Design and Transmissibility Investigation of Shock Absorber Test Rig

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Abstract— The main aim of this project is to analyse the transmissibility at various speeds and load with minimum possible errors. The study of the motion of deformation of mechanical system is a "Mechanical Vibration". If motion of such system repeats itself after a given interval of time, the motion is known as "vibration" or in other words vibration are the fluctuation of mechanical system about equilibrium position. To find the transmissibility of the shock absorber, we will made the shock absorber test rig in which we will used scotch-yoke mechanism for remove the jump phenomenon. Shock absorber is an example of under damped vibration. Here, we will use the scotch-yoke mechanism where motion is transmitted from motor shaft to the shock absorber through the disc. Eccentricity is given to the disc and rotor motion of motor shaft is converted into linear motion of shock absorber. By plotting the graphs at various speeds, we will conclude their effect on the damping properties.

Key words: Test Rig, Transmissibility

I. INTRODUCTION

For proper design of machine or machine parts which are subjected to vibratory forces, it is essential to estimate their natural frequency conditions. In most cases there is always certain amount of damping associated with the system. Shock absorber is a device which is generally used in all automobiles. a shock absorber (in reality, a shock "damper") is a mechanical or hydraulic device designed to absorb and damp shock impulses. It does this by converting the kinetic energy of the shock into another form of energy (typically heat) which is then dissipated. Most shock absorbers are a form of dashpot. Pneumatic and hydraulic shock absorbers are used in conjunction with cushions and springs. An automobile shock absorber contains spring-loaded check valves and orifices to control the flow of oil through an internal piston. One design consideration, when designing or choosing a shock absorber, is where that energy will go. In most shock absorbers, energy is converted to heat inside the viscous fluid. In hydraulic cylinders, the hydraulic fluid heats up, while in air cylinders, the hot air is usually exhausted to the atmosphere. In other types of shock absorbers, such as electromagnetic types, the dissipated energy can be stored and used later. In general terms, shock absorbers help cushion vehicles on uneven roads. In a vehicle, shock absorbers reduce the effect of travelling over rough ground, leading to improved ride quality and vehicle handling. While shock absorbers serve the purpose of limiting excessive suspension movement, their intended sole purpose is to damp spring oscillations. Shock absorbers use valving of oil and gasses to absorb excess energy from the springs. Spring rates are chosen by the manufacturer based on the weight of the vehicle, loaded and unloaded. Some people use shocks to modify spring rates but this is not the correct use. Along with hysteresis in the tire itself, they damp the energy stored in the motion of the unsprung weight up and down. Effective wheel bounce damping may require tuning shocks to an optimal resistance.[1]

II. PROBLEM STATEMENT

Suspension system is an important consideration as far as vehicle safety and comfort to the passengers is taken into account. It performs major role of isolating vehicle body from the road shocks which may be in the form of bounce, pitch, roll or sway. These tendencies give rise to an uncomfortable ride and also cause additional stress in the automobile frame and body. Thus in other words suspension system performs following functions.

1) To prevent the road shocks from being transmitted to the vehicle components.
2) To safeguard the occupants from road shocks.
3) To preserve stability of vehicle in pitching or rolling while in motion.

Therefore it is really important to measure the efficiency or effectiveness of the system in order to ensure that whether the suspensions are performing their assigned job in a desired manner.

III. OBJECTIVE

1) To test suspension on different types of oils and stiffness to find out optimum motion transmissibility using DOE
2) To determine dynamic characteristic of shock absorber.
3) Suspension will be test for multiple stiffness by varying loads, speed and different oils.
4) Motion transmissibility develop suspension testing set up for testing a various suspensions.

IV. METHODOLOGY

1) Determination of different loads and boundary condition acting on the component by Studying various reference papers and different resources available.
2) Re-Design, Analysis and Results Making changes in model for optimization, Analyze this new model, check the transmissibility ratio.
3) Fabrication, Experimental validation and Result Fabrication of prototype, Suitable experimentation and comparison with present Model, Validation of result by comparing with software results.

V. TERMINOLOGY & DEFINITION

A. Time Period:

In the both rectilinear & torsion types of vibration analysis a steady state mechanical vibration is the motion of system repeated after an interval of time known as time period.

B. Cycle:

The motion completed in one period of time.

C. Frequency:

The number of cycle per unit time is called time frequency.

D. Amplitude:

The maximum displacement of vibrating body from the mean position.

E. Natural Frequency:

Frequency of free vibration of the system. It is a constant for a given system.

F. Resonance:

The vibration the system when the frequency of external force is equal to natural frequency of the system.

G. Damping:

Damping is nothing but resistance to motion of vibrating body.

H. Phase Difference:

It is the angle between two rotating vector representing simple harmonic motions of same frequency.

I. Simple Harmonic Motion:

A Periodic motion of a particle whose acceleration is always Direct towards the mean position & is proportional to its distance from the mean position.

J. Modes of Vibration:

The word relates to the shape or form of motion.

K. Node:

The word "Node" applies to any point online, which is stationary at all times a vibrating or oscillating system.

L. Degree of Freedom:

A system is said to be n-degree of freedom system if its needs & independent co-ordinates to specify completely the configuration of the system at any instant.

VI. Classification of Vibration

A. Type of Vibrations

1) According to Actuating Force

1) Free Vibrations
2) Frce Vibrations

B. According to External Resistance

1) Undamped Vibrations
2) Damped Vibrations

C. According to Motion of System w.r.t. Axis

1) Longitudinal Vibrations
2) Transverse Vibrations
3) Torsional Vibrations

D. According to Behavior of Vibrating System

1) Linear Vibrations
2) Non Linear Vibrations

E. According to Magnitude of Actuating Force at a Given Time

1) Deterministic Vibrations
2) Random Vibrations

VII. Experimental Setup

Fig. 1: Experimental setup of test Rig

VIII. Experimentation

A. Problem Definition:

The aim of this project to measure transmissibility of shock absorber at various speed and loads. Also it is required to analyze the results of transmissibility and to plot the graph.

B. Experimental Procedure

To conduct the experiment the following procedure has to follow

1) Connect all the set up equipment.
2) Connect the motor and dimmer stat and the strip chart recorder to voltage eliminator.
3) Fix the paper roll on strip chart recorder and ensure the proper working of recorder.
4) Attach the pen in a pen holder and ensure the proper contact between tip of pen and paper.
5) Switch 'ON' the motor so as the rolls freely between rectangular frame.
6) Mark the positions of amplitude on strip chart recorder.
7) Vary the speed & take next reading of amplitude.
8) Put the dead weight in pan and again repeat the procedure.
9) Using three types of weight and four types of speed make the respective value of 'X'.

C. Precautions

1) Lock the weight before the starting.
2) Do not touch the moving parts.
3) Ensure the proper contact between pen tip and the sliding paper.

IX. RESULT AND DISCUSSION

A. Shock Absorber Test Rig

1) Nature of the graph obtained

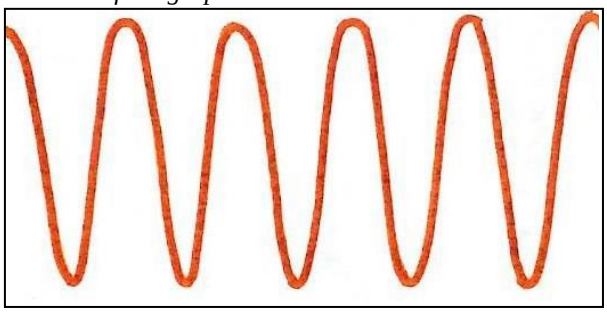

Fig. 2: Nature of graph obtained in shock absorber test rig

The nature of the graph is sinusoidal due to replacing the cam & follower mechanism by scotch yoke mechanism. The scotch yoke mechanism is used to convert the rotary motion into the oscillating motion. The sinusoidal curve which indication of the reduction of vibration in present set up.

In above observation table which shows the results Shock Absorber Test Rig, it gives the motion transmissibility of the system. In this table we can notice that the practical motion transmissibility of the system is less than theoretical motion transmissibility which is correct. There always possibility of the friction between contacting component which result reduction in transmissibility. The actual transmissibility of system is always less than theoretical transmissibility.

By modifying existing shock absorber set up we have reduce the vibration, which results in reduction of jumping phenomenon, & also there is improvement in transmissibility. The life of instrument going to be increase due to this change.

X. CONCLUSION

A. Following Conclusions are carried out from the project work:

1) With the use addition of scotch yoke mechanism, there is much reduction in vibration.
2) Because of less vibration there is less maintenance required will reduce total cost of project, also increase life of instrument.
3) Results obtain sinusoidal curve which indication of elimination of jump phenomenon.
4) There is much improvement in transmissibility of instrument as compares to previous setup.
5) Even through if we operate it at higher speed at constant load, the instrument operates smoothly that means there is much reduction in vibration. That is our ultimate goal.

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