International Conference on Systems, Science, Control, Communication, Engineering and Technology 2015 [ICSSCCET 2015]

ISBN	978-81-929866-1-6
Website	icssccet.org
Received	10 - July - 2015
Article ID	ICSSCCET0019

VOL	01
eMail	icssccet@asdf.res.in
Accepted	31- July - 2015
eAID	ICSSCCET.2015.019

PERFORMANCE ENHANCEMENT OF REFRIGERATED AIR DRYER CANOPY BASE

Vijayan.S.N, Karthik.S, Maharaja.K
Assistant Professor, Department of Mechanical Engineering,
Karpagam Institute of Technology, Coimbatore ,Tamil Nadu, India.

Abstract: *Refrigerated air dryers are basically refrigeration system which is used to remove water vapor from compressed air. In this work the load carrying capacity of canopy base has been analyzed. Refrigerator, heat exchanging unit are to be placed in a canopy which has affected by static and dynamic stresses acting on it. Using alternative approaches the load carrying capacity of the canopy base has been analyzed. Finally adding circular disc and one rib on the back side of the base provide high load carrying capacity compare to other approaches.*

Keyword: Refrigeration, Stress, Deformation, Load.

I. INTRODUCTION

There are many applications where air from the atmosphere is compressed for use. When air is compressed, it leaves the compressor in saturated condition with moisture. Some of this moisture condenses in the air storage tank and is exhausted through a float. The air is still very close to saturated as it leaves the storage tank. This air may be dehydrated using refrigeration. Refrigerated air dryers are normally self contained refrigeration system that may be air cooled or water cooled. Refrigerated air dryers are basically refrigeration systems located in the air supply, after the storage tank. The air may be cooled in a heat exchanger, and then moved to the storage tank where much of the water will separate from the air. The air then passes through another heat exchange where the air temperature is reduced to below the dew point temperature.

Design of Canopy

Design and analysis of the canopy of air dryer for its existing dimensions have been modeled which is shown in the fig.1 Brain-storming sessions are used to generate ideas for alternatives in order to improve the various aspects of the product.

Figure 1. Assembled View Of Canopy

Cite this article as: Vijayan.S.N, Karthik.S, Maharaja.K. "PERFORMANCE ENHANCEMENT OF REFRIGERATED AIR DRYER CANOPY BASE." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 92-97. Print.

The above figure shows the assembled view of the canopy. Canopy is the outer cover of the Refrigerated Air Dryer. It consists of base which is used to locate the components, pillars to provide support, and a roof. Since roof and pillars did not experienced any stress, analysis is carried out only for canopy base.

II. MATERIAL AND METHODS

The material used for the canopy is AISI 1020 Steel and the model type is linear elastic isotropic. The Table I shows the material specifications of canopy.

TABLE I
MATERIAL PROPERTIES OF CANOPY

Properties	Value	Unit
Poisson's ratio	0.29	NA
Mass density	7870	kg/m^3
Tensile strength	4.2e+008	N/m^2
Yield strength	3.5e+008	N/m^2

To overcome the Deformation and stress acting on the refrigerated air dryer canopy by using any one of the following approaches.

- Thickness improvement
- Providing ribs
- Providing circular disc

The above approaches are used to reduce the Deformation on the base due to acting of heavy load and it is reduces with increase in performance.

III. RESULTS AND DISCUSSION

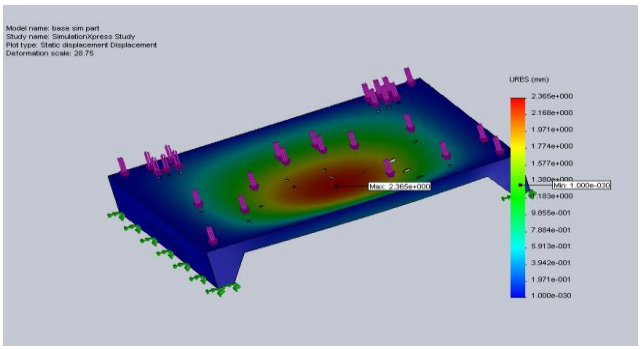

Figure 2. Static deformation of base

The fig. 2 shows the static Deformation of the canopy base. Static Deformation is used to denote how long the surface would deform under the application of load. Here the max. Deformation is 2.365mm.

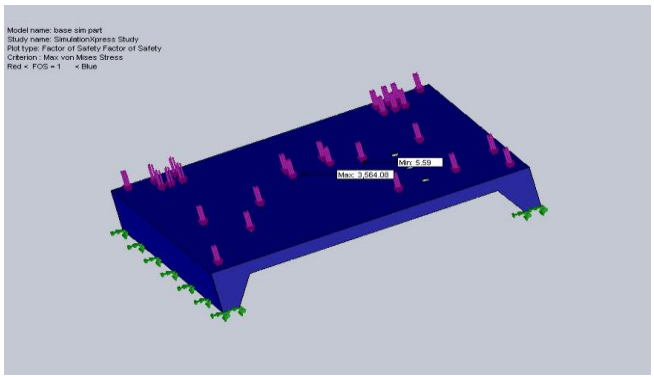

Figure 3. max. von mises stress of base

Cite this article as: Vijayan.S.N, Karthik.S, Maharaja.K. "PERFORMANCE ENHANCEMENT OF REFRIGERATED AIR DRYER CANOPY BASE." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 92-97. Print.

The fig. 3 shows the maximum von mises stress acting on the canopy base. The maximum von mises stress is 62.6225 Mpa, which is greater than the strength of the material. So the canopy base will definitely deform under the given load.

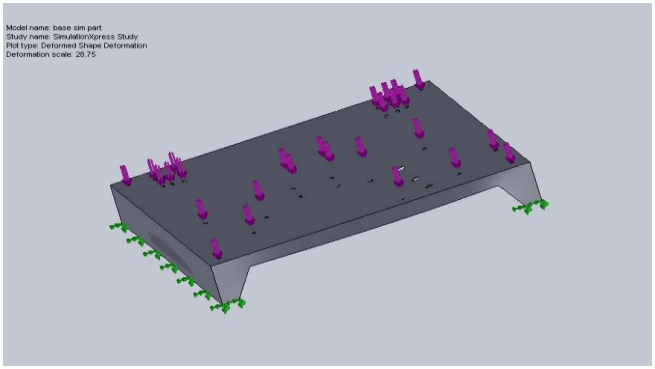

Figure 4.Deformation shape of base

The fig. 4 shows the deformation shape of the canopy base. It denotes the deformation of the surface under the given load.

Thickness Improvement of Canopy

By increasing thickness of base to 5 mm, the Deformation of the base has reduced to 0.18mm with increase the overall weight of the canopy to 25.9 Kg. fig. 5 shows the Deformation view of base for 5 mm thickness.

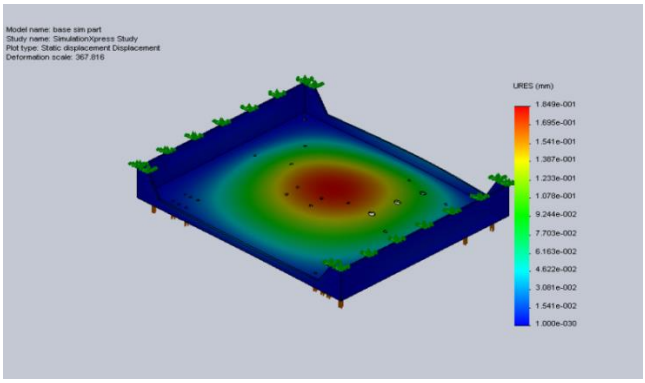

Figure 5. Deformation of base with 5mm thickness

Addition of Ribs

In this approaches number of ribs are added on the bottom side of the base from double rib to four ribs which is perpendicular to the base. The fig. 6 clearly shows the Deformation of base after addition of 4 ribs under the base has reduce the Deformation to 0.09 mm with 4.4 kg increase in weight of base.

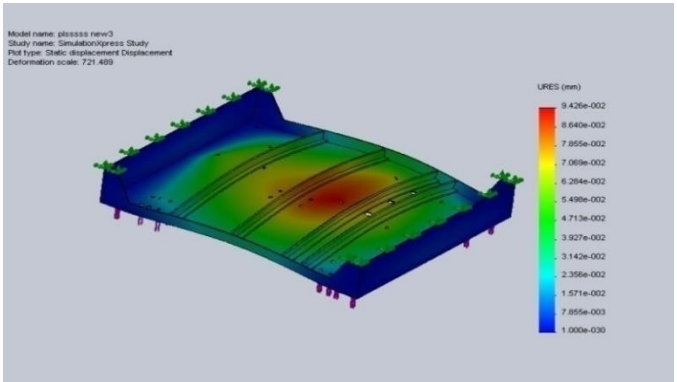

Figure 6. Deformation of base with 4 ribs

Cite this article as: Vijayan.S.N, Karthik.S, Maharaja.K. "PERFORMANCE ENHANCEMENT OF REFRIGERATED AIR DRYER CANOPY BASE." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 92-97. Print.

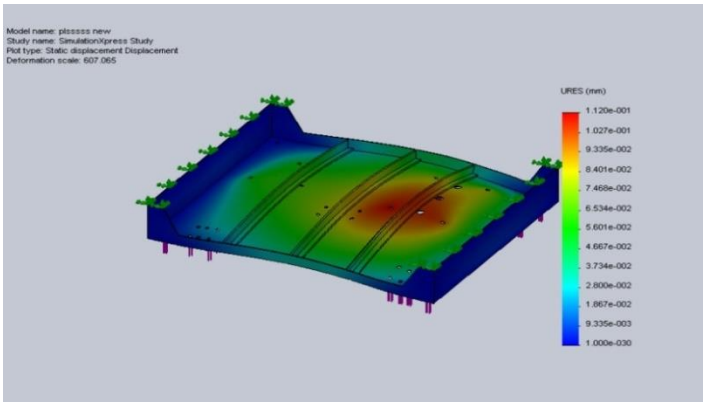

Figure 7. Deformation of base with 3 ribs

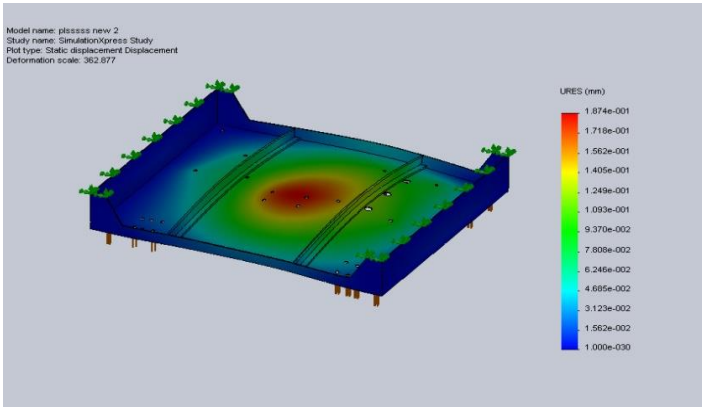

Figure 8. Deformation of Base with 2 Ribs

The weight of the canopy base becomes 24.9 kg, and by adding 3 ribs under the base has reduce the Deformation to 0.11 mm with 3.3 kg increase in weight of base which is shown in fig. 7 The weight of the canopy base becomes 23.8 kg, adding 2 ribs under the base has reduce the Deformation to 0.18 mm with 2.2 kg increase in weight of base. The weight of the canopy base becomes 22.7 kg it is shown in fig. 8.

Addition of Circular Structure

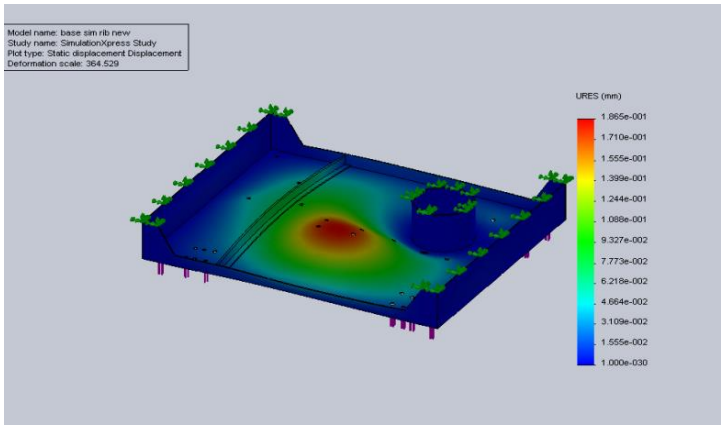

Figure 9. Deformation of base with circular structure

The fig. 9 shows the deformation results after adding a circular structure of 5mm thickness with single rib on the other side at the critical point where the load is maximum, the Deformation of the base will be reduced to 0.19mm with 1.84 kg increased in weight. The overall weight of the canopy becomes 22.3 kg.

Cite this article as: Vijayan.S.N, Karthik.S, Maharaja.K. "PERFORMANCE ENHANCEMENT OF REFRIGERATED AIR DRYER CANOPY BASE." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 92-97. Print.

Table II shows the results obtained by using various alternative approaches used to overcome the Deformation of refrigerated air dryer canopy.

TABLE II
COMPARISON OF DEFORMATION VALUES AND WEIGHT

Sl No.	Approaches	Deformation in mm	Final weight in Kg
1	Adding 2 ribs	0.18	22.7
2	Adding 3 ribs	0.11	23.8
3	Adding 4 ribs	0.09	24.9
4	Improve thickness of base to 5mm	0.18	25.9
5	Rib with Circular Disc	0.19	22.3

From the results obtained using various approaches, by adding four rib can obtain very minimum value of deformation such as 0.09mm when compare with other approaches which is clearly shown in fig. 10.

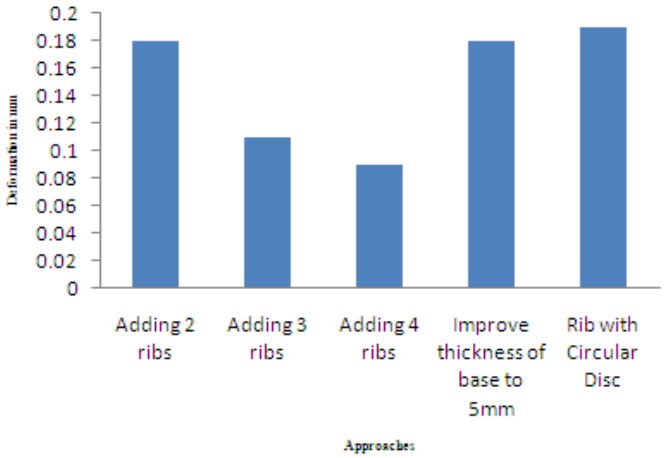

Figure 10. Alternative Approaches vs deformation of canopy base

The fig. 11 shows the results obtained by various alternative approaches with respect to weight of canopy base. By adding circular disc can obtained low weight of canopy with high deformation value when compare to other approaches.

Figure 11. Alternative Approaches vs Weight of canopy

Very minimum deformation value is obtained by adding four ribs on the bottom side of the refrigerated air dryer canopy with increase in overall weight of the canopy. But adding circular disc with one rib on the bottom side of the base give lenient deformation value when compare to other approaches, in this case the overall weight of the canopy is reduced.

Cite this article as: Vijayan.S.N, Karthik.S, Maharaja.K. "PERFORMANCE ENHANCEMENT OF REFRIGERATED AIR DRYER CANOPY BASE." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 92-97. Print.

IV. CONCLUSION

The deformation value of the canopy base varies with respect to overall weight of the refrigerated air dryer and thickness of base plate. If the deformation value is maximum, it indicates the withstanding capacity of canopy is minimum, likewise if the deformation value is minimum it indicates the withstanding capacity of canopy as maximum. By introducing circular disc on the bottom of the canopy base can obtain high withstanding capacity of canopy.

Reference

[1]. A. Futakawa, K. Namura, H. Emoto, "Deformation and Stress of Refrigeration Compressor Flexible Ring Valve", International Compressor Engineering Conference, pp 266, 1978.

[2]. Pushpendra Mahajan, Prof. Abhijit L. Dandavate, "Analysis and optimization of Compressor Mounting Plate of Refrigerator using FEA", International Journal of Emerging Technology and Advanced Engineering, Volume 5, Issue 5, May 2015.

[3]. B. Sreedhar, U. Naga Sasidhar, "Optimization of Mounting Bracket", Simulation Driven Innovation, HTC 2012.

[4].Vyankatesh D. Pawade, Pushkaraj D. Sonawane, " Study of Design and Analysis of Air Conditioner Compressor Mounting Bracket", International Journal of Science and Research, Volume 4 Issue 1, January 2015.

[5].T.Ramachandran, K.P.Padmanaban, P.Nesamani, "Modeling and analysis of IC engine Rubber mount using FEM and RSM", procedia engineering, pp.1683-1692, 2012.

[6].Dr.Yadavalli Basavaraj, Manjunatha.T.H, " Design Optimization of Automotive Engine Mount System", International Journal of Engineering Science Invention, Volume 2, Issue 3, March. 2013, PP.48-53.

[7].K.Nagalakshmi, G. Marurhiprasad Yadav, "The Design and Performance Analysis of Refrigeration System Using R12 & R134a Refrigerants", Int. Journal of Engineering Research and Applications, Vol. 4, Issue 2, February 2014, pp.638-643.

Cite this article as: Vijayan.S.N, Karthik.S, Maharaja.K. "PERFORMANCE ENHANCEMENT OF REFRIGERATED AIR DRYER CANOPY BASE." *International Conference on Systems, Science, Control, Communication, Engineering and Technology (2015)*: 92-97. Print.