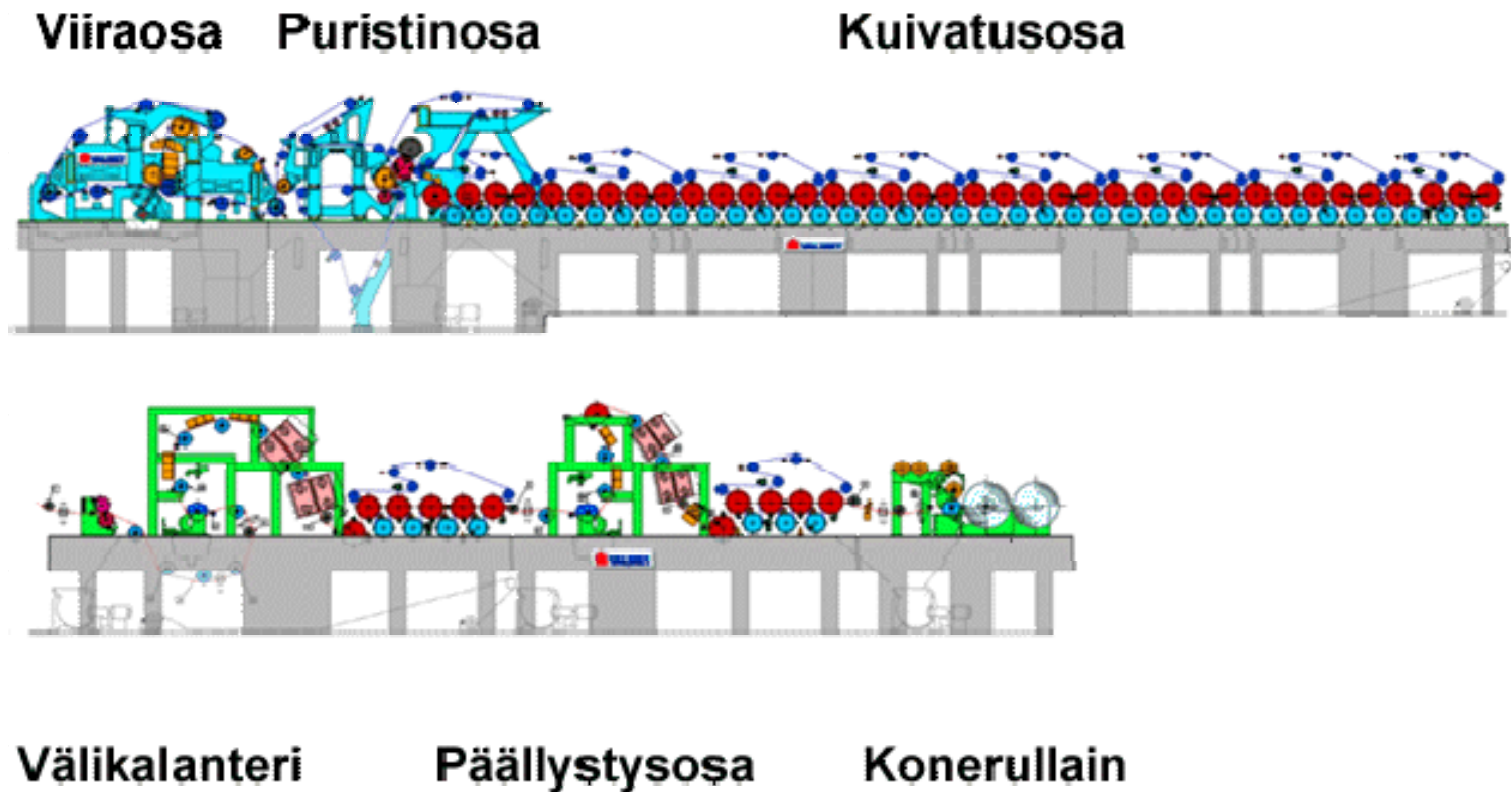




▶ Vibrations in Paper Machines



▶ Exitators

All rotating components like

- Rolls
- Shafts
- Electricity motors
- Gears
- Bearings etc.

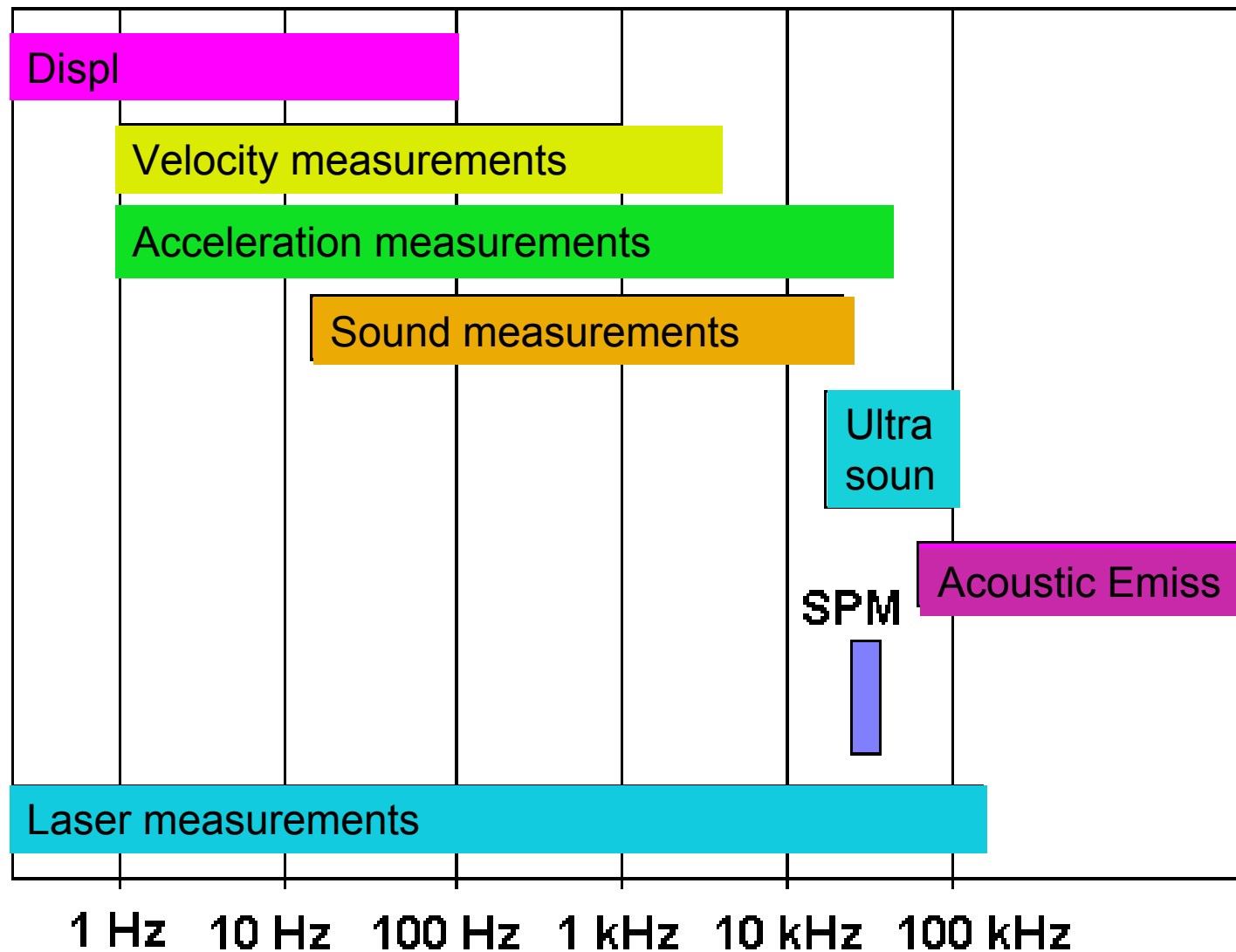
And wire, paper web,
Hydraulic, trucks etc.



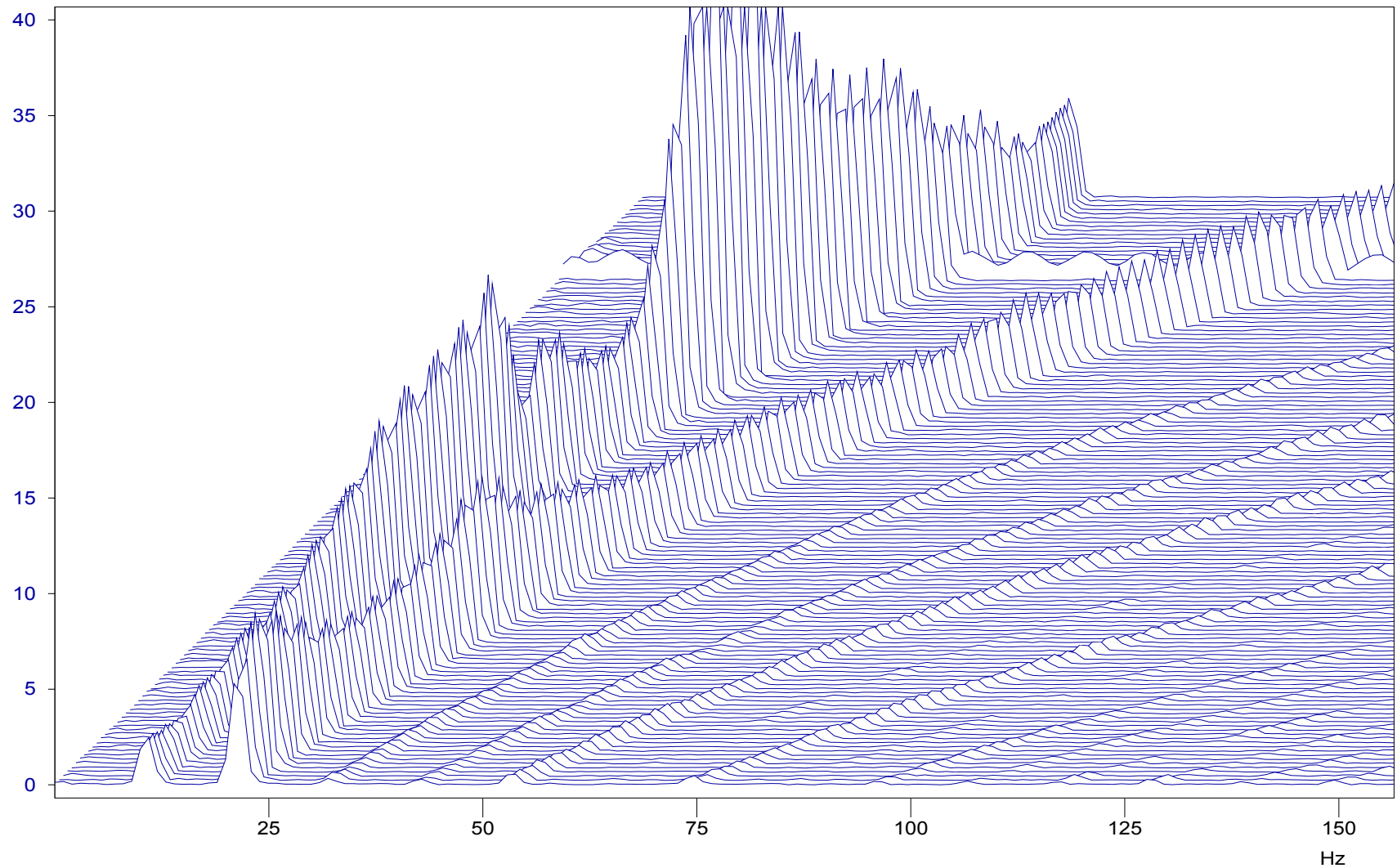
▶ Passive components

- Steel frame
- Concrete foundation
- Bearing houses
- Building
- Control rooms
- Etc.





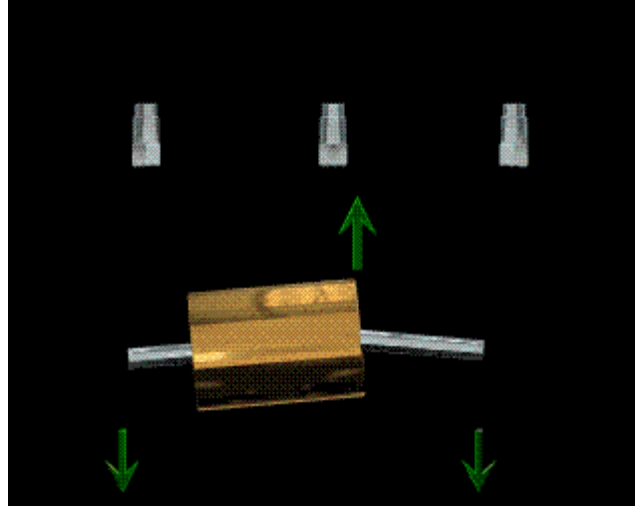
▶ Start up / shut down measurement of the machine



▶ Vibration analysis

- What vibration analysis is all about?
- All rotating machinery rolls, cylinders, pumps, fans, copressors turbines will vibrate.

The level of the vibration , and the pattern of the vibration tell us something about the internal condition of the rotating components.



Vibration analysis

- If we use electronic instruments to measure the vibration, we can monitor those levels and study those patterns. To a large extent, if we see the levels increase and the patterns change we can not only detect that there is a problem, but we can diagnose the type of problem.
- The vibration pattern can tell us if the machine is out of balance, or out of alignment.
- Vibration analysis can also help us to diagnose rolling element bearing problems and faults with journal bearings

▶ Vibration analysis

- The basic procedure involves mounting a sensor on a bearing (either on the bearing with an "accelerometer" or inside the bearing with with a " non-contact eddy current probe" and measuring the vibration with a portable electronic data collector.



Vibration velocity [mm/s]

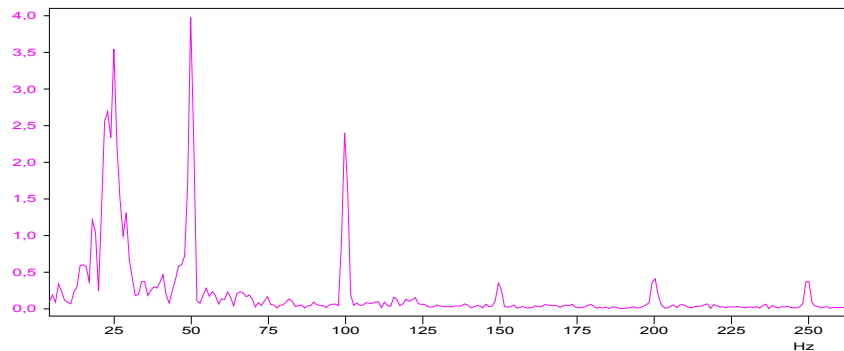
R.M.S or peak

Frequency range normally 10-1000Hz

For rotating machines with speed under 600 rpm Frequency range 2-1000 Hz

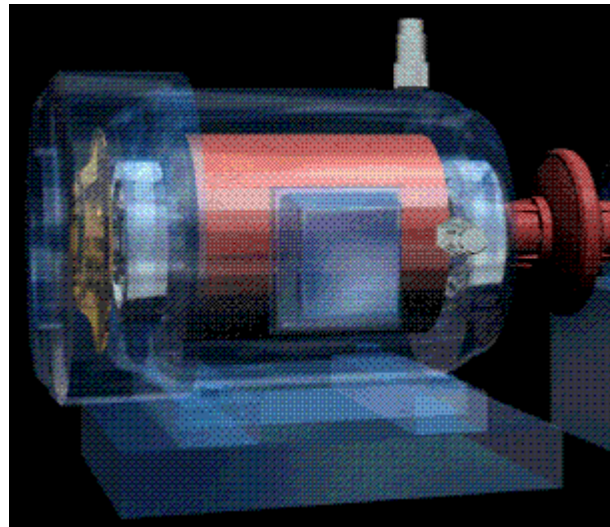
▶ Vibration analysis

- The portable data collector is carried from machine to machine, the sensor is placed on the bearing, and a "snapshot" of the vibration is collected. The data collector is normally taken back to the office so the data can be transferred to a computer where it can be analysed by software package.



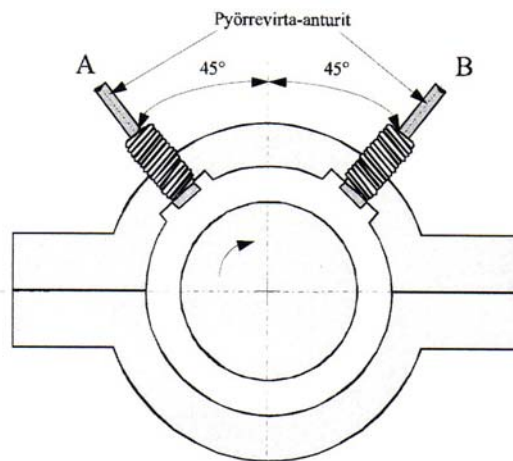
▶ Vibration analysis

- If the machine is critical (like papermachine is), or if it is located in a very remote or hazardous environment (such that routine measurements cannot be taken), sensors will be mounted permanently on the machine, and a monitoring system will be optionally installed that monitors the vibration levels to give an early warning of a fault condition.



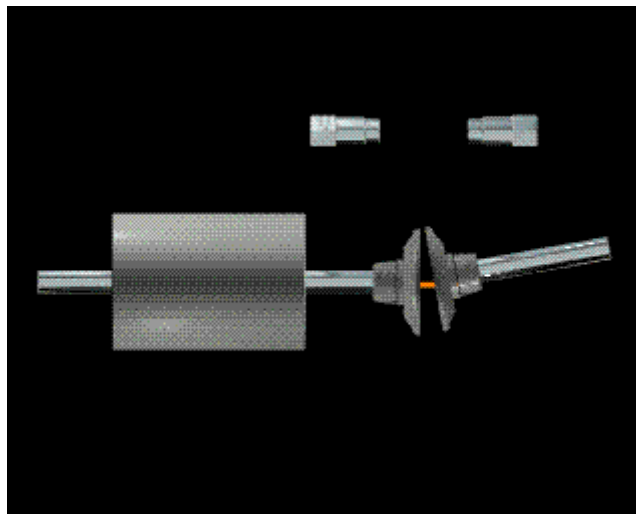
▶ Vibration analysis

- Protection system also exist that continuously watch the vibration level 24 hours a day, with the ability to shut down the machine should a critical fault be detected.



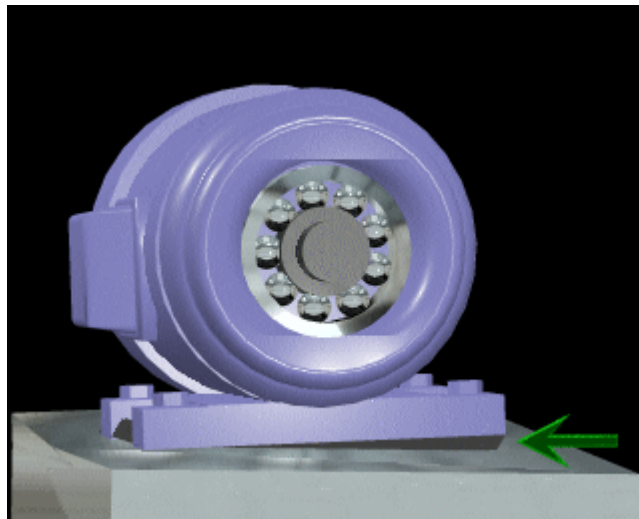
▶ Vibration analysis

We consider that there are four phases: detecting if a problem exists, performing the analysis to diagnose the severity, root cause analysis to determine why it happened and verifying that the problem is solved when the repair is performed.



▶ Vibration analysis

- Before a machine will vibrate there must be internal forces. Those forces may be due to unbalance, misalignment, a bent shaft, looseness, a rub, electrical problems and other factors. The vibration that we measure is due in part to the magnitude of these forces, and in part due to the mass, stiffness and damping of the machine.



Vibration analysis

- For many years research people around the world have been trying to derive a single "magic" number that could be used as a "go- no go" for rotating machinery. There have been many attempts, based on direct measurements and calculations using waveforms and spectra, but to date there has been no success.
- That's not to say that there are not some excellent "measurements" that can be used for trending and comparison against alarms, however the "silver bullet" does not exist.

Vibration analysis

- Today most system suppliers will offer you a variety of parameters that can be trended. Some are commercially patented technologies, some are commercially trademarked names for basically the same technology, and others are just industry standard parameters that have been in use many years.

Typical sources of vibration

- 1. Unbalance (rolls)
- 2. Resonance
- 3. Poor alignment
- 4. Curved Shaft
- 5. Bearing defects (rolling bearing vs. slide bearings)
- 6. Belt drives
- 7. Electricity motor defects
- 8. Gear defects
- 9. Mechanical clearances
- Etc.

► Unbalance

- $F = m \cdot r \cdot \omega^2$

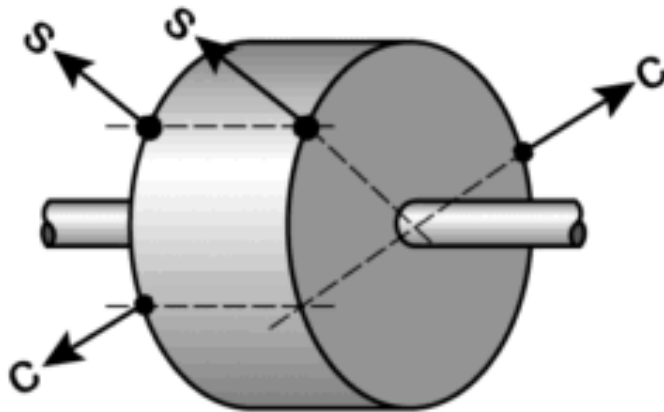


FIG.8 DYNAMIC UNBALANCE SEPARATED INTO ITS STATIC AND COUPLE COMPONENTS

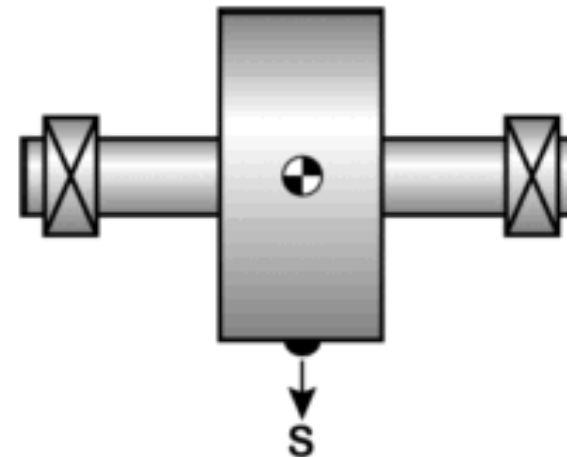



FIG.9 MAIN ROTOR'S STATIC UNBALANCE ACTING THROUGH PLANE OF , CREATING IN-PHASE STATIC UNBALANCE FORCES AT THE BEARINGS

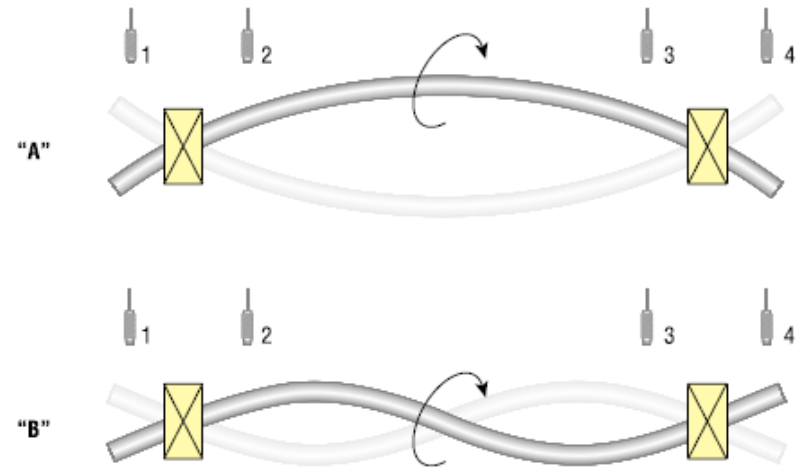
► Natural Frequency

$$f_n = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

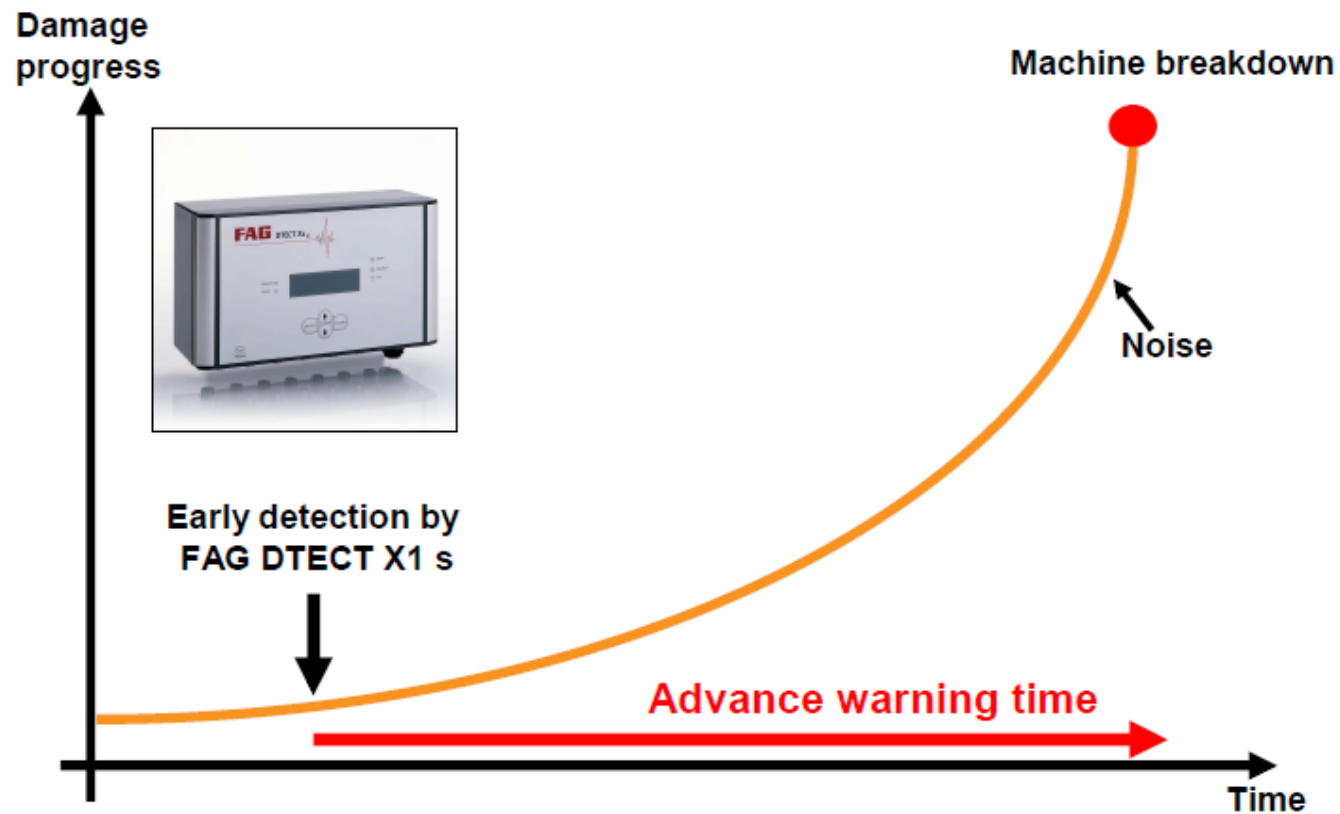
Larger mass = lower resonant frequency

Larger Stiffness = higher resonant frequency

Paper machine dynamic system are no different !!



► Purpose of condition monitoring



The future of Condition Monitoring

- The Future involves tighter integration between technologies and systems, continued integration between condition monitoring and process monitoring, increased use of automated diagnostic systems and on-line systems, an emphasis on information over data, and greater use of the Internet.
- In the future you can be sure that the line between condition monitoring will become blurred, with data and information being shared and systems integrated.

The future of Condition Monitoring

- As a result, on-line systems will become more sophisticated and less expensive. They also need to become smarter. Rather than megabytes of data being transmitted to central groups, better results are achieved if diagnostic information should be transferred.
- If you have an automated on-line system capable of detecting problems, and in some cases actually diagnosing problems, and you involve maintenance and manufacturing groups located away from equipment site, then communications becomes important.
- Enter the Internet.

► ISO 18436 Certification by Mobius and Inspecta



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