بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها

علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار

في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

بعض الوثائق

الاصلية تالفة

بالرسالة صفحات

لم ترد بالاصل

"VIBRATION AND NOISE ANALYSIS INSIDE MOTOR-CAR"

By

MAGDY BEKHIT ABDOU ABD EL HADY

B. Sc. in Automotive Engineering

A THESIS

Submitted in Supplication for the Degree of M. Sc.
in Mechanical Engineering
Faculty of Engineering and Technology

Department of Mechanical Engineering
Minia University

April, 1985

ACKNOWLEDGEMENTS

The author would like to express his gratitude to all who have helped in the prepartion of this thesis, particularly to:

Assoc. prof. Dr. Shawki A.Abou - El-Seoud and Assoc. Prof. Dr. Fawzi M.EL-Sayed for their help and excellent guidance throughout this work.

Prof. Dr. Refaat S. Ghobrial for the help and encouragment in introducing this work.

All the Mechanical Engineering Department Staff in Minia University particularly Automotive Engineering Division Staff for the provision of laboratory and workshop facilities.

SYNOPSIS

This work is concerned with an investigation into the vibro - acoustic problem in vehicle structure. It is based on the concept of the creation of the measurements while the vehicle is driven on the chassis dynamometer in the laboratory. The data obtained are discussed from the point of view of describing the vehicle structure performances. Based on this technique a complete appraisal is made for the saloon vehicle considered, and the reasons for its particular vibro - acoustic response are exposed. By using this technique, the potentially noisy elements forming the vehicle floor panel have been identified. The effect of vehicle speed, gear- shift and tractive effort loading variations on the vibro - acoustic performance of the vehicle structure are included and critically examined with respect to improvements.

A historical review of published work has been introduced and displayed a need for extra work on studying such problem particularly for complete vehicle. This is followed by the description of the instrumentation system and test procedure as used in this work. The experimental and predicted results obtained have been introduced and discussed in the frequency range up to 200 Hz, and recommendations for an extended programme of work on vehicle structure of this type are presented.

CONTENTS

PAGE No

LIST OF SYMBOLS

Unless otherwise specified, the following symbols are used in this thesis:

Symbol	Signification
c	The velocity of sound in the relevant medium (ms^{-1})
f	The natural frequency (Hz)
$F_o(x,y,z)$	The distribution of the sound sourse in the medium (Nm^{-2})
K	The acoustic wave number
L_x, L_y, L_z, ...	The dimensions of the enclosure in three mutually perpendicular directions (m)
n_x, n_y, n_z	The number of nodes in three mutually perpendicular directions, and are integer values (0,1,2,... etc.)
$p(x,y,z)$	The fluid pressure as a function of space dimensions and time ($N\ m^{-2}$)
$p_o\ (x,y,z)$ ...	The fluid pressure as a function of space dimensions only ($N\ m^{-2}$)
S	The area of wall surface (m^2)
S_f	The area of flexible part of wall surface (m^2)
S_r	The area of rigid part of wall surface (m^2)
$S(x,y,z)$	The area of the element (m^2)
$U(x,y,z)$	The average vibration velocity of a point source placed on a perpendicular element (mS^{-1})
x,y,z	The three mutually perpendicular co-ordinates

Symbol		Signification
∇	....	The laplacian operator
w	....	The angular frequency (rad. S^{-1})
ρ		The density of the relevant medium (kg. m^{-3})
Nearside positions (Points)	:	The positions (Points) lie in the right side of the vehicle
Offside positions (Points)	:	The positions (Points) lie in the left side of the vehicle

CHAPTER ONE

INTRODUCTION

The body of a motor car is probably the most complex vibration system in a vehicle and, as such, it defies accurate theoretical analysis over a reasonable bandwidth even with the largest computers at present available. The most that can be done, apart from treating any vibration or associated acoustic problem by trial and error methods, is to study the vibration and acoustic properties of this structure by measuring its dynamic characteristics in order to develop simplified mathematical models, and possibly discover some measuring techniques which will be useful for aiding the solution of future problems. The amount of trial and error work might then be reduced, or carried out with a better understanding of the limitations imposed by the properties of the body.

The body of a motor car from the noise point of view is very important, since it is this structure which finally radiates all the noise heard by the passenger. At frequencies below 10 Hz the body behaves as a lumped mass possessing considerable rotary inertia. At higher frequencies, i.e., in the audio range, the body behaves as a complex distributed spring - mass system, excited at many points simultaneously by linear and rotary forces (inertia and centerfugal forces) in many directions from the various mechanical inputs e.g., engine, road surface, etc., and by direct acoustic radiation through the air from a variety of sources such as the engine.

The acoustic treatment of the body structure necessary to reduce the audible effects of these inputs is made more difficult because the body has to fulfil a number of functions, such as to protect the passenger in an accident and carry the vehicle payload over variety of road surfaces, etc. The properties required for many of these functions are conflicting and, of course, the required acoustic properties cannot be separated from the other requirement nor be given overriding importance, thus despite the increasing subjective importance of noise, many restrictions are still imposed on the acoustic treatment.

The subjective response to interior vehicle noise is, itself a very complex problem due to the fact that the noise covers a wide frequency range and exhibits a spectrum which contains both random and pure tone components. The complexity of the problem is further increased by the properties of the hearing mechanism and the way in which noises are interpreted by the brain.

The noise spectrum in a vehicle can roughly be considered to consist of a random background noise of reasonably constant level over the frequency range 30-200 Hz, falling at 6-10dB per octave above this frequency, superimposed on which are a number of line frequency components. The random background noise can be considered to be the main factor controlling the loudness of internal noise, while the line frequencies chiefly control the degree of annoyance of the noise. A tone is known to be more annoying. In a vehicle, tones can very widely in amplitude owing to the resonant properties