External Steel Stud and Top Hat Walls

External steel framed plasterboard walls protect the inside from weather, noise and when applicable, fire. They must also comply with local energy efficiency provisions.

Fire rated systems in this section can satisfy NCC FRL requirements for spandrel walls and walls built close to a fire source feature such as a property boundary. These walls are often required to be fire rated from the outside only.

TruRock forms part of the outer wall and is covered by a moisture barrier and external cladding which provide the weather protection.

This section contains systems, installation instructions and construction details for fire rated and non-fire rated external steel framed walls.
### KSW73

**EXTERNAL WALL CLADDING:** 1 layer of minimum 7.5mm HardieTex  
**MOISTURE BARRIER:** Wall wrap  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** As specified in table below  
**INTERNAL WALL LINING:** 1 layer of 10mm MastaShield or 10mm WaterShield

<table>
<thead>
<tr>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
<th>Acoustic Report Insul</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>0.6* + Insulation R Value</td>
<td>100</td>
<td>No Insulation</td>
<td>R2.0 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### KSW274

**EXTERNAL WALL CLADDING:** 1 layer of minimum 7.5mm HardieTex  
**MOISTURE BARRIER:** Wall wrap  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** As specified in table below  
**INTERNAL WALL LINING:** 2 layers of 10mm OPAL

<table>
<thead>
<tr>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
<th>Acoustic Report Insul</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>0.7* + Insulation R Value</td>
<td>110</td>
<td>No Insulation</td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### KSW378

**EXTERNAL WALL CLADDING:** 1 layer of minimum 7.5mm HardieTex  
**MOISTURE BARRIER:** Wall wrap  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** As specified in table below  
**INTERNAL WALL LINING:** 3 layers of 13mm FireShield

<table>
<thead>
<tr>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
<th>Acoustic Report Insul</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>0.8* + Insulation R Value</td>
<td>130</td>
<td>No Insulation</td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* R-Value based on anti-glare foil and minimum 13mm gap created by thermal break.
### KSW470

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 1 layer of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 1 layer of 10mm MastaShield or 10mm WaterShield  
[Use approved fire rated penetration details in the non-fire rated internal lining to maintain FRL]

<table>
<thead>
<tr>
<th>FRL 30/30/30</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70</td>
<td>+ 0.8 * Insulation R Value</td>
<td>150</td>
<td>No Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acoustic Report Insul</td>
</tr>
</tbody>
</table>

* R-Value based on anti-glare foil, minimum 20mm air gap and 6mm fibre cement.

### KSW473

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 1 layer of 16mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 1 layer of 10mm MastaShield or 10mm WaterShield  
[Use approved fire rated penetration details in the non-fire rated internal lining to maintain FRL]

<table>
<thead>
<tr>
<th>FRL 60/60/60</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70</td>
<td>+ 0.8 * Insulation R Value</td>
<td>155</td>
<td>No Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acoustic Report Insul</td>
</tr>
</tbody>
</table>

### KSW471

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 2 layers of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 1 layer of 10mm MastaShield or 10mm WaterShield  
[Use approved fire rated penetration details in the non-fire rated internal lining to maintain FRL]

<table>
<thead>
<tr>
<th>FRL 90/90/90</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70</td>
<td>+ 0.9 * Insulation R Value</td>
<td>165</td>
<td>No Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acoustic Report Insul</td>
</tr>
</tbody>
</table>

* R-Value based on anti-glare foil, minimum 20mm air gap and 6mm fibre cement.
### KSW472

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 3 layers of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 1 layer of 10mm MastaShield or 10mm WaterShield  

[Use approved fire rated penetration details in the non-fire rated internal lining to maintain FRL]

<table>
<thead>
<tr>
<th>FRL 120/120/120</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
<th>Acoustic Report Insul</th>
</tr>
</thead>
<tbody>
<tr>
<td>rated from the outside only</td>
<td>70</td>
<td>1.0* + Insulation R Value 175 approximate</td>
<td>No Insulation</td>
<td>R1.5 EarthWool 50 (38)</td>
<td>Polyester 49 (38)</td>
</tr>
</tbody>
</table>

---

### KSW491

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 2 layers of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  

<table>
<thead>
<tr>
<th>FRL 30/30/30</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
<th>Acoustic Report Day Design 3094-33</th>
</tr>
</thead>
<tbody>
<tr>
<td>rated from the outside only</td>
<td>70</td>
<td>0.8* + Insulation R Value 155 approximate</td>
<td>No Insulation</td>
<td>R1.5 EarthWool 34 (30)</td>
<td>Polyester 34 (30)</td>
</tr>
</tbody>
</table>

---

### KSW494

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 2 layers of 16mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  

<table>
<thead>
<tr>
<th>FRL 60/60/60</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
<th>Acoustic Report Day Design 3094-33</th>
</tr>
</thead>
<tbody>
<tr>
<td>rated from the outside only</td>
<td>70</td>
<td>0.9* + Insulation R Value 160 approximate</td>
<td>No Insulation</td>
<td>R1.5 EarthWool 35 (31)</td>
<td>Polyester 35 (31)</td>
</tr>
</tbody>
</table>

---

*R-Value based on anti-glare foil, minimum 20mm air gap and 6mm fibre cement.

---

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KSW492

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 3 layers of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** Optional

<table>
<thead>
<tr>
<th>FRL 90/90/90 rated from the outside only Fire Report FAR 2827</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No Insulation</td>
<td></td>
<td>EarthWool</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>0.9* + Insulation R Value</td>
<td>165 approximate</td>
<td>37 (34) 37 (34) 37 (34)</td>
</tr>
</tbody>
</table>

KSW495

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 3 layers of 16mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** Optional

<table>
<thead>
<tr>
<th>FRL 120/120/120 rated from the outside only Fire Report FAR 2827</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No Insulation</td>
<td></td>
<td>EarthWool</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>1.0* + Insulation R Value</td>
<td>175 approximate</td>
<td>38 (35) 38 (35) 38 (35)</td>
</tr>
</tbody>
</table>

KSW496

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 1 layer of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 1 layer of 13mm FireShield or 13mm TruRock

<table>
<thead>
<tr>
<th>FRL – /60/60 rated from both sides Fire Report FAR 3210</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No Insulation</td>
<td></td>
<td>EarthWool</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>0.8* + Insulation R Value</td>
<td>155 approximate</td>
<td>39 (30) 43 (32) 42 (31)</td>
</tr>
</tbody>
</table>

* R-Value based on anti-glare foil, minimum 20mm air gap and 6mm fibre cement.
### KSW476

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 1 layer of 16mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 1 layer of 16mm FireShield or 16mm TruRock

| FRL
<table>
<thead>
<tr>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/60/60 rated from both sides Fire Report FAR 3371 -/90/90 with EarthWool Fire Report FAR 3210</td>
<td>70</td>
<td>0.9* + Insulation R Value</td>
<td>160 approximate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### KSW477

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 2 layers of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 1 layer of 16mm FireShield or 16mm TruRock

| FRL
<table>
<thead>
<tr>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90/90/90 rated from the outside 60/60/60 rated from the inside Fire Report FAR 3371</td>
<td>70</td>
<td>0.9* + Insulation R Value</td>
<td>170 approximate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### KSW478

**EXTERNAL WALL CLADDING:** Any cladding  
**MOISTURE BARRIER:** Wall wrap  
**EXTERNAL WALL LINING:** 2 layers of 13mm TruRock  
**FRAME:** Minimum 70mm steel studs at maximum 600mm centres  
**WALL INSULATION:** Optional  
**INTERNAL WALL LINING:** 2 layers of 13mm FireShield or 13mm TruRock

| FRL
<table>
<thead>
<tr>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90/90/90 rated from both sides Fire Report FAR 3371</td>
<td>70</td>
<td>1.0* + Insulation R Value</td>
<td>180 approximate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*R-Value based on anti-glare foil, minimum 20mm air gap and 6mm fibre cement.*

---

Technical Advice 1300 724 505 knaufplasterboard.com.au
EXTERNAL STEEL STUD AND TOP HAT WALLS

3.2.1 Technical Advice 1300 724 505 knaufmetal.com.au

**EXTERNAL STEEL STUD AND TOP HAT WALLS**

**Fire Rated**

**KSW479**

**EXTERNAL WALL CLADDING:** Any cladding

**MOISTURE BARRIER:** Wall wrap

**EXTERNAL WALL LINING:** 2 layers of 16mm TruRock

**FRAME:** Minimum 70mm steel studs at maximum 600mm centres

**WALL INSULATION:** Optional

**INTERNAL WALL LINING:** 2 layers of 16mm FireShield or 16mm TruRock

<table>
<thead>
<tr>
<th>FRL 120/120/120</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No Insulation</td>
<td>70</td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
<td>190 approx</td>
<td>51 (43)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Acoustic Report Insul</td>
<td></td>
<td>54 (37)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>53 (45)</td>
</tr>
</tbody>
</table>

* R-Value based on anti-glare foil, minimum 20mm air gap and 6mm fibre cement.

---

* R-Value based on anti-glare foil, minimum 20mm air gap and 6mm fibre cement.
EXTERNAL STEEL STUD AND TOP HAT WALLS

3.2.1 Systems

**KSW70**

**EXTERNAL MASONRY:** Minimum 90mm masonry with FRL 60/60/60 (Minimum laid weight 130 kg/m²)

**FRAME:** Minimum 70mm steel studs at maximum 600mm centres with a minimum 40mm air gap

**WALL INSULATION:** Optional

**INTERNAL WALL LINING:** 1 layer of 10mm MataShield or 10mm WaterShield

<table>
<thead>
<tr>
<th>FRL 60/60/60 rated from the outside only</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Report FAR 3586</td>
<td>70</td>
<td>0.5 + Insulation R Value</td>
<td>210</td>
<td>No Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
</tr>
</tbody>
</table>

**KSW373**

**EXTERNAL MASONRY:** Minimum 90mm masonry with FRL 60/60/60 (Minimum laid weight 130 kg/m²)

**FRAME:** Minimum 70mm steel studs at maximum 600mm centres with a minimum 40mm air gap

**WALL INSULATION:** Optional

**INTERNAL WALL LINING:** 1 layer of 16mm FireShield or 16mm TruRock

<table>
<thead>
<tr>
<th>FRL 60/60/60 rated from both sides</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Report FAR 3586</td>
<td>70</td>
<td>0.5 + Insulation R Value</td>
<td>216</td>
<td>No Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
</tr>
</tbody>
</table>

**KSW371**

**EXTERNAL MASONRY:** Minimum 90mm masonry with FRL 90/90/90 (Minimum laid weight 130 kg/m²)

**FRAME:** Minimum 70mm steel studs at maximum 600mm centres with a minimum 40mm air gap

**WALL INSULATION:** Optional

**INTERNAL WALL LINING:** 2 layers of 13mm FireShield or 13mm TruRock

<table>
<thead>
<tr>
<th>FRL 90/90/90 rated from both sides</th>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Report FAR 3586</td>
<td>70</td>
<td>0.6 + Insulation R Value</td>
<td>226</td>
<td>No Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
</tr>
</tbody>
</table>

Technical Advice 1300 724 505 knaufplasterboard.com.au
KSW374

EXTERNAL MASONRY: Minimum 90mm masonry with FRL 120/120/120 (Minimum laid weight 130 kg/m²)

FRAME: Minimum 70mm steel studs at maximum 600mm centres with a minimum 40mm air gap

WALL INSULATION: Optional

INTERNAL WALL LINING: 2 layers of 16mm FireShield or 16mm TruRock

<table>
<thead>
<tr>
<th>Stud Size (mm)</th>
<th>Estimated Total R-Value (m².K/W)</th>
<th>Width (mm)</th>
<th>Sound Insulation Rw (Rw + Ctr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>0.6 + Insulation R Value</td>
<td>232</td>
<td>No Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1.5 EarthWool</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1.5 Polyester</td>
</tr>
</tbody>
</table>

Acoustic Report

FAR 3586

Stud Size 120/120/120

Rated from both sides

FIRE RATING:

FRL 120/120/120 rated from both sides

Fire Report FAR 3586
### General Requirements

<table>
<thead>
<tr>
<th>Install control joints in plasterboard walls:</th>
<th>Non-Fire Rated</th>
<th>Fire Rated</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 12m maximum intervals</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>At all control joints in the structure</td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>At any change in the substrate material.</td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

Jointing of the TruRock is not required due to the overlying breathable wall wrap and cladding. ✔

Joint the face layer on the internal side with:
- Paper tape and two coats of MastaBase / MastaLongset or ✔
- Paper tape and three coats of MastaLite or ✔
- Bindex Fire and Acoustic Sealant according to the Technical Data Sheet. ✔

Use approved fire rated penetration details. Fire penetrations may require fire collars or other devices to maintain fire performance. ✔

Use approved fire rated penetration details for systems that use the internal non-fire rated plasterboard wall lining to maintain the FRL. ✔

Pack any gaps between the top of the wall and the underside of the roof covering with mineral fibre or other suitable fire resisting material. ✔

Protect plasterboard from water pooling at ground level. ✔ ✔

Use fire sealant on all gaps and around perimeter, vermiculite plaster is not permitted. ✔

Attach all fixtures to studs or noggings. Wall anchors must not be directly fixed to only the plasterboard of fire rated walls. ✔

For acceptable modifications or variations to fire rated systems [Refer to Section 2.3 Fire Resistance].

### Framing

<table>
<thead>
<tr>
<th>Framing members must be spaced at 600mm maximum centres.</th>
<th>Non-Fire Rated</th>
<th>Fire Rated</th>
</tr>
</thead>
</table>

Face studs in the same direction if possible, to allow easier fastening of plasterboard. However, installation of some services may require the studs to be positioned in opposite directions. ✔ ✔

Follow a structural design suitable for the intended dead, live and wind loads in accordance with AS/NZS 1170. ✔ ✔

Noggings are permitted to assist the fixing of services. Copper Chromium Arsenate (CCA) treated timber must not be used.
EXTERNAL STEEL STUD AND TOP HAT WALLS

3.2.1 Installation

Framing

HORIZONTAL TOP HAT FRAMING

HORIZONTAL 50x15x1.15 TOP HAT SPACING TABLE (mm)

<table>
<thead>
<tr>
<th>Span type</th>
<th>Stud spacing (mm)</th>
<th>Ultimate Wind Pressure W₀ (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>600</td>
</tr>
<tr>
<td>Single span</td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>900</td>
</tr>
<tr>
<td>2 or more spans</td>
<td>600</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>700</td>
</tr>
<tr>
<td>2 or more spans</td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>900</td>
</tr>
</tbody>
</table>

1. Check maximum cladding span and fastener spacing requirements from the manufacturer’s literature. Maximum cladding weight 22 kg/m² or seat cladding on floor.
2. Top Hat spacing limited to 900mm to apply an evenly distributed load to stud frame substrate.
3. Tables refer to Knauf Top Hats of grade G300 steel with Zincalume™ AM150 corrosion protection.
4. All Top Hats must be supported 150mm maximum from ends.
5. Tables are applicable to self weight and uniformly distributed lateral pressures. Point loads and other loads such as shelf loads, or live loads are not considered.
6. Calculations based upon either single span or 2-or-more spans, designed in accordance with AS/NZS 4600:2005 Cold Formed Steel Structures.
7. Ultimate Load Case 1.2G + Wu
8. Serviceability Load Case G + Ws, with deflection limited to either span/250 or span/360. Serviceability pressure taken as 65% of ultimate wind pressure.
9. Connections checked using 2 x 12g hex-head screws into minimum 1.15mm thick G300 steel.
10. Splicing of Top Hats is not permitted.
11. Do not use the tables for vertical top hats over horizontal top hat construction.
12. The project engineer must approve the nominated lateral pressures and deflection limits are appropriate for a specific project.
### HORIZONTAL 50x25x1.15 OR 50x35x0.75 TOP HAT SPACING TABLE (mm)

<table>
<thead>
<tr>
<th>Span type</th>
<th>Stud spacing (mm)</th>
<th>Ultimate Wind Pressure $W_u$ (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.0</td>
</tr>
<tr>
<td>Single span</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single span</td>
<td>600</td>
<td>900</td>
</tr>
<tr>
<td>Single span</td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td>Single span</td>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td>Single span</td>
<td>300</td>
<td>900</td>
</tr>
<tr>
<td>2 or more spans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 or more spans</td>
<td>600</td>
<td>900</td>
</tr>
<tr>
<td>2 or more spans</td>
<td>450</td>
<td>900</td>
</tr>
<tr>
<td>2 or more spans</td>
<td>400</td>
<td>900</td>
</tr>
<tr>
<td>2 or more spans</td>
<td>300</td>
<td>900</td>
</tr>
</tbody>
</table>

1. Check maximum cladding span and fastener spacing requirements from the manufacturers literature. Maximum cladding weight 22 kg/m² or seat cladding on floor.
2. Top Hat spacing limited to 900mm to apply an evenly distributed load to stud frame substrate.
3. Tables refer to Knauf Top Hats of grade G300 steel with Zincalume™ AM150 corrosion protection.
4. All Top Hats must be supported 150mm maximum from ends.
5. Tables are applicable to self weight and uniformly distributed lateral pressures. Point loads and other loads such as shelf loads, or live loads are not considered.
6. Calculations based upon either single span or 2-or-more spans, designed in accordance with AS/NZS 4600:2005 Cold Formed Steel Structures.
7. Ultimate Load Case 1.2G + $W_u$
8. Serviceability Load Case G + $W_s$, with deflection limited to either span/250 or span/360. Serviceability pressure taken as 65% of ultimate wind pressure.
9. Connections checked using 2 x 12g hex-head screws into minimum 1.15mm thick G300 steel.
10. Splicing of Top Hats is not permitted.
11. Do not use the tables for vertical top hats over horizontal top hat construction.
12. The project engineer must approve the nominated lateral pressures and deflection limits are appropriate for a specific project.
Many types of modern external cladding products require vertical top hat framing as the substrate. For structural and practical installation reasons, vertical top hats are not permitted to be installed directly over the vertical stud framing, therefore a layer of horizontal top hats directly fixed to the stud framing, then an additional layer of vertical top hats is the typical construction used [Refer to Figure 2]. If this type of construction is required for your project, please contact Knauf’s Technical Services for a framing solution.

When horizontal top hats (under) with vertical top hats (over) framing is used over wall stud framing, no thermal break is required.
# Plasterboard Layout

## External Steel Stud and Top Hat Walls

### Plasterboard Layout

<table>
<thead>
<tr>
<th></th>
<th>Non-Fire Rated</th>
<th>Fire Rated</th>
</tr>
</thead>
<tbody>
<tr>
<td>For single layer systems vertical joints must be 200mm minimum from the edge of any opening such as windows and doorways to minimise cracking at the joints.</td>
<td>✔ ✔</td>
<td>✔ ✔</td>
</tr>
</tbody>
</table>

### Horizontal Layout

- Stagger butt joints in single layer systems by 300mm minimum on adjoining sheets and on opposite sides of the wall. | ✔ ✔ |
- Stagger butt joints in multi layer systems by 300mm minimum on adjoining sheets and between layers. | ✔ ✔ |
- First layer butt joints must be backed by a stud or back-blocked. *(Refer to installation diagrams)* | ✔ ✔ |
- Stagger recessed edges by 300mm minimum between layers. | ✔ ✔ |
- Stagger recessed edges in single layer systems by 300mm minimum on opposite sides of the wall or alternatively, back by a nogging. | ✔ |

### Vertical Layout

- Stagger butt joints in single layer systems by 300mm minimum on adjoining sheets and on opposite sides of the wall. | ✔ ✔ |
- Stagger butt joints by 300mm minimum on adjoining sheets and between layers. | ✔ ✔ |
- First layer butt joints must be backed by a nogging or back-blocked. | ✔ |
- First layer butt joints must be backed by a nogging. | ✔ |
- Stagger recessed edges by 300mm minimum between layers and on opposite sides of the wall. | ✔ ✔ |

> Install plasterboard sheets horizontally when practical to minimise stud twisting and reduce the effect of glancing light.
> Minimise butt joints by using long sheets.
Plasterboard Fixing

<table>
<thead>
<tr>
<th>Non-Fire Rated</th>
<th>Fire Rated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive screws to just below the sheet surface, taking care not to break the paper linerboard.</td>
<td>✔️</td>
</tr>
<tr>
<td>Laminating screws can be used to fix butt joints in the second and third layer.</td>
<td>✔️</td>
</tr>
</tbody>
</table>

**Screw and Adhesive Method**

Apply MastaGrip Stud Adhesive after the frame is clean, dry, and free from grease, dust and other contaminants. | ✔️ |

Apply MastaGrip daubs 200mm minimum from screws and plasterboard edges. | ✔️ |

**Screw Only Method**

Use the ‘Screw Only Method’ in tiled or fire rated areas. Stud adhesive is not permitted. | ✔️ | ✔️ |

The ‘Screw and Adhesive Method’ is recommended for non-fire rated applications. MastaGrip will:

- Minimise screw popping
- Reduce the number of screw heads that may show in glancing light

**SCREW TYPE AND MINIMUM LENGTH FOR THE INSTALLATION OF PLASTERBOARD TO STEEL**

<table>
<thead>
<tr>
<th>Plasterboard Thickness</th>
<th>1st Layer</th>
<th>2nd Layer</th>
<th>3rd Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>10mm</td>
<td>25mm screw</td>
<td>40mm screw*</td>
<td>–</td>
</tr>
<tr>
<td>13mm</td>
<td>25mm screw</td>
<td>40mm screw*</td>
<td>60mm screw*</td>
</tr>
<tr>
<td>16mm</td>
<td>30mm screw</td>
<td>45mm screw*</td>
<td>65mm screw*</td>
</tr>
</tbody>
</table>

For steel ≤ 0.75mm BMT minimum 6g fine thread needle point screws.
For steel ≥ 0.75mm BMT minimum 6g fine thread drill point screws.
*38mm – 10g Laminating screws may be used as detailed in installation diagrams.
**Exterior Cladding**

<table>
<thead>
<tr>
<th>Cladding</th>
<th>Non-Fire Rated</th>
<th>Fire Rated</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERMAROCK Outdoor</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Fibre cement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood or timber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rendered polystyrene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cladding fixed and supported independently of the wall</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fix cladding or cladding top hats to the steel frame through the **TruRock**.

Extend the external fire rated wall up to the non-combustible roof covering or non-combustible eaves lining. [Refer to Construction Details]

- Exterior cladding and moisture barrier must provide protection from the weather.
- Use construction techniques that direct condensation and rain away from plasterboard.
- Knauf recommends a drained cavity between the external cladding and the TruRock for weathertightness.
- Top hats between external cladding and external plasterboard do not change the FRL of the system.

**FIGURE 3 Fire Rated 1 Layer - Horizontal**

- **Sealant** Use Knauf Bindex Fire and Acoustic Sealant on all gaps and around perimeter to maintain fire and acoustic integrity.
- **Butt Joints** Fix at 200mm max centres. Stagger by 600mm min on adjoining sheets and on opposite sides of the wall.
- **Sheet Edges** Fix screws 10 - 50mm from sheet edges except at head and base tracks.
- **Field** 300mm max.
- **Corners** 300mm max.
- **Openings** 300mm max vertical screw spacing.
- **Alternatives**
  - Alternatively, float butt joints and laminate to 1st layer using laminating screws at 200mm max centres.

**FIGURE 4 Fire Rated 2 Layers - Horizontal + Horizontal**

- **Sealant** Use Knauf Bindex Fire and Acoustic Sealant on all gaps and around perimeter to maintain fire and acoustic integrity.
- **Butt Joints** Fix on a stud at 600mm max centres and backed by a stud, or alternatively back with 51mm min track.
- **Sheet Edges** Fix screws 10 - 50mm from sheet edges except at head and base tracks.
- **Field** 2nd layer 300mm max.
- **Openings** 2nd layer 300mm max vertical screw spacing.

**Sheet Width Fixing Pattern**

<table>
<thead>
<tr>
<th>Sheet Width</th>
<th>Fixing Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>600mm</td>
<td>S S S S</td>
</tr>
<tr>
<td>900mm</td>
<td>S S S S S</td>
</tr>
<tr>
<td>1200mm</td>
<td>S S S S S S</td>
</tr>
<tr>
<td>1350mm</td>
<td>S S S S S S S</td>
</tr>
</tbody>
</table>
External Steel Stud and Top Hat Walls

**FIGURE 4 Fire Rated 2 Layers - Horizontal + Horizontal**

- **Butt Joints**
  - 1st layer butt joints must be fixed at 600mm max centres and backed by a stud, or alternatively back with 51mm min track.
  - 2nd layer butt joints fixed to a stud at 200mm max centres. Alternatively, float butt joints and laminate to 1st layer using laminating screws at 200mm max centres.

- **Sheet Edges**
  - Fix screws 10 - 50mm from sheet edges except at head and base tracks.

- **Field**
  - 1st layer 600mm max
  - 2nd layer 300mm max
  - 3rd layer 400mm max

- **Corners**
  - 1st layer 600mm max
  - 2nd layer 300mm max
  - 3rd layer 400mm max

- **Recessed Edges**
  - Fix 1st and 2nd layer recessed edges on each stud. Stagger recessed edges by 300mm min between layers.

- **Sealant**
  - Use Knauf Bindex Fire and Acoustic Sealant on all gaps and around perimeter to maintain fire and acoustic integrity.

- **Openings**
  - 1st layer 600mm max
  - 2nd layer 300mm max
  - 3rd layer 400mm max

- **Stagger**
  - Butt joints by 300mm min on adjoining sheets.

- **Fixing Pattern**
  - 600mm S S S
  - 900mm S S S S
  - 1200mm S S S S S
  - 1350mm S S S S S S

**FIGURE 5 Fire Rated 3 Layers - Horizontal + Horizontal + Horizontal**

- **Butt Joints**
  - 1st layer butt joints must be fixed at 600mm max centres and be backed by a stud, or alternatively back with 51mm min track.
  - Stagger butt joints by 300mm min between all layers.
  - 2nd layer. Fix on a stud at 200mm max centres. Alternatively, float butt joints and laminate to 1st layer using laminating screws at 200mm max centres.
  - 3rd layer laminate to previous layer using laminating screws at 200mm max centres.

- **Sheet Edges**
  - Fix screws 10 - 50mm from sheet edges except at head and base tracks.

- **Field**
  - 1st layer 600mm max
  - 2nd layer 300mm max
  - 3rd layer 400mm max

- **Corners**
  - 1st layer 600mm max
  - 2nd layer 300mm max
  - 3rd layer 400mm max

- **Recessed Edges**
  - Fix 1st and 2nd layer recessed edges on each stud. Stagger recessed edges by 300mm min between all layers.
  - 3rd layer laminate to previous layer using laminating screws at 200mm max centres.

- **Sealant**
  - Use Knauf Bindex Fire and Acoustic Sealant on all gaps and around perimeter to maintain fire and acoustic integrity.

- **Openings**
  - 1st layer 600mm max
  - 2nd layer 300mm max
  - 3rd layer 400mm max

- **Stagger**
  - Butt joints by 300mm min between layers.

- **Fixing Pattern**
  - 600mm S S S
  - 900mm S S S S
  - 1200mm S S S S S
  - 1350mm S S S S S S

- **Technical Advice 1300 724 505 knaufmetal.com.au**
NON-FIRE RATED
HEAD AND BASE DETAILS FOR EXTERNAL STUD WALLS

FIGURE 6 Wall Head
Deflection Head Track
Section

Fix stud through slotted deflection head track using 10g screws (additional nogging 100mm below is not required)

20mm clearance to stud and plasterboard

Fix 60-100mm from sheet top. Do not fix through track

Knauf plasterboard

100mm between soffit and nogging

Sealant, if required to maintain acoustic, thermal integrity

Fix nogging to both sides of stud using 10g screws

FIGURE 7 Wall Head
With Accujamb Connector Bracket
Section

Sealant, if required to maintain acoustic, thermal integrity

Stud

When fixed 8mm from the bottom of the slot, the Slotted Deflection Head allows for 15mm downward, and 5mm upwards slab movement.

Sealant, if required to maintain acoustic, thermal integrity

Insulation not shown for clarity. Refer to System tables for lining and insulation required.

FIGURE 8 Wall Head
Slotted Deflection Head Track
Section

Fix stud through slotted deflection head track using 10g screws (additional nogging 100mm below is not required)

20mm clearance to stud and plasterboard

Fix 60-100mm from sheet top. Do not fix through track

Knauf plasterboard

Slotted DHT are not suitable where inter-storey drift required

FIGURE 9 Wall Head
Slotted Deflection Head Track
Elevation

Fix nogging to both sides of stud using 10g screws. Refer to engineer’s design for number of noggings required

Sealant, if required to maintain acoustic, thermal integrity

Accujamb Connector Bracket (AJCB) to reinforce stud to bottom track connection. Use 12g Hex-head screws through slots to accommodate slab deflection.

Head brackets are not suitable where interstorey drift required

Knauf plasterboard

Single anchor for 92mm studs into concrete, or 2 anchors across width if using 150mm studs. Check anchor’s minimum edge distance with anchor manufacturer.
3.2.1 EXTERNAL STEEL STUD AND TOP HAT WALLS

Construction Details

NON-FIRE RATED

TYPICAL DETAILS FOR NON-LOAD BEARING EXTERNAL STEEL STUD WALLS

FIGURE 12 External Steel Stud Wall Head
Wall with cladding over thermal break
Section

FIGURE 13 External Steel Stud Wall Head
Wall with cladding over horizontal top-hats
Section

FIGURE 14 External Steel Stud Wall Base
Wall with cladding over thermal break
Section

FIGURE 15 External Steel Stud Wall Base
Wall with cladding over horizontal top-hats
Section

Knauf Steel stud

Knauf Earthwool insulation

Wall wrap

Thermal break

Knauf plasterboard

Non-load bearing walls are unsuitable for bracing wall applications

Slotted DHT are not suitable where inter-storey drift is required

Horizontal top hat supporting external cladding

Top hats must not be fixed to noggings or deflection head tracks

Refer to Figures 4, 5 and 6 for typical stud wall head details

Refer to Figures 4, 5 and 6 for typical stud wall head details

Refer to Figures 8 and 9 for typical stud wall base details

Refer to Figures 8 and 9 for typical stud wall base details

Fix top hat to studs using minimum 12g hex-head screws

Damp proof course, if required

Damp proof course, if required

Single anchor for 92mm studs into concrete, or 2 anchors across width if using 150mm studs

Refer to cladding manufacturer for specific installation detail

Non-load bearing walls are unsuitable for bracing wall applications

Knauf plasterboard

Nogging

Knauf steel stud

Horizontal top hat supporting external cladding

Damp proof course, if required
NON-FIRE RATED
TYPICAL DETAILS FOR NON-LOAD BEARING EXTERNAL STEEL STUD WALLS

**FIGURE 16** External Steel Stud Wall Head
Stud with cladding over horizontal + vertical Top Hats
Section

- Fix top hat to studs using minimum 12g hex-head screws
- Refer to Figures 4, 5 and 6 for typical stud wall head details

**FIGURE 17** External Steel Stud Wall Head
Stud with cladding over horizontal + vertical Top Hats
Section

- Fix top hat to studs using minimum 12g hex-head screws
- Refer to Figures 4, 5 and 6 for typical stud wall head details

**FIGURE 18** External Steel Stud Wall Base
Stud with cladding over horizontal + vertical Top Hats
Section

- Refer to Figures 8 and 9 for typical stud wall base details

Non-load bearing walls are unsuitable for bracing wall applications

Slotted DHT are not suitable where inter-storey drift required

Refer to cladding manufacturer for specific installation detail

Non-load bearing walls are unsuitable for bracing wall applications

Refer to cladding manufacturer for specific installation detail
3.2.1 EXTERNAL STEEL STUD AND TOP HAT WALLS

Construction Details

FIRE RATED
TYPICAL DETAILS FOR NON-LOAD BEARING EXTERNAL STEEL STUD WALLS

FIGURE 19 External Steel Stud Wall Head
Stud with cladding over horizontal + vertical Top Hats
Fire rated from the outside only - Section

FIGURE 20 External Steel Stud Wall Head
Stud with cladding over horizontal + vertical Top Hats
Fire rated from both directions - Section

FIGURE 21 External Steel Stud Wall Base
Stud with cladding over horizontal + vertical Top Hats
Fire rated from the outside only - Section

FIGURE 22 External Steel Stud Wall Base
Stud with cladding over horizontal + vertical Top Hats
Fire rated from both directions - Section

Refer to Figures 4, 5 and 6 for typical stud wall head details

Slotted DHT are not suitable where inter-storey drift required

Top Hats must not be fixed to nogging or deflection head tracks

Non-load bearing walls are unsuitable for bracing wall applications

Refer to Figures 8 and 9 for typical stud wall base details

Refer to cladding manufacturer for specific installation detail

Fix top hats using minimum 12g hex-head screws

Knauf Bindex Fire and Acoustic Sealant required to maintain integrity

Knauf plasterboard

Sill opening member

Knauf fire and water resistant plasterboard

Nogging

Knauf steel stud

Earthwool insulation

Horizontal top hats

Vertical top hats supporting external cladding

External cladding

Fix top hats using minimum 12g hex-head screws

Knauf Bindex Fire and Acoustic Sealant required to maintain integrity

Refer to Figures 8 and 9 for typical stud wall base details

Knauf Bindex Fire and Acoustic Sealant required to maintain integrity
NON-FIRE RATED

TYPICAL HEAD AND BASE SECTION DETAILS FOR EXTERNAL STUD WALLS

Refer to Figures 4, 5 and 6 for typical stud wall head details.

Refer to Figures 8 and 9 for typical stud wall base details.

Brick veneer ties must be compatible with Zincalume steel. Stainless steel brick ties and other more noble metals must be electrically isolated from the steel studs.
3.2.1 EXTERNAL STEEL STUD AND TOP HAT WALLS

Construction Details

FIRE RATED

TYPICAL DETAILS FOR SPANDREL WALLS

Spandrel wall height is limited to 1000mm for a non-load bearing wall (FRL -/60/60). For a load bearing spandrel wall (FRL 60/60/60) the wall can be structurally designed to ambient temperature requirements.

Knauf fire rated plasterboard, installed after wall tilted into position.

Knauf fire and water resistant plasterboard.

FIGURE 27 Spandrel Steel Stud Wall
Spandrel wall tilted into position near facade
Section

2 layers of Knauf fire and water resistant plasterboard to maintain fire integrity

Optional stopping angle

FIGURE 28 Spandrel Steel Stud Wall End
Spandrel wall tilted into position near facade
plan

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