CAD AUTOMATION OF ELECTRICAL BUSBAR

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Abstract: In electrical power distribution, Busbar plays a vital role in transmitting power from the source to load. Busbar systems are used to safely implement a three-phase power distribution system in Factories, Data centers, Laboratories, Hospitals, Universities, and more. The conventional busbar CAD design in the energy industries are day to day manual work. This paper explains how to automate this busbar CAD design process and how it can save a few thousand production hours in the energy industries.

Index terms: CAD Automation, Energy Industry, Busbar Design, Busbar Automation, Creo Automation.

I. INTRODUCTION

A Busbar is a strip of metal used to conduct electricity within an electrical substation, distribution board, electrical switchboard, or other electrical equipment. All the energy industries using the busbar in low, medium, and high voltage applications.

Even though the busbar design is simple, considering the production rate, every industry spends thousands of hours on busbar design and drawing release.

One of the reputed energy industries in India is producing 6000 different busbars per year for one of the low voltage switchboard products.

The specific product needs approximately 1000 hours for CAD design per year. While considering the low, medium, and high voltage products with the busbar application, an energy industry spending a few thousand hours for busbar CAD design.

Here, this paper explains

i. How can a CAD automation process help to reduce 1000 hours of busbar design into 3 hours?
ii. What are all the manual process can be eliminated in the automation?
iii. The development process, Automation platform, and design rules.
iv. The application workflow and the user interface.
v. Significant benefits of the automation process.

II. BUSBAR DESIGN PROCESS

The conventional busbar CAD design process consists of the following steps.

1. Get the design input from the product owner.
   i. Size of the Busbar (Length, Width & Thickness.)
   ii. Busbar types
   iii. Busbar details (Part name, description, etc.)
2. Create a new sheet metal part using the CAD software.（Creo, Solid Works, or other)
3. Create a flat base feature for the Busbar flat model.

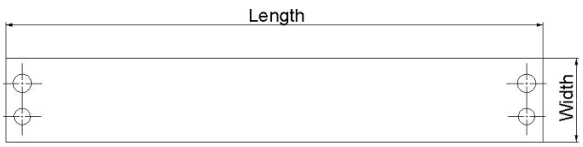

Figure 1: Flat base feature

4. Add the bend features depends on the Busbar type.

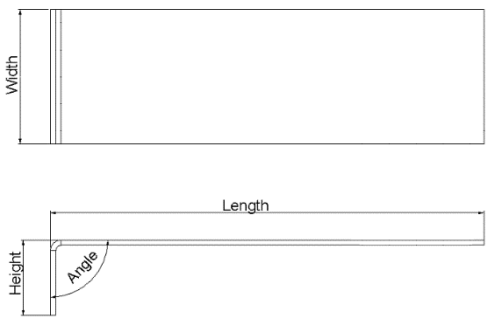

Figure 2: Add the bend features

5. Add the connection holes based on busbar design rules

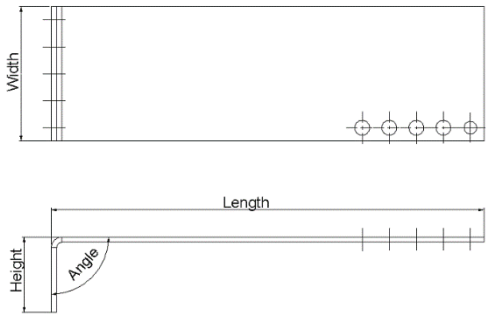

Figure 3: Add connection holes

6. Add the model parameters
7. Save the sheet metal part model
8. Create a new drawing for the part model
9. Place all the part model views
10. Add dimension for each feature
11. Update the parameters in the drawing sheet and title blocks
12. Save the busbar drawing
13. Send drawing to the manufacturing

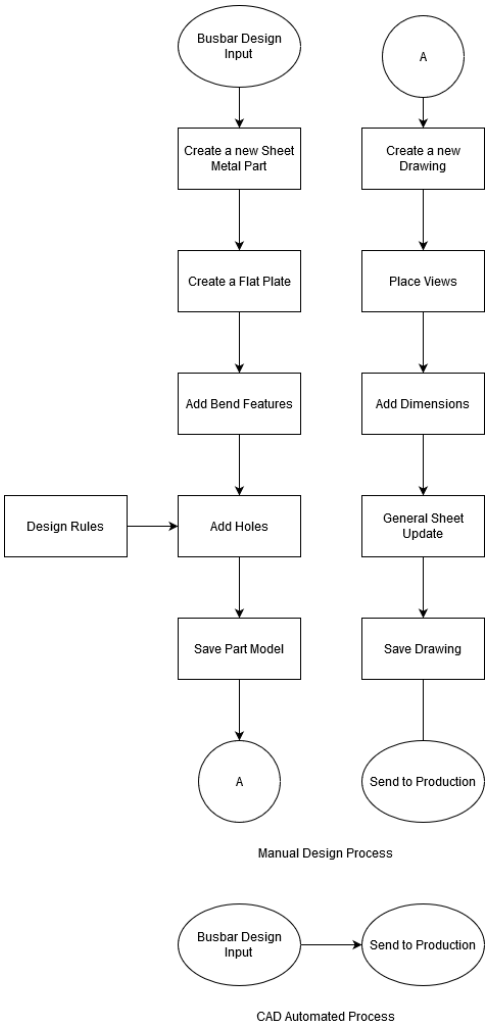

Figure 4: Manual design process Vs CAD Automated Process.

Busbar design automation process following just two steps

1. Enter the busbar design input in the application
2. Send model & drawings to the production

The remaining steps in the conventional process can be taken care of by automation application.

III. APPLICATION DEVELOPMENT

Generally, to start a CAD automation application, we need to decide the design specification such as the maximum and minimum size of the busbar, shapes of busbar, number of connection holes required.

BUSBAR TYPES

Here, the application designed to generate the following types of busbars for automation

1. Flat Busbar

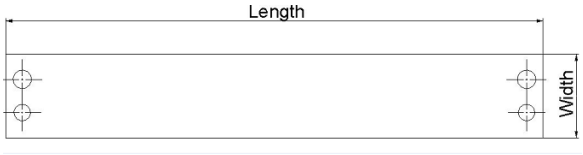

Figure 5: Flat Busbar

2. L Shape Busbar

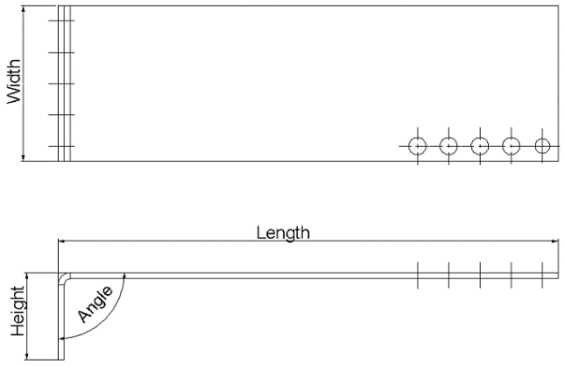

Figure 6: L Shape Busbar

3. Z Shape Busbar

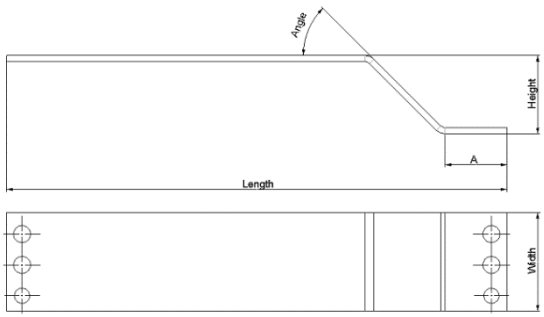

Figure 7: Z Shape Busbar

4. CL Shape Busbar

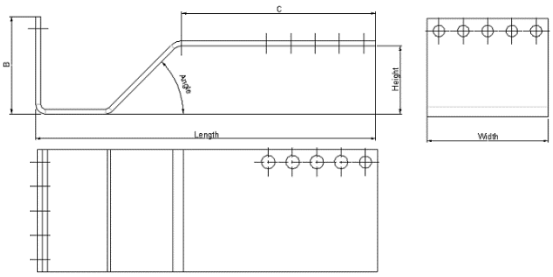

Figure 8: CL Shape Busbar

CONNECTION HOLES

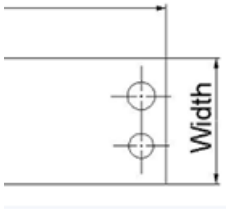

Figure 9: Connection Holes

Design rules added to control the connection holes in the busbar. The number of connection holes in the busbar varies with the width of the busbar.

S. No	Busbar Width	Holes
01	<= 60mm	0
02	>60mm and < 80mm	2
03	>79mm and < 100mm	3
04	>99mm and < 125mm	4

Table 1: Design rule for Connection Holes

Based on the width of the busbar, the application creates connection holes automatically.

APPLICATION PLATFORM

After the design specification, we need to choose the right automation platform. It depends on what is the CAD software used for the design process. Various industries using different CAD platforms and depend on CAD software, the automation process also varies. We've chosen the following platform for this automation.

S. No	Description	Product
01	Design Software	Creo
02	Programming API	Creo Toolkit
03	Programming Language	C++
04	IDE	Visual Studio

Table 2: Application Platform

For Creo, PTC offering the Creo Toolkit Application Programming Interface (API) library to automate the process inside Creo. This library consists of programming objects to control each process.

This API library should include in the Visual Studio C++ Makefile project. We have developed this application in Creo synchronous mode. *i.e.*, the automation plugin can run inside the Creo. All the design rules integrated into the application by C++ programming. The output of the Visual Studio project is a dynamically linked library (*.dll), which can be run by Creo.

IV. APPLICATION WORKFLOW

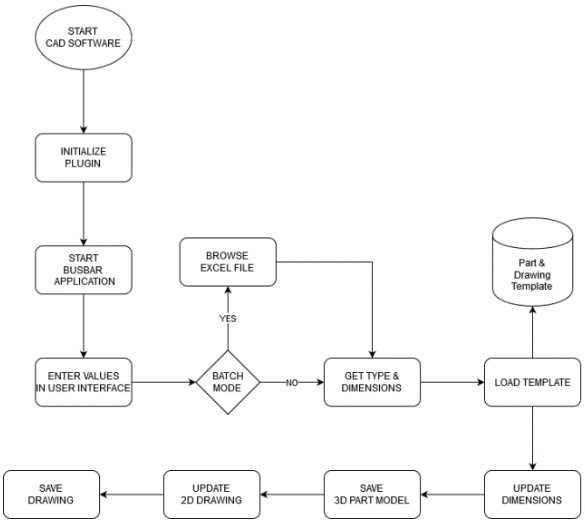

Figure 10: Application process flow

The application plugged into the Creo software. Hence the application initializes with the CAD system. User needs to click the application icon to start it. The user interface asks the user about the type and dimension of the busbar.

Once the user completed the busbar input and starts the model generation process, the application pulls the predefined template from the application folder. Templates are the Creo part model and drawing of the busbar with the basic features. Back-end programming updates the template with the required dimension of the 3D part model and updates the 2D drawing files. Finally, it saves the files into the user workspace.

The workflow supports both individual and batch mode generation. In individual mode, users can generate a one-part model at a time. Model include 3D part and 2D drawings of the busbar.

V. USER INTERFACE

Application User Interface captures the Busbar design inputs.

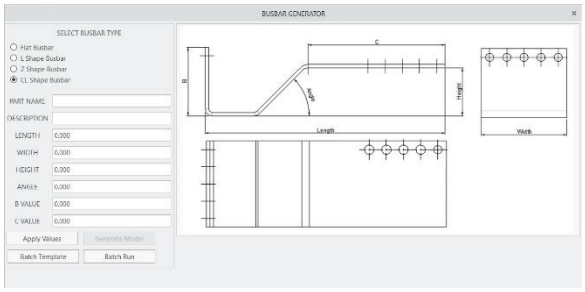

Figure 11: User Interface

The radio button available to choose the appropriate busbar type. When the user selected the busbar type, the reference image of the busbar updates automatically, busbar designers can understand the input requirements from the reference image. When the user enters the part details and description, they can access the Generate model button to create the 3D part and 2d drawing of the busbar.

VI. BATCH PROGRESS

The major part of the busbar generator application is the batch process. Instead of selecting and entering the busbar details, the user can use the excel file to load multiple busbar data at the same time. The application automatically generates all the busbar part and drawings loaded by the excel input.

	TYPE	PART NO	DESCRIPTION	LENGTH	WIDTH	HEIGHT	ANGLE	A VALUE	B VALUE	C VALUE
1	Flat	FLAT_01	DESCRIPTION 1	1100	90					
2	L Shape	LSHAPE_01	DESCRIPTION 2	900	125	70	90			
3	Z Shape	ZSHAPE_01	DESCRIPTION 3	1000	70	80	60	50		
4	CL Shape	CLSHAPE_01	DESCRIPTION 4	700	60	70	70		50	60

Figure 12: Excel Input for Batch Process

This process helps the senior design engineers to feed the data directly to the application instead of sharing the input with the design engineers to assign a new job. Hence this avoids the handoff time for the next process.

The application can generate a single busbar part model and the drawing in 2 seconds (0.033 minutes). Usually, this process takes 10 minutes in the manual method.

VII. PRODUCTION HOURS SAVINGS

Let us consider the low voltage switchboard production rate.

Total busbar designs / Year	6000	Nos.
Manual time consumption / Busbar	10	mts
Automation time consumption / Busbar	0.033	mts
Total manual design hours / Year	1000	Hrs.
Total automation design hours / Year	**3.3**	Hrs.

Table 3: Time Consumption Comparison

Hence the CAD automation application can reduce the production hours from 1000 hours into 3 hours.

VIII. BENEFITS

Since the process is entirely automated, we can achieve the following benefits.

i. Cost-Effective Method.
ii. Non-Technical & Fresh engineers can generate 3D models and drawings.
iii. Since all the models are machine-generated, all the features in the CAD models are consistent
iv. The models are created in a consistent feature methodology to ease the user for modification
v. Error-free drawings achieve 100% quality.

CONCLUSION

While considering the low, medium, and high voltage products using busbar applications, an energy industry can save up to a few thousand hours every year.

Not only in the energy industry, but also this CAD automation concept can be implemented in other industries such as automobiles, hydraulic pipes, injection molding, CNC manufacturing, and more.

REFERENCES

[1] Creo Parametric TOOLKIT User's Guide 4.0 M100

[2] Busbar Technical Design Guide by Schneider Electric

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