TYPE 160/250 LINTELS

DESIGN OF PRESTRESS CONCRETE BASS BEAMS TYPE 1645 AND 2545

1. DESIGN CRITERIA

1.2 ULTIMATE LIMIT STATES

The design criteria for prestress beams will be based on serviceability limit states only. Ultimate loads can be used as a check.

1.2 SERVICEABILITY LIMIT STATES

The design of the beams are based on acceptable deflections and cracking as specified in CP110. The different classes of Tables 33,34 and 35 refer.

2. DESIGN PROCEDURE FOR SIMPLY SUPPORTED BEAMS

2.1 PROPERTIES

Type 1645 and 2545 are rectangular beams 90 mm x 160 mm and 100 mm x 250 mm respectively.

fcu	60	N/sq mm
fci	35	N/sq mm
E	36	kN/sq mm

Table 33 0.2 Limiting crack width 0.1 or 0.2

Table 33 0 Allowed increase in stress

Table 36 0.5 Allow comp stress factor of 0.5 or 0.4 at transfer

	1645	2545
Depth m	0.160	0.250
Area sq m	0.0152000	0.0262500
I m x 4	0.0000324	0.0001366
Yt m	0.079	0.123
Yb m	0.081	0.127
Zt m x 3	-0.0004122	-0.0011106
Zb m x 3	0.0003980	0.0010758
b mm	90	100
Table 14	1.28	1.10
Centroid of wires from bottom	0.035	0.035
e cf wires	0.046	0.092
d	0.125	0.215

It is common practice to pour the rectangular beams in the same beds as the T beams with four 7 mm wires. Therefore the 1647 and 2547 combinations are also calculated.

1645

WIRES	Dia	dx is depth from top
First (Bottom)	5 mm	dx = 137.5
Second (Middle)	5 mm	dx = 112.5
Third (Top) two	0 mm	dx = 90.0

1647

WIRES	Dia	dx is depth from top
First (Bottom)	7 mm	dx = 136.5
Second (Middle)	7 mm	dx = 109.5
Third (Top) two	0 mm	dx = 86.0

2545

WIRES	Dia	dx is depth from top
First (Bottom)	5 mm	dx = 227.5
Second (Middle)	5 mm	dx = 202.5
Third (Top) two	0 mm	dx = 180.0

2547

WIRES	Dia	dx is depth from top
First (Bottom)	7 mm	dx = 226.5
Second (Middle)	7 mm	dx = 199.5
Third (Top) two	0 mm	dx = 176.0

Four 5 mm wires		Four 7 mm wires	
Aps	78.54 sq mm	Aps	153.94
Fpu	-121.74 kN	Fpu	-238.60
fpi	-85.22 kN	Fpi	-167.02
fpf	-59.65 kN	Fpf	-116.92

2.2 TRANSFER

The Bass Beams are limited initially by transfer conditions. Modifications can be made to the reinforcing if transfer conditions are not met.

2.2.1 ASSUMPTIONS

JACK LOSS ASSUMED TO BE BETWEEN 70 AND 80 %

LOSSES DUE TO CREEP ARE NOT APPLICABLE AT TRANSFER

(High initial stressing forces and low final losses give the most restriction on the design at transfer)

2.2.2 LIMITS

Allowable comp stress % fci -17.5 N/sq mm

Allowable tensile stress fti 3.5 N/sq mm

2.2.3 EXAMPLES

APPENDIX 29 1645 3m Beam 70 % Jack Force

APPENDIX 30 1647 3m Beam 70 % Jack Force

APPENDIX 31 2545 5m Beam 70 % Jack Force

APPENDIX 32 2547 5m Beam 70 % Jack Force

It can be seen that four 7 mm wires overstress both the 1647 and the 2547. De-stressing and or Y-bars must be considered when 1647 and 2547 are manufactured as excessive hogging will occur.

2.3 DESIGN OF BASS BEAMS IN POSITION PRIOR TO LOADING

The beams in position need only be designed to carry light working loads. Load of screed is dealt with later.

2.3.1 ASSUMPTIONS
JACK LOSS ASSUMED TO BE 70 %
LOSSES DUE TO CREEP ETC ARE ASSUMED TO BE 30 %
CRACK WIDTH 0.2
DESIGN CLASS 3
LIVE LOADS TO BE CARRIED PRIOR TO SCREEDING 1 kN/sq m
2.3.2 LIMITS
Allowable comp stress - 19.8 N/sq mm
Allowable tensile stress 6.9 N/sq mm Allow max 15
Not applicable
2.3.3 EXAMPLES
APPENDIX 33 1645 6 m Beam 1647 6 m Beam (7.5 actual)
APPENDIX 34 2545 8 m Beam 2547 8 m Beam (10m actual)
The above lengths of 6 m for the 1645 and the 1647 and 8 m for the 2545 and the 2547 indicate a limit beyond which propping may be required. The lengths for the 1647 and 2547 beams are reduced to that of the 1645 and 2545 because the reduction in stresses to keep within transfer limits reduces these beams affectively to that of types 1645 and 2545. (See below)
2.4 MOMENT OF RESISTANCE OF BASS BEAMS
A guideline moment of resistance is calculated to check the loads that the 1645 and the 2545 can carry. This is a serviceability moment of resistance and no load factors are required.

Mom of Resist	1645	7 kNm/m
	2545	15 kNm/m

*******************************IMPORTANT NOTICE***************************
Currant brochures give Moments of Resistance for the 1645 and 2545 AS 8 and 16 which is slightly higher due to an assumption of losses less than the max 30 %. An investigation into actual losses is in progress.
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The 1647 and 2547 beams as mentioned on page 3 are assumed to have a reduced initial prestressing to keep within transfer limits. This reduction in stresses results in the reduction of the moment of resistance of the 1647 and the 2547 namely 7 and 15 kNm/m. This may seem a futile use of the bigger 7 mm wire if the same strength can be obtained with 5 mm wire. The reason however is that the manufacturing process may mix the 1645 or 2545 which require 5 mm in a stressing bed full of 2047 beams which require the 7 mm wires.
2.4.1 ASSUMPTIONS
JACK LOSS ASSUMED TO BE 70 %
LOSSES DUE TO CREEP ETC ARE ASSUMED TO BE 30 %
CRACK WIDTH 0.2
DESIGN CLASS 3
2.4.2 LIMITS

Allowable comp stress	-19.8	N/sq mm
Allowable tensile stress	6.9	N/sq mm Allow max 15

Not applicable
2.4.3. EXAMPLES
APPENDIX 35 1645 6 m Beam
Total load including self weight is 1.55 kN/m
Mom is W*L*L/8 = 1.55*6*6/8 = 7.0 kN/m
APPENDIX 36 2545 8 m Beam
Total load including self weight is 1.9 kN/m
Mom is W*L*L/8 = 1.9*8*8/8 = 15.2 kN/m
The loads of 1.55 and 1.9 kN/m include self weight of the beams.

Self weight	
1645	0.36 kN/m
2545	0.63 kN/m

2.5 DEFLECTIONS (APPENDIX 37)
Only an approximation of deflections are possible as the true values of deflections due to losses are to date not available.
2.6 SHEAR
Extensive shear calculations indicate that shear is not a factor if the above serviceability limits for stressing and deflections are met. Individual cases can be checked conservatively using Table 5 and ignoring the additional shear resistance obtained from the prestressing.

2.7 USE OF BEAMS AS LINTELS
The moments of resistance of 7 and 15 kNm/m for the 1645 and 2545 resp compares with that of only 1 kNm/m of conventional lintels. Conventional lintels are used only as a shutter until the brickwork sets and can arch across the opening. To use prestressed lintels and brickwork as a combined beam is not considered in this report as a special shear design is required to enable the two elements to form a composite beam. Although this is possible it has not proven to be practical. When using Bass Beams as lintels the brickwork is taken as a dead load and assumed not to increase the moment of resistance of the resulting composite beam. The strength of the brickwork as a beam can be calculated by conventional means.

APPENDIX 37

4.3.7 DEFLECTIONS OF BEAMS
4.3.7.1 CLASS 1 AND CLASS 2 MEMBERS
Deflections may be calculated using elastic analysis
4.3.7.2 CLASS 3 MEMBERS
As per Class 1 and Class 2 if permanent load < 25 % of design imposed load
Where permanent load exceeds 25 % then Tables 7 and 8 only i.e. span/20 for effective depth

SPAN 6.0 UDL 1.19 TYPE 1645	INITIAL	FINAL
Elastic deflection due to Prestress P.e.l.l/8EI	-15	-11
Elastic deflection due to self wt 5wl^4/384EI	5	5
Elastic deflection due to topping 5wl^4/384EI		0
Elastic deflection due to UDL 5wl^4/384EI		17
Elastic deflection due to P		0
Elastic deflect due to creep		-2

-10 Hogging at transfer
-7 Prior to loading
10 Final deflection

SPAN	8.0	UDL	1.27		TYPE 2545
				INITIAL	FINAL
Elastic deflection due to Prestress				-13	-9
P.e.l.l/8EI					
Elastic deflection due to self wt				7	7
5wl^4/384EI					
Elastic deflection due to topping					0
5wl^4/384EI					
Elastic deflection due to UDL					14
5wl^4/384EI					
Elastic deflection due to P					0
Elastic deflect due to creep					-2

-6 Hogging at transfer
-4 Prior to loading
10 Final deflection