

Structural Calculations:

Supa Tie Bolt Tension and Shear Checks

Client : VR Access Solutions Ltd

Ref : #1755-C1

Date : April 2017

These calculations are completed to calculate the tensile and shear capacity of the Supa Tie threaded rod, which is an M16 Gd 8.8 bolt. Calculations are based on the physical test results obtained from Element testing laboratory, which are given at the end of the calculations, along with the target specification for the material.

The following page shows the derivation of the figures in the table below:

	M16 Gd 8.8 to specification	Test B0027	Test B0028
Single Shear (kN)	60.3	80	76.1
Tension (kN)	90.4	119.9	114.2

The above values should be divided by 1.65 to derive SWL in accordance with the recommendations of TG20:13

Note that the results apply to the bolt only. Other failure modes will occur before the bolt fails, such as coupler slip and anchor failure in the supporting material.

Bolt Shear Check

Basic Data

Bolt Specification: Gd 8.8 M16

$$A_s := 157 \text{ mm}^2 \quad \text{IStructE EC3 Tbl 10.6}$$

$$f_{ub} := 800 \frac{\text{N}}{\text{mm}^2} \quad \text{IStructE EC3 Tbl 10.5}$$

$$\gamma_{M2} := 1.25 \quad \text{IStructE EC3 Tbl 10.4}$$

$$k_2 := 0.9 \quad \text{IStructE EC3 Tbl 10.4}$$

Bolt Shear Capacity - to specification

$$F_{vRd} := \frac{0.6 \cdot f_{ub} \cdot A_s}{\gamma_{M2}} = 60.3 \text{ kN} \quad \text{Single Shear}$$

$$2 \cdot F_{vRd} = 120.6 \text{ kN} \quad \text{Double Shear}$$

Actual Bolt Shear Capacity - to Element test reference B0027

$$f_{ub} := 1061 \frac{\text{N}}{\text{mm}^2} \quad \text{Element Test B0027}$$

$$F_{vRd} := \frac{0.6 \cdot f_{ub} \cdot A_s}{\gamma_{M2}} = 80 \text{ kN} \quad \text{Single Shear}$$

$$2 \cdot F_{vRd} = 159.9 \text{ kN} \quad \text{Double Shear}$$

Actual Bolt Shear Capacity - to Element test reference B0028

$$f_{ub} := 1010 \frac{\text{N}}{\text{mm}^2} \quad \text{Element Test B0028}$$

$$F_{vRd} := \frac{0.6 \cdot f_{ub} \cdot A_s}{\gamma_{M2}} = 76.1 \text{ kN} \quad \text{Single Shear}$$

$$2 \cdot F_{vRd} = 152.2 \text{ kN} \quad \text{Double Shear}$$

Bolt Tension Capacity - to specification

$$f_{ub} := 800 \frac{N}{mm^2}$$

$$F_{tRd} := \frac{k_2 \cdot f_{ub} \cdot A_s}{\gamma_{M2}} = 90.4 \text{ kN}$$

Design Tension

Bolt Tension Capacity - to Element test reference B0027

$$f_{ub} := 1061 \frac{N}{mm^2}$$

Element Test B0027

$$F_{tRd} := \frac{k_2 \cdot f_{ub} \cdot A_s}{\gamma_{M2}} = 119.9 \text{ kN}$$

Bolt Tension Capacity - to Element test reference B0028

$$f_{ub} := 1010 \frac{N}{mm^2}$$

Element Test B0028

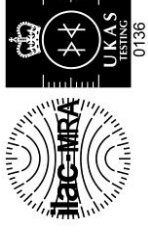
$$F_{tRd} := \frac{k_2 \cdot f_{ub} \cdot A_s}{\gamma_{M2}} = 114.2 \text{ kN}$$



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Report No: 16020021
Date : 05/02/2016
Order Number : 10021
Test Date : 04/02/2016

Material Specification : Not Given
Sample Description : Supa Tie E (Bolt)

Tensile, Hardness, Impacts & Analysis Report

Heat Treatment: N/A Specimen Type: Round Longitudinal = L Transverse = T Tangential = Tn Unspecified = U

Mechanical Properties determined in accordance with : BS EN ISO 6892-1: 2009 A224													
Test No.	Marks	Orientation	Cross Sectional Area	Gauge Length	Temp °C	Spec. Limits	Tensile				Hardness Not Required	Impacts Not Required	
							0.2% Proof Stress N/mm²	UTS N/mm²	El. on 5.65√Area %	Reduction of Area %			
B0027		U	12.5	20	23± 5	Results:	min:	--	--	--	--	--	--
							max:	--	--	--	--		

Chemical Analysis determined by: ICP OES & Combustion												
Test No.	Element :		C	Si	Mn	P	S	Cr	Mo	Ni		
	Limits	min: max:	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --	-- --
B0027A	Results :		0.23	0.07	0.84	0.019	0.018	<0.01	<0.01	<0.01	-- -- --	-- -- --
Analysis results are reported in: %												

Authorised Signatory

B A Bullen

Manager, Mechanical Testing

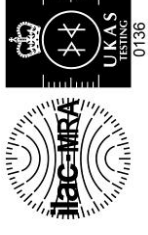
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Report No: 16020022
Date : 05/02/2016
Order Number : 10021
Test Date : 04/02/2016

Material Specification : Not Given
Sample Description : Supa Tie F (Bolt)

Tensile, Hardness, Impacts & Analysis Report

Heat Treatment: N/A Specimen Type: Round Longitudinal = L Transverse = T Tangential = Tn Unspecified = U

Mechanical Properties determined in accordance with : BS EN ISO 6892-1: 2009 A224													
Test No.	Marks	Orientation	Cross Sectional Area	Gauge Length	Temp °C	Spec. Limits	Tensile				Hardness Not Required	Impacts Not Required	
							0.2% Proof Stress N/mm²	UTS N/mm²	El. on 5.65√Area %	Reduction of Area %			
			mm²	mm		min: max:	-- --	-- --	-- --	-- --			-- --
B0028		U	12.5	20	23± 5	Results:	934	1010	14	71	--	--	-- --

Chemical Analysis determined by: ICP OES & Combustion												
Test No.	Element :		C	Si	Mn	P	S	Cr	Mo	Ni		
	Limits min:	Limits max:	--	--	--	--	--	--	--	--	--	--
B0028A	Results :	Results :	0.21	0.20	0.78	0.019	0.008	0.02	<0.01	<0.01	--	--
Analysis results are reported in: %												

Authorised Signatory

B A Bullen

Manager, Mechanical Testing

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