Technical Documentation

Solar Outdoor Lighting Foundation

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Contents

hei solar light™

INFORMATION ON FOUNDATIONS

Depending on local possibilities, conditions and local requirements different foundation types are suitable. hei solar light™ come with light poles having either a underneath lenght, or optionally a square flange plate to fulfill different requirements on mounting.

For detailed planning a local expert for civil engineering has to evaluate the conditions of the soil/ground at site. HEI can only give an overview on the most common foundations designs and mounting methods.

Please note: The manufacturer shall not be liable for improper installation.

The compliance with static and legal requirements lies within the responsibility of the customer and the installer respectively.

1 Pole versions

There are two different pole versions for **hei solar light™** which are suitable for various foundation methods. Version 1 comes with a sleeve foundation (rooted section), Version 2 with a flange plate.

1.1 Pole with sleeve foundation

This pole version comes with a pipe underneath ground level. Different foundation methods can hold the pipe e.g. a sleeve foundation.

Figure 1 shows the poles with a cylindrical underground length used for **Mira** and **Antares**.

In Figure 2 the conic sleeve foundation of **Champ NG 190** is shown.

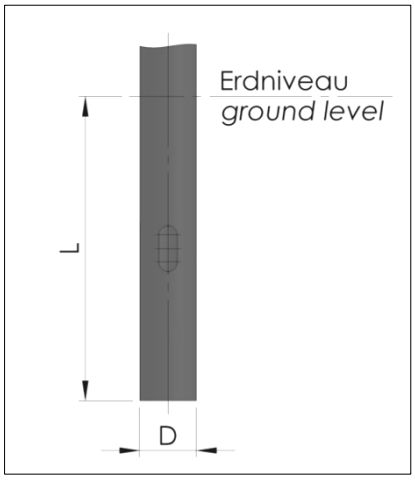


Figure 1: Cylindrical sleeve foundation

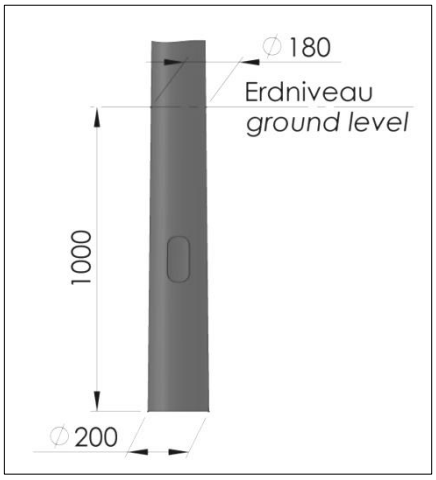


Figure 2: Conic sleeve foundation

The following table shows the dimensions of the sleeve foundation of different poles:

	Dimensions of underground length [mm]	
	L [mm]	D [mm]
Mira S 100	1000	140
Mira 190	1000	178
Mira 380	1200	178
Champ NG 190	1000	conic from 180 to 200
Antares 2000 | twin	1000	100
Antares 4000 | twin	1000	100
Antares 8000 | twin	1000	100
Antares 16000 | twin	1000	1200

Table 1: Dimensions - sleeve foundation

1.2 Pole with flange plate

The flange plate is a steel plate welded to the pole pipe. Poles with flange plates can be mounted right on solid grounds like for example concrete foundations.

Poles with a flange plate come with a square flange plate 330 x 330 mm, see Figure 3. Four slot holes allow a connection with a variable screw distance **A** between 200 and 250 mm, see Figure 3. The maximum diameter of the anchor is M24. The thickness of the flange plate **t** (see Figure 3) is designed and calculated for different wind loads and area surfaces. Calculation is based on European standard EN 40-5 and EN 1991-1-4 (NA). More information on influences by wind can be found in the European standard EN 1991-1-4 or on www.eurocode.at.

The thickness t of **hei solar light™** flange plates varies between 15 and 35 mm.

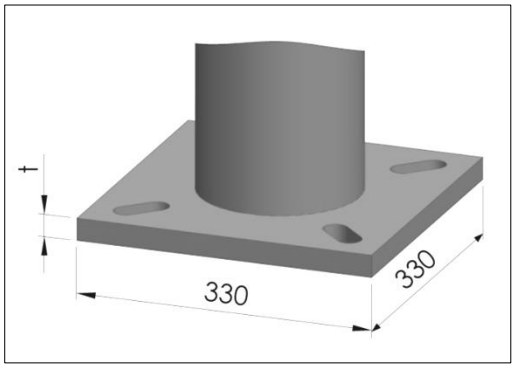


Figure 3: Flange plate - outside dimensions

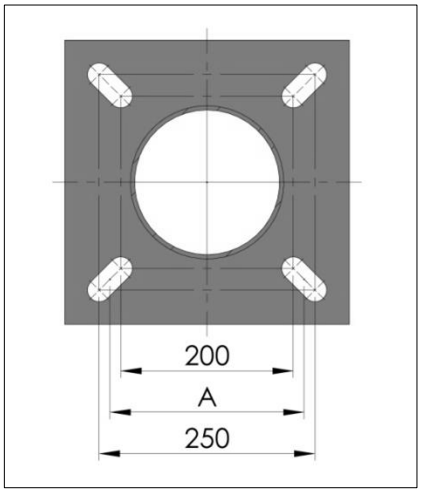


Figure 4: Flange plate - slot hole dimension

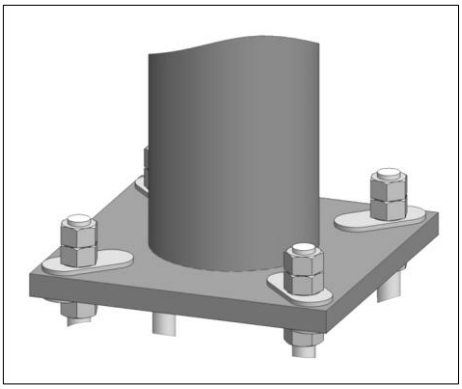


Figure 5: Flange plate with HEI cover plates

2 Installation recommendation for flange plate

The flange plate is mounted with anchor bolts to the foundation. The slot hole of the flange plate is made for diameters up to M24.

Place a washer between nut and flange plate to protect the coated surface.

Large plain washers M24 according to EN ISO 7093 are suitable for M24 bolts. Outside dia = 72 mm / 5 mm thick. To protect slot hole against dirt: Establish anchor distance **A** of 225 mm, see Figure 4.

HEI cover plates for slot holes for M24 and reduced diameters:

HEI cover plates are designed and calculated especially for usage of **hei solar light™** poles. Size: M24 (5 mm thick), see Figure 5. Reduced diameters bring cover plates with a thickness of 10 mm. To protect slot hole against dirt: HEI cover plates cover the slot holes secure for any anchor distances A from 200 to 250 mm, see Figure 4.

The endings of the bolts can be protected against dirt and corrosion with end caps made of plastic. Supplier example: www.radolid.com.

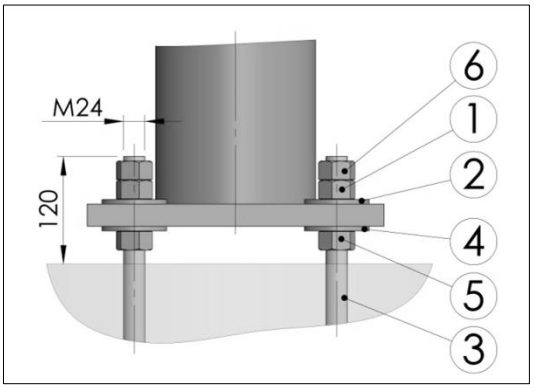


Figure 6: Flange plate – mounting example

Part number	Part description
1	Top nut
2	Top washer
3	Anchor bolt
4	Bottom washer
5	Bottom nut
6	Lock nut

Table 2: Part list (Figure 6)

Figure 6 shows a well-established mounting method suitable for cast concrete foundations. Advantage of this method is the possibility of adjust the bottom nut for vertical alignment. The gap between foundation and flange plate can be filled with non-shrink grout.

Recommended material of screws/threaded rod: 8.8 or higher. All mounting parts should be hot galvanized to avoid corrosion.

Please note: The maximum anchor diameter is M24. The recommended anchor material is steel 8.8. Changing material or reducing the diameter/length of the anchor bolts or foundation basket is possible due different mounting types, but has to be calculated separately by an expert! HEI can provide cover plates for M24 (5 mm thick) and plates with a thickness of 10mm for M22 to M16.

3 Anchoring elements

Anchoring elements connect the flange plate with the foundation. Depending on the foundation either threaded rods or hex bolts are suitable.

Embedded anchor bolts

Anchor bolts are embedded in wet concrete and can have different designs:

L-Bolt (right angle) bend, see Figure 7, J-Bolt (radius bend) or foundation baskets.

L-Bolts / J-Bolts:

The bend part (“leg”) creates resistance against pulling out through force on the pole of **hei solar light™.**

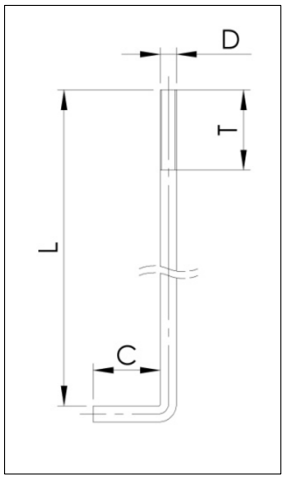


Figure 7: Embedded anchor bolt

Dimensions of L-Bolts for
hei solar light™ as an example.

D	M24
L	865 mm
C	100 mm
T	120 mm

Table 3: Dimensions – L-Bolts (Figure 7)

Due the length L of the L-Bolt a minimum foundation height of 800 mm is required. The position of anchor bolts within wet concrete can be fixed with a foundation template (provided by HEI) and wooden slats.

Supplier example anchor bolts: www.portlandbolt.com, www.simpsonanchors.com

Please note: The maximum anchor dia is M24. The recommended anchor material is steel 8.8. Changing material or reducing the diameter/length of the anchor bolts or foundation basket is possible due different mounting types, but has to be calculated separately by an expert! HEI can provide cover plates for M24 (5 mm thick) and plates with a thickness of 10 mm for M22 to M16.

Foundation basket

Treaded rods fixed together with a plate either through nuts or welded together are called foundation baskets, example shown in Figure 8.

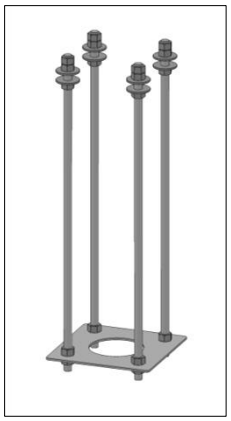


Figure 8: Anchor basket

Please note: Foundation baskets have to fulfill the same requirements as embedded anchor bolts.

Alternative Methods

Embedded anchor bolts require a long time for preparation, due the setting time of concrete, which can take up to three weeks. It might safe time to install anchor bolts in concrete which is already set.

Chemical dowels:

A simple alternative are bolts set in chemical dowels. Chemical dowels should be favored to mechanical dowels or plugs.

Supplier example: www.hilti.com, www.simpson-liebig.com

Expansion anchor:

By tightening an expansion anchor a cone expands and holds the anchor bolt.

Supplier example: www.hilti.com, www.simpson-liebig.com

Please note: The diameter/length of the bolts and the used dowel has to be calculated separately by an expert! HEI can provide cover plates for M24 (5 mm thick) and plates with a thickness of 10mm for M22 to M16.

4 Cable conduit

The conduit protects the cable against damage from force and soil. Cable conduits have to be approved for external use in soil/ground and/or concrete.

Depending on the options of **hei solar light™** cable conduits have to be considered:

- **hei solar light™** with internal batteries (in pole)
  No cable connection or cable conduit is required.
- **hei solar light™** with external battery (in underground enclosure)
  A cable conduit for the battery cable between power control and external battery is required. Inside dia: min. 30 mm - Outside dia: depending on pole, see list below.
- Part-solar (hybrid) versions of **hei solar light™**
  A (additional) cable conduit for the buried cable between power grid and hei power supply is required. Inside dia: depending on buried cable - Outside dia: depending on pole, see list below.

The cable conduit is threaded into the cable entry opening of the pole (poles with sleeve foundation) or through an opening in the flange plate (poles with flange plate). The dimensions of the opening in the version sleeve foundation are equal for all **hei solar light™** lighting poles: 60 x 150 mm, 500 mm below ground level, see Figure 9. Refer also to list below. The dimensions for the opening in the flange plate depend on the outside diameter of the pole pipe, see list below.

Product example conduit:

www.dietzel-univolt.com, FXKVR 50
(ID: 42 mm – OD: 50 mm)

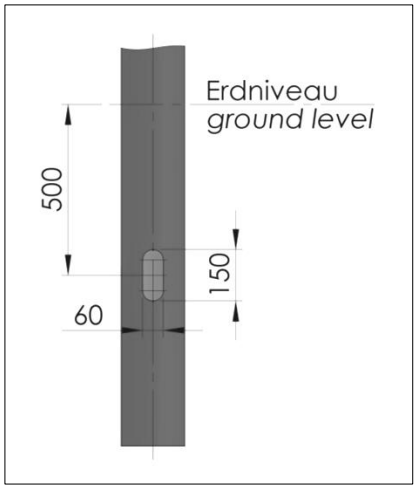


Figure 9: cable entry opening at sleeve foundation

	Maximum outside diameter of cable conduit [mm]	
	With flange plate	With sleeve foundation
Mira S 100	60	60
Mira 190	80	60
Mira 380	80	60
Champ NG 190	80	60
Antares 2000 | twin	60	60
Antares 4000 | twin	80	60
Antares 8000 | twin	80	60
Antares 16000 | twin	80	60

Table 4: Dimensions outside – cable conduit

5 Pit for external battery

In order to increase the battery's life-span in locations with a very hot or a very cold climate an external battery box can be installed under the ground for temperature regulation reasons.

The casing of the pit can be built in various ways. A well-established method is to take a concrete pipe, which is usually used for water drains (see Figure 10). Another possibility is using prefabricated concrete elements or plastic/metal formwork.

Supplier example for formwork: www.msl-bauartikel.com

The battery should be put at a minimum of one meter below the ground level. The pit has to be covered with a (roadworthy) cover. A gravel bed underneath the battery will assist drainage. The optional HEI Protection Box (see Figure 10) will keep the battery poles clean and dry from raising groundwater and any other water from outside.

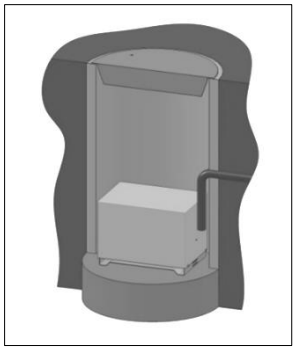


Figure 10: Battery pit – circular

Please note: The inner diameter of the battery pit depends on the used battery and the used HEI Protection Box and has to be approved in detail.

	Minimum inner diameter battery pit [m]
Champ NG 190	0.40
Mira S 100	0.35
Mira 190-2400	0.40
Mira 190-3600	0.45
Mira 380	0.80
Antares 2000 | twin	0.60
Antares 4000 | twin	0.80
Antares 8000 | twin	0.80
Antares 16000 | twin	1.00

Table 5: Dimensions inside – cable conduit

For some foundation methods it is necessary to compact the soil surrounding the pole foundation. To enable compacting, e.g. with a vibrating tamper, respect a minimum distance **C** of 50 cm (see Figure 11) between battery pit and pole foundation.

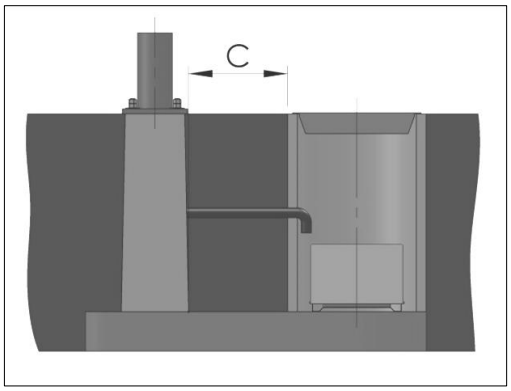


Figure 11: Distance foundation – battery pit

Please note: For detailed planning a local expert for civil engineering has to evaluate the conditions of the soil/ground at site!

6 Examples of foundation designs

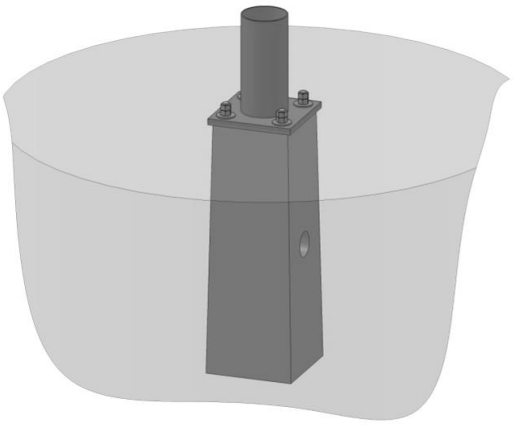
Depending on local possibilities, conditions and local requirements different foundation types are suitable. HEI can only give an overview on the most common foundations designs.

Please respect depth of frost penetration and/or drainage by e.g. a gravel bed underneath the foundation.

Please note: For detailed planning a local expert for civil engineering has to evaluate the conditions of the soil/ground at site.

6.1 Pre-fabricated concrete foundation

Pre-fabricated foundations might save time on-site.



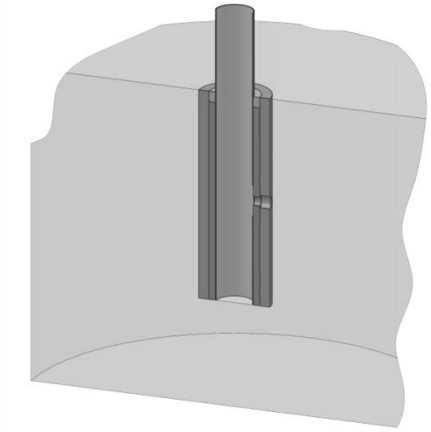
Surrounding ground/soil has to be compacted e.g. by a vibrating tamper

Supplier example for poles with *flange plate*:
www.kromiss-bis.pl
www.rosa.pl
www.vibromat.com (French)

Supplier example for poles with *sleeve foundation*:
www.tibanet.com

6.2 Sleeve foundation

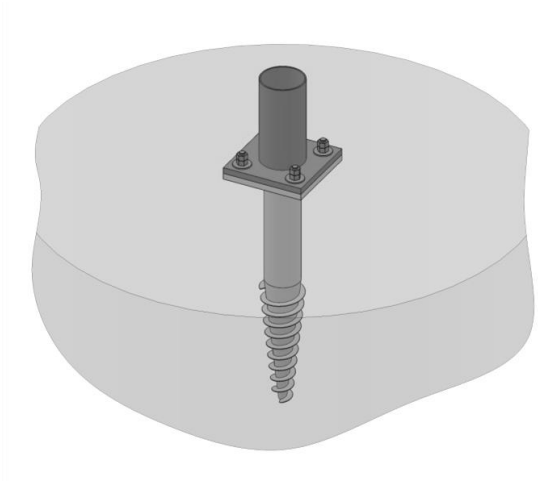
The use of concrete pipes, which are usually used for water drains, is a well-established method to build the sleeve. Minimum inner dia of the concrete pipe is 250 mm. The gap between pole and concrete pipe is filled with ballast. Cover the ballast with mortar to avoid water intrusion.



Surrounding ground/soil has to be compacted e.g. by a vibrating tamper.

6.3 Screw foundation

Screw foundations compact the surrounding area by pushing the ground/soil. The excavation work is reduced to minimum.



Supplier example:
www.krinner.com

6.4 Self-standing concrete foundation

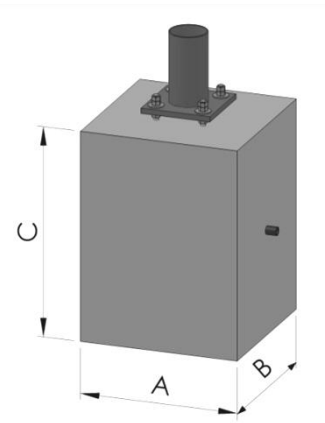
Self-standing foundations are designed and calculated to take the loads of the pole by their dimensions and weight. Surrounding soil is not respected in the calculation. To level the ground surface to flange plate level either soil can be filled around the foundation or the foundation can be buried in the ground.

All dimensions are recommended minimum dimensions. Following conditions were respected (according to EN 1991-1-4): $v_{b,0}$ = 28m/s - terrain category = II.

Placing **hei solar light™** in areas with differing conditions has influence on dimensions.

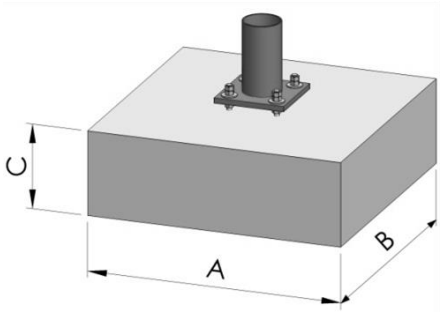
Please note: Detailed design on concrete quality and reinforcement has to be done by an expert referencing to structural engineering guidelines.

Version – square high



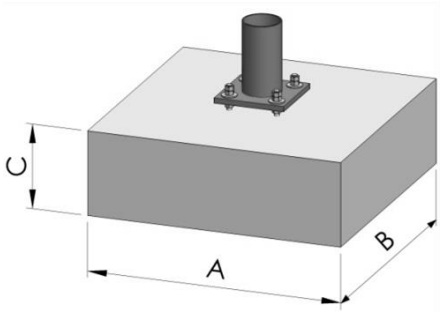
	A = B [m]	C [m]	Approx. weight [kg]
Mira S 100	≥ 0.70	1.00	1,180
Mira 190	≥ 0.75	1.00	1,350
Mira 380	≥ 0.90	1.00	1,940
Champ NG 190	≥ 0.75	1.00	1,350
Antares 2000 | twin	≥ 0.70	1.00	1,180
Antares 4000 | twin	≥ 0.75	1.00	1,350
Antares 8000 | twin	≥ 0.75	1.00	1,350
Antares 16000 | twin	≥ 0.90	1.00	1,940

Version – square low 1



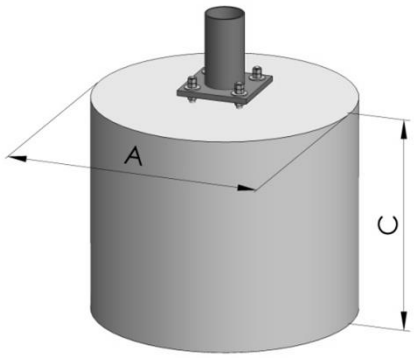
	A = B [m]	C [m]	Approx. weight [kg]
Mira S 100	≥ 1.10	0.20	580
Mira 190	≥ 1.10	0.20	580
Mira 380	≥ 1.45	0.20	1,010
Champ NG 190	≥ 1.20	0.20	700
Antares 2000 | twin	-	-	-
Antares 4000 | twin	-	-	-
Antares 8000 | twin	-	-	-
Antares 16000 | twin	-	-	-

Version – square low 2



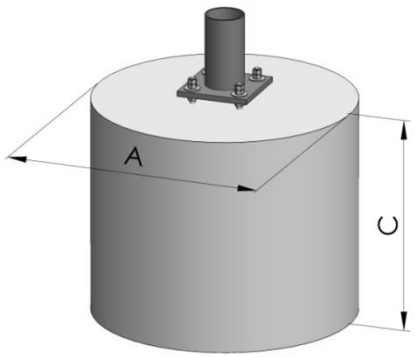
	A = B [m]	C [m]	Approx. weight [kg]
Mira S 100	≥ 0.90	0.40	780
Mira 190	≥ 0.90	0.40	780
Mira 380	≥ 1.20	0.40	1,380
Champ NG 190	≥ 0.98	0.40	870
Antares 2000 | twin	-	-	-
Antares 4000 | twin	-	-	-
Antares 8000 | twin	-	-	-
Antares 16000 | twin	-	-	-

Version – round 1



	A [m]	C [m]	Approx. weight [kg]
Mira S 100	≥ 0.90	0.40	610
Mira 190	≥ 1.00	0.40	780
Mira 380	≥ 1.20	0.50	1,380
Champ NG 190	≥ 1.00	0.45	870
Antares 2000 | twin	-	-	-
Antares 4000 | twin	-	-	-
Antares 8000 | twin	-	-	-
Antares 16000 | twin	-	-	-

Version – round 2



	A [m]	C [m]	Approx. weight [kg]
Mira S 100	≥ 0.90	1.00	1,530
Mira 190	≥ 1.00	1.00	1,880
Mira 380	≥ 1.20	1.00	2,710
Champ NG 190	≥ 1.00	1.00	1,880
Antares 2000 | twin	-	-	-
Antares 4000 | twin	-	-	-
Antares 8000 | twin	-	-	-
Antares 16000 | twin	-	-	-

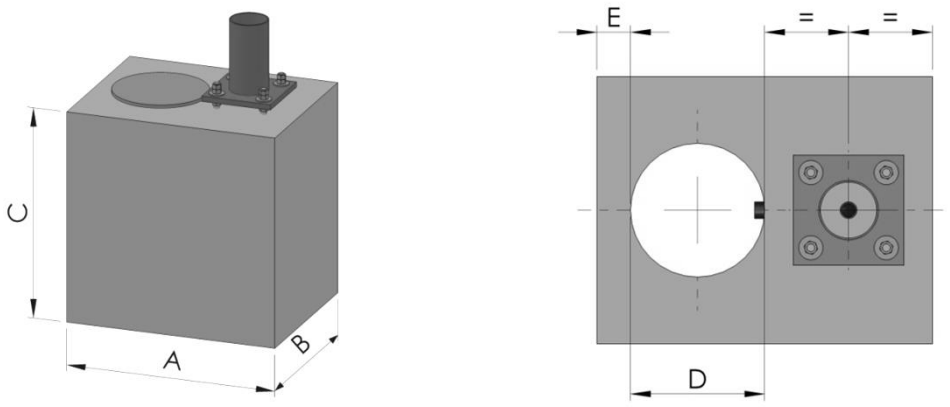
6.5 Self-standing concrete foundation with integrated battery pit

Integrating the battery pit into the pole foundation might reduce work and costs. The distance between battery pit and pole also can be minimized. Due to this foundation design the required space on site can be reduced. Please refer also to the comments at chapter 5: Pit for external battery".

All dimensions are recommended minimum dimensions. Following conditions were respected (according to EN 1991-1-4): $v_{b,0}$ = 28m/s - terrain category = II.

Placing **hei solar light™** in areas with differing conditions has influence on dimensions.

Please note: Detailed design on concrete quality and reinforcement has to be done by an expert referencing to structural engineering guidelines.



	A [m]	C [m]	C [m]	D [m]	E [m]	Approx. weight [kg]
Mira S 100	≥ 0.90	≥ 0.70	1.00	≥ 0.35	≥ 0.10	1,250
Mira 190-2400	≥ 1.00	≥ 0.80	1.00	≥ 0.40	≥ 0.10	1,620
Mira 190-3600	≥ 1.00	≥ 0.70	1.00	≥ 0.45	≥ 0.10	1,300
Mira 380	≥ 1.40	≥ 1.00	1.00	≥ 0.80	≥ 0.10	2,170
Champ NG 190	≥ 1.00	≥ 0.80	1.00	≥ 0.40	≥ 0.10	1,620
Antares 2000 | twin	≥ 0.90	≥ 0.70	1.00	≥ 0.40	≥ 0.10	1,180
Antares 4000 | twin	≥ 0.90	≥ 0.70	1.00	≥ 0.40	≥ 0.10	1,180
Antares 8000 | twin	≥ 1.20	≥ 1.00	1.00	≥ 0.60	≥ 0.10	2,000
Antares 16000 | twin	≥ 1.50	≥ 1.00	1.00	≥ 0.70	≥ 0.10	2,500

6.6 Other foundation methods

Down-the-hole drill (DTH)

Practicable for solid ground: see http://www.bulroc.com, http://www.rockdrill.co.uk