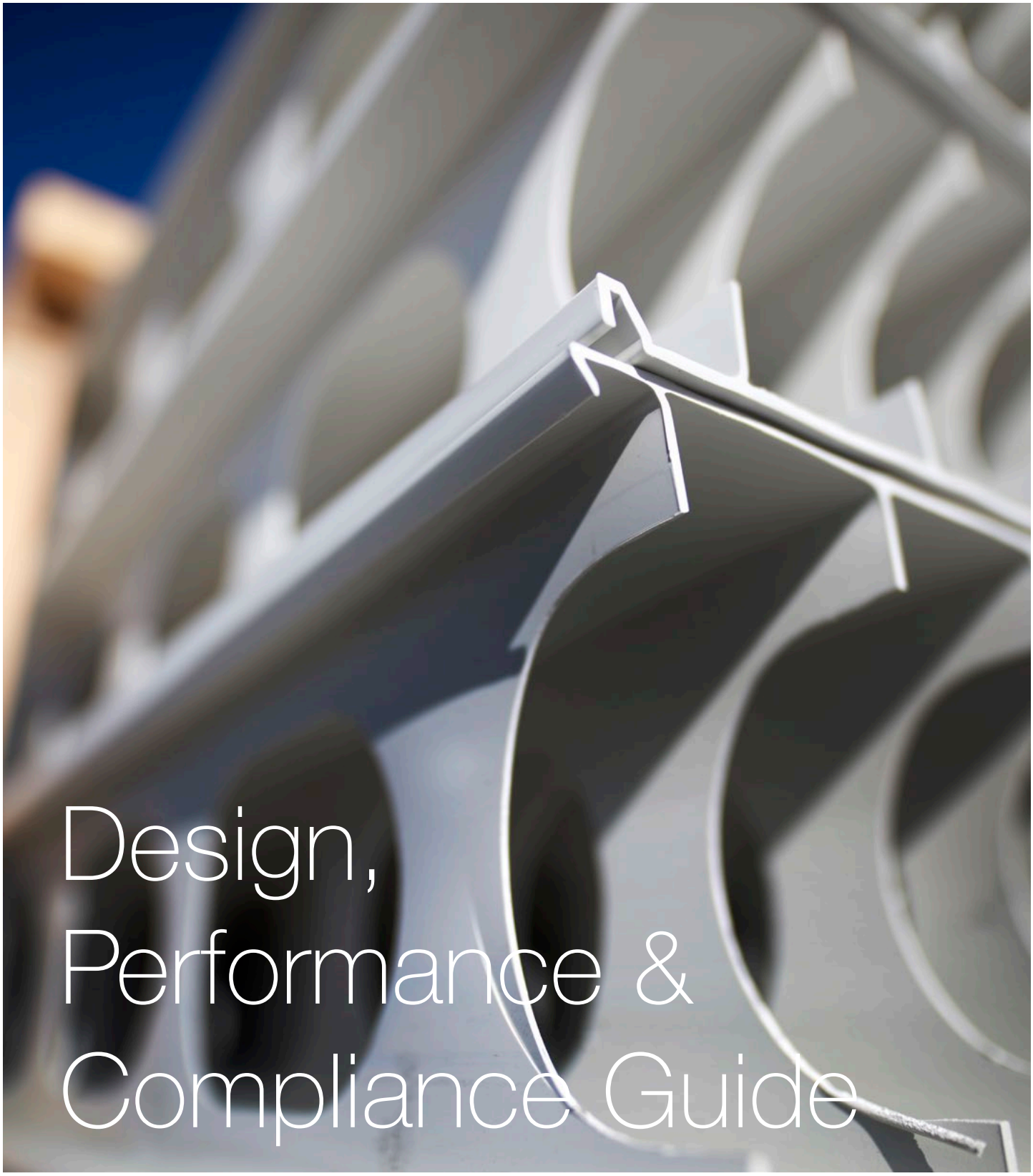
afs rediwall®

Volume 1 – December 2023



Design, Performance & Compliance Guide

Rediwall® Technical Information and Engineered Design Tables

CSR

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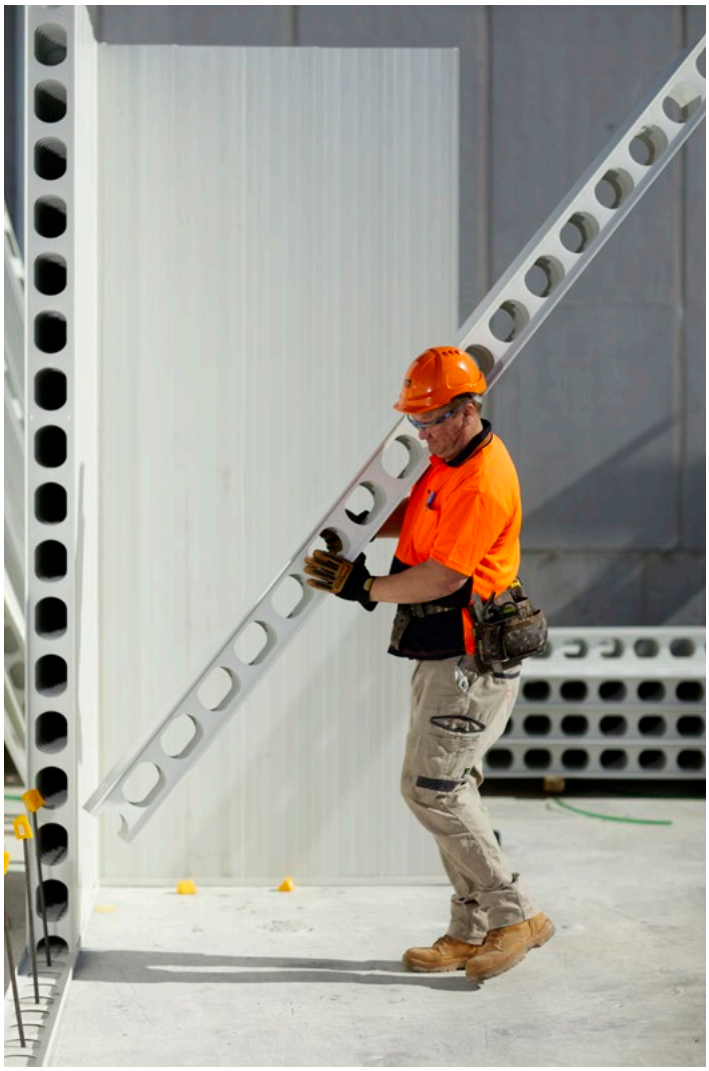
Introduction

Volume 1– 'AFS Rediwall® Design, Performance and Compliance Guide' forms part of a comprehensive afs rediwall® Systems Manual that encompasses Volume 1 , 2 and 3. This manual covers the aspects of Design, Performance, Compliance, Construction and Installation for all rediwall® products current at the time of publication.

Volume 1 should be read in conjunction with Volume 2 and 3. Downloads of these individual Volumes are available via the Resource Centre at www.afsformwork.com.au

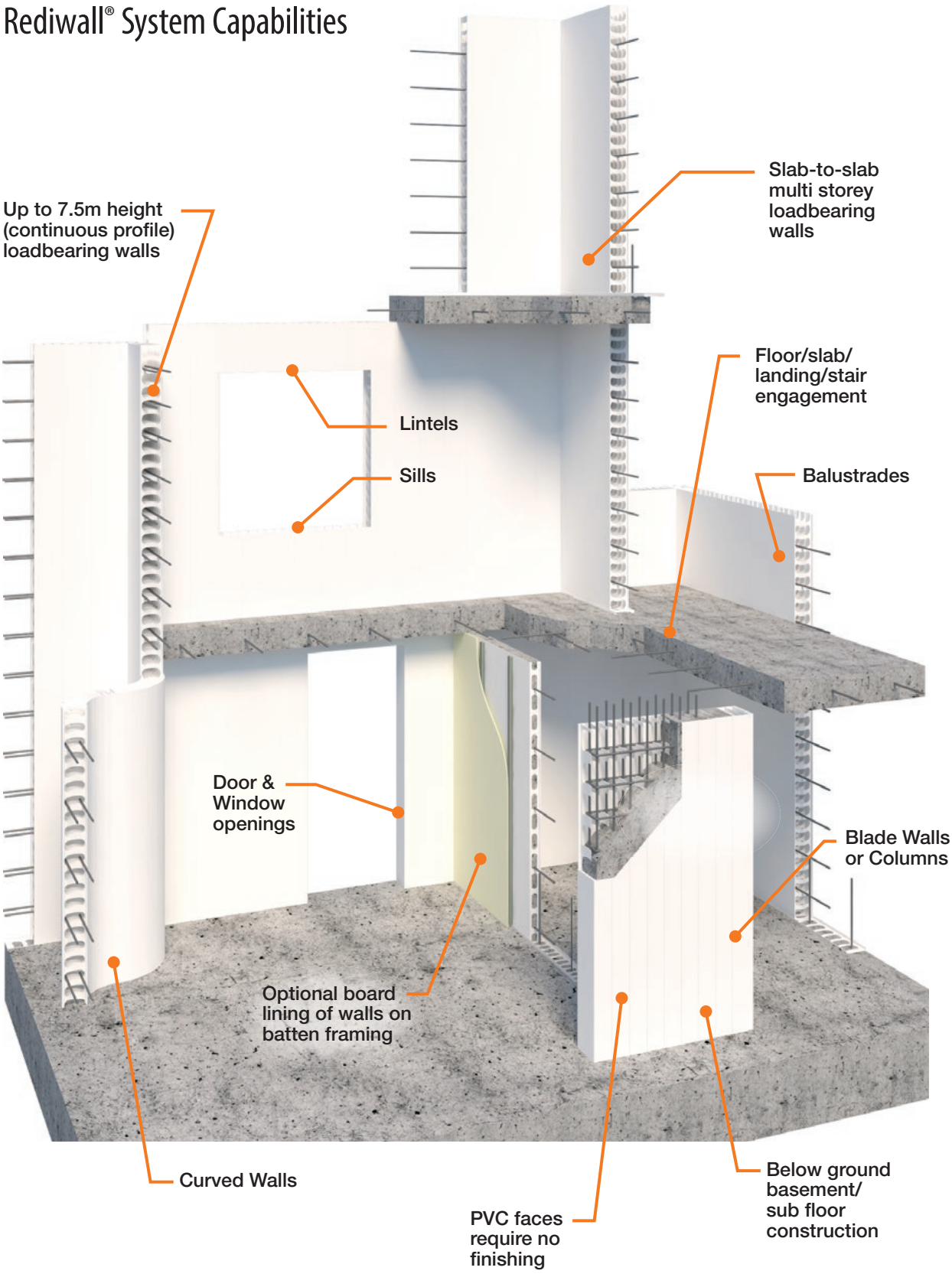
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Rediwall® Capabilities Overview

Rediwall® System Capabilities



Note: If rediwall® is exposed to UV, appropriate protective finish shall be applied.

AFS System Definitions

AFS Blade Column	A short Blade Wall designed and detailed with U-bars in lieu of ties to WSU Advanced Design Methods in accordance with AS3600-2018.
AFS Column	A column designed and detailed with ties to AS3600-2018 Section 10 Columns.
AFS Limited Ductile Walls	Walls designed in accordance with AS3600-2018 Section 2.2 Strength and clauses 14.4 General Earthquake Requirements and 14.6 Limited Ductile Walls.
AFS Non-Ductile Walls	Walls designed in accordance with AS3600-2018 Section 2.2 Strength and clauses 14.4 General Earthquake Requirements.

Definition of Engineering Terms Used in this Section

t_w	Effective structural concrete wall width
$t_{w.fire}$	Effective wall width for fire
S_{web}	Web spacing
S_{punch}	Vertical punch spacing
A_c	Percentage of web opening
Align	Allowance for on-site mis-alignment of web openings
N_{layers}	Number of Reinforcement layers
d_h	Distance to centre of horizontal bar from the rediwall® concrete face
$f'_{c.max}$	Maximum concrete strength
f_y	Steel yield stress
Bar Max	Max reinforcement bar size
e	The eccentricity of the load measured at right angle to the plane of the wall
H_{wu}	Unsupported wall height
H_{we}	Effective wall height
t_{total}	total wall width
D_{punch}	Horizontal width of punch
A_{st}	Area of reinforcement
I_{xx}	Stud moment of inertia
μ	Structural ductility factor [AS3600-2018]
S_p	Structural performance factor [AS3600-2018]

References

1. 'AFS Logicwall® and AFS Rediwall® axial-flexural interaction curve generation numerical and theoretical investigation', Centre for Infrastructure Engineering, Western Sydney University
2. 'AS3600-2018 Concrete Structures Code'
3. 'Fire-Resistance of Rediwall® – Determination in accordance with AS3600', SGA Report 2013/277.26 R1.1 issued 9/9/2019

Lintels

Lintel tables have been prepared based on a wall with minimum reinforcement for bending and shear capacity. If additional capacity is required, extra reinforcement can be designed and detailed by the engineer.

Temporary Works

Temporary works are to be detailed by the project designers to suit the project design and conditions. AFS standard bracing details may be used subject to the limitations given on the drawing and certifications. Refer to Appendix – AFS Standard Bracing Drawings.

AFS standard bracing is to be installed in accordance with the standard bracing drawings and Volume 3 – 'Rediwall® Installation Guide – Rediwall Temporary Construction Bracing'. For further information on AFS standard bracing , please contact AFS Technical Services

Reinforcement Requirements

The individual cells within afs rediwall® allow horizontal shrinkage and thermal movements in the concrete with the PVC webs acting as crack inducers. This allows afs rediwall® to provide crack control without additional reinforcement.

For fire rated reinforced walls to AS3600-2018 Cl11.7.1 use minimum vertical reinforcement ratio (p_w) of 0.0015 or the value required by structural analysis.

Due to the presence of the PVC webs in afs rediwall® steel congestion should be avoided to facilitate adequate compaction of concrete. As a guide steel ratios in excess of 0.02 in a single layer should not be used unless the amount and disposition of the reinforcement will not prevent the proper placement and compaction of the concrete at splices and at junctions of members.

Minimum Reinforcement

For walls that have tensile forces from any load combination AS3600-2018 11.7 Minimum reinforcement shall apply.

Examples of such walls are:

- Walls resisting lateral loads
- Walls acting as deep beams
- Walls with load combinations of bending and compression producing tension stress.
- Where reinforced afs rediwall® walls do not require a high degree of crack control for tensile forces we recommend a minimum reinforcement spacing of 400mm.

Notes: AS3600 does not recognise the use of plain concrete in wall elements, though some International standards offer guidance in this area. Use of afs rediwall® walls unreinforced will require reference to other codes such as ACI 318 and BS8110.1 where it can be shown that no tensile forces result from any load combination of bending and compression.

TABLE A1: Minimum Reinforcement for Reinforced Walls (p) = A_{st}/A_{conc}

Location	Vertical (p)	Horizontal (p)
Internal (A1, A2)	0.0025 (0.0015 Cl.11.7.1(a))	0.0015
External (B1, B2)	0.0025 (0.0015 Cl.11.7.1(a))	0.0025
Limited Ductile	0.0025	0.0025
Deep Beam	AS3600 Sect 12	AS3600 Sect 12

Steel ratios in excess of 0.02 should not be used unless the amount and disposition of the reinforcement will not prevent the proper placement of the concrete in walls and at splices and junction members.

Reinforcement Detailing Constraints

For heavily loaded walls where reinforcement ratio is high, it is critical that reinforcement is detailed carefully to avoid congestion within the wall which creates difficulties when core filling and may result in voids or insufficient concrete compaction.

When detailing reinforcement to be placed in Rediwall® the following spacing constraints must be noted:

- For single reinforcement carrier walls the reinforcement is centrally placed at minimum horizontal centres as shown.
- For double reinforcement carrier walls, RW200C and RW256S, RW275S & RW300S the reinforcement is located toward each face of the wall with concrete cover as shown.
- Typical total reinforcement rates are less then 0.01. Rates in excess of 0.02 are not recommended as it creates possible congestion issues.
- Areas with higher reinforcement concentrations such as laps and corners should be reviewed.

Rediwall® Design for Earthquake Actions

Rediwall® is to be designed to cater for earthquake actions as per AS1170.4 Earthquake Actions and AS3600-2018 Section 14 Design for Earthquake Actions. The design and detailing of the wall will depend on the Structural System selected by the designer for the building from Table 14.3 Structural Ductility Factor and Structural Performance Factor. This will normally be either Non-Ductile Structural Walls or Limited Ductile Structural Walls.

Non-Ductile Wall Design

The use of the Simplified Design Method in Section 11.5 is limited to Non-Ductile Walls by Cl 14.4.4.1 and Cl 11.5.2 Limitations on the use of the Method. Non-Ductile Rediwall® are to designed to Section 2.2 and 14.4.

14.4.4.1 General

'Walls shall be designed in accordance with Section 10 or Section 11 as appropriate except that the simplified design method for walls subjected to vertical compression forces provided in Clause 11.5 of this standard shall only be used for non-ductile walls.'

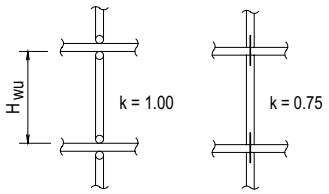
Axial Capacity

AFS Rediwall® can be designed in accordance with Section 11 of AS3600 – 2018.

$$\emptyset N_u = \emptyset(t_w - 1.2e - 2.e_a)0.6f_c$$ [AS3600 Cl.11.5.3]

Where:

$\emptyset = 0.65$	strength reduction factor
$N_u =$	ultimate strength per unit wall length
$t_w =$	thickness of the wall
$e =$	eccentricity of the load measured at right angles to the plane of the wall
$e_a = \frac{H_{we}^2}{2500t_w}$	an additional eccentricity
$H_{we} = kH_{wu}$	effective height of a braced wall



[AS3600 Cl.11.5.3]

11.5.2 Limitation on use of method

'Structural walls designed using Clause 11.5.3 Shall –

(a) be limited to a maximum design axial stress of 3 MPa unless vertical and horizontal reinforcement is provided on both wall faces and divided equally between the two wall faces;

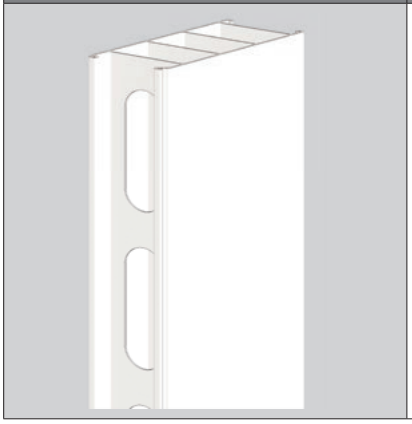
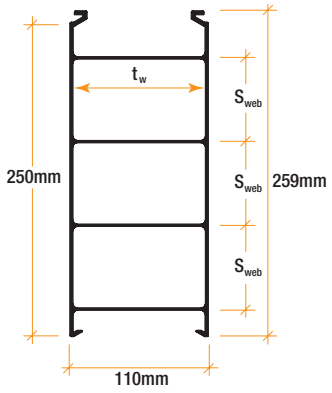
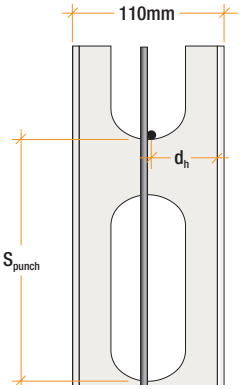
(b) not constructed on sites with soil classifications of De or Ee, as defined in AS 1170.4, and where subjected to earthquake design actions; and

(c) have a ratio of effective height to thickness that does not exceed 20 for singly reinforced wall or 30 for doubly reinforced walls.

Otherwise, the wall shall be designed as a column in accordance with Section 10.'

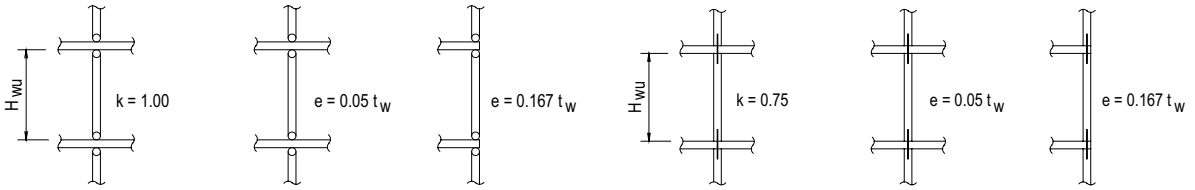
Rediwall® Structural Design Tables

RW110C Structural Capacities

RW110C Panel	Plan	Elevation
		

RW110C Axial Capacity $ØN_u$ (kN/m)

t_w	t_{fire}	S_{web}	S_{punch}	A_c	N_{layers}	d_h	$f'_{c.max}$
105	105	66.6	175	36.9%	1	52.5	40



k = 0.75		Continuous Floor e = 0.05t_w			Discontinuous Floor e = 1/6t_w		
H_{wu}	H_{we}	25 MPa	32 MPa	40 MPa	25 MPa	32 MPa	40 MPa
3000	2250	315*	315*	315*	315*	315*	315*
Bearing capacity at standard bottom plate		861	1102	1377	861	1102	1377

*AS3600-2018 11.5.2(a) 3 MPa max. for centrally reinforced wall.

RW110C Minimum Reinforcement

RW110C		Vertical Bars (min. N12-350)			
Allowable Bars		N12	N16	N20	N24
Horizontal (min. N12-350)	N12				
	N16				
	N20				
	N24				

Horizontal Bar Spacing 175/350
Vertical Bar Spacing 150 to 350

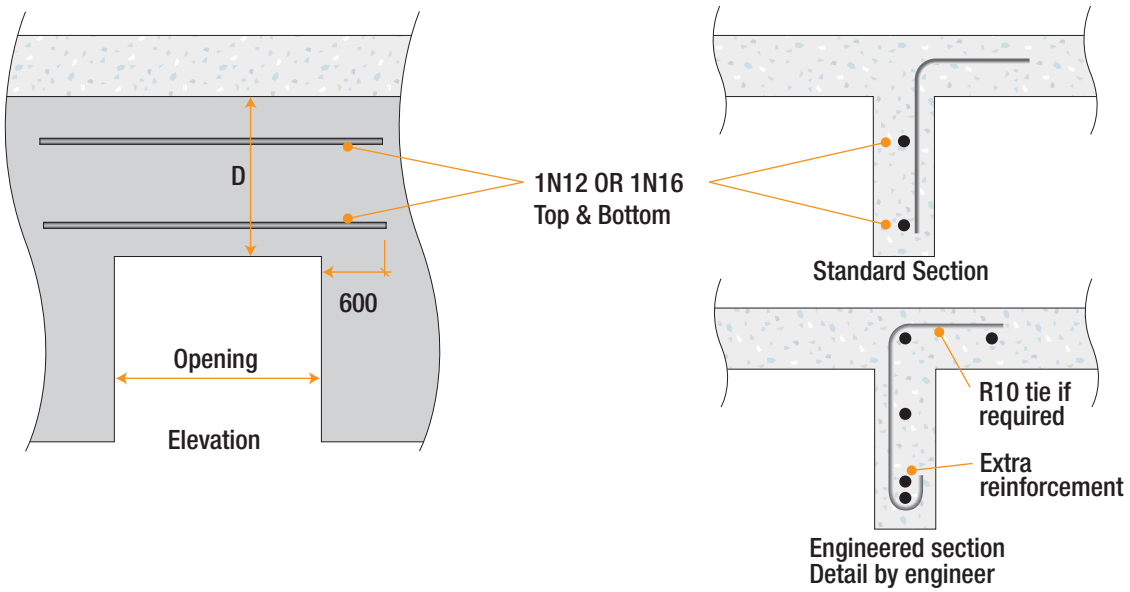
Acceptable
With Caution
Not Recommended

RW110C Out of Plane Flexural Capacity (ϕM_u kNm/m) (N*=0)

Vert. Bars	d	ρ	25 MPa	32 MPa	40 MPa	50 MPa
N12@400	41	0.007	–	–	–	–
N12@300	41	0.0093	5.42	–	–	–
N12@250	41	0.0112	6.34	6.56	–	–
N16@400	39	0.0131	6.53	6.79	6.98	7.13
N16@350	39	0.0149	7.26	7.61	7.85	8.05
N16@300	39	0.0174	8.16	8.63	8.97	9.24
N16@250	39	0.0209	9.28	9.96	10.44	10.83
N16@200	39	0.0261	10.63	11.69	12.45	13.05
	$\rho_{st.min}$ [8.1.6.1.(2)]		0.0089	0.0101	0.0113	0.0126
$\phi M_u = \phi(f_y \rho b d^2(1-0.6\rho f_y/f'_c))$						

RW110C Standard Lintels with Vertical PVC Webs

UDL capacity of a simple standard lintel with minimum reinforcement other than extra top and bottom bars shown. Designer can utilise the slab over as T-beam, extra horizontal or vertical shear reinforcement if extra strength is required.



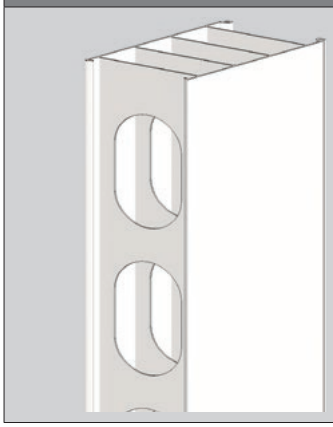
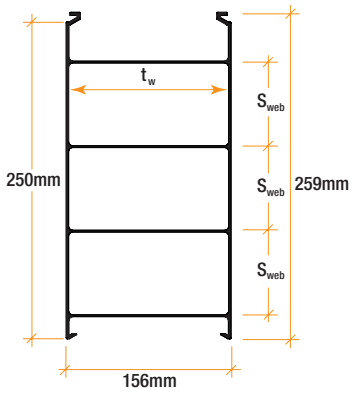
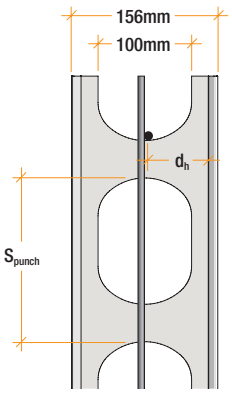
RW110C Standard Lintels with Vertical PVC Webs w*(kN/m) UDL

	1N12 Top & Bottom, Depth (mm)				1N16 Top & Bottom, Depth (mm)			
D	150	300	450	750	150	300	450	750
d_{eff}	50	200	350	650	50	200	350	650
Span (mm)								
3600	4.7	9.8	14.9	25.1	5.6	10.8	16.2	28.8
3300	5.5	11.6	17.7	29.8	5.1	12.1	18.2	33.6
3000	6.7	13.6	20.8	36.1	6.8	13.6	20.8	40.3
2700	7.7	15.5	24.3		7.7	15.5	24.3	
2400	8.8	18.1	29.2		8.8	18.1	29.2	
2100	10.2	21.7	36.5		10.2	21.7	36.5	
1800	12.3	27.1			12.3	27.1		
1500	15.3	36.2			15.3	36.2		
1200	20.4				20.4			
900	30.7				30.7			
	f'_c = 25MPa, 50 cover (min)				f'_c = 25MPa, 50 cover (min)			

= ϕV_{uc} governs, otherwise ϕM_u

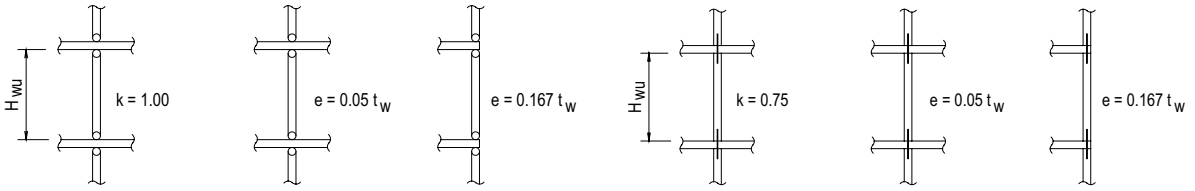
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RW156C Structural Capacities

RW156C Panel	Plan	Elevation
		

RW156C Axial Capacity $ØN_u$ (kN/m)

t_w	t_{fire}	S_{web}	S_{punch}	A_c	N_{layers}	d_h	$f'_{c.max}$
151	151	66.6	175	44.3%	1	75.5	50



k = 0.75		Continuous Floor e = 0.05t_w				Discontinuous Floor e = 1/6t_w			
H_{wu}	H_{we}	25 MPa	32 MPa	40 MPa	50 MPa	25 MPa	32 MPa	40 MPa	50 MPa
3900	2925	450*	450*	450*	450*	450*	450*	450*	450*
Bearing capacity at standard bottom plate		1357	1737	2171	2713	1357	1737	2171	2713

*AS3600-2018 11.5.2(a) 3 MPa max. for centrally reinforced wall.

RW156C Minimum Reinforcement

RW156C		Vertical Bars (min. N12-300)			
Allowable Bars		N12	N16	N20	N24
Horizontal (min. N12-350)	N12				
	N16				
	N20				
	N24				

Horizontal Bar Spacing 175/350
Vertical Bar Spacing 150 to 350

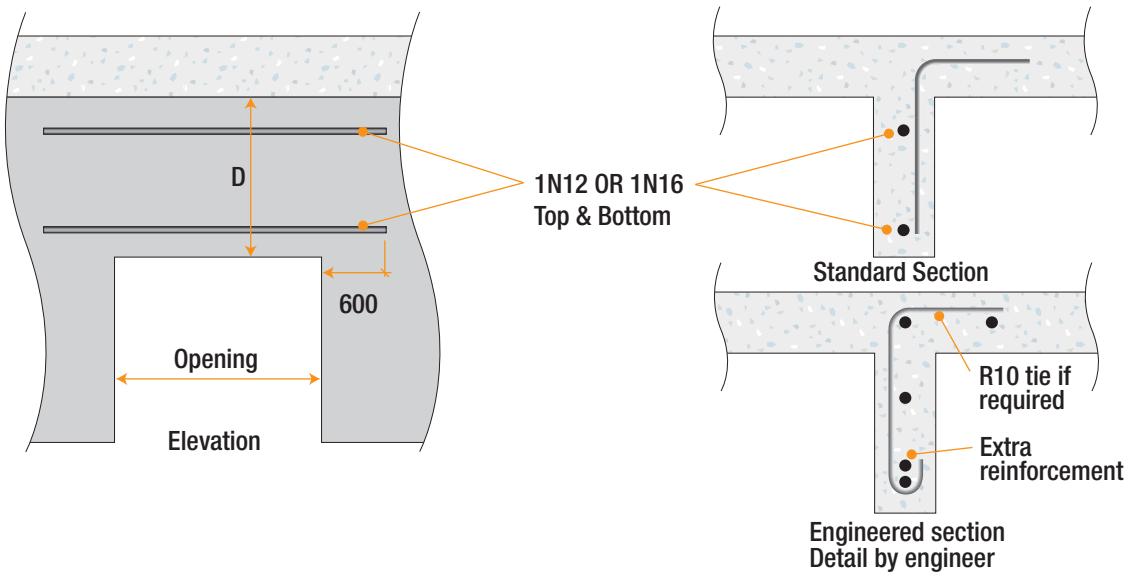
Acceptable
With Caution
Not Recommended

RW156C Out of Plane Flexural Capacity ØM$_u$ (kNm/m) (N*=0)

Vert. Bars	d	ρ	25 MPa	32 MPa	40 MPa	50 MPa
N16@400	62	0.0082	11.15	–	–	–
N16@350	62	0.0093	12.54	12.89	–	–
N16@300	62	0.0109	14.33	14.8	15.14	–
N16@250	62	0.0131	16.68	17.35	17.84	18.23
N16@200	62	0.0163	19.87	20.94	21.69	22.3
N20@300	60	0.0176	19.65	20.8	21.62	22.28
N20@250	60	0.0211	22.32	23.98	25.16	26.11
N20@200	60	0.0264	25.53	28.12	29.97	31.45
	$\rho_{st.min}$ [8.1.6.1.(2)]		0.0077	0.0087	0.0098	0.0109
$ØM_u = Ø(f_y \rho bd^2(1-0.6\rho f_y/f'_c))$						

RW156C Standard Lintels with Vertical PVC Webs

UDL capacity of a simple standard lintel with minimum reinforcement other than extra top and bottom bars shown. Designer can utilise the slab over as T-beam, extra horizontal or vertical shear reinforcement if extra strength is required.

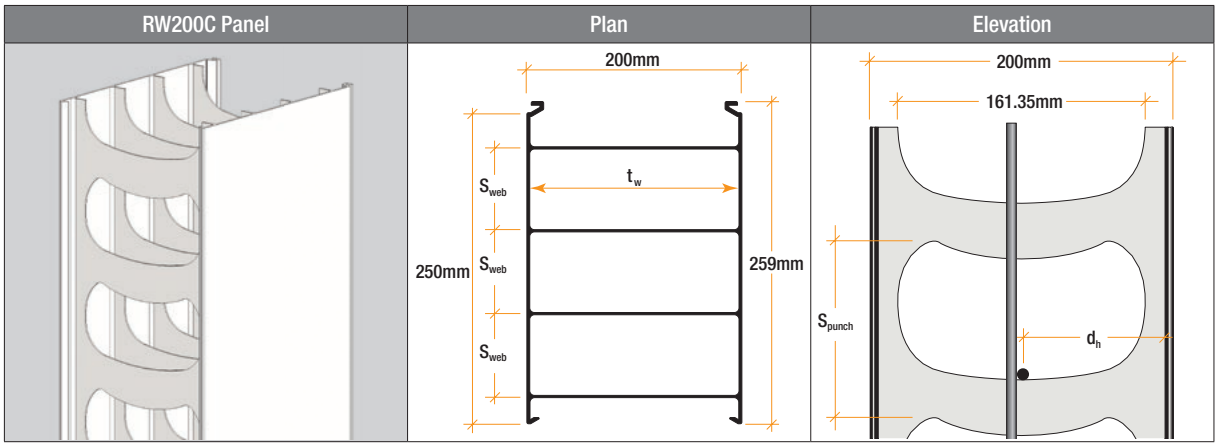


RW156C Standard Lintels with Vertical PVC Webs w*(kN/m) UDL

	1N12 Top & Bottom, Depth (mm)				1N16 Top & Bottom, Depth (mm)			
D	150	300	450	750	150	300	450	750
d_{eff}	50	200	350	650	50	200	350	650
Span (mm)								
3600	4.8	9.9	15.0	25.2	8.1	17.1	26.1	44.2
3300	5.7	11.8	17.8	30.0	9.6	20.3	31.1	52.6
3000	6.9	14.2	21.6	36.3	11.6	23.3	35.7	63.6
2700	8.5	17.6	26.7		13.1	26.6	41.7	
2400	10.8	22.3	33.7		15.0	31.0	50.0	
2100	14.1	29.1	44.1		17.5	37.2	62.6	
1800	19.2	39.6			21.0	46.5		
1500	26.3	57.0			26.3	62.0		
1200	35.1				35.1			
900	52.6				52.6			
	f'_c = 25MPa, 50 cover (min)				f'_c = 25MPa, 50 cover (min)			

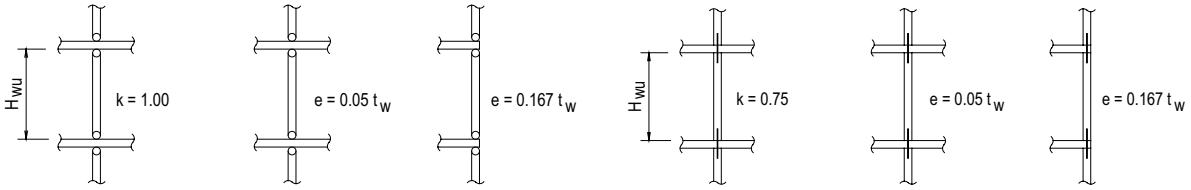
= ϕV_{uc} governs, otherwise ϕM_u
= Design to AS3600–2018 Sect 12

RW200C Structural Capacities



RW200C Axial Capacity ϕN_u (kN/m)

t_w	t_{fire}	S_{web}	S_{punch}	A_c	N_{layers}	d_h	$f'_{c.max}$
195	195	66.6	116.7	50.1%	1	97.5	65



k = 0.75		Continuous Floor e = 0.05t_w					Discontinuous Floor e = 1/6t_w				
H_{wu}	H_{we}	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#
5000	3750	585*	585*	585*	585*	585*	585*	585*	585*	585*	585*
Bearing capacity at standard bottom plate		1863	2385	2982	3727	4845	1863	2385	2982	3727	4845

for f'_c > 50 MPa, CSR appointed installer only.
*AS3600-2018 11.5.2(a) 3 MPa max. for centrally reinforced wall.

RW200C Minimum Reinforcement

RW200C		Vertical Bars (min. N12-350)			
Allowable Bars		N12	N16	N20	N24
Horizontal (min. N12-350)	N12				
	N16				
	N20				
	N24				

Horizontal Bar Spacing 233/350
Vertical Bar Spacing 150 to 350

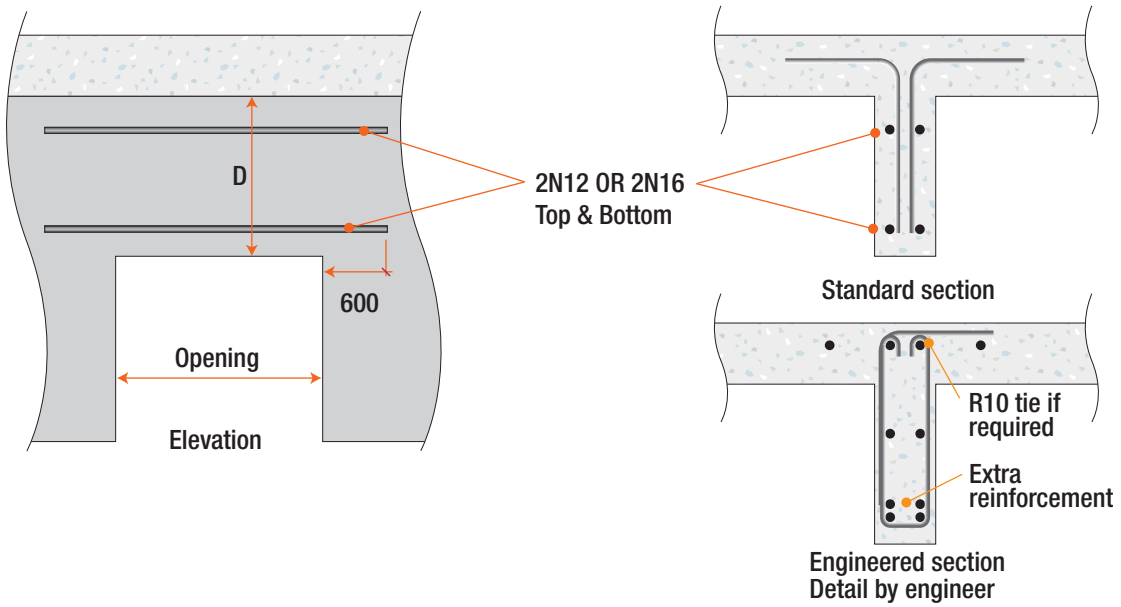
Acceptable
With Caution
Not Recommended

RW200C Out of Plane Flexural Capacity (ØM$_u$ kNm/m) (N*=0)

Vertical Bars	d	ρ	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa
N16@350	84	0.0069	17.6	–	–	–	–
N16@300	84	0.008	20.22	20.69	–	–	–
N16@250	84	0.0096	23.75	24.43	24.91	–	–
N16@200	84	0.012	28.72	29.78	30.54	31.14	31.7
N20@300	82	0.0128	28.86	30.01	30.83	31.49	32.1
N20@250	82	0.0154	33.37	35.03	36.21	37.16	38.03
N20@200	82	0.0193	39.35	41.94	43.79	45.27	46.63
	$\rho_{st.min}$ [8.1.6.1.(2)]		0.0069	0.0078	0.0087	0.0097	0.0111
$ØM_u = Ø(f_y ρ bd^2(1-0.6ρf_y/f'_c))$							

RW200C Standard Lintels with Vertical PVC Webs

UDL capacity of a simple standard lintel with minimum reinforcement other than extra top and bottom bars shown. Designer can utilise the slab over as T-beam, extra horizontal or vertical shear reinforcement if extra strength is required.



RW200C Standard Lintels with Vertical PVC Webs w*(kN/m)

	2N12 Top & Bottom, Depth (mm)				2N16 Top & Bottom, Depth (mm)			
D	150	300	450	750	150	300	450	750
d_{eff}	50	200	350	650	50	200	350	650
Span (mm)								
3600	4.9	10.0	15.1	25.3	8.3	17.3	26.3	44.4
3300	5.8	11.9	17.9	30.1	9.9	20.6	31.3	52.8
3000	7.0	14.3	21.7	36.4	11.9	24.9	37.9	63.9
2700	8.6	17.7	26.8		14.7	30.8	46.8	
2400	10.9	22.4	33.9		18.6	39.0	59.3	
2100	14.3	29.3	44.3		24.4	50.9	77.4	
1800	19.5	39.9			30.9	68.4		
1500	28.0	57.4			38.7	91.2		
1200	43.8				51.5			
900	77.3				77.3			
	f'_c = 25MPa, 50 cover (min)				f'_c = 25MPa, 50 cover (min)			

= ϕV_{uc} governs, otherwise ϕM_u
= Design to AS3600–2018 Sect 12

RW200C In-plane Shear Along Vertical PVC Webs

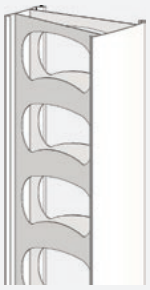
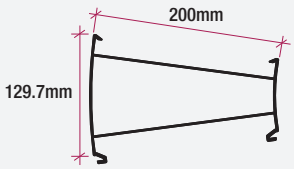
RW200C PVC Profile/Spacing

t_w	S_{punch}	N_{layers}	A_c	Align	Bar Max	Min Reo	Max Spacing	$t_{w.shear}$	μ	k_{co}
195	117	1	50.1%	80%	20	0.0025	350	78.2	0.36	0.20

RW200C In Plane Shear along Vertical PVC Web $ØV_u$ (kN/m)

Horizontal Bars	ρ	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa
N12@233	0.0025	110.5	117	123.5	130.9	140.6
N16@350	0.0029	121.8	128.2	134.8	142.2	151.9
N16@233	0.0044	158.2	164.6	171.2	178.6	188.3
N20@350	0.0046	162.5	169	175.6	182.9	192.7
N20@233	0.0069	219.4	225.9	232.5	239.8	249.6
N16@117	0.0088	266.2	272.6	279.2	286.6	296.3
Max. Shear		273.6	350.2	437.7	547.2	547.2
$ØV_u = Ø(\mu\ \rho\ t_w\ f_y + k_{co}\ t_w\ f'_{ct})$						
$ØV_{max} = Ø\ 0.2\ f'_c\ t_{w\ shear} < Ø\ 10\ t_{w\ shear}$						

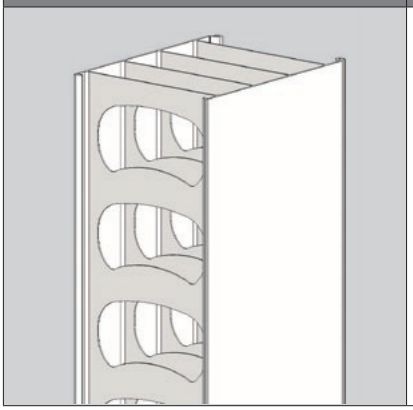
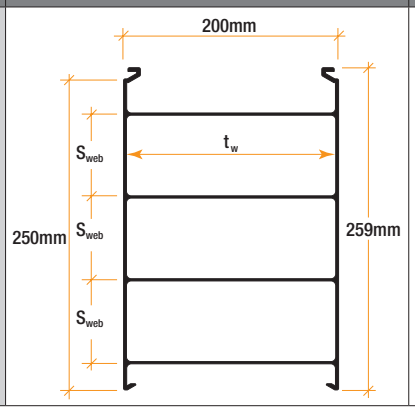
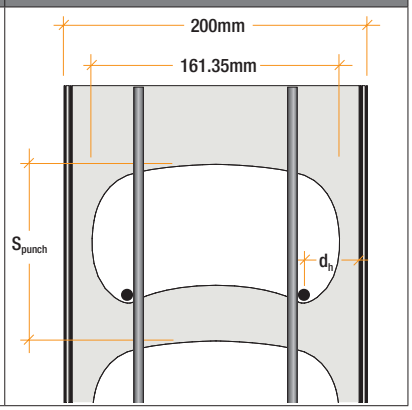
RW200C Curve Panel Radius

15° Curved Wall Panel		Description
		An extruded PVC panel used to form curved walls. Each panel produces a 15° curve. Adjoining panels, either the 115mm spacer or additional curved panels are added to create walls of the required radius between 0.7m to 4.8m.

Example of Achievable Radius with 15° Panel & Spacer/Panel Combinations

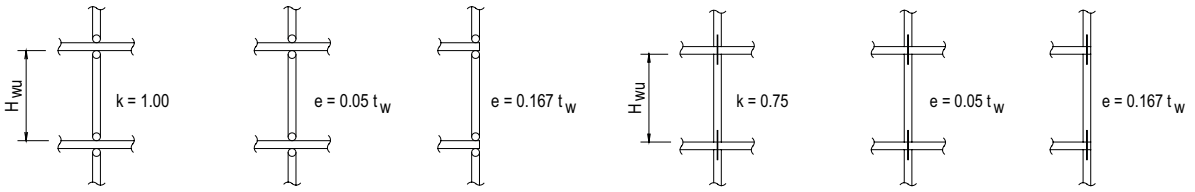
Panel Arrangement	Outer Radius
15° panel	500 ± 25mm
2 x 15° panel + 1 x 115 Spacer	700 ± 25mm
1 x 15° panel + 1 x 115 Spacer	950 ± 25mm
1 x 15° panel + 1 x RW200C Panel	1450 ± 50mm
1 x 15° panel + 1 x RW200C Panel + 115 Spacer	1900 ± 50mm
1 x 15° panel + 2 x RW200C Panel	2450 ± 50mm

RW200C Structural Capacities (Double Reinforcement)

RW200C Panel	Plan	Elevation
		

RW200C Double Reinforcement Axial Capacity $ØN_u$ (kN/m)

t_w	t_{fire}	S_{web}	S_{punch}	A_c	N_{layers}	d_h	$f'_{c.max}$
195	195	66.6	116.7	50.1%	2	38.5	65



k = 0.75		Continuous Floor e = $0.05t_w$					Discontinuous Floor e = $1/6t_w$				
H_{wu}	H_{we}	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa*#	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa*#
6000	4500	902	1155	1443	1804	2345	656	840	1050	1313	1706
5000	3750	1130	1447	1809	2261	2939	885	1133	1416	1770	2300
4500	3375	1229	1573	1967	2458	3196	983	1259	1573	1967	2557
4200	3150	1283	1643	2053	2567	3337	1038	1328	1660	2075	2698
3900	2925	1334	1707	2134	2668	3468	1088	1393	1741	2176	2829
3600	2700	1381	1767	2209	2761	3589	1135	1453	1816	2270	2951
3300	2475	1424	1822	2278	2847	3701	1178	1508	1885	2356	3062
3000	2250	1463	1872	2340	2926	3803	1217	1558	1947	2434	3164
2700	2025	1498	1918	2397	2997	3896	1253	1603	2004	2505	3257
2400	1800	1530	1958	2448	3060	3978	1284	1644	2055	2569	3339
2100	1575	1558	1994	2493	3116	4051	1312	1680	2100	2625	3412
1800	1350	1582	2025	2532	3165	4114	1337	1711	2139	2673	3475
Bearing capacity at standard bottom plate		1863	2385	2982	3727	4845	1863	2385	2982	3727	4845
* for f'_c > 50 MPa, CSR appointed installer only.											
# for non-ductile walls only.											

RW200C Double Reinforcement Minimum Reinforcement

RW200C##		Vertical Bars - Each Face (min. N12–350)			
Allowable Bars		N12	N16	N20	N24[1]
Horizontal (min. N12–350)	N12				
	N16				
	N20				
	N24				

Double layer if specified by project engineer.
Horizontal Bar Spacing 233/350
Vertical Bar Spacing 150 to 350
[1]N24 One side only, N16 max other side.

Acceptable
With Caution
Not Recommended

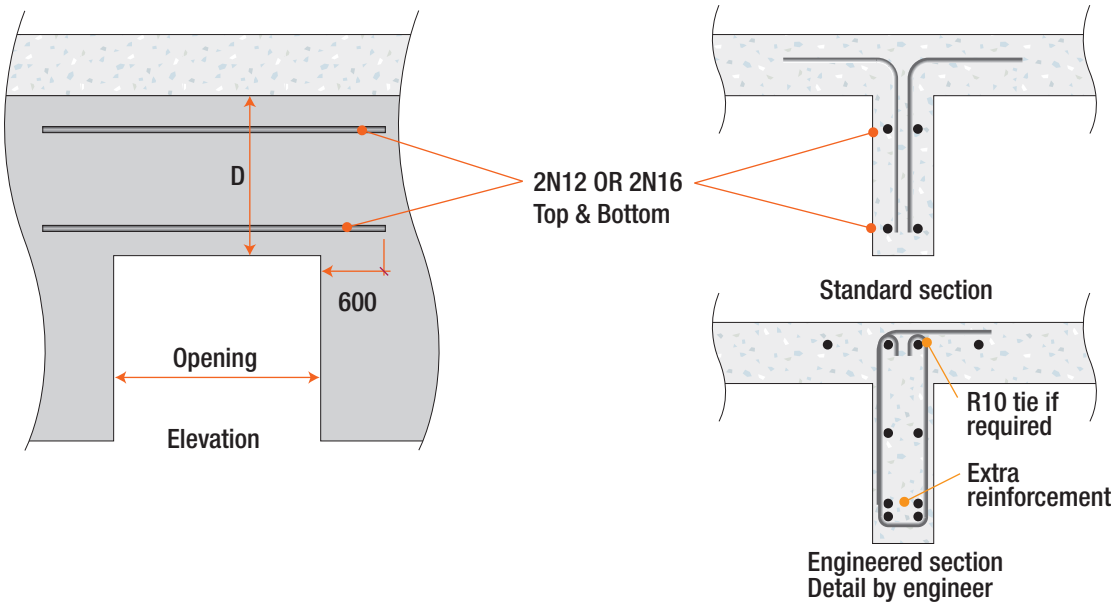
RW200C Double Reinforcement Out of Plane Flexural Capacity ($ØM_u$ kNm/m) (N*=0)

Vertical Bars*	d	ρ*	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#
N12@300	145	0.0026	21.09	–	–	–	–
N12@250	145	0.0031	25.14	25.36	25.51	–	–
N16@400	143	0.0035	27.43	27.7	27.88	28.04	–
N16@350	143	0.004	31.15	31.5	31.74	31.94	32.13
N16@300	143	0.0047	36.04	36.51	36.84	37.11	37.36
N16@250	143	0.0056	42.73	43.4	43.89	44.28	44.63
N16@200	143	0.0071	52.44	53.5	54.25	54.86	55.42
N20@300	141	0.0074	53.56	54.71	55.54	56.19	56.8
N20@250	141	0.0089	63.02	64.67	65.85	66.8	67.67
N20@200	141	0.0112	76.4	78.99	80.84	82.32	83.68
	$\rho_{st.min}$ [8.1.6.1.(2)]		0.0023	0.0026	0.0029	0.0033	0.0037

$ØM_u = Ø(f_y ρ bd^2(1-0.6ρf_y/f'_c))$
*Tension bars one face.
for non-ductile walls only.

RW200C Double Reinforcement Lintels with Vertical PVC Webs

UDL capacity of a simple standard double reinforcement lintel with minimum reinforcement other than extra top and bottom bars shown. Designer can utilise the slab over as T-beam, extra horizontal or vertical shear reinforcement if extra strength is required.



RW200C Double Reinforcement Lintels with Vertical PVC Webs w*(kN/m)

	2N12 Top & Bottom, Depth (mm)				2N16 Top & Bottom, Depth (mm)			
D	150	300	450	750	150	300	450	750
d_{eff}	50	200	350	650	50	200	350	650
Span (mm)								
3600	9.3	19.5	29.7	50.1	14.1	27.4	40.9	72.6
3300	11.0	23.2	35.3	59.6	15.5	30.4	46.0	84.7
3000	13.3	28.0	42.7	72.1	17.2	34.2	52.6	101.6
2700	16.5	34.6	52.7		19.3	39.1	61.3	
2400	20.8	43.8	66.7		22.1	45.6	73.6	
2100	25.8	54.7	87.2		25.8	54.7	92.0	
1800	30.9	68.4			30.9	68.4		
1500	38.7	91.2			38.7	91.2		
1200	51.5				51.5			
900	77.3				77.3			
	f'_c = 25MPa, 50 cover (min)				f'_c = 25MPa, 50 cover (min)			

= ϕV_{uc} governs, otherwise ϕM_u
= Design to AS3600–2018 Sect 12

RW200C Double Reinforcement In-plane Shear Along Vertical PVC Webs

RW200C Double Reinforcement PVC Profile/Spacing

t_w	S_{punch}	N_{layers}	A_c	Align	Bar Max	Min Reo	Max Spacing	$t_{w.shear}$	μ	k_{co}
195	117	2	50.1%	100%	16	0.0025	350	97.7	0.36	0.20

RW200C Double Reinforcement In Plane Shear along Vertical PVC Web ϕV_u (kN/m)

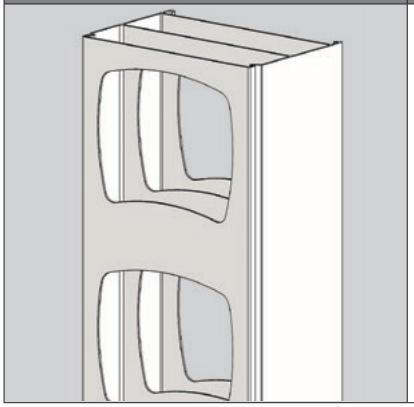
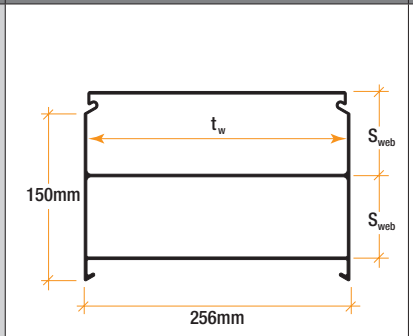
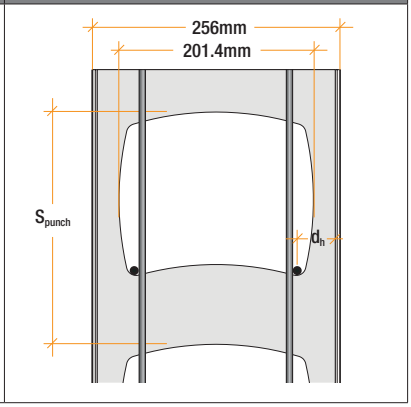
Horizontal Bars	ρ	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#
2N12@350	0.0033	175.1	183.8	192.6	202.4	215.5
2N12@233	0.0050	230.0	238.6	247.4	257.3	270.5
2N16@350	0.0059	260.2	268.8	277.6	287.5	300.5
2N16@233	0.0088	357.7	366.3	375.1	385.0	398.1
2N16@117	0.0176	366.4	468.9	586.2	674.2	687.3
Max. Shear		366.4	468.9	586.2	732.7	732.7

$\phi V_u = \phi(\mu\ \rho\ t_w\ f_y + k_{co}\ t_w\ f'_{ct})$

$\phi V_{max} = \phi\ 0.2\ f'_c\ t_{w\ shear} < \phi\ 10\ t_{w\ shear}$

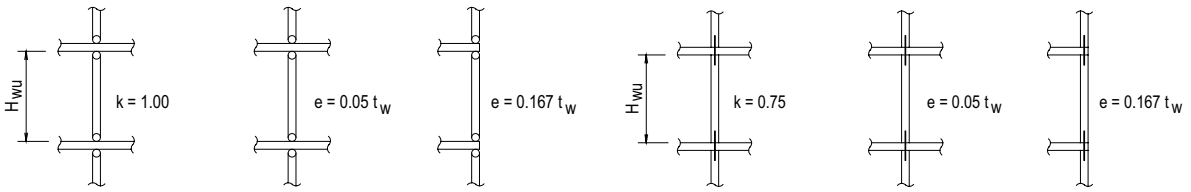
for non-ductile walls only.

RW256S Structural Capacities

RW256S Panel	Plan	Elevation
		

RW256S Axial Capacity $ØN_u$ (kN/m)

t_w	t_{fire}	S_{web}	S_{punch}	A_c	N_{layers}	d_h	$f'_{c.max}$
251	251	73.5	240	51.3%	2	42.7	65



k = 0.75		Continuous Floor e = 0.05t_w					Discontinuous Floor e = 1/6t_w				
H_{wu}	H_{we}	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa*#	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa*#
6000	4500	1543	1975	2468	3085	4011	1226	1570	1962	2453	3188
5000	3750	1720	2202	2752	3440	4472	1404	1797	2246	2808	3650
4500	3375	1797	2300	2875	3593	4671	1480	1895	2369	2961	3849
4200	3150	1839	2354	2942	3678	4781	1523	1949	2436	3045	3959
3900	2925	1878	2404	3005	3756	4883	1562	1999	2499	3124	4061
3600	2700	1914	2450	3063	3829	4977	1598	2046	2557	3196	4155
3300	2475	1948	2493	3116	3895	5064	1631	2088	2610	3263	4242
3000	2250	1978	2532	3165	3956	5143	1662	2127	2659	3324	4321
2700	2025	2006	2567	3209	4012	5215	1690	2163	2703	3379	4393
2400	1800	2031	2599	3249	4061	5279	1714	2194	2743	3429	4457
2100	1575	2052	2627	3284	4105	5336	1736	2222	2778	3472	4514
1800	1350	2071	2651	3314	4142	5385	1755	2246	2808	3510	4563
Bearing capacity at standard bottom plate		2362	3024	3780	4725	6142	2362	3024	3780	4725	6142
* for f'_c > 50 MPa, CSR appointed installer only.											
# for non-ductile walls only.											

RW256S Minimum Reinforcement

RW256S		Vertical Bars - Each Face (min. N12-350)				
Allowable Bars		N12	N16	N20	N24	N28
Horizontal (min. N12-350)	N12					
	N16					
	N20					
	N24					

Horizontal Bar Spacing 240
Vertical Bar Spacing 150 to 350

Acceptable
With Caution
Not Recommended

RW256S Out of Plane Flexural Capacity $ØM_u$ (kNm/m) (N*=0)

Vertical Bars*	d	ρ*	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#
N12@250	194	0.0023	34.13	–	–	–	–
N16@400	192	0.0026	37.42	37.69	–	–	–
N16@350	192	0.003	42.57	42.91	43.16	–	–
N16@300	192	0.0035	49.35	49.83	50.16	50.43	50.68
N16@250	192	0.0042	58.71	59.39	59.87	60.26	60.62
N16@200	192	0.0052	72.42	73.48	74.23	74.84	75.4
N20@300	190	0.0055	74.37	75.52	76.34	77	77.61
N20@250	190	0.0066	87.98	89.64	90.82	91.77	92.64
N20@200	190	0.0083	107.61	110.2	112.05	113.53	114.9
N24@250	188	0.0096	120.42	123.85	126.3	128.26	130.07
N24@200	188	0.012	145.62	150.98	154.81	157.87	160.7
N24@150	188	0.016	183.26	192.79	199.6	205.05	210.08
	$ρ_{st.min}$ [8.1.6.1.(2)]		0.0021	0.0024	0.0027	0.0030	0.0034

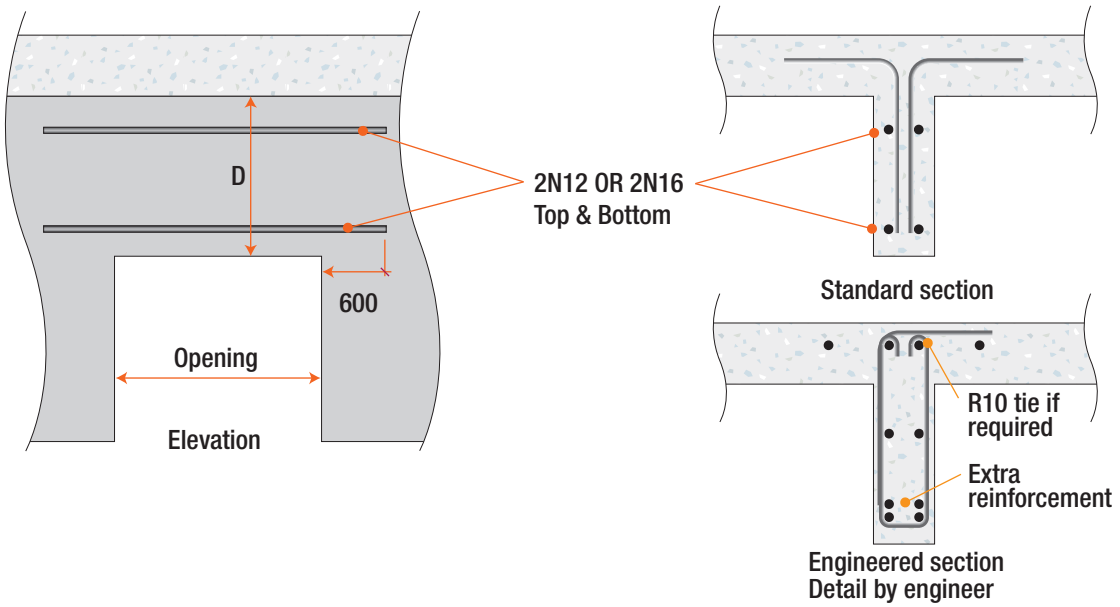
$ØM_u = Ø(f_y ρ bd^2(1-0.6ρf_y/f'_c))$

*Tension bars one face

#for non-ductile walls only

RW256S Standard Double Reinforcement Lintels with Vertical PVC Webs

UDL capacity of a simple standard double reinforcement lintel with minimum reinforcement other than extra top and bottom bars shown. Designer can utilise the slab over as T-beam, extra horizontal or vertical shear reinforcement if extra strength is required.



RW256S Standard Double Reinforcement Lintels with Vertical PVC Webs w*(kN/m)

	2N12 Top & Bottom, Depth (mm)				2N16 Top & Bottom, Depth (mm)			
D	150	300	450	750	150	300	450	750
d_{eff}	50	200	350	650	50	200	350	650
Span (mm)								
3600	9.5	19.7	29.9	50.3	15.7	33.8	50.8	88.0
3300	11.3	23.4	35.5	59.8	18.7	37.8	57.2	104.7
3000	13.6	28.3	43.0	72.4	21.4	42.5	65.4	126.4
2700	16.8	35.0	53.1		24.0	48.6	76.3	
2400	21.3	44.2	67.2		27.5	56.7	91.5	
2100	27.8	57.8	87.8		32.0	68.0	114.4	
1800	37.9	78.7			38.5	85.1		
1500	48.1	113.3			48.1	113.4		
1200	64.1				64.1			
900	96.1				96.1			
	f'_c = 25MPa, 50 cover (min)				f'_c = 25MPa, 50 cover (min)			

= ϕV_{uc} governs, otherwise ϕM_u
= Design to AS3600–2018 Sect 12

RW256S In-plane Shear Along Vertical PVC Webs

RW256S PVC Profile/Spacing

t_w	S_{punch}	N_{layers}	A_c	Align	Bar Max	Min Reo	Max Spacing	$t_{w.shear}$	μ	k_{co}
251	240	2	48.6%	100%	20	0.0025	350	121.5	0.35	0.19

RW256S In Plane Shear along Vertical PVC Web $\emptyset V_u$ (kN/m)

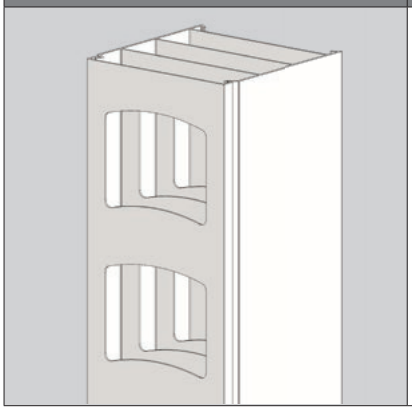
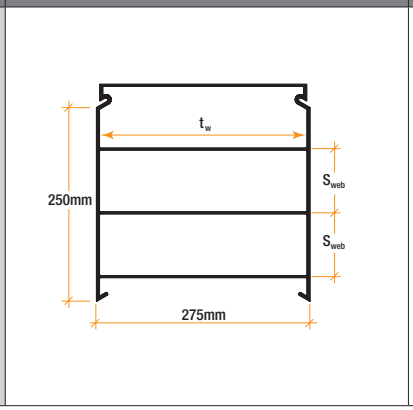
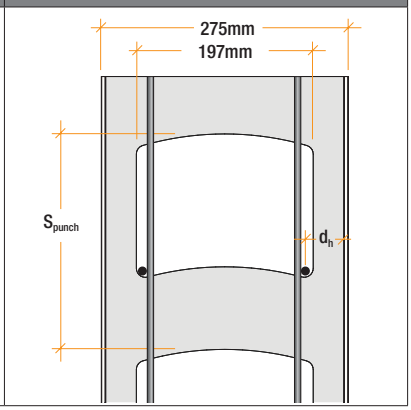
Horizontal Bars	ρ	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#
2N12@360	0.0025	185.0	195.8	206.7	219.0	235.2
2N12@240	0.0038	236.5	247.2	258.2	270.4	286.7
2N16@360	0.0045	265.2	275.9	286.9	299.1	315.4
2N16@240	0.0067	356.8	367.5	378.5	390.7	407.0
2N20@360	0.0070	368.1	378.9	389.9	402.1	418.4
2N20@240	0.0105	455.6	522.0	532.9	545.2	561.4
2N16@120	0.0134	–	583.2	653.2	665.5	681.7
2N20@120	0.0209	–	–	729.0	911.3	911.3
	Max. Shear	455.6	583.2	729.0	911.3	911.3

$\emptyset V_u = \emptyset(\mu\ \rho\ t_w\ f_y + k_{co}\ t_w\ f'_{ct})$

$\emptyset V_{max} = \emptyset\ 0.2\ f'_c\ t_{w\ shear} < \emptyset\ 10\ t_{w\ shear}$

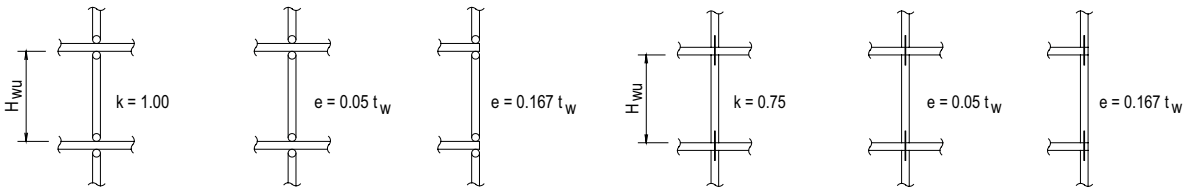
for non-ductile walls only.

RW275S Structural Capacities

RW275S Panel	Plan	Elevation
		

RW275S Axial Capacity ØN$_u$ (kN/m) Non-Ductile (2-Layers)

t_w	t_{fire}	S_{web}	S_{punch}	A_c	N_{layers}	d_h	$f'_{c.max}$
270	270	79	240	51.8%	2	41	65



k = 0.75		Continuous Floor e = 0.05t_w				Discontinuous Floor e = 1/6t_w			
H_{wu}	H_{we}	25 MPa	32 MPa	40 MPa	50 MPa	25 MPa	32 MPa	40 MPa	50 MPa
6000	4500	1671	2139	2674	3342	1329	1701	2126	2657
5000	3750	1863	2385	2981	3727	1521	1947	2433	3042
4500	3375	1946	2491	3114	3893	1604	2053	2566	3208
4200	3150	1992	2550	3187	3984	1649	2111	2639	3299
3900	2925	2035	2604	3255	4069	1692	2166	2707	3384
3600	2700	2074	2655	3318	4148	1731	2216	2770	3463
3300	2475	2110	2701	3376	4220	1767	2262	2828	3535
3000	2250	2143	2743	3429	4286	1800	2305	2881	3601
2700	2025	2173	2781	3477	4346	1830	2343	2929	3661
2400	1800	2200	2816	3520	4399	1857	2377	2971	3714
2100	1575	2223	2846	3557	4447	1881	2407	3009	3761
1800	1350	2244	2872	3590	4488	1901	2433	3042	3802
Bearing capacity at standard bottom plate		2362	3024	3780	4724	2362	3024	3780	4724

RW275S Minimum Reinforcement

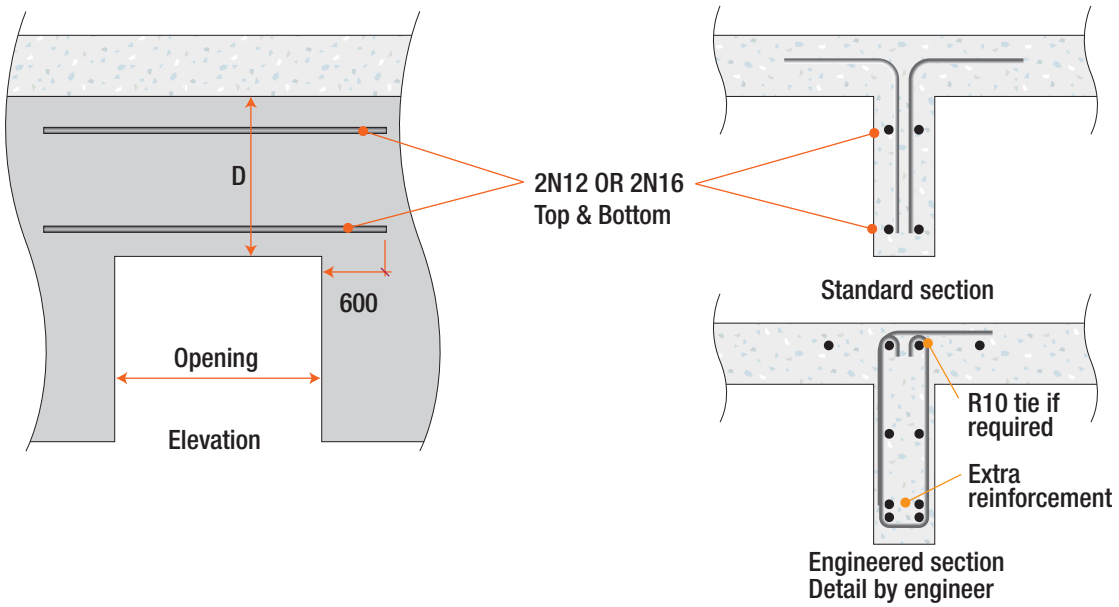
RW275S		Vertical Bars - Each Face (min. N12-330)				
Allowable Bars		N12	N16	N20	N24	N28
Horizontal (min. N12-350)	N12					
	N16					
	N20					
	N24					

Horizontal Bar Spacing 240
Vertical Bar Spacing 150 to 350

Acceptable
With Caution
Not Recommended

RW275S Standard Double Reinforcement Lintels with Vertical PVC Webs

UDL capacity of a simple standard double reinforcement lintel with minimum reinforcement other than extra top and bottom bars shown. Designer can utilise the slab over as T-beam, extra horizontal or vertical shear reinforcement if extra strength is required.



RW275S Standard Double Reinforcement Lintels with Vertical PVC Webs w*(kN/m)

	2N12 Top & Bottom, Depth (mm)				2N16 Top & Bottom, Depth (mm)			
D	150	300	450	750	150	300	450	750
d_{eff}	50	200	350	650	50	200	350	650
Span (mm)								
3600	9.5	19.7	29.9	50.3	15.9	34.0	52.0	88.1
3300	11.3	23.5	35.6	59.9	18.9	40.4	61.9	104.9
3000	13.7	28.4	43.1	72.5	22.9	48.8	74.9	126.9
2700	16.9	35.1	53.2		27.6	55.7	87.4	
2400	21.4	44.4	67.3		31.5	65.0	104.9	
2100	28.0	57.9	87.9		36.8	78.0	131.2	
1800	38.1	78.9			44.1	97.5		
1500	54.8	113.6			55.1	130.1		
1200	73.5				73.5			
900	110.3				110.3			
	f'_c = 25MPa, 50 cover (min)				f'_c = 25MPa, 50 cover (min)			

= ϕV_{uc} governs, otherwise ϕM_u
= Design to AS3600–2018 Sect 12

RW275S In-plane Shear Along Vertical PVC Webs

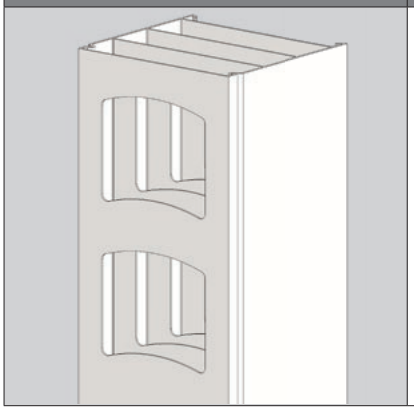
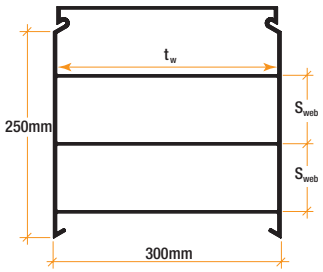
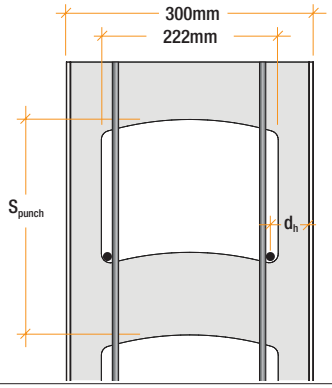
RW275S PVC Profile/Spacing

t_w	S_{punch}	N_{layers}	A_c	Align	Bar Max	Min Reo	$t_{w.shear}$
269	240	2	51.8%	100.0%	20	0.0025	139.3

RW275S In Plane Shear along Vertical PVC Web $ØV_u$ (kN/m)

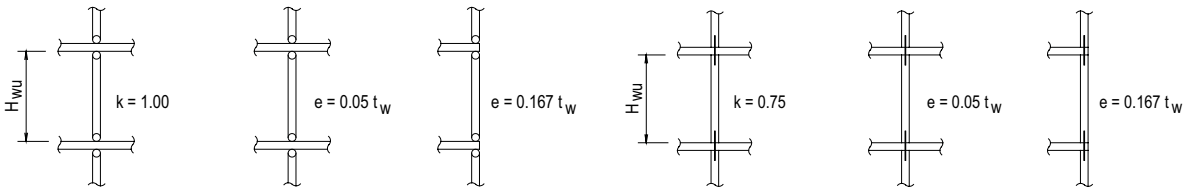
Horizontal Bars	ρ	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#
2N12@240	0.0035	258.7	271.0	283.6	297.6	316.3
2N16@360	0.0042	289.3	301.6	314.2	328.2	346.9
2N16@240	0.0062	386.9	399.2	411.8	425.8	444.5
2N20@360	0.0065	399.0	411.4	423.9	438.0	456.6
2N20@240	0.0097	522.5	563.9	576.4	590.5	609.1
2N16@120	0.0125	–	668.8	704.6	718.7	737.3
2N20@120	0.0195	–	–	836.1	1045.1	1045.1
	Max. Shear	522.5	668.8	836.1	1045.1	1045.1
$ØV_u = Ø(\mu\ \rho\ t_w\ f_y + k_{co}\ t_w\ f'_{ct})$						
$ØV_{max} = Ø\ 0.2\ f'_c\ t_{w\ shear} < Ø\ 10\ t_{w\ shear}$						
# for non-ductile walls only.						

RW300S Structural Capacities

RW300S Panel	Plan	Elevation
		

RW300S Axial Capacity $ØN_u$ (kN/m) Non-Ductile (Layers)

t_w	t_{fire}	S_{web}	S_{punch}	A_c	N_{layers}	d_h	$f'_{c.max}$
295	295	79	240	51.8%	2	41	65



k = 0.75		Continuous Floor e = 0.05t_w				Discontinuous Floor e = 1/6t_w			
H_{wu}	H_{we}	25 MPa	32 MPa	40 MPa	50 MPa	25 MPa	32 MPa	40 MPa	50 MPa
6000	4500	2223	2845	3557	4446	1814	2321	2902	3627
5000	3750	2384	3051	3814	4768	1974	2527	3159	3949
4500	3375	2453	3140	3925	4907	2044	2616	3270	4088
4200	3150	2492	3189	3986	4983	2082	2665	3331	4164
3900	2925	2527	3235	4043	5054	2118	2710	3388	4235
3600	2700	2560	3277	4096	5120	2150	2753	3441	4301
3300	2475	2590	3315	4144	5180	2181	2791	3489	4361
3000	2250	2618	3351	4189	5236	2208	2827	3533	4417
2700	2025	2643	3383	4229	5286	2233	2859	3573	4467
2400	1800	2665	3412	4264	5331	2256	2887	3609	4512
2100	1575	2685	3437	4296	5370	2276	2913	3641	4551
1800	1350	2702	3459	4323	5404	2293	2935	3668	4585
Bearing capacity at standard bottom plate		2915	3731	4664	5830	2915	3731	4664	5830

RW300S Minimum Reinforcement

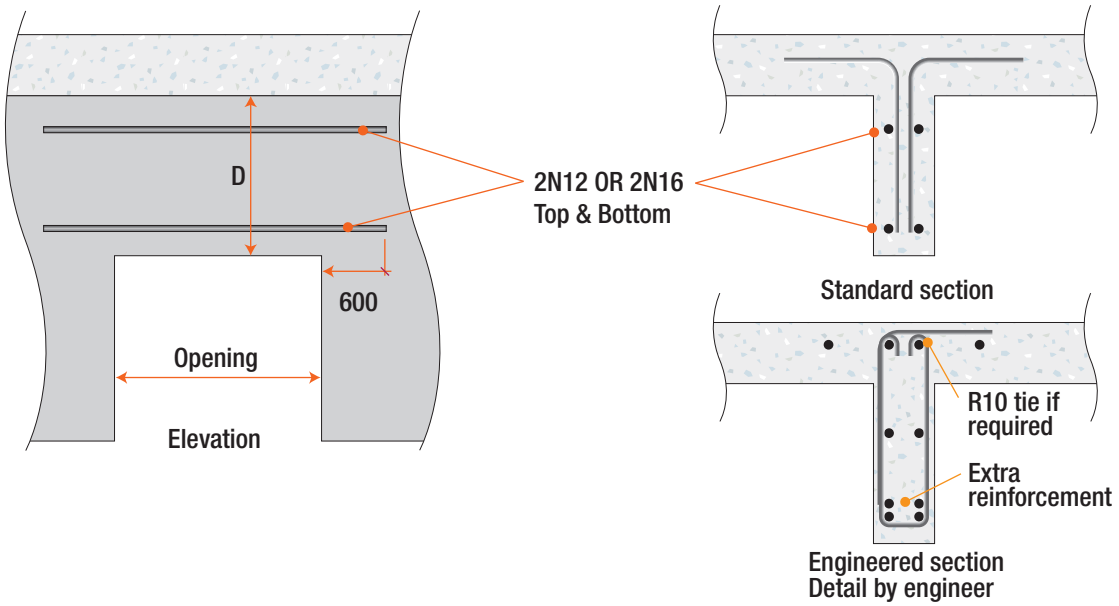
RW300S		Vertical Bars - Each Face (min. N12-330)				
Allowable Bars		N12	N16	N20	N24	N28
Horizontal (min. N12-350)	N12					
	N16					
	N20					
	N24					

Horizontal Bar Spacing 240
Vertical Bar Spacing 150 to 350

Acceptable
With Caution
Not Recommended

RW300S Standard Double Reinforcement Lintels with Vertical PVC Webs

UDL capacity of a simple standard double lintel with minimum reinforcement other than extra top and bottom bars shown. Designer can utilise the slab over as T-beam, extra horizontal or vertical shear reinforcement if extra strength is required.



RW300S Standard Double Reinforcement Lintels with Vertical PVC Webs w*(kN/m)

	2N12 Top & Bottom, Depth (mm)				2N16 Top & Bottom, Depth (mm)			
D	150	300	450	750	150	300	450	750
d_{eff}	50	200	350	650	50	200	350	650
Span (mm)								
3600	9.5	19.7	29.9	50.3	15.9	34.0	52.1	88.2
3300	11.3	23.5	35.6	59.9	19.0	40.5	62.0	104.9
3000	13.7	28.4	43.1	72.5	23.0	49.0	75.0	127.0
2700	16.9	35.1	53.2		28.1	56.8	89.1	
2400	21.4	44.4	67.3		32.1	66.2	106.9	
2100	28.0	58.0	88.0		37.4	79.5	133.6	
1800	38.1	78.9			44.9	99.4		
1500	54.9	113.6			56.2	132.5		
1200	74.9				74.9			
900	112.3				112.3			
	f'_c = 25MPa, 50 cover (min)				f'_c = 25MPa, 50 cover (min)			

= ϕV_{uc} governs, otherwise ϕM_u
= Design to AS3600–2018 Sect 12

RW300S In-plane Shear Along Vertical PVC Webs

RW300S PVC Profile/Spacing

t_w	S_{punch}	N_{layers}	A_c	Align	Bar Max	Min Reo	$t_{w.shear}$
274	240	2	51.8%	100%	20	0.0025	141.9

RW300S In Plane Shear along Vertical PVC Web $\emptyset V_u$ (kN/m)

Horizontal Bars	ρ	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa#
2N12@240	0.0034	260.4	273.0	285.8	300.1	319.1
2N16@360	0.0041	291.0	303.6	316.4	330.7	349.7
2N16@240	0.0061	388.6	401.2	414.0	428.3	447.3
2N20@360	0.0064	400.8	413.4	426.2	440.5	459.5
2N20@240	0.0095	532.2	565.8	578.6	592.9	611.9
2N16@120	0.0122	–	681.3	706.8	721.2	740.1
2N20@120	0.0191	–	–	851.6	1050.4	1064.5
	Max. Shear	532.2	681.3	851.6	1064.5	1064.5
$\emptyset V_u = \emptyset(\mu\ \rho\ t_w\ f_y + k_{co}\ t_w\ f'_{ct})$						
$\emptyset V_{max} = \emptyset\ 0.2\ f'_c\ t_{w\ shear} < \emptyset\ 10\ t_{w\ shear}$						
# for non-ductile walls only.						

Non–Ductile Wall Detailing

Standard AFS Wall Detailing for Non-Ductile Wall Designs in accordance with AS3600-2018 Section 2.2 and the relevant clauses in Section 14.4.

Junctions

In general Wall Junctions are not required to transfer in plane Lateral or Shear loads across the junctions. Where transfer of in-plane Lateral or Shear loads across junctions is required the Project Engineer is to specify the AFS Special Junction Details on the Structural Documentation. If detailing is required beyond these special junctions AFS Technical Support is to be consulted and detailing reviewed.

Standard Wall Junctions

Standard junctions are used except where the structural documentation indicates otherwise. Core Walls would generally be specified with special Junctions.

Standard Junctions Details – Single Reinforcement

AFS Standard Junction Detailing is used unless alternate AFS details are specified in the Project Documentation. If Junction Details beyond the details provided in this manual are to be used, then AFS Technical Support is to be consulted and detailing reviewed.

Fig A1: Standard Cross Junction

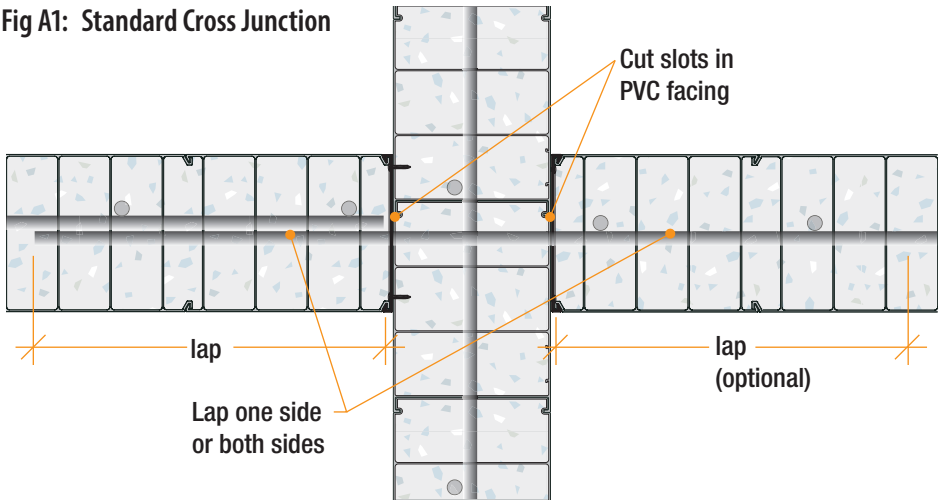


Fig A2: Standard Corner 90°

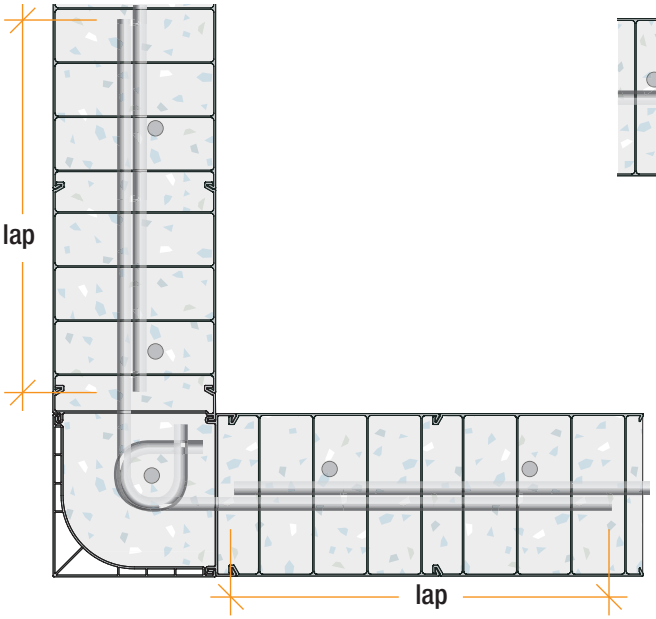


Fig A3: Standard T-Junction

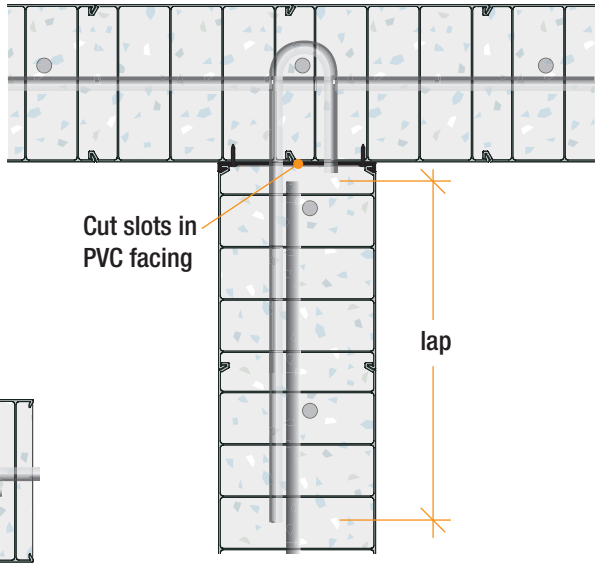


Fig A4: Standard Angled Junction

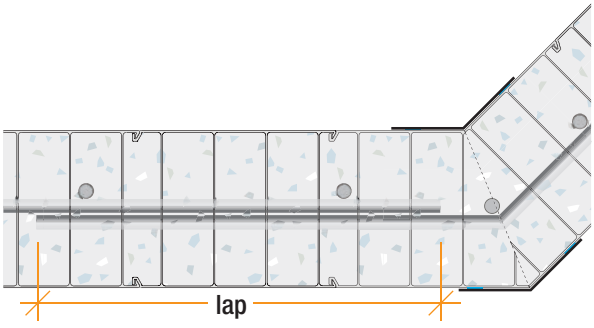
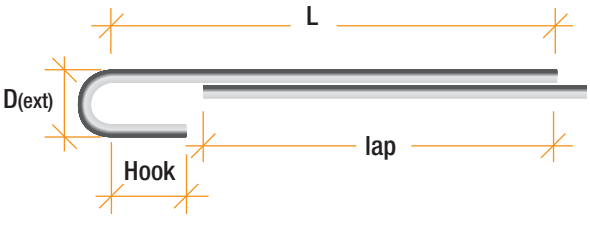


Fig A5: Standard Hook Bars and Lap Details



Standard Hook Bar (mm)

Reo	D	L	Hook	Lap	RW110C	RW156C	RW200C
N12	60	550	70	450	Y	Y	Y
N16	80	700	70	600	N	N	Y
Acceptable					Not Recommended		

Standard Junctions Details – Double Reinforcement

Where Boundary Elements are required, provide laps 1.2 x L,compliant with AS3600-2018 Amdt 2, refer to Standard U-Bar table.

Fig A6: Standard Cross Junction

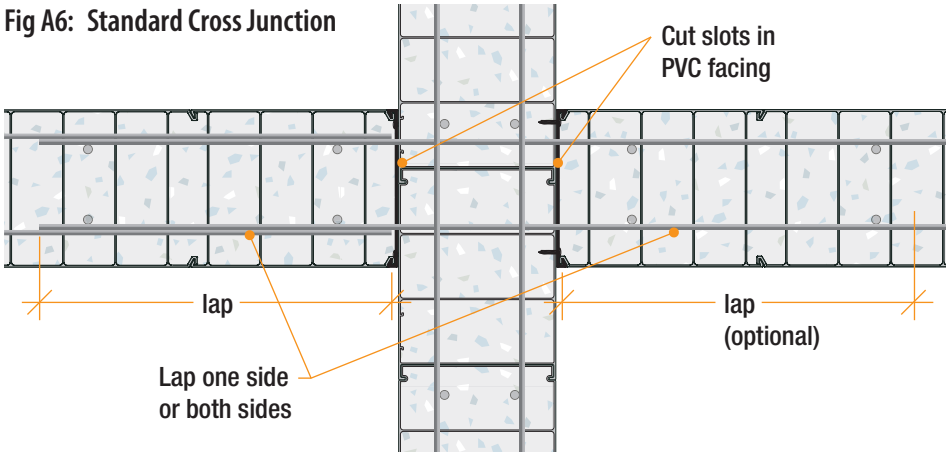


Fig A7: Standard Corner 90°

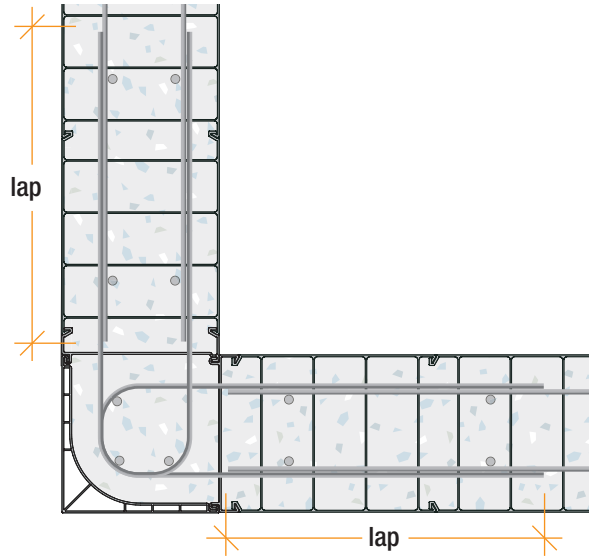


Fig A8: Standard T-Junction

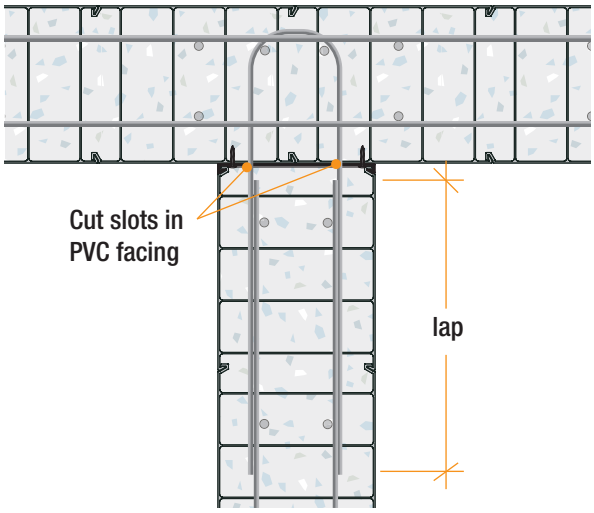


Fig A9: Standard Angled Junction

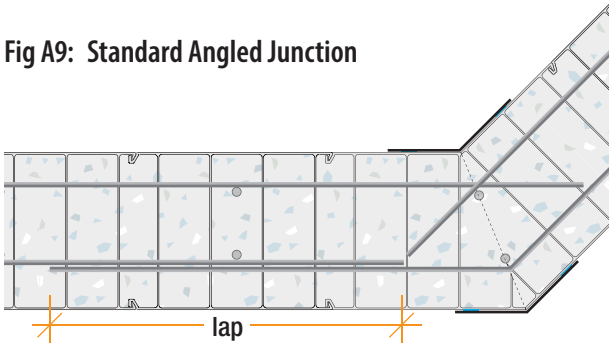
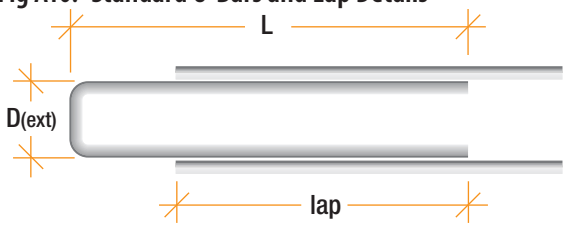


Fig A10: Standard U-Bars and Lap Details



Standard U Bar

Wall Type	Reo	Standard U-Bars			Boundary Element U-Bars		
		Lap	D	L	Lap	D	L
RW200C	N12	450	105	750	500	105	750
RW256S	N12	450	155	750	500	155	750
RW256S	N16	600	155	900	800	155	1050
RW275S	N12	450	175	750	500	155	750
RW275S	N16	600	175	900	800	155	1050
RW300S	N12	450	205	750	500	155	750
RW300S	N16	600	205	900	800	155	1050

Non-Ductile Blade Walls/Columns

AFS uses the following definitions for Blade Walls/Columns, with typical standardised reinforcement detailing that is compliant to AS3600–2018

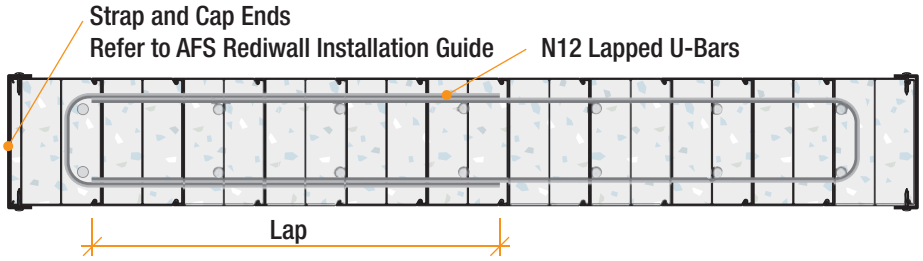
Blade walls

Blade walls are short walls designed as non-ductile walls without ligatures in accordance with Section 11 of AS3600-2018. They are generally loaded concentrically, with concrete strength not greater than 50MPa and have no net tension in the strong or weak axis.

Blade wall

Detail to AS3600-2018 Section 11 (where applicable).

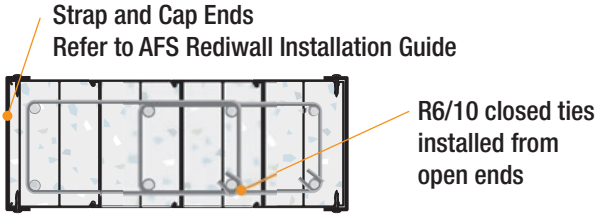
Fig A11: Rediwall® Blade Wall



Blade Column

Detail to AS3600-2018 Section 10 (where applicable).

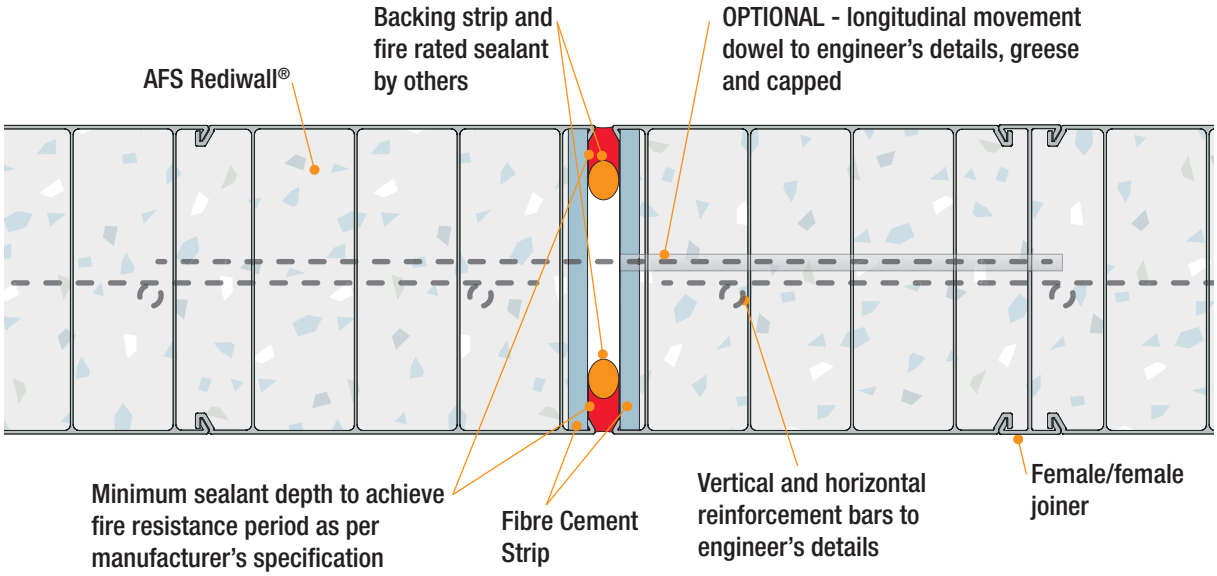
Fig A12: Rediwall® Blade Column



Movement Joints

The structural concrete wall effectively has 'control joints' at each plastic web so no additional crack control joints are necessary. Full depth 'movement joints' may be required depending on the geometry of the structure and other considerations such as thermal loads, exposure and building joints. Movement joints shall be placed in locations nominated by the structural engineer and must be documented on structural drawings. These will be installed at construction stage by the rediwall® installation contractor. As a guide the engineer should review joint reinforcement requirements for wall runs longer than 16 metres. Refer to Fig A13.

Fig A13: Movement Joint Non-Ductile Design Detail



Note: Can be dowel jointed if required structurally. Must be clearly specified and negotiated with installers at time of tender. Installed where nominated by project engineer. Must be clearly documented on drawings.

Limited Ductile Wall Design

Limited Ductile Design

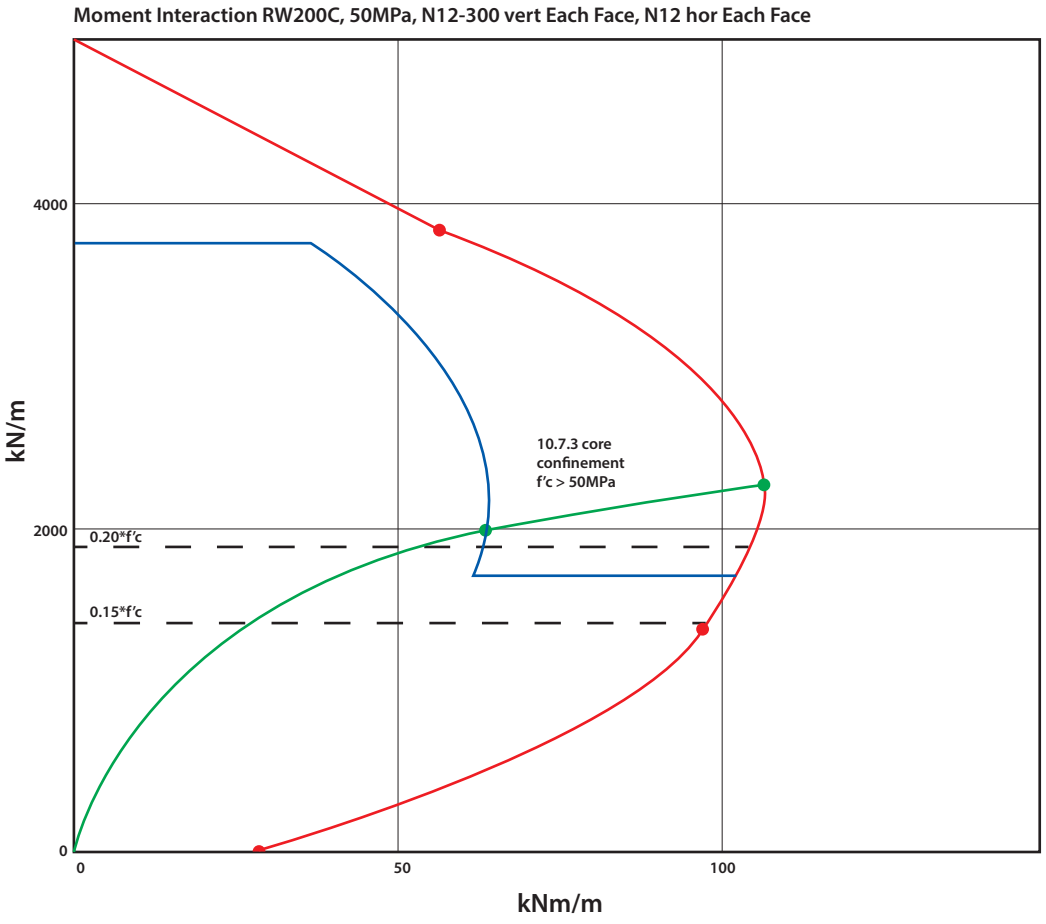
AFS Rediwall® can be designed to the requirements of AS3600-2018 Limited Ductile Walls. Limited Ductile Walls are to be designed to Section 2.2, Clause 14.4 and Clause 14.6 of AS3600-2018. Clause 14.6.1 requires the Limited Ductile walls to have reinforcement on each face and be detailed in accordance with the requirements of Clause 14.6.

Refer to the following sections for standard detailing to suit Rediwall® Limited Ductile Walls with boundary elements.

It is recommended that AFS Limited Ductile Walls are only to be installed by experienced installers due to the additional detailing requirements. AFS detailing is to be used unless AFS Technical Support reviews and approves alternate detailing.

Below is a sample Moment Interaction curve showing RW200C capacity without core confinement.

Fig A14: Sample Moment Interaction



Limited Ductile Design Examples

The following tables provides other design examples for Rediwall® sizes over a range of reinforcement and concrete strengths.

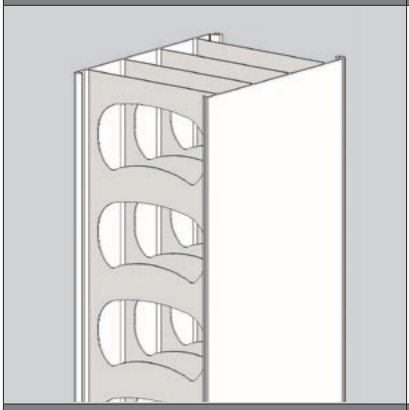
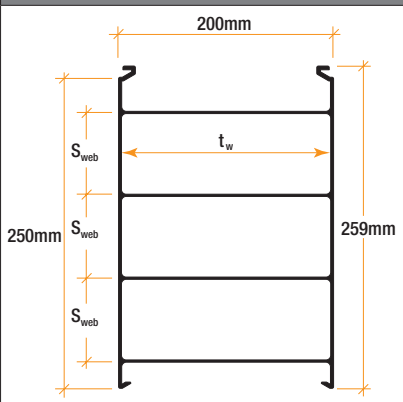
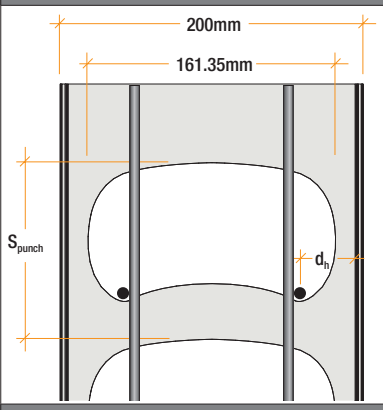
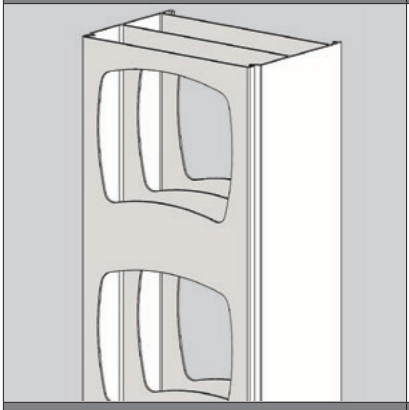
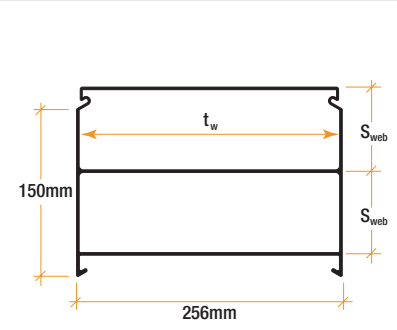
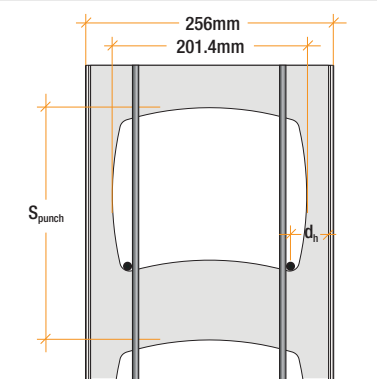
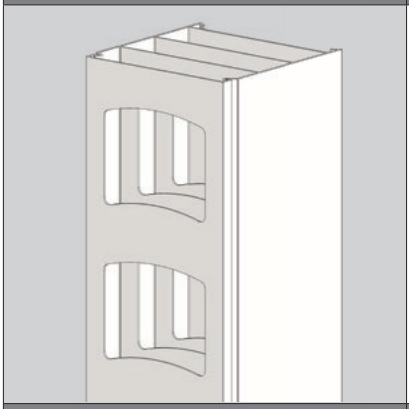
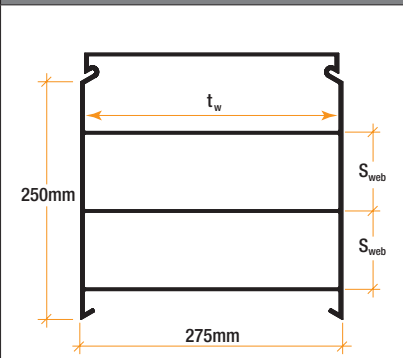
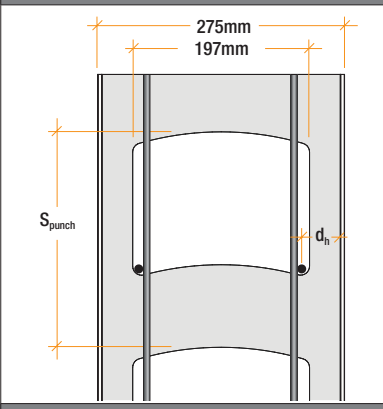
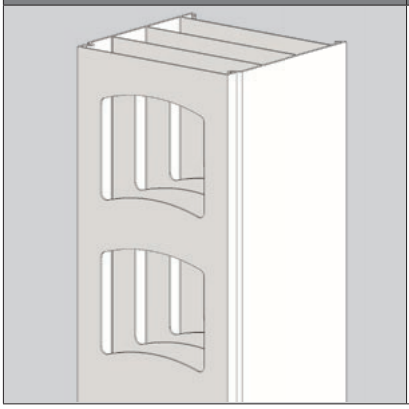
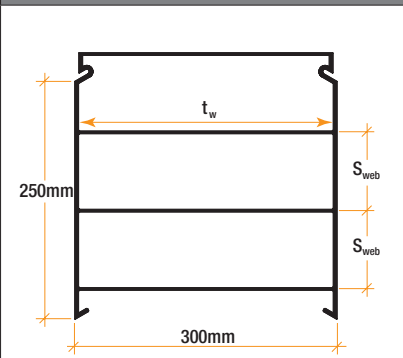
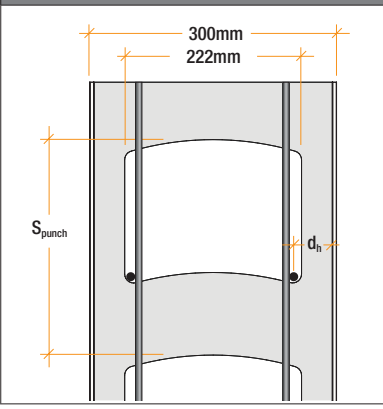
RW200C Panel	Plan	Elevation
		
RW256S Panel	**Plan**	**Elevation**
		
RW275S Panel	**Plan**	**Elevation**
		
RW300S Panel	**Plan**	**Elevation**
		

TABLE A2: Rediwall® Panel Properties

Wall Type	t_w	S_{web}	S_{punch}	N_{layers}	A_c	Slender. Limit	d_h	Min Reo	$f'_{c.max}$
RW200C	195	66.6	116.7	2	50.1%	30	39	N12-350hor. N12-300 vert.	50
RW256S	250	73.5	240	2	48.6%	30	45	N12-350hor. N12-300 vert.	50
RW275S	269	75.0	240	2	51.8%	30	45	N12-233hor. N12-300 vert.	50
RW300S	274	75.0	240	2	51.8%	30	45	N12-233hor. N16-300 vert.	50

TABLE A3: Rediwall® Design Axial Forces

Wall Description	C11.7.4 restraints not required	H_{wu} k = 0.75 mm	t_w mm	d_c mm	p_{vert} %	ϕN_u kN/m	14.3.2.1 $0.20*f'_c$ kN/m	ϕM_u kNm/m
RW200C (194), 32MPa, N12-300 vert. Each Face, N12 hor.	Each Face (≤1%)	3000	194	50.5	0.39	1760	1242	31
RW200C (194), 50MPa, N16-200 vert. Each Face, N12 hor.	Each Face (≤1%)	3000	194	52.5	1.0	2730	1455	65
RW200C (194), 50MPa, N20-175 vert. Each Face, N12 hor.	EF Tens. Only	3000	194	54.5	1.9	2930	1455	69
RW256S (250), 32MPa, N12-300 vert. Each Face, N12 hor.	Each Face (≤1%)	3000	250	56.8	0.30	3040	1200	52
RW256S (250), 50MPa, N20-250 vert. Each Face, N12 hor.	Each Face (≤1%)	3000	250	60.8	1.0	4820	1875	110
RW256C (250), 50MPa, N28-200 vert. Each Face, N16 hor.	EF Tens. Only	3000	250	66.8	2.5	5440	1875	125
RW275S (269), 32MPa, N12-250 vert. Each Face, N12 hor.	Each Face (≤1%)	3000	269	57	0.34	3470	1291	62
RW275S (269), 50MPa, N28-200 vert. Each Face, N16 hor.	EF Tens. Only	3000	269	67	2.3	6150	2018	148
RW300S (294), 32MPa, N16-300 vert. Each Face, N12 hor.	Each Face (≤1%)	3000	294	45	0.46	4110	1411	82
RW300S (294), 50MPa, N28-200 vert. Each Face, N16 hor.	EF Tens. Only	3000	294	45	2.1	7370	2205	209

Limited Ductile Wall Detailing

Standard afs rediwall® Detailing for Limited Ductile Wall Designs in accordance with AS3600-2018 Section 2.2 and Clauses in 14.4 and 14.6. All limited Ductile Walls will have 2 layers of reinforcement.

In general wall fitments are not used in afs rediwall® when designed in accordance to AS3600-2018 Clause 14.6 with f'_c <= 50 MPa. If fitments are required in small areas outside of boundary elements consult the AFS Technical Support for assistance.

Boundary Elements

AS3600-2018 Cl14.6.2 Boundary Elements requires boundary elements where extreme fibre compressive stress exceeds 0.15 f'c. The extent and detailing of the boundary elements are to be determined by the designer.

AFS Rediwall® Boundary Elements have special installation requirements and are only to be installed by AFS approved experienced installers. AFS detailing is to be used unless AFS Technical Suport reviews and approves alternate detailing.

Reinforcement

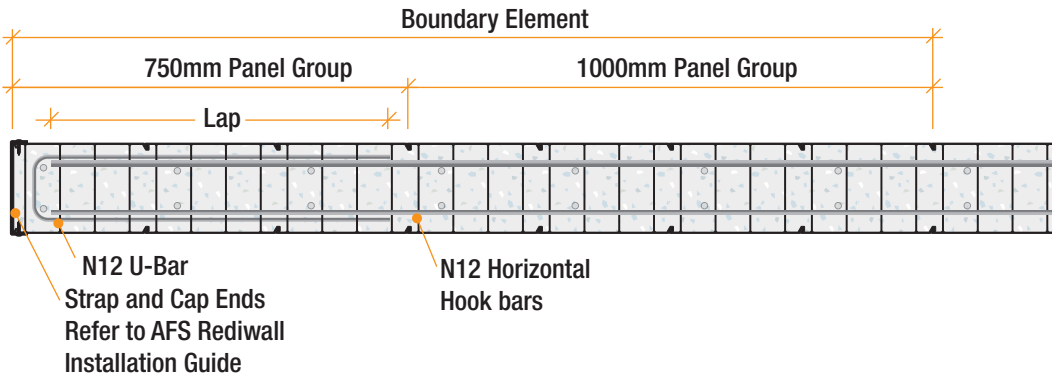
In accordance with AS3600-2018 Cl14.6.7 maximum vertical reinforcement for afs rediwall® shall be 2.1% (Half 21/f_{sy}) including areas with boundary elements and laps. Minimum horizontal and vertical reinforcement shall be 0.0025.

Structures not more than four storeys

'For structures not more than four stories above their structural base and where boundary elements are required' [AS3600 Cl14.6.2.2] the AFS Standard End detail may be used as the boundary element.

AFS Standard Boundary Element will be used at all Boundaries unless specified in the Project Documentation.

Fig A15: AFS Rediwall® Standard Boundary Element Not More Than Four Storeys
Detail to AS3600-2018 Section 14.6.2.2



Structures more than four stories

For structures more than four stories Cl14.6.2.3 requires boundary elements to conform to Cl10.7.4. The AFS Standard Boundary Element below can be installed during installation of the walls.

Fig A16: AFS Standard Boundary Element More Than Four Storeys

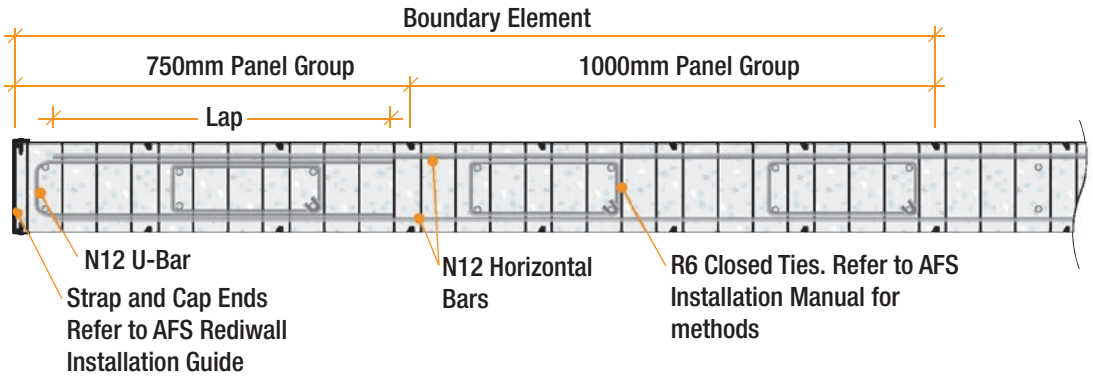
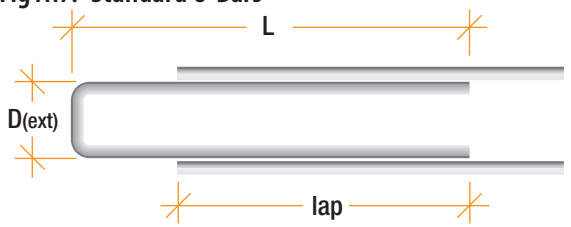


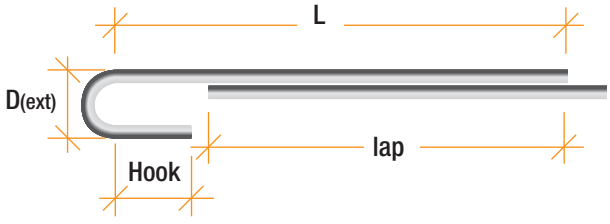
Fig A17: Standard U-Bars



Standard U Bar

Wall Type	Reo	Standard U-Bars			Boundary Element U-Bars		
		Lap	D	L	Lap	D	L
RW200C	N12	450	105	750	500	105	750
RW256S	N12	450	155	750	500	155	750
RW256S	N16	600	155	900	800	155	1050
RW275S	N12	450	175	750	500	155	750
RW275S	N16	600	175	900	800	155	1050
RW300S	N12	450	205	750	500	155	750
RW300S	N16	600	205	900	800	155	1050

Fig A18: Standard Hook Bars



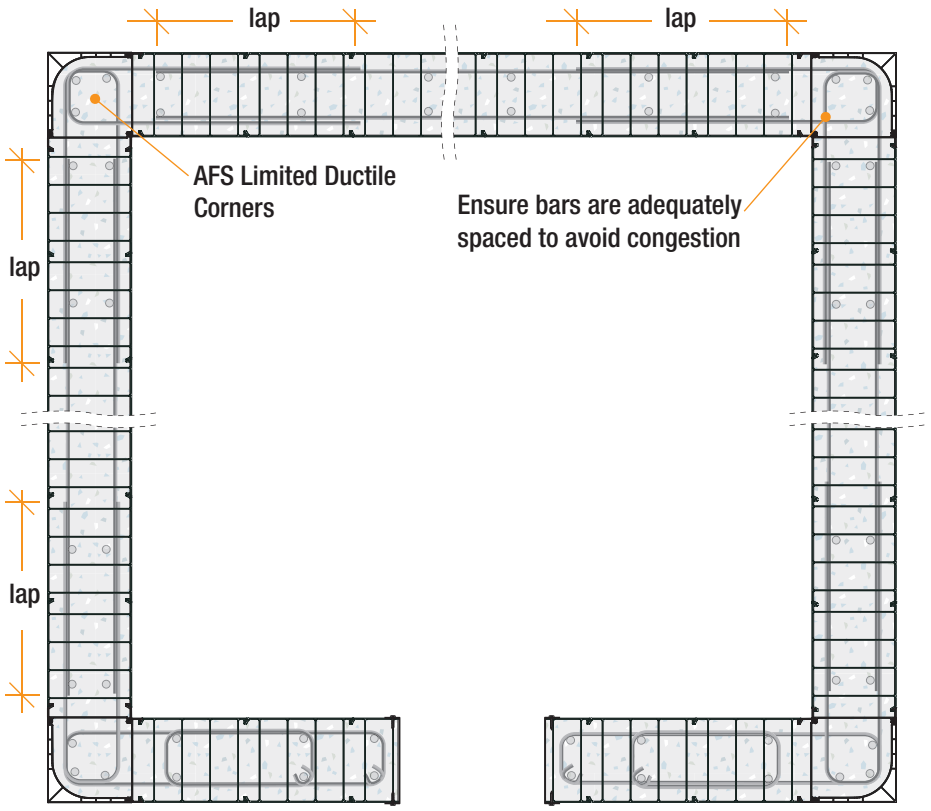
Standard Hook Bar (mm)

Reo	D	L	Hook	Lap	RW110C	RW156C	RW200C
N12	60	550	70	450	Y	Y	Y
N16	80	700	70	600	N	N	Y
Acceptable					Not Recommended		

Boundary elements closed fitments are to be spaced vertically in accordance with Cl 14.6.2 of AS3600-2018 as follows:

- Spaced at lesser of t_w and 200mm
- For structures more than four stories as per Cl 14.6.2.3 of AS3600-2018.

Fig A19: AFS Limited Ductile Core Wall Detailing



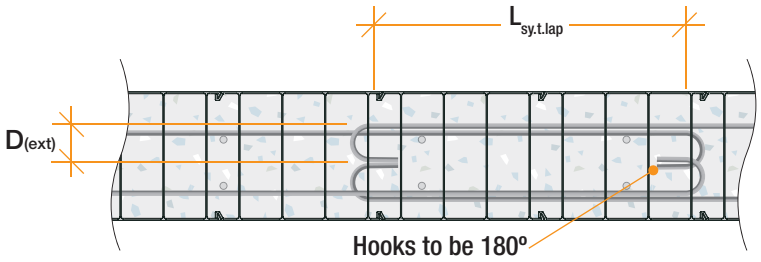
Limited Ductile Wall – Horizontal Reinforcement Laps

AFS recommends only Fig 14.6.7(D) of AS3600-2018 be used where required.

Alternatives to the 14.6.7 detail are:

- Construction joints to split the walls and prevent transfer of in-plane lateral and shear loads.

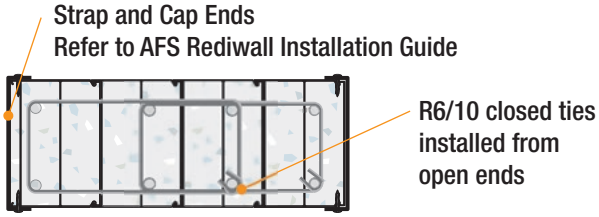
Fig A20: Horizontal Bar Lap Detail 14.6.7(D) from AS3600



Blade Columns

Blade Columns are short walls designed as columns with ligatures to AS3600-2018 Sections 14 and 10.

Fig A21: Rediwall® Blade Column



Junctions

AFS Standard Junctions

Standard single reinforcement junctions are not to be used with Limited Ductile Walls. Junction Joints may be used to structurally isolate walls either side of the junction and prevent transfer of in-plane forces

AFS Special Junctions

Structural Documentation is to specify where Special Junctions are to be used. If detailing is required beyond these special junctions AFS Technical Support is to be consulted and detailing reviewed.

Special Limited Ductile Junction Details – Without Boundary Elements

Fig A22: Corner Type 1

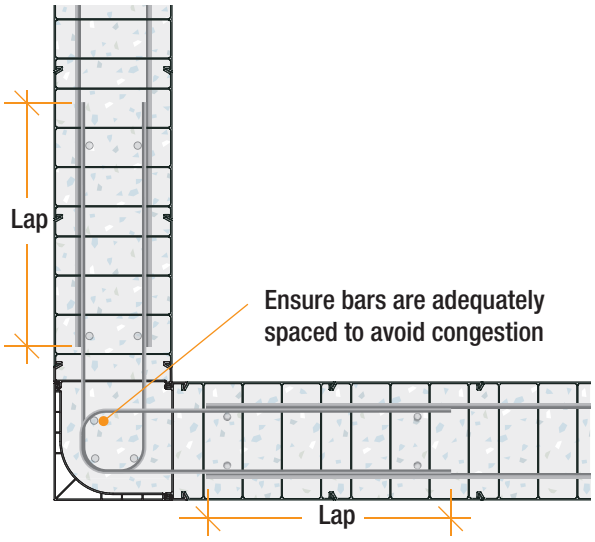


Fig A23: Special T-Junction

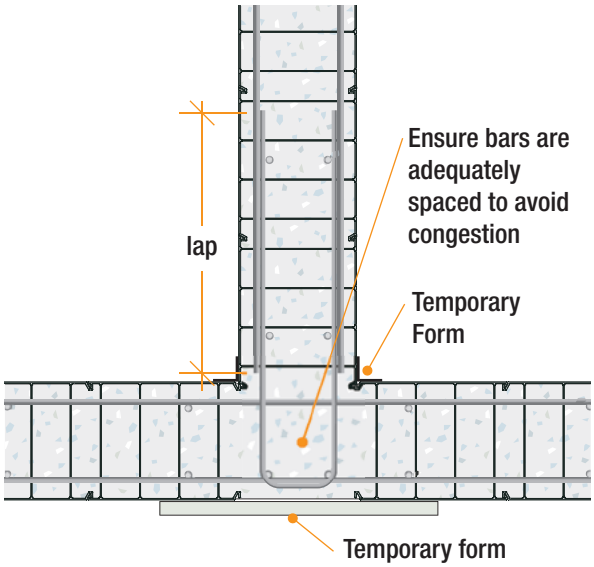
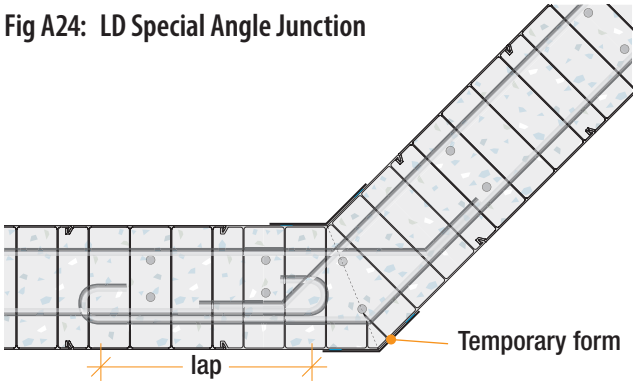


Fig A24: LD Special Angle Junction

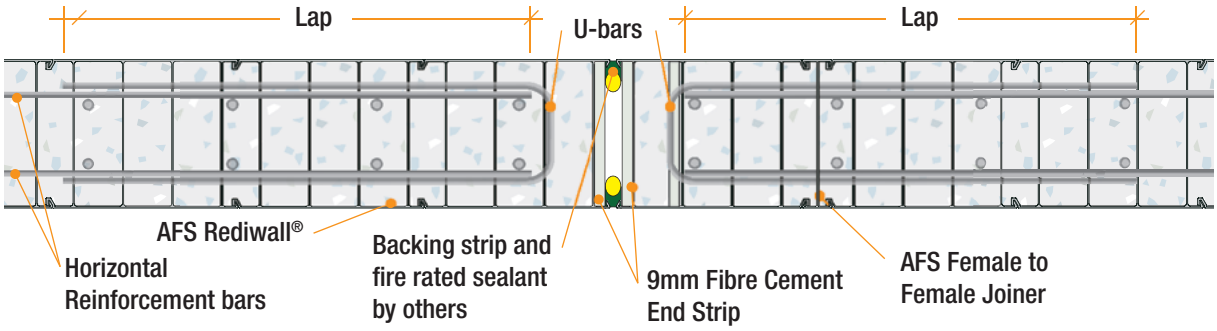


Movement Joints

Movement Joints will be required over any building joints and where specified on the Project Documentation

The structural concrete wall effectively has control joints at each stud so no additional crack control joints are necessary. Full depth 'movement joints' may be required depending on the geometry of the structure and other considerations such as thermal loads, exposure and building joints. In general 'movement joints' would not be required for walls less than 16m long. Structural movement joints will be placed in locations nominated by the structural engineer and must be documented on structural drawings. These will be installed at construction stage by the afs rediwall® installation contractor.

Fig A25: Rediwall® Movement joint

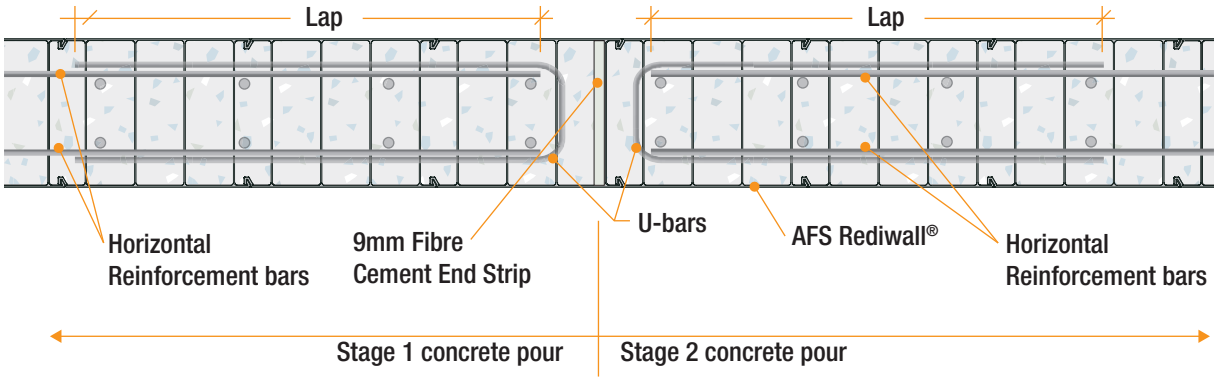


Note: Installed where nominated by project engineer. Must be clearly documented on drawings. Typically not required in walls less than 16m in length.

Construction Joint

Construction Joints can be used wherever a pour break is required. Walls may be split to prevent transfer of in-plane forces. Locations are to be specified on the Project Documentation.

Fig A26: Rediwall® Construction Joint



Wall Junctions Joints

Junction Joints to structurally isolate walls either side of the junction and prevent transfer of inplane forces.

Fig A27: Rediwall® Corner Joint

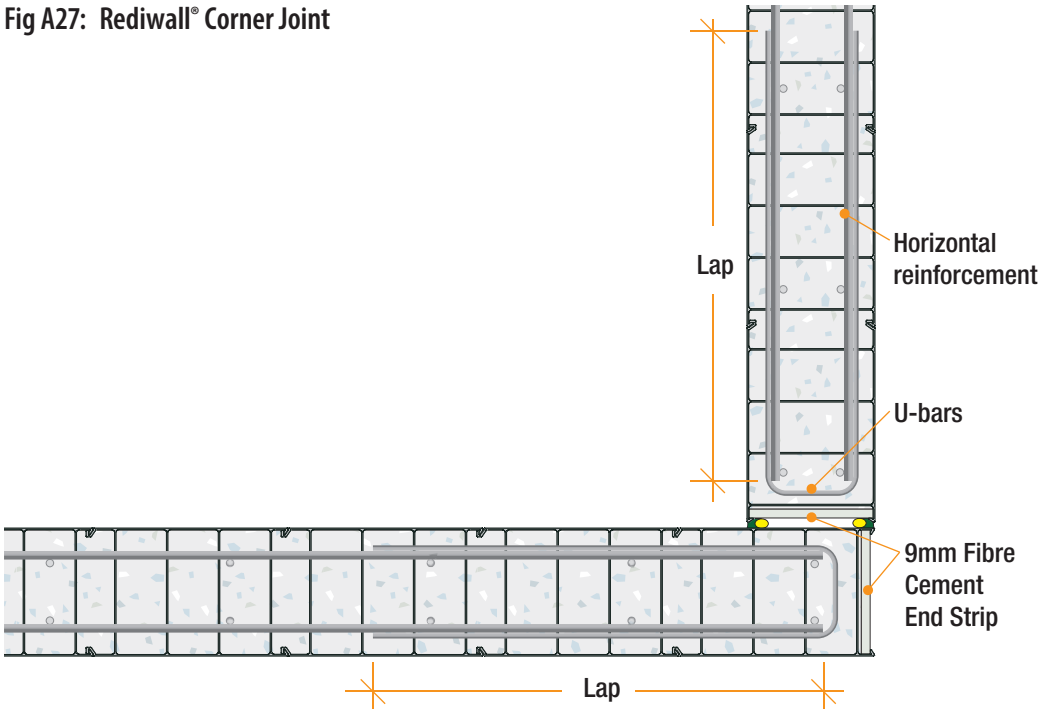
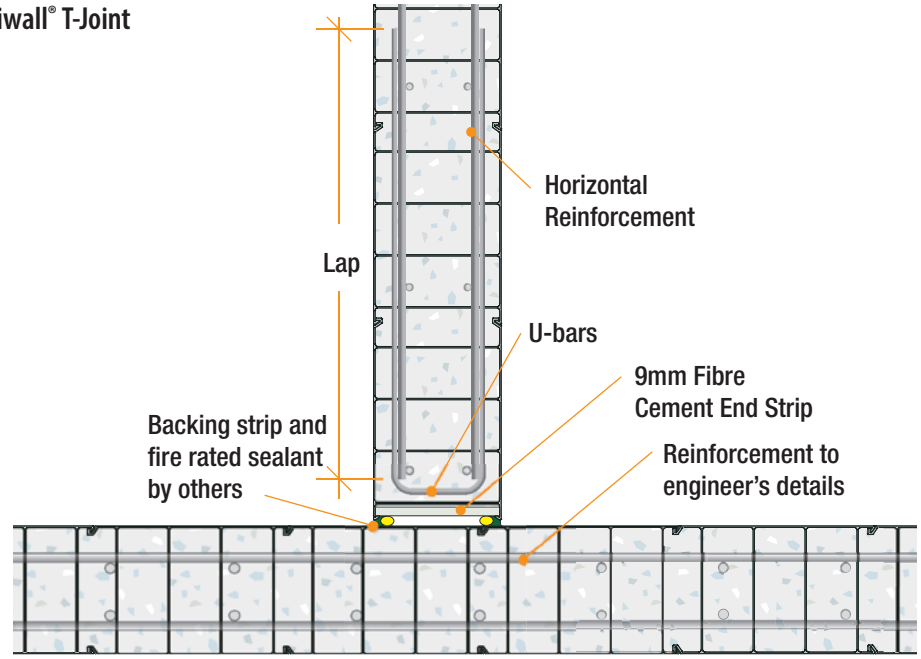


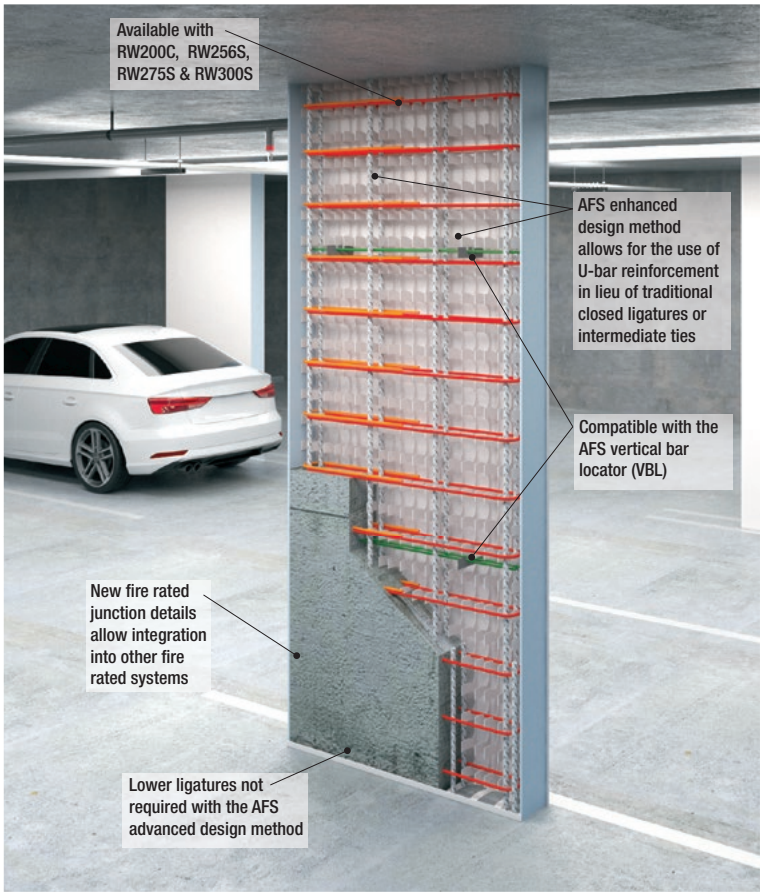
Fig A28: Rediwall® T-Joint



AFS Rediwall® Blade Columns

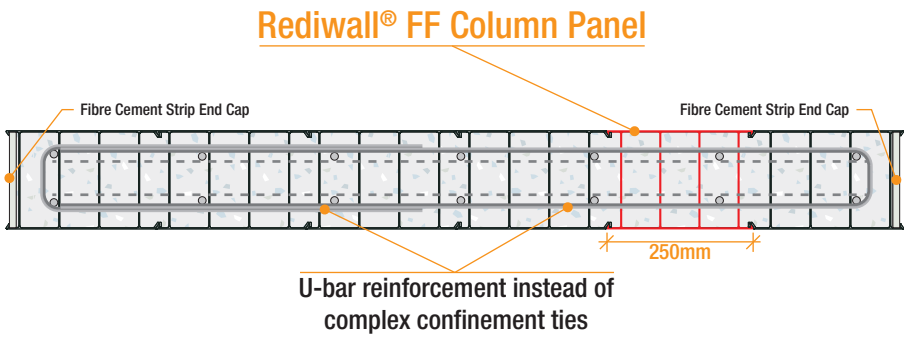
Introduction

AFS in conjunction with the Centre for Infrastructure Engineering, Western Sydney University (WSU) evaluated performance of AFS Rediwall® Blade Columns with simplified detailing utilising the standard U-bars instead of traditional closed ligatures or intermediate ties. The elimination of ties within the limitations detailed in this guide, simplifies design, detailing and installation of AFS Rediwall® Permanent Formwork systems. These methods can be used by the designer to significantly increase the speed of installation, improve construction flexibility and reduce construction costs while continuing to meet the compliance requirements of AS3600-2018 Amendment 2 and the NCC.



Rediwall® RW200C FF Column Panel

The RW200C FF (Female-Female) Column Panel can be use to reverse the ends of a panel section. This is particularly useful during column construction when fibre cement end caps are required. Reversing the panel end results in a female end being present at both ends of the column, allowing for the installation of neat fibre cement end caps.



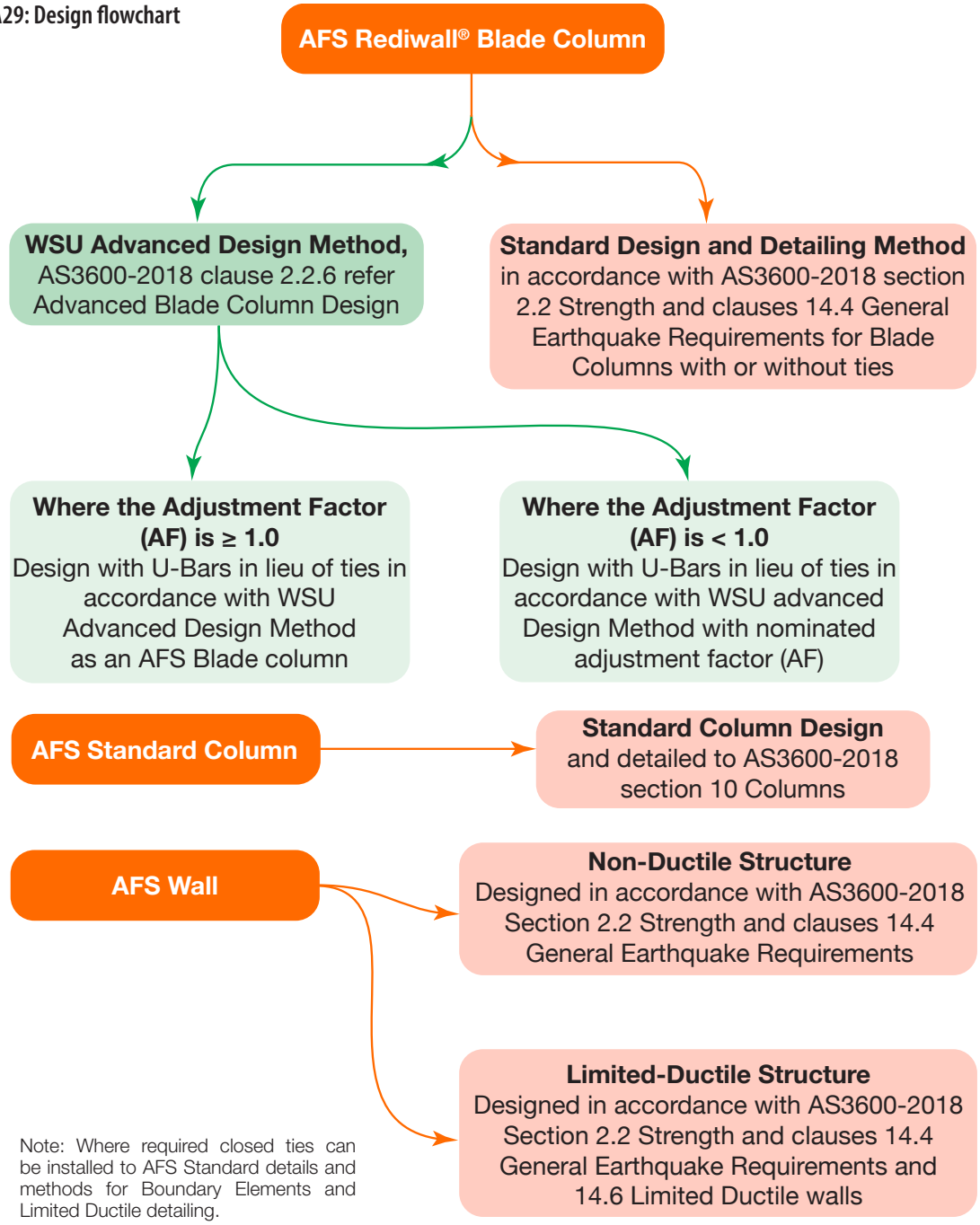
Compliance and Verification

AFS Blade Column capacities have been load tested and verified by Western Sydney University using existing Deemed To Satisfy (DTS) and alternate performance design methods for the performance equivalence U-bars without ties to walls designed as columns with ties in accordance with the AS3600-2018 Strength check procedure for use with non-linear stress analysis.

The Advanced Design for AFS Blade Columns with end U-bars in-lieu of ligatures has been developed to AS3600-2018 clause 2.1.1 Design for strength and serviceability, in accordance with clause 2.2.6 Strength check procedure for use with non-linear stress analysis using Advanced Finite Element non-linear stress analysis (ABAQUS) and comparative physical prototype testing to Appendix B3 Proof Testing of Members and Structures, to evaluate the structural performance of AFS Blade Columns with reduced reinforcing steel tie complexity under eccentric axial load.

Existing AS3600-2018 Design Methods and the new Advanced Design Methods are summarised in the following Design Flowchart:

FIG A29: Design flowchart



Note: Where required closed ties can be installed to AFS Standard details and methods for Boundary Elements and Limited Ductile detailing.

AFS Rediwall® Advanced Blade Column Design

The AFS Rediwall® Advance Blade Columns design is in accordance with AS3600-2018 Section 10 provided the restraint provisions are satisfied within the provision of the WSU report[1] referring to clause 11.7.4 (a) & (b) Restraint of Vertical Reinforcement for Walls.

Detailing is as for walls designed as columns in accordance with AS3600-2018 clause14.4.4 General Requirements, Structural Walls with the end U-bars replacing the closed ties.

AS3600-2018 11.7.4 Restraint of Vertical Reinforcement

In addition to providing transverse reinforcement required for any design actions, the following restraint to vertical reinforement provisions shall be satisfied:

(a) For all walls in structures with a structural ductility factor (μ) greater than 1.0, the vertical reinforcement shall be restrained in accordance with Clause 14.6

(b) For walls with concrete strength not exceeding 50MPa and designed as columns in accordance with Section 10, the vertical reinforcement shall be restrained in accordance with Clause 10.7.4 unless one or more of the following conditions is met, in which case no restraint is required:

(i) $N^* \leq 0.5\ \varnothing N_{\mu}$

(ii) The vertical reinforcement is not used as compressive reinforcement.

(iii) The vertical reinforcement ratio is not greater than 0.01 and minimum horizontal reinforcement ratio or 0.0025 is provided.

Non-Ductile AFS Rediwall Blade Columns can be designed to AS3600-2018 as Columns with U-bars in lieu of ties utilising the adjustment factor relevant to various design parameters according to the following WSU findings:

1. For AFS-Rediwall detailed with end U-bars and no ligatures AS3600-2018 reference interaction diagram can be used utilising the adjustment factor relevant to various design parameters in the table below.

TABLE A4: WSU adjustment factor table for afs rediwall®

Concrete strength (MPa)	Vertical reinforement (P_{wv})	Wall Length (L_w)		
		≤ 600	≤ 1500	≤ 2500
		Adjustment Factor		
32	< 0.5%	1.00	1.00	0.95
	0.5% to 1.0%	1.00	1.00	0.95
	1.0% to 2.2%	1.00	1.00	1.00
40	< 0.5%	1.00	1.00	0.95
	0.5% to 1.0%	1.00	0.95	0.90
	1.0% to 2.2%	1.00	1.00	1.00
50	< 0.5%	1.00	0.95	0.90
	0.5% to 1.0%	1.00	0.90	0.90
	1.0% to 2.2%	1.00	1.00	1.00

Note: for ρ > 1% all compressive reinforcement was excluded for calculating interaction curves as per AS3600
- Refer Figure14 p52 WSU Report - for further deatils

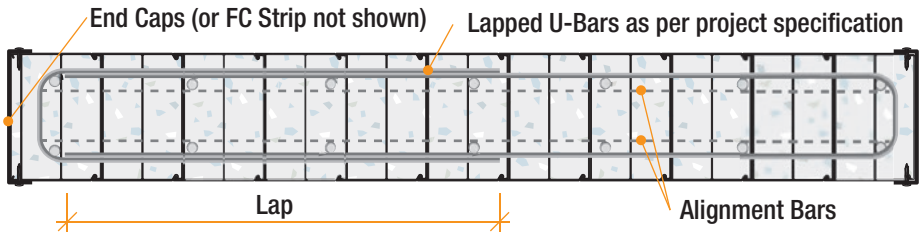
2. The moment magnifier technique of AS3600:2018 can conservatively be used to modify moment capacity for AFS encased columns for slenderness effects, (refer clause 6.5.3)
3. Since the ratio of the larger to smaller cross-sectional dimension for the majority cases of afs rediwall® columns exceeds 3.0, biaxial bending and compression shall be satisfied as per clause 10.6.4 AS3600, (refer to Section 6.6)
4. For afs rediwall® systems acting as part of seismic-lateral-bearing system with limited ductility criteria as per AS3600-2018 (μ=2 and s_p=0.77), the additional checks for boundary element confinement using strength index method shall be conducted
5. The report is for Non-Ductile Blade Column design only as section 14.6 Limited Ductile Design requirements were not included

Non-Ductile AFS Blade Columns can be designed in accordance with AS3600-2018 clause 14.2.2 for strength for the calculated horizontal drifts. In other words, for the vertical loads with an offset equaling the inter story drift which produces an additional bending moment along the major axis of the element.

Design Examples

The following examples of AFS Blade Column solutions use the WSU AFS Advanced Blade Design methodology. Refer to the appropriate Blade Column Axial Capacity design table found in this document for detailed information.

FIG A30: Typical Blade Column

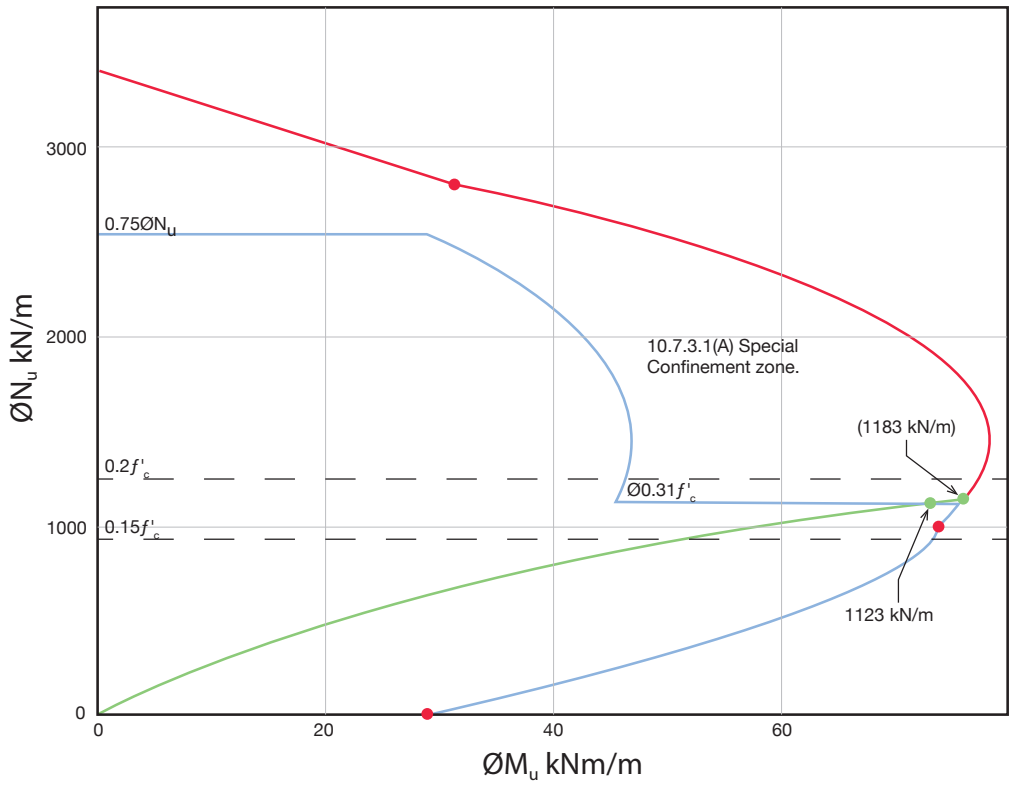


Example 1 – For an RW200C Blade Column 1500 long

From RW200 Design Table $\emptyset N_u$ = 1123 kN/m x 1500mm = 1684 kN

Values in tables were generated from standard moment interaction curves and moment magnifier loading. Check detailing against points 1 to 6 in 'WSU AFS Advanced Blade Design' section.

FIG A31: Moment interaction chart: RW200C, H_{wu}=3000mm, k=0.75, 50MPa, 2N20-200 vert, N12-233 horizontal U-bars each side



Note: AS3600-2018 14.6.2.3 Limited Ductile Structures of more than four storeys stress limits for longitudinal reinforcement restraint limits of 0.2f'$_c$ and Boundary Elements requirement of 0.15f'c have been shown for comparison.

TABLE A5: FRP structural adequacy from AS3600-2018 clause 5.7.2

RW200C FRP Structural Adequacy	90 minutes	120 minutes	180 minutes
RW200, exposed one side, built in to fire separating wall	u_{fi} =0.7	u_{fi} =0.7	u_{fi} =0.53
RW200 x:y > 4,exposed two sides not built into fire separating walls	u_{fi} =0.7	u_{fi} =0.62	u_{fi} =0.31

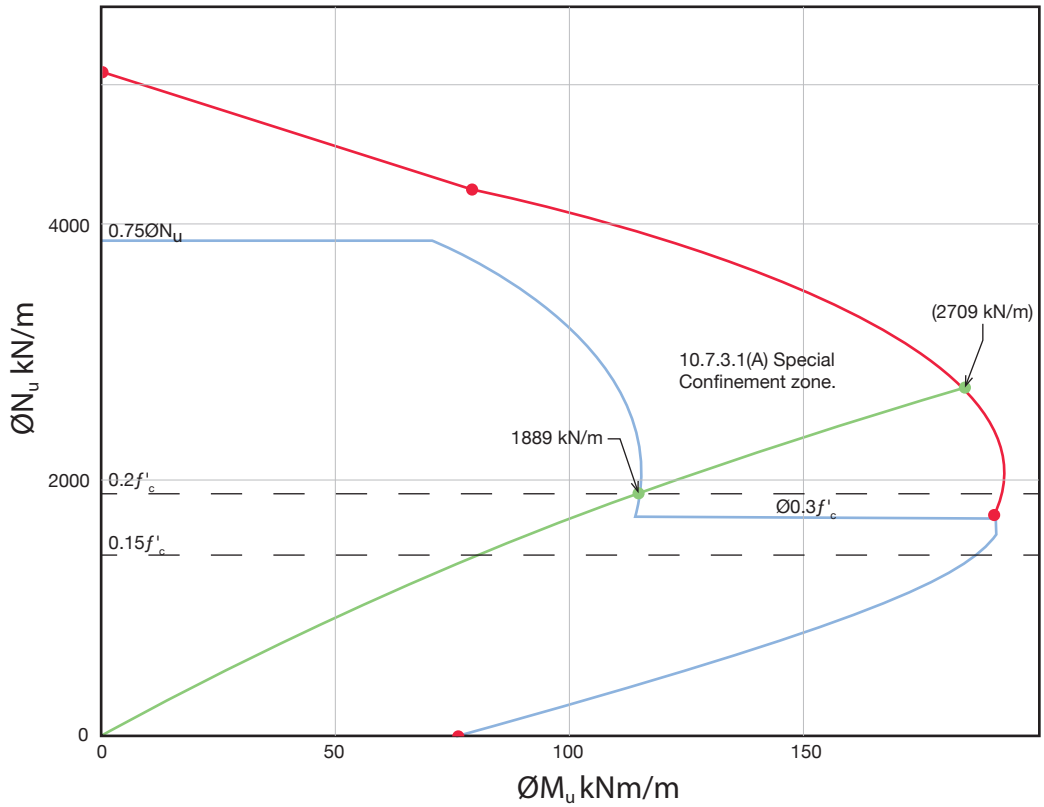
• a_s= 55mm (d_h=41+(N16+N12)/2), D=195mm, H_{we} < 7800, $u_{fi}=N^*_f/\emptyset N_u$

Example 2 – For an RW300S Blade Column 2500 long

From RW300 Design Table $ØN_u$ = 1889 kN/m x 2500mm = 4722 kN

Values in tables were generated from standard moment interaction curves and moment magnifier loading. Check detailing against points 1 to 6 in 'WSU AFS Advanced Blade Design' section.

FIG A32: Moment interaction chart: RW300S x2500long , H_{wu}=3000mm, k=0.75, 32MPa, 2N16-300 vert, N12-233 horizontal U-bars each end



Note: AS3600-2018 14.6.2.3 Limited Ductile Structures of more than four storeys stress limits for longitudinal reinforcement restraint limits of $0.2f'_c$ and Boundary Elements requirement of 0.15f'c have been shown for comparison.

TABLE A6: FRP structural adequacy from AS3600-2018 clause 5.7.2

RW300S FRP Structural Adequacy	90 minutes	120 minutes	180 minutes	240 minutes
Built into fire separating wall, exposed one side,	u_{fi} =0.7	u_{fi} =0.7	u_{fi} =0.7	u_{fi} =0.7
Isolated Blade, x:y > 4, B>1200, exposed two sides	u_{fi} =0.7	u_{fi} =0.7	u_{fi} =0.7	u_{fi} =0.54
Isolated Blade, x:y < 4, B<1200, exposed four sides, [Eq 5.6.3(2)]	u_{fi} =0.7	u_{fi} =0.5	u_{fi} =0.15	–

• a_s= 55mm (d_h=41+(N16+N12)/2), D=295mm, H_{we} < 7800, u_{fi}=$N^*_f/ØN_u$

AFS Rediwall® Advanced Column Design Tables

The following afs rediwall® design tables have been prepared utilising moment interaction curves and moment magnifier in accordance with the Advanced Design Methods to determine the member capacities for non-ductile vertical load bearing Blade Columns. Other column design tools can also be used provided they account for the adopted clause 11.7.4(b) where for vertical reinforcement ratios exceed 0.01 the vertical reinforcement is not used as compression reinforcement and concrete strength does not exceed 50MPa.

RW200C Blade Column Structural Capacity

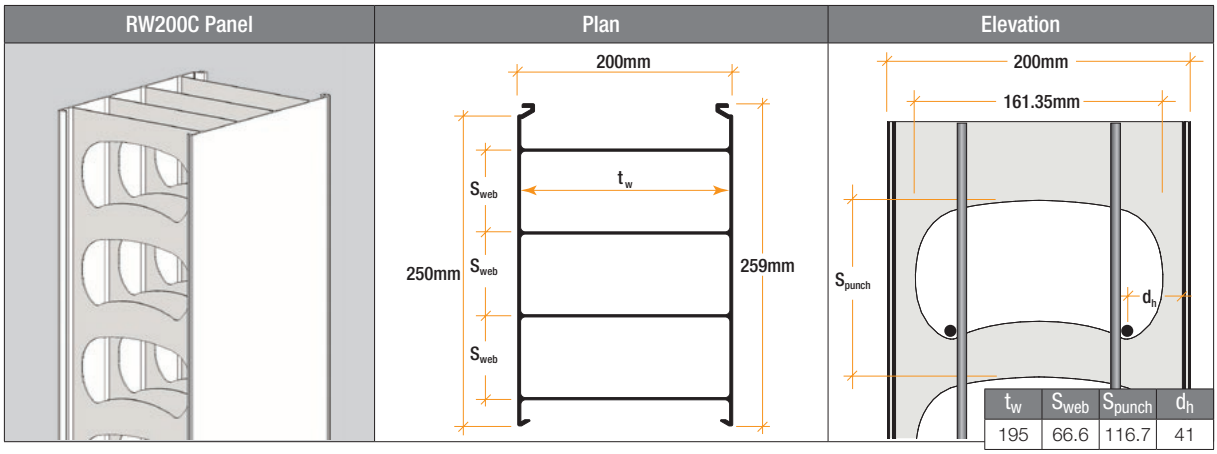
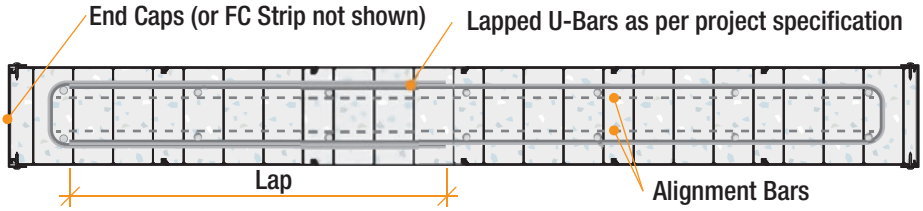


FIG A33: RW200C typical Blade Column



RW200C Blade Column Axial Capacity ØN$_u$ (kN/m) Non-Ductile 2 Layers

AFS Rediwall® Axial Loaded Blade Columns with U-bars in lieu of ties in accordance with 'AFS Logicwall® and AFS Rediwall® axial-flexural interaction curve generation numerical and theoretical investigations', Western Sydney University and AS3600-2018 Amdt 2 clause11.7.4(b) Restraint.

		ØN$_u$(kN/m), Vertical Bars, f'_c 32 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 40 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 50 Mpa		
ecc < 1/6	Hwu(k=1.0)	2N12-300	2N20-300	2N20-200	2N12-300	2N20-300	2N20-200	2N12-300	2N20-300	2N20-200
H_{wu}(k=0.75)	H_{we}	0.0039	0.0107#1	0.0161#1	0.0039	0.0107#1	0.0161#1	0.0039	0.0107#1	0.0107#1
5500	4125	486	537	579	575	629	680	679	734	792
5000	3750	567	622	668	672	732	783	794	856	918
4500	3375	670	722	777	795	855	911	940	1006	1066
4000	3000	798	847	907	950	1003	1068	1127	1182	1252
3600	2700	921	967	1030	1100	1148	1217	1309	1357	1431
3200	2400	1062	1106	1123	1271	1319	1387	1516	1565	1639
3000	2250	1123	1123 (1183)	1123 (1243)	1372	1404	1404 (1480)	1640	1681	1754
2800	2100	1123 (1233)	1123 (1263)	1123 (1321)	1404 (1482)	1404 (1513)	1404 (1577)	1755	1755 (1805)	1755 (1876)
0.15f'_c Lateral limit		936			1170			1463		
Max Blade Length#2		1500 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)	

Number in brackets designates lower value where clause 10.7.3.1(2) applies.
#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)
#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0
#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

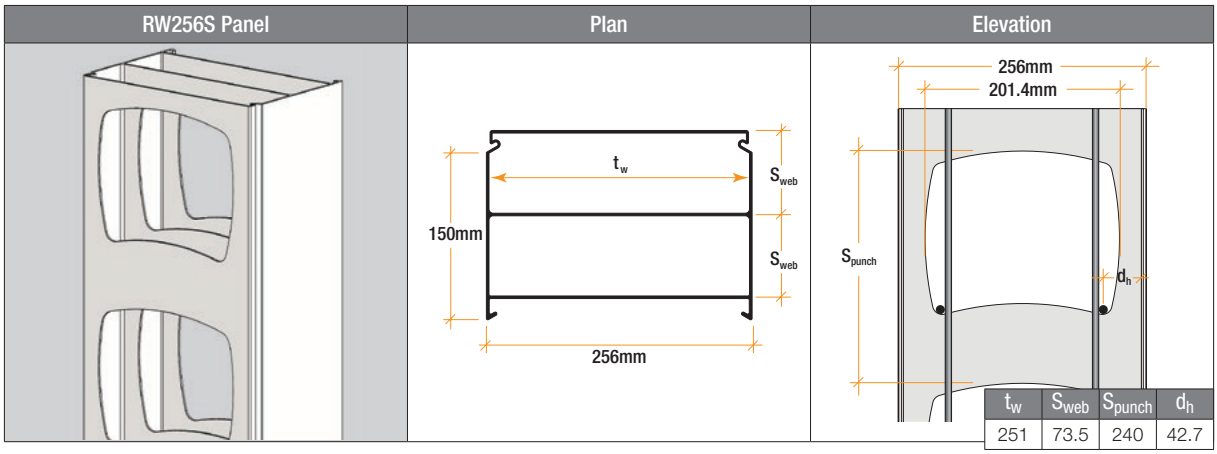
RW200C Minimum Reinforcement

RW200C	Vertical Bars - Each Face			
Allowable Bars	N12	N16	N20	N24
N12 Horizontal				
N16 Horizontal				

Horizontal Bar Spacing 233/350
Vertical Bar Spacing 150 to 350

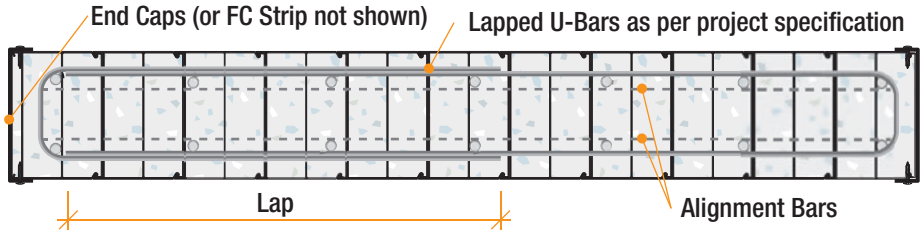
Acceptable
With Caution
Not Recommended

RW256S Blade Column Structural Capacity



t_w	S_{web}	S_{punch}	d_h
251	73.5	240	42.7

FIG A34: RW256S typical Blade Column



RW256S Blade Column Axial Capacity ØN$_u$ (kN/m) Non-Ductile 2 Layers

AFS Rediwall® Axial Loaded Blade Columns with U-bars in lieu of ties in accordance with 'AFS Logicwall® and AFS Rediwall® axial-flexural interaction curve generation numerical and theoretical investigations', Western Sydney University and AS3600-2018 Amdt 2 clause 11.7.4(b) Restraint.

		ØN$_u$(kN/m), Vertical Bars, f'_c 32 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 40 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 50 Mpa		
ecc < 1/6	H_{wu}(k=1.0)	2N12-300	2N20-300	2N24-200	2N12-300	2N20-300	2N24-200	2N12-300	2N20-300	2N24-200
H_{wu}(k=0.75)	H_{we}	0.0030	0.0084	0.0107#1	0.0030	0.0084	0.0107#1	0.0030	0.0084	0.0107#1
5500	4125	1011	1182	1239	1202	1378	1449	1425	1604	1689
5000	3750	1162	1334	1386	1384	1562	1627	1644	1826	1903
4500	3375	1332	1440 (1515)	1440 (1548)	1592	1775	1800	1895	2079	2145
4000	3000	1440 (1518)	1440 (1720)	1440 (1721)	1800	1800 (2024)	1800 (2042)	2172	2250 (2378)	2250 (2413)
3600	2700	1440 (1693)	1440 (1900)	1440 (1862)	1800 (2034)	1800 (2243)	1800 (2223)	2250 (2437)	2250 (2645)	2250 (2641)
3200	2400	1440 (1878)	1505 (2086)	1504 (2001)	1800 (2263)	1800 (2473)	1800 (2403)	2250 (2721)	2250 (2929)	2250 (2872)
3000	2250	1440 (1970)	1559 (2179)	1546 (2068)	1800 (2379)	1832 (2588)	1844 (2490)	2250 (2865)	2250 (3072)	2250 (2986)
2800	2100	1440 (2062)	1614 (2270)	1587 (2131)	1800 (2493)	1899 (2702)	1897 (2574)	2250 (3007)	2250 (3213)	2255 (3096)
0.15f'_c Lateral limit#3		1200			1500			1875		
Max Blade Length#2		1500 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)	

Number in brackets designates lower value where clause 10.7.3.1(2) applies.
#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)
#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0
#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

RW256S Minimum Reinforcement

RW256C	Vertical Bars - Each Face			
Allowable Bars	N12	N16	N20	N24
N12 Horizontal				
N16 Horizontal				

Horizontal Bar Spacing 240
Vertical Bar Spacing 150 to 350

Acceptable
With Caution
Not Recommended

RW275S Blade Column Structural Capacity

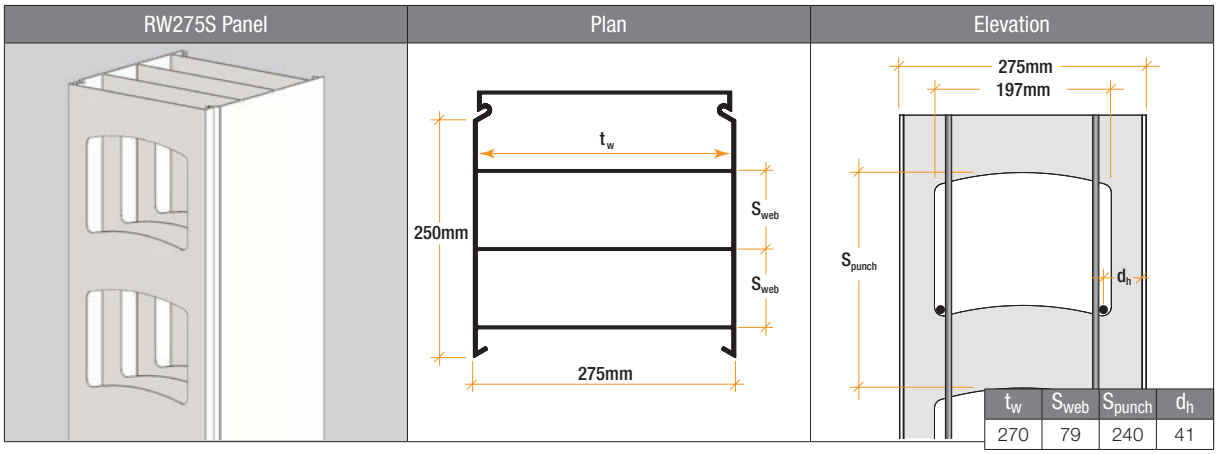
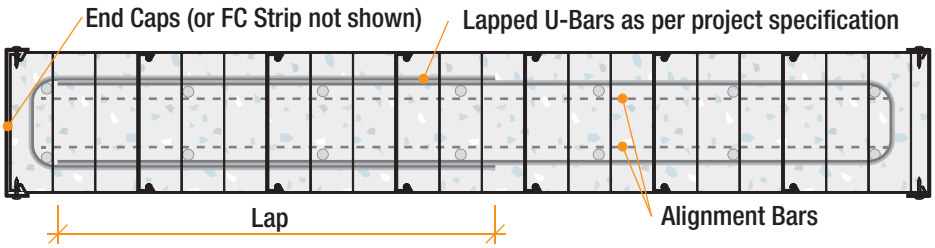


FIG A35: RW275S typical Blade Column



RW275S Blade Column Axial Capacity ØN$_u$ (kN/m) Non-Ductile 2 Layers

AFS Rediwall® Axial Loaded Blade Columns with U-bars in lieu of ties in accordance with 'AFS Logicwall® and AFS Rediwall® axial-flexural interaction curve generation numerical and theoretical investigations', Western Sydney University and AS3600-2018 Amdt 2 clause 11.7.4(b) Restraint.

		ØN$_u$(kN/m), Vertical Bars, f'_c 32 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 40 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 50 Mpa		
ecc < 1/6	H$_{wu}$(k=1.0)	2N16-300	2N20-300	2N24-200	2N12-300	2N20-300	2N24-200	2N12-300	2N20-300	2N24-200
H$_{wu}$(k=0.75)	H$_{we}$	0.005	0.0078	0.0107#1	0.0028	0.0078	0.0107#1	0.0028	0.0078	0.0107#1
5500	4125	1333	1431	1480	1571	1675	1737	1848	1955	2032
5000	3750	1498	1549 (1605)	1549 (1639)	1774	1880	1931	2094	2199	2268
4500	3375	1549 (1687)	1549 (1804)	1549 (1809)	1937 (2000)	1937 (2119)	1937 (2143)	2366	2421 (2487)	2421 (2529)
4000	3000	1549 (1901)	1549 (2023)	1549 (1984)	1937 (2262)	1937 (2385)	1937 (2365)	2421 (2687)	2421 (2811)	2421 (2808)
3600	2700	1549 (2083)	1601 (2206)	1603 (2122)	1937 (2486)	1937 (2611)	1937 (2544)	2421 (2963)	2421 (3088)	2421 (3037)
3200	2400	1591 (2265)	1710 (2388)	1688 (2254)	1937 (2713)	2008 (2838)	2014 (2717)	2421 (3245)	2421 (3370)	2421 (3261)
3000	2250	1645 (2353)	1764 (2476)	1728 (2317)	1949 (2823)	2075 (2948)	2066 (2799)	2421 (3383)	2437 (3507)	2456 (3368)
2800	2100	1698 (2438)	1817 (2561)	1768 (2375)	2014 (2930)	2140 (3054)	2117 (2878)	2421 (3516)	2518 (3640)	2521 (3471)
0.15f'_c Lateral limit#3		1291			1614			2018		
Max Blade Length#2		1500 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)	

Number in brackets designates lower value where clause 10.7.3.1(2) applies.
#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)
#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0
#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

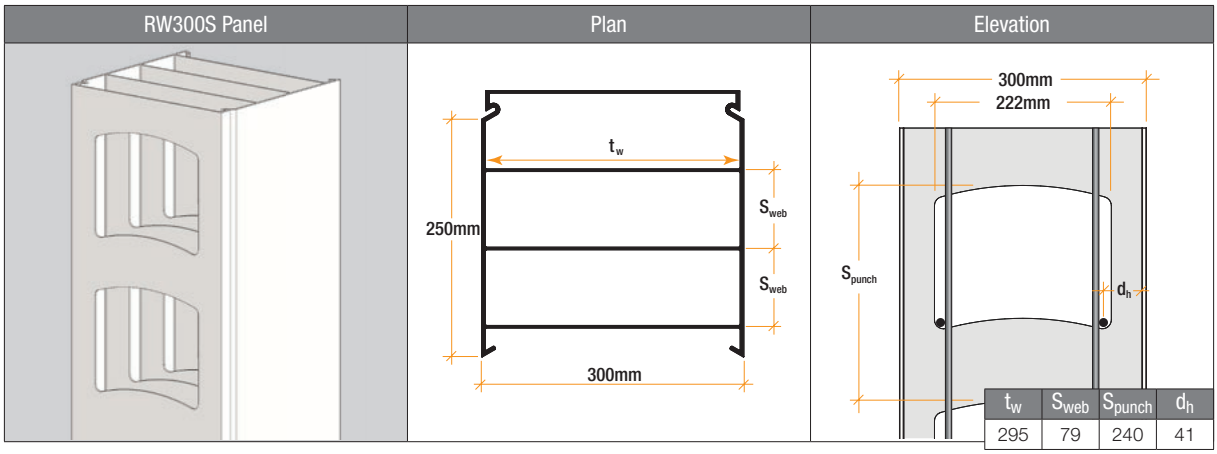
RW275S Minimum Reinforcement

RW275S	Vertical Bars - Each Face				
Allowable Bars	N12	N16	N20	N24	N28
N12 Horizontal					
N16 Horizontal					

Horizontal Bar Spacing 240
Vertical Bar Spacing 150 to 350

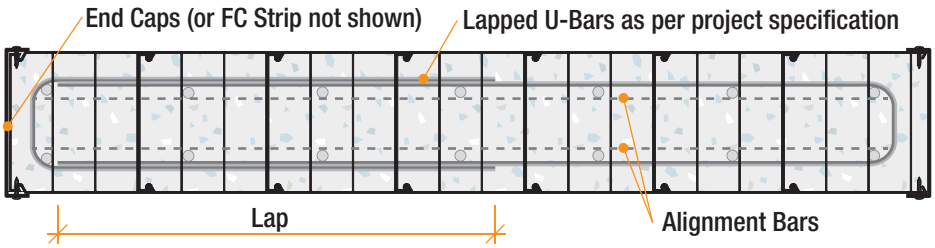
Acceptable
With Caution
Not Recommended

RW300S Blade Column Structural Capacity



t_w	S_{web}	S_{punch}	d_h
295	79	240	41

FIG A36: RW300S typical Blade Column



RW300S Blade Column Axial Capacity ØN$_u$ (kN/m) Non-Ductile 2 Layers

AFS Rediwall® Axial Loaded Blade Columns with U-bars in lieu of ties in accordance with 'AFS Logicwall® and AFS Rediwall® axial-flexural interaction curve generation numerical and theoretical investigations', Western Sydney University and AS3600-2018 Amdt 2 clause 11.7.4(b) Restraint.

		ØN$_u$(kN/m), Vertical Bars, f'_c 32 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 40 Mpa			ØN$_u$(kN/m), Vertical Bars, f'_c 50 Mpa		
ecc < 1/6	H_{wu}(k=1.0)	2N16-300	2N20-300	2N24-200	2N16-300	2N20-300	2N24-200	2N16-300	2N20-300	2N24-200
H_{wu}(k=0.75)	H_{we}	0.0046	0.0071	0.0107#1	0.0046	0.0071	0.0107#1	0.0046	0.0071	0.0107#1
5500	4125	1659	1693 (1779)	1693 (1807)	1963	2083	2117	2318	2437	2504
5000	3750	1693 (1843)	1693 (1976)	1693 (1976)	2117 (2185)	2117 (2321)	2117 (2341)	2585	2646 (2723)	2646 (2763)
4500	3375	1693 (2053)	1693 (2191)	1693 (2150)	2117 (2442)	2117 (2582)	2117 (2561)	2646 (2899)	2646 (3041)	2646 (3039)
4000	3000	1693 (2276)	1758 (2416)	1758 (2322)	2117 (2717)	2117 (2859)	2117 (2783)	2646 (3239)	2646 (3382)	2646 (3322)
3600	2700	1731 (2456)	1866 (2595)	1842 (2454)	2117 (2941)	2189 (3082)	2196 (2955)	2646 (3516)	2646 (3658)	2646 (3544)
3200	2400	1837 (2628)	1972 (2766)	1923 (2575)	2177 (3156)	2320 (3296)	2300 (3116)	2646 (3785)	2727 (3926)	2736 (3754)
3000	2250	1889 (2709)	2024 (2846)	1961 (2632)	2241 (3258)	2385 (3397)	2350 (3191)	2656 (3913)	2807 (4052)	2800 (3853)
2800	2100	1939 (2785)	2075 (2922)	1998 (2685)	2305 (3354)	2448 (3492)	2398 (3261)	2735 (4034)	2885 (4172)	2862 (3945)
0.15f'_c Lateral limit#3		1411.2			1764			2205		
Max Blade Length#2		1500 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)		600 (0.5 to 1.0%)	2500 (1.0 to 2.2%)	

Number in brackets designates lower value where clause 10.7.3.1(2) applies.
#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)
#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0
#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

RW300S Minimum Reinforcement

RW300S	Vertical Bars - Each Face (min. N12-350)				
Allowable Bars	N12	N16	N20	N24	N28
N12 Horizontal					
N16 Horizontal					

Horizontal Bar Spacing 240
Vertical Bar Spacing 150 to 350

Acceptable
With Caution
Not Recommended

AFS Rediwall® Fire Performance

AFS Rediwall® has been fire tested and assessed. Stephen Grubits & Associates (SGA) have analysed the fire-resistance of afs rediwall® to be in accordance with AS 3600-2018 allowing the FRP of afs rediwall® to be determined for structural adequacy, integrity and insulation.

For more details, refer to the SGA report 2013/277.26 R.1.1 Issued 9/9/2019 'Fire-Resistance of Rediwall® – Determination in accordance with AS 3600'[3].

Fire Rated Junctions

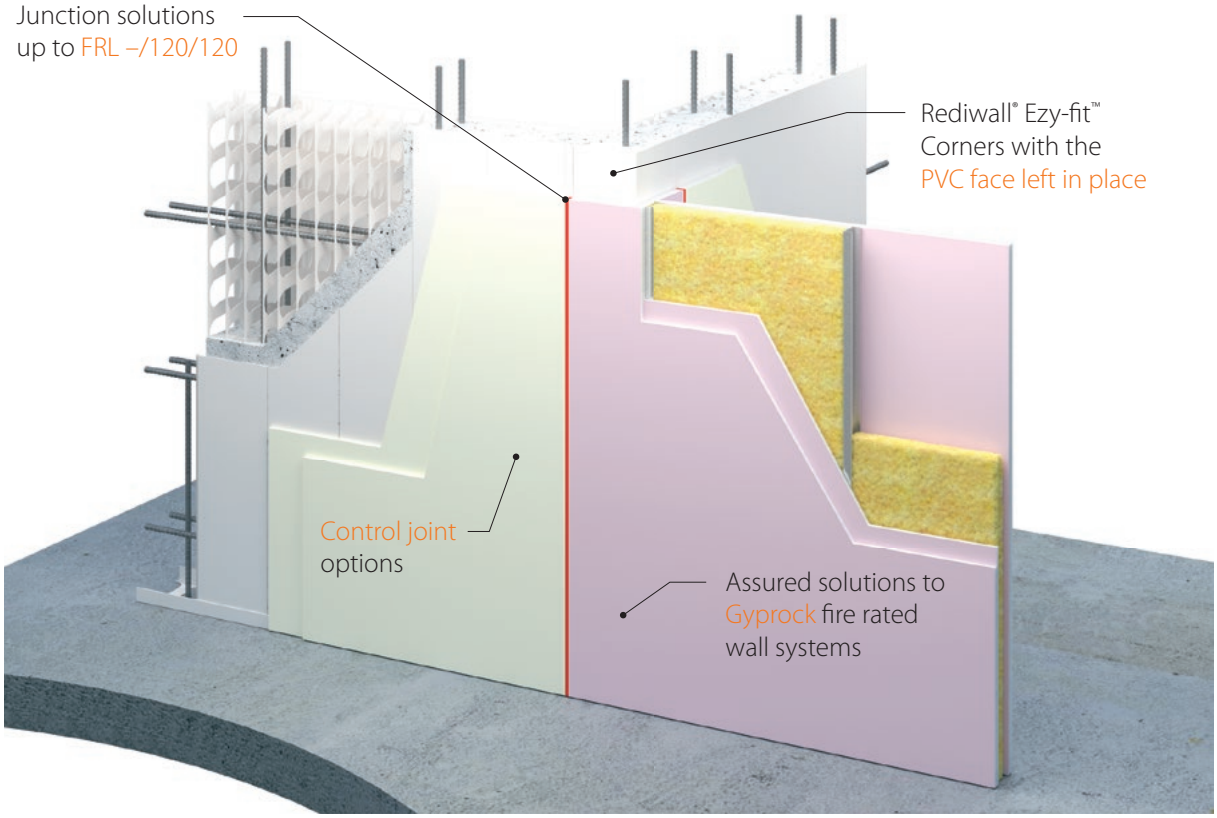
A range of fire junction solutions have been fire tested and assessed to AS1530.4–2014 for the easy integration of various fire rated system and Rediwall®.

The junction details include options to connect afs rediwall® with pvc face left in place, to:

- CSR Gyprock Fyrchek
- CSR Gyprock Shaft Liner Panel
- CSR Hebel
- Concrete and concrete masonry wall systems

For a additional information refer to afs rediwall® Fire Rated Junction Guide or contact AFS Technical Support.

FIG A37: Example of a fire rated junction



Core Filling of Walls

Introduction

AFS Rediwall® is to be filled with AFS special concrete mix. The concrete mix and concrete placement technique is critical to the successful outcome of filling rediwall®.

AFS has carried out tests which achieved desired compaction and dense, homogeneous coverage of afs rediwall®.

This guide sets out the methods used by AFS to achieve suitable compaction.

The contractor or installer is responsible for achieving compaction and dense, homogeneous coverage of the concrete mix in Rediwall®. AFS accepts no responsibility for achieving compaction of the concrete in afs rediwall® or core filling of walls.

Concrete Mix Design

The following afs concrete mix guide shall be used together with concrete placement in accordance with Volume 3 – 'rediwall® Installation Guide' to achieve the requirements of AS3600 – 2018. Reputable concrete suppliers have standard mix designs to achieve these requirements.

Rediwall® Concrete Mix Design Guide

	AFS Rediwall® (Refer to Structural Engineer for Mix specification)				
Strength $f'c$ (MPa)	S25	S32	S40	S50	S65
Target Installation Slump	180±20	180±20	180±20	180±20	180±20
Design Slump (mm)	180	180	180	180	180
Maximum W/C Ratio	0.7	0.6	0.45	0.4	0.35
Nominal Fine to Total Aggregate Percentage (%)	65	60	55	50	50
Maximum Aggregate Size (mm)	10	10	10	10	10
Maximum 56 Day Drying Shrinkage (µm)	1000	1000	1000	1000	1000
Recommended Admixtures	WRPAPN20 (WR) ex Grace, ADVA-142 (HWR) ex Grace, or equivalent				

Notes:

- For higher on-site temperature environments slump at the batching plant may be varied to suit these conditions.
- Site water is allowed to be used to reach desired installation slump however, the maximum W/C ratio must not be exceeded.
- Due to local raw material availability, characteristics will vary significantly, refer to Project Engineer for further details.
- The addition of all admixtures are typically dosed at the beginning of the batch.
- Concrete mix should have a typical 'Gel' time of 30-60min in accordance with the Gel Test detailed in this guide.

Self Compacting Concrete

AFS Approved SCC Mix

The concrete supplier is responsible for providing a Self Compacting Concrete (SCC) Mix design that satisfies the performance requirements of the Building specification, AS3600-2018 and Rediwall concrete specification. The mixing and design for SCC is critical for it's performance to prevent segregation while allow adequate time for pumping and placement prior to consolidation without requiring vibration.

AFS trials and experience have shown that a SCC mix that is designed such that segregation and blowouts are prevented whilst achieving the required level of compaction will have the following characteristics:

- $f'c$ = 32 to 50 MPa, as specified in project documentation
- SCC Spread 500 to 700 mm
- 7-14 mm maximum aggregate
- Long line or pumpable wall mix
- Segregation and consolidation

Small scale trials should be undertaken to confirm performance of any proposed SCC mix prior to approval. Trial to consist of:

- Supplier and plant to have previous experience with SCC mix
- Minimum 3 metre high short wall panel
- Panel to be filled in accordance with this guide
- Braced plain plastic end caps to be used to allow stripping
- End caps to be stripped and inspected for:
  - Segregation
  - Honeycombing
  - Voids.
  - Surface should be relatively uniform with minimal defects.

AFS has undertaken these trials for the following approved SCC suppliers:

- For Sydney Metro Area - Order: (32/40/50) MPa Algiria SCC, 10mm aggregate, Spread 650mm

Pre-Construction

Panels and accessories to be inspected and any damaged or distorted items to be discarded. Gaps or mismatch may result in leaks or failures.

It is important to arrange concrete supply allowing for 90 minute discharge and 15 minute hold limit on site. Each truck should be discharged continuously with minimum of holds. If a leak is observed hold pour until rectified.

For pump clean our It is recommend having material for, bulk cleanout bags or other arrangements.

Wall Detailing

Details have been trialled to suit the pressures of SCC concrete and are to be used in place of the similar standard details

Construction

It is recommended that this guide be read to ensure correct installation of rediwall®. Preparation, layout and construction are similar to normal concrete with extra core and detailing at joints and junctions. Good planning is important to ensure that core filling occurs with minimal holds.

AFS Rediwall® should be fully braced in accordance with the appropriate Design and Installation details. Due to the higher concrete pressures SCC can require additional bracing at some details beyond what is detailed in the rediwall® Design and Installation guide. Additional examples of SCC bracing have been provided in this guide. Consultation with the site engineer should occur before pouring commences.

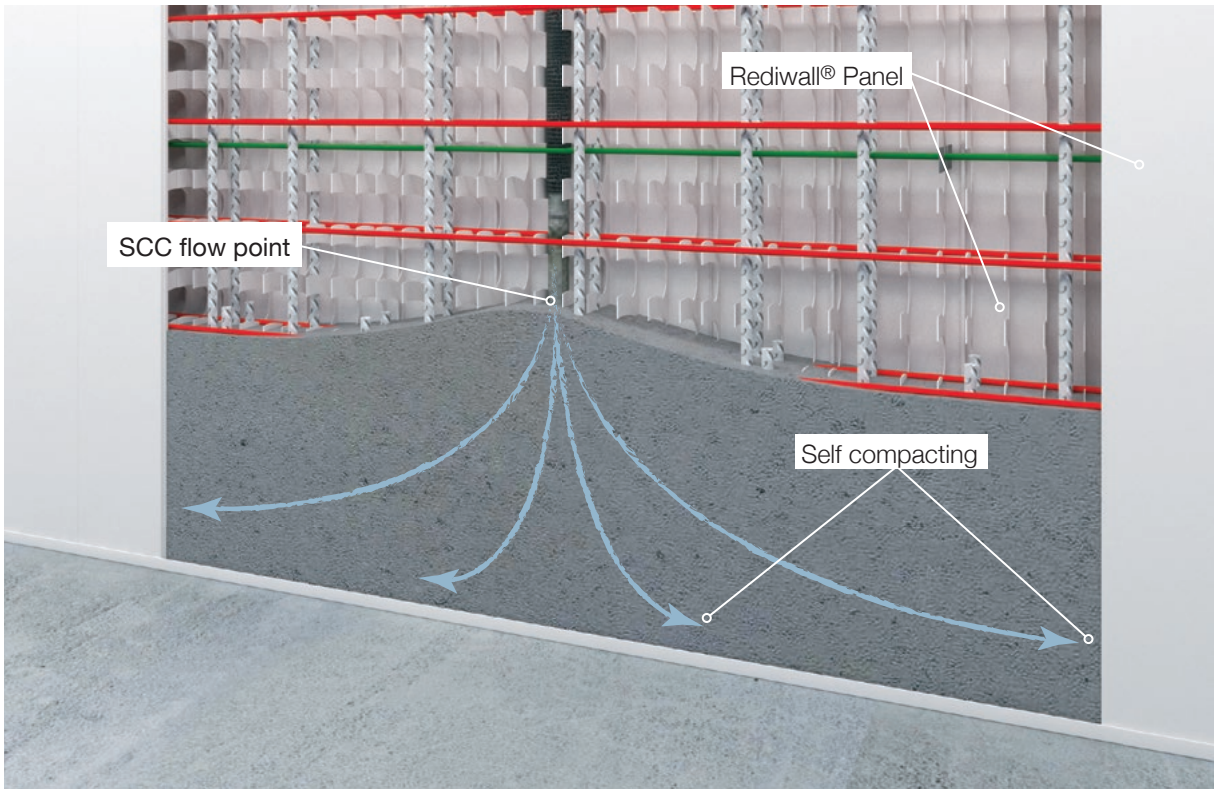
Concrete placement

- Walls up to 3 metres high can be filled in 2 passes/ lifts with the first pass being to a maximum height of 1.2 – 1.5m.
- Walls from 3 – 6m should be filled in 3 – 4 passes with the first and second pass being to a maximum height of 1m each.
- Allow at least 30 minutes between passes for higher walls to allow concrete to partially set.
- Prior to filling wall inspect all detailing for gaps or weaknesses. Ensure all bracing has been installed to AFS guidelines or Engineers requirements.
- SCC spread test is required for each batch. Reject concrete load if out of specification.
- Excessive Water is not to be used to wet up concrete. Maximum 10 litres per m3.
- Wall shall be filled from static locations, maximum 8 metres apart) allowing SCC to flow and fill the wall.
- Concrete filling should be landed onto wet concrete allowing the concrete to flow out filling the wall.
- Maximum drop from hose to concrete shall be 3 metres. Minimise drop distance were possible by lowering hose into wall.
- Concrete bonding agent to be sprayed on surface between lifts.
- Single fill will require additional bracing of junctions and details.

The Standard AFS Gel Test is not required for SCC and does not provide a useful measure of time between lifts. Follow procedures above for time between lifts.

Higher concrete strength mixes will gel faster than low strength mix designs. These guidelines will vary according to site conditions, with the requirement of extra passes and extra gelling time in wet/cold weather. In cases of extreme weather the concrete pour should be postponed.

FIG A38: Typical SCC flow



Concrete Clean-up

During the pour, some concrete splatter may occur on the slab bellow and down the afs rediwall® panels.

All concrete splatter must be cleaned off before it cures.

Team members should follow the pour, brushing all splatter concrete off the slab and walls and if necessary, wiping the walls down with a wet sponge.

Performance

The afs rediwall® system has Codemark Certification to confirm that it can be designed, detailed and installed to satisfy the relevant requirements of NCC 2022. These include the following:

Section C. Fire Resistance:

- C1P1 (NCC2019 CP1) Structure stability
- C1P2 (NCC2019 CP2) Avoid spread of fire
- C1P3 (NCC2019 CP3) Protect from spread of fire and smoke in patient care and aged care buildings
- C1P4 (NCC2019 CP4) Safe conditions for evacuation
- C1P7 (NCC2019 CP7) Avoid spread of fire to emergency equipment
- C1P8 (NCC2019 CP8) Protect spread of fire to openings and penetrations

Section F. Health and Amenity

- F3P1 (NCC2019 FP1.4) Weatherproofing
- F7P2 (NCC2019) Sound transmission through walls
- F7P4 (NCC2019 FP5.5) Sound transmission and insulation – Walls in age care buildings

Section G. Ancillary Provisions

- G5P1 (NCC2019 GP5.1) Bush fire resistance

Sections J. Energy efficiency

- J1P1 (NCC2019 JP1) Energy efficiency

Fire Testing

AFS Rediwall® has had extensive fire testing and fire assessments to provide supportive evidence to back the Rediwall® fire and non-combustibility compliance. This includes:

- AS5113 (BS8414) Facade Fire Test
- AS5637.1 Reaction of Fire Classification (AS/ISO9705 Room Fire Test)
- AS1530.4 Fire Resistance Levels (FRL) Test/Assessment
- AS1530.4 FRL Penetration Test/Assessment
- AS1530.3 Fire Hazard Properties Test

Fire Resistance Levels (FRL)s

Fire rating requirements of the NCC are specified in terms of Fire Resistance Levels (FRL). The FRL specifies the performance , in minutes, of the fire tested specimens for each of the following three design criteria when fire tested to the requirements of the Australian Standards AS1530 'Methods for Fire Test on Building Materials, Components and Structures' part 4 'Fire-Resistance Tests of Elements of Building Construction.

- Structural adequacy
- Integrity
- Insulation

A wall system under fire test that carries its load for 240 minutes and maintains its integrity and insulation for 240 minutes is given a FRL of 240/240/240, i.e 240 minutes structural adequacy, 240 minutes integrity and 240 minutes insulation.

Systems constructed to the standard required for particular FRL may be used to satisfy the requirements of lesser FRL.

Fire resistance levels of rediwall may be determined in accordance with NCC 2022 using the FRL given in the CSIRO Fire Test Reports. Where the wall characteristics are outside the limits of the CSIRO Fire Test Reports the FRL may be determined by the standard methods in AS3600–2018.

TABLE A7: FRL by CSIRO Fire Test

Type	t_w	F'_c	H_w max	N* max	FRL
	(mm)	(MPa)	(mm)	(kN)	(Ade/Int/Ins)
RW110C	105	32***	2700	152	90/90/90**
RW156C	150	32 ***	3000	333	240/240/240*
RW200C	195	32 ***	3000	333	240/240/240*
RW256S	250	32 ***	3000	333	240/240/240*
RW275S	270	32 ***	3000	333	240/240/240*
RW300S	295	32 ***	3000	333	240/240/240*

*FRL Determined by CSIRO Fire Test Report Number FCO3399

**FRL Determined by SGA Report 2013/277.65 R1.6

***S32 MPa afs concrete mix

TABLE A8: AS3600 Fire Resistance Period (FRP) Structural Adequacy^ – Exposed 1 Side

		60 Minutes	90 Minutes	120 Minutes	180 Minutes	240 Minutes	FRP Insulation^^
Wall	$t_{w.fire}$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	Minutes
RW110C	105	0.26	0.09	–	–	–	90
RW156C	150	0.70	0.70	0.35	–	–	180
RW200C	195	0.70	0.70	0.70	0.53	–	240
RW256S	250	0.70	0.70	0.70	0.70	0.54	240
RW275S	269	0.70	0.70	0.70	0.70	0.69	240
RW300S	294	0.70	0.70	0.70	0.70	0.70	240

Acceptable $N^*f/ØN_u = 0.7$ | With Caution $N^*f/ØN_u < 0.7$

^ FRP Structural Adequacy based on AS3600 – 2018, Table 5.7.2
^^ FRP Insulation based on CSIRO Test Report Nº FCO3399

TABLE A9: AS3600 Fire Resistance Period FRP Structural Adequacy^ – Exposed 2 Side

		60 Minutes	90 Minutes	120 Minutes	180 Minutes	240 Minutes	FRP Insulation^^
Wall	$t_{w.fire}$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	Minutes
RW110C	105	–	–	–	–	–	90
RW156C	150	0.70	0.50	0.20	–	–	180
RW200C	195	0.70	0.70	0.62	0.31	–	240
RW256S	250	0.70	0.70	0.70	0.60	0.35	240
RW275S	269	0.70	0.70	0.70	0.70	0.45	240
RW300S	294	0.70	0.70	0.70	0.70	0.54	240

Acceptable $N^*f/ØN_u = 0.7$ | With Caution $N^*f/ØN_u < 0.7$

^ FRP Structural Adequacy based on AS3600 – 2018, Table 5.7.2
^^ FRP Insulation based on CSIRO Test Report Nº FCO3399

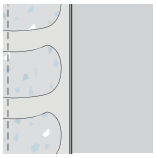
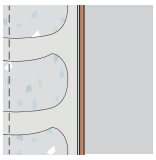
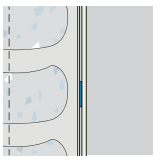
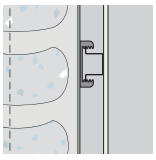
Non-Combustibility – Wall Applications & Finishes

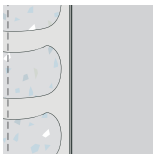
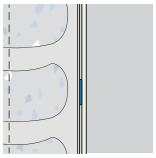
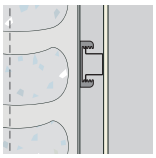
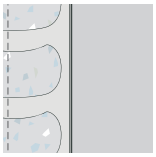
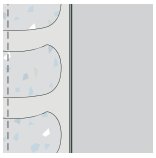
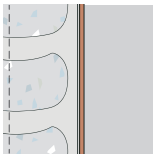
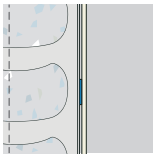
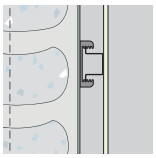
Rediwall® is compliant with the relevant parts of the National Construction Code 2022 (NCC 2022) for use within various non-combustible wall applications internally and externally for Classes 1, 10, and Class 2-9 buildings.

The following summaries of rediwall® internal and external wall applications with associated finishes have been assessed by Stephen Grubits & Associates, Fire Safety Engineer's Report 2013/277.78 R1.6 to be complaint with the relevant fire resistance performance requirements in NCC 2022.

TABLE A10: Summary of compliance with Performance Requirements & Essential Safety Precautions

Rediwall® as Internal Wall Applications[1]

Applications	Compliance with NCC 2022 Performance Requirements	Finishes	Safety Measures
Non-loadbearing fire resisting internal walls (Assessment 1A)	PVC formwork is not considered to affect compliance with C1P2, C1P3 and C1P4 (NCC2019 CP2, CP3 & CP4)	a. Unclad and PVC lining left in place 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork as well as over-cladding has been determined to be unlikely
Loadbearing fire resisting internal walls (Assessment 1B)	PVC formwork is not considered to affect compliance with C1P1, C1P2, C1P3 and C1P4 (NCC2019 CP1, CP2, CP3 & CP4)		
Non-loadbearing non-fire resisting internal walls (Assessment 1C)	PVC formwork is not considered to affect compliance with C1P3 and C1P4 (NCC2019 CP3 & CP4)	b. Cement render or similar non-combustible render finish over unclad rediwall® 	
Loadbearing non-fire resisting internal walls (Assessment 1D)	PVC formwork is not considered to affect compliance with C1P3 and C1P4 (NCC2019 CP3 & CP4)		
Separating walls in Class 1 buildings (Assessment 1E)	PVC formwork is not considered to affect compliance with H3P1 (NCC2019 P2.3.1)	c. Plasterboard lining directly affixed to surface of unclad rediwall® 	
Non-loadbearing fire walls (Assessment 2A)	PVC formwork is not considered to affect compliance with C1P2, C1P3 and C1P4 (NCC2019 CP2, CP3 & CP4)		
Loadbearing fire walls (Assessment 2B)	PVC formwork is not considered to affect compliance with C1P1, C1P2, C1P3 and C1P4 (NCC2019 CP1, CP2, CP3 & CP4)	d. Plasterboard lining affixed to unclad rediwall®, using steel furring channels of specific orientation and spacing 	
Continued on next page…			

Applications	Compliance with NCC 2022 Performance Requirements	Finishes	Safety Measures
Non-loadbearing fire walls (Assessment 6A)	PVC formwork is not considered to affect compliance with C1P1, C1P2, and C1P7 (NCC2019 CP1, CP2, & CP7)	a. Unclad and PVC lining left in place  c. Plasterboard lining directly affixed to surface of unclad rediwall®  d. Plasterboard lining affixed to unclad rediwall®, using steel furring channels of specific orientation and spacing 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork as well as over-cladding has been determined to be unlikely
Internal lift shaft wall (internal face of the shaft wall (Assessment 7A)	PVC formwork is not considered to affect compliance with C1P1, C1P2, C1P3, C1P4 and C1P7 (NCC2019 CP1, CP2, CP3, CP4 & CP7)	a. Unclad and PVC lining left in place 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork has been determined to be unlikely
Internal walls in fire isolated exits (Assessment 8A)	PVC formwork is not considered to affect compliance with C1P1, C1P2, C1P3, C1P4 and C1P7 (NCC2019 CP1, CP2, CP3, CP4 & CP7)	a. Unclad and PVC lining left in place  b. Cement render or similar non-combustible render finish over unclad rediwall®  c. Plasterboard lining directly affixed to surface of unclad rediwall®  d. Plasterboard lining affixed to unclad rediwall®, using steel furring channels of specific orientation and spacing 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork as well as over-cladding has been determined to be unlikely

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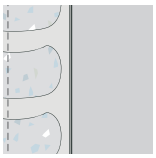
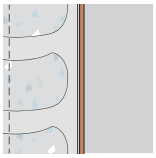
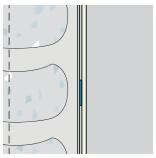
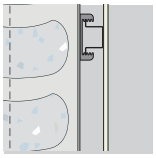
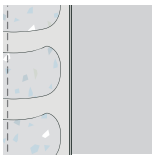
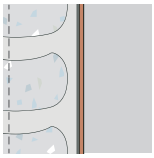
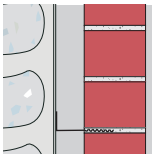
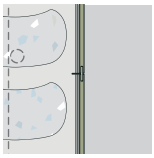
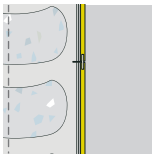
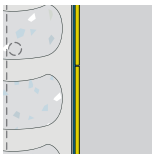
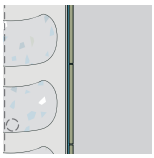
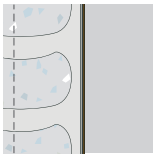
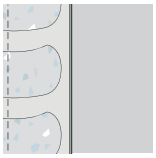
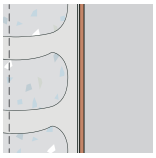
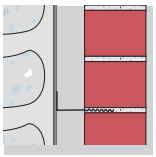
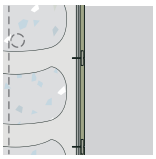
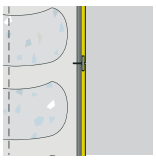
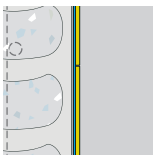
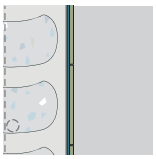
Applications	Compliance with NCC 2022 Performance Requirements	Finishes	Safety Measures
Internal walls in fire-control rooms (Assessment 9A)	PVC formwork is not considered to affect compliance with C1P1, C1P2, C1P3, C1P4 and C1P7 (NCC2019 CP1, CP2, CP3, CP4 & CP7)	a. Unclad and PVC lining left in place  b. Cement render or similar non-combustible render finish over unclad rediwall®  c. Plasterboard lining directly affixed to surface of unclad rediwall®  d. Plasterboard lining affixed to unclad rediwall®, using steel furring channels of specific orientation and spacing 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork as well as over-cladding has been determined to be unlikely
Service penetrations in fire resisting walls (Assessment 11A)	PVC formwork is not considered to affect compliance with C1P2 and C1P8 (NCC2019 CP2 & CP8)	a. Unclad and PVC lining left in place 	Penetration in unclad and PVC lining left in place rediwall®, the PVC skin on the panel face is not considered to affect compliance with C1P2 and C1P8. For fire dampers, 6mm FC sheet is to be fitted between wall face and damper frame extending 20mm beyond frame edge.
1. This table is based on the Stephen Grubits & Associates rediwall Codemark Certification report, 2013/277.78 R1.6			

TABLE A11: Summary of compliance with Performance Requirements & Essential Safety Precautions

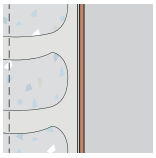
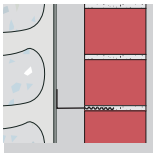
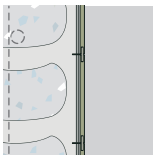
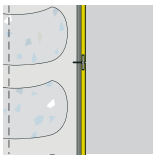
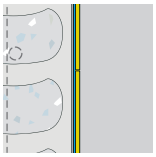
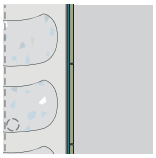
Rediwall® as External Wall Applications[1]

Applications	Compliance with NCC Performance Requirements	Finishes	Safety Measures
Non-loadbearing fire resisting external walls (Assessment 3A)	PVC formwork is not considered to affect compliance with C1P2 (NCC2019 CP2)	a. Unclad PVC lining left in place 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork as well as over-cladding has been determined to be unlikely, subject to the following: – When applying finishes e, f or g, installation of an appropriate fire-stopping system[3] in the cavity is considered essential.
Loadbearing fire resisting external walls/spandrels (Assessment 3B)	PVC formwork is not considered to affect compliance with C1P1and C1P2 (NCC2019 CP1& CP2)	b. Non-combustible cement render or similar render finish over unclad Rediwall® 	
Non-loadbearing non-fire resisting external walls (Assessment 4A)	PVC formwork is not considered to affect compliance with C1P2 (NCC2019 CP2)	e. Face brick with inner rediwall® skin forming a cavity wall 	
Loadbearing fire resisting external walls/spandrels (Assessment 4B)	PVC formwork is not considered to affect compliance with C1P1 and C1P2 (NCC2019 CP1 & CP2)	f. Mechanically fixed tile system (<32kg/m²) to unclad rediwall® 	
External walls above fire exits (Assessment 5A)	PVC formwork is not considered to affect compliance with C1P1 and C1P2 (NCC2019 CP1 & CP2)	g. Mechanically fixed non-combustible cladding to unclad rediwall®  h. Direct-stick non-combustible cladding + adhesive to unclad rediwall®  i. Glue-fixed tile systems (<32kg/m²) + adhesive to unclad rediwall® 	The following safety measures are required when installing rediwall® above fire exit discharges: – When applying finishes e, f or g, installation of an appropriate fire-stopping system in the cavity is considered essential. – When unclad rediwall® (type a finish) or when applying finishes h or i, appropriate protection over/near fire exit discharges as detailed in this assessment is required.[4] – When apply finish b, no additional measures are required.

Continued on next page…

Applications	Compliance with NCC Performance Requirements	Finishes	Safety Measures
Retaining walls (external face of panel) (Assessment 10A)	PVC formwork is not considered to affect compliance with C1P1 and C1P2 (NCC2019 CP1 & CP2)	a. Unclad PVC lining left in place  j. With membrane 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork as well as over-cladding has been determined to be unlikely, subject to the following: – For finish j, the membrane is to be buried below ground.
Openings in fire resisting walls (Assessment 11B)	PVC formwork is not considered to affect compliance with C1P1 and C1P2 (NCC2019 CP1 & CP2)	a. Unclad PVC lining left in place  b. Non-combustible cement render or similar render finish over unclad rediwall®  e. Face brick with inner rediwall® skin forming a cavity wall  f. Mechanically fixed tile system (<32kg/m^2) to unclad rediwall®  g. Mechanically fixed non-combustible cladding to unclad rediwall®  h. Direct-stick non-combustible cladding + adhesive to unclad rediwall®  i. Glue-fixed tile systems (<32kg/m^2) + adhesive to unclad rediwall® 	No additional measures are required as fire spread and development of untenable conditions due to PVC formwork as well as over-cladding has been determined to be unlikely, subject to the following: – When applying finishes e, f or g, installation of an appropriate fire-stopping system[3] in the cavity is considered essential.

Continued on next page…

Applications	Compliance with NCC Performance Requirements	Finishes	Safety Measures
Rediwall® used externally at less than 2m above the ground (Assessment 12A)	PVC formwork is not considered to affect compliance with C1P1 and C1P2 (NCC2019 CP1 & CP2)	a. Unclad PVC lining left in place  b. Non-combustible cement render or similar render finish over unclad rediwall®  e. Face brick with inner rediwall® skin forming a cavity wall  f. Mechanically fixed tile system (<32kg/m^2) to unclad rediwall®  g. Mechanically fixed non-combustible cladding to unclad rediwall®  h. Direct-stick non-combustible cladding + adhesive to unclad rediwall®  i. Glue-fixed tile systems (<32kg/m^2) + adhesive to unclad rediwall® 	If the over-cladding extends beyond the extent of the rediwall®, installation of an appropriate fire-stopping system[3] in the cavity at the top of the rediwall® over-cladding is considered essential.

[1]. This table is based on the Stephen Grubits & Associates rediwall Codemark Certification report, 2013/277.78 R1.6

[3]. Installation of a fire-stopping system would include but is not limited to systems such as Rockwool™ cavity barrier, intumescent or steel cavity barrier or similar in between rediwall® external wall and cladding system where a continuous cavity from one floor to another floor is created. It is recommended that a fire-stopping product is to be installed where the continuous cavity starts and on the level of floor slab that is separating floors, in a horizontal manner.

[4]. Protection over/near external fire exits (i.e where rediwall® is installed over or near external fire exits) includes:

- Removal of the PVC lining, or
- Construction of a non-combustible overhead protection (e.g. awning) with the minimum requirements of:
  - Construction to be made of non-combustible material, and be able to resist the impact of falling debris, and
  - Projection of the overhead protection to be:
    - Parallel to the external wall with an overall width equal to the fire exit doorway width plus 300mm extending either side of the doorway, and
    - Extending a perpendicular distance of 3m minimum from the external wall.

Non-Combustibility – Specific Wall Applications

In addition to the general rediwall® applications with associated applied finishes, a number of specific rediwall® applications have also be assessed by Stephen Grubits & Associates, Fire Safety Engineers in Report 2013/277.78 R1.6 to confirm compliance with the relevant Performance Requirements, NCC 2022 C1P1, C1P2, C1P3, C1P4, C1P7 and C1P8 (NCC2019 CP1, CP2, CP3, CP4, CP7 and CP8).

Rediwall® as a Boundary Wall

Based on the following arrangement, the rediwall® Boundary Wall has been assessed to achieve compliance to the relevant Performance Requirement of the NCC 2022 C1P1 and C1P2 (NCC2019 CP1 & CP2).

This is achieved when unclad rediwall® is used as an external boundary wall and is located directly adjacent to an existing non-combustible fire resisting external boundary wall forming a cavity no greater than 50mm, there are no openings in either wall (unless it is a fire window as specified in the NCC), both walls can be of different height. The top and sides of the cavity space are to be fully enclosed by non-combustible flashing of appropriate size to suit the wall(s) configuration.

Fig A39: Rediwall® Boundary Wall Capping (elevation view)

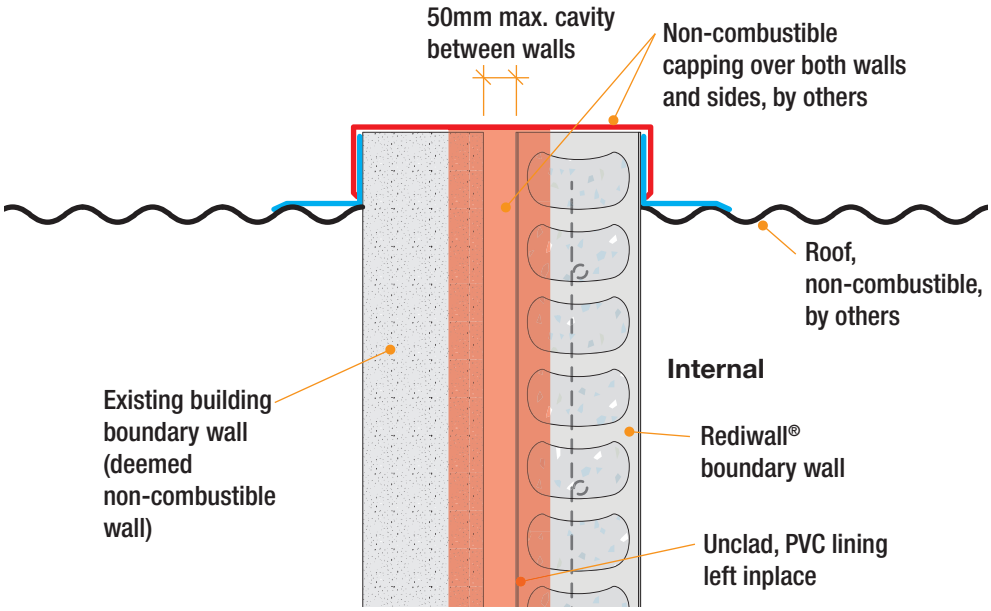
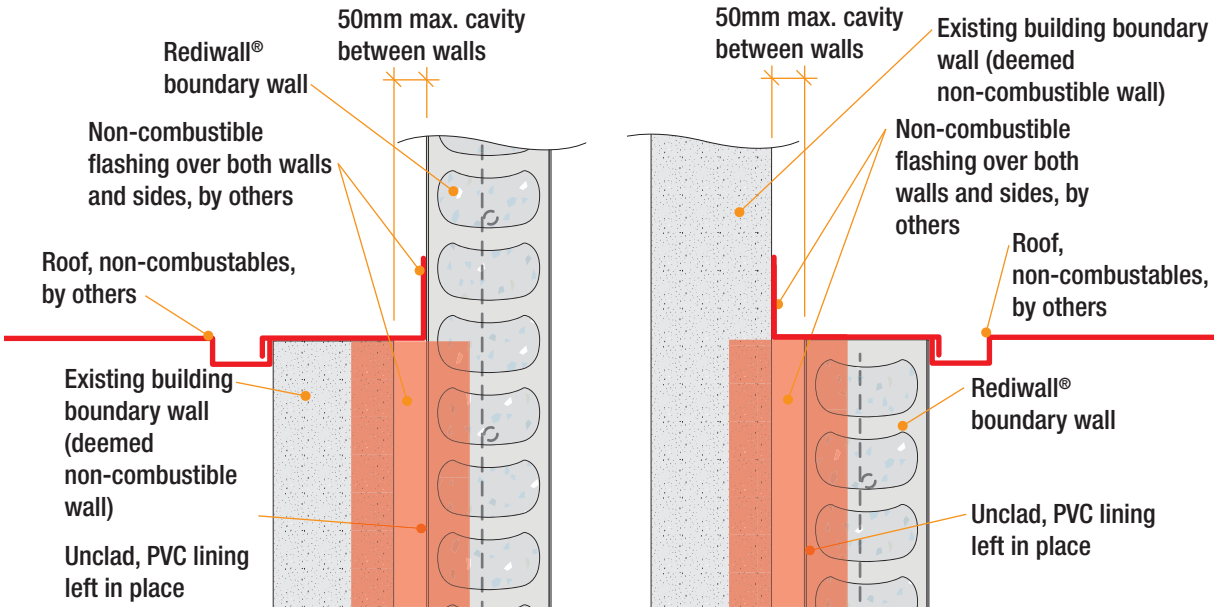


Fig A40: Rediwall® Boundary Wall with Different Wall Heights



Fire Rated Junction (Internal Rediwall® to External Logicwall® or internal Rediwall® to internal Rediwall®)

When a junction is formed between a rediwall® (internal fire rated wall) and a Logicwall (external fire rated wall), or where a rediwall (internal fire rated wall) abutts end to end with another rediwall (internal fire rated wall), and the junction is required to be fire-resisting.

In order to seal the gap and maintain the appropriate integrity and insulation criteria of the FRL, fire-resisting sealant such as Fosroc Flamex, CSR FireSeal or similar that has been tested to AS1530.4 must be installed so that the sealant continuously fills the gap between the fibre cement face on each side of the junction and backing rod.

The required insulation and integrity FRL values are achieved by meeting the width and depth of the fire rated sealant as per the sealant manufacturer's specifications.

Based on these arrangement, rediwall® has been assessed to achieve compliance to the relevant Performance Requirements, NCC 2022 C1P1,C1P2 and C1P4 (NCC2019 CP1,CP2 & CP4). Refer to Fig A41.

Fig A41: Internal Rediwall® to External Logicwall Fire Rated Junction

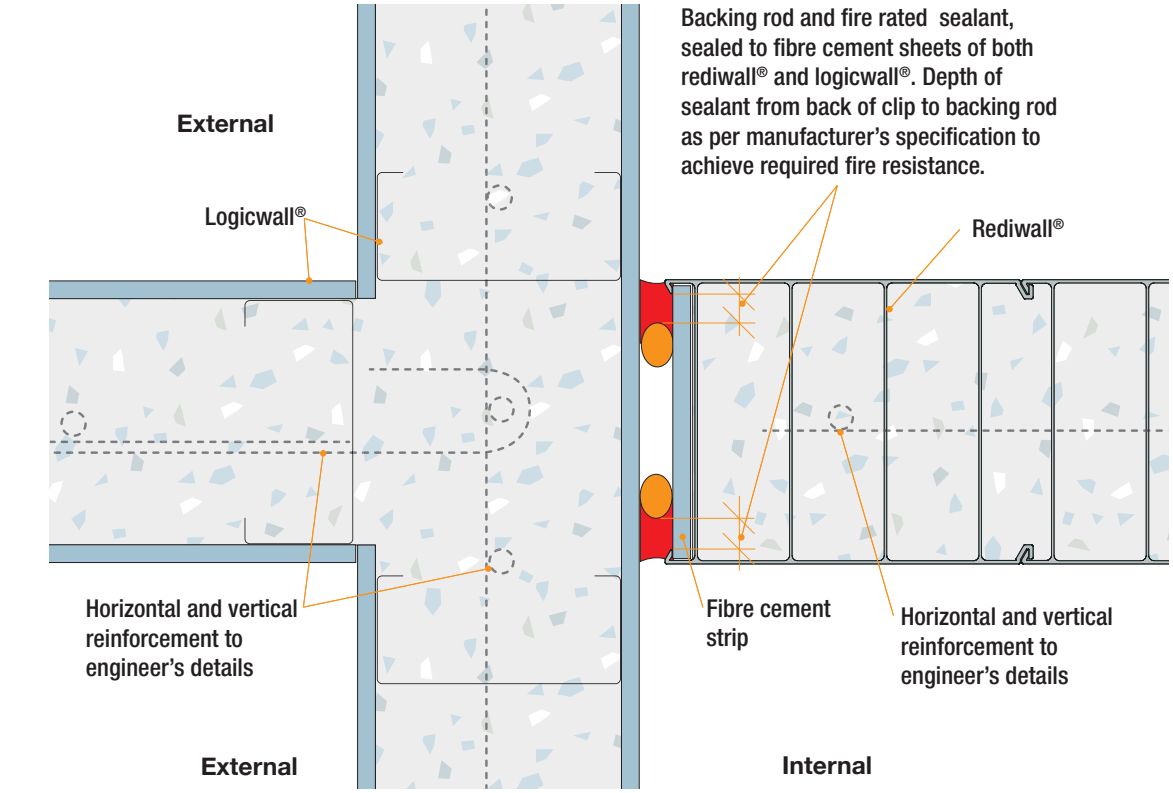
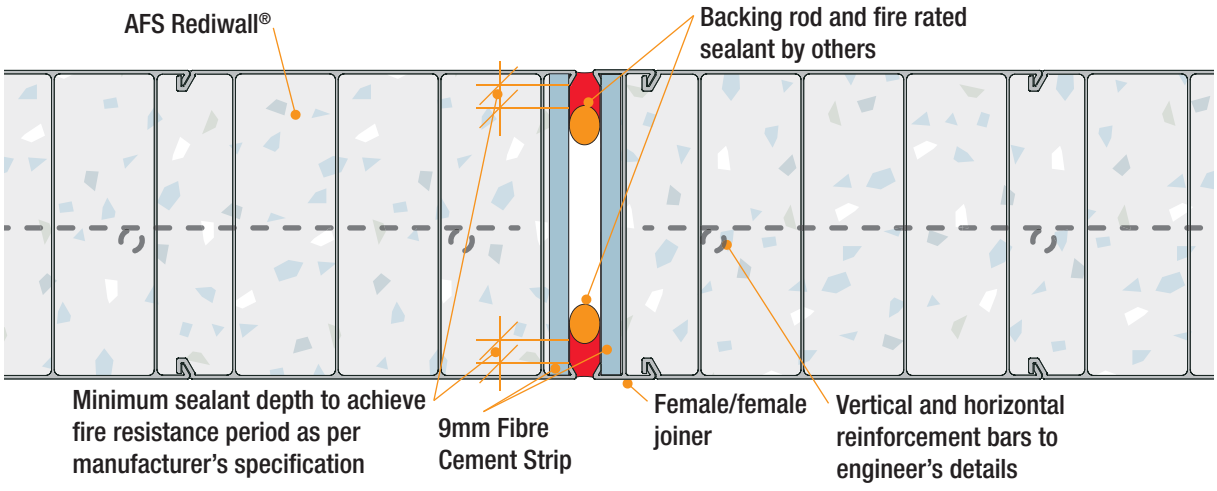


Fig A42: Rediwall® to Rediwall® Fire Rated End Junction



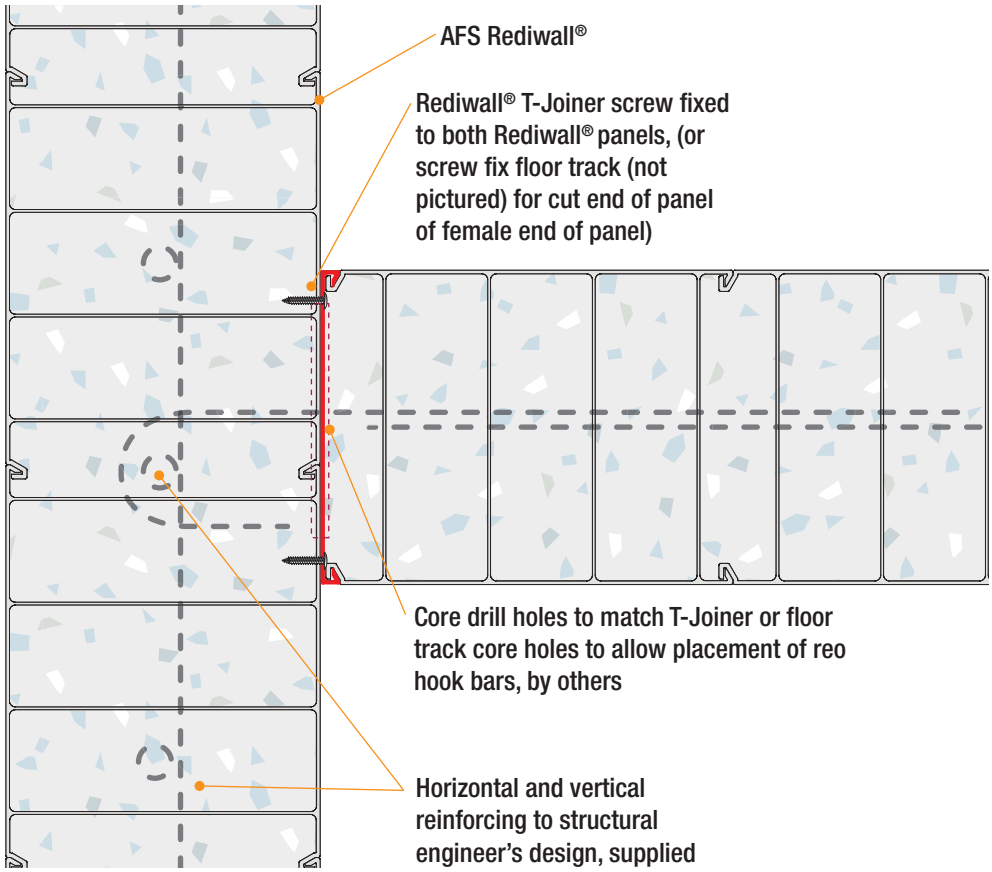
Rediwall® Fire rated T-junction

A T-junction system incorporating the rediwall® T-Joiner (or floor track) is suitable to protect from the spread of fire across the junction. The joint is sealed by the concrete core which is filled so that it flows across the joint, and is strengthened by steel reinforcing across the joint.

Both walls are of the same FRL, each wall is expected to expand and deform at comparable rates when subjected to the heat of a fire. The concrete that bounds the joint is expected to act as a heat sink to any fire products passing through the junction. The concrete would therefore not permit the transfer of sufficient heat (either by radiation or by the transmission of hot gases) to enable ignition on the non-fire side of the rediwall®, thereby resisting fire spread between compartments.

Based on this particular arrangement, the rediwall has been assessed to achieve compliance to the relevant Performance Requirements, NCC2022 C1P1,C1P2 and C1P4 (NCC2019 CP1,CP2 & CP4).

Fig A43: Rediwall® T-Junction



Rediwall® Fire Rated Penetrations

AFS Rediwall® has been tested and assessed by CSIRO (test report FSV 2094 and assessment report FCO 3380) to AS1530.4 for fire resistance levels of various service penetrations to achieve up to FRL –/120/120 for service penetrations in the Rediwall® without the need to remove the PVC lining.

Service penetration types tested and assessed include:

- Clay Brick Infill
- Cable trays
- PVC Pipe work
- Electrical Cable (Single or bundled)
- Copper and metal pipe work
- Fire Dampers FRL –/120/– (Integrity)

These service penetrations types are allowed to be used through Rediwall® RW110C, RW156C, RW200C, RW256S, RW275S and RW300S with penetration apertures as close as 40mm spacing.

TABLE A12: AS1530.4 –Rediwall® Service Penetration FRL Rating and Protection Measures

Service Penetration Type	RW110C	RW156C, RW200C, RW256S RW275S, RW300S
Cable Trays or Bundled Cables	**FRL –/120/120** **Promat Supawrap** **PLUS** **Promat Promaseal A Sealant** **OR** **ANY** sealant tested or assessed for FRL –/120/120 when protecting AS1530.4 appendix D1 Group A cable configurations in concrete walls **105mm** thick or less.	**FRL –/120/120** **Promat Supawrap** **PLUS** **Promat Promaseal A Sealant** **OR** **ANY** sealant tested assessed for FRL –/120/120 when protecting AS1530.4 appendix D1 Group A cable configurations in concrete walls **150mm** thick or less.
Cables or PVC pipes	**FRL –/120/120** **Promat Promaseal FC100 Fire Collar** **OR** **ANY** fire collar tested or assessed for FRL –/120/120 protecting plastic pipes in concrete walls **105mm** thick or less	**FRL –/120/120** **Promat Promaseal FC100 Fire Collar** **OR** **ANY** fire collar tested or assessed for FRL –/120/120 protecting plastic pipes in concrete walls **150mm** thick or less
Copper Pipes or Metal Pipes	**FRL –/120/120** **Promat Supawrap & metal pipe clamps** **PLUS** **Promat Promaseal A Sealant** (with sealant depth to 20mm in wall) **OR** **ANY** sealant tested in or assessed for FRL –/120/120 protecting AS1530.4 appendix E metal pipe configurations in concrete **105mm** thick or less, (with increase sealant depth to 20mm into wall)	**FRL –/120/120** Promat Supawrap & metal pipe clamps **PLUS** **Promat Promaseal A Sealant** (with sealant depth to 20mm in wall) **OR** **ANY** sealant tested or assessed for FRL –/120/120 protecting AS1530.4 appendix E metal pipe configurations in concrete **150mm** thick or less, (with increase sealant depth to 20mm into wall)
Brickwork Infill	**FRL –/120/120** **Clay Bricks + Render infill** in accordance to AS3700 with **CSR Fireseal Sealant** sealed perimeter of infill **OR** use of FRL –/120/120 rated Blocks/Bricks	
Fire Dampers	**FRL –/120/–** **Bullock Model 4900 Curtain Fire Damper** (6mm FC sheet around damper frame to PVC facing both sides **OR** **ANY** conventional curtain/blade fire damper tested or assessed for –/120/– to AS1530.4 in concrete walls **150mm** thick	
Note: Installation must be in accordance with manufacture's requirements. For further information refer to CSIRO assessment report FC3380		

Acoustic Performance

Acoustic performance requirements for a building project are determined by the NCC, local authorities and the developer requirements. A typical wall separating sole occupancy units is required to have an R_w+C_{tr} not less than 50 when measured in an acoustic laboratory.

Laboratory and Field Performance

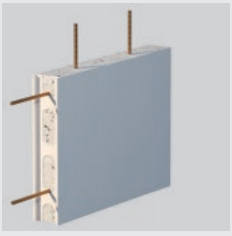
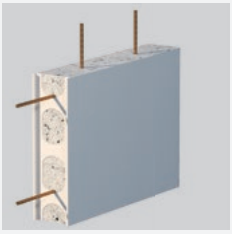
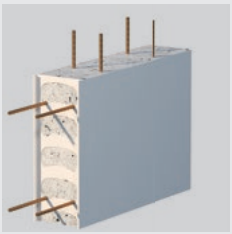
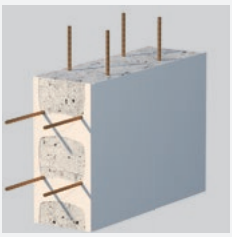
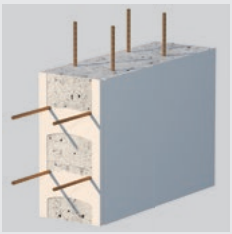
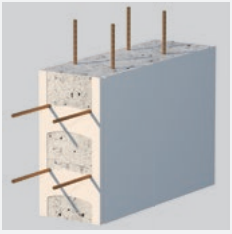
There is however the verification clause that states that when the wall is installed in the actual dwelling that it shall achieve not less than a $D_nt_w+C_{tr}$ of 45. In the end, it is the field conditions that dominate, as people do not live in acoustic laboratories. It is important that all the components in the chain of providing sound insulation have adequate performance and it is critically important to demonstrate in an acoustic laboratory that the chosen element has the potential performance.

Acoustic Performance

The acoustic performance of the rediwall® systems in various wall configurations have been assessed by Acoustic Logic Consultancy Pty Ltd.

The TABLE A13 provides acoustic performance ratings for unclad rediwall systems with PVC in place. These systems have been assessed by Acoustic Logic Consultancy Pty Ltd.

TABLE A13: Acoustic Performance Ratings for Standard Rediwall® Wall Systems (unclad with PVC in place)

Rediwall® System	Description		R_w	C_{tr}	R_w+C_{tr}
RW110C	110mm thick wall 105mm of concrete core		50	-5	45
RW156C	156mm thick wall/ 151mm of concrete core		54	-4	50
RW200C	200mm thick wall 195mm of concrete core Single or double reinforcement options		58	-5	53
RW256S	Double reinforcement, 251mm of concrete core		60	-5	55
RW275S	Double reinforcement, 270mm of concrete core		61	-5	55
RW300S	Double reinforcement, 295mm of concrete core		61	-5	55

Some typical rediwall® wall configurations and their assessed acoustic performance are given below. For further assistance on wall configurations and acoustic performance assessments, please contact AFS Technical Services.

TABLE A14: Sample Rediwall® Wall System Applications – Acoustic Performance Ratings

Rediwall®	Typical Application	Rediwall® System [1]	R_w	C_{tr}	R_w+C_{tr}
RW110C	External or dry to common area	afs rediwall® 110mm, 20mm air gap, 64mm Rondo Stud frame, Bradford Acoustigard insulation (75mm R1.8), 6mm Ceminseal Wallboard	62	-10	52
RW156C	External or dry to common area	afs rediwall® 156mm, 20mm air gap, 64mm Rondo Stud frame, Bradford Acoustigard insulation (75mm R1.8), 6mm Ceminseal Wallboard	65	-10	55
RW156C	Inter-tenancy dry to dry	13mm Gyprock Standard Plasterboard, 64mm Rondo Stud frame, Bradford or Martini non-rigid insulation (11kg/m2), 20mm air gap, afs rediwall® 156mm, 13mm Gyprock Standard Plasterboard	65	-10	55
RW156C	Inter-tenancy wet to wet	6mm Cemmseal wallboard, 64mm Rondo Stud frame, Bradford or Martini non-rigid insulation (11kg/m2), 20mm air gap, afs rediwall® 156mm, 20mm air gap, Bradford or Martini non-rigid insulation (11kg/m2), 64mm Rondo Stud frame, 6mm Ceminseal wallboard	>70	-10	>60
RW156C	Inter-tenancy dry to service shaft	13mm Gyprock Standard Plasterboard, afs rediwall® 156mm, 20mm air gap, Bradford or Martini non-rigid insulation (11kg/m2), 64mm Rondo Stud frame, 6mm Ceminseal wallboard	65	-10	55

1 To achieve a discontinuous construction a separate stud wall is required. To maintain discontinuous construction the plumbing or other services must be run within the studs of the separating wall. There must be no direct connection between the plumbing services and the afs rediwall® wall other than at the perimeter.

Thermal Insulation

A primary objective for a designer when planning a building is to design a building fabric – external elements such as ceilings, roofs and floors, that will deliver a cost effective, comfortable living or working environment for the inhabitants.

AFS rediwall® walls being a monolithic concrete barrier possess inherent features which greatly assist the designer in achieving the objective of thermal mass and air tightness.

Energy Efficiency

The NCC contains thermal performance requirements in terms of **minimum Total R** for building fabric (the external ceilings, floors and walls) of new buildings in Australia.

The total R-Value is the total thermal resistance of a building surface, including indoor and outdoor air film resistance.

Thermal Insulation & Mass

The NCC recognises the benefit of thermal capacity or mass, and so provides R concessions for heavyweight walls such as afs rediwall® walls.

Heavy mass delays the transfer of outdoor temperature variations, improving indoor comfort. The concrete construction of afs rediwall® walls provides a significant thermal mass barrier to the external elements. If necessary additional insulation materials may be installed with afs rediwall® walls to achieve higher R-values specified by the BCA. This in turn not only enhances occupant comfort, but also reduces heating/cooling costs and may also improve the acoustic performance of the wall. Insulation materials should be installed with afs rediwall® walls so as to form a continuous thermal barrier.

Condensation Management

An afs rediwall® external wall system can comply to the NCC 2022 Pliable Building Membrane deemed to satisfy provisions where the rediwall® as the external wall can have a vapour permeable pliable building membrane (complaint to AS4200.1 and AS4200.2) installed by others to the inside face of the rediwall® prior to any insulation layer, then internal wall lining system. Refer to Volume 2 - Detailing & Finishing Guide wall system details.

Consideration should be taken for poor sealing and high-level open wall vents, water vapour from clothes dryers, showers and baths was carried from the building before condensing. With increased insulation and better techniques for preventing heat loss, make it more difficult for water vapour to exit the dwelling as there are no air gaps for the air to carry it away, so it condenses on the coolest surface, typically the window glass can be more prevalent, however, it is an ‘operational’ issue rather than a building fault.

Activities such as failing to run fans while showering and while a room dries out, drying clothes inside without a dryer and exhaust fan operating, and appliances such as food steamers, kettles, urns and humidifiers, all contribute to water vapour and therefore potentially to condensation. The formation of condensation typically illustrates that the building is well sealed against draughts and is well insulated.

Prevention of condensation can be achieved by the following common practices:-

- Running bathroom fans while showering and leaving them on for a time afterwards.
- Dry clothes outside, in a dryer with the laundry fan running or on a rack in the bathroom with the bathroom fan running, or in a communal drying facility.
- Avoid using humidifiers and other appliances which create steam/water vapour.
- If using steamers, urns or boiling water, ensure the rangehood is operating. (Rangehoods should exhaust to outside and must not be recycling type.)
- Leave windows ajar some of the time, particularly in bathrooms.
- Consider opening the outside doors and windows for a few minutes each day to ‘flush out’ humid air.

AFS Rediwall® Thermal Performance

AFS Rediwall® wall systems have been assessed for their thermal performance by thermal efficiency consultants, James M Fricker Pty Ltd (JMP). The thermal performance assessments in accordance with AS/NZS 4859.1 – 2018 for the rediwall® unclad walls with PVC in place are detailed in the following table.

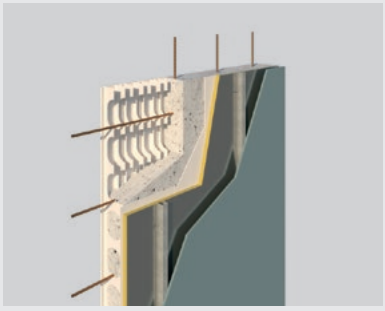
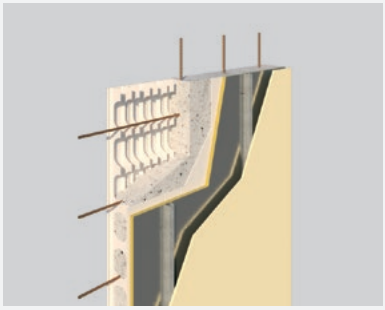
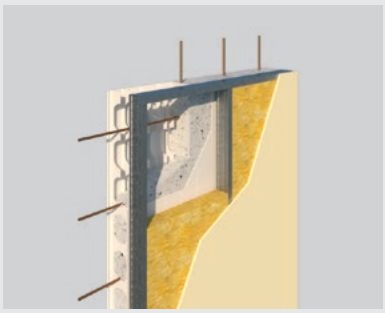
Rediwall® System	Thermal Resistance
RW110C	R 0.091m² K/W
RW156C	R 0.123m² K/W
RW200C	R 0.153m² K/W
RW256S	R 0.192m² K/W
RW275S	R 0.205m² K/W
RW300S	R 0.223m² K/W

Total R-value thermal assessments have been performed for a variety of afs rediwall® wall configurations.

The following table provides examples of some afs rediwall wall system configurations along with their total R-values.

For assistance with additional rediwall® wall configurations and thermal performance assessments, please contact AFS Technical Services.

TABLE A15: Examples of AFS Rediwall® Wall System Configurations and Thermal Performance Total R-Values

AFS Rediwall®	Composition	System Overview	Total R- Value	
			Summer	Winter
RW156C	– RW156C – 28mm Rondo furring channel on Betafix Clip – Bradford 25mm PIR for CLass 1&10 buildings – 6mm Cemintel Wallboard		1.61	1.75
RW156C	– RW156C – 28mm Rondo furring channel on Betafix Clip – Bradford 25mm PIR for CLass 1&10 buildings – 13mm Gyprock standard plasterboard		1.67	1.81
RW156C	– RW156C – 20mm air gap – 64mm Rondo stud frame – Bradford Acoustigard 75mm R1.8 – 13mm Gyprock standard plasterboard		2.24	2.44

Weatherproofing

For any external façade design applicable to a building, it is essential that the system adopted is capable of withstanding the various environmental conditions which the façade is subject to during its life. In particular the prevention of water ingress into the building is critical. afs rediwall® as an external façade, with an applied weatherproofing coating performs as a successful barrier to water ingress, and has been tried and proven on numerous buildings, many of which are in coastal locations. The system chiefly relies upon the following:

1. Adoption of horizontal slab junction details as recommended by AFS. Refer to Volume 2 for further details.
2. The water resistance of the PVC face used in afs rediwall® itself.
3. Appropriate location of flashings, especially to cap exposed parapet walls typically located on the top level of buildings.
3. Correct application of a quality external weatherproofing coating system to supplier's specifications.

AFS Rediwall® systems will comply with the weatherproofing performance verification methods NCC2019 FV1.1 Weatherproofing (Volume 1) and V2.2.1 (Volume 2) of the National Construction Code, in accordance with the report 'Weatherproofing to Xaviar Knight report April 2022.

Termite Resistance

Australian Standard AS 3660.1 – Termite Management – New building works, Clause 4.3.2.2 confirms that as long as the construction joints at the wall/concrete slab junction are designed and constructed in accordance with AS2870 or AS3600, no other termite treatment is required as the junction becomes a suitable termite barrier.

Furthermore, rediwall®, consisting of concrete elements designed and constructed in accordance with AS3600 as a monolithic construction, together with PVC linings in accordance with AS3660.1, Clause 3.2, is deemed to be termite resistant.

Bushfire Resistance

AFS Rediwall® is suitable for use in external wall construction in designated bushfire prone areas. Rediwall® systems have been fire tested to confirm Fire Resistance Levels of 60/60/60 up to 240/240/240. Refer to the Fire Resistance Levels section of this guide.

Australian Standard AS3959 – Construction of buildings in bushfire prone areas, Clause 9.4, Item C, and Cl 3.4 confirm that external wall systems with an FRL 30/30/30 or –/30/30 or higher are suitable for all Bushfire Attack Levels (BAL), i.e. BAL-Low to BAL-FZ.

For further details, refer to the latest Codemark requirements for bushfire construction provisions.

Appendices

The following are sample documents for:

AFS Rediwall® Standard Bracing & Lifting Bar

AFS Rediwall Standard Bracing Drawing and Certificate

AFS Rediwall® approved N16 Lifting Bar Drawing and Certification

Certifications

Rediwall® Codemark Certification

CM30107

Fire Resistance Level (FRL)

AS1530.4 FRL Fire Test Certificates

AS1530.4 FRL Assessment Report

AS1530.4 FRL Service Penetration Test and Assessment Report

Non-combustibility and Fire Performance

Stephen Grubits & Associates Safety Engineers, Rediwall® – Non-Combustibility Assessment Report

AS5113 Facade Fire Test Report

AS5637.1 Classification (AS/ISO 9705 Room Test) Report

AS1530.3 Fire Hazard Properties Fire Test Certificates

Acoustic Performance

Acoustic Logic Consultancy – Acoustic Performance Certificates for – RW110C, RW156C, RW200C, RW256S & RW300S.

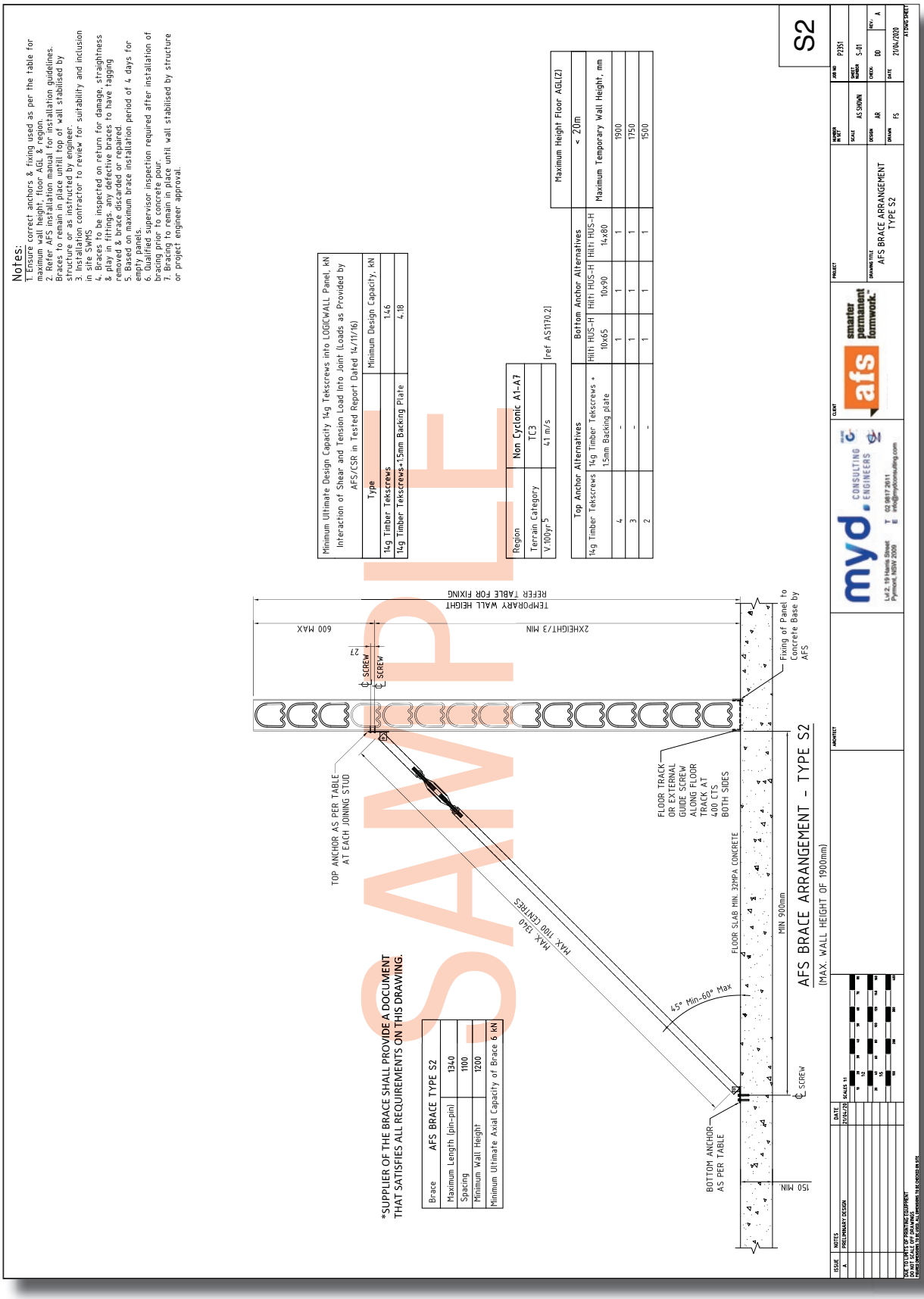
Thermal Performance

James M Fricker Pty Ltd – R-value certificates – RW110C, RW156C, RW200C, RW256S, RW275S and RW300S.

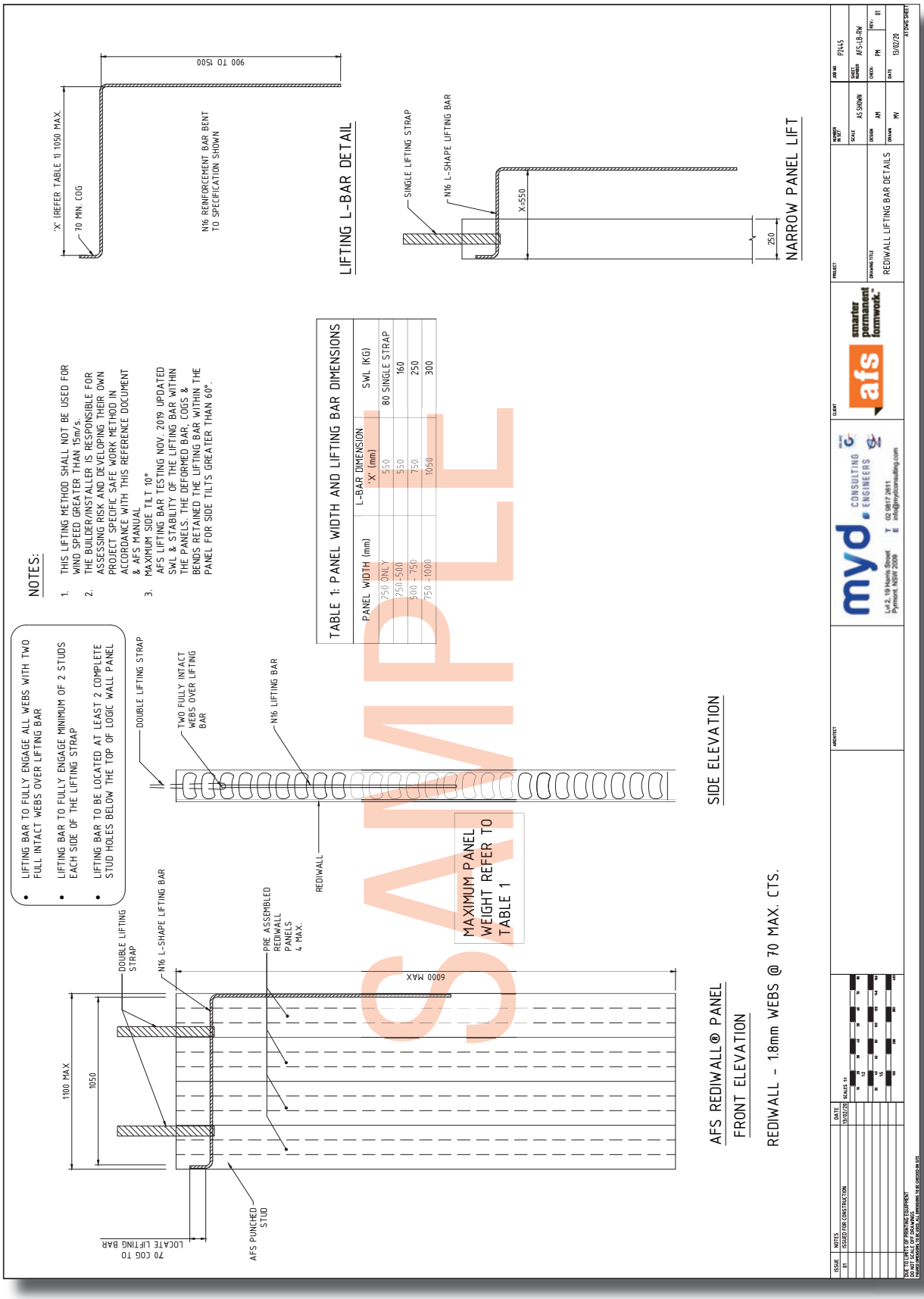
Weatherproofing

Xavier Knight Weatherproofing Verification Report.

AFS Rediwall Standard Bracing



AFS Rediwall® Standard Lifting Bar



Certificate of Conformity

Global-Mark Pty Ltd,
Suite 4.07, 32 Delhi Road, North Ryde
NSW 2113, Australia

Tel: +61 (0)2 9886 0222 - www.Global-Mark.com.au

Certificate Holder:

AFS Systems Pty Ltd
110 Airds Road
Minto, NSW, 2566

Tel: 1300 727 237

afsformwork.com.au

Certificate number: CM 30107 Rev 5

THIS TO CERTIFY THAT

AFS REDIWALL®

Type and/or use of product:

AFS REDIWALL® is a permanent formwork system for internal and external loadbearing and non-loadbearing reinforced concrete walls with structural, fire, weatherproofing, acoustic and thermal performance characteristics.

Description of product:

AFS REDIWALL® comprises:

1. Interlocking PVC panel extrusions as permanent formwork, and associated PVC accessories.
2. Fibre cement sheet or PVC end closures.
3. Reinforcing steel.
4. Concrete fill.
5. A range of finishing options as described in A2.

AFS REDIWALL® types are as follows, the numerical values representing the thickness of the wall in millimetres:

1. RW110C Single Reinforcement.
2. RW156C Single Reinforcement.
3. RW200C Single or Double Reinforcement.
4. RW256S Double Reinforcement.
5. RW275S Double Reinforcement.
6. RW300S Double Reinforcement.

SAMPLE

COMPLIES WITH THE FOLLOWING BCA PROVISIONS AND STATE OR TERRITORY VARIATION(S) — **BCA 2022**

Scope of certification: The CodeMark Scheme is a building product certification scheme. The rules of the Scheme are available at the ABCB website www.abcb.gov.au. This Certificate of Conformity is to confirm that the relevant requirements of the Building Code of Australia (BCA) as claimed against have been met. The responsibility for the product performance and its fitness for the intended use remain with the certificate holder. The certification is not transferrable to a manufacturer not listed on Appendix A of this certificate.
Disclaimer: The Scheme Owner, Scheme Administrator and Scheme Accreditation Body do not make any representations, warranties or guarantees, and accept no legal liability whatsoever arising from or connected to, the accuracy, reliability, currency or completeness of any material contained within this certificate; and the Scheme Owner, Scheme Administrator and Scheme Accreditation Body disclaim to the extent permitted by law, all liability (including negligence) for claims of losses, expenses, damages and costs arising as a result of the use of the product(s) referred to in this certificate.
The purpose of Global-Mark **construction site audits** is to confirm the practicability of installing the product; and to confirm the appropriateness and accuracy of installation instructions
In placing **the CodeMark mark** on the product/system, the certificate holder makes a declaration of compliance with the certification standard(s) and confirms that the product is identical to the product certified herein. In issuing this Certificate of Approval Global-Mark has relied on the **expertise of external bodies** (laboratories, and technical experts).

Herve Michoux
Global-Mark Managing Director

Peter Gardner
Unrestricted Building Certifier

Date of issue: 01/05/2023

Date of expiry: 10/05/2025

AFS Rediwall® Fire Resistance Level (FRL) Reports

INFRASTRUCTURE TECHNOLOGIES
www.csiro.au

14 Julius Avenue, North Ryde NSW 2113
PO Box 310, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2667

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without written authorisation from CSIRO is forbidden.

This is to certify that the element of construction described below was tested by the CSIRO Infrastructure Technologies in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2005 on behalf of:

AFS Products Group Pty Ltd
22-24 Sommerville Circuit
Emu Plains NSW

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSV 1704.

Product Name: Load-bearing 150-mm thick AFS 150 Rediwall Panel structural wall system.

Description: The specimen comprised a reinforced concrete wall system 3000-mm high x 3000-mm wide x 150-mm thick made up of twelve pre-fabricated permanent formwork panels core-filled with concrete after assembly.
The pre-fabricated permanent formwork system comprised 250-mm wide x 3000-mm high x 150-mm thick AFS 150 Rediwall panels. The extruded PVC panels comprised 2.5-mm thick perforated internal webs spaced at nominally 80-mm centres, as shown in drawing numbered AFS-DT-345, dated 8 April 2015, by AFS Systems Pty Ltd. The panels interconnected vertically by integrated sliding male to female connectors to form a hollow panel wall. The ends of the wall were finished with solid End Caps, while the bottom consisted of a perforated Floor Track.
The wall was reinforced with N12 reinforcing bars at 350-mm centres vertically and 400-mm centres horizontally.
The panels were appropriately braced and 32 Mpa, 120-mm slump concrete mix was pumped in through the top openings and trowelled off along the top, when completely filled.
A total load of 700 kN was applied to the specimen for the duration of the test. The load requested by the client, was applied uniformly along the top of the wall.

The element of construction described above satisfied the following criteria for fire-resistance for the period stated.

Structural Adequacy	no failure at 241 minutes
Integrity	no failure at 241 minutes
Insulation	no failure at 241 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of 240/240/240. The FRL is applicable for exposure to fire from either direction.
This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 17 July 2015

Issued on the 7th day of August 2015 without alterations or additions.

Brett Roddy
Manager, Fire Testing and Assessments

NATA	**NATA Accredited Laboratory** **Number: 165** **Corporate Site No 3625** **Accredited for compliance with ISO/IEC 17025**

SAMPLE

INFRASTRUCTURE TECHNOLOGIES
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14 Julius Avenue, North Ryde NSW 2113
PO Box 310, North Ryde NSW 1670, Australia
T (02) 9490 5444 • **ABN** 41 687 119 230

Certificate of Test

No. 2580

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This is to certify that the element of construction described below was tested by the CSIRO Division of Materials Science and Engineering in accordance with Australian Standard 1530, Methods for fire tests on building materials, components and structures, Part 4-2005 on behalf of:

AFS Products Group Pty Ltd
22-24 Sommerville Circuit
Emu Plains NSW

A full description of the test specimen and the complete test results are detailed in the Division's Sponsored Investigation report numbered FSV 1654.

Product Name: 200-mm thick, load-bearing AFS 250 Rediwall Panel, structural wall system.

Description: The specimen comprised a reinforced concrete wall system 3000-mm high x 3000-mm wide x 200-mm thick made up of twelve pre-fabricated permanent formwork panels core-filled with concrete after assembly.
The pre-fabricated permanent formwork system comprised 250-mm wide x 3000-mm high x 200-mm thick AFS 250 Rediwall panels. The extruded PVC panels comprised 2.5-mm thick perforated internal webs spaced at nominally 80-mm centres, as shown in drawing titled "AFS U250 Panel 200 THK Rediwall", dated 22 July 2014, by LMGDS Pty Ltd. The panels interconnected vertically by integrated sliding male to female connectors to form a hollow panel wall. The ends of the wall were finished with solid End Caps, while the bottom consisted of a perforated Floor Track.
The wall was reinforced with N12 reinforcing bars at 350-mm centres vertically and 400-mm centres horizontally.
The panels were appropriately braced and 32 Mpa, 120-mm slump concrete mix was pumped in through the top openings and trowelled off along the top, when completely filled. The concrete mix design is specified in Hanson Construction Materials Pty Ltd report in Appendix D.
A total load of 1000 kN was applied to the specimen for the duration of the test.
The wall specimen wall was constructed on 20 January 2014.

The element of construction described above satisfied the following criteria for fire-resistance for the period stated.

Structural Adequacy	no failure at 241 minutes
Integrity	no failure at 241 minutes
Insulation	no failure at 241 minutes

and therefore for the purpose of Building Regulations in Australia, achieved a fire-resistance level (FRL) of 240/240/240. The FRL is applicable for exposure to fire from either direction.

This certificate is provided for general information only and does not comply with regulatory requirements for evidence of compliance.

Testing Officer: Chris Wojcik Date of Test: 11 August 2014

Issued on the 5th day of September 2014 without alterations or additions.

Brett Roddy
Manager, Fire Testing and Assessments

This document is issued in accordance with NATA's accreditation requirements.
Accreditation No. 165 – Corporate Site No. 3625
Accredited for compliance with ISO/IEC 17025

SAMPLE

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Unit 2, 409-411 Hammond Road
Dandenong Victoria 3175
Australia
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F: +61 (0)3 9767 1001
W: www.exova.com

Testing. Advising. Assuring.

EWFA CERTIFICATE OF ASSESSMENT	CERTIFICATE No : SFC 51713600.1 Page 1 of 2

Report Sponsor	Certificate Issue Date	Products Name
AFS Systems Pty Ltd 110 Airds Road Minto NSW 2566	17/04/2018	**The fire resistance performance of AFS Rediwall loadbearing wall systems if tested in accordance with AS1530.4-2014**

Assessment Report Reference	Referenced Standard	Report Issue Date	Report Validity Date
EWFA 5173600.1	AS1530.4-2014	17/04/2018	30/04/2023

Introduction

The element of construction described below was assessed by this laboratory on behalf of the report sponsor in accordance with the stated test standard and achieved the results stated below. Refer to the referenced test report for a complete description of the assessed construction.

Assessed systems description and performance

Based on the discussion presented in the assessment report, it is the opinion of this testing authority that if the specimen described in section 1 of the report had been modified within the scope of section 3, it will achieve the performance as stated below if tested in accordance with the test method referenced in Section 4 and subject to the requirements of Section 7:

RW156C Wall System, FRL: 240/240/240, uniformly applied load is 700kN

RW200C Wall System, FRL: 240/240/240, uniformly applied load is 1000kN

RW256S Wall System, FRL: 240/240/240, uniformly applied load is 1000kN

For full and detailed discerption of the assessed systems please refer to assessment report EWFA 51713600.1

Conditions/Validity

- THIS CERTIFICATE IS PROVIDED FOR GENERAL INFORMATION ONLY AND DOES NOT COMPLY WITH THE REGULATORY REQUIREMENTS FOR EVIDENCE OF COMPLIANCE.
- Reference should be made to the relevant test report or regulatory information report to determine the applicability of the test result to a proposed installation. Full details of the constructions and justification for the conclusions given, along with the validity statements, are given in the assessment reports.
- The assessment report or short form assessment report does not provide an endorsement by Exova Warringtonfire Aus Pty Ltd of the performance of the actual products supplied. It is intended to provide a brief outline of the above referenced assessment reports and not to replace them.
- The conclusions in this certificate of assessment relate to the configurations as detailed, and should not be applied to any other configuration. The conclusions expressed in this document assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all conditions.
- Full copies of the assessment and relevant test reports may be obtained from the sponsor.

SAMPLE

STEPHEN GRUBITS & ASSOCIATES

Stephen Grubits & Associates Pty Ltd
Suite 5A, Level 4, 189 Kent Street, Sydney NSW 2000
PO Box N522, Grosvenor Place NSW 1220
Tel: +61 2 9247 1444 Fax: +61 2 9247 1499
Email: sydney@grubits.com.au
ABN: 24 075 049 688

File: 2013/277.65 R2.2 **ASSESSMENT SUMMARY**

Product Name	CSR Rediwall®
Manufacturer	AFS Walling Solutions, a division of CSR Ltd
Assessment Reports	Stephen Grubits & Associates, Fire Engineering Report 2013/277.65 R1.4, Issued 01 July 2020
Applicable Building Code	National Construction Code 2019 Amendment 1 Building Code of Australia (BCA), Volume One
Relevant BCA Performance Requirements	CP1 and CP2
Purpose of this document	To summarise findings of SGA Report Number 2013/277.65 R1.4
Date of Issue:	01/07/2020
Date of Expiry	Date NCC 2019 Amendment 1 is amended or superseded

Overview

The fire-resisting performance of the above-mentioned product was assessed by Stephen Grubits & Associates (SGA) at the request of AFS Walling Solutions, a division of CSR Ltd. The fire-resistance level achieved by 110 mm thick CSR Rediwall® walls was evaluated based on test data relating to 150 mm thick and 200 mm thick CSR Rediwall® (see limitations). The findings were applicable to 110 mm thick CSR Rediwall® of the following dimensions

- 2.7 m floor-to-floor wall height, restrained such that the *k* factor (in accordance with AS 3600-2018) is no greater than 0.75.
- 2.9 m floor-to-floor wall height, restrained such that the *k* factor is no greater than 0.75.
- 2.2 m floor-to-floor wall height, restrained such that the *k* factor is no greater than 1.

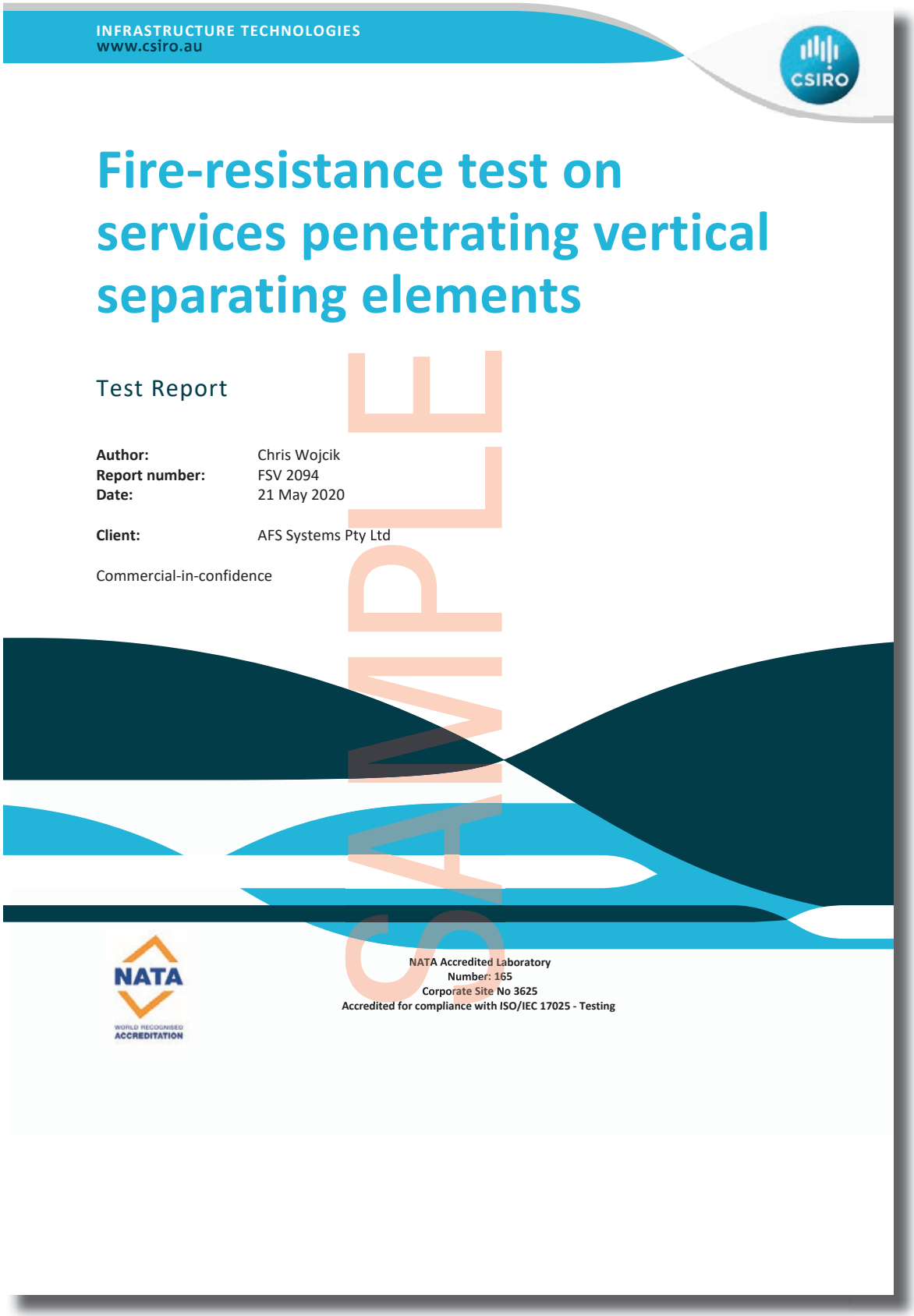
Assumptions and Limitations

The assessment is strictly limited to 110 mm thick CSR Rediwall® with the following characteristics:

- One layer of N12 steel reinforcing bars located in the centre of the wall thickness at 350 mm centres vertically and 400 mm centres horizontally
- Rediwall® to be arranged such that its plastic webs are in a vertical arrangement only.
- The FRLs described in this document are valid for exposure to fire on one-side only.

Issued by:	Carlos Quaglia (C10 - BPB0334)		Approved by:	Rose Pengilly (Director)	

SAMPLE


INFRASTRUCTURE TECHNOLOGIES
www.csiro.au
CSIRO
Fire-resistance test on services penetrating vertical separating elements
Test Report
Author: Chris Wojcik
Report number: FSV 2094
Date: 21 May 2020
Client: AFS Systems Pty Ltd
Commercial-in-confidence
SAMPLE
NATA
WORLD RECOGNISED ACCREDITATION
NATA Accredited Laboratory
Number: 165
Corporate Site No 3625
Accredited for compliance with ISO/IEC 17025 - Testing

INFRASTRUCTURE TECHNOLOGIES
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The fire resistance of AFS Rediwall and AFS Logicwall including various service penetrations in accordance with AS 1530.4 – 2014 and AS 4072.1 – 2005 Amdt 1

Assessment Report

Author: Keith Nicholls

Assessment Number: FCO-3380 Rev B

Quote Number: CO5209

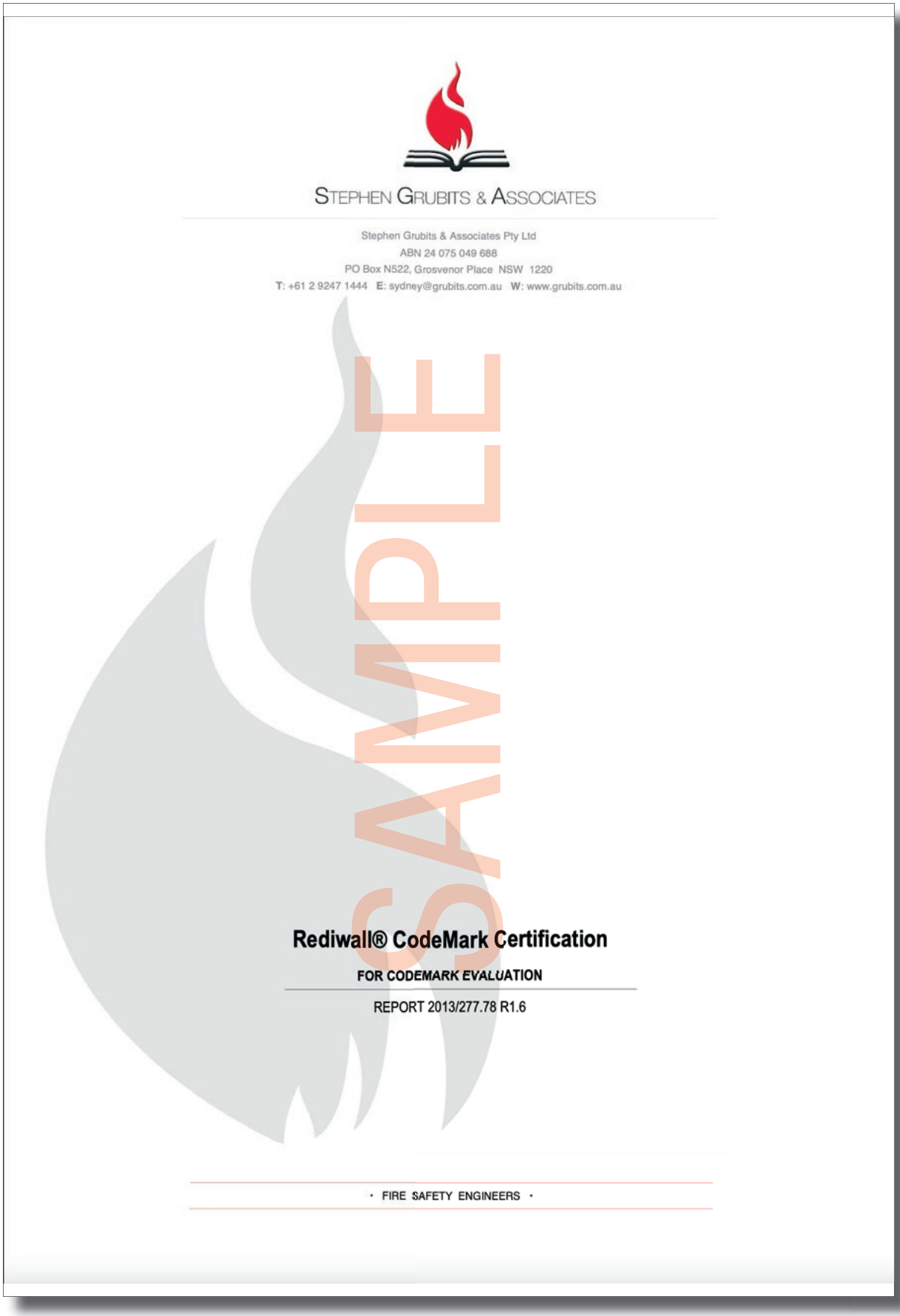
Date: 8th July 2020

The Client: AFS Systems Pty Ltd

Commercial-in-confidence

SAMPLE

Stephen Grubits & Associates – Rediwall® CodeMark Evaluation



STEPHEN GRUBITS & ASSOCIATES

Stephen Grubits & Associates Pty Ltd
ABN 24 075 049 688
PO Box N522, Grosvenor Place NSW 1220
T: +61 2 9247 1444 E: sydney@grubits.com.au W: www.grubits.com.au

SAMPLE

Rediwall® CodeMark Certification

FOR CODEMARK EVALUATION

REPORT 2013/277.78 R1.6

· FIRE SAFETY ENGINEERS ·

Rediwall® AS5113 Facade Test Report

SAMPLE

Exova Warringtonfire

TEST REPORT

External Wall reaction to fire testing of a 110mm thick external wall system in accordance with AS5113: 2016.

EWFA Report No:

51713900.1

Report Sponsor:

AFS Systems Pty Ltd
110 Airds Road
Minto NSW 2566

Test Date:

17 October 2017

Testing, Calibrating, Advising

Rediwall® AS5637.1 Classification Report

warringtonfire
Proud to be part of element



Classification report

Classification of wall and ceiling lining in accordance with AS 5637.1:2015

Test sponsor: AFS Systems Pty Ltd

Product: Concrete-filled AFS rediwall, PVC reference No: RE05D02DB

Report number: ASCRRTF190226

Test date: 25 November 2019 Revision: R2.0

Rediwall® AS1530.3 Fire Hazard Properties Test Report

AWTA PRODUCT TESTING

Australian Wool Testing Authority Ltd - trading as AWTA Product Testing
A.B.N 43 006 014 106
1st Floor, 191 Racecourse Road, Flemington, Victoria 3031
P.O Box 240, North Melbourne, Victoria 3051
Phone (03) 9371 2400 Fax (03) 9371 2499

TEST REPORT

Client : CSR - AFS Walling Solutions
110 Airds Road
Minto NSW 2566

Test Number : 17-003237
Issue Date : 21/06/2017
Print Date : 28/06/2017

Sample Description
Clients Ref : "Rediwall"
Walling system with PVC facing
Nominal Composition : PVC/Concrete
Nominal Mass per Unit Area/Density : Approx. 450kg/m2
Nominal Thickness : Approx. 60mm

AS/NZS 1530.3-1999 **Methods for Fire Tests on Building Materials, Components and Structures Part 3: Simultaneous Determination of Ignitability, Flame Propagation, Heat Release and Smoke Release**

Face tested:	Face		
Date tested:	21/06/2017		
	Standard Error	Mean	
Ignition time	0.43	10.35	min
Flame propagation time	Nil	Nil	sec
Heat release integral	2.2	16.8	kJ/m²
Smoke release, log d	0.0400	-0.4439	
Optical density, d		0.3670	/ metre
Number of specimens ignited:		6	
Number of specimens tested:		6	
Regulatory Indices:			
Ignitability Index		10	Range 0-20
Spread of Flame Index		0	Range 0-10
Heat Evolved Index		0	Range 0-10
Smoke Developed Index		6	Range 0-10

SAMPLE

96083 20342

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NATA
Accredited for compliance with ISO/IEC 17025
- Chemical Testing : Accreditation No. 983
- Mechanical Testing : Accreditation No. 985
- Performance & Approvals Testing : Accreditation No. 1356

AWTA LIMITED

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APPROVED SIGNATORY

MICHAEL A. JACKSON B Sc(...)
MANAGING DIRECTOR

0204/11/06

ACOUSTIC LOGIC

DIRECTORS
MATTHEW PALAVIDIS
VICTOR FATTORETTO
MATTHEW SHIELDS

20181292.1/1801A/R2/JL

18/01/2019

CSR - AFS Walling Solutions
110 Airds Road
MINTO NSW 2566

AFS Rediwall 110mm Base Wall - Acoustic Performance Opinion - AFS6001

This letter presents the professional acoustic assessment of Acoustic Logic Consultancy (ALC) in relation to the following AFS wall system:

- AFS Rediwall 110mm Base Wall

R_w: Weighted Sound Reduction Index which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

D_{nTw}: Weighted Standardised Level Difference which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

C_{tr}: Spectrum adaptation term.

It is the opinion of ALC that this construction will achieve the acoustic rating presented in the table below:

Table 1 – Predicted Acoustic Rating

Predicted R_w	Predicted C_{tr}	Predicted $R_w + C_{tr}$
50	-5	45

SAMPLE

SYDNEY
A: 9 Sarah St
MASCOT 2020
T: (02) 8339 8000

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

ABN: 11 068 954 343

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ACOUSTIC LOGIC

DIRECTORS
MATTHEW PALAVIDIS
VICTOR FATTORETTO
MATTHEW SHIELDS

20181292.1/1801A/R0/JL

18/01/2019

CSR - AFS Walling Solutions
110 Airds Road
MINTO NSW 2566

AFS Rediwall 156mm Base Wall - Acoustic Performance Opinion - AFS7001

This letter presents the professional acoustic assessment of Acoustic Logic Consultancy (ALC) in relation to the following AFS wall system:

- AFS Rediwall 156mm Base Wall

R_w: Weighted Sound Reduction Index which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

D_{nTw}: Weighted Standardised Level Difference which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

C_{tr}: Spectrum adaptation term.

It is the opinion of ALC that this construction will achieve the acoustic rating presented in the table below:

Table 1 – Predicted Acoustic Rating

Predicted R_w	Predicted C_{tr}	Predicted $R_w + C_{tr}$
54	-4	50

SAMPLE

SYDNEY
A: 9 Sarah St
MASCOT 2020
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SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

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ACOUSTIC LOGIC

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20181292.1/1801A/R0/JL

18/01/2019

CSR - AFS Walling Solutions
110 Airds Road
MINTO NSW 2566

AFS Rediwall 200mm Base Wall - Acoustic Performance Opinion - AFS8001

This letter presents the professional acoustic assessment of Acoustic Logic Consultancy (ALC) in relation to the following AFS wall system:

- AFS Rediwall 200mm Base Wall

R_w: Weighted Sound Reduction Index which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

D_{nTw}: Weighted Standardised Level Difference which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

C_{tr}: Spectrum adaptation term.

It is the opinion of ALC that this construction will achieve the acoustic rating presented in the table below:

Table 1 – Predicted Acoustic Rating

Predicted R_w	Predicted C_{tr}	Predicted $R_w + C_{tr}$
58	-5	53

SAMPLE

SYDNEY
A: 9 Sarah St
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20181292.1/1801A/R0/JL

18/01/2019

CSR - AFS Walling Solutions
110 Airds Road
MINTO NSW 2566

AFS Rediwall 256mm Base Wall - Acoustic Performance Opinion - AFS9001

This letter presents the professional acoustic assessment of Acoustic Logic Consultancy (ALC) in relation to the following AFS wall system:

- AFS Rediwall 256mm Base Wall

R_w: Weighted Sound Reduction Index which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

D_{nTw}: Weighted Standardised Level Difference which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

C_{tr}: Spectrum adaptation term.

It is the opinion of ALC that this construction will achieve the acoustic rating presented in the table below:

Table 1 – Predicted Acoustic Rating

Predicted R_w	Predicted C_{tr}	Predicted $R_w + C_{tr}$
60	-5	55

SAMPLE

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ACOUSTIC LOGIC

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20181292.5/2004A/R1/GW

20/04/2020

CSR - AFS Walling Solutions
110 Airds Road
MINTO NSW 2566

275MM THICK AFS REDIWALL - ACOUSTIC ASSESSMENT

This letter presents the professional acoustic assessment of Acoustic Logic Consultancy (ALC) in relation to the following AFS wall system:

- AFS Rediwall 275mm Base Wall

R_w: Weighted Sound Reduction Index which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

D_{nTw}: Weighted Standardised Level Difference which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

C_{tr}: Spectrum adaptation term.

It is the opinion of ALC that this construction will achieve the acoustic rating presented in the table below:

Table 1 – Predicted Acoustic Rating

Wall	Predicted R_w	Predicted C_{tr}	Predicted $R_w + C_{tr}$
AFS 275mm Rediwall	61	-5	56

SAMPLE

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ACOUSTIC LOGIC

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20181292.5/2004A/R2/GW

20/04/2020

CSR - AFS Walling Solutions
110 Airds Road
MINTO NSW 2566

300MM THICK AFS REDIWALL - ACOUSTIC ASSESSMENT

This letter presents the professional acoustic assessment of Acoustic Logic Consultancy (ALC) in relation to the following AFS wall system:

- AFS Rediwall 300mm Base Wall

R_w: Weighted Sound Reduction Index which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

D_{nTw}: Weighted Standardised Level Difference which is calculated using the third octave frequency bands between and including 100 Hz to 3150 Hz.

C_{tr}: Spectrum adaptation term.

It is the opinion of ALC that this construction will achieve the acoustic rating presented in the table below:

Table 1 – Predicted Acoustic Rating

Wall	Predicted R_w	Predicted C_{tr}	Predicted $R_w + C_{tr}$
AFS 300mm Rediwall	61	-5	56

SAMPLE

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OVERALL "TOTAL R" (THERMALLY BRIDGED) THERMAL PERFORMANCE CALCULATIONS TO AS/NZS 4859 Parts 1 & 2:2018

SAMPLE

The following calculations by James M Fricker Pty Ltd are based upon:

a) AS/NZS 4859.1:2018 "Thermal insulation materials for buildings. Part 1: General criteria and technical provisions",

b) AS/NZS 4859.2:2018 "Thermal insulation materials for buildings. Part 2: Design",

c) the Australian Institute of Refrigeration Air-conditioning & Heating (AIRAH) Handbook (Edition 5, 2013), and (if necessary) the ASHRAE Fundamentals Handbook.

Initial results report Total R for each thermal path. These results are combined by area weighting and isothermal planes method to deduce **Overall Surface Total R**. This is per AS/NZS 4859.2:2018 Clause 4.3 – *"A total resistance associated with a construction of materials, computed or measured over an area sufficient to be fully representative of the element of construction, and specified as a Total R-value, including surface film resistances and thermal bridging."*

Total R-values are based on product in-service conditions in accordance with AS/NZS 4859.2:2018 including the alteration of insulation Material R for temperature, and Air Space R for temperature and infrared emittance.

Each calculation result is subject to any specific notes and assumptions listed on the calculation.

If a construction differs from the described system, the thermal resistance may be different.

All calculations were done by James M Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus)

ENGINEERS AUSTRALIA
Chartered Professional Engineer
MEMBER 1179647

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http://fricker.net.au

XAVIER KNIGHT



SAMPLE

Weatherproofing Assessment

AFS Logicwall and Rediwall

NOTES:

PVC-based permanent formwork for basements, columns, blade & party walls, lift & stair cores, retaining walls and retention tanks



Disclaimer: The products referred to in this document have been manufactured by or on behalf of CSR Building Products Limited ("CSR") to comply with the Building Code of Australia and any relevant Australian Standards. While any design or usage guidelines set out in this document have been prepared in good faith by CSR, they are of a general nature only and are intended to be used in conjunction with project specific design and engineering advice.
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