MSc Wood Based Building Design
for Sustainable Urban Development

TU WIEN CONTINUING EDUCATION CENTER

POLITECNICO DI TORINO

TECHNISCHE UNIVERSITÄT DRESDEN

eco-village Absam

Vision for a collective housing in future with renewable resources

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
Dr. Yoshiaki Amino

DI. Markus Englisch
9818511

Innsbruck, Feburary 2010

TU WIEN CONTINUING EDUCATION CENTER

POLITECNICO DI TORINO

TECHNISCHE UNIVERSITÄT DRESDEN

Affidavit

I, **Markus Englisch**, hereby declare

1. that I am the sole author of the present Master's Thesis, "ecovillage Absam; vision for a collective housing in future with renewable resources", 82 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 12.02.2010

Signature

Abstract

Starting point of my thesis occures after meeting Prof. Flach in Garmisch at the „holzbauforum 2009“. There I get also interesting lectures about wood based flexible urban buildings.
He reports about his project *Intensys*, an alternative renewable social housing project with an interdesciplinary team of sociologists, technicians and urban planners.

The idea to develope the project as an *eco-village* with multifunctional program was born further on. It should be run with autarc energy flow systems.

Aim of my study is the research of reducing factors for energy consumption in residential buildings. The whole life-cycle (construction; life-time and recycling) is focused on using renewable resources through **interdepending design criterias** to create a social sustainability. In the last part of my thesis, all choosen building-tools takes influence on two prototypes.

From the diversity of living typologies like terraced houses, courtyard houses, loft-maisonettes and apartments buildings, I emphasized on two significant architypes with different philosophies.
The **cross-generation housing** will become more and more attraction for the future with their additive services. The **courtyard housing** type is a well-proven alternative to detached houses for young families. The proposal shows a solution for wooden-based construction design with the natural materials straw and loam.

Table of Content

1 Motivation

Wood as a high efficient material

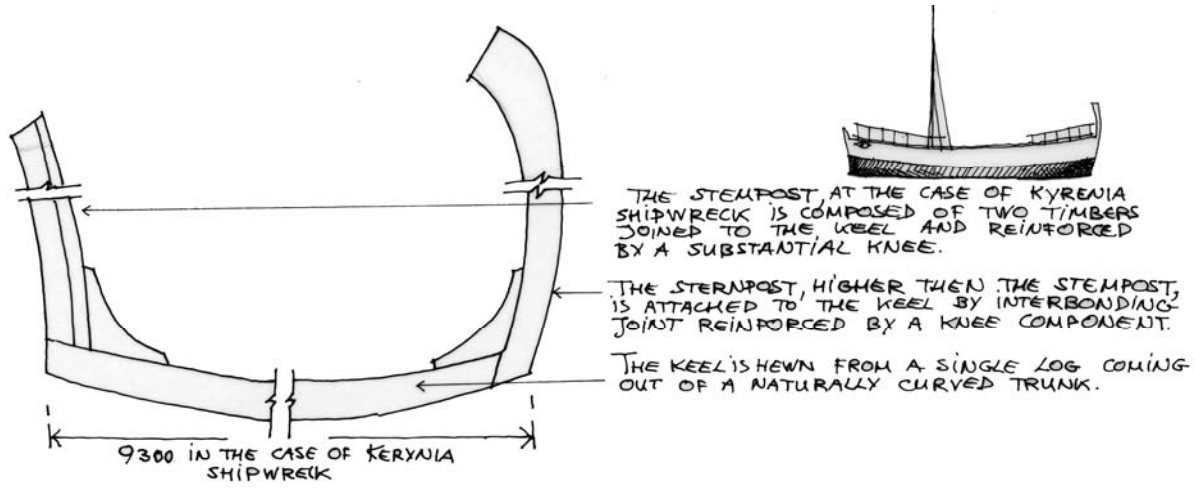
Wood is a highly efficient material in its natural growing context, which is in general too complex for us that we could analyse it without destroying.

It grows as the natural forces (slope, wind, sun orientation etc) are attacking it with the reaction of a higher strength like in parts as compression or tension wood.

Prof. Haller is using the 3d-photogrametry for scanning the branches of trees, to get an idea about the inner structural strength by analysing the outside form. (lecture of Prof.Haller, 2008 TU-Dresden) [1]

This could be a step to reuse the capacity of this kind of timber for wood-wood connections.In the middle age these natural curved wood had a high value compare to straight trunks, because of the application for the ship construction.The higher strength in this parts was well known. They used them in the hulk, where the most aggressive forces from the waves occur [2]. In these days, they had not any knowledge about the anatomic properties and the anisotropic character of wood.

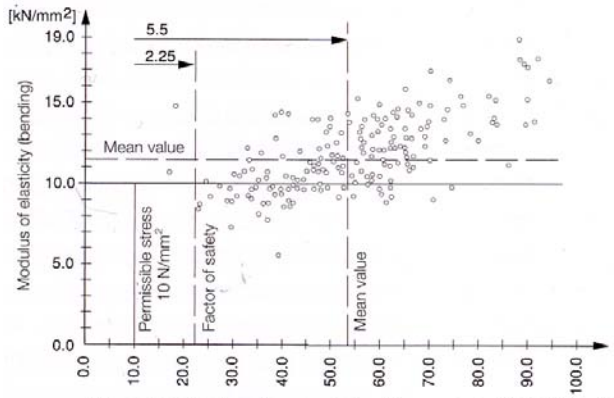
1.1 curved wood from branches and trunk



1.2 Freehand sketch of Prof. Panos Touliatos; curved wood used in the hulk of ship construction [2]

Today we have lost the knowlegde of craftmanship for these constructions and the use for the natural curved wood. For the wood industry, the straight trunk has a higher value and can be used for standardized sections. All the other parts of the wood fees into a downgraded process like paper or partical boards, which need much energy for the composite-process.

The industrial context has build up a classifing hierachy and even in the new Eurocode 5 we dimension our sections with the worst case of the classified wood.



1.3 relationship between modulus of elasticity and ultimate stress messured with ultrasonic [30]

Non-destructive tests

Prof.Natterer has developed tests with ultrasonic, laser and acoustic values to select the pieces on side for their demanded loads. He shows with these methods the wide range of pieces, which has an individual higher strenght than the classification says [3].

On a workshop in France, Epinal "le Defis du Bois" I get in contact with practical testing method and how strong structures build by vertical orientated boards can be. The Working task was to construct a wooden structure to reach the neighbour for a symbolic shaking hand. Between the two groups was a span of 14m. We needed to estimate if our platform would be strong enough to carry the five participants with a cantilever of 7m. We made some strain tests on a table before lifting up the whole structure. For the building process we had a limited quantity of material.

1.4 learning by doing „entre deux"-project in process

All further mentioned, gives me the advice that we should take care, how to use wood-or wood composite materials for the building sector.There should be a potential to use wood in a more efficient way in construction and in combination with other renewable resources. In the past mostly in Europe, the wood-constructions were mixed structures where wood was used for the load-bearing construction; the thermic envelope mostly was done with other renewable resources like straw, loam and stone.

1.5 "Umgewindehaus" in the region of Oberlausitz

I want to give special thanks to Dr. Yoshiaki Amino for his advices by the development of my project and the professors of the three modules for their interesting lectures and given input. I want to give Exclusive thanks to my cheaf who gaves me the time to work on my project for the last 3 month and my sister and husband for their help to motivate me repeatedly. Thanks to all participants of UrbanWood, who helps me a lot and the nice time together in Dresden, Torino and Vienna. I hope we will stay in contact.

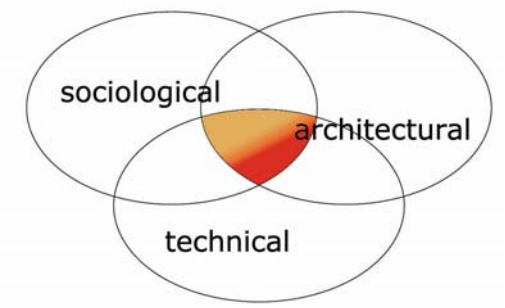
2 introduction

Introduction

The agglomeration around the city of Innsbruck is growing rapidly, without limitations of land consumption; consequences are high rising costs for infrastructure (water pipe, streets etc.) and mobility. Especially Tirol lacks with affordable land for building. The building costs and the real estate value in Tirol are the highest compared to whole Austria. Innovative high-density housing projects could prevent these tendencies and should give alternatives for the individual dream of an own detached house.

In my thesis, the interest of planning an ecovillage shows the different interdependent criterias, which have a mutual influence to construct a **sustainable settlement** for a micro society. The **combination of wood with other natural grown materials** by using them in their natural given properties, has a high potential for saving energy, by recycling them easily and by creating a healthy envelope. The **developement of the urban plot** has a big influence for creating **social tolerance** as a part of sustainability. The developement of the different building types are in relation with this urban plan.

There will be some interdependant design criterias in case of three different fields



2.1 interdepending fields

Hypothesis

High-density housing has a better potential in case of land-development, building-costs and energy consumption as solitary detached housing settlement in the agglomerations. Between sociological, architectural and the technical sustainability, there is to find the good solution for the inhabitants. Low-rise to middle rise high-density building types have a good capacity to interact between these three aspects.

...

Questions:

What influence has the topography, the environmental location and the existing urban plot for the concept of project? Which construction methods and what building design will be suitable for different generations of residents? What building typologies will be developed?

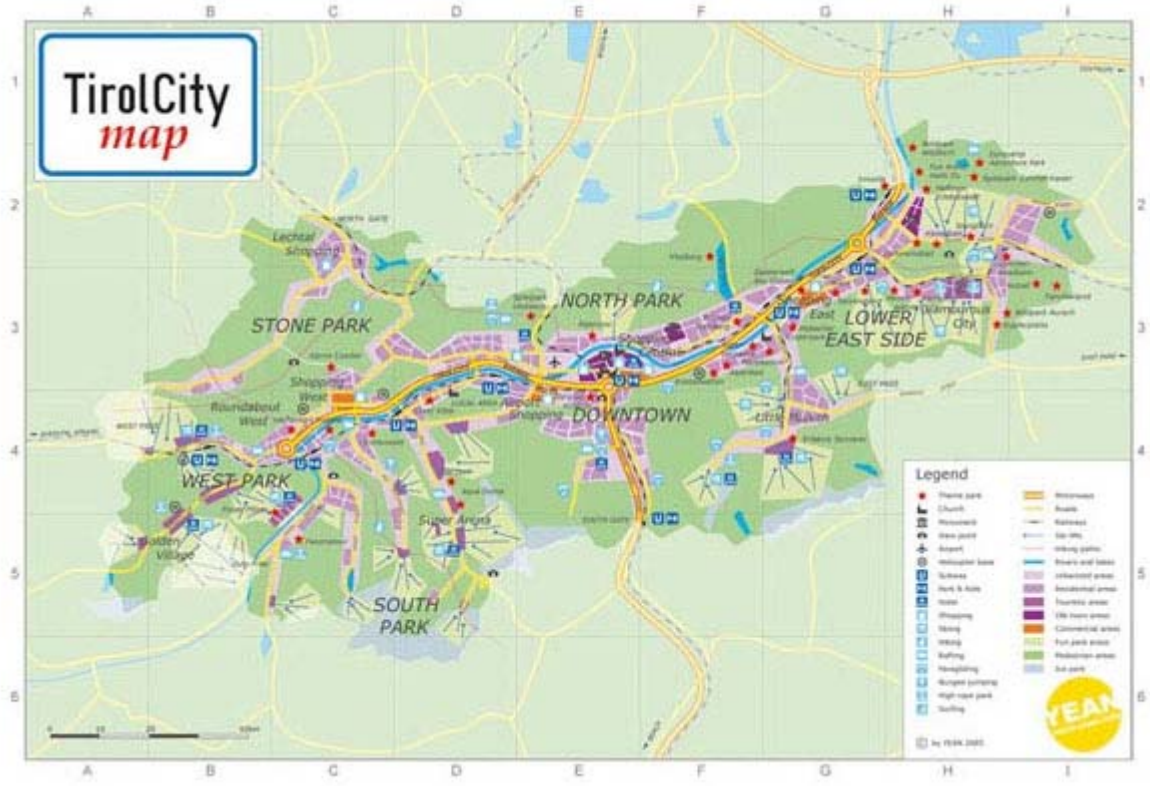
Target group:

Municipality of Absam or other small towns around Innsbruck, self-organised building cooperations

3 Absam and its agglomeration

3.1 TIROL: a region of contrasts

Tirol is famous for its unspoilt nature, magnificent Alpine landscape and traditional farming. But in fact the **agricultural sector** today employs **no more than 5 per cent** of the working population, and more than 60 per cent of the Tyrolean population live 800m below sea level in the densely populated 'Inntal'. The amorphous structure of the settlement area spreading along the 150 km-long 'Inntal' and its adjoining valleys is home to **636,000 people** (7.8 per cent of the total Austrian population). The main characteristics of the region are the **limited amount of usable land** (only 13 per cent of the total area can be used for settlement due to the extreme topography), **mass tourism** (8 million visitors every year) and impressive traffic flows. Every year, 10.8 million cars cross the Brenner Pass, and **the Tyrolean ski lift network** can transport **more than 1.3 million people per hour**, which is comparable to the capacity of a metropolitan public transport network such as the Tokyo subway system. The importance of the 'Inntal' as a significant transit corridor is translated into a tightly knit pattern of roads, motorways, railway tracks and power lines, which are meandering, ribbon-like, along the river Inn. New trading estates and industrial zones are being set up at the major traffic junctions and slowly but steadily they are filling up the vacant areas between local communities with small-scale businesses, shopping malls, petrol stations, leisure parks, etc. The ongoing decentralisation is dissolving administrative boundaries between the communities, and new functional and social contexts are emerging that can only be understood within a larger context.([Yean 2005, TyrolCity][4]



3.1 Tirol as a long agglomeration – TirolCity map

3.2 facts to Absam and the agglomeration

Absam is integrated in the **small-region** 18 "Hall und Umgebung" with **36.000 habitants**. It is after Innsbruck itsself, **the largest small-region** in Tirol. The durable settlement area of this small-region has 3000ha that is **21.4%** of the whole land. 1/3 is already building plot. The divergence of the region is high, Gnadenwald has used just 7.8% as building plot, but the **city of Hall** has already changed **3/4** (77%) to building plot. Absam is just 3 km from Hall. It has already **34%** of the durable settlement area changed in land of building.

Dauersiedlungsraum und Flächenwidmung 1991

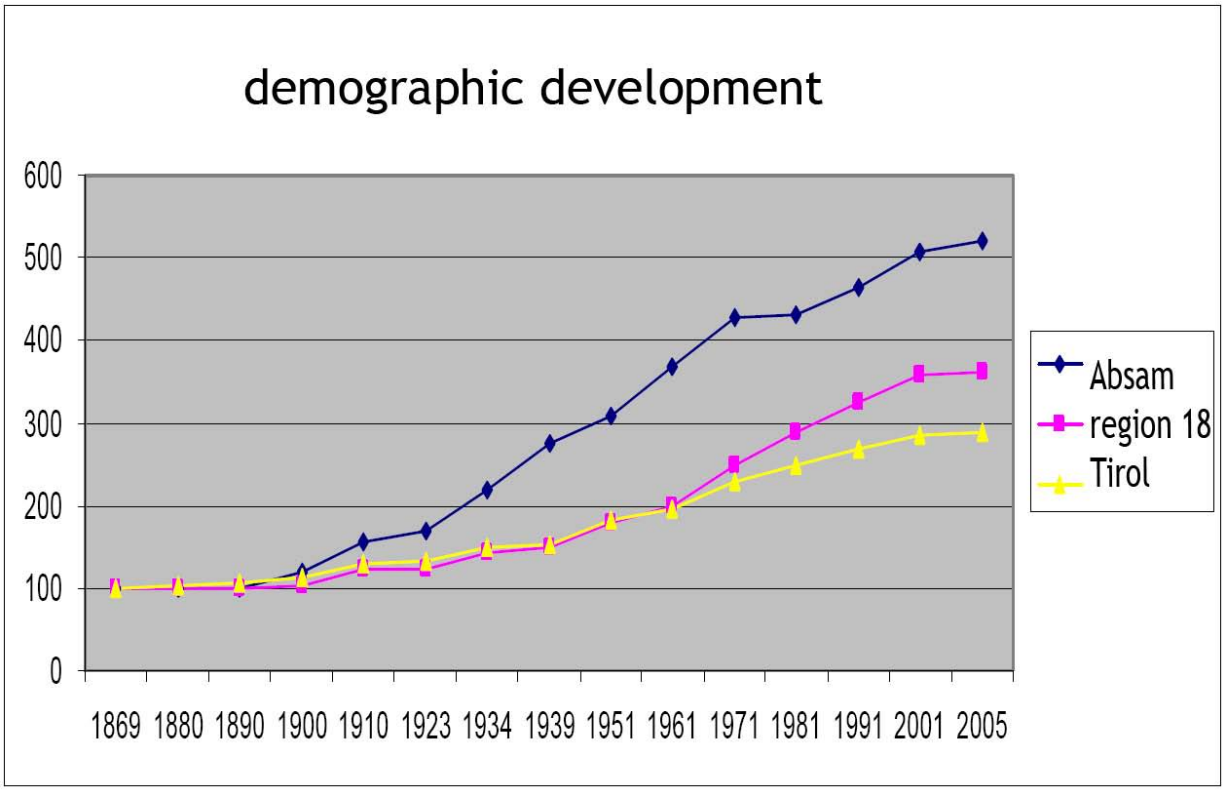
Gemeinde	Dauersiedlungs-raum (ha)	Gewidmetes Bauland ohne Sonderflächen im Freiland absolut (ha)	in % des Dauersiedlungs-raumes
Absam	467,2	162	34,7
Ampass	310,7	31,5	10,1
Gnadenwald	254,8	22,1	8,7
Hall i.T.	425,3	327,3	77,0
Mils	326,4	128,0	39,3
Rum	248,6	169,1	67,9
Thaur	569,1	122,6	21,5
Tulfes	422,3	49,0	11,6
Region 18	**3.024,4**	**1.011,6**	**33,4**

3.2.1 constant settlement-area and zonal dedication [5]

Growing tendancy of the region/ population

There is a growing tendency for the region around Hall and especially in Absam there is a **high demand of new building plots** for the population. A reason for this could be the close position to Hall and the good connections with bus, train and road to Innsbruck. At the same time Absam is founded as an origin of agricultural village which belongs to the MARTHA villages and has the image of „living on the countryside“ with the significant managed grassland with fruit trees „Streuobstwiesen“. One other argument for new incoming habitants from the cities is the rare affordable housing space, especially for young people and families. Absam

is member of the climate alliance communities in Austria and has get a certification for eco-management. Hot themes for the community in future are the Drinkwater-supply for Mils and the co-financiation of the purification system in Hall. Therefore, water economy becomes more and more a very high importance also in these areas of the Alps.



3.2.2 demographic development

demographic view of the small region 18

Wohnbevölkerung 1961, 1991 und 1998
Haushalte 1961 und 1991

	Wohn-bevölkerung 1961	Wohn-bevölkerung 1991	Wohn-bevölkerung 1998 *)	Zunahme 1961-1991 in %	Haushalte 1961	Haushalte 1991	Zunahme 1961-1991 in %
Absam	4.640	5.876	6.374	26,6	1.290	2.127	64,9
Ampass	534	1.141	1.306	113,7	134	370	176,1
Gnadenwald	309	558	583	80,6	65	183	181,5
Hall i. T.	10.750	12.384	11.526	15,2	2.975	4.499	51,2
Mils	1.101	3.687	3.785	234,9	243	1.149	372,8!
Rum	3.166	8.111	8.250	156,1	931	3.005	222,8!
Thaur	1.942	3.227	3.340	66,2	518	1.156	123.2
Tulfes	640	1.124	1.270	75,6	141	361	156,0
Region	**23.062**	**36.108**	**36.434**	**+ 56,4**	**6.297**	**12.850**	**+ 104,1**

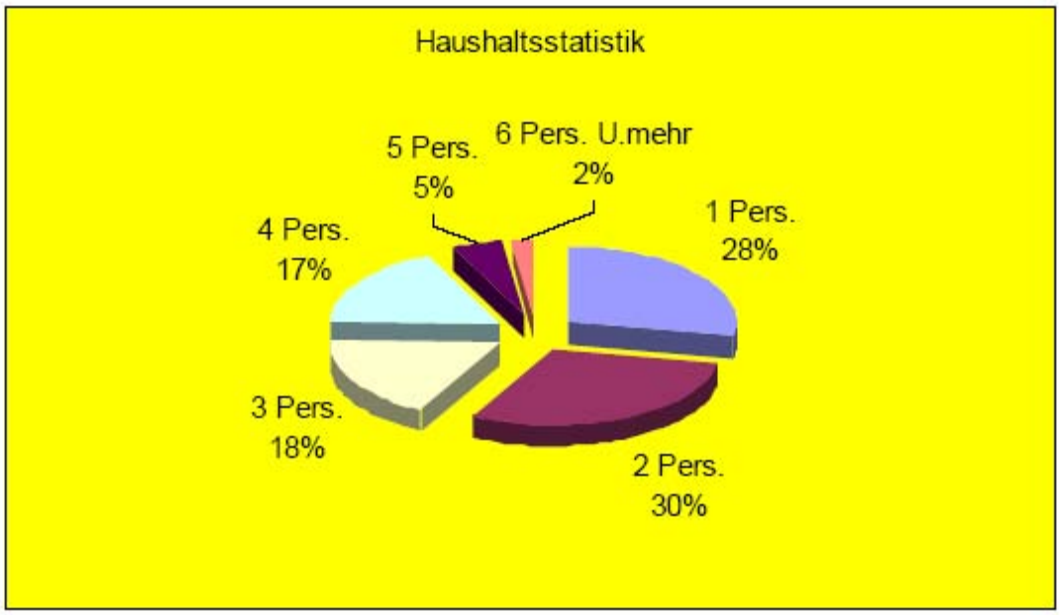
3.2.3 demographic view of small region 18 [5]

household Absam: **58% max 2 Pers.**

35% max 4Pers.

7% 5 or more Pers.

[Gemeinde Absam; Gemeindeversammlung 11.03.2005]



3.2.4 household Absam [6]

From the statistics of the housholds in Absam we can already see a trend to small households with 60% of them. The other 40% are mostly family households.

Location side

The building side is aproximatly 1km from the historical centre of Absam. The exposition of the building plot is south orientated. It is located on 685m altitude over the" Inntal", 3km from the next city Hall i.T.

The village Absam belongs historically to the MARTHA-villages along the old road to Innsbruck (MARTHA = Mühlau, Arzl, Rum, Thaur, Absam). They are all street villages, and they had all the same significant economic approach from the Argriculture. Today only 3% of the economy of the region is depending on farming.

Next to the building plot, there are several functions like a kindergarden, the church on west side and the primary school on south-east side. On the easten side there are detached houses with a low density. In the north side, there are apartment houses with three stories.

3.2.5 view over the construction site

4 ecovillage Absam

4.1 functional description

The ecovillage will be a part of the community of Absam-Eichat, that means all visitors, habitants and neighbors are welcome to active or passive participation. There will be three different layers located at a surface of 12800m²

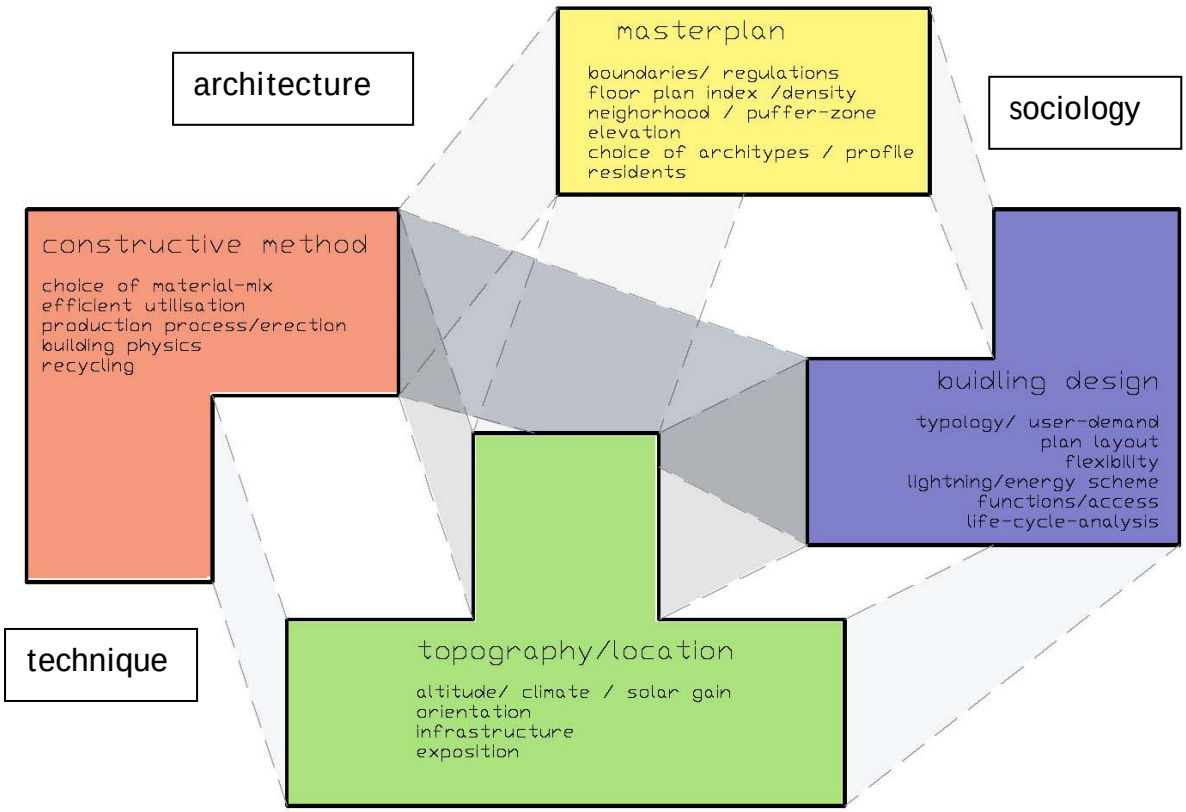
- living-space like appartement-housing, terraced and individual compact houses
- public functions and space as a community hall, offices and shops
- energy saving infrastructure, like photovoltaik, solarpanels and water-recycling-system

There will be a certain independancy from energy flow from the community, but it should be not seen as an island. It is more an experiemental settlement for a living space where a diversity of the society can meet and share resources.

The idealist form should show a vision of a **sustainable society,** which has their additional benefit by living in a heathy ambiance for the inhabitants, by saving environmental and economical outsources and by creating an intact social network, which is **spanning the generations**.

The buildings are demonstrating constructions with **renewable natural resources** where **wood is used as constructive load bearing system**. Infill materials are straw bales as superinsulation and earth-bricks for a higher thermal mass.

4.2 interdependent design criterias of the ecovillage



4.2 interdependent design criterias

There are many interdependent design criterias, which influence each other, and it is not easy to filter out the main task of them, even when there is a hierarchy of importance. In my case the most importance is related to the goal for a very low level of renewable energy consumption over the whole life cycle process. It starts with the intervention and building process, the energy demand of the whole service and ends with the demolishing and recycling on site. The following description will show the different design criterias and the chosen solution, which leads into the design proposal of two different architypes on the building plot.

4.3 the movement of ecovillages

Ecovillages are intentional communities with the goal of becoming more socially, economically and ecologically sustainable. Some aim for a population of 50-150 individuals because this size is considered to be the maximum social network according to findings from sociology and anthropology.[7]

(Hill, R. and Dunbar, R. (2002). "Social Network Size in Humans." Human Nature 14(1): 53-72. Retrieved on: 2008-04-09).

Ecovillage members are united by shared ecological, social- economic and cultural-spiritual values.[8] An ecovillage is often composed of people who have chosen a alternative to centralized electrical, water, and sewage systems. Many see the breakdown of traditional forms of community, wasteful consuming lifestyles, the destruction of natural habitat, urban sprawl, factory farming, and over- reliance on fossil fuels, as trends that must be changed to avert ecological disaster.

(Van Schyndel Kasper, D. (2008). "Redefining Community in the Ecovillage." Human Ecology Review 15:12-24. Retrieved on: 2009-08-27).

Definition:

In 1991, Robert Gilman set out a definition of an ecovillage that was to become a standard. Gilman defined an ecovillage as a:

- human-scale
- full-featured settlement
- in which human activities are harmlessly integrated into the natural world
- in a way that is supportive of healthy human development, and
- can be successfully continued into the indefinite future. [9]

(Gilman, Robert; Summer1991 "The Eco-village Challenge")

the origin of ecovillages_self-organised building groups

The orgin of ecovillages is a self-organised group of people who has their own definition of living together, so there is no principal planning hierachy between or above them, the group itself owns the building. The members of the ecovillage have the same rights to involve themselves to the project. Nevertheless, there is a certain selection to become a member of the participants.

In my case, this project is a **top-down project**, that means that the habitants are not the building owners. In this case the community of Absam is. This ecovillage has to be developed without the specific knowledge of the target group. It should be run over a certain time with a fluctuation of inhabitants. So we can get an idea about the demographic processes and statistical data of the community to plan for the future.

5 Low-tech-building tools

There will be different low tech tools used for the settlement which are mostly prevent a too much overloaded home automation technic inside of the building envelope. Therefore, the impulse is to use passive interventions in the building with simple methods, which are easy to prefabricate under controlled conditions. It is the goal to reach **zero energy consumption**, a low energy concept to build it up and an easy recycling system by avoiding multi-composite materials and to preferred renewable monolithic materials, like loam, straw and wood.

Brise-soleil (sun-breaker) as element or through constructive shape

Earth sheltering or **green roof** (cool roof in summer), in same manner collecting rain water as a swap. Rainwater collecting for graywater use

Non-sealed surfaces in the settlement area (intrusion of surface-water)

Passive solar buildings aim to maintain interior thermal comfort throughout the sun's diurnal and annual cycles whilst reducing the requirement for active heating and cooling systems.

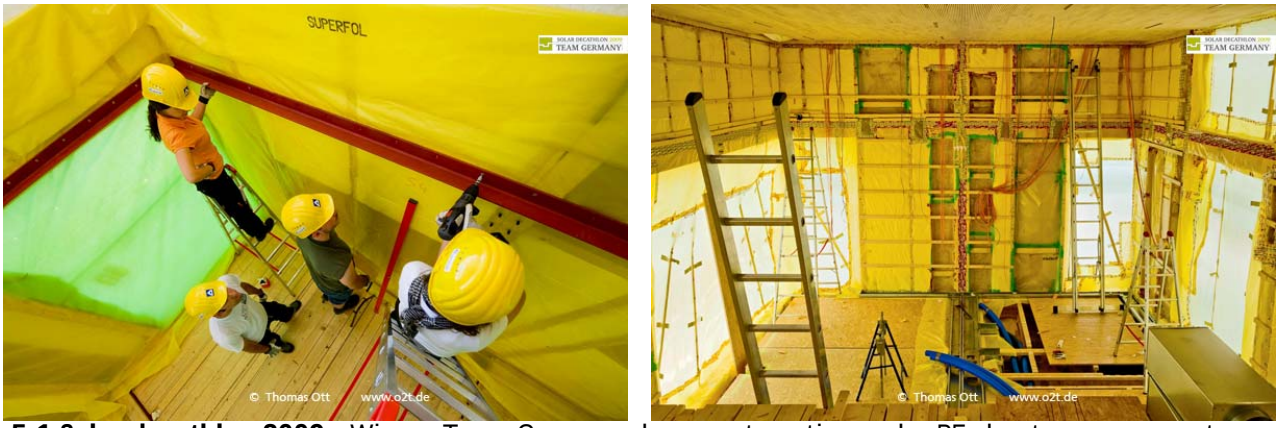
Using **thermal mass** to store excess solar energy during the winter day (which is then re-radiated during the night).

Heat enters the building through windows and is captured and stored in thermal mass (e.g water tank, masonry wall) and slowly transmitted indirectly to the building through conduction and convection.

Superinsulation with straw bales or cellulose flakes

By using raw materials (clay and straw) available on-site or in the region, environmental pollution caused by the manufacturer and transportation of building materials can be minimised. With the clay plaster applied directly on straw, an alternative to the otherwise commonly used films (mostly compound material made of fossilised synthetics) is available.

Air-tightness by the outside plaster layer or wind-paper (carton-paper, no PE-sheet)

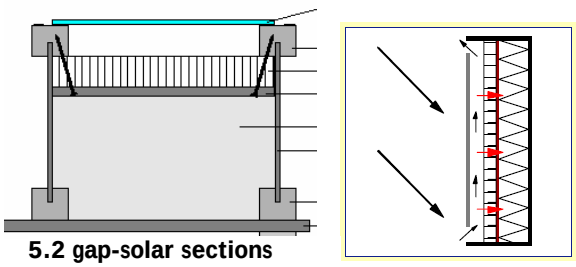


5.1 Solar decathlon 2009 - Winner Team Germany; home automation under PE-sheet – no comment

Qualified passive house windows (Uges = 0,7W/m²K with wooden frame)

Transparent insulation (TWD)

GAP- solarpanels with cartonhoney cams in the south-parapeth of the generationhouse



5.2 gap-solar sections

and in some parts of southfassade of courtyard house; U-value = min 0,08 W/m²k (www.gap-solar.at)

Common **photovoltaik-panels** on the facade (roof) of the community hall

Solar collector panel for warmwater/heating integrated as angular attica for the purification system in the north; orientated to the plaza

Surface-to-volume ratio (SA:V)

The surface-area-to-volume ratio also called the surface-to-volume ratio and variously denoted sa/vol or SA:V, is the amount of surface area per unit volume of an object or collection of objects. A cube with sides of length a will have a surface area of $6a^2$ and a volume of a^3. The surface to volume ratio for a cube is thus 6/a.

Independent from a given shape, SA/V decreases by an increasing volume, because of increasing the squaring surface area and the cubing volume.

Shape		Length a	Area	Volume	SA/V ratio	SA/V ratio for unit volume
Tetrahedron		side	$\sqrt{3}a^2$	$\frac{\sqrt{2}a^3}{12}$	$\frac{12\sqrt{3}}{\sqrt{2}a} \approx \frac{14.697}{a}$	7.21
Cube		side	$6a^2$	a^3	$\frac{6}{a}$	6
Dodecahedron		side	$3\sqrt{25+10\sqrt{5}}a^2$	$\frac{1}{4}(15+7\sqrt{5})a^3$	$\frac{12\sqrt{25+10\sqrt{5}}}{(15+7\sqrt{5})a} \approx \frac{2.694}{a}$	5.31
Sphere		radius	$4\pi a^2$	$\frac{4\pi a^3}{3}$	$\frac{3}{a}$	4.83

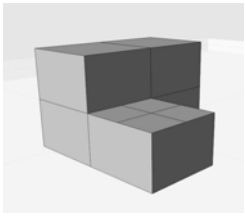
5.3 surface to volume ratio [www.wikipedia.org: surface area to volume ratio]

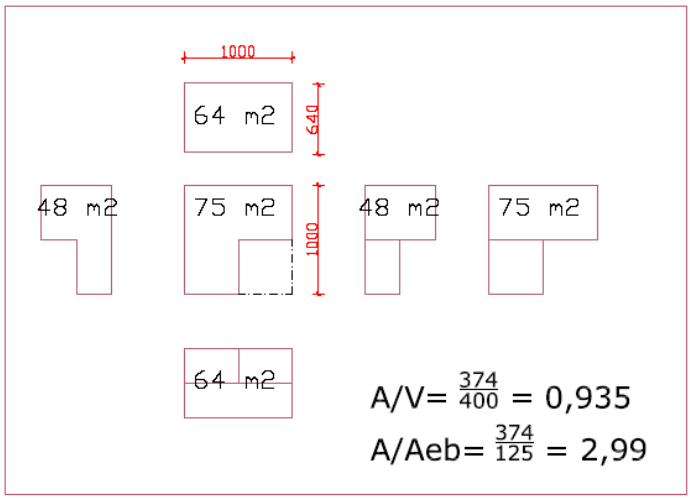
For typical detached houses we can reach SA/V = 0,8- 1,0m²/m³. By bigger compact units like multi-storey buildings, we can reach > 0,2m²/m³. In the new energy requirements EnEV 2009 in Germany, they use also the ratio between outside surface area and the heated useable surface. This relation is better comparable to different appartments.

Short overall calculation of the SA/V for the two-choosen architypes:

In the next tables, I want to give a short estimation for the two architypes courtyard and generation house

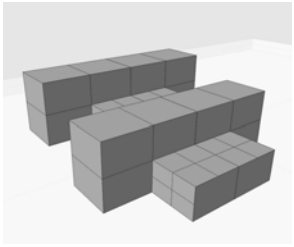
Courtyard house:

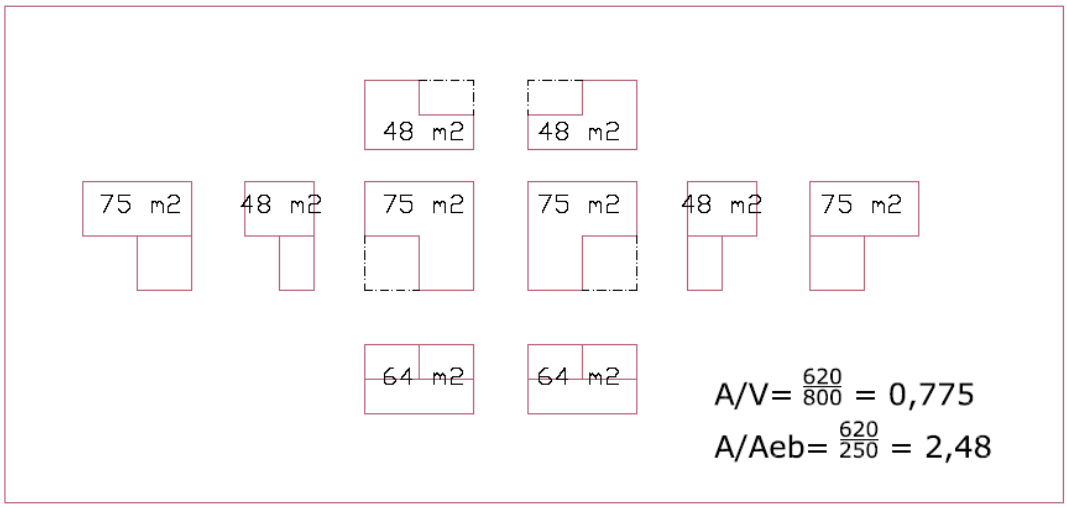




5.4 SA/V courtyard house

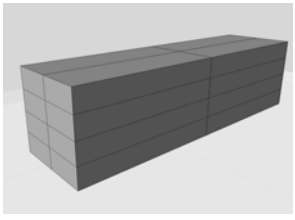
Double courtyard house as terraced houses with with two neighbors behind:

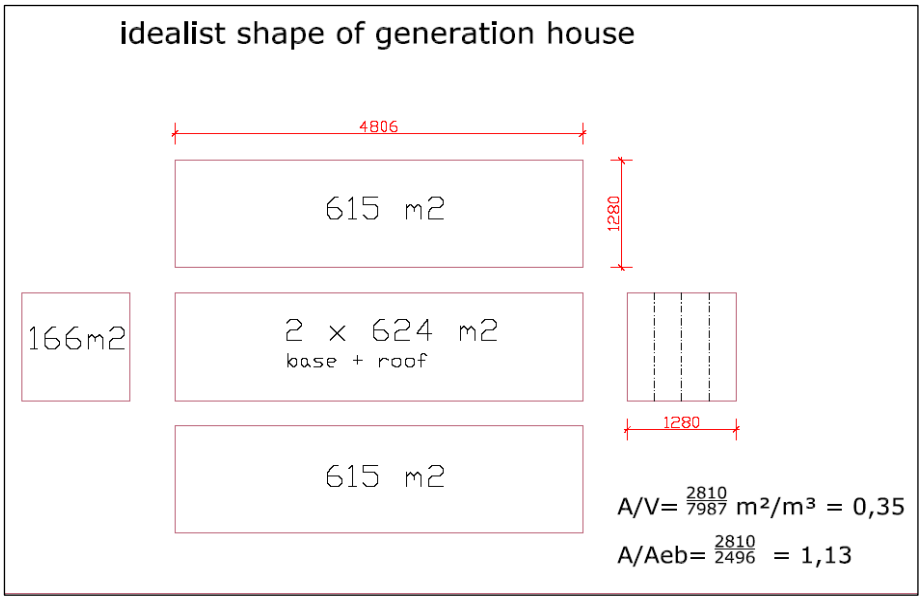




5.5 SA/V courtyard housing

Generation house in it´s row design:

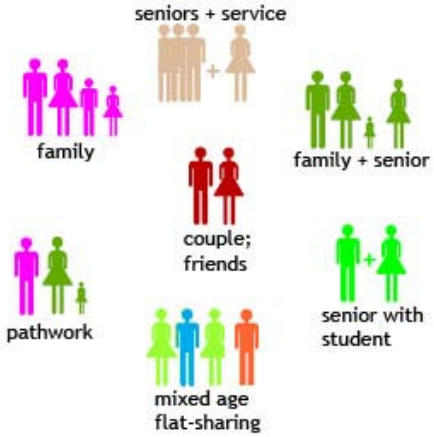




5.6 SA/V generation house

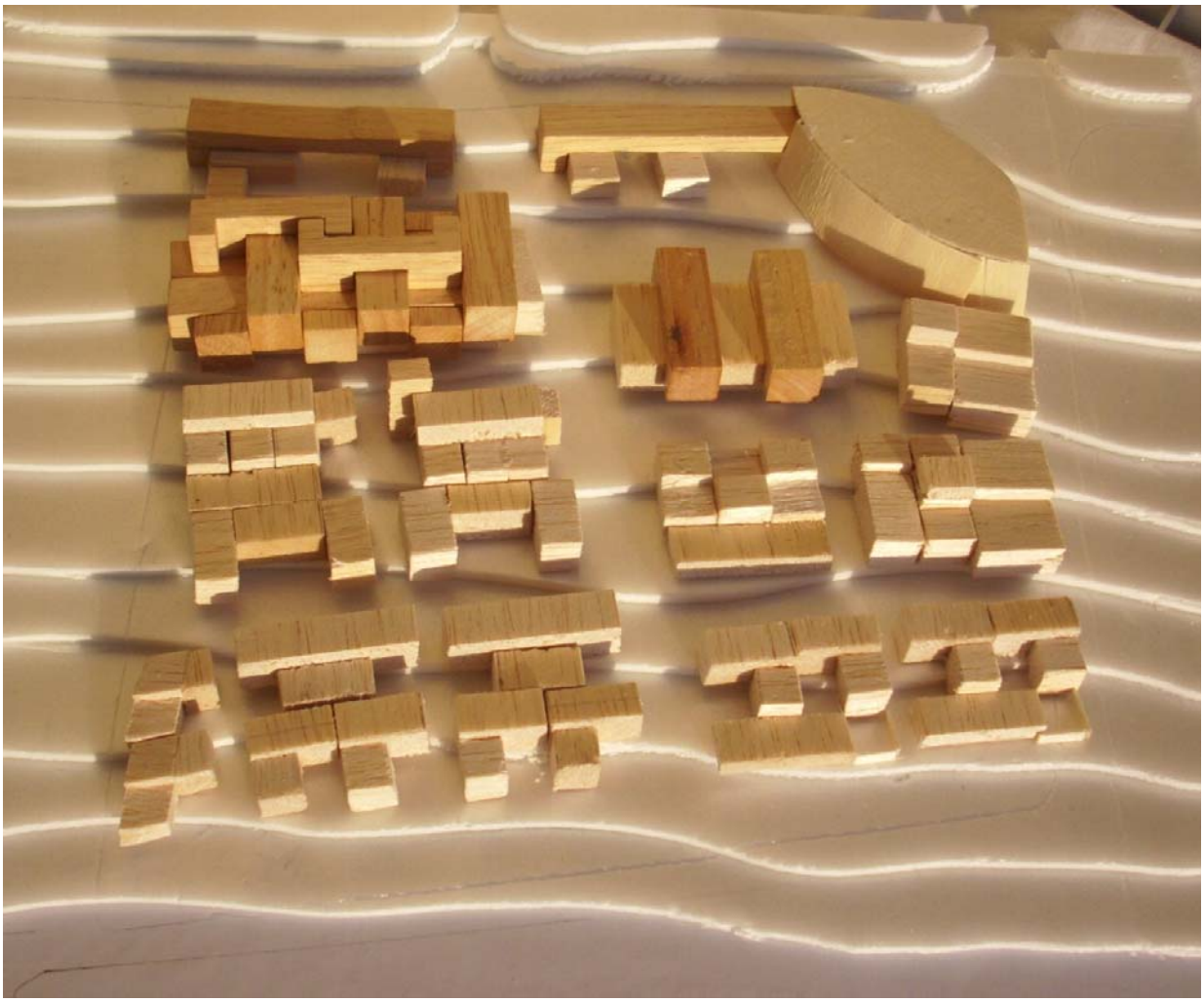
6 future society tendencies

There are different **target groups** of habitants for the future: [*typology*]



6.1 target groups

- **cross generational living** that appeals to people of all ages, but mostly there is a co-herance between young students and old peoples (55+) (economical/social) [*doublette*]; [*flat sharing_ mixed ages*]
- **peoples with special needs** (handicaped people, seniors etc.) [*assisted living*]
- family adapted housing or **patchwork-families**, comes from the [*individual housing*]
- **single parent**, adult + child etc. [*single M*]
- **singles**, young peoples (young workers,students, etc.) [*single S*], mixed age colocations
- inter-cultural living (minorities, freemover)
- combinations between **working + living** [*atelier*]; [*maisonettes*]



6.2 working-model of the urban- plot

Residential Living trends:

In the date of origin, there was an ideological colored community basement of young people, but later on it became more and more a pracmatical way of flat-sharing and at least a community structure of differnet households.

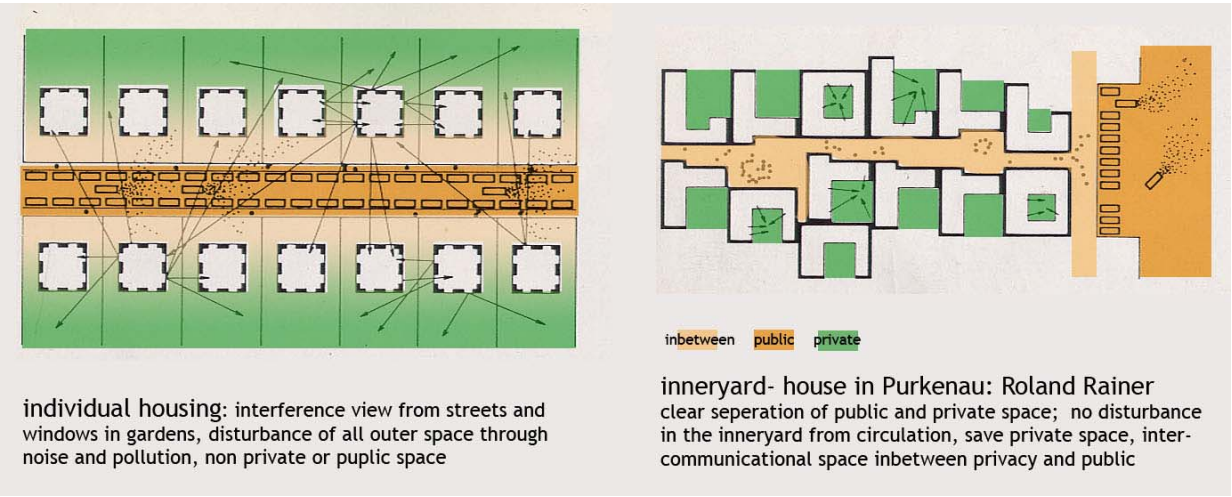
In the 80s, there were the first iniatives to create practicable, qualified and cost efficient commune living concepts, which should help manage the daily routine easier. In future, more and more new living concepts for seniors and communities with different therapeutical focus and socio-pedagogic approach will gain importance.

One motivation is to create social networks, in which definite household-functions could be done in cooperatives, to negotiate social isolation and to promote communication. It counterbalances discomfort in a globalised world, which are up-and-coming smaller household-types (singles, etc.) and gives us the chance to reach architectural standards, which could be able to finance better as community.

7 guiding ideas

7.1 guiding concept for the urban plot: Purkenau I+II Roland Rainer

Roland Rainer created with the project of Purkenau I in the late 60s his **own idea of a garden city** for a wide range of the working society. His structure shows a **diversity of housing types**, especially inneryard houses, but also four-storey apartment houses that he is using as a trafic wall to the outside. The aggromeration of Purkenau is just 15 km far away from Linz. He uses a **hierarchic principle** for the **seperation of public and private space**.



individual housing: interference view from streets and windows in gardens, disturbance of all outer space through noise and pollution, non private or puplic space

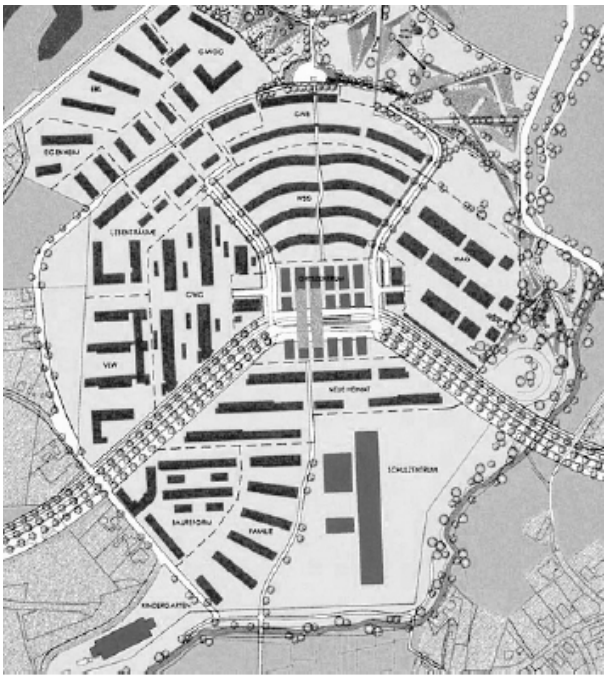
inneryard- house in Purkenau: Roland Rainer
clear seperation of public and private space; no disturbance in the inneryard from circulation, save private space, inter-communicational space inbetween privacy and public

7.1.1 comparison of detached housing with Purkenau of urban hierarchy [12] modified table from book: Gartenstadt Purkenau II; Roland Rainer 1984

The different pathways allow a **high identification** for the inhabitants and it is **communication platform and playground** itself. Unforced communication is possible.

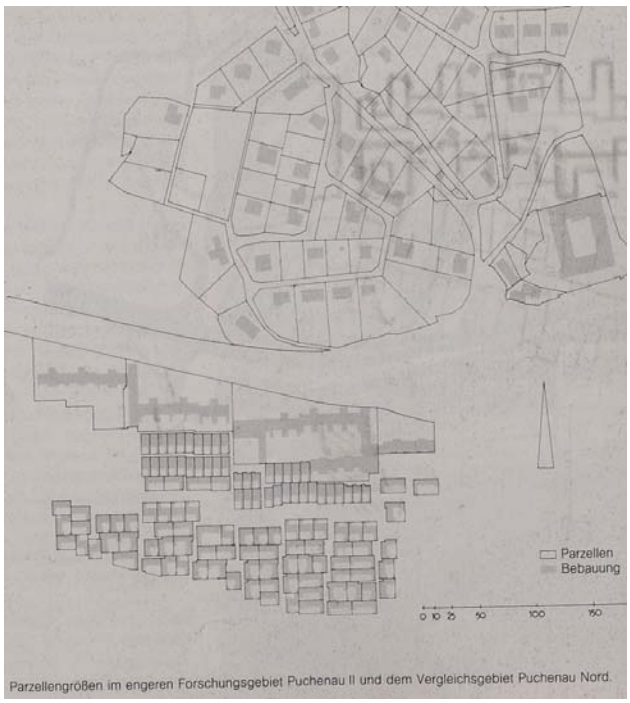
He brings his idea of human scale together with principles of energy saving systems, by using the topography for solar orientation, solar panels and reducing the conduction pipe-length with **high density grouping of houses** as alternative system to the tendencies of individual housing settlement. The people have the opportunity to **buy an individual partion of the urbangrid**. His parcel/ building lot is much more compact compare to parcels of the village Purkenau, He reached a **floor space index** (GFZ) of **0,5**. His parcels have a length of 7, 85 - 8m and a depth of 14 - 15m [14].

A successful story – continues



bb. 1: Lageplan Solar City Linz Pichling

7.1.2 Solarcity Linz masterplan [13]



7.1.3 comparision of parcels in Purkenau [12]

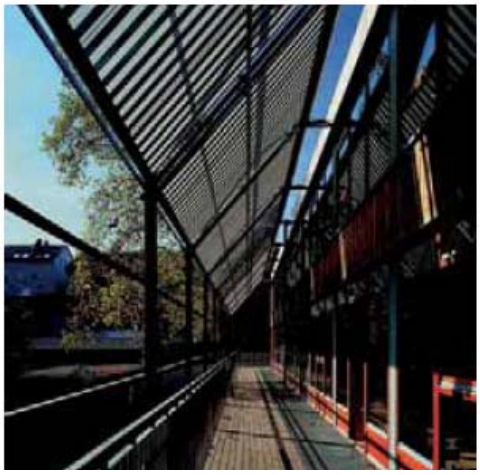
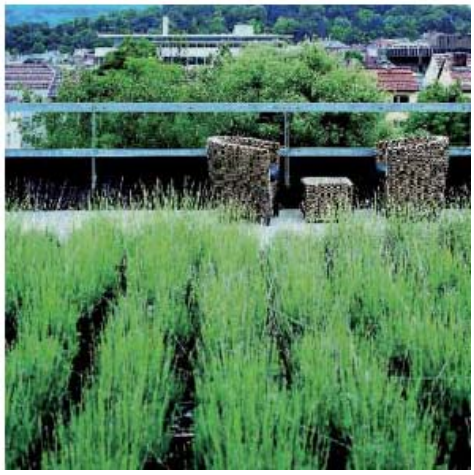
After nearly 20 years of experience with Purkenau I, the municipaltity of Linz wanted to follow this strong idea. The result is Purkenau II, with some changes, but the principles are the same. Furthermore the masterplan for the solarcity Linz in the beginning 90s was designed by Roland Rainer, a gremium of international architects like Thomas Herzog developed the housestypes on his plot.

7.2 guiding ideas for generation housing

7.2.1 Generation house Brüder Rudolf and Hermann Schmid Stiftung

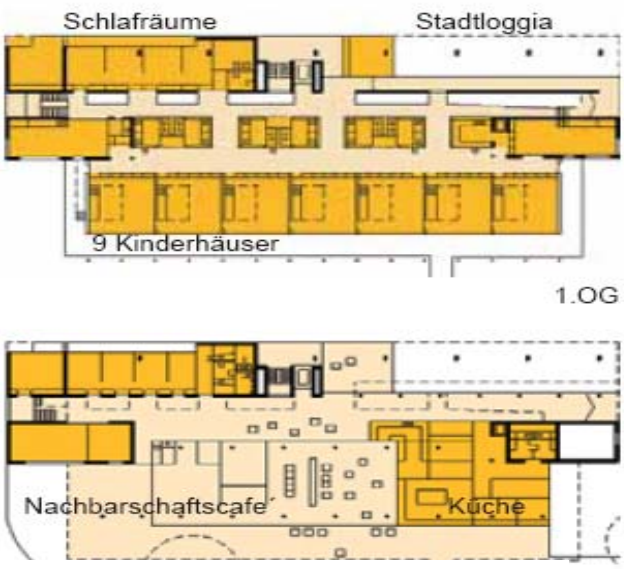
In addition, I will show an example of a generation-house in the city of Stuttgart. The concept is made **to mix different people with different activities**. The building functions consist on:

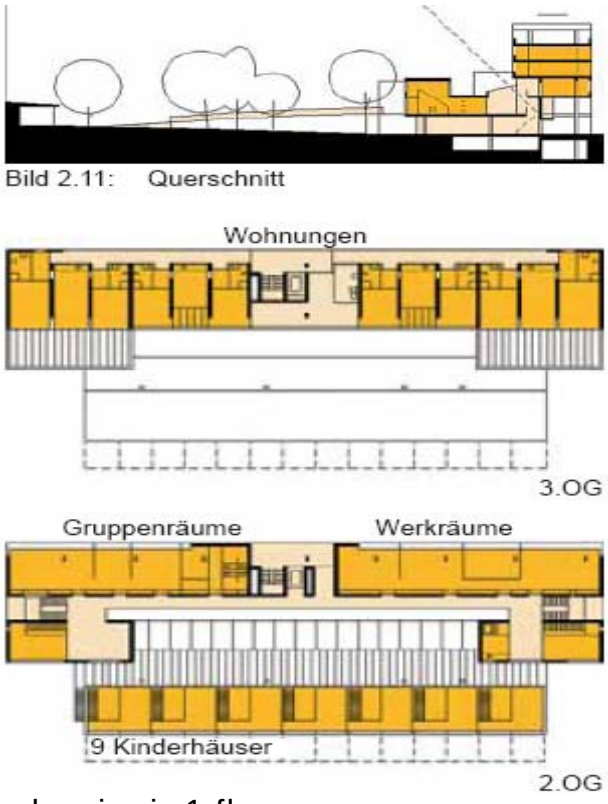
- Ambulance Elderly Care for residents but also for the neighborhood.
- Whole day kindergarden
- A community kitchen for 500 people
- Children-parents center
- and 10 double resident-appartements

7.2.1 unconstrained communication spaces

the community hall, on the path to the appartements, on the roof decking [15]





7.2.2 floorplans of the project

"city loggia" on the ground-level; kindergarden-housing in 1.floor; group and atelier in 2.floor; 3.- 5. floor residental

7.2.2 “WohnreWIR”- Tremoniapark, mix-generation house in Dortmund NRW, "so much public as possible, so much privacy as neccessary"

7.2.2 outer spaces – unconstrained communication and playground [14]

The complex has **21 apartments** from 55m² to 153m², which are all facing to an inneryard playground with access balcony.

The apartments have south- west orientation and they are facing the community hall in the center of the courtyard. Different people with different age are living "house by house". All apartments are **individual planned in coordination with the inhabitants**.

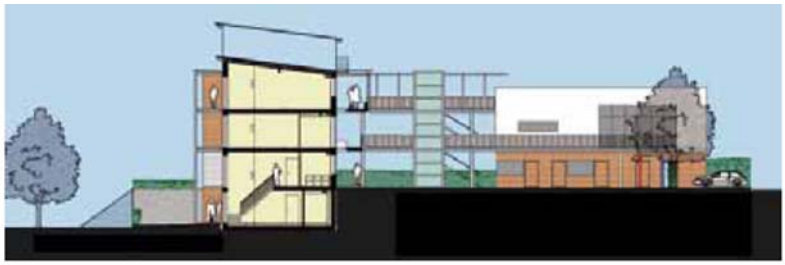


Bild 2.30: Querschnitt

Bild 2.31: Grundriss EG

7.2.3 floorsplan and section WohnreWir [14]

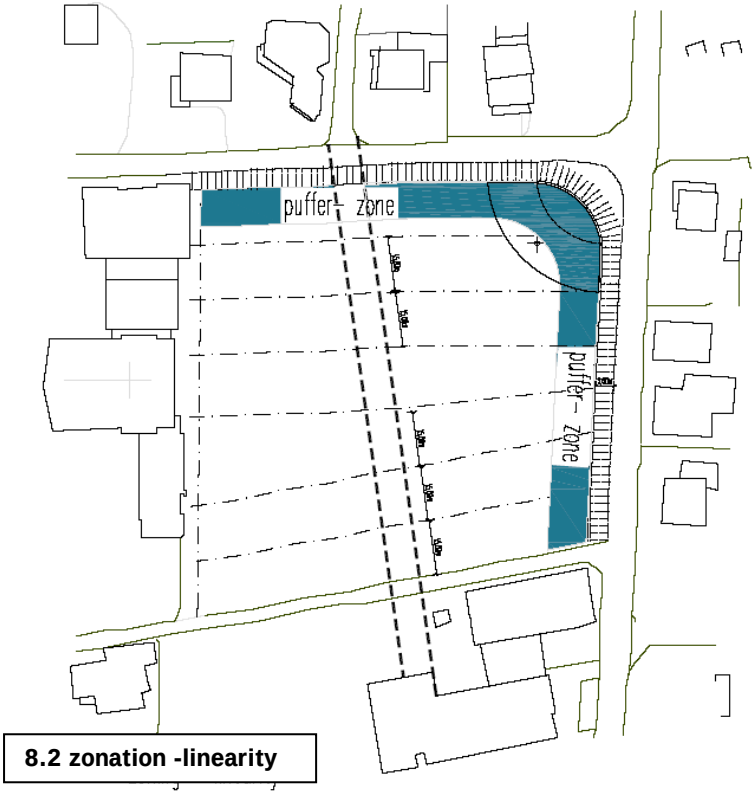
8 urban integration

*8.1 existing greenspace_*

8.1.1 urban-plot and environment [www.google-earth.org]

The new urban plot located between two important cultural landmarks, Schloß Melans and the stream Weißenbach. There are visible connections given and pathways between the development and the agrar fields.

8.2 zonation

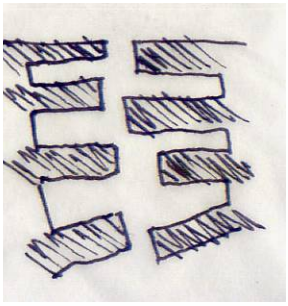


8.2 zonation -linearity

the intension is to create a "buffer- zone" around the edge of the north-west carfour which is lower constructed than the rest of the plot. There will be integrated **public infrastructure,** like a bakery,

some shops and a medicine center. The **linearity** across to the slope follows the **topography of the contour lines**. The parcels are on a **15 m grid**.

8.3 Volumina/density



8.3.1 Volumina

Volumina

The development mass follows a **ripped fingerjoint** to create a diversity of small streets and places where identification and orientation for the inhabitants is easier. The **upper street is linked with an axis** to the school downside to the plot. This axis is not strait but it is visible and gives the opportunity of small nishes for some corner date.

Elevation scheme

1. The situation of the elevation of the buildings is adapted to the idea of **buffer zone** around the outer parts next to the streets. There we have **one or two stories**.

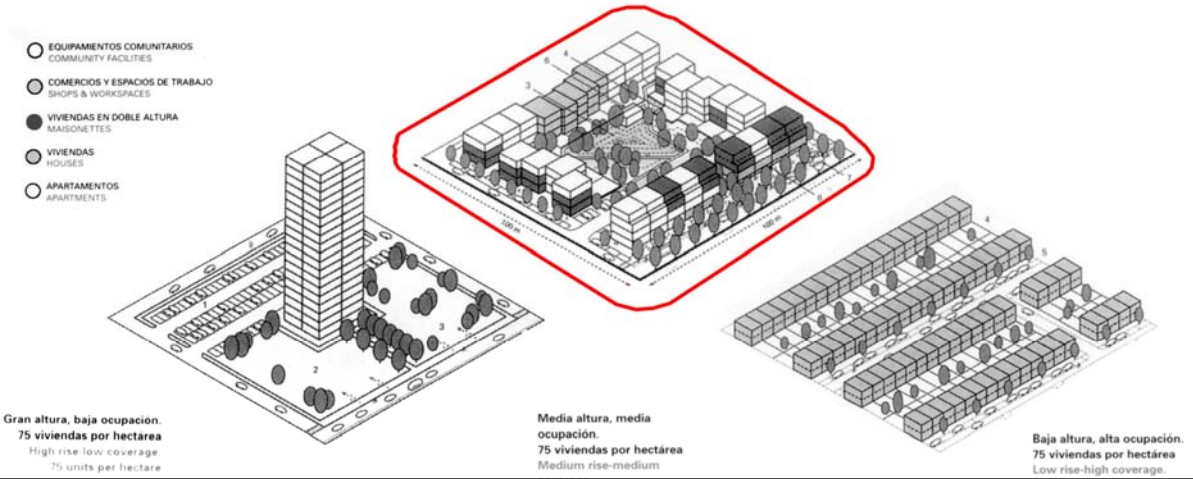
2. The hierarchy of the topography is the second reglement for the elevation. The **highest buildings** are in the **upper 1/3 part** of the plot. Following the slope, **the elevation comes down** to the „“ street in the south. That makes sense also for visibility and sun orientation.

8.3.2 elevation scheme

Density _floor space index

8.3.3 floor space index

The floor space index (**FSI** = Geschossflächenzahl = GFZ) is a significant statement to the **compactness** and **density** of the **urban plot**. It means the relation between the building plot and the constructed floor squaremeters. For individual housing the factor is mostly less than 0,5. I complained the environment with my approximately planned urban design. For residential apartement buildings which are mostly between 3-4 stories we have factors between 0,5-0,9 in general. **Over the whole building plot** (generation-house, courtyard-houses, terraced houses, etc) I reach a floor space index of **0,81**, which is really high. **Compared to the environment** I reach **a higher value** and compare to the three or four story buildings in the east neighbourhood, I come to nearly the same level. In this case, we can say that more stories in **residential building haven´t automatically a higher FSI**, because the **distances between these buildings are much more expanded**, of cause of the reglementation but also infact of non-shadowing eachother (themselves). That means low-rise high-density buildings are competitive to multi-storey buildings in this case.



8.3.4 three different concepts to reach the same floor space index [15]

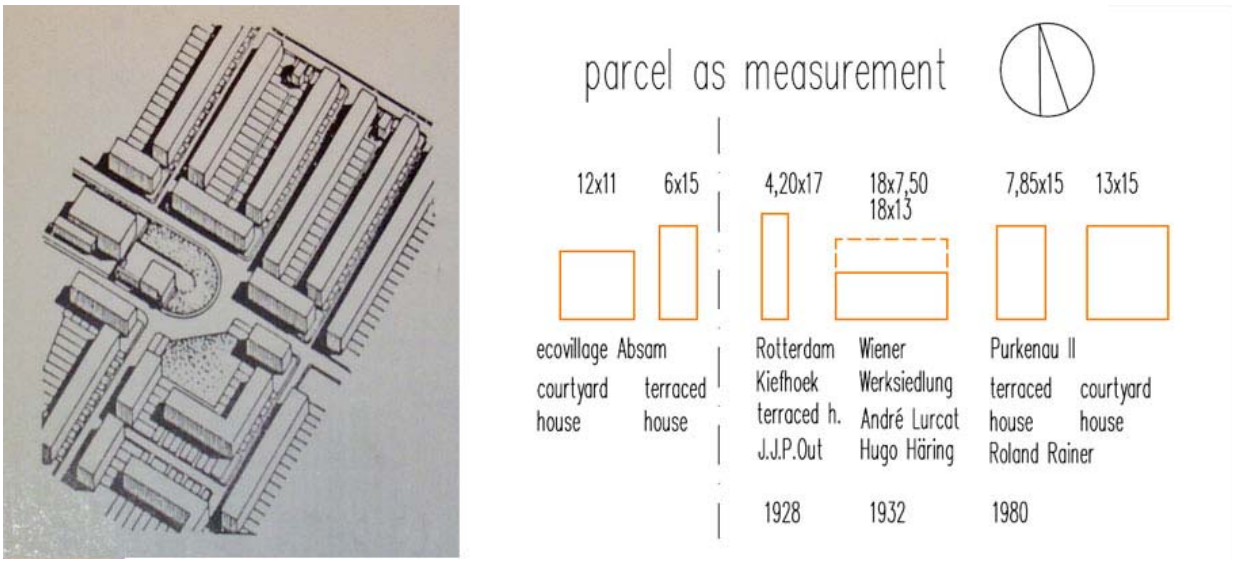
8.4 parcels

8.4.1 first parcel propostion

8.4.2 final proposal

The parcels on the building plot are **reduced** for a maximum to the **outside-surface** of the buildings, that means the **half-public space „inbetween“** is very high and accessible from the public streets.

8.4.3 parcels of the ecovillage compare to the surrounding



8.4.4 project Kiefhoek parcels 4,20 wide, 86 units/hectar [12]

I compared different parcels from different residental projects in the past with my project, which has the same goal to find a practicable level between space for privacy and for a maximum of parcels on the urban plot (urban compactness). The project from J.J.P.Out from 1928 in Rotterdam Kiefhoek on a parcel of **4,20 x 17m** was planned as a terraced house with 2 stories for a minium of one family (picture left). These densely populated countries like the Nederlands and Begium traditionally build very compact. The project was for 86 units/hectar which reach a floor space index of 0,8. However, these small parcels have some **problems of privacy**, because the hedges in the front garden cannot protect enought against views and listeners from outside.

In my project the frontside of the parcel is more expanded with 12m, because of the courtyard and the aim to run the heat consumption only with the passive solar gain concept.

8.5 continuing of urban streetscape

8.5.1 continuing axis

By **shifting the axis**, I wanted to **reduce it's hierarchic importance** and create niches to relate the urban space to human scale. This intervention splits automaticaly the long small streets from West to East into shorter ones. The **non-surveillance atmoshere** with niches invites the people to have a rest.

8.5.2 visible connections

There are visible relations between the neighbors and the new building plot. The space inbetween is continuing.

8.6 energy flow system

rainwater- collecting system

The ecovillage is using a decentralised rainwater-collecting system. The surface of all roofs is aproximatly **5446m²**. The climate chart of Innsbruck says **911mm**/annual rainfall.

That gives us a capacity of 4961.306l rainwater per year. That means we can save 63l/per day and person for graywater consumption (washing machine, shower, etc.)

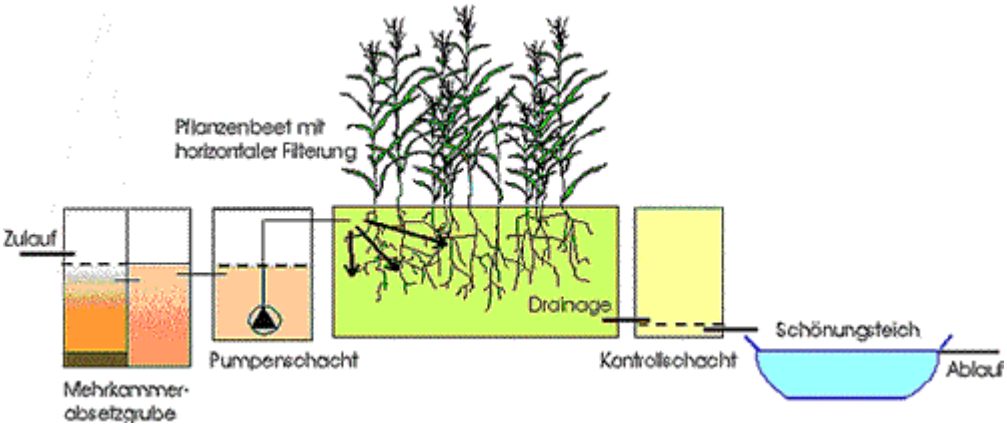
63/150l = 42 percentage of consumption by rainwater

[approcimation is 86 living units with 2,5 inhabitants = 215 inhabitants x 150l/day consumption]

For some years, there is a **vacuum-toilette system** available on the market. The developement comes from aeroplanes and traintoilettes like TGV, in our days also in the new generations of regional trains. Future urban development areas should use these systems too; it should **save 84% of a normal downpipe-system**. By using this system, we can reach the whole consumption by rainwater!

gray-water-recycling system by biological sewage purification

The ecovillage will be equiped with a biological sewage purification system, which is installed on the roof of the infrastructure zone ("buffer-zone") in the north.



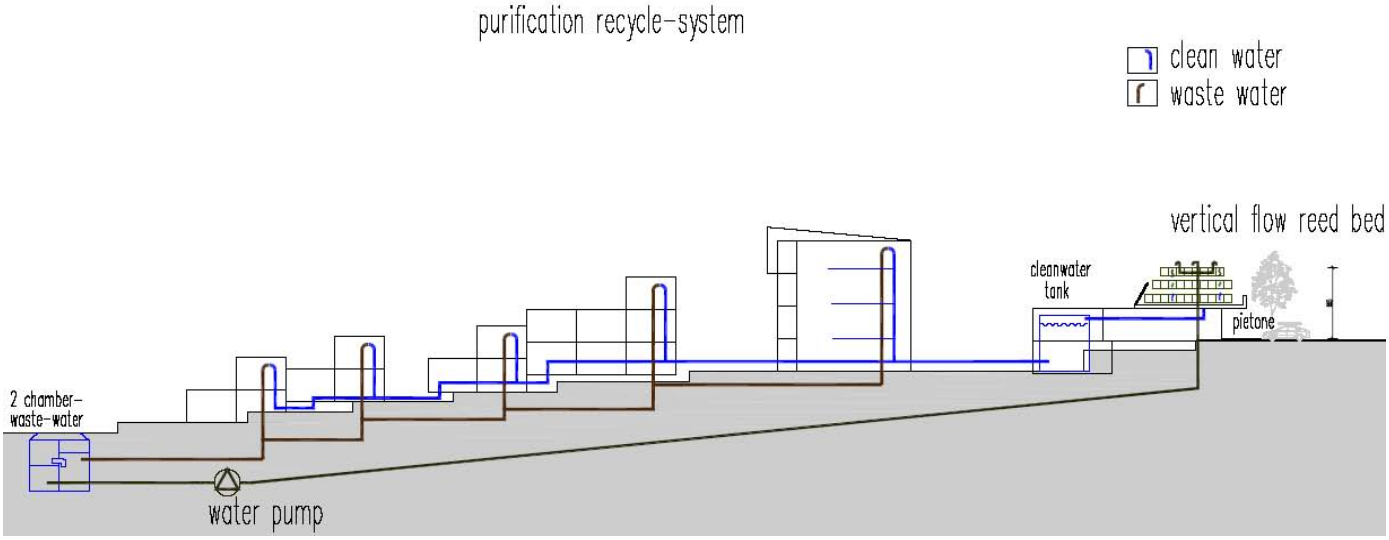
8.6,1 scheme of a biological sewage purification [16]

My system is using a **vertical perfusion**, because this consumes between 2-3m³ of earth against **4- 5m³** of horizontal perfusion **per habitant**. The system is self-cathartic and runs the whole year, in winter with a reduced output, but for this reason it has a higher dimension as it needs for summertime.

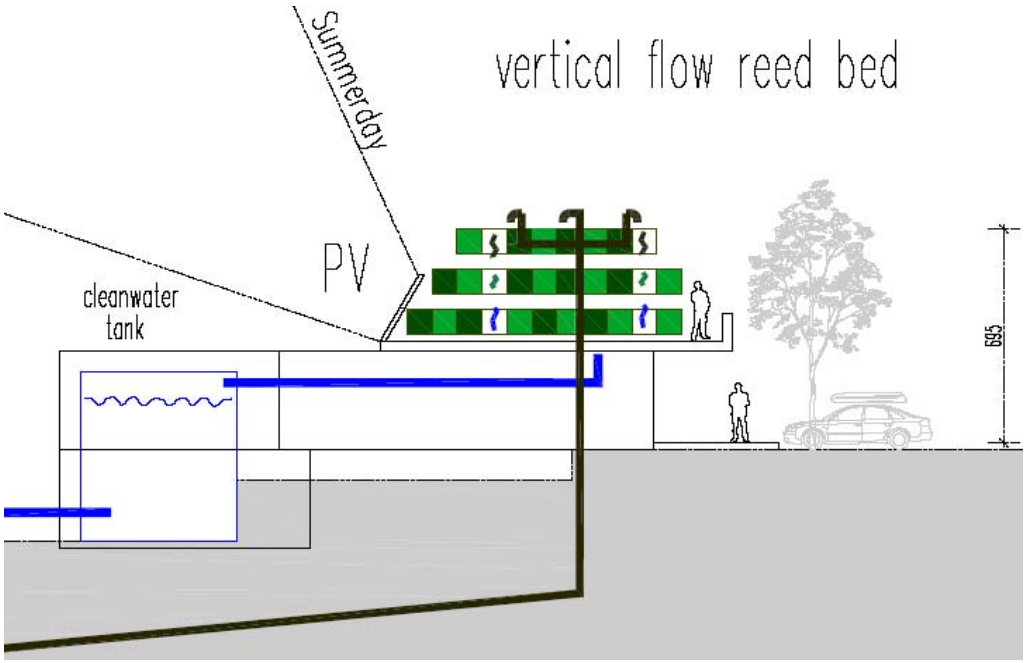
If we use all availabel space of the northern roof, we reach 1395m³ of vertical purification that means a capacity of 216% [2726 baskets 80cm x 80cm], we need aprocimatly just **645m³** by **215** habitants. The system is expandable, that means we can start with a lower number of baskets

I dimensioned the purification basket with a 80cm x 80cm x 80cm, that allows for an independent working process of the organism also in winter and thad does not dry out or gets frozen. Inside there is a medium temperature between 5-7°C from the biomass-process.

For technical check, but also for interested visitors there is a path along the vertical flow reed bed. This "**green wall**" protects at the same for acoustic noise from outside and refreshs the air in summer.

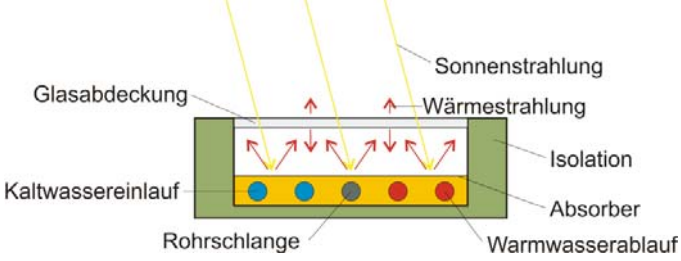


8.6.2 scheme of the purification recycle system



Electricity

Next to the vertical flow reed bed there is space for the installation of two rows **photovoltaik panels** along 75m. The investment of the PV could be done **step by step**. There is more than enough space to support the whole village with power. Only electric devices (wasching machine, cooker, fridge a.s.o.) from the last generation with the Index A+ should be installed.



8.6.3 scheme of low temperature collector

Passive solar water heating -

low temperature solar collectors 65°C

The **decentralised solar collectors** are installed in the façade of the buildings or partial on the roofs where they are needed. The choice is on low temperature flat plate collectors, because they have **less thickness** for the integration in the façade than tube collectors. Since longtime they are on the market and they have a **better rentability** than the vacuum tube collectors (cheaper) and a long lifetime. They can be integrated as a façade element under the parapeth. The dimension and quantity is adapted on the size of building and inhabitants. Its possible too use them for the hot water supply for a floor or wall heating-system [low temperature system] .

8.7 Building industry and waste-production

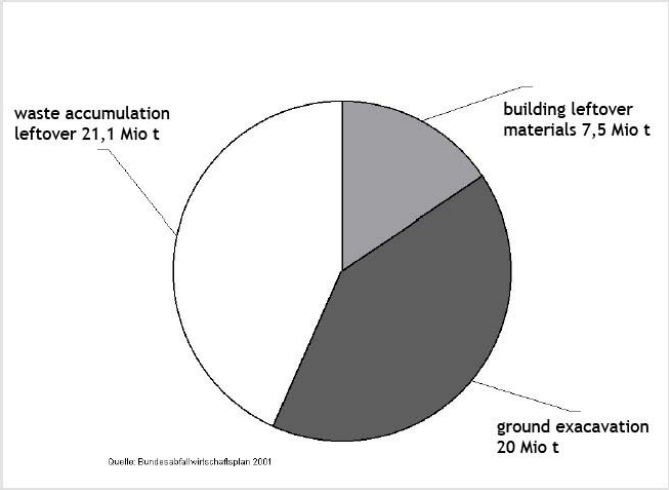
8.7.1 concrete cutting process by demolishing a 40cm thick reinforced concrete floor, BKH Hall

From my own experience on the construction site, I have supervised 5 month of continuing demolishing work by a reinforced concrete structure. The steel side-cut [Eisenanschnitt] is the most problematical point in this case, it breaks the saw blades. Therefore the construction company count every diameter of cutted steel in the section. There are different dimensions (from 12 -18mm) of cutted steel. Second difficult work is the removing process of cutted concrete blocks (max weigth 4t, depends on crane), the transportation and the waste disposal.

The principle for the foundation in my project is following the strategy:, “What you don´t need to build up, you don´t need to demolish!”

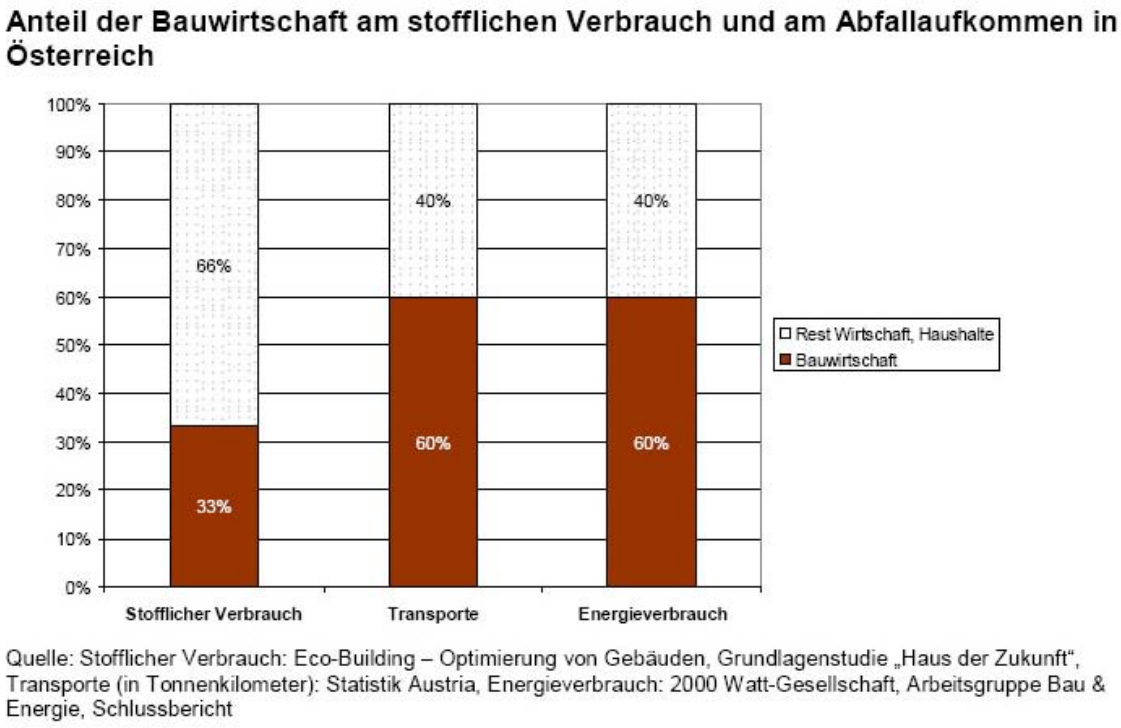
The building sector is reponsable for 1/3 of the substantial consumption of raw materials and produces 57% of the whole waste production in Austria (includes the ground excavation 41,15%). Sooner or later that will influence the market to develop a higher total productivity of resources being used.

Austria's annual waste accumulation is growing:



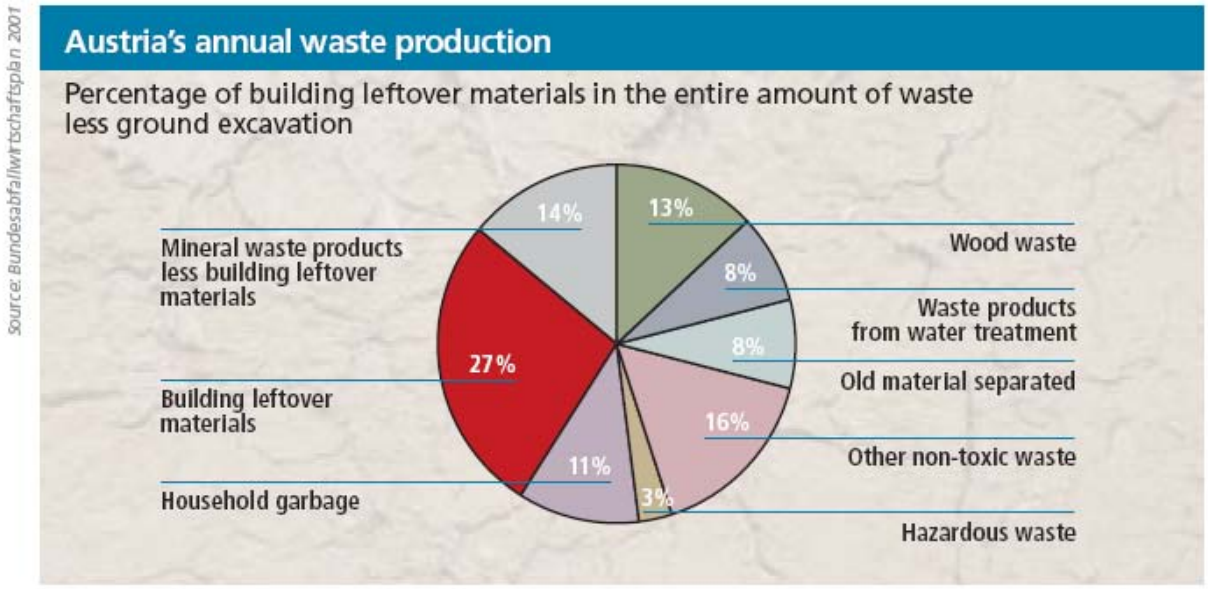
8.7.2 waste accumulation ; source Bundesabfallwirtschaftsplan 2001 [17]

Proportion of the construction industry of consumption of row materials and the waste production



Quelle: Stofflicher Verbrauch: Eco-Building – Optimierung von Gebäuden, Grundlagenstudie „Haus der Zukunft", Transporte (in Tonnenkilometer): Statistik Austria, Energieverbrauch: 2000 Watt-Gesellschaft, Arbeitsgruppe Bau & Energie, Schlussbericht

8.7.3 consumption of raw materials, transport and energy; [18]

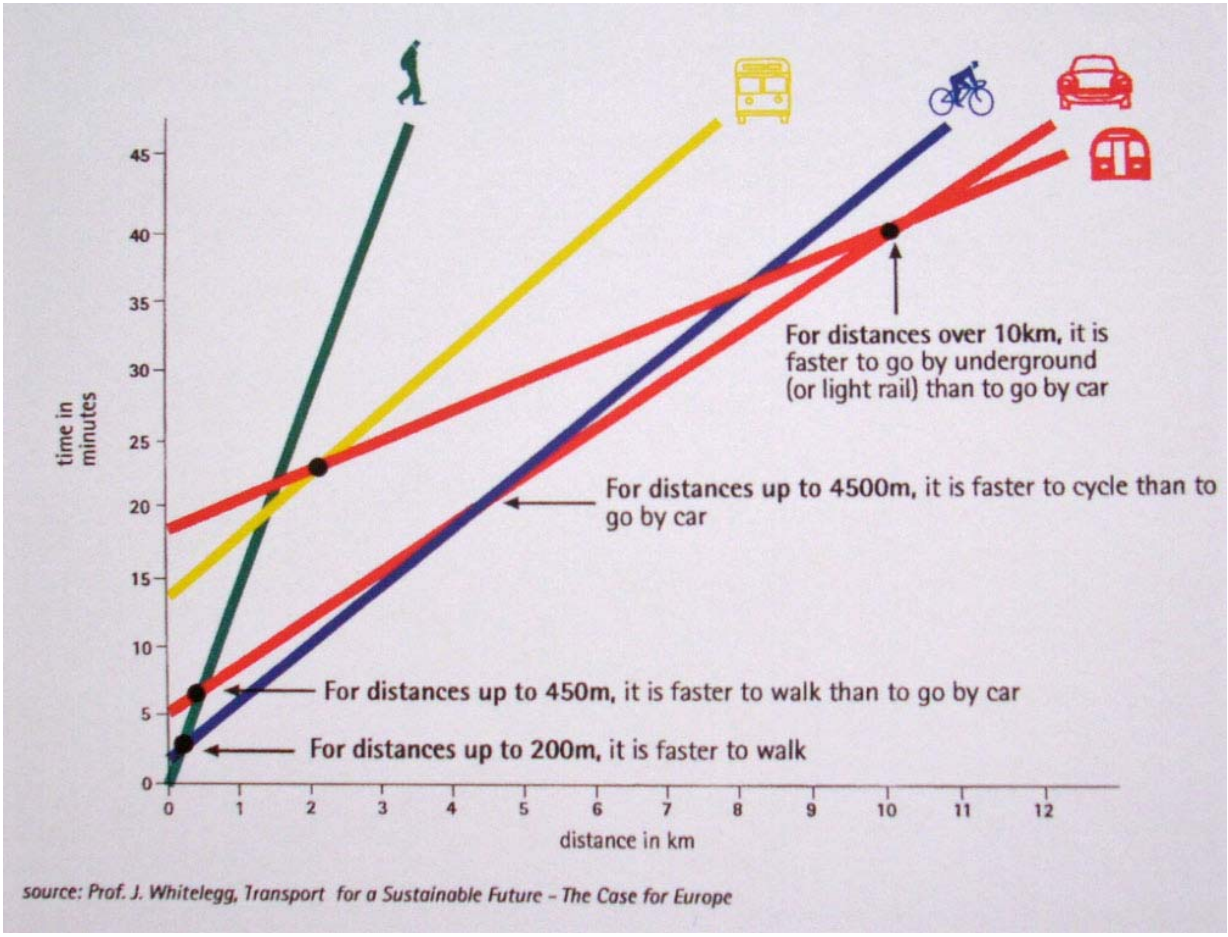


8.7.4 waste production less ground excavation, [17]

By using natural resources for example **a tapped loam pavement** as alternative to a concrete pavement, the input of gray energy is much less. Local loam can be utilised from the ground excavation and it can be prepared for the necessary on site. In addition, after the life-cycle periode, the demolishing is much easier and we can **deposite the material on site**. (Attention by bonding the raw material with other artificial chemical stabilisers! Lime or other natural binding agents are common). Further on the changement of the non-loadbearing intermediate walls betweem the apartment's are easy to handle. The **loam can be removed** and after constructing the new intermediate wall, **the material can be reused**.

8.8 mobility

8.8.1 travel times for different Modes of Transport in urban areas, from Door to Door [13]: Solarcity Linz Pirching

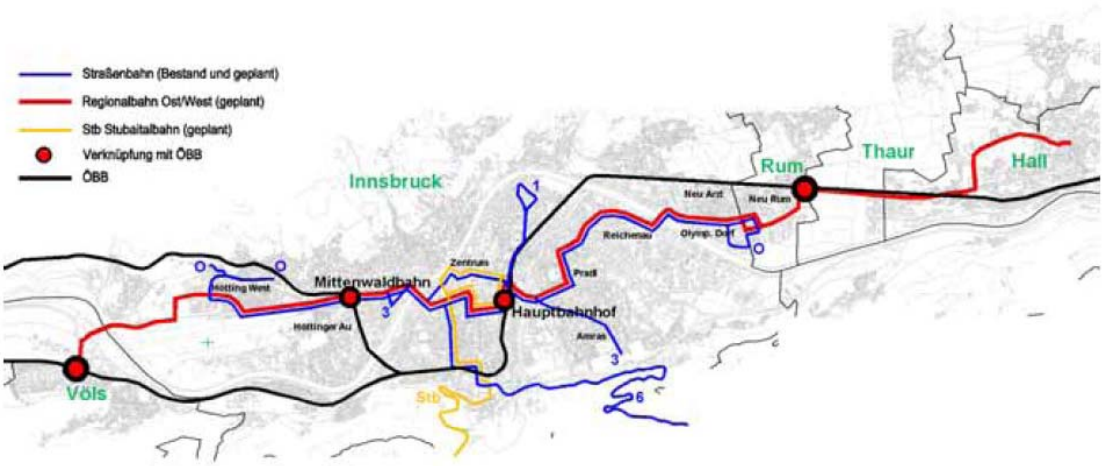


From our own experience, we know that **in urban areas** the **individual transport is slower** than to walk or to cycle. The stop and go by car is inefficient in time and consumes a lot of non-renewable energy. It pollutes the sensitive urban areas, where subnatural space is rare. Therefore, there is just one fact why so many of the population are using their own car, **the convenience.** By using the car, they are thinking to be independ at any time. Even politicans acclaim the importance of public transportation and they improve the comfort and attractivity. Especially for the suburbs around Innsbruck, there are several offers. The Austrian train company ÖBB has changed their timetable for the regional trains since December 2009. Between Innsbruck and Hall there is now every 15min a train who is going up to Schwarz or Kufstein. The travel time from Innsbruck to Hall is between 9 - 12 min. There are already people who combine different means of transportation. For example in combination with bicycle, like I do it every day for work, I need 30min from door to door. Of cause of the traffic we aren´t faster by using the car. For sure, there could be a better offer again. For example, taking the bike on the train should be free, which is for example already possible in city busses of Innsbruck.

In countries like the Nederland's, the concept of **„shared space"** is in use for urban circulation in sensitive high frequented spots. Since 2004 there are projects financed from the EU with the same concept. Actually, there are too many traffic reglementations between the different transporting systems. The concept of shared space for example is to avoid traffic lights on hot spots of a frequent road junction.

The system is counting on the **consideration of the different members of the circulatio**n. There is no abstract machinery anymore between the different traffic participants. *„User behaviour becomes influenced and controlled by natural human interactions rather than by artificial regulation“*[19]. The statistics supports less conflicts and accidents. In Graz there will be an area for the inner city, which follows this idea of shared space. ["Shared Space" Shared Space Institute; EU]

Here in my special situation there isn´t a must for these concepts, but we need to see these concepts more in a wider scale. For the **commuter** the actractivity to circulate by foot or bicycle in the inner cities is depending on these concepts and will have a positive influence for the public transport too. The **regional tram** in combination with the train will give the starting effects for an actractive city with less individual car circulation.



8.8.2 connecting points of the train with the new tram

My concept is based on these tendencies. The consequences are **less car parking space** in the architecture and **more space for the community.** The reduced costs for the residence itself can investigate in better renewable building materials, envelopes and renewable technics.

8.8.3 mobility-mix service

There are serveral **mobility-mix range-services** on place, from car-sharing, self-organised lift service, busconnections and bike-service (E-bikes) for rent.

8.8.4 Comparison of different traffic transport to their ecological-footprint

Parameter verschiedener Verkehrsmittel (bei gleichen Personen-km) [Quelle: Meschik]

	Pkw		Fahrrad	Bus	Bahn
	 Ottomotor mit Kat.	Diesel			
Platzverbrauch	100	100	8	10	6
Primärenergieverbrauch	100	89	0	30	34
CO_2	100	89	0	29	30
Stickoxide NO_x	100	161	0	60	27
Kohlenwasserstoffe HC	100	29	0	53	13
CO	100	8	0	13	6
Luftverschmutzung	100	Partikel	0	60	20
Induziertes Unfallrisiko	100	100	2	9	3

➢ Es ist zu beachten, dass der Katalysator erst nach etwa 4 km Betriebstemperatur erreicht und einwandfrei arbeitet. Auf Kurzstrecken können die Bezugsemissionen vielfach überschritten werden. Dieselfahrzeuge emittieren Russpartikel < 1µm.

The table takes as the reference value the car with 100% of emissions and space consumption. The data compares the other transport possibilities by the same quantity of persons and distance.

9 project_

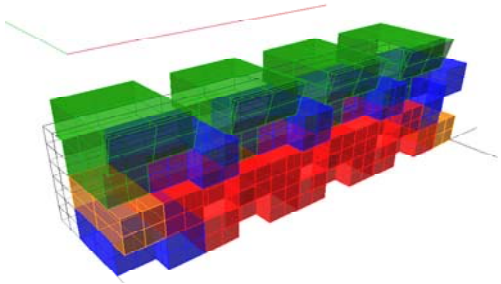
low rise high density building versus multistorey building

9.1 Building typologies

- Low-rise Pavillion;
- **L-shaped courtyard-house**, two-storey;
- Row house/terraced house (2-3 storey);
- Ateliers_ Maisonettes two-storey to the upgoing street in east;
- Multi-storey building (3-4 story) – assisted living;
- **Generation house** four-storey;
- Shops and infrastructure as strip in the north(buffer-zone);
  two-stories with parking
- Community hall with significant round shape at the edge, two stories, higher altitude than the other parts of the "buffer zone"; loadbearing straw bale system - participational workshop with residents possible

9.2 focus on two types: Generation house_ courtyard housing

Generation house



9.2.1 choosen combination of living types

Sociological aspect: different living typologies under one roof; cross generation living in shared apartments like 2-room-flats (doublette) or more residents, single-apartments, patchwork families. There are unconstrained communication spaces in the access-zone next to the flats, where the residents can meet. Every flat has a private balkony to the south.

Technical aspect: naturally a four story building has a better compactness-value (see to SA/V ratio) than a detached house. This belongs to the relation that with increasing volume, we have automatically a less outer-surface-area to the environement. The building is based on a **skeleton post and beam** system with **cross-walls of massive timber plates** at the outerwalls. The energy concept is based on **passive solar radiation** with solar warmwater panels. They are integrated in the facade cladding between the stories.

Architectural aspect: **Flexible floor plan** through skeleton-system, non loadbearing seperation walls, curtain-facade in prefabricated elements, choice of differents flat-types, barrier-free.

Historical approaches to construction and architecture:

9.2.2 apartment house in Weißenhofsiedlung

Five points of architecture

It was Le Corbusier's twinhouse together with P.Jeanneret for the Weißenhofsiedlung in Stuttgart (1927) [exibition Deutscher Werkbund] of that most succinctly summed up his five points of architecture. Le corbusier had elucidated the five points in the journal *L'Esprit Nouveau* and his book *Vers une architecture*, which he had been developing throughout the 1920s. First, Le Corbusier lifted the bulk of the structure off the ground, supporting it by **pilotis** – reinforced concrete stilts. These *pilotis*, in providing the structural support for the house, allowed him to elucidate his next two points: **a free façade**, meaning non-supporting walls that could be designed as the architect wished, and an **open floor plan**, meaning that the floor space was free to be configured into rooms without concern for supporting walls. The fourth point constitute **long strips of ribbon windows** that allow unencumbered views of the large surrounding yard. The fifth point was the **Roof garden** to compensate for the green area consumed by the building and replacing it on the roof. [le corbusier; the fifth point of architecture, www.wikipedia.org]

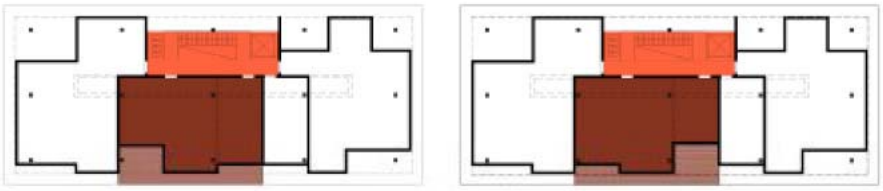
It is amazing that these five points have not lost actuality in our days' design. Especially for flexible floor plan design it is necessary.

What means flexible and changeable? Architectural flexibility:

from a view of the project *inkl.Wohnen;* Haus der Zukunft[17]

1. **Choice of modul:** how many units/moduls or how many squaremeters I would buy and where?

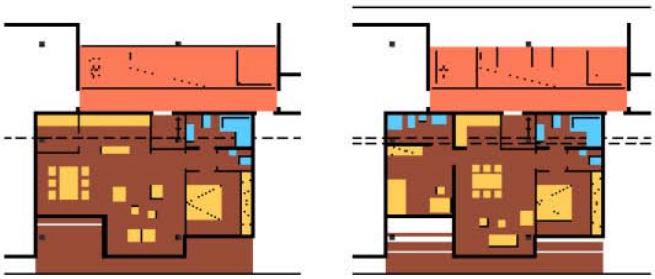
2. **Choice of the exterieur space:** how big/small I want to have my private free space? where?



9.2.3 choice of exterieur space

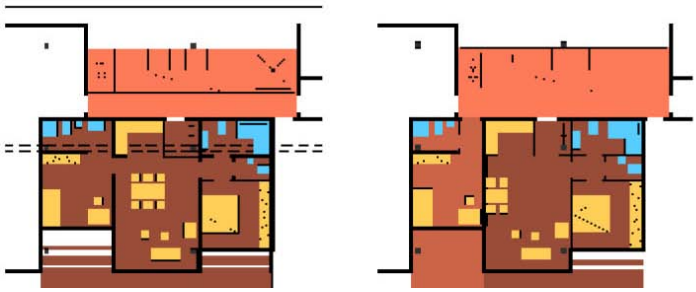
3. **Choice of current floor plan:** what is my current individual floor plan layout ?

4. **Additional adaption** of the floor plan through different life situations



9.2.4 possibility of additional adaption

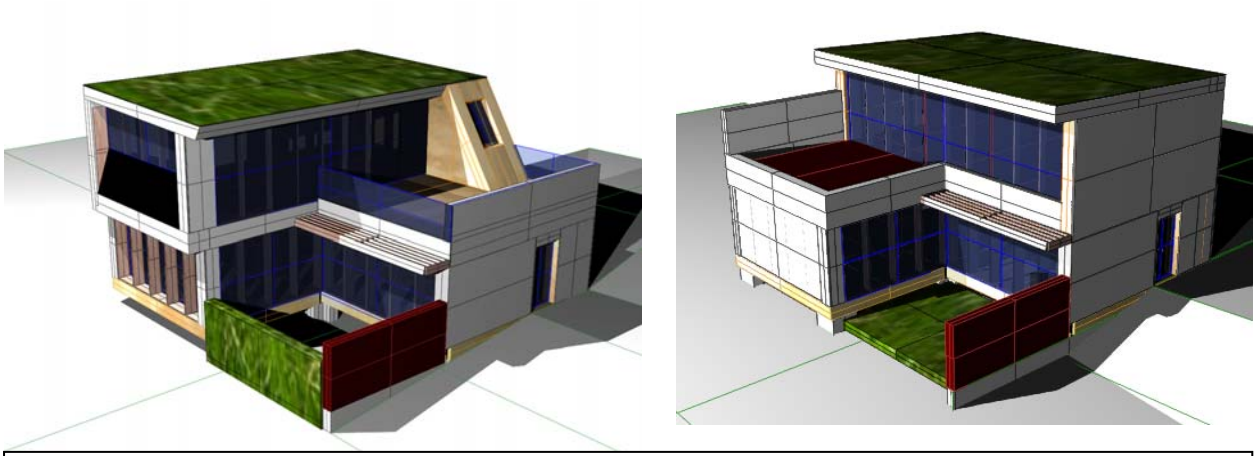
5. **Partition of the apartment**



9.2.5 partition of the apartment [inkl. Wohnen_ Haus der Zukunft 41/2006 page 55-57]

All these questions I can response with a positive argumentation for my projet, only the choice of an individual plan layout is not realistic. We will not know the first and future client. My project is a **top-down project**, so we don t know the individual user and we need to plan for generations.There will be a fluctuation rate by the inhabitants. The most apartments will be not for saling and only for rent. The courtyard houses could be directly sold, because of its own parcel.

L-shaped courtyard house:



9.2.6 different layouts of the L-shape house; left the house next to the street – right the house behind

sociological aspect: for young families who have a small economic budget, but who want to have their own house. The communication with the neighborhood is important for them, they don´t want to live anonymous, neighbourly help.

technical aspect: self-finishing and extension possible, linking with an other household, timber-frame construction with fill-in straw bale walls, implementation of thermal mass in ceilings, floorconstructions and walls with adobe elements. Thermal mass materials store solar energy during the day and release this energy during cooler periods. Integration of low temperature collectors (solar panels) in front of south-facade.

architectural aspect: L-shape-type for the integration of the private garden, passive energy saving system through wide openings to the south, Urbanistic sequence of the same housetype with different floorplan has the effect of reduced outside envelope, different urbanistic compositions possible (see SA/V result)

definition for an courtyard house: [22]

center of the house is the courtyard

all rooms and functions are facing to the garden

the whole parcel is (overbuild) taken from the house and the courtyard

the access is only from on side

the house can be occupied from three sides

(ref.:low rise – high density, Helmut Schramm 2008)

I composed **two different prototypes** of the L-shape courtyard house, because of the neighborhood. Upstairs of the courtyard house in the first rank the orientation is longitudinal to the slope. In the second rank, the orientation of the upper floor follows perpendicual to the slope. With this orientation the house in the second rank get enough sun radiation in wintertime. The shadowing of the first house to the second house is minimised.

9.3 Constructive differences of the two architypes

general aspects for the concept of construction and architecture:

excavation earth:

abdication of the cellar; the intervention for a construction plot is much easier and faster with reduced foundations and a **1/3 of building costs** can be saved (detaches houses) **without a basement-construction of cellar**. We do not need packing the plattform and the walls aren´t in contact with the earth. But a drainage around the foundations is important for these kind of construction, therefore we can garant a „dry base“ for the upgoing walls in wood and straw.

foundations:

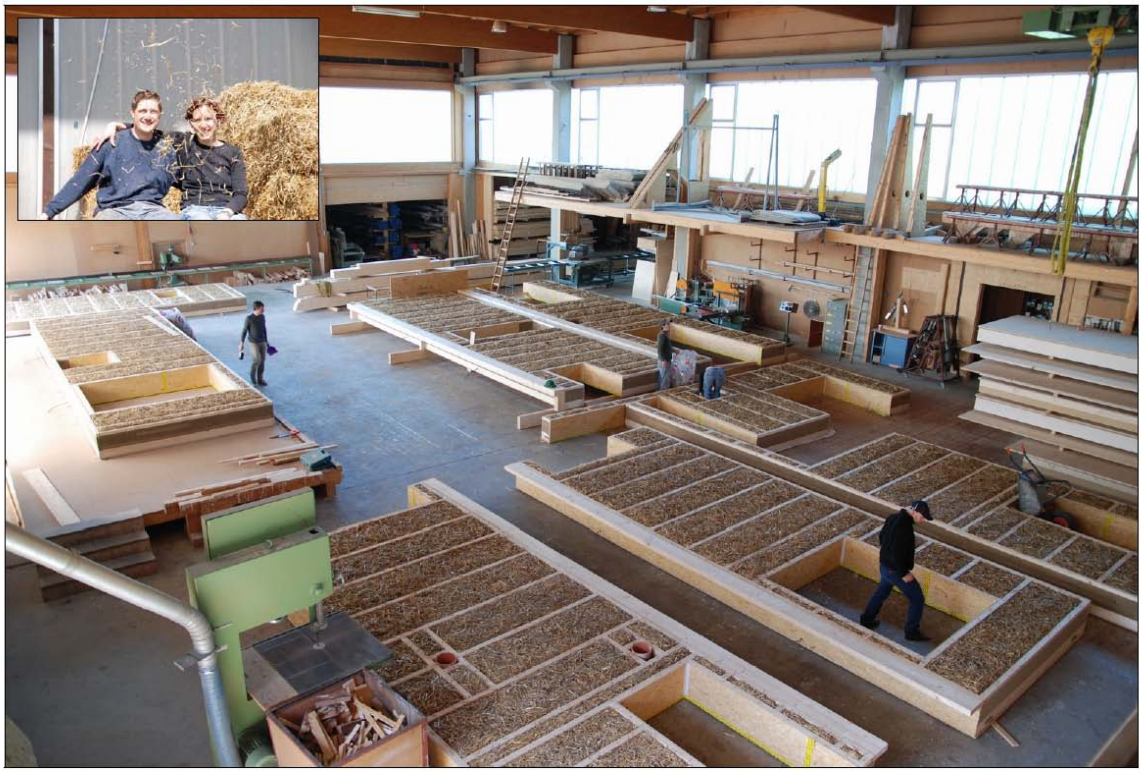
advantage: small punctual foundations or stripe foundations(no base-plattform), are better for **life-cycle costs** (see 8./ building industry and waste production).

general used materials

wood - straw - loam an old liance

There is a strong liance between these three natural growing materials from history. The old skeleton timber framework from the middleage was built in a long periode for many reasons. Wood was the **constructional part** of these buidings and the loam-straw mixture, as infill element, had s multifunctional use. They helped to **protect, heat-insulate and conservate** the house. Some of these are resisting just up to our days. There were *nearly up to 100% built by renewable materials*. High evoluted craftmanships, like carpenters, are made them, which are not exist anymore in this manner.

Why not follow this idea with our knowledge of industrialised methods to build with the same-based materials on wood, straw and earth!



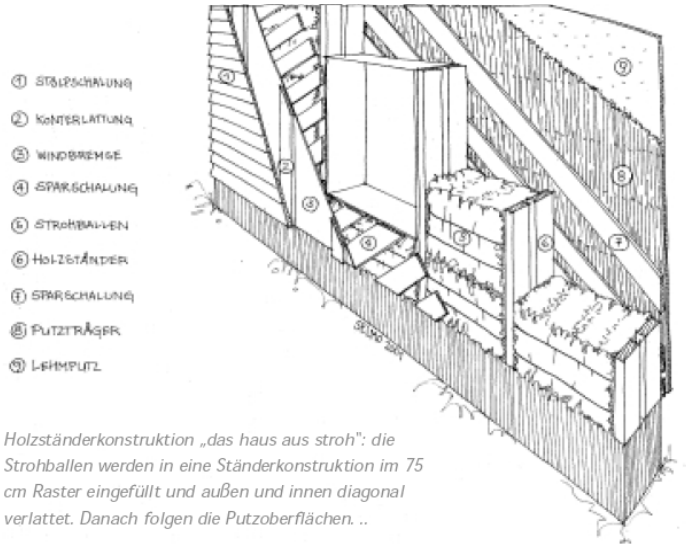
9.3.1 prefabrication of wooden framework with strawbale-infill; [23] www.fasba.de

strawbale construction methods:

One architecture – two ways of construction

There are several methods to build strawbale houses. Basically **loadbearing** (on the basis of traditional design) and **non-loadbearing** constructions are distinguished.

I will use for my design mostly the **non-loadbearing** system for the generation-house and the courtyard-houses, which I will discribe in more detail further on. There is a high prefabrication level useable for this kind of construction of cause of the use of wood sections. For the community hall with the expressive round shape the **loadbearing construction** method is the prefered design. Architect Werner Schmidt is well known for these kind of construction method in Switzerland and in South-Tirol. The straw bales are placed in a kind of masonry bond, which are connected with sticks together (wood or bamboo). It would be interesting to build up the community hall in a participated workshop with the new inhabitants of the community, when the other buildings are finished from professionals. This could be a good occasion for develope relationships between the different residents.



Holzständerkonstruktion „das haus aus stroh": die Strohballen werden in eine Ständerkonstruktion im 75 cm Raster eingefüllt und außen und innen diagonal verlattet. Danach folgen die Putzoberflächen. ..

Non loadbearing section

from outside to inside

1 weather boarding

2counter- batten

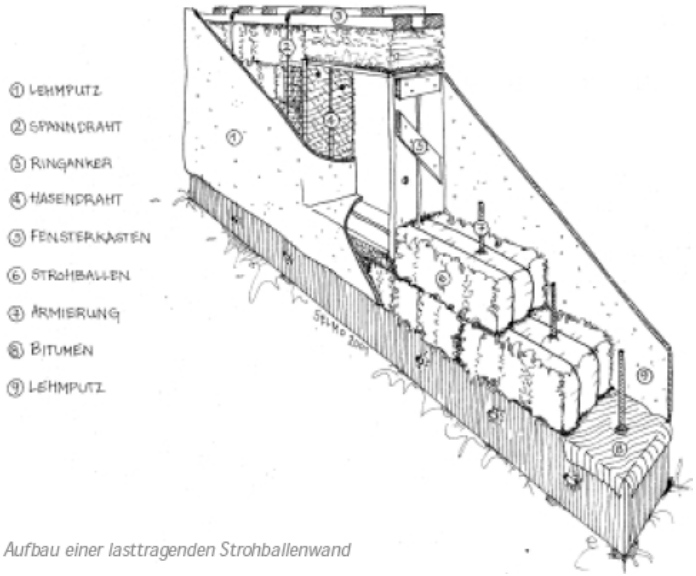
3 wind-paper

4 strawbales in wood-frame

5 economist boarding

6 plaster base

7 loam plaster



Aufbau einer lasttragenden Strohballenwand

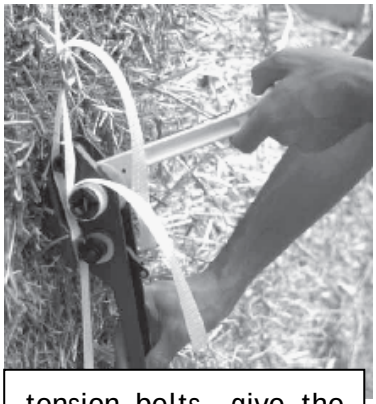
loadbearing section

from outside to inside:

1 loam/lime plaster

2 strawbale as same as plaster base

3 loam plaster inside



tension belts give the wall the needed initial

9.3.2 loadbearing and non-loadbearing section

[24] source: neues Bauen mit Stroh; Gruber Sandler 2008

9.3.3 tension belts

Covering of the surfaces: Plaster and other coats (air-tightness)

The longest experience with protection of straw bale buildings is the covering with plaster. Anyway, straw in connection with clay or earth has been in use for thousands of years. In the beginning of the renaissance of strawbale building, lime- and cement-plaster was often be in use. This offers advantages in stability but should not be seen as a problem in a warm and dry climate. Today mostly clay plaster with moisture regulating qualities is applied, which is the only possibility in a more humid and cold climate.

Fire prof F 90 (Annex)

One argument in favour of covering the strawbale, with a loam plaster inside and with a lime-plaster outside, is the good fire resistance. In the Vienna city-labortory MA 39 a section of wooden framework with straw bale infill has been tested (see Annex) and achieved the standard of an F 90 wall. In Munich has occurred a similar test with the same results. Logically we know that it isn't easy to burn a telephone book, the same effect we have here. In addition the plaster protects the construction, it **encrust the section** behind.

Humidity

Similar to wood constructions, it should be pay attention in construction process to protect the walls from rain. The straw bale should be dry under 15% rel. humidity before placing it into the construction. By prefabication the whole wall under qualified conditions in the capentry, we do not have such problematic. A **diffusion-open construction** or a ventilated facade is the best solution for avoiding fungis in the construction.

Timber frame constructions:[23]

- strawbale frame-work constructional distance of posts > 1m
- systems for straw bale infill constructional distance of posts < 1m it belongs to the used straw bales dimensions (70-90cm)
- insulation in plane of the rafters
- stick- frame- elements with straw insulation
- It should be payed attention do a permeable construction for vapour diffusion.

[www.fasba.de]

Some important aspects why to build with straw

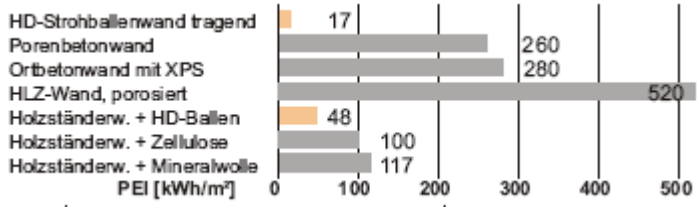
1. energy saving:

Straw is a waste product from the agrar industry. There are 2.2 million t available per year. The energy to produce a straw bale is just the pressing and the transportion. Straw is produced locally in nearly all regions of Austria and Europe. The "primary energy-impact" PEI is very low compared to other insulation materials.

[**8,16** MJ **strawbale** ; **73,44** MJ **EPS**; 155,04 MJ XPS; [25] Zuschnitt 34, page 17 see Annex

Comparison of different constructions

(Primary Energy Index = PEI) by same U-value



9.3.4 comparision PEI of diff. constructions [26] Uni Kassel FB6 Forschungslabor für experiementelles Bauen; Dissertation D.I.Benjamin Krick]

Strawbale dimensions and properties

A straw bale construction is naturally based for a passive-house because of its minimum dimensons of thickness of the straw bale of 35cm x ca 70-90cm x 50cm.

In my constructions I will use the **straw bale vertical orientated** with a lambda = **0,045W/mk**, so the insulation diametre is **35cm**. A horizontal orientated straw bale has a diametre of 50cm, but a less lambda = **0,05 W/mK** and is used mostly in load-bearing systems, but also jumbo bales of 70cm x 120cm x 50cm are used. There is an **idealist straw bale product** on market (with EU licence ETZ) from Palia in Austria with straight egdes and straight orientation. It is composed with only one single layer of straw and reaches **a certified lambda of 0,042 W/mK**, a small revolution! They have also smaller straw bales as product (all vertical orientated) with the smallest side of 26cm and you can order a whole wall with your special diameters. (www.palia.at) Completely new is a straw insulation panel of 6cm diameter.

There is also a modular systems on the market; modcell. It was developed with the University of London,…. Together. It´s a complete building cage with finished surfaces.

Compressed strawbales have a weight of 150kg/m³, so it's a **superinsulation with a high thermal mass.**

horizontaly orientated	verticaly orientated	vertical and idealist bale

9.3.5 orientation of straw bales [24]

comparison between concrete construction and a wood-straw construction by the same insulation impact (passive-house standard)

Wandaufbau 1: Strohballenkonstruktion	45 cm	Wandaufbau 2: Beton-EPS Verbund	49 cm
Lehmputz	2	Kalkputz	1
Innenschalung	2	Beton armiert	15
Dampfbremse	0	Kleber	0,2
Strohballen	35	EPS	32
Winddichtung	0	Kleber, Armierungsgitter	0,2
Schalung	2	Organischer Außenputz	0,6
Lattung	2		
Sichtfassade Holz	2		

9.3.6 comparison timber framework with concrete [27] construction; S-house Broschüre

If we compare a **reinforced concrete wall** with a thermal insulation composite system (WDVS) and a **wooden framework construction** with straw bale infill, the framework needs less wall thickness by the same u-value.

2. quality of living

90% of our lives we are in a closed constructed envelope, so it should be important to know in which atmosphere of humidity and poluted emissions we are all day. Straw bale constructions are diffusion-open constructions, whose absorb or deliver the inner climate with a rel.humidity around 50%, which is very healthy. Between the inner-temperature and the surface temperature there is just a difference of max. 3°C. In combination with a clay cover the wall absorbs also bad emission or smoke.

3. ecology

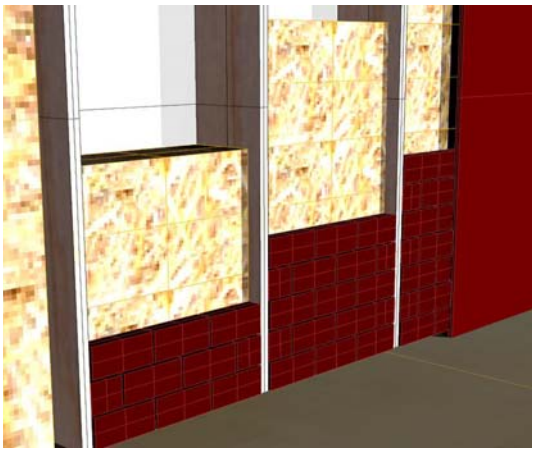
Cultural plus effect: a higher demand of qualified small-straw bales will have a positive sociocultural effect for the regional agriculture and farmers. They would get a better price and from a waste product the straw bale would become to a qualified building product!

- regional available row-material
- no chemical treatement is needed (straw is heavily digestible)
- the ecological footprint for this kind of construction is less than factor 10
  (see www.s-house.at)

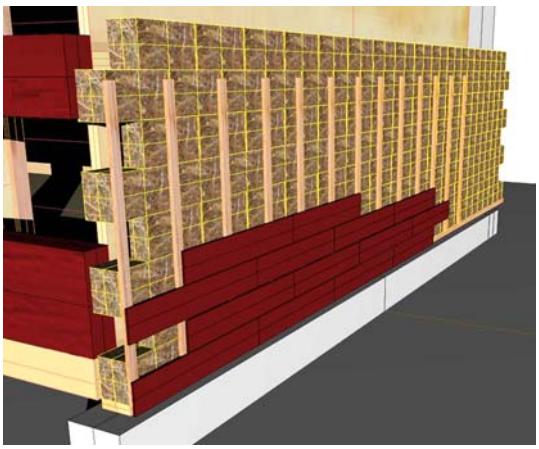
4. economy

straw is very cheap in seasonal time available. Of course, of the more complex planing process and a higher percentage of craftmen-shop, we can reach a higher building standard with approximately the same price like a conventional massive construction.[27]

Advantages/disadvantages of the chosen principal sections



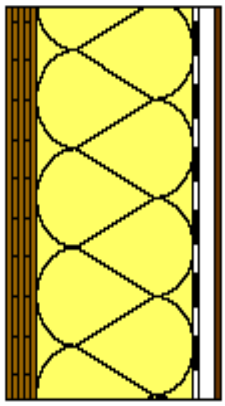
9.3.7 Wooden framework 36cm with straw bale infill



9.3.8 clt panel with straw bale + ventilation

clt with strawbale masonry

Advantages:



9.3.9 clt with straw-bale

Monolithic layers with mechanical connections [strawbale connected to clt with hemp robe, **treeplast screw** connection between strawbale - fassade [27]

easily to seperate after life-cycle, low energy impact by construction

Clt is **air tight**, no other windpaper etc. neccessary

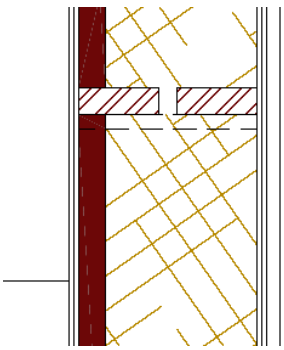
Seperated layers: clt loadbearing – straw bale insulation - **no thermal bridges**, better u-value

more wood is inside of the construction, **more thermal mass**

Disadvantages:

Because of the seperated layers **High thickness** of the section
Higher price compared to the infill method; low prefabication level

Wooden- framework with infill



9.3.10 wooden-framework

Advantages:

Small wood sections are used, - less material less costs
cheaper than massive wood panels
High prefabrication of whole wall possible, but also just **prefabicated wood frame, infilling by the owner himself**
-> reduced costs by internal labour
Smaller thickness of the section (slender) compared to massive construction

Disadvantages:

Less high u-value compare to clt because of wood section in insulation layer (10%)
Less thermal mass compare to clt method

Conclusion for the architypes:

Generation house

The construction method of **clt with straw** has a better thermal behaviour compared to the light infill method. The section is a slitly thicker, but incase of the good SA/V ratio of the generationhouse this is not of great importance. The architype courtyard is clearly higher at **2,99m²** envelope/to 1m² usable area compared to **1,13m²envelope/1m² usable area**. The generation house concept can be seen as a good **balance** between **compact design and thermal storage** with passive heat radiation through the use of massive wooden elements.

Courtyard house:

In concern of compactness, the courtyard house cannot be compared to the generation house. *This is based on the building typology*. There we have 1 unit compare to 18 units in one envelope. In this case the **low-cost construction method can be considered as the better solution**.

In conclusion of the negative balance SA/V ratio we **need to implement thermal mass**. This also follows the concept of a passive storage for solar gain. The massive wooden panels as thermal mass would not be enough for this light constructive typology (160t in such a small volume) The adobe walls creates a heathy inner climate and have high aesthetic qualities as well as a very low energy impact (see detail of the gain collectors in the discription of energy scheme).

U-value calculation for the courtyard house and generation house

building part:	outer wall **courtyard house** wooden framework with infill			
Schichtaufbau	Dicke in m	Wärmeleitfähigkeit	Wärmedurchlaßw.	D/Lambda
	thickness	heat conductivity		
Wärmeübergangwiderstand innen			0,123	
claytec dry clay panel with reed	0,02	1,3	0,015	
Grünlinge Adobe	0,06	0,7	0,086	
Strawbale 94% (of 35cm)	0,33	0,045	7,311	
wood section 6% (of 35cm)	0,02	1,3	0,016	
Rauschalung/ wooden boarding	0,02	1,3	0,015	
lime plaster with core	0,02	0,7	0,029	
hole thickness of components	0,47			
Gesamtwärmedurchlasskoeffizient			7,595	m²K/W
u-value		U=	0,132	W/m²K
gefordert lt. TBV			*0,35*	
gefordert lt. ESH			*0,27*	
gefordert lt. NEH			*0,2*	

9.3.11 wooden-framework with infill; section of courtyard house 47cm

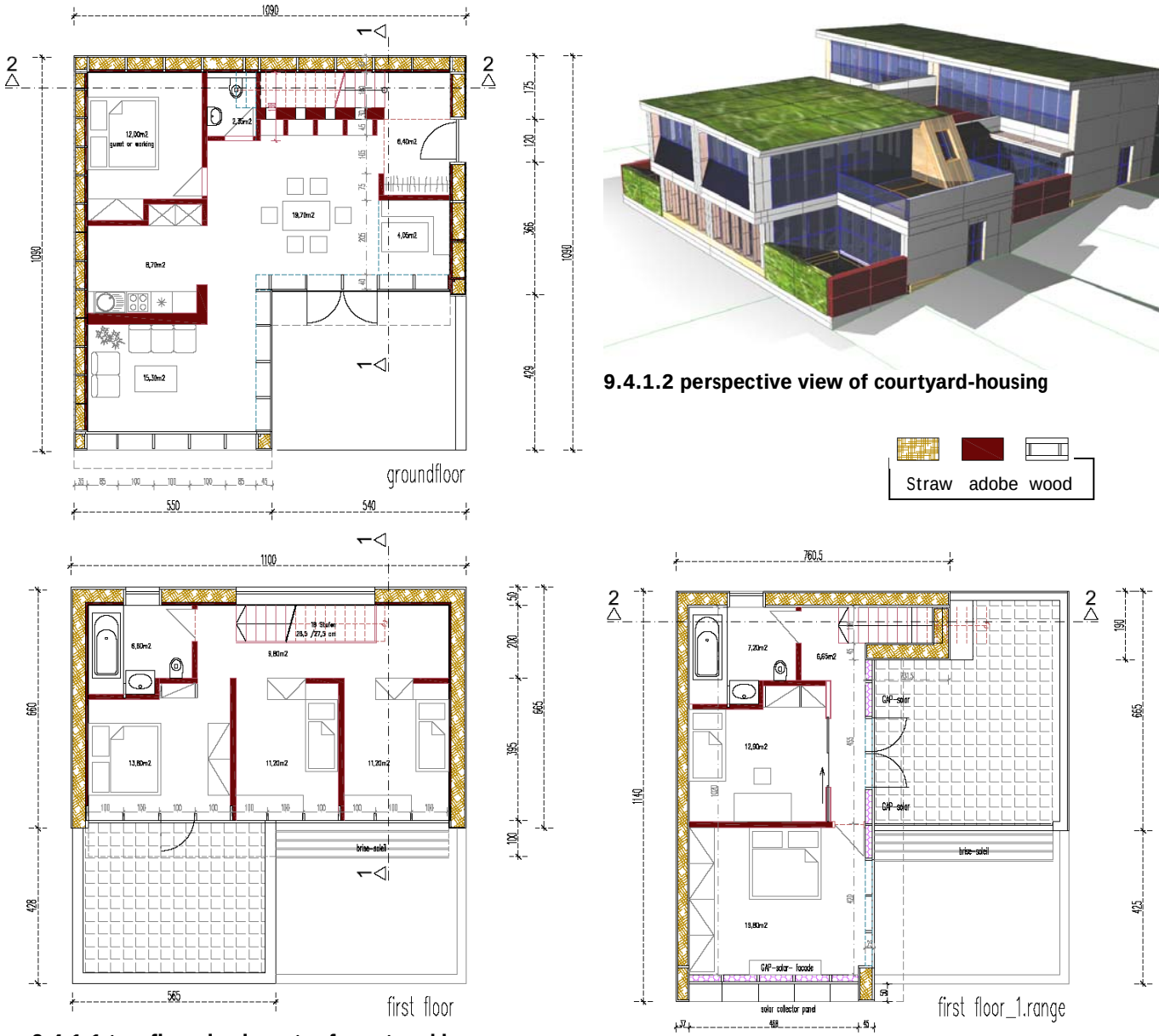
building part:	outer wall **Generationhouse** clt			
Schichtaufbau	Dicke in m	Wärmeleitfähigkeit	Wärmedurchlaßw.	D/Lambda
	thickness	heat conductivity		
Wärmeübergangwiderstand innen			0,123	
CLT panel	0,12	1,3	0,092	
strawbale 35 x 50 x 75	0,35	0,045	7,778	
loam plaster (wind-tight)	0,02	0,6	0,033	
vertical battens/ air	0,04	1,3	0,031	
larch wood ventilated	0,03	1,3	0,019	
hole thickness of components	0,56			
Gesamtwärmedurchlasskoeffizient			8,076	m²K/W
u-value		U=	0,124	W/m²K
gefordert lt. TBV			*0,35*	
gefordert lt. ESH			*0,27*	
gefordert lt. NEH			*0,2*	

9.3.12 clt with straw bale; section of the generation house 56cm

*I take both **principal wall sections** for my prototypes into a validation.Therefore I need to calculate the heat conductivity of the u-value. The **generation house** reach a u-value of **0,124W/m²K** and the **courtyard type** a u-value of **0,132W/m²K**. In general we can reach a passive-house standard with u-values of all envelope parts between **0,12-0,15 W/m²K.** This depends on the compactness (SA/V-ratio) as well as on **thermal bridges** in the envelope.. For detail analysis we would need to make a whole heating/cooling demand with the passive house project package (PHPP).*

9.4 courtyard house_ in detail

9.4.1 two different floorplan layouts

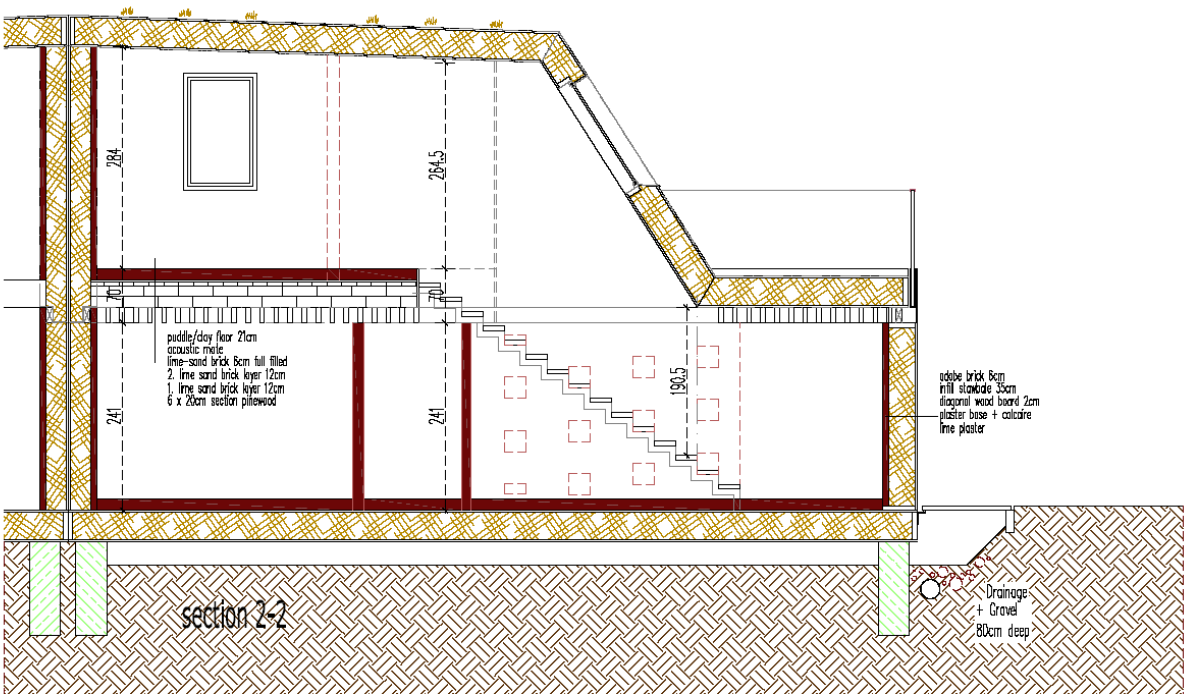


9.4.1.1 two floorplan layouts of courtyard house

9.4.1.2 perspective view of courtyard-housing

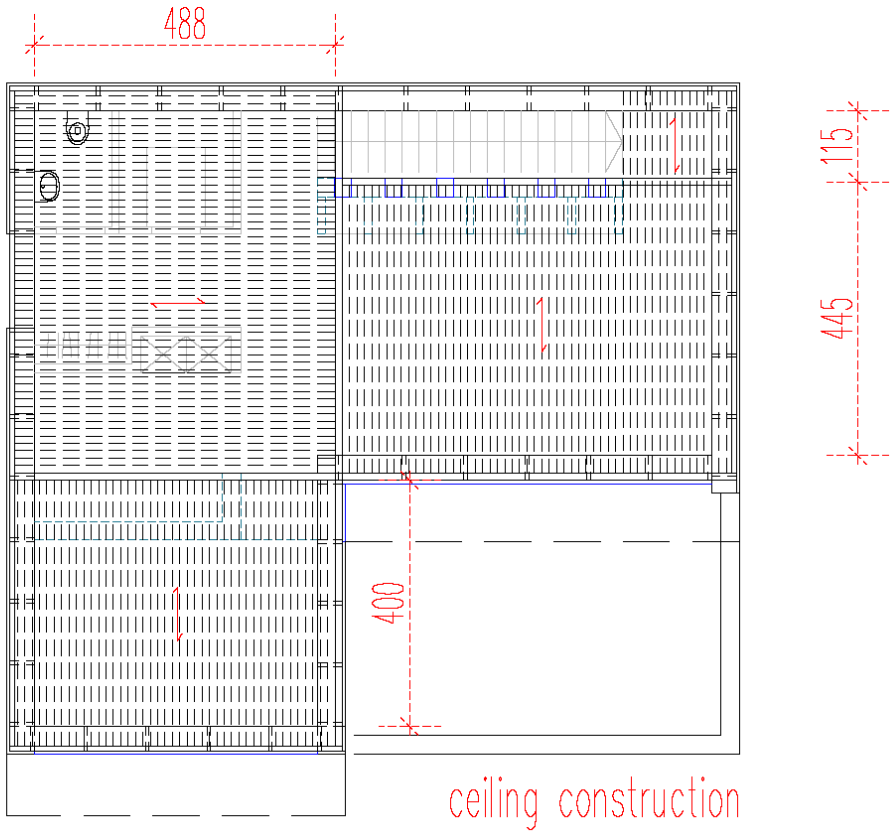
Like I already explained the typology, I designed two floorplan layout as solution to combine them without interfere the neighbours unit .The two designs are founded on the same module of ground floor .

Section 2-2 of the courtyard house in the first range. Ventilation-system: you can see how the air can pass through small holes in the intermediate adobe wall before going up to the window.



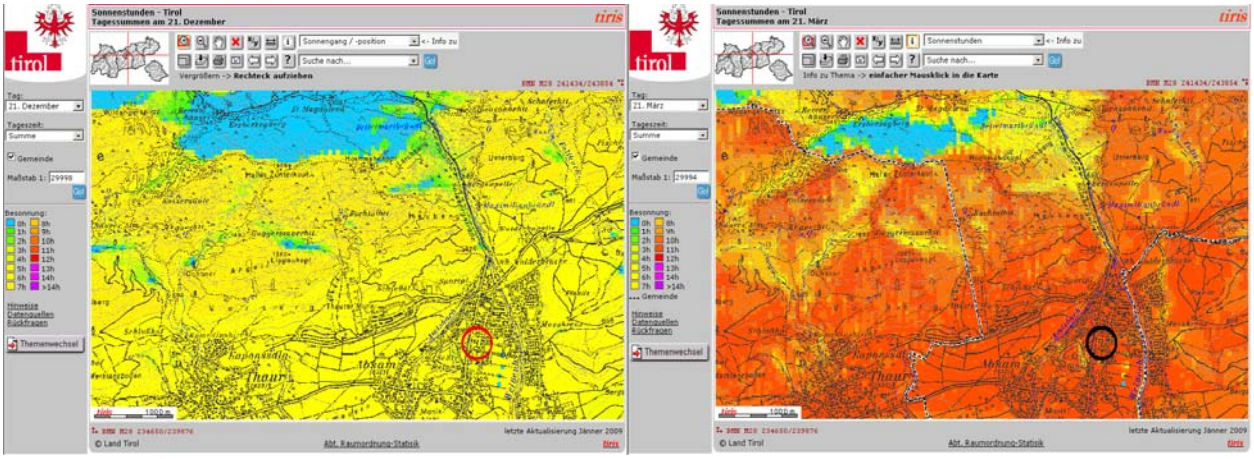
9.4.1.3 section 2-2 of courtyard house in the first range

Constructive principle of the bars (6 x 20 every 18cm) in the first floor with span



9.4.1.4 constructive principle of the ceiling

The houses are south orientated. In the Inntal-valley we have a aproximately high solar-gain. On the **shortest winter day** in Absam-Eichat there are **8 hours** of sunlight. In march there are almost **12h** of sunlight per day.



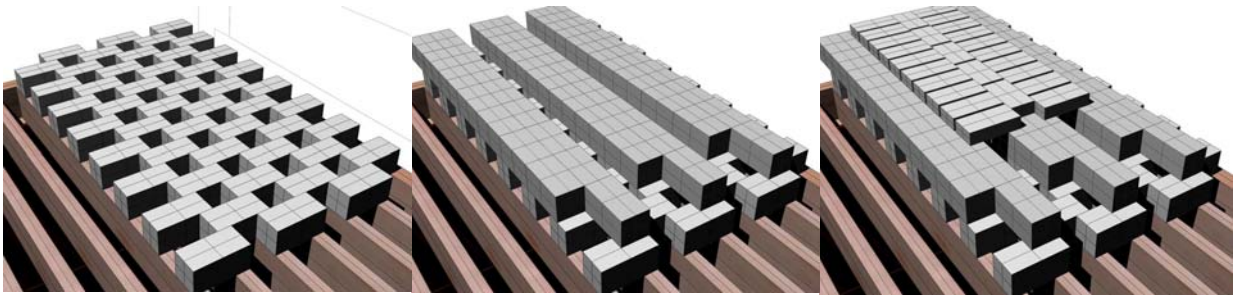
9.4.1.5 sun-radiation on the 21.Dec and 21.march; [Land Tirol Sonnenstunden tiris: http://gis3.tirol.gv.at]

The days in this area are mostly clear, foggy days are uncommon. Thaur is a neighbour community with the same altitude as Absam(2km) and has **493 KWh/m²a solar gain in south orientation**. In comparison Vienna has approximatly 370KWh/m²a of solar gain. [OIB- KIimadaten Nummer OIB-382-011/99; Tirol].

Instead of this a **passive solar use** should be the most efficient system. The house is considered with a superinsulation envelope of straw bales (min 35cm thickness). The construction methode is the non-load-bearing infill system with a wooden framework.

That can be prefabricated easily in a local carpentry. The span of the house isn't more than 4,88m, which works well with the system of 6 x 20 cm bars every 18cm.

Principle of the thermal mass collector in the ceiling with three layer of lime-sand-bricks



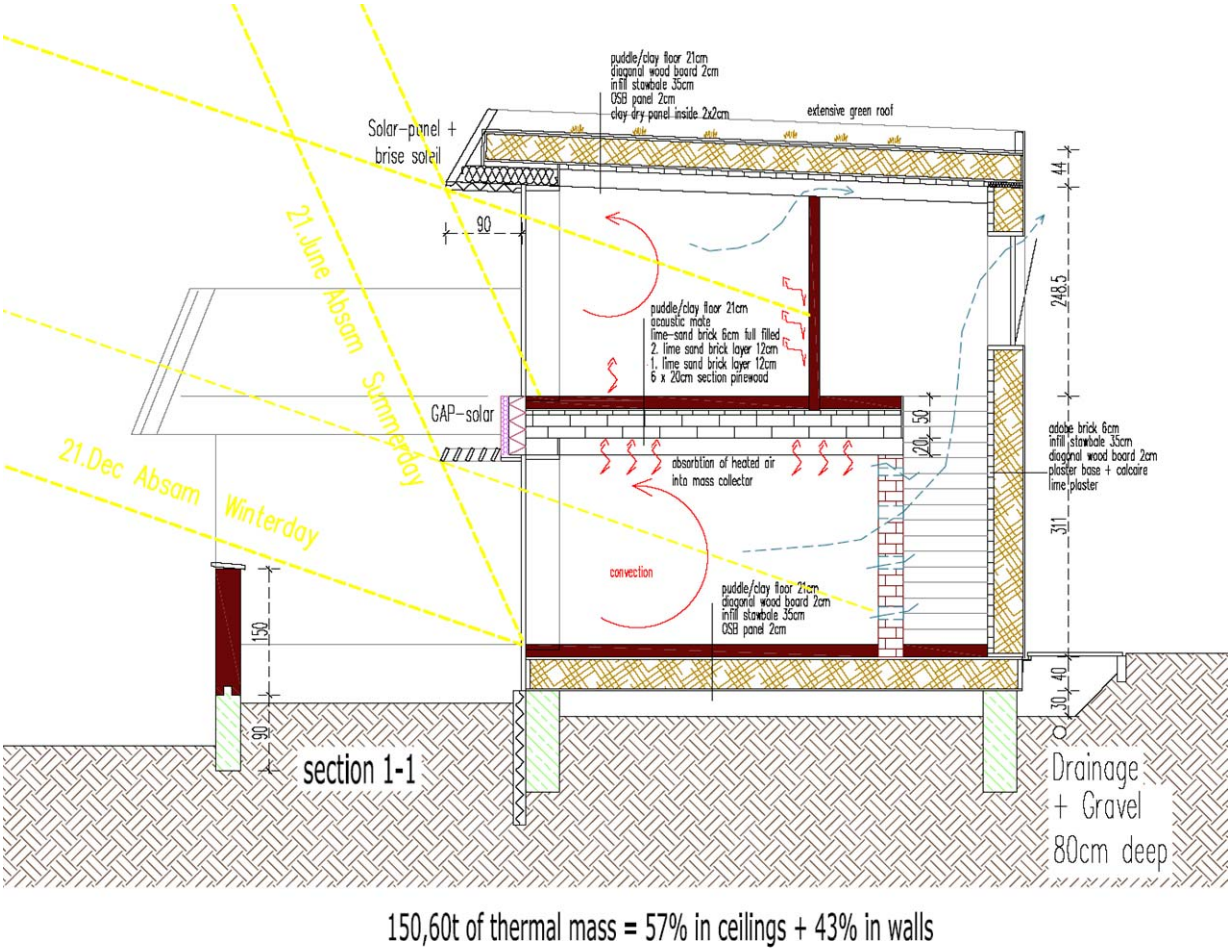
9.4.1.6 secondary mass collector

First layer of lime-sand bricks 12x24x6cm	second layer	third layer

The house is using the function of thermal mass activation for winter and also for summer time. For this reason the primary mass-layer, the floor itself, is charging the sun energy on day. In the ceiling there is a grid of massive **lime-sand brick layers** which collect the heated air into the mass. The stones absorb and reflect the

temperature later on. The heat can be stored max. 3 days without direct sunlight in wintertime. This system is in use since 1993 in a detached house in Trin, switzerland

9.4.2 energy scheme of the courtyard house



150,60t of thermal mass = 57% in ceilings + 43% in walls

9.4.2 energy scheme of courtyard house; section 1-1

as a **zero-energy-concept.** Nearly at the same time there was the implementation of the first passive house in Darmstadt 1990 [28] see annex; Einfamilienhaus Rüedi, Trin.

It does not need any energy recovery ventilation, because of its cross ventilation use. In concideration of the **chimney effect**, I organised my plan layout for a possible **cross-ventilation** with windows. One window is placed upstairs next to the staircase, an other downstairs infront of the garden. It is very important for summer saison to cool down the mass collectors efficient by night. The windows are well organised like this and the air is **crossing the whole space** under the ceiling to mount up the higher opening**.** Through his **cool surface temperature,** the mass collector can provide the inside with cool air during the day.

Therefore it is the inhabitant who has the active role to controll the innerclimate and not the automated ventilation system. He becomes sensiblised to observe the outer weather changes.

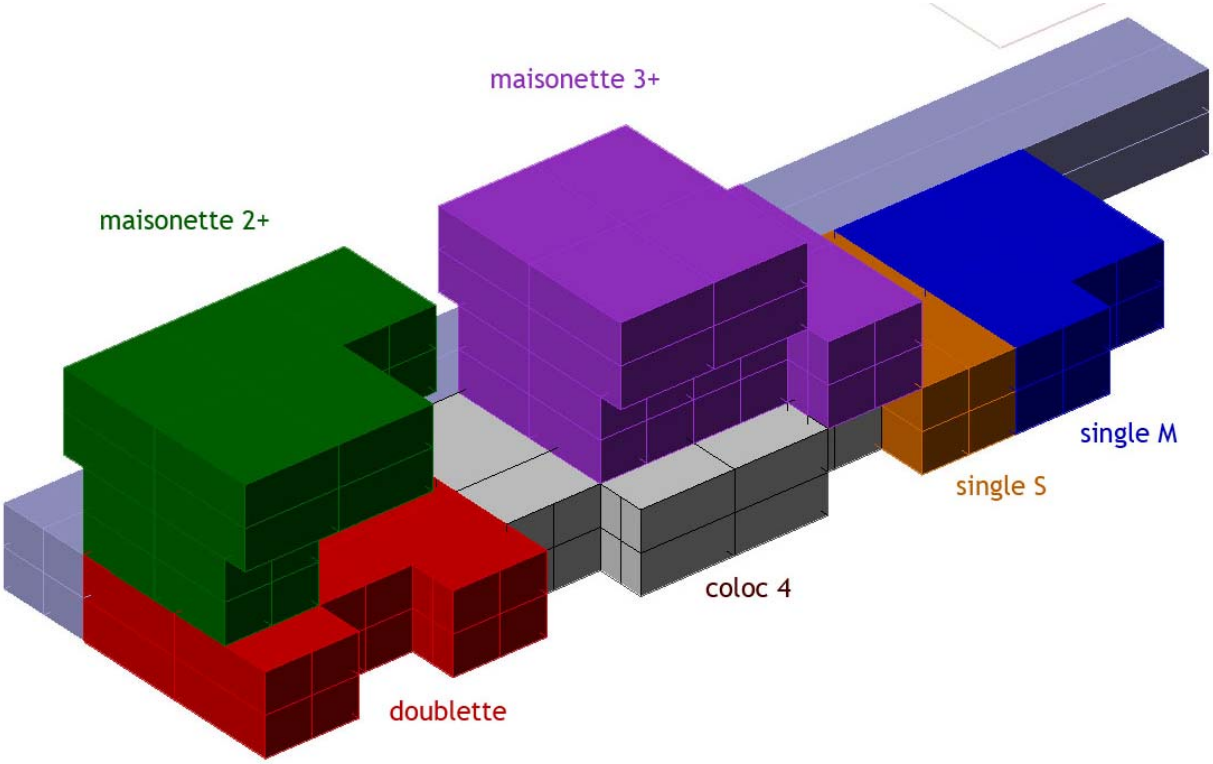
From our own experience we know, that in summer the old houses built by stones are staying cold inside. In this case the thermal mass collector is relatively cold tempered compare to the outdoor climate and refresh the inner space. For this system it is very important to have a constructive sun protection in summer. Direct sun radiation should be avoided on the surfaces of floors and ceilings.

I compared the m² of the project in Trin with my project. In Trin there are 220t of thermal mass located in the house with 170m². That is around 1,29t/m²of thermal mass. For my project, I need to reach an estimated thermal mass of 155t by 120m² useful space. In my consiuation there were four main constituents: **the primary mass collector** with ceiling and floor as a pavement of 21cm , **the secondary mass collector** (lime-sand-bricks), **the outer walls** (straw bales 150kg/m²) and the mass of the **adobe intermediate walls**.

9.5 the generation house_ in detail

9.5.1 living typologies

5 different living types can be choosen: 1. single S, 2. single M, 3. doublette, 4. maisonette 2+, 5. maisonette 3+

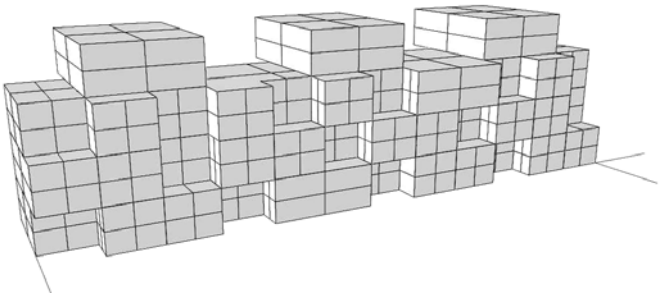


9.5.1 different living types

I have choosen 6 different types, which are starting with sizes of 31,50m² (**single S)** to 145m²(**maisonette 3+)**. Therefore a range of different living types can be found. Starting single-flats up to family-flats or flat sharing possibilities, anything goes. Following the analysis of the given demography the segmentation with 60% doublettes for a two person household can be considered reasonable.

Different composition of the living types

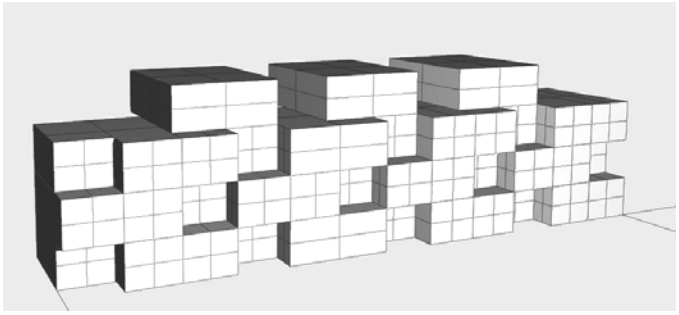
After the definition of **living types**, I tried to combine the different variantes. In my planning the arguments of compactness, lightning and outside space (balkony), were not coherent. Both, the forstanding as well as the backstanding façade, was for me an expressive tool to reach a complexity in the façade. Another effect,



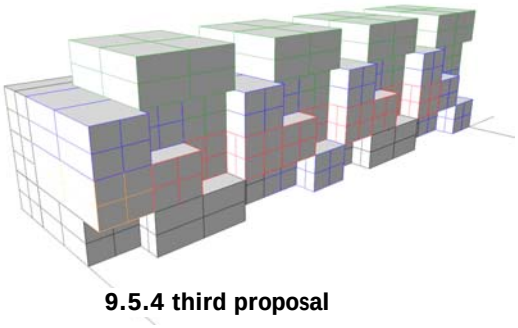
9.5.2 first proposal of composition

is the **protection of privacy** of the outer space as well as the protection of the inner space from too much **sun radiation in summer.** with the overhanging ceiling. I wanted to include the balkonies into the structure of the building. The possibility of **extending the living space** should be given. Like this, the **facade needs to be easily removable** and **replaced** on other positions. For this reason the last post is not

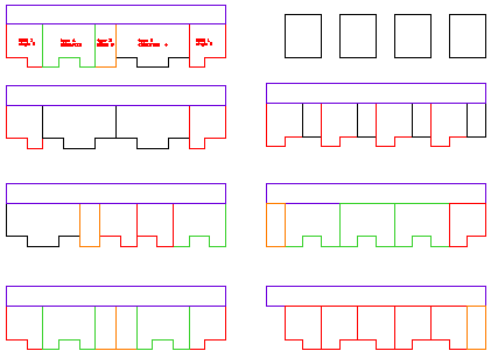
directly infront of the façade. Between the apartments there are **different separation position** possible to create other living types or sizes in the future.



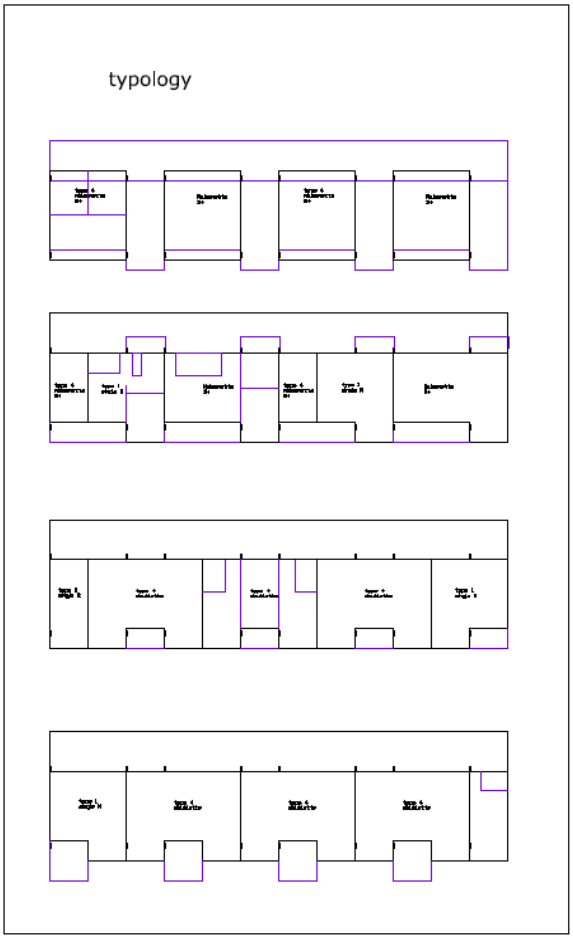
9.5.3 second proposal



9.5.4 third proposal

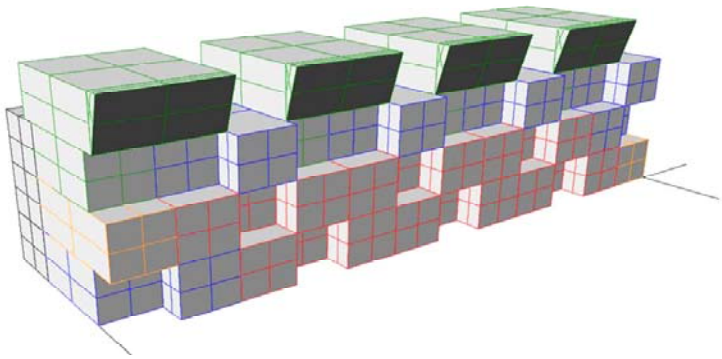


Choosen typology



9.5.5 choosen combination

The choosen typology is just one example of many possible combinations. The apartment above has the function of a sun breaker for the apartment underneath. An extension of the apartement to the outer space is possible. On the top-level is a maisonette which has an open terrasse to the roof.

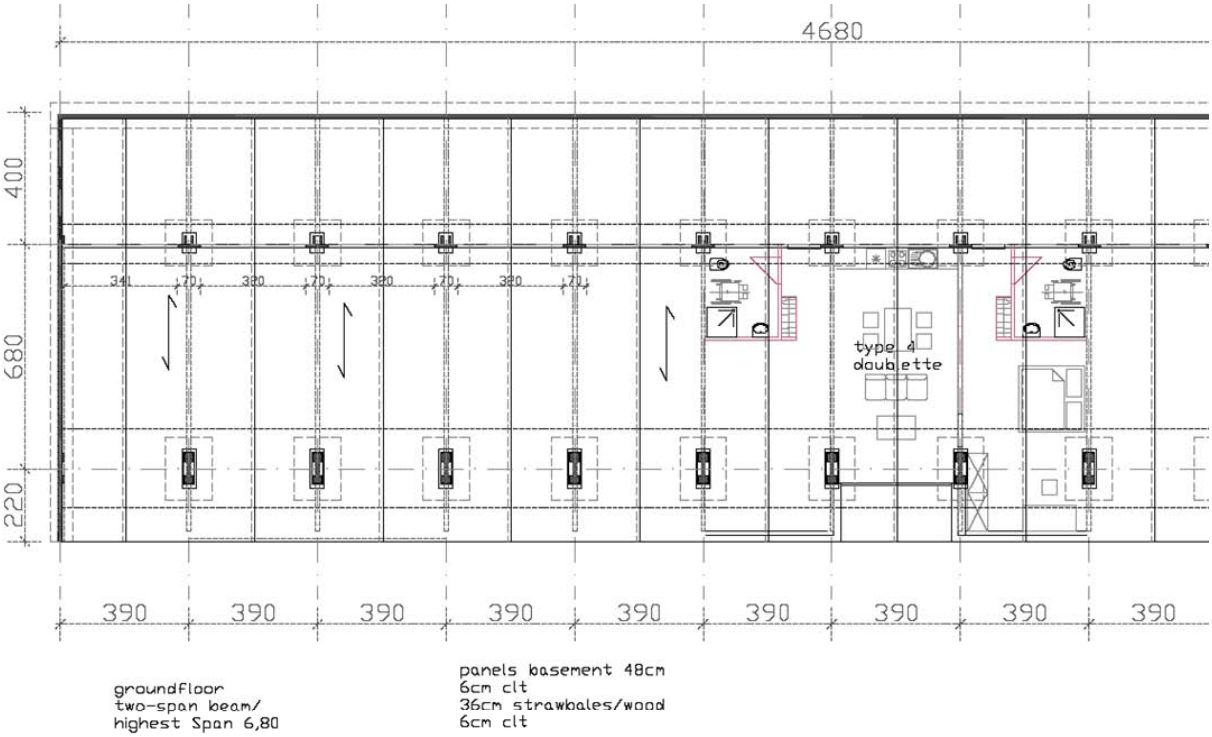


9.5.6 choosen combination in 3d

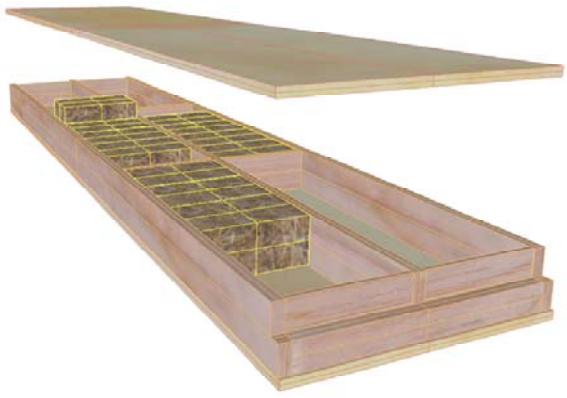
9.5.2 constructive details of generation-house

The construction follows the principle of a wooden mixed structure, as a **[continuous] post and beam system with clt panels** for the horizontal load. The cross bracing is done with **short clt stripes of 70cm** each 3,20m and with the facade elements. The south facade works as a **curtain wall** for less thermal bridges. The **outer walls** in West/East and North orientation are **loadbearing walls**.

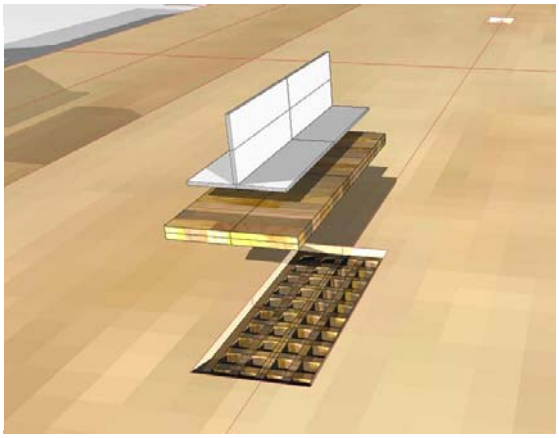
The plattform basement is made of two-span beam panels of a box filled with straw bales. These boxes are prefabricated with 3,90 x 12,80 x 0,48m and they are placed on punctual foundations.



9.5.2.1 groundfloor with the two-span beam boxes of the basement



9.5.2.2 boxes with straw bale

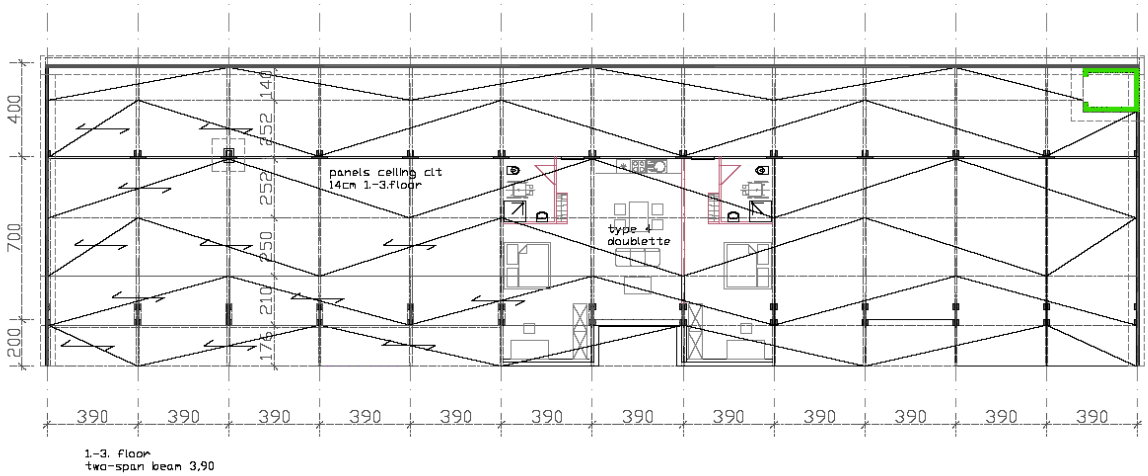


9.5.2.3 integration of the NFC box

Integrated in the box is the bearing platform for the post. This area needs to have high **compression strength**, because of the four-storeys. I suggest using a box made of a natural fibre compound NFC (for example abroform ~90N/mm²), which bridges the load through the pattform basement into the foundation. The posts are connected on the box with a metall plate.

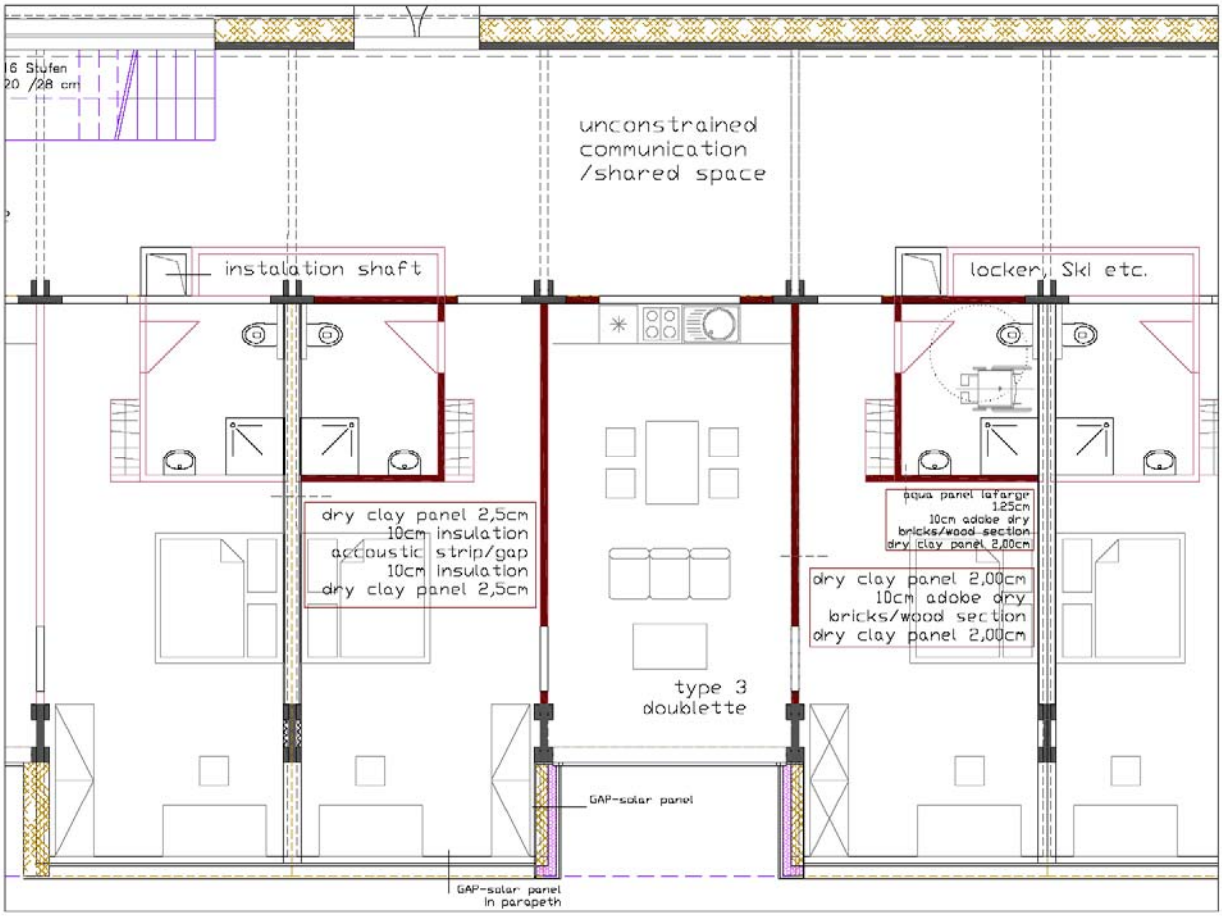
The loadbearing floors are made with cross-laminated-timber. There are also two-span beams, but in **longitudinal direction** of the building and the span is just 3,90. I

dimensioned it with 14cm as clt panel of 5 layers. As alternative, we could use stacked planks joint as a panel with long beech dowels in 45°to the span.



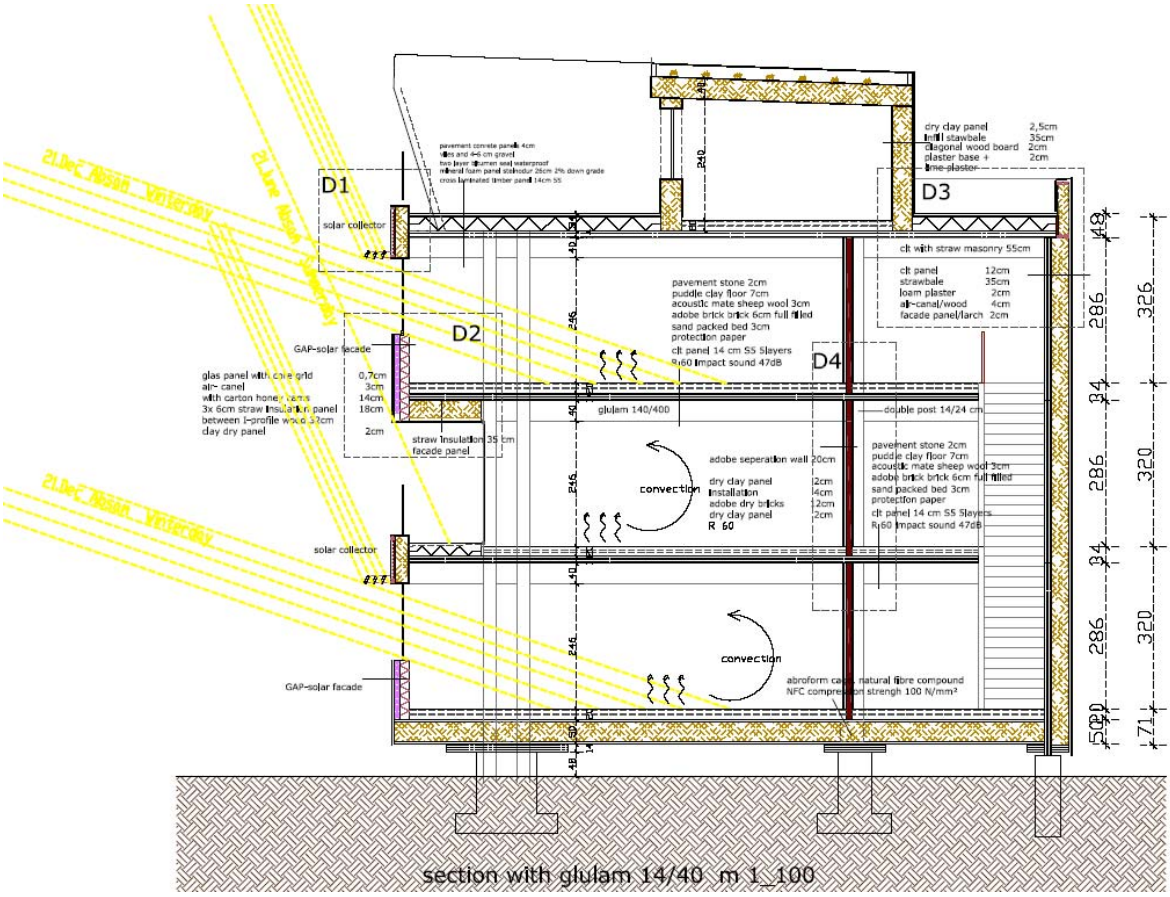
9.5.2.4 first to third floor; two-span clt panels in longitudinal direction

In the plan above the details of the groundfloor with one doublette apartment is shown. The posts next to the outside is composed to an **I-Profile**; two pairs of 14 x 24 cm timber are connected with a clt-panel of 75cm in longitudinal axis. They built together with the beam of 40cm glulam in the middle of the post a stiff frame. The technical shafts are on the outside face of the apartments, where the half-public area is located. Therefore the technic shafts are accessible for technicians without disturbing the residents. The technic shaft can be movable along the intermediate wall without constructive problems, because its taking any loads. The waterpipes are running in the floor section, where we have 20cm floor section without decking. The seperation walls between the apartments are constructed in axis to the beams.



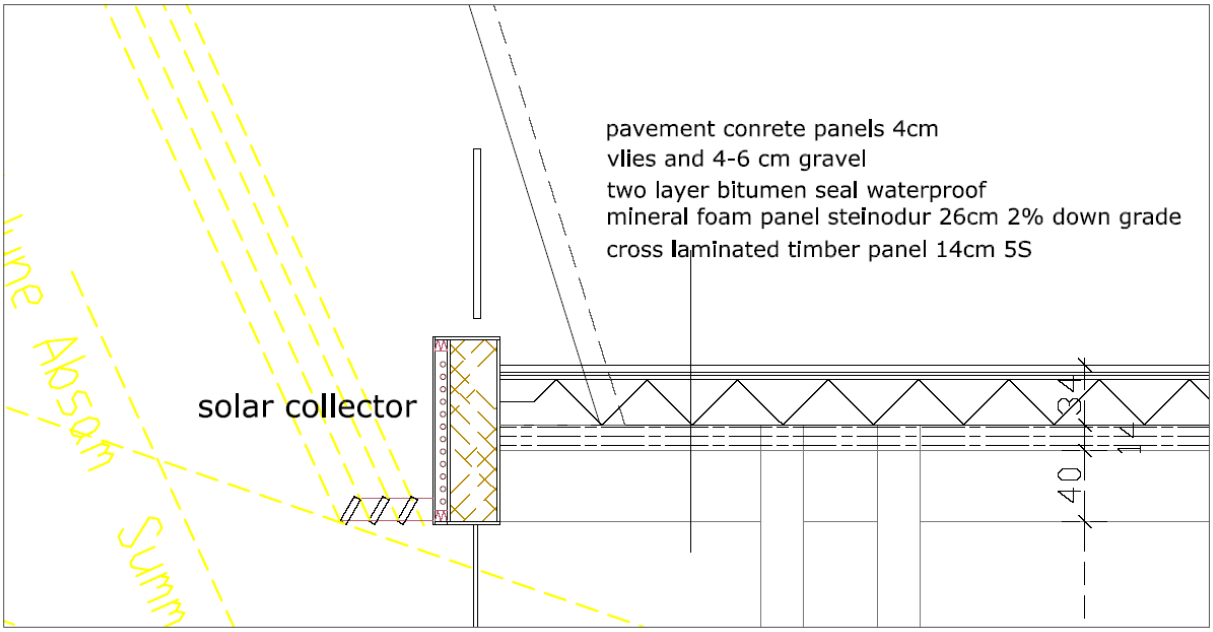
9.5.2.5 groundfloor detail of intermediate wall sections; living typology doublette with universal design configuration

9.5.3 energy scheme of generation house



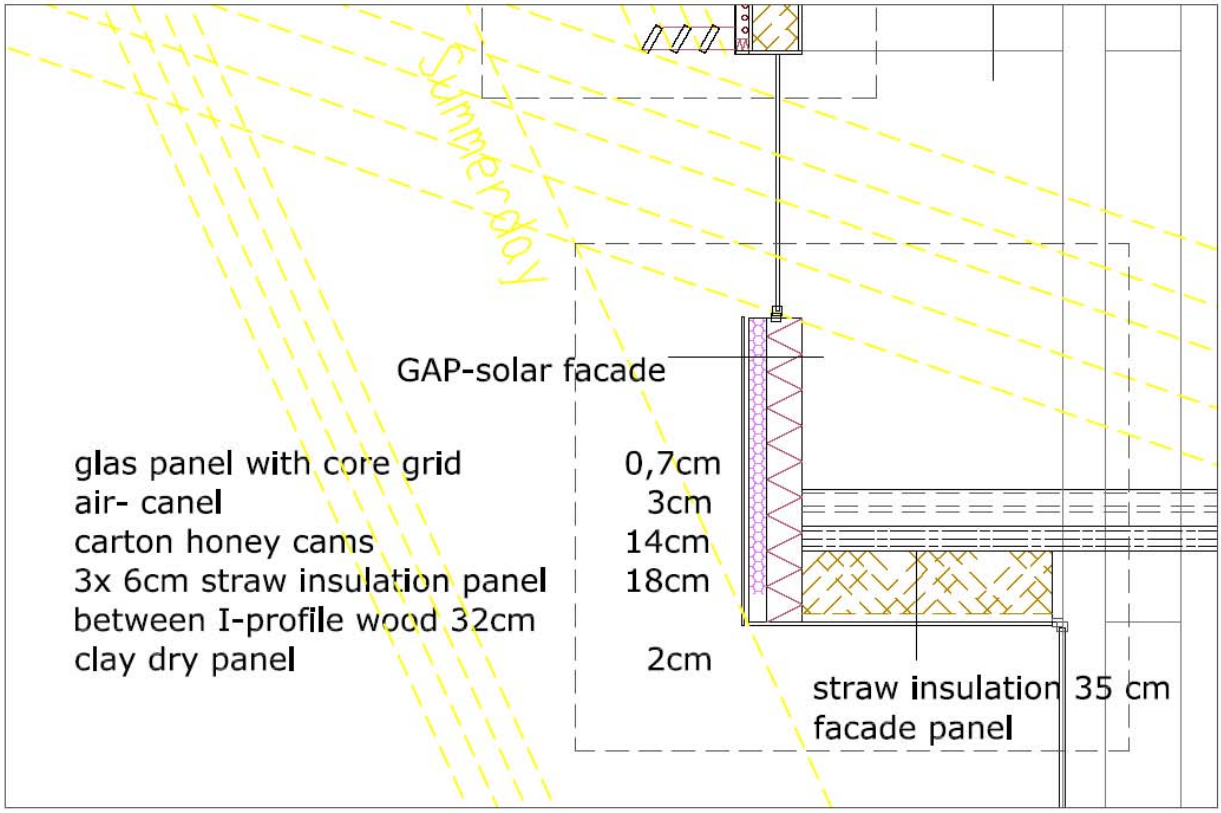
9.5.3 section of generation house with thermal mass activation of floors and walls

The energy scheme of the generation house is similar to the courtyard house. In this case we have just the floor construction as the primary mass collector. The seperation walls are made with dry adobe bricks. For hotwater supply, there are solar collectors integrated into the façade. If the passive thermal mass radiation isn't enough, we can use the solar collector for under floor heating.



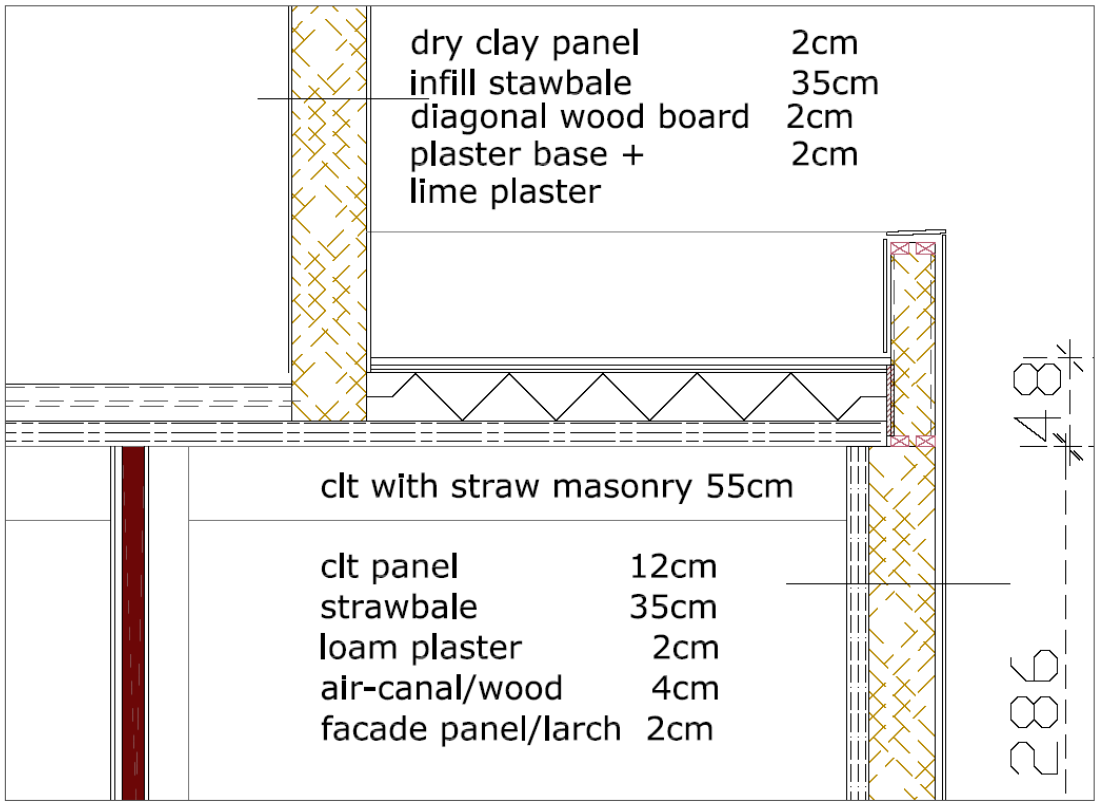
9.5.4 Detail D1 low temperature solar collector

The solar collectors are integrated into the façade. It's a low temperature system, which has a long lifetime because of the max. temperature of 65°C.

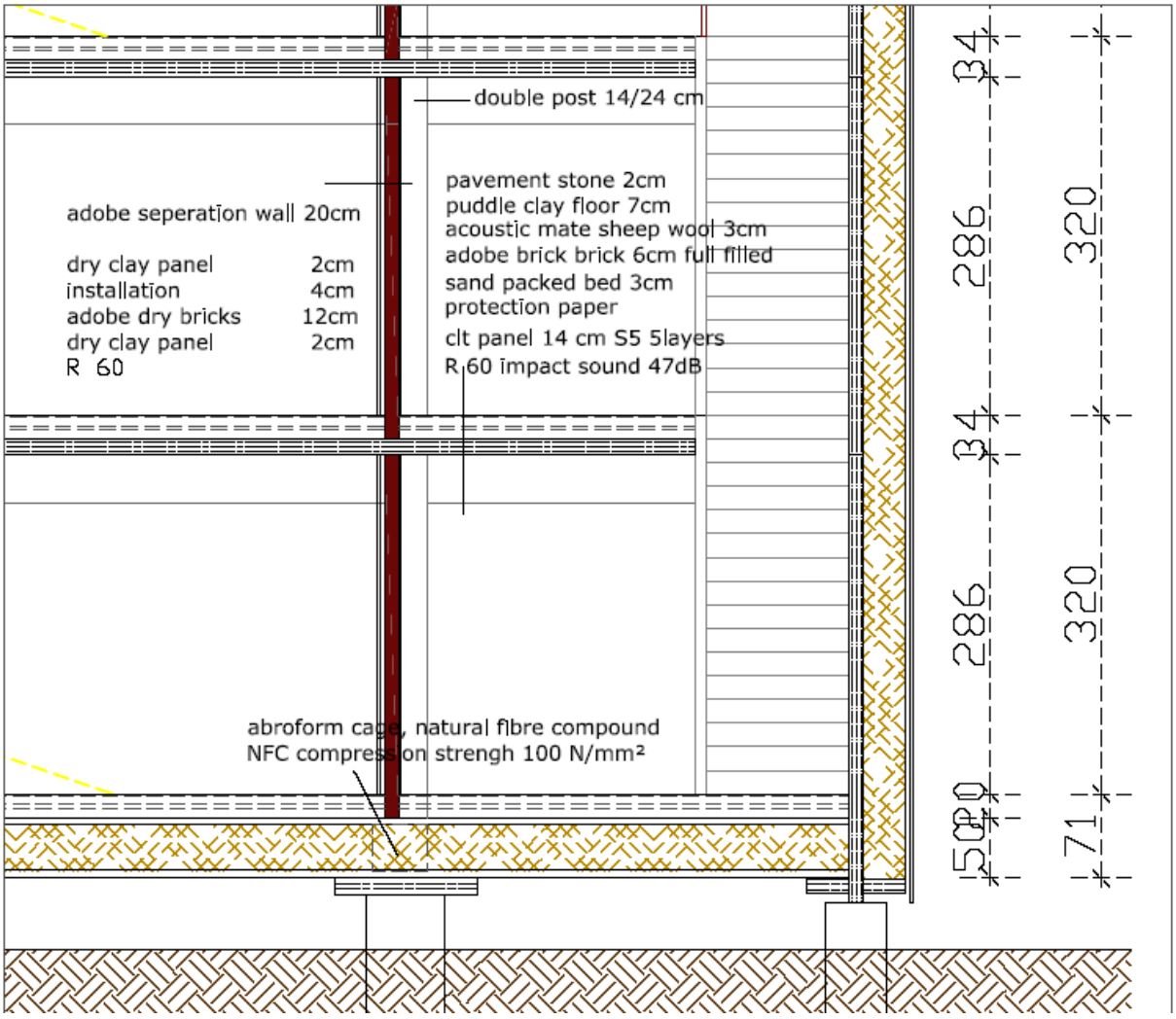


9.5.5 Detail D2 parabeth with GAP solar façade

The Gap solar system is integrated in the parapeth of every outside wall to the south. The heated up air stays into the cams and acts like a buffer. In summer the air is mounting into the air-chanel between glas-panel and carton honey cams.

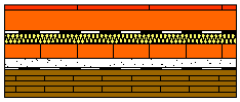


9.5.6 Detail D3 timber framework wall 3.floor and clt outer wall



9.5.7 Detail D4 ceiling and floor section

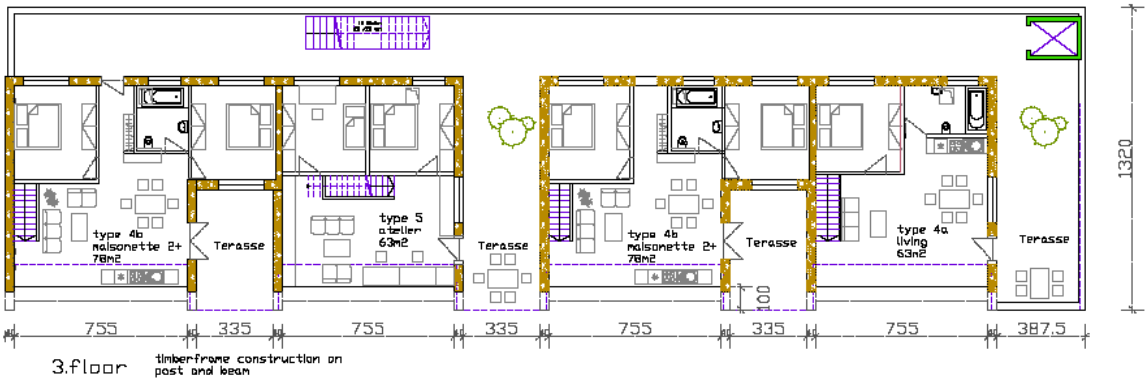
Dataprofil building physics for floor section



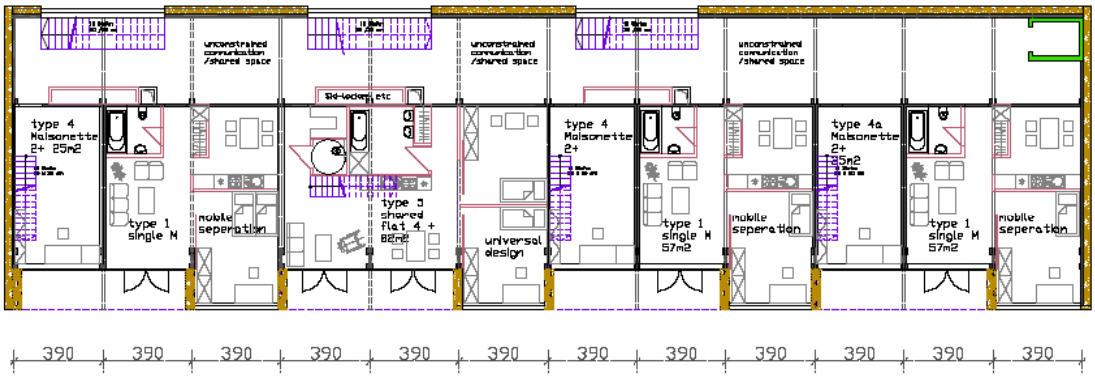
Bauphysik	Einheit	DE1
Wärmedurchgangskoeffizient (U-Wert)	W/m²K	0,47
Bew. Schalldämmmaß R_w	dB	65-68
Bew. Standard-Trittschallpegel $L_{n,T,w}$	dB	47-48
Feuerwiderstandsklasse		F60
Speicherwirksame Masse unten/oben	kg/m²	49/115

9.5.8 dataprofile of the floorsection [TU Wien Grat; www.nawaro.com]

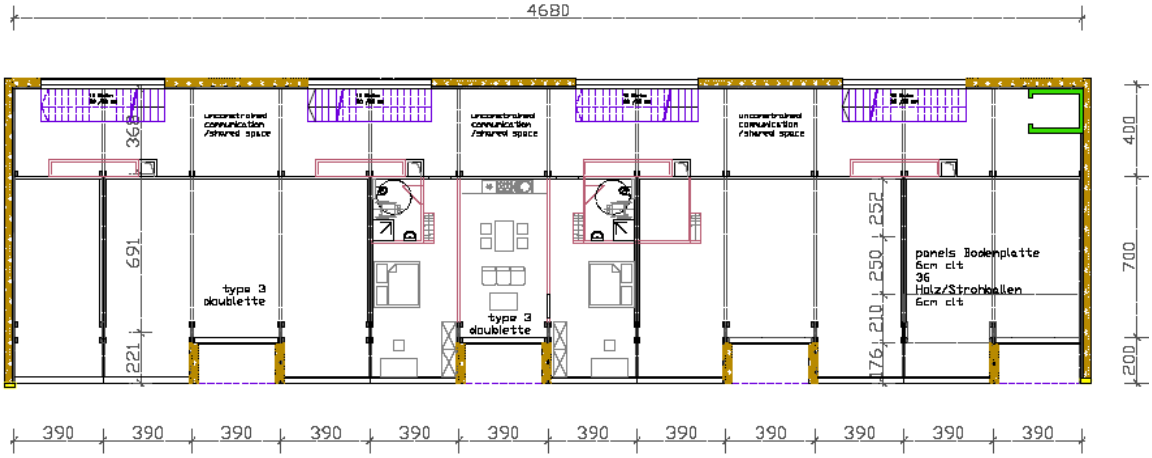
The section has a good thermal mass capacity with the adobe bricks, the 6cm clay layer as pavement and the 14cm wood section from the clt. The acoustic and fire resistance with F60 is enough for a fourstorey residential-building .



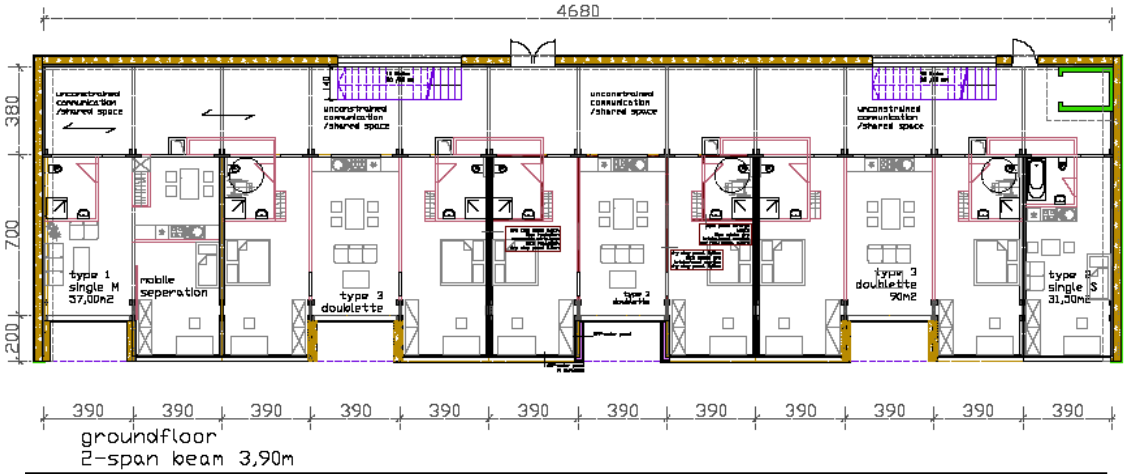
3.floor timberframe construction on post and beam



2.floor



1. floor



groundfloor
2-span beam 3,90m

9.5.9 all floorplans for the generation house:

9.6 erection and building process:

9.6.1 generation house

prefabrication :

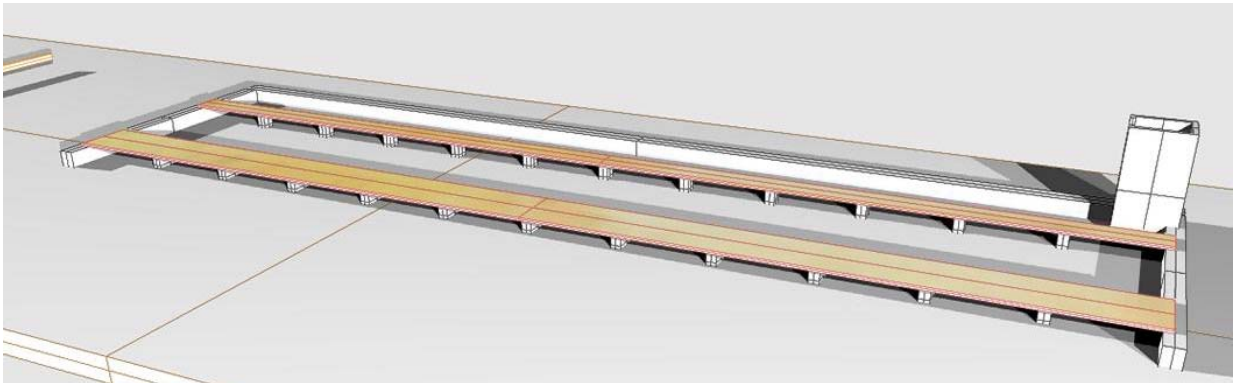
The **boxes for the platforms** of the basement are prefabricated and fulfilled with straw in a carpentry. For the generation house, the both outsides are 6cm clt panels as diagonal boarding.
Integrated in the infill layer is a high **densified natural-fibre-compound** as bioplastic-block, to bridges the vertical loads from the post into the foundation.
The **roof** is also a box construction with straw infill, there we have OSB boarding (18mm air-tight).

The **outer wall is 3,20cm high** each storey and divided in smaller parts which is adapted to the product (we do not know - open tender)

erection process:

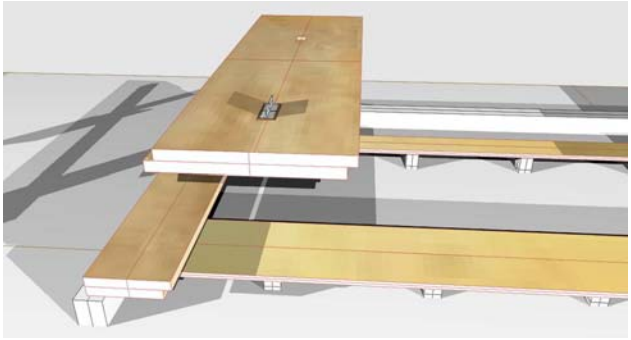
We start with the excavation of the earth for the punctual and stripe foundations and we will charge the earth by side for the preparation of loam plaster and the puddle on the ceilings. The concrete process for the foundation is against the earth and without formwork.

After the stripe and other foundations are done, we can start to implant the timberconstruction with **a long stripe of clt** to join the punctual foundations. After the first boxes for the basement platform over ground can be installed.



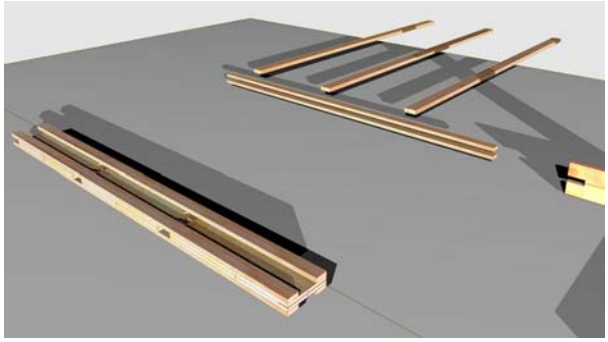
9.6.1 location of two clt-panel stripes on foundation

First box of the basement

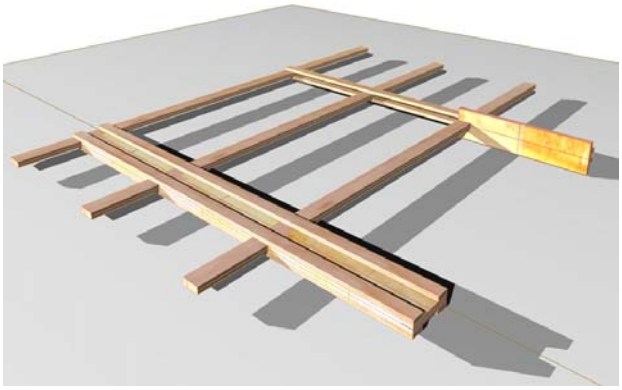


9.6.2 deplacement of the groundfloor boxes

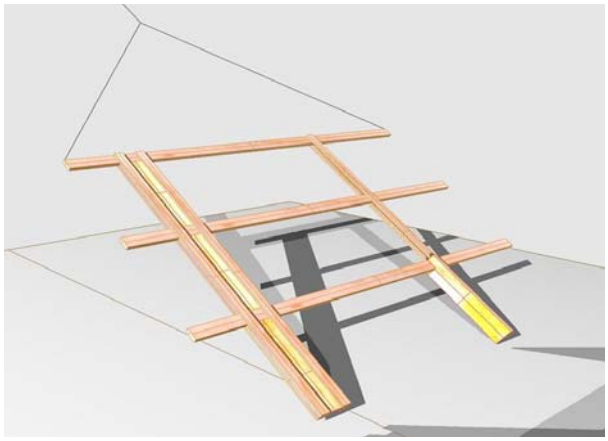
The **posts** are partly prefabricated; the **multistorey frame** will be finished on side.



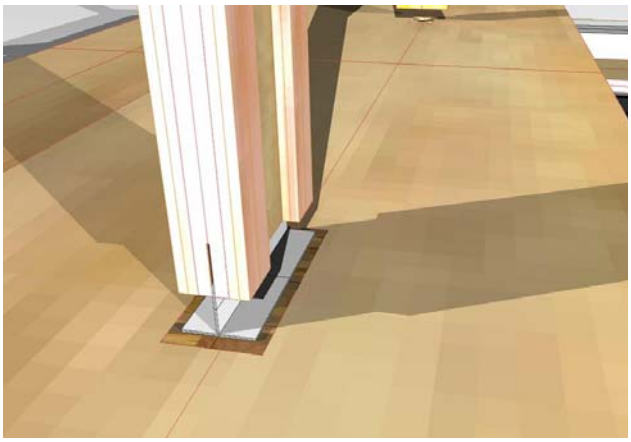
9.6.3 parts of multistorey frame



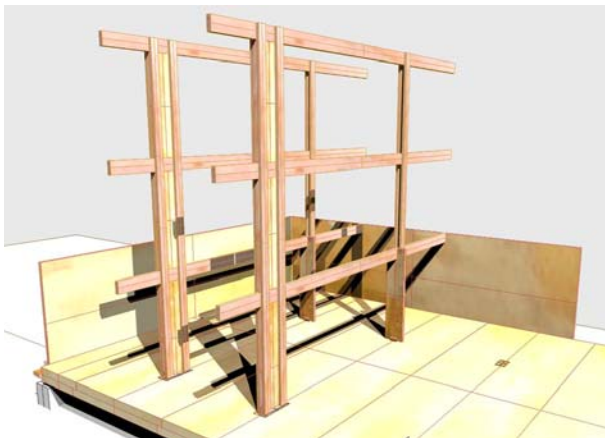
9.6.4 Composition of the multi-storey frame on side with prefabricated post



9.6.5 lifting of the first multi-storey frame



9.6.6 bearing plat and post connection

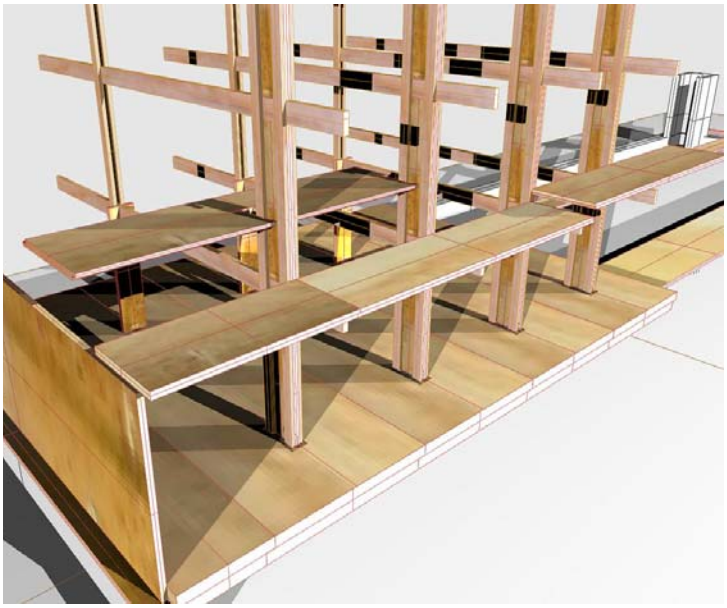


9.6.7 installation of the first frames

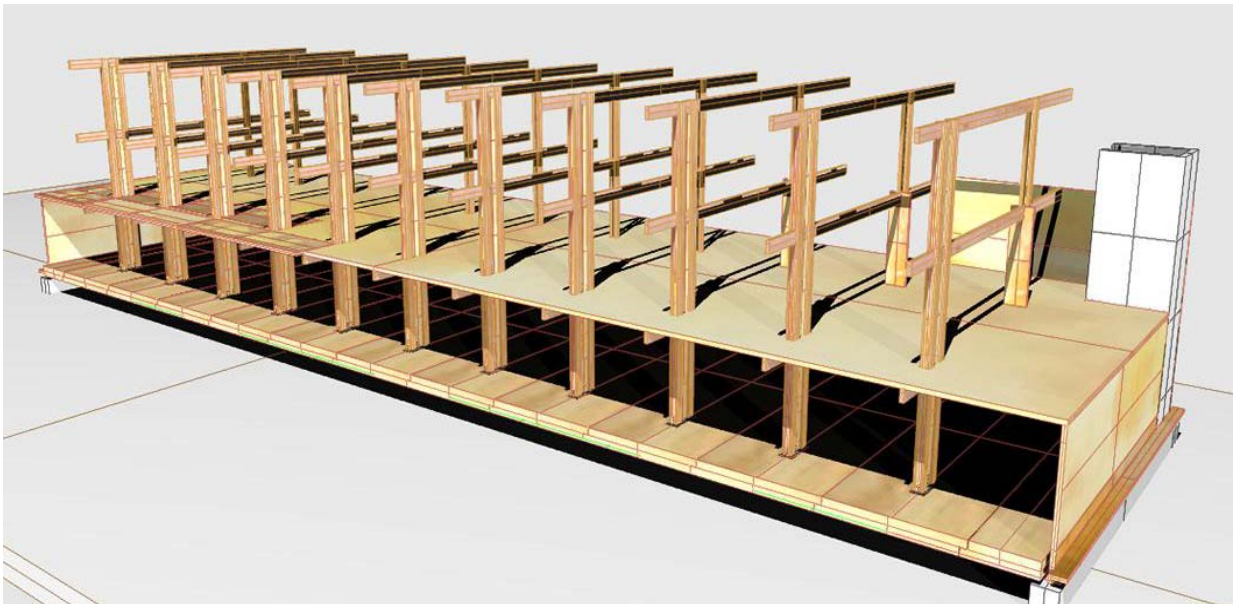
Installation of the first frames: with the installation of the first clt-panels on back and side the multi-storey-frames gets directional stability.

The **clt panels for intermediate floors** have in general **7,80 x 2,00 - 2,50m** dimensions and are places on the beams with sections of 14/36cm glulam. Clt panel and beam will be connected with screws, so that the section together becomes a **T-profil**.

All clt panels are placed on elastic mates for acoustic reasons.

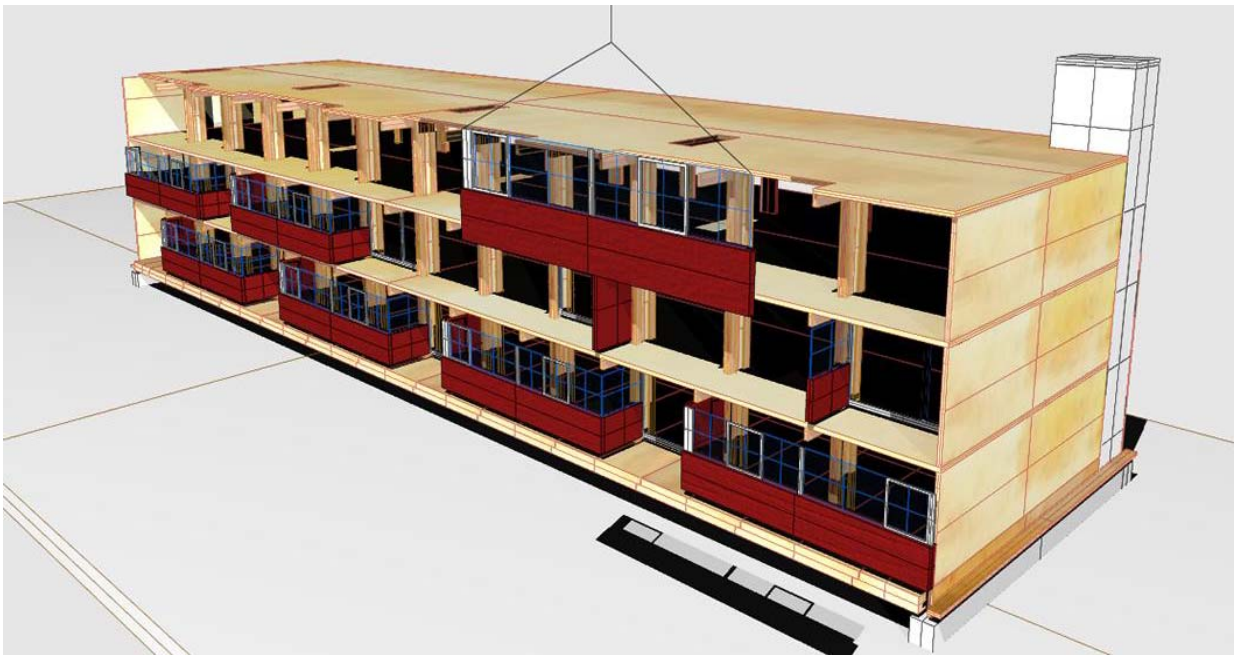


9.6.8 Implementation of the floor-panels as two span beams of 3,90m



9.6.9 finish of the first floor

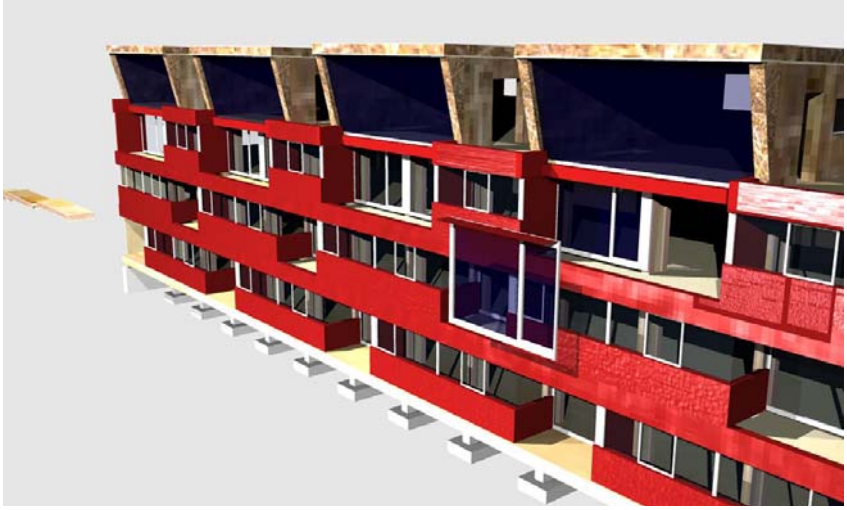
The next floor can be started with the outer walls and the floor ceilings for the second floor**.**



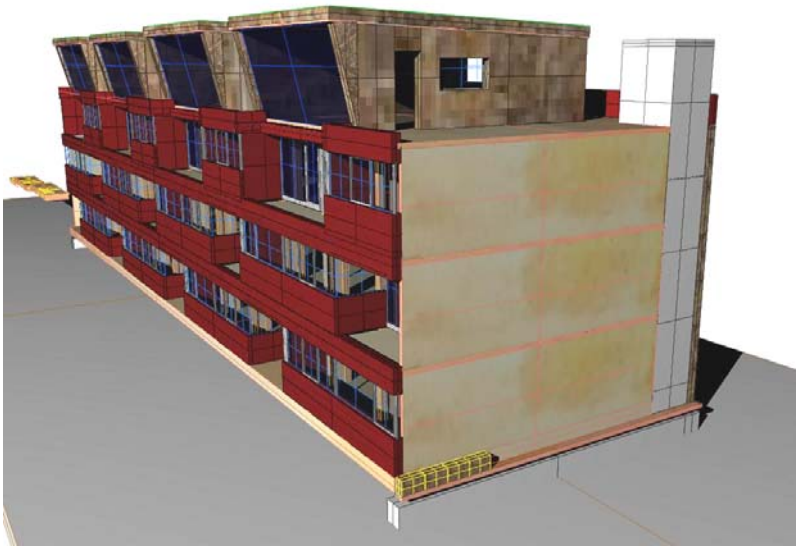
9.6.10 assembly of the prefabricated facade

Prefabricated façade.

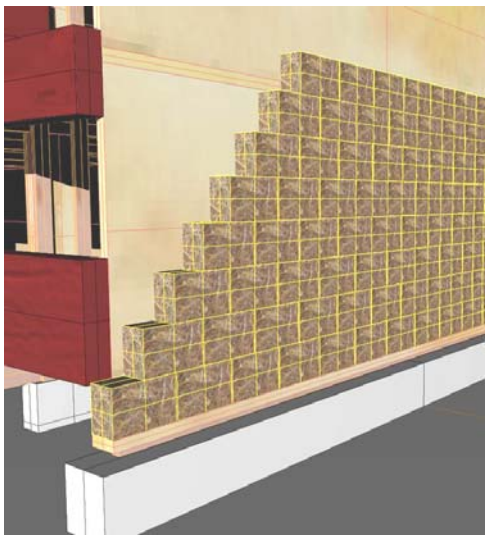
There are three different façade elements, the loggia window with integrated door, the façade with the gap-solar elements which is flush with the ceiling (curtain façade) and the corner elements



9.6.11 installation of the glas-elements to the loggia



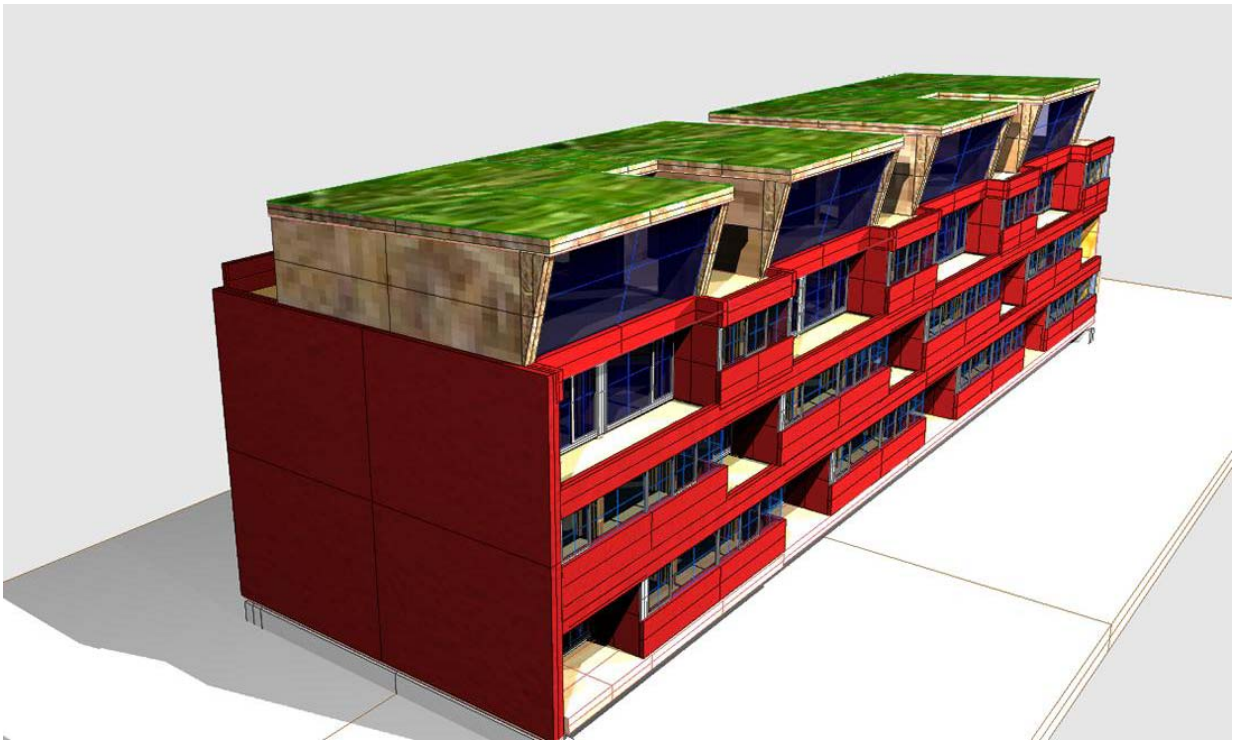
9.6.12 side-front of generation-house



9.6.13 straw bale masonry

The last walls in the fourth floor are **wooden-framework**, because we have more envelope surface and with this construction we have a slender section and its lighter constructed. The construction method is similar to the courtyard section.

Right you can see the start up of the straw bale masonry method on the side-front of the building.



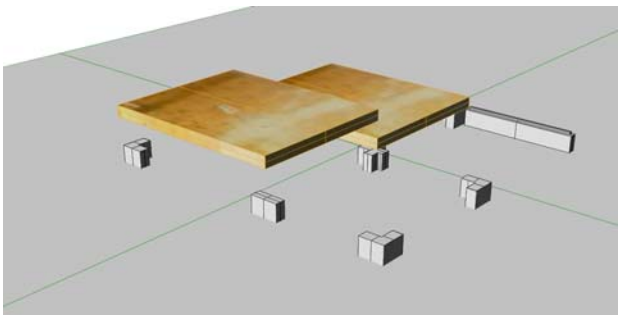
9.6.14 green roof on the last ceiling

At the end there is the implementation of the green roof and so the residents can come…

9.6.2 courtyard house

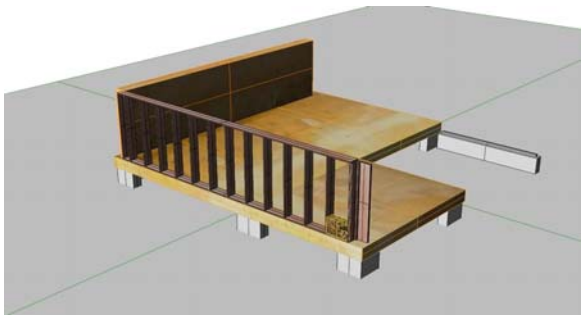
Prefabrication of wall section timber frame:

The framework of the walls of the courtyard house is made of simple sawn timber sections. The framework is closed on the outside surface with diagonal boarding with planks (sawn timber, unplaned) to have a good conncetion with the lime plaster. On the butterfly table we can turn the wall to work for the inner-side. We take attention to avoid gaps between section and the straw bale by infilling (otherwise we need to tamp the gaps with straw). The layer of the air-dry adobe bricks couches on the straw bale. We close with a 2,0cm dry clay panel (diagonal stiff; alternative to gipsen fibreboards)



9.6.2 positioning of the basement boxes

The first floor panels (boxes) will be placed on the foundations

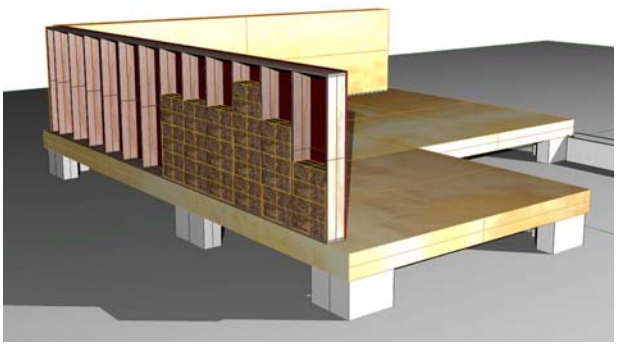


9.6.3. open frame

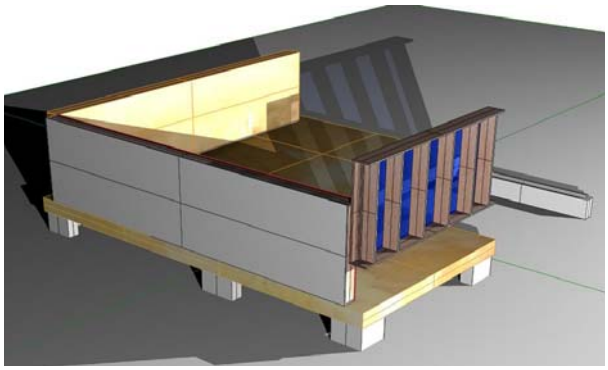
the walls can be prefabricated just as open frames, like this the “owner” can do the infill work on his own.

9.6.4 layers of the outer courtyard wall

Here you can see the **different layers of the outer wall**, straw bales, adobe dry bricks and covering with a dry clay panel



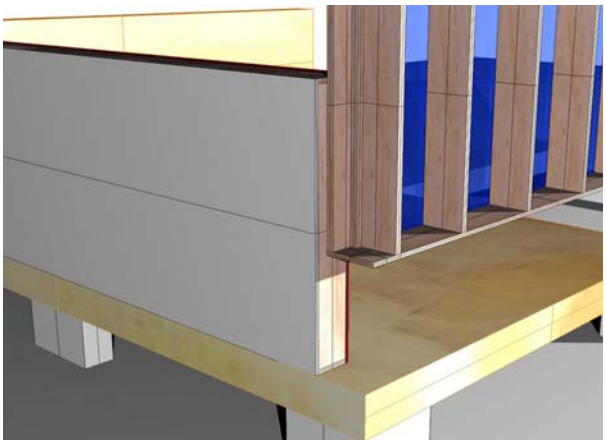
9.6.5 economic version of prefab. Framework



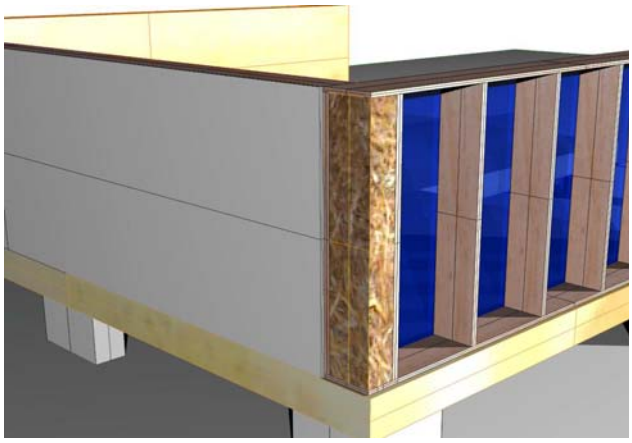
9.6.6 full-finished wall

The timber framwork can be prefabricated in two different levels. One is the economic version, where just the framing is prefabricated. The rest needs to be

done from the owner themself. The second version is full-prefabricated wall, where the outside finish, for example a lime-plaster, is already done. Different claddings can be chosen from the owner.

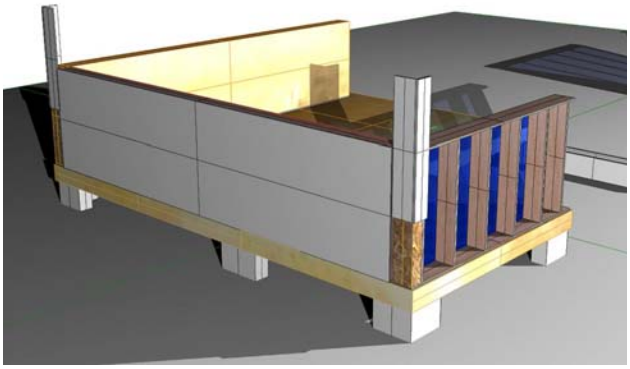


9.6.7 setting of the first wood-glas element

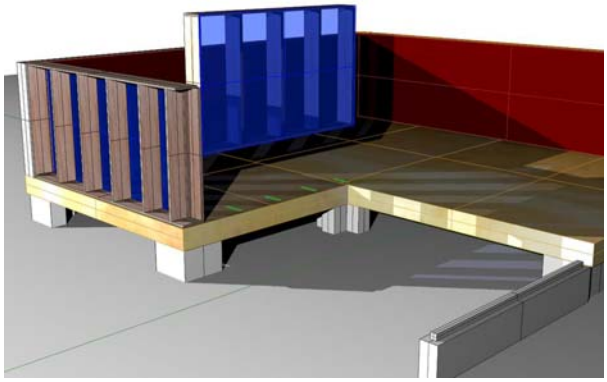


9.6.8 straw bale element

The window glassing is integrated in a wooden frame and can be installed in one piece. The connection through the other full-filled wall is to be done with screws through the edge. After this a prefabricated straw bale element will be tamped into the corner

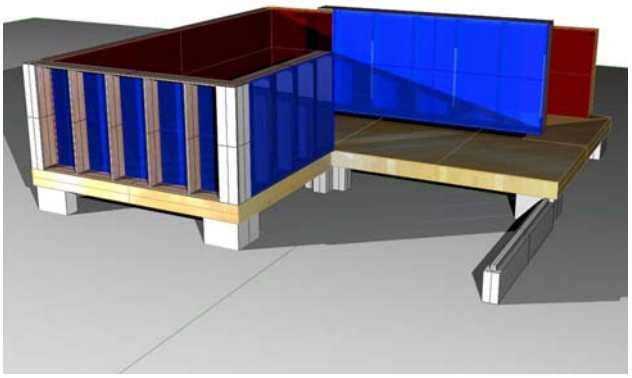


9.6.9 edge covering

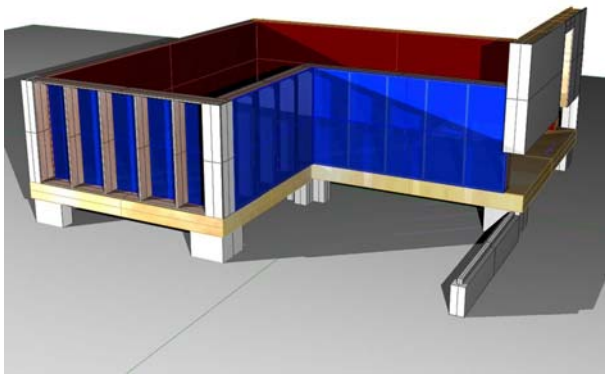


9.6.10 installation of east glas-elment

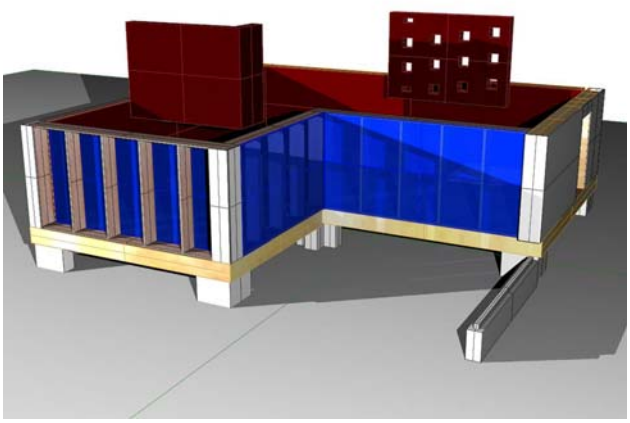
Now we can close the edges with corner facade elements. The next wood-glas element can be fitted in.



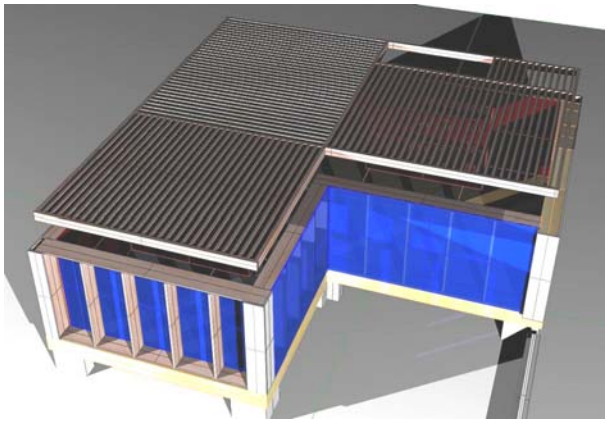
9.6.11 installation of the south facade



9.6.12 the last wall to the east

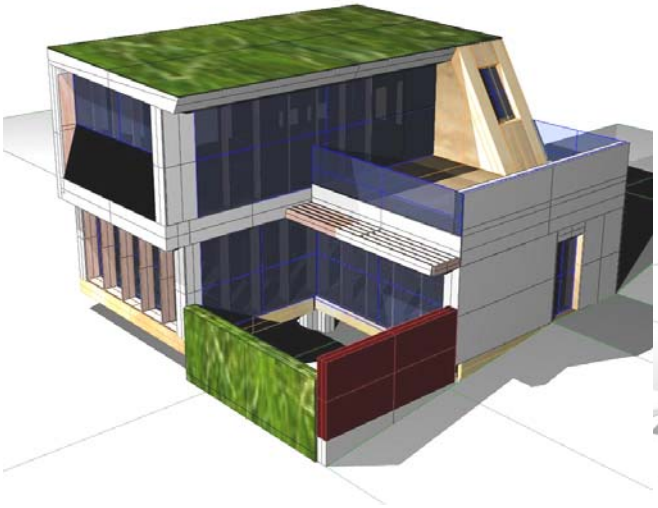


9.6.13 prefabicated adobe walls 30cm

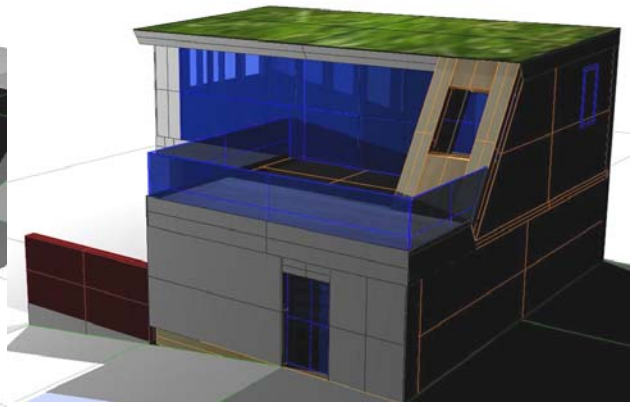


9.6.14 ceiling with 6 x 20cm bars

The adobe walls can be lifted into the building. They are responsible for a good inner climate also in summertime



9.6.15 the courtyard house finished



9.6.16 courtyard house from backside

The first floor has similar building elements. The house-type 1, in the first range of the urban-plot, has a cantilever of 90cm to the south.

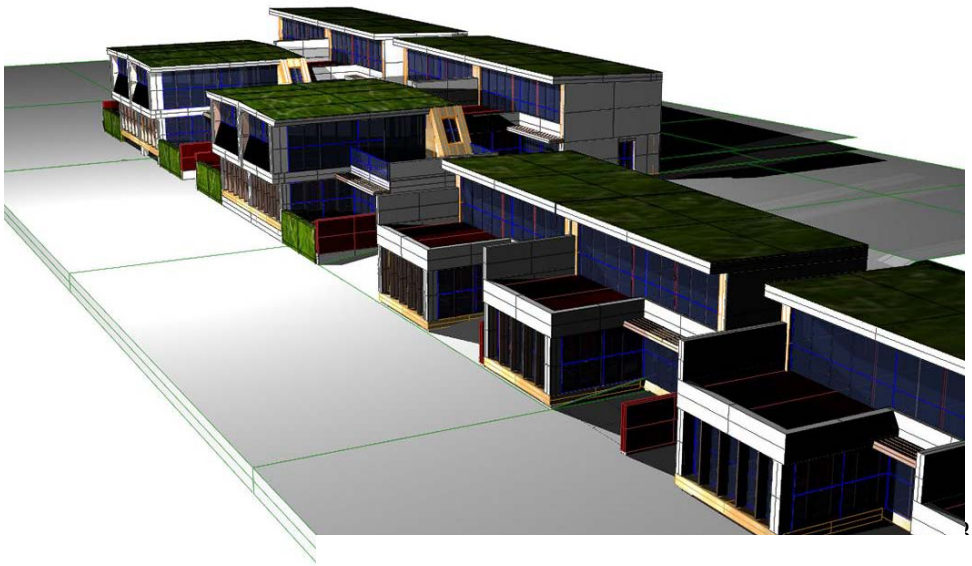
9.7 integration of the results on the plot

9.7.1 urban plot – final masterplan

Here you can see the whole masterplan of the urban-plot. In the north there are mixed functions around living with a health care center, mobility service, a cafe with bakery, the technical support and the community center on the edge of the junction. All parking places are accessible from the local streets around the plot. No car can enter into the half private space. The community hall has functions like open kitchen, créche and a libary.

9.7.2 generation house south orientated

The **generation house** is located next to the center of the eco-village and across the community hall. In front of them are the terrassed housed which are directly behind the courtyard housing. Next to the school are pavillions with one storey. Behind them is an other **grouping of courtyard housing**, which have all the same orientation. The atelier or loft-houses are next to the street on the easten part of the plot. A multistorey building for assisted living is inbetween the generation house and the loft-houses.



9.7.3 courtyard housing next to the lower street in south

10 Conclusion:

A ecovillage is a small micro-society, which can prevent high energy consumption through urban strategies. **Social sustainability** and networks can be developed in such communities with **sensitive urban planning**, where short ways and neighbourly help is active.

This thesis shows the possibilities to build **low rise to middle rise residential buildings** using nearly 100% locally available and renewable resources. By utilizing **straw bales as super insulation** (30cm+) in the envelope of Wooden-based building design, this ecovillage becomes competitive to the conventional building method in terms of **heat conductivity** by similar diameters of the sections.

In addition, the straw bale building envelope will have advantages in primary energy impact, recycling process, heat capacity and healthy inner climate.

The combination of wood, straw and loam is high qualified for a passive house energy concept.

The **architectural design** and the **construction method** will have an economical influence to be competitive with renewable materials.

Further studies required to complete this topic can be on building physics properties of such renewable building components comparing to conventional concrete structures with thermal simulation and analysis.

Annex:

List of References

[1] Haller, Peer, Prof.*; lecture of Wood Textile and Projects*, 2008 TU Dresden
[2] Touliatos. Panos, Prof*; lecture of TIMBER IN SHIPBUILDING IN PREHISTORIC AND ANCIENT GREECE;* 2008 Polytechnico di Torino - National Technical University of Athens
[3] Natterer*, Julius, Prof.; lecture of Timber Structures I*, 2008 TU Dresden – ETH Lausanne
[4] Yean 2005, *TyrolCity - new urbanity in the Alps* ; www.tirolcity.at
[5] Sailer,] Martin; Abteilung Raumordnung Stadt Innsbruck; *Raumordnungsprogramm; überörtliche Grünzonen in der Kleinregion 18 "Hall u.Umgebung*"

[6] Gemeinde Absam; Bevölkerungsentwicklung, *Gemeindeversammlung 11.03.2005*, www.absam.at

[7] Hill, R. and Dunbar, R. (2002); "*Social Network Size in Humans*." Human Nature 14(1): 53-72. Retrieved on: 2008-04-09)

[8] Van Schyndel Kasper, D. (2008). "*Redefining Community in the Ecovillage*." Human Ecology Review 15:12-24. Retrieved on: 2009-08-27

[9] Gilman, Robert; Summer, 1991 "*The Eco-village Challenge*")

[10] TU Darmstadt*; Solar decathlon 2009* Winner Team Germany, http://www.sd-live.de/blog/blog/gallery/?album=all&gallery=34

[11] R. Korab, E. Delugan-Meissl; *HY3GEN ein nachwachsendes Haus*; Haus der Zukunft Schriftenreihe 27/2007 etc. p 57

[12] Rainer, Roland; Amiras, Nikolaus; *Forschungsarbeit Gartenstadt Puchenau II*; Architektur- und Baufachverlag 1984, 120 S.

[13] Treberspurg, Martin; *SolarCity Linz Pirchling*; Nachhaltige Stadtentwicklung. Sustainable Urban Development; 2008, 214 Seiten, Springer, Wien ISBN-10: 3211305629

[14] Rietz, Andreas; *Zukunftsweisende Wohnprojekte in der Stadt;* http://www.baufachinformation.de/literatur.jsp?bu=08049029050 Generationshaus West, Stuttgart pp.21-23; "WohnreWir" Tremoniapark, Dortmund pp.29-31;

[15] Mozas, Javier, Fernádez Per, Aurora; *densidad/density_ new collective housing* 2004 p.206-207

[16] *Scheme of a biological sewage purification*; http://www.klaeranlagen-vergleich.de/kleinklaeranlagen/technik/systembeschreibungen/pflanzenklaeranlage.htm

[17] source Bundesabfallwirtschaftsplan 2001, Austria)

[18] G. Thür, W. Ritsch, M. Summer; *Inkl.wohnen Nachhaltige Wohnungsangebote* - individuellen und gemeinschaftlichen Mehrwert schaffen - Schriftenreihe 41/2006 ,p.20 http://www.hausderzukunft.at/publikationen/view.html/id1

[19] Shared Space Institute, Brüssel; "*Shared Space*". http://www.sharedspace.eu/en/publications/downloads/cat_view/15-boeken-en-brochures/17-eigen-uitgaven/

[20] own source, images, drawings, 3d renderings

[21] le corbusier; *the fifth point of architecture*, www.wikipedia.org

[22] Schramm, Helmut; *Low Rise - High Density; Horizontale Verdichtungsformen im Wohnbau*;- 2008, 2. überarbeitete und ergänzte Auflage, 178 Seiten, Springer, Wien ISBN-10: 3211757937

[23] FASBA; Fachverband Strohballenbau Deutschland e.V; www.fasba.de

[24] Gruber, Herbert und Astrid, Santler, Helmut; *Neues Bauen mit Stroh*; ökobuch Verlag Staufen; ISBN 978-3-936896-35-0 3.überarbeitete Auflage 2008

[25] proHolz Austria; *Zuschnitt 34*, page 17

[26] Krick, Benjamin; *Primary Engery Impact of different straw-bale constructions*; University of Kassel; FB6 Forschungslabor für experiementelles Bauen; Prof. Gernot Minke; http://www.uni-kassel.de/fb11/agrartechnik/Fachgebiet/bilder/krick/PEI_Plakat.pdf

[27] R. Wimmer, H. Hohensinner, M. Drack, C. Kunze; *S-house: Innovative Nutzung von Nachwachsenden Rohstoffen am Beispiel eines Büro- und Ausstellungsgebäudes* Schriftenreihe 2/2005 http://www.hausderzukunft.at/results.html/id1752?active=

[28] Zero-energy-house: *Einfamilienhaus Rüedi Trin*; http://www.energienetz.ch/solargebaeude/Text/SG/SG_index.html

[29] Gruppe für angewandte Technologien; *platform for renewable resources*, databank TU Wien Grat; www.nawaro.com

[30] Herzog, Natterer, Schweitzer, Volz, Winter; *Timber Construction Manual*; Birkhäuser Verlag Birkhäuser 3.d edition; ISBN 978 -3- 7643-7025-1

[31] archplus; Zeitschrift für Architektur und Städtebau; *cover Holz 193;* September 2009

Interesting Internet resources:

passive house institut darmstadt http://www.passiv.de/

dry clay panel diagonal stiff alternative to gipsen fibreboards
Claytec Lehmbauplatte; www.claytec.de or
Natur und Lehm Biofaserlehmplatte; www.lehm.at

fertighauscity5+ – Typologische und technische Untersuchung zu mehrgeschossigen Holzbauweisen in innerstädtischen Bereichen unter dem Gesichtspunkt der Vorfabrikation und Partizipation der Nutzer (Kundenindividuelle Fertigung). Abschlussbericht 2009, 343 S. ISBN 978-3-8167-7797-7 | Fraunhofer IRB Verlag
http://www.baufachinformation.de/artikel.jsp?v=226998

ecological building datas from German Federal Ministry of Transport, building and urban development; **ökobaudat**: http://www.nachhaltigesbauen.de/baustoff-und-gebaeudedaten/oekobaudat.html

information about ecological footprint **example lime-sand-brick**
http://wecobis.iai.fzk.de/cms/content/site/wecobis/lang/de/Kalksandsteine

Dwellings for Senior Citizens in Donat; Ems published in Detail 2007/6 energy-efficient architecture pp.633-637

List of Illustrations

9.6.13 prefabicated adobe walls 30cm

9.6.14 ceiling with 6 x 20cm bars

9.6.15 the courtyard house finished

9.6.16 courtyard house from backside

9.7.1 urban plot – final masterplan

9.7.2 generation house south orientated

9.7.3 courtyard housing next to the lower street in south

Fire prof- Certification of the MA 39 for a wooden framework with strawbale infill

Gruppe Angepaßte Technologie
Technische Universität Wien

Wiedner Hauptstrasse 8-10
1040 Wien

MAGISTRAT DER STADT WIEN
MA 39 – VFA
MAGISTRATSABTEILUNG 39
VERSUCHS- UND FORSCHUNGSANSTALT DER STADT WIEN
gegründet 1879
AKKREDITIERTE PRÜF- UND ÜBERWACHUNGSSTELLE
A-1110 Wien, Rinnböckstraße 15
Telefon: (national 01), (international +43/1) 79514-8039 oder DW
Telefax: (national 01), (international +43/1) 79514-99-8039 oder DW
Internet e-mail: post@m39.magwien.gv.at

MA 39 - VFA 2000-0644.04

Wien, 6. Oktober 2000

Prüfbericht

über

das Brandverhalten einer Strohballenwand (mit Innen- und Außenputz)

Antragsteller:	Gruppe Angepaßte Technologie Technische Universität Wien
Antragsdatum:	7. Februar 2000
Prüfgut:	Strohballenwand in einer Holzständerkonstruktion eingebaut, beidseitig verputzt; Gesamtdicke 43 cm
Prüfprogramm:	Prüfung der Strohballenwand als nichttragender, raumbegrenzender Bauteil hinsichtlich der Brandwiderstandsklasse F90 gemäß ÖNORM B 3800-2, Ausgabe 1997.
Kurzbeurteilung:	Auf Grund der Versuchsergebnisse hat die geprüfte Strohballenwand, eingebaut in einer Holzständerkonstruktion, einem Lehm-Innenputz (2 cm), und einem Kalk-Außenputz (2 cm), mit einer Gesamtdicke von 43 cm, die Anforderungen an die Brandwiderstandsklasse F90 (brandbeständig) gemäß ÖNORM B 3800-2, Ausgabe 1997, erfüllt.

neu

Der Bericht umfasst 4 Seiten
und 1 Beilage (8 Seiten).

Zu kurz gedacht Eine Ökobilanz der Dämmstoffe

Anne Isopp

In Österreich werden thermische Sanierungen hoch gefördert. Erst kürzlich wurden vom Bund erneut 100 Millionen Euro an nicht rückzahlbaren Zuschüssen bereitgestellt. 5,3 Millionen Tonnen CO_2 werde man damit einsparen, heißt es von Seiten des Ministeriums. Mit welchem Dämmstoff saniert wird, bleibt dabei jedem selbst überlassen. Wichtig ist nur das Endergebnis, die Energieeffizienz des sanierten Gebäudes. Eine Wärmedämmung hat aber nicht nur durch ihre Dämmleistung Einfluss auf unsere Umwelt, sondern ebenso durch ihren Rohstoff- und Primärenergieverbrauch bei der Herstellung sowie ihre Lebensdauer und ihre Wiederverwertbarkeit. Diese Aspekte finden in der öffentlichen Diskussion jedoch kaum Erwähnung. Auch wenn immer mehr Dämmstoffe aus nachwachsenden Rohstoffen oder Recycling-Materialien auf den Markt kommen – von Hanf bis hin zu Zellulose aus Altpapier oder Wiesengras –, spielen sie kaum ein Rolle: Der tatsächliche Marktanteil von alternativen Wärmedämmungen liegt in Österreich bei vier Prozent.

Mineralwollen und künstliche Schaumstoffe wie EPS (Expandiertes Polystyrol) und XPS (Extrudiertes Polystyrol) dagegen werden kubikmeterweise an die Fassaden montiert, in immer größeren Dicken: im Passivhausbereich sogar von bis zu 40 cm. Wenn diese das Zeitliche gesegnet haben, in voraussichtlich 30 bis 50 Jahren, wird man ebenso viele Kubikmeter Bauabfälle entsorgen oder wiederverwerten müssen. Man geht davon aus, dass man bis dahin entsprechende Verfahren entwickelt hat.

In Form von Ökobilanzen wird versucht, die Auswirkung eines Dämmstoffs auf die Umwelt darzustellen. Dabei werden Zahlen zum Primärenergieinhalt, zum Treibhaus-, Ozonzerstörungs-, Versauerungs-, Eutrophierungs- sowie Sommersmogpotenzial ermittelt. Da der Einsatz von Dämmungen jedoch generell die Energieaufwendung für den Betrieb eines Gebäudes reduziert, amortisieren sich selbst jene Dämmstoffe, deren Erzeugung viel Primärenergie verbraucht, innerhalb kurzer Zeiträume. Ökobilanzen umfassen eigentlich den gesamten Lebenszyklus. Das Thema der Entsorgung von Wärmedämmungen ist jedoch noch schwer zu fassen, da es keine vergleichbaren Zahlen gibt. Fest steht aber: „Trennbarkeit ist die zentrale Größe für die Beurteilung der Entsorgungseigenschaften von Gebäudekomponenten" (Hildegund Mötzl, IBO). Geklemmte und lose verlegte Dämmstoffe lassen sich einfacher rückbauen als mechanisch befestigte. Mechanisch befestigte leichter als geklebte. Eine lose in einer Holzständerwand verlegte Dämmung ist ökologisch besser, da leichter zu entsorgen, als ein Wärmedämmverbundsystem.

	Wärmeleitfähigkeit W/mK	Dichte kg/m³	PEI ne MJ	GWP 100 kg CO_2 equiv.
• Stroh	0,064	150	8,16	−12,00
• Zellulosefaserflocken	0,040	55	15,47	−2,00
• Schafwolle Dämmfilz	0,040	30	17,64	0,05
• Mineralschaumplatte	0,045	115	24,68	2,43
• Steinwolle MW	0,040	30	27,96	1,97
• Korkplatte	0,040	120	34,08	−5,90
• Zellulosefaserplatte	0,040	50	36,60	−0,70
• Perlite expandiert	0,050	85	39,74	2,08
• Glaswolle MW	0,040	20	39,84	1,81
• Flachs mit Polyestergitter	0,040	30	45,60	0,43
• Schaumglas	0,040	105	65,94	3,95
• Vakuum-Isolations-Paneel	0,006	190	70,79	3,91
• Polystyrol expandiert (EPS)	0,040	18	73,44	2,48
• Hanfdämmplatte	0,040	85	105,74	−0,44
• Polyurethan (PU)	0,030	40	122,40	4,85
• Holzfaserdämmplatte	0,040	160	124,80	−3,71
• Blähton-Schüttung	0,160	350	129,36	12,88
• Kokosfasermatten	0,050	90	147,15	1,85
• Polystyrol extrudiert (XPS) CO_2-geschäumt	0,040	38	155,04	5,23

Ökokennzahlen gängiger Dämmstoffarten
Primärenergiegehalt an nicht erneuerbaren Ressourcen (PEI ne), der für die Herstellung jener Dämmstoffmenge benötigt wird, die für einen Wärmedurchlasswiderstand von 1 m²K/W benötigt wird, sowie der jeweilige Beitrag zum Treibhauseffekt (GWP 100).

Marktanteil Dämmstoffe in Österreich

- Mineralwolldämmstoffe 3.065.000 m²
- Schaumstoffe 2.235.000 m²
- Sonstige 235.000 m²

Quellen: gdi Dämmstoffstatistik 2007
www.ibo.at sowie „Ökologie der Dämmstoffe", Hildegund Mötzl, Thomas Zelger, Springer-Verlag, Wien 2000, gebundene Ausgabe, 195 Seiten, ISBN 978-3211835234, € 66,–