Crane Pads

Requirements

DMS no: 0050-8073

Version No.	Date	Prepared by	Revised by	Approved by	Description of changes
10	06/09/18	RGOBA	LGB/RUSUM	TKJ/PIPRE	E2E Requirements.
11	26/04/19	RGOBA	LGB/ADMAD	TKJ	V162 Requirements.

CONTENTS

1. INTRODUCTION

The purpose of the present document is to define the requirements for the crane pads used for all the Vestas wind turbines to guarantee a safe assembly and erection of the components.

This document must be used as a guideline for the design of the crane pads, which must be customized in every project depending on the specific conditions and constraints. Standard crane pads drawings are supplied in the Annex as a reference for the designer, who must adapt them to the real project by following the criteria that are explained on this document.

Very Important: Addendum to the present document

In the event that any of the standards set forth herein cannot be fulfilled because of technical or economic reasons, an alternative solution shall be found in order to allow a safe wind turbine installation.

Such alternative solutions shall be reviewed and agreed by Vestas prior to the execution of works. The agreed special solutions can be attached as an addendum to the present document in order to be applied in a specific project as valid alternative.

Furthermore, in some specific geographical areas it may be possible to customize and/or to optimize some of the requirements of the present specification. These complementary guidelines can also be attached as an addendum to the present document for exclusive application on such areas.

Note: For everything concerning preservation and storage of wind turbine components, please refer to the applicable Work Instructions from Vestas, which are relevant to the specific turbine type and Mk.

2. ZONES OF A CRANE PAD

A crane pad is composed by the following zones, which are shown on Figure 1:

- Nacelle storage area
- Cranes working area
- Tower sections storage area
- Blades storage area
- Main crane lattice boom assembly area

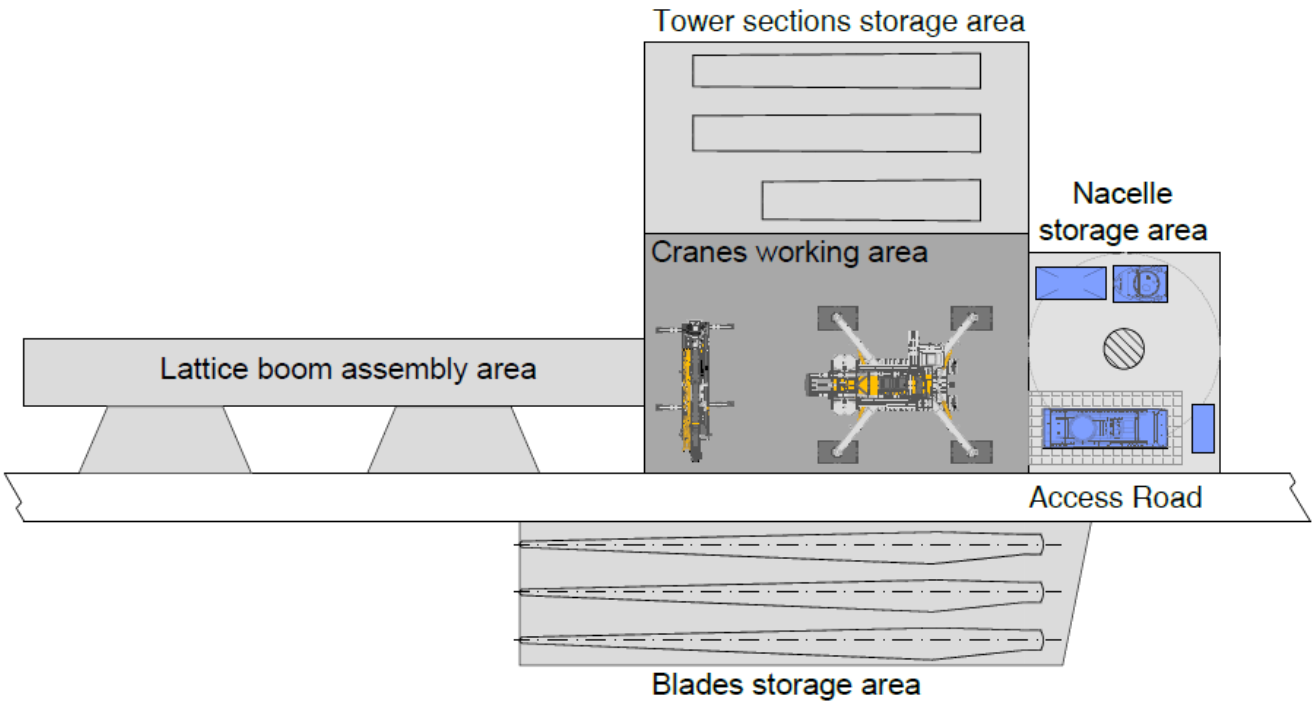


Figure 1: Crane Pad Zones

Note: Figure 1 is just a sketch to indicate the different areas of the crane pad, which are explained on the following sections. Please refer to the next corresponding sections and to the Annex drawings for specific details.

General criteria for crane pads design

- **"Just in Time" Configurations**

  Tower sections and/or Blades storages areas could be eliminated in case of lack of space, but then another storage yard must be prepared nearby the wind farm to store these components.

  It implies some additional cranes and trucks movements to transport the components from the yard to the crane pads with its corresponding over costs. This must be taken into account to take the optimum economical decision for the overall project.

  On these cases, some additional space on the cranes working area can also be saved according to the drawings below (corner on the upper left side).

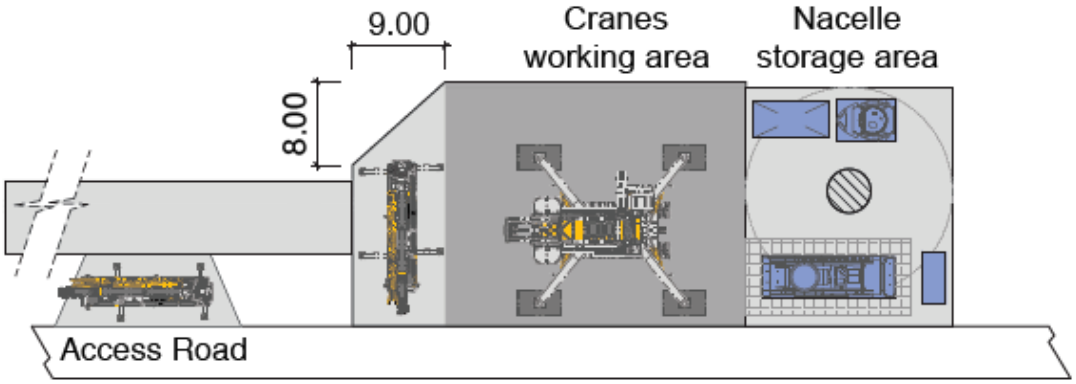


Figure 2: Complete "Just in Time" configuration

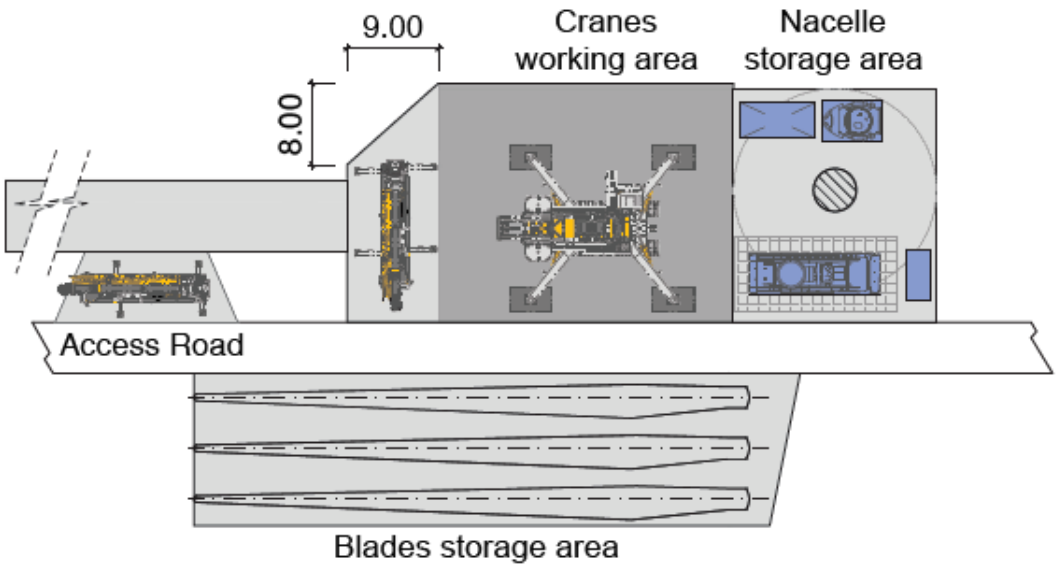


Figure 3: Partial "Just in Time" configuration

- **Main crane lattice boom assembly area**

  The main crane lattice boom assembly area could be eliminated if the main crane can circulate from the previous pad and to the next one.

  To take this decision, it is necessary to find out what is the available crane for the project and to analyze if it is possible the circulation of the crane between the wind turbine positions.

- **Ideal access road position**

  The access road should ideally be located parallel to the crane pad and at the same level. This position makes easier the access to the crane pad and it also allows internal movements during installation works, which saves pad space. However, the access road cannot be considered part of the crane pad and therefore, components storage is not allowed in the access road.

  The access road should never cross the cranes working area.

- **Preferred blades storage area location**

  It is preferred that the blades storage area is located on the right of the cranes working area, looking from the cranes working area to the wind turbine foundation This is to facilitate the blades installation with the “Multi Blade Installer” (also called “Blade Gripper”). (See section 2.4.- Note 1.)

- **Foundation should never be located in the middle of the pad.**

  The cranes working area shall be always located beside the wind turbine foundation to allow the safe positioning and movement of the cranes. The foundation must never be in the middle of this area.

- Crane pad shall always be located **above the maximum ground water level** expected according to the hydrological survey.

- The **crane pad number must be signalized** on a way that it could be easy to see from the road.

2.1. NACELLE STORAGE AREA

As a general rule, nacelle and its components will be stored over the wind turbine foundation. It typically covers a square area of 19-22 m side (the same as the foundation excavation diameter).

If possible, the nacelle storage area will be extended to the access road (unless the distance were very big) in order to make easier the nacelle unload. The final surface of the nacelle storage area will be at the same level as the main crane working area and the road.

A free corridor around the nacelle of 1,5 m wide must be foreseen. This is to allow the installation of a scaffold to prepare the nacelle. It implies a total space for the nacelle preparation of 13,5 x 6,6 m for the 2 MW wind turbines and 15,7 x 7,2 m for the 3 and 4 MW ones.

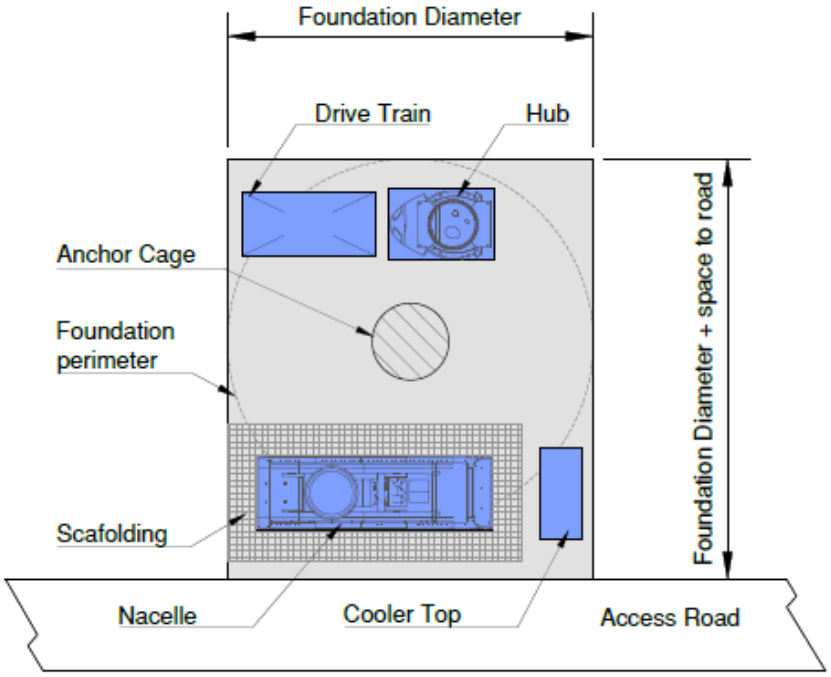


Figure 4: Nacelle storage area

After the foundation concrete curing, the area will be backfilled by compacted layers of 20 cm in accordance with the foundation project requirements about density and compaction.

This area will always be covered by a pavement of graded aggregate to avoid mud and dust around the wind turbine. This is important for safety reasons and also to keep clean the wind turbine both during the construction and during the operation and maintenance phase. A levelling at 1% for drainage can be performed.

Very Important

The access for vehicles from the road to the wind turbine door shall also be foreseen for the later operation and maintenance phase.

2.2. CRANES WORKING AREA

The cranes working area will be placed next to the wind turbine foundation, with the shortest side next to it. It must be observed that the cranes working area must not be located over the foundation.

Furthermore, the cranes working area will be placed parallel to the road and at the same level as the final road surface and the nacelle storage area. These criteria must be followed in order to allow working at the same level and to optimize the space.

If the above criteria were not possible to be followed, a specific drawing must be prepared taking into account the safety distance in proximity of slopes (see section 3.2.) and noticed to Vestas.

The cranes working area is divided on two zones: one for the Main crane and another one for the Auxiliary crane.

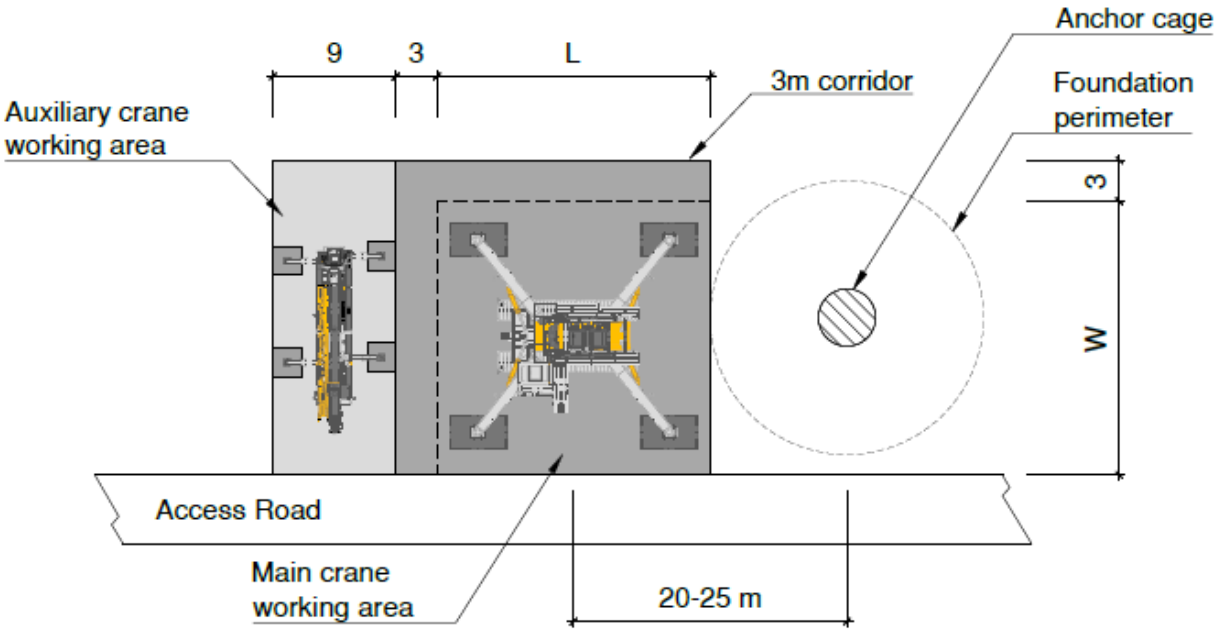


Figure 5: Cranes working area (see “L” and “W” on Figure 6)

2.2.1. Main crane working area

Dimensions

The dimensions of this area will be the width and the length of the main crane on working position (extended outriggers jacks or just the crawlers) plus the following spaces around it:

- On the side of the wind turbine foundation, the distance from the centre of the main crane to the centre of the foundation is typically around 20-25 m, depending on the crane size. The space in the main crane area on this side will be the difference of this distance minus the foundation radius.

  Note: As exception, the telescopic crane LTM11200 needs a distance to the centre of the foundation of only 16 m. It implies that the main crane working area will be partially located over the foundation and so the front mats will be at only around 8 m from the centre of the foundation.

- A corridor of 3 m around the main crane will be placed on the rest of sides. If the access road is placed parallel to the crane pad, the function of corridor is fulfilled by the road and so it is not necessary any additional corridor on this side. Furthermore, on the side next to the tower sections storage area, there will be only a distance of 3 m between the main crane and the tower section.

- If the cases where the main crane needs a derrick counterweight, please check section 2.5.3.

In case of non-available data about the main crane to be used, the following dimensions can be taken as reference.

	W - Width	L - Length
Narrow track crawler crane	16,4 m	18,2 m
Conventional crawler crane	10,4 m	15,8 m
Crane over wheels	18,4 m	24,6 m
Telescopic over wheels (LTM11200)	15,5 m	16,5 m

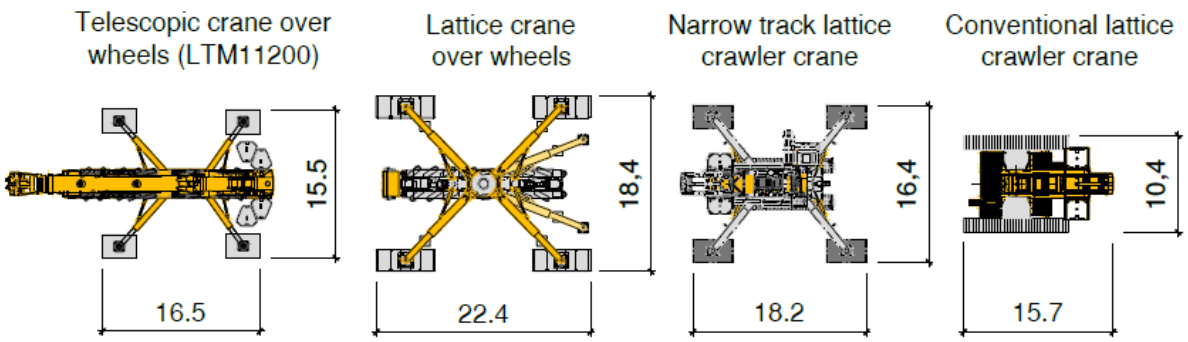


Figure 6: Different types of Main Cranes (approx. dimensions)

Bearing capacity

The bearing capacity of the main crane area will be the maximum pressure that the main crane transmits to the soil in the most critical lifting (the highest weight), plus a safety margin to cover gusts of wind and possible soil deterioration by rain water.

The maximum pressure transmitted to soil will be determined by the crane company by making the simulation of the most critical lifting to be performed. The simulation shall be made with the software that is supplied by the crane manufacturer. Typical values of the transmitted pressure to the soil by the main crane vary in the range from 2 to 4 kg/cm^2.

The safety margin to be added to the maximum pressure will be estimated between 0,5 as a minimum and 1 kg/cm^2 if wet soil conditions are expected.

The bearing capacity will be verified by the Plate Bearing Test as indicated on section 4.1.1. If the test result shows an insufficient bearing capacity, some action must be taken for soil improvement.

Pavement and levelling

The Main crane area will be covered with a pavement of graded aggregate.

In case of using a conventional crawler crane, this area will be levelled at 0%. If cranes over outriggers are used, the area may be levelled at 1% towards the opposite direction to the foundation for easier drainage.

Erection in advance of bottom tower sections (T1 and T2)

In the cases where the bottom tower sections are erected in advance, it must be taken into account that the lifting will be performed by a telescopic crane over wheels, which outrigger mats will be placed around 8 m away from the centre of the foundation.

It implies that the crane working area must be extended over the foundation up to 8 m from the wind turbine foundation centre in order to allow this operation.

2.2.2. Auxiliary crane working area

The Auxiliary crane area will be placed behind the Main crane area on the opposite side of the wind turbine foundation. The function of the Auxiliary crane is to help to the Main crane on the erection of the tower sections.

It will have the width of the Auxiliary crane on working position with the extended outrigger jacks (9 m by default) and the same length of the Main crane area. In case of “Just in Time” situation, the length of this area could be reduced as it is shown in the Figures 2 and 3.

The bearing capacity for the auxiliary cranes area will be 2 kg/cm2. It will be covered by a graded aggregate pavement and it may be levelled at 1% towards the opposite direction to the foundation for easier drainage.

2.3. TOWER STORAGE AREA

The towers storage area will be placed parallel to the crane working area and at the same level.

The length of the towers storage area (parallel) to the crane area, the length of the towers storage area (parallel) to the crane area should be dimensioned according the longest tower section, adding two corridors of 3m on every side. Just for a reference the longest tower section is usually 30 m long, to be checked in every case.

The width of the towers storage area will depend on the number of tower sections to be stored. It will be foreseen 0,5 m more on every side of every tower section in order to allow a corridor of 1 m between towers for inspection and cleaning. On the side next to the cranes working area, this 0,5 m corridor is not needed because there is already space.

If the bottom tower section (T1) is erected in advance, before the main crane arrives to the crane pad, then the corresponding area for this component may be eliminated.

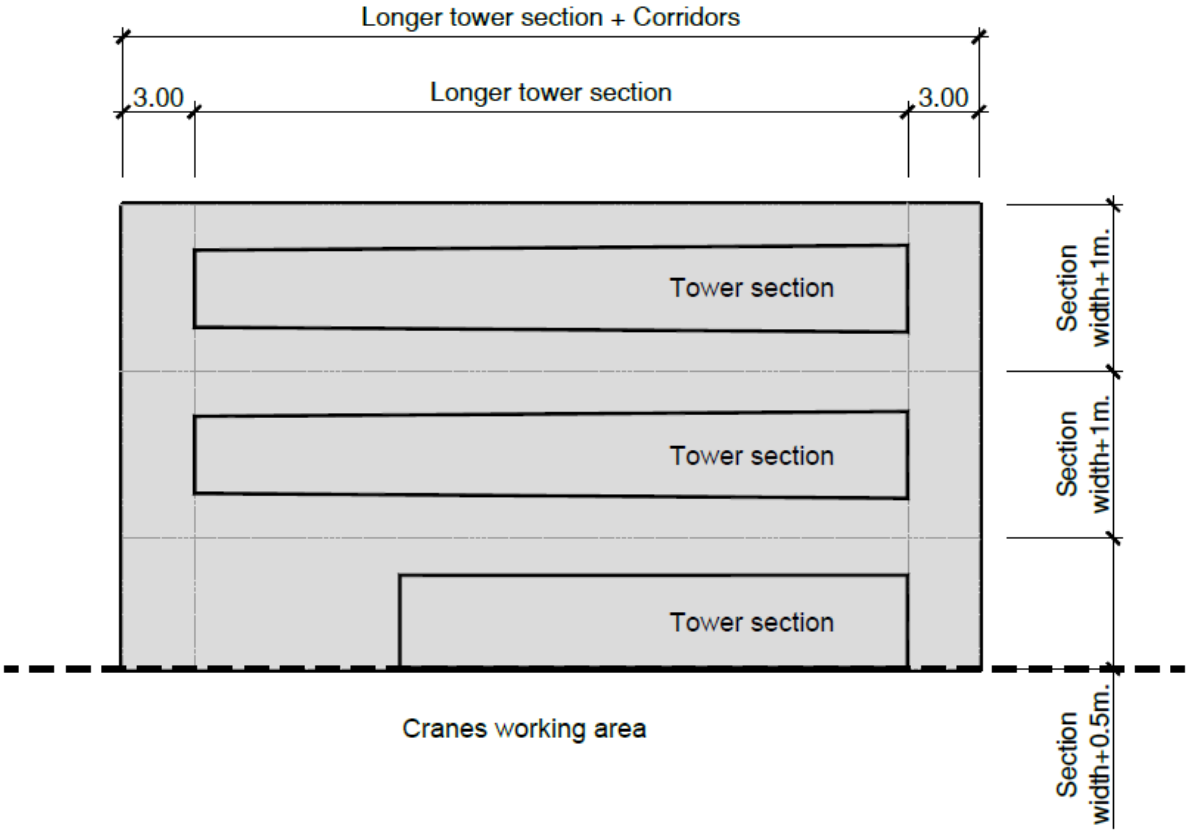


Figure 7: Tower storage area

The area will be levelled and compacted and the bearing capacity will be 2 kg/cm^2. If drainage is necessary, a slope of 1% drainage could be made on the longitudinal direction of the towers and always opposite to the foundation.

Very Important. Safety remark.

For safety reasons, slippery work areas cannot be accepted. If it is foreseen often rain and/or mud, the surface of this area shall be covered by a layer of graded aggregate or gravel in order to assure safe work conditions.

Otherwise, if slippery unsafe conditions are found during the construction, the Safety Officer and/or the Vestas Representative will have the right to stop the works to prevent accidents and the Contract lead time will be extended automatically.

2.4. BLADES STORAGE AREA

The blades storage area will be placed parallel to the cranes working area, if possible on the opposite side of the towers area. This area can even be placed on the other side of the access road. Moreover, this storage area should be accessible from the wind farm road by auxiliary cranes.

The length of the blades storage area will be the length of the blade plus a working area that shall be located at root end to allow the circulation of a forklift. The width of the area will be 14,5 m for the blades around 3,5 m of maximum chord (V80, V90 and V110) and 16 m for the blades around 4 m of maximum chord (V100, V112, V116, V117, V120, V126, V136 and V150).

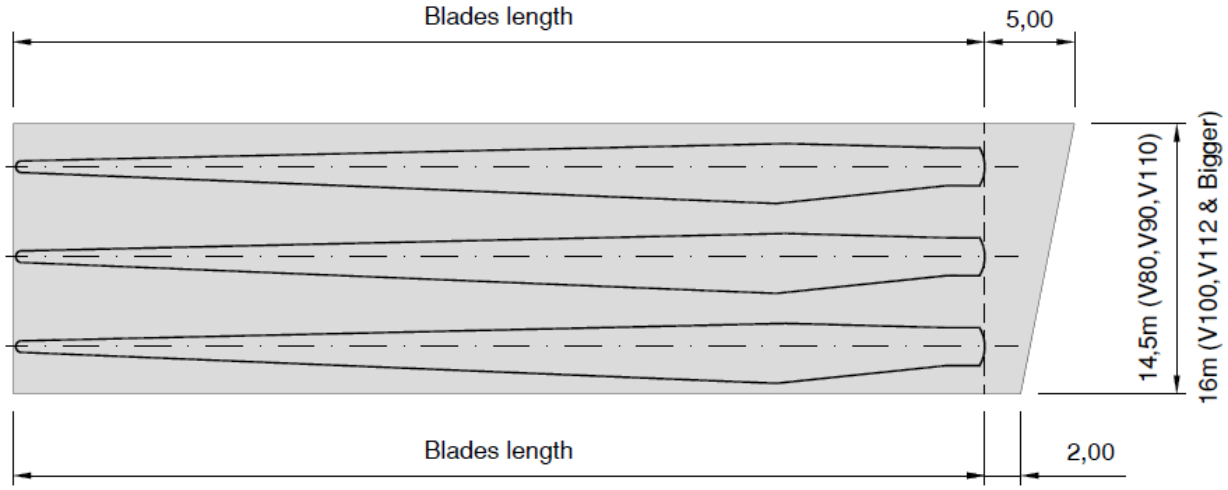


Figure 8: Blades storage area

The area will be free of obstacles and levelled with a maximum slope of 1%. The necessary bearing capacity is 2 kg/cm^2. The bearing capacity will be verified on backfilled areas.

Very Important. Safety remark.

For safety reasons, slippery work areas cannot be accepted.

Underneath the blades, natural soil conditions and vegetation could be kept if the area is flat, there is not obstacles and mud and slippery conditions are not foreseen after rain.

However If it is foreseen often rain and/or mud, and the surface could be slippery, this area shall be covered by a layer of graded aggregate or gravel in order to assure safe work conditions.

Otherwise, if slippery unsafe conditions are found during the construction, the Safety Officer and/or the Vestas Representative will have the right to stop the works to prevent accidents and the Contract lead time will be extended automatically.

Note 1: "Multi Blade Installer" space

The "Multi Blade Installer" (also called "Blade Gripper") needs a free obstacles area of 3x12 m that must be centered at the blade gravity centre to take the blade.

If blades storage area is located at the right of the cranes working area (looking from the main crane to the foundation) and next to the road, nothing especial must be provided. On this case, the temporary free space for the "Multi Blade Installer" is on the road.

In other configurations, this space must be foreseen.

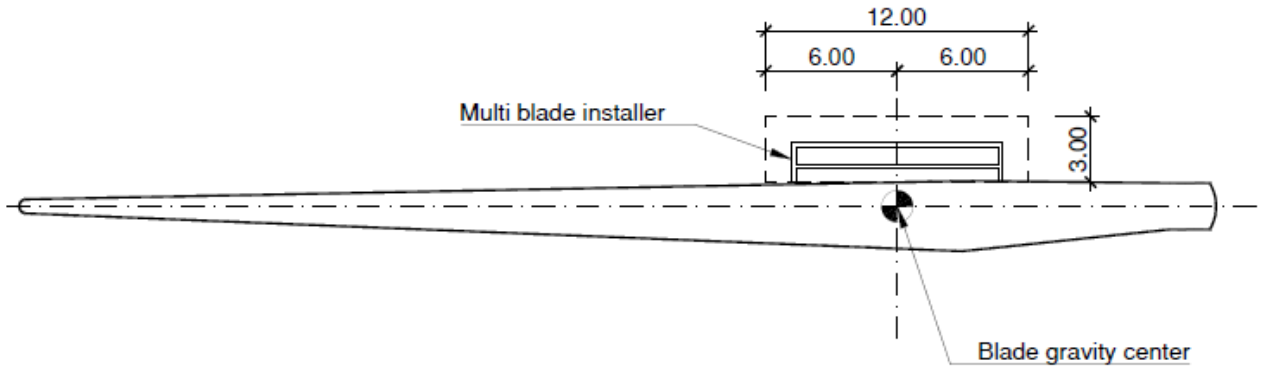


Figure 9: Multi blade installer space

Note 2: Access for blades trucks to blades storage area

In some countries, it is forbidden to extend the boom of the crane with a suspended load. It may affect to the blades unloading when using auxiliary cranes not so powerful, because it may be necessary that the truck with the blade enters into the crane pad.

To allow that the truck with the blade enters into the blades storage area, an access like a road widening must be built as it is shown on the figure below. It will allow to park the truck on the first blade position and so to unload the blade from there to the most far away blade position.

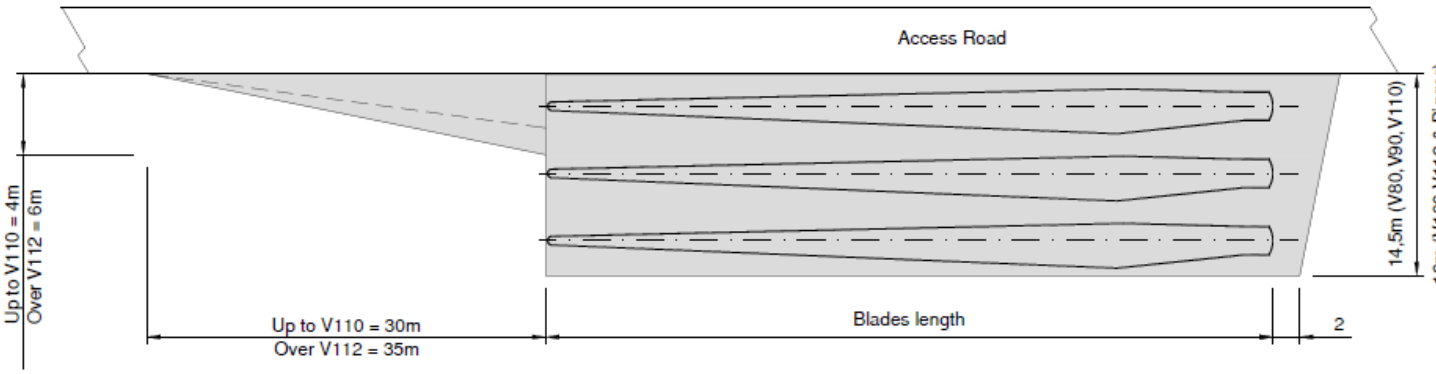


Figure 10: Access to the blade truck to the storage area

Note 3: Minimal blades storage area

In some cases, a minimal blades storage area can be designed as it is shown below, by making just two strips underneath the tip and root supports of the blades.

The two strips will be well compacted and covered by graded aggregate. Both strips will have a bearing capacity of 2 kg/cm2.

The rest of the blades storage area out of the strips will be flat and free of obstacles and must allow the circulation of a forklift and/or an aerial work platform.

The main condition to use this type of blades storage area is that no much rain is expected and that mud or slippery conditions will not appear out of the strips.

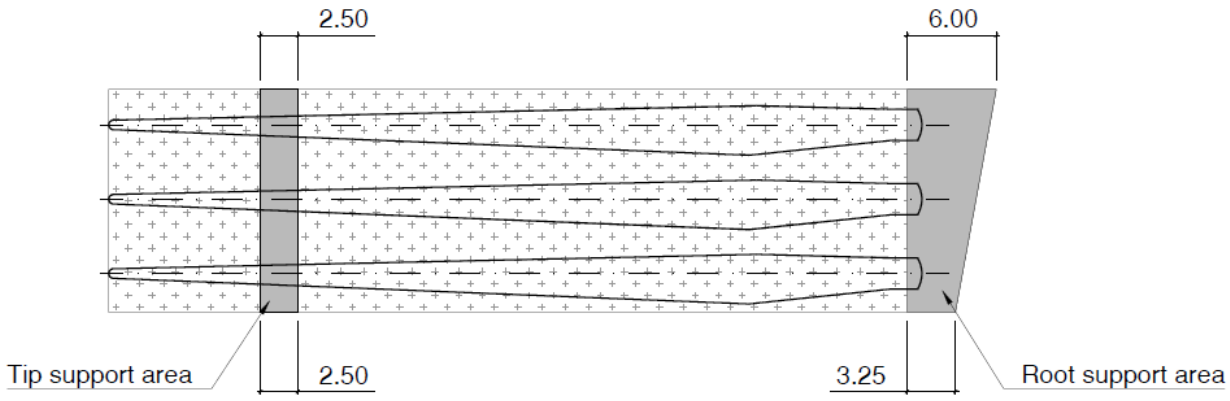


Figure 11: Minimal blades storage area

2.5. MAIN CRANE ASSEMBLY AREA

In the crane pads where the lattice boom of the main crane must be assembled, an area for this purpose must be foreseen.

It will be composed by the area where the lattice boom will be assembled, some small pads for the auxiliary cranes and the derrick movement area.

2.5.1. Lattice boom assembly area

The lattice boom length is around 20 or 25 m longer than the hub height of the wind turbine. It implies that the assembly area must have this length less the lattice part that could be over the crane pad. This area will be straight and will be free of obstacles. The natural soil will be kept and it is not needed to be covered with gravel.

If possible, this area will be placed parallel to the road, in order to use it for the access of the trucks with the boom parts.

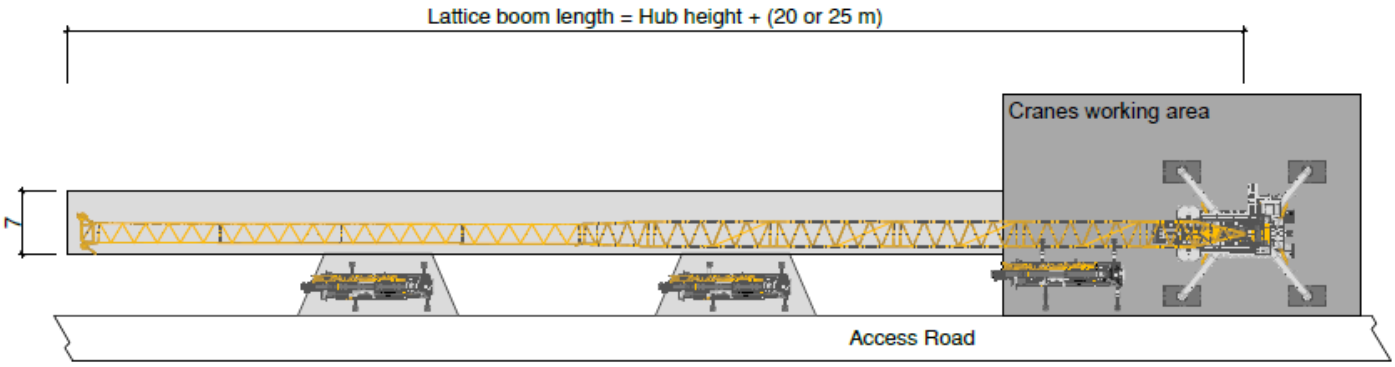


Figure 12: Lattice boom assembly area

2.5.2. Auxiliary pads

The auxiliary pads will have the dimension necessary to place a 100-150 Tm crane and will be located on the side of the road. The auxiliary pads will be placed every 40 m of distance (from centre to centre of the pads).

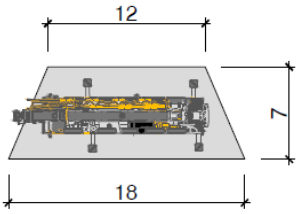


Figure 13: Auxiliary pad for auxiliary assembly cranes

2.5.3. Derrick counterweight movement area

For wind turbine hub heights higher than 90 m, the main crane configuration will include in most of the cases a derrick counterweight.

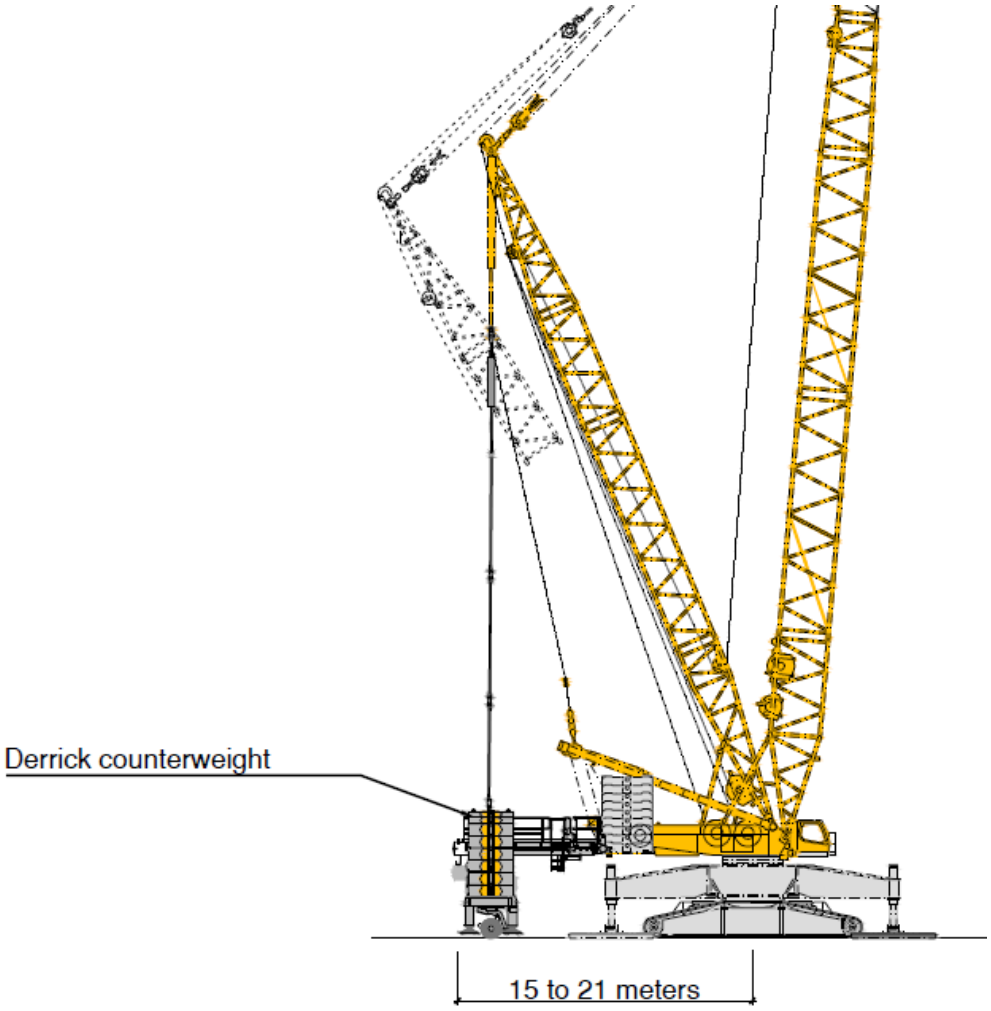


Figure 14: Derrick counterweight

On these cases, it is necessary to foresee the space that is needed for the movement of the derrick counterweight when the main crane is working.

The derrick counterweight is installed once the lattice boom is fully assembled. This work is done in the cranes working area, after the lattice boom is lifted ant turned to the wind turbine foundation.

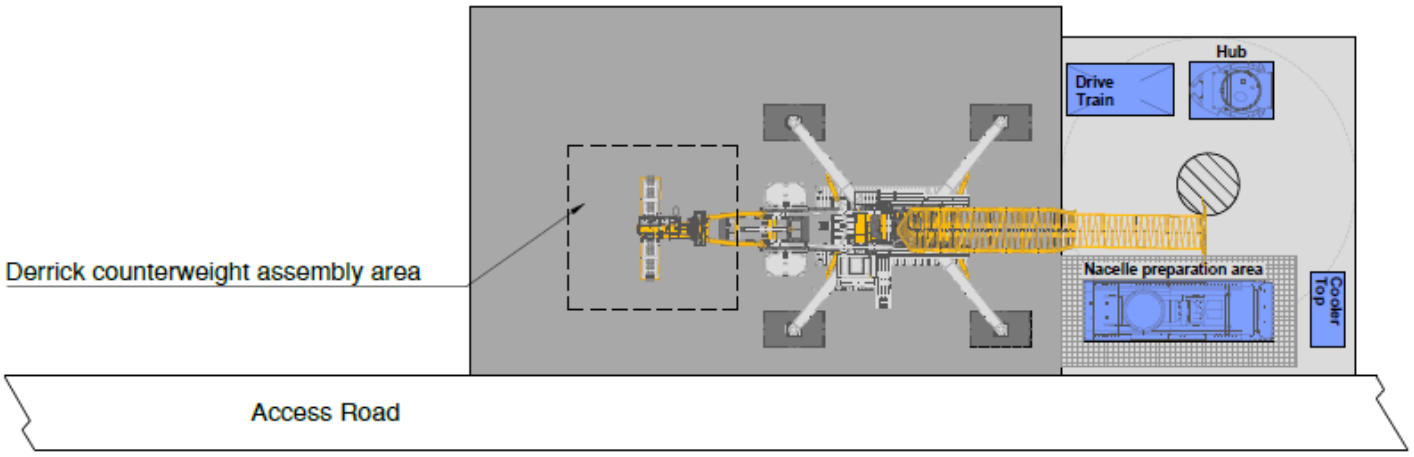


Figure 15: Derrick counterweight assembly area

The typical radius of the derrick counterweight movement area is 15-21 m, depending on the crane model.

The derrick counterweight movement area will be usually needed on the opposite side to tower sections storage and it will force to separate the blades storage area (see figure below).

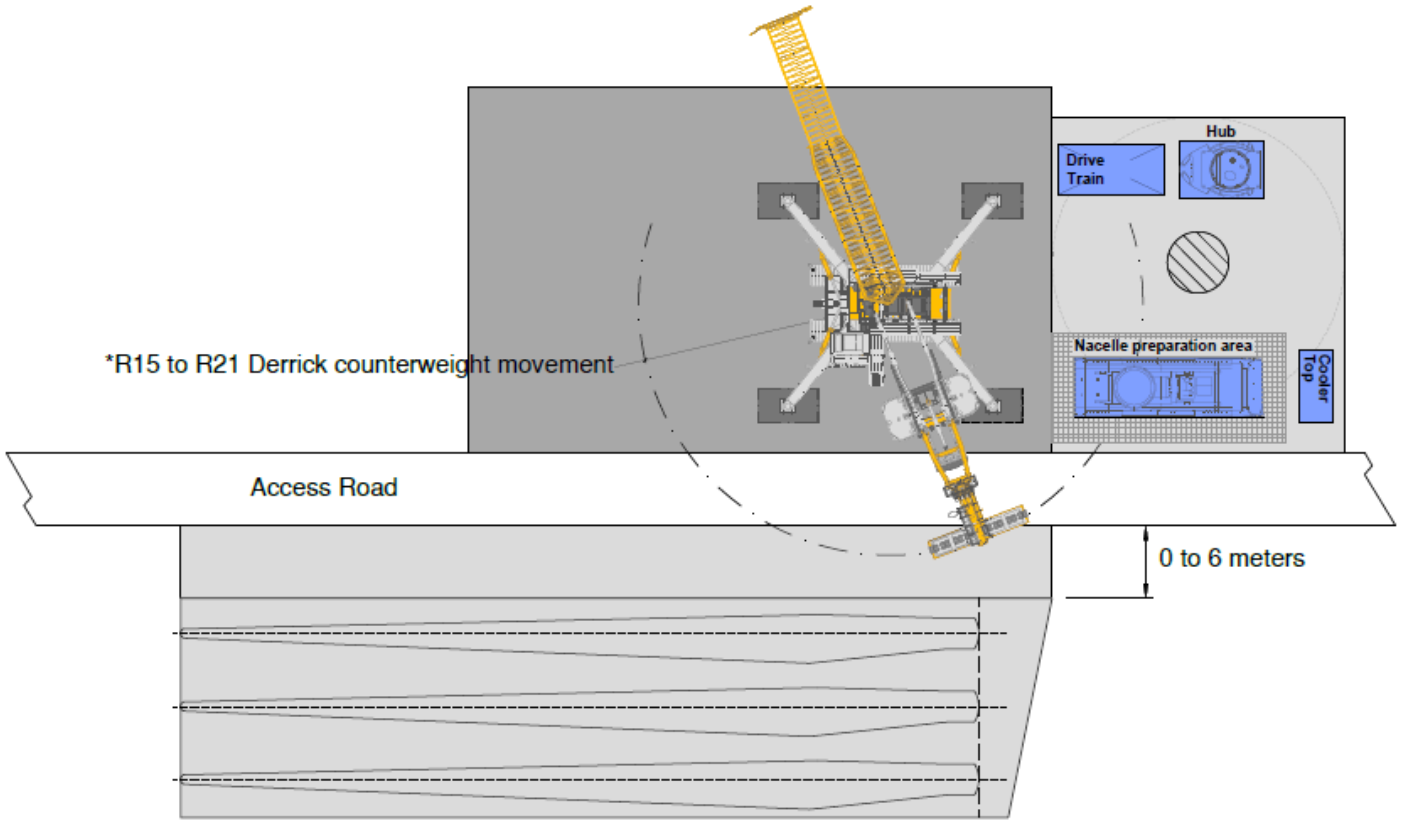


Figure 16: Derrick counterweight movement area

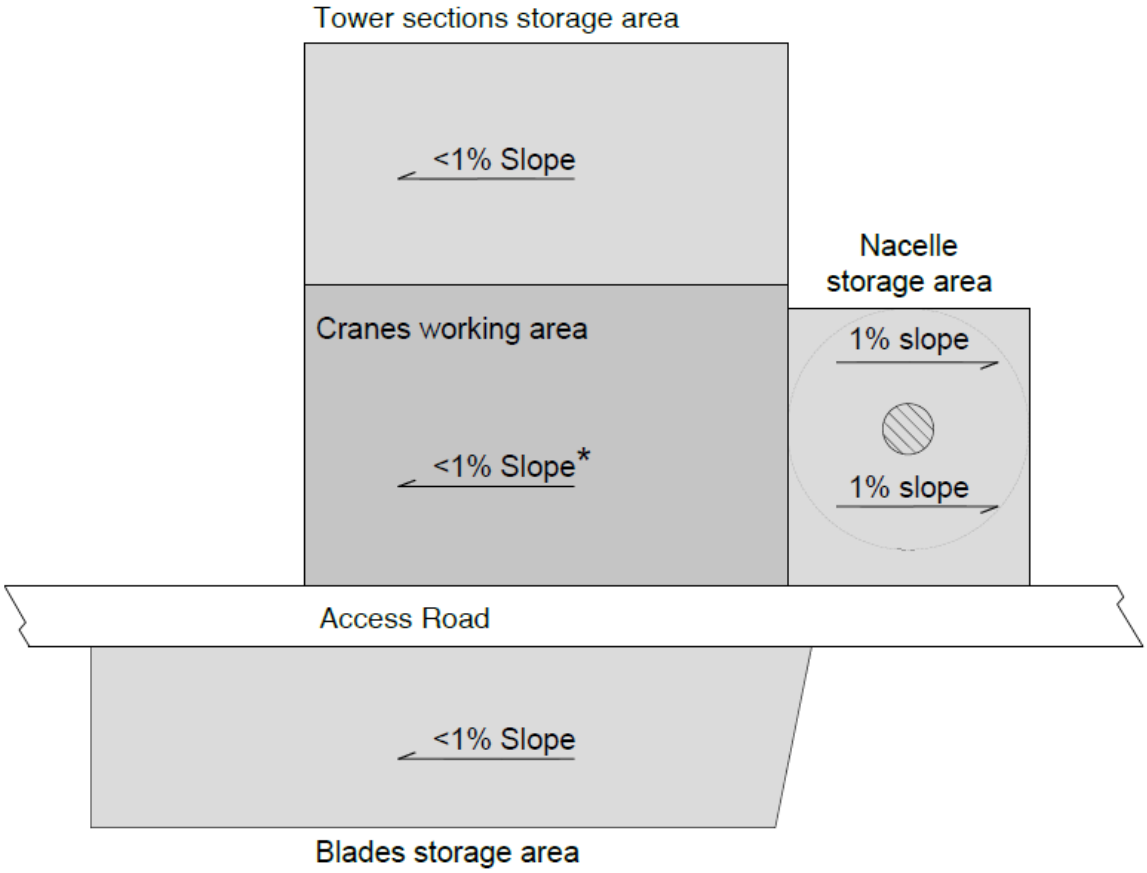
3. OTHER CONSTRUCTIVE DETAILS

3.1. Drainage

3.1.1. Levelling for drainage

In case that it is considered necessary to have a slope for water drainage, it will be 1% in all the area. The water flow will be conducted to evacuate the area of the wind turbine foundation and the main crane working area. The only exception will be the Main crane working area if a conventional crawler crane is used, which will be levelled at 0%.

There will not be any step between the different areas. The corresponding transition slopes will be done to avoid the steps between areas.



(*) If conventional crawler crane is used, the Main crane working area will be levelled at 0%

Figure 17: Drainage Slope

3.1.2. Drainage ditches

In areas where it is foreseen that rain water may invade the crane pad (high mountains around the crane pad, heavy rain is expected and crane pad interrupts the water flow of the natural drainage) a ditch along the perimeter of the crane pad must be made to facilitate drainage.

3.2. Safety distance in the proximity of slopes

In the event that the pad is located on an embankment or a natural slope, the cranes and/or the wind turbine components shall keep an adequate safety distance to prevent the edge from collapsing. Such safety distance will depend on the type of ground:

- Soft/embanked ground: 2 times the slope height h.
- Hard/natural ground: 1 time the slope height h.

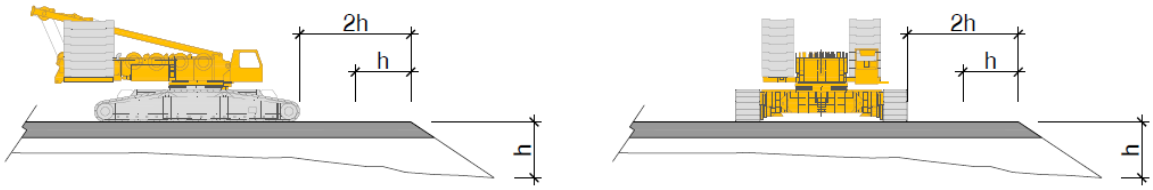


Figure 18: Safety distance in the proximity of slopes

The pad measurements shall be increased with the required safety distance to the slope edge, and a clearly distinguishable line on the ground shall signal the corresponding limits not to be crossed. Main crane area defined in this specification dimensions shall be always ensured although above indicated 2h security distance applies.

The angle of the cut and fill slopes and the maximum height will be defined by a geotechnical specialist.

Furthermore, in case the pad is situated next to a mountain wall or other high-rising obstacles, the crane pad shall be separated by at least an additional 3 meters from such obstacles in order to perform all maneuvers with ease and prevent damaging components.

3.3. Safety distance to overhead power lines

The following safety distance from the wind turbine tower to the nearest overhead power line pylon is required **to ensure safe lifting of tools and parts to the nacelle** during both construction and service phases.

Wind turbine Hub Height	Medium Voltage OH Pylon Height	Critical angle	Minimum distance OH Line – Wind Turbine
65 m	15 m	39,7º	51,5 m
80 m	15 m	35,7º	56,6 m
84 m	15 m	34,8º	57,9 m
91,5 m	15 m	33,3º	60,2 m
94 m	15 m	32,8º	60,9 m
95 m	15 m	32,6º	61,2 m
105 m	15 m	31,1º	64,1 m
116,5 m	15 m	29,3º	67,2 m
117 m	15 m	29,3º	67,3 m
119 m	15 m	29,0º	67,8 m
125 m	15 m	28,3º	69,4 m
140 m	15 m	26,7º	73,1 m

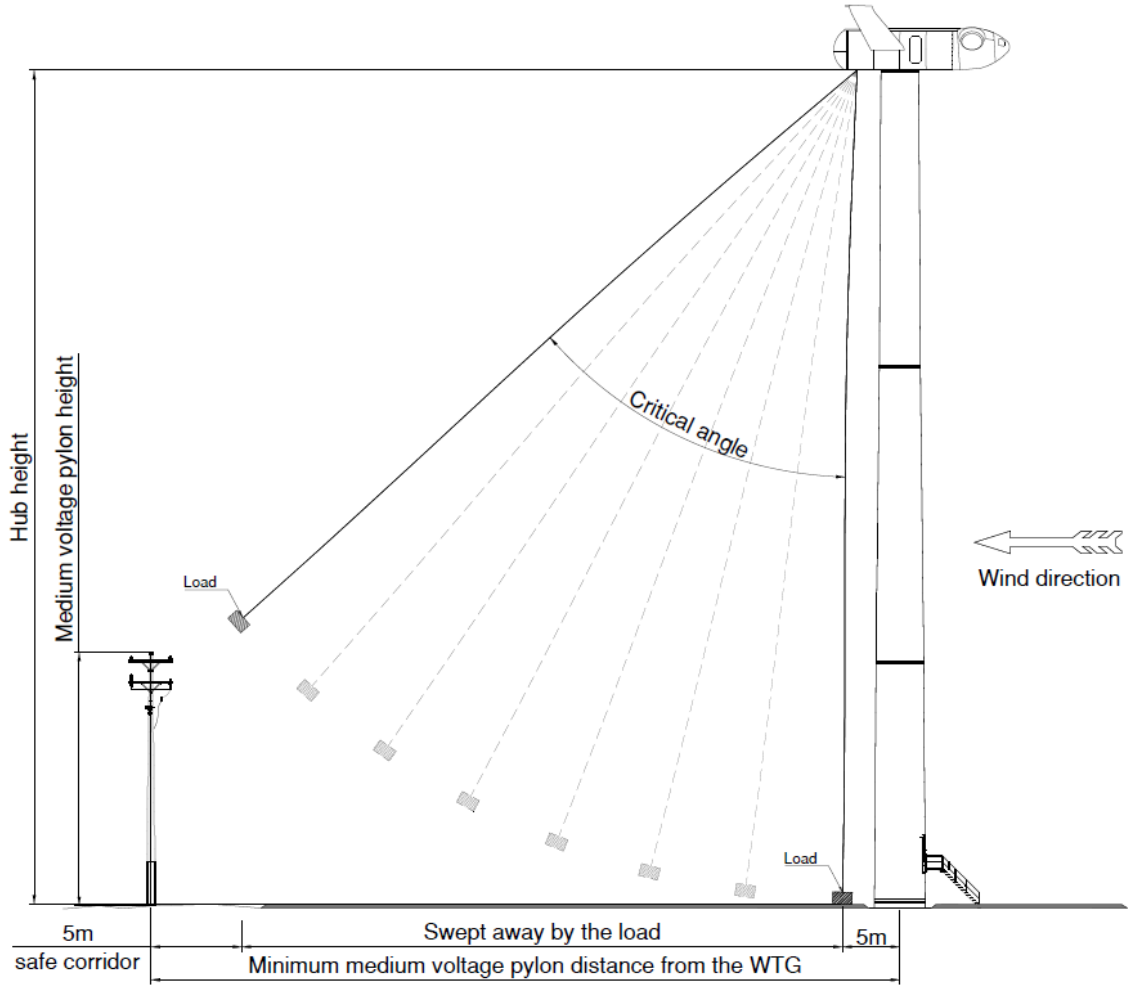


Figure 19: Minimum safety distance from wind turbine tower to nearest overhead power line

In case of other OH Pylon height, the calculation of the safety distance can be done by following the same schema as on the above Figure.

On all the wind turbine components lifting operations, both during wind turbine erection on construction phase and for blades or any other component replacement on service phase, the nearby overhead power lines will be de-energized. Furthermore, if there is any possibility of interference with the wind turbine components lifting operation, the interfering overhead power line will be taken down.

4. CRANE PADS ACCEPTANCE

The following verifications will be performed for the acceptance of the crane pads before unloading the wind turbine components and proceeding to the erection.

4.1. Bearing capacity and compaction

In all the below cases, the corresponding reports will be presented for the crane pads acceptance.

4.1.1. Bearing capacity verification

Bearing capacity on main crane working area

The working area below the main crane, where a high bearing capacity is necessary, will be tested with a static plate bearing test located in the front area of the main crane looking to the wind turbine foundation, where the maximum pressure to the soil is applied.

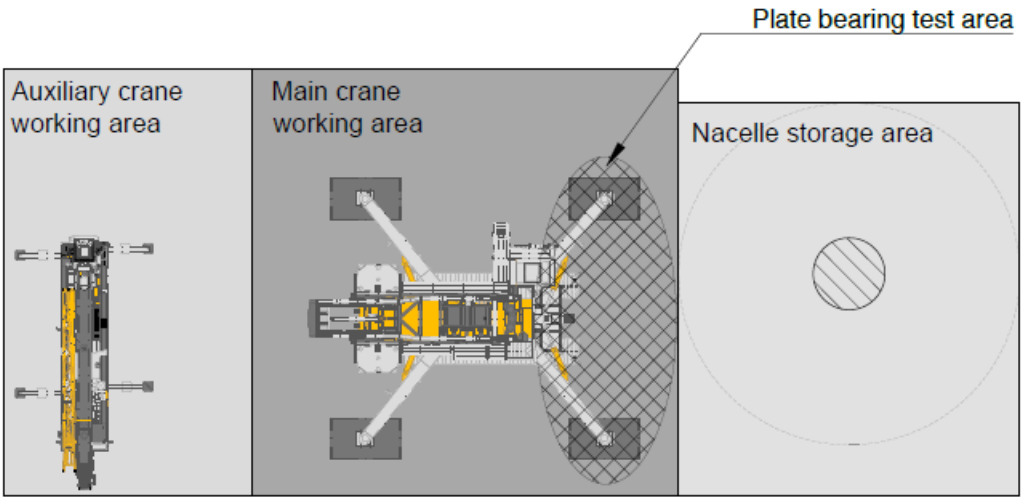


Figure 20: Plate bearing test area on Main crane working area

Bearing capacity on embankments

All the areas of the crane pad that have been built by backfilling must be tested with a static plate bearing test to ensure the required bearing capacity. As exception the backfilling over the wind turbine foundation does not to be verified with the plate bearing test because the soil underneath the foundation must be verified during its construction.

The plate bearing test will be performed in the border of the useful area of the embankment, where the wind turbine components and the cranes can be placed by respecting the safety distance to the slope.

In high embankments, a study of its stability will have to be performed by an accredited laboratory, as an additional safety measurement.

Relation between bearing capacity and plate bearing test

The accredited laboratory that makes the static plate bearing test shall set up the acceptance criteria on it to confirm the required bearing capacity.

Just to have a reference, the following equivalence between the bearing capacity and the plate bearing test can be considered as a first approach, pending of the confirmation by the accredited laboratory that makes the plate bearing test according to the final plate to be used.

Bearing Capacity	Ev_2	Ev_2/Ev_1
2 kg/cm^2	Ev_2 > 50 MPa	Ev_2/Ev_1 < 3
5 kg/cm^2	Ev_2 > 100 MPa	Ev_2/Ev_1 < 2,2

Figure 21: Approximate equivalence Bearing Capacity – Plate Bearing Test

Very Important

Soil conditions can change from the time when plate bearing tests are made on main crane working areas and embankments to the moment of the wind turbine erection. It may happen for instance after heavy rain or high insolation weather. On these cases, it is recommended to repeat the plate bearing test for verification before the cranes and components occupy the crane pad.

4.1.2. Compaction tests

In the backfilled areas, the material will be compacted on layers of 20 cm. The quality of the compaction of every 20 cm layer will be checked by the nuclear density test (or any other available density test). The compacted layer will be accepted if the density reaches 98% of the modified Proctor value.

The preferred areas to check the density will be those ones where the support of the components and the cranes work are located.

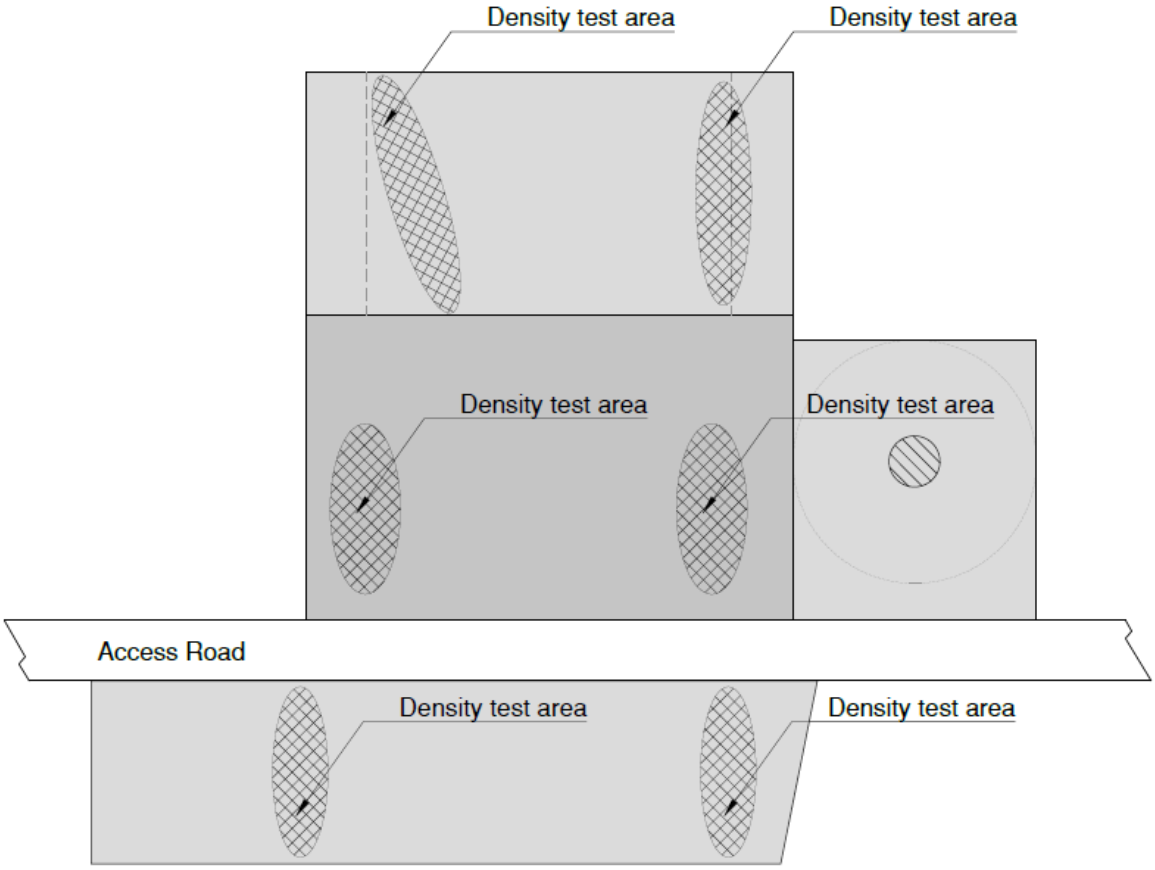


Figure 22: Suggested areas to verify the density after compaction

4.2. Dimensions and levelling

The dimensions of the different crane pads areas will be measured in order to verify the conformity with the present specification and the project specific drawings that could be agreed. In particular, the safety distances in the proximity of slopes and overhead power lines will be verified (see Section 3.2.).

When crawler crane is used, it will be verified the levelling at 0% on the main crane working area. On the rest of the crane pad and for main cranes over outrigger jacks, it will be verified that the maximum slope does not exceed 1%.

4.3. Pavement material

The nacelle storage area (around the wind turbine) and the cranes working area will always be covered by gravel or graded aggregate material. The tower sections and blade storage areas will also be covered with these materials in the cases where rain and mud could be expected, in order to avoid unsafe slippery work conditions.

This pavement layer is recommended to be 15 cm on the nacelle storage area (around the wind turbine) and the cranes working area, and it could be reduced to 10 cm on the tower sections and blade storage areas, depending on the expected conditions (if really needed). It will be compacted to 98% Modified Proctor.

In order to ensure the quality of the pavement material and to avoid mud formation, the following essays should be done.

- Modified Proctor, according to ASTM D1557-09, AASHTO T180-01 (or its national equivalent standard).

- Liquid limit and plasticity index*, according to ASTM D-4318, AASHTO T90-00 (2004) or ISO/TS 17892-12 (or its national equivalent standard).

- Grain Size by sieving**, according to EN 933-1:2012 or ASTM C-136 (or its national equivalent standard).

(*) The graded aggregate used as pavement shall have low plasticity in order to prevent mud formation when it rains. Under no circumstances shall a graded aggregate with plasticity index (PI) value greater than 9 be accepted.

(**) Graded aggregate maximum grain size shall be lower than 25mm and fines content shall be lower than 10% (<10% pass #200mm sleeve). To have a reference, the grain size shall be between the following limits that are indicated on the following tables.

Natural Graded Aggregate

	NATURAL GRADED AGGREGATE SIEVE SIZE: EN-933-2, ASTM C136 % CUMULATIVE PASSING									
Graded Aggregate	**EN**	40	25	20	8	4	2	0,5	0,25	0,063
	ASTM	1,5	1	3/4	3/8	Nº4	Nº10	Nº40	Nº60	Nº230
0/20	max	-	100	100	75	61	50	32	24	11
	min	-	100	80	45	32	25	10	5	0

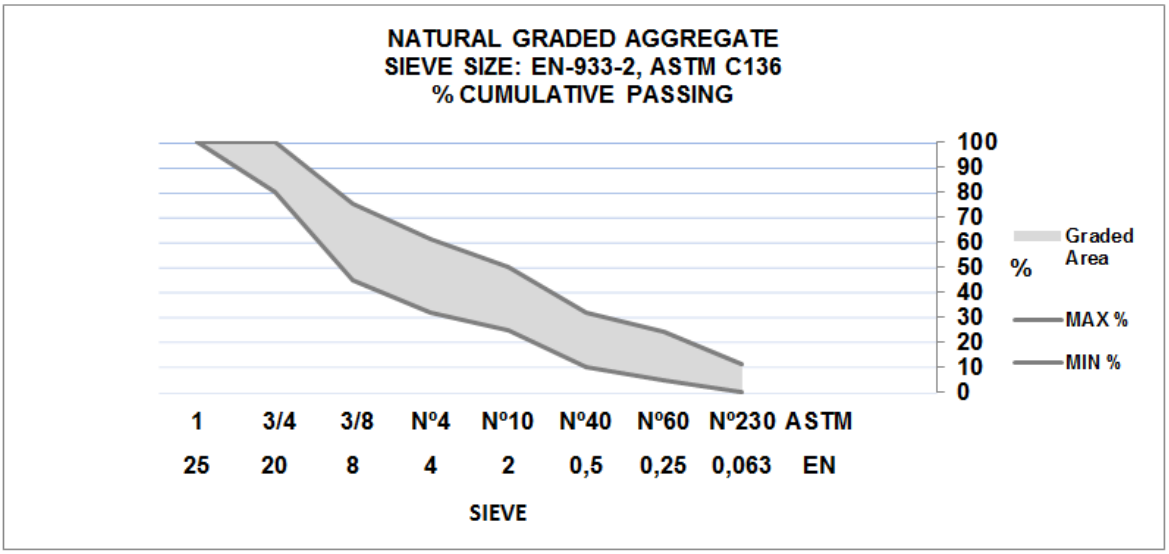


Figure 23: Natural Graded Aggregate Grain size

Artificial Graded Aggregate

	ARTIFICIAL GRADED AGGREGATE SIEVE SIZE: EN-933-2, ASTM C136 % CUMULATIVE PASSING										
Graded Aggregate	**EN**	40	32	25	20	8	4	2	0,5	0,25	0,063
	ASTM	1,5	1,25	1	3/4	3/8	Nº4	Nº10	Nº40	Nº60	Nº230
0/20	% max	-	-	100	100	73	54	40	24	18	9
	% min	-	-	100	75	45	31	20	9	8	0

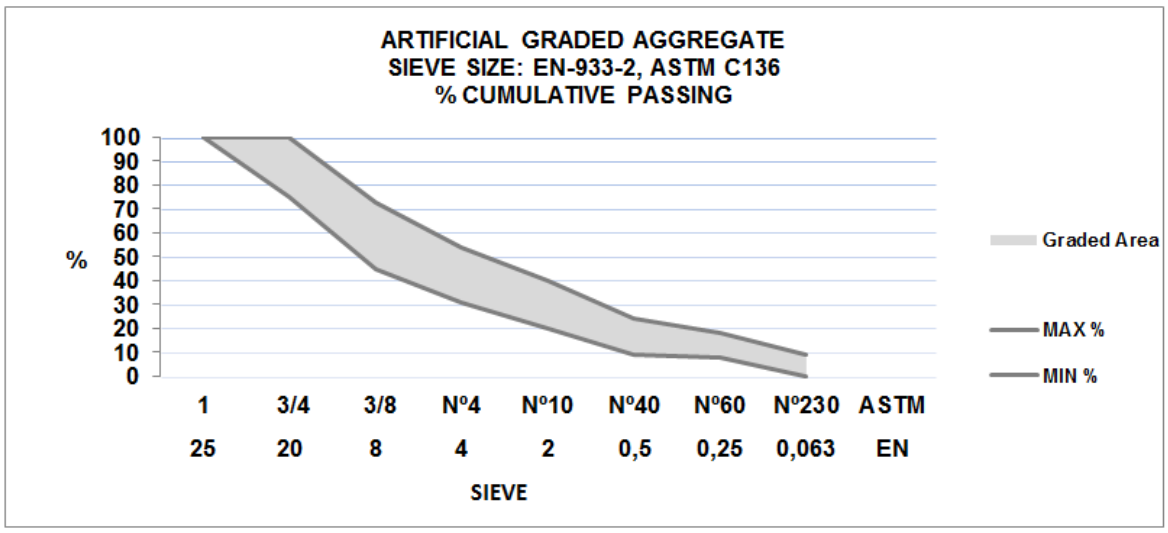


Figure 24: Artificial Graded Aggregate Grain size

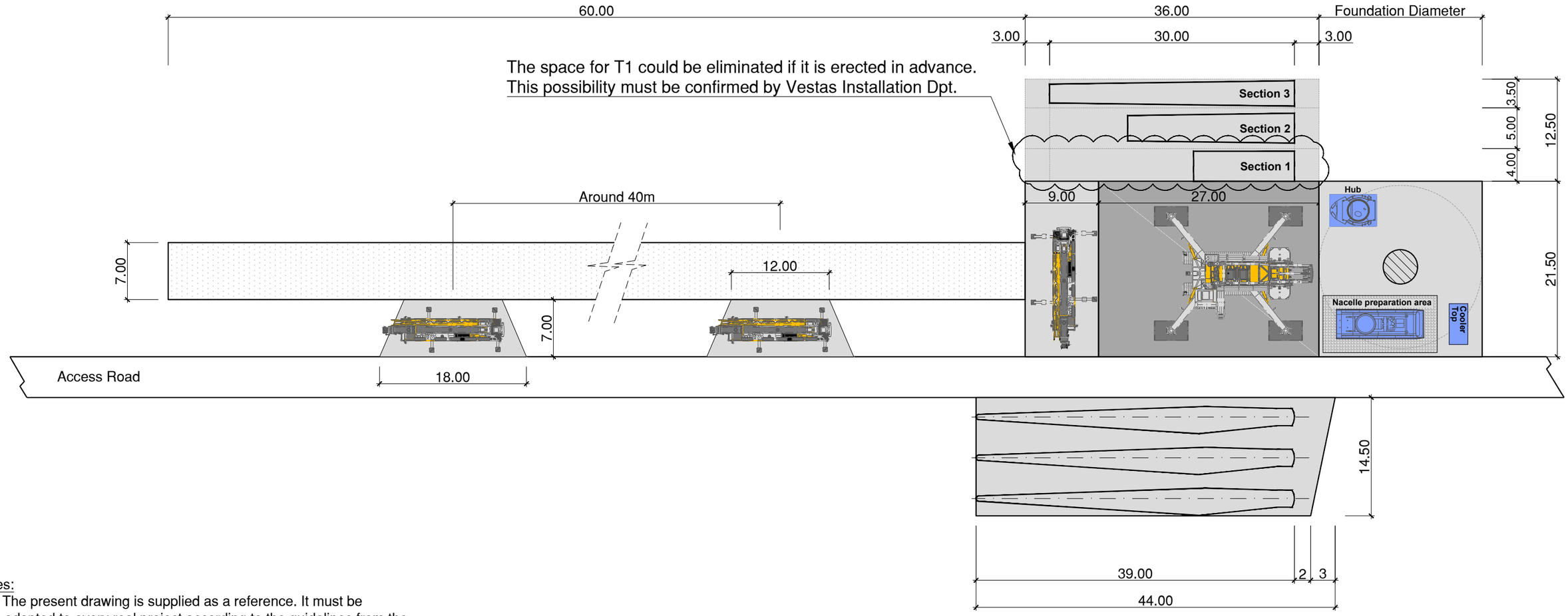
ANNEX: CRANE PADS STANDARD DRAWINGS

Very Important

The following standard drawings show a crane pad general configuration without knowing the conditions, constraints and equipment that will appear on a specific project.

Consequently, the following drawings can be used as a reference, but they are not valid for construction.

The civil designer must adapt the following drawings to every real project according to the guidelines from the present document.



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

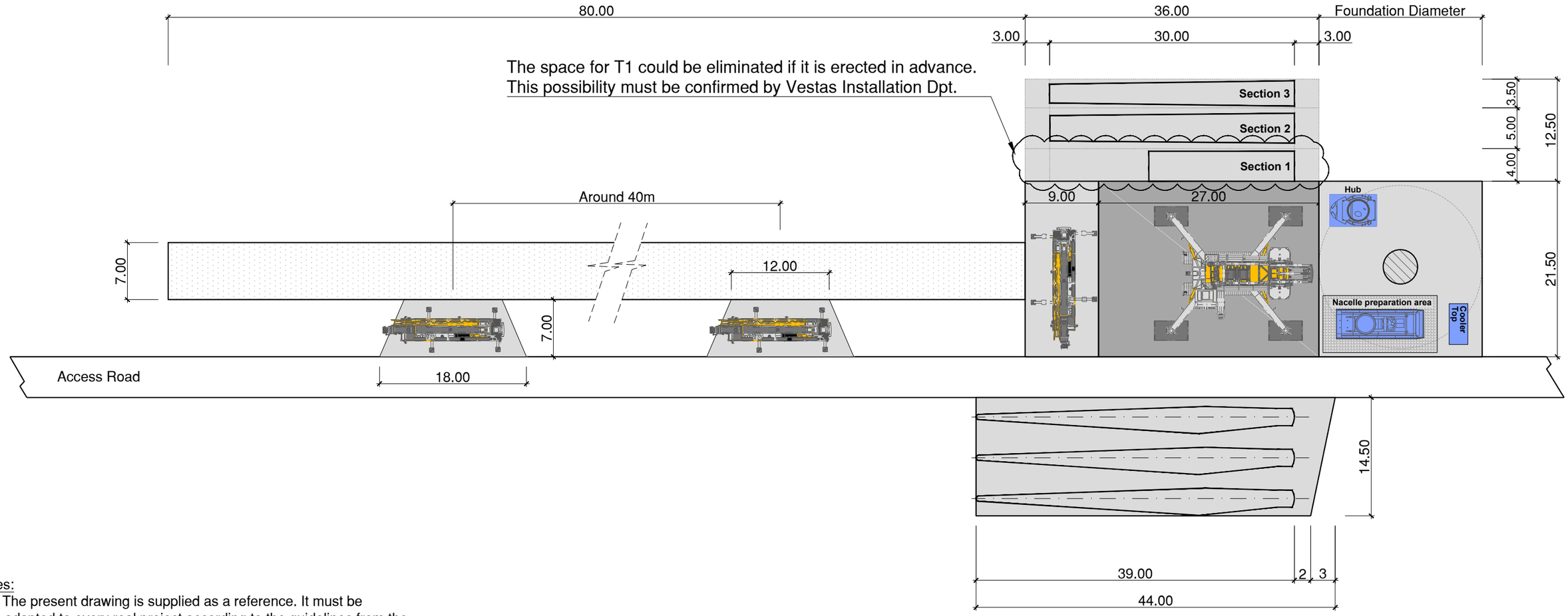
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V80 HH65	DRAW UP: ADYD_RGBA DATE: CHECK BY: LGB DATE: APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

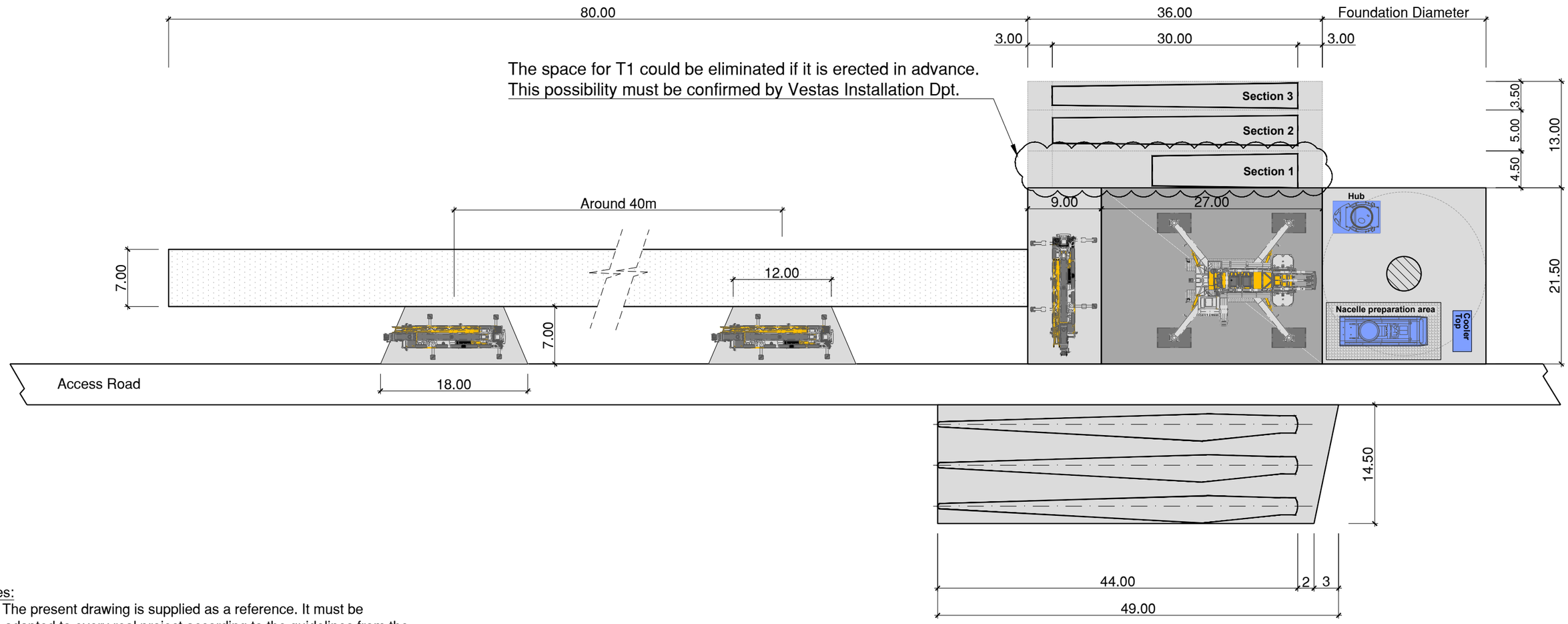
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V80 HH80	DRAW UP: ADYD_RGBA DATE: CHECK BY: LGB DATE: APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

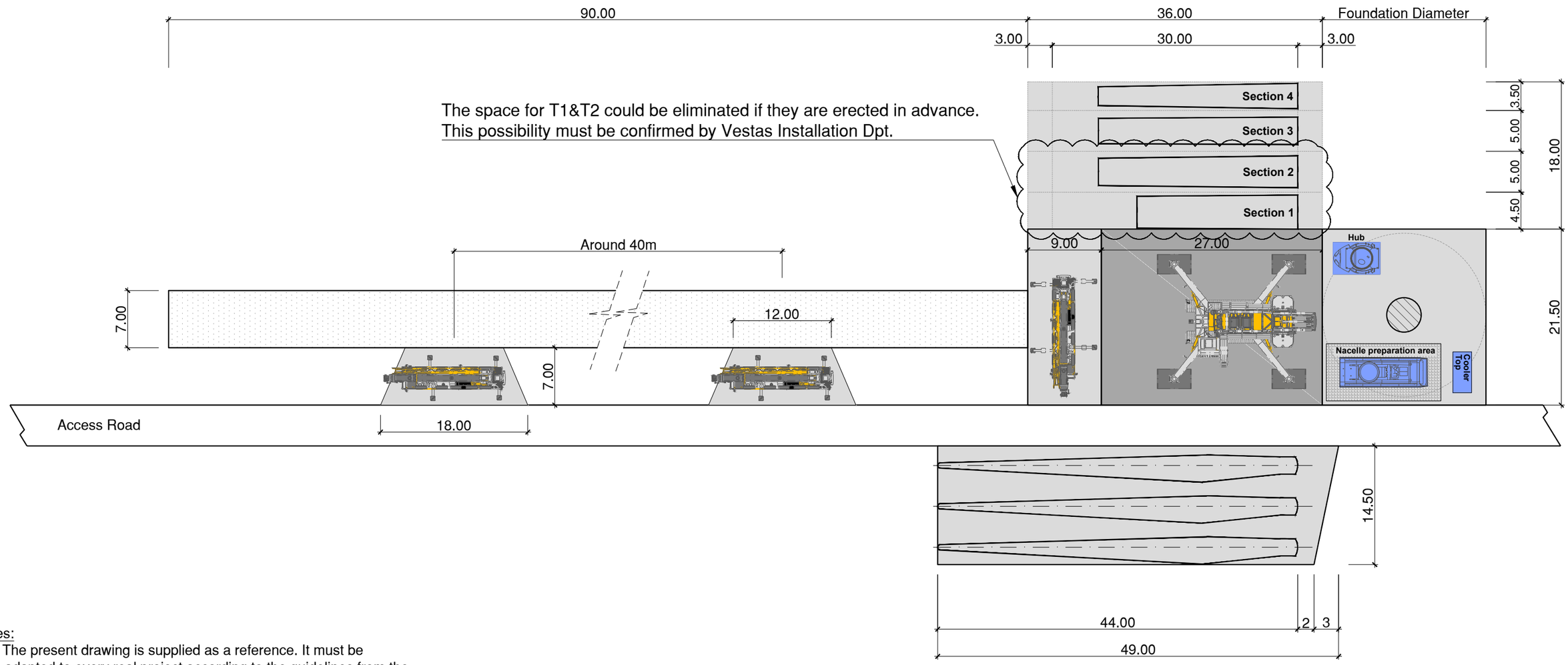
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V90 2.0MW HH80	DRAW UP: ADYD_RGBA DATE: CHECK BY: LGB DATE: APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

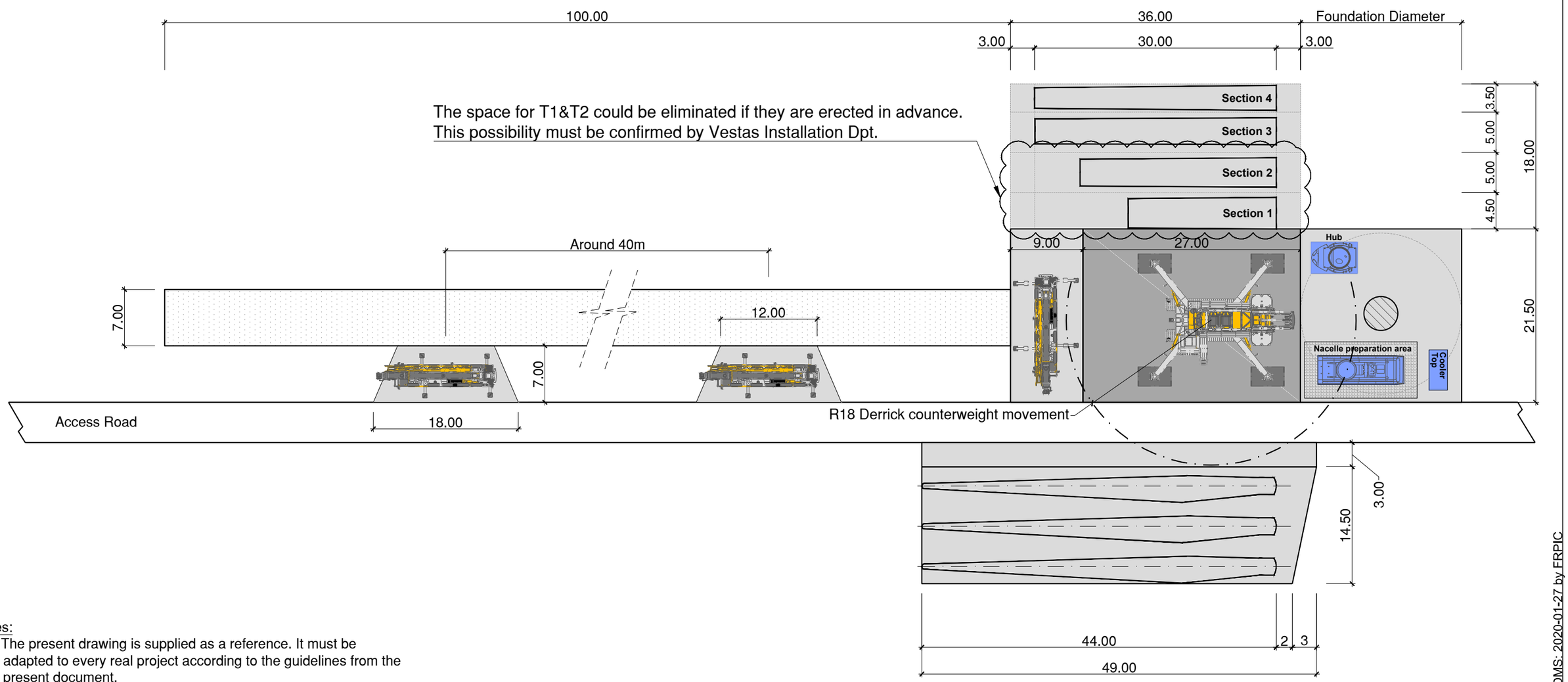
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V90 2.0MW HH95	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

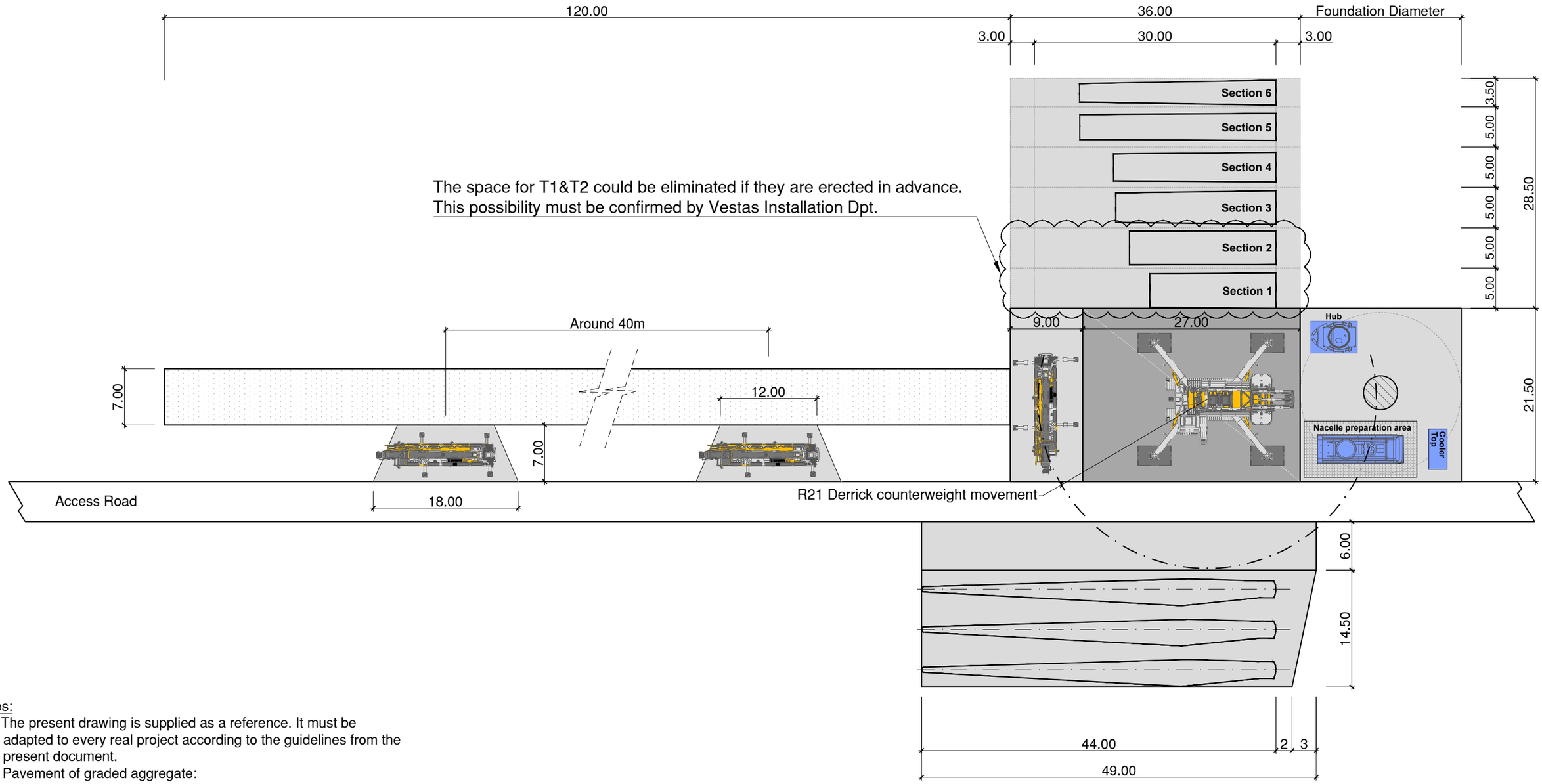
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V90 2.0MW HH105	DRAW UP: ADYD_RGBA DATE: CHECK BY: LGB DATE: APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

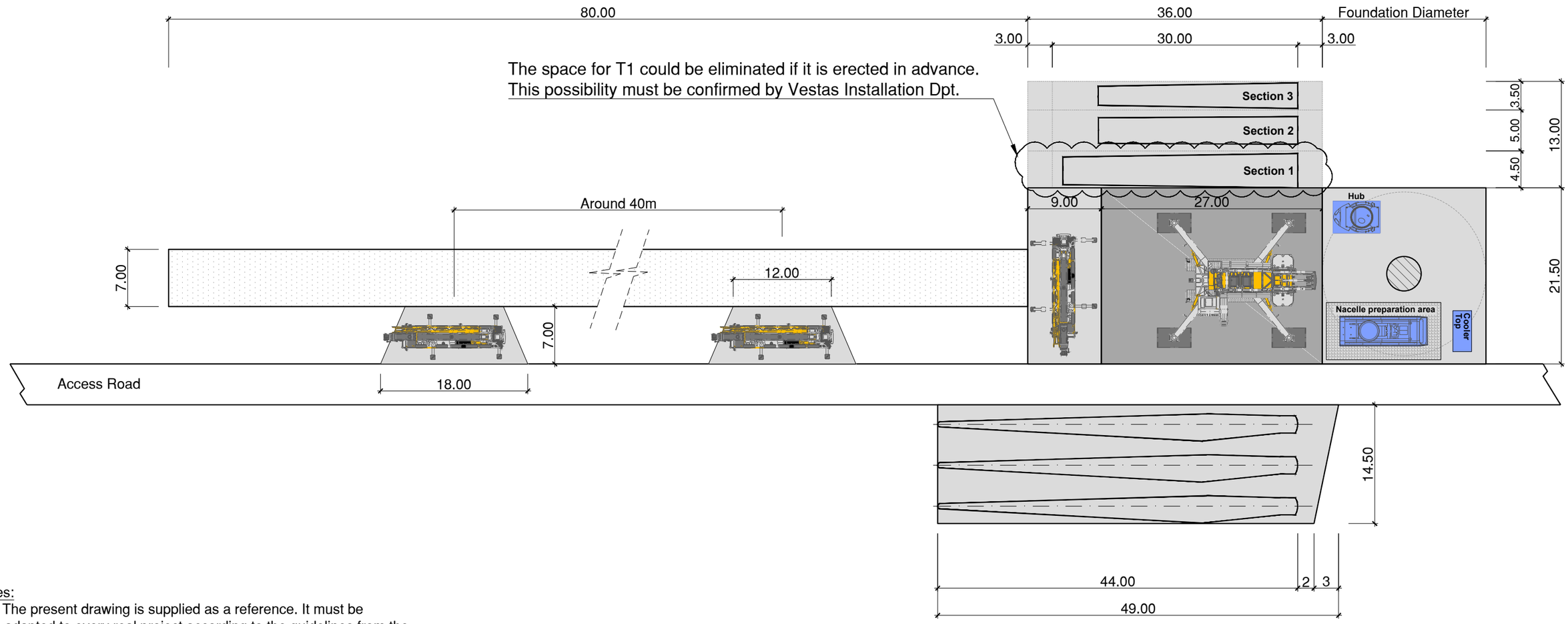
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V90 2.0MW HH125	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

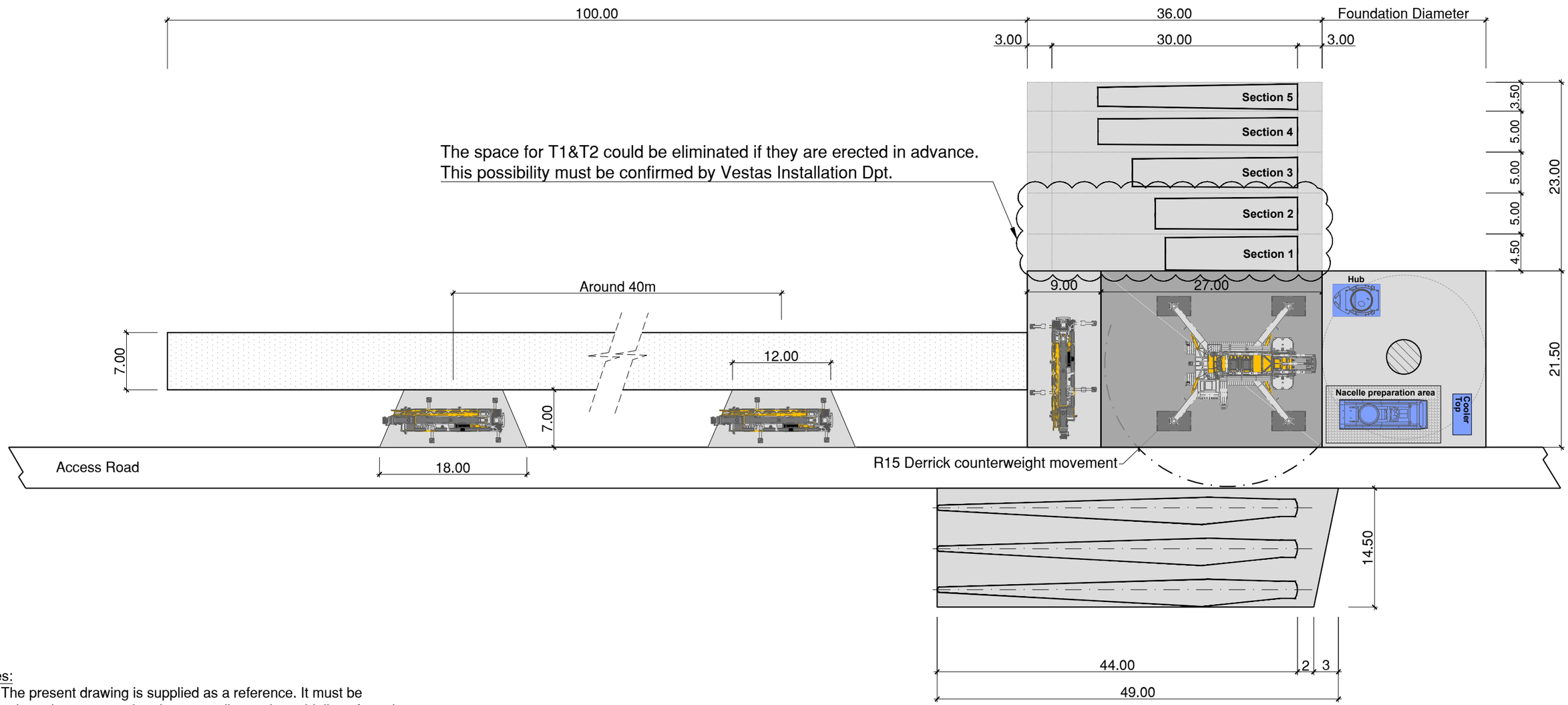
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V90 3.0MW HH80	DRAW UP: ADYD_RGBA DATE: CHECK BY: LGB DATE: APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
- -Mandatory on cranes working area and nacelle storage area.
- -Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

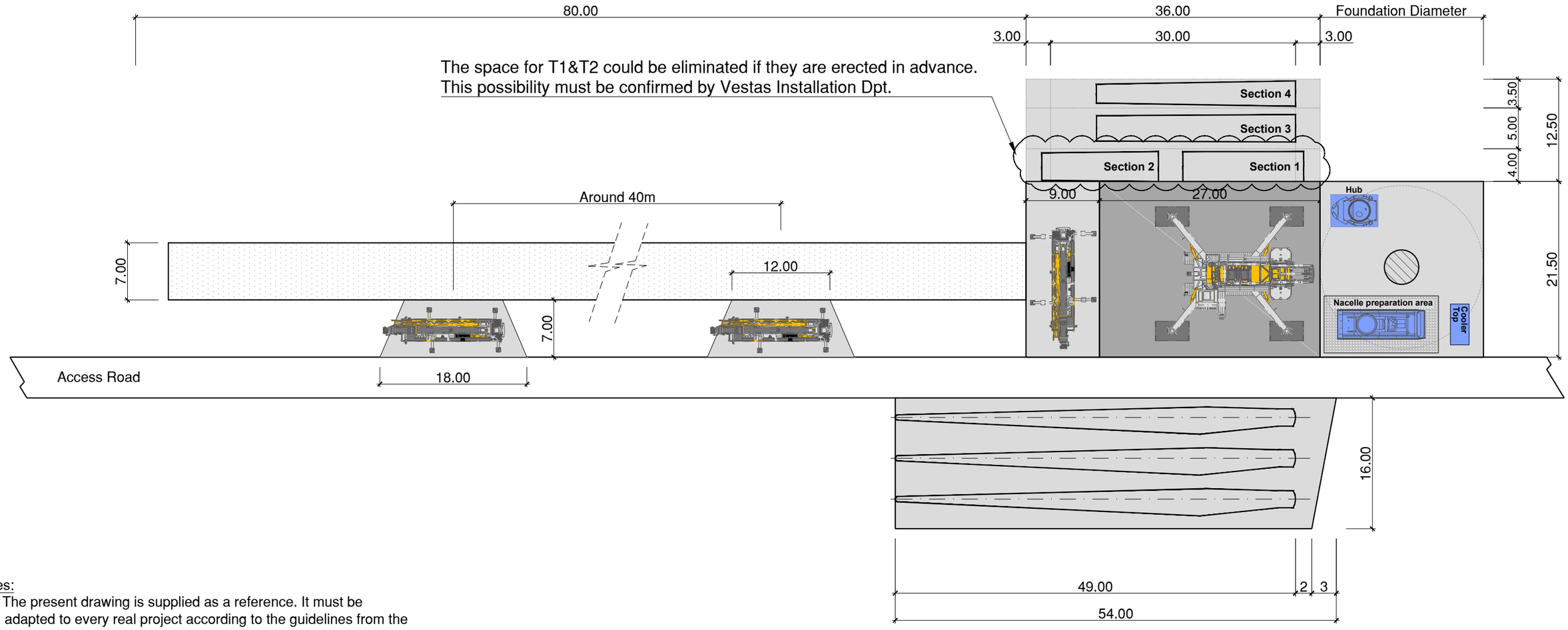
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V90 3.0MW HH105	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
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-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

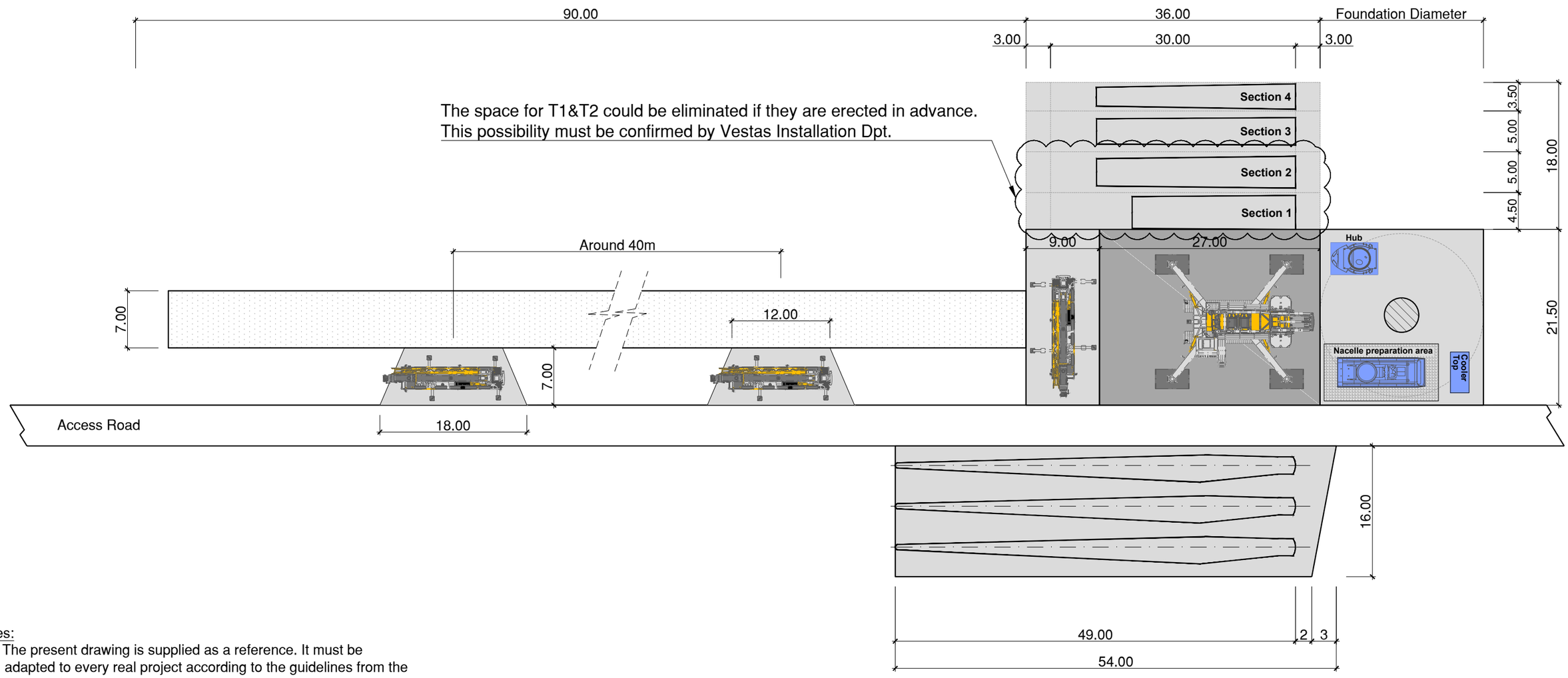
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V100 1.8MW HH80	DRAW UP: ADYD_RGBA DATE: CHECK BY: LGB DATE: APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

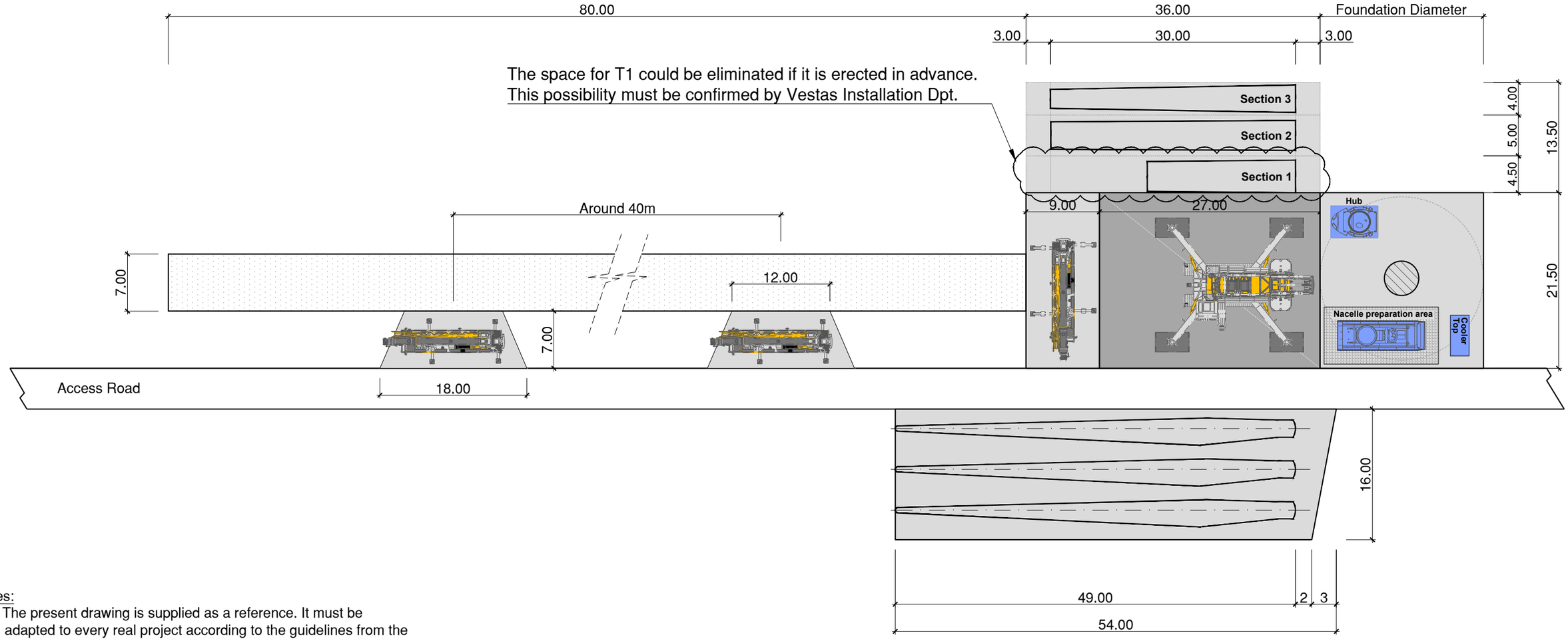
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V100 1.8MW HH95	DRAW UP: ADYD_RGBA DATE: CHECK BY: LGB DATE: APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

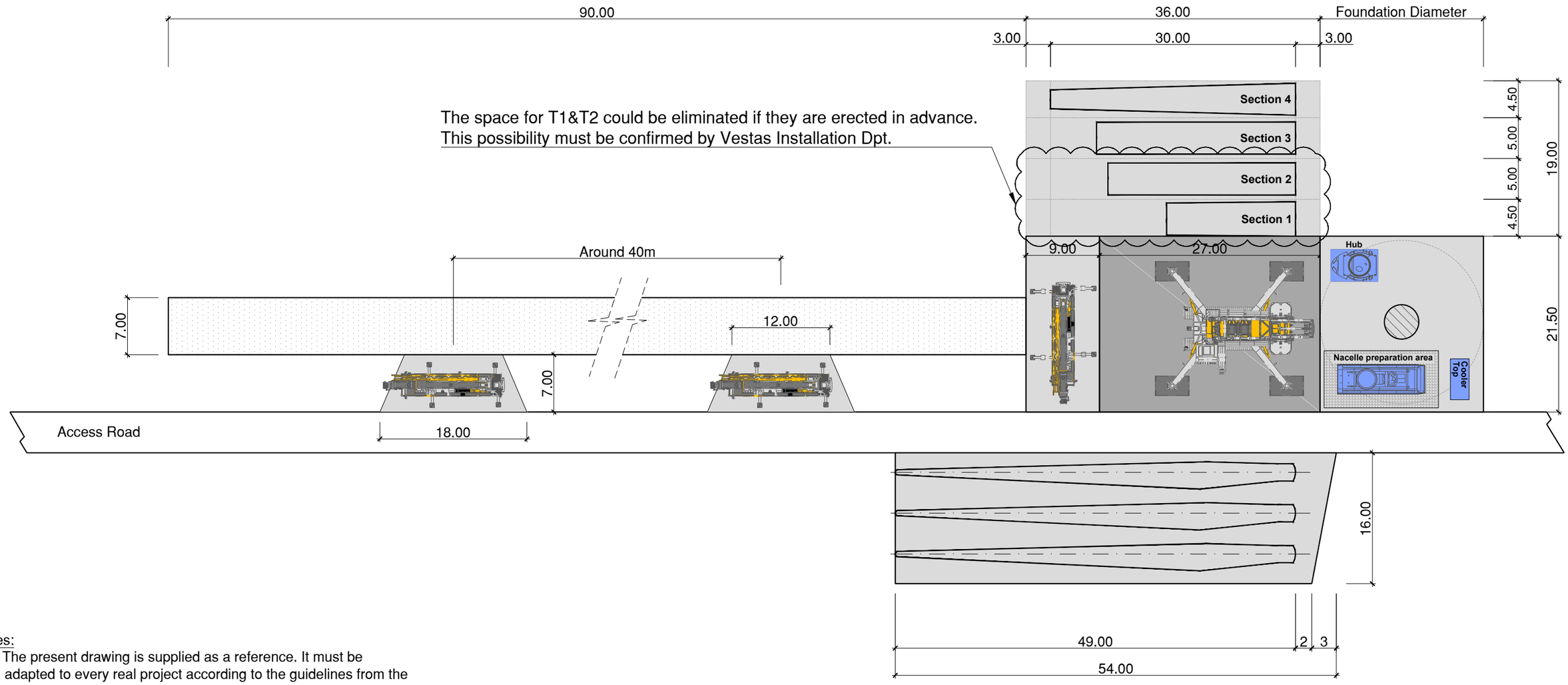
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V100 2.0MW HH80	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

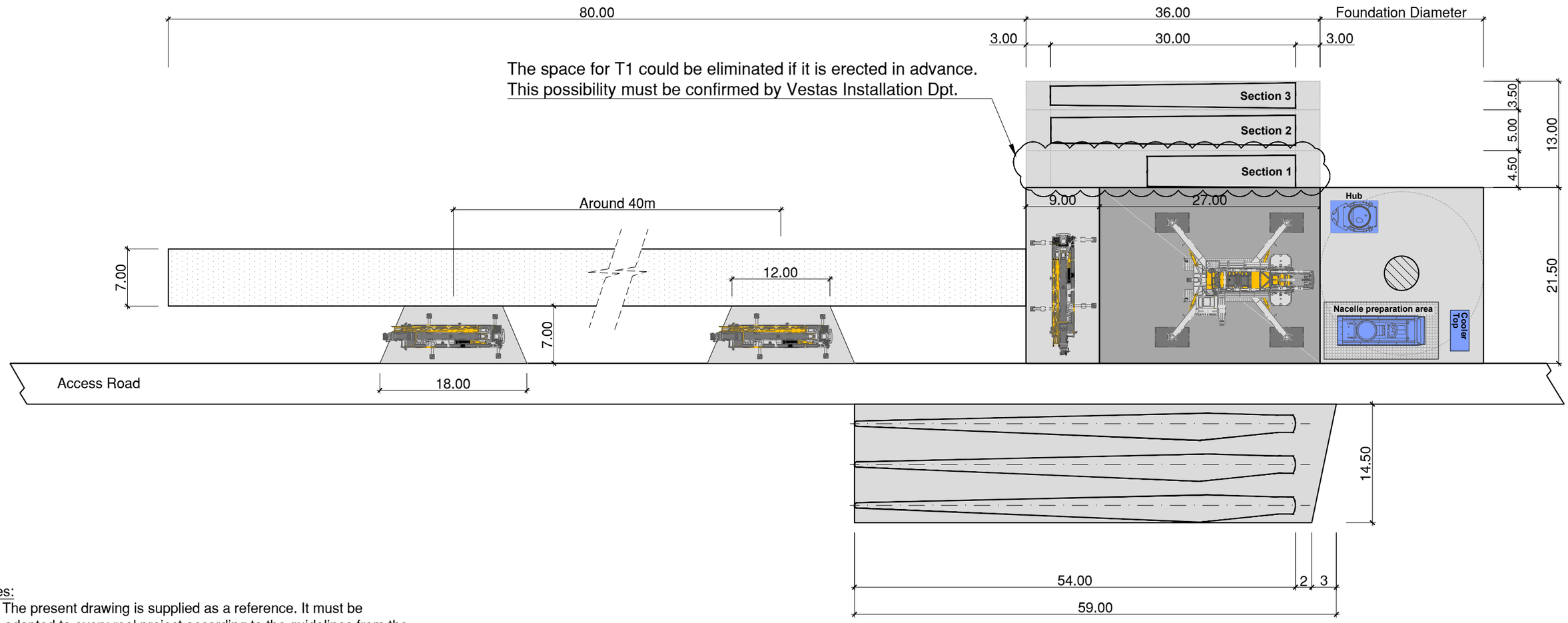
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V100 2.0MW HH95	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 / PAGE 1 OF 1



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-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

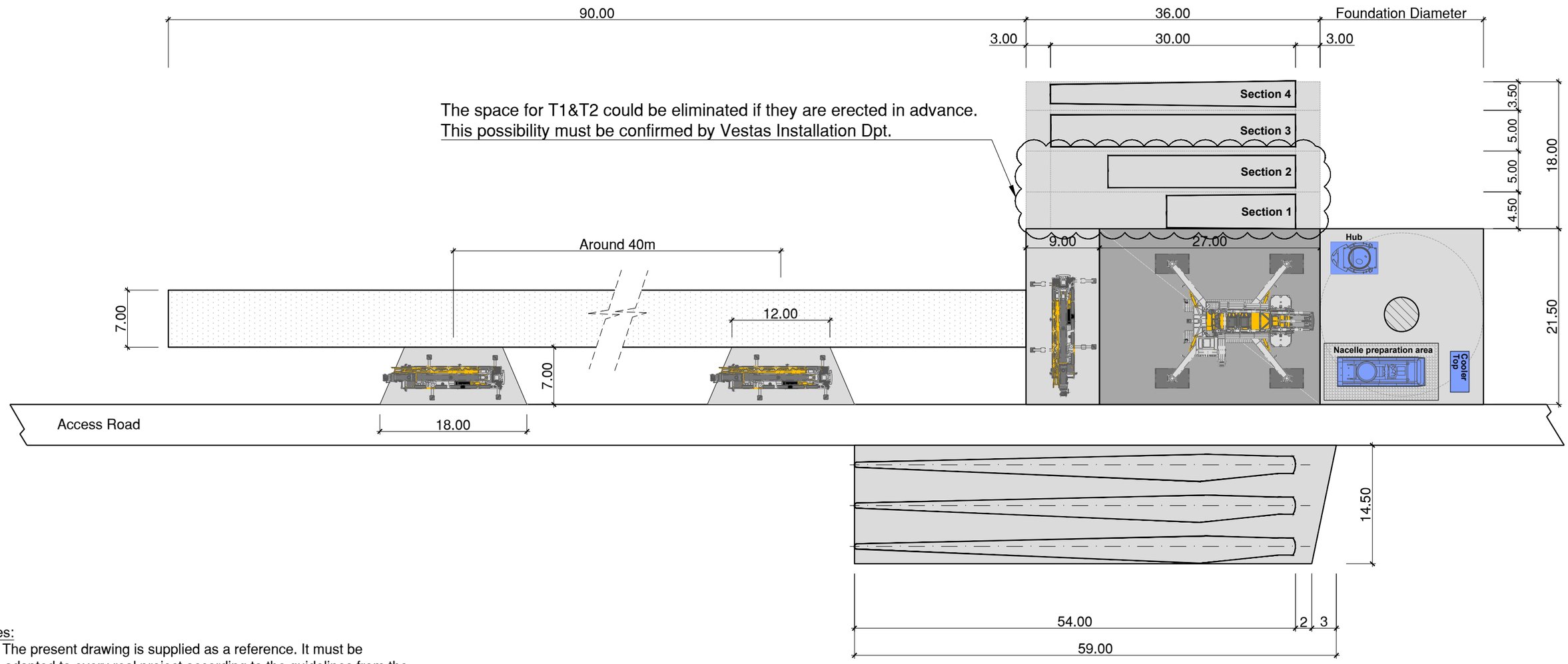
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V110 HH80	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V7	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

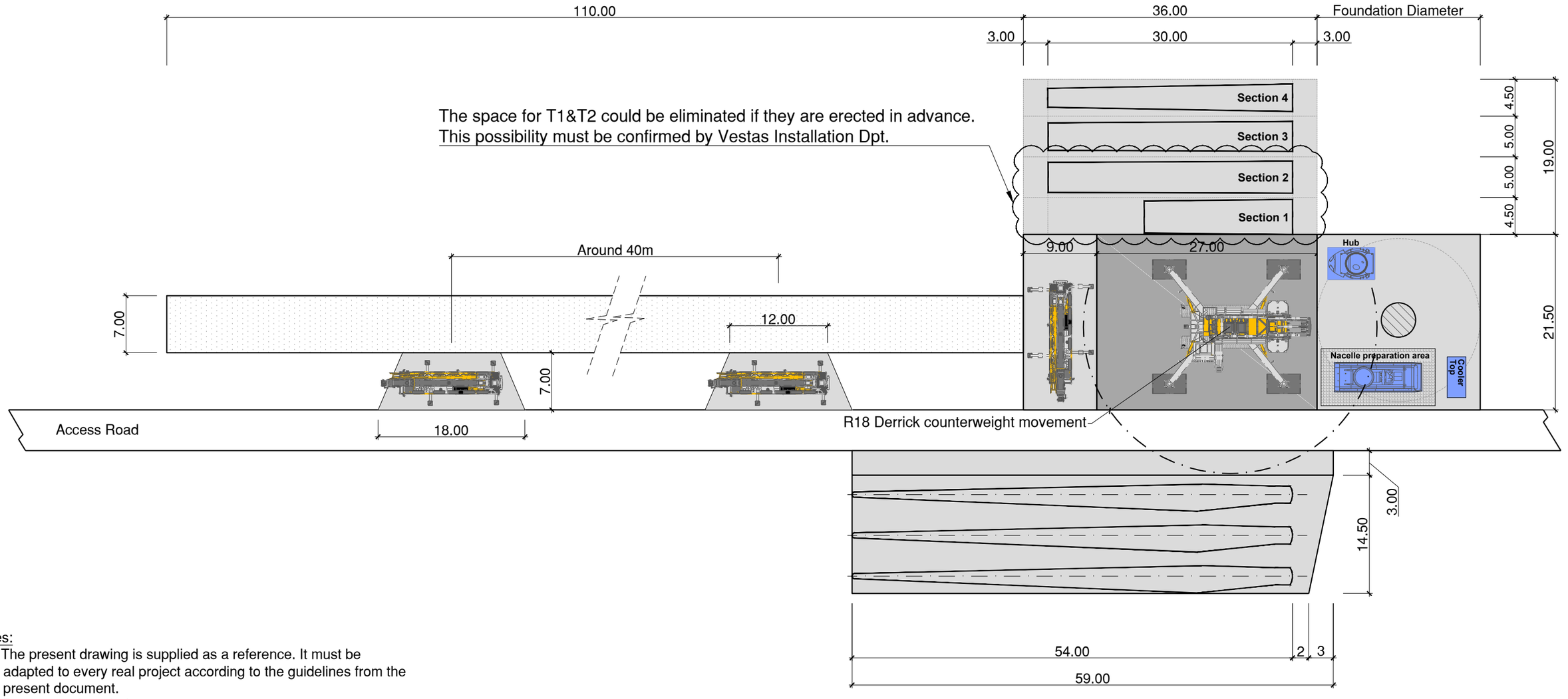
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V110 HH95	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V7	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
- -Mandatory on cranes working area and nacelle storage area.
- -Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

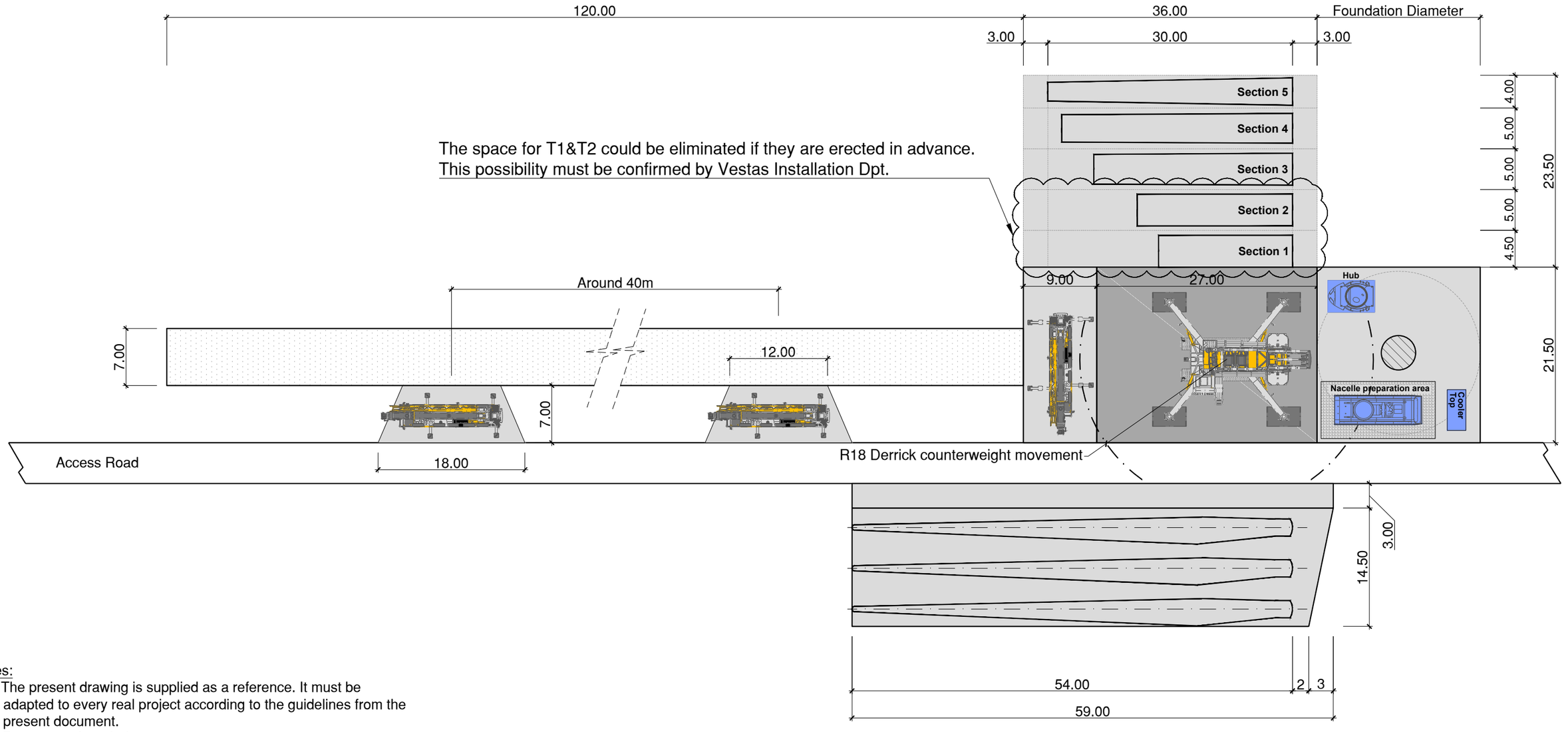
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V110 HH110	DRAW UP: ADYD_RGBA DATE:	EDITION: V7	DRAWING Nº: 1.1
					CHECK BY: LGB DATE:		
					APPROVAL: RUSUM/ADMAD DATE:		PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
- -Mandatory on cranes working area and nacelle storage area.
- -Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

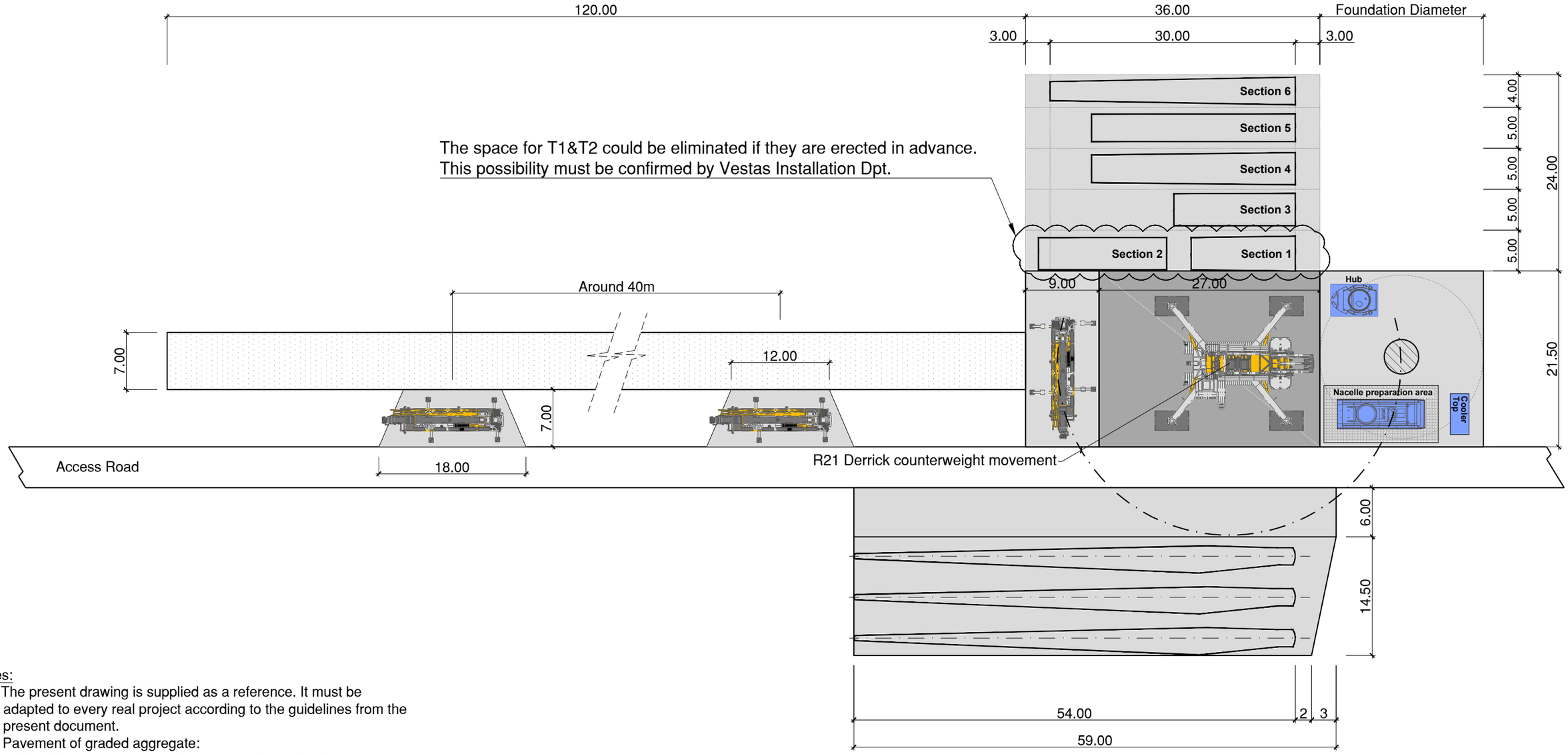
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V110 HH120	DRAW UP: ADYD_RGBA DATE:	EDITION: V7	DRAWING Nº: 1.1
					CHECK BY: LGB DATE:		
					APPROVAL: RUSUM/ADMAD DATE:		PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
- -Mandatory on cranes working area and nacelle storage area.
- -Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

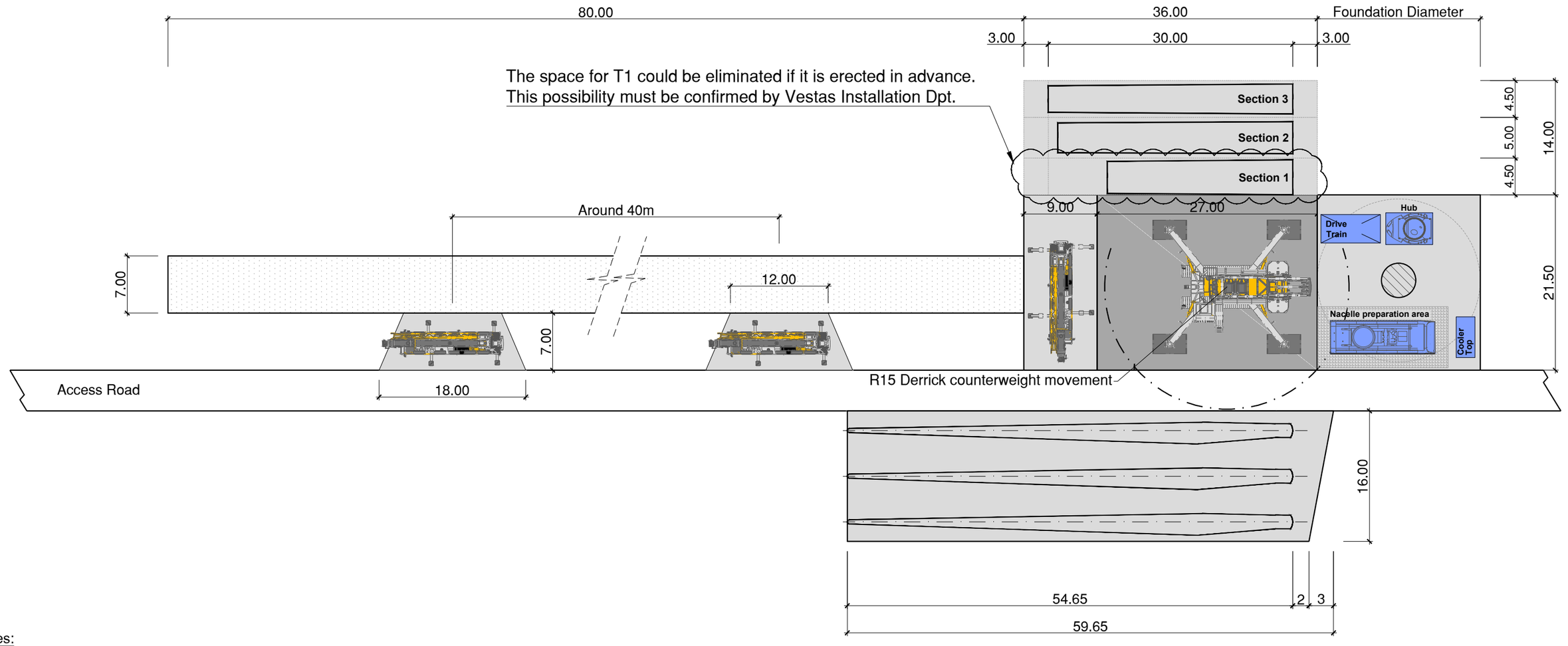
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V110 HH125	DRAW UP: ADYD_RGBA DATE:	EDITION: V7	DRAWING Nº: 1.1
					CHECK BY: LGB DATE:		
					APPROVAL: RUSUM/ADMAD DATE:		PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

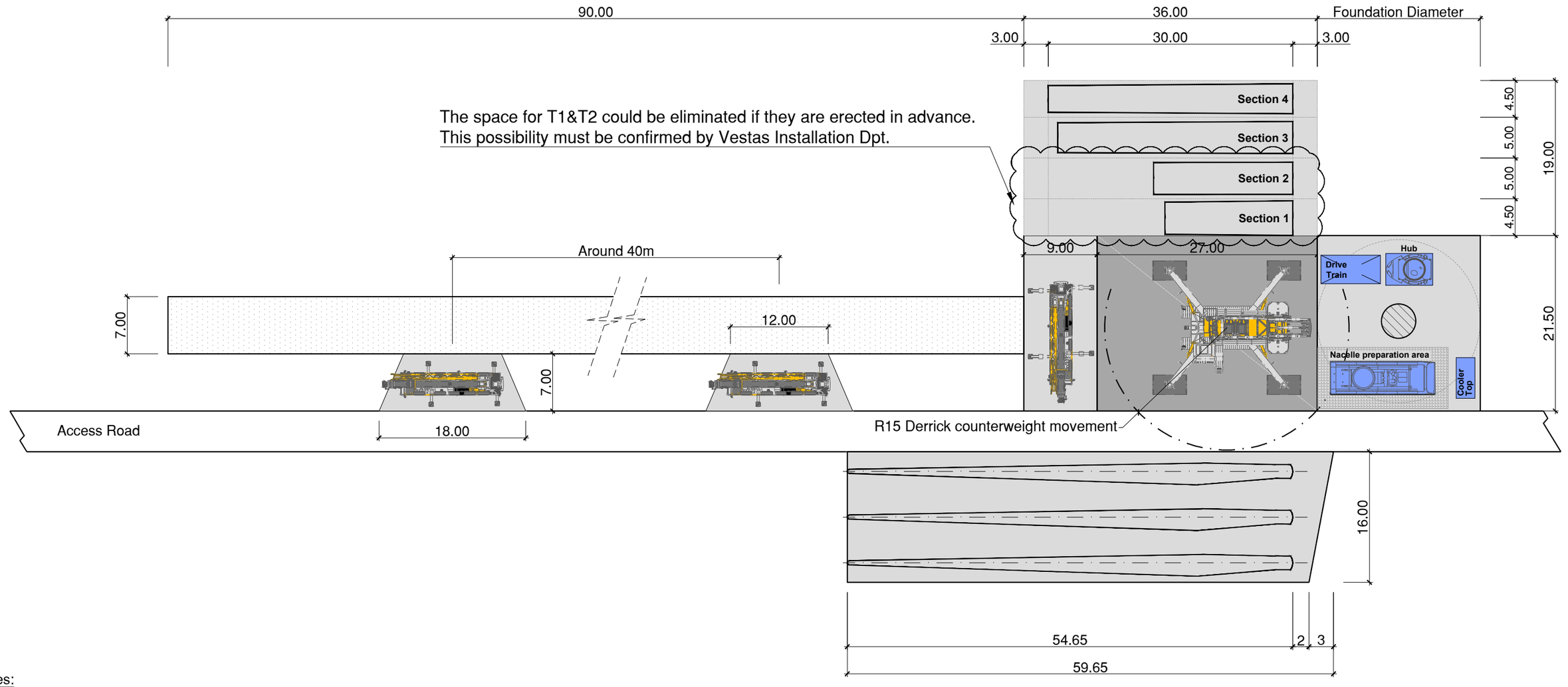
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V112 HH84	DRAW UP: ADYD_RGBA DATE:	EDITION: V5	DRAWING Nº: 1.1
					CHECK BY: LGB DATE:		
					APPROVAL: RUSUM/ADMAD DATE:		PAGE 1 OF 1



Notes:

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(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V112 HH94	DRAW UP: ADYD_RGBA DATE:	EDITION: V5	DRAWING Nº: 1.1
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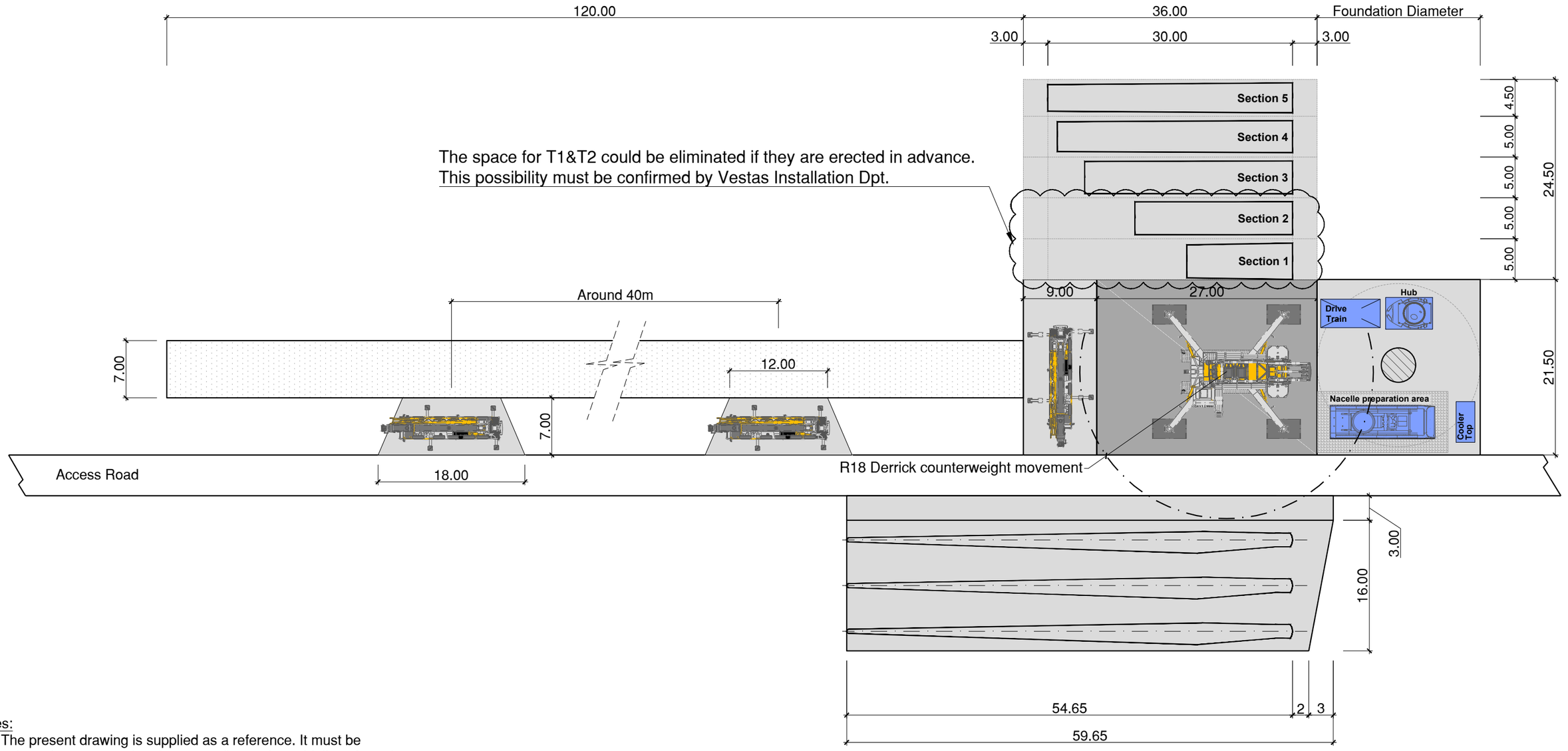
					APPROVAL: RUSUM/ADMAD DATE:		PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

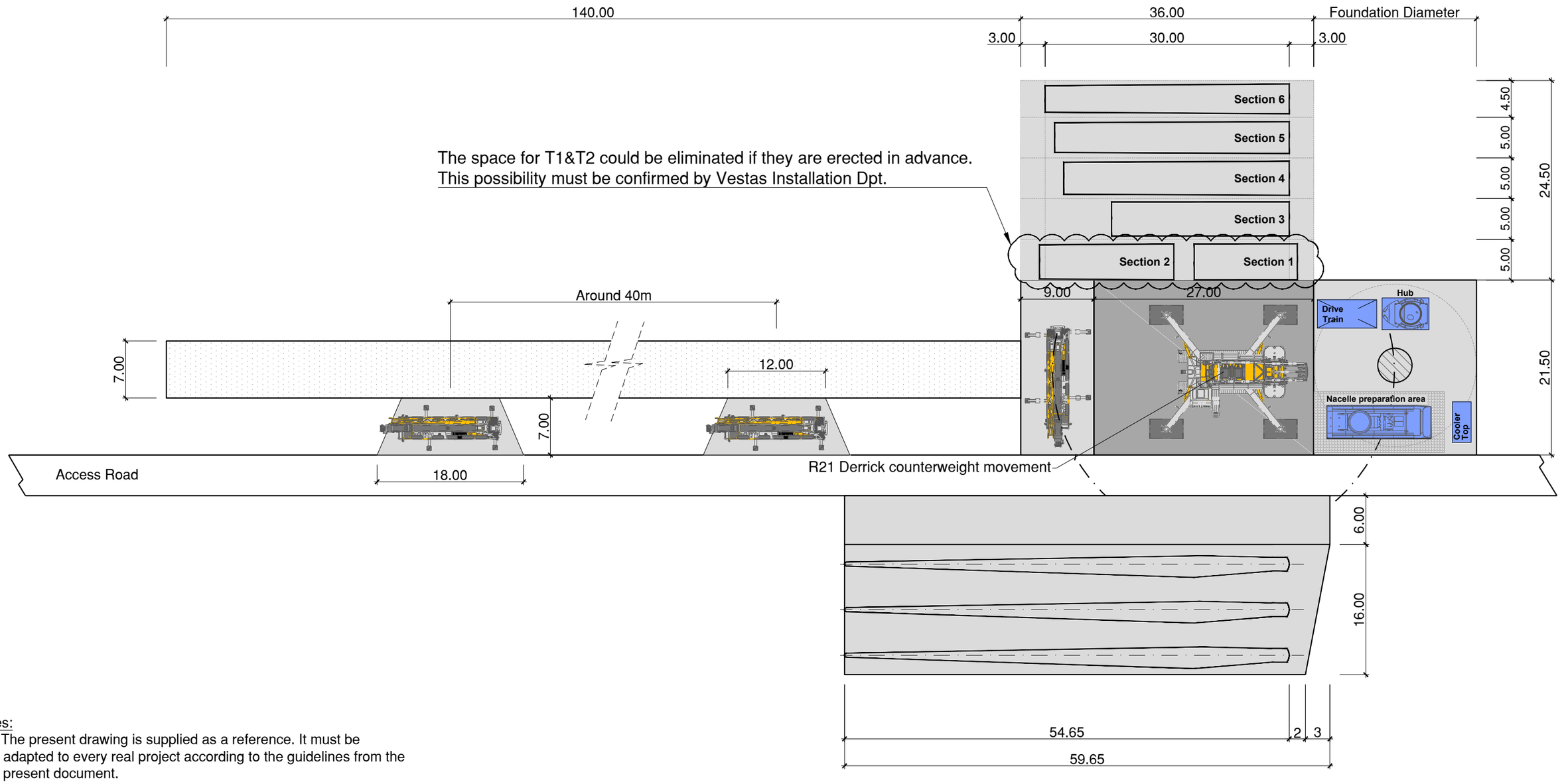
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V112 HH119	DRAW UP: ADYD_RGBA DATE:	EDITION: V5	DRAWING Nº: 1.1
					CHECK BY: LGB DATE:		
					APPROVAL: RUSUM/ADMAD DATE:		PAGE 1 OF 1



Notes:

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(2) Pavement of graded aggregate:
- -Mandatory on cranes working area and nacelle storage area.
- -Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

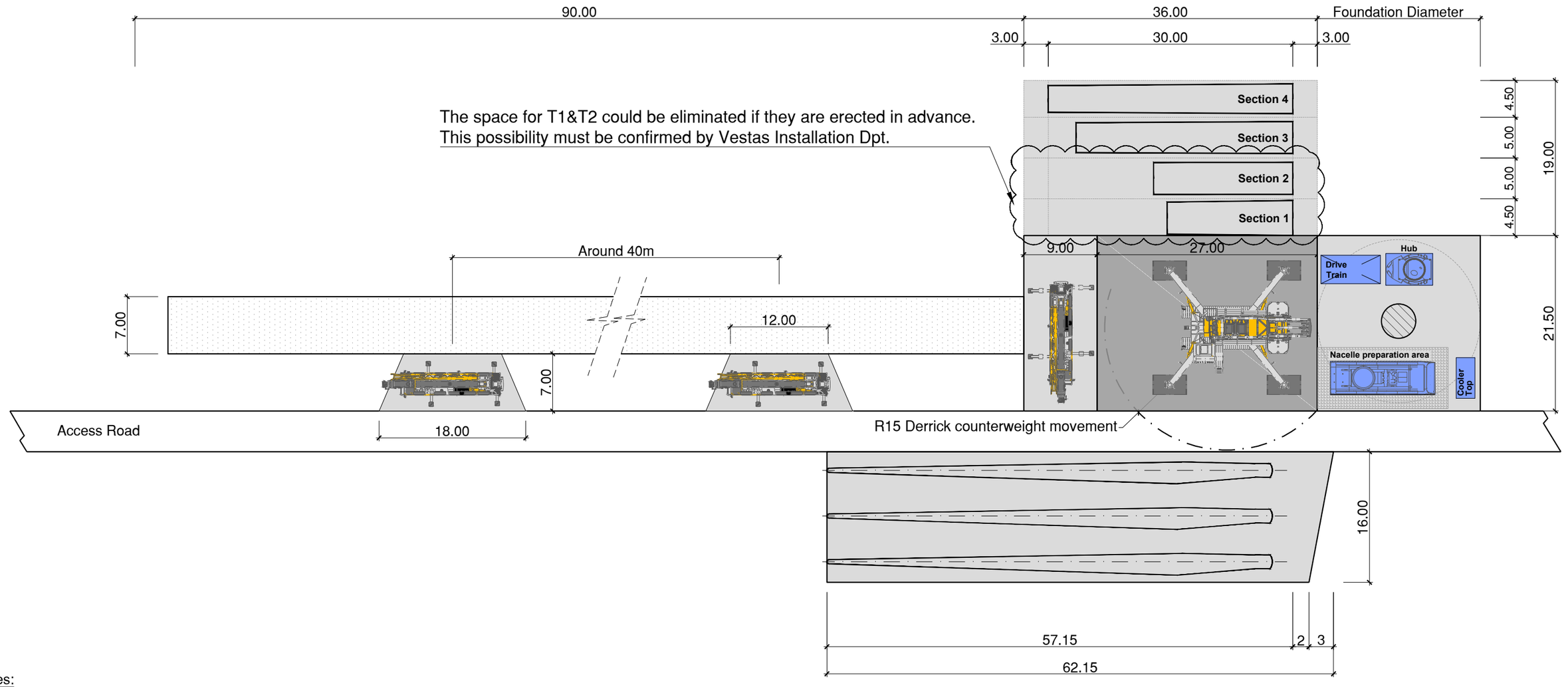
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V112 HH140	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V117 HH91.5	DRAW UP: ADYD_RGBA DATE: / CHECK BY: LGB DATE: / APPROVAL: RUSUM/ADMAD DATE:	EDITION: V5	DRAWING Nº: 1.1 / PAGE 1 OF 1

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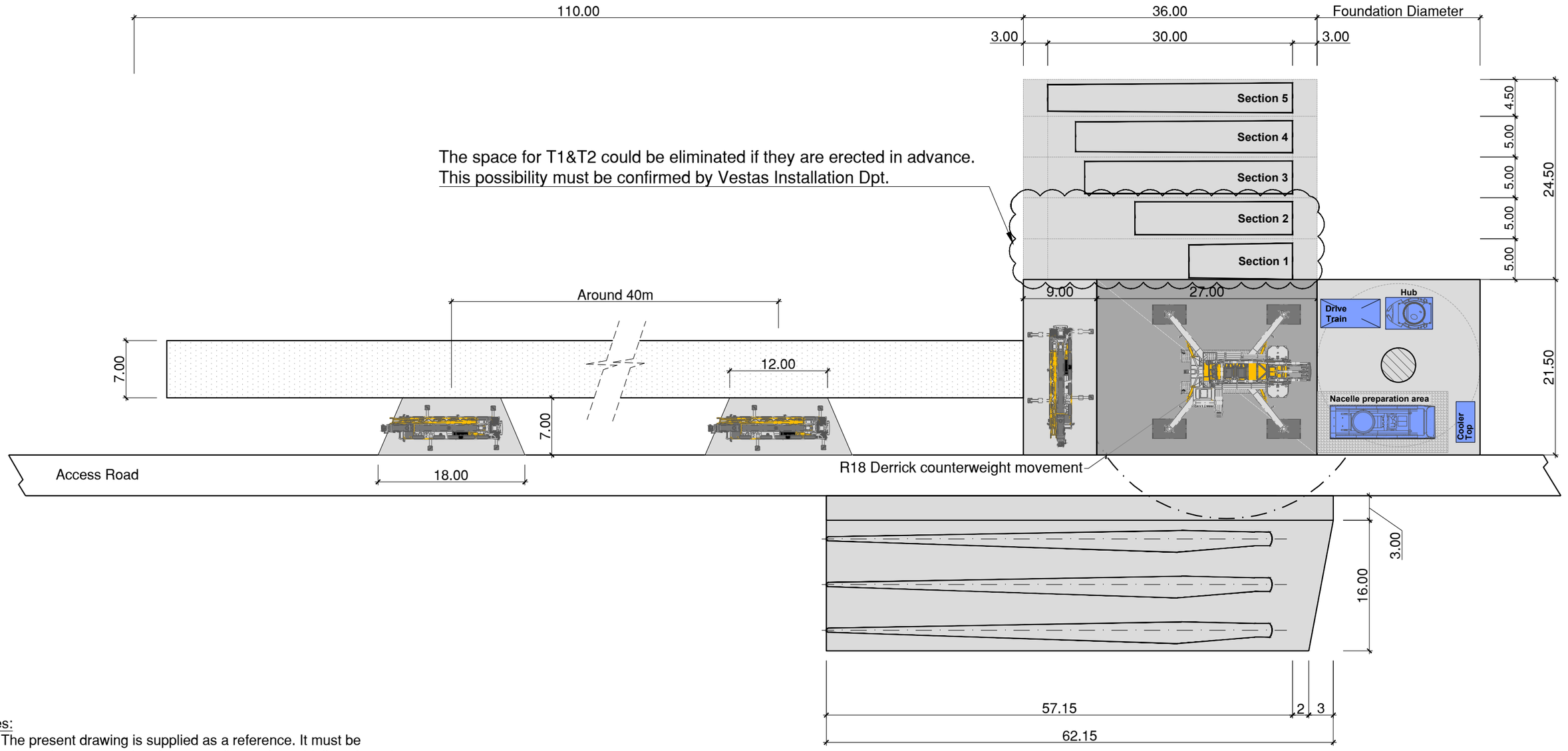


Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) All units are in meters.

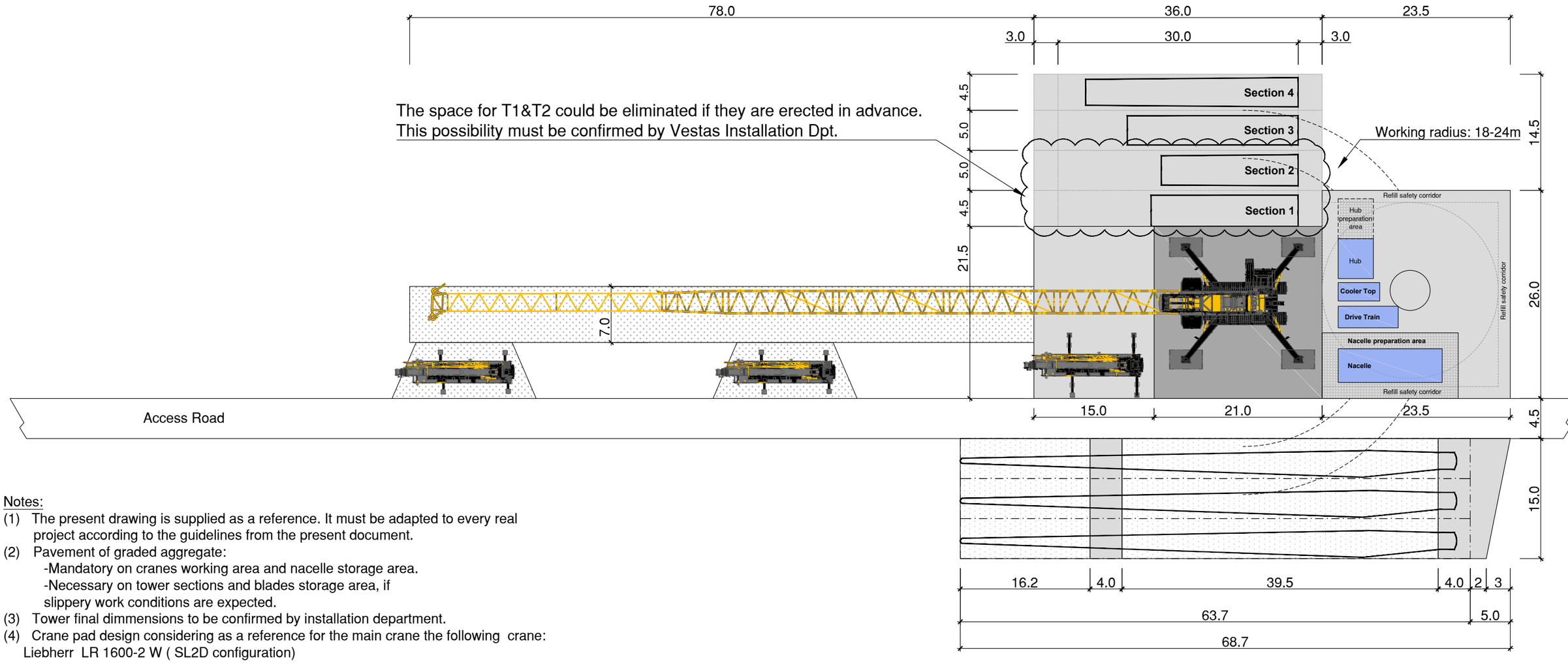
Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

NOT VALID FOR CONSTRUCTION (1)

PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 05 SEPTEMBER 2016	DRAWING: CRANE PAD V117 HH116.5	DRAW UP: ADYD_RGBA DATE:	EDITION: V5	DRAWING Nº: 1.1
					CHECK BY: LGB DATE:		
					APPROVAL: RUSUM/ADMAD DATE:		PAGE 1 OF 1



Notes:

(1) The present drawing is supplied as a reference. It must be adapted to every real project according to the guidelines from the present document.

(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) Tower final dimmensions to be confirmed by installation department.

(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 1600-2 W (SL2D configuration)
Raise capacity of 97 tons up to 138 meters height.

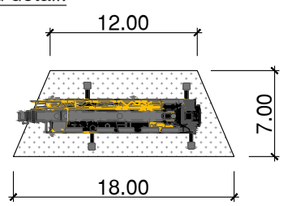
(5) All units are in meters.

Bearing capacity: Crane pressure + safety factor

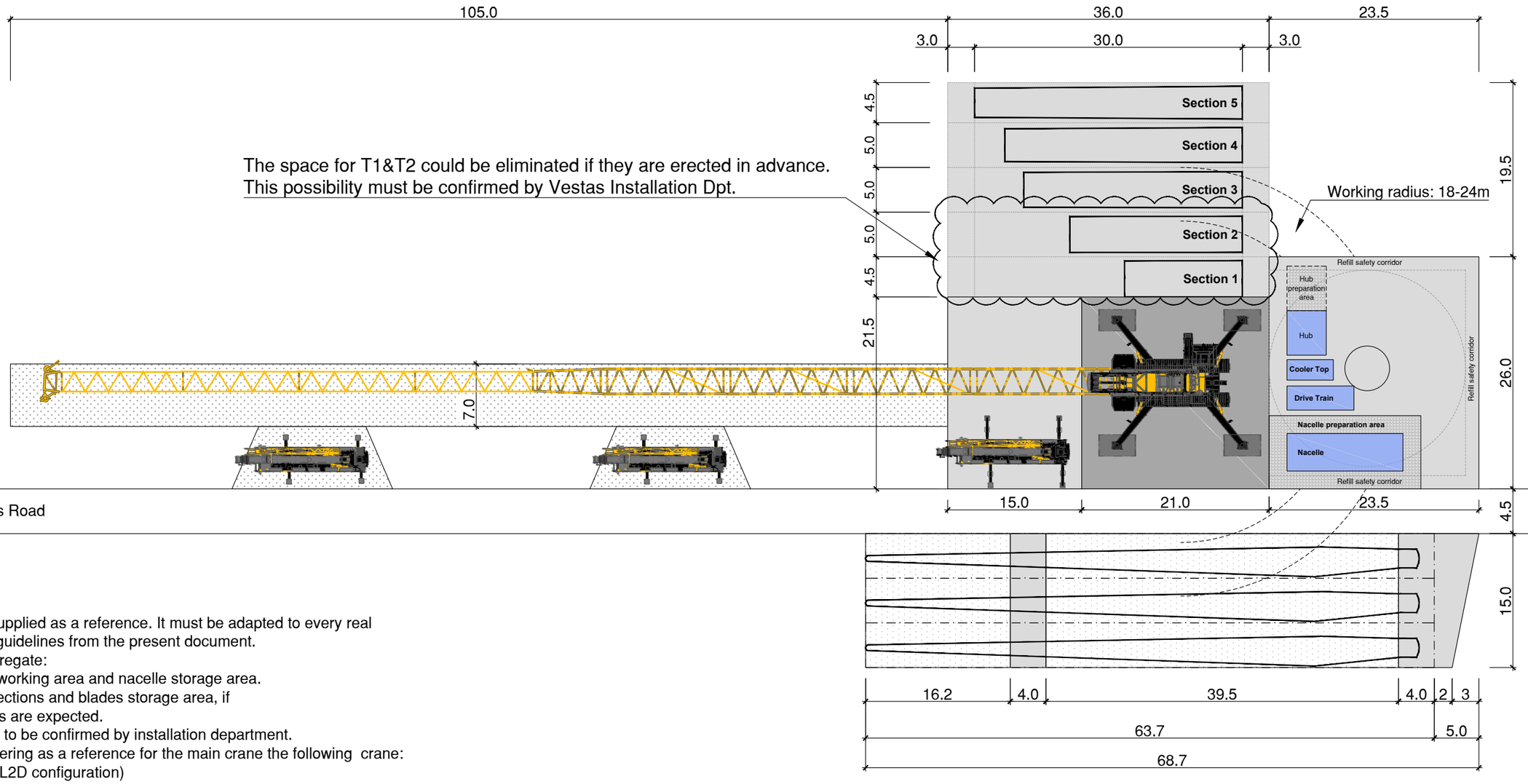
Bearing capacity: 2 Kg/cm²

Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE: 1:500	DATE:	DRAWING:			EDITION:	DRAWING Nº:
TECHNICAL SPECIFICATIONS	Vestas	0m 5 10 15 20	26 - 04 - 2019	CRANE PAD V126 HH87	DRAW UP: RGOBA	DATE:	V9	1.1
					CHECK BY: LGB	DATE:		
					APPROVAL: ADMAD/LGB	DATE:		PAGE 1 OF 1



Notes:

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(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) Tower final dimmensions to be confirmed by installation department.

(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 1600-2 W (SL2D configuration)
Raise capacity of 97 tons up to 138 meters height.

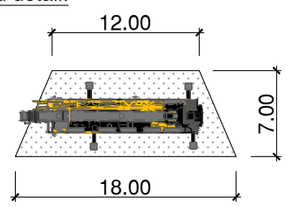
(5) All units are in meters.

Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE: 1:500	DATE:	DRAWING:			
TECHNICAL SPECIFICATIONS	Vestas	0m 5 10 15 20	26 - 04 - 2019	CRANE PAD V126 HH117	DRAW UP: RGOBA DATE: / CHECK BY: 26 - 04 - 2019 DATE: / APPROVAL: ADMAD/LGB DATE:	EDITION: V9	DRAWING Nº: 1.1 / PAGE 1 OF 1

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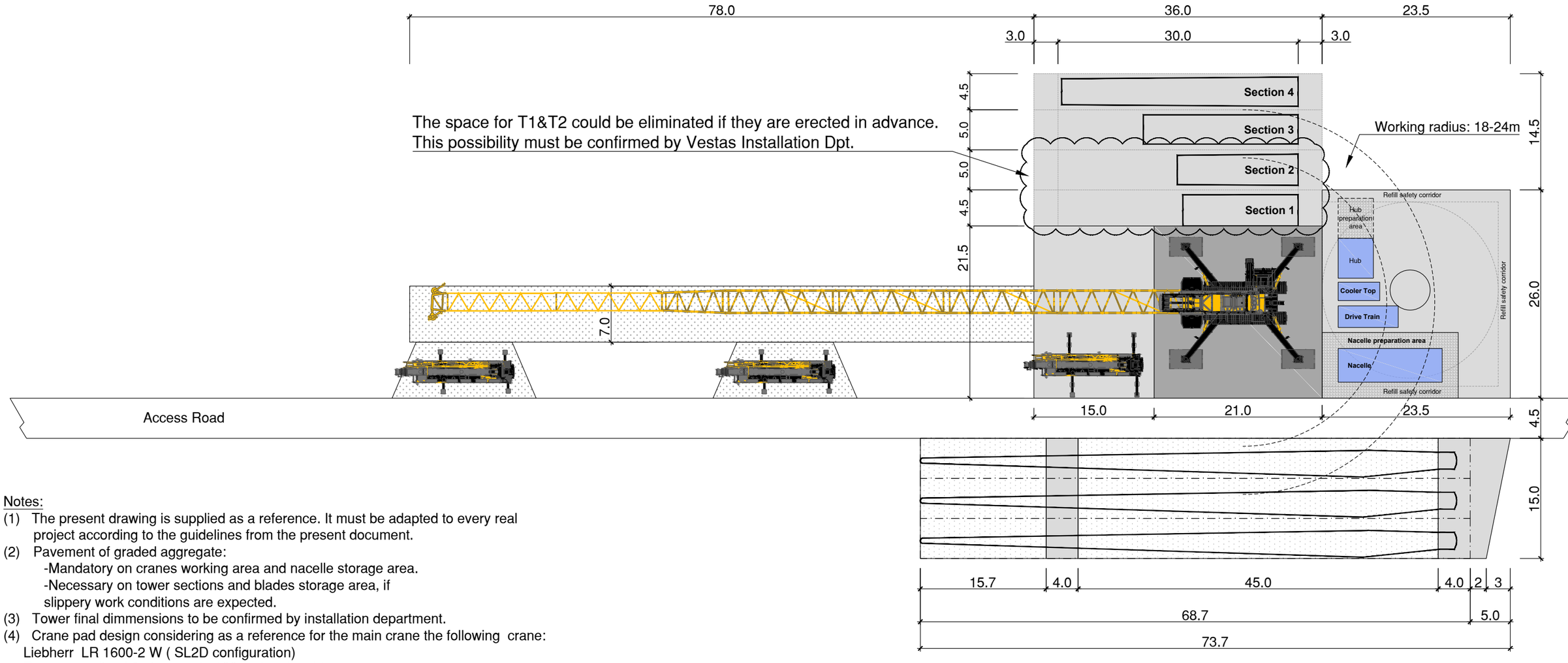

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-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) Tower final dimmensions to be confirmed by installation department.

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Liebherr LR 1600-2 W (SL2D configuration)
Raise capacity of 97 tons up to 138 meters height.

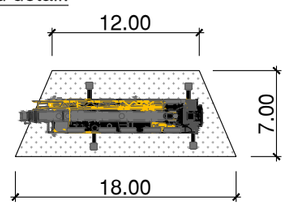
(5) All units are in meters.

Bearing capacity: Crane pressure + safety factor

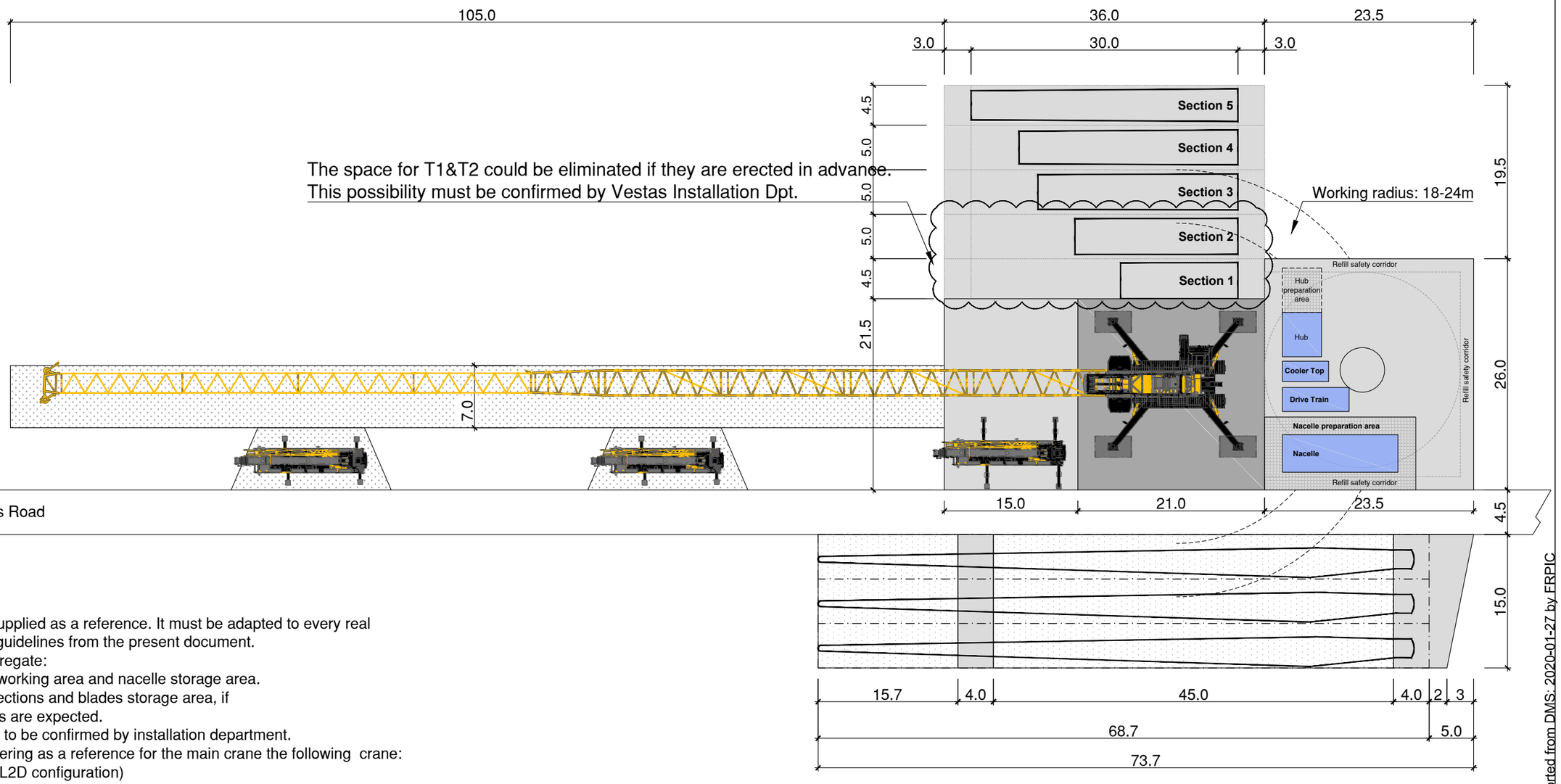
Bearing capacity: 2 Kg/cm²

Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT: TECHNICAL SPECIFICATIONS	AUTHOR: Vestas	SCALE: 1:500 (0m 5 10 15 20)	DATE: 26 - 04 - 2019	DRAWING: CRANE PAD V136 HH82	DRAW UP: RGOBA DATE: / CHECK BY: LGB DATE: / APPROVAL: ADMAD/LGB DATE:	EDITION: V9	DRAWING Nº: 1.1 / PAGE 1 OF 1



Notes:

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-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) Tower final dimmensions to be confirmed by installation department.

(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 1600-2 W (SL2D configuration)
Raise capacity of 97 tons up to 138 meters height.

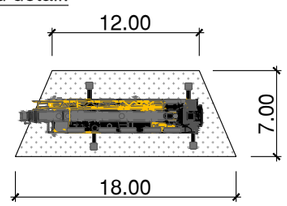
(5) All units are in meters.

Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

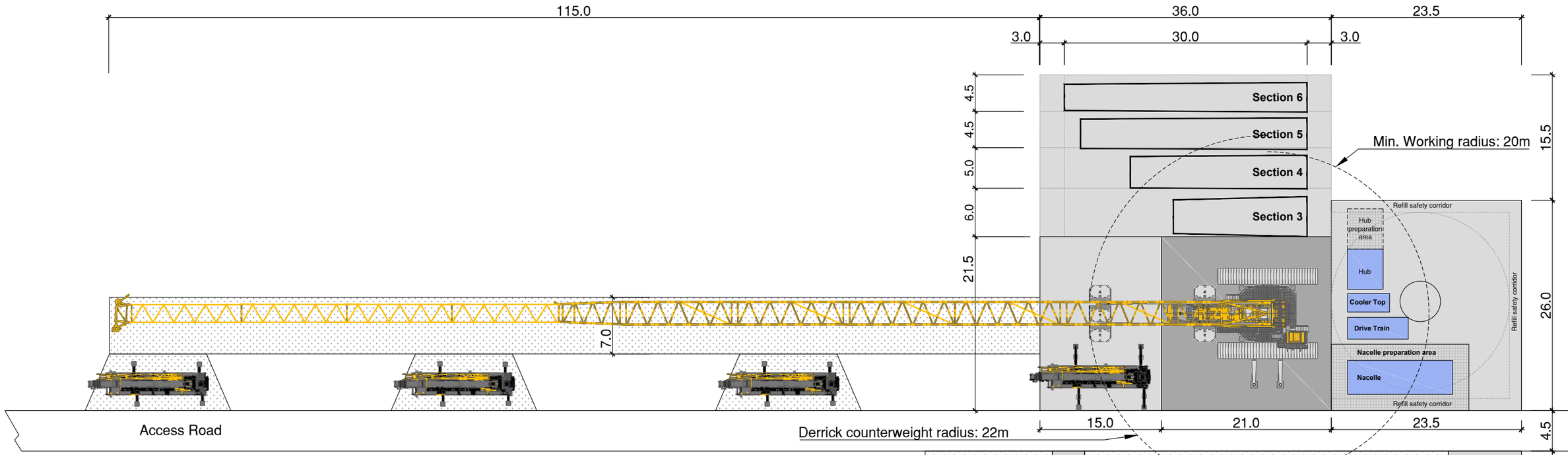
Area free of obstacles.

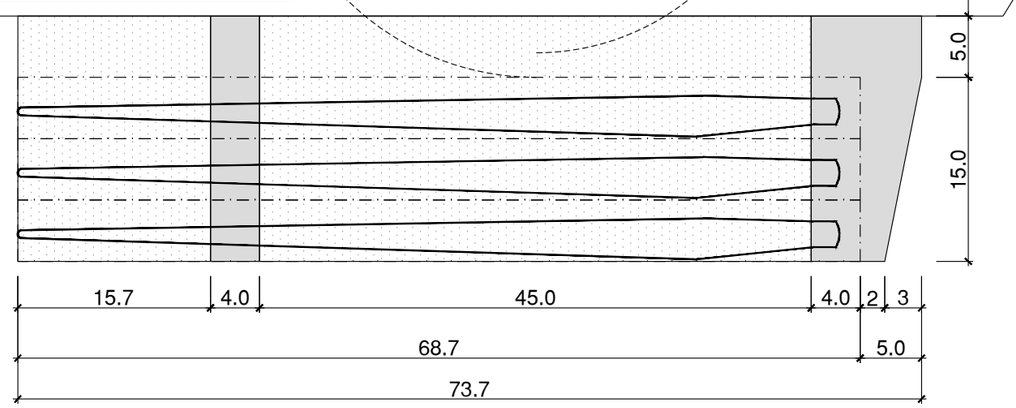
Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE: 1:500	DATE:	DRAWING:			EDITION:	DRAWING Nº:
TECHNICAL SPECIFICATIONS	Vestas	0m 5 10 15 20	26 - 04 - 2019	CRANE PAD V136 HH112	DRAW UP: RGOBA	DATE:	V9	1.1
					CHECK BY: LGB	DATE:		
					APPROVAL: ADMAD/LGB	DATE:		PAGE 1 OF 1

T13 0050-8073 Ver 10 - Approved- Exported from DMS: 2020-01-27 by FRPIC





Notes:

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- -Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) Tower final dimmensions to be confirmed by installation department.

(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 11000 (SL2DB configuration)
Raise capacity of 133 tons up to 156 meters height.

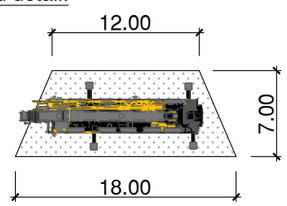
(5) All units are in meters.

Bearing capacity: Crane pressure + safety factor

Bearing capacity: 2 Kg/cm²

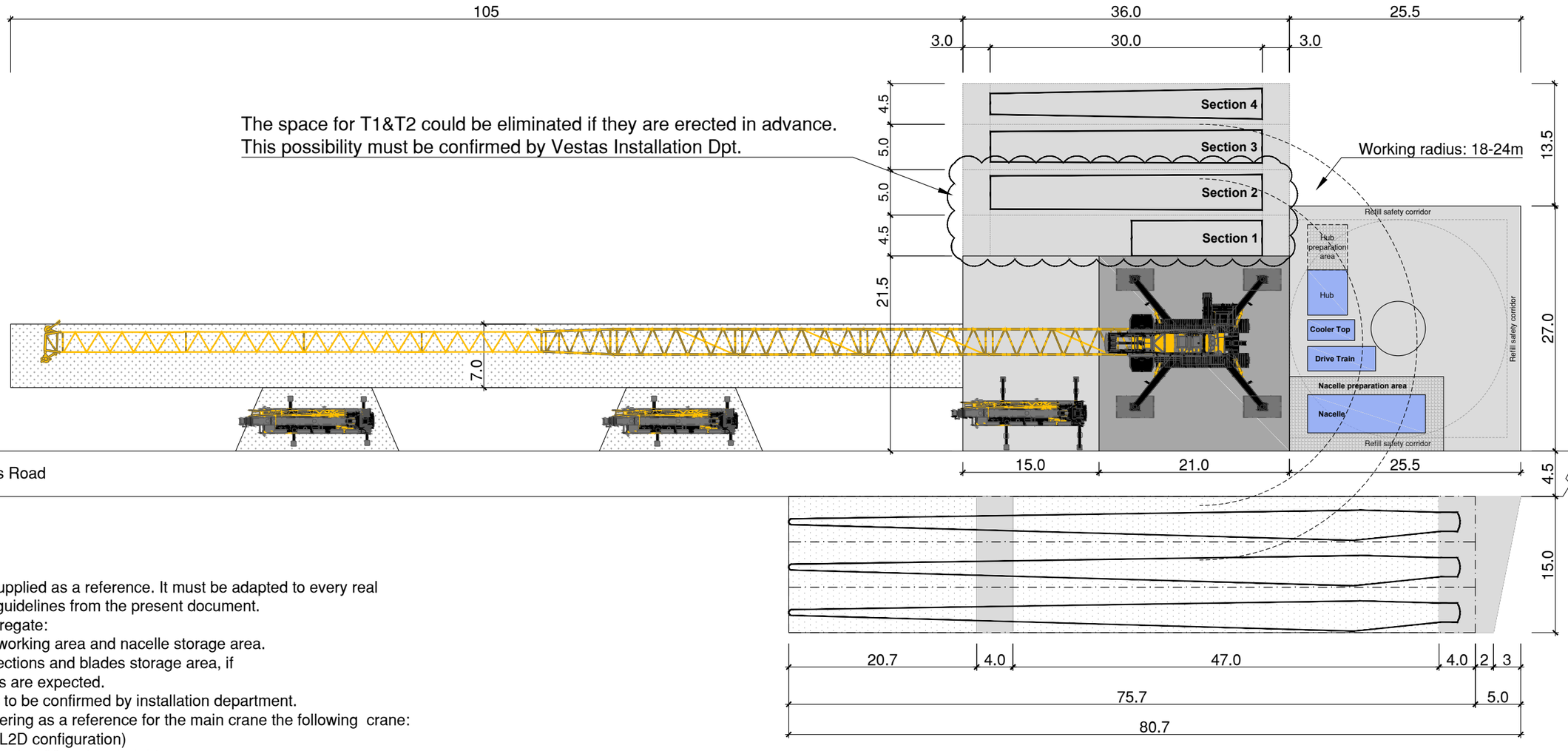
Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE:	DATE:	DRAWING:			EDITION:	DRAWING Nº:
TECHNICAL SPECIFICATIONS	Vestas	1:500 (0m 5 10 15 20)	26 - 04 - 2019	CRANE PAD V136 HH132 3.45-3.6MW MK3	DRAW UP: RGOBA	DATE:	V9	1.1
					CHECK BY: LGB	DATE:		PAGE 1 OF 1
					APPROVAL: ADMAD/LGB	DATE:		

T13 0050-8073 Ver 10 - Approved- Exported from DMS: 2020-01-27 by FRPIC



Notes:

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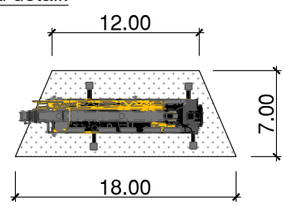
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.
(3) Tower final dimmensions to be confirmed by installation department.
(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 1600-2 W (SL2D configuration)
Raise capacity of 97 tons up to 138 meters height.
(5) All units are in meters.

Bearing capacity: Crane pressure + safety factor

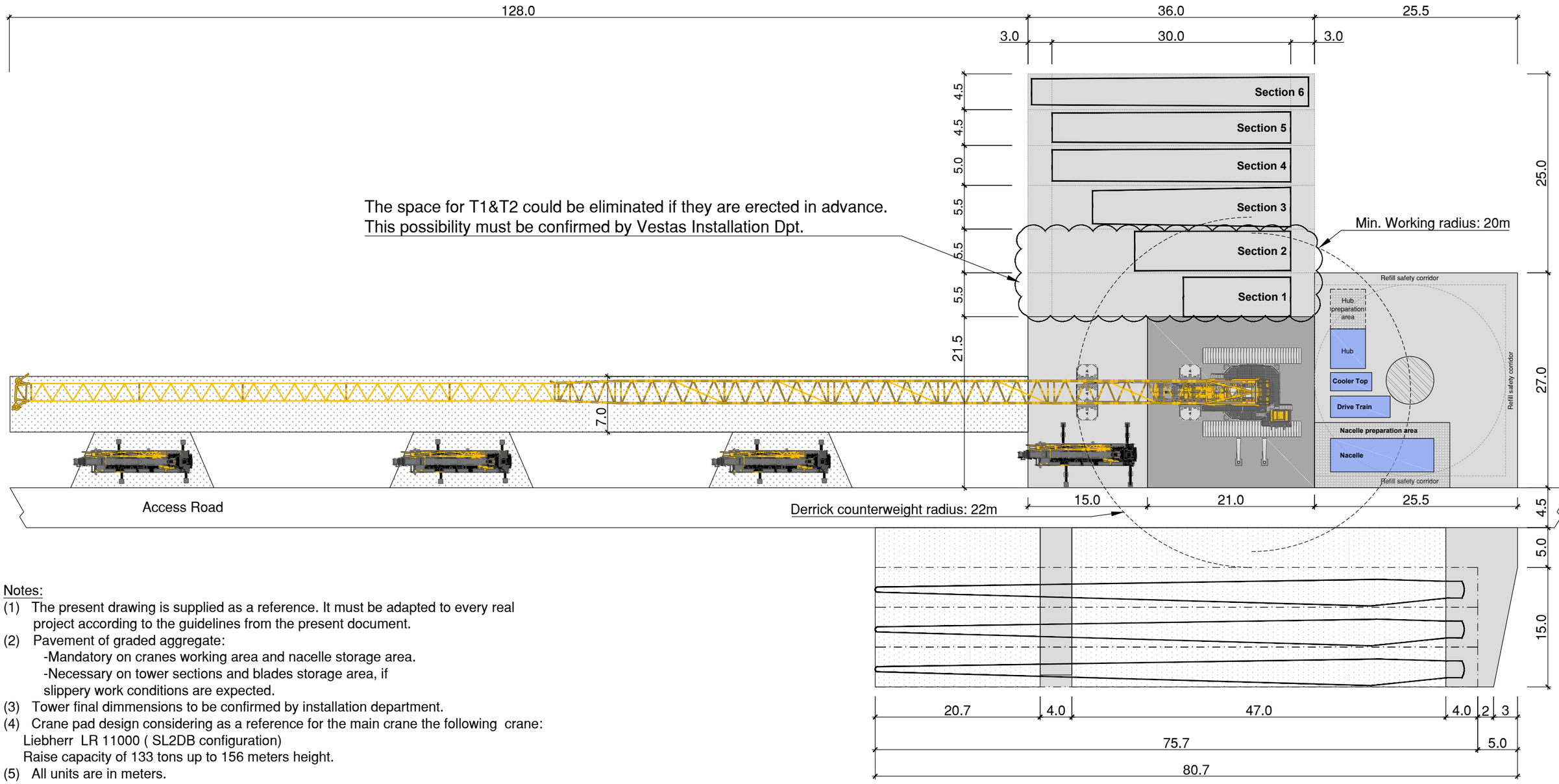
Bearing capacity: 2 Kg/cm²

Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE:	DATE:	DRAWING:				
TECHNICAL SPECIFICATIONS	Vestas	1:500 (0m 5 10 15 20)	26 - 04 - 2019	CRANE PAD V150 HH105	DRAW UP: RGOBA DATE:	EDITION: V9	DRAWING Nº: 1.1	T13 0050-8073 Ver 10 - Approved- Exported from DMS: 2020-01-27 by FRPIC
					CHECK BY: LGB DATE:			
					APPROVAL: ADMAD/LGB DATE:		PAGE 1 OF 1	



Notes:

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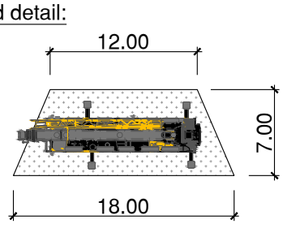
(2) Pavement of graded aggregate:
-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.
(3) Tower final dimmensions to be confirmed by installation department.
(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 11000 (SL2DB configuration)
Raise capacity of 133 tons up to 156 meters height.
(5) All units are in meters.

Bearing capacity: Crane pressure + safety factor

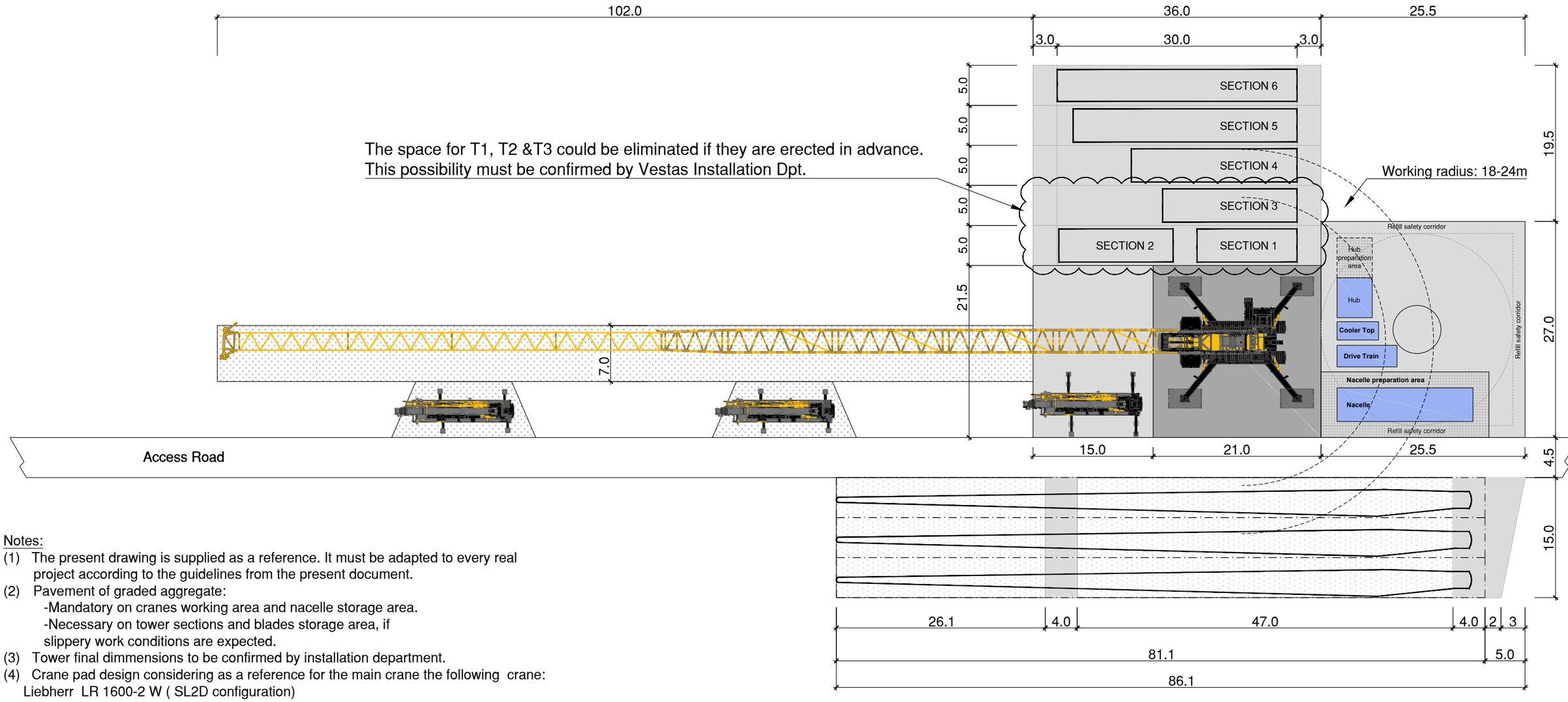
Bearing capacity: 2 Kg/cm²

Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE:	DATE:	DRAWING:				
TECHNICAL SPECIFICATIONS	Vestas	1:500 (0m 5 10 15 20)	26 - 04 - 2019	CRANE PAD V150 HH155	DRAW UP: RGOBA DATE:	EDITION: V9	DRAWING Nº: 1.1	T13.0050-8073 Ver 10 - Approved- Exported from DMS: 2020-01-27 by FRPIC
					CHECK BY: LGB DATE:			
					APPROVAL: ADMAD/LGB DATE:		PAGE 1 OF 1	



Notes:

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-Mandatory on cranes working area and nacelle storage area.
-Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) Tower final dimmensions to be confirmed by installation department.

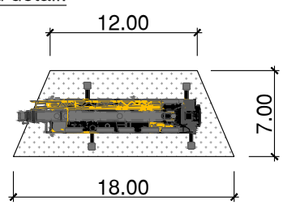
(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 1600-2 W (SL2D configuration)
Raise capacity of 97 tons up to 138 meters height.

(5) All units are in meters.

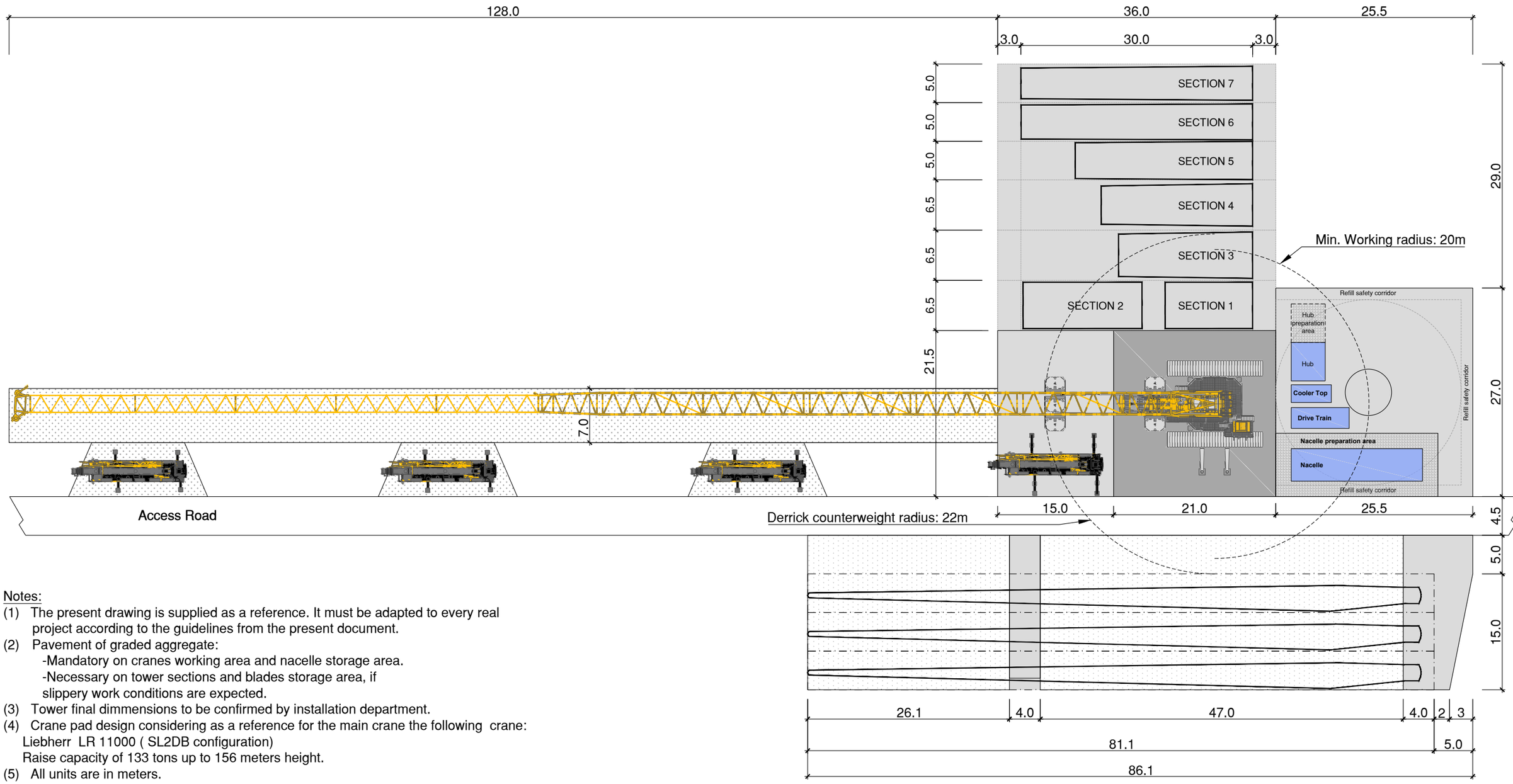
Legend:

- Bearing capacity: Crane pressure + safety factor
- Bearing capacity: 2 Kg/cm²
- Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE:	DATE:	DRAWING:				
TECHNICAL SPECIFICATIONS	Vestas	1:500 (0m 5 10 15 20)	26 - 04 - 2019	CRANE PAD V162 5.6MW HH125 (IEC)	DRAW UP: RGOBA DATE:	EDITION: V9	DRAWING Nº: 1.1	T13 0050-8073 Ver 10 - Approved- Exported from DMS: 2020-01-27 by FRPIC
					CHECK BY: LGB DATE:			
					APPROVAL: ADMAD/LGB DATE:		PAGE 2 OF 5	



Notes:

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(2) Pavement of graded aggregate:
- -Mandatory on cranes working area and nacelle storage area.
- -Necessary on tower sections and blades storage area, if slippery work conditions are expected.

(3) Tower final dimmensions to be confirmed by installation department.

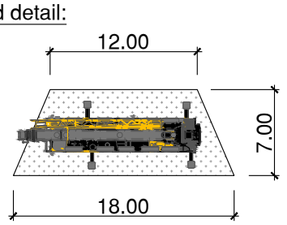
(4) Crane pad design considering as a reference for the main crane the following crane:
Liebherr LR 11000 (SL2DB configuration)
Raise capacity of 133 tons up to 156 meters height.

(5) All units are in meters.

Legend:

- Bearing capacity: Crane pressure + safety factor
- Bearing capacity: 2 Kg/cm²
- Area free of obstacles.

Auxiliary pad detail:
-Every 40m



PROJECT:	AUTHOR:	SCALE:	DATE:	DRAWING:				
TECHNICAL SPECIFICATIONS	Vestas	1:500 (0m 5 10 15 20)	26 - 04 - 2019	CRANE PAD V162 5.6MW HH149 (IEC)	DRAW UP: RGOBA DATE:	EDITION: V9	DRAWING Nº: 1.1	T13.0050-8073 Ver 10 - Approved- Exported from DMS: 2020-01-27 by FRPIC
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2021-04-14

Performance Specification

EnVentus™

V162-6.0 MW 50/60 Hz

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See general reservations, notes and disclaimers (including, Section 5, p. 13) to this Performance Specification.

1 General Description

The Vestas V162-6.0 MW is a wind turbine variant within the EnVentus™ turbine range. It is a pitch regulated upwind turbine with active yaw and a three-blade rotor. The V162-6.0 MW turbine has a rotor diameter of 162 m and a rated power of 6.0 MW.

For more details, please refer to the General Description of the EnVentus™ 5MW turbine range (General Description EnVentus™ - 0081-5017).

2 Type Approvals and Available Hub Heights

The standard turbine is type certified according to the certification standards and available hub heights listed below:

Certification	Wind Class	Hub Height
IECRE OD-501	IEC S	119 / 125 / 149 / 166 m
DIBt 2012	DIBt S	119 / 166 / 169 m

3 Operational Envelope and Performance Guidelines

Actual climate and site conditions have many variables and should be considered in evaluating actual turbine performance. The design and operating parameters set forth in this section do not constitute warranties, guarantees, or representations as to turbine performance at actual sites.

3.1 Climate and Site Conditions

The standard turbine is designed for the wind climate conditions listed below. Values refer to hub height.

Wind Climate	**IEC S**	**IEC S**	**IEC S**	**IEC S**
Power Rating	**6.0 MW**	**6.0 MW**	**6.0 MW**	**6.0 MW**
Hub Height	**119 m**	**125 m**	**149 m**	**166 m**
Average design parameters - IEC				
Wind Speed (10 min average), V_{ave}	7.4 m/s	8.5 m/s	7.9 m/s	7.9 m/s
Weibull Scale Factor, *C*	8.3 m/s	9.6 m/s	8.9 m/s	8.9 m/s
Weibull Shape Factor, *k*	2.48	2.3	2.48	2.48
I_{ref} acc. to IEC 61400-1	0.15	0.14	0.15	0.15
Turbulence Intensity acc. to IEC 61400-1, Including Wind Farm Turbulence (@15 m/s) I_{90} (90% quantile)	16.9%	15.7%	16.9 %	16.9 %
Wind Shear, α	0.30	0.20	0.30	0.30
Inflow Angle (vertical)	8°	8°	8°	8°
Extreme design parameters – IEC				
Extr. Wind Speed (10 min average), V_{50}	37.1 m/s	37.5 m/s	39.5 m/s	39.5 m/s
Survival Wind Speed (3 s gust), V_{e50}	51.9 m/s	52.5 m/s	55.3 m/s	55.3 m/s
Turbulence Intensity, I_{V50}	11%	11 %	11 %	11 %

Wind Class	**DIBt S**	**DIBt S**
Hub Height	**119 m**	**CHT* 166/169 m**
Power Rating	**6.0 MW**	**6.0 MW**
Average design parameters – DIBt		
Wind Speed (10 min average), V_{ave}	7.1 m/s	7.5 m/s
Weibull Scale Factor, *C*	8.0 m/s	8.5 m/s
Weibull Shape Factor, *k*	2.22	2.22
I_{ref} acc. to IEC 61400-1	S	S
Turbulence Intensity, I_{90} (90% quant.)	S	S
Extreme design parameters – DIBt		
Extr Wind Speed (10 min average), V_{50}	39.4 m/s	37.6 m/s
Survival Wind Speed (3 s gust), V_{e50}	55.2 m/s	52.6 m/s
Turbulence intensity, $I_{v(z)}$	11.3%	11.1%
Wind Shear, α	0.25	0.27
Inflow Angle	8°	8°

*CHT is Concrete Hybrid Tower

NOTE The turbine is intended for low to medium wind speed sites and is classified as IEC S. Please contact Vestas Wind Systems A/S for further information if needed.

Climatic conditions for turbines with the optional Vestas Anti-icing System (VAS), may vary from above. Please contact Vestas Wind Systems A/S for further information.

3.1.1 Wind Power Plant Layout

Turbine spacing is to be evaluated site-specifically. Spacing below two rotor diameters (2D) may require sector-wise curtailment.

NOTE As evaluation of climate and site conditions is complex, consult Vestas for every project. If conditions exceed the above parameters, Vestas must be consulted.

3.2 Operational Envelope – Wind

Values refer to hub height and are determined by the sensors and control system of the turbine.

Wind Climate	**IEC S / DIBt S**	
	PO6000	**SO2, SO3, SO4, SO5, SO6**
Cut-In, V_{in}	3 m/s	3 m/s
Cut-Out (10 min exponential avg.), V_{out}	24 m/s	20 m/s
Re-Cut In (10 min exponential avg.)	22 m/s	18 m/s

3.3 Operational Envelope – Temperature and Altitude

Values below refer to hub height and are determined by the sensors and control system of the turbine.

Operational Envelope – Temperature	
Ambient Temperature Interval	-20° to +45°C
Ambient Temperature Interval (Low Temperature operation)	-30° to +45°C

NOTE

The wind turbine will stop producing power at ambient temperatures above 45°C.
For the low temperature operation of the wind turbine please consult Vestas.

The turbine is designed for use at altitudes up to 1000 m above sea level as standard and optional up to 2000 m above sea level.

3.3.1 Temperature dependent operation

Values below refer to hub height and are determined by the sensors and control system of the turbine. At ambient temperatures above the thresholds shown for each operating mode, the turbine will maintain derated production.

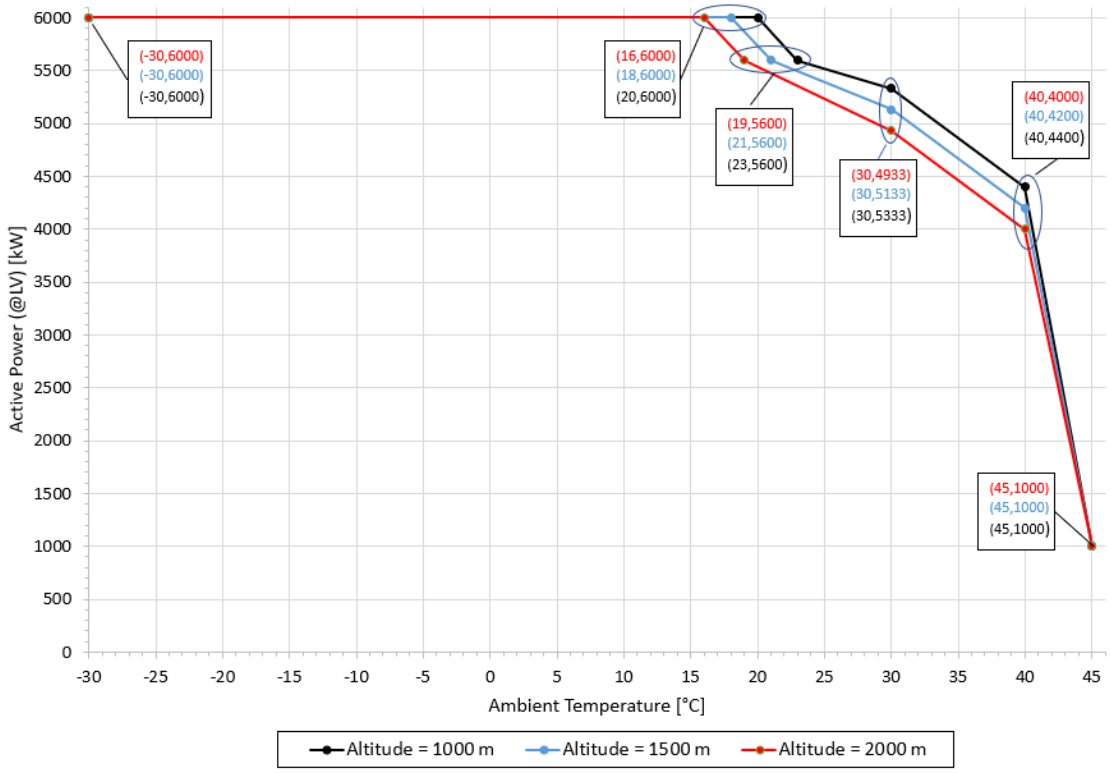


Figure 3-1: Temperature dependant derated operation

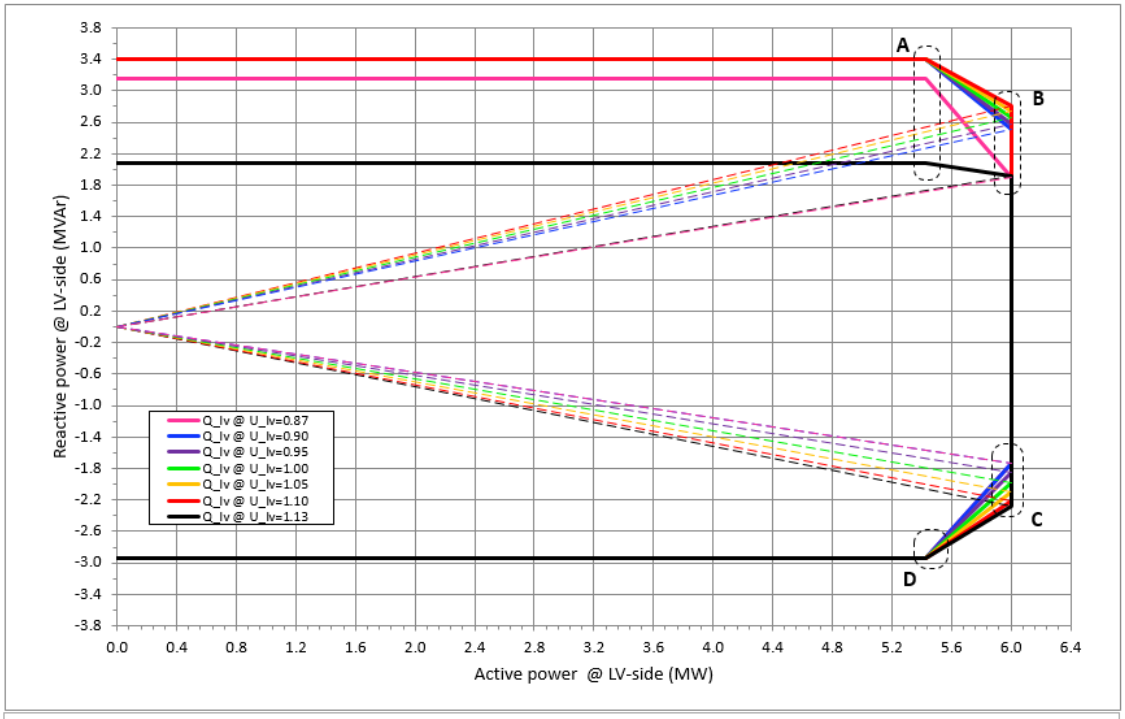
3.4 Operational Envelope – Conditions for Power Curve and Ct Values (at Hub Height)

Please consult section 6 and subsequent, for power curves and C_t values.

Conditions for Power Curve and C_t Values (at Hub Height)	
Wind Shear, *α*	0.00-0.30 (10-minute average)
Turbulence Intensity, *I*	6-12% (10-minute average)
Blades	Clean
Rain	No
Ice/Snow on Blades	No
Leading Edge	No damage
Terrain	IEC 61400-12-1
Inflow Angle (Vertical)	0 ±2°
Grid Voltage	Nominal Voltage ±2.5%
Grid Frequency	Nominal Frequency ±0.5 Hz
Grid Active Power (LV-side)	Per tabulated values in Section 6 and following sections
Grid Reactive Power (LV-side)	Power Factor 1.0

3.5 Operational Envelope – Reactive Power Capability

The turbine has a reactive power capability on the low voltage side of the HV transformer as illustrated in Figure 3-2:



		Coordinates								Power factor	
	Point:	A		B		C		D		B (Capacitive)	C (Inductive)
	Coordinate:	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)	x (P)	y (Q)		
	Reactive power [kVAr] @ LV side @ U_lv = 0.87 p.u. voltage	5.430	3.160	6.000	1.900	6.000	-1.739	5.430	-2.933	0.953	0.960
	Reactive power [kVAr] @ LV side @ U_lv = 0.90 p.u. voltage	5.430	3.400	6.000	2.503	6.000	-1.739	5.430	-2.933	0.923	0.960
	Reactive power [kVAr] @ LV side @ U_lv = 0.95 p.u. voltage	5.430	3.400	6.000	2.584	6.000	-1.856	5.430	-2.933	0.918	0.955
	Reactive power [kVAr] @ LV side @ U_lv = 1.00 p.u. voltage	5.430	3.400	6.000	2.664	6.000	-1.987	5.430	-2.933	0.914	0.949
	Reactive power [kVAr] @ LV side @ U_lv = 1.05 p.u. voltage	5.430	3.400	6.000	2.736	6.000	-2.093	5.430	-2.933	0.910	0.944
	Reactive power [kVAr] @ LV side @ U_lv = 1.10 p.u. voltage	5.430	3.400	6.000	2.807	6.000	-2.213	5.430	-2.933	0.906	0.938
	Reactive power [kVAr] @ LV side @ U_lv = 1.13 p.u. voltage	5.430	2.080	6.000	1.919	6.000	-2.283	5.430	-2.933	0.952	0.935

Figure 3-2: Reactive power capability

The turbine is able to maintain the reactive power capability at low wind with no active power production.

3.6 Sound Modes

The sound modes listed below are available for the turbine.

Sound modes			
Mode No.	**Maximum Sound Level**	**Serrated trailing edges**	**Available hub heights**
PO6000	104.3 dBA	Yes (standard)	119 / 125 / 149 / 166 / 169 m
PO6000-0S	107.1 dBA	No (option)	119 / 125 / 149 / 166 / 169 m

In addition, Sound Optimized (SO) modes as listed below are available as options for the turbine.

Sound Optimized (SO) modes			
Mode No.	**Maximum Sound Level**	**Serrated trailing edges**	**Available hub heights**
SO2	102 dBA	Yes (standard)	119 / 125 / 149 / 166 / 169 m
SO3	101 dBA	Yes (standard)	119 / 125 / 149 / 166 / 169 m
SO4	100 dBA	Yes (standard)	119 / 125 / 149 / 166 / 169 m
SO5	99 dBA	Yes (standard)	119 / 125 / 149 / 166 / 169 m
SO6	98 dBA	Yes (standard)	Site specific

NOTE Sound Optimized (SO) modes are only available with serrated trailing edges on the blades. For further details on sound performance and in case of specific requests, please contact Vestas Wind Systems A/S.

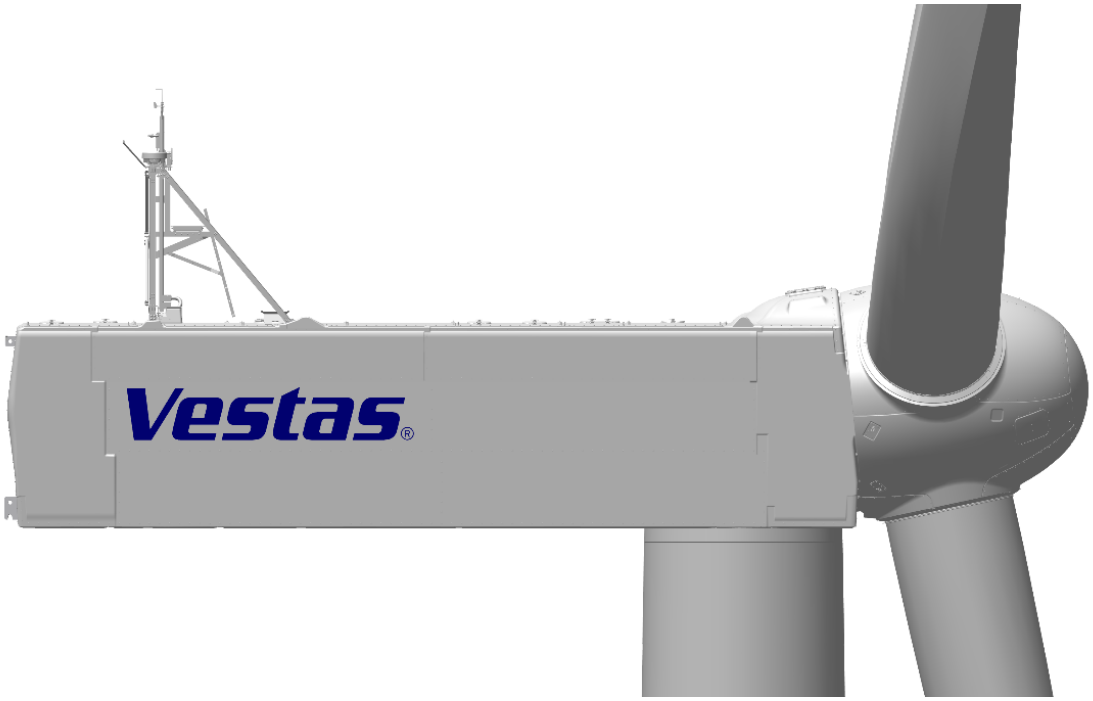
4 Drawings

Overview drawings describing the wind turbines, tower and foundation are shown in these documents.

V162 HH119 – 0075-8518
V162 HH125 – 0079-6651
V162 HH149 – 0079-6675
V162 HH166 – 0075-8514
V162 HH166 (CHT) – 0089-4873
V162 HH169 (CHT) – 0089-4874

NOTE For detailed drawings, please contact Vestas Wind Systems A/S.

4.1 Turbine visual impression – side view



5 General Reservations, Notes and Disclaimers

- The performance specifications described in this document apply to the current version of the V162-6.0 MW wind turbine. Updated versions of the V162-6.0 MW wind turbine, which may be manufactured in the future, may differ from these performance specifications. In the event that Vestas supplies an updated version of the V162-6.0 MW wind turbine, Vestas will provide an updated performance specification applicable to the updated version.
- All listed start/stop parameters (e.g. wind speeds) are equipped with hysteresis control. This can, in certain borderline situations, result in turbine stops even though the ambient conditions are within the listed operation parameters.
- This document, Performance Specification, is not an offer for sale, and does not contain any guarantee, warranty and/or verification of the power curve and sound (including, without limitation, the power curve and sound verification method). Any guarantee, warranty and/or verification of the power curve and sound (including, without limitation, the power curve and sound verification method) must be agreed to separately in writing.

6 Power Curves, Ct Values and Sound Curves, Mode PO6000/PO6000-0S

6.1 Power Curves, Mode PO6000/PO6000-0S

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**32**	13	14	15	17	18	20	22	24	26	28	30	35	38
3.5	**150**	96	101	106	111	116	121	125	130	135	140	145	155	159
4.0	**292**	208	215	223	231	238	246	254	261	269	277	284	300	307
4.5	**467**	344	355	366	378	389	400	411	422	433	444	455	478	489
5.0	**676**	507	523	538	553	569	584	599	615	630	645	660	691	706
5.5	**927**	701	721	742	762	783	804	824	845	865	886	907	948	968
6.0	**1229**	934	961	988	1015	1042	1068	1095	1122	1148	1175	1202	1255	1282
6.5	**1584**	1211	1245	1279	1313	1347	1381	1415	1449	1483	1516	1550	1618	1651
7.0	**2000**	1535	1578	1620	1662	1705	1747	1789	1832	1874	1916	1958	2042	2084
7.5	**2476**	1907	1959	2010	2062	2114	2166	2218	2269	2321	2373	2424	2527	2578
8.0	**3017**	2330	2392	2455	2518	2581	2643	2706	2768	2831	2893	2955	3079	3141
8.5	**3624**	2807	2882	2957	3032	3107	3181	3255	3330	3404	3477	3551	3696	3769
9.0	**4264**	3337	3424	3511	3598	3685	3769	3853	3937	4022	4102	4183	4341	4419
9.5	**4859**	3882	3976	4070	4163	4257	4345	4433	4521	4609	4692	4776	4936	5014
10.0	**5380**	4415	4513	4611	4709	4808	4895	4983	5071	5159	5233	5306	5442	5504
10.5	**5734**	4920	5015	5109	5204	5299	5371	5442	5514	5585	5635	5684	5770	5807
11.0	**5932**	5377	5455	5534	5612	5691	5735	5779	5823	5868	5889	5910	5944	5955
11.5	**5983**	5714	5760	5805	5850	5895	5912	5929	5945	5962	5969	5976	5987	5991
12.0	**5998**	5898	5916	5933	5950	5968	5974	5980	5986	5992	5994	5996	5999	5999
12.5	**6000**	5965	5972	5979	5986	5994	5995	5996	5998	5999	6000	6000	6000	6000
13.0	**6000**	5991	5993	5995	5997	5999	6000	6000	6000	6000	6000	6000	6000	6000
13.5	**6000**	5999	5999	5999	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
14.0	**6000**	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
14.5	**6000**	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
15.0	**6000**	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
15.5	**6000**	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
16.0	**6000**	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
16.5	**6000**	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
17.0	**6000**	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
17.5	**6000**	5987	5989	5991	5994	5996	5997	5998	5999	6000	6000	6000	6000	6000
18.0	**5846**	5728	5737	5747	5757	5766	5777	5788	5799	5810	5822	5834	5858	5871
18.5	**5581**	5483	5490	5498	5506	5514	5523	5532	5541	5550	5561	5571	5593	5604
19.0	**5360**	5270	5277	5284	5292	5299	5307	5315	5324	5332	5341	5351	5369	5379
19.5	**5128**	5019	5028	5036	5045	5054	5065	5075	5086	5096	5107	5117	5139	5151
20.0	**4844**	4735	4744	4753	4762	4771	4781	4791	4801	4811	4822	4833	4854	4865
20.5	**4555**	4450	4459	4468	4477	4485	4495	4505	4515	4524	4535	4545	4565	4574
21.0	**4268**	4175	4183	4191	4198	4206	4215	4223	4232	4240	4250	4259	4278	4288
21.5	**3985**	3898	3905	3913	3920	3928	3936	3944	3952	3960	3968	3976	3993	4002
22.0	**3690**	3600	3608	3616	3623	3631	3639	3647	3656	3664	3672	3681	3699	3707
22.5	**3383**	3306	3313	3319	3326	3332	3339	3346	3353	3361	3368	3376	3391	3398
23.0	**3102**	3034	3040	3046	3052	3058	3064	3070	3076	3082	3088	3095	3109	3115
23.5	**2801**	2728	2734	2741	2748	2755	2761	2768	2775	2782	2788	2795	2809	2816
24.0	**2479**	2405	2412	2418	2425	2432	2438	2444	2450	2456	2463	2471	2484	2490

6.2 Ct Values, Mode PO6000/PO6000-0S

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.908**	0.911	0.911	0.912	0.912	0.912	0.912	0.911	0.911	0.911	0.910	0.909	0.908	0.907
3.5	**0.882**	0.890	0.889	0.888	0.888	0.887	0.887	0.886	0.885	0.885	0.884	0.883	0.881	0.880
4.0	**0.853**	0.859	0.858	0.858	0.857	0.857	0.856	0.856	0.855	0.855	0.854	0.854	0.853	0.852
4.5	**0.837**	0.839	0.839	0.839	0.839	0.838	0.838	0.838	0.838	0.838	0.838	0.838	0.837	0.837
5.0	**0.820**	0.821	0.821	0.821	0.821	0.821	0.820	0.820	0.820	0.820	0.820	0.820	0.820	0.820
5.5	**0.814**	0.814	0.814	0.814	0.814	0.814	0.814	0.814	0.814	0.814	0.814	0.814	0.814	0.814
6.0	**0.812**	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.813	0.812	0.812	0.812	0.812
6.5	**0.810**	0.813	0.813	0.813	0.812	0.812	0.812	0.812	0.811	0.811	0.811	0.810	0.810	0.809
7.0	**0.807**	0.812	0.812	0.811	0.811	0.810	0.810	0.810	0.809	0.809	0.808	0.808	0.807	0.806
7.5	**0.804**	0.810	0.809	0.809	0.808	0.808	0.807	0.807	0.806	0.806	0.805	0.805	0.803	0.803
8.0	**0.800**	0.807	0.807	0.806	0.805	0.805	0.804	0.803	0.803	0.802	0.801	0.800	0.799	0.798
8.5	**0.793**	0.805	0.804	0.803	0.802	0.801	0.800	0.799	0.798	0.797	0.796	0.794	0.791	0.789
9.0	**0.763**	0.800	0.798	0.795	0.793	0.791	0.787	0.784	0.780	0.777	0.772	0.767	0.757	0.752
9.5	**0.701**	0.766	0.760	0.755	0.749	0.744	0.738	0.732	0.726	0.720	0.714	0.707	0.695	0.689
10.0	**0.635**	0.712	0.706	0.699	0.692	0.685	0.679	0.672	0.665	0.658	0.650	0.642	0.626	0.618
10.5	**0.559**	0.655	0.648	0.640	0.633	0.625	0.616	0.607	0.598	0.589	0.579	0.569	0.549	0.539
11.0	**0.484**	0.601	0.591	0.582	0.572	0.563	0.551	0.540	0.529	0.518	0.507	0.495	0.473	0.462
11.5	**0.413**	0.540	0.528	0.516	0.504	0.492	0.480	0.468	0.456	0.444	0.434	0.424	0.404	0.395
12.0	**0.356**	0.475	0.462	0.450	0.437	0.425	0.414	0.404	0.393	0.383	0.374	0.365	0.349	0.341
12.5	**0.310**	0.413	0.402	0.390	0.379	0.368	0.359	0.350	0.341	0.332	0.325	0.318	0.304	0.297
13.0	**0.273**	0.360	0.351	0.341	0.331	0.322	0.314	0.307	0.299	0.291	0.285	0.279	0.267	0.262
13.5	**0.242**	0.317	0.309	0.300	0.292	0.284	0.277	0.271	0.264	0.258	0.252	0.247	0.237	0.232
14.0	**0.216**	0.280	0.273	0.266	0.259	0.252	0.246	0.241	0.235	0.230	0.225	0.220	0.211	0.207
14.5	**0.193**	0.250	0.244	0.238	0.232	0.225	0.220	0.216	0.211	0.206	0.202	0.197	0.190	0.186
15.0	**0.174**	0.224	0.219	0.214	0.208	0.203	0.198	0.194	0.190	0.185	0.182	0.178	0.171	0.168
15.5	**0.158**	0.202	0.198	0.193	0.188	0.183	0.179	0.176	0.172	0.168	0.165	0.161	0.155	0.152
16.0	**0.144**	0.184	0.179	0.175	0.171	0.166	0.163	0.159	0.156	0.153	0.150	0.147	0.141	0.139
16.5	**0.131**	0.167	0.163	0.159	0.156	0.152	0.149	0.145	0.142	0.139	0.137	0.134	0.129	0.127
17.0	**0.120**	0.153	0.149	0.146	0.142	0.139	0.136	0.133	0.130	0.127	0.125	0.123	0.118	0.116
17.5	**0.111**	0.140	0.137	0.134	0.131	0.128	0.125	0.123	0.120	0.118	0.116	0.113	0.109	0.107
18.0	**0.100**	0.124	0.121	0.119	0.116	0.114	0.112	0.110	0.107	0.105	0.104	0.102	0.099	0.097
18.5	**0.089**	0.110	0.107	0.105	0.103	0.101	0.099	0.097	0.095	0.093	0.092	0.090	0.088	0.086
19.0	**0.079**	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.084	0.083	0.081	0.080	0.078	0.076
19.5	**0.070**	0.086	0.084	0.082	0.081	0.079	0.078	0.076	0.075	0.074	0.072	0.071	0.069	0.068
20.0	**0.062**	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.065	0.064	0.063	0.061	0.060
20.5	**0.055**	0.067	0.065	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.057	0.056	0.054	0.053
21.0	**0.048**	0.059	0.058	0.056	0.055	0.054	0.053	0.052	0.052	0.051	0.050	0.049	0.048	0.047
21.5	**0.043**	0.052	0.051	0.050	0.049	0.048	0.047	0.046	0.046	0.045	0.044	0.043	0.042	0.042
22.0	**0.038**	0.045	0.044	0.044	0.043	0.042	0.041	0.041	0.040	0.039	0.039	0.038	0.037	0.037
22.5	**0.033**	0.039	0.039	0.038	0.037	0.037	0.036	0.036	0.035	0.034	0.034	0.033	0.033	0.032
23.0	**0.029**	0.035	0.034	0.033	0.033	0.032	0.032	0.031	0.031	0.030	0.030	0.030	0.029	0.028
23.5	**0.025**	0.030	0.029	0.029	0.028	0.028	0.028	0.027	0.027	0.026	0.026	0.026	0.025	0.025
24.0	**0.022**	0.026	0.025	0.025	0.024	0.024	0.024	0.023	0.023	0.023	0.022	0.022	0.022	0.021

6.3 Sound Curves, Mode PO6000/PO6000-0S

Sound Power Level at Hub Height		
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**	
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA] Mode PO6000 (Blades with serrated trailing edge)**	**Sound Power Level at Hub Height [dBA] Mode PO6000-0S (Blades without serrated trailing edge)**
3	93.9	96.7
4	94.1	96.9
5	94.3	97.1
6	96.2	99.0
7	99.2	102.0
8	102.0	104.8
9	104.1	106.9
10	104.3	107.1
11	104.3	107.1
12	104.3	107.1
13	104.3	107.1
14	104.3	107.1
15	104.3	107.1
16	104.3	107.1
17	104.3	107.1
18	104.3	107.1
19	104.3	107.1
20	104.3	107.1

7 Power Curves, Ct Values and Sound Curves, Sound Optimized Modes

7.1 Power Curves, Sound Optimized Mode SO2

Air density [kg/m^3]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**27**	9	10	12	13	14	16	18	20	21	23	25	29	32
3.5	**144**	91	95	100	105	110	115	120	125	129	134	139	149	153
4.0	**289**	205	212	220	228	235	243	251	258	266	274	281	297	304
4.5	**464**	341	352	363	375	386	397	408	419	430	441	452	475	486
5.0	**669**	502	517	532	547	563	578	593	608	624	639	654	685	700
5.5	**919**	693	714	734	755	775	796	816	837	857	878	898	939	960
6.0	**1219**	925	952	979	1005	1032	1059	1086	1113	1140	1166	1193	1246	1272
6.5	**1574**	1201	1235	1269	1303	1337	1371	1405	1439	1473	1507	1540	1608	1642
7.0	**1991**	1525	1568	1610	1653	1695	1737	1780	1822	1864	1906	1948	2033	2075
7.5	**2461**	1892	1944	1995	2047	2099	2151	2203	2255	2306	2358	2410	2513	2564
8.0	**2983**	2299	2362	2424	2486	2549	2611	2673	2735	2797	2859	2921	3044	3106
8.5	**3530**	2729	2802	2876	2949	3022	3095	3168	3241	3314	3386	3458	3601	3672
9.0	**4079**	3173	3257	3342	3426	3511	3594	3677	3760	3843	3922	4001	4153	4226
9.5	**4500**	3611	3706	3800	3895	3989	4071	4152	4234	4316	4377	4438	4546	4592
10.0	**4745**	4028	4120	4212	4304	4396	4457	4518	4579	4640	4675	4710	4766	4787
10.5	**4860**	4381	4453	4526	4599	4672	4707	4743	4779	4815	4830	4845	4869	4877
11.0	**4928**	4650	4700	4750	4800	4851	4866	4881	4896	4911	4917	4923	4931	4934
11.5	**4972**	4824	4851	4878	4905	4932	4940	4947	4955	4963	4966	4969	4973	4974
12.0	**5009**	4928	4942	4957	4972	4986	4991	4996	5001	5006	5007	5008	5009	5008
12.5	**5038**	4987	4997	5006	5016	5026	5029	5032	5034	5037	5037	5037	5037	5037
13.0	**5052**	5016	5024	5031	5038	5045	5047	5049	5051	5052	5052	5052	5052	5052
13.5	**5057**	5028	5035	5041	5047	5053	5054	5055	5056	5057	5057	5057	5057	5057
14.0	**5057**	5033	5038	5043	5048	5053	5054	5055	5056	5057	5057	5057	5057	5057
14.5	**5052**	5029	5034	5038	5043	5048	5048	5049	5050	5051	5051	5051	5052	5052
15.0	**5037**	5012	5017	5022	5027	5032	5032	5033	5034	5035	5036	5036	5037	5038
15.5	**5015**	4992	4996	5000	5005	5009	5010	5011	5012	5013	5014	5014	5016	5016
16.0	**4990**	4968	4972	4976	4980	4984	4986	4986	4988	4988	4989	4990	4991	4992
16.5	**4964**	4942	4946	4950	4954	4958	4959	4960	4961	4962	4963	4964	4965	4966
17.0	**4938**	4916	4920	4924	4927	4931	4932	4933	4935	4936	4936	4937	4938	4939
17.5	**4912**	4888	4893	4897	4901	4905	4906	4907	4909	4910	4910	4911	4912	4913
18.0	**4885**	4864	4867	4871	4875	4879	4880	4881	4882	4882	4883	4884	4886	4886
18.5	**4859**	4841	4844	4847	4850	4853	4854	4855	4856	4857	4857	4858	4860	4860
19.0	**4836**	4818	4821	4824	4826	4829	4831	4832	4833	4834	4835	4836	4837	4837
19.5	**4813**	4789	4793	4796	4800	4803	4805	4806	4808	4810	4811	4812	4814	4815
20.0	**4736**	4690	4695	4701	4706	4711	4714	4718	4722	4726	4729	4732	4740	4744

7.2 Ct Values, Sound Optimized Mode SO2

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.914**	0.912	0.913	0.913	0.914	0.915	0.915	0.915	0.915	0.915	0.915	0.914	0.913	0.913
3.5	**0.888**	0.894	0.893	0.893	0.893	0.892	0.892	0.891	0.891	0.891	0.890	0.889	0.888	0.887
4.0	**0.851**	0.857	0.856	0.856	0.855	0.854	0.854	0.853	0.853	0.852	0.852	0.852	0.851	0.850
4.5	**0.822**	0.823	0.823	0.823	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822
5.0	**0.801**	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801
5.5	**0.797**	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797
6.0	**0.797**	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797
6.5	**0.798**	0.799	0.799	0.799	0.799	0.799	0.799	0.799	0.799	0.798	0.798	0.798	0.798	0.798
7.0	**0.801**	0.804	0.804	0.803	0.803	0.803	0.803	0.803	0.802	0.802	0.802	0.802	0.801	0.801
7.5	**0.796**	0.798	0.798	0.798	0.798	0.798	0.797	0.797	0.797	0.797	0.796	0.796	0.795	0.795
8.0	**0.784**	0.787	0.787	0.786	0.786	0.786	0.786	0.785	0.785	0.785	0.784	0.784	0.783	0.783
8.5	**0.747**	0.751	0.750	0.750	0.750	0.749	0.749	0.749	0.748	0.748	0.748	0.747	0.746	0.745
9.0	**0.707**	0.717	0.717	0.717	0.716	0.716	0.715	0.715	0.714	0.713	0.711	0.709	0.703	0.699
9.5	**0.634**	0.683	0.682	0.681	0.680	0.679	0.675	0.670	0.665	0.660	0.651	0.643	0.624	0.613
10.0	**0.541**	0.631	0.627	0.623	0.619	0.615	0.606	0.597	0.588	0.578	0.566	0.554	0.528	0.516
10.5	**0.455**	0.566	0.559	0.552	0.544	0.537	0.525	0.513	0.502	0.490	0.478	0.466	0.444	0.433
11.0	**0.385**	0.500	0.490	0.481	0.471	0.461	0.450	0.438	0.427	0.415	0.405	0.395	0.376	0.368
11.5	**0.332**	0.437	0.427	0.416	0.406	0.395	0.386	0.376	0.366	0.357	0.348	0.340	0.325	0.317
12.0	**0.289**	0.382	0.372	0.363	0.353	0.343	0.335	0.327	0.319	0.311	0.303	0.296	0.283	0.277
12.5	**0.254**	0.335	0.326	0.318	0.309	0.301	0.294	0.287	0.280	0.273	0.267	0.261	0.249	0.244
13.0	**0.225**	0.294	0.287	0.280	0.272	0.265	0.259	0.253	0.247	0.241	0.235	0.230	0.220	0.216
13.5	**0.200**	0.260	0.254	0.248	0.241	0.235	0.230	0.224	0.219	0.214	0.209	0.205	0.196	0.192
14.0	**0.179**	0.232	0.226	0.220	0.215	0.209	0.205	0.200	0.195	0.191	0.187	0.183	0.175	0.172
14.5	**0.160**	0.207	0.202	0.197	0.192	0.187	0.183	0.179	0.175	0.171	0.167	0.164	0.157	0.154
15.0	**0.144**	0.185	0.181	0.177	0.172	0.168	0.164	0.161	0.157	0.153	0.150	0.147	0.142	0.139
15.5	**0.130**	0.167	0.163	0.159	0.155	0.151	0.148	0.145	0.142	0.138	0.136	0.133	0.128	0.125
16.0	**0.118**	0.151	0.147	0.144	0.140	0.137	0.134	0.131	0.128	0.125	0.123	0.120	0.116	0.114
16.5	**0.107**	0.136	0.133	0.130	0.127	0.124	0.122	0.119	0.116	0.114	0.112	0.109	0.105	0.103
17.0	**0.098**	0.124	0.121	0.119	0.116	0.113	0.111	0.108	0.106	0.104	0.102	0.100	0.096	0.094
17.5	**0.090**	0.114	0.111	0.109	0.106	0.104	0.102	0.100	0.097	0.095	0.094	0.092	0.088	0.087
18.0	**0.083**	0.104	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.086	0.084	0.081	0.080
18.5	**0.076**	0.096	0.094	0.092	0.090	0.087	0.086	0.084	0.082	0.080	0.079	0.078	0.075	0.073
19.0	**0.070**	0.088	0.086	0.084	0.082	0.080	0.079	0.077	0.075	0.074	0.073	0.071	0.069	0.067
19.5	**0.065**	0.081	0.079	0.078	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063
20.0	**0.060**	0.074	0.072	0.071	0.069	0.068	0.067	0.065	0.064	0.063	0.062	0.061	0.059	0.058

7.3 Sound Curves, Sound Optimized Mode SO2

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO2 (Blades with serrated trailing edge)**
3	93.5
4	93.7
5	94.3
6	97.3
7	100.2
8	102.0
9	102.0
10	102.0
11	102.0
12	102.0
13	102.0
14	102.0
15	102.0
16	102.0
17	102.0
18	102.0
19	102.0
20	102.0

7.4 Power Curves, Sound Optimized Mode SO3

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**27**	9	10	12	13	14	16	18	20	21	23	25	29	32
3.5	**144**	91	95	100	105	110	115	120	125	129	134	139	149	153
4.0	**289**	205	212	220	228	235	243	251	258	266	274	281	297	304
4.5	**464**	341	352	363	375	386	397	408	419	430	441	452	475	486
5.0	**669**	502	517	532	547	563	578	593	608	624	639	654	685	700
5.5	**919**	693	714	734	755	775	796	816	837	857	878	898	939	960
6.0	**1219**	925	952	979	1005	1032	1059	1086	1113	1140	1166	1193	1246	1272
6.5	**1574**	1201	1235	1269	1303	1337	1371	1405	1439	1473	1507	1540	1608	1642
7.0	**1990**	1525	1567	1610	1652	1694	1737	1779	1821	1864	1906	1948	2032	2074
7.5	**2453**	1886	1937	1989	2041	2092	2144	2196	2247	2299	2350	2402	2504	2556
8.0	**2953**	2277	2339	2400	2462	2524	2585	2647	2708	2770	2831	2892	3014	3076
8.5	**3458**	2674	2745	2817	2889	2960	3032	3103	3174	3246	3317	3387	3528	3598
9.0	**3940**	3059	3140	3222	3303	3385	3465	3546	3626	3706	3784	3862	4012	4083
9.5	**4306**	3423	3514	3604	3694	3784	3866	3948	4031	4113	4177	4242	4353	4400
10.0	**4532**	3760	3853	3945	4037	4130	4199	4268	4337	4406	4448	4490	4557	4582
10.5	**4659**	4070	4154	4237	4320	4403	4451	4498	4545	4592	4615	4637	4671	4683
11.0	**4742**	4331	4398	4466	4534	4602	4629	4657	4685	4713	4723	4733	4748	4754
11.5	**4800**	4532	4580	4628	4676	4723	4738	4753	4768	4782	4788	4794	4803	4806
12.0	**4829**	4647	4680	4714	4747	4780	4789	4799	4809	4818	4822	4826	4830	4832
12.5	**4839**	4698	4725	4751	4777	4803	4810	4817	4824	4831	4834	4836	4840	4840
13.0	**4841**	4724	4745	4767	4789	4811	4817	4823	4829	4835	4837	4839	4842	4842
13.5	**4841**	4731	4752	4774	4795	4817	4822	4827	4833	4838	4839	4840	4842	4842
14.0	**4840**	4746	4765	4783	4801	4820	4824	4828	4833	4837	4838	4839	4840	4841
14.5	**4834**	4754	4770	4786	4801	4817	4820	4824	4828	4831	4832	4833	4835	4835
15.0	**4819**	4744	4758	4773	4787	4801	4805	4808	4812	4816	4817	4818	4820	4820
15.5	**4798**	4728	4741	4754	4767	4781	4784	4788	4791	4794	4796	4797	4798	4799
16.0	**4773**	4707	4719	4732	4744	4756	4759	4763	4766	4770	4771	4772	4774	4774
16.5	**4746**	4685	4696	4708	4719	4730	4734	4737	4740	4743	4744	4745	4747	4748
17.0	**4720**	4664	4674	4684	4695	4705	4708	4710	4713	4716	4717	4718	4720	4720
17.5	**4693**	4637	4648	4658	4668	4679	4681	4684	4687	4690	4691	4692	4694	4694
18.0	**4666**	4620	4629	4637	4646	4654	4656	4659	4661	4664	4664	4665	4667	4668
18.5	**4640**	4604	4611	4617	4623	4630	4632	4634	4636	4638	4638	4639	4640	4641
19.0	**4617**	4584	4589	4595	4600	4606	4608	4610	4612	4614	4615	4616	4618	4618
19.5	**4598**	4574	4578	4582	4586	4590	4592	4593	4595	4596	4597	4597	4598	4599
20.0	**4575**	4548	4552	4555	4559	4563	4565	4567	4569	4571	4572	4573	4576	4577

7.5 Ct Values, Sound Optimized Mode SO3

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.914**	0.912	0.913	0.913	0.914	0.915	0.915	0.915	0.915	0.915	0.915	0.914	0.913	0.913
3.5	**0.888**	0.894	0.893	0.893	0.893	0.892	0.892	0.891	0.891	0.891	0.890	0.889	0.888	0.887
4.0	**0.851**	0.857	0.856	0.856	0.855	0.854	0.854	0.853	0.853	0.852	0.852	0.852	0.851	0.850
4.5	**0.822**	0.823	0.823	0.823	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822
5.0	**0.801**	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801
5.5	**0.797**	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797
6.0	**0.797**	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797	0.797
6.5	**0.798**	0.799	0.799	0.799	0.799	0.799	0.799	0.799	0.799	0.798	0.798	0.798	0.798	0.798
7.0	**0.801**	0.803	0.803	0.803	0.803	0.802	0.802	0.802	0.802	0.802	0.801	0.801	0.801	0.800
7.5	**0.792**	0.794	0.794	0.794	0.794	0.794	0.793	0.793	0.793	0.793	0.792	0.792	0.792	0.791
8.0	**0.769**	0.772	0.771	0.771	0.771	0.771	0.770	0.770	0.770	0.770	0.769	0.769	0.768	0.768
8.5	**0.720**	0.723	0.723	0.722	0.722	0.722	0.722	0.721	0.721	0.721	0.720	0.720	0.719	0.718
9.0	**0.670**	0.676	0.676	0.676	0.676	0.675	0.675	0.675	0.674	0.674	0.672	0.671	0.667	0.663
9.5	**0.594**	0.622	0.621	0.621	0.621	0.620	0.618	0.616	0.613	0.611	0.605	0.600	0.585	0.576
10.0	**0.508**	0.562	0.560	0.559	0.557	0.556	0.551	0.545	0.540	0.535	0.526	0.517	0.497	0.487
10.5	**0.431**	0.506	0.502	0.499	0.495	0.491	0.483	0.476	0.468	0.460	0.450	0.440	0.421	0.412
11.0	**0.368**	0.454	0.448	0.442	0.436	0.431	0.422	0.413	0.404	0.395	0.386	0.377	0.360	0.352
11.5	**0.319**	0.405	0.397	0.390	0.383	0.376	0.367	0.359	0.350	0.342	0.334	0.327	0.312	0.305
12.0	**0.278**	0.357	0.349	0.342	0.335	0.328	0.320	0.313	0.305	0.298	0.291	0.285	0.272	0.266
12.5	**0.244**	0.313	0.306	0.300	0.293	0.286	0.280	0.274	0.267	0.261	0.255	0.249	0.239	0.234
13.0	**0.215**	0.276	0.270	0.264	0.258	0.252	0.246	0.241	0.235	0.230	0.225	0.220	0.211	0.206
13.5	**0.191**	0.244	0.239	0.234	0.229	0.223	0.219	0.214	0.209	0.204	0.200	0.195	0.187	0.183
14.0	**0.171**	0.218	0.213	0.208	0.204	0.199	0.195	0.191	0.186	0.182	0.178	0.174	0.167	0.164
14.5	**0.153**	0.195	0.191	0.187	0.183	0.178	0.175	0.171	0.167	0.163	0.160	0.156	0.150	0.147
15.0	**0.138**	0.175	0.171	0.168	0.164	0.160	0.157	0.153	0.150	0.147	0.144	0.141	0.135	0.133
15.5	**0.124**	0.158	0.154	0.151	0.148	0.144	0.141	0.138	0.135	0.132	0.130	0.127	0.122	0.120
16.0	**0.113**	0.143	0.140	0.137	0.134	0.130	0.128	0.125	0.122	0.120	0.117	0.115	0.111	0.109
16.5	**0.102**	0.129	0.127	0.124	0.121	0.118	0.116	0.114	0.111	0.109	0.107	0.105	0.101	0.099
17.0	**0.093**	0.118	0.115	0.113	0.110	0.108	0.106	0.103	0.101	0.099	0.097	0.095	0.092	0.090
17.5	**0.086**	0.108	0.106	0.104	0.101	0.099	0.097	0.095	0.093	0.091	0.089	0.088	0.084	0.083
18.0	**0.079**	0.099	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.077	0.076
18.5	**0.073**	0.091	0.089	0.087	0.085	0.084	0.082	0.080	0.079	0.077	0.075	0.074	0.071	0.070
19.0	**0.067**	0.084	0.082	0.080	0.078	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.066	0.064
19.5	**0.062**	0.078	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.065	0.064	0.063	0.061	0.060
20.0	**0.057**	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.058	0.056	0.055

7.6 Sound Curves, Sound Optimized Mode SO3

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO3 (Blades with serrated trailing edge)**
3	93.5
4	93.7
5	94.3
6	97.3
7	100.2
8	101.0
9	101.0
10	101.0
11	101.0
12	101.0
13	101.0
14	101.0
15	101.0
16	101.0
17	101.0
18	101.0
19	101.0
20	101.0

7.7 Power Curves, Sound Optimized Mode SO4

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**27**	9	10	12	13	14	16	18	20	21	23	25	29	32
3.5	**144**	91	95	100	105	110	115	120	125	129	134	139	149	153
4.0	**289**	205	212	220	228	235	243	251	258	266	274	281	297	304
4.5	**464**	341	352	363	375	386	397	408	419	430	441	452	475	486
5.0	**669**	502	517	532	547	563	578	593	608	624	639	654	685	700
5.5	**919**	693	714	734	755	775	796	816	837	857	878	898	940	960
6.0	**1220**	926	953	979	1006	1033	1060	1087	1114	1140	1167	1194	1247	1274
6.5	**1575**	1201	1235	1269	1303	1337	1371	1405	1439	1473	1507	1541	1608	1642
7.0	**1986**	1522	1564	1606	1649	1691	1733	1776	1818	1860	1902	1944	2028	2070
7.5	**2437**	1874	1925	1977	2028	2079	2131	2182	2233	2284	2335	2386	2488	2539
8.0	**2909**	2243	2304	2365	2426	2486	2547	2607	2668	2728	2789	2849	2970	3030
8.5	**3367**	2602	2672	2742	2811	2881	2951	3020	3090	3160	3229	3298	3435	3504
9.0	**3783**	2932	3011	3089	3167	3246	3323	3401	3478	3556	3632	3708	3854	3924
9.5	**4086**	3219	3304	3390	3475	3560	3641	3722	3803	3884	3951	4019	4138	4190
10.0	**4294**	3496	3586	3675	3764	3854	3927	4001	4074	4147	4196	4245	4327	4359
10.5	**4434**	3770	3855	3941	4027	4113	4171	4228	4286	4344	4374	4404	4451	4469
11.0	**4519**	3996	4072	4148	4224	4299	4342	4384	4427	4469	4486	4502	4527	4536
11.5	**4548**	4117	4185	4254	4322	4390	4421	4453	4484	4515	4526	4537	4554	4559
12.0	**4556**	4182	4244	4306	4368	4430	4455	4480	4505	4530	4539	4548	4560	4564
12.5	**4559**	4228	4285	4341	4398	4454	4475	4496	4517	4538	4545	4552	4563	4566
13.0	**4562**	4274	4324	4375	4425	4476	4492	4509	4526	4543	4549	4555	4565	4568
13.5	**4566**	4308	4352	4396	4440	4484	4501	4517	4534	4550	4555	4560	4568	4570
14.0	**4566**	4347	4385	4423	4461	4500	4513	4526	4540	4553	4558	4562	4568	4570
14.5	**4561**	4372	4405	4438	4471	4504	4516	4528	4539	4551	4554	4558	4563	4564
15.0	**4547**	4374	4404	4434	4464	4494	4504	4515	4526	4536	4540	4544	4549	4550
15.5	**4526**	4368	4396	4423	4450	4477	4487	4497	4506	4516	4519	4523	4527	4529
16.0	**4502**	4360	4384	4409	4433	4458	4466	4475	4484	4492	4496	4498	4503	4504
16.5	**4475**	4352	4373	4394	4415	4436	4444	4452	4460	4467	4470	4473	4476	4478
17.0	**4449**	4347	4364	4382	4399	4417	4423	4430	4436	4442	4445	4447	4450	4452
17.5	**4424**	4322	4340	4358	4377	4395	4400	4406	4412	4418	4420	4422	4425	4426
18.0	**4397**	4319	4333	4347	4361	4375	4379	4384	4388	4392	4394	4396	4398	4399
18.5	**4371**	4314	4324	4334	4344	4354	4358	4361	4364	4367	4368	4370	4371	4372
19.0	**4348**	4303	4310	4318	4326	4333	4336	4339	4341	4344	4345	4346	4348	4349
19.5	**4329**	4298	4304	4309	4314	4320	4321	4323	4325	4327	4328	4328	4330	4330
20.0	**4316**	4296	4299	4303	4307	4310	4312	4313	4314	4315	4316	4316	4317	4317

7.8 Ct Values, Sound Optimized Mode SO4

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.914**	0.912	0.913	0.913	0.914	0.915	0.915	0.915	0.915	0.915	0.915	0.914	0.913	0.913
3.5	**0.888**	0.894	0.893	0.893	0.893	0.892	0.892	0.891	0.891	0.891	0.890	0.889	0.888	0.887
4.0	**0.851**	0.857	0.856	0.856	0.855	0.854	0.854	0.853	0.853	0.852	0.852	0.852	0.851	0.850
4.5	**0.822**	0.823	0.823	0.823	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822
5.0	**0.801**	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801
5.5	**0.798**	0.797	0.797	0.797	0.798	0.798	0.798	0.798	0.798	0.798	0.798	0.798	0.798	0.798
6.0	**0.803**	0.804	0.804	0.804	0.804	0.804	0.804	0.804	0.804	0.804	0.803	0.803	0.803	0.803
6.5	**0.802**	0.803	0.803	0.803	0.803	0.803	0.803	0.803	0.803	0.802	0.802	0.802	0.802	0.802
7.0	**0.798**	0.800	0.800	0.800	0.800	0.800	0.800	0.799	0.799	0.799	0.799	0.799	0.798	0.798
7.5	**0.784**	0.786	0.786	0.786	0.786	0.786	0.785	0.785	0.785	0.785	0.785	0.784	0.784	0.784
8.0	**0.749**	0.751	0.751	0.751	0.751	0.750	0.750	0.750	0.750	0.749	0.749	0.749	0.748	0.748
8.5	**0.692**	0.694	0.694	0.694	0.694	0.693	0.693	0.693	0.693	0.692	0.692	0.692	0.691	0.691
9.0	**0.630**	0.633	0.633	0.633	0.633	0.632	0.632	0.632	0.632	0.631	0.631	0.630	0.628	0.626
9.5	**0.549**	0.563	0.563	0.563	0.563	0.563	0.562	0.561	0.560	0.559	0.555	0.552	0.543	0.537
10.0	**0.472**	0.504	0.504	0.503	0.503	0.502	0.499	0.496	0.493	0.490	0.484	0.478	0.464	0.456
10.5	**0.405**	0.456	0.454	0.452	0.450	0.448	0.443	0.438	0.433	0.428	0.420	0.413	0.397	0.389
11.0	**0.349**	0.410	0.407	0.403	0.400	0.396	0.390	0.384	0.378	0.371	0.364	0.356	0.341	0.334
11.5	**0.301**	0.361	0.357	0.353	0.349	0.346	0.339	0.333	0.327	0.321	0.314	0.308	0.295	0.288
12.0	**0.262**	0.316	0.312	0.309	0.305	0.301	0.296	0.290	0.284	0.279	0.273	0.267	0.256	0.251
12.5	**0.229**	0.278	0.275	0.271	0.268	0.264	0.259	0.254	0.249	0.244	0.239	0.234	0.225	0.220
13.0	**0.202**	0.247	0.244	0.240	0.237	0.233	0.229	0.224	0.220	0.215	0.211	0.207	0.198	0.194
13.5	**0.180**	0.221	0.218	0.214	0.211	0.207	0.203	0.200	0.196	0.192	0.188	0.184	0.177	0.173
14.0	**0.161**	0.199	0.195	0.192	0.189	0.186	0.182	0.178	0.175	0.171	0.168	0.164	0.158	0.155
14.5	**0.145**	0.179	0.176	0.173	0.170	0.167	0.164	0.160	0.157	0.154	0.151	0.148	0.142	0.139
15.0	**0.130**	0.161	0.159	0.156	0.153	0.150	0.147	0.144	0.141	0.138	0.136	0.133	0.128	0.125
15.5	**0.118**	0.146	0.143	0.141	0.138	0.135	0.133	0.130	0.127	0.125	0.122	0.120	0.115	0.113
16.0	**0.106**	0.132	0.130	0.127	0.125	0.122	0.120	0.118	0.115	0.113	0.111	0.109	0.104	0.102
16.5	**0.097**	0.120	0.118	0.116	0.114	0.111	0.109	0.107	0.105	0.103	0.101	0.099	0.095	0.093
17.0	**0.088**	0.110	0.108	0.106	0.104	0.102	0.100	0.098	0.096	0.094	0.092	0.090	0.087	0.085
17.5	**0.081**	0.101	0.099	0.097	0.095	0.093	0.092	0.090	0.088	0.086	0.084	0.083	0.080	0.078
18.0	**0.075**	0.093	0.091	0.089	0.088	0.086	0.084	0.082	0.081	0.079	0.077	0.076	0.073	0.072
18.5	**0.069**	0.086	0.084	0.082	0.081	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.067	0.066
19.0	**0.063**	0.079	0.077	0.076	0.074	0.072	0.071	0.070	0.068	0.067	0.065	0.064	0.062	0.061
19.5	**0.058**	0.073	0.072	0.070	0.069	0.067	0.066	0.064	0.063	0.062	0.061	0.060	0.057	0.056
20.0	**0.054**	0.068	0.067	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056	0.055	0.053	0.052

7.9 Sound Curves, Sound Optimized Mode SO4

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO4 (Blades with serrated trailing edge)**
3	93.5
4	93.7
5	94.3
6	97.3
7	99.7
8	100.0
9	100.0
10	100.0
11	100.0
12	100.0
13	100.0
14	100.0
15	100.0
16	100.0
17	100.0
18	100.0
19	100.0
20	100.0

7.10 Power Curves, Sound Optimized Mode SO5

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**27**	9	10	12	13	14	16	18	20	21	23	25	29	32
3.5	**144**	91	95	100	105	110	115	120	125	129	134	139	149	153
4.0	**289**	205	212	220	228	235	243	251	258	266	274	281	297	304
4.5	**464**	341	352	363	375	386	397	408	419	430	441	452	475	486
5.0	**669**	502	517	532	547	563	578	593	608	624	639	654	685	700
5.5	**919**	693	714	734	755	775	796	816	837	857	878	899	940	960
6.0	**1220**	926	952	979	1006	1032	1059	1086	1113	1140	1166	1193	1247	1274
6.5	**1570**	1198	1232	1266	1299	1333	1367	1401	1435	1469	1502	1536	1603	1637
7.0	**1968**	1509	1551	1593	1635	1677	1718	1760	1802	1844	1885	1927	2010	2051
7.5	**2386**	1835	1886	1936	1986	2036	2086	2136	2186	2236	2286	2336	2436	2486
8.0	**2788**	2147	2205	2264	2322	2380	2439	2497	2555	2613	2671	2730	2846	2904
8.5	**3160**	2438	2503	2569	2635	2701	2767	2833	2898	2964	3029	3095	3225	3290
9.0	**3480**	2693	2765	2837	2909	2980	3052	3124	3195	3267	3338	3409	3550	3620
9.5	**3719**	2891	2968	3044	3121	3198	3274	3350	3425	3501	3574	3646	3783	3848
10.0	**3888**	3047	3127	3208	3288	3369	3447	3525	3603	3681	3750	3819	3943	3998
10.5	**3984**	3155	3238	3320	3403	3486	3564	3642	3720	3798	3860	3922	4030	4075
11.0	**4029**	3234	3319	3404	3488	3573	3646	3719	3792	3864	3919	3974	4071	4112
11.5	**4069**	3302	3386	3471	3556	3641	3710	3779	3848	3917	3968	4018	4105	4141
12.0	**4106**	3375	3458	3542	3625	3708	3773	3838	3903	3968	4014	4060	4135	4164
12.5	**4138**	3455	3536	3617	3698	3779	3839	3899	3959	4019	4059	4099	4161	4184
13.0	**4162**	3531	3608	3686	3764	3841	3896	3952	4007	4063	4096	4129	4180	4198
13.5	**4171**	3594	3666	3738	3810	3882	3932	3983	4034	4084	4113	4142	4188	4205
14.0	**4185**	3652	3720	3789	3857	3926	3972	4019	4065	4111	4136	4161	4200	4214
14.5	**4199**	3713	3778	3842	3907	3972	4013	4054	4096	4137	4158	4178	4211	4223
15.0	**4209**	3773	3834	3896	3957	4018	4053	4088	4124	4159	4176	4192	4218	4228
15.5	**4219**	3839	3895	3951	4007	4063	4092	4121	4150	4180	4193	4206	4227	4234
16.0	**4228**	3909	3958	4007	4056	4105	4128	4152	4175	4198	4208	4218	4234	4240
16.5	**4237**	3978	4019	4060	4102	4143	4161	4178	4196	4213	4221	4229	4241	4246
17.0	**4244**	4041	4074	4107	4140	4174	4187	4200	4213	4226	4232	4238	4246	4249
17.5	**4246**	4074	4102	4130	4157	4185	4197	4209	4221	4233	4237	4242	4249	4251
18.0	**4251**	4122	4144	4166	4188	4209	4218	4226	4234	4242	4245	4248	4252	4253
18.5	**4253**	4164	4179	4195	4211	4226	4232	4237	4242	4248	4250	4251	4254	4254
19.0	**4253**	4189	4200	4211	4222	4234	4237	4241	4245	4248	4250	4251	4253	4254
19.5	**4254**	4212	4220	4227	4234	4242	4244	4247	4249	4252	4253	4253	4254	4255
20.0	**4255**	4228	4232	4237	4242	4247	4249	4250	4252	4254	4254	4255	4255	4255

7.11 Ct Values, Sound Optimized Mode SO5

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.914**	0.912	0.913	0.913	0.914	0.915	0.915	0.915	0.915	0.915	0.915	0.914	0.913	0.913
3.5	**0.888**	0.894	0.893	0.893	0.893	0.892	0.892	0.891	0.891	0.891	0.890	0.889	0.888	0.887
4.0	**0.851**	0.857	0.856	0.856	0.855	0.854	0.854	0.853	0.853	0.852	0.852	0.852	0.851	0.850
4.5	**0.822**	0.823	0.823	0.823	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822
5.0	**0.801**	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801
5.5	**0.799**	0.798	0.798	0.798	0.799	0.799	0.799	0.799	0.799	0.799	0.799	0.799	0.799	0.799
6.0	**0.803**	0.803	0.803	0.804	0.804	0.804	0.804	0.803	0.803	0.803	0.803	0.803	0.803	0.803
6.5	**0.797**	0.798	0.798	0.798	0.798	0.798	0.798	0.798	0.798	0.797	0.797	0.797	0.797	0.797
7.0	**0.786**	0.788	0.788	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.787	0.786	0.786	0.786
7.5	**0.754**	0.756	0.756	0.756	0.756	0.756	0.756	0.755	0.755	0.755	0.755	0.755	0.754	0.754
8.0	**0.703**	0.705	0.705	0.705	0.704	0.704	0.704	0.704	0.704	0.704	0.703	0.703	0.703	0.703
8.5	**0.633**	0.635	0.635	0.635	0.634	0.634	0.634	0.634	0.634	0.633	0.633	0.633	0.633	0.633
9.0	**0.554**	0.555	0.555	0.555	0.555	0.555	0.554	0.554	0.554	0.554	0.554	0.554	0.553	0.553
9.5	**0.481**	0.484	0.484	0.484	0.483	0.483	0.483	0.483	0.483	0.483	0.482	0.481	0.479	0.477
10.0	**0.416**	0.422	0.422	0.422	0.422	0.422	0.421	0.421	0.420	0.420	0.419	0.417	0.413	0.409
10.5	**0.358**	0.367	0.367	0.367	0.367	0.367	0.366	0.365	0.365	0.364	0.362	0.360	0.354	0.350
11.0	**0.307**	0.320	0.320	0.320	0.320	0.319	0.318	0.317	0.316	0.315	0.312	0.310	0.304	0.301
11.5	**0.267**	0.281	0.281	0.281	0.280	0.280	0.279	0.277	0.276	0.275	0.272	0.270	0.264	0.261
12.0	**0.235**	0.250	0.249	0.249	0.249	0.248	0.247	0.245	0.244	0.242	0.240	0.237	0.232	0.228
12.5	**0.208**	0.224	0.224	0.223	0.222	0.222	0.220	0.219	0.217	0.215	0.213	0.210	0.205	0.202
13.0	**0.185**	0.203	0.202	0.201	0.200	0.199	0.198	0.196	0.194	0.192	0.190	0.187	0.182	0.179
13.5	**0.165**	0.183	0.182	0.181	0.180	0.179	0.177	0.175	0.174	0.172	0.170	0.167	0.162	0.160
14.0	**0.148**	0.166	0.165	0.164	0.163	0.162	0.160	0.158	0.157	0.155	0.153	0.150	0.146	0.143
14.5	**0.133**	0.152	0.151	0.150	0.148	0.147	0.145	0.144	0.142	0.140	0.138	0.136	0.131	0.129
15.0	**0.121**	0.139	0.138	0.137	0.136	0.134	0.133	0.131	0.129	0.127	0.125	0.123	0.119	0.117
15.5	**0.110**	0.128	0.127	0.126	0.124	0.123	0.121	0.119	0.118	0.116	0.114	0.112	0.108	0.106
16.0	**0.100**	0.119	0.117	0.116	0.115	0.113	0.111	0.110	0.108	0.106	0.104	0.102	0.099	0.097
16.5	**0.092**	0.110	0.109	0.107	0.106	0.104	0.102	0.101	0.099	0.097	0.095	0.094	0.090	0.089
17.0	**0.084**	0.103	0.101	0.099	0.098	0.096	0.094	0.093	0.091	0.089	0.088	0.086	0.083	0.081
17.5	**0.078**	0.096	0.094	0.092	0.091	0.089	0.088	0.086	0.084	0.083	0.081	0.080	0.077	0.075
18.0	**0.072**	0.089	0.088	0.086	0.084	0.083	0.081	0.080	0.078	0.076	0.075	0.074	0.071	0.070
18.5	**0.067**	0.083	0.082	0.080	0.078	0.077	0.075	0.074	0.072	0.071	0.069	0.068	0.066	0.064
19.0	**0.062**	0.077	0.076	0.074	0.072	0.071	0.069	0.068	0.067	0.065	0.064	0.063	0.061	0.060
19.5	**0.057**	0.072	0.070	0.069	0.067	0.066	0.065	0.063	0.062	0.061	0.060	0.059	0.056	0.055
20.0	**0.054**	0.067	0.066	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.056	0.055	0.053	0.052

7.12 Sound Curves, Sound Optimized Mode SO5

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO5 (Blades with serrated trailing edge)**
3	93.5
4	93.7
5	94.3
6	97.2
7	99.0
8	99.0
9	99.0
10	99.0
11	99.0
12	99.0
13	99.0
14	99.0
15	99.0
16	99.0
17	99.0
18	99.0
19	99.0
20	99.0

7.13 Power Curves, Sound Optimized Mode SO6

Air density [kg/m³]														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**27**	9	10	12	13	14	16	18	20	21	23	25	29	32
3.5	**144**	91	95	100	105	110	115	120	125	129	134	139	149	153
4.0	**289**	205	212	220	228	235	243	251	258	266	274	281	297	304
4.5	**464**	341	352	363	375	386	397	408	419	430	441	452	475	486
5.0	**669**	502	517	532	547	563	578	593	608	624	639	654	685	700
5.5	**919**	693	714	734	755	775	796	817	837	858	878	899	940	960
6.0	**1219**	925	952	978	1005	1032	1059	1085	1112	1139	1165	1192	1245	1272
6.5	**1559**	1190	1224	1257	1291	1325	1358	1392	1425	1459	1492	1526	1592	1626
7.0	**1928**	1479	1520	1561	1602	1642	1683	1724	1765	1806	1847	1887	1969	2010
7.5	**2278**	1751	1799	1847	1895	1943	1991	2039	2087	2134	2182	2230	2326	2374
8.0	**2603**	2004	2058	2113	2168	2222	2277	2331	2386	2440	2495	2549	2658	2712
8.5	**2881**	2225	2285	2345	2404	2464	2524	2583	2643	2702	2762	2821	2939	2998
9.0	**3097**	2398	2462	2526	2590	2654	2717	2781	2845	2909	2972	3034	3157	3217
9.5	**3237**	2522	2588	2656	2722	2790	2856	2922	2988	3054	3115	3176	3290	3342
10.0	**3324**	2608	2676	2745	2814	2883	2950	3017	3083	3150	3208	3266	3369	3414
10.5	**3379**	2675	2745	2816	2886	2956	3023	3089	3155	3222	3274	3326	3419	3459
11.0	**3412**	2737	2809	2881	2952	3024	3086	3147	3209	3270	3318	3365	3449	3485
11.5	**3454**	2808	2879	2951	3022	3094	3152	3209	3267	3325	3368	3411	3486	3517
12.0	**3492**	2880	2950	3020	3090	3160	3214	3268	3322	3376	3414	3453	3517	3541
12.5	**3519**	2947	3014	3082	3150	3218	3268	3318	3368	3418	3451	3485	3538	3557
13.0	**3538**	3008	3072	3137	3201	3266	3312	3359	3406	3453	3481	3510	3554	3569
13.5	**3546**	3065	3124	3184	3244	3303	3346	3388	3431	3473	3498	3522	3561	3575
14.0	**3561**	3125	3181	3238	3294	3351	3389	3426	3464	3502	3522	3541	3573	3586
14.5	**3575**	3188	3240	3293	3346	3398	3431	3463	3495	3527	3543	3559	3585	3595
15.0	**3588**	3256	3304	3352	3400	3449	3475	3501	3527	3553	3565	3576	3595	3602
15.5	**3599**	3327	3369	3410	3452	3493	3513	3533	3553	3572	3581	3590	3604	3609
16.0	**3607**	3394	3428	3462	3496	3530	3545	3559	3573	3587	3594	3600	3610	3614
16.5	**3613**	3453	3479	3505	3532	3558	3568	3578	3588	3598	3603	3608	3615	3617
17.0	**3617**	3504	3523	3541	3560	3579	3586	3593	3601	3608	3611	3614	3618	3620
17.5	**3619**	3528	3543	3559	3575	3590	3596	3602	3608	3613	3615	3617	3620	3621
18.0	**3621**	3560	3571	3582	3593	3604	3607	3611	3614	3618	3619	3620	3622	3622
18.5	**3622**	3584	3592	3599	3606	3613	3615	3617	3619	3620	3621	3621	3622	3622
19.0	**3622**	3595	3600	3605	3610	3614	3616	3617	3619	3620	3621	3621	3622	3622
19.5	**3622**	3606	3609	3612	3615	3618	3619	3620	3621	3622	3622	3622	3622	3622
20.0	**3622**	3613	3615	3617	3618	3620	3621	3621	3622	3622	3622	3622	3622	3622

7.14 Ct Values, Sound Optimized Mode SO6

Air density kg/m³														
Wind speed [m/s]	**1.225**	**0.950**	**0.975**	**1.000**	**1.025**	**1.050**	**1.075**	**1.100**	**1.125**	**1.150**	**1.175**	**1.200**	**1.250**	**1.275**
3.0	**0.914**	0.912	0.913	0.913	0.914	0.915	0.915	0.915	0.915	0.915	0.915	0.914	0.913	0.913
3.5	**0.888**	0.894	0.893	0.893	0.893	0.892	0.892	0.891	0.891	0.890	0.890	0.889	0.888	0.887
4.0	**0.851**	0.857	0.856	0.856	0.855	0.854	0.854	0.853	0.853	0.852	0.852	0.852	0.851	0.850
4.5	**0.822**	0.823	0.823	0.823	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822	0.822
5.0	**0.801**	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801	0.801
5.5	**0.800**	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800	0.800
6.0	**0.802**	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802	0.802
6.5	**0.789**	0.789	0.789	0.789	0.789	0.789	0.789	0.789	0.789	0.789	0.789	0.789	0.788	0.788
7.0	**0.757**	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.757	0.757	0.757	0.757
7.5	**0.702**	0.704	0.704	0.703	0.703	0.703	0.703	0.703	0.703	0.703	0.703	0.703	0.702	0.702
8.0	**0.627**	0.629	0.629	0.628	0.628	0.628	0.628	0.628	0.627	0.627	0.627	0.627	0.626	0.626
8.5	**0.542**	0.544	0.544	0.544	0.544	0.544	0.543	0.543	0.543	0.543	0.543	0.543	0.542	0.542
9.0	**0.468**	0.469	0.469	0.469	0.469	0.469	0.469	0.468	0.468	0.468	0.468	0.468	0.467	0.466
9.5	**0.402**	0.406	0.406	0.406	0.405	0.405	0.405	0.405	0.405	0.404	0.404	0.403	0.400	0.398
10.0	**0.344**	0.350	0.350	0.350	0.350	0.350	0.349	0.349	0.349	0.348	0.347	0.346	0.342	0.339
10.5	**0.296**	0.304	0.304	0.304	0.304	0.303	0.303	0.302	0.302	0.301	0.300	0.298	0.293	0.290
11.0	**0.256**	0.266	0.266	0.266	0.266	0.266	0.265	0.264	0.263	0.262	0.260	0.258	0.253	0.250
11.5	**0.224**	0.236	0.236	0.236	0.235	0.235	0.234	0.233	0.231	0.230	0.228	0.226	0.222	0.219
12.0	**0.198**	0.212	0.211	0.211	0.210	0.210	0.208	0.207	0.206	0.204	0.202	0.200	0.195	0.193
12.5	**0.176**	0.190	0.190	0.189	0.188	0.188	0.186	0.185	0.183	0.182	0.180	0.178	0.173	0.170
13.0	**0.157**	0.172	0.171	0.170	0.170	0.169	0.167	0.166	0.164	0.163	0.161	0.159	0.154	0.152
13.5	**0.140**	0.156	0.155	0.154	0.153	0.152	0.150	0.149	0.147	0.146	0.144	0.142	0.138	0.135
14.0	**0.126**	0.142	0.141	0.140	0.139	0.138	0.137	0.135	0.133	0.132	0.130	0.128	0.124	0.122
14.5	**0.114**	0.131	0.129	0.128	0.127	0.126	0.124	0.123	0.121	0.120	0.118	0.116	0.112	0.110
15.0	**0.103**	0.120	0.119	0.118	0.117	0.116	0.114	0.112	0.110	0.109	0.107	0.105	0.102	0.100
15.5	**0.094**	0.112	0.110	0.109	0.108	0.106	0.104	0.103	0.101	0.099	0.098	0.096	0.092	0.091
16.0	**0.086**	0.104	0.102	0.101	0.099	0.098	0.096	0.094	0.093	0.091	0.089	0.088	0.084	0.083
16.5	**0.079**	0.096	0.095	0.093	0.092	0.090	0.088	0.087	0.085	0.083	0.082	0.080	0.077	0.076
17.0	**0.072**	0.090	0.088	0.086	0.085	0.083	0.081	0.080	0.078	0.077	0.075	0.074	0.071	0.070
17.5	**0.067**	0.083	0.082	0.080	0.079	0.077	0.076	0.074	0.073	0.071	0.070	0.068	0.066	0.065
18.0	**0.062**	0.078	0.076	0.074	0.073	0.071	0.070	0.068	0.067	0.066	0.064	0.063	0.061	0.060
18.5	**0.057**	0.072	0.071	0.069	0.068	0.066	0.065	0.063	0.062	0.061	0.060	0.059	0.056	0.055
19.0	**0.053**	0.067	0.065	0.064	0.062	0.061	0.060	0.059	0.057	0.056	0.055	0.054	0.052	0.051
19.5	**0.049**	0.062	0.061	0.059	0.058	0.057	0.056	0.055	0.053	0.052	0.051	0.050	0.049	0.048
20.0	**0.046**	0.058	0.057	0.055	0.054	0.053	0.052	0.051	0.050	0.049	0.048	0.047	0.045	0.045

7.15 Sound Curves, Sound Optimized Mode SO6

Sound Power Level at Hub Height	
Conditions for Sound Power Level:	**Measurement standard IEC 61400-11 ed. 3** **Maximum turbulence at hub height: 30%** **Inflow angle (vertical): 0 ±2°** **Air density: 1.225 kg/m^3**
Wind speed at hub height [m/s]	**Sound Power Level at Hub Height [dBA]** **Sound Optimized Mode SO6 (Blades with serrated trailing edge)**
3	93.5
4	93.7
5	94.3
6	97.1
7	98.0
8	98.0
9	98.0
10	98.0
11	98.0
12	98.0
13	98.0
14	98.0
15	98.0
16	98.0
17	98.0
18	98.0
19	98.0
20	98.0