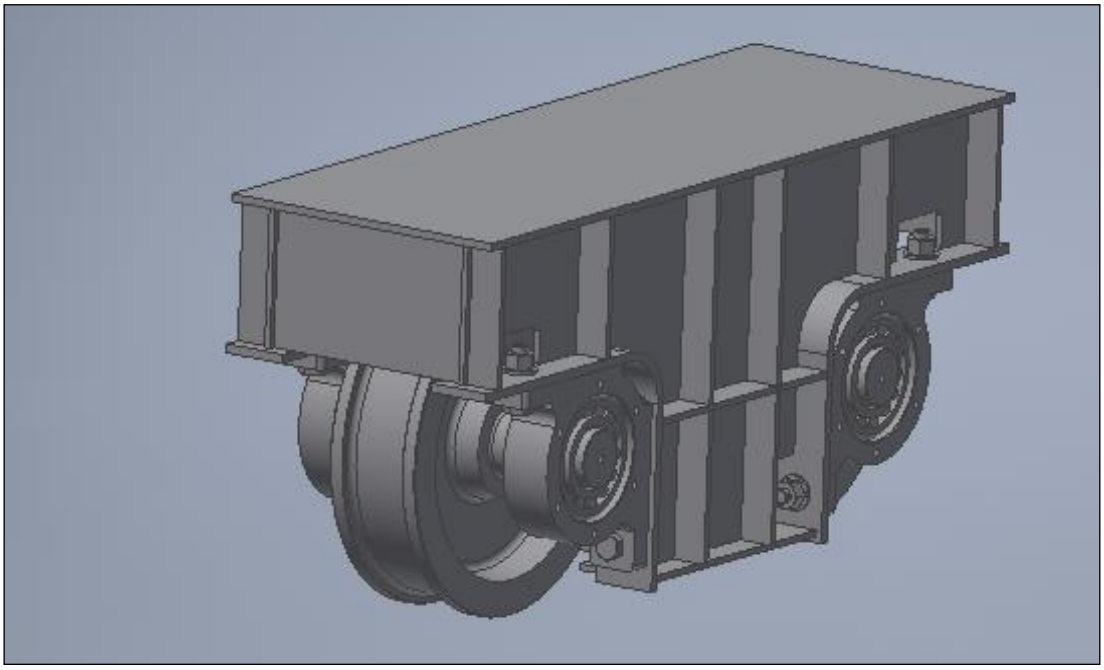

Fig. 6. *Wheel arrangement for base platform.*

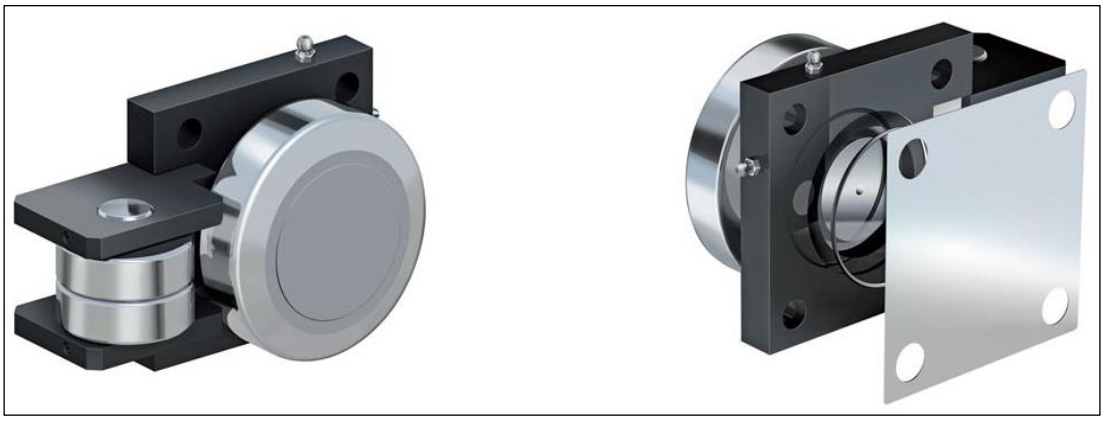

Fig. 7. *Winkel actual bearing arrangement.*

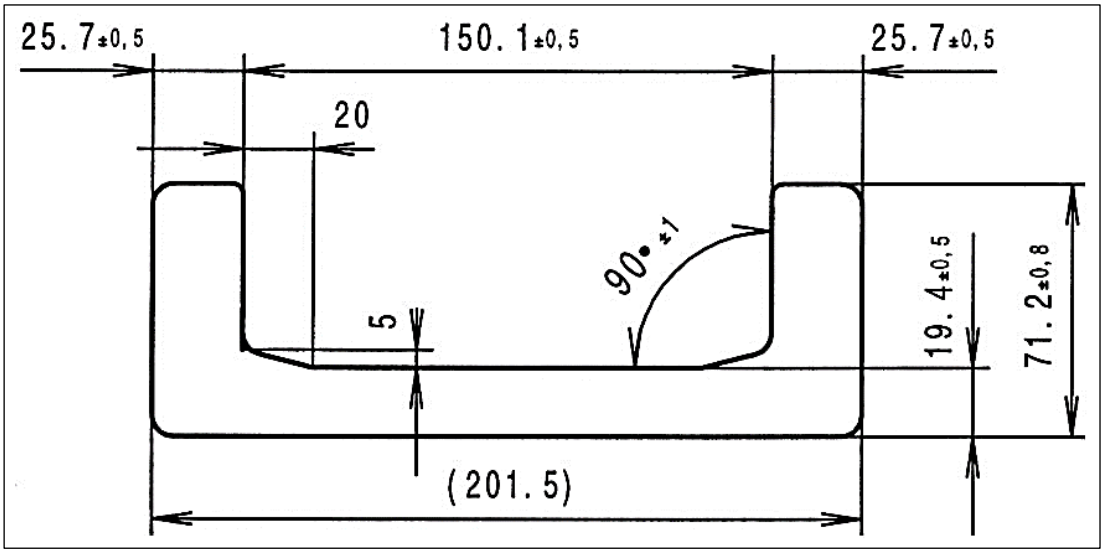

Fig. 8. *Winkel guide column.*

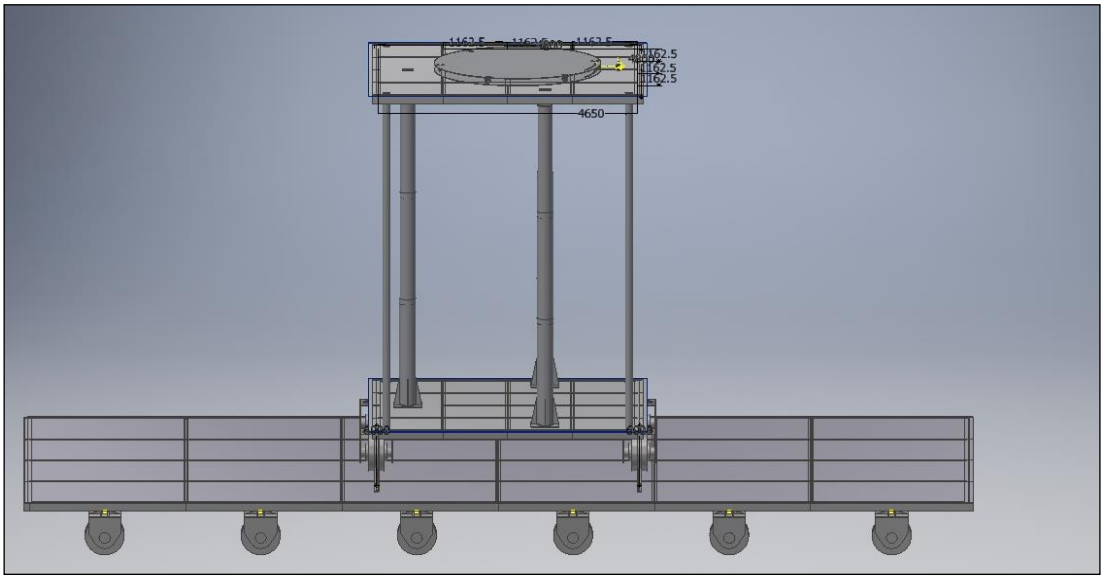

Fig. 9. *Side view of platform.*

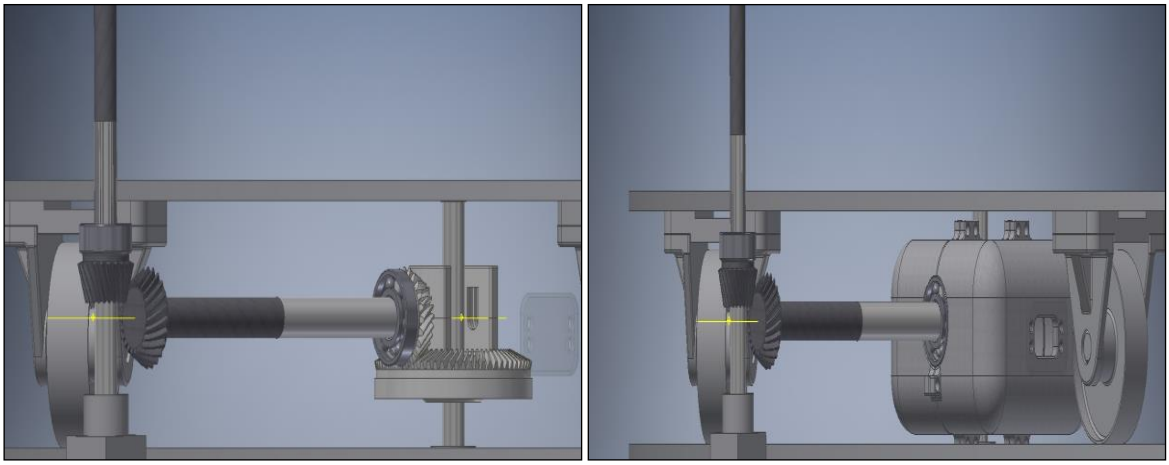

Fig. 10. *Bevelling arrangement for revolution.*

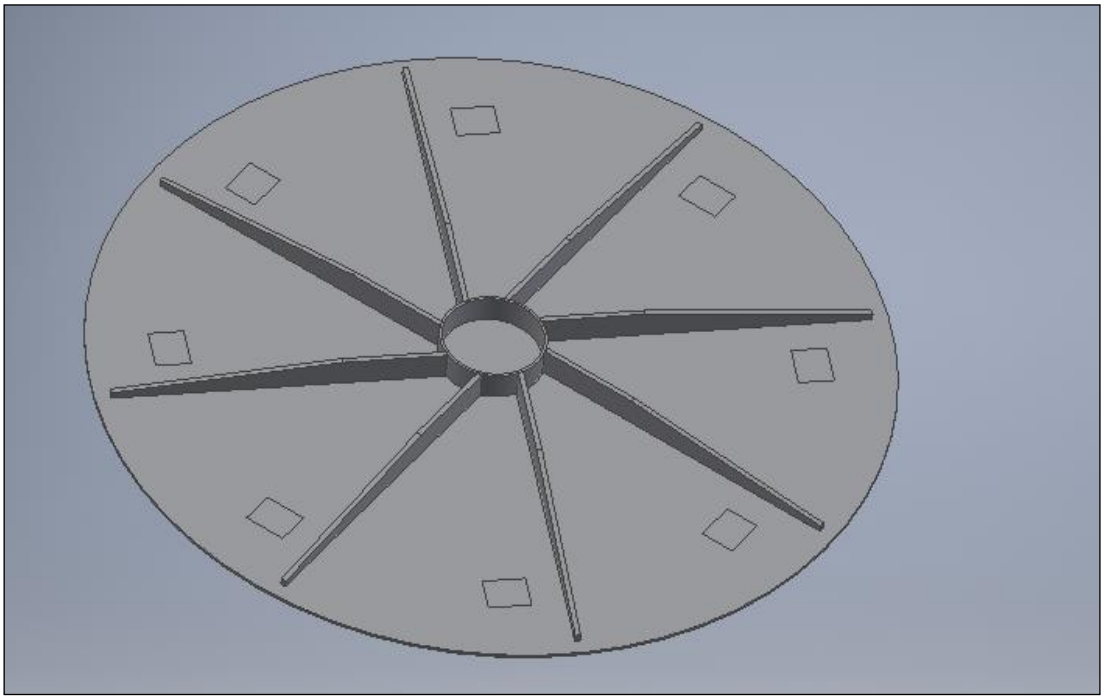

Fig. 11. *Base supporting ribs for the platform (welded).*

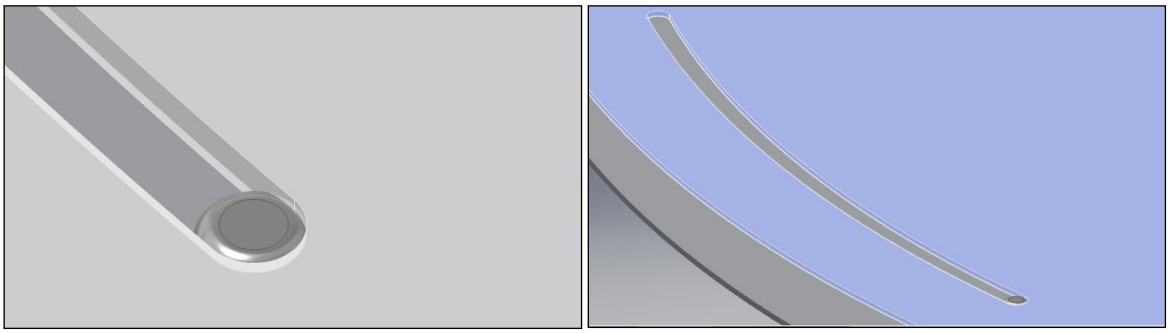

Fig. 12. *Roller rotating the slot (lubricated).*

CONCLUSION

This paper concludes by stating that the self-weight of the platform used is well within the limits of the ultimate tensile strength of the material and can be easily considered for the further live load and corresponding eccentric loading if applied. The main advantage of this assembly is that the structure weight of the assembly is decreased accordingly and the height in expandable.

REFERENCES

[1] Sudhakar P, Gayathri S. Design and Analysis of Spider Web Slab. *Int J ChemTech Res*. 2017; 10(8): 425–430p. ISSN: 0974-4290, ISSN(Online):2455-9555.

[2] Kazakis G, Kanellopoulos I, Sotiropoulos S, Lagaros ND. Topology optimization aided structural design: interpretation, computational aspects and 3D printing. *Heliyon*. 2017; 3(10): e00431.

[3] Patil A, Wangikar S, Patil S, Rajashekhar M. Design and analysis of telescopic jack. *Int Res J Eng Technol*. 2016; 03(07): 1355–1361p.

[4] Yelure DS, Mute GD, Gawande RA, Gadekar AN. Design analysis of lifting device using hydraulic

telescopic jack. *International Conference on Appropriate Technology for Sustainable Development*. 2015.

[5] IS 808. *Dimensions for Hot-Rolled Steel Beam, Column, Channel and Angle Sections*. Bureau of Indian Standards (BIS); 1989.

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