

Structural Calculations:

Supa Tie Bolt Tension and Shear Checks

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

$$A_s := 157 \text{ mm}^2 \quad \text{Structure EC 3 Tbl 10.6}$$

$$f_{ub} := 800 \frac{\text{N}}{\text{mm}^2} \quad \text{Structure EC 3 Tbl 10.5}$$

$$\gamma_{M2} := 1.25 \quad \text{Structure EC 3 Tbl 10.4}$$

$$k_2 := 0.9 \quad \text{Structure EC 3 Tbl 10.4}$$

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

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

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

Element Test B0027

Bolt Tension Capacity - to Element test reference B0028

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

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

Element Test B0028



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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 mm ²	Gauge Length mm	Temp °C	Spec. Limits min: max:	Tensile			Hardness Not Required	Impacts Not Required	
							0.2% Proof Stress N/mm ²	UTS N/mm ²	EI. on 5.65√Area %		Reduction of Area %	Orientation
B0027		U	12.5	20	23±5	Results:	1036	1061	15	72	--	--

Chemical Analysis determined by: ICP OES & Combustion

Test No.	Element:		C	Si	Mn	P	S	Cr	Mo	Ni
	Limits min: max:	Results								
B0027A	--	--	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 mm ²	Gauge Length mm	Temp °C	Spec. Limits min: max:	Tensile			Hardness Not Required	Impacts Not Required	
							0.2% Proof Stress N/mm ²	UTS N/mm ²	EI. on 5.65√Area %		Reduction of Area %	Orientation
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: max:	Results								
B0028A	--	--	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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