

# ENERGY EFFICIENCY IN BUILDINGS

## 5.4. PASSIVE DESIGN

### Natural Ventilation



No ventilation can cause:

- Damage in buildings (damps, etc.)
- Unhealthy environments
- Impossibility of building use



## Air renovation

0.5 ren./hr

- Filtration
- Manual ventilation
- Natural ventilation
- Mechanical ventilation





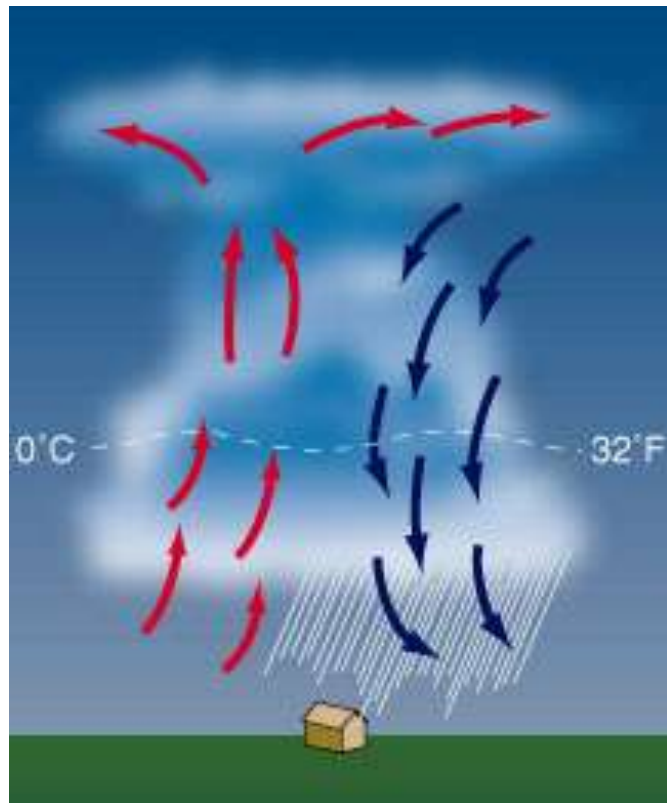
## Air movement

- Cross ventilation
- Movement of interior air mass





## Natural convective properties



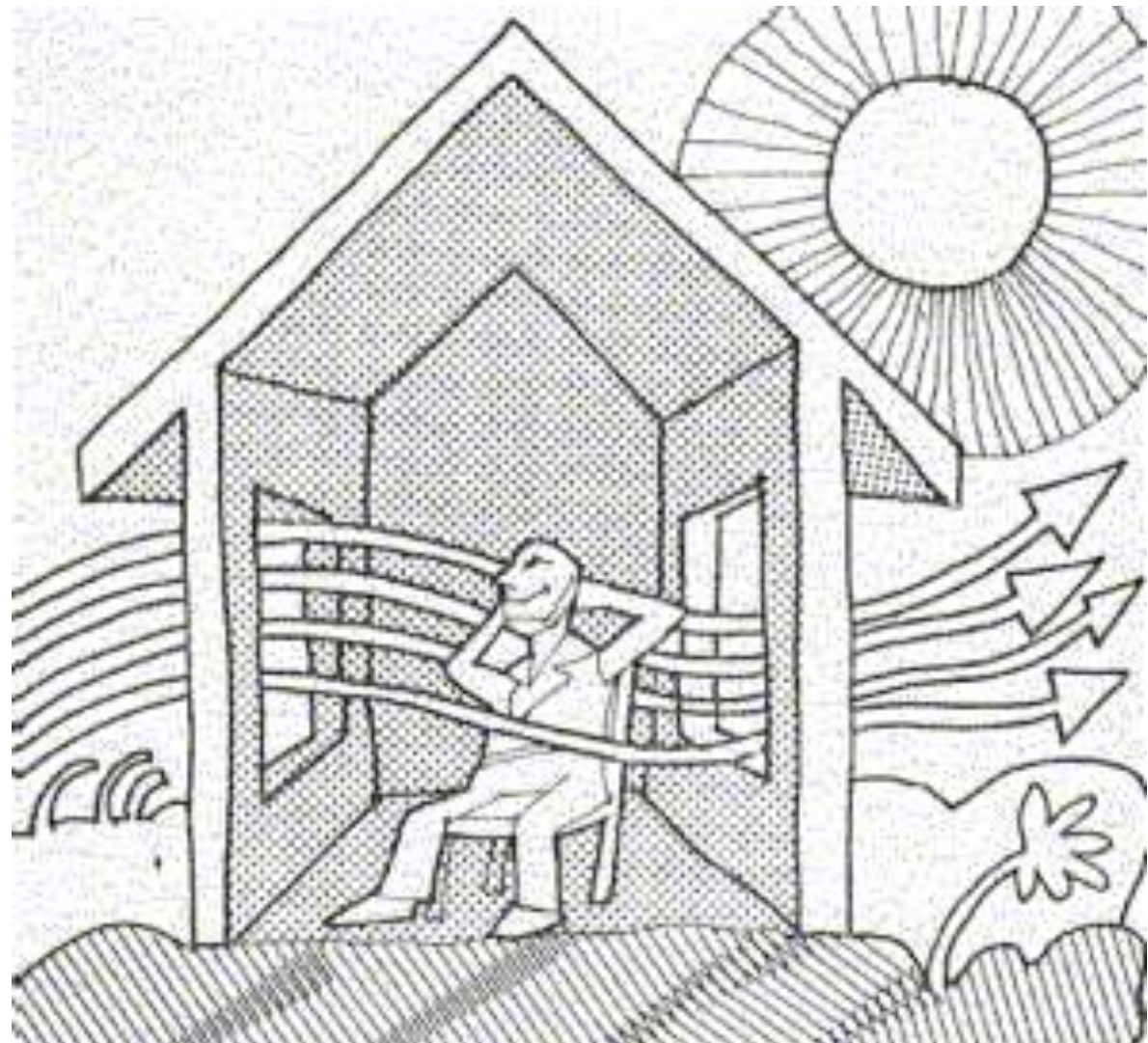


## **Natural ventilation solutions:**

- Cross ventilation
- Solar chimneys
- Cold and warm zones
- Air cooling
- Trickle ventilation



## Cross ventilation

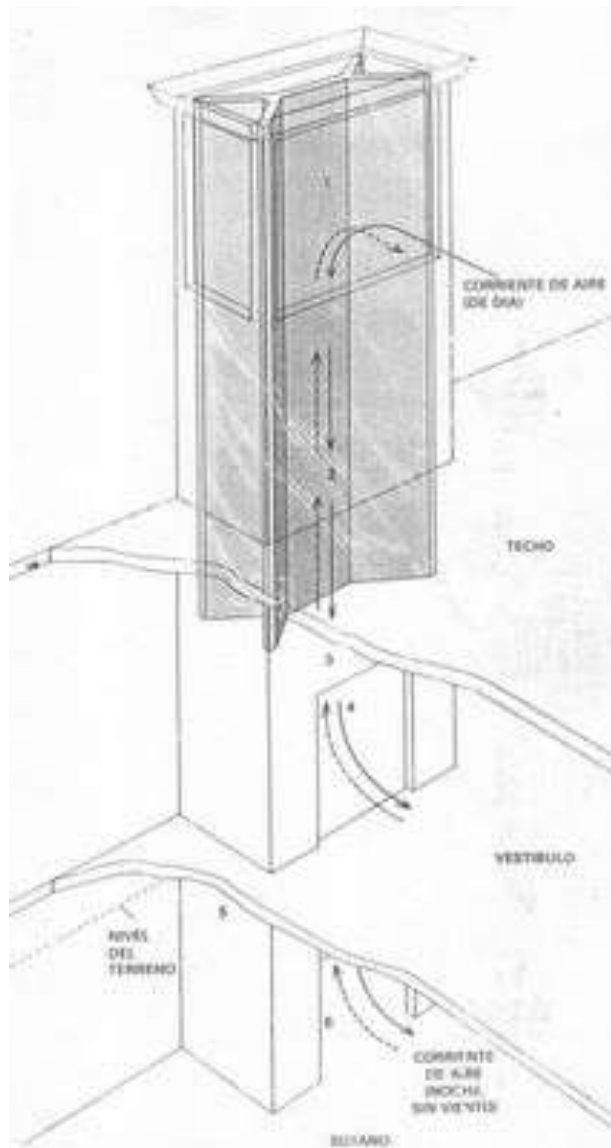




**Wind towers in the desert  
Yazd. Iran**

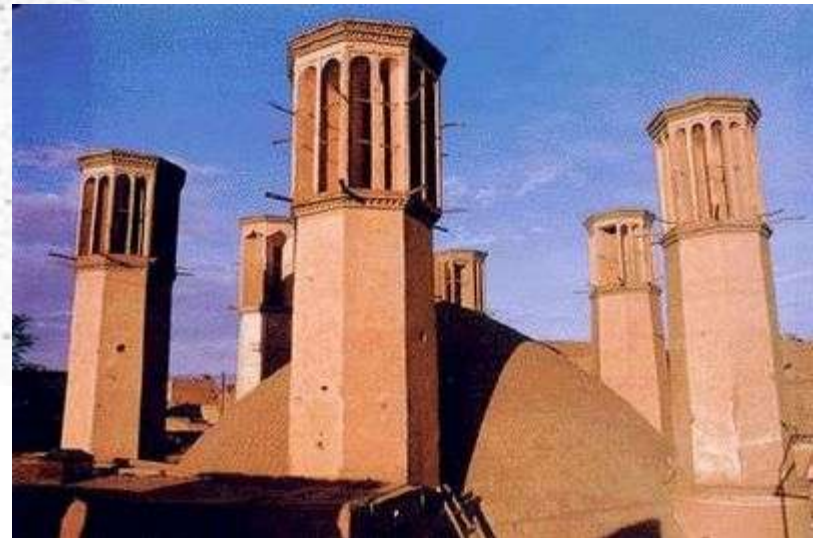
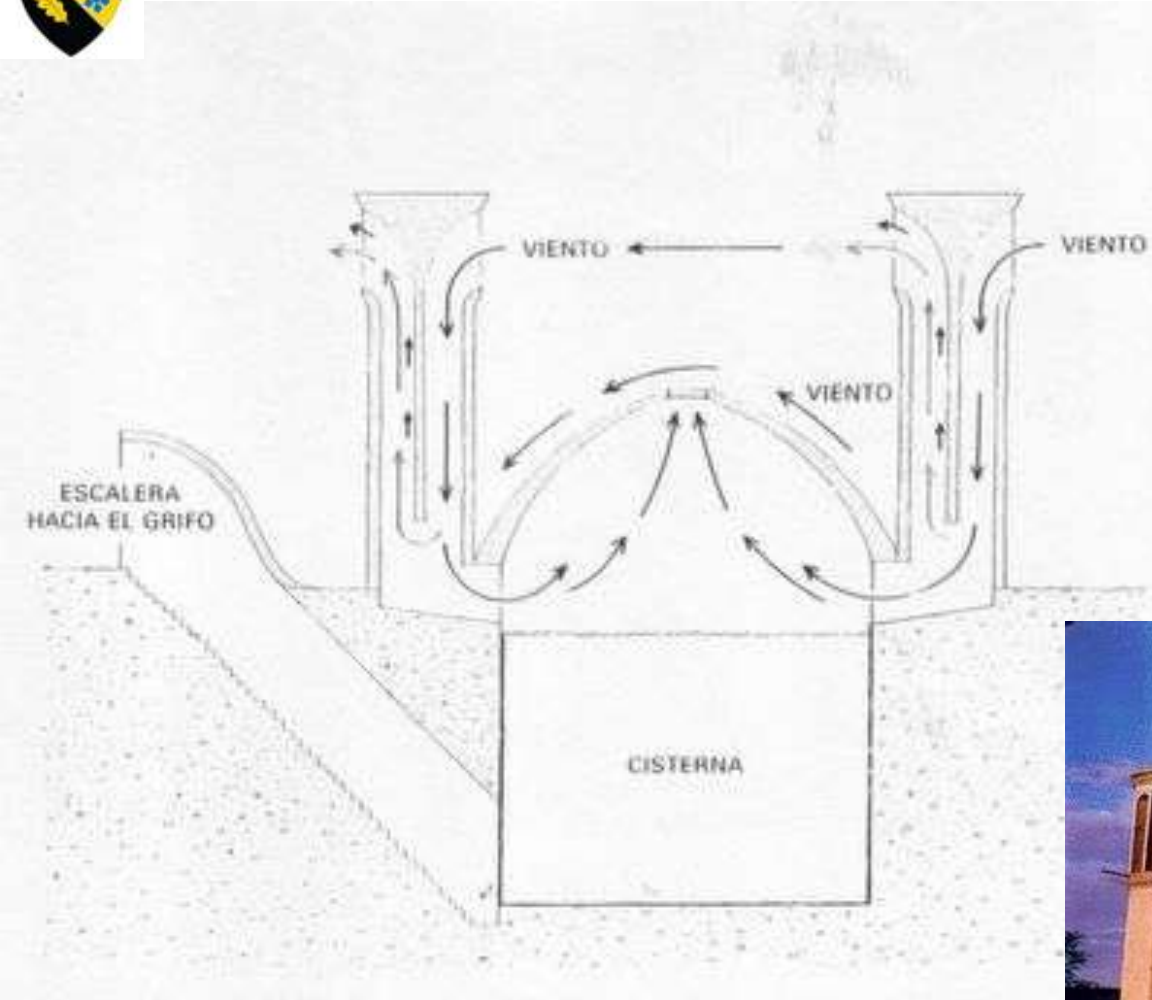


## NATURAL VENTILATION





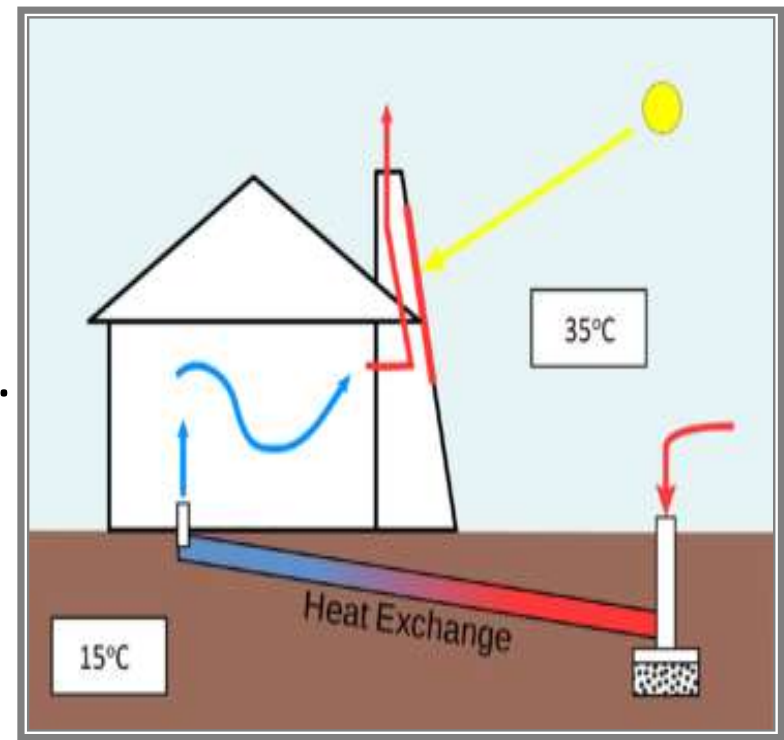
## NATURAL VENTILATION





# Solar Chimney

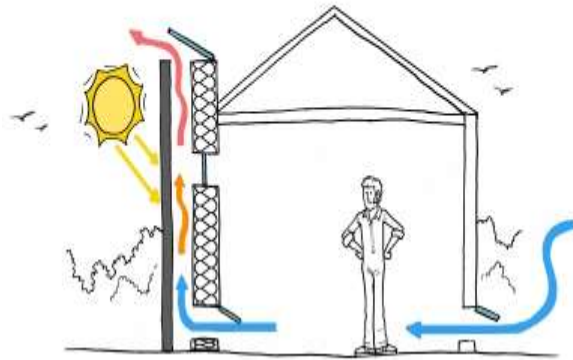
- Can be used to regulate the temperature of a building as well as providing ventilation.
- Easy and inexpensive means to heat and ventilation in a building.





## How it works?

COOLING



HEATING

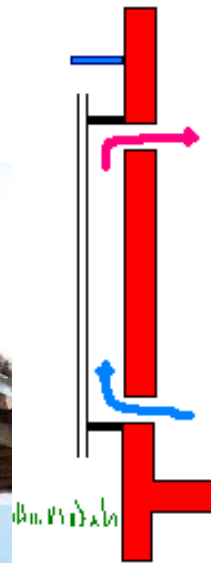


- The solar radiation hits the chimney, then the column of air inside the chimney is heated, if the top exterior vents are closed, the heated air is forced back into the living space.
- Does not require mechanical or electrical systems
- As the chimney becomes hot, the hot air rises up and is vented out of the top. In doing so draws more air in at the bottom of the chimney.
- More effective in hot and humid climates

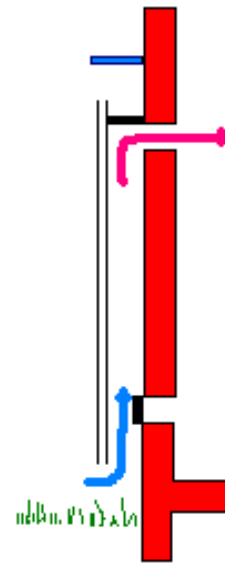


## Trombe wall

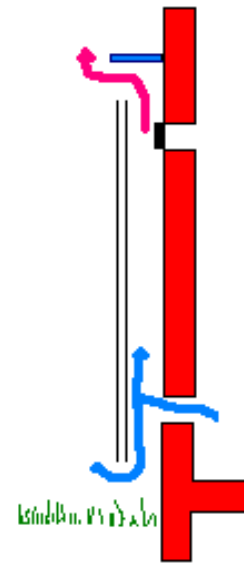
### DIFFERENT USES OF TROMBE WALL



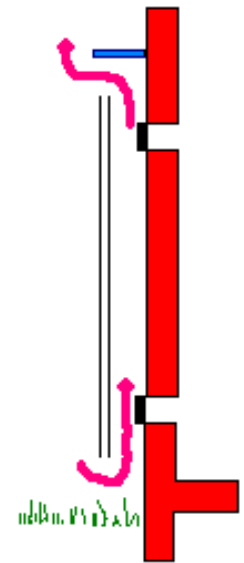
Ingreso de aire  
caliente a la  
vivienda en  
invierno



Para  
ventilar la  
vivienda



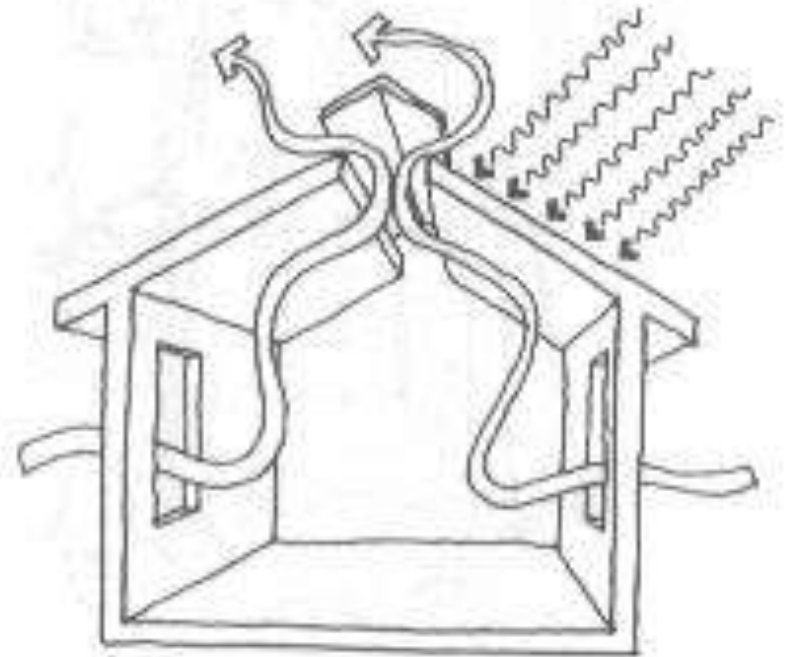
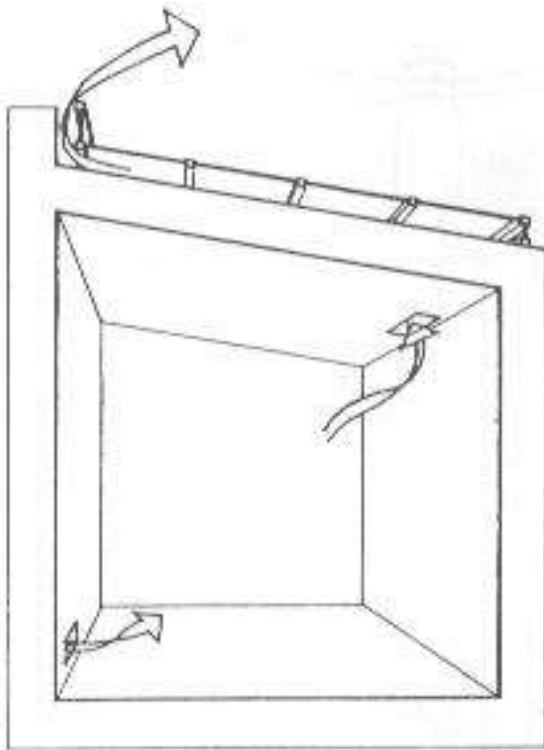
Ventilación  
forzada en  
el verano



Circulación  
de aire en el  
muro Trombe  
cuando no se  
usa



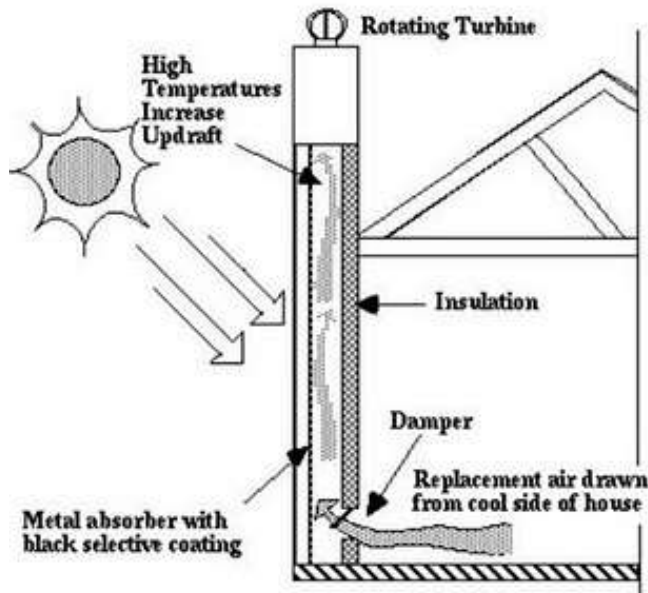
## NATURAL VENTILATION





## How to install it?

- The chimney is coated in a black material to minimise the amount of sunlight that is reflected off.
- Pipe is laid 5ft under ground
- Vent is added to top of chimney.
- Use of vents through windows are more common.





**BRE. Watford**



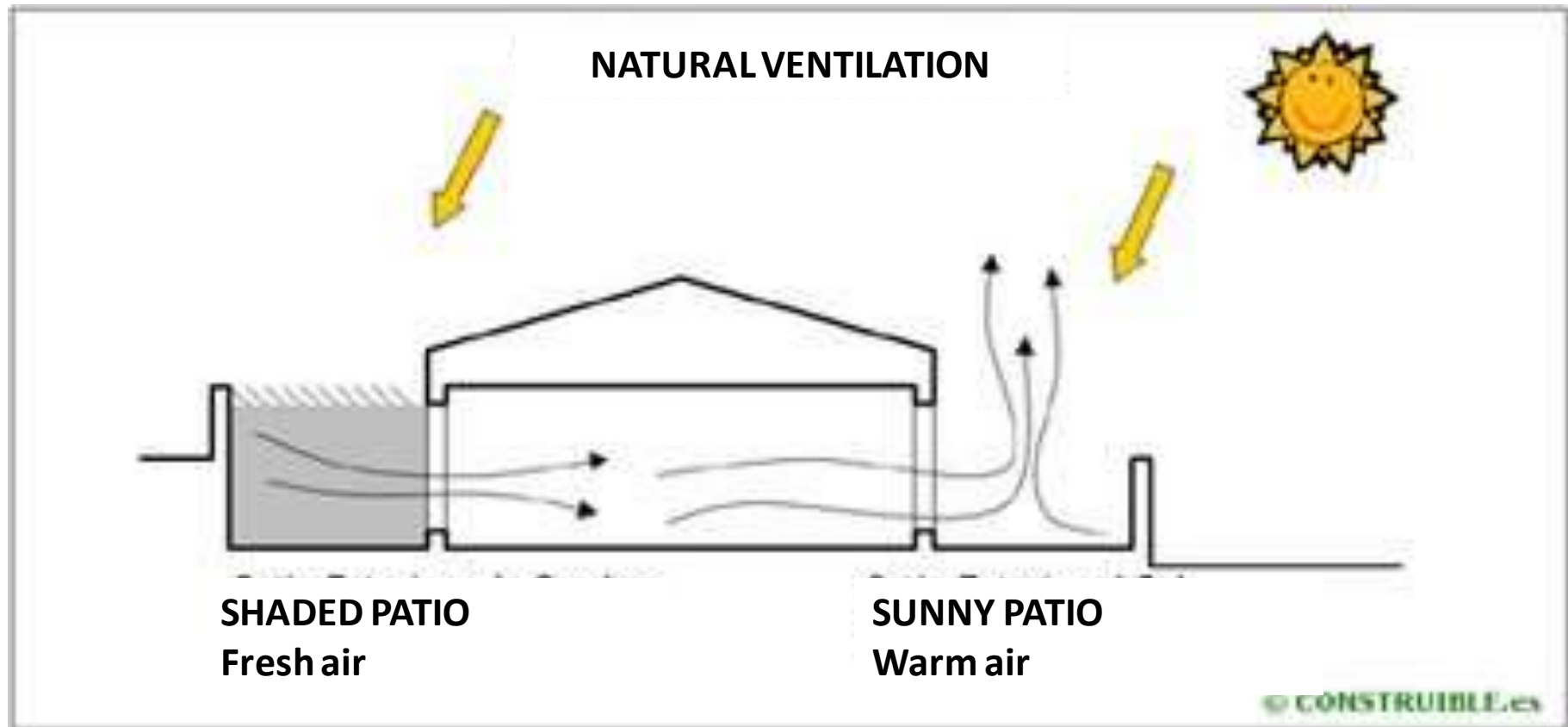
# Trickle ventilation

- Manually controlled slots incorporated into the window frame.
- Operated by opening or closing a flap, depending on the need for ventilation. However, they are intended to be left open.
- Trickle Ventilation can also be provided by trickle vents above the window frame and fitted into the glazed area along the top of the sealed glass.



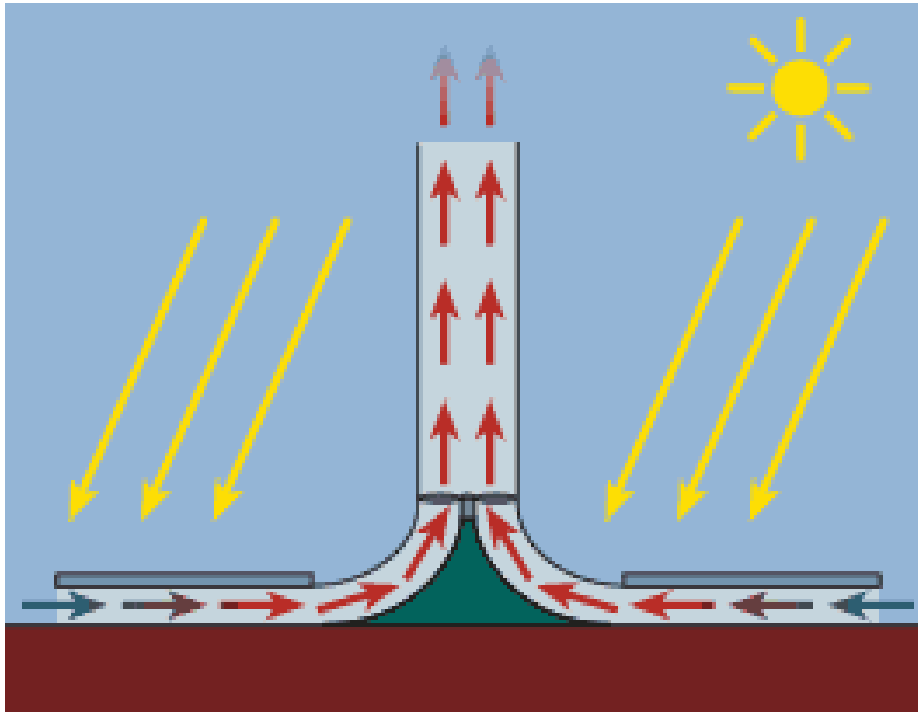


## Cold and warm zones





## Solar Tower Power Station



<https://www.youtube.com/watch?v=0tWIP0knKQU>



Prototipe in Manzanares (Spain). Tower of 192 metres (1982-1989)

Project in Australia (2012)



## Air cooling

## Vaporisation heat

Water, to go from liquid to gas needs to absorb heat. This heat is taken from the environment, the air, cooling it.







## Central patios









**National Museum of  
Anthropology and History.  
Mexico**



La pulverización  
de agua rebaja  
la temperatura  
de 20 a 40 °C

