

SEAWATER INTAKES FOR DESALINATION PLANTS: DESIGN AND CONSTRUCTION

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1. INTRODUCTION



New and bigger
desalination plants



New and bigger water intakes

Aims of a water intake



- Good water quality
- Low environmental impact
- No entrainment of materials
- Stability
- Little maintenance



2. TYPES OF WATER INTAKES



There are three principal types of water intake:

1. Water intake **at the coast**: Environmental impact and risks due to interaction with coastal dynamics. Low energy consumption.
2. Water intake **at the bottom of the sea**: A structure at the seabed, taking water with specific features.
3. **Wells**: Risk of silting fine particles. High energy consumption. Better water quality.



Main types of water intakes at the bottom of the sea:



Concrete structure



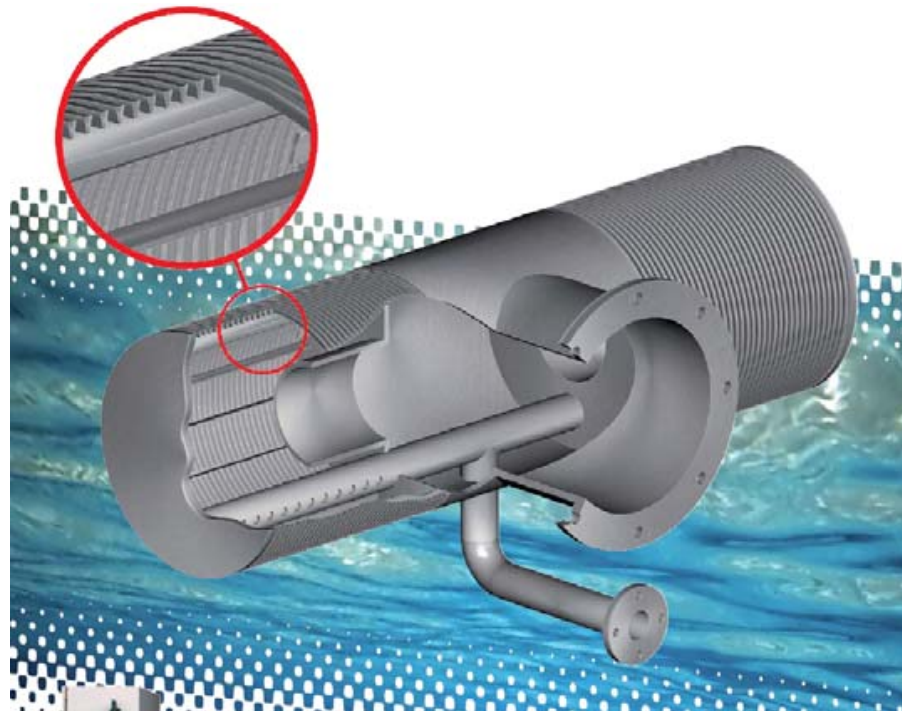
Main types of water intakes at the bottom of the sea:



GRP lantern



Main types of water intakes at the bottom of the sea:



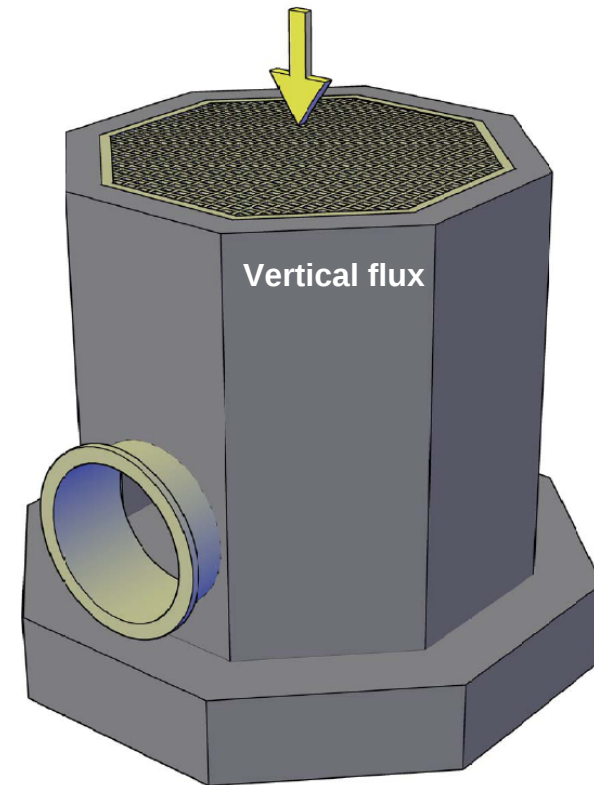
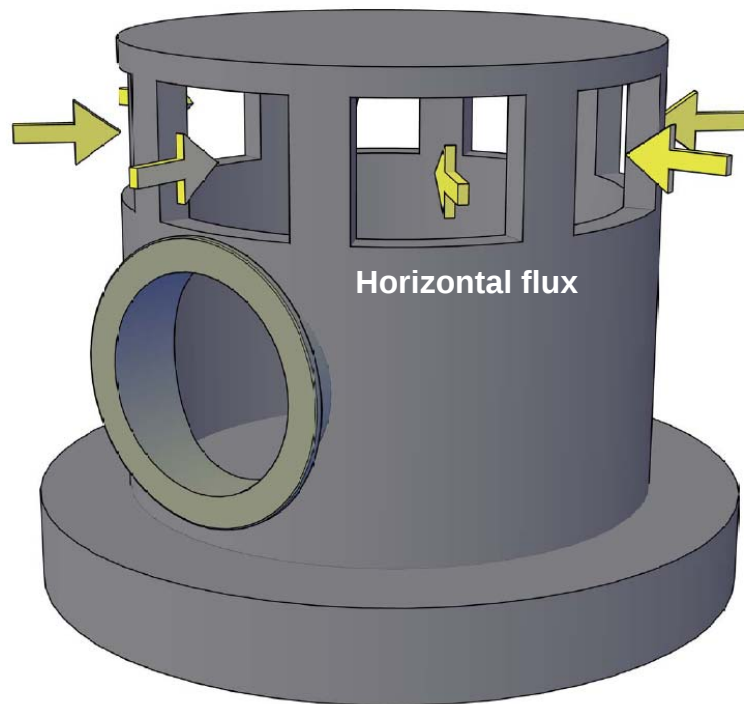
Metallic lantern



3. DESIGN PARAMETERS

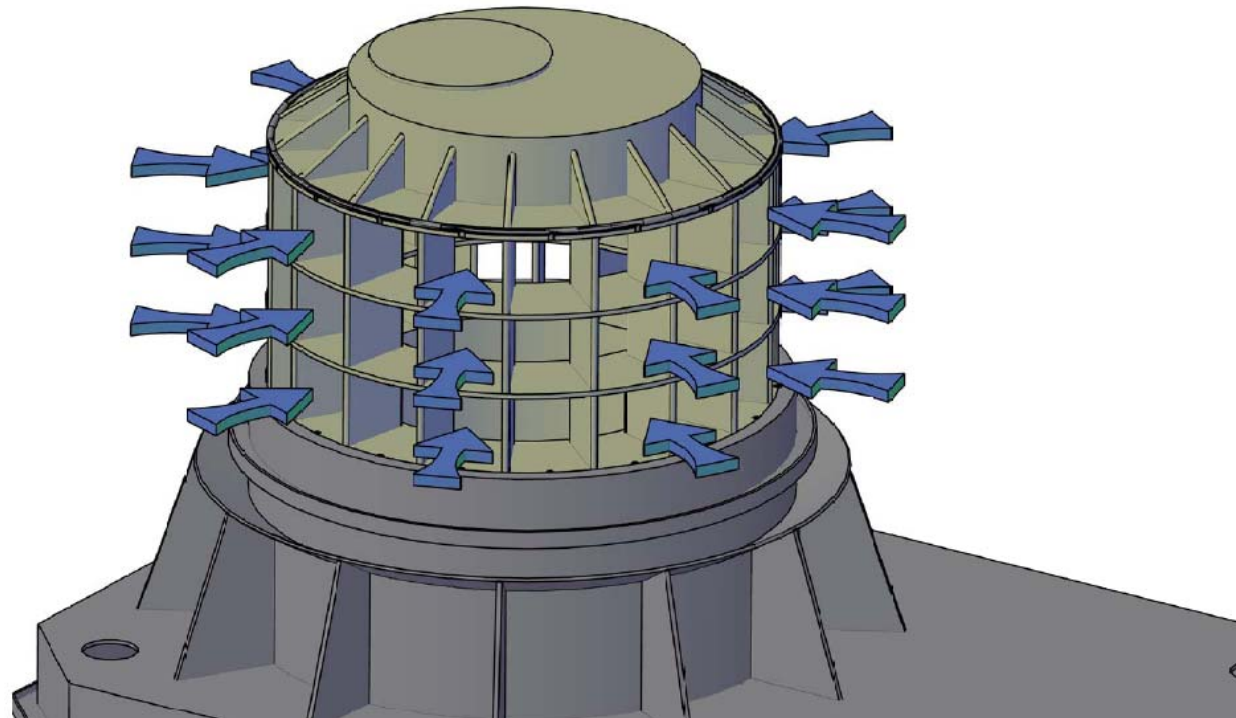


1. Flux direction: horizontal flux better than vertical (downwards) flux. Upwards flow could be even better.



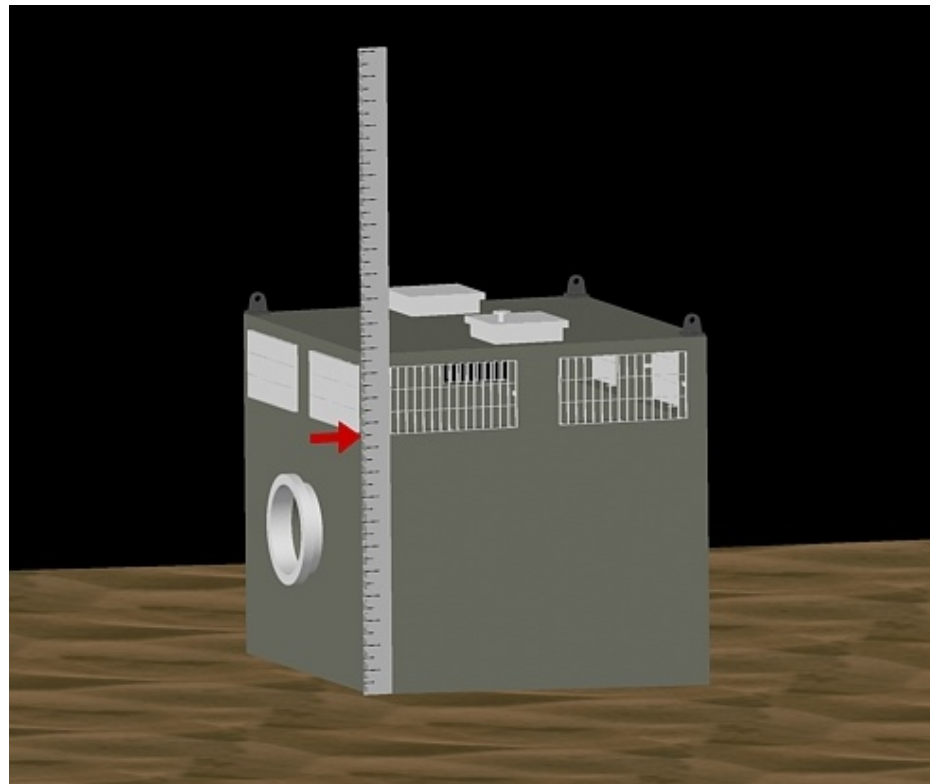


2. Suction velocity: *lower velocity means less organisms and material suction*





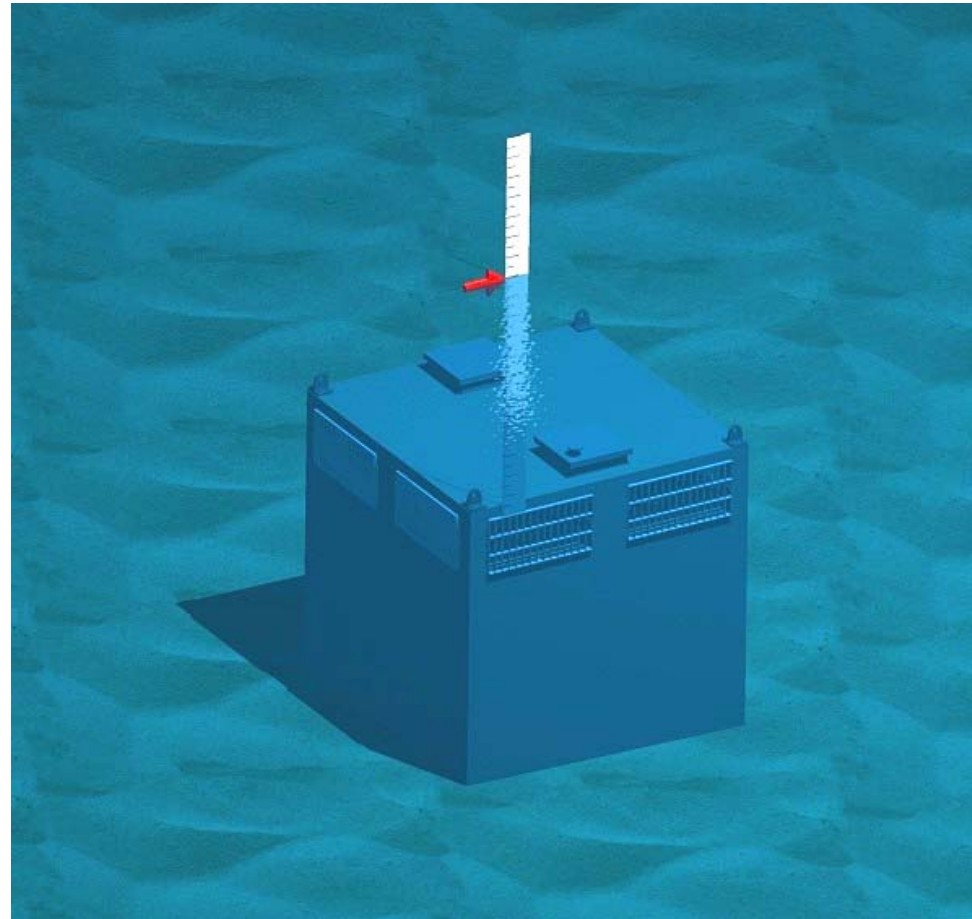
3. Distance seabed - window: higher distance, lower sand suction





4. Window depth: *big depth means:*

- *High quality of water.*
- *Less wave forces.*
- *Less light and, consequently, less organisms growth.*
- *No bother to navigation.*

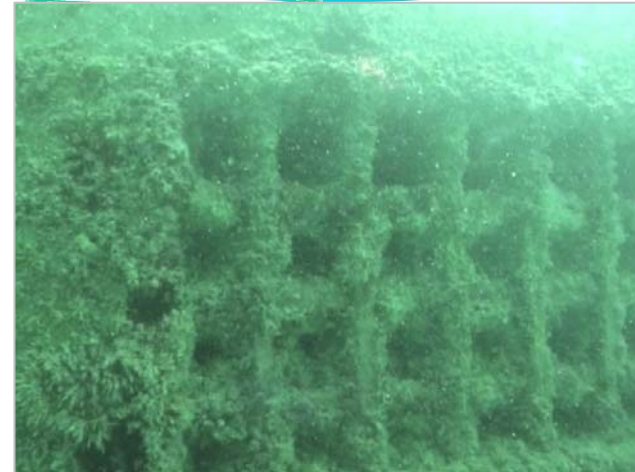




5.- Additives against biofouling

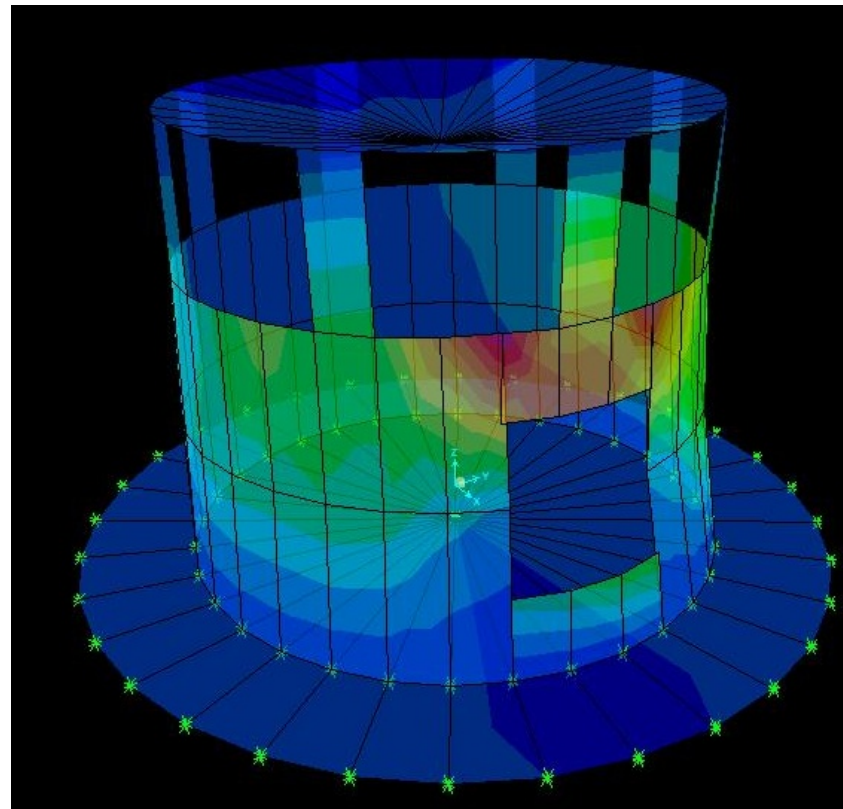
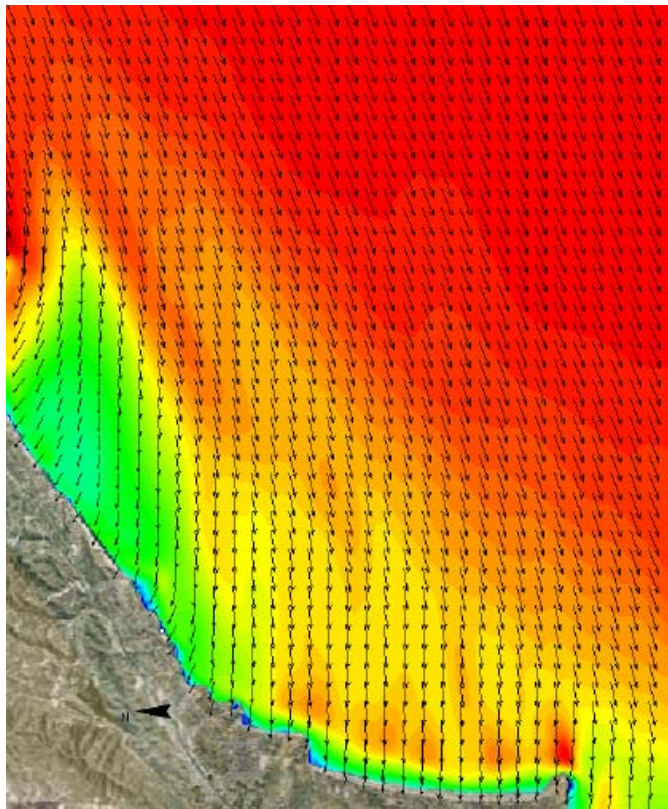


An intake with hipochlorite addition out of work



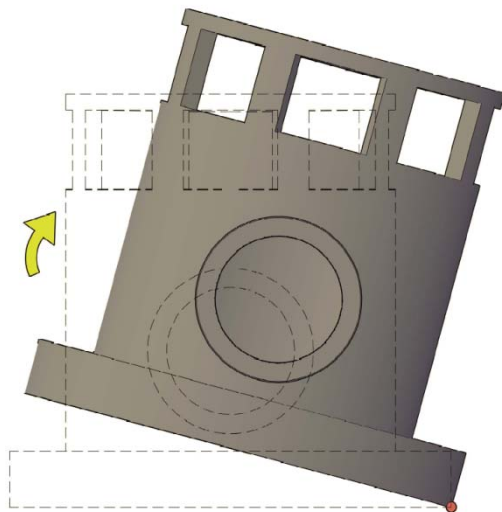


6. Waves at the sea: high waves force against big structures

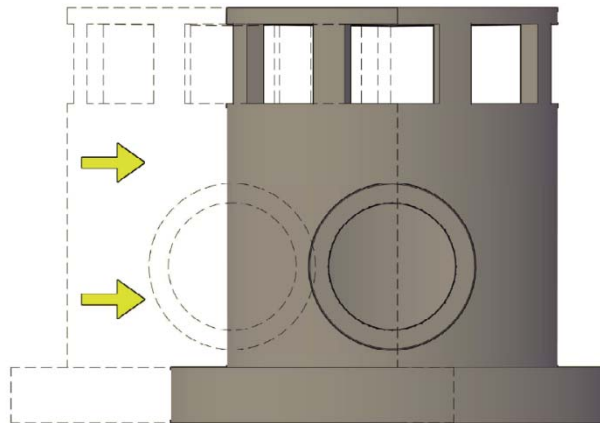




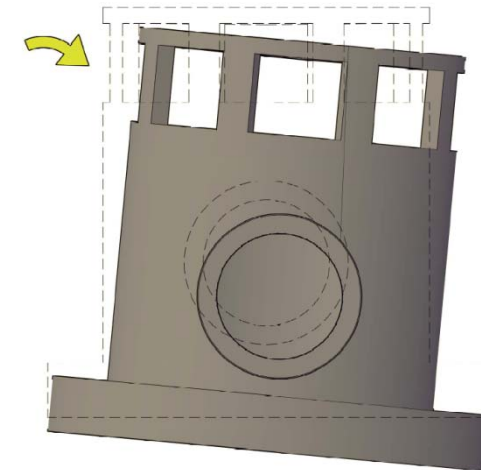
7. Geotechnical stability: *base dimension and weight to avoid overturning, sliding and foundation bearing failure*



OVERTURNING



SLIDING



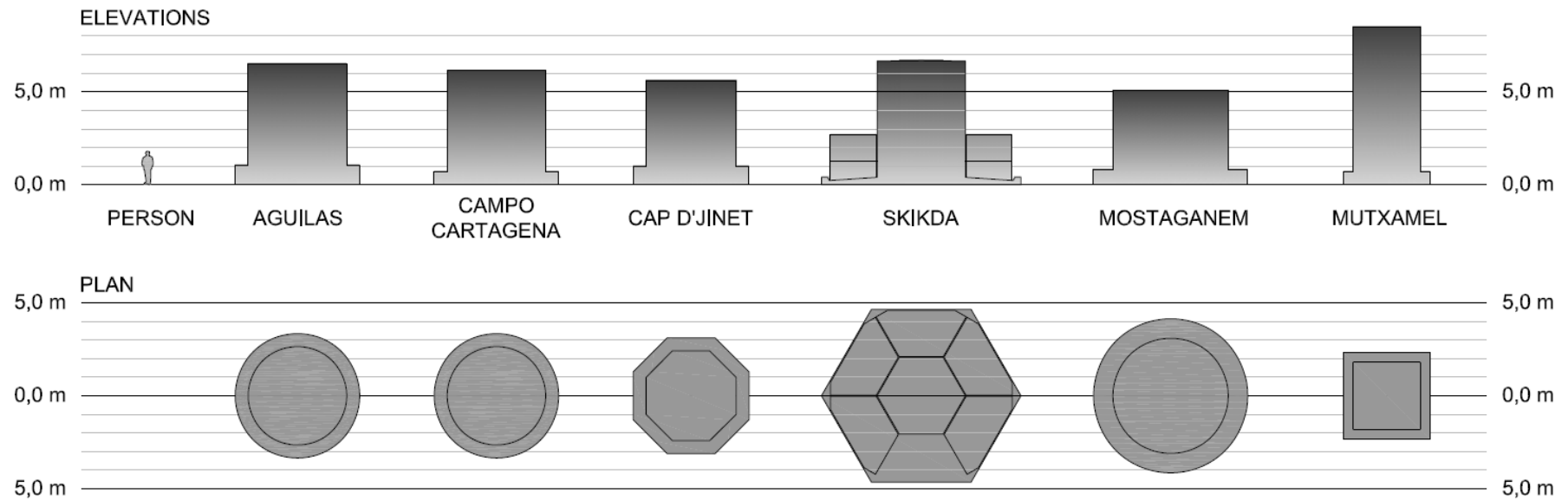
**BEARING CAPACITY
OF THE FOUNDATION**



4. RECENT EXPERIENCES IN WATER INTAKES



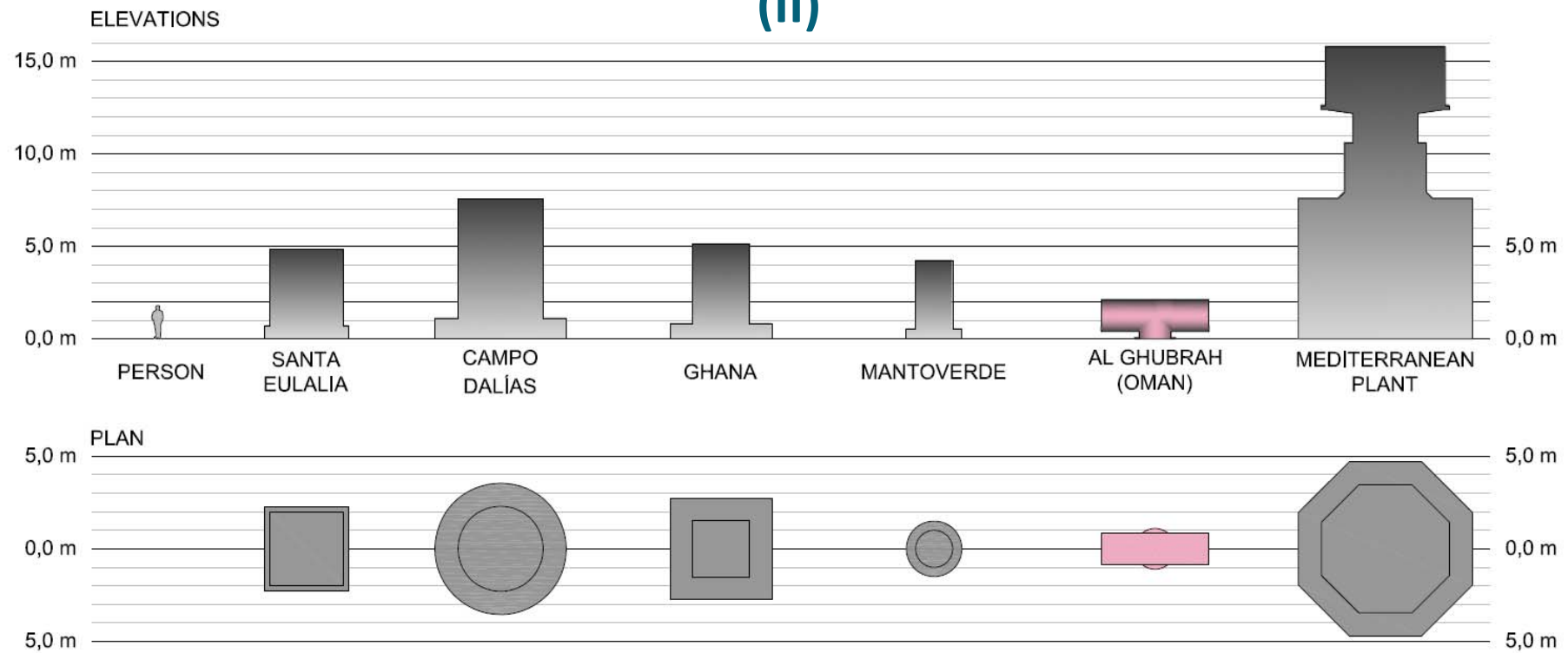
DIMENSIONS COMPARISON OF SOME PROJECTED TOWERS (I)





DIMENSIONS COMPARISON OF SOME PROJECTED TOWERS

(II)





CAMPO DE CARTAGENA



SINKING DEPTH: -26,3 m
SEABED ELEVATION: -25,8 m
LOWER INTAKE ELEVATION: -22,4 m
FLOW RATE: 4,62 m³/s
SUCTION SPEED: 0,20 m/s
TOTAL HEIGHT: 6,15 m
OUTER DIAMETER: 5,30 m
WEIGHT IN AIR OF THE TOWER: 135 t



PLANT OF SIKKDA (ALGERIA)



SINKING DEPTH: -18,5 m
SEABED ELEVATION: -18,0 m
LOWER INTAKE ELEVATION: -13,0 m
FLOW RATE: 2,53 m³/s
SUCTION SPEED: 0,30 m/s
TOTAL HEIGHT: 6,65 m
DIAMETER OF THE CIRCUMSCRIBED
CIRCUMFERENCE: 4,74 m
WEIGHT IN AIR OF THE TOWER: 80 t



PLANT OF SIKDA (ARGELIA)





PLANT OF SIKKDA (ARGELIA)





PLANT OF CAP D'JINET (ALGERIA)





PLANT OF CAP D'JINET (ALGERIA)



SINKING DEPTH: -15,9 m
SEABED ELEVATION: -15,0 m
LOWER INTAKE ELEVATION: -12,3 m
FLOW RATE: 2,64 m³/s
SUCTION SPEED: 0,29 m/s
TOTAL HEIGHT: 5,60 m
DIAMETER OF THE CIRCUMSCRIBED
CIRCUNFERENCE: 5,22 m
WEIGHT IN AIR OF THE TOWER: 140 t



PLANT OF MOSTAGANEM (ALGERIA)



SINKING DEPTH: -16,50 m
SEABED ELEVATION: -16,00 m
LOWER INTAKE ELEVATION: -13,00 m
FLOW RATE: 2,64 m³/s
SUCTION SPEED: 0,19 m/s
TOTAL HEIGHT: 5,10 m
OUTER DIAMETER: 6,20 m
WEIGHT IN AIR OF THE TOWER: 180 t



PLANT OF MOSTAGANEM (ALGERIA)





PLANT OF ÁGUILAS (MURCIA)



SINKING DEPTH: -18,6 m
SEABED ELEVATION: -17,6 m
LOWER INTAKE ELEVATION: -14,1 m
FLOW RATE: 7,14 m³/s
SUCTION SPEED: 0,30 m/s
TOTAL HEIGHT: 6,50 m
OUTSIDE DIAMETER (BODY OF THE TOWER): 5,30 m
WEIGHT IN AIR OF THE TOWER: 160 t

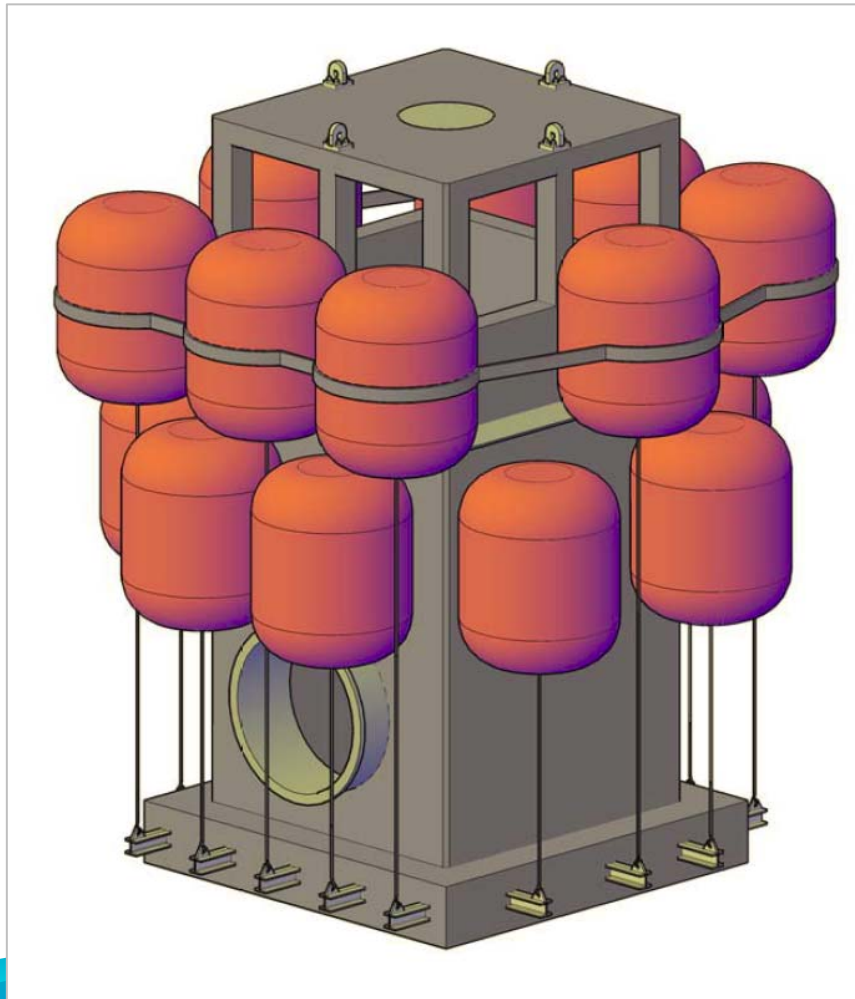


PLANT OF ÁGUILAS (MURCIA)





PLANT OF MUTXAMEL (ALICANTE-SPAIN)



SINKING DEPTH: -12,5 m
SEABED ELEVATION: -8 m
LOWER INTAKE ELEVATION: -5,7 m
FLOW RATE: 1,85 m³/s
SUCTION SPEED: 0,14 m/s
TOTAL HEIGHT: 8,5 m
SIDE LENGTH 3,65 m





PLANT OF SANTA EULALIA (IBIZA- SPAIN)



SINKING DEPTH: -21,7 m
SEABED ELEVATION: -20 m

TOTAL HEIGHT: 4,85 m
SIDE LENGTH 4 m



PLANT OF NUNGUA (GHANA)



SINKING DEPTH: -10.6 m
SEABED ELEVATION: -8.8 m
LOWER INTAKE ELEVATION: -5.7 m

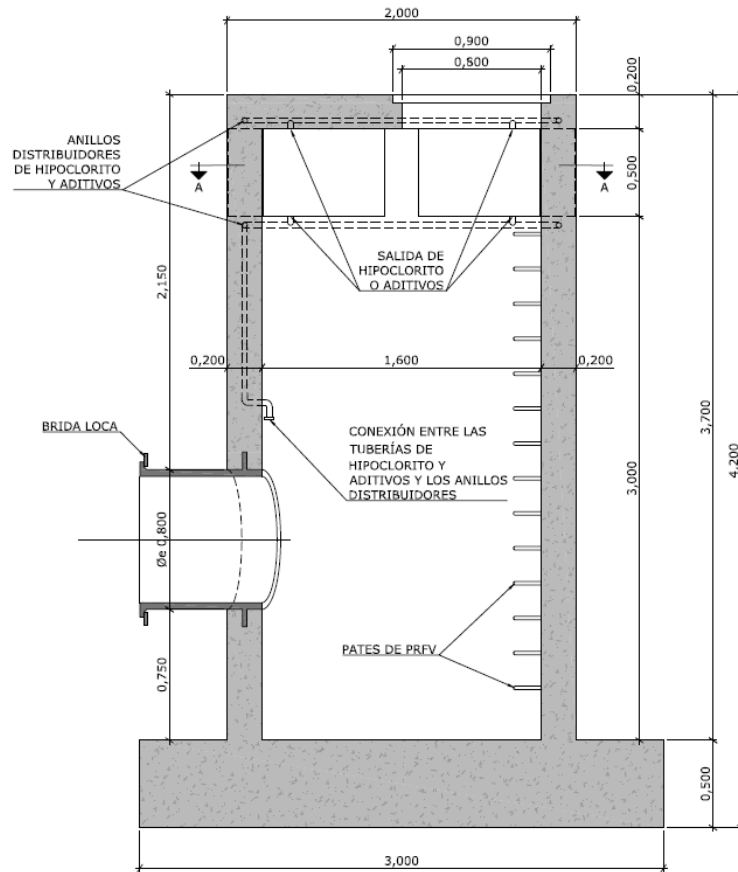
TOTAL HEIGHT: 5.1 m
SIDE LENGTH
(BODY OF THE TOWER): 3.1 m

FLOW RATE: 1.32 m³/s

WEIGHT IN AIR OF THE TOWER: 95 t



PLANT OF MANTOVERDE (CHILE)



SINKING DEPTH: -19 m
SEABED ELEVATION: -18 m

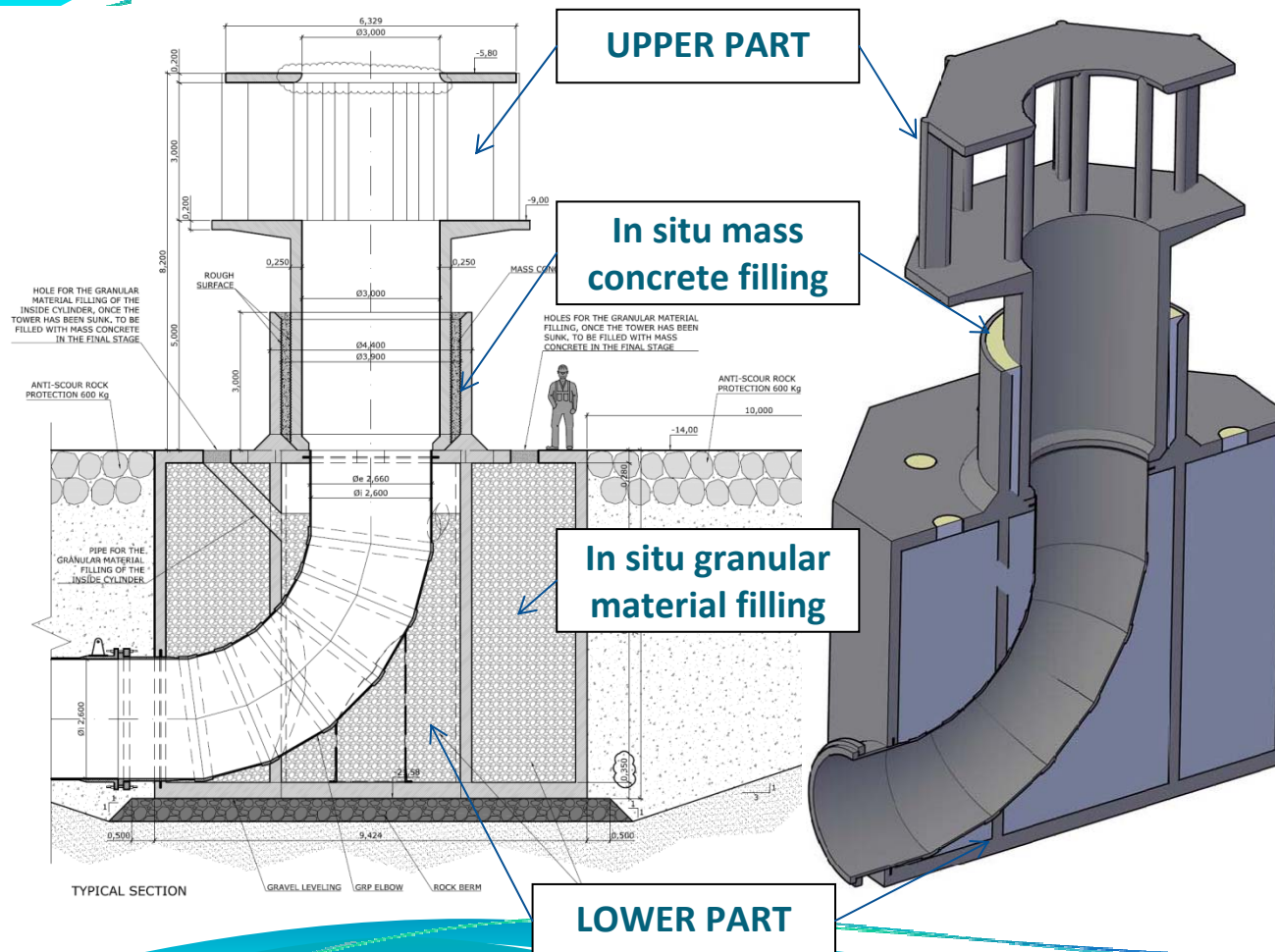
TOTAL HEIGHT: 4.20 m
OUTSIDE DIAMETER (BODY OF THE TOWER): 2.0 m

FLOW RATE: 3.6 m³/s

WEIGHT IN AIR OF THE TOWER: 20 t



PLANT IN THE MEDITERRANEAN SEA (I)



CONSTRUCTION IN TWO PARTS, connected with in situ mass concrete filling.

- **SINKING DEPTH: -21.6 m**
- **SEABED ELEVATION: -14 m**
- **TOTAL HEIGHT: 15.8 m**
- **DIAGONAL OF OCTOGONAL BASE: 10.2 m**
- **FLOW RATE: 10.12 m³/s**
- **MINIMUM DISTANCE REQUIRED FROM THE NATURAL BOTTOM TO THE LOWER PART OF THE INTAKE WINDOWS = 5 m**
- **SUCTION SPEED < 0,15 m/s**
- **TOTAL WEIGHT IN AIR IN SERVICE (concrete + granular filling): 1 320 t**



PLANT IN THE MEDITERRANEAN SEA (II)





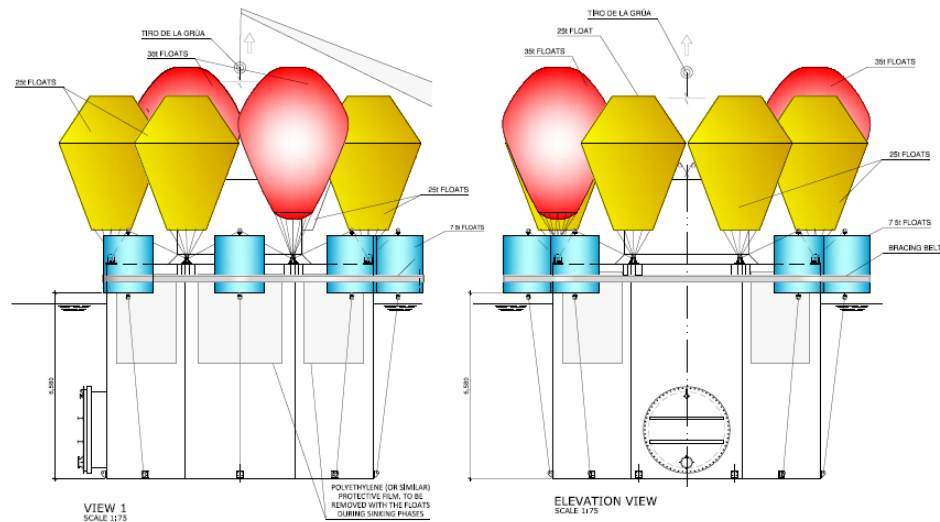
PLANT IN THE MEDITERRANEAN SEA (III): LOWER PART

- TOTAL HEIGHT: 7.6 m
- DIAGONAL OF OCTOGONAL BASE: 10.2 m
- TOTAL WEIGHT IN AIR (only concrete): 340 t

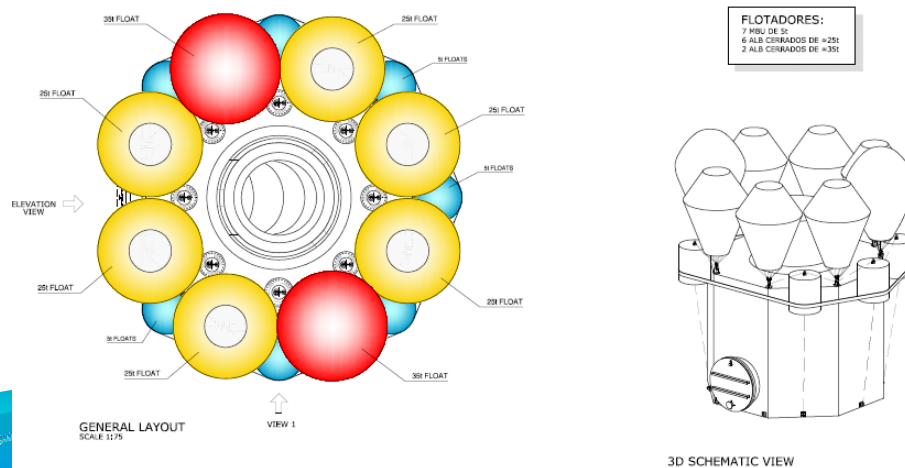




PLANT IN THE MEDITERRANEAN SEA (IV): LOWER PART



- TRANSPORTATION AND SINKING: AUXILIARY FLOATS





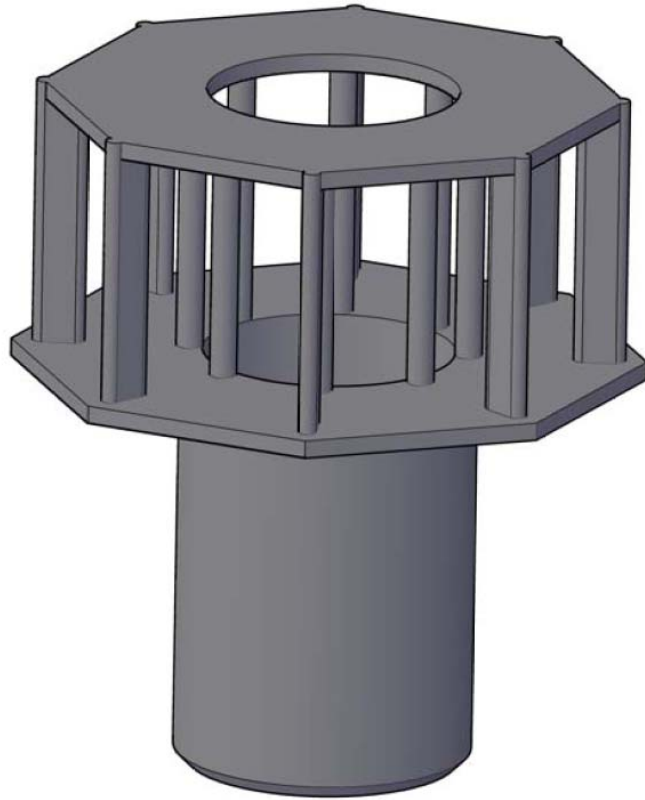
PLANT IN THE MEDITERRANEAN SEA (V): LOWER PART

- TRANSPORT AND SINKING: AUXILIARY FLOATERS





PLANT IN THE MEDITERRANEAN SEA (VI): UPPER PART



- **TOTAL HEIGHT: 8.2 m**
- **DIAGONAL OF OCTOGONAL PART: 7.5 m**
- **HIEGHT OF WINDOWS: 3 m**
- **DIAMETER OF CYLINDER: 3.5 m**
- **TOTAL WEIGHT IN AIR: 76 t**





WHAT DID WE LEARN ABOUT WATER INTAKE STRUCTURES AT THE SEABED?

1. MARINE CLIMATE (WAVES) SHOULD BE CAREFULLY ANALYSED.
2. DESIGNS SHOULD BE ADAPTED TO THE AVAILABLE MEANS.
3. BEST MATERIALS: CONCRETE, GRP AND STAINLESS STEEL.
4. THICK ELEMENTS OF CONCRETE HAVE MANY ADVANTAGES: STRUCTURAL CAPACITY AND LARGER STABILITY.
5. IF USING GRATES, THEY SHOULD BE “EASY TO CLEAN OR DISMANTLE”.
6. SOMETIMES IT COULD BE USEFULL TO MAKE A CFD STUDY TO ASSESS FORCES AGAINST THE STRUCTURE AND THUS OPTIMIZE THE DESIGN.



ADVICES FOR THE PIPE CONNECTING THE INTAKE TO LAND:

1. JOINTS BETWEEN PIPES SHOULD BE CAREFULLY DESIGNED AND CONSTRUCTED.
2. PE IS THE MOST APROPRIATE MATERIAL.
3. AT THE SUFZONE, INSTALL IT INSIDE A TRENCH OR A TUNNEL.
4. INSTALL MANHOLES EVERY 300 M (APROX).



**THANK YOU FOR YOUR
ATTENTION !**

**If you need further
information, do not
hesitate to contact us.**

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