

# Ventilation

## 2 Ventilation and Air-conditioning Systems

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## ➤ Ventilation systems



### Natural ventilation

- is the flow of outdoor air caused by **wind and air density differences**

### Mechanical (forced) ventilation

- is driven by **mechanical work** - fan

### Hybrid ventilation

- combination of natural and mechanical ventilation

## ■ Natural ventilation



- **natural ventilation by louvers** (permanent)
- **shaft ventilation** (permanent)



heat source

- **interrupted natural ventilation** (time limited)
- **infiltration** (time limited)



depends on  
external (ambient)  
climatic conditions

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## ■ Mechanical ventilation



### **Air exchange in the room:**

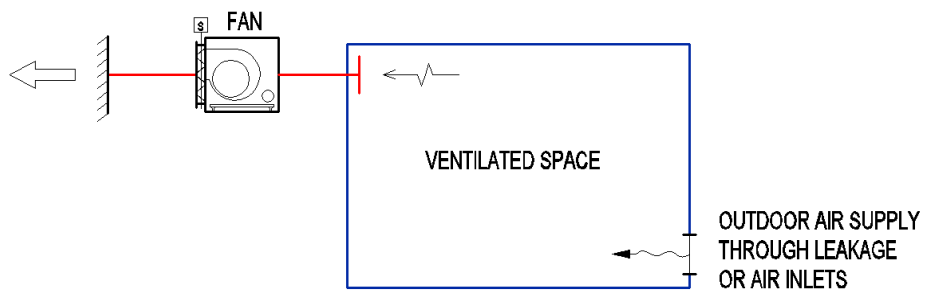
- exhaust-only ventilation system
- supply-only ventilation system
- supply and exhaust ventilation system

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## ■ Mechanical ventilation



### Exhaust-only ventilation systems



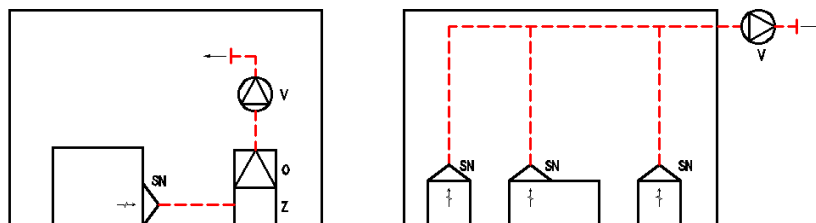
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## ■ Mechanical ventilation



### Local exhaust ventilation systems

- unitary exhaust
- central exhaust

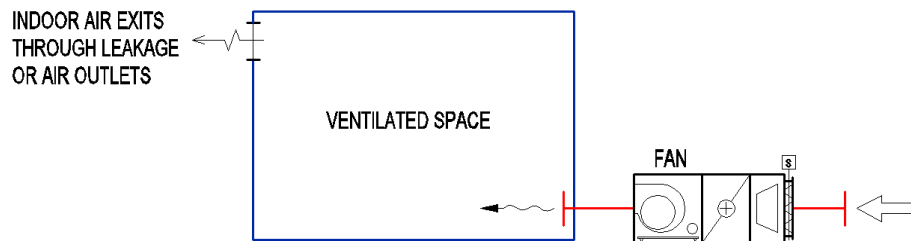


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## ■ Mechanical ventilation



### Supply-only ventilation system

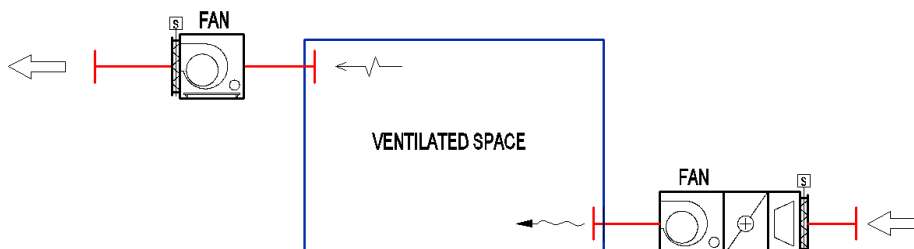


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## ■ Mechanical ventilation



### Supply and exhaust ventilation system



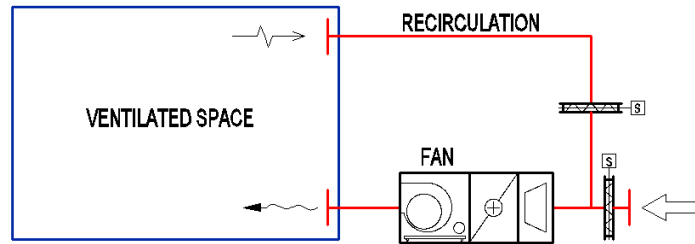
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## Mechanical ventilation



### Supply and exhaust ventilation system

- recirculation without exhaust



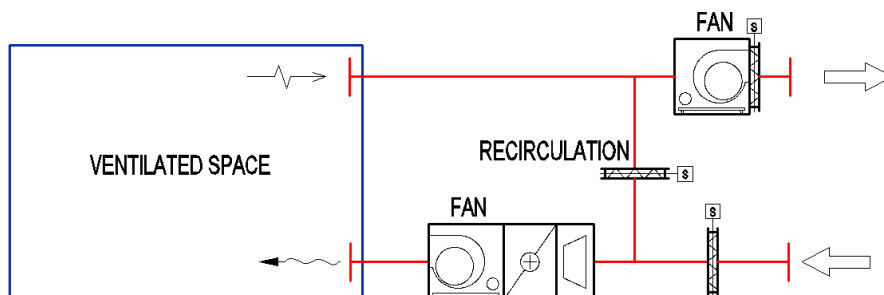
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## Mechanical ventilation



### Supply and exhaust ventilation system

- recirculation with exhaust



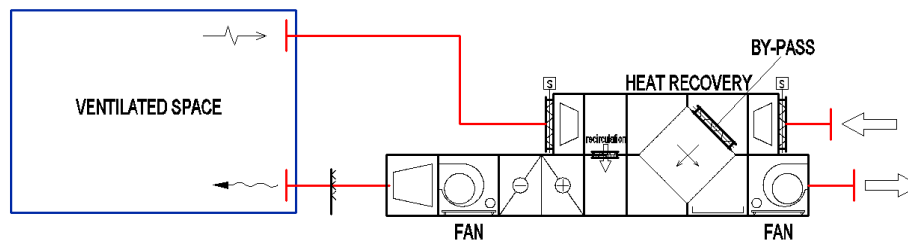
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## ■ Mechanical ventilation



### Supply and exhaust ventilation system

- with heat recovery, recirculation, heating, cooling (drying), humidifying, double filtration



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## ■ Mechanical ventilation



### Pressure condition of the space:

- **underpressure**

$V_s < V_{ex}$  usually 15 - 30 Pa  
400 Pa for work with radioactive materials

- **overpressure**

$V_s > V_{ex}$  e.g. clean rooms, operating room, ...  
min. 10 - 15 Pa

- **balanced**

$V_s = V_{ex}$

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## ■ Mechanical ventilation



### Local air supply

For local conditioning of air temperature or cleanliness

- air curtain
- air shower
- personalized ventilation

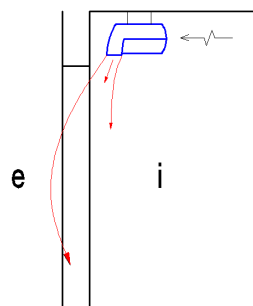
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## ■ Local air supply

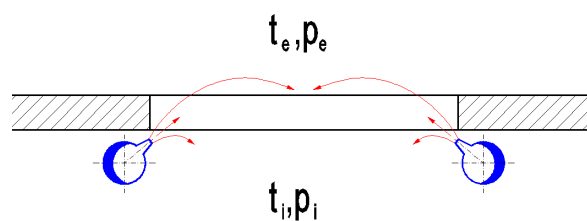


### Air curtain

a) door curtain with upward supply



b) two side curtain



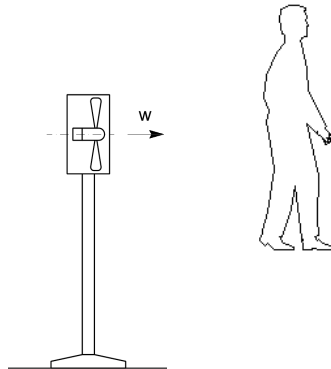
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## ■ Local air supply



### Air shower

- people protection in hot industrial work places with radiation (steel foundry,...)
- higher air convection



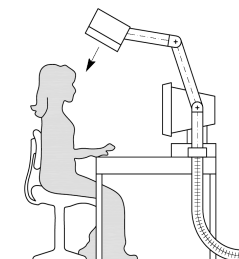
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## ■ Local air supply



### Personalized ventilation

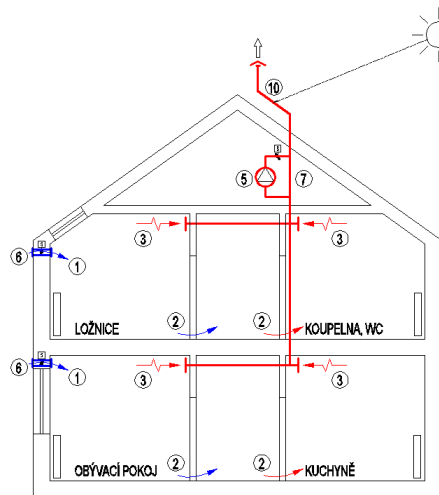
- outdoor air supply directly to the breathing zone



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## Hybrid ventilation

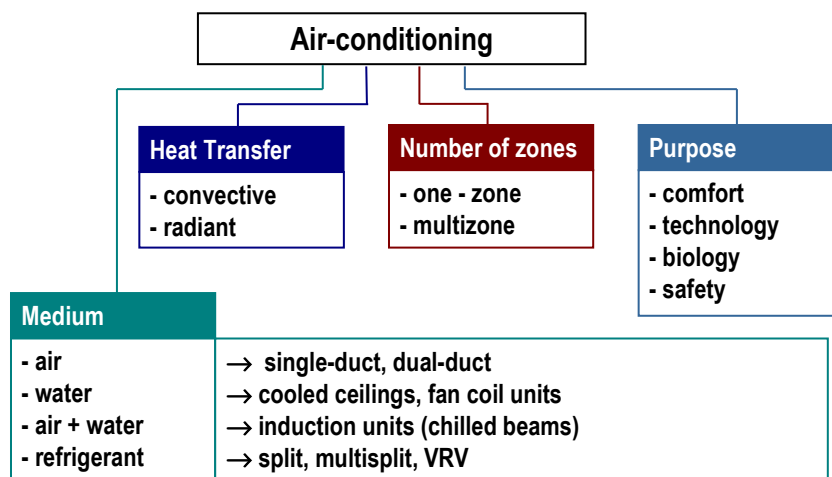


Solar chimney



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## Air-conditioning

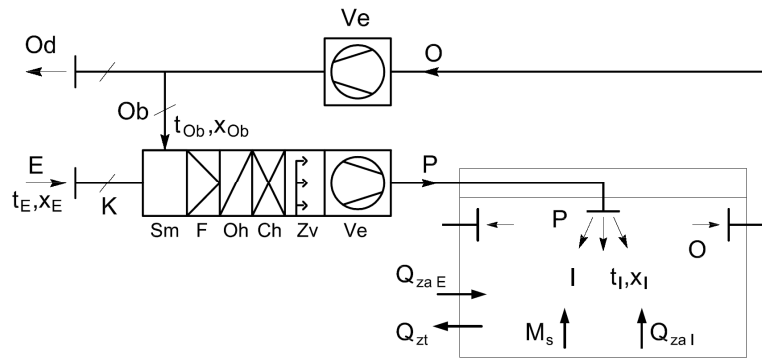


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## ■ Air-conditioning



### Single-duct air system with constant air flow

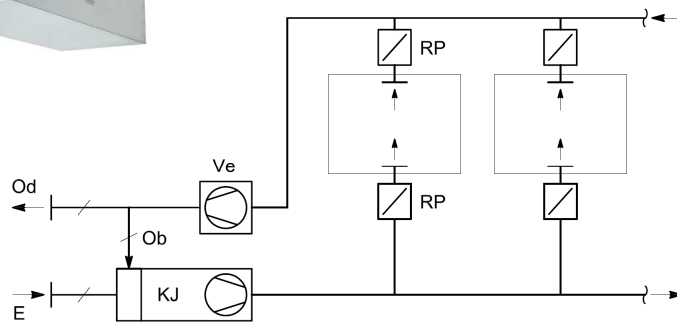


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## ■ Air-conditioning



### Single-duct air system – VAV (variable air volume)

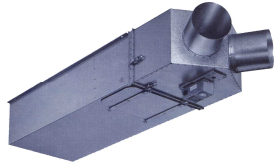
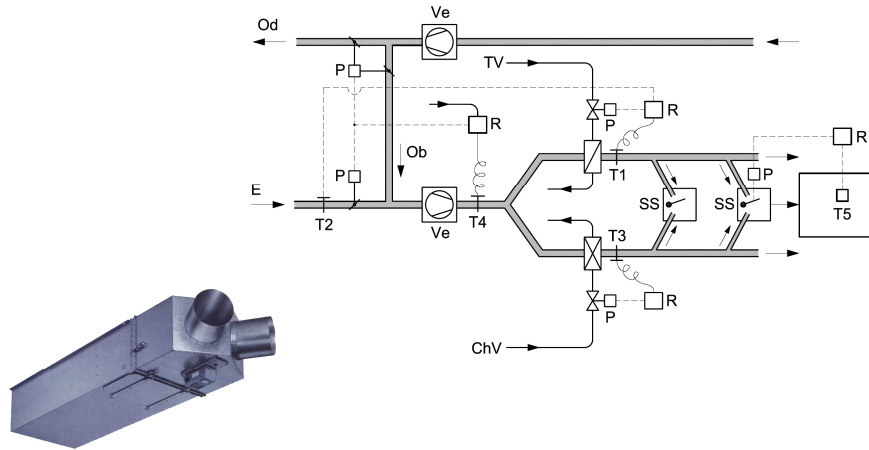


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## Air-conditioning



### Dual-duct air system

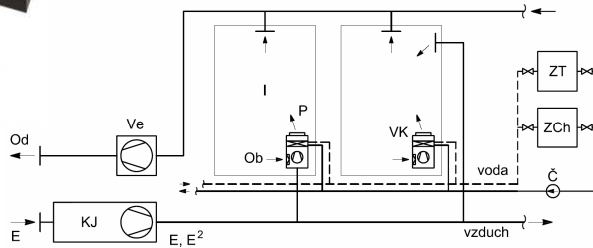
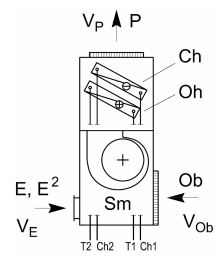


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## Air-conditioning



### Fan-coil unit system

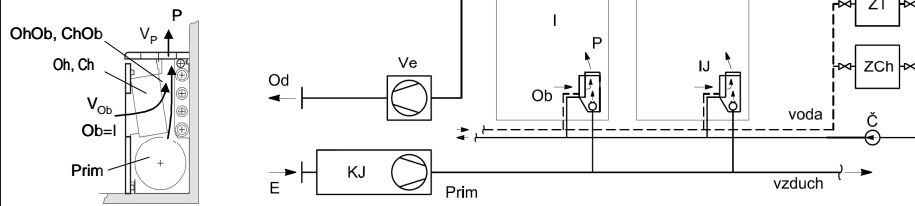


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## Air-conditioning



### Induction unit, Chilled beams system

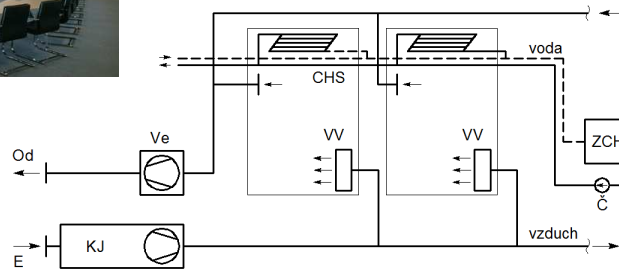


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## Air-conditioning



### Cooled ceiling system

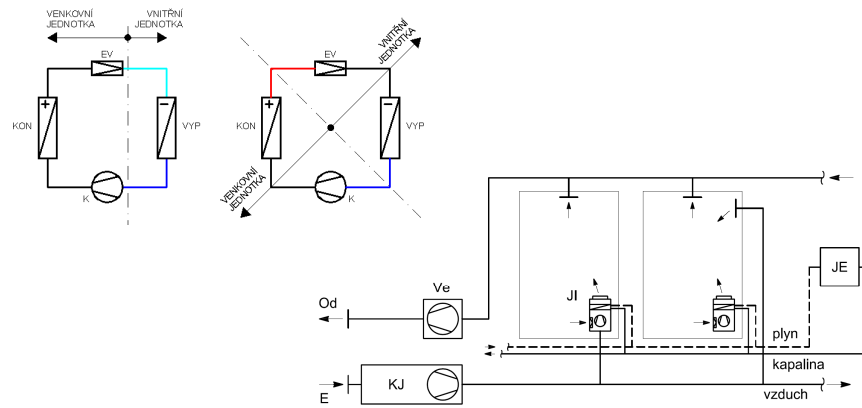


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## Air-conditioning



### Refrigerant systems



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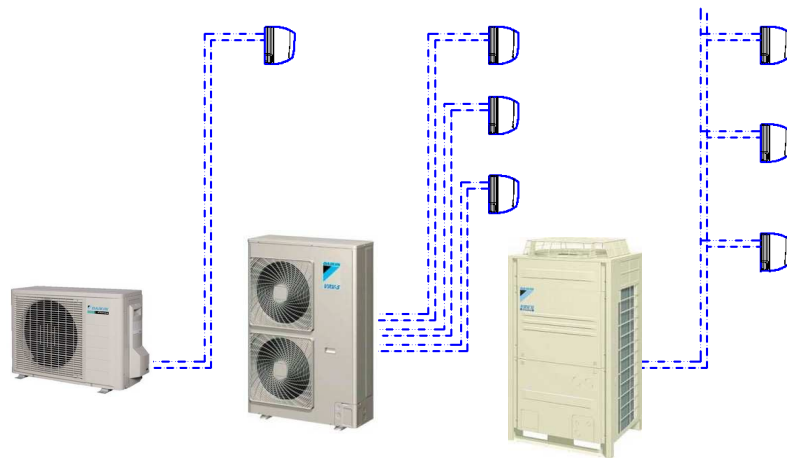
## Air-conditioning



### Split

### Multi-split

### VRV



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**Thank you for your  
attention**

