FORTH ROAD BRIDGE

Project	Job Ref
CABLE BAND BOLT FACTOR OF SAFETY	
Part of structure	**Calc sheet no** **rev**
CABLE BAND/HANGER LOADS	1

Drawing ref	Calc by	Date	Check by	Date
3311/AB/20	DD	22/07/2011		

Ref	Calculations	Output

FOOTWAY HANGER LOADS

BS5400-2 2006

FOR LOADED LENGTHS IN EXCESS 36M k_x 5.0 KN/m²

CLAUSE 6.5.1.1

$$\frac{\text{NOMINAL HA UDL} \times 10}{L + 270} = k \qquad L = \text{LOADED LENGTH}$$

NOMINAL HA UDL CLAUSE 6.2.3

CL6.4.1 $$W = 36\left(\frac{1}{L}\right)^{0.1} \text{ kN}$$

$L = 1414$ m ①

$L = 326$ m ②

$$W = 36\left(\frac{1}{1414}\right)^{0.1} \text{ kN}$$

$= 17.431$ KN/PER METRE OF LANE ①

$= 36\left(\frac{1}{326}\right)^{0.1} = 20.183$ KN PER M OF LANE ②

$$k = \frac{17.43 \times 10}{1414 + 270} = 0.117 \text{ KN} \quad ①$$

$$k = \frac{20.183 \times 10}{326 + 270} = 0.339 \quad ②$$

FOOTWAY LOADING

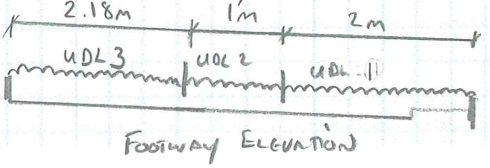
UNIFORMLY DISTRIBUTED LOAD $= 0.117 \times 5 =$ **0.585 KN/m²** ①

UDL LOADING $= 0.339 \times 5 \times$ **1.695 KN/m²** ②

CL6.5.12 INTENSITIES MAY BE REDUCED BY 15% BETWEEN 2-3m WIDTH

" " " " BY 30% BETWEEN 3-6m WIDTH

TOTAL WIDTH OF FOOTWAY = 5.18m



FOOTWAY ELEVATION

FORTH ROAD BRIDGE

Project	Job Ref
CABLE BAND BOLT FACTOR OF SAFETY	
Part of structure	**Calc sheet no** **rev**
CABLE BAND / HANGER LOADS	2

Drawing ref	Calc by	Date	Check by	Date
3311/AB/20	DB	22/07/2011		

Ref	Calculations	Output

BS 5400-2

FOOTWAY LOADING (CONT)

LOADED LENGTH (1)

UDL 1 = 0.585 kN/m² UDL 2 = 0.497 kN/m² UDL 3 = 0.409 kN/m²

CL 6.5.1.1 THESE INTENSITIES MAY BE AVERAGED OVER WIDTH

$$\therefore \frac{2}{5.18} \times 0.585 + \frac{1}{5.18} \times 0.497 + \frac{2.18}{5.18} \times 0.409$$

$$= 0.226 + 0.0959 + 0.172 = \underline{0.494\ kN/m^2}$$

LOADED LENGTH (2)

UDL 1 = 1.695 kN/m² UDL 2 = 1.44 kN/m² UDL 3 = 1.19 kN/m²

$$\therefore \frac{2}{5.18} \times 1.695 + \frac{1}{5.18} \times 1.44 + \frac{2.18}{5.18} \times 1.19$$

$$= 0.654 + 0.278 + 0.500 = \underline{1.433\ kN/m^2}$$

CLAUSE 6.5.1.2

WHERE A MAIN STRUCTURAL MEMBER SUPPORTS 2 OR MORE NOTATIONAL LANES OF TRAFFIC, THE FOOTWAY/CYCLE TRACK LOADING MAY BE FURTHER REDUCED SUCH THAT:

ON FOOTWAYS 0.5 OF UDL ABOVE

ON CYCLEWAY 0.2 OF UDL ABOVE

ASSUMPTION

ASSUME 2M OF WIDTH IS A FOOTWAY & REMAINDER IS AS CYCLE WAY.

FORTH ROAD BRIDGE

Project	Job Ref
CABLE BAND BOLT FACTOR OF SAFETY	
Part of structure	**Calc sheet no** / **rev**
CABLE BAND / HANGER LOADS	3

Drawing ref	Calc by	Date	Check by	Date
3311/AB/20	DB	22/07/2011		

Ref	Calculations	Output

FOOTWAY LOADING (CONT)

LOADED LENGTH ①

$= \frac{2}{5.18} \times 0.494 \times 0.5 + \frac{3.18}{5.18} \times 0.494 \times 0.2$

$= 0.0953 + 0.061 = \underline{0.1563\ kN/m^2}$

FOOTWAY LOADING

$= \underline{0.1563\ kN/m^2}$

LOADED LENGTH ②

$= \frac{2}{5.18} \times 1.433 \times 0.5 + \frac{3.18}{5.18} \times 0.2 \times 1.433$

$= 0.28 + 0.176 = \underline{0.46\ kN/m^2}$

$= \underline{0.46\ kN/m^2}$

BRIDGE SPECIFIC LIVE LOAD

AS STATED IN WAF BRIDGE SPECIFIC FOOTWAY LIVE LOADING REPORT MARCH 2006 RECOMMENDATIONS OF LOADINGS ARE GIVEN BELOW

LOADED LENGTH 300M = 0.67 kN/m

LOADED LENGTH 1414M = 0.23 kN/m

TOTAL LOAD APPLIED

				PER HANGER (APPROX)
①	BD37/01	$1414 \times 0.1563 \times 5.18$	= 1144.8 kN	= 15.3 kN
	BSFLL	1414×0.23	= 325.2 kN	= 4.3 kN
②	BD37/01	$318 \times 0.46 \times 5.18$	= 757.7 kN	= 45 kN
	BSFLL	318×0.67	= 213 kN	= 12.6 kN

FORTH ROAD BRIDGE

Project	Job Ref
CABLE BAND BOLT FACTOR OF SAFETY	
Part of structure	**Calc sheet no** **rev**
CABLE BAND / HANGER LOADS	4

Drawing ref	Calc by	Date	Check by	Date
3311/AIS/20	DB	22/07/2011		

Ref	Calculations	Output

NOMINAL AXIAL LOADS IN HANGER

AVERAGE AXIAL LOAD IN MAIN SPAN HANGER =

= 1470 KN PER HANGER USING BD37/01

CALCULATE LOAD FOR HANGER USING BSFLL & LOADED LENGTH OF

MAIN SPAN L = 318M

HANGER LOAD = 1470 − 45 + 12.6 = 1437.6 KN

AS A PERCENTAGE = $\frac{1437.6}{1470} \times 100 = 97.75\%$

∴ LOAD DECREASE BY 3.2%

HANGER LOAD = 1437.6 KN

SIDE SPAN L = 318

HANGER LOAD = 1955 − 45 + 12.6 = 1922.6 KN

AS A PERCENTAGE = $\frac{1922.6}{1955} \times 100 = 98.3\%$

∴ LOAD DECREASED BY 1.66%

= 1922.6 KN

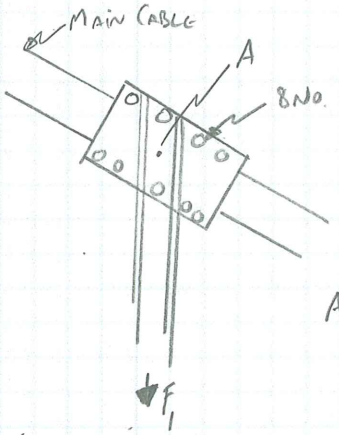
FORTH ROAD BRIDGE

Project	Job Ref
CABLE BAND BOLT FACTOR OF SAFETY	
Part of structure CABLE BANDS	**Calc sheet no** 5 **rev**
Drawing ref 3311/AB/20	**Calc by** DB **Date** 06/07/2011 **Check by** **Date**

Ref	Calculations	Output

DETERMINE FOS AGAINST SLIP

PANNEL POINT 42

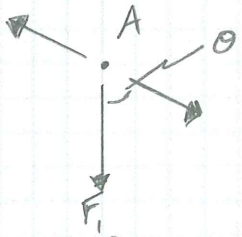


BOLT TENSION = 800KN EACH.

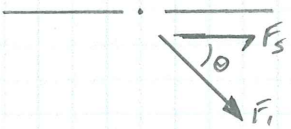
$F_1 = 1920$KN DL+LL

ASSUME SLIP $\mu = 0.3$

IDEALISED DIAGRAM



FORCE CAUSING SLIP



$F_S = \cos\theta \times F_1$

DETERMINE θ SLOPE OF CABLE

$\tan\theta = \frac{1}{0.4432} \Rightarrow \tan^{-1}\left(\frac{1}{0.4432}\right)$

$\theta = 66.09°$

SLOPE = 66.09

$F_S = \cos 66.09 \times 1920$

$= 778.18$KN

FORCE RESISTING SLIP

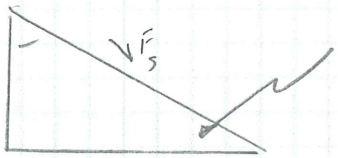
8No BOLTS $= 8 \times 800 \times 0.3 = 1920$KN

$FOS = \frac{1920}{778.18} = 2.46$ THEREFORE MB USED INCORRECT ANGLE

FROM TABLE FOS 2.33

FORTH ROAD BRIDGE

Project			Job Ref
CABLE BAND BOLT – FOS			
Part of structure			**Calc sheet no** / **rev**
CABLE BAND FRICTION			6
Drawing ref	**Calc by**	**Date**	**Check by** / **Date**
3311/AB/20	OD	06/07/2011	

Ref	Calculations	Output
	CALCULATIONS AS MB	
	 F_1 $F_1 = 1920$kN	
	$F_s = \sin(0.4432) \times 1920 = 823.4$kN	
	FORCE RESISTING SLIP	
	8 No. BOLTS $= 8 \times 800 \times 0.3 = 1920$kN	
	$FOS = \frac{1920}{823.4} = 2.33$	AS PER MB CALCULATION SHEET.
	AS STATED USING THE SLOPE AS AN ANGLE IN RADIANS PRODUCED INCORRECT RESULTS.	

FORTH ROAD BRIDGE

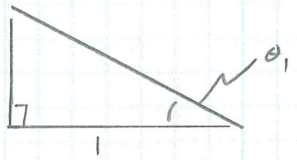
Project			Job Ref
CABLE BAND BOLT - FACTOR OF SAFETY			
Part of structure			Calc sheet no rev
CABLE BANDS FRICTION			7
Drawing ref	Calc by	Date	Check by / Date
3311/AB/20	DB	06/07/2011.	

Ref	Calculations	Output

CHECK SLOPE CALCULATION

PANNEL POINT 42.

AS SLOPE DETERMINED FROM GRAPH OF LINE OF CABLE SLOPE AT PP42:



$$\theta_1 = \tan^{-1}\left(\frac{0.441}{1}\right) = 23.79^\circ$$

CHECK SLOPE USING 2 POINTS ON CABLE

Survey WAF 1986

POINT S3 - LEVEL - 153.6 N - 1993.714

POINT S2 - LEVEL - 146.251 N - 1977.574

$$\text{SLOPE} = \frac{153.6 - 146.251}{1993.714 - 1977.574} = \frac{7.349}{16.14} = 0.455$$

THEREFORE ANGLE IS CORRECT.

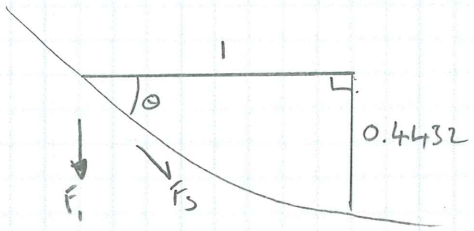
FORTH ROAD BRIDGE

Project	Job Ref
CABLE BAND BOLT - FOS.	
Part of structure	**Calc sheet no** **rev**
CABLE BAND - FRICTION	8

Drawing ref	Calc by	Date	Check by	Date
3311/AB/20	DB	06/07/2011		

Ref	Calculations	Output

CARRY OUT CALC USING RADIANS



$\theta = \tan^{-1}(0.4432) = 0.417$ RADS.

$\sin\theta = \frac{F_1}{F_S}$

$\therefore F_S = F_1 \sin\theta = 1920 \times \sin(0.417)$

$= 774.7$ kN

$FOS = \frac{1920}{774.7} = 2.47$ FOS.

USING DEGREES = 2.46 FOS THESE EQUAL AS EXPECTED.

USE DEGREES AS IT IS SLIGHTLY MORE CONSERVATIVE.