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Finite Element Analysis of Road Marking Paint Machine

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Abstract: Road marking paint machine is a machine which produces different types of road marking paints. In this research work entire road marking paint machine is designed and analyzed on software . New road marking paint machine is installed in industry which is analyzed on ANSYS and designed on CATIA software. MMA acrylic based paint, alkyd based paint, thermoplastic paint are products of road marking paint machine. Increasing cost of raw materials and competitiveness in market tends to pull industry to analyze and optimize processes and machine parts and tools. For reducing cost & defect rates and improving paint quality and machining manufacturers of such paints need finite element analysis. FEA software shows the possibility of error and failure before it is occur. After designing the machine we can actually calculate the total productivity and life of machine parts and mountings. As a future scope loading of raw material can be automated and batch size also can be increase. Machine characteristics and properties can be enhanced through information obtained by analyses on software.
Keywords: Road marking, Road Safety, paint machine, FEA analysis, thermoplastic paint, road marking devices

I. INTRODUCTION

Traffic can be guided and controlled by using road marking. In cities where the crowd found in large quantity, their road markings plays vital role for guiding vehicles, drivers and every road user. Road markings are easily visible from very far distance it is used as signs and signals. Road markings are easily visible and easy to understand, an unskilled person also get the exact information from road marking by just seeing it. There are many devices, instrument and machines which are used for road markings. Road marking instructions are almost standard for the entire world. There are a few rules that may vary from country to country. In many countries, yellow lines are used to make the segment on the road for the opposite direction traffic. Continuous white lines, white dashed lines are used for city roads and highways. Sometimes orange color road marking is used where parallel roads are using instead of main roads for road construction. Road marking rules and regulations and road marking law was different before 1971 after that rules are standardized. United Kingdom, Canada and Hong Kong shares almost the same road marking rules. Japan has some different rules for road marking. Usually in other countries, white dashed lines are used for the direction of traffic and solid white double dashed lines indicates drivers are not permitted to change their roadside. In Japan, traffic is separated by whites lines which also indicates that traffic can go on only one side. Japan is a country where left-side driving is applicable.

Paint manufacturing plants have a higher amount of hazardous gases emissions in all over the world. Emissions starts from where when in paint manufacturing plant pigments and powders and handled which causes emissions of airborne particles. Paint manufacturing industries are currently focusing on developing a manufacturing technique which can efficiently produce a large amount of product and variety of product simultaneously. For completing this target industry must follows standards of quality also. ISO 9000 and ISO 14000 should be used in every industry in order to protect workers from harmful paint excretion. The needs of colorant producing industry is different from paint producing industries. So, Pigments plays an important role for color. Pigments have different property for each type of color paint. Sometimes it may differ from the other pigment. Conventionally paint manufacturing is done by using ball mills and roller mills. Ball mills and roller mills are capable of breaking down the particles of pigments and blend it with the other ingredients. As both mills are not efficient enough to come up with current day demand centrifugal ball mills are used for making paints.

A. Scenario in India

India is a highly populated country. Population density is also high in many cities in India. Modes of transport are mainly from roads, railroads and highways. Entire India is connected with a web of road. Road markings plays an important role in controlling traffic and reducing road accidents. Indian roads are also painted with many types of colours, materials and lines. Yellow lines indicate that people can overtake or pass over that line but without crossing it. Yellow line in India is liberal than white line. Where white lines can be crossed in peak conditions. White lines also used as pedestrian crossing lines.

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B. Road Marking Devices

Road marking devices are coming in a wide range of variety. Road marking devices are designed in order to paint the roads according to the requirement. Road marking devices are also segregated according to the types of paint is used. Waterborne paint, thermoplastic paint, primer or enamel can be used as road marking according to the condition. Road marking devices are available as manual, semi-automatic and fully automatic specifications. Automatic road marking machine can work with less time consumption but where cost and marking area is less there manual applicator is used. Manual road marking applicator is best suited for most of the work because of its smaller size and ease of handling.

C. Road Marking paint Manufacturing Machine

Road marking paint manufacturing machines are very similar to the machines used for manufacturing oil-based paints. Road marking paint machine can be defined as two types one is road marking paint applicator and road marking paint manufacturing machine. Simple set up of mixer, hopper, hydraulic power jack mechanism, compressor and electrical panel makes one complete road marking paint manufacturing machine. Different types of paints can be manufactured through this machine. Thermoplastic paint, waterborne paint, acrylic-based paint, primer and synthetic enamel can be manufactured by using this machine.

Fig.1 Road marking paint manufacturing machine actual model

D. Objectives

1) To study the design road marking paint machine.
2) To finite element analysis of road marking paint machine on ANSYS and CATIA software.

E. Scope

Although machine bought with full specification but there is always chances of improvement in every design. Additionally, the machine is new so there is a requirement to install the machine and analysis it's parts. Automation is the answer to every new machine in the current era but sometimes it is required to check productivity. Machine is semi-automatic and has all possible optimum design configuration. Finite element analysis can give entire information of machine with its life to the properties of its parts. Therefore FEA is required for road marking paint manufacturing machine.

II. TOOLS AND PLATFORM

A. Design using CAD Software

The process of optimization of design, modification, creation, generation, analysis by using computer software is called computer-aided design. Productivity of designer increases by using CAD software. Database creation for production line can also be done on CAD software. Quality of design and those design understanding to everyone makes easier by using CAD software.

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B. CATIA

In this project, we used CATIA software for designing machine parts on it. CATIA is one of the most popular CAD software currently for surface modelling and 3D modelling. CATIA is so versatile that aerospace, automotive, material handling devices and industrial machineries all can be design in CATIA software. I used CATIA V5 software for machine design.

C. ANSYS

Analysing of road marking paint manufacturing machine is done on ANSYS software. It provides a wide range of loading factors and temperature module. One can take a superior decision regarding design quickly. Maximum stress, maximum strain and deformation in machine parts are calculated through software. Software also helps to test a wide range of materials and their effects on it.

Problems of engineering and mathematical physics can be solved by using the finite element analysis(FEA). Different material properties, load distribution and complex geometries where solutions with logical approach cannot be obtained, there FEA is useful.

1) How FEA is Different from Analytical Solution?

a) Analytical Solution

i) Exploration of stresses for trusses, analysis of stresses for beams and analysis of stresses for any other simple geometry can be done by using considerable shortening and ennoblement:

- In this method mass and forces acting on the body is considered at the center of gravity.
- In case of beam and rectangular blocks it is considered as line segment.

ii) Romanticize construction is contemplate for designing. Large amount of factor of safety is given on the basis of previous results.

2) FEA

Tortuous geometry design and more accurate design is most needed. It requires:

i) To acknowledge the bodily deportment of a tortuous entities like heat carrying range, fluid run, strength, etc.

ii) To recognize the feebleness of the design precisely, to prognosticate the performance and etiquette of the design, to enumerate the security gap.

iii) To recognize the superlative design with conviction.

3) General applications of Finite Element Analysis

a) Fluid Flow
b) EMF
c) Acoustics
d) Soil Mechanics
e) Aerospace
f) Automotive Engineering
g) Structural and stress Analysis
h) Heat Transfer
i) Biomechanics

4) Discretizations

Conversation of one model frame into finite number of equal parts which are connected with one another by nodes or boundary lines is called discretizations.

5) Solving Finite Element Analysis : General Procedure

a) Preprocessing

i) Expound the computative sector of the problem.
ii) Clarify the element type to be used.
iii) Elucidate the matter characteristics of the elements.
iv) Explicate the structural characteristics of the elements like extent, span etc.
v) Expound the mesh parts accordance
vi) Explicate the bodily limitation or boundary conditions and elucidate the loadings.

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b) Solutions

i) Calculate the undetermined merit of the principal discipline changeable.

ii) Calculated merits are then utilized by rear replacing to calculate supplemental, attained

iii) Changeable, response forces, element stresses and heat run.

c) Postprocessing

Classifying, organizing, categorizing, printing, marking and graphing all carried out by postprocessor software for selected results from finite element solution.

III. RESULTS

FEA analysis of road marking paint manufacturing machine is done. In this project, a literature survey of researches related to machine is completed. After that design on CATIA software gives various aspects of analysing. Analysis on ANSYS software gives various possibilities of material reaction when applied different loads. Different results obtained from analysing different types of meshing.

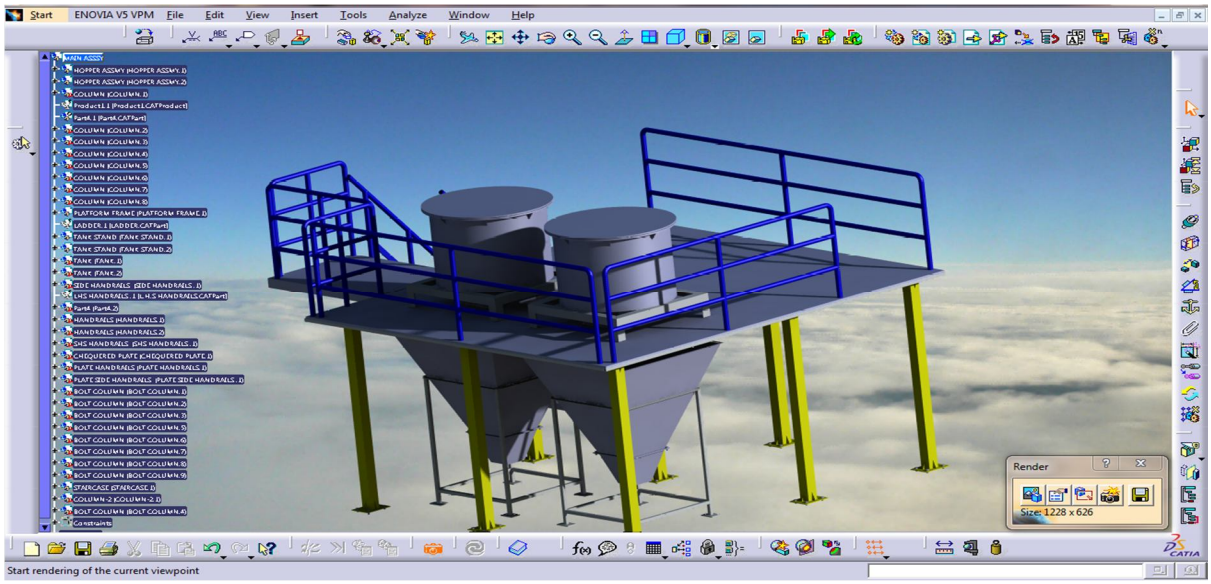

Fig 2 CAD Model Designed on CATIA software

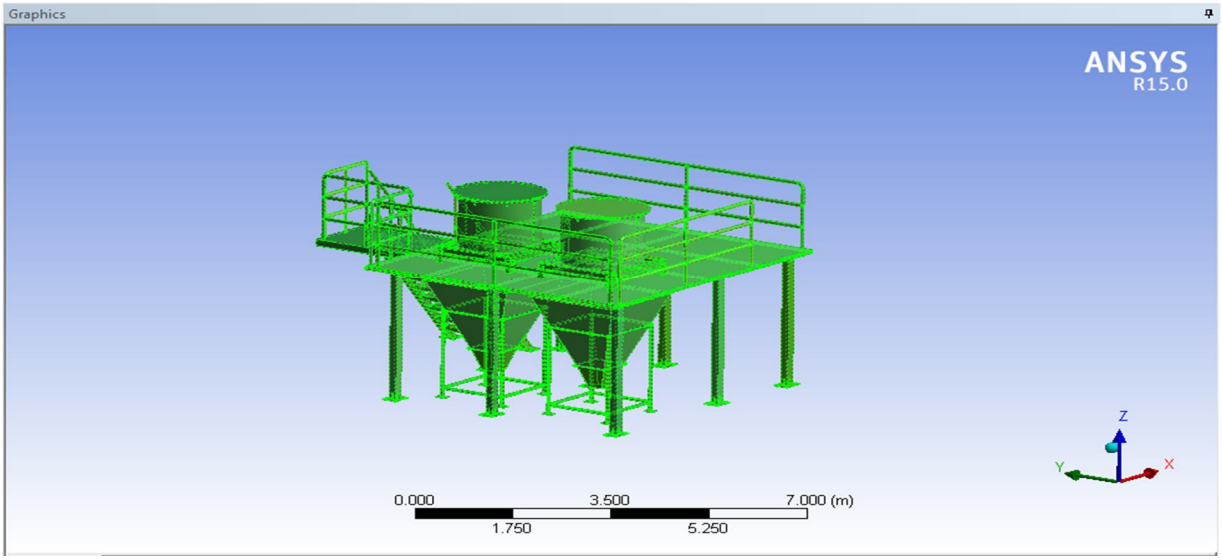

Fig. 3 Model analysed on ANSYS software

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IV. CONCLUSION

On the basis of results obtained and analysis, conclusions can be drawn as, The road marking paint manufacturing machine will work absolutely fine under normal conditions. The difference between a tetrahedron and triangular meshing is considered negligible. Timely maintenance of machine can extend life span of parts. Innovations and modifications are a continuous changing process. Someone's endpoint can be the start point for any other person. The design of road marking paint manufacturing machine also has many possibilities for improvement. Such as, Capacity of mixer can be doubled with minimal calculation. Raw material input can be automated. One more mixer and hopper can be installed without adding power.

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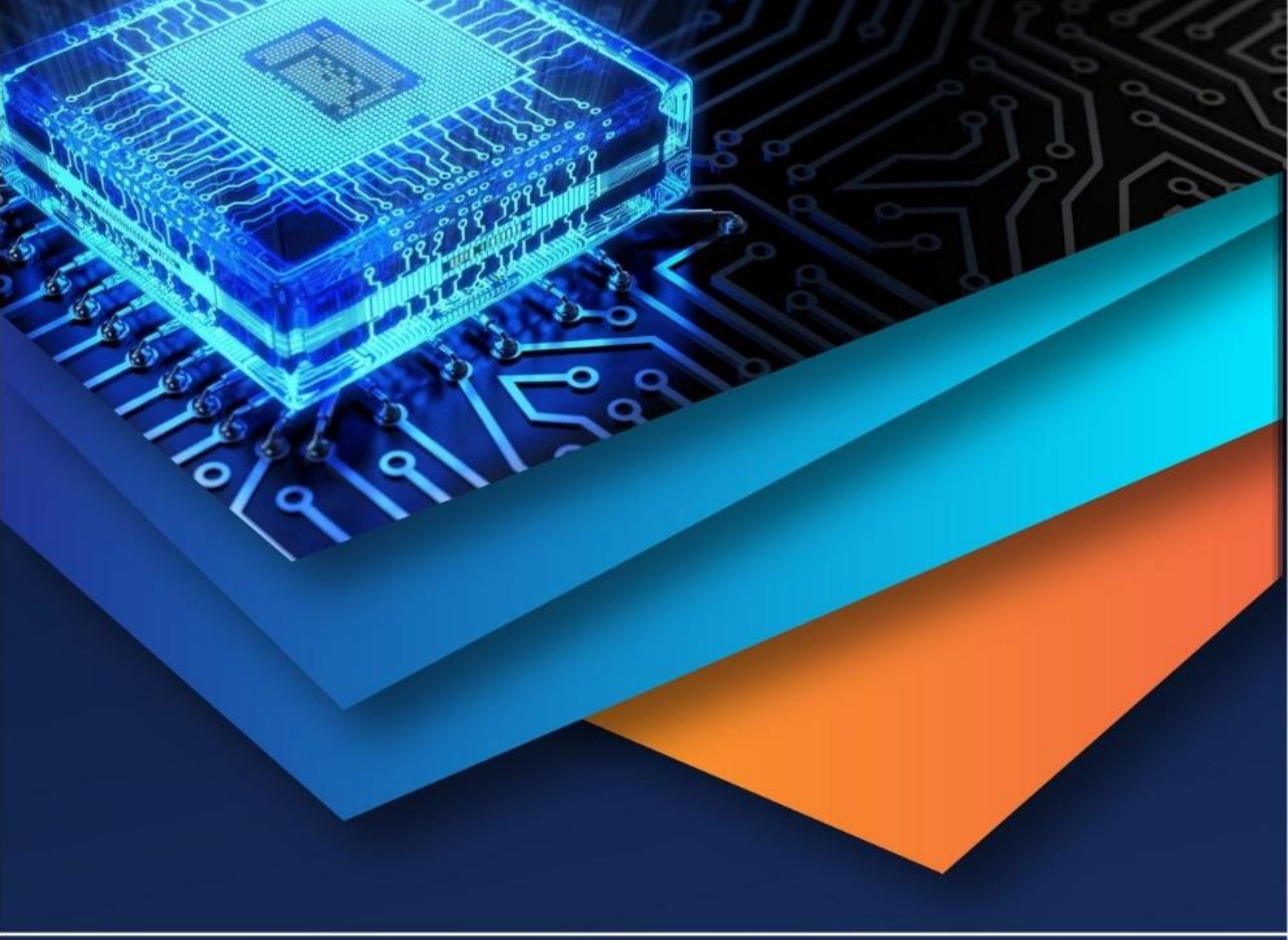

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