Alubond

STRUCTURAL DESIGN CALCULATONS

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 17th Street, Suite2800 South Denver, Co.80202, U.S.A.**
Telephone	:	**(720) 904 – 9180**
Fax	:	**(720) 596 – 5070**

American Building Technologies INC. Alubond 600 17th Street Suite 2800 South, Denver, CO 80202 U.S.A. Tel.: (720) 904-9180, Fax : (720) 596-5070

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****************************************************
*                                                  *
*           S T A A D - III                        *
*           Revision 22.3                          *
*           Proprietary Program of                 *
*           Research Engineers, Inc.               *
*           Date=    APR 23, 2003                  *
*           Time=    12: 2:33                      *
*                                                  *
*                                                  *
****************************************************
```

```
 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
```

P R O B L E M   S T A T I S T I C S

```
NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =      3/     2/     2
ORIGINAL/FINAL BAND-WIDTH =     1/     1
TOTAL PRIMARY LOAD CASES  =     2, TOTAL DEGREES OF FREEDOM =      5
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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```
 *WL=1.00KN/M2, DL=SELF WEIGHT OF ANGLE
++ 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
```

*WL=1.00KN/M2, DL=SELF WEIGHT OF ANGLE

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 $= \frac{Span}{180} = \frac{150}{180} = 0.83 cm$

$> 0.6716 cm$ (Hence O.K)

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*WL=1.00KN/M2, DL=SELF WEIGHT OF ANGLE

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.

Refering Table 6.3.2.of Hilti manual.

using M-8 1 NO of Hilti H.HS self drilling Anchar.

Max tension or pullout force for M-8 is 2.7 KN. which is greater than 1.14 KN (Hence o.k)

∴ Refering table 6.3.4.

Embedment depth 'T' as per Hilti manual table for M-8 HHS self drilling Anchor is T = 31 mm.

∴ depth of M-8 Anchor provided 65mm > 31.0mm Hence safe.

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*WL=1.00KN/M2, DL=SELF WEIGHT OF ANGLE

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
```

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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	AISC- H1-3	.910	4
		.00	.00	-.43	.75
2	RA UA40X40X4	PASS	AISC- H1-3	.910	4
		.00 C	.00	-.43	.00

41. UNIT MET KGS
42. STEEL TAKE OFF

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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 ****

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*******************************************************
*        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      *
*******************************************************
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STRUCTURE DATA

TYPE = PLANE

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

MN/ELEM

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

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STRUCTURE DATA

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

MN/ELEM

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

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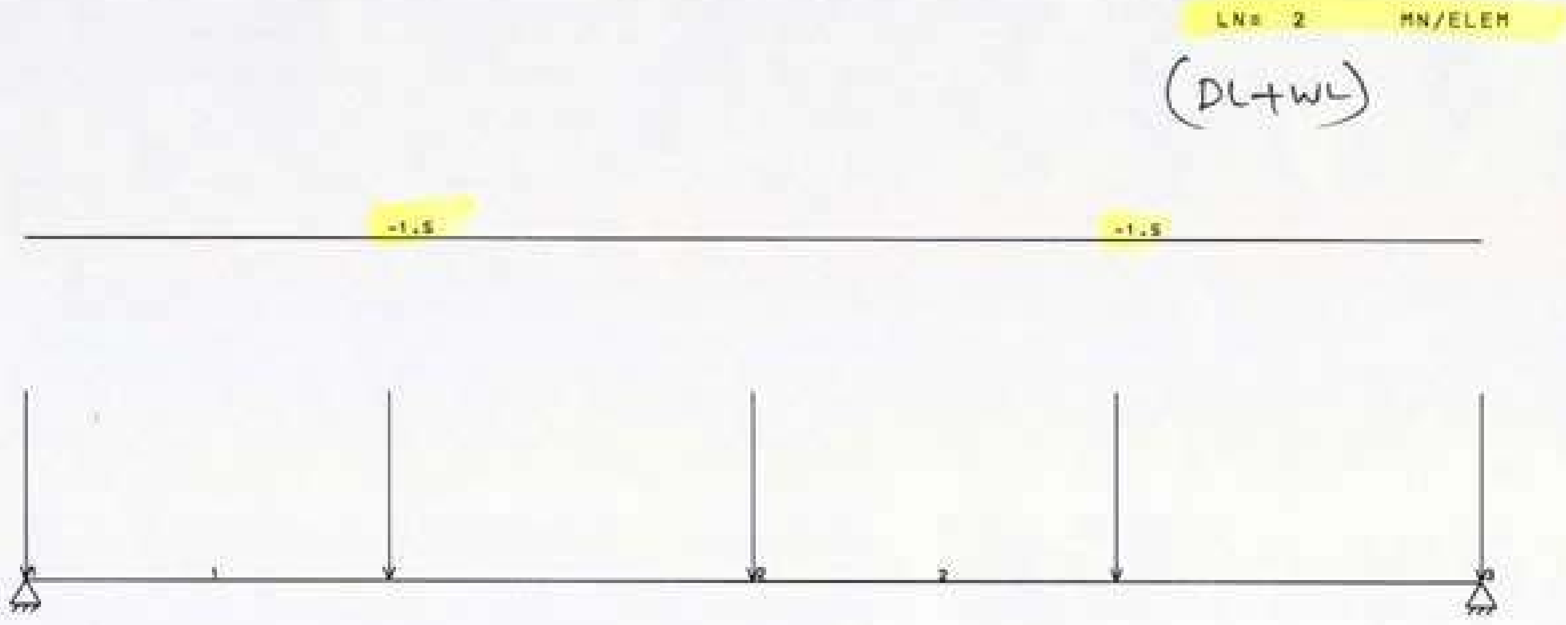
STRUCTURE DATA

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)

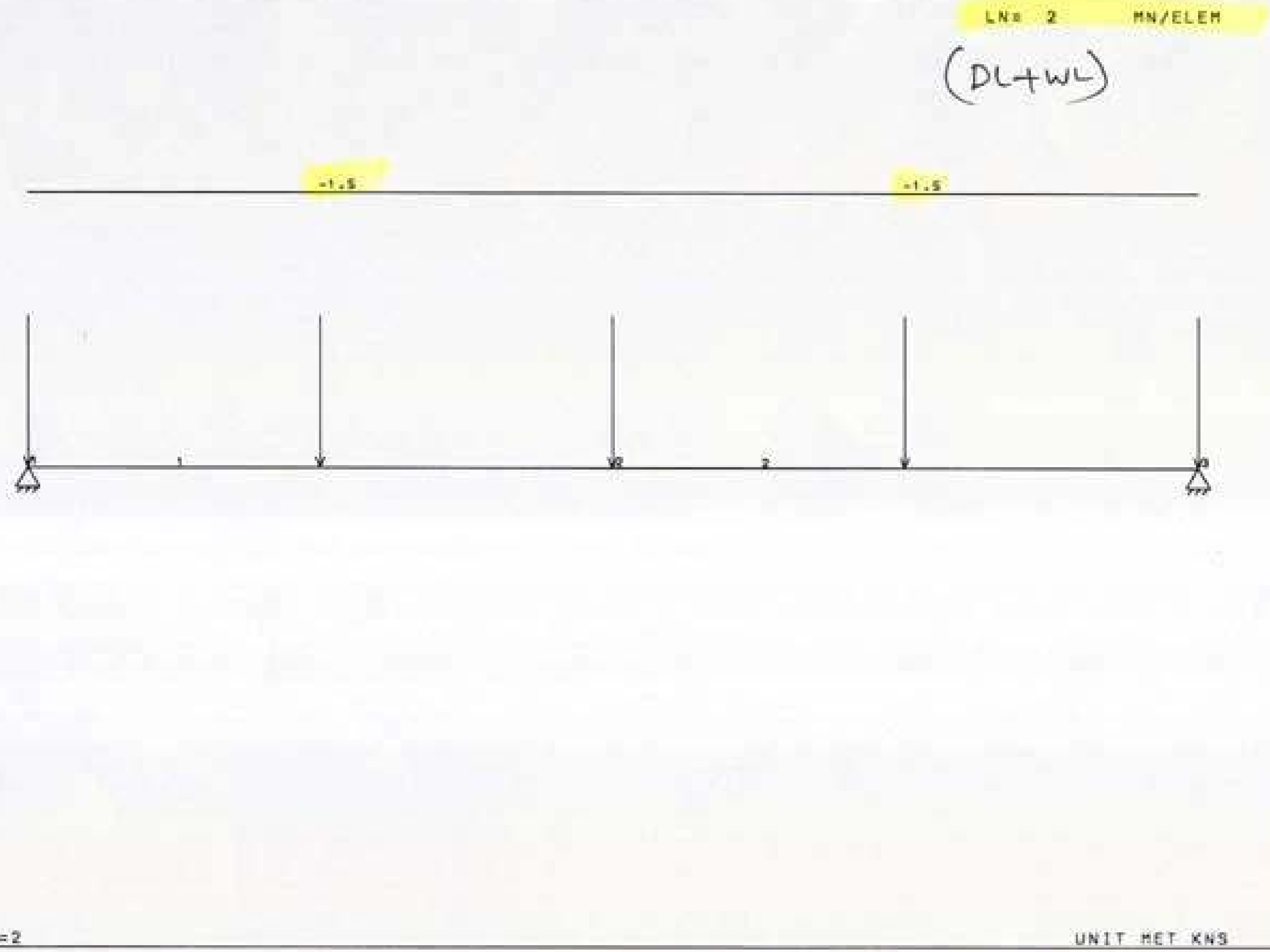
DATE: APR 23, 2003

TITLE: MAIN VERTICAL ANGLE DESIGN, SPAN=1.5M

STRUCTURE DATA

TYPE = PLANE

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



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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

6.2 Anchor chart

HILTI types of anchors		Fastening base material							Application criteria							
		Concrete	L'weight concrete	Aerated concrete	Hard natural stone	Soft natural stone	Solid brick*	Hollow brick*	Solid gypsum	Panels plasterboard asbestos cement	In-place through fastening	Immediate loading	Flush with surface removable	Dynamic loading	Small distance betw. anchors and from edge	Temp. resistant
Heavy-duty	Hilti HSL heavy-duty anchor	●			●						●	●	●	○	○	●
Heavy-duty	Hilti HVA adhesive anchor	●	○		●	○	○				●			●	●	○
Medium-duty	Hilti HKD anchor	●			●						○	●	●	○	○	●
Medium-duty	Hilti HSA stud anchor / Hilti HKB Kwik-Bolt	●			●						●	●		○	●	●
Medium-duty	Hilti HHS self-drilling anchor	●			●							●	●		○	●
Light-duty	Hilti HPS impact anchor	●	○		●	○	●	○			●	●	●		●	○
Light-duty	Hilti HUD anchor	●	○	○	●	○	●	○	○		●	●	●		●	○
Special duty	Hilti HLD light-duty anchor	○	○		○	○	○	●		●		●	●			○
Special duty	Hilti HHD cavity anchor							●		●		●	●			●
Special duty	Hilti HA8 R1 hanger	●			●							●			○	●
Special duty	Hilti HA8 L1 anchor	●			●							●			○	●
Special duty	ID fastener / IN fastener	●	●	○	●	●	●	●	○		●	●			○	○
Special duty	[illegible] fastener	●	○		●	●	●	●							○	●

Key to chart

● very suitable

○ 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

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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	160	200	270
HVA Adhesive anchor	/	120	140	160	180	220	270
HSA/HKB Stud anchor Kwik Bolt	100	100	100	120	160	200	/
HKD Anchor	100	100	100	120	140	180	/
HHS Self-drilling anchor	100	100	100	120	140	180	/

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

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

Product Briefings
Examples of Calculations
Assessments Test Reports

6-3-2

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

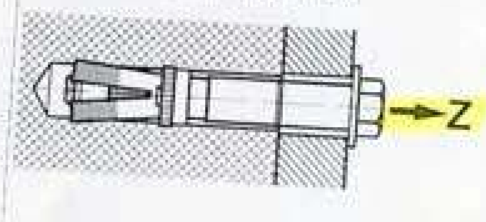
For predominantly static (dead) loads depending on the standard safety factor (ν = 3)

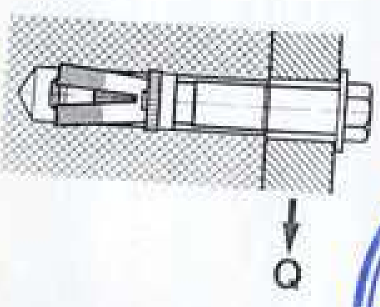
	Z/Q	βw	M6	M8	M10	M12	M16	M20	M24
HSL Heavy duty anchor	Z	20	–	5,8	8,8	13,5	22,2	33,5	40,3
	Z	35	–	7,7	13,3	19,4	32,3	46,3	55,2
	Q	20	–	10,2	15,3	24,9	39,8	50,3	76,7
HVA Adhesive anchor	Z	20	–	3,2	7,4	8,1	17,5	32,3	46,5
	Z	40	–	6,4	12,6	16,3	28,5	49,9	68,0
	Q	A11	–	3,8	6,5	8,5	14,0	23,4	32,7
HSA Stud anchor HKB Rock bolt	Z	25	2,5	3,2	4,2	7,4	11,0	14,1	–
	Z	50	3,5	6,1	8,7	12,2	14,6	22,1	–
	Q	25	1,6	3,6	6,3	9,5	17,1	24,7	–
HKD anchor	Z	25	2,9	3,8	5,5	8,9	14,1	16,9	–
	Z	45	3,4	4,8	5,8	10,8	19,0	25,3	–
	Q	A11	2,1	3,1	4,6	7,5	14,1	20,2	–
[illegible]	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	2,5	3,9	6,5	12,3	14,1	–

βw = concrete compressive strength (N/mm²)

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

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





Distance between anchors A and d

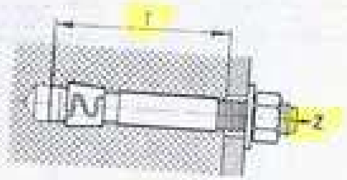
A, R, f		
Anchor type	A	A_{min}
HSL	2.5 T	1 T
HVA	1.0 T	0.5 T
HSA / HKB	2.0 T	0.5 T
HKD	3.5 T	2 T
HHS	3.5 T	2 T

T = depth of embedment
f = 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		55	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 HKB Kwik Bolt	T	50	55	60	80	100	120	
	D	6	8	10	12	16	20	
HKD Anchor	T	25	30	40	50	65	80	
	D	8	10	12	15	20	25	
HHS Self-drilling anchor	T	26	31	38	49	59	81	
	D	11	12	15	17.5	21	25	



Mechanical properties σ_B, $\sigma_{0,2}$, σ_s

		σ_B	$\sigma_{s\,(0,2)}$
HSL		800	640
HVA	HAS	490	390
	HASR	540	355
HSA / HKB	HSA	640	375
	HSAR	540	355
HKD	HKD	460	375
	HKDR	540	355
HHS		460	375

σ_B = ultimate tensile strength
σ_s = yield point
$\sigma_{0,2}$ = proof stress
τ = shear strength (= 0.7 x σ_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

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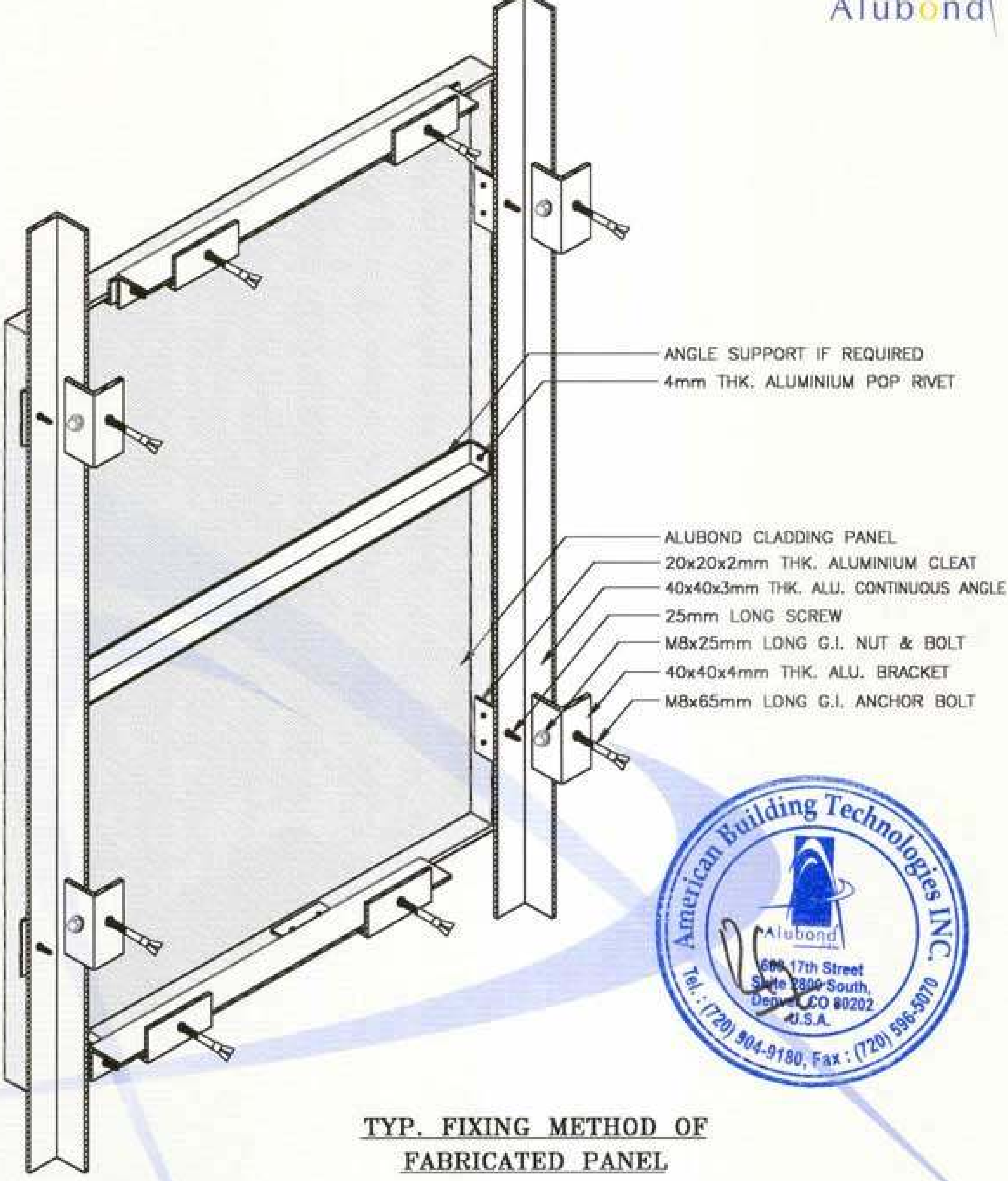

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TYP. FIXING METHOD OF FABRICATED PANEL