HCTL Open International Journal of Technology Innovations and Research (IJTIR)
http://ijtir.hctl.org
Volume 16, July 2015
e-ISSN: 2321-1814, ISBN (Print): 978-1-943730-43-8

# Modelling and Analysis of Vertical Rotary Automated Drilling Fixture

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## Abstract

Project work is with the development of process automation equipment in heavy machineries. Work giving perfect solution to make feasible multiple operation in single machine and with single operator. Indexing bracket made by welding structure is validate with the loading conditions expecting in the process as the 4 numbers of fixtures are going to mount on the bracket simultaneously and 3 process will be carried out on 3 stations that means 3 fixtures will be engaged with loading .the solution is withstanding on boundary conditions all are expected. Mechanical working behaviour also considered while designing this bracket. Stability and anti bending gusseting considered as per the analysis results gets changes. Assembly is made with optimised solution by making validation on optimised components before finalising the same.

## Keywords –

Indexing Fixture, Meshing bracket fixture, Forces applied on four V-clamp, Equivalent stresses developed on bracket fixture, Analysis shows the Deformation on bracket Fixture.

## Introduction

This invention relates to an indexing fixture and jig structure for presses and particularly to a jig structure which is adapted to receive and release fragile work units which when compressed in the jig cavity are difficult to remove in undamaged condition It is an object of my invention to provide a novel jig having a cavity defined by a base member and walls which are retractable in relation to the base member and adapted to contain fragile work units to be compressed in the cavity and thereafter released ‘by means which merely retract the jig sides. A further object is to provide for a press having a vertically reciprocal ram.

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# Literature Review

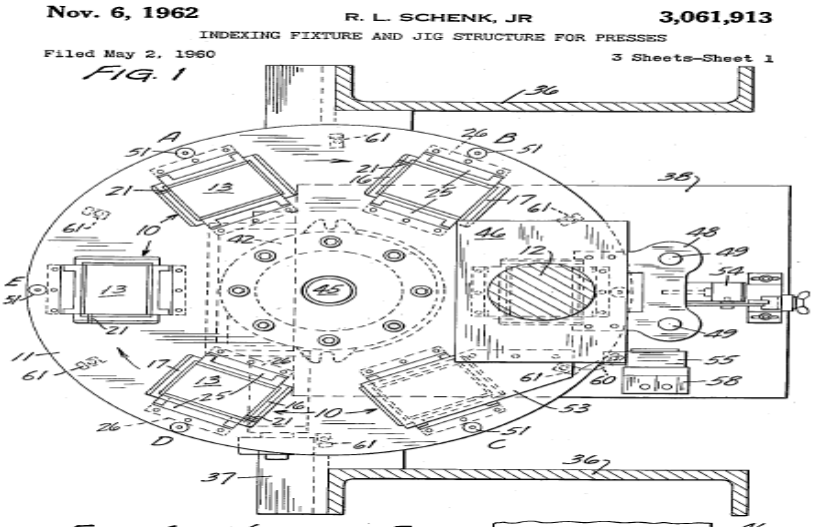



Fig.1. Indexing Fixture for Presses

## Indexing Fixture

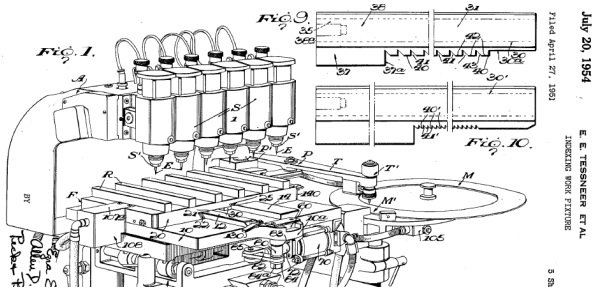



Fig 2.Indexing Fixture

This invention relates to indexing work fixtures of the types particularly adapted, although not limited, to mounting on the work table of an engraving or the like machine tool and the nature and objects of the invention will be readily understood by those skilled in the art in the light of the following explanation and detailed description of a preferred embodiment or mechanical expression of our invention, from among various other embodiments, expressions, forms, designs, constructions and combinations of which the invention is capable within the broad spirit and scope of as defined by the appended claims.

### Machine Tool Design

Indexing Bracket CAD model

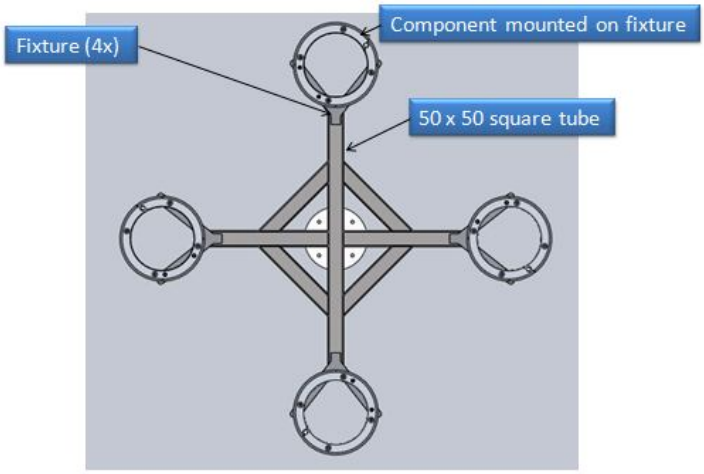



Figure.3: Design parts

Component mount are circular plates with holed surface to make feasible mounting of fixture elements on rings shown:

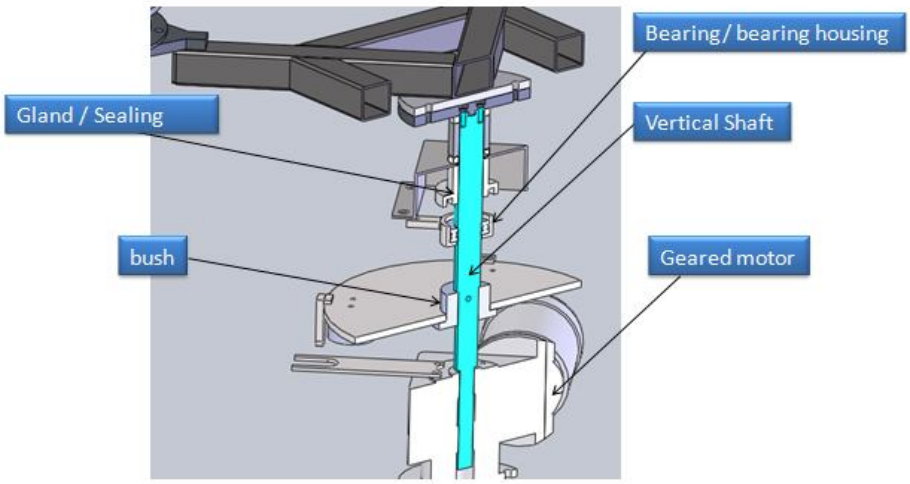



Figure.4: Cross sectional of shaft assembly design

## Bracket Dimensions

Dimensions are considered as per the area available for indexing and fixture mounting machine cabinet. Bracket is major role playing to make feasible assembly holding with cantilever support to hold each fixture on all 4 positions.

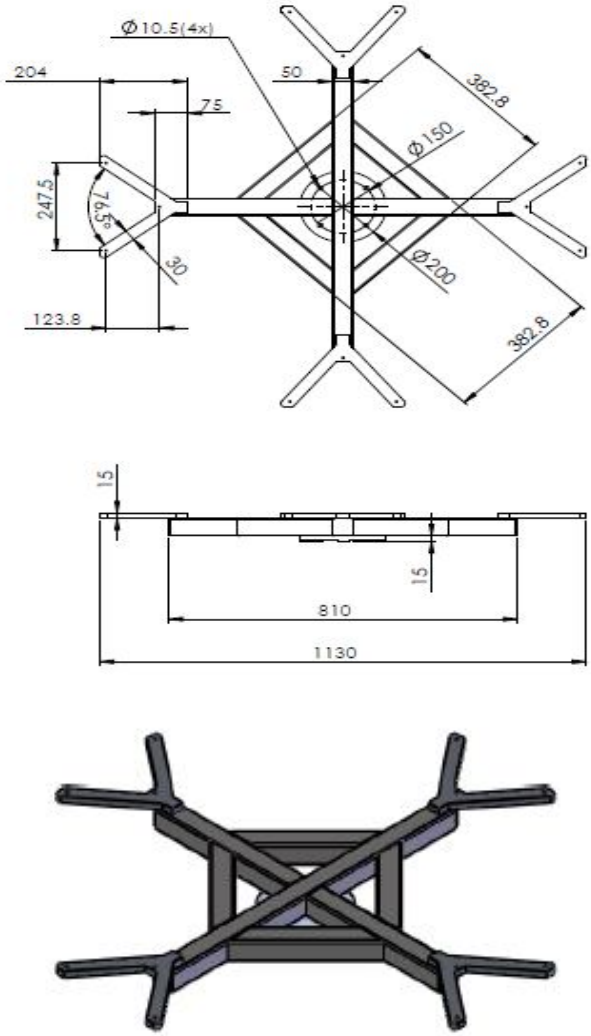



Fig 5: Fabricated bracket

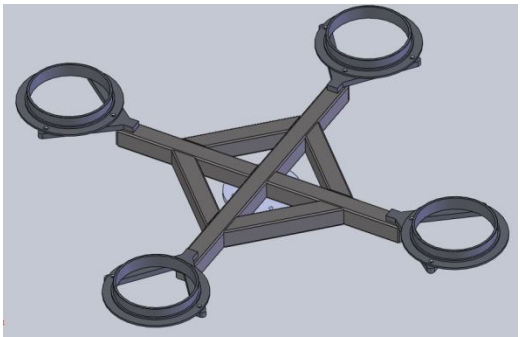
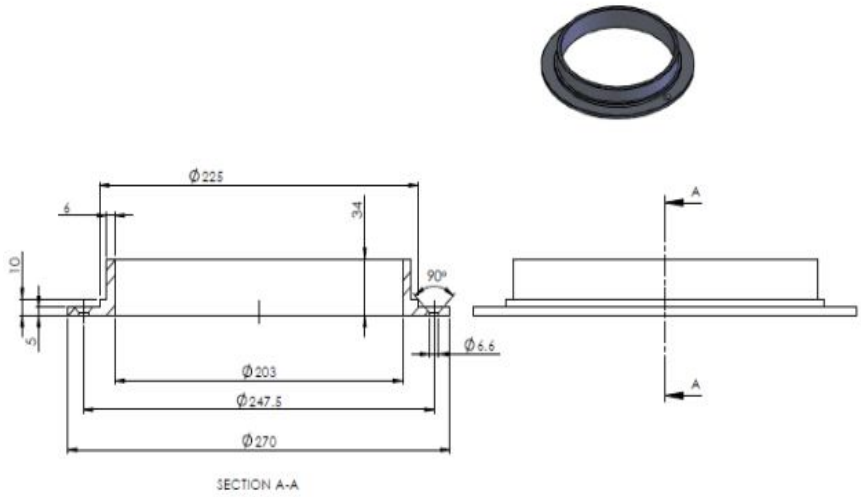


Fig 6: Fixture Ring




Complete assembly ready to install in machine Part to be drilled with M16.

Four holes with auto mated drilling operation. Complete assembly of welding and drilling platform on bracket.

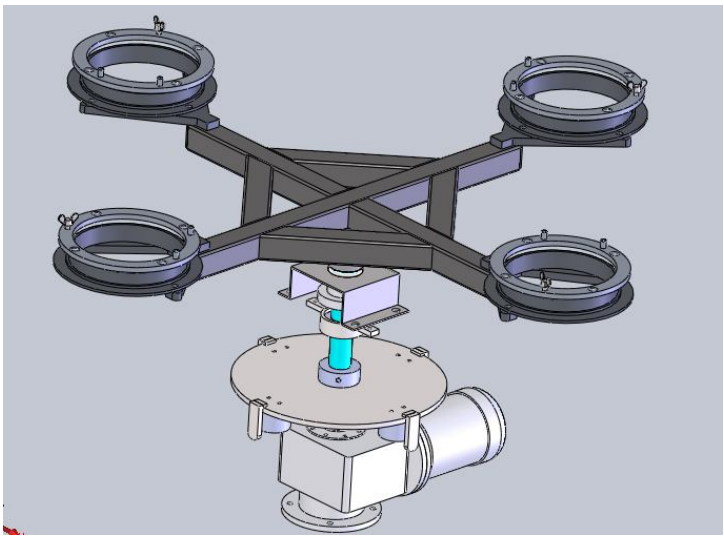


Fig.7: Fixture Ring assembly

**Torque required rotating bracket fixture**

Total load of rotary bracket: 29.6 Kg

Per component weight: =2.5 kg

Total components = 4

Hence ,

- Total pushing weight L = 29 +2.5x4 = 39.6 kg

.Coefficient of friction is 0.3 as in rolling and rotating application =0.3

- Maximum push = L x 0.3 = 11.88 kg
  = 118.8 N

- Diameter of rotary bracket =1100 mm

- Required Torque = max pulling load x d/2 = 118.8 x 810 /2 = 65.34 Nm

**Required RPM**

- To make feasible rotation with matching cycle time to get desired stapages

Rotary Stopages needed 4

1 load/unload

- 2 drilling

- 3 Tapping

- Washing and airblow ,

Maximum time taking activity is tapping it taking 4 mins to make 4 holes on component

so maximum stoppages duration will be 4 min for each stoppages,

So 4 x 4 = 16 minutes required to make one cycle complete,

Total length to cover 2πr = 3454 mm

For one stoppage = 3454/4 = 863.5 mm

Hence pitch =863.5 mm

No. of intervals =4

5 seconds to be given to reach and cross the station ,

RPM = pitch * 60 / time to travel pitch/ no. of interval/ stoppage distance

= 863.5 * 60/ 5/4/863.5 =

= 3 RPM

**Power and torque**

Consider service factor =1.7

FINAL OUTPUT TORQUE= req torque x service factor = 65.34 x1.7

**= 111 Nm**

**Power = 2π N/T/45000 =** 0.046547 HP

# Results and Analysis

## Meshing Bracket Fixture

Figure shows the model of Bracket Fixture,the Bracket fixture converted into the meshing form.Before meshing the model, and even before building the model, it is important to think about whether a free mesh or a mapped mesh is appropriate for the analysis. A free mesh has no restrictions in terms of element shapes, and has no specified pattern applied to it. Compared to a free mesh, a mapped mesh is restricted in terms of the element shape it contains and the pattern of the mesh. A mapped area mesh contains either only quadrilateral or only triangular elements, while a mapped volume mesh contains only hexahedron elements. In addition, a mapped mesh typically has a regular pattern, with obvious rows of elements. If you want this type of mesh, you must build the geometry as a series of fairly regular volumes and/or areas that can accept a mapped mesh.

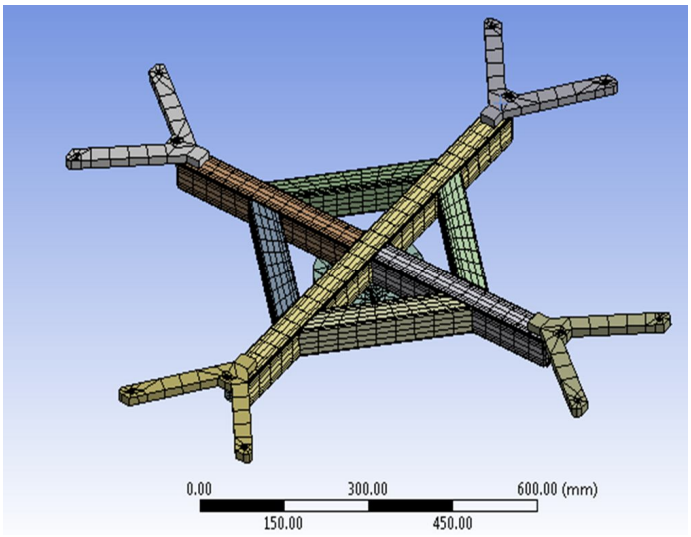



Fig 7.1: Meshing bracket fixture

# Forces Applied on Four V-clamp

## Defining loads and boundary conditions

A wide variety of geometry based loads and boundary conditions are available, On four points loading fixtures 200 N force [D,E,F,G] considered on each drilling point. At the centre of bracket fixture apply the boundary conditions i.e. there is frictionless support[A] applying and on the surface of disc Cylindrical support[B], Fixed support[c].for checking safe stress for bracket there is maximum stress applied on four points of bracket and checking possibility of failure of bracket.

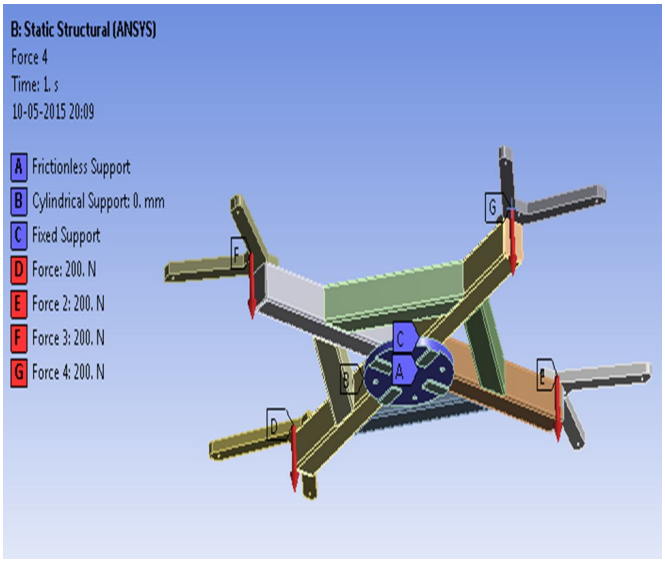



Figure7.2: Static Structural

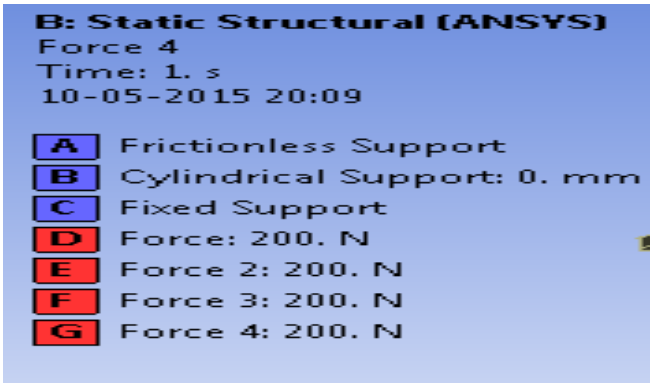



Figure7.3 Applied forces and Boundary Conditions, Loading Conditions

## Equivalent Stresses Developed on Bracket Fixture

After applying loading and boundary conditions, the required result obtained from ANSYS, figure shows the equivalent stresses developed all over Bracket Fixture, which has to be show by changing shades of color around the Bracket. The lower to Higher stresses developed along the surface of bracket i.e. the color shade changes its color from dark blue to red color the meaning of color shades is where dark blue color show at particular location that means, the minimum stresses developed at that place, and light blue color shades scattered all over body of bracket that means the stresses goes on increasing slightly all that particular region of bracket. There is minimum stresses developed on bracket at the center of bracket and maximum stresses developed at the boundary of bracket i.e. near to V-Clamp, Ansys shows the result of stresses developed range minimum to maximum i.e2.0284to 18.255Mpa.

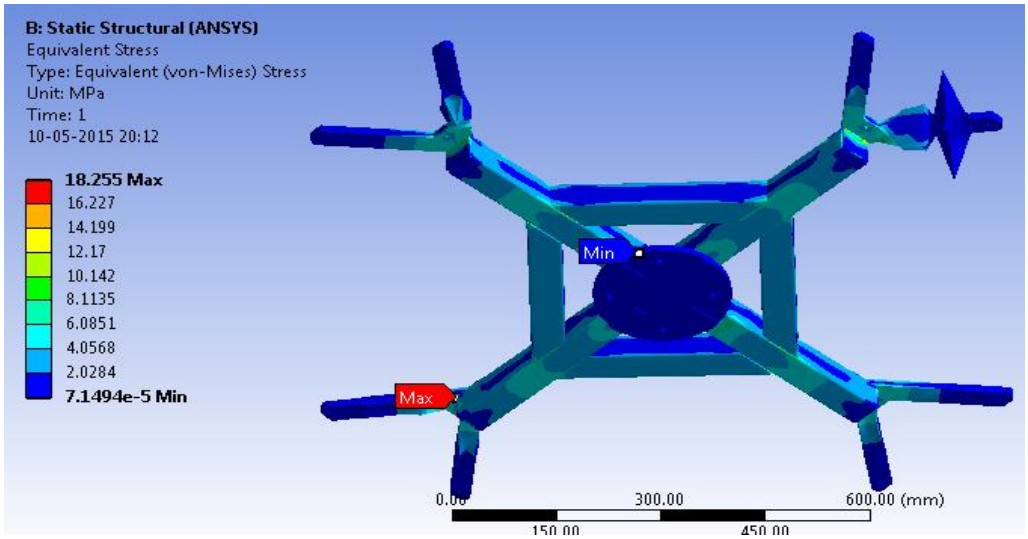



*Figure7.4: Stresses developed on bracket Fixture*

## Analysis shows the Deformation on bracket Fixture

Second result is the total deformation bracket ,the color band which has shows the maximum and minimum deformation developed on bracket, from figure we conclude that there is no any deformation all over bracket, bracket is safe after applying force of 200N.Only at the boundary of bracket means at the place of V-clamp it shows deformation. i.e.4.7605mm,at the place of V-clamp, at the two corners of on which located V-clamp. Just we see minimum deformation, the indication of show deformation by changing the color greenish blue, Other side of V-clamp slightly maximum deformation shows i.e.7.1408mmColor green shows the deformation at particular place. From second result shows the there is minimum deformation on bracket and bracket is not fail by applying maximum stresses Bracket is in not failure.

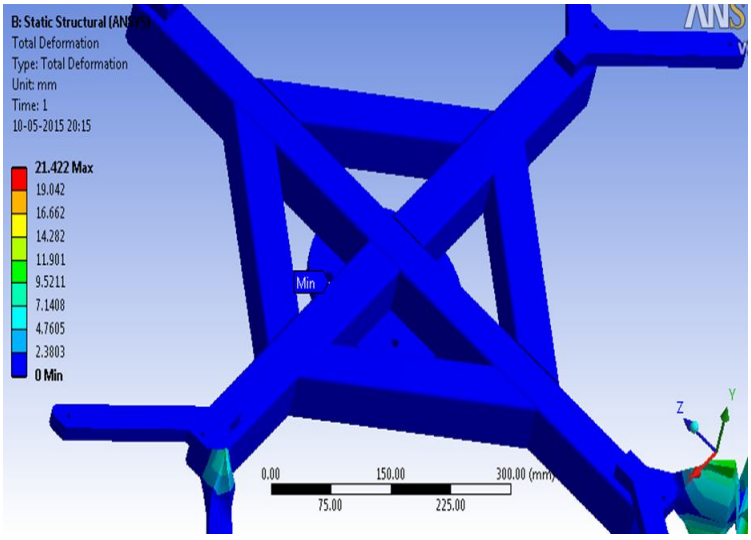



*Figure7.5: Total Deformation on Bracket Fixture*

### Third Result from ANSYS shows the Factor of Safety

Third result from Ansys is evaluate factor of safety, Ansys shows the factor of safety is 13.695,and minimum at the end of bracket i.e. one V-clamp of bracket, and second V-clamp at that side shows the maximum factor of safety. Color band from red to dark blue shows the range of minimum to maximum factor of safety.

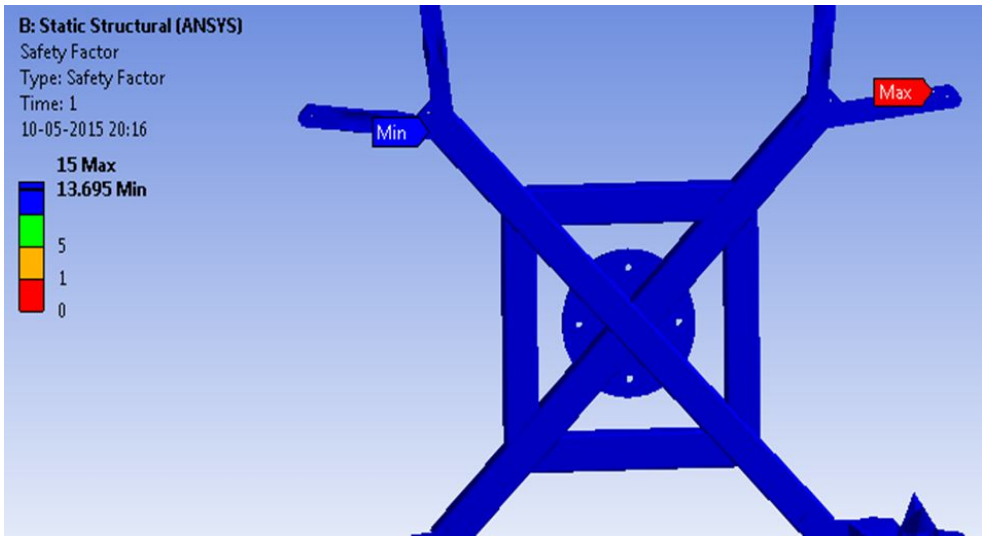



*Figure7.6: Safety factor showing min and max range.*

## Conclusion

The machine tool for indexing is feasible with bracket mounting fixtures with vertical drive fitted.

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