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ACOUSTIC POWER ANALYSIS FOR NOISE PREDICTION ON ENGINE OUTPUT SHELL USING CFD TO DECREASE THE POWER LEVEL OF ACOUSTIC

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***Abstract*— Muffler is a part of exhaust system in I.C Engines which suppress the acoustic pulse generated by the combustion process. A high intensity pressure wave produced by combustion in the engine chamber spreads along the exhaust pipe and transmits from the exhaust pipe end. Exhaust mufflers are intended to decrease sound levels at specific frequencies. New guidelines and principles for noise emissions progressively compel the automotive firms to make some developments about diminishing the engine noise. On the other side, advancements on automobile innovation and expanding rivalry between producers, requires ability of higher sound absorption and lower back pressure mufflers with reduced weight. Lightness could be conceivable if the thickness is diminished or the volume is decreased. Be that as it may, this causes high back pressure. For the most part, muffler design has been an iterative procedure by trial and error. In the scenario of world market, it is significant for an organization to shorten product development cycle time.**

This paper with a analytical way to deal with design, create and approve muffler especially reactive muffler for exhaust system, which will give favourable circumstances over the regular technique with shorten product development cycle time and approval. This paper in like manner emphasis how present-day CAE tools could be utilized for leveraged for optimizing the overall system design adjusting conflicting prerequisites like Noise and acoustic power level.

***Keywords*— Muffler design, IC Engines, Acoustics, Cycle time, Acoustic Power level.**

I. Introduction

Mufflers are main component of our vehicle's exhaust system and are situated at the rear end, bottom of your vehicle. They help in hosing vehicle emissions and engine noise. They are made of steel and are covered with aluminium to give assurance from the heat and chemical substances discharged from the exhaust system. Mufflers are utilized mainly to dissipate the loud sounds made by the engine's piston and valves.

Each time your exhaust valve opens, an enormous burnt of the gases utilized during your engine's combustion is discharged into the exhaust system. This arrival of gases makes incredible sound waves. To see how a muffler scatters the sound waves made by your engine, one must see how sound is delivered. Sound is a pressure wave formed by vibrations. These vibrations are pulses of substituting high and low air pressure.

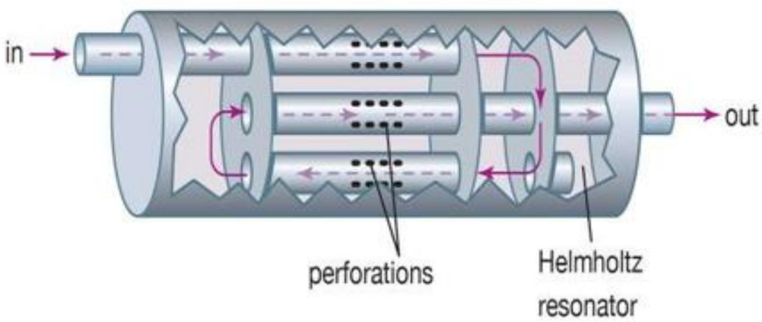
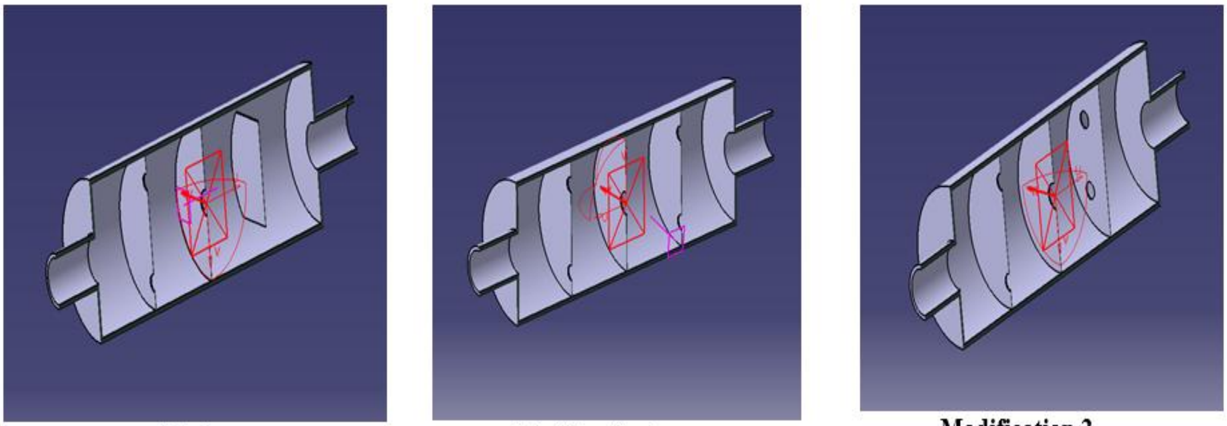


Fig 1 Shows Muffler Design



Main **Modification1** **Modification 2**

Fig 2 shows modified designs of Muffler designed in Catia

I. CFD ANALYSIS ON MAIN ACOUSTIC

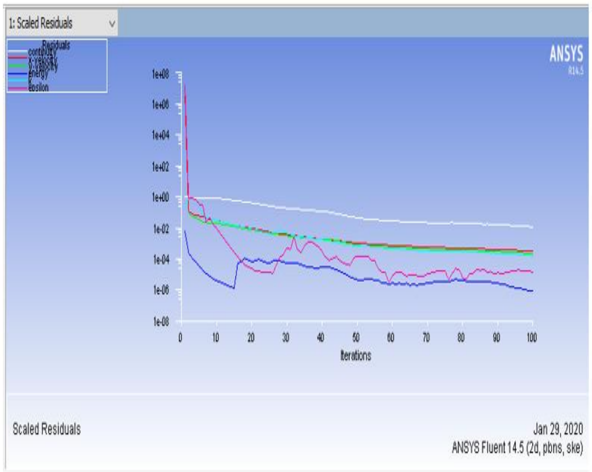


Fig 3 Shows Scaled Residuals of main Muffler model

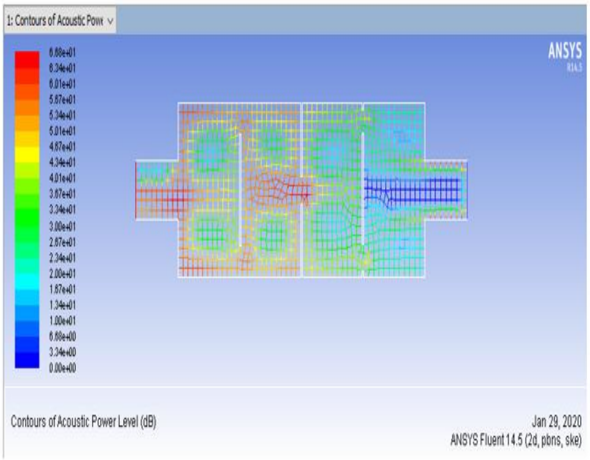


Fig 5 Shows contour of Acoustic Power level of main Muffler model

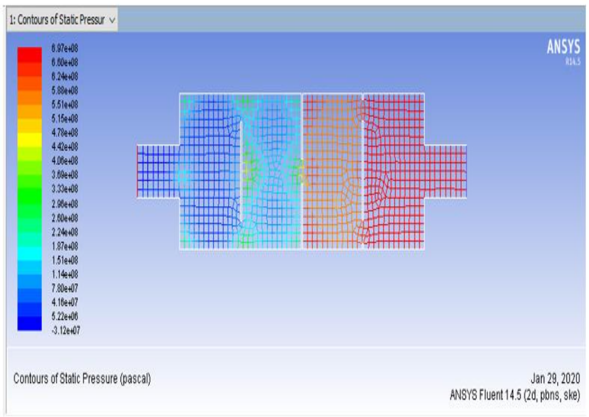


Fig 4 Shows contour of static pressure of main Muffler mode

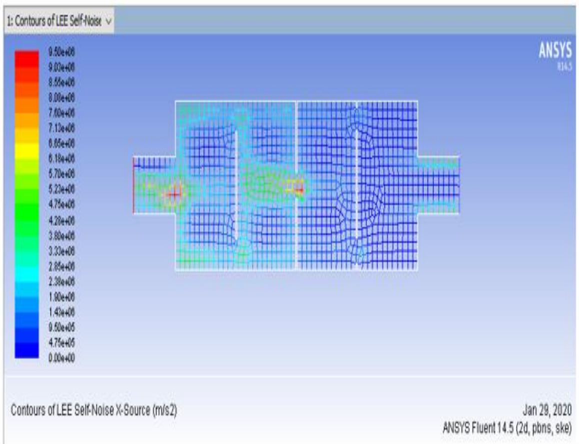


Fig 6 Shows contour of Lee Self-Noise X-Source of main Muffler model

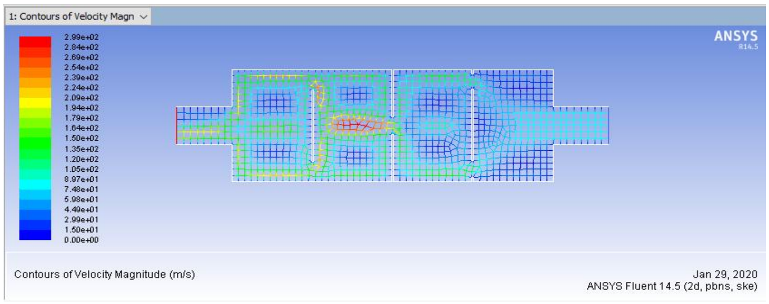


Fig 7 Shows contour of velocity Magnitude of main Muffler model

II. CFD ANALYSIS ON MODIFY 1 ACOUSTIC

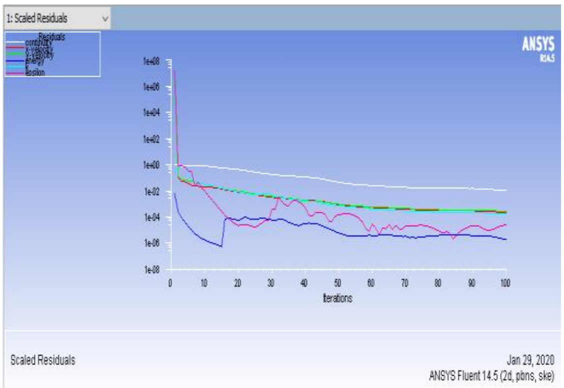


Fig 8 Shows Scaled Residuals of Modified Muffler Model 1

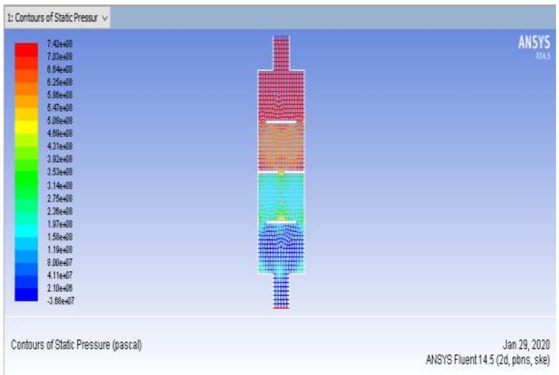


Fig 9 Shows Contour Static Pressure of Modified Muffler Model 1

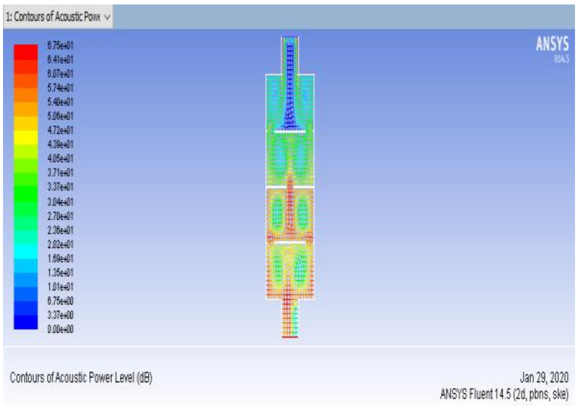


Fig 10 Shows Contour of Acoustic Power Level of Modified Muffler Model 1

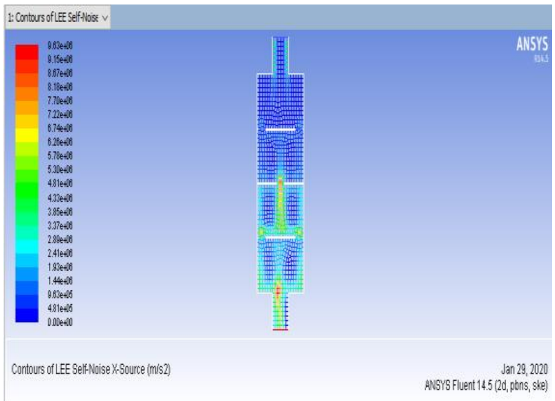


Fig 11 Shows Contour of Lee Self Noise X-source of Modified Muffler Model 1

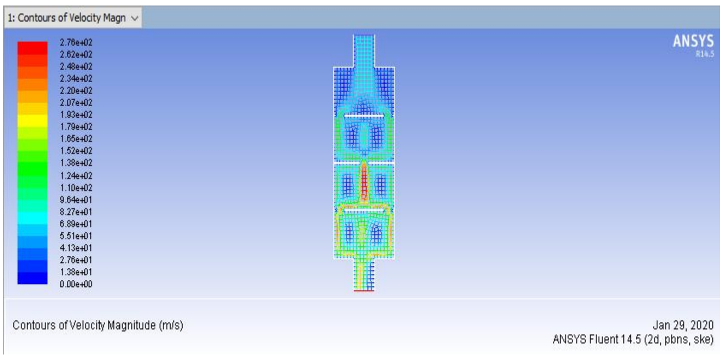


Fig 12 Shows Contour Velocity Magnitude of Modified Muffler Model 1

III. CFD ANALYSIS ON MODIFY 2 ACOUSTIC

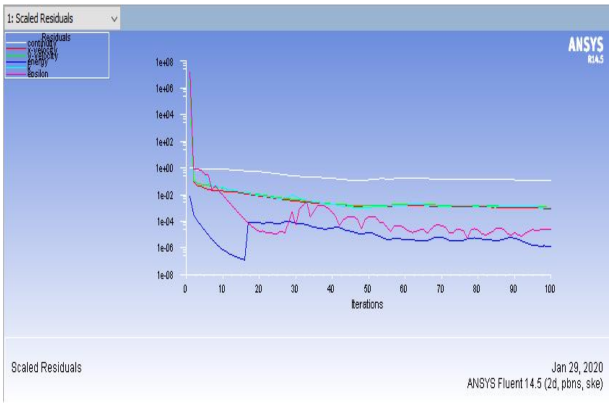


Fig 13 Shows Scaled Residuals of Modified Muffler Model 2

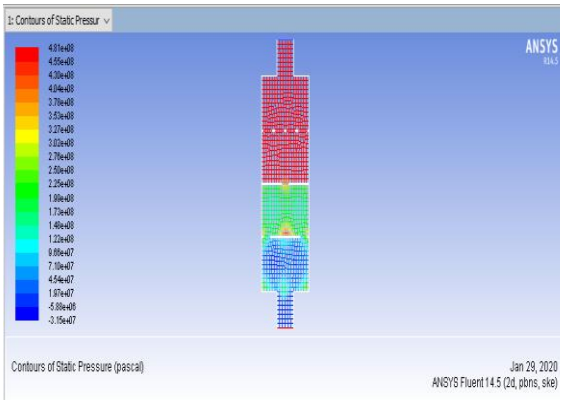


Fig 14 Shows Contour Static Pressure of Modified Muffler Model 2

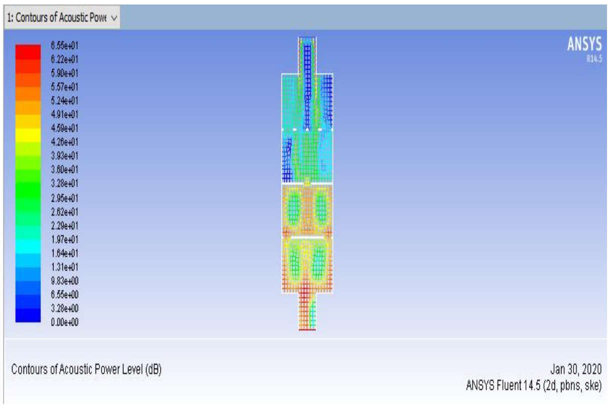


Fig 15 Shows Contour of Acoustic Power Level of Modified Muffler Model 2

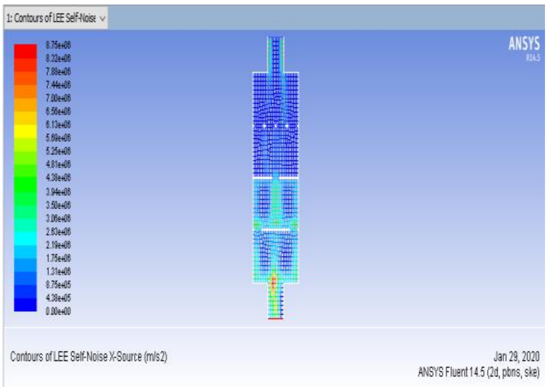


Fig 16 Shows Contour of Lee Self Noise X-source of Modified Muffler Model 2

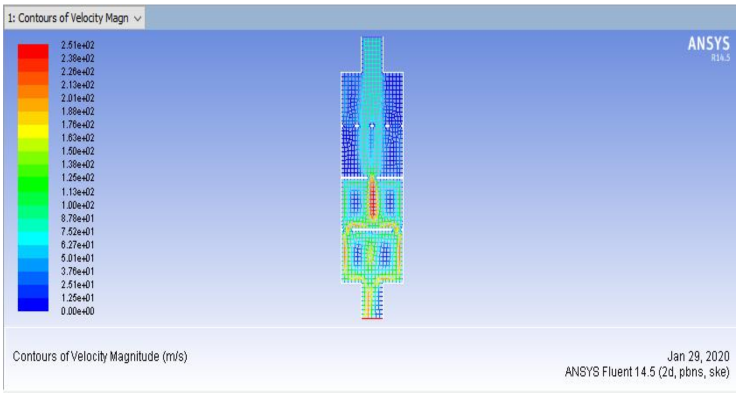
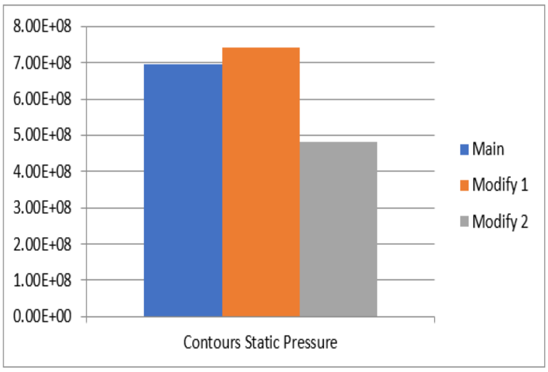


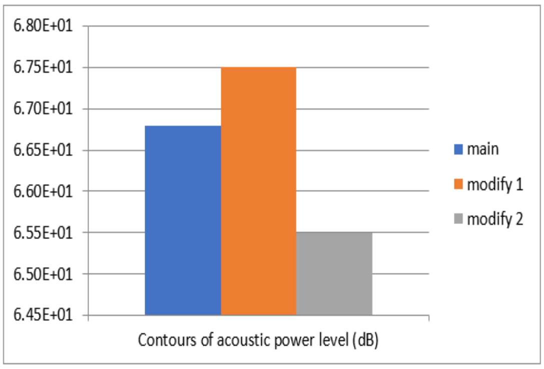
Fig 17 Shows Contour Velocity Magnitude of Modified Muffler Model 2

	Main	Modify 1	Modify 2
Contours Static Pressure	6.97E+08	7.42E+08	4.81E+08
Contours of acoustic power level (dB)	6.68E+01	6.75E+01	6.55E+01
Contours of lee self-noise x-source (m/s^2)	9.50E+06	9.63E+06	8.75E+06
Contours of velocity Magnitude (M/S)	2.99E+02	2.76E+02	2.51E+02

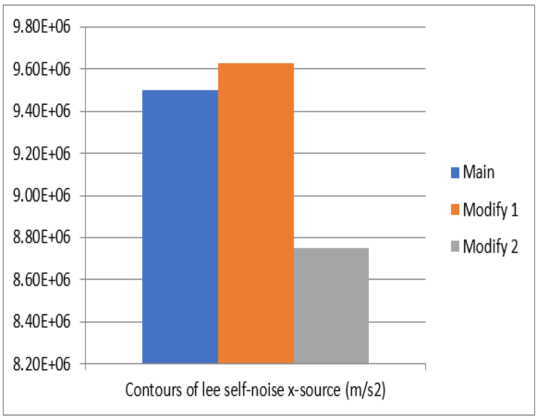
Table 1 shows the differnces between various designs



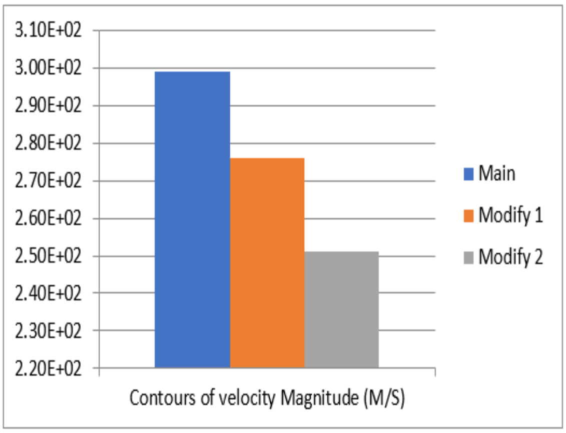
Graph 1 Representation on Contours Static Pressure



Graph 2 Representation on Contours of acoustic power level (dB)



Graph 3 Representation on Contours of lee self-noise x-source (m/s^2)



Graph 4 Representation on Contours of velocity Magnitude (M/S)

IV. VIBRATION (MODEL) ANALYSIS ON MAIN ACOUSTIC

1. Using Al 2024 Material

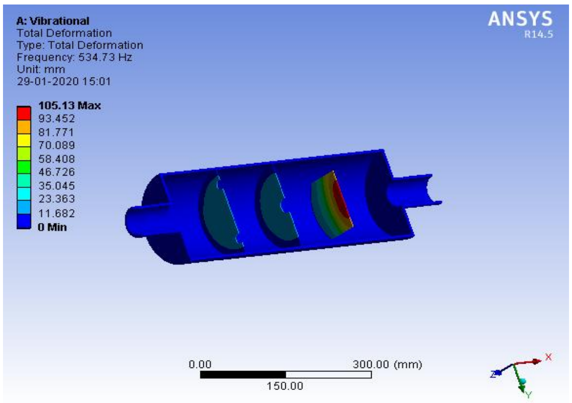


Fig 18 Shows Total deformation of Main Acoustic at 534.73 Hz

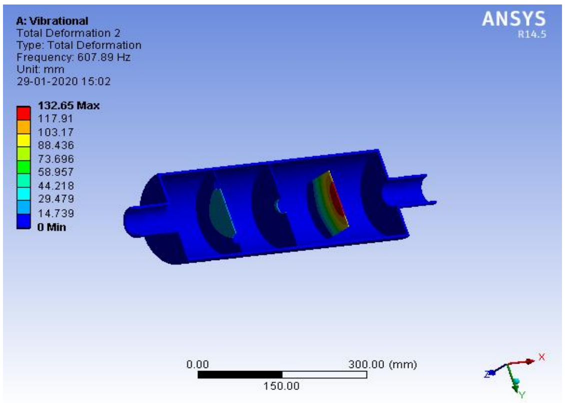


Fig 19 Shows Total deformation of Main Acoustic at 607.89 Hz

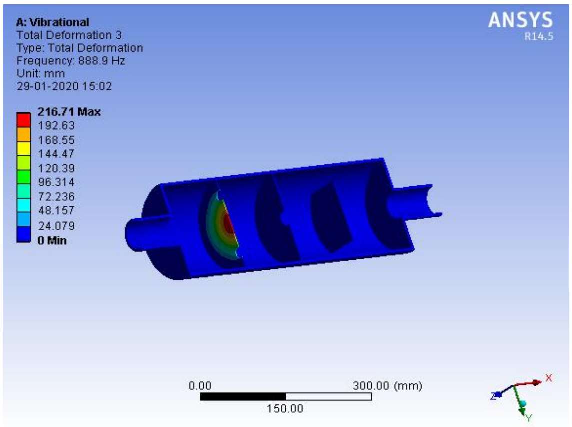


Fig 20 Shows Total deformation of Main Acoustic at 888.9 Hz

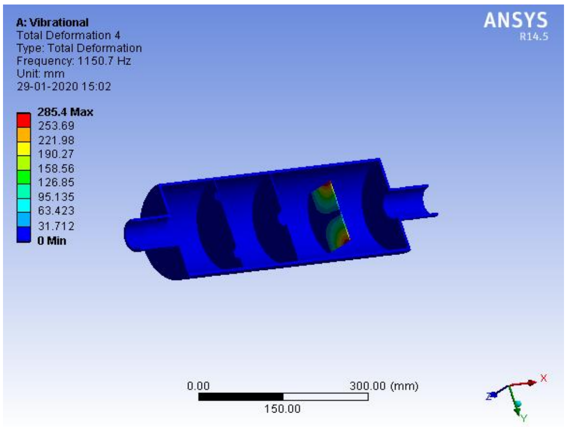


Fig 21 Shows Total deformation of Main Acoustic at 1150.7 Hz

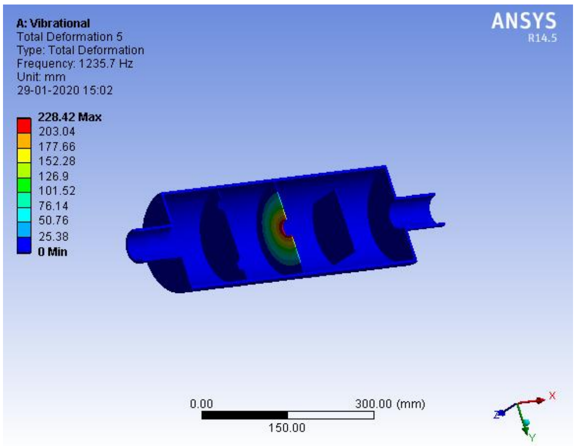


Fig 22 Shows Total deformation of Main Acoustic at 1235.7 Hz

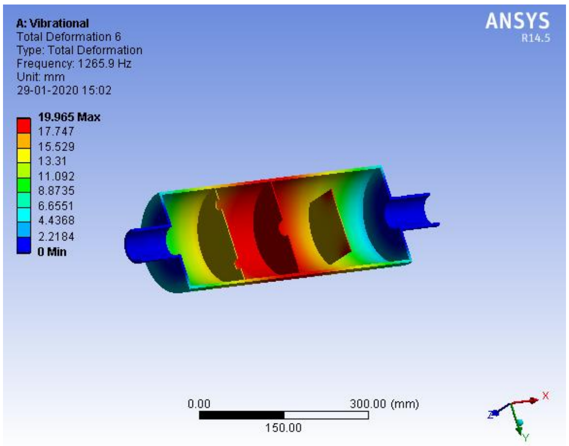


Fig 23 Shows Total deformation of Main Acoustic at 1265.9 Hz

2. Using Al 6061 Material

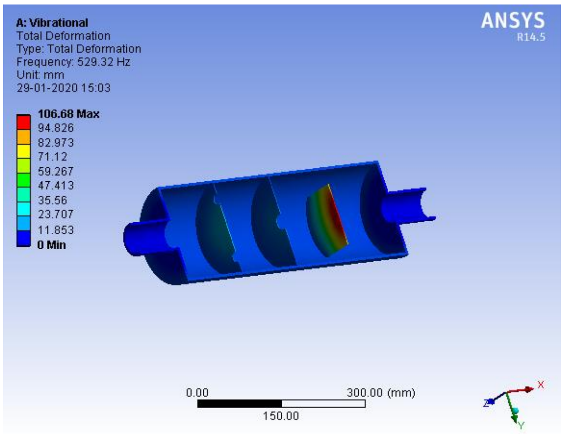


Fig 24 Shows Total deformation of Main Acoustic at 529.32 Hz

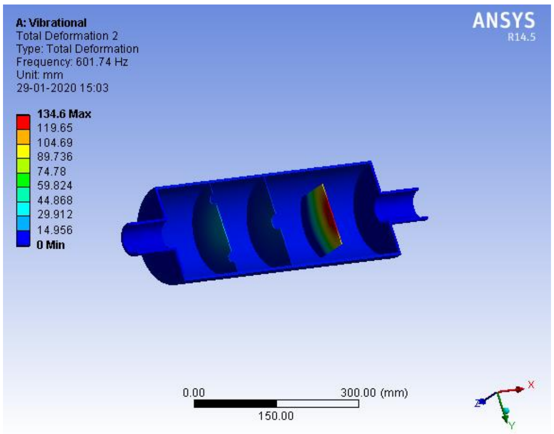


Fig 25 Shows Total deformation of Main Acoustic at 601.74 Hz

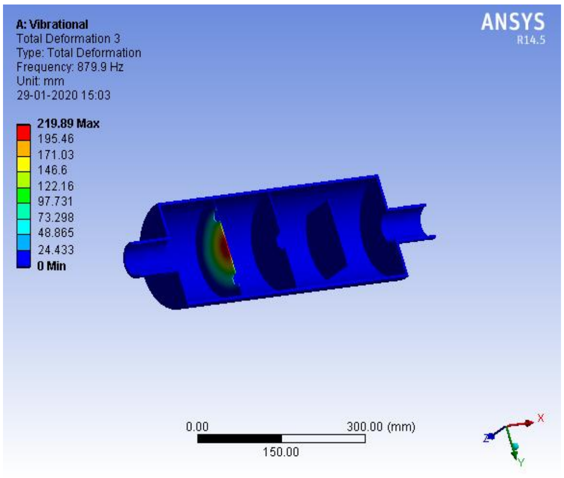


Fig 26 Shows Total deformation of Main Acoustic at 879.9 Hz

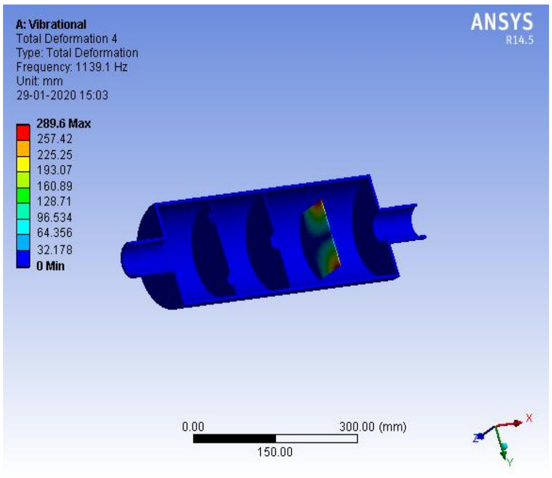


Fig 27 Shows Total deformation of Main Acoustic at 1139.1 Hz

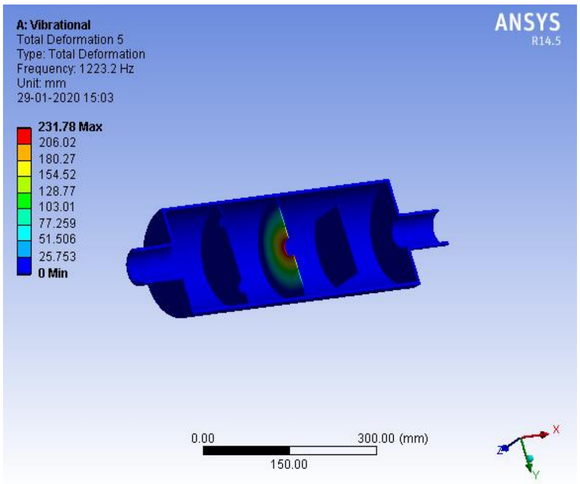


Fig 28 Shows Total deformation of Main Acoustic at 1223.2 Hz

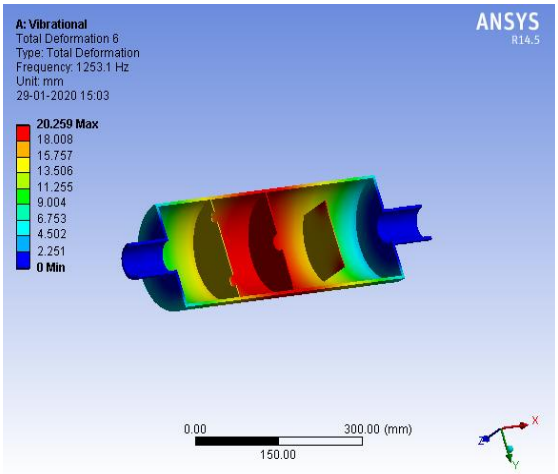


Fig 29 Shows Total deformation of Main Acoustic at 1253.1 Hz

	Vibration Analysis	model 1	model 2	model 3	model 4	model 5	model 6
al 2024	frequency(Hz)	534.73	607.89	888.9	1150.7	1235.7	1265.9
	deformation(mm)	105.13	132.65	216.71	285.4	228.42	19.965
al 6061	frequency(Hz)	529.32	601.74	879.9	1139.1	1223.2	1253.1
	deformation(mm)	106.68	134.6	219.89	289.6	231.78	20.259

Table 2 shows the variation of deformations based on frequencies and model design

V. VIBRATION (MODEL) ANALYSIS ON MODIFY 1 ACOUSTIC

1. Using Al 2024 Material

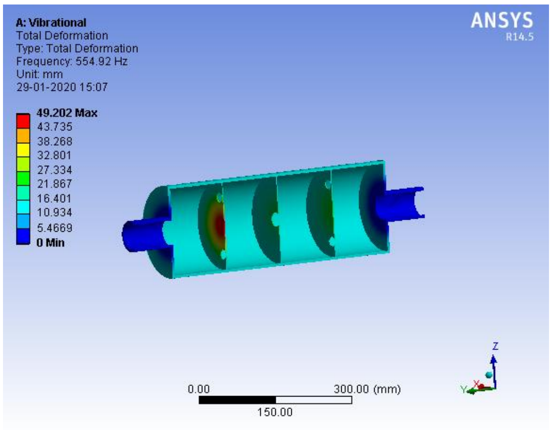


Fig 30 Shows Total deformation of Modify 1 Acoustic at 554.92 Hz

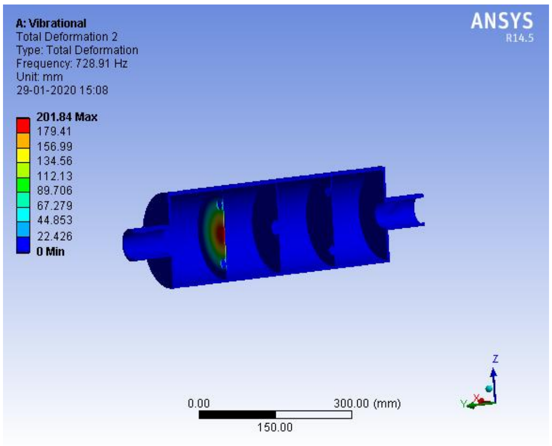


Fig 31 Shows Total deformation of Modify 1 Acoustic at 728.91 Hz

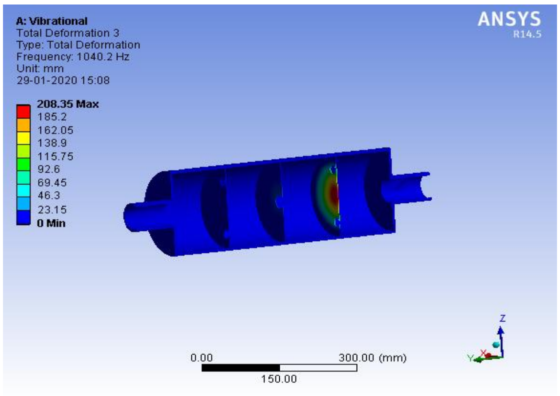


Fig 31 Shows Total deformation of Modify 1 Acoustic at 1040.2 Hz

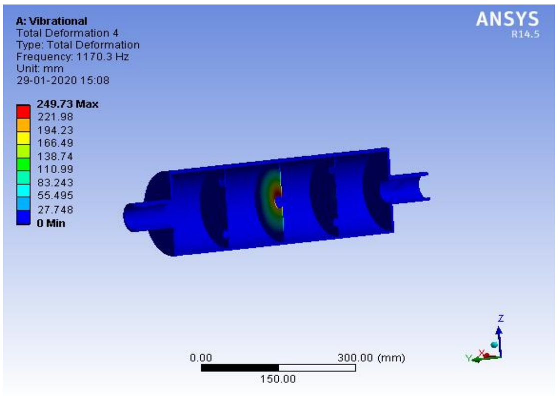


Fig 32 Shows Total deformation of Modify 1 Acoustic at 1170.3 Hz

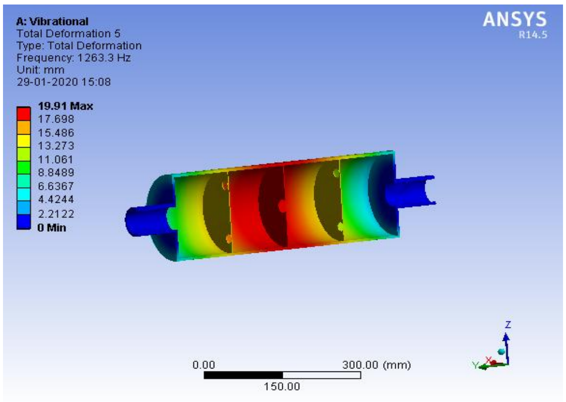


Fig 33 Shows Total deformation of Modify 1 Acoustic at 1263.3 Hz

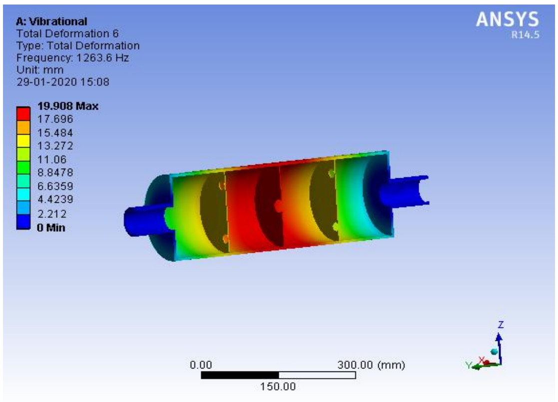


Fig 34 Shows Total deformation of Modify 1 Acoustic at 1263.6 Hz

2. <u>Using Al 6061</u>

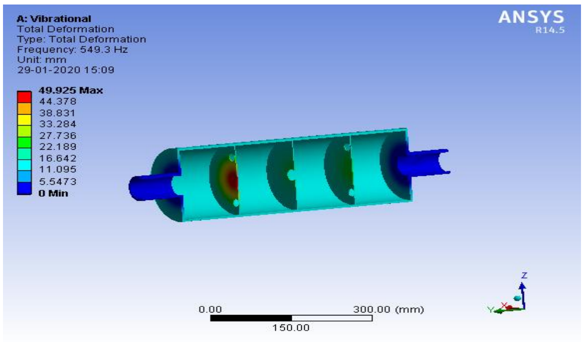


Fig 35 Shows Total deformation of Modify 1 Acoustic at 549.3 Hz

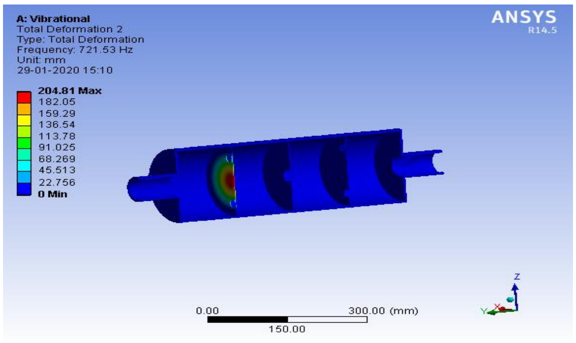


Fig 36 Shows Total deformation of Modify 1 Acoustic at 721.53 Hz

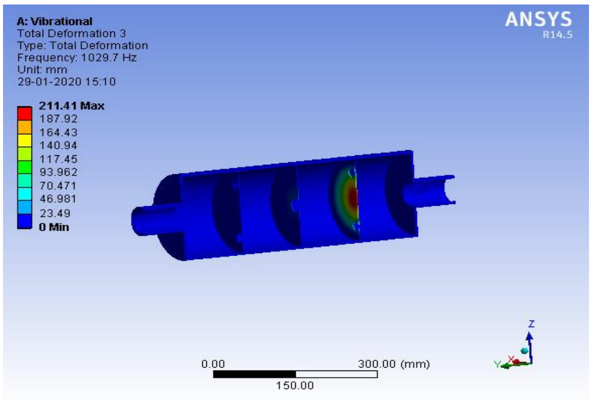


Fig 37 Shows Total deformation of Modify 1 Acoustic at 1029.7 Hz

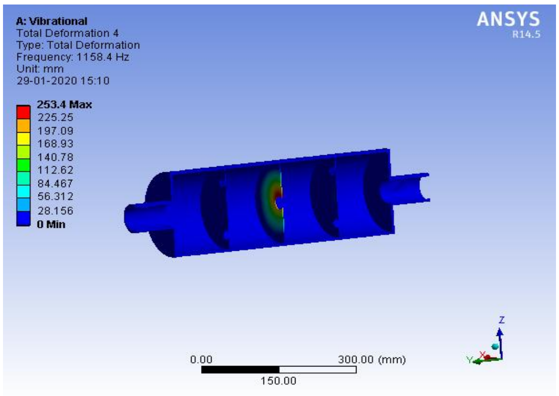


Fig 38 Shows Total deformation of Modify 1 Acoustic at 1158.4 Hz

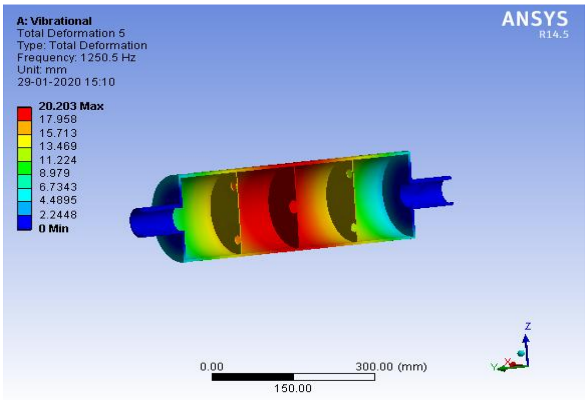


Fig 39 Shows Total deformation of Modify 1 Acoustic at 1250.5 Hz

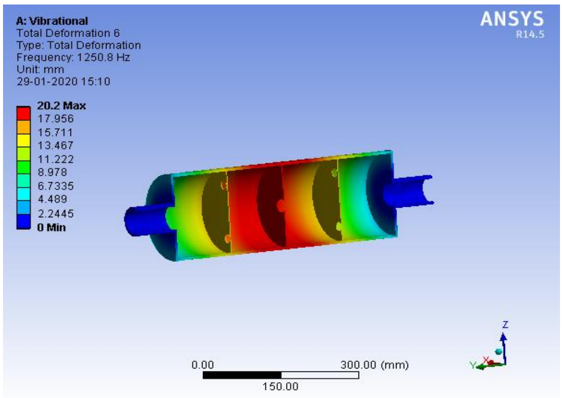


Fig 40 Shows Total deformation of Modify 1 Acoustic at 1250.8 Hz

Material		model 1	model 2	model 3	model 4	model 5	model 6
al 2924	frequency(Hz)	554.92	728.91	1040.2	1170.3	1263.3	1263.6
	deformation(mm)	49.202	201.84	208.35	249.73	19.91	19.908
al 6061	frequency(Hz)	549.3	721.53	1029.7	1158.4	1250.5	1250.8
	deformation(mm)	49.925	204.81	211.41	253.4	20.203	20.2

Table 3 shows the variation of deformations based on frequencies and model design

CONCLUSION

This paper accentuation on how present-day CAE tools could be utilized for improving overall system design adjusting conflicting necessities like Noise and acoustic power level.

As though we confirm the outcomes acquired in the tabular and graphical format, here it is obviously seen that the two new models are been created from the existing models. As though we check the outcomes the modified model 2 has acquired the best outcomes when compared with others. As in this model the power level and the noise proportion is less when compared with others. According to the road transport authority standards the modified model 2 fulfills all the terms.

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