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Low Noise ACC Fan Retrofit Case Study

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Topics of discussion

Retrofit by Chart Industries

Benefits of retrofit.

Which products are best suited to ACC retrofit projects.

How are retrofit projects typically conducted.

Retrofit case study

For a specific retrofit project, how were the fans selected and how was the design of the drive / support altered.

Commissioning

Performance and vibration measurements.

Problems faced and solutions.

Conclusion

Summary and lessons learnt.

Things to look out for during a future retrofit

Retrofit projects

Most commonly, retrofit projects are conducted to improve cooling capacity when the limits of the existing system are reached.

Other reasons for fan retrofit may include:

- Noise reduction
- Fan / plant efficiency improvement
- Improved reliability

Scope of supply may be limited to the fan rotor, but may also include the selection and engineering of:

- Motor and drive
- Support structure

Chart Industries cooling fan products

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Hudson Tuf-Lite fans can be used for retrofit projects where higher efficiency or improved reliability is required. Tuf-Lite fans are strong replacements for OEM fans due to their monolithic design.

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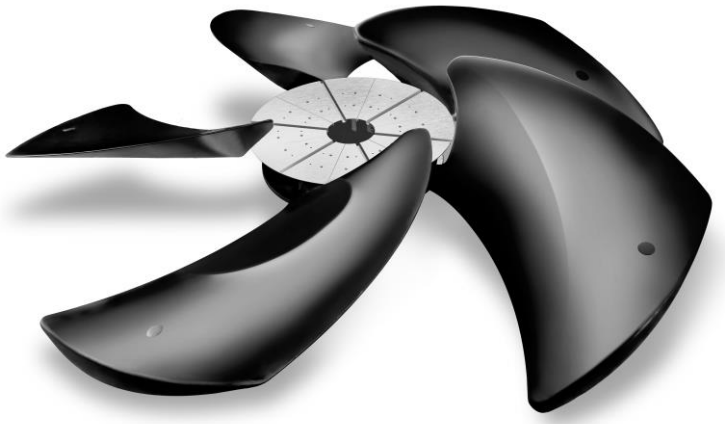
SX or SXT fans are commonly used where additional cooling capacity is needed and/or there is a desire to reduce noise levels.



E- or D-series fans are used where more cooling capacity is needed without noise restrictions.

Retrofit approach

While every project is handled individually according to the needs of the customer, a common approach would be as follows:

1. **Measurement of existing situation** – this includes baseline performance measurements of existing fan. Original design data cannot always be relied on due to changes in the system over many years of operation.

2. **New fan selection** is made based on measured duty point and desired cooling capacity / noise restrictions / motor capacity.

3. **Detailed engineering** of fan (if needed) and other necessary components. This includes measurement of the fan casing and surrounding components on site.

4. **Safety requirements** are assessed and may include aspects such as CE marking of new fan equipment.

5. **Delivery and installation** of fan components. Possibly with the assistance of a Chart supervisor on site.

6. **Commissioning** – Performance, noise and vibration measurements conducted to confirm that requirements have been met.

Retrofit case study

Background and customer requirements

Howden Netherlands performed a retrofit at a customer where there was a desire to improve cooling capacity over the summer months with no increase in noise levels.

Additionally, the customer wanted to implement fan speed control to reduce fan power consumption when the additional cooling capacity is not required.

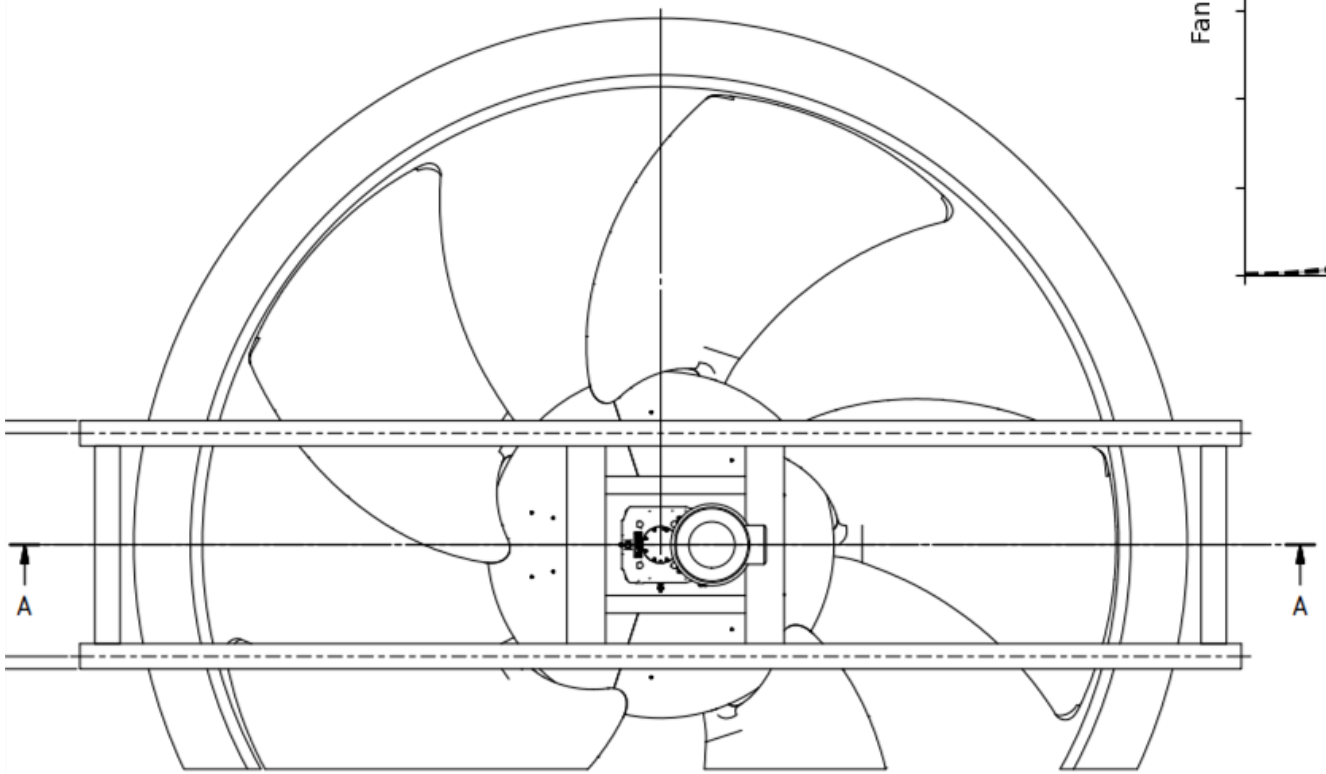
The 10 existing fans were of type Howden 6116ELFA8 that have been in operation for approximately 20 years.

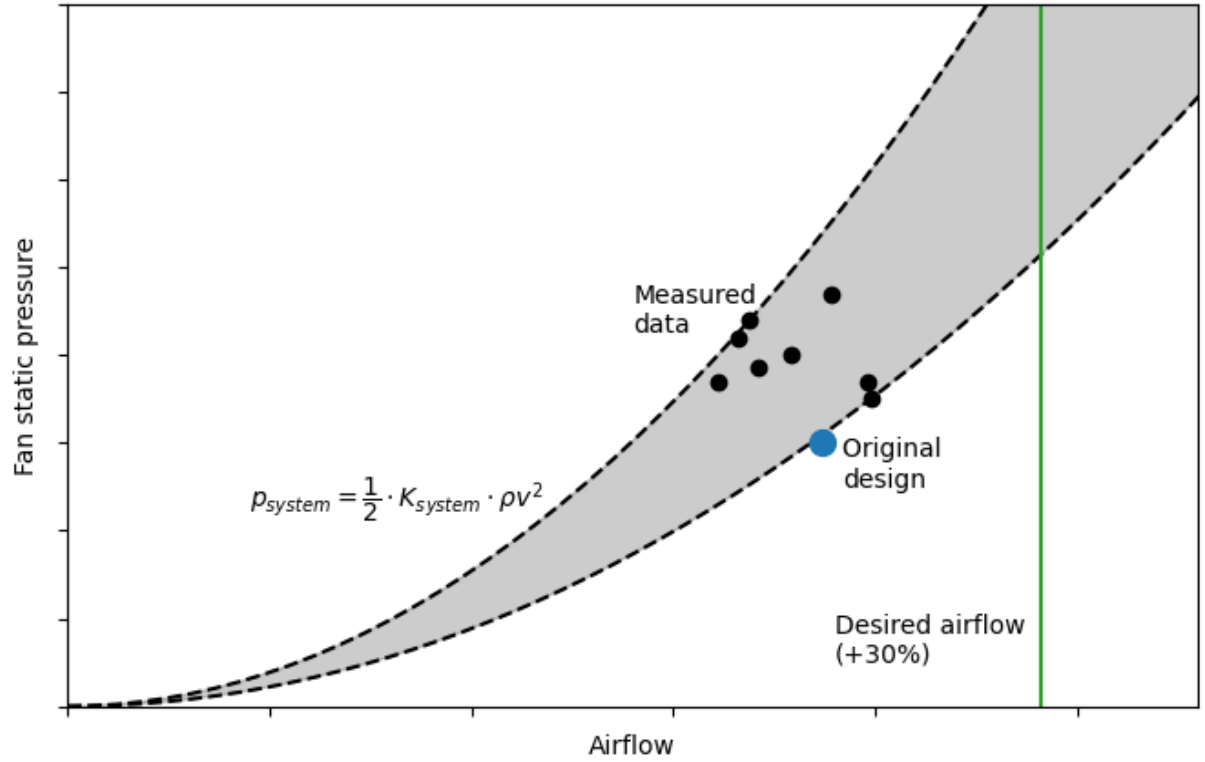
New fan selection

A 6116SXT5 fan was selected to deliver 30 % more flow than the existing fans.

To achieve this, the fan would be running at a higher fan speed than the original equipment.

Even so, a decrease in sound power level of 3 dBA was expected at the higher fan speed.

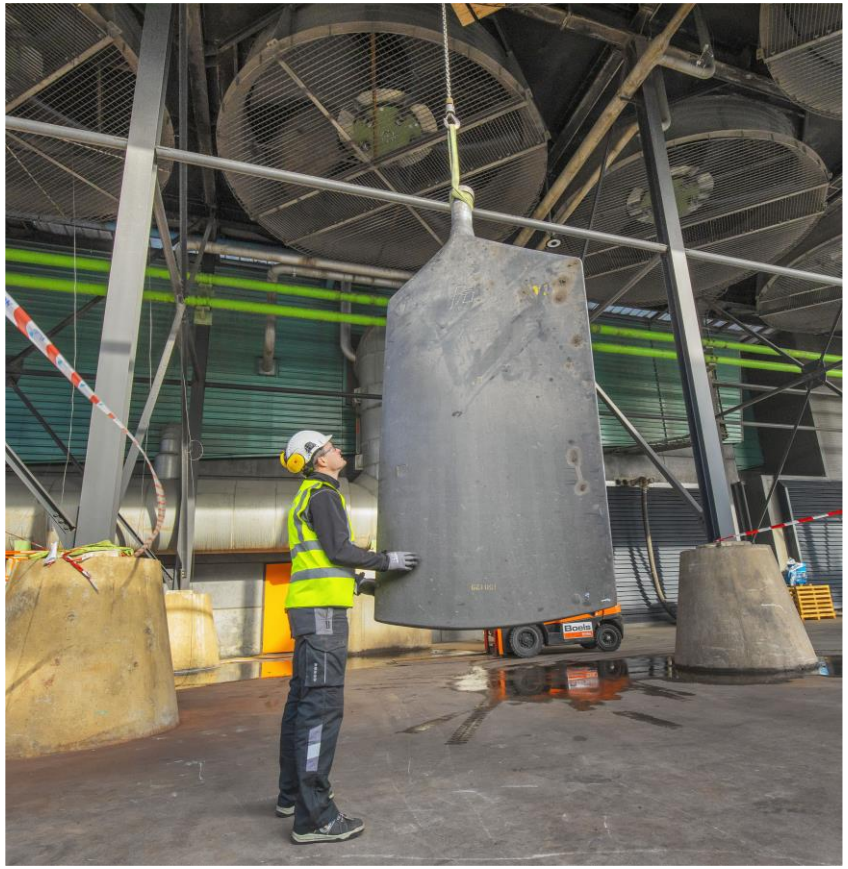


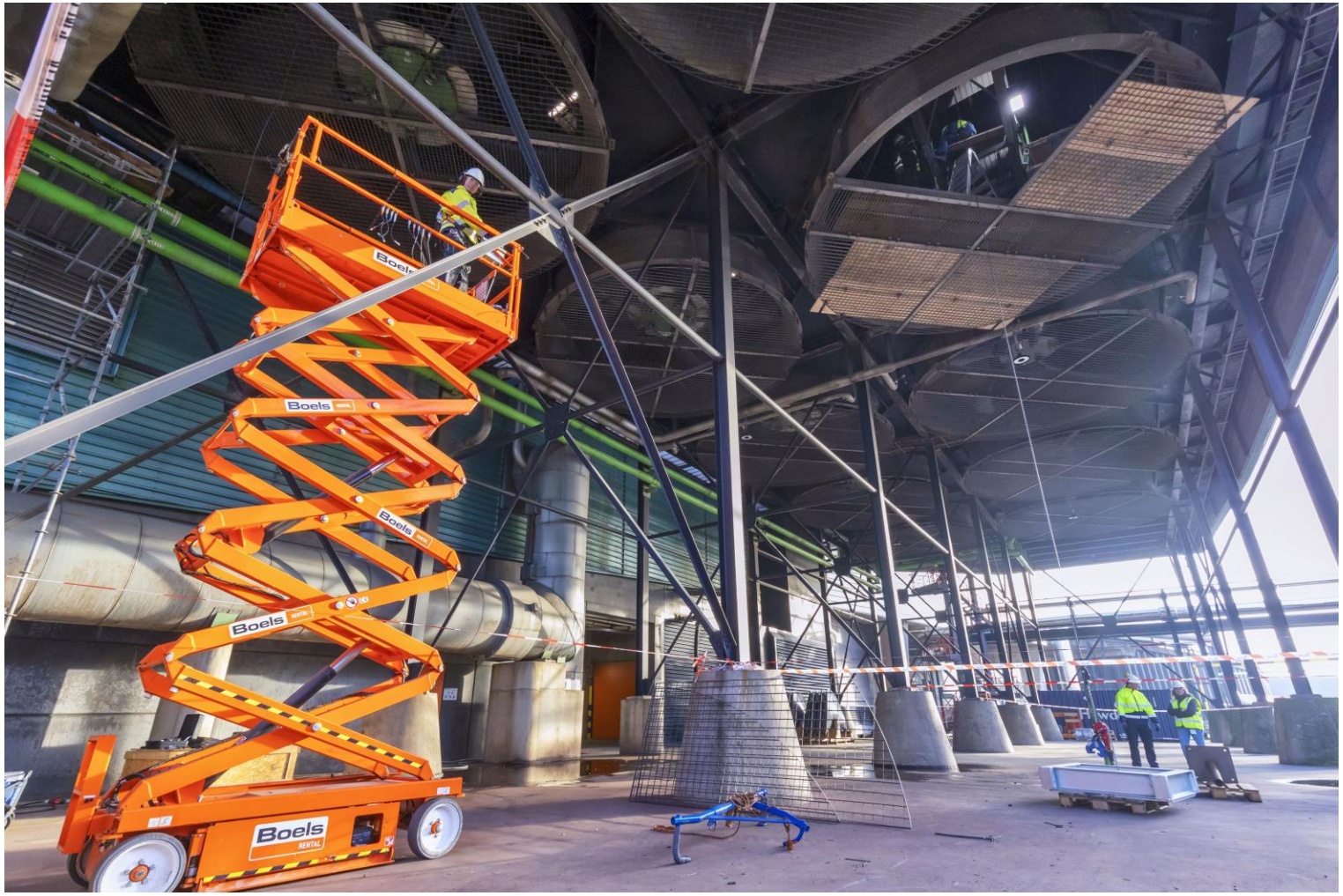


By engineering a fan with a non-standard fan diameter, the original casing could be used.

This was further enabled by the low height of the SXT when compared to the wider SX.

Fan installation

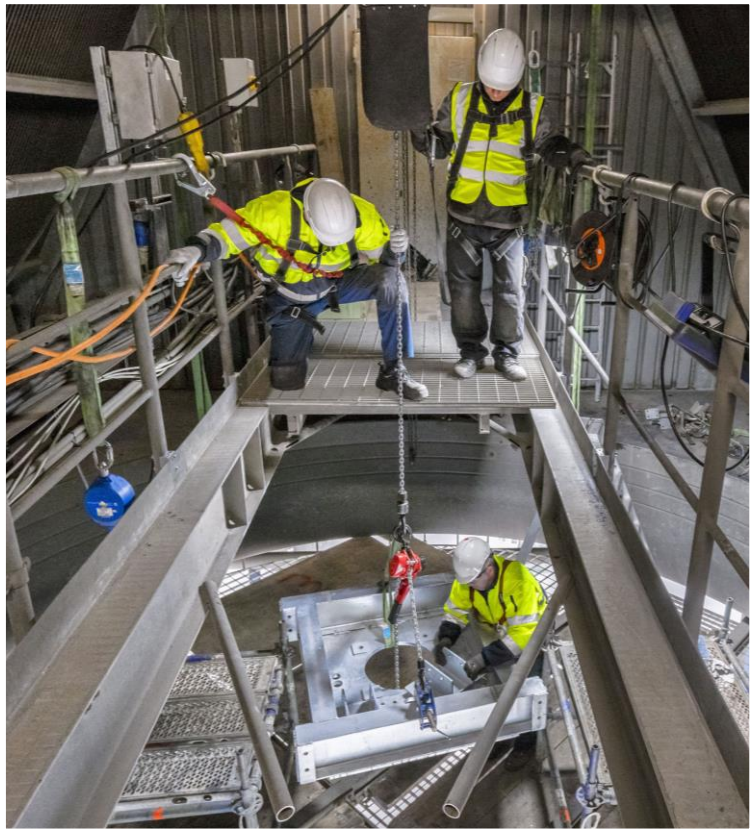


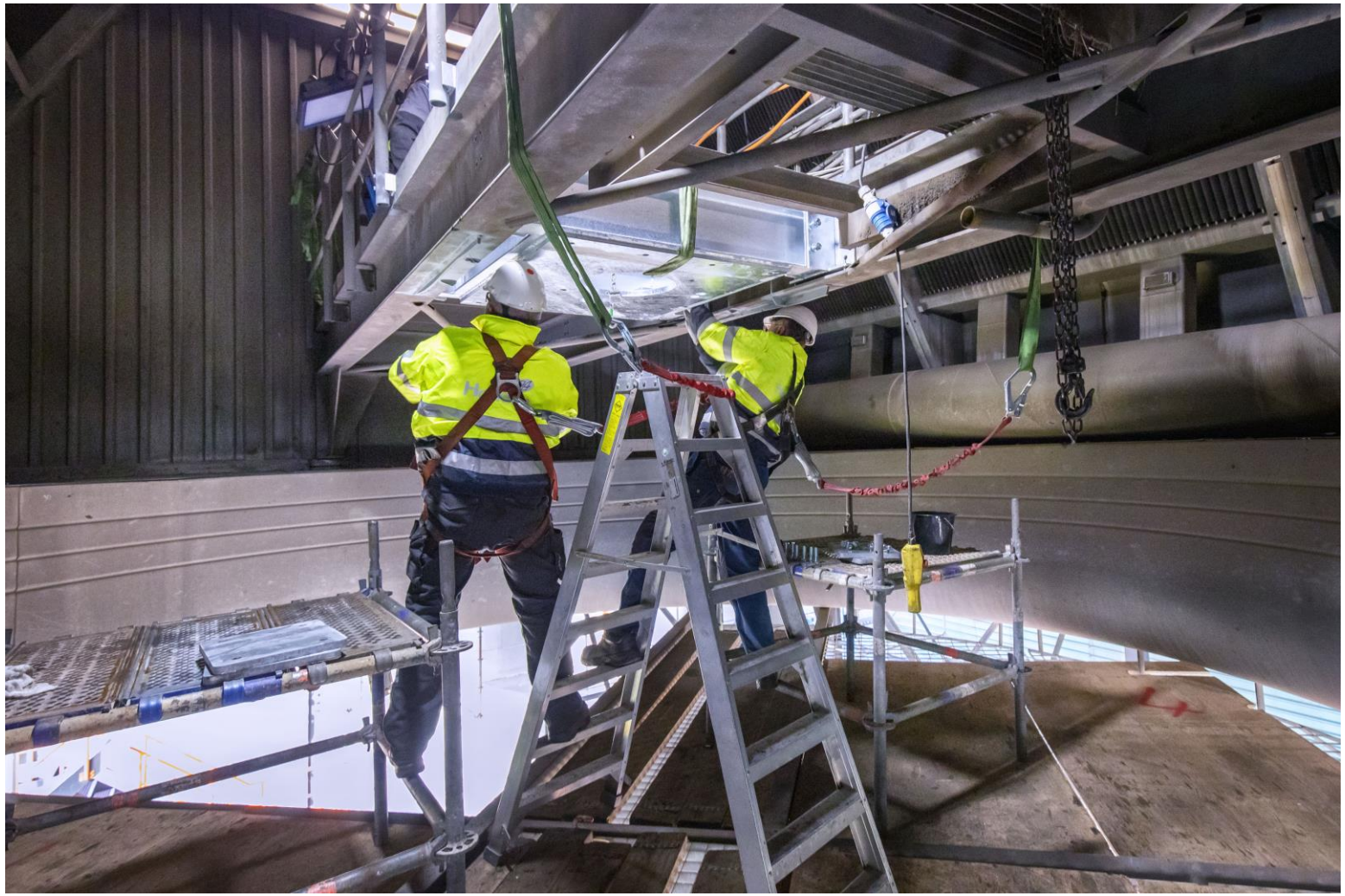


Fan installation

Removal of old belt-driven drive.

Installation of new motor-gearbox support being hoisted and installed.





Fan installation

Fan installation

Completed installation along with the addition of VFDs for fan speed control.

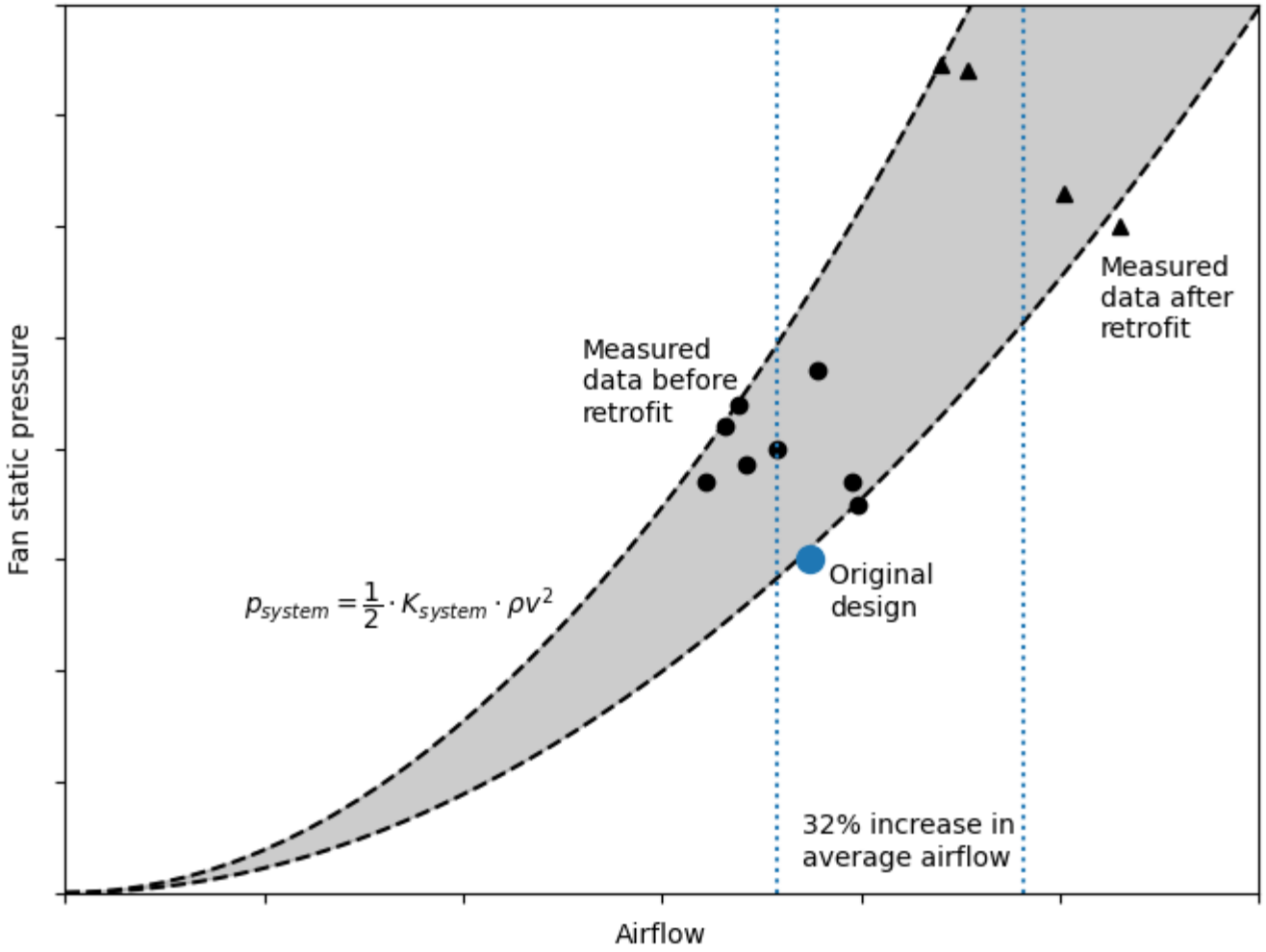
Commissioning measurements

Performance optimisation during commissioning

Initial performance measurements showed a higher flow rate and power consumption than predicted.

This was due to a then conservative estimation of the fan performance.

A reduction in blade angle of approximately 1° resulted in the desired increase in airflow while not exceeding the maximum available motor power.



Vibration issues at the fan casing

When initially running the fans, very high vibrations of the fan casing and safety grid were observed visually and subsequently measured as well.

The increased vibration levels may be attributed to the increased magnitude of the aerodynamic pulse exerted on the fan casing at BPF.

Fewer blades with a higher total aerodynamic load.

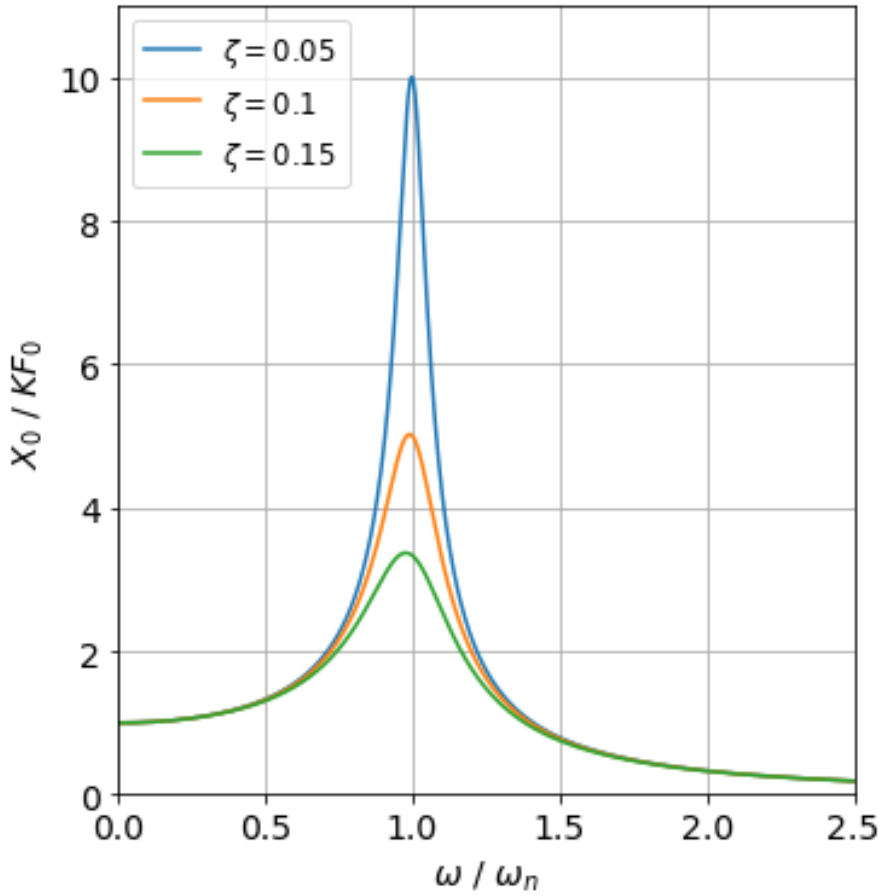
The solution was to add additional stiffening plates to the fan casing.

Vibration issues at the fan casing

Another commonly occurring cause of increased fan support / drive vibration levels are:

- A shift in the natural frequencies of the system through changes in the support structure or rotor mass.
- Changes in the blade pass frequency (BPF) exciting the natural frequencies of the existing structure.
- A combination of the above.

These vibrations are challenging to predict without extensive structural simulation and are generally not caused by fan unbalance.



Conclusion

Summary and lessons learnt

The customer requirements were met:

- The power output of the plant was reported to have increased by approximately 10 % due to increased fan airflow.
- Most structural elements, including the fan casing were reused.
- The fan noise was expected to be lower than with the original fans even though the fan speed was now higher.
- Due to the implementation of VFDs and speed control methodology, energy could be conserved during periods where the additional cooling is not needed.

A retrofit project is best supported by performance measurements of the existing situation – leading to the most appropriate new fan selection.

Every retrofit project is unique:

- The effect of changes to the structure or driving frequencies (BPF) are challenging to predict without detailed structural simulation and may lead to elevated vibration levels that are not a result of fan unbalance.
- Increased aerodynamic performance could come at the cost of an improved fan support structure.

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