wind damage

on roofs

Date 21.02.2016 - Rev 002 - Ref Vento 002 ENG

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

The picture makes full testimony to the destructive actions caused by the wind, in the context of a flat roof. It is appropriate to specify that the event in question must be regarded as exceptional. But we must also highlight how the insulation panels are not affected by any restraint system, neither mechanical or of adhesion

vetroasfalto

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

Premise :
The possible triggering of problems, also important, due to the effects of wind is a topic too often underestimated by professionals. While the damage of remarkable entity, deliberately ignoring those caused by events with chrism exceptionalism, they are not very frequent, it is equally true that are frequently repetitive situations where the extent and severity of damage, even if not very significant, it starts an unwarranted climate of tension and misunderstanding between the different parties competing in the implementation of the works. It would be enough to comply with some simple planning and executive rules to avoid, in most cases, disruption and economic costs to manufacturers, installers and final users.

The wind :
When a flow of air provided with a certain speed blows above of a cover, it generates a force tending to lift the whole cover. This phenomenon, also called "Bernoulli effect" from the name of the physical theorizer, shows how the depressive forces in play reach higher values where the air velocity appears increasing, thus

determining a downforce effect. This same phenomenon is the basis of operation of the wing of an aircraft or of a sailboat. If the coverage is essentially flat the air current passing over its surface tends to lift it in its entirety.and on the the ridge lines and corners we can find pressure pockets.

These low-pressure pockets can exert significant forces breakout and lift through the components of the subsystem waterproof and cause damage of great magnitude materials. Jointly to these basic phenomena may occur additional phenomena of localized lifting which may be additive to the previous ones: is the case due to emerging volumes from the cover or to the lack of upwind walls

For a covering the coefficient of lift pressure is in relation to the change in pressure via a reference value called "stasis" (stagnation) pressure. A pressure coefficient 1 for a component of the cover has means that the possibility, on the part of that component, to withstand a pressure change equal to 1 time of the stagnation pressure at a given wind speed. The equation used for pressure stasis applies :

$q = 0{,}00256 \cdot V^2$ (where: q = pressure doldrums - V = wind speed)

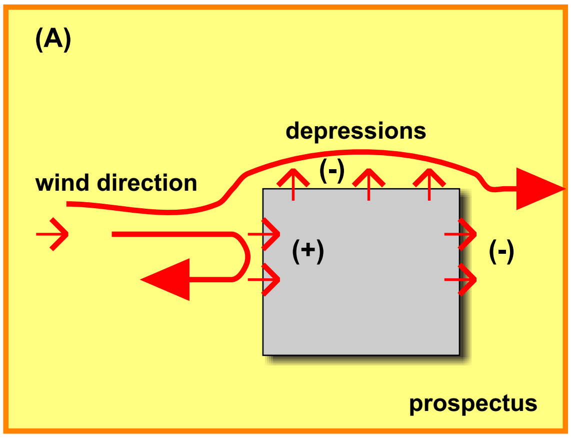
The state and the local variability of wind-produced pressure on coverage are descended from a large number of variables, such as :

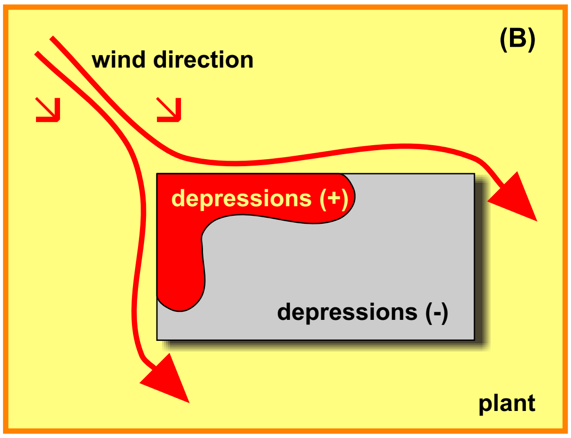
-the characteristics of the incident airstream
-geographical position of the construction
-the roughness of the land surrounding the building
-construction height
-the ratio in plan between the sides of the building
-the shape of the building
-the direction of the incident wind
-the presence and shape of the architectural elements of discontinuity sources such as railings, curbs, ridges, eaves, gutters, ridge tiles, skylights, chimneys, canopies, technical books, plants ....)
-the shape, size and mutual position of any adjacent buildings
-the relative position of a given element in relation to other elements of the roof

vetroasfalto

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

The “wind” engineering :
The discipline known as "wind engineering" is extremely complex and has not yet produced, the official implementing rules applicable to the continuous roofing industry. The Italian territory, subject to certain specific geographical locations, is not classified as "at risk" in relation to the wind engendered actions of continuous coverage plans elements. very important damages caused by not exceptional wind events against bituminous waterproof systems "warm roof" (the most frequent cases) are, in the most recent history of prefabricated waterproof systems, of little importance, so as to be given the status of fact the technical empiricism in as executive rules, which were sparsely followed. Is instead the very numerous cases concerning less important damage, although significant sources of disputes, misunderstandings and suspicions that find their expression in the troubled triangle identified by the manufacturer-applicator-user entities. Most of these problems could be avoided by taking into account, in the planning and execution, some basic rules





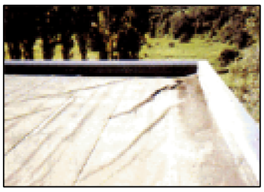
(A) -When the wind impacts a construction causes excessive pressure on the windward sides of the building and accelerates its speed. This acceleration causes a drop in pressure (depressions) on the downwind faces of the building and, above all, in the roofing system. **(B)** -the magnitude and distribution of the depressions in the context of a cover is anything but regular. The air currents that are determined to induce swirling rotational motions also, especially in the corners and perimeter areas of a building

The waterproofing sistem :
The above-mentioned rules can be translated and exemplified in the need to prepare a waterproof system that, both in its current areas as in those specifications, possesses over time, as the result of its own weight, of interadesive forces and those of adhesion to the support, higher values to those determined by the negative pressure produced by a wind reference standard
And 'in fact impossible to assume that a waterproof package consisting of the vapor barrier (3 kg / m²), thermal insulating layer in rigid foam (60 mm = 2.1 kg / m²), the sealing layer in a double membrane polymer bitumen (8.9 kg / m²) can in inaderenza conditions or reduced adhesion to the surface, to oppose with its 14 kg / m² of weight to the downforce of a wind, albeit of reduced intensity and steady seeds regime, which almost touches the surface
We must also consider that the force of adhesion of an impermeable layer to the bitumen matrix, totally welded flame to a rigid and stable support, is certainly feisty against normal depressive wind actions. The problem becomes of course more nuanced and less identifiable numerically when the sealing system is not applied directly on the bearing structure but rather on top of an insulating layer or otherwise in a complex stratigraphy. The problem at this point is no longer to have a very adherent to the substrate surface but rather to also have available a substrate which, for its characteristics, is compatible in time with the expressed needs, views as part of the useful life of the waterproofing system

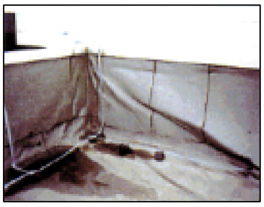
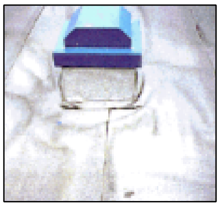
vetroasfalto

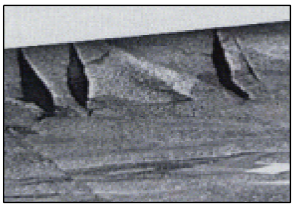
Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

following the “ **waterproofing system** “ :
We must also bear in mind that the action of wind can not be theorized as a constant arising from the composition of known effects but which, by virtue of parameters typically uncertain and probabilistic, can induce a cover also can not be determined in advance and is likely to produce negative effects only in the medium or long term. It is extremely interesting, from a practical point of view, draw some considerations of the depressive effects caused by the wind on the perimeter and corner areas of coverage against what is happening in its central areas and assess the areas of influence of these effects with shifts the ratio between the sides of a building. Some references, taken from specific studies, are to suggest a serious reflection on the application methods of a waterproofing system and attention to be provided in the execution of the same in the field of critical coverage areas





Wind damages on roofs : this photographic sequence sufficiently describe all possible problems that may be induced by wind events against a flat roof. The reproductions in the subject they want to give evidence to the various problems that occurred as a result of not exceptionally large wind events. In all these cases the roof system (or part of the system) lacked the necessary stability

Wind depressions :
By making some simplifications to the terms of the problem and assessing of 100 (reference rate) depression exerted by the wind on current central parts of a cover, this same parameter can have the values mentioned in the following table :

current central zones		coefficient	100
corner inland areas	(flat roofs)	coefficient	320
internal perimeter zones	(flat roofs)	coefficient	200
shelters	(only depression)	coefficient	360
eaves	(pitched roofs)	coefficient	340
corners	(pitched roofs)	coefficient	710
ridges	(pitched roofs)	coefficient	340

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

following **wind depressions :**

Whereas as normally as possible a equal to 50 kg/m² extraction load in the central planar area of a current flat roof, it is easy to identify the extent of the stresses acting on the other parts of a cover which, when in a condition not to oppose effectively, could induce harmful effects within the package and come, for composite effects, to the partial or total removal of the covering continuous system. one should not forget that the negative coverage pressures are often accompanied by positive loads due to uplift pressure exerted by the wind on the inner faces of the cover (just think of the conditions resulting from the opening of a door)

They are therefore to be avoided: the **indipendent laying conditions** (necessary to provide a suitable ballasting layer or a mechanical fastening system). The laying conditions of the layers in semi-adhesion not controlled (p.e necessary to provide the use a layer of partial desolidarisation by the use of a pre-punched component with regularity)

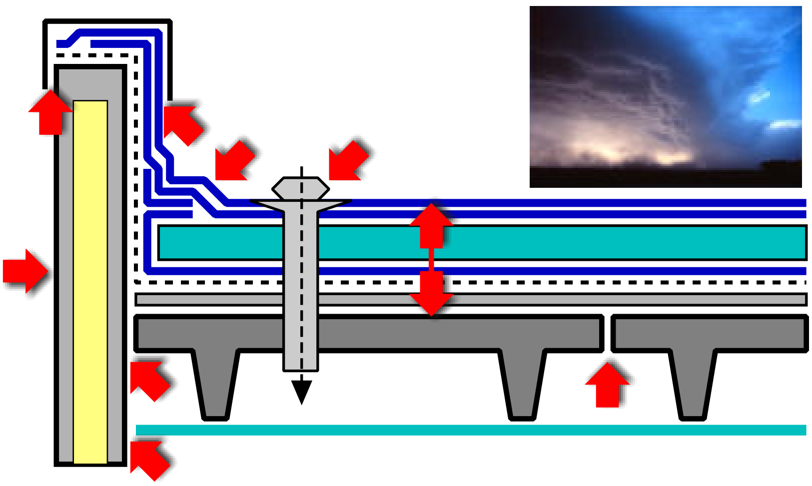
The **composition conditions** of the effects due to the sum of pressures and depressions (requires that all connection areas, continuous or temporary, with the outside or the inside prove airtight). As indicated it must also be provided for ensuring the package in the face of the systematic mechanical stresses induced by the current roofing system, its composed by climatic and environmental thermo-humidity conditions.

The **effects** (see page previous : some typical effects) :
The **most common effects** due to wind action on a continuous coverage are summarized below :

The formation, at the sealing layer in the corner areas of corrugations, which originate in the corner, the partial or total removal of the joints from their site and their respective exhaust downpipes, the delamination of the thermal insulating layer in respect of the sealing system for overlying, the detachment of the connection between the horizontal planes and vertical of the waterproofing layer and, the desoldering, of the joints in the waterproof covering near their intersections when corrugations are present, the formation of lesions or longitudinal cracks in the immediate contiguity of transverse overlaps of the sheets, these zones of higher rigidity lower its resistance

N.B: it is typical to find these problems under a not walkable hot roof, usually equipped with a self-protected final layer.

not walkable flat roof
the most exposed areas to “wind risk”



-joints between the cracks of wall panels
-perimeter of the system summer
vertical lap of the system summer
-attach of the sealing system to the top of the walls
-sealings of the caps of the perimeter crowning
-connection zone between the horizontal and vertical levels
-discontinuties of supports exhaust
-links between functional layers
-joints between the plates of roof

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

Functional recovery :
Where the extension and severity of the detected phenomena specifically requests the removal of the existing package and its total makeover, you can usually restore proper function and temporal reliability of the waterproofing system. Nothing will prevent a thorough pre-examination "on site" of the issues raised and therefore a design, programming and execution of the works necessary for the solution of the specific case.

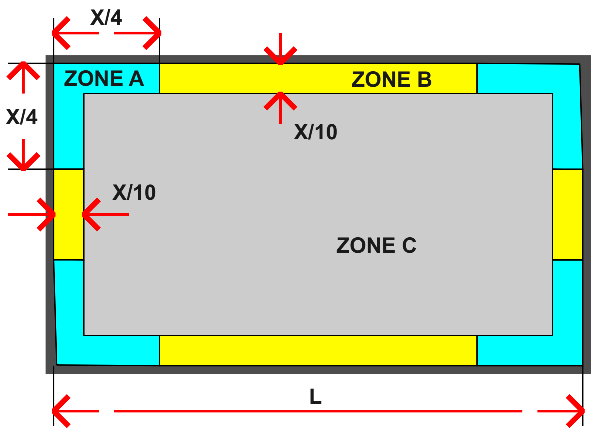
01-removal of the waterproof membrane from the worst-affected areas, taking care to also remove the caps of the coping of walls or curbs interested
02-removal of partially extracted exhaust vents
03-cut and torching of minor corrugations
04-placing of membrane bands to cover up the areas affected by corrugations,
05-repositioning of new exhaust vents in direct adhesion to the vapor barrier by removing, if necessary, a thermal insulation barrier in its perimter,
06-replace the removed waterproofing membrane, ensuring particular care the overlapping areas, its adherence to supports, its welding on the tops of walls or curbs
07-repositioning of the crown caps of the walls and their external elastic seal against the perimeter walls
08-check external sealing of joints of prefabricated panels in the areas concerned by the roofing system
09-dry preparation, in the perimetric areas, in the corner zone and in those downwind to emerging technical volumes, of a separation layer in the nonwoven fabric of polyester 300-400 gr / sqm
10-place for a depth to be determined, of a ballast layer composed of prefabricated squares in concrete thickness 4 cm, size 50 x 50 cm, placed in direct adhesion to the separation layer

N.B : as provided for in points 9:10 can obviously be replaced, the support structure allowing, by a mechanical anchoring system, adequately dimensioned, for points or lines, of the cover package.

THE ROOF ZONES AND THE DEPRESSIVE LOADS

As minimum considerations, albeit very indicative, of the negative loads acting on a flat roof and therefore the stresses depressive interacting, in the long term, with the waterproofing system, the values can be assumed:

current cenral-zone	(Zone C)	kg / m²	- 50	(coefficient = 1)
perimeter-zone	(Zone B)	kg / m²	- 100	(coefficient = 2)
angular-zone	(Zone A)	kg / m²	– 160	(coefficient = 3.2)



The depths and zonal amplitudes :

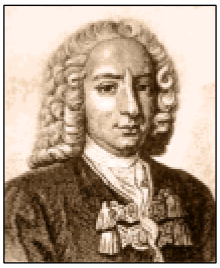
X = L
or
X = 2 H (the height of the building)
(Considered the minimum value resulting from X)

The above conditions with reference to the standard contour: building height from the ground level = not more than 20 m. windy speed = standard. Coefficient = flat profile locations. S.l.m = height not exceeding 300 m. Localization of the building = suburban area or industrial. = absent internal overpressure

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

Bernoulli :

The motion of fluids is governed by a theorem of the Swiss physicist Daniel Bernoulli (1700 - 1782), valid for the perfect fluids, that is, devoid of internal friction, in stationary motion (invariable in time), and without vortices. Bernoulli's theorem is expressed by the equation:



$$v^2 / 2g + h + p / g = \text{constant}$$

where :

$v^2 / 2g$ = kinetic energy (1)
h = geometric height (2)
p / g = the piezometric height (3)

From the above expression it follows that a reduction in speed (less kinetic height) in a geometrical constant height to fluid involves the increase of its pressure (greater piezometric height). The study of motion of real fluid is complicated by the phenomena of internal friction, or viscosity. The viscosity expresses the greater or lesser ease of flow of a fluid layer with respect to the adjacent one. In a laminar regime system, ie free of turbulent motions, the velocity is zero in the layers (laminae) adhering to the sliding planes while in subsequent layers, which slide on each other, the speed increases until reaching its maximum with a nonlinear increase (parabolic). When the flow becomes turbulent, that is, when forming of vortices, the pressure energy is transformed into kinetic energy of rotation

ref 1) = the height at which it can pick up a fluid jet launched upward with speed
ref 2) = the height at which the fluid is considered with respect to a reference level
ref 3) = equal to the height of a column of fluid capable of producing the pressure p

The classification of the winds :

The winds are graded **straight, periodicals, local and cyclonic**. The **constant winds** are those that blow throughout the whole year always in the same direction and the same sense. Among them are the **trade winds,and extra tropical winds**. The trade winds are generated in the tropical anticyclonic zone and converging towards the equatorial. The winds are blowing in the equatorial tropical area which, by heating, they form ascending masses of warm, moist air. The westerly winds blowing between 35 ° and 60 ° and from the southwest to the northeast in the Northern Hemisphere and from the northwest to the southeast in the Southern.

An important classification of the winds, related to the local conditions of each location to which you want to report (even larger individual cities / regions or macro-areas), is the one between "**rulers wind**" and "**prevailing winds.**" It is said "**ruler**" a wind coming from a well-defined direction, when it is from this direction that the winds blow more frequently (and not necessarily with greater intensity), in that given area, city or region. Instead, a wind is said "**dominant**", when blows from a given quadrant and from that direction originate the winds that affect the given geographical area with greater intensity, in absolute value, in the year, and not necessarily for the most number of days

The above considerations have to be evaluated with great attention and taken into consideration not only for the aspects of navigation and the protection of certain agricultural crops, but also in the realization of individual buildings, groups of buildings, neighborhoods and even in building Some cities. They are not infrequent examples of entire historic centers of many cities, especially coastal, leading the planimetric disposition of their buildings the indelible mark of these design criteria. Typical is the urban layout called "herringbone", characteristic of the historic centers of many of the italian coastal towns bordering the southern Adriatic, from Bisceglie to Monopoli, including that of Molfetta are the most representative

A photo taken in a coastal zone of Sardinia. It is a classic demonstration of the presence of local ruling wind.

vetroasfalto

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

The wind (definitions) :
The wind is definable as a horizontal motion of the air masses above the Earth's surface. Because of this motion are existing differences in pressure between two zones in the atmospheric layer closest to the ground. The greater the pressure difference, the greater the intensity of the wind. These pressure differences are typically caused the unequal heating of the ground by the solar radiation. In their horizontal motion of air masses are "held back" by the roughness of the land surface and diverted by forces, called "Coriolis", originated from the motion of the earth's rotation.
The wind is characterized by two parameters: speed and direction. Because of the friction encountered by air masses that flow above the earth's surface, the wind speed has a characteristic vertical gradient, the calculation of which varies for different types of surface roughness. In daily scope the wind speed evolves, influenced mainly by vertical movements of air masses on products for solar radiation effect. The wind speed increases with altitude following a characteristic exponential law :

$$\mathbf{V = Vo\ (Z / Zo)\ .k}$$

where :

V	= wind speed	
Vo	= wind speed at reference height	
Z	= height	
Zo	= reference height	
k	= characteristic exponent of the boundary layer (0.14 = rural areas, 0.29 = peripheral areas, 0.4 = urban centers)	

Covering with ballast :

The extraction of wind load value is obtained by applying the following formula:

$$\mathbf{Wh\ (N / m^2) = qh.\ [G.\ EPC + (- Cpi)]}$$

where :

Wh (N / m²)	= extraction of wind load
qh (N / m²)	= velocity pressure at the maximum effective portion of the hedge from ground level (Crown, full, etc.)
G	= gust factor
EPC	= external pressure coefficient
Cpi	= coefficient of internal pressure

conventionally, for roofs with area greater than 5 m², will assume for the product G. Cpe the -1.0 value on the whole surface

The coefficient of internal Cpi is adopted to the occurrence of a pressure situation in which the action of the wind on the external side of the cover, is added up to the pushing action, determined by the wind on the inner side of the cover (environment in direct contact with the openings). This condition will occur when the base support of the cover will have solutions of continuity both in the planar part and / or in the perimeters (prefabricated elements, corrugated sheets, etc.)

The coefficient Cpi assume the value 0.2 when said pressure is only occasionally may occur, for pressurized air input, from modest openings left open at the moment (windows, doors, etc). The coefficient Cpi assume the value 0.6 when said pressure may occur systematically, for pressurized air inlet, through openings that necessarily remain open for extended periods of time (access doors of trucks, loading bays, etc.)

N.B : when you will have to carry out the evaluation above to resort to abnormally windy scheme with the membership zones (eg: Bora of Trieste), it shall be specified the actual value of the local velocity pressure.

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

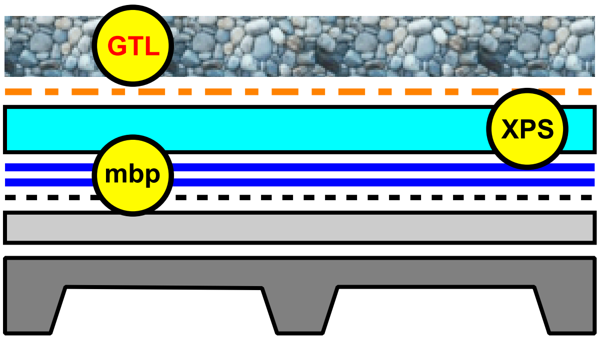
following **Covering with ballast**

the weight of the ballasting Ph (kg / m²) must satisfy the following formula:

Ph = - (Wh / 9,806)
where :
Wh (N / m²) = wind loading on the cover extraction

Ph (kg / m²): in any case must always be ≥ 55 kg / m² (thickness = 4 cm with gravel P.S = 1,400 kg / m³). In the case of ballasting realized with gravel we recommend to increase, by at least 2 times, the thickness of the gravel along the external perimeter band to a width of> = 1 m (thickness gravel = 8 cm) and at least 3.2 times the thickness of the gravel in the vicinity of the corner areas for a width of> = 1 m (= 12 cm thick gravel)

a typical roof system structured as "inverted roof"



Stratigraphy type :

In a typical roofing system structured as "inverted roof" the thermal insulation layer (**XPS**) is positioned externally of the sealing system in polymer-bitumen membranes (mbp)

The heavy security is constituted, in this case, by a heavy layer of washed round gravel (GTL), laying in place in different thicknesses depending on the different coverage area

From inside to outside : supporting structure, adjustment layer, connecting and slope, Bituminous primer, a two-layer sealing system in mbp, xps insulating layer, separating layer, containment and filtration, heavy protective layer of gravel

The mechanical fastening system :
Assessed the strength of the wind extraction W for the various zones of the coverage, you will have to proceed to the design of the mechanical fastening system (for points or lines), so that said system directly interests the sealing element, as it interests only the insulating element on which the sealing element will be placed in total adhesion.

If the sealing member were to be also subsequently laid with mechanical fixing, if laid correctly as regards the number of fasteners and their arrangement, with the mechanical fastening element In this case it will be sufficient to perform, for the heat insulating element, a pre-fixing of the panels to the base support in a number of at least 1 m² for fixing each panel or slabs ≥ 1 m². The insulating panels not affected by the mechanical fastening of the sealing element will be affected by a pre-fixing to the base support in a number of at least 2 fixings cad. panel or m² for plates ≥ 1 m²

Each insulating panel is also affected by the fixation of the sealing element, it will still be bound by at least one fixing or fixing with total extraction value> = 40 kg each panel. Only for the individual panel parts or adjacent fractionated, with total area <= 0,50 m², posed to completion of the surface continuity of the insulating element, will be possible to obtain a mechanical fastening system which has a total extraction value <= 40 kg cad

vetroasfalto

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

following **the mechanical fastening system :**

In the methodology for **mechanical fixing points**, the connecting element, applied on a cover system with corrugated metal sheet base support, the direction of the sealing will have to be transverse to the performance of ribbing, in order to be able to position the fasteners of each seam on separate ribs. May be an exception, depending on the geometry of the cover and of the wind by extraction calculations, the positioning of the fixing lines, and direction of the sheets, when there is located at the inner perimeter and external and vertical joints of emerging bodies.

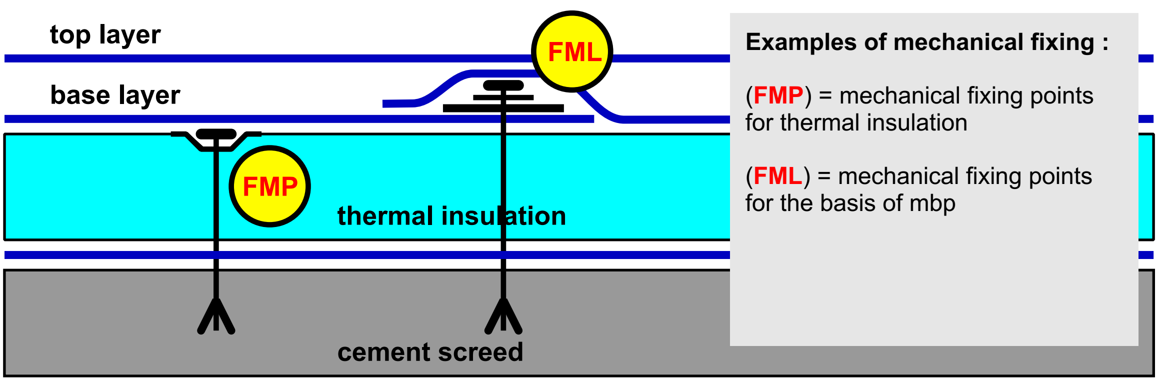
In the methodology of the mechanical fastening element fixing points to the size of the sheets of the junctions must be increased compared to the required width for a standard welding. The breakdown washer must still be distanced from the sheet edges for at least 5 cm.

In **mechanical fastening methodology for lines**, applied on the covering system, with the base support in the corrugated sheets, the direction of the sealing sheeting will have to be longitudinal to the performance of the ribbing, in order to position the transverse fixing bars the performance of the ribbed, so that the hardware of each single line prove places on separate ribs. May be an exception, depending on the geometry of the cover and of the wind by extraction calculations, the positioning of the fixing lines and relaivi towels, when you are at the inner perimeter and external and vertical joints of emerging bodies.

In the methodology of **mechanical fastening of the element for fixing points evenly distributed**, the connection element (washer + dowel / screw), must be configured in such a way as not to damage the overlying and sealing element consists of a membrane cutout, circular or square with rounded corners, of similar type to that of the sealing element, of such a size as to exceed the size of the washer or fixing plate, for at least 8 cm along the edge of the latter, in all conditions of operation load foreseen.

Given that the effective extraction of a mechanical fastening resistance is given by a series of components (structural support, insulation element, impermeable membrane, washer - plate / bar -, dowel / screw, etc.), for safety reasons and for how concerning the maximum load value to be considered it is recommended to use always, in the design phase, a value N = 400 x fixing, although the data sheets of the manufacturer of the hardware should return values> 400 N x fixing. We also recommend , again for security reasons, to reduce the nominal values of extraction of at least 30%

The project will still have to carefully consider the points to be followed and the respective values: characteristics of the membrane or membranes constituting the sealing element, characteristics of the fastening elements in their entirety, the characteristics of the anchor support to the extent relevant to the extraction resistance of the fasteners (for this purpose it is always advisable to carry out the extraction of the element spot fixing practical tests, with torque puller), compatibility of the anchor bracket with the fixing system expected characteristics of the thermal insulation element.



Examples of mechanical fixing :

(**FMP**) = mechanical fixing points for thermal insulation

(**FML**) = mechanical fixing points for the basis of mbp

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

whind speed for reference location

area	reference location	Vref,0	A0	Ka
		m/sec	m	l/s
1	Valle d'Aosta, Piemonte, Lombardia, Trentino A.Adige, Veneto, Friuli Venezia Giuglia (no Trieste)	25	1.000	0,012
2	Emilia Romagna	25	750	0,024
3	Toscana, Marche, Umbria, Lazio, Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, (no Reggio C)	27	500	0,030
4	Sicilia and province of Reggio C alabria	28	500	0,030
5	East side of Sardegna	28	750	0,024
6	West side of Sardegna	28	500	0,030
7	Liguria	29	1.000	0,024
8	Trieste (province)	31	1.500	0,012
9	Islands (except Sicilia and offshore)	31	500	0,030

roughness classes of the land around the building

roughness	description of areas of rilevance
A	urban areas with at least 15% covered by buildings with average height > 15 m
B	urban areas, with the exception of Class A, suburban, industrial and wooded
C	common areas with obstacles (trees, buildings, walls, fences, etc.) and areas not identified in previous classes A and B
D	areas with little common obstacles and blocks (open areas, airports, farmland, grassland, sandy soil, snow, ice, lakes, seas, etc)
The roughness of the terrain is not a function of the topography and the orography of the area. Classes A and B shall apply to buildings surrounded by the areas described for at least 1 km, however, with amplitude areas of no less than 20 times the height of the building	

exposure ratios mediated

building height	coefficient	external values
up to 5 m	2,0	1,6÷2,4
from 5 to 10 m	2,2	1,6÷2,8
from 10 to 15 m	2,3	1,6÷2,3
from 15 to 20 m	2,5	1,6÷3,2
from 20 to 30 m	2,7	2,0÷3,4
from 30 to 40 m	2,9	2,2÷3,6
from 40 to 50 m	3,2	2,5÷3,9

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com

Depressive loads on the covering - hints simplified procedure of calculation :

The Italian territory is divided into five regions (A-E). Each region is further divided into 4 zones (1-4), characterized by different kinetics reference pressures and assessed in the proportion of 20 m with respect to the ground level

REGIONS WITH SIMILAR WINDS

the **reference kinetic pressure**, is based on three level of heights for the buildings :
-height of between 0 and 10 m
-height of between 10 and 20 m
-height between 20 and 100 m

the **velocity pressure** for the project as four function parameters:
-the kinetic pressure reference to the reference rate (coverage)
-the topography coefficient (the exposure of the building)
-the profile coefficient (the orography of the surrounding ground)
-the return coefficient (twenty probabilistic index that relates to the possibility of incurring, on the part of the covering system, in windy critical conditions)

The **final depressive load** is constituted by the product of the above value for conventional local coefficients:

current areas of coverage = -1
perimeter zones = -2
corner areas = -3.2

The presence of overpressure discharging in the internal interface of the covering package entailing an increase of 0.6 (in absolute value) of the local coefficients (respectively -1.6; -2.6; -3.8)

Vetroasfalto SpA
Export Dept - via Pascoli, 3 - 20060 Basiano MI (Italy)
ph : +39 02 95983225 - fax : +39 02 95983557
mail : export@vetroasfalto.com