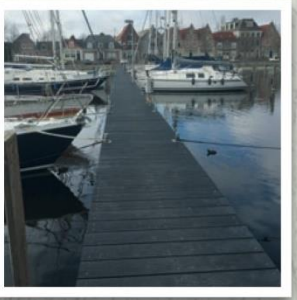
Lankhorst | *Recycling Products*

A trade name of Lankhorst Engineered Products bv

Royal Lankhorst Euronete



Technical Brochure

www.lankhorst-recycling.com

original KLP®

WireCo® WorldGroup

Index

1. General

1.1 What is KLP®

Since 1975 Lankhorst Recycling Products has been supplying innovative products and services that fit a green and sustainable environment. As well as plastic poles and plastic planks we also produce complete plastic pile planking, retaining walls, landing stages, façade panels, decking and bridges from recycled raw materials such as bottle caps, crates and agricultural foil. From these materials we compose the optimal mix with the required strength and stiffness. In the course of many years Lankhorst has developed an extensive knowledge and experience with regard to production processes, material compositions and applications. The starting point at Lankhorst for selecting KLP® components is always a high quality and consistent end result. KLP® is our brand name for products made from recycled plastics. It is the abbreviation of "Kunststof (Plastic) Lankhorst Product" and stands for quality.

KLP® is a reliable construction material and the main advantages compared to wood are that it does not rot nor splinter, it will last decades and is maintenance free. After years of sunshine, rain and frost the construction of KLP® will remain as good as new, because it is UV, water and weather resistant. The material is extremely safe as the material does not splinter and its anti slip properties are twice as good compared to wood, even in wet weather conditions. However, KLP® has properties that are different from what one is used to when using wood, which have to be taken into account when constructing. You can read all about it in this technical brochure.

KLP® plastic products contribute to a better environment as they are made from recycled material and not chemically treated in any way. They will therefore not leach poisonous substances to the environment. Plus, if necessary the sustainable plastic of KLP® can be recycled again.

We pay a lot of attention to safety, environment, product quality and quality for people. Our goal is to constantly improve our organization and services according to the principle of sustainable enterprise. In order to guarantee this we have been certified according to the following international standards: ISO 9001 (Quality), OHSAS 18001 (Safety) en ISO 14001 (Environment). See *Attachment 4*.

KLP® and it's strengths:

- Sustainable
- Environmentally friendly
- UV, water and weather resistant
- Maintenance free
- Easy to process
- No rotting or splintering
- Recyclable

1.2 Material properties en fire conduct

1.2.1 Material properties

The standard color of KLP® is black, other colors are on request. All KLP® products are resistant to UV, caustics, salt and acids. The black pigment (carbon black) is an excellent protector from UV-light. Therefore there will hardly be any effect concerning the mechanical properties. After many years of exposure to the sun the only noticeable effects will be a slightly lighter colour or a somewhat rougher surface. Water and fouling have no influence on KLP® due to the hydrophobic character of Polyolefin that is used. A low energy surface prevents adsorption of moisture and adhesion of fouling. Due to the low surface energy it can be difficult to glue or paint the products.

Resistance properties of KLP® to chemical products are described in table 1.1.

Chemical resistance:	
Organic acids	+
Anorganic acids	±
Oxidizing acids	-
Bases	+
Alcohols	±
Ketones	±
Aliphates	+
Aromatics	-
Trichlorethylene	-
Salt (for icy roads)	+

Table 1.1 Resistance properties

+ = No influence

± = Minor Influence

- = Significant influence

There are several kinds of KLP®, each with their own application possibilities:

1.2.1.1 KLP®

For standard applications and general use, such as decking planks, we advise our standard KLP® compound. The flexural modulus of standard KLP® compound is 1000N/mm^2.

1.2.1.2 KLP®-V glass fiber reinforced

For special heavy duty parts or parts that require a high stiffness we use KLP®-V with glass fiber reinforcement. This if for instance used for support beams or for sheet piling poles. The flexural modulus of KLP®-V is 2000 N/mm^2.

1.2.1.3 KLP®-S steel reinforced

By using steel-reinforced plastic beams it is possible to construct landing stages and bridges with much larger spans. This means that fewer poles are needed, leading to significant savings on the overall material and construction costs. The plastic beams are produced using a unique process developed and patented by Lankhorst. Four steel reinforcement bars are integrated and encased within the plastic during the moulding process. This in turn prevents the corrosion process of the steel reinforcements due to the anaerobic environment. Several diameters of steel bars are possible, depending on the application. When using KLP®-S a structural stiffness value up to 17.000 N/mm^2 can be achieved. See *Attachment 1,* KLP®-S.

1.2.2 Fire conduct

All plastics will burn when in contact with a flame; they are combustible as are most materials. However, there are significant differences in behaviour once the flame is removed. Some materials keep on burning, while others extinguish.

KLP® properties

The standard KLP® mix has been classified as fire class 3 according to NEN 6065. KLP® Facade Panels are also available in classification B according to NEN-EN 13501-1. NEN-EN 13501-1 describes the fire classification of construction products and building elements. A1 being the highest achievable value, with F being the lowest. KLP® façade panels have an additional classification (S1 & d0) with regards to smoke development and (flaming) drip/particles.

Comparison between the fire conduct of wood and plastics

At the request of Lankhorst Recycling Products the well-known TNO institute studied the differences in fire conduct of plastic and wood poles. Some findings from this report*:

In the case of contact with relatively small heat sources, such as matches, cigarette lighters and balls of (news)paper it turned out that wood poles catch fire more easily than plastic poles, especially in the splits.

Using a butane gas heater at the foot of a plastic pole for twice a minute the plastic pole will extinguish within a few minutes. Although a plastic pole could be set on fire with a cigarette lighter, the flames will extinguish within 15 minutes in a draught-free space. Outdoors the flames will probable extinguish much faster due to the wind.

When heating is done with a larger, longer-lasting heat source, a single wood pole would extinguish. A plastic pole will continue to burn, because the plastic will melt due to the heat and the liquid plastic at the foot of the pole continues to burn.

Smoke production:
In general when polyethylene and/or polypropylene is burnt quickly smoke production with a strong soot output will occur, stronger than will be the case with wood. Smoke fumes from plastics will not be more poisonous than fumes caused by burning wood.

** TNO-report B-90-225*

1.3 Tooling possibilities

In principle KLP® can be treated like wood. All treatments possible for wood, are possible for KLP®, such as drilling, sawing, milling and planing. The general rule is not to choose too high cutting speeds to prevent the material from melting which will result in unappealing edges. In cold weather conditions KLP® will be slightly stiffer and more brittle. Due to the chosen combination of materials however, the material will show a high resistance to breaking, up to at least 20 degrees below zero.

Drilling
Use metal or wood bits (HSS or HM type). Spiral or speed bits are both possible. Don't choose too high cutting speeds. See *Table 1.5* en *Figure 1.6*.

Sawing
This can be done with a handsaw, circular saw, chainsaw or any other possible saw. Keep the speed low. See *Table 1.5* en *Figure 1.8.*

Milling and planning
Milling and planning are possible, but keep in mind that if, for instance, you would plane or mill a few centimetres from one side of a pole, it is well possible for the pole to bend. In such case it is preferable to take away an equal part from both sides.

See *Table 1.5* en *Figure 1.7* for further information.

	Unity	Drilling	Circular saw	Band saw	Milling
Clearance angle	degrees	10-12	10-15	30-40	5-15
Cutting-edge side rake	degrees	3-5	0-15	0-5	0-15
Cutting speed	m/minute	50-100	< 3000	500-1500	<1000
Tooth distance	mm	-	>10	>5	-
Tool cutting-edge angle	degrees	-	-	-	-
Nose angle	degrees	60-90	-	-	-
Feed	mm/rotation	0,2-0,5	-	-	0,1-0,5

Table 1.5 Recommended tooling details

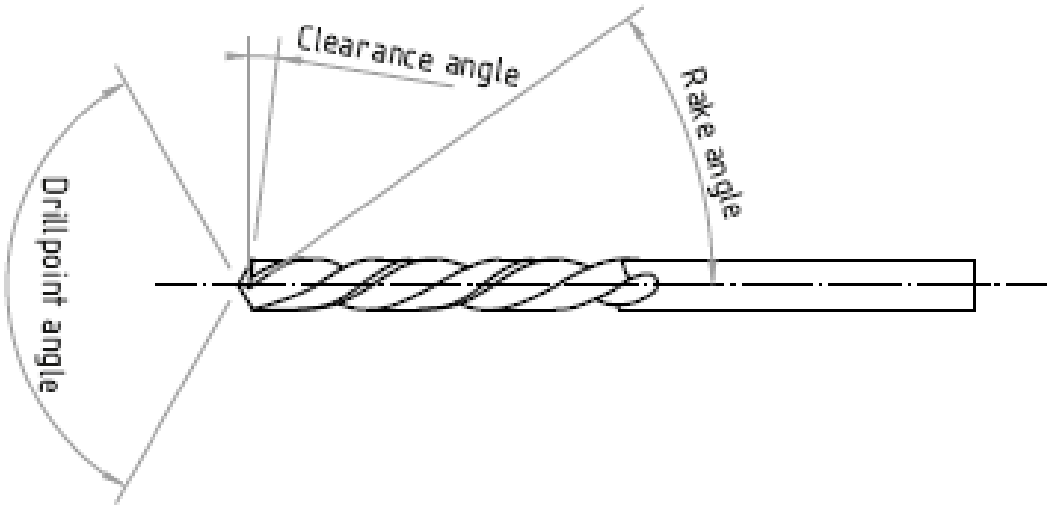


Figure 1.6 Drilling

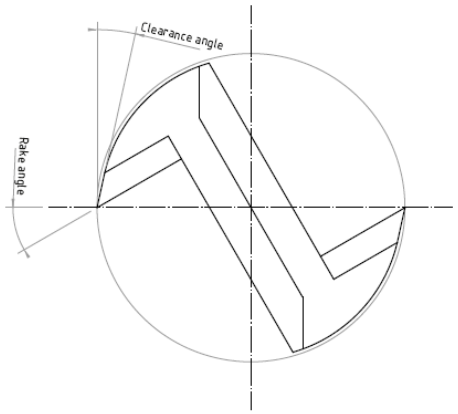


Figure 1.7 Milling

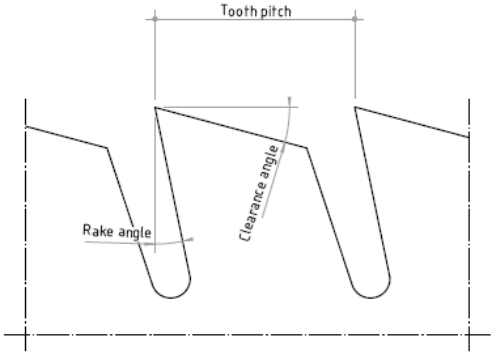


Figure 1.8 Sawing

Nailing
KLP®-materials are no suited to be nailed when used as a constructive element.

Screwing
Chipboard screws are most suitable for KLP®. It is preferable to predrill the holes for the screws and to deepen the holes when using screws with a countersunk head (see *Figure 1.9*.). If this is not done, the material around the screw head will slightly bulge, which can, if necessary, be removed with a sharp knife.

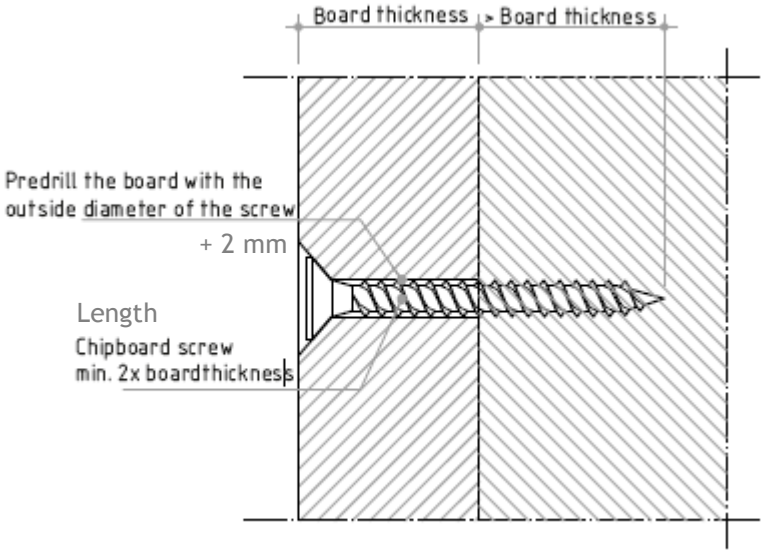


Figure 1.9 Predrilling/countersinking

Bolting
It is recommended to use bolts when making mechanical connections with KLP®- parts. Carriage bolts or wire ends in combiation with washers and nuts for instance can be used. Lenghts and diameters are depending on the load requirements.

Stapling
Stapling is possible. The maximum staple dimension depends on which KLP® compound is used. Stapling as a constructive connection is advised against.

Slit holes
Slit holes can be made by drilling a few holes next to each other and by removing the walls in between by moving the drilling machine sideways (see figure 6). You could also buy milling drills that can be used in a drilling machine for milling holes in soft material such as KLP® (see *Figure 1.10*). Milling will go faster this way, drilling the first hole may take a little longer due to the worse chip removal.

Figure 1.10 Making slit holes

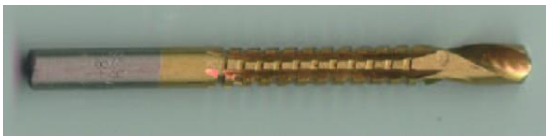


Figure 1.11 Milling drill

Welding
KLP® material can be welded by melting, for which special extrusion welding devices exist. In case welding material has to be added this will roughly have to be of the same consistence as the KLP® material, otherwise solidity will be bad. A test will show whether the weld has the required strength. A good weld can reach 30-50% of the strength of the original material at the most. Without an extrusion welding device the material can also be melted and welded with other heat sources. In that case it is important to prevent temperatures from getting higher than 250-300 degrees Celsius with regards to dissection of the material.

Gluing
The usage of glue, paint or caulk in combination with KLP® materials is often not possible due to the low density surface of the material. This prevents adhesion to the surface.

Sawing, mounting and drilling of KLP®-S

Steel reinforcement is placed in the corners of a KLP®-S beam. This has proven to be the most optimum location (see *Figure 1.2* and *Figure 1.3*).

Figure 1.2 reinforcement in KLP®-S beams

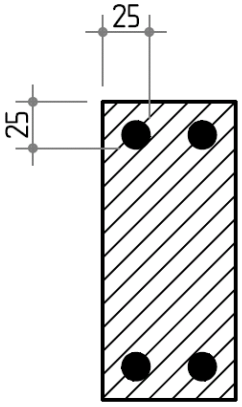


Figure 1.3 cross-section

Since there are only steel reinforcements in the corners of the product, drilling and screwing in KLP®-S will not be a problem when staying away (25mm) from the corners. KLP®-S beams remain straight and won't warp. Due to the unique patented process in which the beams are produced, the steel reinforcements remains 50mm away from the end of the beam on both sides. This makes for easy small adjustments in case the beam needs to be shortened (see *Figure 1.4*).

Lankhorst offers standard lengths of 4000 and 5000mm. When requested, these can be sawn to any desired length. If the beams have to be cut to length through the steel reinforcement, a diamond plated saw at low RPM will provide the best result. If this is not available, an angle grinded with a steel cut-off wheel can also be used. Due to the high speed the plastic will melt and gives a less esthetically pleasing result. When cutting through the steel reinforcement, the ends might start to rust. This will be no consequence to the performance of the beam. Ingress of water into the beam is not possible and therefore a similar process like concrete rot will not happen. The only consequence of cutting the beams is the esthetics. This can solved by applying a zinc spray at the ends.

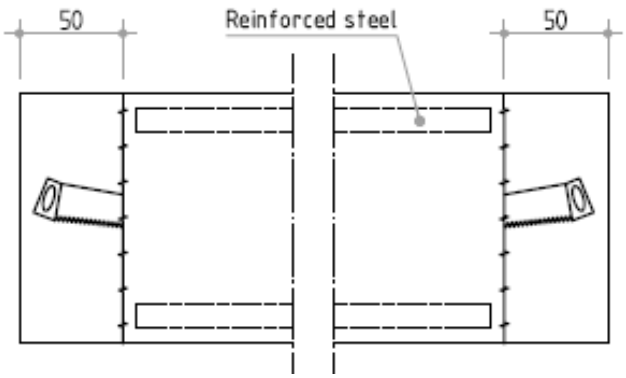


Figure 1.4 sideways cross section steel reinforced beam

1.4 Maintenance

KLP® does not need maintenance. The only thing we advise you to do is to clean it with plain clean water without any additions. Besides that you can use a high-pressure hose to clean it with normally applied pressures. Remain at a minimum distance of 300mm when cleaning the surface to prevent the chance of damaging the surface. Lankhorst advises to do a test on a small surface that is not in direct view. A rotary nozzle cannot be used due to the chance of damaging the material.

Cleaning does not affect the material properties, it's simply done for the looks of it. A high-pressure hose should also be able to remove graffiti to a reasonable extent. We don't recommend cleaning with a steam cleaner. It is advisable to have a specialized company clean the surface with a high pressure washer.

2. Applications

2.0 General construction rules & mechanical load restraining criteria

KLP® can be used for many applications. In principle it is possible to use KLP® anywhere where wood can be used. Many constructions are possible. However, plastic is a different material and therefore requires specific attention. In general plastic is less stiff than wood. Therefore it is not possible to apply the same span used for wood constructions in a 1:1 way. Generally either the span will have to be smaller or a slightly thicker plank will have to be used. By using KLP®-S bigger spans can be made then would be possible with conventional wooden beams. With the help of the information from the chapter "1.2 Material Properties" correct values can be determined. An advantage of plastic is that it is not influenced by moisture. All treatments that are normally performed on wood in order to prevent it from being influenced by water and moisture are not necessary for plastic.

When determining KLP® constructions you have to take two material properties into account: expansion/shrinkage due to temperature fluctuations and creep.

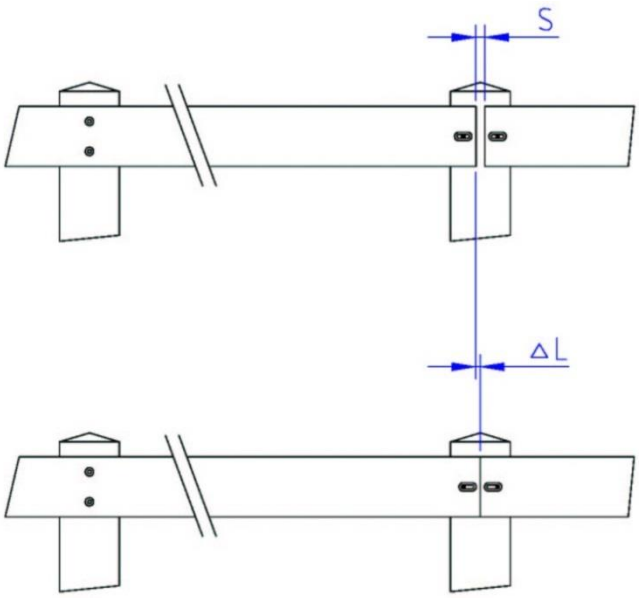
2.0.1 Expansion/shrinkage due to temperature fluctuations

Plastics have a higher expansion coefficient then for instance wood. This means that KLP® products will expand and crimp more under the influence of temperature. This has to be taken into account when used in constructions. Especially when constructions span longer distances (e.g. fencing). The expansion and crimp of the material can exceed the limits of what the construction itself can deform. Lankhorst therefore advises to always take into account the expansion and crimp of the materials to prevent unwanted deformations.

This is something to take into account now: KLP® compound will expand to a maximum of 1.5 mm per meter plank at 10°C. In the case of outdoor applications we expect that mounting normally takes place at a temperature between 10 and 20°C. We assume that -20°C is the minimum temperature. In summer, when the sun is shining on the planks, temperature can rise to approximately 50 to 60°C due to their black colour. The largest possible temperature difference will then be + or -40°C. Therefore it has to be taken into account that the length of the plank can become 6 mm longer or 6 mm shorter per span meter.

Example expansion/shrinkage
If in Figure 2.1 the centre to centre distance of poles is 1.25 meter and the plank is attached to one of the poles you should take into account an expansion of 1,25 x 6 is 7,5 mm (delta L in Figure 2.1). Shrinkage could then also be 7.5 mm. Therefore the slit hole has to have a width of 15 mm. When mounting the screw has to be placed in the middle of the slit hole (see top image of figure 2.1) and, although it has to be tightened somewhat, it must not be tightened completely. The plank underneath still has to be able to be shoved. Further there has to be some free expansion space next to the plank. So planks must not be placed directly next to one another. This is size S in figure 2.1, which is 15 mm in this example; 7.5 mm for expansion of the plank on the left side and 7.5 mm for the plank on the right side.

This example calculation can be translated to any situation.



Figuur 2.1 Example of expansion/shrinkage (top: situation at mounting; bottom: situation in warm weather)

2.0.2 Creep

If you place a load on plastic, it will show a certain deflection. How far this deflection will go can be calculated with the Elasticity modulus. If the load is maintained and the deflection is calculated again later on, you will find an increased deflection in plastics. This phenomenon is called creep. The material will creep away under a constant load of its own weight.

Therefore when calculating stress (load) situations a distinction has to be made between the Elasticity modulus, relevant for short term stress, and the creep modulus, showing the relation between stress and deflection in long term stress situations. For example stress caused by own weight will rest on the construction for the rest of its life. This means that deflection caused by this will have to be calculated by means of the creep modulus. Most of the creep will appear during the first few months, after that the process will slow down. After a couple of years there will hardly be increased deflection due to creep.

The short term strength can't equally be used for tensile strength or bending strength in long term stress situations. See *Attachment 2* for a calculation example.

2.0.3 Dimensioning based on mechanical load restraining criteria

As a quick reference guide, the below tables have been created to provide a means to quickly confirm the maximum mechanical loads according to the commonly used criteria. The criteria are based on the different area's of application. This has resulted in 3 load restrains classes for the concerning KLP® part: Maximum span; Maximum heart to heart distance; Maximum cantilever. If assistance with calculations are required, Lankhorst can assist to provide calculations according to the NEN-EN 1990/1991 (Eurocode).

Assumptions and explanations of the calculation table deck planks

The usage of this table is taking into account that the deck board has been mounted to 4 or more beams with a minimum width of 80mm. The results of the calculation according to the specific criteria has been documented in the table below.

Calculation table, part deck plank		*Dimensions deck plank*				
		KLP®			*KLP®-V glassfiber reinforced*	
		15 x 3 [cm]	*18 x 3,9 [cm]*	*20 x 4,7 [cm]*	*18 x 3,9 [cm]*	*20 x 4,7 [cm]*
Application balcony (2,5 kN/m2+3 kN); applicable for landing stages						
2,5 kN/m2+3 kN	Max. center to center distance girder	37	53	69	70	92
	Max. unsupported span deck plank	29	45	61	62	84
	Max. cantilever deck plank	11	16	22	21	28
Application bridge (pedestrians only), promenade (5 kN/m2+7 kN)						
5 kN/m2+7 kN	Max. center to center distance girder	24	33	42	41	54
	Max. unsupported span deck plank	16	25	34	33	46
	Max. cantilever deck plank	7	11	14	13	17
Calculations and loads based on building regulations 2012 & Eurocode NEN-EN-1990 /1991 and national scedule The Netherlands, design life 50 years, class CC1.						

Assumptions and explanations of the calculation table steel reinforced beams:

The calculated beam has a downward force of 36,3kg/m² due to the deck planks. For economic reasons, the full length of the beam is utilized for the span. However, because of the support of the beam, from both ends 18cm is deducted. This results in the maximum unsupported span of the beam (support on the cross beam is 8cm wide, overhang on both sides due to the width of the pole is 10cm). The calculations show the unsupported span (distance between beams) and maximum cantilever of the beam at a certain center to center distance.

Calculation table, part steel reinforced beam		*Dimensions steel reinforced beams*					
		13,5 x 7 x 400 I-beam KLP®-S16 [cm]	*16 x 8 x 400 KLP®-S16 [cm]*	*16 x 8 x 400 arch 0,8 KLP®-S16 [cm]*	*18 x 8 x 500 KLP®-S16 [cm]*	*24 x 9 x 500 arch 2,0 KLP®-S20 [cm]*	*25 x 15 x 520 KLP®-S16 [cm]*
Application balcony (2,5 kN/m2+3 kN); applicable for landing stages							
2,5 kN/m2+3 kN	Max. center to center distance girder	49	88	138	61	182	130
deck weight 36,3kg/m2*	Max. unsupported span reinforced beam	364	369	364	469	464	484
	Max. cantilever beam**	38	83	48	150	73	193
Application bridge (pedestrians only), promenade (5 kN/m2+7 kN)							
5 kN/m2+7 kN	Max. center to center distance girder	45	54	51	54	67	53
deck weight 36,3kg/m2*	Max. unsupported span reinforced beam	164***	326***	364	385***	464	484
	Max. cantilever beam**	20	31	26	35	64	140

Calculations and loads based on building regulations 2012 & Eurocode NEN-EN-1990 /1991 and national scedule The Netherlands, design life 50 years, class CC1.

* Top load caused by weight of top assembly of construction (deck planks + steel reinforced beams).

** Maximum cantilever is only applicable in combination with give maximum center to center distance of the girder.

*** Girder is in this situation not usable in its full length.

Assumptions and explanations of the calculation table for cross beams:
The calculated cross beam is mounted on both sides on 2 poles 200x200mm. The force is a result of the supported steel reinforced beams 160x80x4000mm, c.t.c. of 380mm, and the deck planks 200x47mm that rest on the cross beam. The result of the calculation is the maximum unsupported span (distance between the poles) and the maximum cantilever of the cross beam.

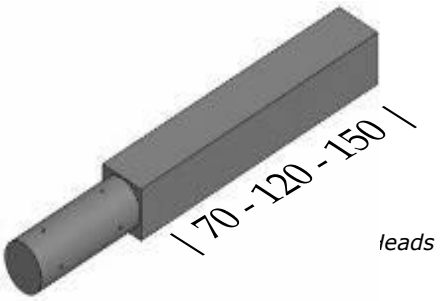
Calculation table, part cross beam		*Dimensions cross beams*		
		14,5 x 7 KLP®-S12 [cm]	*16 x 8 KLP®-S16 [cm]*	*18 x 8 KLP®-S16 [cm]*
Application balcony (2,5 kN/m2+3 kN); applicable for landing stages				
2,5 kN/m2+3 kN	Max. center to center distance poles	155	190	212
deck weight 105kg/m2*,	Max. unsupported span	135	170	192
girder c.t.c. 38 cm	Max. cantilever cross beam	12	15	17
Application bridge (pedestrians only), promenade (5 kN/m2+7 kN)				
5 kN/m2+7 kN	Max. center to center distance poles	103	125	140
deck weight 105kg/m2*,	Max. unsupported span	83	105	120
girder c.t.c. 38 cm	Max. cantilever cross beam	8	10	12
Calculations and loads based on building regulations 2012 & Eurocode NEN-EN-1990 /1991 and national scedule The Netherlands, design life 50 years, class CC1. * Top load caused by weight of top assembly of construction (deck planks + steel reinforced beams).				

2.1 KLP® Landing Stages & Jetties

2.1.1 Introduction

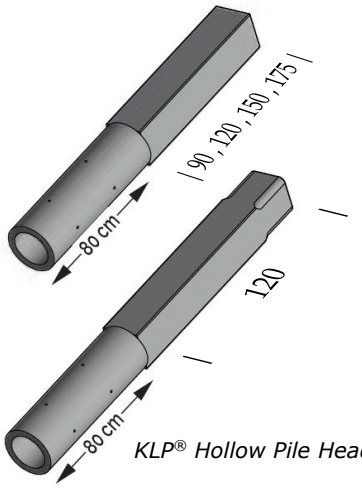
With the following parts you can construct a KLP® Landing:

- KLP® Posts/KLP® (Hollow) Pile Heads
- KLP®-V/KLP®-S Cross-supports & Struts
- KLP®-S Steel reinforced beams
- KLP®/KLP®-V Deck



leads

By using KLP®-S Steel Reinforced Plastic Beams it is possible to construct landing stages with much larger spans. This means that, compared to traditional construction, fewer poles are needed, leading to significant savings on the overall material and construction costs. As well as offering a complete range of individual components for constructions, we also offer a complete design engineering solution for which we have our own project managers and R&D department with the right know-how. We can provide assistance with specification text, advise, calculate *(according to Eurocode NEN-EN 1990/1991)*, design, produce, assemble and pre-fabricate. As part of the prefabrication solutions Lankhorst offers the option to supply completely assembled upper constructions for docks and bridges.



KLP® Hollow Pile Heads

2.1.2 Dimensioning

KLP® Deck planks - profiled
15 x 3,0 x 300 cm
15 x 3,0 x 390 cm
18 x 3,9 x 325 cm
20 x 4,7 x 325 cm
20 x 4,7 x 390 cm

KLP®-V Deck glass fiber reinforced
20 x 4,7 x 325 cm
20 x 4,7 x 390 cm

KLP® Struts
15 x 5 cm, 15 x 7 cm, 16 x 8 cm

KLP®-S Cross supports
14,5 x 7 cm, 16 x 8 cm

KLP®-S Beams steel reinforced

13,5 x 7 x 400 cm	KLP®-S I-beam
16 x 8 x 400 cm	KLP®-S beam
16 x 8 x 400 cm	KLP®-S beam (arch: 0,8 cm)
18 x 8 x 500 cm	KLP®-S beam
24 x 9 x 500 cm	KLP®-S beam (arch: 2,0 cm)
25 x 15 x 520 cm	KLP®-S beam

KLP® Hollow Pile Heads (hollow round bottom part)
20 x 20 x 90/170 cm
20 x 20 x 120/200 cm
20 x 20 x 150/230 cm
20 x 20 x 175/255 cm

Hollow round bottom part inside: Ø18,3 x 74cm for timber post with head diameter of Ø18cm (wooden pole goes into hollow part).

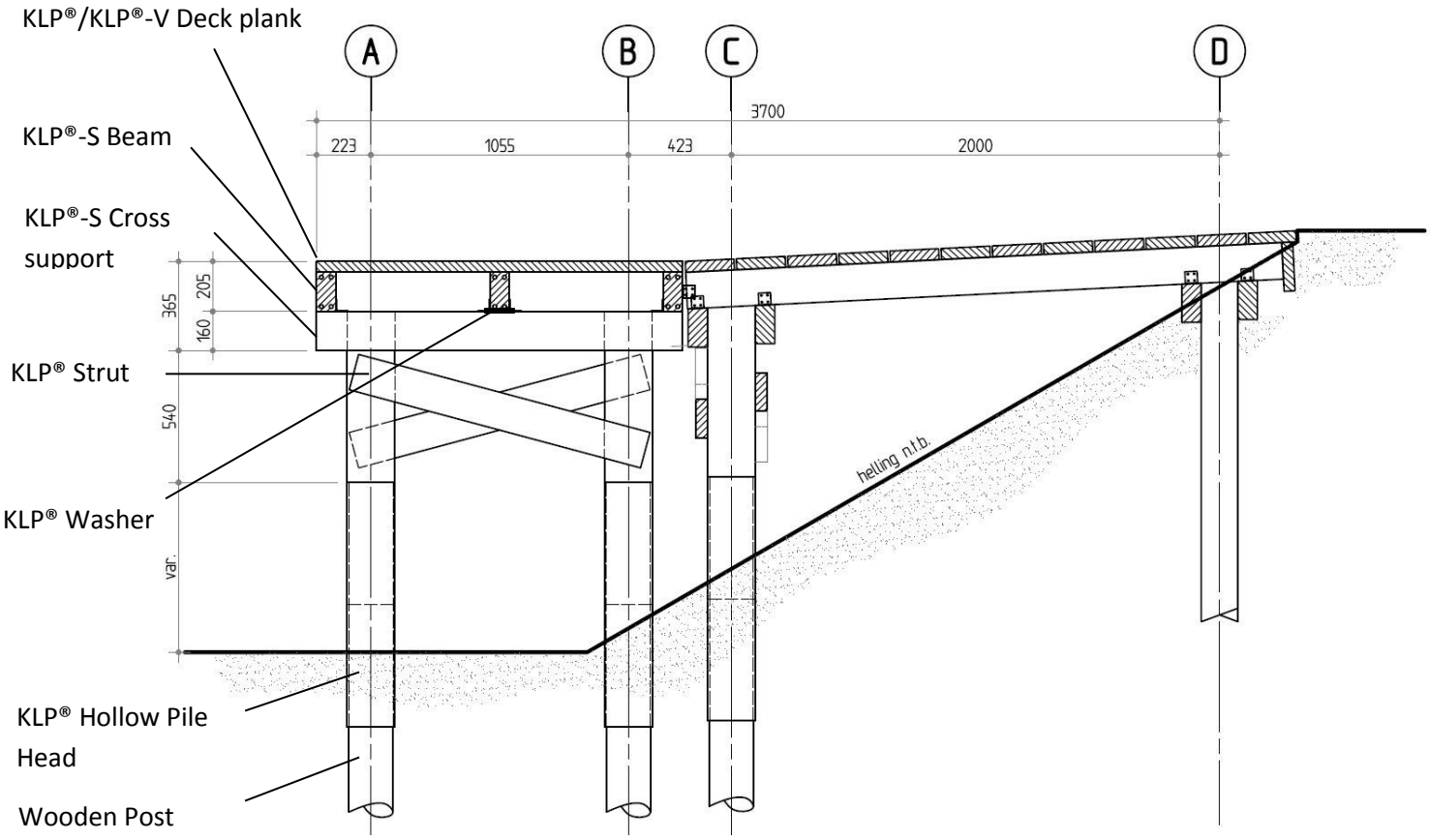
KLP® Pile Heads (solid round bottom part)
19,5 x 19,5 x 70 cm
19,5 x 19,5 x 120 cm
19,5 x 19,5 x 150 cm

Solid round bottom part outside Ø18,5 x 50cm for timber post with head diameter of Ø18cm (wooden pole goes into steel sleeve)

Construction calculations according to Eurocode (NEN-EN 1990/1991).

2.1.3 Impression KLP® Landing Stage

2.1.4 Technical drawing KLP® Landing Stage



Section (sizes in mm)

For loading reference see chapter *2.1.3 Dimensioning based on mechanical load restraining criteria*.

2.2 KLP® Bridges

2.2.1 Introduction

Our assortment offers a KLP® Arched Suspension Bridge (steel reinforced) which can be produced in various widths and a wide range of KLP® Prefab Standard Bridge Segments. KLP® Bridges are produced in the colour black. KLP® Hand Rails can be supplied in white or black.

Construction consists entirely of plastics supported by the unique properties of our KLP®-S Steel Reinforced Plastic Beams. With these steel-reinforced plastic beams, it is possible to construct bridges with much larger spans. This means that - compared to traditional construction - fewer poles or beams are needed. This can lead to considerable savings on the overall material and construction costs.

As well as offering a complete range of individual components for constructions, we also offer a complete design engineering solution for which we have our own project managers and Engineering department with the right know-how We can provide assistance with specification text, advise, calculate (according to Eurocode NEN-EN 1990/1991), design, produce, assemble and pre-fabricate.

With the following parts you can construct a KLP® Bridge:

- KLP® Posts
- KLP® (Hollow) Pile Heads
- KLP® Struts & KLP® Cross supports
- KLP®-S Steel reinforced beams
- KLP®/KLP®-V Deck
- KLP®-V Hand Rails glass fiber reinforced

2.2.2 Dimensioning

KLP® Arched Suspension Bridge

Span:	max. 850 cm by means of steel reinforced arch
Width:	152 and 300 cm (standard)

If supplied prefabricated, the handrail must be adjusted during installation.

KLP® Prefab Standard Bridge Segments
- Suitable for cyclists and pedestrians
- Delivered as a prefabricated unit, FCA Sneek.
- Calculations according to Eurocode NEN-EN 1990/1991
- Handrail construction in color black or white

Bridges white hand rails (eurocode 5kN/m2)

Length segment	Width segment	Free passage space	Size beams
300 cm	128 cm	120 cm	24 x 9 cm
400 cm	128 cm	120 cm	24 x 9 cm
500 cm	128 cm	120 cm	24 x 9 cm
300 cm	158 cm	150 cm	24 x 9 cm
400 cm	158 cm	150 cm	24 x 9 cm
500 cm	158 cm	150 cm	24 x 9 cm
300 cm	188 cm	180 cm	24 x 9 cm
400 cm	188 cm	180 cm	24 x 9 cm
500 cm	188 cm	180 cm	24 x 9 cm
300 cm	228 cm	220 cm	24 x 9 cm
400 cm	228 cm	220 cm	24 x 9 cm
500 cm	228 cm	220 cm	24 x 9 cm
300 cm	128 cm	120 cm	16 x 8 cm
400 cm	128 cm	120 cm	16 x 8 cm
300 cm	158 cm	150 cm	16 x 8 cm
400 cm	158 cm	150 cm	16 x 8 cm
300 cm	188 cm	180 cm	16 x 8 cm
300 cm	228 cm	220 cm	16 x 8 cm
400 cm	228 cm	220 cm	16 x 8 cm

Please take possible height differences into account when installing assembled bridge segments due to different beam sizes.

You can compensate this by altering the height of the substructure locally.

Bridges black hand rails (eurocode 5kN/m2)

Length segment	Width segment	Free passage space	Size beams
300 cm	128 cm	120 cm	24 x 9 cm
400 cm	128 cm	120 cm	24 x 9 cm
500 cm	128 cm	120 cm	24 x 9 cm
300 cm	158 cm	150 cm	24 x 9 cm
400 cm	158 cm	150 cm	24 x 9 cm
500 cm	158 cm	150 cm	24 x 9 cm
300 cm	188 cm	180 cm	24 x 9 cm
400 cm	188 cm	180 cm	24 x 9 cm
500 cm	188 cm	180 cm	24 x 9 cm
300 cm	228 cm	220 cm	24 x 9 cm
400 cm	228 cm	220 cm	24 x 9 cm
500 cm	228 cm	220 cm	24 x 9 cm
300 cm	128 cm	120 cm	16 x 8 cm
400 cm	128 cm	120 cm	16 x 8 cm
300 cm	158 cm	150 cm	16 x 8 cm
400 cm	158 cm	150 cm	16 x 8 cm
300 cm	188 cm	180 cm	16 x 8 cm
400 cm	188 cm	180 cm	16 x 8 cm
300 cm	228 cm	220 cm	16 x 8 cm
400 cm	228 cm	220 cm	16 x 8 cm

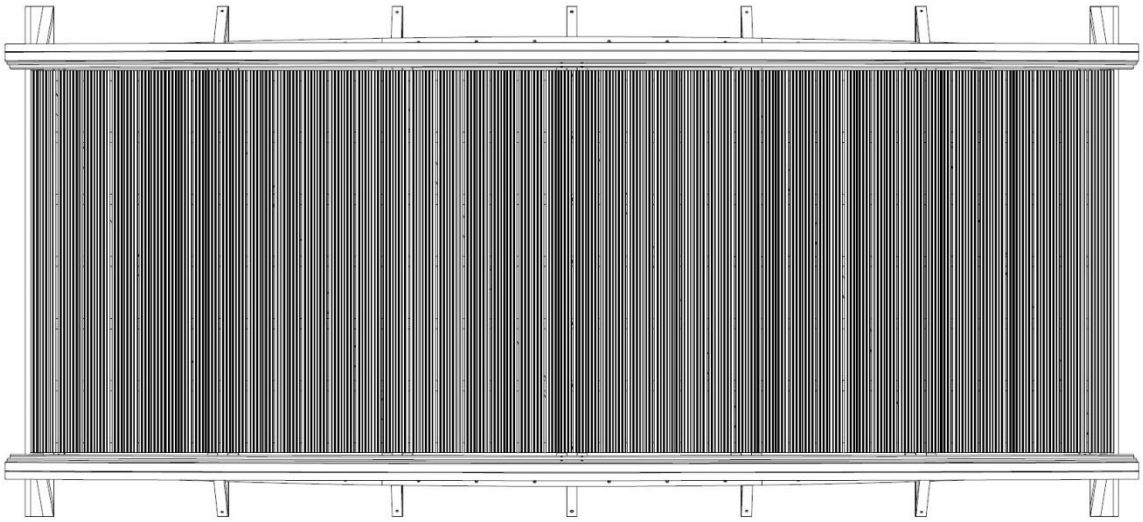
The handrails can be aligned on location by the contractor after installation

Are you looking for a different dimension that is not listed in these standard segments? Please contact us for a customized bridge.

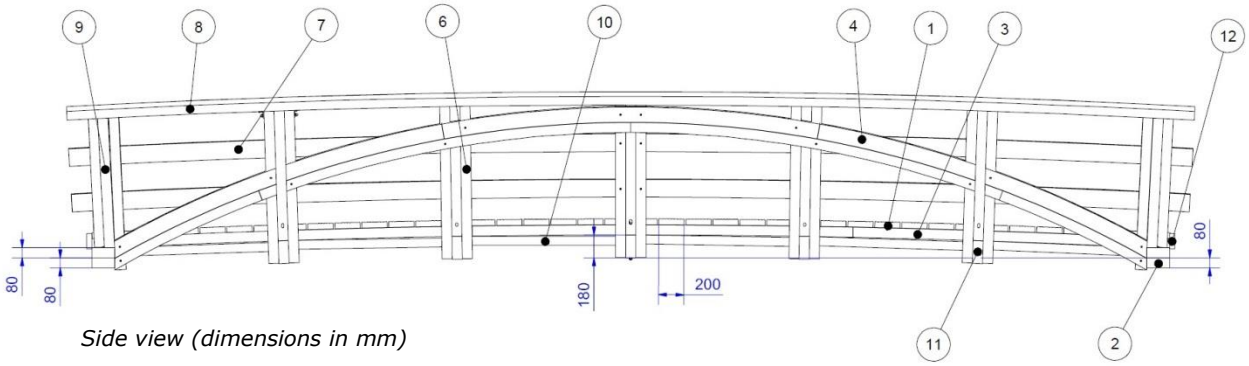
Construction calculations according to Eurocode (NEN-EN 1990/1991).

2.2.3 Technical drawing KLP® Bridges

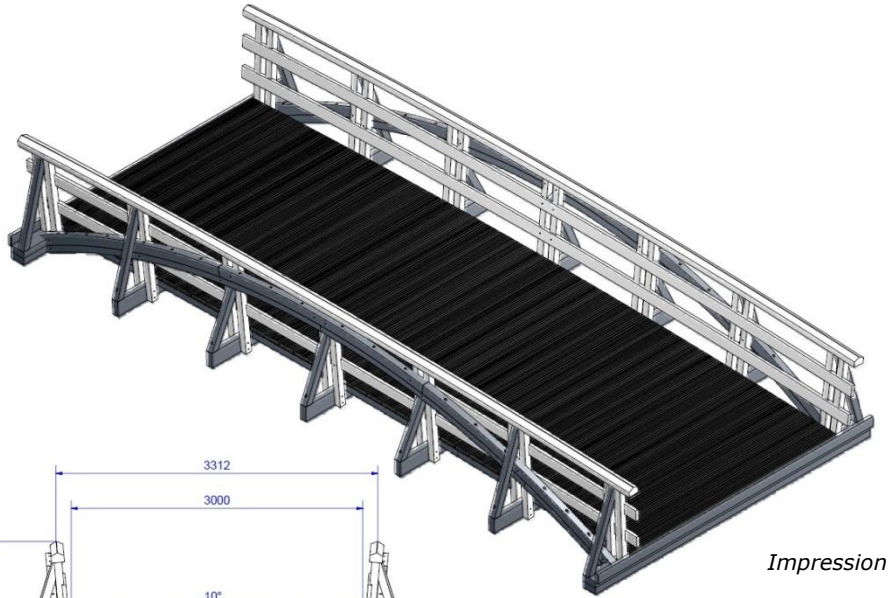
KLP® Arched Suspension Bridge Type, width 300 cm



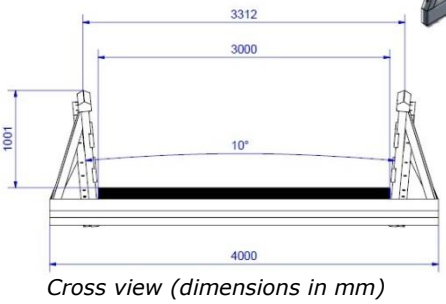
Top view



Side view (dimensions in mm)

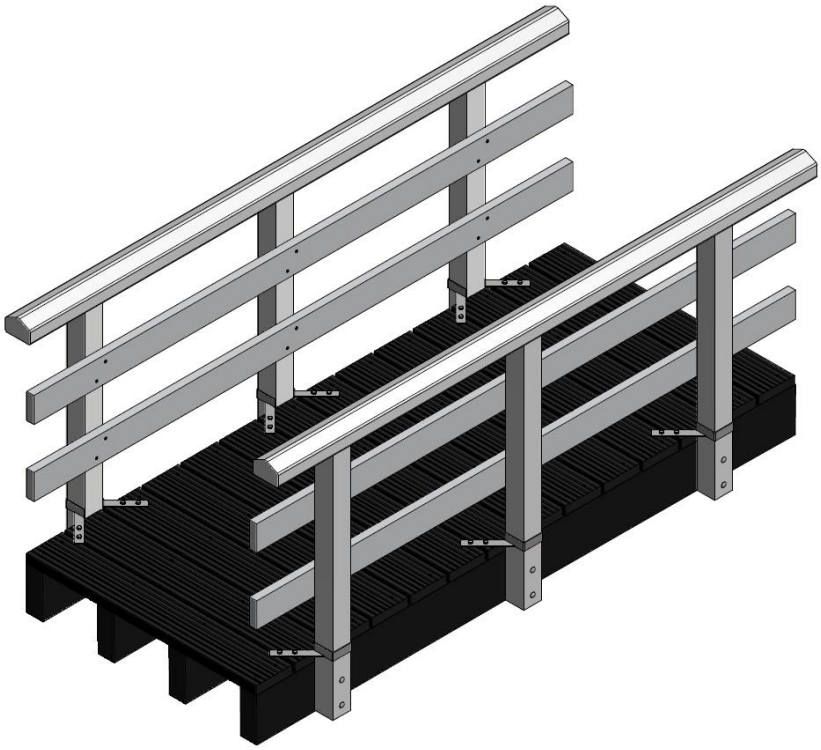


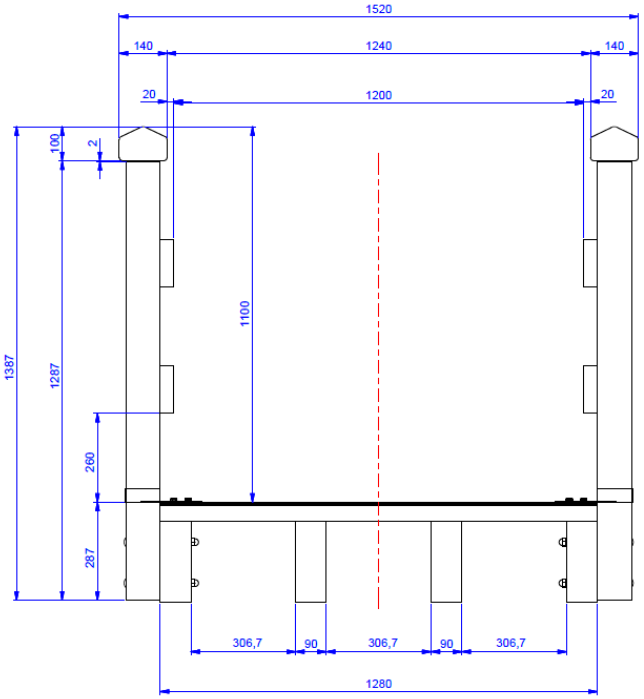
Impression



Cross view (dimensions in mm)

KLP® Prefab Standard Bridge Segments





2.3 KLP® RapidRetain – retaining wall

2.3.1 Introduction

KLP® RapidRetain System consists of plastic panels and combi-poles. The system can installed in an efficient manner by installing the poles first. Thereafter the retaining panels can be easily installed afterwards. Due to the lightweight panels with a working length of 2100mm, easy and fast installation can be achieved. The KLP® RapidRetain panel coupling is made strong, so that no pole is needed directly in front of each connection. The regular Heart to Heart distance between the poles measures 700mm. Maximum distance that can be achieved is 1000mm, depending on the type of soil.

The KLP® combi-pole system consist of a untreated fur pole (C18) with a plastic sleeve top. The advantages are that where water and air meet, rotting will no longer take place and no maintenance is required. The expected technical lifetime of the KLP® RapidRetain System is at least 50 years.

Depending on your application, you may choose from any of three KLP® RapidRetain panel heights. Each of the panel heights can be connected to any other KLP® Rapid-Retain panel. Lankhorst advises to use geotextile. In some cases this may not be necessary, which should be determined per project.

2.3.2 Dimensioning

KLP® RapidRetain system

KLP® RapidRetain panel:
60 x 210 cm (working length)
80 x 210 cm (working length)
100 x 210 cm (working length)

Panel thickness: 4,9 cm

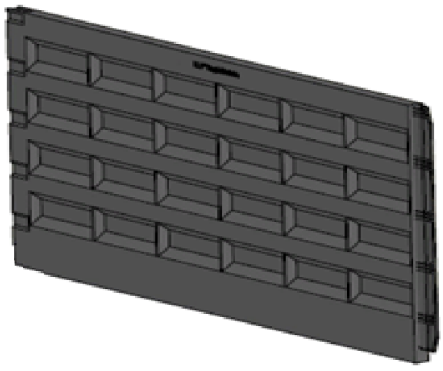
KLP® RapidRetain combi-poles including base point:
Ø12/10 x 300 cm
Ø12/10 x 250 cm

KLP® RapidRetain combi-poles excluding base point:
Ø12/10 x 400 cm
Ø12/10 x 500 cm
Ø12/12 x 500 cm

Length plastic sheath: 100 cm
Commonly used center-to-center distance poles: 70 cm

Optional extras for KLP® RapidRetain
10 x 10 x 520 cm KLP®-S Fender (peg&hole connection)
12 x 12 x 360 cm KLP® Pole-RapidRetain corner solution*

** with a milled-out slot on one side: 5 x 4 x 360 cm*



KLP® RapidRetain panel

KLP® RapidRetain combi-poles

2.3.3 Procedure

- Install the poles at the desired location with the required heart tot hart distance for the type of soil;
- Place all panels in one go;
- No pole is needed directly in front of each connection;

- Panels can easily be connected by means of a smart interlocking tongue & groove system;
- Align panels to the expansion joint to allow for the expansion of KLP® (*Figure 2.2)*;
- The panel can be pushed into the ground to about 150mm;

- Install the panel to the correct heigth and connect the panel to the pole by means of stainless steel chipboard screws;
- Backfill with soil.

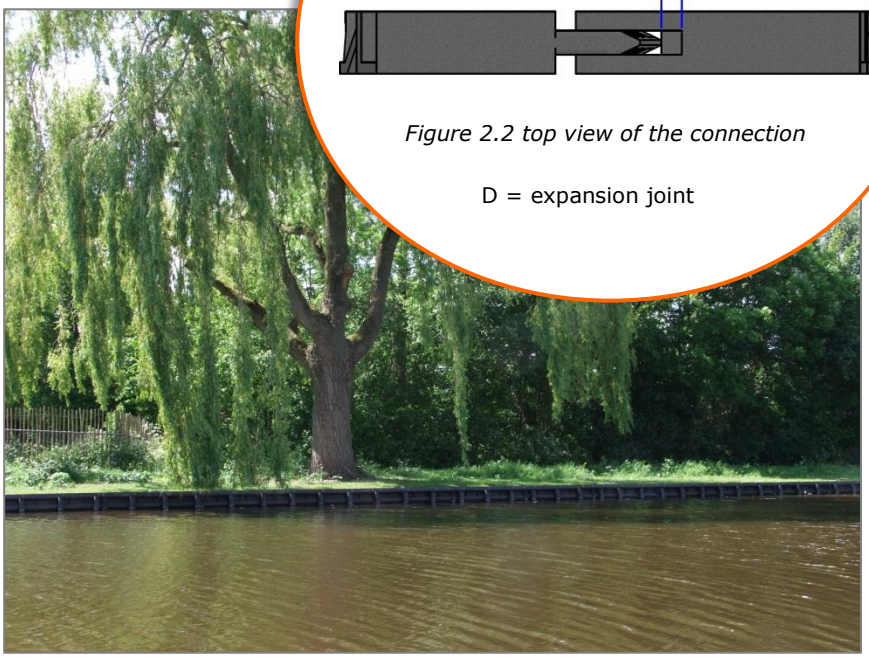
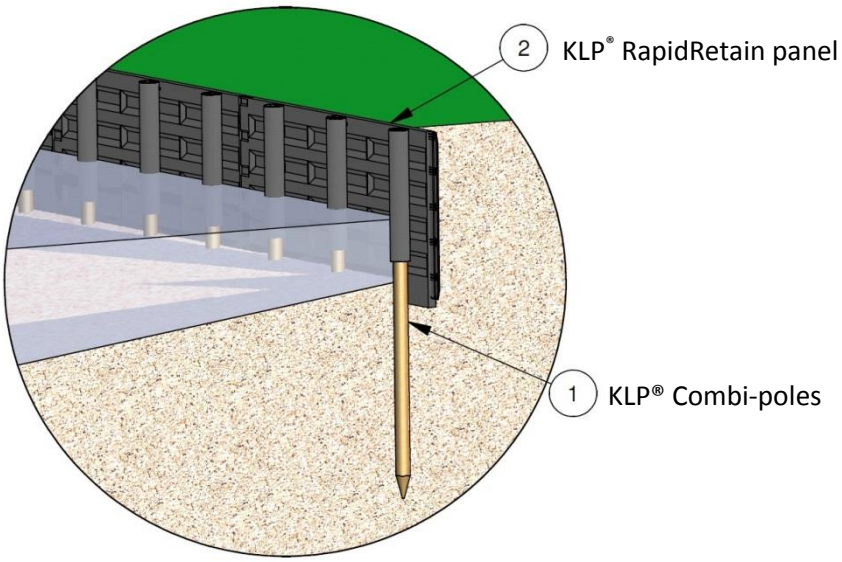


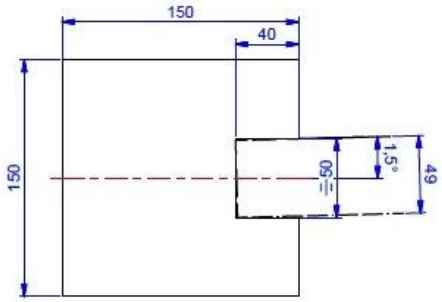
Figure 2.2 top view of the connection

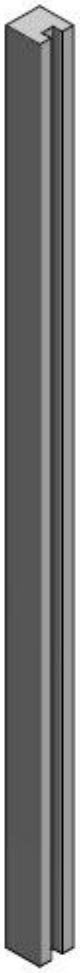
D = expansion joint

2.3.4 Impression drawings KLP® RapidRetain - retaining wall

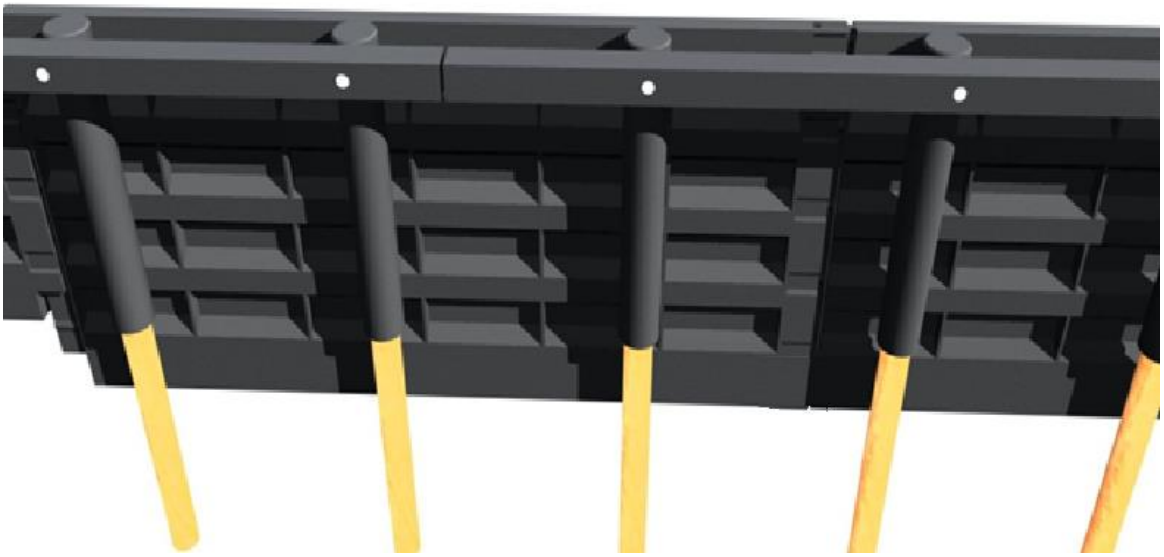


KLP® RapidRetain System in 3D





KLP® Pole for RapidRetain corner solution. Supplied with recess on 1 side (50x40mm). The contractor has to mill the other recess in the right angle on location.



KLP® Anchor Girder (or normal Girder) is optional

2.4 KLP® Pile Planking and Combi Pile Planking

2.4.1 Introduction

KLP®-V Pile Planking consists of solid plastic tongue and groove planks. This connection provides a solid connection and soil retention.

The KLP® Combi Pile Planking consists of PEFC certified wooden pine planks (strength class C24) with plastic covered tops. The result of combining plastics and wood is an extraordinarily stiff sheet piling plank. The advantages of KLP® Combi Pile Planking are that where water and air meet rotting will no longer take place and that it does not require maintenance.

KLP® Combi Pile Planking is subject to sustainability class 1 and has an expected technical lifetime of at least 50 years.

Our range also offers KLP® Fenders (steel reinforced en glass fiber reinforced) for a rigid construction.

KLP®-V Pile Planking

KLP® Combi Pile Planking

2.4.2 Dimensioning

KLP®-V Pile plan (glass fiber reinforced)
Dimension: 20 x 5 cm
Length : max. 390 cm

KLP® Reinforced Fender

- ***KLP®-V (glass fiber reinforced)***

Dimension : 10 x 10 cm
Length : max. 315 cm

- ***KLP®-S (steel reinforced)***

Dimension : 10 x 10 x 520 cm (peg&hole connection)
: 15 x 16 x 500 cm (peg&hole connection, with recess)

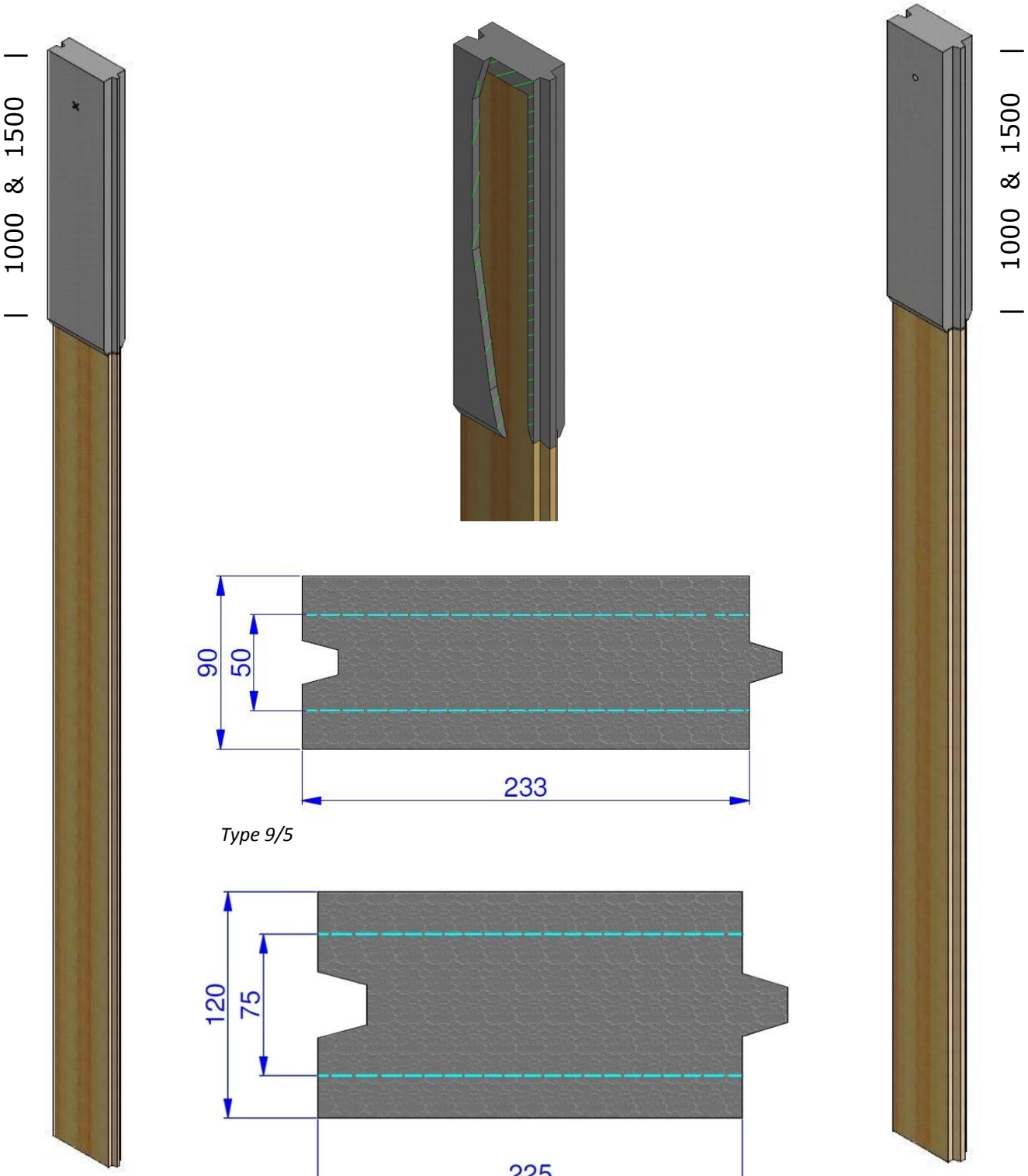
KLP® Combi Pile Planking type 12/7,5
A. plastic part : 22,5 x 12 x 100/150 cm
B. wood part : 22,5 x 7,5 x max. 486 cm
C. maximum, total length : 585 cm

KLP® Combi Pile Planking type 9/5
A. plastic part : 23,3 x 9 x 100/150 cm
B. wood part : 23,3 x 5 x max. 295 cm
C. maximum, total length : 395 cm

KLP® -S Fender steel reinforced
Dimension : 16 x 15 x 500 cm
(with recess, peg & hole connection)

KLP® Sheet Pile Wedge
Dimension : 15/11 x 12 x 400 cm
: 15/11 x 9 x 400 cm

2.4.3 Technical drawing KLP® Combi Pile Planking



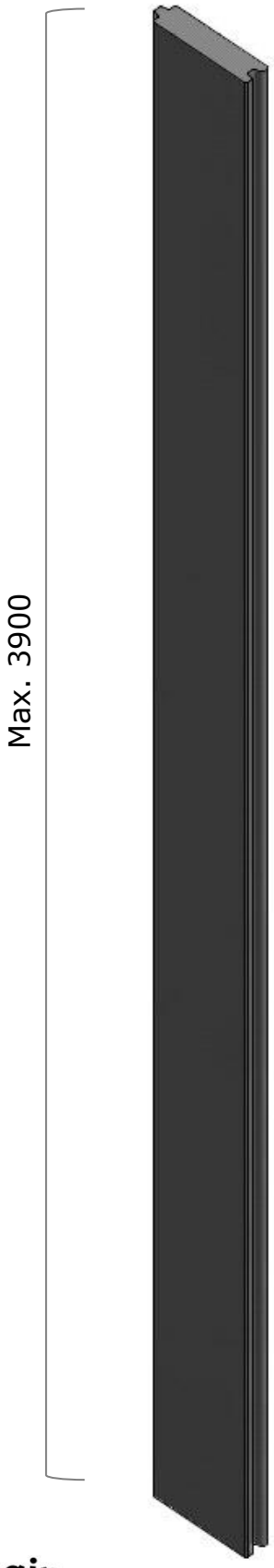
Type 9/5

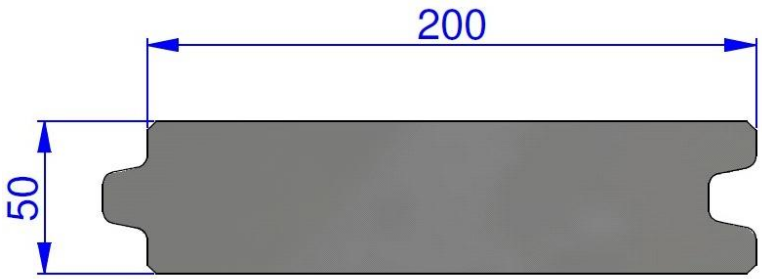
Type 12/7,5

Type 9/5 ***Type 12/7,5***

(Dimensions in mm)

2.4.4 Technical drawing KLP®-V Pile Planking glass fiber reinforced





(Dimensions in mm)

	KLP®-V	KLP®
EI (in kNm²/m) - panel stiffness	19,8 kNm²/m	10,4 kNm²/m
W (cm³/m) - section modulus	417 cm³/m	417 cm³/m
Mrd (kNm/m) - maximum bending moment	3,33 kNm/m	1,51 kNm/m

2.5 KLP® Girders & Marine Fenders

2.5.1 Introduction

KLP®-PE Fenders made from 100% recycled PE plastics are designed for applications such as timber staging, fender piling, quay edges and buffer edges.

KLP®-PE Fenders are wear resistant and they will not leave black marks behind on the hull. The elastic material has excellent damping properties and will help absorb the collision energy.

Should there be less stringent requirements, the fenders can be supplied in standard KLP®-compound as well.

Diameter of the countersunk holes are depending on the bolt diameter.

2.5.2 Dimensioning

KLP®-PE Fenders

Dimensions:	*To fit:*
16,0 x 8,0 x 360 cm	
15,0 x 10,0 x 450 cm	
20,0 x 10,0 x 400 cm	UNP 220
25,0 x 15,0 x 250 cm	UNP 280
25,0 x 15,0 x 295 cm	UNP 280
25,0 x 20,0 x 450 cm	
25,0 x 25,0 x 250 cm	

KLP® Fenders

Dimensions:	*To fit:*
16 x 8 x 400 cm	
15 x 10 x 450 cm	
20 x 10 x 400 cm	UNP 220
25 x 15 x 250 cm	UNP 280
25 x 15 x 295 cm	UNP 280
25 x 20 x 450 cm	
25 x 25 x 250 cm	

A = KLP® Fender

B = UNP Profile (steel)

2.6 KLP® Fencing

2.6.1 Introduction

Due to the specific material properties of KLP®, certain considerations have to be taken into account when used to construct fences. Before fencing can be placed it is important to carefully read '2.1 General Construction Rules'.

Fencing is made of standard KLP® (bending modulus: 1000N/mm^2). This makes it suitable for post not higher then 1500mm above ground level.

When heights of 1500mm or higher are required, KLP®-V fibre reinforced is recommended (bending modulus: 2000N/mm^2).

In case high load constructions are required, KLP®-S can provide the required strength (bending modulus: 17.000N/mm^2).

2.6.2 Procedure

For screwing we advise stainless steel countersunk wood chipboard screws with a 6 mm diameter and a length of at least 2 times the thickness of the plank to be mounted. Holes have to be predrilled and countersunk.

Fencing poles have to set to a minimum depth of 600mm at any time. Depending on the type of soil it can be required to set them deeper.

3 fixing methods are possible:

1. Planks screwed at one side (*Figure 2.3*);
2. Planks screwed at both sides (*Figure 2.4*);
3. Planks through a slit in the poles (*Figure 2.5*);

Method 1: Planks screwed at one side *(Figure 2.3)*

Due to the expansion coefficient of the KLP® mixture, dilatation seams have to be taken into account when installing the product. This will allow for the crimp and expansion of the material (*Figure 2.3*). When installing, the outer holes have to be of a slotted nature to allow for the above described expansion (*Detail 2.3.1*). The inner screws can be fully tightened down during installation. The outer screw in the slotted holes have to be hand tight to allow for movement in lateral direction.

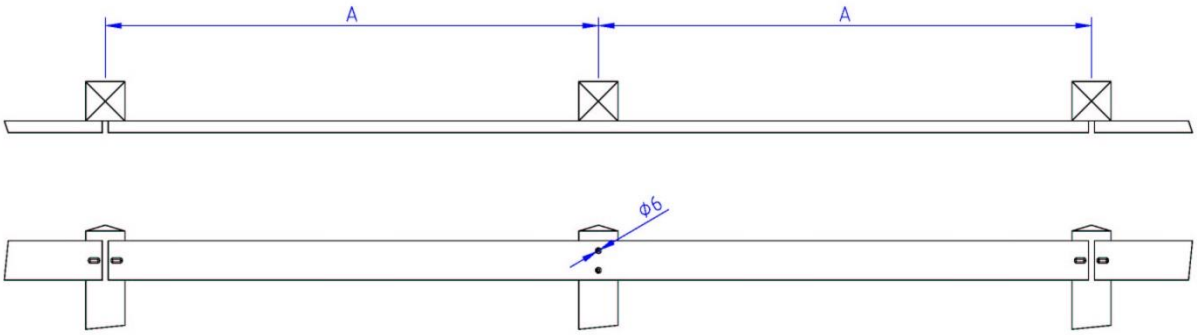
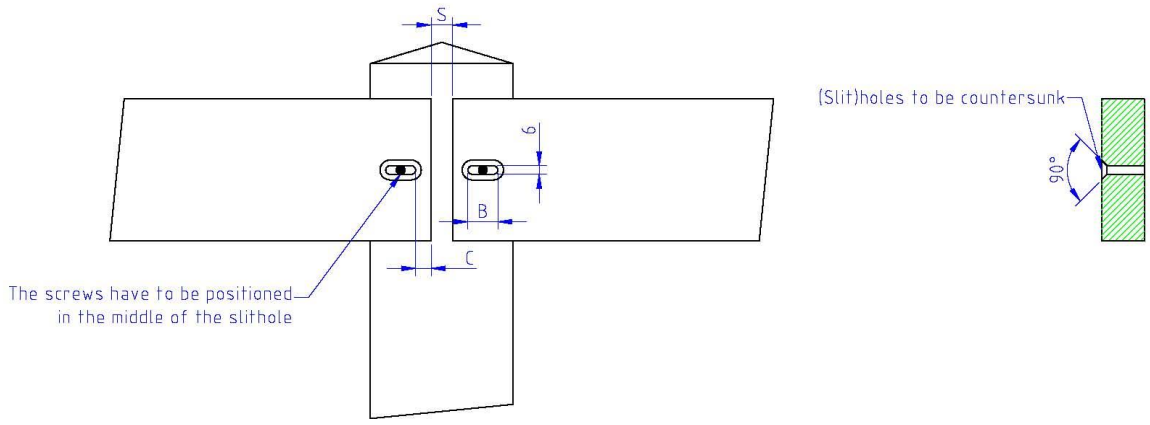


Figure 2.3 Fencing with planks screwed onto one side



Detail 2.3.1 Slit holes method 1

In a situation where all planks are fixed at one side you'll see that where the two planks come together on the pole the two screws are placed rather far towards both sides of the pole. If larger centre to centre distances between the planks are necessary, the slits and the space between two planks will be equally larger. Very soon it will then no longer be possible to fix the screw well onto the pole. Method 2 or 3 will then be more suitable.

Method 2: Planks screwed at both sides *(Figure 2.4)*

When installing the planks in this fashion, no dilatation seam has to be taken into account. This said the same applies as previous described when it comes down to fastening the planks. See method 1 and figures below for further details.

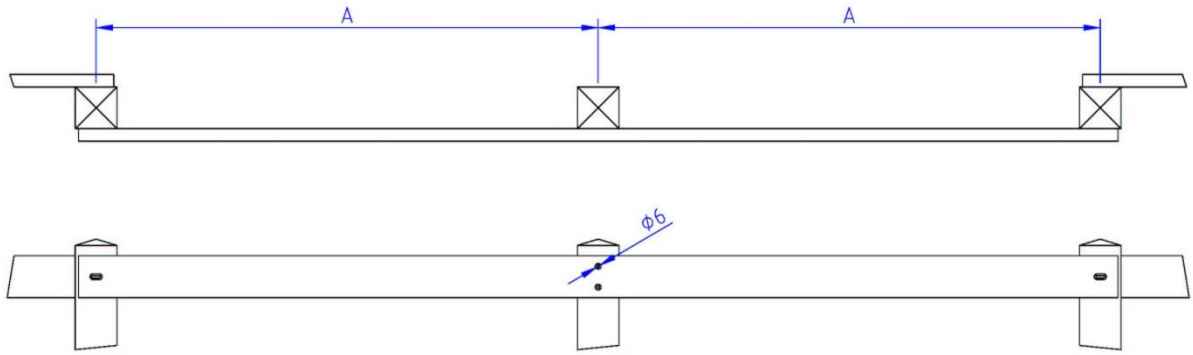
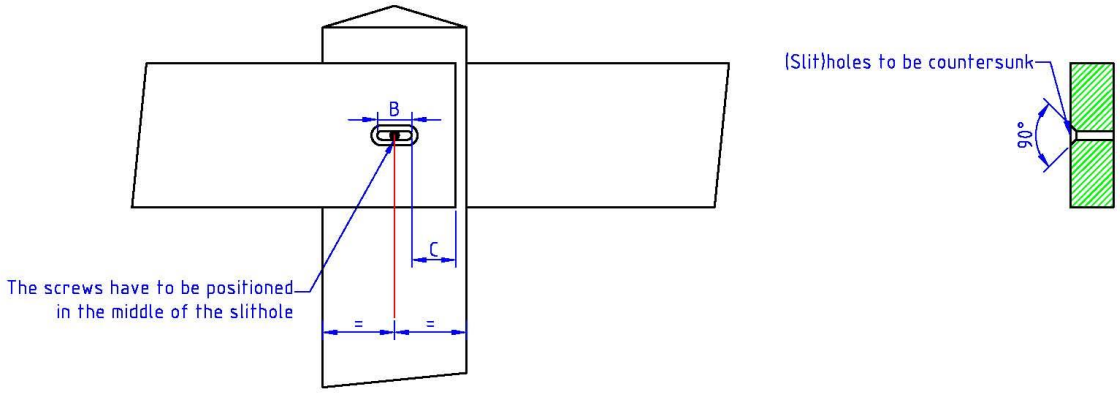


Figure 2.4 Fencing with planks screwed onto both sides



Detail 2.4.1 Slit holes method 2

Method 3: Planks through a slit in the poles (*Figure 2.5*)

When applying this tenon and mortise method, the planks are inserted in the mortise that is made in the pole. Please note that sufficient side material has to remain.

For this method the expansion coefficient of the KLP® plastic has to be accounted for with the use of a dilatation seam between the boards.

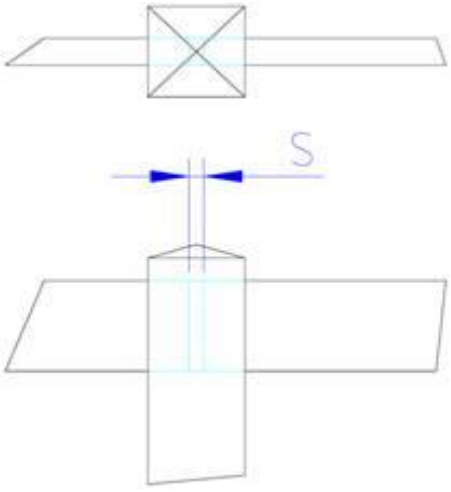


Figure 2.5 Fencing with planks through a slit in the poles

Positioning
At the positioning of the fencing the screws have to be positioned in the middle of the slit hole. The distance between two planks will strictly have to be taken into account.

If more planks are fixed above each other, it would be best to fix them in a staggered way.

2.6.3 Dimensioning

The below tables provide a selection of regular dimensions used in the construction of fencing.

Dimensions KLP®-Poles for the use of fencing:

	Type	Dimension
KLP®	Standard	10 x 10 x 120 cm
KLP®	Standard	10 x 10 x 180 cm
KLP®-V	Glass fiber reinforced	10 x 10 x 250 cm
KLP®-V	Glass fiber reinforced	10 x 10 x 300 cm
KLP®-S	Steel reinforced, S-16	10 x 10 x 520 cm

Dimensions KLP®-planks for the use of fencing:

	Type	Dimension	Centre to centre distance poles
KLP®	Standard	10 x 3 x 300 cm	Max. 150 cm
KLP®	Standard	14 x 4 x 300 cm	Max. 150 cm
KLP®	Standard	15 x 3 x 300 cm	Max. 150 cm

2.7 KLP® Foundation Blocks

2.7.1 Introduction

KLP® Foundation Blocks are designed for lightweight structures such as storage and garden sheds. The easy-to-place plastic foundation blocks offer many advantages over the alternatives from concrete and wood. Seven reasons to choose KLP® Foundation Blocks:

1. Quick installation, up to 50% faster than concrete
2. Made from 100% recycled plastics
3. Do not break or rot
4. Expected technical lifetime of at least 50 years
5. Light-weight, only 8 kg per meter!
6. Patented interlocking elements
7. Can be processed in the same way as wood

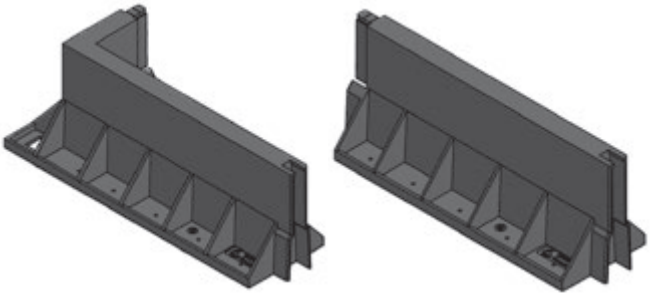
Simplicity
The ingenious patented design makes the beam easy to process. The plastic foundation blocks fit seamlessly together. This avoids the necessity of making post-installation adjustments and gives the interior and exterior sides of the garden shed the perfect finish. With three different types of pieces (straight and corner), foundations can be built for structures with practically all dimensions. The foundation blocks can be processed in the same way as wood. Wooden beams or entire wall units can be fastened to the foundations with standard wood screws.

Health & safety legislation
Compliance with work health and safety legislation is becoming increasingly more important. The overweight of concrete foundation blocks (40 kg) and the related consequences for the health of ground workers on building sites were important reasons behind the development of a plastic alternative. KLP® Foundation Blocks have a weight of only 8 kg, so one man can do the job. The KLP® Foundation Block saves you time, material and your health.

2.7.2 Dimensioning

KLP® Foundation Block:

Dimension	*Description*
25 x 30 x 75 cm	Straight beam
25 x 30 x 100 cm	Straight beam
34,6 x 30 x 87,2 cm	Corner piece



2.7.3 Procedure

Method 1: Without a grid

- Excavate the desired footprint;
- Backfill with sand to create a foundation to reach the desired depth. Level off the foundation. If needed compress the sand to create a stable surface;
- Mark the four corners (as shown);
- Place the first corner, then work in a single direction until you reach the next corner;
- Place the corner piece and resume placing the foundation blocks;
- Once all the foundation blocks have been placed, check for square (both diagonals have to be equal);
- Use a (laser) level to assure all the Foundation blocks are level with each other;
- Backfill the foundation on both sides of the foundation blocks to create equal pressure and downward pressure on the base of the foundation blocks. This will assure a stable position of the foundation blocks.



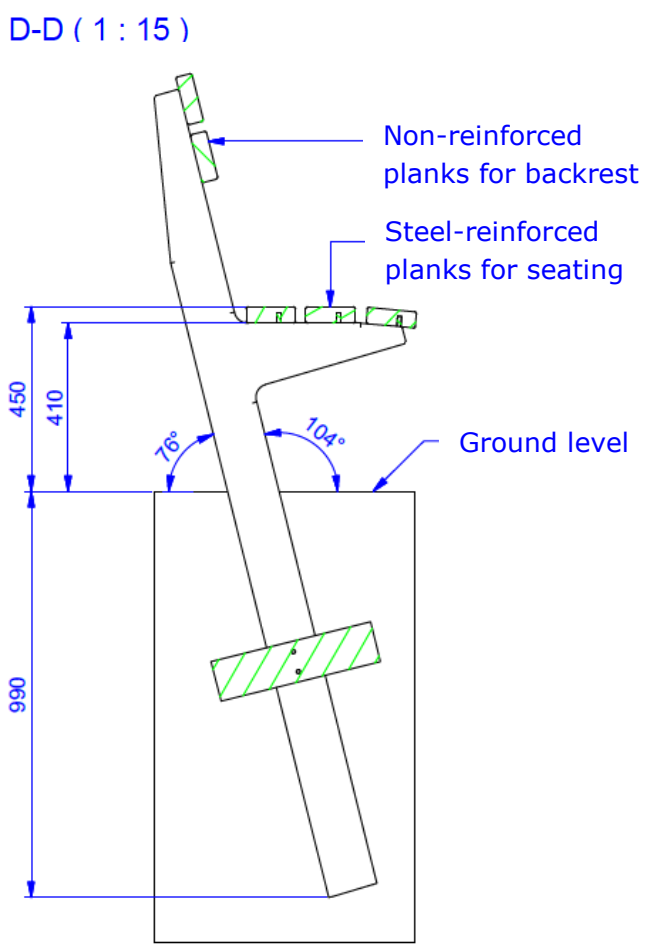
Method 2: With a Grid

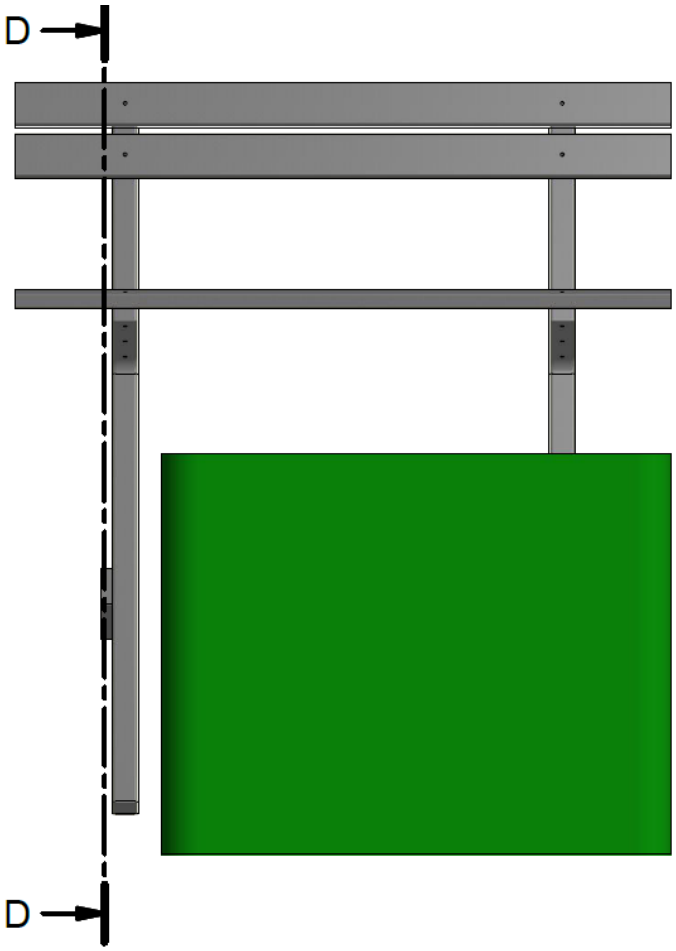
- Setting up the grid;
- Set the first corner piece, aligning it with the wire. Set the following pieces a single direction until reaching the next corner;
- Place the corner piece and resume placing the foundation blocks parallel to the set wire;
- Once all the foundation blocks have been placed, check for square (both diagonals have to be equal);
- Backfill the foundation on both sides of the foundation blocks to create equal pressure and downward pressure on the base of the foundation blocks. This will assure a stable position of the foundation blocks while further backfilling.



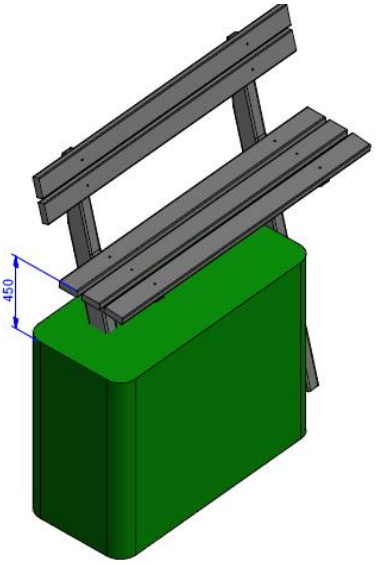
2.8 KLP® Street Furniture

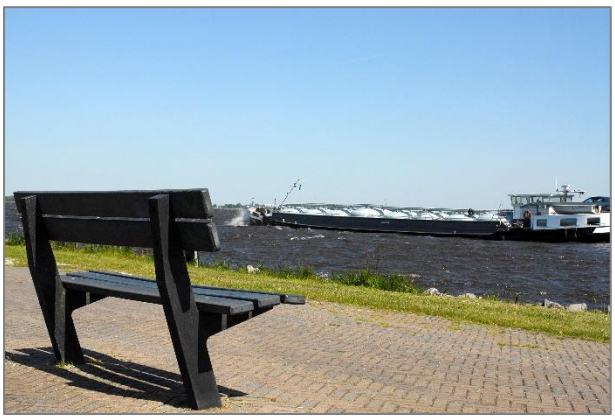
2.8.1 Installation instruction KLP® Bench with backrest



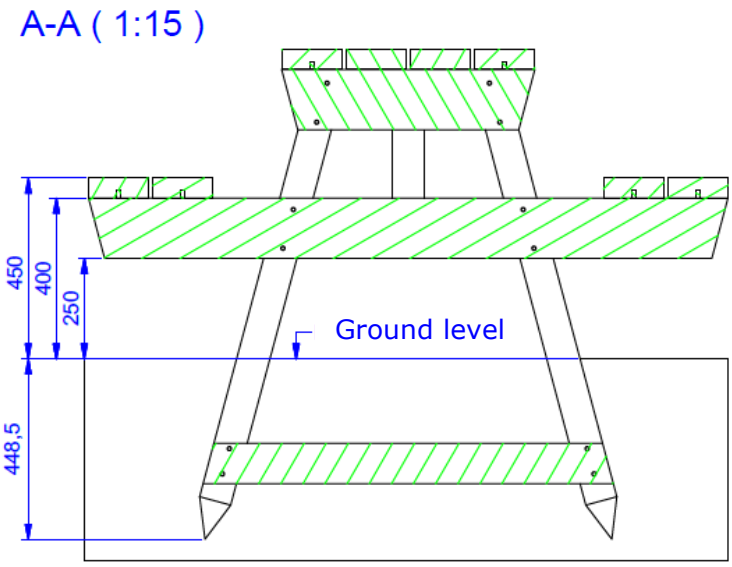


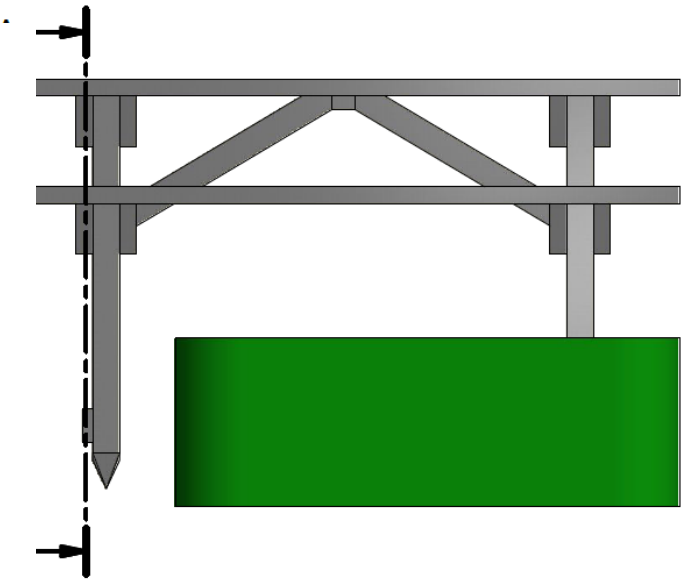
Make sure that the bench seating is placed 45 cm above ground level. This means that the base of the bench has to be buried ca. 99 cm into the ground.
Note: planks with reinforcement are for seating (strips turned downwards), planks without reinforcement are for backrest.



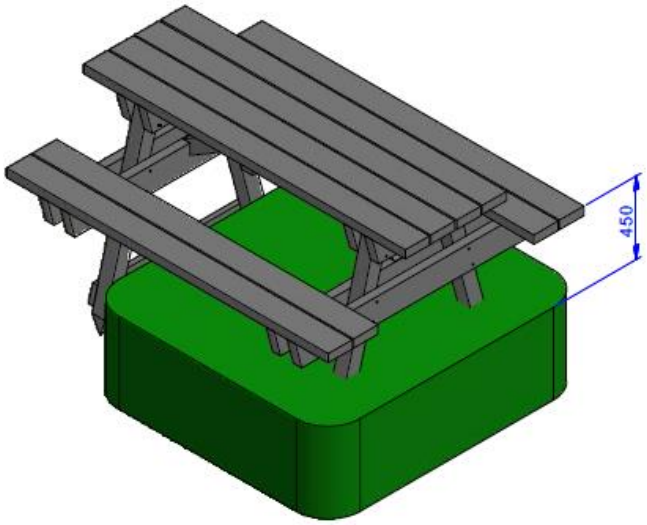


2.8.2 Installation instruction KLP® Picnic set 2 benches



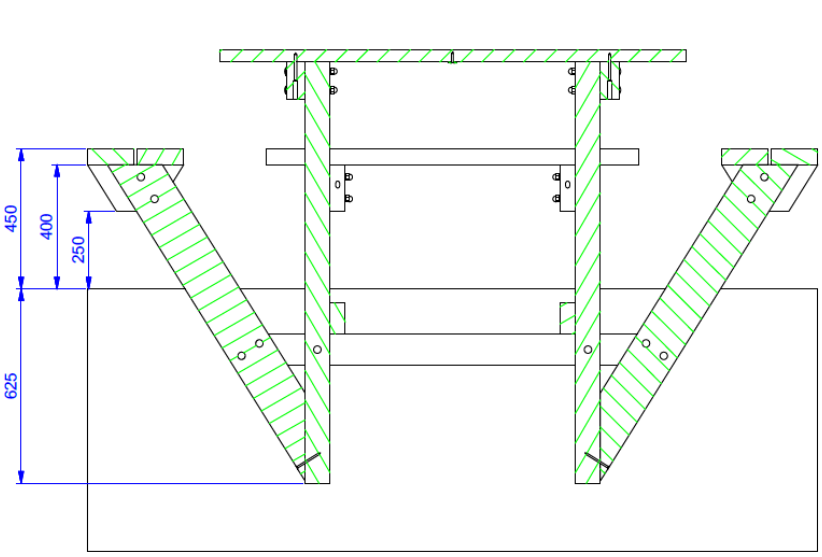


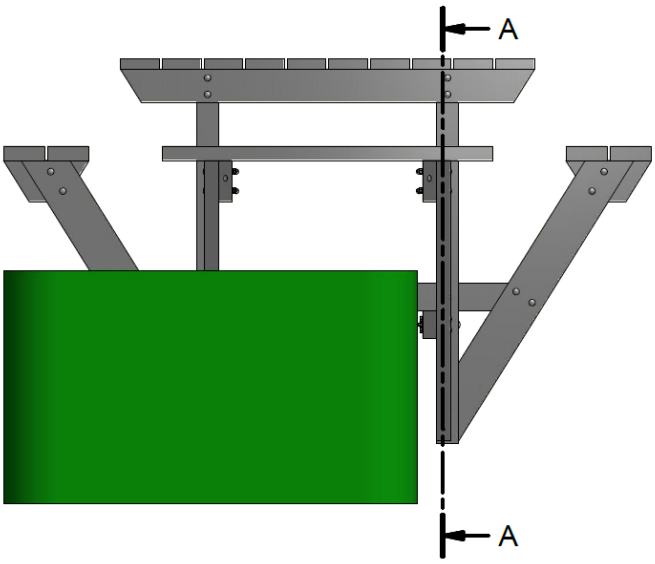
Make sure that the seating planks of the picnic set are placed 45 cm above ground level. This means that the base of the picnic set has to be buried ca. 45 cm into the ground.



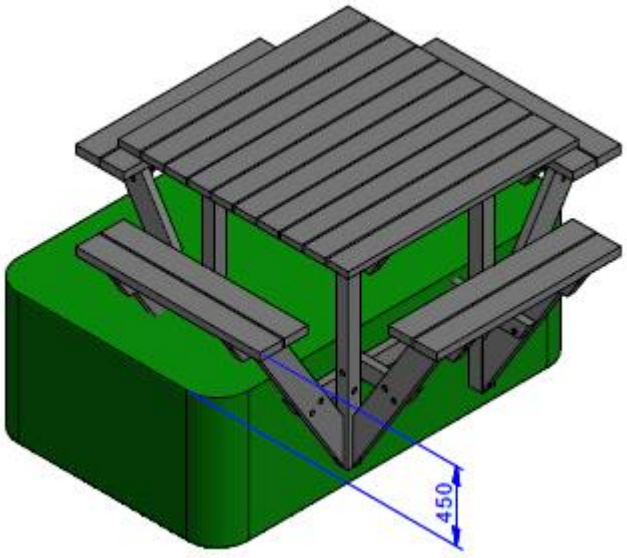
2.8.3 Installation instruction KLP® Picnic set 4 benches

A-A (1 : 15)





Make sure that the seating planks of the picnic set are placed 45 cm above ground level. This means that the base of the picnic set has to be buried ca. 62,5 cm into the ground.



APPENDICES

Appendix 1. Physical and mechanical properties

KLP®

COMPOSITION:

PE/PP

This recycled plastic is sustainable, will last several decades and does not rot as it does not take up any water. It does not require maintenance and can simply be cleaned. KLP® plastic material is also environmentally friendly, because it does not leach any harmful substances to the environment

Physical and mechanical properties

	Standard	Unit	Average value
Density	ISO 1183	kg/m^3	800
Hardness Shore D	ISO 868	-	64
Tensile Strength	ISO 527	MPa	15
Tensile Modulus (1 mm/min)*	ISO 527	MPa	800
Strain at Break	ISO 527	%	10
Flexural modulus	ISO 178	MPa	1000
Flexural Yield Strength	-	MPa	12
Compression modulus	ISO 604	MPa	600
Compression strength @ 20% strain	ISO 604	MPa	18
Charpy Impact Notched at +23°C	ISO 179	kJ/m²	4.2
Abrasion	ASTM 5060	mm^3	37
Water uptake	ISO 1817	%	<0.02
Flammability	UL 94	-	HB
Flashpoint		°C	350
Thermal decomposition		°C	>300
Linear Thermal Expansion	ISO 11359	10^{-6}/ °C	170
Vicat at 10N	ISO 306	°C	-
Melting point	ISO 11357	°C	110-165

* Young's modulus

Disclaimer: All values are indicative. The information presented in this data sheet reflects typical values obtained in our or external laboratories, but should not be considered as absolute or as warranted values.

Rev. 2.0, April 2016

KLP®-V

COMPOSITION:

- Polyolefin glass fibers reinforced

KLP® V a glass fiber reinforced recycled plastic. It is sustainable and will last several decades. It does not rot, as it does not take up any water, does not require maintenance and can simply be cleaned. KLP® V plastic material is also environmentally friendly, because it does not leach any harmful substances to the environment.

Physical and mechanical properties

	Standard	Unit	Average value
Density	ISO 1183	kg/m³	870 – 900
Hardness Shore D	ISO 868	-	68
Tensile Strength	ISO 527	MPa	>21
Strain at Break	ISO 527	%	5
Flexural modulus	ISO 178	MPa	2000
Flexural Strength	ISO 178	MPa	34
Compression modulus	ISO 604	MPa	-
Compression strength @ 20% strain	ISO 604	MPa	>24.5
Abrasion	ISO 4649	mm³	-
Water uptake	ISO 1817	%	0.03
Flammability	UL 94	-	HB
Flashpoint		°C	350
Thermal decomposition		°C	>300
Linear Thermal Expansion	ISO 11359	µm/m/°C	70
Charpy Impact un-notched at +23 ºC	ISO179-1eU	kJ/m²	29
Charpy Impact un-notched at -20 ºC	ISO179-1eU	kJ/m²	24
Vicat at 10N	ISO 306	°C	-
Melting point	ISO 11357	°C	>110

Disclaimer: All values are indicative. The information presented in this data sheet reflects typical values obtained in our or external laboratories, but should not be considered as absolute or as warranted values.

Rev. 3.3, November 2018

KLP®-S

Composition: PE Steel compound

By using steel-reinforced plastic beams it is possible to construct landing stages and bridges with much larger spans. It does not rot or splinter, it does not require maintenance and it contains no poisonous substances.

	Standard	Unit	KLP®- S I-13,5x7-S16 L = 400		KLP®- S 14,5 x 7 – S12 L = 500		KLP®- S 10x10-S16 L=520	KLP®- S 15 x 16 - S16 L = 500		KLP®- S 16 x 8 - S16 L = 400		KLP®- S 18 x 8 - S16 L = 500		KLP®- S 24 x 9 - S20 L = 500		KLP®- S 25 x 15 - S16 L = 520		KLP®- S 25 x 20 - S12 L = 450	
		cm	—	▌	—	▌	□	—	▌	—	▌	—	▌	—	▌	—	▌	—	▌
Orientation cross section																			
Bending stiffness EI short term*	NEN-EN 408	kNm^2	62	275	40	267	170	495		88	461	91	669	178	1624	523	1552	319	984
Bending modulus short term*	NEN-EN 408	MPa	14710	26840	9550	15010	20380	11730		12880	16890	11840	17200	12230	15660	7440	7950	1910	3780
Bending strength short term*	NEN-EN 408	MPa	51	119	32	49	67	37		44	67	39	62	40	68	22	26	8	11
Max. bending moment short term*	NEN-EN 408	kNm	6,0	18,0	3,8	12,0	11,2	21,0		7,4	23,0	7,4	26,9	12,8	58,5	21,0	40,9	12,6	23,8
Compression strength @ 20% strain	ISO 604	MPa	14																
Shear strength short term	-	MPa	6,5																
Density	DIN 53479	g/cm^3	1,50		1,13		1,38	1,07		1,26		1,21		1,23		0,97		0,88	
Abrasion	ISO 4649	mm^3	30																
Water uptake	ISO 1817	%	< 0,01																
Flammability	UL 94	-	HB																
Flashpoint		^0C	> 330																
Thermal decomposition		^0C	> 250																
Linear thermal expansion	ISO 11359	$10^{-6}/^0C$	15																
Vicat at 10N	ISO 306	^0C	97																
Melting Point	ISO 11357	^0C	110-130																

All characteristic values

* Apply for a span equal to full beam length at 23°C

Disclaimer: All values are indicative. The information presented in this Data Sheet reflects typical values obtained in our or external laboratories, but should not be considered as absolute or as warranted values.

Rev. 4.0, December 2019

KLP®-PE

COMPOSITION:

- PE

KLP® PE recycled plastic offers the charm and processing of wood and at the same time the lifetime of plastics. KLP® recycled plastic is sustainable, will last several decades. It does not rot, as it does not take up any water, does not require maintenance and can simply be cleaned. KLP® plastic material is also environmentally friendly, because it does not leach any harmful substances to the environment.

Physical and mechanical properties

	Standard	Unit	Average value
Density	ISO 1183	kg/m^3	880 /920 *
Hardness Shore D	ISO 868	-	50
Melt Flow Rate (190°C /2.16kg)	ISO 1133	dg/min	0.5
Tensile Strength	ISO 527	MPa	9
Tensile Modulus (1 mm/min) **	ISO 527	MPa	240
Strain at Break	ISO 527	%	>250
Flexural modulus	ISO 178	MPa	250
Compression modulus	ISO 604	MPa	120
Compression strength @ 20% strain	ISO 604	MPa	14
Charpy Impact Notched at +5ºC	ISO 179	kJ/m^2	P.B.
Charpy Impact Notched at -5ºC	ISO 179	kJ/m^2	8
Abrasion	ISO 4649	mm^3	30
Water uptake	ISO 1817	%	<0.01
Glow wire	IEC 60695-2-11	°C	550
Flammability	UL 94	-	HB
Flashpoint		°C	>330
Thermal decomposition		°C	>250
Linear Thermal Expansion	ISO 11359	10^{-6}/ °C	170
Vicat at 10N	ISO 306	°C	97
Melting point	ISO 11357	°C	110-130

* Determined on foamed / solid product material respectively.
** Young's modulus

Disclaimer: All values are indicative. The information presented in this data sheet reflects typical values obtained in our or external laboratories, but should not be considered as absolute or as warranted values.

Rev. 2.1, November 2018

Appendix 2. Calculation of permissible material tension

Material tension (permissible) = Material strain x E

(E = Elasticity or creep modulus)

Example of creep calculation
A KLP® Deck plank of 150 x 30 mm has a long term creep modulus of 150 N/mm².
Deflection is represented by the formula:

$$\textbf{Doorbuiging} = \frac{4qL^4}{384EI}$$

(Remark: A mounted deckboard is a combination of imposed and clamped situation. Therefore the calculation is made with 80% of this situation).

Load q in this case is formed by the plank's mass. Density of KLP® is 0,8 g/cm³. This amounts to 3,6 kg per running metre of plank. Value q will then b 0,0353 N/mm.

I is the mass inertia of the plank = 1/12bh³ = 1/12 x 150 x 30³ = 337500 mm⁴.
In this case E is the creep modulus of 150 N/mm².
For the free span, L should be 330 mm.

Deflection due to long term dead weight will then be:

$$\textit{Deflection} = \frac{4 \times 0{,}0353 \times 330^4}{384 \times 150 \times 337500} = 0{,}09 \text{ mm}$$

KLP® has a maximum of tension load of 3,63 N/mm² for long term loads (calculated with 80% load of the above mentioned situation).

$$\textbf{Material tension (actual)} = \frac{3qL^2}{5bh^2}$$

This results in:

$$\textit{Material tension (actual)} = \frac{3 \times 0{,}0353 \times 330^2}{5 \times 150 \times 30^2} = \textbf{0,02 N/mm²}$$

Which is considerably less than the permissible tension.

Appendix 3. Product Safety Datasheet

This Safety Information Sheet has been made to describe safety requirements with regards to products made from KLP®. It does not guarantee certain properties.

1. **Product identification and the company**
   Information on the product
   Trade name: KLP® (KLP®-PE, KLP®-HS, KLP®-V, KLP®-S)

   Information on the company
   Lankhorst Engineered Products bv
   P.O. Box 203
   NL- 8600 AE SNEEK
   TEL.: +31 (0)515 – 487654

2. **Composition of and information on the components**
   Polyolefin. Some products have an added glass fiber (KLP®-V) or are steel reinforced (KLP®-S).

3. **Risk identification**
   There are no specific dangers known.

4. **First Aid Measures**
   Inhalation: in case of inhalation of melted material move the person involved into fresh air.
   Skin contact: in case of skin contact with melted material rinse with cold water quickly. Have a GP treat the person involved
   Eye contact: rinse the material from the eye with plenty of water. If melted material has touched the eye a GP has to be called for immediately.
   Swallowing: Unlikely

5. **Fire extinguishing measures**
   Suitable means of extinguishing:
   - water
   - foam
   - gaseous extinguishing agent
   - extinguishing powder
   - water hose (jet)

   Products burn slowly causing low density smoke and possibly drippings.

6. **Measures in case of unintentionally released material**
   - No special personal precautions are required.
   - No special environmental precautions are required.
   - Clearing method: mechanically.

7. Handling and storage

Handling
Products made from KLP® are machinable; i.e. no harmful substances will arise of be released. When milling or cutting steel reinforced (KLP®-S) or fiber reinforced (KLP®-V), proper PPE's have to be used.

Storage
Unlimited storage is possible at a storage temperature of < 40° Celsius provided that the products are always equally supported.

8. Exposure management / personal protection

Personal means of protection

Respiratory protection:	not necessary
Hand protection:	Gloves.
Eye protection:	not necessary (although advised during processing)
Skin and body protection:	not necessary
Hygienic measures:	do not smoke, eat or drink during processing

9. Physical and chemical properties

Exterior appearance of the products

State of aggregation:	solid substance
Shape:	intruded mould parts
Colour:	several colours
Smell:	odourless

Physical and chemical properties:

pH value:	not applicable
Melting temperature:	120 – 150° Celsius
Decomposition temperature:	approx. 300° Celsius
Flash point:	not applicable
Self-ignition temperature:	approx. 350° Celsius
Density:	0.8 – 0.85 g/cm^3
Solubility in water:	insoluble

10. Stability and reactivity

Dangerous reactions:	no dangerous reactions known
Dangerous decomposition products:	upon burning of this material soot, CO_2 (carbon dioxide) and water will arise. Incomplete burning can cause CO (carbon monoxide gas) to be set free.

Appendix 4. Certificates Quality

DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

Certificate No:
263091-2018-AQ-NLD-RvA

Initial certification date:
19 February 1997

Valid:
29 May 2018 - 29 May 2021

This is to certify that the management system of

Lankhorst Engineered Products B.V.
Prinsengracht 2, 8607 AD, Sneek, The Netherlands
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Quality Management System standard:
ISO 9001:2015

This certificate is valid for the following scope:
Design, production and delivery of plastic end products and plastic semi manufactured products.

Place and date:
Barendrecht, 25 May 2018

MGMT. SYS.
RvA C 024

The RvA is a signatory to the IAF MLA

For the issuing office:
DNV GL - Business Assurance
Zwolseweg 1, 2994 LB, Barendrecht, The Netherlands

J.H.C.N. van Gijlswijk
Management Representative

Lack of fulfilment of conditions as set out in the Certification Agreement may render this Certificate invalid.
ACCREDITED UNIT: DNV GL Business Assurance B.V., ZWOLSEWEG 1, 2994 LB, BARENDRECHT, THE NETHERLANDS. TEL:+31102922689.
assurance.dnvgl.com

Environment

DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

Certificate No:	Initial certification date:	Valid:
287004-2019-AQ-NLD-RvA	02 April 2010	17 May 2019 - 17 May 2022

This is to certify that the management system of

Lankhorst Engineered Products B.V.
Prinsengracht 2, 8607 AD, Sneek, The Netherlands
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Environmental Management System standard:
ISO 14001:2015

This certificate is issued on basis of the ISO 14001 certification scheme from SCCM and is valid concerning all activities related to:
Design, production and delivery of plastic end products and plastic semi manufactured products.

Place and date:
Barendrecht, 02 May 2019

MGMT. SYS.
RvA C 024

The RvA is a signatory to the IAF MLA

For the issuing office:
DNV GL - Business Assurance
Zwolseweg 1, 2994 LB, Barendrecht, The Netherlands

J.H.C.N. van Gijlswijk
Management Representative

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ACCREDITED UNIT: DNV GL Business Assurance B.V., ZWOLSEWEG 1, 2994 LB, BARENDRECHT, THE NETHERLANDS. TEL:+31102922689.
assurance.dnvgl.com

DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

Certificate No:
263097-2018-AHSO-NLD-RvA

Initial certification date:
29 May 2012

Valid:
29 May 2018 – 11 March 2021

Lankhorst Engineered Products B.V.

Prinsengracht 2, 8607 AD Sneek, The Netherlands
and the sites as mentioned in the appendix accompanying this certificate

has been found to conform to the Occupational Health and Safety Management System standard:
OHSAS 18001:2007

This certificate is issued on basis of the OHSAS 18001 certification scheme from SCCM and is valid concerning all activities related to:
Design, production and delivery of plastic end products and plastic semi manufactured products.

Place and date:
Barendrecht, 25 May 2018

MGMT. SYS.
RvA C 024

For the issuing office:
DNV GL - Business Assurance
Zwolseweg 1, 2994 LB, Barendrecht,
The Netherlands

J.H.C.N. van Gijlswijk
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assurance.dnvgl.com

Lankhorst | *Recycling Products*

A trade name of Lankhorst Engineered Products bv

Royal Lankhorst Euronete

Reasons to choose KLP®:

- Sustainable
- Durable
- UV, water and weather resistant
- Maintenance free
- Easy to process
- No rotting, no splintering
- Easy to clean
- Recyclable

People Planet Profit

PEFC

original KLP®

Address Prinsengracht 2
8607 AD Sneek

Postal address P.O. Box 203
8600 AE Sneek

Navigation Sjarke Torenstraat
8607 CS Sneek

E info@klp.nl
I www.lankhorst-recycling.com
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