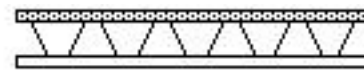


THE RESARO SYSTEM

RESARO AB

energy and construction system



THE RESARO ELEMENT

THE RESARO SYSTEM

gives solutions for some of today's most
common construction problems

This text contains following titles

WHY TO USE THE RESARO SYSTEM?

Complications at today's constructions

Computerised houses

Loss of energy and problems when using a slab cast on ground for under floor heating

Problems when using exhaust air ventilated crawl space foundations in conventional solutions

The risk for condensation in exhaust air ventilated warm crawl space foundations

Radon

Problems caused by moisture and mould.

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Complicated solutions for circulating hot air heating systems at 1 1/2-storied- and two-storied houses

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No profits from using an exhaust air heat pump

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WHY TO USE THE RESARO SYSTEM?

A short summary of serious problems frequently appearing at constructions today which avoids with the RESARO system.

Computerised houses

- The construction trend of today is towards more complicated and complex systems for heating and ventilation. It appears that certain rooms in houses sets aside for computerised supervision systems.

The solution with the RESARO system

- All computer technology is possible to replace with a uncomplicated system, that works in a simple and reliable way, with help from natural air flows.

As an example, in the RESARO system the energy supply controls by a simple temperature regulator placed centrally in the residence.

The Problem

Loss of energy at under floor heating

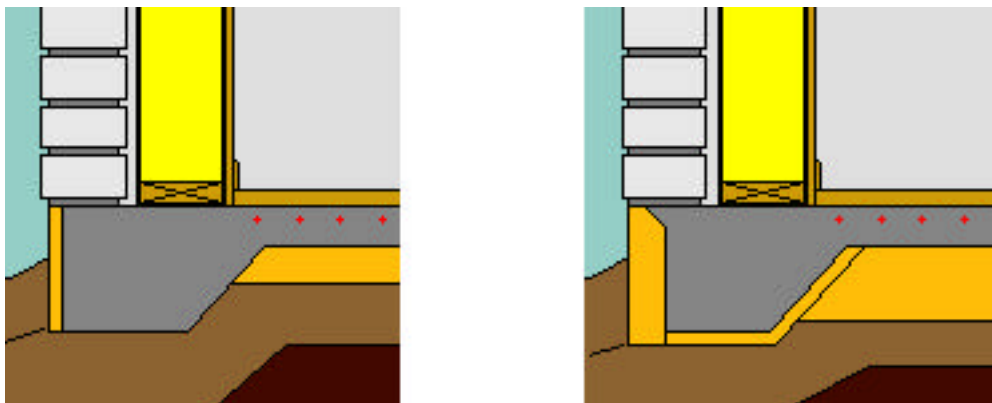
- Today's house buyers or "self-builders" wishes to have under floor heating. The systems available on the market are expensive, though. With reflector systems and tubes or hoses with circulating water.

Other casts in the slab which mostly is placed directly on the ground.

A warm concrete slab on ground causes serious energy losses downwards the ground and casted in installations are inaccessible and must be laid bare by motor hammer drilling at leakage.

In existing systems for under floor heating, the water temperature has not to be below +28 degrees Celsius, when the outdoor temperature is low, seeing that all heat is transferred via the floors to the rooms.

A common design and by building authorities recommended modification.

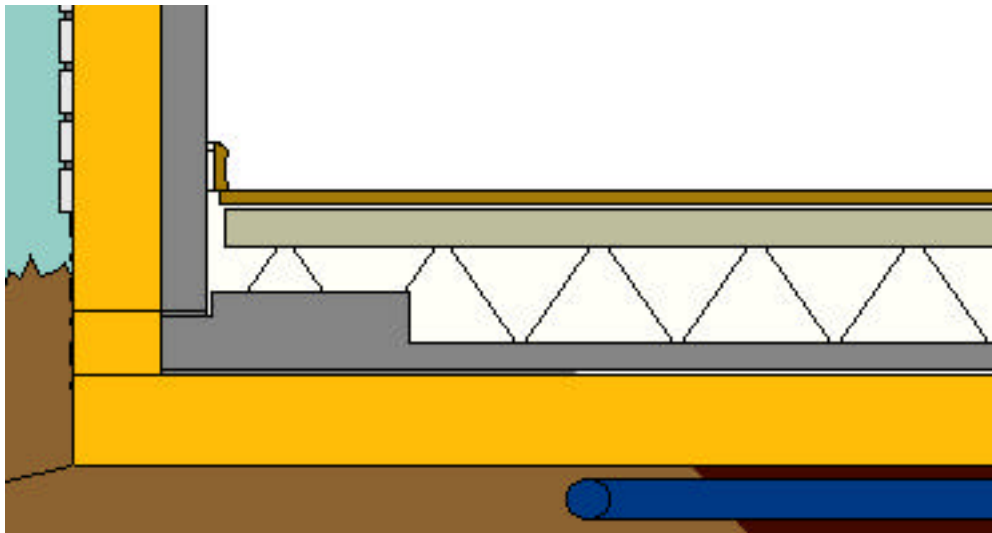


COMMON DESIGN AND RECOMMENDED MODIFICATION

The solution with the RESARO system

When using the RESARO foundation design and the RESARO concrete walls, there are no heat conductive components in contact with the ground below, or the outdoor climate.

The load-bearing wall concrete slab is covered by a continuous equally thick thermal insulation layer.



RESARO'S SOLUTION

No thermal bridges

The floor slab rests on a thermal insulation layer with a thickness of 200 mm.

The outer walls in turn rests on the RESARO floor element. The thermal insulation of the walls encloses the edges of the floor element. Therefore there are no thermal bridges.

The RESARO system: a low temperature system

In existing systems, under floor heating signify floors with high temperatures and hot zones.

In the RESARO system we talk about a surface temperature of +20 to +23 degrees Celsius, "Soft warmth", spreading out over the entire area.

With RESARO elements in the bottom floor, filtered indoor air, mixed with fresh outdoor air, circulates through the double structural floor.

The circulated air has a temperature slightly higher than the indoor temperature but far of the as high as in the heat coils in conventional systems.

- This because the floor surface gets about 50% of its heat from the supply air that circulates through the double structural floors. The floor surface in its turn heats the rooms evenly by radiation and convection (thermal conduction).

The other 50% stays with the supply air which gets transferred up to the residential area, circulates behind floor skirtings and mixes and heats the indoor air.

For this reason the supply air temperature, in the RESARO

system, can be kept considerably lower inside the elements than at conventional under floor heating systems, where all energy is transferred through the floor slab.

- We obtain less energy losses to the ground in spite of the Resaro system holds warm floors in the ground floor.
 - Lower temperature on the floor surface gives better indoor climate. Rustic wooden floors and parquet floors are sensitive to temperatures above +25 degrees Celsius.
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Problems with exhaust ventilated warm crawl space basements in conventional designs.

A common way to recover energy from the exhaust air is by transferring it down the crawl space foundation and from there into a heat pump.

The foundation must have a lower pressure than the rooms to prevent moisture from the ground to leak into the living space.

Hard to get air tight

In practice these systems don't function well, as the basement is hard to get sufficiently tight outwards the environment.

The exhaust air gets sucked down into the foundation with help from a vacuum that the exhaust air fan creates.

Therefore the foundation keeps a pressure which is considerably lower than the environment's.

Outdoor air leaks into the crawl space below the edge beams. The result is in winter time the exhaust air is mixed in with cold outdoor air which ruins the heat recovery.

Furthermore an exhaust air ventilated basement is a passive system, which solely gives a result of a house with "less cold floors". With a lower temperature than the indoor air.

Less cold than e.g. a slab on ground, but not as warm or heated as at under floor heating.

Risk of condense in exhaust air ventilated basements:

The air temperature in an exhaust air ventilated basement is cooler than the indoor air because the ground cools down from underneath.

The exhaust air that comes from the wet premises of the house contains a lot of water, that is to say, it's relative humidity is high.

At cooling there is a risk for condensation, why there is a big risk for a floor construction, consisting of wood or other organic material which faces the ground, to be affected by rot or mould.

The solution with the RESARO system

- In the RESARO system heated air circulates inside the structural bottom floor therefore damages caused by damp is efficiently prevented.

Problems with radon from the ground

- A cast slab directly on the ground is not an efficient protection from radon, even if it is very thick. In most cases no protection at all, as concrete always cracks.

Up-to-date houses have, nearly always, a vacuum inside, why radon gas easily finds it's way up and inside the dwelling through the cracks.

The solution with the RESARO system

- The RESARO system provide an effective shelter against radon coming up from the ground.
With the system solution RESARO OVER PRESSURE FOUNDATION, the radon gas vanishes under a tarpaulin, which makes the bottom of the house.
- When ground with a high level of radon, a strong all over welded tarpaulin will be used.
In order to secure radon from penetrating the dwelling, the tarpaulin is made bigger than the foundation and reaches over the edges.
- Inside the RESARO structural floor, in the circulation space, we can find a slight over pressure, which also obstruct radon from penetrating into the house if the bottom slab cracks

Problems with moisture and mould

Construction moisture

- One of the biggest problems is so-called "sick houses" where mould appears.

Moisture and insufficient ventilation together with inconvenient material chosen combined with a poorly dried out concrete and framework are in most cases the reason.

For example, moisture in heavy concrete constructions where the surface coating was put on too early, maybe on top of putty that is sometime made of organic material.

As a result, chemical reactions exhaling poisoning gases appears, with great inconvenience for the residents.

Mould and damage caused by damp in outer walls behind shower and bathtub are also common problems.

The solution with the RESARO system

- The risk for mould formations in framework eliminates.

When using the RESARO system the structural floors establishes a distribution channel way for heated circulation supply air and ventilation supply air.

Meanwhile the framework dries up.

- Even though the RESARO structural floors do not serve as a supply air duct e.g. in department houses, during the erecting time a simple air circulation can be arranged inside the Resaro elements, for drying.
Possibly with help from a construction drier.
- The surface coating can be applied at an earlier stage than with other systems.

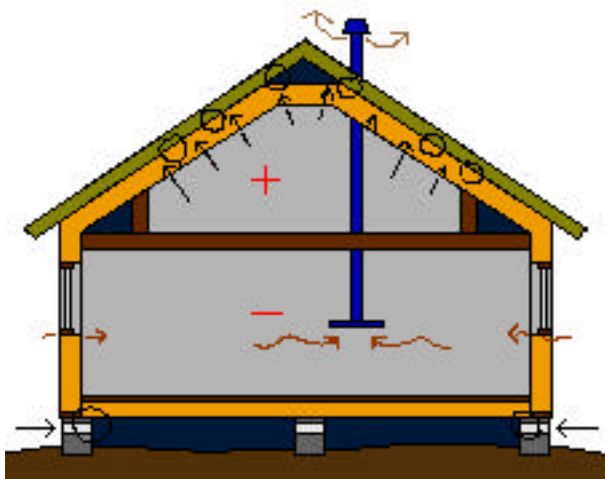
Problems at natural ventilated houses

Mould in framework caused by air leakage

If the house has no exhaust air fan unit which establishes a vacuum, but just natural ventilation, a slight over pressure will establish in top floor.

The warm and humid indoor air penetrates, at smallest openings, through outer walls and ceiling and emits its dampness into the thermal insulation and the wooden framework causing damage.

Places where the house shows up damage are marked with rings



The solution with the RESARO system

- In the RESARO system we always use an exhaust air fan unit which establishes a slight vacuum in the house.

- RESARO AB has a patent application for the arrangements to prevent indoor air to penetrate the thermal insulation when using Dynamic fresh air intake.

See also the paragraph below "Dynamic fresh air intake".

Problems with bad ventilation effect the warm seasons

In natural ventilated houses the ventilation doesn't have any effect during the warm seasons as the qualification to create the density divergences - hot and cold - which composes the power for air movements, are missing.

With wet construction materials that's been stored outside, or if it rained on the framework, maybe even on the thermal insulation, before the roof shelter was put in place, there are great risks for formation of mould to appear.

In a house once damaged by mould or rot, the smell and the influence of poison remains for ever

The solution with the RESARO system

- In the RESARO system an exhaust air fan unit is used, therefore it is always a slight vacuum in the rooms and the ventilation air is sufficient at all seasons.

See also the paragraph below "Dynamic fresh air intake".

Problems with mould in ducts in hot air heating plants

- A plausible reason to the mould to appear, is inconvenient placements of ducts for air heating inside the thermal insulation in the ceiling.

The ducts must be placed above the roof trusses lower chords, which means, closest to the in wintertime cold outdoor air.
The heat from the ducts rises and gives off its energy to the outdoor air.

A plausible reason why these houses requires a lot of energy!

The ducts goes through cold parts of the attic. Warm indoor air which contains a considerable amount of humidity, passes through the ducts and cools of.

To this, the risk for the temperature to get below the dew point is serious, causing moisture on the duct partitions.

If there at the same time is dust to be found in the ducts the possibilities for mould to appear.

The solution with the RESARO system

- The risk for mould to appear in air ducts is completely eliminated.

The simple solution with the RESARO system is to always feed the heated supply air from beneath, always in warm spaces and always indoors.

Problems with mould/mildew behind kitchen cupboards

- A place where mould often appears is behind kitchen cupboards at outer walls. This because the cupboards mostly are crammed with kitchen utensils and food articles which works as an thermal insulation.

Bad ventilation behind the kitchen cupboards and a cold floor, e.g. a slab cast directly on the ground, or a floor on top of a fresh air ventilated crawl-space basement, creates the necessary conditions for mould. Moisture, nourishment and oxygen,

The solution with the RESARO system

- When using the RESARO system the heated ventilation air is lead behind the kitchen cupboards at the outer walls. The supply air passes behind the cupboards, through the cupboard recesses for the skirtings and then into the room. Mostly it also passes the dishwasher.

Problems with mould inside an outer wall in a shower

- With consideration of space, a shower is often placed next to an outer wall. Even though a very thick membrane isolation is placed behind the surface coating inside the shower, moisture always penetrates the membrane because of vapour pressures.

Cold surfaces always attract moisture.

There is always a risk for mould to appear.

The moisture accumulation increases the risk of wallboards to swell and then break the glazed tiles.

The solution with the RESARO system

- A cavity behind the wallboard in the outer wall for circulated indoor air, guided out on a level with the ceiling of the wet premise, makes an efficient stop for the moisture moving towards the cold outer wall.

The RESARO system gives an opportunity to place a shower next to an outer wall without the risk of condensation inside the wall.

Dynamic fresh air intake

Problems with existing systems using dynamic insulation technique for ventilation.

(The design of the RESARO system is designated "Dynamic fresh air intake")

Problems with two-storey houses with dynamic insulation.

In winter time in two-storied houses the warm indoor air creates an over pressure in the higher parts of the house, because of diversities of the density (warm air is lighter than cool).
Therefore the indoor air makes its way upwards.
(Compare natural ventilation with self density draught)

The solution with the RESARO system in two-storied houses:

- In the RESARO system the roof is furnished with an additional ceiling inside the roof's thermal insulation, creating a compartment between the insulation and the additional ceiling boards.
- A vapour retarder placed above the ceiling boards prevents the indoor air from getting to the insulation, and cause damage.

A patent approved construction gives an even distribution of the inlet air over the entire insulation area.

A collection box transfers the fresh outdoor air into the indoor circulation system . This arrangement makes sure that humid indoor air will not go the "wrong way" out towards the thermal insulation.

- Trough the above procedure to let the circulation air transfer the ventilation air into the rooms it also avoids indoor air to get in contact with cool insulation.
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Problems

Complicated solutions for circulating hot air heating systems at 1 1/2- storied- and two-storied houses

- The conventional hot air heating systems, in a 1 1/2-floors- or a two-storied house, are very complicated with many ducts.

Distribution ducts, for heating and ventilation of ground floor and supply ducts which leads up to and are installed inside the roof's thermal insulation for the ventilation of the top floor, are often placed below the intermediate floor in horizontal steel ducts which then changes direction, going upwards.

Covered by immersed ceilings, inside the rooms.

Work operations: The ducts shall be hanged, covered by wood battens and gypsum boards. There after puttying and painting.

This is an expensive installation and difficult to maintain.

The solution with the RESARO system

- With the RESARO system the heat and ventilation air is supplied through the structural floors which are slightly over pressured.

The air flows slowly up behind the floor skirtings along the outer walls and further to a centrally placed return duct leading to for a heat unit for tempering and filtering.

Fresh outdoor air is added in the return duct.

Problems with ventilating of top floor

- A conventional way to guide air to top floor is to use air ducts going trough air inlets (=holes) in the floor or in the wall.

Because of technical reasons a concentrated inflow appears which gives a bad conversion of ventilation air.

An other procedure is to use a hollowed skirting to distribute the supply air along a wall into a room.

But hollowed skirtings are expensive, often appears unattractive and obstructs furnishing.

The solution with the RESARO system

- Using the RESARO system you can ventilate the top floor with the same system as for the ground floor.
- The Resaro system shows a completely new way to transfer supply air, along the skirtings, into a top floor gable room.

This obtains trough a cavity placed in the first floors end wall (or a wall near by). This cavity links the circulation space inside the bottom structural floor with the gable room.

- This procedure gives a rich inlet, which gives an effective conversion of the ventilation air in the entire room.
 - We get the advantage of rooms without radiators and unattractive hollowed skirtings and convenient to furnish and clean.
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Problems with heat exchangers for heat recovery.

- A not so known problem with heat exchangers, is that they must be cleaned at least once a year.

When warm humid exhaust air coming from wet premises meet the heat exchangers cold surfaces, chilled by winter tempered outdoor air, condensation always appears.

When dust in the exhaust air, the necessary conditions for mould creates in the exchanger and mould spores accompanies the outdoor air into the rooms.

This can be one of the reasons why people develop allergies.

The solution: The RESARO system without a recovering unit

- Using the complete solution of the RESARO system in a standard insulated house, there are no recovery units needed to settle the demands of the building codes.

In a standard insulated house with.....

- lower indoor temperature thanks to warm floors
- energy recovery with the design for fresh air intake through the roofs thermal insulation where the heat is transferred back into the house
- the arrangement with the "over pressure foundation" where the bottom parts of the house heats by the exhaust air.....

.....there is no need for a heat recovery unit.

- At cold seasons the intake of fresh outdoor air goes through the roofs thermal insulation and leads the warm air back in again, therefore the insulation can be made a lot thinner than at a conventional application, without losing its effect.
- The fact is that the thickness of the roofs insulation is settled regarding the needs to provide the house from heat from above, at

warm seasons.

Problems

No profits from using an exhaust air heat pump

- Exhaust air heat pumps are expensive to buy and to install
It has turned out that the lifetime of its vital parts is no longer than about 8 years, why service costs usually comes up to a higher sum than the savings.

The solution with the RESARO system

- When using the complete RESARO system solution there is no need for heat recovery units for a standard insulated house.
- However the RESARO system works excellent together with an exhaust air heat pump.

But with today's energy costs the costs for purchase and installation of an exhaust air heat pump "don't pay back" with this system.

- When higher energy costs the RESARO system would be excellent to complete with an exhaust air heat pump.

Therefore are our installations today always prepared for a future connection with an exhaust air heat pump.

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