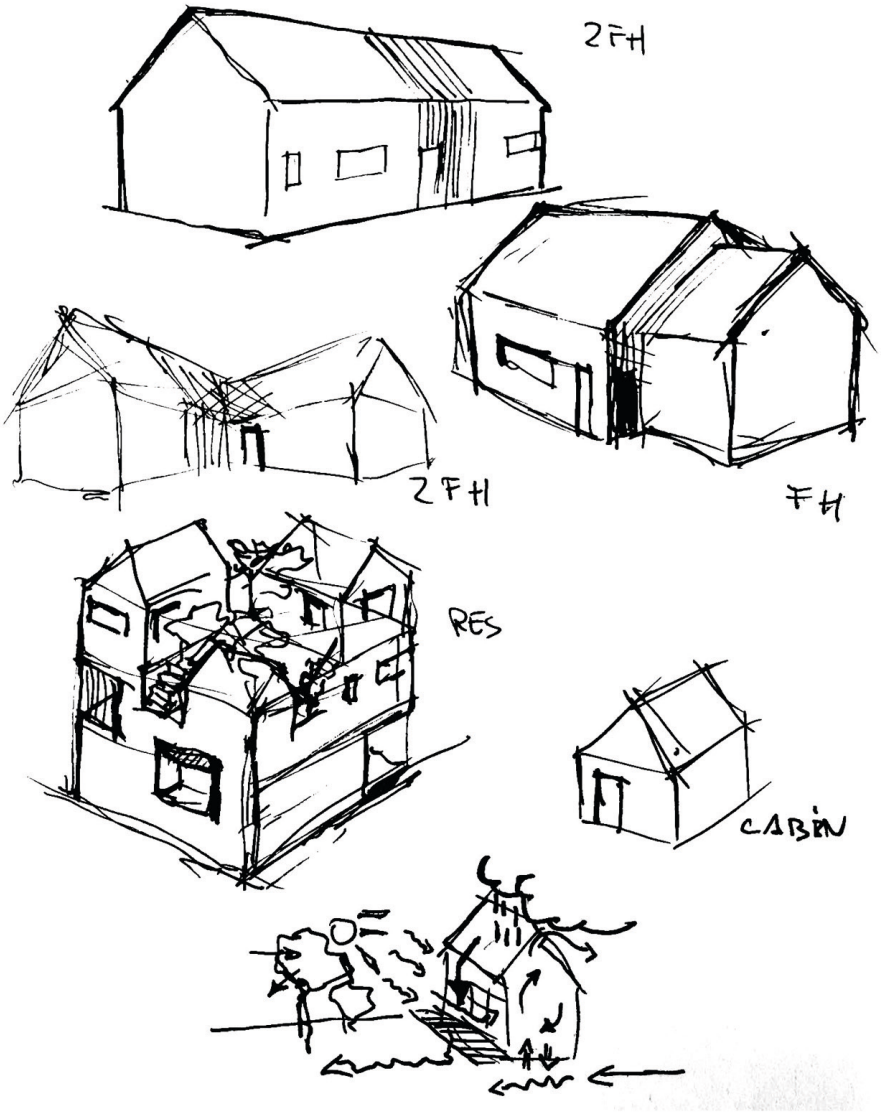
TESI
RURAL LOW-GRID SETTLEMENT
Lukáš Drda, s264681



CONTENTS

ABSTRACT

Author have chosen the locality which he knows very well, which lays in his native country, Czech Republic. A lack of affordable housing is there still big issue in Czech Republic, no matter that the majority of citizens are upper middle class.

Due to examine this phenomenon, an objective of the thesis is set to design low grid settlement, which would fulfil wider range of objectives including reasonable price for one housing unit.

These objectives imply also urban, architectural, environmental, durability, social, legislative and economic aspects. In fact, all proposals should deal with all these design layers equally, but not always it is the case in real life.

Author describes main qualitative characteristics of Czech rural settlement and calculates household / neighbourhood needs based on daily data or assumption of local habits.

At the end, the output describes some limits in the design process such as energy sources capacity/ profitability, developer's costs connected with the construction, or compromises embedded in the design due to local standards.

INTRODUCTION

The issue of the thesis is a design of "Rural Low-Grid neighbourhood" with taking into account all urban, architectural, environmental, durability, social, legislative and economic aspects of the presented proposal. The main goal is to create affordable housing with fulfilling aesthetic, contextual and economic requirements of Czech middle class inhabitant.

First block is dedicated to research, both in bibliography and by fieldwork. It is subdivided into 3 chapters: Village, Context, Design. In the first chapter reader may find author's understanding of rural architecture and what this term means to him, as to former citizen of the exact village. There are described characteristics of traditional rural architecture in Czech Republic and events which influenced its development in 20th century the most.

Second chapter is mostly socio-spatial description of different look of indigenous population and new incomers. I speak here about struggles, positive and negative situation and relationships which may occur in the contemporary Czech village.

The last chapter of the block goes from big scale to the smaller ones. It describes traditional urban typologies of local settlements, rural building typologies and their elements. Of course, the choice of examples is arbitrary, however still based on bibliography and authors fieldwork observations. There are shown most typical construction and decorative elements of the rural buildings, used materials, distribution plans and finally both foreign and local examples somehow related to authors design.

Second block of the thesis is the settlement design proposal itself. It systematically goes through settlement key points of the masterplan design, energy, heat and water treatment, volumetry of houses, chosen construction pattern and materials or the neighbourhood ability to host various events. After there is a chapter dedicated to energy balance simulation of one of the designed houses and to cost estimation of the same house. At the end of the thesis, author elaborates general cash flow plan for hypothetical developer and set the price for design parcels. This financial outcome is compared with current prices in the local real estate market and thus there can be seen, if the lower-middle class can effort kind of dwelling or if it would remain as semi-luxury article.

Lastly, I would point out, that many of the themes I deal with in the research and in the design parts of my thesis could be developed and discuss more in depth and many of them I have studied much deeper that what reader can experience. However this thesis is not intended to be a socio-scientific research paper but rather an "architectural conception" in all basic meanings as Ondřej Synek describes it ("urbanism is here understood as one part of architecture and thus naming it urban conception we would have to exclude layers which not related to urban planning as such"). (Tichá, 2016, p.39)

PROCLAMATION

However, is research made on most relevant bibliography. Some of the quotations may evoke little different premises, because stylistically the Czech language is very different from English. I tried to translate these quotations in the way that they should not lose anything from their semantic layer.

Some of the opinions, which are not quoted, are based on my own live experience in the city of Prague and the village of Senohraby. For 4 years I am a member of local sport institution executive committee, in which 3 out of 9 members are also members of the municipal council, and thus I have access to quite relevant information about local political, social and economic issues.

For better description I am using several notions which have to be described in detail as I didn't find English term which would perfectly correspond to its Czech meaning. Among this I count following terms:

Front garden - a grass lane around 1-3 meters wide

Plaza - cozy place, usually on the crossroad; it acts like a little square and it is often accented by solitaire tree or chapel.

Cluster - assembly of several buildings, which form open courtyard in between; originally enclosed homesteads

ACKNOWLEDGMENT

I would like to thank professors Marco Simonetti and Michele Bonino from Polytechnic University of Turin for supervising my thesis. Francesca Governa, Marco Trisciuoglio, Federica Doglio and many others for their inspiring lessons. I also thank to my family and close friends who supported me through all my studies and special thanks belong to Michaela Uhlíková which critical and supporting role was crucial in many moments on this path.

SECTION 1 - RESEARCH

VILLAGE

Old values

A value of any imaginable thing can be a subjective entity. The very same thing may mean a lot for one, whereas it means nothing to the other. It is one of the hardest things to protect your opinion when it is not shared by your opponent. Despite this fact I believe there exist certain range of perception where any good opera may be followed by vast majority. So, if I speak about “rural settlement” it is not important for me if it is antithesis of urban settlement or subcategory of urban. The clear point for me is its difference from “city”.

The historical value can be taken as something what is now only formal, only the shape which reminds us former way of life. Or it can be true when its essence of everyday way of life survives, yet with the spirit of supermodernity. Great deal about this essence of Czech countryside is developed in publication “Venkov-Countryside” (Tichá, 2016) which I will quote a lot in subsequent lines.

Ondřej Synek characterizes with following word rural as following: “Country (rural) is for me linked to way of life in the first place. A countryman is in many aspects more autonomous then townsman. He doesn’t need specialist. It means neither an architect. A car is fixed by neighbour, food is from a garden, a house he can fix himself.” (Tichá, 2016, p.38)

Changes in system

In the latest history, “big impact on rebuilding settlements as a whole, with all its old and new homesteads on perimeter, has been caused by abolition of serfdom in 1781. Even bigger development has been recorded in 1848 after abolition of corvee, when the market system entered in countryside” (Langer, 2018, p.26).

In the 20th century “Czech countryside and his agrarian landscape have noticed huge transformation in last 50 years. …some decades before 90’s, countryside attempted to deal with collectivization (communist regime). After that, in 90’s, it was marked by opposite spirit of land restitutions.” (Tichá, 2016, p.5)

Municipal budged

The village is an entity with strong bonds between its citizens and on what it wants to spend its money cannot be always in correlation with the general regional priorities. Recent debate between mayor Petra Pecková and Czech prime minister Andrej Babiš showed it perfectly. During the period of Coronavirus restrictions, the government charged municipalities with obligation to pay their citizens in endangered social class certain part of financial support. Prime minister promised to municipalities that they will get this money back in the budged by special subsidies. Mayor Pecková argued bureaucratic power of small villages will not allow them to get these subsidies. She explained that there is a big difference between money from taxes per citizen capita and the subsidies from state/EU on various projects. The selectivity in “how to use the money” derives from municipality or higher authority and thus the decision-making position of villages is limited (web-forum24.cz).

New values

How Marc Auge speaks about obsession of preservation of old. Even when it lacks some contemporary meaning. According him, the society builds thus monuments on which regimes is based. If we take an example of Medieval, most dominant architecture in city landscape would be the church, in 18th century it could be royal place. This monument represented superiority of the ruling class above common people (Auge, 1995). Today, if we understand any individual as a main principal of democracy, the settlement of private houses may have been understood as most important architecture. The live in the village and thus the public places in the village should prefer the need of individual before most of the needs set by the national government.

Nowadays there is one phenomenon which supports this orientation on individual described above. Both in villages and cities, the citizens interest in development of their place of residence grows significantly. Even big developers in Prague now organize participation project in neighbourhoods where they will be building (web-Skanska). As the example of similar initiative in village we may name project “Voselno” from Re:architekti (Re:architekti, 2013).

Architecture

Michal Kuzemenský speaks about architecture as about humanistic discipline. He admits there is included also aesthetic aspect, but it is not the main one. (Tichá, 2016, p.36). In the interview for radio Wave with Adam Gebrian, Kuzementský remembers one discussion with little boy (child of his client) and when he tells the boy that his work is to do the house they are in, he sees in the reaction of the child astonishment that some part of the world can be created by man. That boy not yet influenced by formal society saw in the house something more than a composition of walls and floors, he probably saw the transcending perception of his birthplace with higher significance. I argue that without targeting similar values in architecture, we might speak only about construction.

We may take other examples, about how we are remote from original traditions which many of them are still kept, by citing the Marc Auge’s “Non-Places”. Auge calls for an anthropological understanding of what we are doing on the planet. In one part he also touches the phenomenon of rural in western world. He describes how we flee from cities, where we work, to our homes in little village, not very far by highway (Auge, 1995). In this particular case, the walls of our homes can be built of stone in medieval and thus authentic, but our life style can hardly be called rural anyway. It is an urban society willing to live near something old what possesses historical value. Thus, people fulfil their romantic need. “They seek need of something what they have lost” (Auge, 1995).

Critical view

To contribute also to criticism of rural way of thinking, we may claim that birth of the rural settlement (commonly understood as related with nature) is in fact old urbanization of pure nature for human agricultural needs.

Having an experience in India, Ananya Roy speaks about “the rural as a constitutive outside of the urban”. She argues that “the urban and rural are governmental categories… marking populations where the government of poverty is different, where the relationship between state and beneficiary is of a different socio-spatial character” (Roy, 2015, p. 4-5). Roy presents some examples of huge Indian cities, where regimes of land policy are based on old agrarian patterns and she also argues that “today’s urban question is a land question” (Roy, 2015, p. 8).

In the “municipal budged” above, I touched the issue of difficulty to apply the same legislative order for small villages and cities. Now I would like to point out one example of such approach which contributes on current devastation of rural settlement typology in Czech Republic. When we set the rule of minimal road size in the city, for the village we ought to order mandatory condition of designing front gardens and

set similar rule for maximum street profile in certain areas as well. Of course, narrow street profiles should provide some space for letting the cars pass each other, but this can be solved by arbitrary parking lots or possibility of deviation to the sidewalk in the same elevation. Unfortunately, this approach doesn't exist in our country. To solve this problem, we have to receive a permission from local authority to apply so-called "regulation plan" which in fact can break many of the otherwise compulsory rules.

Taking in count all written above, I claim, based on a discussion with professor Francesca Governa, that the urban and rural should not be two institutionalized terms where existence of one excludes the other.

CONTEXT

Context in its broadest sense implies also historical, spatial, social, economic or political layers. In this chapter I try to point out some of the interesting issues and somewhere I give reader small hint what could we be dealing with in the future.

Type of incomers

We can paraphrase Michal Kuzemenský saying that many new incomers are coming to live in countryside for passion of wild. But there is an interesting difference between point of view of one from the city who seeks romantic landscape and local villager, who is more pragmatic and who wants asphalt road and public lighting (Tichá, 2016, p.37).

One of the new groups we see in countryside are "neorurals". As neorurals we call all kind of people, which typically come from cities and are looking for calm and more friendly environment. Sometimes they are looking for space for their creative work, as there are better opportunities in the village. These outsiders are often the ones who are the most proactive in the village as they possess a lot of energy and new ideas. However, their input is based on good will, this "fresh air" from outside can be negatively perceived by vernacular inhabitants (Tichá, 2016, p.5).

Native

Even the effort and energy, the new settler put in local affairs, their perception remains a way different compared with perception of one which family lives in the village for generations. Native country man lacks some habits deriving from city life. He doesn't need to travel every day to nearest town for work or cultural events. He doesn't use the village to fulfil his romantic ambitions, he lives modest and hones life and has very good or very bad relationships with his neighbours.

Changes in habits

To change vernacular order established for many years and inherited from previous generation is not that easy. Beside legislation limits and application of some kind of new vision for the village. There are other unique forces that shape village development and its way of thinking. As in past the power and main word belonged to feudal lord, now there exist some actors with similar influence on other inhabitants. When we speak about strong bond between people in village, it only natural consequences that great portion of the villagers is employed by several local entrepreneurs. To avoid problems within these groups of co-workers and community members, there is shared certain public opinion, usually not very different from that of group leaders (following their private interests). Thus, to push an idea through this micro-oligarchic system can be serious problem.

Adaptation

Besides Social relationship within the village, much broader discussion can be highlighted in order to future development of urbanization. I have in mind a debate about land tenure and how it affects our welfare and settlements. The reasons for this debate are two. The first of sustainability is mentioned also by Hauserová when she says that “in the past was taking advantage from natural resources limited by technical difficulties, lack of energy or knowledge. After, when human overcame these obstacles, he touched the limits for the first time” (Tichá, 2016, p.6). The second reason is unequal social situation and opportunities of rich and poor. The free market is mostly set to prefer rich and landowners. Therefore, in some of the countries land reforms are the issue of today. Some supports redistribution of land to smaller private unit instead of leaving it under the state or large farmers. To oppose the idea that equally distributed private property is the best way how to enforce the lesser social class and the national economy in general, I am presenting some interesting opinions and arguments on following rows.

Nikolai Fuchs presents in his lecture, devoted to soil and land, other solution already applied in some parts of Germany. He denies the thesis the small private farms could be solution for the future. He sees it as inefficient, because of its natural limits. What he supports is an idea the we should look at soil and land as at common source of every man. In this perspective, every citizen should own certain part of soil and have profit/resources from it. The problem is to cover all the assorted foods for balanced nutrition of each citizen by growing all various foods himself. This imply than specialization and big scale farms are needed anyway. The approach Nikolai Fuchs suggest is on the right of watching over a part of land the one would “own” within the citizen community. This community should control that no farmer is mistreating the soil by causing its erosion, compaction and does not depletes its nutrients. Fuchs argues that “private land is no guarantee for sustainable land use… private commodity is an object of speculation”.

In addition, in our discussion with professors Ash Amin and Francesca Governa, when I developed research paper dedicated to land property rights, Amin also considers the land redistribution of land reforms to be naive or at least not ideal solution for how to deal with basic rights inequality. The most imaginable solution might be to set accurate taxes on land owners and use these finances to mediate the existential minimum of land rights for poor. I argue that searching some way between the free market and support of basic land or opportunity rights will be increasingly on the agenda.

Land bond

“In the village, people tend to stronger identification with settlement and their approach to work or neighbours is also different.” (Tichá, 2016, p.37) Of course this definition is only general and there are a lot of variables among each specific case, but relationship with the free nature is always there. Hauserová contities “Today the image of landscape with small settlements, smaller scale of buildings with variegated mosaic of fields, meadows and woods is becoming a desired idyllic vision. We are barely thinking about social and economic background which let this scenery to happen.” (Tichá, 2016, p.7). Jas describes how some negative aspects, typically damages caused by weather, are at least roughly quantifiable and then how prevention against bad weather is a cheaper solution. He also points out that this responsible care about nature can create many jobs in countryside. (Tichá, 2016, p.7). I would point out also that more effort put in soil treatment, more could we harvest. Couple centuries old example from England confirms, that clever development can significantly prolong harvest period and thus the profit. I am speaking about “water meadows” which operated with water from the river nearby in order to bring nutrition and heat during winter period to the crops. The yield from the water meadows was thus even more than five times higher than without this technology (Heaton, 2019).

Landscape & Architecture

Czech lands all last decade often hit by long during dry periods when stronger rainfall is not observed even for several weeks. The trees can dry up or weaken and thus be vulnerable to bark beetle attacks

or strong wind. The bad care about fields or extensive building construction on greenfield has often influence to soil erosion. Nutrition taken away by erosion limits future crops production and thus fastens again another erosion. Jan Vopravil speaks about many of these issues in his lecture (web-Vopravil) and suggest some solutions for cities like permeable sidewalk or various elements which may retain water longer in landscape. Our ancestors probably knew many of these links between land and treatment of it. Milena Hauserová says that “Fruits of our labour are not harvested by us, but by those who arrive after. We harvest results of effort of our ancestors” (Tichá, 2016, p.6).

To keep the life around or within our settlements, we should work better with water and architectural design at all.

Uncertain bond with nature

Despite all the impulses to hold stronger bond with landscape we describe above, there are some limits of link between local community and the land around. One example for all can be phenomenon of foreign landholder. Especial Dutch companies own huge portion of Czech farmland. Few other local companies, with Czech prime minister concern at first place, have grown into tremendous dimensions. This kind of companies have low interest in maintaining quality of landscape and soil as well. They focus is on maximization of profit and acquisition of subsidies. Because of these reasons, the potential effort of local citizens to take care about surrounding forests and fields can be limited by the fact they don’t own it. I will support this contradictory habit by Hauserová’s statement: “How to live in a landscape, which is cultivated by someone other than who lives in it? Just two centuries ago, this question didn’t have any sense at all?” (Tichá, 2016, p.7).

Phenomenon on Czech countryside

Countryside can contain some typical elements. In Czech case I would highlight front garden, solitaire tree, plaza, pond and chapel. Jan Jehlík very clearly defines the difference between city and village architectural language. He points out the “softness” of countryside, he mentions that Czech word “Venkov” [countryside] derives from “venku” [outside] and finally he accents how letting thinks develop themselves is important for right perception of countryside. Jehlík says that we should let the nature grow freely and morph our parcels or road as much as we can. We should avoid construction methods which need high-tech machinery. The restrictions/standards might be much looser for villages (Tichá, 2016, p.16). Some selected examples of traditional elements on village are shown on pictures bellow.

Front garden

Pic 1 - Front gardens - Radkovice (Pešta, 2014)

Pic 2 - Front gardens - Čertyně (Pešta, 2014)

Solitaire tree

Pic 3 - Solitaire tree on plaza - Písek (fieldwork)

Pic 4 - Solitaire tree & chapel - Senohraby (own)

Plaza

Pic 5 - Plaza - Hrusice (turistika.cz)

Pic 6 - Plaza - Hrusice (1gr.cz)

Pond

Pic 7 - Pond - Struhařov (wikimedia.org)

Pic 8 - Pond - Hrusice (alamyimages.fr)

Chapel

Pic 9 - Chapel - Kukle (fieldwork)

Pic 10 - Chapel - Senohraby (posazavi.com)

Who can act?

There are some decision makers in process of designing settlement. The crucial role belongs to Local Building Authority which has final word in approving construction intention. During this process, the applicant must receive positive opinion from various institution (depends on area of construction) among which are usually: fire precautions, hygiene, heritage institute or concerned municipality. Beside these institutions, any legal or natural person may file an objection to the construction proceedings as far as it concerns him in any possible way.

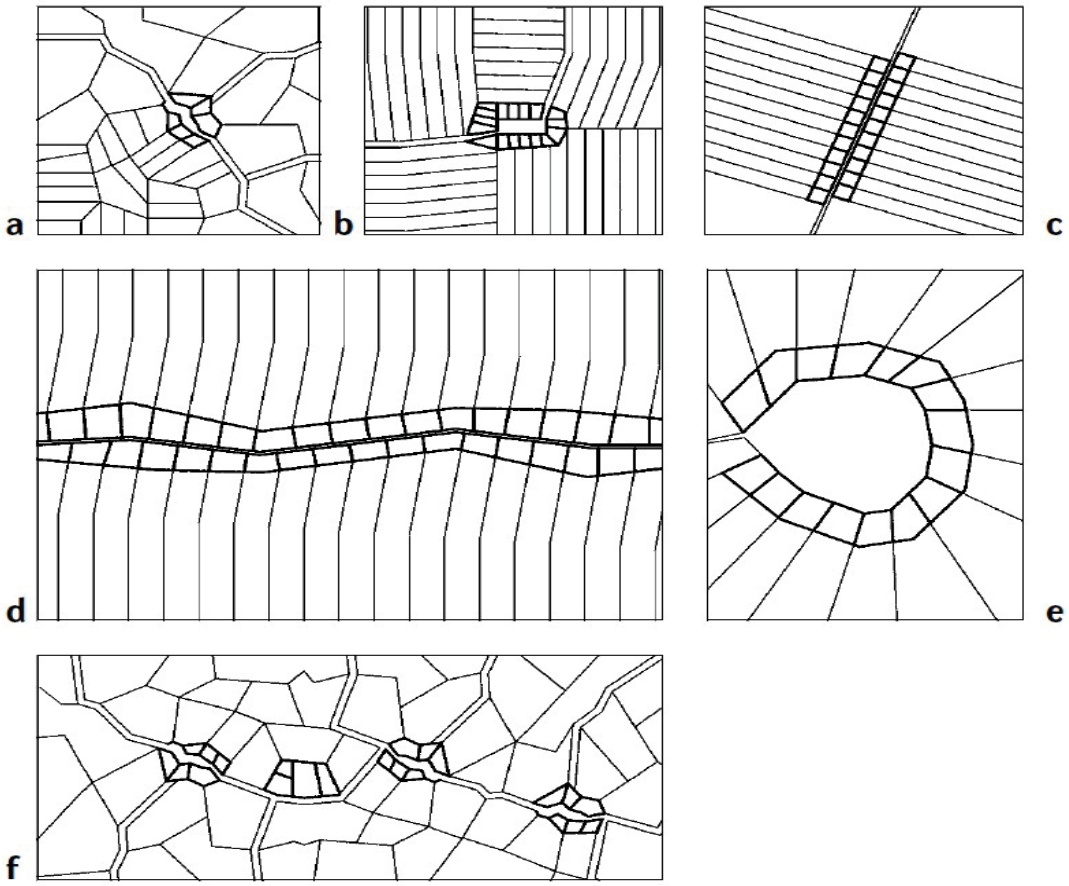
Special case can be seen during participation activities, usually made in the initial part of designing process. The goal is to lose tension between interests of current and incoming inhabitants.

ARCHITECTURE

Urbanism

Today, one of the most discussed topics is an urban planning on both brownfield and greenfield. The same issue is solved in this thesis. However, is urban sprawl bad way of settlement construction, it has still some economic or process reasons and it is still home of people who have relation to it.

In history, villages have grown more or less freely or under certain order (often linked to rental system of feudal lord). We distinguish 4 major subcategories of this patterns: sectional (cz: úseková), track (cz: traťová), “lane field” (cz: lánová), cluster / clump (cz: shluková) (pic.11 - Pešta, 2014, p.27).



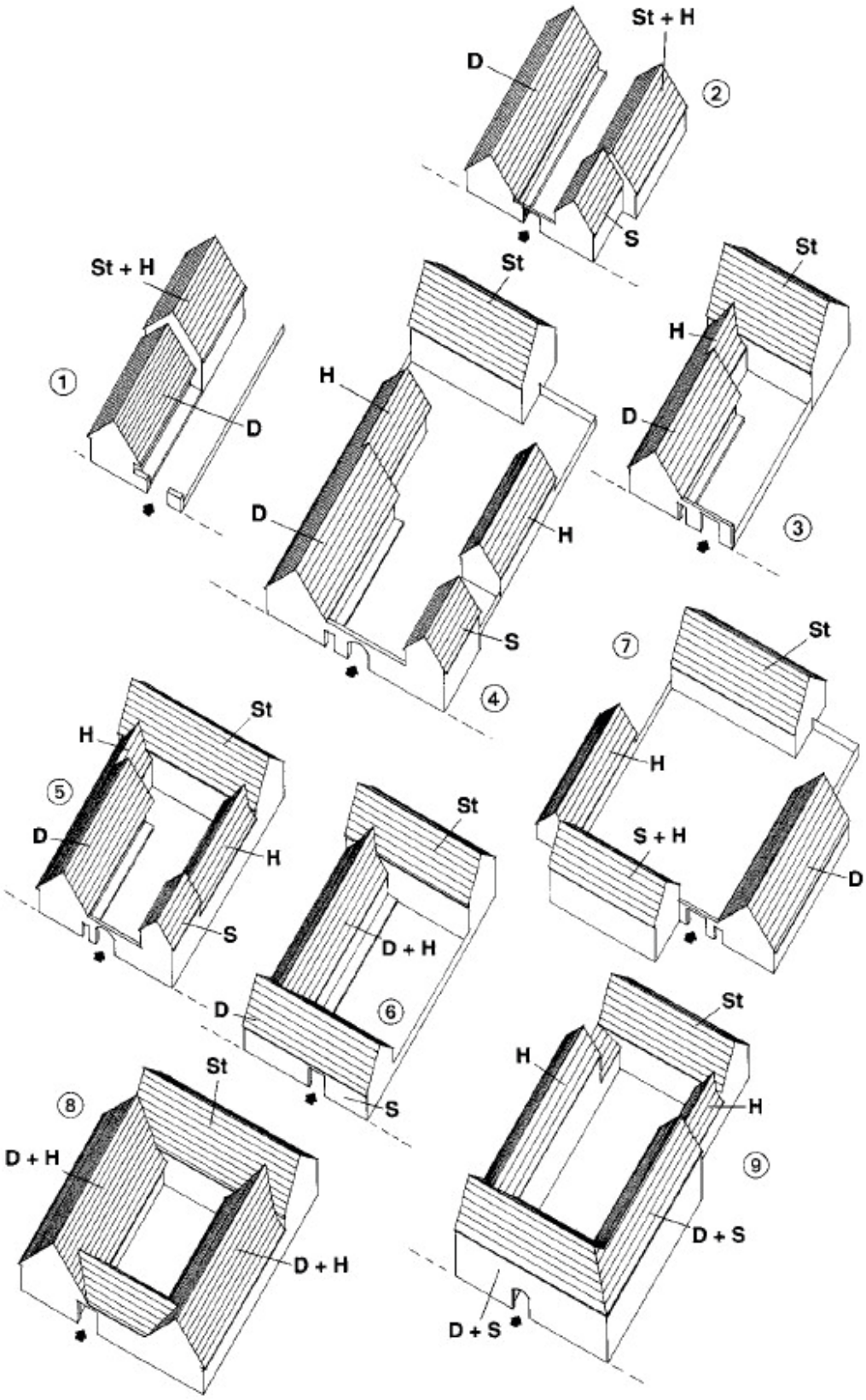
Pic 11 - Village patterns (Pešta, 2014)

In typical village we could find homestead, garden cottage, “house”, or “landless house” (Langer, 2018, p25). Homestead was usually composed from house, barn (stodola), shed (chlév), granary (sýpka), cellar (sklep).

Seeing organization of historical village above, we observe old settlements and quite easily say to which pattern it belongs. I claim, this clarity is no more present in most of today’s design.

We probably cannot obtain the same strong bond between function and form as they did in past, but we might try to design the whole to be more compact or cozy for inhabitants who live in it.

Beside the land parcelling, other levels of urban design have similar importance. I will name pedestrian or road infrastructure, public spaces and significant elements like tree, alley, pond or chapel.



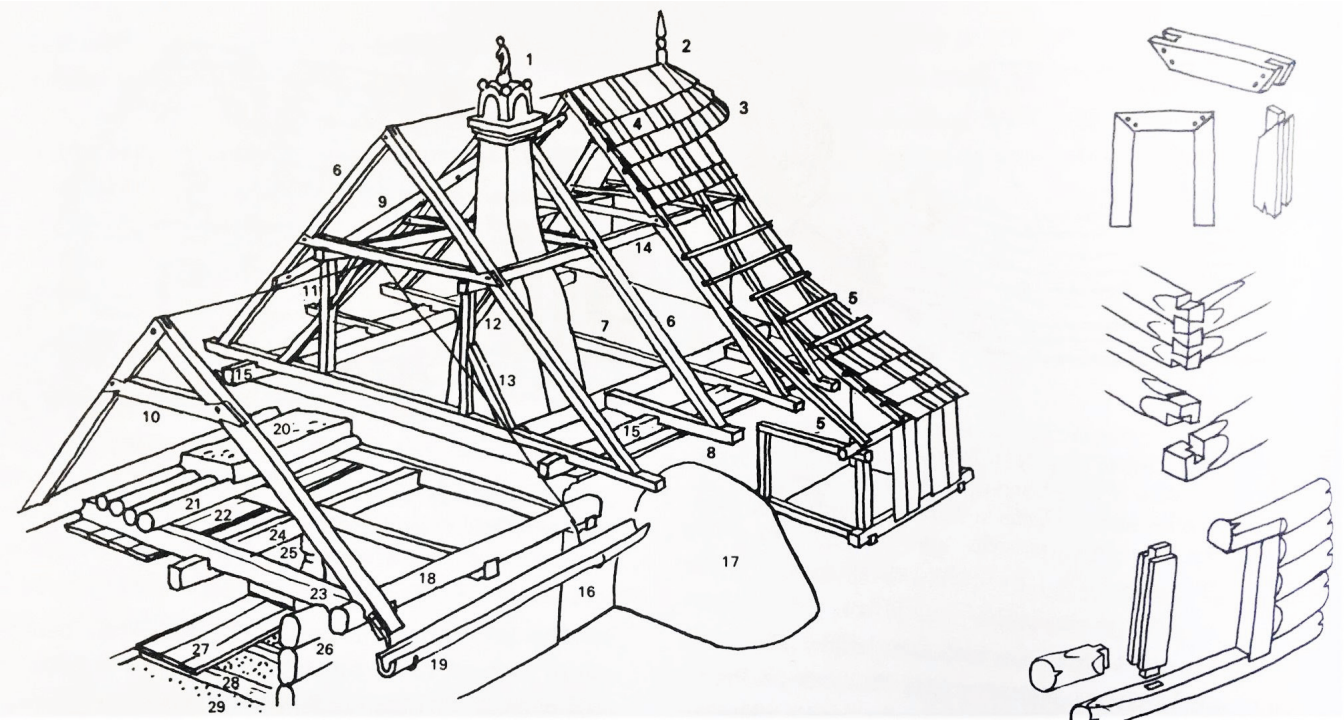
Pic 11b - Homestead buildings (Pešta, 2014)

Buildings & Construction type

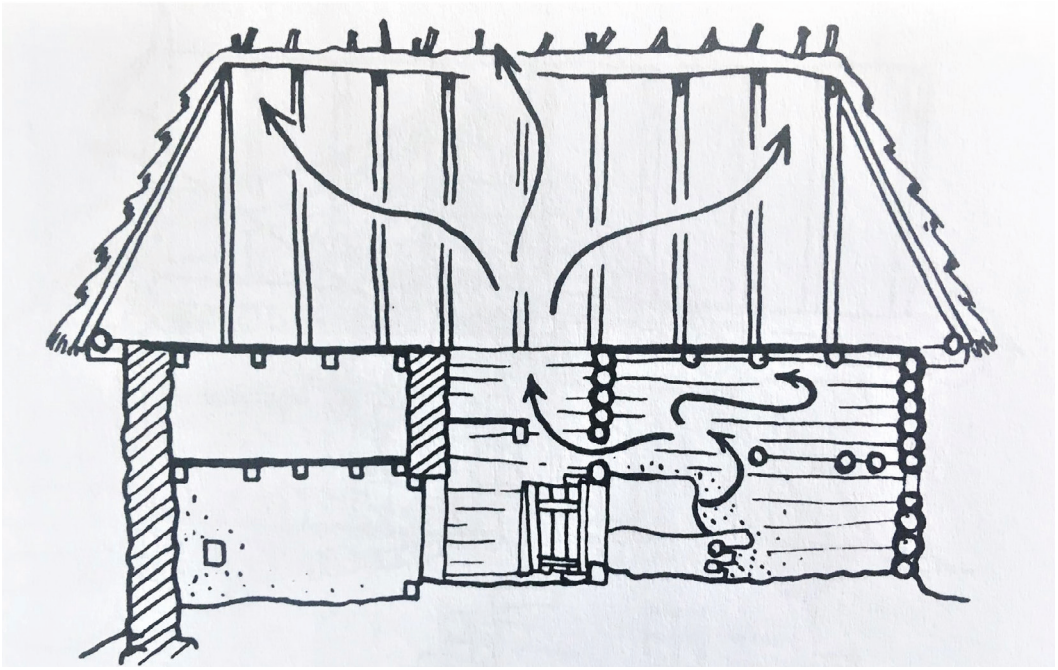
Czech countries are influenced from various culture and the same variations we can see in rural buildings material and construction performance. We can find timbered, half-timbered, masonry and combined building structures dating back to 15th century in Czech country (Pešta, 2014, p.34). Older profane structures have disappeared also for they material character as they were mostly wooden (Pešta, 2014).

One of the architectural languages of studied area we could call “Vltavsko-Otavský” related to area along rivers Vltava and Otava. The building decoration is minimal and the whole perception of these houses is simple and lapidary. This architecture may be one of the best model examples for modern architecture. Another kind of rural buildings largely occurring in the area are masonry building with richer decoration from middle 18th till early 20th century. These buildings are influenced by baroque and historicizing styles and may be, they are less fitting to follow in today’s architecture production, also because this effort could be taken as kitsch, without stronger significance.

Pic 12 - “Vltavsko-Otavský” language (Pešta, 2014)



Pic 13 - Timber house structure (Langer, 2018)

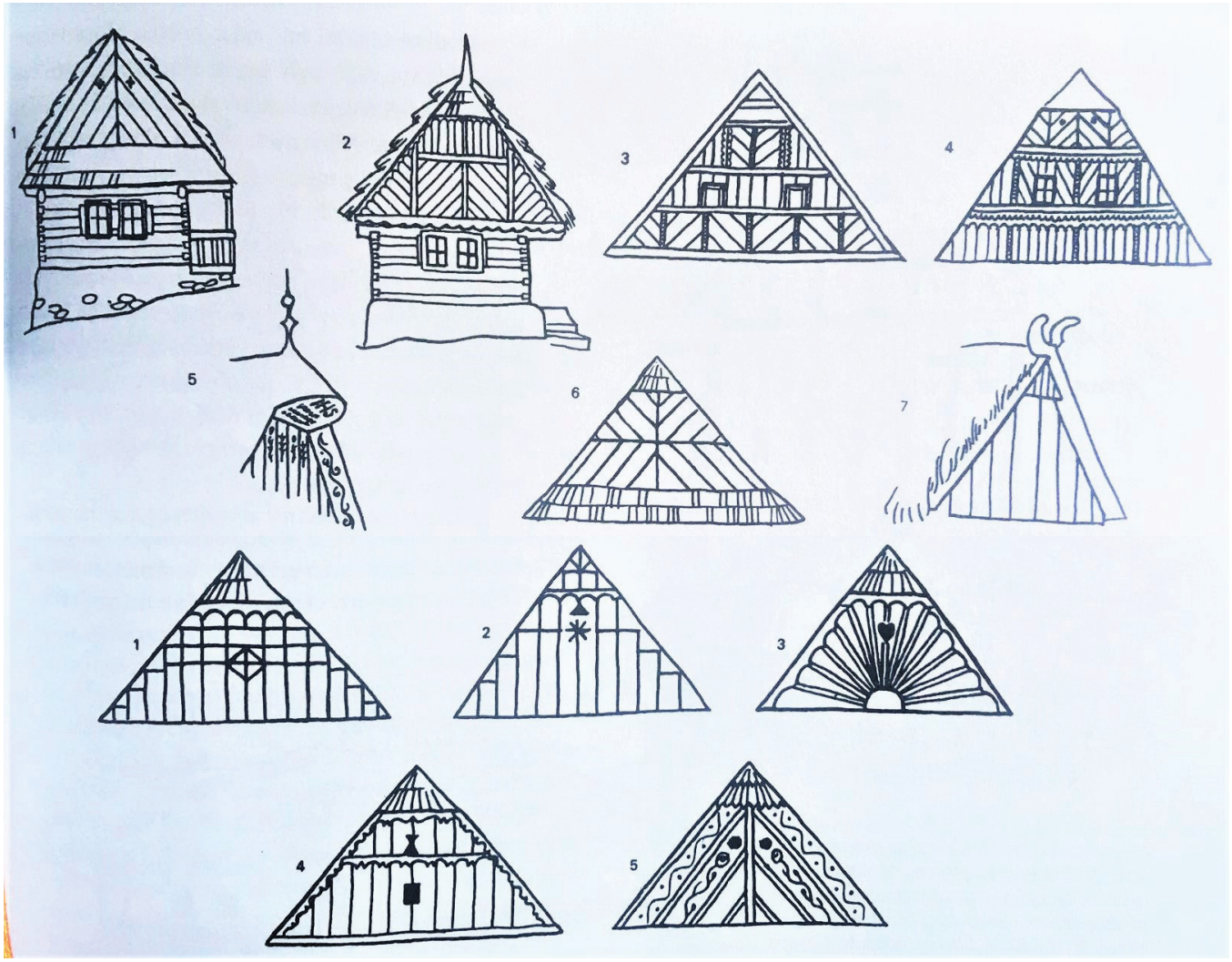


Pic 14 - “Smoke house” (Langer, 2018)

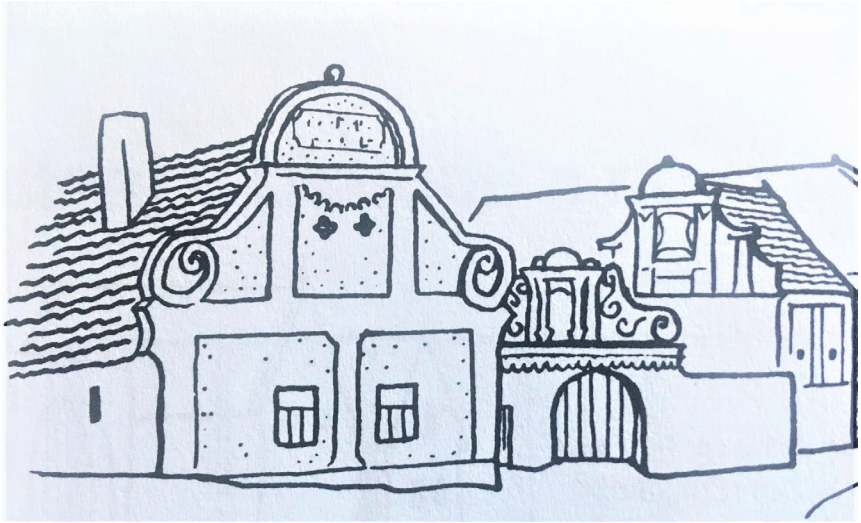
Elements & Materials

Variety of used materials concerns wood, brick and stone structures. There are some exceptions of mud houses but the majority of rural building was constructed from the timber and from the end of 19th century from masonry as material was more available and the law demanded fire resistance. A decoration of building derived from houses of nobility and wealthy landlords. Villager have copied stone-sculpted ornaments carving them into the timber or painting them on the plaster.

The lime plaster could be considered as one of important signs on Czech countryside. In Czech region, unlike in France, or England or Germany almost all houses were covered by plaster, no matter if they are built by timber, brick or stone. This phenomenon creates scenery of white villages in the middle of green hilly landscape.



Pic 15 - Gable walls (Langer, 2018)

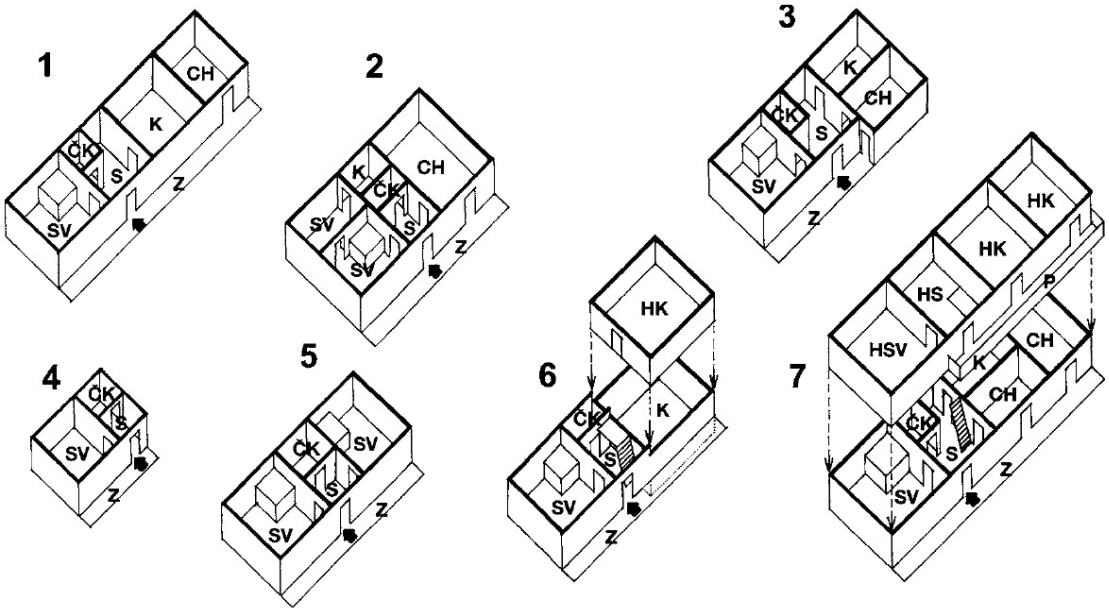


Pic 16 - Plaster decoration (Langer, 2018)

Distribution / disposition

It is quite fascinating that bases of today's distribution, construction, decoration and heating system patterns are significantly close to patterns already present in early medieval time or even long before it (Langer, 2018).

We can divide these patterns in several groups according the sequence of room kinds they contain. They can by composed from hall (cz:síň), living room (cz:světnice), black kitchen, chamber/pantry (komora) and c



Pic 17 - Disposition typologies (Pešta, 2014)

Energy & Habits

The consumption of water per inhabitant in Czech Republic is around 80 litres, the average household counts 2,6 persons and the price of the water is 4 € (EurEau, 2017, p.10-14). By multiplying these numbers, we get average annual water consumption of household equal 75,92 m3 and its cost of 303 € per year. According Australian Government website (Fane, 2013) or ASIO company (ASIO, 2012), greywater (shower, hand basin, washing machine, laundry tap) contributes on water consumption by 50-60 %. This water can be treated easier than blackwater or other kinds of wastewater (toilet, kitchen tap, dishwasher).

Huge saving in energy consumption can be met by reducing U values of building envelope. Current standards in Czech Republic sets minimal U values for roofs, walls and floor on the terrain as follows: 0,24; 0,3 and 0,45. Recommended values are 0,16; 0,25 and 0,30. Values for passive buildings are lower than 0,15; 0,18 and 0,22 (Hudec, 2013, p.14).

Economical aspects

According Czech Statistical Office Czech households spend most on dwelling, water, energy and fuels, after follow transportation, food and recreation. (CSÚ, 2016) From this fact, we can say that dwelling and its energy performance is responsible for major part of our spending.

The price of the design should consider also environmental value of the design, its maintenance advantages of construction and significant money savings due to partial autonomous water treatment and PV panels contribution on energy supply.

Annual energy household consumption in Central Bohemia Region was 4179 kWh in average where, respectively 46 kWh/m2. This value is higher in the region due to higher percentage of family houses compare to flats (CSÚ, 2012. Electricity prices should reach 0,184 € (4,76 CZK) per kWh in 2020 (elektrina.cz, 2020).

From the perspective of developer, the land price in the region have grown between 2016 and 2018 from 58 € (1493 CZK) to 89 € (2331 CZK) (CSU, 2019). Therefore, we can assume that the price in 2020 will be higher than 100 € per m2. Price of family houses I 2018 were 248 (6459 CZK) in average (CSU, 2019). Server hypoindex.cz claims then the yield from residential housing projects are in the region less than 4% (hypoindex, 2020).

Reference Czech neighborhood

Urbanistic study of Voselno (Re:architekti, 2013)

Pic 18 - Voselno: Connections (Re:architekti, 2013)

Pic 19 - Voselno: New volumes (Re:architekti, 2013)

Pic 20 - Voselno: Street profile 1 (Re:architekti, 2013)

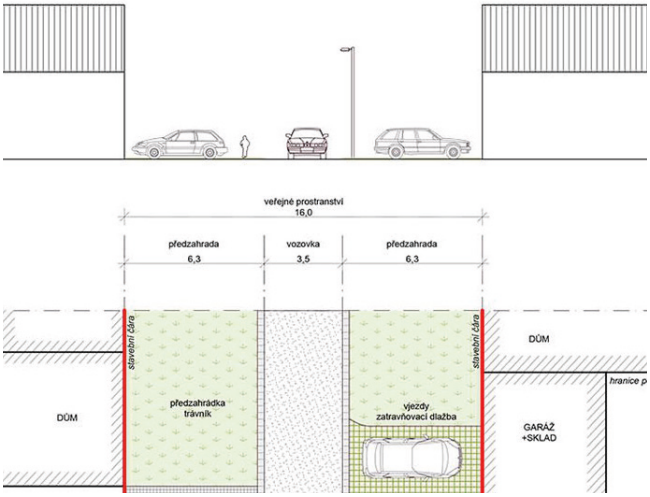
Pic 21 - Voselno: Street profile 2 (Re:architekti, 2013)

Urbanistic study of Rantířov (Hnilicka, 2015)

Pic 22 - Ratířov: Bird perspective (Hnilička, 2015)

Pic 23 - Ratířov: Plaza (Hnilička, 2015)

Pic 24 - Ratířov: Front-gardens (Hnilička, 2015)



Pic 25 - Ratířov: Street profile (Hnilička, 2015)

Reference Czech houses

Village Senohraby

Pic 26 - Senohraby: House 1 (own fieldwork)

Pic 27 - Senohraby: House 2 (own fieldwork)

Pic 28 - Senohraby: House 3 (own fieldwork)

Pic 29 - Senohraby: House 4 (own fieldwork)

Pic 30 - Senohraby: House 5 (own fieldwork)

Pic 31 - Senohraby: House 6 (own fieldwork)

Village Kukle

Pic 32 - Kukle: House 1 (own fieldwork)

Pic 33 - Kukle: House 2 (own fieldwork)

Pic 34 - Kukle: House 3 (own fieldwork)

Pic 35 - Kukle: House 4 (own fieldwork)

Village Nová Ves u Protivína

Pic 36 - Nová Ves u Protivína: House 1 (own fieldwork)

Pic 37 - Nová Ves u Protivín: House 2 (own fieldwork)

Pic 38 - Nová Ves u Protivín: House 3 (own field-work)

Pic 39 - Nová Ves u Protivín: House 4 (own field-work)

Pic 40 - Tálín: House 1 (own fieldwork)

Pic 41 - Tálín: House 2 (own fieldwork)

Reference Foreign houses

House for simple Stay: Litija - Slovenia

Pic 42 - exterior (Skupaj Arhitekti, 2019)

Pic 43 - interior (Skupaj Arhitekti, 2019)

Reference energy solutions

The Central Budapest Sewage Treatment Plant

The project was developed under Organica company. Beside its purpose of natural purification method, it provides direct contact of plant and local community which benefits from it. They can visit plant core as kind of greenhouse and create relationship with this, for them important, part of nature.

Pic 44 - Budapest purification plant (wordpress.com)

SECTION 2 - DESIGN

MASTERPLAN

LOCATION:

Czech Republic - Senohraby (20km dist. from Prague)

CHARACTERISTICS:

-Former tourist resort for elites which contains some of 19th and early 20th century villas.

-Nearby, there is situated river Sázava and most of the village is surrounded by hilly landscape are forests.

SITE:

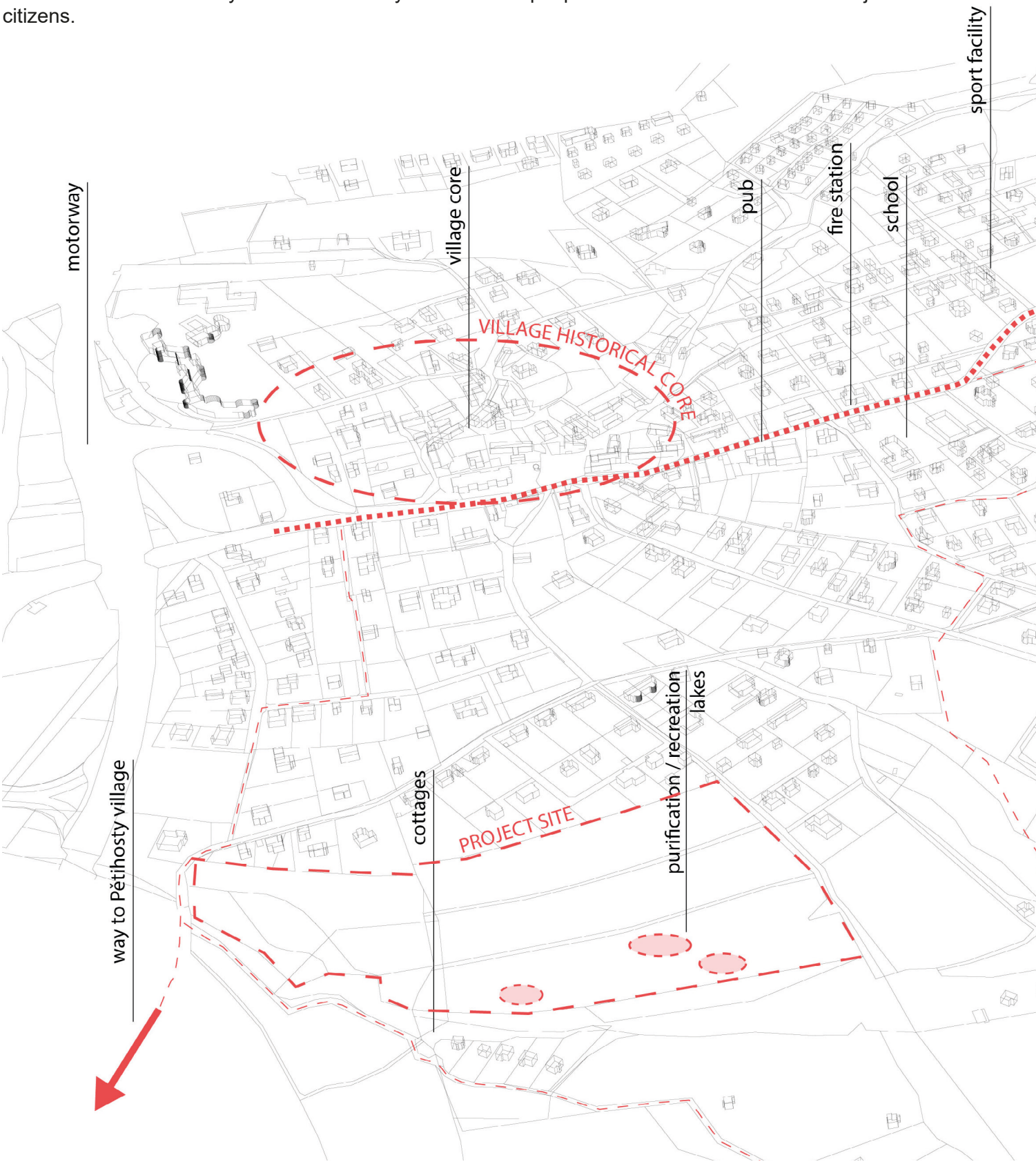
Site is in a slope facing to the south and so there is high potential for solar gains and gravity water treatment.

The site is currently under process of conversion from agricultural land into developable. Under the site there is remaining belt of field which is unlikely to be used as built-up area as in Czech law there exist rules of minimal distances from forest stand.

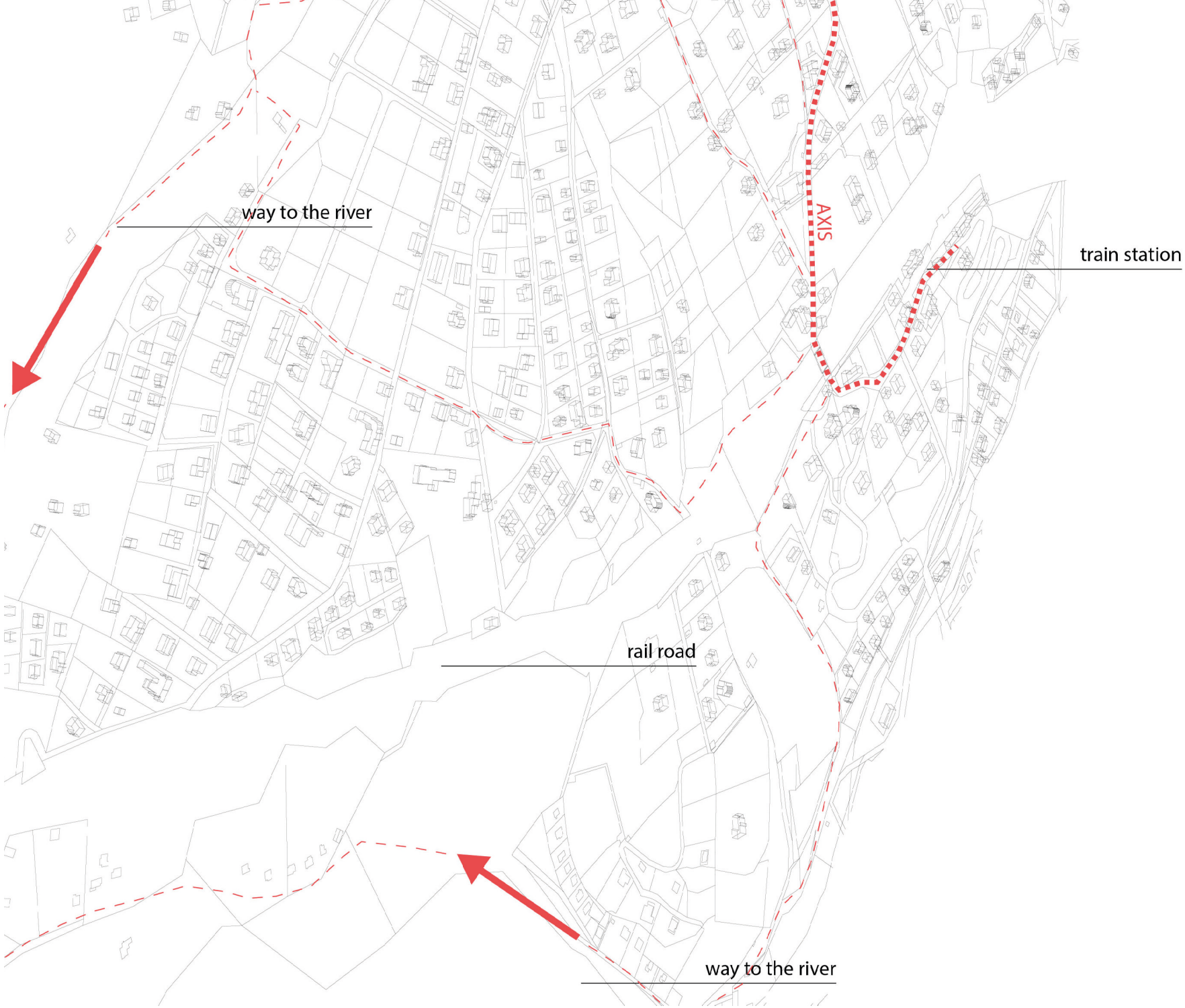
Pic 45 - Location of site (own production)

Historical paths & terrain morphology axis

Location in the village is on the south-west edge of the village. Next to it, there are two important pedestrian ways towards the river and toward the village Pětihosty. I am designing two open plazas in the neighborhood for aesthetic and social purposes. These plazas can host various events and thus force people from all village to see new area. I'm also counting with one commercial building. This facility could be wellness or community center which may attract some people to visit it and also create few jobs for citizens.



Pic 46 - Scheme - Wider relations (own production)


way to the river
AXIS
train station
rail road
way to the river

The site morphology is slightly “curved” towards the south. Contour lines are almost parallel to the curvature of the site. I almost followed cadastral division of former fields. East end of the road deviates towards the north to be aligned with the other road across the existing street. This setting forms public space with exposed pedestrian area - plaza on the corner.

Village typology

Plazas already shown in the research part of the thesis are embedded into the design. Together with “**clusters**” and “**loose profile**” of the street they support aesthetic quality of rural urbanism. **Plazas** are mostly in the core of traditional villages, but there can be many secondary plazas all around the settlement. The problem why there are not planned anymore is basically in the apparent absence of economic value of this area for investor.

Pic 47 - Visualization - Designed Plaza (own production)

Clusters are nothing else than “traditional assembly of buildings”. Their formation in past was either guided by higher authority or arbitrary with some specifics, but in the essence based on the same principles. This principle is efficient division of parcels for agricultural purposes. Homesteads were formed from many buildings making one enclosed cluster, which allowed many peasants to move their seat in the core of the settlement and also to be attached to their fields.

Pic 48 - Analysis - clusters/suburbs (own prod.; large scale picture in appendix)

Nowadays the agrarian motive of urban pattern mentioned above is no more actual but we could easily use its basis for build-up better village pattern than the mindless suburbs. We would achieve aesthetic quality which is closer to countryside typology.

Loose profile is a big issue as there are some legislation obstacles which complicate design on countryside. In newly developed areas, municipality cannot usually build road without solid sidewalks on both sides. This is the same for city centers, suburbs and countryside. Doing that in village we practically deny some of its elementary characteristics which is bond with nature (as Jehlík describes it). This “arteries” have double the size compare what they ought to have. They disable water penetration into earth and thus cause partial soil degradation by erosion from water cumulation nearby.

The only possibility to creating traditional like street profile is by placing road as an **easement on the plot**s of future residents.

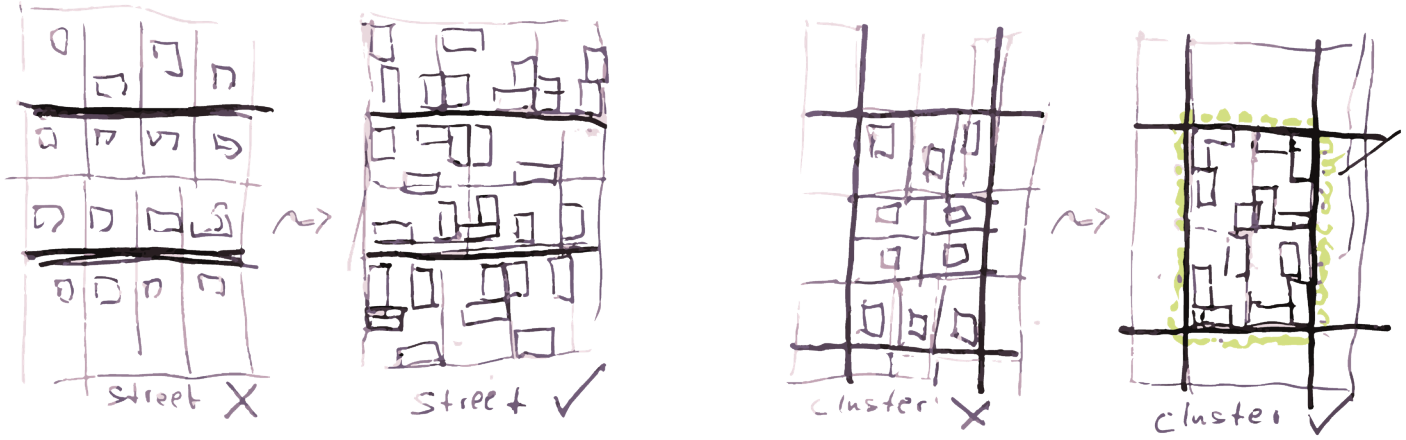
Design limits

By the law there is set minimal distance of two houses as 7,5 meters; minimal distance from plot boundary is 2 meters when building authority usually prefers 3 meters. These rules can be dismissed overlooked if there is a “regulation plan” created for the area. This plan is usually processed by the municipality.

In Senohraby village there is a rule which orders all new family houses to be built on plot larger or

equal to 800 meters square. To achieve desired density o developer, this rule can be easily fulfilled by designing double family houses. This principle is commonly used by designing terraced houses (which would be very likely more economically and environmentally efficient), but in the countryside I have chosen to follow traditional typology.

At last but not least, local authority usually ask builder to build only on 30% of plot. Therefore, we can assume not more than 120 meters for 400 of plot (800*0,3=240m2 for double family house). Following this setting, I divided plot to enclosed parts of about 1600 m2 (2*800) each which form “cluster typology” for 2 double houses (4 housing units). The accessibility to back side of cluster is achieved by law with easement on plot (in this case controlled and design by developer).



Pic 49 - Sketch - clusters/suburbs (own production)

Some of the parcels have to host lakes instead of houses to place water body for natural water purification plant. I have designed these bodies assuming need of 5 m2 water area for 1 resident. This assumption is based on the equation from professor Šálek and collective: Ah= Qd(lnCo-lnC) /KBSK5 (Šálek, 2013). Having the 67 housing units and average 2,6 inhabitant for household, this area is designed to be at least 871 m2.

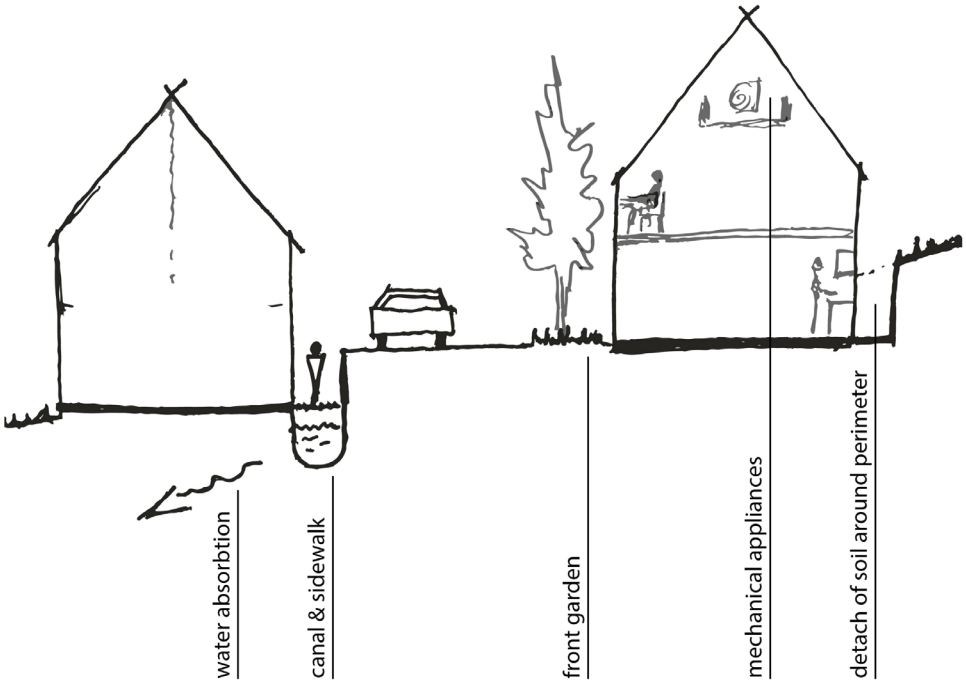
Pic 50 - Site plan (own production)

Street profile

We shall pay attention to design a sort of drainage concept to control torrential rainfall and avoid soil erosion.

Proposed street profile is based on some aspects of traditional village. It has country lane (canal) and front gardens on its sides. The street is not over-sized. Some of the public open parts are private property and they are set as “easement of the community”.

There exist certain design aspects which shall contribute to environmental quality of the design but they are hardly quatifiable. One of these setting of houses on certain elevation of the terrain. I tried to design all foundation plates of units above the surrounding terrain. Where it is deeper than the natural surface, the soil is extracted in perimeter of 1 meter. This performance will have impact on drainage of water out of the facade in the soil and thus it will help to retain water in landscape. It will also optically hold settlement horizon low with letting the rooms hight to be comfortable.



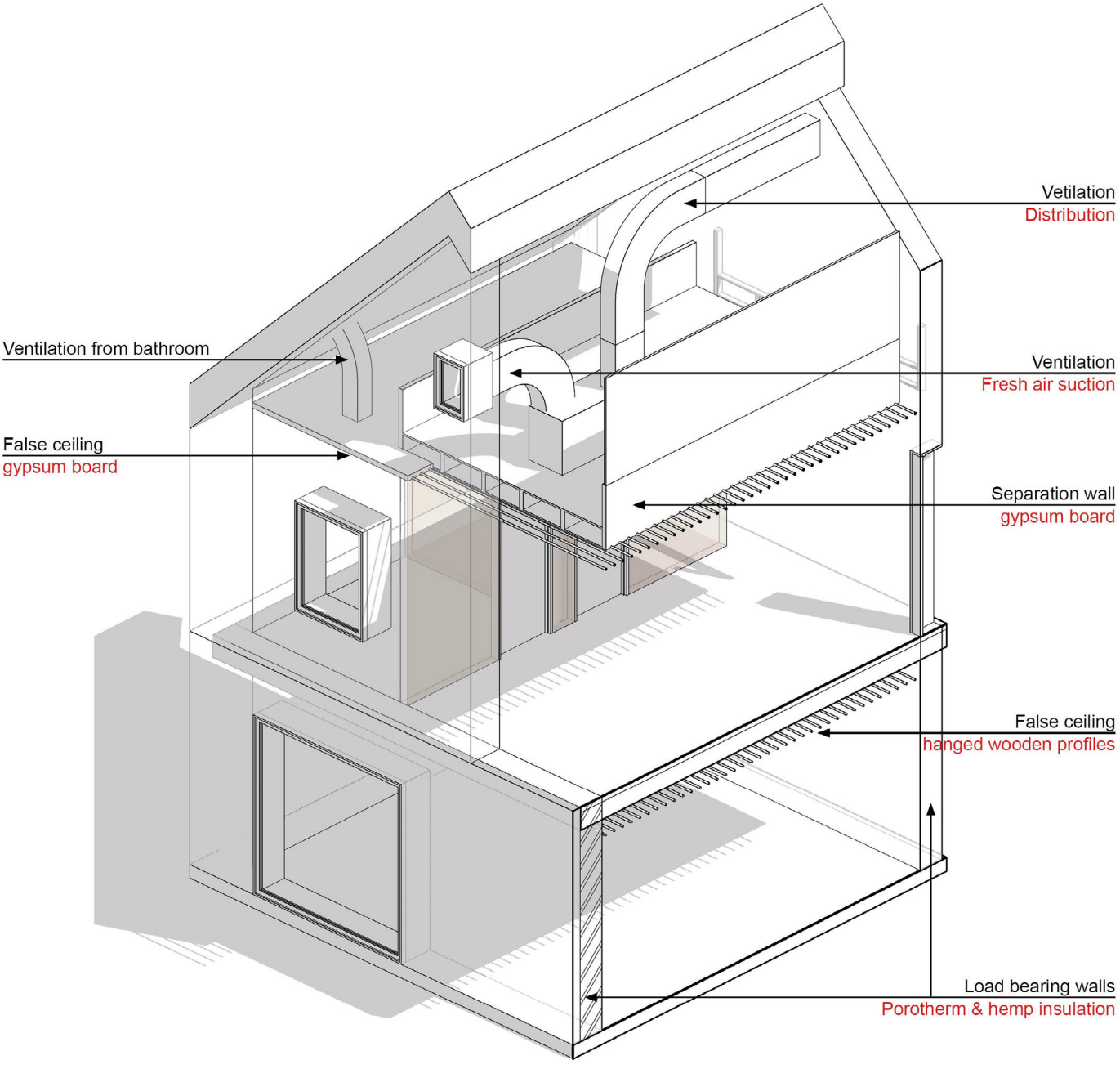
Pic 51 - Sketch - Street profile (own production)

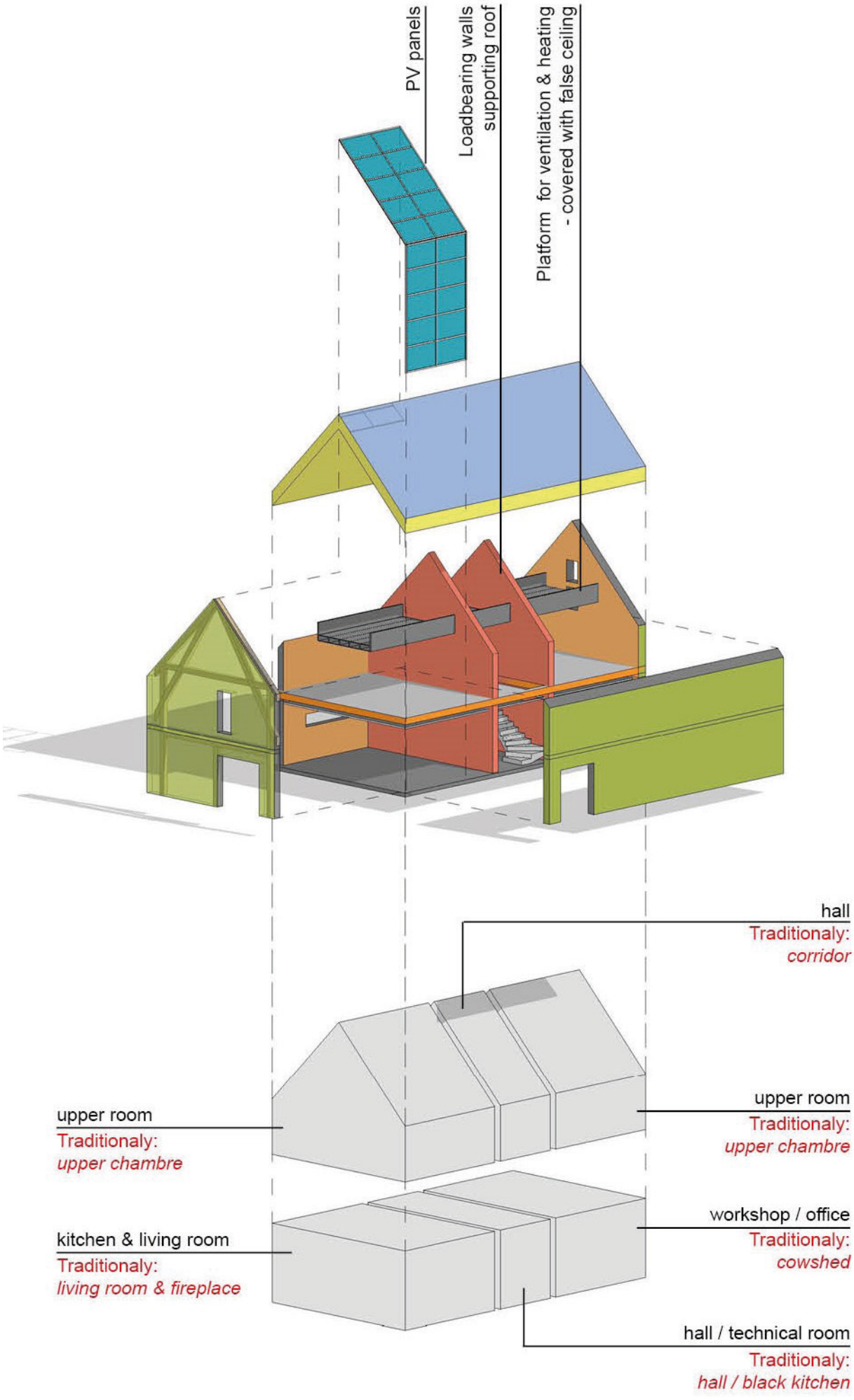
HOUSING UNIT DESIGN

Deriving from tradition

The proposal of representative house is in many aspects inspired by elements appearing in buildings of our ancestors. It takes this inspiration and converges it into new construction typology, which can seem completely modern but it has roots in old habits and way of life.

One of these elements is placement of technical appliances on the platform under the gable roof. This area was used in past for allocation of smoke, I use it for bringing new air into the house. Under this space there is false ceiling from wooden profiles. These profiles refer to timber beam which stiffened the roof construction. We have hints that some of them helped dwellers to hang and store their instruments or for drying a wood (Langer, 2018, p.42). In modern context, I used them for supporting the electrical wiring. With this solution, maintenance if wiring is easily accessible, avoiding cutting other construction.

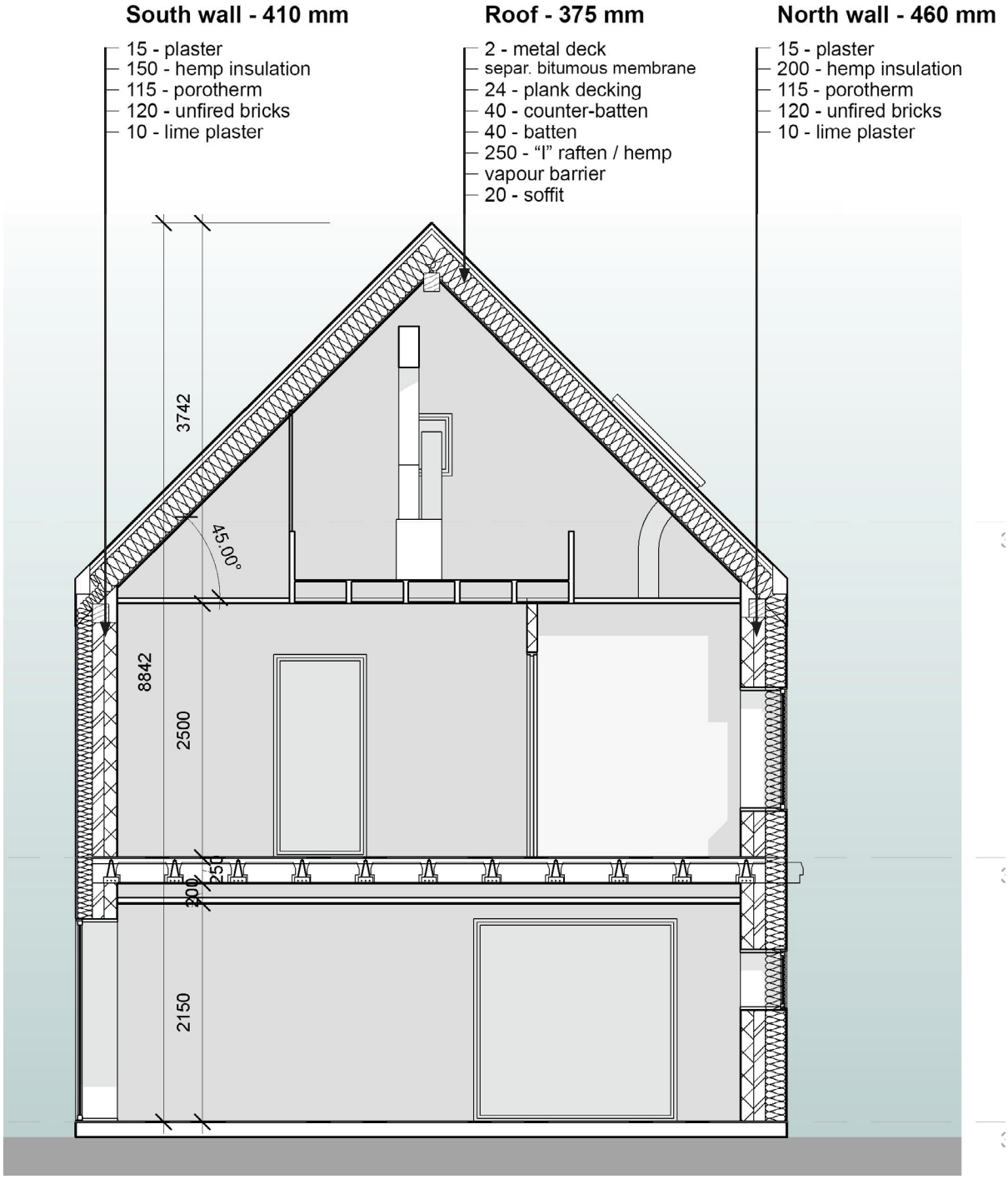

Vetilation
Distribution
Ventilation from bathroom
Ventilation
Fresh air suction
False ceiling
gypsum board
Separation wall
gypsum board
False ceiling
hanged wooden profiles
Load bearing walls
Porotherm & hemp insulation


PV panels
Loadbearing walls supporting roof
Platform for ventilation & heating - covered with false ceiling
hall
Traditionaly:
corridor
upper room
Traditionaly:
upper chambre
upper room
Traditionaly:
upper chambre
workshop / office
Traditionaly:
cowshed
kitchen & living room
Traditionaly:
living room & fireplace
hall / technical room
Traditionaly:
hall / black kitchen

Construction materials

Exterior load bearing walls are composed from Porotherm bricks, internal layer of unfired brick for their humidity absorption ability and from hemp rigid insulation. All the materials are chosen for their easy recycling characteristics and other ecological aspects like embedded CO2 or PEI (primary energy). Internal load bearing wall are from solid bricks for their thermal capacity. The broader investigation on used materials thermal capacity could certainly help to improve the building performance further compare what I achieved in this thesis.

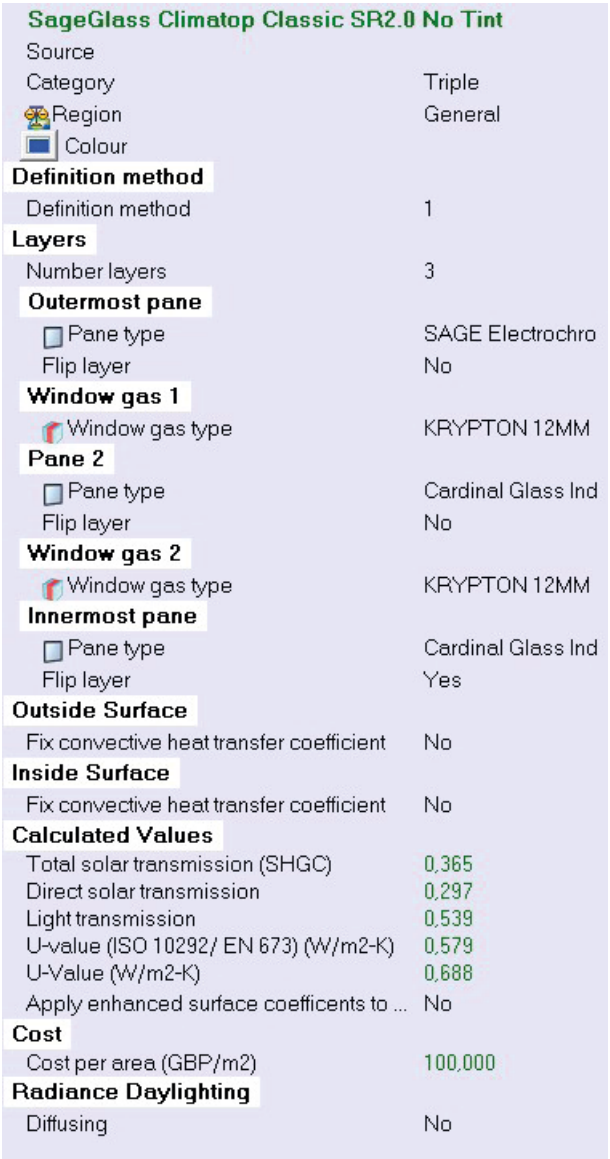
Timber top plates and ridge beam lies on four parallel load bearing walls. They hold “I” rafters from soft wood - filled with hemp insulation. Above, there are counter-battens, battens, plank decking, separation bitumous membrane and a metal deck on the top.



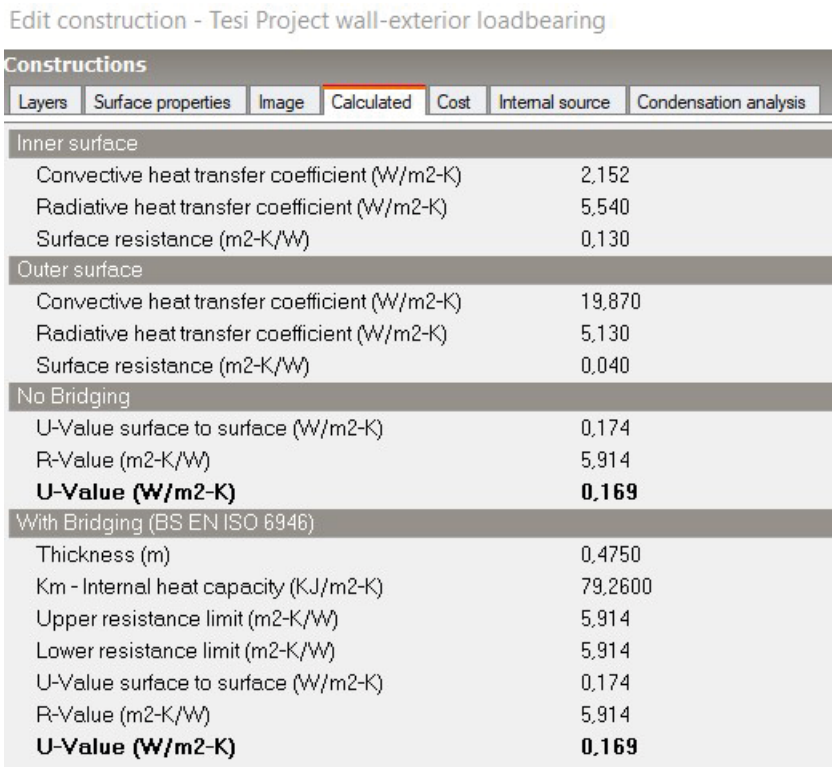
Pic 54 - Section - Composition of construction (own production)

U values overview	REQUIRED	RECOMMENDED	FOR PASSIVE	DESIGNED
ROOF	0,24	0,16	0,15	0,14
EXTERNAL WALL	0,3	0,25 (heavy)	0,18	0,17
FLOOR ON TERRAIN	0,45	0,3	0,22	0,27

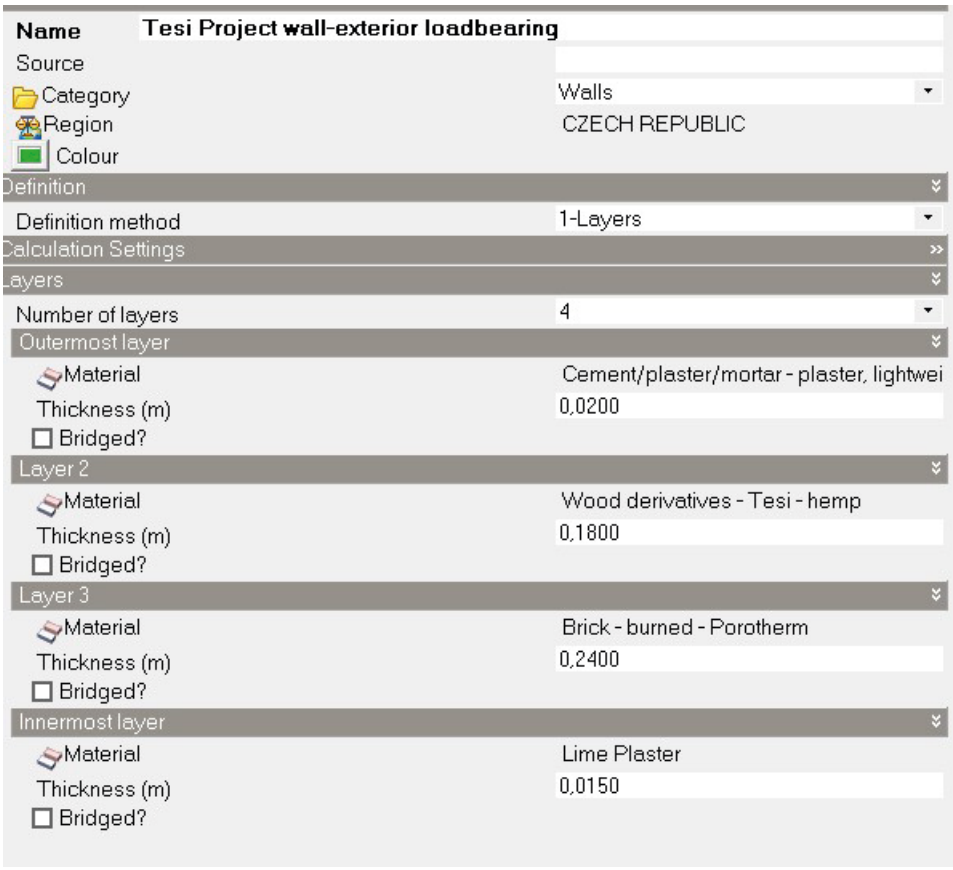
From the overview above, there is clear that most of the envelop fulfils general criteria for passive houses (Hudec, 2013, p.14). Only the floor on terrain would be counted into the recommended range of U values. Detailed digest of designed constructions is shown below on screenshots from the Design Builder software.



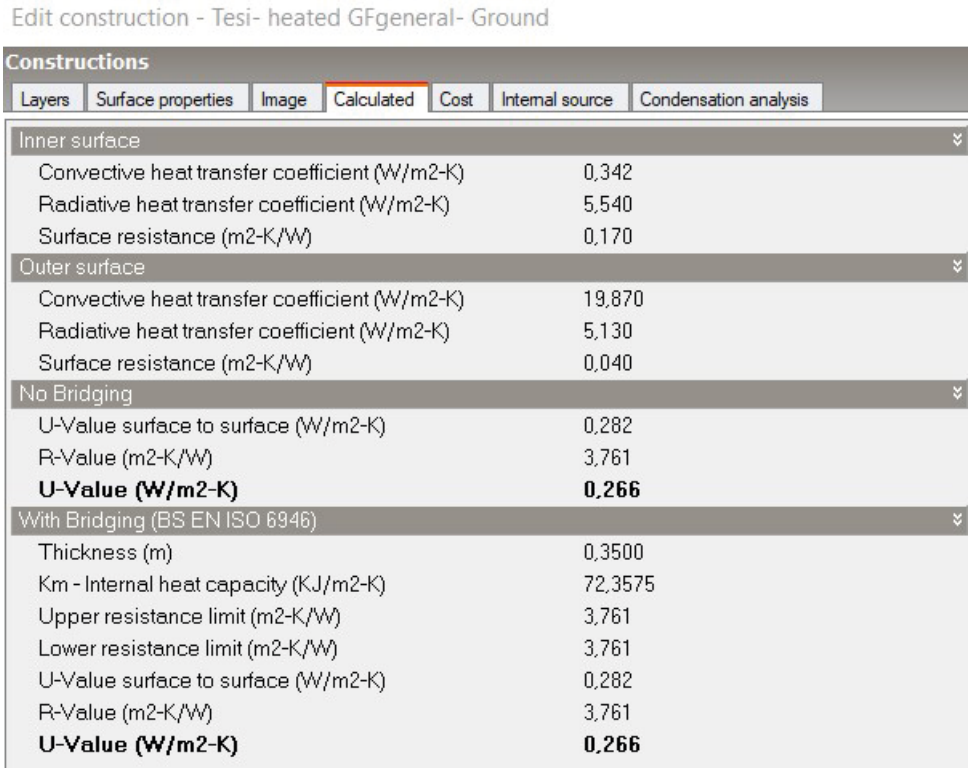
Pic 55 - Design Builder - Glazing U values (own production)



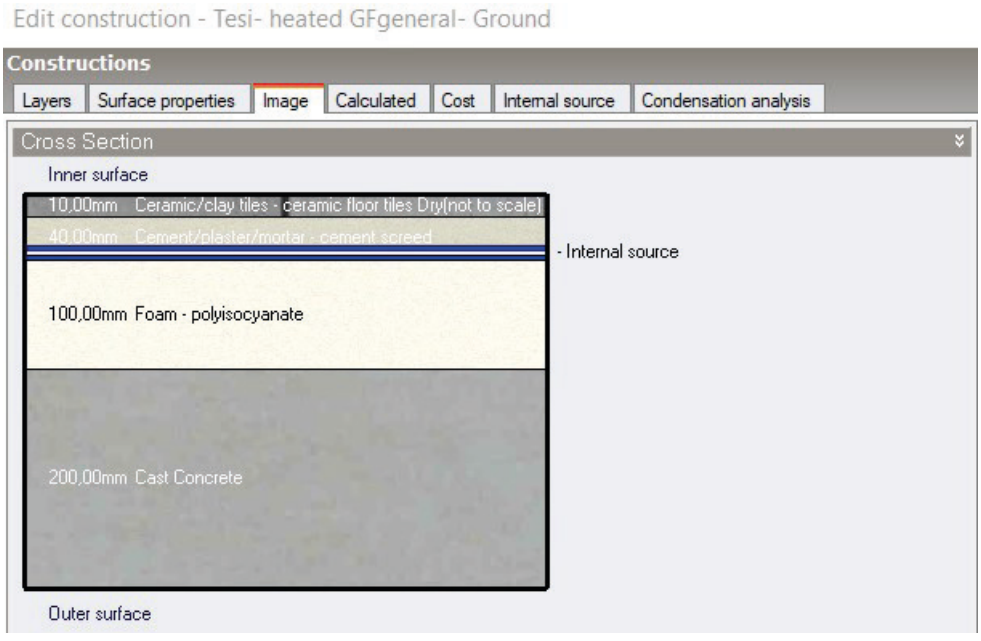
Pic 56 - Design Builder - Wall layers (own production)



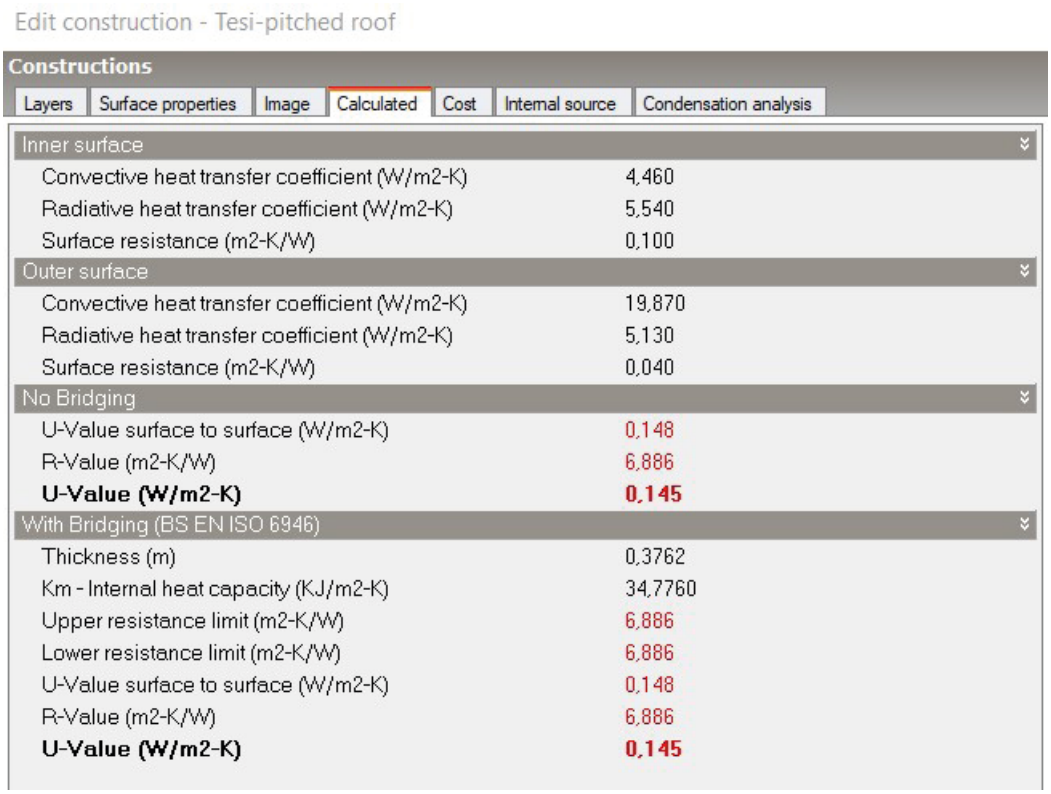
Pic 57 - Design Builder - Wall U values (own production)



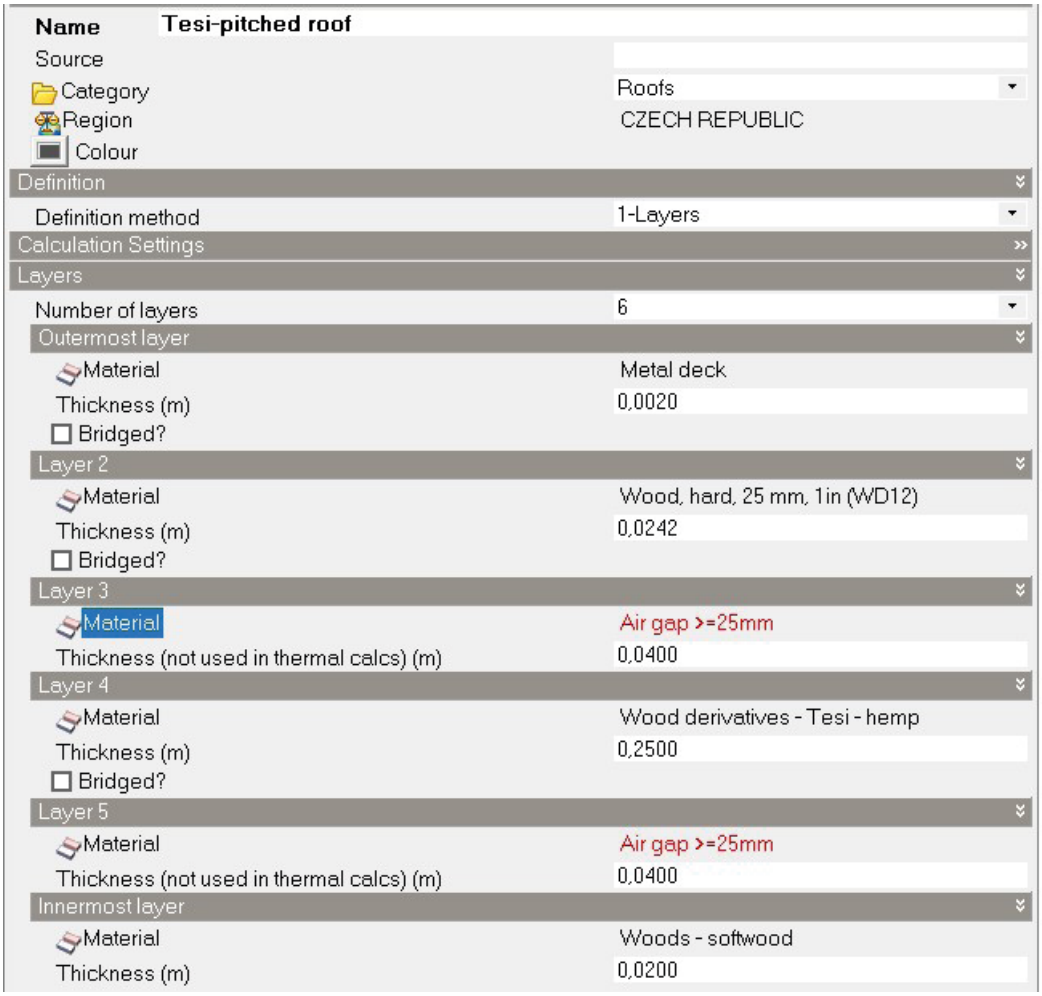
Pic 58 - Design Builder - Floor layers (own production)



Pic 59 - Design Builder - Floor U values (own production)



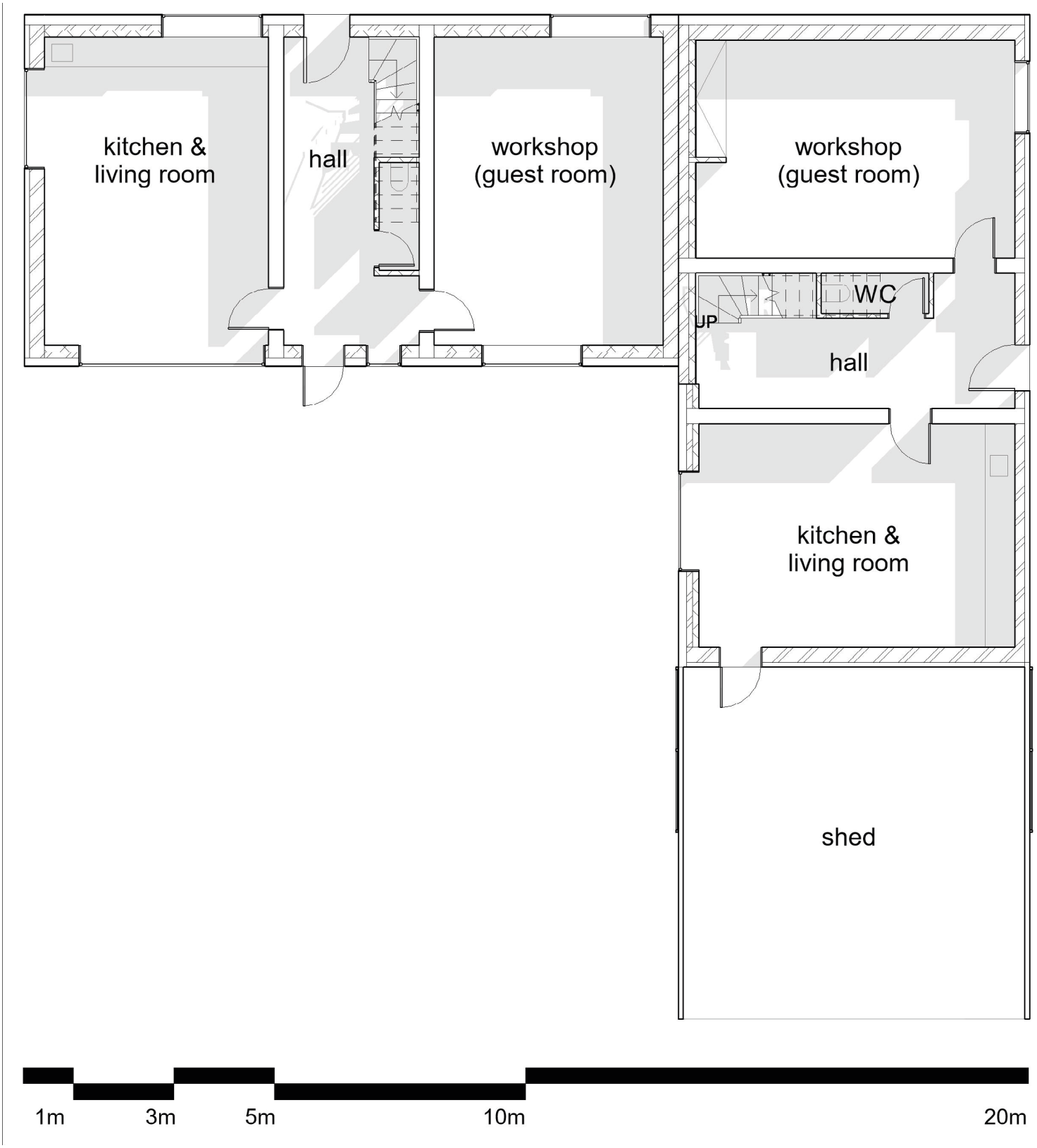
Pic 60 - Design Builder - Roof layers (own production)



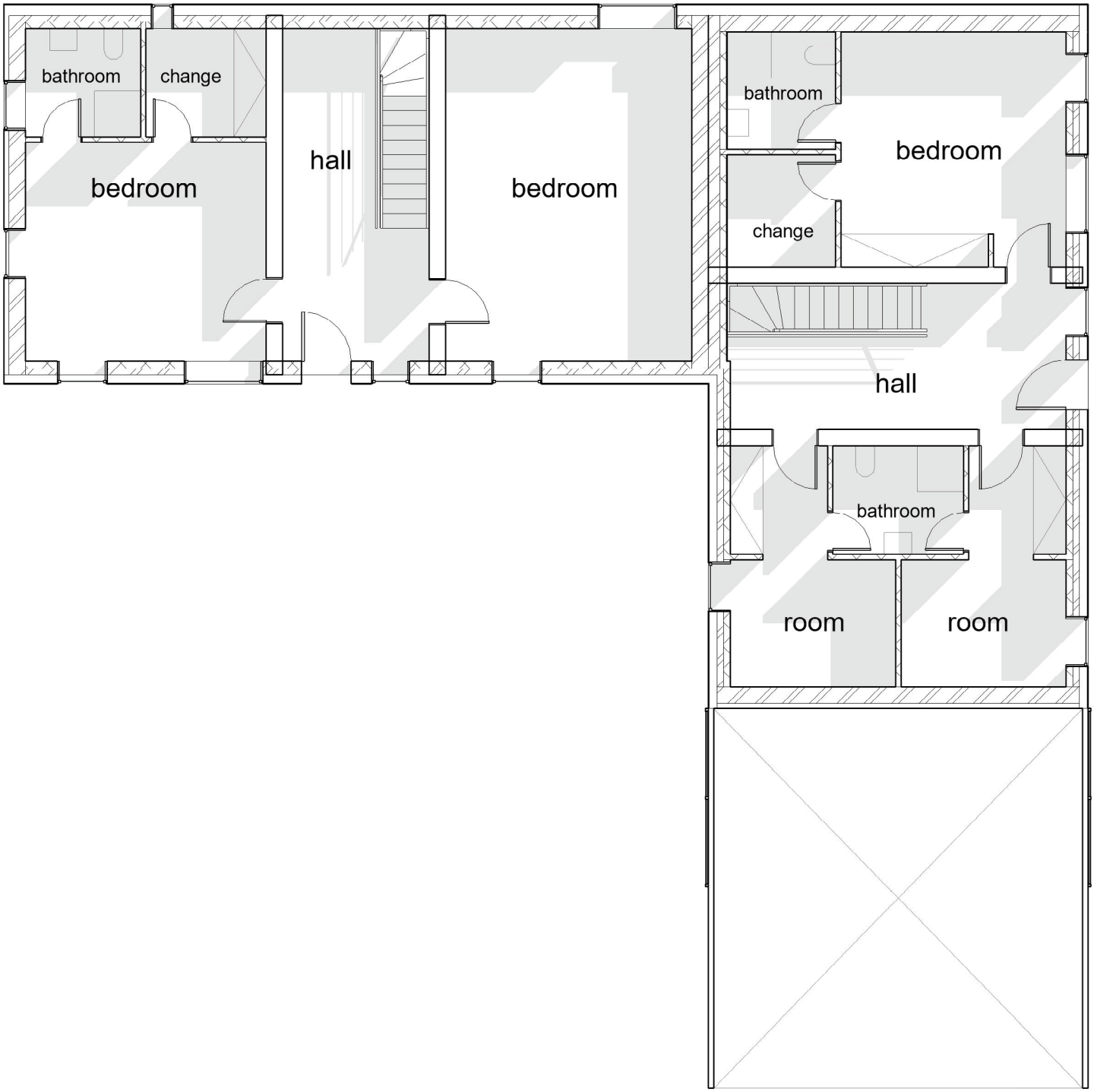
Pic 61 - Design Builder - Roof U values (own production)

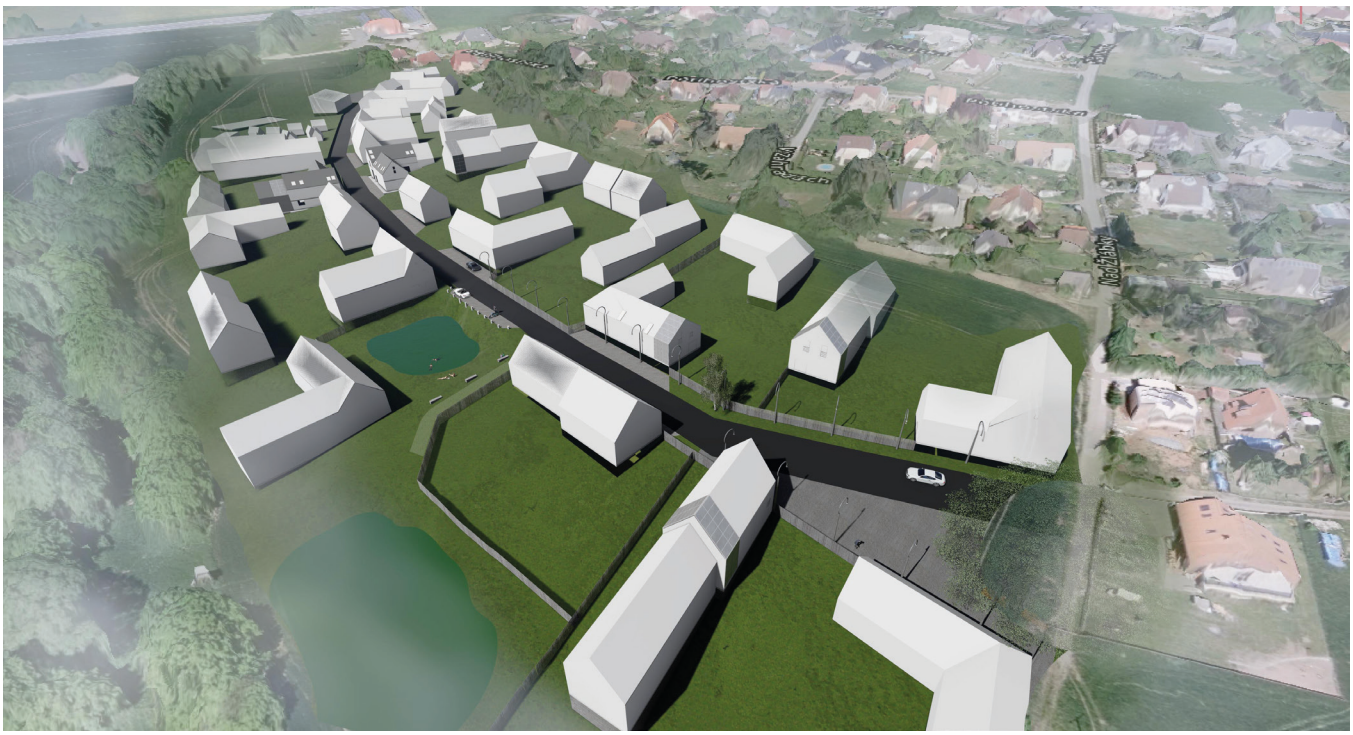
Disposition

House is divided into tree bays by two parallel load bearing walls in the center. Central part is dedicated to entrance hall, staircase and toilet. From the hall we can enter into living room with kitchen corner and to quest room/workshop on the opposite side. In the second floor there are situated two or three rooms with bathrooms serving the rooms. The disposition can vary by orientation to the cardinal.

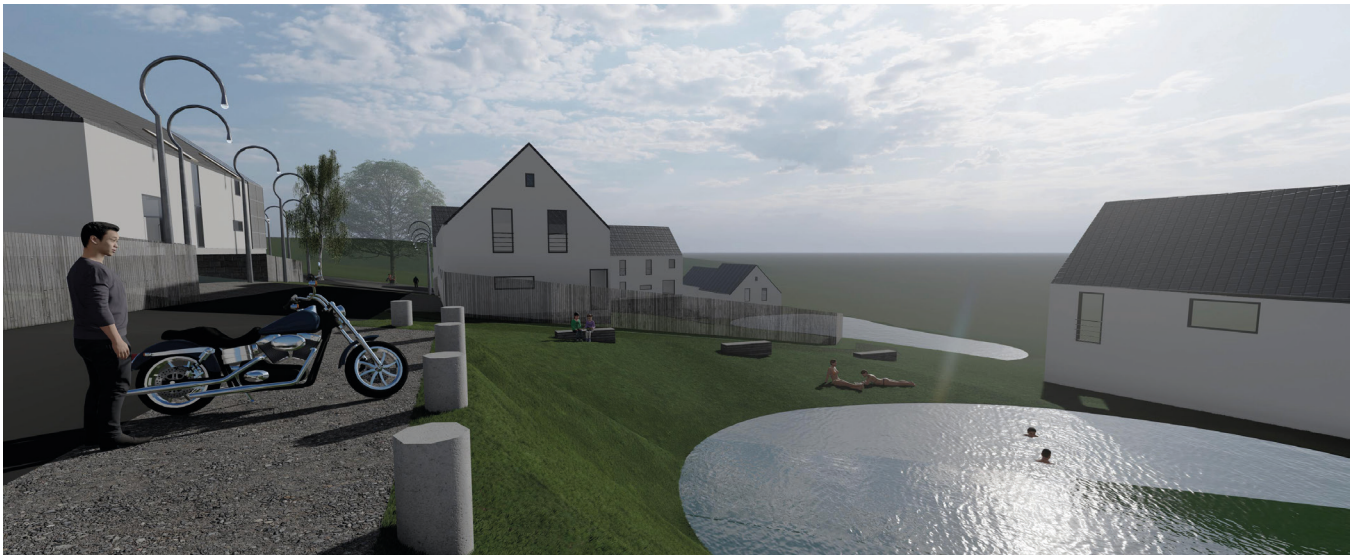


Pic 62 - Floor plans - Scale 1:100 (own production)


bathroom
change
bedroom
hall
bedroom
bathroom
bedroom
change
hall
bathroom
room
room



Pic 63 - Visualization - Bird perspective (own production)

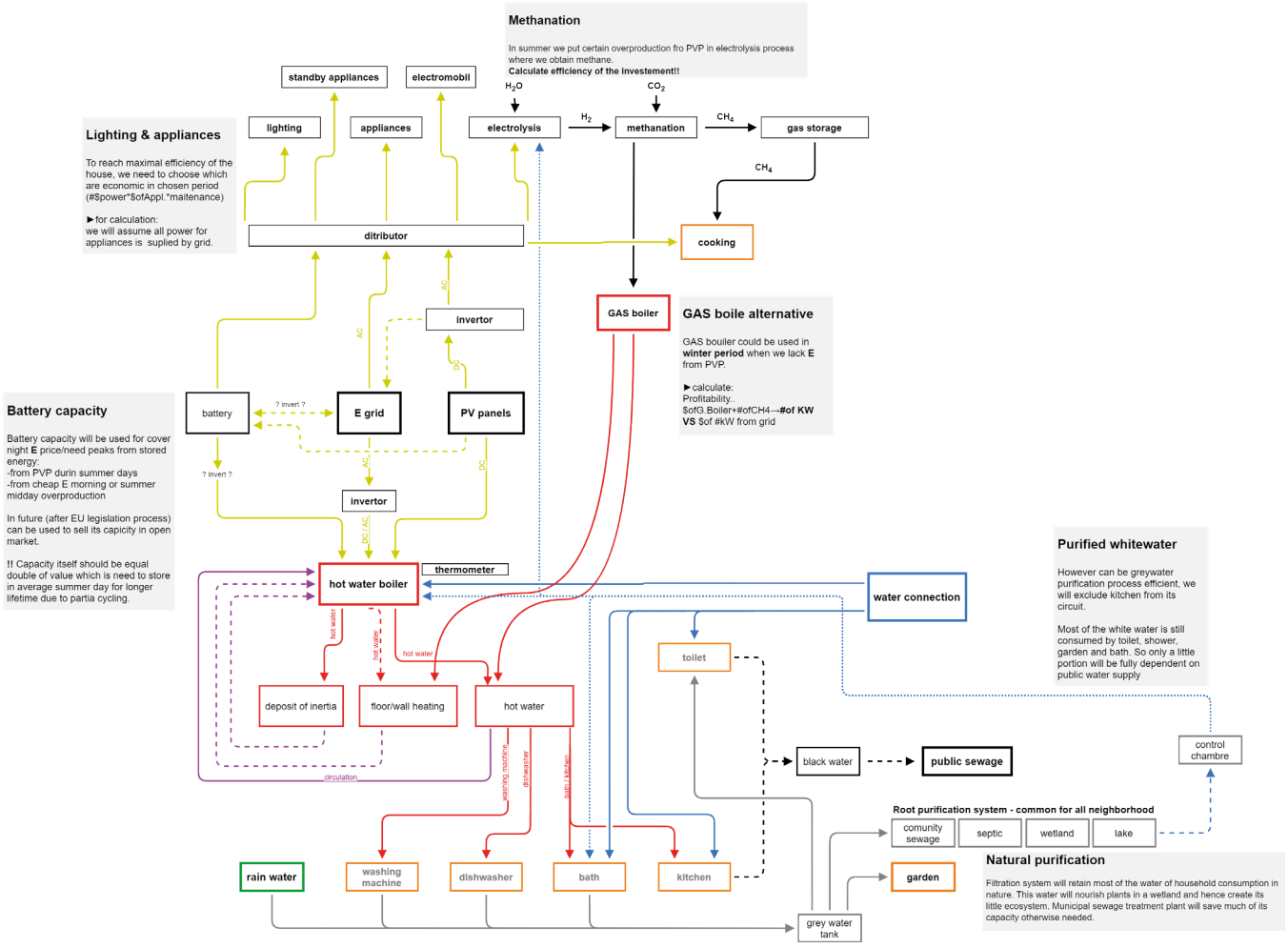


Pic 64 - Visualization - Purification lake (own production)

Pic 65 - Visualization - Example house (own production)

Energy, water & HVAC performance

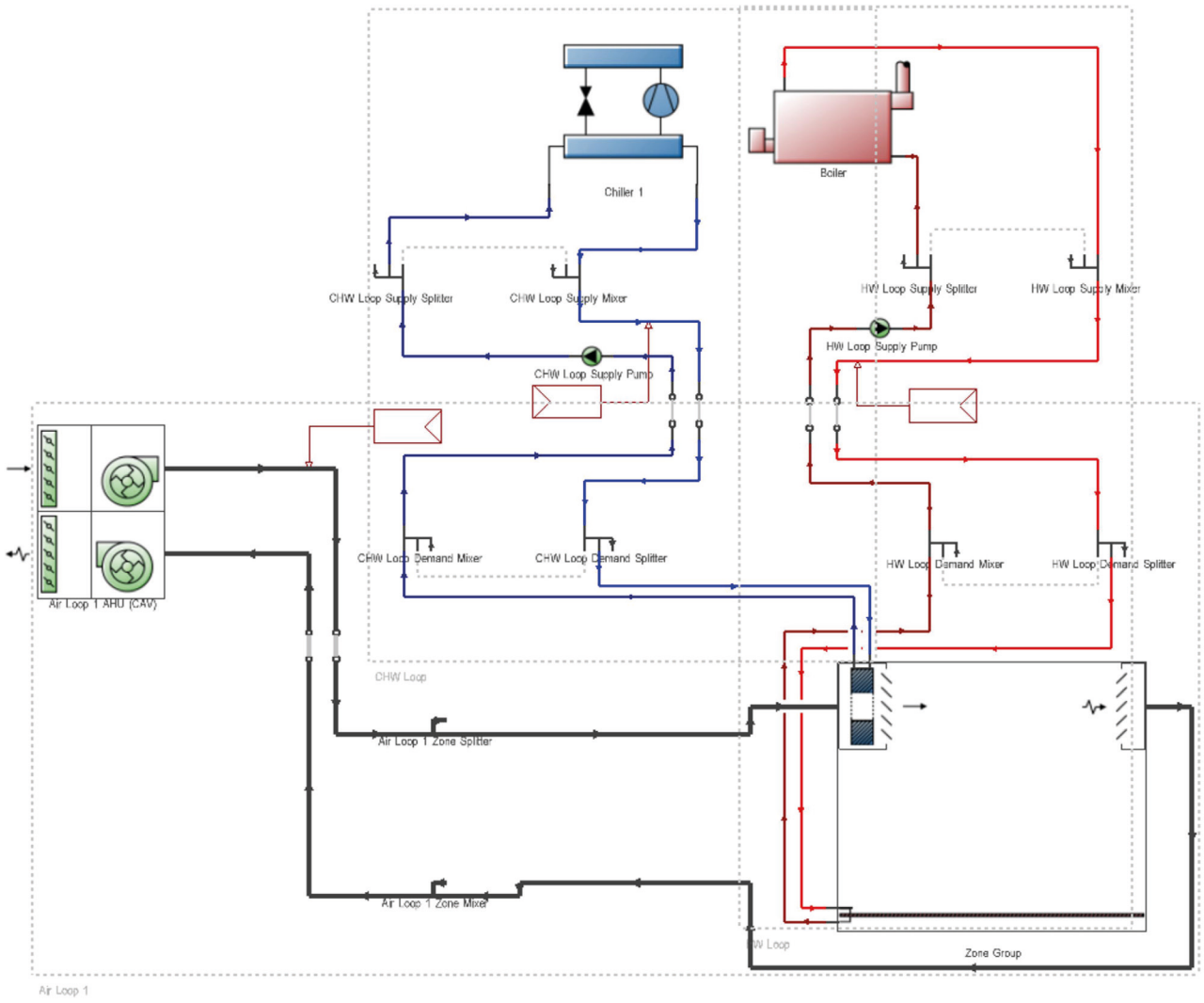
On the picture 66 bellow there is shown initial scheme of possible exemplary house. Technologies like a methane production have not been tested for the energy analysis in software, however they can be an inspiration for further work.



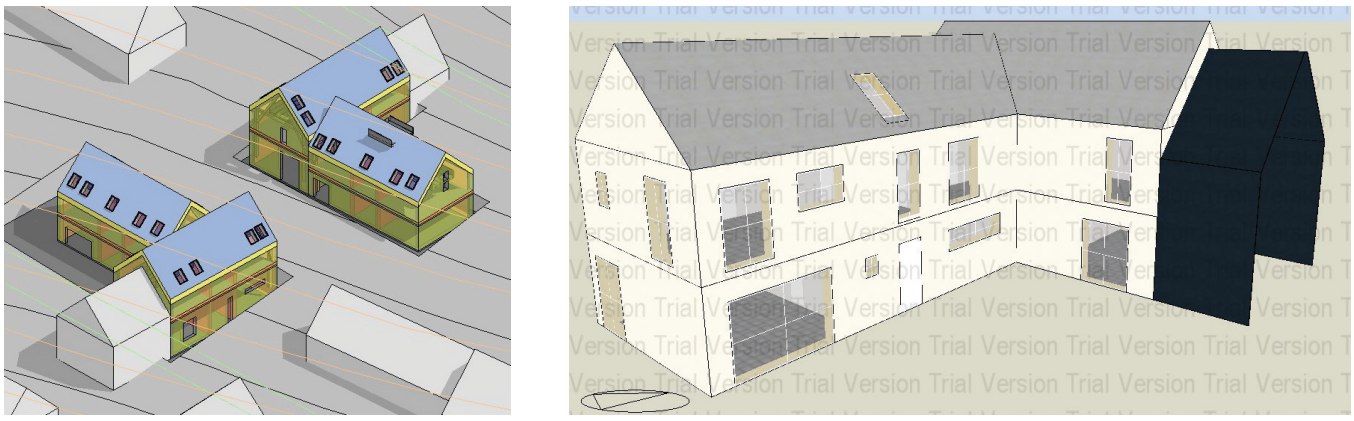
Pic 66 - Diagram - Energy concept (own prod.; larger image in appendix)

After broader research I have chosen to not overdo the design with high-tech technologies and rather I have chosen only a combination of most suitable ones for my case. Significant budget savings can be achieved by natural purification of greywater. Most of the water used in the house can be sent back to the circuit after being treated in natural-lake plant and just the blackwater have to leave the system by public sewage. If we argue, that the price for this district purification system should be comprised in price of the housing unit and it would cost 200 000 € in total, each housing unit would participate by 2985 € and it would take it nearly 20 years to return the investment when we count that graywater contributes on water consumption by at least 50% and so the annual saving on water consumption for average household would be 150 €.

Heating demand is satisfied by floor heating which uses lower temperature of water in the heating medium compared to other technologies. It will be heated in electric double spiral boiler. One spiral heats domestic water while the other is for heating loop. There could be added other water tank used as deposit of inertia, but for simplification of the design I did not counted with this possibility. Water cooling is connected to designed district pond and selected rooms (chosen according analysis in Design Builder) are cooled by air fans connected to a chiller.



Pic 67 - Design Builder - HWAC system (own production)



Pic 68 - Design Builder - 3D model (own production)

PV Panels

I have chosen open gable roof as it is clearly most tradition typology in the region and it is also most efficient in PV panels orientation for autumn/spring where we can meat optimal amount of solar energy power without major overproduction or loss.

PV panel are installed almost only on facades facing east and west because major part of the household energy demand relies to the morning or evening hours and thus the batteries have not to be oversized and the public energy grid overloaded during the day. Need energy is supplied by 85% from utility network and by 15% (2820 kWh) from PV panels. From the Ronet cost estimation software, the cost of designed photovoltaic technology would be 15 385 € for house. If we calculate an annual savings of 542 € by PVP energy production, the technology would be pay up in 28 years. After the legalization would allow selling the surplus energy (2278 kWh) to other users (instead of current system of exclusive rights for energy concerns), we may assume that this refund period might shorten to 15 years.

Utility Use Per Total Floor Area

	Electricity Intensity [kWh/m2]	Natural Gas Intensity [kWh/m2]	Additional Fuel Intensity [kWh/m2]	District Cooling Intensity [kWh/m2]	District Heating Intensity [kWh/m2]	Water Intensity [m3/m2]
Lighting	13.63	0.00	0.00	0.00	0.00	0.00
HVAC	48.26	0.00	0.00	0.00	0.00	0.00
Other	6.10	0.00	0.00	0.00	0.00	0.00
Total	67.99	0.00	0.00	0.00	0.00	0.00

Electric Loads Satisfied

	Electricity [kWh]	Percent Electricity [%]
Fuel-Fired Power Generation	0.000	0.00
High Temperature Geothermal*	0.000	0.00
Photovoltaic Power	5366.247	27.99
Wind Power	0.000	0.00
Power Conversion	-268.31	-1.4
Net Decrease in On-Site Storage	0.000	0.00
Total On-Site Electric Sources	5097.935	26.59
Electricity Coming From Utility	16349.378	85.29
Surplus Electricity Going To Utility	2278.016	11.88
Net Electricity From Utility	14071.362	73.41
Total On-Site and Utility Electric Sources	19169.296	100.00
Total Electricity End Uses	19169.296	100.00

Pic 69 - Design Builder - Electric loads (own production)

FINANCIAL ANALYSIS

Cost estimation

The cost estimation is made in Czech software Ronet, where it is compared with result on SCI-data portal and translated in English language. Special articles are “photovoltaic system” and “purification plant contribution” which can rise significantly the price of construction if compared to common buildings. The highest impact of 24% on construction price has “rough construction” followed by “finishing and other” and “surfaces” at the third place.

COST ESTIMATION FOR DOUBLE HOUSE

Cost estimation of masonry building - Family house - Space 1190 m3 is aproximately **339 360 €** (with VAT)

Land works (2%):	#	4 550 €
Foundation (4,5%):	#	11 400 €
Rough construction (23%):	#	56 850 €
Heating, water & sewage (13%):	#	31 850 €
Roof (truss & sheeting) (3,5%):	#	9 100 €
Door & windows (6%):	#	14 800 €
Surfaces (15.5%):	#	37 550 €
Insulations (damp, air, thermal) (3%):	#	6 850 €
Instalation of electricity etc. (5%):	#	12 550 €
Finnishing and other works (17%):	#	42 100 €
Photovoltaic system (6.5%):		15 400 €
Purification plant contribution (1%):		2 900 €
Subtotal (objects):	#	**245 900 €**
Other connected expenses:		
Survey and projecting works (5% more):	#	12 300 €
Administrative expenses and others (5% more):	#	12 300 €
Reserve (5% more):	#	12 300 €
Total without VAT:	#	**282 800 €**
VAT (20%):	#	**56 560 €**
Total with VAT:	#	**339 360 €**

Pic 70 - Table: Cost estimation for double house (own production)

Profit - cash flow analysis

The cost of land is based on average cost in the region and thus it was set to 75 € per m2. One double house built on the plot area of 800 m2. The construction cost without VAT is 282 800 €. The developer profit was set to 10% which is more than double the average profit for developers in Czech Republic - 4% (hypoindex, 2020). Other expenses are chosen arbitrarily according the course of Economics on Polytechnic University of Turin.

FINANCIAL ANALYSIS FOR DOUBLE HOUSE

COSTS	COST € per m2	QUANTITY [m2]	UNIT OF MEASURE	TOTAL €	INCIDENCE (%) on TOTAL
Cost of the land	**75**	**800**	**m2 (sqm)**	**60 000**	**12,0**
PLANNING FEES					
Primary and Secondary (Residential)	0	0	cubm	0	0,0
Primary and Secondary (Commercial)	0	0	sqm	0	0,0
Primary and Secondary (Offices)	0	0	sqm	0	0,0
Percentage of the construction cost	0	0	%	0	0,0
PARTIAL TOTAL			**€**	**60 000**	
DEMOLITION COST					
Brick buildings	50	0,00	cubm	0	0,0
Concrete buildings	200	0	cubm	0	0,0
Terrain works	30	0	cubm	0	0,0
PARTIAL TOTAL			**€**	**0**	
CONSTRUCTION COST					
Residential	x	x	sqm	282 800	56,6
PARTIAL TOTAL			**€**	**282 800**	
EXPENCES					
Technical *(Construction cost)*	0	282 800	%	0	0,0
General *(Construction cost)*	5	282 800	%	14 140	2,8
Marketing *(Total revenues)*	3	380 000	%	11 400	2,3
Managing and administrative *(Total revenues)*	1	380 000	%	3 800	0,8
Ordinary maintenance *(Total revenues)*	0,5	380 000	%	1 900	0,4
Extraordinary maintenance *(Total revenues)*	0	380 000	%	0	0,0
TOTAL COST (financial charges & profit)			**€**	**374 040**	
FINANCIAL CHARGES *(Construction cost)*	20	380 000	%	76 000	15,2
DEVELOPER PROFIT *(Total revenues)*	10	489 194	%	48 919	9,8
TOTAL COSTS				**498 959**	**99,8**
Insurance *(Total cost)*	0,2	498 959	%	998	0,2
TOTAL COSTS (+ Insurance)				**499 957**	**100**

REVENUES (SALE)	€ per m^2 /month	Price of house unit	n. houses	TOTAL €	INCIDENCE (%) on TOTAL
Residential	x	250 000	2	500 000	100,0
TOTAL REVENUES				**500 000**	**100**
NET VALUE (T. REVUNES - T. COSTS)				**43**	

Pic 71 - Table: Financial Analysis (based on POLITO course "Architecture and urban economics)

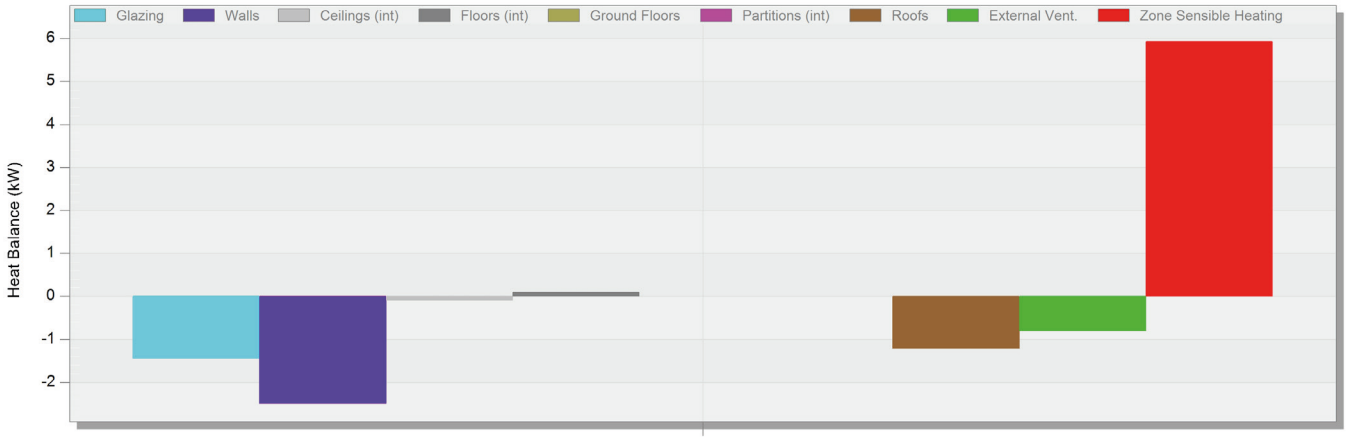
CONCLUSION

Hudec shows some evaluation criteria for certification of passive housed. He presents maximum value of 30 kWh/(m2*a) for low energy houses when this number represents energy need for heating, after he states that 150 kWh/(m2*a) is maximum value of energy need for primary heating (Hudec, 2013, p.20). In Design Builder energy software, I obtained value for use of energy equal to 68 kWh(m2*a) which is higher than expected, but we have to count that more detail setting of occupancy and operation schedules would probably lower this number. Other significant savings on energy demand could be achieved by professional knowledge of HVAC components like pressure in plumbing, variations of connections and autonomous smart management of entire energy system. Simple solution to reduce energy need would be to reduce high of second floor where is large amount of space dedicated to technical appliances and its comfortable access for its maintenance under the gable roof. The average energy need in Central Bohemia Region was 46 kWh/(m2*a), It is the third highest number among the Czech regions, but also CSU claims that this fact if influenced strongly by higher proportion of family houses typology (CSU, 2017). Lastly the better number could be achieved by using polystyrene insulation or wider layer of hemp insulation. I wanted to avoid these solutions and I argue that slightly higher consumption of electricity for heating is balanced by choice of natural materials with lower embedded CO2 and PEI factors.

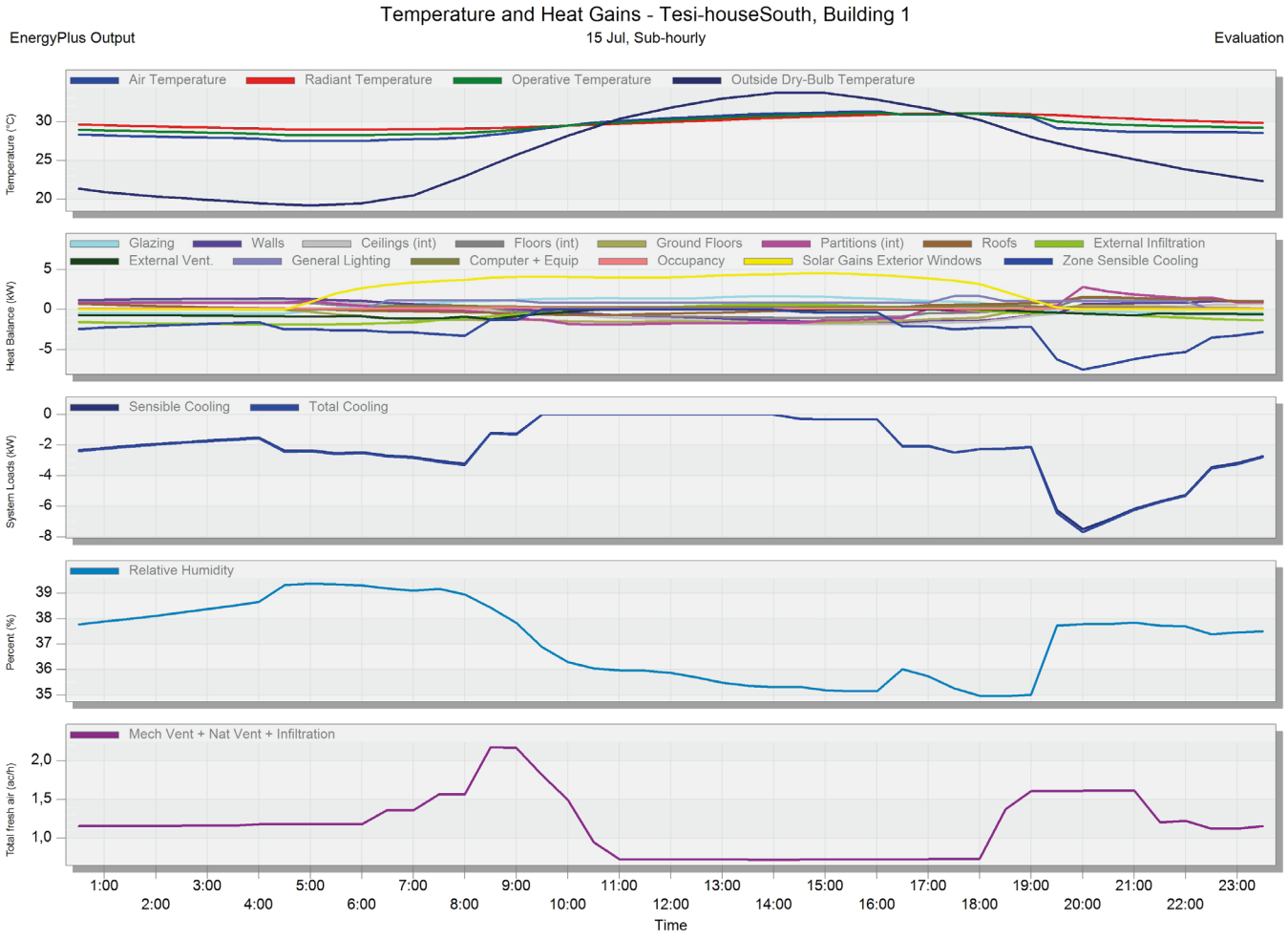
The economic side of the design is developed through cost estimation a financial analysis. The total construction price of example double house would be 282 800 € and with VAT 339 360 €. After adding other connected expenses with developer projects, the total cost of double house would be equal to nearly 500 000 € which means 250 000 € for one housing unit with NIA (Net internal area) 140 m2, on 400 m2 plot and distant 31 km from Prague. If we compare this to some other examples, new settlement in Beroun suburb offers terrace house, with NIA 131 m2, 938 m2 of plot and distance 31 km from Prague for 323 000 € and settlement in Drahelčice offers terrace house, with NIA 116 m2, 348 m2 of plot and distance 23 km from Prague for 317 000 €. Between these mentioned references, my design is significantly cheaper with leaving developer highly above-average profit of 10%, and thus my design could be more affordable for middle class investors.

LOCATION	Distance from Prague	NIA	Plot	Price [€]
Beroun	34	131	938	323 000
Drahelčice	23	116	348	317 000
Senohraby (thesis)	34	140	400	250 000

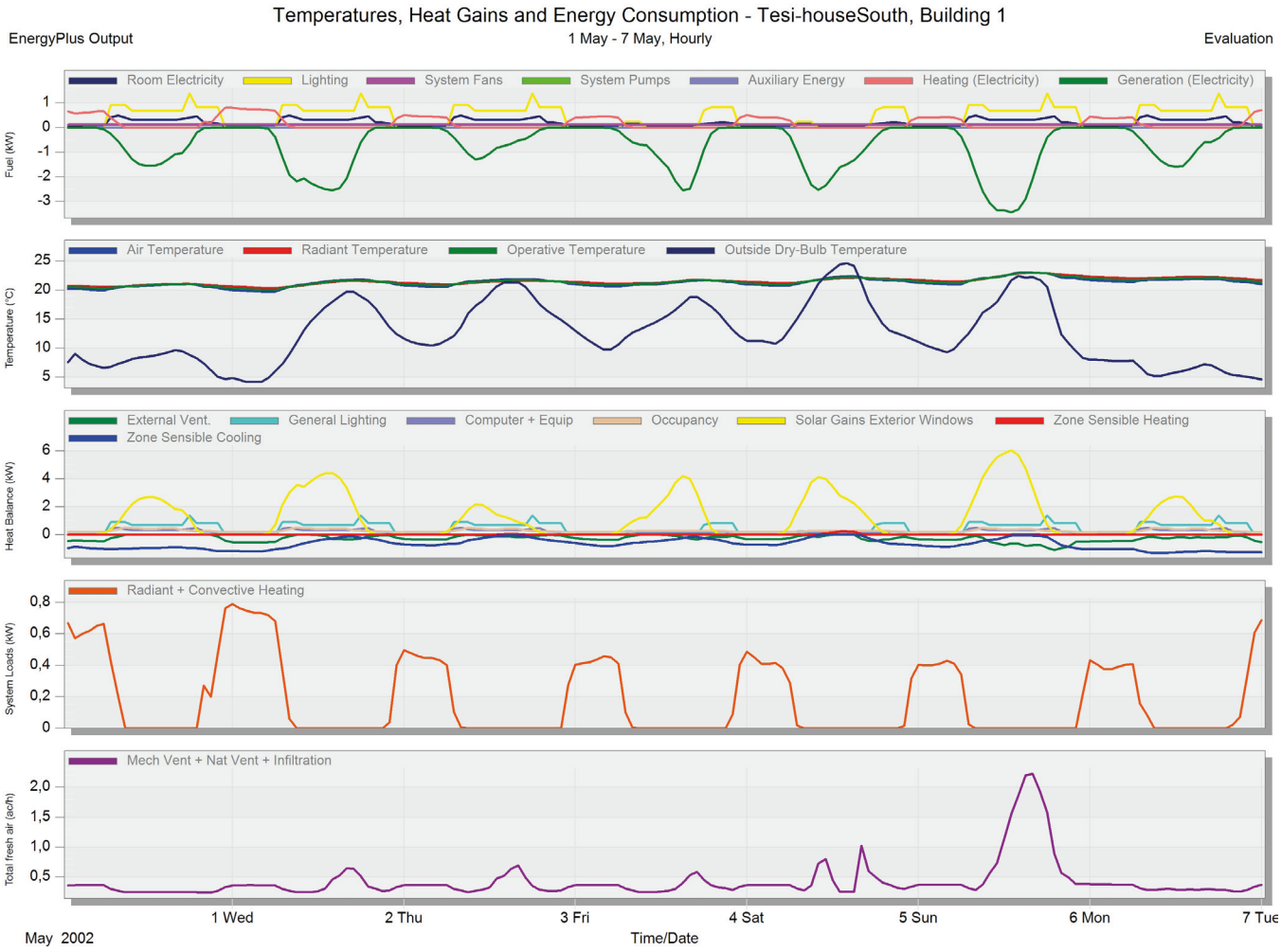
APPENDIX



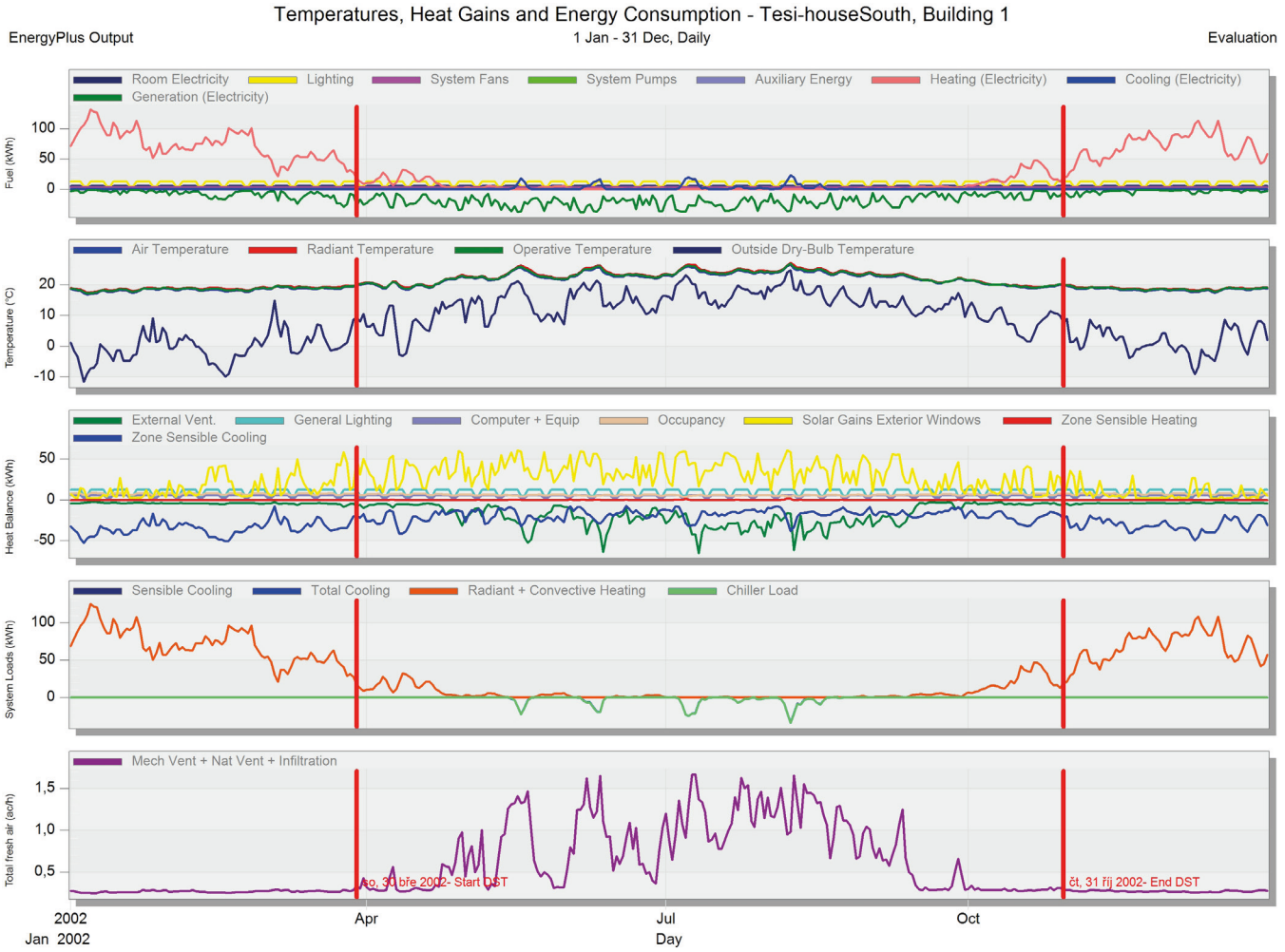
Pic 72 - Design Builder - Heating design (own production)



Pic 73 - Design Builder - Cooling design (own production)

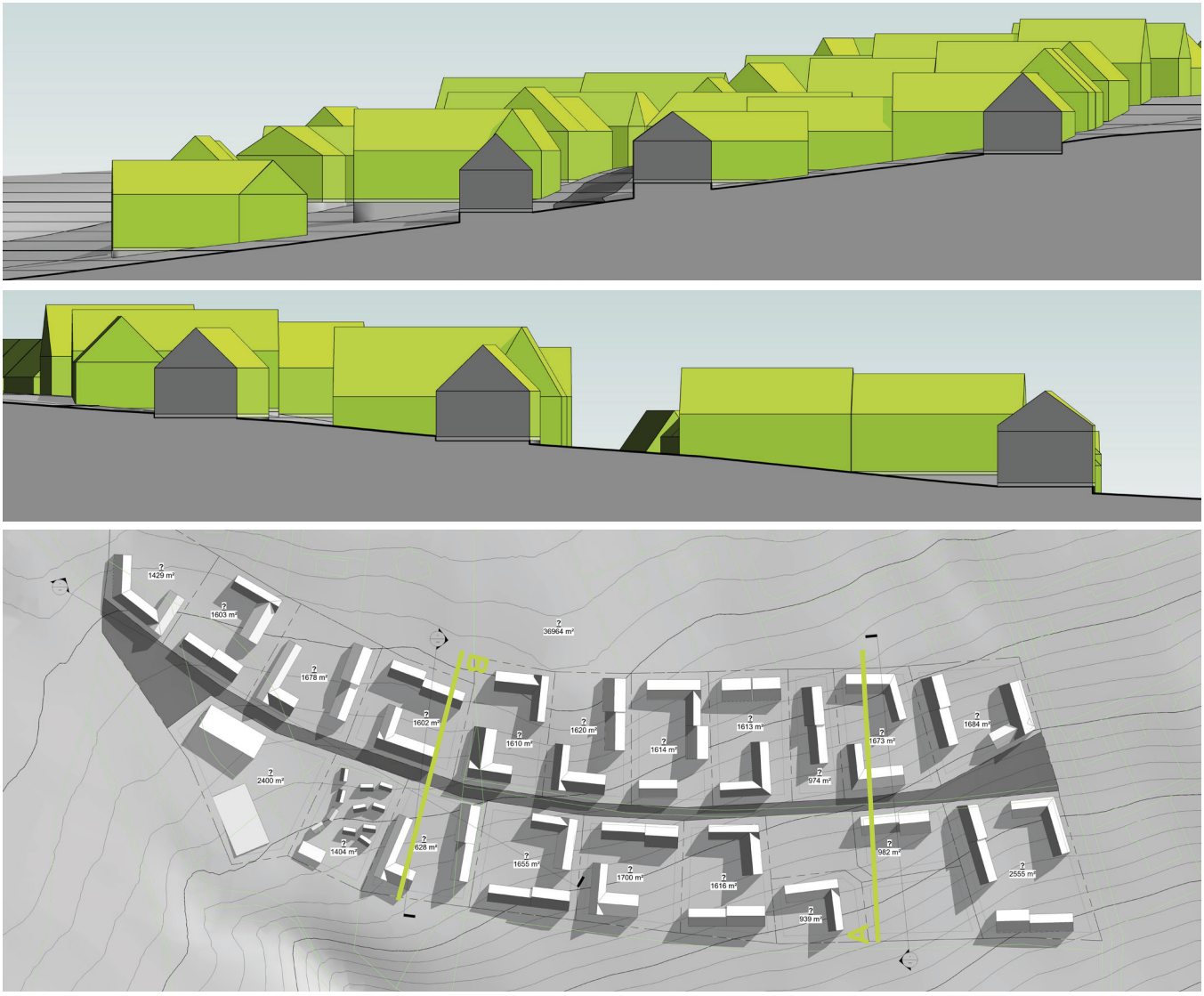


Pic 74 - Design Builder - Spring week simulation (own production)



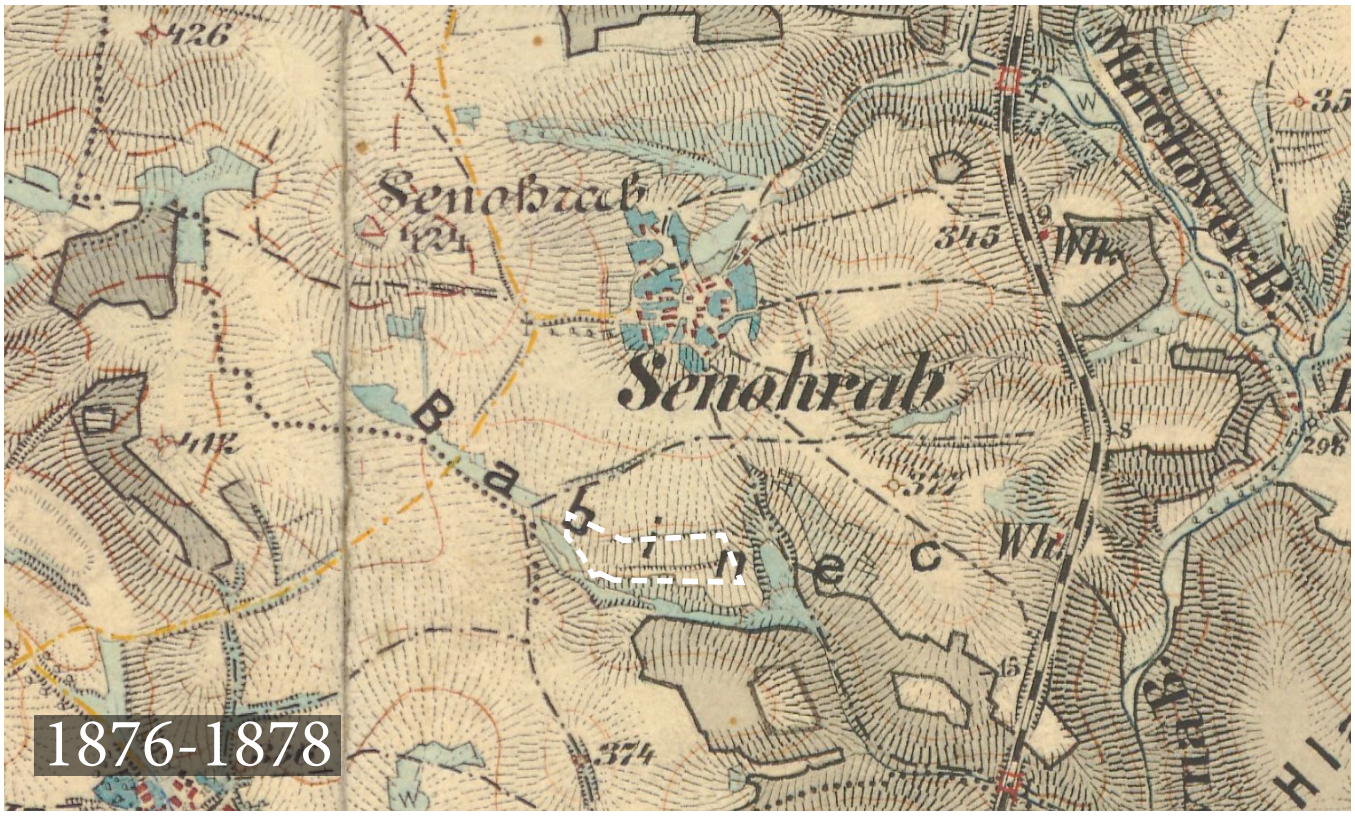
Pic 75 - Design Builder - Annual simulation (own production)

Pic 76 - Possible solar panel orientation (own production)



Sections through geometry

Pic 77 - Historical map: 1764-1768 (geolab.cz)



Pic 78 - Historical map: 1876-1878 (geolab.cz)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URBAN
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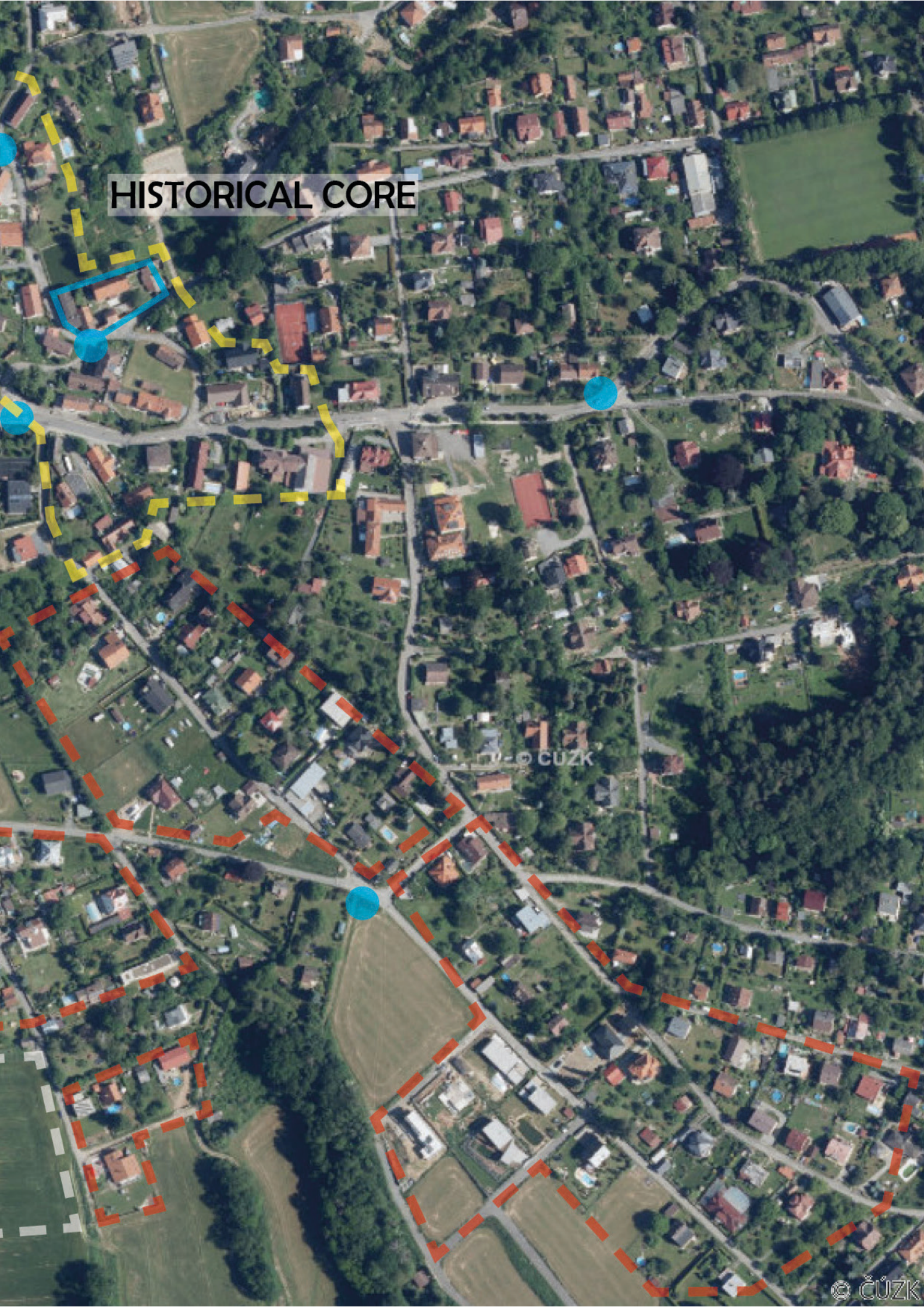
HIST. CORE
HIST. CORE
PLAZA
CLUSTER
SITE
URBAN
SPRAWL
SITE OF THESIS PROJECT


HISTORICAL CORE
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