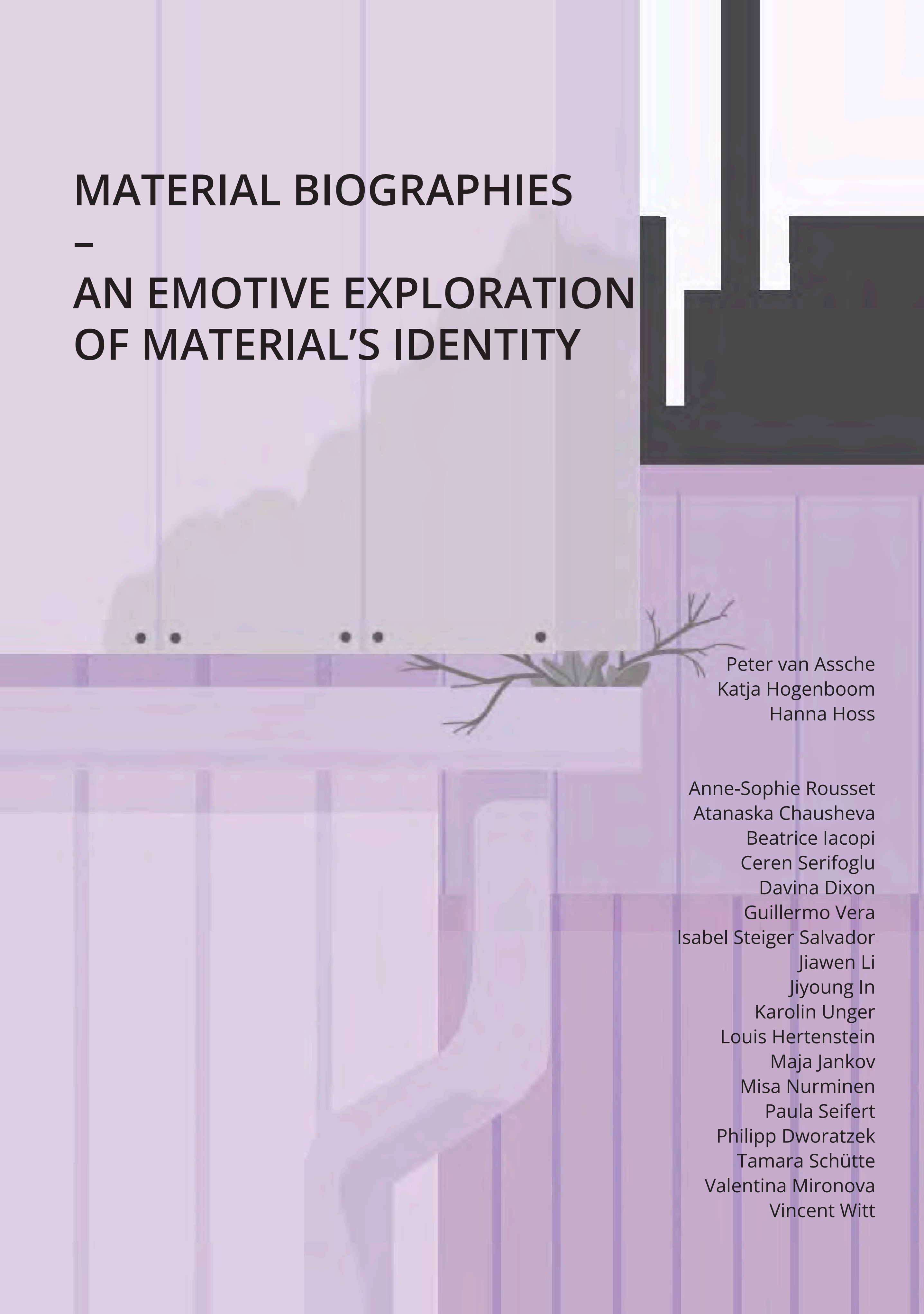

MATERIAL BIOGRAPHIES – AN EMOTIVE EXPLORATION OF MATERIAL'S IDENTITY

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För den här boken gör vi något okonventionellt. Vi bad sju vanliga byggnadselement att skriva, med vår hjälp, sina egna biografier. De berättar inte bara vad de är gjorda av, hur länge de håller eller hur användbara de är. De berättar också vem som gjort dem, vem som älskade dem och vem som hade skickligheten att arbeta med dem. Dessa känslomässiga materialbiografier lär oss det verkliga värdet av sakerna som omger oss – och förändrar hur vi använder dem.

이 책에서 우리는 독특한 시도를 하고있습니다. 우리는 일곱 가지 전형적인 건축 요소들의 전기를 쓰도록 목표했습니다. 이 책은 단지 건축 요소들이 무엇으로 만들어졌는지, 얼마나 오래 지속되고 어떻게 유용한지에 대한 것이 아닙니다. 오히려 누가 그것들을 만들었는지, 누가 그것들을 사랑했고 만들 수 있는 기술을 가졌는지에 대한 책입니다. 이런 감정적인 접근 방식은 우리를 둘러싼 사물의 진정한 가치를 가르쳐주고 우리가 그것을 사용하는 방식을 바꾸게 될 것입니다.

Для створення цієї книги ми зробили дещо особливе. Ми попросили сім звичайних будівельних елементів написати з нашої допомоги автобіографії. Ці елементи не просто розповідають про те, з чого вони зроблені, як довго вони служать чи наскільки вони корисні. Вони також пишуть про те, хто їх робив, кому вони подобались та у кого були навички працювати з ними. Ці емоційні матеріальні біографії вчать нас справжньої цінності речей, які нас оточують, та змінюють те, як ми їх використовуємо.

За тази книга ние правим нещо нетрадиционно. С нашата помощ седем елемента от строителната бронша написаха техните автобиографии. Те не пишат само за това от какво са направени, колко дълго издържат или колко полезни са. Пишат и за това кой ги е направил, кой ги е обичал и кой е имал уменията да работи с тях. Тези емоционални материални биографии ни учат на истинската стойност на нещата, които ни заобикалят – и променят начина, по който ги използваме.

Bu kitap için alışılmadık bir şey yapıyoruz. Yedi yaygın yapı elementinin, bizim yardımımızla öğrencilerimiz tarafından otobiyografilerini yazılmasını istedik. Öğrenciler bu elementelerin sadece neyden yapıldıklarını, ne kadar dayandıklarını ya da ne kadar kullanışlı olduklarını anlatmadılar; aynı zamanda onları kimin yaptığını, kimin sevdiğini ve kimin onlarla çalışma becerisine sahip olduğunu da anlattılar. Bu duygusal malzeme biyografileri bize etrafımızı saran eşyaların gerçek değerini öğretiyor ve onları kullanma şeklimizi değiştiriyor.

この本のために、私たちは型破りなことをやっています。7つの一般的な建築の資材に、手助けをしながら、彼ら自身の自伝を書いてもらったのです。彼らは、自分たちが何でできているか、どれくらい長持ちするか、どれくらい役に立つかを書いただけではありません。彼らは、誰がそれを作り、誰がそれを愛し、誰がそれを扱う技術を持っていたかについても書きました。これらの感情豊かな資材達の伝記は、私たちを取り囲む資材の本当の価値を教えてくれます - そしてそれらの使い方も変えてくれるでしょう。

Для создания этой книги мы сделали нечто особенное. Мы попросили семь обыкновенных строительных элементов написать с нашей помощью свои автобиографии. Эти элементы не просто рассказывают о том, из чего они сделаны, как долго они служат или насколько они полезны. Они также пишут о том, кто их делал, кому они нравились и у кого были навыки работы с ними. Эти эмоциональные материальные биографии учат нас реальной ценности вещей, которые нас окружают, и меняют то, как мы их используем.

Pour ce livre, nous faisons quelque chose de peu conventionnel. Nous avons demandé à sept éléments de construction courants d'écrire, avec notre aide, leur autobiographie. Ils n'écrivent pas seulement sur leur composition, leur durée de vie ou leur utilité. Ils racontent aussi qui les a fabriqués, qui les a aimés et qui avait les compétences nécessaires pour les utiliser. Ces émouvantes biographies de matériaux nous apprennent la valeur réelle des objets qui nous entourent - et modifient la façon dont nous les utilisons.

FOREWORD

Per questo libro stiamo facendo qualcosa di anticonvenzionale. Abbiamo chiesto a sette elementi comuni dell'edilizia di scrivere, con il nostro aiuto, le loro autobiografie. Non scrivono solo di cosa sono fatti, quanto durano o quanto sono utili. Scrivono anche di chi li ha realizzati, di chi li ha amati e di chi ha avuto le capacità di lavorare con loro. Queste biografie emotive ci insegnano il vero valore degli oggetti che ci circondano e cambiano il modo in cui li usiamo.

Tätä kirjaa varten teemme jotain epätavallista. Pyysimme seitsämää yleistä rakennuselementtiä kirjoittamaan, meidän avustuksellamme, omat elämänkertansa. Ne eivät pelkäästään kerro, mistä ne ovat tehty, kuinka kauan ne kestävät tai kuinka hyödyllisiä ne ovat. Ne kertovat myös kuka ne teki, kuka niitä rakasti ja kenellä oli taito työstää niitä. Nämä tunteitaherättävät materiaalielämänkerrat opettavat meille meitä ympäröivän tavaran todellisen arvon - ja muuttavat tavan jolla käytämme sitä.

Para este libro estamos haciendo algo poco convencional. Hemos pedido a siete elementos de construcción comunes que escriban, con nuestra ayuda, sus autobiografías. No se limitan a escribir de qué están hechos, cuánto duran o qué utilidad tienen. También escriben sobre quiénes los fabricaron, quiénes los querían y quiénes tenían la capacidad de trabajar con ellos. Estas emotivas biografías materiales nos enseñan el verdadero valor de las cosas que nos rodean, y cambian la forma en que las utilizamos.

Per aquest llibre estem fent una cosa poc convencional. Vam demanar a set elements de construcció comuns que escrivissin, amb la nostra ajuda, les seves autobiografies. No només escriuen sobre de què estan fets, quant duren o com d'útils són. També escriuen sobre qui els va fer, qui els estimava i qui tenia les habilitats per treballar amb ells. Aquestes biografies emotives ens ensenyen el valor real de les coses que ens envolten, i canvien la manera com les utilitzem.

For this book we are doing something unconventional. We asked seven common building elements to write, with our help, their autobiographies. They don't just write about what they are made of, how long they last or how useful they are. They also write about who made them, who loved them and who had the skills to work with them. These emotive material biographies teach us the real value of the stuff that surrounds us – and changes the way we use it.

Für dieses Buch machen wir etwas unkonventionelles. Wir haben sieben typische Bauelemente danach gefragt ihre Autobiografien, mit unserer Hilfe, zu schreiben. Dabei schreiben sie nicht nur aus was sie bestehen, wie lange sie halten und wie nützlich sie sind. Sie schreiben auch darüber, wer sie erschaffen hat, von wem sie geliebt wurden und wer fähig dazu war mit ihnen zu arbeiten. Diese emotionalen Materialbiografien lehren uns den wahren Wert der Dinge, die uns umgeben und verändern die Art und Weise, wie wir sie nutzen.

Voor dit boek doen we iets ongewoons. We hebben aan zeven alledaagse gebouwelementen gevraagd of ze, met onze hulp, hun autobiografie willen schrijven. Ze schrijven niet alleen waar ze van zijn gemaakt, hoe lang ze meegaan of hoe nuttig ze zijn. Ze schrijven ook over wie hen gemaakt heeft, wie van ze heeft gehouden en wie de vaardigheden had om met ze te werken. De roerende biografieën leren ons over de waarde van de dingen die ons omringen – en veranderen de manier waarop we ze gebruiken.

在这本书中，我们想要做一些非同寻常之事。七种材料在我们的帮助下拥有了自己的编年史。其中不止包含了它们是由什么制成的，它们的生命周期多久，或者它们有多大的用处。还包括是谁制造了它们，谁对它们爱得深沉，谁有加工它们的技能。这些情感丰富的材料传记告诉我们，围绕在我们身边的东西的真正价值，并改变了我们使用它的方式。

On this page you can read a short introduction to this ↑
book in 16 languages. These are all the languages
spoken by the 21 contributors to this book.

MATERIAL BIOGRAPHIES – AN EMOTIVE EXPLORATION OF MATERIAL'S IDENTITY

"It matters what matters we use to think other matters with; it matters what stories we tell to tell other stories with; it matters what knots knot knots, what thoughts think thoughts, what descriptions describe descriptions, what ties tie ties. It matters what stories make worlds, what worlds make stories." [P1]

In our current economy of waste, the remedy to revaluate materials and change the ways we use and dispose them, is to no longer think anonymously about them, but to make them come alive by writing their biographies. In this book we tell anew their material stories and present studies of how materials have been valued and used historically. We also present stories of how builders, building techniques and skills have changed over time. In this way we reveal how the **value** of materials is part of a contingent cultural, economic, social, and technical interrelationship within our world.

This book is the outcome of an exploration to the biographies and the potential future of seven common architectural elements: **door, window, roof, gutter, light, stairs**

and sewage. Through research, interviews, drawings, and visual and textual narration, we have analysed and represented how different people and different worlds engage with materials. The exploration is a kind of **reversing of architecture** - from architectural elements to cultural significance, to personal connections, to raw materials.

With this exploration we reconnect common consumer goods with the societies that create them. In this way we start to understand the different ways that materials are entangled in our lives - as they flow and come to rest in buildings, cities, and landscapes. Please enjoy the stories that open onto other stories.

Peter van Assche
Katja Hogenboom
Hanna Hoss

P1Donna J. Haraway, Staying with the Trouble: Making Kin in the Chthulucene (Durham and London: Duke University Press, 2016).

HUMANS VS. STAIRS

We often think that people can control all buildings, including stairs. But this is not the case. When we pour time, energy and emotion into the design and construction of a staircase, it affects us, even changes us, in a subtle way.

In a lecture delivered during his brief stay in Athens, Rem Koolhaas, a renowned architect and Harvard professor, spoke of how the market economy, and shopping in particular, has been a central force in changing cities and our experience in them, and how this development in turn has fostered new types of architecture. For example, one of the analogies between the shopping experience and architecture is made with reference to the escalator in a store, that sense of being taken almost unconsciously from one level to another. Indeed, Koolhaas argued that the sweeping curves favored in contemporary architecture are a replication of the smoothness of this structural form.

Do we build the stairs, or do the stairs build us? Through our research, this relationship gradually becomes clear. What cannot be ignored is that emotion, eternally, is present in all kinds of architectural relationships.

spiral stair ↑

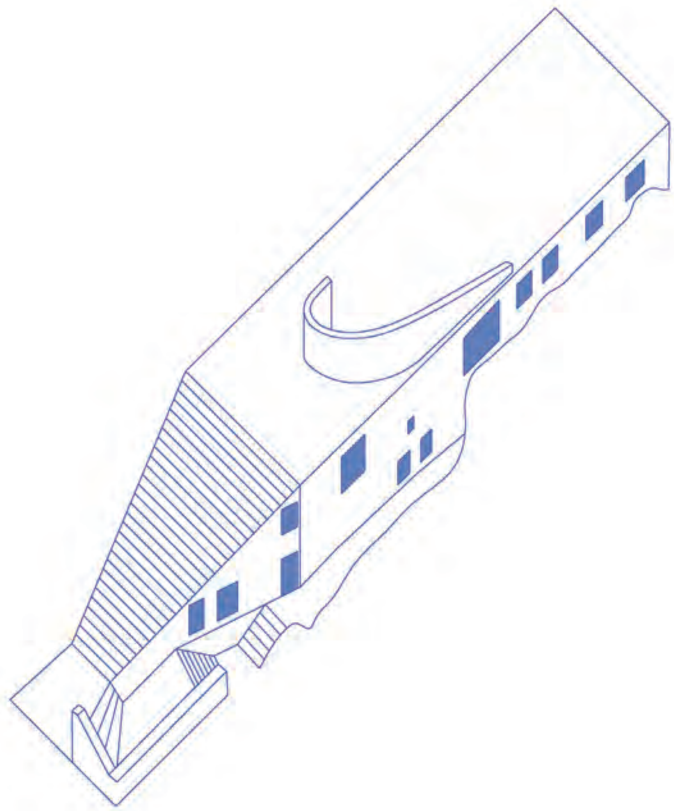
STAIRS BUILD US

Stairs also shape human beings, with its subtle qualities. We present three different representative architectural projects in which stairs play a very important role. Stairs are to architecture as expressions are to faces. As you climb the stairs, you will feel the story the building tells and the feelings it conveys.

The first project is “Why Don’t We Do It On The Stairs” by the architectural collective Re-Make / Re-Model, designed for the Roskilde festival and to be exhibited at the Danish Architecture Centre in Copenhagen, is a concept based on flexible use.[S1]

The second staircase is located at one of the entrances to the Fondation Louis Vuitton, built by Frank Gehry in Paris in 2014. [S2]
It is a monumental staircase that is not accessible to visitors: water flows down the steps from the top to the excavated part, like a fountain.

The third one, imposing inverted pyramid staircase is part of Villa Malaparte, a residence built in 1943 by Adalberto Libera in Capri. It takes a special place, because it leads to the roof, which serves as a solarium, but it is also a part of it. It is a perfect setting for Jean-Luc Godard’s film Le Mépris (1963), and thus contributes to the emotional artistic dimension that can be conferred on the staircase.[S3]



Casa Malaparte ↑
Adalberto Libera
Capri, Italia

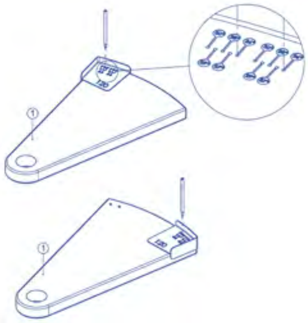
WE BUILD STAIRS

And, of course, people build stairs.

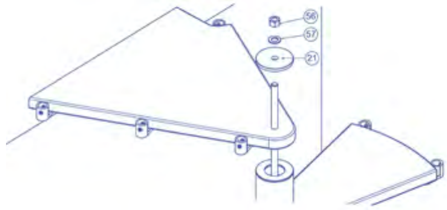
Humans have built all kinds of stairs. From stone stairs, wooden stairs, concrete stairs, to metal stairs. Let's choose a metal spiral staircase that we love and try to figure out where it came from, how it was built, how much it cost, how much time it took, how much energy it took, and finally, the afterlife of it.

There is no denying that building a steel staircase is very energy intensive. Just to build a step, this production process releases 244,85 kg of carbon dioxide, requiring 2,4 trees to be planted to achieve carbon neutrality. That's why it's important to use prefabricated building components and to recycle them. The clever recycling of staircases makes the main building structure more sustainable by increasing the lifespan of the building, as it must be damaged during renewal.

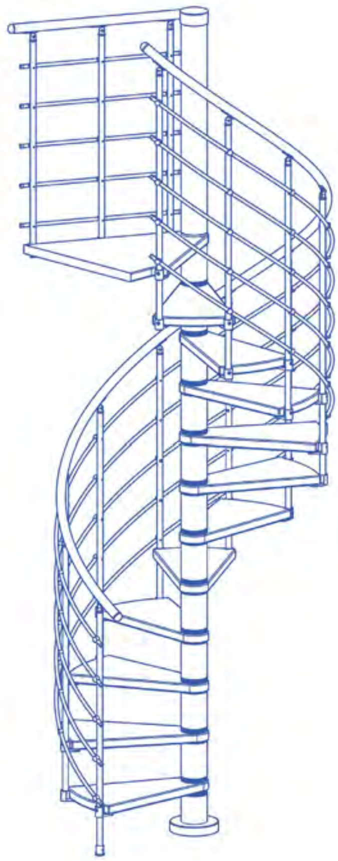
Installation steps of steel spiral stairs →

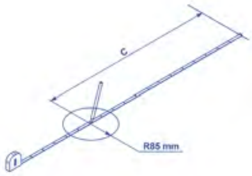


STEP 1
PREPARE THE STEP

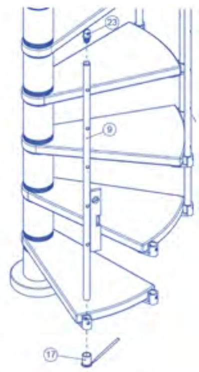


STEP 4
INSTALL THE STEPS

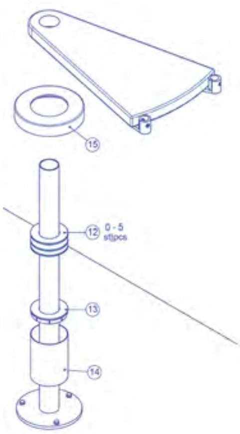




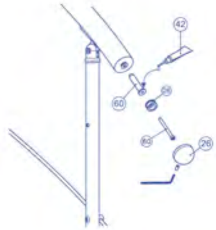
STEP 2
POSITION



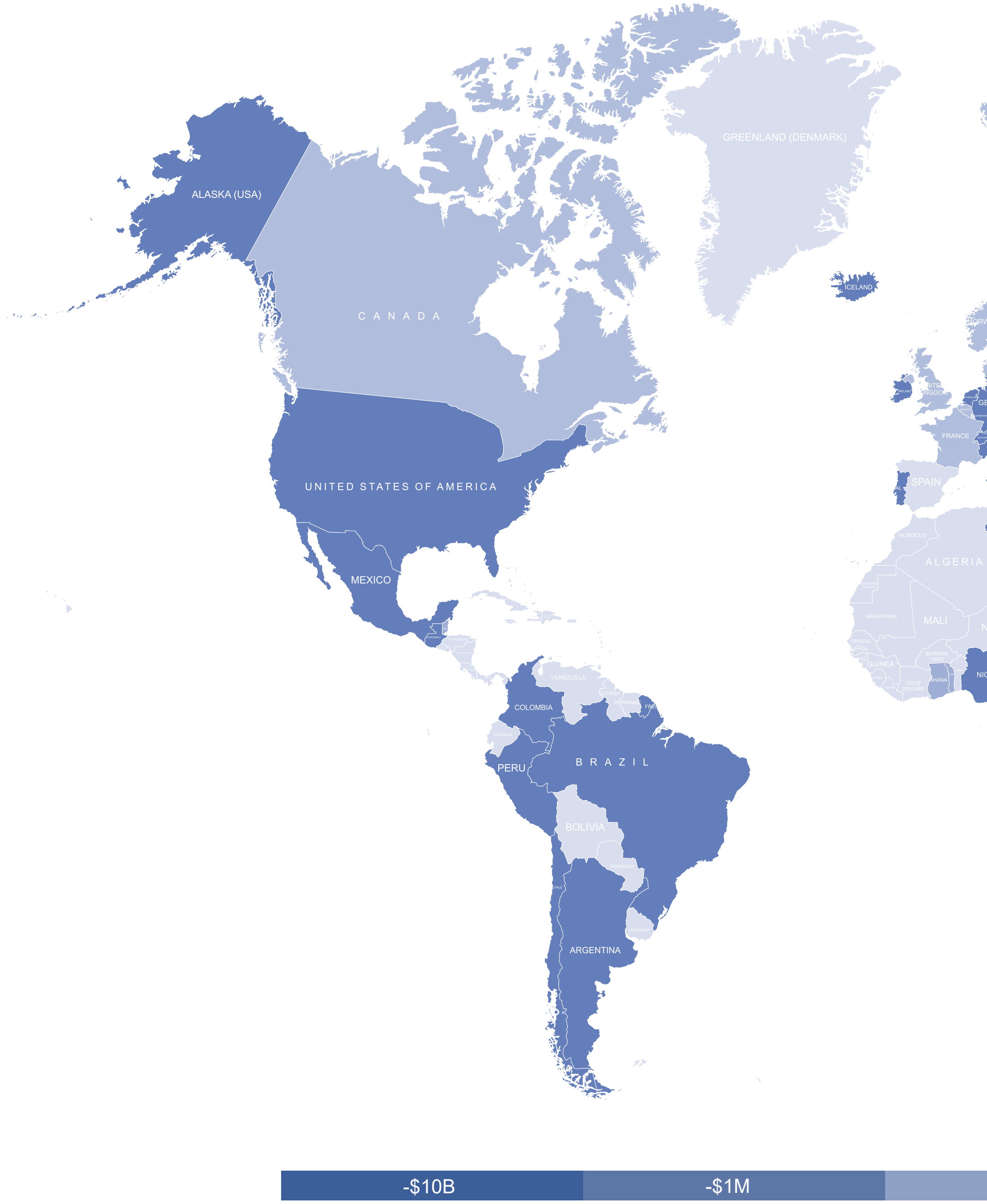
STEP 5
INSTALL THE VERTICAL HAND-
RAILS



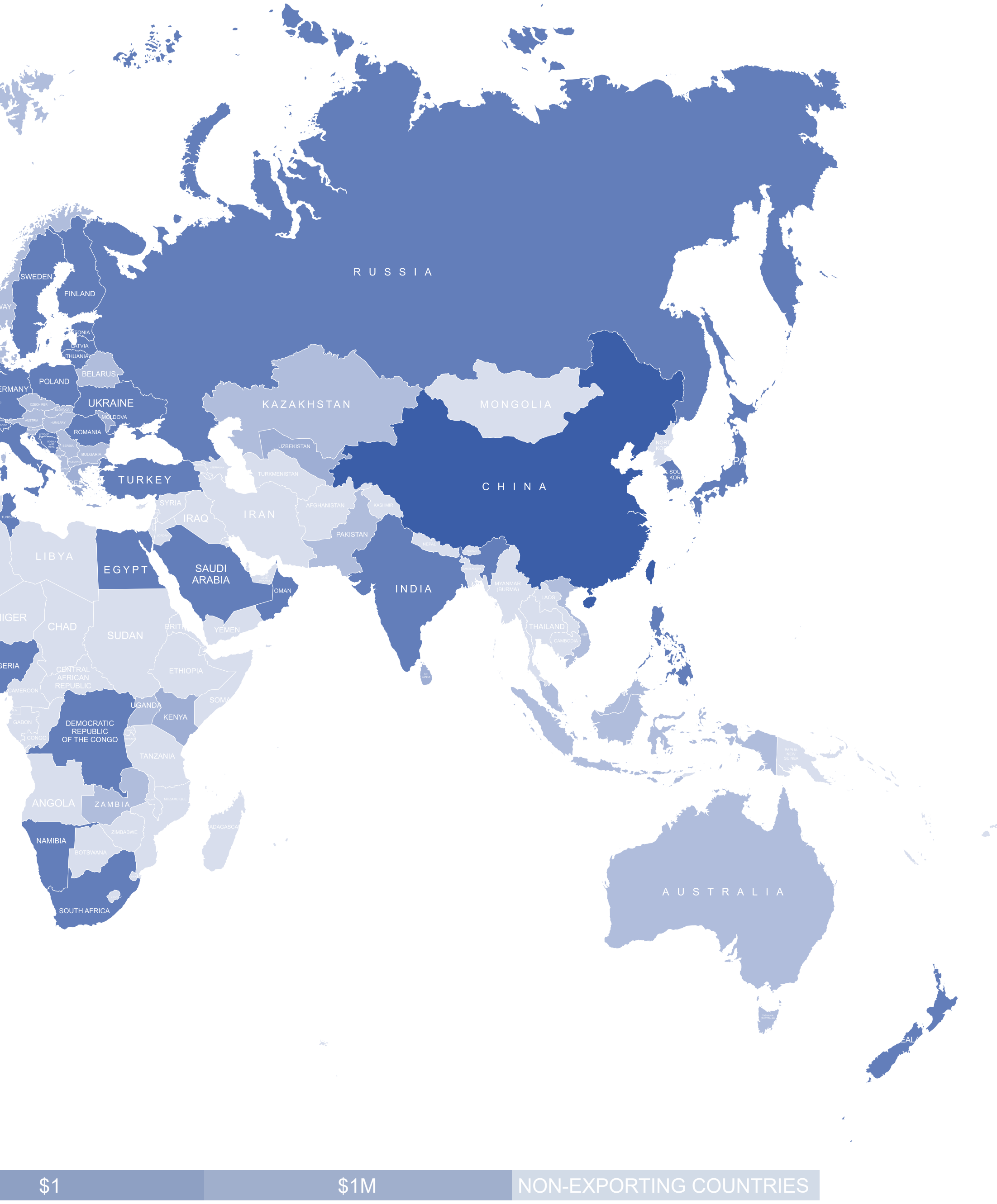
STEP 3
INSTALL THE COLUMN

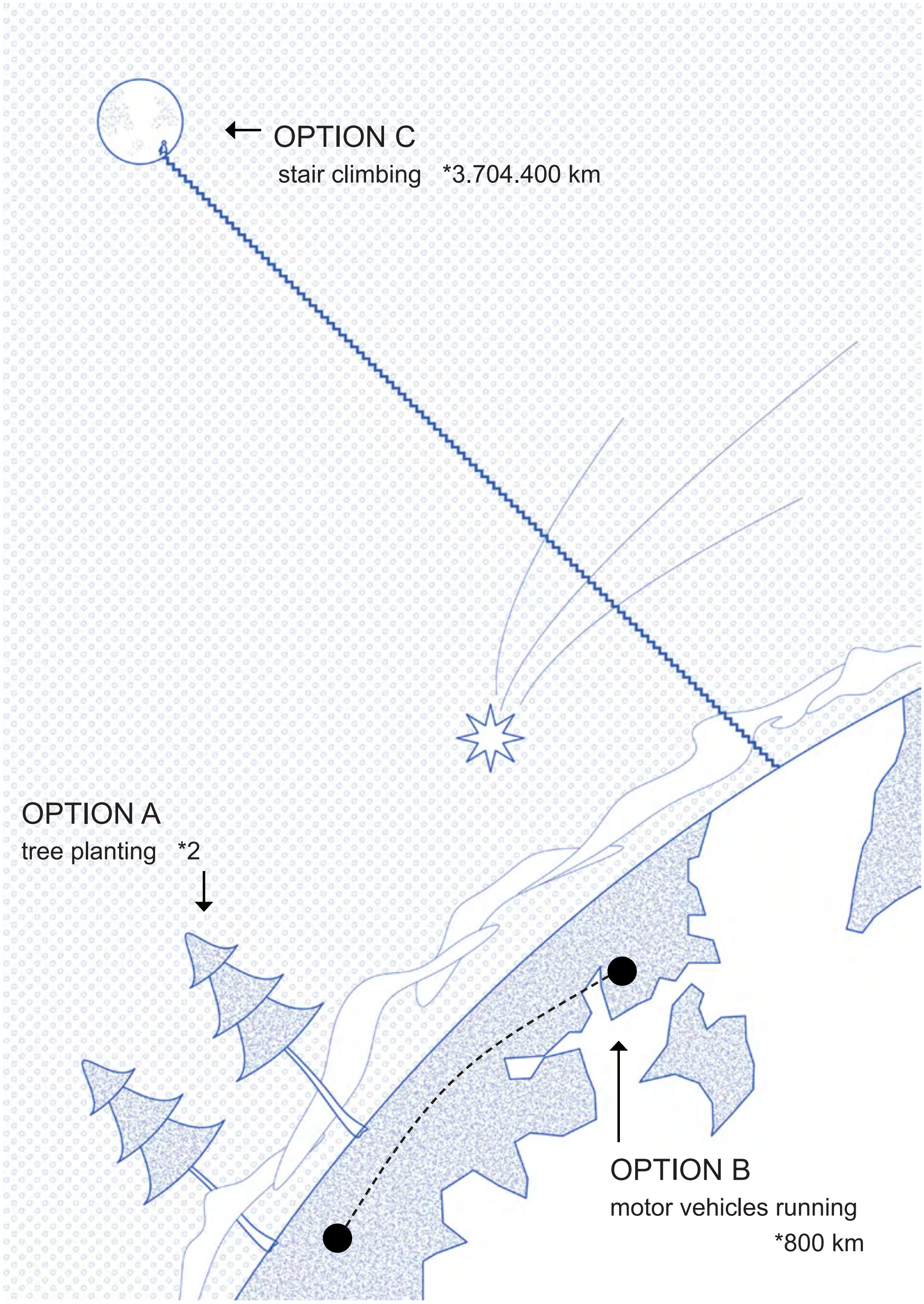


STEP 6
INSTALL THE HANDRAILS



↑ Price map of exporting countries for stainless steel


RUSSIA
SWEDEN
FINLAND
POLAND
BELARUS
UKRAINE
ROMANIA
KAZAKHSTAN
MONGOLIA
CHINA
TURKEY
SYRIA
IRAQ
IRAN
PAKISTAN
LIBYA
EGYPT
SAUDI ARABIA
OMAN
INDIA
CHAD
SUDAN
YEMEN
ETHIOPIA
CENTRAL AFRICAN REPUBLIC
UGANDA
KENYA
DEMOCRATIC REPUBLIC OF THE CONGO
TANZANIA
ANGOLA
ZAMBIA
NAMIBIA
SOUTH AFRICA
THAILAND
AUSTRALIA
$1
$1M
NON-EXPORTING COUNTRIES



↑ What do we have to do in order to talk about neutralizing a step?

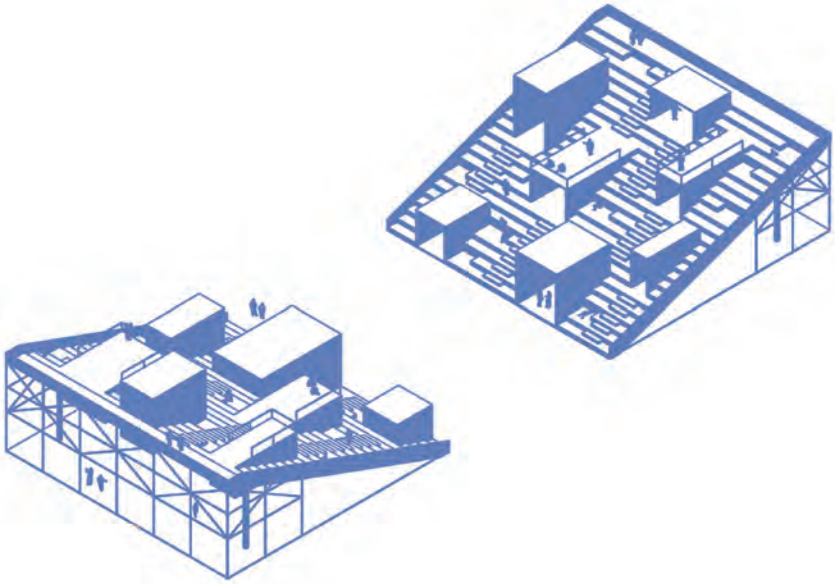
TO NEUTRALIZE ONE STEP...

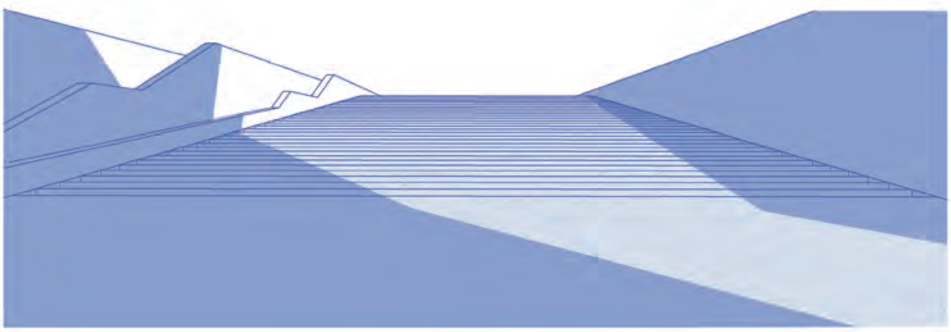
How much energy does it really take to produce one stair board? This is a difficult question to answer, but we found a way to visualize its answer for you quite simply. We offer three quantitative options.[S4]

Option A: Plant two trees
Option B: Drive 800 km in a moderately friendly minivan, from Amsterdam to Munich.
Option C: Climb the stairs from Earth to the Moon, spanning a total of 370.440 km.

If you are interested in how we arrived at this result, here is the arithmetic process.
The volume of a normal steel floor slab is known to be 0.003 m^3, and the raw materials required to obtain 1 ton of billet are 1.7 ton of iron ore and 0.665 ton of coking coal. it is known that the amount of coking coal required to produce a stair slab is 0.01242885 ton - equivalent to 244,85 kg of CO_2.

The equivalent amount of carbon dioxide, which is also equivalent to the calories provided by 80 kg of rice, can supply 308.700 calories to the human body. A 135-pound person can burn 7 calories per minute climbing stairs. It is known that it takes 20 seconds to climb a three-meter-high floor. It is known that this energy can be used to climb the stairs at a height of 3.704.400km. It is equivalent to climbing from the earth to the moon.





↑ Ecalier inhabited
'Why Don't We Do It On The Stairs?
Roskilde Festival 2011
↓ Fondation Louis Vuitton faciat
Frank Gehry
Paris, France

SOURCES

S1 'Why Don't We Do It On The Stairs?
https://www.archdaily.com/126093/why-dont-we-do-it-on-the-stairs-re-make-re-model/axo-35

S2 Fondation Louis Vuitton faciat , Frank Gehry
https://www.alamyimages.fr/photos-images/prix-pritzker.html

S3 Casa Malaparte, Adalberto Libera
https://issuu.com/hendersonevan70/docs/henderson_evan_arch102_sp21_processbook/s/12253907

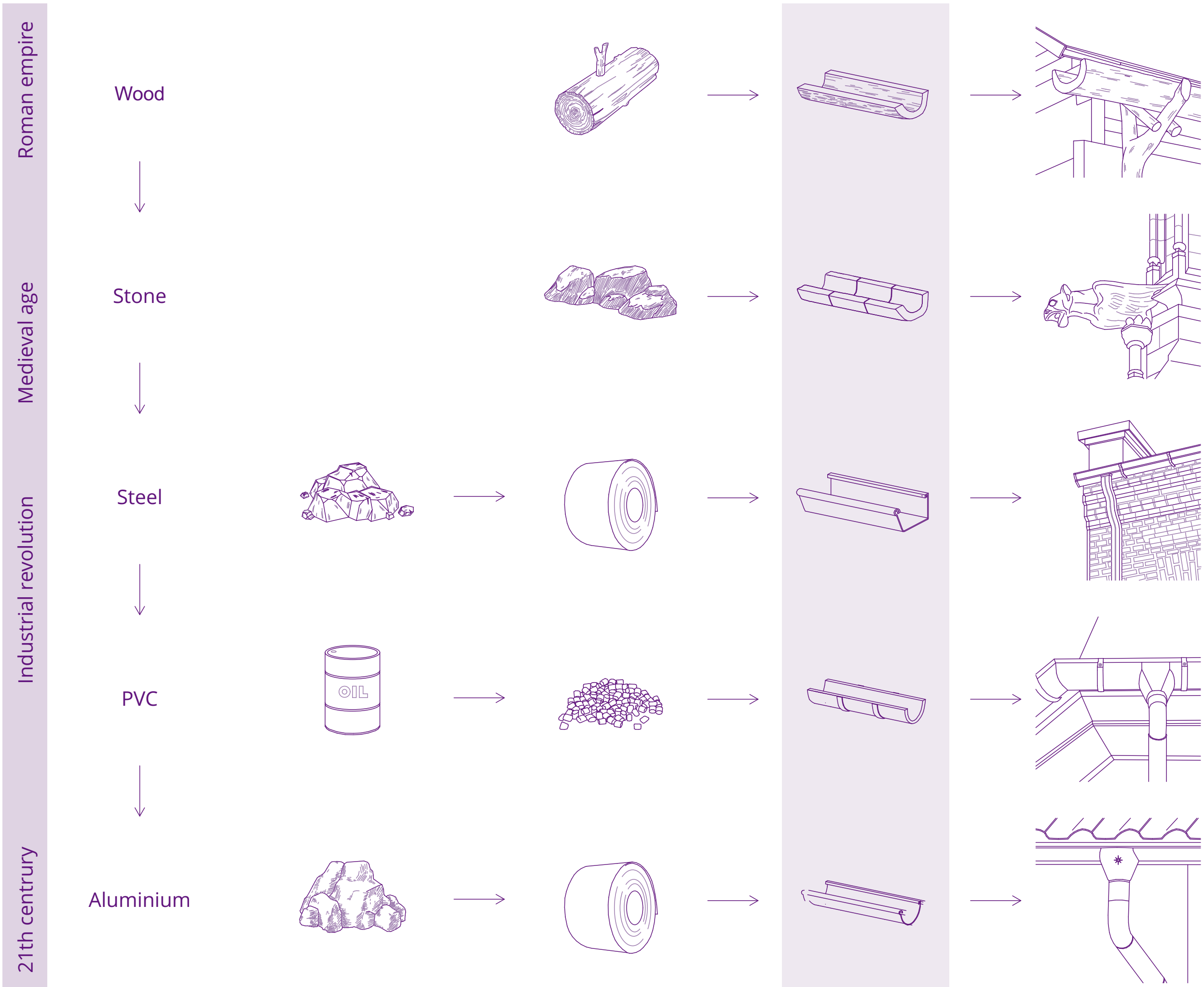
S4 carbon footprint calculater
http://2018.carbonstop.net/carbon_calculator/en/

S5 Architecture for today's metropolis, Alexandra Koroxenidis
https://www.ekathimerini.com/culture/2555/architecture-for-todays-metropolis/

S6 Net Trade (2020)
https://oec.world/en

WHAT IS A GUTTER?

This was the question as we got the assignment to research gutter. A rain gutter is **an element of a water discharge system** for a building.[G1] Normally you can find it easily that gutters surround the whole edge of the roof and the downpipes go down along the wall to the ground. But sometimes, especially in modern buildings, it's hard to find gutters because they are hidden or integrated into the roof system. Bringing the rainwater, collected on the roof, down to the ground is very important, since it prevents harm like damaging construction, fungi, and hurting its residents. This is not only for the pitched roofs but also for the flat roofs where the rainwater should be immediately drained, otherwise it enters the building and gives overweight.
Gutter is so important that we can not live without it at all. But sadly, we as architects forget gutters and plan them just at the end of the planning. Through our research, we found that a gutter as an architectonic element could be as beautiful as well as other classical elements like doors, windows, etc. So, we want to draw your attention to gutters and review the glory of gutters. **Make gutters great again!**


Roman empire
Wood
Medieval age
Stone
Industrial revolution
Steel
PVC
OIL
21th centrury
Aluminium

STORY OF THE GUTTER

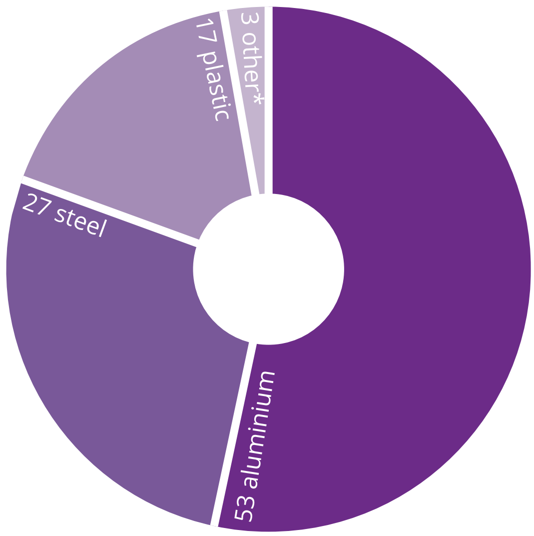
It was a Roman who used the first gutter. It simply covered a roof with two drains. Early gutters were made of wood or stone that were available nearby. These raw materials were direct and easy to transform, but wood is vulnerable to water and humidity and stone is rather massive and heavy to transport.
At same time, the gutter system is introduced by the Romans in Great Britain. Constructing rain gutters in houses in medieval cities was unusual. But more and more important buildings like churches and castles began to build stone roofs that had built-in gutter systems.
Around the 18th century, metals like lead and copper were more available as roofing material and also used to construct pipes. Especially lead was a popular material for gutters, since it was cheap and had a long lifespan of about 100 years. Eventueally using lead for gutters was forbidden, because it contaminates water and causes harm to animals and humans.
In the early 1900's, as the industrial revolution was booming, steel became the material of choice for rain gutters, because of its strength and resistance to rot. During and after the Second World War, steel was harder to obtain and aluminium was becoming popular for industrial purposes. Because of its light weight and durability, aluminium soon became the main material of choice to produce rain gutters, and it still is to this day.

MATERIAL - ZINC

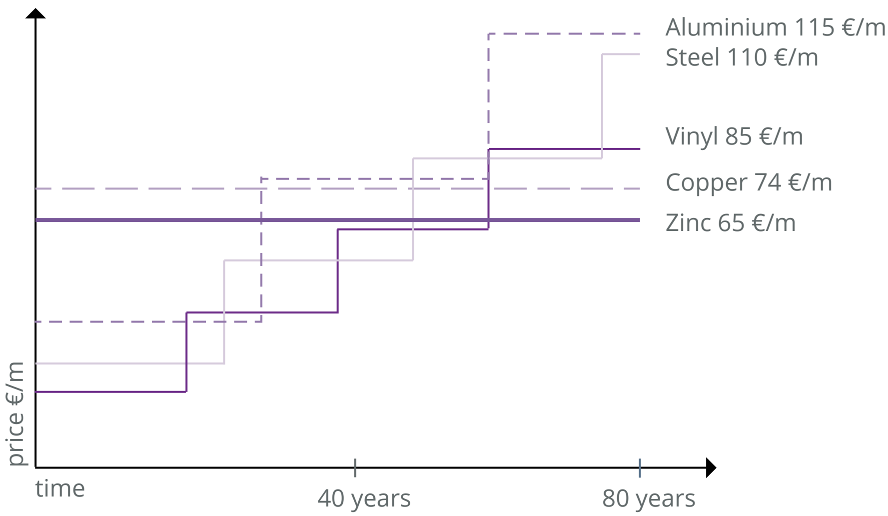
Contempory gutters come in many shapes, forms and materials. In the developed western markets most of the new gutters are made of aluminium, steel or plastic (vinyl). The particular gutter that was researched for this project was made out of zinc. Nowadays zinc is rare choice for new gutters because it is considered expensive.

Our research challenges this claim. Zinc gutter, alongside with copper, has one of the highest material and installation costs, so it's expensive at the first purchase. However, it is one of the longest lasting gutter materials. As the cheaper options have to be replaced every 15-25 years, a zinc gutter can last even 100 years if maintained properly.[G5]

After calculating the average manufacturing and installation costs at the first purchase as well as for replacements, the total price of different gutters was put on a timeline. The cheaper materials have to be replaced often, so in 40 years the difference in price has evened out and in 80 years the more expensive materials end up actually being the most affordable option. By choosing the more durable gutters we wouldn't just save material and energy but also money.



*other materials such as copper and zinc



↑ **Gutter materials**
materiality distribution of new gutters sold in the western developed markets[G3]

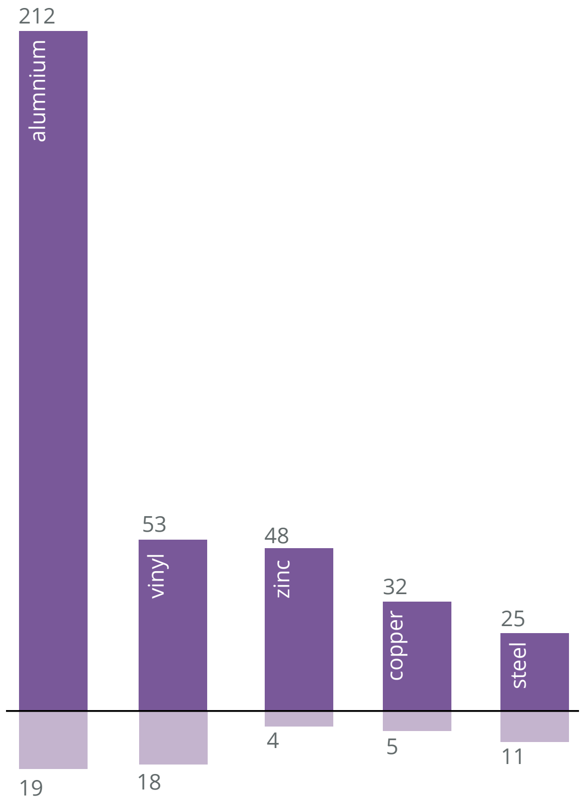
↓ **Total price after installation and renewal**
shows the cost of installing & renewing different types of gutters through the lifespan of 80 years[G4]

In terms of energy, some materials require more processing than others, as can be seen in the diagram on the previous page. The manufacturing of aluminium consumes by far the most energy, whereas steel seems to be the most energy-efficient option.

However, saving energy is not the only aspect we have to consider. Reducing manufacturing energy and prolonging the lifecycle of material is just the first step in sustainability - we have to aim at 100% recyclability in the future.

Steel gutters seem like the ideal option in terms of energy, but they aren't recycled as well as zinc and aluminium. Steel gutters are usually made from galvanized steel, which has a zinc coating. The steel can be easily collected but the zinc coating is mostly sacrificed.[G7]

The reserves of zinc are finite, but as the amount of recycled zinc is increasing, no physical scarcity is expected in near future.[G8] However, in the long run we will run out, if we keep throwing material away. Currently over 50 % of the global zinc consumption goes into galvanizing.[G9] Either better ways to collect zinc from galvanized steel should be invented - or instead of steel gutters we should opt for 100% recyclable zinc gutters.



↑ **Energy consumption in gutter material production, MJ/m**

Above: energy required in new raw material production. Below: energy in production from recycled material.[G6]

AMAZING GUTTERS

There is also a way to approach the gutter other than just as a recyclable, boring object that is replaced every so often. A gutter could be celebrated and appreciated. **It could be beautiful.**

In contempory architecture the beauty for gutters is hard to find. They are forgotten, until the very last moment of designing and added to plans like a sticker, a necessary evil that potentially ruins the aesthetics. They are supposed to be cheap and easy, not something that elevates the building.

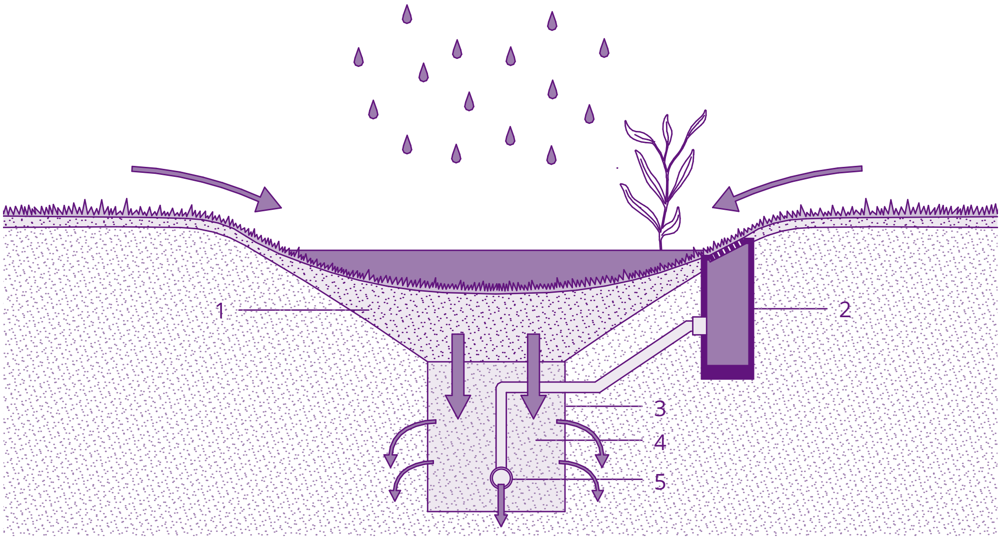
If we would show the gutter some love and let it shine, we could create something that is not only functional, but also interesting. As an important visual part of the building it would be justified to spend more time and money on it. A well-thought solution would outlive any reluctantly added piece of unwanted material.

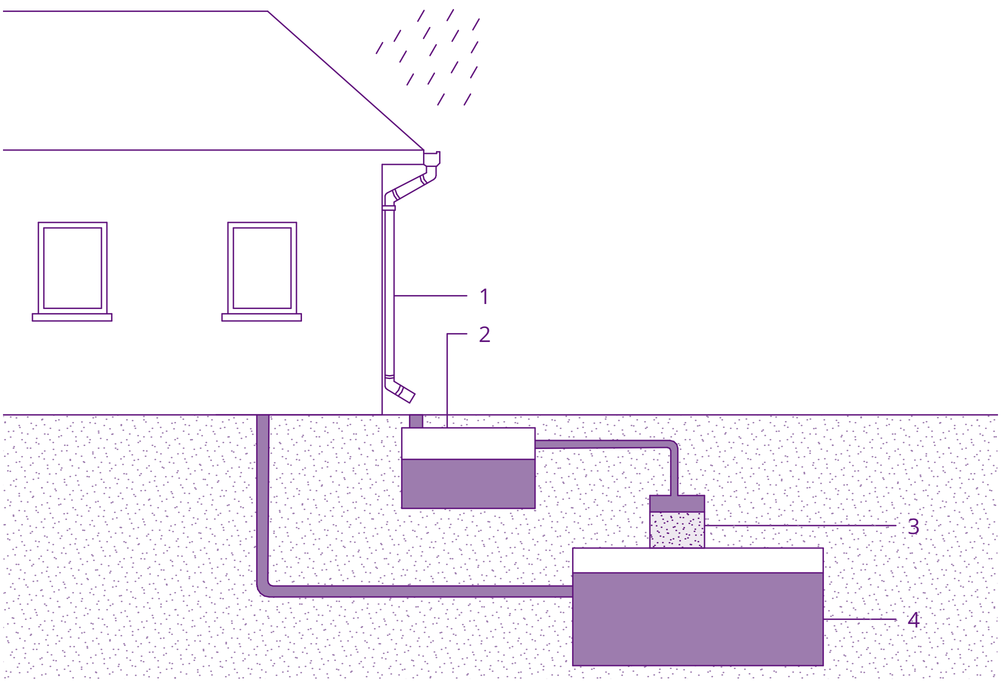
On page on the right there is an example of an extraordinary gutter - which is pretty amazing.

Chapelle Notre-Dame-du-Haut →
Ronchamp, France, 1955
Le Corbusier

WHERE RAINWATER GOES

Have you ever wondered where the rainwater goes after it’s collected on the roof and sent to the gutters and pipes? Normally, the collected rainwater is drained through underground pipes before it goes to a public rainwater sewer, where the water is treated to be used again, or sent to the river.
The main two traditional systems are a **sanitary sewer** and a **combined sewer** for processing rainwater and so-called grey water (water without fecal contamination). Water can be in short supply at times and rainwater is an important resource for nature - and humans. There are two good alternatives to reuse rainwater in a more ecological way: **WADI** (Arabic for riverbed) and **rainwater harvesting systems.**
A Wadi is a ditch filled with gravel and sand, that can both retain and infiltrate water. The water from roofs and roads will flow into the Wadi, where it otherwise would just flow into the sewer system. The second option is a rainwater harvesting system, a system that collects and clarifies rainwater. The clean rainwater is then collected in a water tank and pumped back into the house to be used as rinse water, shower water or other purposes.





The Wadi system ↑

1 Ground improvement | 2 Glutton

3 Aggregate | 4 Geotextile | 5 Draintube

Rainwater harvesting system ↓

1 Downpipe | 2 Rainwater catchment

3 Sand filter | 4 Main water tank

DRINKING WATER

In the developed countries there is a sufficient clean water supply and we can afford to direct the rainwater back to the ground or use it for other purposes. In some parts of the world, lack of clean water has lead to a health crisis and using rainwater as drinking water could help the situation, as a pioneering Sky water - project in Bangladesh has shown.[G10]

Rainwater in itself is in most cases drinkable, but collecting it from the roofs, flowing it through gutters and storing it in watertanks might contaminate it. The risks are in all parts of the system.

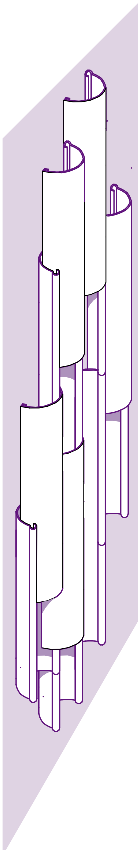
Firstly, in the water might end up dangerous building materials such as lead nails, bitumen, asbestos, treated timber or cracking paint. Secondly, any surface could be contaminated from moss, pollution or animal droppings. Also, trash might block the system or convey bacteria to the water.[G11]

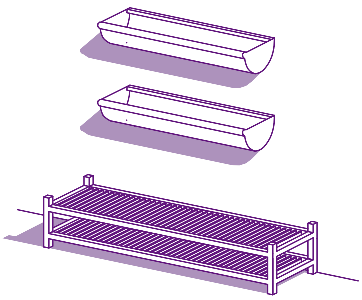
Many metals have also been considered a risk for the water, including zinc. However, a Massey University study discovered that **zinc is in fact benefitial in killing bacteria** in the water.[G12] In addition to choosing right materials and minimizing risks, keeping the system clean is key.

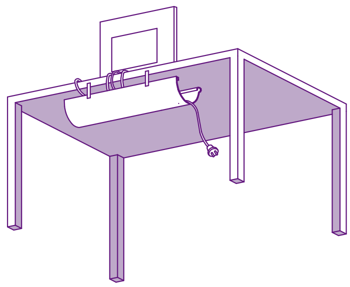
Possible factors to cause contamination ↑
in the water collected from the roofs
through gutters and downpipes.

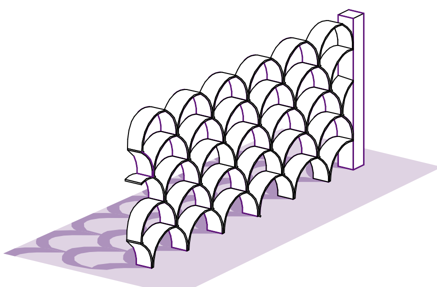
AFTERLIVES

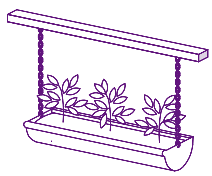
Finally, a gutter has come to the end of it's life on a roof. What happens next? It ends up in the landfill or the material is transformed to something completely different.
But what if we want to keep the gutter, could something amazing be made out of it? The shape of the object would create interesting new structures or useful household objects. Only imagination is the limit.

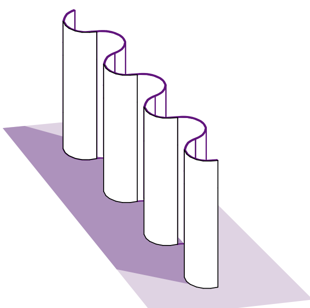


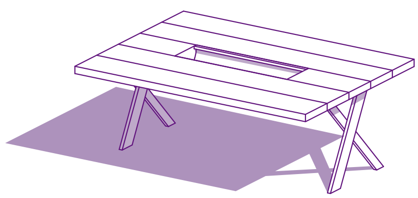












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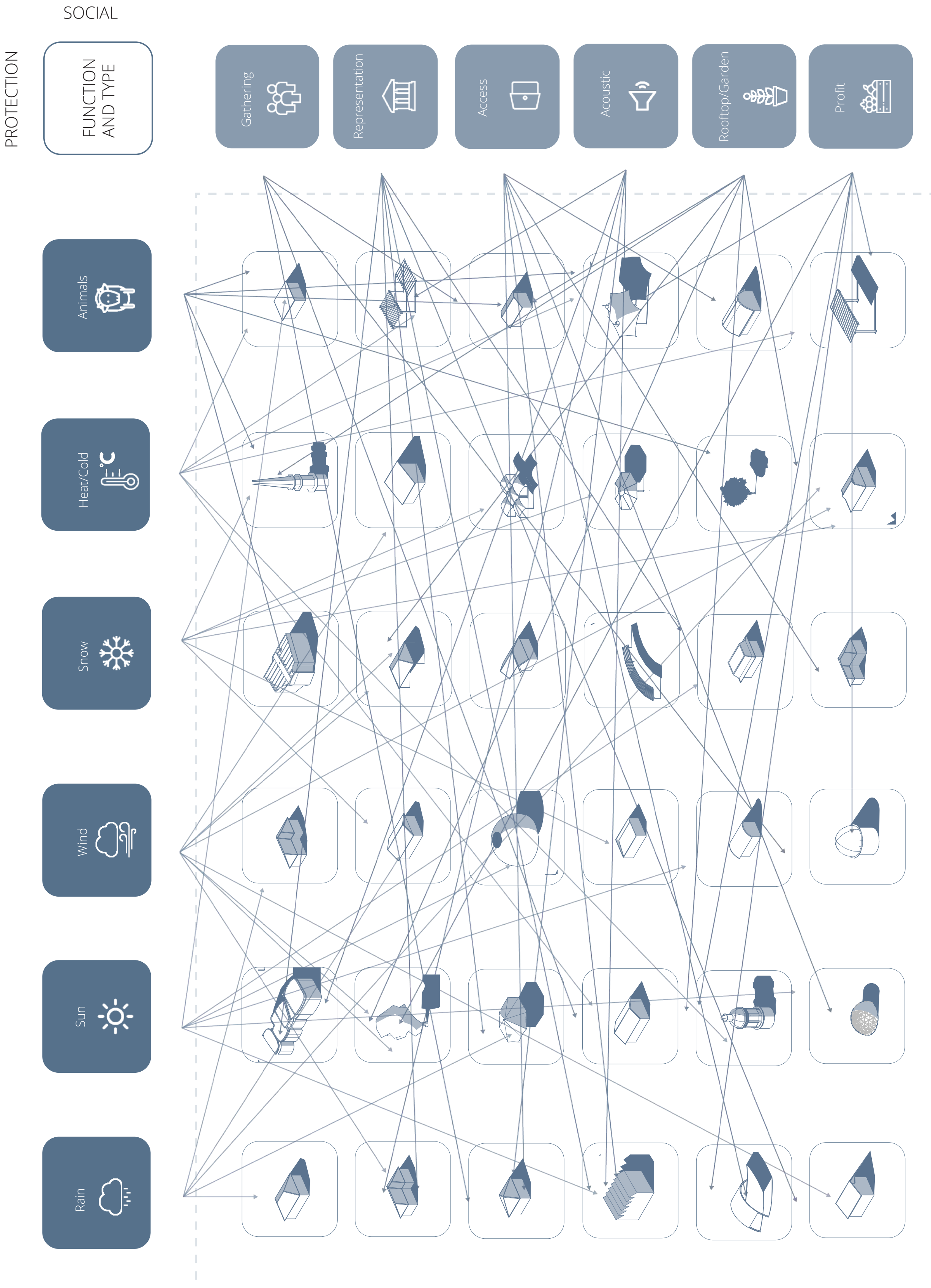
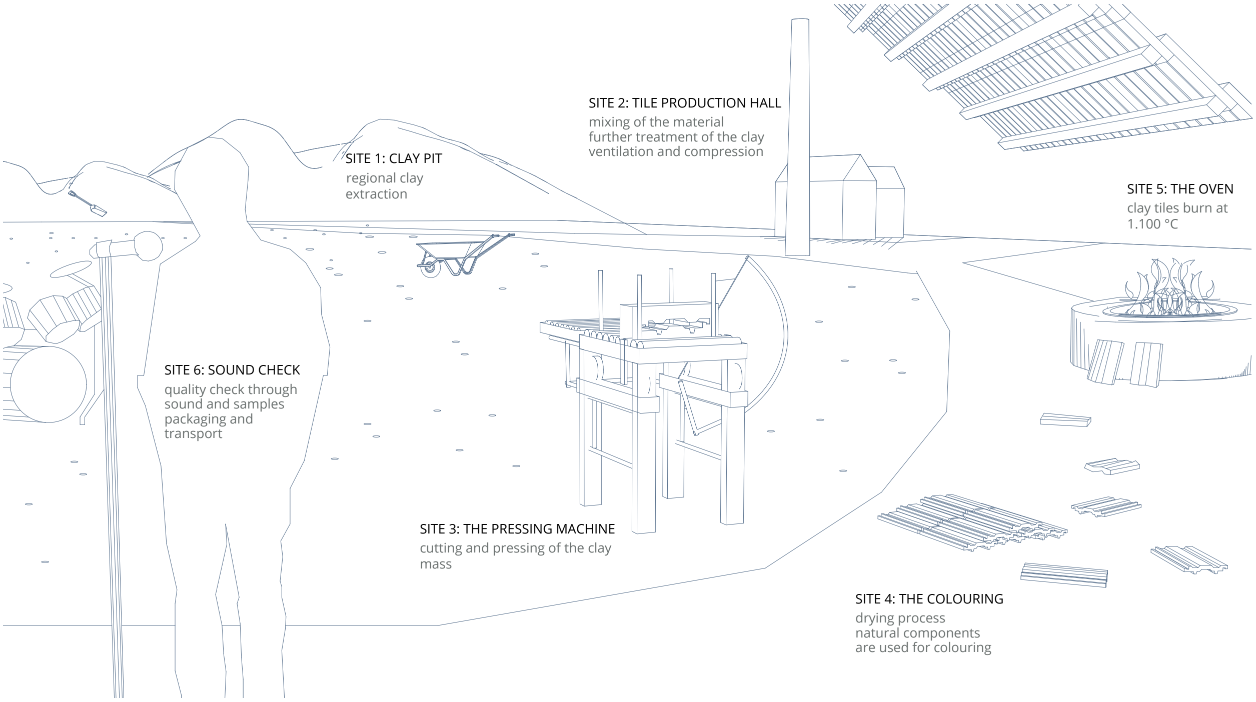
WHAT IS A ROOF?

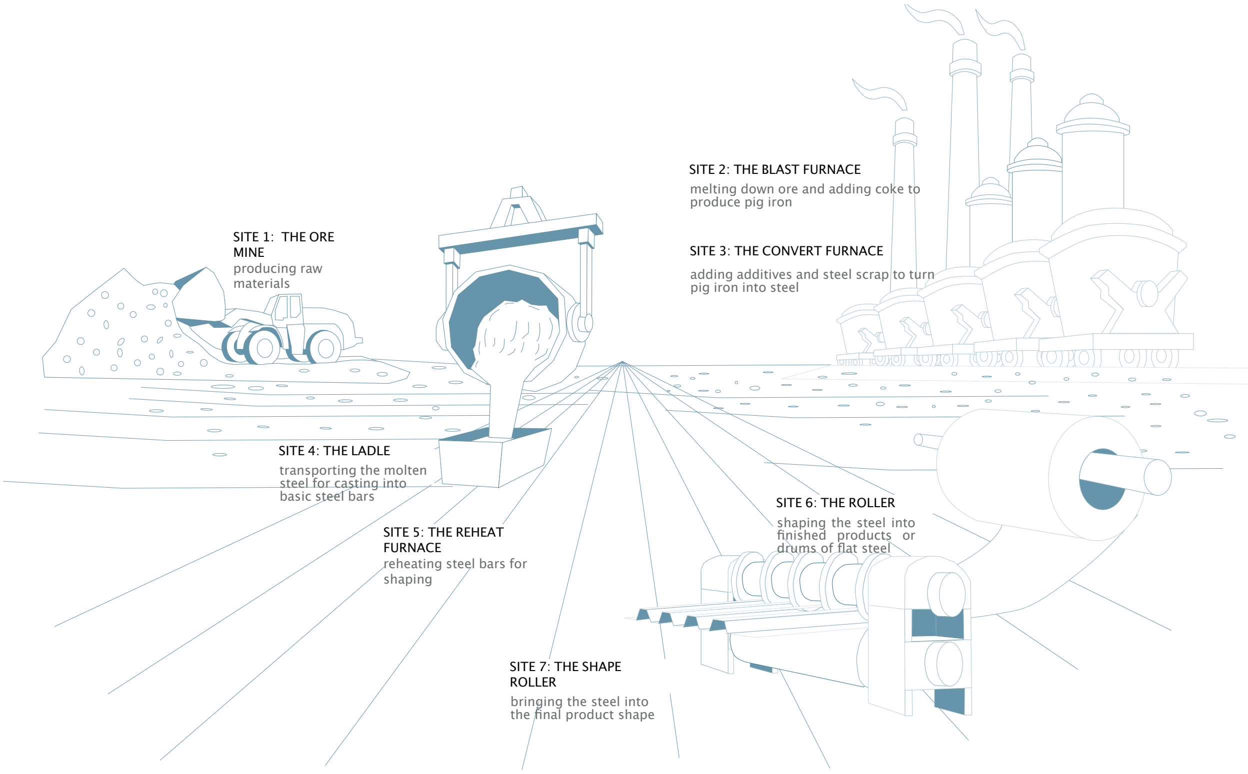
Humankind has always been in need of finding refuge under a roof. The reasons remain the same: a roof protects us from wind, weather and animals. A place to gather, to stay and to live. At first it was caves that gave this protection, but soon humans became more nomadic. While quickly built shelters and tents gave shelter in the beginning, development of the “roof element” started when humans settled and started to build more permanent structures. This marks the historical birth of the roof and furthermore of the house. Unlike any other element of a house, the roof is determined by its geographical location, the societal expectations and the technical capabilities of its creators. Suddenly this most basic of architectural elements becomes a complex mirror of its surroundings. Not only does a roof give a single building its character, it also creates the identity of a whole street, neighbourhood and even of a city[R1]. Likewise then does the city, the neighbourhood, the street determine the shape of a roof. In a unique way does this simple element reflect, in its form and material, the time of its creation, the skill and possibilities of its creators, the site of its construction and the function its society expected it to serve - a monument to the architecture of its time.


SOCIAL
PROTECTION
FUNCTION AND TYPE
Gathering
Representation
Access
Acoustic
Rooftop/Garden
Profit
Animals
Heat/Cold
Snow
Wind
Sun
Rain



Clay tile roofs are a big part of shaping the image of a city. They come in different types, colours and finishes, as they are made from purely natural resources. Starting in the clay pits, the material is gathered and transported to the nearest clay tile factory. There the material is processed into a mouldable clay mass. It is cut in pieces and runs through the pressing machine, which gives the clay tiles their form. After being dryed, coloured and burned, the clay tile is born! One factory produces around 60.000 tiles a day, which would cover 30 roofs of one-family houses. But before they can be sent off to the wide world, they have to be checked for their quality. And they are checked by their sound, so 60.000 sounds a day[R2], that's almost as if In the Air Tonight by Phil Colins played 143 times a day[R3]. And who wouldn't want that?!

↑ Perspective of the production of clay tiles



In principal there are two methods for producing steel[R4]: Using an electric furnace with steel scrap, or using a blast furnace with raw iron and coke (raw carbon refined from coal). In a blast furnace, the iron ore is melted down through multiple heat zones, removing all the impurities, until only the raw pig iron remains. The still melted raw iron is the further refined in a converter furnace, where the steel is finetuned with additives and steel scrap to suit whatever purpose it is later used for. Since steel is an extremely versatile material, the Register of European Steel alone has over 2400 types of steels registered, all with different kinds specifications[S2]. The finished steel is cast into moulds and shaped using a variety of methods. In the case of our trapezoidal sheet, it is first hot rolled into a roll of sheet metal, and then cold rolled into the trapezoid shape[R5.]

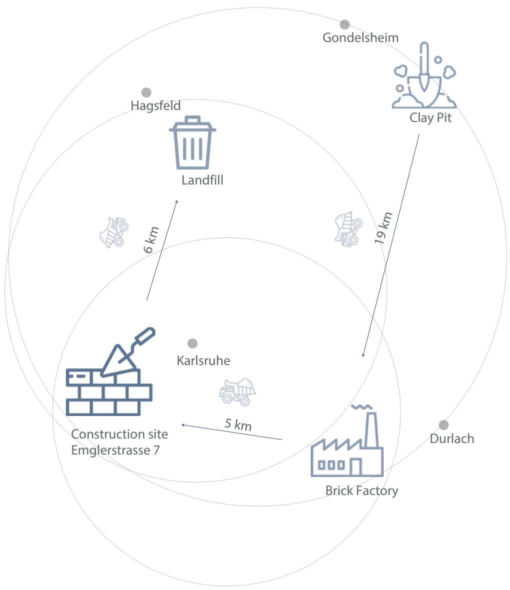
Perspective of the production of steel ↑

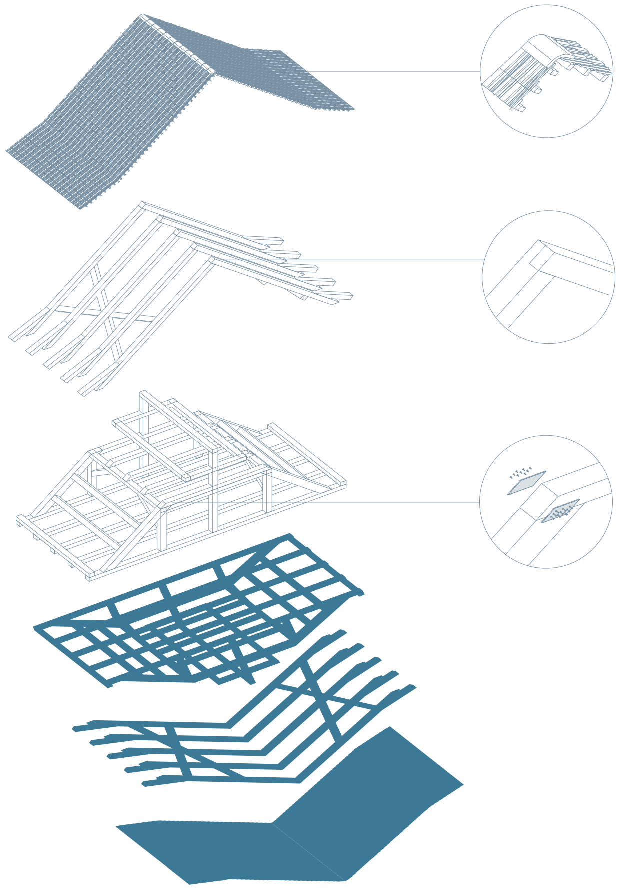
STORY OF THE TILE ROOF

With 3.150 square meters, approximately 61.681 roof tiles are needed to cover the roof of the KIT architectural faculty. A wooden substructure holds the bricks together. At the top end, a special tile is produced to close all gaps. If you stack the roof tiles on top of each other, you get a height of 3.084 m. That is exactly the height of the Swiss mountain called Mont Rogneux (3.084 m) [R6]. Alternatively, ten times the height of the Eiffel Tower (300 m).[R7] That's quite a lot of tiles, considering that they only adorned the roof from 1896 to 1945. Normally, the life span of the tiles is about 60-80 years.[R8] If the war hadn't ended their lives so abruptly, they would have survived another 31 years. At the latest when the tiled roof is no longer watertight, it should be replaced. Gaps in the roof or even broken tiles could be to blame. As soon as the roof leaks, moisture can get into the interior of the house and promote the development of mould. The beams of the attic could also become decayed and no longer provide the load-bearing capacity. Moss and algae on the roof are harmless from a structural point of view. A roof coating seals the affected surface so that neither dirt nor water can infiltrate and prolongs the service life.

STORY OF THE STEEL ROOF

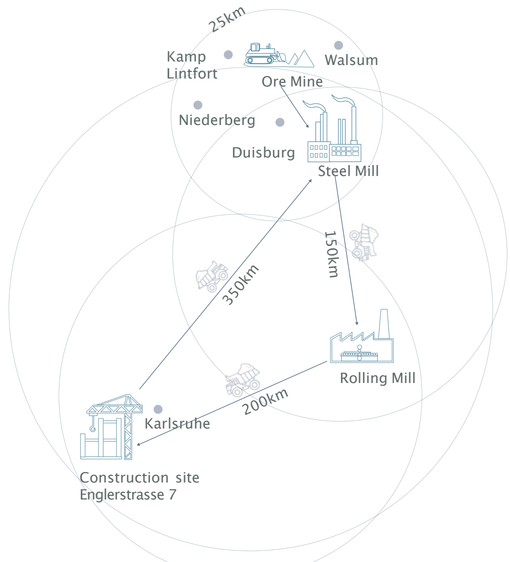
With approximately 3.150 square metres, approx. 433 trapezoidal sheets are needed to cover the roof. These have the dimensions 1,04m x 7m.[s10] This would be 3.031 meter or approx. 7,6 laps of a 400 meter running track. The steel metal roof came in 1956 with the addition of the first floor in the Faculty of Architecture. After the tile roof was destroyed in 1945, the metal roof was the cheaper alternative to rebuild the roof. The pitch of the roof changed and became much flatter. Despite the increase in height, the absolute height of the building did not change due to the flat roof. The new type of roof is called a flying roof and was typical of the 1950s[R9]. Because of the long overhang, and because it was more economical, they were mostly constructed as metal roofs. If they were made of tiles, they would be much too heavy and the overhang could not take the weight and the loads. With careful execution, as guaranteed by the member companies of the craftsmen's association, with adherence to the necessary slope and ventilation of the wooden substructure, one can assume a service life of at least 40 years.[R10] Compared to other roof coverings such as tiles, it is a relatively inexpensive way to cover a roof.

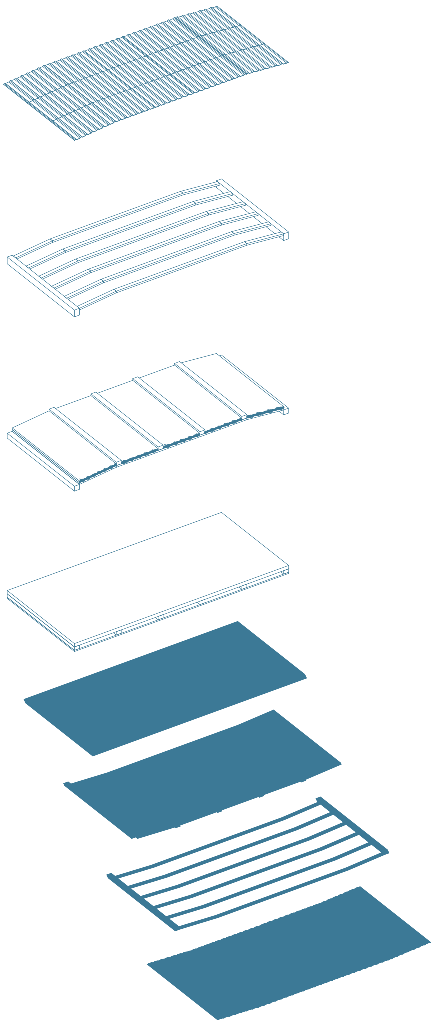




↑ The path of the clay tile in kilometers from birth to life to death to reuse

↓ Axonometric construction drawing of the clay tile roof at the Institute for Architecture at the KIT faculty



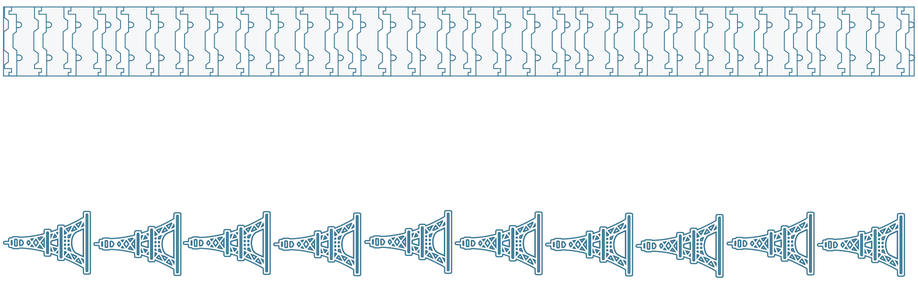


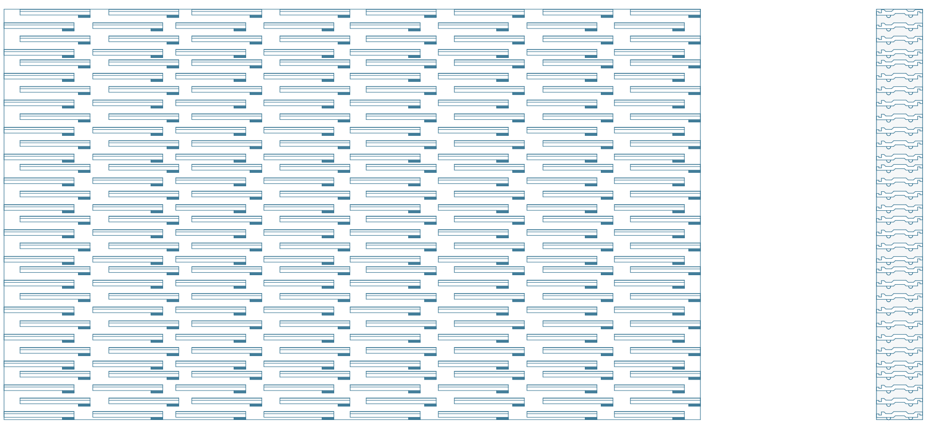
The path of the clay tile in kilometers from ↑
birth to life to death to reuse

Axonometric construction drawing of ↓
the metal sheet roof at the Institute for
Architecture at the KIT

THE AFTERLIFE OF TILES

Although roof tiles are not that cheap and are complex install, they are discarded frighteningly quickly. Since the quality cannot be guaranteed for every tile, most builders do not take the risk and opt for the easier way: the way to the landfill. But some see qualities and alternative uses for the roof tiles: the hidden treasures. If you stack the roof tiles vertically, you can even build walls out of them.[R11] Thanks to modern recycling plants, the demolition material can be used to produce high-quality technical aggregate for road, path and sports field construction or as a vegetation substrate. Everyone has seen another use for old tiles in everyday life. Old tiles (and bricks) can be grounded and transformed into brick sand. This gives tennis courts and sports fields their characteristic red colour.[R12] Historic tiles are also used for renovations and even for designing complete facades. More dealers are gradually appearing on the internet who are putting old tiles back on the market. This way, restoration projects can find the right puzzle pieces and thus save the whole structure. So there are many ways to give tiles a second life before they end up in landfill.





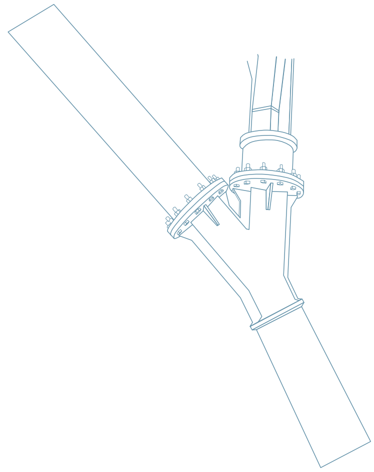
stacked tiles of faculty roof ↑
= 10x Eiffel Tower

Elevation of wall made with reused tiles ↓

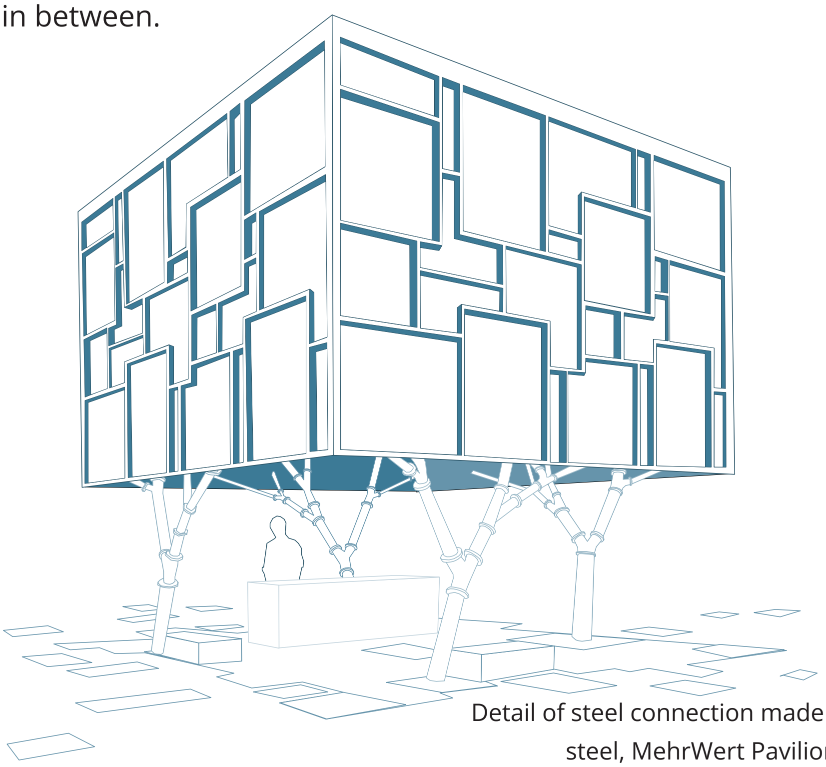
THE AFTERLIFE OF STEEL

Steel is already one of the most recycled materials. 86% of steel in Europe is being recycled in form of steel scrap, with 56% of European steel now being produced out of steel scrap instead of fresh iron ore [R13]. This bypasses the addition of coke and greatly reduces the carbon footprint of the steel. Steel scrap is also used during the traditional steel making process, being added during the refinement process in the converter furnace.

However, steel is not only limited to recycling. It's longevity also invites opportunity for reuse. In architecture, where a long tradition of reusing materials from older structures is being rediscovered in the context of circular design, steel components suit this idea perfectly. Often the steel parts of a building will outlive the rest of the structure. Whether they are beams, pillars or facade or roofing sheets, the longevity of the material allows for excellent reuse in new projects[S14]. The careful removal from the old structure is of course a requirement, something which can be aided by intelligent design in the future, that keeps this aspect in mind when constructing a project. This approach is of course not limited to traditional elements.



The Mehr.Wert Pavilion in Heilbronn was constructed as a temporary structure for the Bundesgartenschau in Heilbronn in 2019. It is built entirely out of reused and recycled materials and constructed in a way that allows the complete reassembly of the pavilion without damaging any of the components[R15]. The building reuses steel pipes for its eye catching primary structure, while a frame made of reused steel profiles and filled with old glass panels fills the space in between.



Detail of steel connection made with reused steel, MehrWert Pavilion, Heilbronn ↑

The MehrWert Pavilion in Heilbronn made from reused materials. The bearing structure is made out of reused steel. ↓

THE ROOF!

The roof - defined by place, time and the people who inhabit both - has it lost its right to be this beautiful multitude of influences? Has the roof been robbed of its multifaceted expression of regionality and identity by the technical possibilities of constructing the same building anywhere? When material and shape become irrelevant, what factors do then define the roof? While functionality has always been a defining factor in determining the form, it surely can not be the only factor. While the geographical location may have lost relevance, the culture in which it is created has gained importance. A house with a red tiled, tilted roof no longer has to have this shape and material. It is now a conscious choice, influenced by the identity of the city, the neighbourhood, the street. Tradition and culture and, consequentially, the deviation from it, more than ever ground the roof in the architectural consciousness of our society.

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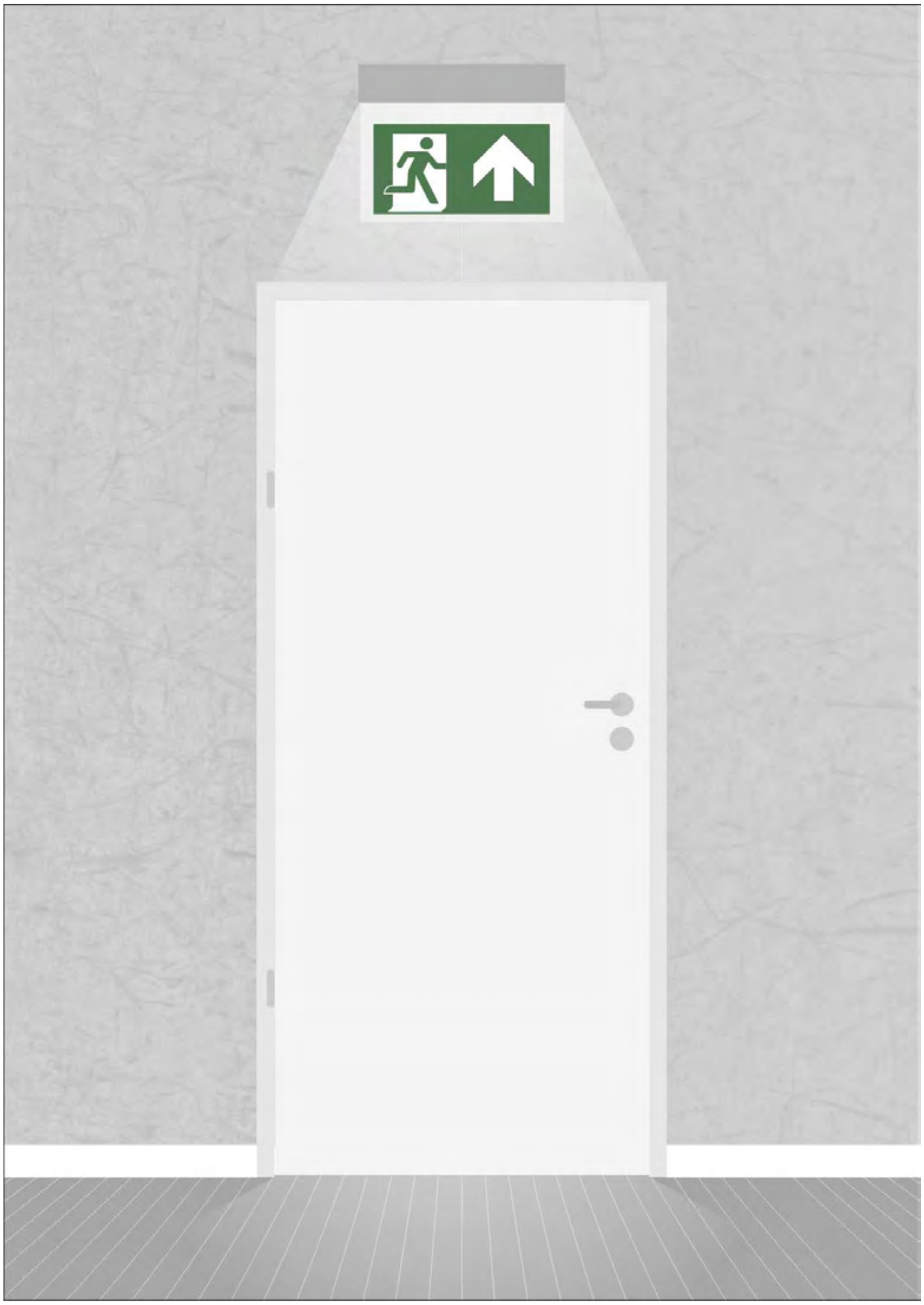
FAST BUT NOT PANICKY

When we think about light, we mostly think about electric light. Lamps which give us light wherever and whenever we desire. Light is essential to our everyday life. Modern society could not persevere without it.

Light has become such a common and available thing that it is used everywhere. Even for emergency exit signs, such as the ones in the faculty building of architecture. Such signs have often become so familiar to people that they no longer see, let alone perceive, them properly. Nevertheless, in the event of an emergency, they help leaving the building quickly, even when visibility is poor. Much anxiety and confusion can be alleviated by strategic placement of emergency lighting and signage indicating the way out of a location or building. Examples of this include placement above doors and in front of stairs.[L1]

Considering the importance of emergency escape route lighting and the sheer amount of these signs in public building lead to the following research. It is intended to illustrate the effect emergency exit light signs have on us and how the signs and their graphics have evolved. And more in detail: which materials are hidden in the small signs and what does the extraction of these mean for the people who are exposed to the corresponding substances?

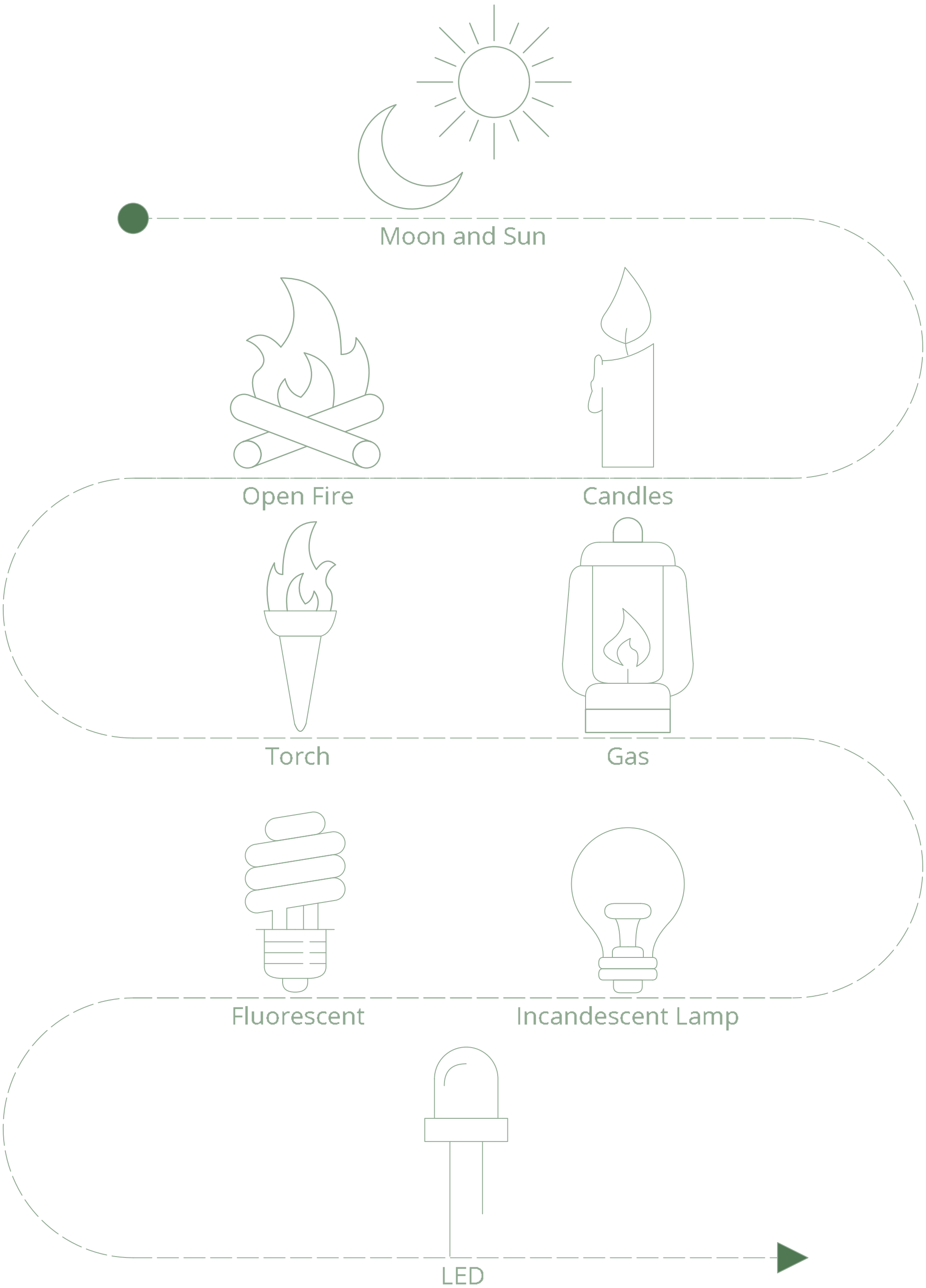


Guiding hope, ↑
Emergency light sign over white door

A HISTORY OF LIGHT

Until little more than a hundred years ago, the open flame was the only known means of illumination.[L2] One of the first technical interventions was the torch.[L3] The next big step was the candle, which is used since the 2nd century. Candles remained essentially unchanged until the 18th century. The cost of candles kept the light consumption in the middle and lower class within limits. They used oil lamps, which often emitted an unpleasant odor.[L4] Around the 18th century, lighting changed with the advent of the industrial production method. For the new factory halls, lighting with candles and oil lamps would have been too expensive. Gas lamps consumed to much oxygen for indoor use.[L2] With the invention of the incandescent lamp by Thomas Edison in 1879 the final separation from the fire took place by abolishing the flame.[L2] After that the invention of the red neon tube, in 1909 light advertising became a huge thing.[L2]

In the next roughly hundred years light got better and cheaper, but with the LED, a completely new illuminant came onto the market. More efficient, versatile and durable than anything before. In 1962, Nick Holonyak developed the first usable red LED.[L4] But only in 2008, the first LED filament lamp was introduced.[L4] Today, 85 percent of new luminaires are equipped with LED light sources.[L4]



A History of Light told by illuminant ↑

↑ Distribution of Emergency exit lights, isometric drawing of southern campus of KIT

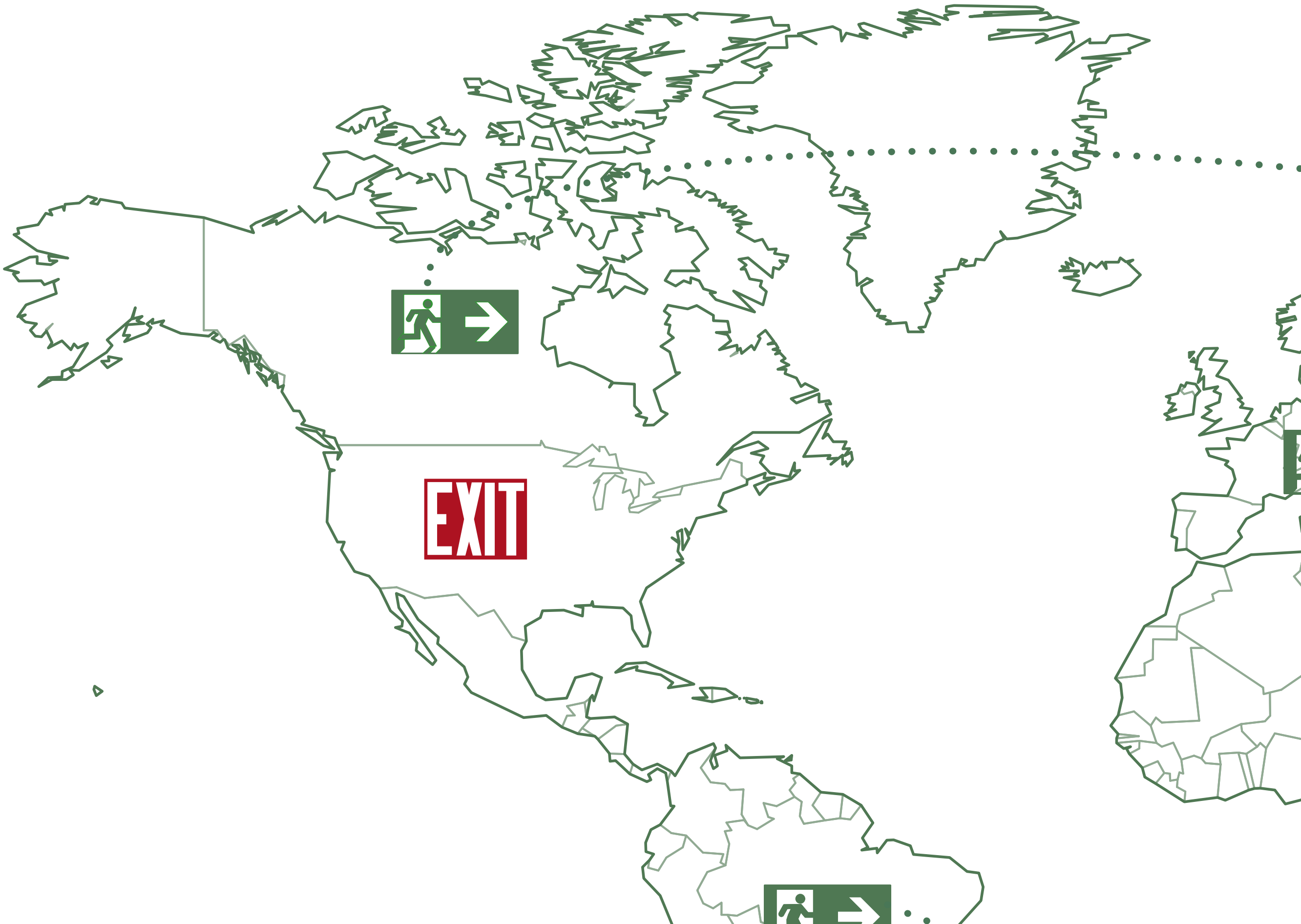
Extrapolated to the entire southern campus of the Karlsruhe Institute of Technology, the campus counts 2.270 signs. Lined up, this results in a length of three quarters of a kilometre: That corresponds to the distance from Karlsruher Schlossplatz to Ettlinger Tor!

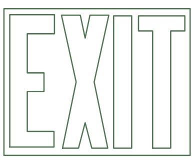
SAFETY FIRST

If the general lighting fails after a power outage, the emergency lighting comes on. Especially in the event of a fire, emergency exit light signs should protect us. Countries like Germany attach great importance to the safety of their citizens and have created corresponding laws and regulations (e.g. DIN EN 1838:2019-11 „Angewandte Lichttechnik – Notbeleuchtung" engl. "Applied lighting technology - emergency lighting").

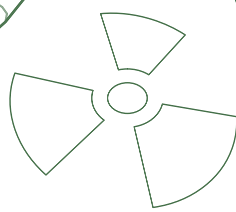
Safety signs have such an essential function that they must be understandable to everyone. The design of the Exit Sign was therefore carefully selected by the International Organisation for Standardisation (ISO) in 1985 and has since been adapted by many countries.[L5] The design has its origin in Japan, where a fire fighters' association held a national competition in 1979. The winner, graphic designer Yukio Ota, was selected from over 3.300 entries. His design shows a figure with ankled legs and arms in front of a door, which is supposed to convey the message "walk slowly". The colour green not only symbolises hope, but is also very visible under smoke. In the USA, the Exit Sign is based on a written text in front of a red background. The sign is often critically discussed, as not everyone is able to read. Complicating matters further is the fact that the colour red is usually associated with a warning and sends the message to stay away.[L5]

Critically drawing ↑
concerning emergency exit light signs,
people running away from the fire



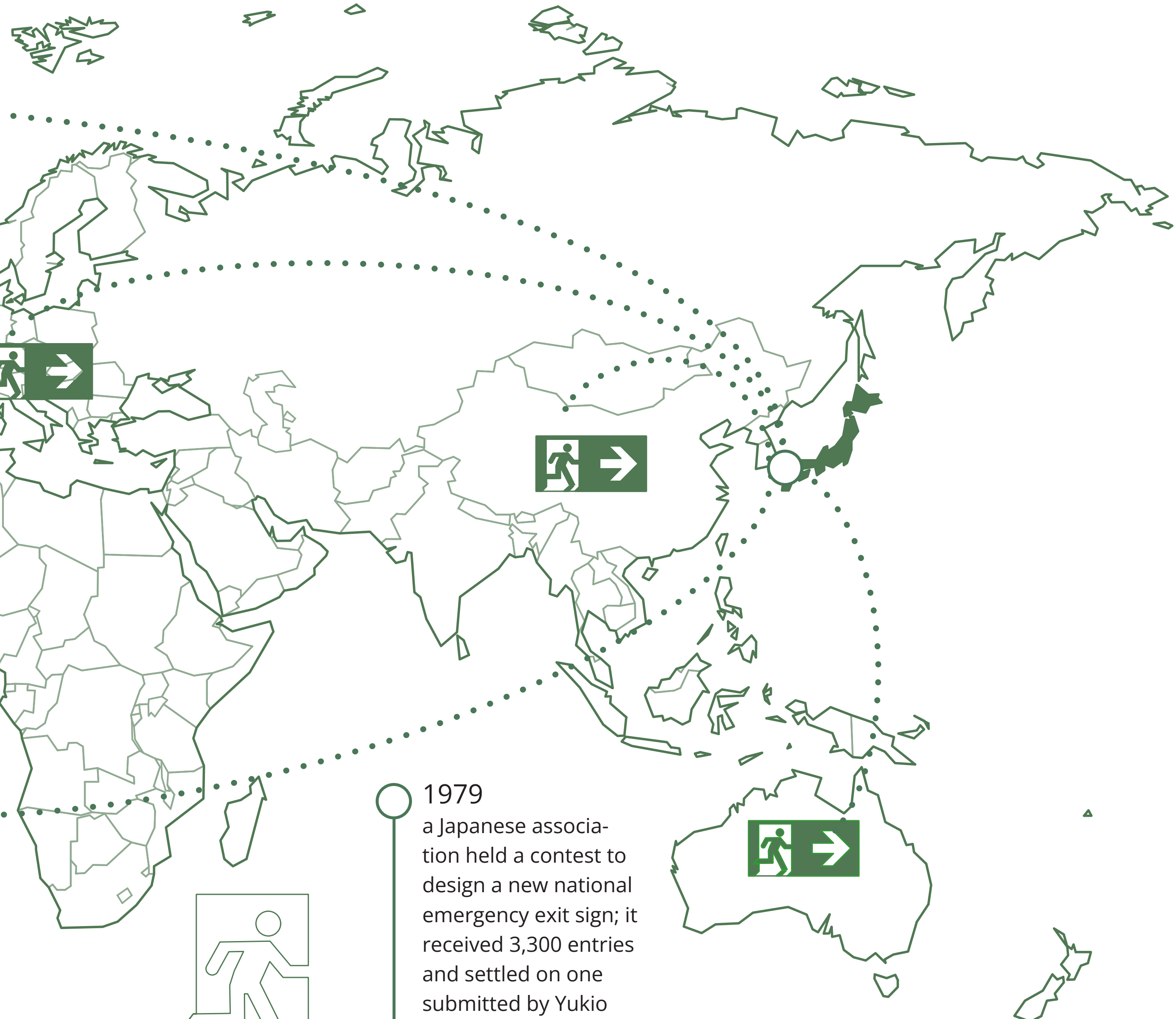


1911
a fire in a garment factory in Manhattan killed 146 workers, which animated the National Fire Protection Association to act on creating a way to evacuate people quicker: the exit sign was born[L5]



late 1950’s
Tritium was discovered as a self powered exit sign alternatives[L8]

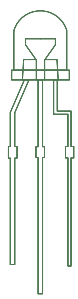
World War II
self powered emergency exits for the military where battery power was unavailable were needed; the dangers of radioactive materials were unknown yet and exit signs were painted with radium and copper-dopped zinc sulfide[L3]



1979
a Japanese association held a contest to design a new national emergency exit sign; it received 3,300 entries and settled on one submitted by Yukio Ota: a figure on a green ground, running out a door[L5]

1964
Japanese graphic designer Yukio Ota publishes the book 'LoCos' where he presents a visual sign language that can be understood with minimal knowledge[L5]

1985
the 'running man' by Yukio Ota was adapted by the ISO and and has since been accepted into standards in many parts of the world[L5]



2000's
the technology of LED (light emitting diodes) is becoming profitable and is rapidly growing in popularity due to its high life expectancy and energy efficiency[L9]

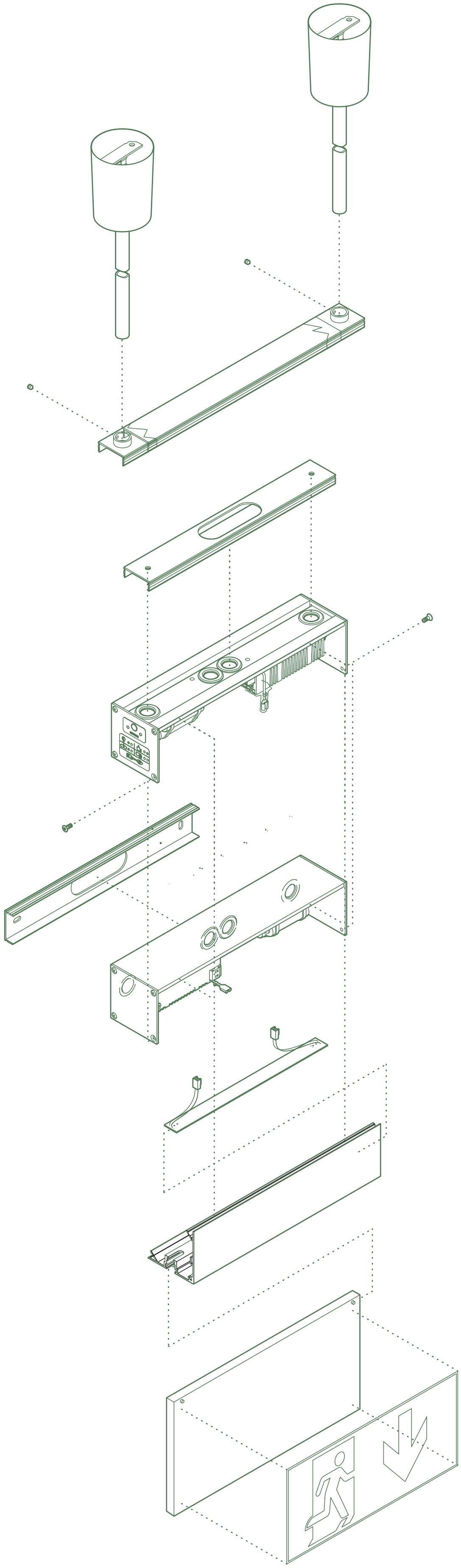
A GLOBAL PRODUCT

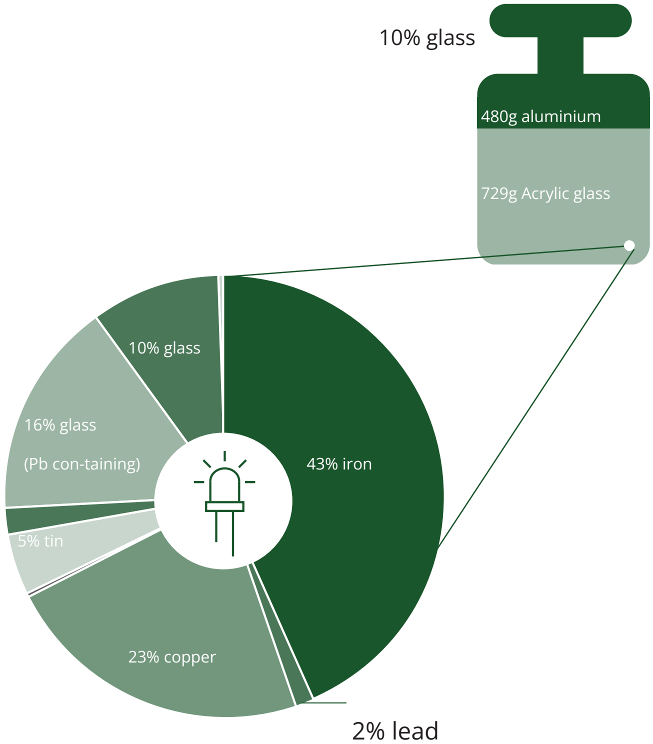
Just in one little emergency exit light sign suffits holding a product in ones hands being highly international. They are complex technical products made of many different materials. Although the main components of the light are the acrylic glass pane and the aluminum housing, there are many more and different materials to be found in the LEDs (here 18 pieces per sign) of an emergency exit light sign.[L6]

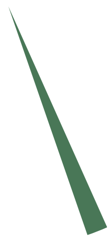
One material used for the production of LEDs is lead. The Institute for Health Metrics and Evaluation estimated that in 2019, lead exposure accounted for 900.000 deaths and 21,7 million years of healthy life lost worldwide due to long-term effects on health. The highest burden was in low- and middle-income countries. IHME also estimated that in 2019, lead exposure accounted for 62,5% of the global burden of developmental intellectual disability whose cause is not obvious, 8,2% of the global burden of hypertensive heart disease, 7,2% of the global burden of the ischaemic heart disease and 5,65% of the global burden of stroke.[L7]

Despite these problems within the production of LEDs lots of money is invested in this lighting technology.

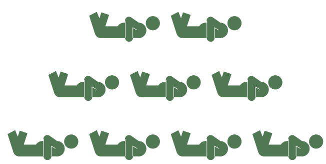
Emergency exit light signs →
exploded isometric drawing
showing the different components
materials in emergency exit light signs [L11] →
health risks of used materials [L10, L12]



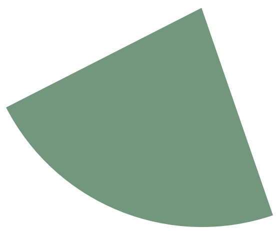


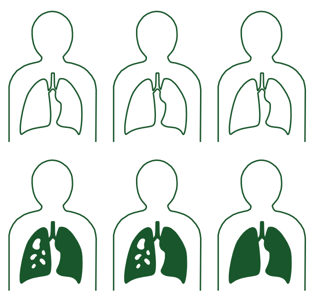


per year:
900,000 deaths and
loss of 21,7 mil. years of healthy life
due to **lead** exposure



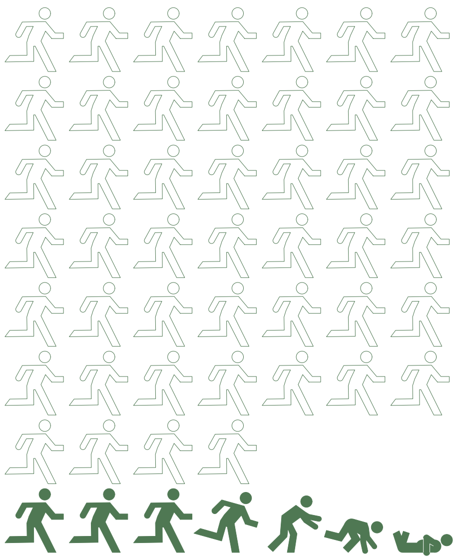
inhabitants of Amsterdam





46%
pulmonary
lesions in
copper mine
workers

35% silicosis 11% others



FINAL QUESTION

Even though the purpose of exit signs is to increase safety, the circumstances of its productions are not always safe. In the first part of the 20th century radium paint was used to create signs that can glow in the dark without any additional power.[L10] The danger of radioactivity was not known at the time and so workers, mostly females, suffered from the radiation and eventually died. A study of Stehney et al. (1978) evaluated the life expectancy of 1.235 of these women over a period of 45 to 60 years. Statistically, 461,2 deaths were expected, but 529 deaths were actually observed. This implies that 68 more people died than on average, indicating that the women had a higher risk of dying prematurely from radium-induced diseases due to their work[L10].

This fact was visualised in the image on the left. Each figure represents ten persons of the study. The colored figures show the statistically striking cases.

Of course, human lives cannot be offset against each other. The dignity of human beings is inviolable. With regard to the sometimes catastrophic conditions for the extraction of rare earths or the handling of toxic substances, one should possibly also point out the existing grievances with a somewhat provocative question:

Do emergency exit light signs save more lives than they cost?

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L1 Orlght Design Studio & Showroom, London (2013): Emergency Lighting Guide, 2014, pp. 3 - 11. Available at: <https://www.orlight.com/resources/res/32/Orlight_guide_on_Emergency_Lighting_1.pdf> [Accessed 29 June 2022]

L2 Schivhelbusch, W., 1983. Lichtblicke. Zur Geschichte der künstlichen Helligkeit im 19. Jahrhundert. München: Hanser-Anthropologie, pp.12-17.

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ENTER OR NOT

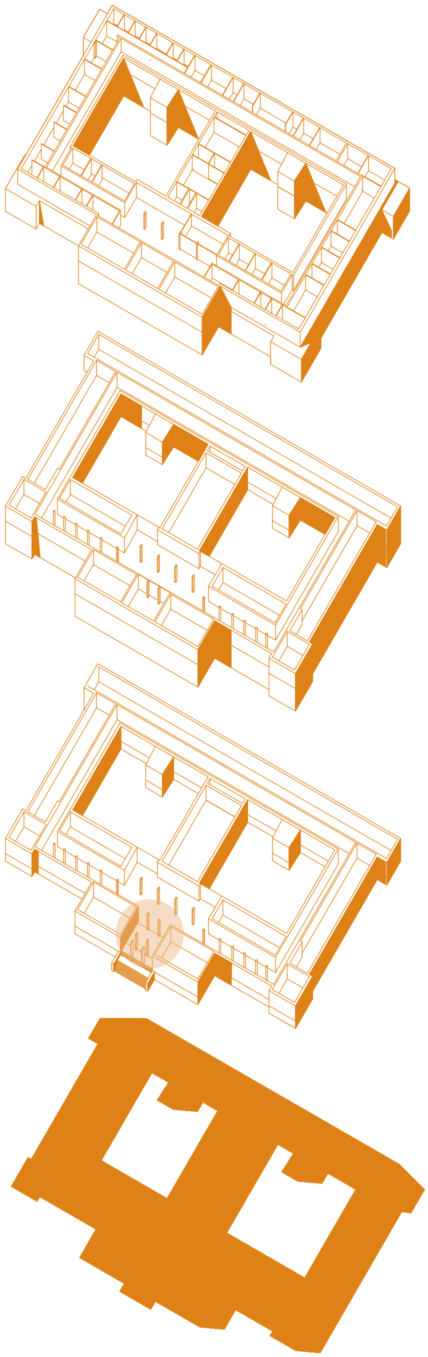
The door is the first architectural element we deal with when entering a building. It carries with it a strong symbolism. In fact its shape, materiality and structure show its interlocutor whether he is welcome or not.

It is no coincidence that public buildings, such as churches, town halls and castles have large portals that can let in many people at once. Or that commercial buildings have transparent glass doors, that show what is inside.

In general, one expects public buildings to have doors open to everyone, but during our analysis of university doors, we came across many closed doors. Even the fact that they are locked communicates a specific message.

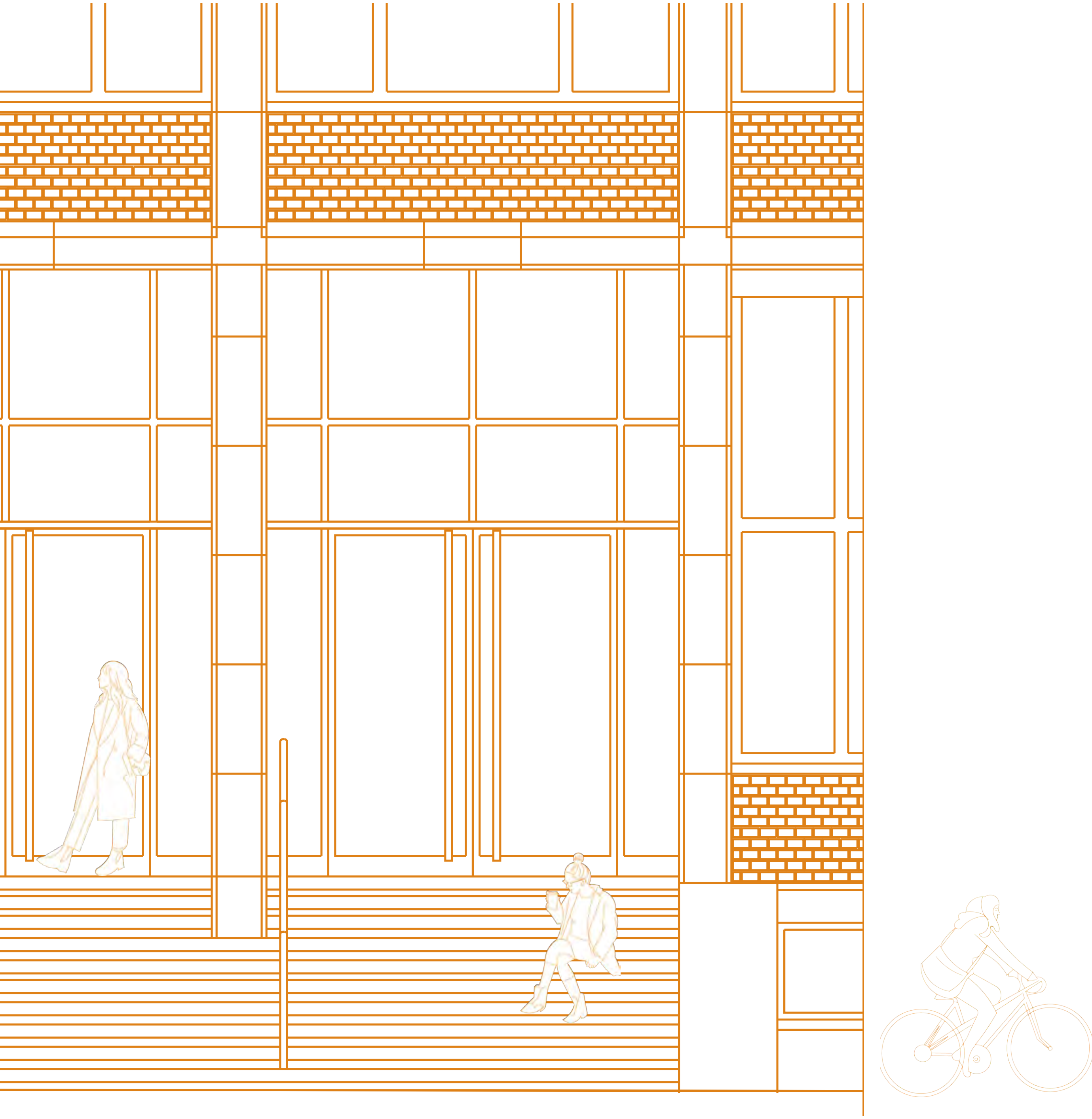
We paid attention to the feelings that the doors of our analysis aroused in us. Each of us has the memory of the first time we entered the faculty, or the day we had to anxiously open the door for a difficult exam or a job interview.

We thought of the great joy of going to collect an award or a diploma. We hope that our analysis will awaken strong feelings in you too.



KIT Faculty of Architecture ↑
Campus South
Element Entrance Door

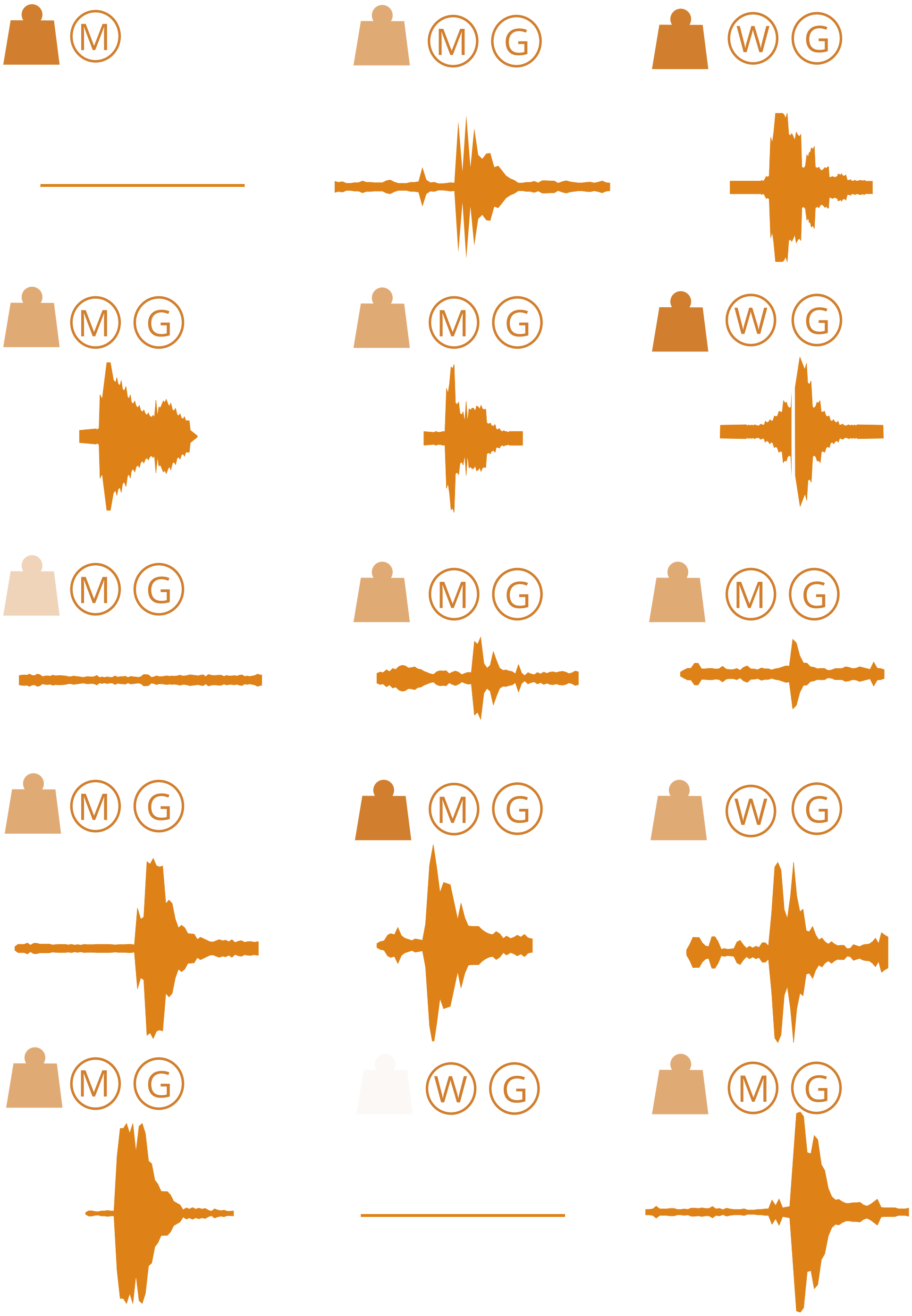
↑ Entrance door
KIT Architecture Faculty
Campus South



↑ Studio Building - KIT Faculty of Architecture
Wood entrance door
Campus South

New cafeteria annex building ↑
Automatic door
Campus South

↑ Doors from
Karlsruhe Institute of Technology
Campus West and South



Comparison of the doors: ↑
frequencies created by recording closing doors,
materials (G=Glass, M=Metal , W= Wood)
weights (the darker the heavier)

↑ Site Plan Karlsruhe
Karlsruhe Institute of Technology
Campus West and South
1:50000

ENDWORD

After comparing the proportions of the doors with the facades, we recorded each door as we closed it and created a table with the collected frequencies to study them in more detail. Some of the doors were not allowed or could not be closed.

Each door symbolized and reflected something different to us. Some of them were difficult to open, closed, very thin, inviting, strict... People really feel the emotions that the door conveys and act according to those emotions they get from the doors.

We already had connections to some of the doors we were looking at, because we as students spend really a lot of time on our campus.

It was also remarkable that the doors are represented by the people that surround them, so they’re not just an element of wood or steel or glass, but they have a meaning.

They represent society, the times we live in, the economy, security, freedom, borders and permanence.

We decided to make some audio recordings to awaken a focus in you, so you can also feel a little of these emotions that the door conveys. If it is too loud or too heavy, of it scares you or invites you.

When one door shuts, another opens.

SOURCES

MyOSMatic: Side Plan Karlsruhe, URL: https://maposmatic.osm-baustelle.de

Fachgebiet Bau- und Architekturgeschichte, Karlsruhe Institute of Technology: Plans of the Building 20.40 (Faculty of Architecture) - Entrance door

INTRODUCTION

The following pages follow the material biography of the windows of the Building of the Faculty of Architecture at the Karlsruhe Institute of Technology. The history of the faculty goes back over 200 years ago when Friedrich Weinbrenner founded his Bauschule. The Faculty Building, the old Aulabau, designed by Josef Durm, was built between 1893 and 1898.

To write this biography we went around the building searching for different types and sizes of windows, and tracing when they were installed or renovated. It was astonishing to find out that some of the windows were the original ones, installed over 120 years ago, survivors of not one, but two World Wars. We measured and compared different opening mechanisms and technical differences, visualizing the increased technological complexity windows gain throughout the years.

While doing that we also asked the people around these windows stories about them and what their relationship to the windows that surrounded them was. One stood out from all the others, the one of Wulf Schirmer, Professor of History of Architecture for over 30 years at Karlsruhe. These lines tell the story of how he could see a treasure, in what other people only saw as trash.

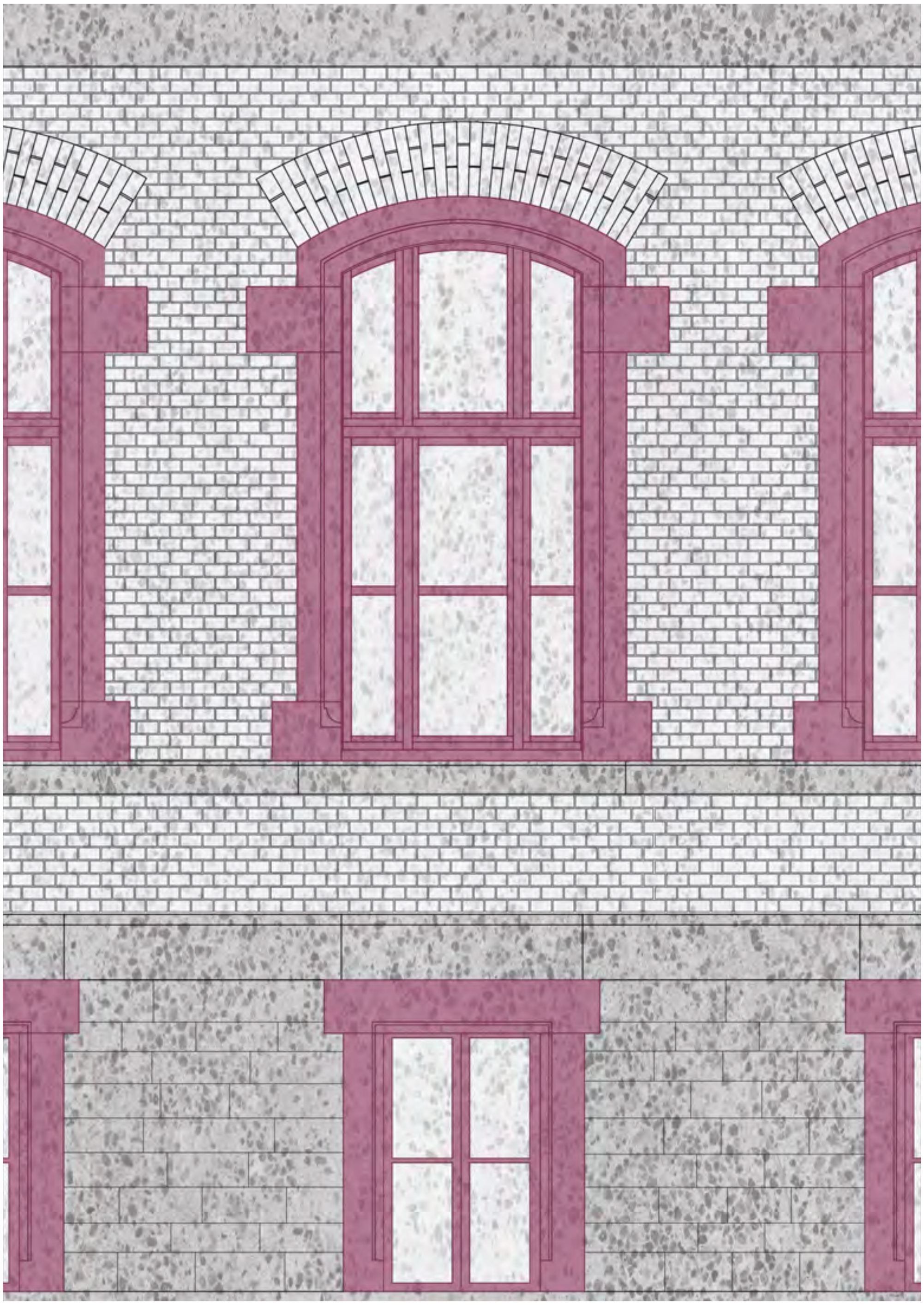
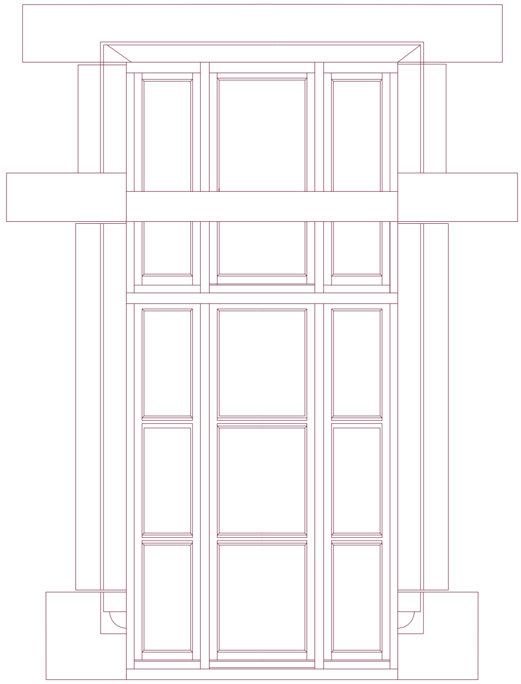
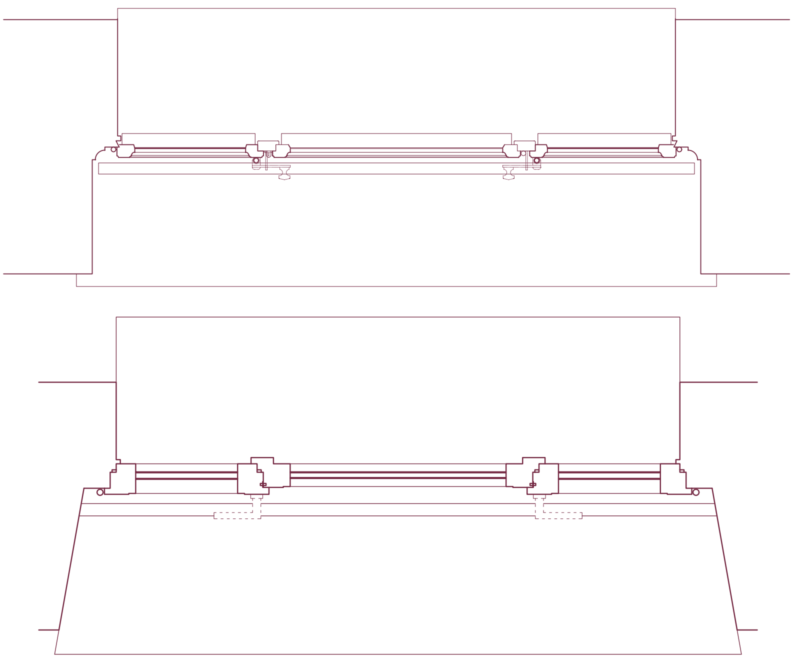


Image of the windows facing the west ↑
courtyard of the Faculty Building

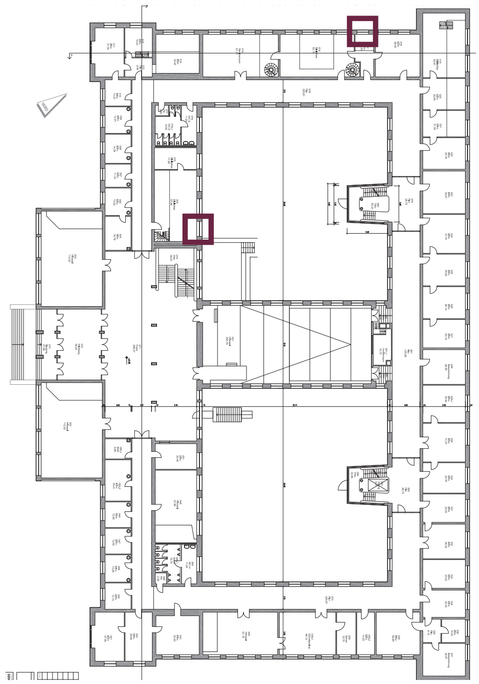


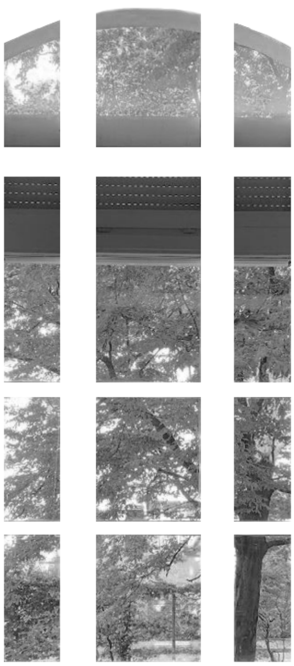


↑ Elevation of the windows that are part of Professor Schirmer's story

↓ Section of an original window (1898) in the Werner Sewing Library and a newer window (1970s) on the hallway in front of the Chair of History of Architecture

The first chosen window was the one of the library. One of the librarians loves the original, single-glazing windows. She loves old things, she loves her old apartment building, and she likes the old windows despite the cold of the room during winter. The other librarian doesn't like them that much, she can't stand the cold. The young assistant would like them to be replaced for new windows, to not freeze during her shifts. Next to the other window, a newer, with double-glazing, works the secretary of the the Chair of History of Architecture. She doesn't have a strong relationship with the window. According to her, it opens and closes without any kind of problem, so it works well and more than that she can not expect from it.





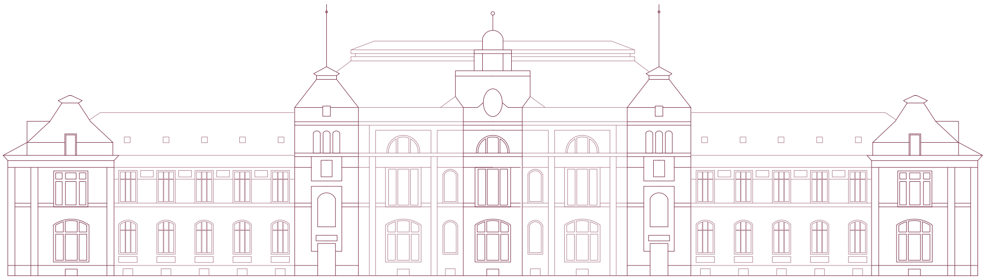
Left: stories about different windows and ↑
the people around them.
Right: Location of measured windows
What do these both windows show ↓

A BUILDING AND TWO WARS

The Bauschule of Friedrich Weinbrenner, the precursor of our Faculty of Architecture, was a founding unit of the Polytechnic School, what is nowadays the Karlsruhe Institute of Technology.

Among many students, Weinbrenner instructed Heinrich Hübsch, who later directed the School. In turn, he taught Josef Durm, who also was a professor between 1868 and his death in 1919. Between 1893 and 1898 he built the Aulabau of the University, which now houses our Faculty.

With hits, the building survived two large-scale wars. A new generation of people, among them Egon Eiermann, reconstructed the Faculty and the building, salvaging most of it, including some original windows. In 1971 the Faculty appointed Wulf Schirmer as Professor of History of Architecture. Almost ten years later, the original, single-glazing windows of his Chair were replaced with double-glazing windows, with better insulation values. They were considered trash now, and as such, they were put in waste skips. Professor Schirmer saw this and realized that was a mistake, so he got eight of the old windows and transported them to his house in East Karlsruhe to make something out of them.



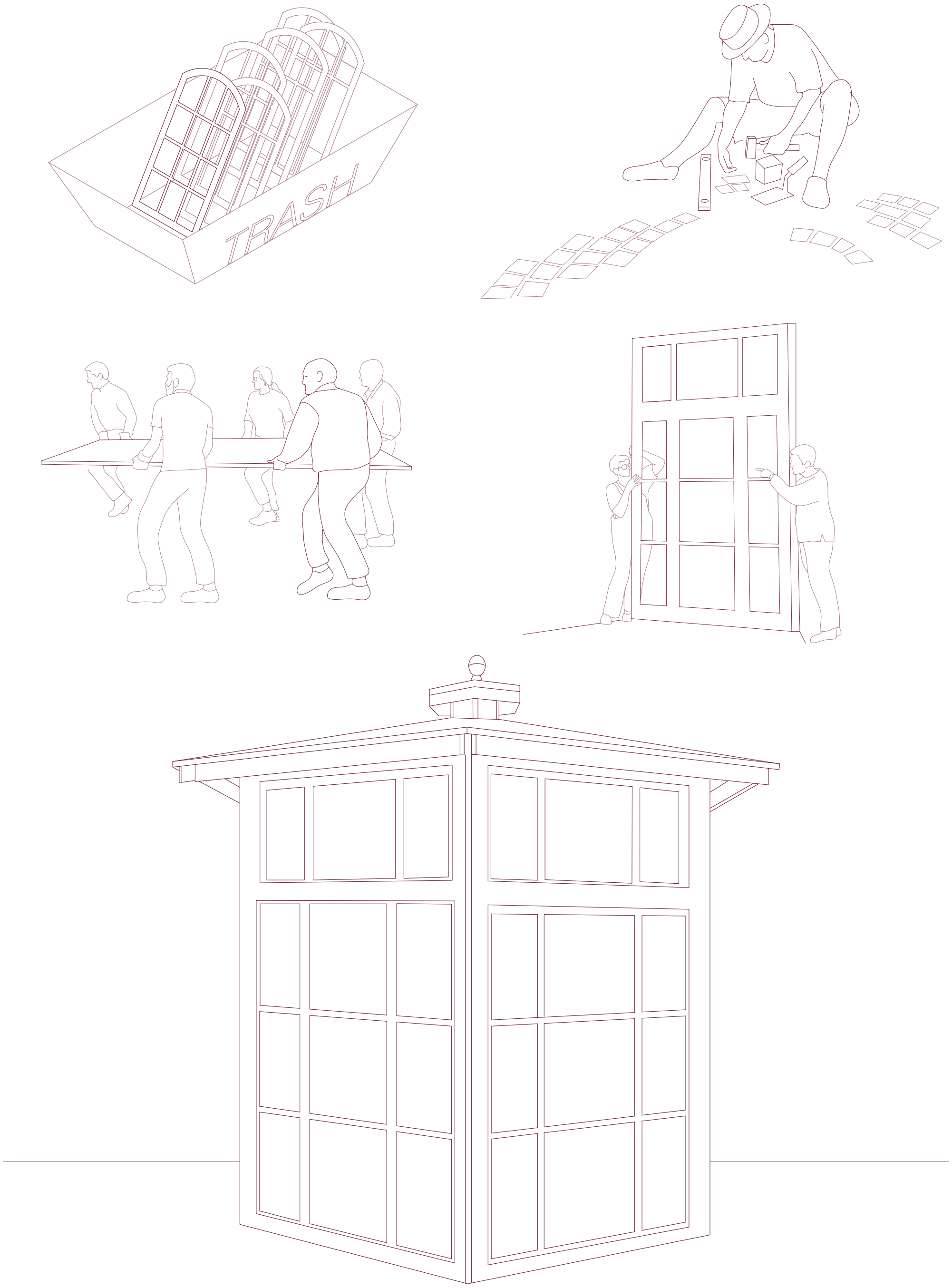
Evolution of the Faculty Building ↑
throughout the years

TRASH?

Professor Schirmer was born in 1934 in Hannover. He was part of a family of architects, his father and all of his three brothers were also architects. After studying in Hannover, he gained his Ph.D. in Berlin. Afterward, he and his wife moved to Karlsruhe. Professor Schirmer was responsible for many excavations and surveys, among them a building research of the Castel del Monte in Italy. Pictures of that project still hang in the Chair.

The eight retrieved single-glazing windows of the Chair were deposited in the basement of the Schirmer house. In the lapse of two years, between the summer of 1980 and 1982, the garden saw the growth of a little glasshouse, built up with the old, single-glazing windows. It was built mostly at night, one or two hours per day, together with family and friends.

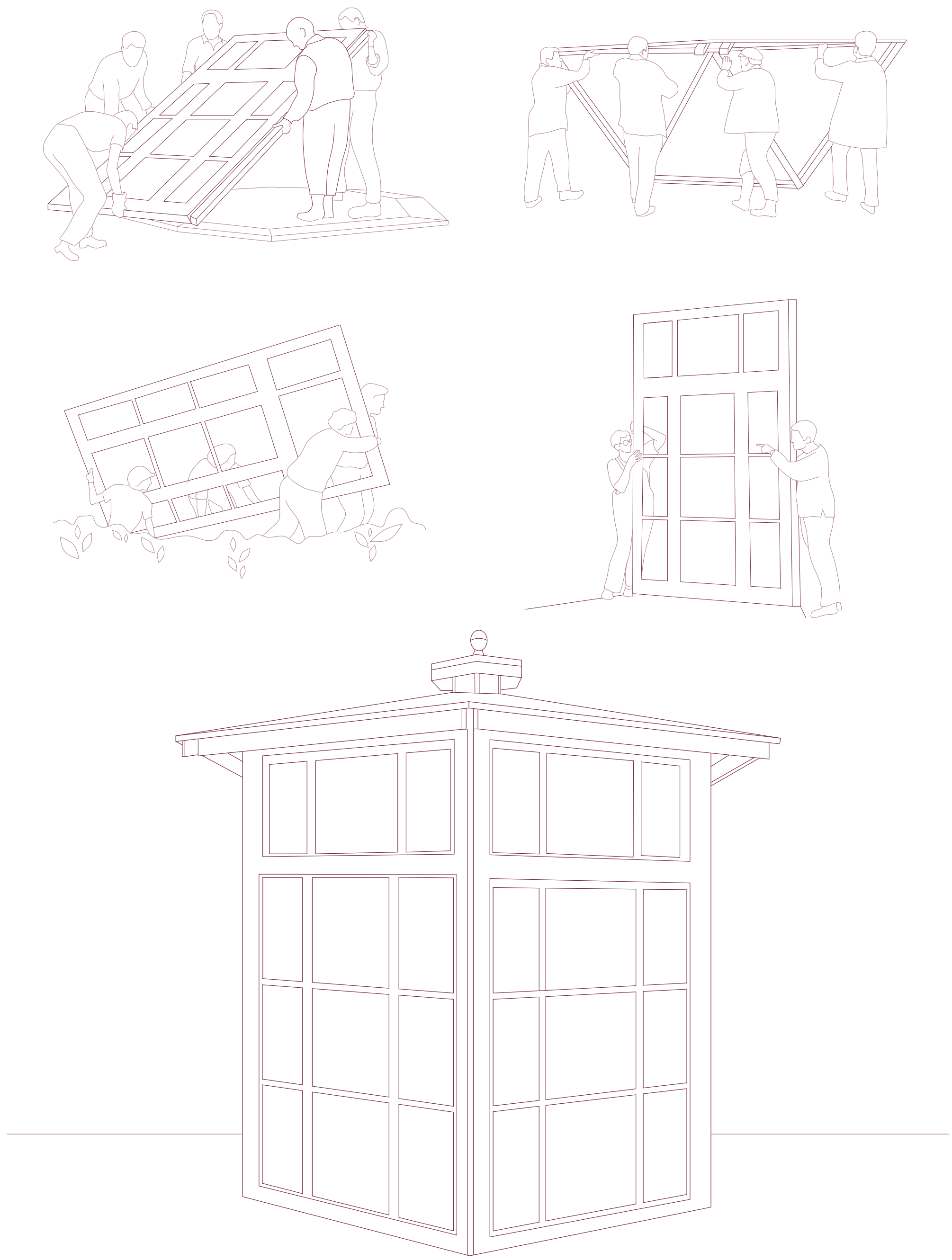
It consisted of six concrete plates that were placed in a hexagon shape. Six old windows from the Chair, made up of oak wood, that was arranged in a hexagonal shape and joined together by wooden studs. A wooden construction was put on top of the windows that could carry the roof. And finally, the roof was made up of the shutters that protected the windows from the sun.



1) Old windows as trash ↑
2) Professor Schirmer’s wife arranging the stones of the foundation
3) Friends and family carrying the windows to the site
4) Windows stand on top of the foundations
5) First iteration of the glasshouse

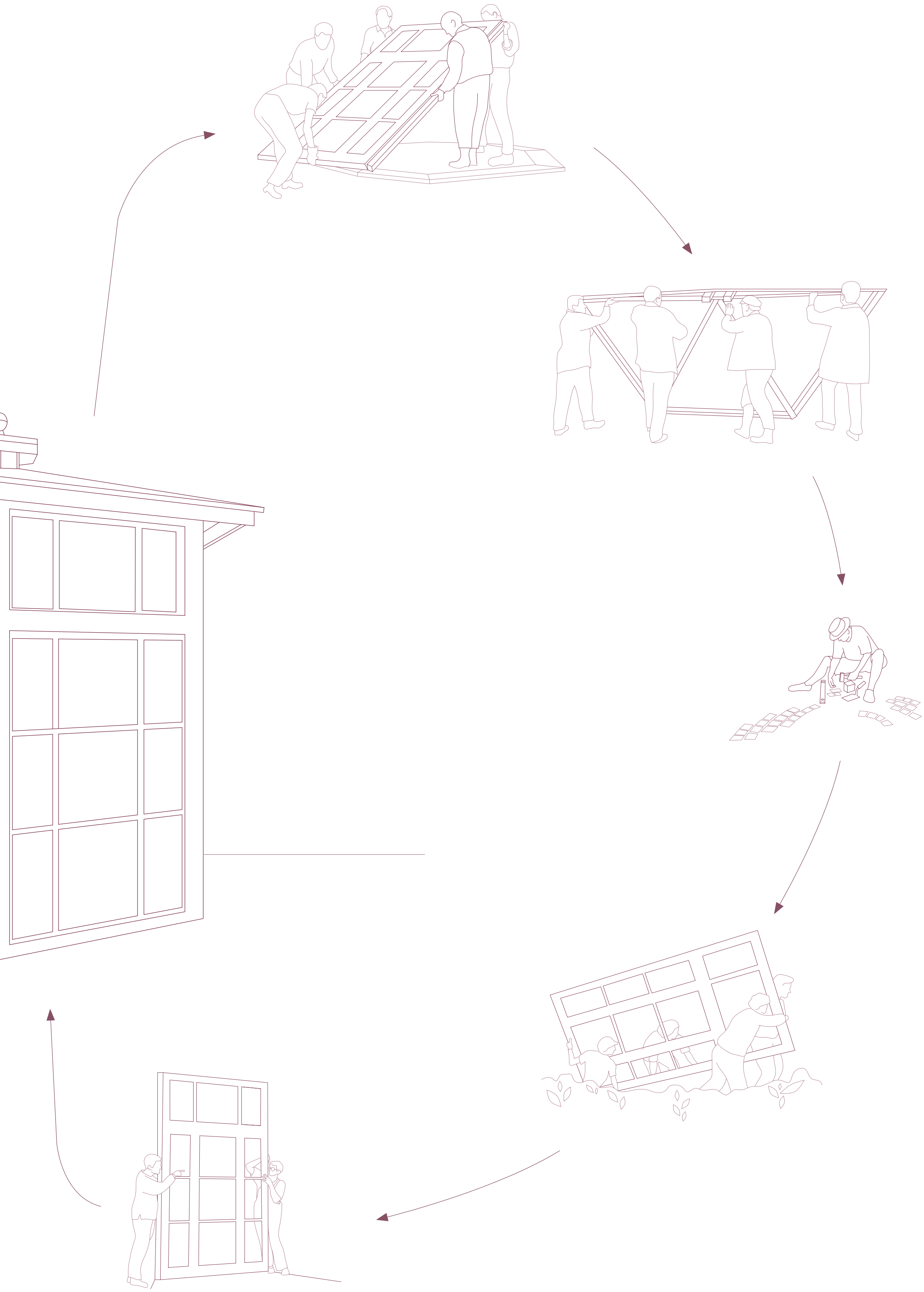
TREASURE!

Life unfolded in and around the little glasshouse. It was the meeting place of the Schirmers to receive friends and family throughout the years. The two windows left were used up to build a little greenhouse.
Fifteen years after the construction of the house, the Schirmers decided to move a little bit farther east. They moved all their belongings and, of course, they also moved the glasshouse. The house was prepared for the move, as it was designed for disassembly. Professor Schirmer oversaw the deconstruction, move, and reconstruction within a day.
The roof was divided into two parts, the wooden studs disjointed from the old windows. Professor Schirmer's wife got every stone of the foundation and placed them in the new garden. Friends and family helped carry the windows to the new location in an uneven, sloping site.
The second iteration of the house stands in that place until today. Very casually, the story of Professor Schirmer was told to us, and very luckily, we were invited by them to visit and see for ourselves how trash can be turned into treasure.



1) Glasshouse is disassembled ↑
2) The roof is divided in two parts
3) Friends and family carrying the windows uphill to the site
4) Windows stand on top of the foundations
5) Second iteration of the glasshouse


TRASH



NOT TRASH, BUT TREASURES

Throughout the years the glasshouse saw the additions of new elements. One of them is an iron sphere the Schirmers found in a flea market. The wife, a goldsmith by profession, gilded it with gold leaves and it was installed on the roof. To do so she used the old working tools of her father, it was the first time she used this technique.

Another addition is a herd that was installed in 2015. It belonged to Professor Schirmer's mother, who bought it from Denmark and installed it in the living room of the house in which Professor Schirmer grew up. It was stored in a deposit, as this kind of herd isn't allowed anymore, and they decided to install it in the little glasshouse so that it can also be used during winters. From a workshop nearby they got a big pipe to retrieve the smoke, and it was also part of the installation.

The Schirmers renovated and repainted the glasshouse two years ago, still putting care to six windows someone considered to be trash forty years ago. They welcomed us into the glasshouse and told us its story, which is also part of their own story. They showed us elements they collected throughout the years. Theirs is a house full of treasures.

The Schirmers and their little glasshouse. ↑
We would like to thank them for having welcomed us into their glasshouse and letting us tell its history

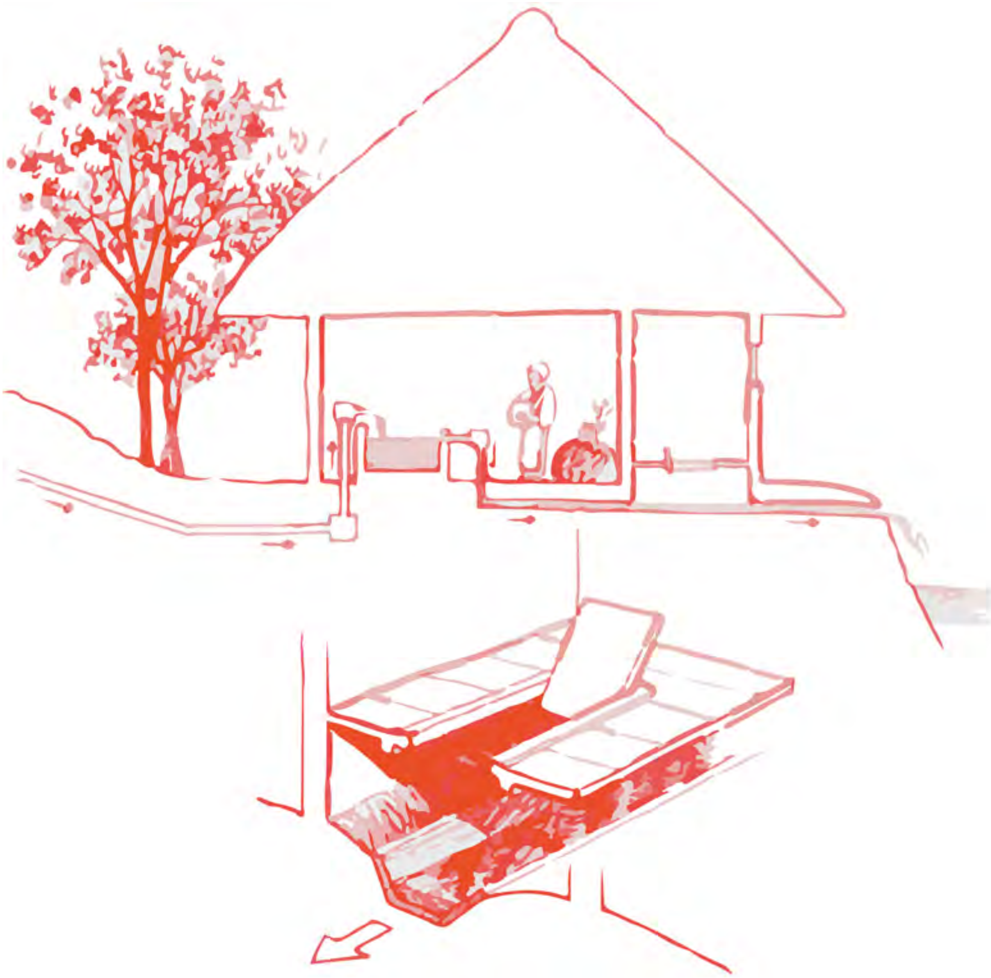
SEWAGE

The modern sewage system and how it has evolved over time is probably the most unsung hero of our recent times. It saved more lives since its inception than any other invention.

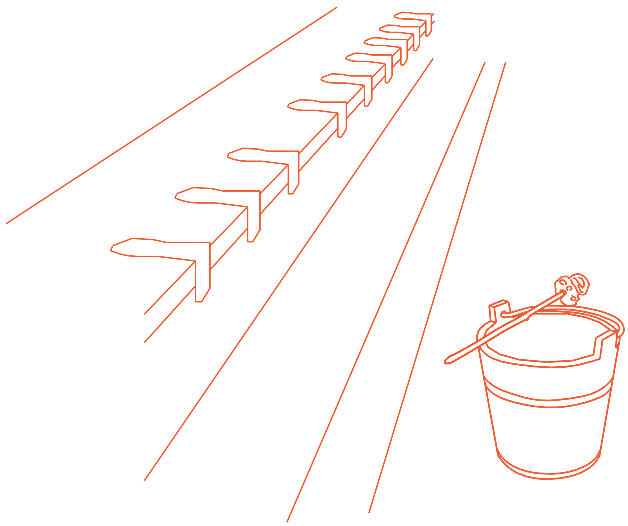
Throughout time there were several developments to improve human waste treatment and transportation, though not everything survived the test of time or even improved on something in the first place.

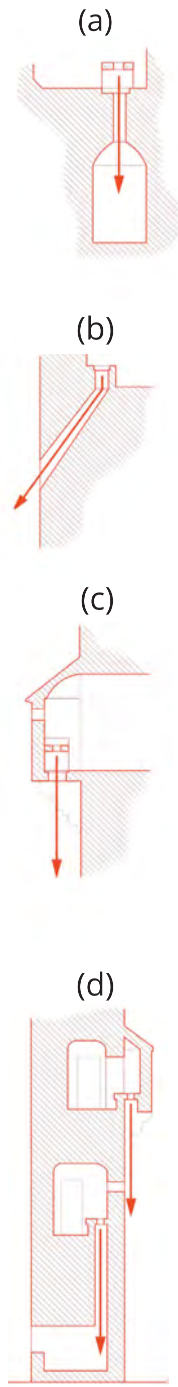
By keeping sewage water and drinking supply separated several diseases can be prevented. However, not everyone on earth has the same access to safe sewage systems. Treatment facilities and bathroom furniture vary widely from region to region and through time.

In monasteries of the Japanese Wakayama prefecture lavatories became quite sophisticated. Water was brought through bamboo piping into the kitchen, providing ever fresh water for cooking. The runoff water continued through the toilet taking excrements to the next river. This can be seen as one of the first greywater systems, dating back to 819 AD.[SE1]



Japanese monastry, showing early materialized ↑
graywater usage.[SE1]





↑ Roman public toilet with seat, trench for washing the stick and bucket for desinfecting

↓ Mapping of cholera cases in Soho distirct of london by John Snow, 1858

Different medieavel ↑ garderobes, Inspired by SE5

In Roman times public latrines seated up to 20 people. For wiping often a sponge tied onto a stick was used.[SE2] After use it was put into a bucket with vinegar for disinfecting purposes. The unhygienic condition of roman toilets and practices led to the spread of diseases and contributed to a high mortality rate.[SE3]

Medieval castles often featured so-called garderobes, these were little alcoves protruding from the castle wall. These had seats with holes discharging directly into a cesspit (a) or into the moat of the castle (c,d). More complex systems had internal channels leading the excrements out of the building (b) or an internal tank that had to be emptied by servants (d bottom).

In 1858 unsanitary conditions in and around the city of London led to the “Great Stink”. During the especially hot July and August of 1858, the accumulating excrement in the Thames led to three cholera epidemics. During the second cholera epidemic, London-based physician John Snow started started mapping cholera cases in the Soho district. He noticed that the cases clustered around a specific water pump. After removing the Pumphandle the cases of cholera declined. It was later found out that a sewer had leaked directly into the well. John Snow is seen by many as the founder of the science of epidemiology. [SE4]

LANDGRABEN KARLSRUHE

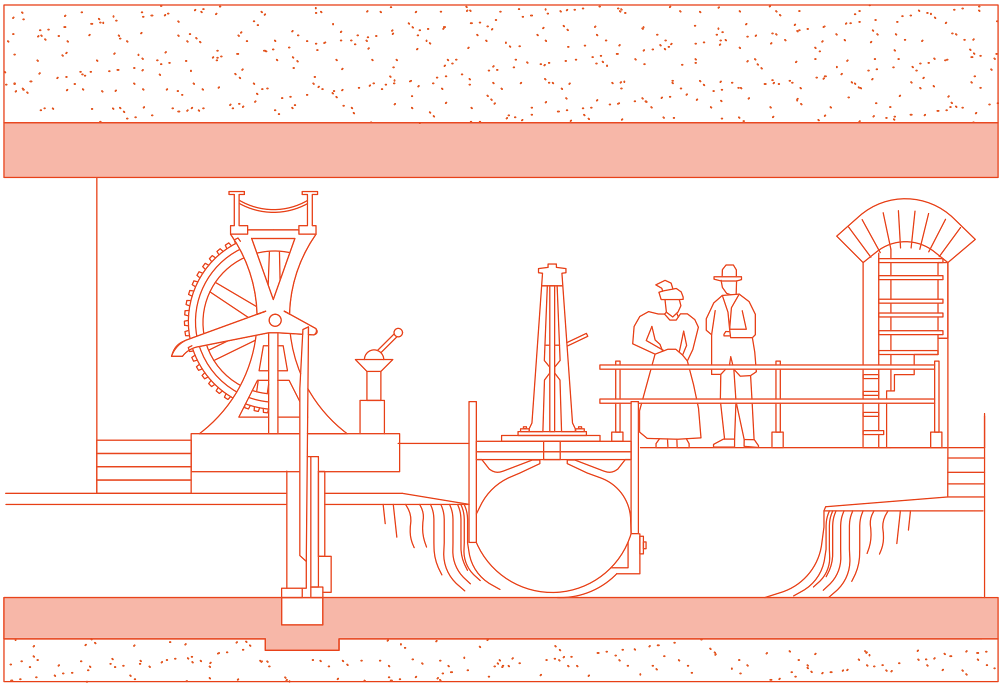
In 1588, Margrave Ernst Friedrich of Baden-Durlach ordered the construction of the trench when building Gottesaue Castle. This was intended to drain waters running between the new castle and Durlach westwards to the Alb in Mühlburg. Floods in the catchment area thus also flowed off more quickly towards the Rhine.

The course of the Landgraben influenced the development of the city of Karlsruhe, which was newly founded in 1715. Triangular squares such as Lidellplatz and Ludwigsplatz were defined by the course of the trench.

In 1768, the Landgraben was extended by the "Stein-Kanal". At the same time, it was used as a transport route for building materials to the growing city of Karlsruhe. From 1794 onwards, the citizens of the city were allowed to discharge wastewater from their kitchens and baths into the Landgraben, but not feces.

In 1815, they began to be built over the Landgraben. The costs for this had to be paid by the owners of the adjoining properties, but in return, they received the right of ownership to the new land.

Construction of the vault over the trench began at Lidellplatz; the last sections in the west of the city were not completed until 1905. The open drainage ditch had become an underground sewage collector.



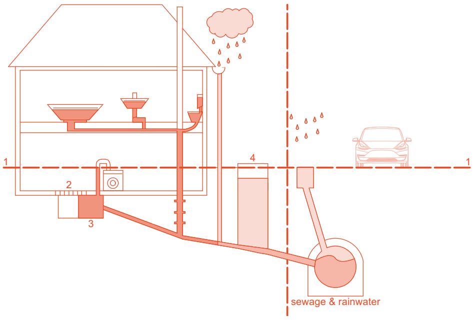
route of original Landgraben ↑
Karlsruhe - Germany

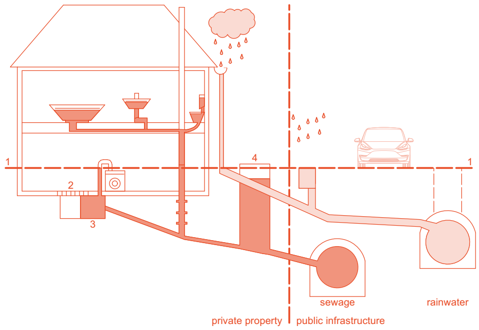
section weir Landgraben ↓
Karlsruhe - Germany

SEWAGE SYSTEMS

A mixed system is the joint discharge of wastewater and rainwater in one sewer. Initially, all city districts in Karlsruhe were severed according to this principle. The combined system simplifies the installation on the properties. Moreover, only one sewer is required in the streets.
However, when it rains, large flows of sewage flow to the sewage treatment plant. At rain overflows, diluted combined sewage is discharged directly into the water bodies during heavy rainfall to reduce the inflow to the sewage treatment plant. In the separate system, two sewers are located in the street. The usually deeper sewer carries the lower volume of wastewater to the treatment plant. The storm sewer collects the rainwater from the roofs, paths, streets and squares and directs it by the shortest route into public waters.
In the past thirty years, the new housing estates on the outskirts of the city have mainly been developed using the separate system. Today, the aim is to return rainwater to the groundwater by infiltration over the shortest possible distance.

[1] backwash level, [2] floor drainage, [3] backflow prevention, [4] inspection shaft

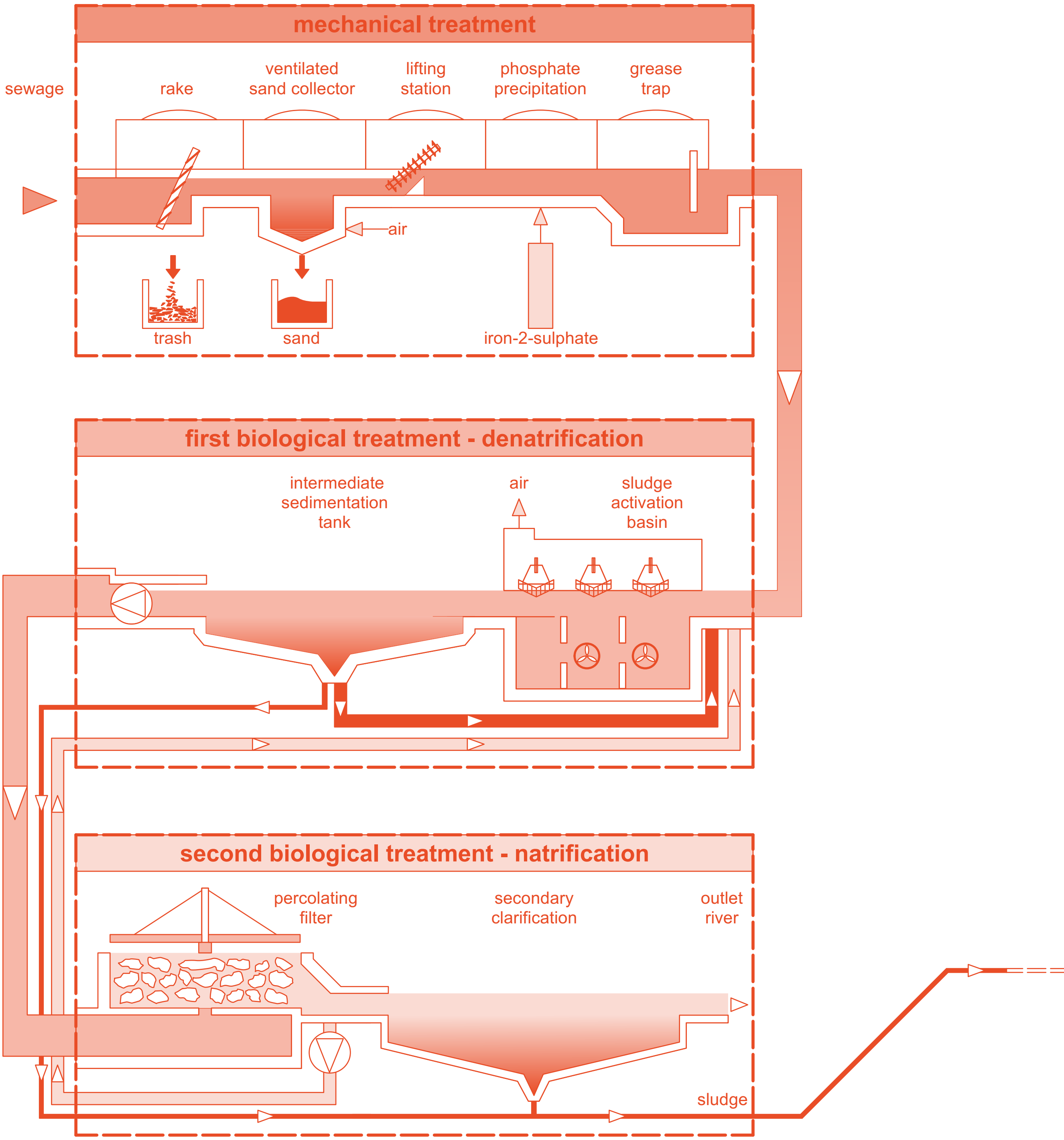




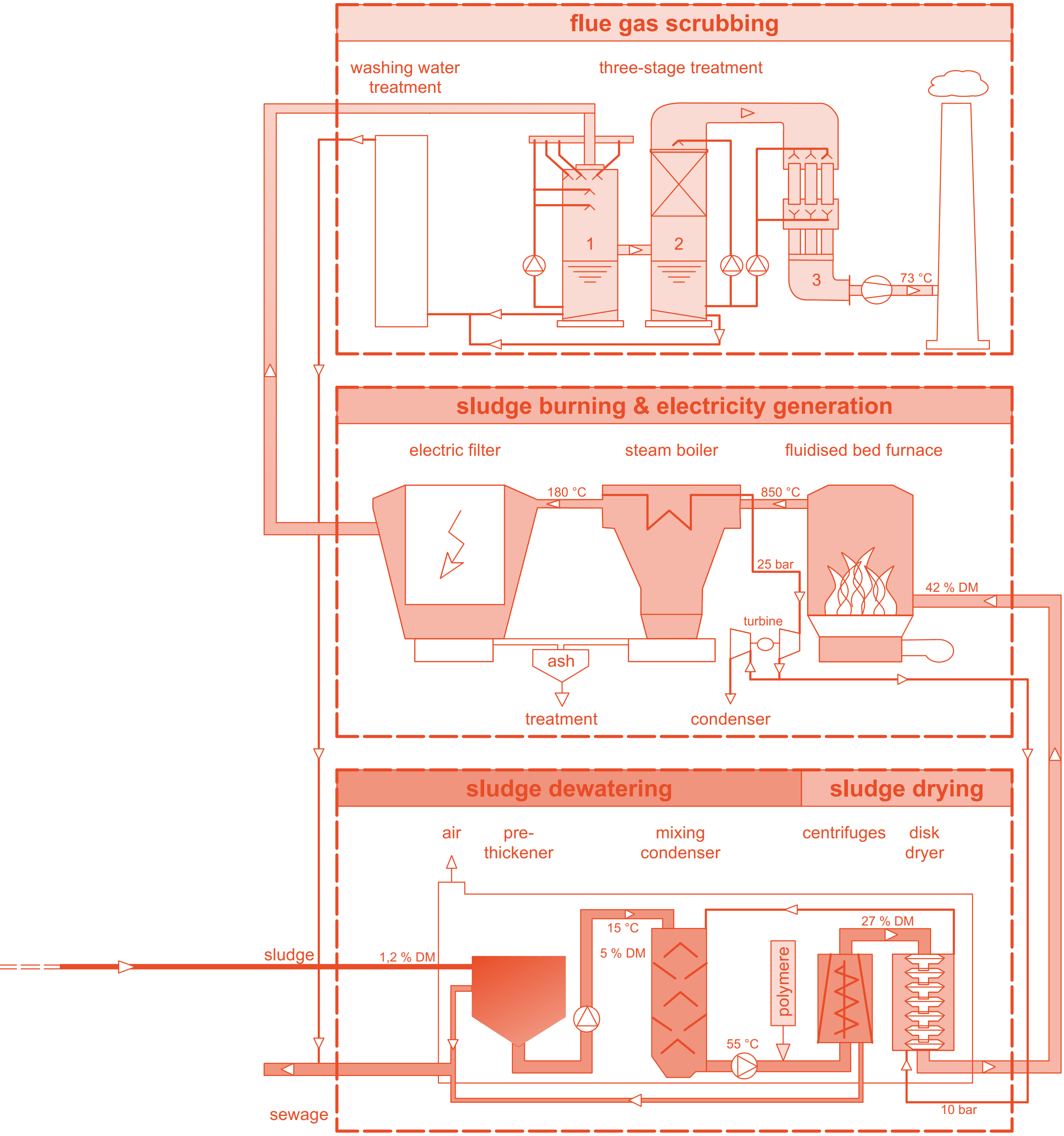
↑ mixed sewage system

separated sewage system ↑

wastewater system ↓
network map
Karlsruhe - Germany



↑ sewage treatment (Karlsruhe)
two-staged system (mechanical + biological)



sludge treatment (Karlsruhe) ↑
[DM] = dry mass proportion
procedure: drying, burning,
energy producing, air cleaning

TECHNICAL FACTS

Compared to what it consisted of back in history, nowadays a sewage system consists out of a complex network of different pumping stations. Pumping stations in sewage collection systems are normally designed to handle raw sewage that is fed from underground gravity pipelines (pipes that are sloped so that a liquid can flow in one direction under gravity). Sewage is fed into and stored in a pit, commonly known as a wet well. The well is equipped with electrical instrumentation to detect the level of sewage present. When the sewage level rises to a predetermined point, a pump will start to lift the sewage upward through a pressurized pipe system, if the sewage is to be transported over some significant distance. From here the cycle starts all over again until the sewage reaches its point of destination—usually a treatment plant. By this method, pumping stations are used to move waste to higher elevations. In the case of high sewage flows into the well (for example during peak flow periods and wet weather) additional pumps will be used. Sewage pumping stations are typically designed so that one pump or one set of pumps will handle normal peak flow conditions.

PUMPING STATIONS:

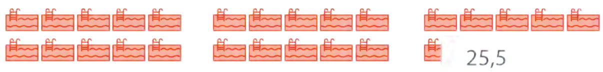
15 Sewage pumping stations

29 Rainwater pumping stations

8 Combined water pumping stations

12 Pressure drainage system

8 Flush well



64 000 000 l
Daily wastewater volume
in dry weather

25,5
olympic
swimmingpools

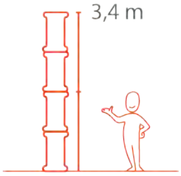
1,8 km/h Speed Wastewater

13 days

Karlsruhe

Amsterdam

1108 km Sewage Network Length



3,4 m

sewagepipe per person
(1,70 m) in Karlsruhe

1200 km

Karlsruhe

Barcelona

36 318 672 EUR Costs per Year

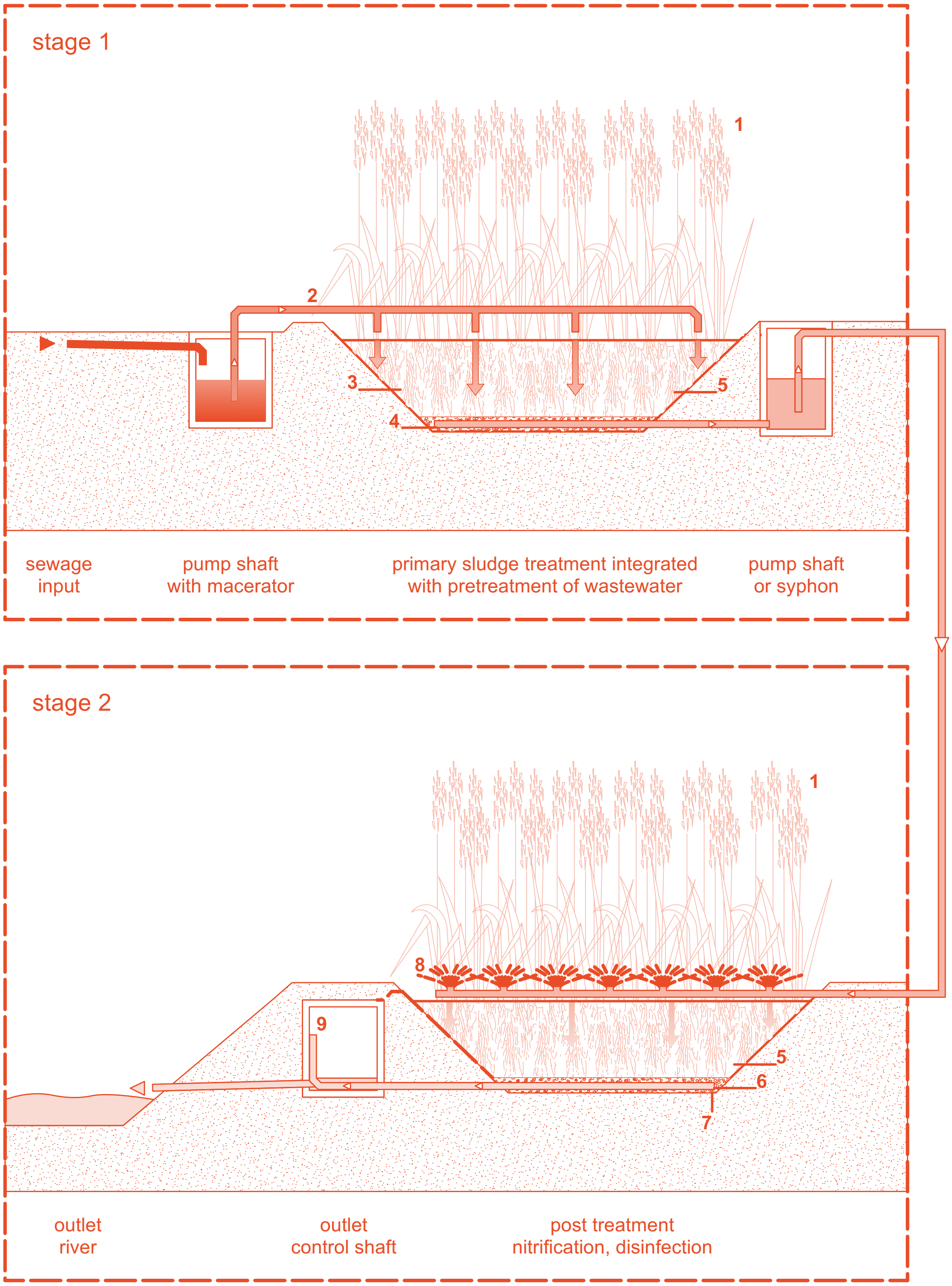
116 EUR
per person per Year

Technical Facts Sewagesystem Karlsruhe ↑
SE6 Comparisons

PLANT BASED TREATMENT

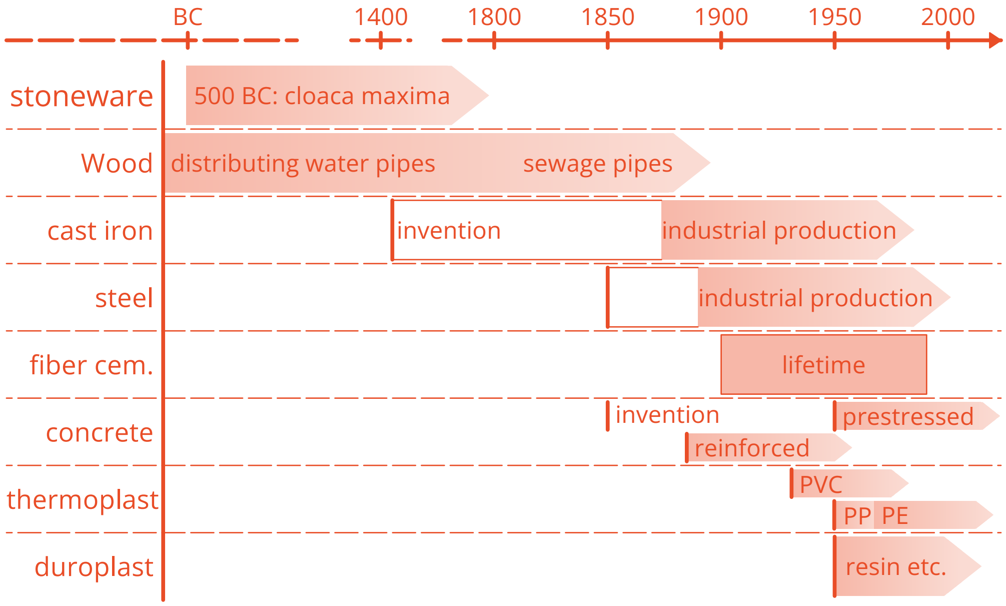
The basic principle is that pre-treatment does not take place in sedimentation basins, as is the case with conventional wastewater treatment plants. Instead, the wastewater is first routed to basins planted with reeds. The basins contain drainage pipes at the bottom, which lie in a layer of coarse gravel. On top of this is another layer of fine gravel, covered with reed plants. In the polluted water flowing in from above, the suspended matter is flocculated. It is crucial that the plants keep the substrate open. Therefore, the wastewater filtered in this way can quickly flow downwards through the drainage layer. By alternately operating several reed basins, their functionality is ensured. The run-off water, still contaminated with pollutants, then flows through a gravel fill with braided rushes. If a cascading basin arrangement is not possible, artificial aeration should be provided.

[1] phragmites communis (reed); [2] wastewater distribution pipes; [3] rhizome and root system of plants; [4] impermeable clay or synthetic lining (PE or PVC membrane); [5] main filter substrate; [6] drainage system - slotted pipes; [7] coarse and fine gravel filter; [8] spray nozzles (Rhizotech); [9] adjustable water level riser[SE7]

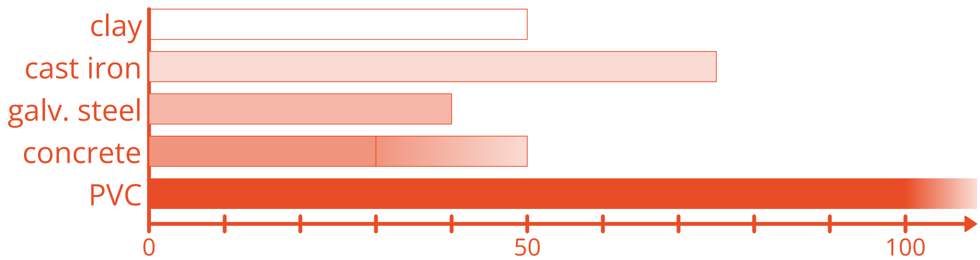


plant based sewage treatment, often used in ↑
developing countries and independent communities
system of mechanical and biological filters
in basins in cascade order with drainage and reeds

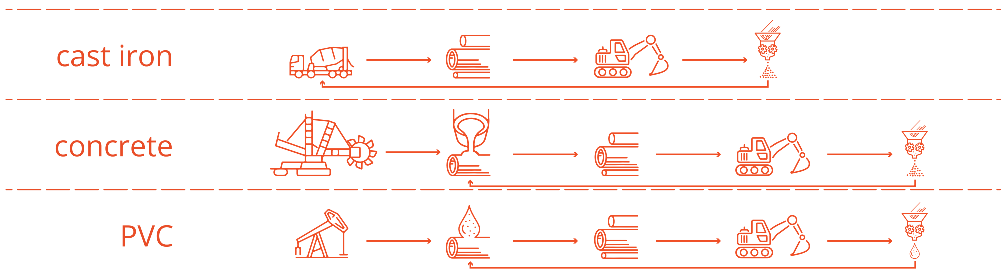
history of pipe materials for wastewater



service life of latest materials in years



recycling of latest materials



↑ History of pipe materials for wastewater[SE9]

↓ service life and life cycle of wastewater pipes[SE8]

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After beginning his career in science and experimental mathematics, **Peter van Assche** transitioned into architecture and is now the founding principal of bureau SLA, an Amsterdam-based firm focused on the necessity of transitioning to a circular economy through design. As a design studio, bureau SLA consists of a team of architects and builders, supported by architectural historians, landscape architects, and energy experts. The studio does not wait for commissions to be given, but builds and develops in the city in an innovative way — from their own initiatives and with their own manpower. By designing, researching, inventing and building the full potential of material use, energy, waste flows, smart living & working and development processes are discovered and implemented.

Peter van Assche is the chairman of the Committee for Architectural Review in Utrecht, supervisor for the Utrecht station area, co-founder of Pretty Plastic and professor Architecture and Circular Thinking at the Academy of Architecture Amsterdam. He received a Master of Information Technology (cum laude) from the Technical University Eindhoven and obtained his architecture degree from the Rotterdam Academy of Architecture. Peter was visiting professor in Erfurt and at Cornell University (NY).

Katja Hogenboom is project architect at bureau SLA, PhD researcher, teacher, photographer and writer. She has worked in several offices before joining the bureau SLA team, in Spain and the Netherlands, on the design and realisation of housing and public buildings, among them regional police headquarters.

Besides architectural design Katja worked two years for the state architect of the Netherlands, setting up educational programs, doing research and curating work. From 2010 tot 2020 Katja Hogenboom studio moved to Umeå, Sweden, where she started to work as an education developer and teacher in the second year bachelors at the Umeå school of Architecture at the Umeå University. Besides working for bureua SLA Katja is finishing her PhD at the KTH in Stockholm.

COLOPHON

Material Biographies - An Emotive Exploration of Material's identity

Spring Semester 2022
Karlsruhe Institute of Technologie (KIT)

teachers
Peter van Assche, Katja Hogenboom, Hanna Hoss

students
Anne-Sophie Rousset, Atanaska Chausheva, Beatrice Iacopi, Ceren Serifoglu, Davina Dixon, Guillermo Vera, Isabel Steiger Salvador, Jiawen Li, Jiyoung In, Karolin Unger, Louis Hertenstein, Maja Jankov, Misa Nurminen, Paula Seifert, Philipp Dworatzek, Tamara Schütte, Valentina Mironova, Vincent Witt

All presented work is made by architecture students at Karlsruhe Institute of Technologie (KIT).

Print
B&K Offsetdruck

This publication is cooperated with bureau SLA, Amsterdam and is funded by the Sto-foundation.

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