



SEISMIC VERSION OF AIR-HANDLING UNITS

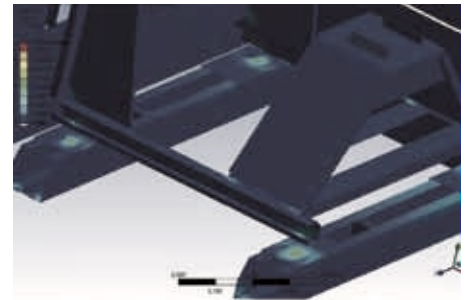
REMAK

General description of application



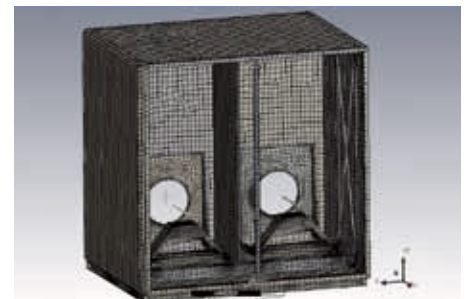
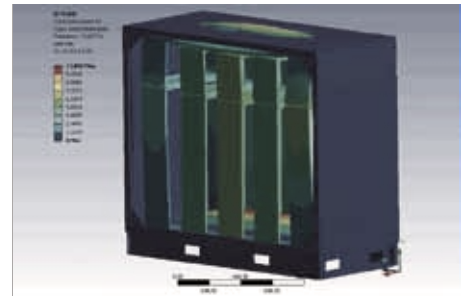
In seismic areas with a high risk of earthquakes, the basic aim is to design and build all structures and systems (including air-handling devices) so that damage to such structures and technology as well as casualties will be reduced as far as possible even if maximum calculated seismic parameters have been reached. Special requirements are applied for power station structures which must allow them to be safely shut down if an earthquake occurs; for nuclear

power plants, it is necessary to ensure such conditions which will enable the reactor's active zone to be safely cooled. The REMAK team has the necessary know-how to ensure the seismic resistance of air-handling unit structures, thanks to which we are able to comply with these very specific requirements to ensure maximum satisfaction of the customer.



Project

Depending on the project type, our company is able to design, manufacture and deliver devices designed for the 1a, 1b, 2a or 2b category up to the level of the maximum design earthquake, sometimes also designated MDE (Maximum Design Earthquake), or for SL-2 Earthquake in accordance with IAEA Safety Standards Series No. NS-G-3.3 and NS-G-1.6. As standard, each device is delivered with accompanying technical and qualification documentation proving its high quality, which includes calculations and graphic outputs of various dynamic analyses and tests, or in-field tests performed by recognised testing bodies, which prove the resistance of these structures. When modelling, we use advanced finite element method computing analyses in the ANSYS environment.



What cooperation with remak brings to investors and designers

Investor

- Complete delivery from a single supplier
- Guarantee of the correct seismic design of all the delivered structures in accordance with seismic classes
- Guaranteed service life of the units and their structures depending on requirements
- Guaranteed technical parameters of the device - among others, also thanks to Eurovent certification
- Ability to work in international teams
- Supervision of installation and initial regulation of air-handling units
- Top-class service assistance
- Fast delivery of spare parts

Designers

- The highest level of design support
- Professional technical outputs
- Expert consulting on design solutions
- Eurovent certified technical designs of air-handling devices



Reference installation of units in seismic versions

In the following article, you can read about our delivery of REMAK air-handling units for the YUNUS EMRE power plant project in Turkey which proves the high level of our know-how.

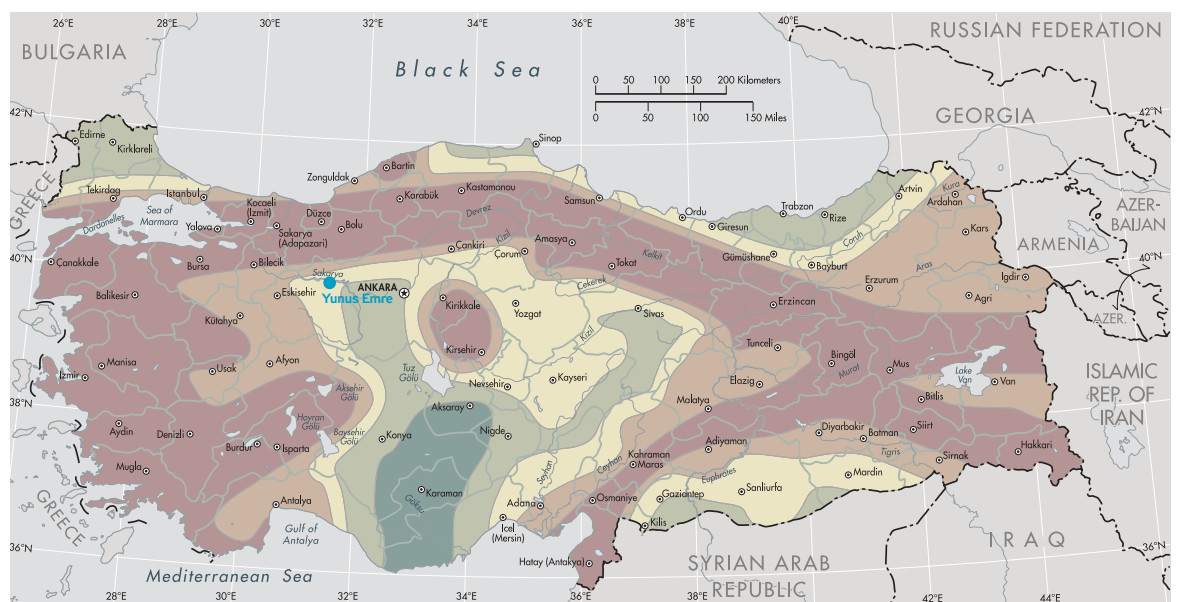
In 2013, REMAK a.s. and VÍTKOVICE POWER ENGINEERING concluded a contract for the delivery of air-handling units for the new Yunus Emre thermal power plant being built in Turkey, for which VÍTKOVICE POWER ENGINEERING is the general contractor. The delivery of REMAK air-handling units had to be completed in the same year so we, as the supplier, were placed under enormous time pressure. In the following text, you can read about all the aspects of this project.



Project description in terms of site requirements, demands and seismicity

This power plant is situated in the Central Anatolia Region (Asia Minor), in the Sundiken Mountains at an altitude of 500 m. It lies 150 km west of the Turkish capital Ankara on the Sakkarya River at the Sariyer dam reservoir. Local temperatures can drop to -20°C in winter, and rise to 42°C in summer. Relative humidity fluctuates between 50 % in summer, and 70 % in winter.

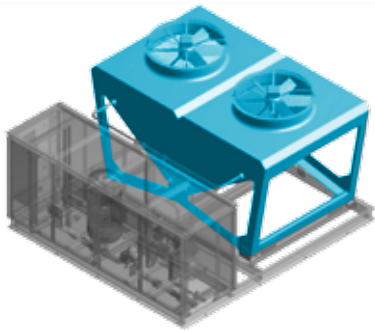
It has been designed as a two-unit power plant with common auxiliary facilities. Each of the two boilers can deliver up to 440 tons of steam per hour with the following steam parameters: 13.9 MPa at 543°C , or 3.7 MPa at 540°C (with reheating). The power plant is fuelled by Turkish lignite from nearby mines. The rated power at the generator's terminals of $2 \times 145 \text{ MWe}$ is provided by two turbines with unregulated steam bleeding and steam admission to the intermediate part from the reheater. The power is supplied to the national 400 kV electricity network. The seismicity of this area is quite mild for Turkish conditions. However, it is very high in comparison to Central Europe



Locality and location of the Yunus Emre power plant on a map of Turkey.

Description of our delivery and how we resolved the requirements resulting from this assignment

Subject of delivery



Kondenzační jednotky v seizmickém provedení

The subject of the REMAK delivery was to deliver 53 AeroMaster XP and Cirrus air-handling units in seismic versions. The delivery included VCS control units, which as well as the air-handling units comply with seismic requirements. Simultaneously, we were chosen to deliver 67 condensing units in seismic versions, including accessories for cooling circuits, control systems and the „Basic Design“ project of the duct lines, for which we also ensured seismic resistance of the structure. The structural seismic resistance was proved by an extensive report, including strength calculations and analyses of dynamic stresses caused by a possible earthquake, a detailed description of the air-handling units and material requirements and specifications. The seismic resistance of the control units was tested on real samples at the Military Research Institute in Vyškov.

Particularities

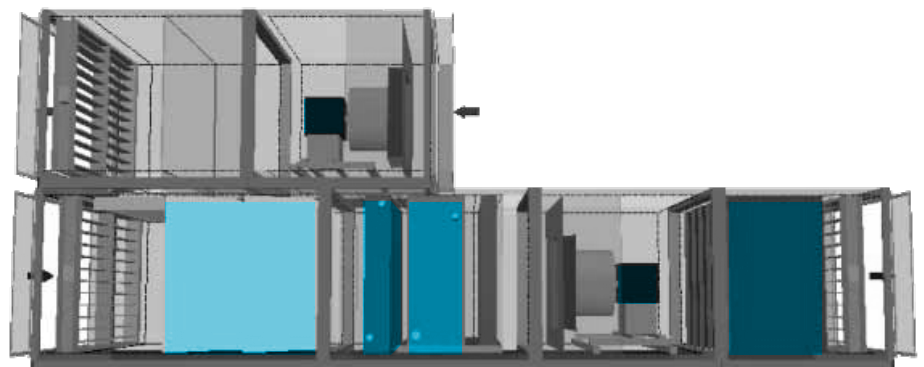
- The total weight of all 53 air-handling units was 86 tons.
- The partial deliveries underwent strict production checks and customer quality inspections. All the inspections were passed without any objections from the customer.
- The delivery logistics were very specific and demanding, especially with regards to the uniform marking system. The arrangements of partial deliveries for such a large project, as this power plant certainly is, had to be perfect. This especially concerned the number of partial deliveries for the different parts of the power plant and different equipment complexes.

Seismic requirements

The air-handling units and accessories were delivered in the 1b seismic category in accordance with the requirements. The air-handling units must feature seismic resistance in the sense of retaining mechanical integrity (strength and leak tightness) in accordance with the applicable regulations up to the Maximum Design Earthquake (SL-2). For this application, functionality can be impaired, i.e. it is acceptable.

Particularities

- Some air-handling units are situated on the building roof, 53 m high. This means that they had to be dimensioned for gravity acceleration of 20 g, while gravity acceleration at the ground level is only 0.2 g.
- The delivery also included air-handling units with an outlet section installed on the inlet section, which further increased the requirements for the seismic resistance of the air-handling unit structure.



Air-handling units with increased structural seismic resistance – the outlet section on the inlet section



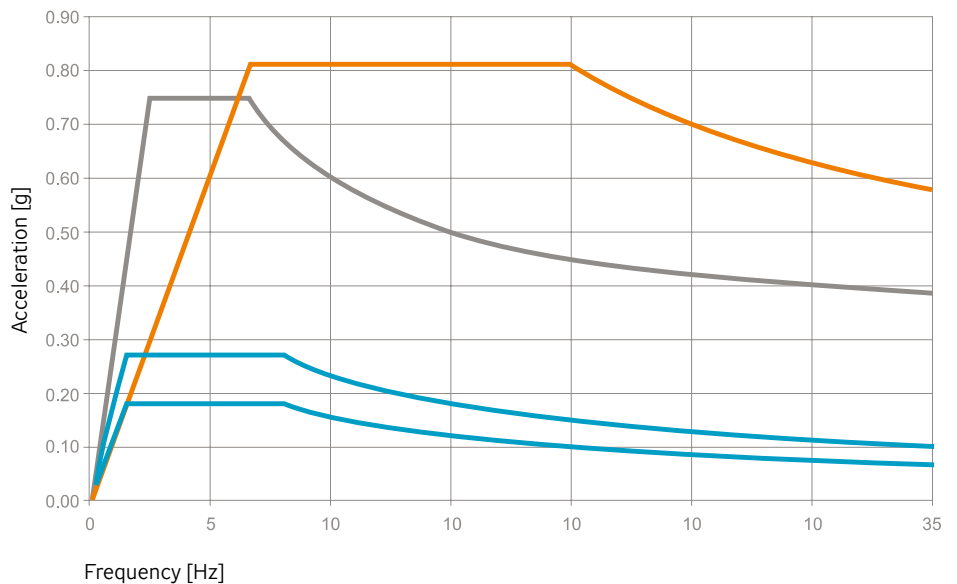
Construction of the boiler structure, the cooling tower height is 115 m, the boiler height is 53 m.

Ground acceleration response

Comparison of the ground acceleration responses for Yunus Emre and JE Temelín, units 1 and 2.** (They specify the seismic load applied to structural objects in the respective locality.)

* GRS – Ground Response Spectrum
 ** Definition of the seismic requirement for the delivery for ETE34 is now being prepared. It is expected that this requirement will be increased in comparison to ETE12 in accordance with the current international requirements of the International Atomic Energy Agency (IAEA)

Yunus Emre GRS* horizontal	JE Temelín GRS horizontal
Yunus Emre GRS vertical	JE Temelín GRS horizontal





According to the project documentation, the locality and power station type required C3 class corrosion resistance close to the C4 class and H class service life in accordance with EN14713-1, especially due to the high SO₂ content in the air. A minimum 15-year service life of the protective coatings results from these requirements for corrosion resistance. Neither Zn275 galvanised sheet, commonly used in construction, nor another commonly used finish, powder coating, comply with this requirement. Therefore, all the devices are manufactured using more surface corrosion resistant Aluzink material or are coated with several layers of protective coatings of the corresponding thickness. The thickness and quality of the protective layers was thoroughly checked and measured during production.

service life minimum of **15** years

Construction of the boiler structure with a cooling tower in the background.



Construction of the boiler structure on which several REMAK air-handling units are placed, these units will stand the highest dynamic load in case of an earthquake.





Design details of seismic air-handling units

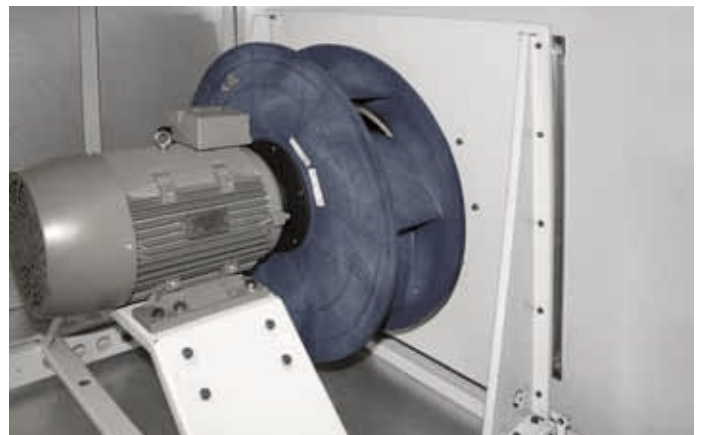
The AeroMaster Cirrus fan assembly equipped with a raised section beam screwed to the unit's base frame and silent-blocs with stops in a design corresponding to the required seismic load.

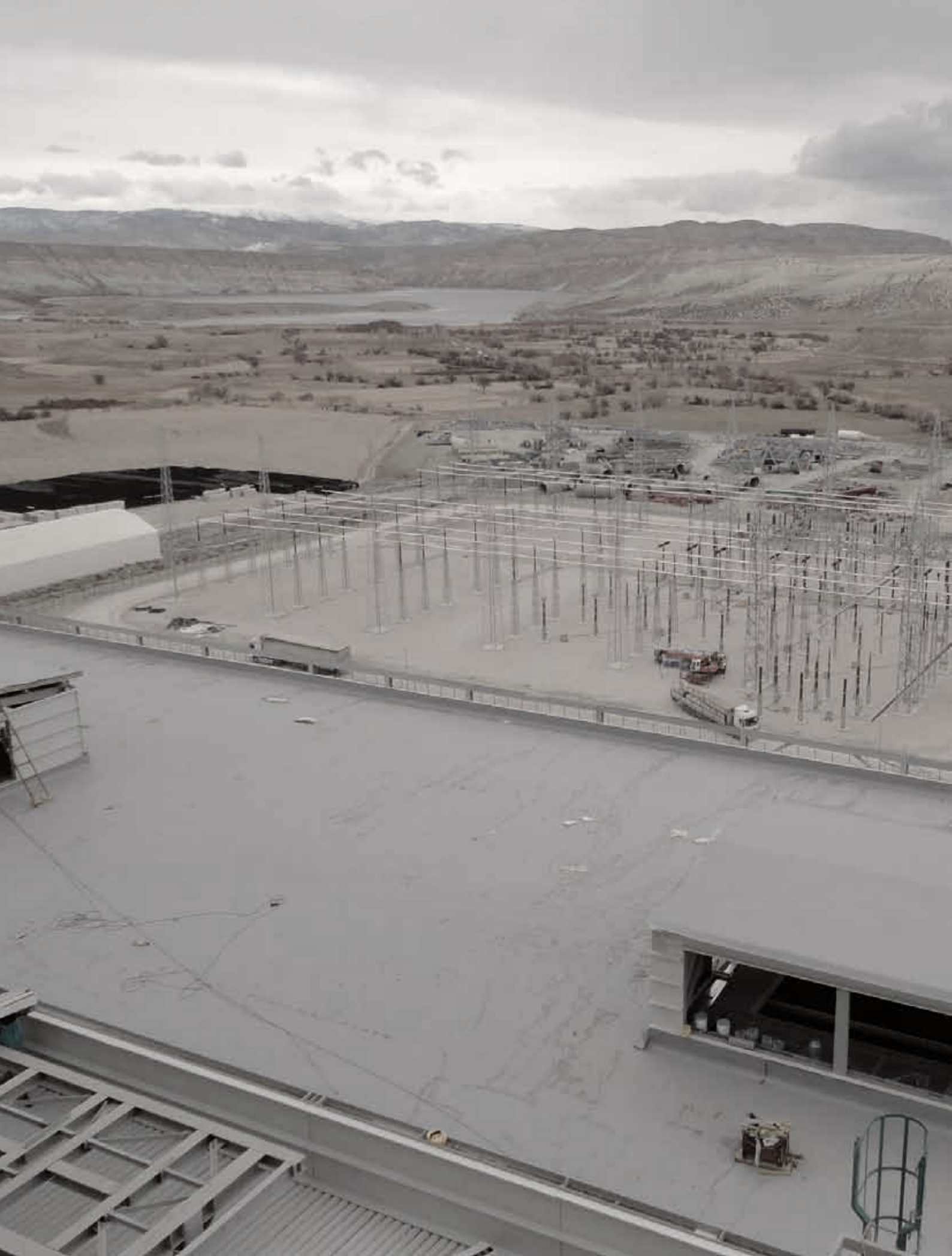


AeroMaster XP fan assembly equipped with a raised section beam and silent-blocs with stops in a design corresponding to the required seismic load.



Fan assembly, overhung impeller and adjustments for seismic version and enhanced corrosion resistance.





Design details of seismic air-handling units

Evaporator fitted on rails and supported with side distancing pieces to transfer seismic responses from the bottom wall.



Seismic fan assembly (twin fan) of the air-handling unit equipped with a reinforced motor bracket and reinforced seismic casing.



Seismic version of the air-handling unit's connecting frame equipped with corner reinforcements .



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