

 <p>W&G WALLBRIDGE & GILBERT Consulting Engineers 60 Wyatt Street Adelaide SA 5000</p>	Project Outback Sleepers				Job Ref. C060604	
	Section Reinforced Concrete Sleepers to Retaining Walls				Sheet no./rev. 11	
	Calc. by CL	Date July 06	Chk'd by PTJ	Date 7/7/06	App'd by	Date

Sleeper Length = 2.4m

Maximum Sleeper Depth = 3.0m

GENERAL SLEEPER COVER REQUIREMENTS

- 1) 1km → 50km from coast Table 4.10.3.4 – AS3600
 - ⇒ B1 exposure class to exposed face
 - N32 concrete $c \geq 30\text{mm}$ (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 $c \geq 35\text{mm}$ (for rigid formwork and intense compaction, 45mm otherwise)

SLEEPER REINFORCEMENT TO AS3600

Length of Sleeper	L = 2400 mm
Height of Wall	H = 3000 mm
Compressive Strength of Concrete	$F'_c = 32 \text{ MPa (B1)}$
Yield Strength of Steel Reinforcement (N grade)	$f_{sy} = 500 \text{ MPa}$
Depth of Sleeper	d = 200 mm
Thickness of Sleeper	t = 120 mm
$b = t / 2$	b = 60 mm
Friction Angle of Soil	$\phi = 30$
$K_a = (\tan(45 - \phi/2))^2$	$K_a = 0.333$
Unit Weight of Backfill Soil	$\gamma_s = 18 \text{ kN/m}^3$
Surcharge	Q = 5 kPa
$\eta_0 = K_a \times Q$	$\eta_0 = 1.667 \text{ kPa}$
$\eta_1 = K_a \times \gamma_s \times H - K_a \times \gamma_s \times d / 2$	$\eta_1 = 17.400 \text{ kPa}$
$\eta_t = \eta_0 + \eta_1$	$\eta_t = 19.067 \text{ kPa}$
$w = \eta_t \times d$	w = 3.813 kN/m
$w^* = 1.5 \times w$	$w^* = 5.720 \text{ kN/m}$
$M^* = w^* \times L^2 / 8$	$M^* = 4.118 \text{ kNm}$

Flexural Strength of Sleeper

Capacity Reduction Factor of Bending	$\phi_b = 0.8$	Table 2.3 – AS3600
$A_{st \text{ required}} = F'_c \times d / (1.2 \times f_{sy}) \times (b - \sqrt{(b^2 - (2.4 \times M^*) / (\phi_b \times F'_c \times d))})$	$A_{st \text{ required}} = 204.17 \text{ mm}^2$	
3 16mm diameter bars required		
Diameter of Bar	$d_b = 16 \text{ mm}$	
$A_{st} = 2 \times \pi \times (d_b/2)^2$	$A_{st} = 402.12 \text{ mm}^2$	
$\phi M_u = \phi_b \times f_{sy} \times A_{st} \times b \times (1 - 0.6 \times (A_{st} \times f_{sy}) / (b \times d \times F'_c))$	$\phi M_u = 6.619 \text{ kNm}$	
$\phi M_u \geq M^*$ therefore OK		

Shear Strength of Sleeper

$V^* = w^* \times L / 2$	$V^* = 6.864 \text{ kN}$	
Calculate $0.5\phi_v V_{uc}$ and check it is larger than $V^* \Rightarrow$ no shear reinforcement is required		cl 8.2.5 – AS3600
$\beta_1 = 1.1 \times (1.6 - b)$	$\beta_1 = 1.694$	cl 8.2.7.1 – AS3600
$\beta_2 = \beta_3 = 1.0$		
Shear Strength Reduction Factor;	$\phi_v = 0.7$	Table 2.3 – AS3600
$\frac{1}{2}\phi V_{uc} = 0.5 \times \phi_v \times \beta_1 \times \beta_2 \times \beta_3 \times b \times d \times (A_{st} \times F'_c / (b \times d))^{1/3}$	$\frac{1}{2}\phi V_{uc} = 7.282 \text{ kN}$	cl 8.2.7.1 – AS3600
As $0.5\phi V_{uc} \geq V^*$ no shear reinforcement is required		