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Drawing Automation of Reactor Nozzle

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ABSTRACT

Reactor is a device or process in which chemical reactions take place during a chemical conversion type of process. Reactor has many parts in their structures such as nozzles, supports, shell and head, etc. All the reactor parts design are required before manufacturing. In industries reactor generation required more time. By changing the dimensions of nozzle according parts model are having similarity in geometry but different in dimensions. Same type of reactor parts model drawing to parametric relation, new manufacturing drawing of reactor nozzle will automatically produced. In this paper drawing automation of reactor nozzle is carried out using Solid Edge. Knowledge from expert engineers and technical literature are captured within the KBE application. The conclusions arrived discussed at the end

Keywords – ***Computer aided design, Drawing automation, Knowledge based engineering, Parametric model.***

I. INTRODUCTION

The Reactor is one type of pressure vessel. It is a closed container designed to hold gases or liquids at a pressure substantially different from the ambient pressure. Reactor is a device or process in which chemical reactions (catalyzed & non-catalyzed) take place during a chemical conversion type of process. A reactor is a vessel designed for internal pressure or vacuum. It has a heat source typically an external jacket and is agitated for proper mixing. Reactor parts are operated at different loading and internal pressure. So reactor parts individual designing will required. Reactor models are having similarity in geometry, but different in dimensions. By changing the dimensions of various parts according to parametric relation, New drawing model will produced, it's called drawing automation. Reactor has various parts like top head, bottom head, shell and nozzles etc. Various parts and locations of nozzles in the vessel are shown in Figure 1. In industries the manufacturing drawing was prepared using AutoCAD as a drafting tool. There was a lot of time consuming in editing, revising the drawing such a fabrication drawing in AutoCAD. Thus, it is needed to automate the manufacturing drawing of nozzle reactor.

In Industries models are having similarity in geometry but only dimensions are different. Same type of models drawing generation required more time. Time is most important factor in industries. So drawing automation of the model is required. With the help of drawing automation new models drawing will be automatically generated. There are two radial nozzle are shown in Figure 2. Both nozzles have same geometry. But dimensions are different. e.g. Nozzle I.D is 930 & 980 mm. Same type of models drawing generation required more time. By changing the dimensions of nozzle according to parametric relation, new model will automatically produced. For isometric view of nozzle on head referred Figure 3 and Figure 4.

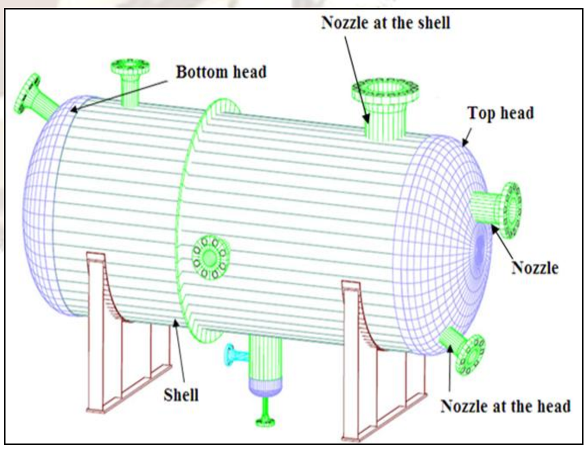

Fig.1.Various parts and locations of nozzles in the vessel

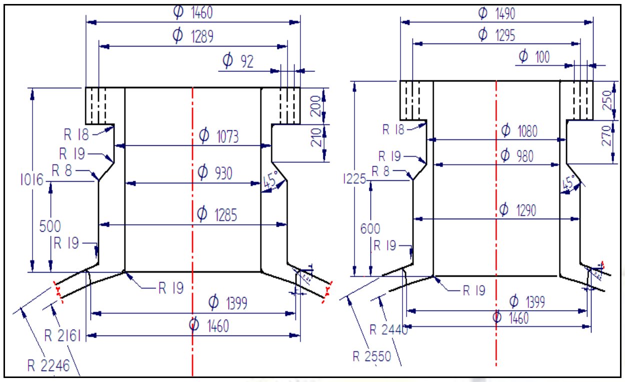

Fig.2. Nozzles

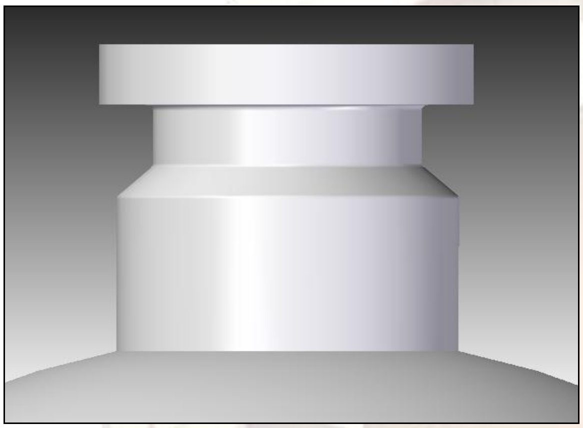

Fig.3. Nozzles on head

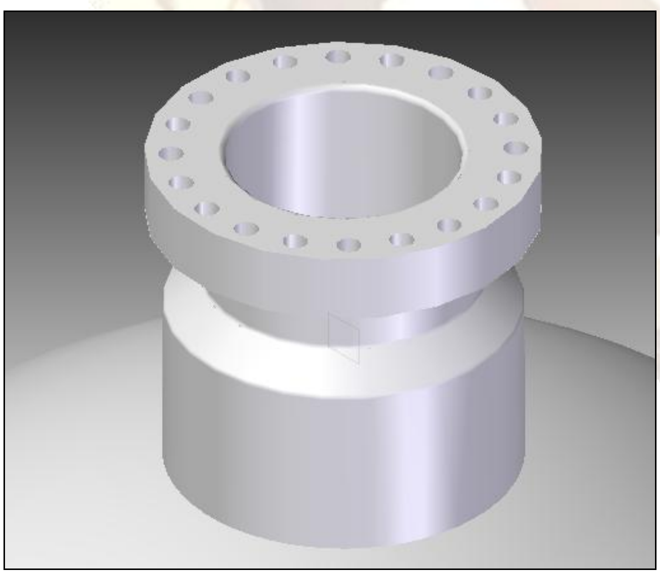

Fig.4. Nozzle on Head (Isometric view)

II. LITERATURE REVIEW

Lin, B. T. and Hsu, S. H. [1] have described an automated design system for drawing dies using CAD software. Taking advantages of pre-built design knowledge base and data base, this system is able to output designs of the main components of a drawing, such as upper dies, lower dies and blank holders, upon users input of design information of blank lines, punch open lines, press data, and types of subcomponents such as hooks, guides, and stopper seats. This die design system is built on top of CATIA V5, and makes use of its built in modules, including part design, automation and scripting and knowledge advisor.

Chavali .S.R and Sen C. and Mocko G. M and Summers J. D. [2] have discussed the development and usage of rule based design (RBD) in an industrial engineer-to order (ETO) application is presented. First, three different design and geometric modeling processes are discussed for specifying customized bottle packaging systems, assemblies, and components. These processes include: (1) a manual method in which custom design specifications are uniquely created using two-dimension CAD software, (2) a custom in-house Visual Basic automated system built on a commercially available three-dimension solid modeling package, and (3) a commercially available rule-based system integrated with a commercially available three-dimensional solid modeling software tool. The advantages and limitations of the different modeling approaches are presented and evaluated qualitatively.

Chapman C. B and Pinfold M. [3] describes a knowledge based engineering system (KBES). knowledge based engineering (KBE) is fundamentally about reuse in engineering knowledge to further multiply productivity by documenting rules & using them to automate design procedures. KBES to extend the current capabilities of automotive body in white (BIW) engineers. It allow them to respond dynamically to change within a rapid timeframe and to assess the effects of change with respect to the constraints imposed upon them by other product cycle factors, the systems operates by creating a unified model description that queries rules as to the suitability of the concept design and is built using a standard KBES to reduce project cost and system implementation.

III. RESEARCH METHODOLOGY

It should be noted that all reactor parts are design as per ASME section VIII, Division II [4]. On order to reduce cycle time in designing the reactor nozzles, the automation has been produced by using solid Edge ST-2 [6] and it linked with Microsoft excel [7]. The software provides the detail manufacturing drawing of the nozzle. The software needs required inputs and necessary information for nozzle drawing. The drawing drawn on the screen corresponds directly with the inputs supplied. The benefit of this feature is that the user always knows where they are within the design. Procedure for drawing automation of reactor nozzle is shown in Figure 5.

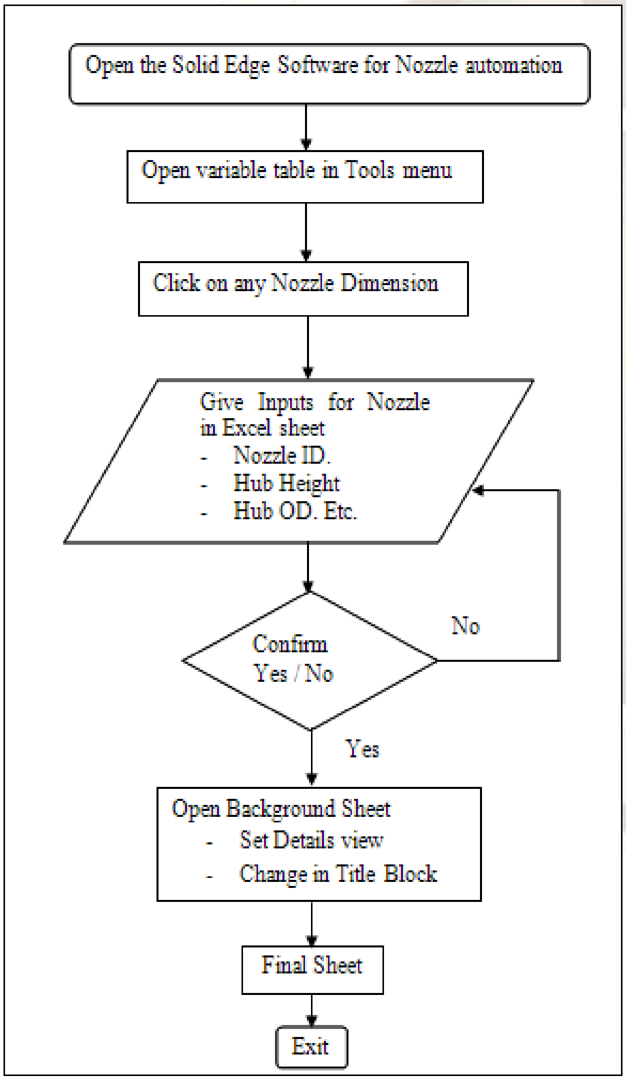

Fig.5. Flowchart

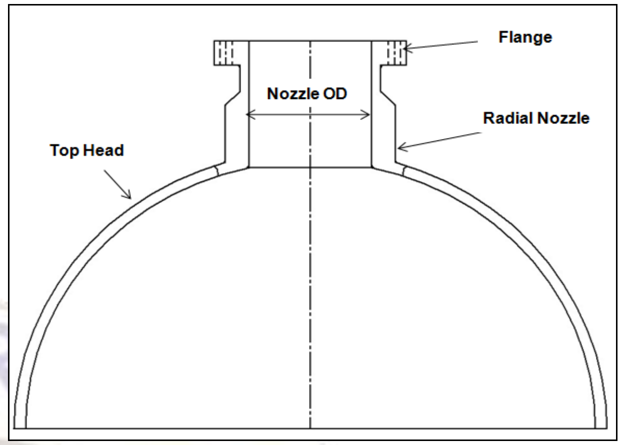

Fig.6. 2D Model

Designer designing nozzle the most important components of nozzle are flange, nozzle and head or shell. For this user has to consider 2D model of nozzle. It's shown in Figure 6. Geometric relationships control the orientation of an element with respect to another element or reference plane. Geometric relationships control a sketch changes when edits are made. Sketch displays and places geometric relationships draw. After complete the sketch, use the various relationship commands and the relationship assistant to apply additional geometric relationships. For automation of reactor nozzle applied more than hundred geometric relationships. For geometric relationships referred Figure 7.

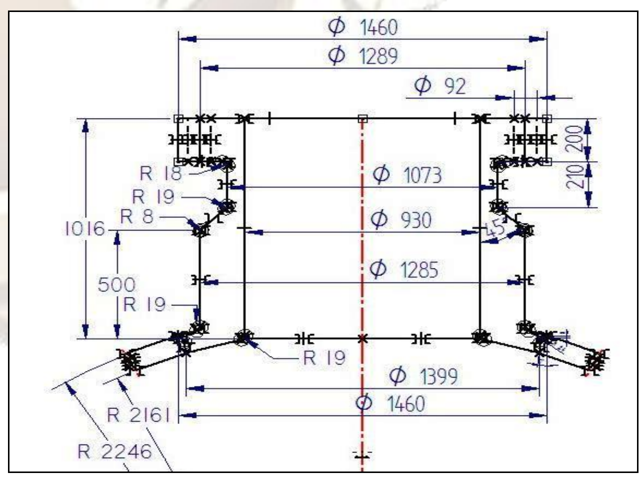

Fig.7. Geometric Relationships

Nozzle main parts Nozzle ID, Hub Height, Hub OD, Neck OD, Bolt Hole Dia., Flange OD, BCD, Flange Height, Neck height, Lip Height, Lip Radius, Lip Angle, Chamfer, Chamfer Angle, Lip OD, Lip

Reference OD, Head Inner Radius, Head Outer Radius and Neck Angle that all nozzle parts taken as users inputs. Nozzle inputs are shown in excel sheet Figure 8 and this excel sheet link applied in variable table formula.

The variable table use to define and edit functional relationships between the variables and dimensions of a design in a familiar spreadsheet format. When select the variables command, the variable table is displayed. Each row of the table displays a variable. A series of columns is used to list the various properties of the variable, such as type, name, value, rule, formula, and range. Variable for nozzle drawing automation table referred Figure 9.

Inputs	Radial Nozzle on Head	
Nozzle ID	930	mm
Hub Height	500	mm
Hub OD	1285	mm
Neck OD	1073	mm
Bolt Hole Dia.	1289	mm
Flange OD	1460	mm
BCD	92	mm
Flange Height	200	mm
Neck height	210	mm
Lip Height	8	mm
Lip Radius	24	mm
Lip Angle	7	°
Chamfer	5	mm
Chamfer Angle	45	°
Lip OD	1460	mm
Lip Ref. OD	1399	mm
Head Inner Radius	2161	mm
Head Outer Radius	2246	mm
Neck Angle	45	°

Fig.8. Excel Sheet

NozzleAutomation.dft:Variable Table

distance | Help

Type	Name	Value	Rule	Formula	Range	Expose	Exposed Name
Dim	V4460	1285.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Hub_OD
Dim	V1896	500.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Hub Height
Dim	V4446	930.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Nozzle_ID
Dim	V3389	45.00 deg	Paste Link	@'C:\Users\Nayak\...		✓	Neck_Angle
Dim	V11579	2246.00 mm	Paste Link	@'C:\Users\Nayak\...			
Dim	V7603	2161.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Nozzle Inner Radius
Dim	V3531	1399.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Ref._OD
Dim	V733	1460.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Lip_OD
Dim	V5458	7.00 deg	Paste Link	@'C:\Users\Nayak\...		✓	Lip_Angle
Dim	V5666	24.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Lip_Radius
Dim	V5664	8.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Lip_Height
Dim	V5862	210.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Neck_Height
Dim	V5897	200.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Flange_Height
Dim	V7295	92.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Hole_Dia.
Dim	V4196	1460.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Flange_OD
Dim	V3387	1289.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	BCD
Dim	V4524	1073.00 mm	Paste Link	@'C:\Users\Nayak\...		✓	Neck_OD
Dim	V709	5.00 mm					
Dim	V603	19.00 mm				✓	Hub angle fillet (F2)
Dim	V1785	8.00 mm				✓	Hub Fillet (F3)
Dim	V1913	19.00 mm				✓	Head Outer Fillet (F4)
Dim	V1863	45.00 deg					
Dim	V620	18.00 mm				✓	Neck Fillet
Dim	V1895	1016.00 mm					
Dim	V690	19.00 mm				✓	Head Inner Fillet (F5)

Fig.9. Variable Table

IV. RESULT

The sheet where all of our drawing view construction is called a working sheet can create as many working sheets as our need. Each working sheet has a background sheet attached to it, that users can modify a drawing sheet's characteristics, such as the size and attached background sheet.

A background sheet is used as a backdrop to the working sheet. Users can attach the same background sheet to any number of working sheets, making them useful for any geometry that want to place on more than one drawing. For background sheet referred Figure 10.

Drawing composition begins with choosing a drawing sheet. Drawing sheets are similar to pages in a notebook. Users can place drawing views on different drawing sheets in the document. Users can place a front view and a right view on one drawing sheet and a section view on another drawing sheet. Both sheets are saved in the same document. To set up a drawing sheet, use the Sheet Setup command on the Application menu. In Figure 11 shows final drawing nozzle different views, various parts details, details of welded joints, general notes and title block.

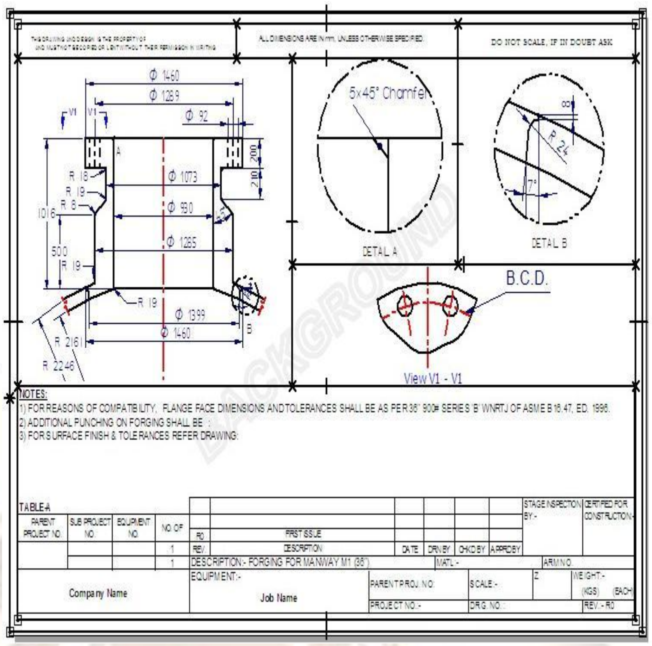

Fig.10. Background drawing sheet

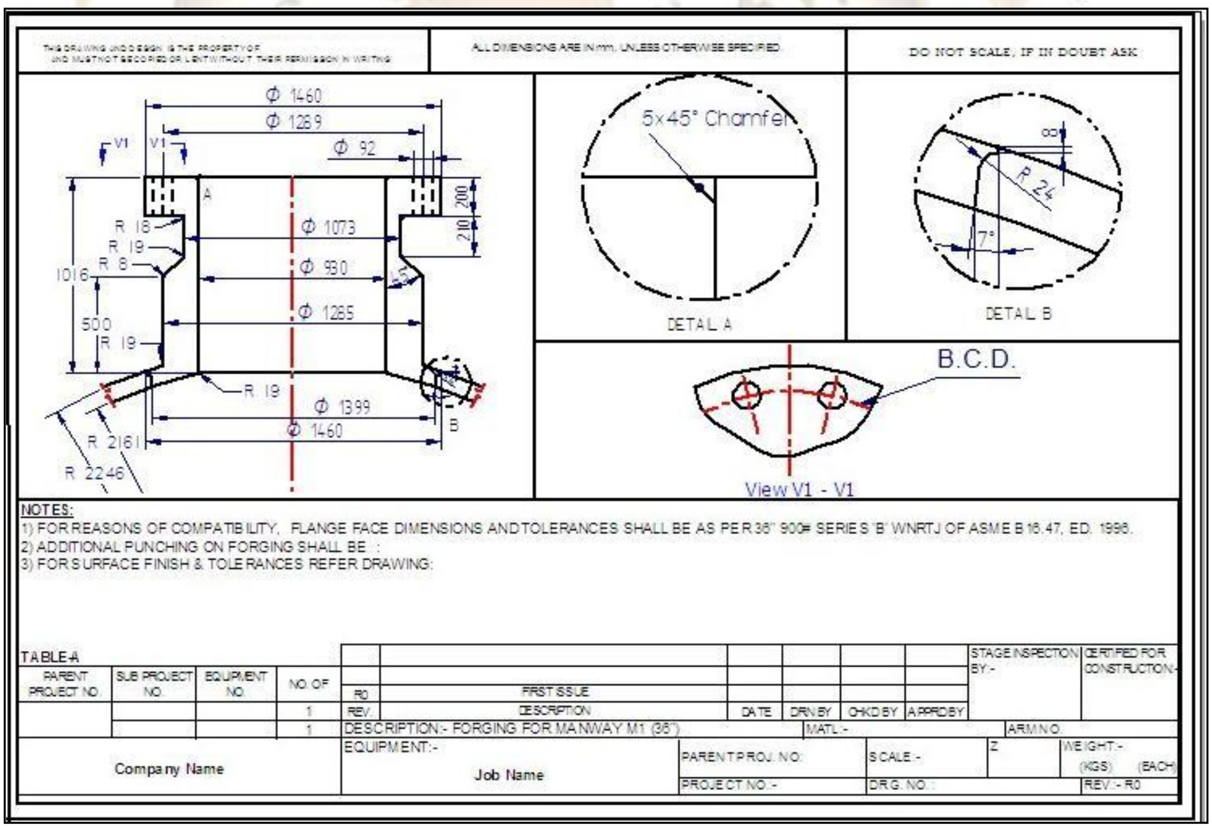

Fig.11. Manufacturing nozzle drawing sheet

Outputs Once the user will enter the required input parameters and close the excel sheet, the background sheet of nozzle drawing will be open in Solid Edge and the drawing will be modified as per the parameters entered. If the user wants to reedit some of the parameters then the user has to go to the required dimensions and can edit the same. It will give the final drawing nozzle with all dimensions.

V. CONCLUSION

Design of reactor nozzle for every individual case is time consuming and uneconomical process. Hence, in order to reduce the design cycle time, the software is developed for the design of nozzle of reactor and to generate the manufacturing drawing.

(1) The time required to generate drawing through models will be approximately 70 % less than current time schedule.
(2) Standardized engineering processes.
(3) Error proofing.
(4) Easy reusability.
(5) Reducing cycle time for drawing generation.
(6) With the help of automation users can generate automatically manufacturing drawing of nozzle front view, various parts detail, detail of all welds required for various welding joints, general notes, fabrication notes, title block.

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