# Västra Balltorp
## Mölndal, Sweden

## PROJECT SUMMARY

The case study project comprises a settlement including 100 dwellings, in the in the city of Molndal on the Swedish west coast. There will be a mixture of 1-2 storey single family houses, terraced houses and attached houses. The ownership will be private or semi-private. The project is focused on providing high quality, modern, energy efficient and sustainable houses at affordable costs.

## SUMMARY STATISTICS

| | |
|---|---|
| Location: | City of Molndal, close to the city of Göteborg, SW Sweden |
| Latitude: | 57,4 N |
| Project: | 100 dwellings, 1-2 storey, mixed single family, terraced and attached |
| Area: | 60 600 m2 |
| Owner: | City of Molndal |
| Developer: | SKANSKA Sweden AB |
| Architect: | CNA-Christer Nordstrom Architects |
| Contact: | Christer Nordstrom, CNA, |

# THE SITE

## Background

The city of Molndal is located south of and in direct connection with the city of Göteborg (Sweden's second city) on the Swedish west coast. Molndal has developed during 4 centuries from an agricultural landscape to a modern industrial city. The location close to Göteborg and access to all kinds of communication, makes Molndal attractive for modern industry and business.

The demand for attractive housing is constantly rising which has led to the decision to exploit a former forest and agricultural landscape for housing. The aim is to create a self sufficient housing area including service and work space based on the principles of the "garden city".

## The site

The Västra Balltorp development has a dramatic topography, dominated by a high forest covered plateau with slops facing the agricultural landscape to the south. The case study settlement is located in the southern part of the development, between the forest and the former agricultural landscape where a golf course is presently under construction. The city centre of Molndal lies within 2 km north of the development, and the city of Göteborg within 7 km in the same direction. The west-coast highway E6 leading from Copenhagen/Malmoe to Oslo runs 2 km east of the site.

## Climate

The climate is typically maritime with influence of the Gulf stream. Summers are quite warm and winters are temperate and rainy. There are prevailing south-west winds coming from the North Sea which can be found approx 4 km in the west direction.

# PROJECT DESCRIPTION

In Molndal, a city of 57 000 inhabitants, on the Swedish west coast, a housing development of 2500 units, called Västra Balltorp is planned in a former forest area. Besides housing, the total development will include 60 000 m2 of service, shops and business area. The area is owned today by the city of Molndal and will be exploited in cooperation with SKANSKA (Swedens largest construction company), Mölndalsbostader (The public housing company of Molndal) and HSB (a major Swedish housing organisation). The total development is divided in 20 separate settlements with different characteristics and exploitation, in the range from 2 storey single houses to 6 storey multi family dwellings.

The main objective with the development of Västra Balltorp is to establish an attractive housing area based on the principles of the garden city:

- Attractive and affordable housing
- Variation in scale and ownership
- Access to local service and work opportunities
- Development in coherence with the local resources and nature values
- Energy conscious planning
- Bioclimatic and sustainable design and building
- Healthy building materials and methods
- High quality of life

The case study project comprises one of the 20 settlements including 100 dwellings, which will be developed by SKANSKA in the south part of Västra Balltorp. There will be a mixture of single family houses, terraced houses and attached houses. The ownership will be private or semi-private.


**Planning process**

A major plan for the total development including guidelines for the 20 settlements has been presented for the community and approved. Detailed planning is a continuous process which will precede the building of each of the settlements. The detailed site plan for the case study is planned to be completed during 2003.

The design process is focused on energy consciousness, sustainability and concern for the environment. Feasibility studies are used for the validation of different scenarios. Innovative methods for the integration of RES and energy conscious techniques are used.

# BASE CASE

## THE SETTLEMENT

The site has an area of 60 600 m2, with mostly open flat fields surrounded by hills and forest in the north and east parts. The level above sea varies between +62 metres in the southern part and +75 metres on the hills in the north-western part. The maximum slope is 25%.  In the west and south directions, there is direct access to a golf course which is presently is under construction.

## Housing

The design of the settlement and the buildings will vary depending on the location within the site;

- Approx. 40 single family, free standing houses, some with roof terraces, on the hill sides,
- Approx. 60 coupled pair- or terraced houses organised in a "garden city" patern around community lawns in the flat central parts.

The height is planned to be 1-2 storeys in order to keep a small and intimate scale. The architecture will be modern yet adapted to the local Swedish building tradition. The buildings will be grouped and oriented in a way which will maximize the access to sun and light at the same time minimize the negative impact of cold winds.

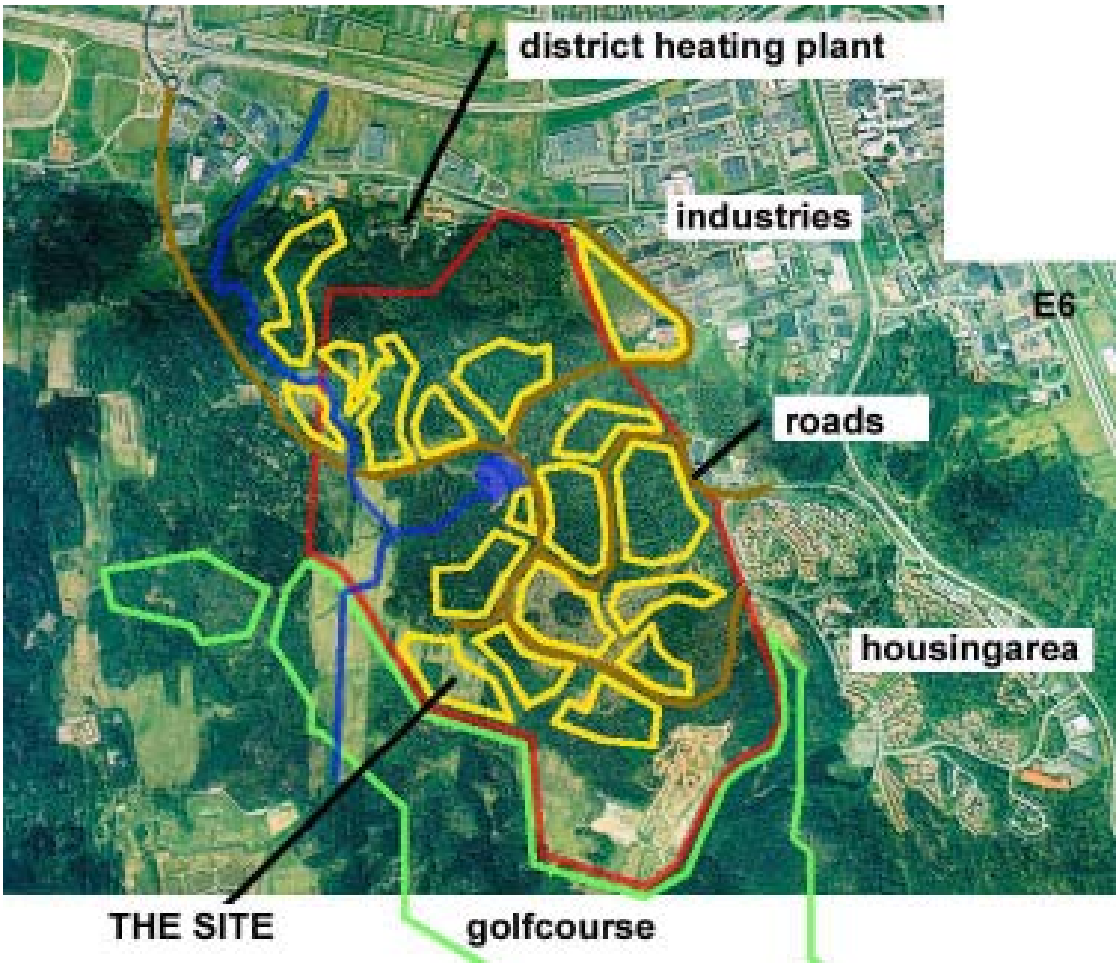
Traffic will be kept at low speed within the settlement. Priorities will be given the pedestrians in the planning of traffic.

**INFRA STRUCTURE**

The **traffic** will reach the site from north and there will be pedestrian walkways running through the site in various directions. **Public bus transportation** can be reached within 100 metres in north direction from the settlement.

A small kindergarten is planned north of the site and a large **service and business centre** with schools, shops and work space is planned in the centre of Västra Balltorp development, at an approx. distance of 400 metres.

The settlement will be connected to the city's **district heating system** which is heated by co-generation plant, close to Västra Balltorp. The plant is presently heated by peat and will be converted to bio-fuel.



**BUILDING DESCRIPTION - BASE CASE**
**Single family house**

Type
The building is a 2 storey, free standing single family house which will be erected on the sloops in the northern and southern parts of the settlement.

Size

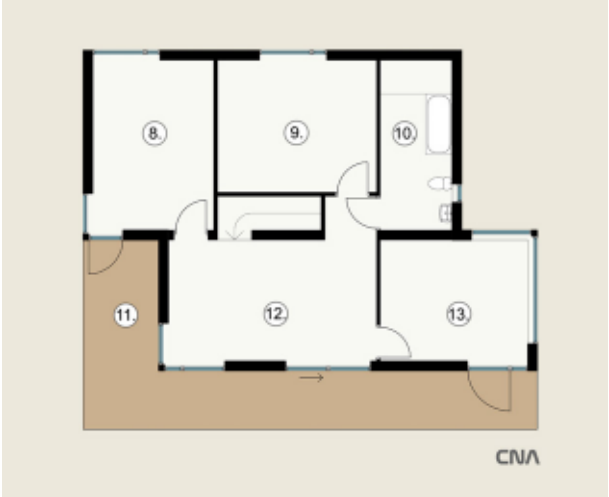
| | |
|---|---|
| Ground floor area | 90 m2 |
| Upper floor area | 75 m2 |
| Building area | 100 m2 |

Structure
The structure is made of wood and insulated with mineral wool. The foundation is as insulated concrete ground slab.

Building materials
The building materials are mostly natural and produced in Sweden:

| | |
|---|---|
| Roofing | Clay or concrete tiles |
| Facades | Painted wood |
| Floors | Wood |

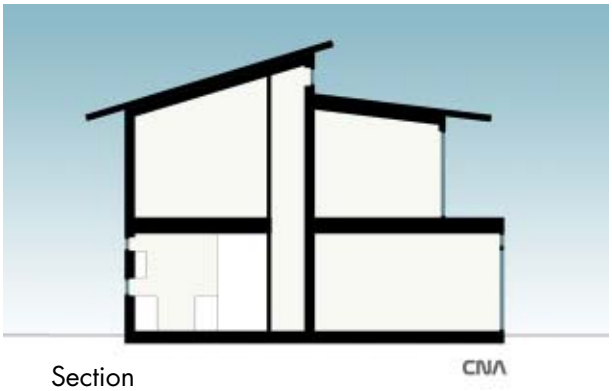
Ground floor



Second floor

Rooms (ref. to the numbers in the plan):

1. Dining room
2. Kitchen
3. Washing
4. WC
5. Entrance hall
6. Living room
7. Study/library
8. Bedroom
9. Bedroom
10. Bath
11. Terrace
12. Family room
13. Bedroom



Section

Sourh elevation CNA

North elevation CNA

East elevation CNA

West elevation CNA

## BUILDING ENVELOPE - BASE CASE

Insulation

| | | |
|---|---|---|
| Roof insulation | 30 cm | U= 0.176 W/m2.C |
| Wall insulation | 20 cm | U= 0.238 W/m2.C |
| Floor insulation | 10 cm | U= 0.551 W/m2.C |
| Terrass insulation | 15 cm | U= 0.374 W/m2.C |

Windows

Windows are 2- paned thermoglass with wooden frames with a U-value of 1,4 W/m2.C
Total window area including frames : 64 m2

Window orientation

In the base case the windows are oriented equally at each direction, N,W,S,E

Auxillary heating system

The heat is provided by district heating

Heat recovery

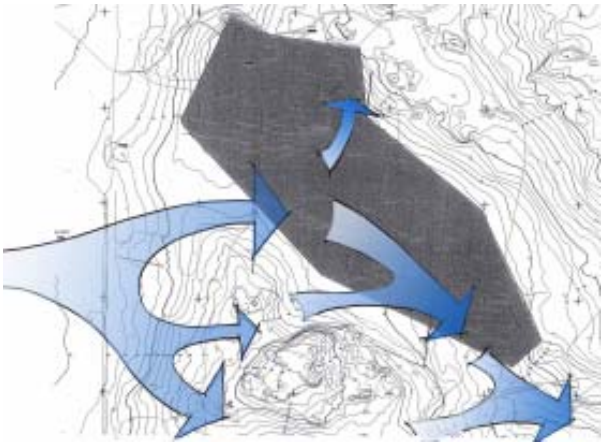
In the base case there is no heat recoveration.

# SCENARIO

## MICROCLIMATE IMPROVEMENTS

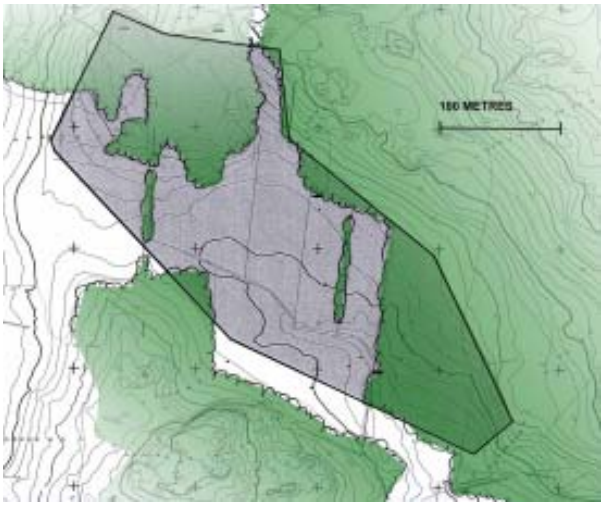
### Wind

There are prevailing winds coming from west. Most of the houses are located behind a hill or close to the woods and are thus quite sheltered from the winds. The houses on the north slopes and the central part of the settlement are more exposed to the winds than the other parts. In order to minimise the impact of wind, the existing vegetation will be preserved as much as possible



### Vegetation

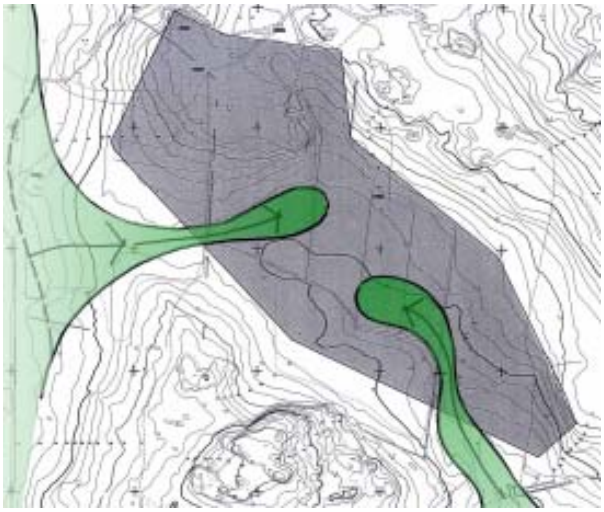
The central part of the site consists of  a small field, surrounded by pine woods on the north and east sides. Within the fields there are rows of small trees and bushes. The sloops in the north and south parts have mixed pine and birch woods.




### Green community space

As much vegetation as possible will be preserved, especially along the borders between woods and open land. New trees will be planted between the buildings in order to create a small garden city.

The buildings will be organised in small groups surrounded by vegetation. In the flat parts, there will be large community lawns penetrating the space between the groups of buildings. These lawns will be used for playgrounds, sport activities and furthermore connected to the golf course.



## IMPROVED BUILDING ENVELOPE

### Scenario 1 - Base case + extra insulation

Insulation
Insulation is added to (compared to Base Case):

| | | |
|---|---|---|
| Roof insulation | 35 cm | U= 0.146 W/m2.C |
| Wall insulation | 25 cm | U= 0.189 W/m2.C |
| Floor insulation | 20 cm | U= 0.290 W/m2.C |
| Floor insulation | 20 cm | U= 0.280 W/m2.C |

Windows
Windows are are the same as in the Base Case
Total window area including frames : 64 m2

Window orientation
The same as in the Base Case with the windows are oriented equally at each direction, N,W,S,E

Auxillary heating system
The heat is provided by district heating

Heat recovery
ISame as in the Base Case: no heat recoveration.

### Scenario 2 - Base case + super insulation

Insulation
Insulation iss added to (compared to Base Case):

| | | |
|---|---|---|
| Roof insulation | 40 cm | U= 0.133 W/m2.C |
| Wall insulation | 30 cm | U= 0.167 W/m2.C |
| Floor insulation | 20 cm | U= 0.290 W/m2.C |
| Floor insulation | 20 cm | U= 0.280 W/m2.C |

Windows
Windows are are the same as in the Base Case.
U-value of 1,4 W/m2.C
Total window area including frames : 64 m2

Window orientation
The same as in the Base Case with the windows are oriented equally at each direction, N,W,S,E

Auxillary heating system
The heat is provided by district heating

Heat recovery
ISame as in the Base Case: no heat recoveration.

### Scenario 3 - Base case + heat recovery

Insulation
Insulation is the same as in the Base Case:

| | | |
|---|---|---|
| Roof insulation | 30 cm | U= 0.176 W/m2.C |
| Wall insulation | 20 cm | U= 0.238 W/m2.C |
| Floor insulation | 10 cm | U= 0.551 W/m2.C |
| Terrass insulation | 15 cm | U= 0.374 W/m2. |

Windows
Windows are are the same as in the Base Case.

Window orientation
The same as in the Base Case with the windows are oriented equally at each direction, N,W,S,E

Auxillary heating system
The heat is provided by district heating

Heat recovery
Hear recovery of ventilation air is installed.
Efficiency: 60%, Ventilation rate: 207 m3/h

Tightness
Extremely cautious mounting of vapour barriers.

## Scenario 4 - Base case + passive solar

Insulation
Insulation is the same as the Base Case.

Windows
U-value is reduced to 1,0 W/m2.C
Total window area including frames : 64 m2

Window orientation
Windows are oriented to the sun for direct solar gain:

| | |
|---|---|
| South window area | 27 m2 |
| West window area | 18m2 |
| North window area | 6m2 |
| East window area | 4 m2 |

Thermal mass
Thermal mass increased to 80 Wh/m2,K

Heat recovery
ISame as in the Base Case: no heat recoveration.

Solar control
On second floor there will be overhangs dimensioned to let winter sun into the building and sheltering from the summer sun.
On ground floor, a pergola will be built, having the same effect.

Cross ventilation
The biuilding will be designed to allow natural ventilation using the maximumstack effect.

## Scenario 5 - All measures - bioclimatic passive solar design

Superinsulation

| | | |
|---|---|---|
| Roof insulation | 40 cm | U= 0.133 W/m2.C |
| Wall insulation | 30 cm | U= 0.167 W/m2.C |
| Floor insulation | 20 cm | U= 0.290 W/m2.C |
| Floor insulation | 20 cm | U= 0.280 W/m2.C |

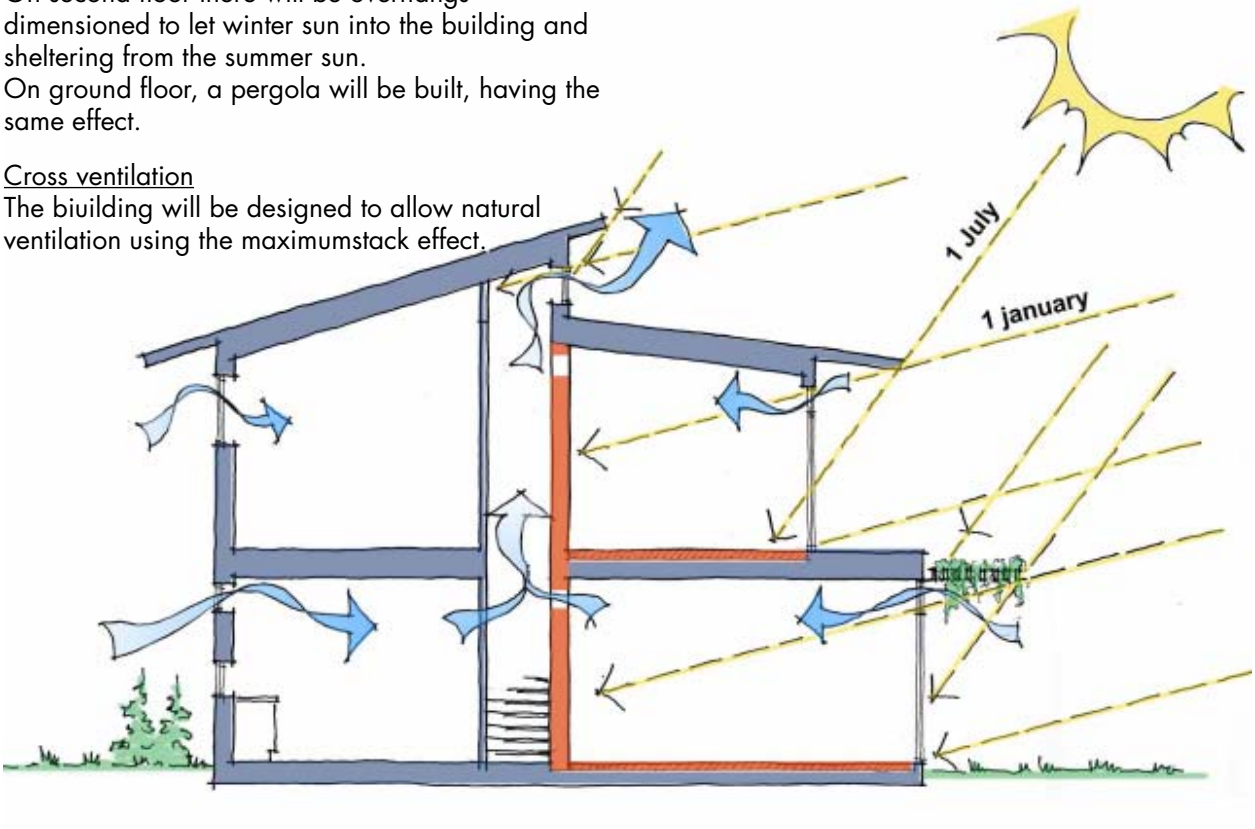
Windows
U-value: 1,0 W/m2.C
Total window area including frames : 64 m2

Window orientation

| | |
|---|---|
| South window area | 27 m2 |
| West window area | 18m2 |
| North window area | 6m2 |
| East window area | 4 m2 |

Thermal mass
Thermal mass increased to 80 Wh/m2,K

Heat recovery
Hear recovery of ventilation air is installed.
Efficiency: 60%, Ventilation rate: 207 m3/h



**RENEWABLE ENERGY**

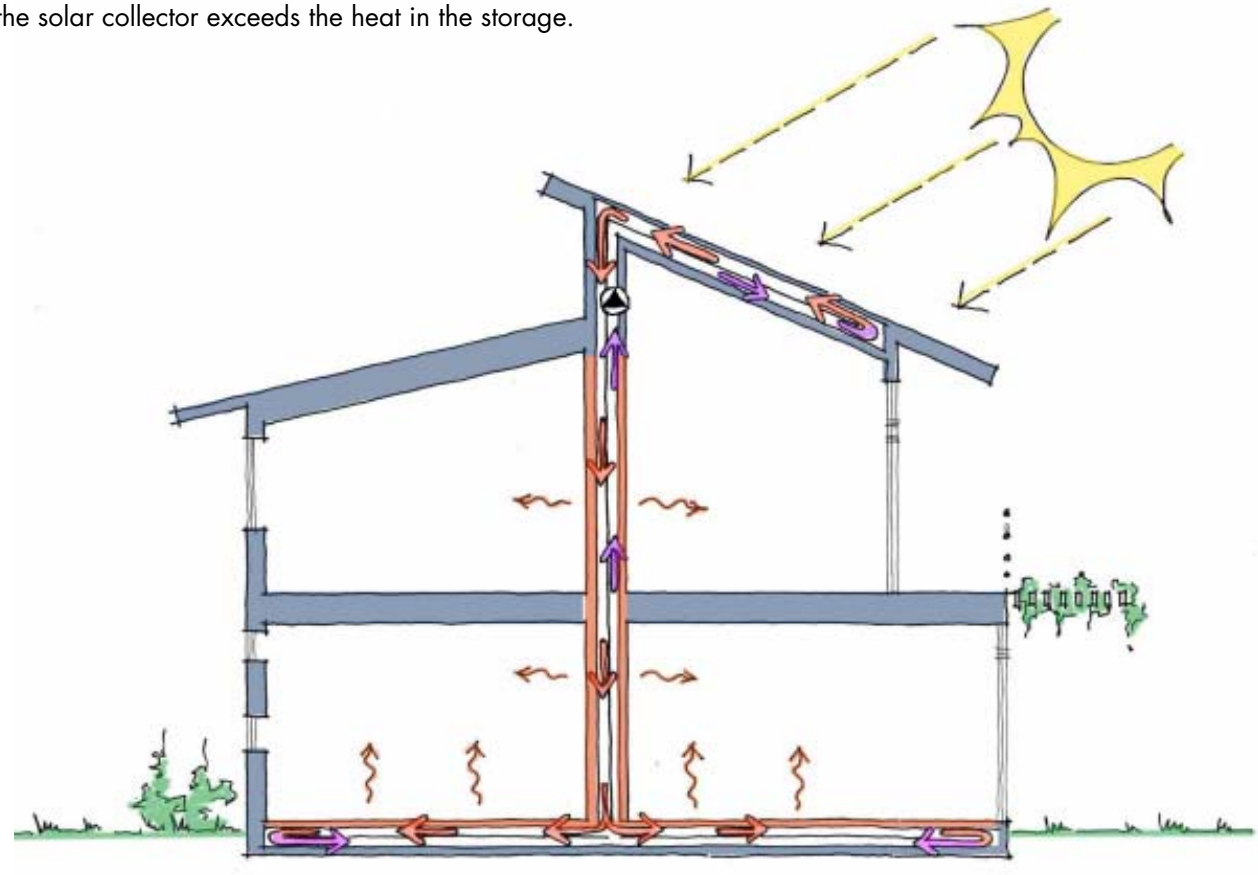
**Active Solar air system**
One roof will have a 23 degree tilt facing south. On this roof, a 35 m2 site built solar air collector will be built. 65 m2 of the ground slab will be made will integrated air ducts.

The solar collector and the hollow ground slab will be connected in a closed air system, where solar heated air is transported to the concrete slab where the heat is stored and distributed through radiation the rooms above.

The air circulation will be forced by a fan in a closed system with no connection of ambient air. Ducts will be integrated in the main supporting inner wall. This wall might also function as a heat storage, but this is not necessary for the function of the system.

The system is controlled by a differential thermostat which will allow the fans to run when the heat in the solar collector exceeds the heat in the storage.

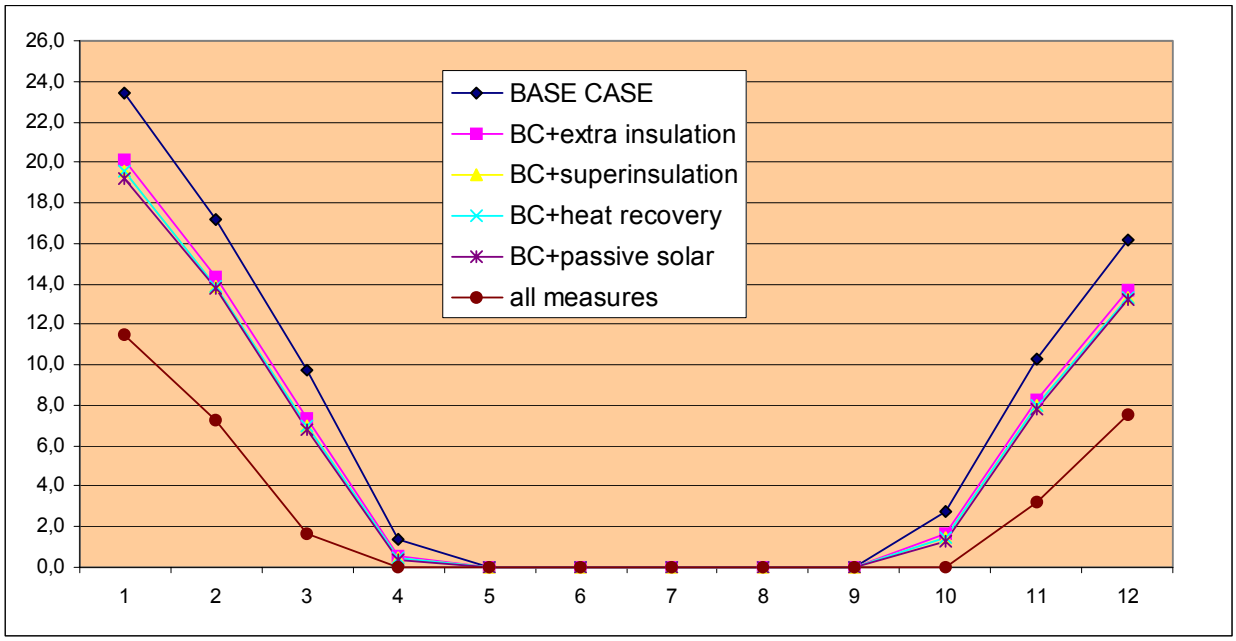
**Solar DHW**
8 m2 of solar water collector will be placed on the south facing roof and connected to a 0,5 m2 water storage for preheating of domestic hot water.



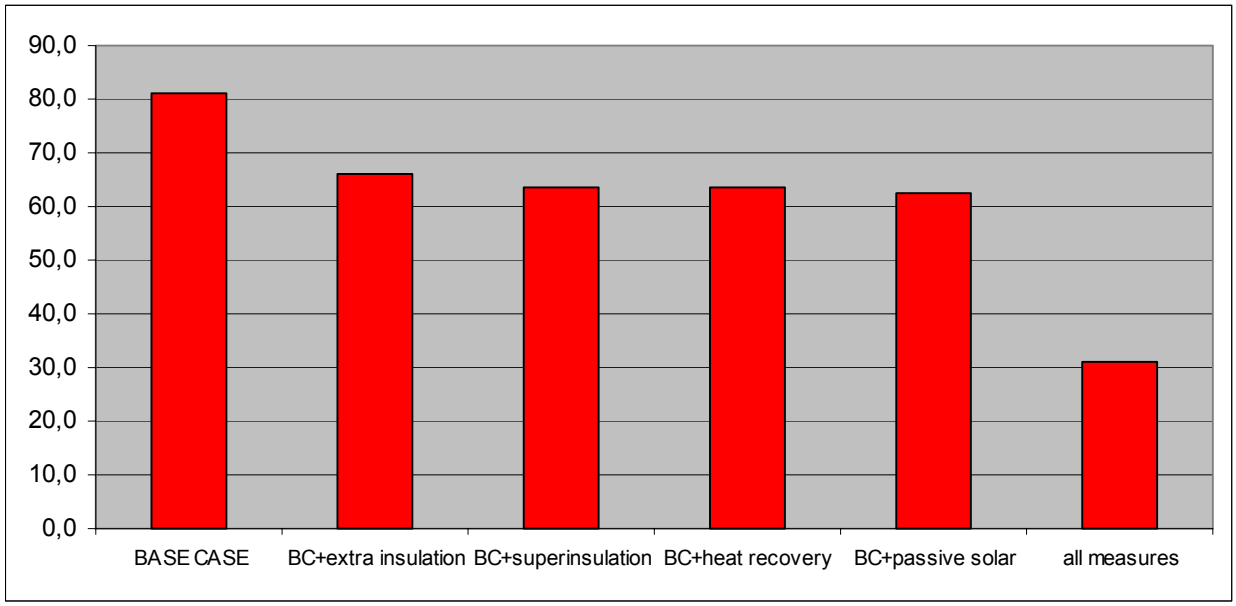
## POTENTIAL ENERGY SAVINGS

The potential improvements monthly and annual space heating load reductions as a result of the scenarios can be seen in the figures below

### Monthly space heating needs (kWh/m2)




### Annual space heating needs (kWh/m2)



## DEMAND SITE MANAGEMENT

### Heating control
The building will be equipped with an advanced system for the control of the floor heating system.

### Artificial lighting and electrical equipment
Automatic light control will be installed and energy efficient state of the art products will be choosen.

## DISTRICT HEATING

The Västra Balltorp housing development will be connected to the city's district heating system.

The system is located very close to, north of the development. The plants are now powered by turf. There are plans to rebuild the heating plant for biomass fuel.

The distribution network will be built when the development's roads are being constructed.

### Water
The development will be connected to the city's fresh water system.

### Sewage
The settlement will be designed and planned for composting of all organic waste and with small local plants for recycling. The fractions will be handled by the community sewage services.

## ENERGY CONSERVATION

### House hold equipment
State of the art, low-energy electrical house hold equipment will be choosen.

### Daylighting
The buildings have been designed for maximum daylighting in order to save energy and increase the comfort.

### Water
Water saving equipment, such as double flush toilets will be used in the buildings

## SUSTAINABLE BUILDING

### Selection of building materials
The EPM (environmental preference method) will be used for the selection of materials. The method gives the user a number of choices of selection and is well suited during the design stage.

Only environmentally friendly materials and paints will  be used for the project. When possible and available, natyrally and locally produced materials will be selected.