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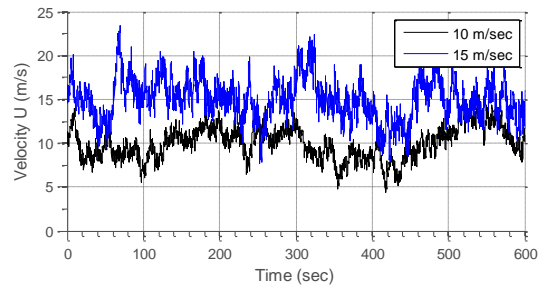
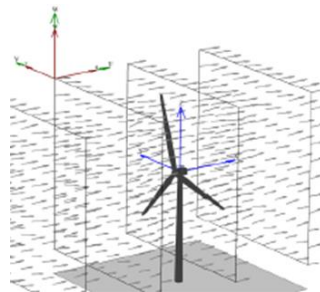
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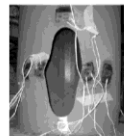
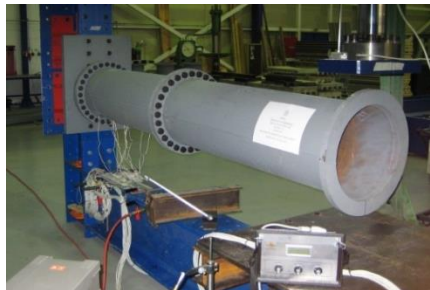
SUMMARY OF ACTIVITIES IN STRUCTURAL DESIGN AND OPTIMIZATION OF WIND TURBINE TOWERS

Year-long investigations in design and optimization of tubular steel wind turbine towers have been carried out, combining experimental, numerical and analytical methods. Particular emphasis is placed on issues of buckling of the steel shell, especially in the area of the man-door opening, behavior of the connections, avoidance of resonance of the tower-foundation system with the rotating blades, and development of new tower concepts to achieve increased height and improved energy production.

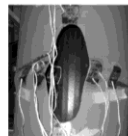
Load generation



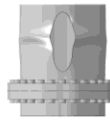
Buckling verification



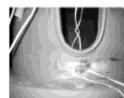
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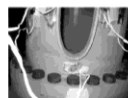
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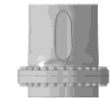
GMNA



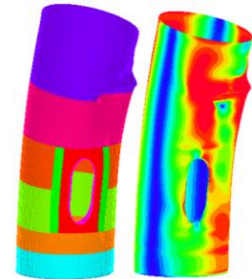
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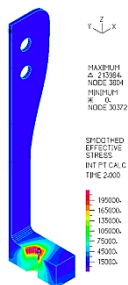
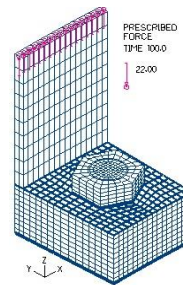
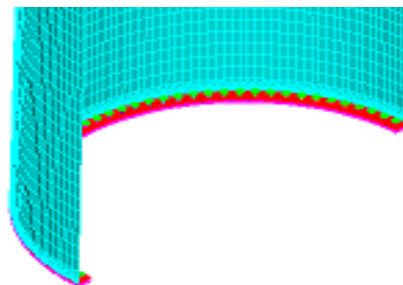
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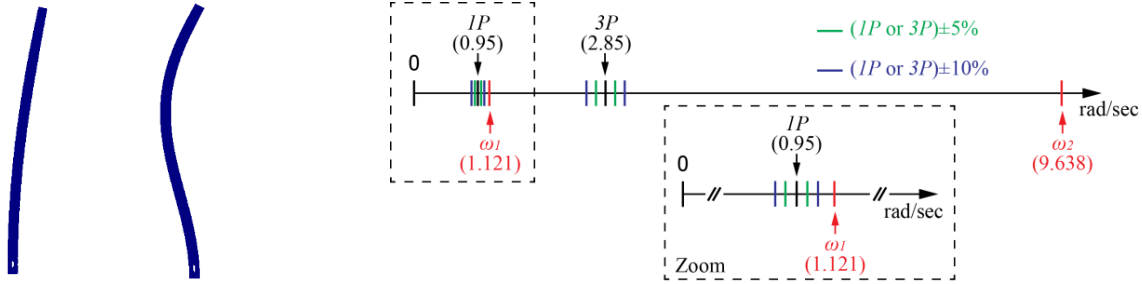
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Verification of connections



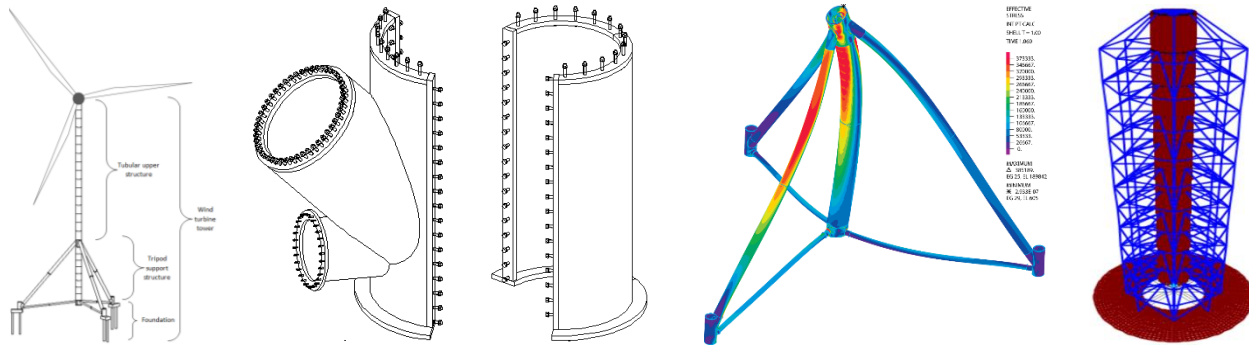
Resonance verification



Sandwich-type towers



Innovative tower concepts



DESIGN AND CONSULTING ACTIVITY

- Consultant of ATES Wind Power for optimization of wind turbine towers (since 2020).
- Consultant for the detection of causes of large amplitude vibrations of wind turbine towers at the location Koryfi, in Serres, Greece (2013).
- Checking of structural and foundation design of three 49m tall wind turbine towers of type NEG-Micon 952 for a wind park in Xirolimni, Lasithi, Crete, Greece (2005).
- Foundation design of forty one 44m tall wind turbine towers of type Vestas for a wind park in Panachaiko, Achaia, Greece (2004).
- Checking of structural and foundation design of 53m tall wind turbine towers of type NEG-Micon of "TERNA Energy S.A." for a wind park in Servouni, Evia, Greece (2002-2003).
- Structural design of 49m tall Vestas wind turbine towers of "Plastika Kritis" and their foundation (2002).

FUNDED RESEARCH PROJECTS

- "ENSSTRAM - Novel Design Concepts for Energy Related Steel Structures using Advanced Materials", Aristeia II program, Greek Secretariat for Research and Technology, budget 296,000.00€, P.I. (2013-2015).

- “SeaWind - Performance Based Engineering of Offshore Wind Turbines”, Program of Bilateral R&D Greece-Chine Cooperation 2012-2014, NTUA budget 150,000.00€, P.I. of the NTUA research team (2013-2015).
- “AIOLOS - Resolution of Complex Problems in the Analysis of "Next Generation" Wind Turbine Towers”, Thalys program, group budget 76,590€, Prof. E. Sapountzakis as P.I. (2012-2015).

SUPERVISION OF DOCTORAL THESES

- Stelios Vernardos (in progress), "Design of Wind Turbine Towers with Sandwich Type Sections".
- Konstantina Koulatsou (in progress), "Behavior and Design of Wind Turbine Tower Connections".
- Christoforos Dimopoulos (July 2012), “Stiffening of Manhole Opening of Steel Wind Turbine Tower Shells - Experimental and Numerical Investigation”.
doi: <http://dx.doi.org/10.26240/heal.ntua.788>

JOURNAL PUBLICATIONS

- Gantes, C.J., Koulatsou, K.G. and Chondrogiannis, K.-A., “Alternative Ring Flange Models for Buckling Verification of Tubular Steel Wind Turbine Towers via Advanced Numerical Analysis and Comparison to Code Provisions”, *Structures*, Vol. 47, pp. 1366-1382, Jan. 2023.
doi: <https://doi.org/10.1016/j.istruc.2022.11.090>
- Gantes, C.J., Villi Billi, M., Güldogan, M. and Gül, S., “A Novel Tripod Concept for Onshore Wind Turbine Towers”, *Energies*, Vol. 14, Issue 18, 5772, 2021.
doi: <https://doi.org/10.3390/en14185772>
- Vernardos, S.M., Gantes, C.J., Badogiannis, E.G. and Lignos, X.A., “Experimental and Numerical Investigation of Steel-Grout-Steel Sandwich Shells for Wind Turbine Towers”, *Journal of Constructional Steel Research*, Vol. 184, 106815, Sep. 2021.
doi: <https://doi.org/10.1016/j.jcsr.2021.106815>
- Koulatsou, K.G., Kazakis, G., Gantes, C.J. and Lagaros, N.D., “Resonance Investigation and its Effects on Weight Optimization of Tubular Steel Wind Turbine Towers”, *Procedia Manufacturing*, Vol. 44, pp. 4-11, 2020.
doi: <https://doi.org/10.1016/j.promfg.2020.02.198>
- Sakka, E.G., Billionis, D.V., Vamvatsikos, D. and Gantes, C.J., “Onshore Wind Farm Siting Prioritization Based on Investment Profitability for Greece”, *Renewable Energy*, Vol. 146, pp. 2827-2839, Feb. 2020.
doi: <https://doi.org/10.1016/j.renene.2019.08.020>
- Vernardos, S. and Gantes, C.J., “Experimental Behavior of Concrete-Filled Double-Skin Steel Tubular (CFDST) Stub Members under Axial Compression: A Comparative Review”, *Structures*, Vol. 22, pp. 383-404, Dec. 2019.
doi: <https://doi.org/10.1016/j.istruc.2019.06.025>
- Vernardos, S. and Gantes, C.J., “Cross-Section Optimization of Sandwich-Type Cylindrical Wind Turbine Towers”, *American Journal of Engineering and Applied Sciences*, Vol. 8, Issue 4, 2015.
doi: <http://dx.doi.org/10.3844/ajeassp.2015.471.480>
- Dimopoulos, C.A., Koulatsou, K., Petrini, F. and Gantes, C.J., “Assessment of Stiffening Type of the Cutout in Tubular Wind Turbine Towers under Artificial Dynamic Wind Actions”, *Journal of Computational and Nonlinear Dynamics (ASME)*, Vol. 10, No. 4, pp. 041004-1 - 041004-9, July 2015.
doi: <http://dx.doi.org/10.1115/1.4028074>

- Dimopoulos, C.A. and Gantes, C.J., “Numerical Methods for the Design of Cylindrical Steel Shells with Unreinforced or Reinforced Cutouts”, *Thin-Walled Structures*, Vol. 96, pp. 11-28, 2015.
doi: <http://dx.doi.org/10.1016/j.tws.2015.07.024>
- Dimopoulos, C.A. and Gantes, C.J., “Comparison of Stiffening Types of the Cutout in Tubular Wind Turbine Towers”, *Journal of Constructional Steel Research*, Vol. 83, pp. 62-74, April 2013.
doi: <http://dx.doi.org/10.1016/j.jcsr.2012.12.016>
- Dimopoulos, C.A. and Gantes, C.J., “Experimental Investigation of Buckling of Wind Turbine Tower Cylindrical Shells with Opening and Stiffening under Bending”, *Thin-Walled Structures*, Vol. 54, pp. 140-155, May 2012.
doi: <http://dx.doi.org/10.1016/j.tws.2012.02.011>

CONFERENCE PUBLICATIONS

- Gantes, C.J., Vernardos, S., Koulatsou, K.G., Doğanli, A.E. and Güneş, O., “Optimization of Mandoor and Ventilation Openings of Tubular Steel Wind Turbine Towers with Respect to Buckling”, *6th Izmir Wind Symposium and Exhibition*, Izmir, Turkey, 23-24 Sep. 2021.
- Gantes, C.J., Villi Billi, M., Güldogan, M. and Gül, S., “A Tripod Substructure for Tall Onshore Wind Turbine Towers”, *6th Izmir Wind Symposium and Exhibition*, Izmir, Turkey, 23-24 Sep. 2021.
- Koulatsou, K.G., Chondrogiannis, K.-A. and Gantes, C.J., “Buckling Verification of Manhole Area of Tubular Steel Wind Turbine Towers via Non-linear Finite Element Analysis”, *ce/papers Special Issue: EUROSTEEL 2021 Sheffield – Steel's coming home*, Vol. 4, Issue 2-4, pp. 2425-2433, *9th European Conference on Steel and Composite Structures*, Sheffield, UK, Sep. 2021.
doi: <https://doi.org/10.1002/cepa.1291>
- Koulatsou, K.G., Kazakis, G., Gantes, C.J. and Lagaros, N.D., “Resonance Investigation and its Effects on Weight Optimization of Tubular Steel Wind Turbine Towers”, *OptArch2019: 1st International Conference on Optimization Driven Architectural Design*, Amman, Jordan, 5-7 Nov. 2019.
- Koulatsou, K.G., Chondrogiannis, K.-A. and Gantes, C.J., “Structural Optimization of Tubular Steel Wind Turbine Towers with Respect to Buckling”, *Form and Force: IASS Annual Symposium 2019 - Structural Membranes 2019*, Barcelona, Spain, 7 - 10 Oct. 2019.
- Vernardos, S.M., Papageorgiou, N. and Gantes, C.J., “Nonlinear Finite Element Analysis of Steel-Concrete-Steel Sandwich Wind Turbine Towers”, *International Association for Shell and Spatial Structures (IASS) Symposium 2018 - Creativity in Structural Design*, Boston, U.S.A., 16-20 July, 2018.
- Koulatsou, K., Kosmidou, E., Lignos, X.A. and Gantes, C.J., “Experimental Investigation of the Behavior of Bolted Wind Turbine Tower Connections under Static Loading”, *9th Hellenic National Conference on Steel Structures*, Larissa, Greece, 5-7 Oct. 2017 (in Greek with English summary).
- Vernardos, S.M., Lignos, X.A., Badogiannis, E.G. and Gantes, C.J., “Experimental Investigation of Bending Behavior of Sandwich Section Shells for Wind Turbine Towers”, *9th Hellenic National Conference on Steel Structures*, Larissa, Greece, 5-7 Oct. 2017 (in Greek with English summary).
- Ntaifoti, A.I., Koulatsou, K.G. and Gantes, C.J., “Numerical Simulation of Flange-Bolt Interaction in Wind Turbine Tower Connections”, *8th GRACM International Congress on Computational Mechanics*, Volos, Greece, 12-15 July 2015.
- Margariti, G., Papadopoulos, A., Barmpas, D., Gantes, C.J. and Gkologianis, C.P., “Design of Monopile vs Tripod Foundation of Fixed Offshore Wind Turbines via Advanced Numerical Analysis”, *8th GRACM International Congress on Computational Mechanics*, Volos, Greece, 12-15 July 2015.
- Margariti, G., Bentas, A., Gantes, C.J., Fourniotis, N. and Dimas, A.A., “Parametric Study of Wind Effect on Wave Hydrodynamic Loading Acting on Monopile Offshore Wind Turbines”, *8th Greek National Steel Structures Conference*, Tripoli, 2-4 Oct. 2014 (in Greek with English summary).

- Margariti, G., Bentas, A. and Gantes, C.J., “Comparative Evaluation of Structural Design Parameters of Monopile Offshore Wind Turbines”, *8th Greek National Steel Structures Conference*, Tripoli, 2-4 Oct. 2014 (in Greek with English summary).
- Vernardos, S.M. and Gantes, C.J., “Preliminary Feasibility Investigation of Sandwich-Type Shells for Wind Turbine Towers”, *8th Greek National Steel Structures Conference*, Tripoli, 2-4 Oct. 2014 (in Greek with English summary).
- Koulatsou, K., Thanasoulas, I., Margariti, G. and Gantes, C.J., “Artificial Wind Load Time Histories Generation on Wind Turbine Towers”, *8th Greek National Steel Structures Conference*, Tripoli, 2-4 Oct. 2014 (in Greek with English summary).
- Thanasoulas, I., Koulatsou, K. and Gantes, C.J., “Nonlinear Numerical Simulation of the Response of Bolted Ring Flanges in Wind Turbine Towers”, *8th Greek National Steel Structures Conference*, Tripoli, 2-4 Oct. 2014 (in Greek with English summary).
- Thanasoulas, I., Koulatsou, K.G. and Gantes, C.J., “Nonlinear Numerical Simulation of Bolted Ring Flanges in Wind Turbine Towers”, *IASS-SLTE 2014 Symposium*, Brasilia, Brazil, Sep. 15-19, 2014.
- Koulatsou, K., Dimopoulos, C.A. and Gantes, C.J., “Evaluation of Stiffening Types of the Cutout in Tubular Wind Turbine Towers via Dynamic Analysis”, *International Association for Shell and Spatial Structures (IASS) Symposium 2013 “Beyond the Limits of Man”*, J.B. Obrębski and R. Tarczewski (eds.), Wroclaw University of Technology, Poland, Sep. 23-27, 2013.
- Dimopoulos, C.A. and Gantes, C.J., “Comparison of Stiffening Types of the Cutout in Cylindrical and Conical Steel Wind Turbine Towers”, *CanCNSM2013: 4th Canadian Conference on Nonlinear Solid Mechanics*, Montreal, Canada, July 23-26, 2013.
- Koulatsou, K., Petrini, F., Vernardos, S. and Gantes, C.J., “Artificial Time Histories of Wind Actions for Structural Analysis of Wind Turbines”, *BCCCE 2013: 2nd International Balkans Conference on Challenges of Civil Engineering*, Tirana, Albania, May 23-25, 2013.
- Dimopoulos, C.A. and Gantes, C.J., “Behaviour and Strength of Cylindrical Shells with Opening and Different Strengthening Schemes under Bending”, *7th Greek National Steel Structures Conference*, Volos, Sep. 29 - Oct. 1, 2011 (in Greek with English summary).
- Psarropoulos, P., Panagiotou, M., Gantes, C.J. and Gazetas, G., “Dynamic Interaction between Soil and Wind Turbines”, *5th Greek National Geotechnical Engineering Conference*, Xanthi, 31 May-2 June 2006 (in Greek with English summary).
- Panagiotou, M., Psarropoulos, P., Gantes, C.J. and Gazetas, G., “The Role of Dynamic Soil-Foundation-Structure Interaction in the Design of Wind Turbine Towers”, *5th Greek National Steel Structures Conference*, Xanthi, 29 Sep.-2 Oct. 2005, E. Galousis, I. Ermopoulos, Ch. Calfas Eds., Vol. II, pp. 289-296 (in Greek with English summary).