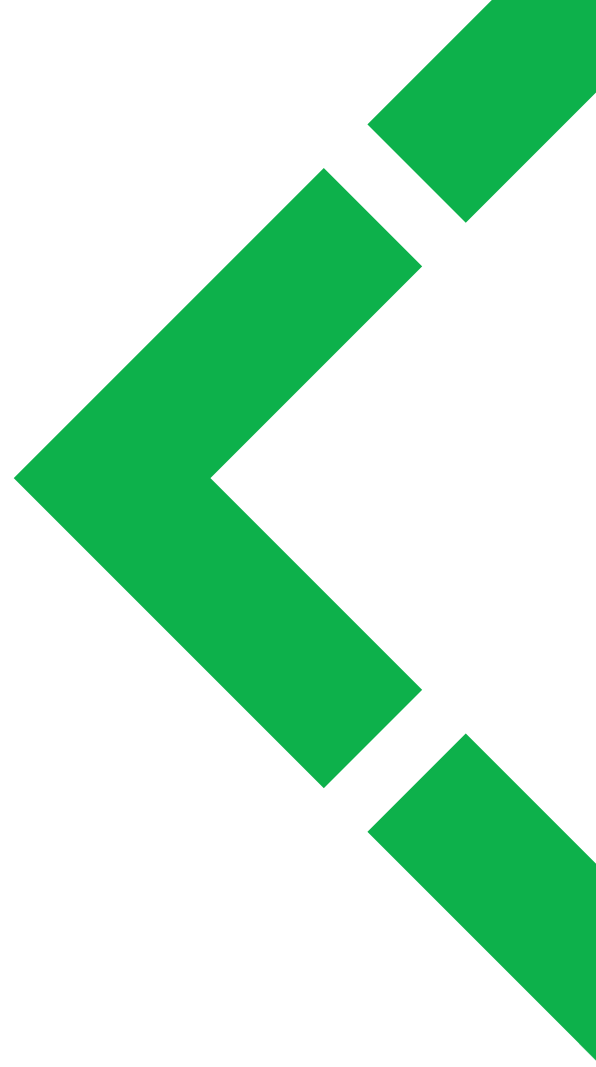




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# Substituting Viribar<sup>®</sup>750 for 500N Fitments

A check against Australian Standard AS 3600: 2018 Concrete structures was completed to demonstrate that standard 500 MPa fitments can be directly substituted with the equivalent force capacity Viribar<sup>®</sup>750 fitment.

**Disclaimer:**

This publication is provided to assist engineers and designers with specifying Viribar®750. Users of this information are required to check this information to satisfy themselves of its accuracy and not rely on it without doing so first. Unless required by the law, the company cannot accept responsibility for any loss, damage or consequence resulting from the use of this publication.



REFERENCE

CALCULATION

This check covers the relevant the Clauses in AS3600 relating to column fitments, specifically Clauses 10.7.2 to 10.7.4 incl. and 14.5.4

Designation	Units	V8.2	N10	V9.8	N12	V13	N16
Diameter	mm	8.165	10	9.798	12	13.064	16
Grade - $f_{sy,f}$	MPa	750	500	750	500	750	500
Area - $A_{b,fit}$	mm <sup>2</sup>	52.4	78.5	75.4	113.1	134.0	201.1
Capacity - $A_{b,fit} \times f_{sy,f}$	kN	39.3	39.3	56.5	56.5	100.5	100.5

Check to show using the data from the table above that:

Viribar®750 V8.2, V9.8 and V13 directly substitutes for N10, N12 and N16 respectively

Let  $(A_{b,fit})_{500} \times 500 = (A_{b,fit})_{750} \times 750$  denote the general case

**AS 3600: 2018**

**Cl.10.7.2 Functions of fitments**

- Satisfy Clause 10.7.3 to confine concrete
- Satisfy Clause 10.7.4 to provide lateral restraint of longitudinal bars against buckling
- Satisfy Section 14 - Earthquake action in moment resisting frames

**Cl.10.7.3 Confinement to the core**

**Cl.10.7.3.1 General requirements**

(a) for columns where  $f_c \leq 50$  MPa - deemed to satisfy if Cl 10.7.4 is satisfied

(b) (i) for columns where  $f_c > 50$  MPa - need to check Cl 10.7.3.2; 10.7.3.3 & 10.7.3.4

(ii) Does not impact on dia., impacts on spacing relative to dimensions only



REFERENCE

CALCULATION

Cl.10.7.3.2 Calculation of core confinement by rational calculation

Use simplified calculation in Cl 10.7.3.3

Cl.10.7.3.3 Calculation of core confinement by simplified calculation

Eq. 10.7.3.3(1) -  $f_{r,eff} = k_e f_r$

Determine  $f_r$  using equation 10.7.3.3(2)

Determine  $k_e$  using equation 10.7.3.3(3)

Eq. 10.7.3.3(2) - 
$$f_r = \frac{\sum_{i=1}^m A_{b,fit} f_{sy} \sin \theta}{d_s s}$$
 Where  $f_{sy} \leq 800MPa$

Since  $(A_{b,fit})_{500} \times 500 = (A_{b,fit})_{750} \times 750$ ;

And  $\sin \theta$ ,  $d_s$  and  $s$  are unchanged,

Then -  $(f_r)_{500} = (f_r)_{750}$

(a) For rectangular sections

Eq. 10.7.3.3(3) - 
$$k_e = \left(1 - \frac{nw^2}{6A_c}\right) \left(1 - \frac{s}{2b_c}\right) \left(1 - \frac{s}{2d_c}\right)$$

No terms dependant on fitment strength  $f_{sy,f}$  or fitment area  $A_{b,fit}$

(b) For circular sections

Eq. 10.7.3.3(4) - 
$$k_e = \left(1 - \frac{s}{2d_s}\right)^2$$

No terms dependant on fitment strength  $f_{sy,f}$  or fitment area  $A_{b,fit}$

**Alternatively**, for rectangular or circular columns the effective

confining pressure can be calculated using:

Eq. 10.7.3.3(5) -  $f_{r,eff} = 0.5k_e \rho f_{sy,f}$

Where 
$$\rho = \frac{A_{b,fit} \times \text{total perim. of fitments crossing the section}}{A_c \times s}$$



REFERENCE

CALCULATION

Substituting into Eq 10.7.3.3(5) -

$$f_{r.eff} = 0.5k_e \frac{A_{b.fit} \times \text{total perim. of fitments crossing the section} \times f_{sy.f}}{A_c \times s}$$

Re-arranging

$$f_{r.eff} = 0.5k_e \frac{(A_{b.fit} \times f_{sy.f}) \times \text{total perim. of fitments crossing the section}}{A_c \times s}$$

Now,  $(A_{b.fit})_{500} \times 500 = (A_{b.fit})_{750} \times 750$ ;

fitment perimeter and spacing is the same as is the column area  $A_c$

$\therefore (f_{r.eff})_{500} = (f_{r.eff})_{750}$

Ie. If the design capacity of the Viribar®750 fitment equals the design capacity of the 500 MPa fitment, then the effective confining pressure is the same.

Cl.10.7.3.4 Deemed to conform core confinement

(a) For rectangular sections:

Eq. 10.7.3.4(1) - Min Fitment spacing  $\leq \frac{15nA_{b.fit}f_{sy.f}}{f'_c \sqrt{A_c}}$

(b) For circular sections:

Eq. 10.7.3.4(2) - Min Fitment spacing  $\leq \frac{100A_{b.fit}f_{sy.f}}{d_s f'_c}$

Now,  $(A_{b.fit})_{500} \times 500 = (A_{b.fit})_{750} \times 750$

And n, number of fitments;  $f'_c$ ;  $A_c$ , area of column and  $d_s$ , overall dimension of fitments do not change

$\therefore (\text{Min fitment spacing})_{500} = (\text{Min fitment spacing})_{750}$



REFERENCE

CALCULATION

**Cl.10.7.4 Restraint of longitudinal reinforcement**

**Cl.10.7.4.1 General requirements**

No impact from fitment strength  $f_{sy,f}$  or fitment area  $A_{b,fit}$

**Cl.10.7.4.2 Lateral restraint**

No impact from fitment strength  $f_{sy,f}$  or fitment area  $A_{b,fit}$

**Cl.10.7.4.3 Diameter and spacing of fitments and helices**

(a) Minimum bar diameter of fitment and helices to conform to **Table 10.7.4.3**

**T. 10.7.4.3 NOTE** - allows the minimum diameter of fitments to be reduced by a

factor of  $\sqrt{500/f_{sy,f}}$ . This is applied and tabulated below.

Longitudinal bar diameter (mm)	Minimum bar diameter of 500 MPa fitment and helix (mm)	Minimum bar diameter of Viribar®750 fitment and helix (mm)
Single bars up to 20	6	4.8
Single bars 24 to 28	10	8.2
Single bars 32 to 36	12	9.8
Single bars $\geq 40$	16	13.1
Bundled Bars	12	9.8

(b) Maximum Spacing of fitments shall not exceed

(i)  $D_c$  and  $15d_b$  for single bars

(ii)  $0.5D_c$  and  $7.5D_b$  for bundled bars

(i) and (ii) are independent of fitment strength  $f_{sy,f}$  or fitment area  $A_{b,fit}$

(iii) If  $L_u \leq 5D$  - Need to check Section 14.5



REFERENCE

CALCULATION

(c) Location of first or last fitment - independent of fitment strength  $f_{sy,f}$  or fitment area  $A_{b,fit}$

**Cl.10.7.4.4** *Detailing of fitments and helices*

Independent of fitment strength  $f_{sy,f}$  or fitment area  $A_{b,fit}$

**Cl.14.5.4** **Columns**

**Only need to check this clause if the column is part of a seismic resisting frame**

The spacing of fitments shall not be greater than

(a) 8 times the diameter of the smallest longitudinal bar enclosed

(b)  $24 \sqrt{f_{sy,f}/500}$  times the diameter of the fitment bar

(c) One-half of the smallest cross-sectional dimension of the column

(d) 300 mm

Only (b) is affected by the fitment strength  $f_{sy,f}$  or fitment diameter  $d_{b,fi}$ .

The table below shows there is no change in the fitment spacing for the equivalent Viribar®750 fitment when the formula in (b) is applied.

Clause 14.5.4 (b) - Maximum fitment spacing for column in a seismic resisting frame			
500 MPa Fitments Diameter (mm)	Maximum Spacing (mm)	Viribar®750 Fitments Diameter (mm)	Maximum Spacing (mm)
10	240	8.165	240
12	288	9.798	288
16	384	13.06	384



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