

Design and CAD Modelling of the Evaporator

5.1 Introduction

Following the experimental analysis of the refrigeration-based atmospheric water generator, key observations regarding airflow, condensation efficiency, and evaporator performance informed the CAD design of an improved evaporator. The purpose of this chapter is to present the design considerations, the modeling process, and the rationale behind the geometric and structural features selected for the evaporator.

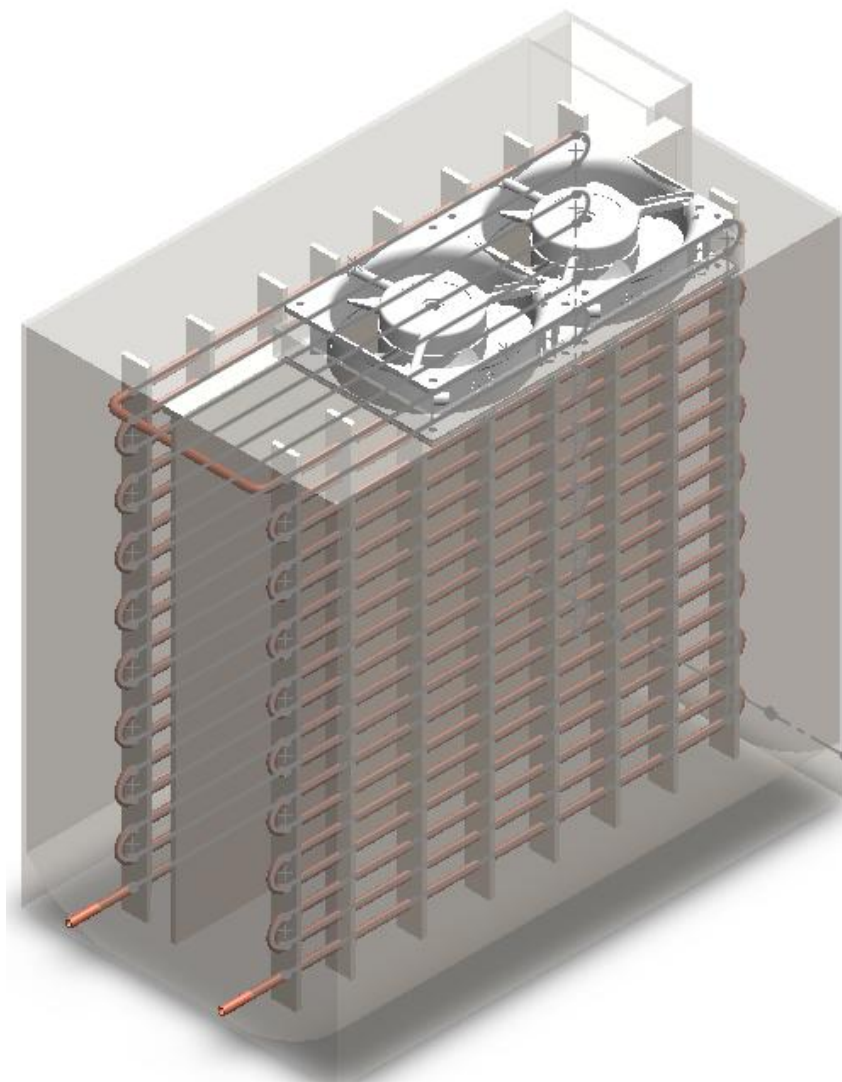


Fig 5.1 CAD model of evaporator with integrated blower mount.

5.2 Design Learnings from Experimental Analysis

The experimental data highlighted several performance factors critical to efficient atmospheric moisture condensation:

- **Air Velocity Impact:** The addition of a blower increased airflow over the evaporator, significantly improving condensation. This indicated the need for a design that promotes efficient airflow circulation.
- **Shape and Surface Area:** The circular helical coil shape demonstrated effective heat exchange due to increased surface area, suggesting its retention or refinement in the CAD design.
- **Condensation Hotspots:** During testing, condensation occurred most heavily where airflow was concentrated, showing the importance of uniform distribution across the coil.
- **Thermal Insulation & Drainage:** Minimal heat gain and proper water collection channels are essential for real-world implementation.

These insights formed the foundation of the CAD modeling phase.

5.3 CAD Model Overview

The CAD model of the evaporator was created using SolidWorks, incorporating improvements based on experimental findings.

Key Features of the CAD Design:

- **Helical Coil Geometry:** Retained and optimized for increased contact surface area and improved air channeling.
- **Blower Mount:** A top-side cap designed for direct blower integration, ensuring uniform forced convection across the coil.
- **Support Structure:** A stable frame was added to secure the evaporator within the system, accounting for vibrations and portability.
- **Condensate Drainage Path:** Designed sloped surfaces and outlets for efficient water collection into the storage unit.

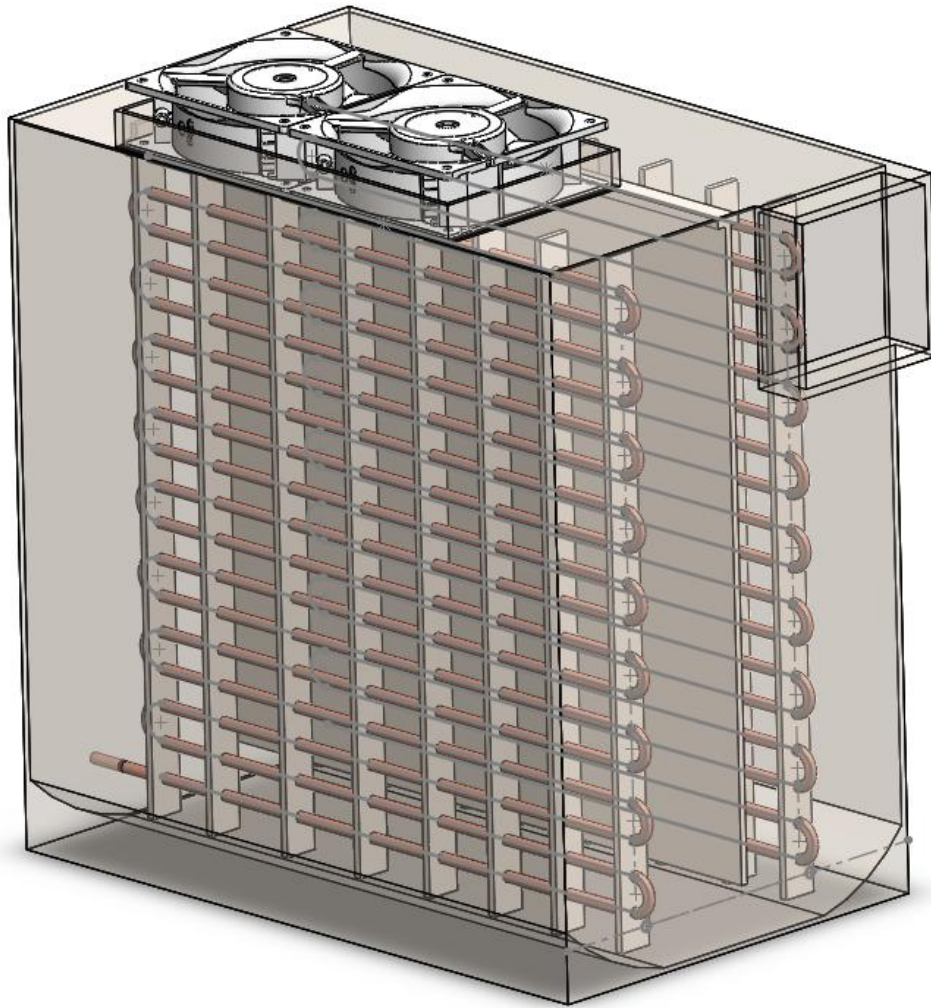


Fig 5.2 CAD model of evaporator with integrated blower mount.

5.4 Design Improvements & Future Scope

The CAD model sets the stage for enhanced prototyping. Future improvements based on this design include:

- **Finned Coils or Mesh Wrapping:** To further increase condensation surface area.
- **Modular Coil Design:** For ease of maintenance and customization based on plant size/water need.
- **Thermal Simulations:** To validate heat exchange efficiency before final fabrication.