ABCB

National Construction Code

Scenario for a Performance Solution

Energy efficiency of fan systems

JP1

The Performance Requirements of the National Construction Code (NCC) can be met using either a Performance Solution, a Deemed-to-Satisfy (DTS) Solution, or a combination of both. The following demonstrates the performance-based design process, aligning with the ABCB's Development of Performance Solutions guidance document.

Scenario

A designer is selecting fans for the heating, ventilation and air-conditioning (HVAC) systems in a new retail building. The HVAC requirements are relatively simple and the designer wishes to save time in the design process by selecting fans based on system resistance and fan efficiency alone. This avoids the need for some complex iterative calculations required to satisfy the NCC energy efficiency DTS Provisions.

Prepare a performance-based design brief

What are the design objectives?

To reduce the time and effort involved in the fan selection process and satisfy the minimum energy efficiency requirements.

Who should be consulted?

The building owner, the HVAC engineer, the environmentally sustainable design (ESD) consultant and the Appropriate Authority are the key stakeholders for this scenario.

What is the basis of the Performance Solution?

- The energy efficiency of the fan system will be assessed using the Fan Manufacturing Association of Australia and New Zealand's (FMA-ANZ) Fan Efficiency Curve. The peak load efficiency point of the fans selected for the proposed HVAC design will be compared with the FMA-ANZ Fan Efficiency Curve.
- The Fan Efficiency Curve uses FMA-ANZ research, applying regression analysis to a large sample of fan data to establish a relationship between the average Overall Static Efficiency and the System Static Pressure. This research resulted in a curve that can be used to identify the minimum Overall Static Efficiency required of any fan in the design relative to the Static Pressure of each system quickly. This allows a simplified way to show the approach will typically meet or exceed the DTS Provisions for fan energy efficiency, particularly for higher system static pressures.

What evidence is proposed?

A written report from the HVAC engineer explaining the approach used, and the result of comparing the fan efficiency of the design with the Fan Efficiency Curve.

Which DTS Provisions are applicable?

J5.4(b) of NCC Volume One.

Which Performance Requirement is applicable?

JP1 Energy use.

Note: for brevity, the applicable Performance Requirements and DTS Provisions have been limited. This solution may also impact other Performance Requirements and DTS Provisions and must be considered in accordance with Part A2 of NCC 2019.

PBDS 1-006-A

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Carry out analysis, modelling or testing

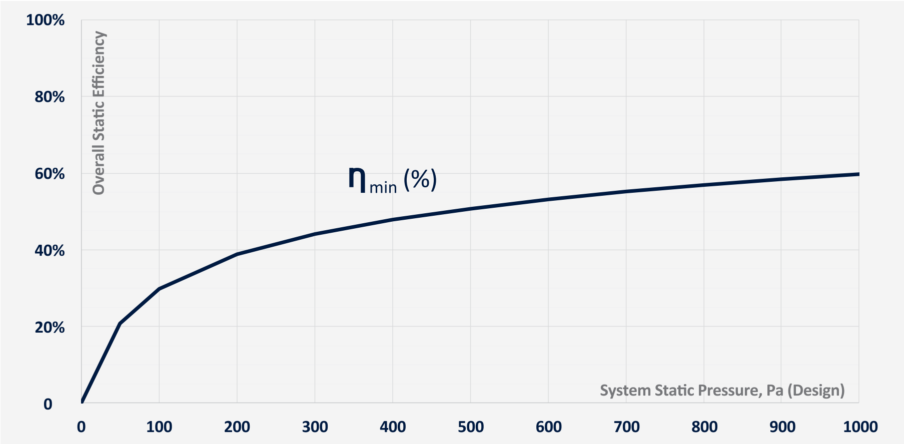
Which Assessment Methods are the most suitable and where can they be found?

Assessment Methods are listed in A2.2 of Part A2. Any Assessment Method or combination of them may be used to determine that a solution complies with the Performance Requirements. In this scenario, Comparison with the DTS Provisions is used as the Assessment Method.

What analysis, modelling or testing is used?

The HVAC engineer completes a system design and undertakes the regression analysis to calculate the minimum Overall Static Efficiency relative to each system's design Static Pressure for the fans. The calculations show the following relationship represented a suitable minimum Overall Static Efficiency (based on the FMA-ANZ Fan Efficiency Curve). This relationship is shown in the curve in Figure 1.

Figure 1: FMA-ANZ Fan Overall Static Efficiency Curve



η_{min} = 0.13 x ln(p) -0.3

Where—

η_{min} = the minimum Overall Static Efficiency for each fan (as defined in AS/NZS ISO 12759:2013).

p = the static pressure of the system design (Pa).

To use the curve, the HVAC engineer firstly determines the overall static pressure of each system. For a system calculated as 200 Pa, the Overall Static Efficiency of the fan must be at least 40%. If the System Static Pressure is 300 Pa, the Overall Static Efficiency of the fan must increase to at least 45%, to offset increased losses in the design of the ductwork. To validate this new criterion, the HVAC engineer also compares a sample of results with DTS Provisions across a range of typical duties. As the efficiency data was not available for all products at the fan duty, the HVAC engineer determined during this process that dividing a fan's Best Efficiency Point (BEP) by 1.1 was a reasonable approximation to accommodate sub-optimum performance.

Collate and evaluate results

The HVAC engineer collates the results and demonstrates to the stakeholder group that the fans selected for each system in the design exceed the efficiency requirements of their alternative criteria. This demonstrates that fan systems based on this Performance Solution satisfies JP1 for fan energy efficiency.

Prepare a final report

What should be in the final submission?

The HVAC engineer prepares a report detailing the approach for this Performance Solution, including supporting calculations. The stakeholder group peer reviews the report. It contains:

- An overview of the Performance-Based Design Brief (PBDB), outlining the Performance Solution; stakeholder group; agreed acceptance criterion; and reference to the relevant NCC Assessment Methods, Performance Requirement and DTS Provisions.
- Detailed calculations and any assumptions made.
- A statement from the stakeholder group. This acknowledges acceptance of the Performance Solution, and evidence demonstrating the suitability of the HVAC engineer to assess the fan product data.
- A summary of the key specifications, including the design and reference to all limitations and conditions of use.