Changing from ACN-PCN to ACR-PCR

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

- Reminder of the ACN-PCN system
- The change to ACR-PCR
- The new ACR-PCR system
- Comparing ACN and ACR values
- Case studies on the transition
- Estimate of the cost to industry

White, G 2022, ‘Practical implications for the implementation of the new international aircraft pavement strength rating system’, 11th International Conference on the Bearing Capacity of Roads, Railways and Airfields, Trondheim, Norway, 28-30 June.
The ACN-PCN System

- In place since the 1981
- Simple in nature
- Relative damage of different aircraft
  - Basis of comparison is stress
  - Simple treatment of pavement
- Calculated in COMFAA
- ACN compared to PCN
- Tyre pressure compared to limit
• Setting a PCN is more challenging
  – Equal to the highest ACN in the design aircraft
  – Equal to the ACN or the plane that operates regularly
  – Following a prescribed methodology like the FAA’s

PCN 46/F/B/1500/T

- Flexible (or rigid)
- Subgrade category
- Tyre pressure
- Subgrade protection
- Technical (or usage)
Changing to ACR-PCR

• Pavement thickness design is more sophisticated
• Differences can create anomalies
  – Designed for aircraft with ACN 90
  – But FAA process returns PCN 88
  – Design aircraft can’t operate freely
• ICAO developed ACR-PCR (over 6 years)
  – Same calculations as FAARFIELD (FAA design software)
  – Reduces anomalies
  – Introduced by member States by 2024
The New ACR-PCR System

- ACR (R = Rating) replaces the ACN
- PCR replaces PCN
- The new system is otherwise identical to ACN-PCN
- Calculation of the ACR
  - Different subgrade categories
  - Different ‘standard’ pavement
  - Aligns the rigid and flexible subgrade categories
  - Anomalies reduced but not avoided
- New FAA and ICAO softwares
The New ACR-PCR System

Layer | ACN-PCN thickness | ACR-PCR thickness for 1-2 wheels | ACR-PCR thickness for 3 or more wheels
--- | --- | --- | ---
Asphalt surface (P401/403) | 75 mm | 76 mm | 127 mm
Crushed rock (P209) | 150 mm | As required | As required
Uncrushed gravel (P154) | As required | Not used | Not used
Subgrade | Infinite | Infinite | Infinite

<table>
<thead>
<tr>
<th>Subgrade Category</th>
<th>ACN-PCN system Nominal CBR</th>
<th>CBR Range</th>
<th>ACR-PCR system Nominal CBR</th>
<th>CBR Range</th>
</tr>
</thead>
</table>
A | 15 | 13 and above | 20 | 15 and above |
B | 10 | 8-12 | 12 | 10-14 |
C | 6 | 4-8 | 8 | 6-9 |
D | 3 | 4 and below | 5 | 5 and below |
If your subgrade CBR value is 9........
Comparing ACN and ACR values

- \( \text{ACR} \approx 10 \times \text{ACN} \)
- To avoid confusing ACR and ACN
- But higher for rigid pavements
- Big differences for some aircraft
- Average ratio is 9.75
- Ratio ranges from 7.7 to 12.0
- So you can’t guess your new PCR
- That is, \( \text{PCR} \neq 10 \times \text{PCN} \)
Case Study 1 – Mudgee Airport

- PCN 12/F/C/Y/U – based on historical F27 usage
- Current critical aircraft Falcon 7X (ACN = 10)
- So reset the PCN after a technical evaluation
- PCN 10/F/C/X/T
- Convert to a PCR, based on the Falcon 7X ACR
- PCR 92/F/C/X/T
- Required and inspection and analysis of historical records
Case Study 2 – Birdsville Airport

• PCN 10/F/B/Y/U – basis not known
• Aspires to a greater strength rating
• Geotechnical investigation procured
• Subgrade CBR 9 (moves from subgrade B to C)
• Found to be suitable for Challenger CL 604 (ACR = 98)
• PCR will be 98/F/C/Y/T
• Required geotech, analysis and a report
Case Study 3 – Proserpine Airport

- Post (2017) upgrade PCN 58/F/A/X/T
- Geotech, construction records and basis of PCN well known
- PCN based on the A330-300
- Calculate the A330-300 ACR to be 754
- Set the PCR to 754/F/A/X/T
- Required the simply calculation of the A330-300 ACR value
Case Study 4 – Brisbane Airport

- New runway PCN 124/F/D/X/T
- International airport accommodating all aircraft
- PCN allows B777-300ER, A380, A350-900, etc
- Calculate the ACR of all the largest aircraft
- Using FAA methodology, PCR should be 1272
- B777-300ER ACR is only 1233
- Set the runway PCR to 1233/F/D/X/T
- Required ACR and PCR calculations using new FAARFIELD
The Cost to Industry

• Every airport with a PCN will need a PCR
• All published on the same day
• Many won’t know their subgrade CBR (5 and 9 change)
• Significant professional service cost
  – 350 airports
  – Range of analyses required
  – Estimate $3.75 M
• When will CASA make the transition?
Conclusions

• ACN-PCN has served us well for decades
• Anomalies with modern pavement design have arisen
• ICAO changing to ACR-PCR by 2024
• Principles are the same
• But every airport with a PCN will need to determine a PCR
• Significant cost to the industry
• No significant benefit outside of the USA
• When will Australia make the transition?