3.12.8.8 ***Anchorage of column starter bars in bases or pile caps***

The compression bond stresses that develop on starter bars within bases or pile caps do not need to be checked provided:

a) the starters extend down to the level of the bottom reinforcement;

b) the base or pile cap has been designed for moments and shears in accordance with **3.11**.

3.12.8.9 ***Laps and joints***

Connections transferring stress may be lapped, welded or joined with mechanical devices[7]. They should be placed, if possible, away from points of high stress and should preferably be staggered. Laps in fabric may be layered or nested to maintain the lapped bars in one plane.

3.12.8.10 ***Joints where imposed loading is predominantly cyclical***

In such cases bars should not be joined by welding.

3.12.8.11 ***Minimum laps***

The minimum lap length for bar reinforcement should be not less than 15 times the bar size or 300 mm, whichever is the greater, and for fabric reinforcement should be not less than 250 mm.

3.12.8.12 ***Laps in beams and columns with limited cover***

Where both bars at a lap exceed size 20 and the cover is less than 1.5 times the size of the smaller bar, transverse links should be provided throughout the lap length. At the lap the links should be at least one-quarter the size of the smaller bar and the spacing should not exceed 200 mm.

3.12.8.13 ***Design of tension laps***

The length should be at least equal to the design tension anchorage length (see **3.12.8.3** and **3.12.8.4**) necessary to develop the required stress in the reinforcement. Lap lengths for unequal size bars (or wires in fabric) may be based upon the smaller bar. The following provisions also apply:

a) where a lap occurs at the top of a section as cast and the minimum cover is less than twice the size of the lapped reinforcement, the lap length should be increased by a factor of 1.4;

b) where a lap occurs at the corner of a section and the minimum cover to either face is less than twice the size of the lapped reinforcement or, where the clear distance between adjacent laps is less than 75 mm or six times the size of the lapped reinforcement, whichever is the greater, the lap length should be increased by a factor of 1.4;

c) in cases where both conditions a) and b) apply, the lap length should be increased by a factor of 2.0.

Values for lap lengths are given in Table 3.27 as multiples of bar size.

3.12.8.14 ***Maximum amount of reinforcement in a layer including tension laps***

At laps, the sum of the reinforcement sizes in a particular layer should not exceed 40 % of the breadth of the section at that level.

3.12.8.15 ***Design of compression laps***

The length should be at least 25 % greater than the compression anchorage length (see **3.12.8.3** and **3.12.8.4**) necessary to develop the required stress in the reinforcement. Lap lengths for unequal size bars (or wires in fabric) may be based upon the smaller bar.

Values for lap lengths are given in Table 3.27 as multiples of bar size.

[7] For further information see CIRIA Report 92, 1981, available from Construction Industry Research and Information Association, 6 Storey's Gate, Westminster, London SW1P 3AU.

Table 3.27 — Ultimate anchorage bond lengths and lap lengths as multiples of bar size

Reinforcement types	Grade 250 plain	Grade 460			
		Plain	Deformed type 1	Deformed type 2	Fabric
	Concrete cube strength 25				
Tension anchorage and lap length	43	79	55	44	34
1.4 × tension lap	60	110	77	62	48
2.0 × tension lap	85	157	110	88	68
Compression anchorage length	34	63	44	35	28
Compression lap length	43	79	55	44	34
	Concrete cube strength 30				
Tension anchorage and lap length	39	72	50	40	31
1.4 × tension lap	55	100	70	56	44
2.0 × tension lap	78	143	100	80	62
Compression anchorage length	32	58	40	32	25
Compression lap length	39	72	50	40	31
	Concrete cube strength 35				
Tension anchorage and lap length	36	67	47	38	29
1.4 × tension lap	51	93	65	52	40
2.0 × tension lap	72	133	93	75	57
Compression anchorage length	29	53	38	30	23
Compression lap length	36	67	47	38	29
	Concrete cube strength 40				
Tension anchorage and lap length	34	62	44	35	27
1.4 × tension lap	48	87	61	49	38
2.0 × tension lap	68	124	81	70	54
Compression anchorage length	27	50	35	28	22
Compression lap length	34	62	44	35	27

NOTE The values are rounded up to the nearest whole number and the length derived from these values may differ slightly from those calculated directly for each bar or wire size.

3.12.8.16 *Butt joints*

3.12.8.16.1 *Bars in compression*

In such cases the load may be transferred by end bearing of square sawn-cut ends held in concentric contact by a suitable sleeve or other coupler. The concrete cover for the sleeve should be not less than that specified for normal reinforcement.

3.12.8.16.2 *Bars in tension*

The only acceptable form of full-strength butt joint for a bar in tension comprises a mechanical coupler satisfying the following criteria.

a) When a test is made of a representative gauge length assembly comprising reinforcement of the size, grade and profile to be used and a coupler of the precise type to be used, the permanent elongation after loading to $0.6f_y$ should not exceed 0.1 mm.

b) The tensile strength of the coupled bar should exceed 287.5 N/mm^2 for grade 250, 483 N/mm^2 for grade 460 A and 497 N/mm^2 for grade 460 B.