afs rediwall®

Volume 1 – April 2019

Design, Performance & Compliance Guide

Rediwall® Technical Information and Engineered Design Tables

CSR

Contents

INTRODUCTION

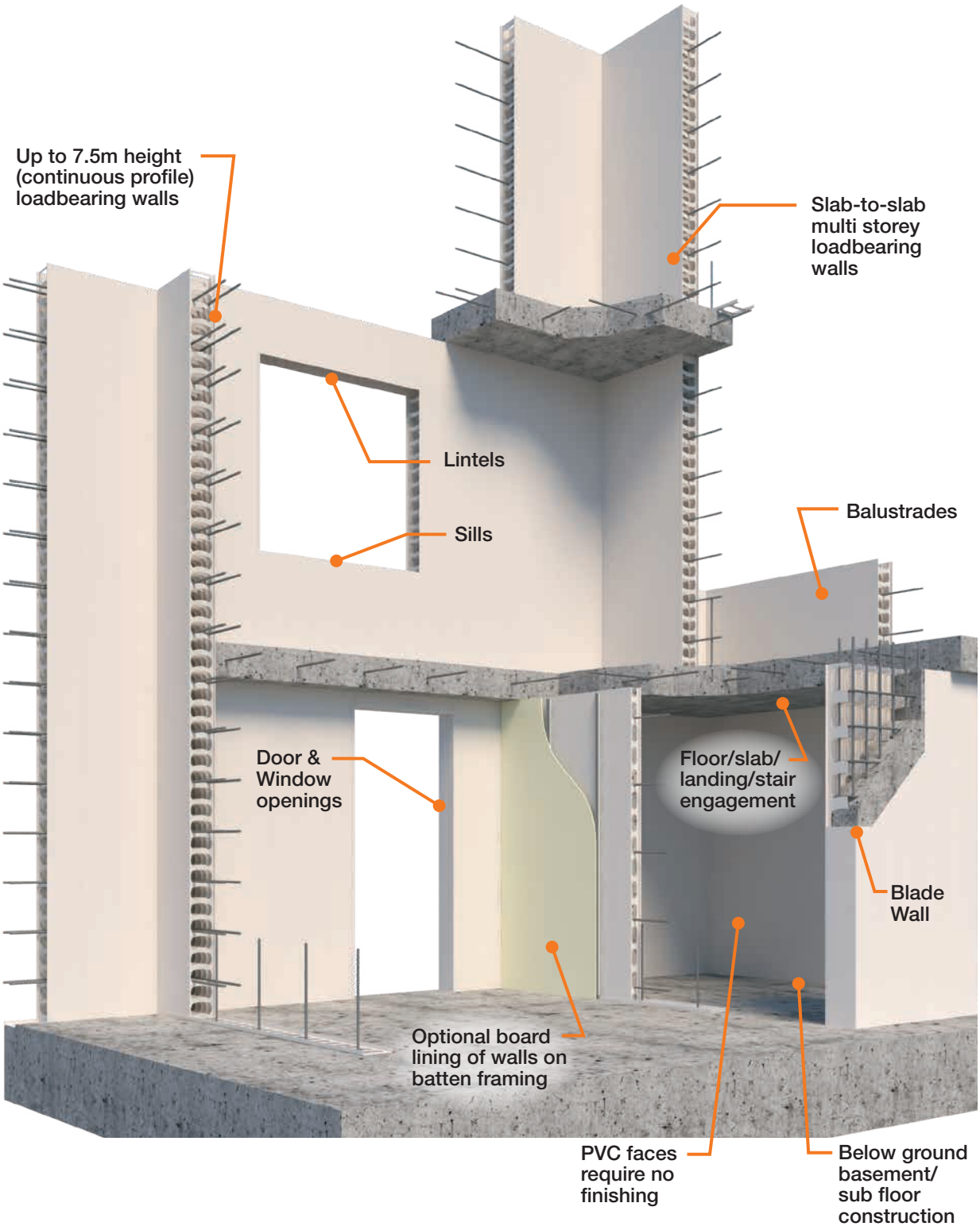
Volume 1– 'AFS Rediwall® Design, Performance and Compliance Guide' forms part of a comprehensive afs rediwall® Systems Manual that encompasses Volume 1 , 2 and 3. This manual covers the aspects of Design, Performance, Compliance, Construction and Installation for all rediwall® products current at the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

Disclaimer: This section of the afs rediwall® Systems Manual is intended to represent good building practice in achieving structural design of rediwall®. This section is not intended in any way by AFS to represent all relevant information required on a project. It is the responsibility of those using and designing rediwall®, including but not limited to builders, designers, consultants and engineers to ensure that the use of rediwall® complies with all the relevant National Construction Code (NCC) requirements such as, but not limited to structural adequacy, acoustic, fire resistance/combustibility, thermal, and weatherproofing provisions. All diagrams, plans and illustrations used in this section, including any reinforcement shown, are supplied for indicative and diagrammatic purposes only. It remains the responsibility of those using rediwall® to ensure that reference is made to the project engineer's structural details for all construction and reinforcement requirements.

REDIWALL® CAPABILITIES OVERVIEW

Rediwall® System Capabilities



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

STRUCTURAL DESIGN

Design Overview

Rediwall® is a PVC panel system that acts as a permanent formwork for insitu concrete walls. This section of the rediwall® Design Guide provides guidelines for the structural design of walls constructed using rediwall® and are designed as reinforced concrete walls in accordance with the AS3600 – 2009 Concrete Structures Code.

The following areas of structural design are discussed in this section:

- Axial Capacity
- Flexural Capacity
- Shear Capacity
- Lintels
- Reinforcement Requirements
- Minimum Reinforcement
- Structural Movement Joints
- Structural Detailing

Definition of 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	Depth to centre of horizontal bar
$f'_{c.max}$	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

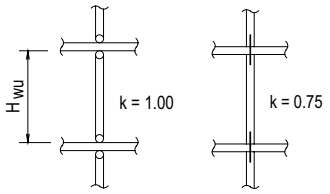
Axial Capacity

Rediwall® can be designed in accordance with Section 11 of AS3600 – 2009. [AS3600 Cl.11.4.4]

$$\text{Ø}N_u = \text{Ø}(t_w\text{-}1.2e\text{-}2.e_a)0.6f_c$$

Where:

Ø = 0.6	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.11.4.3]

Flexural Capacity

The flexural capacity of rediwall® calculated from basic theory ignoring axial forces:

$$\text{Ø}M_u = \text{Ø}f_y A_s d\left(1\text{-}0.6\frac{A_s}{bd}\frac{f_y}{f'_c}\right)$$

Where:

Ø = 0.6	strength reduction factor
M_u	ultimate flexural capacity
f_y	yield strength of vertical reinforcement
A_s	area of steel reinforcement
f'_c	characteristic compressive strength of concrete
d	effective reinforcement depth

Shear Capacity

Rediwall® shall be reinforced and designed in accordance with AS3600 – 2009 Cl.11.6. Design of walls subject to in plane shear forces require an additional check along the shear plane of the webs in accordance with AS3600 – 2009.

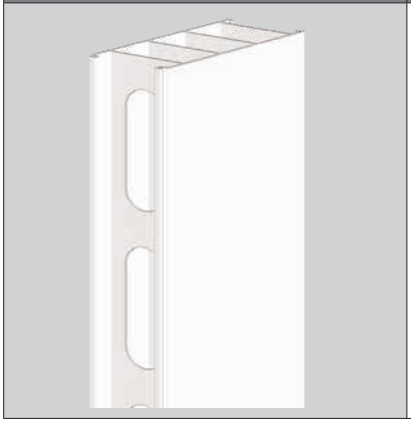
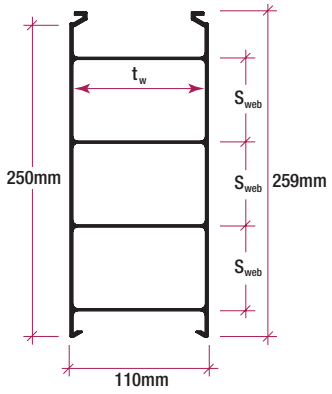
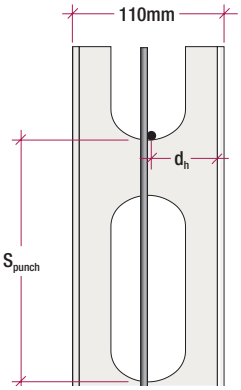
The punched plastic web vertical shear plane forms a reduced shear plane aligned along the webs. The area of the stud opening provides monolithic concrete contact while the plastic is not included and is considered as a compressible air gap.

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.

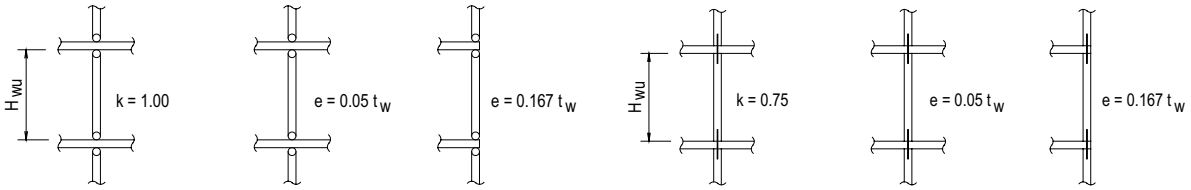
REDIWALL® STRUCTURAL DESIGN TABLES

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	k = 1.0	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	541	693	866	409	523	654
2700	2025	607	777	971	475	608	760
2400	1800	666	853	1066	534	683	854
2100	1575	718	919	1149	586	750	937
1800	1350	763	977	1221	631	808	1010
Limit with bottom plate		861	1102	1377	861	1102	1377

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

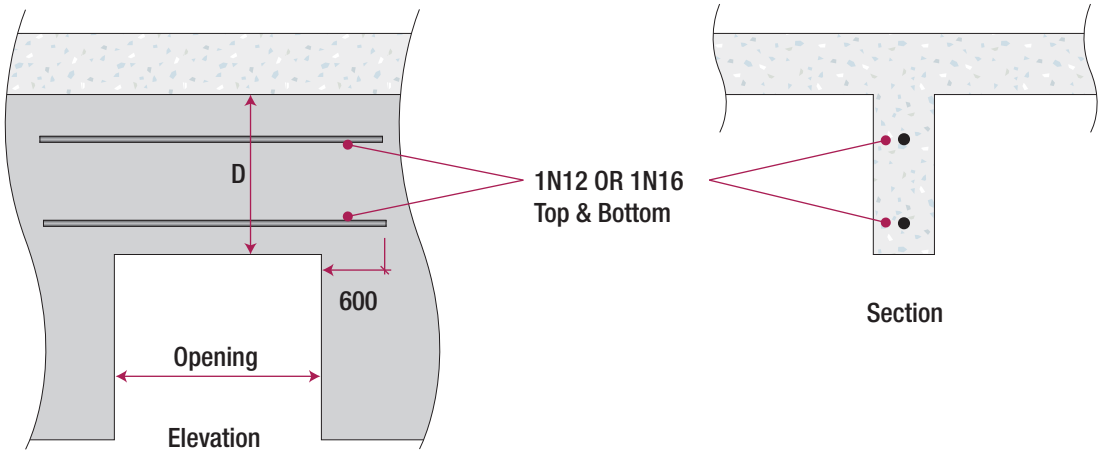
Acceptable
With Caution
Not Recommended

RW110C Out of Plane Flexural Capacity ($\emptyset M_u$ 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
$\emptyset M_u = \emptyset(f_y \rho b d^2(1-0.6\rho f_y/f'_c))$						

RW110C Standard Lintels

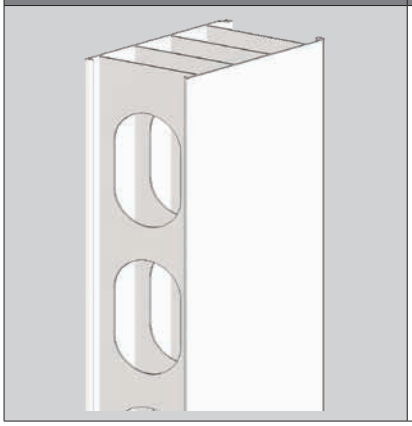
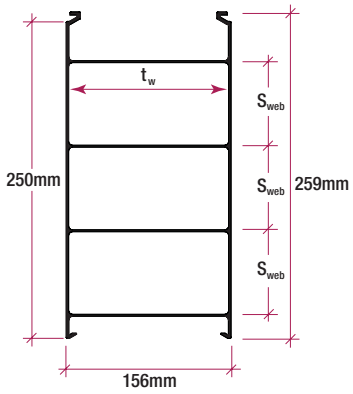
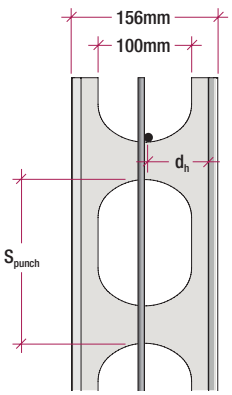
Capacity given is for standard lintel, with minimum reinforcement. Engineer can add extra reinforcement to achieve higher capacity.



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

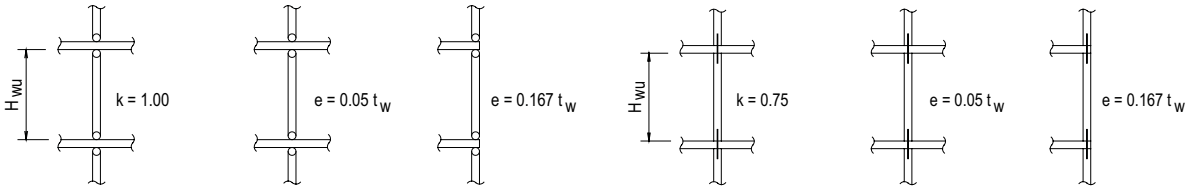
	1N12 Top & Bottom, Depth (mm)					1N16 Top & Bottom, Depth (mm)				
D	300	450	600	900	1200	300	450	600	900	1200
d_{eff}	213	363	513	813	1113	213	363	513	813	1113
Span (mm)										
3900	6.4	8.9	10.4	11.8	11.8	11	11.8	11.8	11.8	11.8
3600	7.5	9.6	11.2	12.8	12.8	12.6	12.8	12.8	12.8	12.8
3300	8.7	10.5	12.3	14	14	13.8	14	14	14	14
3000	9.6	11.5	13.5	15.4	15.4	15.2	15.4	15.4	15.4	15.4
2700	10.6	12.8	15	17.1	17.1	16.8	17.1	17.1	17.1	17.1
2400	12	14.4	16.8	19.2	19.2	18.9	19.2	19.2	19.2	19.2
2100	13.7	16.5	19.3	21.9	21.9	21.6	21.9	21.9	21.9	21.9
1800	16	19.2	22.5	25.6	25.6	25.3	25.6	25.6	25.6	25.6
1500	19.2	23.1	27	30.7	30.7	30.3	30.7	30.7	30.7	30.7
1200	23.9	28.8	33.7	38.4	38.4	37.9	38.4	38.4	38.4	38.4
900	31.9	38.4	44.9	51.2	51.2	50.5	51.2	51.2	51.2	51.2
$\emptyset M_u$(kNm)	8.8	15.4	22	35.2	48.4	15.2	27.2	39.2	63.2	87.2
$V_{u.max}$(kN)	32.9	56.1	79.4	125.8	172.3	32.9	56.1	79.4	125.8	172.3
$\emptyset V_u$ (kN)	14.4	17.3	20.2	23	23	22.7	23	23	23	23
	= Limited by shear									

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	k = 1.0	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	870	1113	1391	1739	679	869	1087	1358
3600	2700	930	1190	1488	1860	740	947	1183	1479
3300	2475	985	1261	1577	1971	795	1018	1272	1590
3000	2250	1036	1326	1658	2072	846	1083	1353	1692
2700	2025	1082	1385	1731	2164	892	1141	1427	1783
2400	1800	1123	1437	1797	2246	933	1194	1492	1865
2100	1575	1159	1484	1855	2318	969	1240	1550	1938
1800	1350	1191	1524	1905	2381	1000	1280	1600	2001
Limit with bottom plate		1357	1737	2171	2713	1357	1737	2171	2713

RW156C Minimum Reinforcement

RW156C		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

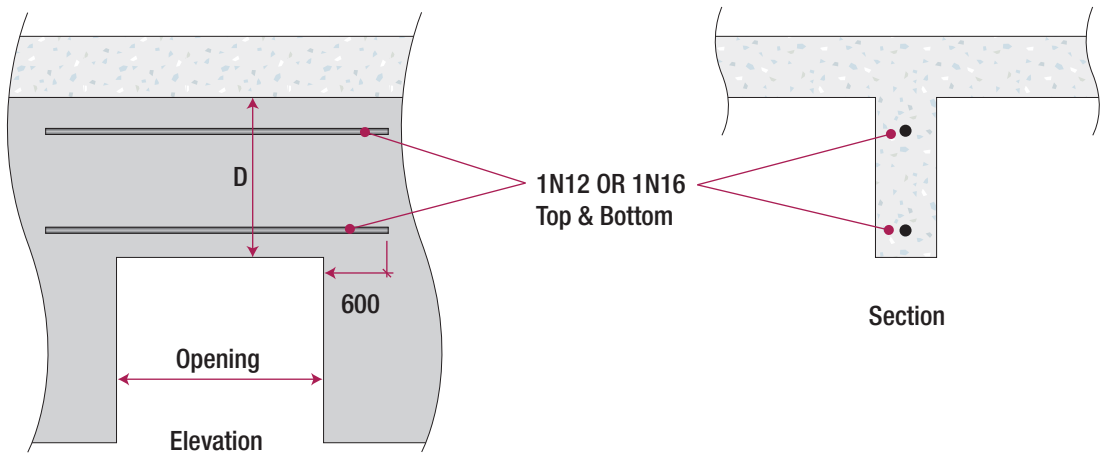
Acceptable
With Caution
Not Recommended

RW156C Out of Plane Flexural Capacity $\emptyset M_u$ (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
$\emptyset M_u = \emptyset(f_y \rho b d^2(1-0.6\rho f_y/f'_c))$						

RW156C Standard Lintels

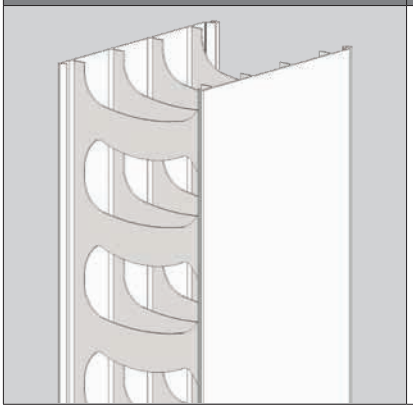
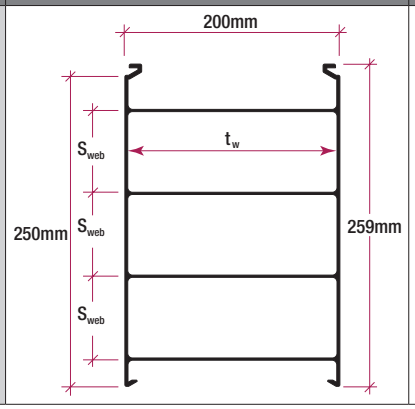
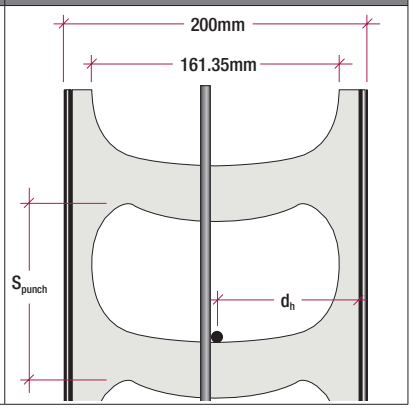
Capacity given is for standard lintel, with minimum reinforcement. Engineer can add extra reinforcement to achieve higher capacity.



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

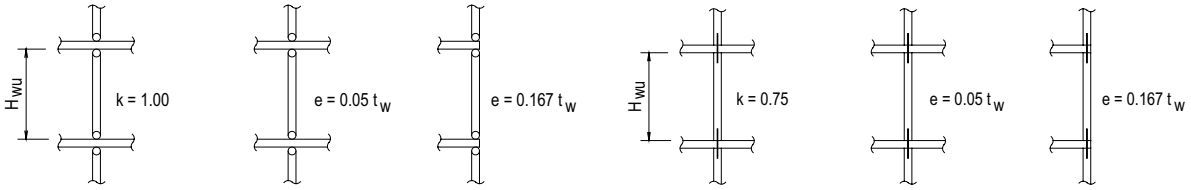
	1N12 Top & Bottom, Depth (mm)					1N16 Top & Bottom, Depth (mm)				
D	300	450	600	900	1200	300	450	600	900	1200
d_{eff}	213	363	513	813	1113	213	363	513	813	1113
Span (mm)										
3900	6.5	11.3	15.2	20.3	20.4	11.4	17.7	20.3	20.4	20.4
3600	7.6	13.2	16.4	22	22.1	13.3	19.2	22	22.1	22.1
3300	9.1	14.8	17.9	24	24.1	15.9	20.9	24	24.1	24.1
3000	11	16.3	19.7	26.4	26.5	19.2	23	26.4	26.5	26.5
2700	13.5	18.1	21.9	29.4	29.5	21.8	25.6	29.3	29.5	29.5
2400	16.2	20.4	24.6	33.1	33.2	24.6	28.8	33	33.2	33.2
2100	18.5	23.3	28.1	37.8	37.9	28.1	32.9	37.7	37.9	37.9
1800	21.6	27.2	32.8	44.1	44.2	32.8	38.4	44	44.2	44.2
1500	25.9	32.7	39.4	52.9	53.1	39.3	46.1	52.8	53.1	53.1
1200	32.4	40.8	49.3	66.1	66.3	49.1	57.6	66	66.3	66.3
900	43.2	54.4	65.7	88.2	88.4	65.5	76.8	88	88.4	88.4
$\emptyset M_u$(kNm)	9	15.6	22.2	35.4	48.6	15.7	27.7	39.7	63.7	87.7
$V_{u.max}$(kN)	56.9	97	137.1	217.4	297.6	56.9	97	137.1	217.4	297.6
$\emptyset V_u$ (kN)	19.4	24.5	29.6	39.7	39.8	29.5	34.5	39.6	39.8	39.8
	=Limited by shear									

RW200C Structural Capacities

RW200C Panel	Plan	Elevation
		

RW200C 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%	1	97.5	65



k = 0.75	k = 1.0	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	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
Limit with bottom plate		1863	2385	2982	3727	4845	1863	2385	2982	3727	4845

* for f'_c > 50 MPa, CSR appointed installer only.

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

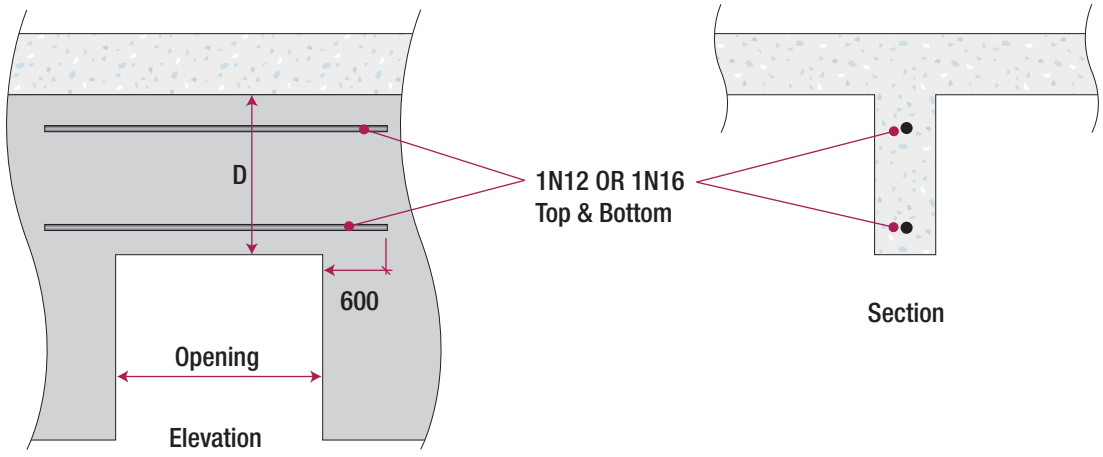
Acceptable
With Caution
Not Recommended

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

RW200C Standard Lintels

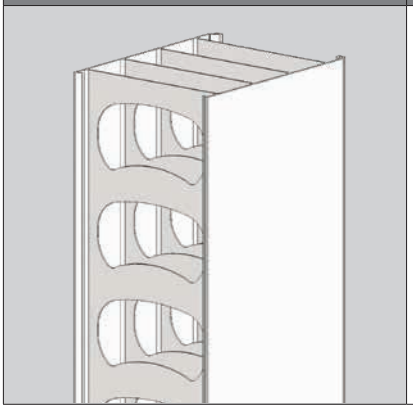
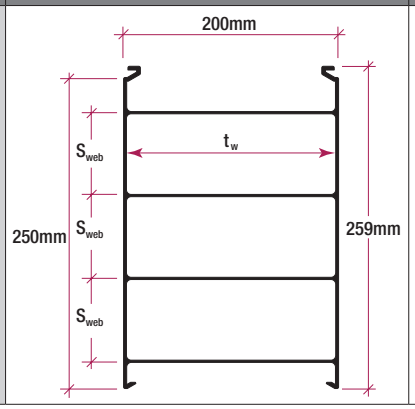
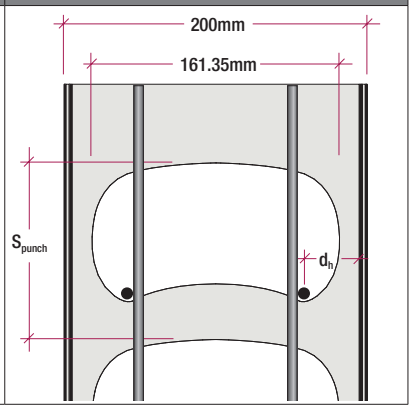
Capacity given is for standard lintel, with minimum reinforcement. Engineer can add extra reinforcement to achieve higher capacity.



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

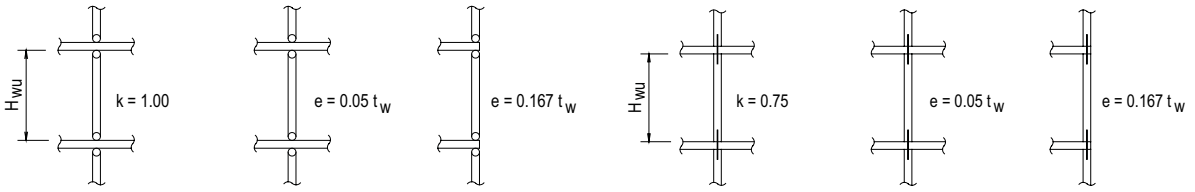
	2N12 Top & Bottom, Depth (mm)					2N16 Top & Bottom, Depth (mm)				
D	300	450	600	900	1200	300	450	600	900	1200
d_{eff}	242	392	542	842	1142	242	392	542	842	1142
Span (mm)										
3900	7.5	12.2	17	26.6	33.9	13.3	21.9	26.6	33.9	33.9
3600	8.8	14.4	20	30.7	36.7	15.6	24.7	28.8	36.7	36.7
3300	10.4	17.1	23.8	33.5	40.1	18.5	27	31.5	40.1	40.1
3000	12.6	20.7	27	36.9	44.1	22.4	29.7	34.6	44.1	44.1
2700	15.6	24.6	30	41	49	27.5	33	38.5	49	49
2400	19.7	27.6	33.8	46.1	55.1	31	37.1	43.3	55.1	55.1
2100	24.6	31.6	38.6	52.7	63	35.4	42.4	49.5	63	63
1800	28.7	36.9	45.1	61.5	73.5	41.3	49.5	57.7	73.5	73.5
1500	34.4	44.2	54.1	73.8	88.2	49.5	59.4	69.2	88.2	88.2
1200	43	55.3	67.6	92.2	110.2	61.9	74.2	86.5	110.2	110.2
900	57.3	73.7	90.1	123	146.9	82.6	99	115.4	146.9	146.9
$ØM_u$(kNm)	10.3	16.9	23.5	36.7	49.9	18.3	30.3	42.3	66.3	90.3
$V_{u.max}$(kN)	94.5	153.1	211.7	329	446.2	94.5	153.1	211.7	329	446.2
$ØV_u$ (kN)	25.8	33.2	40.6	55.3	66.1	37.2	44.5	51.9	66.1	66.1
= Limited by shear										

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	k = 1.0	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
Limit with bottom plate		1863	2385	2982	3727	4845	1863	2385	2982	3727	4845

* for f'_c > 50 MPa, CSR appointed installer only.

RW200C Double Reinforcement Minimum Reinforcement

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

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)

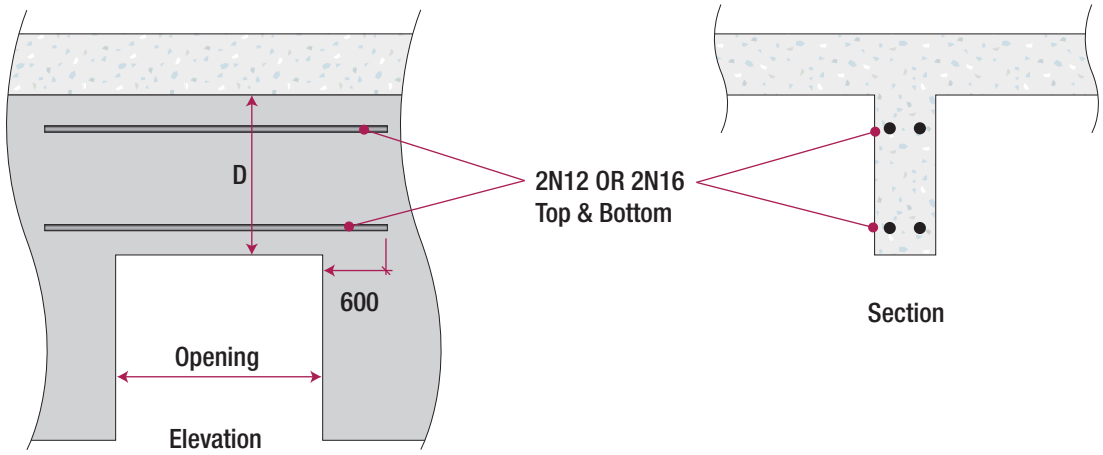
Vertical Bars*	d	ρ*	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa
N12@300	145	0.0026	21.09	–	–	–	–
N12@250	145	0.0031	25.14	25.36	25.51	–	–
N16@400	143	0.0035	27.43	27.7	27.88	28.04	–
N16@350	143	0.004	31.15	31.5	31.74	31.94	32.13
N16@300	143	0.0047	36.04	36.51	36.84	37.11	37.36
N16@250	143	0.0056	42.73	43.4	43.89	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.

R200C Double Reinforcement Lintels

Capacity given is for standard lintel, with minimum reinforcement. Engineer can add extra reinforcement to achieve higher capacity.

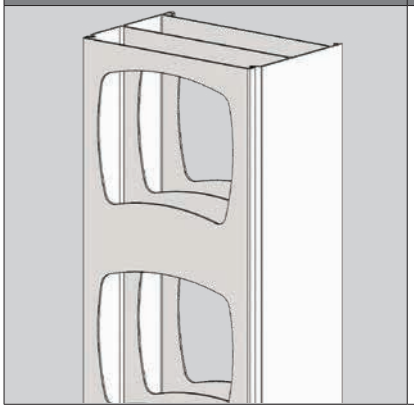
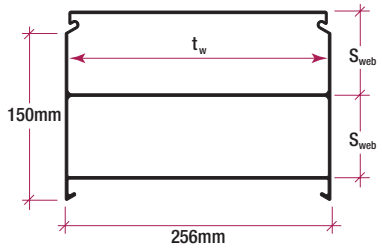
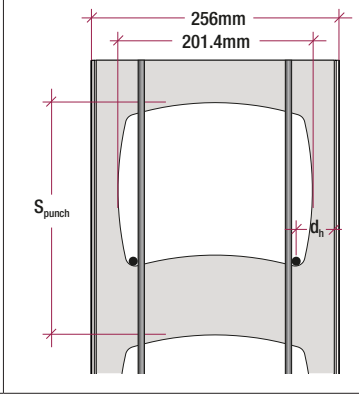


RW200C Double Reinforcement Lintels with Vertical PVC Webs w*(kN/m)

	2N12 Top & Bottom, Depth (mm)					2N16 Top & Bottom, Depth (mm)				
D	300	450	600	900	1200	300	450	600	900	1200
d_{eff}	242	392	542	842	1142	242	392	542	842	1142
Span (mm)										
3900	14.5	24.1	27.9	33.9	33.9	25.1	33.9	33.9	33.9	33.9
3600	17.0	26.1	30.3	36.7	36.7	29.5	36.7	36.7	36.7	36.7
3300	20.3	28.5	33.0	40.1	40.1	35.1	40.1	40.1	40.1	40.1
3000	24.5	31.4	36.3	44.1	44.1	41.6	44.1	44.1	44.1	44.1
2700	29.4	34.9	40.3	49.0	49.0	46.2	49.0	49.0	49.0	49.0
2400	33.1	39.2	45.4	55.1	55.1	52.0	55.1	55.1	55.1	55.1
2100	37.8	44.8	51.9	63.0	63.0	59.4	63.0	63.0	63.0	63.0
1800	44.1	52.3	60.5	73.5	73.5	69.3	73.5	73.5	73.5	73.5
1500	52.9	62.8	72.6	88.2	88.2	83.2	88.2	88.2	88.2	88.2
1200	66.1	78.4	90.8	110.2	110.2	104.0	110.2	110.2	110.2	110.2
900	88.2	104.6	121.0	146.9	146.9	138.7	146.9	146.9	146.9	146.9
$ØM_u$(kNm)	20.1	33.3	46.5	72.9	99.3	34.7	58.7	82.7	130.7	178.7
$V_{u.max}$(kN)	94.5	153.1	211.7	329.0	446.2	94.5	153.1	211.7	329.0	446.2
$ØV_u$ (kN)	39.7	47.1	54.5	66.1	66.1	62.4	66.1	66.1	66.1	66.1

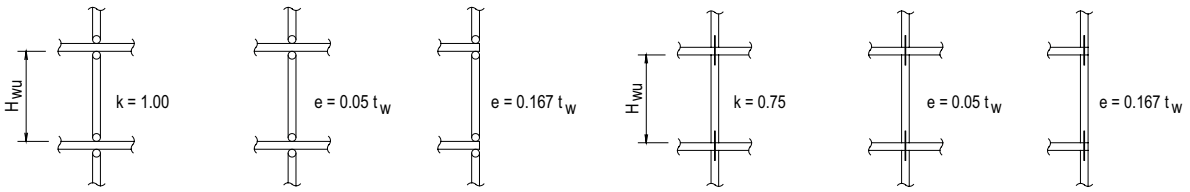
= Limited by shear

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	k = 1.0	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
Limit with bottom plate		2362	3024	3780	4725	6142	2362	3024	3780	4725	6142

* for f'_c > 50 MPa, CSR appointed installer only.

RW256S Minimum Reinforcement

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

Horizontal Bar Spacing 240/480
Vertical Bar Spacing 150 to 350

Acceptable
With Caution
Not Recommended

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

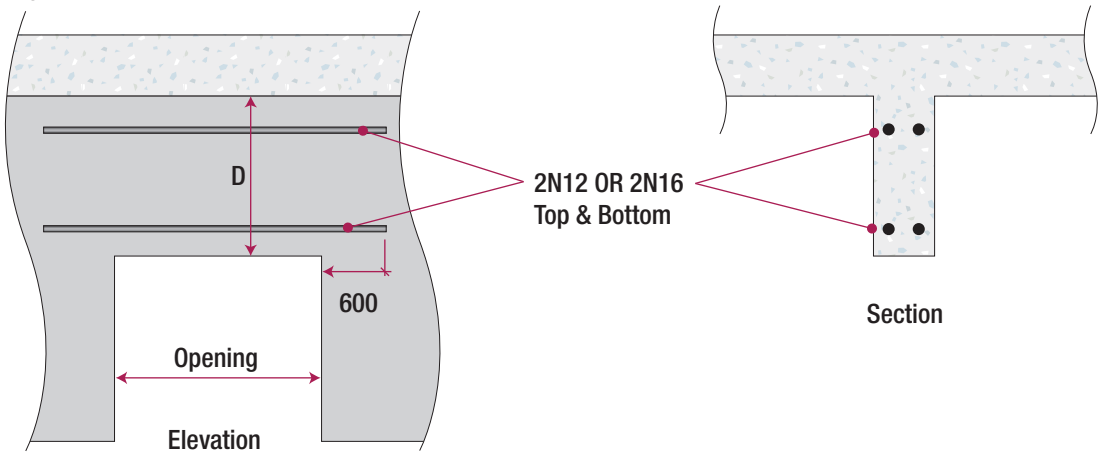
Vertical Bars*	d	ρ*	25 MPa	32 MPa	40 MPa	50 MPa	65 MPa
N12@250	194	0.0023	34.13	–	–	–	–
N16@400	192	0.0026	37.42	37.69	–	–	–
N16@350	192	0.003	42.57	42.91	43.16	–	–
N16@300	192	0.0035	49.35	49.83	50.16	50.43	50.68
N16@250	192	0.0042	58.71	59.39	59.87	60.26	60.62
N16@200	192	0.0052	72.42	73.48	74.23	74.84	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
	$\rho_{st.min}$ [8.1.6.1.(2)]		0.0021	0.0024	0.0027	0.0030	0.0034

$\emptyset M_u = \emptyset(f_y \rho b d^2(1-0.6\rho f_y/f'_c))$

*Tension bars one face

RW256S Standard Lintels

Capacity given is for standard lintel, with minimum reinforcement. Engineer can add extra reinforcement to achieve higher capacity.



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

	2N12 Top & Bottom, Depth (mm)					2N16 Top & Bottom, Depth (mm)				
D	300	450	600	900	1200	300	450	600	900	1200
d_{eff}	180	330	480	780	1080	180	330	480	780	1080
Span (mm)										
3900	10.8	20.3	29	31.5	31.5	18.6	31.5	31.5	31.5	31.5
3600	12.7	23.9	31.4	34.2	34.2	21.8	34.2	34.2	34.2	34.2
3300	15.1	28.4	34.2	37.3	37.3	26	37.3	37.3	37.3	37.3
3000	18.2	31.5	37.6	41	41	31.5	41	41	41	41
2700	22.5	35	41.8	45.6	45.6	38.8	45.6	45.6	45.6	45.6
2400	28.5	39.4	47.1	51.2	51.2	49.2	51.2	51.2	51.2	51.2
2100	36.2	45	53.8	58.6	58.6	57.2	58.6	58.6	58.6	58.6
1800	42.2	52.5	62.7	68.3	68.3	66.7	68.3	68.3	68.3	68.3
1500	50.7	63	75.3	82	82	80.1	82	82	82	82
1200	63.4	78.7	94.1	102.5	102.5	100.1	102.5	102.5	102 .5	102.5
900	84.5	105	125.5	136.7	136.7	133.5	136.7	136.7	136.7	136.7
$\emptyset M_u$(kNm)	14.9	28.1	41.3	67.7	94.1	25.7	49.7	73.7	121.7	169.7
$V_{u.max}$(kN)	87.8	161.1	234.3	380.7	527.1	87.8	161.1	234.3	380.7	527.1
$\emptyset V_u$ (kN)	38	47.2	56.5	61.5	61.5	60.1	61.5	61.5	61.5	61.5

= Limited by shear

Earthquake Actions

Rediwall® is to be designed to cater for earthquake actions as per AS1170.4 Earthquake Actions in Australia.

Cl.5.2.3 Performance under earthquake deformations states:

Stiff components (such as concrete, masonry, brick, pre-cast concrete walls or panels, or stairwells, stairs and ramps)

shall be –

(a) considered to be part of the seismic-force-resisting system and designed accordingly;

or

(b) separated from all structural elements such that no interaction takes place as the structure undergoes deflections due to the earthquake effects determined in accordance with this Standard.

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.

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 – 2009. Reputable concrete suppliers have standard mix designs to achieve these requirements.

Concrete Mix Design Guide

	Standard AFS Pump Mixes				High Workability Mixes		
	Refer to Structural Engineer for Mix specification						
Strength $f'c$ (MPa)	S25	S32	S40	S50	S40	S50	S65
Target Installation Slump	140±10	140±10	140±10	140±10	170±20	170±20	170±20
Design Slump (mm)	140	140	140	140	170	170	170
Maximum W/C Ratio	0.7	0.6	0.45	0.4	0.45	0.4	0.35
Nominal Fine to Total Aggregate Percentage (%)	65	60	55	50	55	50	50
Maximum Aggregate Size (mm)	10	10	10	10	10	10	10
Maximum 56 Day Drying Shrinkage (µm)	1000	1000	1000	1000	1000	1000	1000
Recommended Admixtures	WRPAPN20 (WR) ex Grace, ADVA-142 (HWR) ex Grace						

Notes:

- 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 Volume 3 – rediwall® Installation Guide.
- Slump should be assessed at the hose, and allowance may be required for loss of slump from testing and pumping. This will vary with weather conditions, length and placement of the hose and other factors.

DETAILING

Reinforcement Detailing

Care must be taken when detailing rediwall® to avoid installation problems on site. Important considerations include:

- Location and detailing of starter bars.
- Cast in starter bars or drilled in dowels with limited anchorage.
- Location and size of reinforcement to avoid steel congestion and installation difficulties.
- Allow for location of services such as conduits and junction boxes within walls. If heavy reinforcement is used, care should be taken to avoid damage to the junction boxes.
- Services within walls should be avoided in highly stressed areas or allowed for in the design.
- Rediwall® panels are not to be placed horizontally.

The individual cells within rediwall® allow horizontal shrinkage and thermal movement in the concrete, with the internal webs acting as crack inducers. This allows rediwall® to provide crack control. The vertical webs can be considered as non-fire rated vertical reinforcement.

Due to the presence of the plastic webs in the rediwall®, steel congestion should be avoided to facilitate adequate compaction of concrete. As a guide 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 and compaction of the concrete at splices and at junctions of members.

Minimum Reinforcement

For fire rated reinforced walls to AS3600 – 2009 Cl.11.6.1, use minimum vertical reinforcement ratio (pw) of 0.0015 or the value required by structural analysis.

For walls subjected to load combinations other than just simple vertical axial compression loads , AS3600 – 2009 Cl.11.6 minimum reinforcement shall be provided.

Examples of such walls include, but are not limited to:

- Walls resisting lateral loads
- Walls acting as deep beams
- Walls with load combinations of bending and compression producing tension stresses.

Where reinforced rediwall® walls do not require a high degree of crack control for tensile forces, a minimum reinforcement spacing of 350mm is recommend.

Horizontal reinforcement may be reduced to zero for walls supporting vertical loads only where there are no net tensile stresses developed in the wall cross-section, where the wall is designed for one way buckling and the webs act as crack inducers for eliminating restraint against horizontal shrinkage or thermal movement.

Notes: AS3600 – 2009 does not recognise the use of plain concrete in wall elements, though some International standards offer guidance in this area. Use of unreinforced rediwall® walls 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.

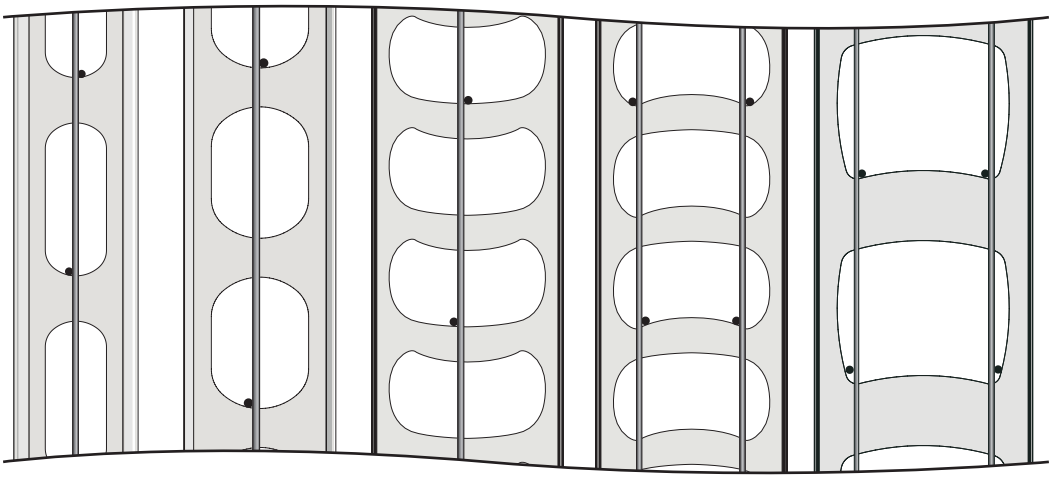
Reinforcement Detailing Constraints

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, the reinforcement is located toward each face of the wall with concrete cover as shown.
- Vertical bars are located at the top and bottom of the walls with a laced bar. A laced bar is a horizontal bar placed on the alternating sides of the vertical bar to correctly locate their position.
- 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.

Fig 1. Reinforcement Placement



Reinforcement is to be placed, located and fixed in accordance with Volume 3 – ' rediwall® Installation Guide – Reinforcement bar placement'. Reinforcement bars are to be suitably fixed via lacing, spacers or ties.

Reinforcement Detailing Constraints – Single Reinforcement

Fig 2. Cross Wall Junction

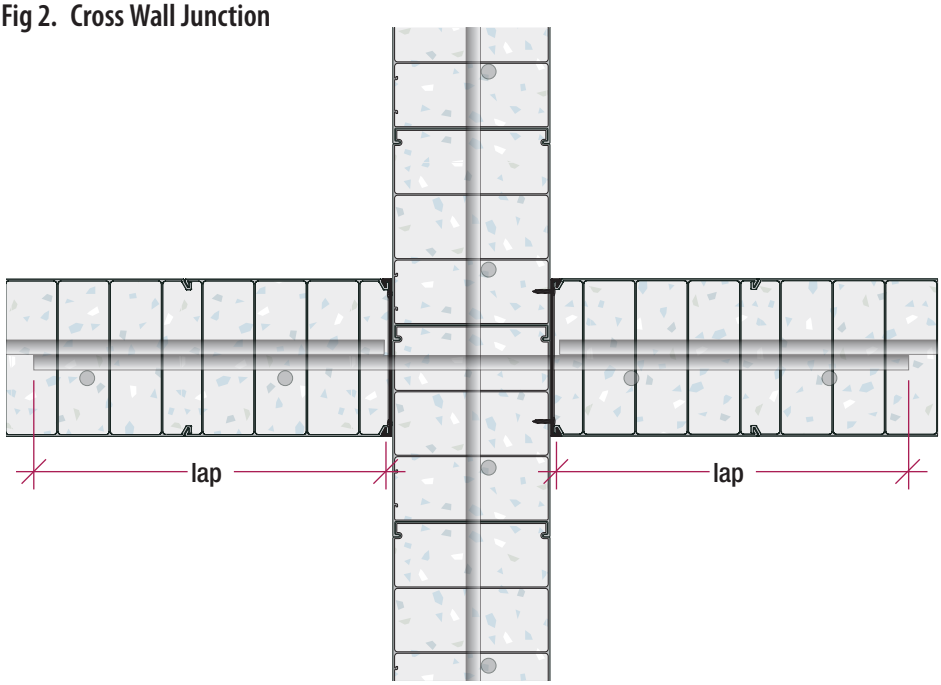


Fig 3. Corner 90°

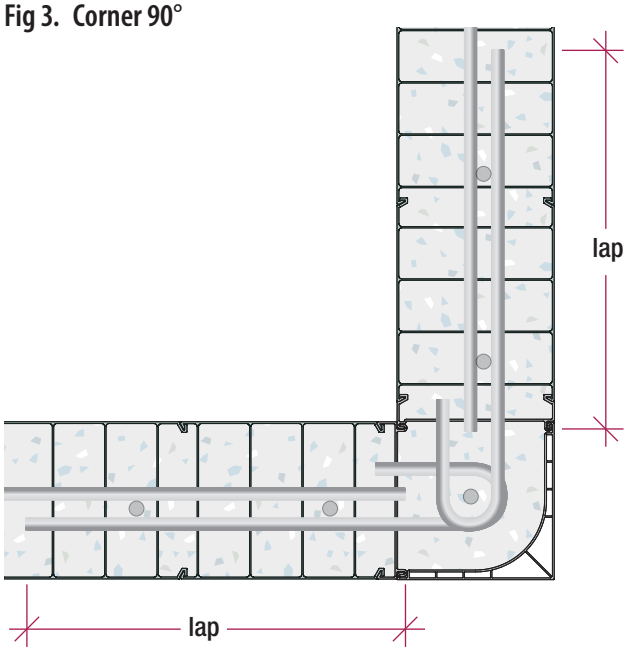


Fig 4. T Wall Junction

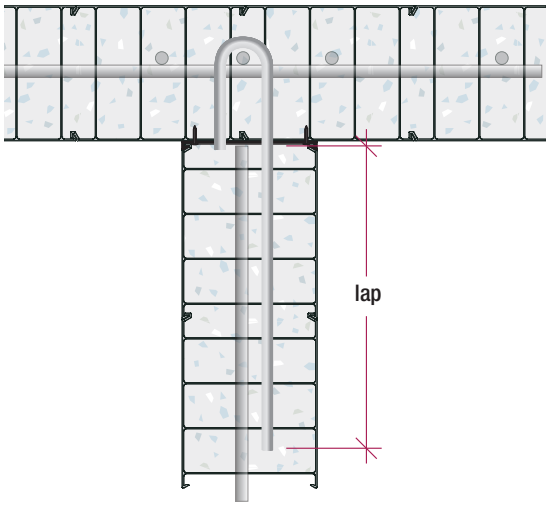
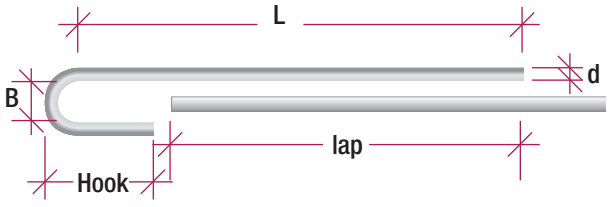


Fig 5. Standard Hook Bars



Standard Hook Bar

Reo	B	L	Hook	Lap	RW110C	RW156C	RW200C
N12	60	550	150	450	Y	Y	Y
N16	80	700	150	600	N	N	Y
N20	100	900	150	800	N	N	Y

Reinforcement Detailing Constraints – Double Reinforcement

Fig 6. Cross Wall Junction

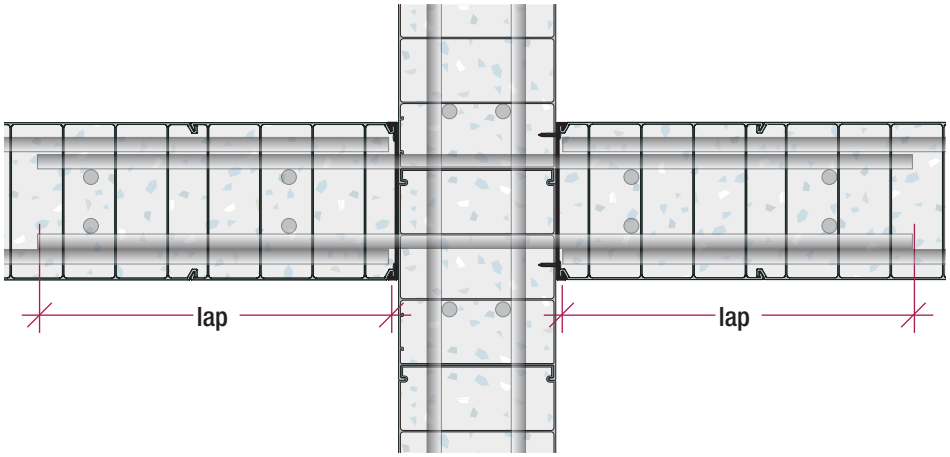


Fig 7. Corner 90°

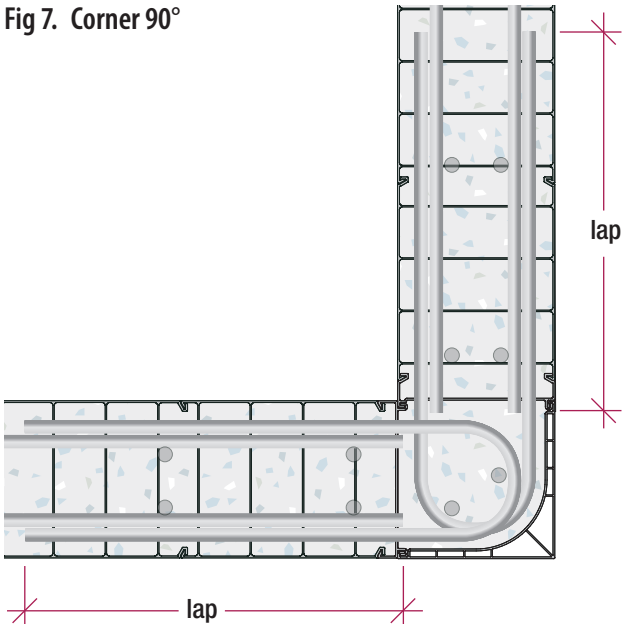


Fig 8. Corner 90°

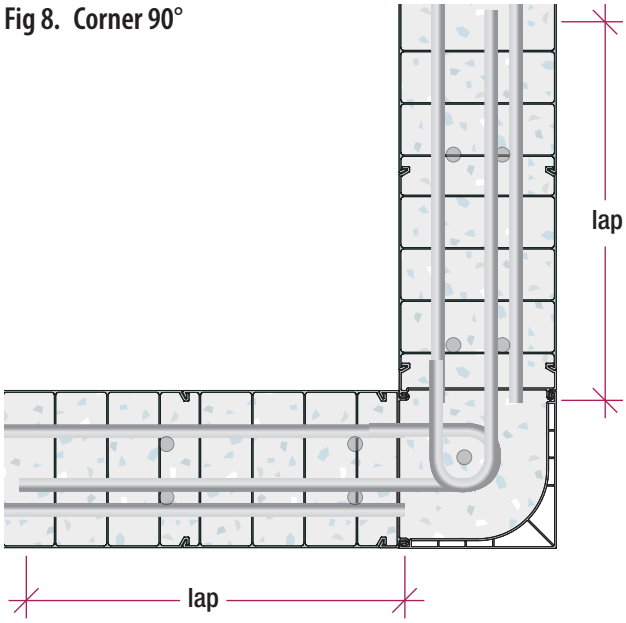
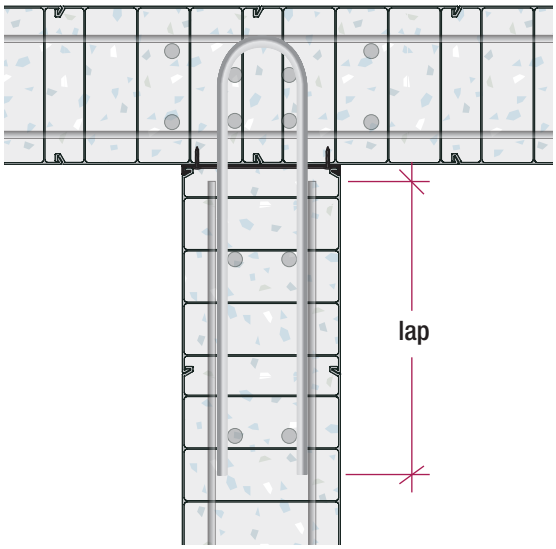


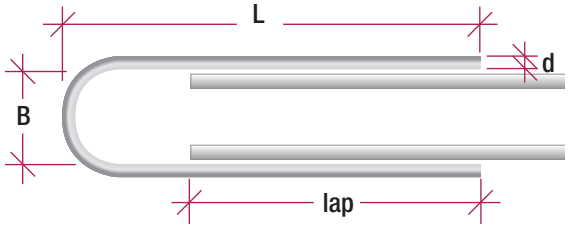
Fig 9. T Wall Junction



Standard U Bar

Reo	B	L	Lap	RW156C	RW200C	RW256S
N12	94	700	450	Y	Y	Y
N16	140	700	600	N	N	Y

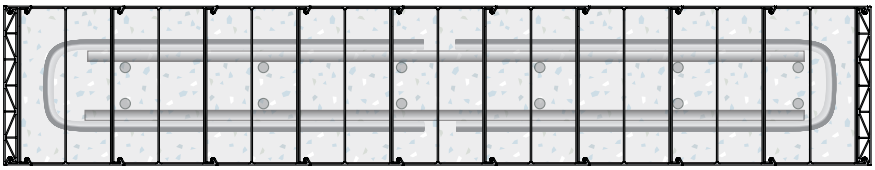
Fig 10. Standard U Bars



Blade Walls

When detailing ligatures within the rediwall® panels, care must be taken to ensure the ligatures fit within the parameters governed by the holes in the PVC webs. Refer to Fig 11.

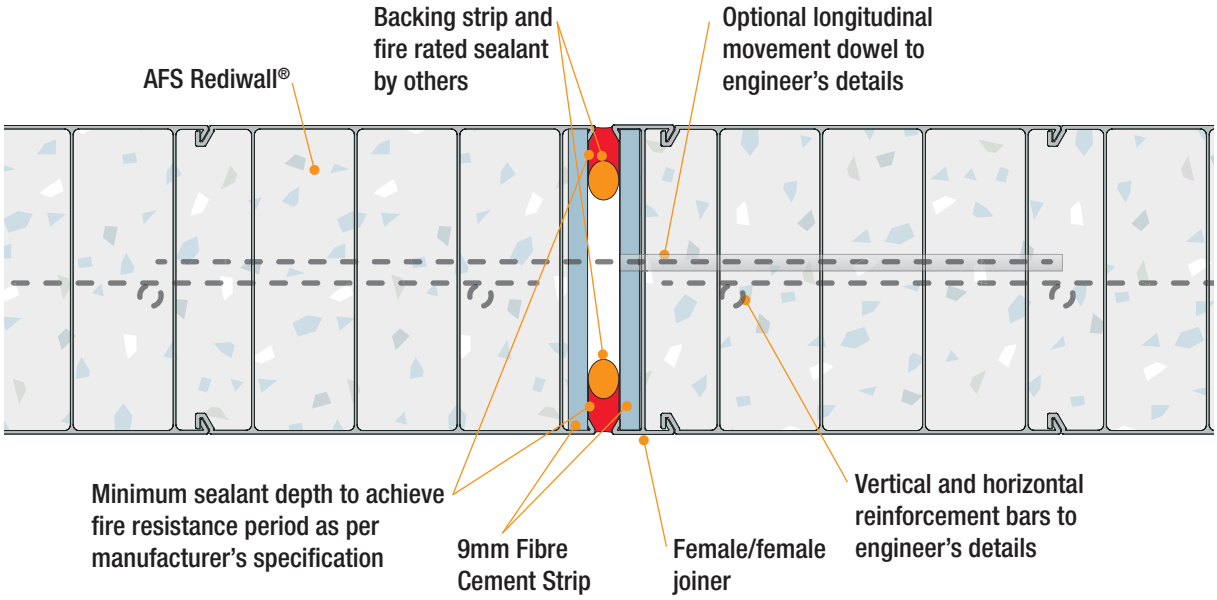
Fig 11. Blade Wall



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 12.

Fig 12. Movement Joint



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.

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 2016 Amendment 1. These include the following:

Section C. Fire Resistance:

- CP1 Structure stability
- CP2 Avoid spread of fire
- CP3 Protect from spread of fire and smoke in patient care and aged care buildings
- CP4 Material and assembly
- CP7 Avoid spread of fire to emergency equipment
- CP8 Protect spread of fire to openings and penetrations

Section F. Health and Amenity

- FP1.4 Weatherproofing
- FP5.2 Sound transmission and insulation – Walls
- FP5.5 Sound transmission in insulation – Walls in age care buildings

Section G. Ancillary Provisions

- GP.5.1 Construction in bush fire prone areas

Sections J. Energy efficiency

- JP1 Energy efficiency

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 fire tested specimens for each of the following three design criteria when fire tested to the requirements of the Australian Standard AS1530 'Methods for Fire Tests 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 or 240/240/240, i.e. 240 minutes structural adequacy, 240 minutes integrity and 240 minutes insulation.

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

Rediwall® may be determined in accordance with NCC 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 – 2009.

TABLE A1: 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*

*FRL Determined by CSIRO Certificate of Test No.2667 and Fire Test Report Number FSV1704

**FRL Determined by SGA Report 2013/277.65R1.2

***S32 MPa afs concrete mix

TABLE A2: AS3600 FRP Structural Adequacy^ – Exposed 1 Side

		60 Minutes	90 Minutes	120 Minutes	180 Minutes	FRP Insulation^^
Wall	t_{fire}	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	Minutes
RW110C	105	0.26	0.09	–	–	90
RW156C	150	0.70	0.70	0.35	–	180
RW200C	155	0.70	0.70	0.70	0.31	240
RW256S	250	0.70	0.70	0.70	0.70	240

^ FRP Structural Adequacy based on AS3600 – 2009, Table 5.7.2
^^ FRP Insulation based on CSIRO Structural Adequacy Certificate of Test Nº 2667 and Report Nº FSV1704

TABLE A3: AS3600 FRP Structural Adequacy^ – Exposed 2 Side

		60 Minutes	90 Minutes	120 Minutes	180 Minutes	FRP Insulation^^
Wall	t_{fire}	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	$N^*f/ØN_u$	Minutes
RW110C	105	–	–	–	–	90
RW156C	150	0.70	0.50	0.20	–	180
RW200C	155	0.70	0.70	0.62	0.31	240
RW256S	250	0.70	0.70	0.70	0.60	240

^ FRP Structural Adequacy based on AS3600 – 2009, Table 5.7.2
^^ FRP Insulation based on CSIRO Structural Adequacy Certificate of Test Nº 2667 and Report Nº FSV1704

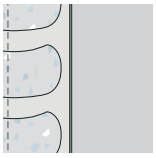
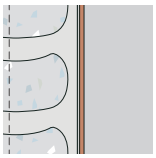
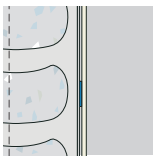
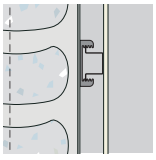
Non-Combustibility – Wall Applications & Finishes

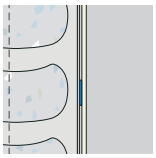
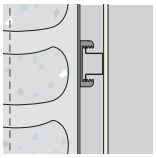
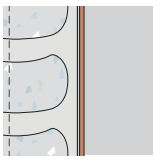
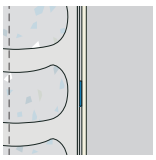
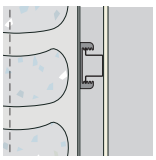
Rediwall® is compliant to the relevant parts of the Building Code of Australia (NCC2016 Amendment 1) for use within various non-combustible wall applications internally and externally for Class 1 and Class 2-9 buildings.

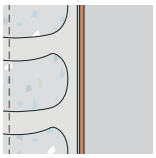
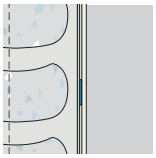
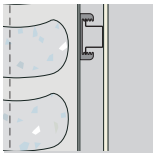
The following summaries of rediwall® internal and external wall applications with associated finishes have been assessed by Stephen Grubits & Associates, Fire Safety Engineer's Report 2013/277.78 R1.2 to be complaint with the relevant fire resistance performance requirements in NCC 2016 Amendment 1.

TABLE A4: Summary of compliance with Performance Requirements & Essential Safety Precautions

Rediwall® as Internal Wall Applications[1]

Applications	Compliance with NCC Performance Requirements	Finishes	Safety Measures
Non-loadbearing fire resisting internal walls (Assessment 1A)	PVC formwork is not considered to affect compliance with CP2, CP3 and 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 CP1, CP2, CP3 and CP4		
Non-loadbearing non-fire resisting internal walls (Assessment 1C)	PVC formwork is not considered to affect compliance with CP3 and 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 CP3 and CP4		
Separating walls in Class 1 buildings (Assessment 1E)	PVC formwork is not considered to affect compliance with P.2.3.1	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 CP2, CP3 and CP4		
Loadbearing fire walls (Assessment 2B)	PVC formwork is not considered to affect compliance with CP1, CP2, CP3 and CP4	d. Plasterboard lining affixed to unclad rediwall®, using steel furring channels of specific orientation and spacing 	
Continued on next page…			

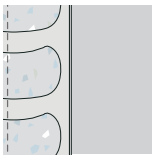
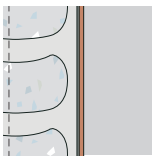
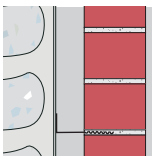
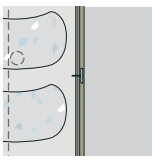
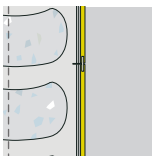
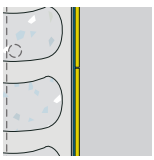
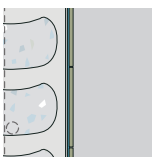
Applications	Compliance with NCC Performance Requirements	Finishes	Safety Measures
Non-loadbearing fire walls (Assessment 6A)	PVC formwork is not considered to affect compliance with CP1, CP2 and CP7	a. Unclad and PVC lining left in place  c. Plasterboard lining directly affixed to surface of unclad 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 CP1, CP2, CP3, CP4 and 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 CP1, CP2, CP3, CP4 and 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
Continued on next page…			

Applications	Compliance with NCC Performance Requirements	Finishes	Safety Measures
Internal walls in fire-control rooms (Assessment 9A)	PVC formwork is not considered to affect compliance with CP1, CP2, CP3, CP4 and 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 CP2 and 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 to be removed for at least 20mm beyond the fire-stopping system

[1]. This table is based on the Stephen Grubits & Associates rediwall Codemark Certification report, 2013/277.78 R1.2

TABLE A5: 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 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 CP1 and 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 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 CP1 and CP2.	f. Mechanically fixed tile system (<32kg/m^2) to unclad rediwall® 	
External walls above fire exits (Assessment 5A)	PVC formwork is not considered to affect compliance with CP1 and 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/m^2) + 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.

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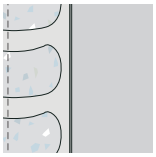
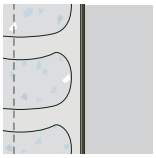
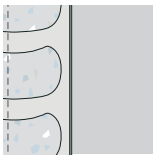
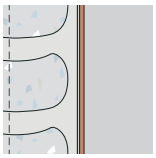
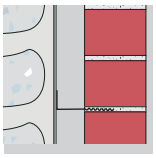
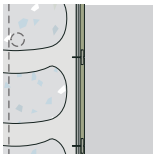
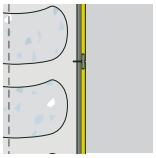
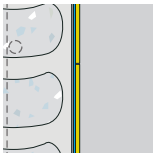
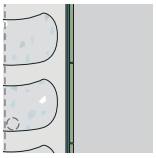
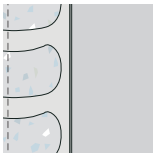
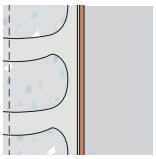
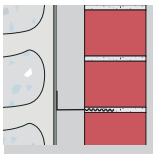
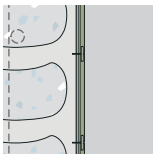
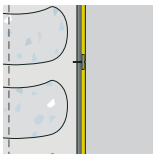
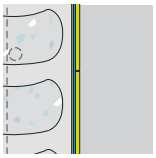
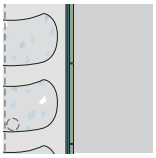
Applications	Compliance with NCC Performance Requirements	Finishes	Safety Measures
Retaining walls (external face of panel) (Assessment 10A)	PVC formwork is not considered to affect compliance with CP1 and CP2.	a. Unclad PVC lining left in place  j. With membrane 	No additional measures are required 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 CP1 and 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 CP1 and 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/m2) 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/m2) + 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 R1.2

[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 R1.2 to confirm compliance with the relevant Performance Requirements, CP1, CP2, CP3, CP4, CP7 and CP8 of the NCC 2016 Amendment 1.

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 CP1 and CP2 of the NCC 2016 Amendment 1.

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 A13: Rediwall® Boundary Wall Capping (elevation view)

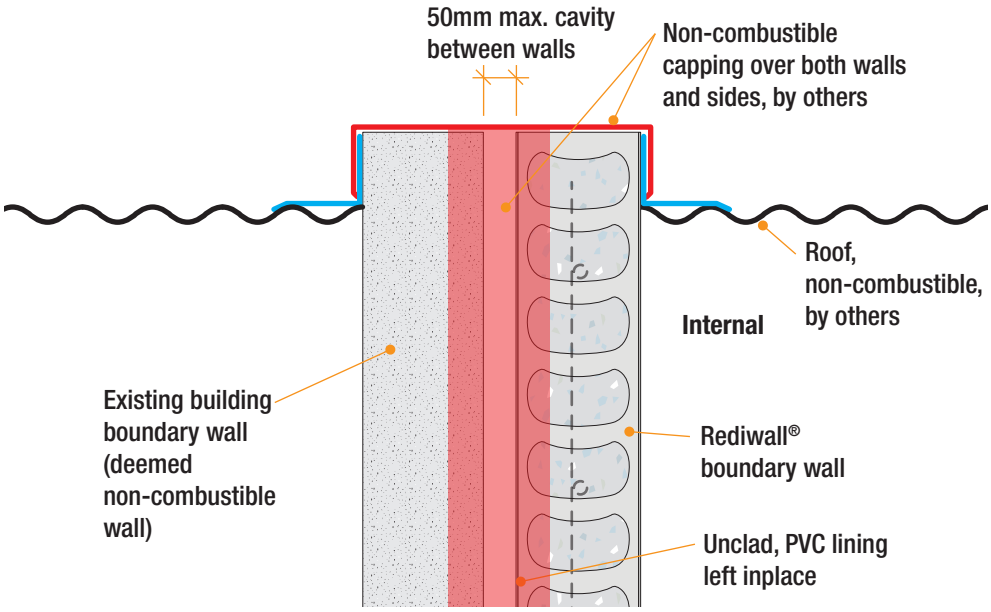
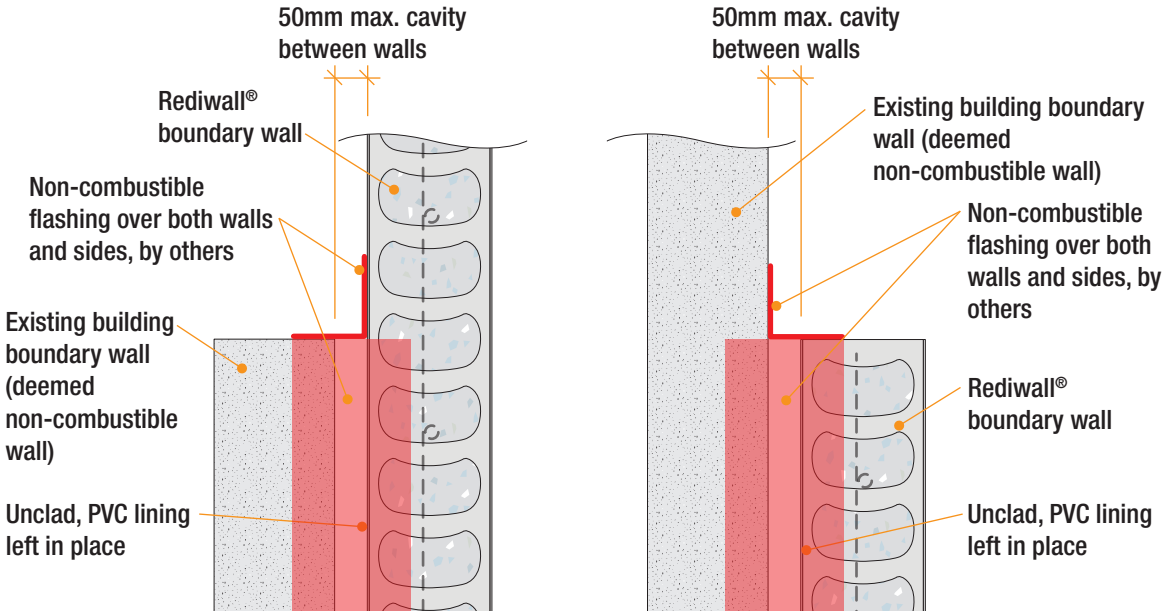


Fig A14: Rediwall® Boundary Wall with Different Wall Heights



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, CPI, CP2 and CP4 of the NCC 2016 Amendment 1. Refer to Fig A15.

Fig A15: Internal Rediwall® to External Logicwall Fire Rated Junction

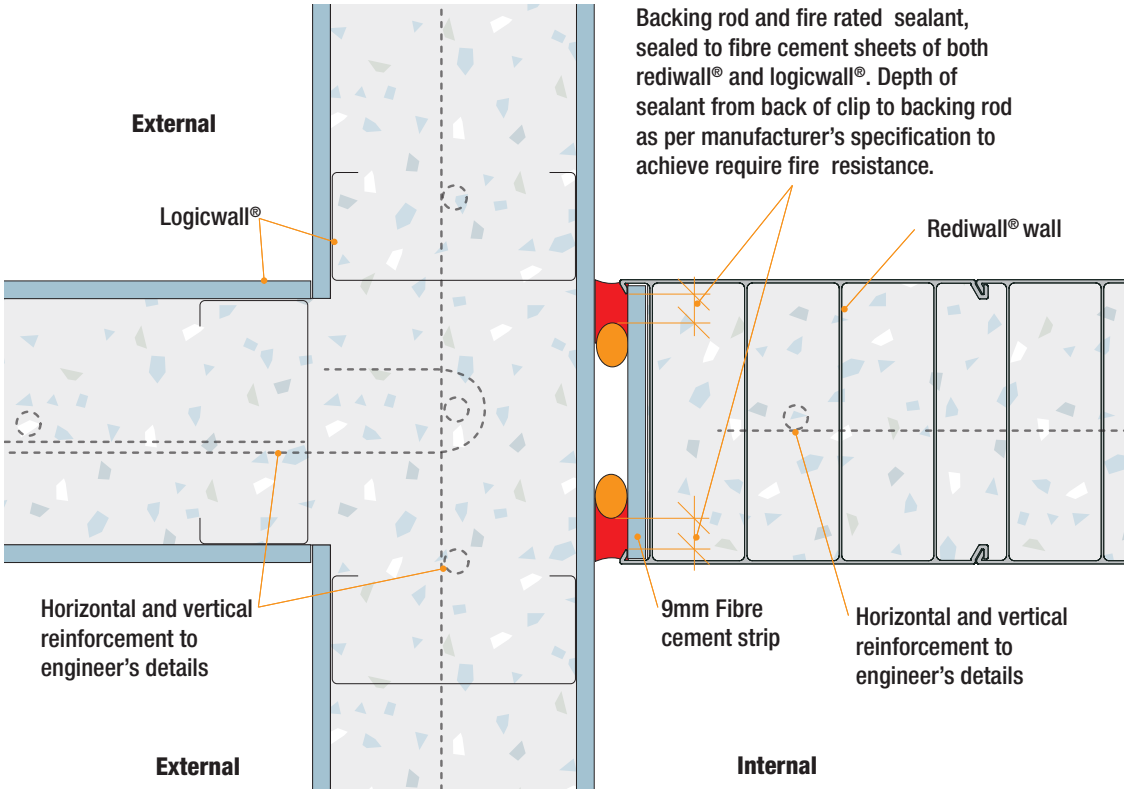
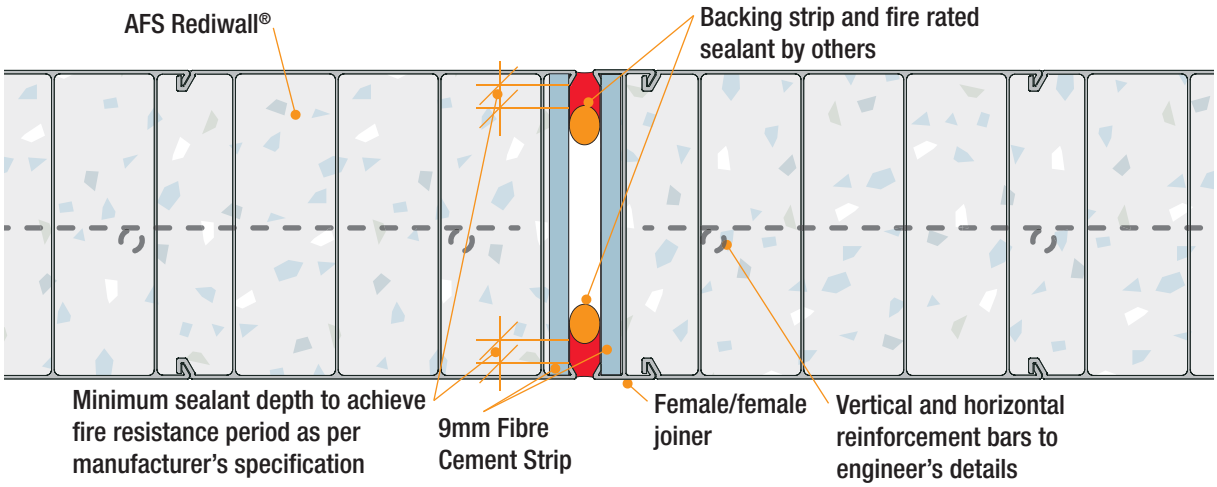


Fig A16: Rediwall® to Rediwall® Fire Rated End Junction



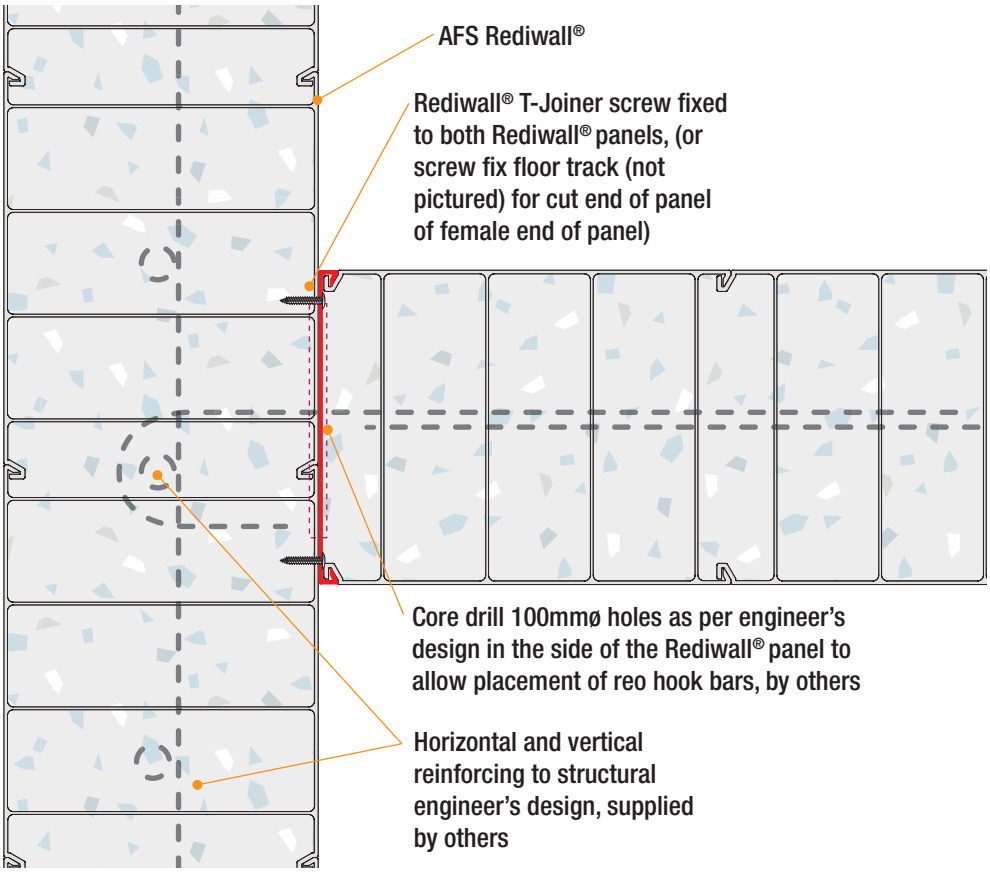
Rediwall® Fire rated T-junction

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, CPI, CP2, and CP4, of the NCC2016 Amendment 1.

Fig A17: Rediwall® T-Junction



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

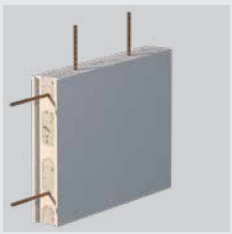
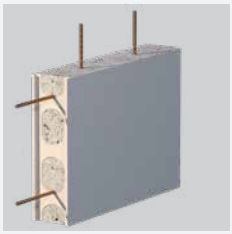
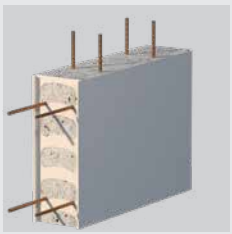
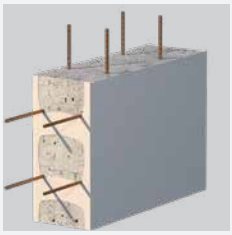
There is however the verification clause that states that when the wall is installed in the actual dwelling that it shall achieve not less than a $D_nt_w+C_{tr}$ of 45. In the end, it is the field conditions that dominate, as people do not live in acoustic laboratories. It is important that all the components 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 following table provides acoustic performance ratings for unclad rediwall systems with PVC in place. These systems have been assessed by Acoustic Logic Consultancy Pty Ltd.

TABLE A6: 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

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 A7: 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/m^2), 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/m^2), 20mm air gap, afs rediwall® 156mm, 20mm air gap, Bradford or Martini non-rigid insulation (11kg/m^2), 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/m^2), 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.

Air Tightness & Condensation

Due to afs rediwall® walls being a uniform concrete monolithic mass, the air infiltration rate is practically zero, eliminating the possibility of drafts and currents from outside. This contributes significantly to the thermal insulation of the building.

Condensation is not uncommon in new buildings, apartments in particular. In fact, it is increased thermal insulation requirements that exacerbate condensation risk, so careful thermal design, vapour barrier placement and construction practices are essential to minimise condensation.

Housing stock in Australia has historically been quite deficient in preventing air leakage. Poor sealing and high-level open wall vents, meant 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, buildings can no longer accommodate significant evaporation inside. The water vapour does not 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. Although it may look excessive, 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 – 2002 / Amdt 1 – 2006 for the rediwall® unclad walls with PVC in place are detailed in the following table.

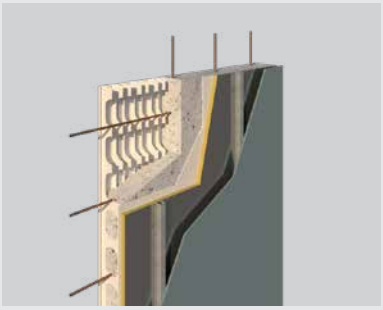
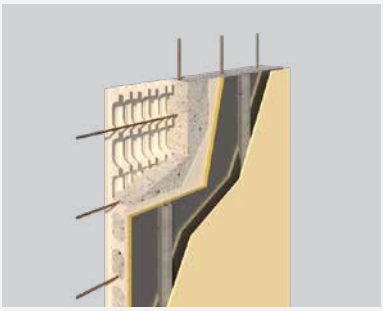
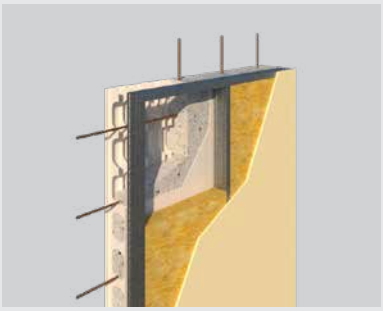
Rediwall® System	Thermal Resistance
RW110C	R 0.091m² K/W
RW156C	R 0.123m² K/W
RW200C	R 0.153m² K/W
RW256S	R 0.192m² K/W

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 A8: 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 Xtroliner R1.19 – 6mm Cemintel Wallboard		1.61	1.75
RW156C	– RW156C – 28mm Rondo furring channel on Betafix Clip – Bradford 25mm Xtroliner R1.19 – 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 FV1 Weatherproofing (Volume 1) and V.2.2.1 (Volume 2) of the National Construction Code, in accordance with the report "Weatherproofing to NCC 2016 afs rediwall® System, AECOM Dec 2017.

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 AS3600.1, 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.

NCC Vol. 1, Part C5 – Construction in Bushfire Prone Areas and Vol. 2, Part 3.7.4 confirms AS3959 as a deemed to satisfy solution and acceptable construction manual, respectively.

APPENDICES

The following are sample documents for:

AFS Rediwall® Standard Bracing

Bracing Drawing

Certifications

Fire Resistance Level (FRL)

FRL fire test certificates

FRL assessment report

Non-combustibility

Non-combustibility assessment report

AS5113 fire test report

AS/NZS3837 test certificate

AS1530.3 fire test certificates

Acoustic Performance

Acoustic Logic Consultancy – Acoustic Performance certificates for – RW110, RW156, RW200 and RW256.

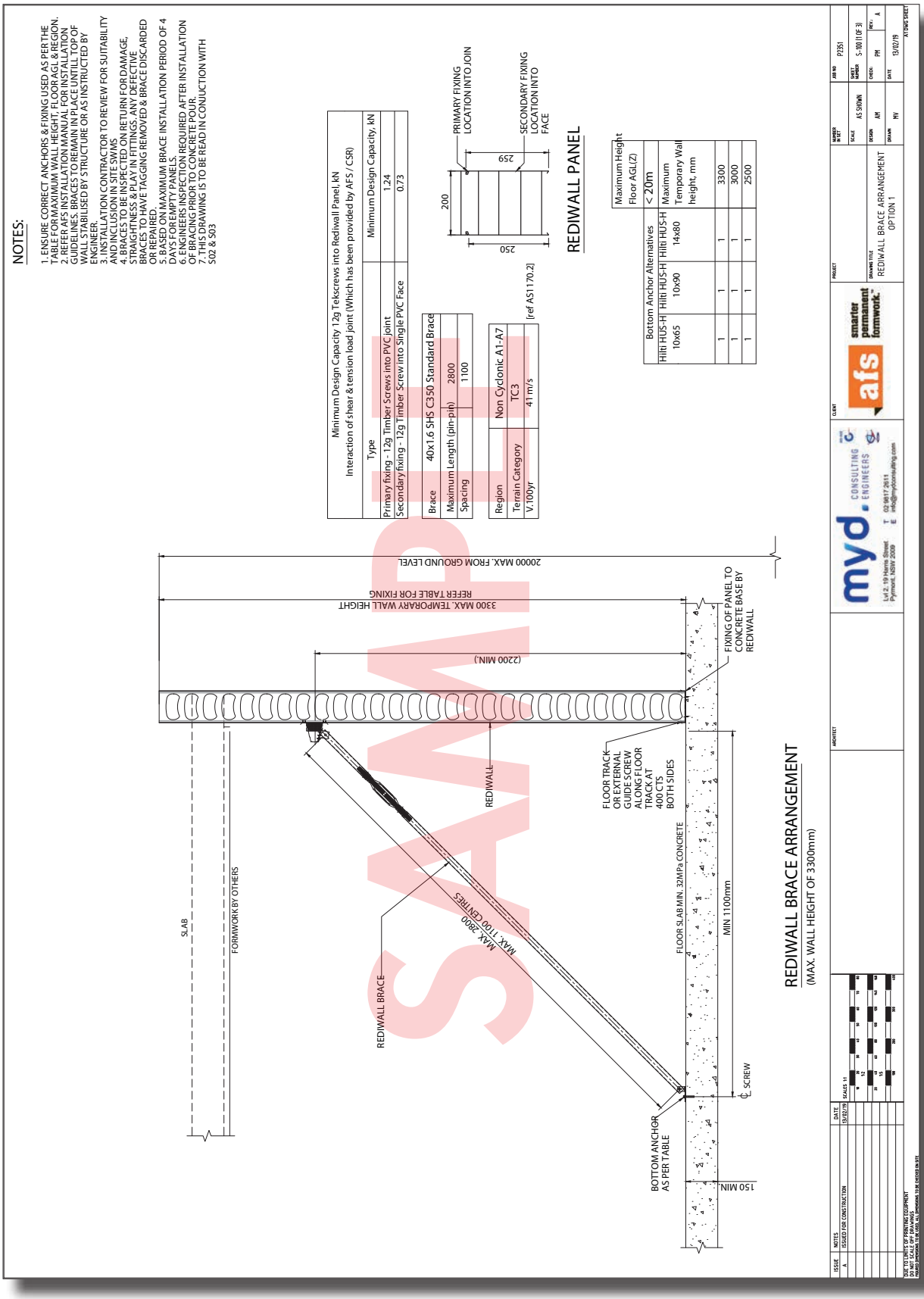
Thermal Performance

James M Fricker Pty Ltd – R-value certificates – RW110, RW156, RW200 and RW256.

Weatherproofing

AECOM weatherproofing verification report.

Sample Standard Bracing Detail



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Rediwall® CodeMark Certification

FOR CODEMARK EVALUATION

REPORT 2013/277.78 R1.2

· FIRE SAFETY ENGINEERS ·

STEPHEN GRUBITS & ASSOCIATES

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File: 2013/277.65 R2.1

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 R1.2, Issued 13 June 2018 Stephen Grubits & Associates, Fire Engineering Report 2013/277.57 R1.1, Issued 13 June 2018.
Applicable Building Code	National Construction Code 2016 Amendment 1 Building Code of Australia Volume 1
Relevant BCA Performance Requirements	CP1 and CP2
Purpose of this document	To summarise findings of SGA Report Number 2013/277.65 R1.2
Date of Issue:	15/06/2018
Date of Expiry	Date BCA 2016 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 3600-2009) 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)	

Findings – SGA Report 2013/277.65 R1.2

SGA Evidence of Suitability Report 2013/277.65 R1.2 found that the 110 mm Rediwall® may be used where the DTS Provisions of the BCA require the use of products with the specified fire-resistance level, within the constraints summarised below. It is also a condition that the Rediwall® product meets the remaining performance requirements of the BCA such as sound and moisture proofing, which are to be assessed by others.

In SGA Report 2013/277.65 R1.2., the fire-resistance of 110 mm thick CSR Rediwall® walls was estimated based on AS 1530.4 Standard Fire Test data for 150 mm thick and 200 mm thick Rediwall®, and the Australian Standard for Concrete Structures, AS 3600-2009.

The maximum applied loads and k-factors for each wall type are summarised in Table 1.

Table 1: Loads and restraint conditions for fire-resisting 110 mm thick Rediwall®

Floor-to-floor height (m)	K-factor	Applied Load (kN/m)	FRL (min)
2.2	1.0	161 kN/m	FRL 60/60/60
2.7	0.75	183 kN/m	FRL 90/90/90
2.9	0.75	176 kN/m	FRL 60/60/60
3.0	N/A	0 kN/m	FRL -/120/120

The estimated fire-resistance levels described in Table 1 were assumed to depend on the following wall characteristics:

1. Concrete composition
2. Wall Height
3. Wall Restraint
4. Applied Loads
5. Reinforcement

Incorporating the above characteristics, Rediwall® 110 mm thick walls could be expected to achieve an FRL of 60/60/60 if it were tested to AS 1530.4 subject to conditions described below.

Conditions

The 110 mm CSR Rediwall® must be designed and specified so as to meet the following conditions:

(a) The wall is located such that the ratio of axial load to ultimate strength is no greater than 0.32 (using calculation methods described in AS 3600-2009).

(b) The concrete in the 110 mm Rediwall® must have a compressive strength of no less than 32 MPa at 28-days, a slump of 120 mm, and must contain the same proportions of ground-granulated blast furnace slag (GGBS, 3% by weight), and same proportion of water (194 litres per m^3)

(c) The 110 mm Rediwall® when installed must have a maximum effective height of 2.2 m (as calculated using the restrain conditions described in AS 3600-2009)

(d) Minimum nominal concrete thickness of 105 mm.

The test results for 150 mm thick and 200 mm thick Rediwall® "Slide-In" panels and assessed herein, also apply to the Rediwall® "Speedy-Snap-In" panels, as described in Report. Therefore, the conclusions of this assessment of the 110 mm Rediwall® "Slide-In" are applicable to the Speedy-Snap-In panels of the same thickness.

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

96083 20342

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

Samples and their identifying descriptions have been provided by the client unless otherwise stated. AWTA Ltd makes no warranty, implied or otherwise, as to the source of the tested samples. The above test results relate only to the sample or samples tested. This document shall not be reproduced except in full and shall be rendered void if amended or altered. This document, the names AWTA Product Testing and AWTA Ltd may be used in advertising providing the content and format of the advertisement have been approved by the Managing Director of AWTA Ltd.

APPROVED SIGNATORY

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

0204/11/06

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

These results only apply to the specimen mounted, as described in this report. The result of this fire test may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all fire conditions.

Ignition is initiated by a pilot flame that is held near, but does not touch the specimen . A material that does not ignite during the standard test may ignite if contacted with a pilot flame during the test.

Each test specimen was clamped in four places.

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- Chemical Testing : Accreditation No. 983
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- Performance & Approvals Testing : Accreditation No. 1356

Samples and their identifying descriptions have been provided by the client unless otherwise stated. AWTA Ltd makes no warranty, implied or otherwise, as to the source of the tested samples. The above test results relate only to the sample or samples tested. This document shall not be reproduced except in full and shall be rendered void if amended or altered. This document, the names AWTA Product Testing and AWTA Ltd may be used in advertising providing the content and format of the advertisement have been approved by the Managing Director of AWTA Ltd.

APPROVED SIGNATORY

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

0204/11/06

Certificate of Assessment

Job No.: NK7380 **No. 2215**

This is to certify that the specimen described below was tested by the CSIRO Infrastructure Technologies in accordance with Australian/ New Zealand Standard 3837, Method of test for heat and smoke release rates for materials and products using an oxygen consumption calorimeter, 1998, at 50 kW/m², on behalf of:

CSR Building Products Limited
3 Triniti, 39 Delhi Road
NORTH RYDE NSW 2113
AUSTRALIA

A full description of the test specimen and the complete test results are detailed in the Division's sponsored investigation report numbered FNK 11438.

SAMPLE IDENTIFICATION: The Sponsor identified the specimen as Rediwall.

DESCRIPTION OF SAMPLE: The sponsor described the tested specimen as an extruded rigid polyvinyl chloride (PVC) profile used as permanent formwork for concrete walls. The rigid PVC profile formed the exposed face of the tested specimen and was laid onto the horizontal surface of the concrete substrate and allowed to dry.

Nominal thickness of PVC facing:	2.4-mm
Nominal thickness of concrete substrate:	35-mm
Nominal mass of PVC facing:	72.9 kg/m^2
Colour:	off-white (PVC)

SAMPLE CLASSIFICATION: Group Number: Group 1
(In accordance with Specification A2.4 of the Building Code of Australia.)

Average specific extinction area: 226.2 m²/kg
(Refer to Specification C1.10 section 4(c) of the Building Code of Australia.)

Testing Officer: Heherson Alarde Date of Test: 13 July 2015

Issued on the 30th day of July 2015 without alterations or additions.

Brett Roddy
Team Leader, Fire Testing and Assessments

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

CSIRO INFRASTRUCTURE TECHNOLOGIES
14 Julius Avenue, Riverside Corporate Park, North Ryde NSW 2113 AUSTRALIA
Telephone: 61 2 9490 5444 Facsimile: 61 2 9490 5555 www.csiro.au

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

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**

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. 2580

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

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

Exova Warringtonfire Aus Pty Ltd
Unit 2, 409-411 Hammond Road
Dandenong Victoria 3175
Australia
T: +61 (0)3 9767 1000
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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.

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

TESTING AUTHORITY	Exova Warringtonfire Aus Pty Ltd
Address	Unit 2, 409-411 Hammond Road , Dandenong Victoria 3175
Phone / Fax	T: +61 (0)3 9767 1000
ABN	81 050 241 524
Email / Home Page	www.exova.com
Authorisation	Prepared By: O. Saad Reviewed By: C. McLean

ACOUSTIC LOGIC

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

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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Allowing for field testing tolerances, the $D_{nT,w} + C_{tr}$ rating would normally be expected to be within 5 points of the documented $R_w + C_{tr}$ rating, which correlates with the relationship as documented in the National Construction Code.

The opinions are made on the following basis:

- The systems are installed in accordance with the manufacturer's standard installation details.
- Good quality installation practices including the sealing of all junctions and joints and maintaining specified clearances.
- The systems are installed with all junctions acoustically sealed so that negligible sound transmission occurs at these points.
- All services penetrations etc. are acoustically sealed and treated so that negligible sound transmission occurs through these points.
- Flanking paths are eliminated and the structures into which the systems are installed are capable of allowing the nominated rating to be achieved.
- Wall systems do not have penetrations, or these are acoustically treated to prevent sound leakage, and the perimeters are acoustically sealed (unless otherwise stated).

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Justin Leong

ACOUSTIC LOGIC

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

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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Allowing for field testing tolerances, the $D_{nT,w} + C_{tr}$ rating would normally be expected to be within 5 points of the documented $R_w + C_{tr}$ rating, which correlates with the relationship as documented in the National Construction Code.

The opinions are made on the following basis:

- The systems are installed in accordance with the manufacturer's standard installation details.
- Good quality installation practices including the sealing of all junctions and joints and maintaining specified clearances.
- The systems are installed with all junctions acoustically sealed so that negligible sound transmission occurs at these points.
- All services penetrations etc. are acoustically sealed and treated so that negligible sound transmission occurs through these points.
- Flanking paths are eliminated and the structures into which the systems are installed are capable of allowing the nominated rating to be achieved.
- Wall systems do not have penetrations, or these are acoustically treated to prevent sound leakage, and the perimeters are acoustically sealed (unless otherwise stated).

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Justin Leong

ACOUSTIC LOGIC

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

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

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

ABN: 11 068 954 343

Allowing for field testing tolerances, the $D_{nT,w} + C_{tr}$ rating would normally be expected to be within 5 points of the documented $R_w + C_{tr}$ rating, which correlates with the relationship as documented in the National Construction Code.

The opinions are made on the following basis:

- The systems are installed in accordance with the manufacturer's standard installation details.
- Good quality installation practices including the sealing of all junctions and joints and maintaining specified clearances.
- The systems are installed with all junctions acoustically sealed so that negligible sound transmission occurs at these points.
- All services penetrations etc. are acoustically sealed and treated so that negligible sound transmission occurs through these points.
- Flanking paths are eliminated and the structures into which the systems are installed are capable of allowing the nominated rating to be achieved.
- Wall systems do not have penetrations, or these are acoustically treated to prevent sound leakage, and the perimeters are acoustically sealed (unless otherwise stated).

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Justin Leong

ACOUSTIC LOGIC

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

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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Allowing for field testing tolerances, the $D_{nT,w} + C_{tr}$ rating would normally be expected to be within 5 points of the documented $R_w + C_{tr}$ rating, which correlates with the relationship as documented in the National Construction Code.

The opinions are made on the following basis:

- The systems are installed in accordance with the manufacturer's standard installation details.
- Good quality installation practices including the sealing of all junctions and joints and maintaining specified clearances.
- The systems are installed with all junctions acoustically sealed so that negligible sound transmission occurs at these points.
- All services penetrations etc. are acoustically sealed and treated so that negligible sound transmission occurs through these points.
- Flanking paths are eliminated and the structures into which the systems are installed are capable of allowing the nominated rating to be achieved.
- Wall systems do not have penetrations, or these are acoustically treated to prevent sound leakage, and the perimeters are acoustically sealed (unless otherwise stated).

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
Justin Leong

"TOTAL R"
THERMAL PERFORMANCE CALCULATIONS
TO AS/NZS 4859.1:2002/Amdt 1 (Dec 2006)

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

a) AS/NZS 4859.1:2002/Amdt 1 (Dec 2006) "Materials for the thermal insulation of buildings. Part 1: General criteria and technical provisions",

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

Results reported are for the **insulation path** only per the original AS/NZS 4859.1:2002 Clause 1.5.3.3 – *"Total thermal resistance - A total resistance associated with a material or a system or construction of materials, specified as a Total R, including surface film resistances"* to be in alignment with the BCA2009 Specification J1.3 examples.

Total R-values are based on product in-service conditions in accordance with AS/NZS 4859.1:2002/Amdt 1 (Dec 2006) including the alteration of insulation material R for temperature.

The calculations have not yet been independently verified per requirements of AS/NZS 4859.1:2002/Amdt 1.

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.

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THERMAL INSULATION EVALUATION BY CALCULATION

JMF Calc.

107wRW01a Bare RW110C REDIWALL

	Wall section elements	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	mm
	Outside air film	0.040	**12.00**	12.96	12.48	0.96	0.040	**36.00**	34.09	35.04	1.91	
System R0.091	2.5mm REDIWALL PVC skin	0.009	12.96	13.17	13.06	0.21	0.009	34.09	33.66	33.87	0.43	2.5
	105mm REDIWALL concrete void	0.073	13.17	14.92	14.04	1.74	0.073	33.66	30.17	31.91	3.49	105
	2.5mm REDIWALL PVC skin	0.009	14.92	**15.13**	15.02	0.21	0.009	30.17	29.74	29.96	0.43	2.5
	Indoor still air film (unreflective surface):	0.120	15.13	**18.00**	16.56	2.87	0.120	29.74	**24.00**	26.87	5.74	110
	Total Thermal Resistance, R_{Ti} =	0.25	winter				0.25	summer		0.25	AVG	
	Overall Surface Total Thermal Resistance, R_T =	**0.26**	**winter**				**0.26**	**summer**		**0.26**	**AVG**	

107wRW01b Bare RW156C REDIWALL

	Wall section elements	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	mm
	Outside air film	0.040	**12.00**	12.85	12.42	0.85	0.040	**36.00**	34.30	35.15	1.70	
System R0.123	2.5mm REDIWALL PVC skin	0.009	12.85	13.04	12.94	0.19	0.009	34.30	33.92	34.11	0.38	2.5
	151mm REDIWALL concrete void	0.105	13.04	15.26	14.15	2.23	0.105	33.92	29.47	31.70	4.45	151
	2.5mm REDIWALL PVC skin	0.009	15.26	**15.45**	15.36	0.19	0.009	29.47	29.09	29.28	0.38	2.5
	Indoor still air film (unreflective surface):	0.120	15.45	**18.00**	16.73	2.55	0.120	29.09	**24.00**	26.55	5.09	156
	Total Thermal Resistance, R_{Ti} =	0.28	winter				0.28	summer		0.28	AVG	
	Overall Surface Total Thermal Resistance, R_T =	**0.29**	**winter**				**0.29**	**summer**		**0.29**	**AVG**	

107wRW01c Bare RW200C REDIWALL

	Wall section elements	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	mm
	Outside air film	0.040	**12.00**	12.77	12.38	0.77	0.040	**36.00**	34.47	35.23	1.53	
System R0.153	2.5mm REDIWALL PVC skin	0.009	12.77	12.94	12.85	0.17	0.009	34.47	34.13	34.30	0.34	2.5
	195mm REDIWALL concrete void	0.135	12.94	15.53	14.23	2.59	0.135	34.13	28.94	31.53	5.19	195
	2.5mm REDIWALL PVC skin	0.009	15.53	**15.70**	15.62	0.17	0.009	28.94	28.60	28.77	0.34	2.5
	Indoor still air film (unreflective surface):	0.120	15.70	**18.00**	16.85	2.30	0.120	28.60	**24.00**	26.30	4.60	200
	Total Thermal Resistance, R_{Ti} =	0.31	winter				0.31	summer		0.31	AVG	
	Overall Surface Total Thermal Resistance, R_T =	**0.32**	**winter**				**0.32**	**summer**		**0.32**	**AVG**	

107wRW01d Bare RW256S REDIWALL

	Wall section elements	m².K/W	°C out	°C in	°C avg	Δt	m².K/W	°C out	°C in	°C avg	Δt	mm
	Outside air film	0.040	**12.00**	12.68	12.34	0.68	0.040	**36.00**	34.64	35.32	1.36	
System R0.192	2.5mm REDIWALL PVC skin	0.009	12.68	12.83	12.76	0.15	0.009	34.64	34.33	34.48	0.30	2.5
	251mm REDIWALL concrete void	0.174	12.83	15.80	14.32	2.97	0.174	34.33	28.39	31.36	5.94	251
	2.5mm REDIWALL PVC skin	0.009	15.80	**15.96**	15.88	0.15	0.009	28.39	28.09	28.24	0.30	2.5
	Indoor still air film (unreflective surface):	0.120	15.96	**18.00**	16.98	2.04	0.120	28.09	**24.00**	26.04	4.09	256
	Total Thermal Resistance, R_{Ti} =	0.35	winter				0.35	summer		0.35	AVG	
	Overall Surface Total Thermal Resistance, R_T =	**0.36**	**winter**				**0.36**	**summer**		**0.36**	**AVG**	

NOTES: **Determinations based upon AS/NZS 4859.1:2002/Amdt 1 2006, Materials for Thermal insulation of buildings.**
Above indoor & outdoor air temperatures per 4859.1:2002/Amdt 1 2006
"System R" values do not include air film resistances. As there is no insulation, summer and winter R values are identical.
The results are believed representative at the date of calculation, however the author reserves the right to revise calculations.
In these cases without insulation, the Total R through the PVC webs is greater than through the concrete, so Overall Surface Total R is 0.01 higher than Total R through the concrete path.
Total Conductance (U) can be calculated by U=1/R Total R values include indoor and outdoor air films.
This report may not be reproduced except in full. Results may not be quoted without reference to the assumptions.
Calculated by James Fricker, F.AIRAH M.IEAust CPEng NER APEC Engineer IntPE(Aus)

Signed: James Fricker

ENGINEERS AUSTRALIA Chartered Professional Engineer MEMBER 1179647

Calculation date 15/03/2019
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