



# Pultrusie profielen

## als constructie materiaal

- Wat is het ?                    Hoe is het ontstaan ?
- Wat kun je er mee bouwen ?
  
- Uw spreker:
- Joop van der Burg – Bijl Profielen BV in Heijningen



# Pultrusie profielen

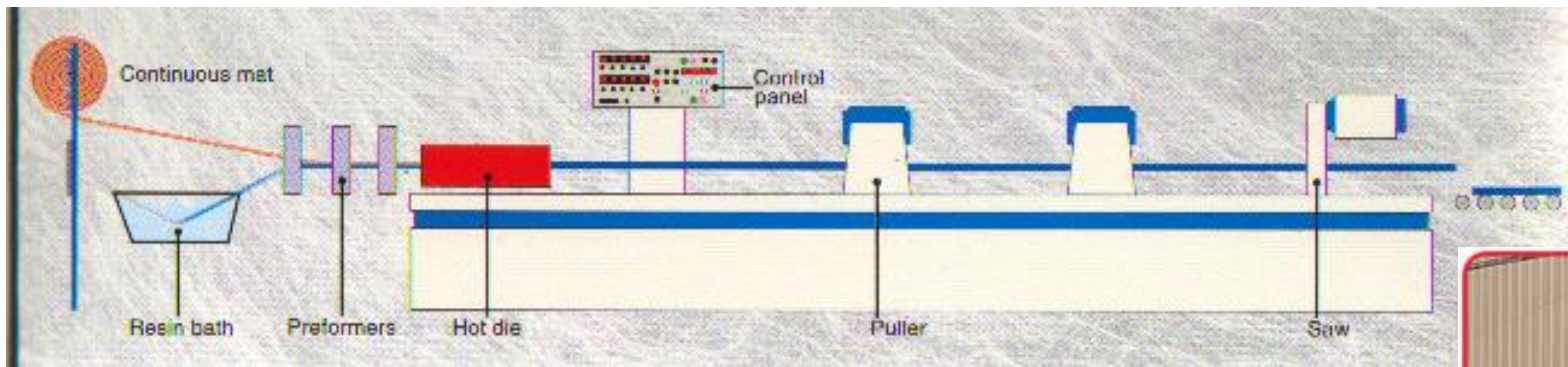
## als constructie materiaal

Een composiet is een materiaal dat is opgebouwd uit verschillende componenten. Vaak worden hiermee vezelversterkte kunststoffen bedoeld. De vezels zorgen voor de krachtdoorleiding en de matrix (vaak kunststoffen) houden de vezels samen en zorgen voor het overbrengen van schuifspanningen. Bekendste vezels zijn glas, aramide (twaron en kevlar) en koolstofvezel (carbon). Momenteel kijkt men ook naar het gebruik van natuurlijke vezels zoals vlas.



# WAT IS PULTRUSIE ?

schema



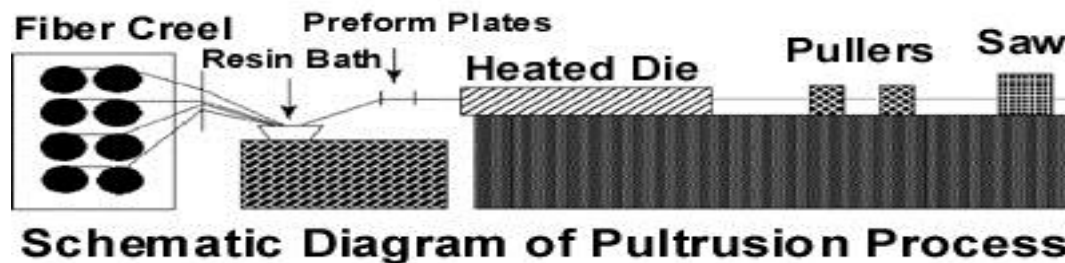
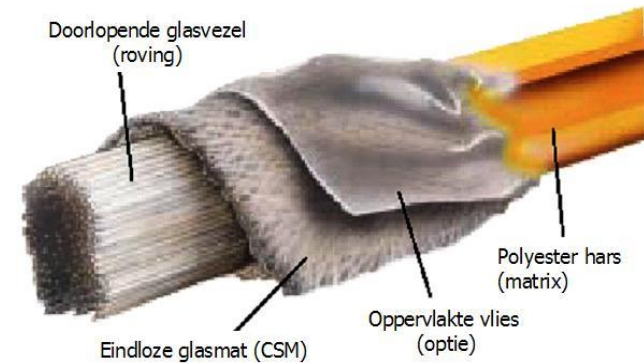
- Ontstaan na 1945 voor vishengel productie
- Verbeterd van interval naar continue
- door toepassing van lossing middel
- opstart ladder profielen in 1959



# WAT IS PULTRUSIE ?

- Het trekken van polyester profielen
- Continu proces
- Goede fysische- en mechanische eigenschappen
- 60-70% glasgehalte makkelijk haalbaar
- Glad oppervlakte aan beide zijden gekleurd tot in de massa

## Opbouw pultrusie profiel

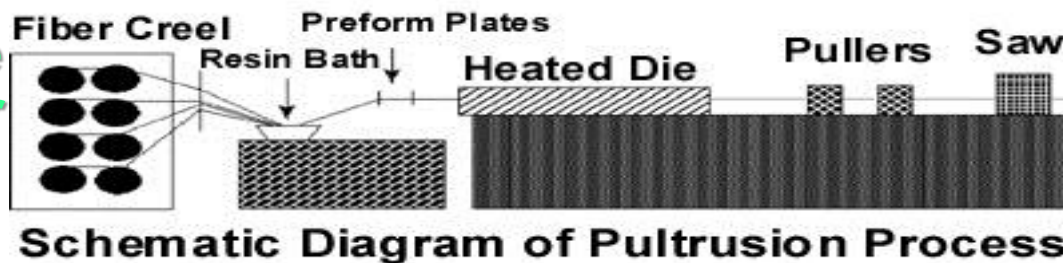
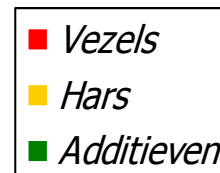




- **Vezels**
- **Glas**
- **Aramide**
- **Koolstof**
- **Twintex**
- **natuurvezel**
- **Hars**
- **Orthoftaalzure polyester**
- **Isoftaalzure polyester**
- **Epoxy**
- **Vinylester**
- **Phenol**
- **Acryl (PMMA) modar**
- **polyurethaan**
- **Additieven**
- **Mold release**
- **UV vertrager**
- **Pigment**
- **Vulstof**
- **Verharder**

# WAT IS PULTRUSIE ?

stoffenlijst

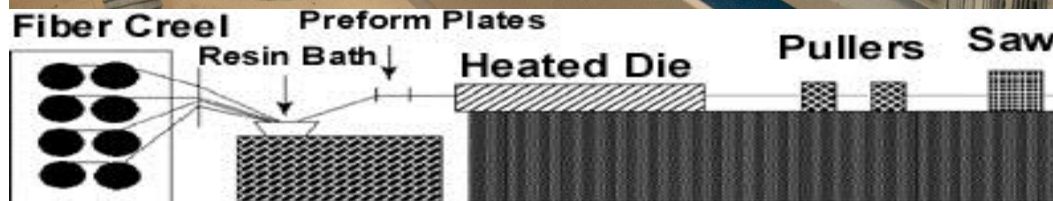


# WAT IS PULTRUSIE ?

machine



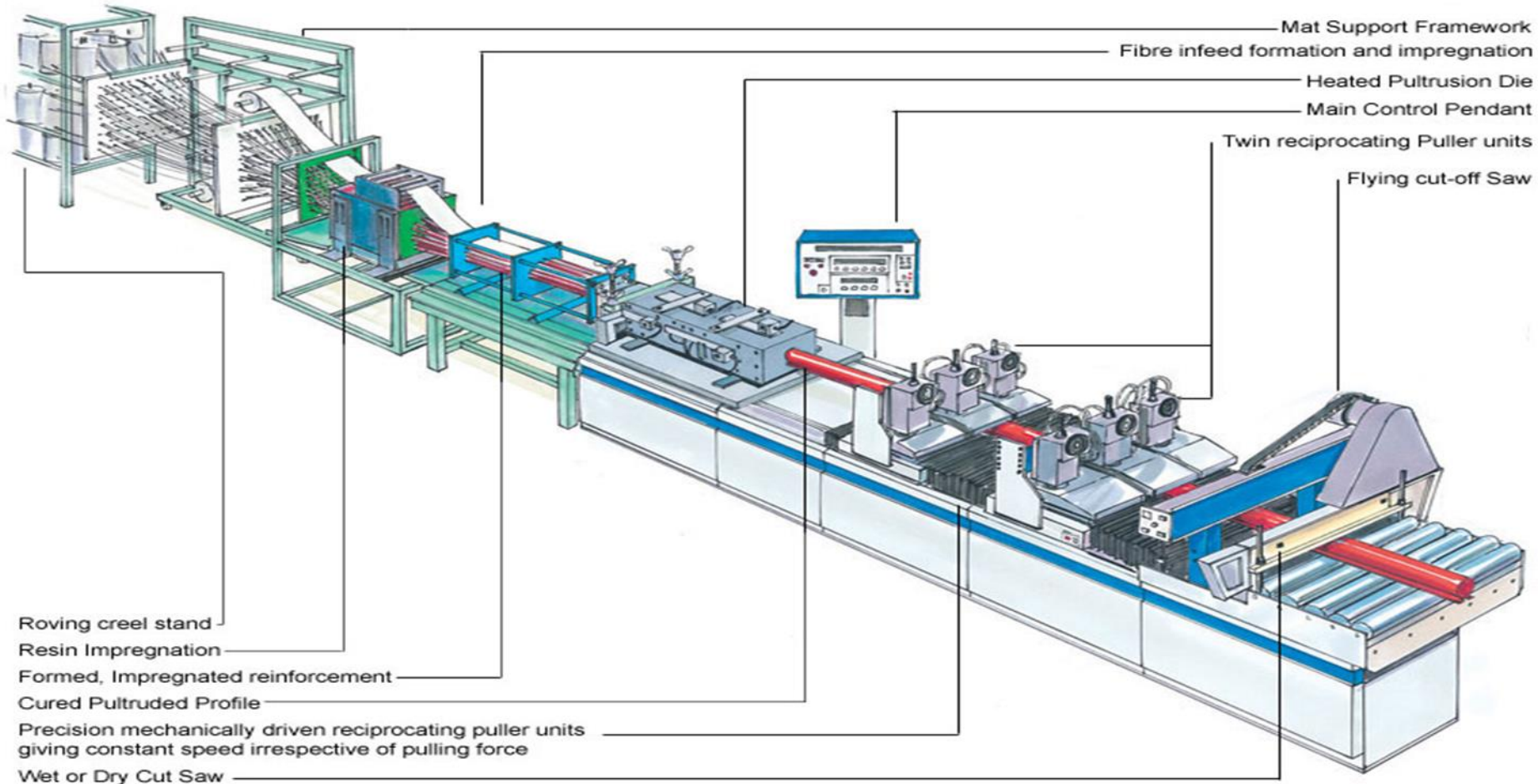
- Invoer glaswapening
- Benatting glaswapening
- Vorming en uitharding in matrijfs
- Trekunit
- Zaagunit



**Schematic Diagram of Pultrusion Process**

# WAT IS PULTRUSIE ?

overzicht



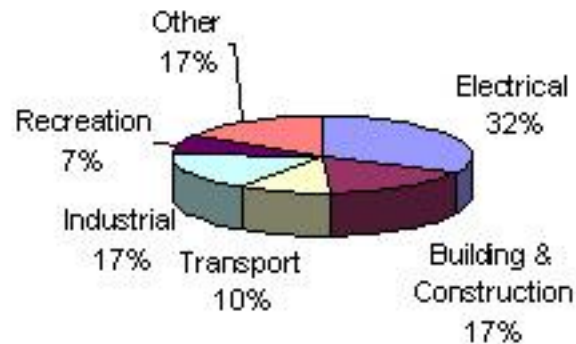


# TOEPASSINGEN

markten

- Thermische isolatie
- Elektrische isolatie
- Onderhouds arm
- Licht gewicht in verhouding tot hoge sterkte, veel vezels
- Chemisch bestendig
- Lage productie energie benodigd
- Lange gebruiksduur
- Alle boven staande punten zijn een milieu voordeel !!!

Application Areas of Pultrusion





# STANDAARD

## VOORRAAD PRODUCTEN

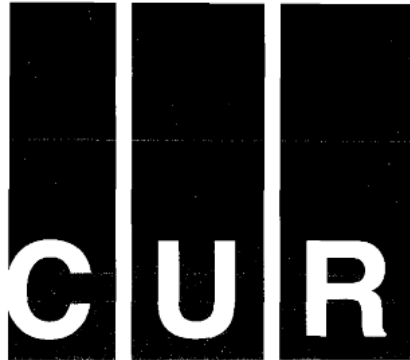
- Standaard producten uit voorraad leverbaar volgens
- EU norm EN13706



# STANDAARD

## voorraad producten

Mechanical properties		NEN 13706-grade E23	
ITEM	Fiber orientation	UNIT	E23
Modulus of Elasticity	axial	Gpa	23
-	transverse	Gpa	7
Tensile strength	axial	Mpa	240
-	transverse	Mpa	50
Pin bearing strength	axial	Mpa	150
-	transverse	Mpa	70
Bending strength	axial	Mpa	240
-	transverse	Mpa	100
Inter laminate shear strength	axial	Mpa	25
	transverse	Mpa	50
Physical properties			
ITEM		UNIT	VALUE
Density		kg/m <sup>3</sup>	1800
Barcol hardness		BARCOL	50
Water absorbtion		weight%	0,007
Linear coefficient of thermal expansion		mm/°C	10-16 x 10 <sup>-6</sup>



# STANDAARD

## ontwerp aanbeveling

Civieltechnisch Centrum Uitvoering Research en Regelgeving

### Aanbeveling 96

## VEZELVERSTERKTE KUNSTSTOFFEN IN CIVIELE DRAAGCONSTRUCTIES

Deze aanbeveling is in bewerking om opnieuw uitgebracht te worden met aanpassingen volgens de huidige inzichten en stand der techniek

De toepassing van vezelversterkte kunststoffen (VVK) in civieltechnische draagconstructies mag zich verheugen in een toenemende belangstelling. Hierdoor ontstaat bij de constructeur de behoefte aan rekenregels om dergelijke constructies te ontwerpen en te dimensioneren. Zijn in andere sectoren, zoals vliegtuigbouw, windenergie en scheepsbouw rekenregels inmiddels vertaald in normen en richtlijnen, voor de civiele techniek ontbreken ze nog.

In deze CUR-Aanbeveling wordt ingegaan op het constructief ontwerp van civieltechnische constructies uit glasvezelversterkte kunststoffen (GVK), een van de verschillende vezelversterkte kunststoffen (VVK). Het is de verwachting dat hiermee het gebruik van glasvezelversterkte kunststoffen (GVK) als constructief materiaal in de civiele techniek wordt gestimuleerd. Het is de wens de Aanbeveling in de toekomst uit te breiden naar andere vezelversterkte kunststoffen.



# STANDAARD

## end of life



### Glass fibre reinforced thermosets: recyclable and compliant with the EU legislation

June 2011

The European Plastics Converters (EuPC), the European Composites Industry Association (EuCIA) and the European Composite Recycling Service Company (ECRC) welcome the End-of-Life of Vehicles Directive (2000/53/EC) and the Waste Framework Directive (2008/98/EC): **glass fibre reinforced thermosets are both material and energy recyclable through the cement kiln route and compliant with the EU legislation.**

#### Glass fibre reinforced thermosets

The high range of major industrial sectors such as automotive & transport, building and construction, electrics & electronics, sport & leisure, wind energy and energy conservation are demanding various materials during the manufacturing process. The material choice is dependent on several factors such as material properties, price, and availability and lower environmental impact. The use of composites material solutions increased significantly during the last years, because of optimal combinations between mechanical strength, design flexibility, reduced weight and costs attached.

Composites are composed of a fibrous material and a resinous matrix. In many applications glass fibre is used as reinforcement material. The resinous matrix is frequently a thermosetting polymer, such as unsaturated polyester resins or epoxy resins. Inorganic fillers, such as calcium carbonate, can be used to adapt material properties and in some cases to reduce the cost price.

#### Glass fibre reinforced thermosets: recyclable and compliant with the EU legislation

The recycling of glass fibre reinforced thermosets parts has been studied extensively for many years. Fundamentally, three recycling technologies have been researched and yield potential waste management solutions:

- **Material recycling:** Which involves grinding of glass fibre reinforced thermoset parts to a recycle that can be used as a new raw material with reinforcing properties in composite parts and in other products that need reinforcement. It can also be used as filler.
- **Chemical recycling:** Chemically dissolve the polyester and re-use it in new polyester. Fibers can be

Composiet te recyclen

Volgens EU toelating

industry, as a substitute for fossil fuels and recycling.

**Thermosets recycling**  
of alternative fuels and raw materials in cement Association (CEMBUREAU) it is

noted the following.

*"Cement is an essential product, providing society with what it needs in terms of safe, comfortable housing and reliable modern infrastructure. Co-processing in the cement industry is the optimum way of recovering energy and material from waste. It offers a safe and sound solution for society, the environment and the cement industry, by substituting non renewable resources with societal waste under strictly controlled conditions. The co-processing of alternative fuels provides a solution in terms of reducing fossil fuel dependency as well as a contribution towards the lowering of emissions. The use of alternative raw materials also has numerous benefits, including a reduced need for quarrying and an improved environmental footprint of such activities. Substitution of clinker in cement is an example of the positive contribution of the European cement industry to resource management. The use of alternative materials in the cement industry lowers global CO2 emissions and does not have a negative impact on production process emissions, nor on the environmental and technical quality of the final product. Furthermore, co-processing in the cement industry is carried out in a safe and sound manner, thus not affecting the health & safety of its workers or neighbourhood."*

The Composites Industry supported and founded several projects which showed that glass fibre reinforced thermosets parts are recyclable and can successfully be fed into a cement kiln as a substitute for other raw materials and for primary fuel. With the developed cement kiln route, the waste parts are co-processed into valuable new material finding its way in the final cement. The cement kiln route is a recycling process compliant with the recycling definition in the Waste Framework Directive (Art.3 (17)).

*"Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations"*

When recycling glass fibre reinforced thermosets through the cement kiln route, most of the material (approx. 2/3<sup>rd</sup>) is transferred into material for cement production. A small part of the waste, the organic part (approx. 1/3<sup>rd</sup>) generates energy. This process translates as **energy recovery** according to the recycling definition.

The cement kiln route is not used to generate energy from burning glass fibre reinforced thermosets waste. When feeding composite waste in a cement kiln, the main part of the material is turned into cement or a useful part of the cement composition. This process translates as **reprocessing into materials or substances whether for the original or for other purposes** in the recycling definition. And it is also compliant with Article 3 (15).

*"Recovery means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy."*

Following the outcomes of the recycling technologies developed so far, the European composites industry considers the cement kiln route to be the most sustainable solution for waste management of glass fibre reinforced thermoset parts.

###

This Position Paper is supported by:

The European Plastics Converters (EuPC) [www.plasticsconverters.eu](http://www.plasticsconverters.eu)  
European Composites Industry Association (EuCIA) [www.euCIA.org](http://www.euCIA.org)  
European Composite Recycling Service Company (ECRC) [www.ecrc-greenlabel.org](http://www.ecrc-greenlabel.org)

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# TOEPASSINGEN

BIJL PROFIELEN BV / GROOT-LEMMER BV



**DRAAGBALKEN**

**VAN POLYESTER KOKER**

Niet in polyethyleen uit te voeren



# BRUG ZAA NSTAD

BIJL PROFIELEN BV



**VOLLEDIG KUNSTSTOF BRUG**



# Conservering





# PERRONRAND BODEGRAVEN



RAND 300mm x 150mm  
Inclusief anti-slip



# JACHTHAVEN TERNEUZEN



loopvloer  
inclusief anti-slip



# TRAMTUNNEL PROJECT



Onder deze houten vloer  
liggen: pultrusie planken

# TRAMTUNNEL PROJECT



Onder deze houten vloer  
ligt:

**DUTCH-PLANK®**



# TRAMTUNNEL PROJECT

DEN-HAAG



**DUTCH-PLANK®**

tussenvloer op beton  
met houten afwerkvloer



# Composiet dek Hardenberg

- Grootste kunststof fiets / voetgangers brugdek in Europa  
800 m<sup>2</sup> in 2006



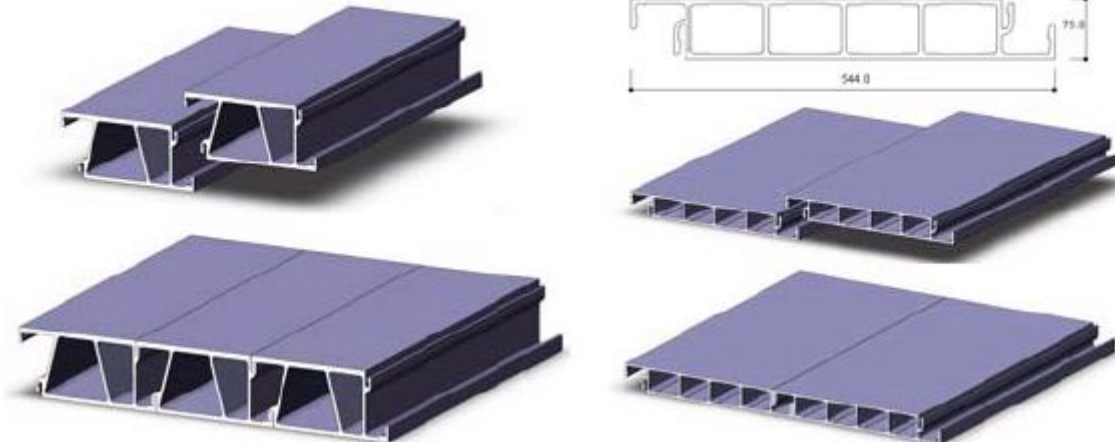
# BRUG HARDENBERG



# VERBINDINGEN

methoden 1

- Lijmen
- Klinken
- Klemmen
- Schroeven
- Ingieten
- Pen / gat





# VERBINDINGEN

## methoden 2

- Lijmen
- Klinken
- Klemmen
- Schroeven
- Ingieten





# PROJECTEN

algemeen: koeltoren



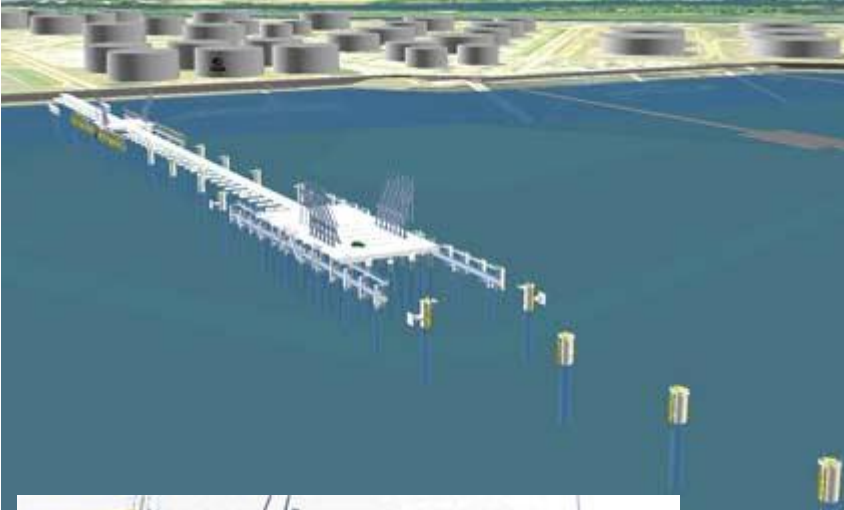
Koeltoren : zout water



- Makkelijk te bouwen
- Corrosie bestendig
- Alternatief voor tropisch hard hout

# PROJECTEN

algemeen: leuningen zeehavens

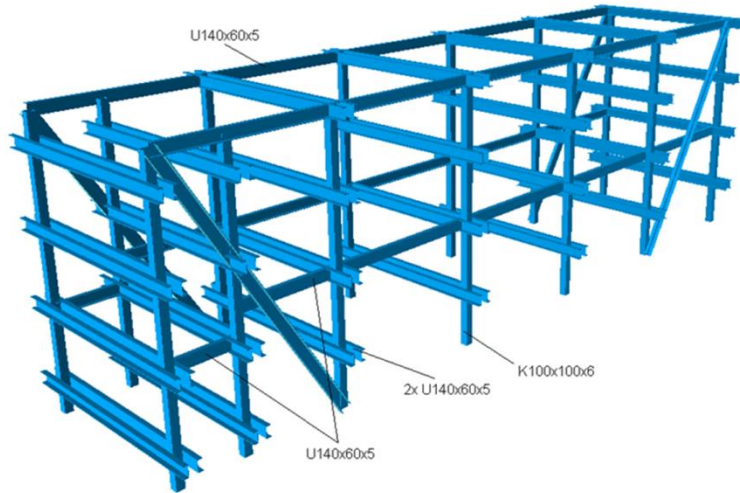


**VOPAK** europoort



# PROJECTEN

algemeen: constructies



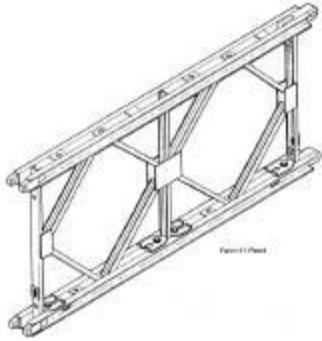
•BIJL PROFIELEN

# PROJECTEN

algemeen: platforms







# PROJECTEN

algemeen: bruggen

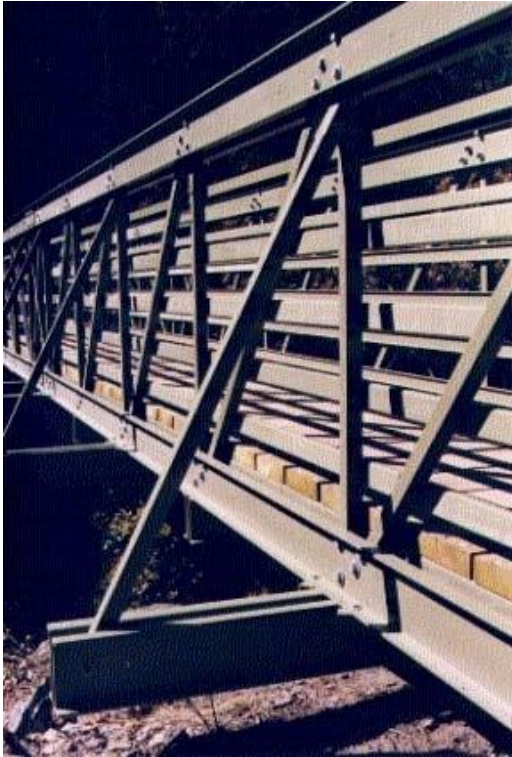


Foto: Strongwell



# PROJECTEN

algemeen: zwembad koepel

