



SHEET METAL SIMULATION FORMING THROUGH HYPER-FORM SOFTWARE

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Abstract - Hyper-form job is a comprehensive finite-element based sheet metal forming simulation framework. Hyper-form offers a high performance feasibility analysis tool in combination with parametric rapid draw die design capability and final process validation, optimization and results visualization. In this paper we highlights the preparation procedure of the sample die forming the sheet metals with hyper-form simulation process which is very useful and beneficial for the production that gets the perfect designed products.

Key Words:-Sheet metal, Hyper-form software

I. INTRODUCTION

The sheet metal forming process in which we see what would be effect in sheet metal when applied load and it form to get a shape and deep drawn technology is one of the most challenging processes in manufacturing. Drawing operation is the process forming a flat piece of material into a hollow shape by means of punch which causes the blank to flow into the die cavity (refer figure 1). The depth of the draw may be shallow, moderate or deep, various geometries and sizes are made by drawing operation, two extreme examples being bottle caps and automobile panels. Typical defects that occur due to incorrect flow of material into the die during the stamping process are wrinkling caused by excessive compression, tearing or splitting caused by excessive tension, and spring back caused by elastic recovery of the material [1-3].

While the die designer attempts to design a draw die, the process for drawing entails the use of hydraulic press since the rate of deformation has to be controlled throughout the operation of draw. The draw die should be built to tackle the problem of wrinkling especially prominent at the top corners; tearing along the sides of the corner and the bottom area; while thinning is associated along the corner edges prone to uneven flow. And the problem of spring back may occur due to elastic recovery of material. The rejection amounts to a loss of man hours of the hydraulic press, skilled labor, special material (DD or EDD quality for draw) and other resources directly or indirectly associated with the process.

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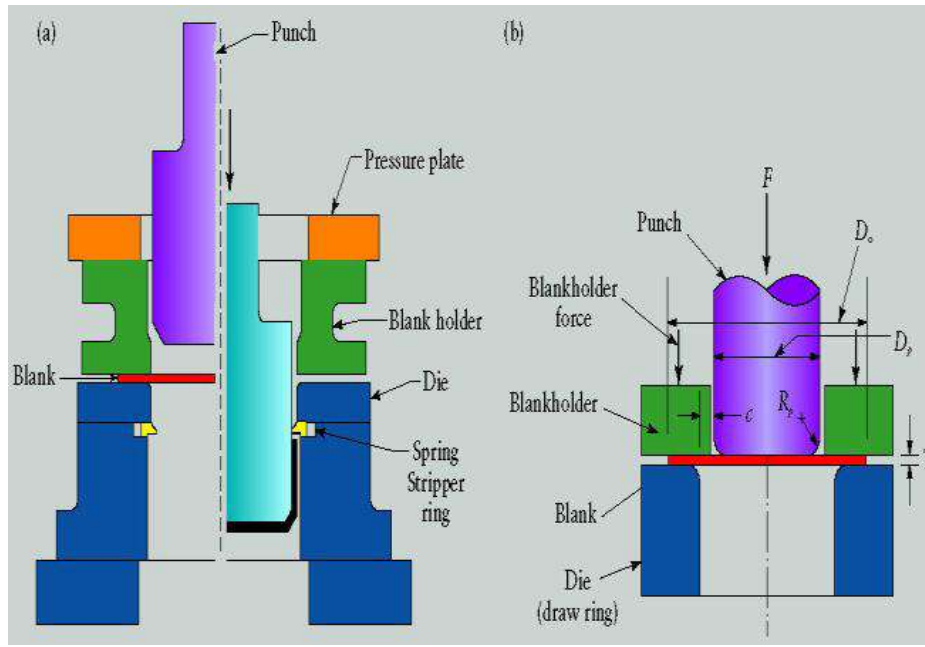


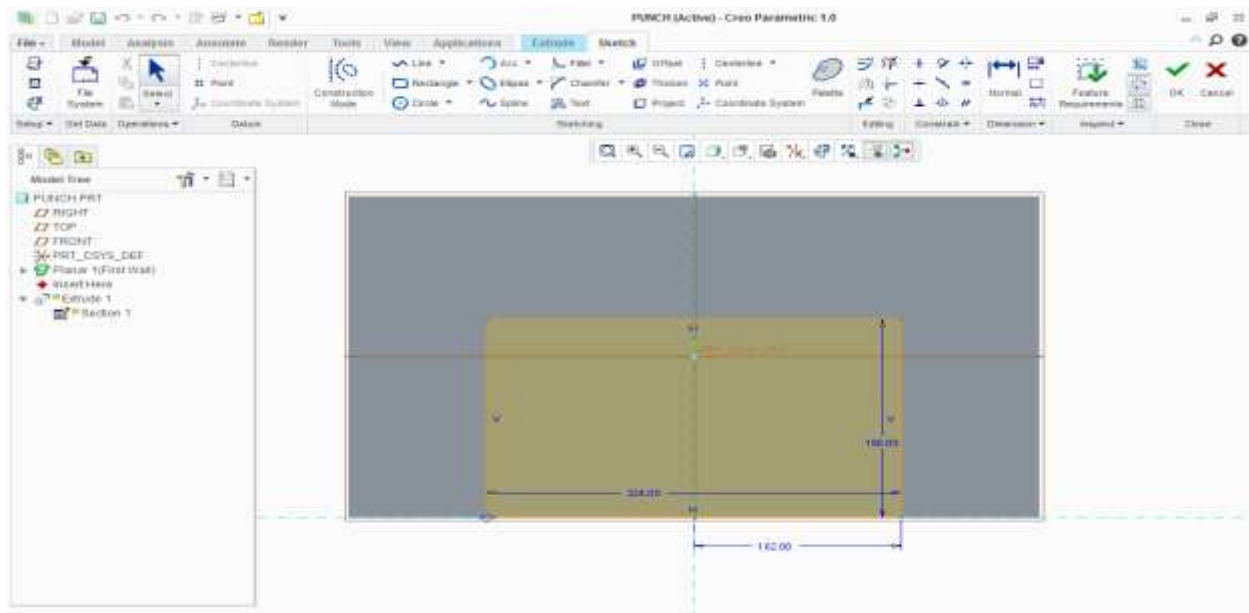
Fig.1 (a) Schematic illustration of the deep drawing process on a circular sheet-metal blank. (b) Variables in deep drawing of a cylindrical cup [10]

Benefits of hyper-form:-

- 1) Immediate Cost Savings a remarkable cost savings is driven by competitive pricing and the dramatic reduction of the overall product development cycle time.
- 2) Perfect and consistent work out..
- 3) The most accurate additional sheet metal forming solver on the market.
- 4) This work out allows the users to quickly predict wrinkles and splits prior to cutting steel, avoiding the

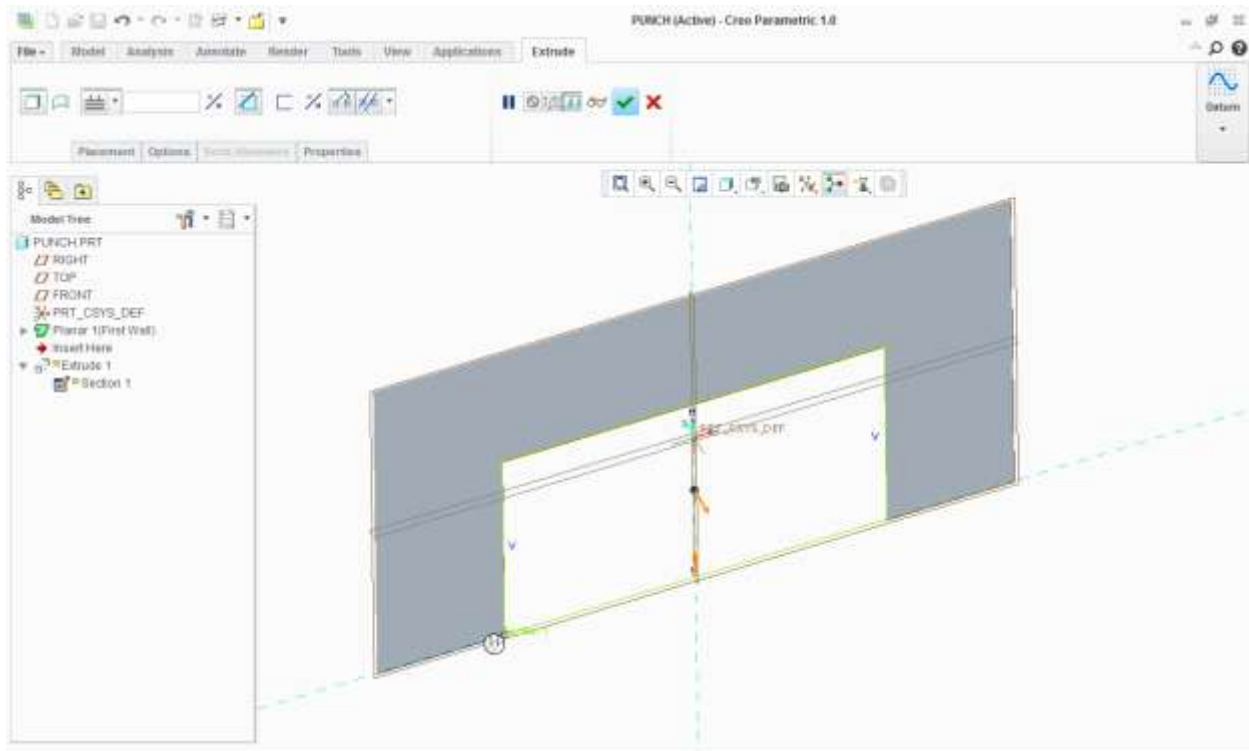
unnecessary costs associated with die machining and press downtime.

- 5) Proficiently incarcerates the stamping process hyper form's open framework combined with an extensive e-built-in knowledge of the manufacturing domain efficiently captures the stamping process.
- 6) This further increases user productivity through a comprehensive collection of modified, process automations for virtually every stamping application.
- 7) Elastic user defined automations through TCL macro generator.



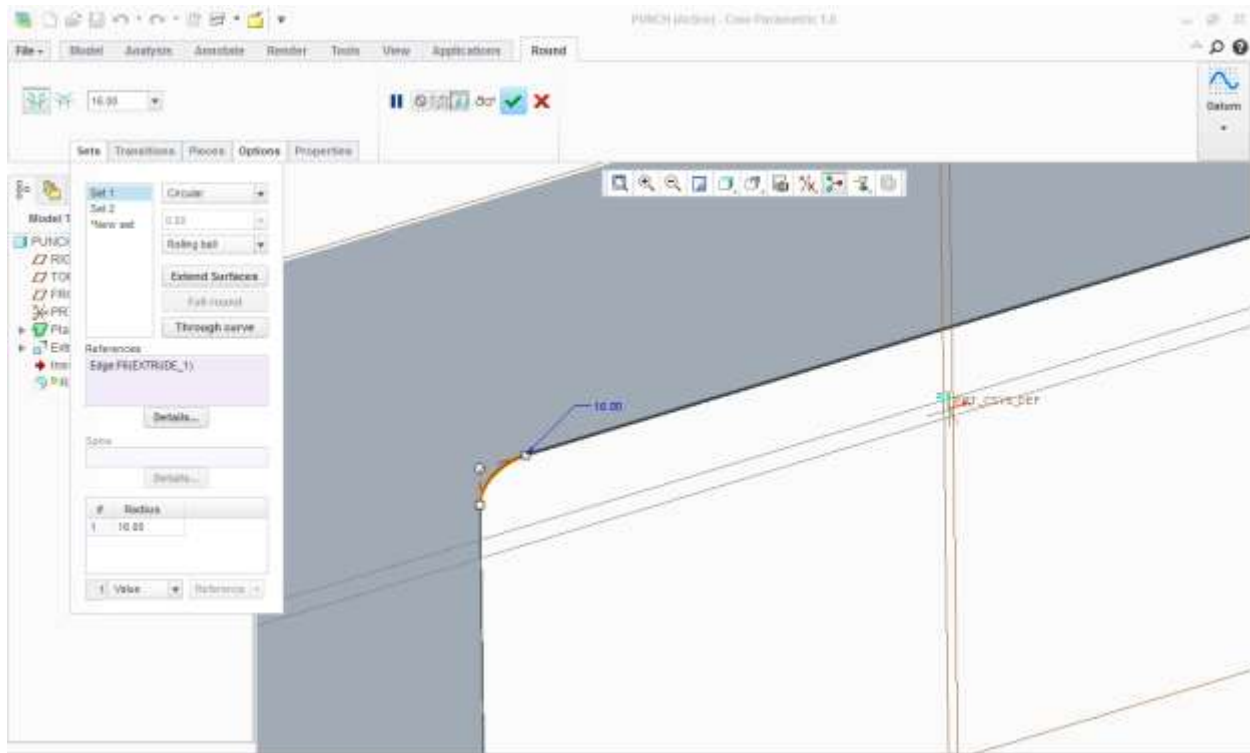
Die fig:-3

Then select cut extrude. Now done it to continue.



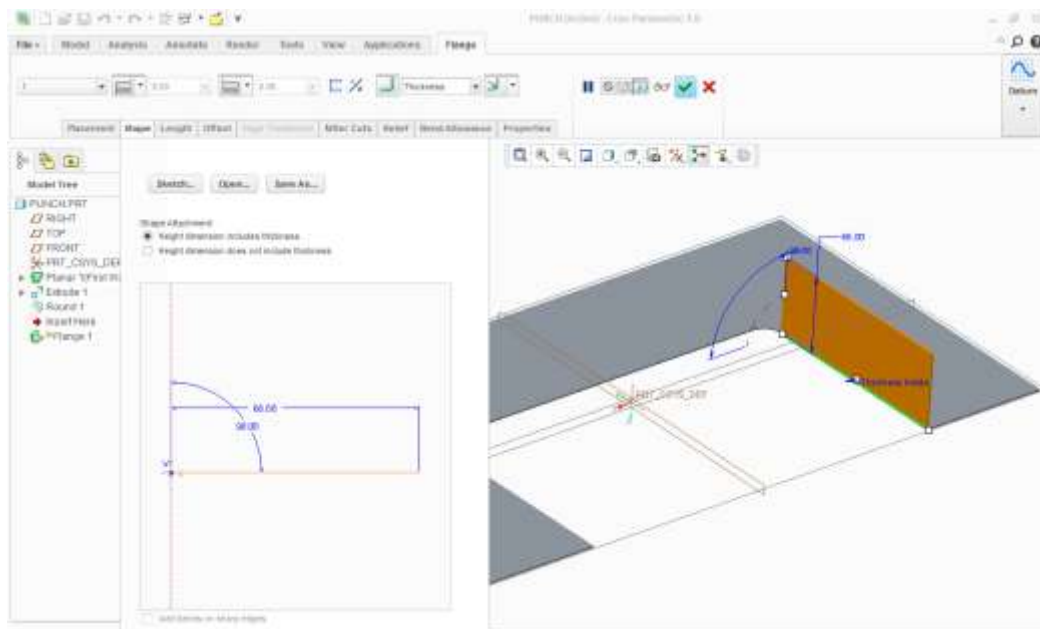
Die fig:-4

Now we remove the corner material form the sheet for that act we select fillet tool to make particular radius in the specific radius and the radius is 16.



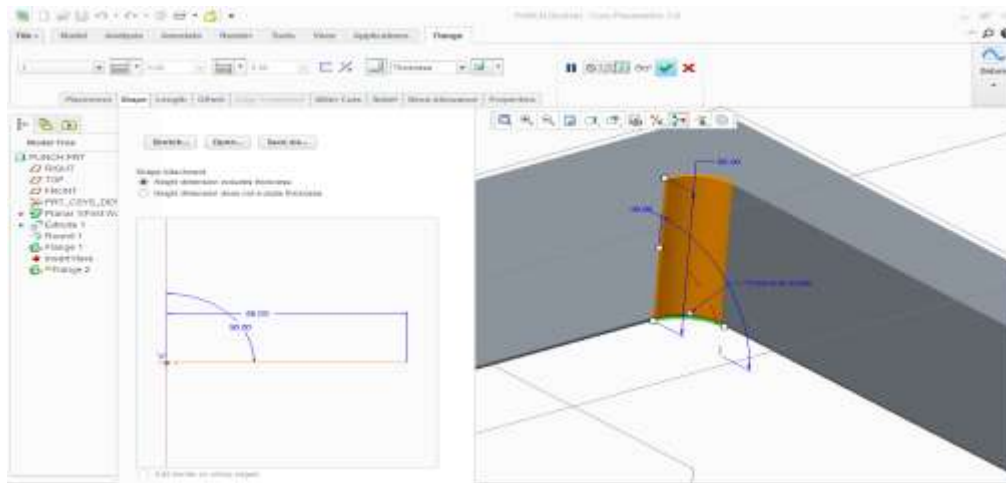
Die fig:-5

Now we select flat tool to make profile of the required shape for that we need to select the edge of the sheet metal and extrude it up to the 66 mm and 90 degree angle from the flat surface to the sheet.



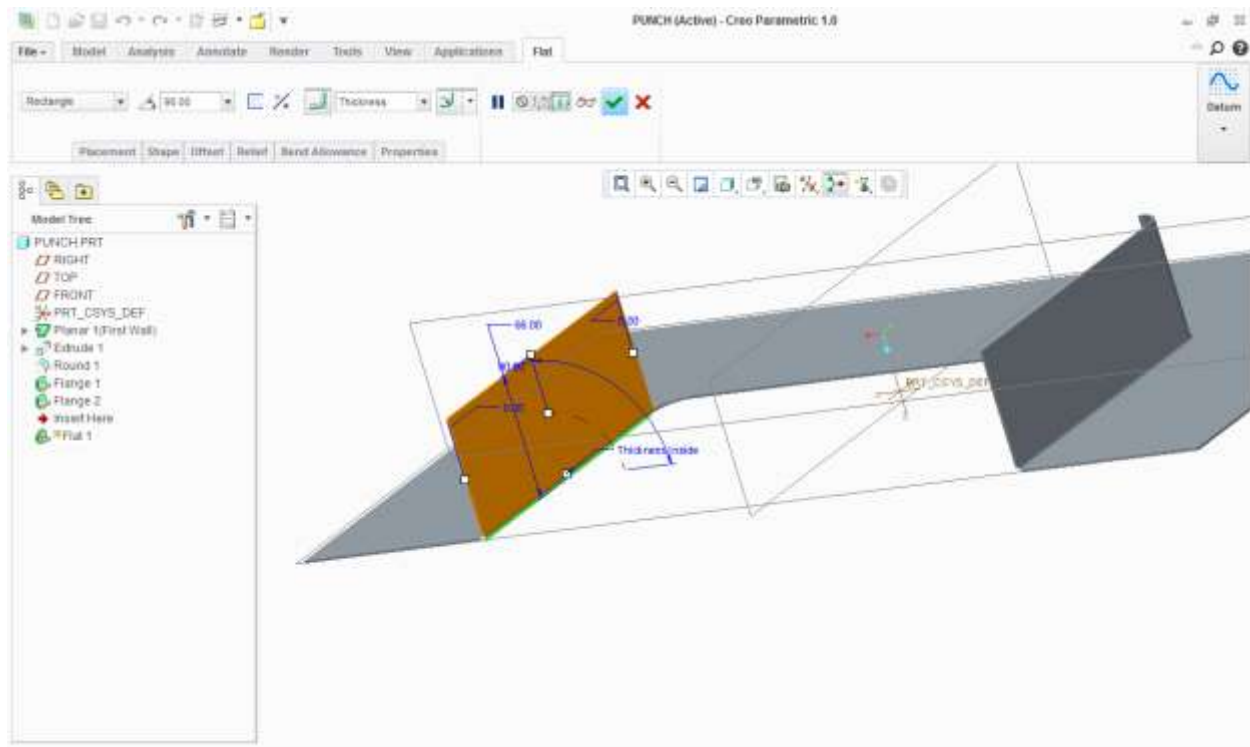
Die fig:-6

Now we have to make a curvature profile in the corner for that we select flange tool to from such a profile in the design[6-8]. In the specific area.



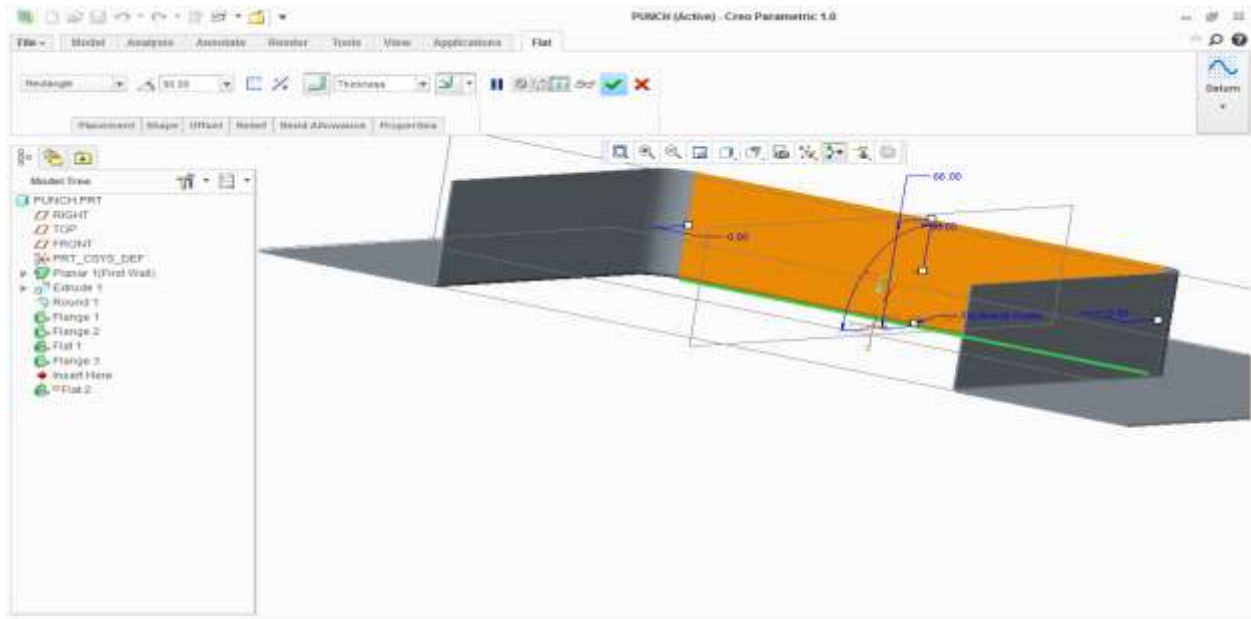
Die fig:-7

Again we select that particular edge to make curve profile in the design so that it will complete the design required shape and size.



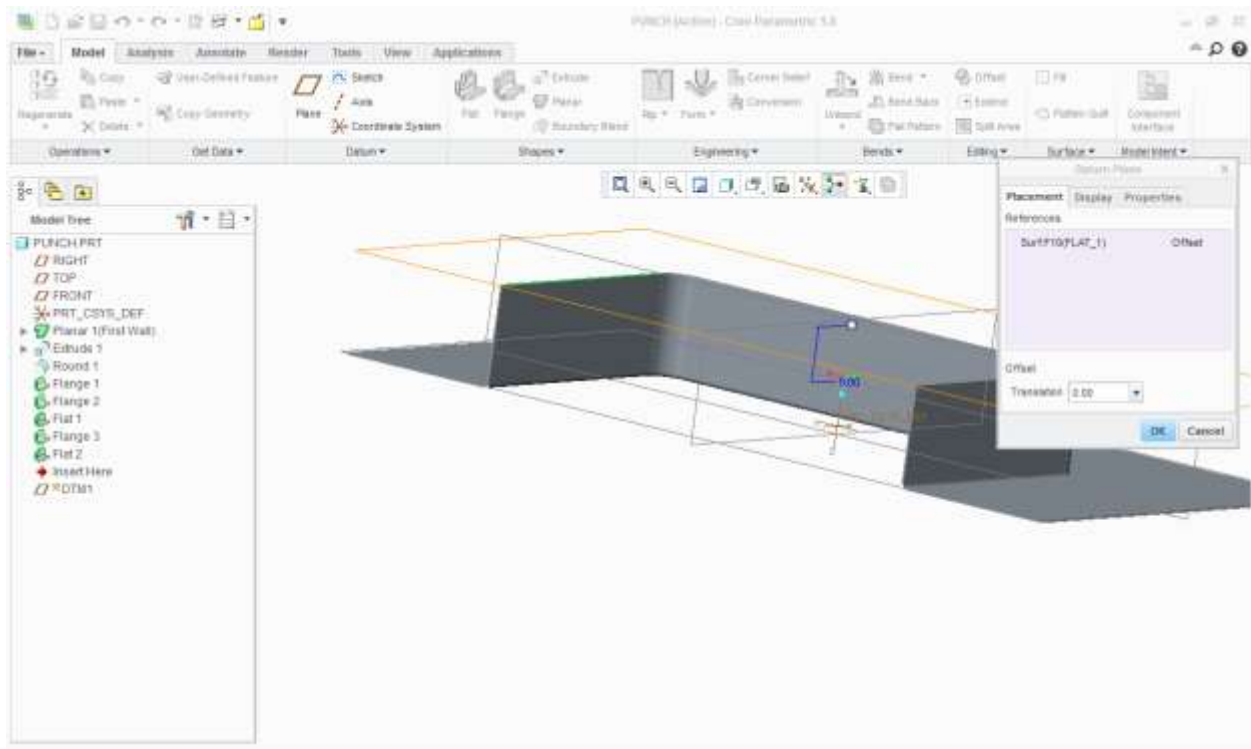
Die fig:-8

This is the final flat and flange required after that we select datum plane in top of the surface to give specific dimension and dimension is 66mm.

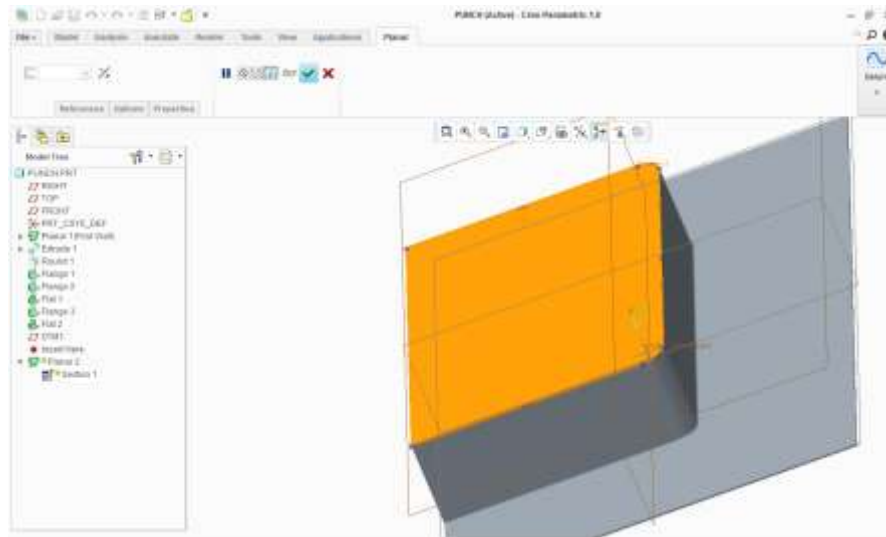


Die fig:-9

Select sketch tool to make top profile to cover the flat and flange profile.

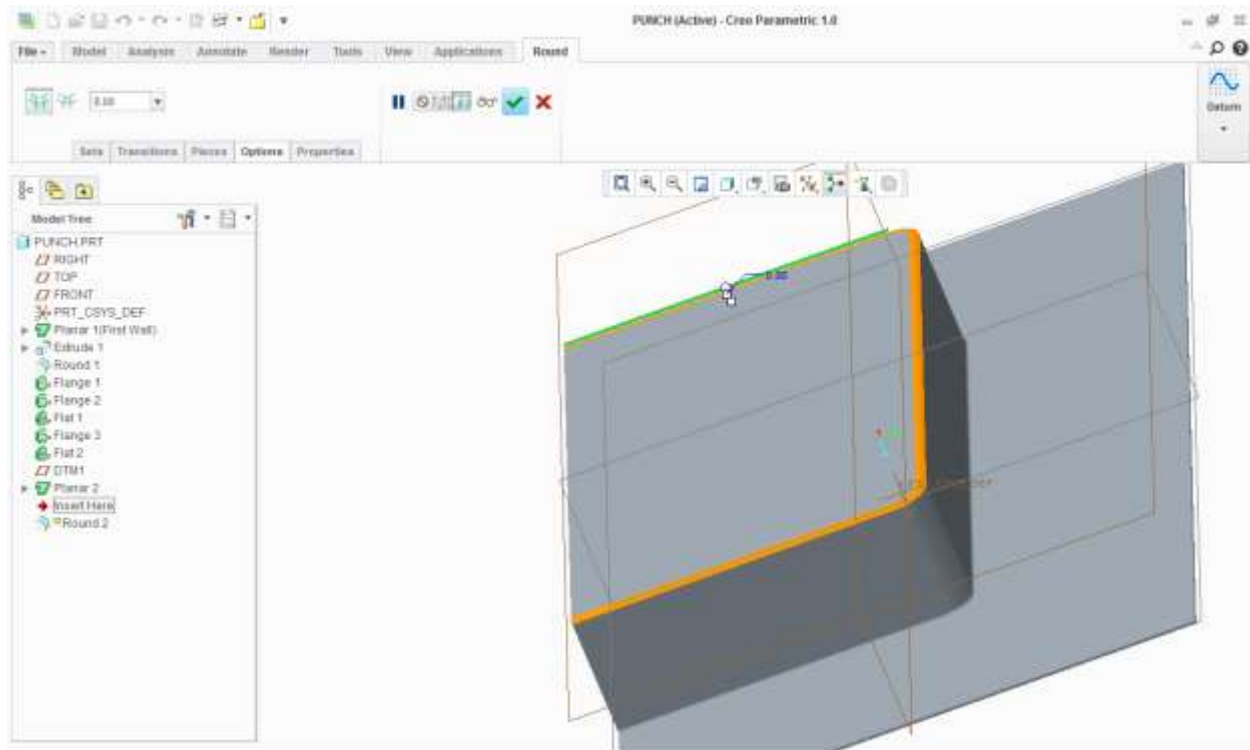


Die fig:-10



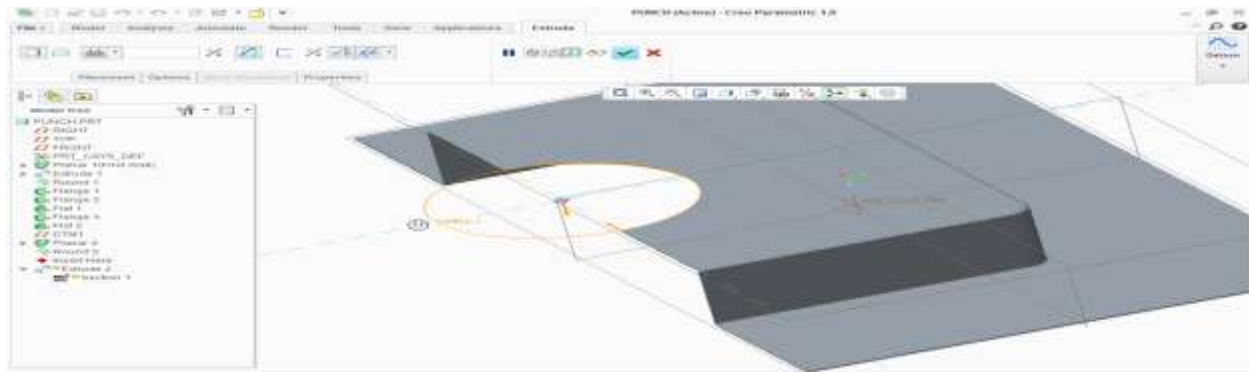
Die fig:-11

As we make this top sheet now change the direction of the sheet from the neutral from the basic sketch.



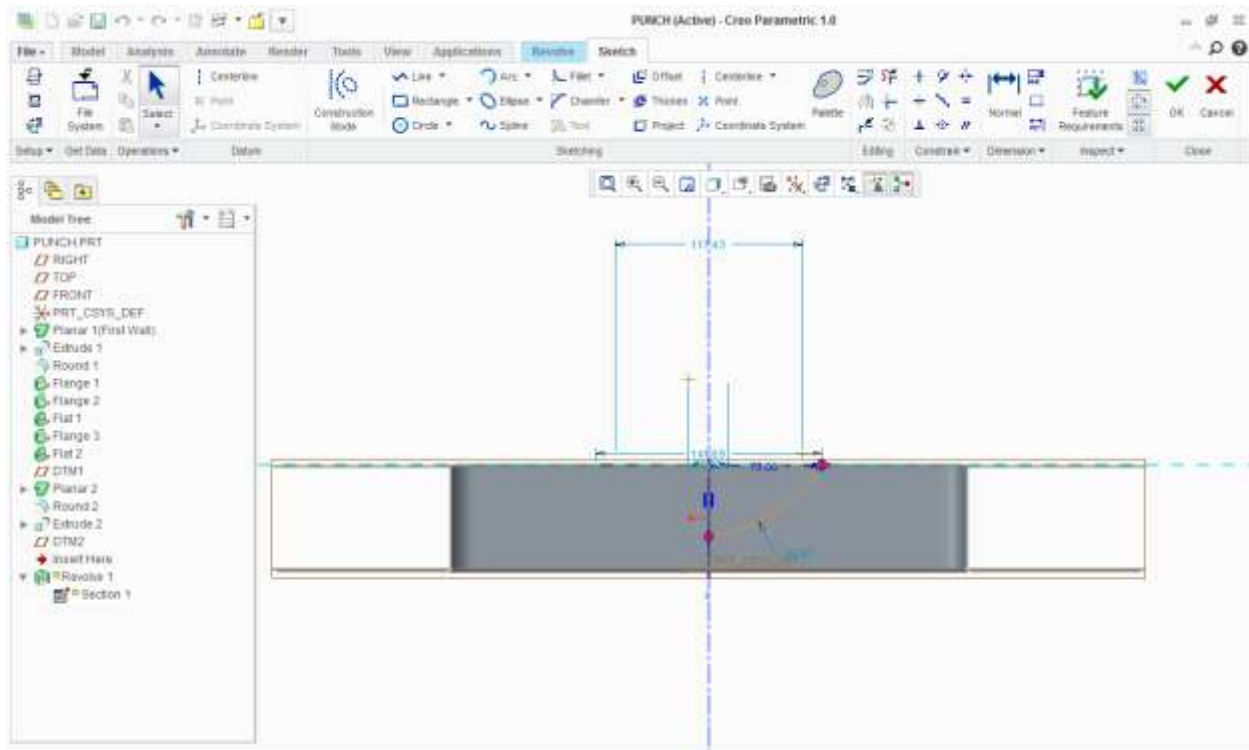
Die fig:-12

Now we have to make fillet in the edge of the sheet and the sheet thickness is 1.5mm under this thickness we cannot give more radius upto 1.5.



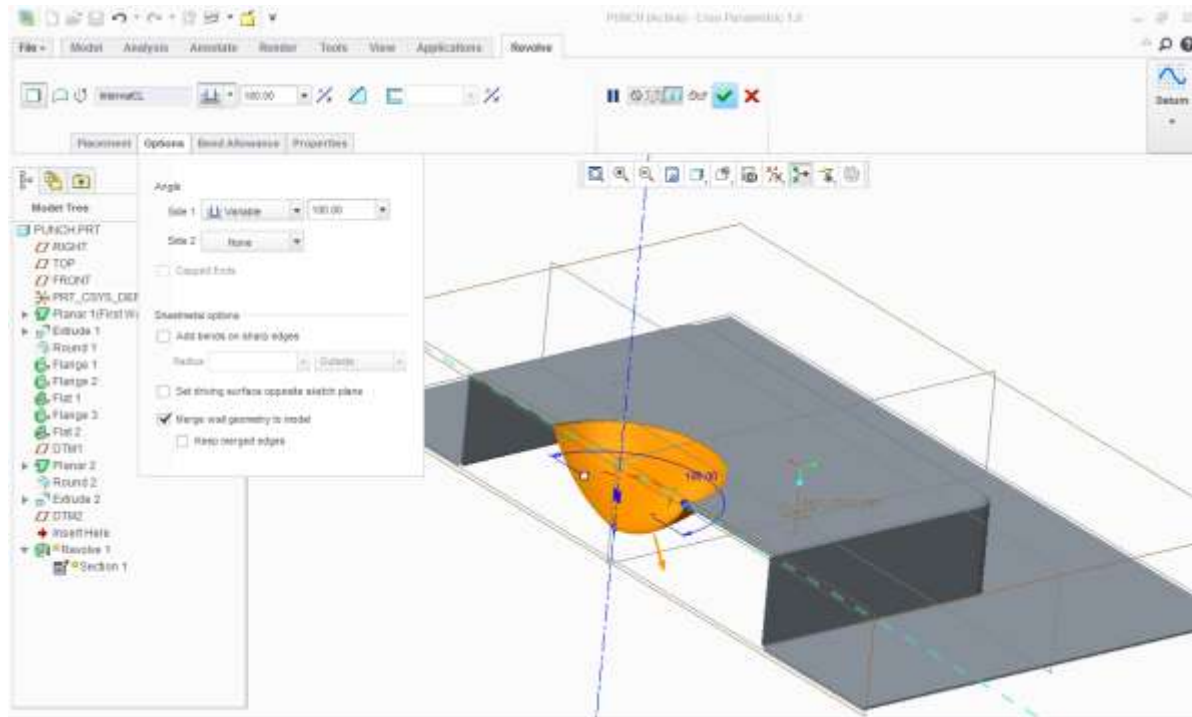
Die fig:-13

As we done the upper profile in the design know we have to cut the unnecessary material for make a semicircular profile as required in the design and the radius of the profile is 80.



Die fig:-14

For that first of all we have to make profile as arc as specified in above figure. For that we select revolve tool

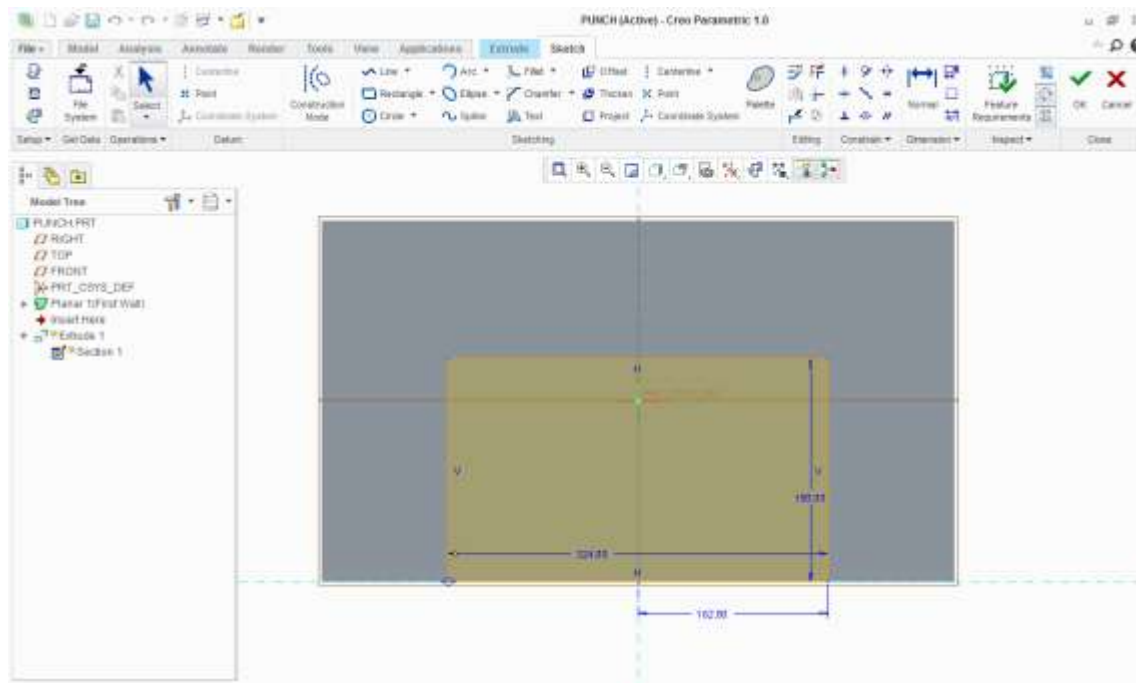


Die fig:-15

As we complete the sketch we select to revolve tool and select 180 degree and then change the direction in the material side .Thats about the final design of the die.

Design of binder:-

First of all select sheet metal option in which we define the particular unit as dimension as in the above parts.

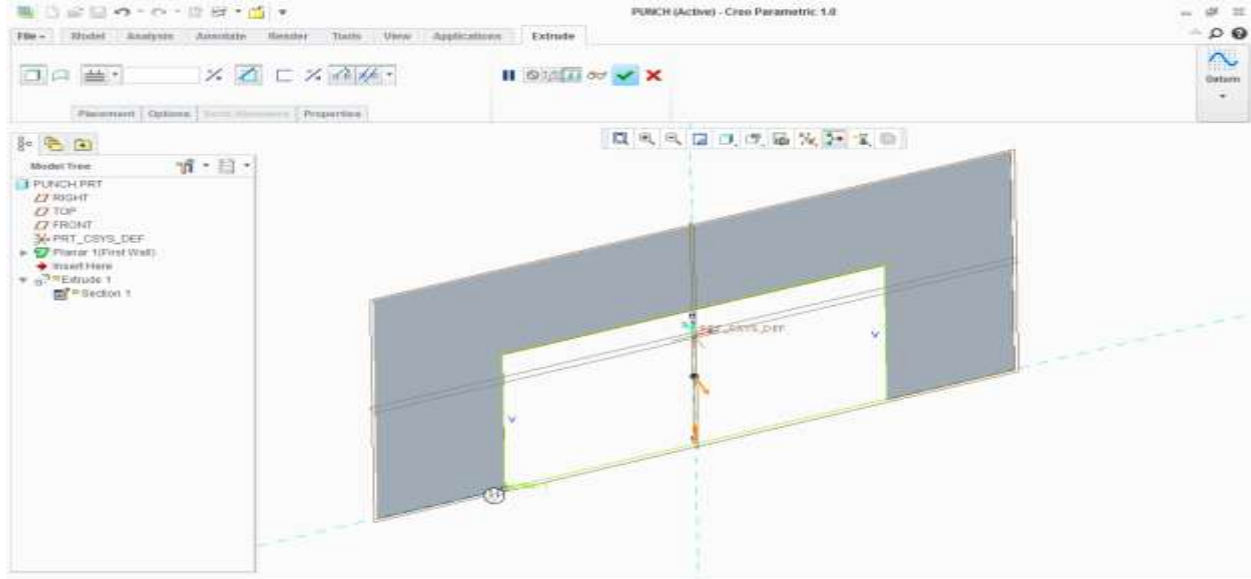


Binder fig:-1



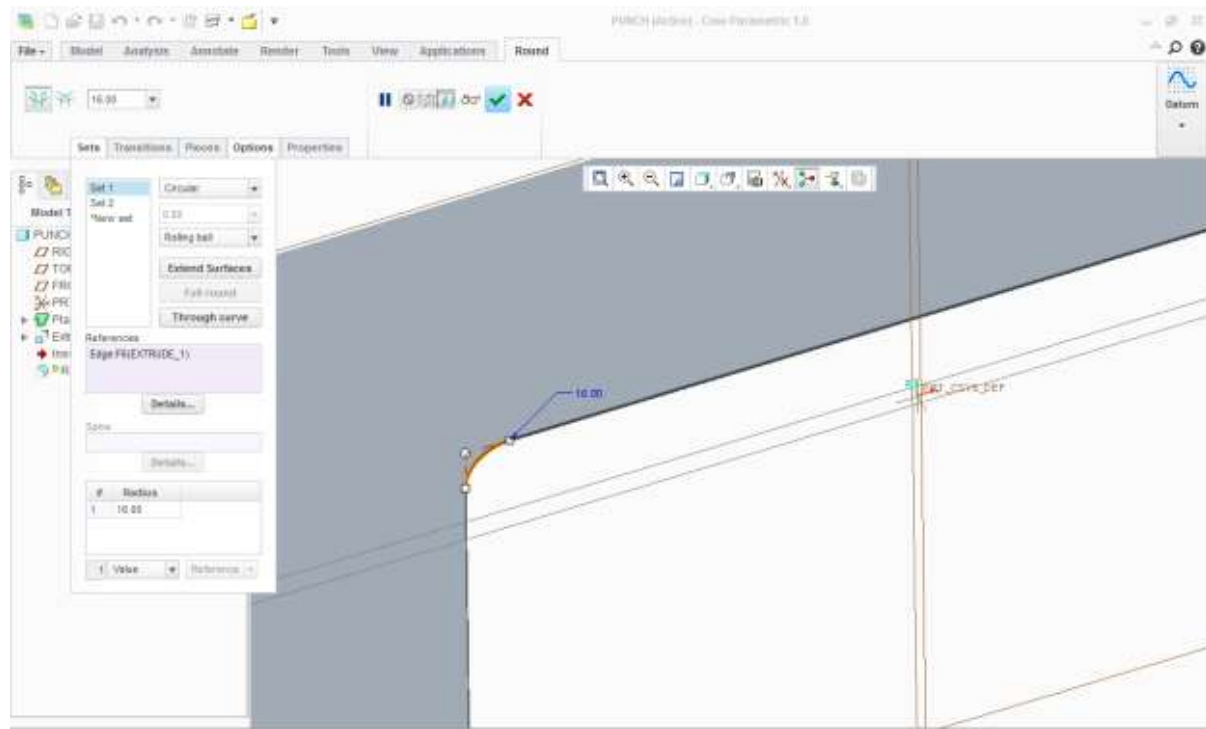
We have to remove that particular areas material for that select specific dimension.

As we remove unnecessary material from that particular resin area material which is required to hold the blank or sheet from the top of the die model[4-7].



Binder fig:-2

Now we are going to make particular fillet angle in the edge of the as per requirement of product when punch move from top to bottom toward the die profile. Fillet angle of the edge is 16.

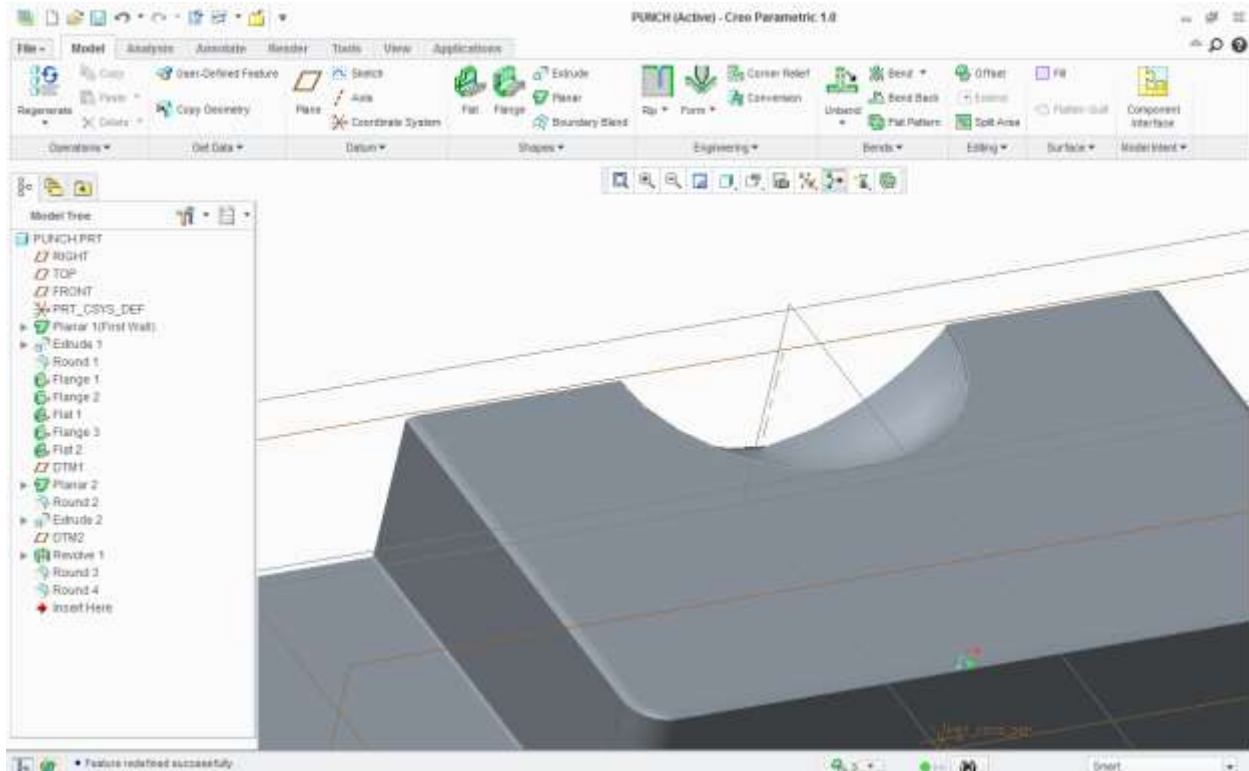


Binder fig:-3



Design of punch:-

Dimension of punch is as same as the dimension of die only we reduce 1.5mm in compare of die dimension as well as we provide 0.04 micron for clearance[8-11].



Punch fig:-1

II. CONCLUSION

As we know that hyper form is one of the best sheet metal analysis software so in this software we examine that what would be effect in the part design of sheet metal when applied difference pressure level. The problem areas such as wrinkling, thinning, spring back are the biggest challenges to the industry now a days but these problems can be tackled and sorted out in the initial phases of the design by using simulation techniques.

While designing new product for a particular requirement, the product designer and tool designer should have good communication between them and each of them should share their thoughts and queries in front of development team and final product should validate all the functional and manufacturing requirements.

Decreasing the lead time for product development along with the cost and time is the real challenge to the industry. It can be achieved with latest CAE techniques such as simulation, efficient use of

simulation method at the earliest stages of design can help to make necessary corrections and improvement when it takes least cost. Defects can be minimized or eliminated before try-out. So that lead time along with time and cost can be minimized.

III. REFERENCES

- [1] Ontology based design meta intent representation, Yingzhong Zhang, Xiaofangleo, school of mechanical engineering Dalan university of technology, China V978-1-4244-5268-2/09/2009IEEE PP 2-6
- [2] Behavior and design intent based product modeling, Laszlo Horwath &Imre J Rudas , Volume 1 2004 Hungary PP[10-25].
- [3] Fuh-Kuo Chen, Yeu-Ching Liao “Finite element analysis of draw-wall wrinkling in a stamping die design” VIII International Conference on Computational Plasticity COMPLAS VIII © CIMNE, Barcelona, 2005 PP 2-4



[4] Yang Feng, Xiaochun Lu, Bing Gao “Numerical Damage prediction and Experiments in Deep Drawing of Irregular Square Cup” 978-0-7695-4353-6/11 © 2011 IEEE DOI 10.1109/ICICTA.2011.221 PP 853-856.

[5] Journal of achievements in material and manufacturing engineering, volume 24 issue 1 september2007 PP 436-439.

[6] International journal of Intelligent Computer-Aided Stamping System (ICASS), intellicass inc.PP-2-5

[7] Hitenkumar Patel “optimization of an aerospace component die design using metal forming simulation capability of hyper-form” Hyper-works Technology conference (HTC), 2008. PP 1-7

[8] S.J. Hu, Z. Marciniak, J.L. Duncan Text 0Book Of ” Mechanics of Sheet Metal Forming” ISBN 0 7506 5300 0 PP 50-60

[9] Ninig-an Hu, Ning-yan Zhu” Aid Design Die of Auto-Body Using Numerical Simulation of 3-D Sheet Metal Forming Processes” SAE China (Society of Automotive Engineering of China) PP 14-20

[10] Kalpakjian “Manufacturing Processes for Engineering Materials”, 5th ed. •Schmid© 2008, Pearson Education ISBN No. 0-13-227271-7 PP 39-50

[11] T.S. Yang, “Finite element analysis of elliptic cup deep drawing of magnesium alloy sheet, VOL. 27, issue 2, April 2008, NSC- 95-2221-E-150-015, pp 139-142