

Case History	Vibration due to Unbalance of Generator	Rotating machinery (turbine & generator)
Resonance		

#### Object Machine

Gas turbine driven generator

#### Observed Phenomena

As shown in Fig.1 (a), the power generation equipment consisting of a gas turbine and a generator is gear-coupled and mounted on a common base. During commissioning performed immediately after delivery, the casing experienced vibration with an amplitude of about 30  $\mu\text{m}$ , and thus a countermeasure had to be taken.

#### Cause Presumed

Vibration waveforms at the point D measured using an electrodynamic vibrometer and an electromagnetic oscillograph, as shown in Fig.1 (b), have a frequency equal to the rotational speed of the generator, and thus it has turned out to be a forced vibration caused by rotation of the generator. As it was a synchronous vibration corresponding to its rotational speed, the problem was estimated to be an unbalance vibration.

#### Analysis and Data Processing

The relationship between the rotational speed and the amplitude of vibration measured in the course of being stopped is as illustrated in Fig.1 (c). A natural frequency exists at a speed about 10% less the rated rotational speed of 1,500 rpm, which suggests that it was rotating in the resonance region. On the other hand, the investigation of the vibration amplitude around the casing during rated operation found that as shown in dashed lines in Fig.1 (a), the common base was deformed so that the generator portion swayed.

#### Countermeasures and Results

Based on the above, remedial measures to reinforce the base portion were considered. However, incomplete enhancement of stiffness may pose a risk of coming closer to the natural frequency as it is currently rotating in the upper region of the resonance frequency. In addition, since an adequate time was not available to introduce sufficient reinforcement, the countermeasure taken this time was to reduce the excitation force by on-site balancing. Specifically, after removing the generator cover and mounting a trial weight at a hole on the cooling fan tip, the optimum balancing position and correction weight were obtained through several trial operations. Finally, by attaching a correction weight of 290 g to the fan tip, the maximum vibration amplitude went down to 5  $\mu\text{m}$  or less.

#### Lesson Learned

A majority of vibration problems of rotating machinery is caused by unbalanced resonance. Resonance frequencies of both the rotor and the base should be surveyed.

#### References

Fujikawa. *Research of Machine* Vol.36 No. 1 (1984): 148

★ Precise evaluation of the base of a large rotating machine cannot be made without taking into account the stiffness of its fixing bolts, to which attention shall be paid.

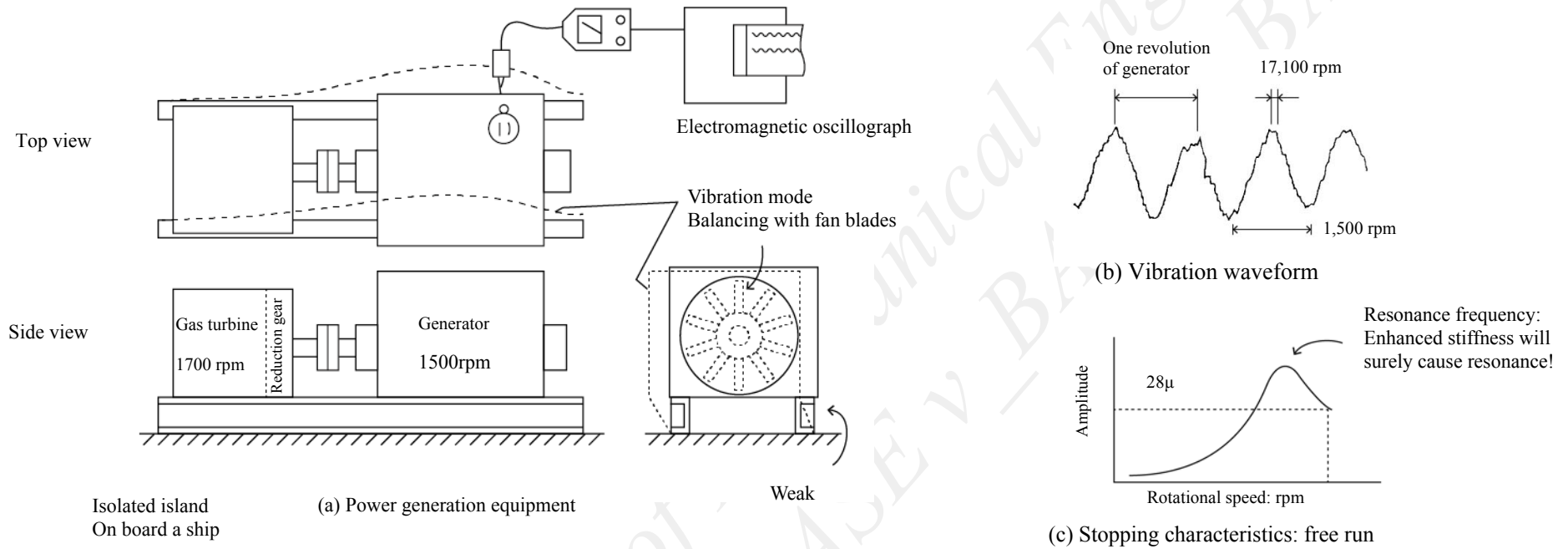


Fig.1: Unbalance vibration of generator

(Emergency use)

- ★ Reinforced frame will raise the resonance point.
- ★ Shaft balancing correction was performed to reduce the excitation force.