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Earth-air heat exchanger system on model

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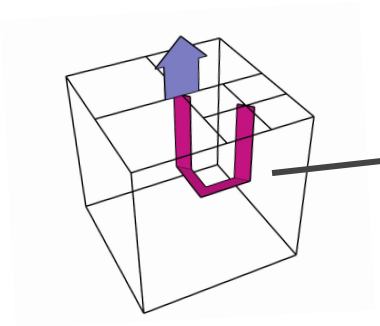
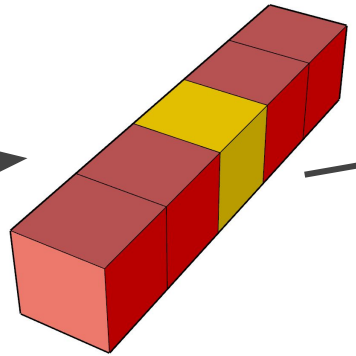
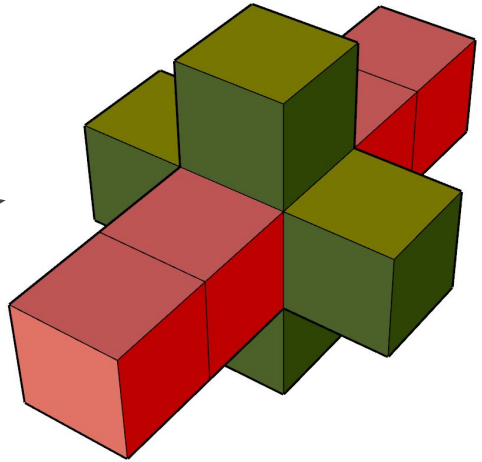
Previous Concept

1) Added





air tube nodes

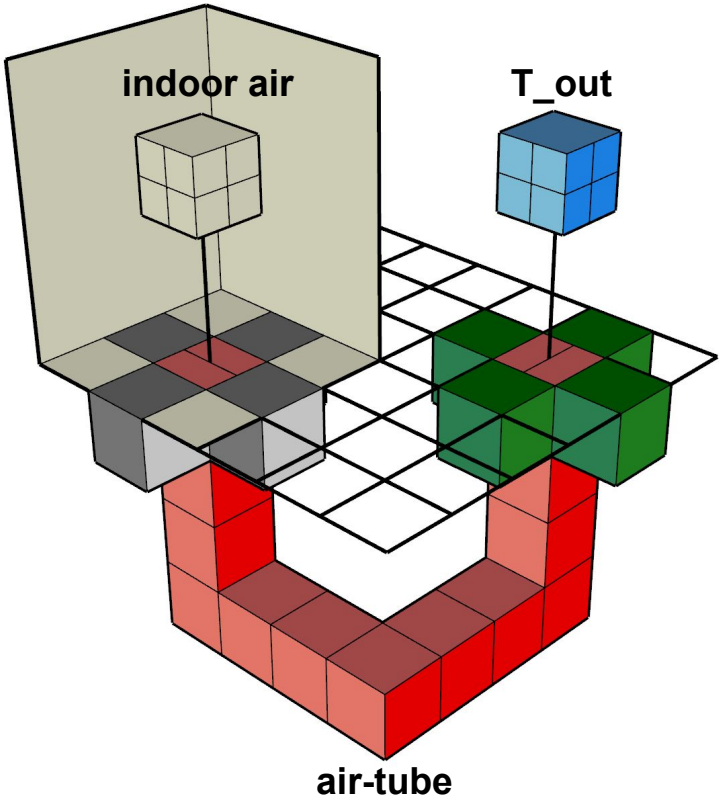


1. **conduction**
   with 4 adjacent ground cubes (green cubes)

2. **convection**
   with 2 adjacent air-tube cubes (red cubes)

3. **ventilation**
   with 2 adjacent air-tube cubes (red cubes)

2) inlet, outlet



- Heat - transfer at **inlet, outlet**

1. **conduction**
   with 4 adjacent ground cubes (green cubes)
   and floor node

2. **convection**
   with 1 adjacent air-tube cube (red cube)
   and T_out node
   and indoor air node

3. **solar radiation**
   can be added based on the design

4. **longwave radiation**
   with T_sky node

5. **ventilation**
   with 1 adjacent air-tube cube (red cube)
   and T_out node
   and indoor air node

2) M, S, f matrix

1. **conduction**
   with adjacent ground cubes (green cubes)
2. **convection & ventilation**
   with adjacent air-tube cubes (red cubes)
   and T_out, T_indoor
3. **longwave radiation**
   with T_sky

→ **S matrix**

4. **thermal mass**
   of the air-tube cubes → **M matrix**

5. **solar radiation**
   at the inlet of the air-tube → **f matrix**

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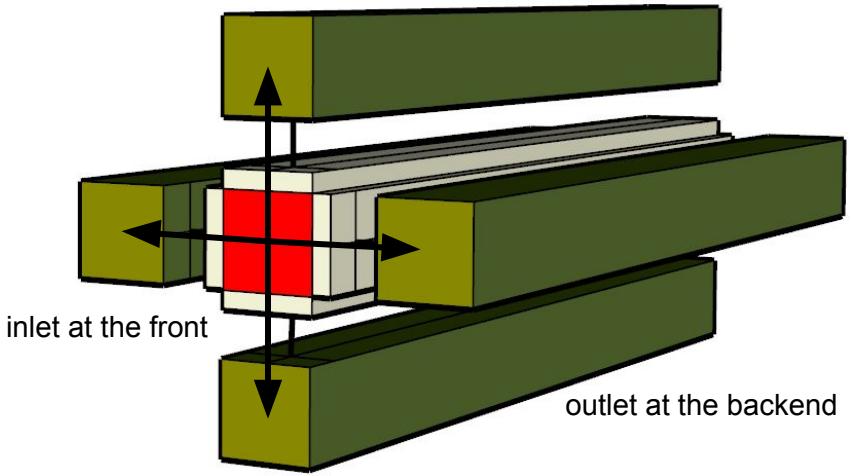
*Adjusted Concept

1) Concept



ground nodes
(boundary conditions)

↑

air duct walls X 4

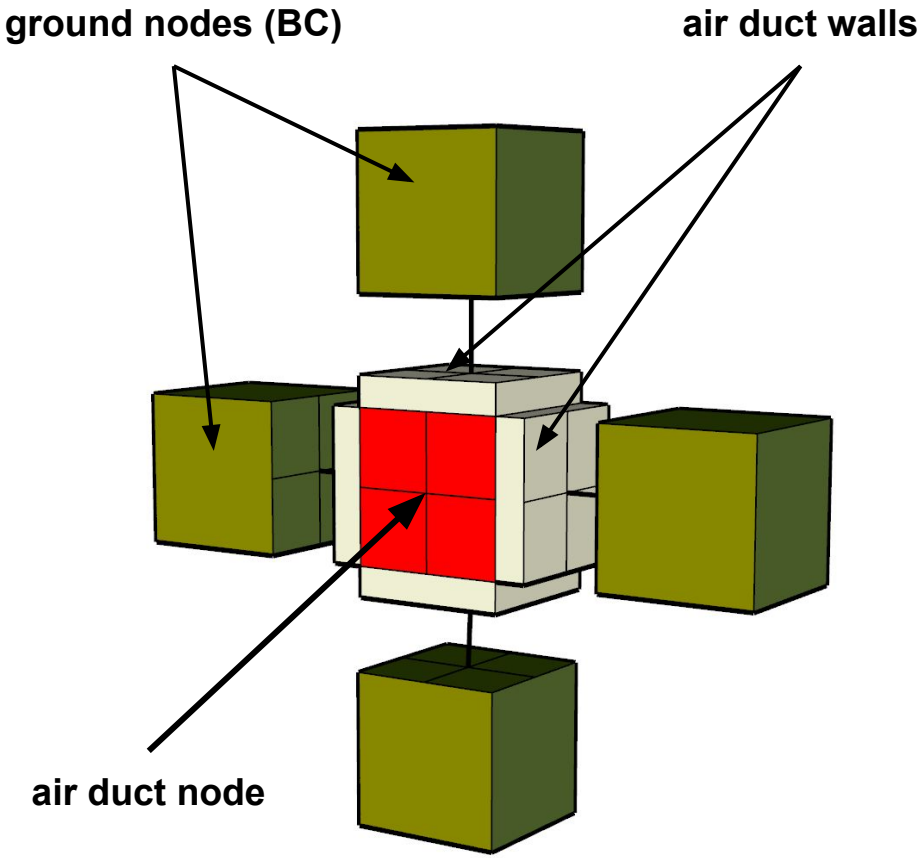
↑

air duct node

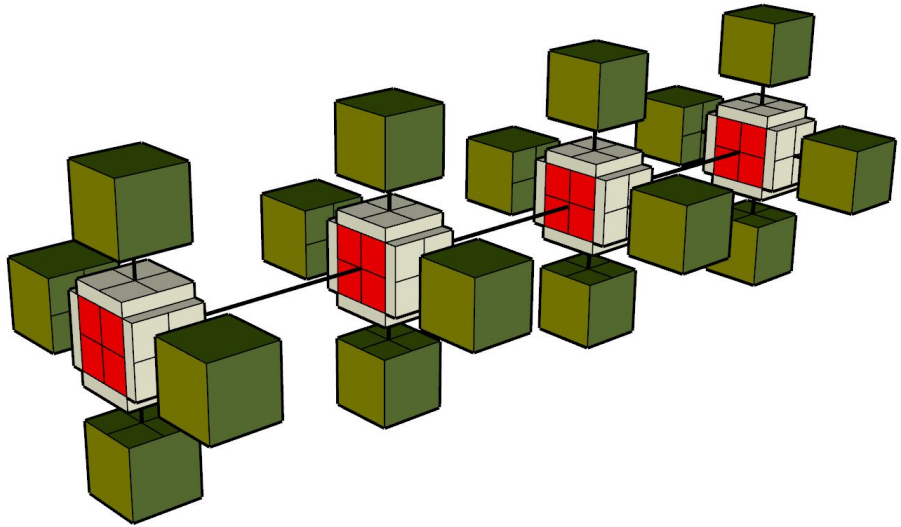
ignores the vertical / horizontal geometry of the air duct
- ignores the joints
- ignores the depth of the grounds

air inside the air duct is represented by single node

1) Concept (sliced)



1) Concept (sliced)



ground nodes
(boundary conditions)

↑

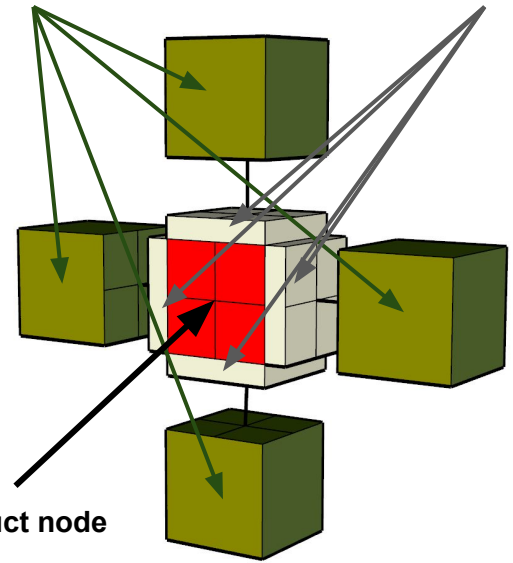
air duct - surface

X 4 X 4

↑

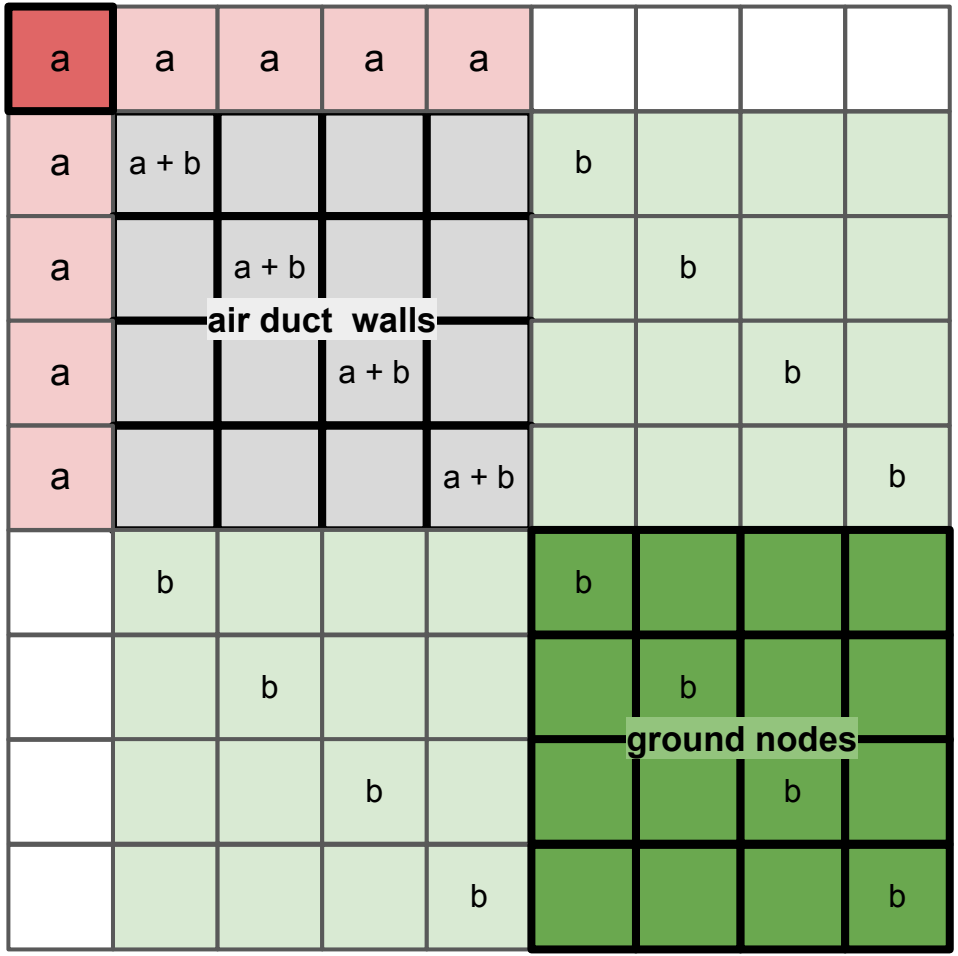
air duct - air

2) S_ductcube

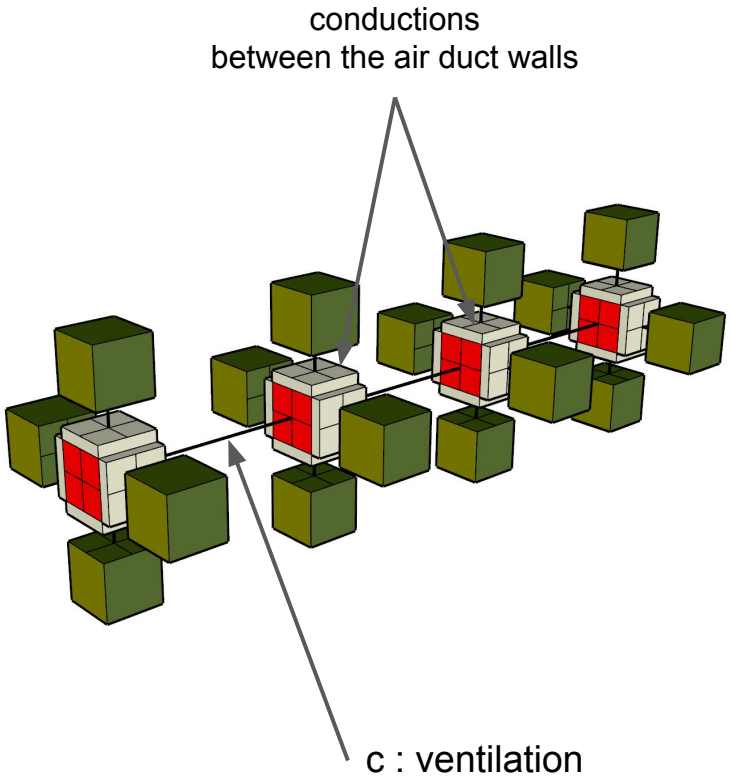


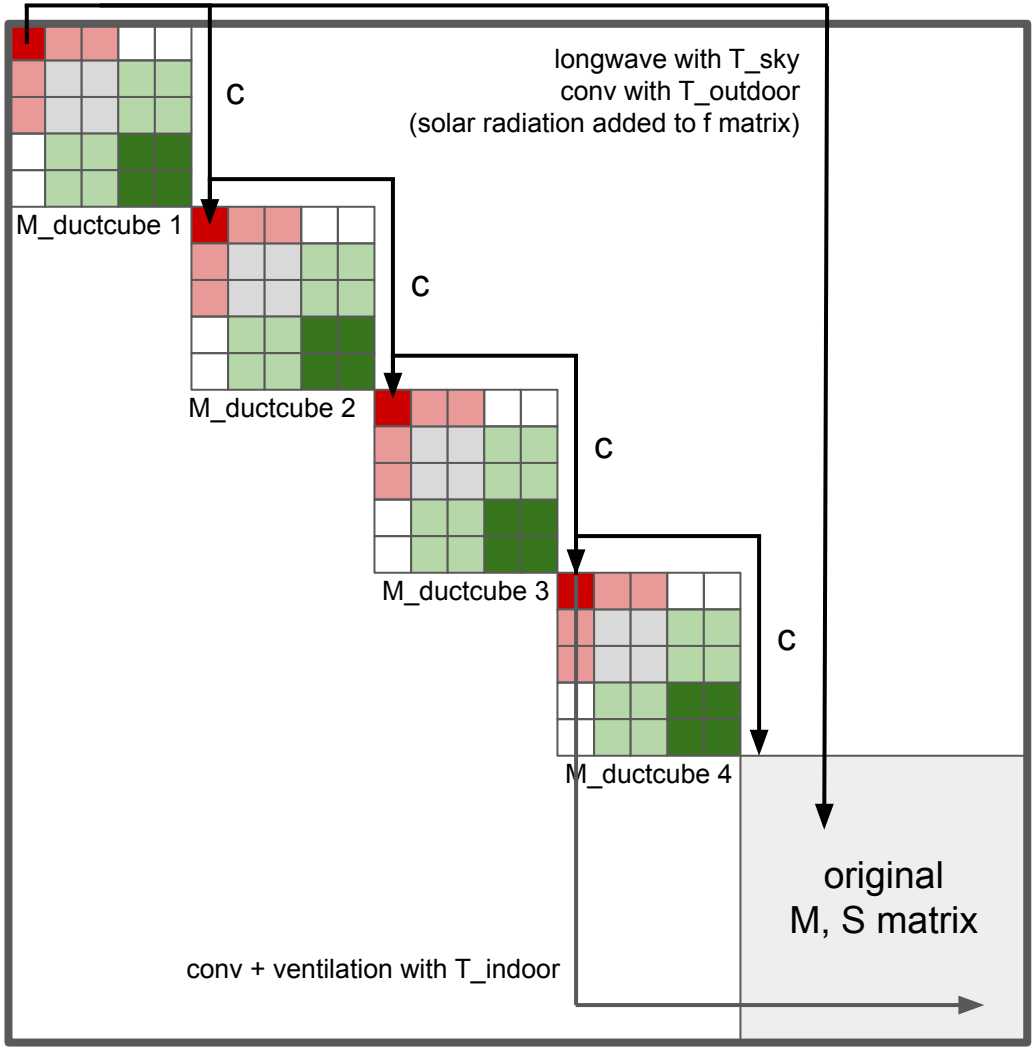
a : conv
b : cond

air duct node



2) M_all


conductions
between the air duct walls
c : ventilation


c
longwave with T_sky
conv with T_outdoor
(solar radiation added to f matrix)
M_ductcube 1
c
M_ductcube 2
c
M_ductcube 3
c
M_ductcube 4
original
M, S matrix
conv + ventilation with T_indoor