

# Development and Implementation of guideline for Die Casting Process in DFMPPro Software.

Mr. Mandar U. Magdum, Prof. S.N.Jalwadi, Mr. Yogiraj Dama, Mr. Pradip Pulujkar

**Abstract**— In current competitive environment, it is very important to analyze product development process based on customer requirement. In market different options are available for customer to complete the functional requirement so it is important to address customer's requirement with respect to cost as well as time to launch in market. DFMPPro help designers check their designs for manufacturability and assembly and correct these problems early in the design stage. It automates the iterative design change phase between design and manufacturing team. So it helps to get design right in early stage of product development. The present article discusses the method for analysis of die casting part for minimum wall thickness check (i.e. it will check all the dimensions of part with input dimension given in software).The check is created with using FR (Feature Recognition) technology. FR is helping to identify different features and faces of part. Information obtained from FR and using vector and geometrical concept it is possible to obtain wall thickness of part. To develop this guideline the programming is done in C and C++.The result demonstrate that the developed guideline will help to measure wall thickness across the all feature of part and avoid defects like misrun effectively before first part being manufactured.

**Keywords**—Minimum Wall Thickness, DFMPPro checks, Die casting wall thickness, Uniform wall thickness.

## 1 INTRODUCTION

Design for Manufacturing (DFM) is a philosophy and mind-set in which manufacturing input is used at the earliest stages of design in order to design parts and products that can be produced more easily and more economically. Design for Manufacturing is any aspect of the design process in which the issues involved in manufacturing the designed object are considered explicitly with a view to influence the design. Examples are considerations of tooling costs, time required, processing costs, controllability and variability control, assembly time, costs, human concerns during manufacturing, availability of materials, equipment, and so on. Design for manufacturing occurs or should occur throughout the design process

On an average 30% of product development time is spent on rework designing a product first then optimization of product design to meet downstream manufacturing requirement. Consideration of manufacturing and assembly issue during early design stages can shorten the product development time, minimize cost and ensure a smooth transition into production. It is well-known that, although design costs consume approximate 10% of the total budget for a new project, a major part between 70% and 80%, of the Accumulated production cost of a product is defined

during the design phase.

DFA methodology helps to simplify the product in terms of number of parts, where the desired is to have the minimum possible, also quantifying the time and therefore costs of the assembly process. DFM methodology helps in the selection of materials and manufacturing processes, presenting trade-off decisions to be made for the designs.

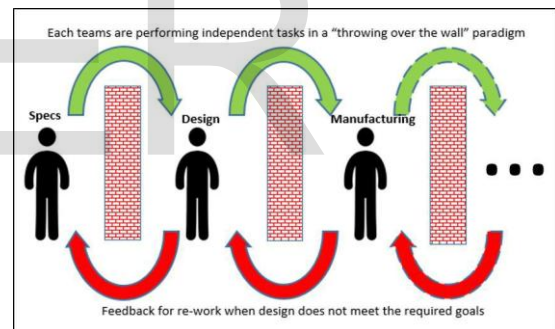


Fig. 1 Traditional product development procedure

Die casting is a moulding process in which the molten metal is injected under high pressure and velocity into a split mould die. It is also called pressure die casting. The split mould used under this type of casting is reusable.

In this paper we will see the details of guideline Minimum Wall Thickness for die casting in DFMPPro software. Uniform wall thickness need to be maintained so as to achieve a minimum porous die casted product. The injected liquid metal cools rapidly on contact with the die casting surface resulting in a fine grained dense structure (the surface is termed as skin) generally devoid of porosity and is considered to be the strongest region of the die casted product. Misrun and cold shut defects are caused either by a lower fluidity of molten metal or the section

- Mr. Mandar U. Magdum, Mechanical Department Rajarambapu Institute of Technology Islampur, India-415414. Email ID: [mandar.magadum@gmail.com](mailto:mandar.magadum@gmail.com)
- Prof. S.N.Jalwadi, Mechanical Department Rajarambapu Institute of Technology Islampur, India-415414. Email ID: [sudhindra.jalwadi@ritindia.edu](mailto:sudhindra.jalwadi@ritindia.edu)
- Mr. Yogiraj Dama Geometric Limited Pune-411057
- Mr. Pradip Pulujkar, Geometric Limited, Pune-411057

thickness of the casting is very small. So to address this issue minimum wall thickness guideline is important.

Kristian Amadori et al. [1] explores novel methodologies for enabling Multidisciplinary Design Optimization (MDO) of complex engineering products. To realize MDO, Knowledge Based Engineering (KBE) is adopted with the aim of achieving design reuse and automation. To eliminate non-creative work, methods for creation and automatic generation of High Level CAD templates (HLCT) are suggested. KBE is utilized to manage the framework which creates the geometric CAD models.

Thorsten Wuest et al. [2] describe challenges for product development and design. However, when the design is becoming more complex this often leads to more challenging requirements towards manufacturing processes and operations. Design is in most cases a compromise of conflicting goals. Manufacturing state drivers are relevant parameter with a strong influence on a certain target value, e.g., product quality. Being derived through a comprehensive analysis of the specific manufacturing sequence, they allow for targeted monitoring and optimization efforts as a means of improvement. Utilizing more detailed, even product-instance specific manufacturing information and knowledge to incorporate within DFM is a valid approach that seems promising.

Claudio Favi et al.[3] describes multi-objective approach to core of the proposed workflow and aim to balance different aspects of industrial production, such as assembly, materials and manufacturing processes taking into account the overall cost as a driver for the optimization design process. With the reference to case study of a tool-holder carousel of a CNC machine, describes new solution consisting in a new shape is able to meet assembling, manufacturing and cost requirements, improving the old solution. The approach proposed by researchers is cost-driven and help designers and engineers in the selection of the cost-effective design solution.

Yannick Bodein et al. [4] describe parametric associative CAD systems to create more efficient virtual development processes. While dealing with complex parts (e.g. the number of surfaces of the solid) no CAD modeling methodology is existing. Based on the analysis of industrial designers' practices, they identified key factors that lead to better performance. Objective in that article is to propose a practical method for complex parts modeling in parametric CAD system.

By studying all above literature, it is found that for complicated parts it is necessary to use some software tool for reusability of parts and minimize time to market and cost of product. So DFM is promising approach for product development in most of cases.

## 2 PART ANALYSIS

### Introduction:

The work related to this topic is carried out at Geometric limited Pune and Rajarambapu Institute of Technology Islampur. DFMPPro is engineered to help designers check their designs for manufacturability and assembly and correct these problems early in the design stage. It automates the iterative design process via a series of rules-based checks, identifying design areas that are difficult, expensive or impossible to manufacture. It helps organization improve engineering efficiency by minimizing rework and engineering changes (ECOs).

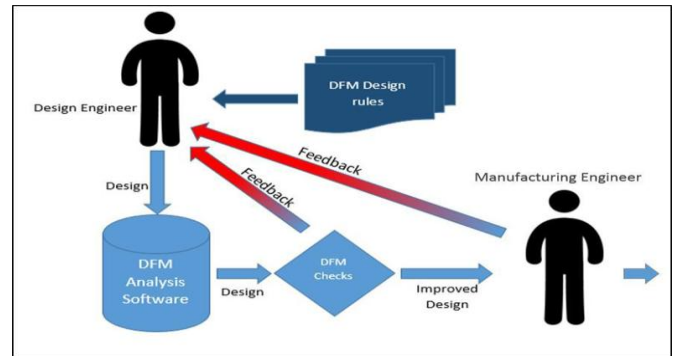


Fig. 2 Advances product development procedure

### Analysis process of CAD model in DFMPPro Software:

- Start the DFMPPro Software
- Import the CAD model if DFMPPro in standalone model. For other options make a model in respective software or import in proper format
- Open rule manager select rule which we want to validate against CAD model feature. There are standard values are available for rule if we want to change according to our need then change it and save.
- Select the required module for analysis ex. injection molding, die casting, sheet metal, additive manufacturing etc.
- Click on Run button which will start the analysis.
- Specify direction of pulling (this option available for some specific application).
- View the results on clicking on result option and its sub options.
- Export the results in different form available ex. Exel sheet, e-Drawing, XML file format
- Change the necessary feature which will not affect the functionality and ignore feature which will not want to change.
- Run the analysis process again and check for failed rule.

- Continue the process till we will get zero failed rules.

Wall thickness based upon Material:

Material	Min. Thickness mm (in)
Aluminum alloys	0.9 mm (0.035 in)
Zinc alloys	0.6 mm (0.025 in)
Copper alloys (Brass)	1.25 mm (0.050 in)

Fig. 3 Wall Thickness Values

Guideline Development Methodology/Setup:

- i. Need to be installed VS12 setup on machine.
- ii. API and corresponding library of DFMPPro software.
- iii. Identify the feature faces of part whose wall thickness to be measured.
- iv. Select one outer face using API command, and identify the direction in which thickness need to measure.
- v. Make points on every surface with specific distance.
- vi. Select one point face and connect to all points opposite faces.
- vii. Using geometry find all the distance make it in ascending order.
- viii. Compare values obtained with configured value and identify the position where it violets the configured value which will give direction and value of minimum wall thickness.
- ix. Doing above procedure for all feature faces will give complete analysis of part.

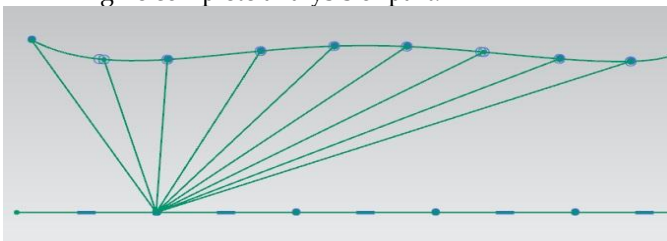


Fig. 4 Find Thickness of material

Below steps are required to create a new Custom Rule:

- Setup Required to Build
- Create rule module
- Add rule in rule module
- Create validator in module

- Add rule logic in validator module
- Compile and build
- Setup required to run
- Run

### 3 RESULTS

Rule Result Validation procedure:

Case 1) Flat plates

1. Take a simple flat plate with known thickness which is lower that recommended value and Running DFMPPro analysis will get Thickness so comparing Obtained thickness with predefined thickness.

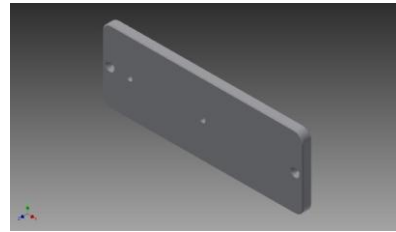


Fig. 5 Flat Plate CAD model

Case2) Concentric cylinder

1. Draw a two concentric cylinder with known diameter and extrude the sketch so that solid body can be formed. So difference between two diameters will give the wall thickness so comparing this result with obtained result through DFMPPro Software.



Fig. 6 Hollow cylinder CAD model

Case 3) Random Part

1. This validation method is little costly.so we need to manufacture the part and manually calculate the wall thickness across all surfaces of part and validating results with software results.

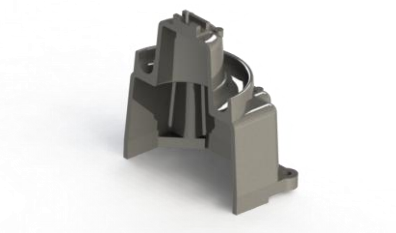


Fig. 7 CAD model

## 4 CONCLUSION

The following conclusions can be made from the present study of the Die casting minimum wall thickness analysis through DFMPPro software.

- For simple part it is easy to check wall thickness manually or using measuring command in CAD software
- For the part which are complicated and size part is huge then it is become difficult to calculate wall thickness at various location and chances of getting appropriate result so this rule definitely help to get minimum value of thickness in the part and saves time as well as cost.
- Misrun and cold shut defects are caused either by a lower fluidity of molten metal or the section thickness of the casting is very small. So to address this issue minimum wall thickness guideline is important.
- So, with the presence of the crack and the delamination the stiffness of beam will decrease and this will cause a decreasing in the natural frequency of the corresponding mode (bending mode for crack and torsion mode for delamination) of the composite sandwich structure.

So, we can develop the robust techniques for Measuring Wall Thickness which is essential to avoid failure during operating condition or during manufacturing time.

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