

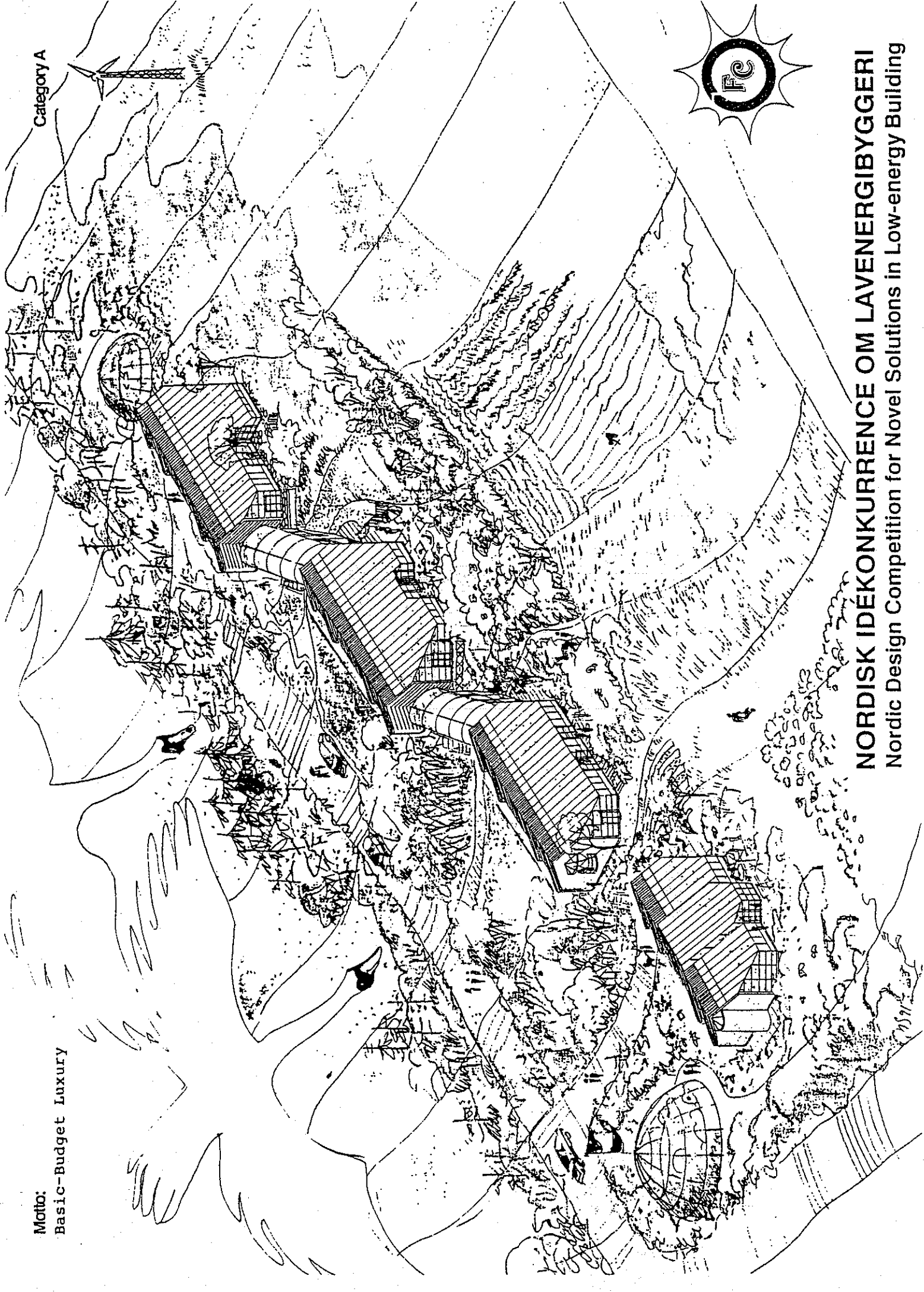
Motto:
Basic-Budget Luxury

Category A



NORDISK IDEKONKURRENCE OM LAVENERGIBYGGERI

Nordic Design Competition for Novel Solutions in Low-energy Building



INTRODUCTION.

The climate variation from north to south in Scandinavia is so great that it is not possible to design a single all-purpose Scandinavian low-energy dwelling.

We have designed a project which is optimal for the middle and southern regions of Scandinavia. Nevertheless, the concepts behind the project can be adjusted to all areas within the region, by allowing for the variations in solar radiation that latitude imposes.

THE SITE PLAN:

Large uncluttered buildings in an open and unspoiled landscape, such as the chosen site's location. The buildings are placed in a gradual progression that follows the downward slope.

The group of buildings comprise an integrated housing and business facility with service functions such as youth housing, guest-rooms and child-care areas.

The total built area is 1.300 m².

Apart from housing and business areas, with driveways and parking the rest of the ground is given over to kitchen gardens and grazing for small domestic animals.

Both the entrance to the site and the extremity of the building are marked by a dome at each end. These domes are a manifestation of our attitude to wastewater treatment and water conservation. The insides of the domes are laid out in such a way that as well as fulfilling their educational and technical functions, they also meet aesthetic requirements which make them pleasant to sit and be in.

THE DWELLINGS:

The buildings are oriented north - south with private and secondary rooms located in the mass-heavy north-facing part. The large open-kitchens and living-dining areas, which are covered by a glass construction with mobile insulation are situated on the south side of the buildings.

The mobile insulation can act as a shield to cold or heat according to need and at the same time gives an architectural variation in light intensity.

The buildings are classified as "low-energy" (with a heating demand of 55 kWh/m²/yr) and are designed so that the house itself has the form of a large passive solar-collector. As well as passive solar heating, moist warm air given off by the green plants in the living areas, is condensed by the use of a heat-pump, simultaneously generating heat and controlling humidity levels.

FINANCIAL CONSIDERATIONS:

The standardised building techniques and an uncomplicated finish result in a square metre price of approx. 70% of that of a normal Danish dwelling. We have decided that instead of reducing apartment costs by this margin, it is preferable to increase the size of the apartments and thus achieve qualities of space which are normally regarded as unaffordable luxury.

Our motto is therefore - Basic-budget luxury.

Contents:

Isometric view of the site	p. 1
Contents, program and perspective	p. 2
Energy and insulation	p. 3
Wastewater systems	p. 4
Siteplan, South- & north elevation	p. 5
House plans	p. 6
Interior perspective drawing of a house	p. 7
Section through house	p. 8

INDHOLD:

Isometri af bebyggelsen	s. 1
Indhold, program & perspektiv	s. 2
Energi og isolering	s. 3
Spildevandssystemer	s. 4
Bebyggelsesplan, Syd- & nordfacade	s. 5
Boligplaner	s. 6
Interiørperspektiv af bolig	s. 7
Snit i bolig	s. 8

INTRODUKTION.

Variationen i Skandinavien's klima fra nord til syd er så stor, at det ikke er muligt at udforme en generel skandinavisk lavenergi-bolig.

Vi har udformet et projekt, der er optimalt i den midterste og sydlige del af Skandinavien. Dog kan tankerne i projektet tilpasses byggen i hele regionen, med de variable solindfaldet giver.

BEBYGGELSESPLANEN:

Store bygninger i et stort enkelt landskab, som anydet i den valgte grund, - sådan ligger bebyggelsen i et glidende forløb nedover skråningen.

Boligblokkene udgør et integreret bolig- og erhvervs miljø med servicefunktioner som ungdomsbolig/gæsterum og børnehush.

Nettoareal bolig + service rum + erhverv = 1.300 m². Grunden benyttes foruden boligarealet med tilkørsel etc. til køkkenhave for beboerne og græsning for små dyrehold.

Indgangen til bebyggelsen og afslutning på bygningsforløbet markeres af 2 kupler, som synliggør holdningen til spildevandsrensning og vandcirkuleringsprocesserne. De indrettes, så de foruden deres tekniske og pædagogiske funktioner også dækker æstetiske behov, som gør dem værd at opholde sig i.

BOLIGERNE:

Boligerne er orienteret nord/syd, med private værelser og sekundære rum i den tunge nordvendte del. Mod syd er boligernes store åbne køkken-alrum og stuer overdækket af en glaskonstruktion med mobilisolering, som isolerer mod kulde eller skygger for solen efter behov og samtidig giver en ny varieret lysarkitektur.

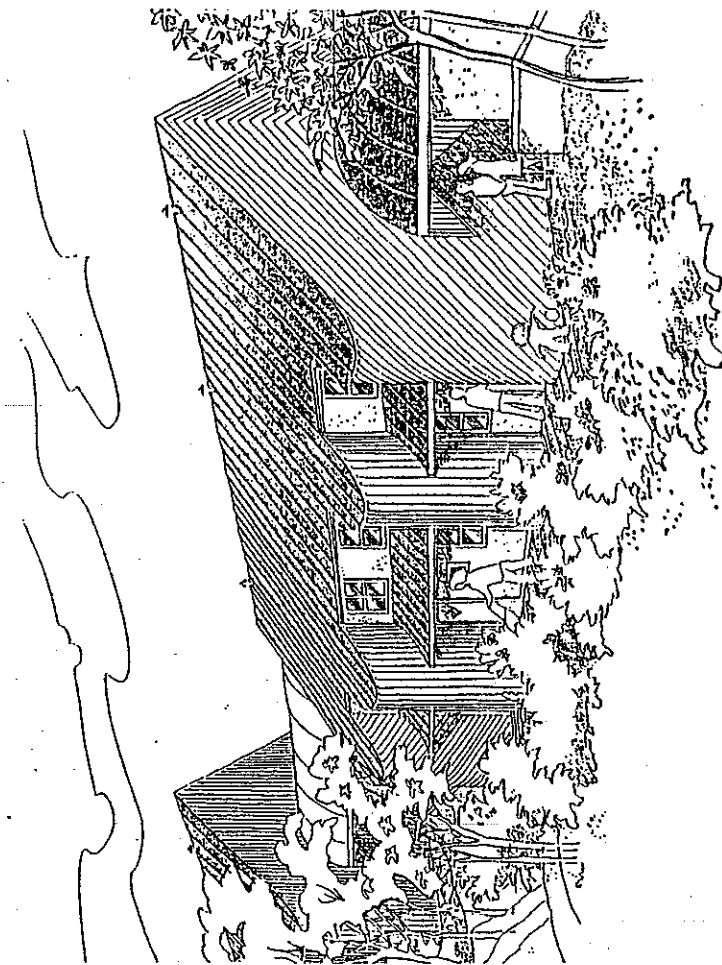
Byggeriet er lavenergi-byggeri (55 kWh/m²) og udformet, så det i sig selv udgør en stor passiv solfangst. Desuden udnyttes fordampningsvarmen fra de grønne planter i alrum og stue via et kondenseringsanlæg, der samtidig sikrer et behageligt indaklima.

ØKONOMI:

Den standardiserede byggeteknik og ukomplicerede finish giver en kvadratmeterpris på ca. 70% af almindeligt dansk boligbyggeri. I stedet for at "nedsætte huslejens" har vi valgt at gøre lejlighederne større, og derved opnået bolig- og iværkskvaliteter, der normalt regnes for luksu.

Vores motto er derfor: Basic-budget luxury.

EKSTERIØRPERSPEKTIV SET FRA NORD
Exterior view seen from the north



MOBIL ISOLERING.

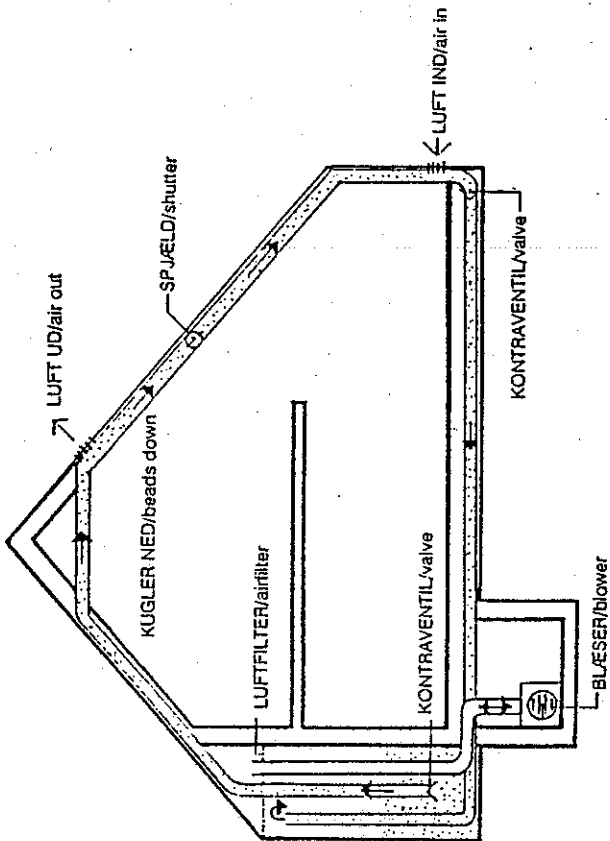
Drivhuset består af to lag hærdet glas med 20 cm mellemrum, hvor mobil isoleringsmateriale i form af polystyrenkugler kan fyldes og tømme efter behov.

Når kuglerne er ude af vinduet (inde i siloen), kan solvarme frit stråle ind gennem hele tagfladen og opvarme husets tunge bygningselementer (gulve, vægge, lofter). Når huset er opvarmet (27°C), hvilket kun kræver få timers sol, kan det "holde varmen" i op til to døgn med mobil isolering i glaslaget, før det igen skal op tilføres varme.

I månederne november, december og januar vil det være nødvendigt at supplere solvarmen med indkøbt varme (el, central- eller fjernvarme), mens huset i resten af året er selvforsynende.

Overskydende solvarme kan enten sælges til fjernvarmenet eller ventileres bort. Det er også muligt at bruge mobilisoleringen som skyggegardiner, idet glaslaget kan fyldes helt eller delvis.

Silo med blæser fungerer som en kæmpe støvsuger, der suger og puster polystyrenkuglerne ud og ind af taget.



MOBILE INSULATION.

The greenhouse roof consists of 2 layers of hardened glass with an air-space of 20 cm. The space, which is filled with insulating material in the form of polystyrene spheres, can be filled and emptied on demand.

When the beads are emptied out of the window (stored in the silos), solar energy radiates in across the whole of the glass area and heats the house's heavy building elements (floor, walls, ceilings). To heat the house up (27°C), requires only a few hours of sunshine. The building can then, due to the mobile insulation and slow release of heat, maintain a comfortable temperature for up to two days, before the need for additional heating arises.

Supplemental heating, in the form of district heating will be necessary in the months of november, december and january, but the house will otherwise be self-sufficient.

Excess solar heat can either be sold to the district heating network or be ventilated out of the building. On hot days the mobile insulation can also be used as shading material, by either partially or wholly filling the window space.

The silo system functions like a large vacuum cleaner, sucking or blowing the beads in and out of the window.

PLUSENERGIHUS.

Husets energindkøb til rumopvarmning, varmt vand og elektricitet er 79 kWh/m²/år.

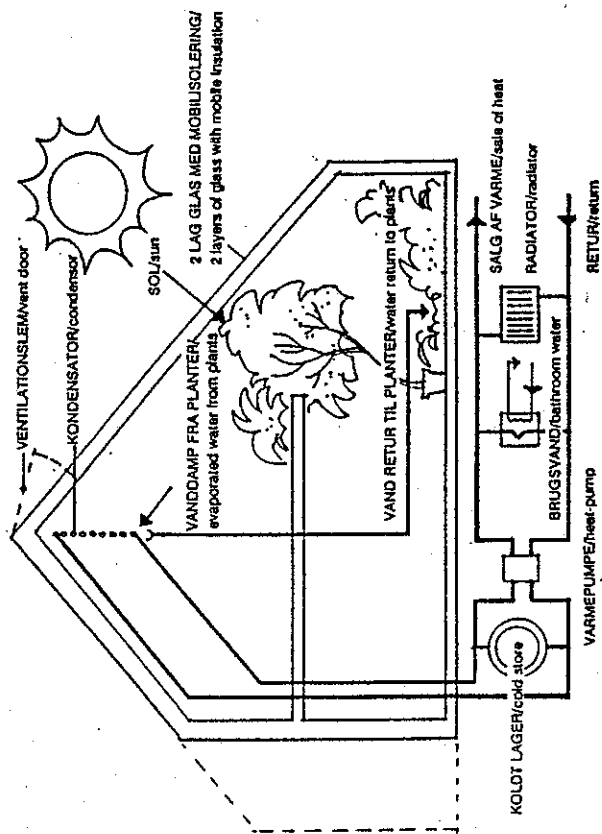
Derudover kan huset sælge 86 kWh/m²/år til evt. eksisterende fjernvarmenet.

Kun i månederne november, december og januar er det nødvendigt med supplerende varme på 11 kWh varme/m²/år enten fra evt. eksisterende fjernvarmenet eller som her kalkuleret fra bebyggelsens centralfyr.

Hvis huset blev bygget som et traditionelt passiv solvarme hus med beadwall, men uden planteproduktion, varmepumpe og eksport af varmesalg ville det totale energindkøb blive 55 kWh/m² (se bilag).

Varmepumpesystemet leverer næsten al varmen og løser samtidig to andre opgaver. Det sikrer et behageligt indeklima ved at affugte luften, og det eksporterer overskudsvarme til fjernvarmenettet.

Den energi, som varmepumpen kan levere, kommer fra planternes vandfordampning. Det er derfor muligt at forøge varmeproduktionen ved at udvide dyrkningsarealet eller vælge plantekulturer med en større vandfordampning/blåddareal.



Plus Energy House.

The energy consumption of the house for space heating, hot water and electricity, is 79 kWh/m²/yr. In addition to this the house has 86 kWh/m²/yr of heat available for sale to e.g. an existing district heating network. Supplemental heating to a level of 11 kWh/m²/yr will be necessary in the months of November, December and January. This demand can be met as in this calculation, by the building's own central heating system, or by an already existing district heating network.

If the house was built as a traditional passive solar energy house with bead wall, but without a heatpump, fruit and vegetable production and export of heat, the total purchase of energy would be 55 kWh/m²/yr (see enclosure).

The heat pump system supplies almost all heat needs and at the same time solves two other problems. It controls the inside climate in the house by reducing humidity and in addition can "export" surplus heat to other parts of the house and to the district-heating network.

The energy, which is delivered by the heatpump, comes from the plants' evaporation of water. It is therefore possible to increase the heat production by increasing the cultivated area or choose a crop with a larger water evaporation/leaf area.

Energy consumption and sale assuming a 228 m² building is connected to a district heating network.

	MWh/yr	kWh/m ² /yr	DDK/kWh	Price DKK
Bought:				
Electricity	19.6	68	1.00	19,600
Heat	3.2	11	0.60	1,920
Total	22.8	79		17,680
Sale:				
Heat	24.7	86	0.40	9,880
Balance				7,800

VARMEINDVINDING.

Ti procent af huset vil blive brugt til drivhusplanter. Planteme - for eksempel frugt, grøntsager og blomster - afgiver fugtig luft, og den energi, der ligger i fugten (fordampningsvarmen), indgår som et vigtigt led i opvarmningssystemet.

Planteme fordampner vand, når solen skinner på dem. Oppe under loftet hænger en række plastslanger med koldt vand i. Damper fra planteme sætter sig som dråber på slangerne og afgiver fordampningsvarmen til vandet inde i slangerne. Dråberne drypper derefter ned i en tegnødv, der leder vandet retur til planterne.

Vandet i slangerne løber tilbage til det varmepumpesystem, der i første omgang sendte det op under loftet. Varmepumpen sender derefter opvarmet vand ud i husets varmesystem samt til salg af fjernvarme. Plusenergihuset er forsynet med et koldt lag, der udlæver forskelle mellem kølebehov og kuldeproduktion fra varmepumpen - på den måde kan varmepumpens størrelse reduceres væsentligt.

VAND - SPILDEVAND - NÆRINGSSTOFFRESSOURCER.

VANDFORBRUG.

I Danmark regnes i dag med et normalforbrug af drikkevand på ca. 200 ltr. pr person pr dag. Heraf går ca. 60-80 ltr. til madlavning/køkkenbrug samt bad og personlig hygiejne. De resterende 120-140 ltr. går til toiletvisk, tøjvask m.m. Disse 120-140 ltr. drikkevand erstattes i dette byggeri med såkaldt friskvand, der i denne forbindelse er en blanding af opsamllet regnvand og rensat, hygiejniseret spildevand.

SPILDEVANDSRENSNING.

Alt spildevand fra bebyggelsen passerer gennem en trix-tank, hvori slammet bundfældes. Herefter renses spildevandet i et såkaldt grønt spildevandsanlæg, der er etableret i den nederste kuppel. Denne form for rensning er baseret på anvendelse af sølenergi. I det alger og højere planter ved deres vækst i spildevandet fjerner næringsstofferne. Udover planter indgår også bakterier, zoooplankton, snegle, muslinger og fisk i rensningsprocesserne. Denne rensningsproces har ingen lugtgener.

HYGIENISERING.

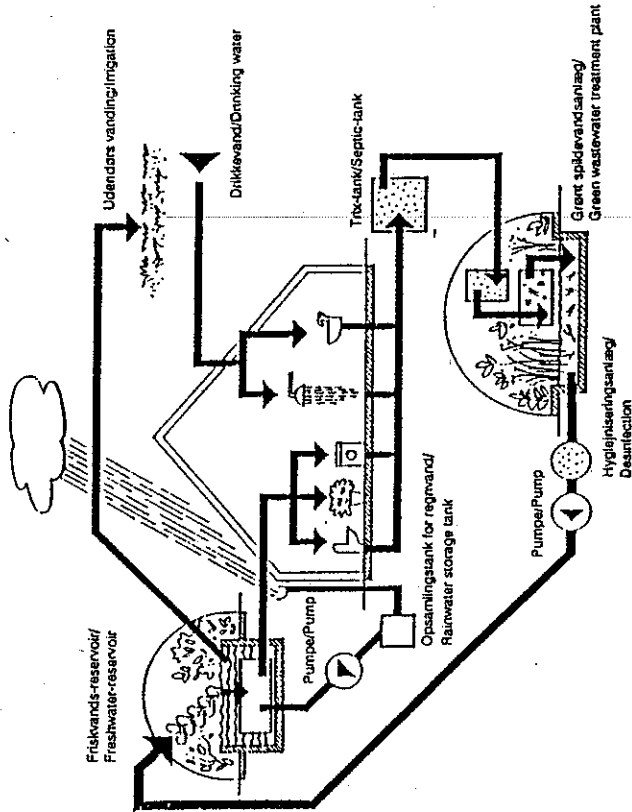
Spildevandet, der nu er rensat for næringsstoffer behandles afsluttende i et hygiejniseringsanlæg. Ved en kombination af chokbølger og UV-bestråling sikres en 100% tilintetgørelse af smittekim.

FRISKVANDRESERVOIR.

Efter hygiejniseringen pumpes det rensede vand til toppen af systemet - dvs. den øverste kuppel, hvor det indledningsvis iltes i en vandtrappe. Herefter oplagres vandet sammen med opsamllet regnvand til brug i bebyggelsen.

ANVENDELSE AF FRISKVAND.

Den vigtigste anvendelse af vandet er til genbrug i bebyggelsen - d.v.s. til tøjvask, toiletviski og indendørs vanding. Herudover anvendes overskud af det friske vand i bassiner i den øverste kuppel i. eks. til opdræt af krebsdyngel, ligesom det kan anvendes til udendørs vanding.



HEAT PRODUCTION.

Ten percent of the house's area will be used for greenhouse plants. The plants, for example fruit, vegetables and flowers, give off warm moist air and the energy in the moisture (the heat of evaporation) is an important part of the house's heating system. The plants evaporate water when the sun's rays shine on them. Under the ceiling are placed rows of corrugated plastic piping filled with cold water. The moisture from the plants condenses on the pipes and the heat is transferred to the water inside the pipes. The drops that have formed on the outside of the pipes are collected in a gutter which returns the water to the plants.

The water in the plastic pipes runs back to the heat-pump which in the first place pumped it up to the ceiling. The heat-pump then pumps the heated water to the house's heating system, or for sale to the district heating network. The Plus-energy house has a cold store which evens out the differences between cooling demand and the heat-pump's production of cold water. Due to this the size of the heat-pump can be reduced.

WATER - WASTE WATER - NUTRIENT RESSOURCES.

WATER CONSUMPTION.

The normal personal water consumption in Denmark is 200 litres per day. Of this 60-80 litres are used in the kitchen and for bathing and personal hygiene. The remaining 120-140 litres are used in flush-toilets, laundry etc. These 120-140 litres of drinking-quality water are substituted in this building project by so-called freshwater, which in this case is a mixture of harvested rainwater, together with biologically and hygienically treated wastewater.

WASTEWATER TREATMENT.

All wastewater from the buildings passes through a 3 chamber septic tank, where solids sink to the bottom. The remaining wastewater is then treated in a so-called "green wastewater treatment system", which is established in the dome at the lowest part of the site. This form of treatment is based on solar energy, in that algae and higher plants remove nutrient salts. As well as plants the system utilises bacteria, zoooplankton, snails, freshwater mussels and fish. There are no noxious smell problems associated with the process.

HYGIENISATION OF THE WATER.

The wastewater which has been treated for nutrients receives a final treatment for pathogens in an hygienisation device. A combination of shock waves and ultraviolet radiation ensure a 100% destruction of pathogenic organisms.

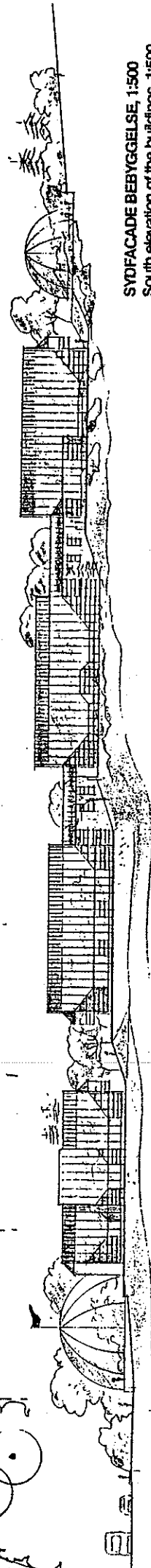
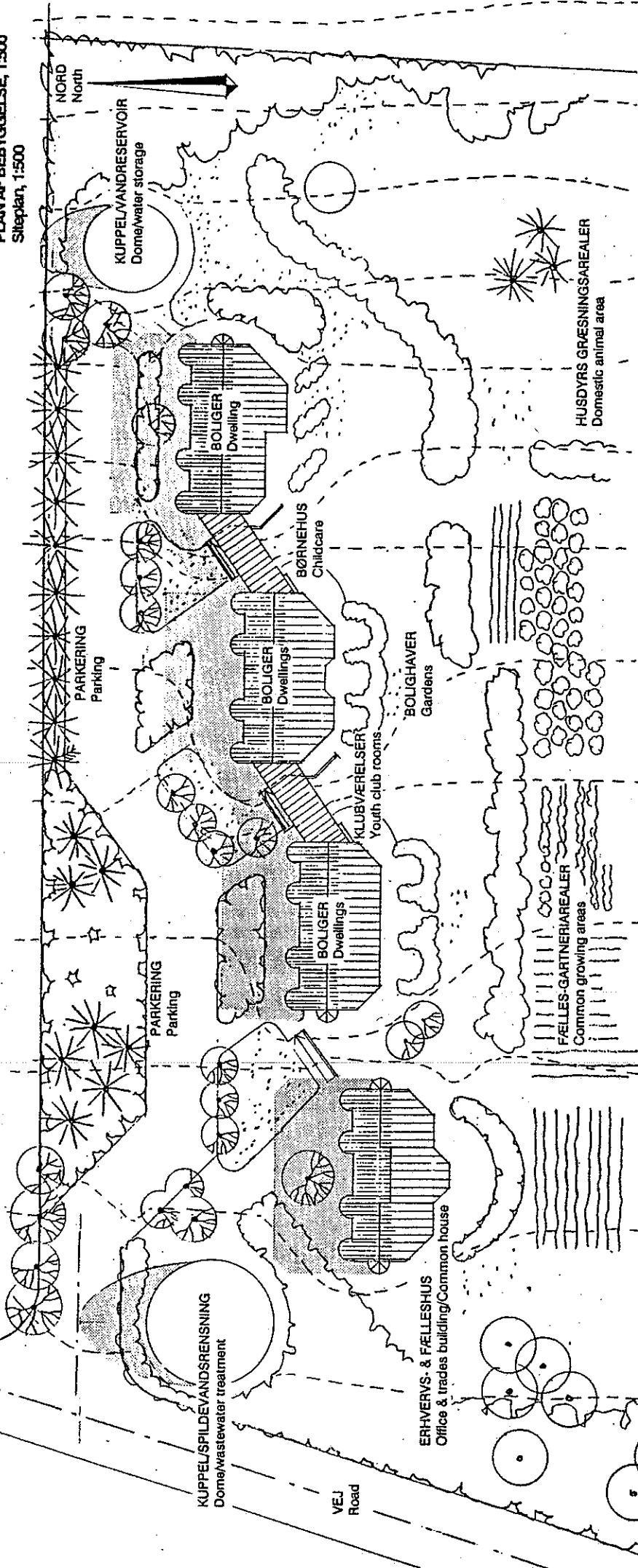
FRESH-WATER RESERVOIR.

After hygienisation the treated water is pumped up to the little dome at the top of the site where it is oxygenated in a water-stair. The treated water, together with harvested rainwater is now stored for use in the buildings.

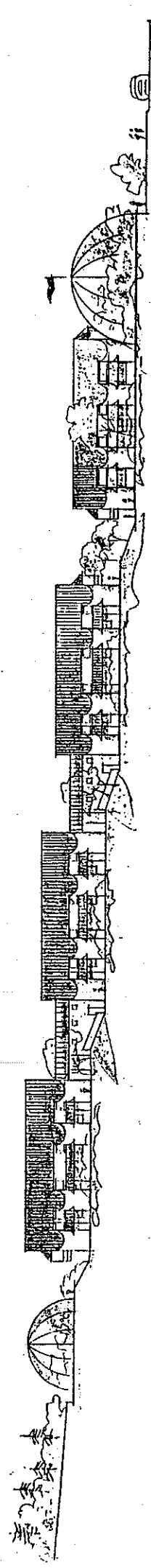
FRESH-WATER UTILISATION.

The primary function of the freshwater is for recirculation to the buildings where it is used for laundry, toilet-flush and watering of houseplants. Water that is in excess of the buildings' demand can be used in the dome for freshwater crayfish culture, or for watering of outside areas.

PLAN AF BEBYGGELSE, 1:500
Siteplan, 1:500

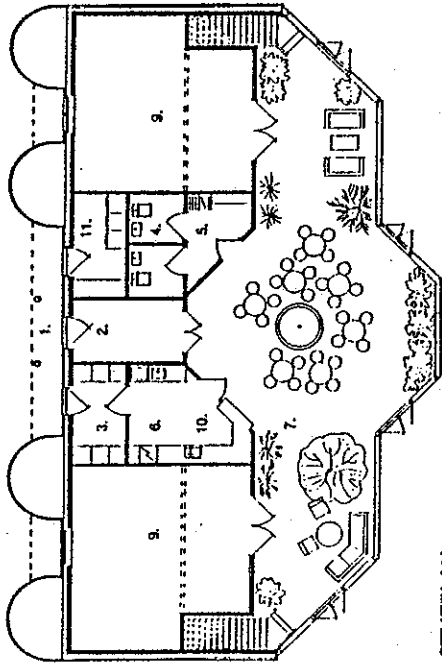


SYDFACADE BEBYGGELSE, 1:500
South elevation of the buildings, 1:500



NORDFACADE BEBYGGELSE, 1:500
North elevation of the buildings, 1:500

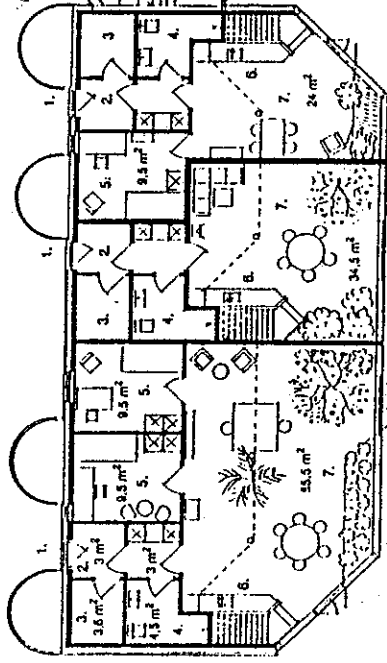
ERHVERVS- & FÆLLESHUS
Office & trades building/Common house



STUEPLAN
Ground floor
200 m²

- 1. SALS PLAN**
1. floor plan
110 m²
- | | |
|----------------------------------|-----------------------------------|
| 1. INDGANG | Entrance |
| 2. ENTRE | Porch |
| 3. DEPOT | Store |
| 4. TOILET | Toilet |
| 5. GARDEROBE | Wardrobe |
| 6. KØKKEN | Kitchen |
| 7. KANTINE & FÆLLESRUM | Canteen & Common room |
| 8. BALKON | Balcony |
| 9. ERHVERV, VÆRKSTED EL. ATELIER | Office, trade workshop or atelier |
| 10. KIOSK | Kiosk |
| 11. VASKERI | Laundry |

BOLIGER
Dwellings

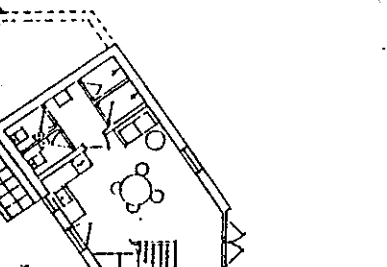


STUEPLAN
Ground floor
140 m²

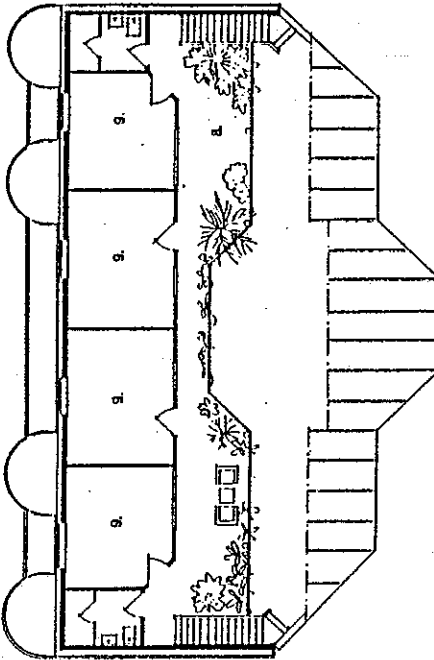
- 1. SALS PLAN**
1. floor plan

- | | |
|-------------|-------------|
| 1. INDGANG | Entrance |
| 2. VINDFANG | Porch |
| 3. DEPOT | Store |
| 4. BAD | Bathroom |
| 5. VÆRELSE | Room |
| 6. KØKKEN | Kitchen |
| 7. AL-RUM | Dining area |
| 8. BALKON | Balcony |
| 9. STUE | Living area |

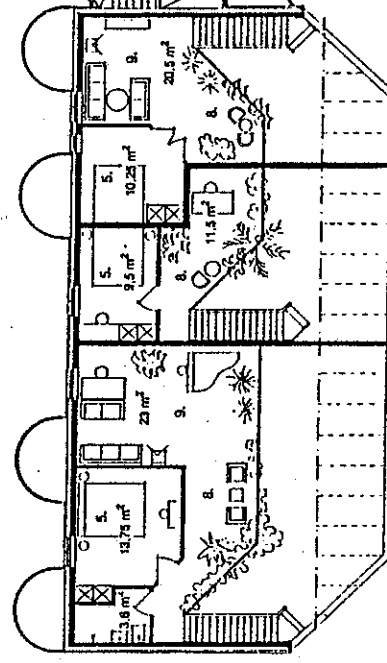
UNGDOMSBOLIGER
Youth clubrooms



STUEPLAN
Ground floor
78 m²



STUEPLAN
Ground floor
70 m²



1:200

Bygningsbeskrivelse

Forudsætningerne for den valgte byggeteknik er et byggeri med lavt energiforbrug ved fremstilling samt minimal vedligeholdelse og energiforbrug ved drift. Byggeriet er baseret på standardiserede og industrialiserede komponenter i en simpel byggeteknik, der kan udføres af enhver håndværker uden brug af særligt grej.

Der er valgt en meget enkel finish, som i kombination med en minimering af de dyre kvadratmetre (køkken og bad) og billige glashuskvadratmetre samlet giver en håndværker m²-pris på 4.600 DKK. Til sammenligning koster socialt boligbyggeri i Danmark ca. 6.500 DKK/m².

Lysindfald

Mobiliseringen bevirker store variationer i lysindtag i tag og vægge i husets glasdel.

Når isoleringskuglerne pustes ud i glasbanerne lukkes for lysindfald. Tagbanen bliver da hvid og en anelse translucent og ligner et hvidt glasloft inde fra rummet. 3 glasbaner styres samtidig. Oplydningsgraden kan derfor være forskellig hen igennem rummet.

Rummene mod nord har små vinduer, men får også lys fra syd gennem glasdøre til alrum og balkon.

Maximalt kan lysindfald begrænses til de rimeligt store glasdørspartier.

1. salens balkon kan evt. opdeles med faste og oplukkelige glaspartier efter beboernes behov.

Description of buildings

The principle behind the chosen building technique is creation of a building where the energy cost of building materials is low, and where there is a minimum demand for maintenance and energy consumption in its lifetime. The building style is based on standardised industrial components and an uncomplicated building technique, which can be easily be implemented by the building trades, and without the use of special equipment.

A simplified finish has been chosen, and this together with a combination of relatively cheap glass-covered areas and a minimising of the expensive square metres (kitchen and bathroom) gives an ab builder price of 4,600 DKK/m². For comparison, the normal cost of social housing in Denmark is approx. 6,500 DKK/m².

Light

The mobile insulation gives large variations in light intensity through roof and walls in the glass covered part of the house.

When the insulating beads are blown into the space between the glass the transparent surfaces are blocked for the passage of light. The windows, seen from beneath, look like a white slightly translucent glass-ceiling.

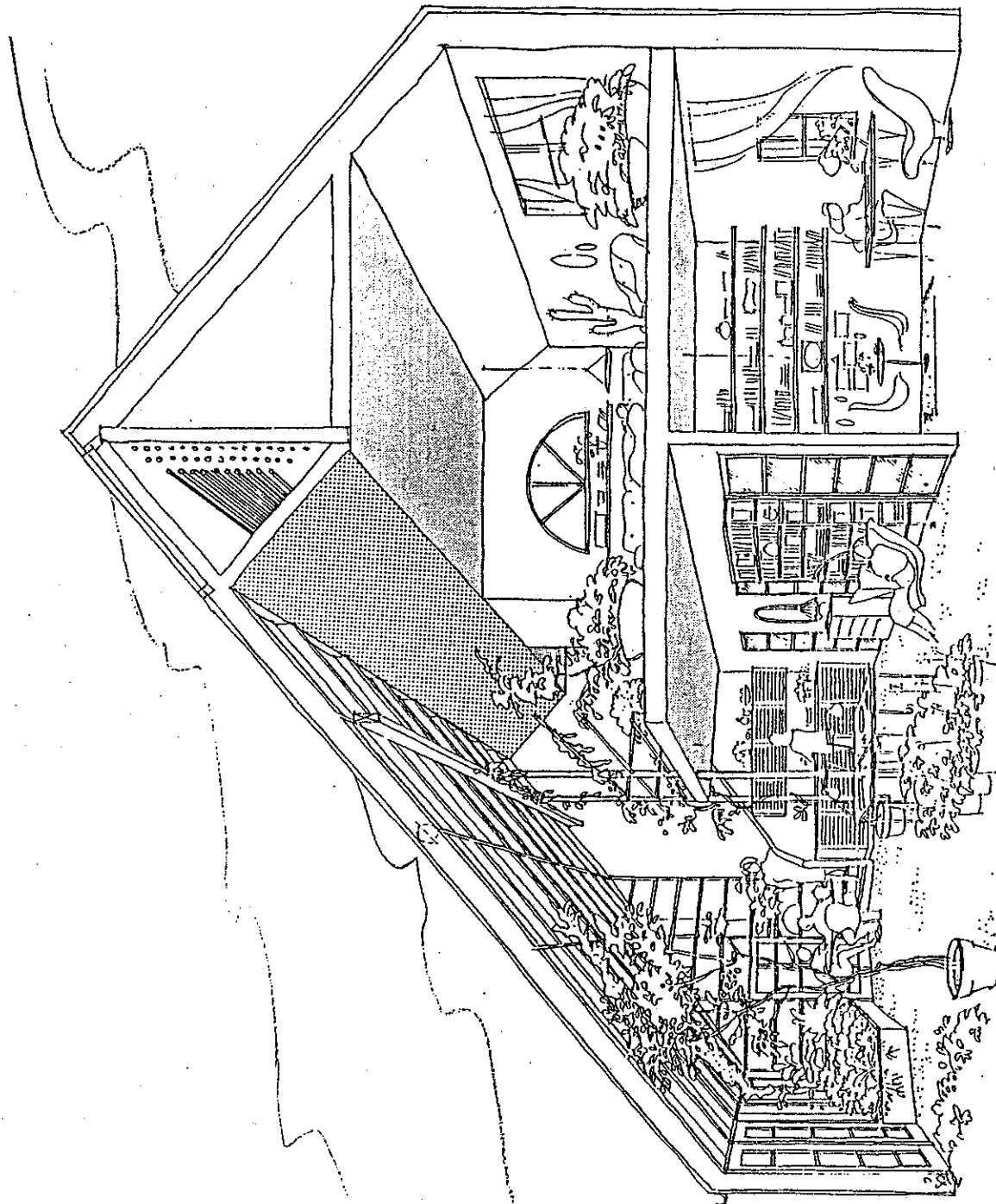
The channels which make up the glass roof, are controlled in threees. The degree of filling can thus be different for different areas of the room.

As a maximum the light penetration can be reduced to the light coming through the rather large glass doors.

The rooms to the north of the building have small windows, but get additional light from the south through glass doors to the living-room and balcony.

The first floor balcony could be divided by openable or fixed glass partitions, according to the tenants wishes.

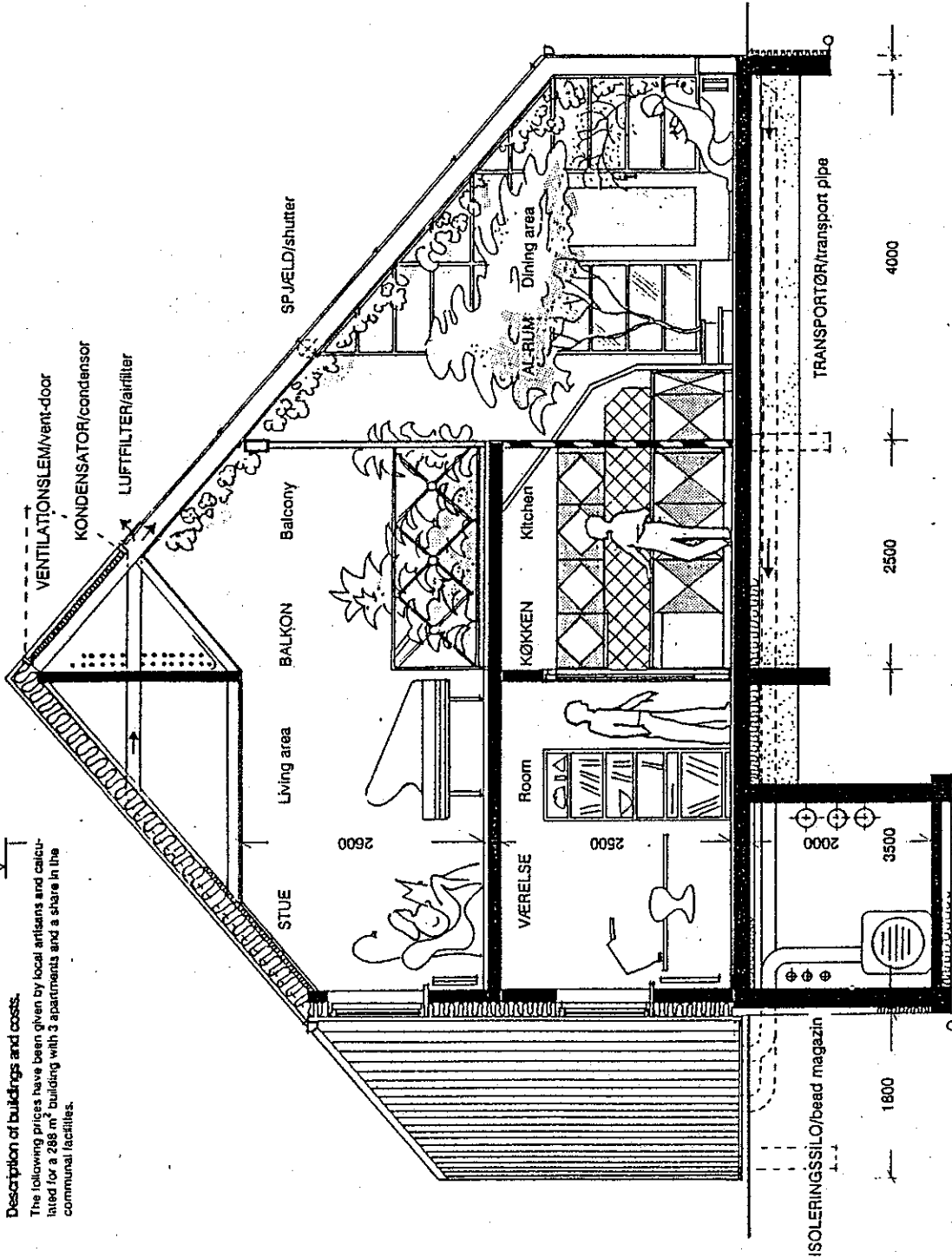
INTERIÖRPERSPEKTIV, SET FRA AL-RUM
Interior perspective drawing, seen from dining room



8000

Description of buildings and costs.

The following prices have been given by local artisans and calculated for a 288 m² building with 3 apartments and a share in the communal facilities.



Bygningsbeskrivelse og økonomi

De følgende priser er indhøvet hos lokale entreprenører og regnet på en boligblok med 3 stk. lejligheder, plus andel i tekniske fællesanlæg.

MURER- OG JORDENTREPRISE: 219.000 DKK = 706 DKK/m²
 Udgravning, støbning af fundamenter og ingeniørgang, randisolering, terrændæk på støbsbatts og 40 cm LECA-nodder, 4 cm slidlag i hvid eller farvet cement, der stenslibes (som terrasso), dræn og lagvandsaflob til ingeniørgang, samt fliser i brusestiche og ved køkkenbord.

LECA-ELEMENT ENTREPRISE: 205.150 DKK = 662 DKK/m²
 Udvendige væglementer i 15 cm, indv. 10 cm. Lejlighedsstak i 20 cm elementer, samt 16 cm etagedæk. (Montage med lastbøjkran).

TOMRENTREPRISE: 481.570 DKK = 1.553 DKK/m²
 Limtræsspær 6,5x20 cm, 2x5 mm hærdet glas, div. beslag, stålpladebeklædning, søjler i stål, 15 cm mineraluldisolering i vægge og 25 cm i laglade, inddækninger, gibstoffer, udluftningslemme, plastvinduer med 3 lag termo, udvendige isolerede døre, indvendige glasdøre, hævedøre i aluminium med 2 lag termo, trapper, 12 mm trægulve i stue og værelser, køkkenelementer samt ventilation, komfur og vask, garderbeskabe.

VVS: 265.000 DKK = 865 DKK/m²
 Radiatorer og andel i varmecentral, armaturer, sanitet, ventilation, spildvand og kloak samt andel i rensningsanlæg og vandrecirkulering.

EL: 46.000 DKK = 148 DKK/m²
 Eltavle, delvis synlige installationer af stik og afbrydere (120 stk.), andel i el-stik.

MALERENTREPRISE: 21.700 DKK = 70 DKK/m²
 Vægge og loft med hvid cempexo, støvbinding af stenslebne gulve, samt maling af indv. døre.

VARMEINDVINDINGSANLÆG: 76.000 DKK = 245 DKK/m²
 Varmepumper, lagertank, kondenseringsslanger, fittings.

MOBILISOLERING: 108.000 DKK = 348 DKK/m²
 Siloer, blæsere, rør, fittings, isoleringskugler.

BYGNINGSENTREPRISE: håndværkerudgifter = 1.422.421 DKK
BYGNINGSENTREPRISE: pr. m² = 4.588 DKK

MASONRY AND

SITE EXCAVATION: 219.000 DKK or 706 DKK/m²
 Includes: excavation, formwork for foundations and engineer passage, foundation insulation, concrete flooring on hard fibre insulation and 40 cm of burnt clay insulation pebbles (LECA-nuts), 4 cm covering layer of polished white or coloured cement (like a patio-finish), sewage and rainwater drains connected to engineer passage. Tiles in shower cabin and around kitchen working tops.

ERECTOR OF LECA-ELEMENTS

(insulating element elements): 205.150 DKK or 662 DKK/m²
 Includes: external wall elements 15 cm thick, internal elements 10 cm thick, partition walls of 20 cm thick elements, plus 16 cm first storey flooring (erected by terry crane).

WOODWORK AND CLOSURE: 481.570 DKK or 1.553 DKK/m²

Includes: laminated beams 6.5 cm x 20 cm, 2 layers 5mm hardened glass, diverse fittings, steel sheeting, steel supports, 150 mm mineral wool insulation in walls, 250 mm insulation in north facade, plasterboard ceilings, ventilation openings, plastic window frames with 3 layers thermoglass, external insulated doors, internal glass-doors, french windows (aluminium with 2 layers thermoglass), stairs, 12 mm wooden floor in living and other rooms, kitchen units and ventilation, cooler and sink, wardrobes.

PLUMBING:

265.000 DKK or 865 DKK/m²
 Includes: radiators and share in central heating system, armatures, W.C. handbasin etc., ventilation, wastewater and sewage plus share in treatment and water recirculation system.

ELECTRICITY:

46.000 DKK or 148 DKK/m²
 Electrical meter board, partially visible plugs and switches (120 pcs), share of utility connection fee.

PAINTING AND DECORATING:

21.700 DKK or 70 DKK/m²
 Walls and ceilings with white Cempexo (cement based paint), dust binder for stone polished floors, inside doors.

HEAT PRODUCTION SYSTEM:

76.000 DKK or 245 DKK/m²
 Includes: heat pumps, storage tank, condensation pipes, fittings.

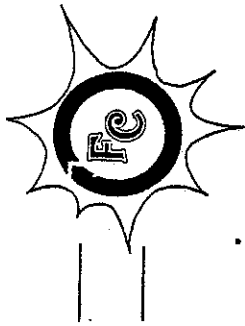
MOBILE INSULATION:

108.000 DKK or 348 DKK/m²
 Includes: silos, blower, transport pipes, fittings, insulation beads.

BUILDING CONTRACTOR:

1.422.421 DKK or 4.588 DKK/m²
 Artisans expenses

PRINCIPSNIT AF BOLIG, 1:50
Section of house, 1:50



Nordvestjysk
FOLKECENTER
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