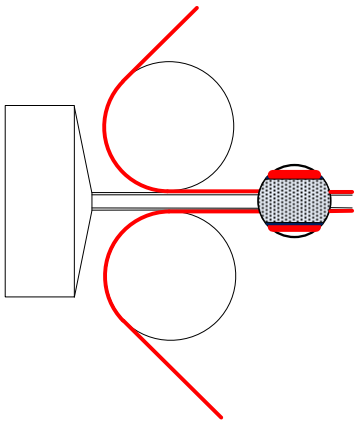
ALBOND®

Aluminum Composite Panel

ALBOND TECHNICAL CATALOG



APRIL – 2008

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Albond® Aluminum Composite Panel

Albond® Aluminum Composite Panel is a Composite construction material that is formed by affixing low-density polyethylene core between two dyed aluminum panels using state of the art technology. (Figure 1)
Despite the fact that Albond® Composite Panel is formed by using light aluminum; it provides metallic strength with superior smoothness, vibration absorption, extreme endurance and ease of maintenance.

Polyethylene chromate

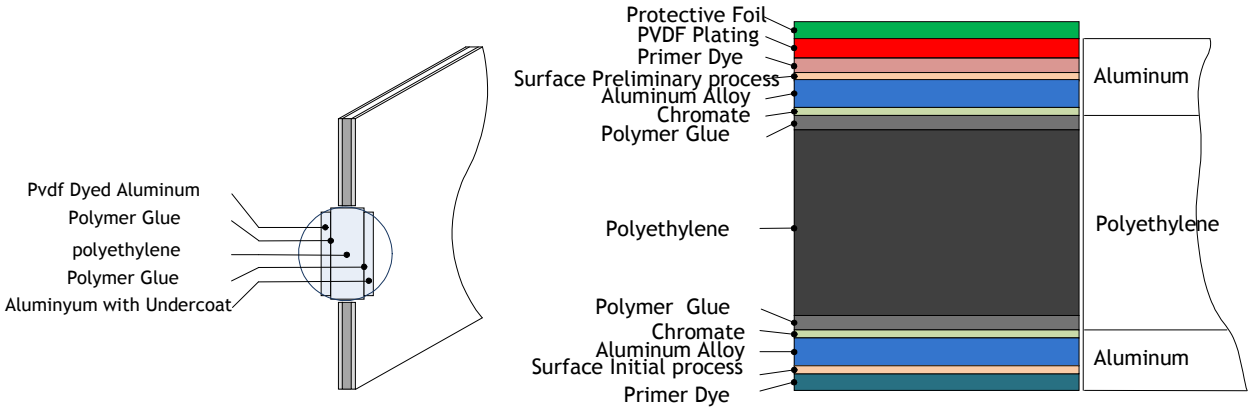


***Figure 1**. Details of Albond Composite Panel*

Aluminum Panel	**:** EN AW 3005 (Al Mn1 Mg 0.5) / H42-H46
Aluminum Panel Exterior Surface	**:** PVDF / Kynar 500
Aluminum Panel Interior Surface	**:** Protective Dye
Plastic Filling Material	**:** Low-destiny Polyethylene (LDPE)

Albond® Composite Panel Usage Areas

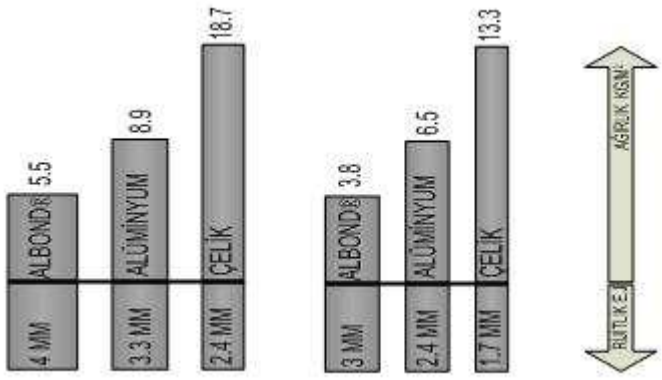
- On The Exterior And Interior Surfaces Of Buildings
- In The Restoration Of Old Buildings
- In All Kinds Of Balcony Decorations
- In All Sorts Of Colon-Beam Coverings
- On Eaves And Ceiling Coverings
- At Business Centers, Shopping Centers, Office Buildings And Stores
- At Banks And Hotels
- In Designing And Implementation Of Advertisements, Billboards
- On Interior Surface Coverings Of Tunnels-Subway Stations
- At Airports, Train Stations, Bus Terminals
- At Exhibition Centers And Fairs And Stand Applications
- In Tourist Stores

- At Stadiums
- On All Sorts Of Signs And Direction Signs
- In Escalators And Elevators
- At Gas Stations

Why Use Albond® Composite Panels?

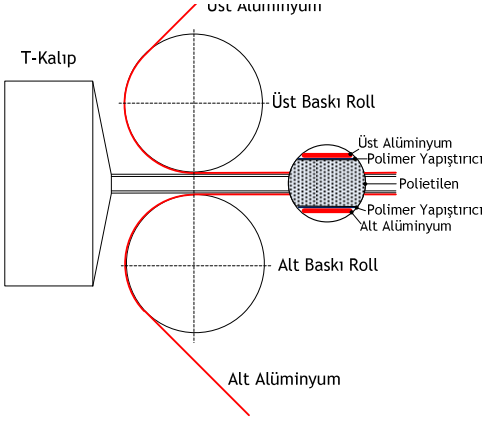
- Provides freedom of design and flexibility.
- Composite panel provides metal resilience in spite of the fact that it is lighter and thinner in comparison to the other surface elements.
- It has superior surface smoothness
- Offers many color varieties and flexible design
- It is easy to transport.
- Provides ease of maintenance and cleaning.
- It covers the surface defects.
- It is rust and corrosion free.
- It is safe in terms of earthquakes, it does not add extra load on buildings.
- It is not harmful on environment and nature.
- The raw materials used in its manufacturing can be re-cycled.
- It is economically advantageous in the long run.
- Its assembly can be performed in a short time.

Thickness and Weight Comparison Table of Materials with the same rigidity



Production Technique of Albond® Aluminum Composite Panel

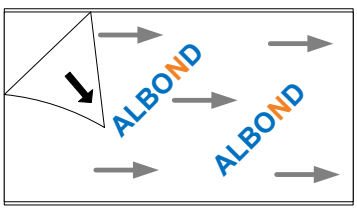
Melted polyethylene filling material is spread homogeneously inside the block as its upper and lower surfaces are joined with glue. Composite material is formed initially by coalescing of top and bottom aluminum, polyethylene and glue under a specific pressure and temperature. Thicknesses of Albond® Composite Panel is set in this process. The thickness value that is set as such, never varies and remains constant during all through the production process.
(Figure 2)



After the Albond® Composite Panel has taken its initial shape, it is processed in heating and cooling units.
After shearing and reshaping of Polyethylene edges, Albond® Composite Panel is processed in traction, aluminum foil covering and stacking operations and the production process is realized in a fully automated manner thanks to PLC control.

***Figure 2**.Albond Composite Panel Production Technique*

Protective Foil



Protective aluminum foil of Albond® Composite Panel ensures that the product reaches its destination without losing anything from its physical properties.
It provides high UV resistance, easy and spotless disassembling and standardized to ROHS. Assembled Albond® Composite Panel must be disassembled at an angle of 180 °.

***Figure 3**. Disassembly Directions for Albond Protective Foil*

The disassembly of the composite panel, of which the implementation is completed, must be carried out at the latest 30 days. (Figure 3)

EN AW 3005 Aluminum Mechanical Criteria

Tensile Strength (Rm) Mpa	: 140-195	(EN 10002)
Yield Strength (Rp0.2) Mpa	: ≥160	(EN 10002)
Elongation (A50) %	: ≥5	(EN 10002)
Elasticity Module Mpa	: 70.000	
Thickness Tolerance mm	: ± 0.02	(EN 485/4)
Width Tolerance mm	: +2/0	(EN 485/4)
Smoothness (Side Wave) mm	: d≤6 max. d/f ≤ 1 %	(EN 485/4)
Smoothness (Curl) mm	: d≤6 max. d/f ≤ 1 %	(EN 485/4)
Smoothness (Diagonally Bending) mm	: d≤6 max.	(EN 485/4)

EN AW 3005 Aluminum Chemical Composition

Fe %	Cr %	Ti %	Zn %	Mg %	Mn %	Si %	Cu %
0,45	0,01	0,02	0,03	0,45	1,13	0,21	0,11

Albond® Composite Panel Mechanical Criterions

Tensile Strength (kg/mm^2) : 4.1
Yield Strength (kg/mm^2) : 4.8
Breaking Elongation ($l0=5,65\ A0^{1\,2}$- %) : 15
Peeling of Strength (N/mm) : 12.5
Bending Strength (Mpa) : 122

Bending Elastisity Module (Mpa) : 10834

Thermal Resistance (m^2K/W) : 0.0103

Deviation Temperature (^0C) : 115

Temperate Coefficient (Wm^2/K) : 5.54

Thermal Coefficient of Expension ($mm/m/^0C$): 0.024

Temperature Range (^0C) : -50 ^0C / +80 ^0C

Sound Insulation : 25 dB

Rigidity ($kN\ m^2/m$) (4mm) : 0.240

Cross-section Module (cm^3/m) (4mm) : 1.75

Rigidity (kN m^2/m) (3mm)	: 0.125
Cross-section Module (cm^3/m) (3mm)	: 1.25

Albond® Composite Panel Production Tolerances

Thickness (mm)	: ± 0.2
Width (mm)	: +2 / 0
Length (mm)	: +4 / 0
Diagonal (mm)	: max.3

Albond® Composite Panel Production Criteria

Standard Dimensions (mm)	: 4 X 1250 X 3200
Thickness (mm)	: 2-6
Width (mm)	: 1000 / 1250 / 1500
Length (mm)	: Special Measures up to 6000 mm

Test Results of Albond® Composite Panel Pvdf Coating

Type	**: PVDF**	
Pretreatment Process	: Alkali oil receiving	
Primer Thickness	: 5 ± 2µm	(ECCA T1-EN 13523-1)
Topcoat Thickness	: 21 ± 2µm	(ECCA T1-EN 13523-1)
Total Thickness	: 26 µm	
Gloss (60°)	: 30 ± 5	(EN 13523-2)
Color Difference	: ΔE ≤ 1	(EN 13523-3)
Pencil Hardness	: ≥HB	(EN 13523-4)
Adhesion to Cracking Test	: ≤ GT1	(EN 13523-5)
T-Bending	: T ≤ 1	(EN 13523-7)
Acid Resistance (1000hr)	: Class 3	(EN 1396)
Water Immersion Resistance (1000hr)	: No influence (EN 13523-9)	
Resistance Weathering Accelerated	: Gloss ≤10	(EN 13523-10)
Methyl-Ethyl-Keaton Resistance (MEK)	: >100	(ECCA T11)
Temperature Resistance (1/2 ho. 60° cont.)	: No difference	(ECCA T13)
Measurmennt of Chalking (500 hour)	: ≤10	(EN 13523-14)
Humidity Resistance (after 1000 hour)	: No difference	(ASTM D2247-68)

Palletizing and Dispatching of Albond® Composite Panel

Albond® Composite Panels should be stored in dry places under normal conditions and they must not receive any humidity from the ground they are placed on while being water impermeable.

Composite panels must not be stacked in groups of more than six palettes.

Unless otherwise is specifically requested by the customer, Albond® Composite Panels must be palletized in two standard measurements that contain either 50 of 100 panels each.

(Figure 4)

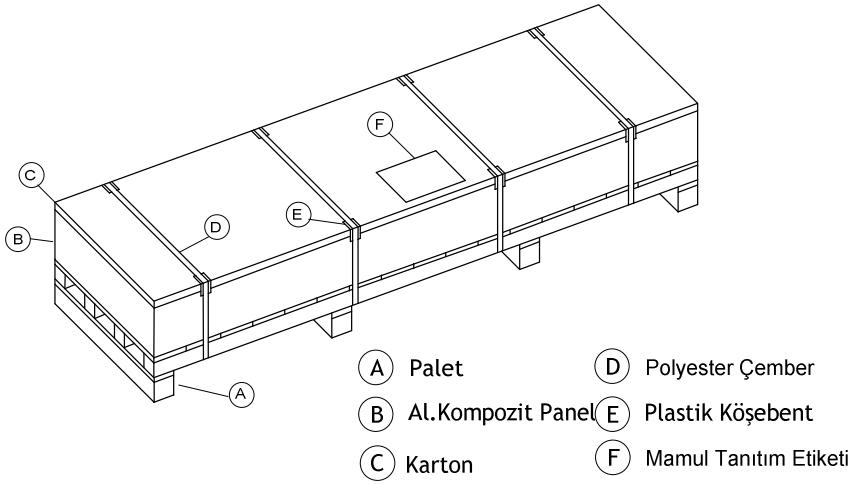


***Figure 4**. Palletizing of Albond Composite Panel*

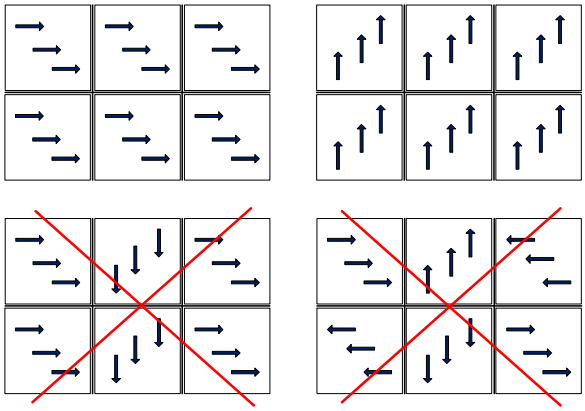
Recycling of Albond® Composite Panel

Albond® Composite Panel is manufactured of materials that can be totally recycled.

Polyethylene core, with aluminum panels on both sides can be recycled and transformed into raw material for other products.

Albond® Aluminum Composite Panel does not have any damaging effects on **environment** and **nature**.

Assembling Direction of Metallic Color Albond® Composite Panel



A point that requires attention in the assembly of Albond® Composite Panels is making sure that the direction of arrows on protective foil are the same. (Figure 5)
These arrows on the protective folio cover also indicate the direction of dying of aluminum as well as the direction of manufacturing of aluminum composite panels.

Figure 5. *Assembly Direction of Metallic Colored Panels*

Directions of metallic pieces in metallic colors are arranged accordingly. When the directions of arrows are used differently, different color tones on panels can be realized.
It is strongly recommended that the indicated directions are used in matte colors as well, though the result is not affected.

Processing Techniques of Albond® Composite Panel

Sawing and Cutting

Albond® Composite Panel can be sheared easily by using a carbide tip saw. Also guillotine shears can be used (Figure 6). However, shearing by using guillotine shears may cause a slight tilt at an approximate angle of 1° - 1, 5°, in the shearing process at the point of shearing.

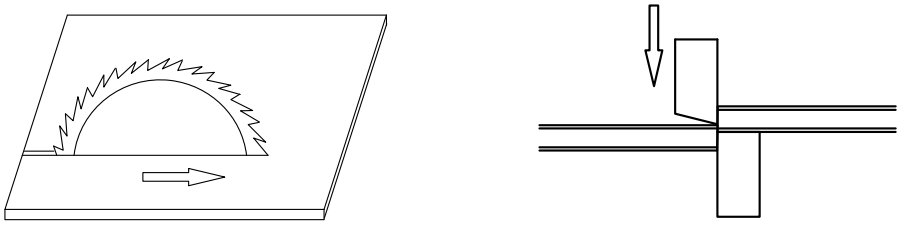


***Figure 6**.Shearing with a saw and guillotine shears.*

Jointing

First the tip should be chosen according to the folding type of jointing gaps to be opened by using the machinery.
Polyethylene filling material should be left at a thickness of 0.3 mm at the point of jointing opened.
0.5 mm and thicker polyethylene cannot be folded easily. On the other hand 0.1 mm and thinner polyethylene causes fracturing of aluminum, and no polyethylene at the jointing point causes the aluminum to break at the first impact. (Figure 7)

Jointing Angles

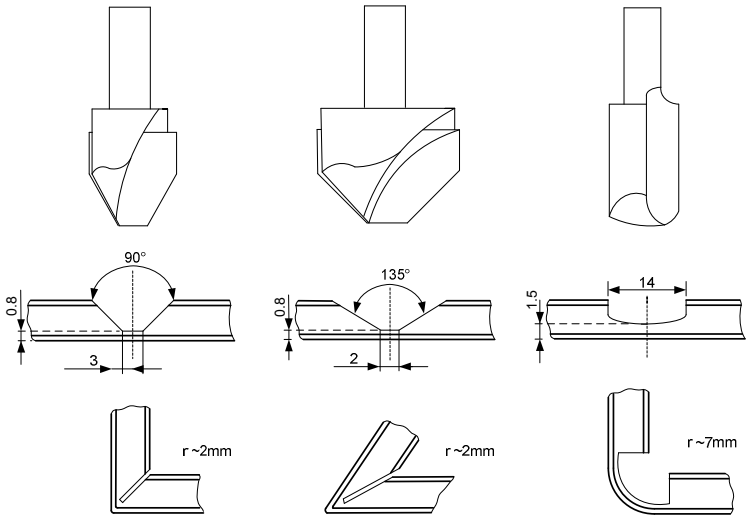


***Figure 7.** Jointing angles and folding Patterns.*

Bending Process under Pressure

Albond® Composite Panels can be easily bent and shaped by single roll press machine.
Bending angle is determined by the mould width, roll radius, stroke force and stroke distance. Front opening of the mould must be smooth and in a specific radius.

The two ends of shaping mould must not be sharp cornered but rather rounded at a specific radius.
Besides a soft buffer material can be placed to prevent crushing. The ideal mould width is calculated using the formula below. Bending radius is 40-55 mm with press and 200-300 mm with three roller machine. (Figure 8)

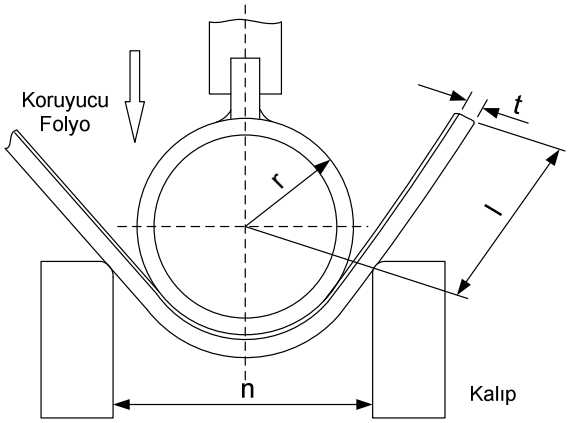


Figure 8.Pres Bending Process underPressure

l min = d x 5
r min = t x 15
t: Albond Panel Thickness
Ideal Mould Width (n) = (2xt) + (Roll Radius) + (Foil Thickness) +15 mm

Removing Edges and Folding

Initially, it is started by opening V shaped canals at 25 mm distance from panel sides. Panel corners are removed and bent towards the dyed side and a 25 mm deep cassette formed then panel corners are reinforced by either riveting or bonding of aluminum pieces. (Figure 9)

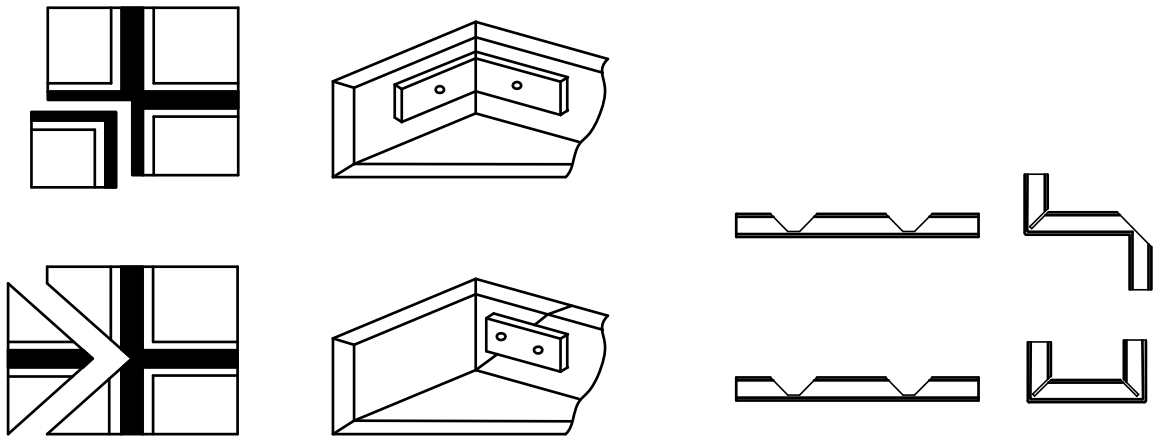


***Figure 9**.Removing Corners* ***Figure 10**. Folding Pattern*

After Jointing, Albond® Composite Panel can be folded and shaped on a smooth and straight surfaced desk. Recommended temperature is between 20ºC and 35ºC. Folding process must be done under 10ºC or lower temperatures otherwise cracking of dye can be possible. (Figure 10)

Maintenance and Cleaning of Albond® Composite Panel

Albond® Composite Panel must be maintained by cleaning at least once every year, by using warm water with detergent and a soft cleaning cloth. Cleaning liquid with temperatures higher than 40 ºC must not be used. This may lead to the formation of permanent stains on the paint. All the cleaning agents must have a pH between 5 and 8. Strong alkali cleaning agents must not be used.(Potassium Hydroxide, Sodium Carbonate, Caustic Soda .....). In the same manner, strong acidic cleaning agents and corrosive agents must also never be used.

Bending of Bottom Construction

The bottom construction of Albond® Composite Panel is important in terms of its resilience as the point of connection. At this point, the stress of the composite panel which is connected to construction is defined by the criteria below.

- Wind load,
- Support, assembly conditions,
- thickness of Albond panel,
- Aluminum thickness and yield point,
- Dimensions of Albond panel,

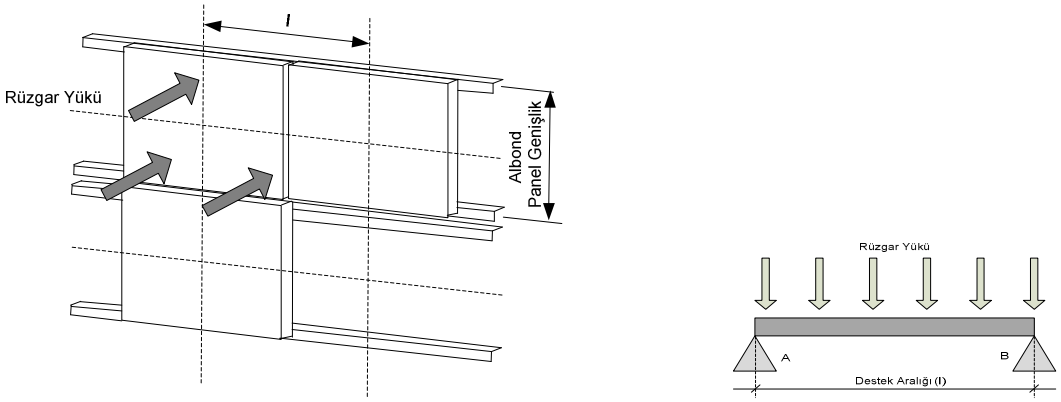


***Figure 11** Wind Load and Load Distribution on Composite Panel*

Composite panels are installed on steel or aluminum constructions so they are affected by the same wind load as the construction that they are installed on. (Figure 11) The stress that the construction material will be exposed to, depends on its rigidity, space between beams and force exerted by the wind load on the construction. The deflection made by the construction must be less than l/200 mm and it must not exceed the maximum allowed stress value.

Maximum Stress

$Z > W.l^2 / 8.\sigma_{\%0.2}$

Deflection

$l/200 > 5.W.l^4 / I.E.384$

Z : Cross-section Module of Bottom Construction (mm^3)
W : Wind Load (N/mm)
l : Support Interval (mm)
$\sigma_{\%0.2}$:%0.2 Stress Endurance (N/mm^2)
E : Elastic Module of Bottom Construction (N/mm^2)
I : Moment of Inertia of Bottom Construction (mm^4)

	BOTTOM CONSTRUCTION MATERIAL	
	STEEL	ALUMINUM
Cross-section	40 * 40 * 3 L	40 * 40 * 3 L
Moment of Inertia (I)	3.54 * 10000 mm4	3.54 * 10000 mm4
Cross-section Module (Z)	0.121 * 10000 mm4	0.121 * 10000 mm4
Elasticity Module	210000 N/mm2	70000 N/mm2

%0.2 Stress Endurance (N/mm2)	235 N/mm2	117 N/mm2

Calculation of Wind Load

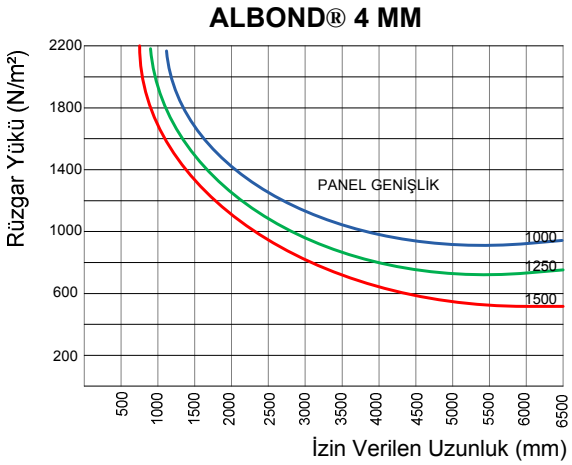
Wind force on m² can be calculated if speed of wind is defined.

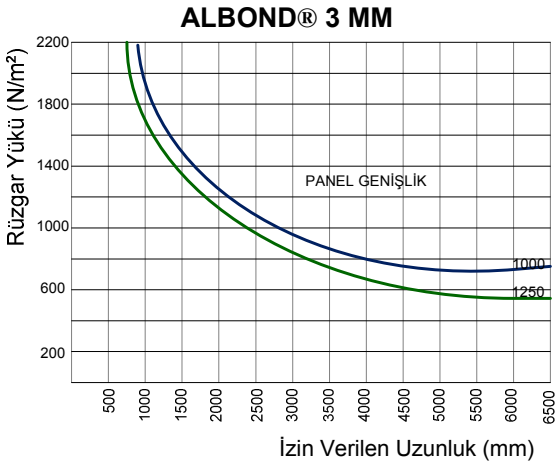
Pw=k.q k: Aerodynamic factor (between 1,2 and 1,6 according to height)

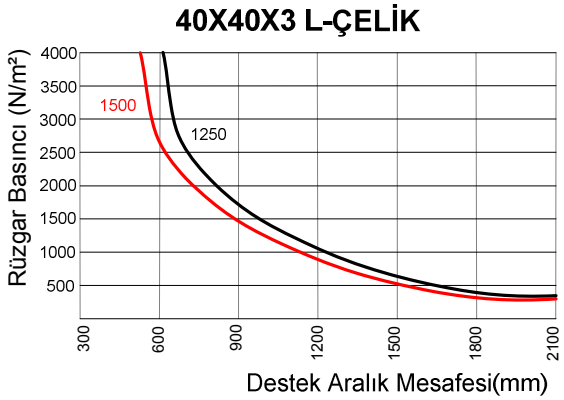
q=v²/16 v: Speed of Wind (m/sec) Pw: Wind Force (kg/m²)

Maximum Panel Width and Connection Spaces according to Wind Load

Maximum panel widths and spaces on connections according to wind load are defined in graphics below. (Figure 12) (The given values are for Albond® Composite Panel fixed at four corners. Maximum allowed stress: 53 N/mm²)







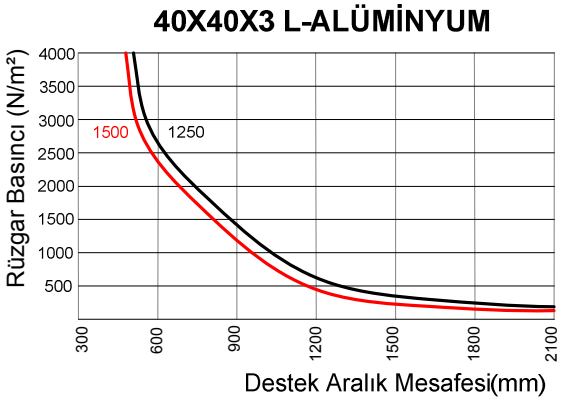


***Figure 12**. Panel Width and Connection Spaces according to Wind Load*

Strength on Connections

Albond® Composite Panels are connected to aluminum profile and others mostly with nut-bolt, rivet and screw. These forces cause stress on connections. (Figure 13) This stress must be within elasticity limits. (Figure 14) Distance between hole and edge must be twice of hole diameter. The connector materials must have endurance against corrosion (aluminum, stainless steel, strong plastic etc.) Materials like copper, bronze, brass etc., should not be used due to their corrosive effect.

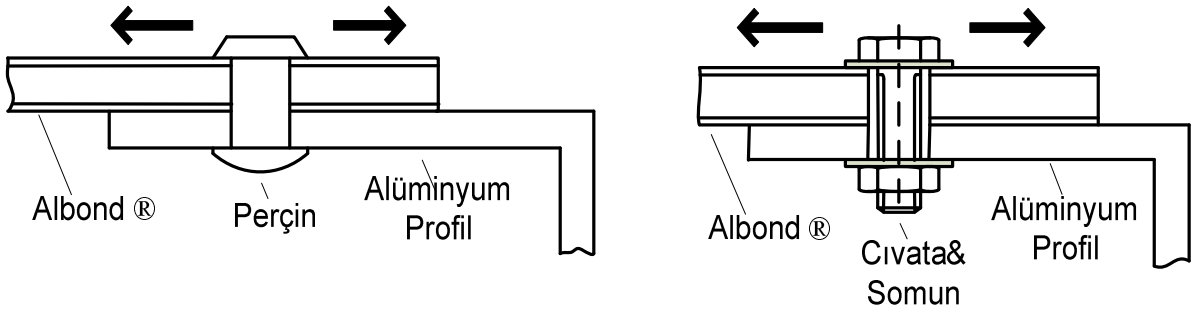


***Figure 13**. Forces that the composite panel is exposed to at points of connection*

The rivet as a connector material should be chosen appropriate to panel pressure, otherwise it will snap under strong wind load. Tensile force, shear force and thermal extending should be taken into consideration. Hole diameter must be 0.2 mm bigger than rivet diameter at connection. (Figure 15)

Hole Diameter (mm)	Distance from center of hole to edge (mm)	Maximum Elastic Stress (N/mm_2)	Maximum Stress Force (N)
5	5	21	320
	10	48	720
	15	55	820
10	9	20	590
	19	38	1150
	30	39	1170

***Figure 14**. Elastic Stress Limits according to Hole Diameters of Connector*

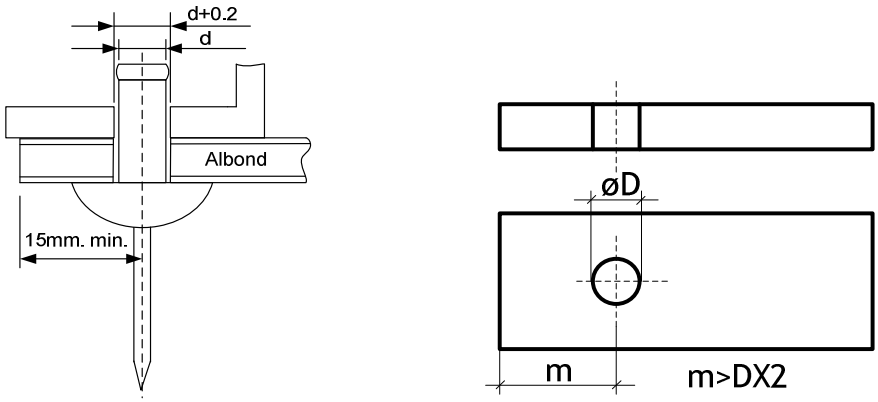


***Figure 15**. The Rivet and possible Diameter Measures/Edge Distance Measures*

Fmax=σ x s x ø
Fmax : Stress Force (N)
σ : Elastic Stress (N/mm²)
s : Albond® Composite Panel Thickness (mm)
ø : Hole Diameter (mm)

Water Isolation

Isolation and silicone can be used at connections. Impermeability is important at connections. Silicone must be implemented throughout panel lines with a little slope. The filling material must have superior attributes with regard to endurance to conditions and fatigue. Silicone material has less deformation than the others because of temperature and age. While the possible long-term using temperature range of Polysulfide and Polyurethane filling materials is -20/+80 ºC, long-term using temperature range of silicone is -40/+120 ºC. Silicone and other filling materials do not suffer so much after fillings. (Figure 16)

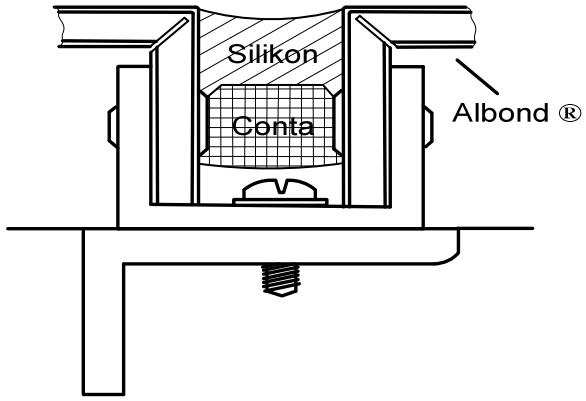


***Figure 16**.Silicone and Connection Details on Composite Panel*

Example:
Panel Width : 1250 mm.
Wind Load : 2.2 Kpa
Construction Material : 40X40X3 L (Aluminum)

What should connection space be when composite panel connects to aluminum construction material?

Wind Load (W): 2.2 Kpa = 2200 N/m² X 1250 = 2.75 N/mm

According to Stress;
$Z > W.l^2 / 8.\sigma_{\%0.2}$
$1210 > 2.75X\ l^2 / 8x117$ $1210 > 2.75x\ l^2 / 936$ $l^2 < 1210x936 / 2.75$
$l^2 < 411840$ $l < 641$ mm.

According to Bending;
$l/200 > 5.W.l4 / I.E.384$
$l/200 > 5x2.75xl4 / 35300x70000x384$ $l/200 > 5x2.75xl4 / 948864000000$
$L/200 > 13,75xl4 / 948864000000$ $l^3 < 345041454$ $l < 700$ mm.
The connection distance must be lower than 641 mm when aluminum L 40X40X3 is used as a bottom construction material.

Strength Force of Albond® Composite Panel

The stress of Albond® Composite Panel is calculated according to aluminum. The coefficient table is given below according to regular distributed surface affect area and panel side ratios. So;

$\sigma max = \beta x w x b^2 / t^2$

t^2 = (Albond® Thickness^3 - Polyethylene Thickness^3)/Albond® Thickness

β : The coefficient comes from panel side ratios and connection type
W : Wind Pressure (N/mm^2)
b : Length of Short Side (mm)

Example:
Albond® Composite Panel has 1000x1000 measures. Panel thickness is 4 mm. Four sides are connected to bottom construction and wind load measured as 160 kg/m^2. Is a permanent deformation possible under these conditions?

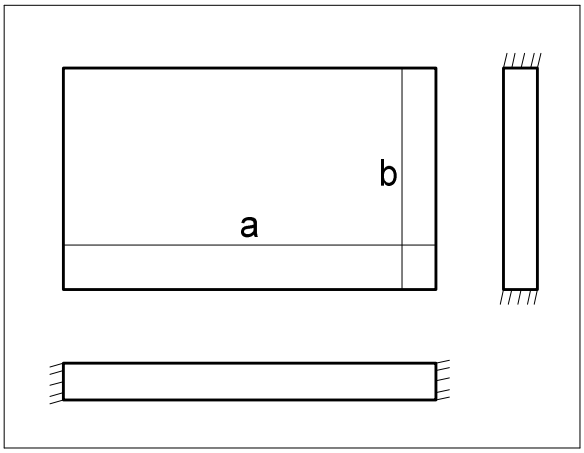
$\sigma max = \beta x w x b^2/t^2$
t^2 = (Albond® Thickness^3 - Polyethylene Thickness^3)/Albond® Thickness
$t^2 = (4^3-3^3)/4 = 9{,}25$

β=0.3078 (a/b: 1000/1000=1) the coefficient is showing table below according to a/b ratio (Figure 17)
$\sigma max = \beta x w x b^2/t^2$ $\sigma max = (0.3078X0.00016x\ (1000)^2)\ /\ 9.25$

Allowed Stress: 15.5 kg/mm^2
σmax= 5.32 kg/mm^2 (5.32 kg/mm^2 < 15.5 kg/mm^2)

A permanent deformation is not possible under these conditions.

4 KENARI SABİTLENMİŞ (Düzgün Dağılım Yüzey Etki Hesaplama)

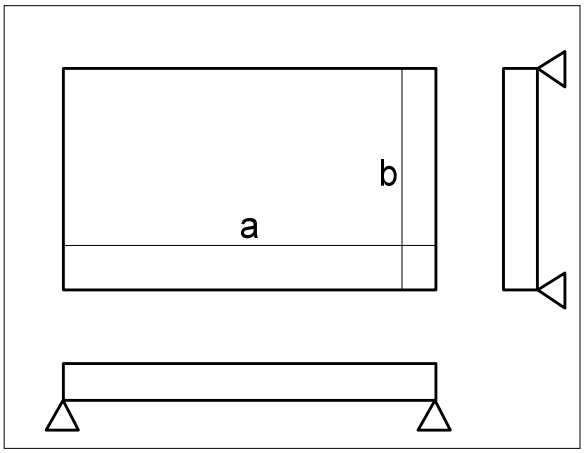


Maksimum Gerginlik

$$\sigma_{max} = \beta \times wb^2/t^2$$

a/b	1	1.2	1.4	1.6	1.8	2	↗
β	0.3078	0.3834	0.4356	0.4680	0.4872	0.4974	0.5000

4 KENARI DESTEKLENMİŞ (Düzgün Dağılım Yüzey Etki Hesaplama)



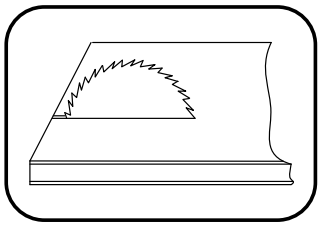
Maksimum Gerginlik

$$\sigma_{max} = \beta \times wb^2/t^2$$

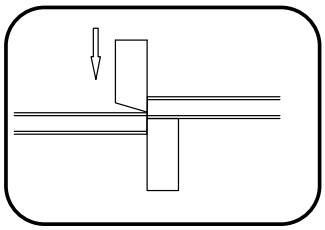
a/b	1	1.2	1.4	1.6	1.8	2	3
β	0.2874	0.3762	0.4530	0.5172	0.5688	0.6102	0.7134

***Figure 17**.Surface Force Calculation Table on 4 sided fixed and supported Composite Panel*

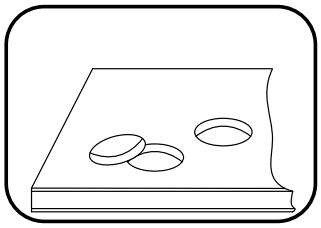
Process Techniques of Albond® Composite Panel



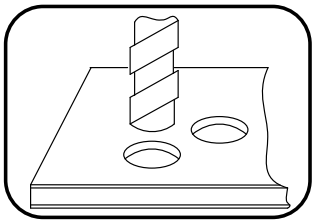
Sawing



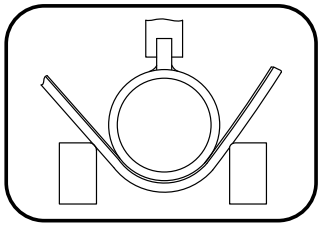
Cutting



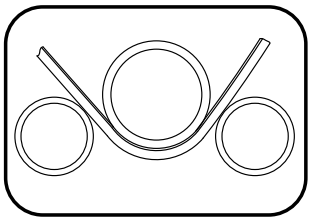
Punching



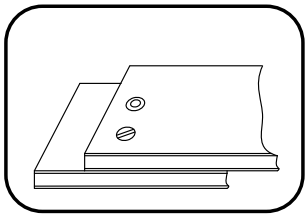
Drilling



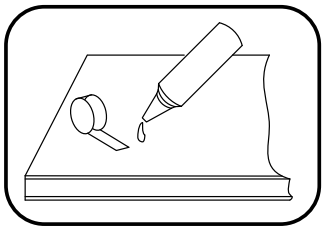
Bending



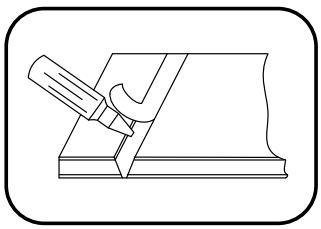
Roll Bending



Screwing&Riveting



Glueing



Welding

Assembly Technical using Cassette System

Albond® Composite Panels are shaped as cassette then are assembled as in the figure below. (Figure 18) The profile of cassette system must be made of aluminum or steel material. This is can be only at connection claws also one-pieced.

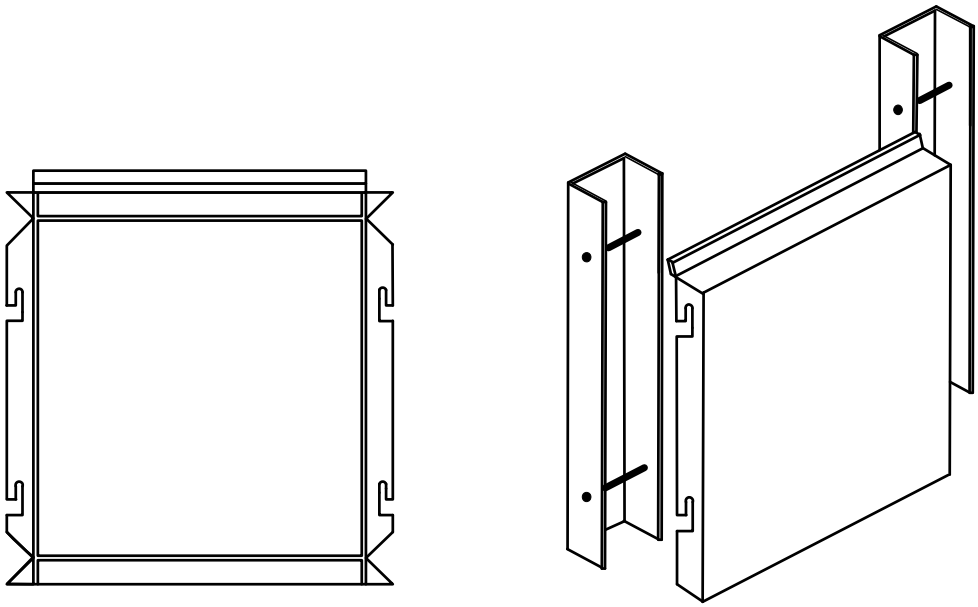


***Figure 18**. Albond Composite is Processing as Cassette Type*

Composite panel is clawed at 15 mm spacing on cassette construction. This shortens the production time and facilitates assembly process.
(Figure 19)

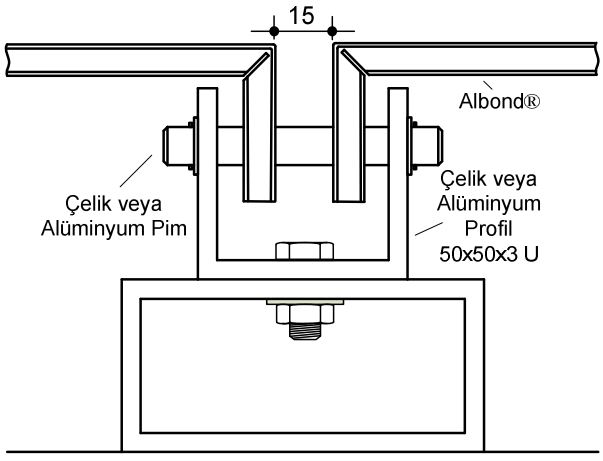
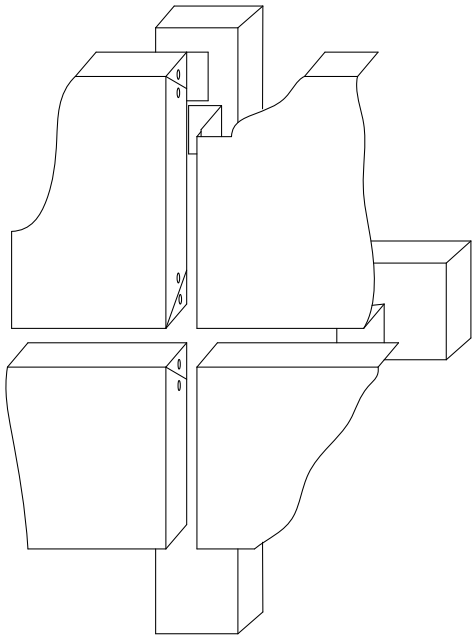
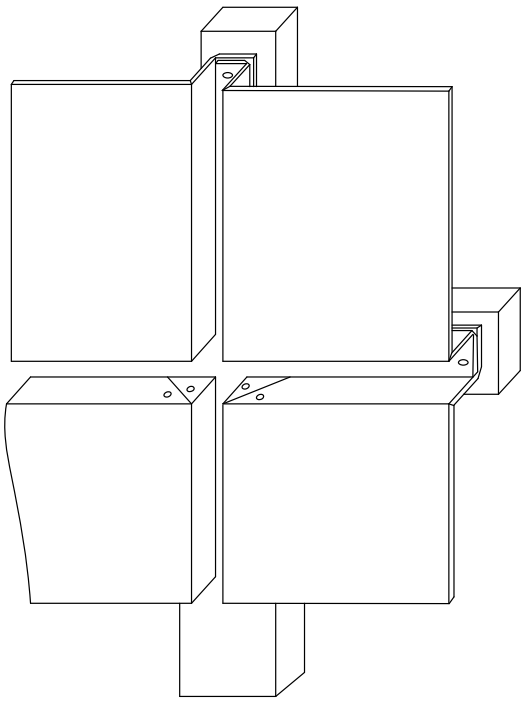
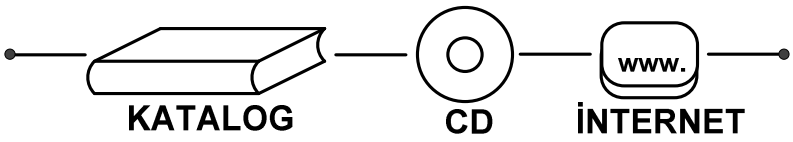


***Figure 19**. Connection Details of Cassette Type Albond Composite Panel*

Application of Albond® Composite Panel







ALBOND®

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