



## STRUCTURAL DESIGN CALCULATIONS

### ON TYPICAL FIXING DETAILS OF 4MM THICK ALUBOND u.s.a. ALUMINIUM COMPOSITE PANELS.

**PROJECT** : **ALUBOND u.s.a  
Aluminium Composite  
Panels**

**Owner** : **American Building  
Technologies INC.**

**Plot No. & Location** : **600 17<sup>th</sup> Street, Suite2800  
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U.S.A.**

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*
*          S T A A D - I I I
*          Revision 22.3
*          Proprietary Program of
*          Research Engineers, Inc.
*          Date=   APR 23, 2003
*          Time=   12: 2:33
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1. STAAD PLANE MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M
2. *WL=1.00KN/M2, DL=SELF WEIGHT OF ANGLE
3. UNIT KNS MET
4. JOINT COOR
5. 1 0.0 0.0
6. 2 0.75 0.0
7. 3 1.5 0.0
8. MEMB INCI
9. 1 1 2
10. 2 2 3
11. UNIT KNS MMS
12. MEMBER PROPERTY BRI
13. 1 2 TA RA UA40X40X4
14. UNIT KNS MET
15. CONSTANTS
16. E STEEL ALL
17. DEN STEEL ALL
18. SUPPORTS
19. 1 3 PINNED
20. LOAD 1 DEAD LOAD
21. SELFWEIGHT Y -1.0 ALL
22. LOAD 2 WIND LOAD
23. MEMB LOAD
24. *WL:1.0KN/M2X1.50M=1.5 KN/M
25. 1 2 UNI GY -1.50
26. LOAD COMB 3 1.0 DL + 1.0 WL
27. 1 1.0 2 1.0
28. LOAD COMB 4 0.75 DL + 0.75 WL
29. 1 1.0 2 1.0
30. PERFORM ANALYSIS

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PROBLEM STATISTICS

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NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =    3/    2/    2
ORIGINAL/FINAL BAND-WIDTH =    1/    1
TOTAL PRIMARY LOAD CASES =    2, TOTAL DEGREES OF FREEDOM =
SIZE OF STIFFNESS MATRIX =    20 DOUBLE PREC. WORDS
REQRD/AVAIL. DISK SPACE = 12.00/ 2047.7 MB, EXMEM = 1968.4 MB

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MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M  
\*WL=1.00KN/M2, DL=SELF WEIGHT OF ANGLE

-- PAGE NO. 2

++ Processing Element Stiffness Matrix.	12: 2:34
++ Processing Global Stiffness Matrix.	12: 2:34
++ Processing Triangular Factorization.	12: 2:34
++ Calculating Joint Displacements.	12: 2:34
++ Calculating Member Forces.	12: 2:34

31. LOAD LIST 1 2 3

32. PRINT ANALYSIS RESULTS



JOINT DISPLACEMENT (CM RADIANS) STRUCTURE TYPE = PLANE

JOINT	LOAD	X-TRANS	Y-TRANS	Z-TRANS	X-ROTAN	Y-ROTAN	Z-ROTAN
1	1	.0000	.0000	.0000	.0000	.0000	-.0002
	2	.0000	.0000	.0000	.0000	.0000	-.0140
	3	.0000	.0000	.0000	.0000	.0000	-.0142
2	1	.0000	-.0104	.0000	.0000	.0000	.0000
	2	.0000	-.6611	.0000	.0000	.0000	.0000
	3	.0000	-.6716	.0000	.0000	.0000	.0000
3	1	.0000	.0000	.0000	.0000	.0000	.0002
	2	.0000	.0000	.0000	.0000	.0000	.0140
	3	.0000	.0000	.0000	.0000	.0000	.0142

max Allowable deflection =  $\frac{\text{span}}{180} = \frac{150}{180} = 0.833\text{cm}$

> 0.6716cm (Hence O.K)



SUPPORT REACTIONS -UNIT KNS MET STRUCTURE TYPE = PLANE

JOINT	LOAD	FORCE-X	FORCE-Y	FORCE-Z	MOM-X	MOM-Y	MOM Z
1	1	.00	.02	.00	.00	.00	.00
	2	.00	1.13	.00	.00	.00	.00
	3	.00	1.14 (DL+WL)	.00	.00	.00	.00
3	1	.00	.02	.00	.00	.00	.00
	2	.00	1.13	.00	.00	.00	.00
	3	.00	1.14 (DL+WL)	.00	.00	.00	.00

Maximum tension or pullout force due to wind is 1.14 KN.

Referring Table 6.3.2. of Hilti manual.

using M-8 1 NO of Hilti H.H.S self drilling Anchor.

max tension or pullout force for M-8 is 2.7 KN.

which is greater than 1.14 KN (Hence o.k)

∴ Referring table 6.3.4.

Embedment depth (T) as per Hilti manual table for M-8 H.H.S self drilling Anchor

is  $T = 31 \text{ mm}$ .

∴ depth of M-8 Anchor provided is 65mm

> 31.0mm Hence safe.



MEMBER END FORCES      STRUCTURE TYPE = PLANE

ALL UNITS ARE -- KNS    MET

MEMBER	LOAD	JT	AXIAL	SHEAR-Y	SHEAR-Z	TORSION	MOM-Y	MOM-Z
1	1	1	.00	.02	.00	.00	.00	.00
		2	.00	.00	.00	.00	.00	.01
	2	1	.00	1.13	.00	.00	.00	.00
		2	.00	.00	.00	.00	.00	.42
	3	1	.00	1.14	.00	.00	.00	.00
		2	.00	.00	.00	.00	.00	.43
2	1	2	.00	.00	.00	.00	.00	-.01
		3	.00	.02	.00	.00	.00	.00
	2	2	.00	.00	.00	.00	.00	-.42
		3	.00	1.13	.00	.00	.00	.00
	3	2	.00	.00	.00	.00	.00	-.43
		3	.00	1.14	.00	.00	.00	.00

\*\*\*\*\* END OF LATEST ANALYSIS RESULT \*\*\*\*\*

- 33. PLOT BENDING FILE
- 34. PLOT DISP FILE
- 35. LOAD LIST 4
- 36. PARAMETER
- 37. CODE AISC
- 38. FYLD 275000 ALL
- 39. RATIO 1.0 ALL
- 40. CHECK CODE ALL



STAAD-III CODE CHECKING - (AISC)  
\*\*\*\*\*

ALL UNITS ARE - KNS MET (UNLESS OTHERWISE NOTED)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
1	RA UA40X40X4	PASS .00	AISC- H1-3 .00	.910 -.43	4 .75
2	RA UA40X40X4	PASS .00 C	AISC- H1-3 .00	.910 -.43	4 .00

41. UNIT MET KGS  
42. STEEL TAKE OFF



MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M  
\*WL=1.00KN/M2, DL=SELF WEIGHT OF ANGLE

-- PAGE NO. 7

STEEL TAKE-OFF  
-----

PROFILE	LENGTH (MET )	WEIGHT (KGS )
RA UA40X40X4	1.50	3.619
	TOTAL =	3.62

\*\*\*\*\* END OF DATA FROM INTERNAL STORAGE \*\*\*\*\*

43. FINISH

\*\*\*\*\* END OF STAAD-III \*\*\*\*\*

\*\*\*\* DATE= APR 23,2003 TIME= 12: 2:34 \*\*\*\*

\*\*\*\*\*  
\* For questions on STAAD-III, contact: \*  
\* Research Engineers(Europe) Ltd \*  
\* 10 St Mary Street, Thornbury, Bristol, BS12 2AB, UK \*  
\* Tel: +44 1454 281080 Fax: +44 1454 415866 \*  
\*\*\*\*\*





MN/ELEM

STRUCTURE DATA

TYPE =	PLANE
NJ =	3
NM =	2
NE =	0
NS =	0
NRJ =	2
NL =	4
XMAX =	1.5
YMAX =	.8
ZMAX =	.8



J=3, M=2

UNIT: MET KNS

S T A D P O S T - P L D T (REV: 22.3 )

DATE: APR 23, 2003

TITLE: MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M



MN/ELEM

STRUCTURE DATA

TYPE = PLANE  
 NJ = 3  
 NH = 2  
 NE = 0  
 NS = 0  
 NRJ = 2  
 NL = 4  
 XMAX = 1.5  
 YMAX = .0  
 ZMAX = .0



J=3, M=2

UNIT MET KNS

DATE: APR 23, 2003

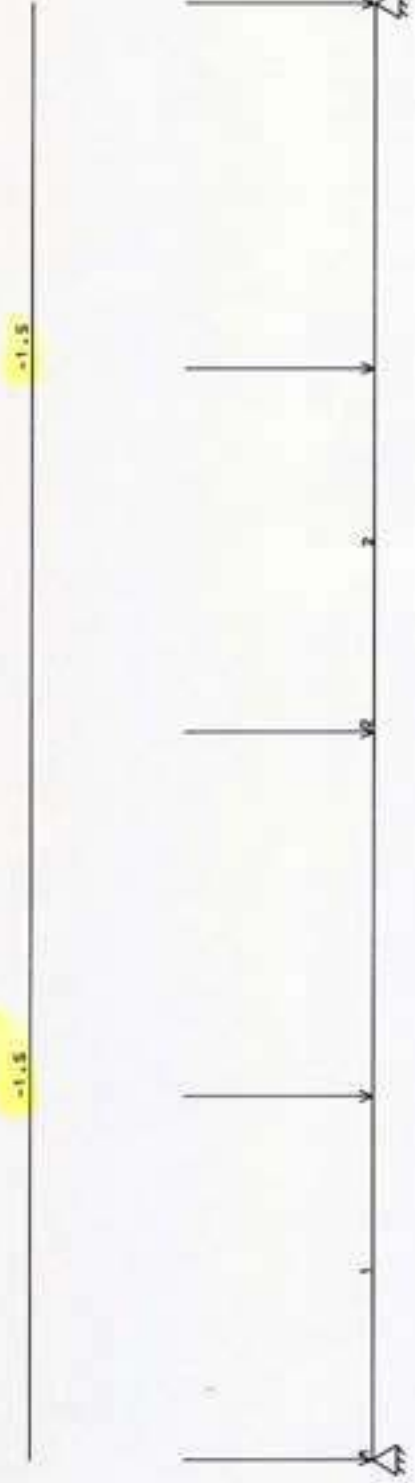
S T A A D P O S T - P L O T (REV: 22.3 )

TITLE: MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M



LN= 2 MN/ELEM

(DL+WL)



STRUCTURE DATA  
 TYPE = PLANE  
 NJ = 3  
 NM = 2  
 NE = 0  
 NS = 0  
 NRJ = 2  
 NL = 4  
 XMAX = 1.5  
 YMAX = .0  
 ZMAX = .0



J=3, M=2

UNIT: MET KNS

S T A A D P O S T - P L O T (REV: 22.3 )

TITLE: MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M

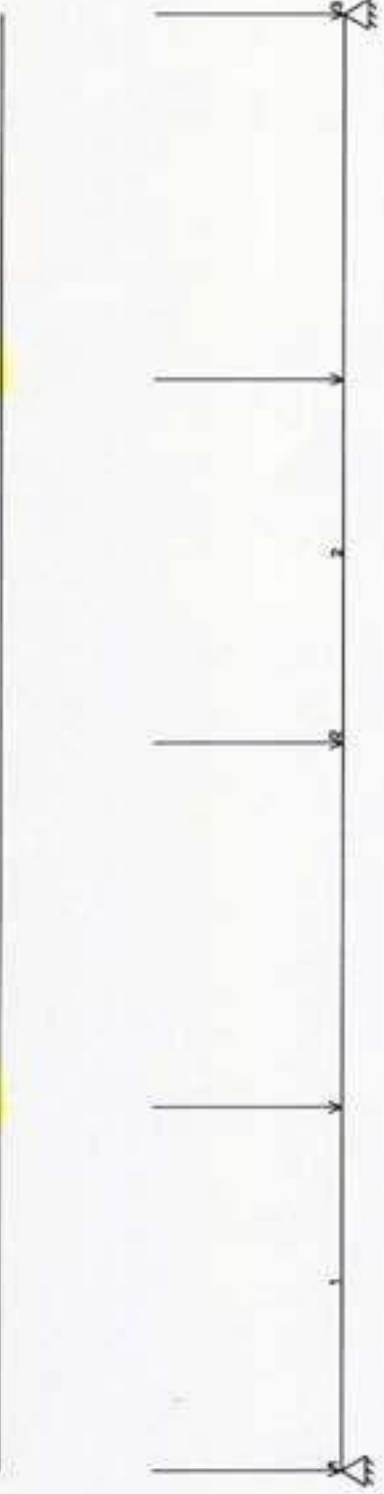
DATE: APR 23, 2003

LN# 2 MN/ELEM

(DL+WL)

-1.5

-1.5



STRUCTURE DATA

TYPE = PLANE

NJ = 3  
 NM = 2  
 NE = 0  
 NS = 0  
 NRJ = 2  
 NL = 4  
 XMAX = 1.5  
 YMAX = .8  
 ZMAX = .8



J=3, M=2

UNIT MET KNS

S T A A D P O S T - P L O T (REV: 22.3 )

DATE: APR 23, 2003

TITLE: MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M

# 0.2 Anchor chart

## HILTI types of anchors

## Fastening base material

HILTI types of anchors	Fastening base material						Application criteria						
	Concrete	Lightweight concrete	Aerated concrete	Hard mineral material	Soft natural stone	Solid brick*	Hollow brick*	Spalls through fastening	Impressions taking	Flush with surface	Dynamic loading	Small dis. locations and anchors from edge	Temp. resistance
Heavy-duty HIS HSL heavy-duty anchor	●			●				●	●	○	○	○	●
Medium-duty HIS HVA medium-duty anchor	●	○		●		○		●		●	○	○	○
Medium-duty HIS HVA anchor	●			●		○		○	●	○	○	○	○
Medium-duty HIS HSA stud anchor HIS HCB Kwik-Bolt	●			●				●	●	○	○	○	○
Medium-duty HIS HCS self-drilling anchor	●			●				●	●	○	○	○	○
Light-duty HIS HPS impact anchor	●			●				○	○	○	○	○	○
Light-duty HIS HUD anchor	●			●				○	○	○	○	○	○
Light-duty HIS HLD light-duty anchor	○			○				○	○	○	○	○	○
Special duty HIS HD cavity anchor	○			○				○	○	○	○	○	○
Special duty HIS HBS RT hanger	●			○				○	○	○	○	○	○
Special duty HIS HBS LT anchor	●			○				○	○	○	○	○	○
Special duty ID fastener H4 fastener	●			○				○	○	○	○	○	○

Key to chart

●	very suitable
○	not suitable

Duty classification:  
(relative to failure load)

Heavy duty:  
20,000 to 200,000 N

Medium duty:  
10,000 to 100,000 N

Light duty:  
up to 10,000 N

WORKS & BUILDING EST.  
**HILTI.**

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P. Box 415, Suwaikih, KUWAIT.

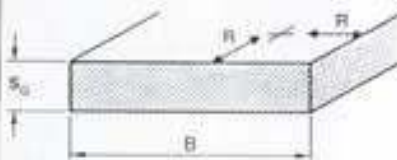


### 6.3 Table of technical data for anchors

6-3-1

Min. thickness of concrete base material  $S_G$  (mm)

Anchor	M6	M8	M10	M12	M16	M20	M24
HSL Heavy-duty anchor	✓	120	140	160	180	220	270
HVA Adhesive anchor	✓	120	140	160	180	220	270
HSA/HKB Stud anchor Kwik Bolt	100	100	100	120	160	200	✓
HKO Anchor	100	100	100	120	140	180	✓
HKG Self-drilling anchor	100	100	100	120	140	180	✓



$$B_{min} \geq 2 \cdot R$$

$B$  min. and  $S_G$  min. may not occur at the same time  
 $R$  = Distance from edge

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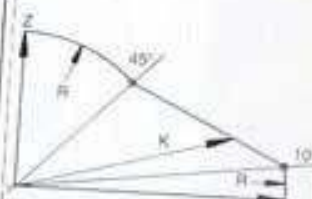


6-3-2

Safe working tensile load  $Z_{sw}$  (kN)  
Safe working lateral load  $Q_{sw}$  (kN)

For predominantly static (dead) loads depending on the standard safety factor ( $\gamma = 3$ )

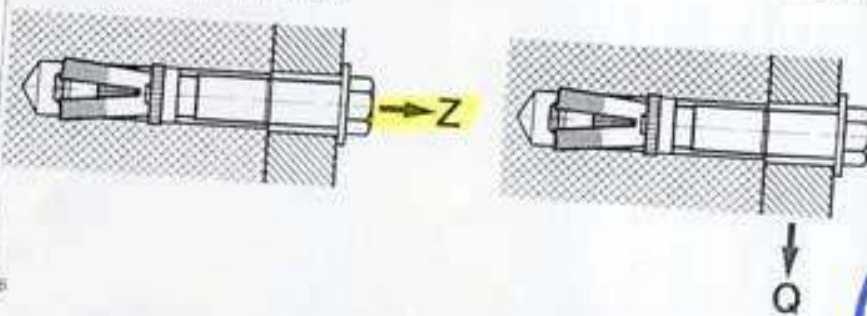
	Z/O	$f_{ck}$	M6	M8	M10	M12	M16	M20	M24
HSL Heavy duty anchor	Z	20	-	3.8	8.8	13.5	22.3	33.6	40.3
	Z	35	-	7.7	13.3	19.4	32.3	46.3	55.2
	O	20	-	10.2	15.3	24.9	39.8	50.3	76.7
HVA Adhesive anchor	Z	20	-	3.2	7.4	8.1	17.5	32.3	46.5
	Z	40	-	6.4	12.6	16.3	28.5	49.9	68.0
	Q	A11	-	3.8	6.5	8.5	14.0	23.4	32.7
HSA Stud in other HKB Kwik Bolt	Z	25	2.5	3.2	4.2	7.4	11.0	14.1	-
	Z	50	3.5	6.1	9.7	12.2	14.6	22.1	-
	Q	25	1.6	3.6	6.3	9.5	17.1	24.7	-
HKB anchor	Z	25	2.9	3.8	5.5	8.8	14.1	18.9	-
	Z	45	3.4	4.8	5.8	10.8	18.0	25.3	-
	Q	A11	2.1	3.1	4.6	7.5	14.1	20.2	-
HHS Heavy Duty Adhesive	Z	25	1.9	2.7	4.2	6.1	8.2	10.8	-
	Z	45	3.0	4.1	5.7	7.9	9.3	14.0	-
	Q	25	1.9	2.3	3.0	6.5	12.3	14.1	-



With combined loads K (inclined tensile load), the closest approximation to the best results is achieved when the magnitude of the load is given by the polar coordinate in the above graph.

When Z is greater than Q the graph will hold true, i.e. the inclined load remains the same (arc) up to 45° from load Q.

$f_{ck}$  = concrete compressive strength (N/mm<sup>2</sup>)



Distance between anchors A and d

A, R, I	A	A <sub>min</sub>
Anchor type		
HSL	2.5T	1T
HVA	1.0T	0.5T
HSA/HKB	2.0T	0.5T
HKB	3.5T	2T
HHS	3.5T	2T

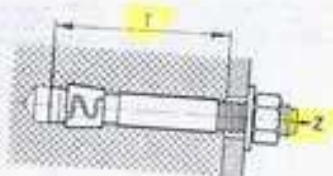
T = depth of embedment  
I = reduction factor



6.3.4

Depth of embedment T and hole diameter D (mm)

		M6	M8	M10	M12	M16	M20	M24
HSL Heavy-duty anchor	T		65	75	80	105	130	155
	D		12	15	18	24	28	32
HVA Adhesive anchor	T		80	90	110	125	170	210
	D		10	12	14	18	25	28
HSA Stud anchor HRB Kwik Bot	T	50	55	60	80	100	120	
	D	6	8	10	12	16	20	
HKD Anchor	T	25	30	40	50	55	60	
	D	8	10	12	15	20	25	
HHS Self-drilling anchor	T	26	31	38	49	59	61	
	D	11	12	15	17.5	21	25	



Mechanical properties of B,  $\sigma_b$ ,  $\sigma_s$ ,  $\sigma_a$

		$\sigma_b$	$\sigma_s$ , $\sigma_a$
HSL		600	640
HVA	HAS	490	390
	HASR	540	355
HSA/HRB	HSA	640	375
	HASR	540	355
HKD	HKD	460	375
	HKDR	540	355
HHS		460	375

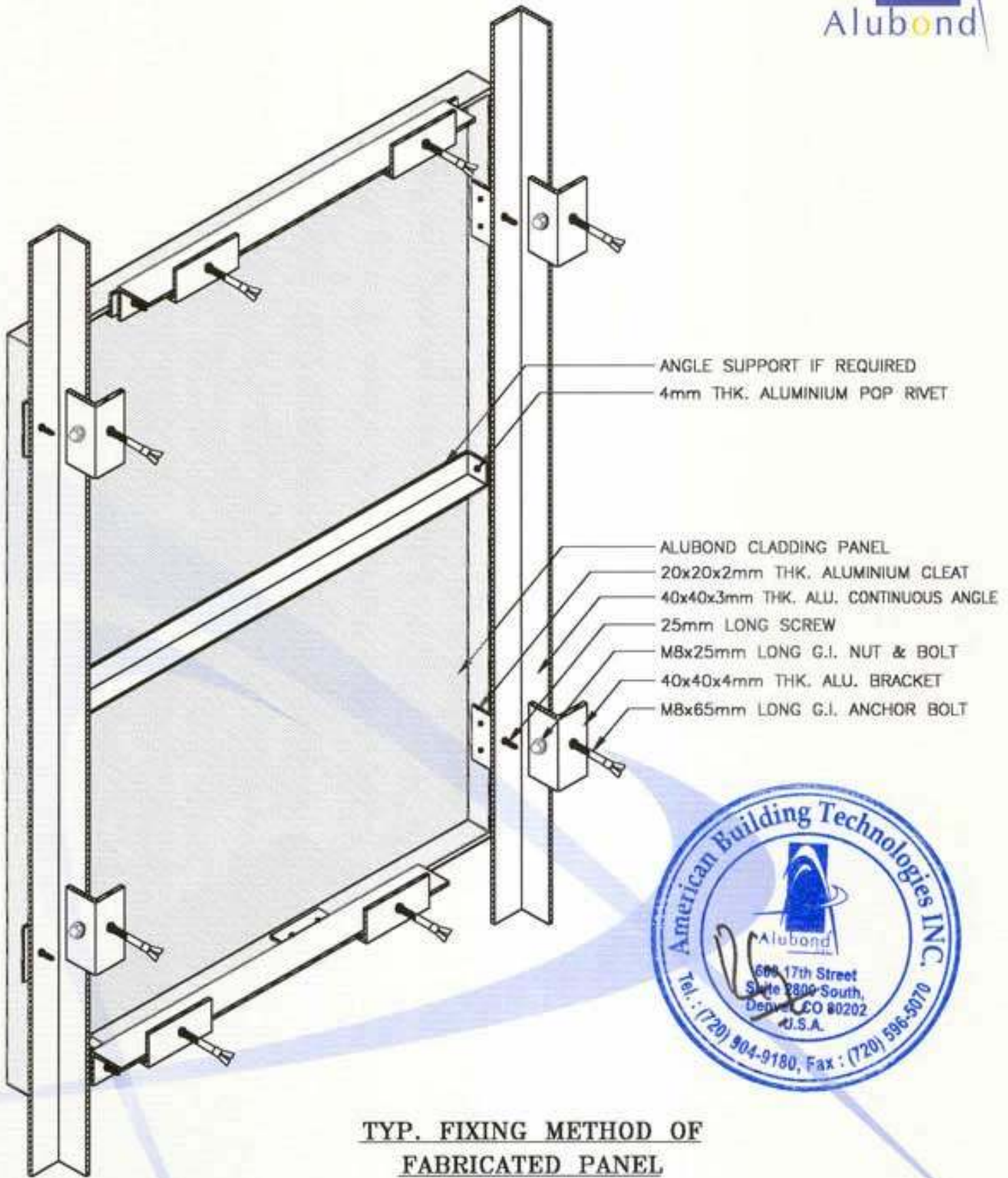
$\sigma_b$  = ultimate tensile strength  
 $\sigma_s$  = yield point  
 $\sigma_a$  = proof stress  
 $T$  = shear strength ( $= 0.7 \times \sigma_b$ )

Moment of resistance N.m

		M6	M8
HSL	without sleeve		31.3
	with sleeve		119
HVA			31.3
HSA		8.4	31.3
HKD		34.4	58
HHS		101	114







TYP. FIXING METHOD OF FABRICATED PANEL