Sleeper Length = 2.4m

Maximum Sleeper Depth = 1.0m

GENERAL SLEEPER COVER REQUIREMENTS

1) 1km → 50km from coast — Table 4.10.3.4 – AS3600

⇨ B1 exposure class to exposed face

- N32 concrete c ≥ 30mm (for rigid formwork and intense compaction, 40mm otherwise)

2) < 1km from coast — Table 4.10.3.4 – AS3600

⇨ B2 exposure class to exposed face

- N40 concrete c ≥ 35mm (for rigid formwork and intense compaction, 45mm otherwise)

SLEEPER REINFORCEMENT TO AS3600

Length of Sleeper	L = **2400** mm
Height of Wall	H = **1000** mm
Compressive Strength of Concrete	F'_c = **32** MPa (B1)
Yield Strength of Steel Reinforcement (N grade)	f_{sy} = **500** MPa
Depth of Sleeper	d = **200** mm
Thickness of Sleeper	t = **100** mm
b = t /2	b = **50** mm
Friction Angle of Soil	ϕ = **30**
$K_a = (\tan(45-\phi/2))^2$	K_a = **0.333**
Unit Weight of Backfill Soil	γ_s = **18** kN/m^3
Surcharge	Q = **5** kPa
$\eta_0 = K_a \times Q$	η_0 = **1.667** kPa
$\eta_1 = K_a \times \gamma_s \times H - K_a \times \gamma_s \times d / 2$	η_1 = **5.400** kPa
$\eta_t = \eta_0 + \eta_1$	η_t = **7.067** kPa
$w = \eta_t \times d$	w = **1.413** kN/m
$w^* = 1.5 \times w$	w^* = **2.120** kN/m
$M^* = w^* \times L^2 / 8$	M^* = **1.526** kNm

Flexural Strength of Sleeper

Capacity Reduction Factor of Bending	ϕ_b = 0.8	Table 2.3 – AS3600
$A_{st\ required} = F'_c \times d / (1.2 \times f_{sy}) \times (b-\sqrt{(b^2 - (2.4 \times M^*)/(\phi_b \times F'_c \times d))})$	$A_{st\ required}$ = **82.74** mm^2	
2 10mm diameter bars are required		
Diameter of Bar	d_b = **10** mm	
$A_{st} = 2 \times \pi \times (d_b/2)^2$	A_{st} = **157.08** mm^2	
$\phi M_u = \phi_b \times f_{sy} \times A_{st} \times b \times (1 - 0.6 \times (A_{st} \times f_{sy})/(b \times d \times F'_c))$	ϕM_u = **2.679** kNm	
$\phi M_u \geq M^*$ therefore OK		

Shear Strength of Sleeper

$V^* = w^* \times L / 2$	V^* = **2.544** kN	
Calculate $0.5\phi_v V_{uc}$ and check it is larger than V^* => no shear reinforcement is required		cl 8.2.5 – AS3600
$\beta_1 = 1.1 \times (1.6 - b)$	β_1 = **1.705**	cl 8.2.7.1 – AS3600
$\beta_2 = \beta_3 = 1.0$		
Shear Strength Reduction Factor;	ϕ_v = 0.7	Table 2.3 – AS3600
$\frac{1}{2}\phi V_{uc} = 0.5 \times \phi_v \times \beta_1 \times \beta_2 \times \beta_3 \times b \times d \times (A_{st} \times F'_c /(b \times d))^{(1/3)}$	$\frac{1}{2}\phi V_{uc}$ = **4.745** kN	cl 8.2.7.1 – AS3600
As $0.5\phi V_{uc} \geq V^*$ no shear reinforcement is required		