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Design and Failure Analysis of Pneumatic Operated 2" Diaphragm Pump

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Abstract

This paper presents an analysis of the diaphragm of a Pneumatic operated 2" diaphragm pump. The diaphragm pump, the core power output device of pipeline transport, is one of the most important types of pipeline transport equipment. The diaphragm pump's efficiency is the key security issue of pipeline transport. The diaphragm pump is generally composed of valves and actuation. Diaphragm pump forms pressure difference in the fluid to produce power to change the flow rate and flow of the fluid. Only keeping the diaphragm pump operating effectively can ensure the normal operation of pipeline transport. This paper shows how the material change can change the Diaphragm Pump's efficiency and increase the life cycle of the diaphragm. As the diaphragm's life cycle is increased, maintenance hours are reduced and hence the efficiency of the Pneumatic operated 2" Diaphragm Pump will increase, which is shown in this dissertation.

Keywords: *Diaphragm, Pump, Pneumatic, suction.*

I. INTRODUCTION

In recent years, the pipeline transport industry has developed rapidly, but there is an urgent problem of ensuring pipeline transport's security and stability. The diaphragm pump, which is the core power output device of pipeline transport, is one of the most important equipment for pipeline transport, so the diaphragm pump's security issues are the key security issues of pipeline transport. The diaphragm pump is generally composed of valves and actuation. Diaphragm pump forms pressure difference in the fluid to produce power to change the flow rate and flow of the fluid. Only keeping the diaphragm pump operating effectively can ensure the normal operation of pipeline transport. As rubber-coated fabric diaphragms are prepared by shaping the fabric, reinforced diaphragms are prepared by molding a fabric containing two sheets of rubber. Compared to the rubber-coated Diaphragms fabric reinforced diaphragms are reliable. This paper is related to a diaphragm for a diaphragm valve and, more particularly, to a manner of reinforcing the diaphragm with fabric. The part of such a diaphragm that is in contact with the greatest stress concentration and the central portion is in contact with the enlarged head of a stud. This practice is particularly concerned with reinforcement to withstand stresses in the latter portion. Fabric reinforcement sustained a rupture of the diaphragm due to its deformation while in use.

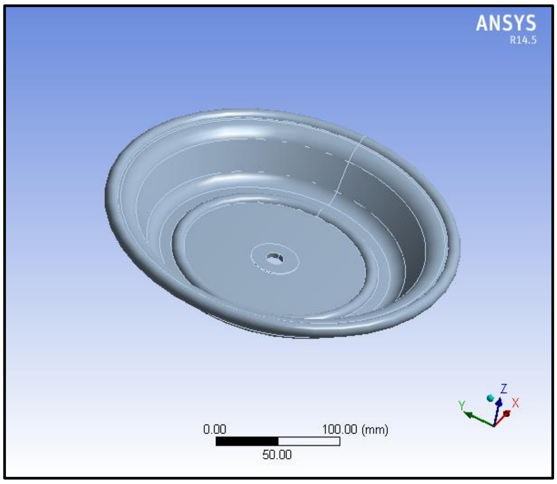

Fig. 1: The imported body of diaphragm.

II. LITERATURE SURVEY

1. Mr. KapilRangari, Prof. RavindraGandhe, *"Design And Failure Analysis Of Pneumatic Operated 2" Diaphragm Pump,"* International Journal of Research, International conference on innovation and Research in Engineering, Science & Technology,eISSN:2348-6848 & PIssn:2348-795X Vol-5 special Issue-13.

This paper presents a review on failure analysis of Pneumatic operated 2" diaphragm pump. The diaphragm pump, which is the core power output device of pipeline transport, is one of the most important equipment for pipeline transport, so the diaphragm pump's security issues are the key security issues of pipeline transport. The diaphragm pump is generally composed of valves and actuation. Diaphragm pump forms pressure difference in the fluid to produce power to change the flow rate and flow of the fluid.

2. Jia Yin, Jiande Wu, Xuyi Yuan, Xiaodong Wang and YugangFan, *"Study and Design of Diaphragm*

Pump Vibration Detection Fault Diagnosis System Based on FFT," Research Journal of Applied Sciences, Engineering and Technology 5(4): 1238-1244, 2013, ISSN: 2040-7459; e-ISSN: 2040-7467 Maxwell Scientific Organization, 2013.

This paper deals with the system using the CMSS 2200 acceleration sensor to collect vibration signals, processing spectrum with FFT (Fast Fourier Transform) which is used effectively in the current industry and finally achieves fault diagnosis and prediction diaphragm pump. Through collection and analysis of the history signal.

3. Ms. Madhani Khushbu1 Prof. AshwinThakkar, *"Analyzing the Effect of Fabric Reinforcement on Some of the Properties of Rubber Diaphragm,"* International Journal for Scientific Research & Development| Vol. 3, Issue 03, 2015 | ISSN (online): 2321-0613**.**

This study involves the result of an effect of the use of elastomeric fabric on the rubber-coated diaphragm. In such cases, when rubber is composite with some fabric material, it will have revised and improved property. This paper has been studied how (elastomeric fabric) improves the quality of the rubberized diaphragm. The experiment investigates comparison with other fabric reinforced diaphragm.

4. P. V. SumanthChowdary, SenthilPandian. *"A Comparative Study on RCC Structure with and without Shear Wall,"* International Journal for Scientific Research & Development| Vol. 2, Issue 02, 2014 | ISSN (online): 2321-0613.

Nowadays, tall buildings are provided with shear walls to improve lateral load resistance. In the present paper, we are studying the shear wall location and type of shear wall in seismic prone areas. The effectiveness of RCC shear wall building is studied with the help of four different models. Model one is a bare frame system, and the remaining three types are different shear wall buildings. An earthquake load is applied to 8 story buildings located in different zones. The performance of the building is evaluated in terms of lateral displacements of each story. The analysis is done by using structural finite element analysis (SAP2000) software.

5. Parth D. Shah Prof. Binita A. Vyas *"Automation of Diaphragm Wall Design for 3 Layers of Soil"*, International Journal for Scientific Research &Development| Vol. 3, Issue 03, 2015 | ISSN (online): 2321-0613.

With the scarcity of space in urban India, upcoming metro trains and development in ports, going deep in the foundation will become common. A diaphragm wall is a very common type of earth retention scheme in deep excavation/foundation, weak/poor soil condition or congested site condition. Diaphragm walls are generally used in the deep basement of buildings, congested urban spaces, underground structures of metro trains, riverfront structures and marine structures. In the absence of a standard procedure for analysis and design, a tool which will take care of soil variation & give quick optimized results is considered here

6. Ambarish G. Mohapatra, *"Design and Implementation of Diaphragm Type Pressure Sensor in a Direct Tire Pressure Monitoring System (TPMS) for Automotive Safety Applications,"* International Journal for Scientific Research & Development| Vol. 3, 2015.

Correct tire pressure is a critical factor in the safe operation and performance of a motor vehicle. Overinflated tires often result in unnecessary tire wear, reduced gas mileage and less than optimal vehicle performance and vehicle safety. A tire pressure monitoring system (TPMS) monitors air pressure and temperature in a motor vehicle's tires. That generates a signal indicative of the tire pressure and temperature in each of the tires to increase vehicle performance and safety. The present work is based on the tire pressure monitoring system design, including a pressure sensor, an RF-communication unit, a signal processing unit, and a display unit.

III. ANALYSIS

Pneumatic operated 2" Double Diaphragm Pump has its original material as Polypropylene. But during a long time, the diaphragm gets worn out and hence it causes a reduction in the pump efficiency. Hence, to increase the Pump's efficiency and increase the life cycle of the Diaphragm other materials are used and analysis is done to attain the dissertation's goal.

Let us have a look at the meshed body and boundary conditions of the diaphragm.

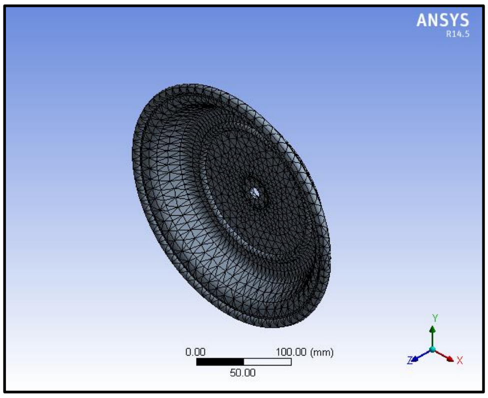

Fig.2: Meshed body of Diaphragm (View 1).

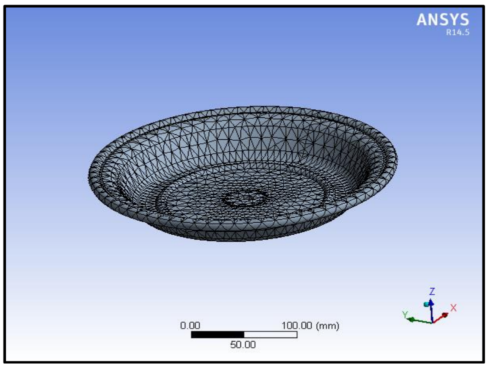

Fig.3: Meshed body of Diaphragm (View 2).

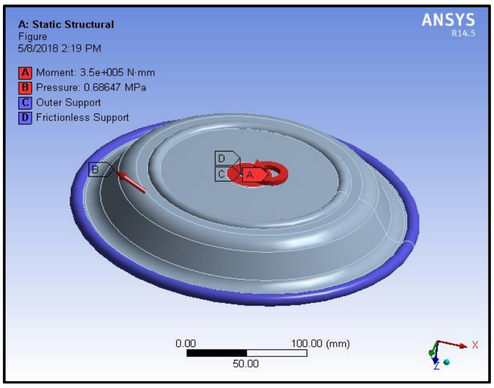

Fig.4: Boundary Conditions are shown in the diaphragm.

Let us first look at the diaphragm analysis with its original material, i.e., Polypropylene.

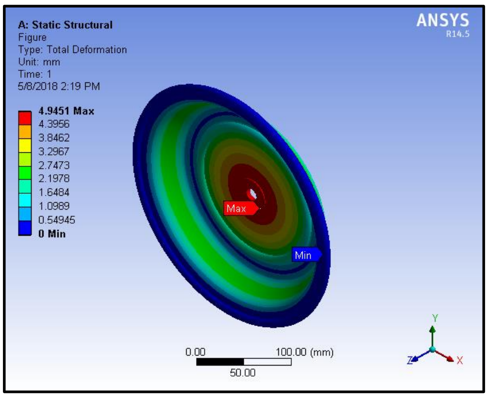

Fig.5: Total Deflection /Deformation in Diaphragm (View 1).

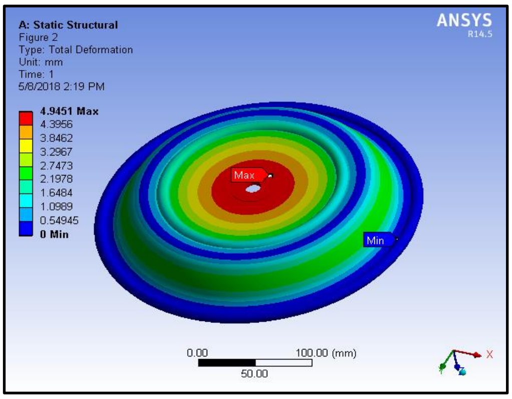

Fig.6: Total Deflection /Deformation in Diaphragm (View 2).

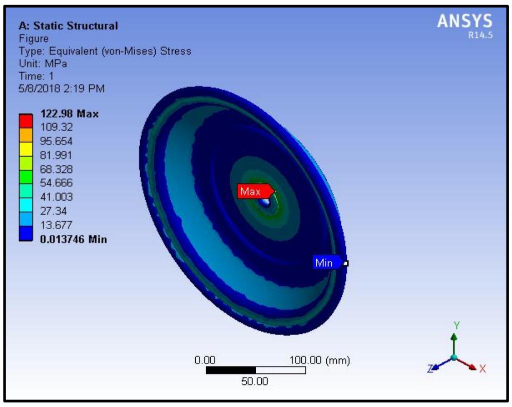

Fig..7: Equivalent Stress in Diaphragm (View1).

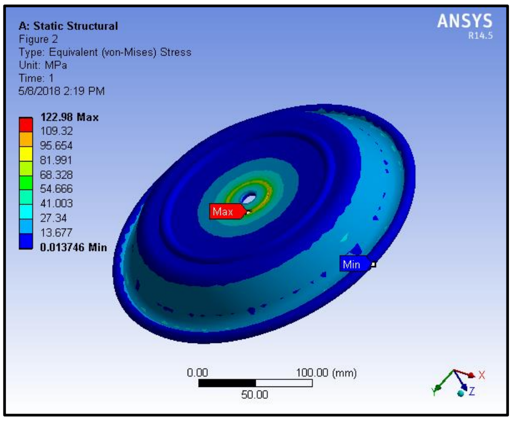

Fig. 8: Equivalent Stress in the diaphragm (View2).

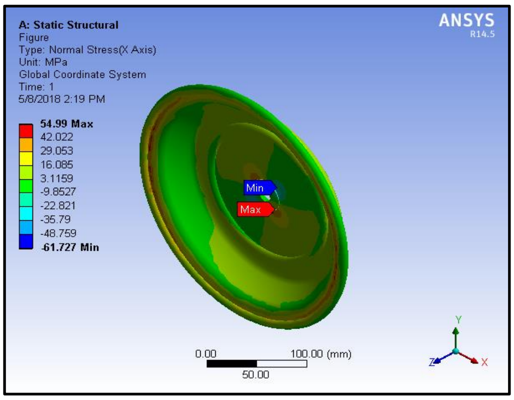

Fig.9: Normal Stress in Diaphragm (View1).

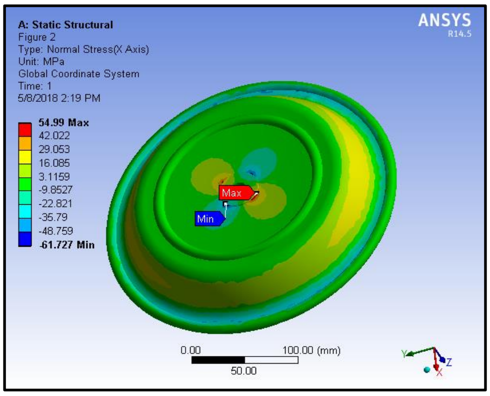

Fig. 10: Normal Stress in Diaphragm (View2).

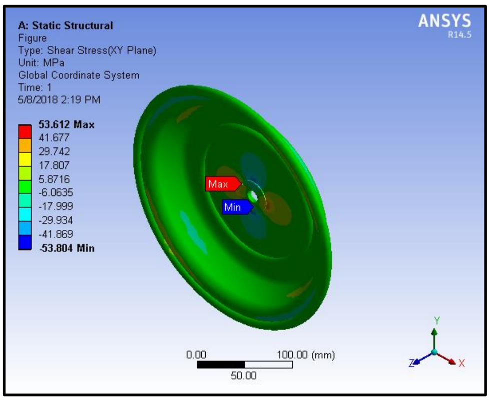

Fig.11: Shear Stress in Diaphragm (View1).

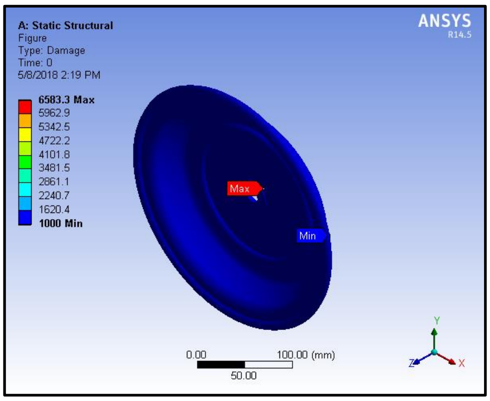

Fig.15: Damage in Diaphragm (View 1).

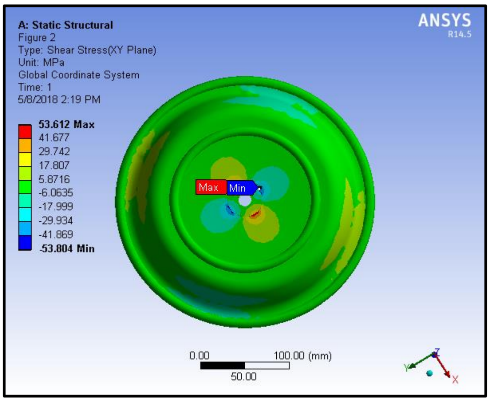

Fig.12: Shear Stress in Diaphragm (View2).

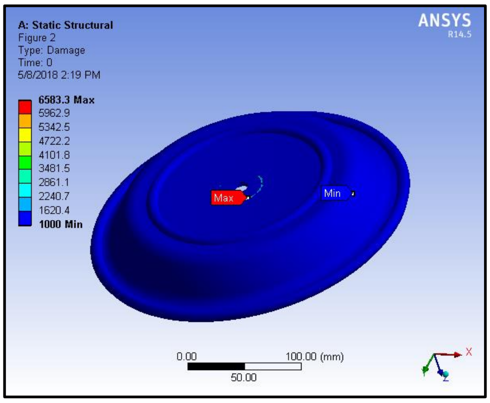

Fig.16: Damage in Diaphragm (View2).

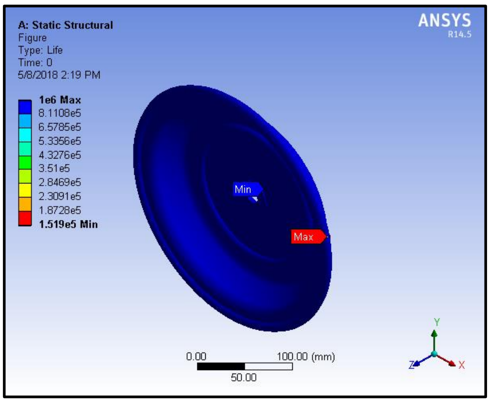

Fig.13:Life of Diaphragm(View1).

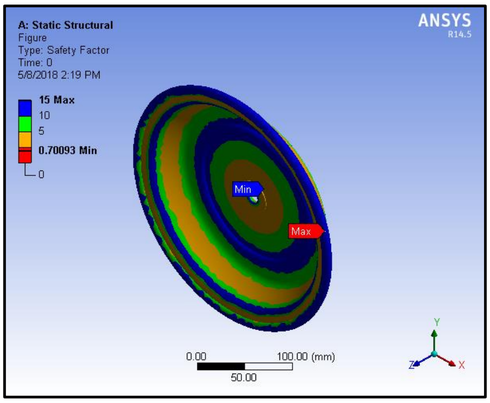

Fig. 17: Safety FactorofDiaphragm (View1).

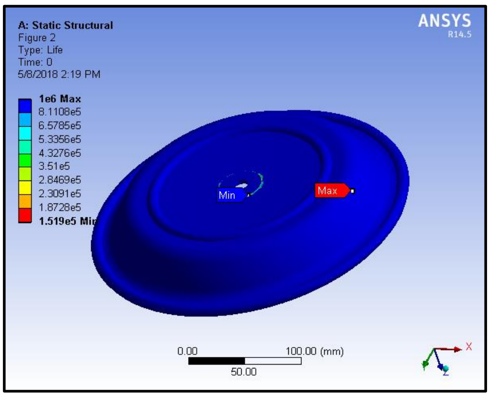

Fig.14: Life of Diaphragm(View2).

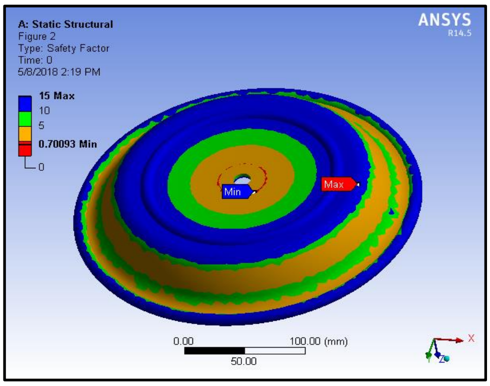

Fig.18: Safety Factor of Diaphragm (View2).

Let us now look at the Diaphragm Analysis with the second material, i.e., E Glass Epoxy.

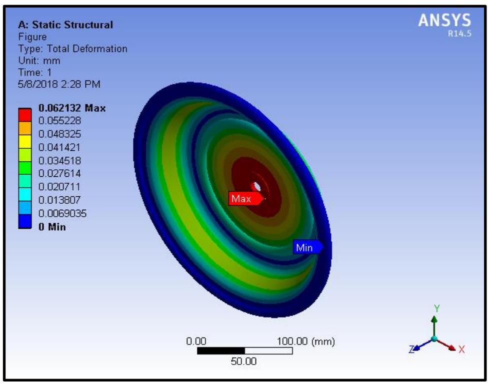

Fig.19: Total Deflection /Deformation in Diaphragm (View 1).

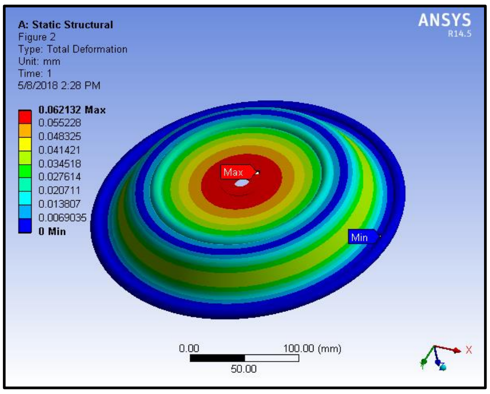

Fig. 20: Total Deflection/Deformation in Diaphragm (view 2).

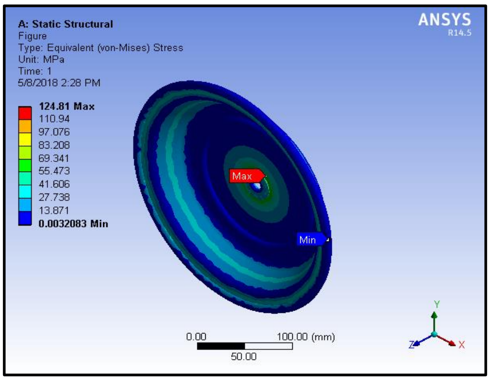

Fig.21: Equivalent Stress in Diaphragm (View 1).

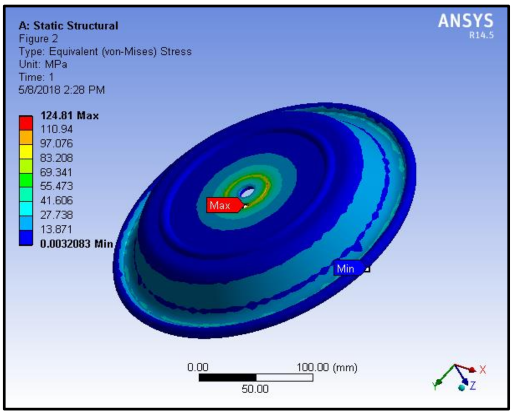

Fig.22: Equivalent Stress in Diaphragm (View 2).

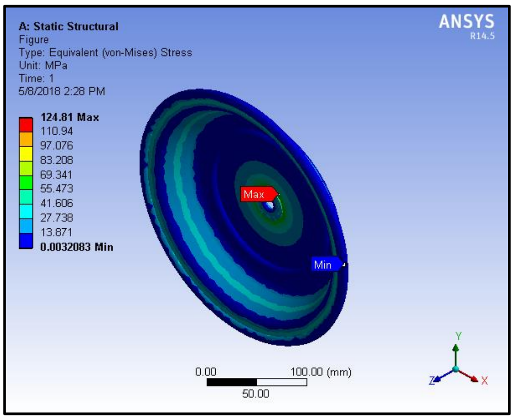

Fig.23: Normal Stress in Diaphragm (View1).

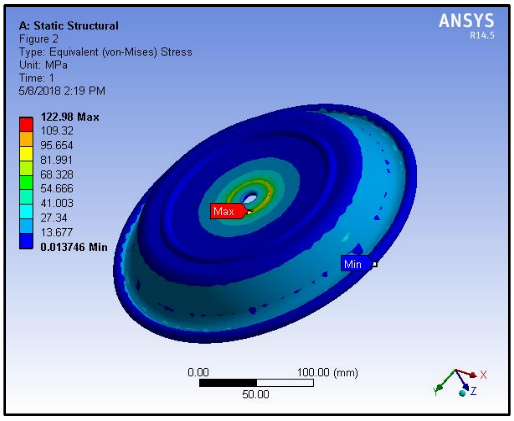

Fig.24: Normal Stress in Diaphragm (View2).

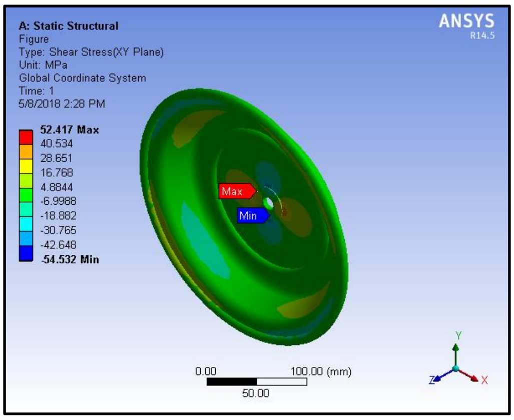

Fig.25: Shear Stress in Diaphragm (View1).

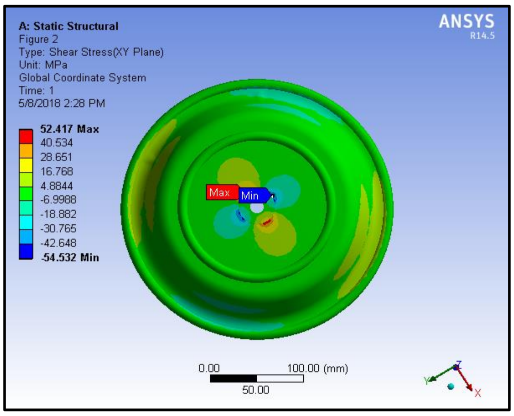

Fig.26: Shear Stress in Diaphragm (View2).

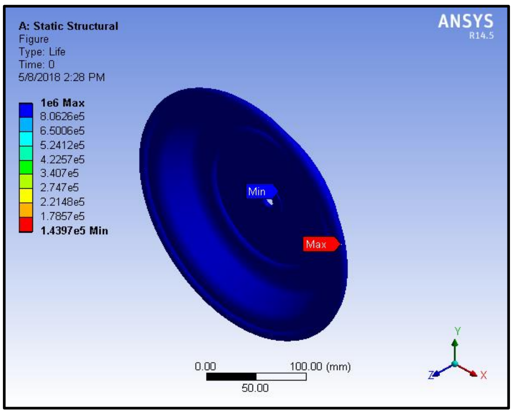

Fig.27: Life of Diaphragm (View1).

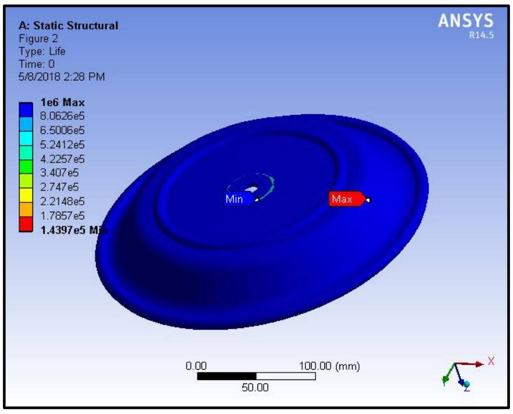

Fig.28: Life of Diaphragm (View2).

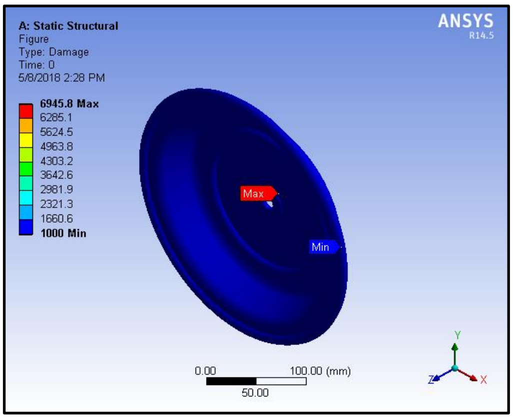

Fig. 29: Damage in Diaphragm (View1).

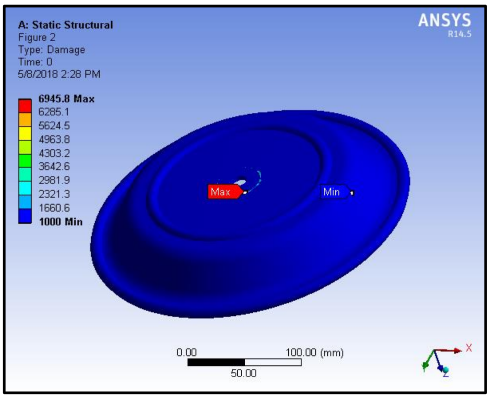

Fig.30: Damage in Diaphragm (View2).

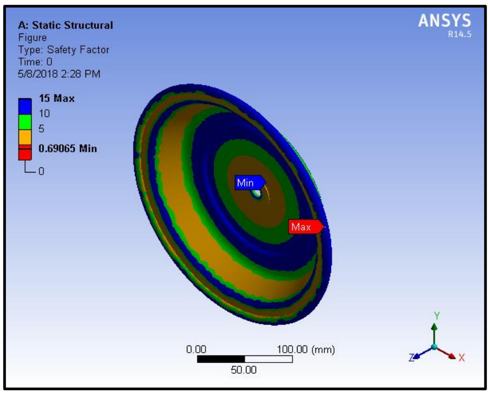

Fig.31: Safety Factor of Diaphragm (View1).

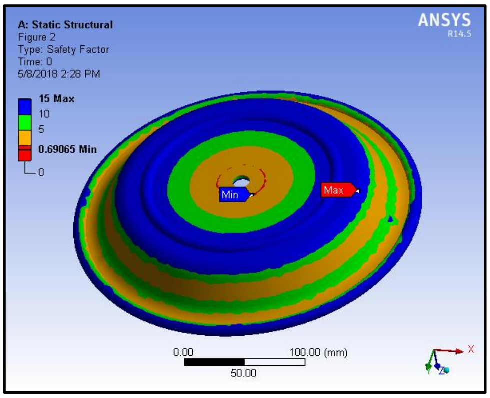

Fig.32: Safety factor of Diaphragm (View2).

Let us now look at the Diaphragm Analysis with the third material, i.e., HS Carbon Epoxy.

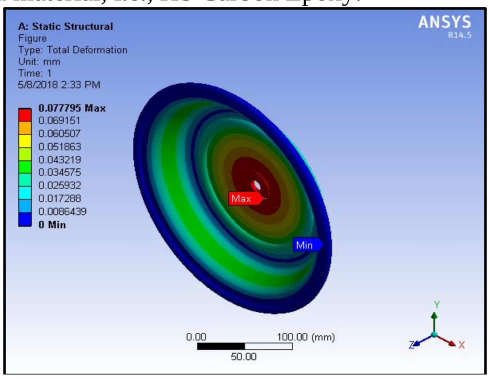

Fig. 33: Total Deflection / Deformation in Diaphragm (view1).

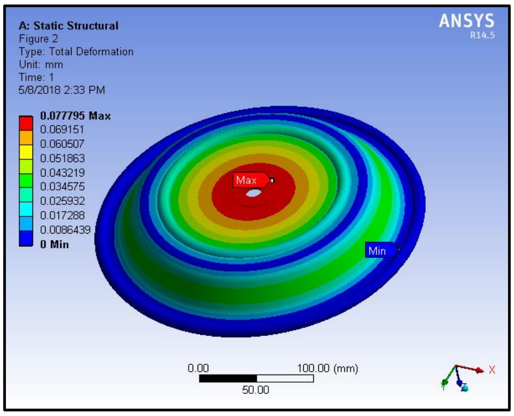

Fig. 34: Total Deflection / Deformation in Diaphragm (View2).

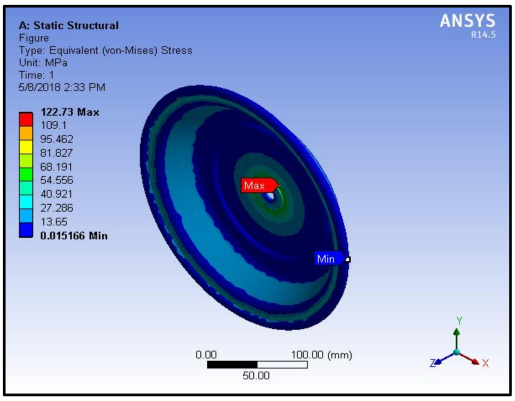

Fig.35: Equivalent Stress in Diaphragm (View1).

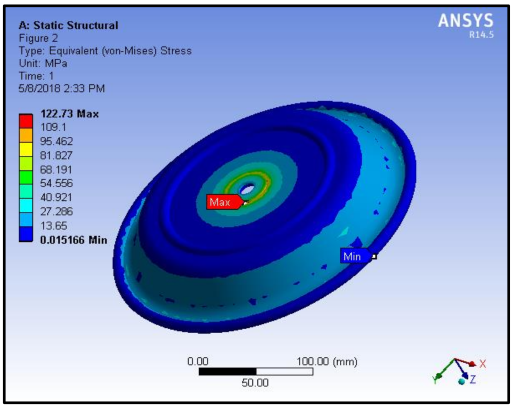

Fig. 36: Equivalent StressinDiaphragm (View2).

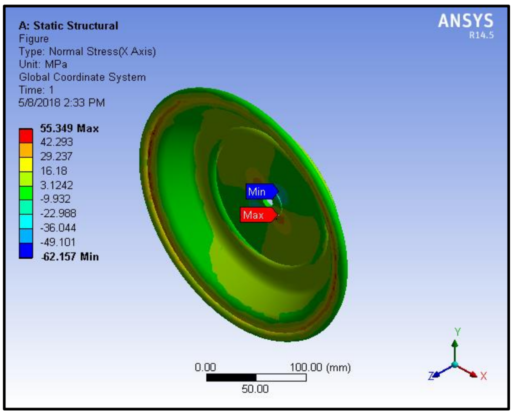

Fig.37: Normal Stress in Diaphragm (View1).

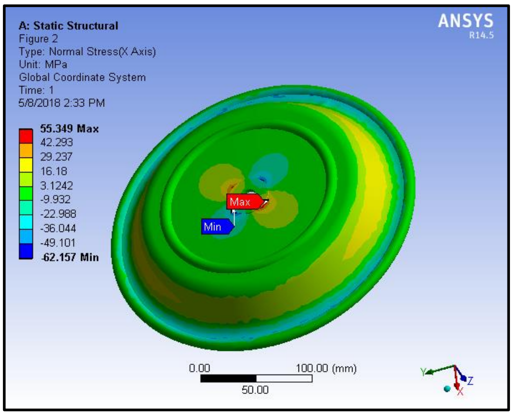

Fig.38: Normal StressinDiaphragm (View 2).

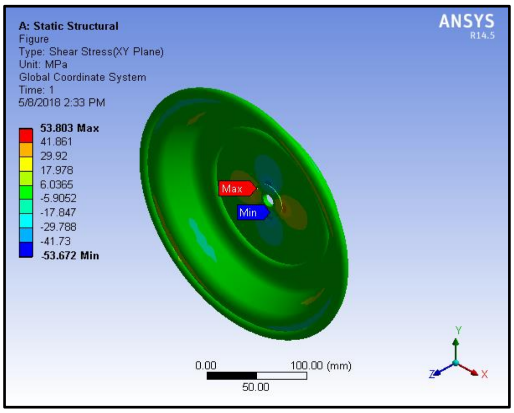

Fig.39: Shear Stress in Diaphragm (View1).

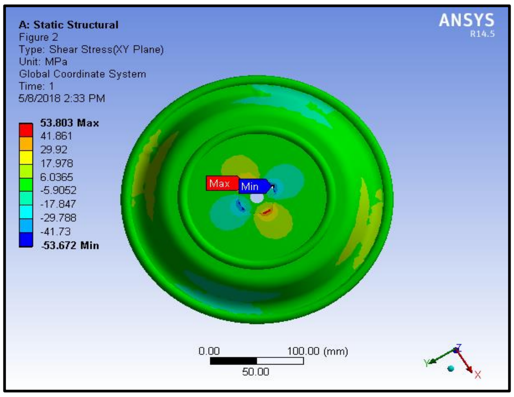

Fig.40: Shear Stress in Diaphragm (View2).

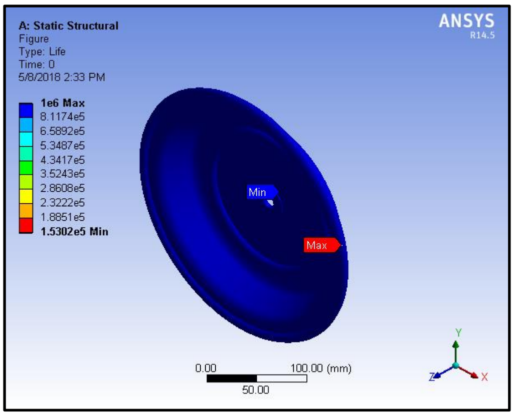

Fig.41: Life of Diaphragm (View1).

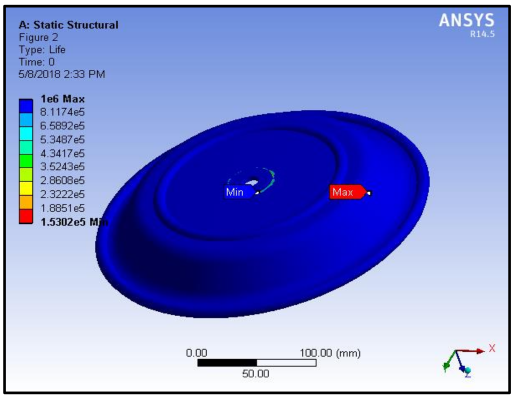

Fig. 42: Life of Diaphragm (View2).

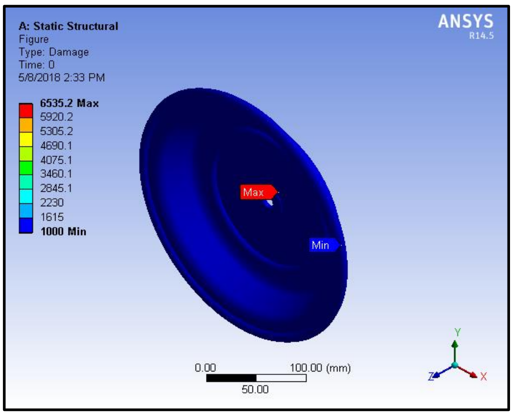

Fig. 43: Damage in Diaphragm (View1).

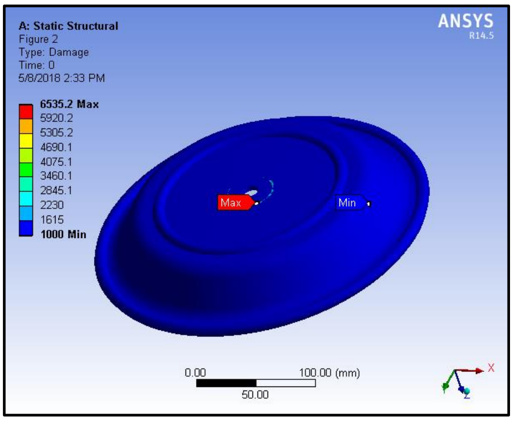

Fig. 44: Damage in Diaphragm (View2).

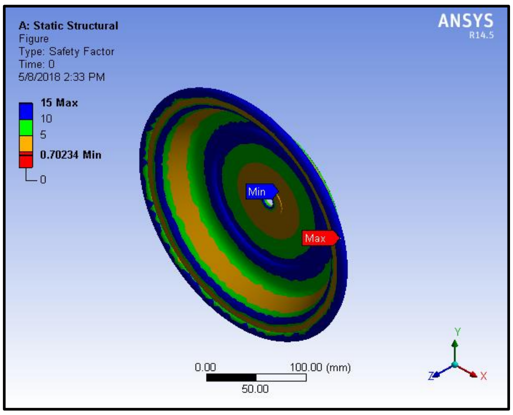

Fig. 45: Safety FactorofDiaphragm (View 1).

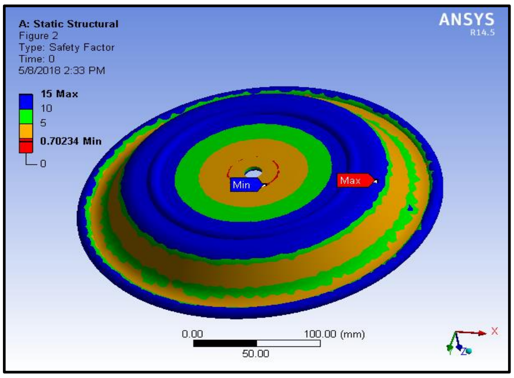

Fig.46: Safety Factor of the diaphragm (View2).

IV. CONCLUSION

Pneumatic operated 2" Diaphragm Pump suffers usual breakdown due to failure of the diaphragm. In this dissertation, we have shown that change in diaphragm material improves the diaphragm's life cycle, which lowers the breakdown or maintenance hours of the Pump. Hence, the Pump's efficiency increases, and the Pump can run for a long time without any maintenance because other pumps transfer only water. This type of Pump is usually used for the discharge of slurry from one place to another. Diaphragm Pump has very low maintenance, and the main advantage of this Pump is that it can run dry in dry condition while other pumps cannot. Hence, it can be concluded that change in diaphragm material will result in its long run and performance availability.

V. REFERENCE

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[3] Ms. Madhani Khushbu1 Prof. Ashwin Thakkar2, All *"Analyzing the Effect of Fabric Reinforcement on Some of the Properties of Rubber Diaphragm"* International Journal for Scientific Research & Development| Vol. 3, Issue 03, 2015 | ISSN (online): 2321-0613

[4] P. V. SumanthChowdary, SenthilPandian. *"A Comparative Study on RCC Structure with and without Shear Wall"* International Journal for Scientific Research & Development| Vol. 2, Issue 02, 2014 | ISSN (online): 2321-0613

[5] Parth D. Shah1 Prof. Binita A. Vyas2" *"Automation of Diaphragm Wall Design for 3 Layers of Soil"* International Journal for Scientific Research & Development| Vol. 3, Issue 03, 2015 | ISSN (online): 2321-0613.

[6] Ambarish G. Mohapatra *"Design and Implementation of Diaphragm, Type Pressure Sensor in a Direct Tire Pressure Monitoring System (TPMS) for Automotive Safety Applications"* International Journal for Scientific Research & Development| Vol. 3, 2015.