Case History	Baseplate Vibration of Compressor Driven by Reciprocating Engine	Rotating machinery (compressor)
Forced Vibration		

Object Machine

Heat pump
(Diesel engine-driven)
Water-cooled , 4-cylinder diesel engine (100 HP)

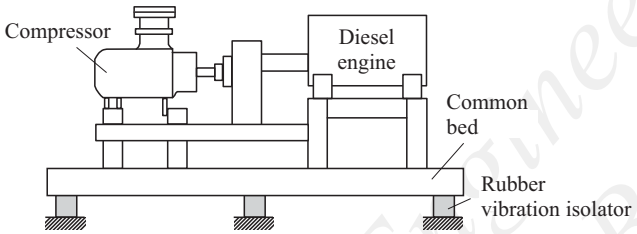


Fig.1: Engine-driven compressor

Observed Phenomena

During acceleration after starting the diesel engine, vibrations with a large amplitude occurred at the baseplate end.

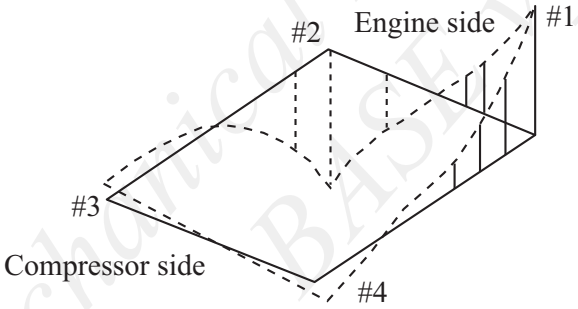


Fig.2: Shape of baseplate vibration at 2,400 rpm

Cause Presumed

Resonance due to one of the higher harmonics was estimated to be the cause because the engine excitation force has a large number of them. A major component is 1/2 × rotational speed × 4 * multiplied by integers.

Analysis and Data Processing

(1) Vibration displacement

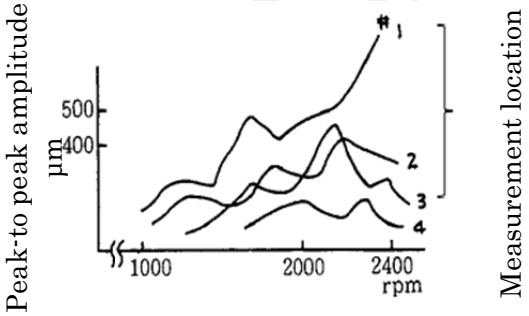


Fig.3: Changes in amplitude for rotational speed
Result of frequency analysis

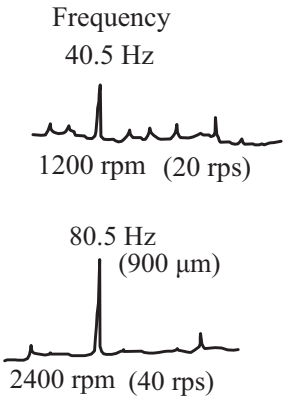


Fig.4: A component with frequency equal to twice the rotational speed is predominant (Forced vibration)

(2) Hammering test
Measurement of natural frequencies by a hammering test has not produced any remarkable peaks.

(3) Cause of vibration
Because of large pulsating torques from the diesel engine (4-cycle, 4-cylinder, and twice the rotating speed component is predominant), the entire system including the baseplate forcibly vibrated (vibrations are considered to have increased due to deformation, as the baseplate is not rigid enough).

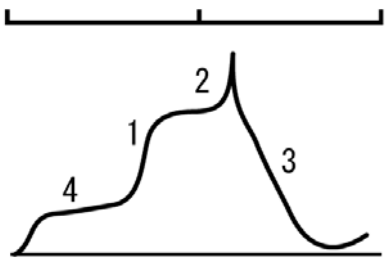
Countermeasures and Results

(1) Method for countermeasures:
To improve rigidity by adding a reinforcing support for the engine base.
To reduce the operating rotational speed.

(2) Result of countermeasures:
The compressor was operated at a slightly reduced rotating speed, as no problem was found in terms of performance of the compressor when reducing the speed.

Lesson Learned

It has been fully realized that engines are a typical example of double harmonic excitation source.



1. Compression
2. Explosion
3. Ehaust
4. Suction

One cycle per two revolutions × 4 cylinders

Excitation force: rotational speed × 2

(Engine)