# Garden Bridge - Design

Paul Sanders

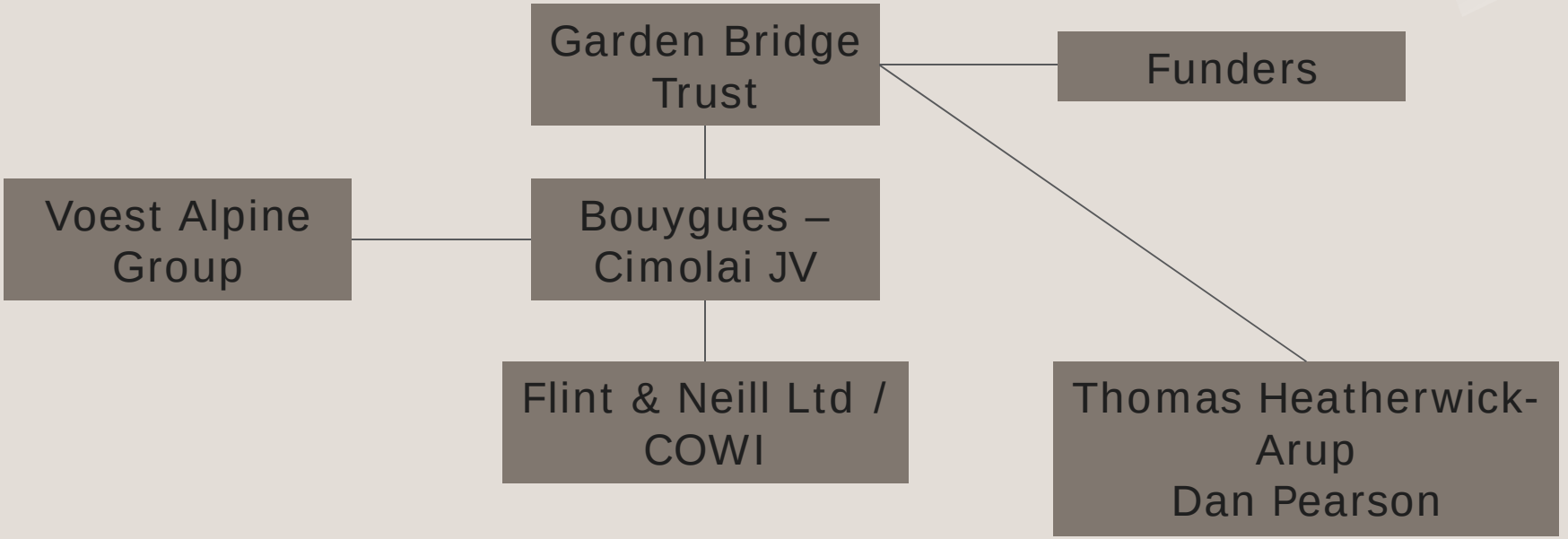
# Contents

- Background and inspiration
- Design
- Construction
- Conclusions



flint neill
a CDM company

# Project Organisation






flint neill
a COWI company

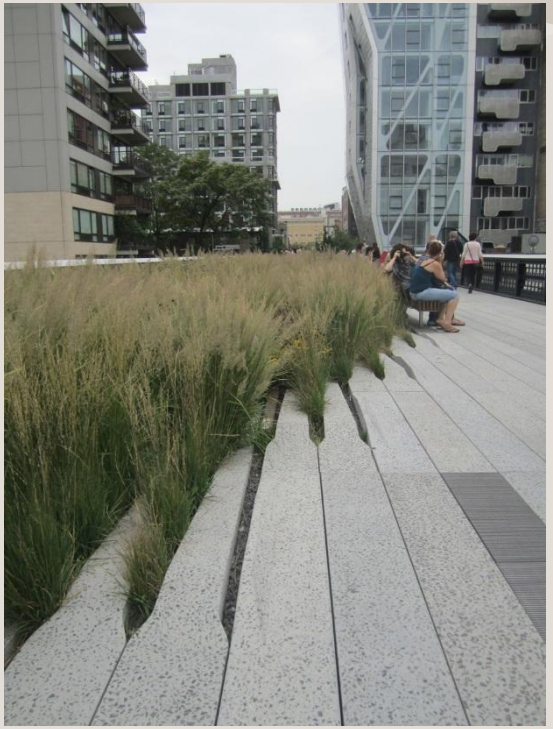
# Project Vision

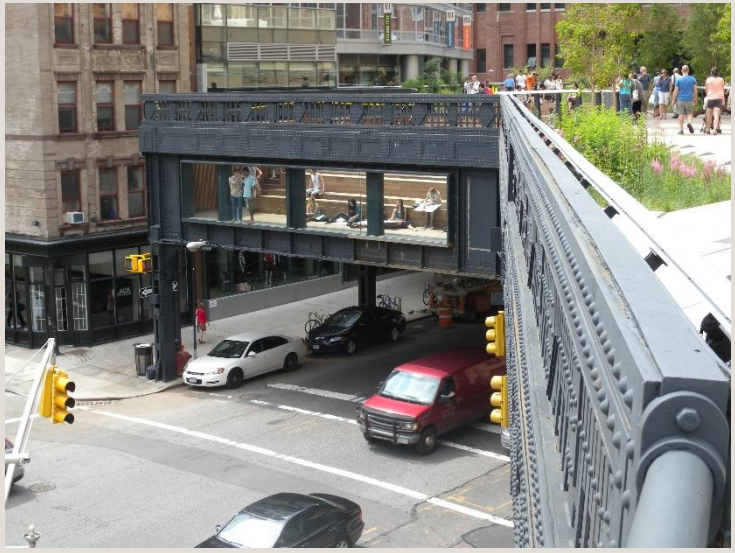
- Garden on the Thames
- New destination
- Free for all
- Horticultural excellence
- Views of the river and city
- A new perspective on the city

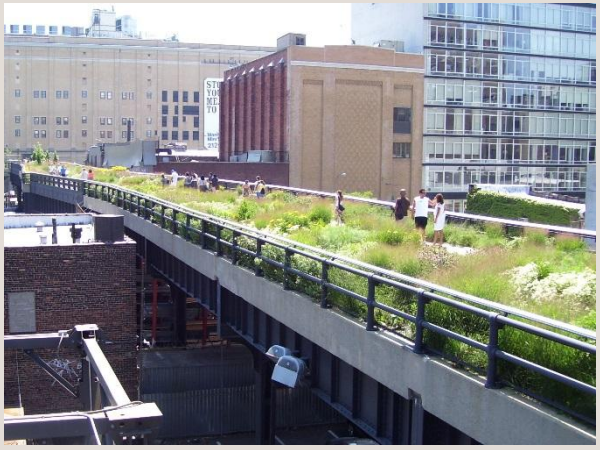
- Joanna Lumley

- Thomas Heatherwick

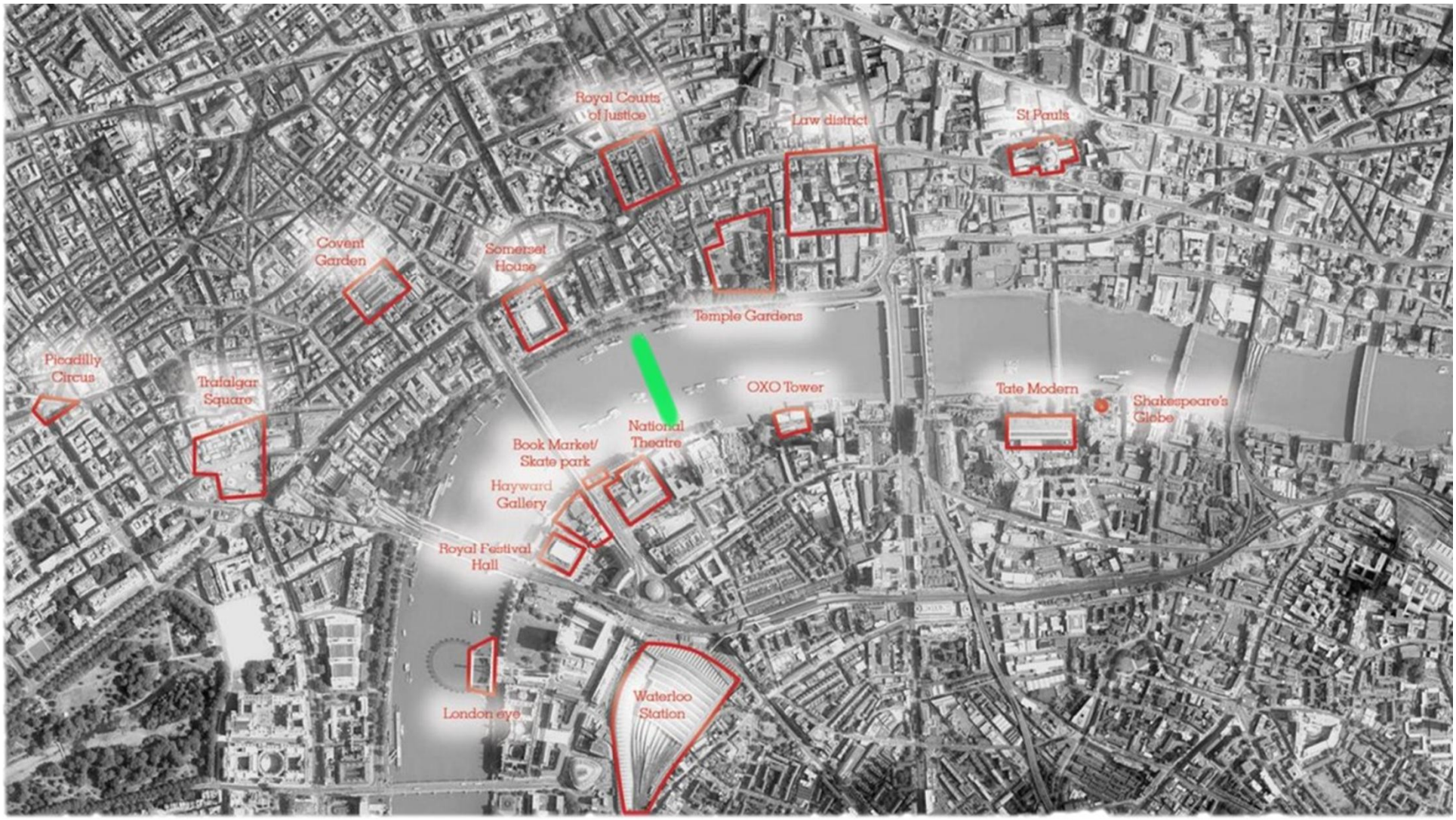
# New York High Line Bridge



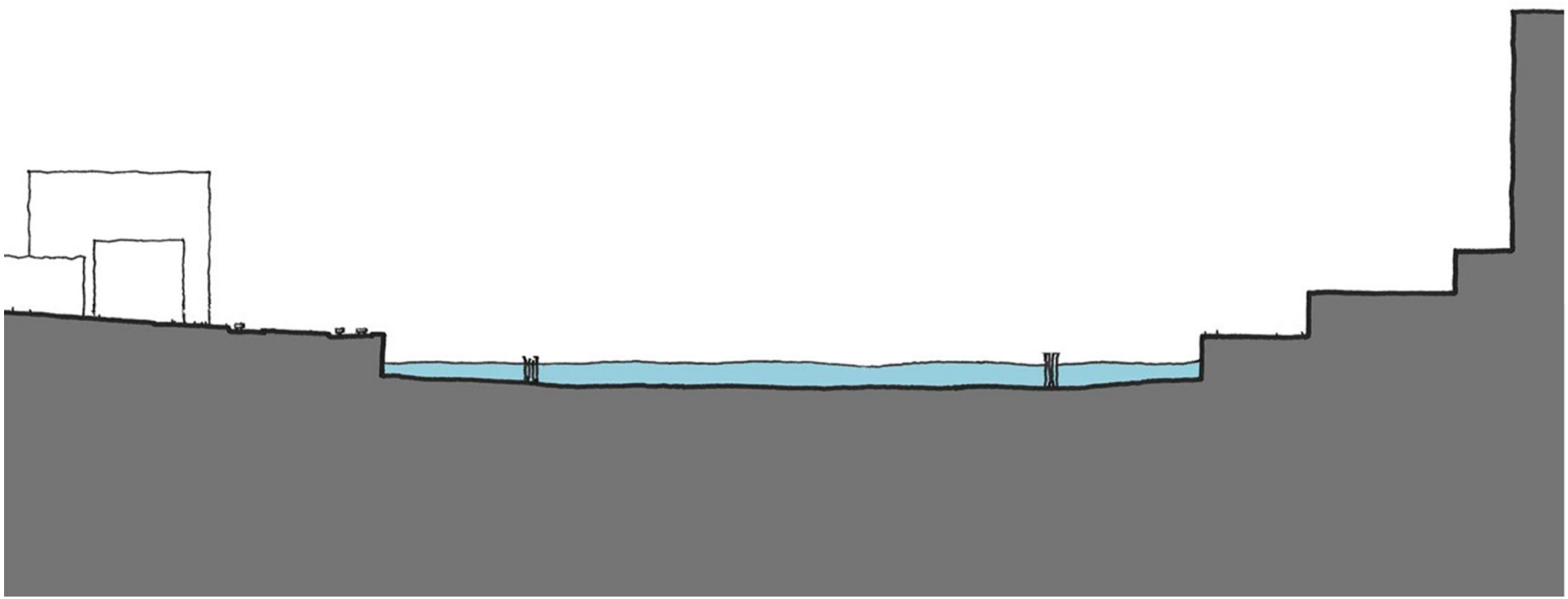


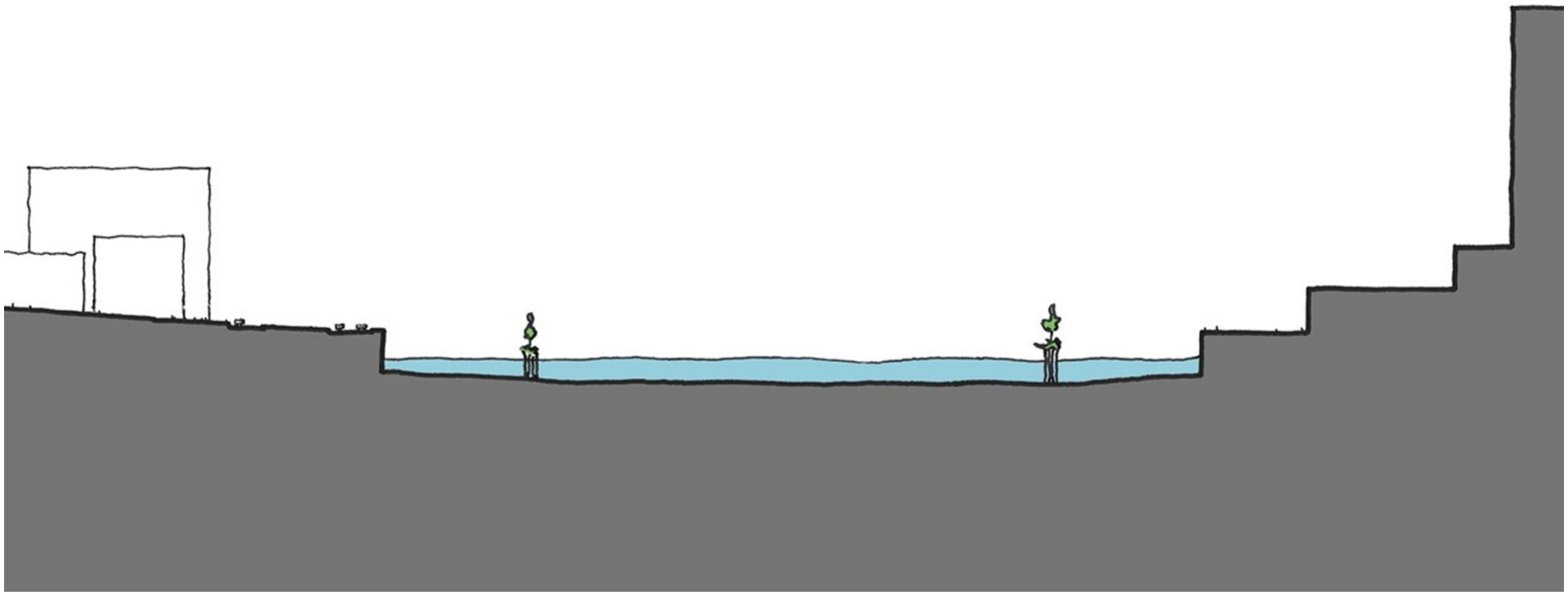


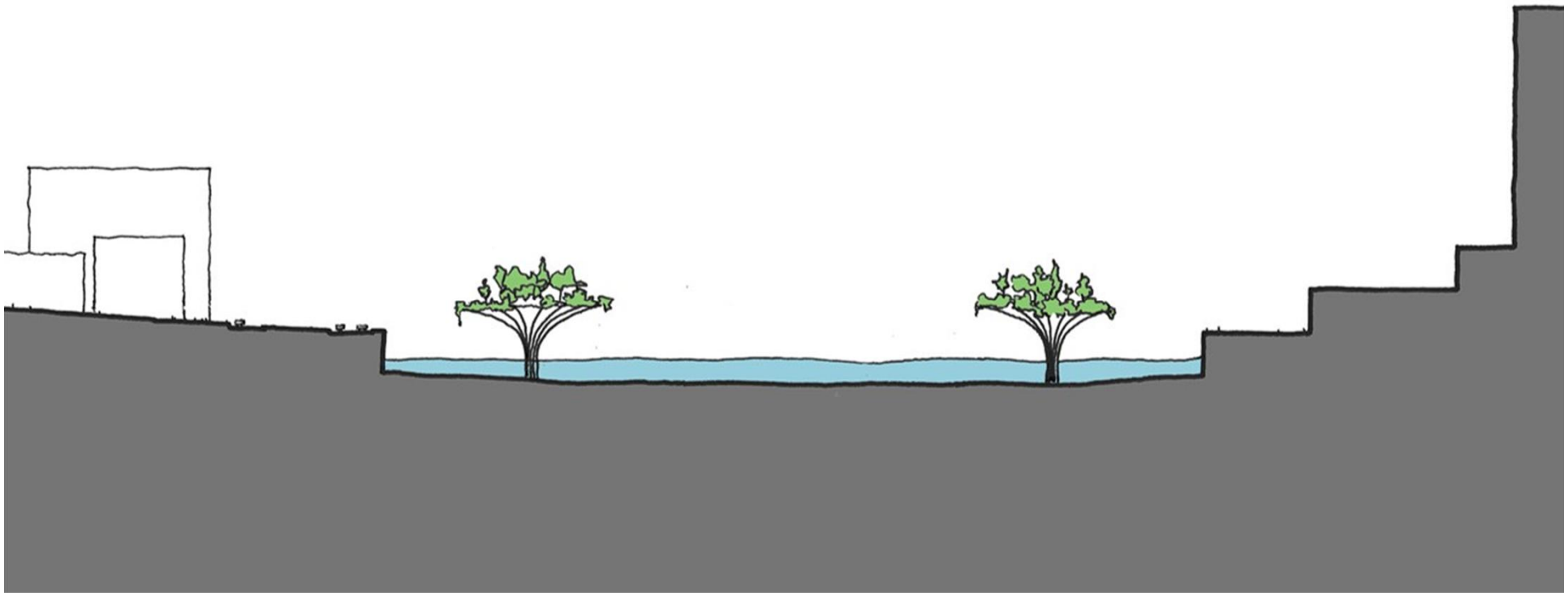
flint neill
a COWI company

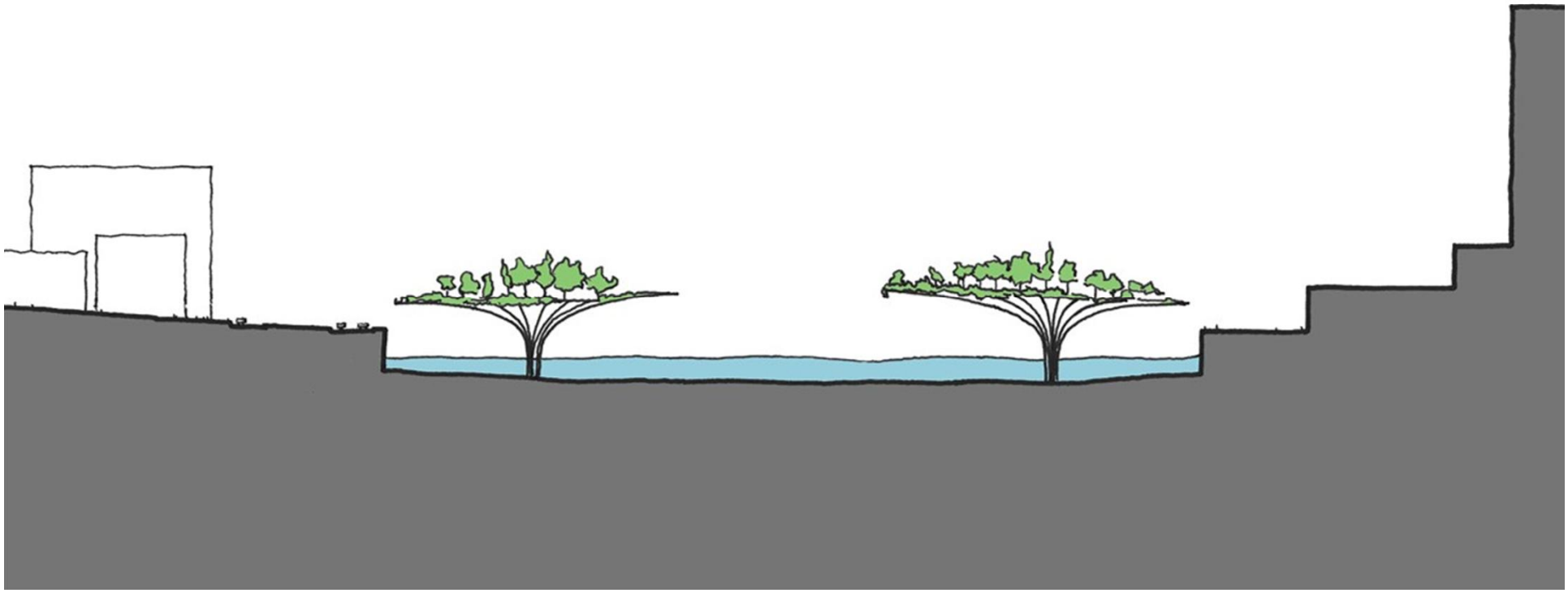

Royal Courts of Justice
Law district
St Pauls
Covent Garden
Somerset House
Temple Gardens
Piccadilly Circus
Trafalgar Square
OXO Tower
Tate Modern
Shakespeare's Globe
National Theatre
Book Market/ Skate park
Hayward Gallery
Royal Festival Hall
Waterloo Station
London eye

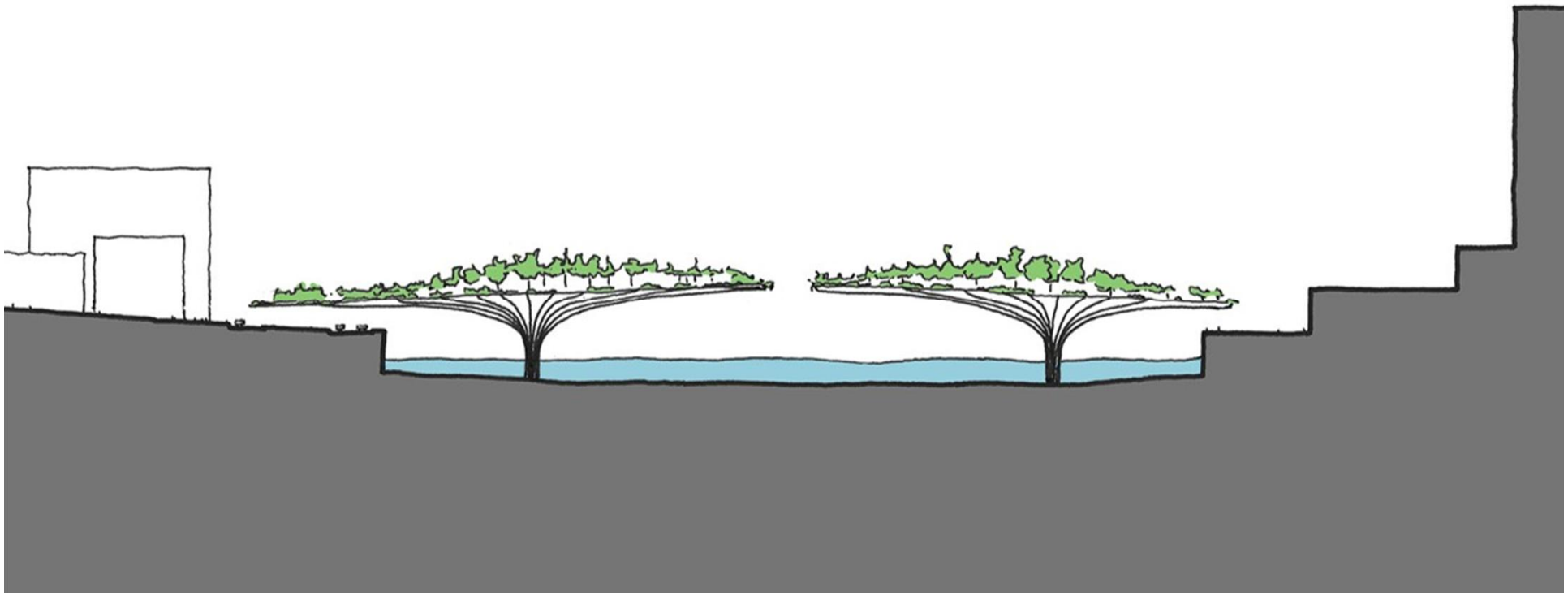

9 JUNE 2016
GARDEN BRIDGE
flint neill
a COWI company

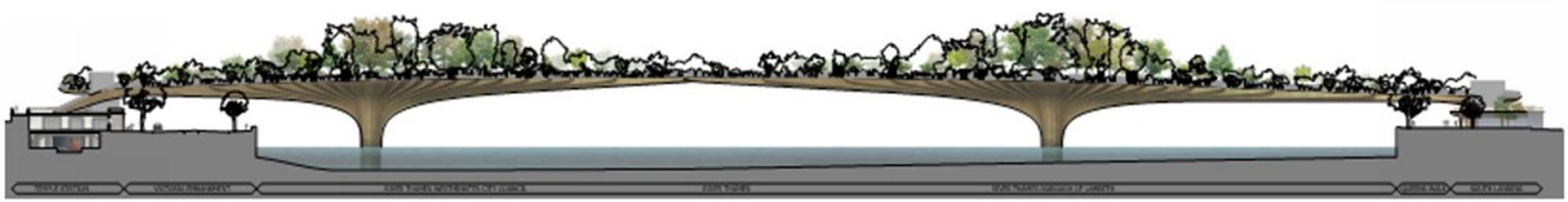




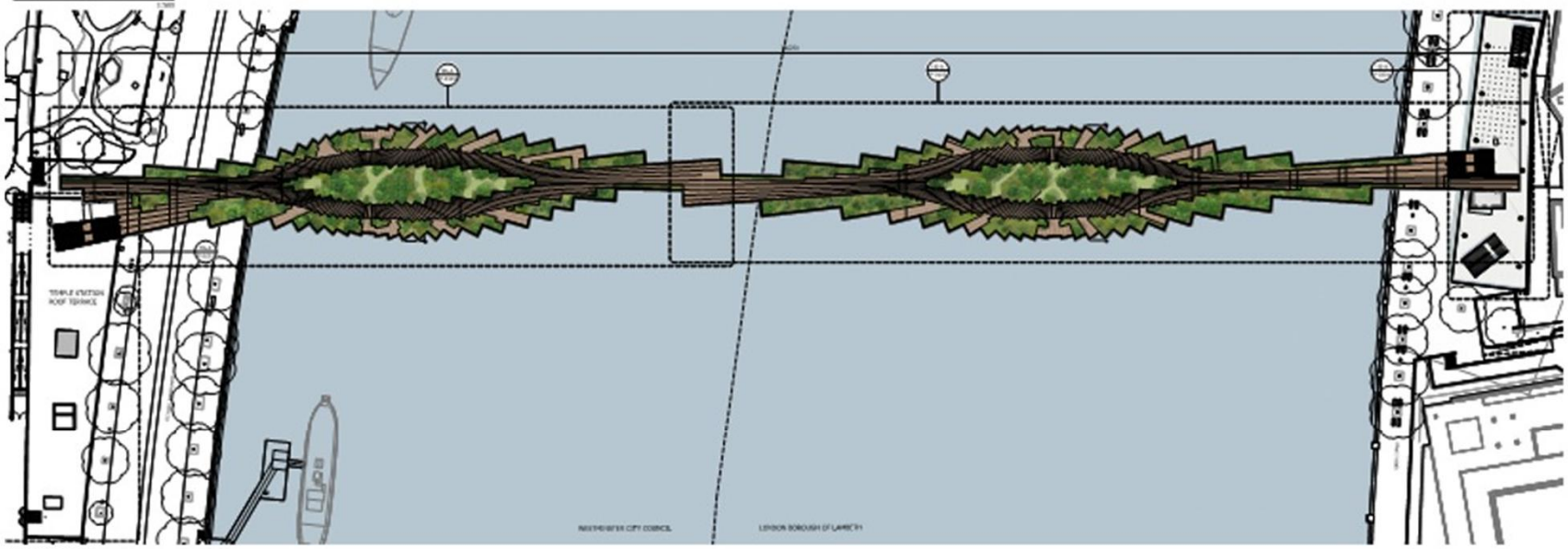




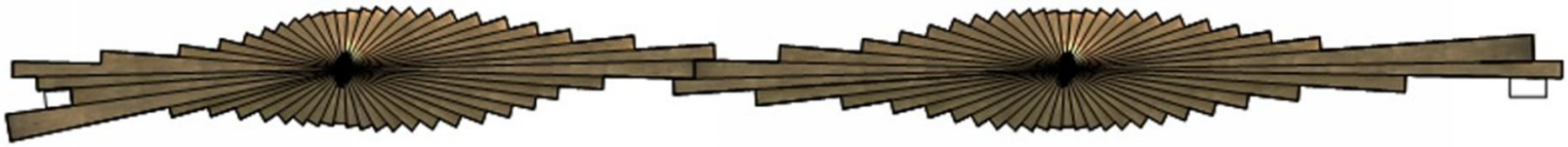




PROPOSED WEST ELEVATION

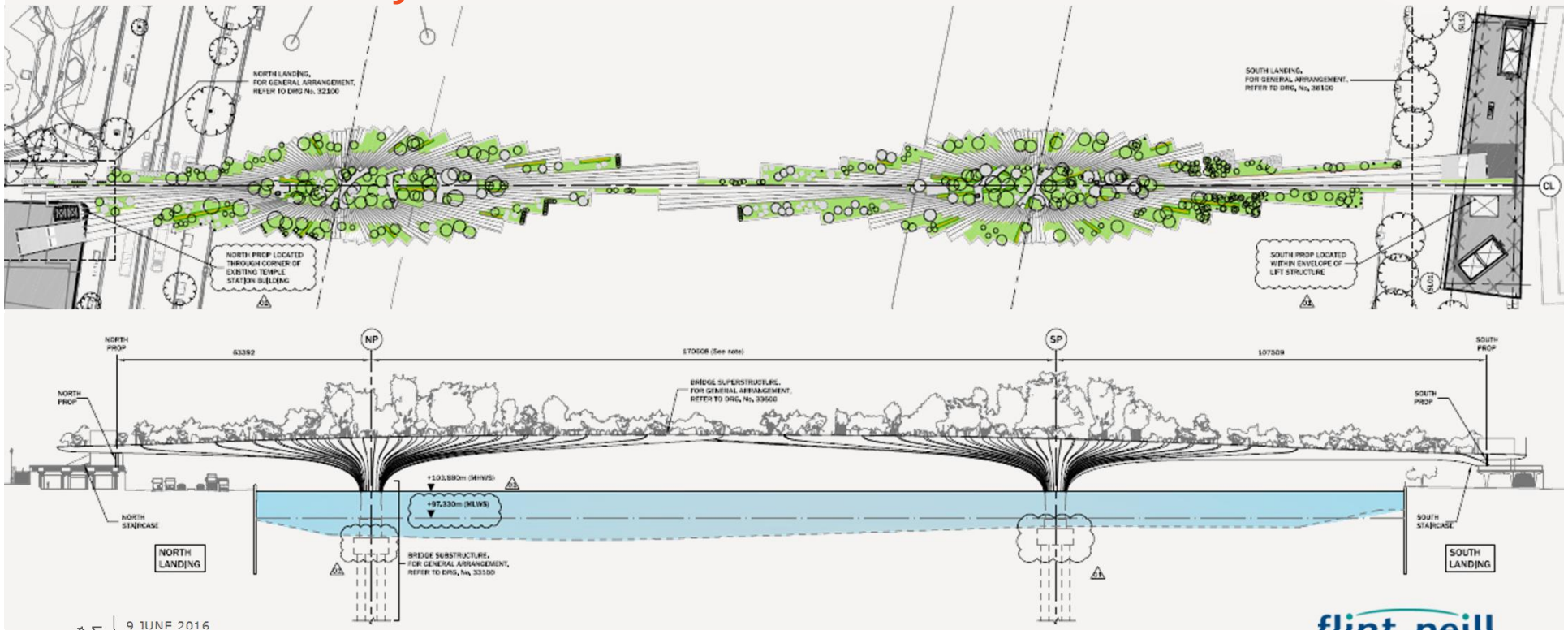



PROPOSED DECK PLAN



PROPOSED REFLECTED SOFFIT PLAN

# Structural System



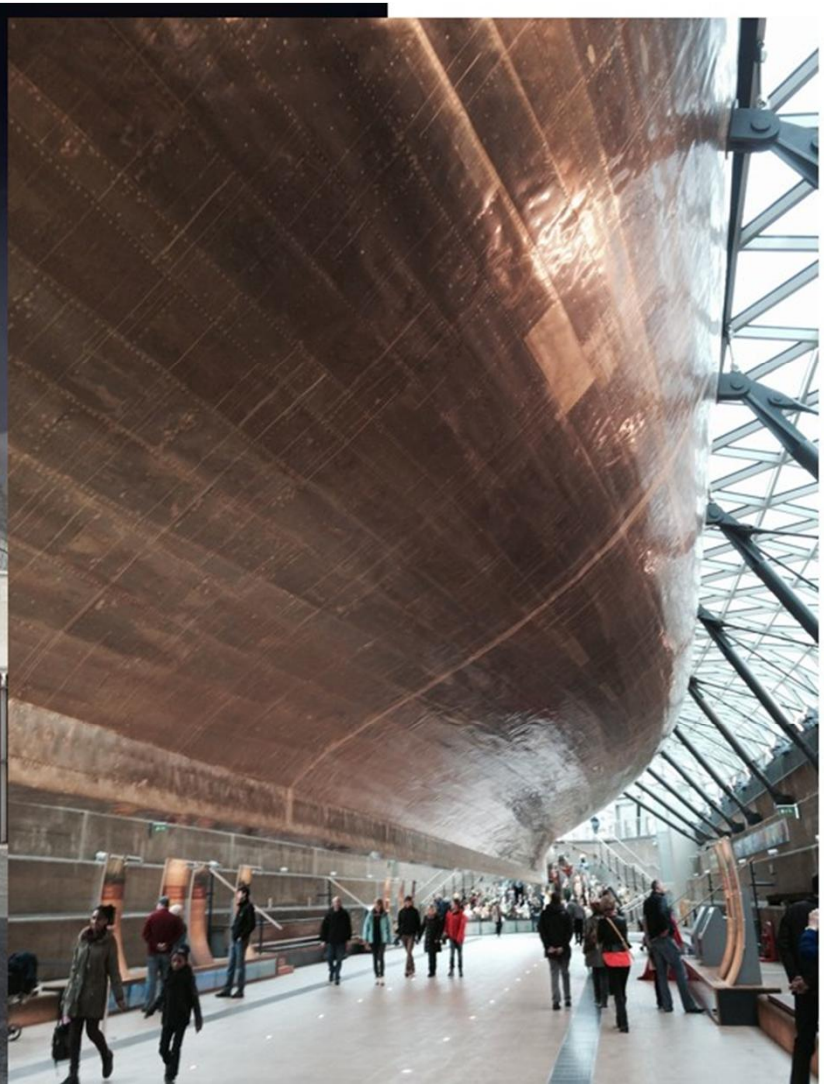


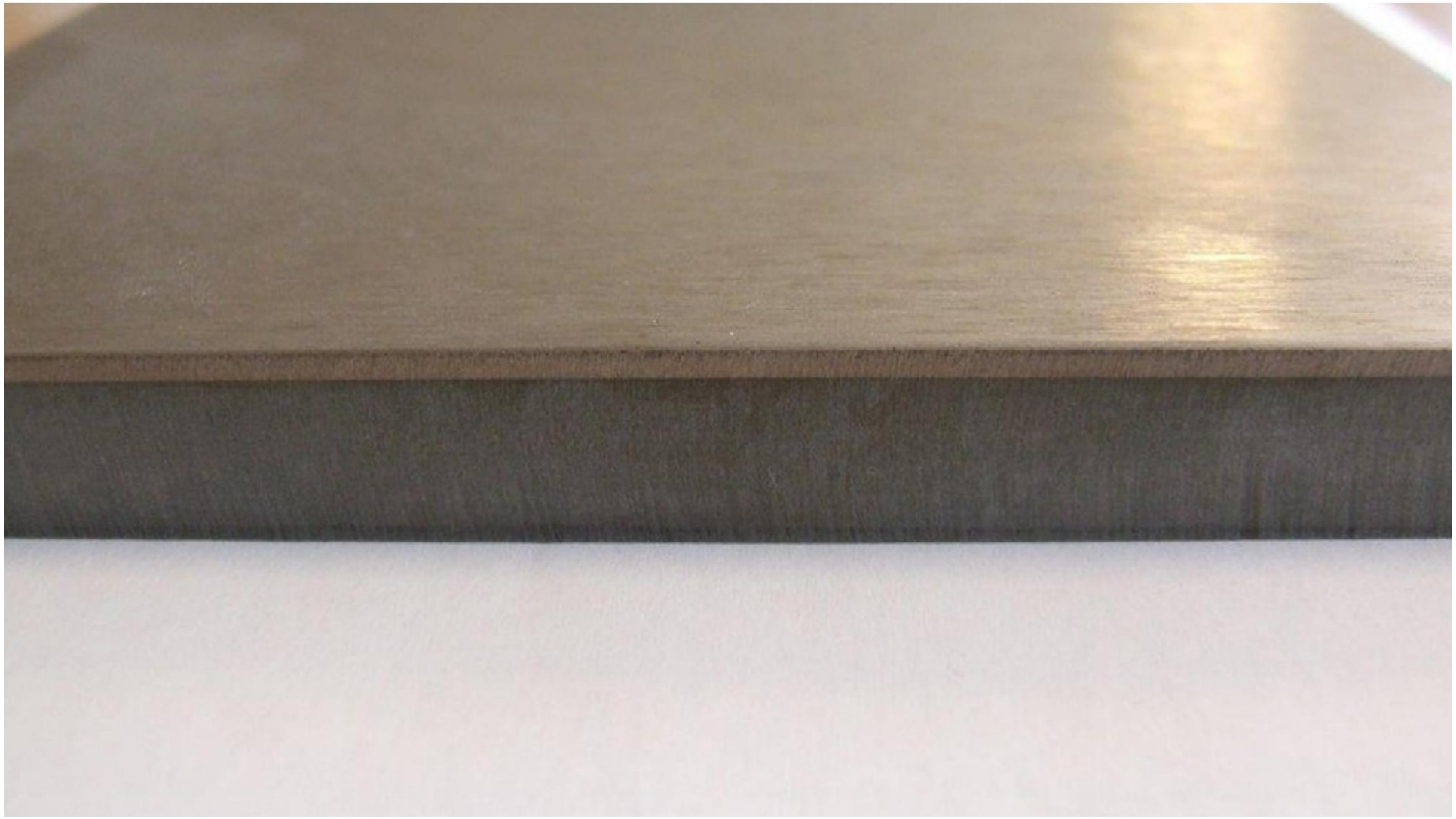

flint neill
a COWI company

**Table 3:** Estimated annual visitors for similar bridges/attractions

| Comparators | Estimated Annual Visitors | Peak Weekday | Peak Saturday | Peak Sunday |
|---|---|---|---|---|
| Blackfriars Bridge | 4.1 million | 15,000 | 8,000 | 7,000 |
| High Line, New York | 4.4 million | 3,000-15,000 | 18,000-20,000 | - |
| Waterloo Bridge | 4.9 million | 17,000 | 14,000 | 12,000 |
| Millennium Bridge | 6.1 million | 24,000 | 29,000 | 17,000 |
| Tower Bridge | 7.4 million | 27,000 | 32,000 | 30,000 |
| Hungerford Bridge (northside + southside) | 8.5 million | 34,000 | 49,000 | 28,000 |
| **Garden Bridge**[9] | **7.1 million** | **27,000** | **30,000** | **18,000** |

Cutty Sark, 1869



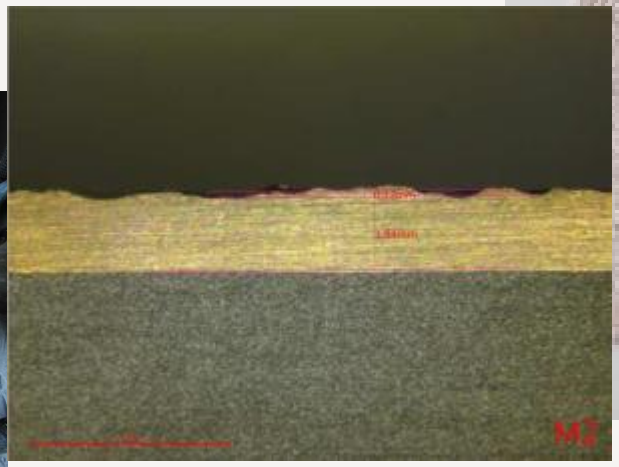


# Cu-Ni

- Appearance
- Durability
- Resistance to fouling
- Welding consumables – 70:30 Cu-Ni – tolerate iron dilution

# Trials and Mock-Ups

# Glass Bead Shot Peened



- Area "M" – Shot peened with 2.85-3.45mm dia.
- Area "L" - Shot peened with 2.00-2.40 mm dia.



flint neill
a COWI company

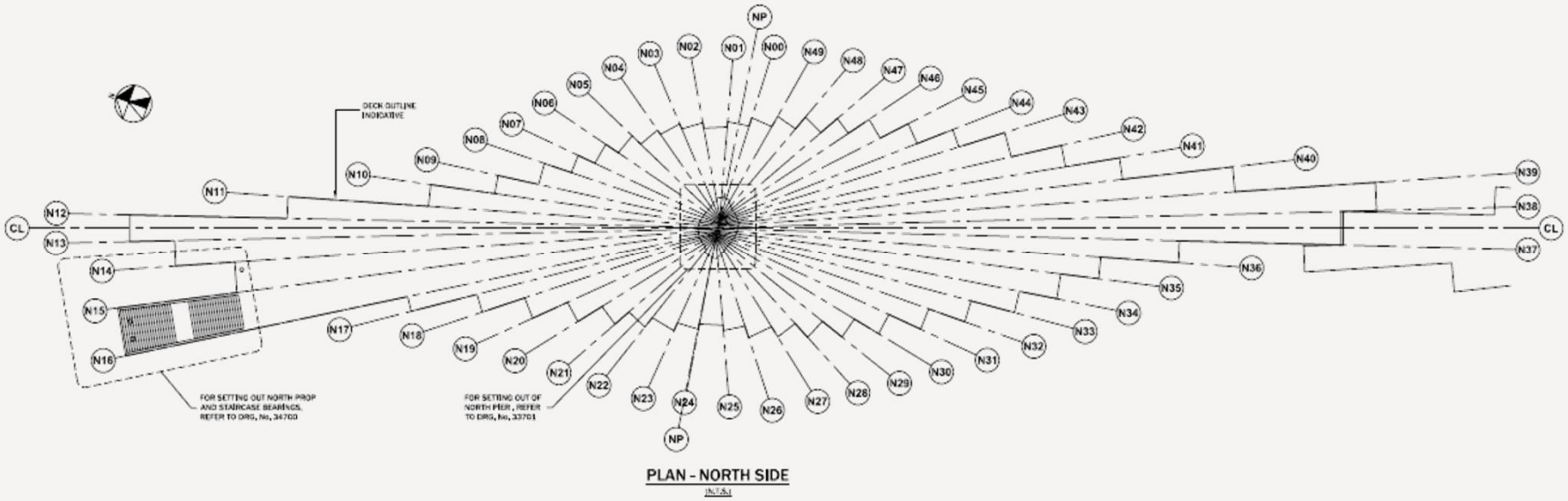
# Plate

- 90-10 Cu-Ni Rolled bonded
- 2mm Cu-Ni everywhere except piers which have 5mm Cu-Ni
- Cu-Ni - R=300MPa, $Rp_{(0.2)}$ > 100MPa
- Cu-Ni - Elongation at failure =30%
- Carbon steel plate 355-500MPa



flint neill
a COWI company

# Structural System

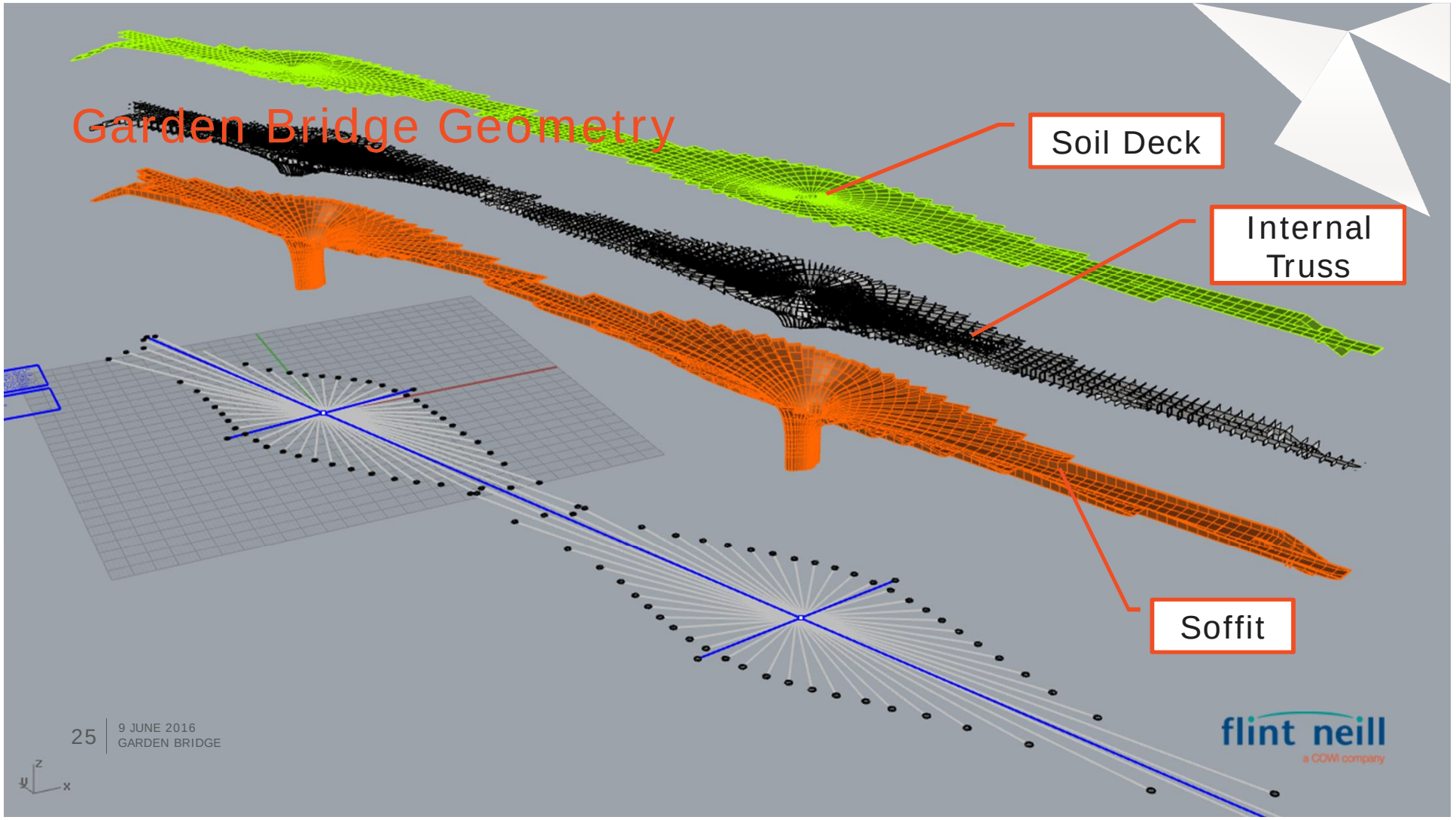



PLAN - NORTH SIDE



flint neill
a COWI company

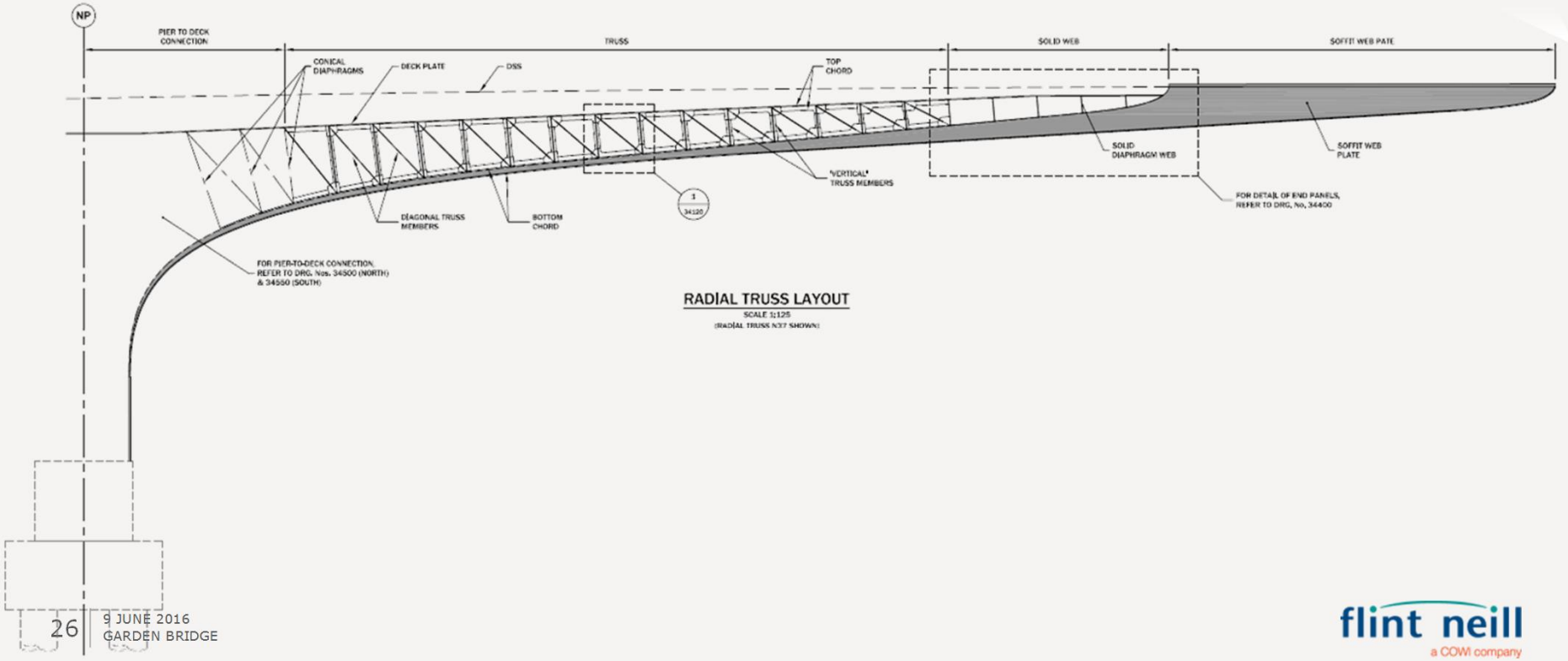
# Garden Bridge Geometry






flint neill
a COWI company

# Structural System






flint neill
a COWI company

# Plate Thickness <=65mm

## Steel strength 355-500MPa

WEST

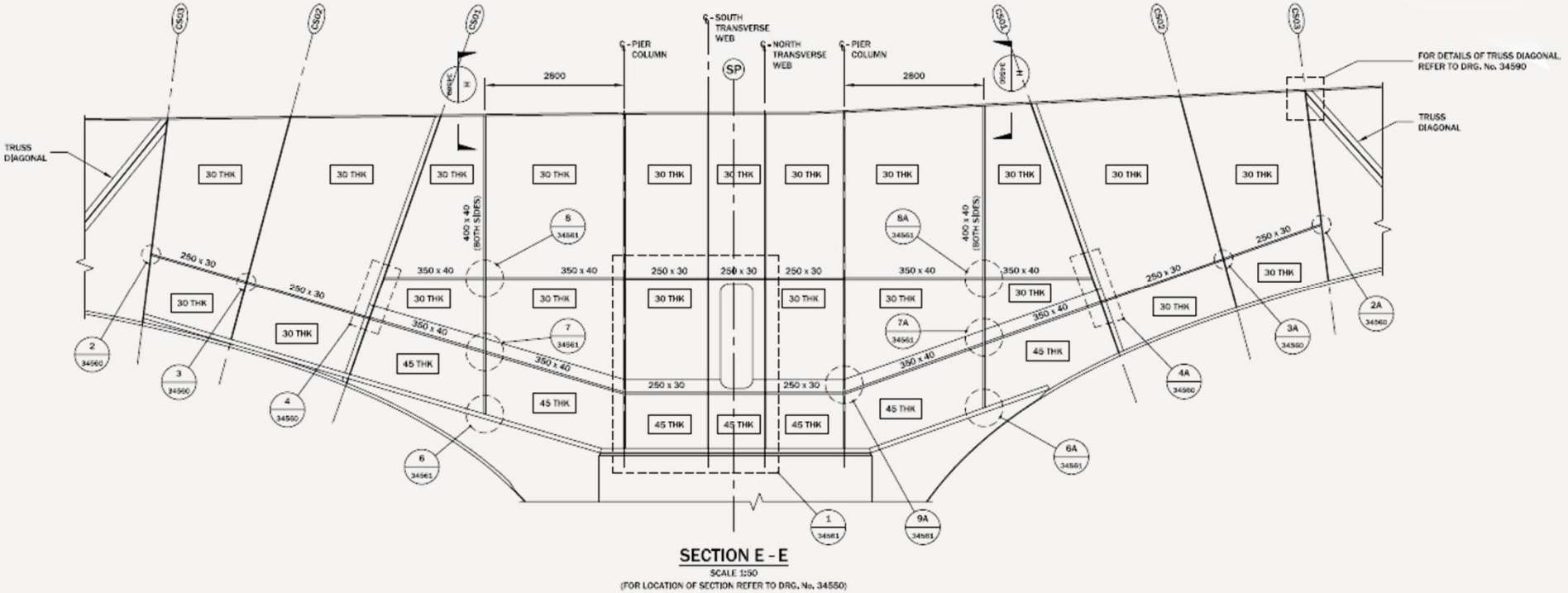
SOUTH BACK SPAN

RADIAL

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S25 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S26 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | - | - |
| S27 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | - | - |
| S28 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | - | - |
| S29 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | S355 | - | - | - | - | - | | | | | | | | | | | | | | | | | | | | | - | - |
| S30 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S31 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S32 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S33 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S34 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S35 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S450 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S36 | S460 | S460 | S460 | S460 | S460 | S500 | S500 | S500 | S500 | S500 | S460 | S460 | S460 | S450 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S37 | S460 | S460 | S460 | S460 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S450 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - |
| S38 | S460 | S460 | S460 | S460 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S450 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S460 | S460 | S460 | S460 | S460 | S450 | S460 | S460 | S460 | S460 | - | - |
| S39 | S460 | S460 | S460 | S460 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S500 | S450 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | S355 | S355 | S460 | S460 | S450 | S460 | S460 | S460 | S460 | - | - |
| S40 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S500 | S500 | S500 | S500 | S500 | S500 | S450 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - |
| S41 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S450 | S460 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S42 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S43 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S44 | S460 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S45 | S460 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S46 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S47 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S48 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| S49 | S460 | S460 | S460 | S460 | S460 | S355 | S355 | S355 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

EAST

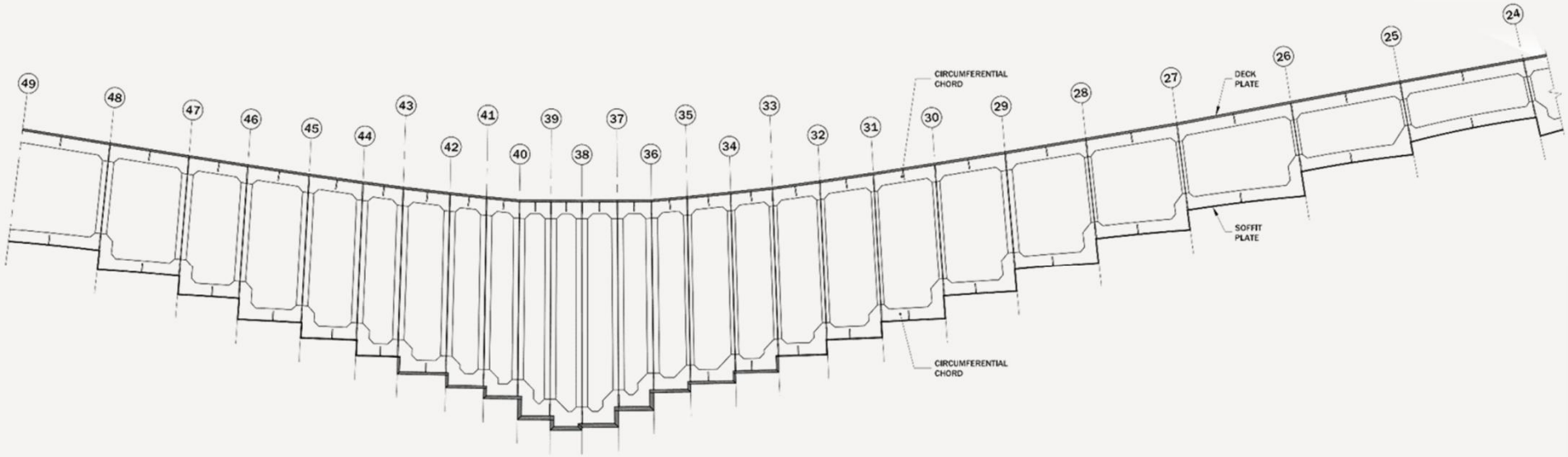
# Structural System






flint neill
a COWI company

# Structural System



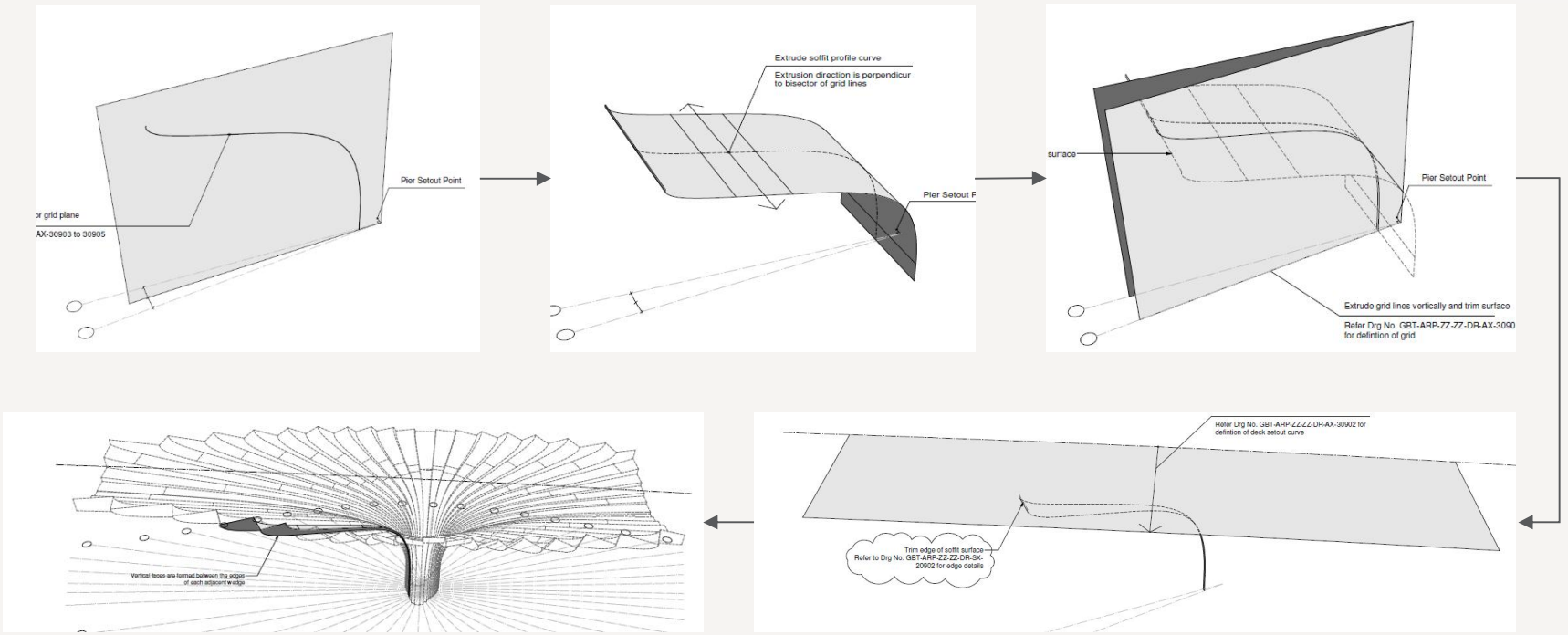

**DEVELOPED CIRCUMFERENTIAL GRIDLINE N03**

SCALE 1:50



flint neill
a COWI company

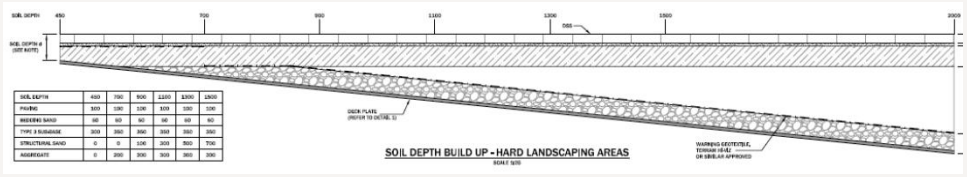
# Garden Bridge Geometry - Soffit

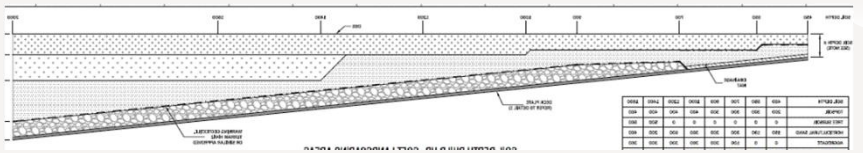


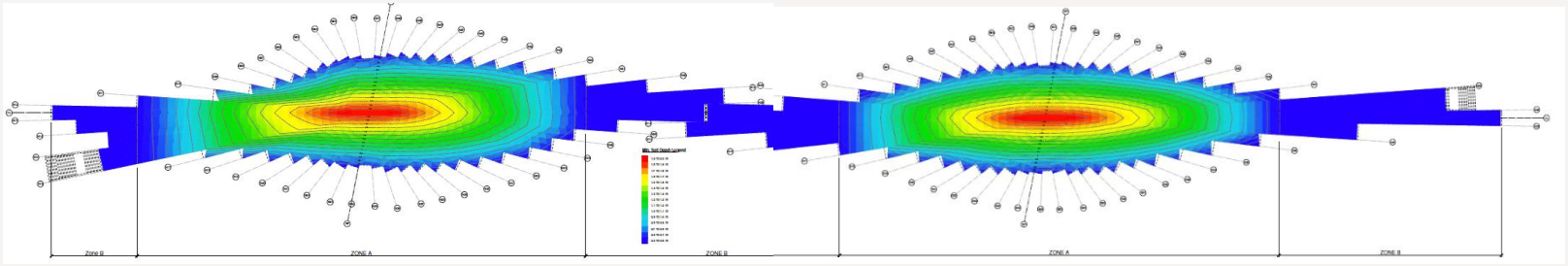


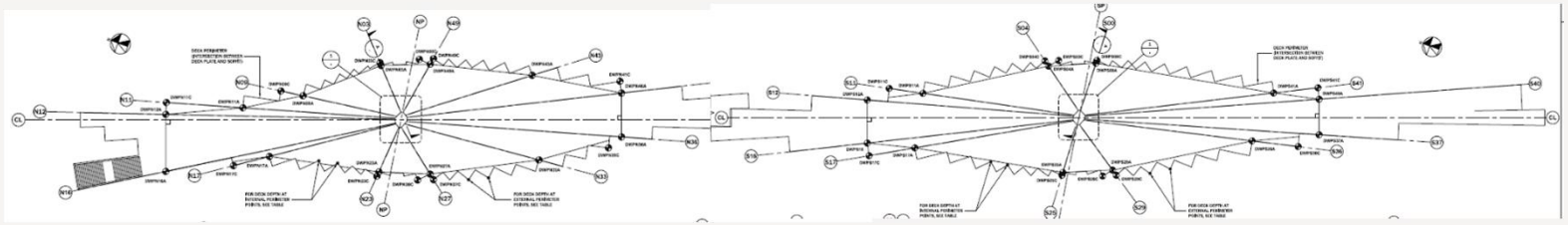

flint neill
a COWI company

# Garden Bridge Geometry – Soil Deck



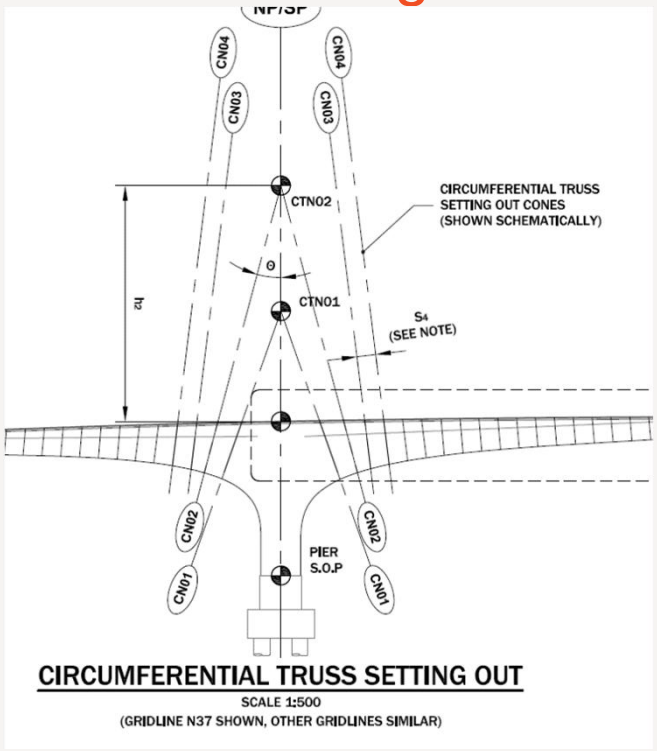


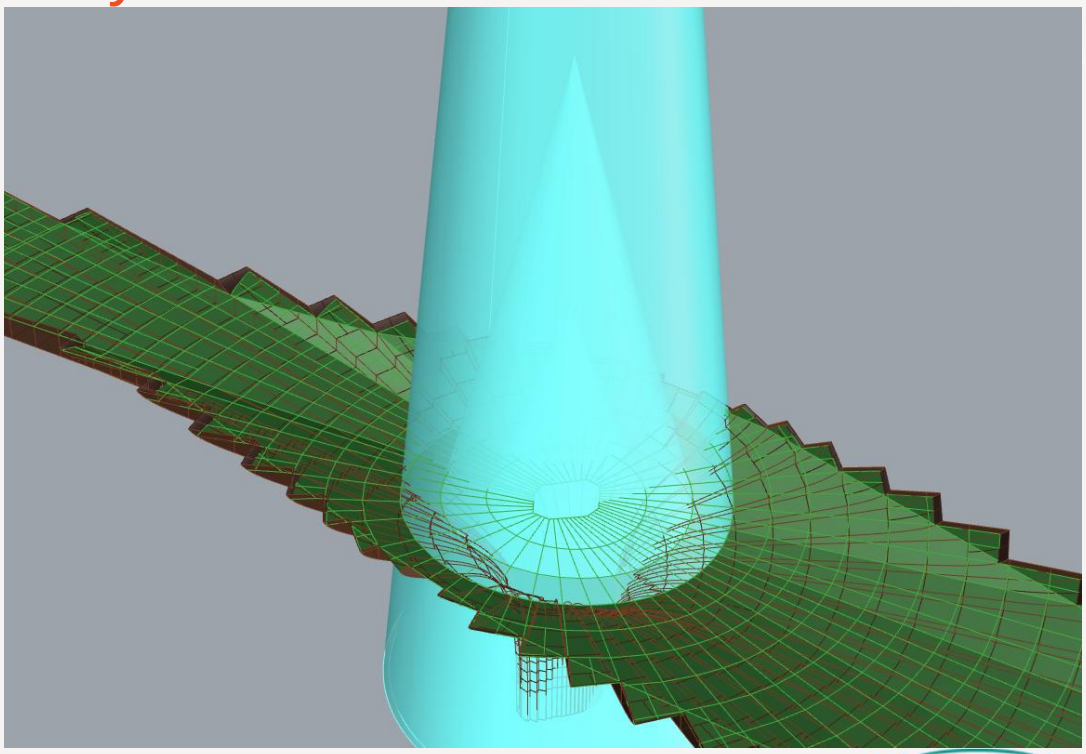





flint neill
a COWI company

# Garden Bridge Geometry – Cones

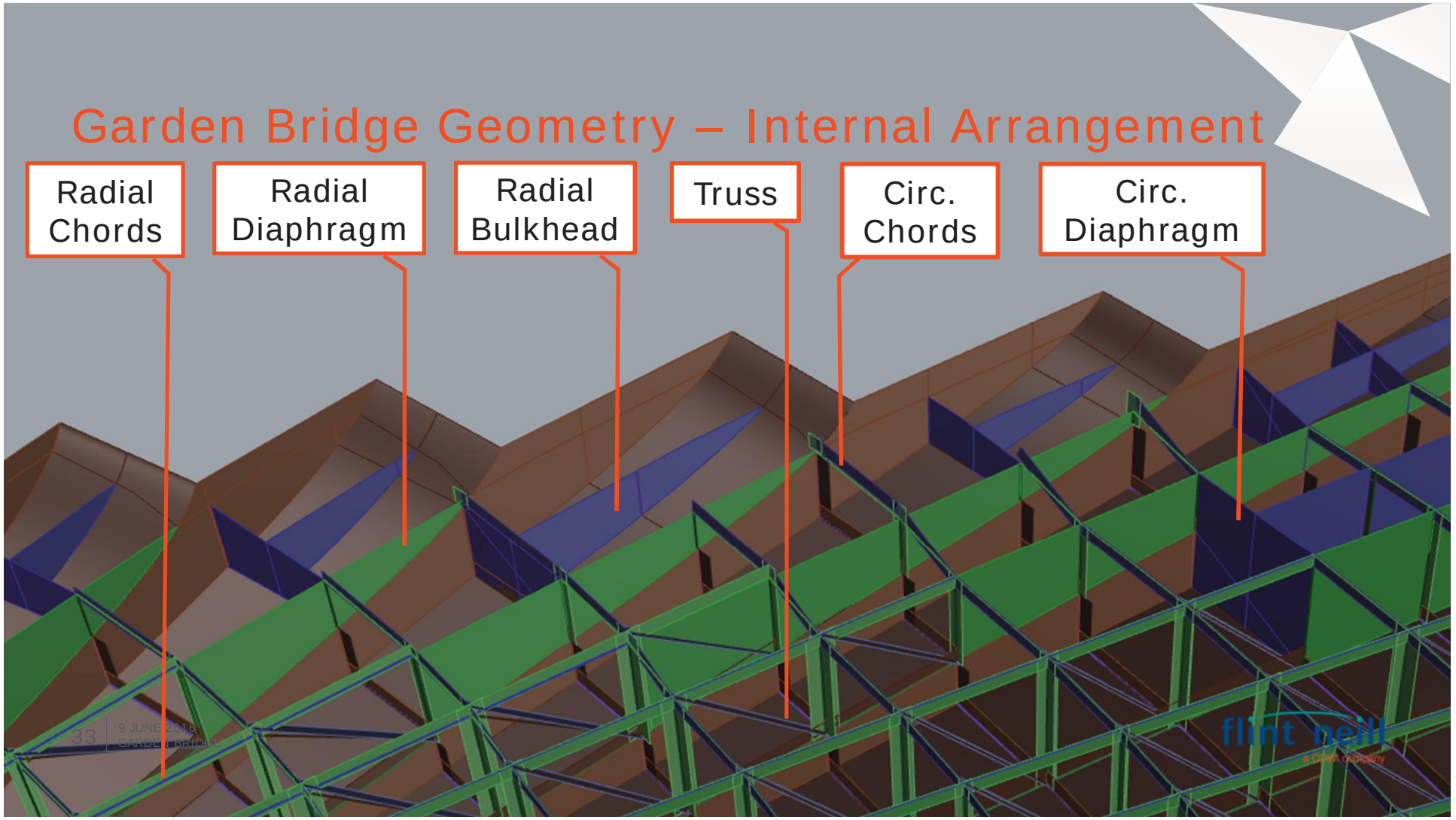


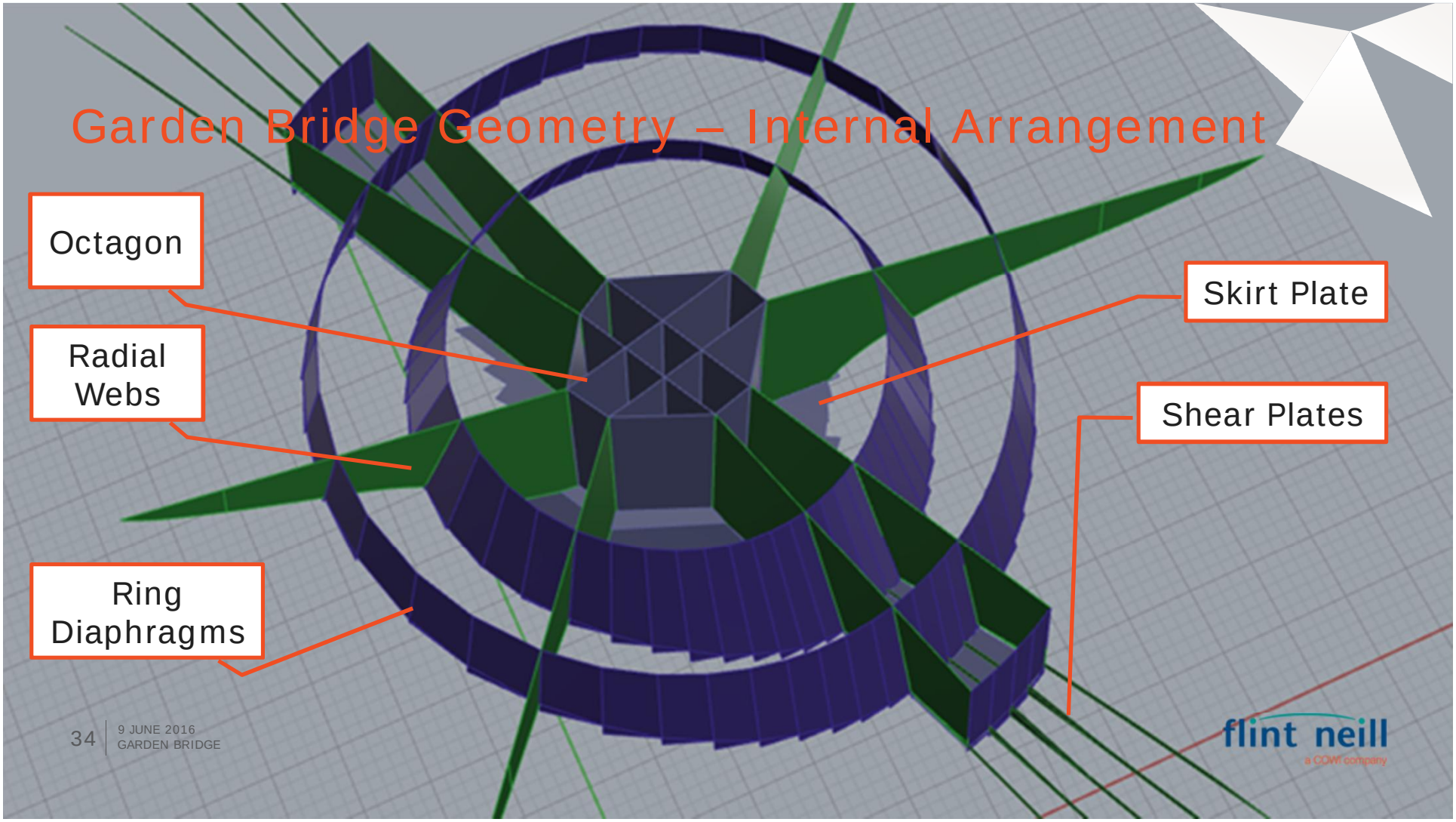


flint neill
a COWI company

# Garden Bridge Geometry – Internal Arrangement



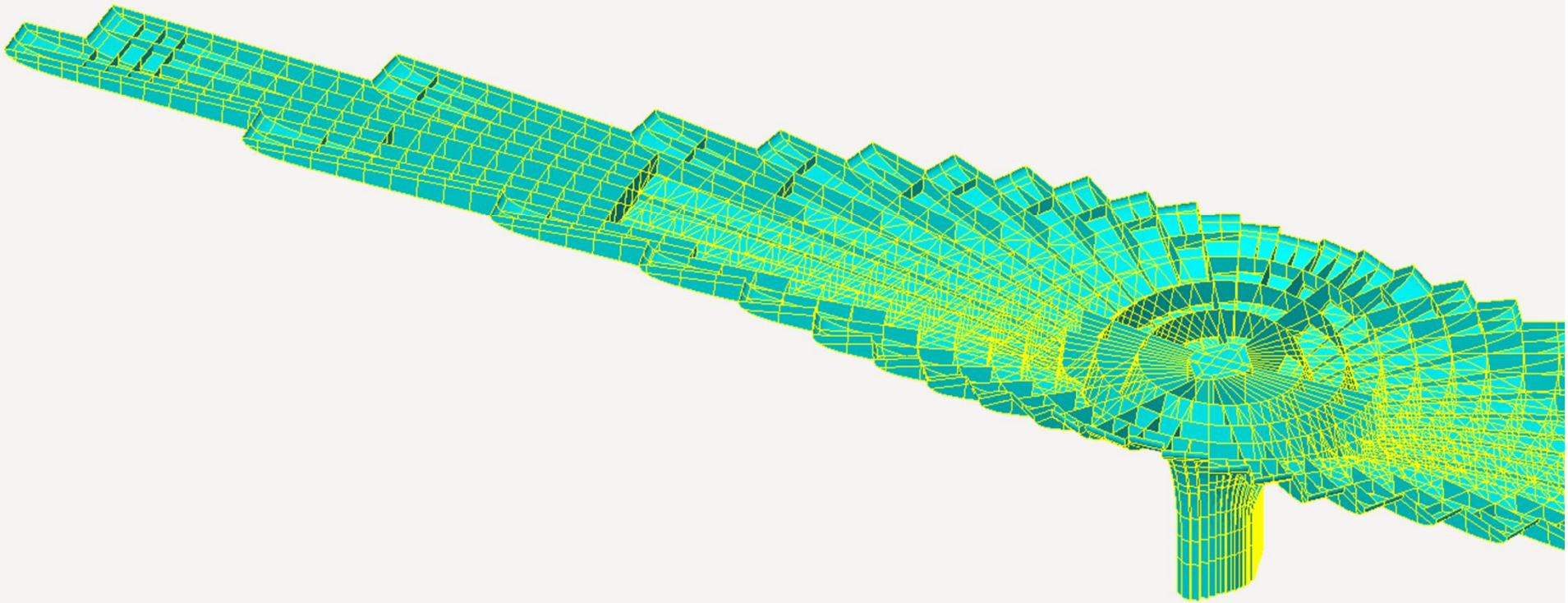
# Garden Bridge Geometry – Internal Arrangement






flint neill
a COWI company

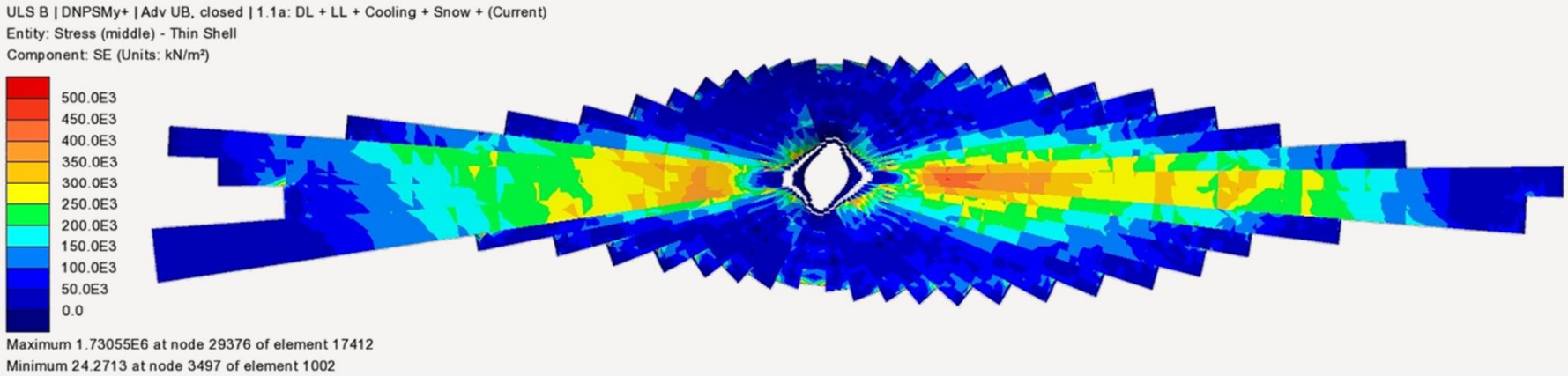
# Analysis





flint neill
a COWI company

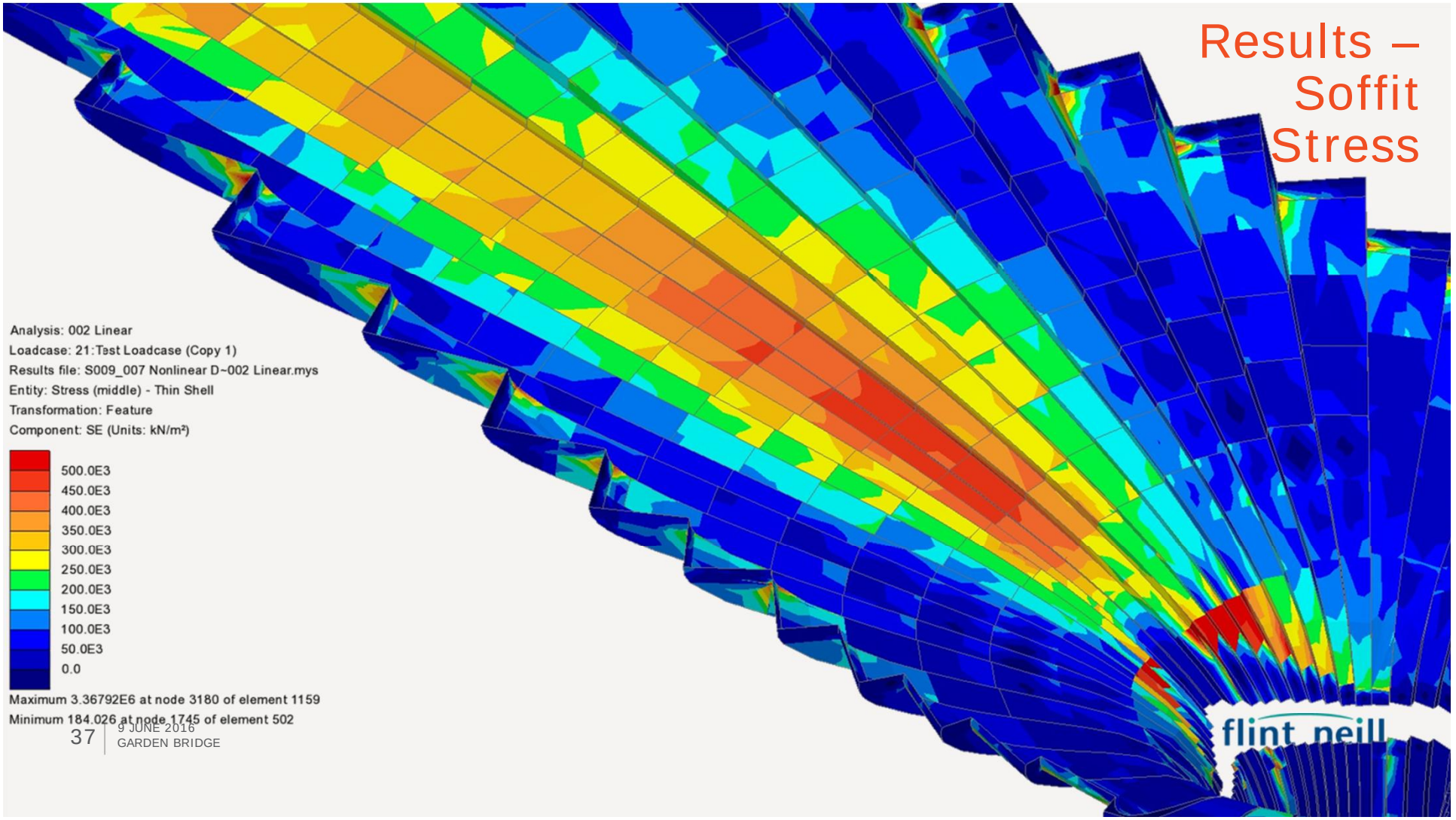
# Results – Soffit Stress



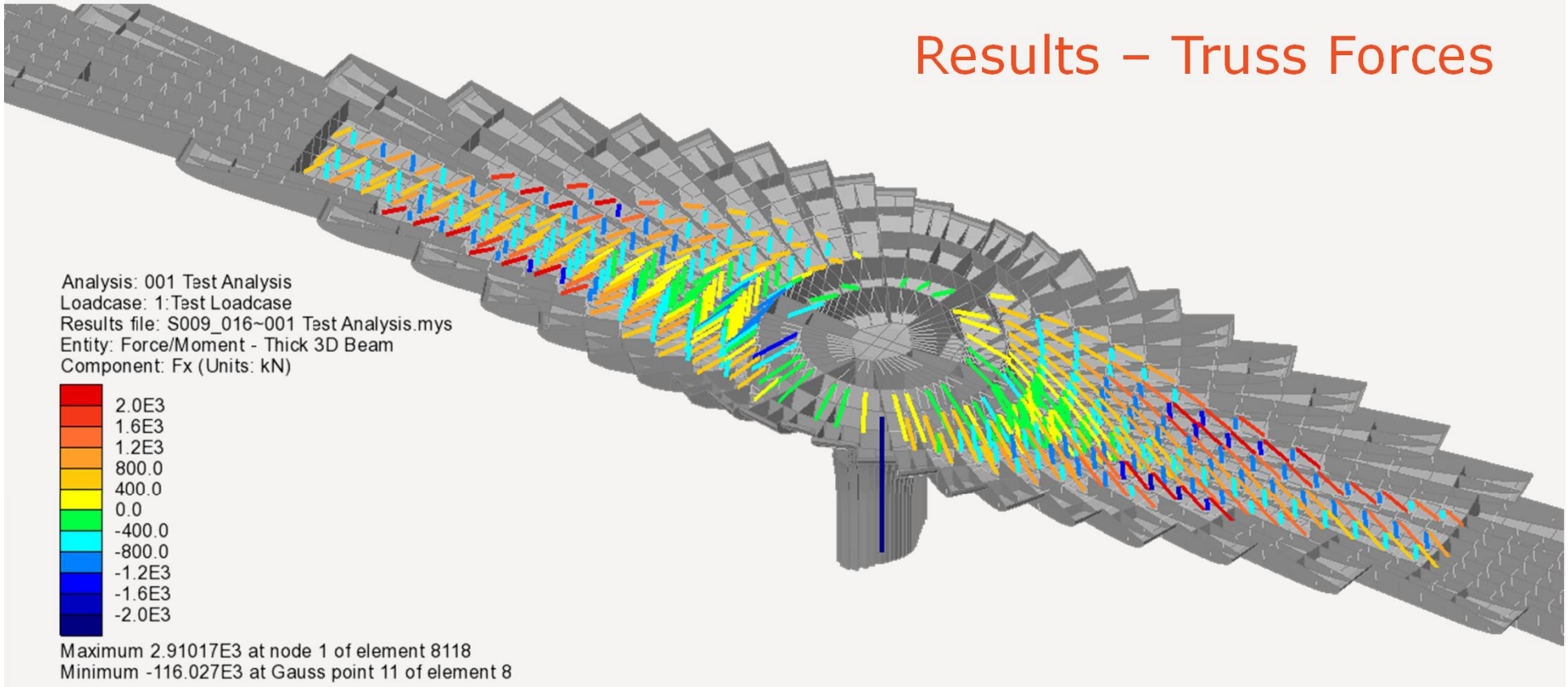



flint neill
a COWI company

# Results – Soffit Stress



# Results – Truss Forces






flint neill
a COWI company

# Automation of Checking

flint neill
a COWI company

| Client / Project | Job No. | Sub Ref | No. |
|---|---|---|---|
| Garden Bridge | 1499 | | |

| SUBJECT | Date | Prep | Check |
|---|---|---|---|
| Von Mises (Surface) Plot of Utilisation for Soffit Flanges - SOUTH | 30/03/16 | RIJK | BNCY |

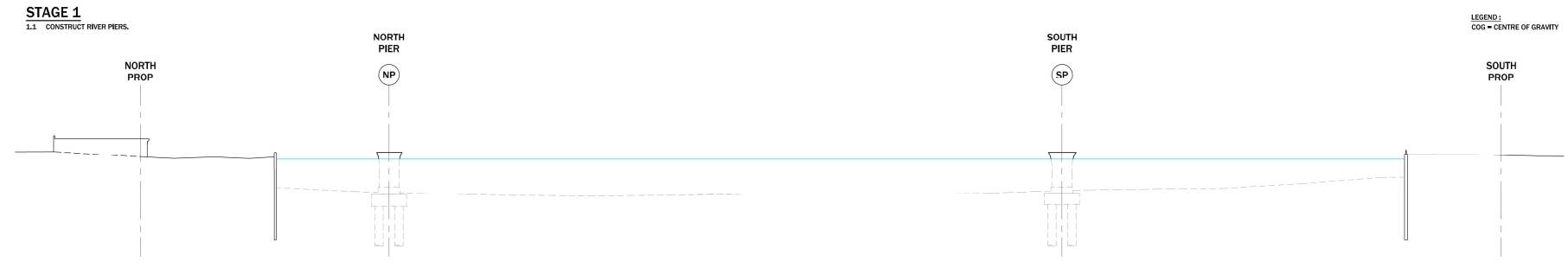
Circumferential Gridlines

| Radial Gridlines | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 | | 0.38 | 0.35 | 0.33 | 0.92 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 01 | | 0.23 | 0.57 | 1.01 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 02 | | 0.30 | | 0.35 | 0.60 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 03 | | 0.19 | 0.11 | 0.21 | 0.50 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 04 | | 0.20 | | | 0.53 | 0.79 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 05 | | 0.47 | 0.20 | 0.16 | 0.23 | 0.57 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 06 | | 0.28 | 0.29 | 0.23 | 0.22 | 0.30 | 0.35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 07 | | 0.30 | 0.31 | 0.21 | 0.22 | 0.18 | 0.37 | 0.47 | 0.39 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 08 | | 0.39 | 0.36 | 0.27 | 0.22 | 0.15 | 0.13 | 0.13 | 0.34 | 0.45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 09 | | 0.44 | 0.41 | 0.40 | 0.35 | 0.30 | 0.23 | 0.16 | 0.14 | | 0.23 | 0.44 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | 0.66 | 0.53 | 0.55 | 0.47 | 0.48 | 0.41 | 0.36 | 0.30 | 0.33 | 0.29 | 0.29 | 0.31 | 0.24 | 0.36 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | 0.81 | 0.57 | 0.72 | 0.74 | 0.66 | 0.59 | 0.61 | 0.49 | 0.48 | 0.37 | 0.38 | 0.30 | 0.24 | 0.19 | 0.10 | 0.15 | 0.25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | | 0.68 | 0.73 | 0.86 | 0.86 | 0.85 | 0.75 | 0.80 | 0.76 | 0.66 | 0.62 | 0.59 | 0.57 | 0.55 | 0.47 | 0.45 | 0.49 | 0.34 | 0.29 | 0.29 | 0.24 | 0.19 | 0.15 | 0.11 | 0.10 | 0.10 | 0.14 | 0.22 | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | | 0.61 | 0.80 | 0.94 | 0.95 | 1.01 | 0.91 | 0.86 | 0.80 | 0.74 | 0.68 | 0.74 | 0.70 | 0.63 | 0.58 | 0.54 | 0.61 | 0.53 | 0.52 | 0.50 | 0.45 | 0.41 | 0.37 | 0.33 | 0.30 | 0.40 | 0.37 | 0.36 | 0.28 | 0.28 | 0.24 | 0.19 | 0.16 | 0.11 | 0.10 | 0.15 | 0.20 | | | | | | | | | | | | | | | |
| 14 | | 0.62 | 0.80 | 0.91 | 1.00 | 1.00 | 0.90 | 0.87 | 0.82 | 0.75 | 0.69 | 0.74 | 0.77 | 0.65 | 0.59 | 0.56 | 0.58 | 0.50 | 0.53 | 0.53 | 0.48 | 0.45 | 0.41 | 0.38 | 0.34 | 0.45 | 0.41 | 0.40 | 0.33 | 0.31 | 0.26 | 0.24 | 0.17 | 0.06 | 0.05 | 0.10 | 0.02 | | | | | | | | | | | | | | | |
| 15 | | 0.84 | 0.71 | 0.83 | 0.89 | 0.85 | 0.77 | 0.81 | 0.76 | 0.71 | 0.62 | 0.59 | 0.60 | 0.60 | 0.51 | 0.51 | 0.58 | 0.46 | 0.40 | 0.42 | 0.39 | 0.28 | 0.24 | 0.19 | 0.20 | 0.16 | 0.13 | 0.14 | 0.15 | 0.18 | 0.18 | | | | | | | | | | | | | | | | | | | |
| 16 | | 0.89 | 0.59 | 0.73 | 0.80 | 0.71 | 0.66 | 0.65 | 0.58 | 0.52 | 0.46 | 0.39 | 0.35 | 0.42 | 0.30 | 0.29 | 0.24 | 0.29 | 0.24 | 0.52 | 0.47 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 17 | | 0.67 | 0.63 | 0.56 | 0.50 | 0.50 | 0.43 | 0.41 | 0.35 | 0.31 | 0.30 | 0.34 | 0.21 | 0.29 | 0.70 | 0.67 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18 | | 0.42 | 0.45 | 0.41 | 0.36 | 0.31 | 0.23 | 0.19 | 0.19 | 0.26 | 0.41 | 0.25 | 0.30 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 | | 0.31 | 0.32 | 0.26 | 0.22 | 0.16 | 0.14 | 0.20 | 0.56 | 0.23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20 | | 0.25 | 0.28 | 0.21 | 0.19 | 0.16 | 0.25 | 0.41 | 1.01 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21 | | 0.63 | 0.26 | 0.19 | 0.24 | 0.30 | 1.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 22 | | 0.60 | 0.25 | 0.21 | 0.20 | 0.86 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 23 | | 0.55 | 0.24 | 0.25 | 0.11 | 0.19 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 24 | | 0.40 | 0.25 | 0.20 | 0.48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 | | 0.20 | 0.27 | 0.25 | 1.49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 26 | | 0.25 | 0.40 | 1.40 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 27 | | 0.38 | 0.42 | 0.53 | 0.78 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 28 | | 0.21 | 0.24 | 0.29 | 0.44 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 29 | | 0.31 | 0.38 | 0.20 | 0.55 | 0.63 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | | 0.34 | 0.29 | 0.12 | 0.18 | 0.30 | 0.34 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31 | | 0.27 | 0.31 | 0.19 | 0.19 | 0.38 | 0.70 | 0.82 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 32 | | 0.32 | 0.35 | 0.23 | 0.19 | 0.28 | 0.34 | 0.50 | 0.66 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 33 | | 0.38 | 0.43 | 0.31 | 0.23 | 0.19 | 0.22 | 0.19 | 0.22 | 0.29 | 0.88 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 34 | | 0.66 | 0.47 | 0.48 | 0.38 | 0.36 | 0.41 | 0.29 | 0.23 | 0.18 | 0.29 | 0.35 | 0.55 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 35 | | 0.83 | 0.56 | 0.60 | 0.53 | 0.57 | 0.54 | 0.49 | 0.37 | 0.33 | 0.37 | 0.21 | 0.18 | 0.10 | 0.22 | 0.62 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 36 | | 0.59 | 0.58 | 0.71 | 0.77 | 0.88 | 0.76 | 0.69 | 0.64 | 0.52 | 0.52 | 0.47 | 0.45 | 0.36 | 0.34 | 0.23 | 0.12 | 0.09 | 0.10 | 0.27 | 0.33 | 0.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 37 | | 0.64 | 0.72 | 0.90 | 0.92 | 1.06 | 0.94 | 0.86 | 0.80 | 0.73 | 0.78 | 0.71 | 0.62 | 0.62 | 0.59 | 0.59 | 0.59 | 0.45 | 0.38 | 0.31 | 0.28 | 0.30 | 0.20 | 0.14 | 0.09 | 0.06 | 0.07 | 0.05 | 0.10 | 0.11 | 0.18 | 0.25 | 0.40 | 0.41 | | | | | | | | | | | | | | | | | |
| 38 | | 0.53 | 0.79 | 0.87 | 0.98 | 1.06 | 0.98 | 0.89 | 0.84 | 0.84 | 0.74 | 0.86 | 0.80 | 0.77 | 0.77 | 0.68 | 0.71 | 0.63 | 0.59 | 0.53 | 0.57 | 0.46 | 0.39 | 0.33 | 0.27 | 0.21 | 0.17 | 0.15 | 0.25 | 0.29 | 0.30 | 0.42 | 0.41 | 0.53 | 0.37 | 0.32 | 0.34 | 0.35 | 0.36 | 0.36 | 0.35 | 0.35 | 0.43 | 0.56 | 0.56 | 0.43 | 0.37 | 0.33 | 0.13 | 0.06 | 0.03 | 0.03 | 0.03 |
| 39 | | 0.66 | 0.69 | 0.87 | 0.88 | 0.99 | 0.89 | 0.81 | 0.78 | 0.72 | 0.75 | 0.74 | 0.67 | 0.64 | 0.66 | 0.72 | 0.69 | 0.65 | 0.57 | 0.52 | 0.45 | 0.42 | 0.34 | 0.35 | 0.25 | 0.21 | 0.18 | 0.16 | 0.27 | 0.29 | 0.39 | 0.39 | 0.45 | 0.35 | 0.27 | 0.31 | 0.32 | 0.34 | 0.35 | 0.36 | 0.39 | | | | | | | | | | | |
| 40 | | 0.63 | 0.61 | 0.73 | 0.82 | 0.92 | 0.78 | 0.74 | 0.73 | 0.64 | 0.61 | 0.69 | 0.59 | 0.54 | 0.63 | 0.58 | 0.55 | 0.52 | 0.51 | 0.42 | 0.32 | 0.18 | 0.65 | 0.40 | 0.18 | | | | | | | | | | | | | | | | | | | | | | | | |
| 41 | | | 0.60 | 0.68 | 0.61 | 0.71 | 0.70 | 0.60 | 0.54 | 0.61 | 0.41 | 0.63 | 0.44 | 0.53 | 0.36 | 0.22 | 0.30 | 0.59 | 0.41 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 42 | | 0.93 | 0.59 | 0.56 | 0.49 | 0.54 | 0.53 | 0.51 | 0.43 | 0.53 | 0.37 | 0.42 | 0.45 | 0.70 | 1.14 | 1.11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 43 | | 0.64 | 0.44 | 0.46 | 0.34 | 0.36 | 0.41 | 0.49 | 0.32 | 0.33 | 0.21 | 0.82 | 0.92 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 44 | | 0.33 | 0.26 | 0.30 | 0.24 | 0.19 | 0.34 | 0.39 | 0.39 | 0.93 | 1.49 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 45 | | 0.26 | 0.21 | 0.24 | 0.16 | 0.14 | 0.23 | 0.46 | 0.75 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 46 | | 0.18 | 0.17 | 0.14 | 0.13 | 0.20 | 0.33 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 47 | | 0.42 | 0.18 | 0.12 | 0.16 | 0.35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 48 | | 0.52 | 0.22 | 0.26 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 49 | | 0.40 | 0.35 | 0.49 | 0.60 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



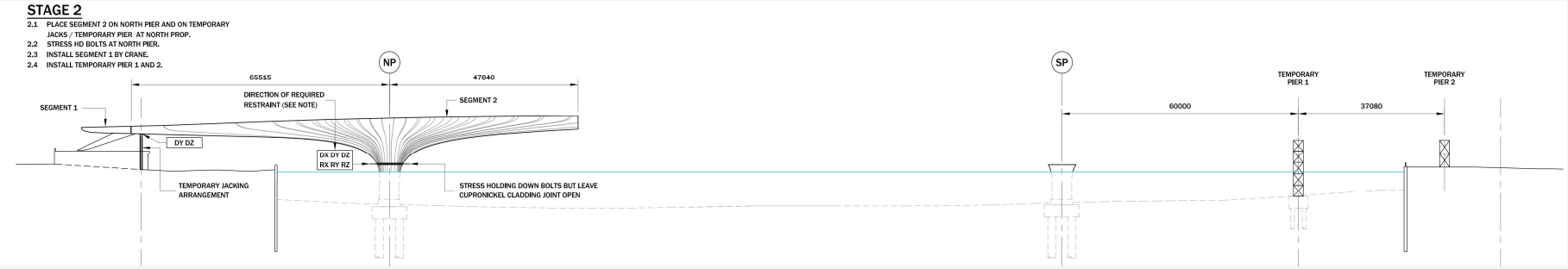
flint neill
a COWI company

# Erection sequence
# Stage 1



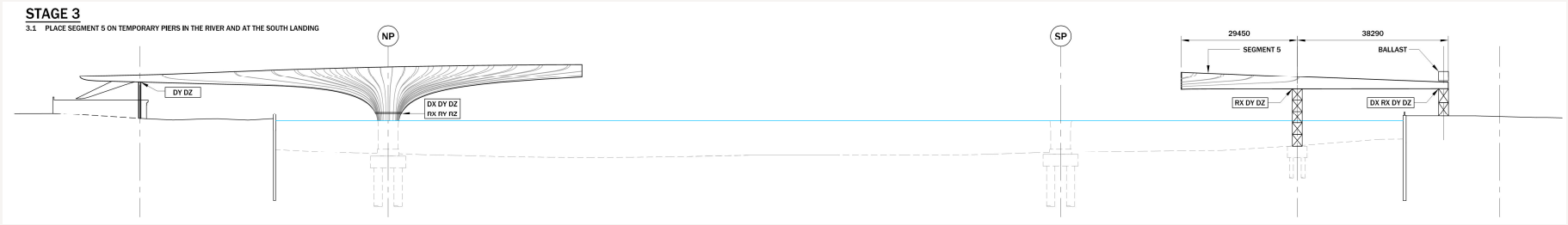

flint neill
a COWI company

# Erection sequence
# Stage 2



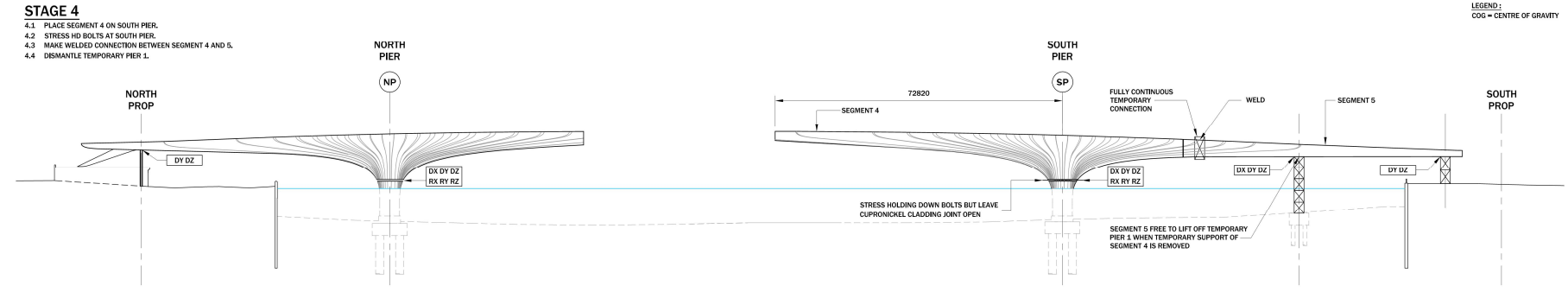

1. NORTH PROP IS SET LONGER THAN ITS FINAL REFERENCE STRESSED LENGTH TO ALLOW LATER INCREMENTAL JACKING OF THE NORTH PROP. AT STAGE 2 THE FORCE IN THE NORTH PROP IS ZERO UNDER UNFACTORED PERMANENT LOAD.
2. REQUIREMENT FOR TEMPORARY PIER AT NORTH PROP TO BE CONFIRMED BY CONTRACTOR.
3. WEIGHT, COG AND AS-BUILT FABRICATION GEOMETRY OF COMPLETED SEGMENT 1 AND 2 TO BE DETERMINED BY WEIGHING PRIOR TO DELIVERY TO SITE.
4. GEOMETRY OF BRIDGE CANTILEVERS TO BE SURVEYED AFTER STRESSING OF MACALLOY BARS. REACTION FORCE IN NORTH PROP TO BE RECORDED.

# Erection sequence
# Stage 3



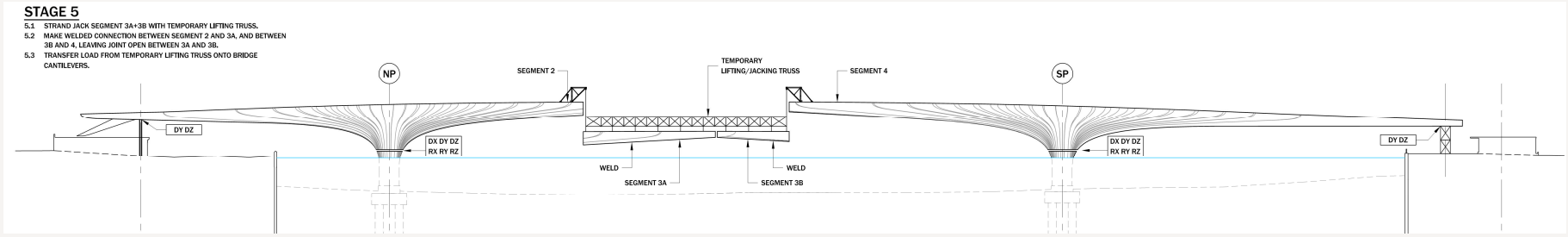

1. HEIGHT OF TEMPORARY PIERS IN THE RIVER AND THE SOUTH LANDING TO BE ADJUSTABLE VIA TEMPORARY JACKS/PACKERS.
2. BALLAST REQUIREMENT AT TEMPORARY PIER TO BE CONFIRMED.
3. WEIGHT AND COG AND AS-BUILT FABRICATION GEOMETRY OF COMPLETED SEGMENT 5 TO BE DETERMINED BY WEIGHING PRIOR TO DELIVERY TO SITE.

# Erection sequence
# Stage 4



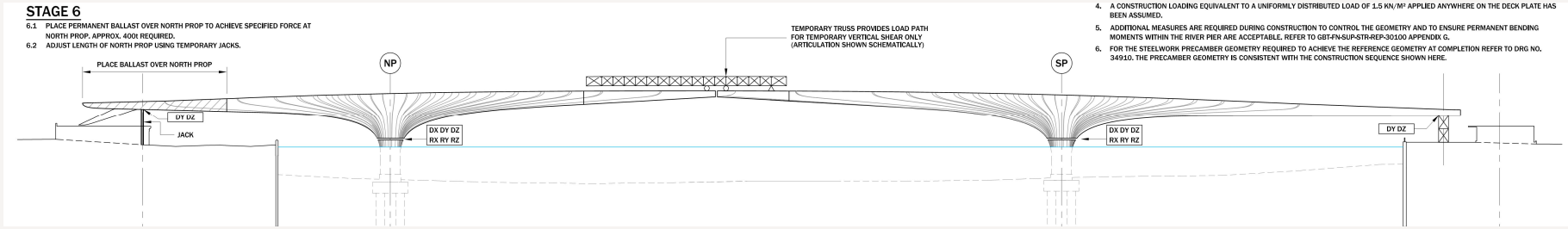

1. **WEIGHT AND COG AND AS-BUILT FABRICATION GEOMETRY OF COMPLETED SEGMENT 4 TO BE DETERMINED BY WEIGHING PRIOR TO DELIVERY TO SITE.**
2. **IN ORDER TO LIMIT SOUTH PIER BENDING MOMENTS, THE SELF-WEIGHT OF SEGMENT 4 MUST REMAIN SUPPORTED BY THE TRANSPORT BARGE UNTIL THE TEMPORARY CONNECTION BETWEEN SEGMENT 4 AND 5 IS COMPLETE.**
3. **GEOMETRY OF BRIDGE CANTILEVERS TO BE SURVEYED. REACTION FORCE NORTH PROP AND TEMPORARY PIER 2 TO BE RECORDED AFTER DISMANTLING TEMPORARY PIER 1.**

# Erection sequence
# Stage 5



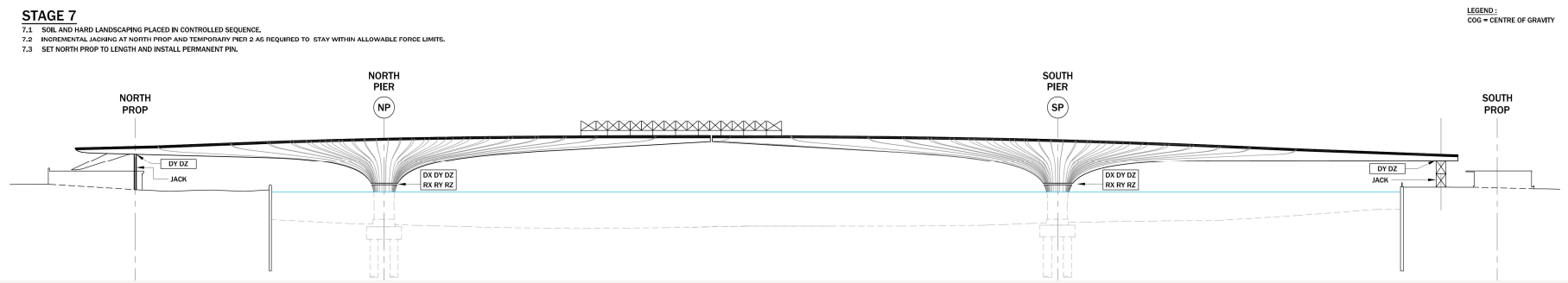

1. WEIGHT AND COG AND AS-BUILT FABRICATION GEOMETRY OF COMPLETED SEGMENTS 3A AND 3B TO BE DETERMINED BY WEIGHING PRIOR TO DELIVERY TO SITE.
2. GEOMETRY OF BRIDGE CANTILEVERS TO BE SURVEYED. REACTION FORCE NORTH PROP AND TEMPORARY SOUTH LANDING PIER TO BE RECORDED AFTER UNLOADING TEMPORARY LIFTING TRUSS.

# Erection sequence
# Stage 6




1. GEOMETRY OF BRIDGE CANTILEVERS TO BE SURVEYED. REACTION FORCE IN NORTH PROP TO BE MONITORED.
2. THE LENGTH OF THE NORTH PROP IS ADJUSTED TO MAINTAIN ZERO FORCE IN THE PROP UNDER UNFACTORED PERMANENT LOAD.

# Erection sequence
# Stage 7




1. JACKING AT NORTH PROP AND TEMPORARY PIER 2 REQUIRED TO ACHIEVE BALANCED CONDITION WITH ZERO ROTATION OR BENDING MOMENT IN THE PIERS IN THE COMPLETED STRUCTURE.
2. GEOMETRY OF BRIDGE CANTILEVER ENDS TO BE SURVEYED AT FREQUENT INTERVALS DURING SOIL PLACEMENT.
3. MONITOR REACTION FORCES IN NORTH PROP AND TEMPORARY PIER 2.
4. SOIL FILL MATERIAL PROCURED FROM SINGLE SUPPLIER.
5. EACH BATCH OF AS-SUPPLIED SOIL FILL MATERIAL TO BE DENSITY TESTED.
6. VOLUME AND LOCATION OF SOIL PLACEMENT ON EACH CANTILEVER TO BE DOCUMENTED AND SUBJECT TO INSPECTION ON SITE.

# Headline Quantities

- Steel 5,200 Tonnes
- Roll bonded plate 1,700 Tonnes – up to 65mm thick
- 10,000 Tonnes of soil
- 65m long piles ≈ 2,070$m^3$
- Piers and Pile caps ≈ 1,760$m^3$



flint neill
a COWI company

# Summary

- Iconic new bridge for Central London
- Destination!
- Durable aesthetically pleasing end structure
- Novel use of roll bonded plates in exposed civil engineering structure
- Complex geometry and structural behaviour



flint neill
a COWI company

# Thank you!