

CONCRETE TOWERS TECHNOLOGY

ESTEYCO'S EXPERIENCE AND TRACK RECORD

Cutia e Bento Miguel WF. 149 x 120mHH
Precast concrete towers
Sao Bento do Norte (RN), Brazil
Design: ESTEYCO



Introduction

Experience on Strategic partnership with other proprietary technologies





Hybrid Concrete Towers

Proprietary technologies and unique capabilities for concrete wind towers design.

Esteyco has been designing different concrete foundations and towers typologies for more than 20 years. Because there is no a one fits all solution.



PRECAST PANEL CONCRETE TOWER

A solution that combines the advantages of concrete with serial manufacturing and industrialization, through a prefabricated concrete tower, built in easily transportable segments, pre-assembled in rings up to 20 m in the WTG location, before finally erecting the tower.

This technology allows to match the performance of the steel alternative and install 2–3 towers per week, with all the advantages of concrete and precasting.

Both full-concrete or hybrid concrete-steel towers are feasible.

Today more than **3,000 towers have been installed all over the world** based on this design and IP.



MODULAR RING CONCRETE TOWER

A mature and widely proven technology, the concrete ring tower is today the most implemented concrete tower concept in wind farms worldwide. Its extensive track record, accumulated over years of successful operation across multiple markets, stands as the best guarantee of reliability and performance. This concept offers reduced structural requirements for concrete and a system that is easily applicable anywhere in the world. Esteyco is currently collaborating with one of the world's leading OEMs in the design and optimization with **multiple innovation and validation work streams on going** at present.



FULL RING CONCRETE TOWERS

Ideally, a very competitive tower would have as few parts as possible and a very simple architecture, with concrete sections, without vertical joints.

The limitations to reducing the number of pieces are mainly the available means for transportation.

This concept offers the combination of on-site manufacturing by use of specific heavy lift transportation of full components vertically. Esteyco is currently collaborating with one of the world's leading OEMs in the **design and optimization of this tower typology for wind farms totaling over 4 GW** of capacity.



TELESCOPIC HYBRID CONCRETE TOWER

A completely new way of erecting WTG. All the assembly operations performed at lower height (less than 100m instead of 160m or beyond), greatly reducing the requirements on the crane.

Nacelle and rotor erected prior to the self-lifting by conventional crawler cranes.

Turbine and tower lifting performed with hydraulic jacking equipment → Reduced working height and crane needs.

Niche technology for isolated WF with few units and hub heights over 160m.

ESTEYCO's patented self lifting telescopic technology already **tested in 2 different real projects (on & offshore)**.

Today, the onshore prototype built in China in 2021 is still one of the tallest wind towers in the world.

Esteyco holds its own IP and property technologies as a baseline to develop the know-how which enables the capabilities to accomplish any concrete tower technology to achieve a successful route to market.

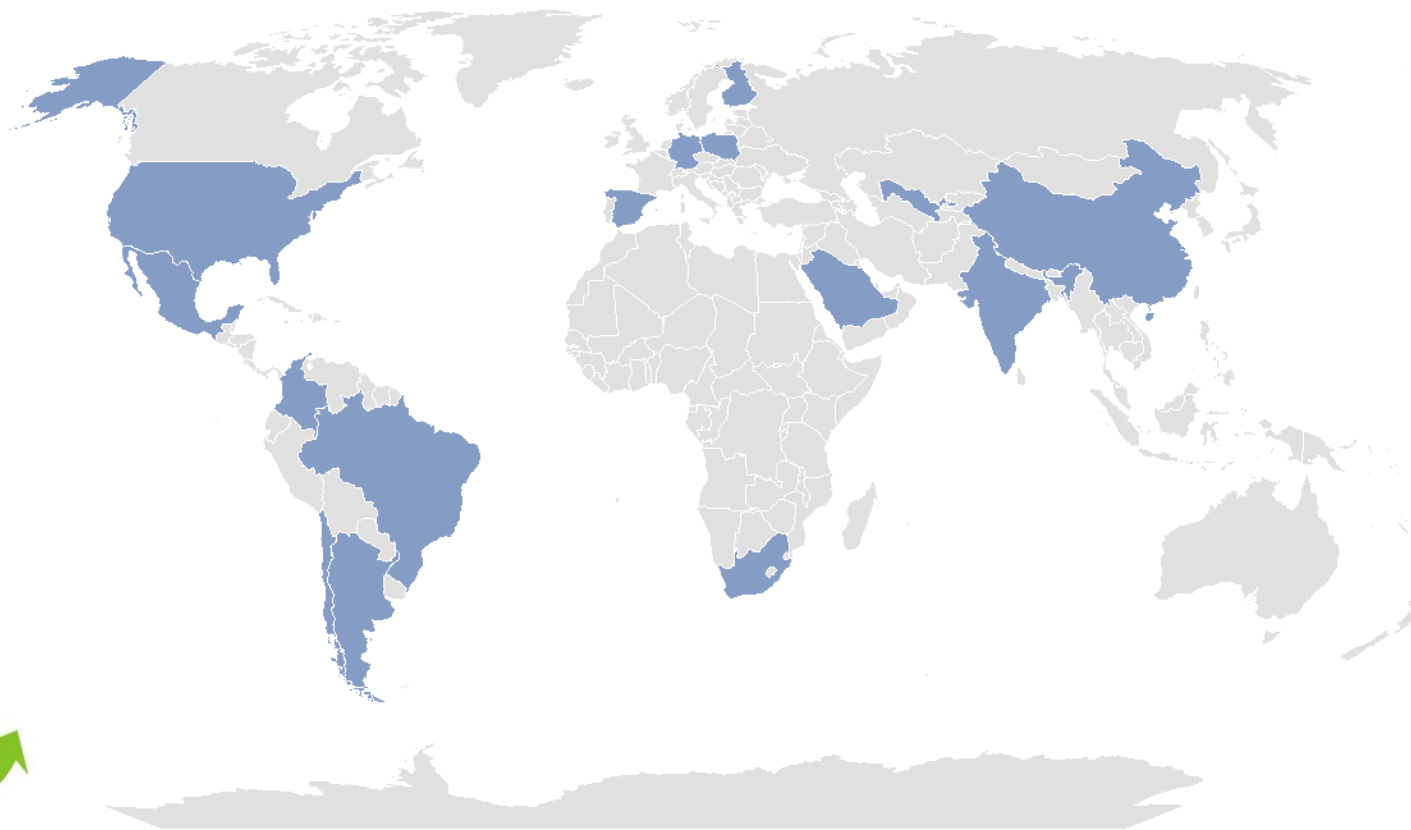


Hybrid Concrete Towers

Esteyco experience in pre-cast concrete towers: Clients and Countries

ESTEYCO is and has been a pioneer -along with some other few companies- when it comes to the precast concrete towers for the wind energy sector. Since its first realization in 2004 for ACCIONA WINDPOWER, several designs for different wind turbine manufacturers have been built.

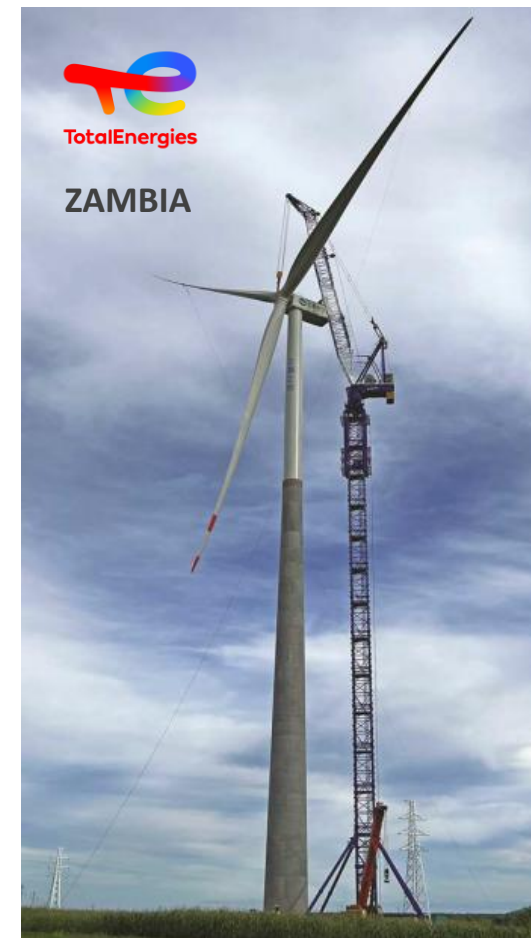
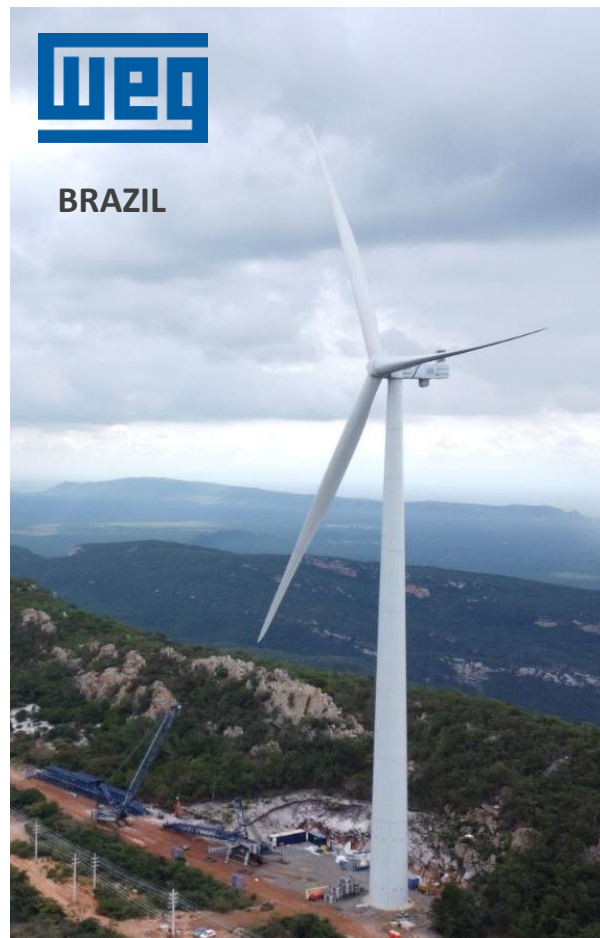
Concrete wind towers engineered by Esteyco are operating today in over 10 countries around the world.





Hybrid Concrete Towers

Esteyco current work on concrete hybrid towers: at the forefront of all technology variants.





Track Record on Hybrid Concrete Towers

Consultancy Services:

	CLIENT	WIND FARM	COUNTRY	DESCRIPTION	TYPE OF TURBINE	YEAR
TOTAL ENERGIES		UNIKA WF	ZAMBIA	CONSULTANCY SERVICES FOR THE FEASIBILITY ANALYSIS OF CONCRETE TOWERS IN ZAMBIA, INCLUDING THE PRELIMINARY DESIGN FOR DIFFERENT HEIGHTS (FROM HH140 TO HH180), AS WELL AS SCREENING, COST AND TIME ESTIMATION TASKS	GWH182-7.5; EN182-8.0	2025
ACWA		SHAQRA AND STARAH WF (PIF 5)	SAUDI ARABIA	TECHNICAL DUE DILIGENCE OF DIFFERENT HYBRID TOWER TECHNOLOGIES BASED ON PRECAST RINGS	EN-TP PRO 10.X; 146HH GWH204/10.X ; 148 HH	2025
CELSIA		PE CARRETO	COLOMBIA	INSPECTION AND ANALYSIS OF CRACKS IN CONCRETE PANELS STACKED FOR NORDEX TOWER AND SUBSEQUENT EVALUATION OF DAMAGE AND STRUCTURAL SAFETY AS WELL AS DEFINITION OF REPAIR PROCEDURE	NORDEX DELTA 4000 HH120	2024
ACWA		KUNGRAD WF	UZBEKISTAN	TECHNICAL DUE DILIGENCE OF DIFFERENT HYBRID TOWER TECHNOLOGIES BASED ON PRECAST RINGS	EN-182/8.0; 138HH GWH182/7.5; 140 HH	2024
ACCIONA ENERGIA		GOSTYN WF	POLAND	CONSULTANCY SERVICES FOR ANALYZING POTENTIAL CAUSES OF CONCRETE TOWER FREQUENCY DROP OVER WF LIFETIME	AW3000 HH120	2023
ACTIS		TAIBA & ICARAI WF	BRAZIL	TECHNICAL DUE DILIGENCE OF CONCRETE TOWERS ALREADY BUILT BASED ON PRECAST RINGS TECHNOLOGY	S95 2.1MW; HH100m	2022
NORDEX / AWP		HALTERN AN SEE WF	GERMANY	CONSULTANCY SERVICES FOR ASSESSING THE CAUSES BEHIND THE COLLAPSE OF THE VENTUR HYBRID TOWER. DEFINITION OF REINFORCING MEASURES.	N149/4.X HH164	2022
NORDEX / AWP		DOLORES WF	MEXICO	DAMAGE ASSESSMENT AND DEFINITION OF REPAIR PROCEDURE FOR LEVEL T5 CONCRETE PANELS	AW132/3300 HH120	2021
NORDEX / AWP		-	SOUTH AFRICA	DAMAGE ASSESSMENT AND DEFINITION OF REPAIR PROCEDURE FOR CONCRETE PANELS	AW132/3300 HH120	2021
NORDEX / AWP		SANTA VITORIA DO PALMAR WF	BRAZIL	DAMAGE ASSESSMENT AND DEFINITION OF REPAIR PROCEDURE FOR CONCRETE STEEL INTERFACE	AW3000 HH120	2017
NORDEX / AWP		GOSTYN WF	POLAND	INSPECTION, ANALYSIS AND DEFINITION OF REPAIR PROCEDURE FOR DAMAGES DETECTED IN VERTICAL JOINTS OF T5 LEVELS.	AW3000 HH120	2017
NORDEX / AWP		-	SPAIN	DAMAGE ASSESSMENT AND DEFINITION OF REPAIR PROCEDURE FOR VERTICAL JOINTS GAPPING DETECTED IN T5 LEVELS.	AW3000 HH120	2017
NORDEX / AWP		SAN GABRIEL WF	BRAZIL	CONSULTANCY FOR SEISMIC ANALYSIS DURING CONSTRUCTION STAGES OF THE CONCRETE TOWER	AW3000 HH120	2017
NORDEX / AWP		SAN GABRIEL WF	CHILE	CONSULTANCY FOR THE ADAPTATION OF THE CONCRETE TOWER TO SEISMIC SCENARIO	AW3000 HH120	2017

Design Services:

	CLIENT	WIND FARM	COUNTRY	DESCRIPTION	TYPE OF TURBINE	YEAR
	GOLDWIND	KUNGRAD WF	UZBEKISTAN	DETAIL DESIGN ANDE CERTIFICATION WITH DNV OF FULL-CONCRETE TOWER BASED ON PRECAST RINGS TECHNOLOGY	GWH182-7.X; HH140 m	2024-2025 (WIP)
	WEG	BROTAS DE MACAUBAS WF (PROTOTYPE)	BRAZIL	DETAIL DESIGN AND CERTIFICATION OF CONCRETE TOWER AND SITE TECHNICAL ASSISTANCE	AGW 172/7.0 HH134 m	2024
	NORDEX / AWP	-	-	PRELIMINARY DESIGN OF ONSHORE HYBRID TOWER BASED ON ESTEYCO TECHNOLOGY	N175/6.X; HH200	2024
	NORDEX / AWP	-	-	DETAIL DESIGN OF ONSHORE HYBRID TOWER BASED ON ESTEYCO TECHNOLOGY; AND CERTIFICATION WITH TUV-SUD ACCORDING TO DIBT GERMAN STANDARD	N175/6.X; HH179	2023
	NORDEX / AWP	#¡VALOR!	-	DETAIL DESIGN SUPPORT FOR ONSHORE HYBRID TOWER BASED ON ESTEYCO TECHNOLOGY; DEFINITION OF REINFORCEMENT, REVIEW/DEFINITION OF TOOLING AND PRE-ASSEMBLY AND ASSEMBLY OPERATIONS. VERIFICATION OF TOP CONCRETE SECTION UNDER LOACAL EFFECTS. ASSESSMENT OF SECOND PORFER EFFECTS OF EXTERNAL TENDONS.	N163/5.X; HH168	2022
	NORDEX / AWP	-	CHILE	PRELIMINARY DESIGN OF ONSHORE FULL-CONCRETE TOWER BASED ON ESTEYCO TECHNOLOGY;	N163/5.X; HH100	2023
	VESTAS	RIETKLOOF WF	SOUTH AFRICA	PRELIMINARY DESIGN OF FULL-CONCRETE TOWER BASED ON ESTEYCO TECHNOLOGY	V150-4.5MW HH90	2021
	JINKE 金科	PROTOTYPE	CHINA	DETAIL DESIGN OF AN ONSHORE HYBRID WIND TOWER BASED ON ESTEYCO SELF-LIFTING TELESCOPIC TECHNOLOGY	XW3600DF; HH170m	2019-2020
	DOISA	-	BRAZIL	PRELIMINARY DESIGN OF FULL-CONCRETE TOWER BASED ON ESTEYCO TECHNOLOGY	GW155-4.5 HH110- HH130	2020
	SGRE	-	BRAZIL	PRELIMINARY DESIGN OF FULL-CONCRETE TOWER BASED ON ESTEYCO TECHNOLOGY	SG 6.0-170 HH135	2019
	ESTEYCO	PROTOTYPE	SPAIN	DESIGN AND CONSTRUCTION OF THE FIRST OFFSHORE GBS IN SPAIN, BASED ON ESTEYCO SELF-LIFTING TELESCOPIC TECHNOLOGY	G132 5.0MW; HH83m	2015-2018
	NORDEX / AWP	-	-	PRELIMINARY DESIGN OF FULL-CONCRETE TOWER BASED ON ESTEYCO TECHNOLOGY	NORDEX DELTA 4000 HH120	2018
	NORDEX / AWP	-	-	PRELIMINARY DESIGN OF HYBRID TOWER BASED ON ESTEYCO TECHNOLOGY	AW 4500 HH164	2018
	GE	-	INDIA	DETAIL DESIGN OF ONSHORE HYBRID WIND TOWER BASED ON ESTEYCO SELF-LIFTING TELESCOPIC TECHNOLOGY	GE137-3.6 HH164	2017

Track Record on Hybrid Concrete Towers

Certification



TOWER	CLIENT	COUNTRY	TURBINE	HH	YEAR	CERTIFICATION BODY	
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW1500	100m	2007		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW109/3000	100m	2009		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW3000	100m	2009		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	INNEO	-	3 MW CII	100m	2009		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW1500	80m	2010		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	SPAIN	AW3000	100m	2010		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	SUZLON	-	S95 2.1MW	80m	2011		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	forres	-	TWT-2.5MW	101.7m	2011		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	Gamesa	-	G90X 2.0MW	120m	2011		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW3000	100m-120m	2012		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	INNEO	-	3MW CIII	120m	2012		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	Gamesa	-	G90GF 2ME	100.5m	2012		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	IMPSA	BRASIL	IV82	100m	2013		GL RENEWABLES CERTIFICATON

TOWER	CLIENT	COUNTRY	TURBINE	HH	YEAR	CERTIFICATION BODY	
ONSHORE PRECAST CONCRETE TOWER	INNEO	INTERNATIONAL	3MW CIII	100m	2013		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	ALSTOM	SPAIN	ECO 110 3MW		2013		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW3001	120m	2013		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	SIEMENS	BRAZIL	SWT-2.3-101	80m	2013		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	SIEMENS	BRAZIL	SWT-2.3-101	80m	2014		GL RENEWABLES CERTIFICATON
ONSHORE TELESCOPIC CONCRETE TOWER	EUROPEAN UNION	SPAIN	-	100m	2014		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW3000	120m	2015		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW3000	137.5m	2015		GL RENEWABLES CERTIFICATON
ONSHORE PRECAST CONCRETE TOWER	acciona	-	AW3000	137.5m	2018		DEWI-OCC
OFFSHORE TELESCOPIC CONCRETE TOWER	EUROPEAN UNION	SPAIN	G132 5MW	111m	2019		TÜV-SUD
ONSHORE TELESCOPIC CONCRETE TOWER	JINKE 金科国际	CHINA	D155 3.6MW	170m	2021		DNV-GL
ONSHORE PRECAST CONCRETE TOWER	WEG	BRAZIL	AGW172 /7.0MW	134m	2023		UL
ONSHORE PRECAST CONCRETE TOWER	NORDEX acciona Windpower	GERMANY	N175/6.X	179m	2023		TUV-SUD
ONSHORE PRECAST CONCRETE TOWER	Goldwind	UZBEKISTAN	GWH 182-7.7	140m	2025		DNV

Track Record on Hybrid Concrete Towers

Advisory

➤ Due diligence of concrete tower technologies

- Utilities and final windfarm customers ask Esteyco for a technical report on the concrete towers they are thinking of buying, comparison of different concrete tower concepts pros and cons, etc. Recent projects:

CLIENT		WIND FARM	COUNTRY	DESCRIPTION	TYPE OF TURBINE	YEAR
ACWA		KARAKALPAKS TAN	UZBEKISTAN	TECHNICAL DUE DILIGENCE OF DIFFERENT HYBRID TOWER TECHNOLOGIES BASED ON PRECAST RINGS	EN-182/8.0; 138HH GWH182/7.5; 140 HH	2024
ACTIS		TAIBA & ICARAI WF	BRAZIL	TECHNICAL DUE DILIGENCE OF CONCRETE TOWERS ALREADY BUILT BASED ON PRECAST RINGS TECHNOLOGY	S95 2.1MW; HH100m	2022



Due diligence of concrete towers technology for Taiba and Icarai WF.

➤ Concrete tower inspections, damage analysis, pathology and collapse studies, repair procedures

- Clients asked for consultancy services to determine root cause and potential mitigation actions not only for towers designed by ESTEYCO but also for towers from different technologies. Recent projects:

CLIENT		WIND FARM	COUNTRY	DESCRIPTION	TYPE OF TURBINE	YEAR
NORDEX / AWP	 	HALTERN ANSEE WF	GERMANY	CONSULTANCY SERVICES FOR ASSESSING THE CAUSES BEHIND THE COLLAPSE OF A HYBRID TOWER. DEFINITION OF REINFORCING MEASURES.	N149/4.X HH164	2022
ACCIONA ENERGIA		GOSTYN WF	POLAND	CONSULTANCY SERVICES FOR ANALYZING POTENTIAL CAUSES OF CONCRETE TOWER FREQUENCY DROP OVER WF LIFETIME	AW3000 HH120	2023



Hybrid tower collapse.

