



AFS Rediwall® Blade Columns

Advanced Blade Column Design with AFS Rediwall®

AFS Rediwall® Overview



Introduction

AFS in conjunction with the Centre for Infrastructure Engineering, Western Sydney University (WSU) evaluated performance of AFS Rediwall® Blade Columns with simplified detailing utilising the standard end **U-bars in lieu of ties**. The elimination of ties within the limitations detailed below **simplifies design, detailing and installation** of AFS Rediwall® Permanent Formwork systems. These methods can be used by the designer to minimise construction costs.

AFS Rediwall® Blade Columns offer a simplified design and reinforcement detailing provides flexibility. The use of U-bar reinforcement instead of complex confinement ties significantly increases the speed of installation while continuing to meet the **compliance** requirements of **AS3600-2018** Amendment 2 and the **NCC**.

Up to
8 storeys



Benefits of Rediwall® Blade Columns



Advanced Blade Column Design

AFS Rediwall® Blade Columns provide simplified detailing utilising the standard end U-bars in lieu of closed ligatures or intermediate ties. Rediwall® Blade Columns are AS3600-2018 compliant. We have provided an example using the WSU advanced design method.



Build Cost Reductions

The new AFS Rediwall® advanced design method now allows for reinforcement detailing that greatly reduces the construction time of higher capacity Blade Columns.

- No additional on-site trades
- Faster completion time
- Standard U-Bar (no need for custom reinforcement)
- Standard horizontal and vertical reinforcement
- No need for specialised column formwork bracing
- No need for on-site crane to lift formwork or reinforcement into place



Architectural Flexibility

AFS Rediwall® advanced Blade Column design method offers greater architectural flexibility to help maximise lettable area by combining walls, columns, blades, and cores.



Ease of Installation

The AFS Rediwall® Blade Column results in a reduction in formwork, labour, and disciplines on site.

Other advantages include:

- No requirement for base ligature
- No pre-installation of starter bar ligatures
- Compatible with standard U-bars
- Compatible with the AFS Vertical Bar locator system
- Ease of inspection with open end caps



Introducing the new RW200C FF Column Panel

The new RW200C (Female Female) FF **Column Panel** can be used to reverse the ends of a panel section. This is particularly useful during column construction when fibre cement end caps are required. Reversing the panel end allows a female clip end to be present at both ends of the column allowing for the **neat** fibre cement end caps.

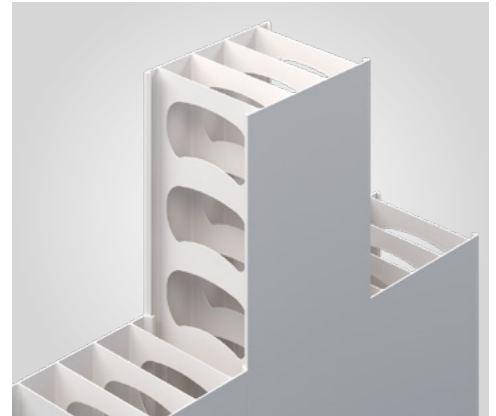
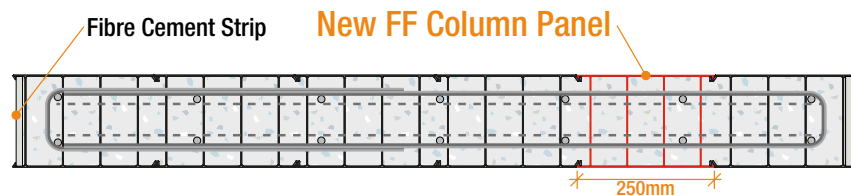
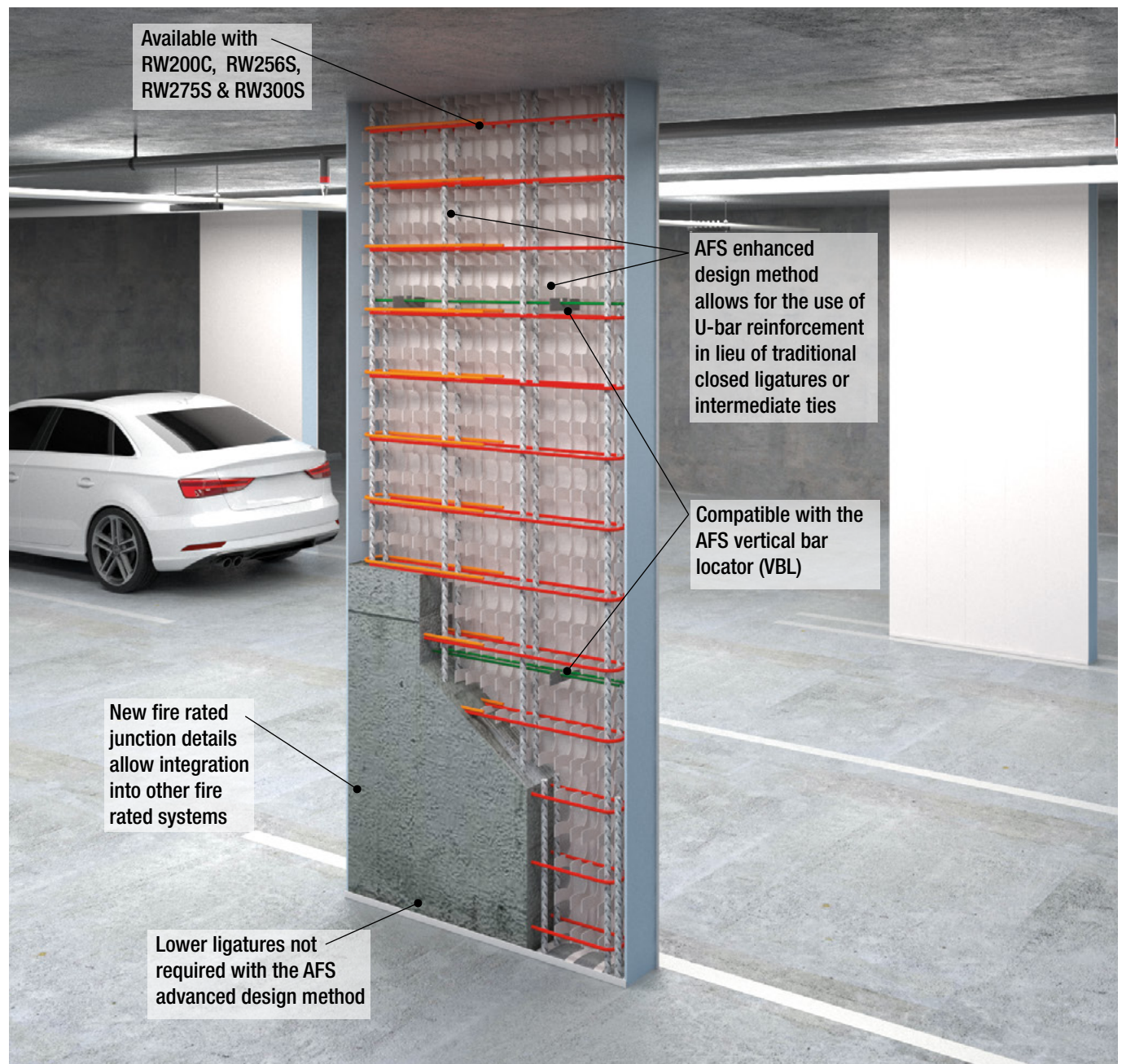


Fig 1. AFS Rediwall® isolated Blade Column



Compliance and Verification

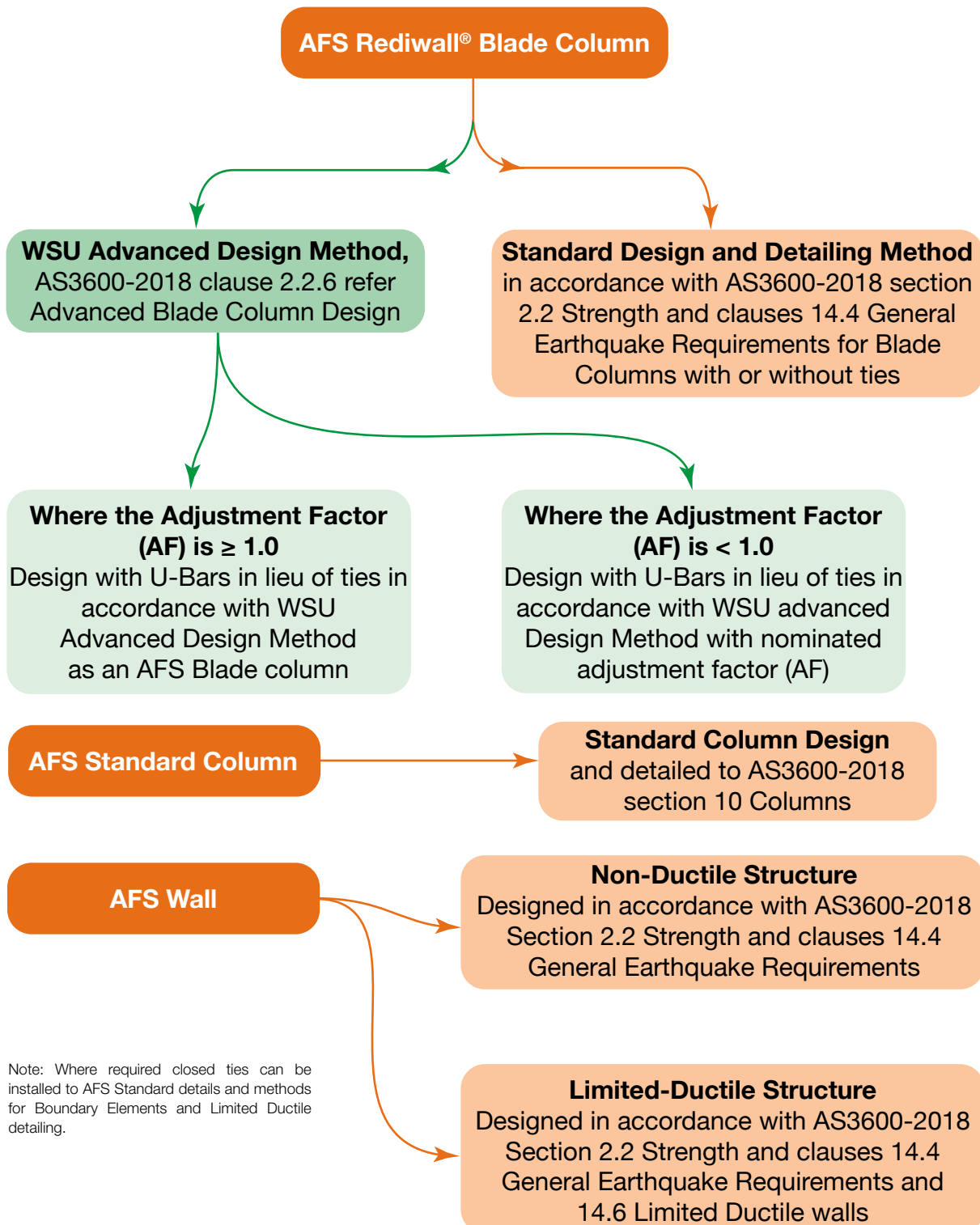
AFS Blade Column capacities have been load tested and verified by Western Sydney University using existing Deemed To Satisfy (DTS) and alternate performance design methods for the performance equivalence U-bars without ties to walls designed as columns with ties in accordance with the AS3600-2018 Strength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

The Advanced Design for AFS Blade Columns with end U-bars in-lieu of ligatures has been developed to AS3600-2018 clause 2.1.1 Design for strength and serviceability, in

accordance with clause 2.2.6 Strength check procedure for use with non-linear stress analysis using Advanced Finite Element non-linear stress analysis (ABAQUS) and comparative physical prototype testing to Appendix B3 Proof Testing of Members and Structures, to evaluate the structural performance of AFS Blade Columns with reduced reinforcing steel tie complexity under eccentric axial load.

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

Fig 2: Design flowchart



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

AFS Rediwall® Advanced Blade Column Design

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

Detailing is as for walls designed as columns in accordance with AS3600-2018 clause 14.4.4 General Requirements, Structural Walls with the end U-bars replacing the closed ties.

AS3600-2018 11.7.4 Restraint of Vertical Reinforcement

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

- (a) *For all walls in structures with a structural ductility factor (μ) greater than 1.0, the vertical reinforcement shall be restrained in accordance with Clause 14.6*
- (b) *For walls with concrete strength not exceeding 50MPa and designed as columns in accordance with Section 10, the vertical reinforcement shall be restrained in accordance with Clause 10.7.4 unless one or more of the following conditions is met, in which case no restraint is required:*
 - (i) $N^* \leq 0.5 \phi N_{\mu}$
 - (ii) *The vertical reinforcement is not used as compressive reinforcement.*
 - (iii) *The vertical reinforcement ratio is not greater than 0.01 and minimum horizontal reinforcement ratio or 0.0025 is provided.*

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

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

Table 1: WSU adjustment factor table for AFS Rediwall®

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

Note: for $\rho > 1\%$ all compressive reinforcement was excluded for calculating interaction curves as per AS3600
- Refer Figure14 p52 WSU Report - Conclusions

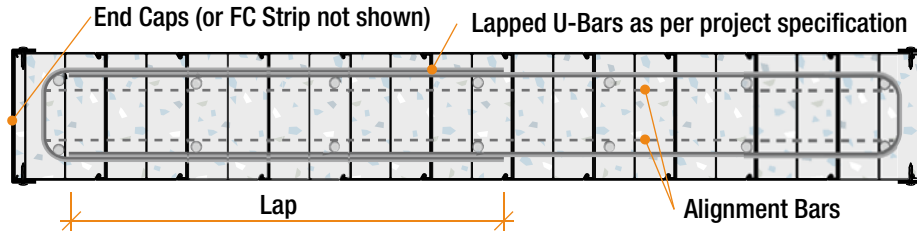
- The moment magnifier technique of AS3600:2018 can conservatively be used to modify moment capacity for AFS-encased columns for slenderness effects, (refer clause 6.5.3)
- Since the ratio of the larger to smaller cross-sectional dimension for the majority cases of AFS Rediwall® columns exceeds 3.0,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

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

Design Examples

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

Fig 4: Typical Blade Column

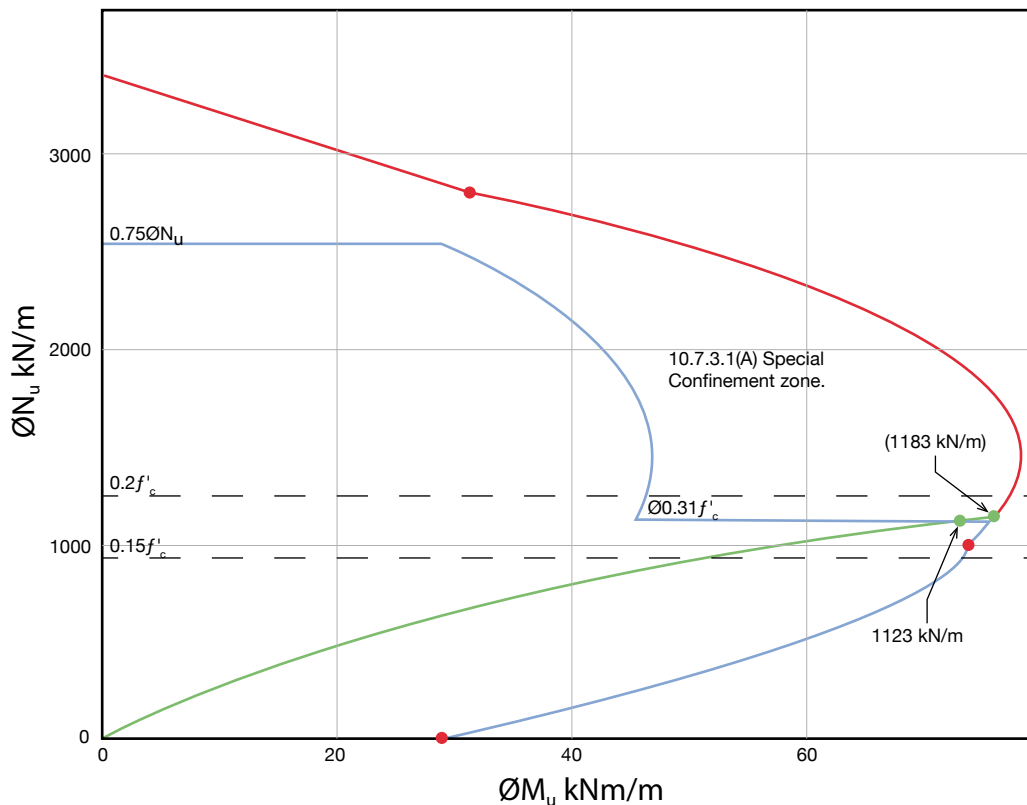


Example 1 – For a RW200C Blade Column 1500 long

From RW200 Design Table $\phi N_u = 1123 \text{ kN/m} \times 1500\text{mm} = 1684 \text{ kN}$

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

Fig 5: Moment interaction chart: RW200C, $H_{wu}=3000\text{mm}$, $k=0.75$, 50MPa, 2N20-200 vert, N12-233 horizontal U-bars each side



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

Table 2: FRP structural adequacy from AS3600-2018 clause 5.7.2

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

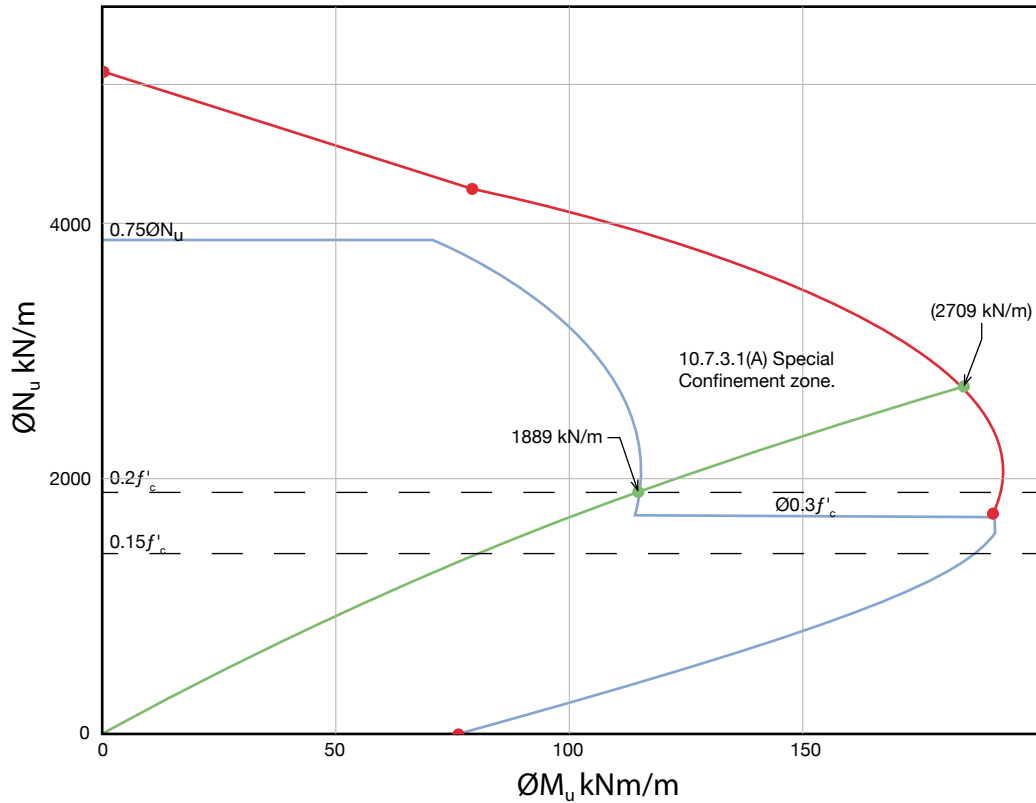
• $a_s = 55\text{mm}$ ($d_n = 41 + (N16 + N12)/2$), $D = 195\text{mm}$, $H_{we} < 7800$, $u_{fi} = N^*_f / \phi N_u$

Example 2 – For a RW300S Blade Column 2500 long

From RW300 Design Table $\phi N_u = 1889 \text{ kN/m} \times 2500 \text{ mm} = 4722 \text{ kN}$

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

Fig 6: Moment interaction chart: RW300S x2500long, $H_{wu}=3000\text{mm}$, $k=0.75$, 32MPa, 2N16-300 vert, N12-233 horizontal U-bars each end



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

Table 3: FRP structural adequacy from AS3600-2018 clause 5.7.2

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

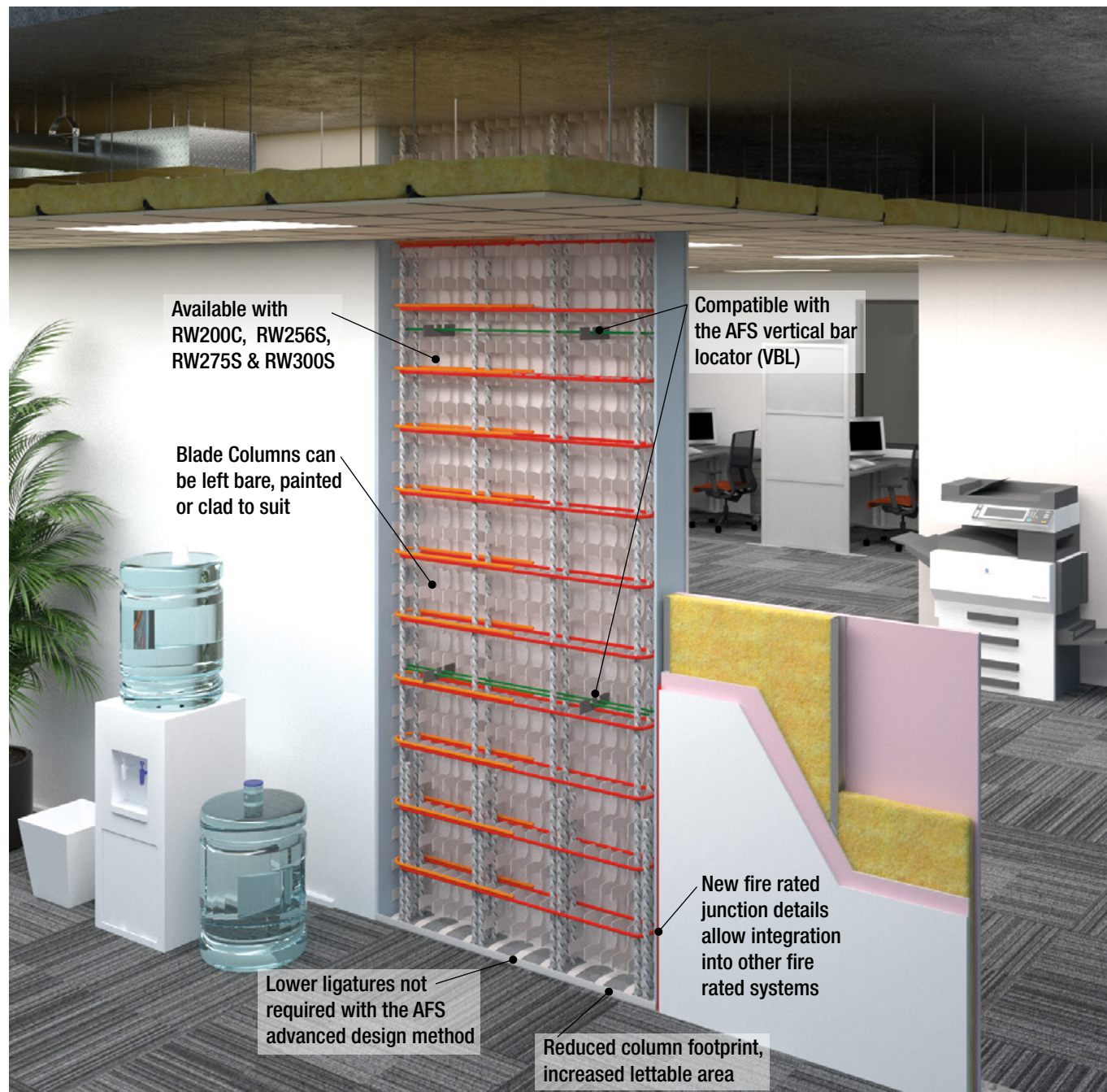
• $a_s = 55 \text{ mm}$ ($d_h = 41 + (N16 + N12)/2$), $D = 295 \text{ mm}$, $H_{wb} < 7800$, $u_{fi} = N^*_f / \phi N_u$

AFS Rediwall® Advanced Column Design Tables

The following AFS Rediwall® design tables for rediwall have been prepared utilising moment interaction curves and moment magnifier in accordance with the Advanced Design Methods to determine the member capacities for non-ductile vertical load bearing Blade Columns. Other column

design tools can also be used provided they account for the adopted clause 11.7.4(b) where for vertical reinforcement ratios exceed 0.01 the vertical reinforcement is not used as compression reinforcement and concrete strength does not exceed 50MPa.

Fig 7: AFS Rediwall® Blade Column integration into a dividing wall



RW200C Blade Column

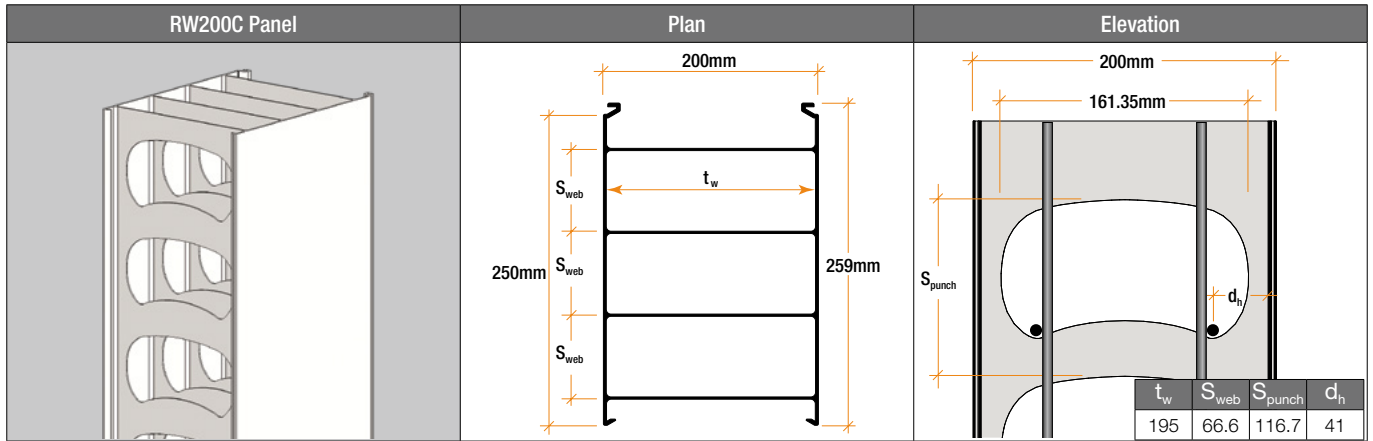
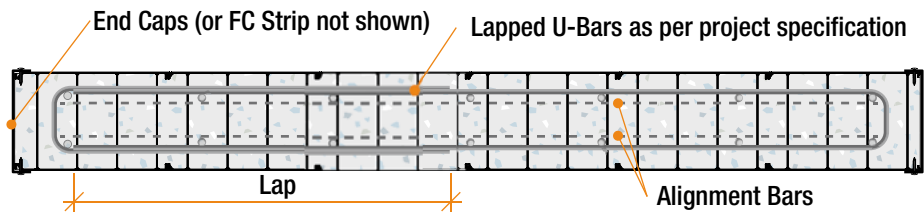


Fig 8: RW200C typical Blade Column



RW200 Blade Column Axial Capacity ϕN_u (kN/m) Non-Ductile 2 Layers

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

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

1123 (1233) - lower value where clause 10.7.3.1(2) applies

#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)

#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0

#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

RW200C Minimum Reinforcement

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

| |
|---------------------------------|
| Horizontal Bar Spacing 233/350 |
| Vertical Bar Spacing 150 to 350 |
| Acceptable |
| With Caution |
| Not Recommended |

RW256S Blade Column

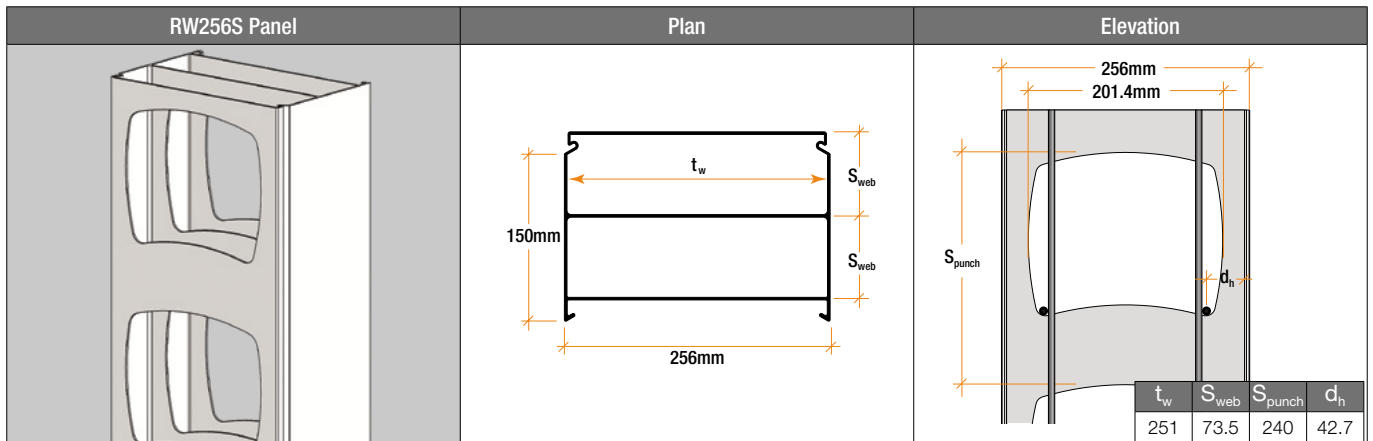
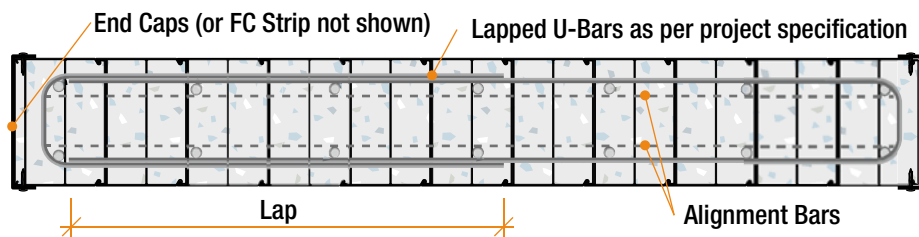


Fig 9: RW256S typical Blade Column



RW256S Blade Column Axial Capacity ϕN_u (kN/m) Non-Ductile 2 Layers

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

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

1440 (1518) - lower value where clause 10.7.3.1(2) applies

#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)

#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0

#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

RW256S Minimum Reinforcement

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

| |
|---------------------------------|
| Horizontal Bar Spacing 240 |
| Vertical Bar Spacing 150 to 350 |
| Acceptable |
| With Caution |
| Not Recommended |

RW275S Blade Column

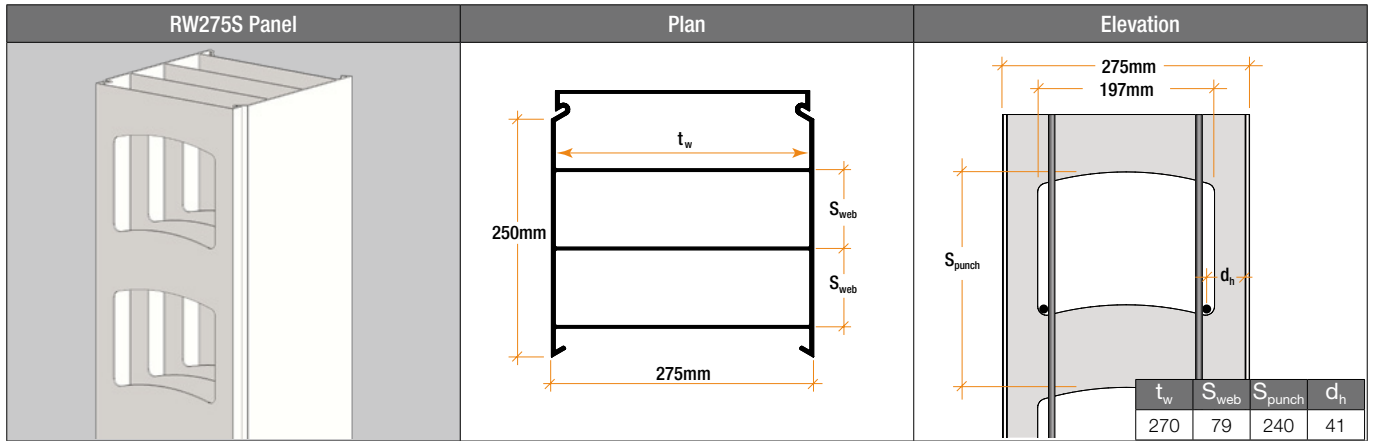
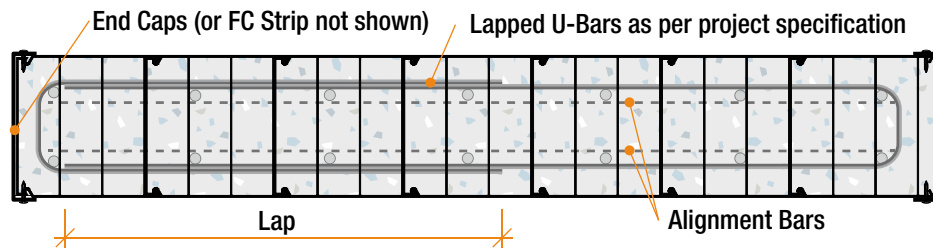


Fig 10: RW275S typical Blade Column



RW275S Blade Column Axial Capacity ϕN_u (kN/m) Non-Ductile 2 Layers

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

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

1546 (1687) - lower value where clause 10.7.3.1(2) applies

#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)

#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0

#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

RW275S Minimum Reinforcement

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

Horizontal Bar Spacing 240

Vertical Bar Spacing 150 to 350

Acceptable

With Caution

Not Recommended

RW300S Blade Column

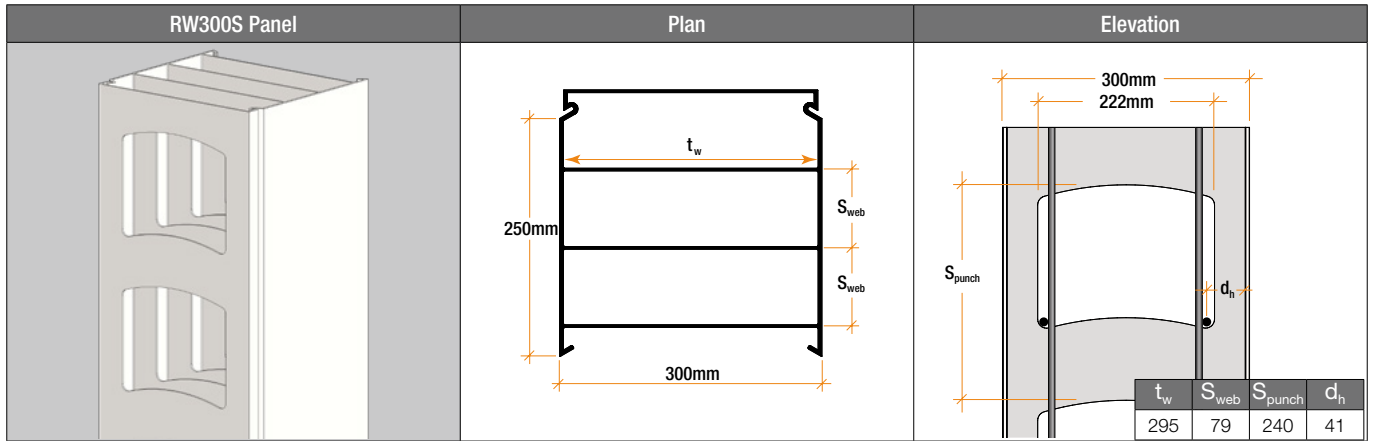
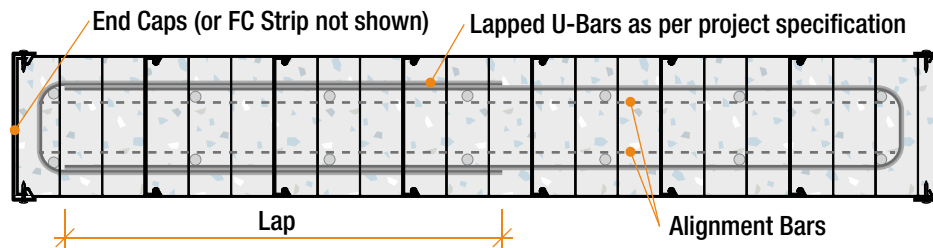


Fig 11: RW300S typical Blade Column



RW300S Blade Column Axial Capacity ϕN_u (kN/m) Non-Ductile 2 Layers

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

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

1693 (1843) - lower value where clause 10.7.3.1(2) applies

#1 Compression reinforcement ignored in accordance with clause 11.7.4(b)

#2 Max Blade Length from WSU Report Fig 16 for Standard AFS detailed Blades with U-bars and no ties with Adjustment Factor to AS3600-2018 ≥ 1.0

#3 Clause 14.6.2 Boundary Element limit if acting as part of Lateral System, refer WSU Report p4 Note 6

RW300S Minimum Reinforcement

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

Horizontal Bar Spacing 240

Vertical Bar Spacing 150 to 350

Acceptable

With Caution

Not Recommended

AFS Rediwall® Fire Performance

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

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

Fire Rated Junctions

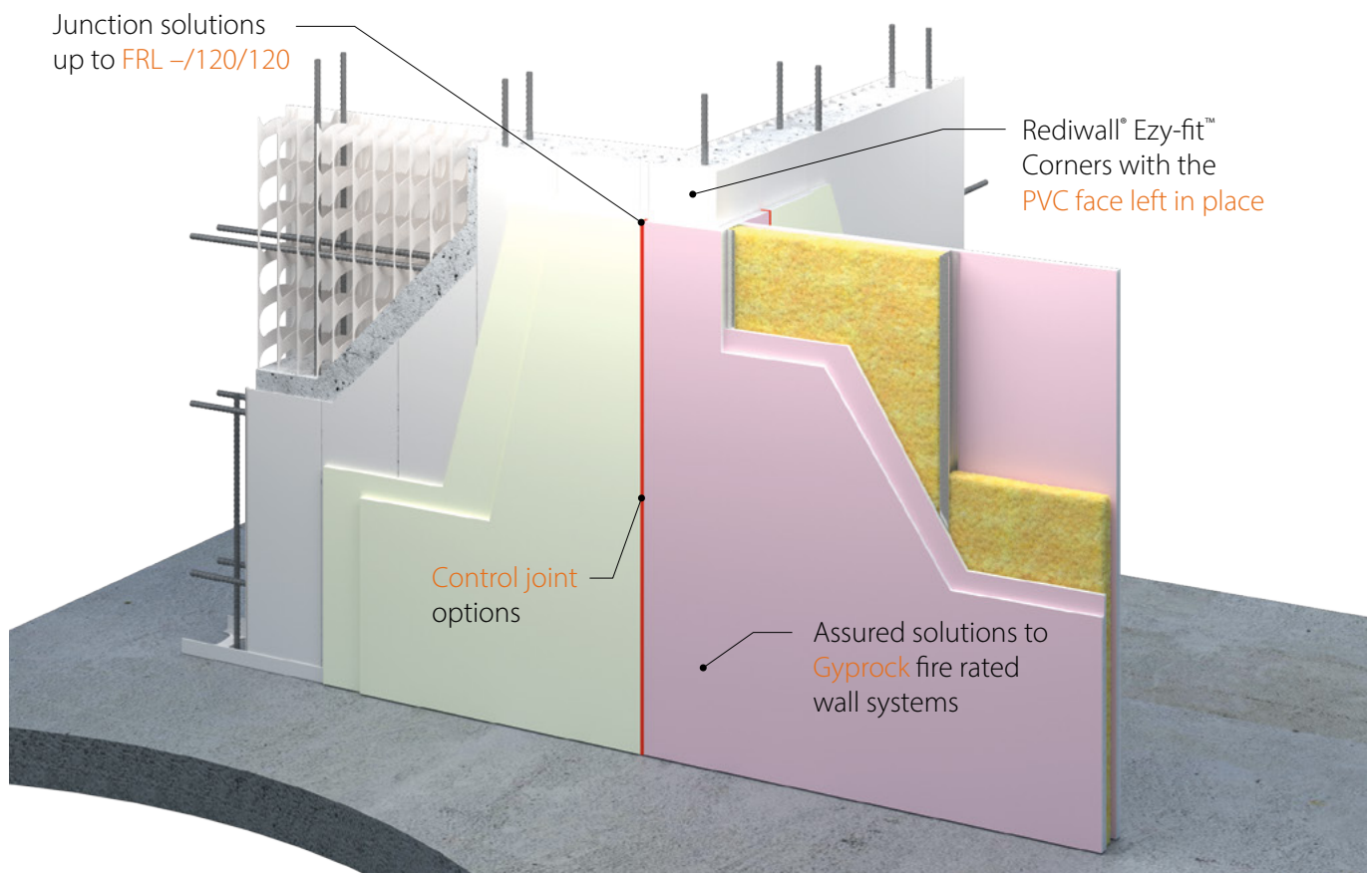
A range of fire junction solutions have been fire tested and assessed to AS1530.4-2014 for the easy integration of various fire rated system and Rediwall®.

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

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

For a additional information refer to "AFS Rediwall® fire rated junction guide" or contact afs.

Fig 12: Example of a fire rated junction



Column Construction

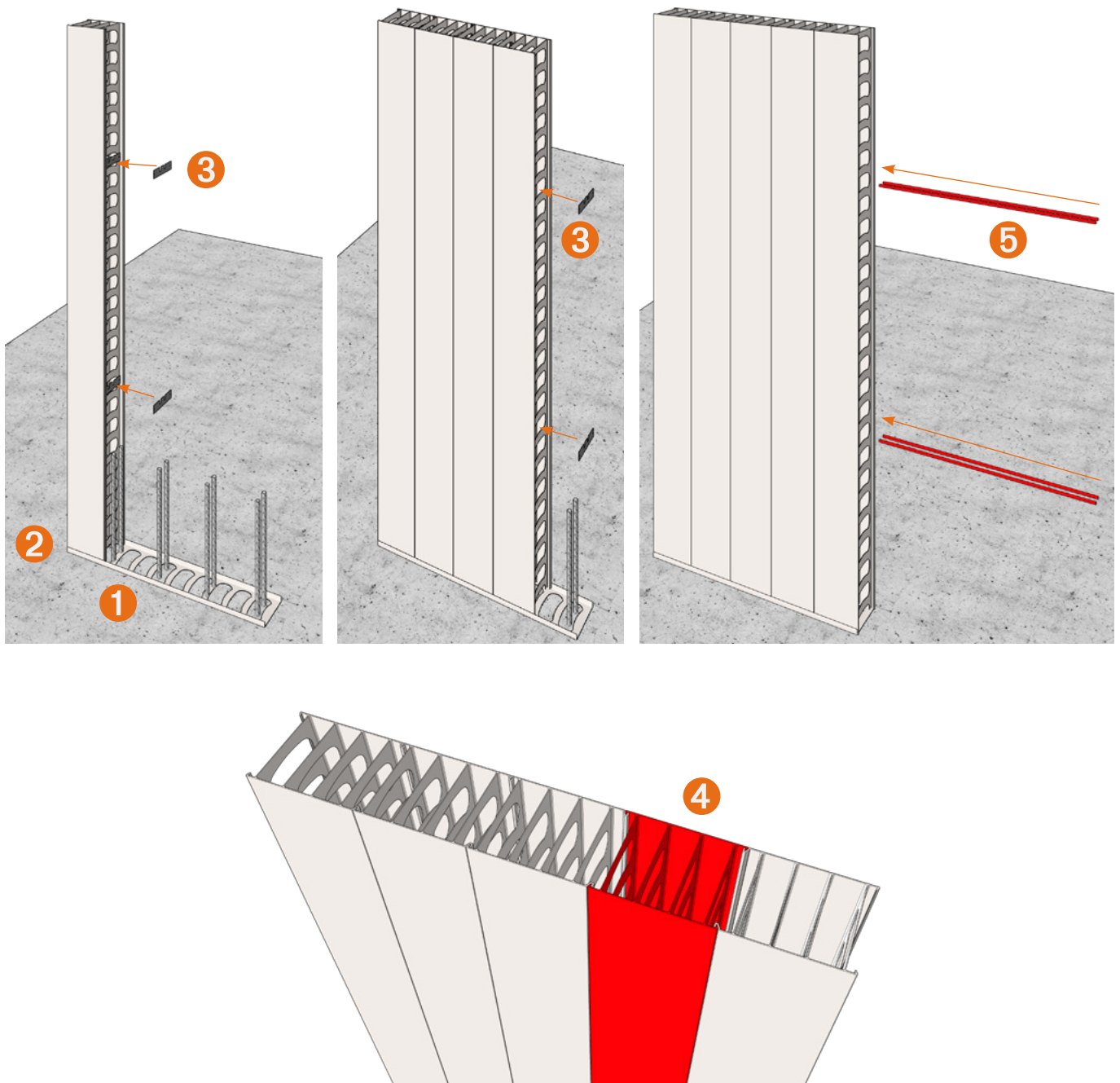
Rediwall® Floor Track and Panel Fixing

- 1** Position the Rediwall® floor track or angles at the correct column location and fix the track to the slab.
- 2** Screw fix each Rediwall® panel to the floor track on both sides of the panel.
- 3** Vertical bar locators (VBL) and alignment bars can be used to assist with location and installation of the vertical reinforcement. Once sufficient number of Rediwall® panels are fixed in place, fix the VBL to the inside web face of the AFS Rediwall® panel at the desired locations of the vertical bar alignment guides.

4 If using the RW200C FF Column Panel, it is recommended that it be used at least 1 full panel from the end of the column. The RW200C FF Column Panel **CANNOT** be used as the end panel.

5 If VBL are used, slide the alignment bar (R10) through the VBL.

Note: These guide bars are **NOT** to be considered as part of the wall structural reinforcement.



U-Bar Installation

U-Bar Installation

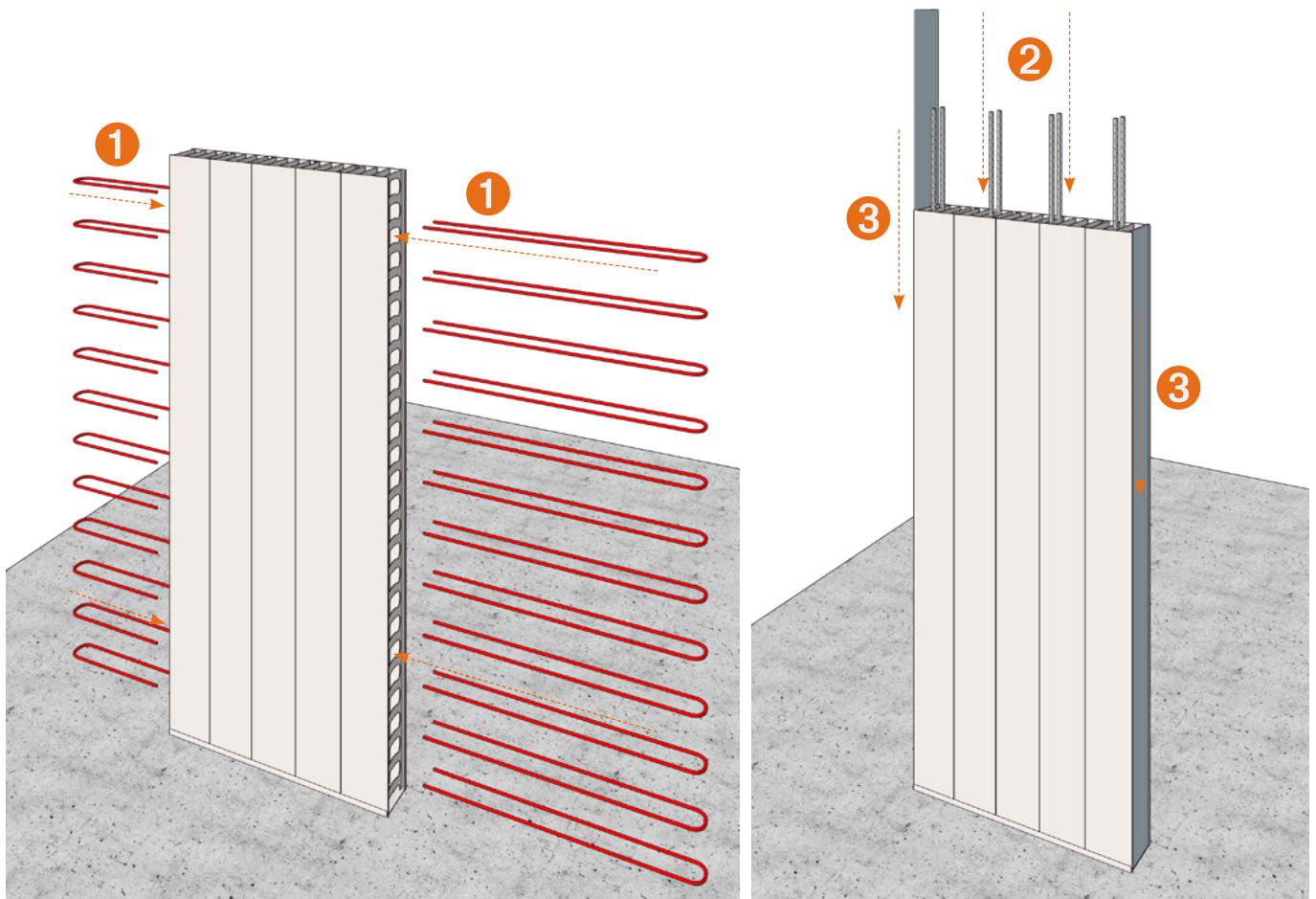
- 1** Insert the U-Bars into the Column at the required spacings. Refer to engineers details.
- 2** The vertical reinforcement bars are then lowered into the Rediwall® panel, at the correct locations. Ensure that the vertical bars are on the internal side horizontal U-bars, and on the outer side of the alignment bars.

Note: A small 20mm bend at the base of the vertical bar can be used to “joggle” the bar past the horizontal bars.

The offset makes it easy when lowering the vertical reinforcing bars into the wall to weave it in between the locator bars and the outer horizontal reinforcing bars.

A mark on the vertical joggle bars can facilitate locating the alignment bars so that the joggle bars can be paused just above the horizontal locator bar can speed up reinforcement installation.

- 3** Insert the two fibre cement end caps into the Rediwall® panel clips. Ensure that the column is fully braced.



Definitions

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

Reference

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



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