Skid Design Procedure

by 3D-LABS

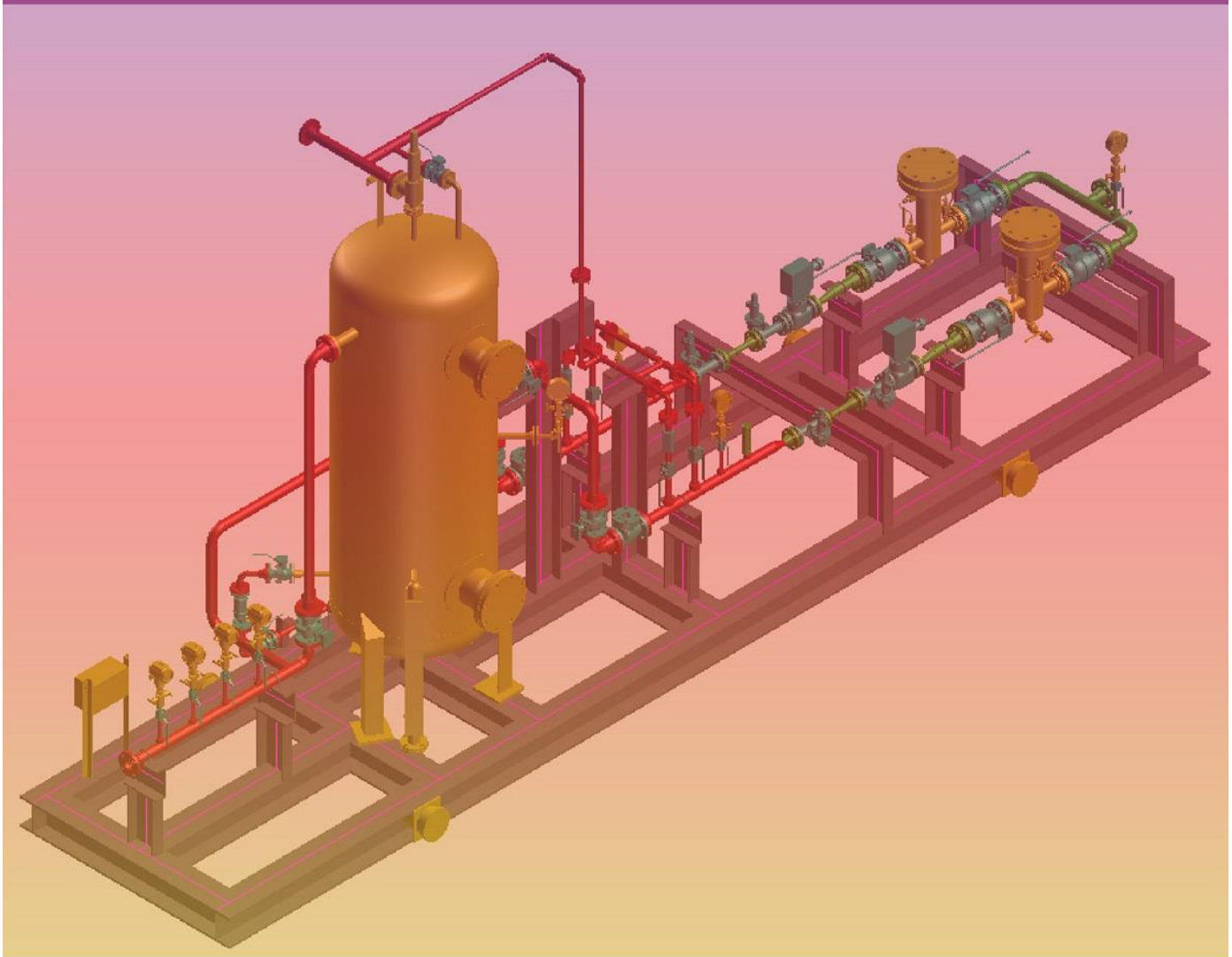

Table of Contents

1.0 introduction
- 1.1 autocad & cadworx commands you should know
- 1.2 page setup
- 13 basic commands
- 1.4 to modify
- 1.5 p&id for skid modelling

2.0 cadworx plant piping
- 2.1 setup settings
  - 2.1.1 current drawing
  - 2.1.2 configuration setting
  - 2.1.3 specification / size
  - 2.1.4 configuration layer
  - 2.1.5 piping rules
- 2.2 spec fitting components
- 2.3 piping rooting
  - 2.3.1 components attachments
  - 2.3.2 branch connections
  - 2.3.3 weldolet
  - 2.3.4 threadolet

3.0 cadworx plant structural steel
- 3.1 cadworx steel
- 3.2 structure rooting
  - 3.2.1 steel shapes
  - 3.2.2 factors needs to be considered while selecting the members
  - 3.2.3 steel draw
  - 3.2.4 steel coping
- 3.3 p&id samples

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CADWORX PLANT REFERENCE MANUAL

1.0 INTRODUCTION

AutoCAD is a 2-D and 3-D computer-aided drafting software application used in architecture, construction, and manufacturing to assist in the preparation of blueprints and other engineering plans. It is also used to create blueprints for buildings, bridges, and computer chips, among other things. Discover how AutoCAD is used by drafters and other professionals like CAD Drafting and Design Technology.

CADWorx is an AutoCAD-based system, CADWorx is the next generation software solution, providing intelligent drawing/database connectivity, advanced levels of automation, easy-to-use drafting tools and the world's only intelligent link between CAD and pipe stress analysis. It increases accuracy and improves the quality of deliverables for both designers and engineers. Compared to every other 3D plant design tool on the market, CADWorx lets you get more done in less time - period.

1.1 AUTOCAD & CADWORX COMMANDS YOU SHOULD KNOW

In the commands list of AutoCAD, I have tried to include some of the most useful commands which every AutoCAD user must know which is also suitable for CADWorx. Some of the commands in this list are very basic commands which are used very frequently and also there are commands which are not often used despite their great features.

1.2 PAGE SETUP

1. File	-	New, open, save, save as
2. Limits	-	Paper sizes – A4, A3, A2, A1, A0 (Display paper)
3. Zoom all and	-	Key board and mouse handling
4. Esc, Space bar		
5. Units	-	Decimal - mm, m, cm Architecture - Inches, feet
6. Draw	-	Line
7. Main layers	-	(Center, hidden, faint, object, hatch, Text, heading, border, dimension)
8. Paper size	-	A4 - 210 x 297 A3 - 297 x 420 A2 - 420 x 594 A1 - 594 x 841 A0 - 841 x 1189 (Show a sample Paper)
9. 1m	=	1000mm = 100cm
25.4mm	=	1 inch
12 inch	=	1 feet = 30.48cm

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1.3 BASIC COMMANDS

01. Line	-	(L)	To draw a line
02. RAY	-	(RAY)	Infinite line in one direction
03. Construction line	-	(XL)	Infinite line in both directions
04. Multiline	-	(ML)	Multiple lines
05. Poly line	-	(PL)	Arc (Width-Used for isometric piping)
06. List	-	(LI)	To List the properties of an object
07. Polygon	-	(P)	Inside, circum (ex: circle)
08. Rectangle	-	(REC)	Chamfer, fillet, thickness, width
09. Snap settings	-	SNAP	Memorize all symbol, purpose, functions
10. Arc	-	(A)	All (to make an arc)
11. Circle	-	(C)	All (to make a circle)
12. Donut	-	(DO)	Purpose
13. Spline	-	(SPL)	Without Radius
14. Ellipse	-	(EL)	All (to make a ellipse)
15. Block	-	(B)	Make, base
16. Point	-	(P)	All (format-point style, divide, Measure, single, multiple)
17. Hatch	-	(H)	All (material purpose)
18. Region	-	(REG)	Separate Lines to region
19. Wipe out	-	(WIP)	Hide
20. Revision cloud	-	(REV)	Drawing details and any doubt
21. Text	-	(T)	All (short key diameter underline, Plus / Minus, Degrees, other symbol)

1.4 TO MODIFY

22. Match Properties	-	(MA)	To Copy a style, text, size
23. Erase	-	(E)	Selection (Window, cross) add, Remove
24. Copy	-	(CO)	Multiple
25. Mirror	-	(MI)	Angle
26. Offset	-	(O)	Normal, Distance
27. Array	-	(AR)	Rectangular array, Polar array (Preview must)
28. Move	-	(M)	Base point to base point
29. Rotate	-	(R)	Angle
30. Scale	-	(SC)	1:5… length (reference) on book
31. Stretch	-	(S)	Selection – add, remove
32. Lengthen	-	(LEN)	All
33. Trim	-	(TR)	Extend, No Extend (fence selection)
34. Break	-	(BR)	to break an object into two or more
35. Chamfer	-	(CHA)	Distance, angle, trim, multiple
36. Fillet	-	(F)	Radius, Trim, Multiple
37. Dimensions	-	(D)	All
38. Purge	-	(PU)	to remove all unused objects from dwg
39. Flatshot	-	(FL)	to create 2D views from a 3D solid
40. Layer	-	(LA)	to view all layers list

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1.5 P&ID FOR SKID MODELLING

- A piping and instrumentation diagram (P&ID) is a drawing in the process industry. A P&ID shows all piping, including the "physical sequence of branches, reducers, valves, equipment, instrumentation and control interlocks.
- INPUT and OUTPUT parameters will also be provided in the P&ID of a skid as per the requirements and flow of the fluids.
- We have to prepare a complete skid package out of it by considering the parameters such as height, man accessing level and valve accessing without causing any disturbance to piping systems.
- Now let us see how a skid is to be modelled in CADWorx for the P&ID shown below

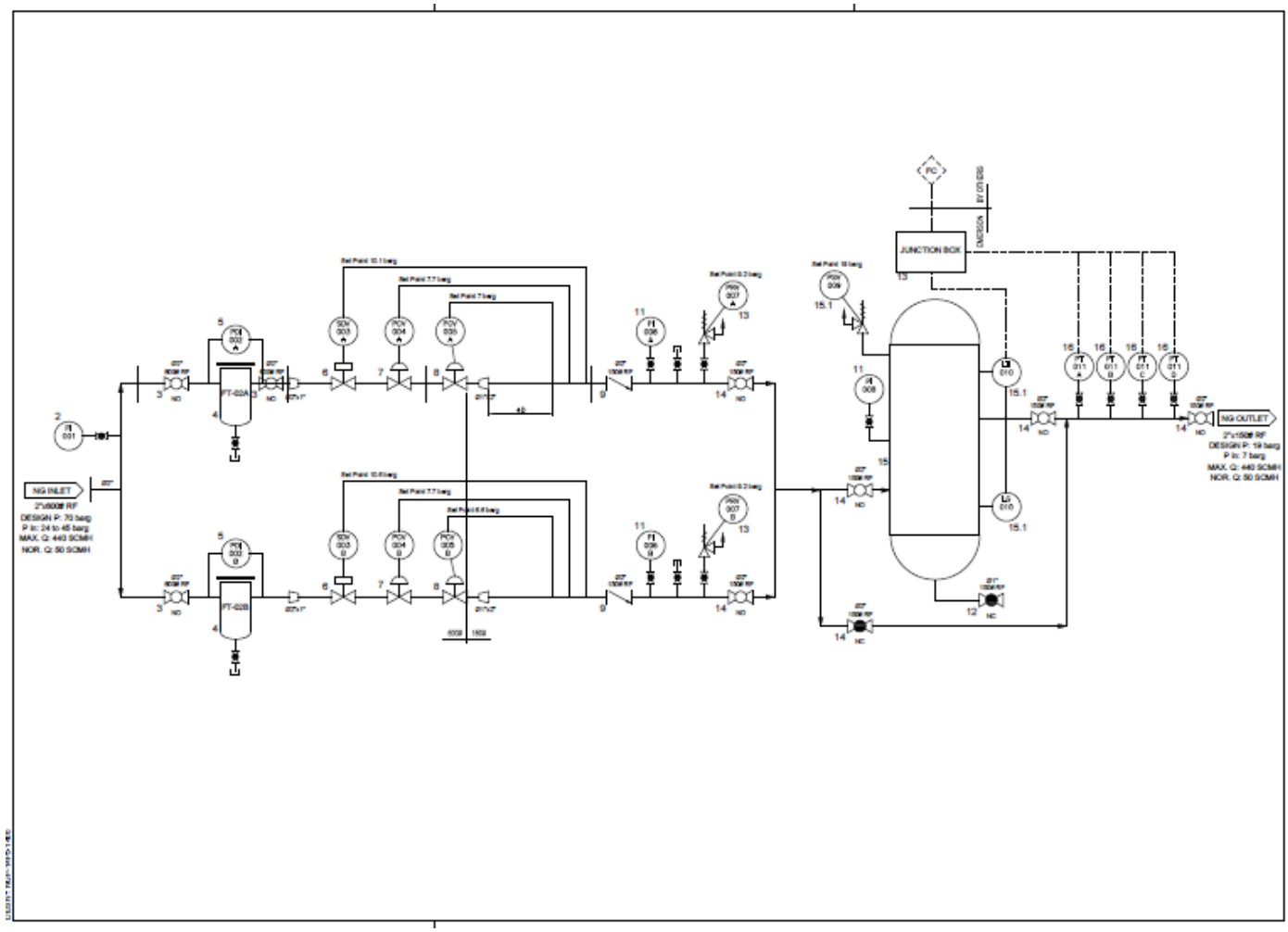

Fig: 1

- A Step by step procedure of modelling process in CADWorx is given below:

2.0 CADWORX PLANT PIPING

2.1 SETUP SETTINGS

01. Use right click & open or Double-click the CADWorx plant shortcut icon on your desktop to launch the program,

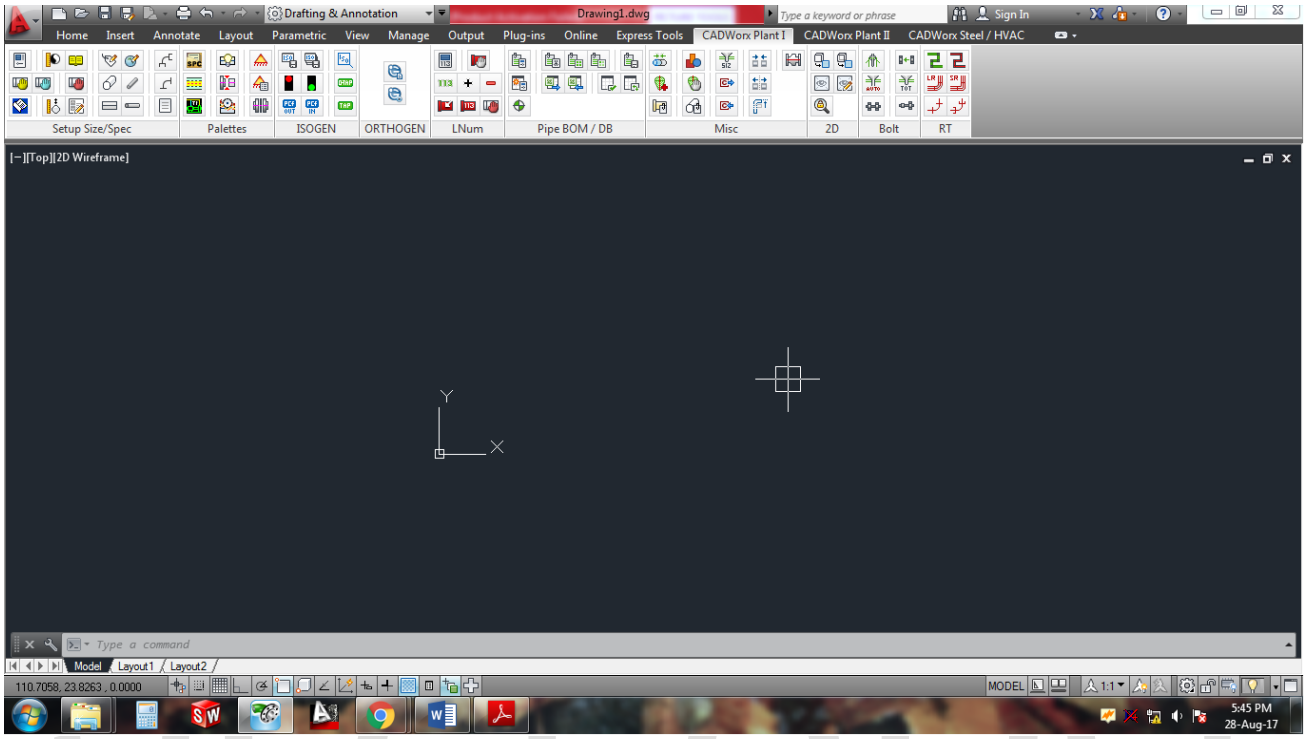

Fig: 2

02. Depending on the version of AutoCAD and the version of CADWorx running on your system, its interface could look different. The layout for CADWorx looks the same. We have a ribbon along the top: refer fig:3

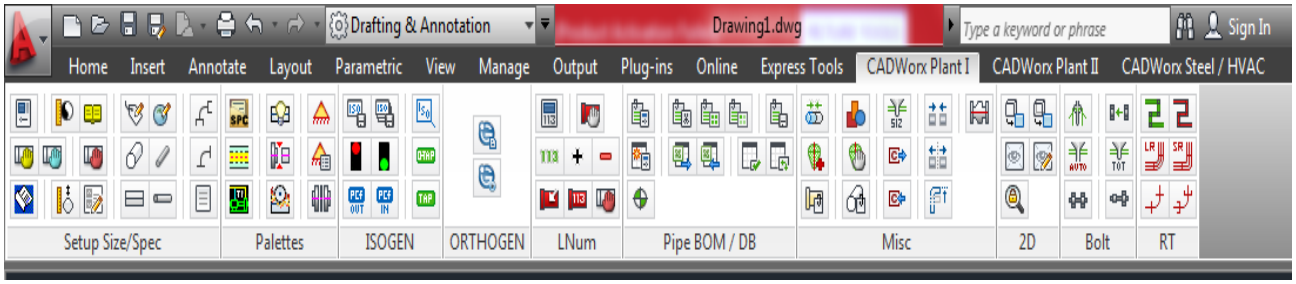

Fig: 3

03. We have CADWorx Plant I, Plant II, CADWorx Steel and CADWorx HVAC in the Menu bar.

04. In some versions CADWorx Steel and CADWorx HVAC is hidden. Clicking the arrow at the side of CADWorx Plant II then the CADWorx Steel and CADWorx HVAC will make it appear.

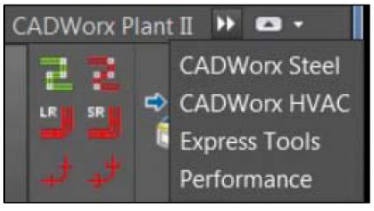

Fig:4

05. In the CADWorx Plant I tab we have panels. These panels allow easy access for many of the features in CADWorx.

We have a section for setting up the size and the specifications.

Fig: 5

06. Likewise we have a section for palettes, so we can use some of these options. We have a spec view tool palette, an insulation view palette, and line number views palette, as well as a few others.

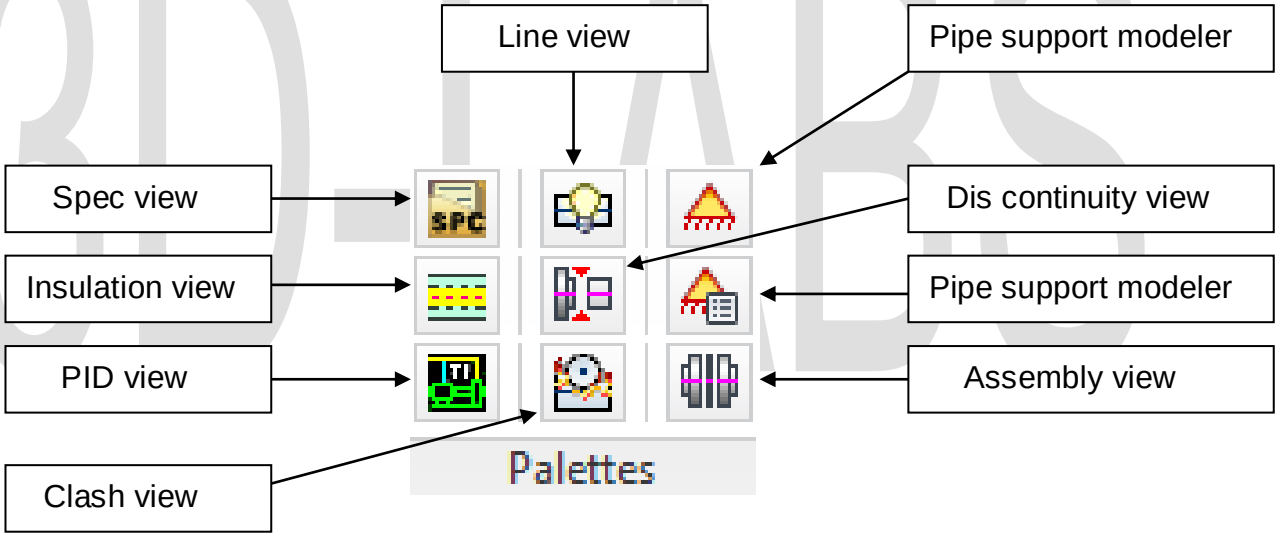

Fig: 6

07. Click New to start a new drawing.

08. When you start a drawing in CADWorx, make sure you are using a template. For this example, we are going to use the Metric template. **Select Metric, and then click Open**.

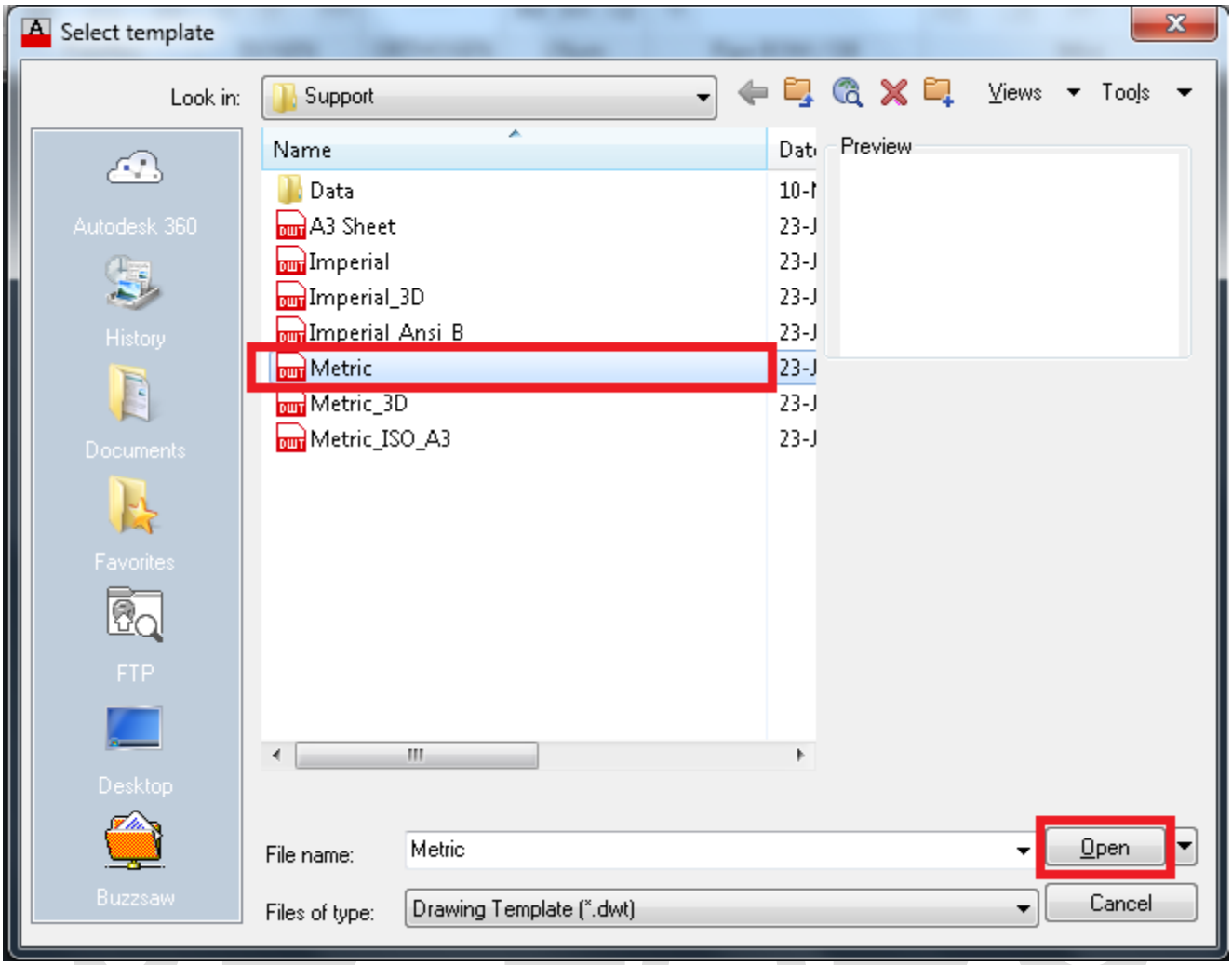

Fig: 7

09. You can run CADWorx in feet and inches, millimeters, or metric/inch. Metric/Inch runs the software with the pipe bore diameters in inches and the lengths in millimeters. That's how we are going to do in this example. Later, you can run in any unit's version you would like.

2.1.1 CURRENT DRAWING

10. **Click Setup** on the **Setup Size/Spec panel**, The CADWorx plant setup dialogue box will be displayed on the screen.

11. Select the **3D Enhanced** on the **current drawing**.

Fig: 8

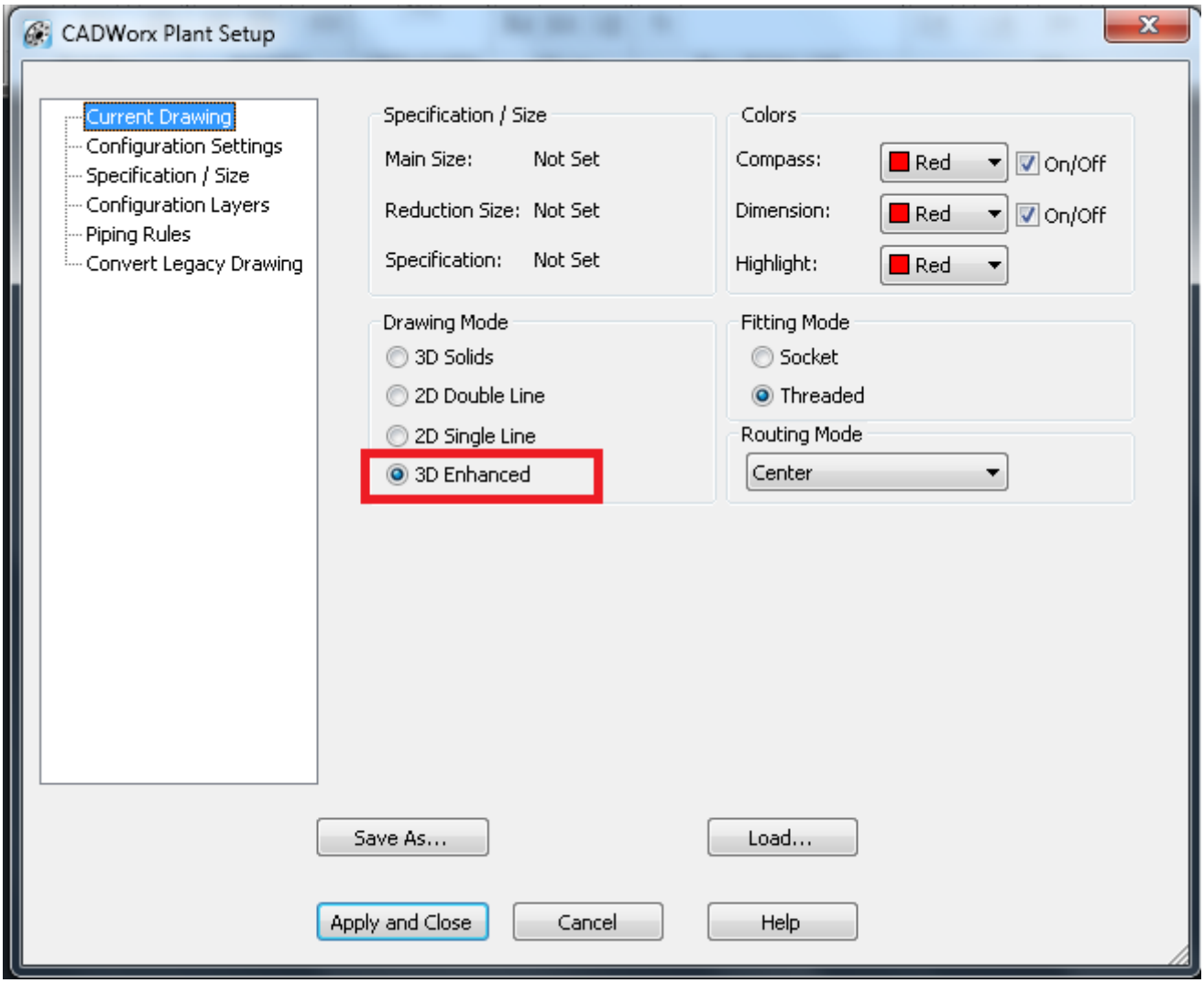

Fig: 9

2.1.2 CONFIGURATION SETTING

12. Then click the **Configuration Settings**, you can see the **Drawing Prototype** set to **Metric/Metric**.

13. If it's not shown as metric, then set it. You can click the drop-down to change it based upon your requirements. If you want to run in Inches, Metric/Inch, or Metric, Set it to Metric/Metric and notice you should have a metric configuration file set as indicated above.

14. Scroll down and check the Specification Directory.
    This configuration setting is pointing to C:\cadworx 2014\Plant\System\Metric.cfg

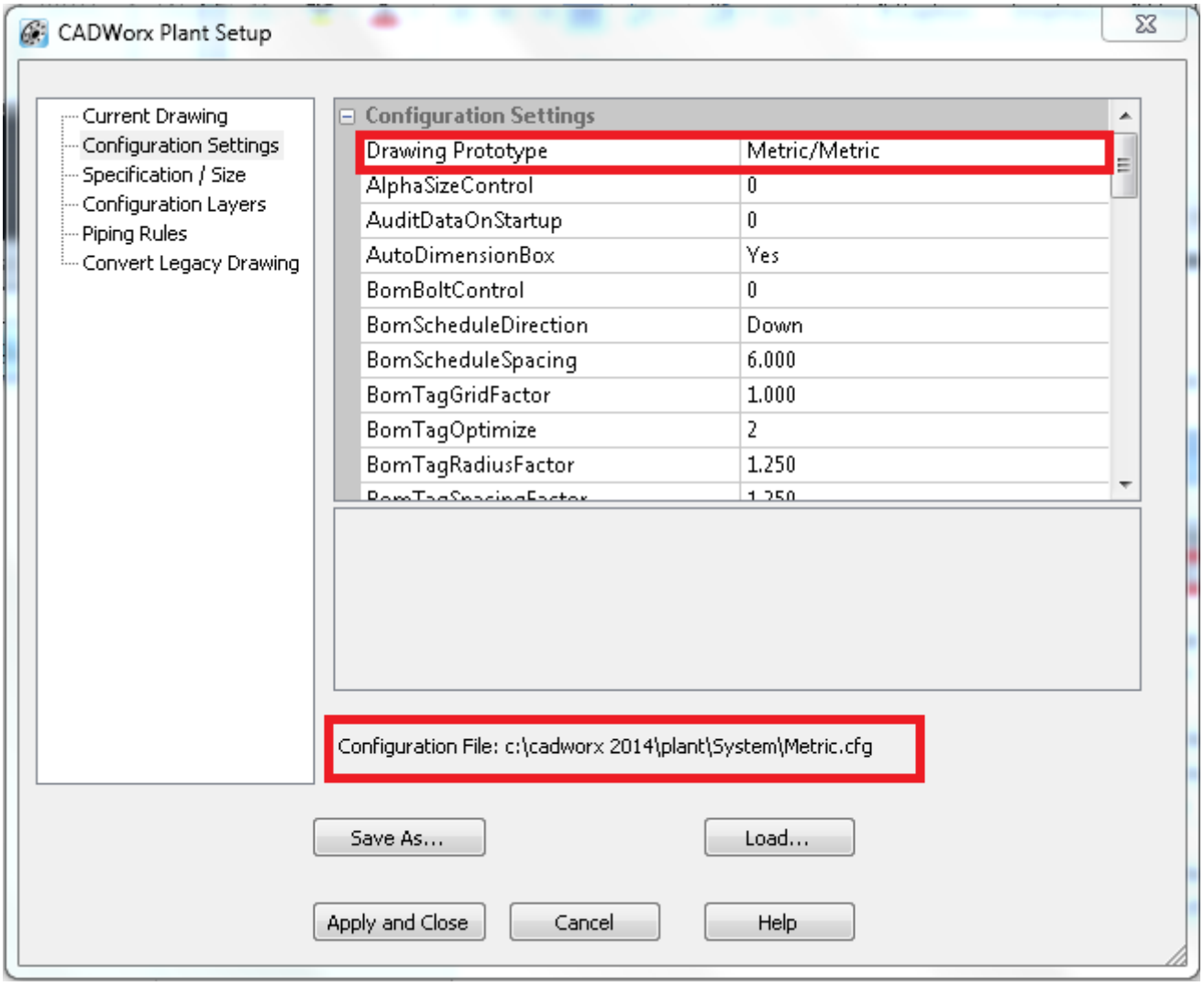

Fig: 10

2.1.3 SPECIFICATION / SIZE

15. **Click the specification / Size** and set the project to **Metric Specs.prj** to set it to imperial or metric. **Click Open.**

16. Select the **Rating** of the pipes in the **Specifications box**. Then the **Nominal and Actual pipe sizes** appears on the Main/Reduction size column, **Select** the pipe sizes as per the requirements.

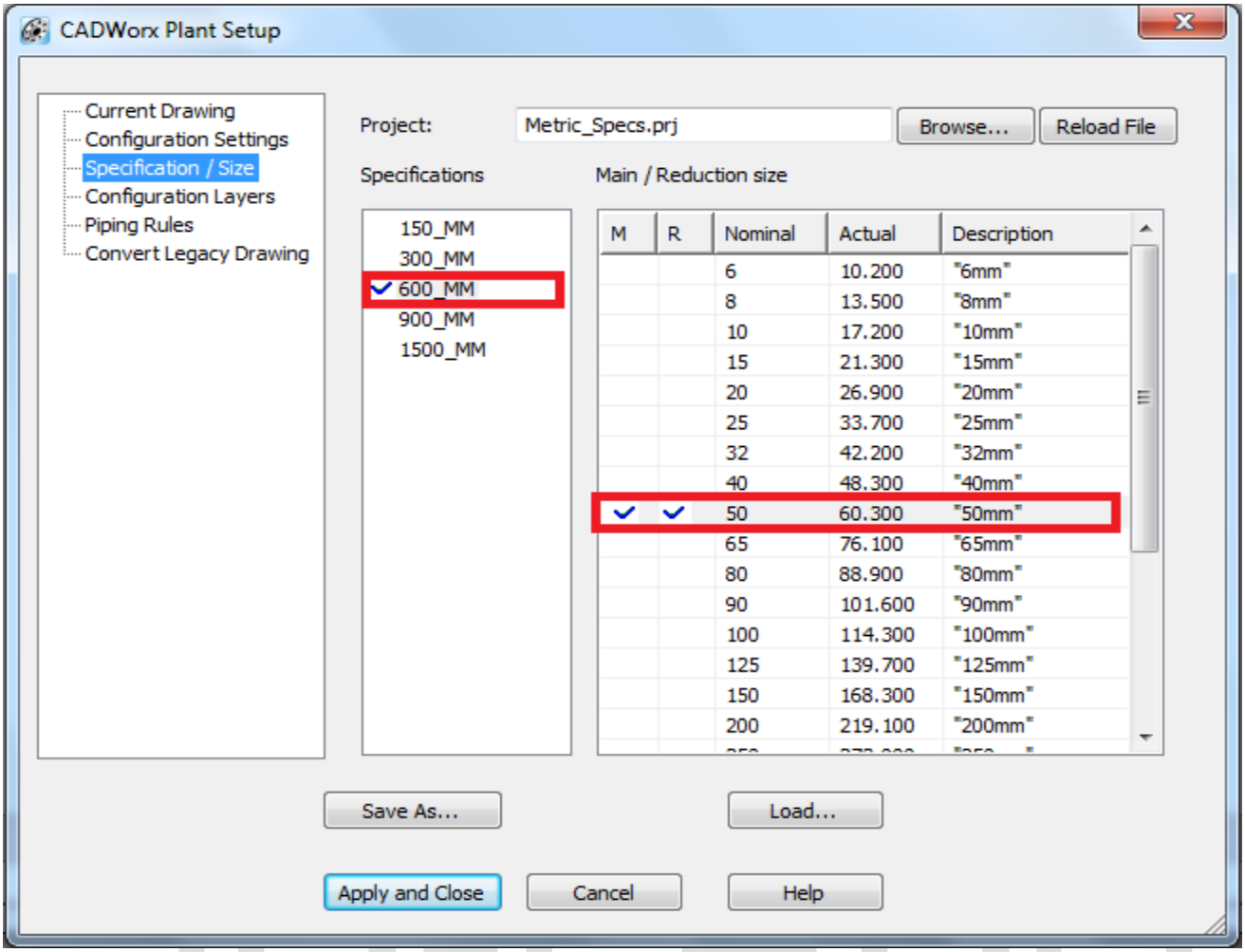

Fig: 11

2.1.4 CONFIGURATION LAYER

17. **Click Configuration Layer**. These are standard settings which are present in the system for layers. You can edit these layers and set up your own system as per your requirements or use the default layers.

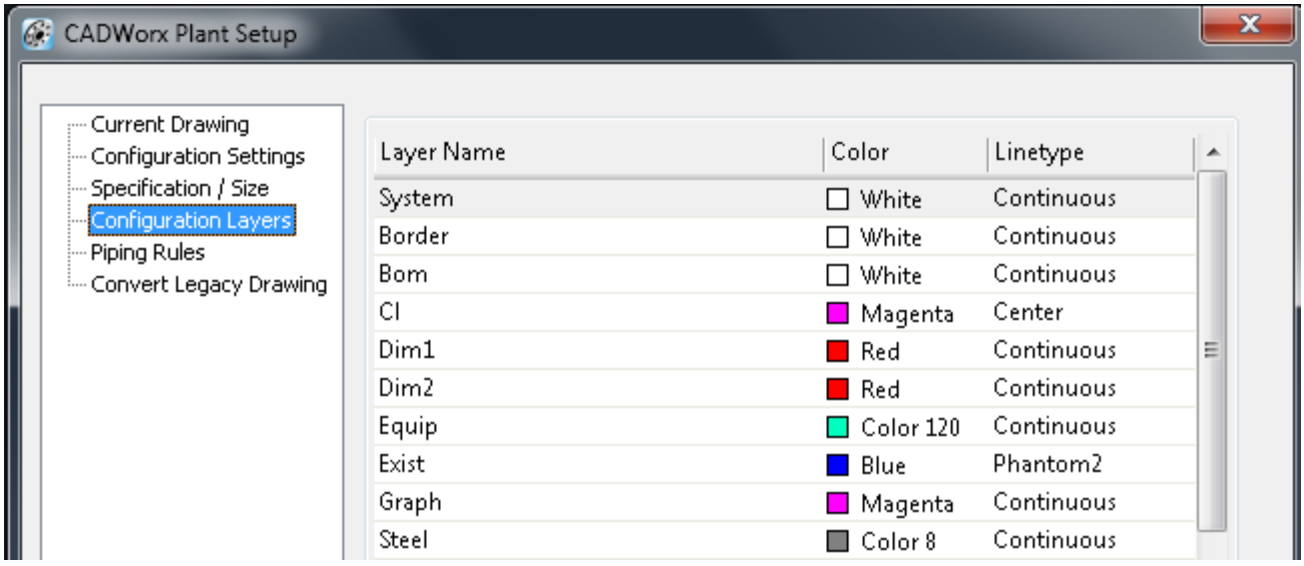

Fig: 12

2.1.5 PIPING RULES

18. We have another section to look at, called Piping Rules. These are built-in rules in the system which prevent errors and make things connecting up properly.

19. There are a variety of rules in Piping Rules as shown below.

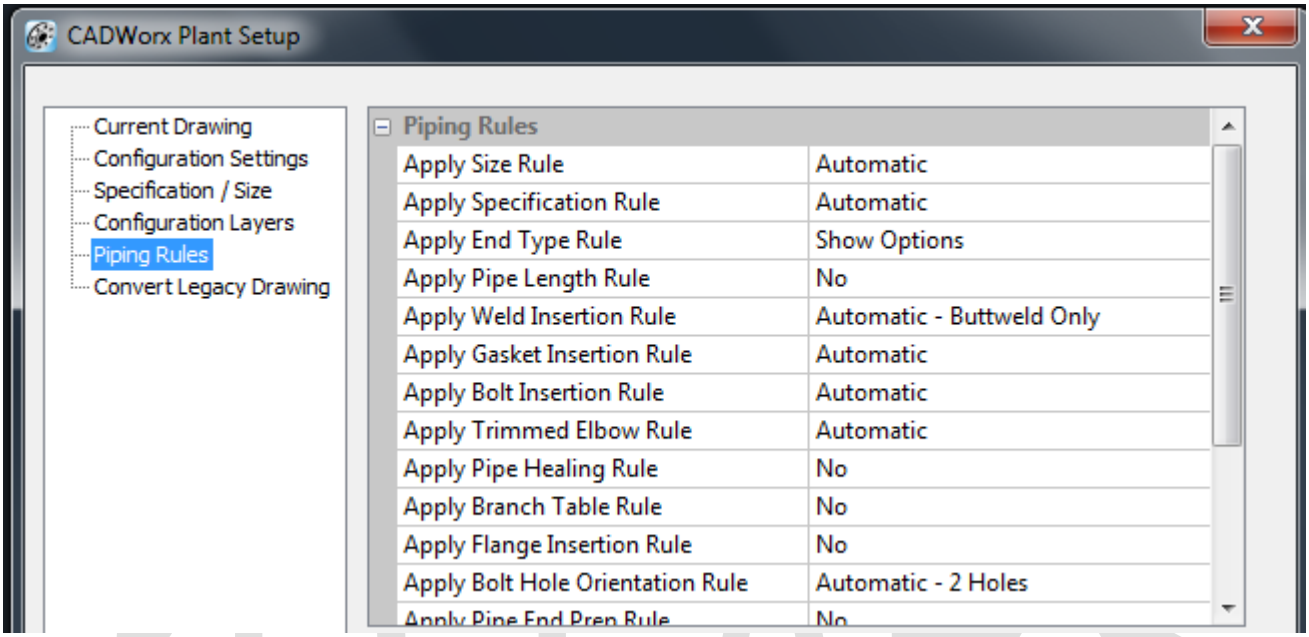

Fig: 13

20. You have been provided settings on these so that you can set to No, Automatic, or Show Options, which shows you the different options based on your actions in the software.

21. Likewise the Gasket Insertion rule, this rule place a gasket in automatically when needed, such as with a flange set. The same thing goes for bolts as well.

22. Finally Click **Apply and Close,** appearing at the bottom of the CADWorx plant setup dialogue box.

2.2 SPEC FITTING COMPONENTS

01. On the Palettes panel, different icons available. However the icon indicated below and you see that it's the Spec View tool pallet. **Click Spec View**.

02. In the Spec View palette display, you can see it is set as 2-inch size, and spec is 600_MM. When you see the _MM, it means that's going to be all in metric. Click the drop- down arrow to set the main and reduction size.

03. Some fittings listed below in spec. There are some components in red and some components in blue which represents the main size, optional size, reducing size, reducing optional size, etc.

Fig:14

04. Well, let's say that we wanted to see threaded. Here the spec might have butt weld, flange, threaded, socket weld. To show more fittings in the Spec View pallet, go to Settings & **Click the Settings tab**.

05. Then select the Show Threaded. For clarity, let's turn off the Show Socket weld check box. **Click Show Threaded and clear Show Socket Weld**.

06. We are able to use that fitting components directly by double click or dragging it to the screen.

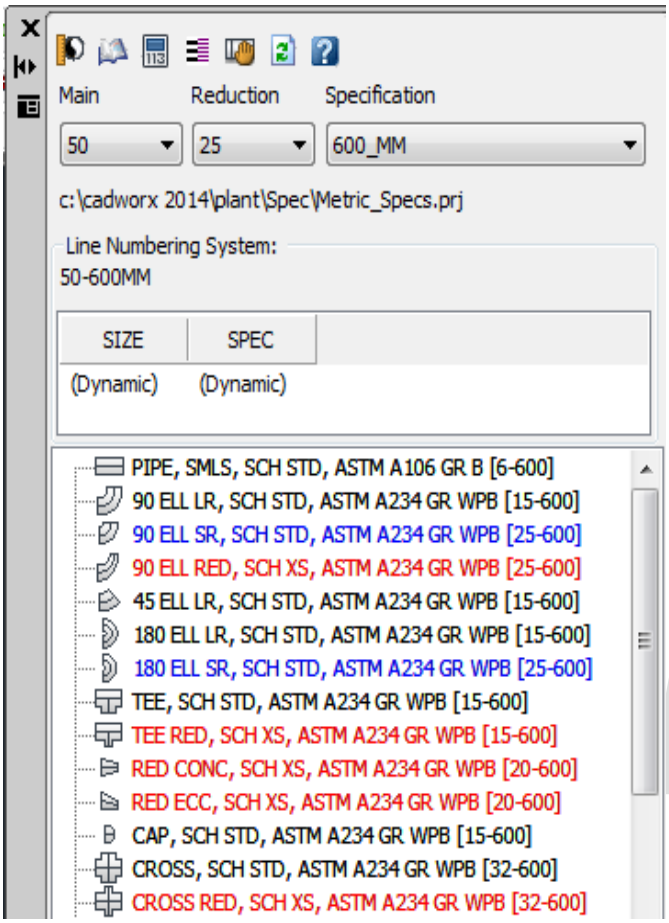

Fig: 15

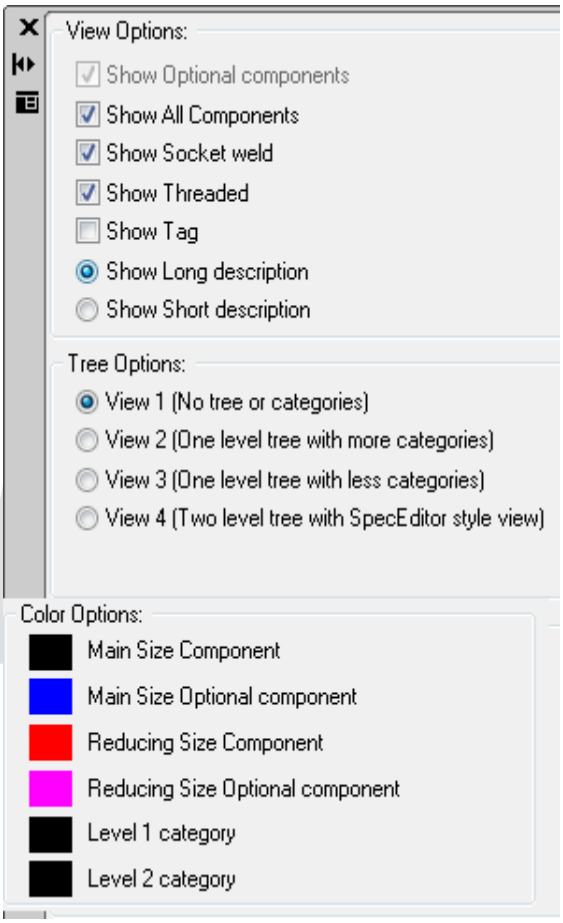

Fig: 16

2.3 PIPING ROOTING

01. Various kinds of routing available on the CADWorx Plant I ribbon.

02. Now we're going to start from the inlet which is given in the P&ID.

03. **Click** the **AUTOROUTE** symbol to start piping.

04. Click a point on the screen, drag out to the left or in right direction,
Right click ⟶ component list ⟶ flange ⟶ weld neck
As per P&ID we need a 600# weld neck flange hence we select Weld neck, we can choose any the flanges as per the requirement.

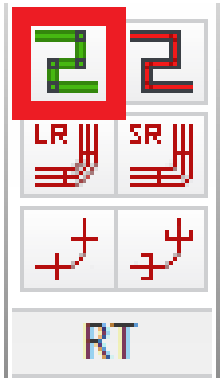

Fig: 17

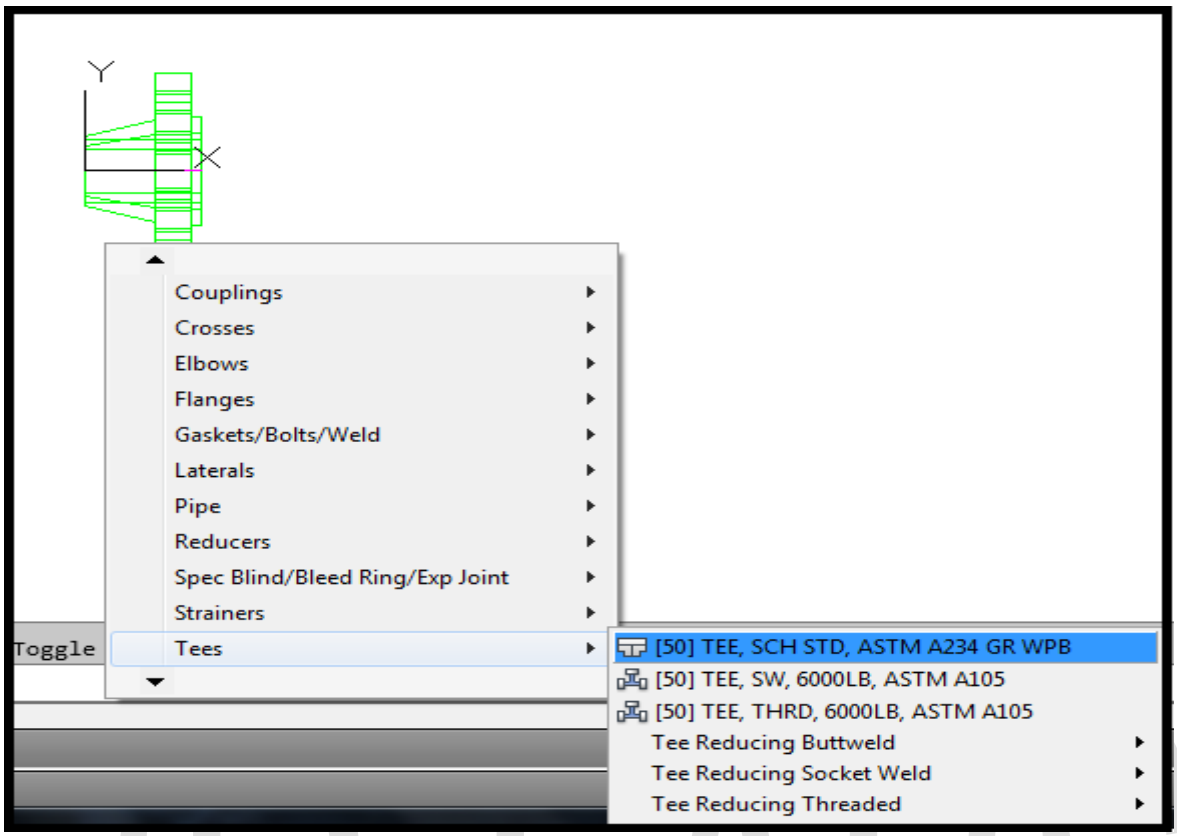

Fig: 18

05. Likewise we can select the **tees, reducers, pipes, elbows, couplings, caps, etc. Click** the **2" tee** to use the tee. The tee will be placed on the piping, which breaks the pipe into two pieces or it mates the two pipes into a single pipe. To change the tee direction type **"C"** to change the direction of tee.

06. If we need to bend a pipe we shall use the **elbows** option.

07. After the completion of each part, there will be a small addition symbol appears in blue color which helps us to drag the pipe routing further or to add a new component.

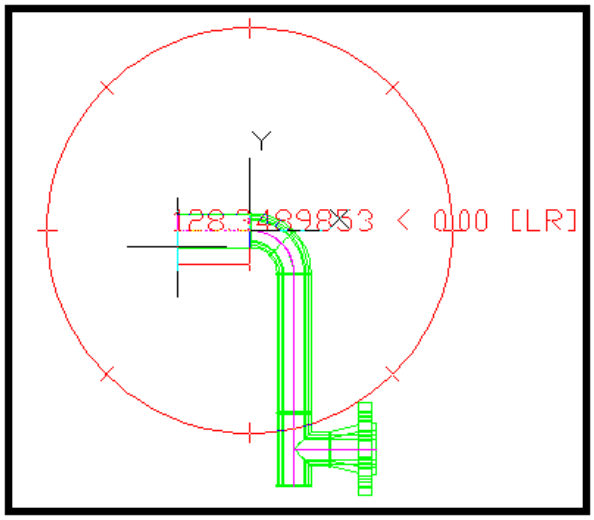

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Fig: 19

2.3.1 COMPONENTS ATTACHMENTS

01. Each company will have a **specific standard** and **specifications for their components, fittings and instruments.**

02. In the CADWorx spec, dimensions of some components and instruments are schematic only. As for the companies they might follow certain standards, hence we should model those components as per their standards using modelling software such as **Solidworks, Inventor, Catia, Creo, etc.**

03. After the completion of modelling process, those components has to be imported into CADWorx and fixed in their respective positions. See Fig:20

04. We should bend the pipes without causing any disturbance to other components.

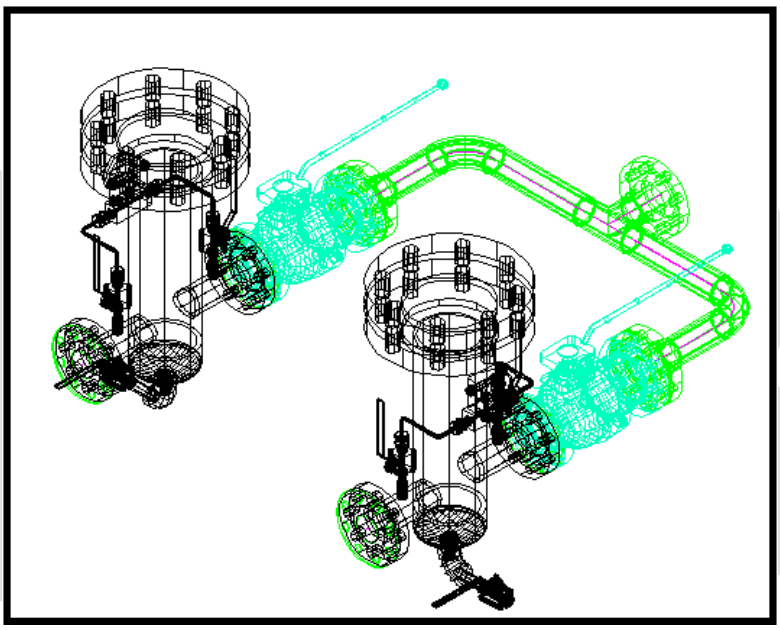


Fig: 20

05. The modelling components are fitted to the piping by flange connections. The component flange ratings and pipe flange ratings should be the same for bolting one another.

06. While establishing flange to flange connections the bolts shall be added automatically, if we set automatic in the **Apply bolt insertion rule.**

07. Similar process shall also be applied for gasket, if we set automatic in the **Apply gasket insertion rule**.

2.3.2 BRANCH CONNECTIONS

- ELO - Elbolet
- LOL - Latrolet
- SOL - Socolet
- TOL - Threadolet
- WOL - Weldolet
- NOL - Nipolet

Fig: 21

2.3.3 WELDOLET

A Weldolet makes a 90° branch connection which comes in full or reduced size for a straight piece of pipe. A weldolet is designated by the run length by the branch length. For example a 6-inch weldolet on a 10-inch pipe would be designated as 10x6 Weldolet. A weldolet is designed to minimize stress concentrations and provide integral reinforcement thus eliminating the need for reinforcing the weld.

2.3.4 THREADOLET

A Threadolet is the same basic design as a "weldolet." However the main difference is the fitting has a female threaded connection to mate to the branch connection. This makes a 90° branch and comes in full or reduced size for a straight piece of pipe.

- In the P&ID, some branch connections were present to monitor the pressure of flowing fluids in the pipe from the inlet.
- The pressure indicator is mounted on the threadolet 2”x1/2” then the valve & Pressure indicator is connection in the branch connection.
- The same procedure followed for the branch connection in manifold & PIT connections.

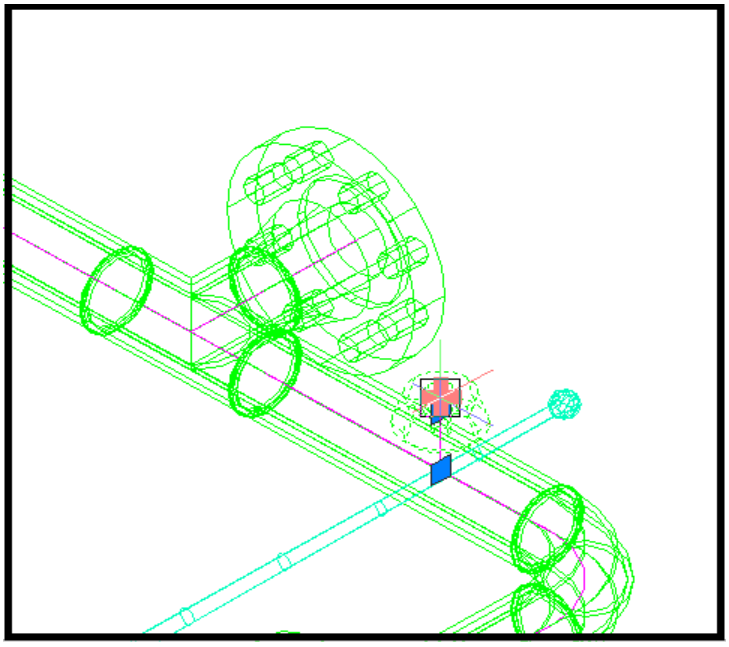


Fig: 22

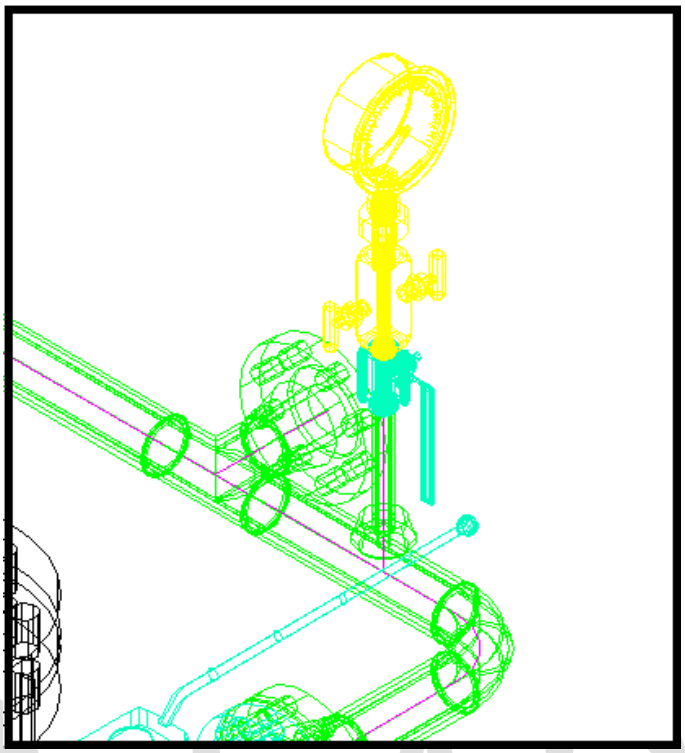


Fig: 23

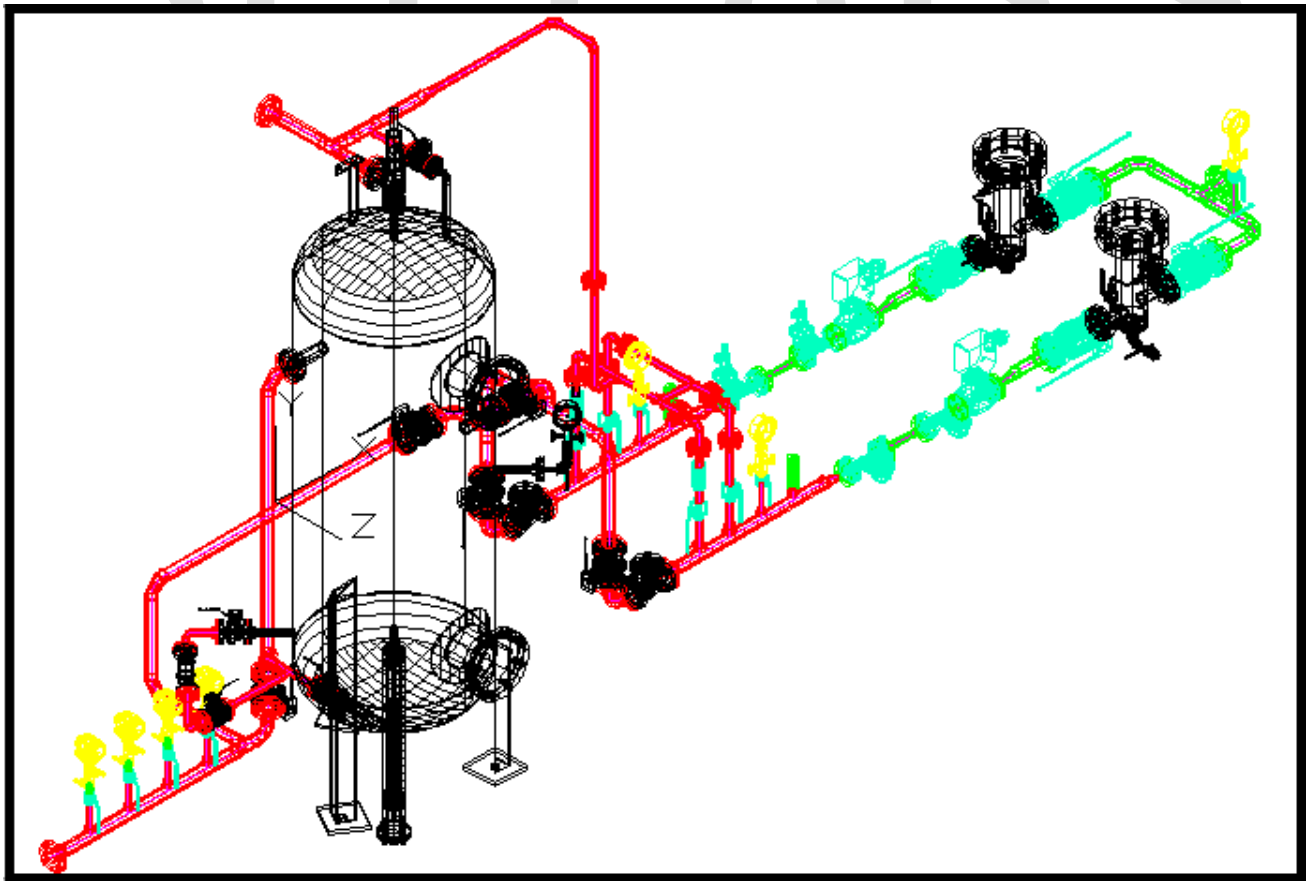


Fig: 24

3.0 CADWORX PLANT STRUCTURAL STEEL

It includes the most complete range of tools for efficient plant design. It is a 3D steel structure design package that has the necessary tools and international steel catalogue needed for today's **industrial applications**. Like CADWorx Plant, CADWorx Structure gives simplicity and efficiency in design thus providing a good reduction in **modeling time**.

- 3D Structural Design
- Easily modified
- Easy-to-Place Assemblies
- Drawings
- Bills of Material
- Centre of gravity
- Creation of stairs, ladders

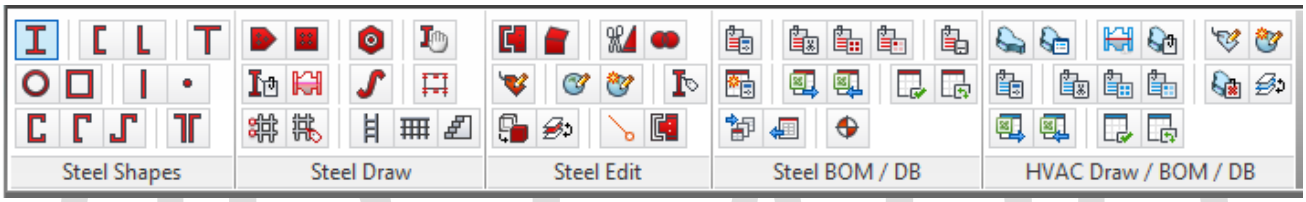


Fig: 25

3.1 CADWORX STEEL

CADWorx steel professionals makes the creation of complex 3D steel structures into simple. Multi-level frames with vertical or sloped sides can be combined to create intricate layouts that allow the easy placement of steel members by the picking of single or multiple frame lines.

- CADWorx steel professional allows structural designers and engineers to **create user shapes** that can be made up of plates or derived from any **extruded profile**.

- Here it is easily modified. Functionality also exists that allows the automatic **coping** of members against one another. Members can be **cut, trimmed and also joined to other members**. It allowing design modifications without remodeling.

- The steel professional has a full **library of international steel shapes** in both imperial and metric units. Metric or imperial shapes can be placed in either environment without modifying their underlying data files.

- **Center-of-gravity** calculations are automatically created and can be shown on-screen, in drawings or in detailed reports. User-configurable **bills of material** are available directly from the model or from the external database.

- In this steel professional includes routines for the parametric creation of **stairs, ladders (both caged and un-caged) and hand railings**. Any attribute of these items can be modified at any time instantly updating the model.

-

3.2 STRUCTURE ROOTING

- Skid coverage area shall be provided by the client based on their space allocation.
- Here the given area of the skid is 7500 mm length x 1600 mm width.
- To form a structure, draw a rectangle with the above dimensions.
- Then assign a suitable member size to it (beam, channel, angle, etc.)
- Likewise to model a complete structure of skid, the whole process shall be repeated accordingly

3.2.1 STEEL SHAPES

- **On Clicking the CADWorx steel / HVAC**, the structural ribbon appears. It consists of steel shapes, steel draw, steel edit, steel BOM / DB, HVAC draw / BOM / DB.

- In the **steel shapes** we can choose steel shapes and assemblies from a library of steel standards and templates.

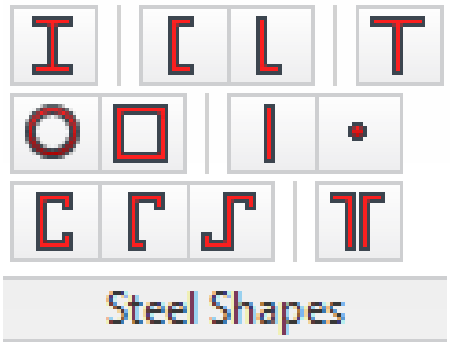


Fig: 26

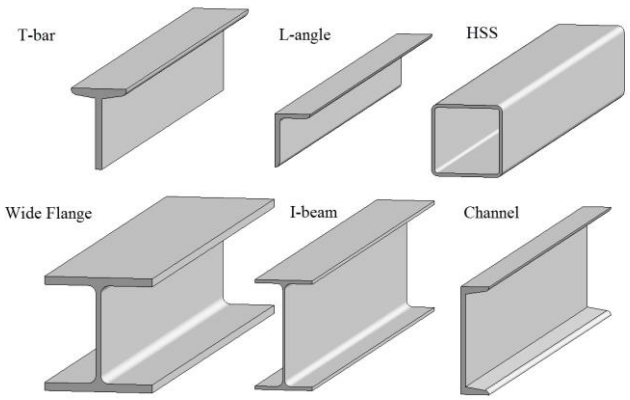


Fig: 27

- The steel shapes contains a number of shapes like wide flange, Channels, Angles, Tee, Structural pipes, Structural tubing, Flat bar, Round bar, lip, etc…

- We can choose from the **ribbon or dialogue box**.
- **Click** any shapes in the dialogue box

  Open then choose the type of shape from the **select type**.

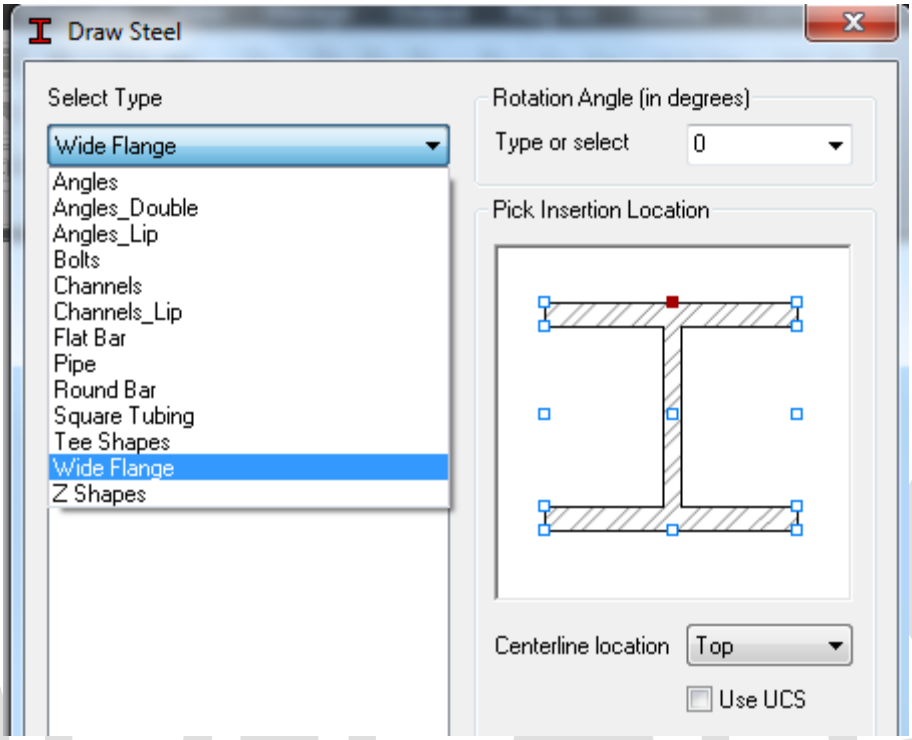


Fig: 28

- In the side of the dialogue box we have to select the **centerline location** by using scroll buttons up and down.
- While selecting the centerline whether it is top, bottom or center of the member which is used to mate the materials one another.
- We can also change the **angle of rotation** in degrees as per the requirements. In some places the angle or a channel connected to the beam in some degrees there we using the angle of rotation.
- In the same dialogue box click the data file library. It has a full **library of international steel shapes** in both imperial and metric units.
- The imperial system uses yards, feet, inches, etc. to measure length. It was developed over hundreds of years in the UK, then the French developed the metric system like meters in 1670, which soon spread through Europe.
- In the **library of international steel shapes** it consists of many international standards generally we following a European standards for skid, so **click** the **European standards** in the Data file.

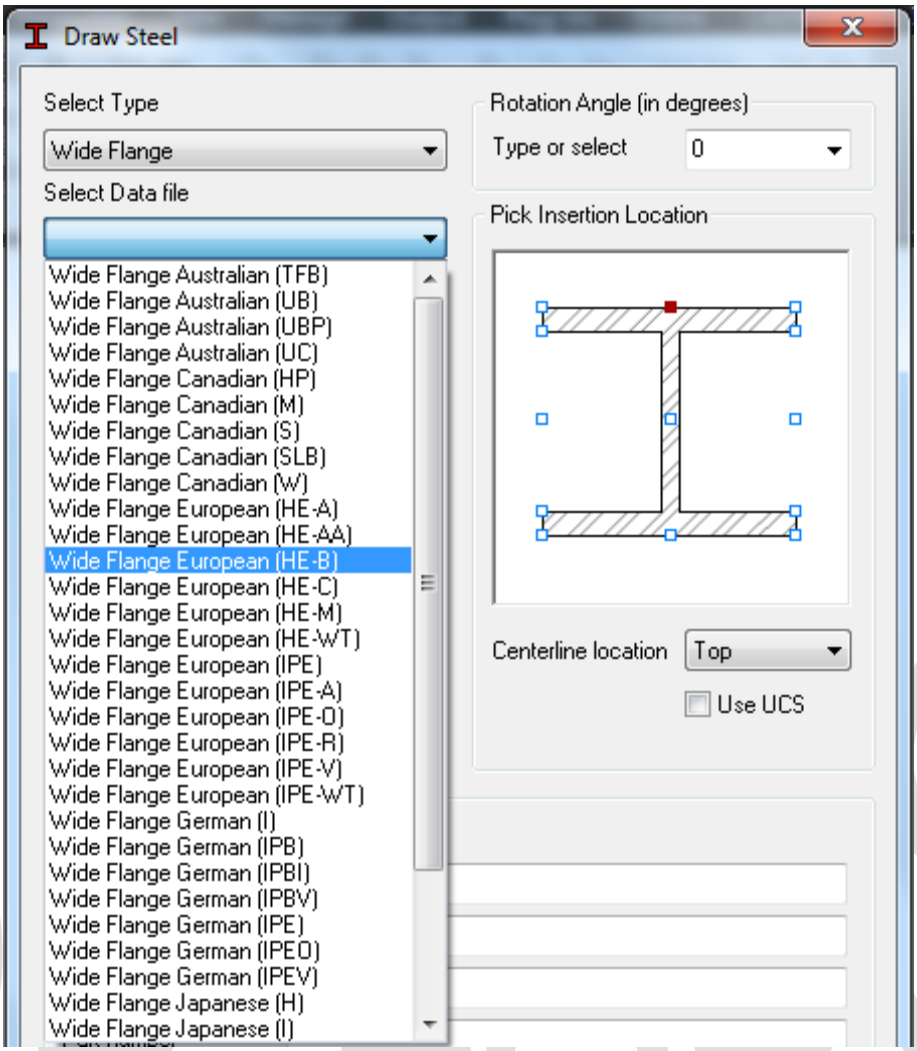


Fig: 29

3.2.2 FACTORS NEEDS TO BE CONSIDERED WHILE SELECTING THE MEMBERS

We have to select the members for the material by taking some factors into consideration which are given below:-

- Based on availability
- Based on cost
- Based on load withstanding capacity
- Based on standards
- Based on corrosion

Fig: 30

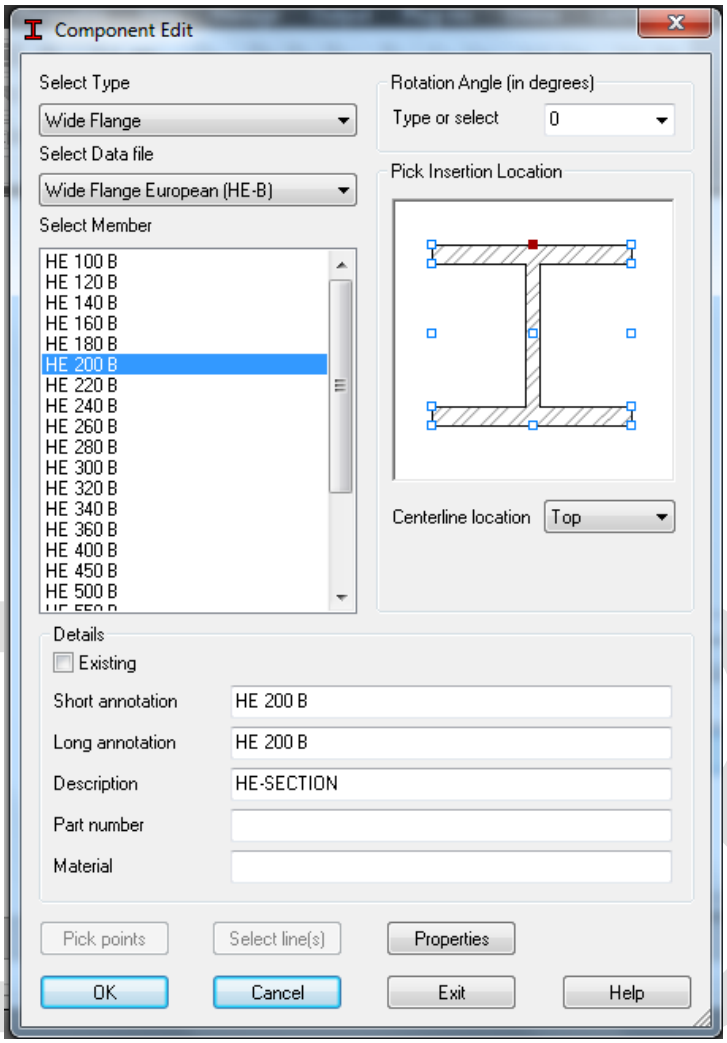


Fig: 31

3.2.3 STEEL DRAW

- With the help of steel draw it is easy to use tools capable of laying out complex steel structures, including modelling stairs, ladder and handrail.
- The structural library contains a variety of international steel shapes and it can be modified to include any project requirements.
- All structural entities created with CADWorx plant professional from wide flanges to base plates and bolts.
- The frame creator tool allows simple creation of complex 3D steel structures and parametric tools allows the rapid creation of stairs, ladders and handrails.
- Generally it comes with complete toolset for modelling intelligent structural shapes.

Fig: 32

- With the help of a steel draw we can model plates with standard hole sizes.
- We can set the components with various beam sizes with the help of a set size by component. We can able to attaches the information to any generic components.

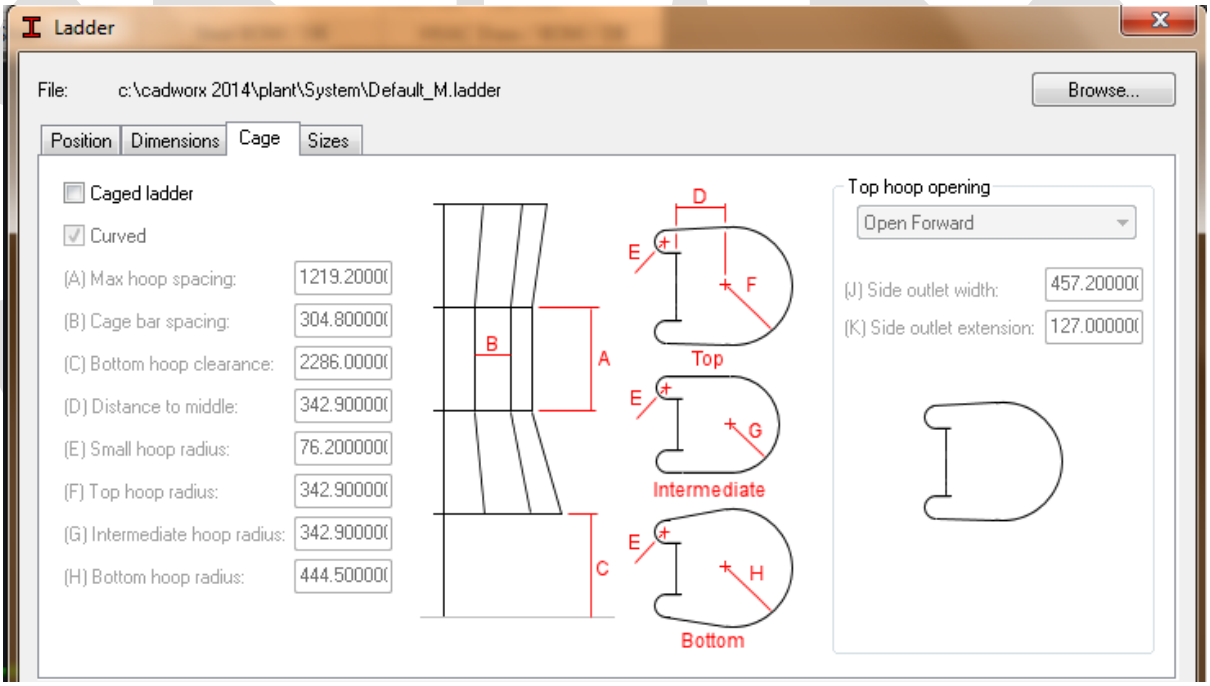


Fig: 33

- Set up the dimensions as per your requirements to get a complete structure of a stair, caged ladder, ladder without cage and handrails.

3.2.4 STEEL COPING

- After setting up the material **click the select line** box present at the bottom of the dialogue box.
- Now select the line which you have already drawn for the skid, then press enter to change the line to the required material.

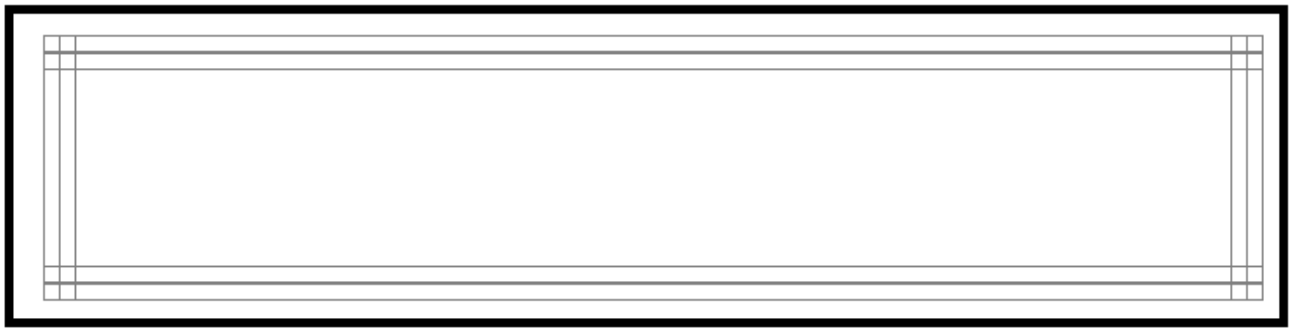


Fig: 34

- Now base frame is created from the given dimension, but at the ends of the frames the webs extends throughout the end of the frame.

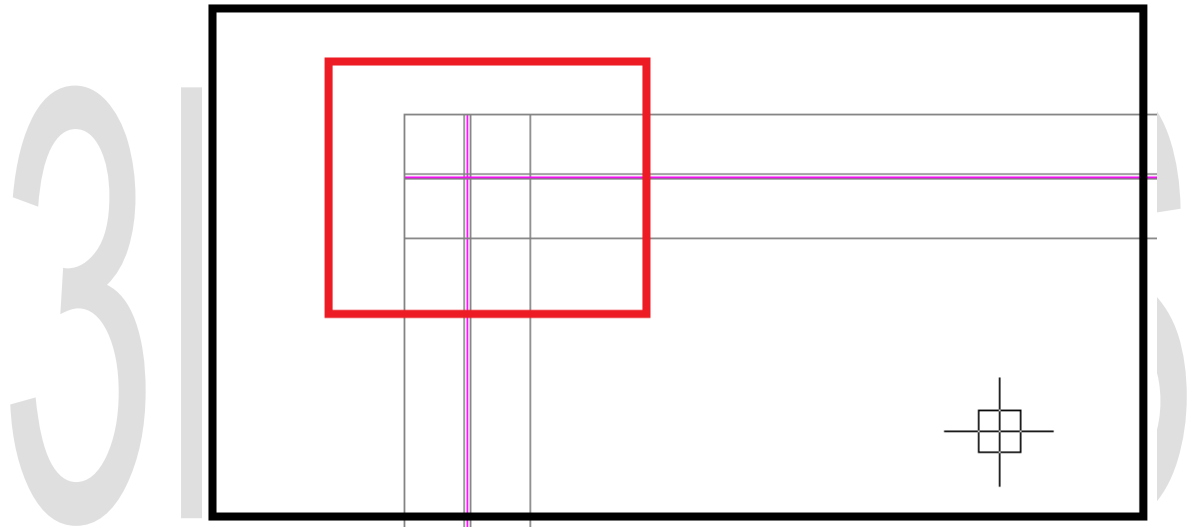


Fig: 35

- The extended solid shall be removed by using steel coping. **Click cope** option in the **steel edit**.

- Select the object or beam to be removed from the frame. Press the enter button then select the object or beam which is stable and press enter.

- Now the beam splits from two pieces, so that we can remove the unwanted one easily. Same procedure shall be followed for the sides. Refer Fig: 32, 33, and 34.

- Here we are using wide flanges, but we shall also use channels, angles, double angles, tee, lips, etc.

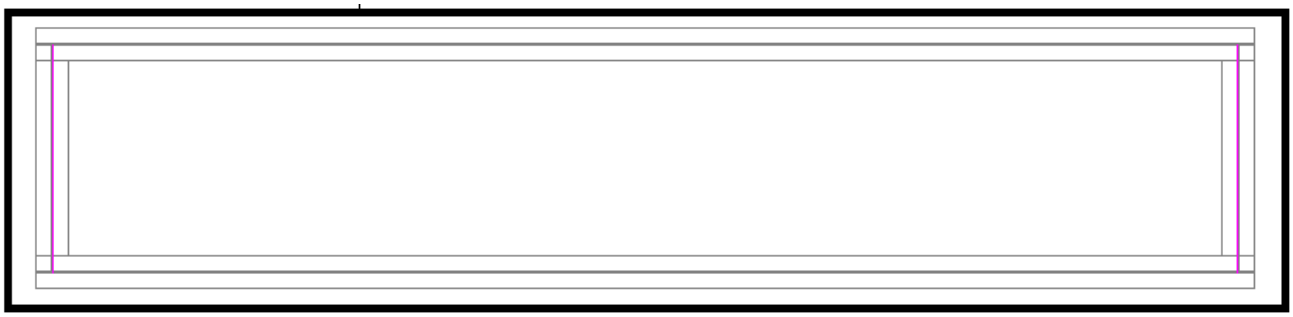


Fig: 36

- Once the base frame has been completed, then intermediate frames shall be modelled.
- Depending upon pipe elevations, pipe supports shall be introduced as well. Due to the flow of oil or gas in the pipes, deflection will arise in pipes.
- To avoid such defects, deflections & damages, additional pipe supports shall be added to hold the pipes.
- Pipe hanger is a designed element which transfers the load from the pipe to the supporting structures.
- The load includes the weight of the pipe, the content the pipe carries, all the pipe fittings attached to pipe, and the pipe covering such as insulation.
- The supported frames also to be selected as per requirements and material availability.
- In pipe supports, the pipes are held by supports like u-clamps, guide support, anchor support, hanger support, etc.

3D-LABS

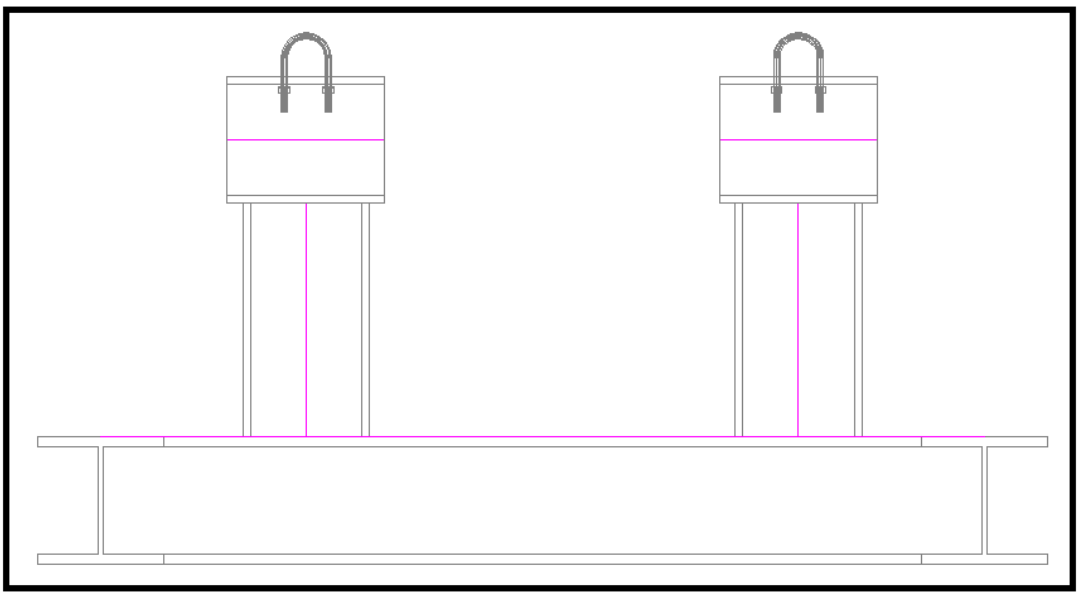


Fig: 37

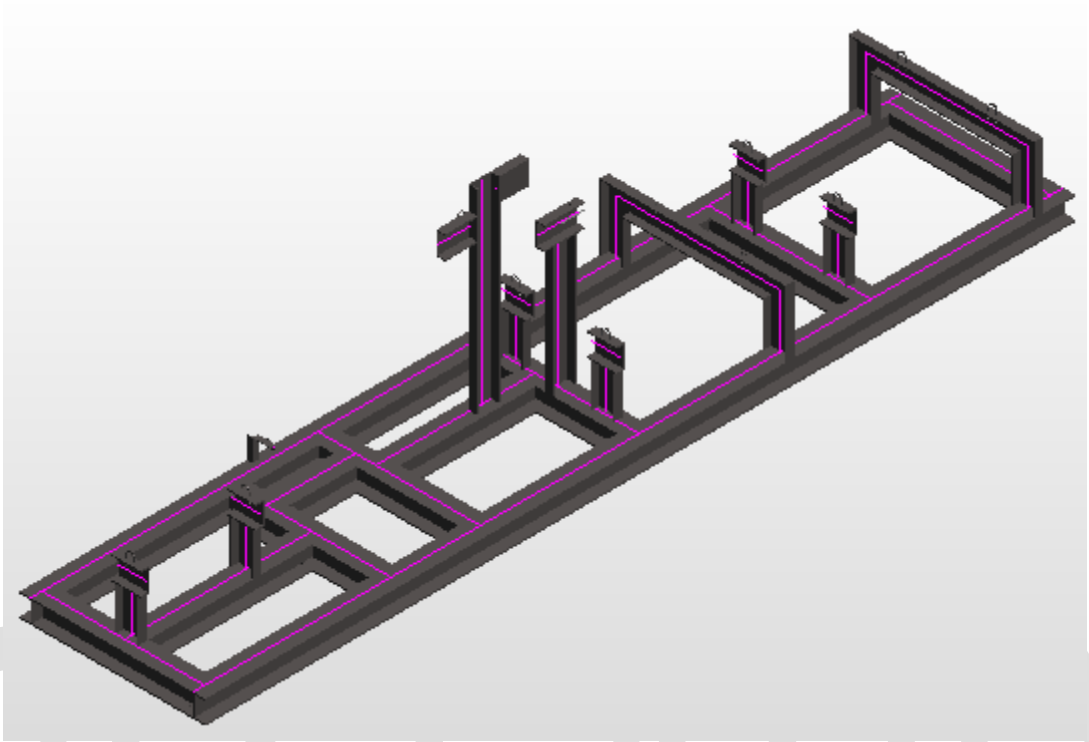
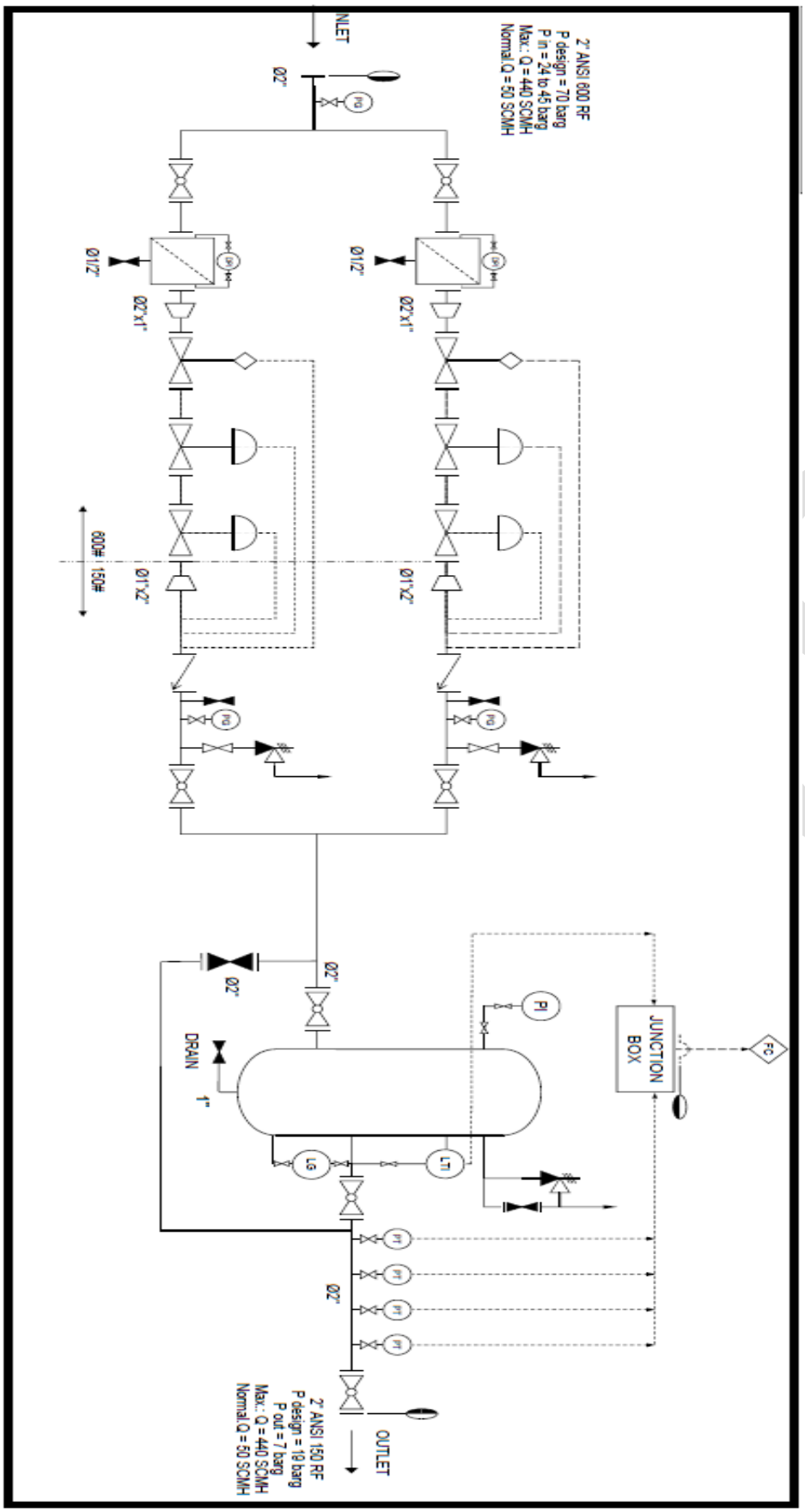
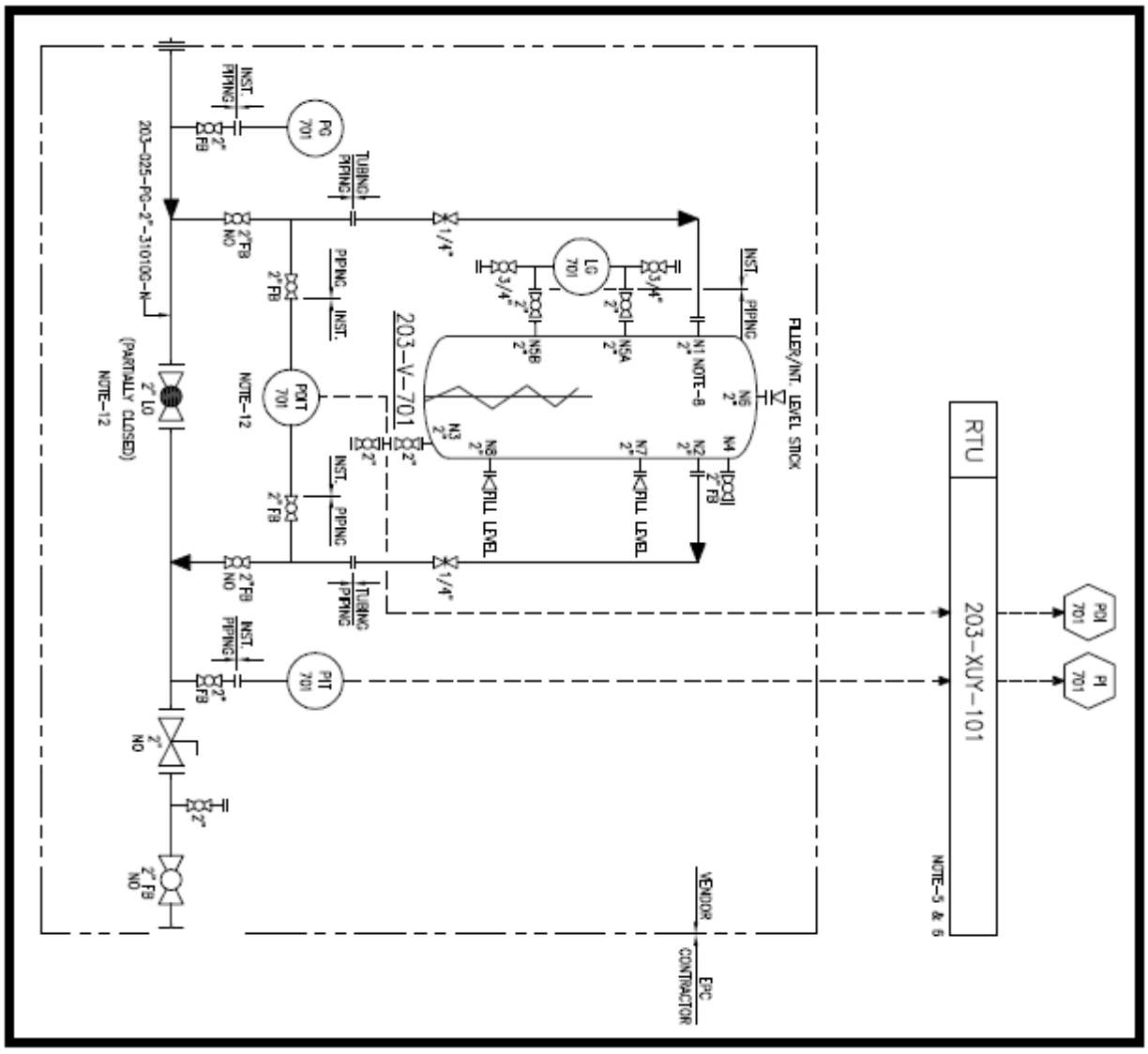
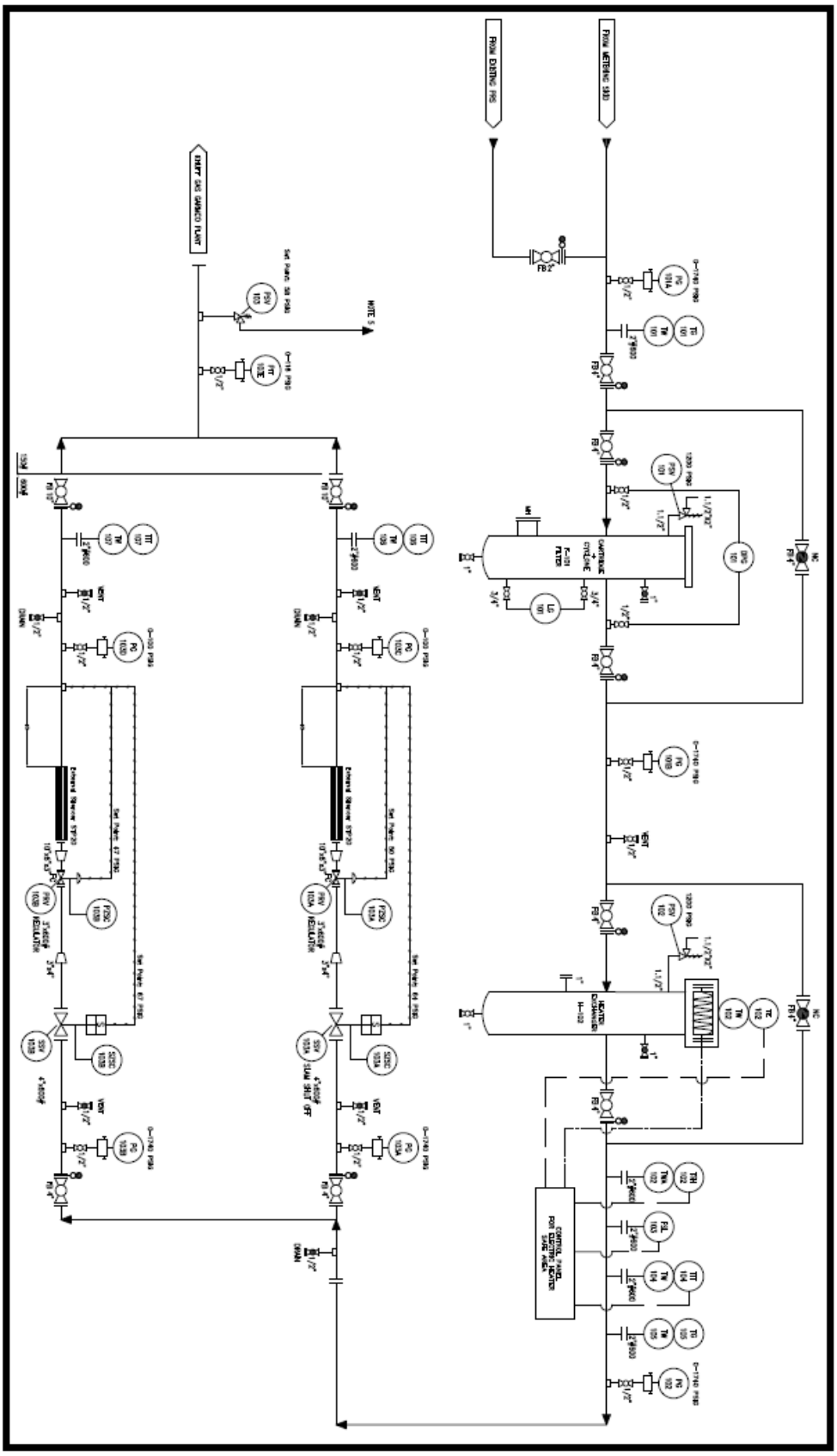


Fig: 38

3D-LABS

3.3 P&ID SAMPLES




RTU
203-XUY-101
NOTE-5 & 6
PDI 701
PI 701
203-V-701
FILLER/INT. LEVEL STICK
FILL LEVEL
FILL LEVEL
LG 701
PG 701
PDIT 701
PIT 701
203-025-PG-2"-31010G-N
2" LO (PARTIALLY CLOSED)
NOTE-12
NOTE-12
VENDOR
EPC CONTRACTOR