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Design and Software Analysis of Economic and Eco-Friendly Kerb for Road Construction

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ABSTRACT: As known to us the constant demand of the ever-growing population urges newer and more infrastructures hence in order to meet this ever-growing demand for development, massive production of cement concrete, and other building materials produce is manufactured, eventually creating greenhouse gases, air, water, and land pollution causing a harmful impact on the environment as well as to living being. Hence, this project aims at analyzing and providing an eco-friendly and economical substitute material for Kerbs in road construction by utilizing recycled waste which will save the cost of new production, thereby reducing the negative impact on our environment. A 3D design of the kerb model is created on CATIA Software. And the properties of our analyzed and selected substitute materials (i.e. waste rubber and polyethylene) are compared in ANSYS Software on the basis of some parameters e.g. Compressive strength, ultimate tensile strength, density to name a few.

KEYWORDS: Kerb, CATIA Software, ANSYS Software, Cost Analysis.

I. INTRODUCTION

KERB: A kerb is a vertical component of a road. This is a vertical or sloping block member which is provided along the edge of a pavement, strengthening and protecting it. Also separating the sidewalk from the street. Usually, a kerb is 150mm above the level of the road. Its length is 915mm with a radius of 780mm generally. There are a number of kerbs that are categorized according to their shapes, height, materials used and their combination with the gutters to be aligned. Materials for kerb construction include stone or masonry, asphalt, portland cement cast-in-situ concrete, precast concrete kerbs etc.



TYPES OF KERBS:

1. Low/Mountable/Roller Kerbs: This type of kerbs differ from barrier kerbs in terms of shape or design, i.e. they have sloping faces with steep or gentle slope provided for vehicles to encroach over them to reach driveways without causing harm to vehicle tyres. This is known as a class-I kerb. These are typically seen in commercial areas with expansive parking lots, cycleways, lawns and gardens. They are also beneficial for longitudinal drainage with a height of 70 to 80mm.
2. Low-Speed Barrier/Urban Parking Kerbs: This type of kerbs is built along the sidewalk to prevent vehicle enrichment or parking by vehicles. These are also named class-II kerbs. They can also allow emergency vehicles to climb or be parked on the shoulders. Their height can be kept from 150mm to 200mm in order to avoid tire scapping.
3. High-Speed Barrier Kerbs: This type of kerb is also known as class-III kerbs. They are built along the roadway with a critical path for high-speed vehicles passage e.g. Bridges, mountains etc. The height of this type of kerbs is between 230 mm to 450 mm or more.
4. Submerged Kerbs: This type of kerb is called class-IV kerbs. They can be seen in rural areas. These kerbs provide lateral stability to the granular base course and flexible pavement. Its constructed-in standing brick form or concrete blocks wise with a total height including the submerged portion to be 406 mm.



ENVIROKERB:

Envirokerb is an economical and eco-friendly kerb that can be built by utilizing recycled materials there-by reducing undesirable costs and lessening the negative impact on the environment to the same extent.

II. LITERATURE REVIEW

Poor subsurface drainage causes pavement disruption and shortens pavement servicelife, according to the author of this research. The use of envirokerb helps to solve this problem.¹

The problem of high runoff and water logging on highways, which most likely causes road accidents, was analysed in this research, and the author found that envirokerb is an effective strategy for water management.²

The author of this research investigated how bad drainage on highway structures affects the economics of users, as there are both functional and structural failures as a result of poor drainage.³

Various tests conducted on 7 kerbs after 3 years of construction are mentioned in this research article. Compressive strength, water absorption, freeze-thaw resistance (resistance to internal cracking), and capillary absorption (internal cracking and surface scaling) were among the tests carried out. Only two of the seven kerbs passed the freezing and de-icing salt resistance tests.⁴

III. OBJECTIVE

- To study and analysis a substitute material which is more economical and eco-friendly than the concrete kerb.
- To design the envirokerb.
- To prepare a 3D model of kerb in CATIA software.
- To analysis the concrete and rubber envirokerb in ANSYS software.

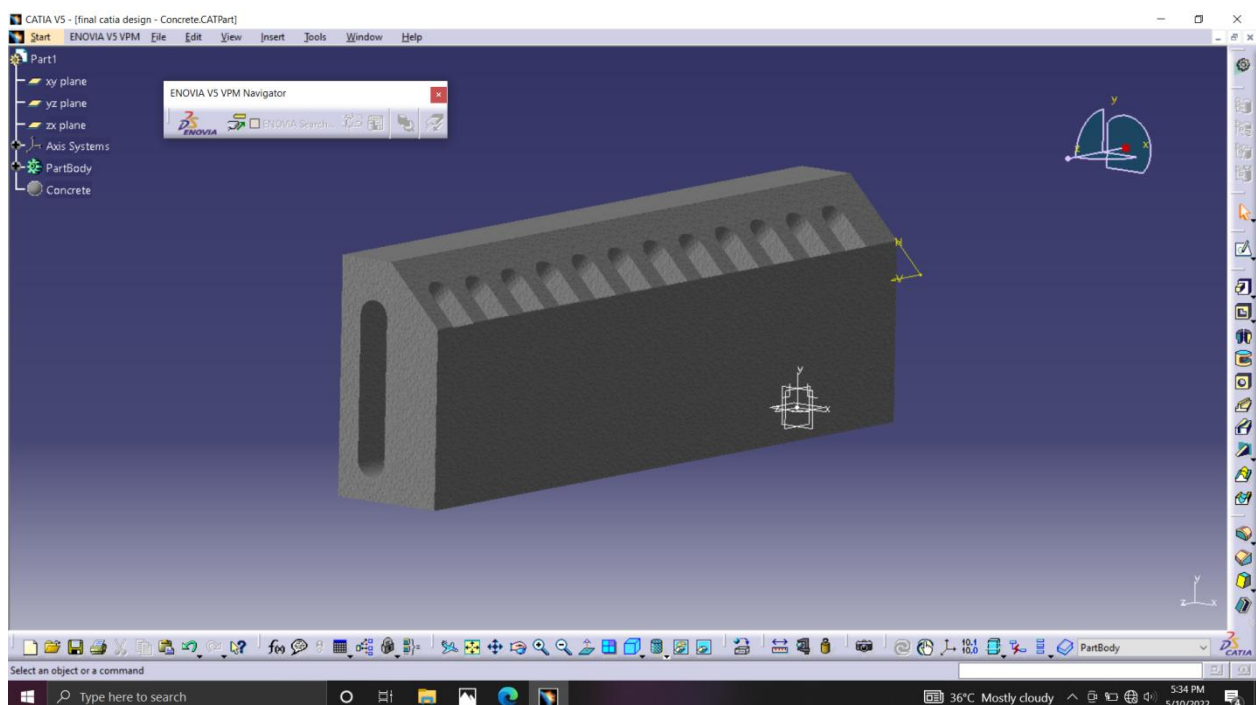
IV. METHODOLOGY

To achieve the objective, the following process is carried out to show the methodological structure of the research.

- **Design 3D Model:**

Computer Aided Three Dimensional Interactive Application (CATIA) is a software from Dassault systems, a France based company. CATIA delivers innovative technologies for maximum productivity and creativity, from the inception concept to the final product.

CAD Model Of Kerb:

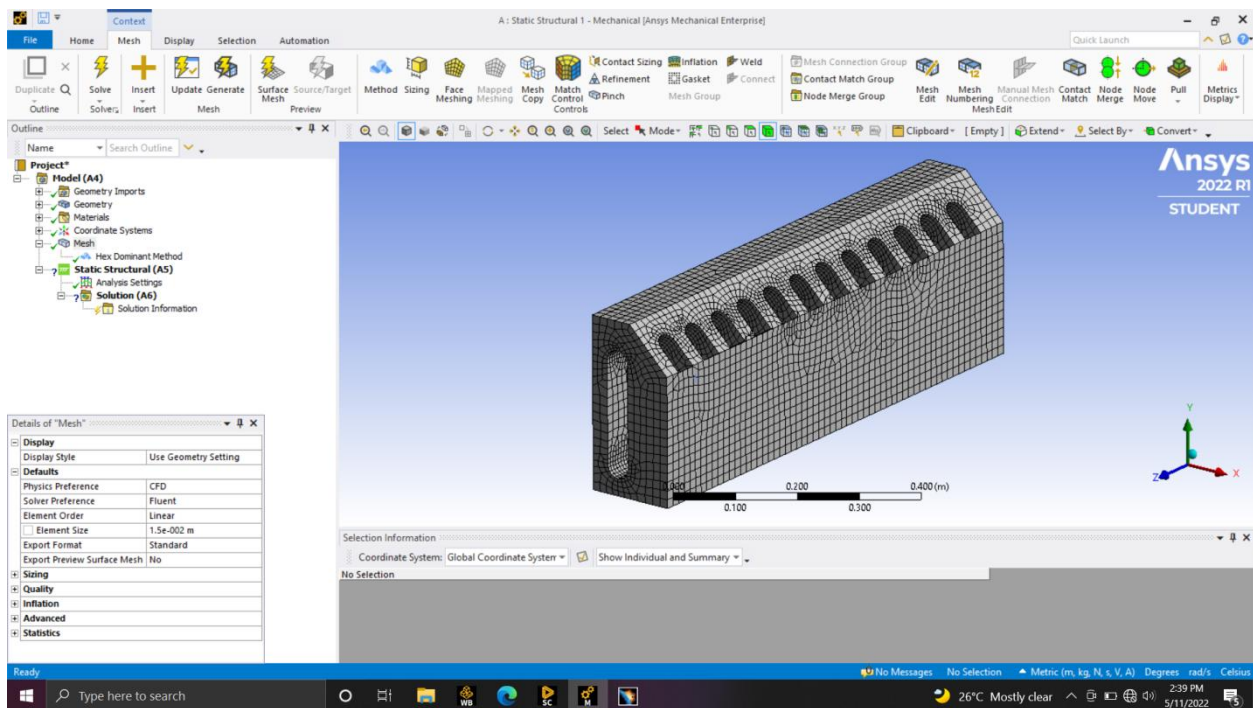


- **Analysis Of Kerb In Ansys Software:**

Analysis is done by selecting appropriate solver and carrying out the operations in various stages to obtain solution. Particularly analysis is carried out in three stages by performing various operations in software.

Meshing:

Initially the step file is imported to the meshing software ANSYS. The CAD data of the Kerb is imported and the surfaces were created and meshed. As all the dimensions of Kerbs are comparable the element for meshing the Kerb is Shell 181 (2D Mesh Element Type).



- **Static structural analysis:**

In this study the static structural analysis is done for the three materials.

- Concrete
- Rubber
- polyethylene

V. RESULTS

After analyzing and working through different aspects on the basis of the properties of substitute materials using software analysis, the overall study shows that rubber and polyethylene can be used as substitute kerb materials.

VI. CONCLUSION

In this project, Envirokerb is conceived and modeled. Envirokerb is one of the fastest-growing kerb systems because it uses recycled materials such as rubber, plastic, and polyethylene. Finite element analysis was performed on concrete, rubber, and polyethylene in this study. CATIA is used for three-dimensional modeling, and ANSYS is used for analysis. Rubber or polyethylene can be utilized as a concrete substitute, according to the findings. Kerb stones are environmentally benign since they conserve topsoil and make use



of rubber or polyethylene waste products. It is more durable than regular Kerb stones. It is critical in the reduction of carbon-dioxide emissions, a damaging greenhouse gas that threatens to put the earth's atmosphere out of balance.

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