



Satish Lele

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Program for Design of Agitator / Mixer for Vessels with Drawing

I offer Design and Drawing program which Designs and Draws a detailed drawing of Agitator / Mixer, with user friendly dialog boxes, which is an add-on for any inexpensive CAD program like **BricksCAD**, **ProgeCAD**, **IntelliCAD**, **Draftsight**, **CADLogic**, or **ZWCAD** program, for Designing and Developing GA drawing for Agitator / Mixer. The Program for Design and Drawing of Agitator / Mixer asks for some parameters and designs the basic parameters of agitator. It writes all these in a text file which can be submitted as design criteria. Program for Design and Drawing of Agitator / Mixer then draws the GA drawing and components. Program for Design and Drawing of Agitator / Mixer gives all minor details (even weight of each component and total weight) at Quotation Stage itself and this helps to quote in most competitive manner.

► Charges for Design and Drawing of Agitator: US\$ 60 OR ₹ 4,000.

► Charges for Drawing of Agitator: US\$ 30 OR ₹ 2,000.

► Program of Drawing of Agitator is for sale:

Original Price US\$ 250 OR ₹ 15,000.

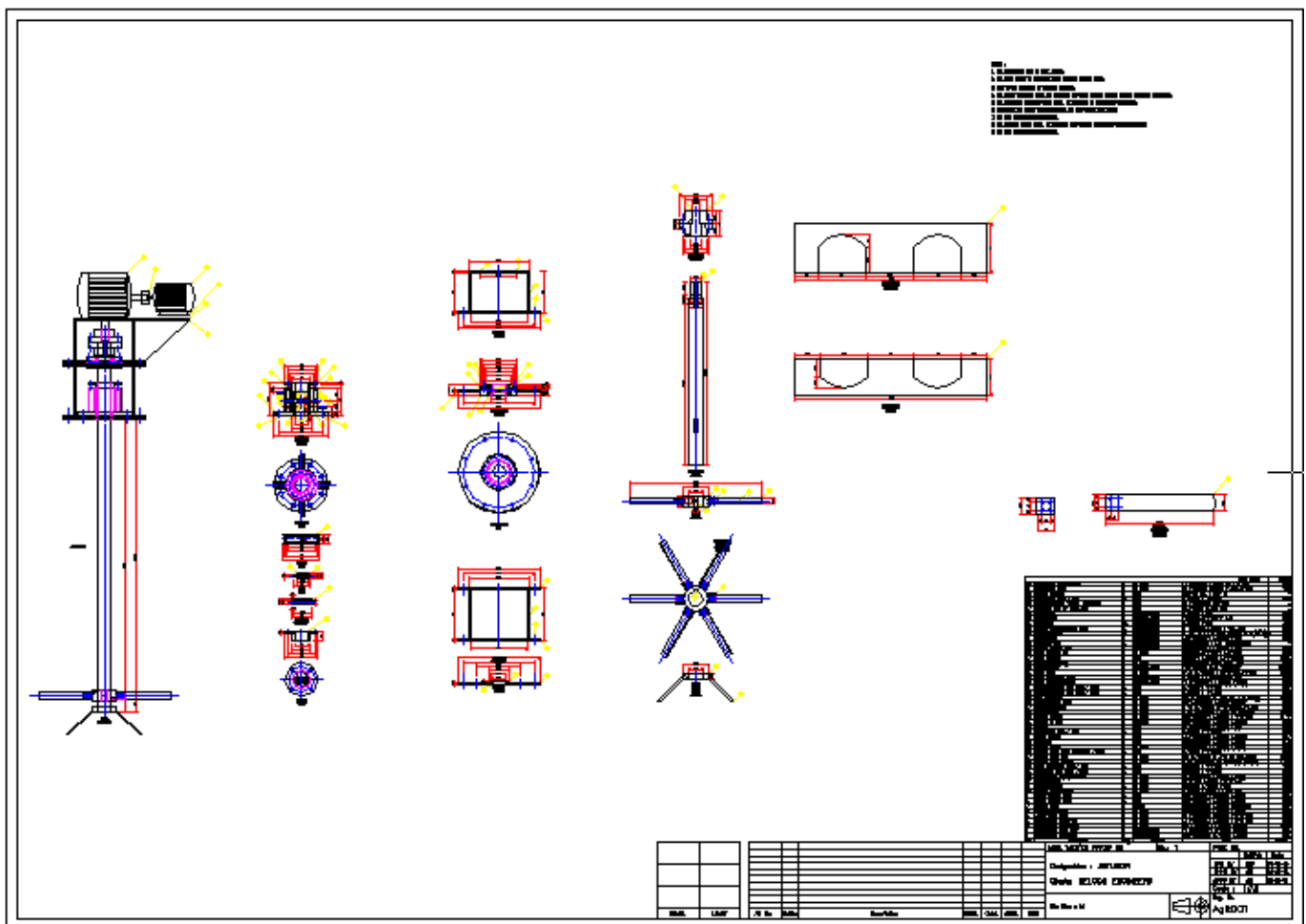
Special Price: US\$ 175 OR ₹ 10,000>

Information required for Design and Drawing of Agitator

1. Type of Tank: Vertical Cylindrical or Rectangular
2. For Vertical Cylindrical Tank: Diameter and length
3. For Rectangular Tank: Length, Width and height
4. Viscosity of Liquid in cP
5. Specific Gravity of liquid
6. Any preference for type of Impeller
7. Bearing Housing: Double, Single or none
8. Type of Mixing by Impeller: Axial flow or Radial Flow
9. Drive: Motor + Geabox or Geared Motor

10. RPM of shaft if specifically required
11. Material of Wetted Parts
12. Number of impellers: especially for long vessel
13. Impeller Blades: Bolted or Welded
14. Type of Seal: Mechanical Seal, Stuffing Box or none
15. Placement of Agitator: On top of vessel, On Channels (for open vessel)
16. Bottom Bearing (especially for long vessels)
17. Any Other

Note : Program can not design and draw Fast Speed Mixers, helical screw mixers or mixers with hollow shaft.

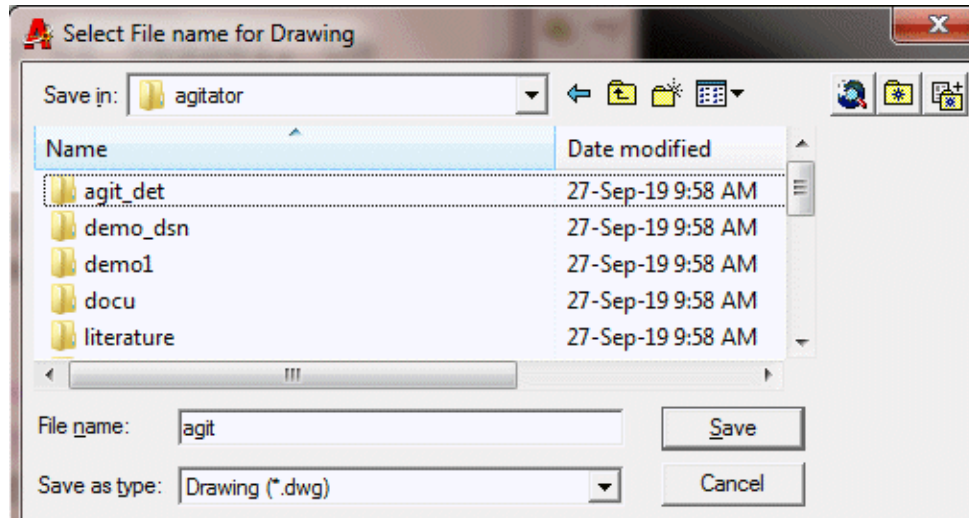


Program for Design and Drawing of Agitator / Mixer will draw Drawing like this.

How the Program for Design and Drawing of Agitator / Mixer Runs?

The Program for Design and Drawing of Agitator / Mixer asks for parameters in the following dialog boxes, and based on these values, designs

and draws.

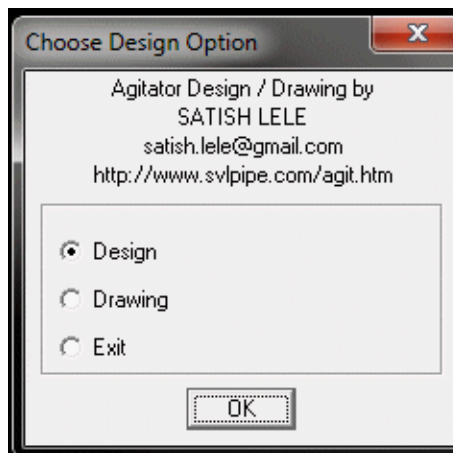


To run the program, unzip agit.zip and copy files in one folder on hard disk (and not on desk top), say agit. While running inexpensive CAD program like **BricksCAD**, **ProgeCAD**, **IntelliCAD**, **Draftsight**, **CADLogic**, or **ZWCAD** program, click on tools -> Options (or Preferences) -> Files -> + of Support File Search Path -> Add -> Browse -> Select the folder (agit), and click on apply. The agit.zip file contains agit.lsp, agit.dcl and agit.slb, other lsp files, A1.dwg (Border drawing) and trial.dwg (dummy drawing). To run the program always open trial.dwg and load agit.lsp by appload or by typing (load "agit.lsp") at command prompt. (If you get message "File not found", please set up folder path settings again.) Type agit and press <enter> and program will start. The produced drawing can be saved in any folder you select and by the name you decide.

In a inexpensive CAD program like **BricksCAD**, **ProgeCAD**, **IntelliCAD**, **Draftsight**, **CADLogic**, or **ZWCAD** Program, first open trial.dwg. It is a blank drawing. It is in the same folder where program files are located. It automatically defines the path (folder) to search the program files. At command prompt type (load "agit.lsp"). Agitator program will be loaded. Next type agit and press <enter>. The Program for Design and Drawing of Agitator / Mixer will ask for Drawing name and directory where it is to be stored.

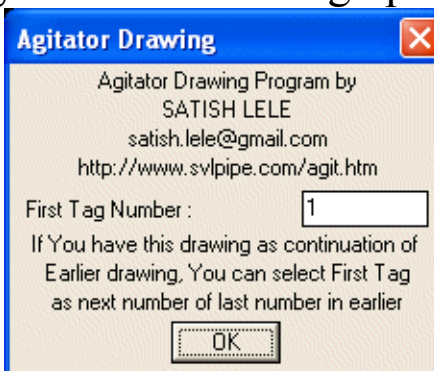


You can draw either in Foot-Inch units or in Metric Units. In Metric system it asks for all values in millimeters and in Foot-inch systems it asks for all values in Foot-inch.

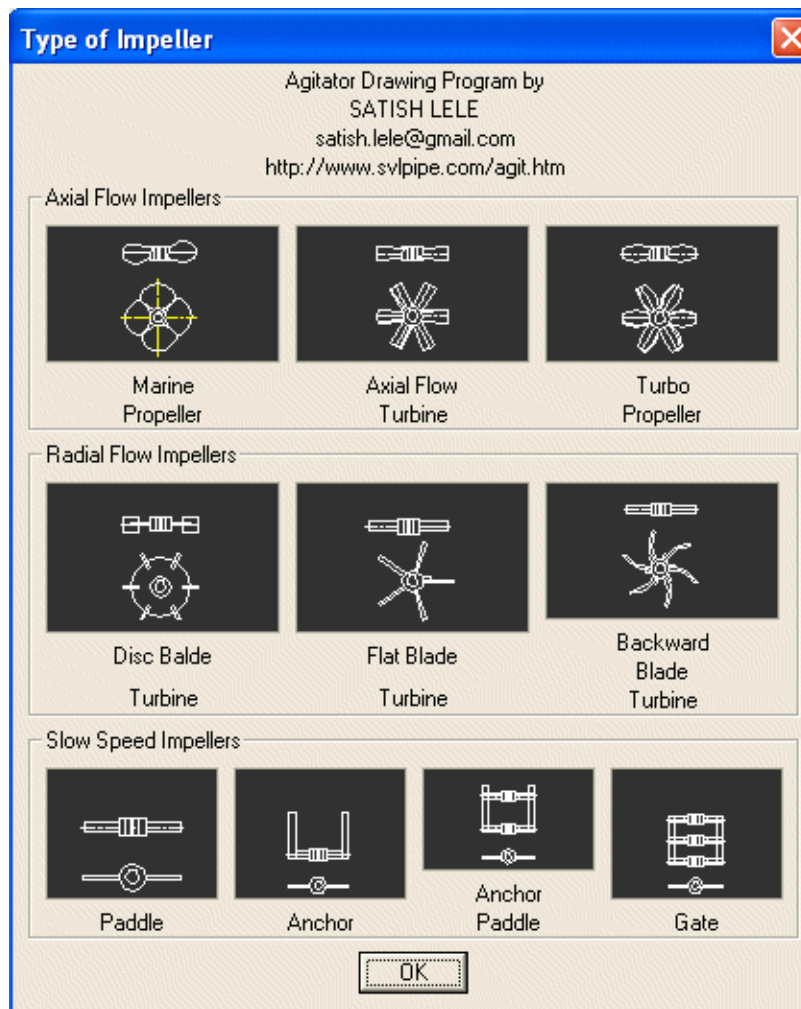


You can design, create a drawing or exit/quit
If you select drawing option

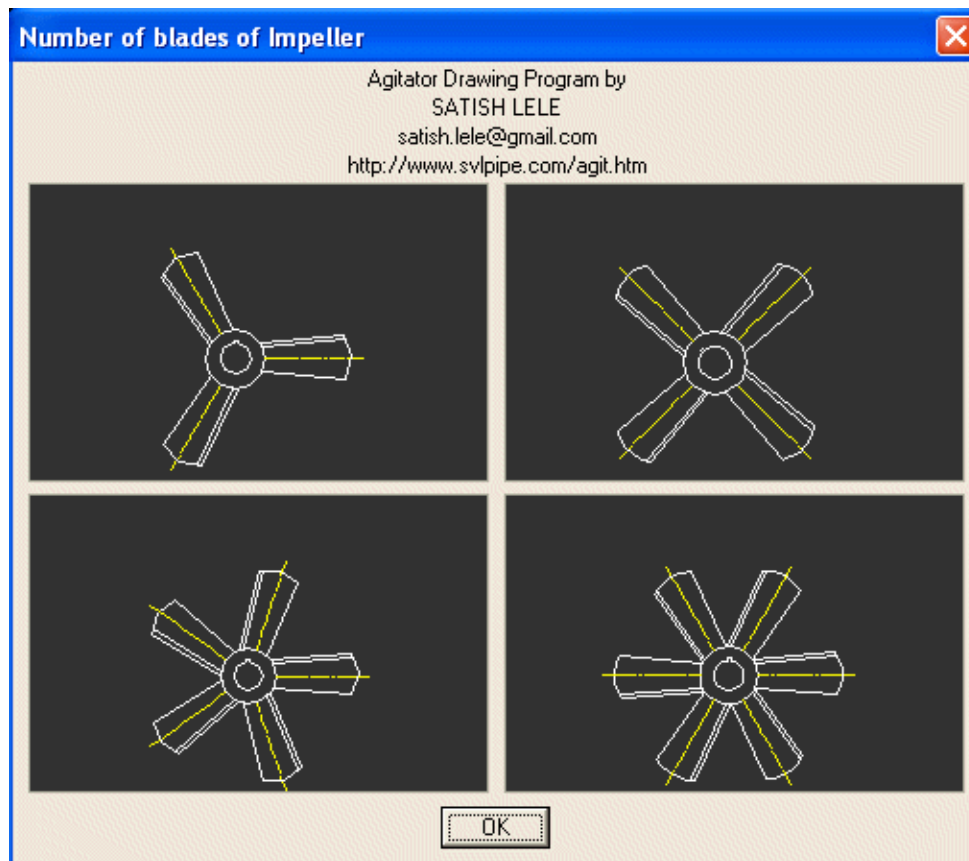
If you select Drawing option:



You can select the first tag number in this drawing. If this drawing is continuation of another drawing, first tag number will be the next number after the last number in earlier drawing.



You can select the impeller.



For Marine Propeller you can select 3 or 4 blades. For Axial Flow Turbine, TurboProp, Flat Balde turbine and Disc Blade turbine you can select 3 to 6 blades. For Backward Blade Turbine you can select 2 to 6 blades. For Paddle, Anchor, Anchor/Paddle or Gate you can select only 2 blades.



You can have a bottom bearing for shaft, if the shaft is very long. It effectively reduces shaft length to half for design calculations. Due to this shaft diameter is also reduced.

Axial Flow Impeller Data:

Agitator Drawing Program by

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<http://www.svlpipe.com/agit.htm>

A = Shaft Diameter :	55	Blade Thickness :	8
B = Hub Diameter :	105	G = Width of Key :	10
C = Hub Height :	50	Length of Key :	50
D = Impeller Diameter :	400	Thickness of Key :	10
E = Impeller Base Height :	38	Dia of Grub screw :	6
F = Impeller End Height :	50		

OK

Program automatically calculates all the demensions and shows in this table. You can accept the same or change sizes for parts of Impeller.

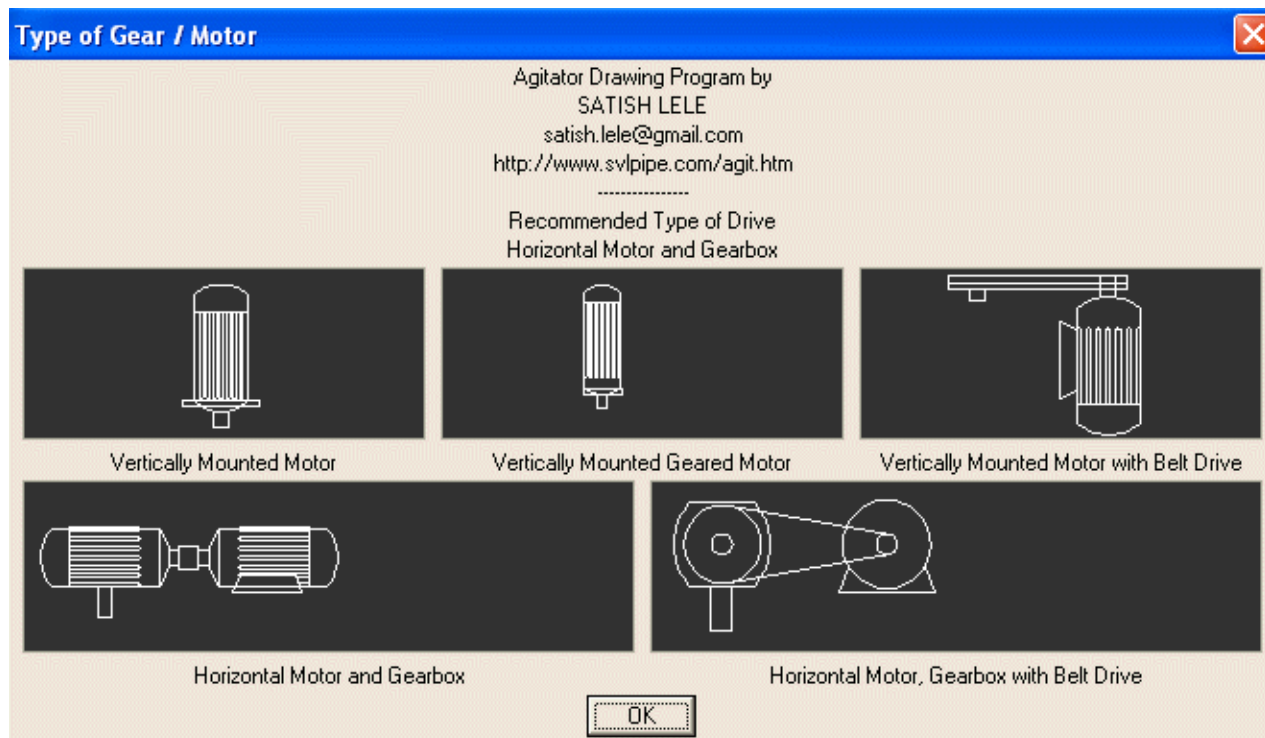
The image displays three separate dialog boxes from a software application titled "Agitator Drawing Program by SATISH LELE". Each dialog box has a blue title bar with a close button (X) and contains the same header text: "Agitator Drawing Program by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm".

- Select Motor Horse Power:** This dialog box contains a vertical list of radio buttons for selecting motor power: 1 HP, 2 HP, 3 HP, 5 HP (selected), 7.5 HP, 10 HP, 15 HP, 20 HP, 25 HP, 30 HP, 40 HP, and 50 HP. An "OK" button is at the bottom.
- Select Motor Speed RPM:** This dialog box contains a vertical list of radio buttons for selecting motor speed: 1500 RPM (selected), 1000 RPM, and 750 RPM. An "OK" button is at the bottom.
- Select Size of GearBox:** This dialog box contains a vertical list of radio buttons for selecting gearbox size: Size 112, Size 162, Size 200 (selected), Size 237, Size 287, Size 337, Size 400, Size 450, Size 500, Size 600, Size 700, Size 800, Size 900, Size 1000, Size 1100, Size 1200, and Size 1400. An "OK" button is at the bottom.

Program for Design and Drawing of Agitator / Mixer shows recommended HP of motor, RPM of motor and size of gearbox. You can select Horse Power of Motor, Speed (RPM) of Motor and size of gearbox. If you have selected Geared motor you need not select RPM and gearbox size.

An "AutoCAD Message" dialog box with a blue title bar and a close button (X). The message text reads: "Drive unit recommended Horizontal Motor and Gearbox OR Verically Mounted Geared Motor". An "OK" button is located at the bottom.

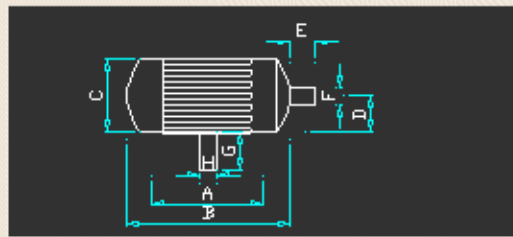
Program for Design and Drawing of Agitator / Mixer shows best possible combination based on rotational speed of agitator and gear ratio of gearbox.



You can still select the Drive unit.

Gear Box data:

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Gear Box data:

A = C to C of Bolts : 410

B = Length of Gear Box : 210

C = Total height of Gear Box : 210

Input Shaft data :

D = CL height : 100

E = Length : 100

F = Diameter : 29

Output Shaft data:

G = Length : 100

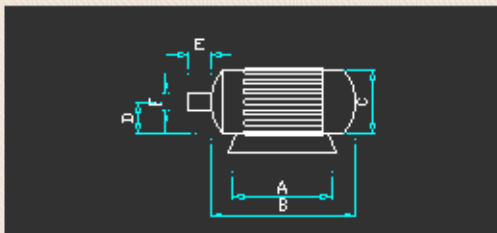
H = Diameter : 33

OK

You can select sizes for parts of Gear Box. The default values are based on standard gearboxes.

Motor data:

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Motor data:

A = C to C of Bolts :

B = Length of Motor :

C = Total height of Motor :

Shaft data:

D = CL height :

E = Length :

F = Diameter :

OK

You can select sizes for parts of Motor. The default values are based on standard motors,

Agitator Drawing

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Please enter Drawing data:

Clients Name :

Designed by:

Drawn by:

Checked by:

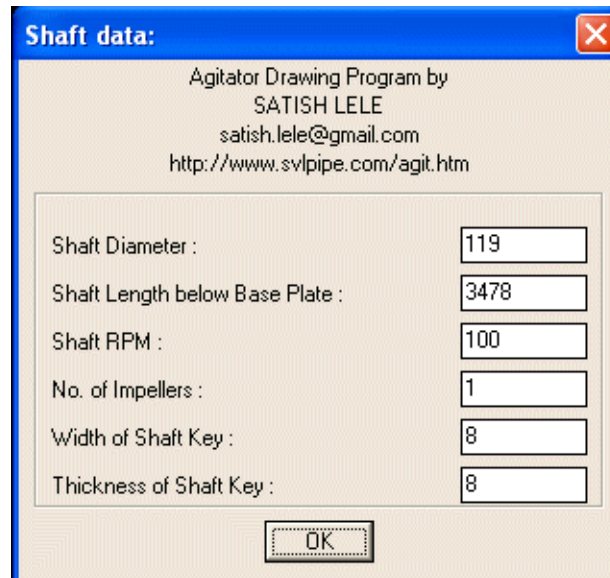
Appd by:

Date:

Drawing No.:

OK

You can enter the data generally entered in Title Block. Current date is automatically displayed. You can enter drawing number. The drawing will be saved with this number.



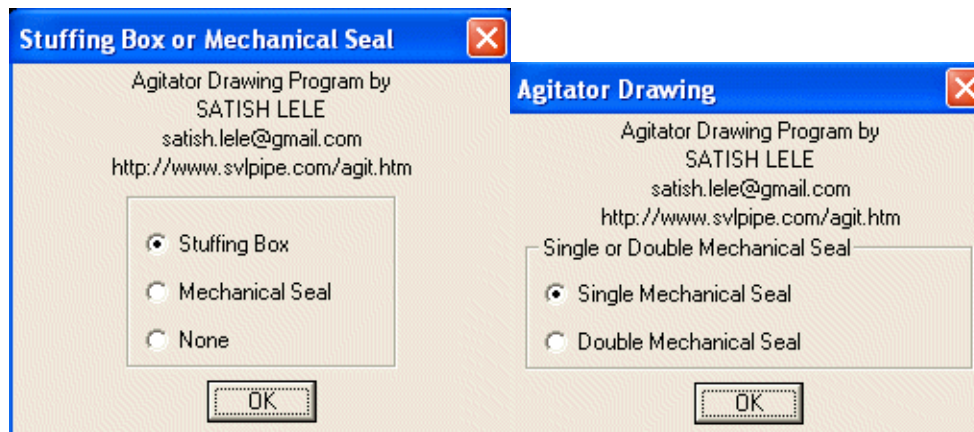
Shaft data:

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Shaft Diameter :	119
Shaft Length below Base Plate :	3478
Shaft RPM :	100
No. of Impellers :	1
Width of Shaft Key :	8
Thickness of Shaft Key :	8

OK

If diameter and length of shaft is calculated by process design calculations, diameter and length of shaft will be automatically indicated. You can round up diameter and length of shaft.



Stuffing Box or Mechanical Seal

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☒ Stuffing Box
☐ Mechanical Seal
☐ None

OK

Agitator Drawing

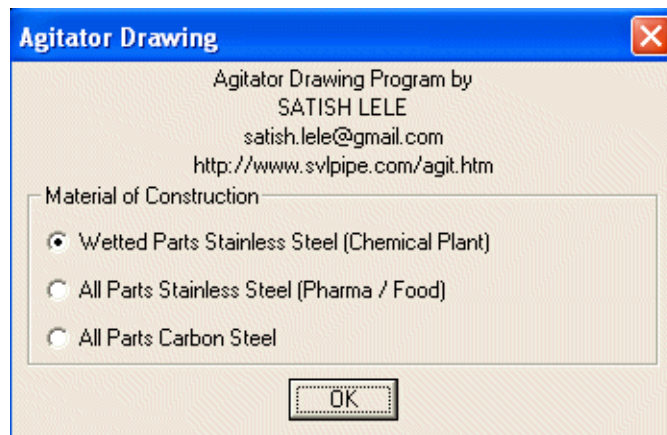
Agitator Drawing Program by
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<http://www.svlpipe.com/agit.htm>

Single or Double Mechanical Seal

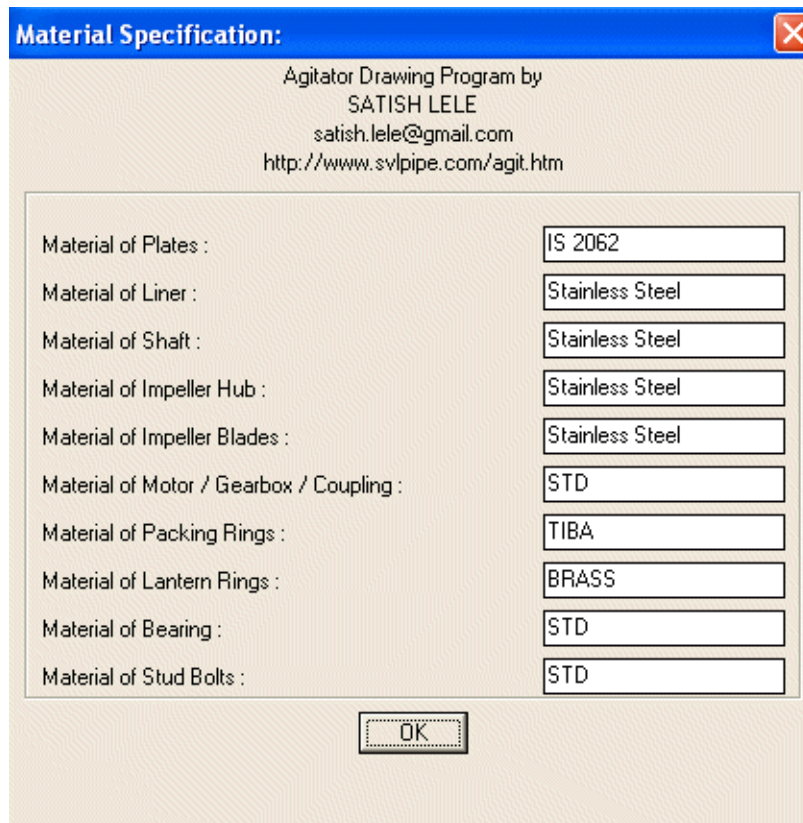
☒ Single Mechanical Seal
☐ Double Mechanical Seal

OK

You can select either Stuffing Box, Mechanical seal or without any seal. If you select Mechanical Seal, you can select Single or Double Mechanical Seal.



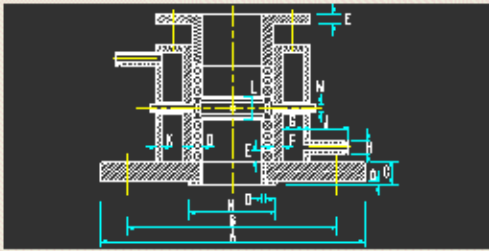
You can select Material of construction for wetted parts. Material of construction can be All Parts of Stainless Steel, Wetted Parts Stainless Steel or All Parts of Carbon Steel. SS liner will be provided on CS base plate if wetted parts are SS.



If you select Stuffing Box, Program indicates appropriate material of construction for parts. You can select / modify material for all parts. If you select Mechanical Seal, Program indicates appropriate material of construction for parts. You can select / modify material for all parts.

Stuffing Box data:

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**Liner data:**

N = Liner Width :
O = Liner Thickness :

Base Plate data:

A = Outer Diameter :
B = Bolt Circle Diameter :
C = Thickness :

Gland Packing data:

Number above Lantern, (Max 6) :
D = Thickness :
E = Height :
Number below Lantern, (Max 8) :

Stuffing Box data :

F = Thickness of Plate of Stuffing Box :
G = Width of Cooling Jacket :
H = Dia of CW Nipple :
J = Length of CW Nipple :
K = Thickness of Plate of Cooling Jacket :

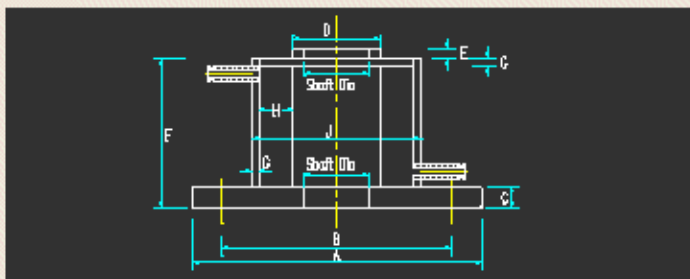
Lantern Ring data :

L = Height :
M = Dia of Grease Nipple :

If you select Stuffing Box, with respect to diameter of shaft, all the dimensions for Stuffing Box will be calculated and indicated by Program for Drawing of Agitator / Mixer. You can change any value.

Mechanical Seal data:

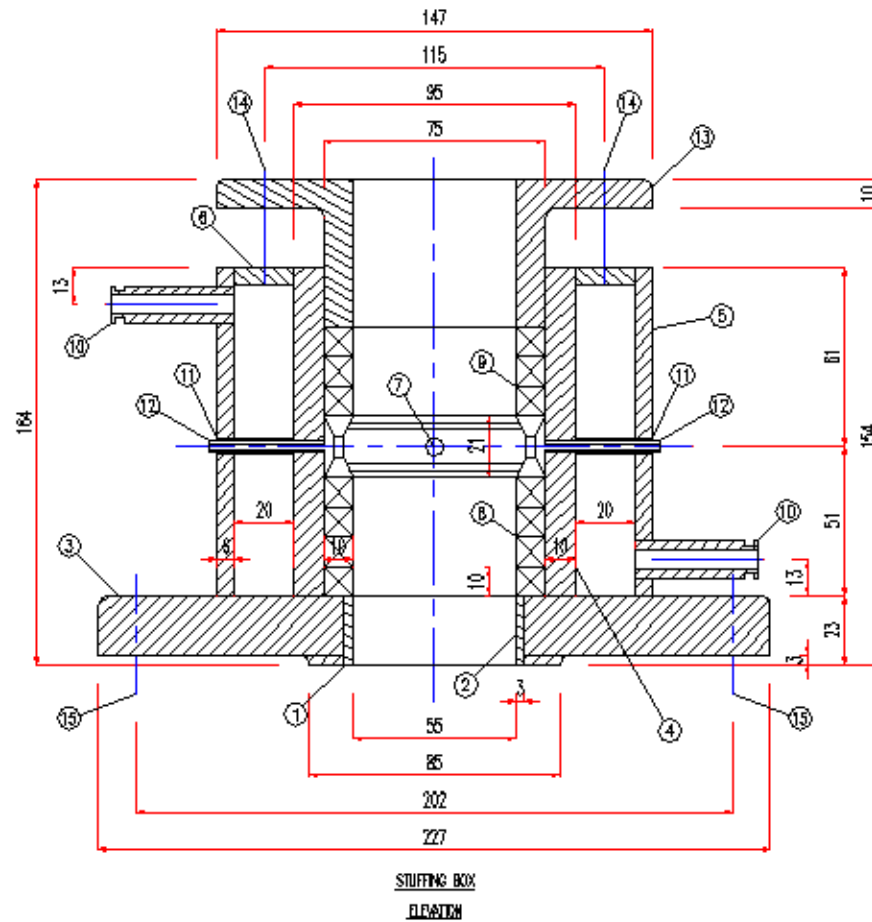
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**Base Plate data:**

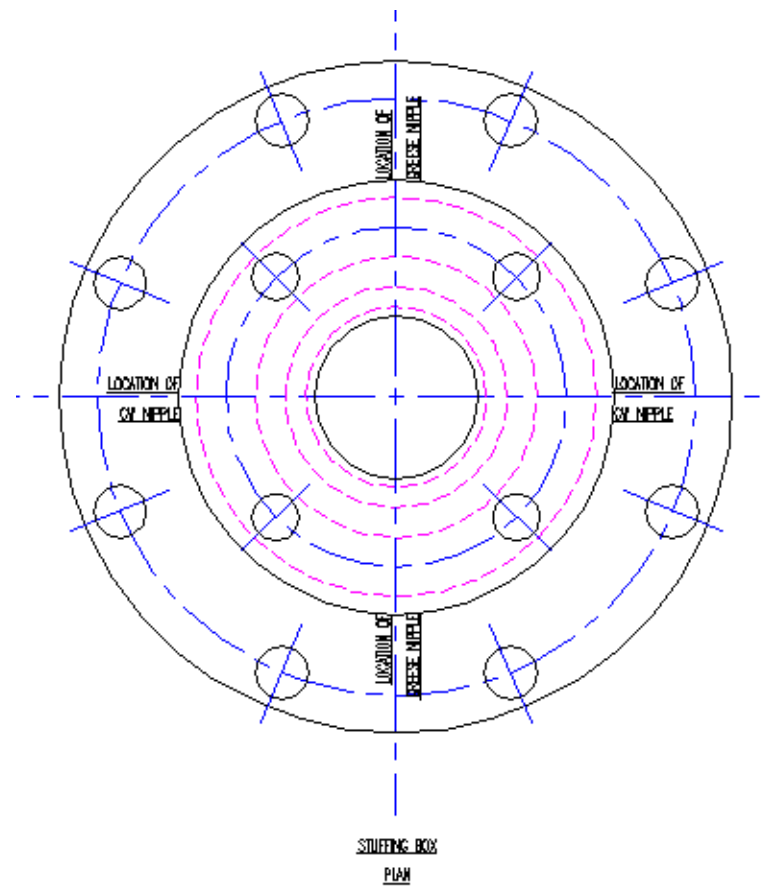
A = Outer Diameter :
B = Bolt Circle Diameter :
C = Thickness :

D = Diameter of Top Ring :
E = Height of Top Ring :
F = Total Height :
G = Thickness of Plates :
H = Width of Cooling Jacket :
J = Diameter of Cover :
Number of Bolts :
Diameter of Bolt Holes :
Dia of CW Nipple :
Length of CW Nipple :

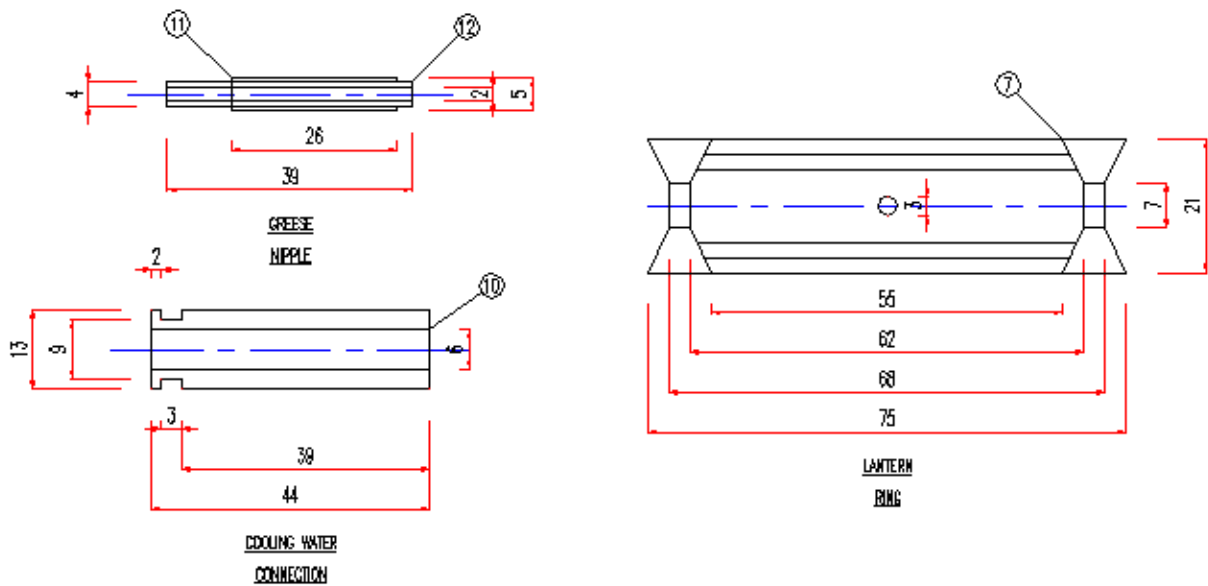
If you select Mechanical Seal, with respect to diameter of shaft, all the dimensions for Mechanical Seal will be calculated and indicated by Program for Drawing of Agitator / Mixer. You can change any value.



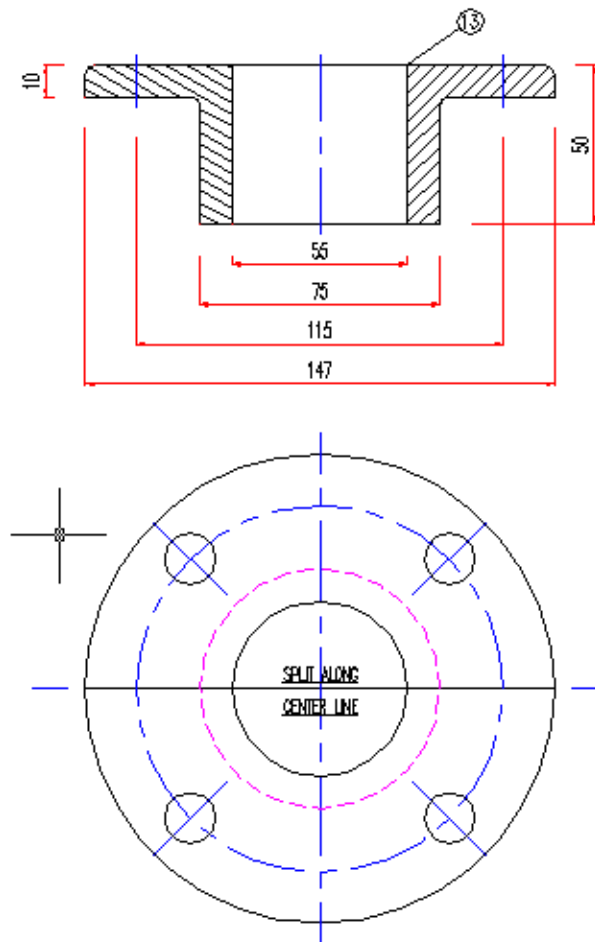
It draws Elevation of Stuffing Box. It shows all the dimensions.



Under elevation it draws Plan of Stuffing Box.



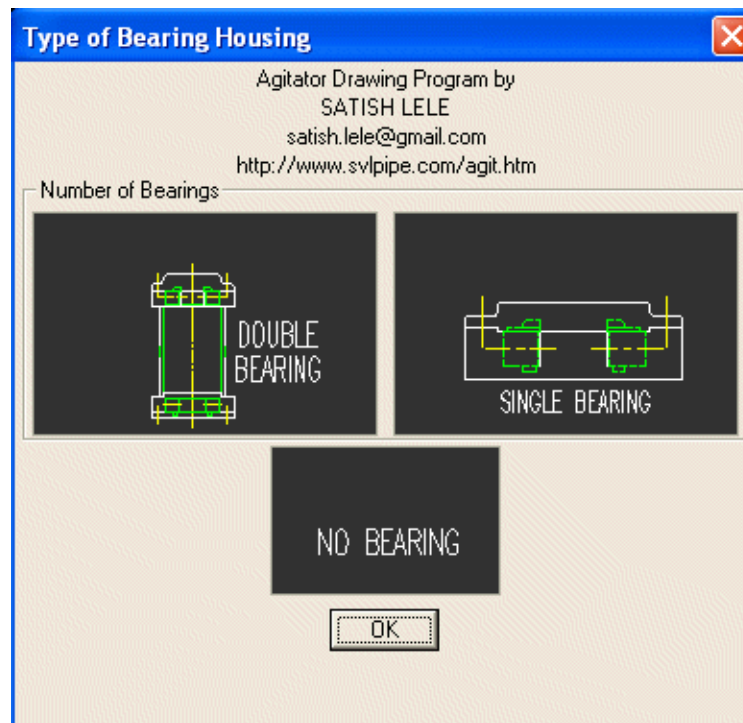
Details of smaller parts of Stuffing Box.



Elevation and Plan of top pressure ring.

15	Base Plate Stud Bolts / Nuts	8	STD	16(Dia) 39(Lg)	0.52
14	Top Cover Stud Bolts / Nuts	4	STD	16(Dia) 39(Lg)	0.26
13	Stuffing Box Top Split Cover	2	CS	147(OD) 55(ID) 20(Lg)	3.04
12	Grease Nipples	2	CS	4(OD) 2(ID) 39(Lg)	0.01
11	Grease Nozzles	2	CS	5(OD) 4(ID) 26(Lg)	0.00
10	Cooling Water Nozzles	2	CS	13(OD) 8(ID) 42(Lg)	0.06
9	Upper Packing Rings	3	TIBA	75(OD) 55(ID) 10(Ht)	0.06
8	Lower Packing Rings	4	TIBA	75(OD) 55(ID) 10(Ht)	0.08
7	Lantern Ring	1	BRASS	75(OD) 55(ID) 21(Th)	0.35
6	Jacket Cover Plate	1	CS	135(OD) 95(ID) 6(Th)	0.35
5	Jacket Shell Plate	1	CS	147(OD) 135(ID) 111(Lg)	2.40
4	Stuffing Box Shell Plate	1	CS	95(OD) 75(ID) 111(Lg)	2.42
3	Stuffing Box Base Plate	1	CS	227(OD) 55(ID) 20(Th)	6.21
2	Stuffing Box Shaft Liner	1	SS	61(OD) 55(ID) 23(Lg)	0.10
1	Stuffing Box Base Liner	1	SS	85(OD) 61(ID) 3(Th)	0.07
No	Description	Qty	Material	Size	Wt Kgs

Bill of material for the parts of Stuffing Box.



You can select type of Bearing Housing. Bearing Housing can be made up of 2 bearings or only 1 bearing. You can also have a shaft without any bearing on shaft.

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OD of Top Bearing : 97

ID of Top Bearing : 47

ID should be < or = indicated

Height of Top Bearing : 25

OD of Bottom Bearing : 51

ID of Bottom Bearing : 51

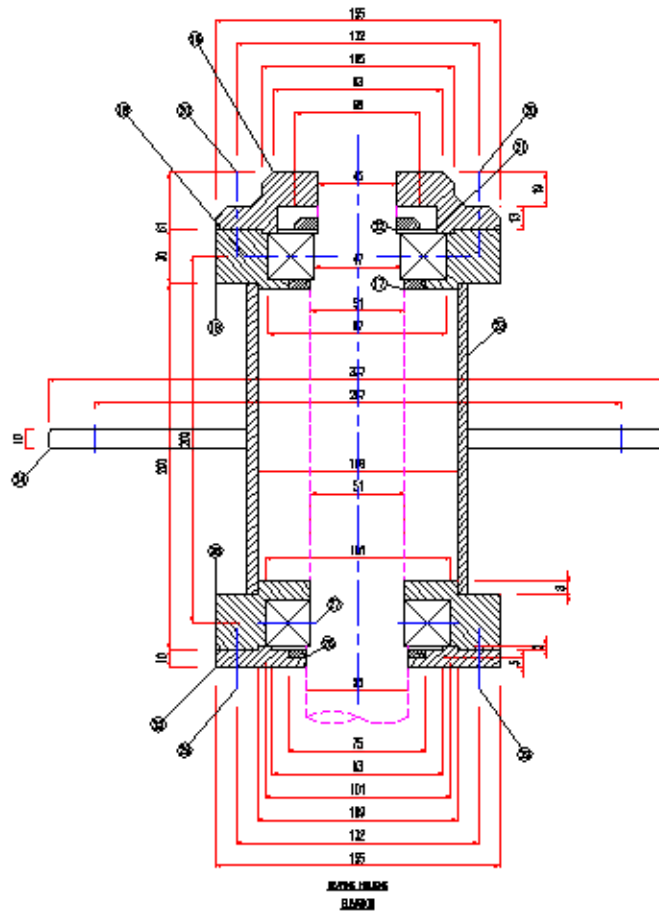
ID should be < or = indicated

Height of Bottom Bearing : 25

Gap between CL of two Bearings : 200

OK

For a bearing housing having 2 bearings, all the dimensions will be calculated and indicated by Program for Design and Drawing of Agitator / Mixer. You may change some of these.



Double Bearing Housing Assembly.

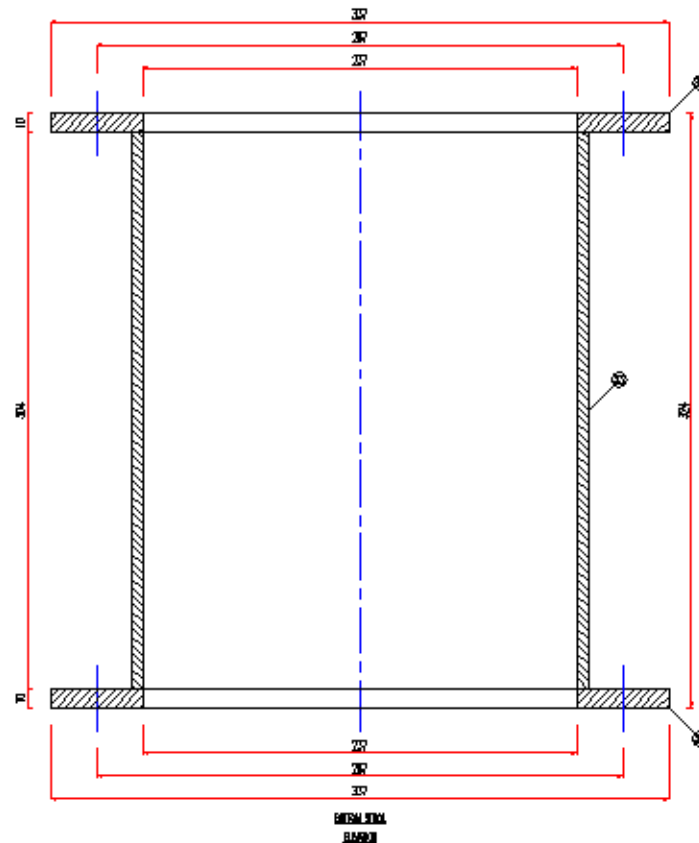
Stool data:

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ID of Pipe Stool :	257	OD of Top / Bottom Flanges :	357
Calculated as per OD of Stuffing Box		Calculated as per OD of Stuffing Box	
Thickness of Pipe Stool :	6	PCD of Top / Bottom Flanges :	307
		Calculated as per OD of Stuffing Box	
		Thickness of Flanges :	10

OK

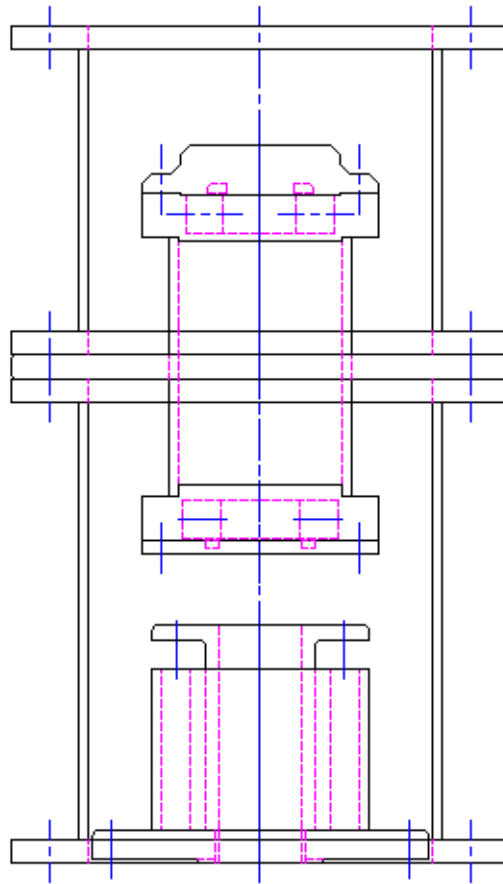
The dimensions of top and bottom stool will be calculated and indicated by Program for Design and Drawing of Agitator / Mixer. You may change or round up some of these.



Drawing of Stool.

No	Description	Qty	Material	Size	Total Weight	Wt Kgs
33	Bottom Stool Shell	1	CS	249(OD) 237(ID) 304(Lg)		11.35
32	Bottom Stool Flanges	2	CS	337(OD) 237(ID) 10(Th)		7.35
31	Top Stool Shell	1	CS	249(OD) 237(ID) 190(Lg)		7.09
30	Top Stool Flanges	2	CS	337(OD) 237(ID) 10(Th)		7.35
29	Lower Cover Stud Bolts / Nuts	4	STD	6(Dia) 33(Lg)		0.03
28	Lower Bearing Casing	1	CS	155(OD) 51(ID) 37(Th)		5.08
27	Lower Bearing	1	STD	101(OD) 51(ID) 25(Ht)		1.22
26	Lower Bearing O Ring	1	RUBBER	75(OD) 55(ID) 5(Th)		0.01
25	Lower Bearing Cover	1	CS	155(OD) 55(ID) 10(Th)		1.34
24	Support Ring	1	CS	337(OD) 121(ID) 10(Th)		6.33
23	Bearing Casing Channel	1	CS	121(OD) 109(ID) 170(Th)		3.00
22	Lock Nut	1	CS	68(OD) 43(ID) 3(Th)		0.06
21	Spring Washer	1	CS	87(OD) 43(ID) 2(Th)		0.07
20	Top Cover Stud Bolts / Nuts	4	STD	6(Dia) 46(Lg)		0.04
19	Top Bearing Casing	1	CS	155(OD) 51(ID) 30(Th)		4.06
18	Top Bearing	1	STD	97(OD) 47(ID) 25(Ht)		1.15
17	Top Bearing O Ring	1	RUBBER	75(OD) 51(ID) 5(Th)		0.01
16	Top Bearing Cover	1	CS	155(OD) 43(ID) 33(Th)		4.72

Bill of material for the parts of Bearing Housing and Stool.



Assembly of Stuffing Box, Bearing Housing, and Top and Bottom Stools.

Base Plate data:

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OD of Base Plate :
Matches with OD of stool

PCD of Stool Flanges :
Matches with PCD of stool

Thickness of Base Plate :

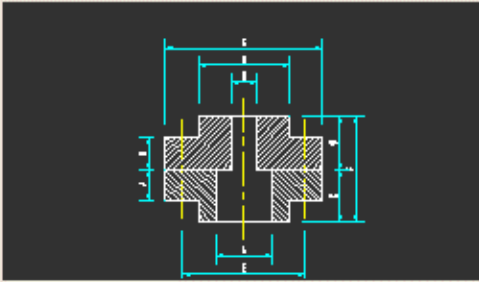
Liner Thickness :
Matches with thickness of Stuffing Box

Liner Width :
Matches with Width of Stuffing Box

You can select sizes for Base Plate. You may change or round up some of these.

Rigid Coupling data:

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A = OD of Agitator Shaft : 39

B = OD of Top Shaft : 18

C = OD of Rigid Coupling : 115

D = Collar OD of Rigid Coupling : 67

E = PCD of Rigid Coupling : 90

F = Length of Rigid Coupling : 77

G = Length of Top Coupling : 39

H = Thickness of Top Flange : 24

J = Length of Bottom Coupling : 38

K = Thickness of Bottom Flange : 23

OK

You can select sizes for Rigid Coupling.

In trial mode of Program for Design and Drawing of Agitator / Mixer, you can select values of Radio Button, Image Buttons, Check Boxes and List box, but you can not change values in Edit Boxes.

The dialog boxes in Design mode are different.

Agitator Design Option

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Tank Type Option

☐ Vertical Cylindrical

☒ Rectangular

OK

Program for Design and Drawing of Agitator / Mixer, program asks for type of vessel (Vertical Cylindrical or Rectangular).



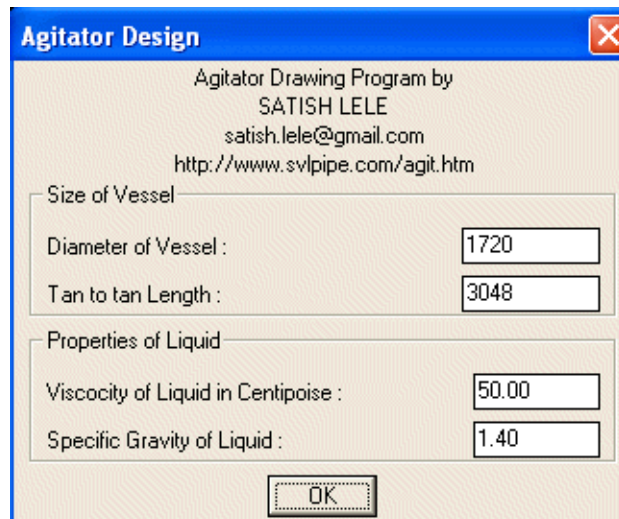
The screenshot shows a Windows-style dialog box titled "Agitator Design". At the top, it says "Agitator Drawing Program by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this, there are two sections: "Size of tank" and "Properties of Liquid". The "Size of tank" section has three input fields: "Width Of Tank :" with value 1000, "Length of Tank :" with value 1500, and "Height of Tank :" with value 1500. The "Properties of Liquid" section has two input fields: "Viscosity of Liquid in Centipoise :" with value 50.00 and "Specific Gravity of Liquid :" with value 1.40. At the bottom center is an "OK" button.

Size of tank	
Width Of Tank :	1000
Length of Tank :	1500
Height of Tank :	1500

Properties of Liquid	
Viscosity of Liquid in Centipoise :	50.00
Specific Gravity of Liquid :	1.40

Program for Design and Drawing of Agitator / Mixer asks for size of Rectangular tank, Width, Length and Depth, and properties of liquid.

OR

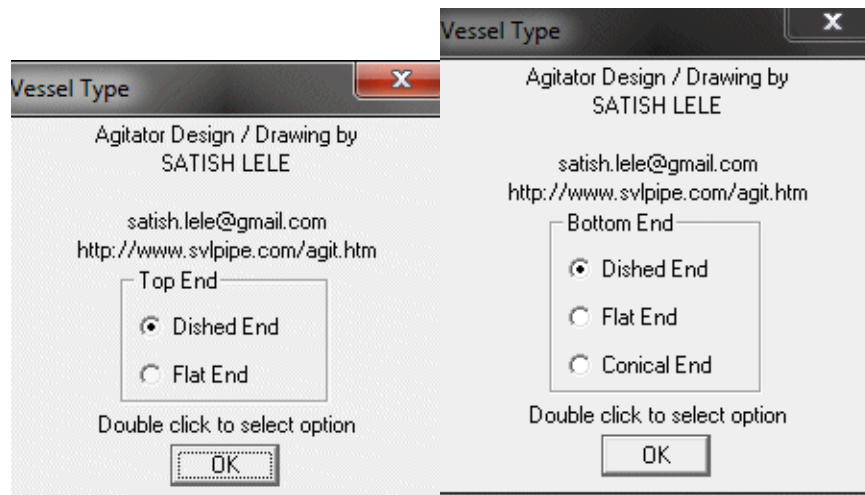


The screenshot shows a Windows-style dialog box titled "Agitator Design". At the top, it says "Agitator Drawing Program by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this, there are two sections: "Size of Vessel" and "Properties of Liquid". The "Size of Vessel" section has two input fields: "Diameter of Vessel :" with value 1720 and "Tan to tan Length :" with value 3048. The "Properties of Liquid" section has two input fields: "Viscosity of Liquid in Centipoise :" with value 50.00 and "Specific Gravity of Liquid :" with value 1.40. At the bottom center is an "OK" button.

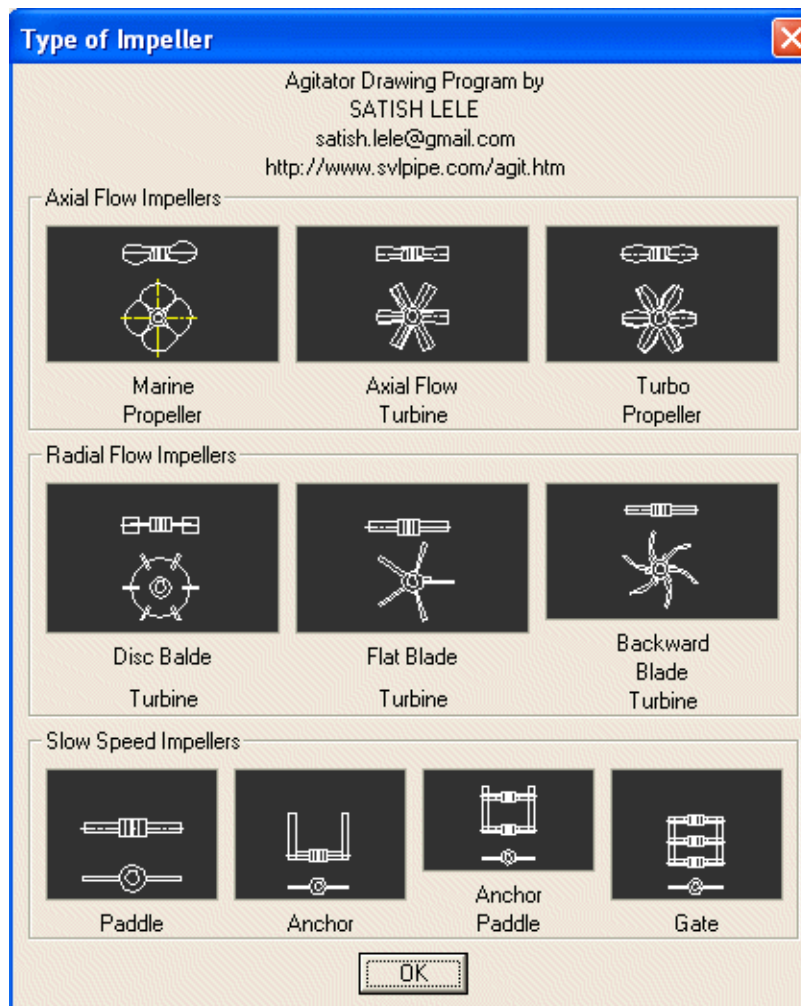
Size of Vessel	
Diameter of Vessel :	1720
Tan to tan Length :	3048

Properties of Liquid	
Viscosity of Liquid in Centipoise :	50.00
Specific Gravity of Liquid :	1.40

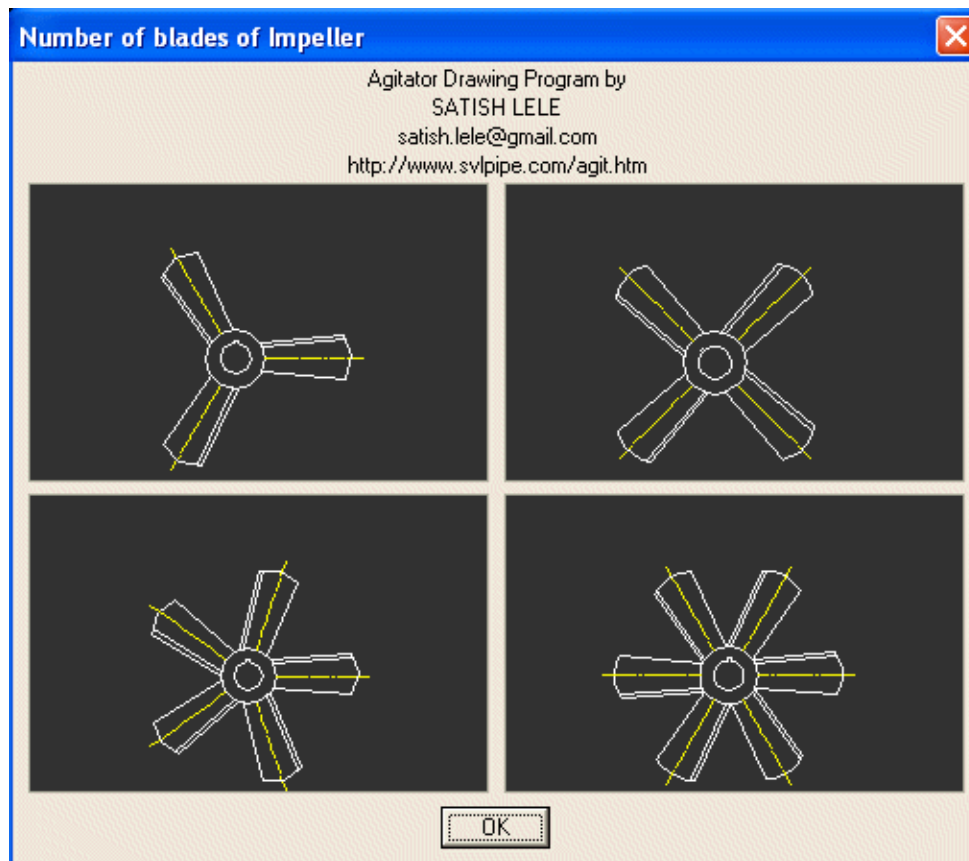
Program for Design and Drawing of Agitator / Mixer asks for Diameter and Tan to Tan Length of vessel and properties of liquid.



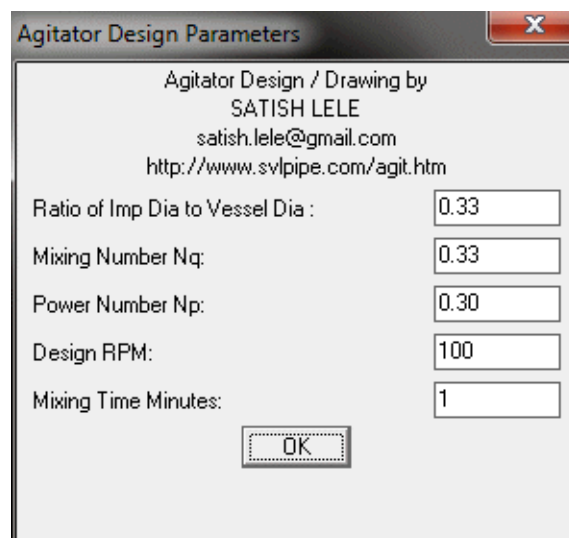
Next it asks for head at top and bottom end: Flat, conical or Torispherical.



It asks you to select type of Imeller.

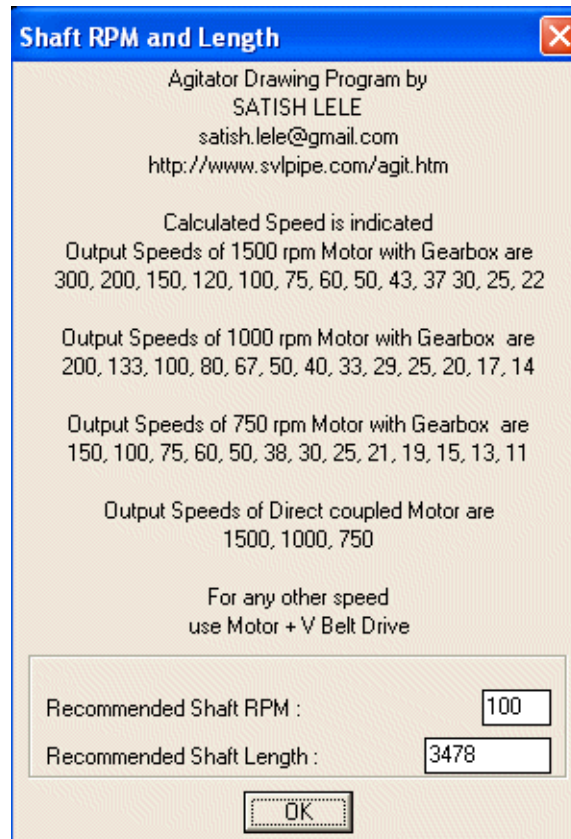


It asks you to select number of blades of Impeller. For Marine Propeller you can select 3 or 4 blades. For Axial Flow Turbine, TurboProp, Flat Balde turbine and Disc Blade turbine you can select 3 to 6 blades. For Backward Blade Turbine you can select 2 to 6 blades. For Paddle, Anchor, Anchor/Paddle or Gate you can select only 2 blades.

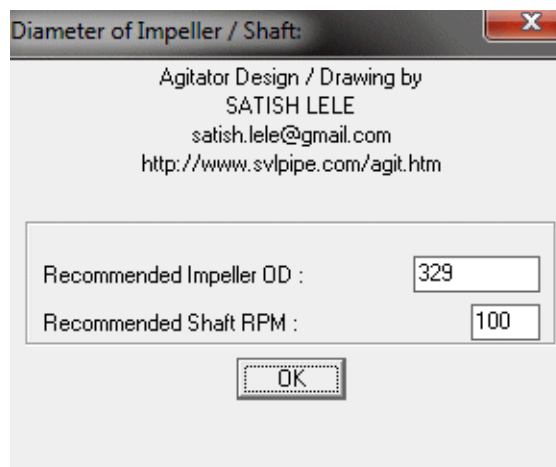


It shows properties of particular impeller. You can change Design RPM and Mixing time. Mixing time decides the Pumping rate of impeller. If mixing

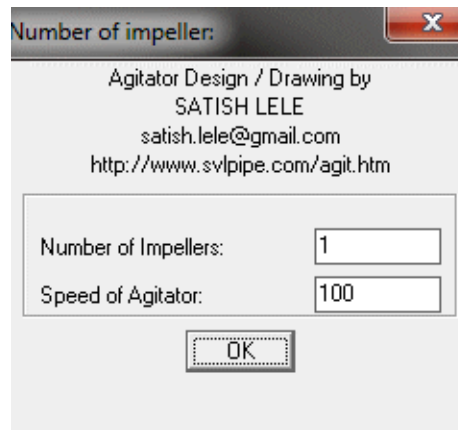
required is vigorous, mixing time should be small. If mild mixing is required mixing time should be high. Entire content of the vessel will be mixed in so many minutes.



Based on Reynold's number and ratio of Impeller dia to Vessel dia, program for Design and Drawing of Agitator / Mixer calculates the desired rotational speed of agitator. Program for Design and Drawing of Agitator / Mixer also calculates length of shaft inside vessel and indicates length of shaft.



The program shows recommended impeller OD and RPM. You can round up OD.



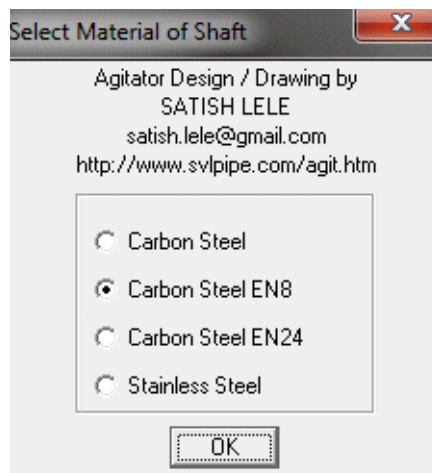
A screenshot of a Windows-style dialog box titled "Number of impeller:". The dialog box has a close button (X) in the top right corner. Inside, it displays the text "Agitator Design / Drawing by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this, there are two input fields: "Number of Impellers:" with the value "1" and "Speed of Agitator:" with the value "100". At the bottom, there is an "OK" button.

Program asks for number of impellers and confirm RPM.



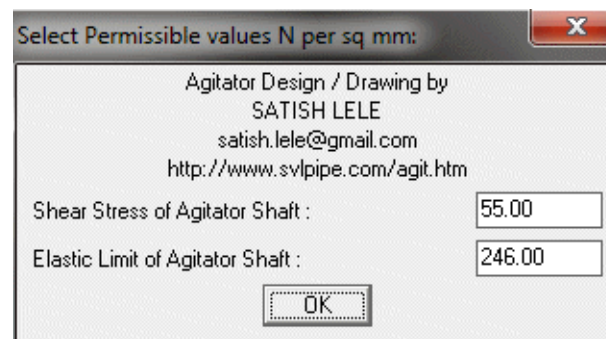
A screenshot of a Windows-style dialog box titled "Select Safety factor for Shaft". The dialog box has a close button (X) in the top right corner. Inside, it displays the text "Agitator Design / Drawing by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this, there is a group box containing four radio button options: "Safety Factor = 1.0" (selected), "Safety Factor = 1.1", "Safety Factor = 1.2", and "Other Value". At the bottom, there is an "OK" button.

Program ask for safety factor for the shaft.



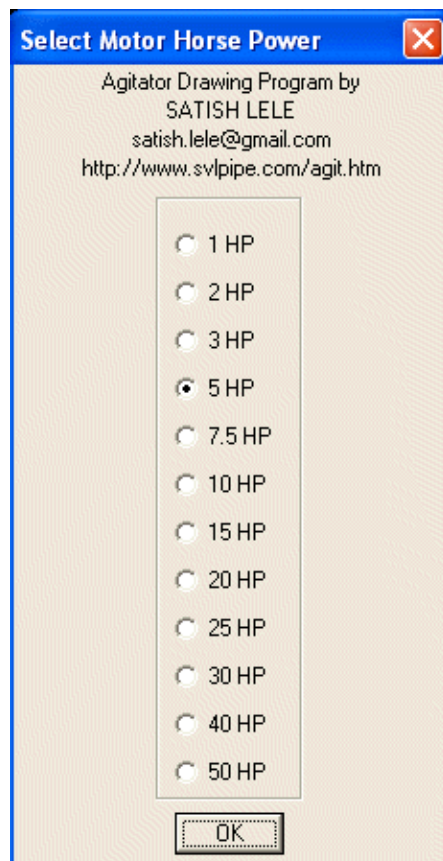
A screenshot of a Windows-style dialog box titled "Select Material of Shaft". The dialog box has a close button (X) in the top right corner. Inside, it displays the text "Agitator Design / Drawing by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this, there is a group box containing four radio button options: "Carbon Steel", "Carbon Steel EN8" (selected), "Carbon Steel EN24", and "Stainless Steel". At the bottom, there is an "OK" button.

Program for Design and Drawing of Agitator / Mixer then asks for material of construction for shaft.



A dialog box titled "Select Permissible values N per sq mm:" with a close button (X) in the top right corner. The text inside reads: "Agitator Design / Drawing by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this, there are two input fields: "Shear Stress of Agitator Shaft :" with the value "55.00" and "Elastic Limit of Agitator Shaft :" with the value "246.00". At the bottom center is an "OK" button.

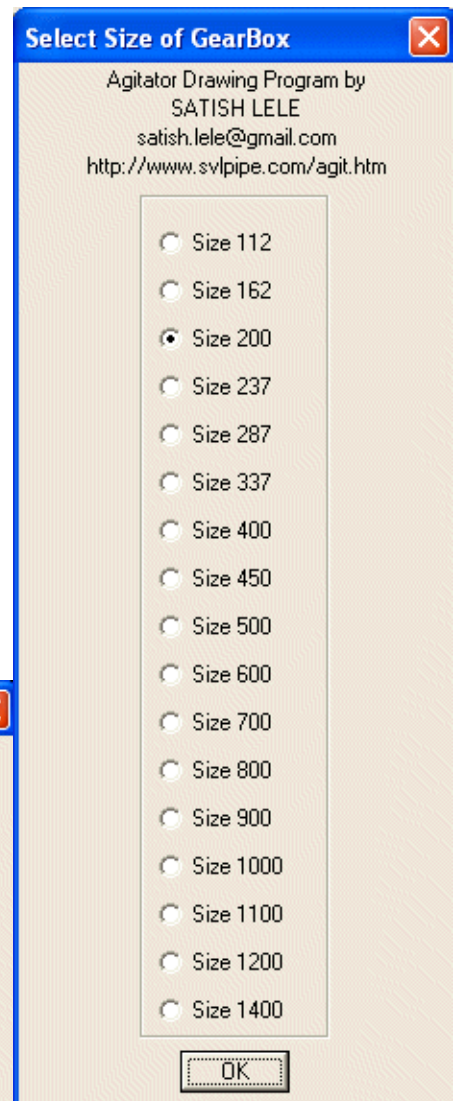
Program ask for Shear Stress and Eleastic limit for the shaft. Values for the shaft material are automatically filled in.



A dialog box titled "Select Motor Horse Power" with a close button (X) in the top right corner. The text inside reads: "Agitator Drawing Program by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this is a list of radio buttons for motor power: 1 HP, 2 HP, 3 HP, 5 HP (selected), 7.5 HP, 10 HP, 15 HP, 20 HP, 25 HP, 30 HP, 40 HP, and 50 HP. At the bottom center is an "OK" button.



A dialog box titled "Select Motor Speed RPM" with a close button (X) in the top right corner. The text inside reads: "Agitator Drawing Program by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this is a list of radio buttons for motor speed: 1500 RPM (selected), 1000 RPM, and 750 RPM. At the bottom center is an "OK" button.



A dialog box titled "Select Size of GearBox" with a close button (X) in the top right corner. The text inside reads: "Agitator Drawing Program by SATISH LELE", "satish.lele@gmail.com", and "http://www.svlpipe.com/agit.htm". Below this is a list of radio buttons for gear box size: Size 112, Size 162, Size 200 (selected), Size 237, Size 287, Size 337, Size 400, Size 450, Size 500, Size 600, Size 700, Size 800, Size 900, Size 1000, Size 1100, Size 1200, and Size 1400. At the bottom center is an "OK" button.

Program for Design and Drawing of Agitator / Mixer shows recommended HP of motor, RPM of motor and size of gearbox. You can select Horse Power of Motor, Speed (RPM) of Motor and size of gearbox. If you have selected Geared motor you need not select RPM and gearbox size.



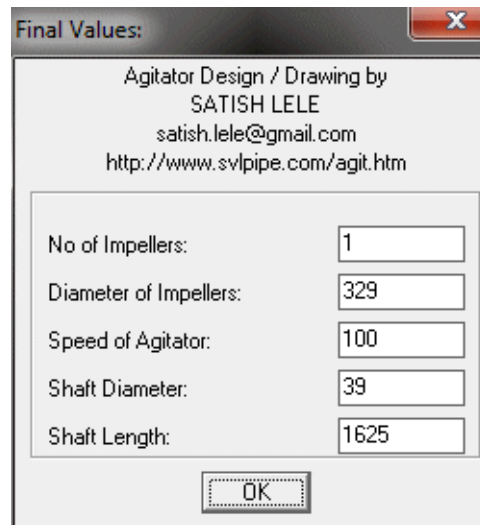
Program for Design and Drawing of Agitator / Mixer shows best possible combination based on rotational speed of agitator and gear ratio of gearbox.



You can still select the Drive unit.



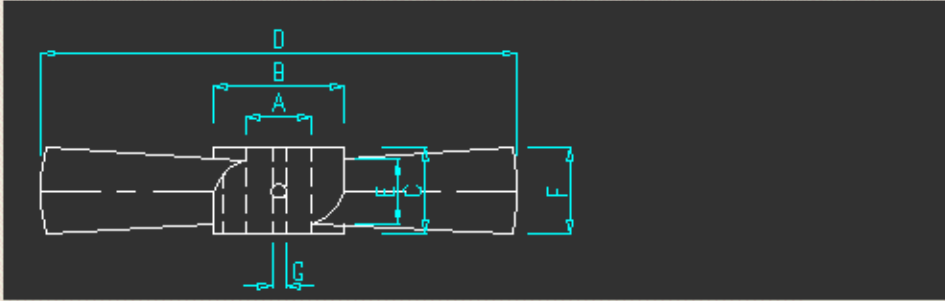
You can have a bottom bearing for shaft, if the shaft is very long. It effectively reduces shaft length to half for design calculations. Due to this shaft diameter is also reduced.



Program shows final values that will be used for drawing.

Axial Flow Impeller Data:

Agitator Drawing Program by
SATISH LELE
satish.lele@gmail.com
<http://www.svlpipe.com/agit.htm>



The diagram shows a cross-section of an axial flow impeller. Dimension A is the shaft diameter. Dimension B is the hub diameter. Dimension C is the hub height. Dimension D is the impeller diameter. Dimension E is the impeller base height. Dimension F is the impeller end height. Dimension G is the width of the key.

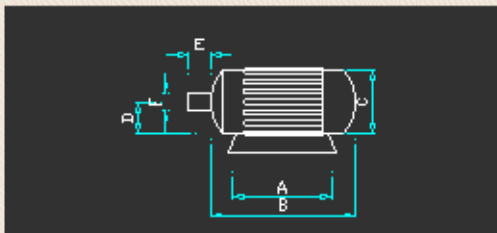
A = Shaft Diameter :	55	Blade Thickness :	8
B = Hub Diameter :	105	G = Width of Key :	10
C = Hub Height :	50	Length of Key :	50
D = Impeller Diameter :	400	Thickness of Key :	10
E = Impeller Base Height :	38	Dia of Grub screw :	6
F = Impeller End Height :	50		

OK

Program automatically calculates all the demensions and shows in this table.
You can accept the same or change sizes for parts of Impeller.

Motor data:

Agitator Drawing Program by
SATISH LELE
satish.lele@gmail.com
<http://www.svlpipe.com/agit.htm>



Motor data:

A = C to C of Bolts :

B = Length of Motor :

C = Total height of Motor :

Shaft data:

D = CL height :

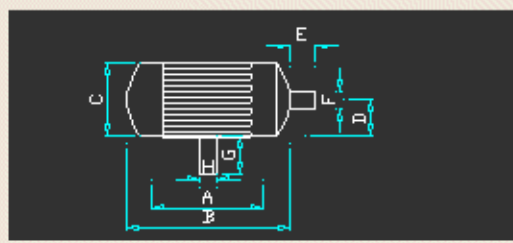
E = Length :

F = Diameter :

You can select sizes for parts of Motor. The default values are based on standard motors.

Gear Box data:

Agitator Drawing Program by
SATISH LELE
satish.lele@gmail.com
<http://www.svlpipe.com/agit.htm>



Gear Box data:

A = C to C of Bolts :

B = Length of Gear Box :

C = Total height of Gear Box :

Input Shaft data:

D = CL height :

E = Length :

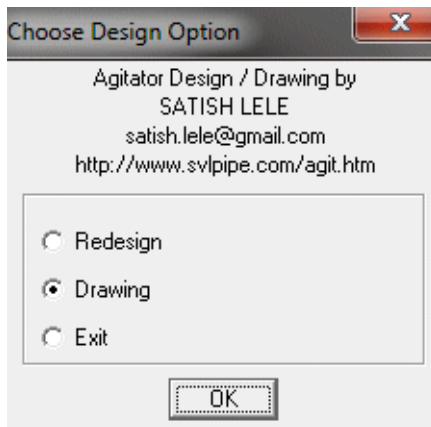
F = Diameter :

Output Shaft data:

G = Length :

H = Diameter :

You can select sizes for parts of Gear Box. The default values are based on standard gearboxes.



You can select to redesign, draw or exit. If you select drawing option its starts Dialog Boxes for drawing.

Design of Agitators / Mixers for Vessels with Drawing

For Agitators / Mixers, factors to be considered for design are

1. Type of Agitation: Agitation can be Vigourous, Moderate or Mild. For Vigourous mixing, time required for total mixing can be few seconds. For Moderate mixing, time required for total mixing can be few minutes. For Mild mixing, time required for total mixing can be few hours. Degree of agitation increases with increase in number of revolutions of agitator and increase in impeller diameter.
2. Type of Agitator: Generally it is mounted vertically at the top of the tank. This is the normal practice for mounting an agitator in small and medium size tanks. It is also mounted horizontally from side of a tank, called side entering agitator, for very large diameter storage tanks.
3. Pattern of Circulation: Axial or Radial. When a vessel is heated or cooled by coil or jacket, axial flow is preferred. When the contents are to be mixed, radial circulation is preferred. When both patterns of circulation are required, radial flow impeller is installed at the bottom of agitator shaft, while radial flow impeller is installed at the center of agitator shaft.

4. Location of agitator in the equipment: Generally it is centrally located for better flow pattern. It is located off-center if some part of vessel is occupied by internal coil or some other internal.
5. Shape and size of tank: Vertical cylindrical vessel is the best type for installing an agitator. However, it is also installed in vertical rectangular tank, in water and waste water treatment tanks.
6. Impellers: There can be following simple Impellers. Marine Propeller, Axial Flow Turbine, Turbo Propeller, Disc Blade turbine, Flat Blade Turbine, Backward turned turbine, Paddle, Anchor, Anchor/Paddle or Gate. Main parts of impeller are hub and blades. Hub is installed on the shaft by shaft key and grub screw. Impellers may be one piece or split into two or many pieces, bolted together. Marine Propeller is generally a casting. All other impellers are of fabricated construction and can be either Bolted or Welded type.
7. Diameter of Agitator: It depends on diameter of tank. It is generally $\frac{1}{3}$ rd the diameter of the tank for

- Marine Propeller
- Axial flow turbine
- Turbo Propeller
- Disc Blade turbine
- Flat Blade turbine
- Backward Blade turbine

It is generally 80% of the diameter of the tank for

- Paddle
- Anchor
- Anchor/Paddle
- Gate

8. Baffles / Coils: Generally 4 baffles are provided in a vertical cylindrical vessel for good mixing in case of first 6 (axial flow) impellers. For last 4 (radial flow), no baffles are provided. Coils are provided in some vessels, for heating or cooling. Baffles and coil reduce effective diameter of the vessel.

9. Power required for agitation: It depends on diameter of impeller, revolutions of agitator shaft, power number of impeller, number of impellers, density, content of solids and viscosity of liquid.
10. Overhang of shaft and lower fixed bearing: The shaft is supported at the top end by bearing housing assembly. The lateral movement of impeller at the bottom of the shaft, tries to bend the shaft, if shaft is long (more than 3 meters). To avoid this a bottom bearing is provided. It is a non rotating bearing, made of a sleeve of softer metal or plastic material.
11. Type of Seal: Stuffing Box or Mechanical Seal: A sealing arrangement is provided in a closed vessel, along agitator shaft at the top. This does not allow vapours to leak out of vessel, along the rotating shaft. These can be of two types.
- Stuffing Box: This has two shells. The diameter of inner shell is larger than diameter of shaft. 3 or 4 packing rings are installed in this gap at bottom, followed by lantern ring on top and 3 or 4 packing rings on top. Packing rings act as sealant while lantern ring provides lubrication to shaft. The top rings are pressed from top by a ring. Cooling water flows in outer shell, which keeps the packing rings and lantern ring cool. It fits directly on top of closed vessel inside the stool.
 - Mechanical Seal: It is similar to stuffing box, but in this mechanical seals are provided in place of packing rings. Mechanical seal assembly is readily available as one unit. It can have one mechanical seal (Single mechanical seal unit) or two mechanical seals (Double mechanical seal unit). In Double mechanical seal unit, one mechanical seal is at top and one at bottom. These provide better sealing along the agitator shaft. These are used in case of vessels having high vacuum inside or if vapours are corrosive. These are expensive and difficult to maintain.
12. Number of Bearings on Shaft: There can be bearing housings with 2 or 1 bearings. For agitators having short length, there can be no bearing housing.

- Double Bearing Housing: A housing in which 2 ball bearings are installed, called double bearing housing, is preferred as it reduces deflection of shaft. This is normally used for shafts rotating at higher speeds, with Marine Propeller, Axial flow turbine, Turbo Propeller, Disc Blade turbine, Flat Blade turbine, Backward Blade turbine Impellers. One bearing is installed at the top and one at bottom. Arrangement for greasing the bearings is provided for both bearings.
- Single Bearing Housing: A housing in which 1 ball bearing is installed, called single bearing housing, is preferred as it reduces deflection of shaft. This is normally used for shafts rotating at slow speeds, with Paddle, Anchor, Anchor/Paddle, Gate impellers.
- No Bearing Housing

13. Drive Assembly: A number of combinations are possible, based on speed of drive motor and rotational speed of shaft of agitator.

- Vertically mounted motor: It is mounted on top of stool. It is used when rotational speed of shaft of agitator is same as that of motor.
- Vertically mounted geared motor: It is mounted on top of stool. It is used when rotational speed of shaft of agitator is same as that of reducing gear integral with motor.
- Vertically mounted motor with pulleys and V belts: It is mounted on the side of stool. It is used when rotational speed of shaft of agitator is not the same as that of motor. A combination of pulleys of different diameters, with V belts, reduces the rotational speed of shaft of agitator to required speed.
- Directly coupled horizontal gearbox and motor: It is mounted on the top of stool. Gearbox is mounted directly on top of stool and motor is placed on side platform. It is used when rotational speed of shaft of agitator is same as output speed of gearbox.
- Horizontal gearbox and motor coupled by pulleys and V belts: It is mounted on the top of stool. Gearbox is mounted directly on top of

stool and motor is placed on side platform. Pulleys and V belts are used to get exact input speed of gearbox. It then matches rotational speed of shaft of agitator with the output speed of gearbox.

14. Mixing by agitators: It takes place by momentum transfer. Marine Propeller, Axial Flow Turbine, Turbo Propeller, Flat Blade Turbines, have smaller blade area and these rotate at relatively high speeds (100 to 400 RPM). These are used to mix liquids with low viscosity. Agitators having large blade area like Paddle, Anchor, Anchor/Paddle or Gate rotate at lower speeds (40 to 50 RPM). These are used to mix liquids with high viscosity. Top entering agitators are used for smaller size vessels (1,000 to 10,000 liters) and for applications involving higher power requirements per unit volume. Side entering are installed in storage tanks having large diameters (more than 10 meters), with non-corrosive liquids, especially in tanks which store Crude Petroleum.

Type of Agitators and their functions

- Marine Propeller is generally an item produced by casting process in a foundry and it has 3 or 4 blades. Cast agitators have two basic advantages, uniformity of material and hard surface. These have tapering blades, and angle of blade varies from root to tip. This produces maximum axial flow. The diameter of Marine Propeller impeller is 15% to 30% of diameter of tank. These have tip speeds between 300 to 500 meters per minute.
- Axial Flow Turbine, Turbo Propeller and Flat Blade Turbine have blades ranging from 3 to 6. These have tip speeds between 200 to 300 meters per minute. The diameter of impeller is 25% to 60% of tank diameter. For Axial Flow Turbine and Turbo Propeller, the angle of blade varies from 30 degrees (for less viscous liquids) to 60 degrees (for more viscous liquids). Standard angle is 45 degrees. Power requirement increases with higher pitch angle. For Flat Blade Turbine, the length of blade is 25% of diameter, and disk diameter is 60% to 70% of the diameter of impeller.
- Paddle, Anchor, Anchor/Paddle or Gate have only 2 blades. These extend close to the tank wall and have tip speeds between 80 to 150

meters per minute. These push and rotate the liquid in a laminar flow. There is no axial or radial mixing. The width of blade is 1/8th or 1/10th of the agitator diameter.

- There are more complex impeller like helical screws, cones and high speed discs.

15. There can be one or more impellers on shaft. Number of agitators = (Maximum liquid height x average specific gravity) / Diameter of tank. The gap between two impellers = Liquid height / (Number of impellers - 0.5).
16. Most important parameters are diameter and length of agitator shaft and impeller diameter. These are decided by process design calculations.
17. Gland seal can be either Stuffing Box or Mechanical seal. If you select Mechanical Seal, it can be Single or Double Mechanical Seal.
18. Couplings used for connecting agitator shaft to drive shaft is rigid coupling.
19. Bearing housing is used to hold bearings in it. Bearings outside the tank give rigidity against bending of the shaft. There can be double bearings for long shaft, single bearing for shorter shafts. No bearing is generally provided for agitators installed on open tanks. Internal bearings help in holding shaft in position. A bottom bearing is provided for a long shaft.
20. Material of construction for wetted parts can be Stainless Steel, Carbon Steel or other metals and alloys. SS liner is provided on CS base plate if wetted parts are SS.
21. Top and bottom stool is provided for housing Gland and Bearing Housing. Base Plate is provided to install assembly on it.

Process and Mechanical Design of Agitator

To do process design of agitator, first the volume of vessel is calculated. For Vertical Cylindrical Vessels.

Vessel Volume = $(\pi * \text{vessel dia} * \text{vessel dia} * \text{vessel len}) / 4.0$

Agitator Shaft length = vessel length + (vessel dia * 0.25).

For Rectangular Tanks.

Tank Volume = Vessel Length * Vessel Breadth * Vessel Height.

Agitator Shaft length = Vessel Height.

You have to then find out Viscosity and Specific Gravity of Liquid that will be in the vessel.

Based on Viscosity and Specific Gravity of Liquid, design will depend on Reynold's Number.

- If the liquid is very viscous (viscosity = 500 to 1000 cp) the Reynold's Number can be in laminar zone. For this range, Reynold's Number is less than 200.
- If the liquid is less viscous (viscosity = 100 to 500 cp) the Reynold's Number can be in laminar zone. For this range, Reynold's Number is 200 to 10,000.
- If the liquid is not viscous (viscosity = 1 to 100 cp) the Reynold's Number can be in turbulent zone. For this range, Reynold's Number is greater than 10,000.

Based on geometry of vessel, many factors for impeller can be decided.

1. Marine Propeller:

- Agitator speed, RPM of shaft is preferred as 100 or 200 or 300. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 0.3 for 3 bladed and 0.33 for 4 bladed impeller.
- Pumping factor, which decides flow rate of mixing, is 0.33 for 3 bladed and 0.34 for 4 bladed impeller.
- Pumping factor, which decides flow rate of mixing, is 0.33 for 3 bladed and 0.34 for 4 bladed impeller.

2. Axial flow turbine:

- Agitator speed, RPM of shaft is preferred as 100 or 200 or 300. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 1.35 for 3 bladed, 1.4 for 4 bladed, 1.45 for 5 bladed, 1.5 for 6 bladed impeller.
- Pumping factor, which decides flow rate of mixing, is 0.6 for 3 bladed 0.69 for 4 bladed, 0.78 for 5 bladed, 0.87 for 6 bladed impeller.
- Diameter of impeller is generally $\frac{1}{3}$ rd the diameter of the tank.

3. Turbo Propeller:

- Agitator speed, RPM of shaft is preferred as 100 or 200 or 300. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 1.35 for 3 bladed, 1.4 for 4 bladed, 1.45 for 5 bladed, 1.5 for 6 bladed impeller.
- Pumping factor, which decides flow rate of mixing, is 0.6 for 3 bladed 0.69 for 4 bladed, 0.78 for 5 bladed, 0.87 for 6 bladed impeller.
- Diameter of impeller is generally $\frac{1}{3}$ rd the diameter of the tank.

4. Disc Blade turbine:

- Agitator speed, RPM of shaft is preferred as 100 or 200 or 300. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 5.0.
- Pumping factor, which decides flow rate of mixing, is 0.7 to 0.8.

- Diameter of impeller is generally $\frac{1}{3}$ rd the diameter of the tank.

5. Flat Blade turbine:

- Agitator speed, RPM of shaft is preferred as 100 or 200 or 300. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 5.0.
- Pumping factor, which decides flow rate of mixing, is 0.7 to 0.85.
- Diameter of impeller is generally $\frac{1}{3}$ rd the diameter of the tank.

6. Backward Blade turbine:

- Agitator speed, RPM of shaft is preferred as 100 or 200 or 300. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 5.0.
- Pumping factor, which decides flow rate of mixing, is 0.65 to 0.85.
- Diameter of impeller is generally $\frac{1}{3}$ rd the diameter of the tank.

7. Paddle:

- Agitator speed, RPM of shaft is preferred as 50. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 5.0.
- Pumping factor, which decides flow rate of mixing, is 0.03.
- Diameter of impeller is generally 80% the diameter of the tank

8. Anchor:

- Agitator speed, RPM of shaft is preferred as 50. This speed is easier to achieve with motor/gearbox combination.

- Power number, which decides power required for mixing, is 5.0.
- Pumping factor, which decides flow rate of mixing, is 0.05.
- Diameter of impeller is generally 80% the diameter of the tank

9. Anchor/Paddle:

- Agitator speed, RPM of shaft is preferred as 50. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 5.0.
- Pumping factor, which decides flow rate of mixing, is 0.07.
- Diameter of impeller is generally 80% the diameter of the tank

10. Gate:

- Agitator speed, RPM of shaft is preferred as 50. This speed is easier to achieve with motor/gearbox combination.
- Power number, which decides power required for mixing, is 5.0.
- Pumping factor, which decides flow rate of mixing, is 1.0.
- Diameter of impeller is generally 80% the diameter of the tank

Calculation of Diameter of Impeller

1. For Marine Propeller, Axial flow turbine, and Turbo Propeller, based on the Type of Impeller, Agitator speed and Reynold's number selected, program will calculate the diameter of the impeller. Program reiterates till the width factor of impeller diameter to vessel diameter, is achieved by increasing or decreasing the agitator speed. It will indicate the calculated agitator speed and diameter of impeller. You can round it up to nearest value.

- Output Speeds of 1500 rpm Motor with Gearbox are : 300, 200, 150, 120, 100, 75, 60, 50, 43, 37 30, 25, 22.

- Output Speeds of 1000 rpm Motor with Gearbox are : 200, 133, 100, 80, 67, 50, 40, 33, 29, 25, 20, 17, 14.
- Output Speeds of 750 rpm Motor with Gearbox are : 150, 100, 75, 60, 50, 38, 30, 25, 21, 19, 15, 13, 11.
- Output Speeds of Direct coupled Motor are : 1500, 1000, 750.
- For any other speeds use Motor + V Belt Drive.

It then calculates pumping rate. Pumping rate = (pumpfac * (shaft rpm / 60.0) * impeller od³) in cu mm / sec. It then calculates Mixing time = Vessel Volume / Pumping Rate. Program indicates the value of mixing time. You can choose mixing time as per your requirements.

Program will recalculate the diameter of the impeller and shaft rpm. You can choose these per your requirements.

Program asks for number of impellers on shaft. If these are more than one, program will recalculate the diameter of the impeller. You can choose it per your requirements.

2. For Disc Blade turbine, Flat Blade turbine and Backward Blade turbine: Diameter of impeller depends on Width factor to Vessel Diameter. Program calculates Impeller OD and indicates it.

Tip speed of impeller = 175 meters per minute, or 500 feet per minute. Agitator Speed depends on tip speed of impeller. It calculates RPM of agitator.

3. For Paddle, Anchor, Anchor/Paddle and Gate: Diameter of impeller depends on Width factor to Vessel Diameter. It calculates Impeller OD. Tip speed of impeller = 82.5 meters per minute or 250 feet per minute. Agitator Speed depends on tip speed of impeller. It calculates RPM of agitator.

Program then calculates the power absorbed for mixing.

Absorbed Power in HP = (specific gravity * 1000 * number of impellers * power number * (shaft rpm / 60.0)³ (impod / 1000.0)⁵ * 1.1 * 1.2) / (9.81 * 75.0)

If the shaft RPM is less than 300, based on the absorbed power (output power of gearbox) and output RPM of gearbox, it selects gearbox. It indicates

selected size of gearbox, which can be changed to next higher or lower value. It then calculates diameter of shaft. You can select 4 types of materials for shaft. Indicated values of Yield Stress and Elastic Limit, in Kgs/ mm² are as follows.

Carbon Steel: Shear Stress 30.0, Elastic Limit 170.0.

EN8: Shear Stress 55.0 Elastic Limit 246.0

EN24: Shear Stress 80.0 Elastic Limit 320.0

Stainless Steel: Shear Stress 50.0 Elastic Limit 230.0

You can select Safety Factor for calculation of shaft diameter. Torque at end of shaft = $(746 * \text{motor hp}) / (2 * \pi * (\text{rpm} / 60))$ [in N-mt]

Bending Moment = Torque * Safety Factor [in N-mm]

Force at the end of impeller blade, $F_m = \text{Bending Moment} / (0.75 * 0.5 * \text{Impeller Dia})$

It then calculates maximum Bending Moment is at the end of shaft, Average Bending Moment at the end of shaft and Polar modulus of the shaft in cubic mm.

It then recalculates Diameter of Impeller based on Critical Speed. and indicates recommended Impeller OD for Critical Speed. It then reiterates till elastic limits is less than permissible value by increasing shaft diameter. It then calculates Critical Speed of Impeller. It then reiterates till critical speed is more than 20% of agitator speed by increasing shaft diameter.

It then indicates Final values after calculation of Critical Speed, Shaft RPM, Impeller Diameter and Shaft Diameter.
