



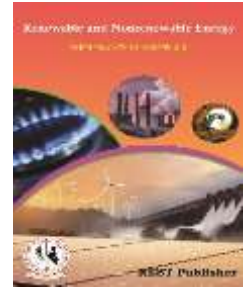
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Structural Performance Enhancement through Wall Thickness Optimization of Center Fascia

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Abstract: The main scope of the project is to design centre fascia for three different materials (plastics, steel, wood) used on three different variants of car. To achieve this, it is proposed to design centre fascia with three different wall thickness using cad tool i.e.; CATIAV5. The whole instrumental panel will be taken as an input. With the help of the supplied input different proposals of centre fascia will be proposed to the customer. The proposals will be developed by using master sectioning once the proposal is finalized by the customer, A-surface of the centre fascia will be developed with the help of master section. Once the A-surface is developed, the prepared surface will be offset to the desired thickness depending upon the material. This offset surface is called as B-surface. While developing the B-surface all the non-offset areas are to be solved using CATIA. On the later part, engineering features are created to the solid model so that it will fit with the instrumental panel assembly. Once the model is finalized, the complete model will be sent to the customer for the final review. Once the model is reviewed by the customer, modifications will be made to the design based upon the feedback received.

Keywords: center fascia, Wall thickness, instrumental panel, ABS+PC

1. INTRODUCTION

The center fascia in an Automobile refers to the control-bearing surfaces in the center of the front of the vehicle interior, the area beginning in the dashboard and continuing beneath it, and often merging with the transmission tunnel which runs between the front driver's and passenger's seats of many vehicles. Most of the cars commonly include entertainment and climate system controls, auxiliary power outlets, and sometimes widow controls when these are not in the doors. Increasingly, centre fascia include a wide variety of options like outside temperature display and controls (car audio) entertainment media: AM/FM radio, satellite radio, CDs MP3, GPS navigation, Bluetooth etc. Generally, plastic materials are used to manufacture the centre console frames (console frame). Designing a console frame is always a challenging task, because with-in a design/package space it should be robust enough to with-stand the various design and abusive loads.



FIGURE 1. Centre fascia portion

From the above figure No.1 shows the full portion is called instrumental panel and the marked portion called centre fascia which is my current project. The centre console in an Automobile refers to the control-bearing surfaces in the centre of the front of the vehicle interior. Designing a central console frame is always a challenge task, because with-in a design/package space it

should be robust to with-stand various structural and abusive loads. Free-size optimizations are performed on console frame to get the optimal material distribution and wall thicknesses

Tool used:

CATIA is ICEM Shape introduction in the CATIA V5 portfolio sustaining its principles of seamless data flow using one common data format throughout the CATIA V5 portfolio across all phases of the design cycle, ICEM Shape Design (ISD) R20 extends its advanced and powerful free form surface creation, modification, and analysis capabilities within the Class A modelling domain. Protecting your investment in previous releases and supporting seamless migration, ISD R20 further adopts and supports CATIA V5's trusted methodology and proven update mechanism.

2. DEVELOPMENT OF CENTRE FASCIA

Optimization of wall thickness for centre fascia:

Optimization is a procedure used to make the effective design and reduce the material where ever it is not required, resulting material savings. Size optimization is useful in optimizing the shell thickness, beam cross sections, spring stiffness. In this paper, free-size optimization is performed on automobile console frame to get the optimal material distribution and wall thicknesses. The structural design process relies on the optimum solution being found through prior knowledge, engineering experience and simple trial and error methods. Centre fascia is subjected to various design and abusive loads. So, optimized model should be robust and be able to with stand all the loads and meet the frequency targets.

3. MATERIAL USED FOR DESINGING

In this project we used the material is ABS+PC.

PROPERITIES OF ABS+PC:

1. Density 1.0-1.05g/cm³
2. Melting Temperature: 80 -95⁰ c
3. Good shock absorbance
4. Electroplating property
5. It is strong and impact resistant
6. Can be made in many colours
7. Good surface finish property
8. Heat resistance
- 9.15 to 35% acrylonitrile, 5 to 30% butadiene and 40 to 60% styrene
10. The styrene gives the plastics shiny, imperious surfaces. The butadiene, rubbery substances, provides resilience even at low temperatures.

APPLICATIONS:

1. Injection moulding
2. Blow moulding
3. Thermo forming

USES:

1. Light rigid, moulded products such as piping, musical instruments (most notably recorders),
2. Golf club heads
3. Automotive body parts
4. Wheel covers
5. Enclosures, pipes, toys

POLY CARBONATE (PC):

1. Density 1.2 gm/cm³
2. Melting temperature:267⁰ c
3. Excellent Toughness
4. Thermal stability
5. Very good dimensional stability
6. High transparent
7. Chemical Resistance
8. Good optical properties

APPLICATIONS:

1. Injection moulding
2. Blow moulding
3. Thermo forming

USES:

1. Compact Discs
2. Riot shields
3. Baby feeding bottles
4. Electrical components
5. Safety helmets
6. Headlamp lenses
7. Food containers
8. Chemical pipette, burette, conical flask

These are the plastics materials which are used in this project.

4. INPUT GIVEN

An input received of Legacy part with carryover parts and New A -surface of the instrumental panel.

Comparison of legacy part and new 'a' surface:

Legacy Part: From the below figure.No.2 shows the Legacy part has leather skin on top of it which acts as a texture. This legacy part is a solid component where our new instrumental panel given is only a thin surface for which case studies has to be done with respect to the carryover parts and then it has to be converted to solid model by optimizing the wall thickness according to material selection. Carryover parts mean assembly parts which have relation with instrumental panel.

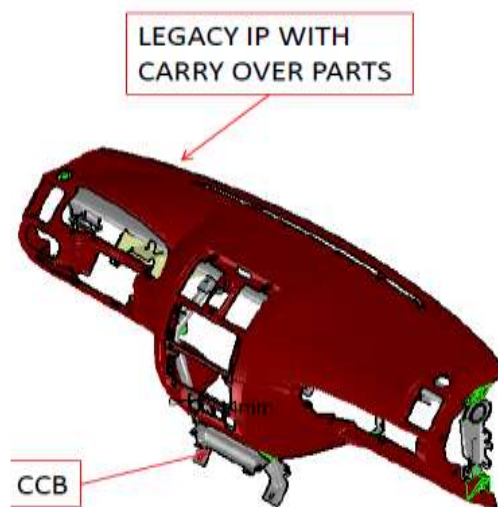


FIGURE 2. Legacy part of I.p

New A Surface: From the below figure No.3 shows the new A surface covered with leather skin is eliminated and texture is obtained by maintaining the draft angle 16.5 degrees on top and 7.5 degrees on bottom. It is a thin surface for which case studies has to be done with respect to the carryover parts and then it has to be converted to solid model by optimizing the wall thickness according to material selection .By increasing draft angle itself acts as a texture.

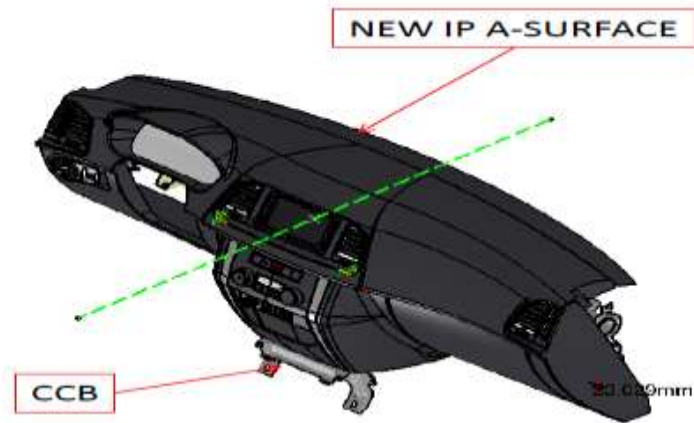


FIGURE 3. New Ip A surface

Case Studies: Assembling parts of centre fascia for which case studies is being done:

1. CCB-cross car beam
2. Blower assembly
3. Cassette Din
4. Cigarette lighter
5. Climate control
6. Remote heater auto

These are the different technical cut sections where we are going to do case studies
 .To checks the clearance, clash analysis, and flush analysis for given input case studies.

Case Study for CCB

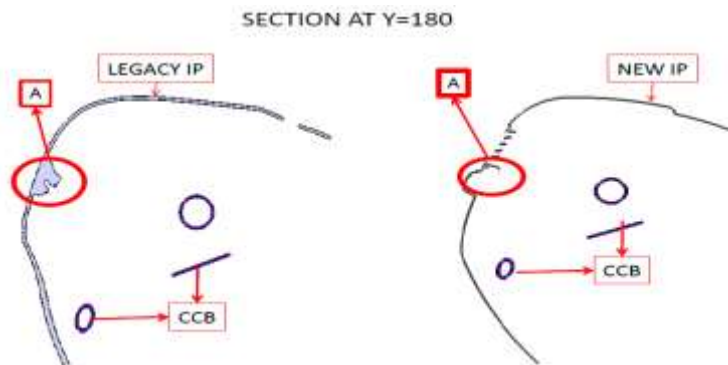


FIGURE 4. CCB Section at y=180

In Detailed view

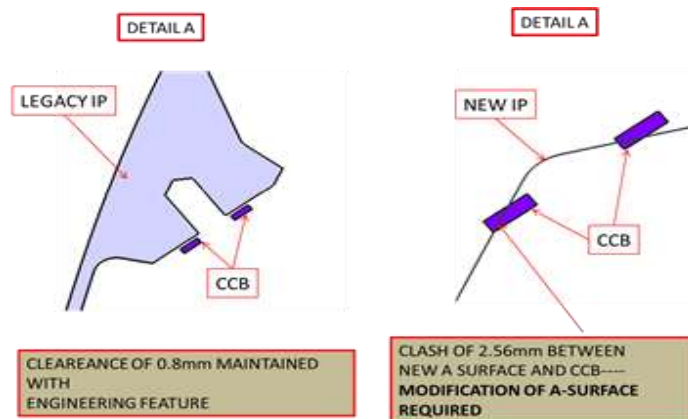


FIGURE 5. Detailed View of CCB

In above Fig.No.5 shows 0.8 clearance between legacy instrumental panel and cross car beam there is a clash of 2.56 between new instrumental panel and cross car beam which will damage new instrumental panel which modifications require in A-surface where as

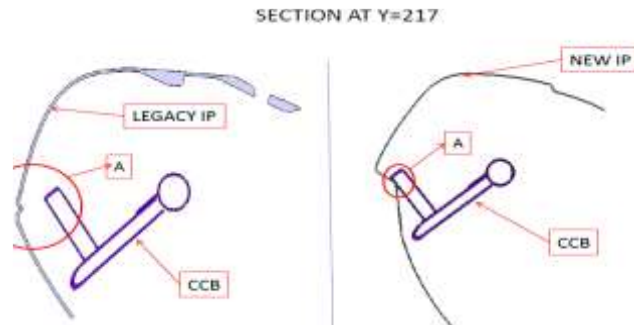


FIGURE 6. CCB Section at Y=217

In Detailed view

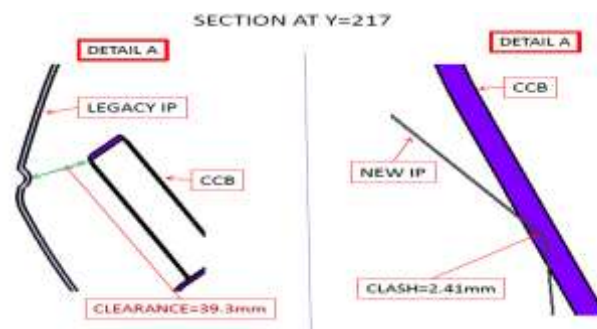


FIGURE 7. Detailed View Of CCB

There is a clearance in the above Fig.No.7 shows 39.3 between legacy and instrumental panel where as we have clash of 2.41 in new instrumental panel for which A surface should be modified. Rest of case studies are same as above.

Methodology for designing:

PROPOSAL OF CENTRE STACK

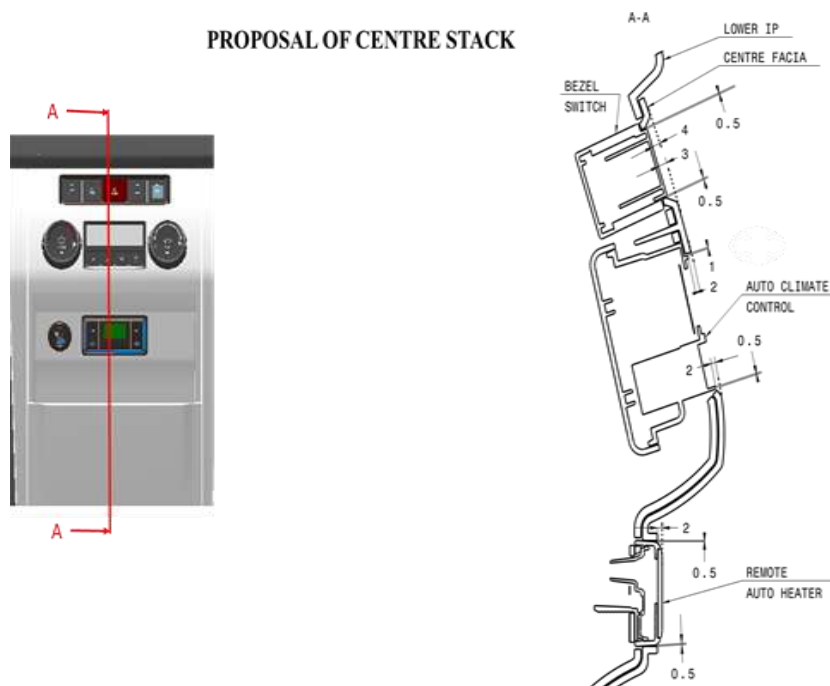


FIGURE 8. Proposal of centre stack

We will check in the above Fig.No.8 shows the proposals or Master sections for centre fascia, and to check the clearance clash analysis and flush analysis.

To check the Tangency continuity and Curvature continuity for given input surfaces

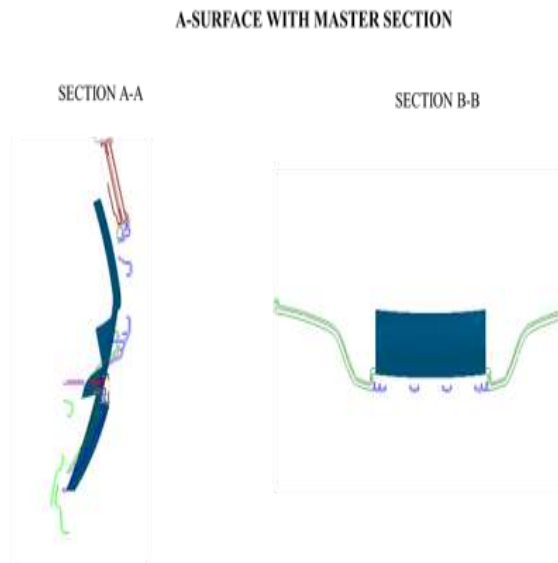


FIGURE 9. A surface with master section

Above figure.no.9 shows the A Class surfacing and its importance: A class surfaces are those aesthetic/ free form surfaces, which are visible to us (interior/exterior), having an optimal aesthetic shape and high surface quality.

Mathematically class a surface are those surfaces which are curvature continuous while providing the simplest mathematical representation needed for the desired shape/form and does not have any undesirable waviness.

Curvature Continuity: It is the continuity between the surfaces sharing the same boundary. Curvature continuity means that at each point of each surface along the common boundary has the same radius of curvature.

Here, Generative shape design surfaces are showed in below fig.no.10 describe clearly

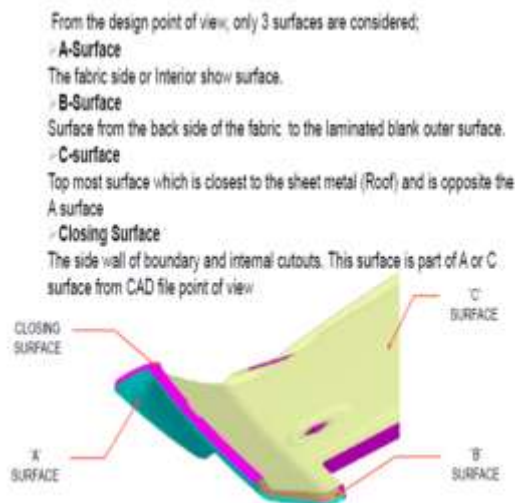


FIGURE 10. Generative design surfaces

Craftsmanship for a surface: Check the Tangency continuity and curvatures continuity for given input surfaces. Draft analysis provided to check the manufacturing feasibility of the component. It also tells whether the component is clearing tooling direction

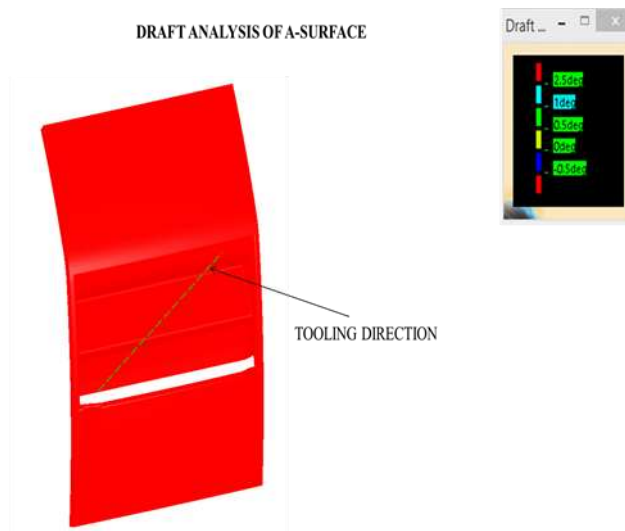


FIGURE 11. Draft analysis of a surface

1. Provide a minimum of 1 deg draft.
2. Parts made from hard materials (e.g. PS, PC, Acrylic etc.) should have larger draft angles.
3. For textured surfaces add additional 1 deg draft per 0.025 mm.
4. Parts with deep draw should have more draft.
5. Lifters and slides should be designed with draft in consideration

Creating B Surface: Offset the B surface with 2.5mm thickness surface from the backside

Parting Surface: The connecting surfaces between A and B surfaces is called parting surfaces.

Main Toolind Direction: The direction of pull required for mold opening.

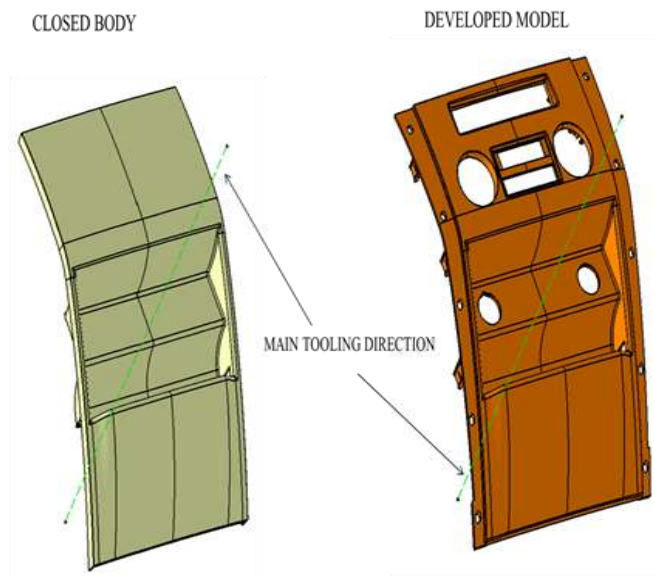


FIGURE 12. Closed Bodies

Closed Body: We will cover into the Solid body with respect to the closed surface.

Closed Body Draft Analysis: To identify the parting line we will check the draft analysis for the closed body

Parting Line: we created the parting line with respect to draft analysis done for the closed body .The parting line is to split the core and cavity.

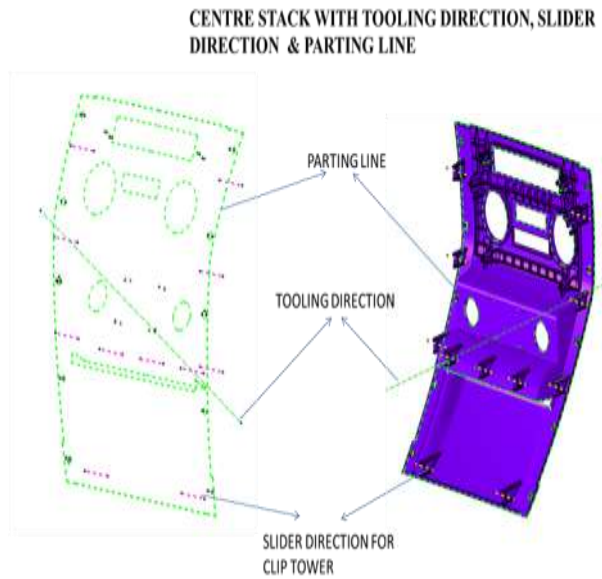


FIGURE 13. Developed Models

Lifter and slider direction:

Lifter and slider directions are given for overhanging parts which are not cleared by the main tooling direction.

Engineering features:

RIBS

- 1 .Ribs is added to improve the strength of the design.
2. If designed properly ribs can improve the melt flow dynamics
- 3 .Ribs can also be used as locating features
4. For hard plastics (e.g. ABS, PC) rib thickness should not exceed 75% of nominal (60% would be ideal).
5. For soft plastics (e.g. PP, PE) the rib thickness should not exceed 50% of nominal.

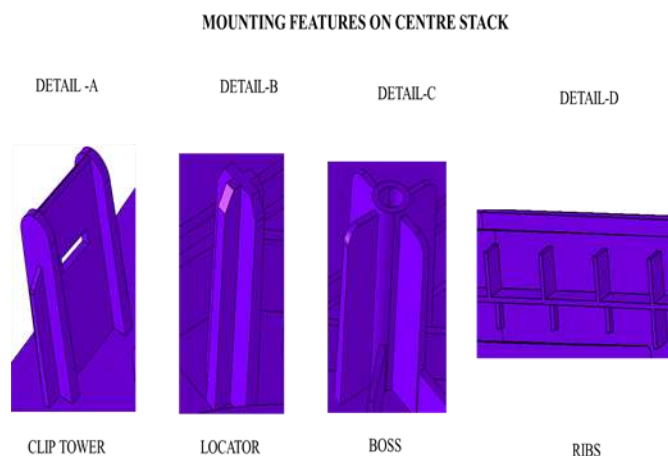


FIGURE 14. Engineering Features

1. Radius at the junction should be 25% of nominal. Rib height should be between
2. 2.5 to 5 times the nominal wall thickness
3. The distance between two ribs should be at least 2 times the nominal wall thickness.

4. Free standing ribs should be avoided.
5. Ribs should have a draft of 0.5 to 1.0 degree per side.

BOSS:

1. Bosses can be used to impart strength, or as an attachment and a locating Feature.
2. Feature.
3. It is recommended to add gusset plates to bosses used as an attachment feature.
4. Independently gussets can also be used as flow enhancers and as strength.

LOCATER:

It is used for locating purpose.

CLIP TOWER:

It is a good lead in for the fastner. The designer can speed the assembly by adding lead in to his design.

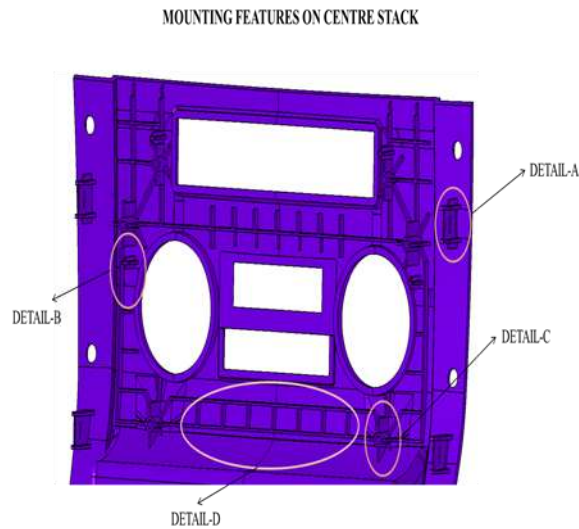


FIGURE 15. Mounting features on center stack

5. RESULT

From CATIA V5, according to the given input the designed product is

DEVELOPED MODEL WITH MOUNTING FEATURES

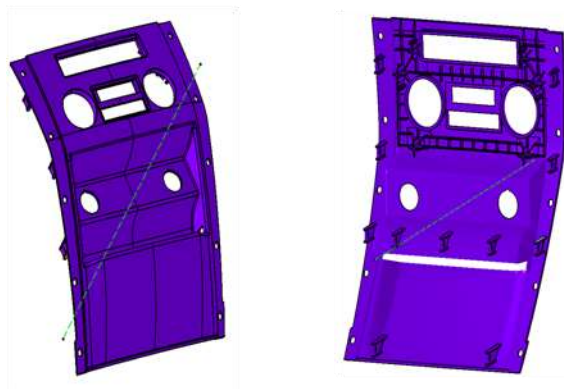


FIGURE 16. Developed Model with mounting features

Crash Analysis: To check the manufacturing feasibility crash analysis had been used. From Crash analysis it can be said the plastics is preferable from comparing the three materials used (wood, steel, plastics) respectively on three different variants of cars

Comparison of materials:

TABLE 1. Comparison of Materials

property	Wood	steel	plastics
strength	Very low	low	high
weight	High	Very high	low
cost	High	medium	low
manufacture	Difficult	medium	easy
availability	Low	medium	high
utility	Non reusable	reusable	reusable

CENTRE STACK WITH DIFFERENT MATERIALS



FIGURE 17. Centre stack with different materials

Wood :

Advantages :

- 1.Wood give good astehtics look and fine finishing
- 2.Material is durable &cost effective.
- 3.It can with stand any other climate change.

Disadvantages:

- 1.It has less impact strength, manufacturing is more costly,
- 2. But manufacturing of complex shapes like center facia is difficult.
- 3. It has less tensile strength over other materails.
- 4. there is no color varients over other materials.it cannot be reuseable.
- 5. Maintance of wood is costly

Steel :

Advantages:

- 1.It has impact strength very high.
- 2.good surface finish ,
- 3.It has good strength.
- 4.Good phycial properties.

Disadvantage:

- 1.manufacturing of the center fascia in steel comparatively more costly over other materials
- 2.it is difficult to manufacture complex shape like center fascia.
- 3.There is no color options
- 4.If any collusion happens it will be harmful.
- 5.Assembling is complicated.

Plastics:

Advantages:

1. It is Lighter than metal.
2. Can be easily manufacturable, so processing is easy.
- 3 .It has Good surface properties. Smooth, even surface can be achieved.
- 4 .Manufacturing processes is economical.
- 5 .Plastics have good optical properties.
- 6 .It is Good insulators.
- 7 .Plastic products are much cheaper over metals.

Disadvantages:

1. Less impact strength.
2. Low useful temperature range (up to 600 °F)
3. Aging effect, hardens and become brittle over time Sensitive to environment, moisture and chemicals
4. Sensitive to environment, moisture and chemicals
5. Poor machinability.

6. CONCLUSION

Earlier years people used wood and metal for the interiors before the usage of plastic. Wood and metal parts manufacturing is difficult in early years. Cost of the manufacturing and time consume is more compared to plastics. Wood cannot be able to mass production .when plastic came in to industry most of the automotive interiors and exteriors changed to plastics. In this product plastic found to be appropriate material as it is more cost effective than other materials. Complicate shapes like center fascia can be manufactural over the other materials such as wood and steel, and also gives very good surface finish so we can maintain good aesthetics. Less impact strength which will not harmful to passenger. Weight of the plastic material is comparatively less compare to other materials such as steel and wood .so plastic found to be a appropriate material for center fascia. The center fascia with three different wall thickness using cad tool i.e.; CATIAV5 is designed and is used on three different variant of materials. The whole instrumental panel is taken as input and is proposed to the customer and plastics gave higher customer satisfaction.

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