PROJECT1: DESIGN FOR MANUFACTURABILITY IN COMPOSITES

COMPANY: MAHINDRA COMPOSITES, PUNE
GUIDE: NACHIKET THAKUR
Duration: 5th May to 5th June

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INTRODUCTION TO MAHINDRA COMPOSITES

- Mahindra Composites, formerly Siro Plast ltd., is a branch of the Mahindra Systech, which is a part of the various business sectors of Mahindra Group.
- Basically established by M&M in 1982 with SICOM
- Mahindra Systech consists of various manufacturing units as MUSCO, Mahindra stampings, Mahindra castings, etc.
- The design activities undertaken by Mahindra Composites consists of Product Concept Designing, Prototyping and Mold Development

ACTIVITIES UNDERTAKEN AT MAHINDRA COMPOSITES

- Raw Material – Compounds:
  - Sheet Molding Compound (SMC)
  - Dough Molding Compound (DMC)
- Manufacturing Processes:
  - Compression Molding
  - Resin Transfer Molding (RTM)
  - Hand Lay Up (HLU)
- Design Activities:
  - Product Concept Designing
  - Prototyping
  - Mold Development

PRODUCTS DEVELOPED FOR

Automotive Sector

Electrical & Switchgear

Farm Equipment Sector

Railways

Medical Equipments

Defense Equipments

FEW EXAMPLES OF THE COMPANIES PRODUCTS

Front Fender

CNG Cover + Driver Seat Support

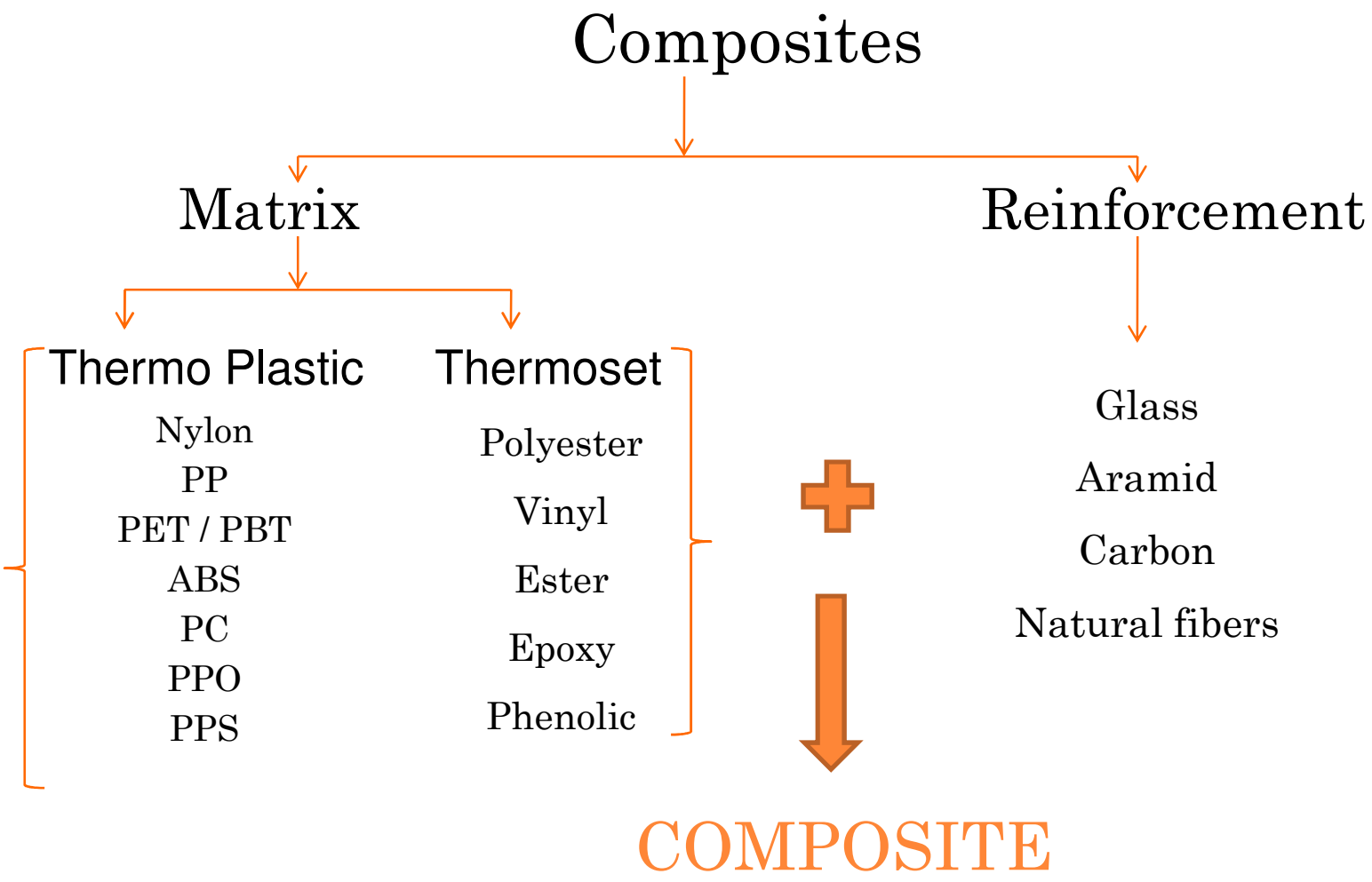
Engine hood for commercial vehicles

Scuttle Lamp Housing for tractor

Introduction to composites

COMPOSITE MATERIALS AND COMPOSITE MANUFACTURING TECHNIQUES

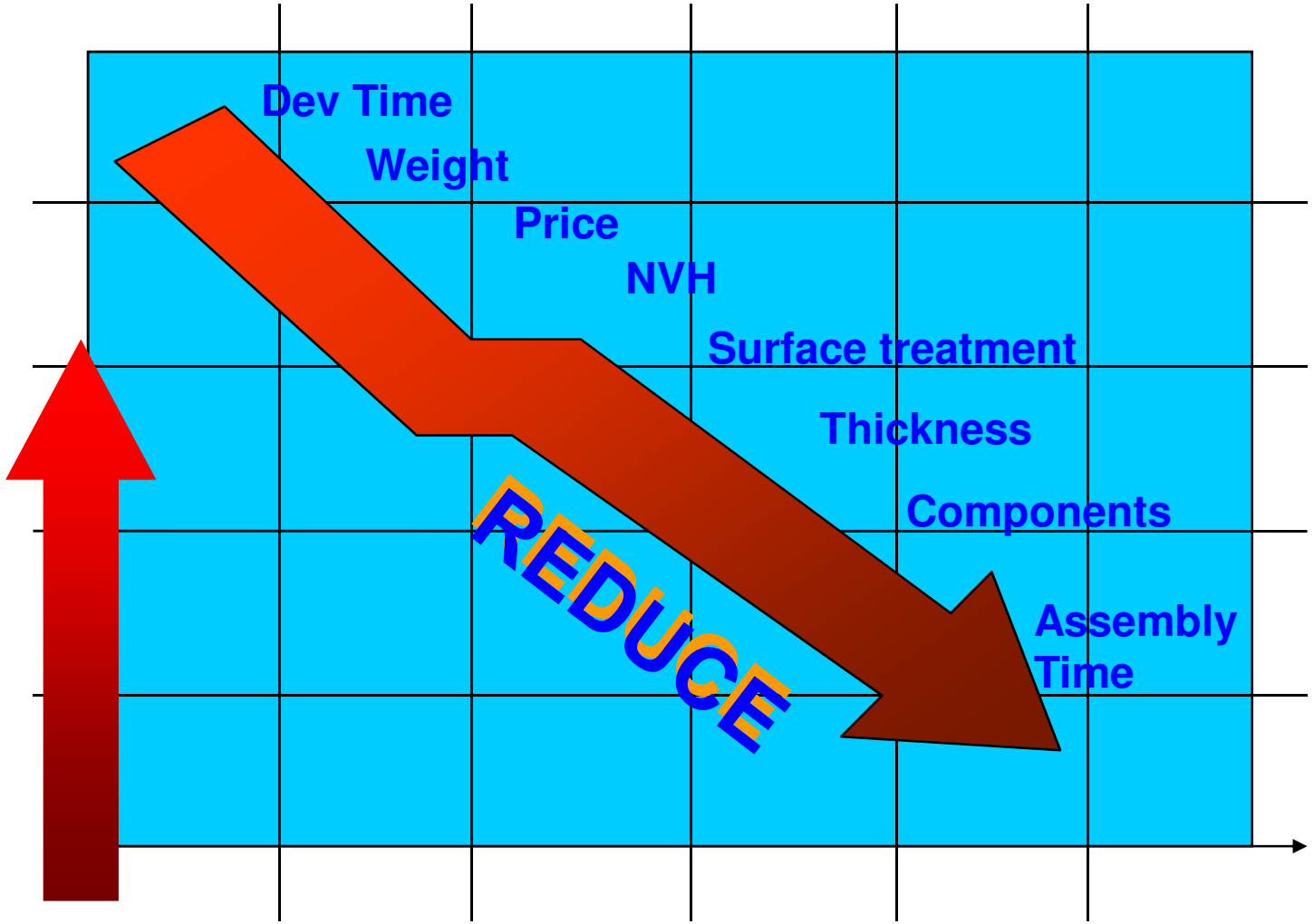
- Understanding Composite manufacturing process
  - Composite materials are those that are formed by the combination of two or more materials, especially load bearing fiber as reinforcement, and matrix as binder, to achieve properties that are superior to those of its constituents


Composites
Matrix
Reinforcement
Thermo Plastic
Nylon
PP
PET / PBT
ABS
PC
PPO
PPS
Thermoset
Polyester
Vinyl
Ester
Epoxy
Phenolic
Glass
Aramid
Carbon
Natural fibers
COMPOSITE

COMPOSITES MANUFACTURING TECHNIQUES

- Hand lay up / spray up
- Vacuum bag / autoclave moulding
- Tape layering
- Compression molding
- Glass matt thermoplastic (GMT)
- Resin infusion moulding (RIM)
- Resin transfer moulding (RTM)
- Injection moulding
- Filament winding
- Pultrusion
- Thermoforming

ADVANTAGES



- Increase Design Flexibility, Surface finish, aesthetics, aerodynamics
- Dent resistance, Corrosion Resistance

Design for manufacturability in composites

OBJECTIVE

- To re-design and modify the vehicle concept to suite composite manufacturing process.

- Component level detailing according to the composite manufacturing process and materials

INITIAL INPUTS

- The basic configuration and structure of the concept was already finalized
- Process selected for this project is SMC (compression molding)
- Process provides high volume production, both side finish, ease in painting, light in weight
- Panels to be assembled by bonding
- Panels to be designed with optimization of form and manufacturability

PROJECT OUTPUT (AS PER THE COMPANY'S REQUIREMENT)

- 3D CAD data – Pro E
- BOM of the vehicle components – Excel
- Weight and cost calculation of components
- Exploded views of the vehicle – Images
- Concept presentation in .ppt file
- Project Report in print

EXITING PRODUCT SURVEY

Cree SAM

Aptera

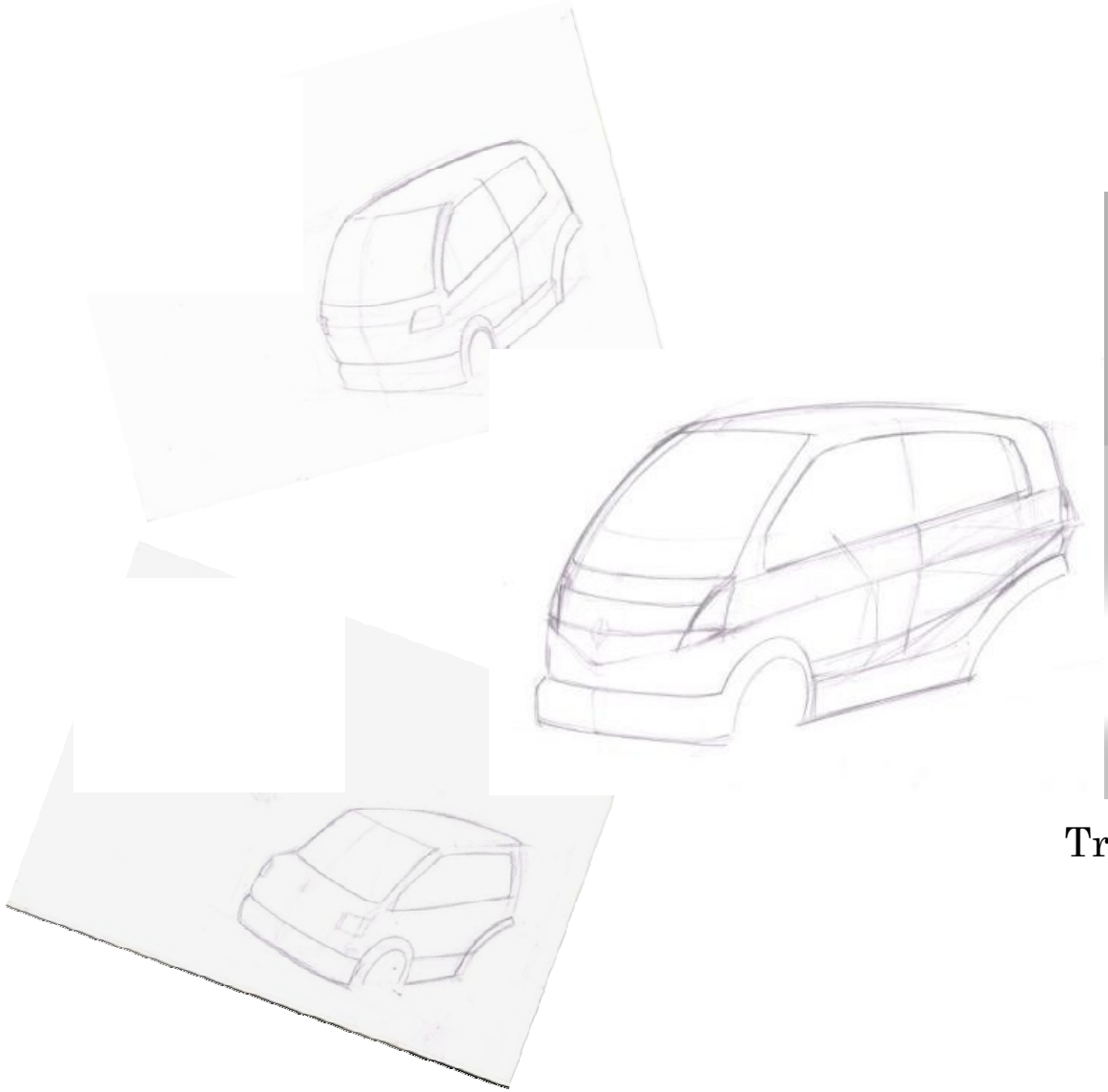
Lumeneo SMERA

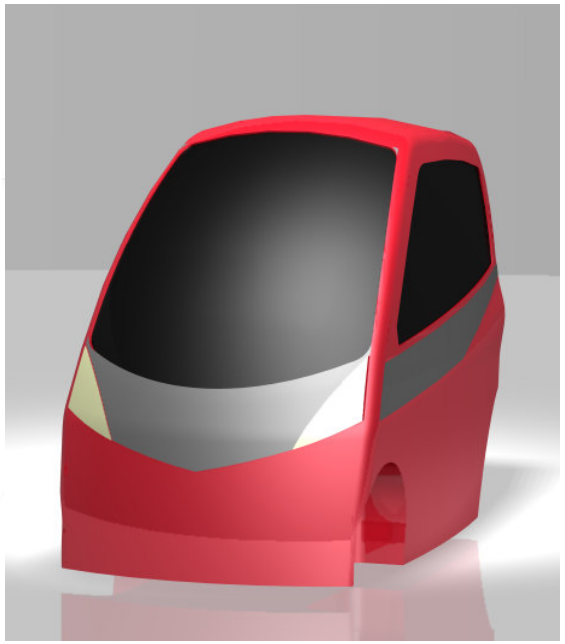
NMG Sparrow

DESIGN PROCESS

- Modifying the basic rough form of the existing concept
- Design and developing the load floor of the vehicle
- Design and development of the final 3d form of the vehicle
- Breaking down the external body into individual components
- Detailing each component according to manufacturing
- Design and development of the interiors

Basic initial form exploration

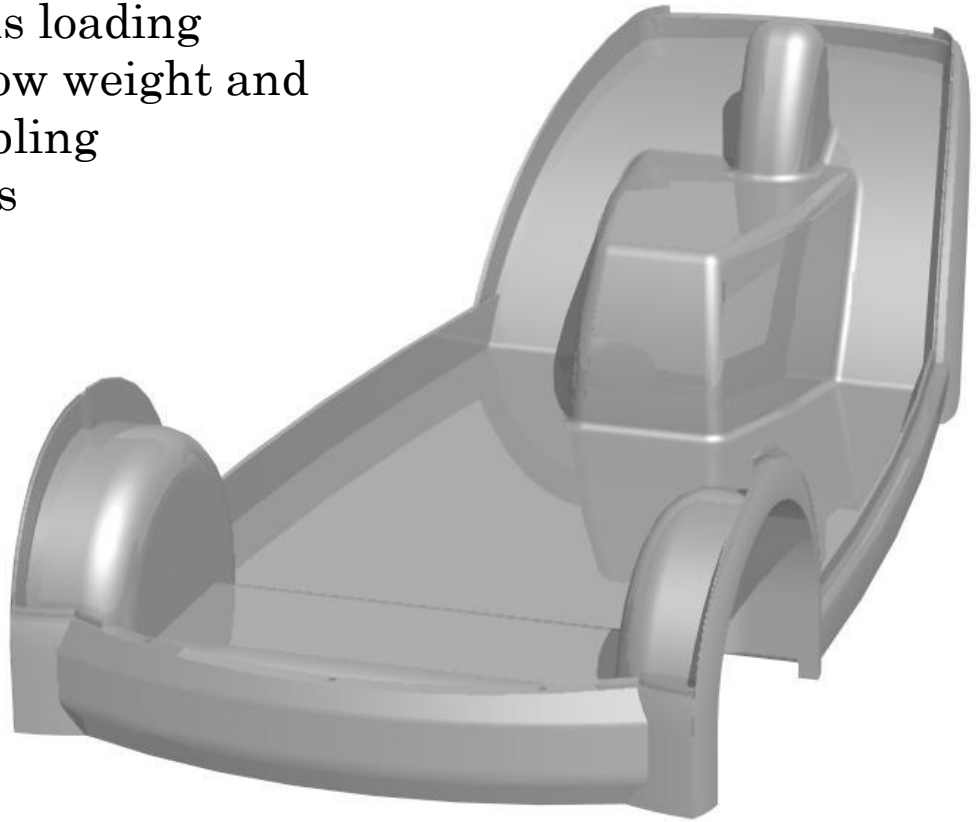




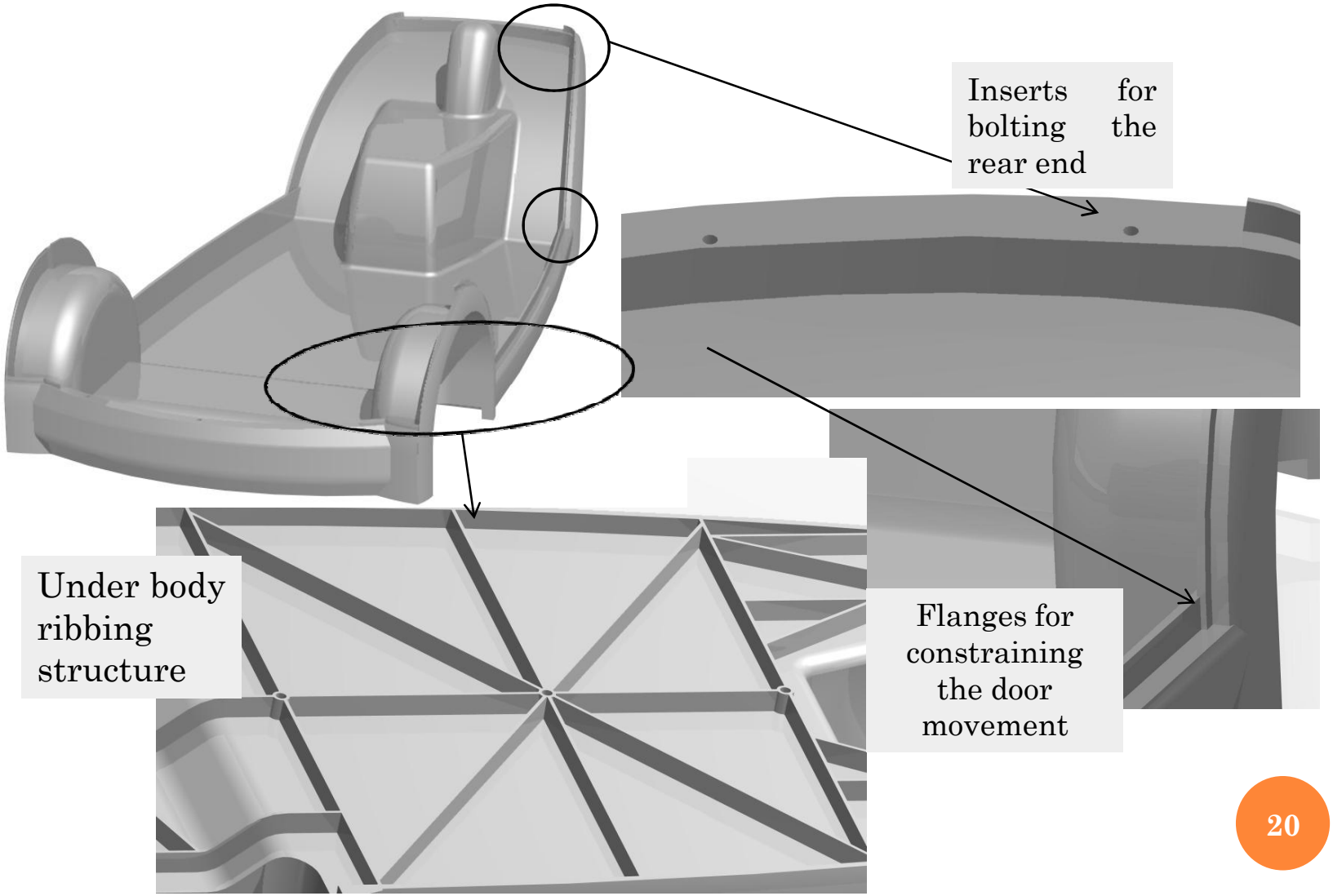
Trial modeling for basic shape

DEVELOPMENT AND DESIGNING OF LOAD FLOOR

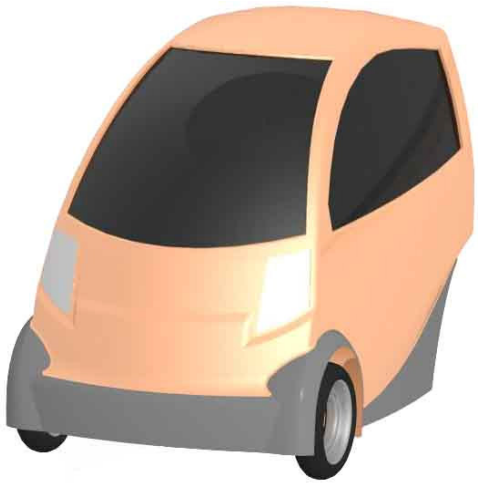
- Designed optimally according to the various loading conditions, low weight and other assembling requirements

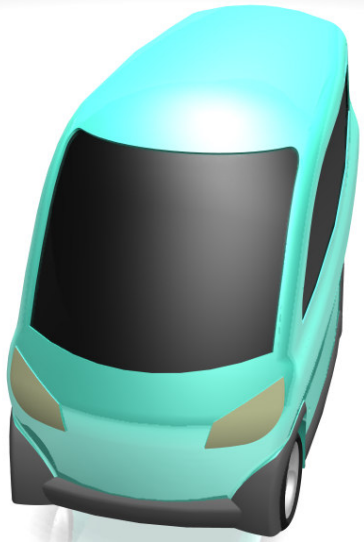


DETAILING OF THE LOAD FLOOR



3D FORM EXPLORATION



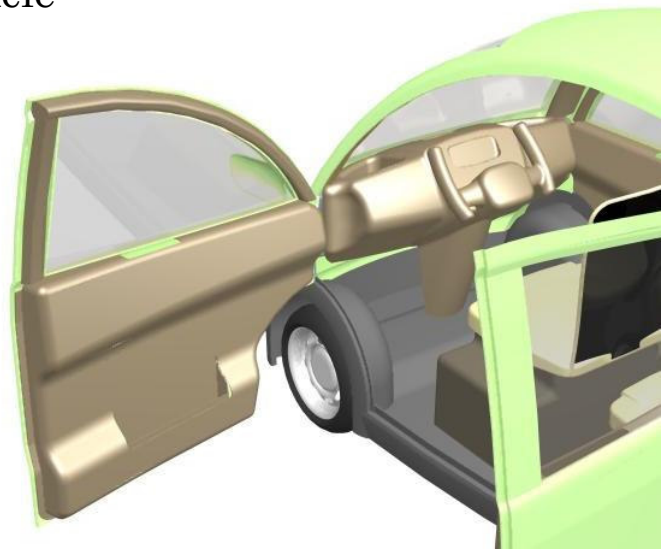


FINAL FORM

Basic Information

- Two Seater
- Tandem seating
- Suicide doors
- Compact dimensions

The components, both external as well as interior panels, were designed considering ease in manufacturing for composite process and also considering the basic form of the vehicle

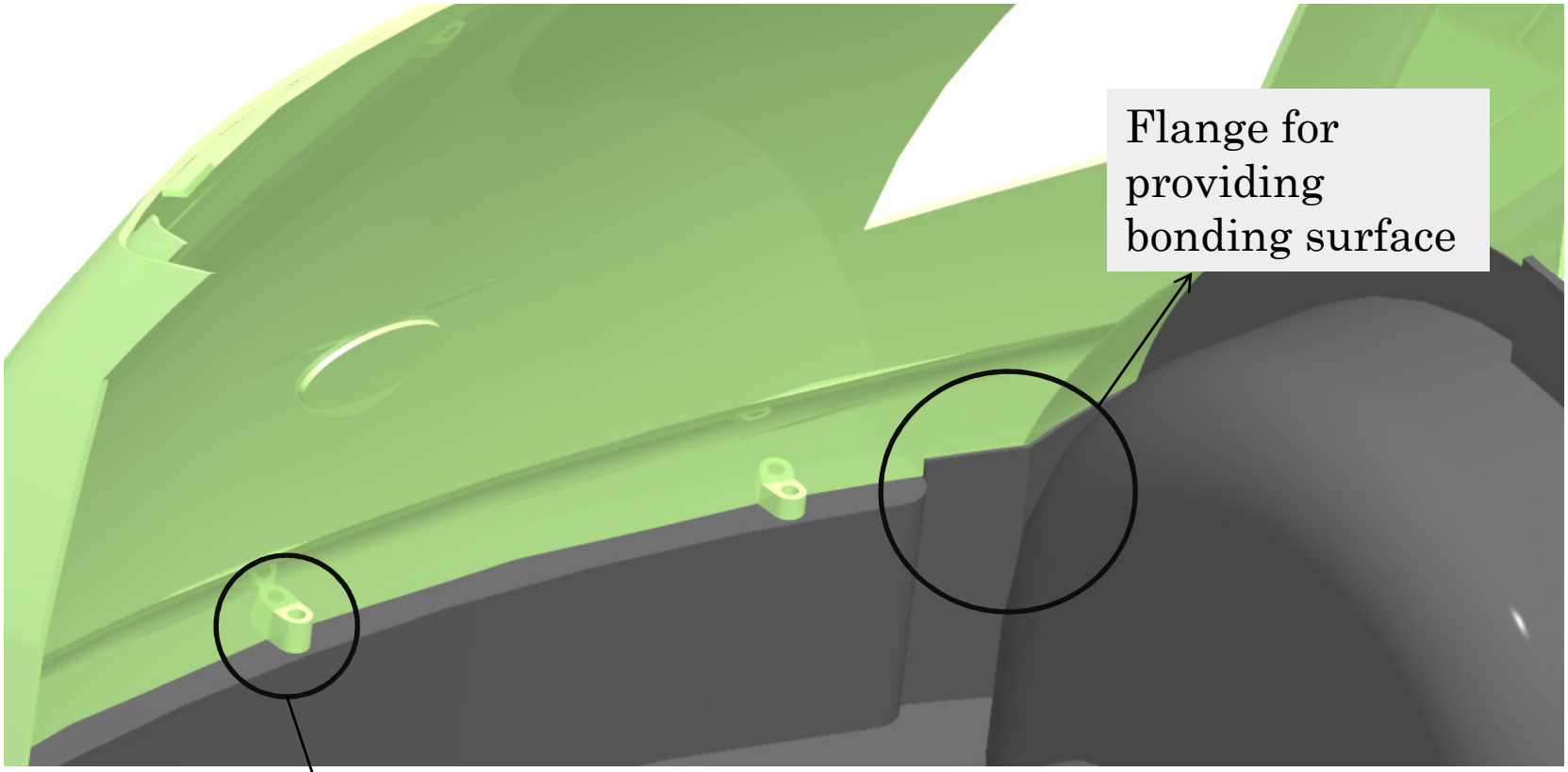


Detailing to components

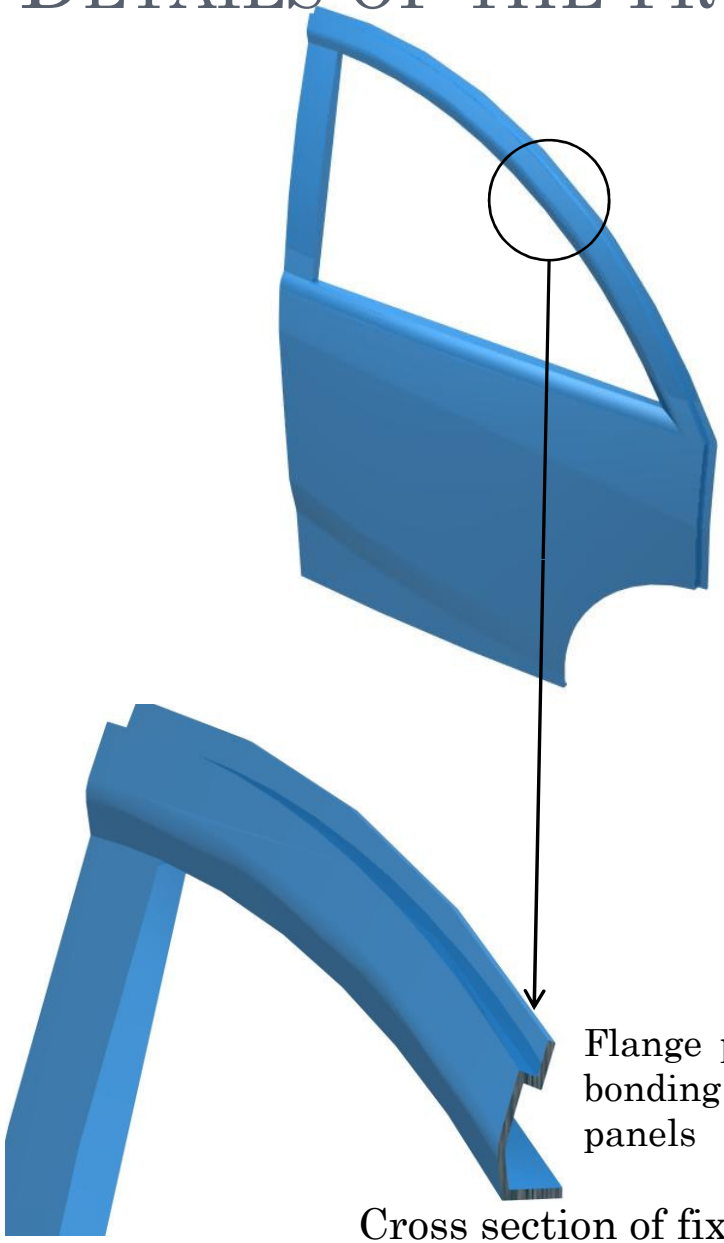
- Exploded view

Detailed explanation

- Front body panel and Load floor

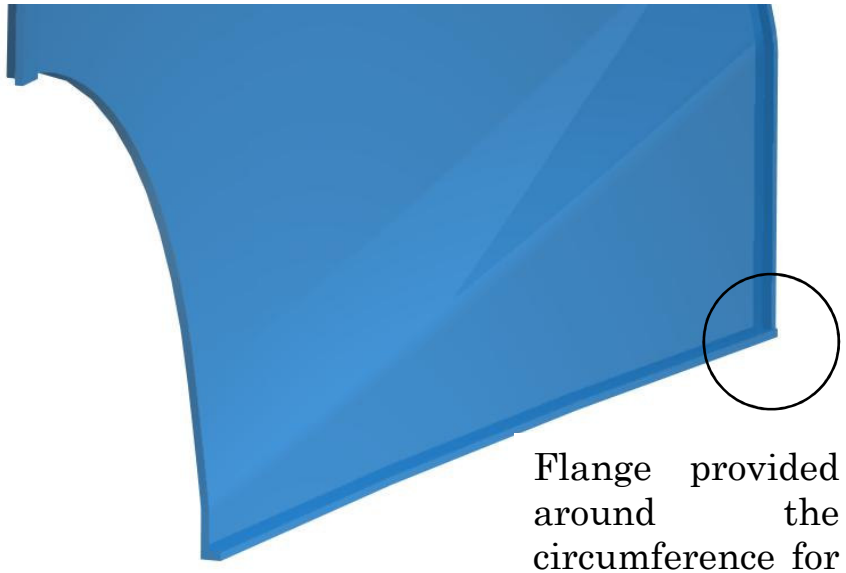


DETAILS OF THE FRONT FIXED DOOR



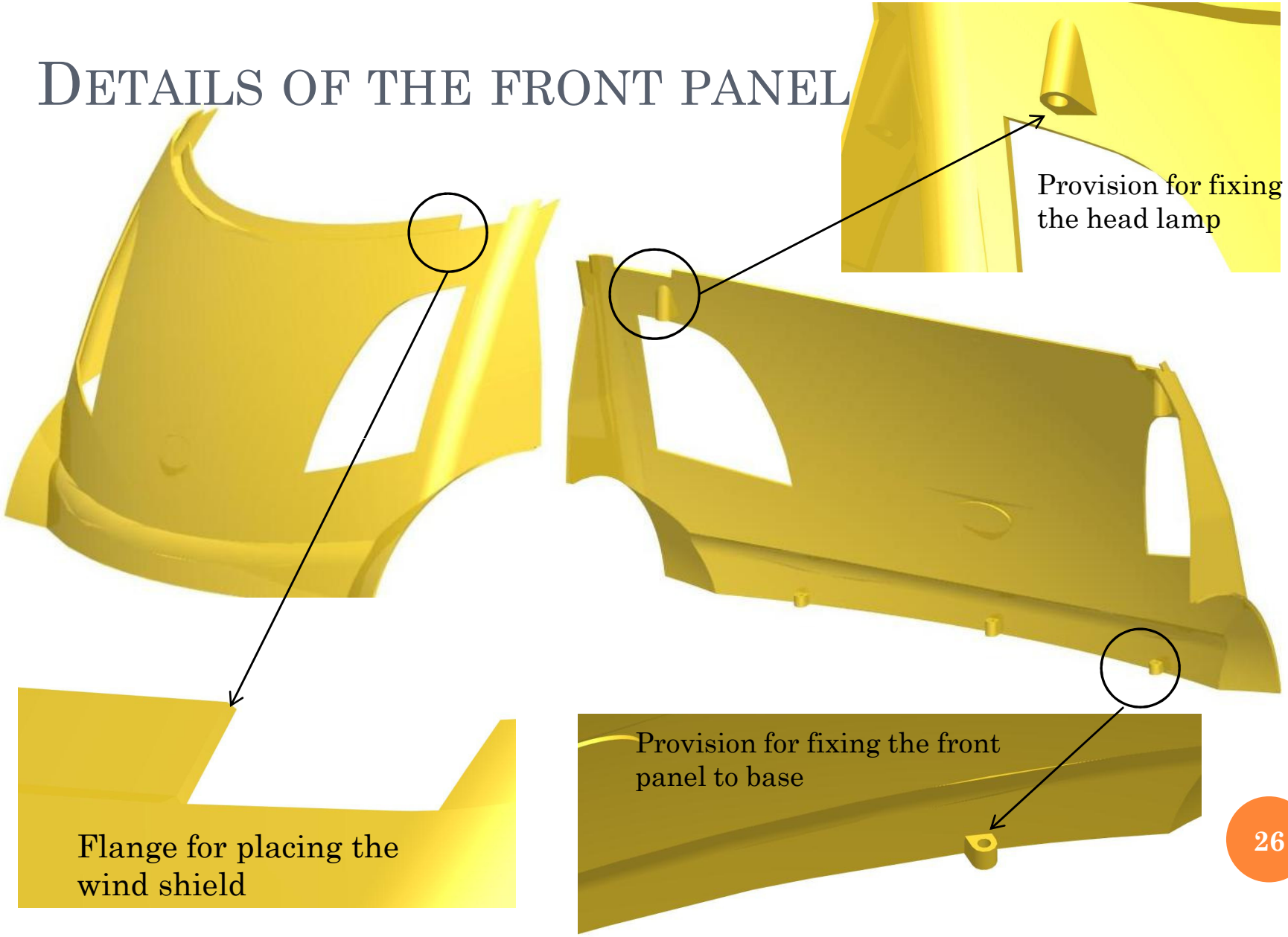
Flange provided for bonding on other panels

Cross section of fixed door



Flange provided around the circumference for providing extra rigidity

DETAILS OF THE FRONT PANEL



MY PROJECT WILL LEAD TO..

- Understanding of no. of components, product detailing and cost
- 3 D CAD data generated on PRO-E will be used directly
- Soft validation will be done using this CAD data
- This will facilitate prototype manufacturing

EXPERIENCE

- Knowledge gained enormous from fields of manufacturing, composite material and manufacturing, design & development activities, etc.
- Learnt a lot regarding the automobiles and aspects concerned while converting a concept to almost a final product
- Importance of interaction with various people directly or indirectly involved in the project
- Finally the understanding of a component, the material and implementing proper technique and material for achieving the desired output as a component.

LIST OF PEOPLE INVOLVED IN THIS PROJECT

- Mr. Nachiket Thakur, DGM, PDDC, Mahindra Composites Ltd., Pune
- Mr. Tapan Basu, Sr.GM, Alternative Energy Vehicles, Mahindra.
- Mr. Pravin Phatak
- Mr. Vivek Kulkarni
- Mr. Manoj Gaikwad

REFERENCES:

- Reinforced Plastic Handbook – John Murphy
- www.azom.com
- www.wikipedia.com
- www.composites-by-design.com

THANK YOU