

Title

1. Development of a point loading device for a paper machine roll to simulate paper track load
2. Feasibility of point loading when examining the behaviour of paper machine roll under dynamic load.
3. Effect of loading on cylinder vibration

Introduction

-Describe the nature of the work and explain its significance, the motivation behind the project.

-Why this research is done? Who cares?

The behavior of a paper machine rotor under dynamic loads caused by the paper track has significant impact to the paper quality as well as the efficiency and reliability of the process. Especially vibration of the rotor causes many troubles in paper manufacturing process, and the constantly increasing quality requirements of paper leads to higher quality requirements of critical rotor components as well. In this context, the bearings of the rotor are the most critical component, since they sustain the vibration coming from the rotor. The vibration of the rotor effects to eg. homogeneous thickness, surface quality and fine structure of the paper been processed. Also for the sake of cost-effect construction and manufacturability of the rotor, understanding this behaviour is important.

Paper industry is still a remarkable field in Finland, as there is currently 17 paper factories in operation /1/. Aalto University does a lot of research related to paper manufacturing processes under the faculty of Mechanical Engineering in cooperation with finnish paper industry.

The objective of this research project is to measure vibration qualities on the rotor under constrained load caused by the paper track. A point loading device is built for this

purpose. It will be studied, how the transform of the loading case and the damping effect of the paper track is affecting the amplitude of the rotor on different rotational speeds. Also the feasibility of the point loading device is computationally validated if it corresponds to real-world continuous force -loading case.

-Important part of the introduction is the state of the art in the research field in question. What others have already done, what is known and what is not known. How these things are normally done?

Current research in Aalto university is done without the constrained load of the paper track. The paper track load is a significant factor in real-world paper machines, and the past experiments related to rotor vibration could be replicated with the load present.

Viitala has showed in his doctoral dissertation the effect of bearing geometry on subcritical rotor vibration. During the machining of bearing rings clamping causes differences in inner ring thickness. This excites vibrations on subcritical speeds. Measurements have been made without rotor loading. /2/

Kiviluoma et.al. have developed a method for in situ runout measurement of large cylindrical rotors. The method enables measuring thermal bending or so-called polygon effect in running rolls. /3/

Juhanko et.al. have pointed out that rotor wall thickness variation can cause dynamic geometry change. This change can be misinterpreted as either unbalance or half-critical vibration. /4/

Kurvinen et.al. have studied in which use cases complex and computational heavy bearing models should be used instead of simple models on order to get results accurate enough. /5/

-What are the theories behind your research question? This is the part of the paper where most of the literature references will be used.

The fundamental theory behind this phenomena is harmonic excitation of damped system. The loading belt can be seen as a viscous damper.

Fourier transformation is used to shift from time domain to frequency domain in order to find periodic phenomena.

VANHAT:

(The objective of this research project is to mimic the distributed load to a paper machine roll caused by a paper track with a point loading device.

The objective of this research project is to examine the behaviour of a paper machine roll and bearings under dynamic load. The distributed load caused by a paper track is imitated with a loading device that. The loading device

The objective of this research project is to develop a loading equipment for a paper roll, to simulate the distributed load caused by the paper track going around the roll. The device is made as an attachable upgrade module for the existing testing equipment found in Aalto University's laboratory facilities.

At present the research related to paper machine rolls is mostly done without external loading.)

-Perus voimansiirtodynamiikka?

Methods

- Brief description of the environment
- Description of the development process of the loading device.
- Description of measurement arrangements
- Signal Processing used
- Theories used to validate the results

Results

Present the measured results (vibration, bearing parameters.)

Discussion

Discussion of feasibility using point load to simulate case where distributed load is present.

References

/1/ <https://www.metsateollisuus.fi/tilastot/massa-ja-paperiteollisuus/>

/2/ Viitala, Raine. 2018. Effect of Assembled Bearing Inner Ring Geometry on Subcritical Rotor Vibration.

/3/ Kiviluoma, P., Porkka, E., Pirttiniemi, J. & Kuosmanen, P. 2010. ACCELEROMETER BASED IN SITU RUNOUT MEASUREMENT OF ROTORS.

/4/ Juhanko, J.; Porkka, E.; Widmaier, T. & Kuosmanen, P. 2010. EFFECT OF WALL THICKNESS VARIATION ON DYNAMIC GEOMETRY OF ROTATING CYLINDER.

/5/ Kurvinen, Emil; Sopanen, Jussi; Mikkola, Aki. 2015. Ball bearing model performance on various sized rotors with and without centrifugal and gyroscopic forces.