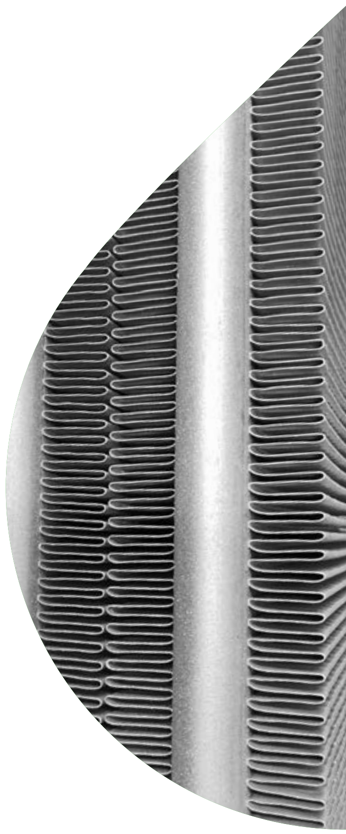
IWC

Air-Cooled Condensers

Recognised as a market leader, IWC supplies a competitive range of air-cooled condensers around the globe.

Each condenser requirement is analysed and designed by our engineers who collectively, have over a century of experience in this field.



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Air cooled condensers (ACCs)

Air cooled condensers (ACCs) are commonly found in power plants and transfer heat from the steam that exits a steam turbine into the surrounding air, without consuming water. This is achieved by passing air over finned tube bundles arranged in either an A-frame or V-frame configuration – also known as forced draft and induced draft respectively.

Although the capital cost of an ACC is generally higher than that of a water-cooled alternative, the cost of providing suitable cooling water and other running expenses may be such that the former is more cost effective over the projected life of the system. In arid areas where insufficient or no cooling water is available, air cooling is the only effective method of heat rejection.

IWC supplies a competitive range of air-cooled condensers around the globe and each condenser requirement is analysed and designed by our engineers who collectively, have over a century of experience in this field.

Our engineers review each condenser application to ensure that the components selected will work together as an integrated system, ensuring efficient performance and a long, reliable operational life.

Environmental Considerations

The environmental impact of using an air-cooled condenser (ACC) can vary depending on the specific application and system design. **However, here are some potential environmental impacts of using an ACC:**

ACCs over Wet cooling:

- No Water consumption
- No plume

Induced over Forced:

- Less plot area for the same performance (improved efficiency)
- Less structural steel needed for construction (Less CO2 emitted from steel manufacturing)
- Less Transportation needed (Less CO2 emissions)
- Better fan performance due to the diffuser

Water Conservation

One of the main benefits of using an ACC is the conservation of water. Unlike traditional cooling towers that evaporate water to remove heat from a system, ACCs use air as the cooling medium. This reduces the water usage of the system and can be particularly beneficial in water-scarce areas.

Energy Consumption

ACCs typically require more energy to operate than traditional cooling towers due to lower power plant efficiencies and the larger number of fans needed to circulate air. Net energy consumption of ACCs can be reduced significantly by incorporating partial evaporative cooling, such as the IWC Hybrid (Dry/Wet) Dephlegmator (HDWD) to increase power plant efficiency/ output with minimal water consumption

Air Quality

Another major benefit of an ACC is the absence of a visible plume as seen in traditional cooling towers. Plumes are visual pollution and can affect the micro-climate around the plant, cause poor visibility and freezing of roads and the ground. Furthermore, cooling towers emit harmful chemicals and can be a health hazard due to the spreading of legionella.

The use of large fans in an ACC can have an impact on local air quality due to noise pollution and the potential for dust or other airborne particles to be stirred up. However, proper design and maintenance of the system can minimize these impacts.

CO2 emissions

One of the drawbacks of using an ACC is that power plant efficiencies are significantly lower than with traditional cooling towers, resulting in higher CO_2 emissions per unit plant output. This can, however, be mitigated by incorporating an IWC HDWD.

When employing an induced draft ACC, less structural steel is needed for construction and erection is simpler than for a forced draft ACC, which means less CO_2 is emitted from steel manufacturing and the erection process.

Land Use

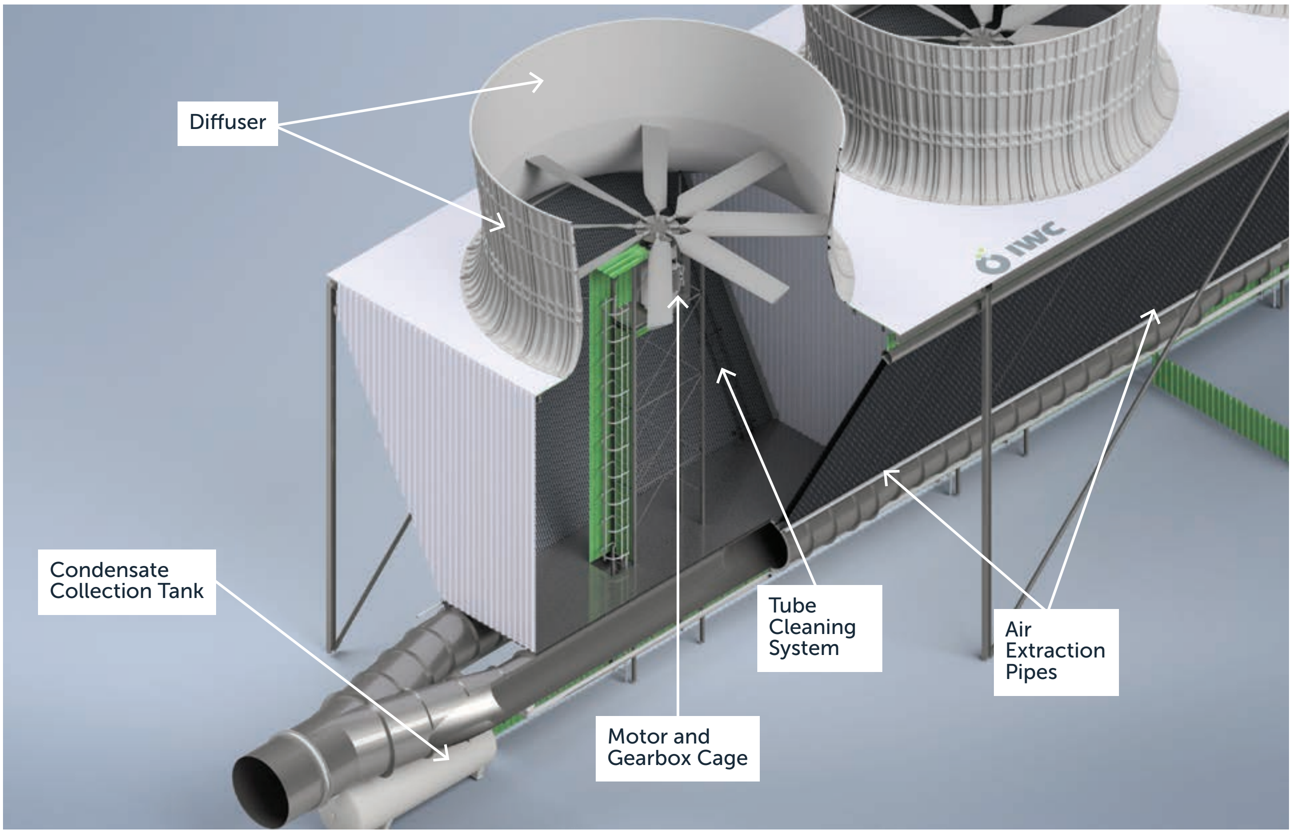
ACCs typically require more land than traditional cooling towers due to the larger footprint of the system. This can be a consideration in areas with limited space or where land use is a concern. However, by employing an induced draft ACC and/or a HDWD the required land size can be reduced significantly.

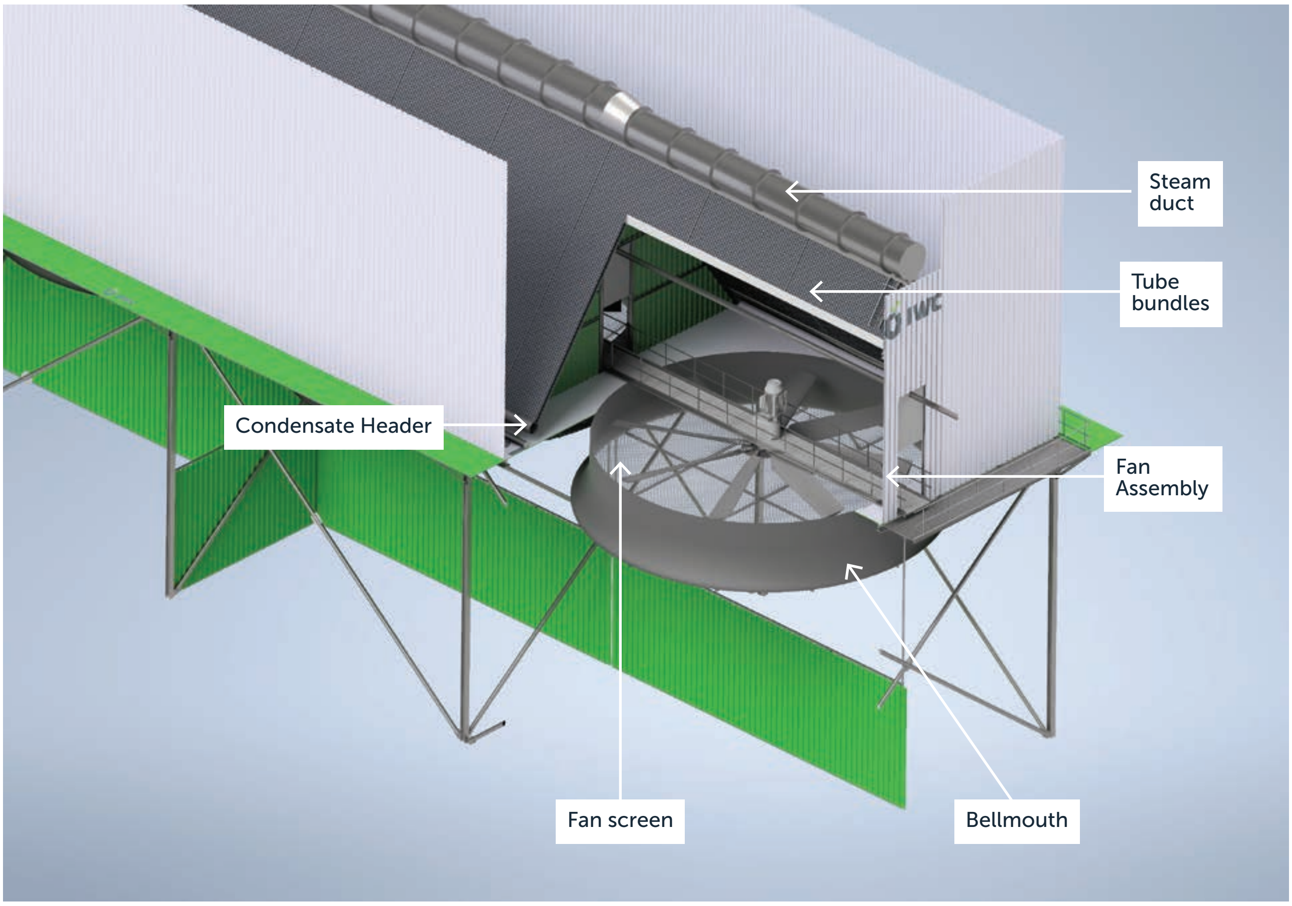
Cost

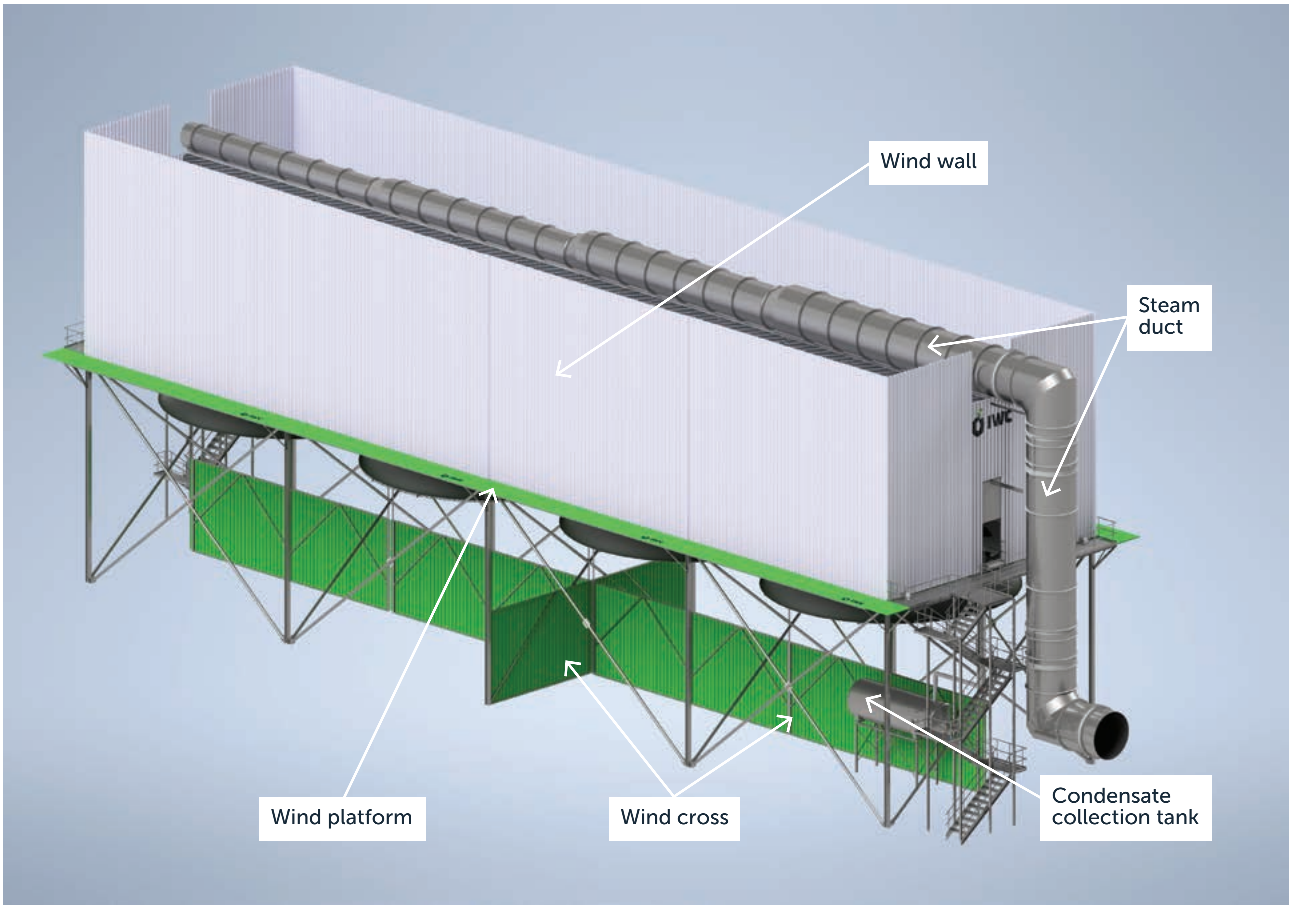
The cost of implementing an ACC can be higher than that of a traditional cooling tower due to the additional equipment. However, the long-term cost savings from reduced water usage and lower maintenance costs generally offset these initial costs over time.

Overall, the environmental impact of using an ACC can be positive, particularly in areas where water conservation is a priority and visible vapour plumes are an issue. Proper design and maintenance of the system can minimize any potential negative impacts on air quality and land use.

Components (Forced and Induced Draft)




Steam duct
Tube bundles
Condensate Header
Fan Assembly
Fan screen
Bellmouth


Wind wall
Steam duct
Wind platform
Wind cross
Condensate collection tank

Components (Forced and Induced Draft)

Steam Duct

The steam duct connects to the turbine exhaust and conveys the steam to the steam distribution system. The steam duct includes expansion joints, anchors, hangers, a safety valve (if required) as well as a rupture disc.

Fan Unit

The fan unit produces a flow of cool ambient air over the heat exchanger tube bundles in order to condense the steam from the turbine exhaust. The fan unit consists of multiple fan blades which are secured to a hub. This hub is then connected to a parallel shaft gearbox which is driven by an electric motor.

Hotwell Pit & Pumping Station

The large steam duct condenses a large amount of steam during a cold start-up due to natural condensation, if not drained this will restrict the exhaust steam flow from the turbine exhaust to the condenser manifold. This condensate must be drained from a suitable low point in the duct system (at the hotwell - to be located in a pit) and be pumped via drain pumps to the condensate collection tank.

The hotwell shall be adequately sized to accommodate the condensate for the turbine gland seals and other low-temperature drains.

Tube Bundles

The tube bundles consist of two headers that are interconnected with finned tubes. The tubes are usually made from carbon steel (SA214) and finned with Aluminium fins through brazing.

In a typical design, the ACC has two stages in series, first the condenser stage (C-bundles), followed by the dephlegmator stage (D-bundles). The bulk of the steam is condensed in the first stage. The balance of the steam condenses, while flowing from the bottom into the lower side of the D-bundles. Non-condensable gases are concentrated in the D-bundles where they are extracted from the top of the dephlegmator through an air extraction line connected to the air extraction system.

Finned tubes are tested frequently to verify finned tube quality and thermal performance characteristics.

Condensate Collection Tank

The condensate collection tank shall be sized for a minimum required hold up time (at normal water level (centre) in the tank) and is provided with a level indicator, level transmitter, required nozzles, manholes and supports.

Condensate Pumping System

Due to the very low net positive suction head the condensate extracting pumps (CEP) are to be installed very close to the condensate collection tank. These pumps are designed to pump the condensate to the main condensate storage tank/deaerator (by others) via the discharge control valve station.

Air Extraction System

The equipment extracting non-condensable gases from the system typically consists of two vacuum pumps (water ring pumps). During start-up, both vacuum pumps (2x 50% hogging) are in operation to remove air from the turbine, steam ducts, steam manifolds and bundles via the air extraction line connected to the dephlegmator bundles. It creates a vacuum in a specific period of time. During normal ACC operation, only one of the vacuum pumps is in operation (2x 100% holding) while the other one is in standby mode.

These are designed as per Heat Exchange Institute (HEI) Standards for steam surface condensers. Each vacuum pump consists of the water ring pump, a separator tank, the heat exchanger for the internal recirculation water (cooling water by others), internal piping, valves, and instruments.

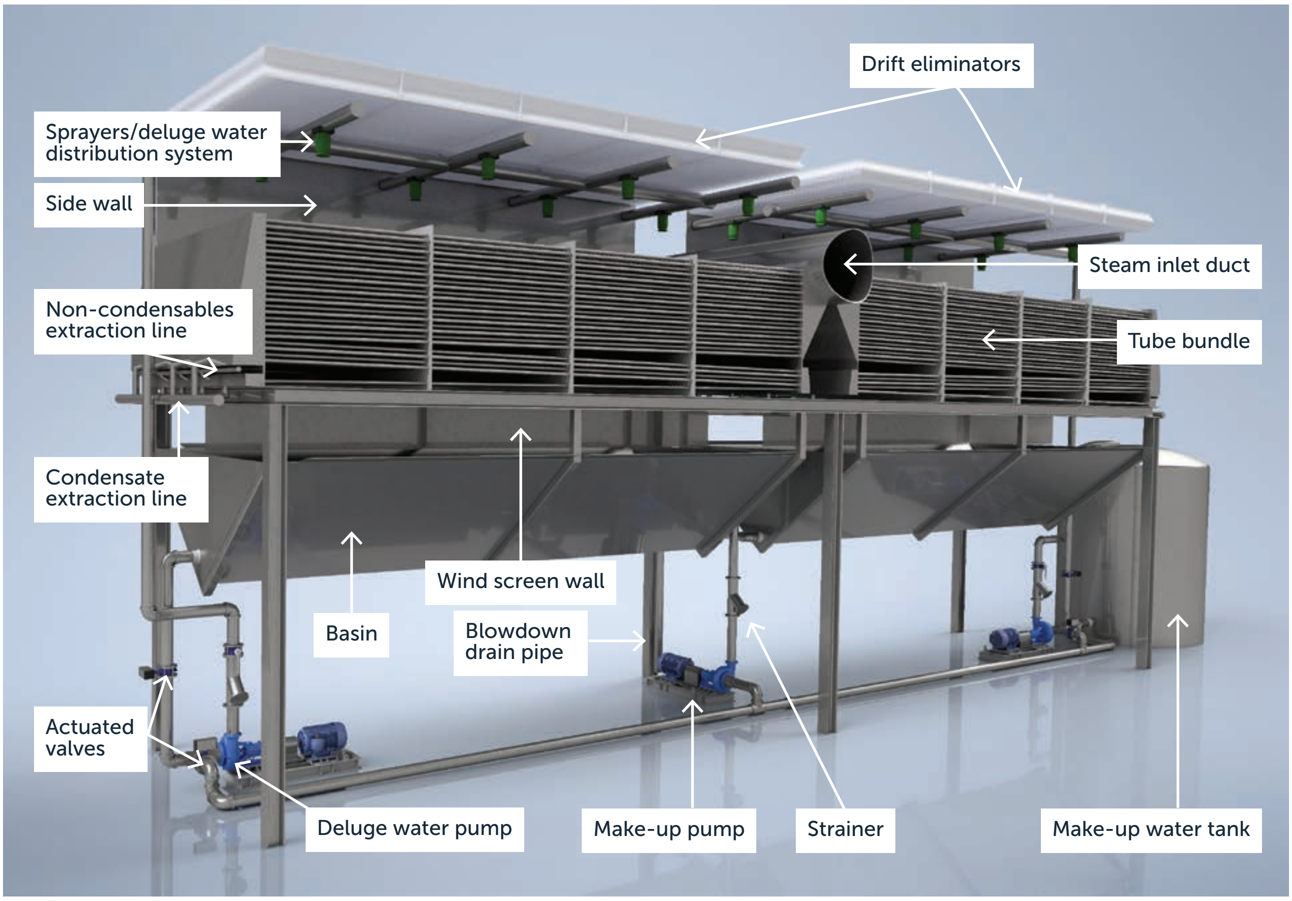
Condensate Collection Tank Level (Min. Flow) Control

The condensate minimum recirculation branch is taken out from the common condensate extraction pump discharge line upstream of the discharge control valve station. The purpose of this line is to maintain the required level of condensate so that enough condensate is available at the inlet of the condensate extraction pumps. This line consists of a control valve station which is controlled by a signal from condensate collection tank level measurements. The control valve station includes isolation valves, min. flow control valves, which are pneumatically/electrically actuated, and a manually operated bypass control valve.

Finned tube cleaning system

A high-pressure water-jet tube cleaning system can be provided. The system consists of a truss frame that travels on rails in the horizontal direction, with a spray frame trolley that runs up and down along the truss frame.
The sprayers are connected to a high-pressure pump by means of flexible hosing.

Components (HDWD)



Tube Bundles

The tube bundles consist of two tube sheets with headers welded to them that are interconnected with bare tubes. The tubes are usually made from carbon steel and are either externally coated or hot-dip galvanised.

The steam is condensed in three tube passes. Condensate is extracted from the headers after each tube pass. Non-condensable gases are concentrated in the final pass where they are extracted from the top of the outlet header through an air extraction line connected to the air extraction system.

Deluge water system

Deluge water is sprayed onto the tube bundle by means of sprayers attached to a network of water distribution pipes. The water trickles through the tube bundle under gravity and collects in a basin, from where it is pumped back to water distribution system by means of a centrifugal pump.

Fan Unit

Similar to an ACC, a fan unit produces a flow of cool ambient air over the heat exchanger tube bundles in order to condense the steam from the turbine exhaust. If incorporated in an induced draft ACC, no dedicated HDWD fans are required, and the ACC fans are designed to provide the necessary air flow through the HDWD.

Drift eliminators

To prevent deluge water drift from impinging on the finned tubes, wave type drift eliminators are installed at the HDWD air outlet.

Make-up water and blowdown systems

A make-up water system is provided to replenish the water lost by evaporation, drift and blowdown as well as to rinse the tube bundles prior to stopping the deluge water system pumps. This system essentially comprises of a tank, pump, piping and control valves. The make-up flow rate is controlled by means of actuated control valves that maintain a given water level in the basin.

Blowdown flow rate through the blowdown drain-pipe is controlled by means of an actuated valve to maintain acceptable TDS and TSS levels in the basin.

Special design features (Forced Draft)

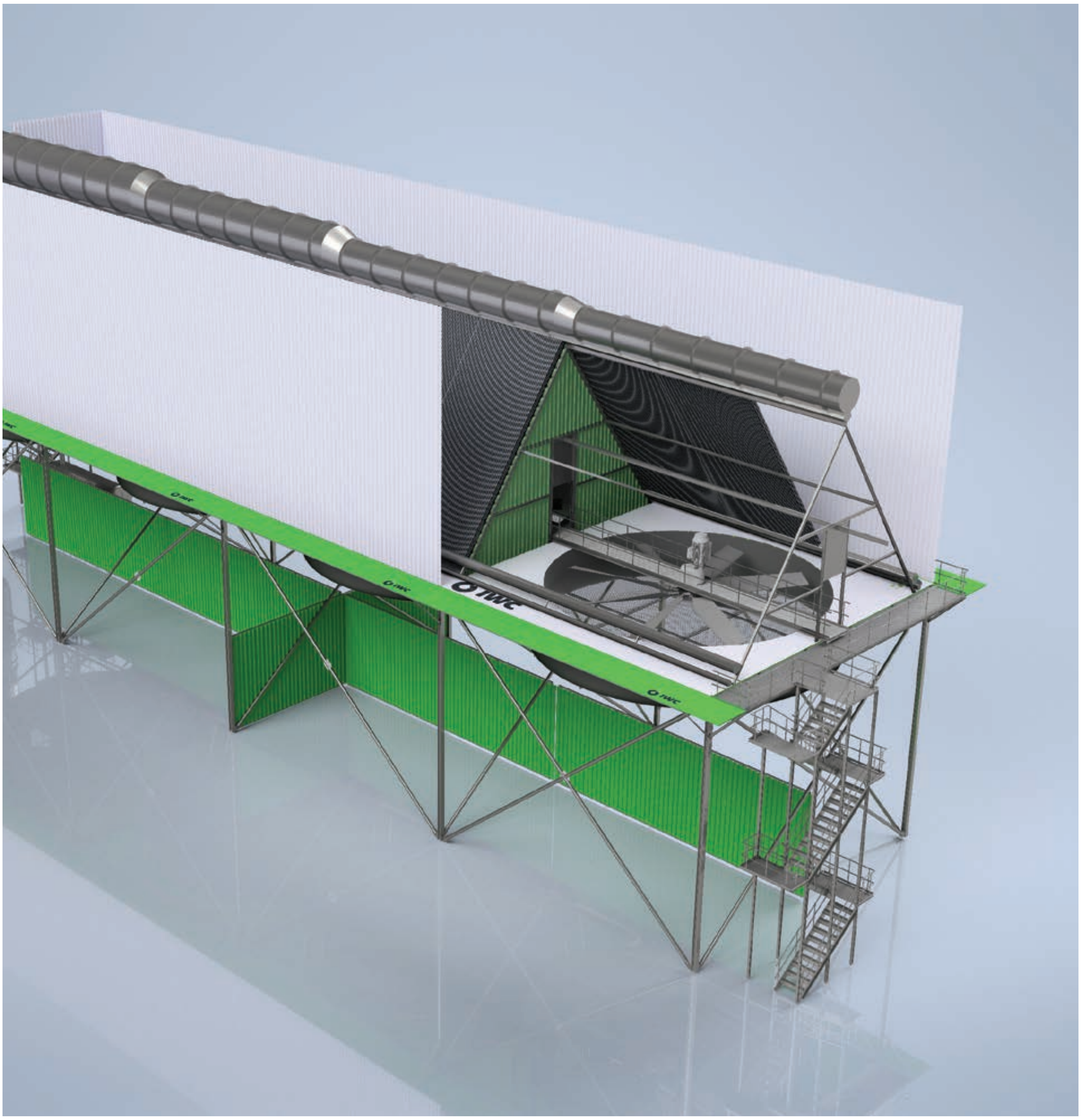
A forced draft air cooled condenser is a type of heat exchanger used in various industrial applications to remove heat from a process fluid by transferring it to the surrounding air. Movement of the cooling air across the finned tubes is achieved by electrically driven axial flow fans that are installed in the cooler inlet air, below the finned tubes.

Wind Cross and Wind Platform

Each street is fitted with a wind cross to mitigate the effects of wind on fan performance. Coupled with this is a wind platform to optimize air flow into the fan inlet.

Fan Screen

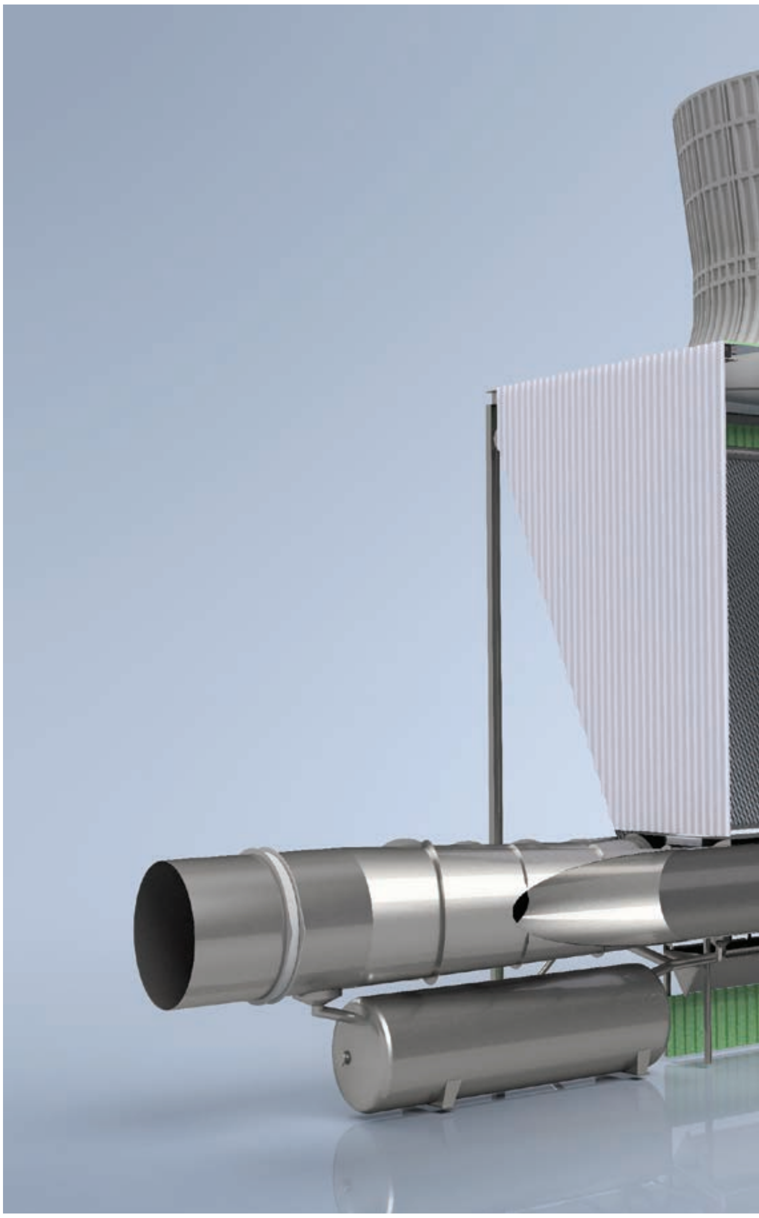
Each fan has a fan screen attached to the bellmouth. This screen is made of small structural members and coarse grating to prevent falling of fan blades and occasionally can act as a platform for maintenance access.



Special design features (Induced Draft)

The Induced Draft Air Cooled Condenser uses a combination of sucked air and natural draft to remove heat from the system, allowing for efficient cooling without the need for water or other cooling fluids.

Movement of the cooling air across the finned tubes is achieved by electrically driven axial flow fans that are installed above the tube bundles in the warm outlet air.



Steam Duct

The steam duct is below the bundles and is supported directly on foundations reducing the loads on the steel support structure

Motor and Gearbox Cage

The motor and gearbox are both secured in a single cage as a unit. This cage can then be lowered from the ACC and maintenance can either be performed at ground level or the unit can be replaced.

Diffuser

Each fan unit is fitted with a diffuser at the air outlet to aid in pressure recovery, thus decreasing required fan power or reducing the plot size of the ACC.

Access Ladder

The access ladder is used to provide access to both the motor and the gearbox while in operation. The access ladder is insulated from the outlet heat from the tube bundles by means of cladding and an additional cooling unit which also passes cool ambient air past the motor and gearbox to cool them while in operation.

Central Support Structure for the fan unit mechanicals

The central support structure is used to secure the motor, gearbox, fan unit and the access ladder. It is independent from the main structure and is used to lower the motor and gearbox cage for repairs/replacement.

Wind mitigation

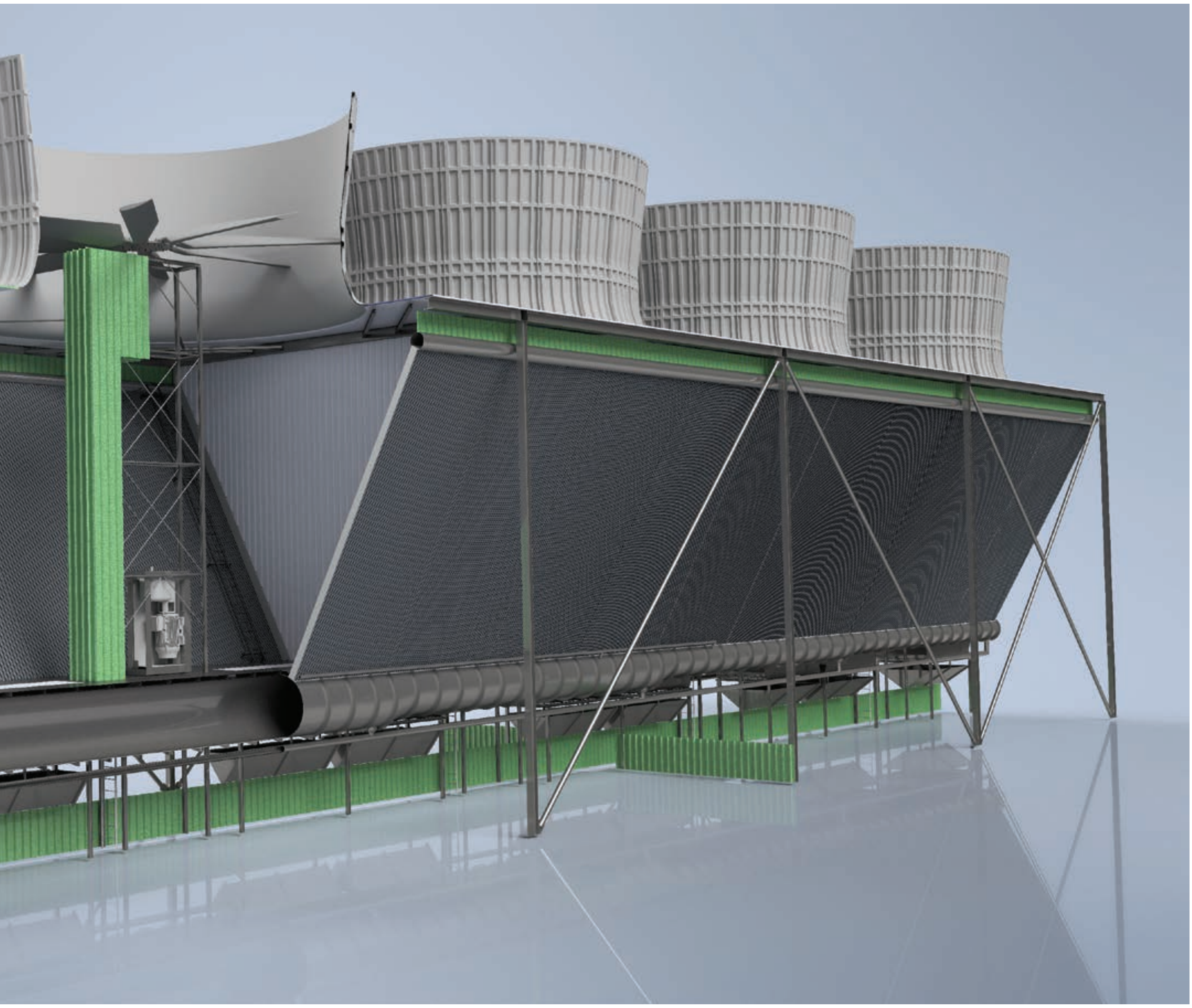
Induced draft ACC performance is fewer sensitive to wind and sidewalls to prevent hot air recirculation are not required. Furthermore, fewer wind mitigating devices are therefore required.

Finned tube cleaning system

Hatches are provided in the plenum partition walls to allow the tube cleaning system to move to adjacent fan modules.

Incorporation of evaporative cooling

HDWD units can be installed between the steam headers to enhance ACC performance during high ambient temperatures with minimal water consumption.



Forced Draft vs Induced Draft vs HDWD unit

Why choose our Forced Draft Unit

Advantages of Forced Draft unit over Induced Draft

- Easy access to fan mechanicals for maintenance and repairs.
- No auxiliary cooling required for motors and gearboxes.
- Condensate tanks can be at higher elevations for improved pump NPSH.

Advantages of our Forced Draft unit over our competitors

- Reduced wind sensitivity due to wind mitigating devices.

Why choose our Induced Draft Unit

Advantages of Induced Draft unit over Forced Draft

- Improved constructability and shorter erection period.
- Fewer bends in the steam duct leading to lower steam-side pressure drop.
- Reduced negative performance impact due to wind.
- Improved condensate and air extraction pipe routing.
- Mechanicals have a dedicated support structure on foundation plinths.
- Lower overall ACC height
- Reduced fan vibration and structural issues due to wind.
- Reduced steam duct length as steam headers are below the bundles and the fan deck is lower.
- Steam ducts are directly supported on the foundation plinths.
- Potentially no additional hotwell and drain pumps are required as condensate in the steam duct drains directly into the condensate tank.
- Less steam duct expansion joints if no risers are required.
- Less structural steel.
- Improved air extraction.
- Reduced plot size for the same fan power consumption due to lower steam-side and air-side flow losses.
- No wind walls.

Advantages of our Induced Draft unit over our competitors

- Simplified removal of motor and gearbox assembly for repair/ maintenance.
- Ambient air-cooled motor and gearbox.
- Ventilated access ladder and platform for gearbox and motor maintenance.
- Simplified erection as steam duct is below the bundles, mechanicals are on a separate central structure and less components.
- Reduced plot size due to diffusers on the fan stacks.
- Simple conversion to dry/wet configuration using hybrid (dry/wet) dephlegmator technology on the same plot size as ACC only cooling.
- Parallel shaft gearboxes are used with higher efficiencies than right-angled gearboxes.
- Single tube cleaning system required per side due to hatches in the plenum walls.

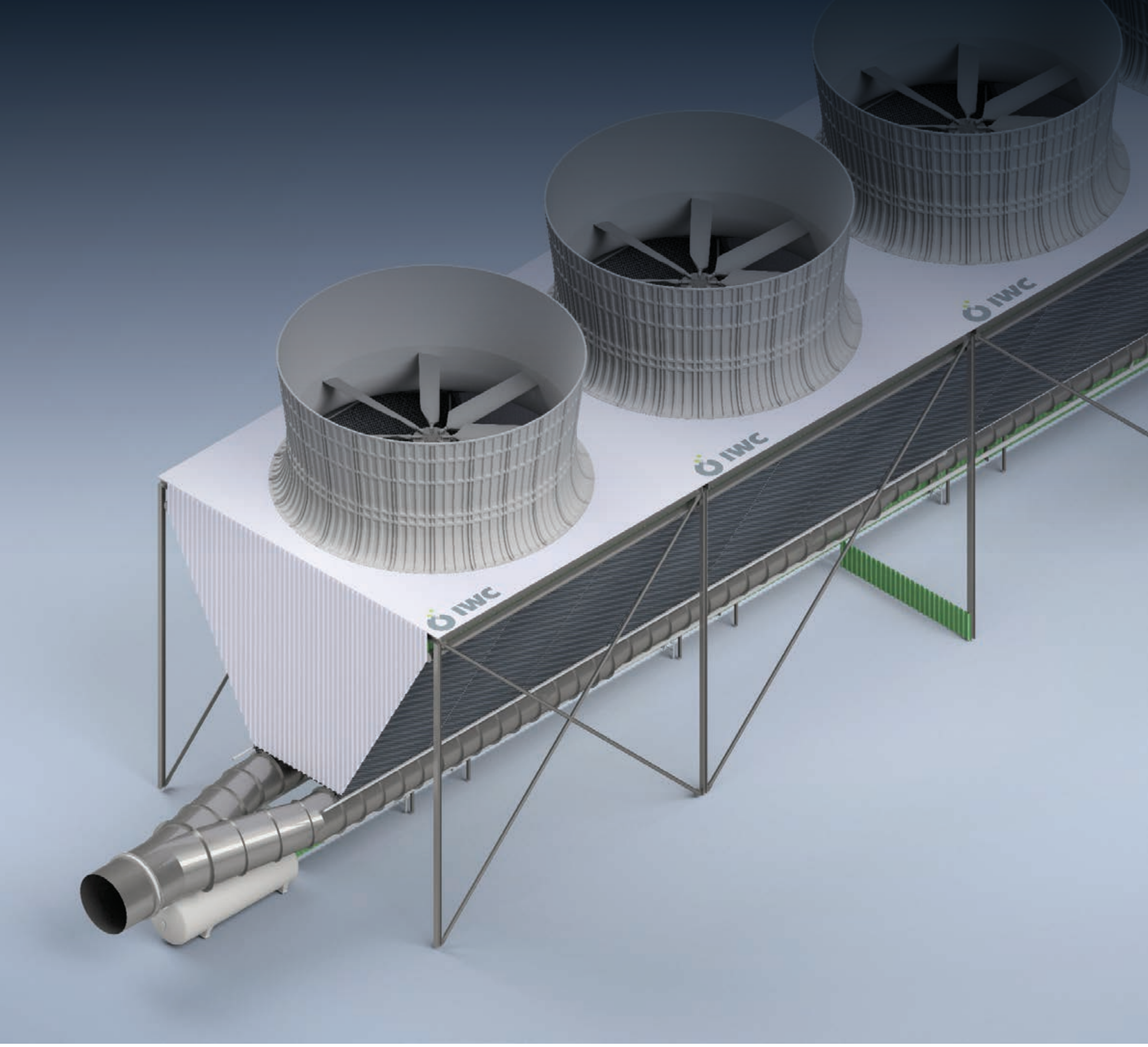
Why choose our HDWD Unit

Advantages of HDWD unit over ACC

- Much smaller plot size for equivalent thermal performance.

Advantages of our HDWD unit over our competitors

- Simple incorporation into the IWC Induced Draft ACC without any change in ACC plot size and no additional fans.
- No visible plume due to mixing of HDWD plume with hot ACC outlet air.
- Modular skid-mounted design possible.
- Standalone HDWD can be retrofitted to any existing ACC for performance enhancement.



Advantages of HDWD unit over a traditional evaporative cooling tower steam condensing system

- Less overall plot space required
- No surface condenser required
- Less components and interfaces to equipment.
- Can be operated in dry and wet mode.
- Much simpler for conversion of existing ACCs to combined dry/ wet systems.

IWC

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