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Experimental Analysis Of Single Cylinder Diesel Engine

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Abstract- This paper present general information of internal combustion engine and measurement of vibration. This internal combustion engine is a heat engine that converts chemical energy in a fuel into mechanical energy. This mechanical energy is utilize to drive the various application such as agriculture, Automobile, concrete mixer, sprayer pump.etc.

In every diesel engine there is vibration due to reciprocal component, rotational component, unidirectional combustion forces, structural resonance etc. As per standard it is necessary to analyze the vibration.

In this paper vibration testing of single cylinder diesel engine by using FFT (Fast Fourier Transform) & Accelerometer.

Keywords: Diesel engine, Vibration, FFT, Accelerometer

1. Introduction

A diesel engine (also known as a compression-ignition engine) is an internal combustion engine that uses the heat of compression to initiate ignition to burn the fuel, which is injected into the combustion chamber. This is in contrast to spark-ignition engines such as a petrol engine (gasoline engine) or gas engine (using a gaseous fuel as opposed to gasoline), which uses a spark plug to ignite an air-fuel mixture. The engine was developed by Rudolf Diesel in 1893. The diesel engine has the highest thermal efficiency of any regular internal or external combustion engine due to its very high compression ratio. The compression ratio is a measure of how much the engine compresses the gasses in the engine's cylinder. In a diesel engine compression ratio ranging from 14:1 to as high as 24:1 are commonly used. The higher compression ratios are possible because only air is compressed, and then the fuel is injected. A diesel engine is widely used in various applications such as agriculture, stone crusher, sugar crane crusher, threasher, concrete mixer, sprayer pump etc. Following figure 1 shows the actual model of Single Cylinder Water Cooled Diesel Engine.

Fig. 1: Single Cylinder Water Cooled Diesel

Table 1 Technical Data of 8.0 H.P Water Cooled Diesel engine

SR. NO	ITEM	TECHNICAL DATA
1	Method of Cooling	Water
2	No. of Cylinder	1
3	Rated Power - B.H.P. / Kw	8.0/5.9
4	Rated R.P.M.	2600
5	Compression Ratio	16.7:1
6	Engine Net Weight (kg)	80

2. Vibration measurement equipments

2.1 FFT (Fast Fourier Transform)
2.2 Accelerometer

2.1 FFT (Fast Fourier Transform)

The resulting digital time record is then mathematically transformed into a frequency Spectrum using an algorithm known as the Fast Fourier Transform (FFT). The Fast Fourier Transform (FFT) is a development of the Discrete Fourier Transform (DFT) which removes duplicated terms in the mathematical algorithm to reduce the number of mathematical operations performed. It is possible to use large numbers of samples without compromising the speed of the transformation.

Fig 2: Fast Fourier Transform

2.2 Accelerometer

The accelerometer generates an output signal that is proportional to the acceleration of the vibrating mechanism. This device is, perhaps, preferred over the velocity pickup, for a number of reasons. For example, accelerometers have good sensitivity characteristics and a wide useful frequency range; they are small in size and light in weight and thus are capable of measuring the vibration at a specific point without, in general, loading the vibrating structure. In addition, the devices can be used easily with electronic integrating networks to obtain a voltage proportional to velocity or displacement. However, the accelerometer mounting, the interconnection cable, and the instrumentation connections are critical factors in measurements employing an accelerometer. The general comments made earlier concerning the mounting of a velocity pickup also apply to accelerometers.

Fig 3: Accelerometer

3. Procedure to measure vibration level

3.1 Place single cylinder diesel engine on dynamometer with speed of 2600 rpm.
3.2 For that we make the practical on single cylinder diesel engine (8 hp, 2600 rpm).
3.3 Give power to FFT analyzer.
3.4 Connect accelerometer to FFT analyzer.
3.5 Open the pulse labshop from start menu and create new project and press ok.
3.6 Now we fill hardware setup in that we fill the type numbers of the accelerometer. Now we select transducer database option in that we select Edit/Add option and then select the option accelerometer.
3.7 Now again we need to go back to the hardware setup to enter FFT analyzer, the type numbers and serial numbers of the accelerometer for signal 1.
3.8 Now activate the template or press F2.
3.9 After then select frequency span.
3.10 Save the project, we complete the hardware setup.
3.11 Now we use display menu.
3.12 Display the required graphs like, frequency domain, time domain.
3.13 Then place the accelerometer on appropriate location.
3.14 Then start the measurement at various locations and find out natural frequency, sum of RMS value.

4. Experimentation

Different location where accelerometer mount

4.1 Crankcase

4.2 Cylinder block

Fig 4: crankcase Measurement

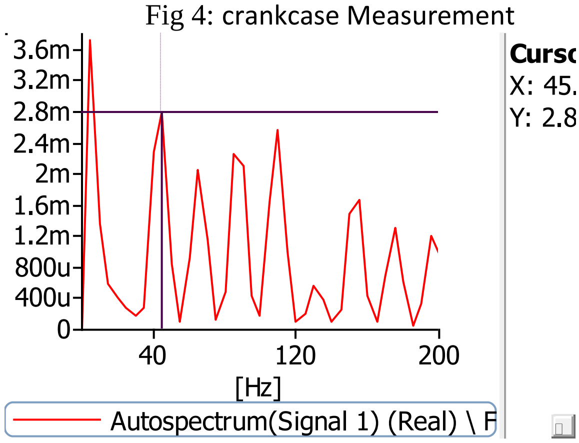

Fig 5: Auto spectrum 2600 RPM

Fig 6: crankcase measurement

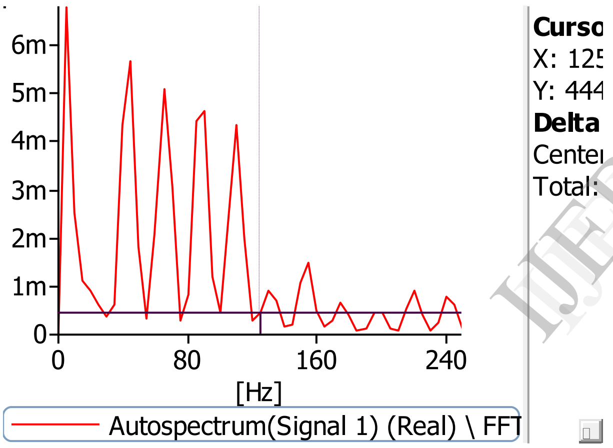

Fig 7: Auto spectrum 2600 RPM

Fig 8 Cylinder Block

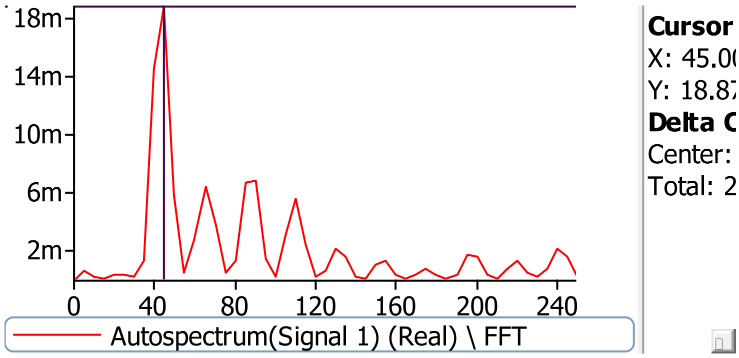

Fig 9: Auto spectrum 2600 RPM

Fundamental frequency= 43.33Hz

5. Result & Discussion

Sr. No	Acceler-ometer Location	Dominant frequency	Direction of accelero meter	Fault
1	Crank-case (lower side)	n 2n,3n etc	R	Rotating unbalance, Reciprocati ng unbalance
2	Cylinder block	1.5n, 2.5n	R	Reciprocati ng unbalance
3	Cylinder block	n	A	Mechanical looseness

6. Conclusion

In this paper, vibration level of single cylinder diesel engine was investigated through an experimental program. Some of the significant factors were examined experimentally. This work supports the following conclusions,

1. The dominant frequency of engine is proporsion to fundamental frequency of engine from result reciprocating balancing and rotary balancing is necessary.

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