scSTREAM

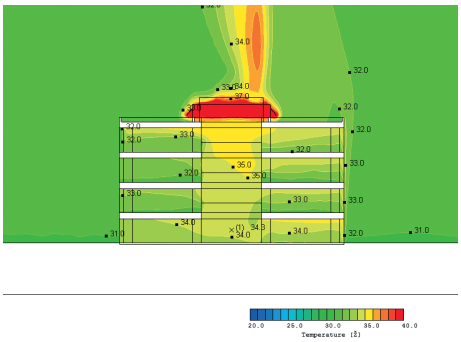
Cradle
MSC Software Company

Ventilation Analysis of an Office Building Using an Earth Tube Cooling System

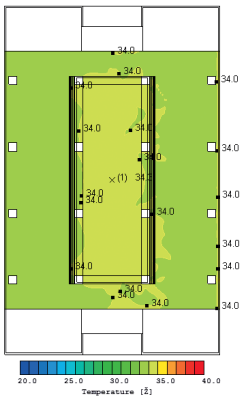
Effect of an Earth Tube Cooling System on Indoor Temperature during the Summer

Baseline Analysis without Earth Tube Cooling System

Temperature distribution of the building cross section

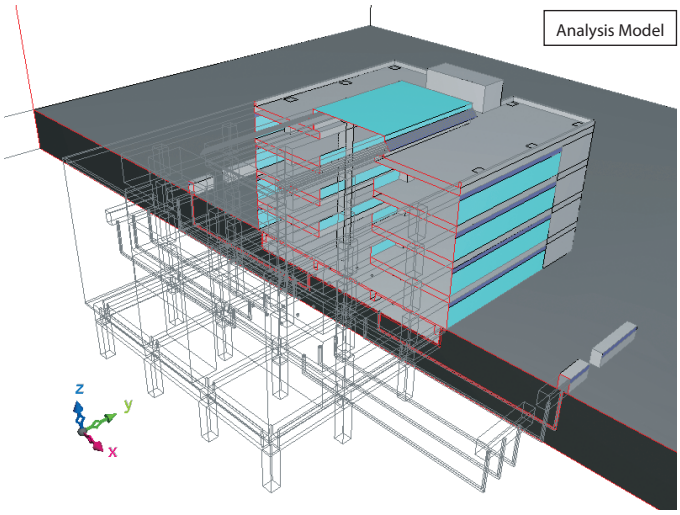


Temperature distribution of the first floor (1m above the floor)



Office space temperature is 32 to 35°C. Existing air conditioning is ineffective.

Temperature of the first floor central space, 1m above the floor, is 34.3°C.



Setting Conditions

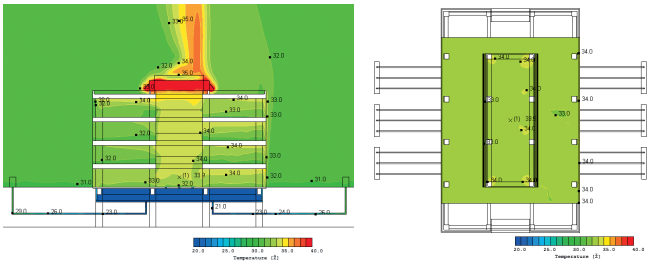
Outdoor Temperature:	31°C, calm. Solar radiation is simulated by using panel heat sources on the windows. Transmitted radiation is simulated by using volumetric heat sources near the top light.
Air Conditioning within Office Space:	4kW (cooling)
Soil Temperature:	Specified at 16°C, 6m below ground.
Windows:	Only windows on the top floor are open.

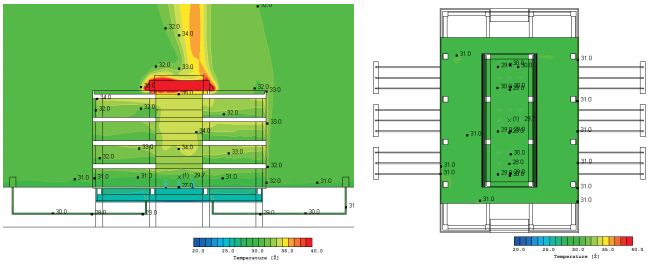
Calculation Conditions

Number of Mesh Elements:	911,160
Calculation Time:	300 cycles, 2-3 hours (8 cores used), steady state analysis.

The Effects of Earth Tube Cooling and Under-Floor Air Ventilation*

Difference in earth tube cooling system with and without under-floor air ventilation





Without fans (volume of under-floor air ventilation: 0.0 m³/h)

- Natural ventilation is not sufficient to circulate air; earth tube cooling by itself is largely ineffective
- Temperature of the first floor is 33.9°C

With fans (volume of under-floor air ventilation: 100 m³/h)

- Cool air is released from below ground
- Earth tube and under-floor ventilation produce temperature of the first floor of 29.7°C, a temperature drop of 4-5°C.

*Forced airflow through the earth tube

Notes

An earth tube cooling system, which uses underground pipes to supply cool air and under-floor ventilation fans, can effectively provide passive air conditioning for an office building. Maximizing system effectiveness requires controlling the volume of the air that has been cooled and heat exchange ability of the tubes. With scSTREAM, engineers can simulate real-world scenarios and improve the air conditioning system design.