local identity

materials.

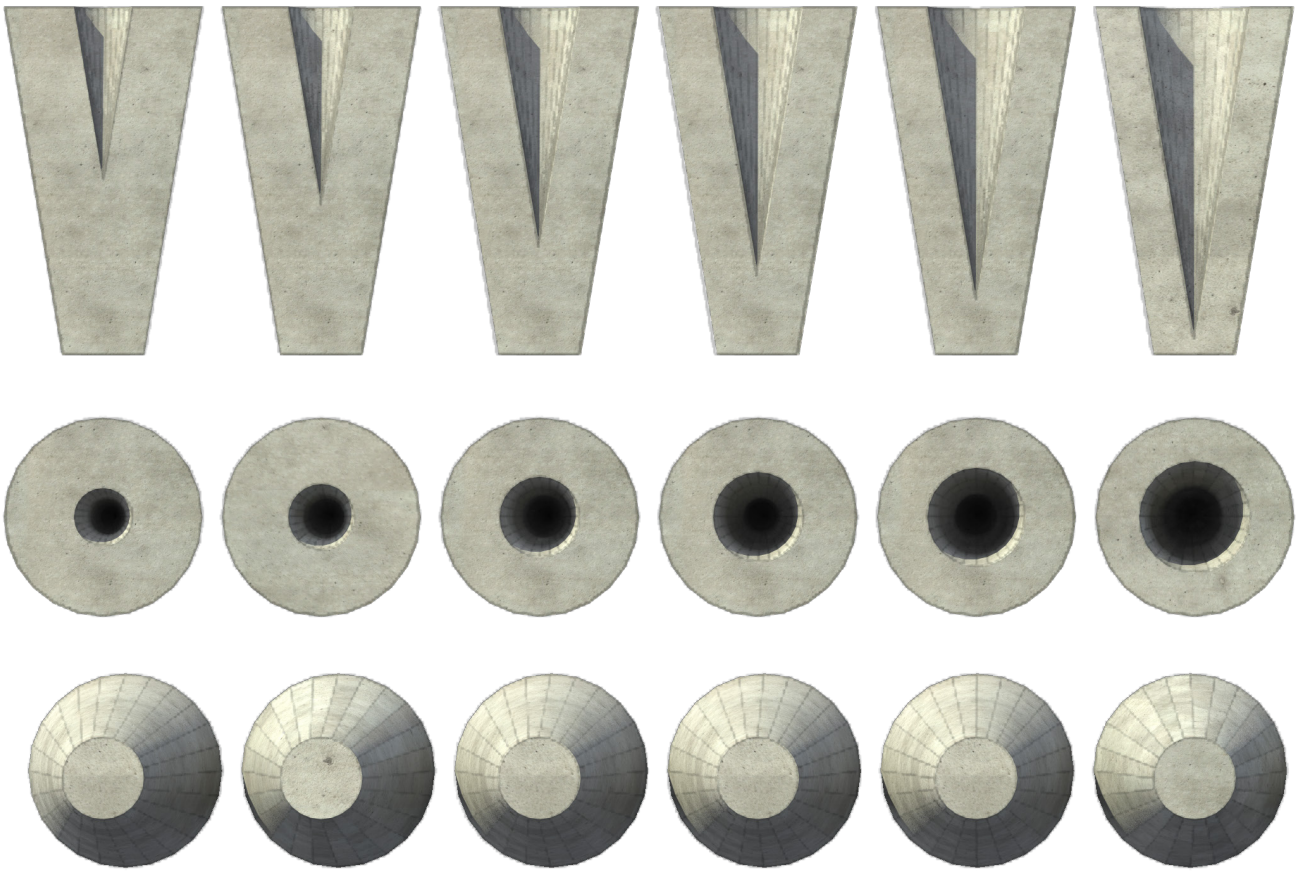
explore lab graduation thesis: Tim Jongerius 1360515

2.

Figure 1: Tidal flat, Oosterschelde

content.

Front Dunes, sea side near the Neeltje Jans.
Figure 1 Tidal flat, Oosterschelde. Own image.



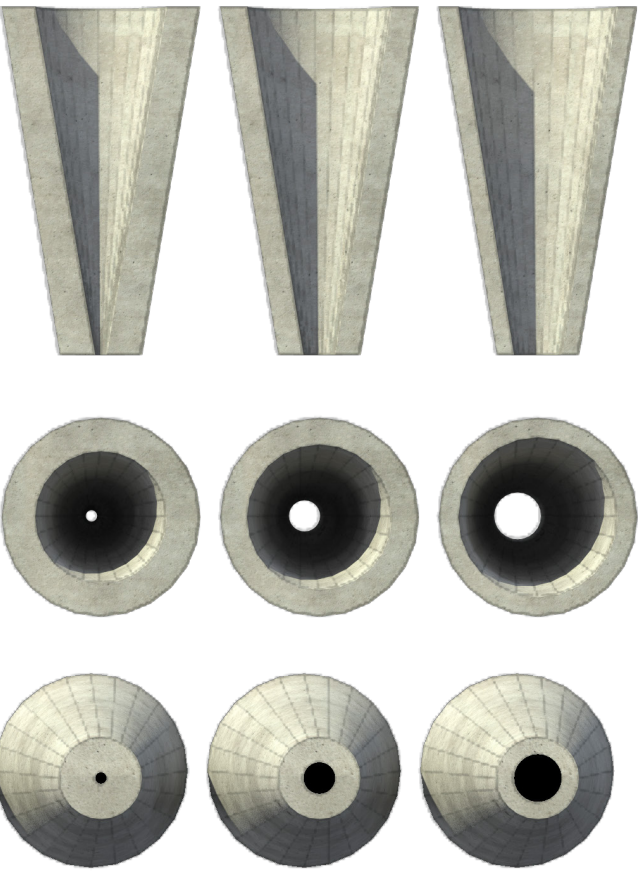


Figure 2: Concrete cones

preface.

Throughout my study I noticed that materials were, in my opinion, a too often 'not properly used' subject.

I found this in the way some projects where taught, but especially in how students tackled projects. Materials were simply forgotten or ignored in the design process only to be remembered at the end, where the need of detailing forces the issue. When applying materials is forced there is the tendency to reach out for the known materials: concrete, wood, brick and steel. Concurrently this leads to known techniques and form language, losing a layer of depth, creating a way of working where architecture looks similar. Materials make architecture possible, they should play an important role in creating it.

Throughout my studies I developed the need to give materials an important factor in my design and design process. I studied new materials (rammed earth, ETFE), I used materials that are not common in architecture (felt) or I would go into depth in a widely used material, such as concrete, trying to find a new technique or a new form language for this material. The logical step was to pursue this fascination for materials in my graduation project.

Before I begin, this thesis and the corresponding design is focussed on the Netherlands, but it is written with the idea to make it a blueprint that can be used all over the world.

Figure 2 Concrete Cones, stackable cones made from concrete. Searching for a different formlanguage. Own work 2016.

introduction.

The Netherlands possesses a lot of beauty.

Beauty in the flat stretched landscapes where ninety per cent of the view is air and clouds, beauty in the purple heathland with its sandy hills and flats, beauty in its beaches and dunes covered in pale tinted scrubs and grasses, beauty in the rolling hills further to the south. The landscape has a lot of variety, caused by nature or the hands of man. But this variety is hard to find in the build environment. The conclusion of personal observations is that the build environment doesn't reflect the landscape well. There is no obvious build to landscape relation, even though the Dutch landscapes offer geological differences and differences in flora and fauna. This ought to translate to a noticeable variety in materials? Materials, such as clay show that it could. The colours of clay are different depending on location, this can be translated to colours of brick per location. If we look at another material, glass, different kinds of sand produce different colours of glass. These are just two materials which can, only by colour, adjust a building to better fit the 'genius loci' (spirit of the location). If only colour could give such a difference in a local building identity in the Netherlands, what more is there to discover?

Figure 3: Glass samples, AtelierNL

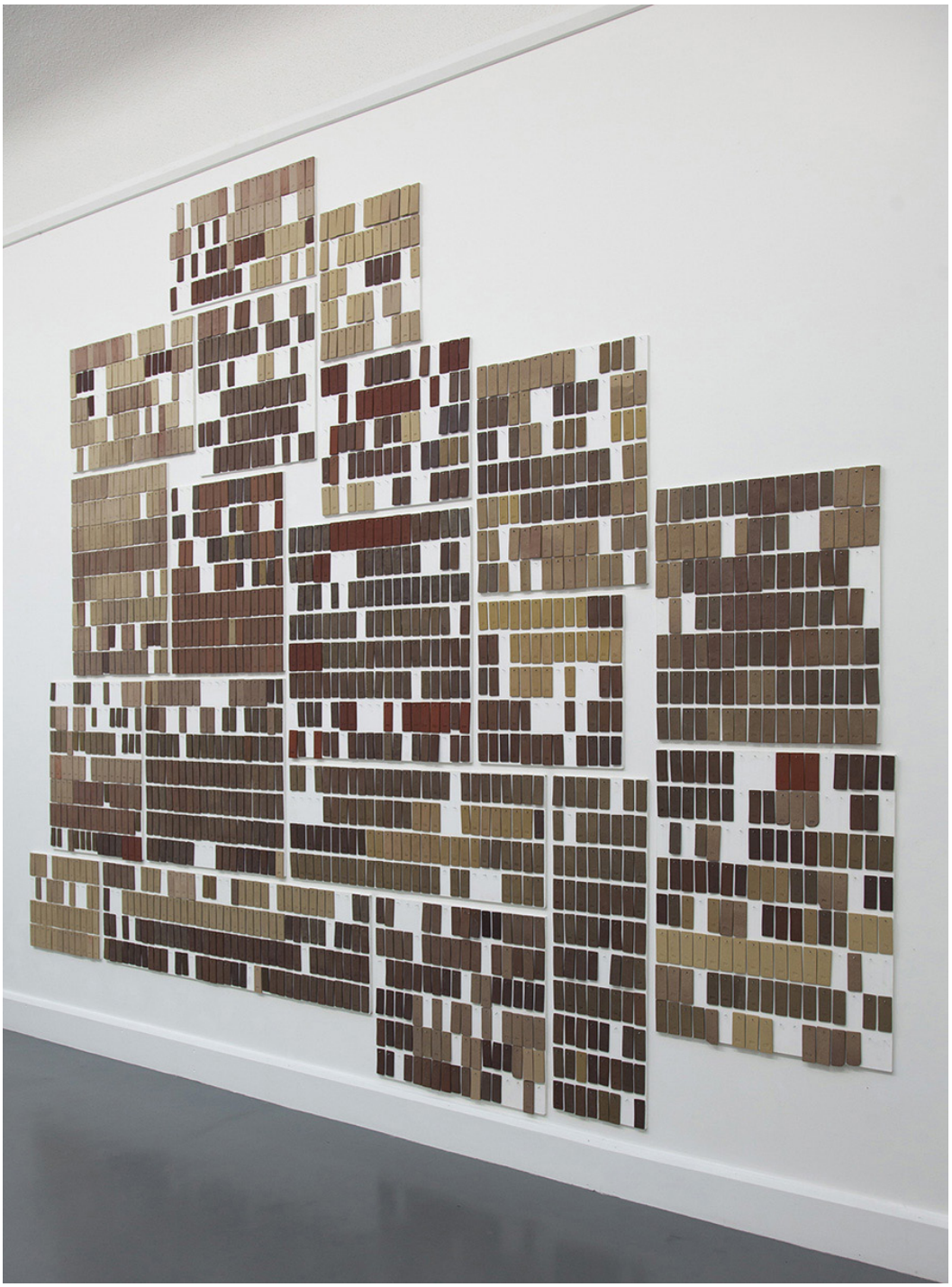


Figure 4: Clay samples, AtelierNL

Figure 3 Glass made from sand collected in different area's in the Netherlands. AtelierNL, Sand Journey, retrieved 15 june, 2016, from http://www.ateliernl.com/projects/sand-journey

Figure 4 Ceramic tiles made from ground samples from different area's. AtelierNL, Earthfactory project, retrieved 10 januari, 2017, from http://www.ateliernl.com/projects/tilewall

problem statement

The problem, of the build environment not reflecting the landscape well, becomes even more evident when confronted with the average new development.

The problem, of the build environment not reflecting the landscape well, becomes even more evident when confronted with the average new development. This generic form of architecture is found in many new and old neighbourhoods all over the Netherlands. While these neighbourhoods may not be specific for a place in the Netherlands, they are quite specific for the Netherlands. Think of the vernacular, the slanted roofs and the usage of brick. Culturally they are connected to the Netherlands. This is different in case of high rise, the tall concrete, steel and glass structures. If we look at the high rise building and forget the location, it's hard to guess in which city it stands. Most of the high rise is universal. It doesn't matter if we place it in Rotterdam, New York or any other big city. Frampton writes about this subject in his essay critical regionalism (Frampton, 1987 [2007], p. 382). He differentiates the terms 'typology' and 'topology'. Under the term typology he describes 'culturally grounded' and 'universal'. The 'universal' is suitable for multiple kind of programs on any regular site, describing perfectly the high rise from earlier. The 'culturally grounded' has a specific program wherein the form is grounded in the history of a place, describing the new developments, which through their form and use of materials reference culturally to building traditions in the Netherlands. *"Topography, on the other hand, is unequivocally site-specific. It is, so to*

Figure 5: Culturally grounded

Figure 6: Universal

speak, the concrete appearance of rootedness itself. Nature, even manipulated man-made nature, is the precondition for its being."(Frampton, 1987 [2007], p. 382). With topography Frampton means all site-specific elements: the climate, the landscape (hills or flat for example), site-specific history, the eco system present and, while he doesn't explicitly touch the subject, materials available. The question is, why do we forget the topology? This topography doesn't need to be, as Frampton names it, sentimental, but it can be layered in, to make a building more site-specific (Frampton, 1983 [1983], p. 26). Materials can play an important role in this. They can be the base that binds a building to its location without being overly sentimental (exaggerating). It has to feel logical and natural. *"If it grows together, it goes together" (Wells, 1995)*, this saying is from the restaurant business but that doesn't devaluate a ring of truth in the saying. If translated from food to architecture the following can be said: If one chooses a location, gathers materials indigenous for this location, and constructs a building with them, a building will more naturally fit this location. This sounds logical, but is it? It must not be forgotten that how these 'indigenous' materials are used, and given form in the construction of the building, plays a critical role. The form language is the way we are able to relate to the building, whether this is typological, topological or both. The material

Figure 5 Avarage new development in the Netherlands, literally googled, retrieved 10 januari, 2017, from https://goo.gl/cWXfhy

Figure 6 Avarage high rise in the Netherlands, literally googled, retrieved 10 januari, 2017, from https://goo.gl/3NvHfu

performs a subconscious, though crucial, role in the whole.

To make people conscious of the missing role of topography, in our build environment the following proposition for a design project is made. A couple of locations throughout the Netherlands will be chosen. On these locations locally sourced buildings will be constructed. The local sources, derived from Frampton's typology and topography, being the history of the landscape, the raw materials available, the climate and the local architectural expression. These buildings will be a meticulous layering of idiosyncrasies contemplating the location. They will not be sentimental. The idea is to create discourse, in an effort to change the way we see the build environment of the Netherlands, not a historical theme park. To stimulate this discourse a building type has been chosen: the inn. The inn is a social place, a place where people can gather to talk, eat, drink and sleep. The inn is a typically smaller and a more social affair than for instance a hotel. The hearth can be a stimulating element within the inn. From times lost, people gathered around the hearth. The hearth is a place where food was prepared, a place to eat and keep warm, but most important a place for discussion (Semper, 1851 [1989]), something we lost with the advent of central heating, the modern stove and our new media like the television, computer and internet. With every location having the same program, an inn, the emphasis is on how the intricate relationship between local sources and building works. To weave these inns even more into their location, they will be located near hiking and biking routes, this way, when walking or biking from one to another, the changes in topography and maybe even in culture, can be experienced. Important to this design proposition is that the choice is made to emphasise materials. Materials are what physical architecture is made of, which gives the usage of them a strong influence on the connection to a location.

research question

To understand how these inns will take shape the following research question is formulated:

'How can we give buildings, more specifically an inn, in the Netherlands a local identity through the use of local resources, with the emphasis on materials?'

Important questions that come out of this research question are:

What is local?
What is identity?

What is local in a world where everything is available at the touch of a finger? Is local on the scale of Europe? The Netherlands? The province of South-Holland? Or a dune area? Or even smaller, a part of a dune area, such as Sollenveld (area near the Hague). First of all, this thesis sets the Netherlands as its boundary, within the Netherlands the definition of

Figure 7: Dutch landscape, Maasduinen

local is questioned and researched. The expectation is to find that the definition of local differs per element (resource). The elements being the earlier mentioned terms derived from Frampton: the history of the landscape, the raw materials available, the climate and the building culture. For instance, an area with a predominant wet climate probably has other borders than an area with a lot of sand as a raw material. It are exactly these borders that have to be identified and this brings us to identity. Between all these different borders, which ones together create a local identity? What is identity? The Dutch dictionary defines it as, *"eigen karakter"(Van Dale, 2016)*, which means, 'individual character'. A character, in our case a building, described by its individual or even unique traits of a place. *"This inscription, which arises out of "in-laying" the building into the site, has many levels of significance, for it has a capacity to embody, in built form the prehistory of the place, its archaeological past and its subsequent cultivation and transformation across time. Through this layering into the site the idiosyncrasies of place find their expression without falling into sentimentality."(Frampton, 1983 [1983], p. 26)*. If we read Frampton, a local identity would consists out of multiple layers, the layers we earlier translated to our elements. So to help answer the research question these elements should be investigated. This leads to the following sub questions, which all have as demarcation the Netherlands:

1. What is the landscape and its history?
2. What are the raw materials available?
3. What is the climate?
4. What is the typical local architectural expression?

Answering these sub questions will create the possibility to designate similar regions within the Netherlands. These regions should have a similar feel or experience when moving through them, but also similar possibilities in creating, be it a product or a building. For a building, the inn, the sub questions should give a better understanding on how each element has to interact with one another to meticulously create the different layers in which we perceive a local identity, thus giving the tools to create an inn with a local identity. In short two things have to come forth from the sub questions successively the research question, a way to identify similar regions and the tools for building in these similar regions.

The next chapters will be about the sub questions. This means understanding the history, creation and current state of affairs of the Dutch landscape, mapping the raw materials in this landscape, mapping the climate and mapping the local architectural expression. When all are mapped they can be compared with the aim to distil an answer to the research question: "How can we give buildings, more specifically an inn, in the Netherlands a local identity through the use of local resources, with the emphasis on materials?". Important in this mapping process is that the research will be broad, but will not go into depth. When it's possible to define locations for the inns, a deep research per location can be done, finding for that region a more specific picture of its *"…prehistory…archaeological past… cultivation…transformation..", its "idiosyncrasies" (Frampton, 1983 [1983], p. 26).*

Figure 7 Dutch landscape, Maasduinen, retrieved 10 januari, 2017, from http://www.fietsenwandelweb.nl/images/regios/Maasduinen.jpg

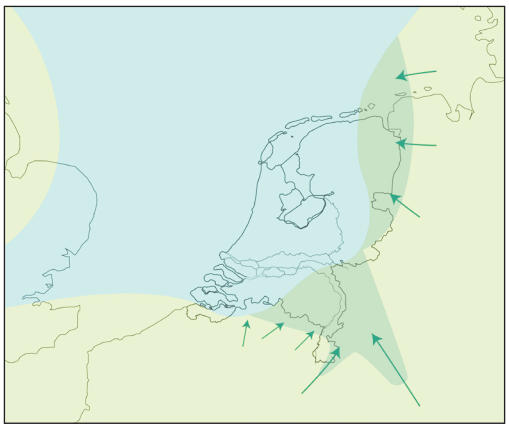
elements.

history of the landscape

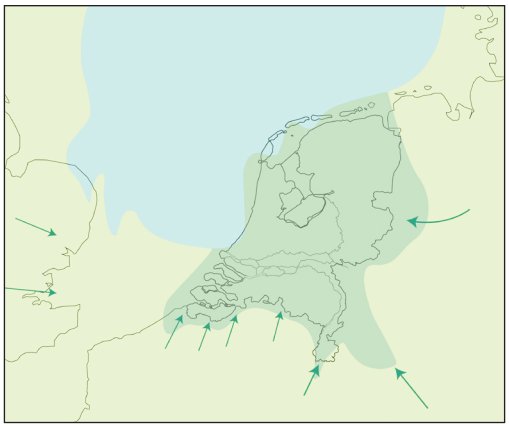
Before seeking out the raw materials available we need to understand how the Dutch landscape came to be.

With that knowledge we'll not only know where most of the raw materials originated, but also are able to recognise different landscapes and different subtleties in and between these landscapes for implementing in our inn. For example, the dune area and the Utrechtse Heuvelrug both have sand and dunes, but have a completely different origin, understanding this peculiarity in origin is key. The landscape also dictates how to build, a swamp will require a different strategy, such as taking in consideration the high groundwater level, than the sand dunes near the sea, which are above ground water level.

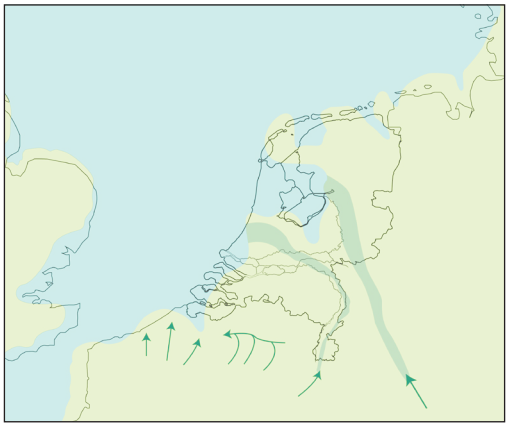
The most important forces that shaped the Netherlands, which are still visible in the landscape, started acting 2,6 million years ago. The Netherlands was a huge river delta, approximately the size of the Amazon. The East Sea didn't exist which meant that all rivers had to come through the Netherlands. The rivers deposited sediments like clay and sand. From then to 20.000 years ago there were numerous colder and warmer periods, but especially the last three cold periods, or better named the last three ice ages, left recognisable traces on the landscape of the Netherlands. The first ice age (450.000 years ago) scraped out the East Sea, which meant that a huge part of the Dutch river delta, that drained the northeast of Europe, ceased to exist. Also in



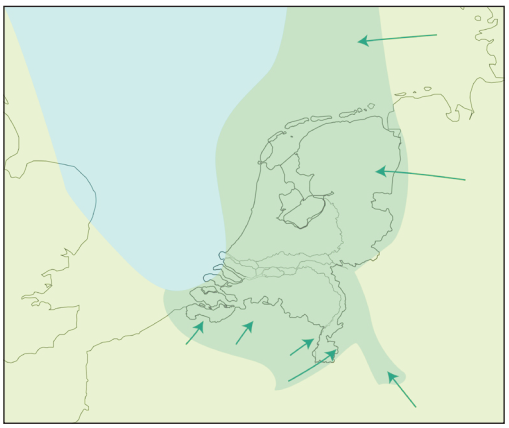
A. *2.600.000 years ago, the Netherlands was a river delta.*



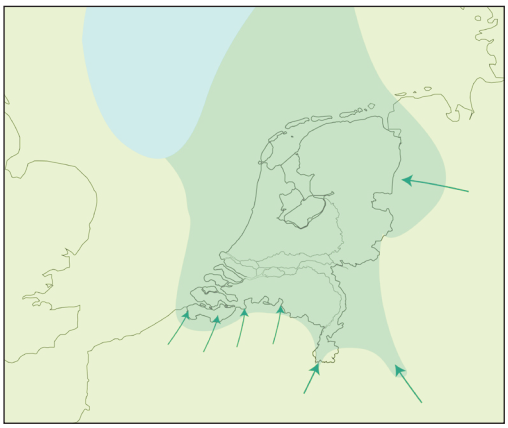
D. *800.000 years ago, the sediments undergo phases of erosion.*



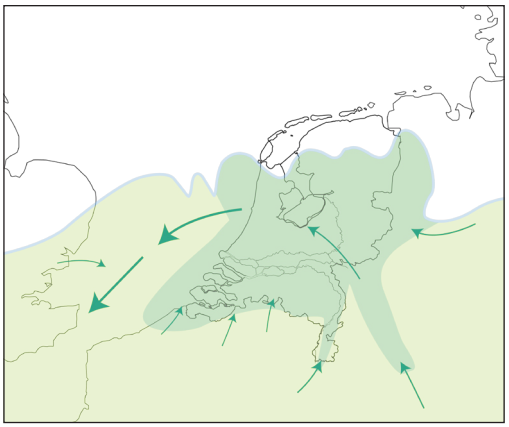
G. *120.000 years ago, the East-sea was eroded by ice meaning less rivers through the Netherlands.*



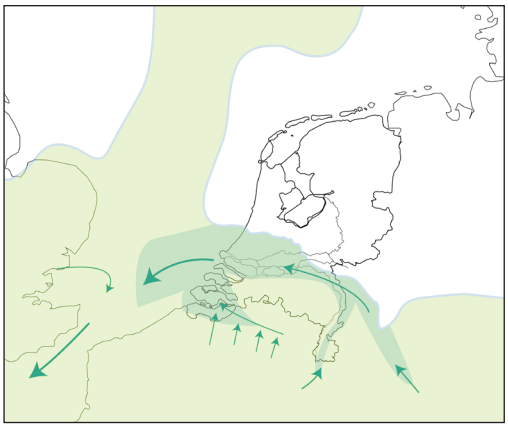
B: *1.800.000 years ago, huge amounts of sediment were deposited.*



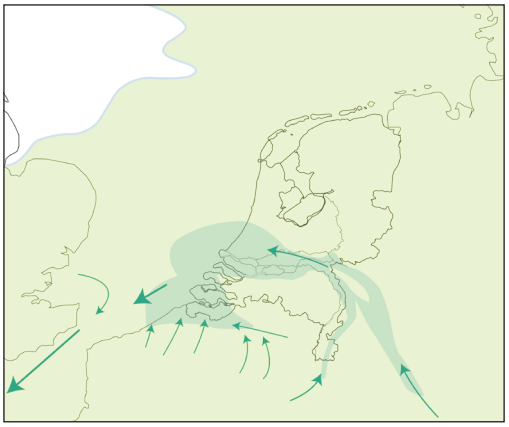
C. *1.400.000 years ago, the North-sea is being filed up by sediments.*



E. *450.000 years ago, an ice age reverts the flow of the rivers.*



F. *150.000 years ago, land ice pushes down creating moraines.*



H. *20.000 years ago, Another ice age, the Netherlands is a 'pole dessert'.*

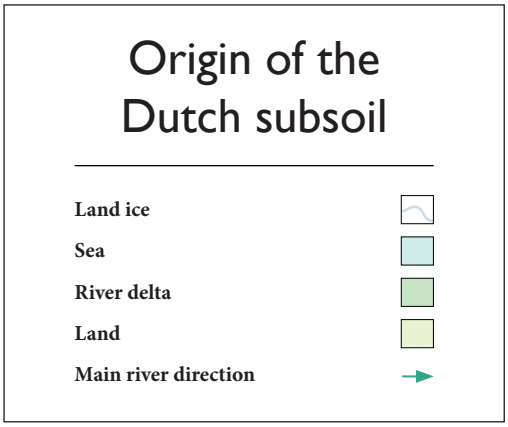


Figure 8 **All figures on page.** Origination of the subsoil of the Netherlands, 2,6 million years ago to 20.000 years ago. Figures and text based on (Noordhoff, 2007, p. 172)

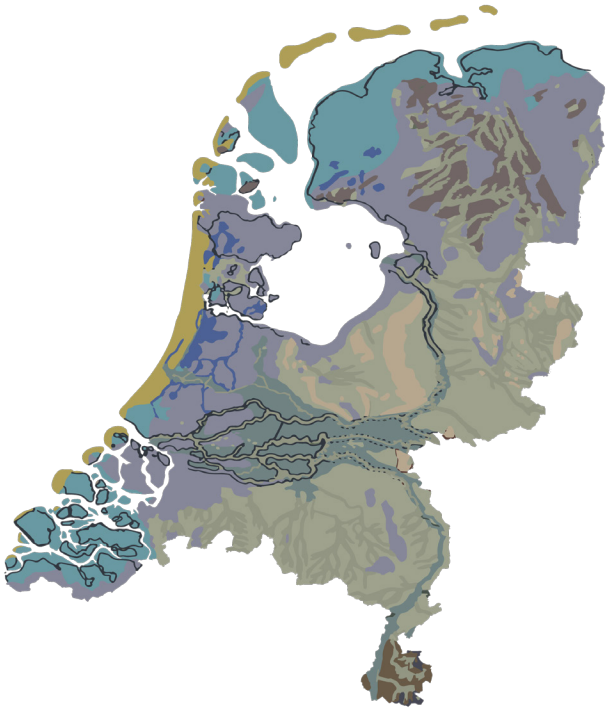
A. *6500 years ago: The sea came land inward, starting to erode away the moraines left by the last ice age.*

B. *5100 years ago: The sea eroded most of the western moraines away. At this point almost all the ice, from the last ice age, had melted.*

D. *50 A.D. : The sea slowly started to break through again in Zeeland, around the Maas and the Wadden Eilanden.*

E. *800 A.D. : The sea has reclaimed land, particularly Zeeland stands out.*

C. *2600 years ago: With all the ice melted the sea level stabilized, which allowed the formation of dunes along the coast. These dunes protected the hinterland, allowing peat to grow.*



F. *1250 A.D. : Around the year 1000 A.D. man started to build dikes in an effort to tame the sea and the rivers.*

this first, but also the second ice age (150.000 years ago), land ice reached the Netherlands. The land ice pushed sediments, mainly sand, into moraines ('stuwwallen' in Dutch), forming for instance the 'Utrechtse Heuvelrug'. The ice also milled sediment into Loam, it left boulders, which it carried from Scandinavia and the ice deposited sand and gravel (Noordhoff, 2011). The third, and the last, ice age (20.000 years ago), transformed the Netherlands into a polar desert. The North Sea bed lay dry due to the huge amounts of water being ice, lowering the sea level. Sand and other fine sediments were deposited from the North sea by wind, onto where now the Netherlands is (Wesselingh, 2009c). After the ice ages (6500 years ago) the sea came land inward, washing away sediments and moraines in the western part of the Netherlands. When most of the ice had melted, the sea level stabilized. This stabilization allowed the forming of dunes along the Dutch coastline. The dunes protected the wetland beyond, mostly keeping salt water at bay, while keeping wet conditions, allowing peat to grow. On some places the sea broke through again, creating the islands of Zeeland and the Zuiderzee (Now the Ijselmeer). In the meanwhile rivers kept on moving and depositing sediments, creating moraines (Noordhoff, 2011).

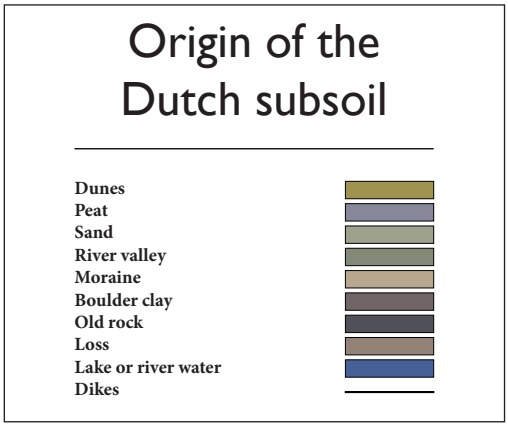


Figure 9 **All figures on page.** Origination of the subsoil of the Netherlands, 6500 years ago to 1250 A.D. Figures and text based on (Noordhoff, 2007, p. 175)

While briefly described, these forces created the Netherlands. The rivers, the ice, the constant fight with the sea, they all contributed to the different subsoils. But how does the subsoil compare to the landscape above ground?

Above ground man had a tremendous influence on the shape of our landscape. Through time we deforested (one theory is that the name Holland comes from Holtland, which means woodland), excavated mineral resources, gathered peat and made polders and dikes. This created a manmade landscape, wherein nature is tamed to serve us. Rivers are made to flow on a set place, we built dikes to protect the land from the sea and even created new land from the sea. The landscape is formed by man, making it a culture landscape. In fact, there are no places left which are truly and only nature, untouched by humans.

In our landscape we find typical areas where there are, for instance, many dunes or many rivers. We can make a distinction in these typical areas. We make this distinction based on how the different typical areas formed. This gives us the following types of landscapes: dune landscape, hill landscape (loess landscape), river landscape, peat landscape, sand landscape and the sea clay landscape (Ahrens, 2009; Noordhoff, 2007, p. 201). We can see this as the base on which the culture landscape can be overlaid.

Dune landscape

The dune landscape is found all along the Dutch coast, created by the ever pounding, sand shifting waves. We can differentiate two types of dunes, the old dunes and the new dunes. The origin of the old dunes we find around 5000 years ago. Most of them eroded away, where excavated or lay underground (example: part of the Hague is built on old dunes). The highest still visible old dunes have a maximum height of two meters. The new dunes, as the name suggests, are relatively new. They started forming roughly 1000 years ago and new dunes are still being created today. These new dunes can reach heights of 53 meters (this highest dune is located near Schoorl, Noord-Holland) and are formed on top of the old dunes. The dunes are higher than their surroundings and protect the hinterland from the sea. This was noticed by man early on. It was a safe haven in comparison to the adjacent wetlands, which were subjugated to flooding from rivers and sea. Man used the dunes for settlement, agriculture, logging (the old dunes around the year 800 were overgrown with forests), extraction of sand and the extraction of drink water (Wesselingh, 2009a). This usage shaped the dunes. The most influential were the deforestation, there is no forest to speak of anymore, and the sand excavation, the dunes are a fraction of what they were.

Hill landscape

The hill landscape is the oldest landscape in the Netherlands, with its oldest rock formation dating back 315 million years. The most abundant rock is the limestone, most of which was formed 70 million years ago when the Netherlands was a shallow tropical sea by billions of sea creatures and corals. The hill landscape can be seen as once being a plateau that was over time eroded by rivers, which created the valleys we now see. Quite early man settled in the hill landscape due to the fertile land (Loess which was transported by wind from the dry North-Seabed during the last ice age) and the available minerals (limestone, lead, zinc, lignite). The influence of man is still visible today. The land is allotted and in some places quarries are visible as scars in the landscape (Haring, 2009).

River landscape

The Netherlands was at one time the Amazon basin of Europe. After the first ice age (as described earlier) the river delta became considerably smaller. The rivers still remaining streamed freely through the landscape creating riverbanks, river dunes and depositing (fertile) silt, sand and other minerals. The sandy riverbanks where higher places in a landscape which was subjugated to flooding by the river, thus an appealing place for man to settle. Today we've tamed the rivers with dikes and cribs. The rivers flow, but now their place is bound by man. There are no free flowing rivers left in our landscape (Ahrens, Haring, & Wesselingh, 2009; Noordhoff, 2007).

Peat landscape

When the sea level stabilized after the last ice age the coastal dunes were created by the wind and sea. This protected the hinterland and together with the rivers and the intrusion of groundwater it created the perfect wet conditions for the formation of peat. This type of wetland we call 'fen' (In Dutch it's called 'laagveen', literally 'lowpeat'). The other

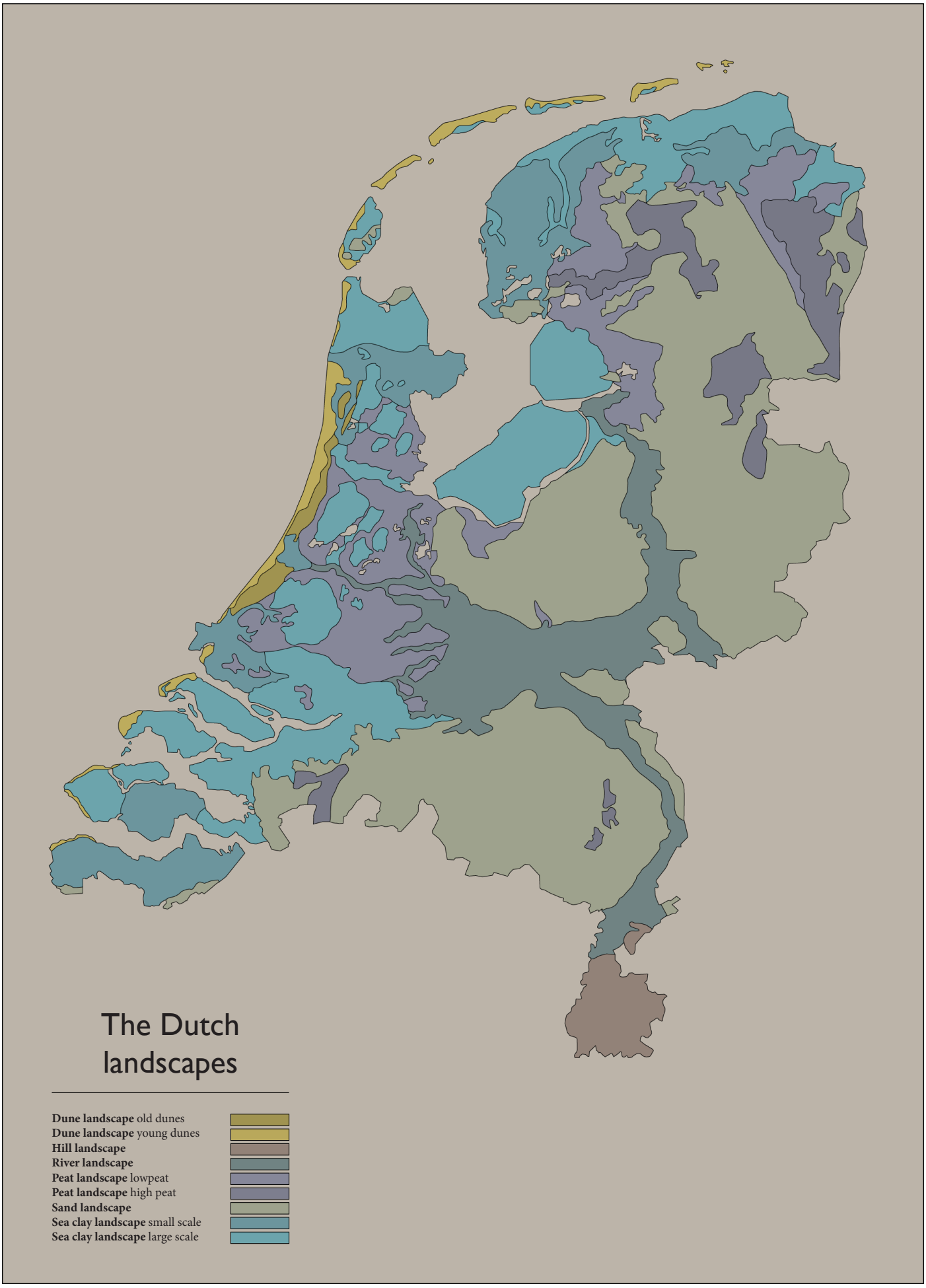


Figure 10 **Above figure.** The Dutch landscapes. Own image based on (Noordhoff, 2007, p.201)

Figure 11: Dune landscape

Figure 12: Peat landscape

Figure 13: Hill landscape

Figure 14: River landscape

Figure 15: Sand landscape

Figure 16: Sea clay landscape

Figure 11 **Dune landscape**, Terschelling. Photo by W. Janssen. Retrieved 12 January, 2017, from http://static.panoramio.com/photos/original/4023428.jpg

Figure 12 **Hill landscape**, Limburg. Photo by J. Maschino. Retrieved 12 Januari, 2017, from http://www.almeersefotoclub.net/component/joomgallery/image?view=image&format=raw&type=orig&id=2632

Figure 13 **River landschap**, Arnhem-Kampen. Photo by J. van Houdt. Retrieved 12 January, 2017, from https://beeldbank.rws.nl/MediaObject/Details/366331

Figure 14 **Peat landscape** (high peat), Ravenswoud. Photo by Peter de Wilde. Retrieved 12 January, 2017, from http://static.panoramio.com/photos/original/32768503.jpg

Figure 15 **Sand landscape**, Kootwijkerzand. Retrieved 12 January, 2017, from https://upload.wikimedia.orgwikipediacommons226Kootwijkerzand_2.jpg

Figure 16 **Sea clay landscape**, Burgh-Haamstede, Karrevelden. Photo by Natuurmonumenten. Retrieved 12 January, 2017, from https://www.natuurmonumenten.nl/sites/default/files/Koudekerkse%20Inlaag%20-%20Foto%20Rene%20Koster.jpg

type of wetland in the Netherlands is called 'bog' (In dutch it's called 'hoogveen', literally 'highpeat'). This 'bog' wetland is found on higher ground and came to be due to a layer in the ground that could hold the water from rainfall, this could be clay or boulder clay. In these wet conditions Sphagnum (peat moss) could grow, which could retain even more water, expanding the bog area. Important in this peat forming process is the acidity of the water, which made it hard for plant material to decay, thus the depositing of layer up on layer of peat could take place. Man used peat as fuel, to keep warm or to cook on, it was more efficient and gave more heat than wood. Since the eleventh century peat was extracted on a large scale. This large-scale extraction had a big influence on the landscape. Bogs and fens were drained and excavated. This caused shrinkage of the land, which caused the land to sink lower and becoming wetter and more susceptible to flooding. Also the land became less useful by becoming too wet and swampy. If we look at the landscape today we can see numerous, allotment shaped lakes, the result of excavating turf and the shrinkage. Due to this, many of these places were diked and drained, in an effort to be useful as land again (Wesselingh, 2009b).

Sand landscape

The sand landscape is a varied landscape with many idiosyncrasies. The base came to be because of the countless rivers depositing sand and gravel. Later it was the land ice that pushed the frozen layers of sand into moraines. Underneath the land ice boulder clay was formed, the fine clay formed due to the immense pressure and grinding of the ice and the boulders were deposited when the land ice melted. In the time that the Netherlands was a polar desert, sand and finer particles where transported by wind from the dry seabed to the Netherlands. Later in history parts of this sand eroded away again by sea and rivers. This roughly explains the origin of the sand landscape. We can make a rough division into three different kinds of sand landscapes, the north (around Drenthe) which contains boulder clay due to the grinding of land ice. The middle (around the Utrechtse Heuvelrug) which has the highest moraines due to being on the edge of where the land ice reached. And the south part (around Noord-Brabant) mostly formed by sand from the wind and rivers. Man used and uses the landscape for cattle and agriculture, but in past times overgrazing made these areas susceptible to drift-sands. Plants and trees were put in place to help combatant the drift-sands, taming the sand landscape (Wesselingh, 2009c).

Sea clay landscape

When the sea came in and flooded the land, sea clay was deposited. Clay is fertile and can hold water, this makes it an interesting place for agriculture. Man settled on the, somewhat, higher ground and used the land for cattle and small scale farming. In the north mounds against flooding were constructed as protection. A lot of these mounds are still visible today. Later, around the year 1000, in the north, middle and south of the sea clay landscape dikes were build. The land was protected from flooding or even laid dry to use it for agriculture. This gave shape to the allotted, diked landscape we see today, which can be further divided in the small-scale polders and the large scale polders. The difference is that most, not all, small scale polders are older. They can be recognized by their odd shaped, small allotment. The large scale allotment is newer and has bigger, straight, geometric allotted polders (Wesselingh, 2009d).

Local identity

If we look at the landscape and its history it's striking that they are fairly easy to classify into types. The

cultivation of the land took place as reaction to the landscape, which in some cases changed the type of the landscape, for instance bigger parts of Zuid-Holland used to be a peat landscape, when all the peat was excavated the old sea clay layers became the new top layer, making it a sea clay landscape again (winding back time almost 5000 years). How can we define a local landscape? On a broader scale local would be one of the six types, but when we look closer, say for instance, at the sand landscape, we can see that there are three different kind of sand landscapes within (Drenthe, Utrechtse Heuvelrug and Noord-Brabant). We can see the classification of the landscapes into types as a tool that can tell us where to start searching for a local identity. It's the first layer of the idiosyncrasies that we are looking for. These idiosyncrasies give us, while being still quite crude, conditions for our architecture. We can define these conditions per landscape.

Dune landscape
Sturdy ground for foundation, drift-sands and shifting new dunes, higher than the sea, drink water, long history of human habitation, height differences.

Hill landscape
Many minerals, rich and old history of man, fertile land, height differences, a little piece of abroad in the Netherland (very unique due to different old rock formations near the surface).

River landscape
Settlements were built on high ground (doesn't really apply anymore due to the control of the rivers but is typical for this landscape), fertile land.

Peat landscape
Not fertile, wet and swampy with many lakes, land below the sea level (without pumping stations the land would flood (Heteindevandewereld.nl, 2014; VPRO, 2016)).

Sand landscape
Sturdy ground for foundation, height differences, to a small extend drift-sand, very local climate (very hot or cold (Wesselingh, 2009c), roughly three types of sand landscape.

Sea clay landscape
fertile, land below sea level, impoldered and strongly allotted landscape, flat.

Next to these crude conditions there is the understanding of the landscape. While this doesn't directly conjure a set of conditions, it can shape a feel for the landscape, helping the intuition of an architect in making choices toward a local architectural identity.
While for this research we explore the landscape only superficial, the idea is that when choosing a more specific location for the architecture, the inn, an in depth research on the specific area is done. This will reveal differences on an even smaller scale than the three sand landscapes (Drenthe, Utrechtse Heuvelrug and Noord-Brabant) within the sand landscape.

Conclusion
The Dutch landscape is classifiable into six types: dune landscape, hill landscape (loess landscape), river landscape, peat landscape, sand landscape and the sea clay landscape. These types each give 'crude' conditions for the architecture, the inn, to be build, but more important they create an understanding of these landscapes and their formation. This understanding substantiates the intuition of an architect to make choices toward a local architectural identity. Though this understanding will be even stronger when researching an even more specific location within these six types of landscape.

raw materials

First of all, for this thesis it's important to make a clear distinction between a 'material' and a 'raw material'

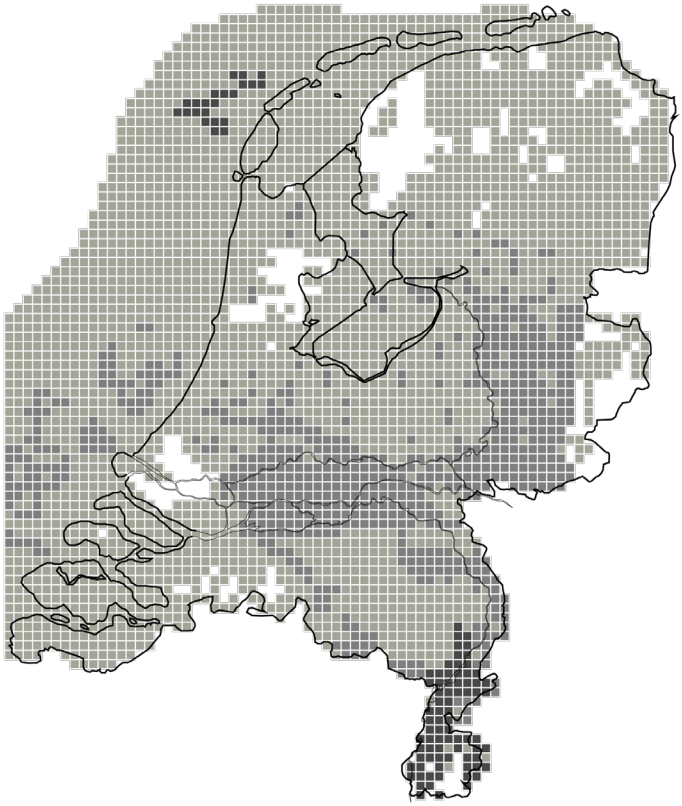
(in Dutch there are two less similar words: 'materiaal' and 'grondstof'). 'Raw material' means straight from its source, unaltered, such as the hide (raw material) of a skinned cow (source). A 'material' is a raw material processed to make it usable. The hide of the cow is tanned and turned into leather. The leather is the usable material. The leather can be made into a product.

At the base of this research we find the raw materials. When constructing something there is the inescapable need for raw materials, without them we cannot, in a physical way, create. When creating architecture that has to express a local identity, it's evident that the raw materials used in its construction should be locally sourced. In identifying these different raw materials and cataloguing where they were found, one expects to find regions. Regions, like the six types from the previous chapter, of raw material similarity, which can lead us to a local 'raw material' identity. This identity is explicitly based on the raw materials. When a raw material is transformed to a material without considering the other elements specific for that location, such as the landscape, climate and architectural expression, the bonds of the raw material to that location can be lost. Only when the relation between the other elements and the raw materials is understood then a statement can be made about materials.

To get a clear picture on what is available where, several maps were created, depicting the found raw materials in the Netherlands. The maps are an approximation of the raw materials available, meaning that not all existing raw materials are covered and that they are not 100% accurate. There are two groups of raw materials, the first group consists of raw materials extracted from the ground, geologic raw material such as rocks, minerals, etcetera. The other group are the surface bound raw materials. The surface bound raw materials are harder to bind to a specific location. If we talk about wool for example, there are some races of sheep that find their origin in a specific region of the Netherlands, but are now spread all over the Netherlands. For instance, the 'Drents heideschaap', named after the place and the heathland from which it originated as a breed, we can find in Drenthe but also in the dunes of the Hague.

The raw material will, when there is a connection, be linked to the landscapes mentioned in the previous chapter. This way the raw materials can, where possible, be bound to a more specific location. If we look for example at the raw material 'sand', we can see that it is most typical, and found on the surface in the sand landscape and the dune landscape, while deeper under the surface it can be found all over the Netherlands.

Geological raw materials



Sand

Types:
Fine, medium and gravel

Description:
Sand is in abundance available in the Netherlands, it was sedimented by rivers, ice and wind. It's deep in the ground, near the surface and in some areas on the surface.

Landscape:
Sand landscape and dune landscape. While sand is available everywhere in the Netherlands it's most typical for these two landscapes (visible sand).

Translation to possible materials:
Glass, used in concrete, synthetic sandstone, filler material.

(Noordhoff, 2009, p.48)

Rocksalt

Description:
The huge salt field underneath our surface is the residue of an 260 million year old, vaporised, inland sea. To extract the salt we drill into salt pilars (salt that was pushed up by heat and pressure from a 3000 meter depth to 250 ~ 1300 meter deep). Than water is pumped in to disolve the salt and pumped up.

Landscape:
Not specifically bound to a landscape

Translation to possible materials:
When bound with a polymer salt can be molded in a free shape or into building blocks.

(Gebroer, 2015; Noordhoff, 2009, p.62)

Bog ore

Description:
Ferruginous (iron containing) water is transported by groundwater or river. When the ferruginous water is near the top groundwater level and comes in contact with oxygen, it's deposited in iron-oxide form. Most important is that the ground is quite wet, but has dry periods. In these dry periods oxide can penetrate the ground to bind the iron to iron-oxide.

Landscape:
River landscape (small parts), sand landscape, hill landscape, (high)peat landscape. What stands out is that these landscapes all lay well above sea level.

Translation to possible materials:
Everything iron and steel, all kinds of fittings, beams, plates, tubes, etc.

(Bosboom, 2009; Heidinga, Laban, & Kars, 1988)

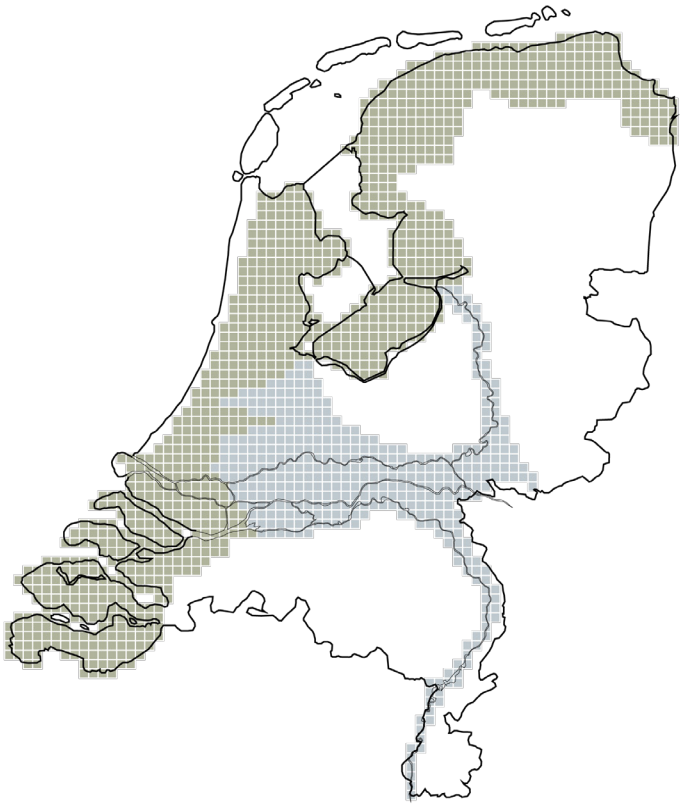
Gypsum

Description:
The concentrations of gypsum are small in the Netherlands. This makes the extraction not profitable.

Landscape:
Not specific. The gypsum is found in rock from the Triassic period (around 240 million years ago). This connects it to the oldest landscape in the Netherlands the hill landscape, but it's also found in the sand landscape. This is because there are several places where the rock from the Triassic period pierced the other layers and thus now resides near the surface.

Translation to possible materials:
Wall panels (fire resistant properties), plasters, molds.

(Beenhakker, 2009b)



Clay

Types:
Sea **and** river

Description:
Sedimented by sea and rivers, clay is fertile ground and has been used for milenea in pottery and since Roman times as bricks and roof tiles.

Landscape:
River landscape, sea clay landscape.

Translation to possible materials:
Brick, roof tiles, piping, wall tiles, floor tiles, decoration.

(Bazelmans & Colenbrander, 2005; Noordhoff, 2009)

Zinc **and** lead

Description:
The minerals from which Zinc and Lead are extracted are named Sphalerite and Galena. These minerals were mainly found in the coal mines of South-Limburg. Today it's not profitable anymore to extract the minerals.

Landscape:
Hill landscape. The region with lead higher up in the Netherlands (tip of Gelderland) is a phenomenon where a piece of lime rock was pushed up and pierced the landscape. The type of lime is around 240 million years old, while the rest of the landscape is at most 2,6 million years old.

Translation to possible materials:
Zinc roofing (strips, plates), Zinc facade covering (strips, plates), Zinc decoration, Zinc for flashing (waterproofing of a roof), lead for flashing.

(Beenhakker, 2009a, c)

Loam and loess

Description:
Loam and loess consist mostly out of very fine sand. Loess is even finer than loam. They were both carried from the dry seabed when the Netherlands was a cold desert in the last ice ages. In the last ice ages huge amounts of sediments were moved, only the finer particles were transported as far as southern Limburg. Loam and loess are very fertile soils.

Landscape:
Hill landscape. While loam and loess occur in some other places they are specific for the hill landscape

Translation to possible materials:
Wall rendering (needs protection from direct rain).

(Noordhoff, 2009; Kokshoorn, 2009)

Stone

Types:
Limestone, clay stone and flint

Description:
Limestone is mainly found in the southern parts of Limburg, where in different periods, starting 240 million years ago, lime was deposited by millions of sea creatures. Clay stone is formed under high pressure and if it is all layered in one direction it is called shale (looks similar to slate). Flint is a type of rock found all over the Netherlands, transported by rivers and land ice. But in southern Limburg there is also flint in the limestone layer, where it formed under pressure. This was used by prehistoric man who between 4000 and 2500 B.C. had a flint stone mine in southern Limburg.

Landscape:
Hill landscape (and the east tip of Gelderland, as explained in zinc and lead.).

Translation to possible materials:
Block, lintel, floor.

(Huijgen, 2009; Janssens, 2009; Noordhoff, 2009)

Surface bound raw materials

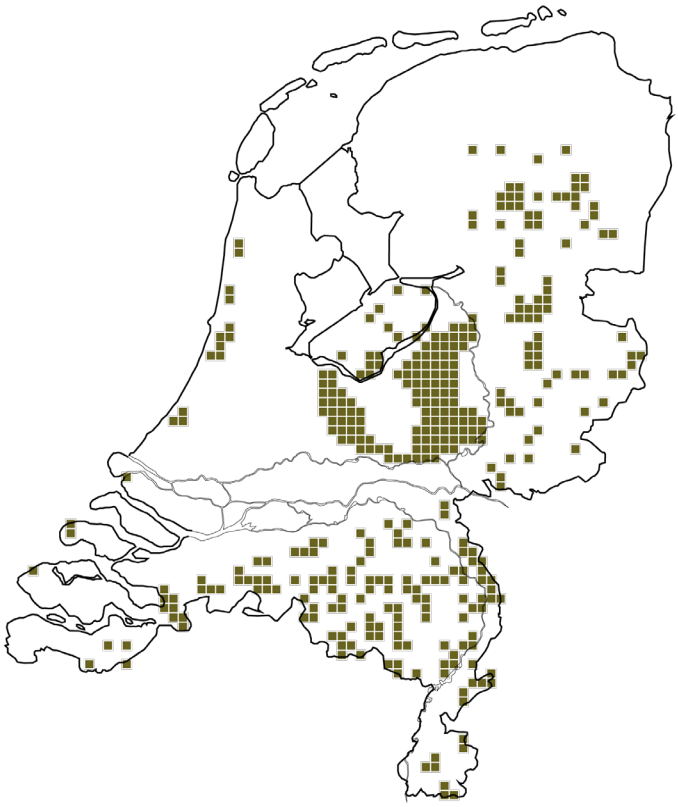
Flax

Description:
Grows well on seaclay and has strong fibers. The cultivation of flax used to be on sand landscape. This shifted at the end of the 18th century. *(Kunst, 2003, chapter 3.2).*

Landscape:
Sea clay landscape

Translation to possible materials:
Yarn, paper, insulator, plate material.

(Kunst, 2003)



Wood

Description:
Staatsbosbeheer controls the forests in the Netherlands. The timber gained is milled in Germany and sold preferably to the Dutch market. There are now more forests than there were at the beginning of the 20th century, this is due the replanting of the forests. For example in the 1930s, forests were planten through provision of work (if you didn't have work, the govenerment offered a job).

Landscape:
Some parts of the dune landscape, but mainly sand landscape.

Translation to possible materials:
Plate material, beams, planks, insulator, etc.

(Broek, 2015; Noordhoff, 2007)

Sheep

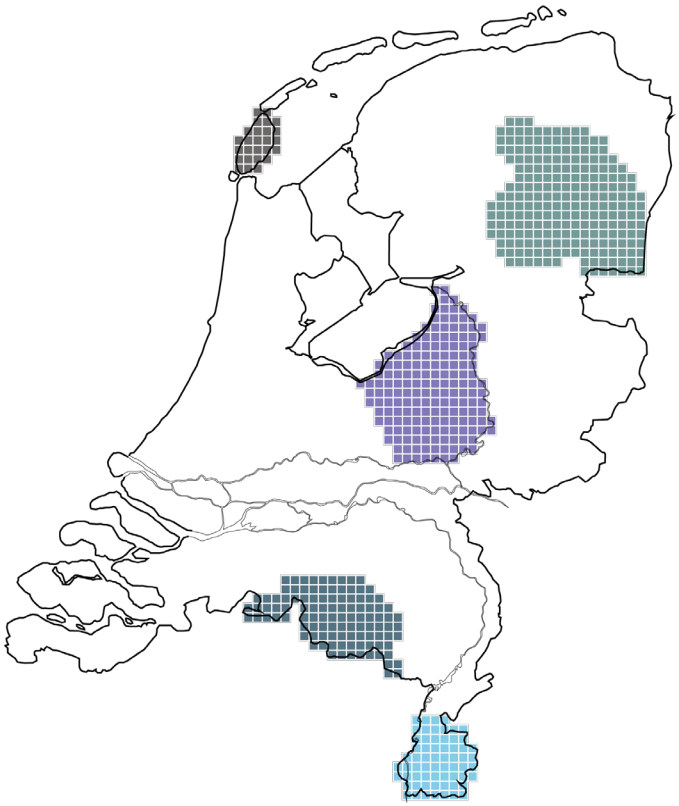
Breeds:
Drents Heideschaap, Texelaar
Veluws Heideschaap,
Kempisch Heideschaap,
Mergelland Schaap

Description:
Sheep are very versatile animals, next to that they are living mowing machines they also produce milk and wool. When butchered we can use the hide to make leather.

Landscape:
Sheep mainly roamed on heathland, because this was one of the only uses of this wilderniss. The heathland was and is mainly located on the sand landscape. That is why most sheep races find their origin on sand landscape.

Translation to possible materials:
Insulator, felt (wall rendering/insulator), carpets and tapestries.

(SHZ, 2013b)



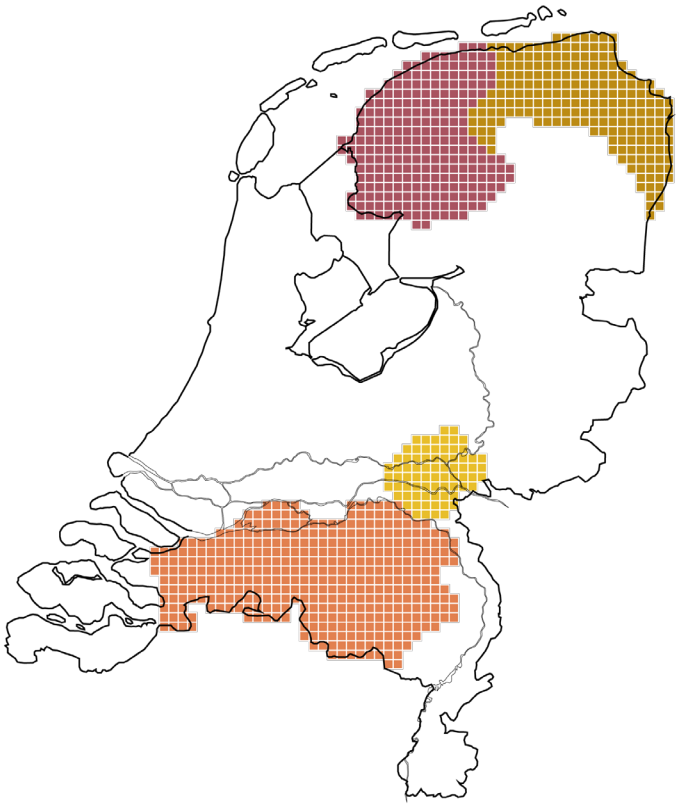
Seaweed

Description:
Grows in abundance in the sea. This namely because seaweed thrives from the phosphates with which we are poluting the sea. There is so much seaweed that it is a very sustainable source of raw material.

Landscape:
N.A. (Sea)

Translation to possible materials:
Insulator, roof material, colouring material, yarn.

(Hoogvliet, 2016)



Bovinae

Breeds:
Fries Roodbont, Fries Hollands
Groninger Blaarkop,
Brandrode Rund,
MRIJ Rund

Description:
The bovinae today find their origin with the Aurochs, an extinct large type of bovinae. First kept for meat, later also as workanimal and milk. Today we still use them for milk, meat and hides for leather.

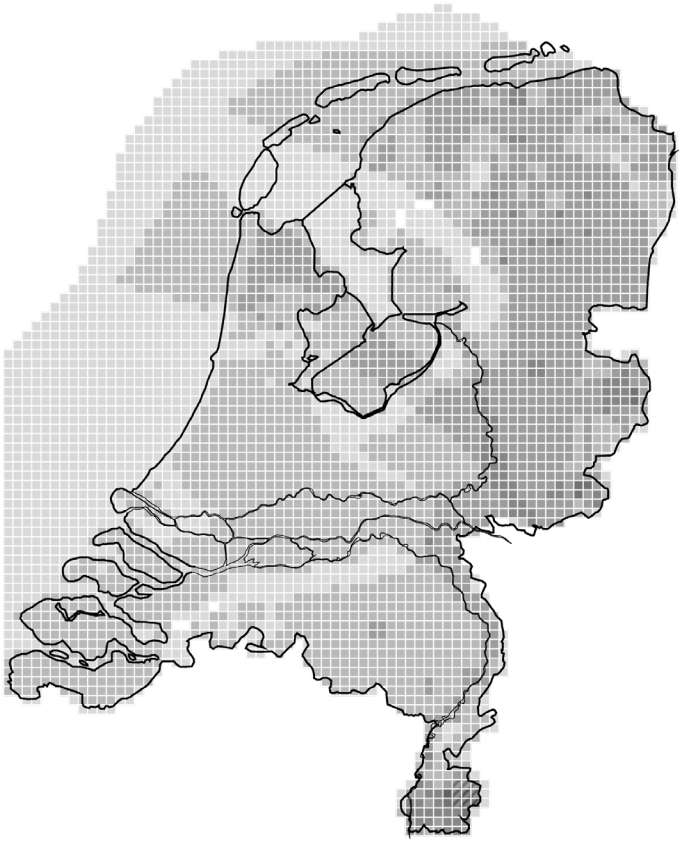
Landscape:
Not specific

Translation to possible materials:
Flooring, walling.

(SHZ, 2013a)

Overlaid maps

The next few maps are the raw materials overlaid. This means that every material is represented by a transparant black (the same tint per map). The more raw materials, the darker the map.

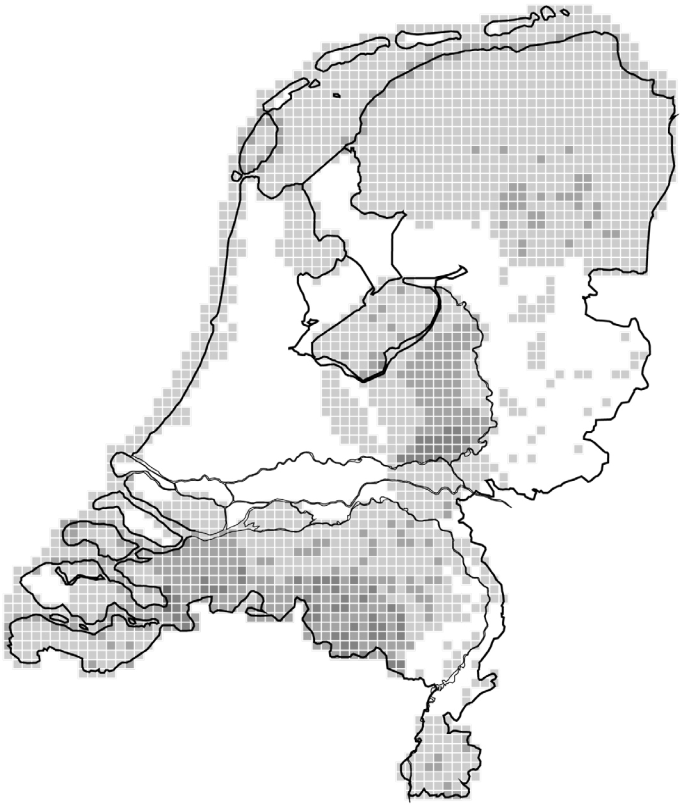


All geological raw materials

Description:
The highest concentration of geological material is in the eastern part of the Netherlands. Especially the southern part of Limburg stands out.

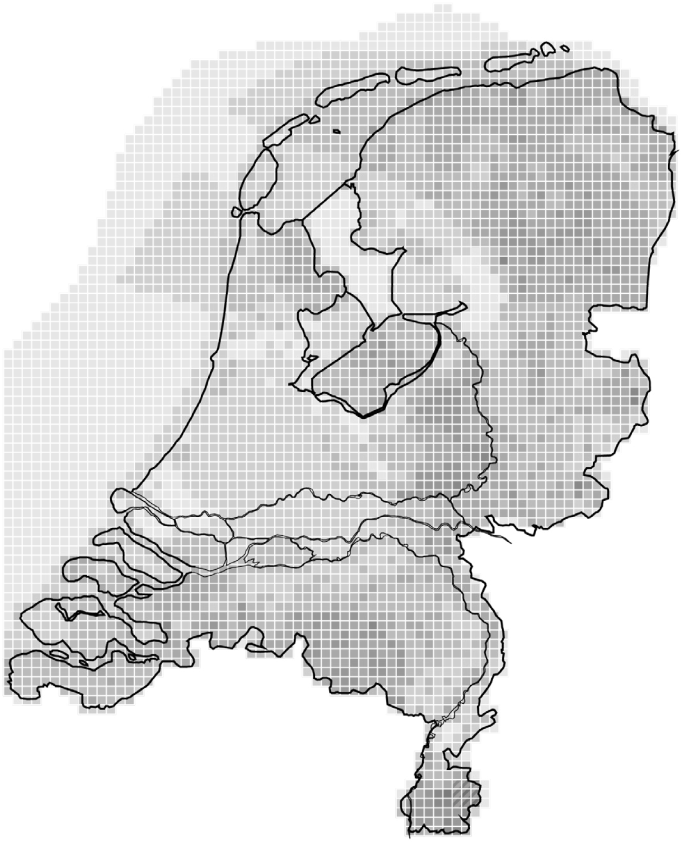
All surface bound raw materials

Description:
The concentrated areas are more spread. The heathland (Utrechtse heuvelrug and southern part of Noord Brabant) are darker because of specific animals that find their origin in those regions.



All raw materials

Description:
Aside from some small areas, most parts of the Netherlands have a broad choice of materials.



Maps

When looking at all the maps we can see that there are many raw materials in a wide range available. If we would specifically zoom in on a certain area we would find that the raw materials mentioned are just the tip of the iceberg. Next to that we haven't even begun with exploring the subtle differences per region in certain materials, for instance sand, the Noordhoff atlas alone has a page with sixteen different kinds of sand found in the Netherlands (Noordhoff, 2009), which could lead, if we look at the work of AtelierNL, to sixteen types of glass.

Landscape, economics and architecture

If we compare the raw materials with the types of landscape found in the previous chapter we can see that some raw materials originate in and are still found directly in a specific type of landscape, therefore binding it to the type of landscape, for instance clay. Other raw materials, like rock salt, originate in the distant past which results in it being buried deep underground. The rock salt doesn't relate to the type of landscape above ground. We can say that the rock salts only relation to the type of landscape is its position, therefore it doesn't relate or belong to a type of landscape, it rather relates to a position. We can rank these relations between raw materials, position and type of landscape, with the lowest rank being 'the only relation is location' and the highest 'the raw material is at the surface and it has a major influence on the type of landscape in a formative and visual way'. This could set a condition on how to use a raw material. The higher the relation ranks, the more it can or should be used in the architecture. These conditions could play out something like this: The rock salt, at a minimum depth of 350 meter, is ranked very low on the relation scale and should rather not be used. Sand, on the other hand, is near the surface in the whole of the Netherlands. In the sand landscape and the dune landscape it's found on the surface. Sand is in these two landscapes ranked very high on the relation scale, making it a material that could be used generously in architecture built in these landscapes. In other parts of the Netherlands sand is rated lower on the relation scale, it's near the surface, but doesn't have a big influence on the type of landscape. Sand should get a less prominent presence in architecture built in the other parts of the Netherlands. Another thing that stood out was that some raw materials, like zinc and lead, are not profitable to be extracted in the Netherlands. This gives an economic condition for the architecture. For zinc and lead this condition will be that they can't be used in huge quantities, due to them being expensive. For instance, using zinc to waterproof small parts of a roof is feasible, using zinc to make the whole roof would require large quantities of zinc thus not feasible. These are ways of implementing the subtleties of different raw materials on different locations.

Conclusion

Locally sourced raw materials are a logical step to make architecture with a local identity. Trough comparing a raw material to the location where it's found and the type of landscape we can rank its relationship to the location. This rank can than determine in what kind of quantities we can use the raw material in the architecture to be built. Raw materials such as zinc and lead are not viable for extraction in the Netherlands due to the costs. For the architecture this means that they should be used only where necessary, for instance as flashing (waterproofing the roof) and not as roofing.

climate

Climate can dictate architectural form based on wind, sun, rain, temperature etcetera.

For instance a roof in a rainy climate will be slanted to guide the rain off, while a roof in a dry climate tends to be flat due to the simpler construction and lower cost. To understand the climate in the Netherlands the most important aspects of the climate were mapped.

First of all we can state some general remarks about the climate in the Netherlands. The climate is oceanic climate, which means that the Netherlands has, by the presence of a warm oceanic current, moderate winters and summers. This oceanic climate also has the effect that there is no dry season in the Netherlands, meaning it can rain throughout the year. The dominant wind direction is south-west (Noordhoff, 2007). These aspects of the climate are quite the same in the whole of the Netherlands. We can trace that back to the Netherlands being a small country, drastic change in climate needs distance or an intervening landscape, like a mountain range (stopping clouds, forcing rains and with the height dropping temperatures), both of which we don't have. We do, however have smaller differences within the Netherlands as the maps show. Important is to think about the consequences for the architecture when evaluating the maps. Which conditions does a local climate set for the architecture?

Figure 17: Pier in Ijmuiden

Figure 17 Waves against the pier in Ijmuiden. Photo by ANP, retrieved 31 januari, 2017, from http://www.metronieuws.nl/nieuws/binnenland/2016/11/door-deze-versterkingen-kan-nederland-superstorm-aan

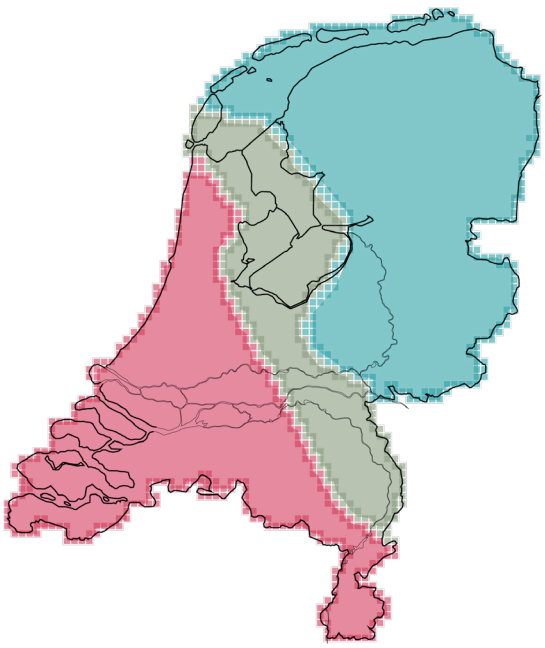
Temperature
If we look at the average temperature in the Netherlands we can conclude that the maximum difference of 1,5 degrees Celsius won't have an impact on the architecture. The minimal and the maximal temperature differ a bit more, 3,5 to 4 degrees Celsius. We also can see that the coastal areas have a higher minimal temperature and a lower maximum temperature, making them a more moderate area compared to the rest of the Netherlands. While these differences won't have a technical impact on the architecture, we can take it as an idiosyncrasy for the coastal area, adding to the understanding of a place.

Wind
The maps show that the winds in the coastal area are on average double that of those in the hinterlands. This does result in an architecture that can withstand the harder winds and/or is orientated on the dominant wind direction, guiding the wind around the building. This sets a condition for the architecture in the coastal area.

Rainfall
Throughout the Netherlands the amount of rainfall is quite similar, though the area with the least and the most rain differ 300mm rainwater per year. While rainwater is a thing to keep in mind in the whole of the Netherlands, this extra dry or extra wet area in the Netherlands could differentiate itself by making a gesture of this occurrence toward the architecture.

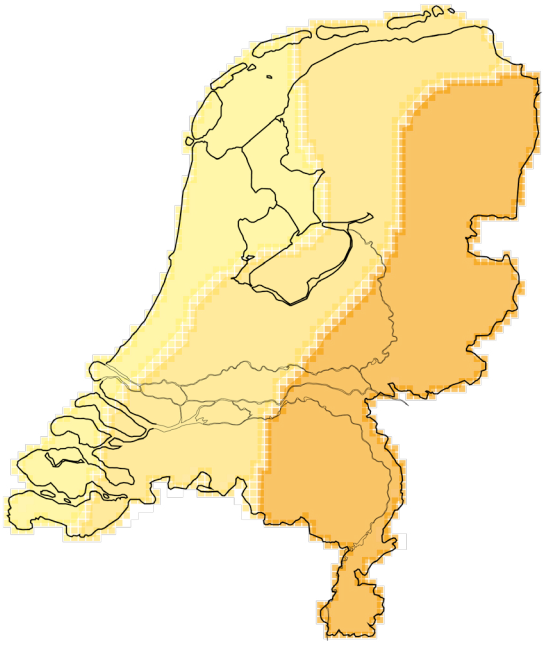
Sun hours
The coastal area has up to 350 more hours of sun than the far east of the Netherlands. This can have an impact on the architecture, for instance the amount of shading or the usage of solar panels.

Conclusion
We can see different gradations in how important the climate is relative to architecture. In case of wind it can be very shaping and on the other hand, in case of the temperature, it's a non-direct-architecture-shaping idiosyncrasy which can help interpreted the location, developing a more specific feel for a location. The most notable difference in climate is between the coastal area and the rest of the Netherlands. The influence of the climate in architecture would thus be most notable between there areas.



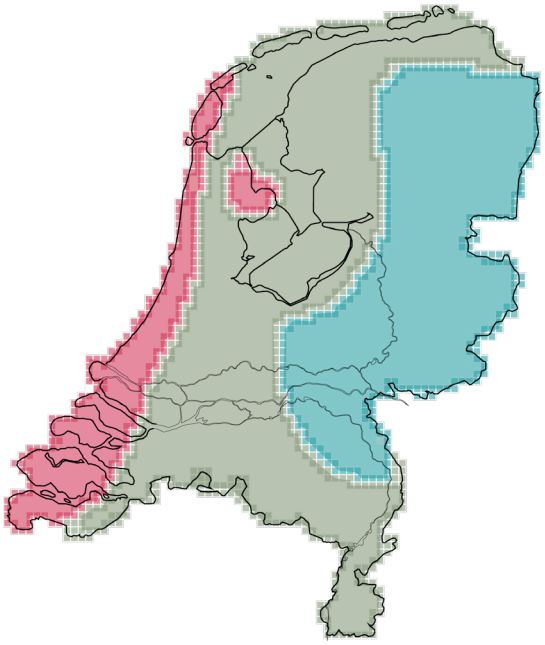
Average temperature
(red=warm)
The southern and western part of the Netherlands have a higher average temperature than the north east part.

Temperatures differ from 8,9 to 10,4 degrees Celcius.



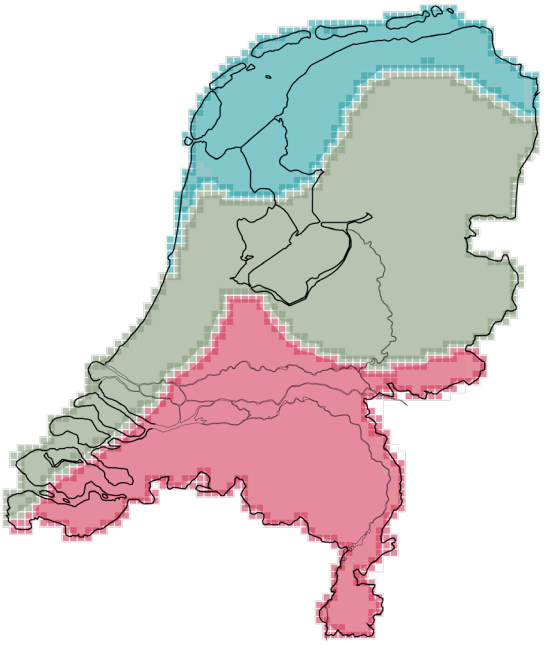
Sun hours
(light yellow=more sun)
The coastal area has the most sun hours.

Sun hours differ from 1400 to 1750 hours of sun per year.



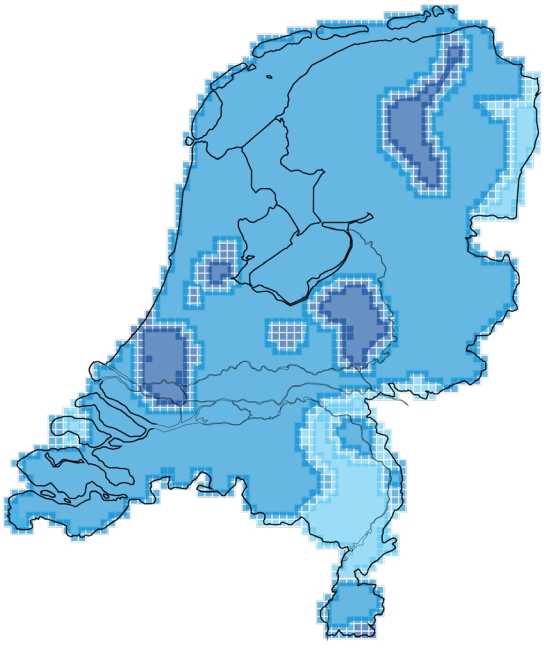
Minimal temperature
(red=warm)
North eastern part of the Netherlands is the coldest.

Temperatures differ from 4,5 to 8,5 degrees Celsius.



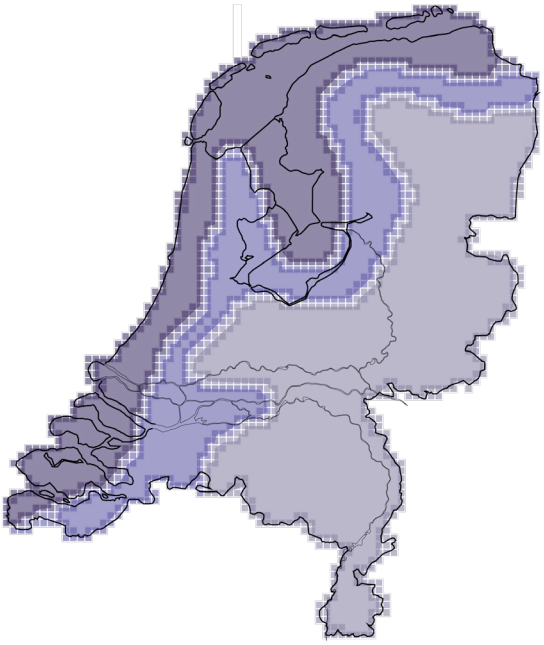
Maximum temperature
(red=warm)
Southern part has the highest temperatures.

Temperatures differ from 11 to 14,5 degrees Celsius.



Rainfall
(dark blue=more rain)
The rain is quite similar throughout the Netherlands.

Rainfall differs from 650 to 950 milimeters of rain per year.



Windspeed
(dark purple=more wind)
The coastal area has on average higher windspeeds.

Windspeed differs from 3,5 to 7,5 meter per second.

Figure 18 **All figures on page.** Differencs in climate throughout the Netherlands. Own images based on (Noordhoff, 2007, p. 284)

local architectural expression

How do we define a local architecture expression and how local is this expression? It depends on how a building came to be, a process that is influenced by the elements in the previous chapters.

Thinking on how to build with the raw materials available, the influences of the climate and the landscape is nothing new. Our ancestors did this since the beginning of human times. They developed ways of coping with these elements, creating a massive variety of materials and form languages. Where Frampton clearly makes a distinction between typography (culturally grounded) and topography (landscape, material and climate based) one can imagine that once they went hand in hand. Before there was rapid communication and means to travel quickly one was dependent on what the topography had to offer. Step by step this evolved, from simple tents, to buildings, copying and adjusting materials and form language accordingly, leaving traces of past details along the way. Details that were once necessary and in the next copy, due to a change in material, obsolete but still used. Take for instance the triglyphs of a Greek temple. Triglyphs were once the endings of wooden roof beams in the façade Than stone took the place of the wooden beams. The timber form language kept on existing as triglyphs. This was the development of form language, the development of architectural culture.

To understand the local architectural expression a research in history has been done. This research starts at the very first type of housing that we have found traces of in the Netherlands and stops at the Roman age. The Roman age was the start of a change in the architectural expression in the Netherlands, later in this chapter more on this. The research has been documented and can be found in the appendix (page 48).

Figure 19: Cone shaped tent

The first kind of housing we find in the Dutch history are tent like structures. This type of housing was used between 9000 to 5300 B.C. by hunter-gatherers. Two types stand out, one made of sticks and hides (cone shaped tent) and a type made of sticks and reeds (dome house). If we take a look at the elements from the previous chapters and compare these to the architectural expression of these tent like structures we find that there are connections. The raw materials for making these tents are directly sourced from the landscape.

Figure 20: Dome house

Branches were used for the construction which were then covered with hides from reindeers or with reeds from the wetlands. These materials were all typical at the time and readily available. The type of building (the tent) fitted the purpose of the hunter-gatherer living style. The people living in the cone shaped tents traveled after a herd of reindeer, explaining the non-permanent, simple to move style of building (there are still people living this way, for instance the Tsaatan in Mongolia, they even live in very similar cone shaped tents (Biekart, 2015)). The architectural expression is one out of need. They needed a place to be protected from the elements that could be easily moved, they had trees or fallen branches and reindeer, bring those ingredients together in a simple way and you get the cone shaped tents. We can also see, or rather imagine (the archeology of the tents is based on imprints of the tents in the soil, no whole tents were ever found in the Netherlands) the evolution of the cone shaped tent, looking at the Indians in the Americas. They added two flaps which could be adjusted by two sticks, this was to guide the airflow and thus control the climate inside the tent. The influence of a different landscape with different resources is visible in the dome houses, which were, depending on the landscape, built with mammoth tusks, with peat and even hides (Bloemers, Kooijmans, & Sarfatij, 1981; Rapoport, 1969; Stenchlak, 1983). These stone age tents where locally sourced, adjusted, if needed, to the climate and probably placed according to the landscape (high ground for instance). We can say they had a strong local identity. The typography of these tents is found and was found all over the world, this is curious, for there was no quick communication yet. Probably it was the simplicity of the housing (it was easy to think of) or that the type had thousands of years to spread around the world, eliminating the need for fast communication. We can see the simple tent as a typography that reacts to the topography. There is a synergy between both. We can see this collaboration continuing through time from the hunter-gatherers to small farming communities who build the 'Linear Pottery houses'. These houses were

Figure 19 Cone shaped tent. More information in the appendix. Own images based on (Bloemers, Kooijmans, & Sarfatij, 1981; Emmons, 2004; Lavvu, (n.d.)., 2016; Rapoport, 1969; Stenchlak, 1983)

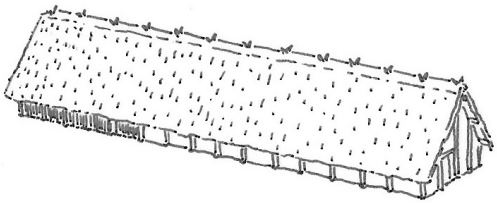
Figure 20 Dome house. More information in the appendix. Own images based on (Bloemers, Kooijmans, & Sarfatij, 1981; domes.(n.d.). 2016; Emmons, 2004; Lavvu, (n.d.)., 2016; Rapoport, 1969; Stenchlak, 1983)

Figure 21: The Tsaatan still live in a similar style as people in the Netherlands lived in the stone age

constructed out of locally sourced raw materials, had raised floors and slanted roofs against rainwater and were all build in the same direction to guide the wind between them. Their roofs were supported by columns rather than the cob walls (mixture of water, soil and straw) (Bloemers et al., 1981; culture.(n.d.). 2016; Stenchlak, 1983). This type of construction evolved and changed. In the Bronze Age (around 1700- 700 B.C.) the roof was extended to be closer to the ground, this is probably to protect the cob walls from direct rain. In the Iron Age (around 800-0 B.C.) a controllable hatch was added to vent smoke from hearth or fireplace inside. Also in the north of the Netherlands mounds ('terp' in Dutch) were constructed to protect the housing from flooding (Boer, Haan, Hoekstra, & Kramer, 2009; Stenchlak, 1983; Waterbolk, 2010).

All these types are a slow but steady evolution from the one before, finding upgrades through necessity. Think of the hatch to control smoke venting out. This slow and steady evolution stopped the moment the Romans came to the Netherlands (around 15 B.C.). The villa rustica in Rijswijk is a perfect example of this. Multiple farms were built replacing each other, each new one being slightly bigger than the previous one. The last one clearly shows the influence of the Romans. The main shape was still based on a prehistoric farm, with cob walls and a reed roof, locally sourced. On one side of the farm there was an ornamental façade and the other side an extra building. Both of these were made out of limestone, sourced from the Belgian part of Limburg and were covered in a layer of stucco, which was made of lime, sand and plant or animal fibers. The roofing was made out of Roman roof tiles, which were probably made in the area of Roomburg (now Leiden). Also new techniques were implemented, the new Roman parts of the building got floor and wall heating.

The arrival of the Romans ushered in a new period of faster communication and trade. The Romans wanted to defend their land and built a network of settlements containing vicussus (forts), centuria (barracks), horreums (storage or granary), mansios (state inn), amphitheaters, bridges, and thermae (bathing houses)(see appendix). On the outer border of this network they constructed a road running alongside the river the Rijn and on regular



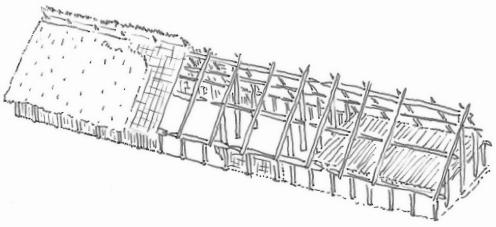
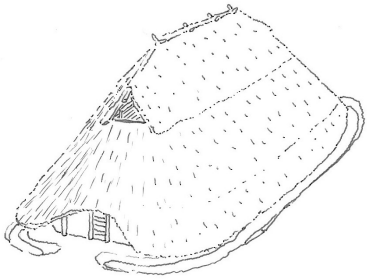


Figure 22: Linear Pottery house (farm), right image, farm under construction



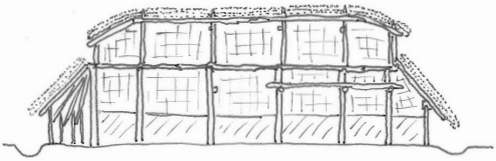


Figure 23: Bronze Age farm, right image, section

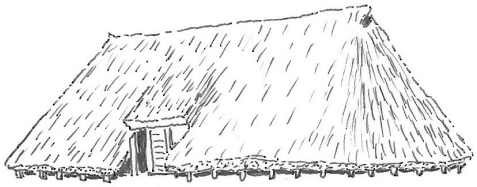


Figure 24: Iron Age farm, right image farm with a smoke vent

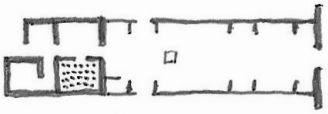


Figure 25: Villa rustica, Rijswijk, right image, plan

Figure 21 Tsaatan child with reindeers and a cone shaped tent. Photo by: Pascal Mannaerts, retrieved 31 januari, 2017, from http://www.parcheminsdailleurs.com/SITE_ANGLAIS/tsaatanEN.html

Figure 22 Linear pottery house (farm). Right image is one under construction. Own images based on (Bloemers et al., 1981; culture.(n.d.). 2016; Stenchlak, 1983)

Figure 23 Bronze age farm. Right image is an section in the long direction. Own images based on (Bloemers et al., 1981; Stenchlak, 1983)

Figure 24 Iron age farm. Right image shows the smoke vent of a terp farm, which is a type of iron age farm. This terp farm is reconstructed in the Archeon. Own images based on (Boer, Haan, Hoekstra, & Kramer, 2009 ; Stenchlak, 1983)

Figure 25 Villa rustica, Rijswijk. Right image is a plan view of the villa. Own images based on (Bazelmans & Colenbrander, 2005; Livius.(n.b.)., 2015; Moerman,

intervals a vicus and a settlement. This route ran from around Katwijk deep into Europe and is called the Limes route. The Romans constructed many roads, bridges and even dug cannels, networking all the different settlements together. Everything was meticulously planned, as we can see in the layout of the settlements and the distances between them. The Romans also brought new techniques, materials, raw materials and the roads, cannels and rivers brought fast transport.

The arrival of the Romans in the Netherlands also started the break-up between typography and topography. Due to the improved roads and connections via cannels and rivers, raw materials could be sourced from far away and new techniques, like brick making, were brought in. In the case of villa rustica in Rijswijk we can also see a shift from farming to farming and trade. This trade brought in money which the owner used to improve his farm in Roman style.

When the Romans left the Netherlands, their roads, canals, bridges and techniques stayed, although they were subjected to decay. Parts of roads were no longer usable so new roads were made. Some techniques were forgotten, some were given on to next generations. We can see the expansion of the road network in the Middle Ages, these were most of the time nothing more than a well-traveled path (some middle ages cart trails are still visible in the landscape today). While not as effective as in Roman times trade of (raw) materials and techniques continued. As examples we can see churches, which were generally built from natural stone or brick. Most natural stone was not locally sourced. For instance tuff was won in the Eifel area, transported via the rivers and used mostly in Romanesque style churches (Smulders, 2009). Brick was forgotten after the Roman period but rediscovered in the twelfth century. From that time on the use increased exponentially, for it being cheap and fire resistant (KNB, 2007). We can also see this in churches, which were after the rediscovering more and more built with brick. The styles of the churches, such as Romanesque and Gothic, were shared in larger regions than the Netherlands and

Figure 26: Gold: Roman road network in the Netherlands. Brown: known roads from the Middle Ages

weren't very specific to, for instance, a city.
Where the villa rustica in Roman times was still by style (the middle part) and raw materials partly bound to its location, the churches of the middle ages weren't. The brick churches were and are bound by brick to the Netherlands, but not to a certain location anymore. It became a mixture of European styles and materials.

If we look in a later time frame, around 1650, with the scope on farms, we can see that the types of farms could spread out over, not only the Netherlands, but parts of Europe (Boer et al., 2009). While these types had a wide spread the raw materials used were most of the time quite local (Friesian brick).

Trade and communication only improved after the Dark Ages, making it easier to share ideas and to trade materials. Sometimes these styles and/or materials were quite local, sometimes materials and styles came from far away. Coming to our time frame we can say that everything is available

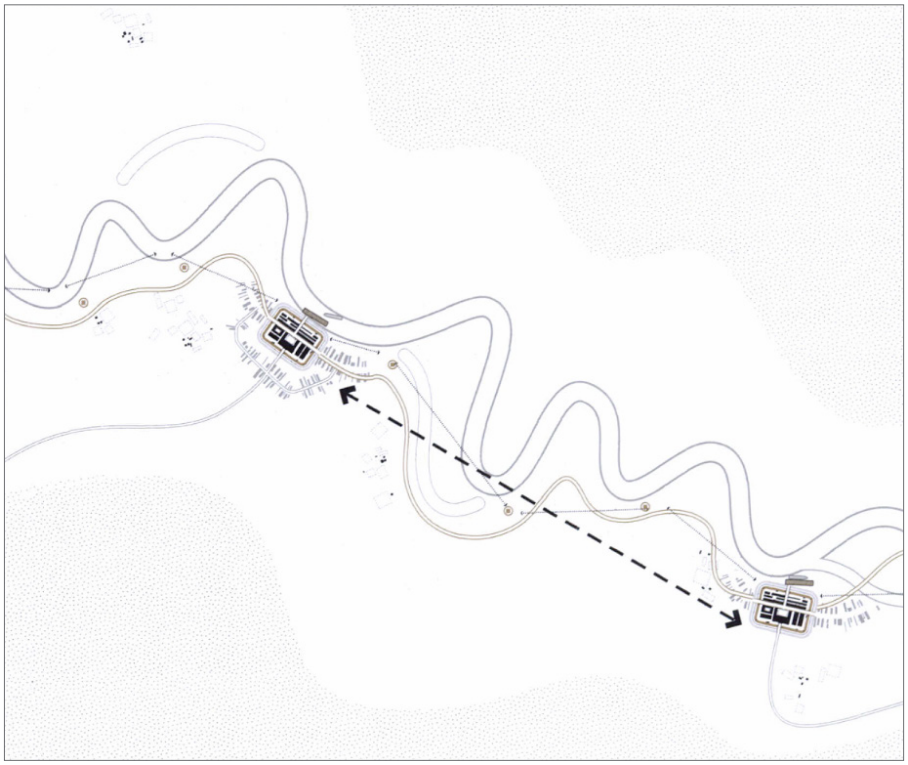


Figure 27: Limes Atlas: military system and settlements

at the touch of a button. This accounts for the high availability of ideas, techniques and materials. This, as mentioned in the problem statement, gives a lot of generic architecture, an architectural expression that isn't bound to a location by anything. So how is an architectural expression bound to a location? Since the beginning of time we built style upon style, meaning that when we came on a location, we already knew what we were going to build. This we adapted to the location through landscape, raw materials available and the climate. This changed in Roman times, as described earlier. Eventually there came so many styles, materials and thus possibilities available, that the connection to a location became lost. If we look at some types nowadays we can almost sort them as European, North American, Asian etcetera, divided per continent. There is no local architectural expression anymore on the small scale we're looking.

This doesn't mean we should go back in time and forget all the developments and techniques throughout history. Building only from the distant past would alienate us from it. We should use the developments and techniques but give it a subordinate role in comparison to the elements that define a location.

Conclusion

Through time typology and topology broke-up. The main break-up was when the Romans reached the Netherlands. They brought well thought out routes for defending their empire which were also perfect for trade. Through the Romans and the trade new techniques and materials came available. Later in history this became more and more until the present time, were materials, techniques and ideas are so readily available that it resulted in generic architecture, an architecture that can be build continent wide and wouldn't stand out. The connection to location is lost, there is no local architectural expression anymore on the small scale we're looking.

Figure 26 Roman road network and Middle Age roads in the Netherlands. Own image based on (Bazelmans & Colenbrander, 2005; Helmer & Proos, 1990)
Figure 27 Limes Atlas: military system and settlements in the Netherlands. Image from (Bazelmans & Colenbrander, 2005, p. 85)

conclusion.

The severed connection between typography and topography is the reason that a local identity in architecture is missing.

In this research we found where this separation in time occurred, also we found a possible answer in how to connect the two again. Guiding in this research was the research question:

‘How can we give buildings, more specifically an inn, in the Netherlands a local identity through the use of local resources, with the emphasis on materials?’

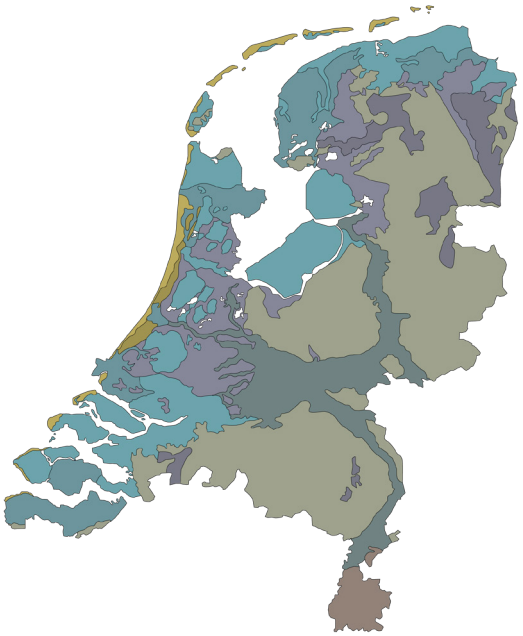


Figure 28: Landscapes

The separation occurred because of the Roman improved network of roads, rivers and canals. This made techniques and materials from far away available, separating them from a specific location. If we already can see the separation then, we can understand why there is so much generic architecture now. Everything is available at the touch of a button.

To better understand what typography and topography exactly mean and how they influence a local identity in architecture they were divided in four elements. We needed guidelines for these elements, a way to order them in how influential they are for a local identity.

The first element, the landscape, plays a big role in how we perceive a place, this gives us, next to a feeling on how to design for a place (intuition), some simple conditions, such as, it’s a wet area below sea level. The second element is raw materials. These have a big impact on what we can build. They can be ranked on how available they are on a location. This is translated to architecture in how much they are used. The third element, climate, has a bigger scale than the first two. The most distinct areas are the coastal area and the rest of the Netherlands. In comparison the coastal area receives more sun and has more wind. This gives us that in some cases the climate can help to define a more specific location, but overall the Netherlands has the same climate which has no direct consequences when defining a location. The last element, local architectural expression, is the least influential. We can look back in time to the Stone Age, Bronze Age and Iron Age, when typography and topography went hand in hand, but then we forget all the new techniques and types available. Ignoring the progression of the world, won’t make us relate to architecture with a local identity. It will make us think of it as a

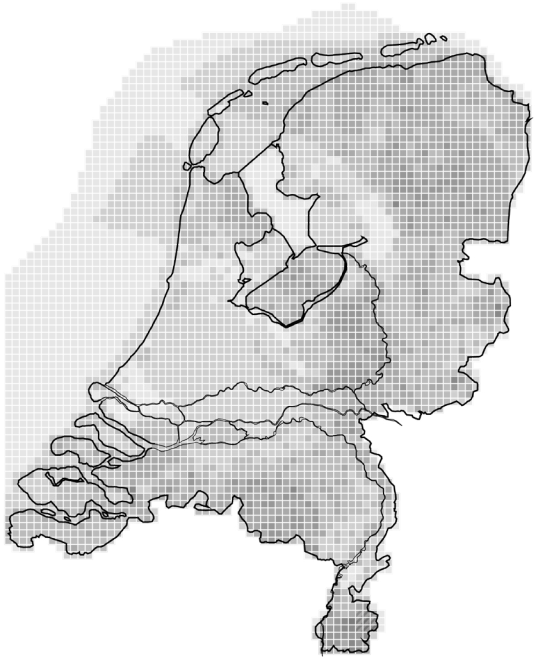


Figure 29: Raw materials

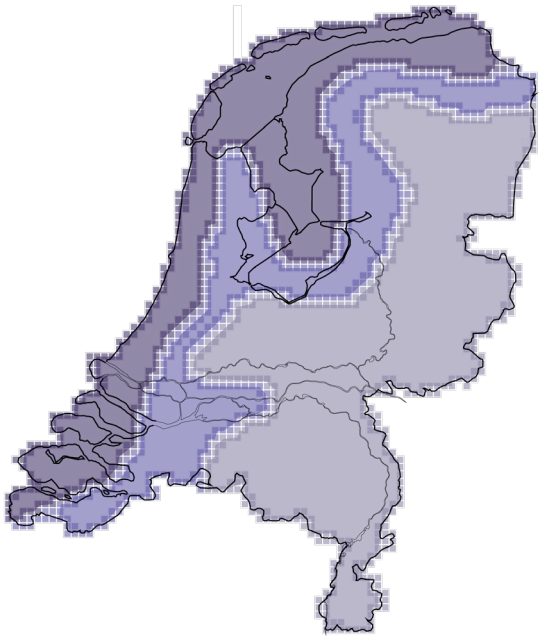


Figure 30: Climate, wind

reconstruction of history. What we can use of this element is the wide availability of techniques and use it as a condition to keep the architecture related to our region (North-West Europe). This prevents a scenario where we build for instance in the dune landscape, make blocks out of sand, put them in an optimal form to guide the wind, sand and rain off and over the structure and end up with a pyramid. While this is exaggerated, it's a good example how not to handle the element architectural expression.
How would this translate to the design proposition of the inns? First we would have to pick locations for the inns. These would be based on the different types of landscapes. To fine-tune a location within these landscapes more specific research has to be done, but one can imagine that a specific location can be chosen on a typical landscape feature (Wadden-Eiland), the history of a place (Limes route) or a specific raw material that is only available in parts of a landscape. This is a choice that would be different for each architect, for everyone has their own fascinations. When the locations for the inns are more specific we can go into depth on the raw materials available. The climate simply sets conditions for the architecture on the chosen location. From there on we can start designing an inn with contemporary techniques, while keeping in mind the architectural expression of the region. If all the elements are controlled during the design process, this should lead to an inn with a local identity. Important is that these steps are a guideline. As named earlier, every architect has his or her own fascinations which will guide them through the research. Using the research as a guide in these feelings and fascinations will assure that a common thread appears between the inns, making them comparable. This way we can visit multiple inns and understand what kind of impact a location can have on architecture.

Figure 28 See "Figure 10: The Dutch landscapes" on page 17
Figure 29 All raw materials in one map. See on page 30
Figure 30 See "Figure 18: Climate in the Netherlands" on page 35

epilogue.

What became more apparent when trying to bring order in the chaos that was brought with researching this subject, is that the feeling about a landscape, the feeling about something in history plays a significant role in making decisions toward defining a local identity.

I found that I could not make a definitive formula on how to make architecture with a local identity. In my own design project I chose the dune landscape. This decision was based purely on the feeling I had for this landscape. I grew up near the dunes, I biked there and played there. I enjoyed warm summers and loved the raging storms. I felt like I understood this landscape. After choosing it quickly became evident that I didn't. There was so much history in the ground that I wasn't aware of, Roman forts, farms from the early Middle Ages, but also more recent roads that have been swallowed by the shifting dune sand. Next to history there were other things that amazed me, for instance there is the huge drinkable water bubble underneath the dunes which has an intricate balance with the salt water from the sea. Also I found bog ore on the beach, which shouldn't be there according to my research. This mystery was solved after talking to a geologist, it seems to be pumped up from the old sea bed (where it formed when the sea bed lay dry) when they spray sand to improve the coastline. All these finds amazed and helped me to get a new and better understanding about the dune landscape, but also helped me to pick a more specific location within this landscape (around the Roman fort). It gave me a list conditions and idiosyncrasies, which are helping me design an inn for this location. Combining these feelings and guidelines I set myself in the research are, I think,

crucial in obtaining a local identity that feels natural to the landscape thus its location, but is still relatable to people.

An important element which I left out for the reason of making the research less complex, is how to react when building an inn in a city. What would be the local identity there? One could not simply ignore the city. While this is one of the things

Figure 31: Dune landscape

which make this research 'not yet' complete, I hope that it can be a begin on which others can build. It's a rich and complex cohesion between elements and idiosyncrasies and will take the effort of many to complete. To conclude, I would like to thank my tutor Peter Koorstra, who guided me through this enormous amount of information to this thesis.

Figure 31 Dune landscape, own image

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appendix.

This appendix contains the research of the historical architectural expression in the Netherlands up to Roman times. If an image is empty it mean there was no available information. The sources used for this research are found per item at the bottom of the page.

Map

Architectural types

all types

9000 b.c. - 340 a.d.

The green dots represent the prehistoric period. The golden dots represent Roman times. The Abbreviations refer to the types.

Map based on Google Maps.

Meaning Abbreviations

Explaination of the abbreviations in the upper right corners

Abbreviations
upper right corner

P|t|a.t|m.a ~ Province

b : N-Brabant
d : Drenthe
f : Friesland
fl : Flevoland
g : Groningen
ge : Gelderland
l : Limburg
o : Overijsel
nh : N-Holland
t : theoretical
u : Utrecht
zh : Z-Holland

p|**T**|a.t|m.a ~ Time

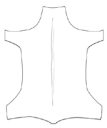
p : pre-historic
r : roman time

p|t|**A.T**|m.a ~ Architectural Type

b : bridge
g : grave
h : house
he : herberg
f : fort
s : storage
p : pleasure

p|t|a.t|**M.A** ~ Main Materials

c : cob
cl : clay
e : earth
l : leather
r : reed
s : sand
st : stone
w : wood



Leather

source: *animals; reindeer, wolf, fish, rabbits..*
ways of use: *hides, fur, rope..*

Wood

source: *trees; oak, birch, pine, alder..*
ways of use: *branches, beams, columns, roof tiling..*

Reeds

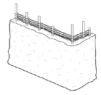
source: *grasses; earopean beachgrass, flax, common reed..*
way of use: *roofing, walls, cob enhancer..*

Stone

source: *mines, quarries, glacier erratic; sandstone, limestone, granite, flint..*
way of use: *walls, roof, tools..*

Bone

source: *animals; mammoth, reindeer, fish..*
way of use: *colomns, beams, tools..*



Cob

source: *ground/earth/plants; sand, clay, earth, straw, reeds..*
way of use: *walls, floors, mounds..*

Sand

source: *ground/earth; fine sand, coarse sand, gravel..*
way of use: *glas, cob enhancer, stucco..*

Earth

source: *ground/earth; depends on location..*
way of use: *filler..*

Lime

source: *ground/earth; calcium and magnesiumcarbonate..*
way of use: *lime plaster, stucco, roman concrete..*

Clay

source: *ground/earth; sea clay, river clay..*
ways of use: *bricks, roof tiles, pots, dikes, mounds..*

Tuff

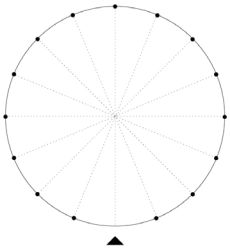
source: *ground/earth; rock from volcanic ash..*
ways of use: *walls..*

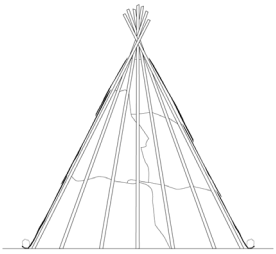
1. Cone Shaped Tents

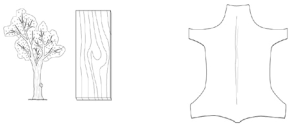
Usselo, Geldrop

o.b|p|h|w.l

9000 - 5300 b.c.

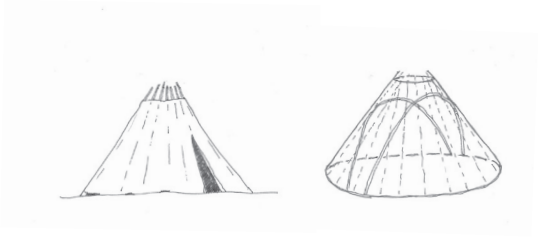






The construction consisted out of branches in a circle. The branches connected in the top. To make the construction stable and to protect the inhabitants against the elements, reindeer hides where used. These hides where drawn tight around the branches. The hides where either weighed down by stones or pegged to the ground.

The tents have a shape that naturally guides water of the sides. The Indians in America conceived a way to control the climate in the tents. They attached two flaps connected to poles. By adjusting these flaps they could controll windflow, keep out rain or trap heat inside.



There are a lot of variants in the cone shaped tent family. The tipi, chum, lavvu, the goahti and more. The tipi is the Native American variant, the chum the Siberian variant and the lavvu and goahti the Scandinavian variant. The cone shaped tents where mainly used by hunter gatherers.

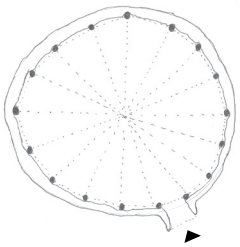
Stenchlak, M. (1983). Architectuurgids van Nederland: Een overzicht van de meest markante bouwwerken, hun ontstaansgeschiedenis, bouwperiode en - stijlen. Rijswijk: Elmar.
Bloemers, J. H., P., L. K., & Sarfatij, H. (1981). Verleden land: Archeologische opgravingen in Nederland.
Rapoport, A. (1969). House form and culture. Englewood Cliffs, NJ: Prentice-Hall.
Lavvu. (n.d.). Retrieved June 06, 2016, from https://en.wikipedia.org/wiki/Lavvu
An Investigation of Sami Building Structures. (n.d.). Retrieved June 14, 2016, from https://www.laits.utexas.edu/sami/dieda/anthro/architecture.htm

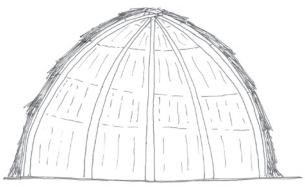
2. Dome House

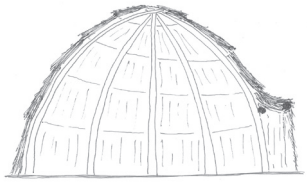
Bergumermeer

f|p|h|w.r

9000 - 5300 b.c.

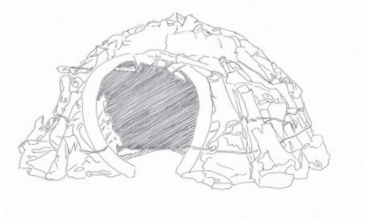






House made of a branch frame, covered with reeds. These reeds where probably woven to mats.

The dome shape is ideal for guiding strong winds around it.



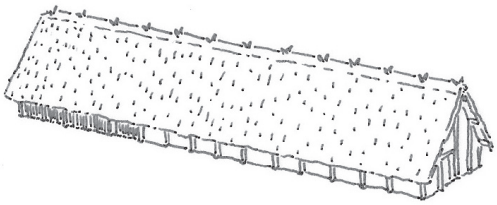
The wigwam is one of the most well known variants on the dome house, the construction was simulair to the one above. Material wise there are alot of variants, think of mammoth bones, peat and hides. Dome houses where mainly used by hunter gatherers.

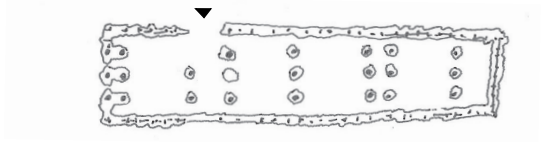
Stenchlak, M. (1983). Architectuurgids van Nederland: Een overzicht van de meest markante bouwwerken, hun ontstaansgeschiedenis, bouwperiode en - stijlen. Rijswijk: Elmar.
History of early and simple domes. (n.d.). Retrieved June 06, 2016, from https://en.wikipedia.org/wiki/History_of_early_and_simple_domes
Bloemers, J. H., P., L. K., & Sarfatij, H. (1981). Verleden land: Archeologische opgravingen in Nederland.
Rapoport, A. (1969). House form and culture. Englewood Cliffs, NJ: Prentice-Hall.

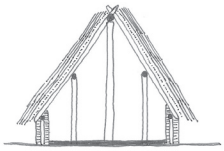
3. Linear Pottery house

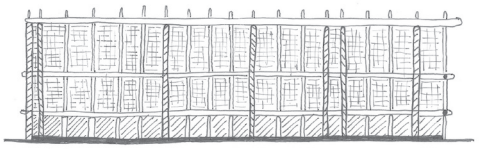
Elsloo Stein Geleen Sittard Swifterband Meppel

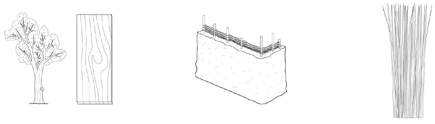
d.fl.l|p|h|w.c.r
5300 - 4900 b.c.





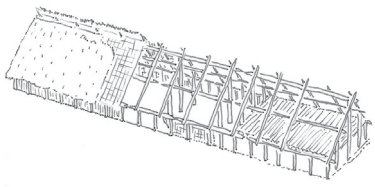






The floor of the house was raised with cob. The core consisted of sturdy oak columns. These carried the roof, which was made of reeds. The walls where composed of columns with wickerwork of branches in between. This wickerwork was covered in cob.

The raised floor offers protection from water coming in. The slanted roof guides water of it. The buildings lasted for around 25 years.



Some houses had wooden planks instead of loam, probably for someone with power, like the village chief. The culture following the Linear Pottery culture was the Rössen culture. This culture had similar houses but was not found in Holland. Inhabitants of the Linear Pottery houses were farmers.

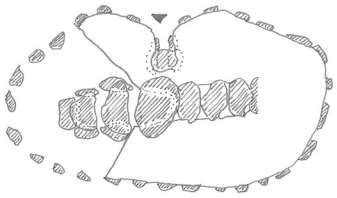
Stenchlak, M. (1983). Architectuurgids van Nederland: Een overzicht van de meest markante bouwwerken, hun ontstaansgeschiedenis, bouwperiode en - stijlen. Rijswijk: Elmar.
Bloemers, J. H., P., L. K., & Sarfatij, H. (1981). Verleden land: Archeologische opgravingen in Nederland.
Linear Pottery culture. (n.d.). Retrieved June 12, 2016, from https://en.wikipedia.org/wiki/Linear_Pottery_culture

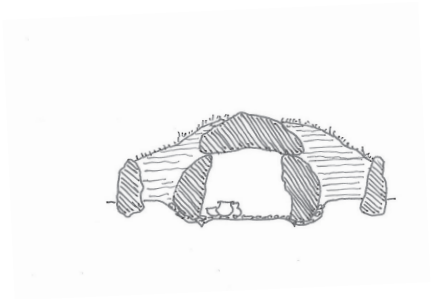
4. Dolmen

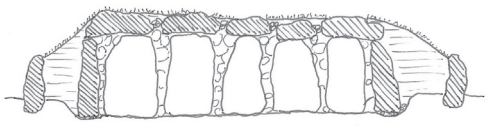
Emmen Havelte Drouwenerveld Eext Schoonoord

d|p|g|st.s

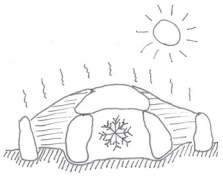
3500 - 2100 b.c.







The dolmen is build up from big stones, which have been transported in the last ice age by glaciers from Scandinavia. These stones are mostly granite. The gaps are filled with smaller stones than the whole is burried under a layer of earth.



The big mass of stones and earth give a stable low temperature inside.

Dolmen are found all over the world, in different forms and shapes. The basics are mostly the same: upright stones supporting a stone roof. This one above is found in Ireland.

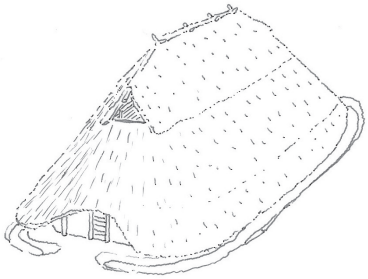
Stenchlak, M. (1983). Architectuurgids van Nederland: Een overzicht van de meest markante bouwwerken, hun ontstaansgeschiedenis, bouwperiode en - stijlen. Rijswijk: Elmar.
Bloemers, J. H., P., L. K., & Sarfatij, H. (1981). Verleden land: Archeologische opgravingen in Nederland.
Dolmen. (n.d.). Retrieved June 12, 2016, from https://en.wikipedia.org/wiki/Dolmen

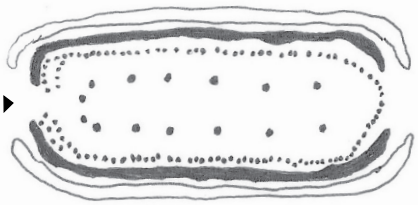
5. Bronze age farm

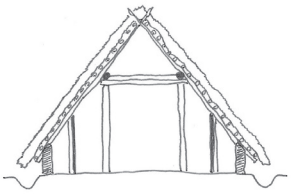
Andijk Hoogkarspel Bovenkarspel Emmen Elp

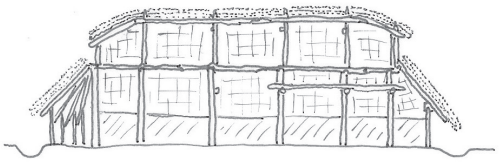
nh.d|p|h|w.s

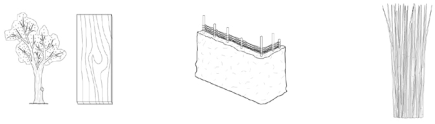
1700 - 700 b.c.



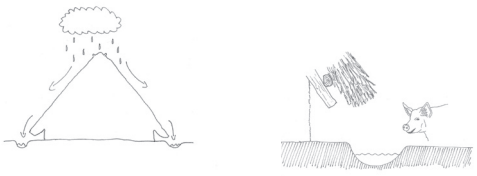








The roof construction is hold up by wood columns. The roof is clad in reeds, which extent almost to the ground. The outer walls are non-load bearing and made up of wickerwork and cob.



Around the house a ditch was dug to fend of rain water and protect the walls from cattle. Seeing the roof extend that far to the ground one can see the ditch as a gutter.

The same materials but different in shape is this house which was found in the neightbourhood of Peterborough, UK: Must farm. The most interesting thing is that it kept its distance from the ground by using poles.

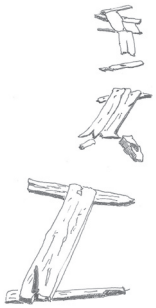
Stenchlak, M. (1983). Architectuurgids van Nederland: Een overzicht van de meest markante bouwwerken, hun ontstaansgeschiedenis, bouwperiode en - stijlen. Rijswijk: Elmar.
Bloemers, J. H., P., L. K., & Sarfatij, H. (1981). Verleden land: Archeologische opgravingen in Nederland.
Ancient village yields secrets. (n.d.). Retrieved June 12, 2016, from http://www.cnn.com/2016/01/23/europe/england-bronze-age-village/

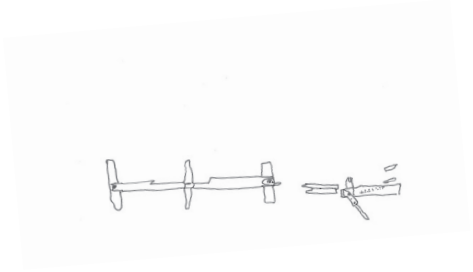
6. Bog path

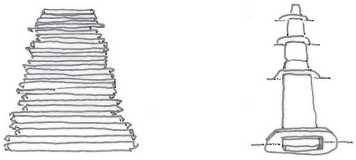
Emmen Ter Apel

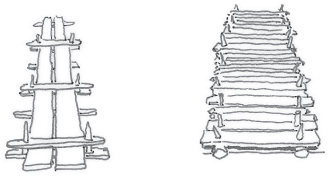
g.d | p | b | w.r

2700 - 200 b.c.

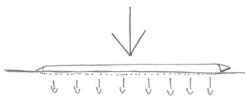




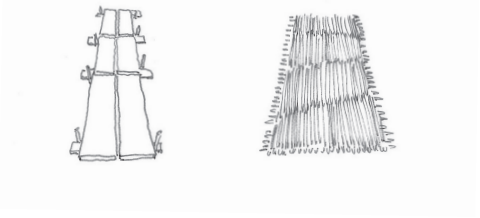




The paths through the bog consisted of in different ways linked wooden planks, logs or wickerwork from reeds.



Spreading the weight through the use of planks, logs or wickerwork made crossing the bog easier.



More variants that where found in Holland and Germany.

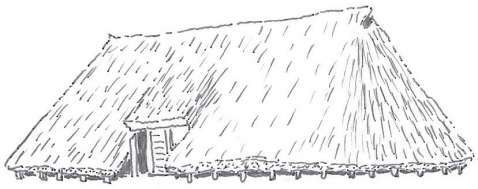
Bloemers, J. H., P., L. K., & Sarfatij, H. (1981). Verleden land: Archeologische opgravingen in Nederland.

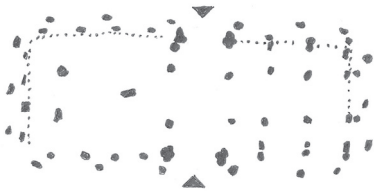
7. Iron age farm

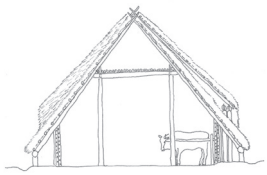
Wijchem Oss Overasselt Meerlo Haps Hijken Vaassen Ezinge

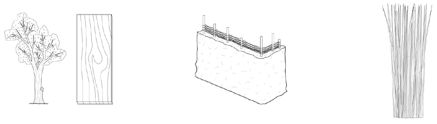
nb.l.ge.d|p|h|w.c.r

800 - 0 b.c.









The reed roof was carried by two rows of wooden columns and a wooden roof construction. The walls weren't strong enough for this. The walls were build up out of wickerwork which were covered in manure and earth to create cob walls.

A reconstruction of a terp farm (also a type of iron age farm) in the Archeon has a controllable opening to vent smoke from the fire. The roof is shaped to guide rain off.

A variant on the iron age farm was the terp farm. This farm was located on a man-made hill. This offered protection from flooding. These terp farms were located all along the Wadden Sea.

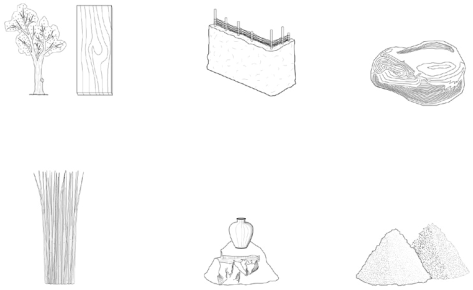
Stenchlak, M. (1983). Architectuurgids van Nederland: Een overzicht van de meest markante bouwwerken, hun ontstaansgeschiedenis, bouwperiode en - stijlen. Rijswijk: Elmar.
Hoekstra, W., Kramer, E., Haan, H. D., & Boer, S. D. (2009). De Friese boerderij: 2500 jaar geschiedenis van de Fryske pleats. Leeuwarden: Friese Pers Boekerij.
Waterbolk, H. (n.d.). Wonen op de Wadden: 1500 jaar boerderijbouw op onbedijkte kwelders. Lecture. Retrieved 2016, from http://www.waddenacademie.nl/fileadmin/inhoud/pdf/03-Thema_s/Cultuur/10-042_Waddenlezing_Waterbolk.pdf

8. Villa rustica

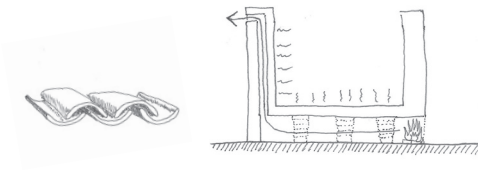
Rijswijk

zh | r | h | w.c.l.s

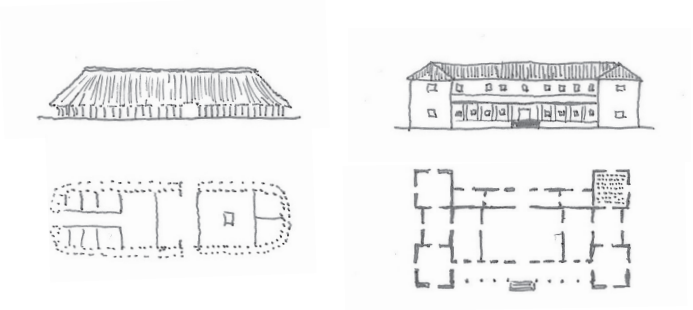
125 a.d.



The central part of the building consists of wooden columns, cob walls and a roof of reed. The later added parts were made of limestone imported from Limburg. The wall got a layer of stucco, which consisted of lime, sand and plant or animal fibers. The lime probably came from Limburg, where it was transported down river. The roof of the later added parts had clay tiles which were either from Leiden or Nijmegen.



In comparison to the reed roof, the tiles were far more durable and superior in guiding rain of the roof. In the later added part there was also floor and wall heating.



What stands out is the transformation of the prehistoric style cob and reed farmhouse to a more roman style house. This transformation depended on region for form. In Forum Hadriani, a roman settlement found in Voorburg, there were terraced houses. These houses were build from wood. Other houses were found in Duurstede and Lemiers.

Colenbrander, B., & Bazelmans, J. (2005). Limes atlas. Rotterdam: Uitgeverij 010.

[Brochure]. (n.d.). Retrieved June 13, 2016, from http://www.erfgoedhuis-zh.nl/clientdata/downloads/brochure-haaglanden-in-de-romeinse-tijd.pdf

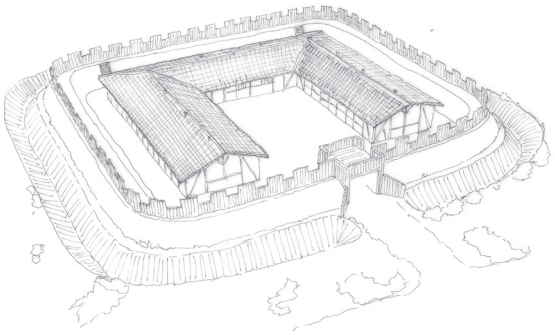
Rijswijk - De Bult. (n.d.). Retrieved June 13, 2016, from http://www.livius.org/articles/place/rijswijk-de-bult/

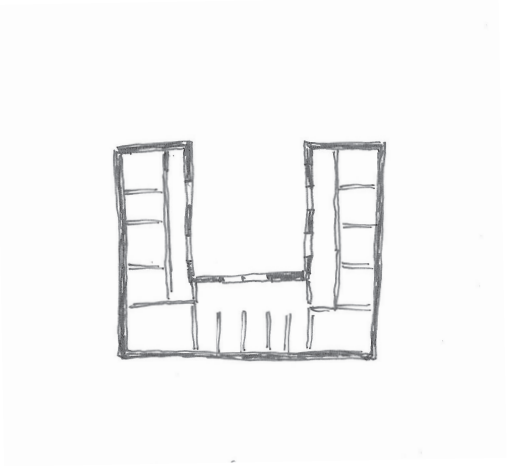
9. Vicus of Ockenburgh

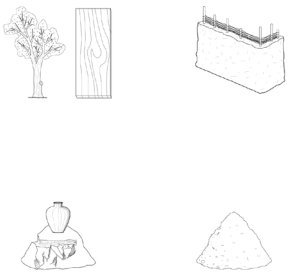
Den Haag

zh|r|f|w.c.cl

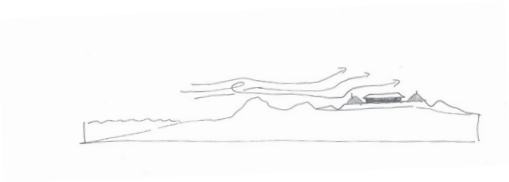
150 a.d.



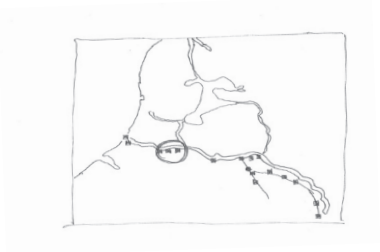


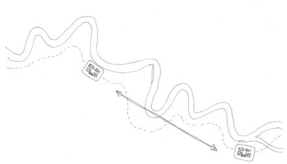


The ditch was clad with wooden planks. The earth from the ditch was used to make a wall. On top of this wall more wooden defenses were placed. The entrance gate also consisted of wood. The U-shaped building consisted of a wood and cob construction with a clay tiled roof.



The earthen wall and the wooden defenses could have helped to break the wind.





Vicus of Ockenburgh is one of the many defenses the Romans had in their defense network. This network followed the rivers into Germany counting many castellum, roads and vicus.

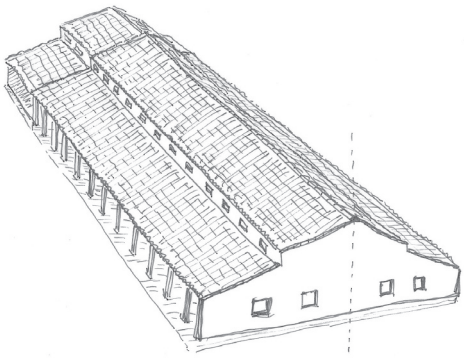
Waasdorp, J., Zoolingen, R. V., Aarts, J., & Kersing, V. (2015). Den Haag Ockenburgh II. Een Romeinse militaire vicus vlak bij de kust. Den Haag: Gemeente Den Haag, Dienst Stadsbeheer, Afdeling Archeologie.
Vicus van Ockenburgh. (n.d.). Retrieved June 13, 2016, from https://nl.wikipedia.org/wiki/Vicus_van_Ockenburgh

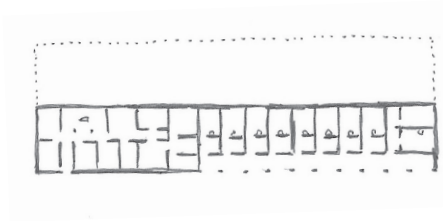
10. Centuria (barracks)

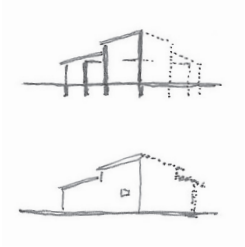
Nijmegen Valkenburg

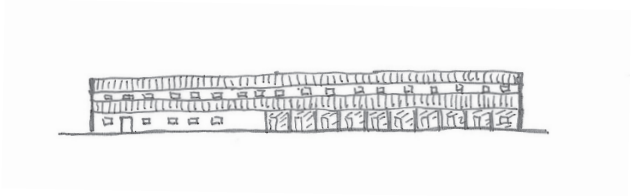
ge.l|r|h|w.c.s.cl

40 - 250 a.d.

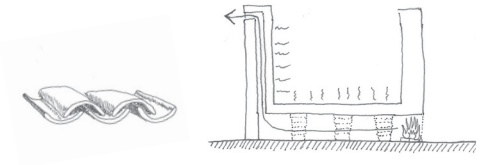




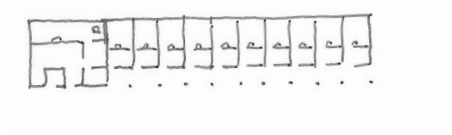




The centuria in Nijmegen was build up from stone with a wooden roof structure and clay tiles on the roof. We are not sure if it was completely stone or stone to a certain hight and the rest wood. The one in Valkenburg was build up from wood and had a tiled or shingled roof.



In later years luxury's were added like floor and wall heating. The shape of the roof made easy to shed rain.



The centuria was build up out of a large officer room and smaller rooms, which were for multiple soldiers. Although there were some variants in material and form the basics were the same.

Colenbrander, B., & Bazelmans, J. (2005). Limes atlas. Rotterdam: Uitgeverij 010.

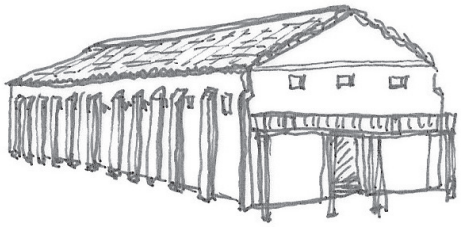
Berkvens, R. (n.d.). De opbouw en inrichting van de Romeinse soldatenbarak. Retrieved June 13, 2016, from http://www.ethesis.net/soldatenbarak/soldatenbarak.htm

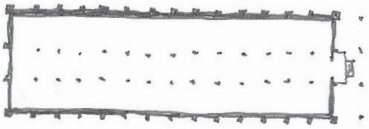
11. Horreum (storage, granary)

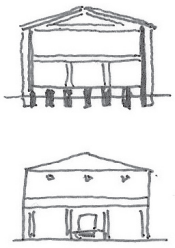
Nijmegen Valkenburg

ge.l|r|s|s.w.cl

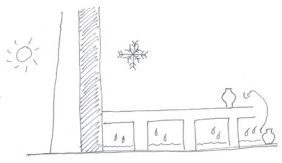
100 - 320 a.d.



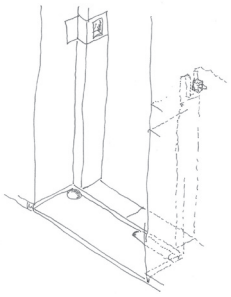




Build from stone, brick or wood. Stone and brick were covered in stucco, which consisted mainly of sand and lime. The roof was either clay tiles or shingles.



The stone or brick variant was build with thick walls, heavy foundations and buttresses. This insulated it better from fire and probably kept it cooler inside. The floor was lifted above the ground, this kept the content away from moist.



A variant located near Rome. This one housed little shops inside it and had some serious locks.

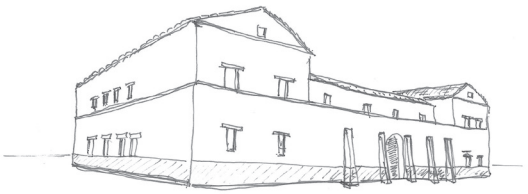
Colenbrander, B., & Bazelmans, J. (2005). Limes atlas. Rotterdam: Uitgeverij 010.
Regio I - Insula VIII - Horrea Epagathiana et Epaphroditiana (I,VIII,3). (n.d.). Retrieved June 13, 2016, from http://www.ostia-antica.org/regio1/8/8-3.htm

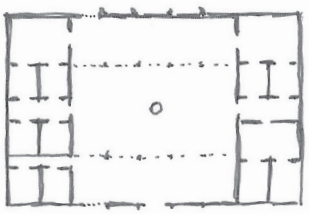
12. **Mansio** (state inn)

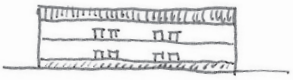
Nijmegen

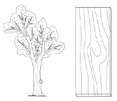
ge | r | he | s.w.cl

70 a.d.



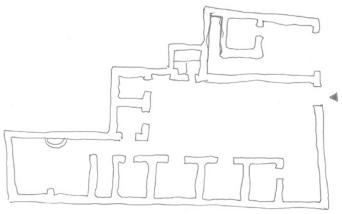






Build from stone or brick. Stone and brick were covered in stucco, which consisted mainly of sand and lime. The roof construction consisted of wood and was clad in clay tiles.

Slanted clay tile roof for the rain. The horses were inside the building, protected against the elements and predators.



The mansio was for Roman officials and they were all along the Roman routes. They were also used for the mail service; the postman had to sleep and eat. Other travellers stayed with houses near the road. Houses which were frequently visited transformed to taverns, serving food and drinks and offering places to sleep. Above a Cauponae, a cheap hospita in Pompeii (they think it was cheap because a lot of graffiti was found).

Colenbrander, B., & Bazelmans, J. (2005). Limes atlas. Rotterdam: Uitgeverij 010.

Cauponae (ook wel hospitia). (n.d.). Retrieved June 13, 2016, from http://www.romeinspompeii.net/hospitium.html

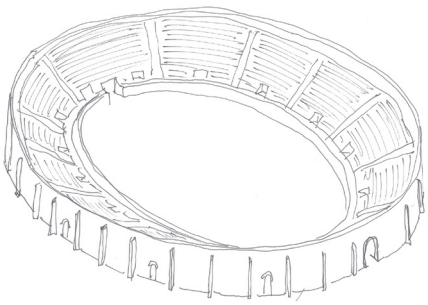
Mansio. (n.d.). Retrieved June 13, 2016, from https://en.wikipedia.org/wiki/Mansio

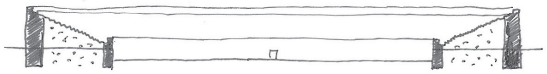
13. Amfitheater

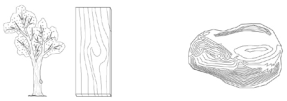
Nijmegen

ge | r | p | s.e

100 a.d.







Outside was a stone wall, inside a tuff wall. The space in between was filled in with earth. On this earth wooden seats were placed. The tuff is available in the area around Nijmegen, but in small quantities. It is more likely it was imported from Germany in the area of Bonn.

Simple structure that could hold a lot of weight easily.

The xanten theater had a far more complex build.

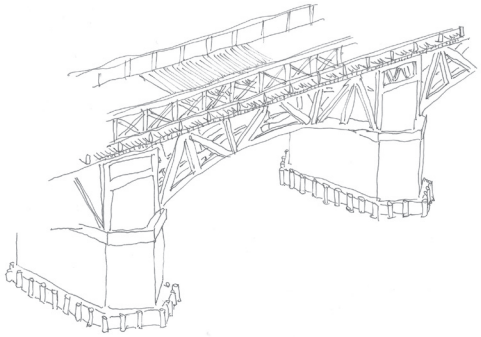
Colenbrander, B., & Bazelmans, J. (2005). Limes atlas. Rotterdam: Uitgeverij 010.
Amfitheater van Nijmegen: Brood en spelen - Historiën. (2016). Retrieved June 13, 2016, from http://www.historien.nl/amfitheater-van-nijmegen/

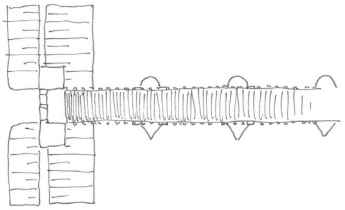
14. Bridge

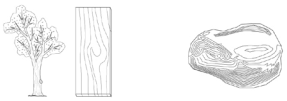
Nijmegen Cuijk

ge | r | b | w.s

180 - 340 a.d.







The bridge was build up of stone pillars which were founded on wooden poles. On top was a wooden construct, connecting the pillars and carrying the wooden deck.

The stone pillars could handle the stress of the water better that a wooden construct. On the other hand the wooden construction and deck was easily repairable. The stone pillars were shaped to guide the water around them.

The Romans build alot of bridges. Stone ones, wooden ones and aquaducts. From the stone bridges and aquaducts quite alot still stand today. Some stone bridges are still used, some are in ruin.

Colenbrander, B., & Bazelmans, J. (2005). Limes atlas. Rotterdam: Uitgeverij 010.

De eerste brug over de Waal. (n.d.). Retrieved June 13, 2016, from http://www.huisvandenijmeegsegeschiedenis.nl/info/De_eerste_brug_over_de_Waal

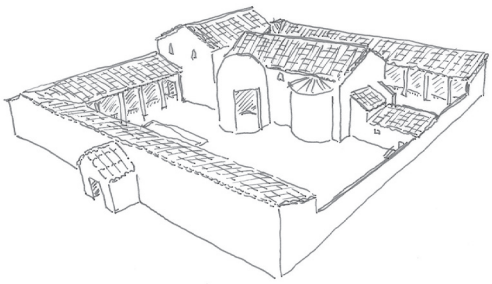
Roman bridge. (n.d.). Retrieved June 14, 2016, from https://en.wikipedia.org/wiki/Roman_bridge

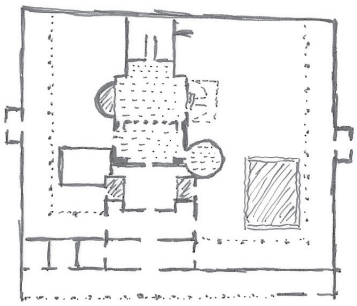
15. Thermae

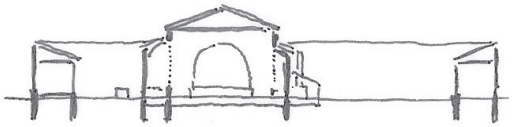
Utrecht Heerlen Maastricht

u.l|r|b|cl.w

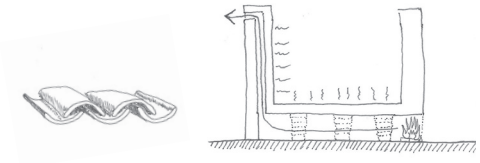
100 - 200 a.d.







The walls were made of clay brick and covered in stucco, which consisted mainly of sand and lime. The flooring was made from stone which was either bigger tiles of mosaic. The roof was a wooden construct which was closed by clay tiles.



The thermae had floor and wall heating. There were also steam rooms, hot, warm and cold water baths. The tile covered roof ensured a durable water resistant roof.

In Khenchela, northern Algeria there is a thermae that, after almost 2000 years, is still in use. The best preserved thermae are to be found in Pompeii, Herculaneum and other villages that where swallowed by the Vesuvius.

Colenbrander, B., & Bazelmans, J. (2005). Limes atlas. Rotterdam: Uitgeverij 010.
A Roman bathhouse still in use after 2,000 years. (n.d.). Retrieved June 14, 2016, from http://www.bbc.com/news/magazine-24493177
Thermae. (n.d.). Retrieved June 14, 2016, from https://en.wikipedia.org/wiki/Thermae