RABLE

Unlocking the solar energy potential of all roofs

RABLE4Roofs

Ballastfree Mounting system

- **Innovative Truss Principle:** Unique ballast-free and self-supporting system due to advanced truss principle.
- **Maximumspan:** Suitable for roofs with constructive limitations , where distance between roof beams span up to 25 meters for various roof types.
- **Equal Weight Distribution**: Each point carries equal load, from 7 kg/m² to 13 kg/m² for lightweight respectively standard panels.
- **Stability & Scalability:** Placement of roof anchors at the corners of a panel field, up to 80% fewer roof anchors than conventional systems, for safe and efficient installation.

Relevant norms

NEN 1010

All-metal construction with excellent grounding & bonding

NEN 7250 – EN 1990 – EN 1991

Delivered in accordance with forces standardization based on Eurocodes

SCOPE 12

RABLE installations have been inspected and approved by SCOPE 12 inspectors

20 years warranty

Full Specs

Technical features of RABLE4roofs

General

Roof type	Flat roofs, max. slope 10°
Material	Aluminium en Magnelis
Panels	Universal application
Arrangement	East West

	RABLE Standard	XXL
Panels per A-Frame	4	8
Dimensions Frame (cm)	200 x 480	200 x 950
Max. Span (m)	10	25

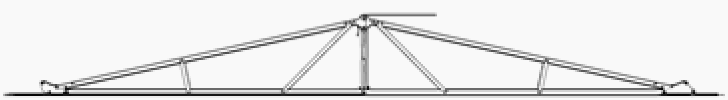
Unique Truss Principle

Using the patented steel cable, a truss is formed in the longitudinal direction. The central trellis forms a truss in the width direction. These two trusses over two axes form an extremely rigid structure.

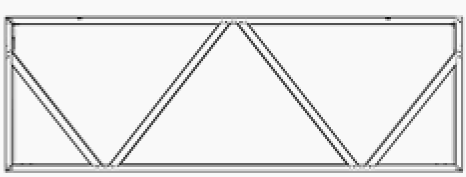
The steel cable creates a longitudinal bending resistance, allowing significant spans, up to a maximum of 25 meters, to be realized. The rigid structure provides even weight distribution across the entire field, leaning on the beams and rafters of the roof. The truss structure not only provides efficient load-bearing capacity, but also minimizes the load on roof panels, making the system suitable for various roof types.

The mounting system can already be used with an allowable roof load as of

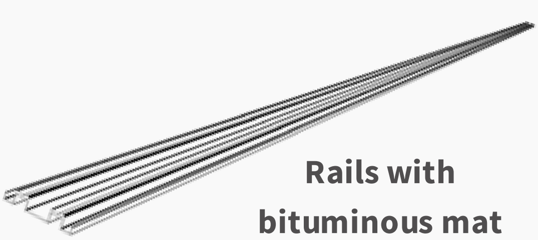
- 7 kg/m² with lightweight panels, or 11 kg/m² with regular panels.
- Of which weight of the substructure is 3 kg/m².
- The RABLE roof system may add up to 10% stiffness to the underlying roof.
- For advice on permitted roof loads, please contact RABLE.



(Un) foldable Side



Customized Center



Rails with bituminous mat

Wind tunnel test

TU Delft has carried out wind tunnel research as commissioned by RABLE Group B.V. in accordance with CUR recommendation 103.

The results have been processed by RABLE B.V. Group into calculation tables for design of layout and anchoring plans for PV installations in accordance with NEN 7250 / EN 1990 / EN 1991 and Eurocodes.

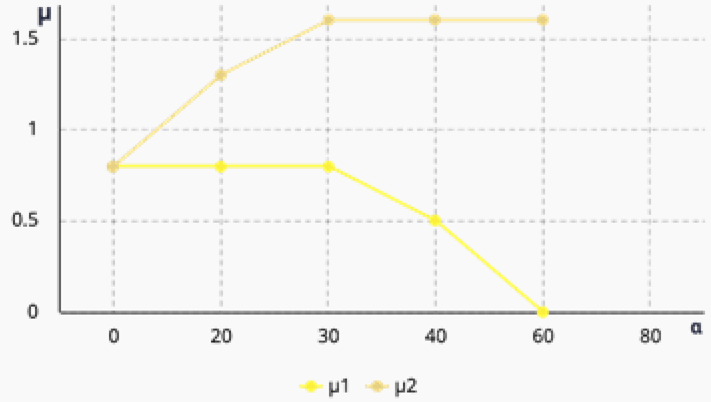
Wind tunnel tests provided insights into the loads on the mounting structure under different weather conditions. The research, simulations and analyses sconfirmed that RABLE can significantly reduce the number of roof anchors (up to 80% less than traditional systems) without affecting the stability and safety of the structure. This results in a more cost-effective solution.

Loads

Snow load coefficiënt

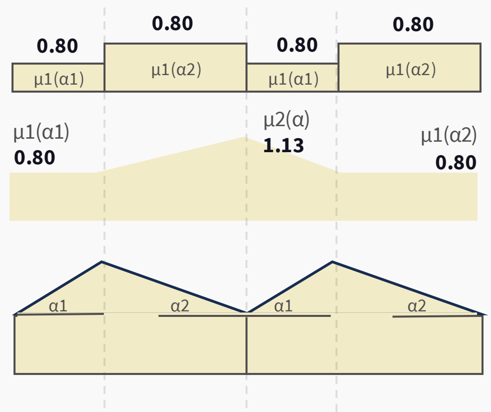
The reference period for PV systems is set at 15 years. Here the snow load (0.7 kN/m²) may be reduced by 25%, not to be confused with the reduction for flat roofs, which may be reduced by 20%).

In addition, a 3% reduction may be applied according to Eurocode NEN-EN 1991-1-3 General loads - Snow load. This calculation is based on the slope angle of 12.5° which is applicable for EW-series of RABLE.



Daken met meer dan één overspanning

Roof slope α1 = 10
Roof slope α2= 15
Sneeuw can slide off unimpeded = yes
Average roof slope= (α1 + α2)/2 = 12.5°



μ1 gives 0,80 and μ2 gives 1,13 where μ-average results in 0,97
Snow load RABLE: 0.7 · 0.75 · 0.97 = 0.51 kN/m²

Tax combination factors

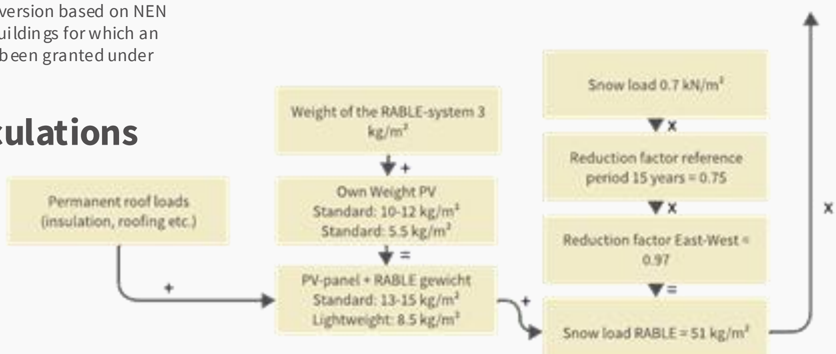
For the load combination factors, the factors for rebuilding should be used.

The above assumptions are common for structural calculations. The inherent stiffness of the RABLE system is not taken into account in the construction of the roof. Should the roof construction not be strong enough after calculating the above assumptions, it is possible to calculate the roof construction including the stiffness of the RABLE system. Ask about the possibilities if required.

	Permanent loads	Prevailing variable load other than wind	Variable wind normative load
Vgl 6.10a			
CC 1	1.15	1.10	1.20
CC 2	1.30 (1.20)	1.30	1.40
CC 3	1.40 (1.30)	1.50	1.60 (1.50)
Vgl 6.10b			
CC 1	1.05	1.10	1.20
CC 2	1.15	1.30	1.40
CC 3	1.25 (1.20)	1.50	1.60 (1.50)

Table: load factors for buildings during conversion based on NEN 8700; values in parentheses apply only to buildings for which an environmental permit for construction has been granted under Building Code 2003 or before

Input structural calculations RABLE distributed load



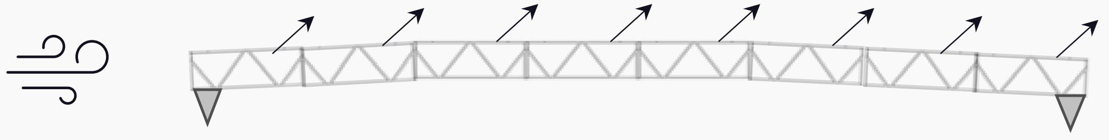
Expert Report

Clarification Anchorplan

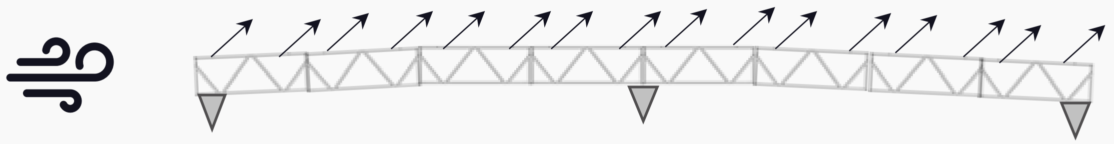
Based on the wind tunnel tests, the elevation coefficient on the RABLE substructure was determined. Using this coefficient and the maximum thrust pressure, which depends on the factors **Building height, Wind zone, Building grade**, etc. the environmental force factors (lift, pressure, lateral) on the system and roof is calculated.

By using the **Finite Element Analysis (FEA)**, the strength and stiffness of the RABLE substructure was determined. In combination with this stiffness and strength, and the buoyant force (depending on factors discussed above) on the system, the number and position of anchors is determined. Here, a maximum anchor force of 150 kg per anchor is assumed.

Wind Zone 3 | Built-up Area | Low building



Wind Zone 1 | Non Built-up Area | High building



NEN 1010

Meting nr.	Eerste meetpunt	Tweede meetpunt	Lengte tracé (geschat)	Weerstand	Afwijking
1	Meetpunt onderconstructie	Meetpunt onderconstructie	2,00 meter	0,03 Ohm	Nee
2	Meetpunt onderconstructie	Meetpunt onderconstructie	4,00 meter	0,03 Ohm	Nee
3	Meetpunt onderconstructie	Meetpunt onderconstructie	6,00 meter	0,04 Ohm	Nee
4	Meetpunt onderconstructie	Meetpunt onderconstructie	1,00 meter	0,07 Ohm	Nee

Inspection SCIOS V2.0 | 21-04-2023 | Chris van Emmerik
12996 Report SCOPE 12 RABLE Substructure

omega inspectie

SCOPE 12 Inspection DBD

Bearing capacity
The load-bearing capacity of the building's structure is insufficient to support a conventional solar installation held in place by ballast. By using this newly developed mounting construction, ballast is not required to hold the system in place. The entire (pilot) system is fixed to the structure at the four corners. According to the structural calculations, all weights remain within the margins of what the structure could carry.

Conclusion
It is an innovative system that has the potential to be widely applied.

Corrosion Magnelis

RI.SE

Type Approval and decision on production control
SC0559-13

Steel flat products for cold forming coated with Magnelis® ZM310

Holder/Issued to

ArcelorMittal Europe - Flat Products
1160 LUXEMBOURG, LUXEMBOURG

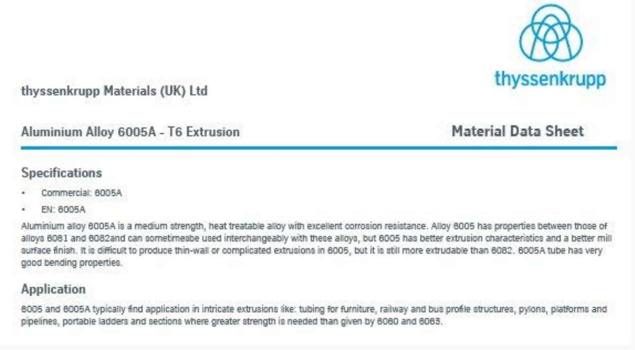
Product description

Steel flat products for cold forming coated with Magnelis® ZM310. Products are manufactured in accordance with EN 10346:2015 with steel grades as specified in table 1, table 2 and table 3 of the standard. Magnelis® ZM310 is a corrosion protective alloyed coating composed of zinc, aluminium and magnesium.

Intended use

Products and structures manufactured from steel flat products for indoor- and outdoor applications. Products coated with Magnelis® ZM310 are suitable for corrosivity category C5, according to in SS-EN ISO 12944-2 described class, based on a deemed expected lifetime of 15 years.

Corrosion Magnelis



thyssenkrupp

thyssenkrupp Materials (UK) Ltd

Aluminium Alloy 6005A - T6 Extrusion — Material Data Sheet

Specifications

- Commercial: 6005A
- EN: 6005A

Aluminium alloy 6005A is a medium strength, heat treatable alloy with excellent corrosion resistance. Alloy 6005 has properties between those of alloys 6061 and 6082and can sometimesbe used interchangeably with these alloys, but 6005 has better extrusion characteristics and a better mill surface finish. It is difficult to produce thin-wall or complicated extrusions in 6005, but it is still more extrudable than 6082. 6005A tube has very good bending properties.

Application

6005 and 6005A typically find application in intricate extrusions like: tubing for furniture, railway and bus profile structures, pylons, platforms and pipelines, portable ladders and sections where greater strength is needed than given by 6060 and 6063.

Voor parkeerterreinen

RABLE10carpark

General

- **Maximum Capacity**
  Supports 80 solar panels per column, optimizes space for at least 16 cars on 300 m²
- **99% Waterproofing**
  For a drier parking experience
- **Cost Effective Solution**
  With 50% fewer support columns, it creates an impressive business case of only €0,08 per kWh

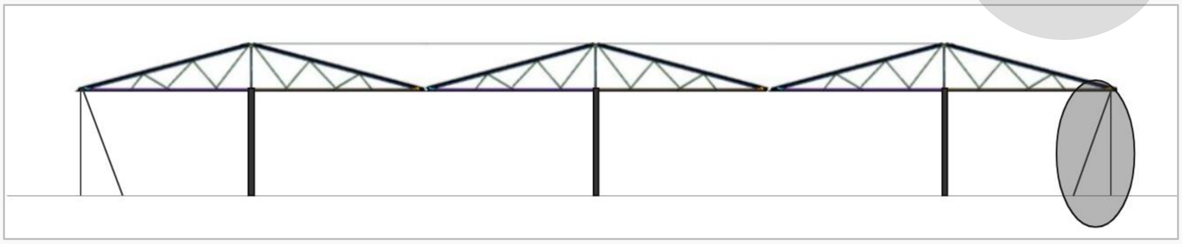
Material

✓ Galvanized steel C5 or similar
✓ Stainless Steel 316 fixing material

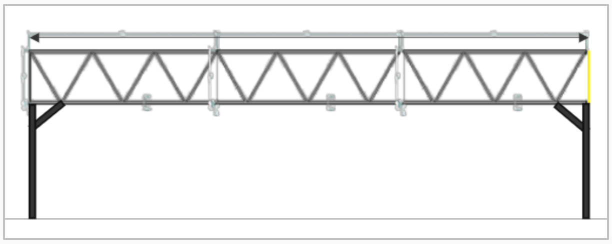
Truss technology for optimal span

The RABLE10carpark features the same lattice technology used in RABLE4roofs. Thanks to the use of steel cables, this technology offers significantly improved span capacity. Whereas traditional systems typically require a support pillar or column every 5 meters, our advanced approach makes it possible to limit to one support points every 11.5 meters over a width of 15 to 16 meters.

Anchoring only at field corners



Longitudal direction



Transverse direction