POSEIDONE PROJECT

DEVELOPMENT OF A WAVE ENERGY CONVERTER FOR MEDITERRANEAN OPERATION

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Partners:

Faggiolati Pumps S.p.A.

WavEnergy.it S.r.l.

Dipartimento di Meccanica e Materiali

Università Mediterranea di Reggio Calabria

Centro Ricerche Aerospaziali

Sapienza Università di Roma

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OWC Oscillating Water Column

http://www.faggiolatipumps.it/fag/store/ocean_energy/ocean_energy_01.html

Wave

Mechanical Energy

Kinetic and potential

→

Compression-decompression air in chamber

Pneumatic Energy

→

Turbine-expander

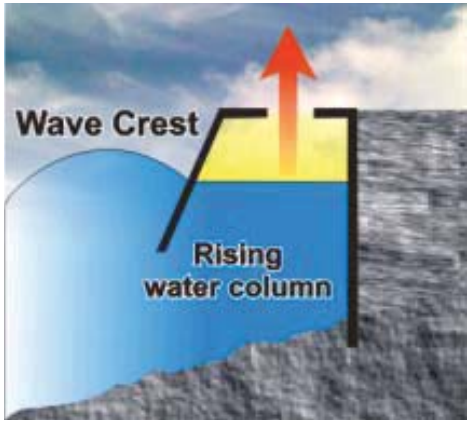
Mechanical Energy

→

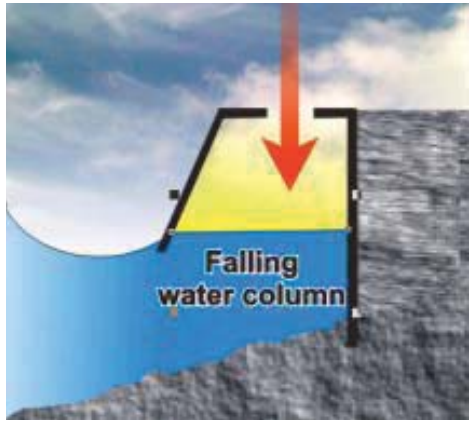
Alternator

Electric Energy

Compression phase



Suction phase



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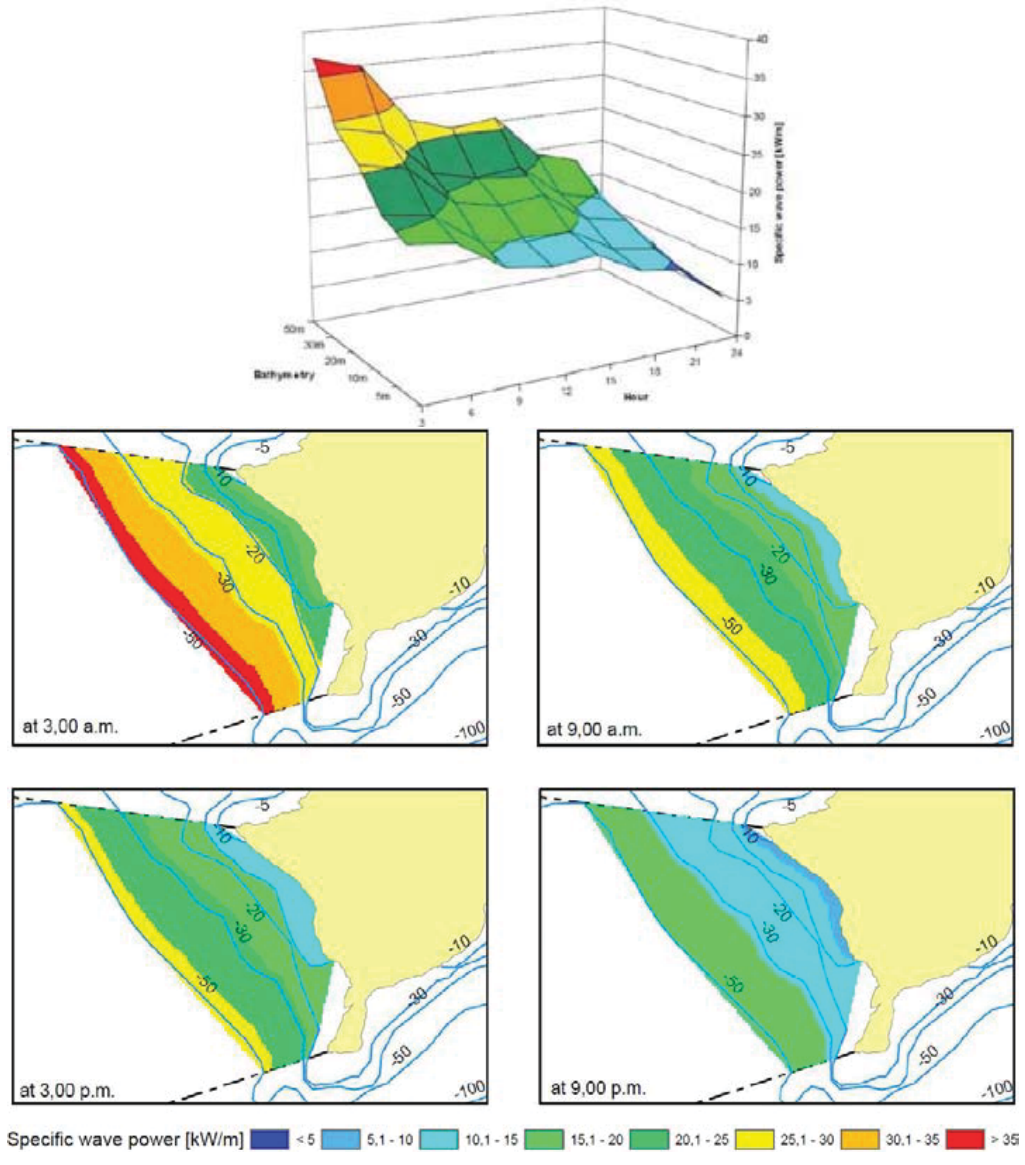
Motivations, why *Ocean Energy in Mediterranean sea*

Corsini A., et al Space-Time Mapping Of Wave Energy Conversion Potential In Mediterranean Sea States. ASME-ATI-UIT 2010



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State-of-the-art class of *wave energy converters*

State-of-the-art OWC chamber

- standard OWC chamber features small period of oscillation
  difficult resonance in case of near-shore waves
- reduced structural resistence
  owing to the geometrical configuration
- opening in OWC attenuates energy conversion from small period waves

State-of-the-art Wells turbine, *mono-plane*

- self-rectifying turbine
- narrow operating margin
- designed for ocean conditions above 30 kW/m

Potenza installata	Località, Paese	Tipo di OWC	Dimensioni Profondità dell'acqua	Periodo
500 kW	Toftestalen, Norvegia	OWC (costa a picco)	diametro: 10 m, d: 70 m	1985-1988
150 kW	Trivandrum, India	OWC in un frangiflutti	larghezza: 8 m, d: 10 m	dal 1990
75 kW	Isle of Islay, Scozia	OWC (costa a picco)	larghezza: 17 m, d: 3 m	dal 1988
60 kW	Sakata, Giappone	OWC in un frangiflutti	larghezza: 20 m, d: 18 m	dal 1988
40 kW	Sanze, Giappone	OWC (costa a picco)	larghezza: 17 m, d: 3 m	1983-1984
40 kW	Niigata, Giappone	OWC in un frangiflutti	larghezza: 13 m, d: 6,5 m	1986-1988
30 kW	Kujukuri, Giappone	OWC con polmone di aria compressa	10 cilindri diametro: 2 m, d: 2 m	dal 1987
3 kW	Dawanshan Island, Cina	OWC (costa a picco)	larghezza: 4 m, d: 10 m	dal 1990

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New class of *wave energy converters (i)*

POSEIDONE project

This programme of research aims at the definition of a technology standard for on-shore WEC suited for Mediterranean sea states and port breakwater caisson integration

in a view to develop the first Italian full-scale prototype and a open-ocean test-rig @ NOEL Lab in Reggio Calabria

The proposed WEC defines a RES for μ-power generation (1 - 100 kWe)

The WEC is based on the combination

an innovative resonant caisson (U-OWC or REWEC3) designed by P. Boccotti and industrialized by WavEnergy.it s.r.l. (pat. n. 1332519)

Boccotti P., 2007. Part I: Theory. Ocean Engineering. vol. 34, pp. 806-819.

Boccotti P., Filianoti P, Fiamma V, Arena F. 2007. Part II: A small-scale field experiment. Ocean Engineering. vol. 34, pp. 820-841.

Wells turbine concept tailored to cope with low-energy wave conditions

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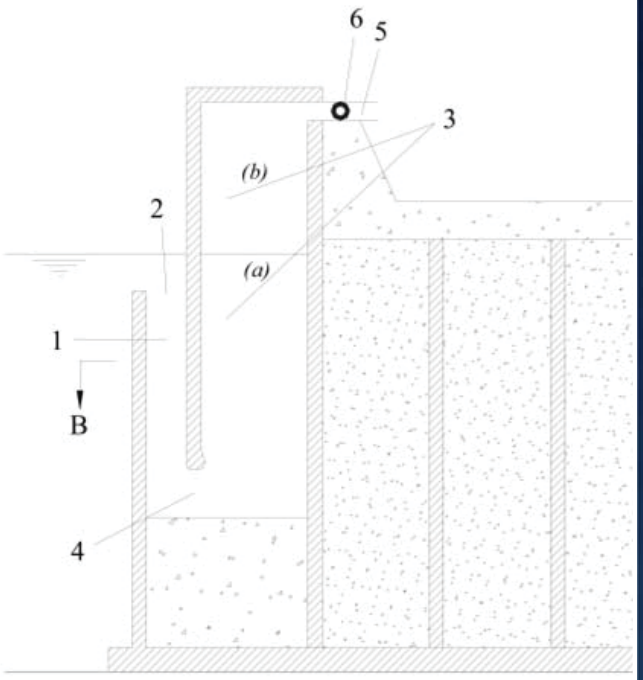
REsonant Wave Energy Converter

Università Mediterranea RC, Wavenergy.it

REWEC (Resonant Wave Energy Converter), is a caisson breakwater to protect a port and to convert wave energy into electrical power.



Example of REWEC breakwater
a vertical duct (1) that is connected both to the sea through an upper opening (2), and to an inner room (3) through a lower opening (4).
This inner room contains a water mass (3*a*) in its lower part and an air pocket (3*b*) in its upper part. An air-duct (5), which connects the air pocket (3*b*) to the atmosphere, contains a Wells turbine (6). Waves produce a pressure fluctuation at the outer opening (2), water oscillates up and down in the duct (1), and the air pocket alternately is compressed and expanded. Then, an alternate air flow is obtained in the air duct, which drives the turbine (6).

Main innovations

super-amplification of swells is not dangerous for the stability of the caisson: wind waves of severe sea storms remain, by far, more critical for the stability;

an U-OWC reduces the height of reflected wind waves, being able to absorb a great share of the energy of **wind waves** (even if not the 100% in this case)

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DIMA-FP TW1.5 turbine

Design data requirements

Target peak turbine power 2 kW

Blade profile:	NACA 0015
Configuration:	Monoplane
Outer diameter:	0.5 m
Rotational frequency:	3000 to 36000 rpm
Bulk velocity (design):	9.1 m/s

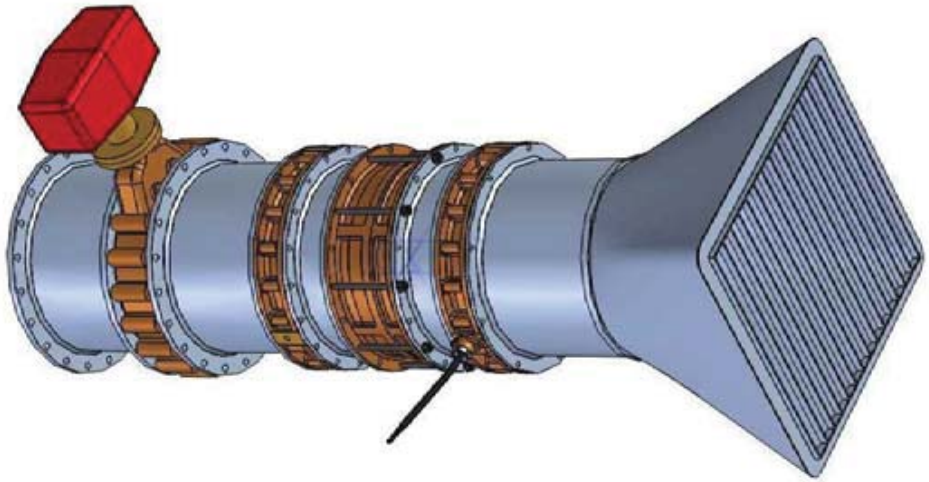
Aerodynamic design process

Solidity check

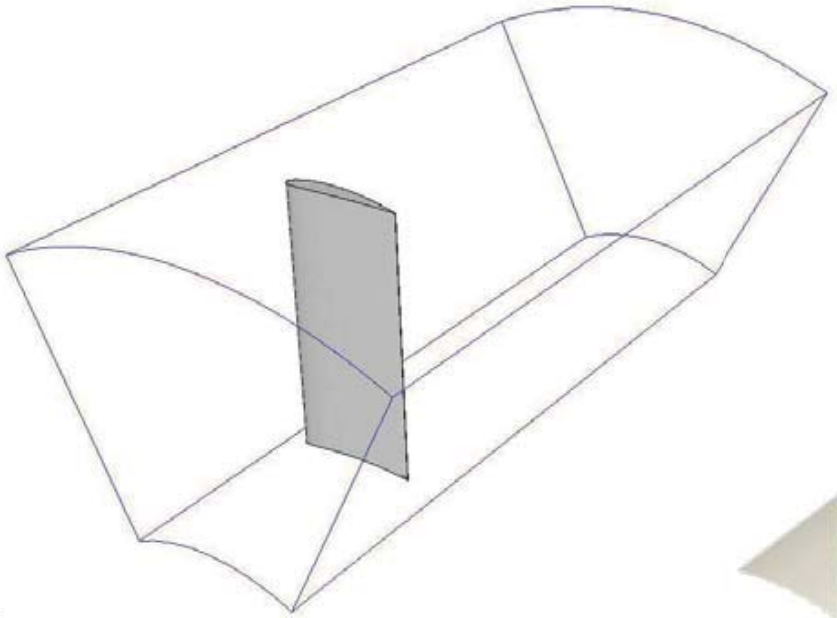
Caisson hydrodynamic interface

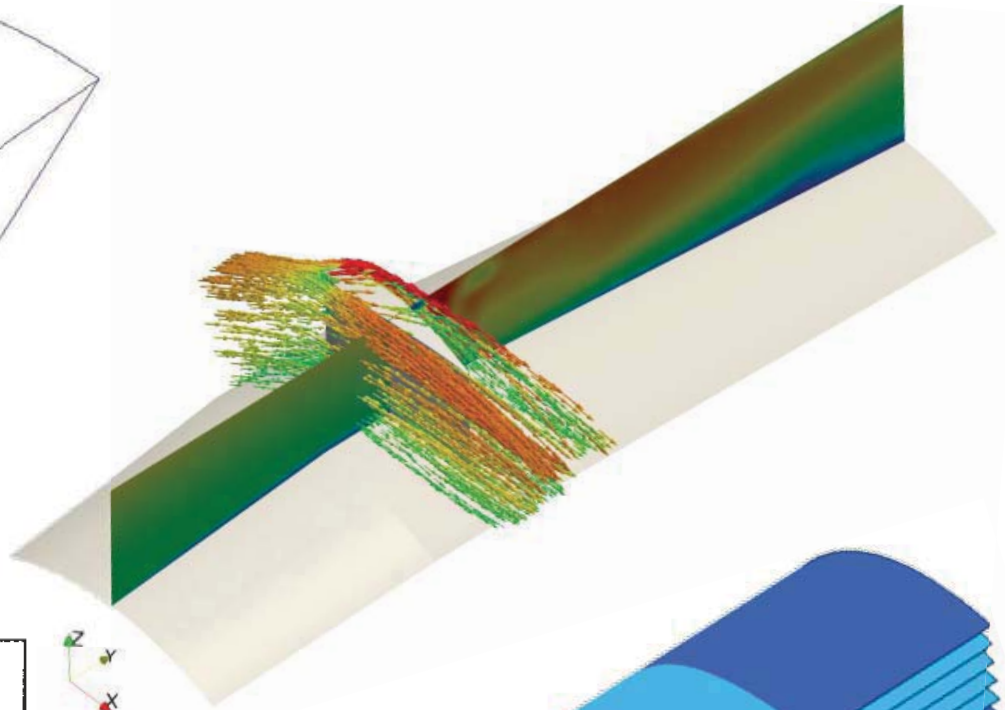
Self-starting

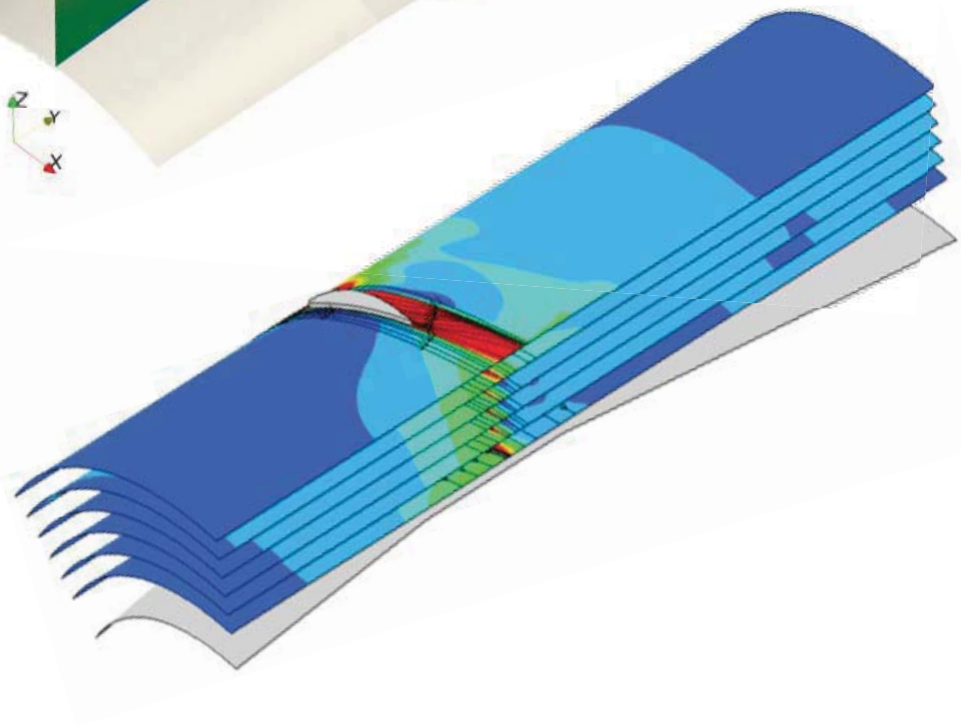
CFD-aided IGV-OGV design

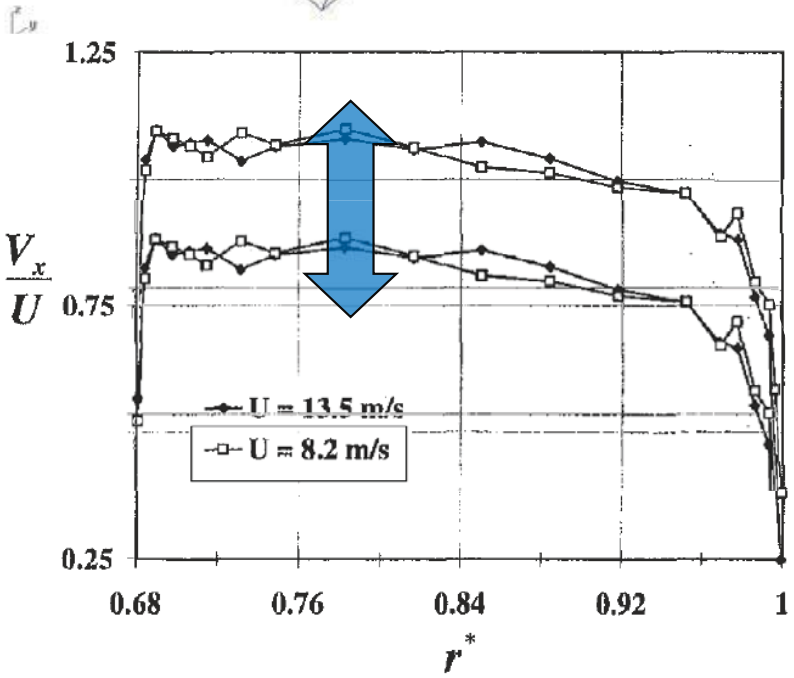


DIMA-FP TW1.5 turbine, CFD based design of IGV-OGV









Inflow velocity radial profile

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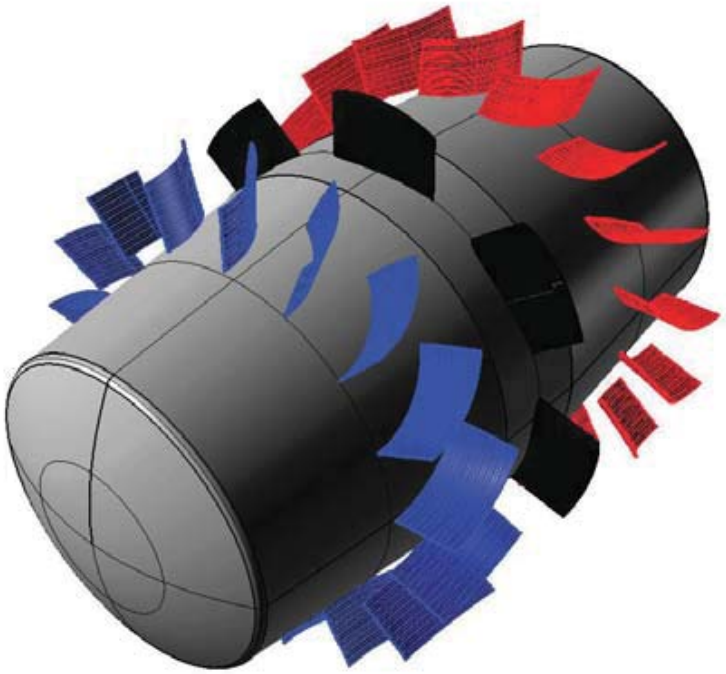
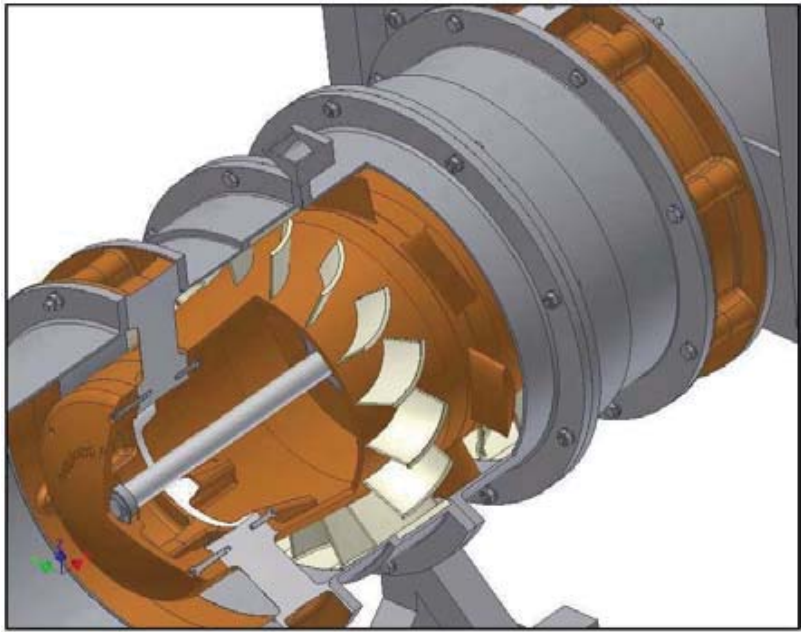
DIMA-FP TW1.5 turbine
CFD based design of IGV-OGV performance





	DIMAFP-TW1.5 CFD rotor only	DIMAFP-TW1.5 design	DIMAFP-TW1.5 field data (NOEL Lab)
Q [m^3/s]	1.0178	0.948	
Δp [Pa]	2679	2578	2707
Cm [Nm]	4.48	5.07	
P [W]	**1408**	**1592**	**1401**

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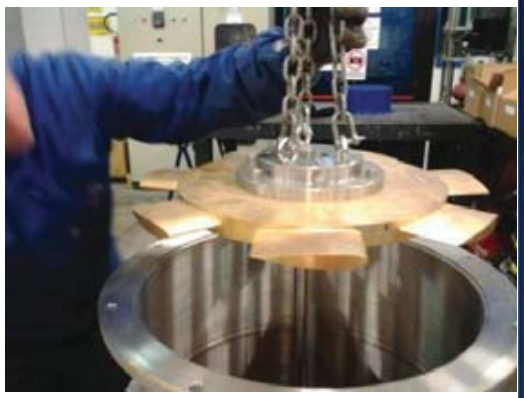
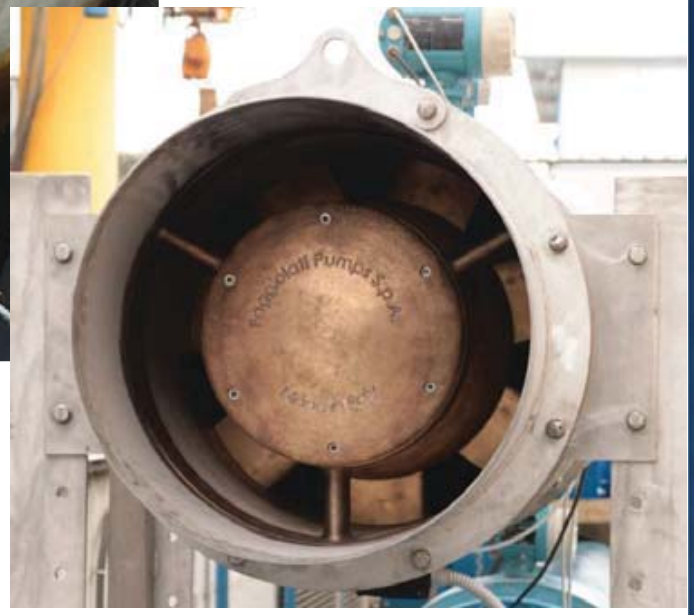
Poseidone test rig @ Faggiolati Pumps

rectifier

inverter and *braking chopper*

anemometer and pressure gauge





centrifugal fan

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Poseidone Plant@ NOEL lab

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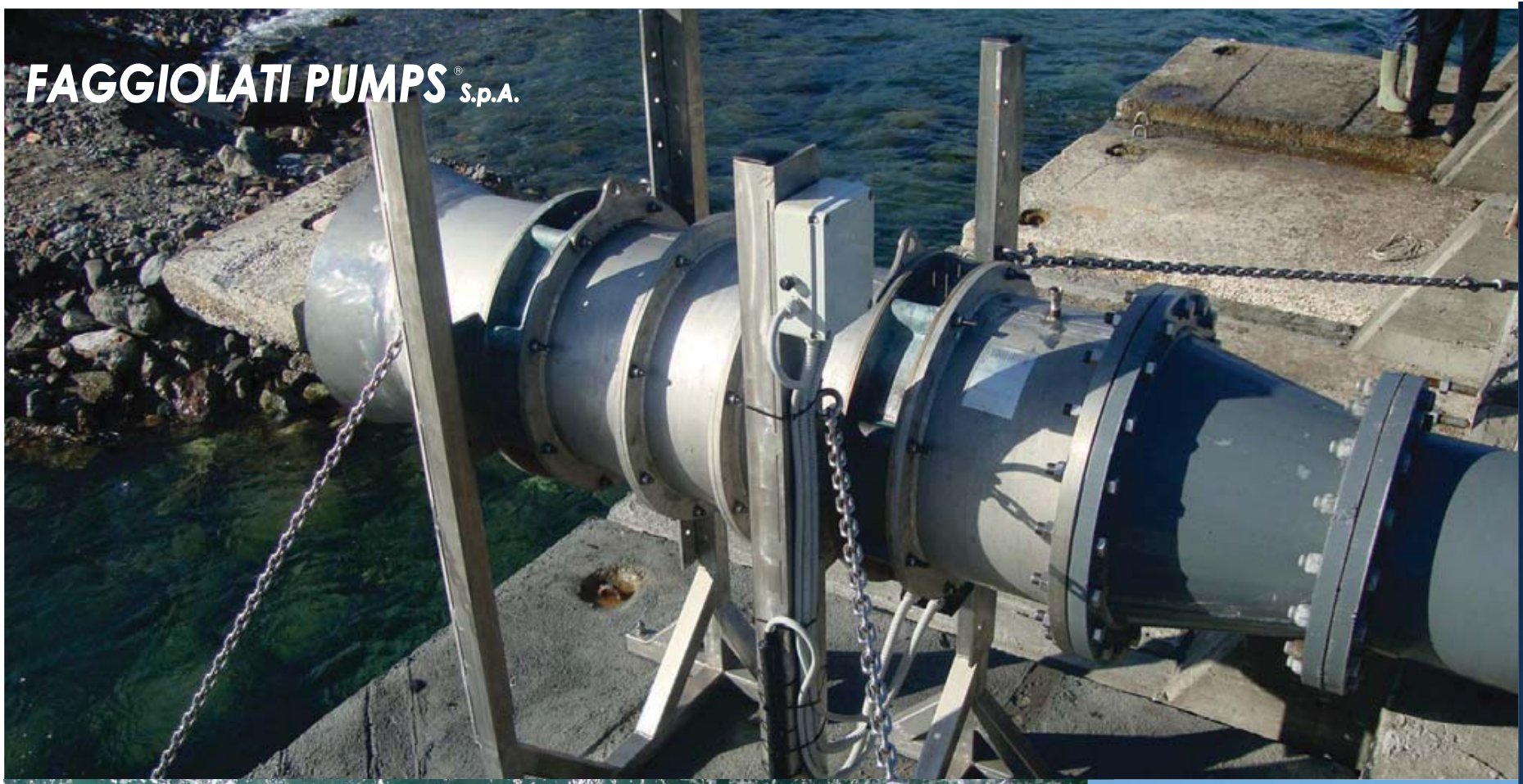

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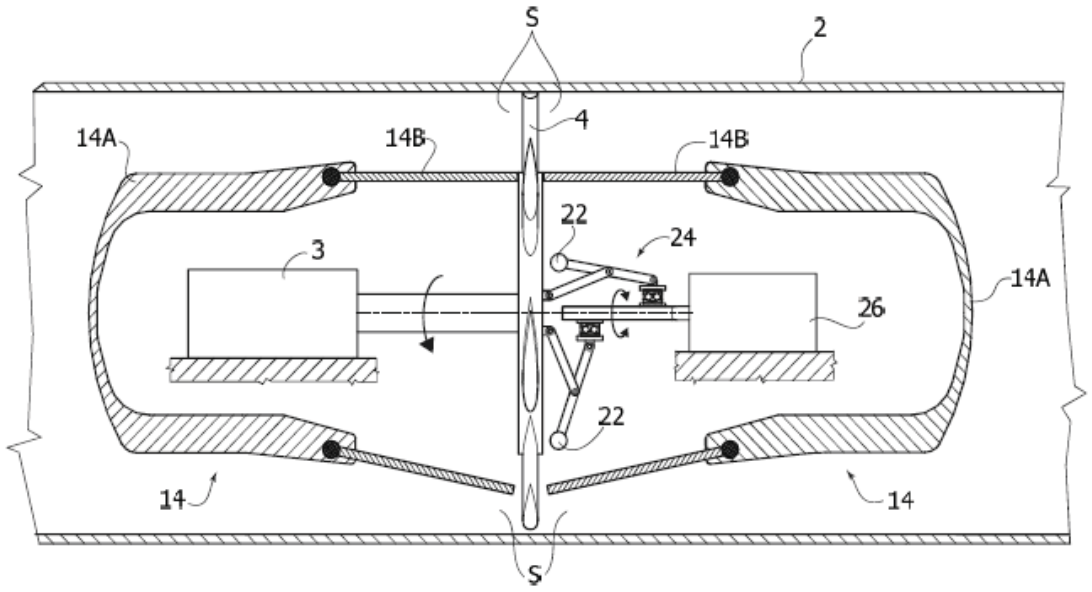
Faggiolati International Patent

"Installation for electricity generation"

Description:

Mechanical and fluid-dynamic system to omptimize performance of unidirectional or bidirectional turbines with variable flow conditions



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POSEIDONE consortium

Development of a wave energy converter for Mediterranean operation

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SAPIENZA
UNIVERSITÀ DI ROMA

FMGroup @ DMA-Sapienza
CRAS Sapienza

Università degli Studi Mediterranea di Reggio Calabria

Wavenergy.it

Mec Mat


"Noi non andiamo in Cina perché Cina è più vicina!"


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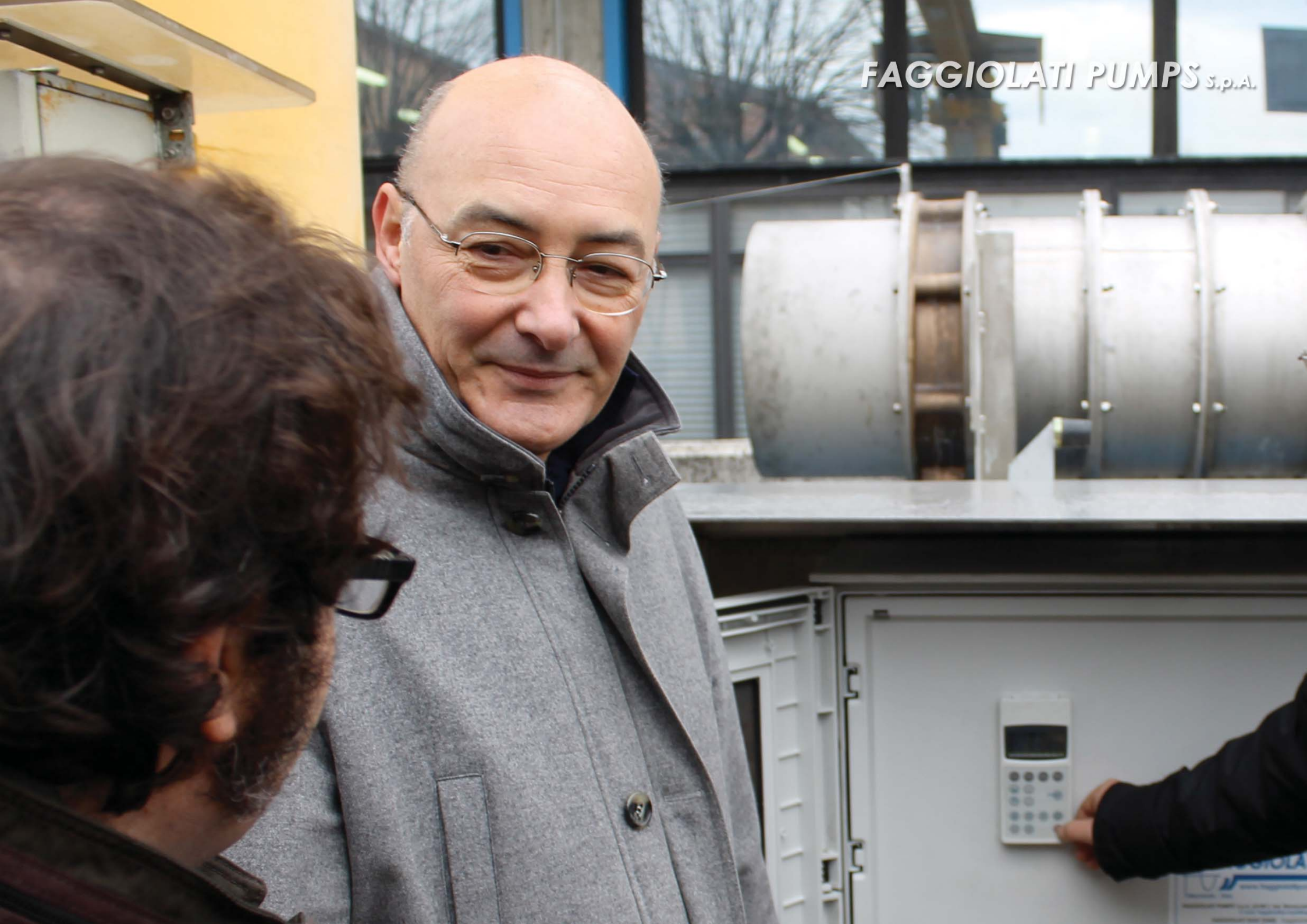
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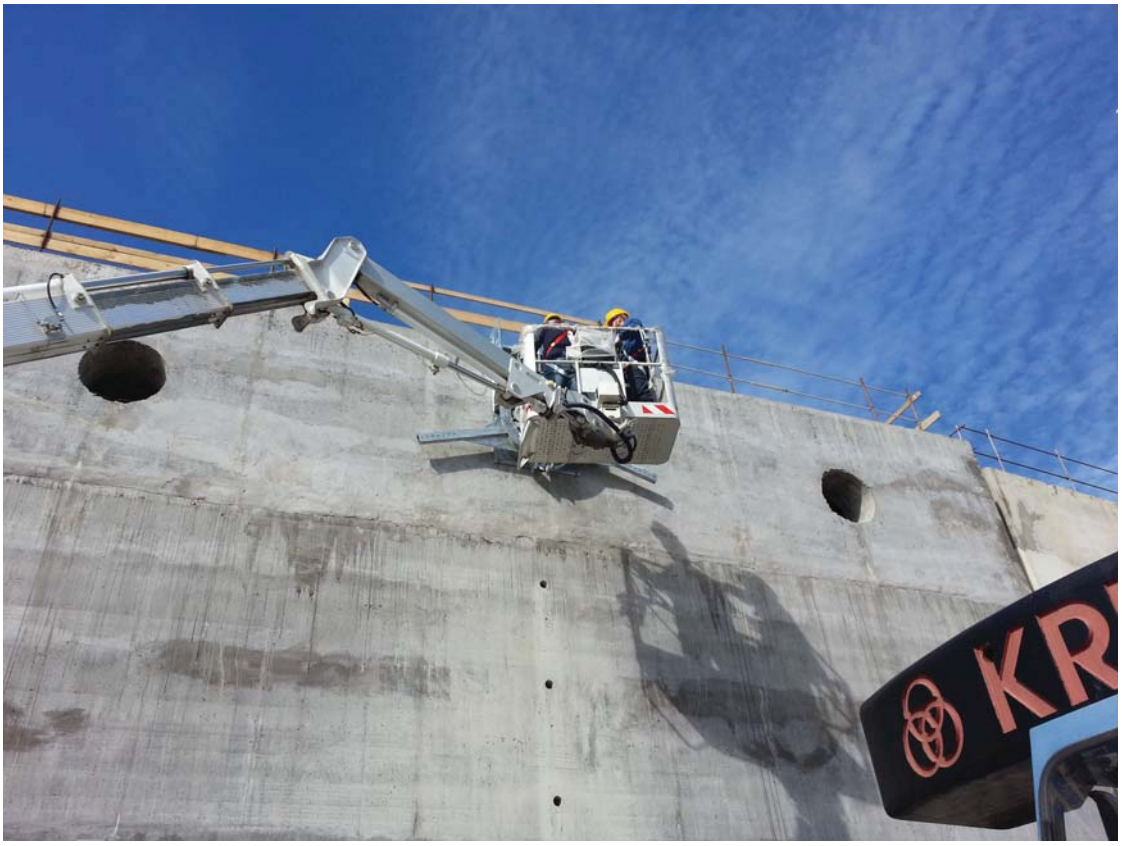

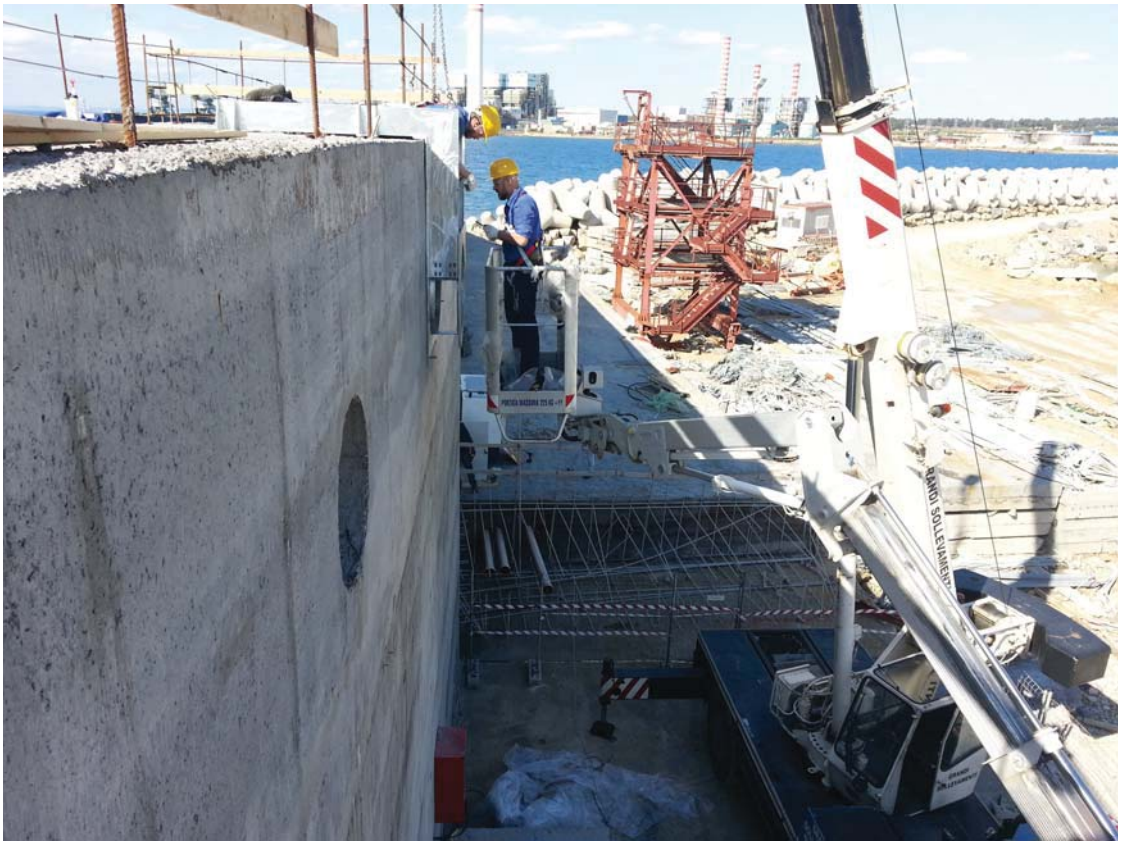

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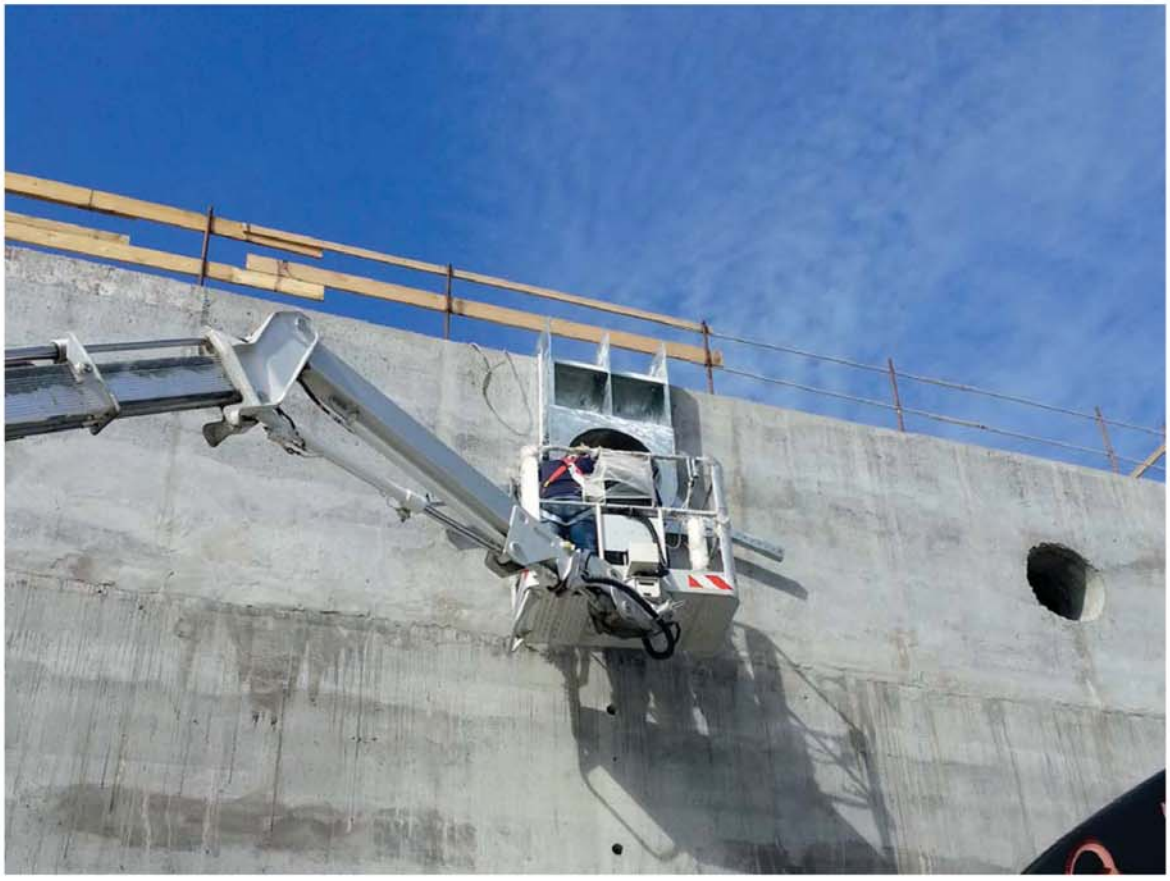

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