Early Thermal Cracking of Concrete  
BD28/87

Base Length $L_w = 11600$ mm  
Base Thickness $T_w = 1000$ mm  
Reinforcement Strength $f_y = 500$ N/mm$^2$  
Concrete Strength $f_{cu} = 40$ N/mm$^2$  
Cement content = 350  
Formwrk : 18mm ply  
Season: Summer  
Short-term fall in temperature $T_1 = 45$ (+10 for wall>500 thick)  
Ac for outer 250mm of wall for 1m length of wall = 500000 mm$^2$  
Tensile strength of immature concrete $f_{ct} = 0.12f_{cu}^{0.7} = 1.587169$ N/mm$^2$

Using the prediction method (Section 5.1)

Minimum area of reinforcement $= f_{ct}A_c/f_y = 1587.169$ mm$^2$  

For crack control:

$$f_{ct}/f_b = 0.67 \text{ for Type 2 deformed bars }$$

Permissible crack width $w$ from Table 1 (Pt 4) = 0.25

Ultimate tensile strain of concrete $\varepsilon_{ult} = 200$ microstrains

Shrinkage strain of concrete $\varepsilon_{sh} = 0.5\varepsilon_{ult} = 100$ microstrains

Clause 5.7 Thermal Strain:

Coefficient of thermal expansion $= \alpha = 1.20E-05$

Long-term fall in temperature $T_2 = 0$ (Wall less than 15m long or at same climatic exposure)

Thermal strain of concrete $\varepsilon_{th} = 0.8\alpha(T_1+T_2) = 0.000432$

Restraint Factor (from Table 2) = 0.2 (Base cast onto blinding)

Required Reinforcement:

$$A_s = (f_{ct}/f_b)A_c\phi[R^*(\varepsilon_{sh}+\varepsilon_{th})-0.5\varepsilon_{ult}]/(2w) = 68.608 \text{ mm}^2/m$$

Bar diameter $\phi = 16$ mm

Height of wall = 150 mm

Length to height ratio = 77.33333333 : 1  
Min $A_s$ required = 1587.169 mm$^2$/m

Height for reinforcement = 150 mm  
Min $A_s$ each face = 793.5846 mm$^2$/m

Reinforcement = B16 @ 253.4 c/c in each face