

RAPID PROTOTYPING TECHNOLOGY: FUSED DEPOSITION MODELING USING FINITE ELEMENT METHOD. A REVIEW

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ABSTRACT

In this paper, review on Determination Of Stresses In Experimental Model Developed By Fused Deposition Modeling Rapid Prototyping Technology And Analysis Using Finite Element Method is carried out. This paper shows basic and advanced methods of Rapid Prototyping (RP) technology, with a special provision of Fused Deposition Modeling (FDM) method. In this paper we have discussed about Principles of Fused Deposition Modeling technology, materials used for production of models and products. In this work we have consider the example of experimental model of flange coupling that is made in CATIA 3D software. So, we goes for 3D modeling of given part, then determination of stresses occur during the process is calculated. The stresses can be calculated by ANSYS 14.5. On the basis of result of analysis we get the value of stresses. Then we compared RP model and Casting model of flange coupling. On the basis of this Comparison of stresses we suggest that this method is preferable or not.

Keywords: ANSYS 14.5, Rapid Prototyping, Fused Deposition Modeling (FDM)

1. INTRODUCTION

Prototyping or model making is one of the important steps to finalize a product design. It helps in conceptualization of a design. Before the start of full production a prototype is usually fabricated and tested. Rapid prototyping (RP) is a technology wherein the physical modelling of a design is done using a specialized machining technology. The systems used in rapid prototyping quickly produce models and prototype parts from three-dimensional (3D) computer aided design (CAD) model. Using an additive approach for building shapes, the systems in RP join different materials like liquids or powder to form some physical objects. Layer by layer, the RP machines fabricate these powdered ceramic, wood, plastic and metal powders using very small and thin horizontal cross sections of the generated computer model. Rapid prototyping is an emerging technology, the definition of which is derived from the key concept - making it rapid. Rapid prototyping is creating a profound impact on the way companies produce models, prototype parts, and tooling.

This work describe basic and advanced methods of Rapid Prototyping (RP) technology, with a special provision of Fused Deposition Modelling (FDM) method. In this paper we have discussed about Principles of Fused Deposition Modeling technology, materials used for production of models and products. In this work we have consider the example of experimental model of flange coupling that is made in CATIA 3D software. So, we goes for 3D modeling of given part, then determination of stresses occur during the process is calculated. The stresses can be calculated by ANSYS 14.5. On the basis of result of analysis we get the value of stresses. Then we compared RP model and Casting model of flange coupling. On the basis of this Comparison of stresses we suggest that this method is preferable or not.

2. LITERATURE SURVEY

NOVAKOVA - MARCINCINOVA, L[udmila] & NOVAK - MARCINCIN, J[ozef] [1] Studied on Fused Deposition Modeling (FDM) represents one from basic Rapid Prototyping (RP) methods used in industrial practice. In this work he presented basic about common and advanced materials used for realization of products by Fused Deposition Modeling rapid prototyping technology application. The basic method of Rapid Prototyping devices the initial state of material can be taken either solid, liquid or powder state. In solid state material can be in form wire, pellets or laminates. The current range materials include paper, nylon, wax, resins, metals and ceramics. Directly in FDM technology are used as basic material Acrylonitrile Butadiene Styrene, polyamide, polycarbonate, polyethylene and polypropylene.

Ludmila Novakova-Marcincinova, Ivan Kuric [2] Mainly focussed on Fused Deposition Modeling (FDM) is one from basic Rapid Prototyping (RP) technologies used in technical practice. In this contribution are presented basic information about common and advanced materials used for realization of products by Fused Deposition Modeling Rapid Prototyping technology application. In different Rapid Prototyping Technologies the initial state of material can come in either solid, liquid or powder state. In solid state it can come in various forms such as pellets, wire or laminates. The current range materials include paper, nylon, wax, resins, metals and ceramics. In Fused Deposition Modeling are used as basic material ABS - Acrylonitrile Butadiene Styrene, polyamide, polycarbonate, polyethylene, polypropylene. Instead of these materials in special FDM applications can be used silicon nitrate, PZT, aluminium oxide, hydroxyapatite and stainless steel for a variety of structural, electroceramic and bioceramic applications.

NICOLAE BALC, R. IAN CAMPBELL. [3] He described from CAD and Virtual Prototyping, there are already available many Rapid Prototyping (RP) techniques to produce physical, hand hold able parts. A brief overview is presented of some important aspects regarding how to get a good 3D solid model, how to transfer it to RP machines and how to produce quickly a physical prototype. The RP models could be used for different downstream applications. The paper gives some alternative tooling routes, depending on some criteria, such as: volume production, material and complexity of the parts. The RP models could be used as master models for vacuum casting, metal spraying, investment casting and other innovative manufacturing techniques. And he conclude The main applications of rapid prototyping in engineering are: Concept Modeling, Functional Testing, Tooling and Manufacturing.

PROF. DEEPA YAGNIK [4] He presents in his paper Rapid Prototyping (RP) is the term given to a set of processes that can quickly fabricate any given three-dimensional object into a model or prototype, directly from a CAD file via the additive deposition of individual cross-sectional layers of the part. Over the years, RP has evolved from producing prototypes for form, fit and functional testing to producing final end products for functional use. FDM, a RP technique has made its mark for providing cost effective product along with making impossible geometries possible. It also confirms performance prior to implementation. Fused deposition Modeling is being used to shorten and simplify the product development cycle cost efficiently and act as ideal method for many applications including aerospace, medical, automobile and consumer products etc.

CHRISTOPHER B. WILLIAMS.[5] He suggested that in his this paper, a review of metal RP technologies was provided. Through the use of a working principle based classification scheme, the focus of this paper was narrowed to the use of a RP machine to directly fabricate a metallic part. Three specific technologies, LENS, SLS, and MJS, and their associated material properties were investigated. It should be noted that due to the infancy of many of these technologies, specific material property data was difficult to find. The research focus for each of these techniques seems to be focused on process control or the deposition of specific materials. Also, many of these technologies have been commercialized and are in direct competition with one another – as a result, the focus on limitations of each of these technologies is difficult to find. It seems as though the driving force for this research work is to obtain higher accuracy in the products, to use higher melting metals and new building materials, to avoid the

application of binders or infiltration material, to manage more complex geometry, to reduce the building time, and to decrease pre- and post-processing efforts (Karlsen et al. 2003). Given the overview presented in this paper, this “driving force” seems appropriate as researchers continue their search for a true Rapid Manufacturing technology.

V.G.VIJAYA [6] He suggested that This project deals with stress analysis of rigid flange couplings subjected to torsion using ansys. The theory related to the title will be studied from ‘FUNDAMENTALS OF MACHINE DESIGN by T.J.PRABHU, page no 12.3 Analytical solution will be obtained. To obtain computer solution ANSYS will be used. A comparison of results obtained from 2 & 3 will be presented.

PULAK M. PANDEY.[7] This paper provides an overview of RP technology in brief and emphasizes on their ability to shorten the product design and development process. Classification of RP processes and details of few important processes is given. The description of various stages of data preparation and model building has been presented. An attempt has been made to include some important factors to be considered before starting part deposition for proper utilization of potentials of RP processes.

PROF. D.V. MAHINDRU & PROF. PRIYANKA MAHENDRU.[8] He studied the The term “Rapid Prototyping” (RP) refers to a class of technologies that can automatically construct physical models from computer-Aided Design (CAD) data or is a group of techniques used to quickly fabricate a scale model of a physical part or assembly using three-dimensional computer aided design (CAD) data. The “three dimensional printers” allow designers to quickly create tangible prototypes of their designs rather than two dimensional pictures. Such models have numerous uses. They make excellent visual aids for communicating ideas with co-workers or customers apart from design testing.

PRANJAL JAIN,*, A. M. KUTHE.[9] In his Recent reports The objective of this work is to bring about a revolution in Manufacturing Industry from Mass-Production Manufacturing to Tailor-Made Manufacturing in which products are manufactured according to the whims of the customer. For that, Rapid Prototyping (RP) method was used for making a prototype or pattern for casting a product. A new method for investment casting was found out using RP: Fused Deposition Modeling (FDM). RP parts were also tested for using them as a pattern for sand casting. Software named “AUTOCAST-X” was used for designing and simulating zero defect casting. A case study of a middle disc of Oldham coupling was done, in which the disc was produced using both the new investment casting and the sand casting and the parts made by both the methods were compared. Views of foundry personnel were recorded on using RP Patterns in sand casting.

VIKRAM SINGH [10] In this study This paper provides an overview of RP Technology in brief and emphasizes on their ability to shorten the product design and development process and detail of few important processes is given. The RP technologies provide the freeform fabrication of the complex geometry directly from their CAD models automatically.

The future looks very promising for rapid prototyping. The benefits for most applications far outweigh the disadvantages especially when they are used in the correct situation. The price and size are rapidly falling to the point where they will soon be commonplace in any manufacturing company.

3. AIM AND OBJECTIVE

- To use Fused Deposition Modelling Rapid Prototyping Technology for product development and design process.
- To carry out approximate analysis by Finite Element Method of Flange Coupling.

OBJECTIVE

- To understand basic step in RP process.
- To understand the importance and application of Rapid Prototyping Technology in product design and development process.
- To find out stress in flange coupling.

4. METHODOLOGY

1. First study and understand the concept of Rapid Prototyping and Fused deposition method of RP.
2. Geometrical modelling of our project with 3D software CATIA.
3. Analysis using ANSYS14.5 software to calculate the stresses of given 3D model.
4. Prototype of Flange coupling by Rapid Prototyping and FDM method.
5. Testing of flange coupling model..
6. Results representation for variation in parameters.
7. Graphical plots for both temperature and stress across the thickness direction.
8. Report generation.

4.1 Initial Geometrical Model

The figure 03 shows geometrical model of flange coupling. The geometry is built using CATIA. After making model the STEP file is made and save for further Analysis. Once the analysis is completed the comparison will be made on the basis of result.



fig 04 Geometrical Model of the problem

5. CONCLUSION

The aim of this paper is to put in front the basic fundamentals of Rapid prototyping and fused deposition method process. The rapid prototyping pattern differs not only in cast, but also in capabilities. It proves the RP pattern (ABS model) is feasible for sand casting. It minimizes lead-time thereby assured delivery complexity of object-required deviations from conventional techniques used in tooling. Rapid prototype proved superior to traditional method technical Standpoint, especially where limited number of run are required. Rapid Prototyping promises good surface finish, dimensionally accurate and suitable for intricate geometry.

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