Design and Analysis of Die Cating Mould

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Abstract: Effective die casting can produce thousands of high-quality molded casts in a relatively short amount of time while utilizing a single mold. This highly economical and cost-effective approach to die casting mold design can produce casts with uniform quality and high degrees of accuracy. Die casting mold development provides premium quality, near "net shape" parts at a price point that is extremely cost-effective.

The machining process of die-cast parts must be considered well before any order for the tooling is released. A careful evaluation of machined requirements can lead to redesign for net shape die-casting or near-net shape with a reduced number of operations.

The Design Can Be Made in CATIA V5. Using part design in catia v5.
Analysis Can be Done in Ansys workbench by taking materials cast iron, structural steel and aluminium.

Keywords: Die casting, mold design,CATIA V5,ANSYS

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I.INTRODUCTION

Die casting is an automated casting process in which liquid metal is pressed into a mold under extreme pressure at a high rate of speed. This casting process is highly suitable for mass production of components and is generally used with alloys that have a lower melting point. Since permanent metal molds are utilized for the die casting mold process, it is possible to produce large and complex components with low wall thicknesses.

The molds that are utilized within the die casting mold design process are constructed from premium, heat-resistant steel grades. The molds are halved to form a cavity into which the liquid metal is pressed during the casting process. A die casting mold is so strong, over a million parts can generally be created with a single mold. However, the actual life of the mold will solely depend on the die casting materials that are used.

Casting is a manufacturing process by whicha liquid material is usually poured into a moldwhich contains a hollow cavity of the desiredshape, and then allowed to solidify. The solidified part is also known as a casting, whichis ejected or broken out of the mold to complete the process. Casting is most oftenused for making complex shapes that would be otherwise difficult or uneconomical to makeby other methods. Casting is a 6000 year old process. The oldest surviving casting is acopper frog from 3200 BC.

Die cating definition:

This section is designed to introduce the reader to the basic concepts of die casting. It covers a comprehensive definition about die casting.

By the end of this chapter, you will be able to understand the following key factors:

1. Basic understand of the meaning for die casting
2. History of die casting
3. What products are often made of die casting in our life

What is die casting

According to the Engineer's Handbook, this is a manufacturing process where solid metals are melted and heated to desired temperature after which, it is poured into a cavity or mold with proper shape.

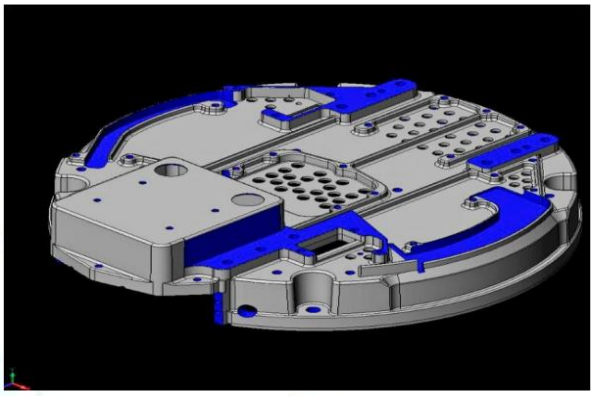
The melting and heating process may require different furnace heating temperatures.

Moreover, different chemical substances may be added to modify chemical composition of metals.

It is this mold that contain the desired shape and size.

2.METHODOLOGY

2.1 DIE CASTING MOULD



The process may be a single step of a series steps depending on the complexity of the metal substance. And final product can have virtually any size depending on what designer desires. Cast parts may range from fraction of inches to over 35 feet. It will depend on the design of mold or end product.

part from these, it is also crucial to highlight the major metal casting processes that have been used in this industry.

- Sand casting
- Lost Wax casting
- Permanent mold casting
- Centrifugal casting

It is a key factor that distinguishes this metal fabrication process from the other metal casting procedures listed above. For instance, if we look at a process such as lost wax casting, investment casting or sand casting procedures, the underlying factor in this case is the fact that, the process depends on gravity to fill the mold.

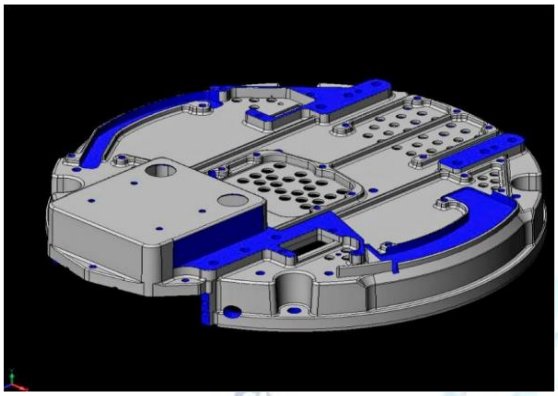
The Cambridge Dictionary defines gravity as a natural force that attracts objects towards one another, more so that force, which makes things fall on the ground. This further reveal more properties of die casting in relation to other metal casting processes

Here are three key points to note:

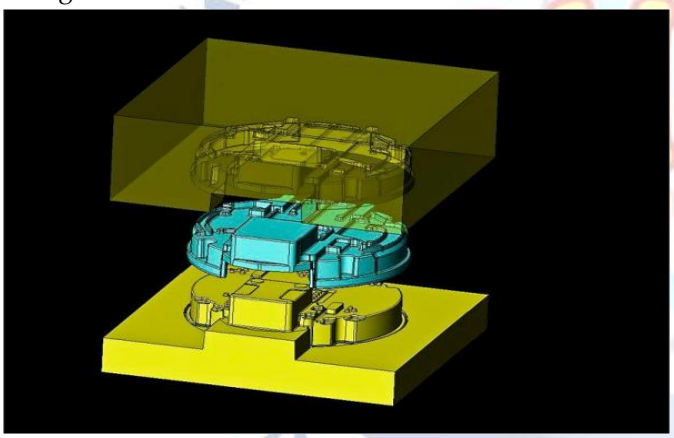
- Metal die casting process has a short cycle time

- Metal flow is faster in die casting due to existence of external force
- Molds in die casting are not as thick as those used in the sand casting or investment casting processes

Metal die casting process is used to produce various shapes from a number of non-ferrous metals such as brass , zinc, aluminum, magnesium and copper among other metals.



3D Rendition of casting converted from hog out configuration



Computer graphic of die casting mold

Aluminum alloy casting for aerospace industry

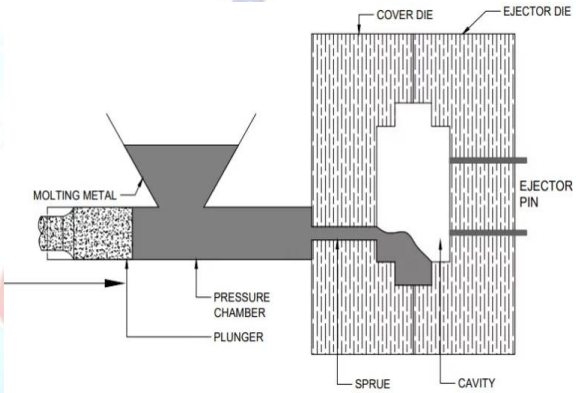
The Mold Development Process

Die casting is an automated casting process in which liquid metal is pressed into a mold under extreme pressure at a high rate of speed. This casting process is highly suitable for mass production of components and is generally used with alloys that have a lower melting point. Since permanent metal molds are utilized for the die casting mold process, it is possible to produce large and complex components with low wall thicknesses.

2.2 Components of Die Casting:

The Components are as follows:

- Pouring basin
- Plunger
- Pressure chamber
- Die
- Cavity
- Ejector Die and Ejector pins



Die Casting Molds

The molds that are utilized within the die casting mold design process are constructed from premium, heat-resistant steel grades. The molds are halved to form a cavity into which the liquid metal is pressed during the casting process. A die casting mold is so strong, over a million parts can generally be created with a single mold. However, the actual life of the mold will solely depend on the die casting materials that are used.

Advantages of Die Casting Mold Development

Die casting utilizes non-ferrous metals (such as aluminum alloys or zinc alloys) to manufacture components. The chosen alloy for an application depends on budget, weight, and material properties. Other benefits associated with the use of die casting mold design, include:

- High thermal conductivity
- High electrical conductivity
- Good processing properties
- Very good EMI/ RFI isolation
- High corrosion resistance
- High strength and hardness

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2.3 Casting Defects

- Any unwanted deviation from the desired
- requirements in a cast product results in a
- defect (Allsop and Kennedy, 1983). Some
- defects in the cast products are tolerable while
- others can be rectified by additional processes
- like welding, etc. The following are the major
- defects which are likely to occur:
- 1. Hot tearing
- 2. Blow holes
- 3. Porosity
- 4. Pouring metal defects
- 5. Pin holes

Quality Die Casting Mold Design Benefits

When it comes to high quality die casting mold development there are several influences that contribute to the overall success of the process. These factors include the following:

- First Class Engineering, die-cast tools design in house. Manage and oversee all aspects of tooling by SKS.
- Developing injection process parameters: gate size, location, feeding speed, fill time, injection pressure, press size.
- Parting line, runner, overflows, venting, cooling.
- Minimum and Maximum wall thickness.
- Choice of the mold material and hardness based on mold forces calculation.
- Superior or Premium Grade H13, Uddeholm Orvar or Dievar.
- Flow simulation.
- Draft, radii, filets.
- Establishing machining stock.
- Utilization of both domestic and overseas tooling suppliers.

Additional Considerations for Die Casting Mold Design

Some of the additional factors that should be considered before starting a die casting mold development project include the following:

- Gate calculation, feeding speed and fill time.
- Press size, clamping forces calculation.
- Shot sleeve choice and calculation.
- Venting and overflows.
- Establishing cast and technological Datums
- Establishing machining stock.

3.RESULTS AND DISCUSSION

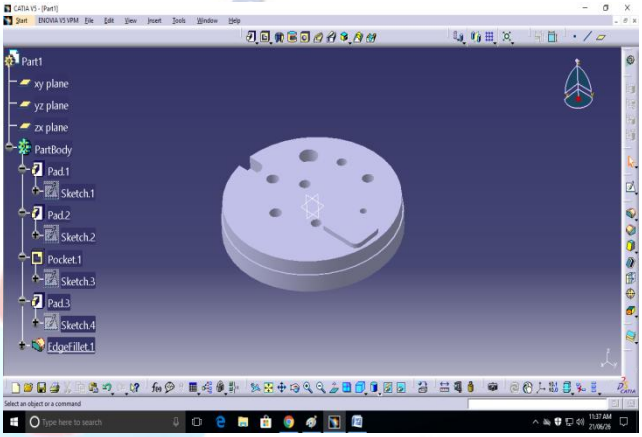
3.1 2D & 3D CAD Modeling

With the industry's most powerful and versatile CAD modeling tools, NX enables you to freely use any modeling approach that fits your design challenge and get innovative products to market faster.

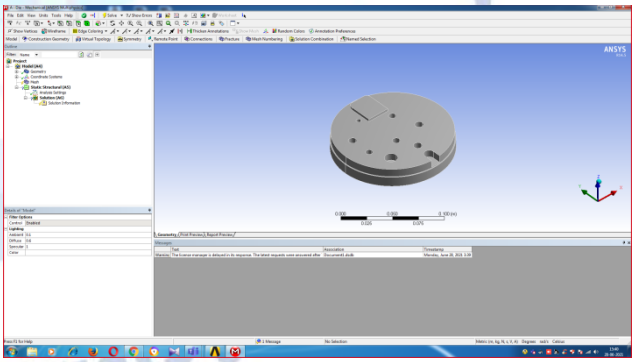
Modeling Technology Platform

Speed innovation by using the most productive modeling approaches interchangeably – from explicit solid and surface modeling to parametric and direct modeling, along with facet-based modeling.

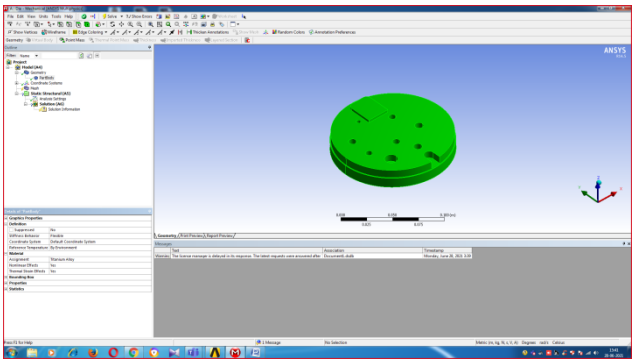
Catia Design of Die:



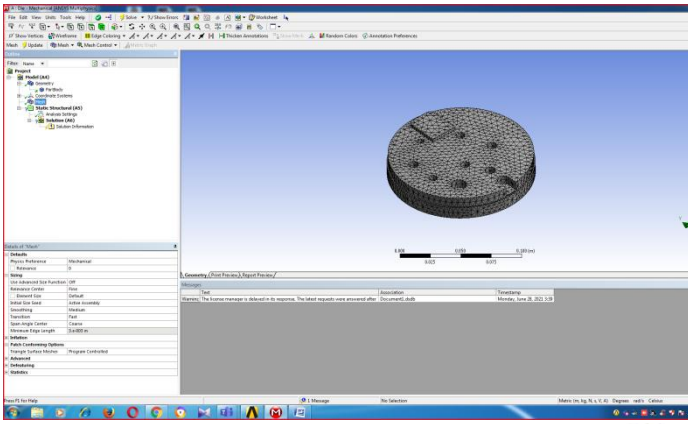
Importing into ansys



Chenging material

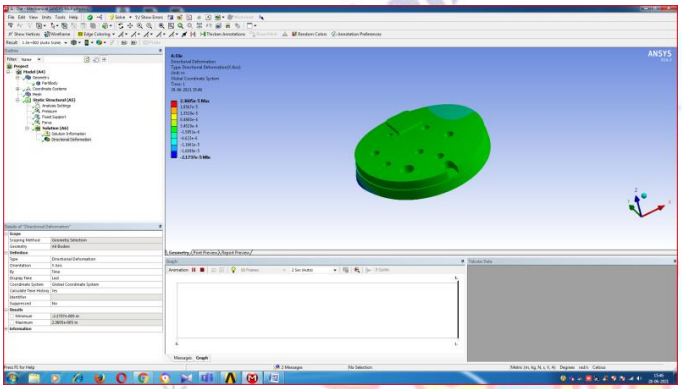


Applying mesh on the die

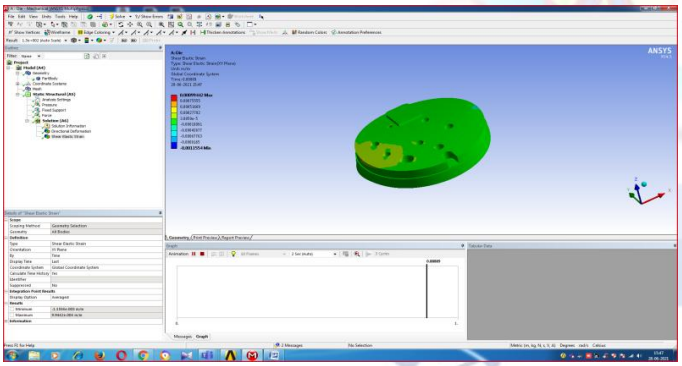


STRUCTURAL ANALYSIS

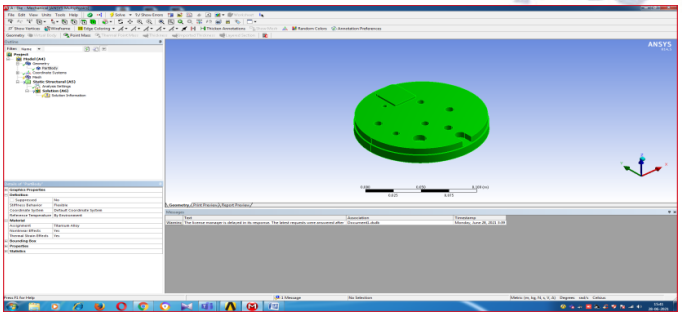
DEFORMATION TITANIUM ALLOY



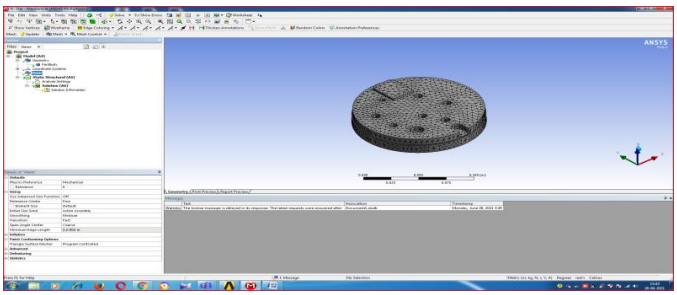
STRESS



STRAIN

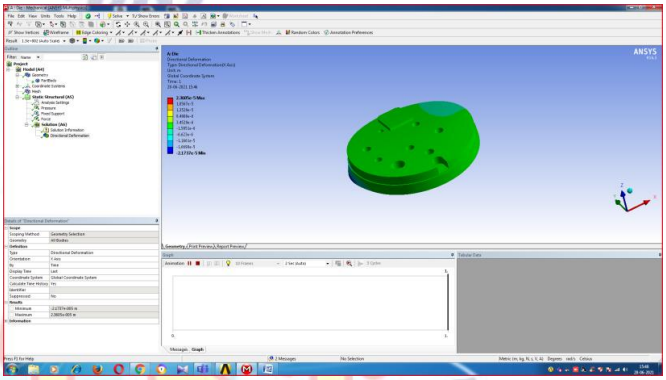


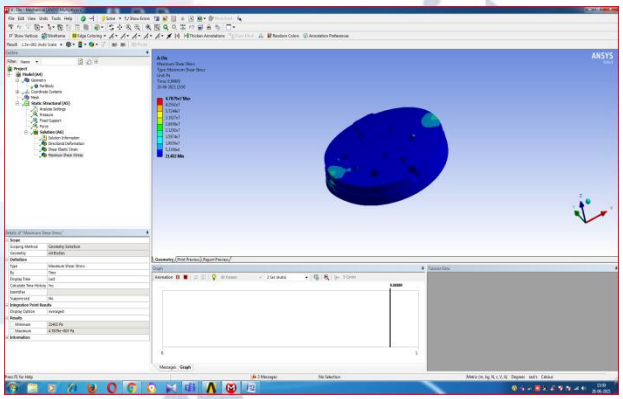
Applying mesh on the die



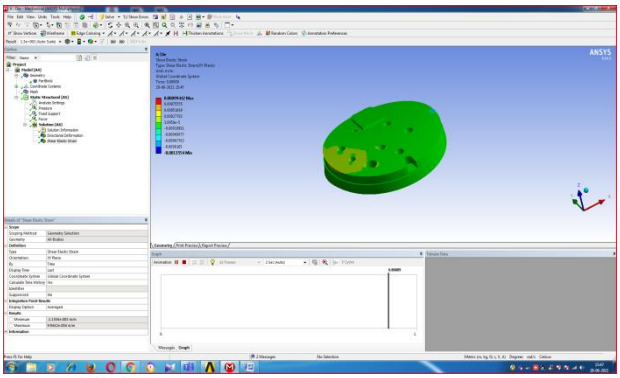
TRANSIANT STRUCTURAL

TOTAL DEFORMATION ON CAST IRON MATERIAL





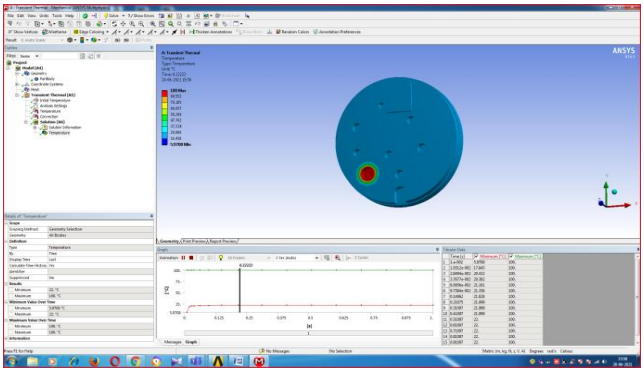
STRESS



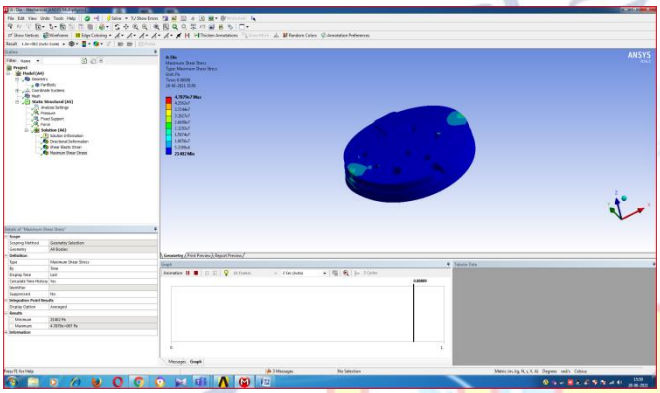
STRAIN

THERMAL ANALYSIS

TEMPARATURE



HEATFLUX



4. CONCLUSION

The main aim of this work was to design a Die Cast Mould and further by applying twoselected materials the total deformation and stress distribution was to be determined and out of that which material suits best for the piston was to be investigated. And from the analysis carried out and the results we can conclude that Titanium alloy is efficient under stipulatedconditions.

REFERENCES

1. Manjunath Swamy H. M., J. R. Nataraj, C. S. Prasad (2012) "Design Optimization of Gating System by Fluid Flow and Solidification Simulation for Front Axle Housing" International Journal of Engineering Research and Development, Vol. 4, Issue 6, pp. 83-88.
2. Ashish Powar, Hrishikesh Joshi, Sanket Khuley and D.P. Yesane, Design of Racing Motorcycle Swingarm with Shape Optimization, International Journal of Current Engineering and Technology (2016)
3. Giacomo Risitano, Lorenzo Scappaticci, Guglielmo Marconi, Carlo Grimaldi, Francesco Mariani, Analysis of the Structural Behavior of Racing Motorcycle Swingarms, SAE International: 2012-01-0207 (2012)
4. João Diogo da Cal Ramos, Front and Rear Swing Arm Design of an Electric Racing Motorcycle, Master of science degree thesis in mechanical engineering, Tecnico Lisboa. 2016
5. B. Smith and F. Kienhöfer, A Carbon Fibre Swingarm Design, R & D Journal of the South African Institution of Mechanical Engineering 2015, 31, 1-11
6. S. Aswath, Nitin Ajithkumar, Chinmaya Krishna Tilak, Nihil Saboo, Amal Suresh, Raviteja Kamalapuram, Anoop Mattathil, H. Anirudh, Arjun B. Krishnan, Ganesha Udupa, 'An Intelligent Rover Design Integrated with Humanoid Robot for Alien Planet Exploration', Robot Intelligence Technology and Applications 3 pp 441-457.
7. G.B.Veeresh Kumar, R.Pramod, C.S.P.Rao, P.S. Shivakumar Gouda, Artificial Neural Network Prediction On Wear Of Al6061 Alloy Metal Matrix Composites Reinforced With -Al2O3, Materials today : Proceedings Volume 5, Issue 5, Part 2, 2018, Pages 11268-11276
8. Manikyam Sandeep S Sampath Kumar,K V Sai Pavan,T.Rajasanthosh Kumar, Laser Heat Treatment was Performed to Improve the Bending Property of Laser Welded Joints o Low-Alloy Ultrahigh-Strength Steel with Minimized Strength Loss, 2019,83,pp. 2659 – 2673.
9. Siddam, Sampath & Todupunuri, Somasekhar & Reddy, P. & kumar, T.. (2021). Duplex stainless steel welding microstructures have been engineered for thermal welding cycles & nitrogen (N) gas protection. Materials Today: Proceedings. 10.1016/j.matpr.2020.11.091.
10. K B SAI SANJANA1 , K SAI MOUNIKA2 , T RAJA SANTHOSH KUMAR3 & D V SRIKANTH4, THERMAL ANALYSIS OF ADVANCED IC ENGINE CYLINDER, International Journal of Automobile Engineering Research and Development (IJAuERD) ISSN(P): 2277-4785; ISSN(E): 2278-9413 Vol. 6, Issue 3, Jun 2016, 17-26.

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