**CG ANALYSIS OF MATERIAL HANDLING TROLLEYS**

**Mid Term Project Report**

**Under the Supervision of: Submitted by:**

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Mechanical Engineering

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**Project Details**

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| *Project Details* |  | | | | |
| **Project Title** | **CG ANALYSIS OF MATERIAL HANDLING TROLLEYS** | | | | |
| Project Duration | 16-20 weeks | | Date of reporting | 5th February 2019 | |
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| *Organization Details* |  | | | | |
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This is to certify that the above project is being carried out under my supervision and guidance

Place: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. **INTRODUCTION**

Operation Process Control is the department of the organization that deals with the different production processes that are present in the vehicle manufacturing lines. This includes processes like logistics, material handling, storage, plant layout and a lot more.

The department is currently working on a project regarding the analysis of the center of gravity of the trolleys used for material handling inside the plant. This project is to ensure stable and safe handling of parts and materials that arrive from the vendor end.

1. **MOTIVATION**

It has been observed that the center of gravity of some trolleys carrying material from the vendors is at a much higher point than prescribed by safety standards that can cause the trolleys to topple while in transit. This not only causes heavy financial losses (the parts get heavily damaged and are then rejected) to the company but also can potentially cause heavy injuries to the personnel transporting the materials.

Through this project, the trolleys are first re-modelled in their current condition in a Product Lifestyle Management (PLM) software. Subsequently, the position of the center of gravity (CG) is determined and analyzed against the prescribed safety standards. After careful analysis of the concerned trolleys and making the needful changes, the process of material handling through trolleys becomes more efficient and safe resulting in smooth production.

1. **LITERATURE REVIEW**

Maruti Suzuki is one of the fastest vehicle manufacturing companies in the country. The organization proudly claims to roll out a new car every 40 seconds. Therefore, smooth and efficient production is a priority. To ensure this, the processes must be seamless, and any chances of hold ups or delays have to be duly eliminated or at the very least, reduced. This, however is severely hindered when there is a shortage of material or delay in the arrival of materials at any respective station on the production line due to material being rejected because of damage.

In the present state of things, the company has trolleys in circulation transporting different parts from the vendors to the plant for production on a daily basis. There are in total of 246 types of trolleys that come to the plant in Gurgaon carrying different parts for the vehicle production. Out of these trolleys, some have been identified as trolleys with much shorter wheelbase and larger height than usual. These trolleys due to their shape and size tend to be more prone to toppling on favorable conditions. These trolleys have thus been labelled “unreliable” and proper analysis of such trolleys needs to be done in order to establish if they are safe for use or not.

After analysis, it can be concluded if the trolleys are unsafe and suitable changes in the shape or loading method of the trolley can be brought about to make them safe for work. This process is completed with the help of Siemens’ Solid Edge, which is a PLM software.

Recently, the organization has started modifying the trolleys that are unsafe. This process is done with the help of the ‘Kaizen’ department which is the department that deals with continuous modifications in the existing machinery and tools of the plant. The organization plans to modify all unsafe trolleys and make them safe for transportation over the next two months. This will aid the fast production of vehicles without any chances of financial losses or injuries. As of date, 143 types of trolleys are under analysis and 14 have been successfully modified as per the safety standards. The department also looks to increase the capacity of the trolleys so that less trips are required from the vendors’ end.

1. **OBJECTIVE OF THE WORK**

The main objective of this project is to ensure stable and safe handling of parts and materials that come to the plant for manufacturing of vehicles from vendors by altering the center of gravity of the trolleys. Parts of different shapes, sizes, materials and weights are received in the plant from vendors for production. These parts arrive in different types of trolleys that have been designed for safe transportation of the material in bulk quantity. To ensure that the shape of the trolleys is such that toppling is not possible, the center of gravity needs to be analyzed and modified wherever necessary.

1. **TARGET SPECIFICATIONS**

The target of the project is to ensure that no cases of toppling are observed after all the due modifications are done. This will eliminate chances of injuries and also loss/rejection of material.

1. **FUNCTIONAL PARTITIONING OF PROJECT**

The project has been divided into the following parts:

1. **Collection of data:** Proper measurements, part type (that the trolley is carrying) and carrying capacity of the trolleys.
2. **Compilation**: Compiling the recorded data at a single spreadsheet to ensure the analysis is done in an efficient manner and no cases are left for analysis.
3. **Examination of CG against prescribed standards:** Using Solid Edge, the trolleys are examined in fully loaded condition for the proper positioning of the center of gravity.
4. **Suggesting changes if required**: Alteration in part quantity or trolley design to bring down the center of gravity.
5. **Compiling final report:** After the analysis is complete, forming the final report for reference.

# METHODOLOGY

**Identification:**

Firstly, the trolleys that are unreliable are identified and located at their stations and storage areas in the plant. The part number being carried by the trolley along with part name and vendor code is checked. Once the trolley is properly identified, a record is made regarding the same for future reference.

**Measurement:**

Once the identification of the trolley is complete, a proper drawing (free hand) of trolley is made noting down all the dimensions along with the dimensions of any supports or jigs that are present in the trolley. This is done in order to recreate the trolley on the software and analyze it further. The drawing is made describing all the three views in detail with measurements like thickness of pipes used and angles at which supports have been installed. The plant uses standardized wheels for the trolleys and hence the type of wheels and its measurements are easily identified.

**Modeling:**

After the first two steps have been successfully completed, the drawing is then referred to make a recreation of the trolley with exact dimensions and weight (adding the material to the model through software). Once the entire frame of the trolley is ready, part models are accessed from the database and assembled to the trolley model to simulate a fully loaded condition of the trolley. After the trolley is properly loaded, the center of gravity is calculated through the software and the exact position of the center of gravity (height from the ground) is identified. The loaded trolley model is saved in the database for future reference.

**Analysis:**

After the center of gravity of a fully loaded trolley is determined, the static stability factor is calculated. The formula for the SSF is T/2H where T is the width of the trolley where as H is the height of the CG from the ground. If the SSF comes out to be greater than 0.5, the trolley is considered safe. Whereas, if the SSF is lesser than 0.5, it is deemed unsafe and design modifications are made to make it safe. The status of the trolley is constantly updated on the database as ‘safe’ and ‘unsafe’ for reference of other personnel working in the same area or department.

**Modifications:**

Trolleys that need modifications get them in the Kaizen area, which in Japanese means continuous betterment of existing systems. Therefore, the current trolleys get taken to the Kaizen area and due modifications are brought to the trolley in this area. After the trolley is modified, there is a test run on the line which ensures that with the new modifications, the foreman is sill being able to unload the trolley and work with the parts conveniently also that there is no damage to the parts while the trolley is in transit from the vendors.

**Final Approval:**

After the above steps are done, the trolley is then sent for approval by all the concerned departments of the organization (Supply chain, OPC, Production etc.). Once the approval is given by each department, the modified trolley is sent to the vendor so that the same modification is done to all the trolleys and hence make the entire process faster, more efficient and safer.

# 8. TOOLS REQUIRED

1. Regular measurement apparatus (measuring tape) for measurement of the dimensions of trolleys for CG analysis.
2. **Software tools:** Solid Edge (PLM Software) for designing, altering designs and analysis of the CG using the analytical tools of the software.
3. Microsoft Excel to prepare spreadsheets and compile data which is collected throughout the duration of the process.
4. Adobe reader to form PDFs as final individual reports of each trolley under examination.
5. **Safety Apparatus**: Helmet, Wrist covers, Safety goggles and Safety shoes.

# 9. CONCLUSIONS

# In any organization that is striving to achieve excellence, continuous improvement of existing systems is just as important as introduction of new systems. Both these processes require innovation in their own respect. By improving the process in place continuously, the overall production becomes more efficient and economical. This project aims to do just the same by eliminating the chance of mishaps in the area of material handling. By preventing the trolleys from toppling and at the same time looking to increase the capacity of trolleys by redesigning or modifying the current design, this will lead to a great development for the production process as a whole.

# 10. PROJECT WORK SCHEDULE

1. **February 2019:**
2. Getting introduced to various areas and shops of the plant.
3. Understanding the production process and how materials are transported to the plant from various vendors.
4. Modifying a trolley to increase its SSF and carrying capacity.
5. Designing and fabrication of the modified trolley
6. Separate project of collection of data for packaging repository in order to better understand the layout of the plant and locations of different parts.

1. **March 2019:**
2. Identification of unreliable trolleys for CG analysis.
3. Drawing and dimensioning of the trolleys to create part model on Solid Edge.
4. Modeling the trolleys on Solid Edge.
5. Analyzing and determining the position of the CG and calculating the SSF for each trolley.
6. **Apr 2019:**
7. Compiling the list of analyzed trolleys.
8. Suggesting modifications for the unsafe trolleys.
9. Modification of trolleys on Solid Edge.

(d) **May 2019:**

TBD, Final Report.