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Structures for Air Cooled Condensers: A Review

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Abstract—

"*This contribution summarizes the knowledge and results obtained in the field of designing technology platforms for the energy sector. A convenient solution to distribute elements and materials for various technological platforms with special digital modules is sought. The technology platform is the main support structure for the air-cooled condenser (ACC) that provides cooling for the equipment. The core of the solution consists of at least one bed built on the platform and at least one horizontal section to support the load-bearing column and the condenser converter. The structure of the platform must ensure sufficient spatial strength and the stability and performance of the ACC. Design requirements are determined by the size and weight of individual condenser modules and the total number of installation modules".*

Keywords: Air Cooled Condensers, Concrete, Composite, Steel, Technological Platforms

I. INTRODUCTION

Every power source using turbines and the Rankine cycle requires a source of cooling in addition to a source of heat and steam. Here, the heat of the steam is extracted and the steam condenses after passing through the turbine. Cooling is usually provided by a water-cooled condenser. This means that the steam condensation process is provided by cooling water supplied either from an artificial reservoir or from a natural source such as a river. However, this cooling system cannot be used in all areas. The problem arises especially in situations where only a small amount of water is available at a given location, such as in arid regions where water is a scarce commodity or in countries where strict environmental legislation does not allow the use of water or where a wet solution is very expensive. Another problem arises if there is no suitable place for sewage discharge nearby and the integrity of the system is at risk in winter. In this case, it is ideal to use an air-cooled condenser, thus avoiding the aforementioned complications caused by the use of water. Dry cooling technologies that use air as a cooling medium are more environmentally friendly. The application and use of air-cooled condensers logically saves water, which allows us to achieve a greener variant of improving environmental care. These low-emission systems, which do not discharge hot water into the sea or rivers, have no effect on the ecosystem. In addition, dry cooling systems have very low maintenance requirements, which makes it possible to minimize overall costs. In actual operation, individual air condenser fans that ensure air intake are placed on a support structure that ensures their position in space and enables their operation. Such a structure must be able to support its own weight, the weight of the ACC and ancillary equipment required for proper operation, the load caused by the control device and the external load acting on the structure.

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II.PRINCIPLE OF AIR-COOLED CONDENSER

Evaporation condensation is used as all forms of refrigeration in all commercial establishments to remove excess heat produced by the technology. Therefore, the water-cooled condenser dissipates after condensing water vapor at low vapor pressure. In theory, it is cooled by atmospheric air with compressed air flow. The waste stream flows from the turbine through a large diameter pipe to the ACC itself. The soil from the buried pipe is used for thermal insulation. Condensing agent - steam - flows through them and cold air escapes from the tube. Steam condenses directly in the parallel tube motor and returns to the unit. An axial fan located in each module ensures that the cooling air passes through the heat exchanger tubes.

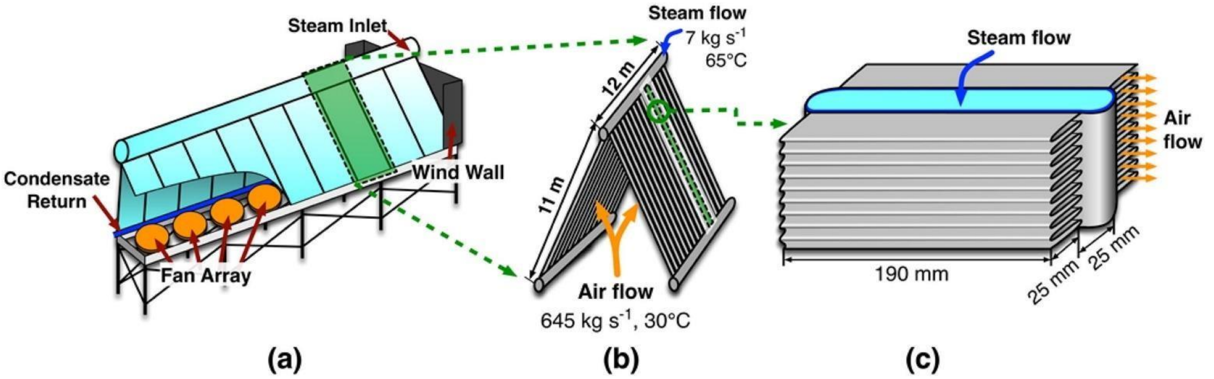

Fig. Principle of air-cooled condenser

III.MATERIAL AND CONSTRUCTION

The selection of substances for the development of the technological platform of capacitor storage relies upon on several elements. The maximum important are, as an instance, geography, the area of the condenser within the constructing and the full heat output of the strength plant. The output strength determines the range of fans required to cool the final extent of steam. This determines the height of the support shape. as the number of fans increases, so does the height of the support shape. because of the peak of the probe, enough space is needed for the fan to characteristic nicely. the subsequent fabric answer is based totally on the above elements and the outside format of the fan. Constructing a metallic production is the highest high-quality general constructing fabric. because of power, steel elements are skinny and light. This advantage also takes place for the duration of transportation and set up. metallic creation gives high-quality clearance and top when carrying heavy loads. steel elements are produced using production strategies that assure high exceptional. Assembling the metal structure is achieved very quickly and isn't always restrained through weather conditions. metallic structures are smooth to manufacture, the process commonly requires no labor, and 90 percentage of the materials are recycled. In this example, metal is an environmentally friendly fabric. The disadvantage of metal production is the fundamental safety against corrosion and fire. protecting metal structures is technically viable, but very luxurious. With corrosion and fireplace protection because of the excessive electricity of the metallic shape, ACC can offer an elegant, light and reasonable shape that meets the technical necessities of the technology platform. A stable mixture of cement, mixture and water.

The choice of materials for the construction of the technological platform of capacitor storage depends on several factors. The most important are, for example, geography, the location of the condenser in the building and the total heat output of the power plant. The output power determines the number of fans required to cool the final volume of steam. This determines the height of the support structure. As the number of fans increases, so does the height of the support structure. Due to the height of the probe, enough space is required for the fan to function properly. The following material solution is based on the above factors and the external layout of the fan. building

A. Steel structures

Steel construction is the highest quality general building material. Because of strength, steel elements are thin and light. This benefit also occurs during transportation and installation. Steel construction provides great clearance and height when carrying heavy loads. Steel elements are produced using manufacturing methods that guarantee high quality. Assembling the steel structure is done very quickly and is not limited by weather conditions. Steel structures are easy to manufacture, the job usually requires no labor, and 90 percent of the materials are recycled. In this case, steel is an environmentally friendly material. The disadvantage of steel construction is the elemental protection against corrosion and fire. Protecting steel structures is technically possible, but very expensive. With corrosion and fire protection due to the high strength of the steel structure, ACC can provide an elegant, light and economical structure that meets the technical requirements of the technology platform. A solid mixture of cement, aggregate and water. Features.

B. Concrete structure

Concrete is a building material that results from hardening a mixture of cement, aggregate and water. Its properties are influenced by the ratio of components. The special properties of the concrete mixture are achieved by the addition of admixtures and additives. This affects the workability of the concrete mix as well as the final properties of the concrete. The degree of workability is consistency, which can objectively evaluate the properties of fresh concrete. Concrete is strong and durable, usually it is used in combination with various types of reinforcement, thereby improving the possibilities of use in compressive strength and tensile strength; non-reinforced concrete, so-called "plain concrete", resists compressive stress well, and "reinforced concrete".

Even in tension. The advantage of concrete is its good formability, which corresponds to the formwork used and the possibility of recycling, so it is suitable for various applications of structures in civil engineering, even for the structure of parts made of completely different building materials as foundations. Concrete has become a byword for durability during use. However, to actually meet the demands placed on it; Fresh concrete should be produced in uniform quality. This is best achieved through production in specialized fresh concrete mass production plants, professional transportation of fresh concrete and its professional placement.

C. composite structure

The principle of these structures consists of rigid connection of steel or wooden beams and reinforced concrete slabs in horizontal structures. For example, vertical structures are concrete steel pipes or concrete rolled sections. The combination of steel and concrete allows for the best use of the beneficial properties of both materials and the elimination of their disadvantages. properly by placing these materials into the structure, each material is given a stress pattern that makes the best use of its individual properties. This means that concrete elements are placed in a narrow area of the structure, because concrete can only carry minimal tensile stress. Instead, steel elements are placed in the tension area of the structure. Although steel has the same tensile and compressive strength, rolled and welded profiles today are thinner, causing stability problems in the area of compression.

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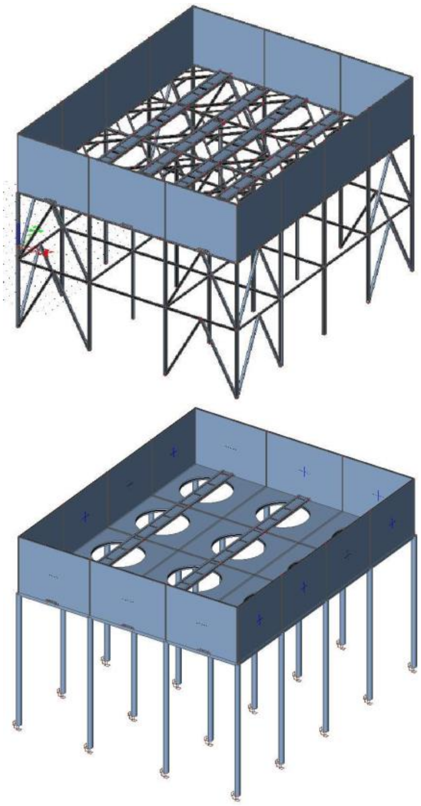
IV. DESIGN OF PLATFORMS

The supporting structures of the ACC were solved in two type series, namely A and B. The module size and the number of needed ACC fans are chosen according to the required capacity of the operation. A units are used for smaller capacities type, where the fan diameter is 5.5 m and the module dimensions of one condenser field are 8 x 8 m.



. Fig. 4x3 series A disposition – steel and concrete (composite) structure.

V.SUMMARY

An overview of sample layout units with different variants is given in Table I and Table II. The variant of the material in which the adjustment was made is indicated by o - steel, b - concrete. The steel variant was considered with S235 steel design, mainly HEA (for series A) and HEB (for series B) profiles were used for columns and reinforcements and IPE elements for less stressed elements. The static scheme of the structure mainly contains hinged or semi-rigid joints, and the spatial rigidity is ensured by lattice reinforcements.

TABLE I: MODULAR SERIES OF TYPE A UNITS

Unit type	Disposition	Heat output [MW]	Dimension [m]	Column heights [m]	Bracing options	Combination of extreme conditions
A	1x1	5	7.70 x 7.75	3.37		
A	2x1	10	15.40 x 7.75	4.49		o, b - 6 combinations
A	3x1	15	23.10 x 7.75	5.06		
A	2x2	20	15.40 x 16.70	6.48		
A	3x2	30	23.10 x 16.70	7.84		
A	4x2	40	30.80 x 16.70	8.76		
A	3x3	45	23.10 x 26.65	9.60		
A	5x2	50	38.50 x 16.70	9.42	o 3 variants	o, b - 6 combinations
A	4x3	60	30.80 x 26.65	11.05	o 3 variants	

TABLE II: MODULAR SERIES OF TYPE B UNITS

Unit type	Disposition	Heat output [MW]	Dimension [m]	Column heights [m]
B	3x2	75	34.20 x 24.20	11.32
B	4x2	100	45.60 x 24.20	12.63
B	3x3	113	34.20 x 36.90	13.95
B	5x2	125	57.00 x 24.20	13.57
B	4x3	150	45.60 x 36.90	16.03
B	5x3	188	57.00 x 36.90	17.60
B	6x3	225	68.40 x 36.90	18.84
B	5x4	250	57.00 x 49.60	20.68
B	6x4	300	68.40 x 49.60	22.41
B	6x5	375	68.40 x 62.30	25.29
B	6x6	450	68.40 x 75.00	27.67
B	7x6	525	79.80 x 75.00	29.90
B	7x7	613	79.80 x 87.70	32.24
B	8x7	700	91.20 x 87.70	34.50
B	8x8	800	91.20 x 100.40	36.81
B	8x9	900	91.20 x 113.10	38.84
B	8x10	1000	91.20 x 125.80	40.63

VI.RESULTS OF THE PROJECT

The result of the project is the utility model application on “Technological platform for condensers “and the industrial design application on “Performance series of direct air condensers”.

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