QuantumBasel

Hybrid

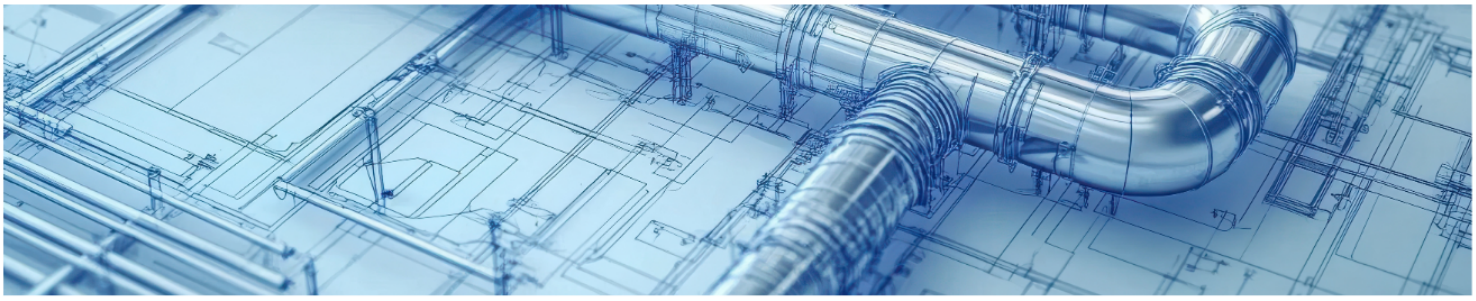
Quantum Annealing

Optimizing HVAC Network Design

2023 | Use Case | HVAC Design Optimization

CHALLENGE

During the construction of a building, the **design of the heating, ventilation, and air conditioning (HVAC) network** involves several steps. One of the final steps in the HVAC design process is called "network generation". This step ensures that all HVAC elements are correctly connected while meeting safety and sustainability requirements. This step is critical. However, it is also a step that is computationally very expensive or even prohibitive. **The challenge is to optimize the design of HVAC duct networks in new buildings by minimizing the cost of the duct layout while efficiently delivering the required airflow.** The current semi-automated solution used by VINCI Energies is labor-intensive and costly, requiring significant manual work by engineers.



SOLUTION

As part of the solution, D-Wave designed a hybrid quantum-classical model to address VINCI Energies' HVAC duct network design problem, leveraging quantum computing's strengths in tackling complex combinatorial optimization tasks. By expressing the model in terms of quadratic forms, the team played to D-Wave's expertise, allowing for efficient evaluation of various duct placement configurations. Several models were developed, and the one that provided the **optimal balance between accuracy and cost-effectiveness** was selected and implemented. This model integrated advanced modeling techniques and **utilizing both classical and quantum computing resources, significantly reducing manual engineering efforts while optimizing parameters like duct lengths, diameters, and crossings.** The solution aimed to streamline the design process by minimizing duct lengths and other unnecessary complexities, leading to improved efficiency and cost savings.

RESULTS

27%

reduction in duct length and major efficiency gains when compared to the existing ML-based approach

VINCI ENERGIES

D-Wave The Quantum Computing Company™

In this proof of concept, **the solution outperformed the previous semi-automated method on all performance metrics** and achieved a significant reduction in duct length, resulting in significant savings in materials, construction costs, and engineering time, **demonstrating the potential of quantum computing in real-world engineering applications**.

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