Early Thermal Cracking of Concrete
BD28/87

Wall Length \( L_w \) = 11600 mm
Wall Thickness \( T_w \) = 1000 mm
Reinforcement Strength \( f_y \) = 500 N/mm²
Concrete Strength \( f_{cu} \) = 40 N/mm²

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 mm²
Tensile strength of immature concrete \( f_{ct} \) = 0.12*\( f_{cu} \)^{0.7} = 1.587169 N/mm²

Using the prediction method (Section 5.1)

Minimum area of reinforcement = \( f_{ct} \)*\( A_c / f_y \) = 1587.169 mm²

For crack control:
\[ f_{ct} / f_b = 0.67 \] 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) = 0.6 (Wall cast onto base)

Required Reinforcement:
Bar diameter \( \phi \) = 16 mm
\[ A_s = (f_{ct} / f_b) \cdot A_c \cdot \phi \cdot [R \cdot (\varepsilon_{sh} + \varepsilon_{th}) - 0.5 \cdot \varepsilon_{ult}] / (2 \cdot w) = 2349.824 \text{ mm}^²/m \] ……………..(3)
Height of wall = 6630 mm
Length to height ratio = 1.749622926 : 1
Min \( A_s \) required = 2349.824 mm²/m

Height for reinforcement = 3315 mm
Min \( A_s \) each face = 1174.912 mm²/m

Reinforcement = B16 @ 171.1 c/c in each face of wall