



## Neue Gerätekonzepte für fassadenintegrierte Lüftung **Innovative Concepts for Facade Integrated HRV/ERV**

Manufacturer-Workshop 16.11.23

Rainer Pfluger, Universität Innsbruck

### **HRV/ERV Integration in Retrofit?**

- » Surface-mounted, flush-mounted or completely integrated into the wall?
- » In the existing window opening or a separate wall opening?
- » How much effort does the breakthrough and additional structural work require?
- » Are there static problems or space problems?
- » Can the opening be made at the desired place?  
Routing for supply/exhaust air ducts inside or outside of the existing wall?

## High percentage of regenerative push-pull HRV especially in refurbishing due to easy installation



Source:  
FGK, BDH

## Push-Pull regenerative decentral heat recovery units



Vallox: B44 160

Zewotherm: Zewo-Smart-Fan



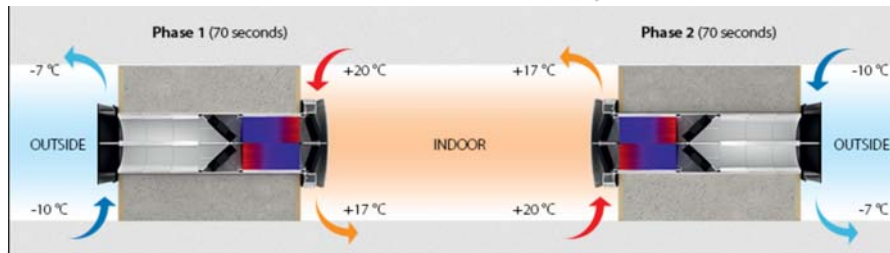
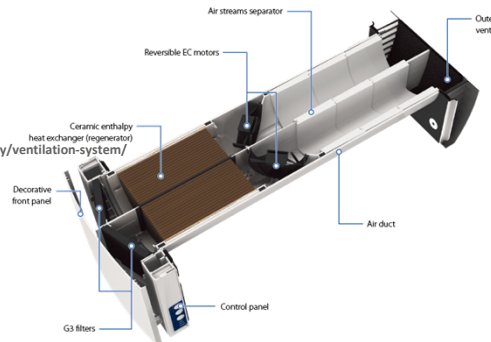
© Zewotherm

Source: Vallox, Zewotherm

## Pendellüfter mit Zu-/Abluft in einem Gerät

### Push/Pull bidirectional unit

EXPERT A30 DUO DECENTRALISED HEAT RECOVERY VENTILATION  
<https://renergise.ie/shop/heat-recovery-ventilation/single-room-heat-recovery/ventilation-system/>



## Reasons for the high popularity of push-pull-fans

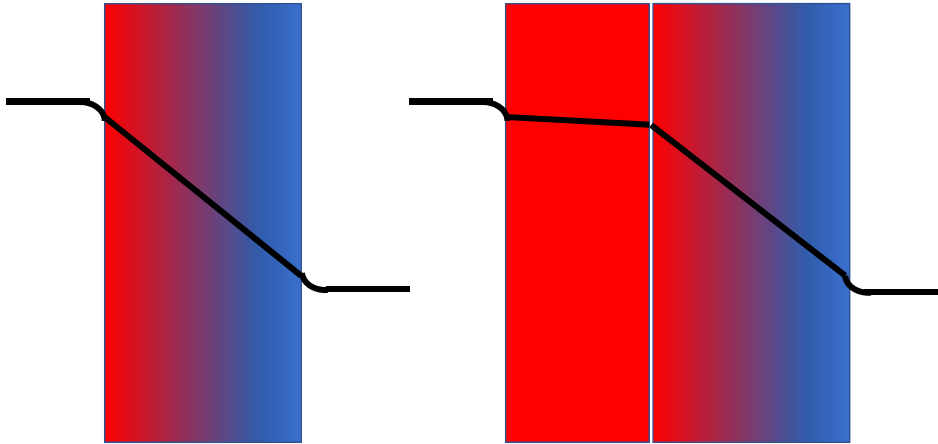
- » Easy to install in core hole drilling
- » No additional installation space
- » No effort for ducts

### Disadvantages:

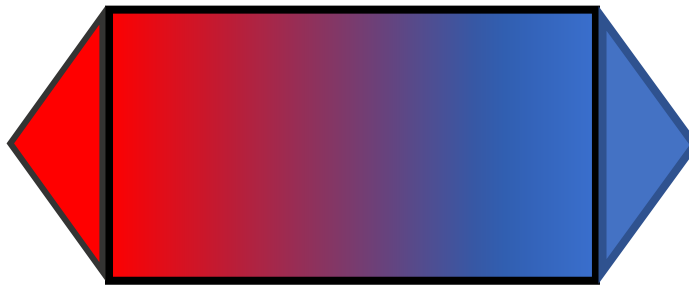
- » Susceptibility to wind pressure
- » Ambient noise problem
- » Varying sound emission due to reversal of flow direction



**Wall integration = best place for counter flow HRV**  
**Temperature gradient in wall and insulation cross section**




**Wall integration = best place for counter flow HRV**  
**Temperature gradient in Counter Flow Heat Exchanger**



Cylindrical installation but heat exchanger transverse to the temperature gradient

## Zehnder Comfo Spot 50



Cylindrical installation but heat exchanger transverse to the temperature gradient

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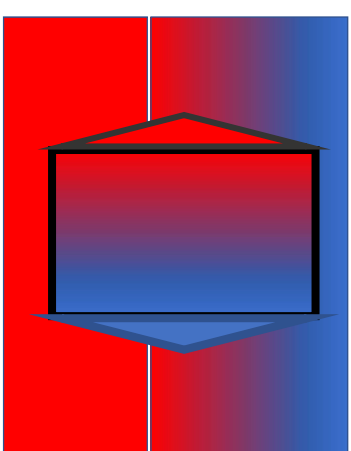
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## Wall integration = best place for counter flow HRV

### Temperature gradient in Counter Flow Heat Exchanger



Heat losses due to temperature gradient

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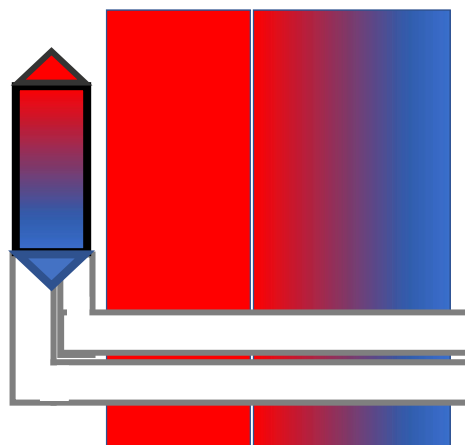
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## Zehnder ComfoAir 70 – Wärmeübertrager raumseitig, Wanddurchführung DN 270



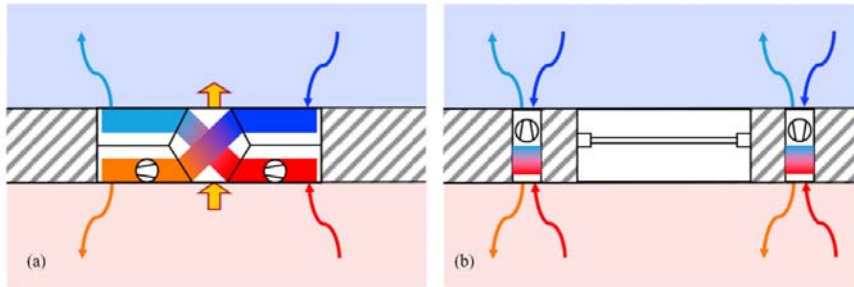
Heat exchanger on the room side, wall duct DN 270

## Wall integration = best place for counter flow HRV Temperature gradient in Counter Flow Heat Exchanger



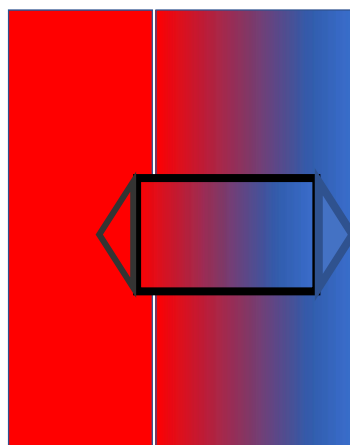
Heat losses  
due to  
temperature  
gradient

### Units installed in temperature gradient direction



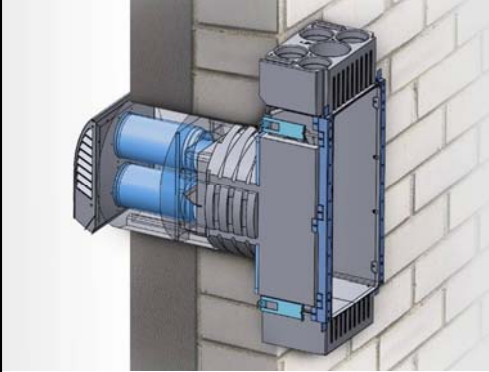
Facade system with (a) counter flow heat recovery and (b) regenerative heat recovery

### Wall integration = best place for counter flow HRV Temperature gradient in Counter Flow Heat Exchanger

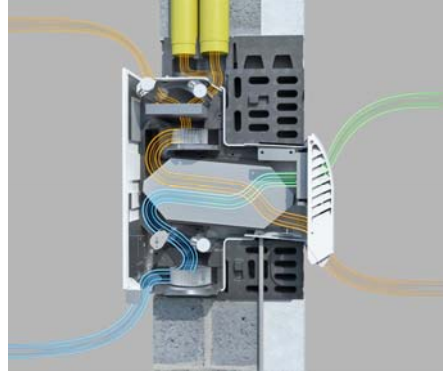


Adiabatic  
boundary  
condition =  
minimum heat  
losses, less  
insulation

## Wandintegration Aufputz bzw. Unterputz Wall integration surface-mounted or flush-mounted



Cylindric wall opening



Rectangular wall opening

Quelle: BluMartin freeAir 100



## Zehnder Comfoair Fit 100 Facade and ceiling mounting for larger units

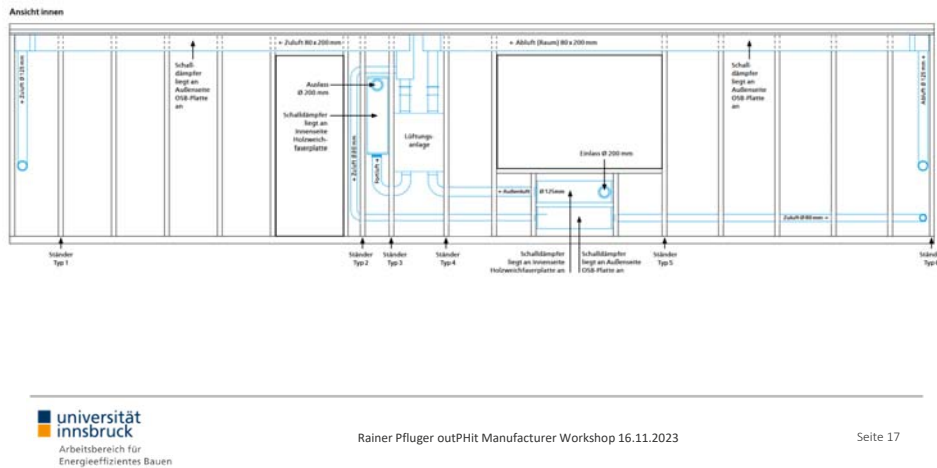




## Haustechnikintegration in der vorgefertigten Sanierung **HVAC Integration in Serial Renovation**

» Quelle: Informationsdienst Holz, Spezial September 2023

[https://informationsdienst-holz.de/fileadmin/Publikationen/3\\_Spezial/IDH-Serielles-Sanieren-2023-06\\_print150dpi\\_230912.pdf](https://informationsdienst-holz.de/fileadmin/Publikationen/3_Spezial/IDH-Serielles-Sanieren-2023-06_print150dpi_230912.pdf)



## Lüftungsgerät in der Laibung

Quelle: Informationsdienst Holz, Spezial September 2023

[https://informationsdienst-holz.de/fileadmin/Publikationen/3\\_Spezial/IDH-Serielles-Sanieren-2023-06\\_print150dpi\\_230912.pdf](https://informationsdienst-holz.de/fileadmin/Publikationen/3_Spezial/IDH-Serielles-Sanieren-2023-06_print150dpi_230912.pdf)



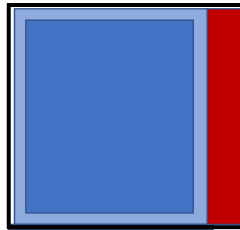
Ventilation  
device in the  
window reveal

Abb. 58:  
Außenansicht des  
Lüftungsgeräts in der Laibung

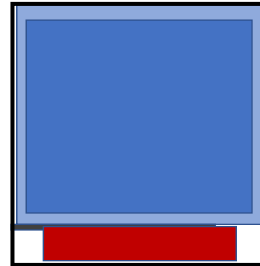
Abb. 59:  
Lüftungsgerät und  
Leitungsführung im Element

## Varianten zum Geräteeinbau am Fenster

### Variants for window integrated Units – See AK 61



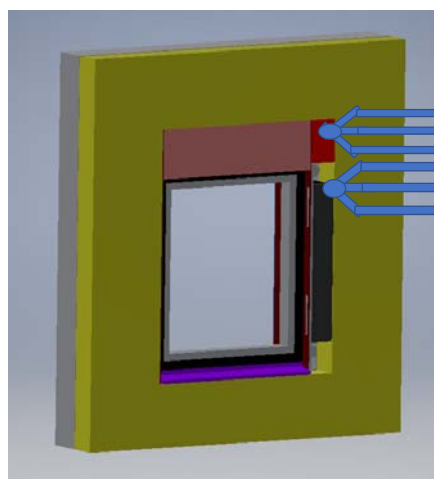
Fenster seitlich in der Rohbauöffnung  
Fensterfläche reduziert  
Window on the side of the shell  
opening, Window aperture reduced



Gerät in der Fensterbrüstung  
Fensterfläche bleibt gleich, aber Stemmarbeiten  
Device in the window sill Window area remains  
the same, but chiseling work

## Zu- Abluftverteiler über Sternverteiler

### Supply/Extract Ducts at the outside (covered by external Insulation) See AK 61



DN75

Supply Air

Extract Air

DN75



DN75

Eingang DN 125

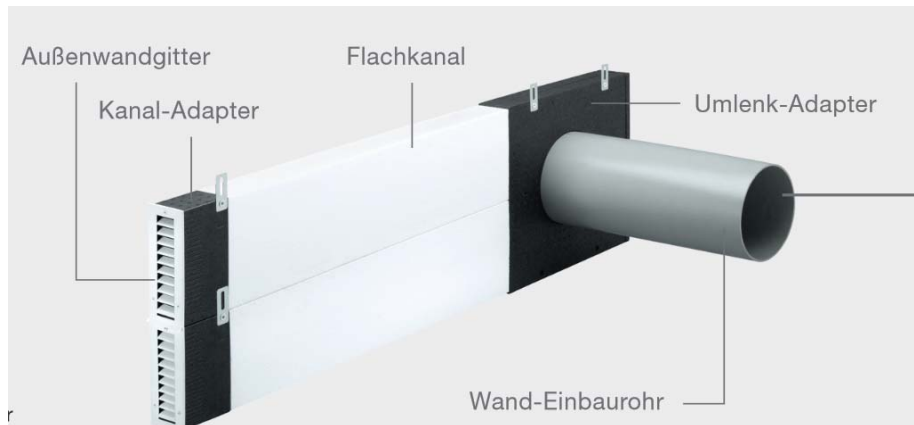
## Development needs for cylindric wall integrated units for refurbishing purposes

- » Core hole drilling max. 300 ... 400 mm
- » Maximum efficiency
- » Minimum pressure loss
- » ERV preferably (frost protection, condensate etc.)
- » Surface-mounted part reduced to a minimum

## Core hole drilling (wall breakthrough) – also possible with 45° inclination



## Zehnder Laibungsmodul (Optional) **Reveal-Module**



## **Development of a cylindrically shaped heat exchanger for application in renovation**

- » Alternative solution if there is no need to change the window or the window area cannot or should not be reduced.
- » Extremely limited space available when renovating small residential units
- » Limit structural interventions to just one core drilling

**Solution:** cylindrical heat exchanger that can be inserted into a core hole

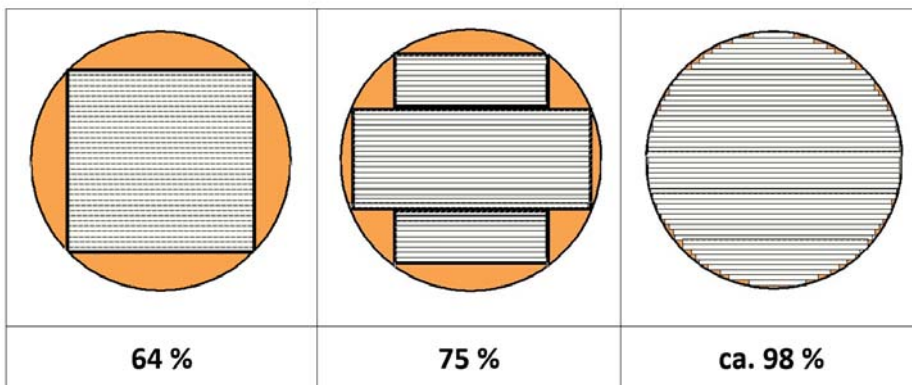
## Cylindric Counter flow Heat Exchanger

- » Already available as a push-pull fan, widely used due to low effort, but disadvantages in terms of efficiency, noise and comfort/air quality
- » Wall-integrated recuperative HRV is already available, but usually only as a single room ventilation device

Is developing of a innovative device with approx.  $85 \text{ m}^3/\text{h}$  helpful here?

## Flächennutzungsgrad bei rechteckigem Querschnitt

Degree of utilization of the cross-sectional area in case of rectangular shape



### Wärmerückgewinnungsgrade in Abhängigkeit der Geometrie und Plattenform

### Heat recovery rate depending on geometry and shape of plates

Patent: [AU4620297A](#);  
[DE19635552C1](#);  
[WO9810232A1](#)

Planparallele Platten	Schachbrettmuster	
Kreuzstrom	Gegenstrom	Gegenstrom
50 - 70 %	70 - 80 %	85 - 99 %

Fig. 2

Fig. 4

Fig. 5

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### Patent EP3921582 A1

Fig. 1

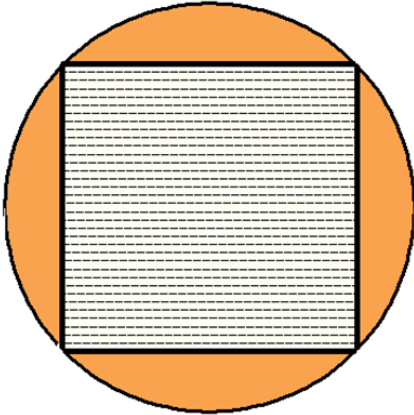
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## Quadratic shape




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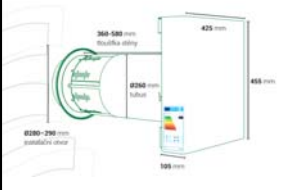
## Recuair DC 40 (15-40 m<sup>3</sup>/h) <https://www.recuair.com>


Rotating Counterflow Heat Exchanger (Frost protection, humidity recovery)

















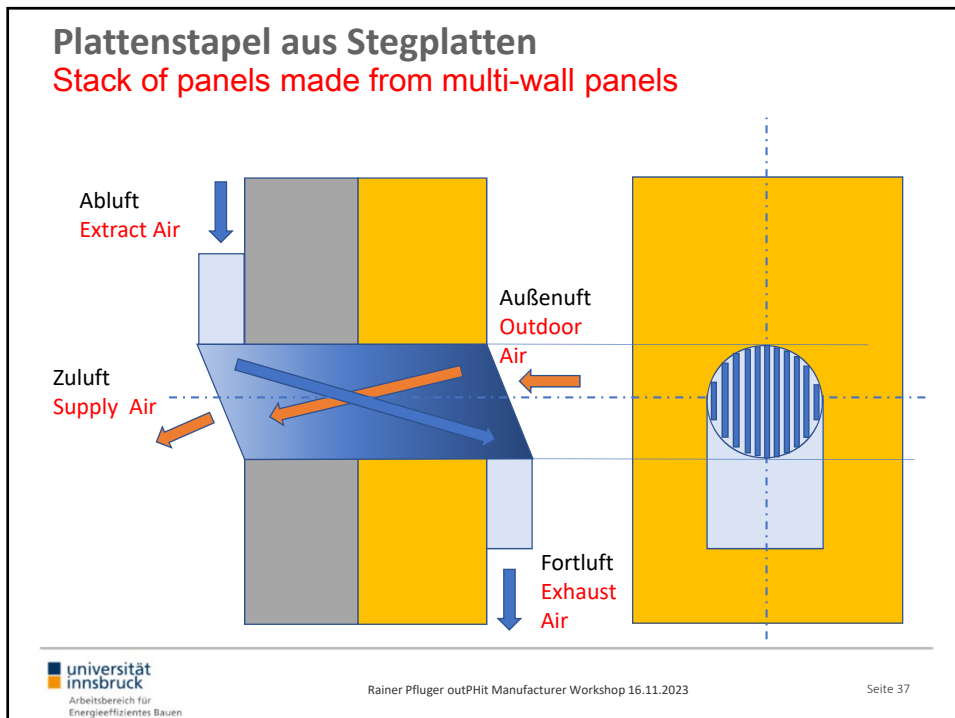
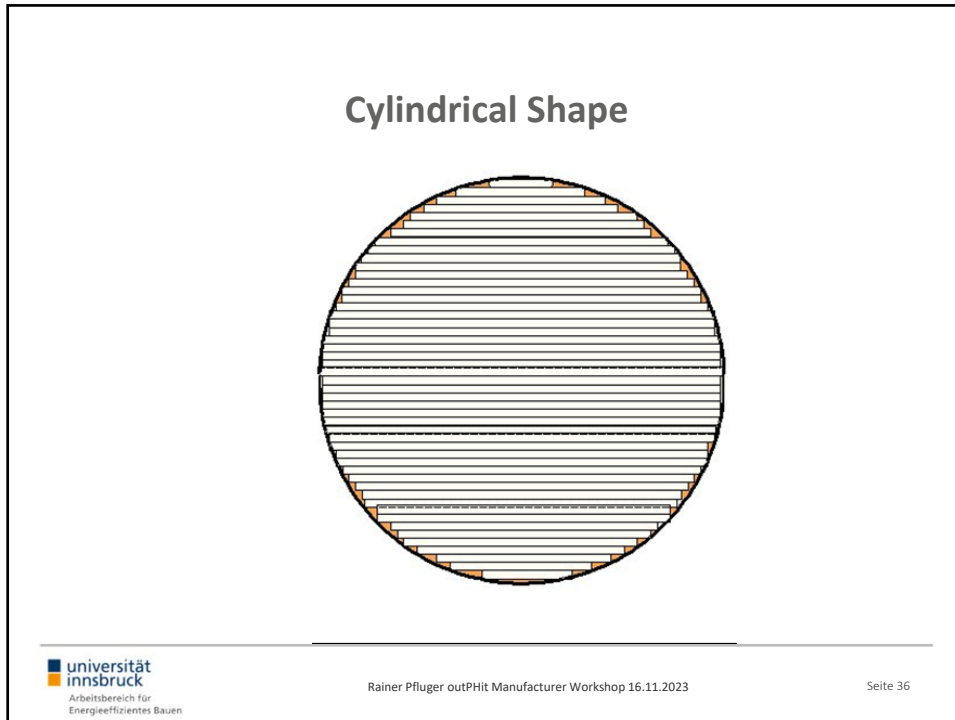
**Durchmesser 260 mm**  
**Core hole diameter 260 mm, 360- 580 mm length**

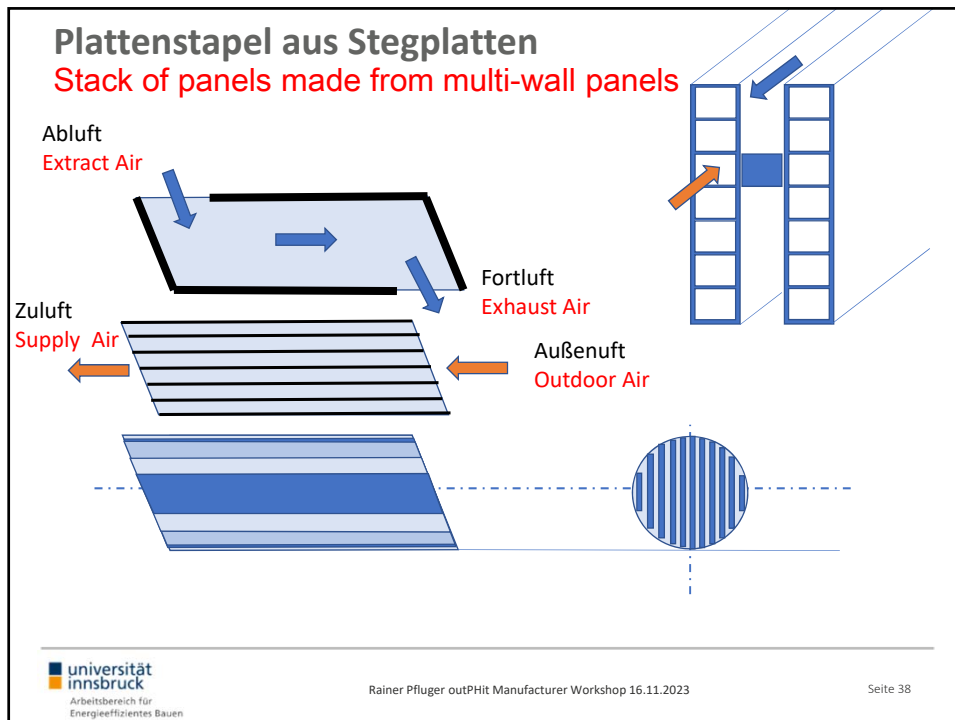
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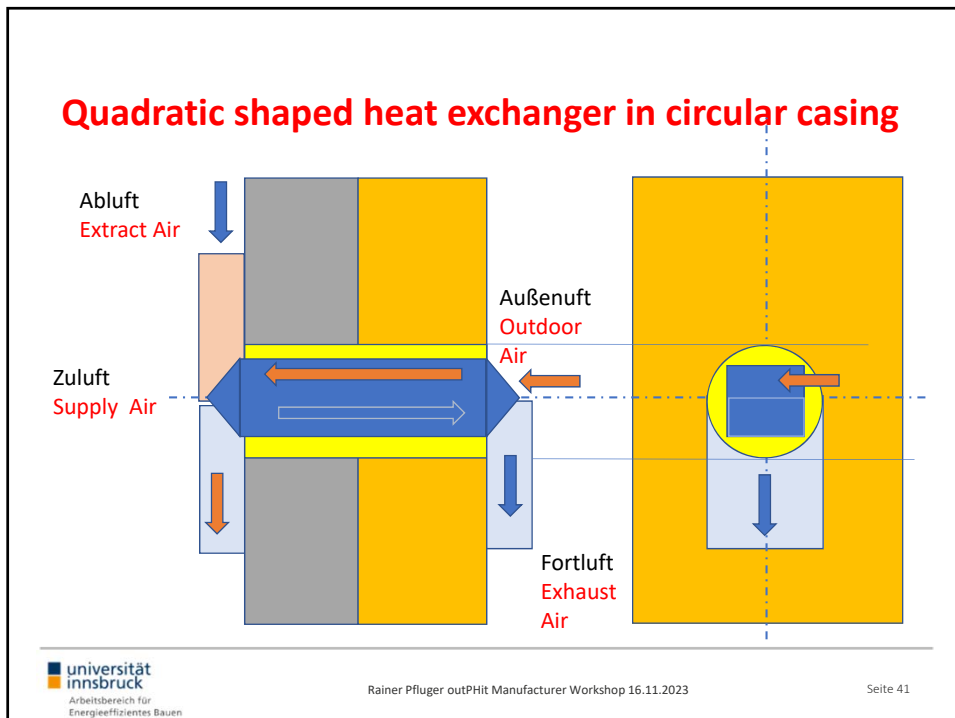
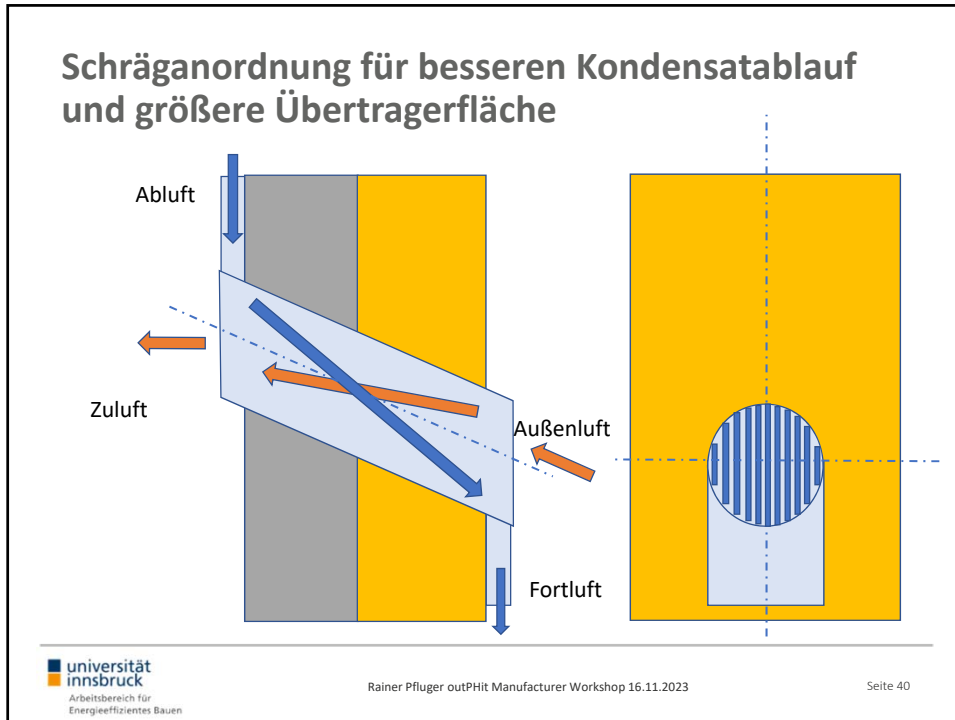


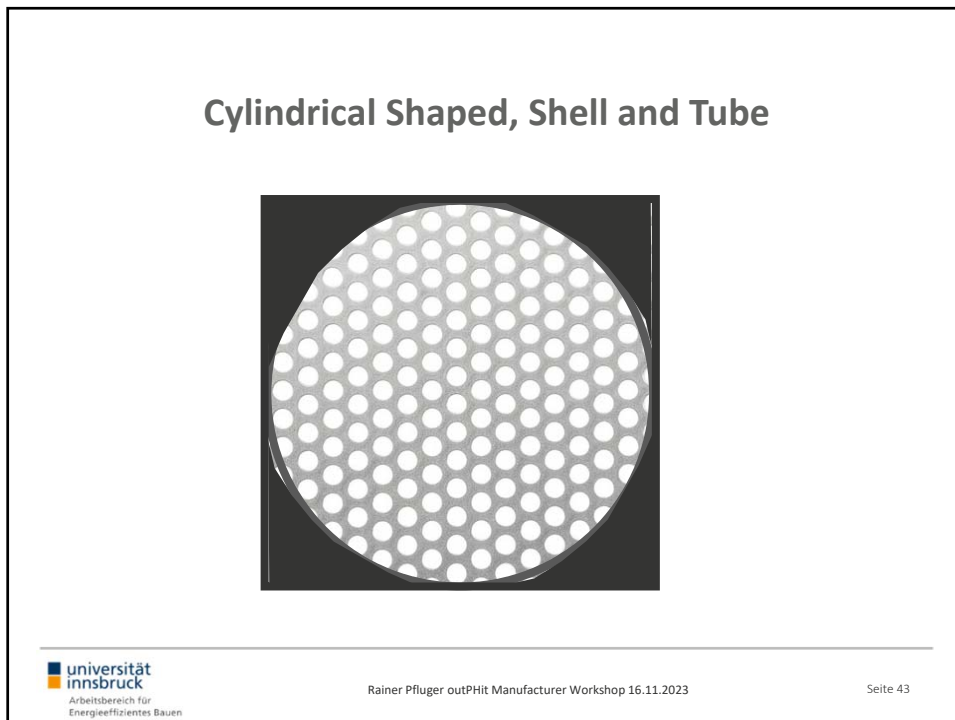
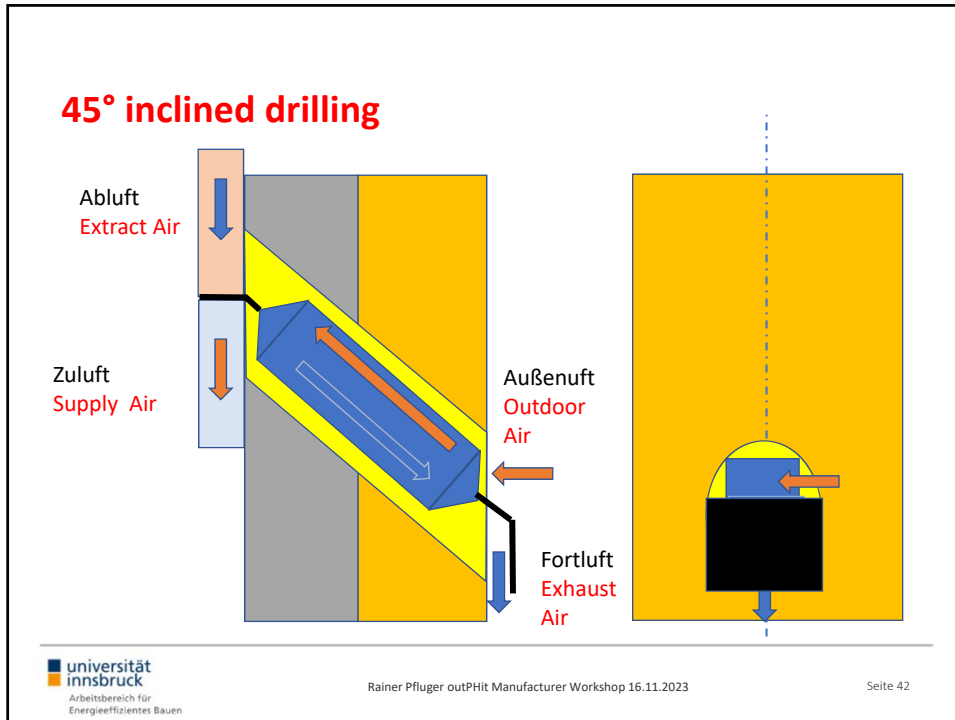


## Condensate Drainage

- » **Problem:** Capillary action holds drops in a horizontal design despite air flow in the chambers, resulting in an increase in pressure loss, imbalance, loss of efficiency
- » **Solution:** tilted drilling

**Advantages:** Condensate drain possible, longer heat exchanger and therefore higher efficiency





## Rohrbündel Wärmetauscher für Einzelräume

<https://www.brinkclimatesystems.de/PDF/Dezentrale%20L%C3%BCftungsg%C3%A4rte/Air70%20Flyer.pdf>

### Shell and Tube counter flow heat exchanger

Fa. Brink

Decentral Unit  
100% bypass



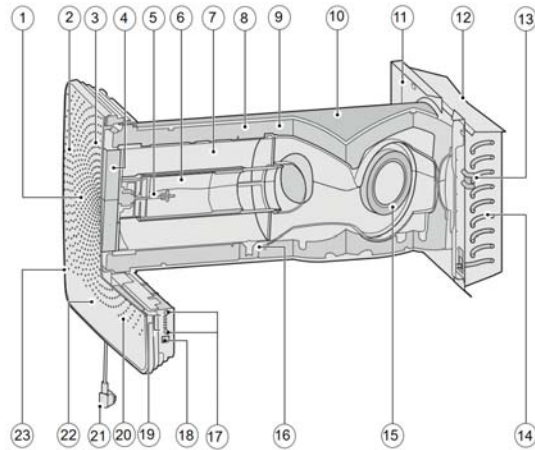
## Gegenstrom-Wärmeübertrager Bypass, Frostschutz Counter Flow Heat Exchanger, bypass, frost protection

Wolf: CWL-D-70



© Wolf

### Wolf: CWL-D-70 = BRINK AIR 70



### Zylindrischer Rohrbündel-Wärmetauscher aus Trinkhalmen und 3D-Druck-Endstücken (Quelle: dragonator NL) <http://ytec3d.com/3dp-heat-exchanger/>



### Spiralwärmeübertrager Spiral type heat exchanger

**Probleme:**

- Konstante Temperatur über die Länge
- Querschnitte der Verteiler/Sammler müssen relativ groß ausfallen damit gleichmäßige Durchströmung über die gesamte Fläche.

Evtl. geeignet um in ehemalige Rolladenkästen eingebaut zu werden

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### Koaxialzylinder-WT (längsdurchströmt) Coaxial cylindric eat exchanger (longitudinal flow)

» Vorteil: Temperaturänderung über die Länge linear

» Nachteil: Problematische Herstellung wegen unterschiedlichen Durchmessern und ungleichmäßige Durchströmung

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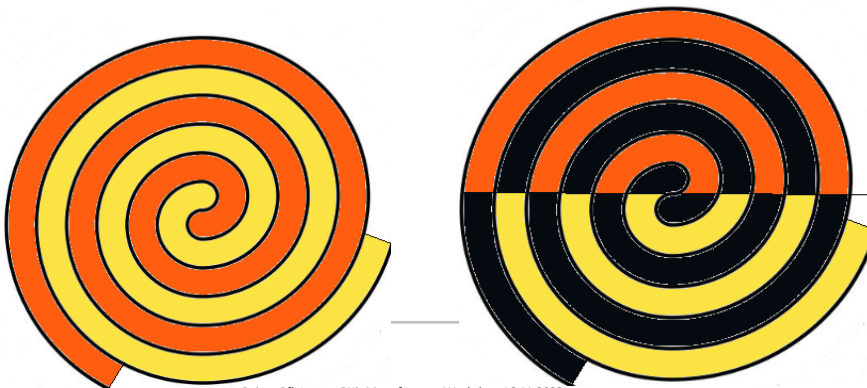
Ort | Name | Datum

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## Idee von Gabriel Rojas-Kopeinig Spiralzylinder-Wärmetauscher (längsdurchströmt) **Spiral type heat exchanger (longitudinal flow)**

**Vorteil:** Relativ einfache Fertigung aus einem Folienband (Abstandshaltegewebe erforderlich), gute „Entflechtung“ mit „selbstständiger“ Strömungsverteilung

**Nachteil:** Verschweißung/Verklebung muss im gerollten Zustand erfolgen

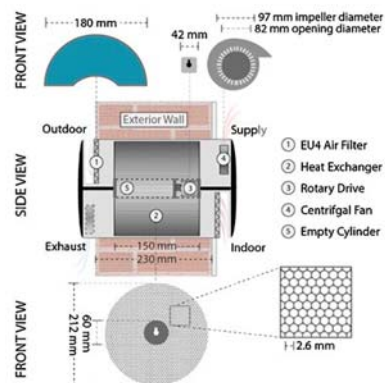


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## Wandintegrierter Rotationswärmeübertrager **Wall integrated rotary heat exchanger**




Rotierende Speichermasse  
Feststehende Luftführung



Wandintegrierter Rotor





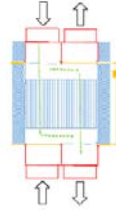
## EuroPHit-Guidelines

Idea: Wolfgang Hasper,  
PHI

Download:  
[https://europhit.eu/sites/europhit.eu/files/Design%20briefs/EuroPHit\\_D5.1.18\\_Regenerative\\_MVHR\\_alternating\\_PHI.pdf](https://europhit.eu/sites/europhit.eu/files/Design%20briefs/EuroPHit_D5.1.18_Regenerative_MVHR_alternating_PHI.pdf)


**D5.1.18\_Guidelines\_Regenerative\_MVHR\_alternating\_type**

V1.0




**INTELLIGENT ENERGY – EUROPE II**  
Energy efficiency and renewable energy in buildings  
IEE/12/070

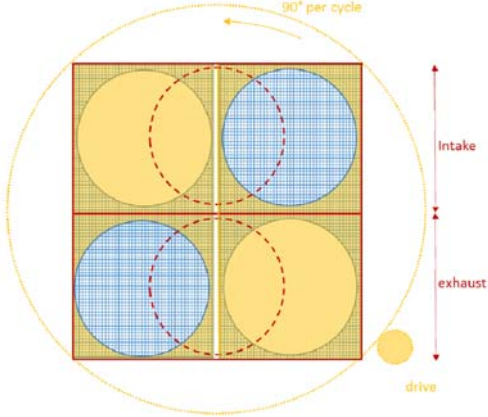
**EuroPHit**  
[Improving the energy performance of step-by-step refurbishment and integration of renewable energies]  
Contract N°: SI2.645928

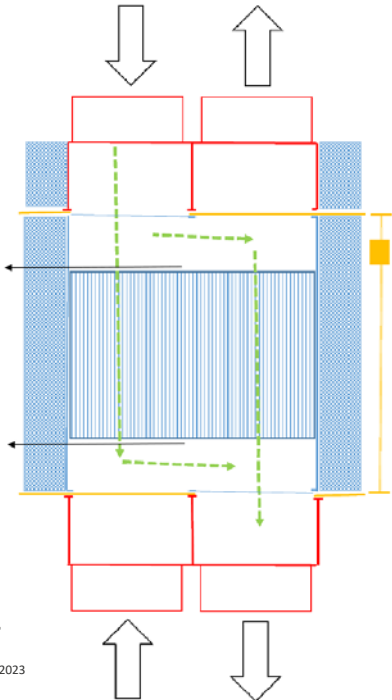



Co-funded by the Intelligent Energy Europe Programme of the European Union



## Rotary Slide Valves and Drive







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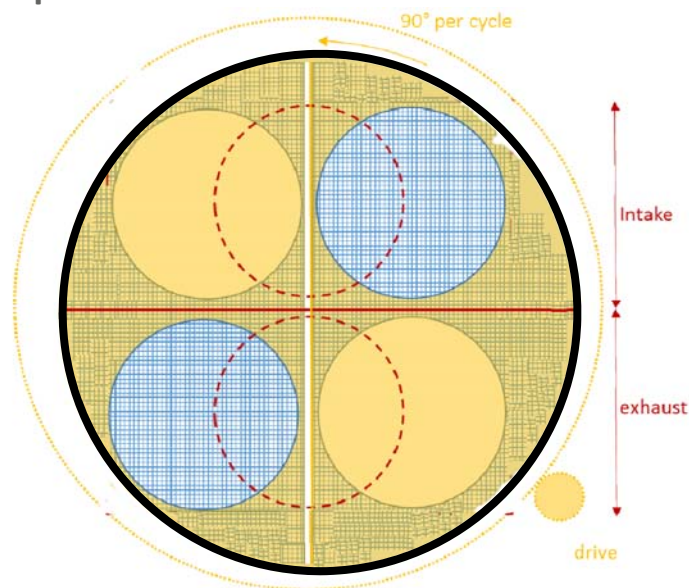
## Stack of Polypropylene (PP) Twin Wall Panels

- » Thickness: 2,5 mm
- » Low pressure drop due to small wall thickness (slight obstruction of air flow)
- » Easy to cut (laser-cutter)
- » Price < 2 €/m<sup>2</sup> inkl. VAT
- » PP density: 0,9 g/cm<sup>3</sup>, thermal capacity 1700 J/(kgK)



## Cylindrical Shape

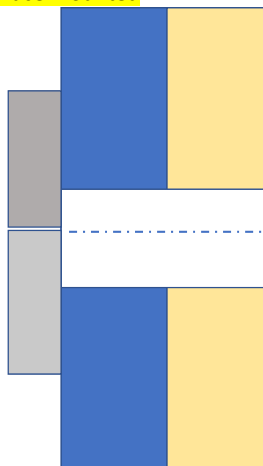
- » 120 m<sup>3</sup>/h
- » D=340 mm
- » D P= 28 Pa
- » Eta > 80 %
- » 5 m<sup>2</sup> = 10€
- » Time 90s



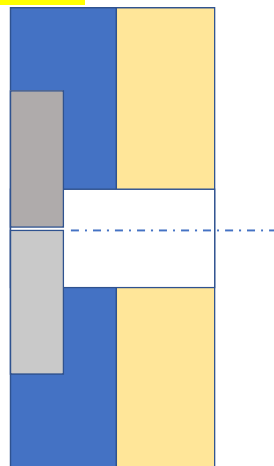
## Placement of Fan and Filters

## Fans and Duct installation

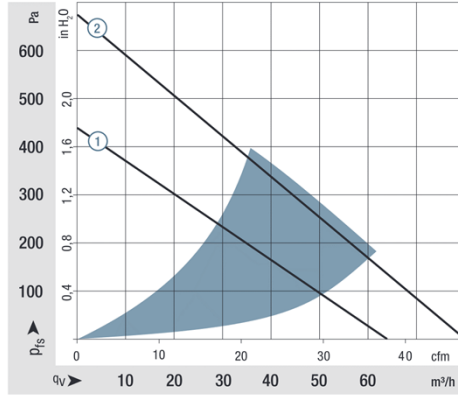
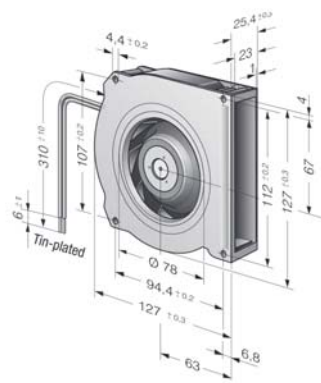
Surface mounted



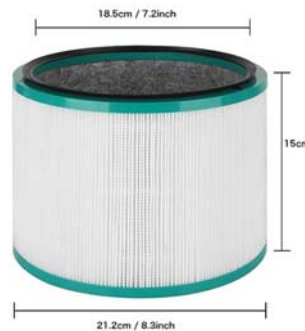
Flush-mounted



**Innenwandoberfläche mit Flachkanälen (Ab-/Fortl.)  
Flat radial fan for surface-mounting and flat channel**



**Filter (Platzsparende Z-Filter oder Zylinder-Filter)  
Flat Z-Filter or cylindric Filters (automotive or dyson)**



## Summary

- » Cylindric wall integrated heat exchanger advantageous
- » Inclined position enables greater installation length and condensate drainage
- » Checkerboard pattern for highest efficiency
- » Alternative to recuperator: cylindric regenerator

## Danksagung

Diese Entwicklung wurde mit Mitteln des EU Horizon 2020 –  
Programms im Projekt [outphit.eu](https://outphit.eu) gefördert

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