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REVIEW ON NOISE AND VIBRATION IN AUTOMOBILES

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ABSTRACT

The major amount of worldwide transportation is done by using automobiles. Besides considering the advantages of automobiles for transportation there are lot of adverse effect of automobiles on surrounding environment as well as on human health. About 20% -25% of total greenhouse gas emission in industrialized countries is generated by transportation .Transportation noise is one of the main source of noise pollution which also causes annoyance during night. The given paper describes the noise and vibration in automobiles, its sources, methods to control and its effect.

Keywords: conti seal, driveline, engine noise

I.INTRODUCTION

Study of noise and vibration is very important task in front of acoustic engineer while designing and manufacturing of any vehicle. Sound is propagating type of energy travelling with particular velocity through a medium [1]. When a sound wave crosses its particular limit it becomes an unwanted and that unwanted sound is known as noise. Vibration is variation or displacement of body with respect to specific reference position with time. Vibration is oscillation that is typically felt instead of heard. Within a vehicle many components contribute to overall emitted noise and vibration of vehicle. The treatment of only one source will not affect the overall radiated noise. In order to achieve an overall noise reduction for automobile all noise sources and their transfer path to radiating component have to be treated simultaneously and in holistic approach [3].

II.SOURCES OF NOISE AND VIBRATION

The noise which generate in the interior of vehicle reduces the user ride comfort [1]. So as to reduce the noise and vibration in automobile, acoustic engineers have to focus on its respective sources.

2.1 Engine:

Engine being the main source of noise, the noise from engine is transmitted through two paths viz, direct infiltration and structural vibration [1]. The parameters which are responsible for generating noise in engine are holes in lower dashboard, improper sealing, complex geometry worn out engine mounts. When a vehicle is running at high speed on a road if any demerits as mention above found leads to noise from engine to reach

directly into the cabin. Vibration in engine are generate due to the reciprocating mechanism of piston for converting energy into rotary motion. Reciprocating, combustion, and rotational forces are responsible for producing the engine vibration [2]. As the combustion occur in the cylinder large amount of vibrations are generate. During reciprocating of piston also noise and vibration generates. As the connecting rod and crankshaft rotate generates a torque around crankshaft axis. Torsional vibrations are generates due to torque variations. Figure 1 shows the engine vibration in vehicle.

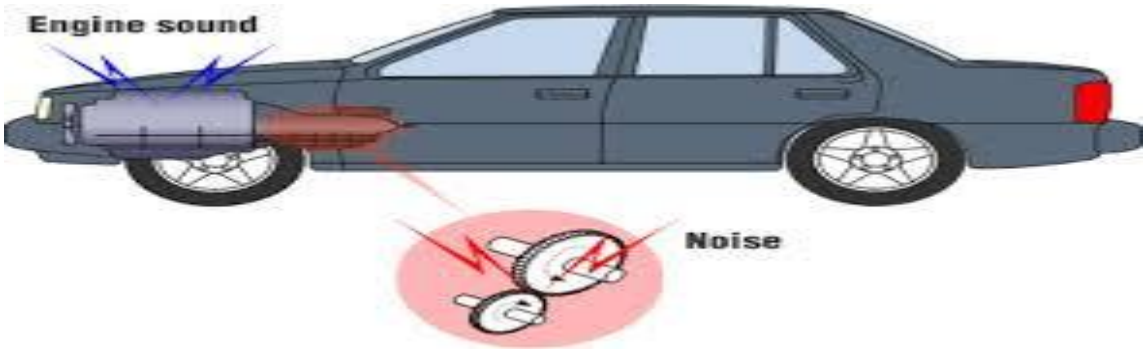

Fig.1 Engine noise and vibration in vehicle.

2.2 Driveline Sources:

Driveline is way or path from engine to power transmitting element. While power transmission from engine to wheel noise and vibration generate. various components are responsible for power transmission such as gear, axle, shaft, tyres, etc. and all these generates noise and vibrations during its working. Improper bending dynamic of gear tooth and both tortional and bending characteristics of shaft are responsible for the generation of noise and vibrations from gear. When the vehicles runs at high speed propeller shaft generate excitation. Presence of large coupling angles, universal joints also generate excitation. Axle noise because of response angle to vibration generated by meshing action of axle gear set. Tyre vibrations are generates due to tribology between the tyre and road. Tyre vibrations are the results of running over a road having irregularities. Also tread squirm results lateral vibrations and generates noise spectra. Figure 2 shows the propagation of tyre noise of an automobile at frequency of 600Hz. Whatever driveline noise generated is annoying even at squat level in passengers compartment of vehicle [2].

Fig. 2Propagation of tyre noise of an automobile at frequency of 600Hz.

2.3 Induction Noise:

Induction noise is due to the opening and closing mechanism of valves. Due to the suction stroke of the piston inlet valve of cylinder get opened and the inlet air column is set into oscillation due to intense pressure thump [2].when the inlet valve closed with high speed produces force undamped vibrations.

II.IV Exhaust noise:

Combustion process completed and whatever combusted gas in cylinder is release out through exhaust valve and due to exhaust of gas through valves it generates noise.

2.4 Engine Fan:

Engine fan is used for cooling in addition to radiator. It being a source of noise while it runs.

II.VI Aerodynamic and Wind noise:

Aerodynamic noise is generated due by anarchic flow of air around the tyre. Also theAerodynamic noise is depend upon the shape of automobiles. How fluently the highly accelerated air flows over automobile during ride defines the Aerodynamic noise. Wind noise is experienced at the interior of vehicle. Wind noise is due to the presence of imperfect sealing of door frame and glass. As the vehicle is ride with high velocity air passes through the gap present between the door and glass with high speed and generate unwanted high frequency noise. Ample number window and door seals ensures successful wind noise control. figure[3] shows the schematic view of wind noise.

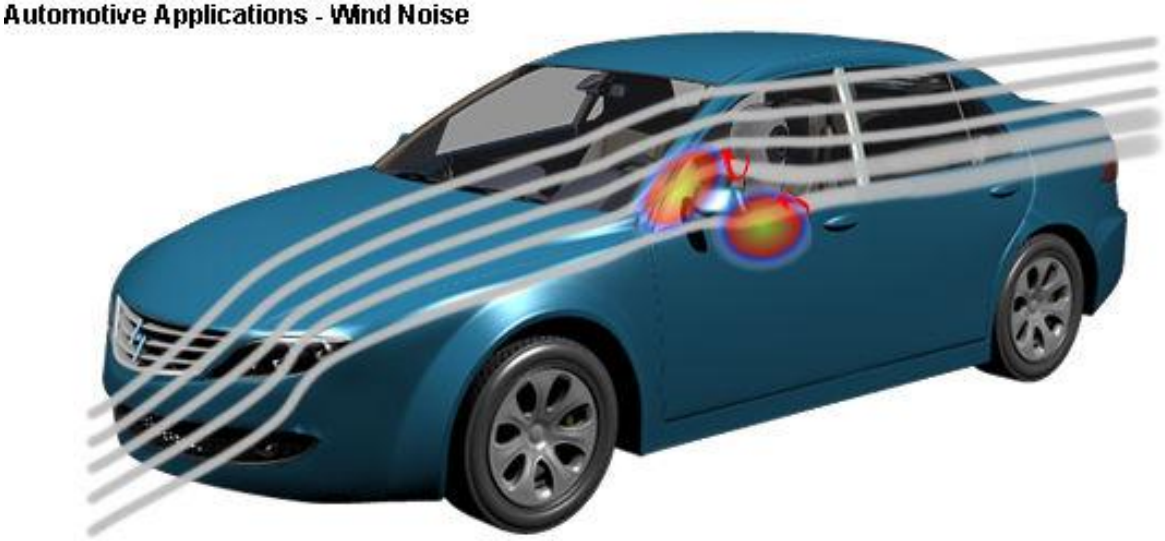

Fig.3 Wind noise in automobiles.

2.5 Interior noise:

Prominence acceptance criterion of any vehicle in terms of comfort at the interior part is an interior noise [2]. It generates due to contribution from each vehicle component, panel acoustic leakage, panel vibration, gear shifting and steering wheel vibrations. Figure 4 shows the sources of noise in automobile.

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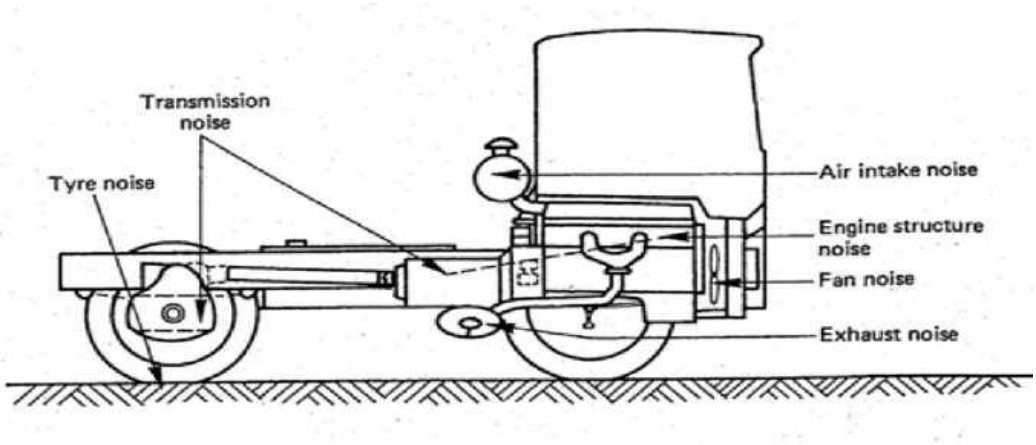

Fig.4 Noise and vibration sources in automobiles.

III.OVERALL PERCENT CONTRIBUTION OF SOURCE TO TOTAL NOISE

Sr.No.	Sources	% contribution
1	Exhaust system	25 to 35
2	Engine	22 to 30
3	Intake system	05 to 15
4	Fan and cooling system	07 to 15
5	Transmission	12 to 15
6	Tyres	09 to 15

IV.NOISE CONTROL TECHNIQUES

4.1 Sound Absorption:

It is done by using porous material which act as 'noise sponge'. Whatever noise generated is converted into heat within the sponge. Commonly used sound absorber materials are open cell foam and fiber glass [2]. That's the logic behind use of sponge in seat of automobiles.

4.2 Sound Insulation:

Noise transmission is prevent by using introducing of a mass barrier. Commonly used materials are thick glasses, metal.

4.3 vibration isolation:

It prevent the transmission of vibration from source to receiver by introducing a flexible element in its path. Commonly used vibration isolators are spring, rubber mount, cork, etc.

4.4 Vibration Damping:

It is applicable for large vibrating surfaces. Damping mechanism works by extracting the vibration energy from the thin sheet and dissipating it as heat.

4.5 Conti Seal Tyre:

It is similar to normal tyre but built with a conti seal. Conti seal is an additional air proof layer applied after the tyre curing. The tyre mounted on a standard rim. Noise level measured inside the automobile were lowered by 2-3dB for low frequency and upto 5dB for high frequency additional foam absorber on seal applied which extremely improves the cavity noise performance of tyre. This solution is very efficient and contribute to much comfort inside the vehicle. The only drawback is increase the weight of each tyre by 1Kg mass. Figure 5 shows the conti seal layer in tyre.

Fig.5 Conti seal tyre.

V.HEALTH EFFECTS FROM NOISE

Most commonly observed health effects on human health due to noise are hearing impairment, hypertension, ischemic heart disease, annoyance and health disturbance. Change in the immune system and birth defects have been attributed to noise exposure. Children from noisy residence often possess a heart rate that is significantly higher than in children from quieter residence [2].

VI.CONCLUSIONS

The study of noise and vibration is very important while designing and manufacturing of any automobile as far as users comfort concern. Experiments results from laboratory and under real life conditions are promising and prove the applicability of concept. Various sources of noise as well as vibrations from automobiles are identified and detailed study of course is carried. Considering the various adverse effect of noise on human health many of the countries put the limit on the level of noise emission from the automobiles.

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