Innovative Method Of Design Automation For Air Cooled Heat Exchanger

Rakesh Kumar Singh[1]

(M.Tech-Product Design, B.E- Mechanical Engineering, Madhya Pradesh, India).

Abstract:
[1] An Innovative method of using excels and programming language is developed for design automation assemblies for Air Cooled Heat Exchanger. The design engineers have developed all data bank of design basis, standards, catalogue and basic programming on excel sheet and this is integrated with Solid Edge for 3 dimensional modeling & 2 dimensional manufacturing drawing using CADCUSTOMIZATION++ (ETO based software). In this paper we are explaining benefits of using Design automation which has resulted into very remarkable reduction in design time & is generating flawless manufacturing drawing. Such success in automation also opens the door for further enhancements to the design process resulted into implementation this technology in many of their products for Air Cooled Heat Exchangers and Air Cooled Condensers.

--- -----

I.   Introduction

[2]Heat exchangers are systems that transfer heat between fluid mediums. The Air Cooled Heat Exchangers (ACHE) is heat transfer equipment in which the process fluid is flowing inside the tubes and the ambient air, forced over these tubes, which acts as the cooling medium. Any ACHE has three major parts

1)   Pressure Parts.
2)   Cooling Circuit.
3)   Air cooler Support Structure.

This cooling circuit of ACHE consists of Ducting for air flow, Fan with driving equipments and supporting structure. Mechanical Designing, Preparation of its Material's specifications for Procurement and Manufacturing drawings for shop floor of cooling circuit ACHE should be done appropriately, accurately in order to have long trouble free years performance of Exchanger. As this process involves integrating the requirements of Client specification, vendor's standards information of Bought-outs items like axial flow Fan, Electric Motors, Vibration Switches/Transmitters Power Transmission Belt, and Driving & Driven Pulleys Gearbox and Design requirement of Fabricated items like mounting structure, Plenum chamber, Bearing Block, Fan Ring, Drive structure Assembly & Fan Guard.
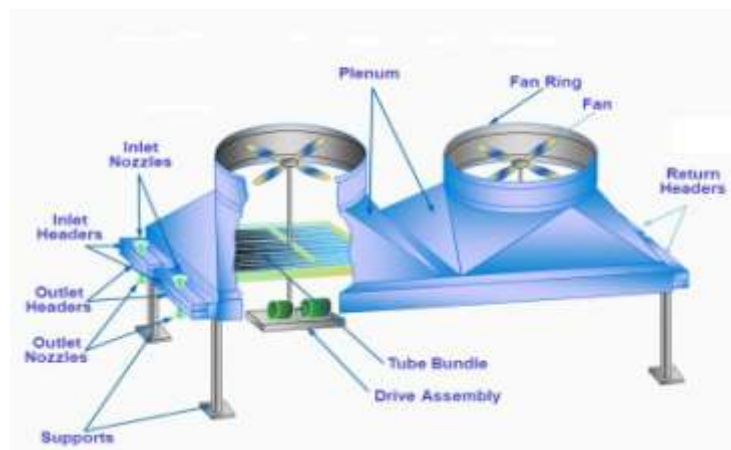

Figure 1: 3- Dimensional view of Drive Part of ACHE.
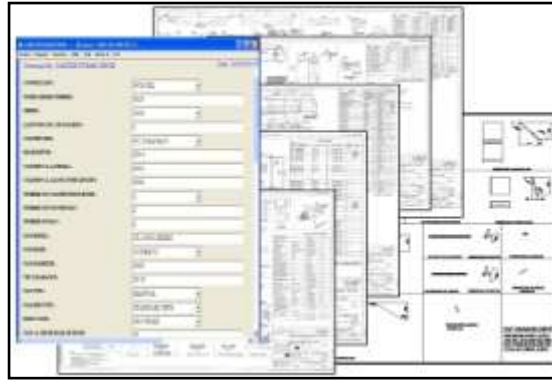

Figure 2: Input Screen, 5-Fabrication and 1 CNC Input Drawings.

As its designing calls for high experience level of Engineer with the knowledge and information of above and additionally many iteration for the provisions maintainability and accessibility during operation needs to be considered. For this reasons we has opted for complete automatic Designing & Drafting of this product in ACHE.

The basic information of selected bought out items are converted by software CAD customization ++ into 3D scale model in solid edge, once this model is reviewed with a click of button it can immediately converted into 2 dimensional drawing which ready for manufacturing check print drawing with few errors.

For design automation using Cad customization++ software, first master model and master drawing of final output in Solid Edge is created, Then all data bank of design basis, standards, catalogue and basic programming is done in excel spread sheet, & Finally with this Cad customization++ software all parameters of assembly like updating of part file and assembly file and also the 2D drawing with welding symbol, view scale, text, title block etc. with a single input screen integrated.

In all minimum five different manufacturing Drawings of Drive part of ACHE of A1 size & 1 drawing for CNC controlled laser cutting Machine (See figure 2) gets generated

II. Industry Practice in Design Automation.

Existing practice of computerized design automation requires a programmer, who can understand the Design methodology & requirements with good understanding of final product in order to effectively transfer these into computer codes to automate the process. Once these are converted into design automation program, Working engineer needs to input the Front-end sheet in form of few input data and Engineering output like Drawing, Material specifications and Design Data gets automatically generated for others use.
1. The time required to generate drawing through will be approximately 90 % less than current time schedule by conventional process.
2. Human errors can be completely avoided by incorporating checks/defaults in input stages itself.
3. Consistent Output and is independent of Engineer experience who generating the output.
4. Product can be Standardized which are easy to manufacture.
5. Repeatability in document hence is easy to understand and review.
6. CAM drawing input for CNC cutting Machine.
7. Number iterations of bought out is possible make the selection optimum.
Due above reasons overall productivity in all stages from Design, Procurement, Manufacturing, inspection, Logistic, Installation etc gets improved.
These benefits are passed on to client as:-.
1. Reduced delivery schedule, hence faster realization of Client capital investment.
2. Lower procurement cost to client.
3. Reliable, Accurate & Trouble free optimum design.
However, there are certain short comings in design automation which are listed below.
(1) The coding the program is herculean task and it requires high level of computer science expertise and additionally one should be sound in design and drafting aspects also. This means in order to make best automated design we need have the best of both the world in one who write the program.
(2) As there is always a room for improvement, and hence as any modification in automated design is a cost. As this will have the involvement of computer expert programmer otherwise we have to live with it.
(3) Design improvement feature in existing design may require either modification in Design automation or make it obsolete if modification is major. Hence viable choices of products are limited.
(4) Any unprecedented design modification in Bought out item may affect automated design program itself.

(5) Manufacturing 2D drawing can be controlled by 3D model generated by CAD software only. Hence minor detail typical for fabricated items need to manually edited.

Due to above some points there some define deficiency in such program and hence may not be viable the entire product range.

However, with Cad customization++ it is possible to integrate simple coding in MS-Excel with Solid edge to make fully automated Design Module.

As MS-Excel and solid edge is in the easy reach of Mechanical Design Engineer with the use of automation software Cad Customization++ a very flexible Design automation can be done which address all the points discussed in (1), (2), (3) (4) and (5) above.

This automated design tool is responsible for extraction of all the information of 3D model and 2D drawing & Excel spread sheet gets generated with all the information through which the model and 2D drawing can be controlled. Engineer is supposed to link this excel to have the desired output.
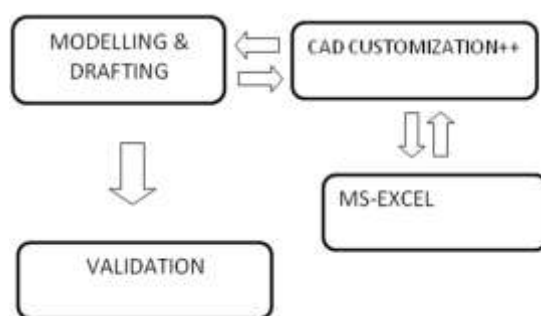

Figure: 3: Methodology of CADCustomization++.

Platforms
1. M.S office – Mainly as spread sheet (excel sheets).
2. CAD customization ++- It's a Visual Basic based interface tool between spread sheet & Solid Edge.
3. Solid Edge - It's a software use for 2 Dimensional drawings & 3Dimensional models.

III. Conclusion

The automated design via built-in scripting tools has proven to be an effective way of reducing design time, increasing the number of feasible design iterations, increasing the quality of processes and the company's control over them, and enhancing integration with other automated processes outside of CAD. With the help of this automation all the 5no's A1 size fabrication drawings and a 1 CNC input drawing can generate in 4 hours including checking and minor correction if required by using txt files to control important engineered data in tandem with robust relational modeling techniques.

References
[1]. Ramesh K. Shah, D. P. (2003).Fundamentals of Heat Exchanger Design. New Jercy and Canada: John Wiley & sons Inc.
[2]. 15th Australasian Fluid Mechanics Conference, Sizing of air-cooled heat exchanger, 2005.
[3]. ASME (American Society of Mechanical Engineers) code sec VIII Div-1.
[4]. ASME (American Society of Mechanical Engineers) code sec VIII Div-2.
[5]. API (American Petroleum Institute) 661 for air cooled heat exchanger.
[6]. www.Google.com
[7]. www.wikipedia.org
[8]. www.cadcust.com
[9]. http://www.premasoftware.com
[10]. https://www.plm.automation.siemens.com