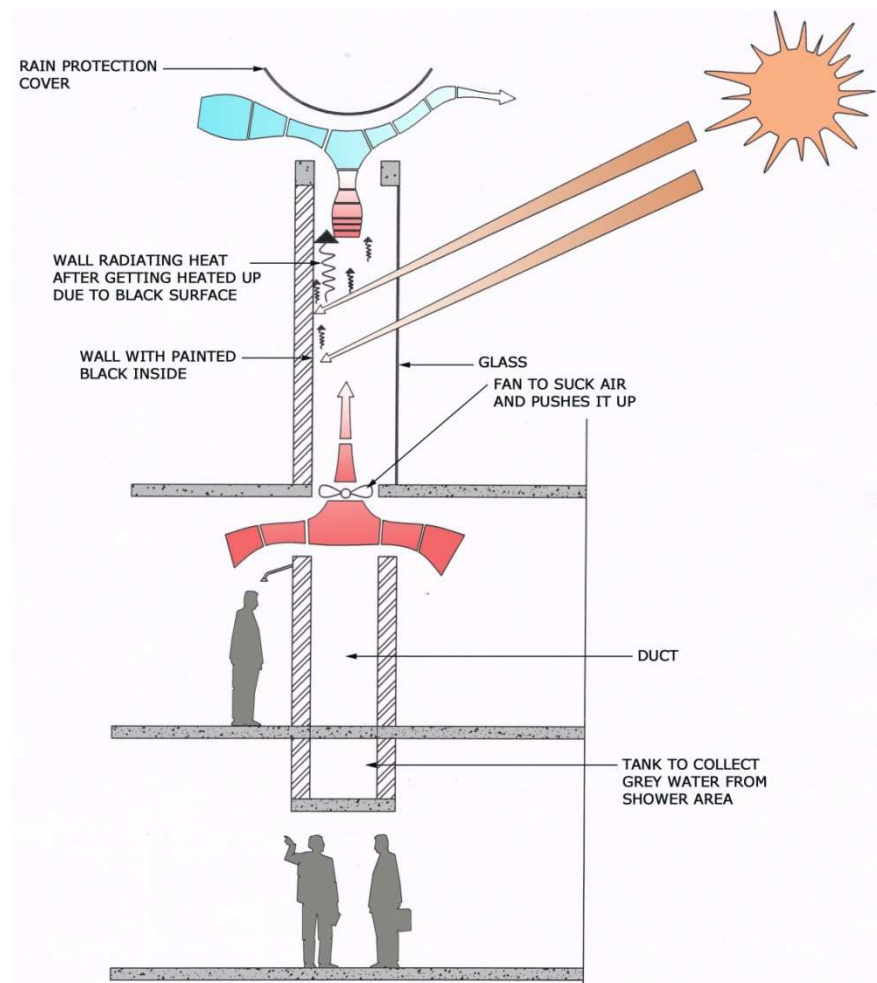


### 3. Stack effect – Natural ventilation system

Pressure differences due to buoyancy are directly proportional to both height and the temperature difference between incoming and outgoing air. As a result, there are two ways to increase buoyancy-driven flow: increasing the height of building and heating air within the building. Buoyancy, or “stack effect”, can induce natural cooling and ventilation within the building, though typically it creates lower pressure differences than wind. Columns of warm air rise, and if allowed to exit from the top of a space, will draw air in at lower levels. Stack ventilation is especially useful for deep core spaces, spaces with only one exposed side, and with atria and courtyard designs.

In general, natural cooling should be examined on a whole-building basis to ensure airflow paths into, through and out of occupied zones and spaces, and to ensure safety in the event of fire. Room-by-room analysis is helpful when placing windows and openings, and to help place interior partitions.



3.1

- Use roof monitors, atria or tall chimneys to increase stack height, and thus buoyancy pressure differences. These features can be placed at the center of a building, creating cross-flows from the sides of the building; or at one end of the building, creating cross-flow from one side to the other.
- Limit the maximum depth of spaces from the air inlet to the stack outlet to less than five times the ceiling height (~45 to 50 ft.).

Examine possible ways of reinforcing the stack effect by installing:

- Outlets in negative pressure areas due to winds. Outlets should be placed downwind of prevailing breezes to avoid overwhelming the stack effect, i.e., on east and southeast orientations.
- Solar chimneys, where sunlight at high levels heats outgoing air above the occupied volume



3.2

### **Cautions**

- Airflow should be examined at low, mid and high altitudes within the building to ensure adequate ventilation under a variety of wind conditions.
- Interior spaces should be arranged to ensure that dead-air pockets in occupied zones do not occur.
- Ventilation openings must be carefully sized, with smaller openings at lower floors, and larger openings at higher floors to provide equal ventilation rates.
- Smoke and fire implications of natural ventilation strategies must be carefully considered.

### **Dark Color**

if the chimney is painted with natural pigment (to absorb the sun's energy), it helps to improve the pressure difference.

### **Glass Interface**

Glass lets through the optical energy from the sun. The wall radiates in the infrared, which does not pass through glass. Hence, the energy is trapped, and makes the air hot.



3.3

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