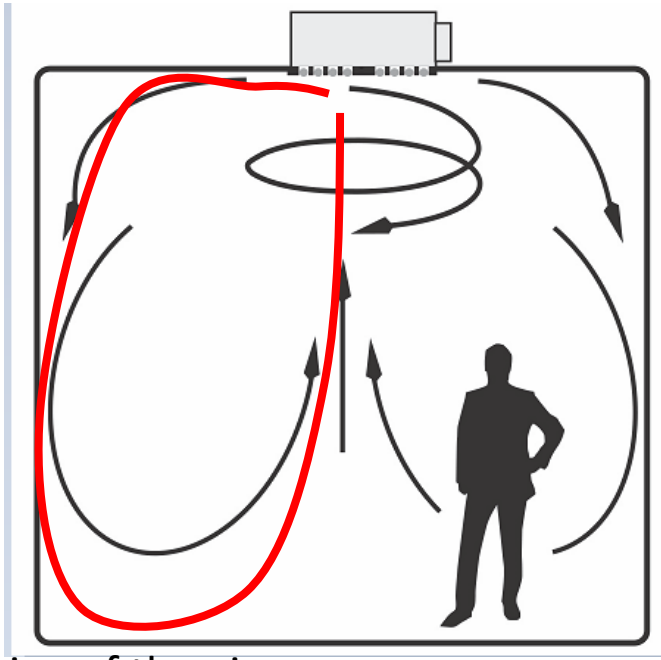
Heating exclusively through the ceiling

Heating exclusively through the ceiling

Why use high induction diffusers to heat through the ceilings ?

Induction diffuser

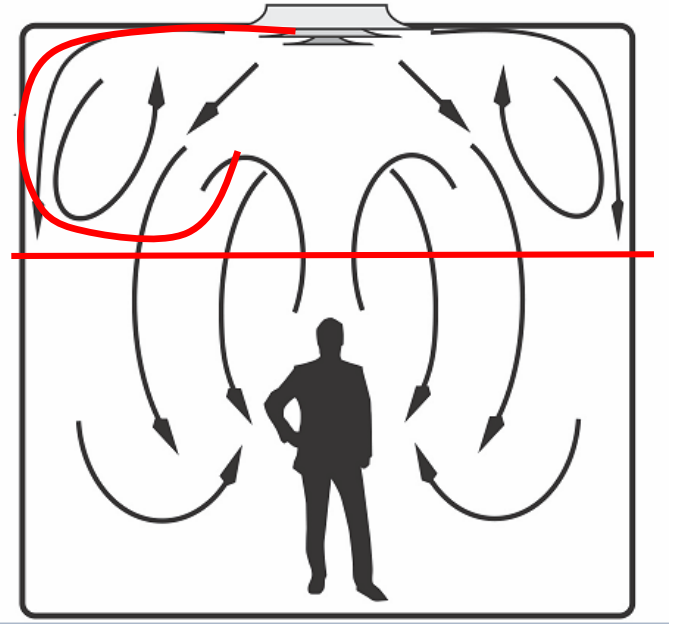


Good mixing of the air

Room air circulation cycle complete

No stagnant air zone present in the room
Possibility of reducing the imput of fresh air

Standard diffuser



Bad mixing and stratification

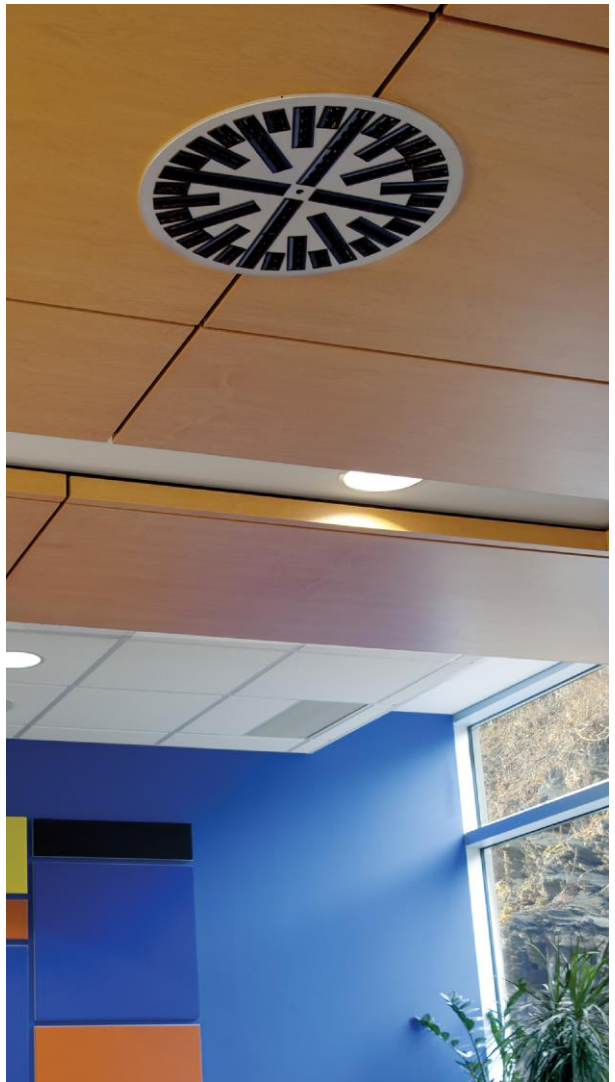
Room air circulation cycle incomplete

Stagnant air zone present in the room
Increase of imput of fresh air

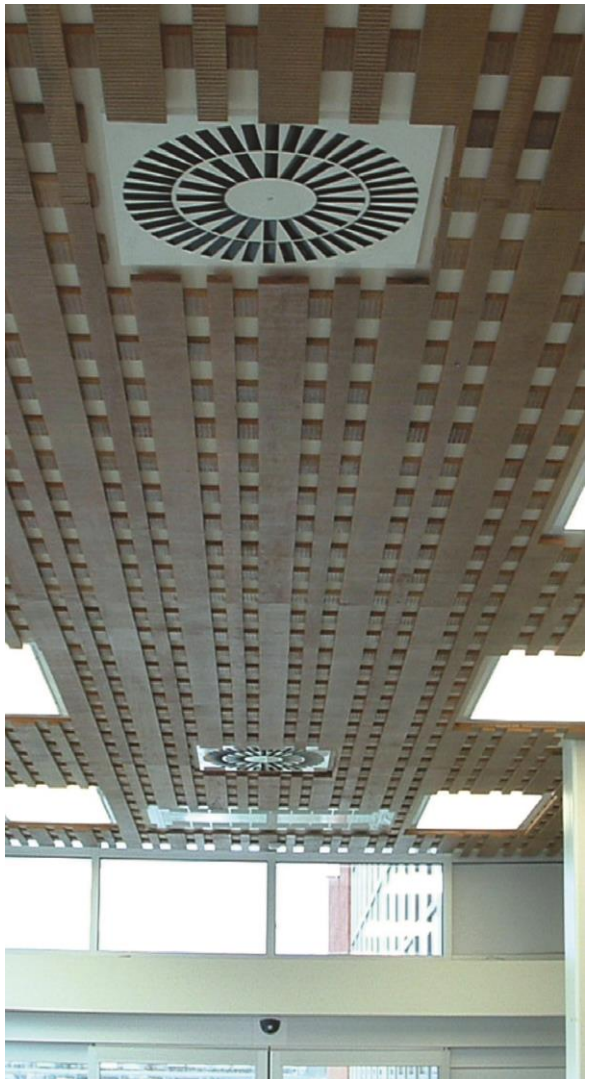
Heating exclusively through the ceiling

Why use high induction diffusers to heat through the ceilings ?

DAL 358



DAL 359



SAL

Le chauffage uniquement par le plafond

In order to heat through the ceiling, you need to respect certain conditions

2 cases

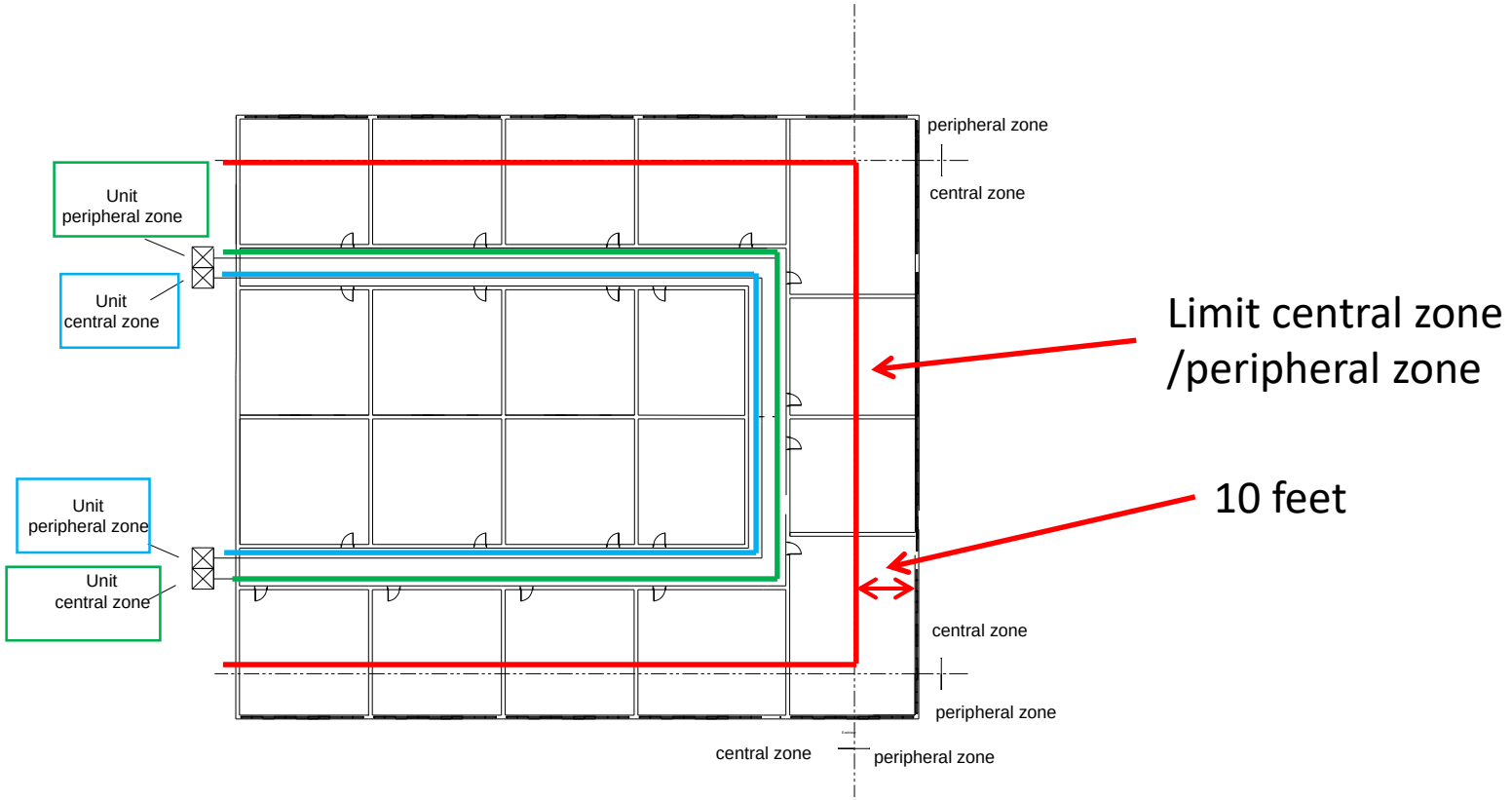
- Room with ceiling height of 14 ft. or less
- Room with ceiling height of 14 ft. or more

Conditions for heating a room with ceiling heights of 14ft and less

1. Proper zoning of ventilation units

Heating exclusively through the ceiling

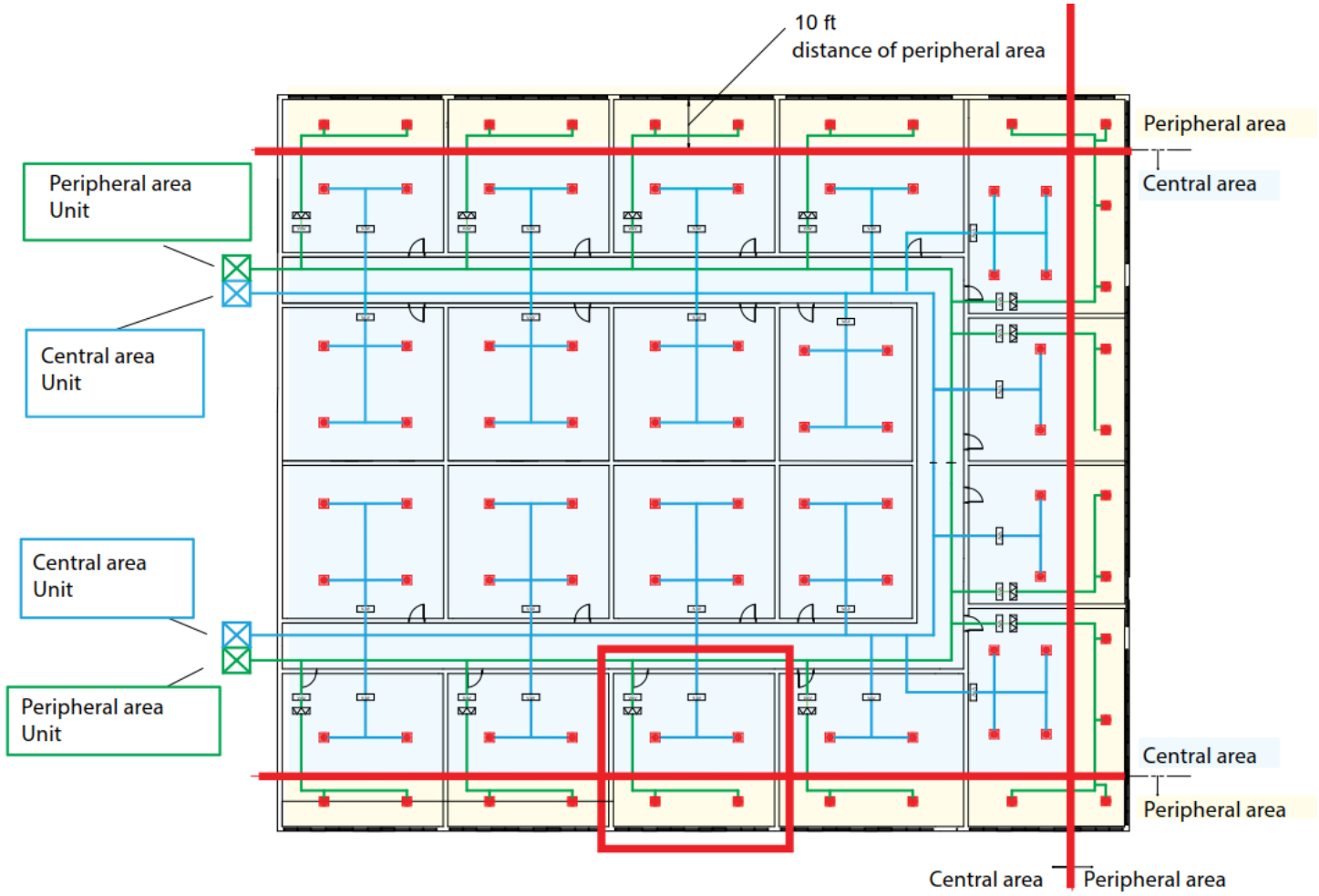
Proper zoning of ventilation units



Heating exclusively through the ceiling

Proper zoning of ventilation units

NOTE : Energy savings: In unoccupied mode (night) the central unit can be turned off, the peripheral unit will assure maintenance of the temperature and supply of fresh air



The diffusers in the peripheral zone are connected to the peripheral zone unit

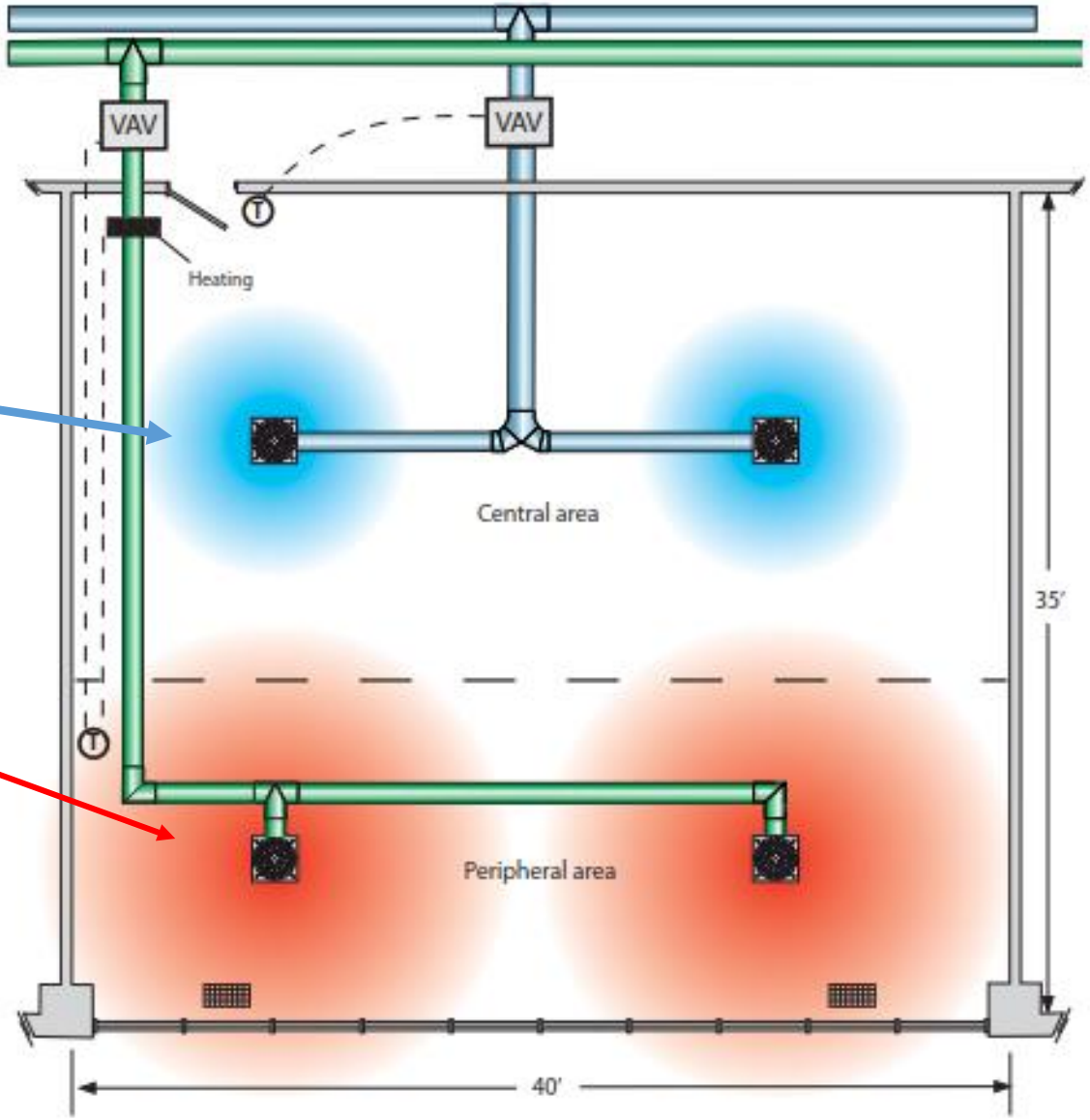
The diffusers in the central zone are connected to the central zone unit

Heating exclusively through the ceiling

Proper zoning of ventilation units

The diffusers in the central zone are supplied with tempered or slighty cooled air

The diffusers in the peripheral zone are supplied with hot air



→ Energy Savings

The supply temperature is adapted to each zone ex: It is not necessary to cool the air from the central zone which has been heated in the peripheral zone

Heating exclusively through the ceiling

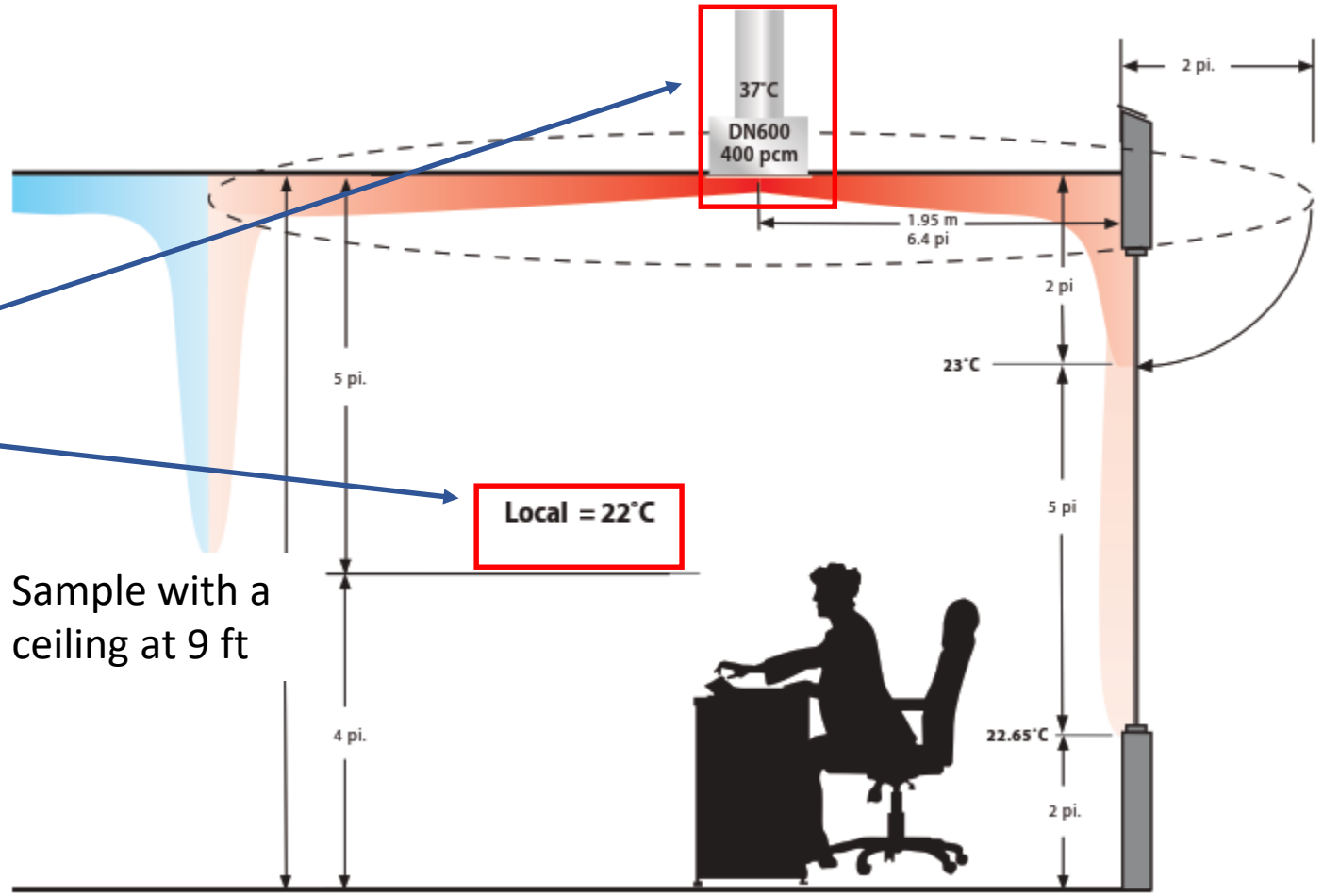
Conditions for heating a room with ceiling heights of 14ft and less

1. Proper zoning of ventilation units
2. **Have a temperature differential of no more than Δ+15 °C at output**

Heating exclusively through the ceiling

Supply temperature of diffusers

Maximum temperature differential of Δ+15 °C

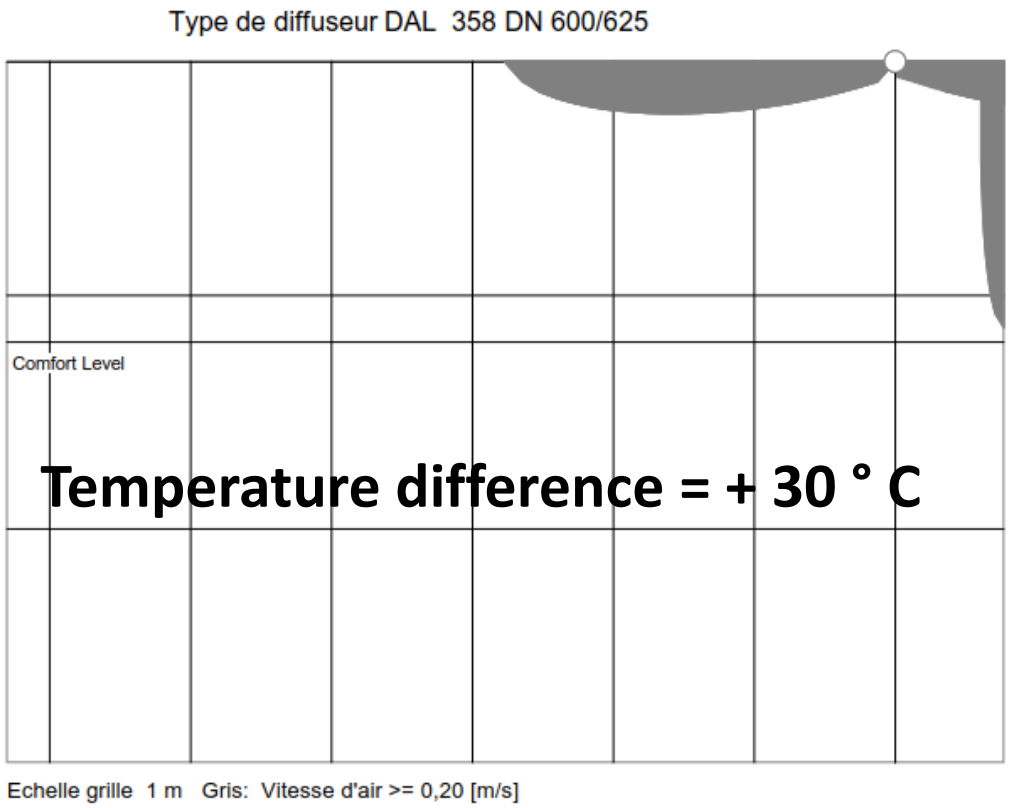


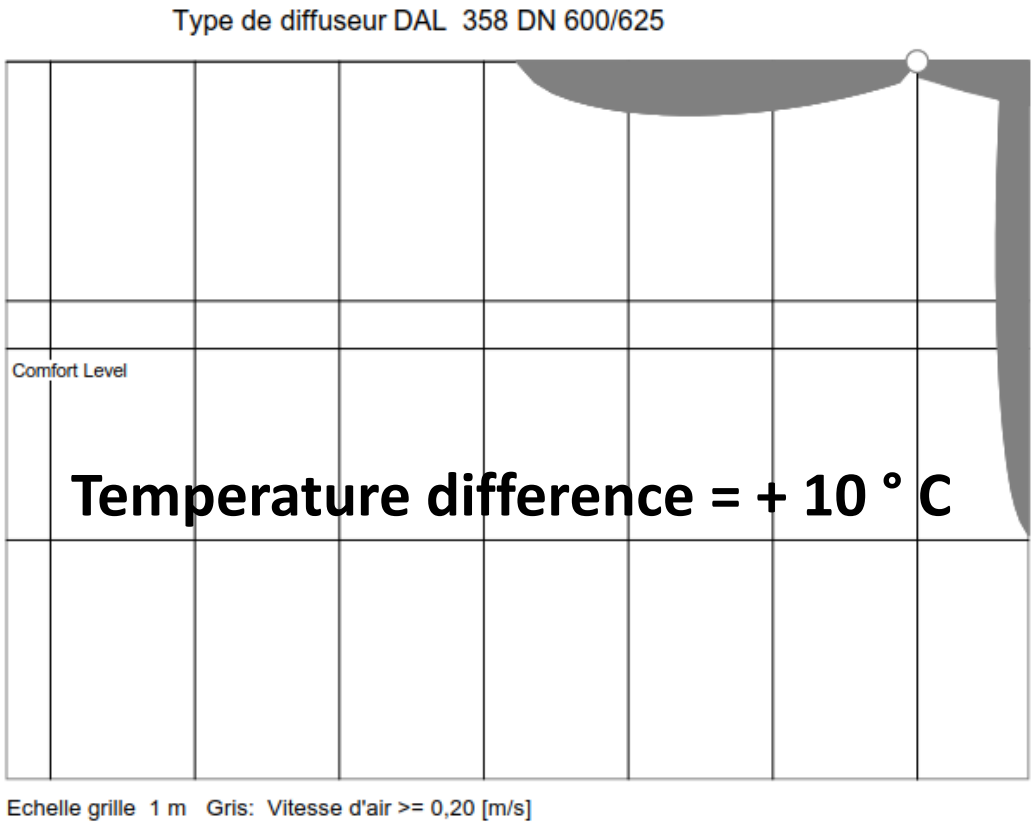
Sample with a ceiling at 9 ft

Heating exclusively through the ceiling

Supply temperature of diffusers

Simulation DAL 358 DN 600





→ **Maximum supply temperature of 37 °C (98 F) (Difference of 15 °C)**
Ex : Set up to avoid : natural gas unit with temperatures + to 55 °C

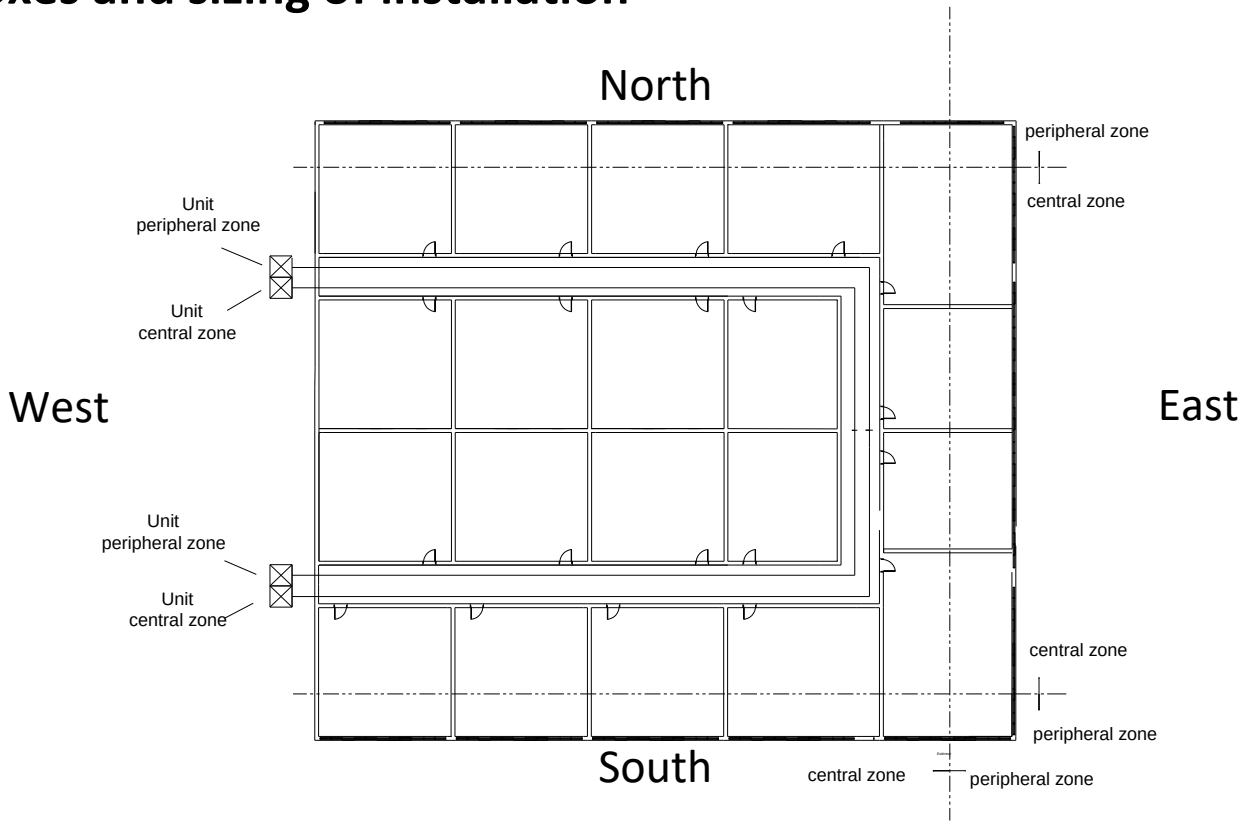
Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and less

1. Proper zoning of ventilation units
2 Have a temperature differential of no more than Δ+15 °C at supply
3. **Ensure VAV boxes are open 100% in heating and size the room using heating parameters for the north**

Heating exclusively through the ceiling

Setting of VAV boxes and sizing of installation



<u>Zone E-S-W</u> : Sizing of installation in cooling, opening of VAV boxes at 100% in heating: good mixture of air in the room

<u>Zone Nord</u>: Determine output in heating and cooling. It is possible the sizing may have to be done in heating

Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and less

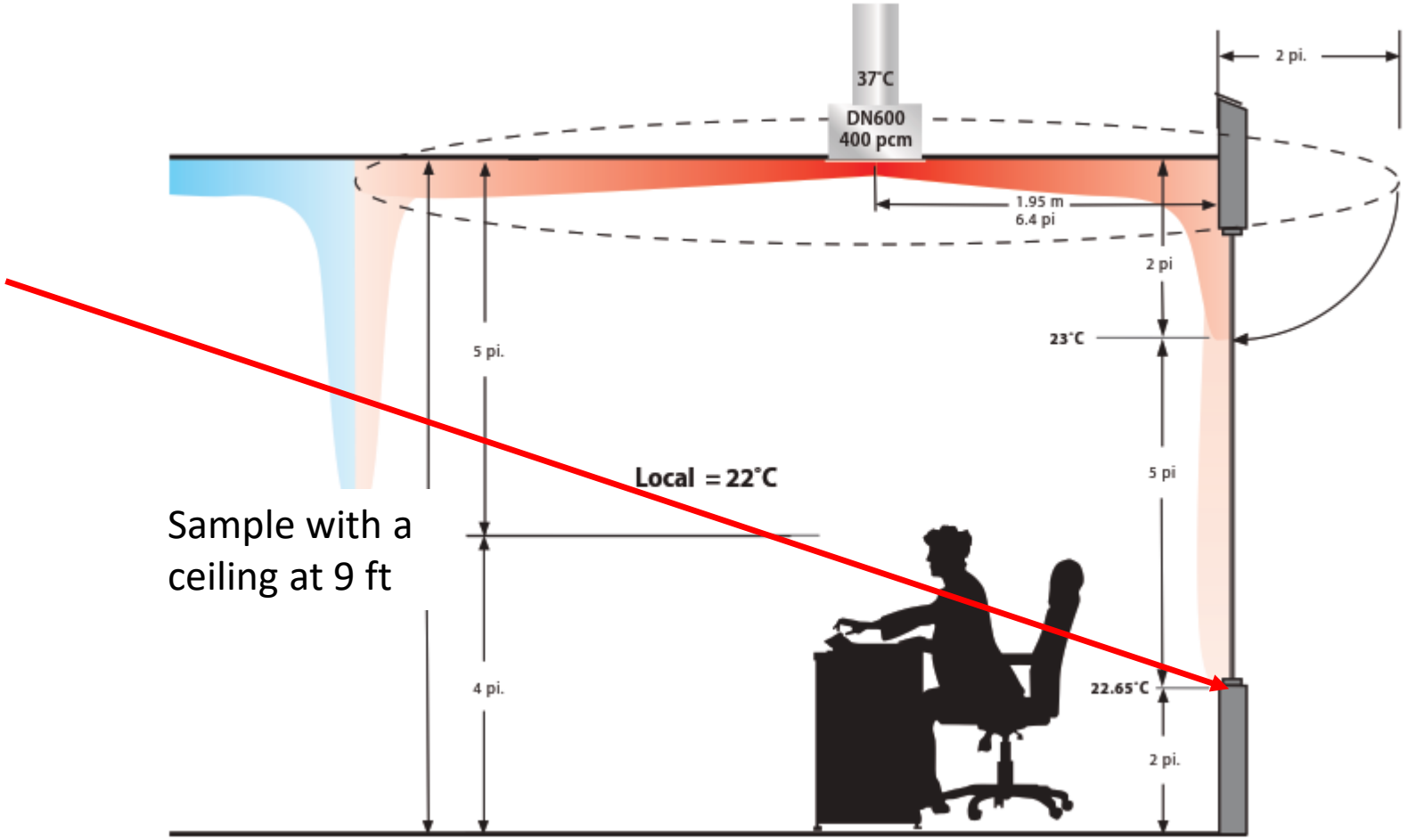
1. Proper zoning of ventilation units
2. Have a temperature differential of no more than Δ+15 °C at supply
3. Ensure VAV boxes are open 100% in heating and size the room using heating parameters for the north
4. **Place diffusers in the proper location**

Heating exclusively through the ceiling

Location of diffusers

Objective : Air speed of 0.15 m/s (30ft/min) @ 0,6 m (2ft) from the floor

→ Validate that the air circulation cycle is complete in the room



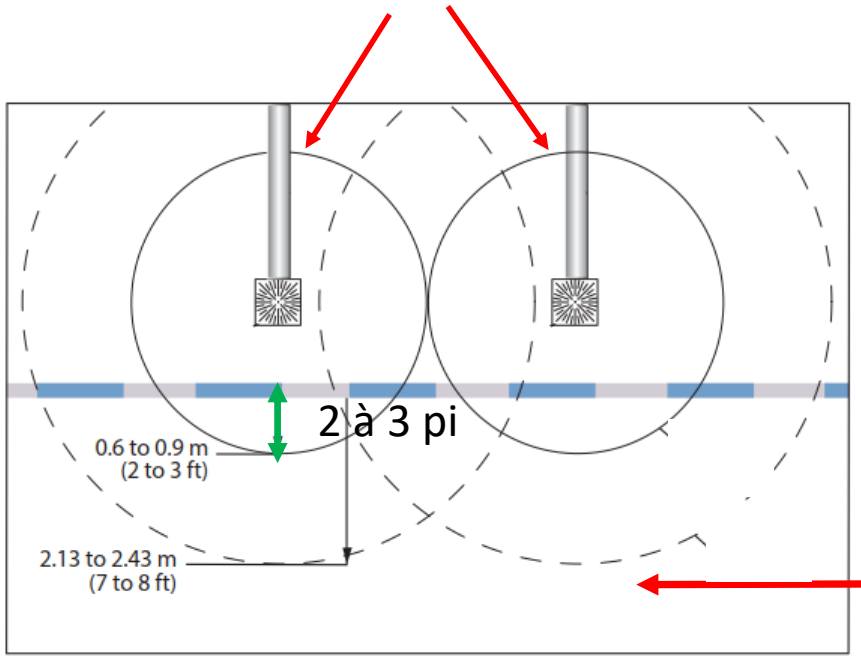
NAD Klima has developed a method of determining the location of the diffuser.

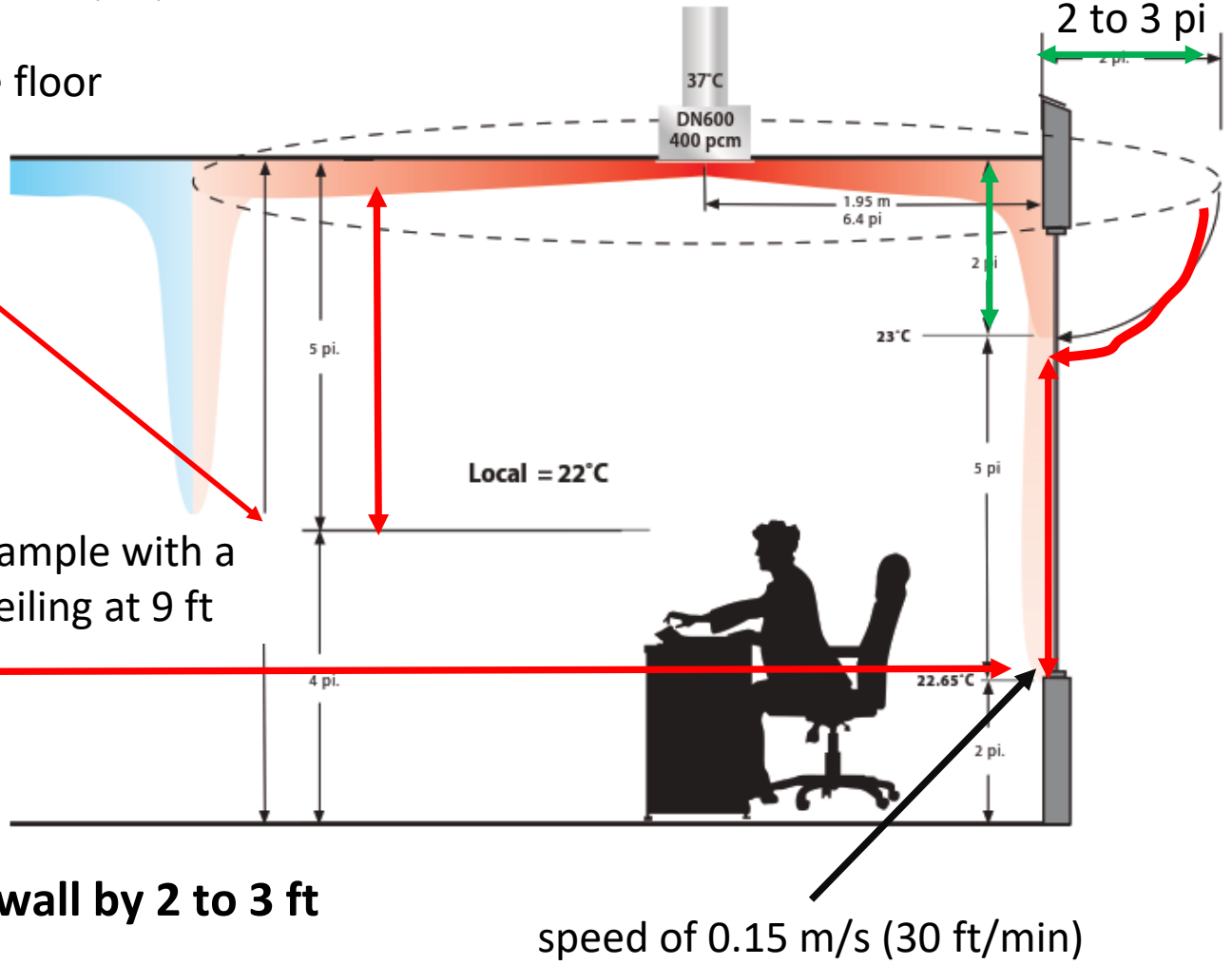
Heating exclusively through the ceiling

Location of diffuser

Objective : Air speed of 0.15 m/s (30ft/min) @ 0,6 m (2ft) from the floor

NAD Circle : speed of 0.15 m/s (30 ft/min) @ 4,3 ft from the floor





The NAD circles must overlap the exterior wall by 2 to 3 ft

speed of 0.15 m/s (30 ft/min)

Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and less

1. Proper zoning of ventilation units
2. Have a temperature differential of no more than Δ+15 °C at supply
3. Ensure VAV boxes are open 100% in heating and size the room using heating parameters for the north
4. Place diffusers in the proper location
5. **Place thermostats in proper location**

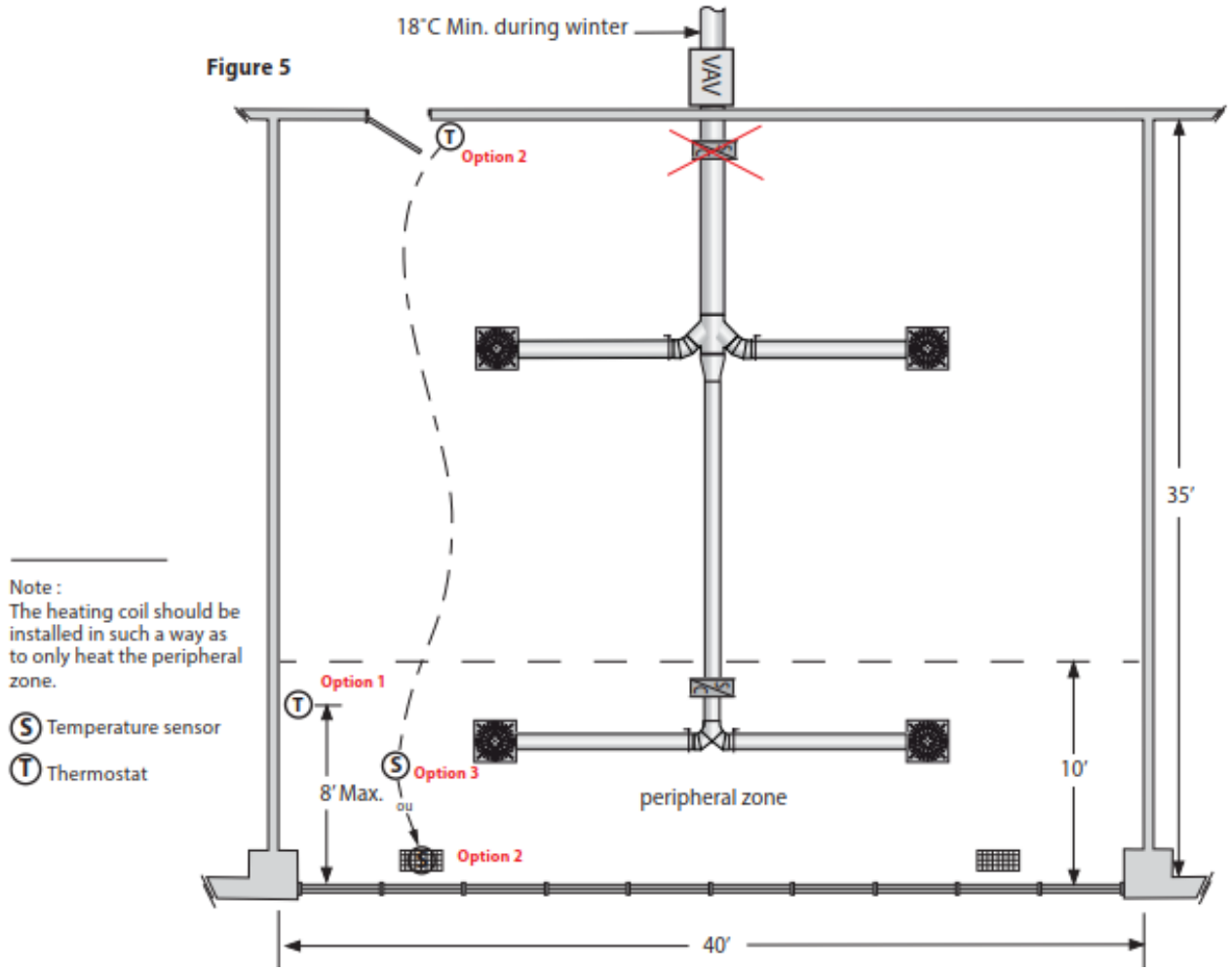
Heating exclusively through the ceiling

Location of thermostats

The peripheral zone detects the thermal load:
- In summer : heat radiation from the sun
- In winter : convection from the cold at the window

→ **Place the temperature sensor in the peripheral zon within 8 ft from the exterior wall**

Note : If it is not possible to install a sensor in the peripheral zone
Install a sensor in the return grid.
or a ceiling sensor with a 4'' long stem (hors jet diffuseur)



Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and less

1. Proper zoning of ventilation units
2. Have a temperature differential of no more than Δ+15 °C at supply
3. Ensure VAV boxes are open 100% in heating and size the room using heating parameters for the north
4. Place diffusers in the proper location
5. Place thermostats in proper location
6. **Place heating coils in proper location**

Heating exclusively through the ceiling

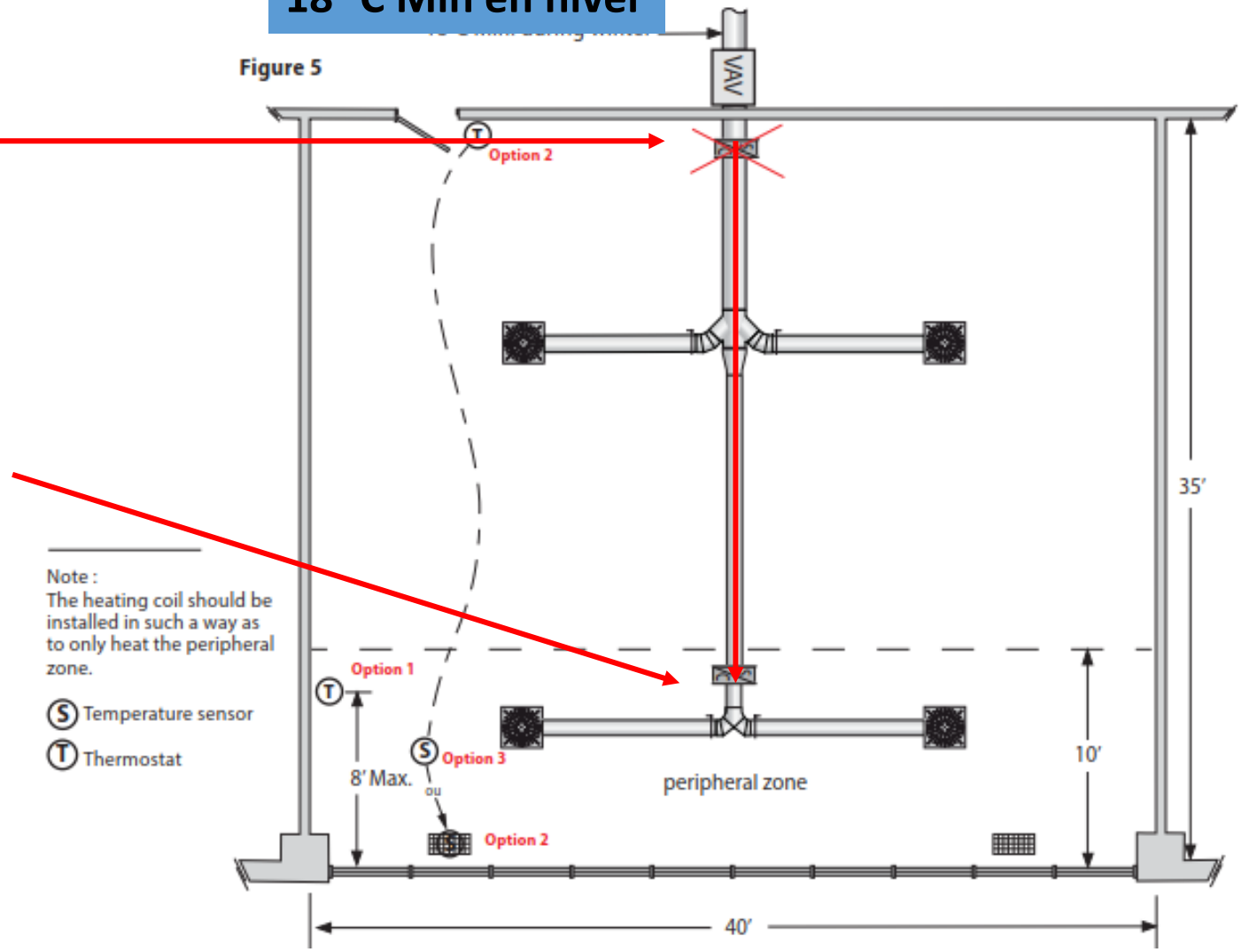
Location of heating coils

The heating coil supplies 4 diffusers

The heating coil supplies **only** the diffusers in the peripheral zone

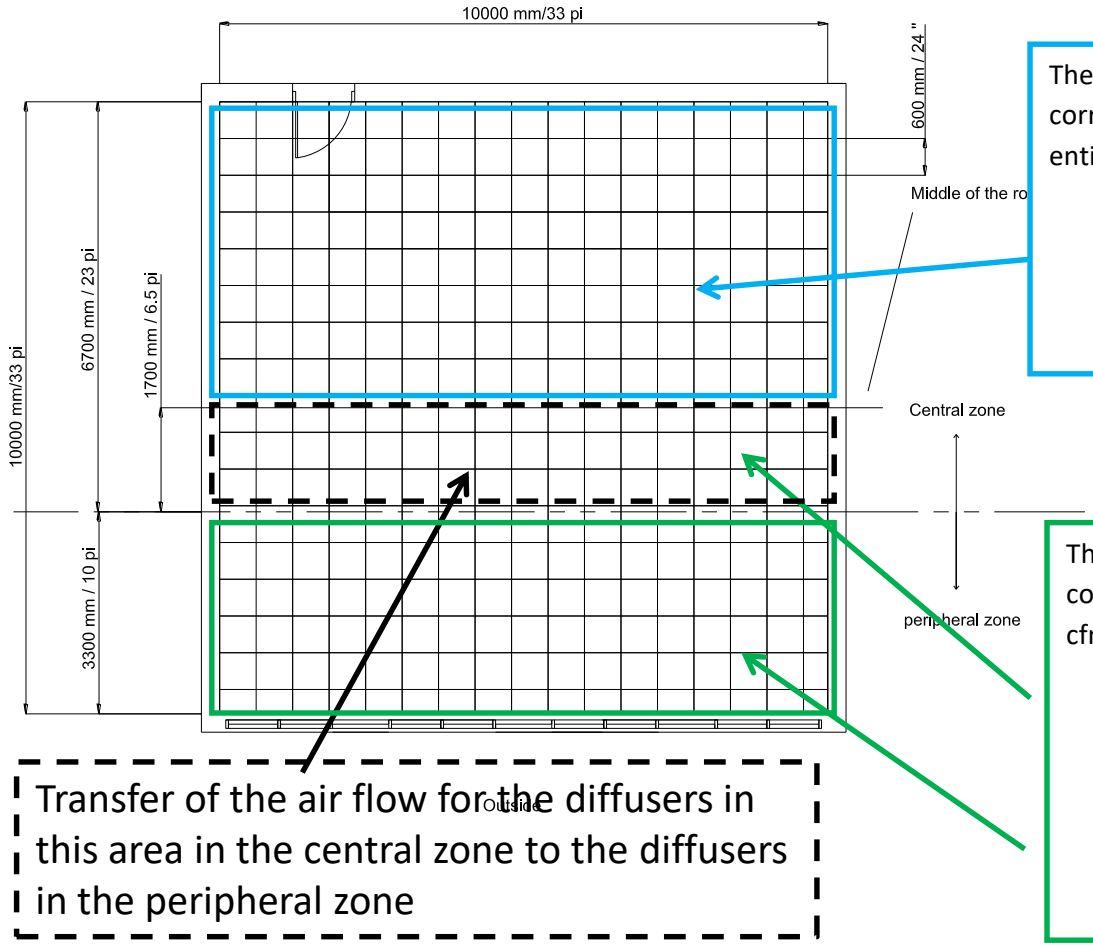
→The installation must be sized with the air supply in the peripheral zone superior to the central zone

18 °C Min en hiver



Sample of calculation of the airflow of the diffusers in peripheral and central zone

In order to determin the air flow of each diffuser, you have to divide the room into 2 geometrically equal parts.



The air flow of the diffusers in the central zone correspond to a load factor of 0.8 cfm / ft² for the entire surface of the zone, namely :

0.8 cfm/ft² for a room

33 ft *16.5ft

The air flow of the diffusers in the peripheral zone correspond to a load factor of 0.8 cfm / ft² and 1.6 cfm / ft² namely :

0.8 cfm/ft² for a room

33ft *6.5ft

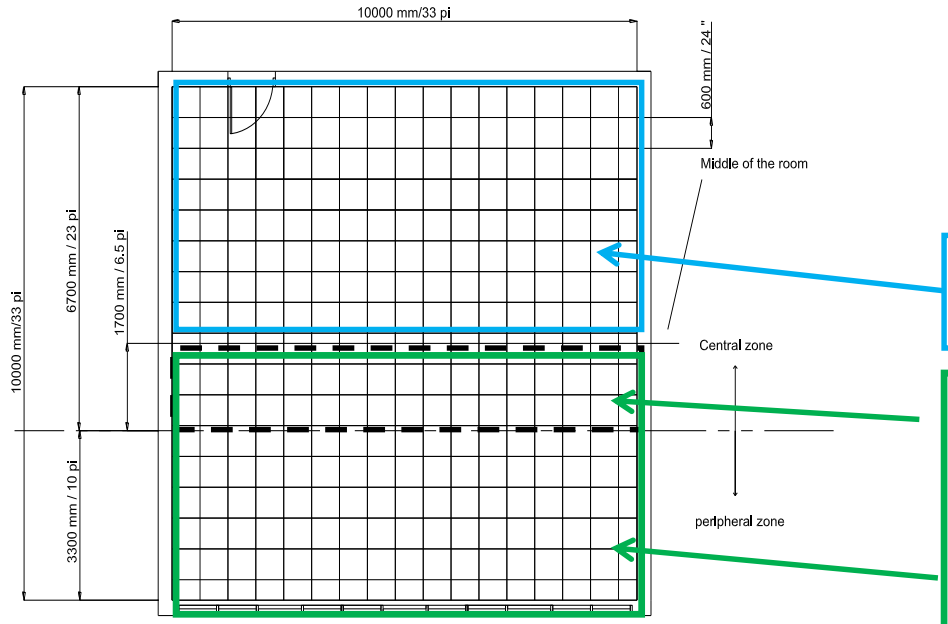
1.6 cfm/ft² for a room

33ft *10ft

Transfer of the air flow for the diffusers in this area in the central zone to the diffusers in the peripheral zone

Heating exclusively through the ceiling

Sample of calculation of the airflow of the diffusers in peripheral and central zone



Qv1 = 0,8x33x16,5 = 435 cfm

Qv2 = 0,8x33x6,5 = 172 cfm

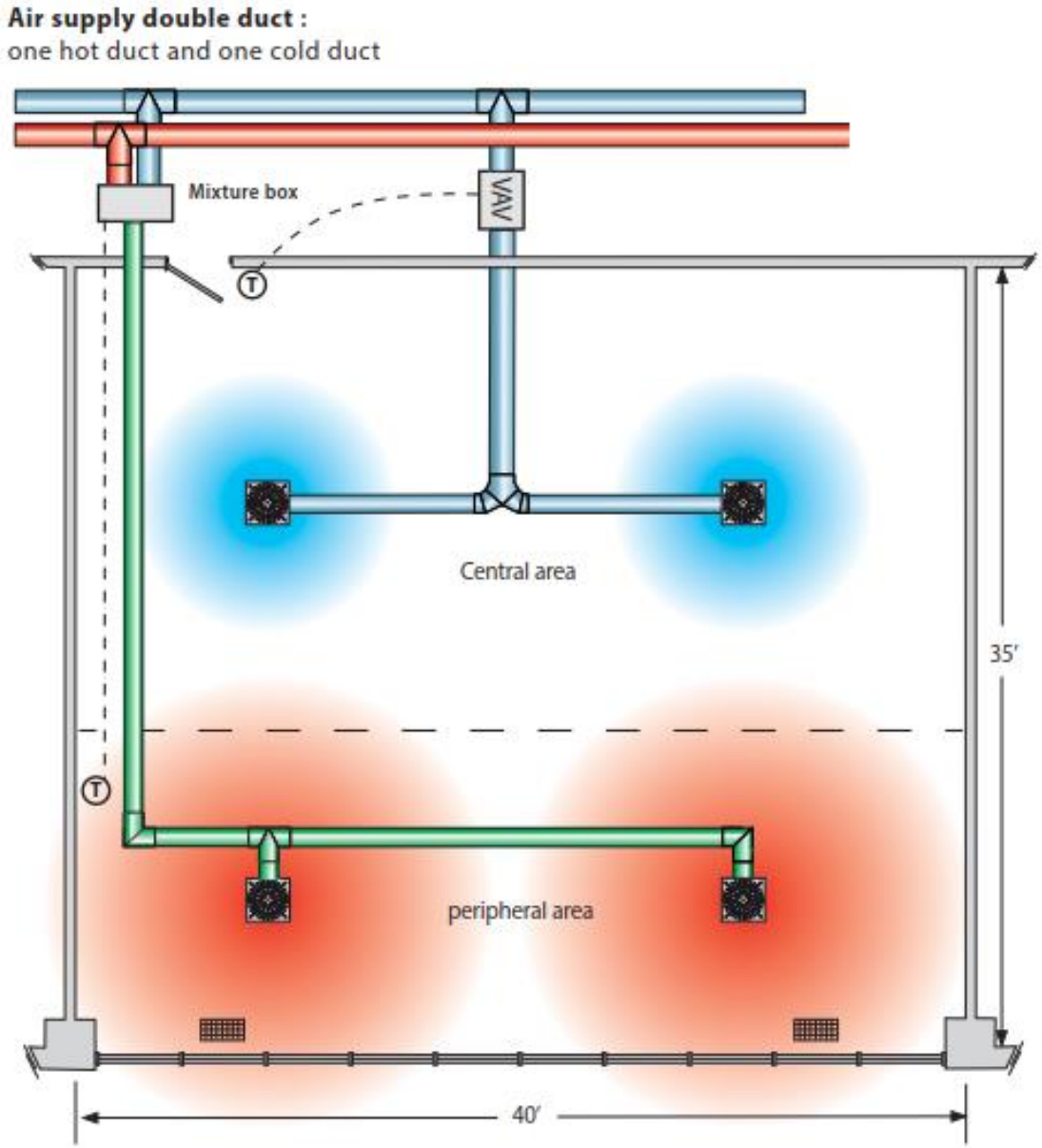
Qv3 = 1,6x33x10 = 528 cfm

	Air flow per zone
Diffusers Central zone	Qv1 = 0,8x33x16,5 = **435 cfm**
Diffusers Peripheral zone	Qv2 = 0,8x33x6,5 = 172 cfm + Qv3 = 1,6x33x10 = 528 cfm **= 700 cfm**

Heating exclusively through the ceiling

Dual duct supply

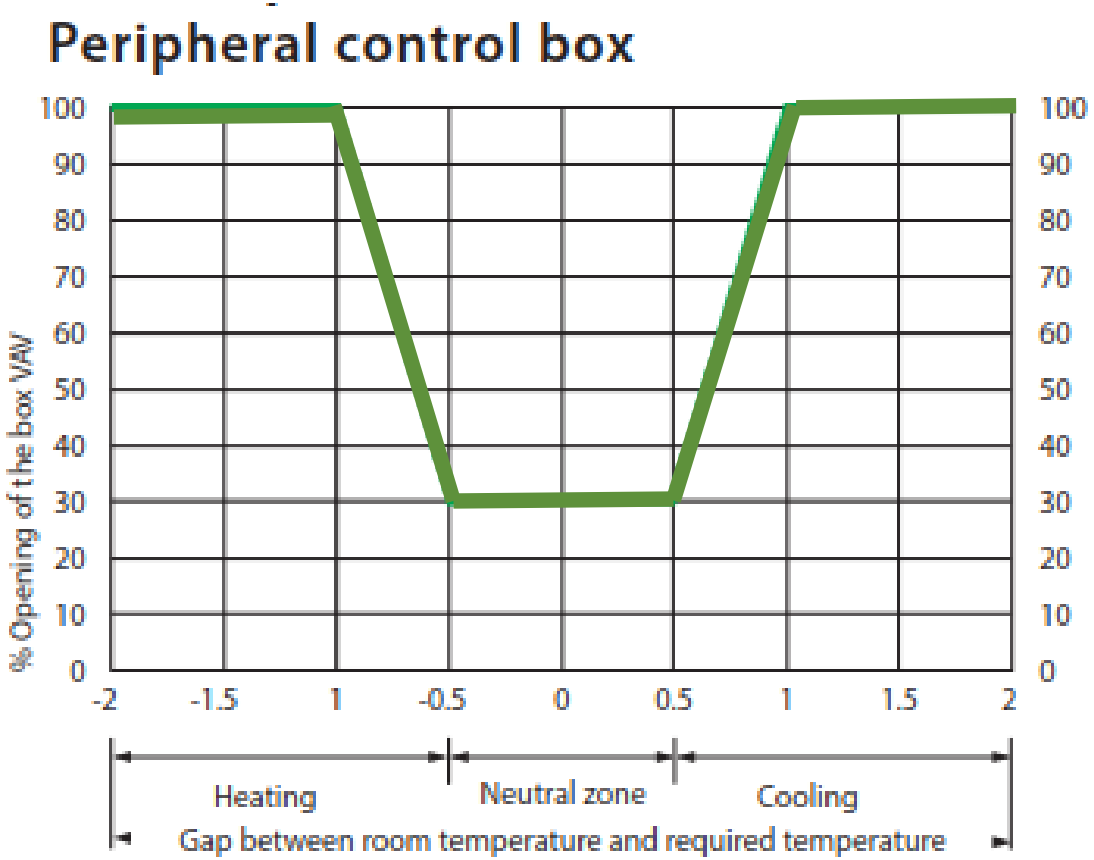
In this case the hot air ducts must be connected to the diffusers in the peripheral zone only



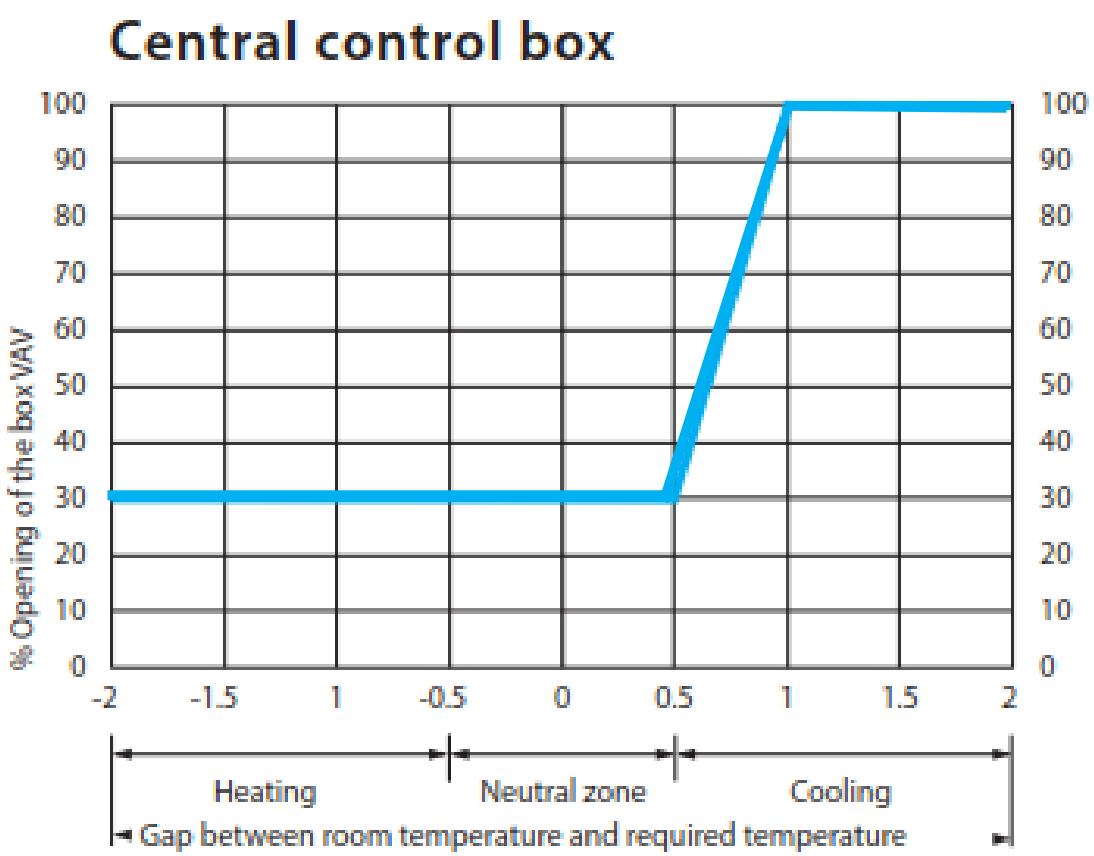
Heating exclusively through the ceiling

Control sequence

Balanced for fresh air, heating and cooling



Balanced for fresh air and cooling



Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and less

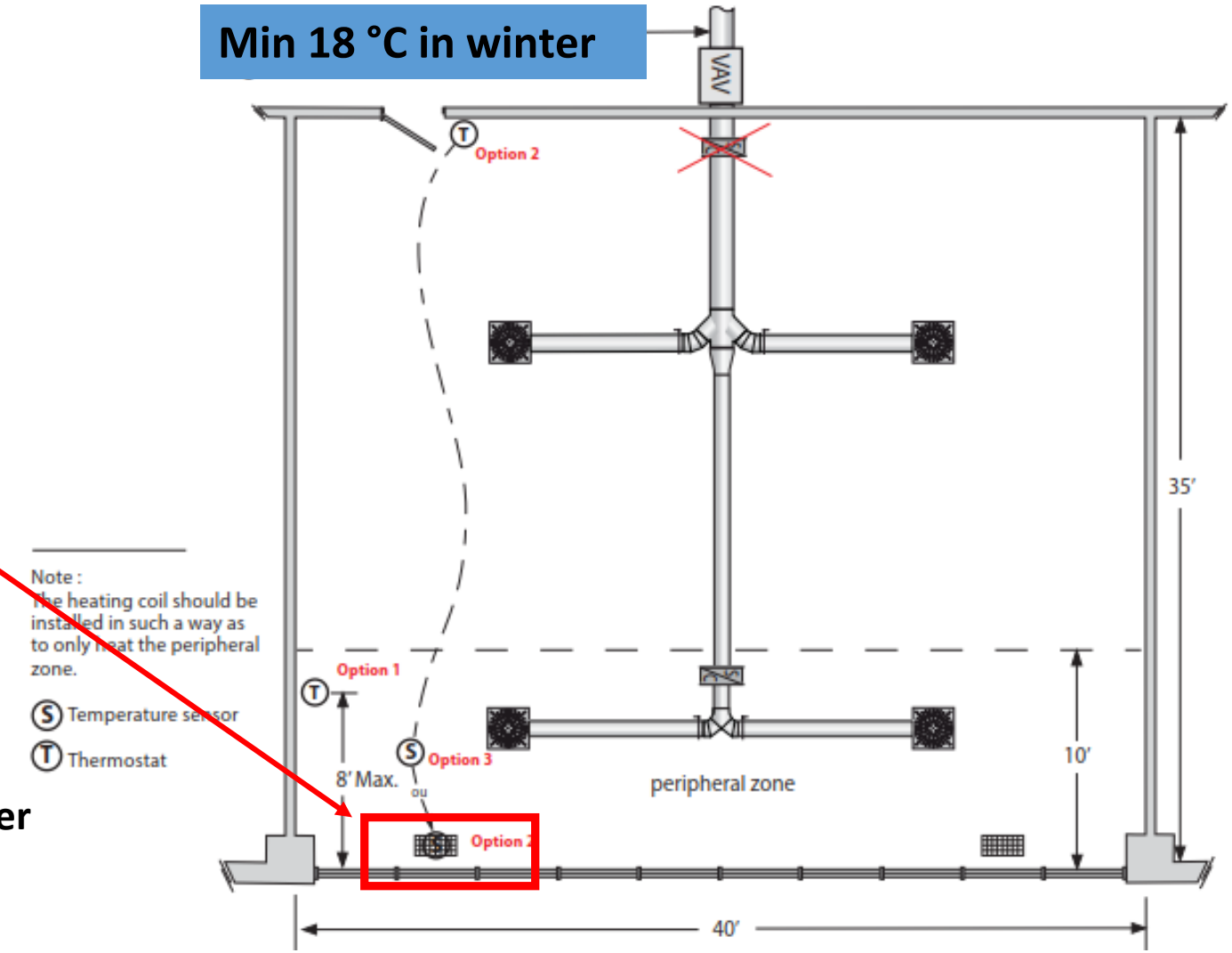
1. Proper zoning of ventilation units
2. Have a temperature differential of no more than Δ+15 °C at supply
3. Ensure VAV boxes are open 100% in heating and size the room using heating parameters for the north
4. Place diffusers in the proper location
5. Place thermostats in proper location
6. Place heating coils in proper location
7. **Place return grids in proper location**

Heating exclusively through the ceiling

Location of return grids

Return grids close to windows

→ **Capture of heat from the windows in the summer**



Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and less

1. Proper zoning of ventilation units
   → **Energy savings : the unit prepares the air at a temperature adapted to each zone**
2. Have a temperature differential of no more than Δ+15 °C at supply → **Complete air circulation cycle in the room + no stratification**

3. Ensure VAV boxes are open 100% in heating and size the room using heating parameters for the north → **Insure a proper mixture of the air all year around**

4. Place diffusers in the proper location
   → **Complete air circulation cycle in the room + window coverage**
5. Place thermostats in proper location
   → **Complete air circulation cycle in the room + window coverage**
6. Place heating coils in proper location
   → **Supply hot air to the peripheral zone**
7. Place return grids in proper location
   → **Gather the thermal zone from the windows in the summer**

Heating exclusively through the ceiling

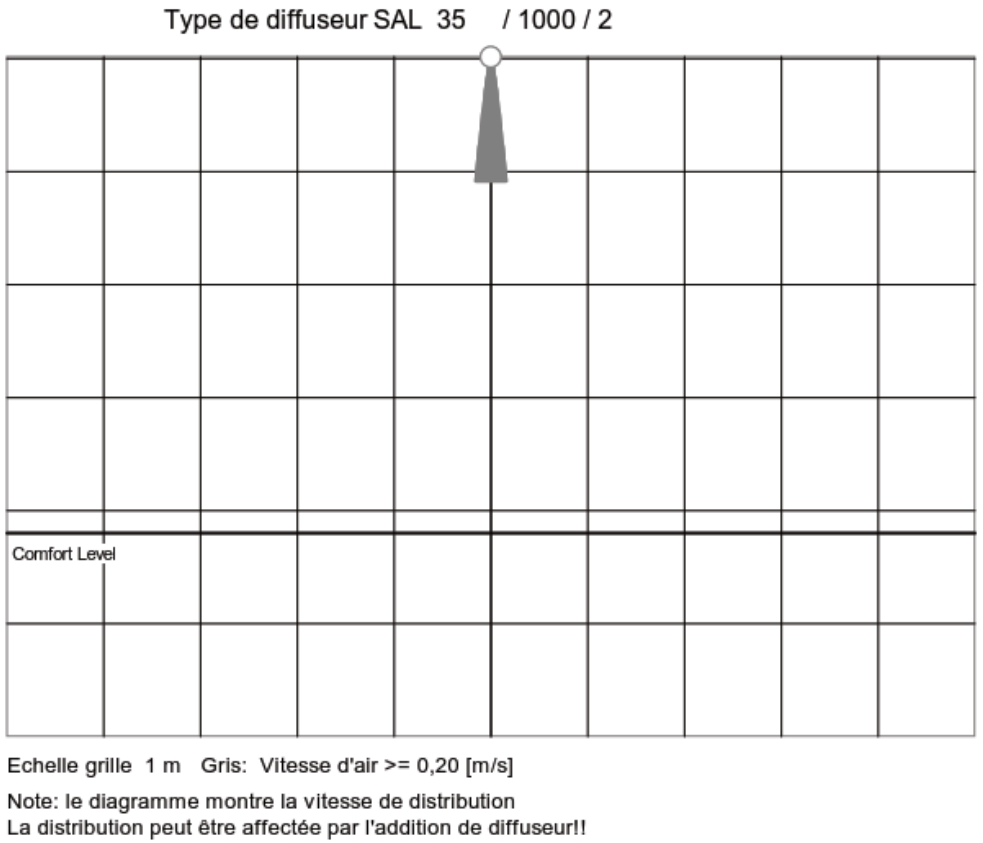
Conditions for heating a room with ceiling heights of 14ft and more

1. Having a temperature differential of no more than Δ+15 °C at supply

Heating exclusively through the ceiling

Difference in temperature of maximum Δ+15 °C at supply

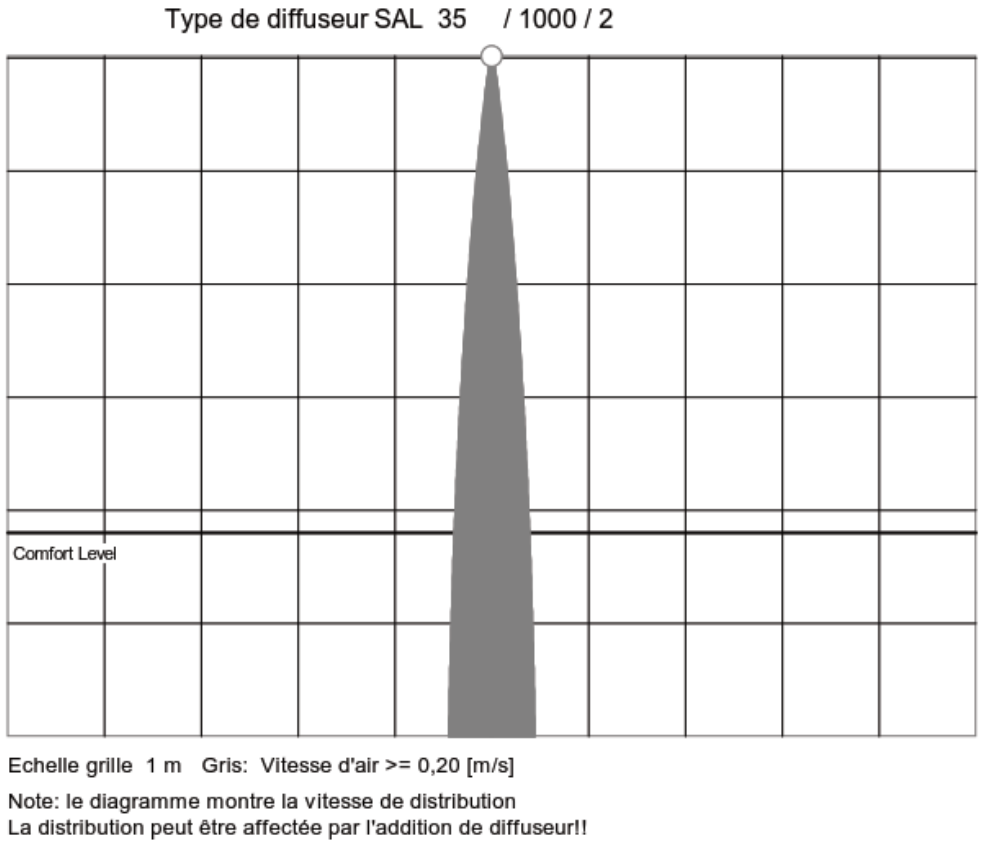
Example SAL eccentric rollers in heating



Echelle grille 1 m Gris: Vitesse d'air >= 0,20 [m/s]

Note: le diagramme montre la vitesse de distribution
La distribution peut être affectée par l'addition de diffuseur!!

Example SAL eccentric rollers in isotherm



Echelle grille 1 m Gris: Vitesse d'air >= 0,20 [m/s]

Note: le diagramme montre la vitesse de distribution
La distribution peut être affectée par l'addition de diffuseur!!

→ Reduce difference in temperature in heating: the air flow will have a larger vertical penetration
→ Nad diffusers allow for the seasonal ajustment of the diffusion pattern:
Long vertical projection in heating (to the floor) and horizontal projection in cooling
OR adjusting the system in heating and cooling.

Heating exclusively through the ceiling

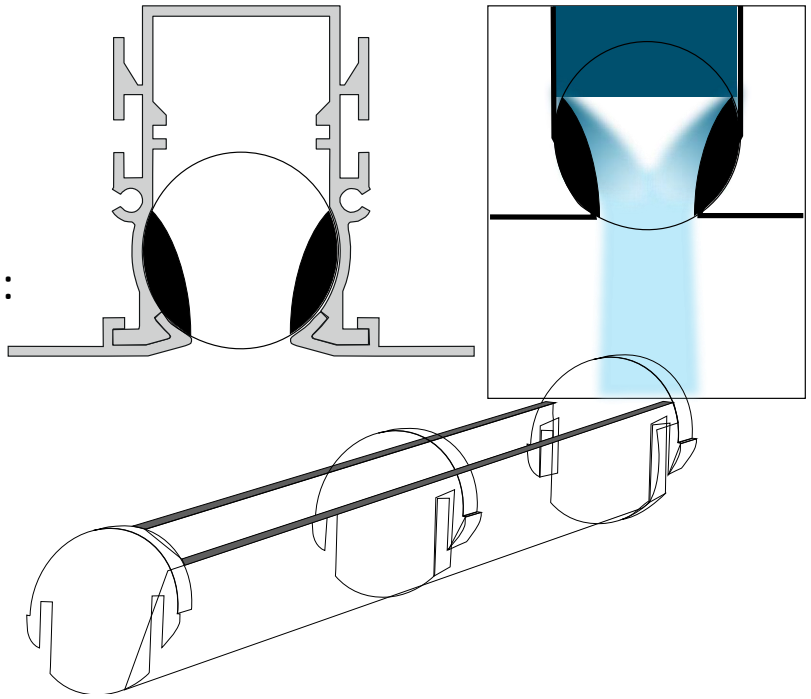
Conditions for heating a room with ceiling heights of 14ft and more

1. Have a temperature differential of no more than Δ+15 °C at supply
2. **Using the proper diffuser with adapted control**
    2.1. **Nozzle roller diffusers: RRA and SAL.**

Heating exclusively through the ceiling

Nozzle roller diffusers: RRA and SAL.

NAD KLIMA has developed a nozzle roller which increases vertical projection.



1st. case : the air flow of the nozzle is localized in an unoccupied zone:
The difference in air flow speed at the floor does not create any discomfort
Example : along the windows in an entrance hall,
No specific air management.

2nd. case : the air flow of the nozzle is localized in an occupied zone:
The difference in air flow speed at the floor does create discomfort

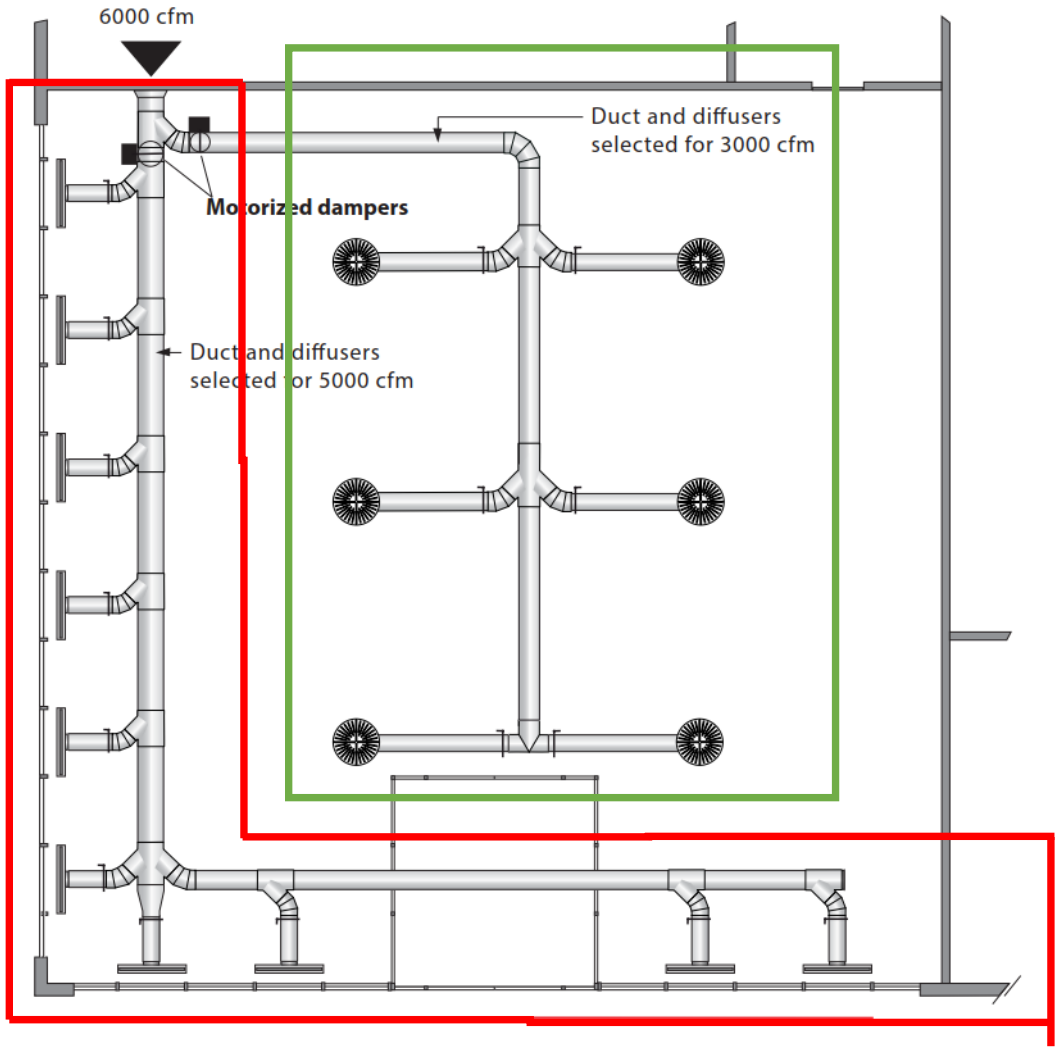
Air management with air flow transfer: see next slide

Nozzle roller diffusers: RRA and SAL: seasonal transfer of air volume

Peripheral area
nozzle roller

Central area
eccentric roller

6000 cfm



Heating exclusively through the ceiling

Nozzle roller diffusers: RRA and SAL: seasonal transfer of air volume

Winter : 5000 cfm

1000 cfm

Transfer of **1000 cfm**

Mid season : 4000 cfm

2000 cfm

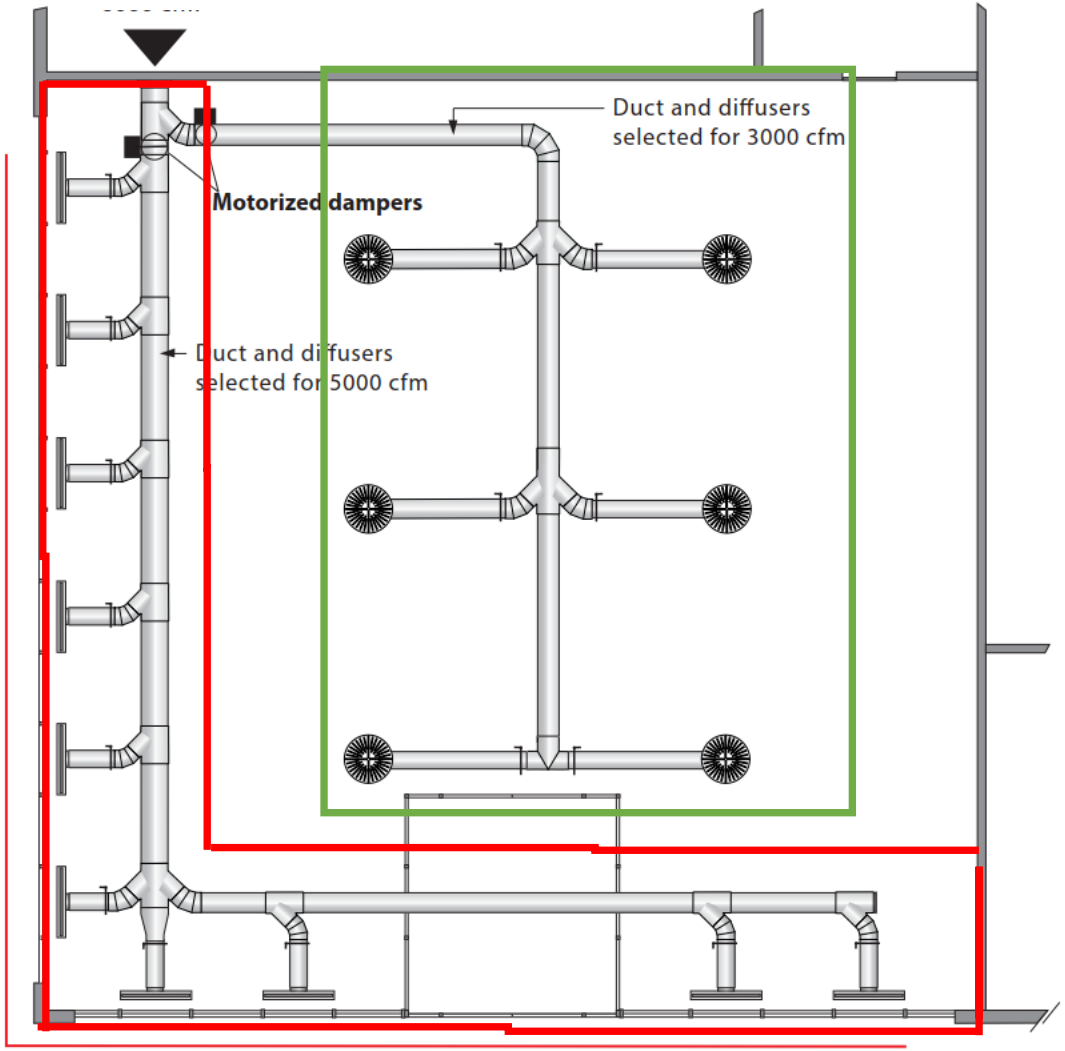
Transfer of **1000 cfm**

Summer: 3000 cfm

3000 cfm

Transfer of **2000 cfm**

6000 cfm



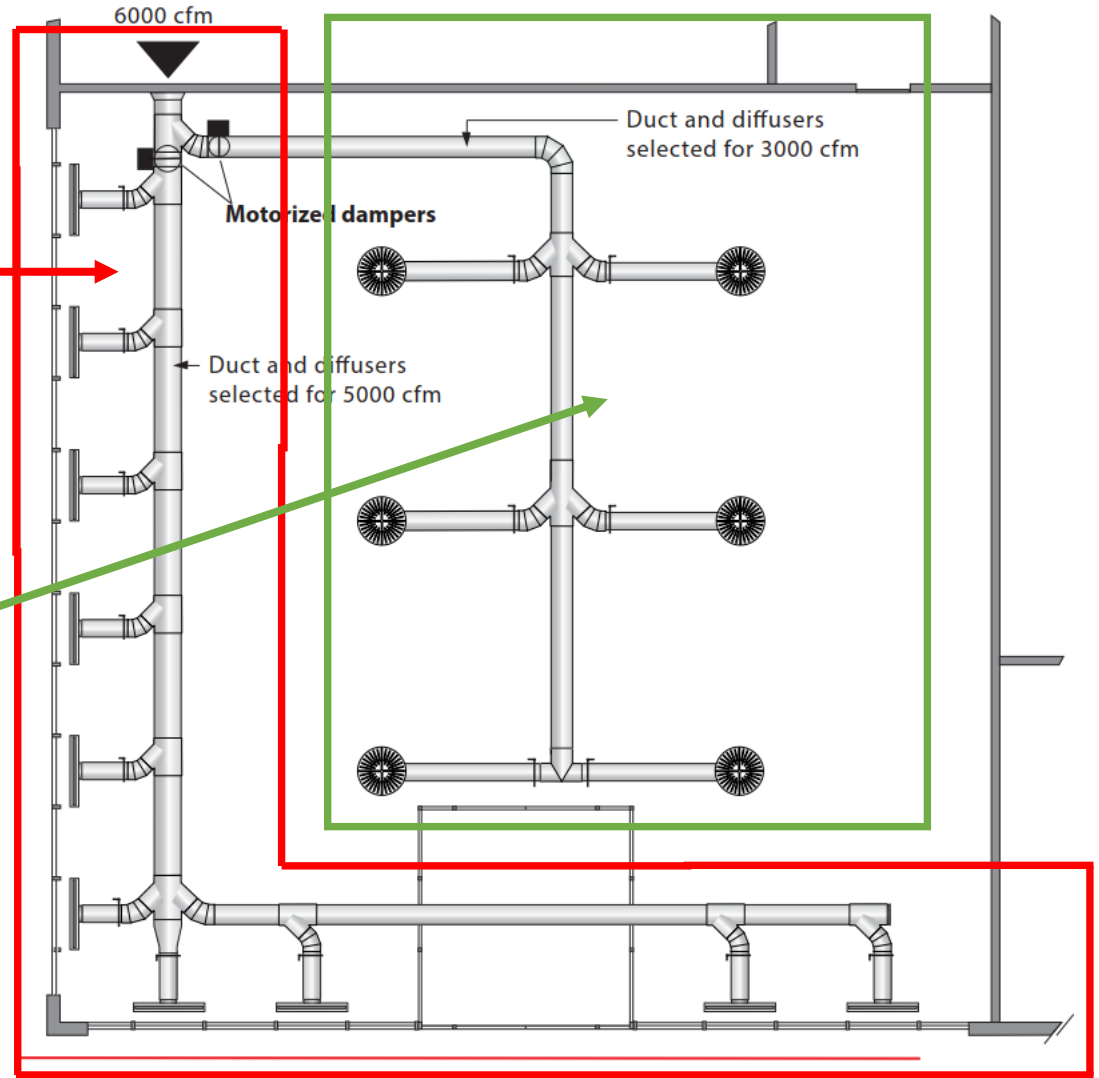
Heating exclusively through the ceiling

Nozzle roller diffusers: RRA and SAL: seasonal transfer of air volume

6000 cfm

Diffusers and ducts concieved for 5000 cfm

Diffusers and ducts concieved for 3000 cfm



Nozzle roller diffusers: RRA and SAL.

The SAL

Audi Sherbrooke

Nozzle roller diffusers: RRA and SAL.

The RRA

Produits BRP, Valcourt

Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and more

1. Have a temperature differential of no more than Δ+15 °C at supply
2. **Using the proper diffuser with adapted control**
    - 2.1. Nozzle roller diffusers: RRA and SAL.
    - 2.2. **Adjustable pattern diffusers: WKD, LDI, VLV, VLD**

Heating exclusively through the ceiling

Adjustable pattern diffusers: WKD, LDI, VLV, VLD

VLD

Heating and cooling

Heating exclusively through the ceiling

Adjustable pattern diffusers: WKD, LDI, VLV, VLD

Ajustment of the diffusion pattern from **vertical to horizontal**:

The jet is adaptable according to the season

Manual or motorized versions of the following diffusers are available

Heating exclusively through the ceiling

Adjustable pattern diffusers: WKD, LDI, VLV, VLD

WKD

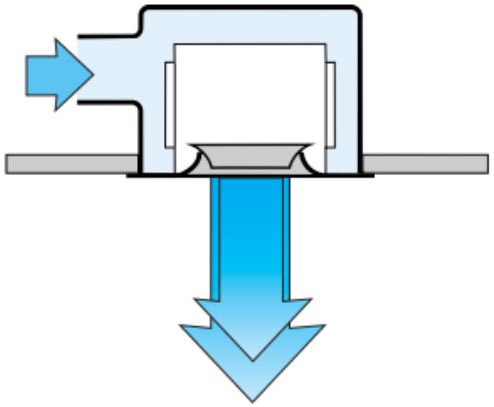
Simons, Edmonton

Adjustable pattern diffusers: WKD, LDI, VLV, VLD

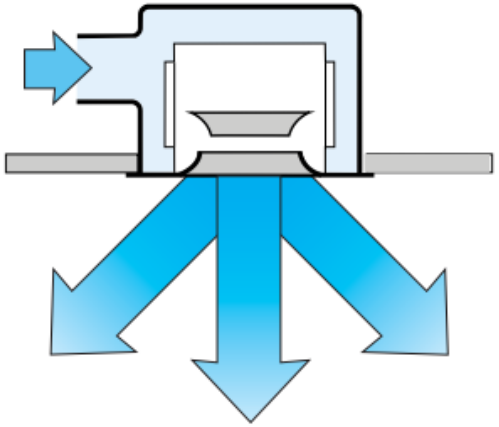
The functioning of the WKD

Heating

Nozzle : Position 1
Stable vertical air flow
with large penetration.

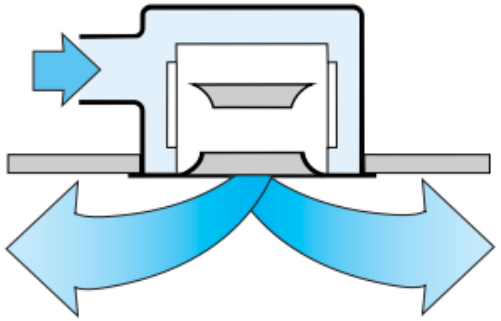


Nozzle : Position 2
Vertical air flow
with helical effect.

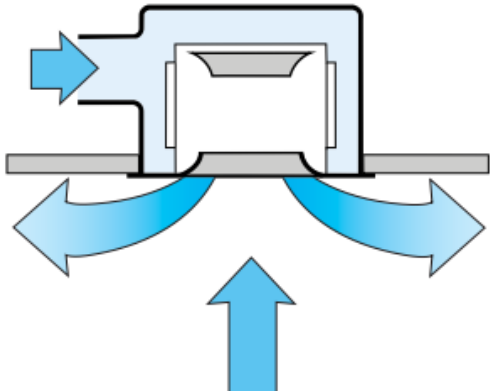


Cooling

Nozzle : Position 3
Horizontal helical air flow
with relatively low impact.



Nozzle : Position 4
Horizontal air flow
(without influence from the ceiling)
with maximum horizontal
reach and elevated primary
induction.



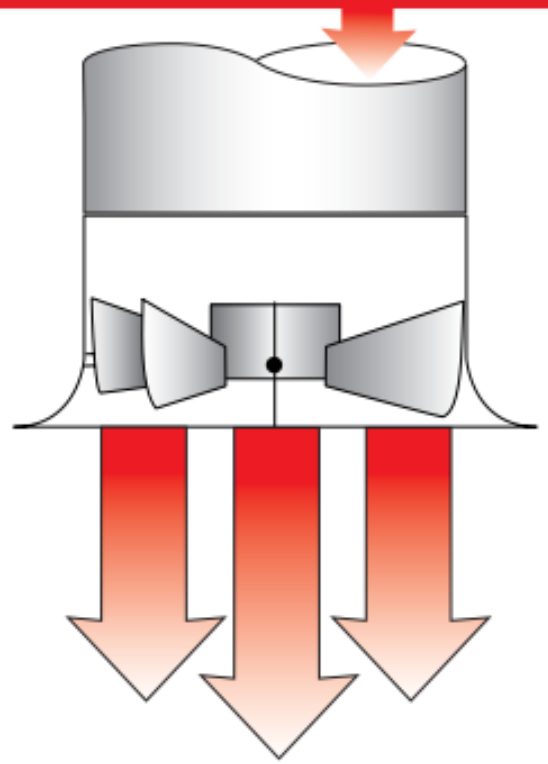
Adjustable pattern diffusers: WKD, LDI, VLV, VLD

LDI

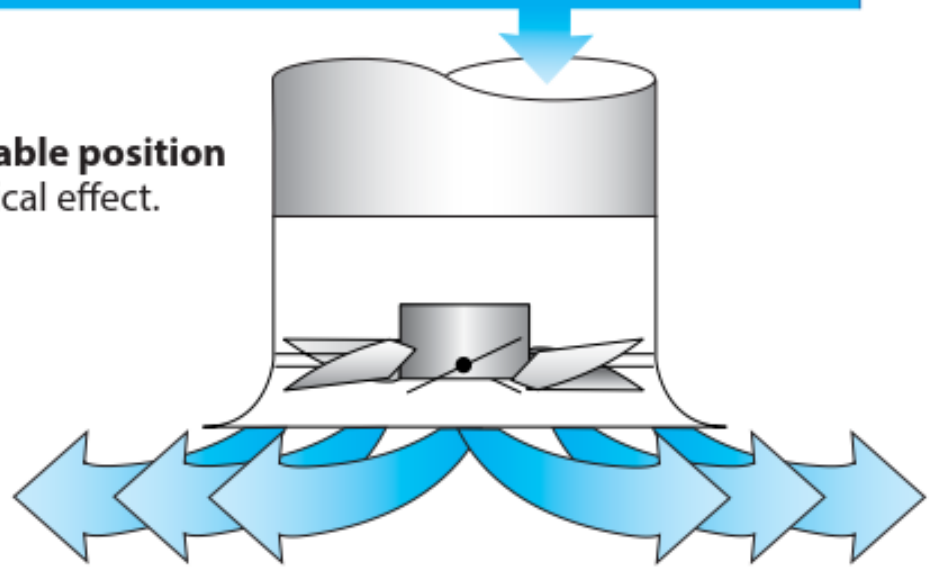
Centre de foires, Sherbrooke

The functioning of the LDI in different operation modes

Blades :
Vertical position
Constant vertical flow
with large penetration.



Blades :
Diagonally variable position
Air flow with helical effect.

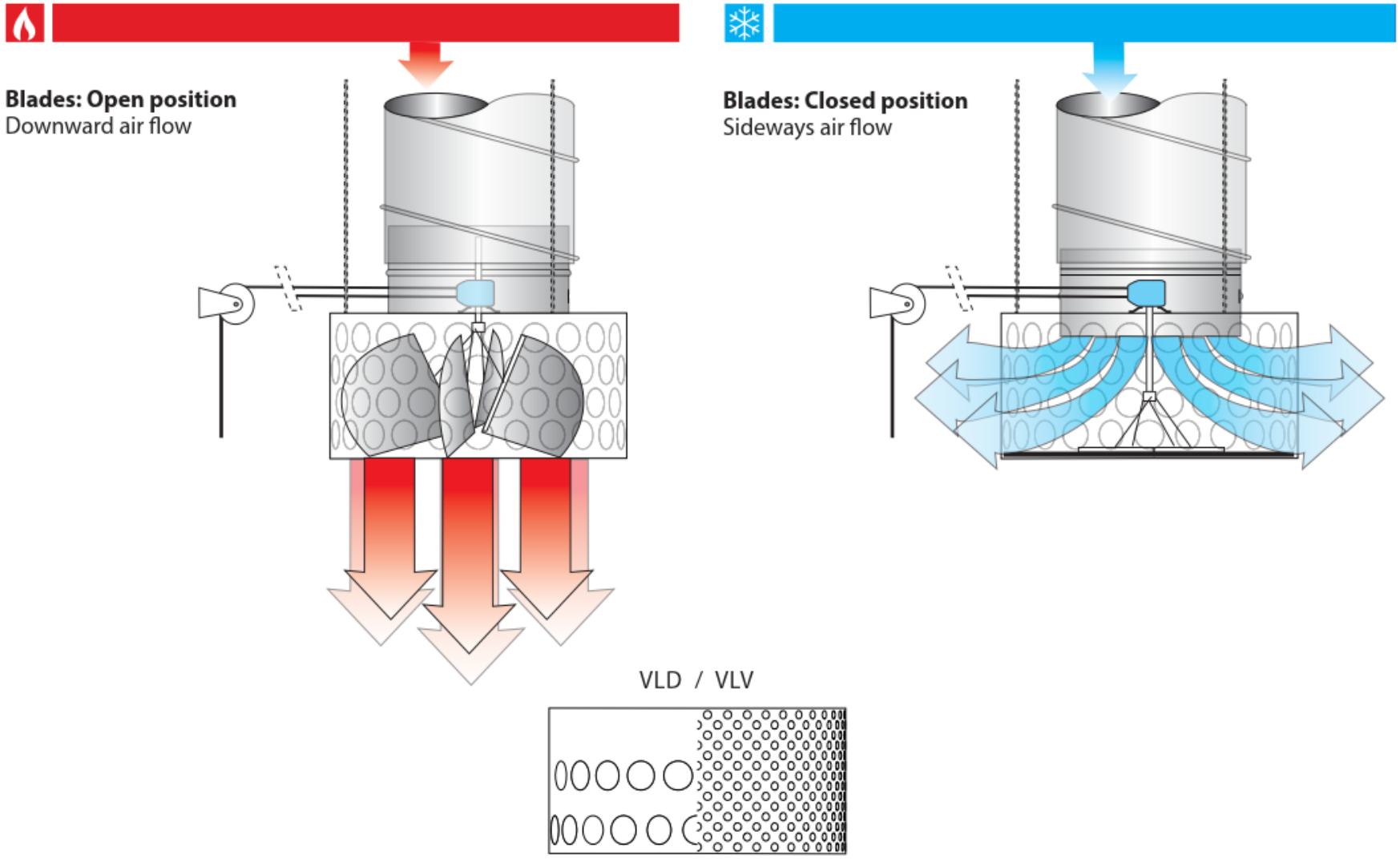


Adjustable pattern diffusers: WKD, LDI, VLV, VLD

VLV

Usine Kraft , Montréal

The functioning of the VLD / VLV in different operation modes



Heating exclusively through the ceiling

Conditions for heating a room with ceiling heights of 14ft and more

1. Have a temperature differential of no more than Δ+15 °C at supply
2. **Using the proper diffuser with adapted control**

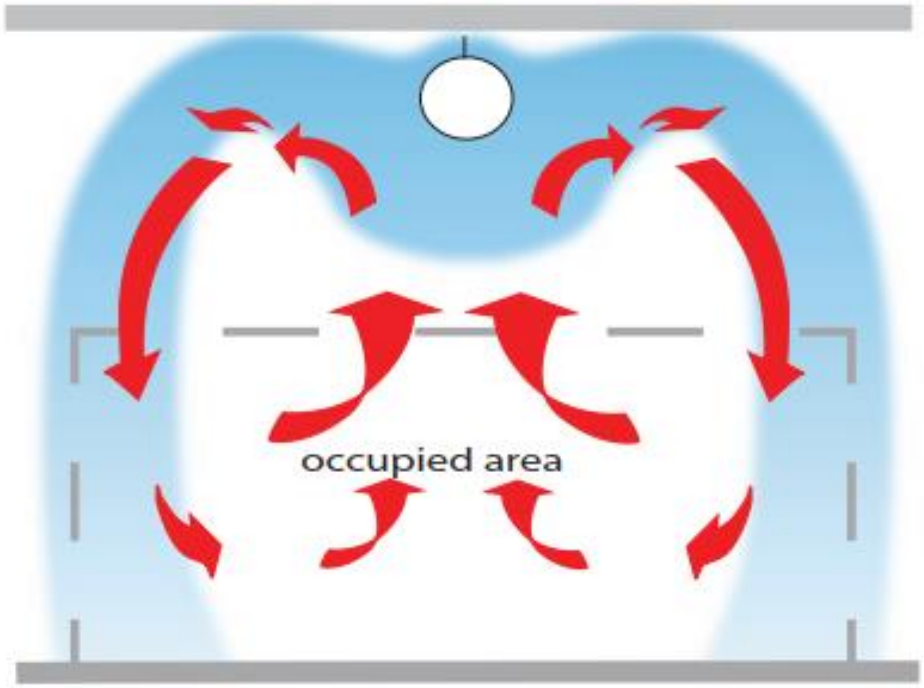
   2.1. Nozzle roller diffusers: RRA and SAL.

   2.2. Adjustable pattern diffusers: WKD, LDI, VLV, VLD

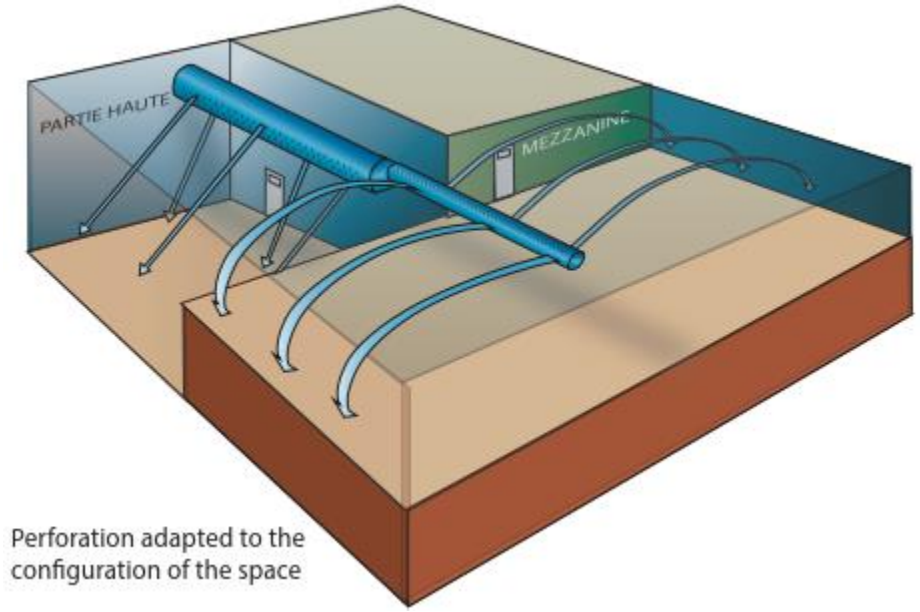
   2.3**. High induction duct diffusers: customized perforations: FDD, RDD**

Heating exclusively through the ceiling

High induction duct diffusers: FDD, RDD



High induction



Configuration adapted to room

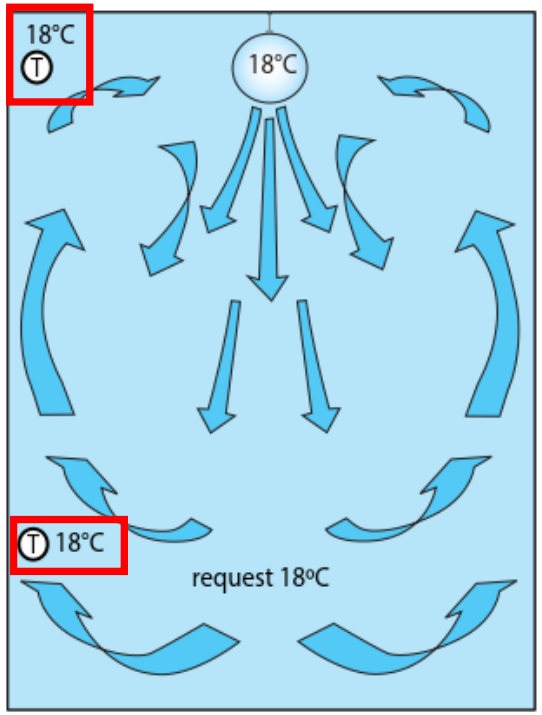
1st. case : The duct diffuser can be configured to obtain a high velocity air jet at the floor level in an unoccupied zone: The difference in speeds of the air jets at the floor level between the heating and cooling does not create any discomfort No adjustment necessairy

2nd. case : The duct diffuser can not be configured to avoid the occupied zone: The difference in air speed at the floor level creates discomfort: Control with a dual sensor thermostat

Heating exclusively through the ceiling

High induction duct diffusers: FDD, RDD : dual sensor control

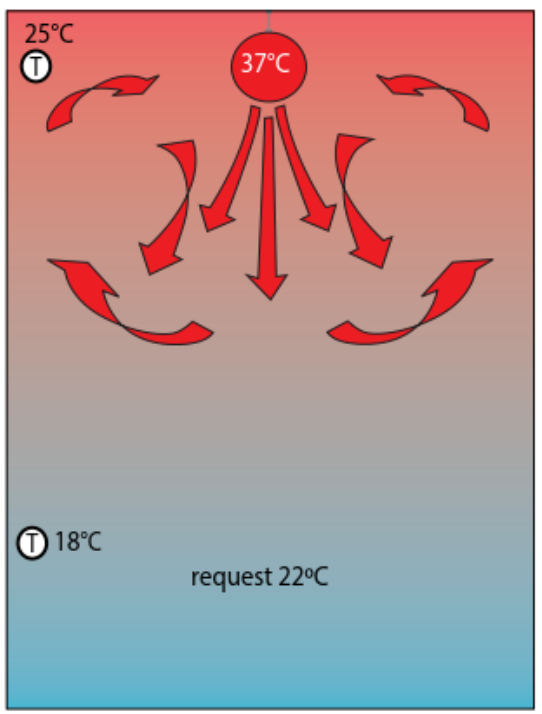
Schema 1



During the night, a temperature of 18°C

Night mode

Schema 2

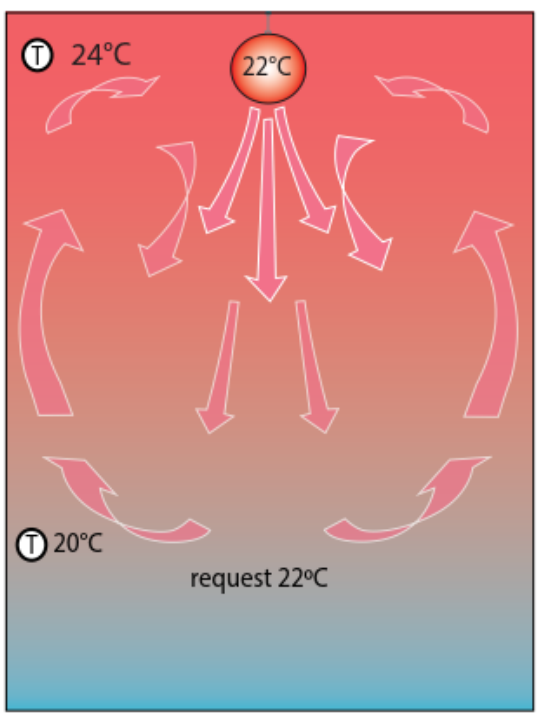


In the morning, a request for 22°C is carried out

- Morning : Heating.
Average Temp. < 22 °C

- Temp increases in ceiling
Average Temp. > 22 °C

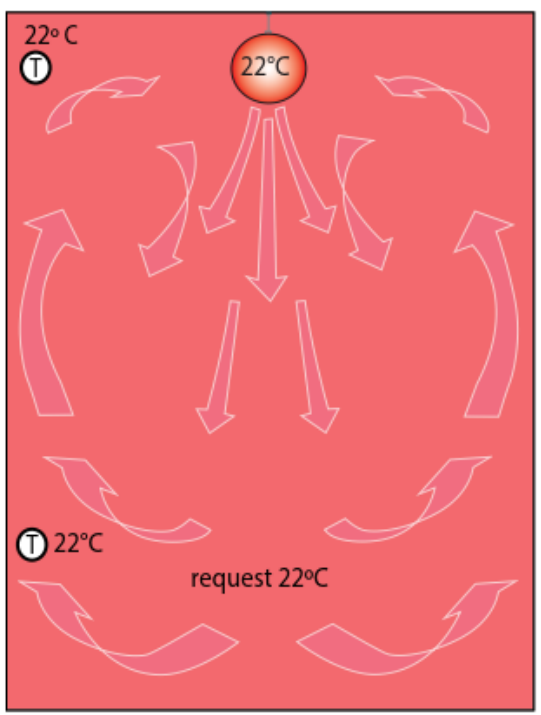
Schema 3



- Temp increases in ceiling
- Average Temp. > 22 °C
- Heating stops

Destratification of the room

Schema 4



Standardisation of the temperature happens quickly
Ex: height = 35 feet
Morning : 15 min for ΔT = 4°C
Daytime : 3 min for ΔT = 1°C
After heating has stopped

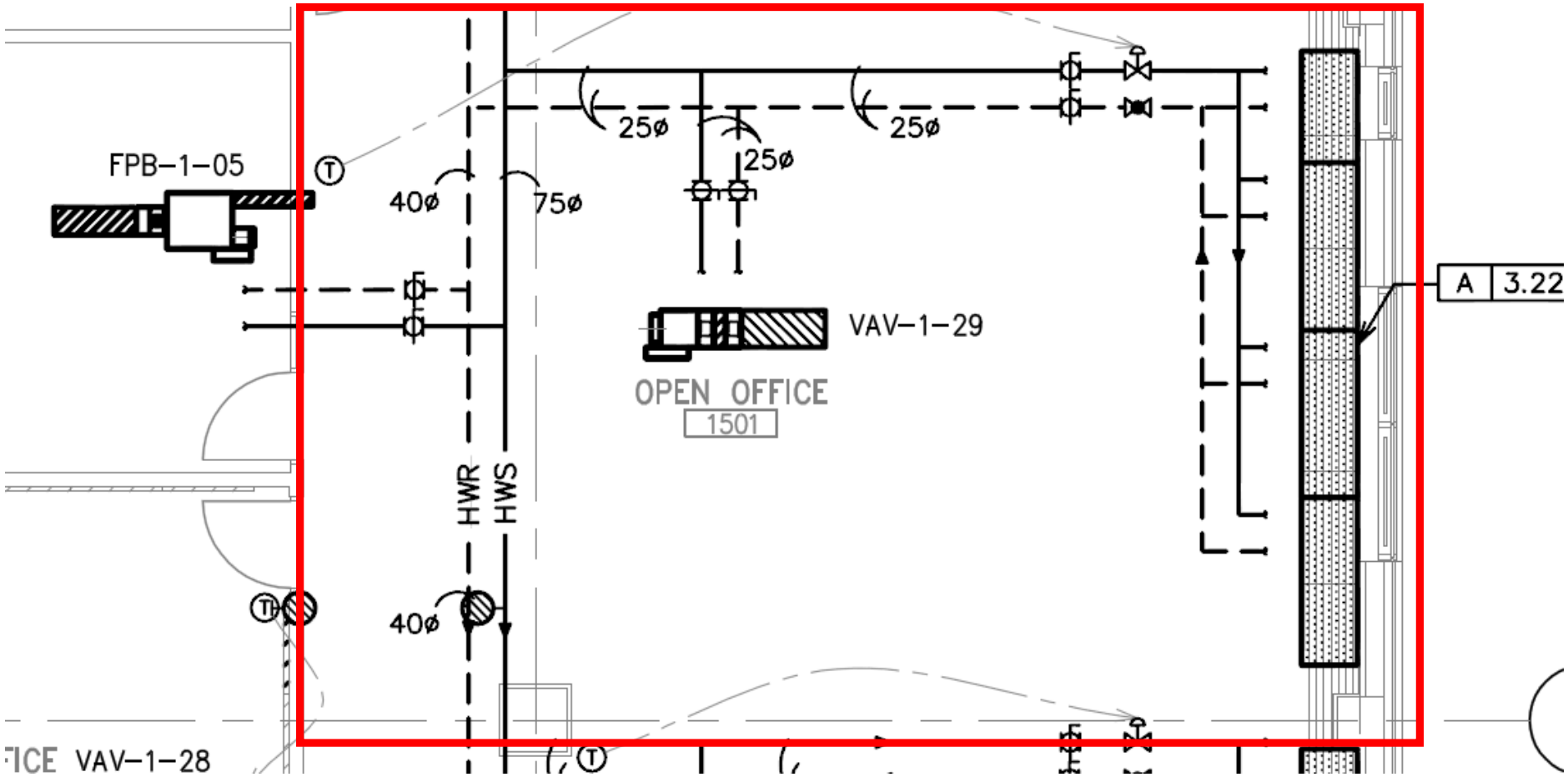
Heating exclusively through the ceiling

RDD

Centre de foires de Sherbrooke

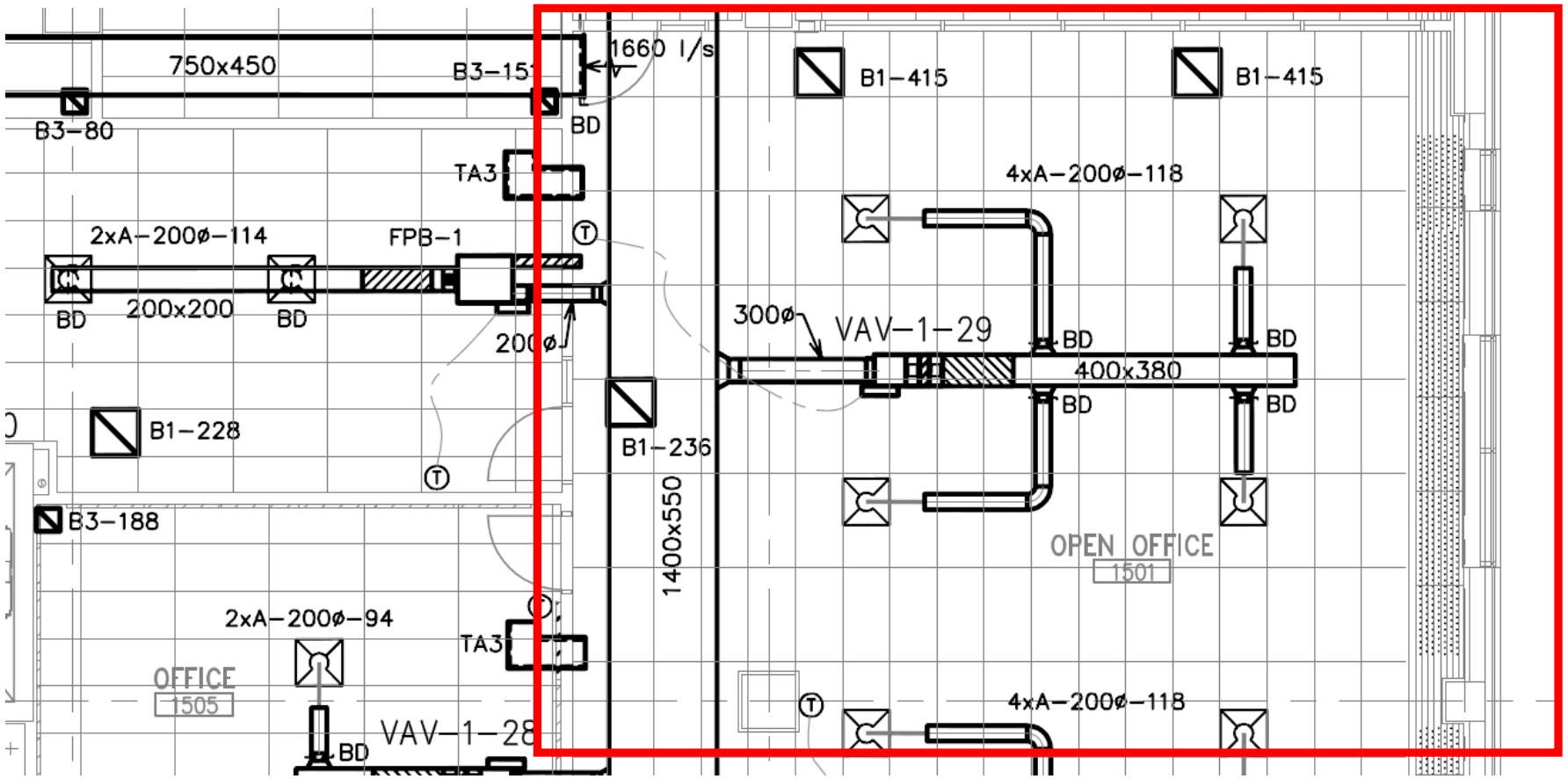
Heating exclusively through the ceiling

Sample plan : plumbing layout



Heating exclusively through the ceiling

EXAMPLE OF DESIGN : 7 points to improve



Heating exclusively through the ceiling

EXAMPLE OF DESIGN : 7 points to improve: modify

1: location of thermostat

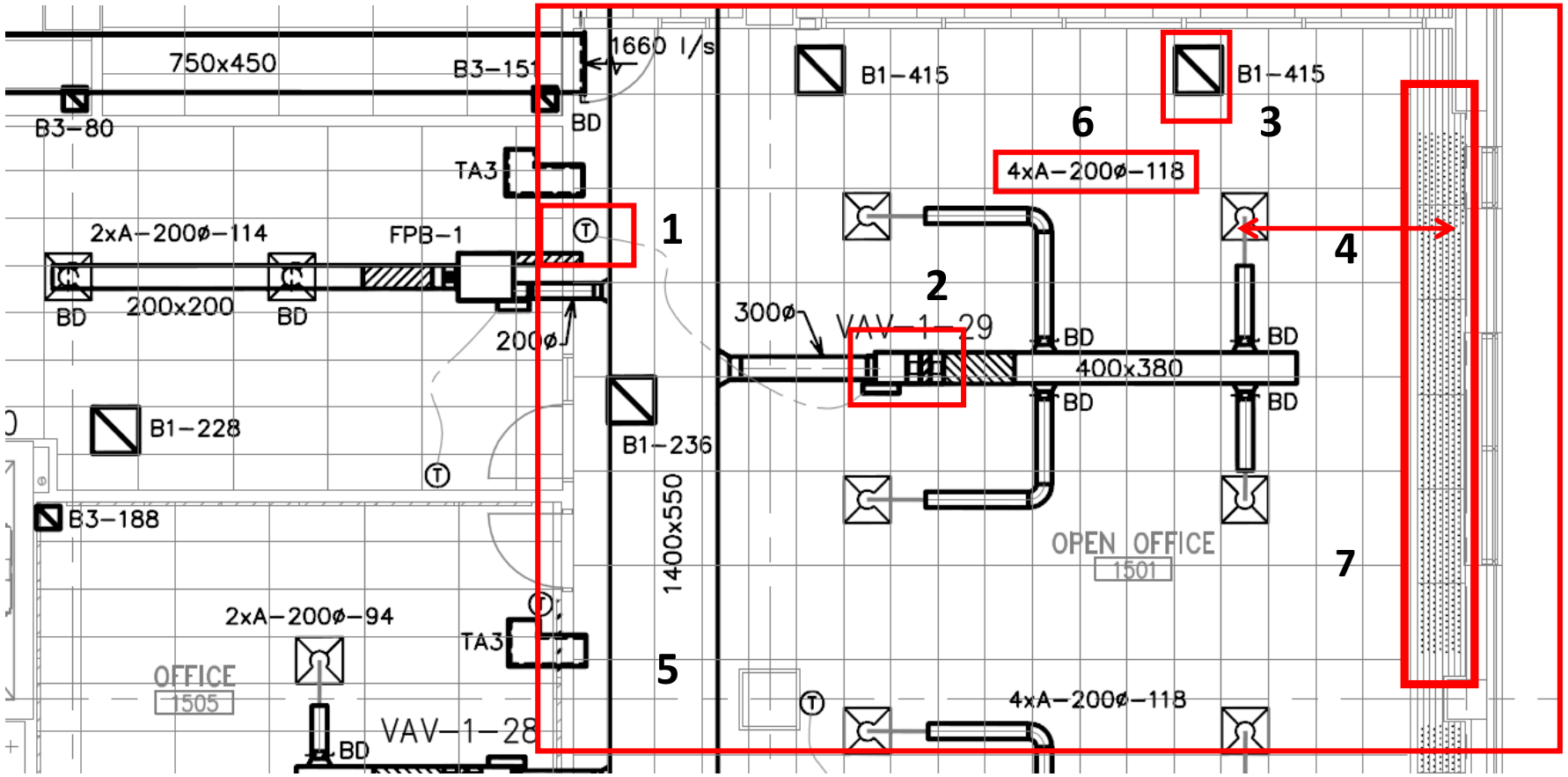
2: location of heating coil

3: location of return grids

4: distance of diffuser from the window

5: zoning of units

6: output of 4 diffusers



7 : deletion of heating by water

5 : Only 1 unit

ADVANTAGES OF HEATING THROUGH THE CEILING WITH HIGH INDUCTION DIFFUSERS

- **Savings in construction costs**

→ **Elimination of hot water or electric baseboards and or** Radiant Ceiling Heating Systems (Plumbing, electrical, thermostats, sensors etc)

→ **High induction diffusers**: reduction of half the number of diffusers required compared to traditional diffusers.

→ **Possibility of reducing the quantity of air introduced into the central zones by interpreting the volume of inducted air flow by the diffusers as the volume of recirculated air (in Quebec : 45 l/s/person in accordance with the regulation of the air quality of the workplace, chap S 2-1,r,11 chart 2 of annex B)**

ADVANTAGES OF HEATING THROUGH THE CEILING WITH HIGH INDUCTION DIFFUSERS

- **Energy savings**

→ Reduction of 25 % of the quantity of fresh air by using high induction diffusers

→ Energy savings through destratification

→ Reduction of the electrical power and consumption of central units

ADVANTAGES OF HEATING THROUGH THE CEILING WITH HIGH INDUCTION DIFFUSERS

- **Reduction in operating costs**

→ Elimination of hot water or electric baseboards:
Reduction of insurance premiums by half
- Hot water baseboards: reduction of the risk of water leakage (Contamination of the walls)

→ Reduction of 95 % of noise and discomfort complaints (Including air speeds and temperature variations)

→ Increased physical space through the elimination of baseboards

NAD Klima

144, rue Léger, Sherbrooke (Qué.) J1L 1L9
819 780-0111

nadklima.com