ENGINEERING FEATURES

DESIGN CONSIDERATIONS AND DRAFT ANALYSIS ON DOG HOUSE

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CONTENTS

1. DOG HOUSE

Dog house is an engineering feature used in plastic trim design. Dog houses are used as supporting feature. Sometimes other engineering features like snaps; locators etc. are mounded on them to increase their strength.

Dog houses are subjected to draft analysis to prevent breakage of the component during ejection from mould cavity. Dog house and other engineering components are built on B-surface.

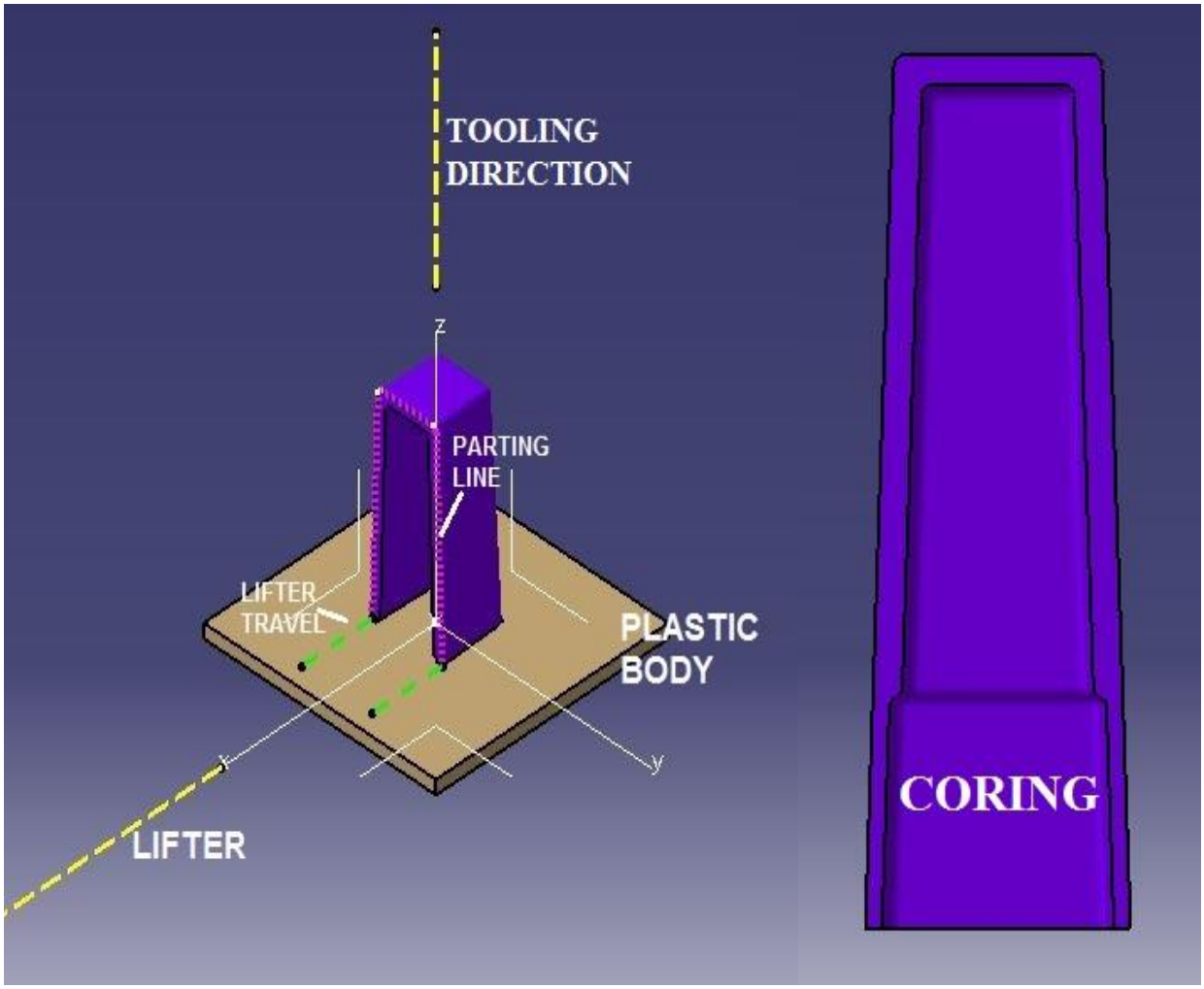


Fig.1. photographic view of dog house made in CATIA

1.1 DESIGN CONSIDERATION FOR PLASTICS

1.1.1 Wall thickness must be maintained uniform

Thick sections waste material and are simply uneconomic. So solid shapes that would do the job well in wood or metal must be transformed to a 'shell' form in plastics. This is done by hollowing out or 'coring' thick parts so you are left with a component which regardless of complexity is composed essentially of relatively thin walls joined by curves, angles, corners, ribs, steps and offsets. As far as possible, all these walls should be the same thickness. Wall thickness guide range is 0.75 mm to 3 mm for reinforced materials 0.5 mm to 5 mm for unreinforced materials

1.1.2 Corner radii

Properly designed corners will make a big difference to the quality, strength and dimensional accuracy of a moulding. But there is another benefit too. Smooth curved corners help plastic flow in the mould by reducing pressure drops in the cavity and minimising flow-front break-up. Internal radii should be at least 0.5 and preferably 0.6 to 0.75 times the wall thickness

1.1.3 Draft angle

Tooling must be cleared for easy ejection of the component, from the core cavity. In order to clear tooling certain value of draft is given to the component. Minimum of 2-3deg is provides on all plastic components.

1.2 DESIGN CONSIDERATION FOR CREATING DOG HOUSE

Wall thickness = 0.70 x Thickness of the plastic material

Fillet on the inner side = 0.25 x Thickness of the plastic material

Fillet on the outer side = 1.25 x Thickness of the plastic material

Fillet on the coring edges = 0.25 x Thickness of the plastic material

Coring thickness = 0.40 x Thickness of the plastic material

Draft angle 2deg to 3deg

1.3 STEPS INVOLVED IN CREATING DOG HOUSE:

Following are the sequence to create DOG HOUSE on a given plastic body. Assume the thickness of plastic to be 10mm

STEP 1: Open CATIA V5 R21 either from desktop or RUN by typing CNEXT.

STEP 2: Open a new part document from start menu. Name the file as DOG_HOUSE (part module).

STEP 3: Hide the given planes and create an axis system (Axis System.1) with a point as origin (Point.1) and rename the geometrical set as TOOLING.

STEP 4: create tooling direction, Line.1 and Line.2 (yellow dotted line)

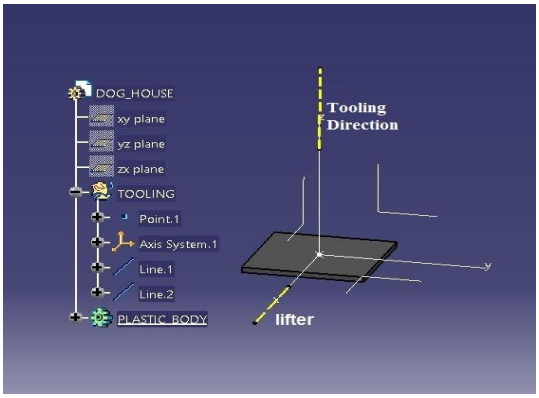


Fig.2. creating tooling direction

STEP 5: Create two bodies and rename them as DOG_HOUSE_1 and DG_1.1. Define DG_1.1 and insert sketch. Sketch positioning parameters are selected as shown in the figure

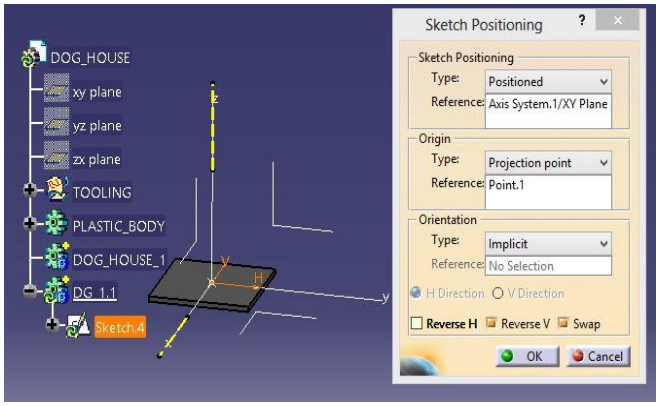
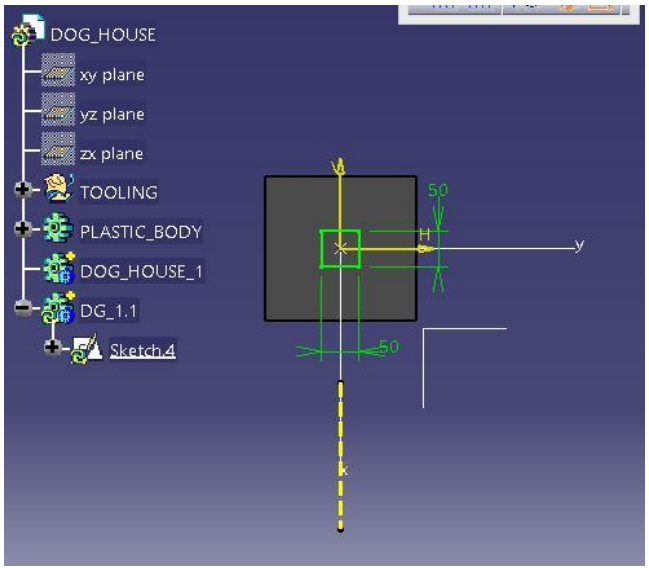


Fig.3. sketch positioning

STEP 6: The sketch made is pad to a certain height as shown in figure below



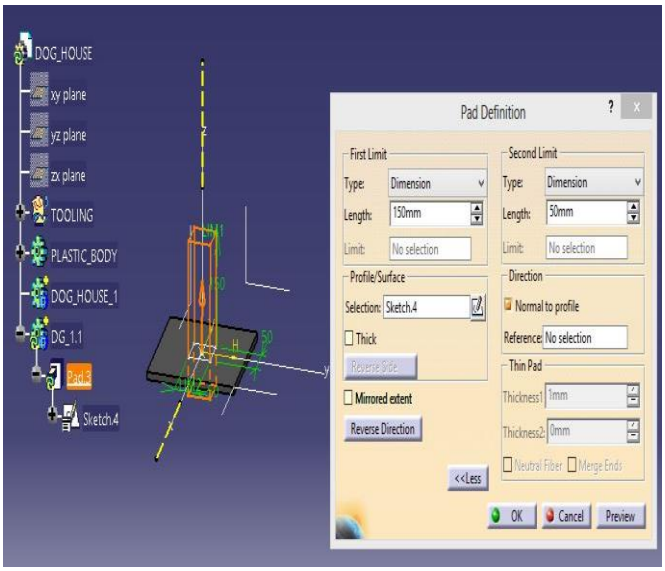
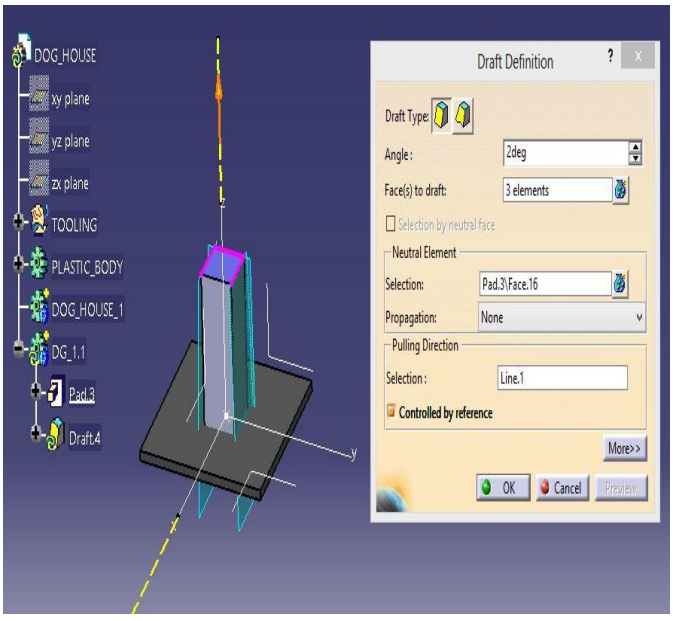


Fig.4. sketch definition ***Fig.5. pad definition***

STEP 7: Leaving the face along the lifter, other three vertical faces of the pad component (Pad.3) are drafted inwards, as shown in the figure.5. Draft angle is maintained between 2^0 to 3^0. (Give Tooling Direction as pulling direction).

Draft again the faces parallel to the zx plane, inwards as shown in the figure.6 (Give lifter as pulling direction).



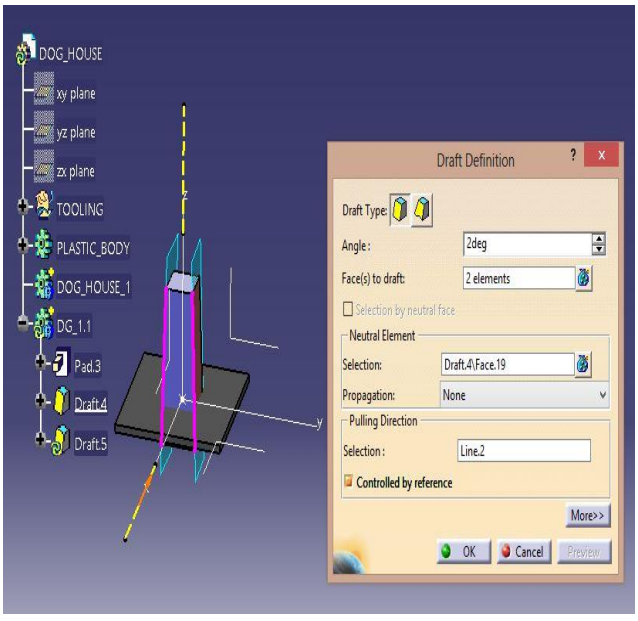


Fig.6. draft definition (vertical faces) ***Fig.7. draft definition (zx plane)***

STEP 8: The component is then subjected to shell definition. It is noted that the shell does not exceed the design relation.

"Wall thickness = 0.70 x Thickness of the plastic material"

In some cases the wall thickness of the dog house is maintained as same as the plastic body.

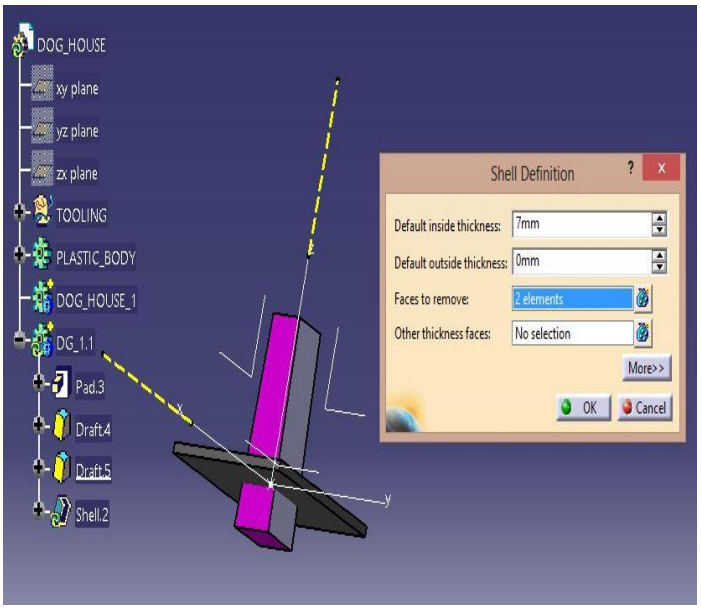


Fig.8. shell definition

STEP 9: Draft the upper wall of the inner surface of the Dog House, to provide easy ejection of the component during manufacturing process. Draft angle is maintained between 2^0 to 3^0.

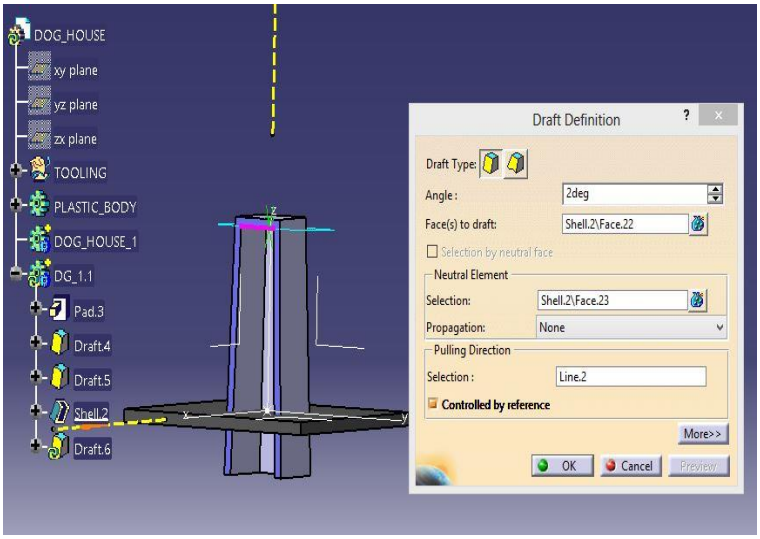


Fig.9. draft definition

STEP 10: Creating fillet is the last step in the body DG_1.1. Fillets are created on both inner and outer side. The following relation is maintained to create fillet.

"Fillet on the inner side = 0.25 x Thickness of the plastic material"

"Fillet on the outer side = 1.25 x Thickness of the plastic material"

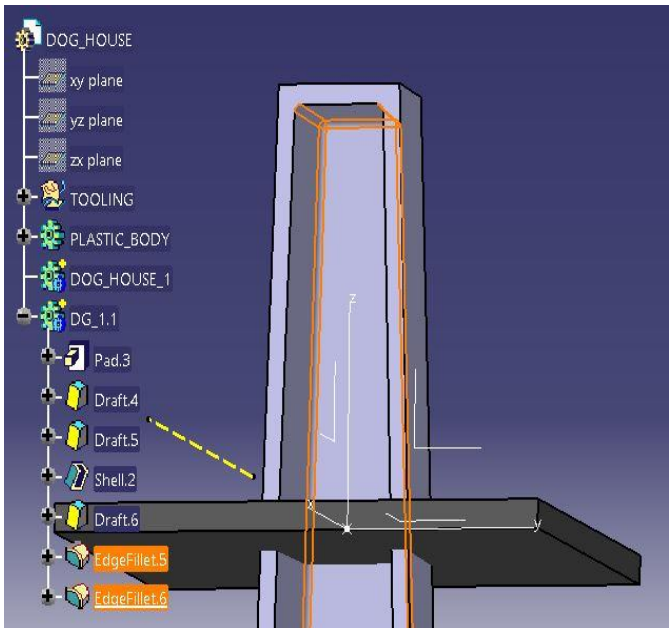


Fig.10. fillet on the inner side

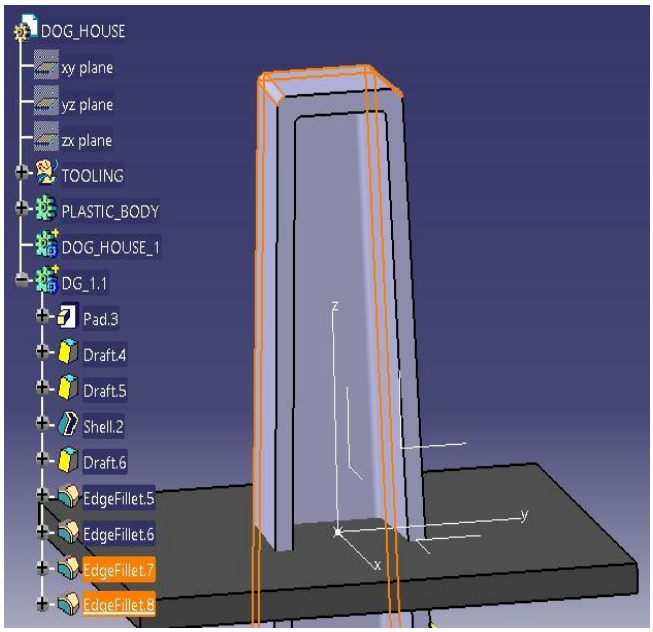


Fig.11. fillet on the inner side

STEP 11: Body DG_1.1, is copied and pasted defining DOG_HOUSE_1. Body DG_1.1 is hided and the pasted DG_1.1 s renamed as DG_1.2.

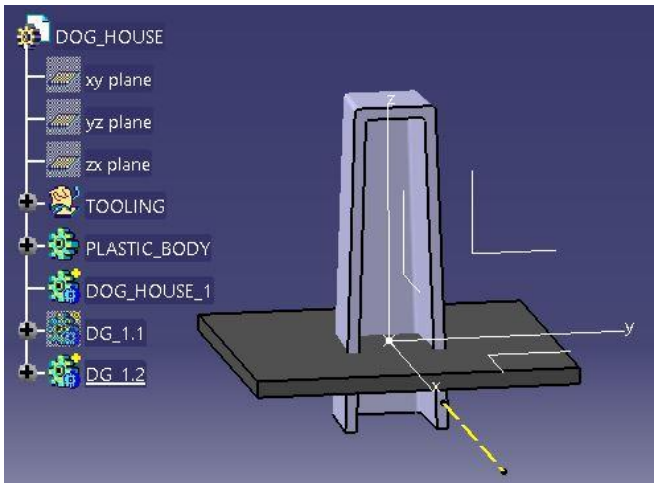


Fig.12. creating DG_1.2

STEP 12: The selected operations in the figure below are deleted to create coring. The sketch inside DG_1.2 is replaced with the sketch from DG_1.1 with link.

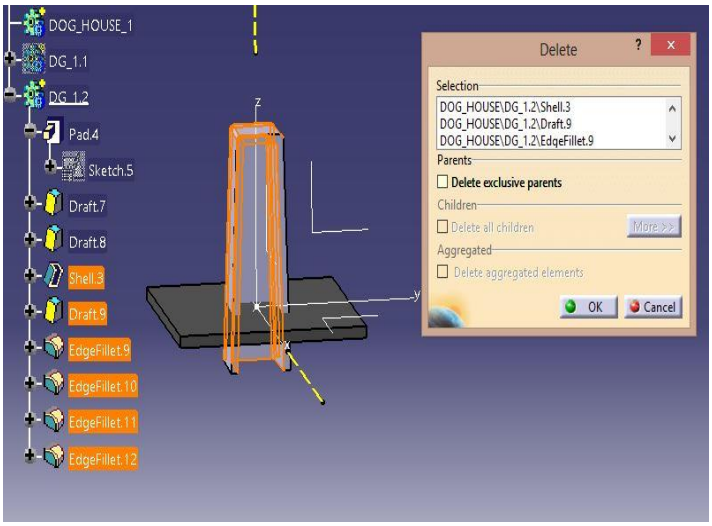
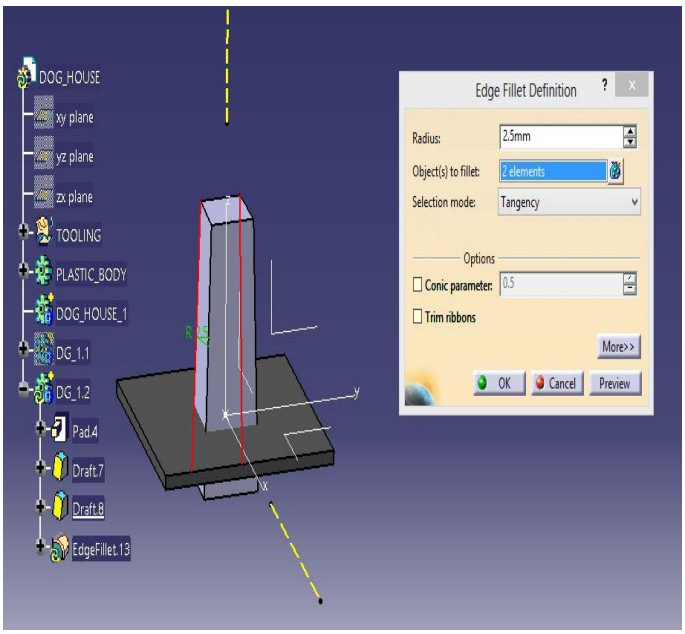


Fig.13. operations to be deleted

STEP 13: Fillet is made and the three vertical faces excluding the face along to the lifter. Thickness of the face is reduced to the below expression

"Fillet on the coring edges = 0.25 x Thickness of the plastic material"

"Coring thickness = 0.40 x Thickness of the plastic material"



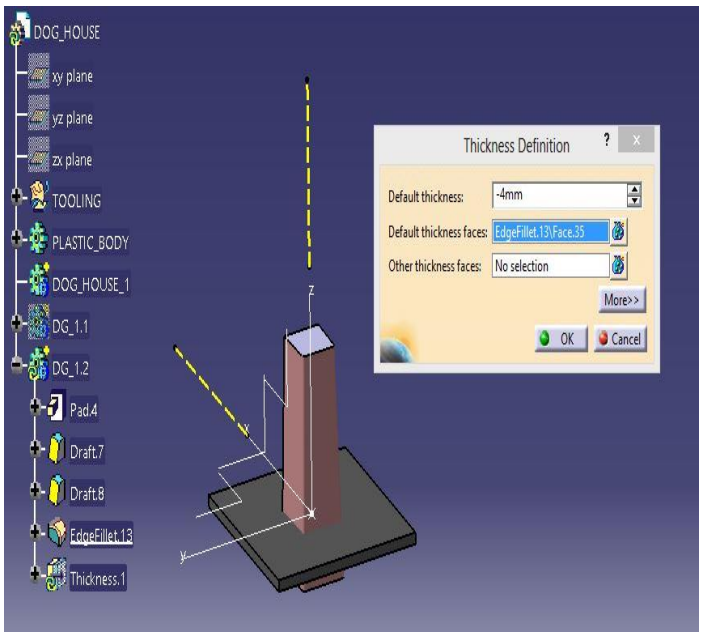


Fig.14. edge fillet definition

Fig.15. thickness definition

STEP 14: The plastic surface is extracted for offsetting using multiple extract option which is available in the GENERATIVE SHAPE DESIGN (GSD) module. The offset value is directly proportional to the coring height. Coring height is generally maintained between 2 to 3mm. The geometrical set named as tooling previously is changed to ENG_FEATRUE

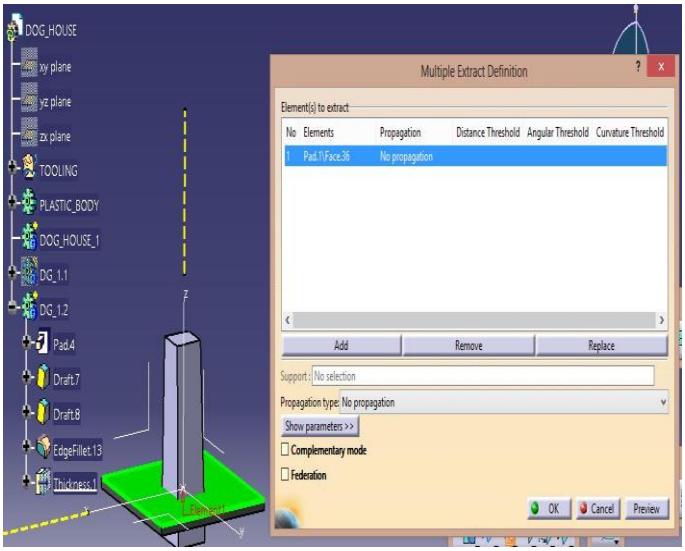


Fig.16. multiple extract definition

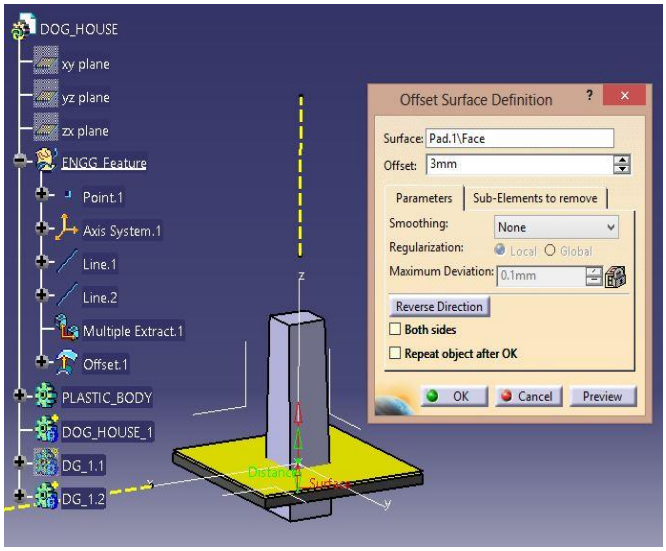


Fig.17. offset definition

STEP 14: The created offset surface is used to split the body, as shown in the figure below. Split is available in PART module under surface based features

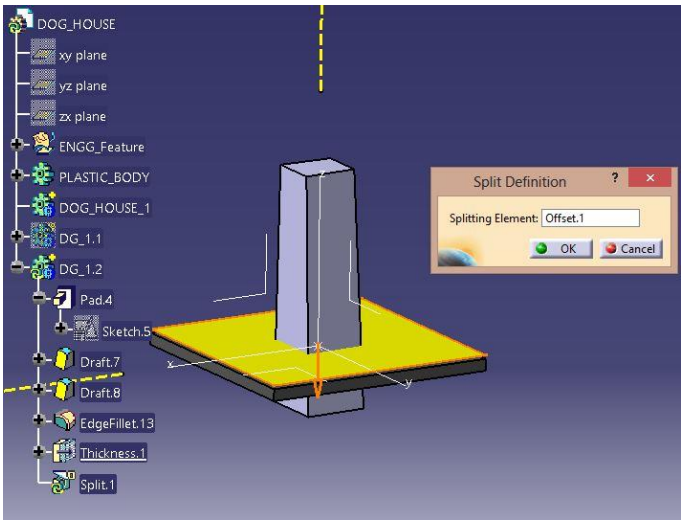


Fig.18. split definition

STEP 14: Fillet is created as per the relation discussed previously. The below figure shows the fillet definition

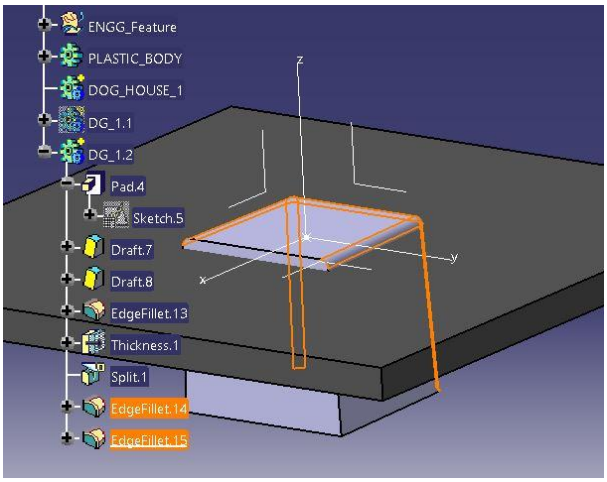


Fig.19. coring fillet definition

STEP 15: when both the bodies DG_1.1 and DG_1.2 are unhidden a similar product is obtained as in figure

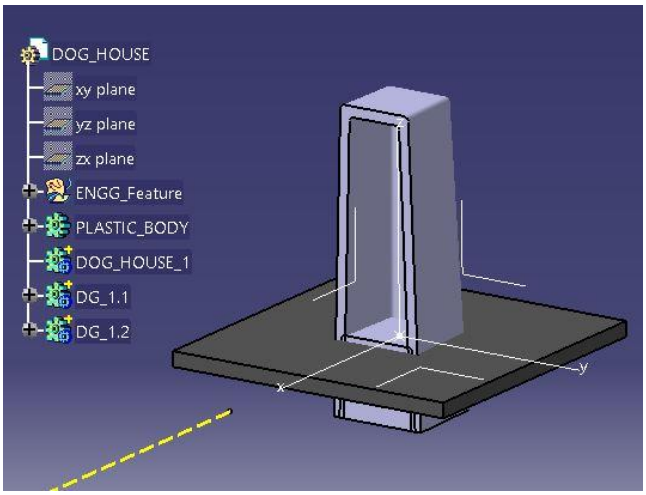


Fig.20. DG_1.1 and DG_1.2 before Boolean operation

STEP 16: The following operation is performed to obtain final component

I. BODY DG_1.2 is removed from BODY DG_1.1. By
II. The resultant body is assembled with DOG_HOUSE_1.
III. Later the assembled body is union trimmed with PLASTIC BODY. Followed by filleting between coring and main body.

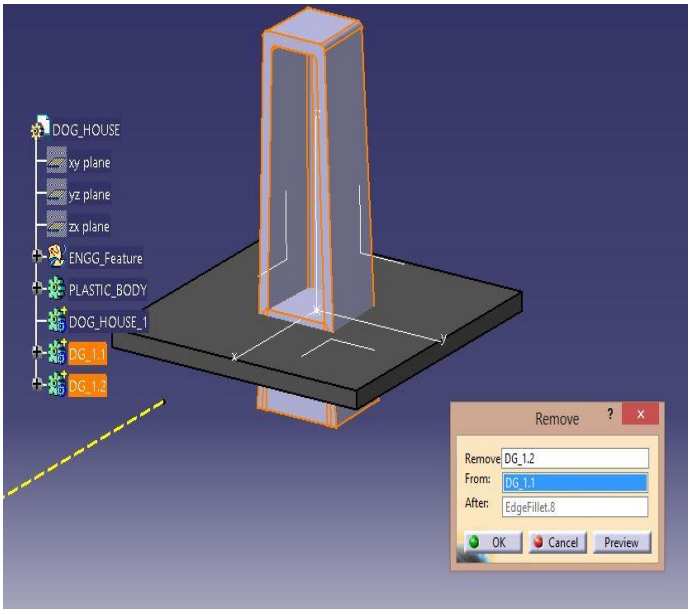


Fig.21. remove (Boolean) operation

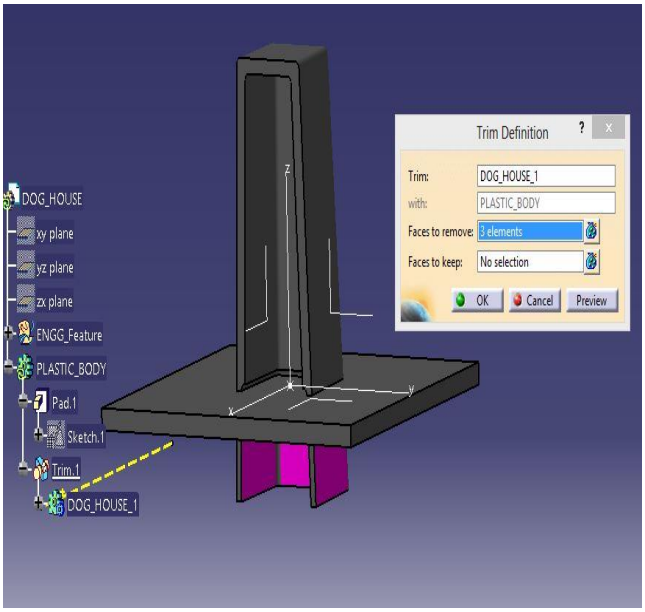


Fig.22. union trim(Boolean) operation

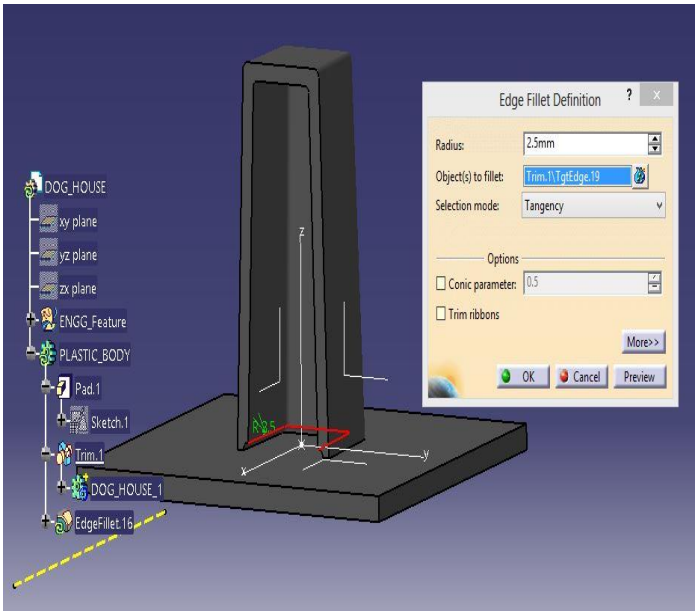


Fig.23. fillet definition between coring and main body

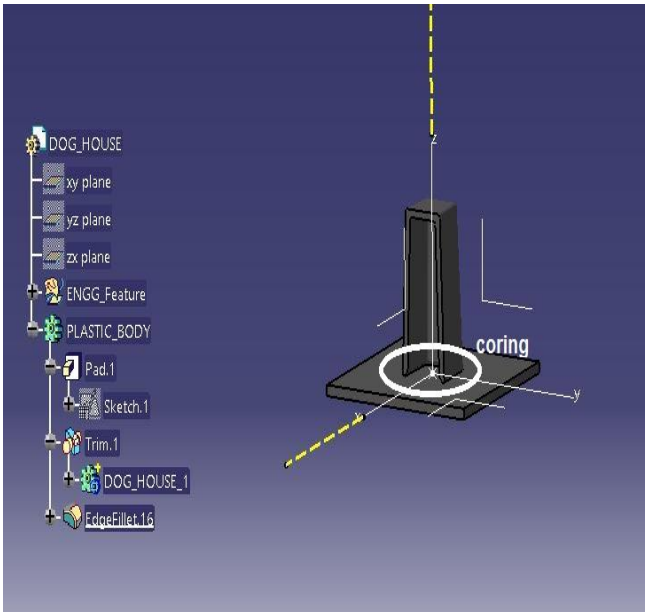


Fig.24. DOG_HOUSE

1.4 STEPS INVOLVED IN PERFORMING FEATURE DRAFT ANALYSIS FOR DOG HOUSE:

Draft analysis is performed to check whether the component is drafted completely. Draft is performed for easy ejection of plastic component during the process of injection moulding. Following are the sequence of operation for draft analysis.

STEP 1: Before performing draft analysis note should be made that the VIEW is set to MATERIAL MODE. Select the draft analysis from INSERT -> ANALYSIS -> FEATURE DRAFT ANALYSIS.

STEP 2: select feature draft analysis from analysis and select HIDE OR SHOW THE COLOUR SCALE and set the value of green to 0.48deg and red to 0deg. 0.48deg represents the maximum draft angle.

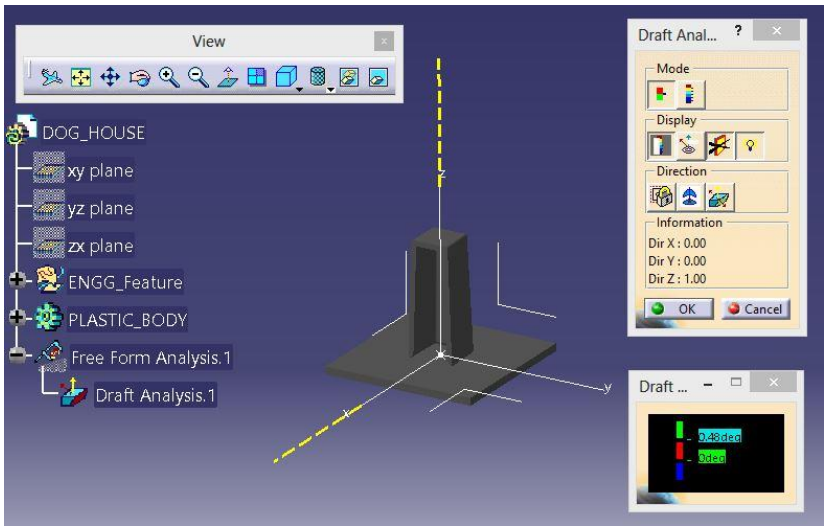


Fig.25. draft analysis

STEP 3: Drag the compass and set it on the 'Tooling Direction'. Use the compass to select new draft direction and reorient the compass direction then select the solid on which feature draft analysis is to be performed. If the orientation of the compass is inverted select the inverse direction command in the draft analysis. The green colour in the figure below represents that the component has cleared draft analysis in the 'Tooling Direction' direction.

Once the analysis is made the draft analysis is saved in tree as Draft Analysis.1 under Free Form Analysis.1.

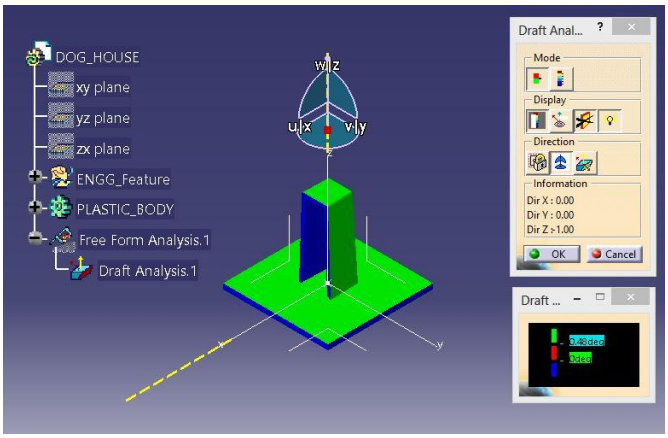


Fig.26. draft analysis in Tooling Direction direction

STEP 4: Drag the compass and set it on the 'lifter'. Use the compass to select new draft direction and reorient the compass direction then select the solid on which feature draft analysis is to be performed. If the orientation of the compass is inverted select the inverse direction command in the draft analysis. The green colour in the figure below represents that the component has cleared draft analysis in the 'lifter' direction.

Once the analysis is made the draft analysis is saved in tree as Draft Analysis.2 under Free Form Analysis.1.

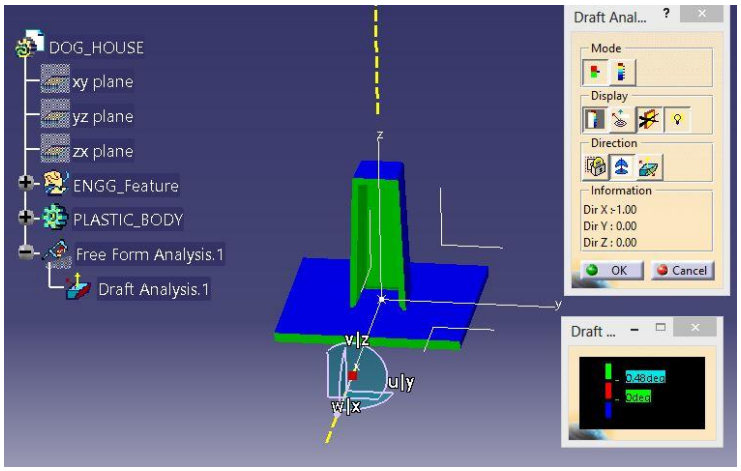


Fig.27. draft analysis in lifter direction

1.5 PARTING LINE:

A parting line is the line of separation on the part where the two halves of the mould meet. The line actually indicates the parting plane that passes through the part. While on simple parts this plane can be a simple, flat surface, it is often a complex form that traces the perimeter of the part around the various features that make up the part's outer silhouette. Part lines can also occur where any two pieces of a mould meet. This can include side action pins, tool inserts and shutoffs. Parting lines cannot be avoided; every part has them. Keep in mind when designing your part that the melt will always flow towards the parting line because it is the easiest place for the displaced air to escape or "vent". Parting lines are generally created where the green and blue colour meets.

STEP 1: Create a new geometrical set, name it as PARTING_LINE and provide unique property, such as colour line thickness and line type. Define the geometrical set in work object before proceeding with next operation.

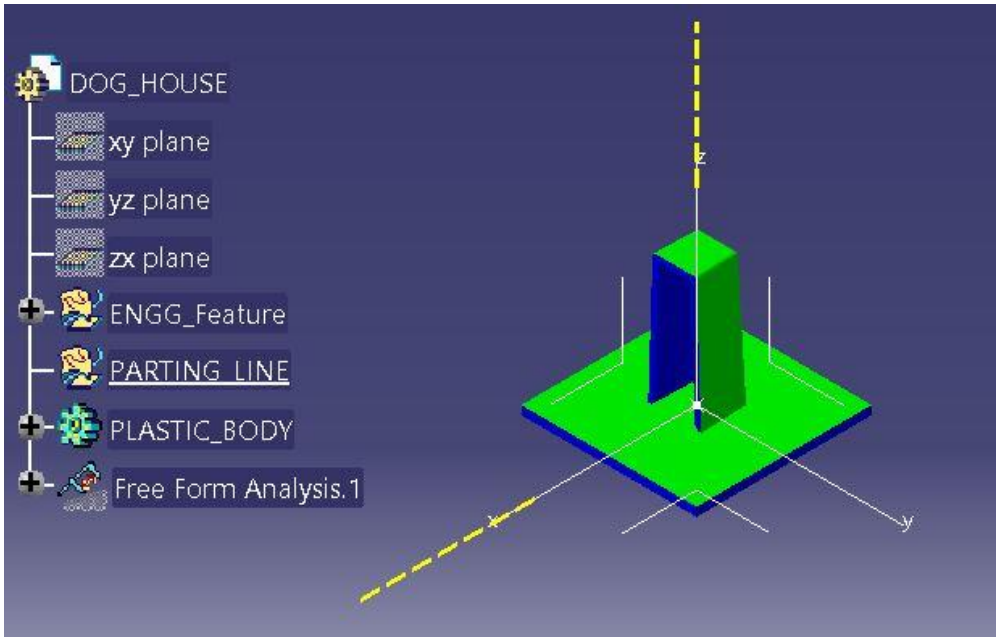


Fig.28.creating geometrical set

STEP 2: Select **Multiple Extract** and set propagation type as tangency continuity. Select the outer edge as element.

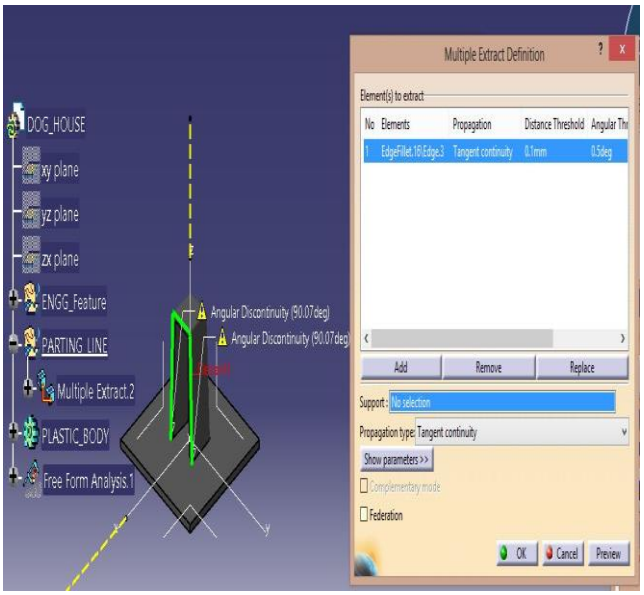


Fig.29. multiple extract definition for creating parting line

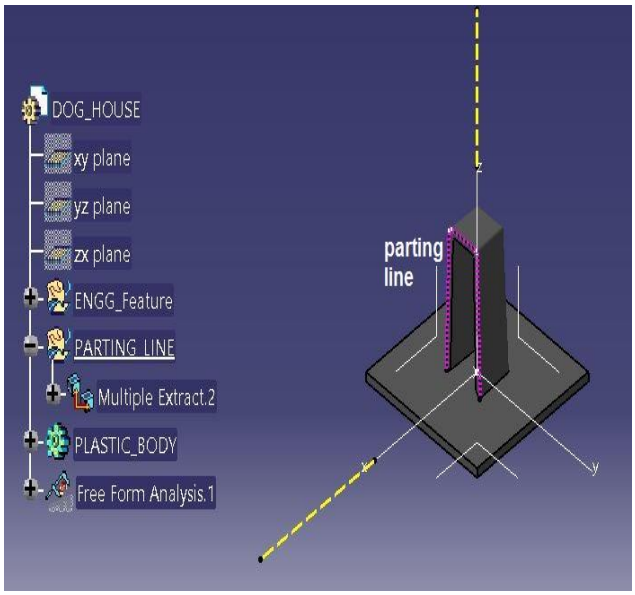


Fig.30. parting line (magenta)

STEP 3: *Creating lifter travel plays an important role in designing DOG HOUSE. Lifter travel is provided so that the lifter does not collide with the other plastic or plastic components. It is noted that lifter travel does not exceed the relation given where x denotes the undercut dog house.*

"LIFTER TRAVEL (mm) **=** $2(x) + 35$

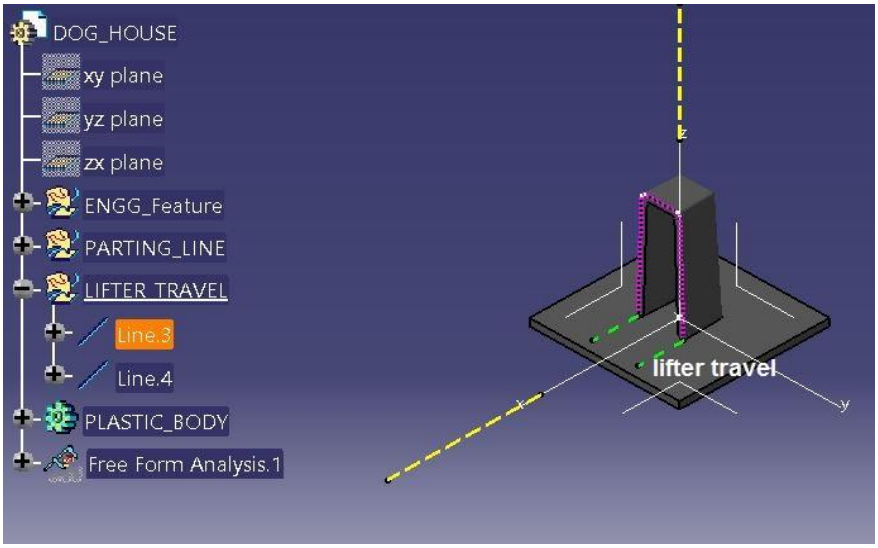


Fig.31. lifter travel (green dotted lines)