The International Bridge Conference

Session W-7
International Bridge Engineering Practices

Specifications and Applications of Composite Materials in Bridge Infrastructure in Australia

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Composite Fibre Technologies
Wagners CFT – Building the Future

Manufacturing Structural Composites since 2002

- Head Office
  Toowoomba, Queensland Australia
- Manufactures and Fabricates over 3 Million pounds of Fibre Composite Material per annum
- Australia’s only Pultruder
- Publicly Listed on Australian Stock Exchange – ASX:WGN
Wagners - Corporate

• Supply of Construction Materials
  – Cement
  – Concrete
  – Quarry Materials
  – Precast
  – Transport
Gross Mass – 300,000 Pounds
Payload – 185,000 Pounds
18 axles total
### Composite Fibre Technologies

Wagners CFT Manufacturing Pty Ltd  A.B.N. 91 099 936 446  •  Telephone +61 7 4637 7777  •  Email: cftsales@wagner.com.au  •  Internet:

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**WCFT Product**

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#### SQUARE HOLLOW SECTIONS – WCFT Grade GV35-S

**Table 2.1**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Depth $d$ (mm)</th>
<th>Width $t$ (mm)</th>
<th>Mass $m$ (kg/m)</th>
<th>Nominal External Flace Area $F_a$ (mm$^2$)</th>
<th>Cross-Sectional Area $A_0$ (mm$^2$)</th>
<th>Moment of Inertia $I_y$ (mm$^4$)</th>
<th>Section Modulus $W_y$ (mm$^3$)</th>
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<th>Width $t$ (mm)</th>
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<th>Section Modulus $W_y$ (mm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCFT 125 x 125 x 6.4</td>
<td>125</td>
<td>125</td>
<td>30.0</td>
<td>6.75</td>
<td>3.81</td>
<td>0.489</td>
<td>2090</td>
<td>6.09</td>
<td>110</td>
<td>49.2</td>
<td>9.60</td>
<td>83.4</td>
<td>7.98</td>
<td>442</td>
<td>6.42</td>
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<tr>
<td>WCFT 150 x 150 x 7.3</td>
<td>150</td>
<td>150</td>
<td>36.0</td>
<td>6.73</td>
<td>3.81</td>
<td>0.288</td>
<td>2045</td>
<td>5.90</td>
<td>110</td>
<td>49.4</td>
<td>9.60</td>
<td>83.4</td>
<td>7.97</td>
<td>442</td>
<td>6.48</td>
</tr>
</tbody>
</table>
Derivation of Characteristic Material Properties

ASCE (2010) *Pre-Standard for Load and Resistance Factor Design (LRFD) of Pultruded Fiber Reinforced Polymer (FRP) Structures (Final)*, American Society of Civil Engineers
Characteristic Values

ASTM D7290

- Statistically determined values
- Considering two parameters – Shape and Scale
- Representing 80% lower confidence bound on a 5th percentile of specific population
Timber Bridges

Bridge repairs form a significant part of asset management for many councils across Australia, with an estimated 40,000 timber bridges in Australia. Recent surveys suggest most timber frames are nearing the end of their structural lives and are in desperate need of repairs to meet current safety standards. But with many councils restricted by limited budgets, many bridge asset owners are unable to fund comprehensive bridge maintenance programs.
• $1.5 billion worth of timber bridges under local council management
• $0.98 billion of those, or around 65% were determined as being in a poor, to very poor state.
Beam Development

Bridging the Gap!
Fatigue Testing
Requirements Met!

<table>
<thead>
<tr>
<th>Beam Property</th>
<th>Requirement</th>
<th>Tolerance</th>
<th>Wagners Beam</th>
<th>Requirement Met?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max width</td>
<td>350 mm</td>
<td>+0</td>
<td>300mm</td>
<td>Yes</td>
</tr>
<tr>
<td>Max depth</td>
<td>425 mm</td>
<td>+0</td>
<td>424mm</td>
<td>Yes</td>
</tr>
<tr>
<td>Mmax at failure</td>
<td>660 kNm</td>
<td>-0</td>
<td>780kN</td>
<td>Yes</td>
</tr>
<tr>
<td>EI of girder</td>
<td>29.6x10^{12} Nmm²</td>
<td>+/- 10%</td>
<td>27.4x10^{12} N.mm²</td>
<td>Yes</td>
</tr>
<tr>
<td>Working live load capacity</td>
<td>109 kNm</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Shear Capacity</td>
<td>350 kN</td>
<td>-0</td>
<td>435 kN</td>
<td>Yes</td>
</tr>
<tr>
<td>Max Deflection (at ultimate = 350kN)</td>
<td>170 mm</td>
<td>+/- 10%</td>
<td>172.4mm</td>
<td>Yes</td>
</tr>
</tbody>
</table>
One is not enough
Trial Installations
Composite Fibre Technologies
Composite Fibre Technologies

Pile Strengthening

Bridge Widening
• Supply of 80 Beams
• Rigourous testing regime
• Not just product properties but Installation methods
• Click on standard drawing #’s SD2285 and SD2286
Queensland Main Roads Specifications

Manufacture Spec
MRTS 59

Installation Spec
MRTS 60

Composite Fibre Technologies
Queensland Main Roads Std Drawings

FIBRE REINFORCED POLYMER (FRP) COMPOSITE GIRDER
FOR TIMBER BRIDGE REHABILITATION

Typical arrangement "A" class timber bridge (1939)
Queensland Main Roads Std Drawings

- New FRP I Beam
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**STEP 8 - JACKING NEW CORDER IN PLACE**

10a. Jack new girder (FRPC) into position under bridge with temporary jacking plate (JP)

*Jacking procedure and details to be approved by an IRWD*

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**STEP 10 - LOWER THE DECK, REPAIR DWG**

10a. Lower jacks.

10b. Drill new holes on Deck Flat Bar (DF) and install DF on top of deck aligned with new girder (FRPC) cambered.

10c. Drill new bolt holes and install bolts with saddle washer (SM).

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**STEP 12 - APPLY EPOXY (IF REQUIRED)**

12a. Apply epoxy when required.

12b. Inspect contact between girder and deck, if significant gap exists, install framework, retain and outlet tubes and pour epoxy.

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**INSTALLATION PROCEDURE SHEET 3 of 3**

FRP COMPOSITE CORDERS FOR TIMBER BRIDGE REHABILITATION

WCFT-51, 52 & 53

Department of Transport and Main Roads

Number of Pages: 3

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Sheet 3 of 3
Implementation and Development

- Baio Bridge
- Rehabilitation of piles and replacement of headstocks / corbels / girders and decking
- Increased load capacity
  - T44 Vehicle Load – Grillage in various positions
  - 5kPa Pedestrian Load
  - 400kN Braking Force
  - Water – 1m above deck / 4 ms\(^{-1}\)
Engineering Design Procedure

- Investigation of Timber Structure
- Definition of desired level of service
- Analysis to determine level of upgrade required
- Options Presented
Pinkenba Wharf

Jetty – 260 ft x 20 ft
Wharf – 825ft x 50ft
Loading

• Superstructure
  – FRP U-Girder Deck
  – Class 25 Wharf – 3.6psi deck UDL (25kPa) + 112,000 lb point load on 3ft square point load from Crane (General Purpose wharf)
  – Construction Load – Liebherr 1280 tracked crane
  – Concrete Top (Earth Friendly Concrete)
  – FRP Rebar in Concrete
  – No Corrosion in Deck

• Substructure – Cathodically Protected
Proposed Section
FE Model

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