05.01_PH-SUMMER SCHOOL

VENTILATION

Composition: Ernst HEIDUK
Language support: William GALLAGHER
Date: 2008-08-15

CONTENT OF THIS PRESENTATION:

Source:

Basics of ventilation

Concepts for ventilation systems

Components of ventilation systems

Source:

Basics of ventilation

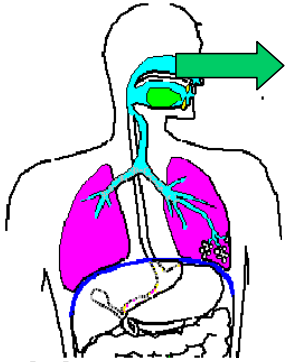
The basis must be the fulfilment of the physiological requirements for air hygiene

- Air change: 25 - 30 m³/Pers.h
- Air movement: < 20 cm/sec
- Humidity: 30 - 70 % rel. Humidity R.H.

Source:

Basics of ventilation

Emissions of the exhaled air per person per day



• CO2	Carbon dioxide	244 - 390 g
• CO	Carbon monoxide	0,3 -1,0 g
•	Ethanol	0,009 - 0,052 g
•	Methane	0,041 - 0,095 g
•	Acetone	0,027 - 0,064 g

Source:

Basics of ventilation

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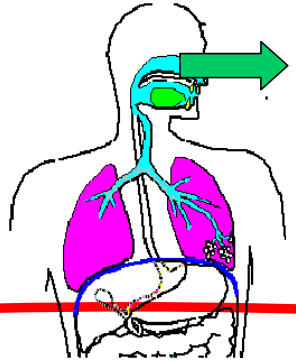

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Source:

Basics of ventilation

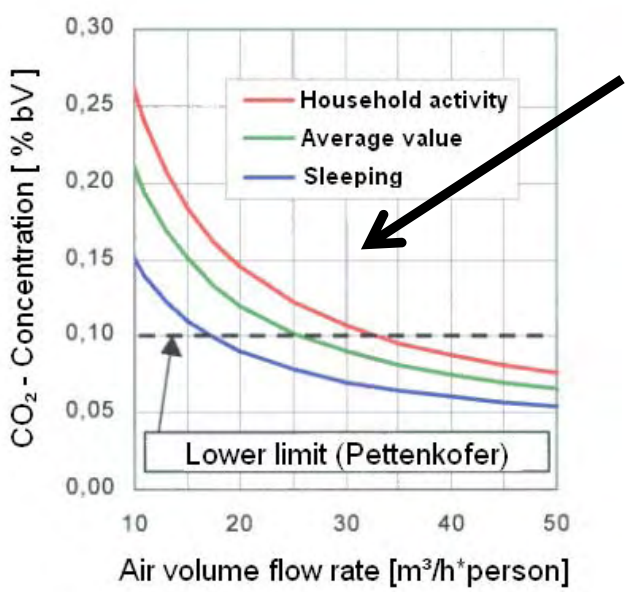
Which volume of fresh air is necessary:

• Apartments	30	(m^3/person/h)
• Bathrooms	60	„
• One-family houses	25 - 30	„
• Single offices	40	„
• Offices	60	„
• Class rooms	30	„
• Sport halls	30	„
• Restaurants	50	„

Source:

Basics of ventilation

Which volume of fresh air is necessary:



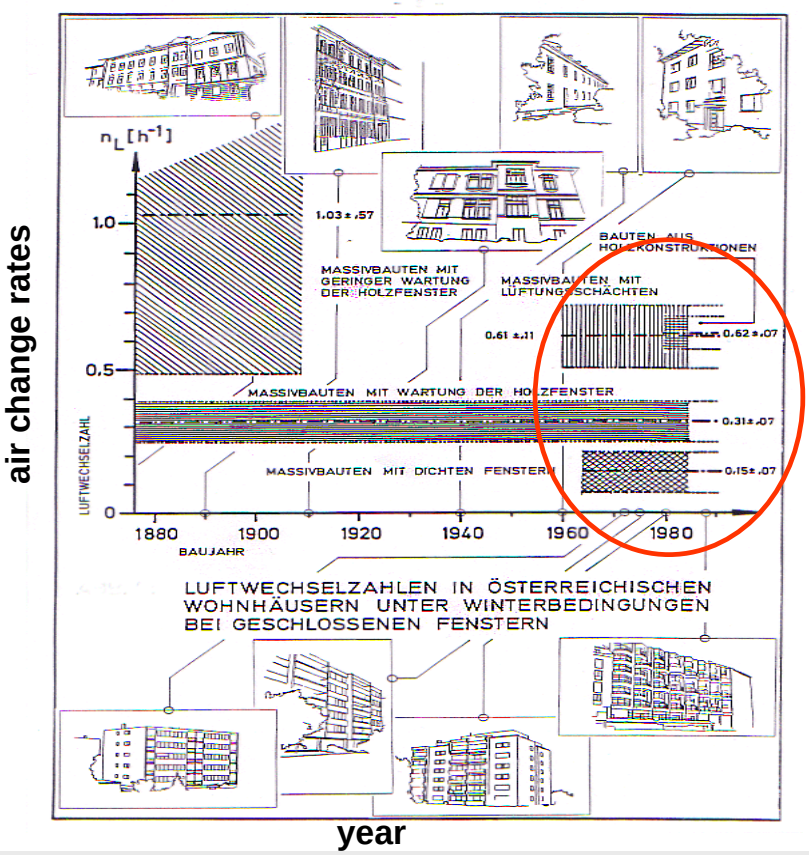
The base value for the calculation is 30 m³/ h for one adult person.

This represents the activity level in a household and is based on the CO_2-concentration and the hygienic limit level. (Max v. Pettenkofer)

Source: © BauNetz Online-Dienst www.baunetzwissen.de/standardartikel/Heizung_Hygienisch-notwendige-Luftmenge_161396.html

Basics of ventilation

The “real” air change rates in Austrian apartments



Many research results show that the hygienically required minimum air exchange is often not reached.

Source: E. Panzhauser, A. Fail, E. Heiduk

Basics of ventilation

Especially (bad) reconstruction can be very dangerous.

- **too much CO_2**
- **moisture**
- **mould**

Source: http://www.mouldpro.ca/Mould%20Growth.htm

Basics of ventilation

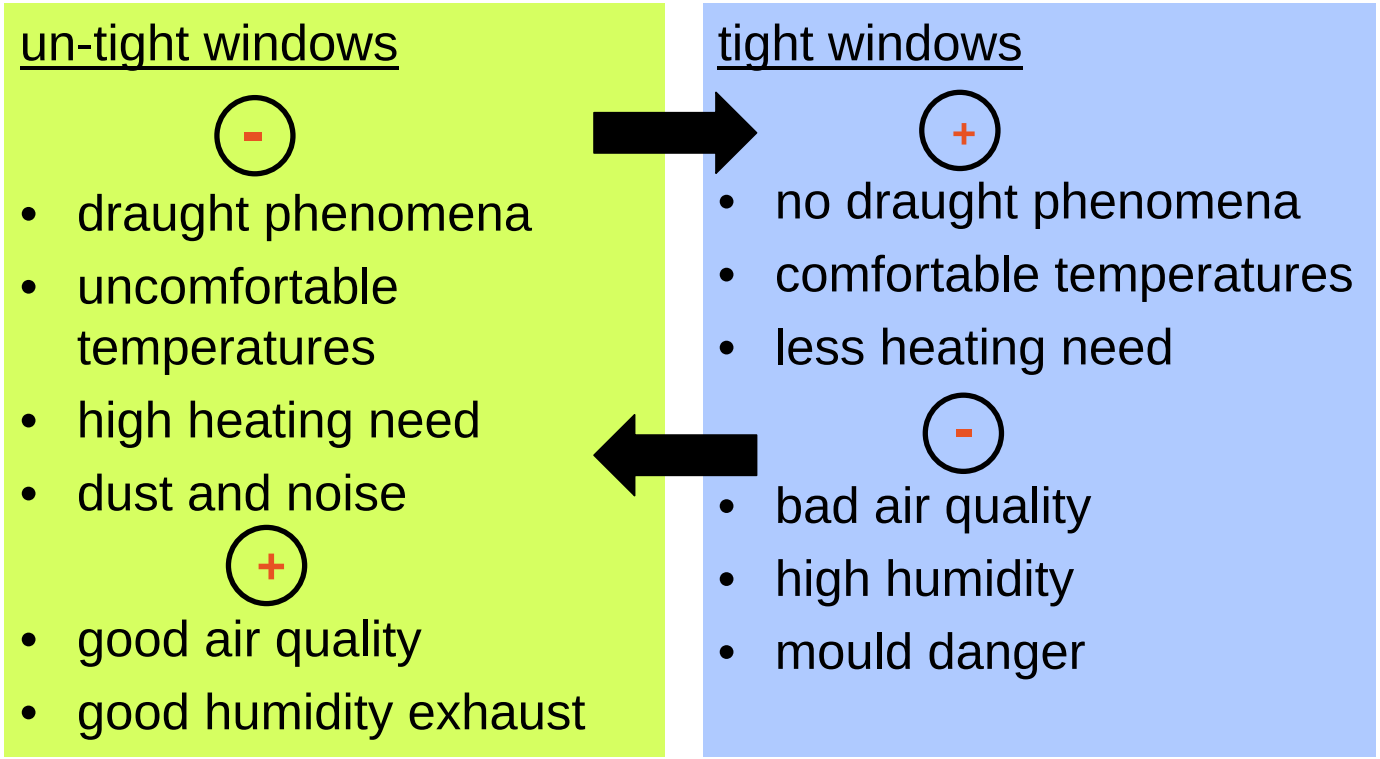
An adverse interaction of:

- Air change
- Air humidity
- Air circulation
- Surface temperatures and
- Dew point leads (very quickly) to
- Condensation with
- Spores germination and mould

Source:

Basics of ventilation

What does that mean for the ventilation element window ?



Source:

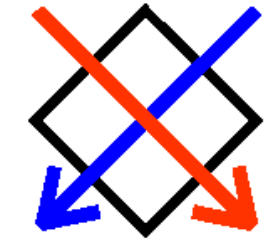
Basics of ventilation

The solution for this problem …

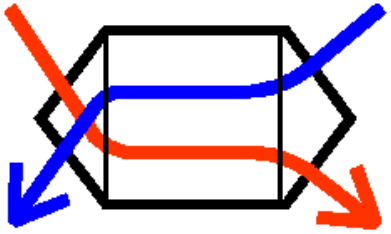
is the…

- controlled (mechanical) ventilation

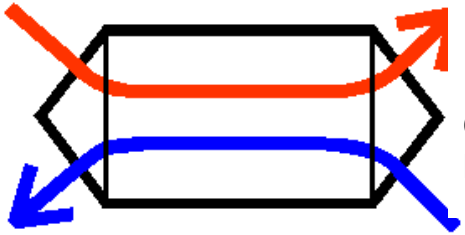
- with heat recovery (comfort ventilation)



Cross flow-heat exchanger



Cross counter flow-heat exchanger

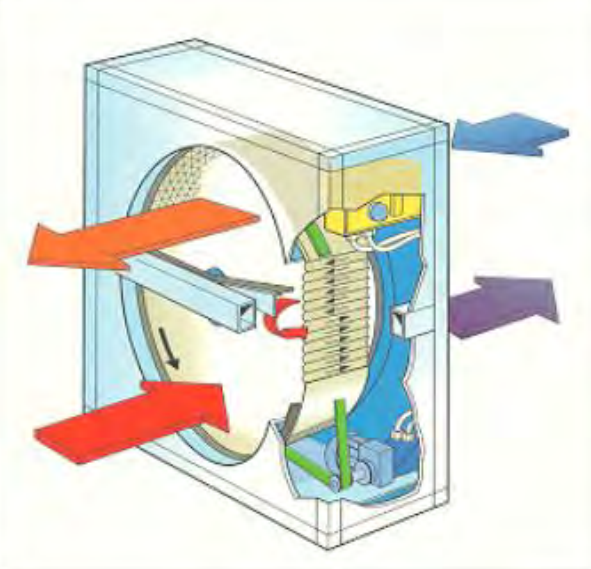


Counter flow-heat exchanger

Source:

Basics of ventilation

Rotation heat exchanger (AL-KO Therm) for heat and humidity recovery



© IGS

Source: www.enob.info/de/neubau/projekt/details/ppp-modell-fuer-neues-regionshaus-hannover/

Basics of ventilation

Concepts for ventilation systems

Components of ventilation systems

Source:

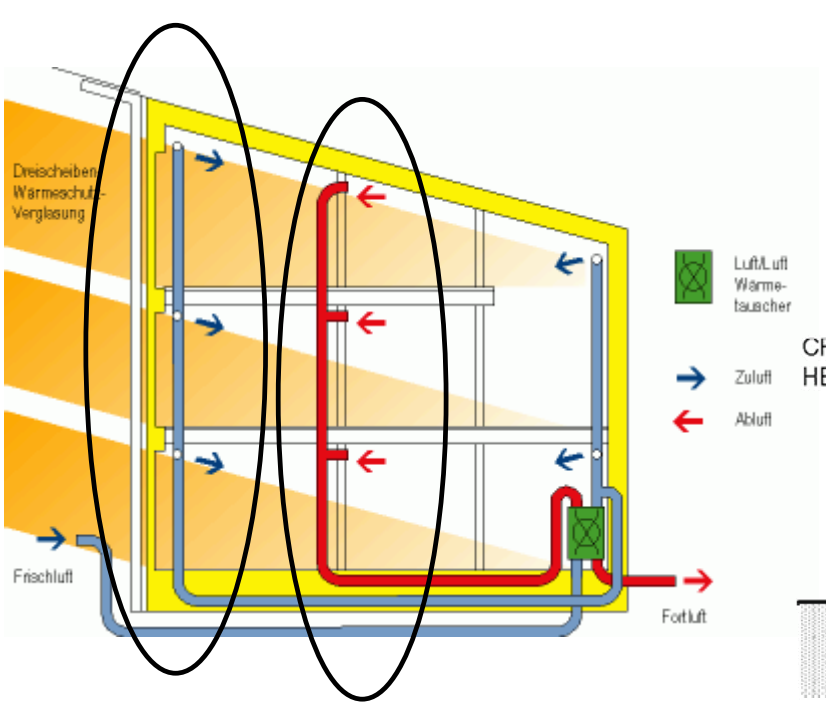
Concepts for ventilation systems

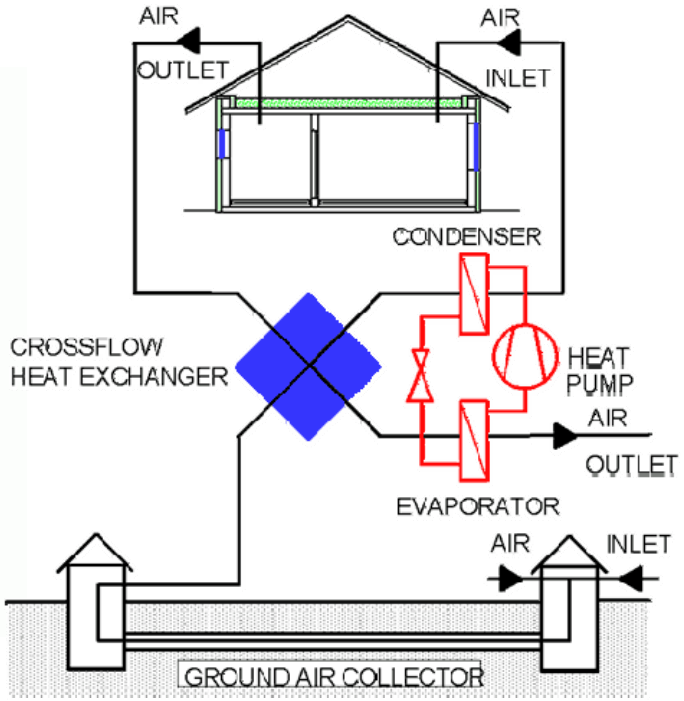
The concept for the ventilation system depends on:

- Air volume (air exchange rate)
- Concept of conditioning
- Concept of distribution
- Dimensions of ducts
- Specific electricity need
- Noise protection
- Fire protection
- Service

Source:

Concepts for ventilation systems



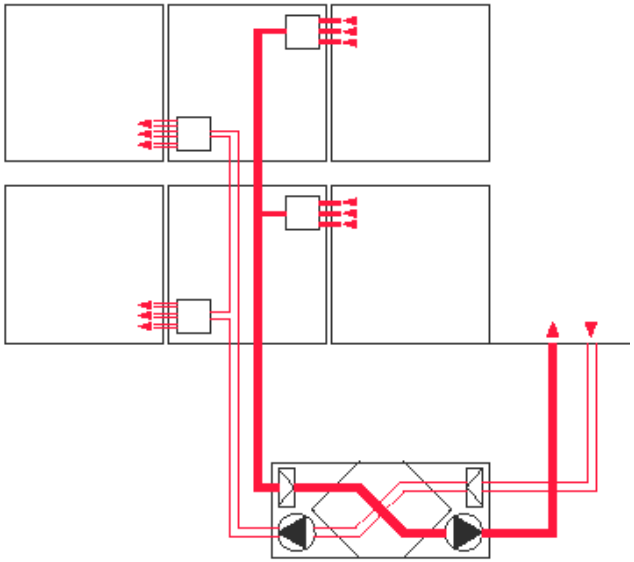


Source: Passivhausinstitut Darmstadt — Abluftwärmerückgewinnung mit Abluftwärmepumpe und Luftvorwärmung in der Erde (Halozan et al. 1999)

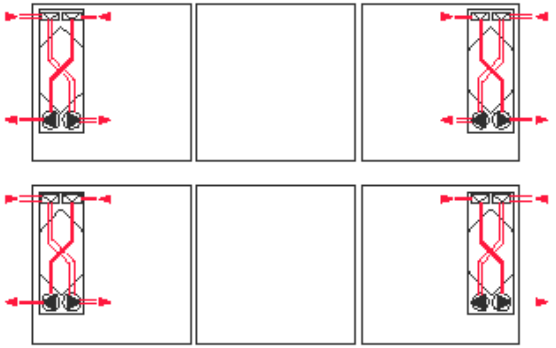
Concepts for ventilation systems

Strategies

central



de-central

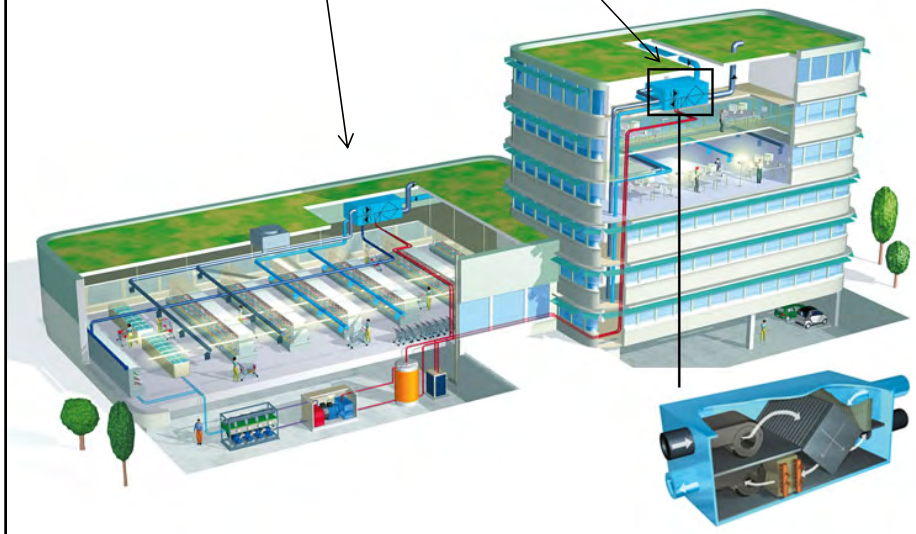


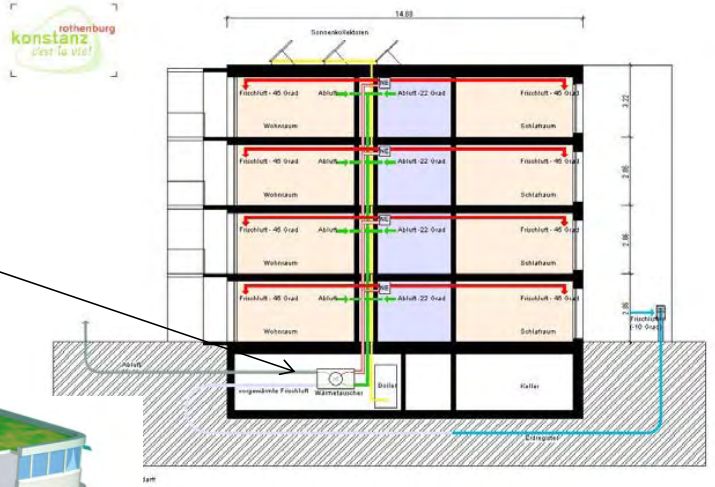
... or semi-de-central

Source: Lüftungssysteme für Niedrigenergie-Wohngebäude, Technologie-Monitoring 2005, BFE Bundesamt für Energie (CH)

Concepts for ventilation systems

Central

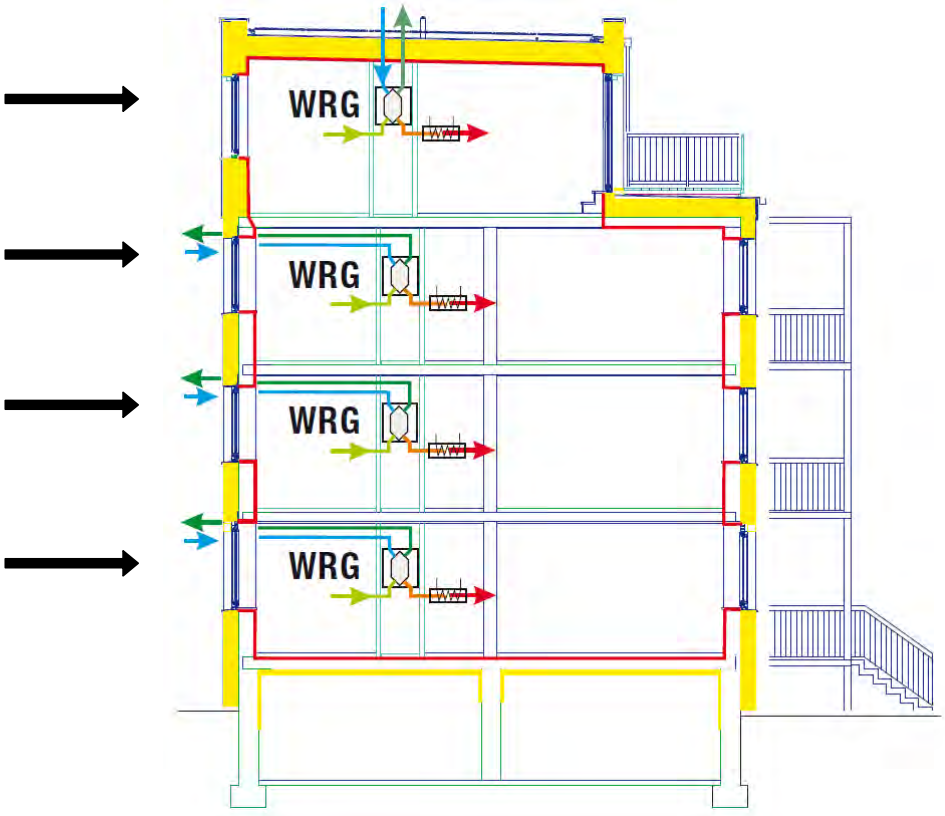




Source: http://www.stromonline.ch/stromanwendung.html www.empa-ren.ch/Internet-Files/Programm/Aktuelles/aktualitaeten/Status-Seminar/pdf-files2004/Sigg%20Konstanz.pdf

Concepts for ventilation systems

De-central



Source:

Concepts for ventilation systems

Air ducts need more space than most other domestic engineering elements

=> very often problems of space

2 strategies

- free installation

- integrated installation

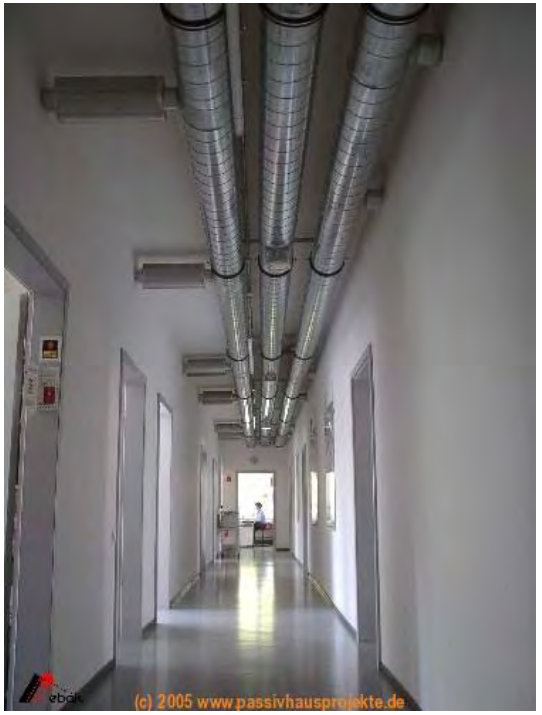
Source: E. Heiduk

Concepts for ventilation systems

Aspects of the design

The “technical” or puristic approach – everything is in the open and visible

Passive House Lang,
Architecture: H. Kaufmann



Office IB ebök GbR, Tübingen
Architectur: Brigitte Cramer, Heiner Maier-Linden

Source: E. Heiduk
www.passivhausprojekte.de/projekte.php?detail=305

Concepts for ventilation systems

Aspects of the design

The “technical” or puristic approach – everything is in the open and visible

Architecture: Moosmann, Vienna

Source: E. Heiduk

Concepts for ventilation systems

Aspects of the design

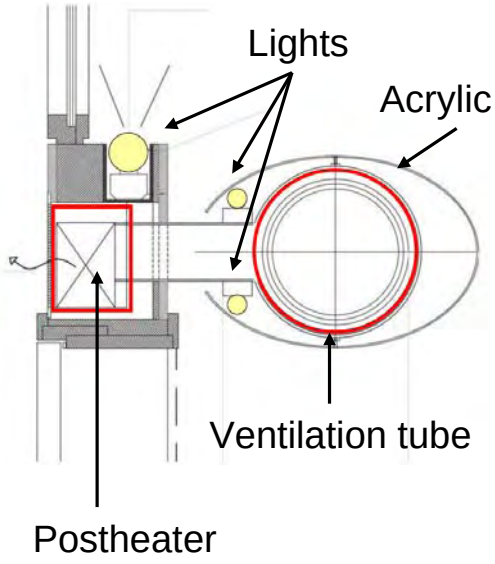
The “technical” or puristic approach – it is part of the design

FH Kufstein (A)

Architecture: Henke & Schreieck, Wien

Source: E. Heiduk

Designed and combined lighting and ventilation



Renovation “Expost” Bolzano (I)
Arch: Michael Tribus

Source: Architect Michael Tribus, Lana

Concepts for ventilation systems

Aspects of the design

The “secret” integrated approach –

everything is integrated into the construction or jacked

in the concrete ceiling

in a suspended ceiling

Source: www.energieagentur.nrw.de/_infopool/page.asp?InfoID=6880&find= Arch: B. Schultze-Darup

Concepts for ventilation systems

Aspects of the design

The “secret” integrated approach – everything is integrated into the concrete ceiling in this case

Source: www.energieagentur.nrw.de/_infopool/page.asp?InfoID=6880&find=

Concepts for ventilation systems

Aspects of the design

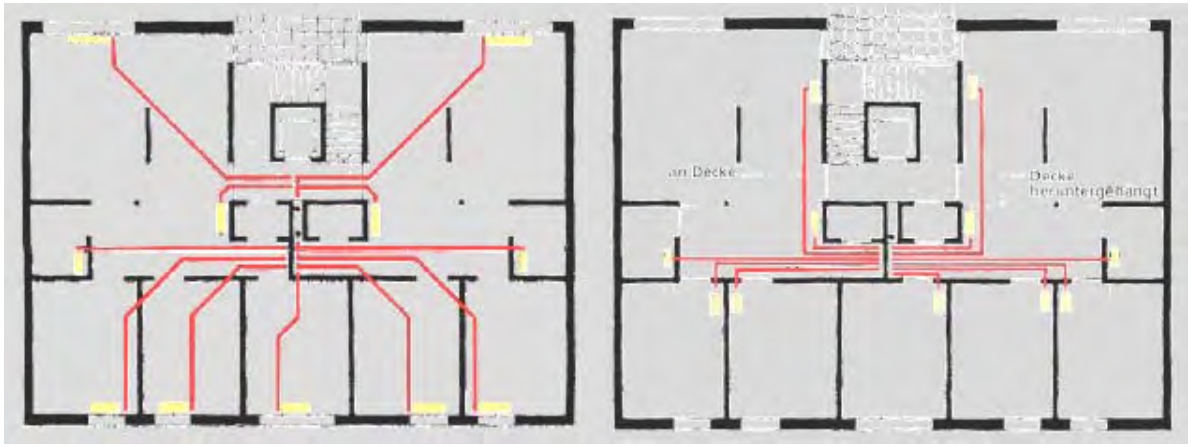
If it is integrated into a suspended ceiling – it is probably necessary to have a smoke detector in there

Source: E. Heiduk

Concepts for ventilation systems

Aspects of the design

The position of the outlets is near the facade and is possible even in the central area.



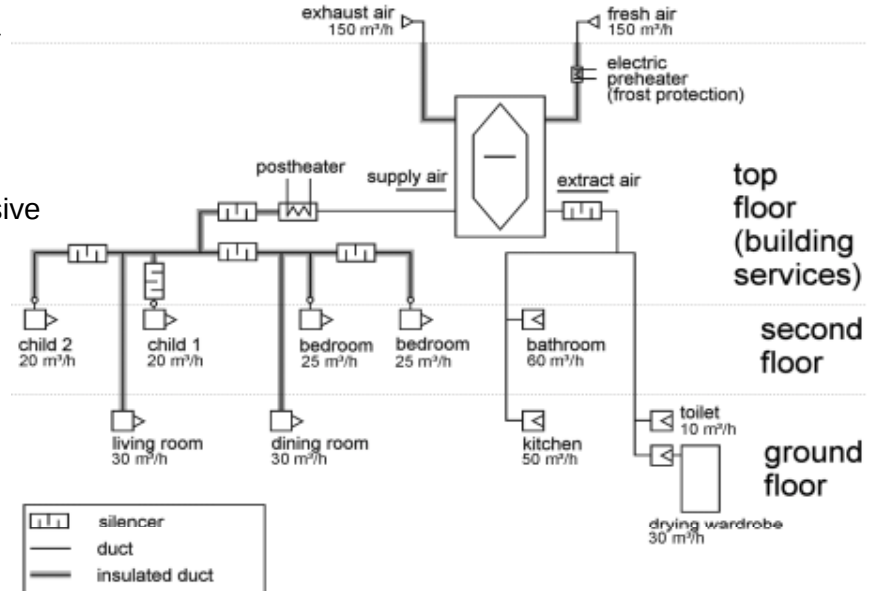
Source:

Concepts for ventilation systems

Aspects of the design

Sound protection is very important !!!

Ventilation system duct network plan for Passive House type „Jangster de Lüx“ with the design layout flow volumes. From the „Aerotechnik Sigwart“ company.



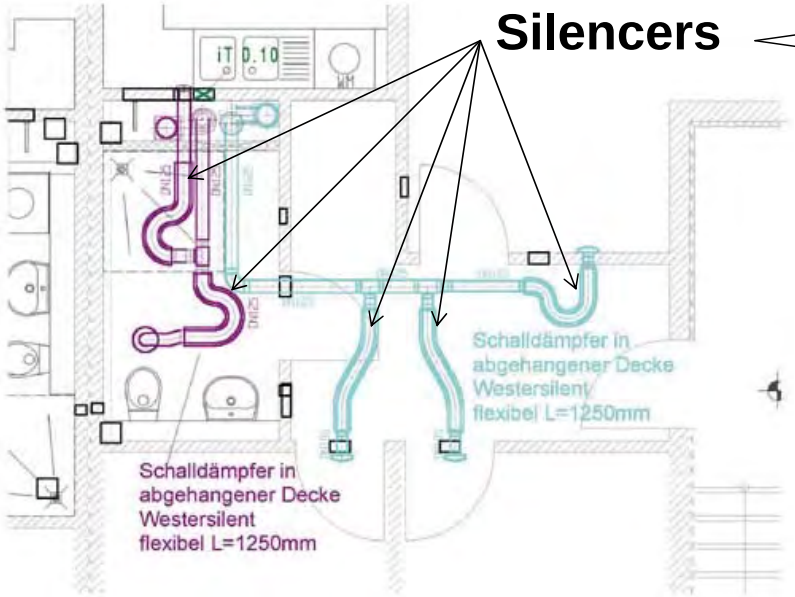
A noise pressure level of 25 dB(A) was aimed for, which is clearly below the limit of 30 dB(A) for so-called “rooms requiring protection”. The **silencers** are flexible pieces made up of a perforated aluminium inner pipe, mineral fibre packaging and an aluminium outer pipe. On the exhaust side, there is a common silencer (nominal diameter 160 mm, packaging thickness 25 mm, length 1000 mm) before the ventilation system.

Source:

Concepts for ventilation systems

Aspects of the design

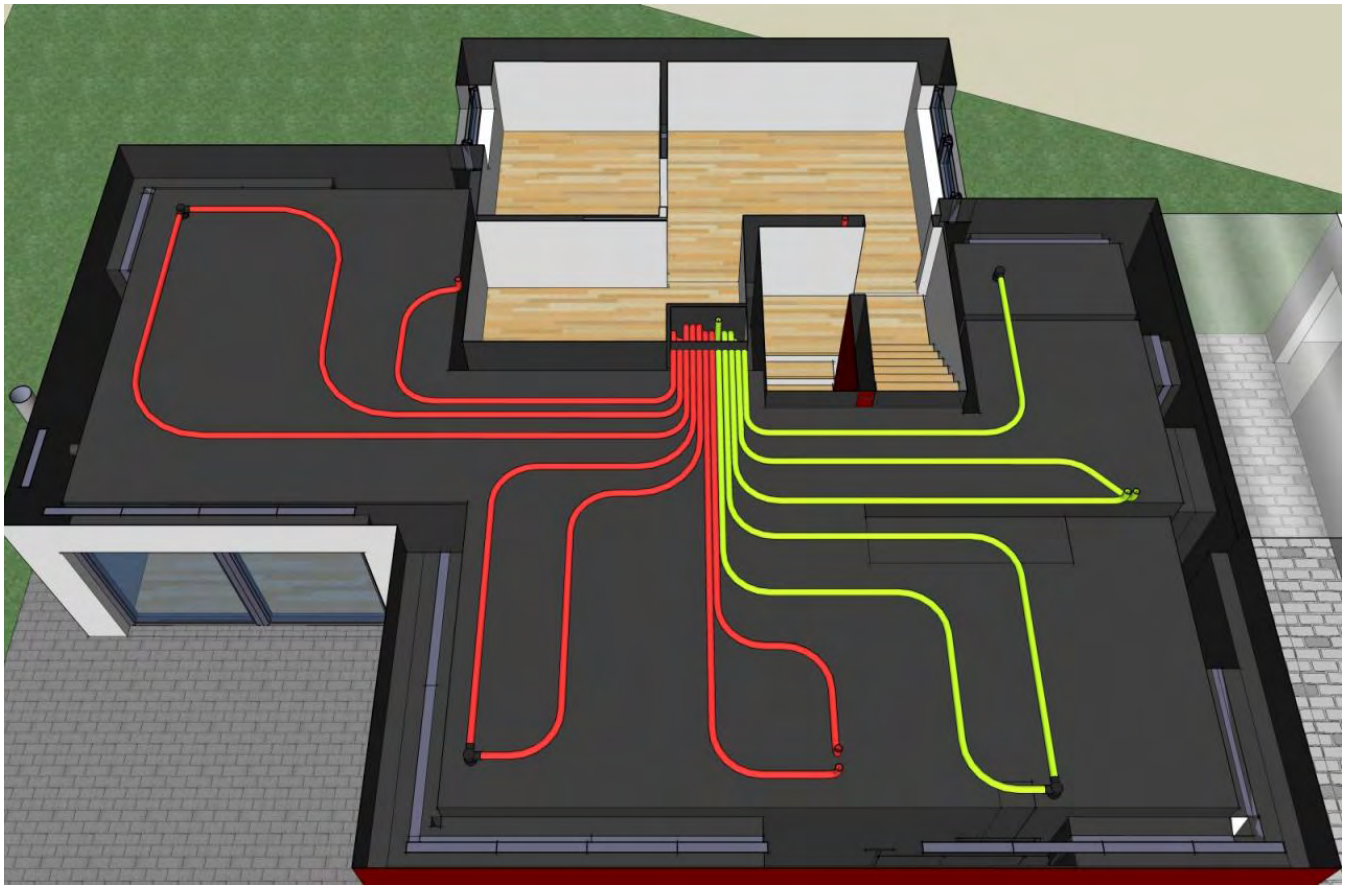
Sound protection is very important !!!



Source: Wolfgang Feist, Rainer Pfluger

Concepts for ventilation systems

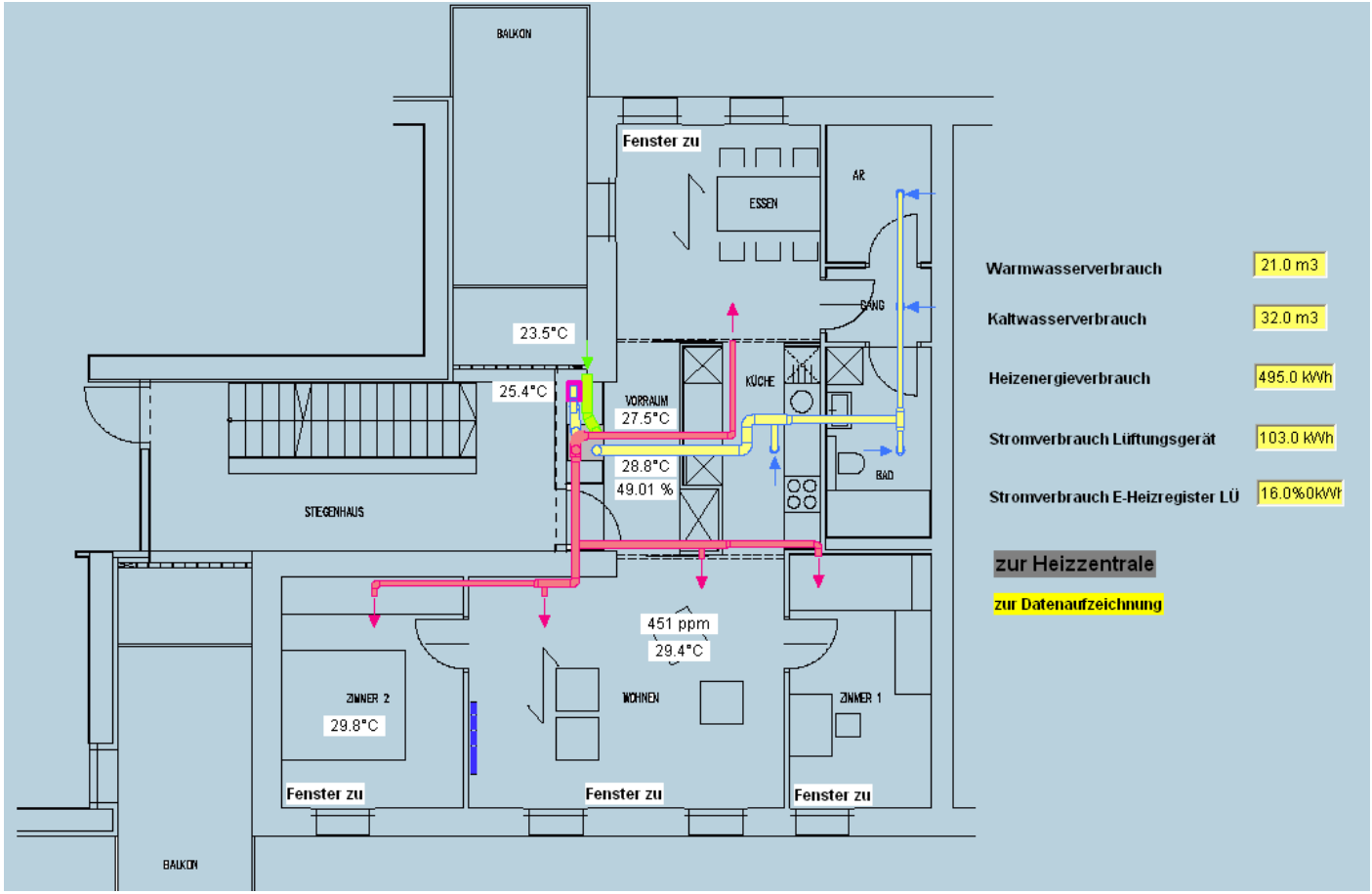
Examples of the design



Source: http://sautter.com/Passivhaus/Lueftungsanlage?action=dispimg&im=haus3dLueftung00.p.jpg

Concepts for ventilation systems

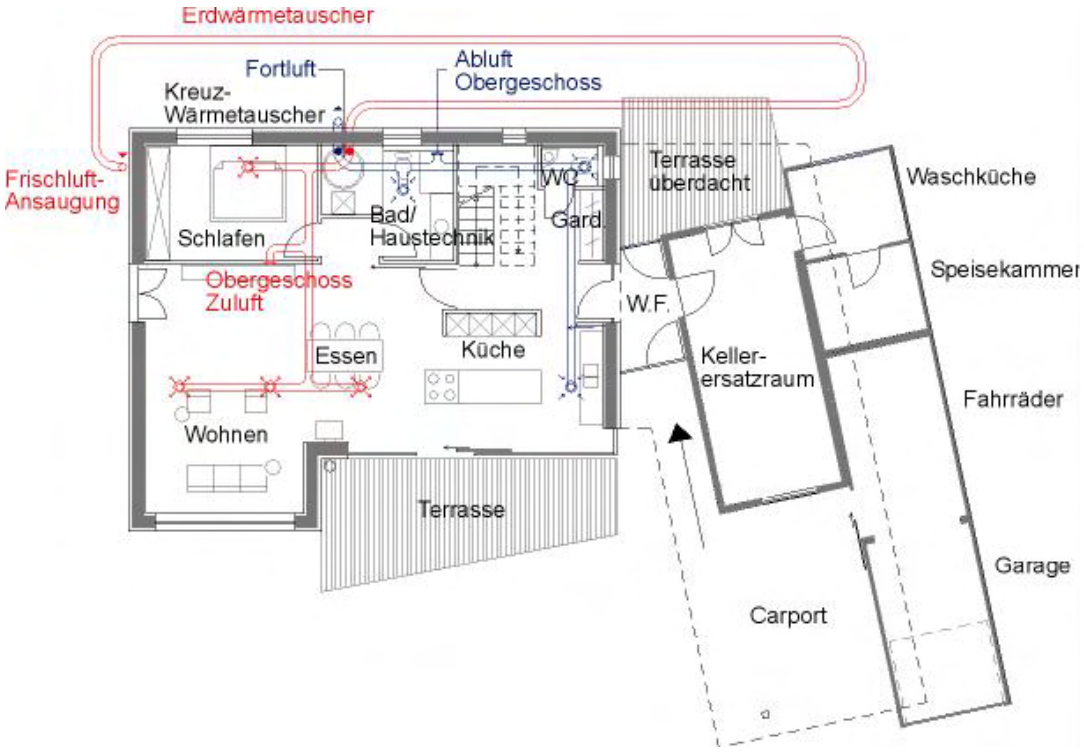
Examples of the design



Source: http://195.70.116.20/wohnung.html

Concepts for ventilation systems

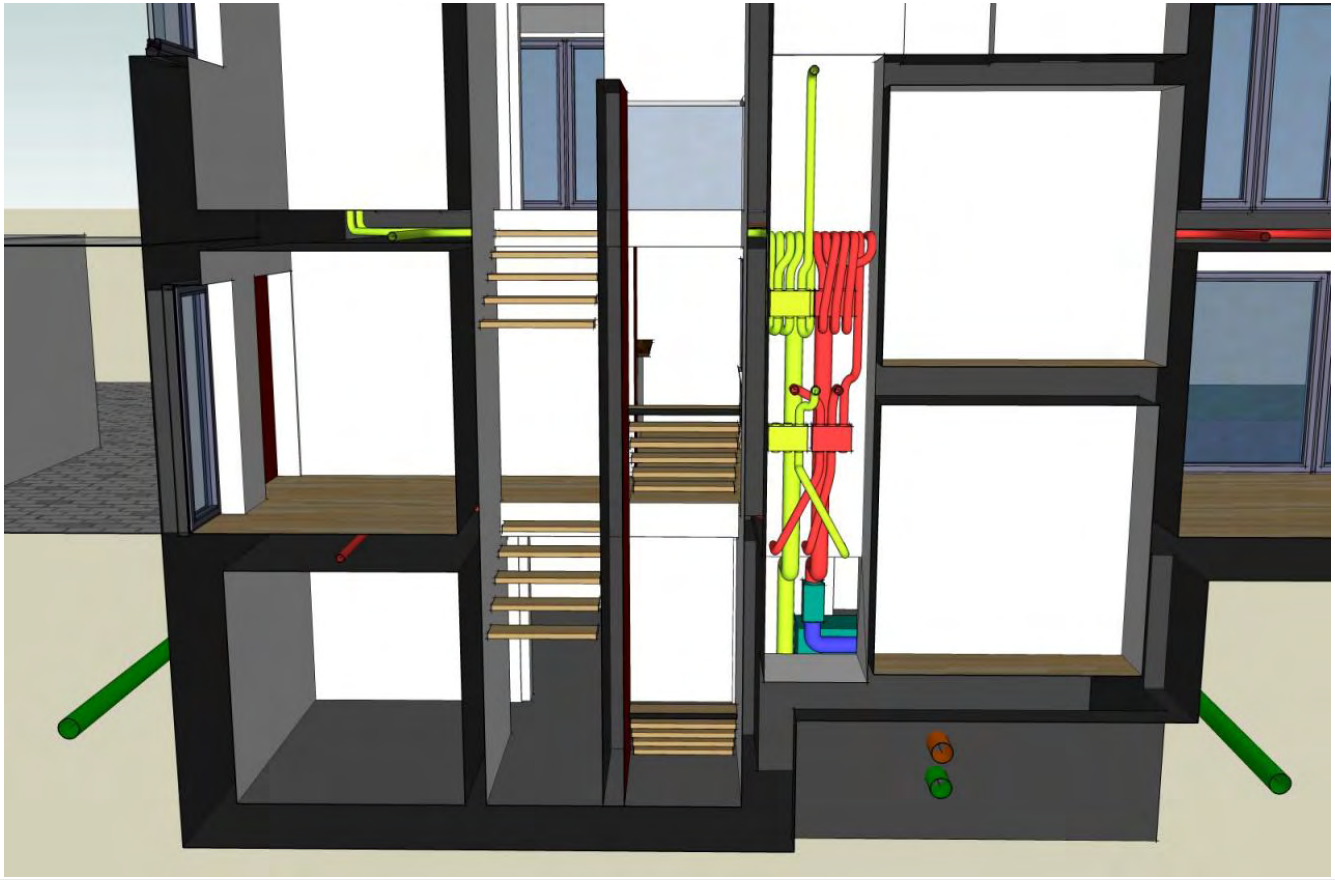
Examples of the design



Source: http://brinkmann-architektur.de/projekte/passivhaus/detail.html

Concepts for ventilation systems

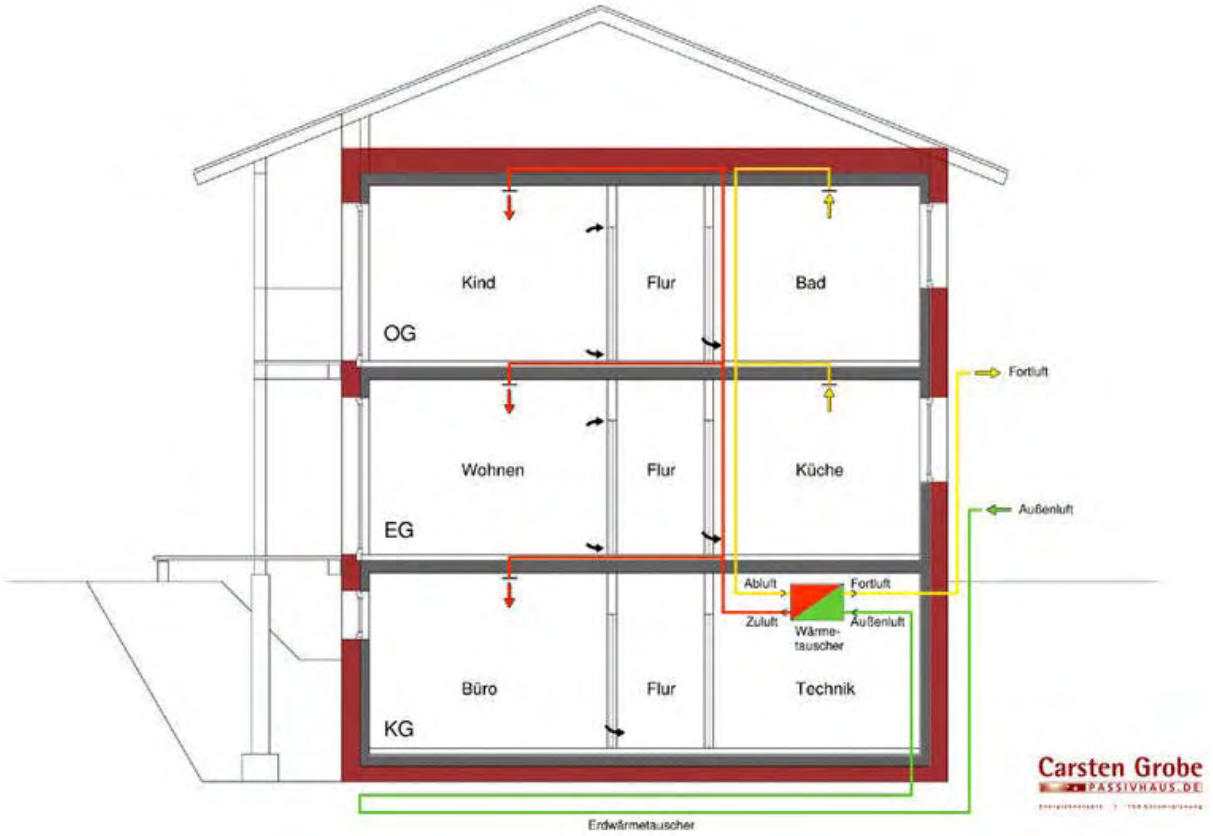
Examples of the design



Source: http://sautter.com/Passivhaus/Lueftungsanlage?action=dispimg&im=haus3dLueftungsschacht.p.jpg

Concepts for ventilation systems

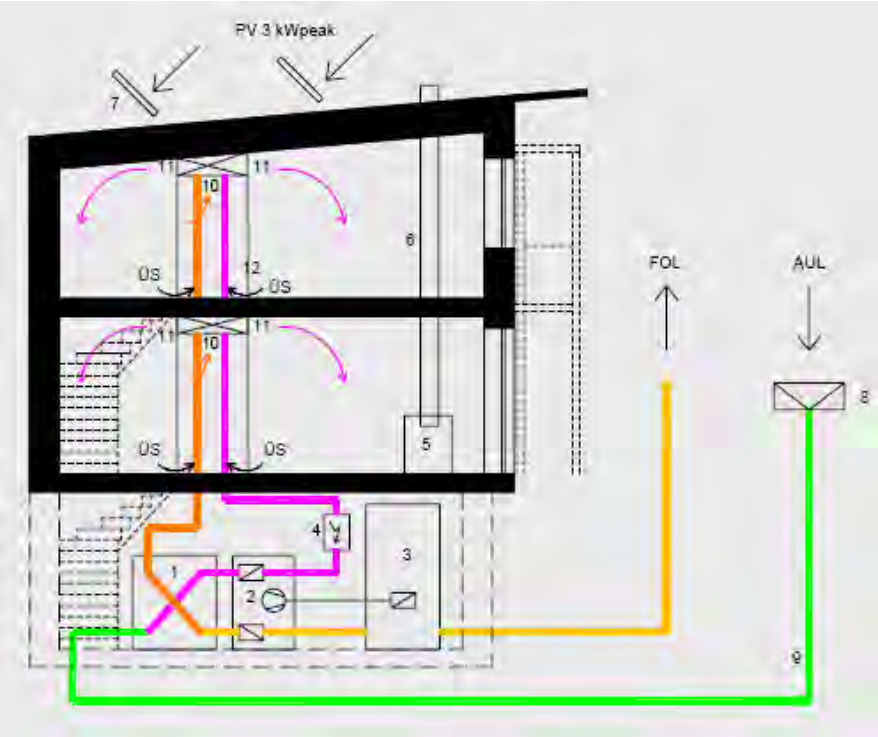
Examples of the design



Source: www.passivhaus.de/passivhaus-grundlagen/gebaeudehuelle/waermedaemmung/

Concepts for ventilation systems

Examples of the design

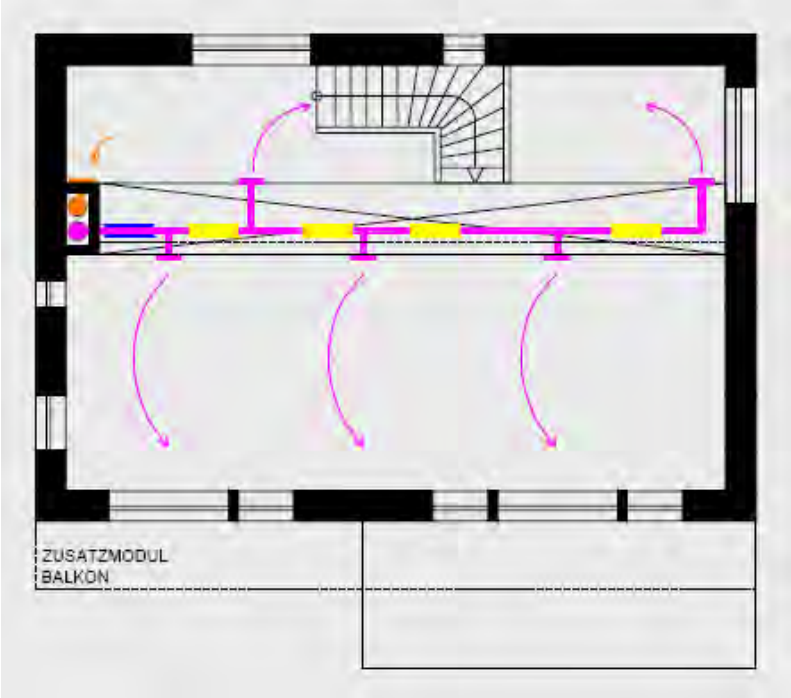


One-family house, Compact unit with 100% air-heating

Source: Qualitätssicherung von Passivhäusern in Holzbauweise - teamgmi Ingenieurbüro GmbH, Arch. Ambrozy, H.G

Concepts for ventilation systems

Examples of the design

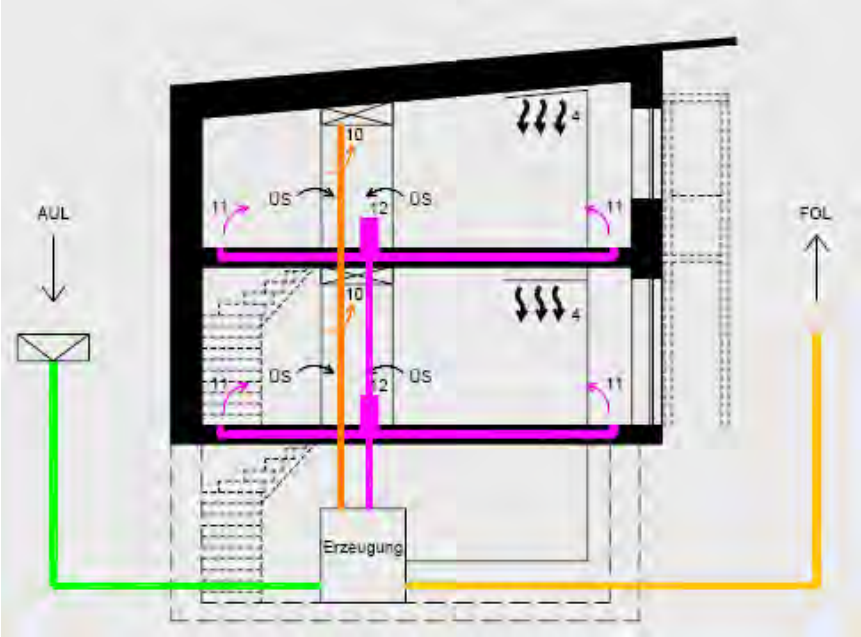


One-family house, Air distribution in suspended ceiling

Source: Qualitätssicherung von Passivhäusern in Holzbauweise - teamgmi Ingenieurbüro GmbH, Arch. Ambrozy, H.G

Concepts for ventilation systems

Examples of the design

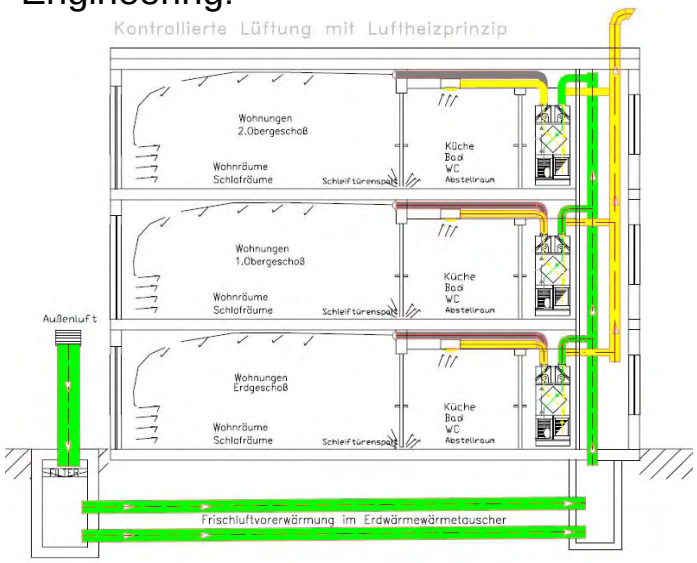


One-family house, Option – Air distribution in primary structure (floor construction).

Source: Qualitätssicherung von Passivhäusern in Holzbauweise - teamgmi Ingenieurbüro GmbH, Arch. Ambrozy, H.G

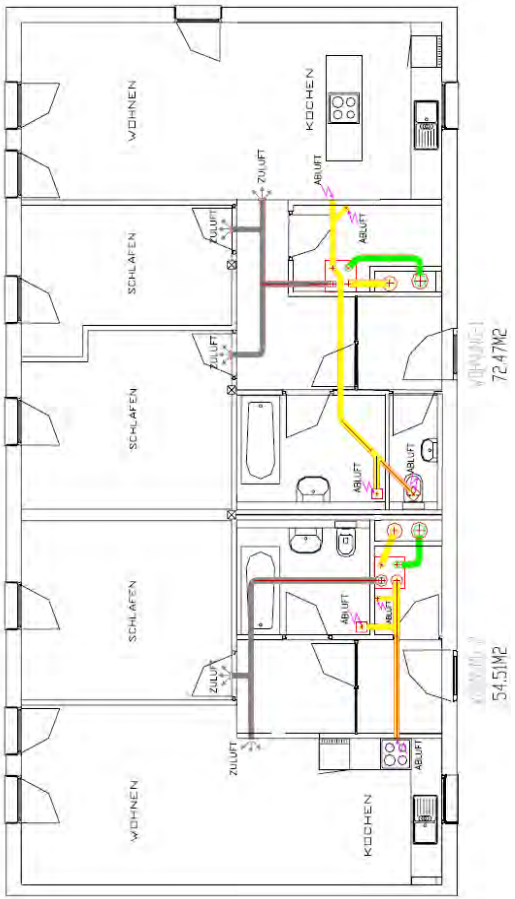
Concepts for ventilation systems

Project “Ölzbündt”, Dornbirn (A)
Architecture: Hermann Kaufmann
Engineering:



Multi-family house, Air distribution in suspended ceiling, de-central compact units with 100% air-heating

Examples of the design

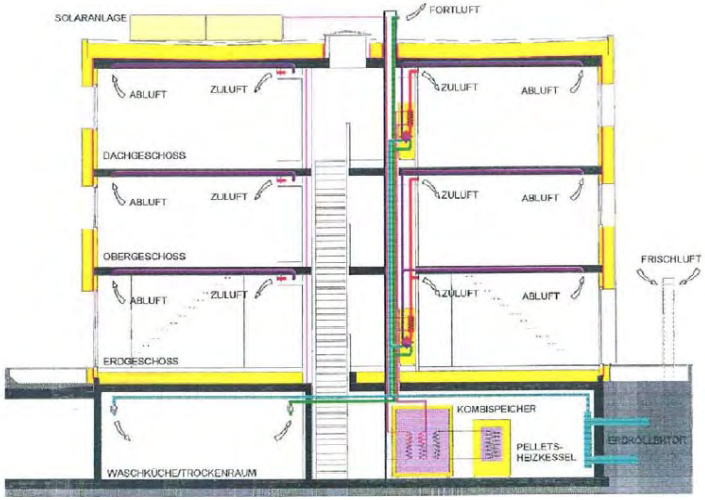


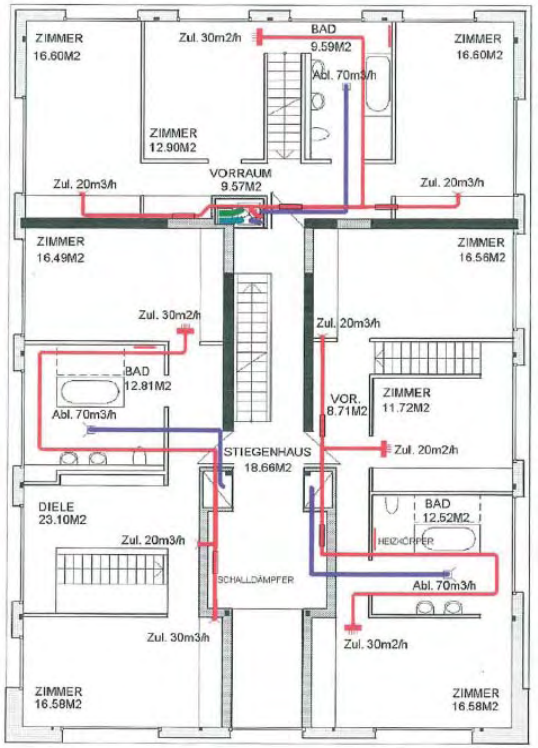
Source: Qualitätssicherung von Passivhäusern in Holzbauweise - teamgmi Ingenieurbüro GmbH, Arch. Ambrozy, H.G

Concepts for ventilation systems

Examples of the design

Project “Wolfurt”, (A)
Architect: Gerhard Zweier
Engineering: team GMI





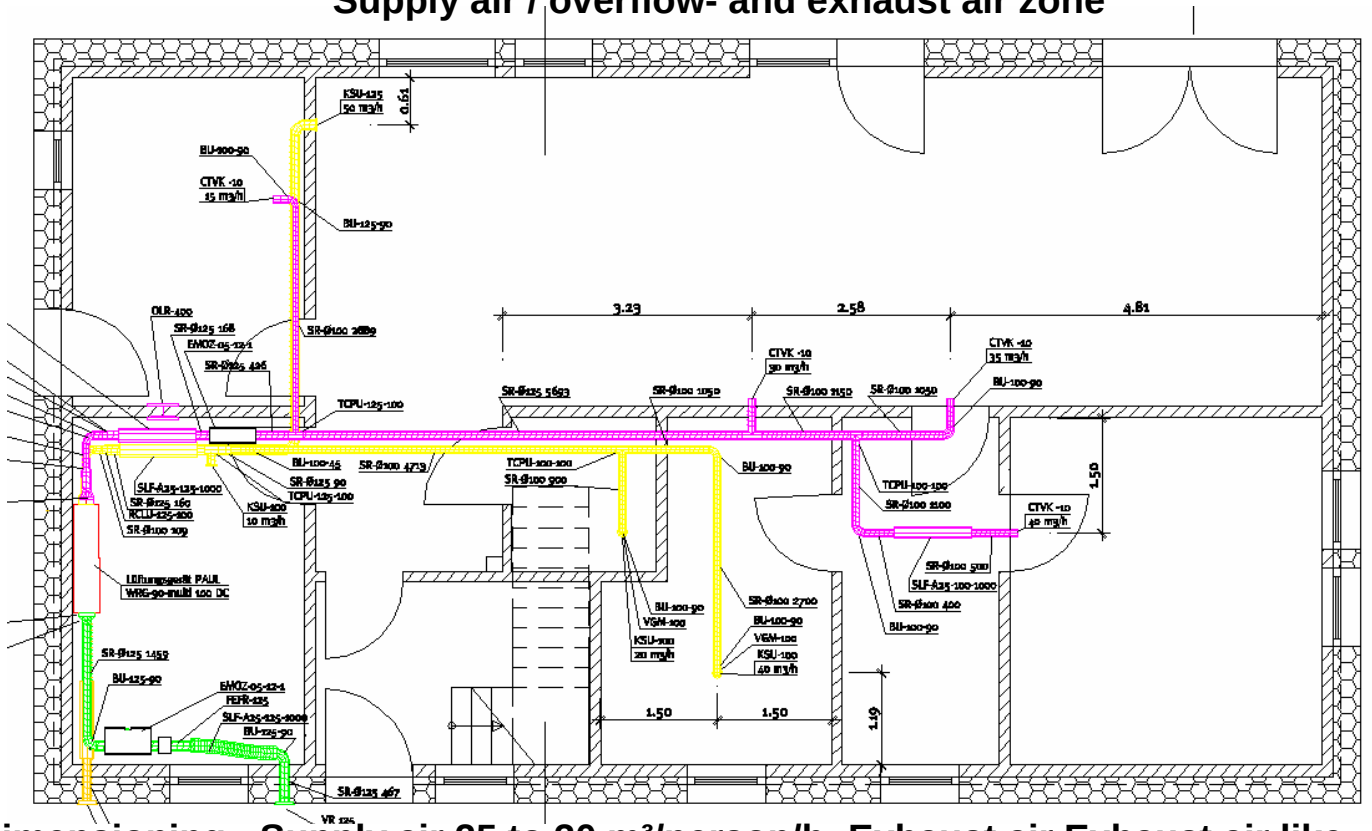
Multi-family house, Air distribution in shafts and suspended ceiling, de-central compact units with 100% air-heating

Source: Qualitätssicherung von Passivhäusern in Holzbauweise - teamgmi Ingenieurbüro GmbH, Arch. Ambrozy, H.G

Concepts for ventilation systems

Examples of the design

Supply air / overflow- and exhaust air zone



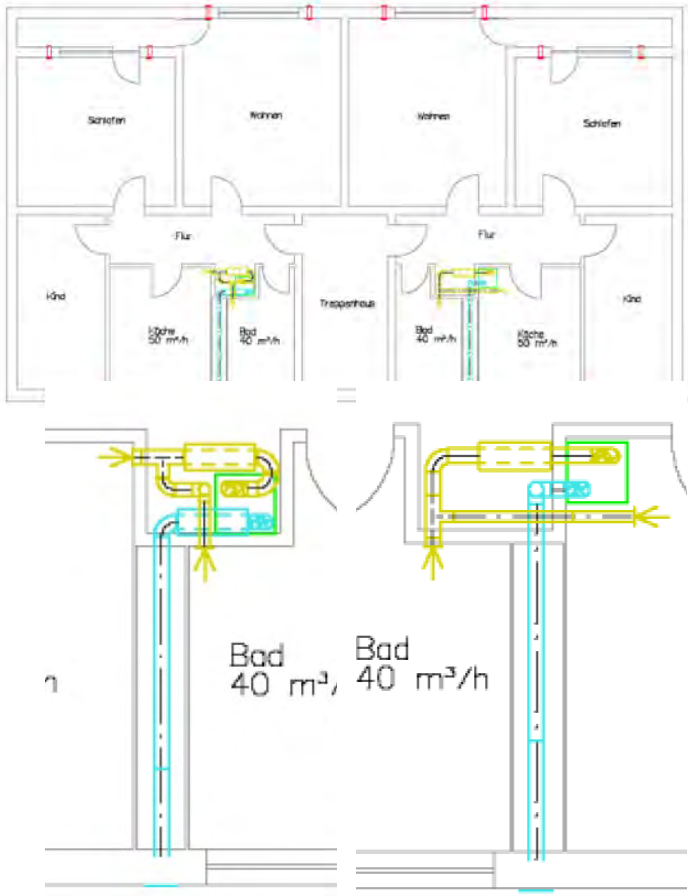
Dimensioning: Supply air 25 to 30 m³/person/h; Exhaust air Exhaust air like DIN 1946

Source:

Concepts for ventilation systems

A de-central concept
– production of warm water with a heat pump

Examples of the design



Source: N. Markus / Fa. Stiebel Eltron

Concepts for ventilation systems

Examples of the design

The “easy service” approach

– integration in the furniture and easily attainable (problem with noise!?)

Zollikofen CH

Luftraten Haus Nr. 2 (11 Wohnungen)		
Wohnungstyp	Spez. Aussenluftrate	Luftwechsel
3 ½-Zimmer	150 m³/h	0,9/h
4 ½-Zimmer	170 m³/h	0,8/h
5 ½-Zimmer	200 m³/h	0,7/h
6 ½-Zimmer	220 m³/h	0,7/h

Apartment house with comfort ventilation system

Source: www.faktor.ch/imgs/gross/?file=278.jpg&l=d

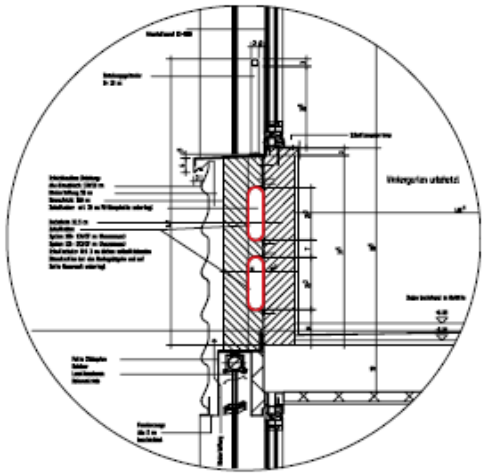
Concepts for ventilation systems

Examples of the design

Strategies for renovation
– integration into the facade

Horizontal distribution

Apartment house »Heumatt« (CH)



Section trough the facade with flat ducts integrated in the heat insulation
(S+P-Haustechnik)

Each air inlet has its own sound absorber (Elcotherm AG)

Source: Faktor 4 – 8 3/06 - Komfortsprung

Concepts for ventilation systems

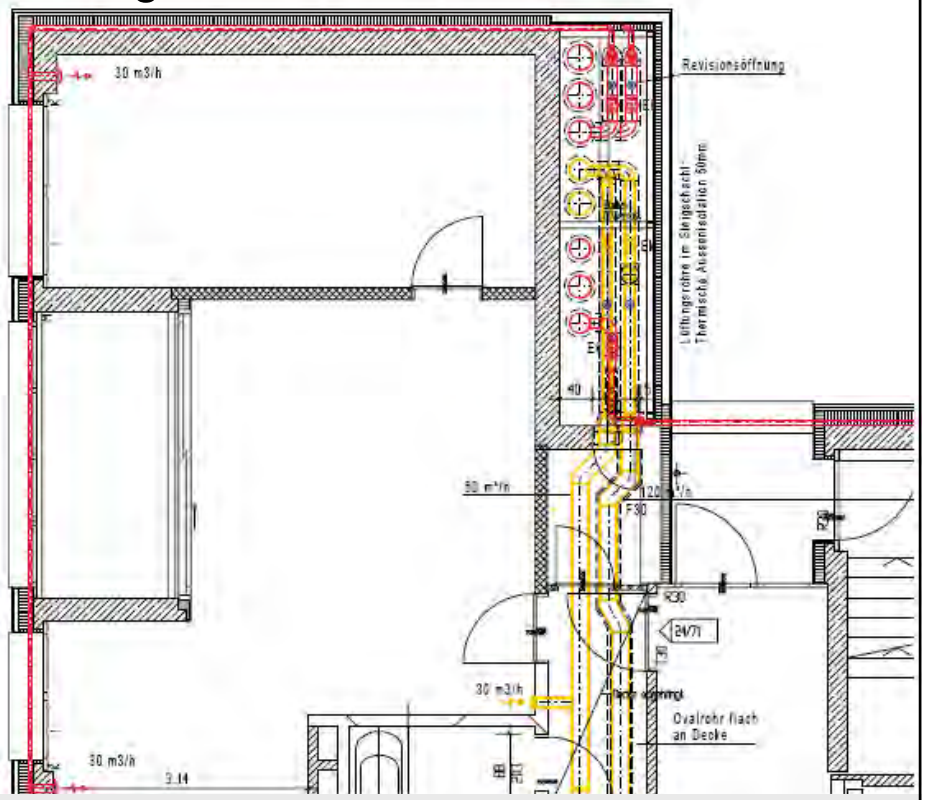
Examples of the design

Aspects of the design and construction

Strategies for renovation – integration into the facade

Horizontal and vertical distribution

Fresh (warm) air comes from the shaft with the vertical rising pipes into the horizontal flat pipes (integrated into the heat insulation).
(S+P-Haustechnik)



Source: Faktor 4 – 8 3/06 - Komfortsprung

Basics of ventilation

Concepts for ventilation systems

Components of ventilation systems

Source:

Components of ventilation systems

In- and outlet next to the building

Source: Pictures: left Dirk Wilhelmy - http://www.architec24.de/viessmann/live/fotogalerie/show.php3 Pictures: right:

Components of ventilation systems

Inlet and outlet in facades

Office building Lu-teco, Ludwigshafen (D)

Inlet and outlet of de-central ventilation systems

School building, Schwanenstadt (A)

Source: http://www.architec24.de/viessmann/live/projekte/tab/detail/55/0/0/112.html, Picture left: Dirk Wilhelmy, right Ernst Heiduk

Components of ventilation systems

Inlet box with air filter

Source: E. Heiduk

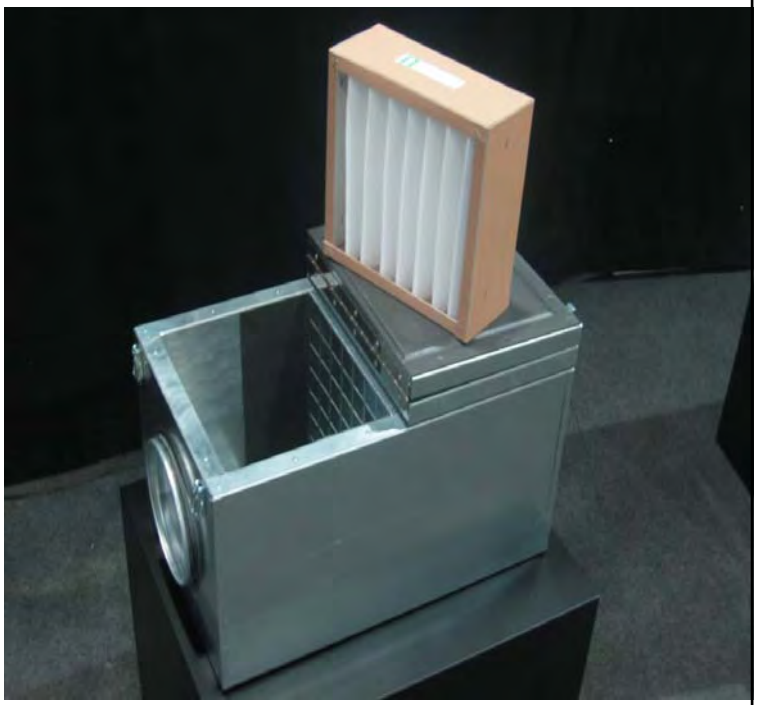
Components of ventilation systems

Inlet with air filter

Source:

Components of ventilation systems

Separated air filter box



Source: E. Heiduk

Components of ventilation systems

Inlet box with pre-heating register (brine)

Source: E. Heiduk

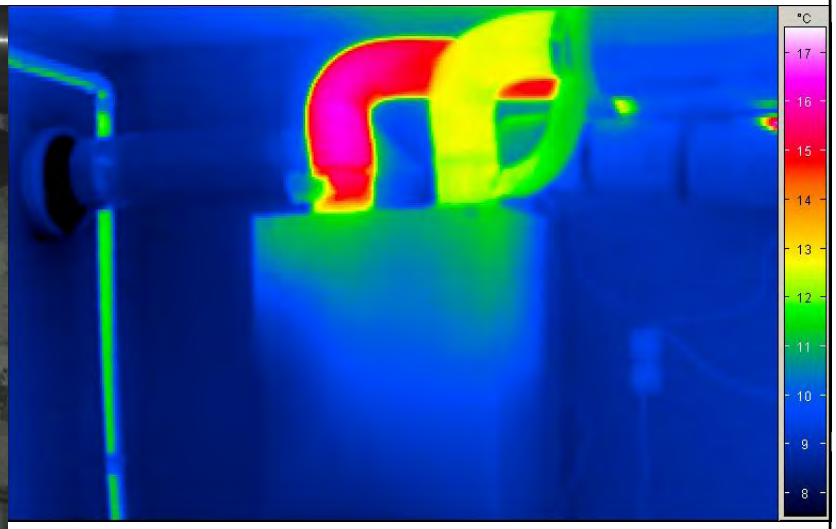
Components of ventilation systems

Inlet box with pre-heating register (brine)

Source: E. Heiduk

Components of ventilation systems

Inlet box with pre-heating register (brine)



Source: http://www.demodomo.de/Lueftung.htm

Components of ventilation systems

Source: E. Heiduk

Components of ventilation systems

Comfort ventilation units (plate heat exchanger)

Source: http://live.pege.org/2005-intersolar/comfort-air-exchange.htm

Components of ventilation systems

Comfort ventilation unit (rotation heat exchanger)

Exchange of heat and humidity (Hoval)

Source: Hoval

Components of ventilation systems

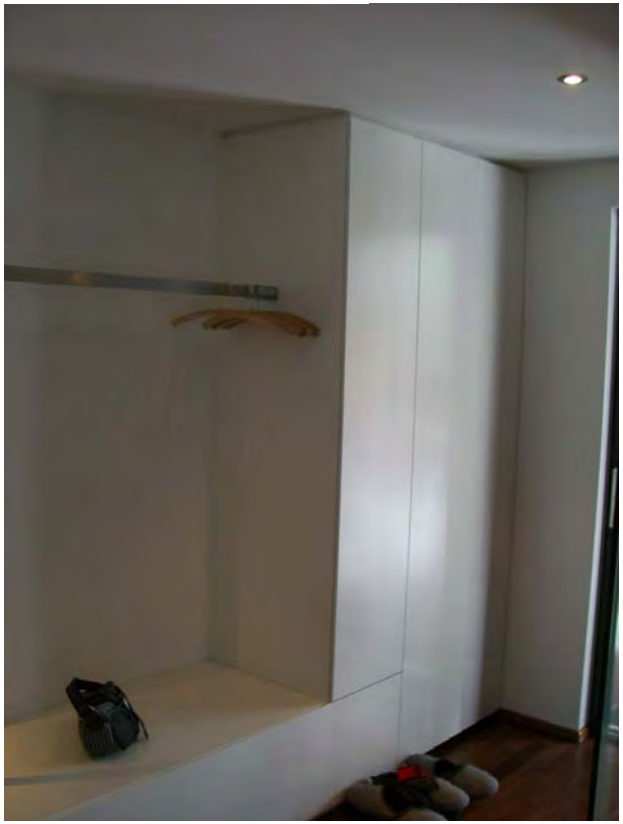
Comfort ventilation unit with warm water boiler

Compact unit (Drexel + Weiss)

Source: E. Heiduk

Components of ventilation systems

Compact unit in a storage room / in a wardrobe



Source: E. Heiduk

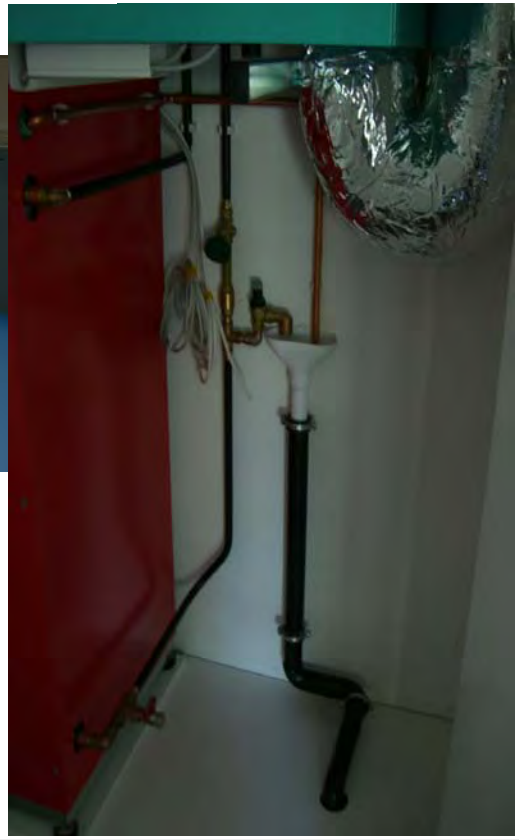
Components of ventilation systems

Compact unit in a wardrobe

Source: E. Heiduk

Components of ventilation systems

Condensation drain of the heat exchanger



Source: E. Heiduk

Components of ventilation systems

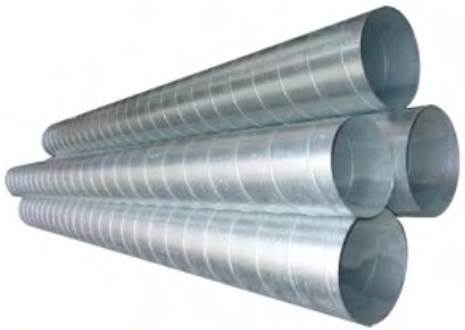
Pre-heating units

Source: E. Heiduk

Components of ventilation systems

Folded spiral-seam tube

DN 80 – 500mm



Source: http://www.klimawent.com.pl/niemiecka/zoom.php3?kat=zoom&file=spiro.jpg www.klimapartner-berlin.de/default.asp?file=303280.xml

Components of ventilation systems

Folded spiral-seam tube

Source: Petrit Ahmeti http://wellenreiter.blog.de/2006/10/ - Judith Rethfeld

Components of ventilation systems

Formed products for folded spiral-seam tubes

Source: www.klimapartner-berlin.de/images/fotoLeiste/abzweig45NEU1.jpg

Components of ventilation systems

Formed products for folded spiral-seam tube (safe-click)



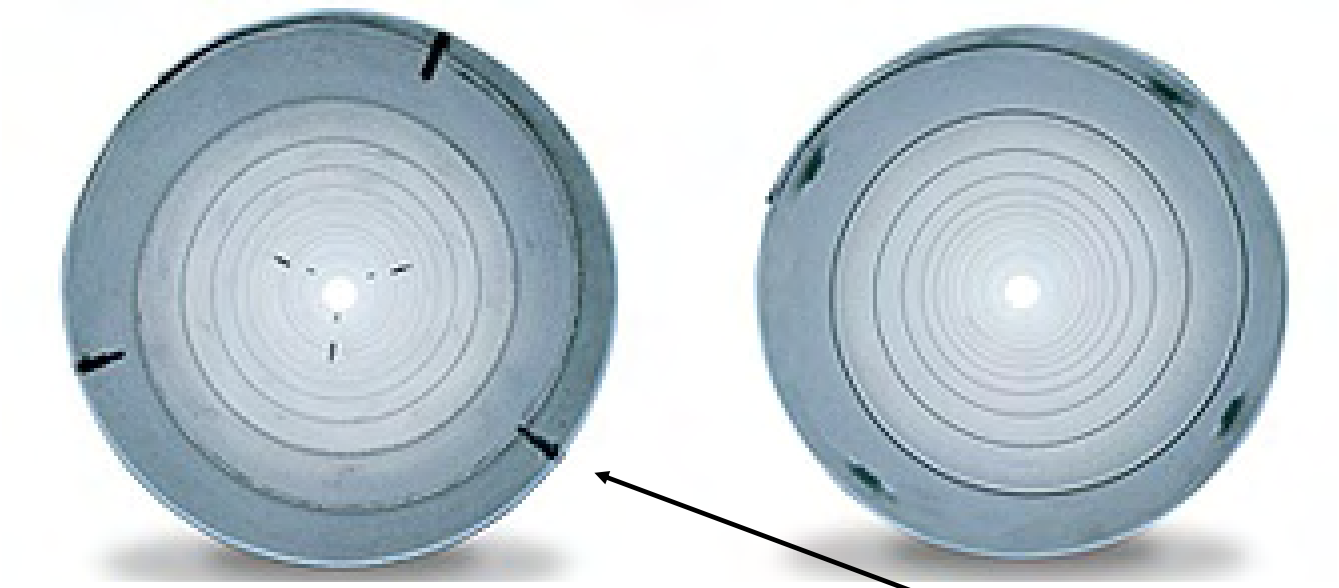





Source: www.klimapartner-berlin.de/images/fotoLeiste/click-steckverbinder1.jpg www9.yatego.com/images/411218b9db4e34.9/lindabreduzierung.jpg

Components of ventilation systems

Folded spiral-seam tube fixing ways



A bad way to fix the pipes are screws (with the spikes inside) as on the left – that makes it impossible to clean the pipes inside. Connections with a plane inside as on the right, are better.

Components of ventilation systems

Final cover

The most important element is :
The **final cover** – to close the pipes during the construction time (to protect the system from dust)

Source: www.klimapartner-berlin.de/images/fotoLeiste/click-enddeckel1.jpg

Components of ventilation systems

Formed products, folded spiral-seam tubes and final cover

Source: http://picasaweb.google.com/galaxyghia/UnserNeuesTraumHaus#5229430506367732626

Components of ventilation systems

Flexible ventilation pipes

Formed and clenched aluminium
(DIN 24164)

Aluminium foil on a steel wire spiral

Plastic foil on a steel wire spiral

Problems:
- **strength and resistance of materials**
- **not cleanable**

Source: www.klimapartner-berlin.de/images/fotoLeiste/alu-compact1.jpg www.elektrotresen.de/images/bilder/003/296/90895/90895.jpg

Components of ventilation systems

Flexible ventilation pipes (with heat insulation)

Source: http://picasaweb.google.com/galaxyghia/UnserNeuesTraumHaus#5229430469656778914 http://www.bensheim-aktiv.de/pdf/2007/Bensheim_Sanieren.pdf

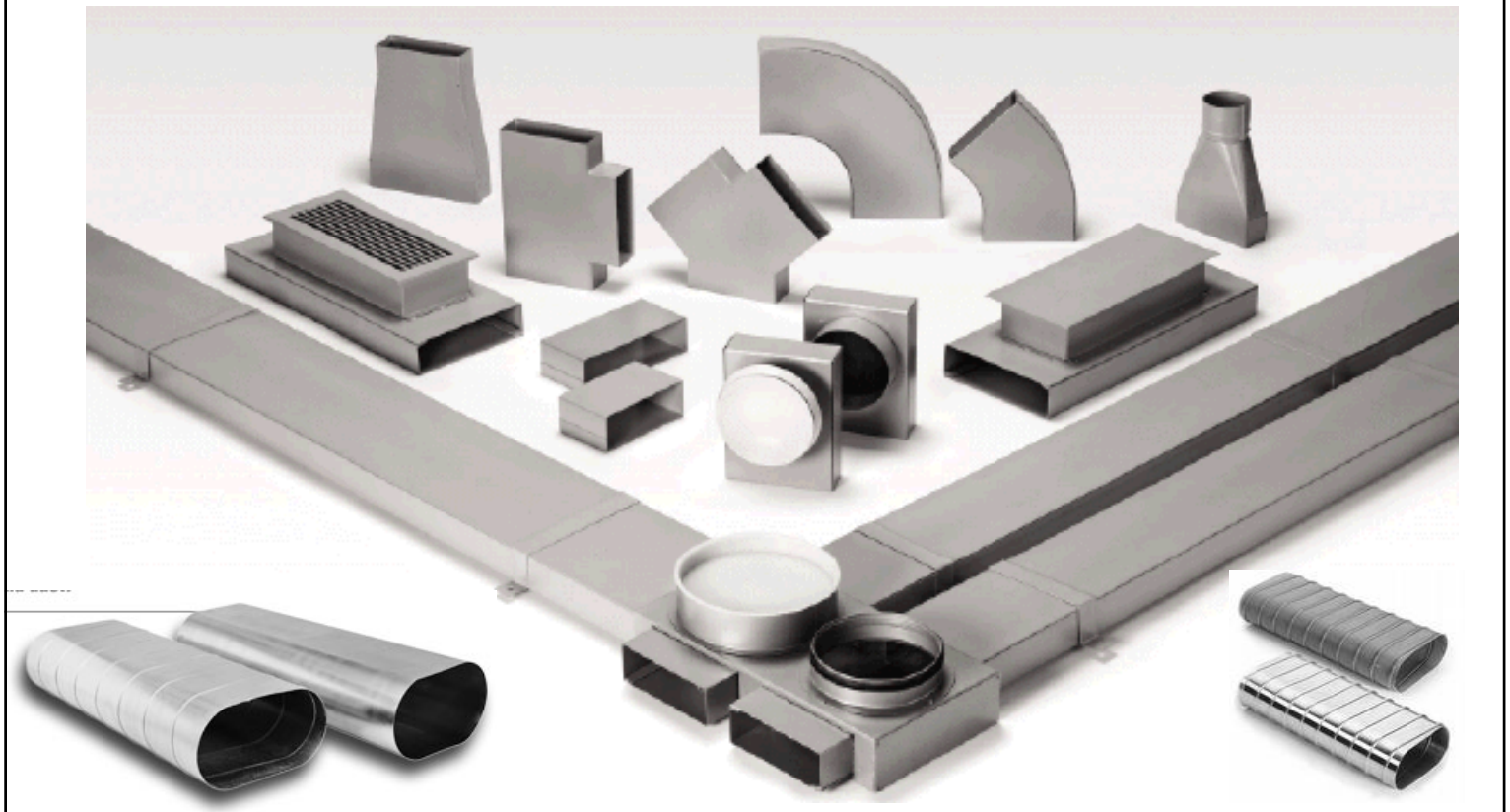
Components of ventilation systems

Flat ducts

Source: www.klimapartner-berlin.de/images/fotoLeiste/kanal.jpg

Components of ventilation systems

Elements for flat ducts (metal)



Source: www.enev-air.de/images/efkvgruppergb_595.gif

Components of ventilation systems

Flat ducts in a wall construction

Source: http://www.wunschhaus.de/index.php?puid=57&imgf=1&pageid=2141&bildID=4063

Components of ventilation systems

Elements for flat ducts (plastic)

Source: xxx

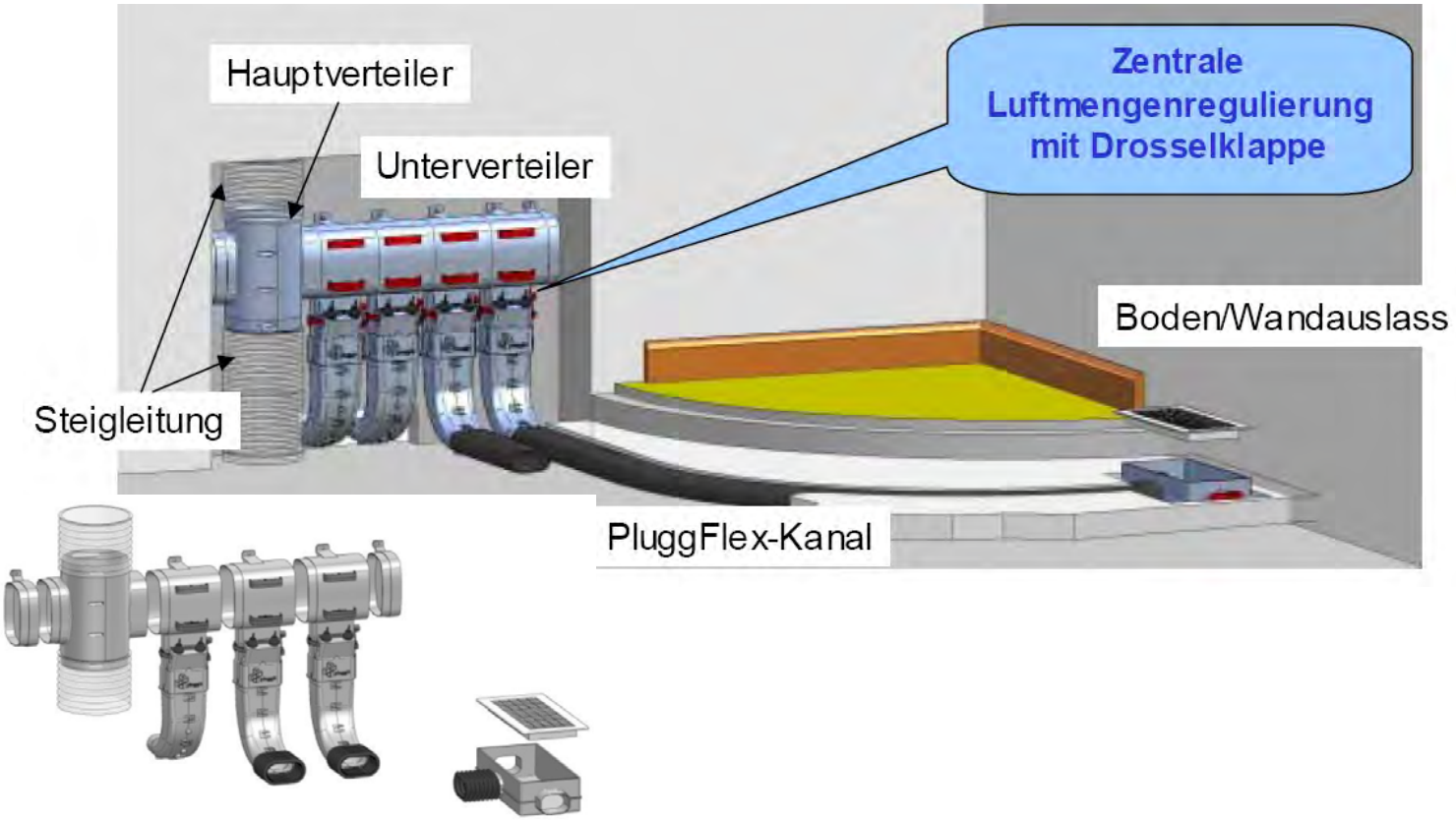
Components of ventilation systems

Flexible flat ducts and distribution unit

Source: www.architec24.de/viessmann/live/glossar/pspic/bild/9/0_kein422735a5801ae.jpg

Components of ventilation systems

Flexible flat ducts and distribution unit



Source: P.Kroeblin/ Fa.Pluggit http://www.pluggit.de/

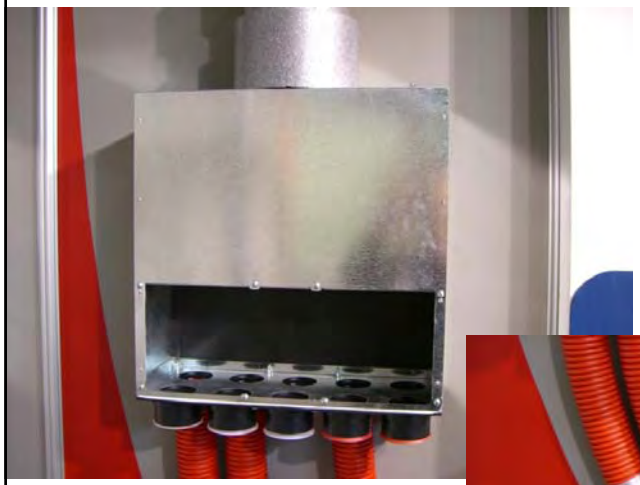
Components of ventilation systems

Flexible flat ducts and distribution unit

Source: P.Kroeblin/ Fa.Pluggit

Components of ventilation systems

Flexible round ducts and distribution unit



Source: E. Heiduk

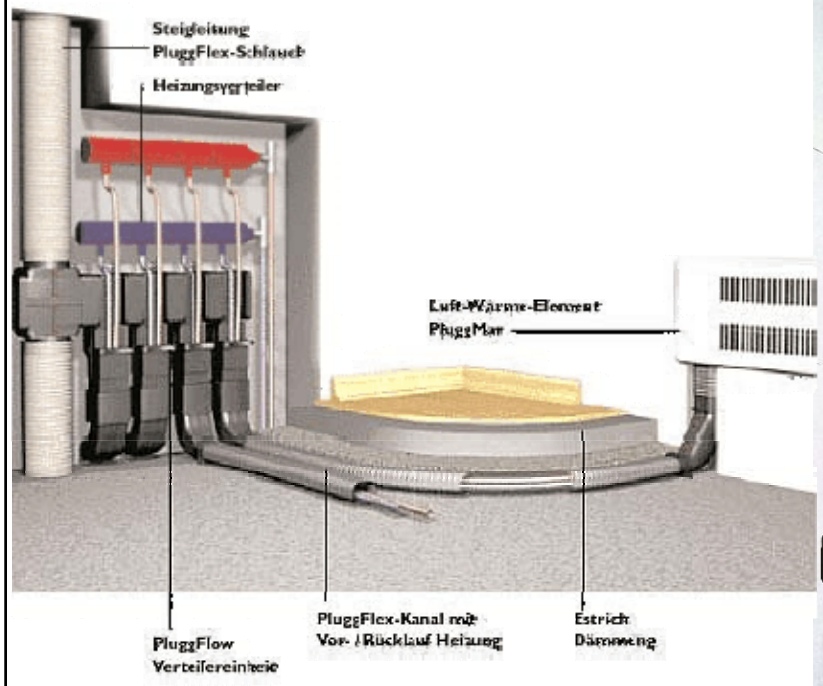
Components of ventilation systems

Examples for flexible flat pipes in the floor

Source: P.Kroeblin/ Fa.Pluggit

Components of ventilation systems

Distribution unit for flat pipes and heating unit



Source: www.passivhausgruppe24.de/passivhaus_lueftung.html

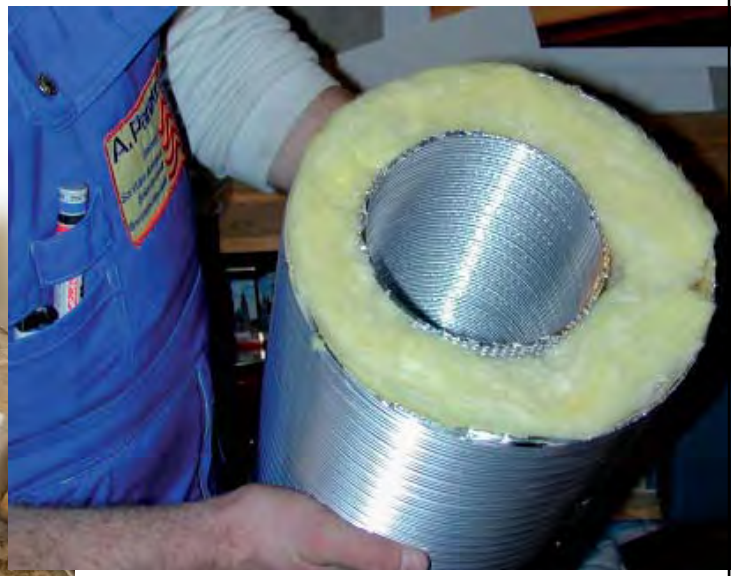
Components of ventilation systems

Duct sound absorber / silencer

Source: E. Heiduk

Components of ventilation systems

Duct sound absorber / silencer



Source: Left - E.Heiduk

www.iwu.de/fileadmin/user_upload/dateien/energie/espi/espi9.pdf

Components of ventilation systems

Duct sound absorber / silencer

Source: www.demodomo.de/images/Lueftung%20Schalldaempfer.JPG E. Heiduk

Components of ventilation systems

Duct sound absorber / silencer

Integrated in the concrete ceiling

In the technical room

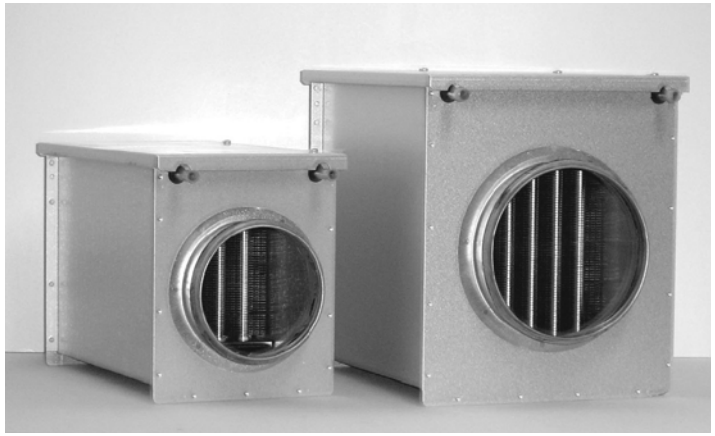
www.ggh-heidelberg.de/content/e7/e2840/e2845/BroschreBlaueHeimat.pdf

Source: www.empa-ren.ch/Internet-Files/Programm/Aktuelles/aktualitaeten/Status-Seminar/pdf-files2004/Sigg%20Konstanz.pdf

Components of ventilation systems

Air radiators **Electric heaters**
Water-to-air heat exchangers

High power air radiators for passive houses giving air temperature up to +52°C (126°F)

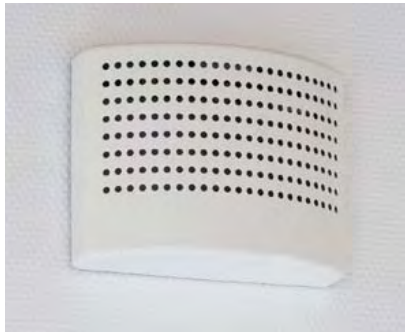


Simple air radiators for lower temperatures

Source: www.sole-ewt.de/index-e.html#lhr (2008-03-13, 17:15)

Components of ventilation systems

Outflow



Source: B. Schulze-Darup, D. Wilhelmy, E. Heiduk

Components of ventilation systems

Outflow

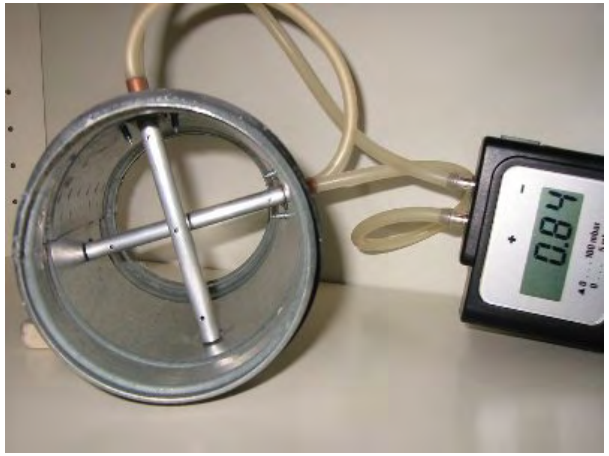
The Coandă effect is the tendency of a fluid jet to stay attached to an adjacent curved surface that is very well shaped. If the outlet is near the ceiling the fresh air lingers up there and streams deep into the room.

Henri Marie Coandă (1886 -1972), Romanian inventor, aerodynamics pioneer

Source:

Components of ventilation systems

Measuring device for the air stream volume of ventilation systems



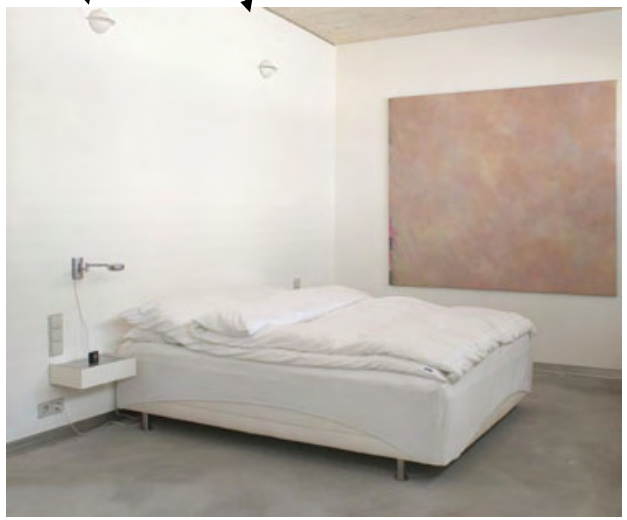
Stau cross

Flow-Finder

Source: www.passivhaustagung.de/siebte/Passivhaus_AGXIV_Qualitaet.html Passivhaus Institut, Darmstadt

Components of ventilation systems

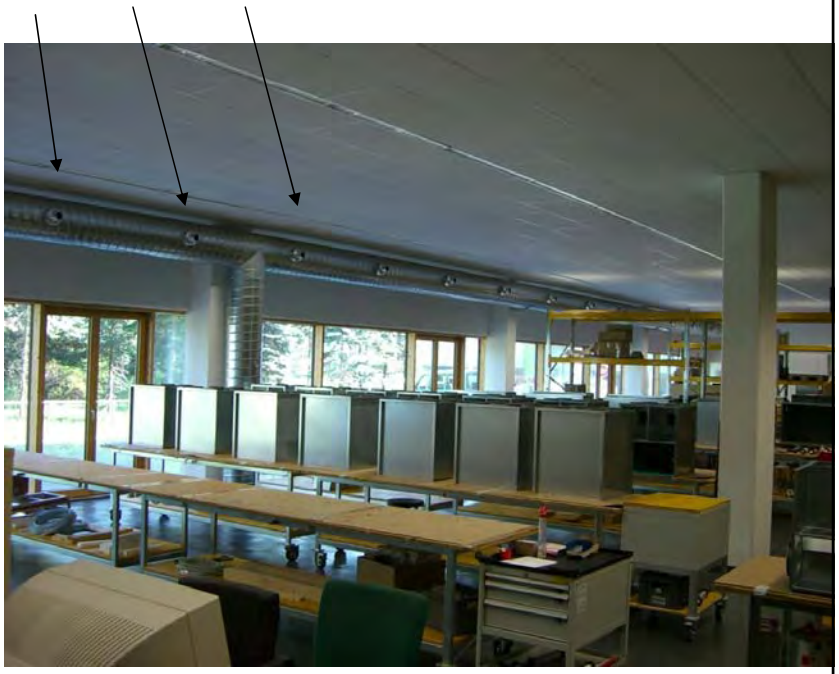
Outflow



Source: Picture: left Ernst Heiduk, right Dirk Übele - http://www.architec24.de/viessmann/live/fotogalerie/show.php3

Components of ventilation systems

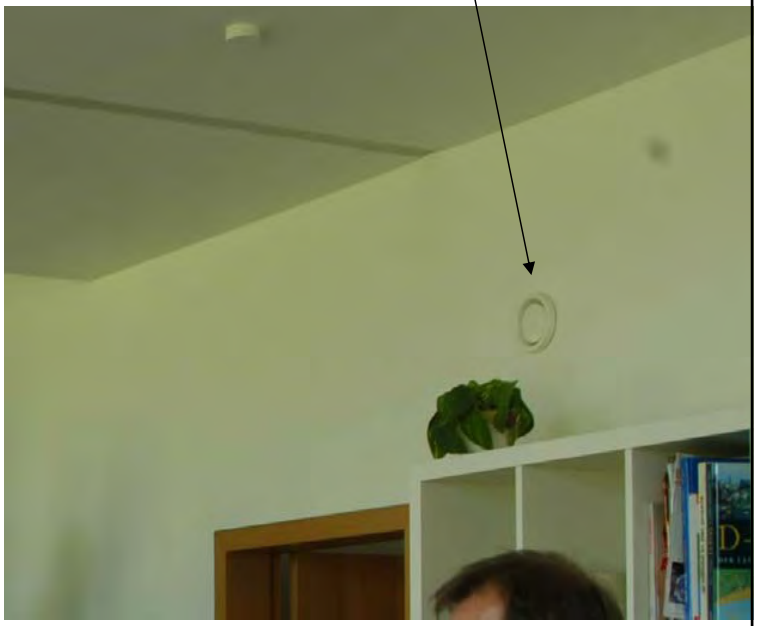
Outflow



Source: E. Heiduk

Components of ventilation systems

Outflow

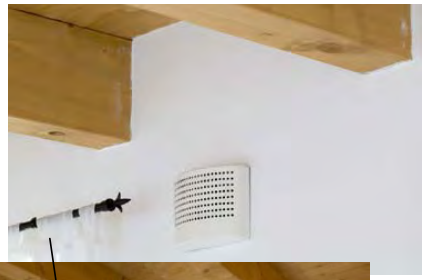


Source: E. Heiduk

Components of ventilation systems

Outflow

House K. Neu-Isenburg
Architektengemeinschaft grabowski.spork

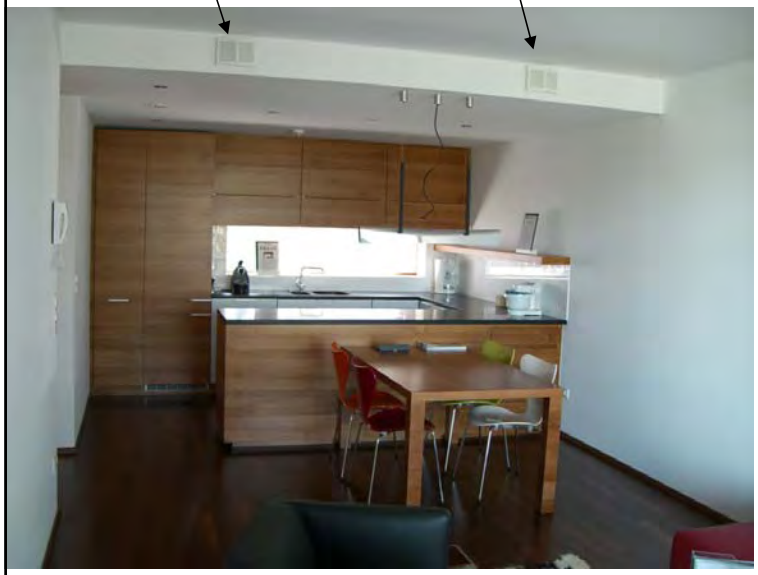


PH Kaltenkirchen
Architekt: passivbau°, Kaltenkirchen

Source: Picture: left D. Übele, right Dirk Wilhelmy - http://www.architec24.de/viessmann/live/fotogalerie/show.php3

Components of ventilation systems

Outflow



Source: E. Heiduk

Components of ventilation systems

Outflow

Source: E. Heiduk

Components of ventilation systems

Outflow

Source: E. Heiduk

Components of ventilation systems

Outflow

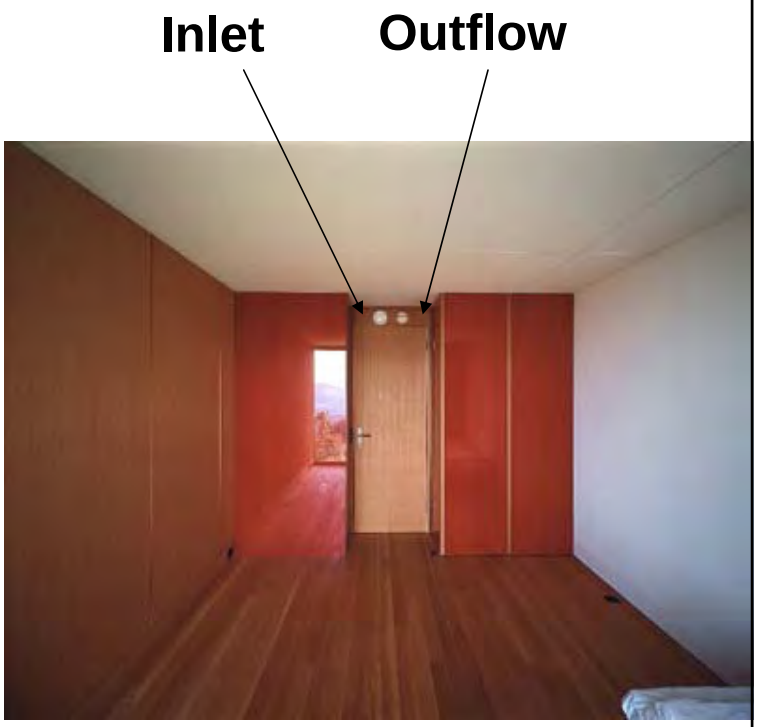
Source: E. Heiduk

Components of ventilation systems

Outflow / Inlet

Source: E. Heiduk

Components of ventilation systems

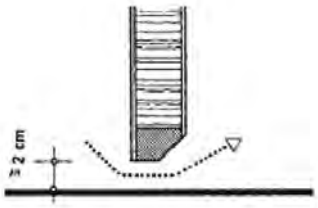


Source: Architect Walter Unterrainer

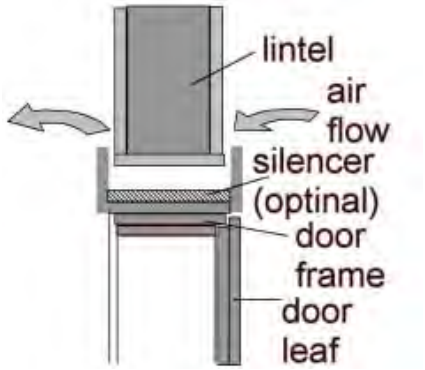
Components of ventilation systems

Overflow (inside doors)

Overflow opening in the door



Overflow opening under the door

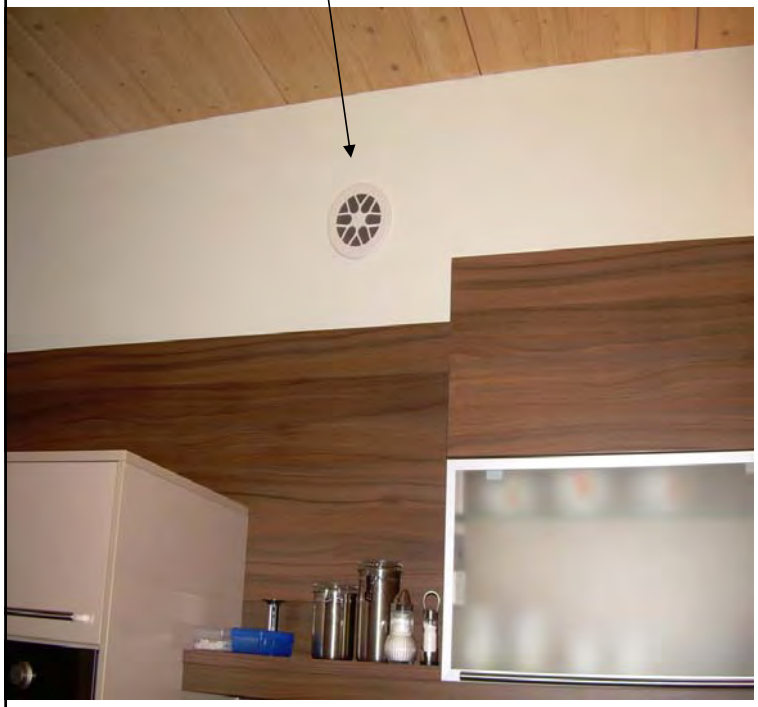


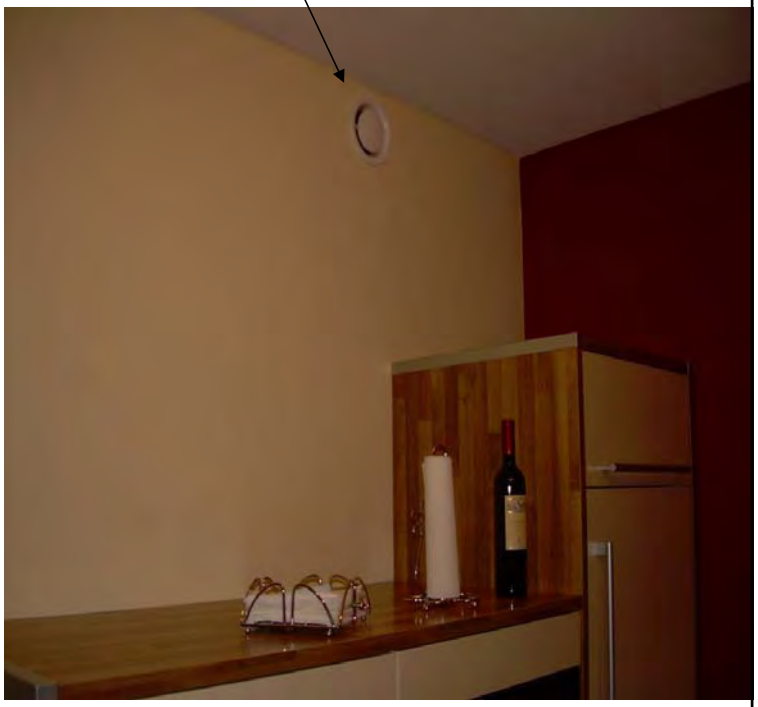
Overflow openings between the lintel and the door frame
(source ebök)

Source: www.bauweise.net/grundlagen/technik/lueftung/uberstroem/tuerspalt.jpg www.passivhaustagung.de/zehnte/englisch/texte/PEP-Info1_Passive_Houses_Kronsberg.pdf

Components of ventilation systems

Inlet





Source: E. Heiduk

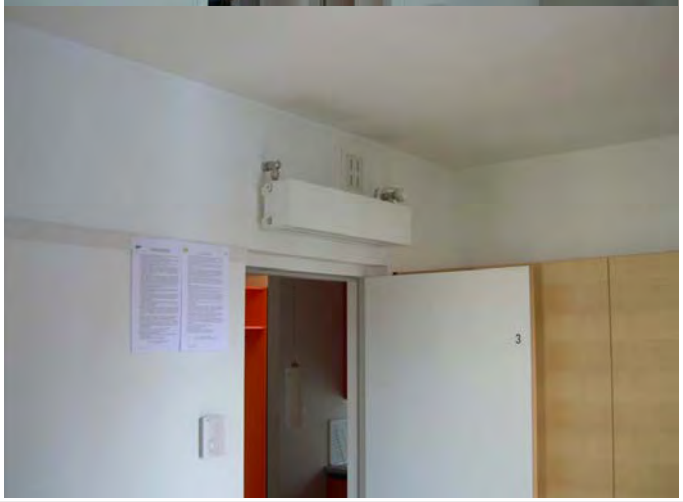
Components of ventilation systems

Inlet and pre-heating unit

Source: E. Heiduk

Components of ventilation systems

Inlet and heater unit



Source: E. Heiduk