

SUBI SMARTZ CONSULTANTS PTY LTD

TERRA TANKS PLUNGE POOLS - JOB No. JB99394 - SLAB CALCULATION

SLAB DESIGN CALCULATIONS

Concrete base slabs for above ground galvanised steel plunge pools - Urban Plunge and Family Plunge

Client	TERRA TANKS PTY LTD
Address	17 Treeby Street, Coolbellup WA 6163
Job number	JB99394
Document	JB99394-CALC-01
Models	Urban Plunge (dia. 1.8 m) / Family Plunge (dia. 2.4 m)
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Revision	0
Date	16-Oct-26

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REFERENCE DOCUMENTS

- Engineering drawings JB99230-UP-01 to UP-03 (Urban Plunge), Revision A - sheet 03 base details
- Engineering drawings JB99230-FP-01 to FP-03 (Family Plunge), Revision A - sheet 03 base details
- Terra Tanks product sheets v1 (10 Nov 2025) - maximum bather mass 600 kg

Values shown in blue are inputs. All other values are calculated. Inputs marked "Designer assumption" are working assumptions by the preparer and are to be confirmed by the certifying engineer. Clause references marked "verify" are to be checked against the current edition of the standard.

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DESIGN BASIS

REFERENCE STANDARDS

- AS/NZS 1170.0:2002 Structural design actions - General principles (Section 4 combinations)
- AS/NZS 1170.1:2002 Structural design actions - Permanent, imposed and other actions
- AS 3600:2018 Concrete structures (Sections 2, 3, 4, 8, 9 and 20)
- AS 2870:2011 Residential slabs and footings (site classification only - see Note 5)
- AS/NZS 4671:2019 Steel reinforcing materials

PARAMETERS

Item	Symbol	Unit	Urban 1.8m	Family 2.4m	Basis / Clause
Overall pool diameter	D	mm	1829	2438	Tarter spec sheet
Effective internal diameter	Di	mm	1760	2350	Tarter spec sheet
Shell height = maximum possible liquid height	H	mm	610	610	Overflow limit - see Note 1
Empty pool mass	m	kg	52.2	79.8	Tarter spec sheet
Slab extension beyond shell	e	mm	200	200	Drawing sheet 03
Unreinforced slab thickness (Class A, S, M)	D1	mm	100	100	Drawing sheet 03
Reinforced slab thickness (Class H1, H2)	D2	mm	150	150	Drawing sheet 03
Concrete characteristic strength	fc	MPa	25	25	Designer assumption - N25, not stated on drawings
Density of reinforced concrete	gc	kN/m3	24	24	AS/NZS 1170.1 Appendix A
Density of water	rho	kg/m3	1000	1000	-
Gravitational acceleration	g	m/s2	9.81	9.81	-
SL92 mesh area per metre	Ast	mm2/m	291	291	AS/NZS 4671 - 8.6 mm wires at 200 mm
SL92 wire diameter	db	mm	8.6	8.6	AS/NZS 4671
Mesh yield strength	fsy	MPa	500	500	AS/NZS 4671 - ductility Class L
Cover to mesh provided	c	mm	50	50	Drawing sheet 03
Exposure classification	Exp	-	A2	A2	AS 3600 Table 4.3 - in contact with non-aggressive soil (verify)
Minimum f'c for exposure A2	fcmin	MPa	25	25	AS 3600 Table 4.4 (verify)
Cover for exposure A2, f'c 25 MPa	cmin	mm	30	30	AS 3600 Table 4.10.3.2 (verify)
Additional cover - cast against ground, no membrane	cg	mm	20	20	AS 3600 Cl 4.10.3.5 (verify)
Load factor - permanent only	gG1	-	1.35	1.35	AS/NZS 1170.0 Cl 4.2.2(a)
Load factor - permanent, with other actions	gG2	-	1.20	1.20	AS/NZS 1170.0 Cl 4.2.2
Load factor - liquid pressure, height limited	gLp	-	1.20	1.20	AS/NZS 1170.0 Cl 4.2.3 (verify) - Note 1
Capacity factor - unreinforced concrete, bending	phi1	-	0.60	0.60	AS 3600 Table 2.2.2 (verify)
Capacity factor - bending, Class L reinforcement	phi2	-	0.65	0.65	AS 3600 Table 2.2.2 - Class L
Capacity factor - shear, no shear reinforcement	phi3	-	0.70	0.70	AS 3600 Table 2.2.2
Max kv - no shear reinforcement	kvmax	-	0.10	0.10	AS 3600 Cl 8.2.4.3
Minimum steel coefficient for slabs	ab	-	0.20	0.20	AS 3600 Cl 9.1.1 (verify)
Allowable bearing capacity	qa	kPa	100	100	Drawing sheet 03
Loss of support span - 100 mm slab	Lu1	m	1.00	1.00	Designer assumption - soft spot, A/S/M
Loss of support span - 150 mm slab	Lu2	m	1.50	1.50	Designer assumption - mound movement, H1/H2
Edge cantilever - 100 mm slab	Lc1	m	0.50	0.50	Designer assumption - edge loss of support
Edge cantilever - 150 mm slab	Lc2	m	1.00	1.00	Designer assumption - centre heave, H1/H2

Note 1 - Liquid is taken at the full 610 mm shell height. The pool overflows at the rim, so this is the maximum liquid height that can occur, which satisfies the condition for the 1.2 liquid pressure factor. It also covers bathers: the 600 kg maximum bather mass displaces water over the rim, so the total load on the floor cannot exceed a brim-full pool. The 550 mm design water depth is therefore not used here.

Note 2 - Three ultimate combinations are checked and the greatest governs: $E1 = 1.35G$ (slab only); $E2 = 1.2G + 1.2Flp$; $E3 = 1.35(G + Flp)$, which treats the retained water as a permanent action. E3 is a conservative bound covering either interpretation of the liquid action.

Note 3 - A fully supported slab-on-ground carries uniform liquid pressure with negligible bending. Bending and shear are checked for a local loss of support: a 1 m strip simply supported over Lu, and an edge cantilever Lc. These spans are designer assumptions to be confirmed.

Note 4 - Rectangular stress block per AS 3600-2018 Cl 8.1.3: $\alpha2 = 0.85 - 0.0015f'c$ and $\gamma = 0.97 - 0.0025f'c$, both not less than 0.67. SL92 mesh is ductility Class L, limiting phi for bending to 0.65.

Note 5 - AS 2870 applies to Class 1 and 10a buildings. The pool is Class 10b, so AS 2870 is used for site classification only and the slab is designed to AS 3600 from first principles. Slab movement stiffness, shrinkage control and joints are not assessed.

SUBI SMARTZ CONSULTANTS PTY LTD**TERRA TANKS PLUNGE POOLS - JOB No. JB99394 - SLAB CALCULATION****CALCULATION 1 - ACTIONS AND ULTIMATE LOAD COMBINATIONS***AS/NZS 1170.0 Section 4. Uniform pressures on the slab under the pool.*

Item	Symbol	Unit	Urban 1.8m	Family 2.4m	Basis / Clause
Internal plan area	Ai	m ²	2.433	4.337	$Pl \times (Di/2)^2$
Pool weight, brim-full	W	kN	15.07	26.74	$(Ai \times H \times \rho + m) \times g$
Liquid pressure on slab at H	F_{lp}	kPa	5.984	5.984	$\rho \times g \times H$
Slab self weight - 100 mm	G₁	kPa	2.400	2.400	$gc \times D1$
E1 = 1.35G (100 mm)	E1_1	kPa	3.240	3.240	AS/NZS 1170.0 Cl 4.2.2(a)
E2 = 1.2G + 1.2F _{lp} (100 mm)	E2_1	kPa	10.061	10.061	AS/NZS 1170.0 Cl 4.2.3
E3 = 1.35(G + F _{lp}) (100 mm)	E3_1	kPa	11.319	11.319	Conservative bound - Note 2
Governing ultimate pressure w* (100 mm)	w₁	kPa	11.319	11.319	Greatest of E1, E2, E3
Slab self weight - 150 mm	G₂	kPa	3.600	3.600	$gc \times D2$
E1 = 1.35G (150 mm)	E1_2	kPa	4.860	4.860	AS/NZS 1170.0 Cl 4.2.2(a)
E2 = 1.2G + 1.2F _{lp} (150 mm)	E2_2	kPa	11.501	11.501	AS/NZS 1170.0 Cl 4.2.3
E3 = 1.35(G + F _{lp}) (150 mm)	E3_2	kPa	12.939	12.939	Conservative bound - Note 2
Governing ultimate pressure w* (150 mm)	w₂	kPa	12.939	12.939	Greatest of E1, E2, E3

The shell self weight (0.5 to 0.8 kN, about 0.09 to 0.10 kN/m around the perimeter) is included in the pool weight for bearing and is negligible as a line load on the slab.

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CALCULATION 2 - SERVICEABILITY BEARING PRESSURE

Brim-full pool plus slab self weight, spread over the full slab footprint, diameter $D + 2e$.

Item	Symbol	Unit	Urban 1.8m	Family 2.4m	Basis / Clause
Slab diameter	Ds	m	2.229	2.838	$(D + 2e)$
Slab plan area	As	m ²	3.902	6.326	$\pi \times (Ds/2)^2$
Total service load - 100 mm slab	N100	kN	24.44	41.92	$W + G \times As$
Bearing pressure - 100 mm slab	q100	kPa	6.26	6.63	N / As
Utilisation - 100 mm slab	ub100	-	0.063	0.066	q / qa
Total service load - 150 mm slab	N150	kN	29.12	49.51	$W + G \times As$
Bearing pressure - 150 mm slab	q150	kPa	7.46	7.83	N / As
Utilisation - 150 mm slab	ub150	-	0.075	0.078	q / qa

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CALCULATION 3 - 100 mm UNREINFORCED SLAB (SITE CLASS A, S, M)

Plain concrete to AS 3600 Section 20. One-way strip, 1 m wide, under local loss of support.

Item	Symbol	Unit	Urban 1.8m	Family 2.4m	Basis / Clause
Governing ultimate pressure	w*	kPa	11.319	11.319	Calculation 1
Bending moment - span Lu	Ms	kNm/m	1.415	1.415	$w^* Lu^2 / 8$
Bending moment - cantilever Lc	Mc	kNm/m	1.415	1.415	$w^* Lc^2 / 2$
Design bending moment	M*	kNm/m	1.415	1.415	Greater of span and cantilever
Design shear	V*	kN/m	5.659	5.659	Greater of $w^* Lc$ and $w^* Lu / 2$
Characteristic flexural tensile strength	fctf	MPa	3.000	3.000	AS 3600 Cl 3.1.1.3: $0.6 \sqrt{f_c}$
Section modulus per metre	Z	mm ³ /m	1,666,667	1,666,667	$b D^2 / 6$
Bending capacity	phiMu	kNm/m	3.000	3.000	$\phi \times f_{ctf} \times Z$ (AS 3600 Section 20)
Utilisation - bending	uM	-	0.472	0.472	$M^* / \phi Mu$
Effective shear depth	dv	mm	72.0	72.0	$0.72 D$ (no reinforcement)
Shear factor kv	kv	-	0.100	0.100	AS 3600 Cl 8.2.4.3, capped at 0.10
Shear capacity	phiVu	kN/m	25.200	25.200	$\phi \times kv \times b \times dv \times \sqrt{f_c}$
Utilisation - shear	uV	-	0.225	0.225	$V^* / \phi Vu$
Durability - minimum strength	uF	-	1.000	1.000	$f_{c,min} / f_c$ - AS 3600 Table 4.4
Check	-	-	SATISFACTORY	SATISFACTORY	All utilisations not to exceed 1.0

Unreinforced slab: no cover requirement applies. Shear uses the AS 3600 simplified method with $dv = 0.72D$ and kv capped at 0.10 for members without shear reinforcement; this is applied to the plain section as a conservative approach (verify against AS 3600 Section 20).

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CALCULATION 4 - 150 mm SL92 REINFORCED SLAB (SITE CLASS H1, H2)

AS 3600 Sections 4, 8 and 9. One-way strip, 1 m wide, under loss of support from reactive ground movement. 1 layer SL92, 50 cover.

Item	Symbol	Unit	Urban 1.8m	Family 2.4m	Basis / Clause
Governing ultimate pressure	w*	kPa	12.939	12.939	Calculation 1
Bending moment - span Lu	Ms	kNm/m	3.639	3.639	$w^* Lu^2 / 8$
Bending moment - cantilever Lc	Mc	kNm/m	6.469	6.469	$w^* Lc^2 / 2$
Design bending moment	M*	kNm/m	6.469	6.469	Greater of span and cantilever
Design shear	V*	kN/m	12.939	12.939	Greater of $w^* Lc$ and $w^* Lu / 2$
Effective depth	d	mm	95.7	95.7	$D - c - db/2$
Stress block factor alpha2	a2	-	0.813	0.813	AS 3600 Cl 8.1.3
Stress block factor gamma	gam	-	0.908	0.908	AS 3600 Cl 8.1.3
Neutral axis parameter ku	ku	-	0.082	0.082	$Ast f_{sy} / (\alpha_2 f_c \gamma b d)$
Bending capacity	phiMu	kNm/m	8.712	8.712	$\phi Ast f_{sy} d (1 - 0.5 \gamma ku)$
Utilisation - bending	uM	-	0.743	0.743	$M^* / \phi Mu$
Effective shear depth	dv	mm	108.0	108.0	$\max(0.9d, 0.72D)$
Shear factor kv	kv	-	0.100	0.100	AS 3600 Cl 8.2.4.3, capped at 0.10
Shear capacity	phiVu	kN/m	37.800	37.800	$\phi kv b dv \sqrt{f_c}$
Utilisation - shear	uV	-	0.342	0.342	$V^* / \phi Vu$
Cover required	creq	mm	50	50	AS 3600 Section 4: A2 + cast against ground
Durability - cover	uC	-	1.000	1.000	$c_{req} / c_{provided}$
Durability - minimum strength	uF	-	1.000	1.000	$f_{c,min} / f_c$ - AS 3600 Table 4.4
Check (strength and durability)	-	-	SATISFACTORY	SATISFACTORY	All utilisations not to exceed 1.0

MINIMUM FLEXURAL REINFORCEMENT - AS 3600 Cl 9.1.1

Item	Symbol	Unit	Urban 1.8m	Family 2.4m	Basis / Clause
Characteristic flexural tensile strength	fctf	MPa	3.000	3.000	AS 3600 Cl 3.1.1.3
Minimum tensile reinforcement	Amin	mm ² /m	282	282	$\alpha_b (D/d)^2 f_{ctf} / f_{sy} x b d$
Ratio Ast,min / Ast provided	uMin	-	0.970	0.970	Not to exceed 1.0
Minimum reinforcement	-	-	SATISFACTORY	SATISFACTORY	AS 3600 Cl 9.1.1
Section modulus, plain section	Zp	mm ³ /m	3,750,000	3,750,000	$b D^2 / 6$
Bending capacity as plain concrete	phiMp	kNm/m	6.750	6.750	$\phi x f_{ctf} x Z$ (uncracked)
Utilisation - plain concrete bending	uMp	-	0.958	0.958	$M^* / \phi Mp$

SL92 (291 mm²/m) satisfies the AS 3600 Cl 9.1.1 minimum for a 150 mm slab. The plain concrete bending capacity is shown for information only.

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SUMMARY OF CHECKS

Check	Reference	Criterion	Urban 1.8m	Family 2.4m	Result
Bearing - 100 mm slab	Calculation 2	$q / q_a \leq 1.0$	0.063	0.066	SATISFACTORY
Bearing - 150 mm slab	Calculation 2	$q / q_a \leq 1.0$	0.075	0.078	SATISFACTORY
Bending - 100 mm plain slab	Calculation 3	$M^* / \phi_i M_u \leq 1.0$	0.472	0.472	SATISFACTORY
Shear - 100 mm plain slab	Calculation 3	$V^* / \phi_i V_u \leq 1.0$	0.225	0.225	SATISFACTORY
Bending - 150 mm reinforced slab	Calculation 4	$M^* / \phi_i M_u \leq 1.0$	0.743	0.743	SATISFACTORY
Shear - 150 mm slab	Calculation 4	$V^* / \phi_i V_u \leq 1.0$	0.342	0.342	SATISFACTORY
GOVERNING UTILISATION - STRENGTH			0.743	0.743	SATISFACTORY
Durability strength - 100 mm	Calculation 3	AS 3600 Table 4.4	1.000	1.000	SATISFACTORY
Durability cover - 150 mm	Calculation 4	AS 3600 Section 4	1.000	1.000	SATISFACTORY
Durability strength - 150 mm	Calculation 4	AS 3600 Table 4.4	1.000	1.000	SATISFACTORY
Minimum reinforcement - 150 mm	Calculation 4	AS 3600 Cl 9.1.1	0.970	0.970	SATISFACTORY

NOTES FOR THE CERTIFYING ENGINEER

Note A - The 150 mm slab is reinforced with one layer of SL92 mesh (291 mm²/m) at 50 mm cover, which satisfies AS 3600 Cl 9.1.1. Drawing sheet 03 is to specify SL92.

Note B - The loss of support spans and cantilevers, concrete strength N25 and exposure classification A2 are designer assumptions to be confirmed. The 150 mm slab bending result is sensitive to the assumed 1.0 m cantilever.

Note C - Clause references marked "verify" in the Design Basis are to be checked against the current editions of AS/NZS 1170.0 and AS 3600.

CONCLUSION

Subject to Notes A to C, the 100 mm unreinforced concrete slab (site classes A, S and M) and the 150 mm concrete slab reinforced with one layer of SL92 mesh at 50 mm cover (site classes H1 and H2) are adequate to support the Urban Plunge and Family Plunge pools filled to the brim, including the maximum bather load, under the load combinations of AS/NZS 1170.0 and the strength and durability requirements of AS 3600.

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