GL Garrad Hassan

ALCANTARA WIND FARM
PROVINCE OF MESSINA, SICILY
TECHNICAL DUE DILIGENCE ON FOUNDATIONS OF SELECTED WTGs

REPORT

Date: Nov 30, 2013

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i) Executive summary

The Alcantara Nord and Alcantara Sud wind farms, located on the ridges of the Peloritani mountains in the Province of Messina, North-Western Sicily, are the property of Società Energie Rinnovabili 1 Spa of Rome (SER1), a JV company owned by API Nova Energia Srl of Italy and Iberdrola Renovables of Spain thorugh its Italian subsidiary Iberdrola Renovables Italia Spa. The facility consists of 56 Gamesa G52-850 kW wind turbines and related infrastructure, for a total installed capacity of 47,60 MW.

The wind farm designers are Messrs Studio Bona of Lanciano (CH), Abruzzi, Italy (Ing. Giuseppe Paolucci). GL Garrad Hassan (GLGH) performed a due diligence technical review of the farm design which spanned over several months of the year 2009 (Reports of April, September and November 2009). Construction began in 2010 and ended in 2012. Main Contractor for civil and electrical works was the Italian subsidiary of Messrs GES of Spain. However, about a year and a half into the contract, the owners resolved to sever ties with GES and complete the construction with GES' former sub-contractors for civil works, i.e. Messrs Cobifur, Messrs Elicona Scavi and Messrs Rotella, all of them from Sicily. SER's Site Engineer (Direttore dei Lavori) was Ms Laura Vaccaro of Francavilla di Sicilia (ME), Sicily.

In 2013 an investigation was started by the Italian judiciary on the three Sicilian contractors above mentioned, prompted by police monitoring of the activities of one of them, suspected of connections with the local Mafia. As a result, GLGH became concerned about the quality of works performed by said civil contractors.

This happened while the consortium of Banks which were financing the project was undergoing a substantial restructuring, as the Royal Bank of Scotland Plc – Milan branch – was about to be replaced by UniCredit in the role of consortium leader. In July 2013 Unicredit resolved to condition their acceptance on the positive outcome of a due diligence review of the foundation works to be conducted by the Banks' technical consultants, i.e. GLGH. Deadline to submit the review findings was set on November 20th, 2013.

The scope and specifications of the review were defined jointly by SER1's appointed technical consultants, i.e Hydro Engineering of Alcamo, Province of Palermo, Sicily, and GLGH's consultant for civil works, i.e. the undersigned Messrs Scangea of Rome.

It was agreed that the review would be based on:

1) Analysis of paperwork relevant to the wind farm construction process;
2) Results of field tests conducted on a sample of 10 no. turbines (out of the 56 no. total), selected with the following criteria: i) to inspect foundations constructed by all suspected firms and, ii) to inspect foundations built across the whole span of the wind farm construction time (2010-2012).

Thus, GLGH selected the following WTGs (5 no. from Alcantara Sud, 5 no. from Alcantara Nord) :

- WTG 110 (Alcantara Sud); contractor: GES; sub-contractor: Elicona; foundation type: Shallow;
- WTG 118 (Alcantara Sud); contractor: GES; sub-contractor: Elicona; foundation type: Piled (11m);
- WTG 130 (Alcantara Sud); contractor: GES; sub-contractor: Rotella; foundation type: Piled (11m);
- WTG 133 (Alcantara Sud); contractor: Rotella; foundation type: Shallow;
- WTG 142 (Alcantara Sud); contractor: Elicona; foundation type: Piled (22m);
- WTG 214 (Alcantara Nord); contractor: Cobifur; foundation type: Piled (22m);
- WTG 217 (Alcantara Nord); contractor: GES; sub-contractor: Cobifur; foundation type: Piled (22m);
- WTG 220 (Alcantara Nord); contractor: Cobifur; foundation type: Piled (22m);
- WTG 310 (Alcantara Nord); contractor: Cobifur; foundation type: Piled (22m);
- WTG 315 (Alcantara Nord); contractor: GES; sub-contractor: Cobifur; foundation type: Piled (22m);

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Definition of field tests to be performed and the relevant specifications entailed a somewhat lengthy process which lasted into the beginning of activities on site. Finally, by the first week of August, 2013, GLGH was satisfied that the scope of the review and the relevant specs were adequate, comprising the following:

- Check of quality of concrete in plinths;
- Check of quality of concrete in piles;
- Check of re-bars in plinths;
- Check of re-bars in piles;
- Check of piles' length and integrity.

Activities on site began on July 30th, 2013, under the direct supervision of GLGH consultants for civil works, Dott. Ing. Luigi Cesare Speranza of Scangea, Rome. Excavations, re-bar inspecting and concrete sampling were carried out speedily and in a satisfactory manner with a break of just ten days for the mid-August vacation. Completion of activities was achieved at the end of September, 2013. Scangea witnessed all steps of each process, including the testing of concrete samples at SER1's appointed laboratory, i.e. GeoLAB of Carini , Province of Palermo, Sicily.

Assessment of piles length with the SIT (Sonic Integrity Tester) method, however, appeared doubtful right at the outset, given that piles were tested without demolishing their connection to the foundation plinth (the SIT method is best suitable to test piles before plinths and/or other overlaying structures are built). GLGH raised the issue with SER1, which finally accepted Scangea's suggestion to conduct Parallel Seismic tests (suitable for piles embedded in foundations) so as to corroborate the SIT tests.

Field activities resumed on October 8, again under the supervision of Scangea, and were concluded on October 27th, 2013. GeoLAB and Geocima illustrated the results of the Parallel Seismic tests and their correlation with the SIT tests during a meeting held at the GeoLAB facilities in Carini on October 29th, 2013.

In the meantime, as a follow-up to a meeting held on 4 October 2013 SER finally delivered a considerable quantity of documents concerning the wind farm construction process. These include: i) documents from the "DL - Direttore dei Lavori" (SER's appointed Site Engineer); ii) documents from the "Collaudatore" (Engineer responsible for commissioning), iii) documents from suppliers and consultants. Iv) documents from labs.

In conclusion, all considered, based on the evidence gathered in-situ during the supervision of field activities and the evaluation of reports received from SER's appointed consultants, i.e.:

- GeoLAB, report on results of destructive tests on concrete samples (receipt date: 10 October 2013);
- Hydro Engineering, report on concrete based on GeoLAB's test data (receipt date 1 October 2013);
- GeoLAB / Geocima, report on SIT tests conducted on the Alcantara Nord and SUD WTG foundations (receipt date: 1 October 2013);
- GeoLAB / Geocima, report on Parallel Seismic tests conducted on the Alcantara Nord and Sud WTG foundations (receipt date: ……);
- GeoLAB, report on pachometer's readings on the exposed lateral surface of piles of Alcantara Sud and Alcantara Nord foundations (receipt date: ……..).

GLGH's findings are as follows:

- Check of quality of concrete in plinths: satisfactory;
- Check of quality of concrete in piles: satisfactory;
- Check of re-bars in plinths: satisfactory;
- Check of re-bars in piles: satisfactory;
- Check of piles' length and integrity: satisfactory.

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Based on the above, as no negative finding has been made on the sample of 10 no. turbines selected for review, considering that the documentation produced by SER concerning the construction process, and in particular the documentation issued by SER's Site Engineer (Direttore dei Lavori), Ing. Laura Vaccaro, yields evidence of a thorough and constant supervision of construction works, it can be reasonably argued that the positive results of the selected sample of 10 no. turbines can be extrapolated to the entire wind farm.

Consequently, all foundations of the Alcantara wind farm turbines can be deemed to be viable.

Please refer to Chapter 1 for more information on the specifications. Chapter 2 and Chapter 3 document the assessment of reinforcement, in plinths and piles. Chapter 4 is dedicated to the assessment of concrete. Finally, Chapter 5 reports the review on piles length and integrity.

Chapter 1, 2, 3, 4 and 5 are separate documents, for easiness of consultation. Likewise, the review process for concrete is given in 10 no. booklets, one per each turbine site, which constitute Annexes to Chapter 4, assessment of concrete.

Findings on each subject of this review process, abstracted from each of the chapters mentioned above, are given in the sections of this document.

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ii) SUMMARY OF FINDINGS

- ***Plinth reinforcement***
- ***Piles reinforcement***
- ***Concrete***
- ***Piles length and integrity***

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SUMMARY OF FINDINGS
Plinth reinforcement
(abstract from Chapter 2)

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Summary of findings
Plinth reinforcement

WTG 110 (Alcantara Sud)
Date when inspection was carried out: July 31st, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 125 mm centre distance on both layers (A1 was all in inner area of upper mat of reinforcement);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 125 mm centre distance on both layers (A2 was all in inner area of upper mat of reinforcement);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, spacing changed from 125 mm to 250 mm centre distance because A3 contained the both the inner and outer area of upper mat reinforcement).

Conclusion:

- **re-bars in compliance with design** (please refer to Chapter 2)
- **quality of workmanship: very good.**

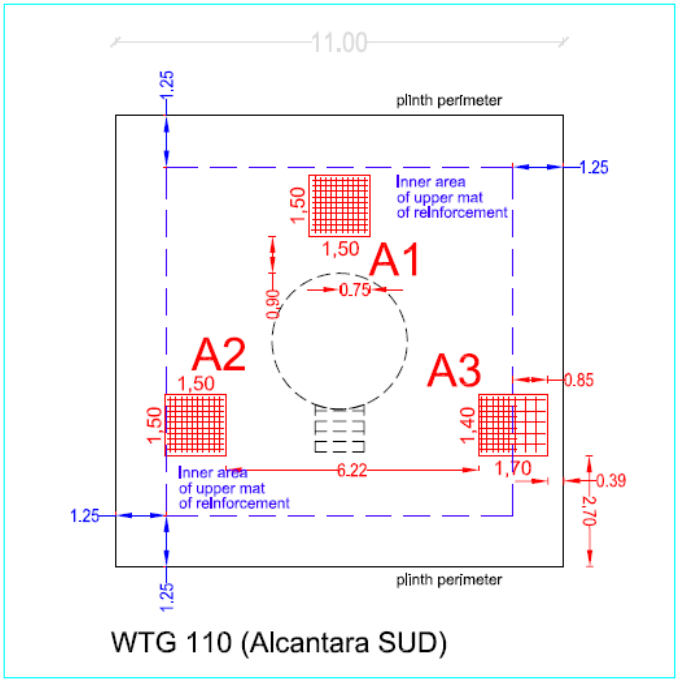

Fig. 2-Ea
WTG 110
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 118 (Alcantara Sud)
Date when inspection was carried out: August 2nd, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chpater 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design** (please refer Chapter 2)
- **quality of workmanship: very good.**

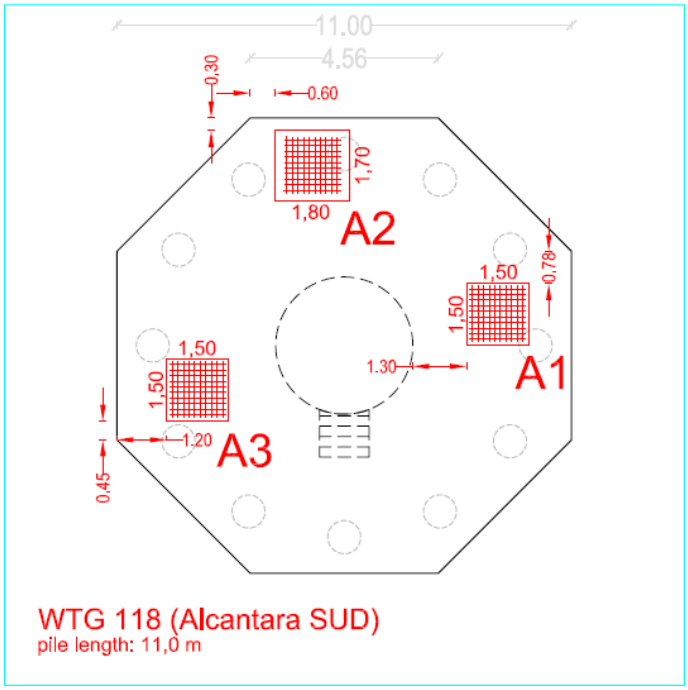

Fig. 2-F
WTG 118
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 130 (Alcantara Sud)
Date when inspection was carried out: August 1st, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design** (please refer to Chapter 2)
- **quality of workmanship: very good.**

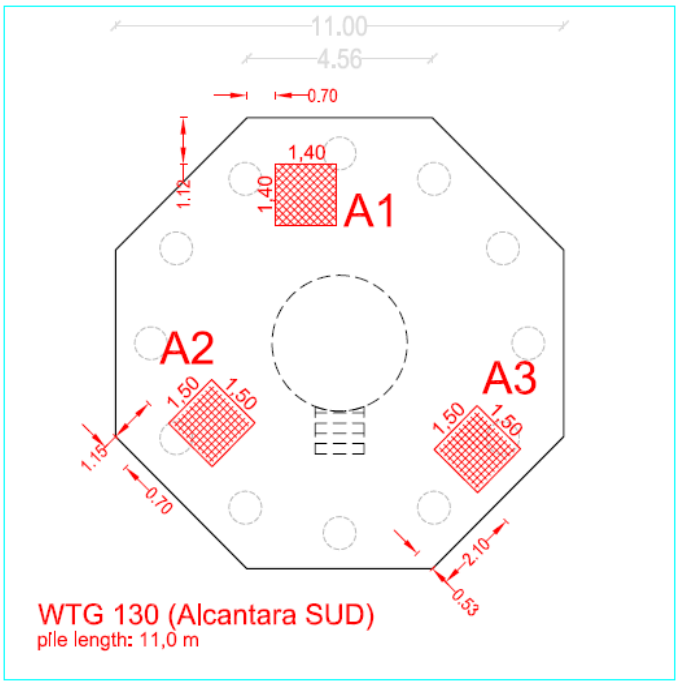

Fig. 2-G
WTG 130
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 133 (Alcantara Sud)
Date when inspection was carried out: August 5th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 125 mm centre distance on both layers (A1 was all in inner area of upper mat of reinforcement);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 125 mm centre distance on both layers (A2 was all in inner area of upper mat of reinforcement);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 125 mm centre distance on both layers (A3 was all in inner area of upper mat of reinforcement).

Conclusion:

- **re-bars in compliance with design (please refer to Chapter 2)**
- **quality of workmanship: very good.**

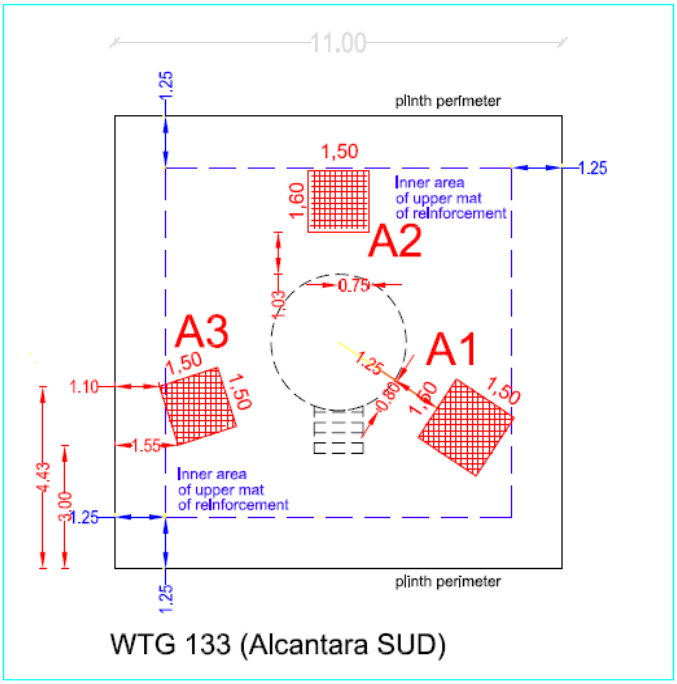

Fig. 2-Ga
WTG 133
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 142 (Alcantara Sud)

Date when inspection was carried out: August 6th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design (please refer to Chapter 2)**
- **quality of workmanship: very good.**

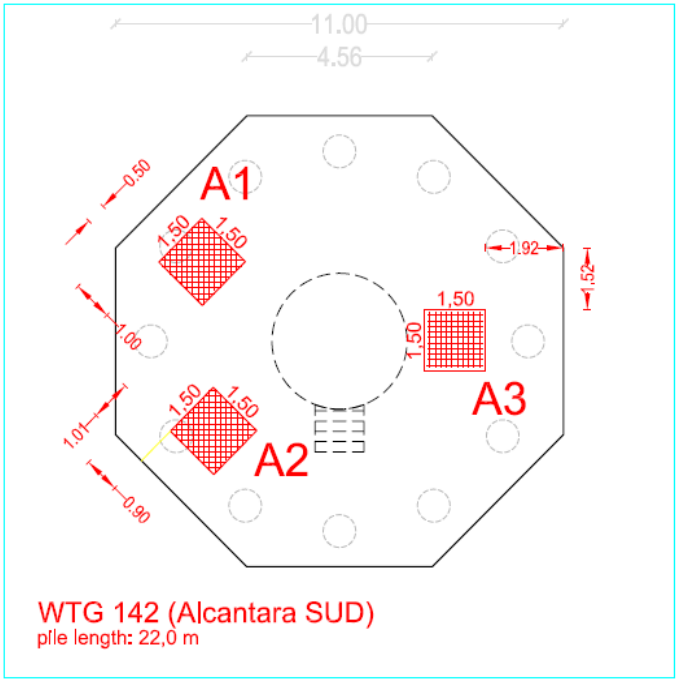

Fig. 2-H
WTG 142
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 214 (Alcantara NORD)
Date when inspection was carried out: September 9th, 2013
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design (please refer to Chapter 2)**
- **quality of workmanship: very good.**

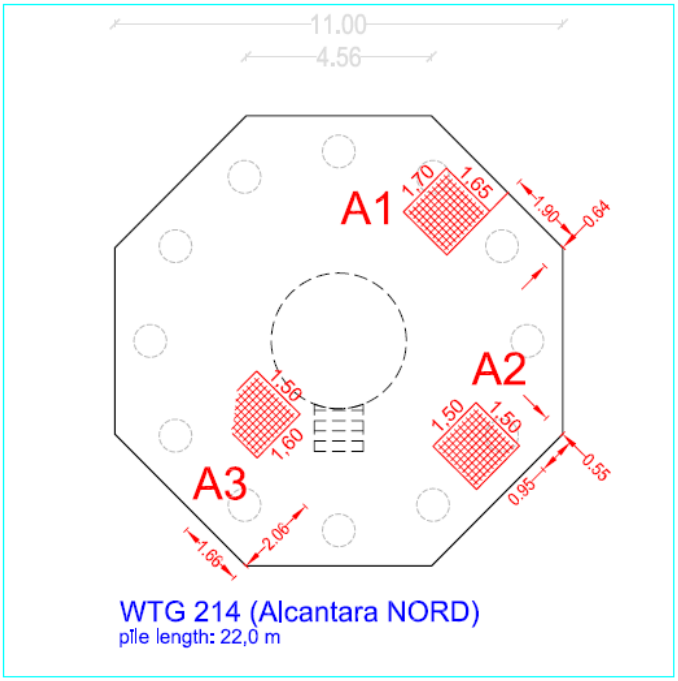

Fig. 2-I
WTG 214
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 217 (Alcantara NORD)

Date when inspection was carried out: September 10th , 2013
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design (please refer to Chapter 2)**
- **quality of workmanship: very good.**

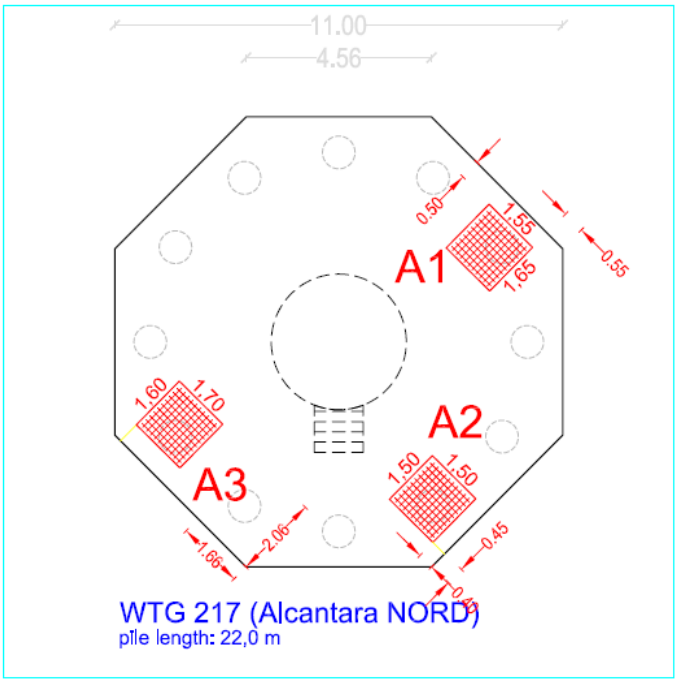

Fig. 2-J
WTG 217
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 220 (Alcantara NORD)

Date when inspection was carried out: September 13th , 2013
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design (please refer to Chapter 2)**
- **quality of workmanship: very good.**

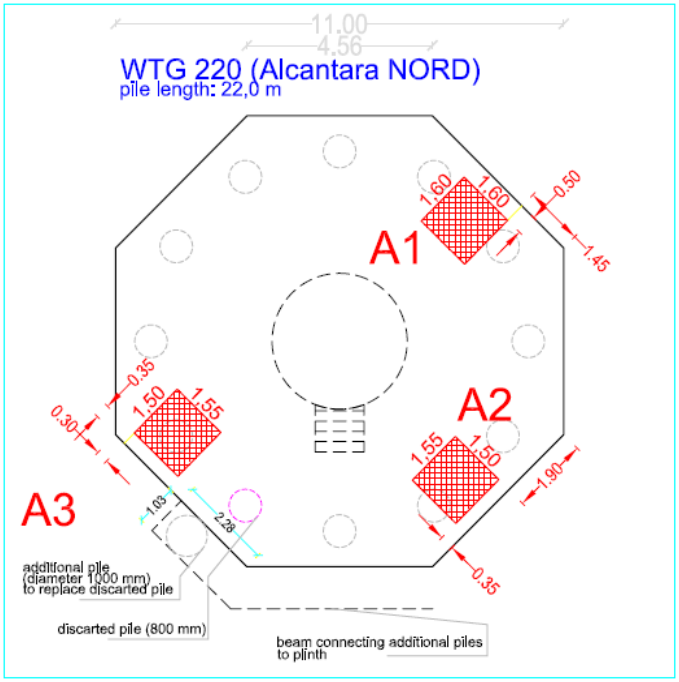

Fig. 2-K
WTG 220
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 310 (Alcantara NORD)

Date when inspection was carried out: September 13th , 2013
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design (please refer to Chapter 2)**
- **quality of workmanship: very good.**

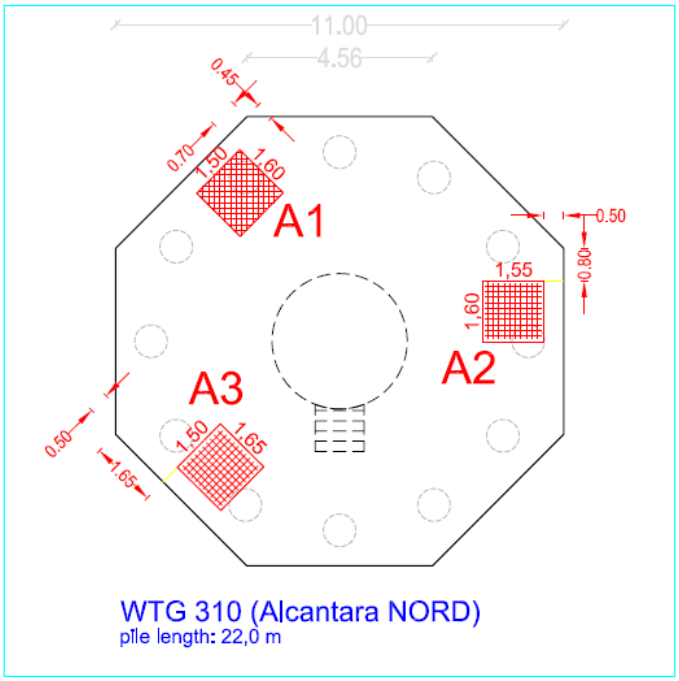

Fig. 2-L
WTG 310
Plinth Plan with Position of Demolition Areas A1, A2, A3

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Summary of findings
Plinth reinforcement

WTG 315 (Alcantara NORD)

Date when inspection was carried out: September 17th , 2013
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea).

Findings (please refer to photos in Chapter 2):

- **A1:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A2:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge);
- **A3:** 2 no. layers of 24 mm diameter bars (measured by gauge) were observed, positioned at 135 mm centre distance on both layers (measured by gauge).

Conclusion:

- **re-bars in compliance with design (please refer to Chapter 2)**
- **quality of workmanship: very good.**

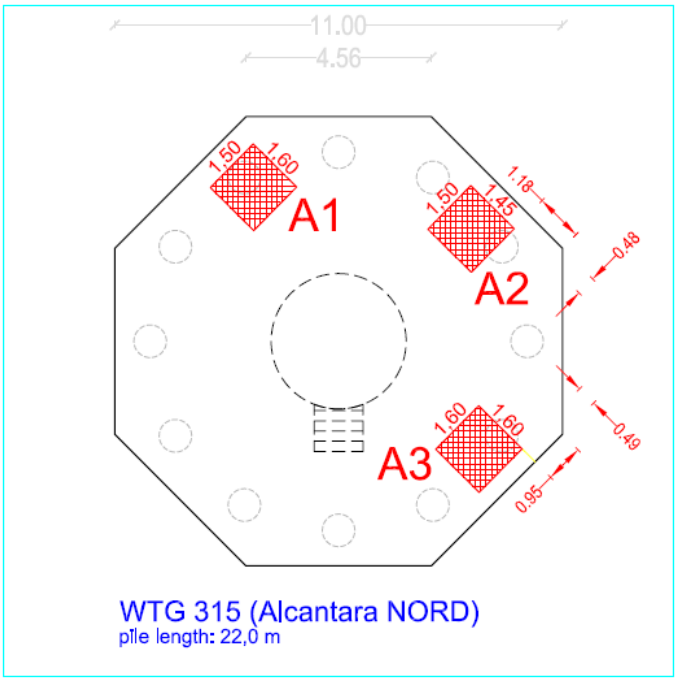

Fig. 2-M
WTG 315
Plinth Plan with Position of Demolition Areas A1, A2, A3

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SUMMARY OF FINDINGS
Piles reinforcement
(abstract from Chapter 3)

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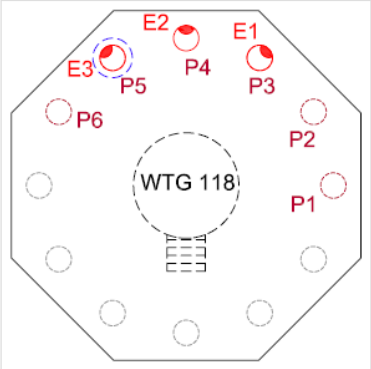
Summary of findings - Piles reinforcement

WTG 118 (Alcantara Sud)
Piled Foundation - Pile length: 11,0 m
Date when inspection was carried out: August 5th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-B)



WTG 118
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5, P6 - Piles where SIT test was performed: E1, E2, E3
Pile chosen for PS test: P5 = E3

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
	PRESENT	NOT PRESENT	Vertical Re-bar Diameter	Helix Re-bar Diameter	Helix Pitch	Reinforc Cover (measured with tape)		Theoretical circumf. 251,2 total bars 18	(*) ACTUAL(**)	1	2	3	4	5	6	7	
118	SIT test code		mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	Pile 11,0 m Reinforcement (0,0 to -2,0 m): 12 + 6 = 18 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm Pile 22,0 m Reinforcement (0,0 to - 2,0 m): 12 + 12 = 24 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm
Palo P1			N/A	N/A	N/A	N/A		0	4	45 - 100 mm	-	-	-				fewer readings because of concrete cover thickness
Palo P2			N/A	N/A	N/A	N/A		0	4	50 -105 mm	-	-	-				idem
Palo P3		E1	22	12	150	85		0	4	70 - 100 mm	-	-	-				idem
Palo P4		E2	22	12	150	97		0	4	65 - 110 mm	-	-	-				idem
Palo P5		E3	22	12	150	107		0	4	55 - 105 mm	-	-	-				idem
Palo P6			N/A	N/A	N/A	N/A		0	4	70 - 110 mm	-	-	-				idem

Date of inspection: August 05, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile

(**) readings may be fewer because of concrete cover thickness higher than 120 mr

(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 118
Pachymeter Readings

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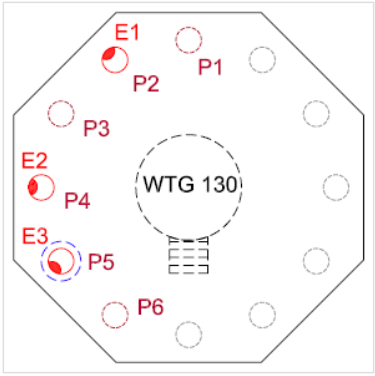
Summary of findings - Piles reinforcement

WTG 130 (Alcantara Sud)
Piled Foundation - Pile length: 11,0 m
Date when inspection was carried out: August 5th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-B)



WTG 130
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5, P6
Piles where SIT test was performed: E1, E2, E3
Pile chosen for PS test: P5 = E3

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
	PRESENT / NOT PRESENT	SIT test code	Vertical Re-bar Diameter	Helix Re-bar Diameter	Helix Pitch	Reinforc Cover (measured with tape)		Theoretical circumf. 251,2 total bars 18	ACTUAL(**)	1	2	3	4	5	6	7	
130			mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	Pile 11,0 m Reinforcement (0,0 to -2,0 m): 12 + 6 = 18 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm Pile 22,0 m Reinforcement (0,0 to - 2,0 m): 12 + 12 = 24 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm
Palo P1			N/A	N/A	N/A	N/A		0	3	55 - 60 mm	-	-	-	-			fewer readings because of concrete cover thickness
Palo P2		E1	22	12	150	85		0	3	75 -105 mm	-	-	-	-			idem
Palo P3			N/A	N/A	N/A	N/A		0	4	85 - 105 mm	-	-	-				idem
Palo P4		E2	22	12	150	95		0	4	85 - 105 mm	-	-	-				idem
Palo P5		E3	22	12	150	105		0	4	80 - 110 mm	-	-	-				idem
Palo P6			N/A	N/A	N/A	N/A		0	4	57	D	D	D	-	-	-	idem

Date of inspection: August 05, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile
(**) readings may be fewer because of concrete cover thickness higher than 120 mr
(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 130
Pachymeter Readings

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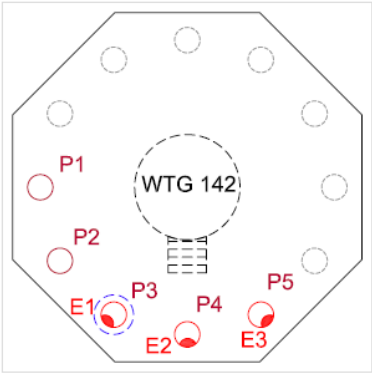
Summary of findings - Piles reinforcement

WTG 142 (Alcantara Sud)
Piled Foundation - Pile length: 22,0 m
Date when inspection was carried out: August 8TH, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-C)



WTG 142
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5 (P6 not excavated because of stability of slope)
Piles where SIT test was performed: E1, E2, E3
Pile chosen for PS test: P3 = E1

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
	PRESENT	NOT PRESENT	Vertical Re-bar Diamete	Helix Re-bar Diameter	Helix Pitch	Reinforc Cover (measured with tape)		Theoretical (*) circumf. 251,2 total bars 24	ACTUAL(**)	1	2	3	4	5	6	7	
142		SIT test code	mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	Pile 11,0 m Reinforcement (0,0 to -2,0 m): 12 + 6 = 18 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm Pile 22,0 m Reinforcement (0,0 to - 2,0 m): 12 + 12 = 24 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm
Palo P1			N/A	N/A	N/A	N/A		0	4	55 - 80 mm	-	-	-				fewer readings because of concrete cover thickness
Palo P2			N/A	N/A	N/A	N/A		0	4	55 - 90 mm	-	-	-				idem
Palo P3		E1	22	12	150			0	3	averg = 80 mm	-	-	-				idem
Palo P4		E2	22	12	150			0	3	averg = 95 mm	-	-	-				idem
Palo P5		E3	22	12	150			0	3	averg=105mm	-	-	-				idem
Palo P6	5 no. PILES EXPOSED WITH EXCAVATIONS, DUE TO SLOPE STABILITY PROBLEMS																This is the only WTG site where 5 piles were expose

Date of inspection: August 08, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile

(**) readings may be fewer because of concrete cover thickness higher than 120 mr

(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 142
Pachymeter Readings

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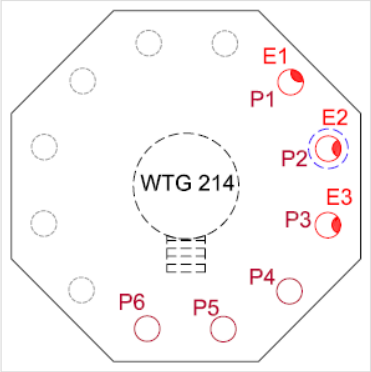
Summary of findings - Piles reinforcement

WTG 214 (Alcantara NORD)
Piled Foundation - Pile length: 22,0 m
Date when inspection was carried out: September 9th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-C)



WTG 214
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5, P6
Piles where SIT test was performed: E1, E2, E3
Pile selected for PS test: P2 = E2

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
214	PRESENT / NOT PRESENT	SIT test code	Vertical Re-bar Diameter	Helix Re-bar Diameter	Helix Pitch	Reinforc. Cover (measured with tape)		Theoretical (*) circumf. 251,2 total bars 24	ACTUAL(**)	1	2	3	4	5	6	7	
			mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	
Palo P1		E1	22	12	150	170	110	11	0	-	-	-	-	-	-	-	no readings because of concrete cover thickness
Palo P2		E2	22	12	150	160	115	11	0	-	-	-	-	-	-	-	no readings because of concrete cover thickness
Palo P3		E3	22	12	150	45	90	9	5	average = 45 mm					-	-	idem
Palo P4			N/A	N/A	N/A	N/A	105	10	5	average = 114 mm					-	-	fewer readings because of concrete cover thickness
Palo P5			N/A	N/A	N/A	N/A	110	11	4	D	D	D	D	-	-	-	idem
Palo P6			N/A	N/A	N/A	N/A	95	9	6	average = 60 mm						-	idem

Date of inspection: September 09, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile
(**) readings may be fewer because of concrete cover thickness higher than 120 mr
(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 214
Pachymeter Readings

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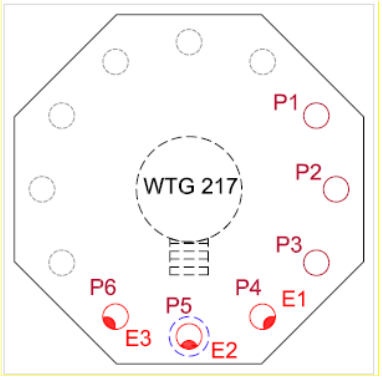
Summary of findings - Piles reinforcement

WTG 217 (Alcantara NORD)
Piled Foundation - Pile length: 22,0 m
Date when inspection was carried out: September 10th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-C)



WTG 217
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5, P6
Piles where SIT test was performed: E1, E2, E3
Pile selected for PS test: P5 = E2

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
	PRESENT	NOT PRESENT	Vertical Re-bar Diameter	Helix Re-bar Diameter	Helix Pitch	Reinforc Cover (measured with tape)	Theoretical (*) circumf. 251,2 total bars 24	ACTUAL(**)		1	2	3	4	5	6	7	
217	SIT test code		mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	Pile 11,0 m Reinforcement (0,0 to -2,0 m): 12 + 6 = 18 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm Pile 22,0 m Reinforcement (0,0 to - 2,0 m): 12 + 12 = 24 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm
Palo P1			N/A	N/A	N/A	N/A	95	9	5	31	83	120	111	94	-	-	fewer readings because of irregular shape of lateral surfac
Palo P2			N/A	N/A	N/A	N/A	85	8	5	75	average = 90 mm				-	-	idem
Palo P3			N/A	N/A	N/A	N/A	80	8	5	120	D	D	D	D	-	-	idem
Palo P4		E1	22	12	150	115	85	8	4	92	D	60	80	-	-	-	fewer readings because of concrete cover thickness
Palo P5		E2	22	12	150	118	80	8	6	78	90	D	D	56	D	-	idem
Palo P6		E3	22	12	150	125	75	7	6	80	120	D	102	D	D	-	idem

Date of inspection: September 10, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile
(**) readings may be fewer because of concrete cover thickness higher than 120 mr
(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 217
Pachymeter Readings

SCANGEA – info@scangea.eu – l.c.speranza@scangea.eu
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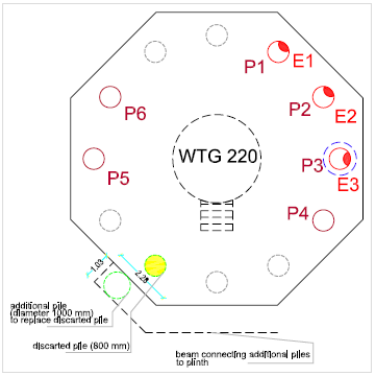
Summary of findings - Piles reinforcement

WTG 220 (Alcantara NORD)
Piled Foundation - Pile length: 22,0 m
Date when inspection was carried out: September 11th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-C)



WTG 220
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5, P6
Piles where SIT test was performed: E1, E2, E3
Pile selected for PS test: P3 = E3

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
220	PRESENT	NOT PRESENT	Vertical Re-bar Diameter	Helix Re-bar Diameter	Helix Pitch	Reinforcement Cover (measured with tape)		Theoretical circumf. 251,2 total bars 24	ACTUAL(**)	1	2	3	4	5	6	7	Pile 11,0 m Reinforcement (0,0 to -2,0 m): 12 + 6 = 18 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm Pile 22,0 m Reinforcement (0,0 to - 2,0 m): 12 + 12 = 24 No.vertical bars (20mm; 16mm) Helix 12 / 150 mm
	SIT test code		mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	
Palo P1		E1	22	12	150	76	60	6	3	D	76	84	-	-	-	-	fewer readings because of irregular shape of lateral surfac
Palo P2		E2	22	12	150	120	75	7	4	D	120	120	109	-	-	-	idem
Palo P3		E3	22	12	150	125	90	9	4	D	D	D	D	-	-	-	idem
Palo P4			N/A	N/A	N/A	N/A	65	6	4	40	25	32	45	-	-	-	fewer readings because of irregular shape of lateral surfac
Palo P5			N/A	N/A	N/A	N/A	70	7	5	D	D	D	D	D	-	-	idem
Palo P6			N/A	N/A	N/A	N/A	70	7	5	81	114	D	54	99	-	-	idem

Date of inspection: September 11, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile

(**) readings may be fewer because of concrete cover thickness higher than 120 mr

(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 220
Pachymeter Readings

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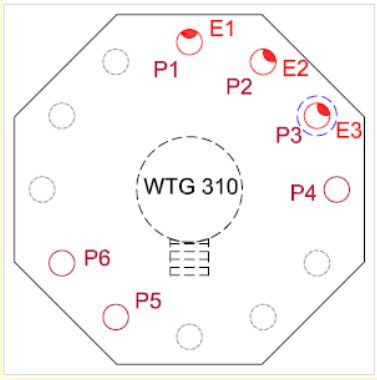
Summary of findings - Piles reinforcement

WTG 310 (Alcantara NORD)
Piled Foundation - Pile length: 22,0 m
Date when inspection was carried out: September 13th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-C)



WTG 310
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5, P6
Piles where SIT test was performed: E1, E2, E3
Pile selected for PS test: P3 = E3

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
310	PRESENT / NOT PRESENT	SIT test code	Vertical Re-bar Diameter	Helix Re-bar Diameter	Helix Pitch	Reinforc Cover (measured with tape)		Theoretical (*) circumf. 251,2 total bars 24	ACTUAL(**)	1	2	3	4	5	6	7	
			mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	
Palo P1		E1	22	12	150	88	60	6	3	44	40	79	-	-	-	-	fewer readings because of irregular shape of lateral surfac
Palo P2		E2	22	12	150	22	48	5	3	26	25	25	-	-	-	-	idem
Palo P3		E3	22	12	150	115	70	7	4	102	73	97	82	-	-	-	fewer readings because of thickness of concrete cover
Palo P4			N/A	N/A	N/A	N/A	60	6	4	102	124	70	70	-	-	-	idem
Palo P5			N/A	N/A	N/A	N/A	60	6	4	D	D	D	D	-	-	-	fewer readings because of irregular shape of lateral surfac
Palo P6			N/A	N/A	N/A	N/A	40	4	3	35	41	15	-	-	-	-	idem

Date of inspection: September 13, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile
(**) readings may be fewer because of concrete cover thickness higher than 120 mr
(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 310
Pachymeter Readings

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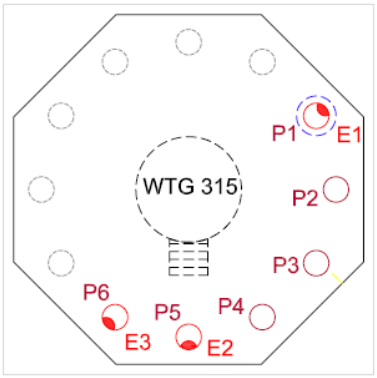
Summary of findings - Piles reinforcement

WTG 315 (Alcantara NORD)
Piled Foundation - Pile length: 22,0 m
Date when inspection was carried out: September 17th, 2013;
Inspecting Officers: G. La Tona (SER), L.C. Speranza (Scangea), GeoLAB Field Technicians.
Conclusion: Pile reinforcement is found in compliance with design (please refer to Fig. 3-C)



WTG 315
Foundation Plan
Piles exposed with excavation: P1, P2, P3, P4, P5, P6
Piles where SIT test was performed: E1, E2, E3
Pile selected for PS test: P1 = E1

WTG	NICHE FOR SIT TESTING		VISUAL INSPECTION OF PILE REINFORCEMENT				EXPOSED ARC OF LATERAL SURFACE OF PILE	NUMBER of PACHYMETER READINGS		PACHYMETER READINGS (***)							REMARKS
315	PRESENT / NOT PRESENT	SIT test code	Vertical Re-bar Diameter	Helix Re-bar Diameter	Helix Pitch	Reinforc. Cover (measured with tape)		Theoretical (*) circumf. 251,2 total bars 24	ACTUAL(**)	1	2	3	4	5	6	7	
			mm	mm	mm	mm	cm	No.	No.	mm	mm	mm	mm	mm	mm	mm	
Palo P1		E1	22	12	150	118	65	6	4	106	99	65	71	-	-	-	fewer readings because of concrete cover thickness
Palo P2			N/A	N/A	N/A	N/A	60	6	4	78	72	40	56	-	-	-	idem
Palo P3			N/A	N/A	N/A	N/A	80	8	5	D	89	D	D	D	-	-	idem
Palo P4			N/A	N/A	N/A	N/A	85	8	6	d	d	d	98	101	103	-	idem
Palo P5		E2	22	12	150	115	68	6	4	86	108	95	D	-	-	-	idem
Palo P6		E3	22	12	150	125	60	6	4	D	D	98	D	-	-	-	idem

Date of inspection: September 17, 2013
Inspected by: G. La Tona (SER)
L.C. Speranza (Scangea)
GeoLAB Personnel

(*) calculated in reference to ratio between exposed arc and total circumference of pile
(**) readings may be fewer because of concrete cover thickness higher than 120 mr
(***) meaning of D: BAR DETECTED BUT NO MEASUREMENT OF CONCRETE COVER GIVEN

WTG 315
Pachymeter Readings

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SUMMARY OF FINDINGS
Concrete
(abstract from Chapter 4)

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Summary of findings - Concrete

SCANGEA
Client: GL-GARRAD - HASSAN
Project: ALCANTARA Wind Farm Region of Sicily, Italy
Document: ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS
Date: November 15, 2013

			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure	
			Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE / NOT VIABLE	CONCRETE IS FOUND
SUD	110	PLINTH (shallow)	25/30	26	30,3	24,3		X	-6,5%		ACCEPTABLE (2)
		-	-	-	-	-					-
SUD	118	PLINTH	25/30	26	33,8	26,8			2,9%		ACCEPTABLE (2)
		PILES (11,0 m)	20/25	21	27,3	23,2			10,4%		ACCEPTABLE
SUD	130	PLINTH	25/30	26	38,1	32,1			23,3%		ACCEPTABLE (2)
		PILES (11,0 m)	20/25	21	25,1	20,1		X	-4,2%		ACCEPTABLE
SUD	133	PLINTH (shallow)	25/30	26	27,7	21,7		X	-16,5%		ACCEPTABLE (2)
		-	-	-	-	-					-
SUD	142	PLINTH	25/30	26	28,0	21,0		X	-19,1%		ACCEPTABLE (2)
		PILES (22,0 m)	20/25	21	24,3	19,3		X	-8,3%		ACCEPTABLE
NORD	214	PLINTH	25/30	26	29,9	22,9		X	-11,8%		ACCEPTABLE
		PILES (22,0 m)	20/25	21	39,0	34,0			62,0%		ACCEPTABLE
NORD	217	PLINTH	25/30	26	38,9	32,9			26,7%		ACCEPTABLE
		PILES (22,0 m)	20/25	21	43,4	38,4			82,7%		ACCEPTABLE
NORD	220	PLINTH	25/30	26	36,2	29,2			12,3%		ACCEPTABLE
		PILES (22,0 m)	20/25	21	38,4	23,6			4,9%		ACCEPTABLE (3)
		Pile 13 (extra pile) (4)	20/25								
		Connecting Beam (4)	25/30	26	40,4	33,4			28,6%		ACCEPTABLE
Annex I	310	PLINTH	25/30	26	33,9	26,9			3,4%		ACCEPTABLE
		PILES (22,0 m)	20/25	21	33,2	27,4			30,4%		ACCEPTABLE
Annex I	315	PLINTH	25/30	26	36,9	30,9			18,9%		ACCEPTABLE
		PILES (22,0 m)	20/25	21	33,0	28,0			33,3%		ACCEPTABLE

(1) ***Abstract from EN 13791 Annex A (informative)*** *The strength of a core with 100 mm diam and a height of (l/d = 1) corresponds to th strength of cube specimens with side length 150 mm.*

Plinth cores taken vertically from top surfac Abstract from EN 13791 - Annex C (informative *" ... height of a concrete pour, in-situ strength dec toward the top of a pour, even for slabs, and can l less at the top than in the body of the concrete. C strength is often concentrated in the top 300 mm depth, whichever is the less".*

(3) Specimens P4est and P4int crushed at 10,71 and 11,99 N /mm2 respectively. These values were accounted for in calculating specimens' average cubic compressive strength, but were excluded from the calculation of characteristic in-situ compressive strength because, based on the results from 3 no. additional cores taken from same pile P4, they were deemed to be the effect of a localized concrete defect.

(4) *Pile 13 and relevant beam connecting it to the plinth was built to replace adjacent pile of original foundation which was found defective by SER's Engineer Ms Vaccaro (Direttore Lavori).*

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Table 01
ASSESSMENT OF CONCRETE – SUMMARY OF FINDINGS

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Summary of findings - Concrete

WTG 110 (Alcantara SUD)
Shallow foundation

- **Plinth concrete: ACCEPTABLE.**

  It should be noted that all cores were taken by drilling vertically for 40 cms through the upper surface of the structure, i.e. from the **weaker concrete region**, as illustrated in Annex C of EN 13791 (… *"strength can be up to 25% less" than in other regions of structure"*…).

  Calculations of characteristic in-situ compressive strength yield a result of **24,3 N/mm2, which is less** (by 6,5%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2). Please refer to chart below.

  However, foundation stability re-calculated with concrete class C20/25 for the plinth (minimum characteristic in-situ strength = 21,0 N/mm2, which is less than 24,3 N/mm2), is found viable. Calculations are given in Appendix A of Annex 1 to this document, dedicated to WTG 110.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN											
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS											
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
SUD	110	PLINTH (shallow)	25/30	26	30,3	24,3		X	-6,5%			ACCEPTABLE (2)
		-	-	-	-	-						-

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Summary of findings - Concrete

WTG 118 (Alcantara SUD)
Piled foundation, length of piles: 11,0 m

- **Plinth concrete: ACCEPTABLE.**

  It should be noted that all cores were taken by drilling vertically for 40 cms through the upper surface of the structure, i.e. from the **weaker concrete region**, as illustrated in Annex C of EN 13791 (… *"strength can be up to 25% less" than in other regions of structure"*…).

  Calculations of characteristic in-situ compressive strength yield a result of **26,8 N/mm2, which is higher** (by 2,9%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2). Please refer to chart below.

- **Piles concrete: ACCEPTABLE**

  Cores (1 no. per each pile) were taken by drilling horizontally for 40 cms through the lateral surface of the piles, in locations whose distance from the lower surface of plinth was comprised between 0,8 an 2,0 m).

  Calculations of characteristic in-situ compressive strength yield a result of **23,2 N/mm2, which is higher** (by 10,4%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2). Please refer to chart below.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN						VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2						
Date:	November 15, 2013											
SUD	118	PLINTH	25/30	26	33,8	26,8			2,9%			ACCEPTABLE (2)
		PILES (11,0 m)	20/25	21	27,3	23,2			10,4%			ACCEPTABLE

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Summary of findings - Concrete

WTG 130 (Alcantara SUD)
Piled foundation, length of piles: 11,0 m

- **Plinth concrete: ACCEPTABLE.**

  It should be noted that all cores were taken by drilling vertically for 40 cms through the upper surface of the structure, i.e. from the **weaker concrete region**, as illustrated in Annex C of EN 13791 (… *"strength can be up to 25% less" than in other regions of structure"*…).

  Calculations of characteristic in-situ compressive strength yield a result of **32,1 N/mm2, which is higher** (by 23,3%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2).

- **Piles concrete: ACCEPTABLE**

  Cores (1 no. per each pile) were taken by drilling horizontally for 40 cms through the lateral surface of the piles, in locations whose distance from the lower surface of plinth was comprised between 0,8 an 2,0 m).

  Calculations of characteristic in-situ compressive strength yield a result of **20,1 N/mm2, which is less** (by 4,2%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2).

  However, foundation stability re-calculated with concrete class C16/20 for piles (minimum characteristic in-situ strength = 17,0 N/mm2, which is less than 20,1 N/mm2), is found viable. Calculations are given in Appendix A of Annex 3 to this document., dedicated to WTG 130

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN											
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS											
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
SUD	130	PLINTH	25/30	26	38,1	32,1			23,3%			ACCEPTABLE (2)
		PILES (11,0 m)	20/25	21	25,1	20,1		X	-4,2%			ACCEPTABLE

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Summary of findings - Concrete

WTG 133 (Alcantara SUD)
Shallow foundation

- **Plinth concrete: ACCEPTABLE.**

  It should be noted that all cores were taken by drilling vertically for 40 cms through the upper surface of the structure, i.e. from the **weaker concrete region**, as illustrated in Annex C of EN 13791 (… *"strength can be up to 25% less" than in other regions of structure"*…).

  Calculations of characteristic in-situ compressive strength yield a result of **21,7 N/mm2, which is less** (by 16,5%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2). Please refer to chart below.

  However, foundation stability re-calculated with concrete class C20/25 for the plinth (minimum characteristic in-situ strength = 21,0 N/mm2, which is less than 24,3 N/mm2), is found viable. Calculations are given in Appendix A of Annex IV to this document, dedicated to WTG 133.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN											
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS											
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
SUD	133	PLINTH (shallow)	25/30	26	27,7	21,7		X	-16,5%			ACCEPTABLE (2)
		-	-	-	-	-						-

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Summary of findings - Concrete

WTG 142 (Alcantara SUD)
Piled foundation, length of piles: 22,0 m

- **Plinth concrete: ACCEPTABLE.**
  It should be noted that all cores were taken by drilling vertically for 40 cms through the upper surface of the structure, i.e. from the **weaker concrete region**, as illustrated in Annex C of EN 13791 (… *"strength can be up to 25% less" than in other regions of structure"*…).

  Calculations of characteristic in-situ compressive strength yield a result of **21,0 N/mm2, which is less** (by 19,1%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2). Please refer to chart below.

  However, foundation stability re-calculated with concrete class C20/25 for the plinth (minimum characteristic in-situ strength = 21,0 N/mm2, which is equal to 21,0 N/mm2), is found viable. Calculations are given in Appendix A of Annex V to this document, dedicated to WTG 142.

- **Piles concrete: ACCEPTABLE**
  Cores (1 no. per each pile) were taken by drilling horizontally for 40 cms through the lateral surface of the piles, in locations whose distance from the lower surface of plinth was comprised between 0,8 an 2,0 m).

  Calculations of characteristic in-situ compressive strength yield a result of **19,3 N/mm2, which is less** (by 8,3%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2).

  However, foundation stability re-calculated with concrete class C16/20 for piles (minimum characteristic in-situ strength = 17,0 N/mm2, which is less than 20,1 N/mm2), is found viable. Calculations are given in Appendix A of Annex V to this document., dedicated to WTG 142.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN						VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2						
Date:	November 15, 2013											
SUD	142	PLINTH	25/30	26	28,0	21,0		X	-19,1%			ACCEPTABLE (2)
		PILES (22,0 m)	20/25	21	24,3	19,3		X	-8,3%			ACCEPTABLE

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Summary of findings - Concrete

WTG 214 (Alcantara NORD)
Piled foundation, length of piles: 22,0 m

- **Plinth concrete: ACCEPTABLE.**

  Calculations of characteristic in-situ compressive strength yield a result of **22,9 N/mm2, which is less** (by 19,1%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2). Please refer to chart below.

  However, foundation stability re-calculated with concrete class C20/25 for the plinth (minimum characteristic in-situ strength = 21,0 N/mm2, which is less than 22,9 N/mm2), is found viable. Calculations are given in Appendix A of Annex VI to this document, dedicated to WTG 214.

- **Piles concrete: ACCEPTABLE**

  Cores (1 no. per each pile) were taken by drilling horizontally for 40 cms through the lateral surface of the piles, in locations whose distance from the lower surface of plinth was comprised between 0,8 an 2,0 m).

  Calculations of characteristic in-situ compressive strength yield a result of **34,0 N/mm2, which is higher** (by 62,0%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2). Please refer to chart below.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN											
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS						VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2						
NORD	214	PLINTH	25/30	26	29,9	22,9		X	-11,8%			ACCEPTABLE
		PILES (22,0 m)	20/25	21	39,0	34,0			62,0%			ACCEPTABLE

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Summary of findings - Concrete

WTG 217 (Alcantara NORD)
Piled foundation, length of piles: 22,0 m

- **Plinth concrete: ACCEPTABLE.**

  Calculations of characteristic in-situ compressive strength yield a result of **32,9 N/mm2, which is higher** (by 26,7%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2).

- **Piles concrete: ACCEPTABLE**

  Cores (1 no. per each pile) were taken by drilling horizontally for 40 cms through the lateral surface of the piles, in locations whose distance from the lower surface of plinth was comprised between 0,8 an 2,0 m).

  Calculations of characteristic in-situ compressive strength yield a result of **38,4 N/mm2, which is higher** (by 82,7%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2). Please refer to chart below.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN											
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS											
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
NORD	217	PLINTH	25/30	26	38,9	32,9			26,7%			ACCEPTABLE
		PILES (22,0 m)	20/25	21	43,4	38,4			82,7%			ACCEPTABLE

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Summary of findings - Concrete

WTG 220 (Alcantara NORD)
Piled foundation, length of piles: 22,0 m

- **Plinth concrete: ACCEPTABLE.**
  Calculations of characteristic in-situ compressive strength yield a result of **29,2 N/mm2, which is higher** (by 12,3%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2).

- **Piles concrete: ACCEPTABLE**
  Calculations of characteristic in-situ compressive strength yield a result of **23,6 N/mm2, which is higher** (by 4,9%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2). Please refer to chart below.

  It is noteworthy that specimens initially obtained from pile P4, i.e. "**220-P4-EST**" and "**220-P4-INT**" failed at 10,71 N/mm2 and 11,99 N/mm2 respectively. Furthermore, pile P4 (please refer to foundation plan in Annex VIII, dedicated to WTG 220) is adjacent to a pile which was found defective, during construction, by the Owner's Engineer (Direttore dei Lavori). These very low values were accounted for in calculating the specimens' mean in-situ compressive strength, but were excluded from the calculation of the characteristic in-situ compressive strength because, based on the results from 3 no. additional cores taken from same pile P4, they were deemed to be the effect of a localized concrete defect.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN											
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS											
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
NORD	220	PLINTH	25/30	26	36,2	29,2			12,3%			ACCEPTABLE
		PILES (22,0 m)	20/25	21	38,4	23,6			4,9%			ACCEPTABLE (3)
		Pile 13 (extra pile) (4)	20/25									
		Connecting Beam (4)	25/30	26	40,4	33,4			28,6%			ACCEPTABLE

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Summary of findings - Concrete

WTG 310 (Alcantara NORD)
Piled foundation, length of piles: 22,0 m

- **Plinth concrete: ACCEPTABLE.**

  Calculations of characteristic in-situ compressive strength yield a result of **26,9 N/mm2, which is higher** (by 3,4%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2).

- **Piles concrete: ACCEPTABLE**

  Cores (1 no. per each pile) were taken by drilling horizontally for 40 cms through the lateral surface of the piles, in locations whose distance from the lower surface of plinth was comprised between 0,8 an 2,0 m).

  Calculations of characteristic in-situ compressive strength yield a result of **27,4 N/mm2, which is higher** (by 30,4%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2). Please refer to chart below.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure	
Client:	GL-GARRAD - HASSAN										
Project:	ALCANTARA Wind Farm Region of Sicily, Italy										
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS										
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
NORD	310	PLINTH	25/30	26	33,9	26,9			3,4%			ACCEPTABLE
		PILES (22,0 m)	20/25	21	33,2	27,4			30,4%			ACCEPTABLE

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Summary of findings - Concrete

WTG 315 (Alcantara NORD)
Piled foundation, length of piles: 22,0 m

- **Plinth concrete: ACCEPTABLE.**

  Calculations of characteristic in-situ compressive strength yield a result of **30,9 N/mm2, which is higher** (by 18,9%) than the minimum value specified by EN 13791 for C25/30 concrete (26 N/mm2).

- **Piles concrete: ACCEPTABLE**

  Cores (1 no. per each pile) were taken by drilling horizontally for 40 cms through the lateral surface of the piles, in locations whose distance from the lower surface of plinth was comprised between 0,8 an 2,0 m).

  Calculations of characteristic in-situ compressive strength yield a result of **28,0 N/mm2, which is higher** (by 33,3%) than the minimum value specified by EN 13791 for C20/25 concrete (21 N/mm2). Please refer to chart below.

SCANGEA			DESIGN CONCRE CLASS (EN 206-1	Minimum characteristic in-situ compressive strength (Table 1 of norm EN13791)	Mean in-situ compress strength (cubic) (BS 1881)	CHARACTERISTIC IN-SITU COMPRESSIVE STRENGTH (cubic) EN 13791	Characteristic in-situ compressive strength must be equal or greater than 0,85 * Rck			Fresh calculations with lesser concrete classes as follows: C20/25 for plinths, and C16/20 for piles, compatible with values of characteristic in-situ strength find the structure		
Client:	GL-GARRAD - HASSAN											
Project:	ALCANTARA Wind Farm Region of Sicily, Italy											
Document:	ASSESSMENT OF CONCRETE SUMMARY OF FINDINGS											
Date:	November 15, 2013		Rck N /mm2	fck,is = 0,85 Rck N /mm2	f is N /mm2	fck,is N /mm2	VERIFIED	NOT VERIFIED	VARIATION (%)	VIABLE	NOT VIABLE	CONCRETE IS FOUND
NORD	315	PLINTH	25/30	26	36,9	30,9			18,9%			ACCEPTABLE
		PILES (22,0 m)	20/25	21	33,0	28,0			33,3%			ACCEPTABLE

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SUMMARY OF FINDINGS
Length and integrity of piles
(abstract from Chapter 5)

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