Alternates to Flexural Strength for Airport Concrete Compliance Testing

Greg White
0400 218 048 | gwhite2@usc.edu.au
Introduction

• Rigid airport pavement design uses flexural strength (beams)
• Economical and convenient alternatives
  • Indirect tensile cylinders
  • Compressive cylinders
• Attractive if they are reliable
• Thanks to BMD, Skyways and Brisbane Airport Corporation

White, G. & Johnson, M. 2021, ‘Investigating alternates to flexural beams for airport concrete strength compliance’, 12th International Conference on Concrete Pavements, Minneapolis, Minnesota, USA, 29 August to 2 September.
Concrete strength

• Flexural beam strength (modulus of rupture)
• Beams are 150 mm × 150 mm × 500 mm
• Two beams per test, 7 and 28 days, four times a shift
• Up to 24 beams per shift in temperature controlled water
• Alternates are attractive
  – 150 mm × 300 mm cylinders
  – Compression or Indirect tensile testing
• Only if they prove reliable
Concrete strength

• Factors affecting concrete strength
  – Mixture design
  – Sample age
  – Curing temperature
  – Sample shape
  – Sample size

• Theoretical inter-conversions
• Usually mixture specific
Concrete strength

- **Compression**
  - Cylinder with dimensions: 2A x A

- **Indirect tension**
  - Cylinder with dimensions: 2B x B

- **Beam flexure**
  - Beam with dimensions: C x C x C
Concrete strength conversions

What have other researchers found?

![Graphs showing concrete strength conversions]
Methods

• Brisbane new runway was producing and testing beams
• Additional production testing to calculate variability
• Added a lab correlation process
• Tested the lab correlation during production
• Included both 7 and 28 day test results
• Included compression and tension cylinders
• Compared to the standard flexural beams
Production strength variability

T = tensile (indirect)
F = flexural
C = Compression

Compressive results divided by 10 to provide a comparable scale
Laboratory correlations

Seven days

- $y = 0.75x + 0.51$
- $R^2 = 0.83$
- $y = 10.41x - 2.29$
- $R^2 = 0.92$

28 days

- $y = 8.98x + 1.66$
- $R^2 = 0.86$
- $y = 0.75x + 0.58$
- $R^2 = 0.88$
Laboratory correlations

Combined laboratory correlations
Production comparisons

28 day production comparisons

Correlations to tensile and compression underestimated the true strength
Production comparisons

- 7 days
- 28 days

Data points and error bars represent flexural strength (MPa) for different sample sets at 7 and 28 days.
Conclusions

• Alternates to flexural beams are attractive
• Excellent relationships developed in the laboratory
• Not reliable on site
• Compression and Tension underestimated true strength
• Must retain Flexural beam testing
• But 7 day to 28 correlation was reliable and consistent
• Could omit 28 day concrete strength testing in the future
Thanks for your attention