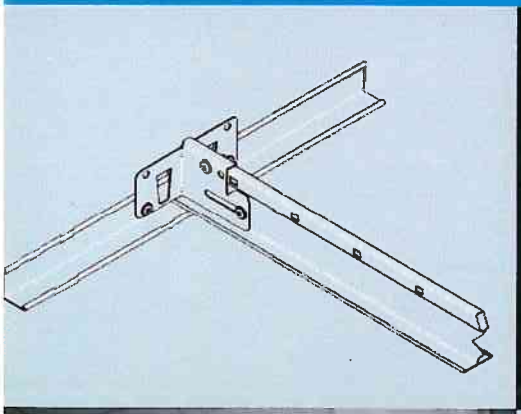
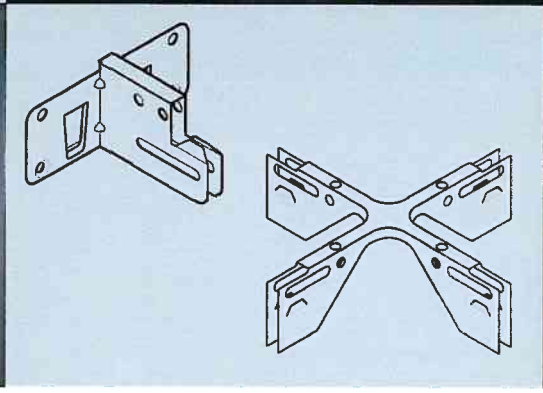
USG Australasia

AS/NZS 2785 : 2000
NZS 1170.5 : 2004

Generic Seismic Design

for USG DONN® Exposed Grid Suspended Ceilings

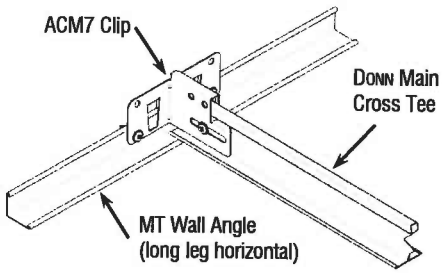


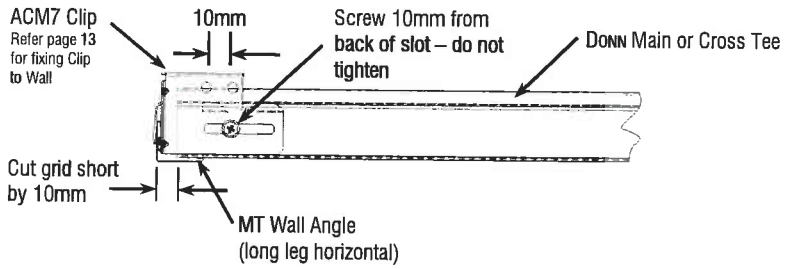


Seismic Design
- USG Suspended Ceilings

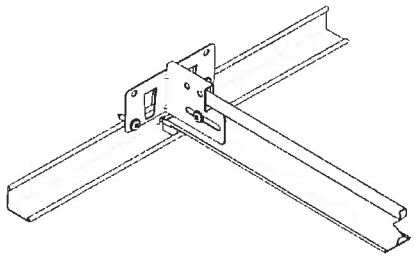
Non-fixed (free) End Options

ACM7 Seismic Clip – MT* Wall Angle — PA1

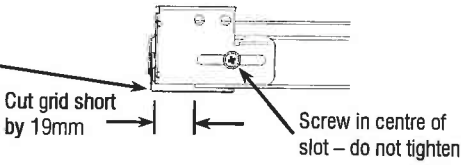




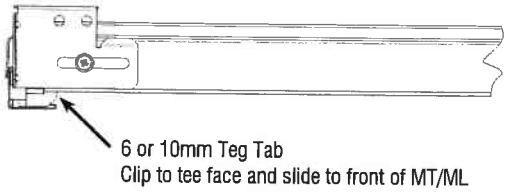
ACM7 Seismic Clip – MT* Wall Angle with Teg Tab — PA2



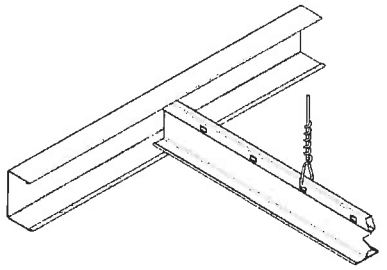
*ML Wall Angle may be substituted where a larger seismic gap is required (long leg horizontal)

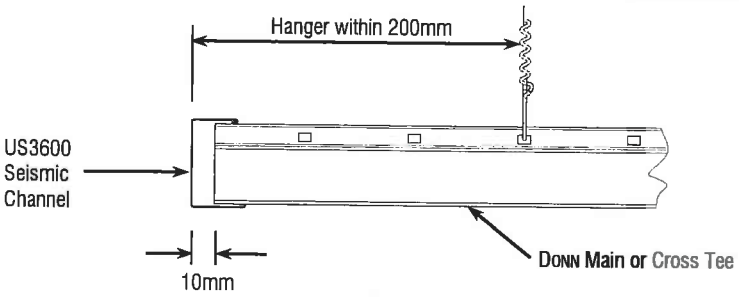


All other details as for no Teg Tab above



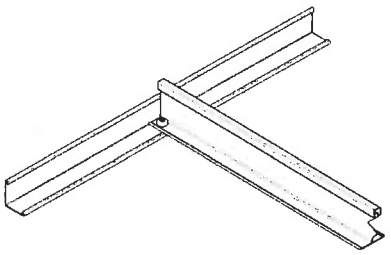
US45-3600 Seismic Channel — PA3

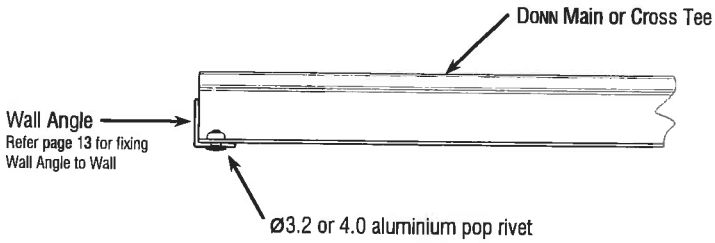




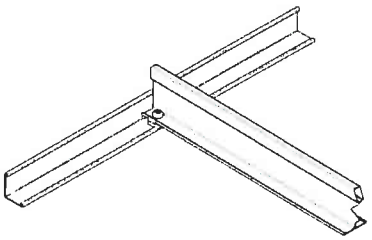
Fixed End Options

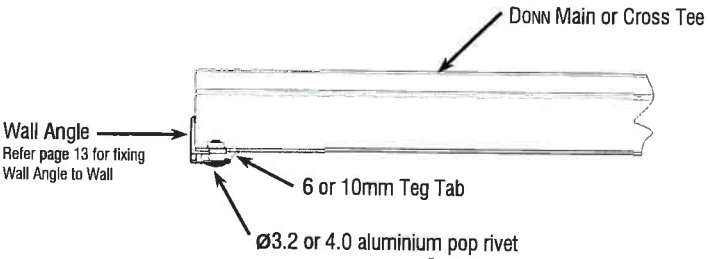
Pop Rivet — PA4





Pop Rivet with Teg Tab — PA5

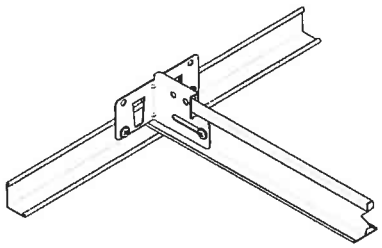


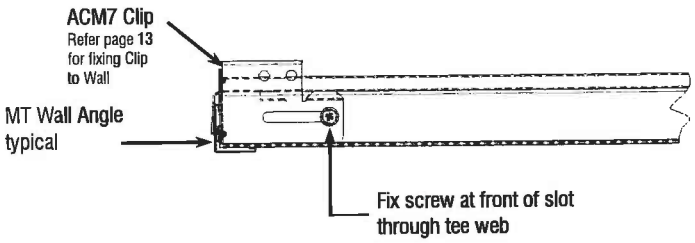


Seismic Design
- USG Suspended Ceilings

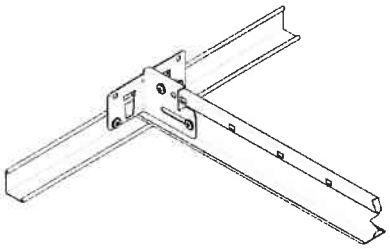
Fixed End Options con't

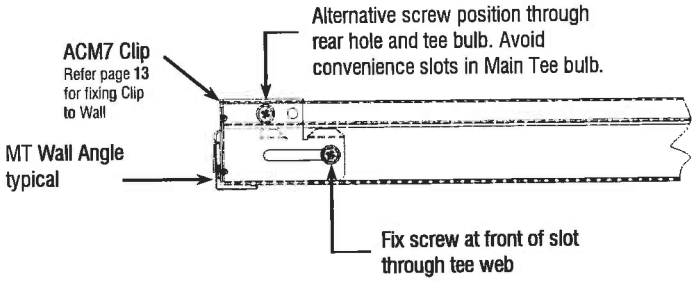
ACM7 Seismic Clip – DX30M Cross Tee PA6



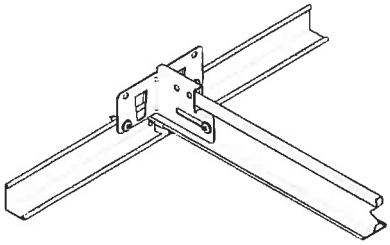


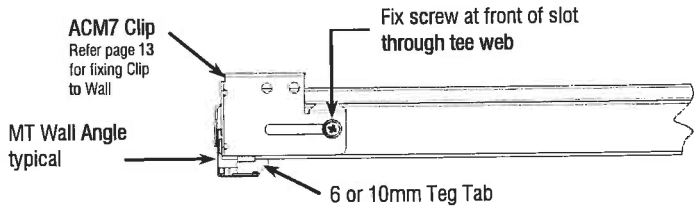
ACM7 Seismic Clip – DX/DXT30D, DX/DXT38D, Main or Cross Tee PA7



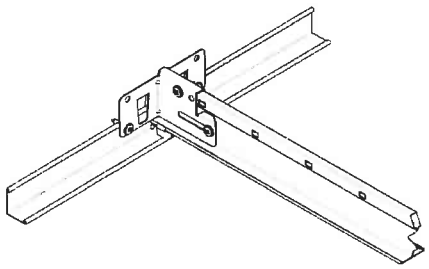


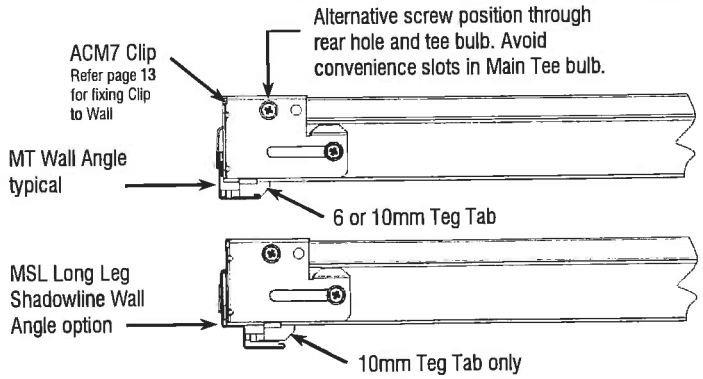
ACM7 Seismic Clip – DX30M Cross Tee with Teg Tab PA8





ACM7 Seismic Clip – DX/DXT30D, DX/DXT38D, Main or Cross Tee with Teg Tab PA9





Seismic Design
- USG Suspended Ceilings

Ceiling Weight	
	kg/m²

(From page 7)

X

Height [1] (metres)	ZONE FACTOR[5]				
	1a	1	2	2a	3
0-3	0.8	1.2	1.8	2.3	2.7
3.1-6	1.0	1.6	2.4	3.1	3.6
6.1-9	1.3	2.0	2.9	3.9	5.0
9.1-12	1.5	2.4	3.5	4.6	6.0
12.1-20	1.5	2.4	3.5	4.6	7.3
20.1-40	1.5	2.4	3.5	4.6	8.5[2]

X

TEG TABS FACTOR[3]	
6mm with rivet	1.7
10mm with rivet	2.0
With ACM7 Clip (no rivet)	-
No Teg Tabs	-

[1] For Perimeter Attachment – height of ceiling from ground level, or For Back Braced - height of structure where ceiling is attached, from ground level

[2] If the result of the Zone Factor x ULS Design Factor x Ceiling Ductility Factor is greater than 8, provide rigid hangers to prevent uplift

[3] The Teg Tabs Factor only applies to design of Perimeter Fixings. Do not include in Seismic Force for design of ceiling tees or for braced ceilings

X

Category Classification
(NZS1170.5, Section 8, Table 8.1)

P.1 - Part representing a hazard to life outside the structure
P.2 – Part representing a hazard to a crowd of greater than 100 people within the structure
P.3 – Part representing a hazard to individual life within the structure
P.4 - Part necessary for the continuing function of the evacuation and life safety systems within the structure
P.5 – Part required for operational continuity of the structure
P.6 – Part for which the consequential damage caused by its failure are disproportionately high
P.7 – All other parts

Ceiling Category	Building Importance Level	Earthquake Zone (see page 7)	ULS DESIGN FACTOR[5]
P.7	1 & 2 & 3	1a & 1 & 2 & 2a & 3	1.0
P.6	1 & 2 & 3	1a & 1 & 2 & 2a & 3	2.0
P.5	4	SPECIFIC ENGINEERING DESIGN	
P.4 & P.2 & P.1	2	1a & 1 & 2 & 3	4.0
		2a	3.1
	3	1a & 1 & 2 & 3	5.2
		2a	4.0
P.3	2	1a & 1 & 2 & 3	3.6
		2a	2.8
	3	1a & 1 & 2 & 3	4.7
		2a	3.6

X

Ductility (μ)[4]	CEILING DUCTILITY FACTOR[5]
1.0	1.0
1.25	0.85
2.0	0.55

[4] A ductility of 1.0 must be assumed, except on the advice of a Chartered professional structural engineer for a specific ceiling

X

Tee Spacing	
1.2	m
0.6	m

[5] If the result of Zone Factor x ULS Design Factor x Ceiling Ductility Factor is greater than 21 before multiplying the Tee Spacing, use 21. This reflects the horizontal seismic force limit of 3.6g in NZS1170.5, equation 8.5(1).

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SEISMIC FORCE

Seismic Design - USG Suspended Ceilings

Summary

Project Name: Project No. : Ceiling Level: floor

Location: _____ Seismic Zone: _____

Seismic Force Calculator Details

	Ceiling Weight kg/m²:		Ceiling Height Factor:		Teg Tab Factor: (N/A)		ULS Design Factor:		Ductility Factor:		Tee Spacing:		**SEISMIC FORCE :**
Tees & Braces	_____	x	_____	x		x	_____	x	_____	x	1.2	=	_____
											0.6	=	_____
Perimeter Fixings	_____	x	_____	x	_____	x	_____	x	_____	x	1.2	=	_____
											0.6	=	_____

Suspension and Wall Angles

(circle required type & spacing) *Note: When using DX38D, use MT55 Wall Angle option for perimeter fixing, not MT45*

Main Tee type DX38D / DX30D / DXL38D / DXT38D / DXT30D @ 0.6 / 1.2 m centres

Cross Tee type DX38D / DX30D / DX30M / DXT38D / DXT30D @ 0.6 / 1.2 m centres

Wall Angle type MT55 / MT45 / ML45 / US45 / MSL45 / MXT45

Wall Angle fastener(s) (see page 13) _____

Perimeter Fixing Options

(tick/circle required type)

☐ **Main Tee** - Fixed on one end only

Max. allowable tee length (tee) _____m

Max. allowable tee length (fixing) _____m

Actual tee length _____m

☐ Fixed on both ends (confirmed with building engineer)

Max. allowable tee length (tee) _____m

Max. allowable tee length (fixing) _____m

Actual tee length _____m

Fixed end fasteners PA __ ø3.2 alu rivet / ø4.0 alu rivet / ACM7 Seismic Clip

Free end fixing PA __ ACM7 Seismic Clip / Hanger ≤ 200mm / Other / N/A_____

☐ **Cross Tee** - Fixed on one end only

Max. allowable tee length (tee) _____m

Max. allowable tee length (fixing) _____m

Actual tee length _____m

☐ Fixed on both ends (confirmed with building engineer)

Max. allowable tee length (tee) _____m

Max. allowable tee length (fixing) _____m

Actual tee length _____m

Fixed end fasteners PA __ ø3.2 alu rivet / ø4.0 alu rivet / ACM7 Seismic Clip

Free end fixing PA __ ACM7 Seismic Clip / Hanger ≤ 200mm / Other / N/A_____

Teg Tab none / 6mm / 10mm ☐ with rivets ☐ without rivets

Seismic Expansion Gap Options

(circle required type)

Main Tee direction DH4 / Other _____

Cross direction DH4 / Other _____

Installation Company: Name: Signed: Date:

USG

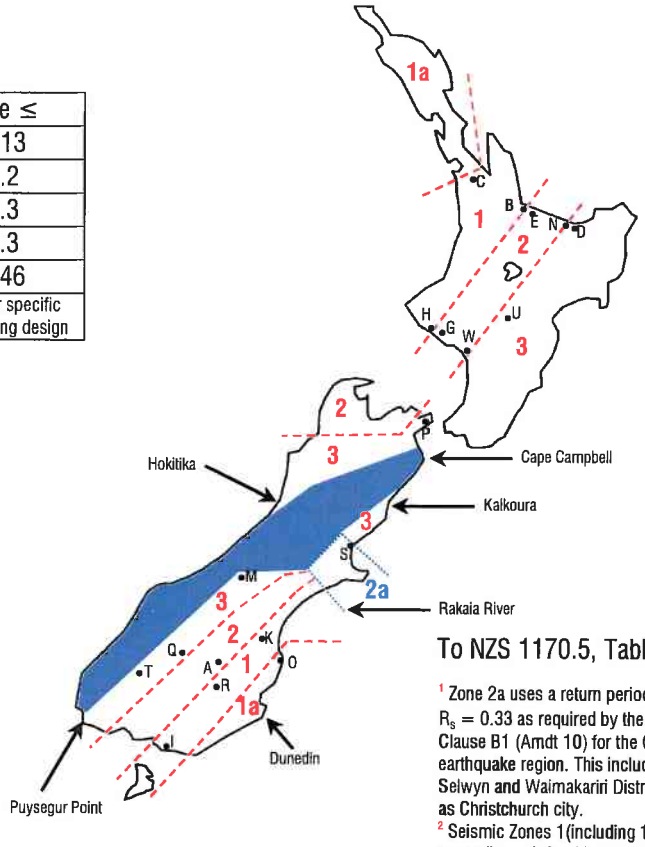
Seismic Design
- USG Suspended Ceilings

Technical Assumptions	The following assumptions apply to all calculations in this design guide: ▪ Refer to page 4 for important design assumptions and limitations ▪ It is assumed that the period of the ceiling is less than 0.75 seconds for assessment of the spectral shape co-efficient for design of parts (conservative) ▪ The following maximum building periods have been assumed for evaluation of the near fault factor which have been applied uniformly throughout Zone 3 only: T=2.0 sec for heights up to 12m, T=3.0 sec for heights up to 20m, T=4.0 sec for heights up to 40m (when designing ceilings for serviceability limit state loads, note that the period will be for a building with stiffness corresponding to serviceability limit state).
Specific Engineering Design	The seismic force calculated on page 7 is a non-standard unit used for ease of calculation. To convert "seismic force" into kg/m length of tee (eg. for use in specific engineering design), follow these steps: 1. Multiply the factors in the height/zone table by 0.1729 (note: this figure represents $C_h(0)_{max} Z_{min} = 1.33 \times 0.13$). The maximum allowable length of tee (or brace spacing) obtained from the design graphs must also be multiplied by 0.1729 in order to balance the design equation. 2. Ignore the Teg Tab factor when calculating the "seismic force" on the perimeter fixings (i.e. multiply by a Teg Tab factor equal to 1.0 only). If a 6mm Teg Tab will be used with a rivet, divide the design strength of the riveted connection by 1.7. If a 10mm Teg Tab will be used with a rivet, divide the design strength of the riveted connection by 2.0 (note: design strength is typically expressed as a maximum allowable length of tee in this brochure).
Ultimate Limit State Design	▪ As stated on page 2, this generic design guide is primarily intended for low risk ceilings where it is appropriate to design for serviceability limit state (SLS) loads only. Some ceilings will need to be designed to maintain their integrity under Ultimate Limit State (ULS) loads, as illustrated in the flow chart on page 6. ▪ The following alternative seismic force calculator (page 25) must be used for Ultimate Limit State design. The designer must select the appropriate Importance Level for the building (with reference to AS/NZS1170.0), the appropriate part classification for the ceiling (with reference to NZS 1170.5:2004, Table 8.1), and the appropriate ductility factor (with reference to NZS 1170.5, relevant materials standards, and current technical literature). ▪ **If the result of Zone Factor x ULS Design Factor x Ceiling Ductility Factor on Page 25 is greater than 21, use 21.** This reflects the horizontal seismic force limit of 3.6g in NZS1170.5, equation 8.5(1). ▪ Anyone using this ULS design guide must be well trained or qualified in the principles of seismic design of ceilings (eg. a Charted Professional Structural Engineer or an approved USG ceiling contractor and installer).

Seismic Design
- USG Suspended Ceilings

Seismic Zones

ZONE	Z Value ≤
1a	0.13
1	0.2
2	0.3
2a[1]	0.3
3	0.46
	Zone for specific engineering design



	Location Key
C	Mercer/Onewhero
B	Papamoa
E	Te Puke
N	Whakatane
D	Ohope
U	Waiouru
H	Hawera
G	Patea
W	Wanganui
P	Picton
S	Sefton
K	Kurow
O	Oamaru
R	Roxburgh
I	Invercargill
T	Te Anau
Q	Queenstown
A	Alexandra
M	Mt Cook

To NZS 1170.5, Table 3.3

[1] Zone 2a uses a return period factor of $R_s = 0.33$ as required by the NZBC, Clause B1 (Amdt 10) for the Canterbury earthquake region. This includes the Selwyn and Waimakariri Districts as well as Christchurch city.

[2] Seismic Zones 1 (including 1a), 2, & 3 are generally as defined in NZS 3604:2011

Ceiling Weight

Ceiling Panel _____ Dead Load

DONN Grid _____ Dead Load

Lighting[4] _____ Services Load

Other[4] _____ Services Load

TOTAL[3] _____ kg/m²

Lighting Weight Calculation Details [4]

Size: _____ X _____ mm

Weight: _____ kg

Spacing Centres: _____ X _____ m

W ÷ SC = _____

[3] NZS1170.5 requires that the ceiling is designed for the actual mass of components that will be installed in the ceiling. If AS/NZS 2785:2000 is also specified, the ceiling must make allowance for a total Services Load of not less than 3kg/m²

[4] Where lighting or other loads greater than 10kg are concentrated along one or more tee lines, the ceiling components that provide horizontal seismic restraint must be designed for this higher intensity of loading.

Seismic Force Calculator (Transfer values to Summary Page)

Ceiling Weight	
	kg/m²

x

Height[5] (metres)	ZONE FACTOR				
	1a	1	2	2a	3
0-3	0.8	1.2	1.8	2.3	2.7
3.1-6	1.0	1.6	2.4	3.1	3.6
6.1-9	1.3	2.0	2.9	3.9	5.0
9.1-12	1.5	2.4	3.5	4.6	6.0
12.1-20	1.5	2.4	3.5	4.6	7.3
20.1-40	1.5	2.4	3.5	4.6	8.5[6]

x

TEG TABS FACTOR[7]	
6mm with rivet	1.7
10mm with rivet	2.0
With ACM7 Clip (no rivet)	-
No Teg Tabs	-

x

Tee Spacing	
1.2	m
0.6	m

=

SEISMIC FORCE

[5] For Perimeter Attachment – height of ceiling from ground level, or
For Back Braced - height of structure where ceiling is attached, from ground level

[6] Provide rigid hangers to prevent uplift

[7] The Teg Tab Factor ONLY applies for calculation for Perimeter Fixing design table on page 9. Do not include in Seismic Force calculation for the Main or Cross tee tables, or for back braced designs