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MODELING AND ANALYSIS OF AUTOMATIC CAR PARKING SYSTEM FOR APARTMENT BUILDING

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Abstract: *Parking has grown to be a significant issue as a result of the dramatic increase in cars. This leads to traffic congestion, which we need parking spaces at strategic locations to address. Since we have a limited amount of land, building multilevel parking is crucial since it allows several cars to be parked in one location. Ten automobiles can fit in the multi-level parking that we built for this property. The design of the parking lot is based on the framed structure. The main objective of our project is to design and evaluate an environmentally friendly parking system that is safe, secure, and won't damage the car or the property. It ought to use less gasoline and time. use contemporary technology to create a system that will reduce the amount of land needed, increase productivity, and yield long-term financial gains. Among the components of the parking lot that we have designed in this paper are the belt, cabin hinge, cabin, control panel, hinge lock, motor, parking tower, payment machine, and pulley. Finite Element Analysis is used to implement the parking system. Analysis of rotational force must be performed using the computed input. The acceleration within the components is checked using gravity analysis. The two main parts of this system are the identification module and the slot checking module. The visitor is identified via the identification module. The slot state is checked by the slot checking module. Models and drawings must be created using CAD software such as CATIA V5 and analyzed using ANSYS APDL Workbench in order to determine the forces acting on the elements. For the convergent solution, a quality mesh is made, and the solver is set up as an analysis package with high optimizing results. The geometry can be designed and the properties can be determined using the resulting calculation method.*

I- INTRODUCTION

A mechanical device known as An APS maximizes parking spaces while utilizing the least amount of space by stacking automobiles vertically on multiple stories, paternoster, animated on the right, is one of the most common and ancient types of APS. Additional general names for APS include: An automated parking system (which should not be confused with parking guidance systems fitted on cars)

Theoretically, parking attendants are no longer required with fully automated APS.

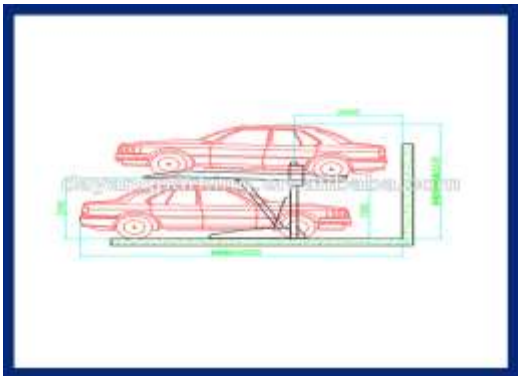
1.1 Fully automated and Semi-automated Parking Systems

Robotic valet parking is similar to fully automated parking systems. An APS entry (transfer) area is entered by the driver. All of the passengers and the driver get out of the vehicle. At a nearby automated terminal, a ticket is bought and given to the driver. The mechanical mechanism raises the vehicle and moves it to a parking spot designated by the system once the driver and passengers have exited the entry area. More advanced completely automated APS will measure the size of cars as they enter to select the smallest parking space.

Even though driver or an attendant still needs to execute all the required actions to park the vehicle and/or control the system. Although large capacity APSs are usually fully automated, cost and space are often the deciding factors when choosing between fully and semi-automated APS.

II - LITRATURE REVIEW

Parking guidance systems collect information about available parking spaces, process it, and then show it to cars via variable message signs.In order to direct cars in crowded regions to the closest parking facility with empty lots, this system can be put into place in two different methods. The latter guiding system answers the question of how many parking spaces are truly available within a parking garage, as well as where they are located. This technique helps the parking lot run more smoothly and saves time and gasoline when looking for empty spaces.



In areas where parking lots are in high demand, indoor parking has gained popularity due to its ease of use and ability to shield vehicles from the sun. This kind of parking lot has a parking guidance system that mainly uses message signs to advise cars about available parking spaces within the lot.

Sensors that track how many cars are entering and leaving a parking lot or, in other situations, by comparing the tickets issued at machines are typically used to determine whether a parking lot is available inside a car park. A computer receives and interprets this data, and the terms "full" and "empty" are typically used to describe availability. In certain instances, the precise number of parking spaces is provided.

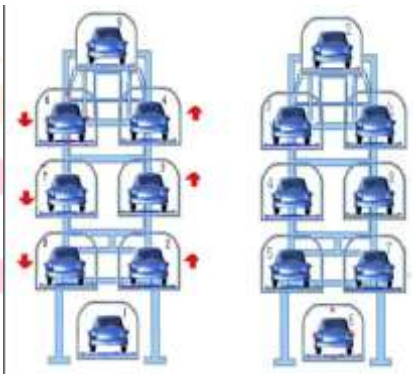
III - DESCRIPTION & WORKING MECHANISM

Description of the Project

Parking systems come in two varieties: automatic and conventional. Automated parking systems are probably going to be less expensive than conventional garages in the long run. The cost per parking space is lower for multi-story automated parking systems because they typically require less ground space and construction volume than a conventional facility of the same size. Because automobiles aren't running or circling as drivers search for parking spaces, automated garage and parking systems help to minimize pollution.

3.1 Operation

The technology employed in automated parking systems is comparable to that utilized in document retrieval and mechanical parcel handling. When the driver gets out of Until it is needed again, the vehicle may be relocated horizontally (left and right) or vertically (up or down) to an empty parking spot. The procedure is reversed when the vehicle is required, and the car lifters return the vehicle to its original location. Sometimes the car is positioned so that the driver can get out without reversing by using a turntable.



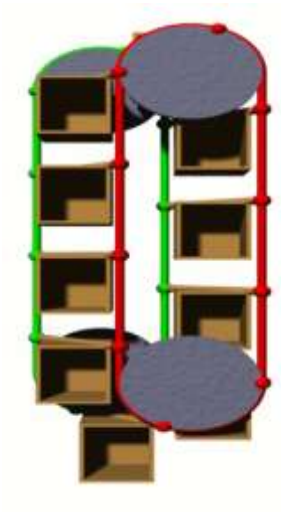
3.2 Benefits

For business owners, drivers, and urban planners, using a parking system has various benefits. They provide automobile users with convenience and urban-based businesses with effective site utilization.

3.3 Maintenance and service

The type of equipment and frequency of use determine how often automatic parking systems need to be serviced. In places with need be maintained and perhaps as frequently as four times. Additionally, frequent required to maintain in optimal condition,

particularly in light of weather-related issues (salt on the road can serious damage if it is not cleared).



The main cause of the APS's greater space the area not used for parking:

• A parking space the width, separation drivers and passengers are no longer forced to make concessions when parking or opening car doors.
• Since parked cars are not accessible to the general public, they and their contents are more secure.
• Minor dings and scrapes in the parking lot have been removed.
Why It is safer for drivers and passengers to avoid parking lots and garages.
• There is no need to drive around looking for a parking spot, which lowers engine emissions.
• Very little lighting and ventilation equipment is required.
• Handicap access has been enhanced.
• The parking structure has a reduced volume and aesthetic impact.
- Shorter construction time

Applications and Advantages
1) Any retail center or multiplex can utilize this concept for their parking system.
2) Suitable for business offices, educational institutions, and enterprises.

Future Development
1. In terms of security, this can be extended. The parking area's security can be improved by using CCTV cameras and metal and explosive detectors.
2. To park the autos automatically, we can include a pick-and-place feature.

IV - OBJECTIVE OF THE PROJECT

4.1 Problems
Automated parking systems have encountered several issues.

Three factors contribute to automated parking garage issues:
1) Technical
2) Bad planning
3) Parking customers

Most automated parking garage problems are not technical in nature.

Despite the fact that automated parking systems are not appropriate for their intended function, the sheer volume of cars on a comparatively small area may astonish architects. Additionally, even if they may be giving their consumers greater advice, manufacturers are occasionally pleased to complete a buy. Therefore, poor planning is the primary cause of unhappy consumers.

For places like train stations and retail malls where traffic is normally balanced, mechanical parking lots are an excellent choice. Although they are not advised for high peak hour volumes, the most of them can manage morning and evening rush hour peaks very effectively. Consequently, there will always be problems when an automated parking lot is installed at a stadium or movie theater. Automated parking is not appropriate for a morning high peak and an evening high peak with little in between. The traffic arrangement must be carefully examined.

Lastly, confusion arises when new parkers use this type of system for the first time, causing several delays.

4.2 Overcoming with the Problems
This leads to traffic congestion, which we need parking spaces at strategic locations to address. Since we have a limited amount of land, building multilevel parking is crucial since it allows several cars to be parked in one location. Ten automobiles can fit in the multi-level parking that we built for this property. The design of the parking lot is evaluating an environmentally friendly parking system that is safe, secure, and won't damage the car or the property. It ought to use less gasoline and time. use contemporary technology to create a system that will reduce the amount of land needed, increase productivity, and yield long-term financial gains.

Finite Element Analysis is used to implement the parking system. Analysis of rotational force must be performed using the computer input. The acceleration within the components is checked using gravity analysis.

There are two primary modules in this system:

• Module for identification

• Module for slot checking

Models and drawings must be created using CAD software, such as CATIA V5, and analyzed using ANSYS software in order to determine the forces acting on the elements. For the convergent solution, a quality mesh is made.

V - DESIGN METHODOLOGY OF AUTOMATED CAR PARKING SYSTEM

5.1 Introduction to CATIA

(Unigraphics), Cero Elements/Pro, and CATIA are rivals in the premium CAD/CAM/CAE industry. In 1999, Dassault Systems published CATIA V5, a 3D CAD application. This completely new design tool, which was very different from CATIA V4, took its place. other visual programs, depending on the IT environment.

Workbenches can be arranged in sets based on user preferences. Dassault Systems thus provides three distinct software installation versions. When less capability is required or for training sessions, the P1 platform—which has the fewest features—is used. The P2 platform is suitable for process-oriented tasks. Along with the basic design components, it enables functions linked to manufacturing and analytical tools. Using third-party software is one of the specific advanced scopes that P3 offers aerospace and military, automotive, industrial equipment, and services are just a few of the industries that can profit from the usage of CATIA. The most popular programs are Solid Works, NX (previously Unigraphics), Pro/ENGINEER, CATIA V4, and CATIA V5.

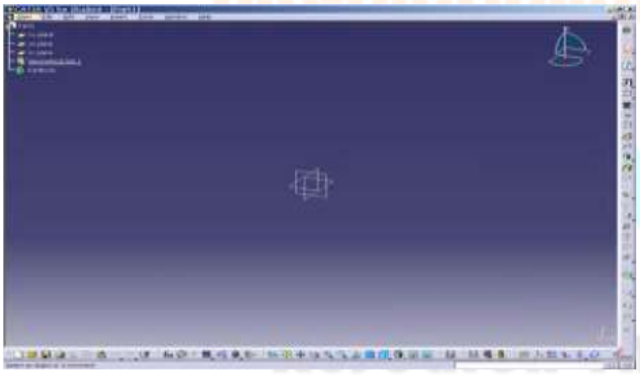


Fig: 5.1: Home Page of CatiaV5

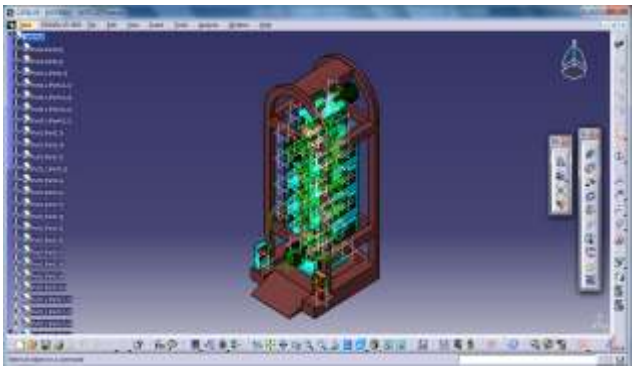


Fig: 5.2: Model design in CATIA-V5

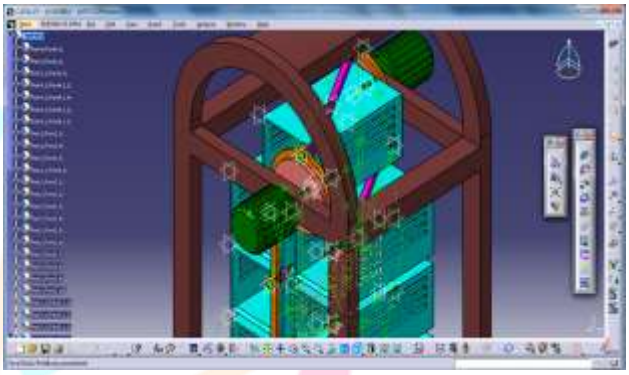


Fig: 5.3: Model arrangement of mechanism in CATIA-V5

5.4.3 Assembly Modeling of Automated Car

Manipulate: This command is used to manipulate / turn / rotate the component in any requried direction as per the need / suitable constraints are to be applied on the component.

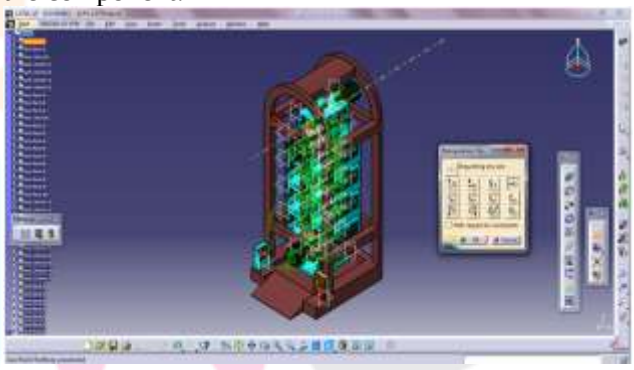


Fig: 5.27: Using Manipulate Command

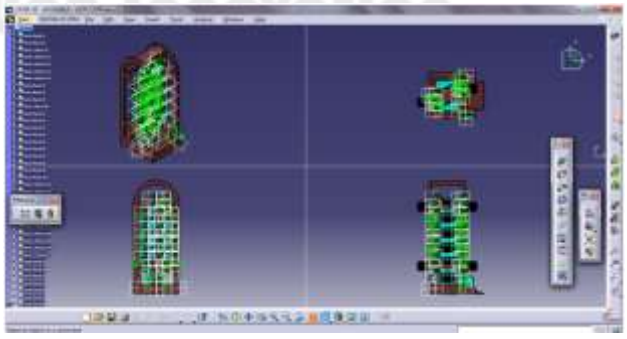


Fig: 5.28: Using Multi View Command

VI - ANALYSIS OF AUTOMATED CAR PARKING SYSTEM

6.1 Procedure for FE Analysis Using ANSYS:

ANSYS is used to analyze the Belt, Cabin Hindge, Cabin, Hindge Lock, Parking Tower, and Pulley. In order to compete, assembly is not necessary; instead, moments must be applied at the rotational location along the axis that we must specify. The machine's bottom legs serve as the fixing location.

6.2 Preprocessor

The following actions were taken at this stage:
Bring the file into the ANSYS window.

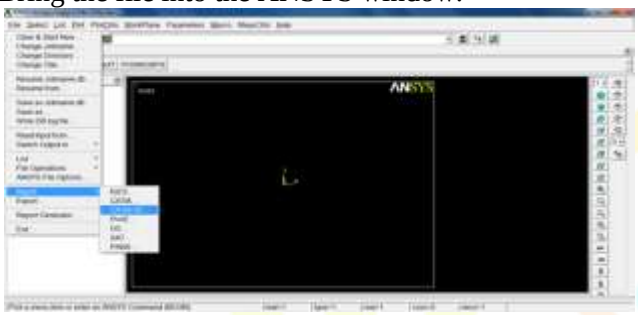


Fig.6.1: Import panel in Ansys.

6.3 Analysis procedure of Automated Car Parking System

Fig.6.6: Entering into preprocessor for selection of Element Type.

Fig.6.11: Entering into preprocessor for displacement of element.

Fig.6.12: Entering into preprocessor for Force / Moment of element.

Fig.6.13: Image of Element where Loads are applied

Fig.6.14: Window for solving the matrices problem, as done

Elements are assembled with neighboring components after being modeled using a 1D element and displayed as above. Rotational force analysis is used to solve a few components in order to verify the stress and displacements during rotation. Following the meshing of each assembly component, analysis based on the Original Equipment of Manufacturer application is the following step. Therefore, in order to obtain accurate results in accordance with the original component, we must mention all of the models that are assessed in the Ansys program. Static analysis is required to solve some of the components. The investigation confirmed that load is imposed and fixed at the system's bottom key location. A list of the geometric and material properties is provided.

VII - DISCUSSION ON ANALYSYS RESULT

7.1 Results of Displacement analysis:

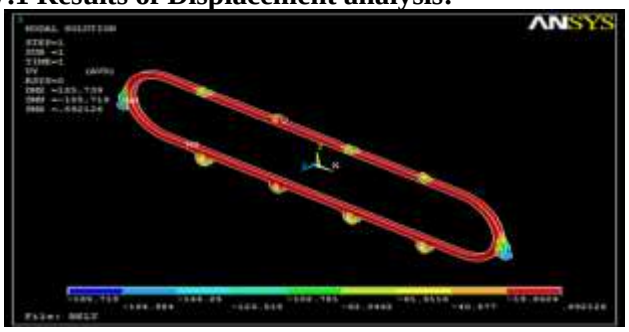


Fig: 7.1.1: Displacement of BELT

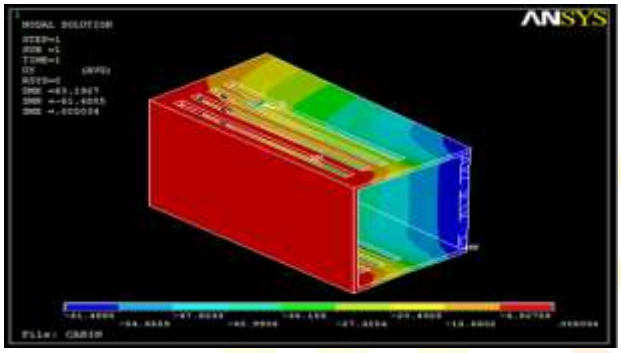


Fig: 7.1.2: Displacement of CABIN

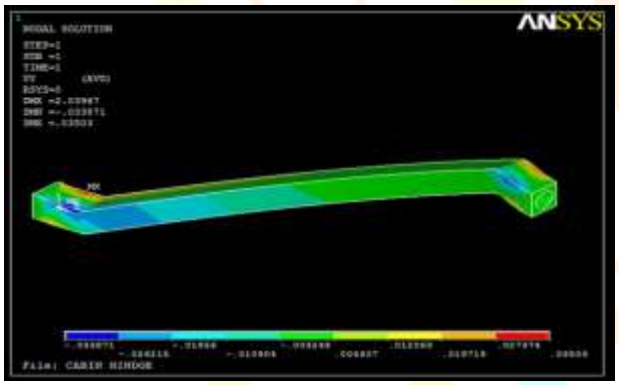


Fig: 7.1.3: Displacement of CABIN HINDGE

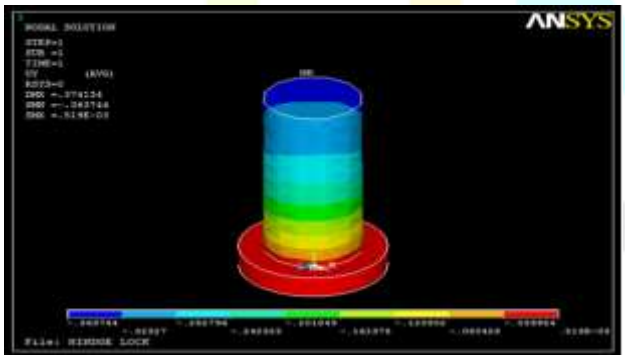


Fig: 7.1.4: Displacement of HINDGE LOCK

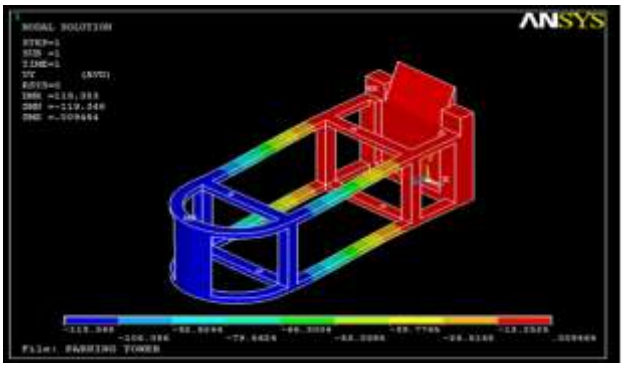


Fig: 7.1.5: Displacement of PARKING TOWER

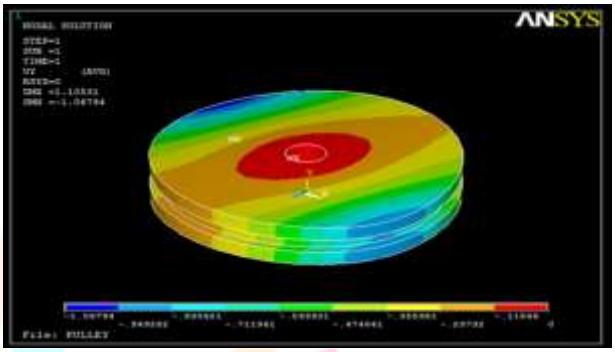


Fig: 7.1.6: Displacement of PULLEY

7.2 Results of Stress analysis:

Fig: 7.2.1: Stress Analysis of BELT

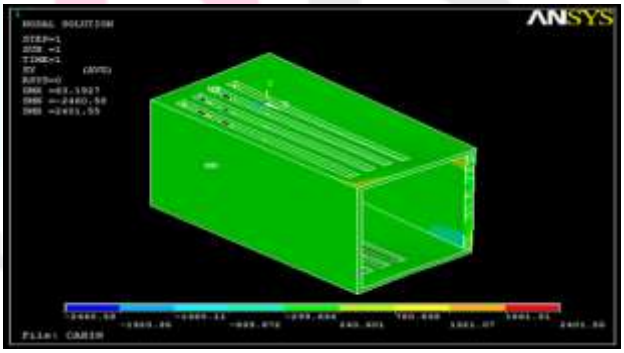


Fig: 7.2.2: Stress Analysis of CABIN

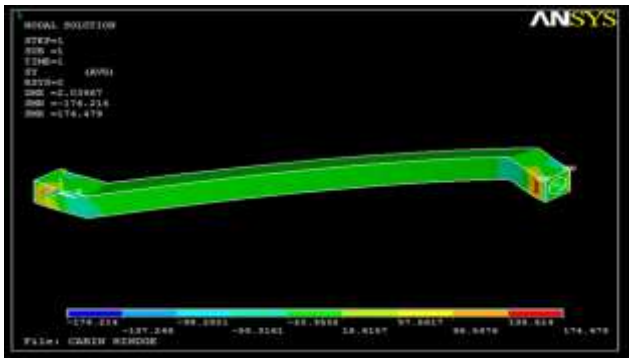


Fig: 7.2.3: Stress Analysis of CABIN HINDGE

Fig: 7.3.1: Strain Analysis of BELT

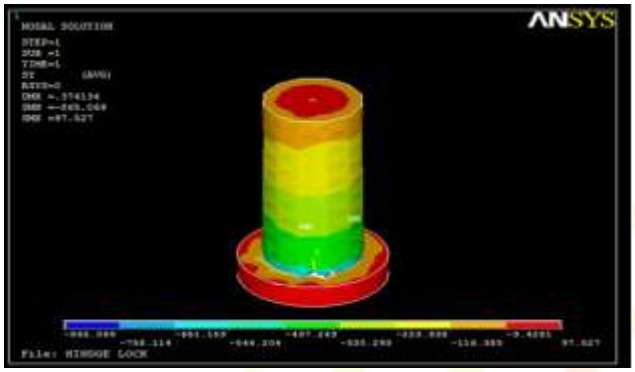


Fig: 7.2.4: Stress Analysis of HINDGE LOCK

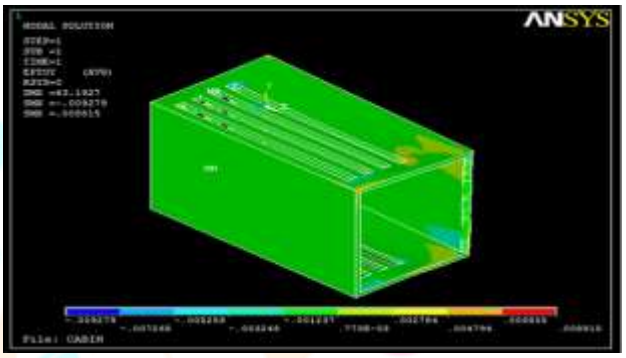


Fig: 7.3.2: Strain Analysis of CABIN

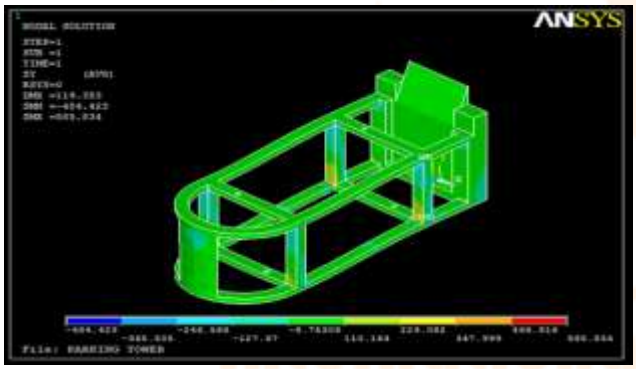


Fig: 7.2.5: Stress Analysis of PARKING TOWER

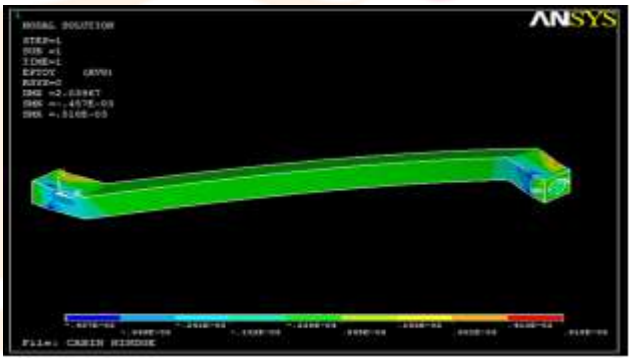


Fig: 7.3.3: Strain Analysis of CABIN HINDGE

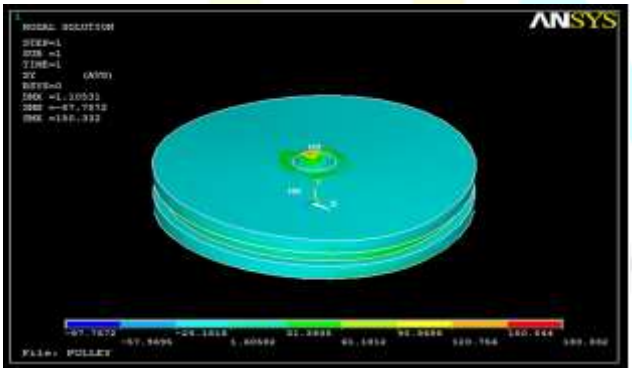


Fig: 7.2.6: Stress Analysis of PULLEY

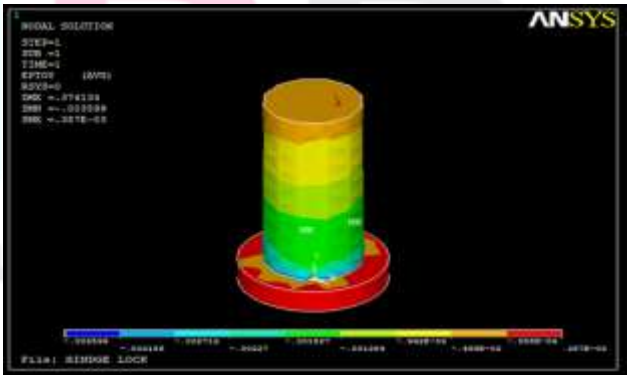


Fig: 7.3.4: Strain Analysis of HINDGE LOCK

6.3 Results of Strain analysis:

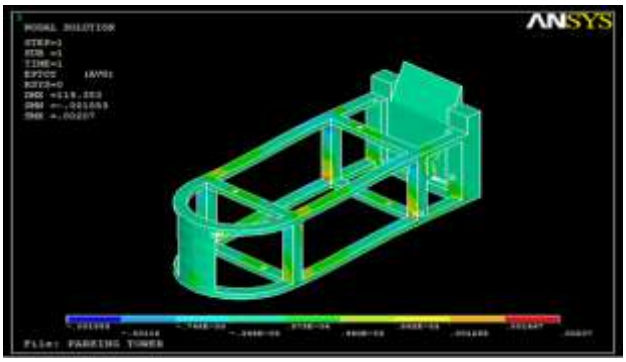


Fig: 7.3.5: Strain Analysis of PARKING TOWER

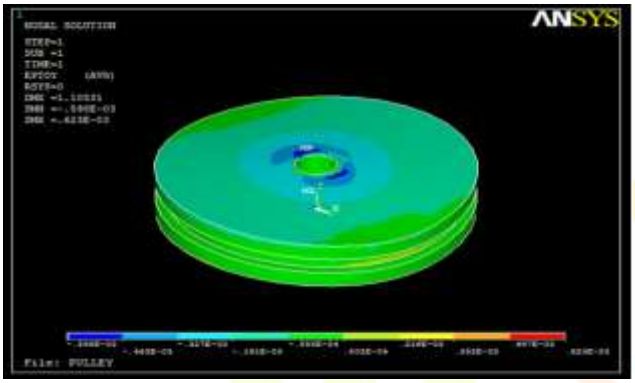


Fig: 7.3.6: Strain Analysis of PULLEY

VIII - CONCLUSION

The aforementioned results show that our objective was to create an environmentally friendly parking system that would be safe and secure without endangering the vehicle or the property. It ought to use less gasoline and time. use contemporary technology to create a system that will reduce the amount of land needed, increase productivity, and yield long-term financial gains. Ansys is used to mesh and solve the design assembly, and the figures above show that the cabin's displacement is 0.00503mm. This shows us that there is clearly some movement in every component of the assembly.

Designs are used to create the current FPGA (Field-Programmable Gate Array) based parking system. State machines increase production, reduce costs, and accelerate time to market. A parking system based on FPGA reacts rapidly. The system's architecture allows for a wide range of applications, and adding more slot possibilities is easy. The system's architecture makes parking easy.

The position of stress is fixed (minimum stress that is tolerable). The number, 2401.55 MPa, is below the yield point and significantly lower than the yield value. With the use of Ansys software, the maximum strain of 0.0088 MPa is resolved, resulting in a lower maximum stress. so that we may determine that our design parameters are roughly accurate.

As a result, the car parking mechanism's design also performed faultless in analysis. All of these facts strongly suggest that we have achieved our goal.

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