

Solar trackers

Structural and wind stability



Solar trackers and their aeroelastic stability

The intense growth of solar photovoltaic energy industry has led to the development of more and more optimised highly productive systems. Nowadays, solar trackers are the most installed system. Nevertheless, their structure has wind-resistance liabilities, and they are prone to experience aeroelastic instabilities (torsional instability and vortex shedding) because of their airplane wing-like geometry, their low mass and torsional stiffness, and their low structural damping. The solar tracker must be designed according to these phenomena in order to guarantee its proper behaviour during plant lifetime. In this way, structural failure, which could lead up to losses on the plant energy production and repairs, are avoided.

As trackers are systematically repeated in every plant, potential defects unnoticed at project phase are spread proportionally according to plant size. Thus, any on-site repair would have a high cost. For this reason, it is highly advisable to ensure the system sturdiness at project phase by means of a specialized due diligence.

The analysis of the aeroelastic response of trackers demands a high technical qualification and experience, for the purpose of determining their safety and reliability based on the environment of each PV plant and the country technical standards. Anyway, the lack of particular design standards implies that the study of the aeroelastic response of trackers must be carried out using wind tunnel testing or computational fluid dynamics (CFD) simulations.

Services

MC2 Estudio de Ingeniería has experience in designing complex and special structures. Besides, MC2 Estudio de Ingeniería engineers are proficient in performing computational fluid dynamics (CFD) simulations to predict wind actions on buildings and other structures. Consequently, an integral approach for the review of a solar tracker design can be offered by MC2 Estudio de Ingeniería to their clients.

- Review of structural design and due diligence.
- Assistance and support for planning and development of wind tunnel testing, and interpretation of results.
- Assistance and support for planning and development of quality control testing of materials, structural elements and mechanisms as dampers and blocking systems.
- Analysis through CFD techniques of trackers stability in the face of aeroelastic phenomena.
- On-site inspection of solar plants and works supervision.
- Statement of the most likely cause of damage to a plant because of wind action. Structural pathology studies and expert witness statements.
- Analysis and design of remedial measures for systems with an insufficient wind-resistance and/or wind-stability design. Both on design phase and already built plants.
- Technical support at structural design for manufacturer and supplier companies, from conception.



Experience

MC2 Estudio de Ingeniería has an extensive experience in performing wind engineering studies, including their integration with structural design projects carried out by the company. Among the performed studies, the following stand out: finding of wind actions on buildings and other structures, studies of pedestrian wind comfort in urban areas, analysis of wind-induced vibrations and assessment of the aeroelastic response of bridges and other slender structures.

MC2 Estudio de Ingeniería has reviewed the design of numerous solar tracker models, including the models of seven companies amongst the top ten largest worldwide suppliers. In this way, MC2 Estudio de Ingeniería knows the most common configurations of the market in depth:

- 1V, 2V and 3H configurations, chord length between 2 and 4 meters.
- Row length between 30 and 100 meters.
- Any position and operation of the torque tube.
- Stow at 0 degrees or any other stow strategy.
- Models without/with blocking systems and/or dampers.

MC2 Estudio de Ingeniería works with absolute independence for any party involved in the project of a solar trackers plant: economic consultants, promoters, construction companies or EPC contractors, and trackers suppliers. MC2 Estudio de Ingeniería has participated in solar trackers projects whose total installed capacity surpasses 1.6 GW.



MC2 Estudio de Ingeniería is also capable of tackling the study of wind action on fixed-tilt solar structures (ground mounted or roof mounted), as well as their structural review or design.

Fluid-structure interaction CFD simulation of an isolated solar tracker



Time-evolution of internal torsional moment experienced by a solar tracker



Finite element models of solar trackers





Replication through a finite element model of the torsional failure experienced by a torque tube on-site



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