

Automated Modeling of Screw Conveyor Components in CATIA

Yogesh H. Sawant, U. M. Nimbalkar

Abstract— Modeling of part is widely used for generation of manufacturing drawings. Modeling is midway between product concept and manufacturing. However modeling is very time consuming process and draftsman require large skill of modeling software's. To speed up cycle time from product design to manufacturing, automation of modeling in CAD software is required. In this paper system is developed for generation of 3D model of horizontal screw conveyor components in CATIA V5 software. Developed system consists of Excel spreadsheet for design calculation and determination of parameters of screw conveyor components and GUI in CATIA for entering of components parameters. CATIA V5 is open system for creation of macros. Screw conveyors are widely used in many industries for handling of non-free flowing, bulk, sticky materials. VBA language is used for generation of screw conveyor components and different loops are used in Excel for automatic determination of screw conveyor components parameters. A screw conveyor has large varieties according to convey capacity, use of different subcomponents, and types of handling material. The developed system is used for generation of 18 components having 29 subcomponents. User can simply enter the parameters of component via developed GUI, the system automatically generates 3D model. The advantage of this developed system is that the end user did not need knowledge of complicated CAD software.

Index Terms— CATIA, VBA, Screw Conveyor, Excel Automatic Modeling.

I. INTRODUCTION

Today's there is huge competition in the market, to maintain position in market product must be effective and efficient in order to meet customer expectations. This can be done by automation. Now a day due to fast development of computer technology, there is wide use of 3D CAD (Computer Aided Design) software in many industries. To avoid the repetitive tasks, thousands of mouse clicking's the automation in CAD software is dominant. The 3D CAD software's like CATIA, Creo (Pro/E), NX, Solid Work etc. are used to generate 3D model. CATIA V5 is open system for creating macros according to required needs and it is widely used in industries. The creation of macros in CATIA V5 is done by three

different programming languages like CATScript, VBScript (Visual Basic Scripting) and VBA (Visual Basic for Application). Out of these three languages VBA has good GUI (Graphical User Interface) because VBA provide many tools for designing user interfaces. Screw conveyor is material handling equipment used in agriculture (grains), cements, chemicals, pharmaceuticals, food processing, plastics, salt, sand etc. industries for moving bulk materials. Screw conveyor has 18 components. The model of screw conveyor is changes according to their capacity, type of screw (like sectional, helicoids, ribbon, cut flight etc.), hand of flighting (right or left), screw pitch (full, short, half ,long), troughs types (formed flange U-though, solid tube trough etc.), end plates type etc. To generate these large varieties of screw conveyor models, time required is more. Also sometimes user may commit some mistakes, while generating the model. To reduce these above drawbacks, the automation of screw conveyor model is must. The design calculation and dimension value of all 18 components is done automatically in Excel Spreadsheet by using different lookup functions, according to the user inputs like conveyor capacity, conveyor type of flighting, type of convey material etc. The purpose of this paper is to develop automated model of screw conveyor by using VBA language in CATIA V5.

II. RELATED RESEARCH

Many research efforts have been made in automated modeling in CATIA and different 3D CAD software's. Wrobel J. et al. [4] described customized tools available in CATIA V5 system. Also they developed a parametric model of mould tool in CATIA V5 using VBA scripting. Lin B. T. et al. [5] developed automated design system for drawing dies for truck lid outer panels and engine hood outer panels. For automated modeling of flange coupling Shah D. B. [6] developed parametric model by using Autodesk Inventor integrate with Microsoft Excel to produce 3D modeling and 2D drafting automatically. Hussein H. M. A. [3] constructed a knowledge base system for sheet metal blanking dies. This system was built under CATIA V5 and program was scripted in Visual Basic. Sanshan Z. et al. [11] developed knowledge base system for composite component design by using VB.NET. They integrated that system with CATIA software. Also they explained the theory, design method and implementation method of knowledge base system for composite component design. Cukovic S. et al. [4] created macro for determination of different profiles of helical surfaces and explained the

Manuscript received April 10 2015.

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principles for complex surface modeling. The macro optimizes the time turning hours in seconds, increase flexibility, possibility to use of unlimited number of times etc.

To make parametric modeling of irregular shaped objects like jewellery with parametric CAD systems is difficult. Gulati V. [10] developed parametric jewellery modeling in AutoCAD by using VBA. Kannan T. et al. [9] developed parametric modeling and assembly of direct type drive wheel assembly of apron conveyor using Pro/Program in Creo (Pro/E) 3D modeling software. The time required to makes 3D modeling and assembly of direct type wheel of apron conveyor is about 36 hours. Bur after customize the Creo by using Pro/Program it is about 3 hours. Trivedi R. D. et al. [12] developed 3D parametric modeling of inner ring of spherical roller bearing by using integration of Pro/E and Microsoft Excel sheet. Zhangtu L. et al. [11] described the knowledge base system approach for mechanical product design. They developed knowledge base system for Intesolid 2.0 system (CAD system) and with this module they explain example of 3D model generation of two-stage gear box.

Chirme A. et al. [1] developed integrated tool for strain extraction in aircraft structure. The integrated tool has been developed by using Abaqus-Python, CATIA-VB and Visual Basic. This tool is used for identifying location, direction and strains in the strain gages of aircraft structure. Fonseca D. J. et al. [16] developed a knowledge base system for selection of conveyor equipment. They created expert system for identify the suitable conveyor from three categories of conveyors (unit, bulk and sortation conveyors) with 76 types of conveyor by simply entering the conveyor attributes. In this paper for the screw conveyor modeling referring the catalogue of Conveyor Engineering and Manufacturing [18] company. The models of 18 components and their sub-components are given. The steps to design simple horizontal screw conveyor is given and also they provides different tables for parameters selection of screw conveyors components.

From above literature survey, it is clear that CATIA is open system for creation of macro to make automated modeling and assembly of mechanical components. Also it is observed that no one can develop an automated system for modeling of screw conveyor. Due to large variety of screw conveyor sub-components, variation in geometrical parameters and open system of CATIA for creation of macro, it is necessary to develop an automated system for modeling of screw conveyor components in CATIA V5.

III. SYSTEM STRUCTURE

For automated modeling of screw conveyor components fig.1 illustrates the architecture of developed system. Which include Excel file, CATIA VBA scripting module and model generation. The detailed of system structure is below:

3.1 Excel file

Excel sheet is used for calculation of screw conveyor component dimensions. User can simply select handling material and enter input parameters, the dimension of screw conveyor components are calculated automatically by using loop functions in Excel. The calculated dimensions are used for modeling of screw conveyor components in CATIA software.

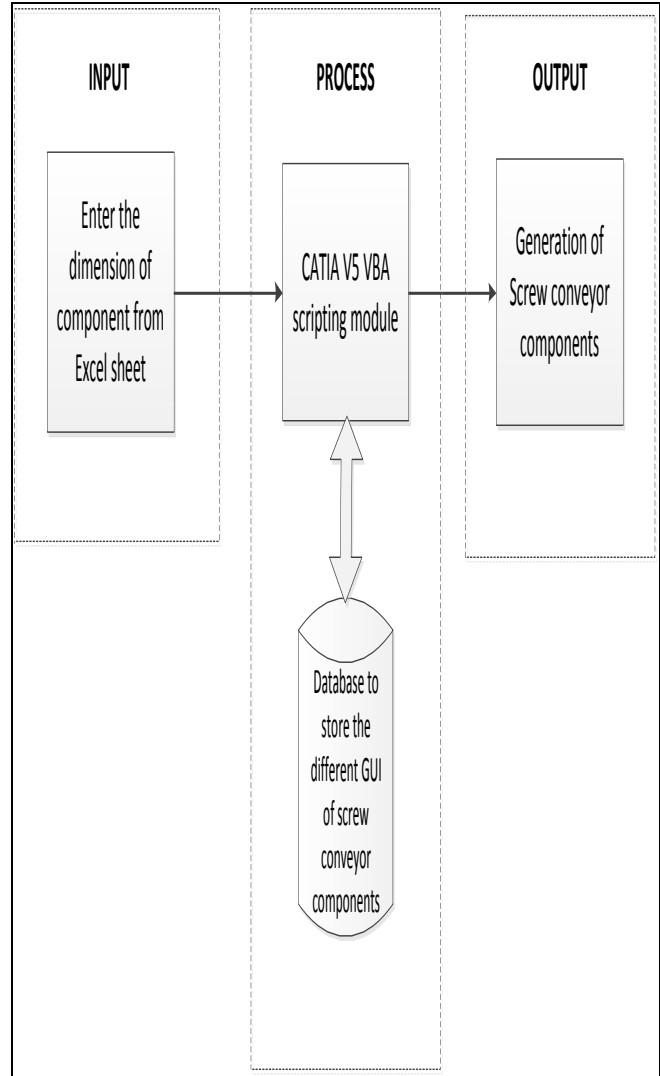


Fig. 1. System Structure

3.2 CATIA VBA Scripting module

CATIA VBA Scripting module is core of our system. It is responsible for automatic generation of screw conveyor components. The code written for automation is in Visual Basic language. The all parameters and user form required for modeling of components are stored in database of CATIA module.

3.3 Model generation

By simply entering the dimension of components from excel sheet into developed user form in CATIA, the models of screw conveyor components are created automatically. These models are further use for assembly of screw conveyor. The developed system produces the 29 subcomponents of screw conveyor.

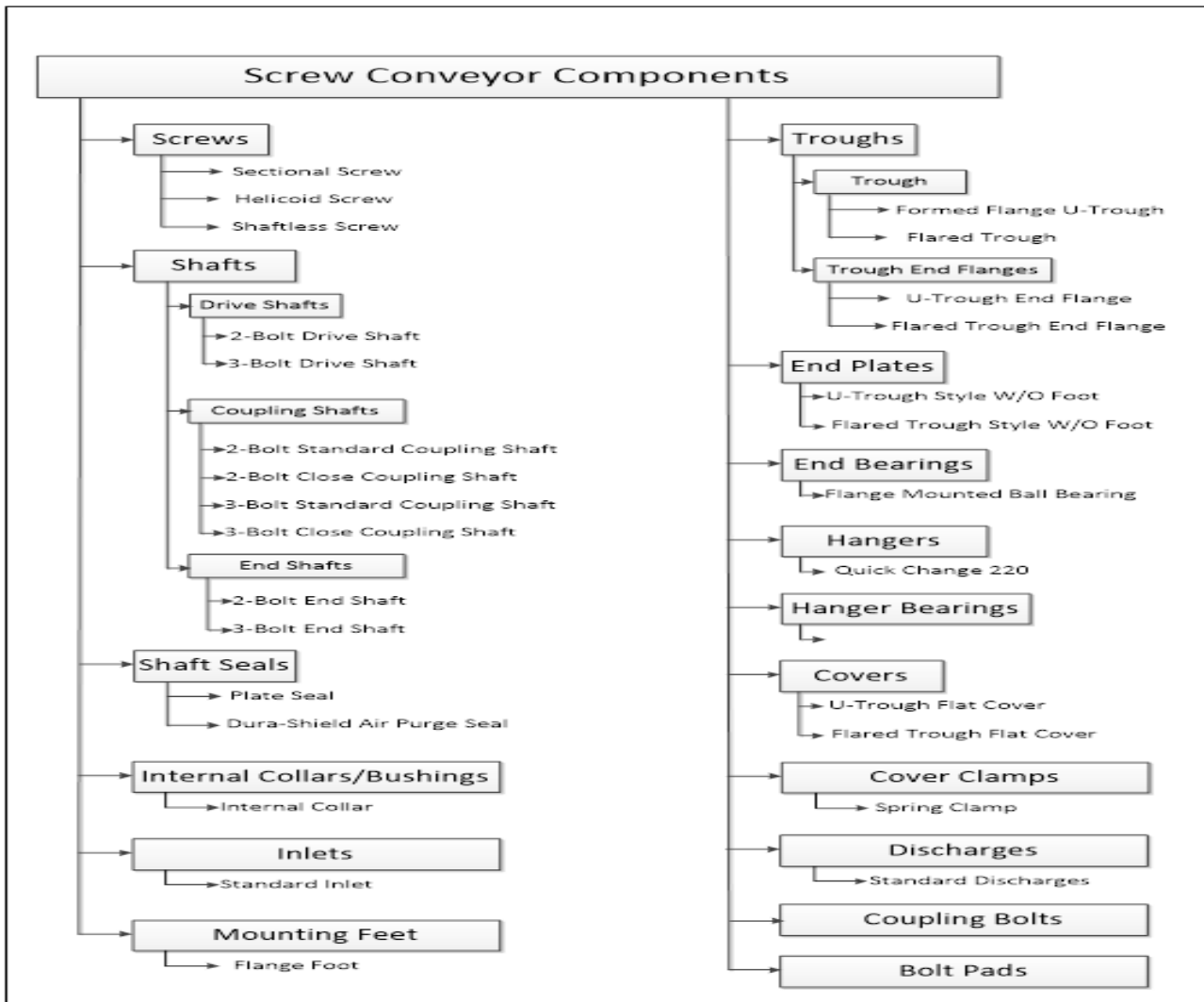


Fig. 2. Screw Conveyor Component

IV. SCREW CONVEYORS

Industrial conveyors are used for transporting materials from one place to another place. Industrial conveyors are classified into bulk material handling conveyor, unit handling conveyor, accumulating and non-accumulating conveyor, fixed and portable conveyors. Bulk material handling conveyors are used for handling of not packed, crated materials. Screw conveyors, belt conveyors, bucket elevators are bulk material handling conveyors [16]. Out of this bulk handling material conveyors screw conveyor is used in many industries like agriculture, cements, chemicals, pharmaceuticals, food processing, salt, plastic, sand etc. [16]. The screw conveyor design is changed according to type of material handling, capacity of conveyors, and use of different components. In this paper system developed for creation of 18 components with 29 subcomponents models of screw conveyor is illustrate in fig. 2.

Screw conveyors have some advantages which are:

1. It is sealed to prevent escape of materials from inside to outside or entry of dust from outside to inside.
2. It has advantage over belt and chain conveyor is disappearance of return of belt or chain.
3. Moving non free flowing, toxic, bulk, and toxic materials.
4. Variety of trough and flight thickness.
5. Convey in either direction (right and left hand flights).

V. CAD SOFTWARE

CATIA (Computer Aided Tree dimensional Interactive Application) developed by Dassault system for 3D modeling, drafting in 1977. Now days due to rapid development in computer technology mechanical computer aided design software's are widely used in many industries. CATIA software having specification tree for keeping process information, geometry parameters, constraints; higher GUI (Graphical User Interface); open system for creation of macros; easy to create part, assembly and drafting document. Due to these factors it widely used industries. CATIA is customized by using in process and out process. In process is done by using VBA, CATScript and VBScript languages. VBA has rich GUI than VBScript and CATScript. Also it has debugging facility. In our developed system VBA is used for automatic creation of screw conveyor components.

VI. METHODOLOGY

The flow chart for developed system is illustrated in fig. 3. At the beginning open the Excel sheet file which contains the data related to handling materials. The parameters of screw conveyor components are calculated by simply selecting type handling material and entering the input parameters like required capacity, length of conveyor, pitch type, flighting type etc. in Excel sheet. After getting the parameters of

components click on the name 'open CATIA' in same Excel sheet. After the opening of CATIA software click on customized icon in toolbar menu, the user form (fig. 4) of screw conveyor components is visualize. Clicking on name of screw conveyor components, the user form which contains name of subcomponents is visualized. By clicking on name of subcomponent the input parameter user form is visualize and entering the dimension of that component, 3D model of component is created automatically. The automatically generation of components in CATIA is done by using VBA

language. CATIA have inbuilt VBA module. The parameters of components are store in database. The system is used for generation of 3D model of 18 components having 29 subcomponents of screw conveyor. Some Screw Conveyor Components are show in fig. 5. Four type of screw, 2-bolt drive shaft, U-trough, U-trough end flange, standard discharge, plate seal, U-trough style end plate are illustrate in fig. 5.

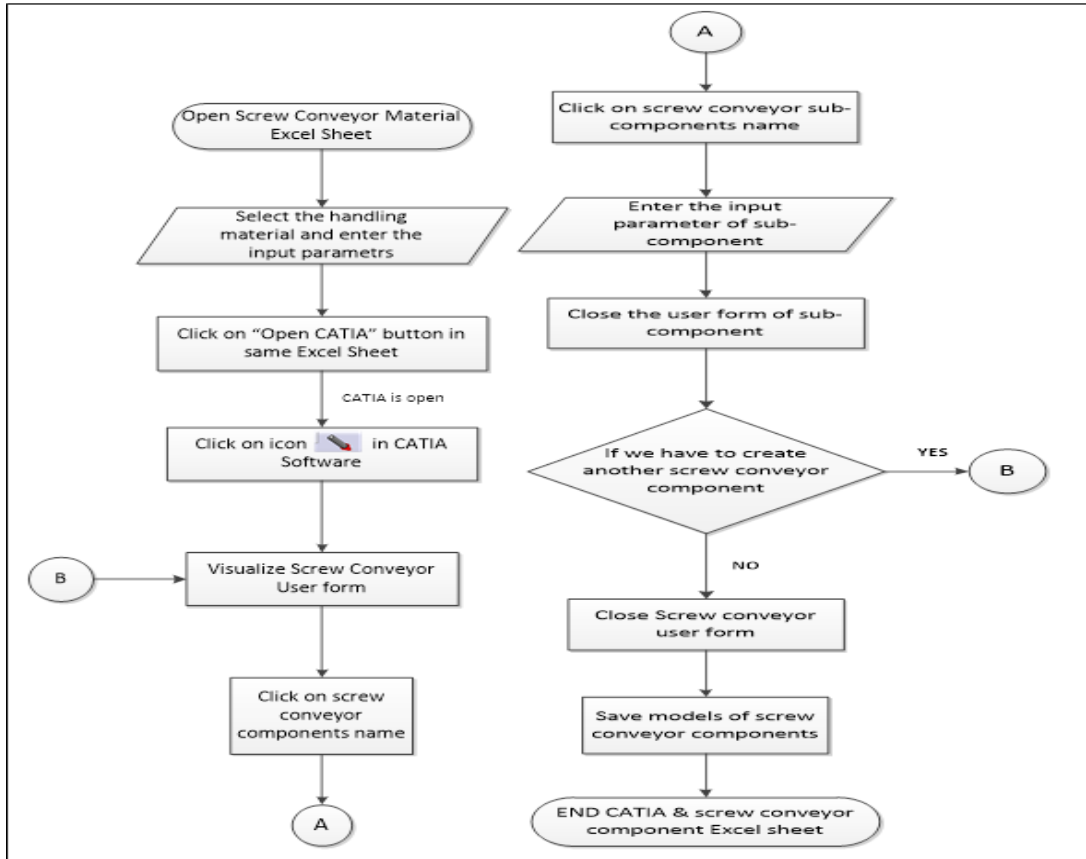


Fig. 3. Flow chart of system

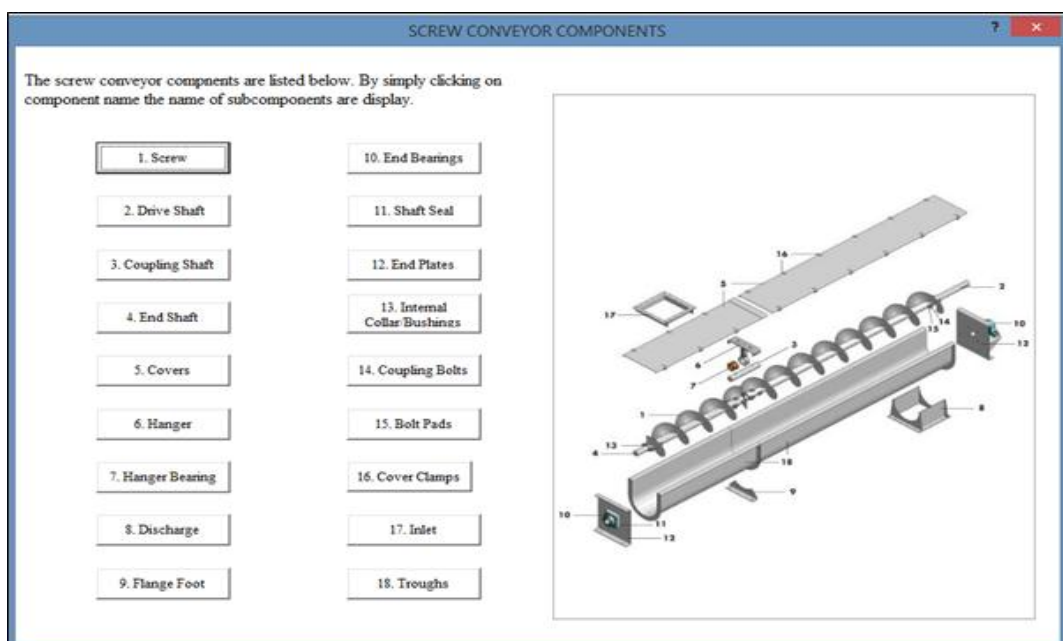


Fig. 4. Screw Conveyor Components User form

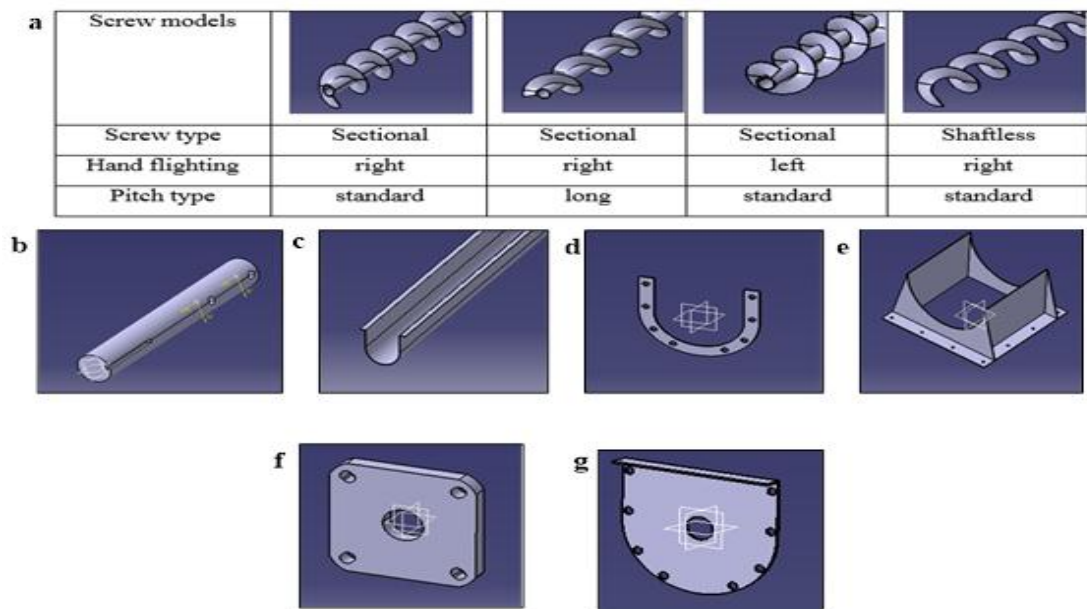


Fig. 5. Screw Conveyor Components a) Screw. b) 2-Bolt Drive Shaft. c) U-Trough. d) U-Trough End Flange e) Standard Discharge. f) Plate Seal. g) U-Trough Style End Plate

VII. CONCLUSION AND FUTURE WORKS

The system can generate 18 components having 29 subcomponents of screw conveyor. The automation is done by using VBA language for CATIA and different loop functions for Excel. The advantage of this system is that, the end user need not have knowledge of complex CAD system. The modeling time is reduces and expendite cycle time from product design to manufacturing. The system is developed only for horizontal screw conveyor, the future work is develop system for vetical and inclined screw conveyor. Also make automated assembly of screw conveyor components.

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