1 FOUNDATION

1.1 Foundation design

The factors affecting the foundation design are:

- Height of the mast
- Quantity of lights / mast (in lattice masts 1-5 pcs)
- Wind load (including jet blast loads caused by the aircraft engines in the proximity of the threshold)
- Soil quality

The following tables describe some typical examples of mast foundations. The calculations have been made for tubular masts carrying single luminaires and lattice masts carrying barrettes of four luminaires. The maximum wind speed used in the calculations is 40 m/s. Dimensioning of the foundations has been done according to DIN V 4017-100.

Two types of foundations have been calculated, slab foundation and drum foundation.

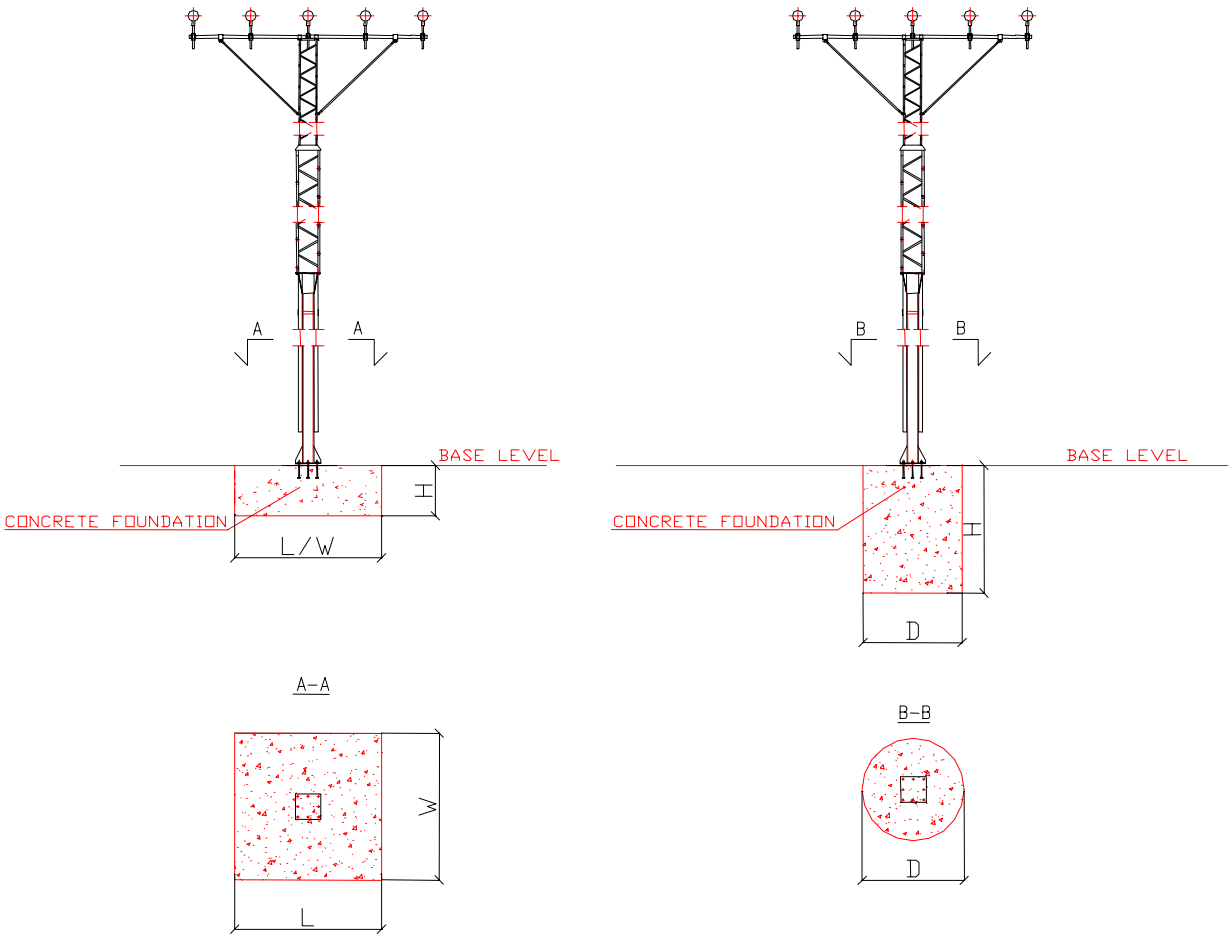

Illustration 1: Slab foundation and drum foundation

Slab foundation		**SOIL TYPE 1**			**SOIL TYPE 2**			**SOIL TYPE 3**		
Mast height	**Type**	**L=W**	**H**	**Mass**	**L=W**	**H**	**Mass**	**L**	**H**	**Mass**
Meters	-	mm	mm	kg	mm	mm	kg	mm	mm	kg
H = 16	Lattice	2300	800	10400	2200	800	9500	2600	900	14900
H = 20	Lattice	2600	900	14900	2500	900	13800	3100	900	21200
H = 25	Lattice	3000	1000	22000	2900	1000	20600	3600	1000	31700

Table 1: Dimensioning of the concrete slab foundation for mast heights from 16 to 25 m.

Drum foundation		**SOIL TYPE 1**			**SOIL TYPE 2**			**SOIL TYPE 3**		
Mast height	**Type**	**D**	**H**	**Mass**	**D**	**H**	**Mass**	**D**	**H**	**Mass**
Meters	-	mm	mm	kg	mm	mm	kg	mm	mm	kg
H = 16	Lattice	1200	2600	7200	1200	2000	5600			
H = 20	Lattice	1200	3100	8600	1200	2400	6700			
H = 25	Lattice	1200	3600	10000	1200	2800	7800			

Table 2: Dimensioning of the concrete drum foundation for mast heights from 16 to 25 m.

Soil type 1: Sand, sandy soil
angle of friction $\delta = 25°$
weight by volume $\gamma = 17\ kN/m^3$
cohesion $c = 0\ kN/m^2$

Soil type 2: Compacted coarse sand and moraine
angle of friction $\delta = 40°$
weight by volume $\gamma = 21\ kN/m^3$
cohesion $c = 0\ kN/m^2$

Soil type 3: Hard clay (drum foundation should not be used!)
angle of friction $\delta = 0°$
weight by volume $\gamma = 19\ kN/m^3$
cohesion $c = 20\ kN/m^2$

Concrete: > K30

- *In a groundwater area the foundation shall be deeper.*
- *In a soil frost area, the foundation shall reach below the soil frost penetration depth.*

- *All design values mentioned in this instruction are purely indicative. Exel Oyj shall not take responsibility for their applicability to the area in question.*
- *It is highly recommended to always consult a local civil engineer about the dimensioning of the foundation.*
- *Exel Oyj will provide the necessary load calculations (shear force and bending moment), when requested.*

- *Positioning of masts has been dimensioned in the layout-drawing.*
- *The heights of the top of foundation have been listed separately for each position in the mast list, if this information has originally been provided to Exel Oyj.*

1.2 Preparation of foundation

1.2.1 Hinged post or permanently fitted post

Part of foundation bolt remaining visible	125 ±5mm
Allowed deviation of the position of the jig/base frame from the approach light centre line.	± 0,5° =8,7mm/1000mm
Allowed deviation of the position of the jig/base frame from the horizontal level.	± 1° =17mm/1000mm

Table 3: Essential information necessary for preparation of foundation.

- *Plywood jigs (option) are available to facilitate concrete casting.*

- *Hot dip galvanised foundation bolts shall in no case be welded to the steel reinforcement of the foundation. Fasten the foundation bolts with wire.*
- *Protect the thread of the foundation bolts during the casting for example with tape.*

- *See: "Preparation of foundation for the erection of the mast".*
- *See: "Installation of wiring".*
- *See Appendix 4: "Assembly drawings".*
- *See Appendix 5: "Foundation lay-out drawings".*

1.2.2 Accessories needed for preparation of foundation

Measure	Instrument	Size
-	Foundation bolt, 8–24pcs	HPM30/L-500 / HPM30/P-1420
Fastening of foundation bolts to the jig	Nut, 16–48 pcs	M 30
-:-	Washers, 16–48 pcs	Ø32
-:-	Wrench	S=46mm
Positioning of foundation bolts	Casting jig 642218 642208 642209A 642210	For 8 bolts For 12 bolts For 20 bolts For 24 bolts
Protection of screw thread	Masking tape	-
Fastening of screws to steel reinforcement	Wire	-
Casting of foundation	Equipment used in casting of concrete including moulds and steel reinforcements.	-
Verification of straightness / angle of the jig	A stiff ruler	L > 1000 mm
-:-	Water level	-

Table 4: Accessories needed for preparation of foundation.

1.2.3 Work instruction for casting of foundation

- Make a cast mould with its steel reinforcements in accordance with the design of a local civil engineer.
- Draw the cable duct (IR 65) under the ground from the transformer housing to the foundation and fasten the cable duct to the steel reinforcement so that its' end comes through the foundation cast at the centre of the foundation.
- Fasten the foundation bolts to the cast jig according to the illustration above.
- Protect the threads in the anchor bolts by using for example tape.
- Place the casting jig with bolts to the correct position. Fasten the bolts to the steel reinforcement with wire if necessary. The foundation bolts shall remain for the length of 125 mm above the concrete surface
- Make sure that the base frame is in straight angle towards the approach light centre line. The allowed deviation of the position of the jig/base frame from the approach light centre line is ± 0,5°, which corresponds to 8,7 mm/1000 mm. Correct if necessary.
- Cast concrete in the foundation mould.
- Make sure that the cast jig is in a horizontal position. Correct the position before the concrete hardens.
- When the concrete is hard, remove the casting jig.

Locate the foundation bolts with a casting jig to fit the bolts exactly at their correct places in the concrete casting (see the illustrations below).

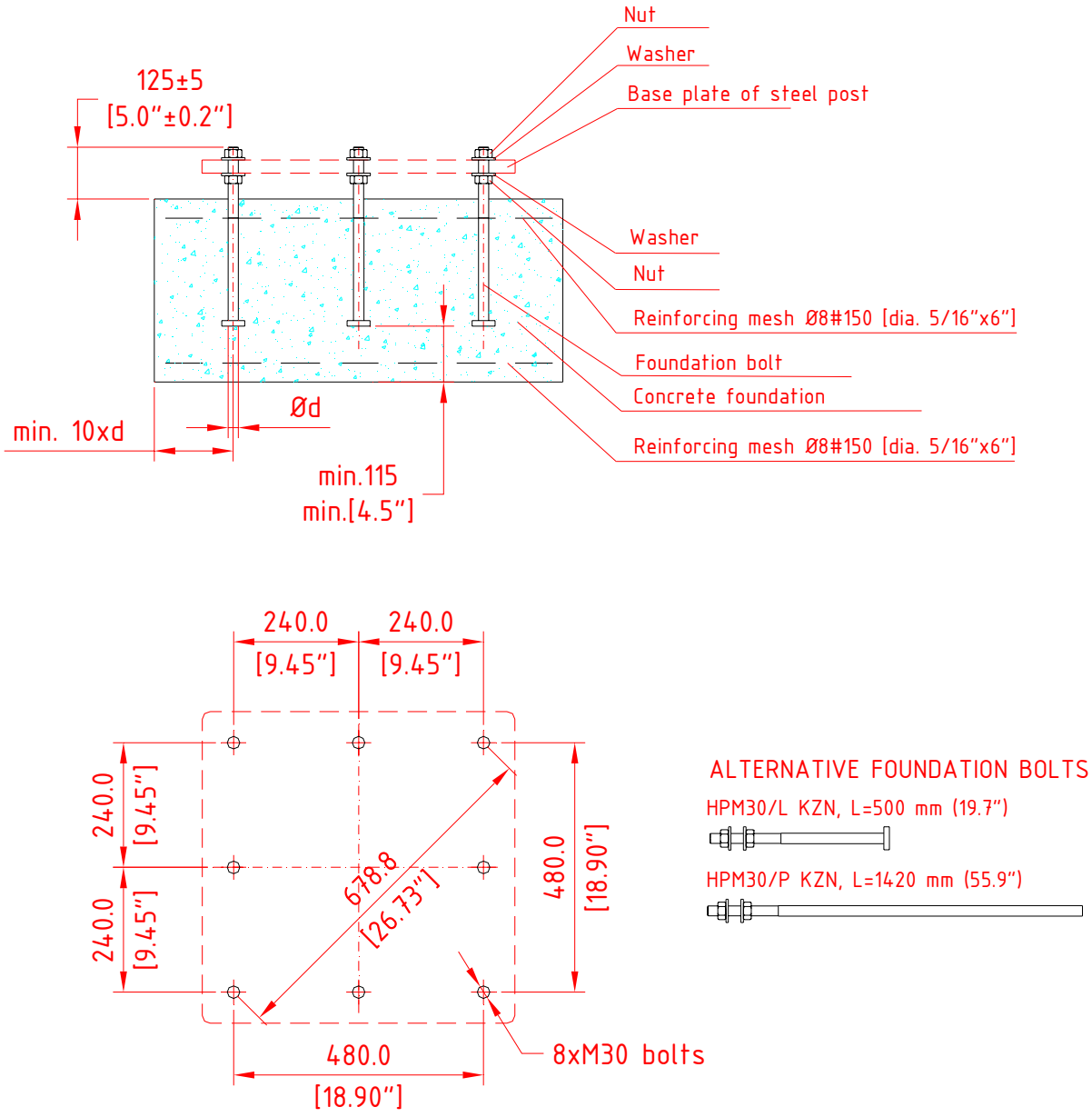

Illustration 1: Principal draft of foundation, casting jig for 8 bolts and foundation bolts of the mast.

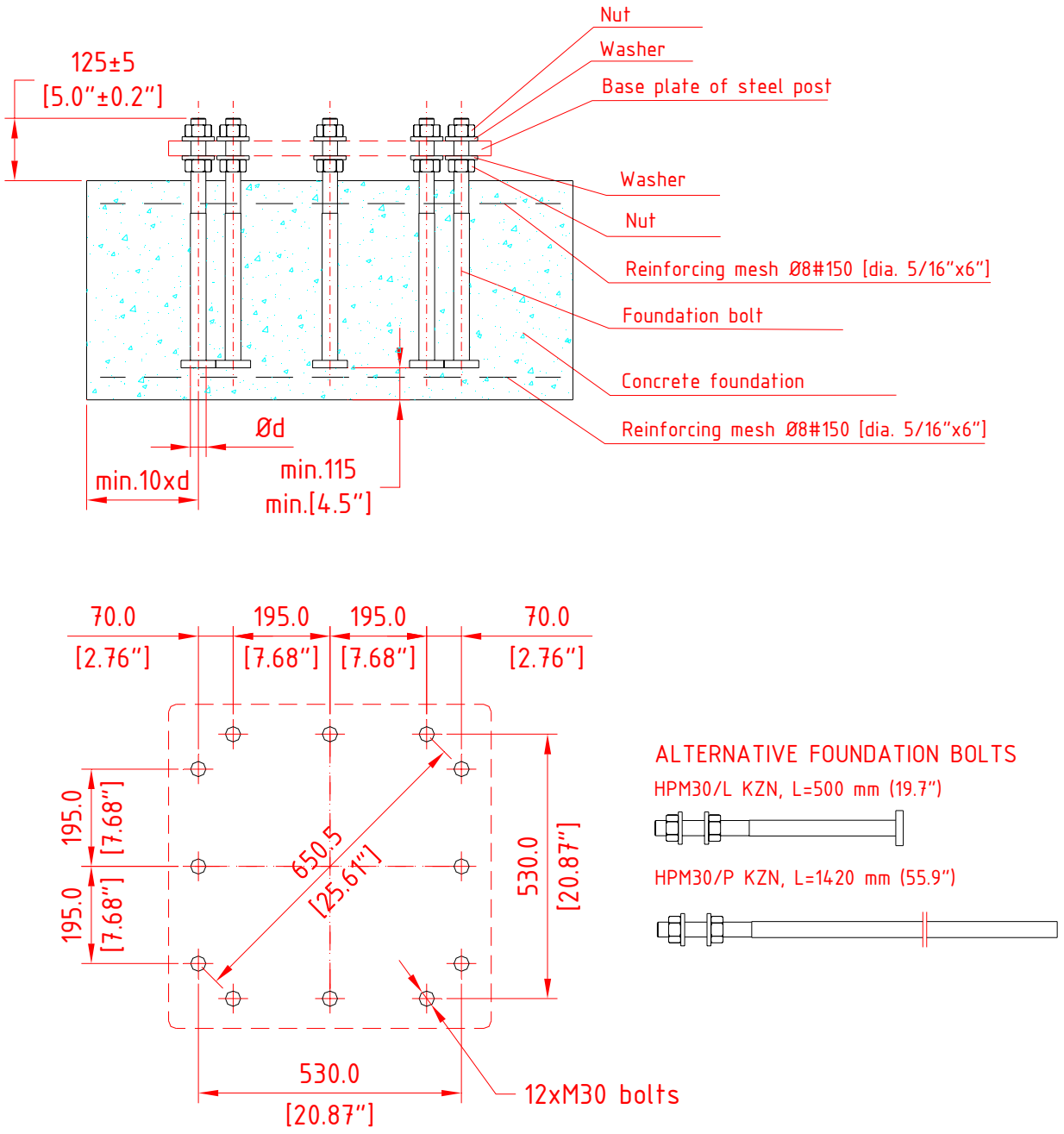

Illustration 2: Principal draft of foundation, casting jig for 12 bolts and foundation bolts of the mast.

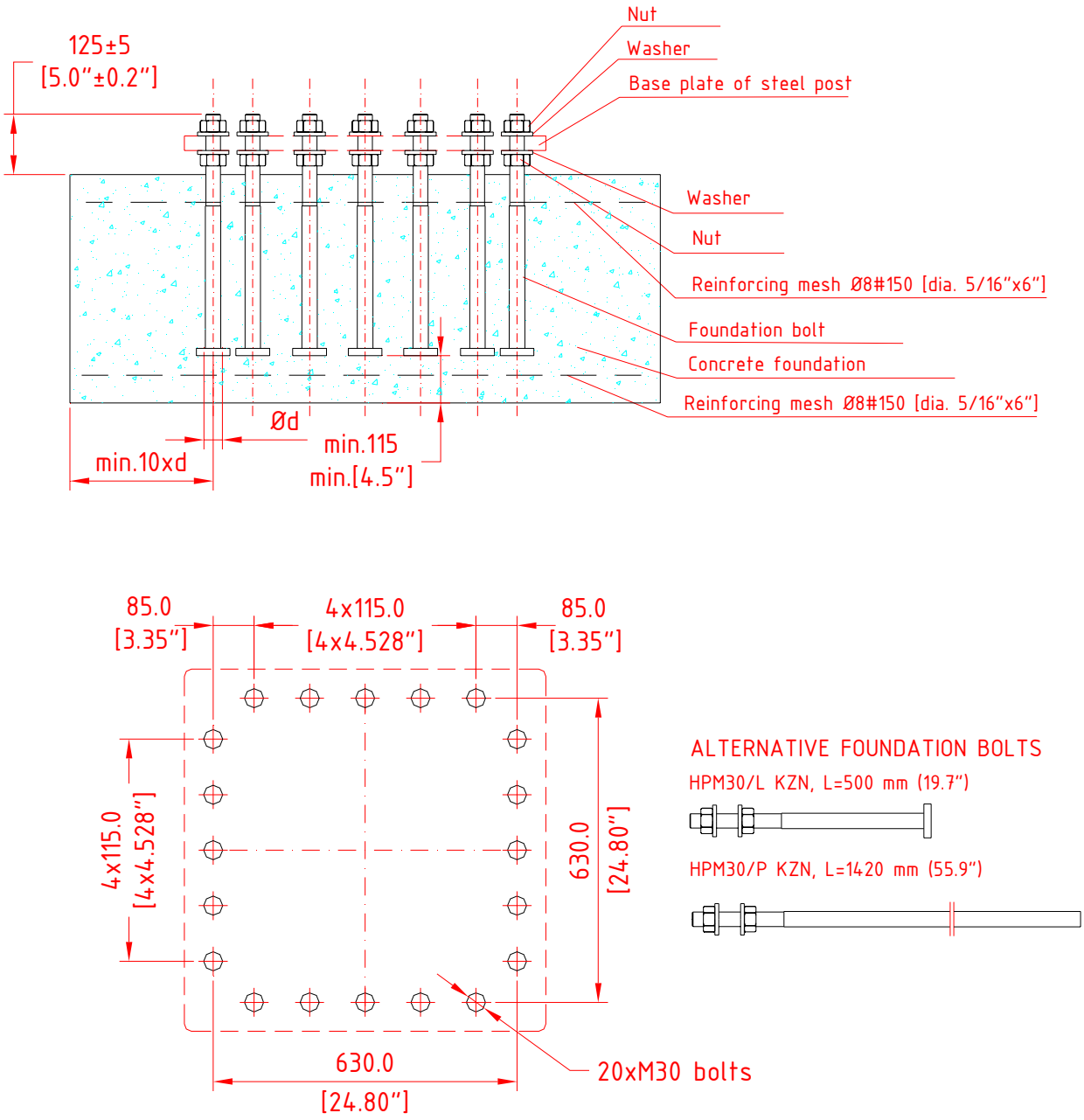

Illustration 3: Principal draft of foundation, casting jig for 20 bolts and foundation bolts of the mast.

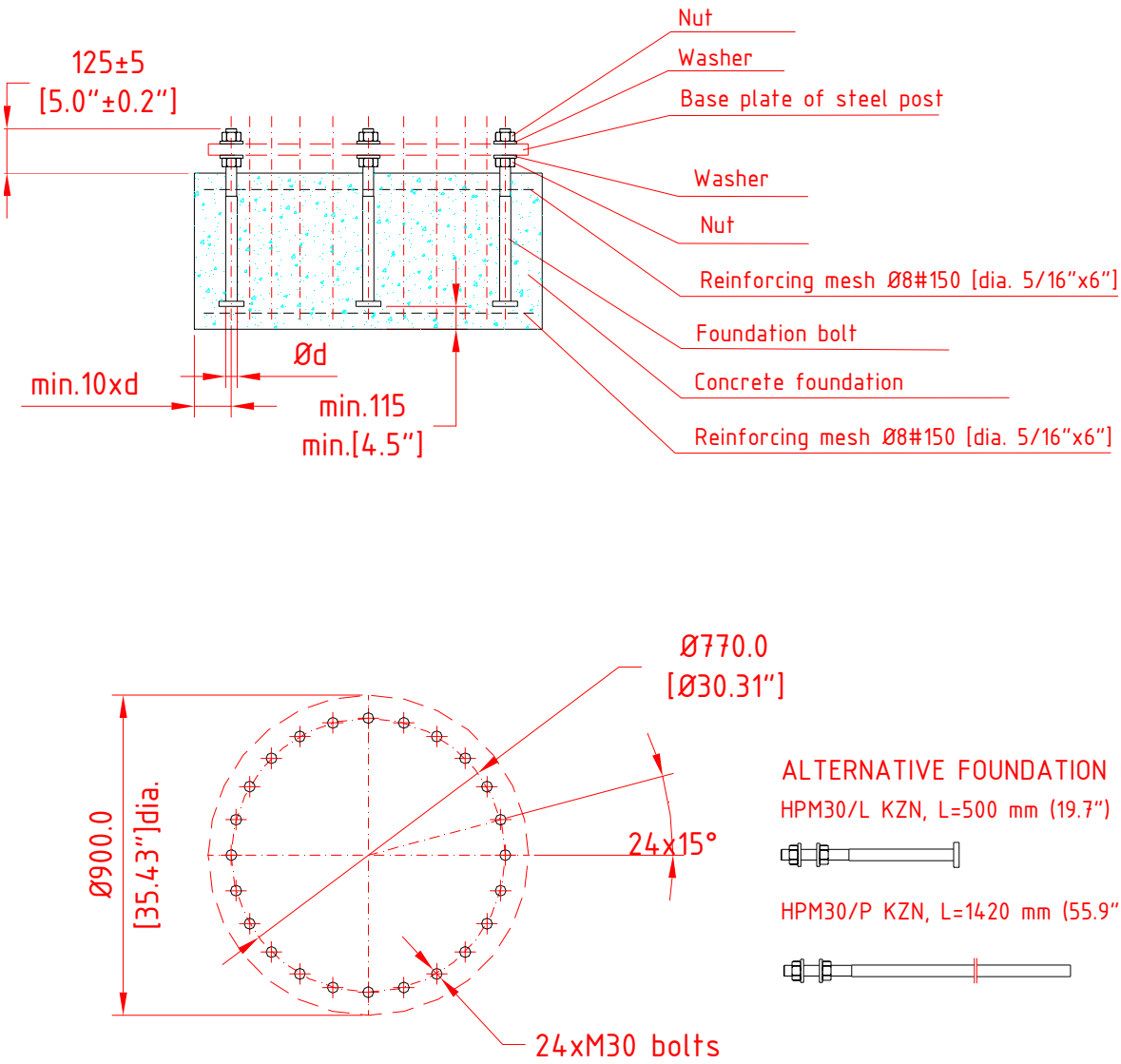

Illustration 4: Principal draft of foundation, casting jig for 24 bolts and foundation bolts of the mast.