A New Post-Tensioned Continuity Detail for Super Tees

David Molloy – BG&E
Why Use a Continuous Superstructure?

- Originally to eliminate joints – reduce maintenance
- In Australia link slabs are common to eliminate joints
- Allow for a reduced structural depth:
  - More efficient moment distribution
  - Lower deflections
PCA Research

• The Portland Cement Association researched continuous bridges with precast, prestressed girders in the 1960s
• Continuity is limited by cracking in the joint over the pier
• Positive moments occur due to restraint of creep and shrinkage deflections
Restraint Moments

(a) Initial Deformation.

(b) Final Deformation if left as Two Simple Spans.

(c) Final Deformation and Restraint Moment if Spans are made Continuous after Prestressing.
Continuity Types

- Cast in Situ Stitch
- Full Length Post Tensioned
- Partial Post Tensioned
Cast in Situ Stitch

- PRECAST - PRESTRESSED GIRDER
- CAST IN SITU DECK SLAB AND STITCH
- NON-PRESTRESSED REINFORCEMENT PROJECTING FROM END OF GIRDER
- 0.5Lsy
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Partial Post Tensioned

- CAP CABLE
- CAST IN PLACE CONCRETE
- ANCHORAGE

- CAST IN PLACE DECK
- CABLE

- POST-TENSIONED BOLT
- VOID TO ALLOW PLACEMENT OF NUT

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Partial Post Tensioned
Melton Highway Bridge

- Melton Highway Level Crossing Upgrade:
  - Designer – SMEC
  - Contractor – BMD
  - Client – Level Crossing Removal Authority (LXRA)
  - Authorities
    - Owner – VicRoads
    - Stakeholder – Metro Trains Melbourne (MTM)
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General Arrangement
Joint Detail

1500 DEEP SUPER TEE
BEARING PLATES
LAMINATED ELASTOMERIC BEARING
BEARING PLINTH

320
700
250

1500 END BLOCK
50 GAP GROUT INFILL
CAST IN DUCTS
STRESS BAR WITH SECONDARY DUCT

TOP OF CROSSHEAD
Construction Sequence

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Construction Sequence

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Photos

End block with ducts extending

Loose fit stress bars
Photos

Grouting gap

Stressing
Joint Detail

1500 DEEP SUPER TEE

BEARING PLATES

LAMINATED ELASTOMERIC BEARING

BEARING PLINTH

FLAT PLATE

1500 END BLOCK

50 GAP GROUT INFILL

CAST IN DUCTS

STRESS BAR WITH SECONDARY DUCT

TOP OF CROSSHEAD
Bearing Plates
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Stage 1: Install Span 1 and 2 Girders (Span 2 First to Set 50mm Gap)

Stage 2: Grout Over Pier 1, Free Ends of Girders Can Move Longitudinally

Stage 3: After Grout Reaches 50MPa Post Tension Pier 1 Joint and Transfer to Pier 1 Bearing

Stage 4: Install Span 3 and Grout Over Pier 2
(Note: Span 3 Girder Can Be Installed at Any Time Before Stage 4 But Grouting Must Be After Stage 3)

Stage 5: After Grout Reaches 50MPa Post Tension Pier 2 Joint and Transfer to Pier 2 Bearing
Code Issues

AS5100.5-2017 Clause 8.10.10.3.3.2 “Positive moment connection at supports”

“In addition to those positive moments due to live load, support settlement and thermal effects, positive moments can develop due to the combined effects of differential creep and shrinkage. Where positive moments occur at supports, fully anchored non-prestressed longitudinal reinforcement shall be cast into the ends of the precast beams to permit the connection of the bottom flanges of adjoining beams at supports.”
Conclusion

• No falsework required;
• Narrow stitch reduces the width of crosshead required;
• Single bearing reduces the width of crosshead required;
• High early strength grout means stressing can be completed quickly; and
• All stressing work can be done from the top of the girder, without a rail occupation.
Acknowledgement

We would like to acknowledge SMEC’s role as lead designers. BMD’s role as the contractor. Westcon’s role fabricating the girders and providing feedback and advice on constructability of the end block and post tension details. Clifton’s role in erecting the girders and providing constructability feedback. LXRA, VicRoads and MTM’s roles as the client and road and rail authorities, providing comments on the design. BECA’s role as the proof engineer.