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Data centres

Prescriptive temperature approach

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What are data centres?

- Evolution from server farms
- Growing popularity for Cloud services and AI
- Dense server racks
- High cooling requirements
  - Possible liquid cooling to racks
- High UPS requirements
  - Battery storage
  - Diesel generators
- Limited use of active fire suppression
  - No sprinklers due to electrical equipment

What is the prescriptive approach?

Normal Prescriptive CCTs

Based on ASFP Yellow Books 5 & 6

Yellow book 5 Table 16

Building type	Non-composite beams	Composite beams	Open columns	Structural hollow sections
Office/domestic	603	576	563	547
Storage	576	544	530	512
Shopping/ congregational/car park	583	553	539	521

Yellow book 6 Table 7

Description	3-sided beam	4-sided beam	Tension members	Compression members
Temperature	580	550	550	500

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How does it compare to an engineered solution?

Loading strategy

Typical building actions

- Equipment loading: 25kPa
- Access loading: 5.0kPa
- Services loading: 3.5kPa
- Raised access flooring: 1.0kPa
- Construction primary structure:
  - Steel framed
  - Concrete frame
- Floor construction:
  - Hollow core
  - In-situ post tensioned slabs
  - Composite decks

- Equipment loading
  - Super imposed permanent action?
  - Variable action?
- Access for day-to-day work in racks
- Maintenance for rack replacement
- Raised access floors to route services
- Services include:
  - Cooling (coolant to rack, ambient air)
  - Power (routine and UPS)
  - Data (ethernet & fibre optics)

Loading for model

Combinations based on BS EN 1990-1:2023+A1:2026

Permanent Actions

• Partitions	1.00kPa
• Raised access floor	1.00kPa
• 75mm screed	1.65kPa
• 300mm hollow core	2.36kPa
• Beams	0.59kPa
• Columns	0.20kPa

Variable actions

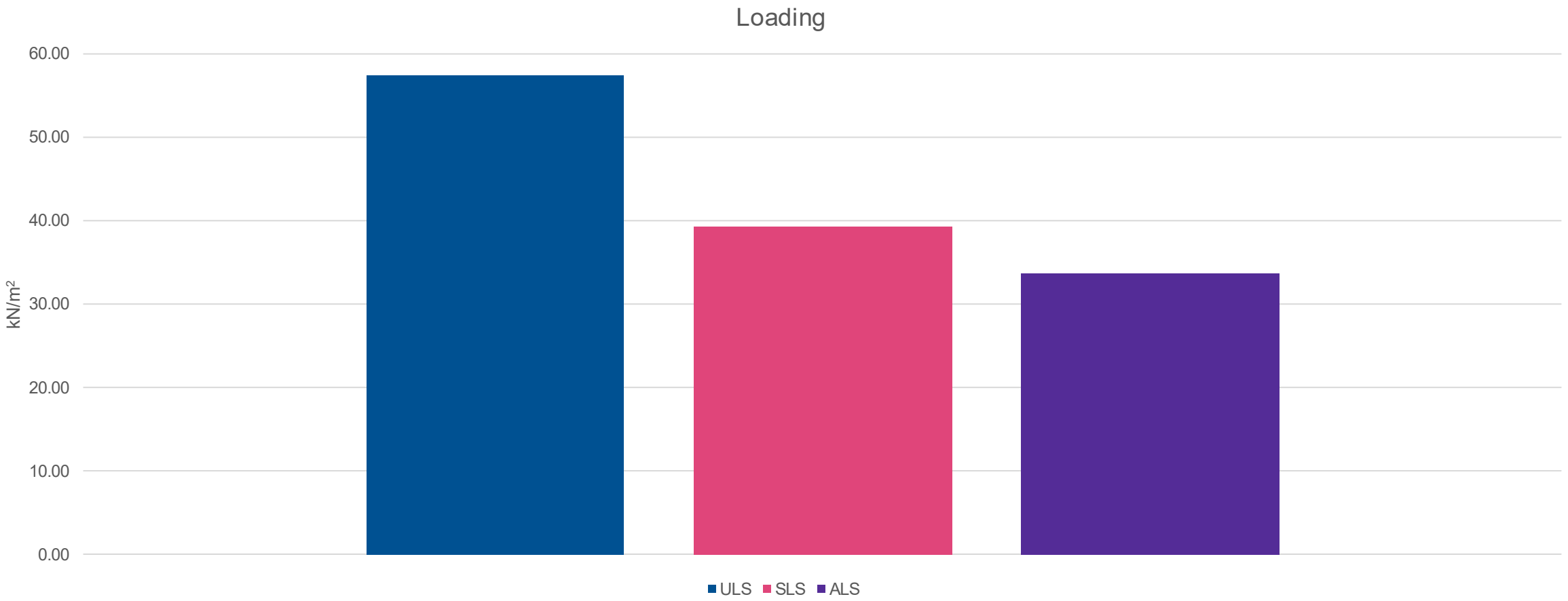
• Equipment	25kPa
• Maintenance	5.0kPa
• Services	3.50kPa

ULS loading	57.41kPa
SLS loading	39.30kPa
ALS loading	33.60kPa

$\eta = 33.60 / 57.41 = 0.5853$

Loading Comparison

ULS, SLS, ALS



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Calculated temperatures for beams

Model based approach

Secondary beams 610x229x101UB S355 (ULS μ = 99.8%; ALS μ_0 = 58.2%)

- Failure in yielding
- CCT 559°C

Primary beams 838x292x210UB S355 (ULS μ = 94.3%; ALS μ_0 = 55.0%)

- Failure in lateral torsional buckling
- CCT 517°C

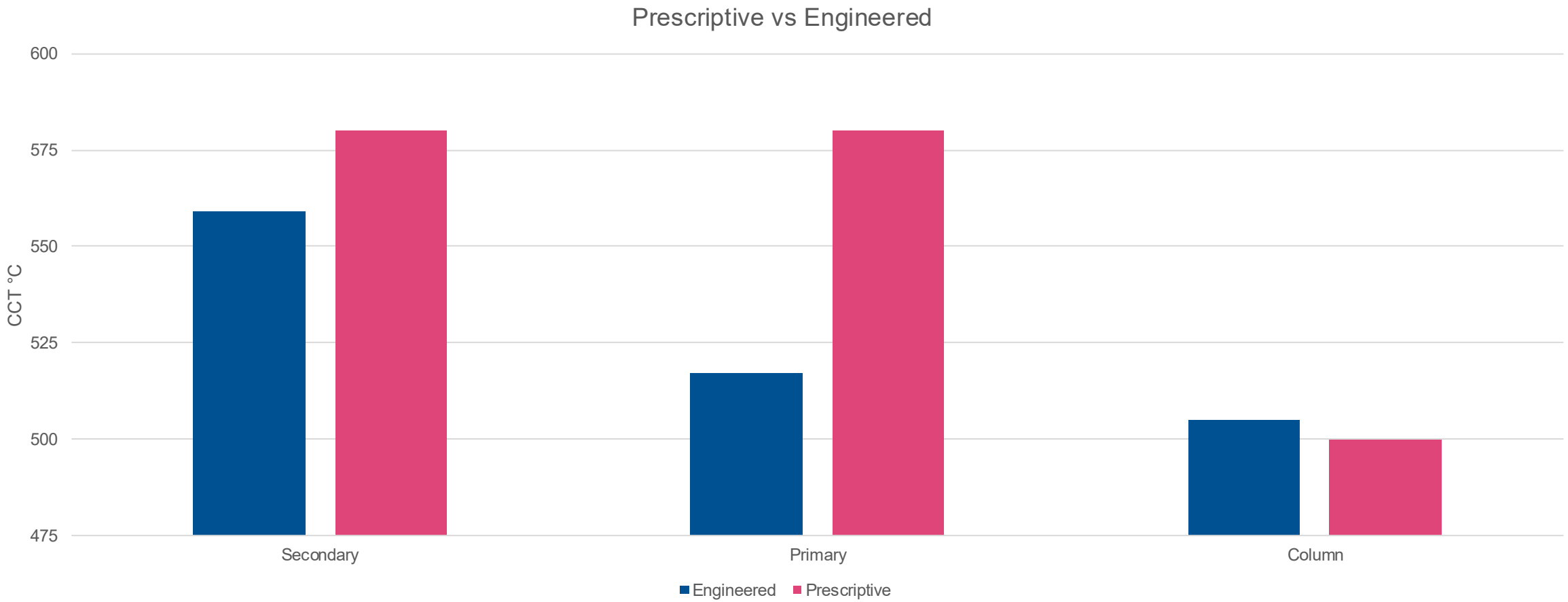
Columns 305x305x179UC S355 (ULS μ = 100%; ALS μ_0 = 58.5%)

- Failure in buckling
- CCT 505°C

Yielding CCT from BS EN 1993-1-2:2024 Eq(7.55); buckling CCT linear interpolated from BS EN 1993-1-2:2024 Table 5.3

Comparison of approaches

Prescriptive vs Engineered



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What does this mean

Are prescriptive approaches appropriate?

- Lower temperature approaches may be suitable
- In general should be treated with caution
- Experienced engineering judgement must be used

What are the next steps?

Next steps

Project basis

- We have the option to investigate a revised prescriptive CCT just for Data Centres
  - Collect more data on typical μ_0 values
  - Base CCT on a suitable confidence ratio (e.g. 95%)
  - Develop better industry guidance on the true loading that is to be expected.
- Direct clients towards an engineered design approach for safety.
- Raise awareness of consulting specialists for high residual load buildings.
- Consider parabolic fire scenarios
- Caution needs to be used when working with AISC 360-22 and IS 800 reduction factors for live loads.

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What questions do you have?

Dulux let's colour

International

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