

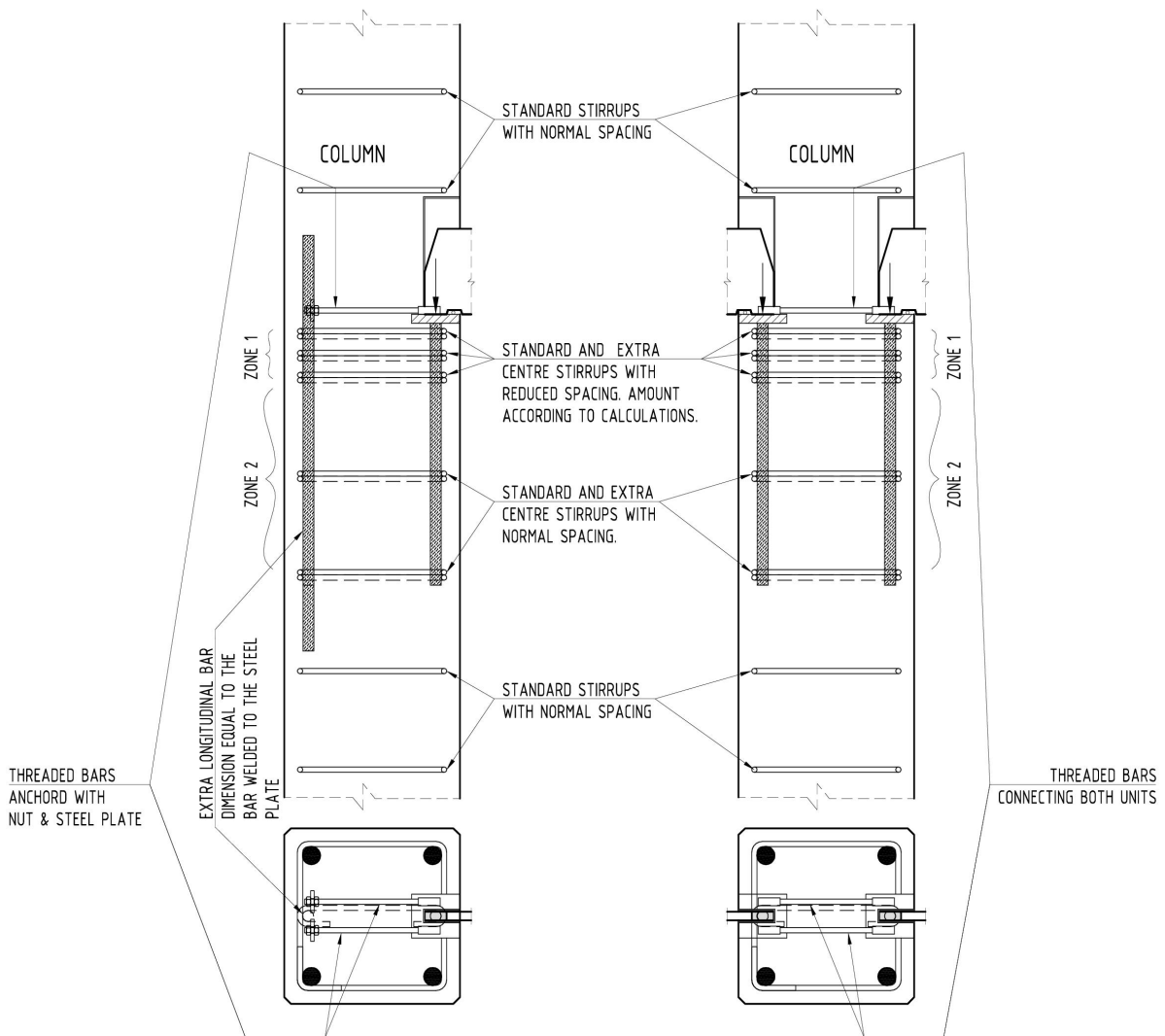
MEMO 523

BSF  
EXAMPLE: REINFORCEMENT PATTERN  
IN COLUMN  
DESIGN

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**BSF - EXAMPLE: REINFORCEMENT PATTERN IN COLUMN**



**Figure 1: Reinforcement in column.**

Figure 1 illustrates the recommended principal reinforcement in the column. A portion of the vertical force will spread into the column via the reinforcement bar welded to the bottom of the steel plate, while the remaining force will go into the column via distributed concrete stress underneath the steel plate. Splitting forces will occur due to horizontal spreading of the forces into the cross section of the column.

The amount of reinforcement in Zone 1 can be calculated in accordance with Memo 521. An example of the amount of stirrups in Zone 1 based on calculations in Memo 521 is given in below Table 1.

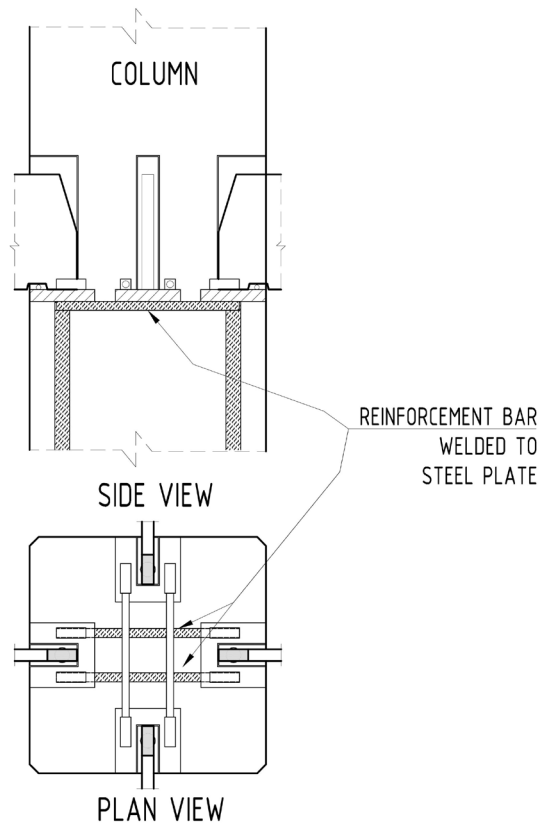
In Zone 2 the stirrups may be distributed with the normal c/c distance.

Note the requirements to the position of the reinforcement anchoring the horizontal force. Only reinforcement within a distance  $0,7d'$  can be assumed effective, see Memo 521 for more information. There must be a consideration in each case up to this requirement. For rectangular columns, an extra set of narrow stirrups close to the unit may be required.

It is recommended to include extra centre stirrups along the length of the unit. These stirrups shall be anchored around the reinforcement bar welded to the steel plate, and it is recommended to use the same spacing and dimension for these stirrups as for the standard stirrups. In case of a single unit, an extra longitudinal bar has to be introduced in order to anchor the centre stirrups at the rear side of the column. For the BSF700/BSF1100 units, the centre stirrup shall enclose both anchoring bars welded to the steel plate.

In case of double units, the treaded bars are screwed into the treaded inserts in both units, making a horizontal connection right through the column.

In case of units on all four sides of the column, there may become collisions between the horizontal treaded bars. One solution is illustrated in Figure 2.



**Figure 2: Alternative solution - horizontal anchoring.**

Special care with respect to anchoring of the vertical force occurring at the rear of the column (due to the angle in the strut & tie model) must be taken if the unit(s) is located near the top of the column, see Memo521 for further information.

Figure 1 illustrates the column with four main reinforcement bars, one in each corner of the stirrups. This is only an illustration. The knife(s) will give eccentric load(s) on the column and the required amount of main reinforcement shall be evaluated in each case, based on the actual occurring axial force and bending moment(s) from the eccentricity (-ies).

It's an assumption the recess for the knife in the column is always filled with grout. Thus, the capacity of the column can be evaluated without reduction in cross-section due to the column unit.

UNIT	VERTICAL REINFORCEMENT BAR WELDED TO UNIT <sup>1</sup>	STIRRUPS IN COLUMN BELOW UNIT <sup>2</sup> (ZONE 1)
BSF225	1× $\phi$ 20 L=600mm	3× $\phi$ 10 c/c 50 (+centre stirrups)
BSF300	1× $\phi$ 20 L=600mm	4× $\phi$ 10 c/c 50 (+ centre stirrups)
BSF450	1× $\phi$ 25 L=600mm	6× $\phi$ 10 c/c 50 (+ centre stirrups)
BSF700	2× $\phi$ 25 L=790mm	5×2 $\phi$ 10 c/c 50 (doubled) (+ centre stirrups enclosing both vertical bars)
BSF1100	2× $\phi$ 32 L=690mm	7×2 $\phi$ 12 c/c 60 (doubled) (+ centre stirrups enclosing both vertical bars)

**Table 1: Example of reinforcement in Zone 1 in column. Assumed column dimension: 400x400. (BSF1100: 500x500)**

<sup>1</sup> Standardized length and dimension.

<sup>2</sup> The given amount of stirrups is calculated with use of the National Determined Parameters and assumptions as given in Memo 521. The assumed column dimension is 400x400. (BSF1100: 500x500) The number of stirrups must be considered as an example, and a final evaluation shall be done by a qualified engineer in each case. See Memo521 for background information on assumed flow of forces in the column.

REVISION HISTORY	
Date:	Description:
17.04.2013	First Edition (for ETA)
30.04.2014	Included reference to Memo 521 for requirements to position of reinforcement anchoring the horizontal force
27.02.2015	Included a nut on the front side of the steel plate anchoring the threaded bars. (To ensure correct position of the plate when casting the concrete).
24.05.2016	New template.
08.11.2018	Included BSF1100
14.02.2020	Included Figure 2. Alternative solution horizontal anchoring - units one four sides of column.