FINITE ELEMENT ANALYSIS OF CIRCULAR DISC WITH DIAMETRAL SLOTS

M. R. Sapali[1], D. S. Kolekar[2]
[1 & 2]Assistant Professor, Department Mechanical Engg, N B Navale college of Engineering, Solapur University, Solapur, Maharashtra, India
Email –sapalimr@gmail.com, kolekardjs@gmail.com

Abstract: *Disks are important structural elements in engineering application as well as in everyday life, such as pressure vessel, missiles, liquid containers, and ship structures. The turbine, brake disc and diaphragm clutch spring are the well known examples for the industrial application of the annular plate with radial slots. Circular plates are fundamental structural elements in ocean engineering applications from offshore platforms to under water acoustic transducers. Circular annular plates with radial slots are extensively used in the construction of aircraft, ships, automobiles and other vehicles. As disks are often subjected to transverse vibrations and these vibrations decrease the mechanism's capabilities. Since the dynamic performance is always of interest, hence a circular plate with diametric slots, fixed at inner edge and free at outer edge is chosen and its dynamic response is investigated in this dissertation work as mentioned below.*
FEM software package (ANSYS) is used for vibration analysis of circular plates of same ratio of inner to outer radius but variable numbers and variable lengths of radial slots with same boundary condition for determining different parameters like natural frequency, mode shapes.

Key Words: *FEM software, ANSYS, frequency, vibration.*

1. ANALYSIS METHOD:

1. To find natural frequency by FEM (Ansys software)
   Vibration analysis of circular plate is done by FEM (ANSYS) software to get natural frequencies and mode shapes of annular disk with same aspect ratio but variable (numbers and lengths) of radial slots for inner edge clamped and outer edge free boundary condition. Results obtained from analysis are shown in table as below: Natural frequencies of disks with diametral slots by FEM (ANSYS)

Test Specimen	Sr No	Mode	Frequency (Hz)			Frequency (Hz)	
		(d,c)	3 Slots of 45mm	6 Slots of 45mm	9 Slots of 45mm	3 Slots of 45mm	6 Slots of 45mm
	1	(1,0)	159.1	149.81	143.04	156.71	147.06
	2	(1,0)	159.63	150.04	143.09	158.15	147.37
	3	(0,1)	171.53	158.95	149.66	166.61	150.35
	4	(2,0)	226.36	222.57	219.29	225.5	221.1
	5	(2,0)	226.51	222.84	219.4	225.63	221.69
	6	(3,0)	453.94	448.43	447.07	443.3	426.3
	7	(3,0)	457.29	455.45	447.1	456.58	453.32
	8	(4,0)	796.29	793.25	786.73	786.24	771.65
	9	(4,0)	796.64	793.61	787.18	786.92	772.28
	10	(0,2)	1124.4	1107.	1086.6	1121.3	1100.4

TABLE NO 1

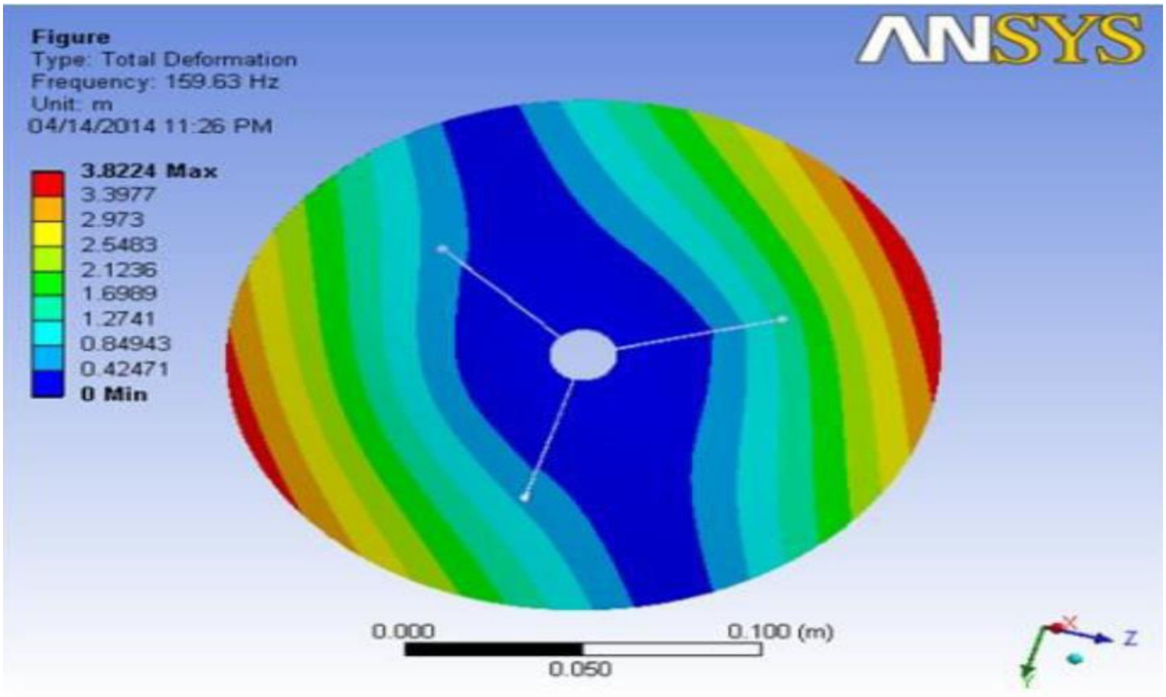

Fig 1 ANSYS mode shape (1, 0)

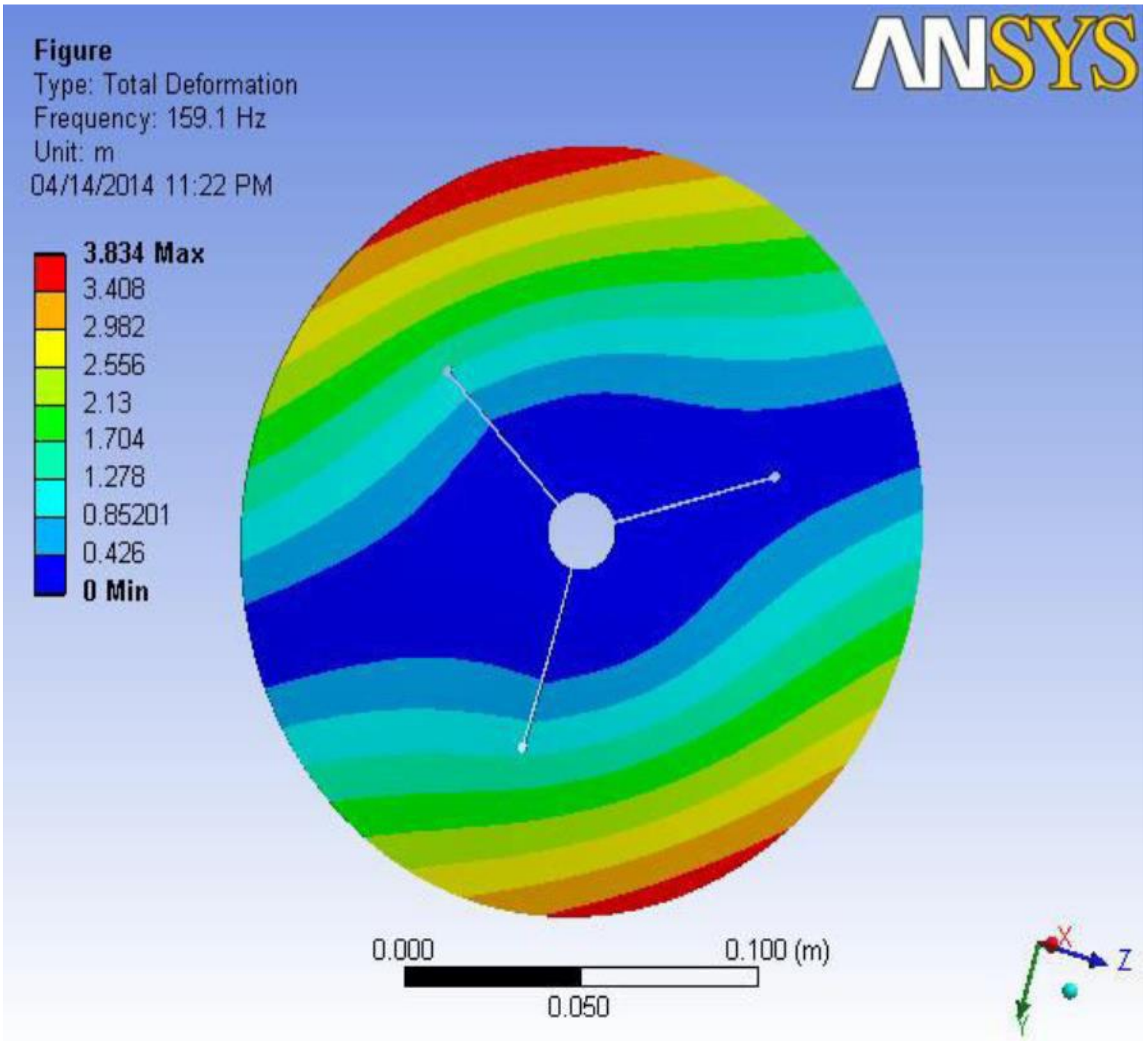

Fig 2 ANSYS mode shape (1, 0)

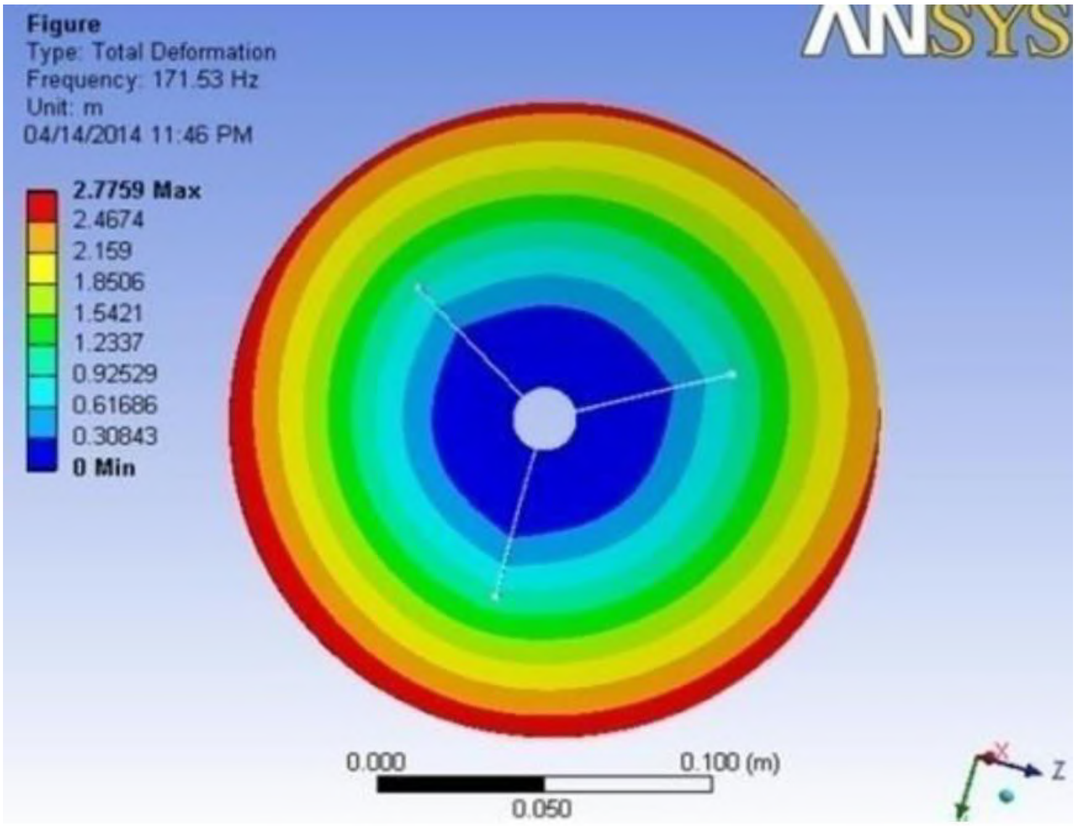

Fig 3 ANSYS mode shape (0, 2)

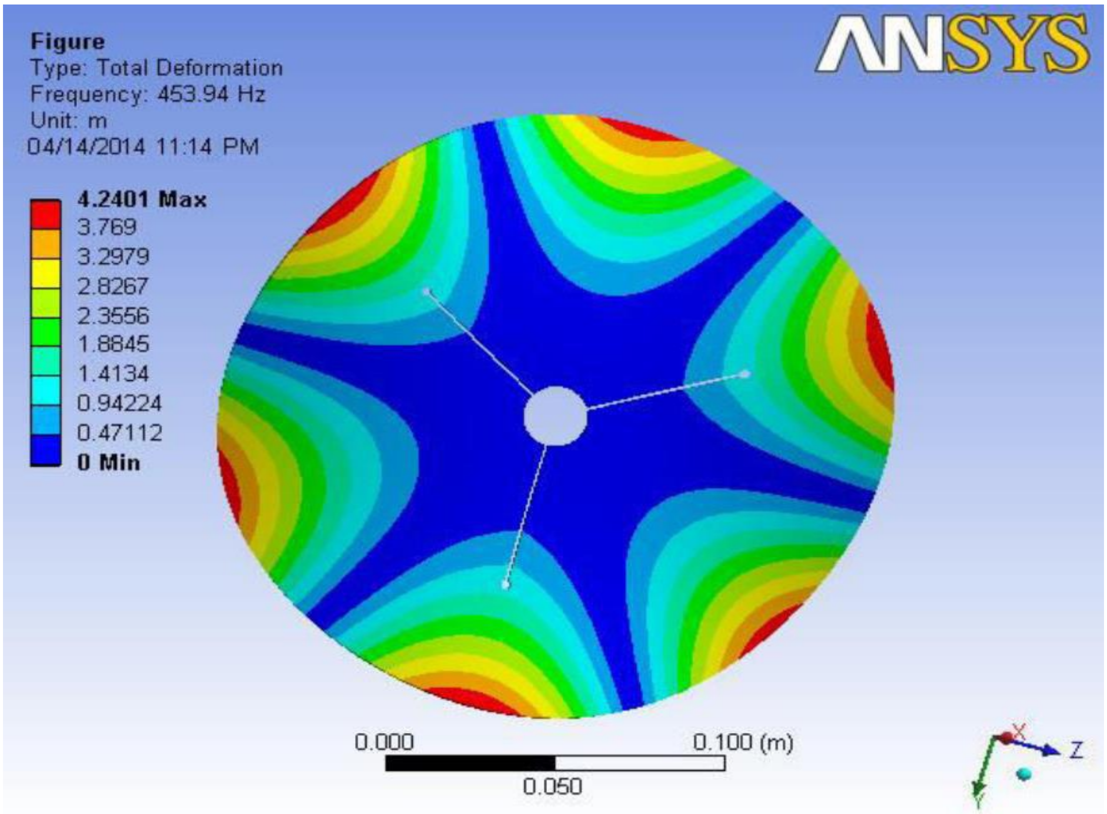

Fig. 4 ANSYS mode shape (3, 0)

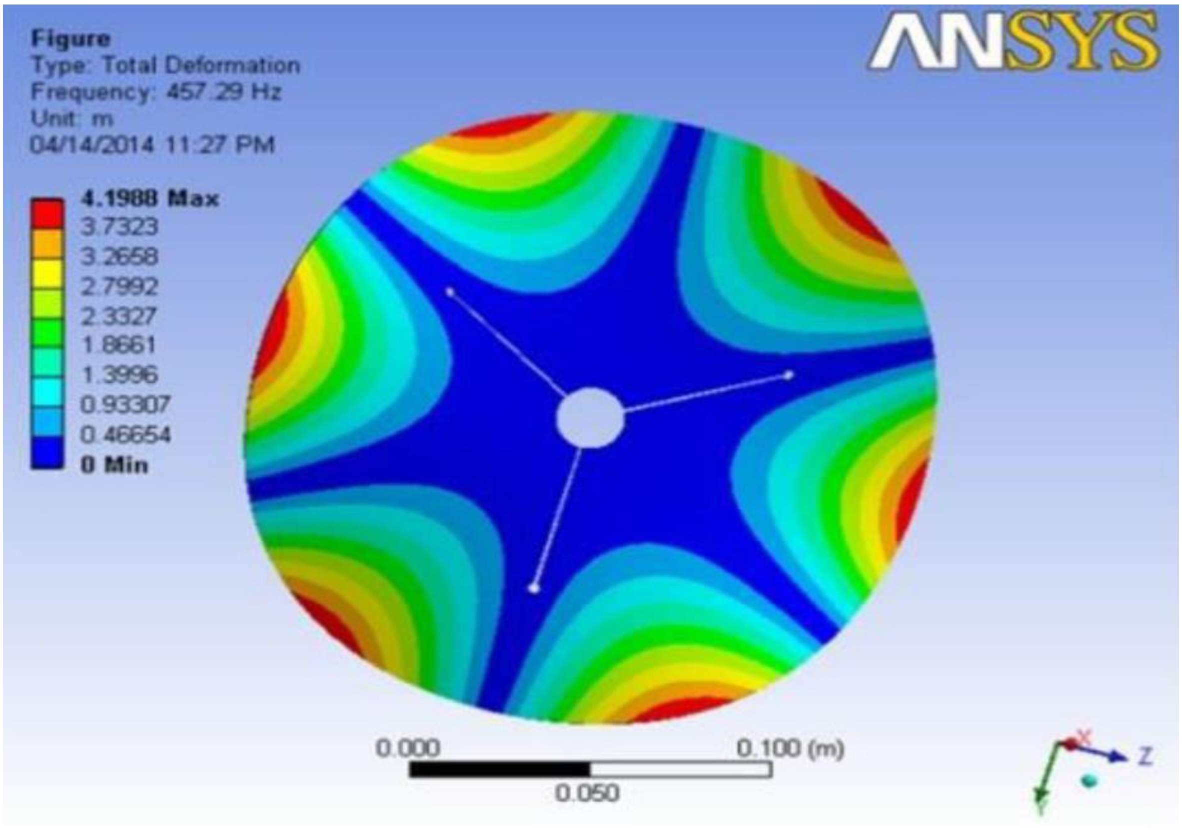

Fig. 5 ANSYS mode shape (3, 0)

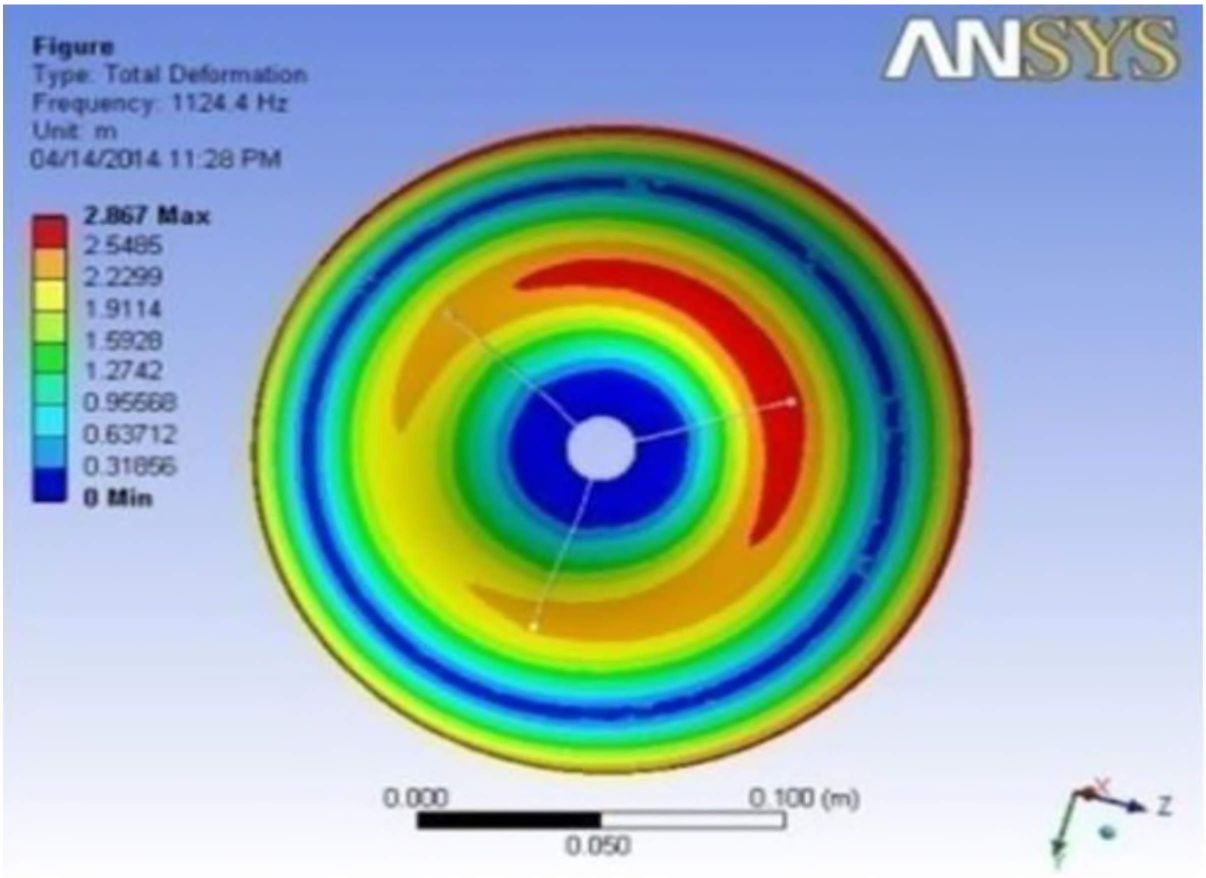

Fig. 6 ANSYS mode shape (0, 2)

2. CONCLUSION:

Computed results have been obtained for the annular disc clamped at inner edge and free at the outer edge system. Annular disk with radial slots for aspect ratio 0.1.Where inner diameter 20 mm, outer diameter 200 mm, thickness 1.5 mm. But variable number of slots (3, 6, 9) and for variable slot length (45, 60) mm with combinations are analyzed FEM analysis for getting vibration characteristics to get following conclusions.

1. Natural Frequency Increases with increase in nodal diameter and it decreases with increase in number of slots for same slot length.
2. Natural Frequency Increases with increase in nodal diameter and it decreases with increase in length slots for same no. of slots.

REFRENCES:

1. Vogel S. M. and Skinner D.W, "Natural frequencies of transversely vibrating annular plates", Journal of Applied Mechanics, December, 1965, 926–931.
2. Leissa Arthur W., 1969, "Vibration of Plates", NASA P160 Watson, GN, 1966.
3. S. S. Rao and A. S. Prasad, "Vibrations of annular plates including the Effects of rotary inertia and transverse shear Deformation", Journal of Sound and Vibration, 1975, vol 4ß, γ05-324.
4. Weisensel G. N. "Natural Frequency information for circular and annular Plates", Journal of sound and vibration,1989, vol. 133, pp129-134.
5. D.V.Bambill, S.La.Malfa, C.A.Rossit, P.A.A.Laura, Analytical and "Experimental investigation on transverse
6. vibration of solid, circular and Annular plates carrying a concentrated mass at an arbitrary position with marine applications", Journal of ocean engineering volγ1, pp1ß7-138.
7. M.Ambali, G.frosali, M.K.Kwak., "Free vibrations of annular plates coupled with fluids", Journal of sound and vibration, 1996 vol.191 (5),pp 825-846.
8. K. Ramesh, D.P.S. Chauhan and A.K. Mallik,"Free vibration of annular plate with periodic radial slots", Journal of sound and vibration, 1997, 206(2)266- 274.
9. J.C. Bae and J.A. Wickert, "free vibration of coupled disk-hat Structures", Journal of sound and vibration, (ß000) 235(1), 117-132.
10. W.T. Norris and J.E.T Penny, **"**Revisitation of the computation of the resonant Frequencies of an annular disc encastred at its inner edge and free at it's outer Edge", Dec ß00ß, AstonUniversity.
11. Murari P.singh, Bhabesh K.Thakur, Willam E. Sullivan, George Donald, Resonance identification for impellers,2003, Proceeeding of thirty second turbomachinary symposium.
12. G.K.Grover, "Mechanical vibrations", Fifth edition, 199γ, Nem Chand & Bros, Roorkee.