
Canadian Wood Council

G063

TIMBER BASED PRODUCTS AND
SYSTEMS ARE HERE – WILL THE
MARKET FOLLOW ?

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ZÜBLIN TIMBER CONSTRUCTION

October 27, 2015



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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Course Description

The timber industry in cooperation with material suppliers, universities and institutes have made significant gains in bringing timber based building systems into the market in recent years. Simultaneously, gains in skilled engineering and machining and designing with the entire buildings physical specifications in mind, such as thermal performance, sound insulation, fire resistance and moisture control are achieved with timber based systems and products. Cost competitiveness, time savings and carbon neutral building processes are also achieved.

Learning Objectives

At the end of the this course, participants will be able to:

- COOPERATION BETWEEN MAIN CONTRACTOR AND TIMBER SPECIALIST
- UNDERSTANDING GLOBAL MARKET FOR ENGINEERED TIMBER
- MULTI STOREY BUILDINGS
- PASSIVE HOUSE STANDARD IN OFFICE BUILDINGS
- COMPOSITE SYSTEMS



BUSINESS MODELL TIMBER INDUSTRY



TRADE

USER

PLANNER

WE SUPPLY

Supplier product

Supplier Systems

Consultant
BoQ – Trade
public

Consultant
BoQ–Trade
private

Part Main
contractor
BoQ
public

Tools +
Fastening
technology

Glulam

LENO und glulam parts,
rib elements, LVL, HTC, Leno 2.0, FLEX-Systems

PROMOTER

INVESTOR

CLIENT

WE BUILD

Part Main
contractor
BoQ private

Sub-contractor
Timber
Constructuon

SF-GU
funktional

Turnkey-MC
team concept

Project
management

Timber frame, LENO, Glulam, HTC; Rib elements, LVL, Post Column Facades,
and all other wood-based materials, the combination of other construction methods and
complex timber engineering

PRODUCTS AND SYSTEMS



CROSS LAMINATED TIMBER

- Large format wall, floor and roof elements
- Dimensionally stable, virtually
- eliminating differential movement
- Solid elements made to measure to the nearest millimeter.

GLUE LAMINATED BEAMS

- Beams for special shapes and lengths up to 50m
- Solid floor and roof elements in various surface qualities
- Support free, large spanning structures

STRESS SKIN PANELS

- Basic Material LVL
- Support free, large spanning
- Light roof and floor elements with space for service installations or insulation
- Optimized for fire protection and sound absorption

TIMBER CONCRETE COMPOSITE

- Special floors for office and light industrial buildings
- High load transfer
- Prefabricated elements with no need for curing time
- Highly versatile elements meeting dimensional, load bearing and visual requirements
- Beam and panel type elements for extreme loads and geometries

TIMBER FRAME

- Basic Material Sawn Timber/KVH
- Material saving system
- Passive house regulations is pushing the use of Timber Frame Elements
- Industrial production
- space for service installations or insulation

OTHER SYSTEMS

- Nailed Laminated Timber
- Doweled Laminated Timber
-

CROSS LAMINATED TIMBER (CLT)



Dimensions

- Length up to 14,80 m (up to 20 m on request)
- Width up to 4,80 m
- Thickness from 51 mm to 297 mm

SPECIALS

- Individually and precisely pre-fabricated
- Dimensionally stable, load bearing in 2 axes
- Approval number Z-9.1-501 / ETA-10/0241

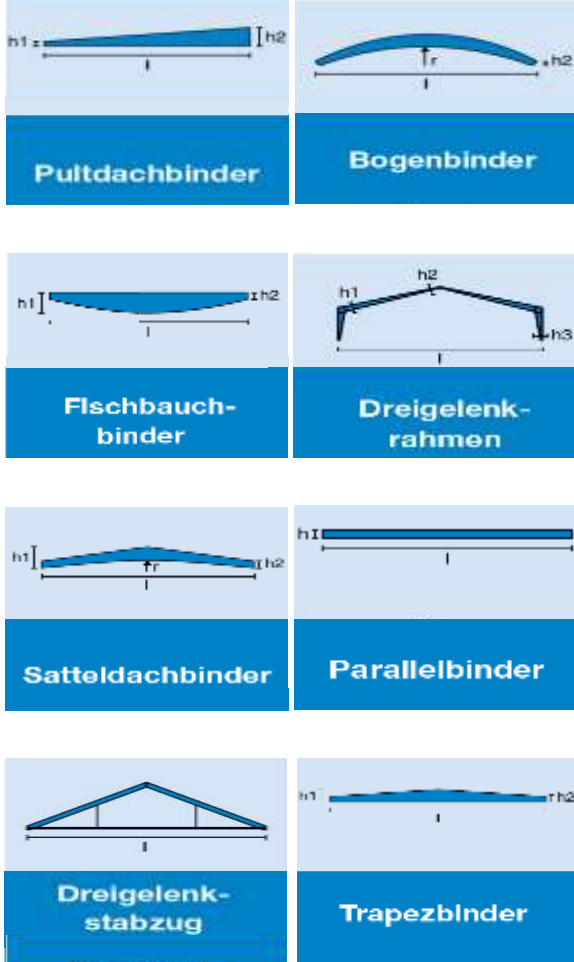
GLULAM- GLUED LAMINATED TIMBER



GLUED LAMINATED TIMBER (GLULAM)

- Free form, free length, free profile
- High dimensional stability and strength
- High-quality surfaces
- No chemical timber preservation
- Good technical and structural properties
- Great architectonic freedom
- High load bearing capacity

GLULAM



GLULAMSYSTEMS

- Glulam out of spruce , GL24h and when desired GL28c or GL32c
- Lamella thickness of 33 up to 42 mm
- Surface in visual or industrial quality
- Chamfered edges
- Weather-resistant gluing with bright joints
- Beams with other cross-sections and other strength classes on request
- Glulam with refined surface- sanded or brushed

STRESS SKIN PANELS



RIB AND BOX ELEMENTS

- Dimensions up to 2,50/23, 0 m
- European approval number ETA-07/0029
- Certificated to CE EN 14374.
- High installation rates up to 1000 m²/day
- Pre-assembled prepared elements, incl. insulation and roof covering
- Acoustic ceiling can be included
- Visible surfaces with top-quality finishing

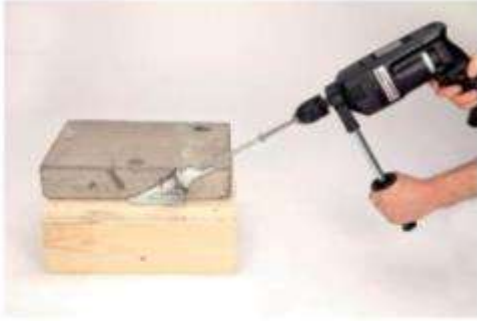
TIMBER FRAME



HIGH QUALITY FOR PASSIVE HOUSING

- Dimensions up to 4,50/23, 0 m
- Off Site industrial production
- M&E partially included
- Pre-assembled elements including windows and external facade
- Fire rating up to REI 60

TIMBER CONCRETE COMPOSITE



Vor-Ort-Verschraubung mit Stahlbetonfertigteilelementen



Würth AG, Anleihen



Das Fertigteil wird im nass-in-nass-Verfahren hergestellt

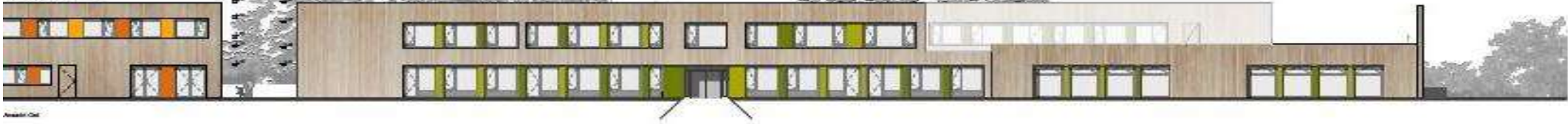
(Applikation des Klebstoffes auf die Holzoberfläche und anschließendes Gießen des Betons)



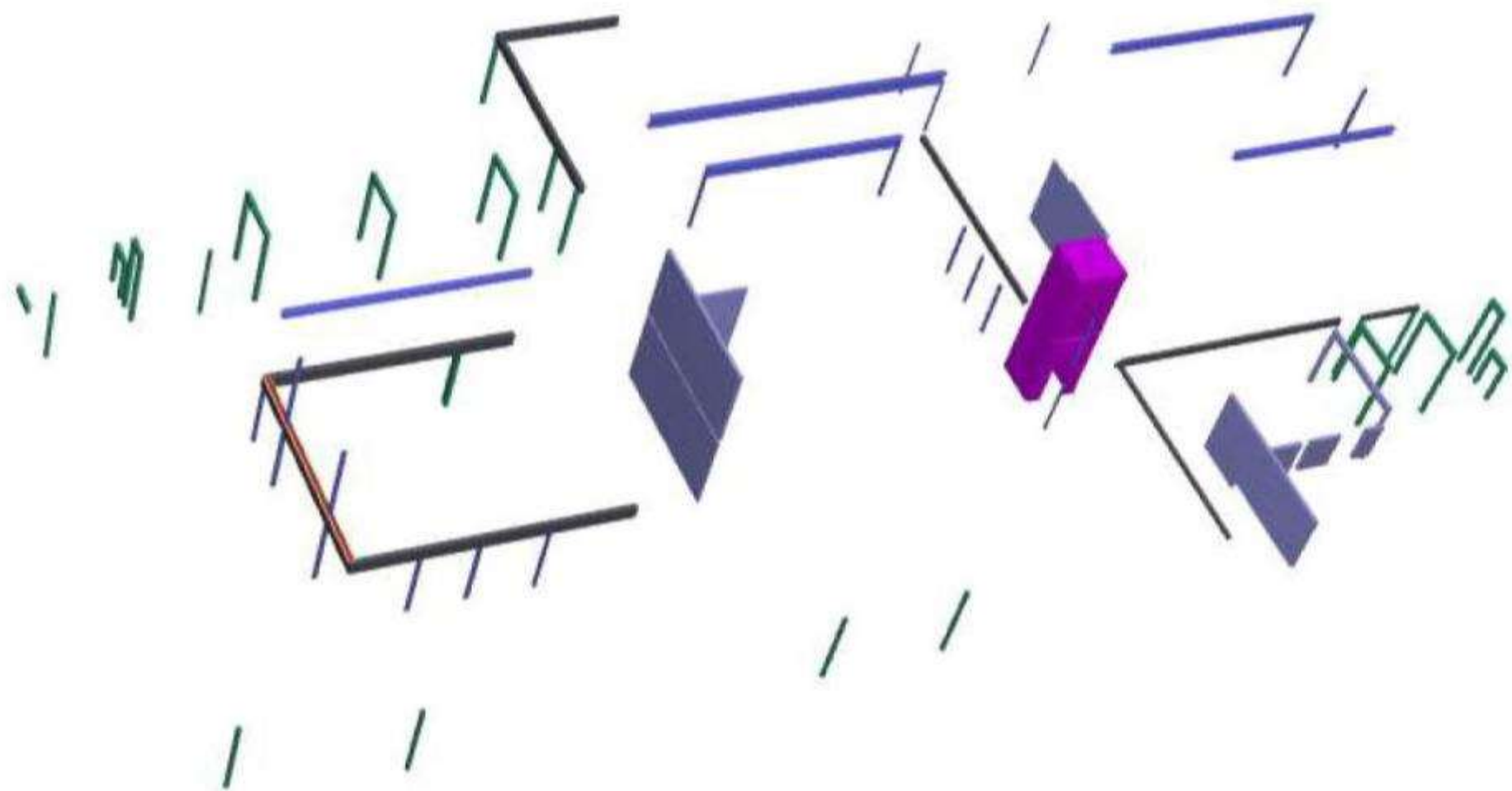
zwischen Holz und Beton ergibt sich ein starrer Verbund



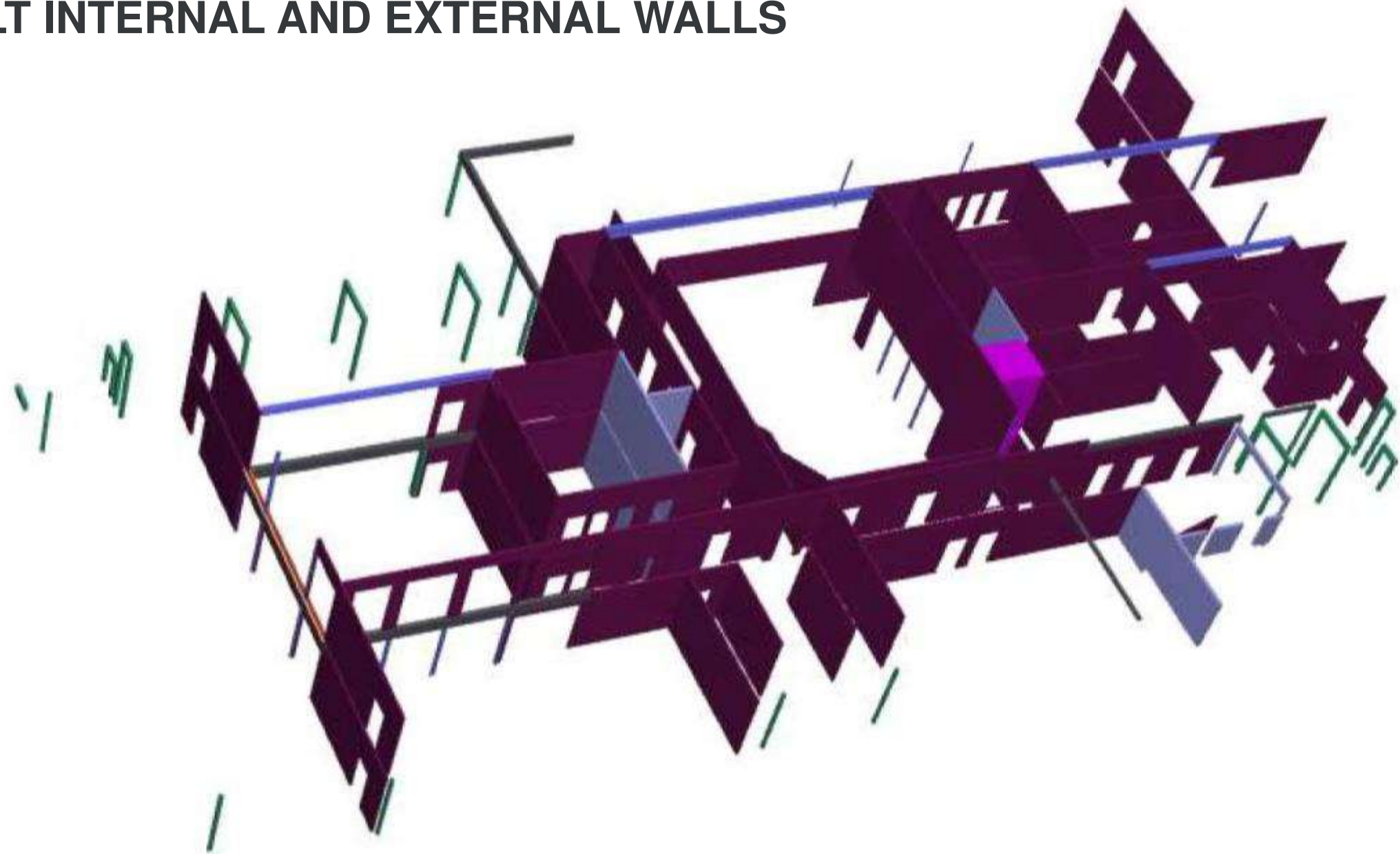
Quelle: BHTV-Mitgliedsunternehmen F+T Berner Hochschule, Biel



CONCRETE AND STEEL



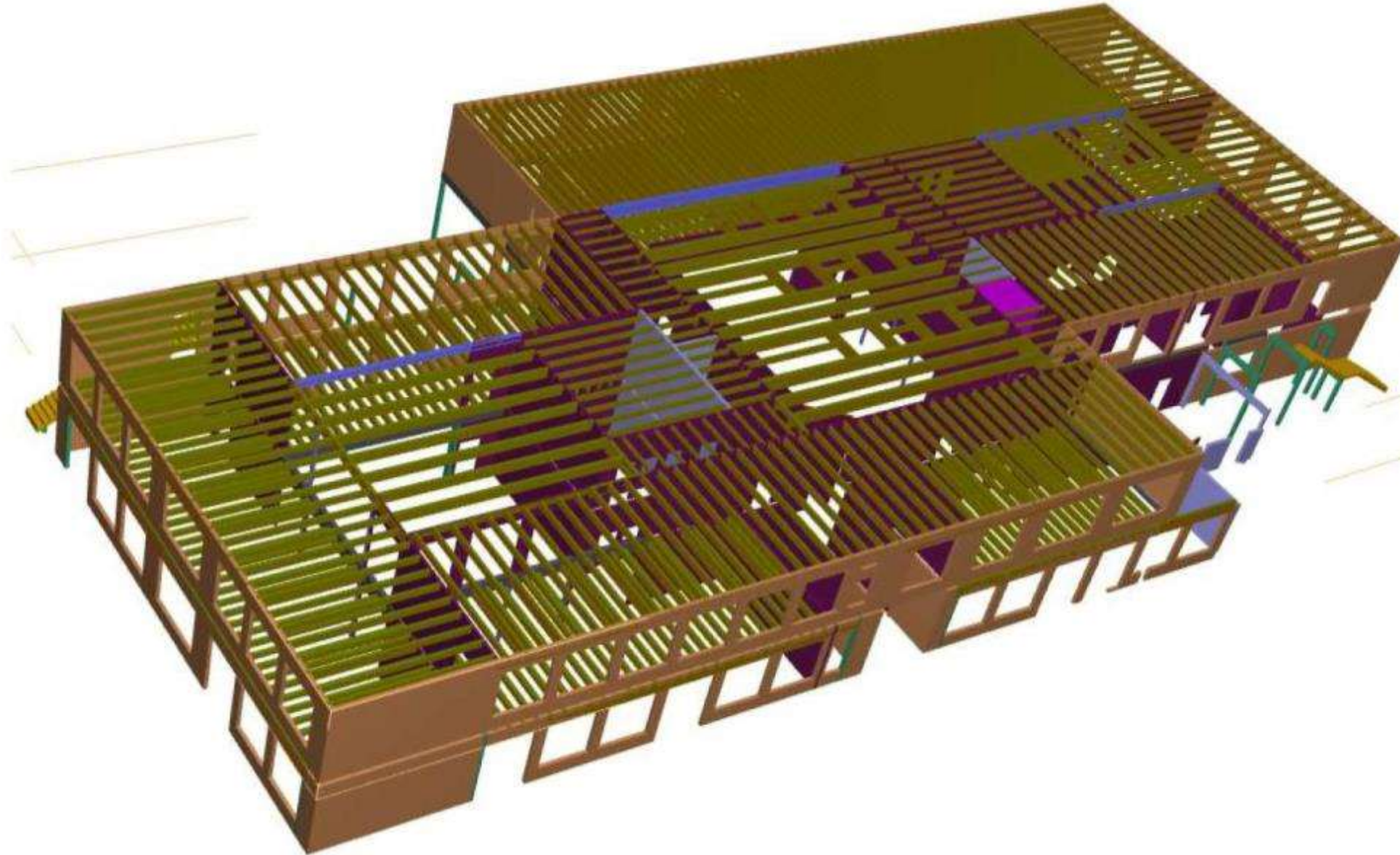
CLT INTERNAL AND EXTERNAL WALLS



PASSIVE HOUSE EXTERNAL TIMBER FRAME WALLS



TIMBER CONCRETE COMPOSITE FLOOR FLOOR PANELS

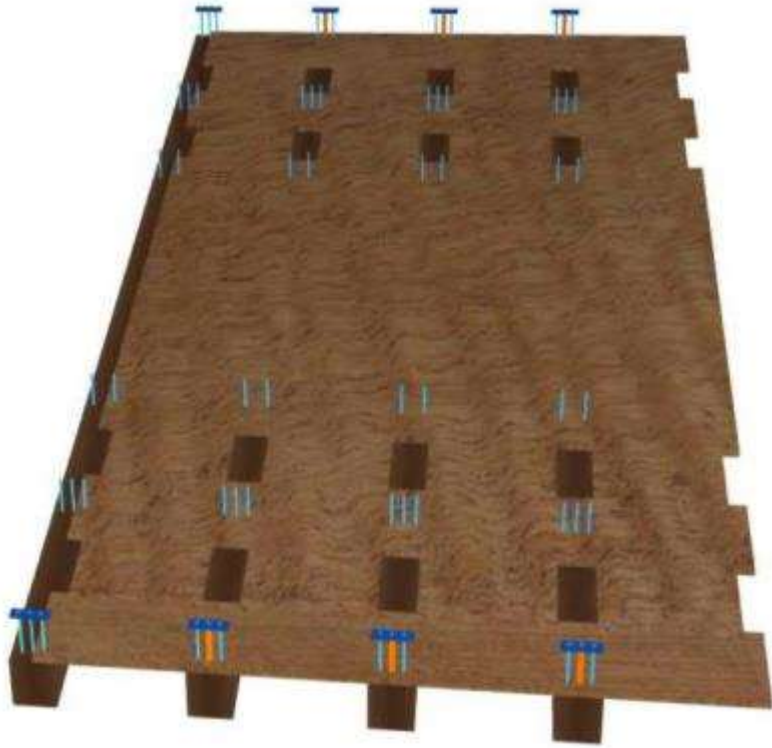




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TIMBER COMPOSITE FLOOR PANELS



TIMBER COMPOSITE FLOOR PANELS





**OFFICEBUILDING PUBLIC SERVICES
LÜBECK/GERMANY**

PUBLIC SERVICES LÜBECK/GERMANY OFFICEBUILDING PASSIVHOUSE



Public Services Lübeck/Germany

Officebuilding Passivhouse

Facts	
Building Type	Office Building, Conference Rooms and Cantine
Energy Standard	Passivhouse – Plus Energy House
Location	Lübeck (30 km to Baltic Sea)
Customer	Stadtwerke Lübeck (Energy Supplier for Lübeck)
Cost	GMP 17,5 Mio € (Design an Build, incl. Funding)
Main Contractor	Ed. Züblin AG (Jena) / Merk Timber Aichach
Structure	10.800 m ² Leno CLT Floor Panels 588 m ³ Glulam 4.800 m ² Timber Frame Walls
Construction Time	10/2013 – 11/2014 (13 Month)
Floor Space / Energy Reference area	13.856 m ² / 10.004 m ²
Volume	50.995 m ³

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Officebuilding Passivhouse

Value Engineering in cooperation with customer based on

- Revised fire concept (GK 4 instead of 5)
- no sprinklering, no encapsulation
- alternative ventilation concept (central ventilation)
- Renouncement of needless outfit (e.g. lightning control via remote control)
- Revised Kitchen (elevator and outfit)
- alternative foundation (eliminating excavation, spread foundation, no piles)

Trade	April 2012 Total / Mio €	February 2013 Total / Mio €
Structure/ Facade	4,80	4,90
Interior fittings	2,80	2,60
Foundation	4,20	2,27
Building Site Equipment	3,00	3,20
Mechanical and Engineering	6,20	4,53
Total	21,00	17,50

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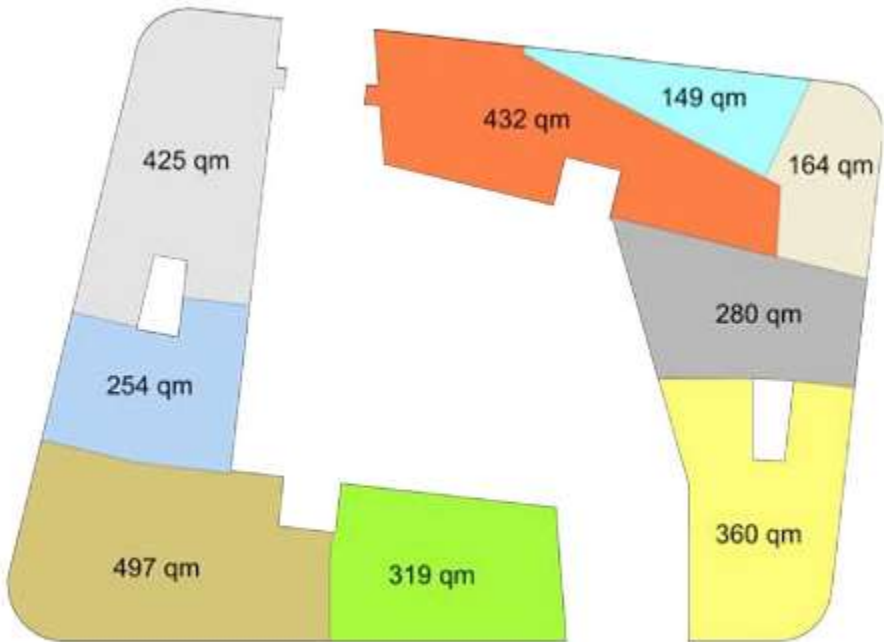
Officebuilding Passivhouse



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Initial Fire concept by customer



Nutzungseinheiteneinteilung Erdgeschoss

areas/partitions ground floor



Nutzungseinheiteneinteilung 1. bis 3. Obergeschoss

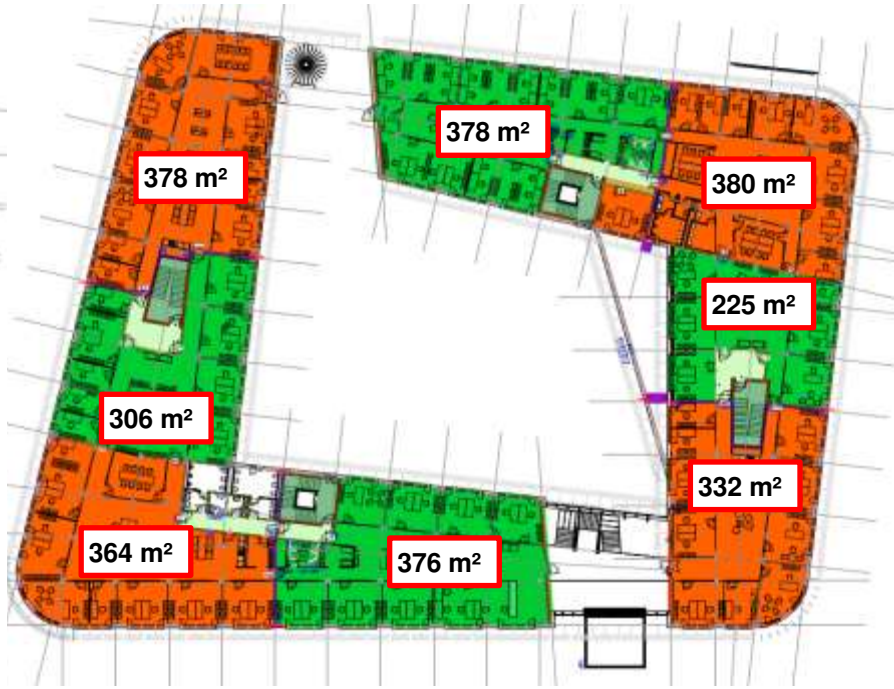
areas/partitions 1.-3. floor

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ZÜBLIN fire concept



areas/partitions ground floor



areas/partitions 1.-3. floor

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Design



Konzept

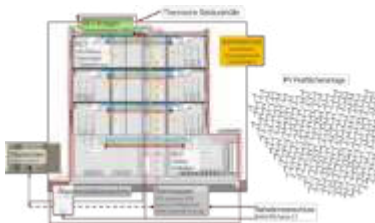
- Modern Design
- Communicative room concept
- Multi functional use

Renewable Building Material



- Timber as main building material for structure, walls, floors and facade
- External larch cladding

Energy



Passivhouse

- Healty internal climate

Plus-Energy-House

- Positive Energy Balance

Ecobalance



- Carbon Balance
- Primary Energy Consumption

■ **TOTAL 2.438 m³ TIMBER**

**Grown within 10 minutes
in German forests**

2400 Tons of CO₂ stored

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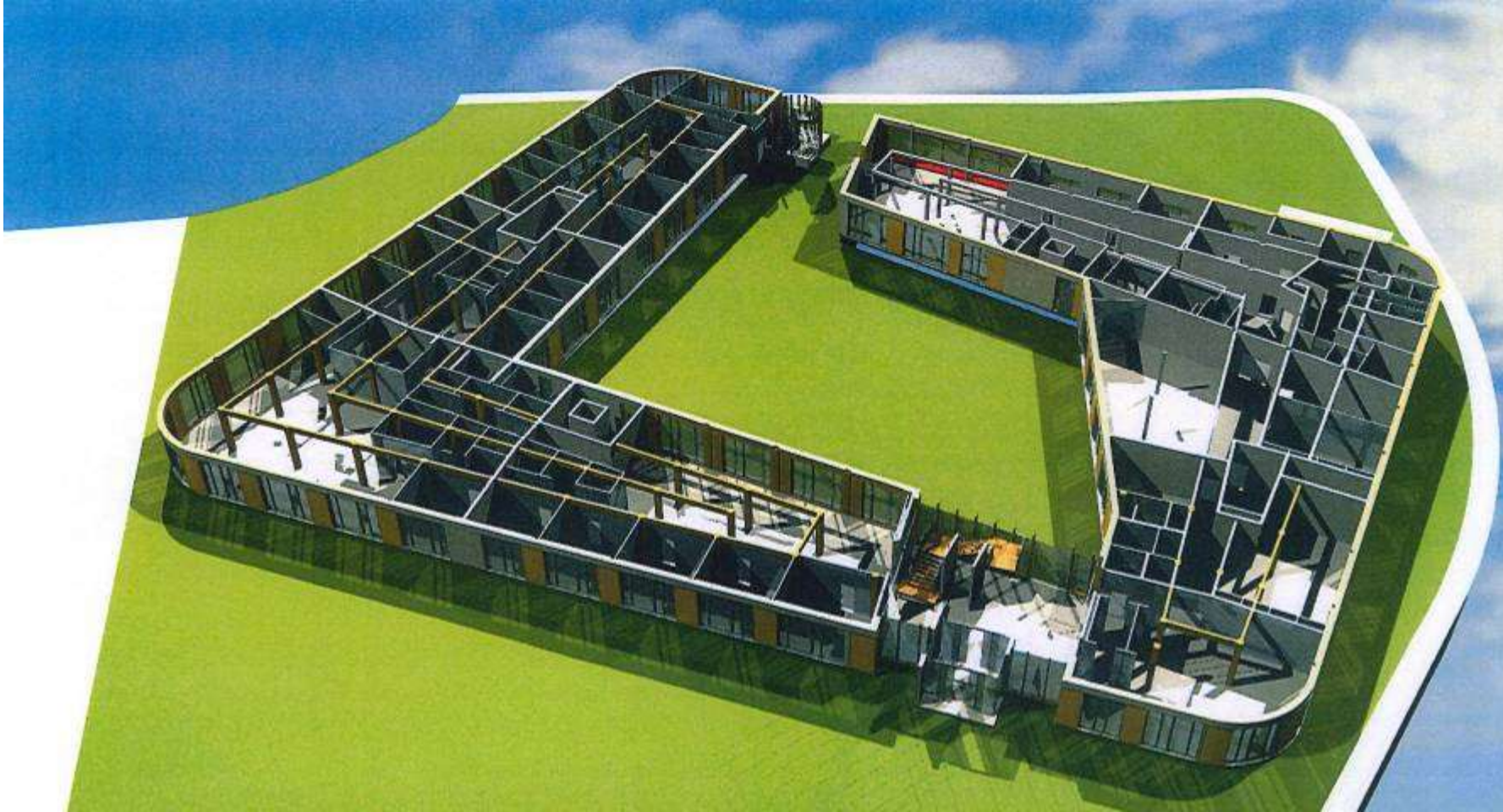
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Officebuilding Passivhouse

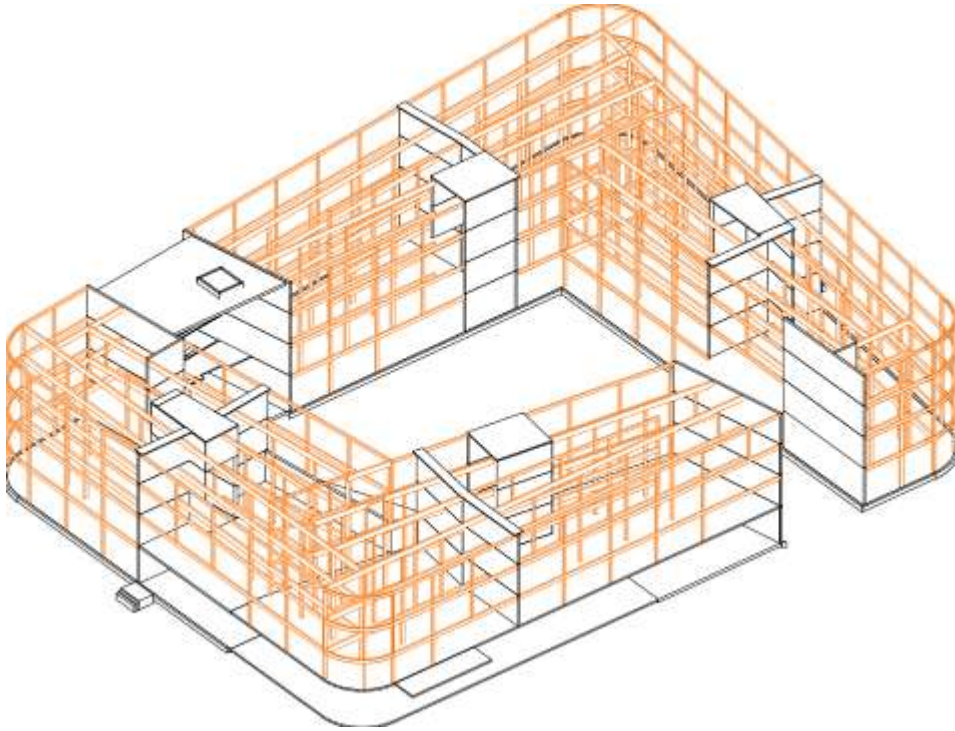


Public Services Lübeck/Germany Officebuilding Passivhouse



Public Services Lübeck/Germany

Officebuilding Passivhouse

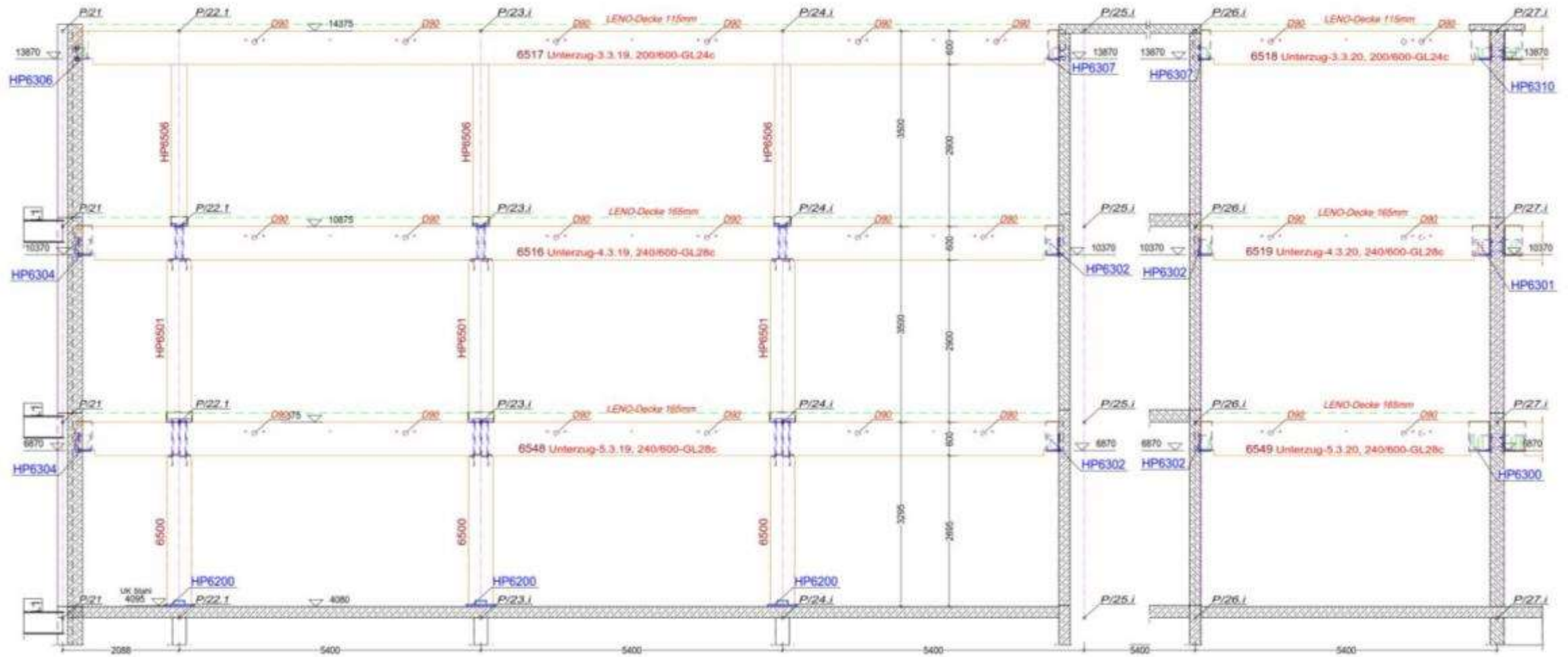


Structure:

- Load Bearing structure done in Glulam and CLT
- and concrete for staircases,, liftshafts and bracing/fire walls

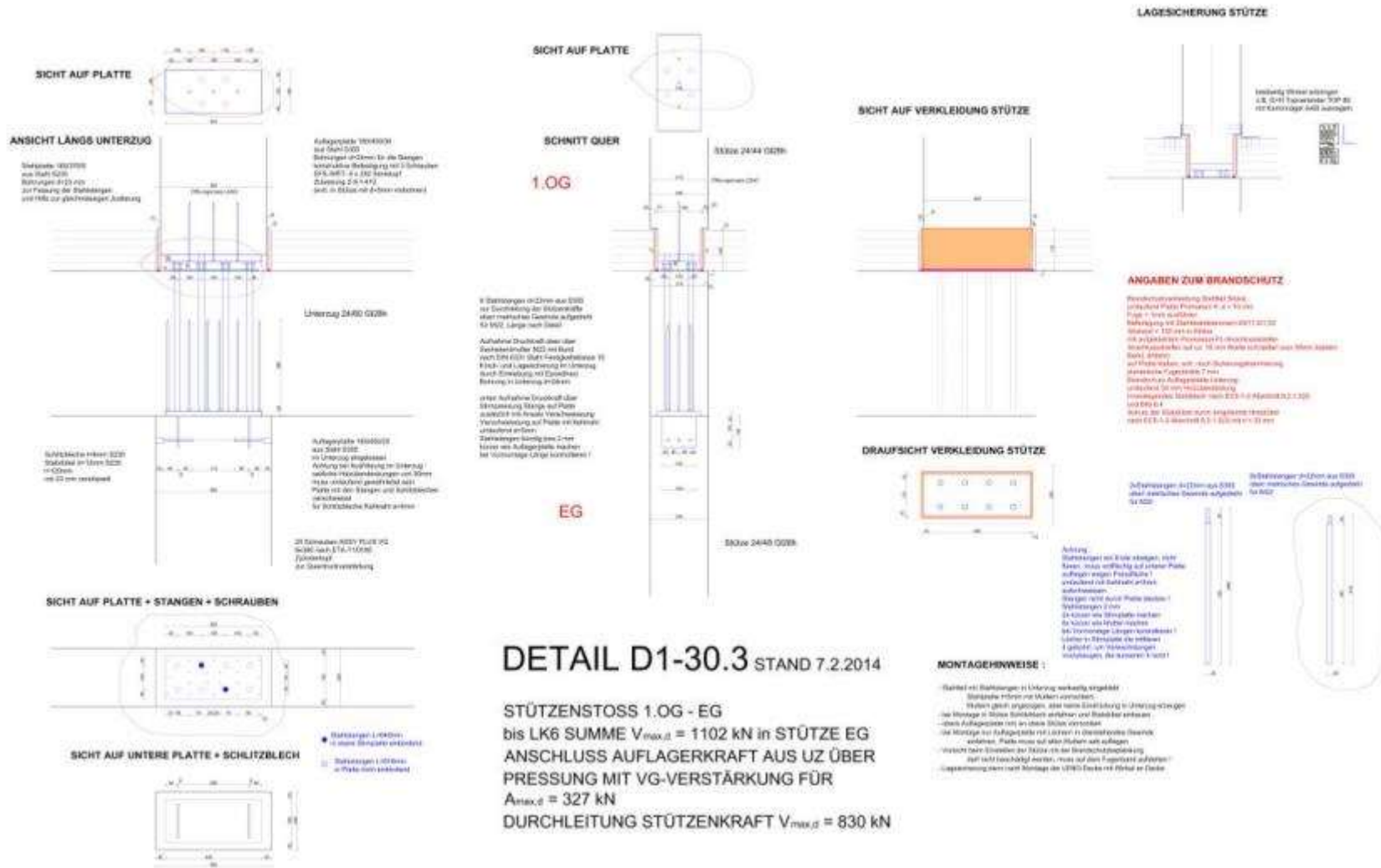
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Schnitt Achse P - M1:50

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External Wall Element, Timber Frame, Glas Fiber Insulation, Off site production

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Prefabricated Wall panel 15 m long 3,60 high

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Site Situation 2 month after start

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Passivehouse Standard

- Requirement 1:
 - max. 15 kWh/(m²a) Heating Demand
- Requirement 2:
 - max. 15 kWh/(m²a) Cooling Demand
- Requirement 3:
 - max. 120 kWh/(m²a) Primary Energy for Heating, Cooling, Electrical Power (incl. Ventilation), dehumidification, hot water, light, electrical devices
- Requirement 4:
 - 0,6 1/h Pressure Test Blower Door n₅₀

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Highly efficient building services

- Very low Pressure loss of ventilation
- Large Ventilation facility (efficient recuperation) and conduit cross section
→ active Floor Panels (heating, ventilation, lightning, accoustic)
- Avoiding of external pipes
- Reduced operating hours
- LED – Lightning and inteligent lightning control

Highly efficient heat insulating thermal shell

- Avoiding of thermal bridging
- High insulation thickness (> 240 mm)
- Windows Passive House Standard 3-layer glazing $U = 0,8 \text{ W/m}^2\text{K}$

Facility Management

- Active Sun Shading
- Cross linked building control

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Result PHPP-Calculation:

Gebäudekennwerte mit Bezug auf Energiebezugsfläche und Jahr					
	Energiebezugsfläche	10004,6	m ²	Anforderungen	Erfüllt?*
Heizen	Heizwärmebedarf	15	kWh/(m ² a)	15 kWh/(m ² a)	ja
	Heizlast	13	W/m ²	10 W/m ²	-
Kühlen	Kühlbedarf gesamt		kWh/(m ² a)	-	-
	Kühllast		W/m ²	-	-
	Übertemperaturhäufigkeit (> 26 °C)	0,1	%	-	-
Primärenergie	Komplett Heizen, Kühlen, Entfeuchten, WW, Hilfsstrom, Licht, elektr. Geräte	120	kWh/(m ² a)	120 kWh/(m ² a)	ja
	Teilbereich WW, Heizung und Hilfsstrom	40	kWh/(m ² a)	-	-
	PE-Einsparung durch solar erzeugten Strom		kWh/(m ² a)	-	-
Luftdichtheit	Drucktest-Luftwechsel n ₅₀	0,6	1/h	0,6 1/h	ja

* leeres Feld: Daten fehlen; '-': keine Anforderung

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How to get a PLUSEnergyhouse:

Limits to be defined:

- Total Energy:
 - 120 kWh/(m²a) Primary Energy used for:
Heating, Cooling, Electrical Power (incl. Ventilation), dehumidification, hot water, light, electrical devices
- Partial Energy
 - 40 kWh/(m²a) Primary Energy used for:
Hot water, Heating, electrical devices

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Required Primary Energy Earnings without using regenerative Energy

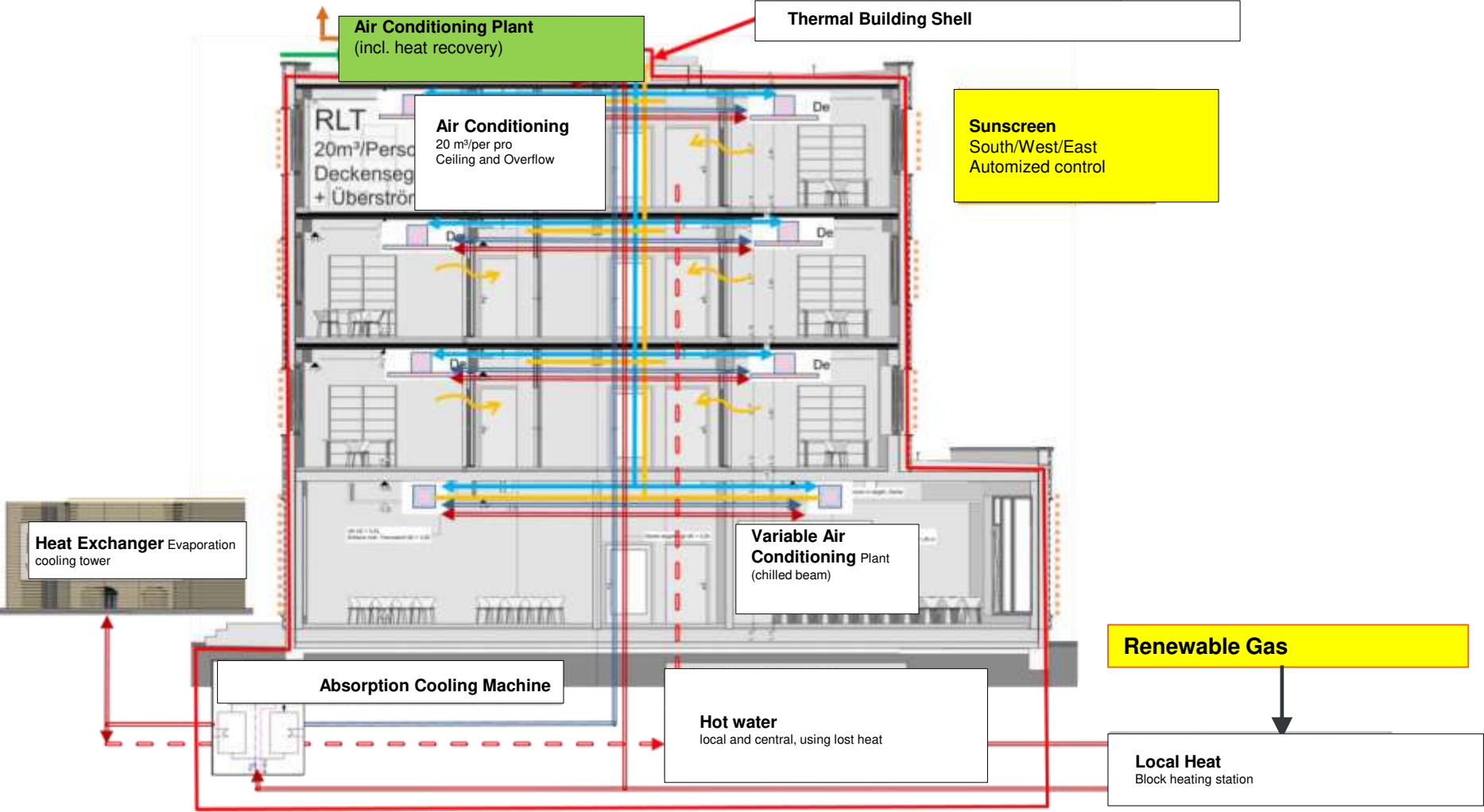
- Conversion:

required power from PV at 10.000 m² Energy Reference Area
(Approach Primary Energy Factor 2,6)

- Total: $1.200.000 \text{ kWh/a} / 2,6 = 462.000 \text{ kWh/a}$
=> 1870 No. PV-Modul → **ca. 5600 m² area**
- Partial: $400.000 \text{ kWh/a} / 2,6 = 154.000 \text{ kWh/a}$
=> 623 No. PV-Modul → **ca. 1870 m² area**
- Partial using regenerarative gas: $300.000 \text{ kWh/a} / 2,6 = 115.000 \text{ kWh/a}$
=> 465 No. PV-Modul → **ca. 1395 m² area**

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Option:

Optimization using regenerative gas at the local block, heat and power plant with primary energy factor 0:

- Heating Energy:
 - $15 \text{ kWh}/(\text{m}^2\text{a}) \times 0,0 = 0 \text{ kWh}/(\text{m}^2\text{a})$
- Reduction of specific Primary Energy Use:
 - Total : $105 \text{ kWh}/(\text{m}^2\text{a})$ Primary Energy for :
Heating, Cooling, Electrical Power (incl. Ventilation), dehumidification, hot water, light, electrical devices

Electrical Power for Services will be delivered by the local block, heat and power plant:

- Final Result total : $0 \text{ kWh}/(\text{m}^2\text{a})$ Primary Energy

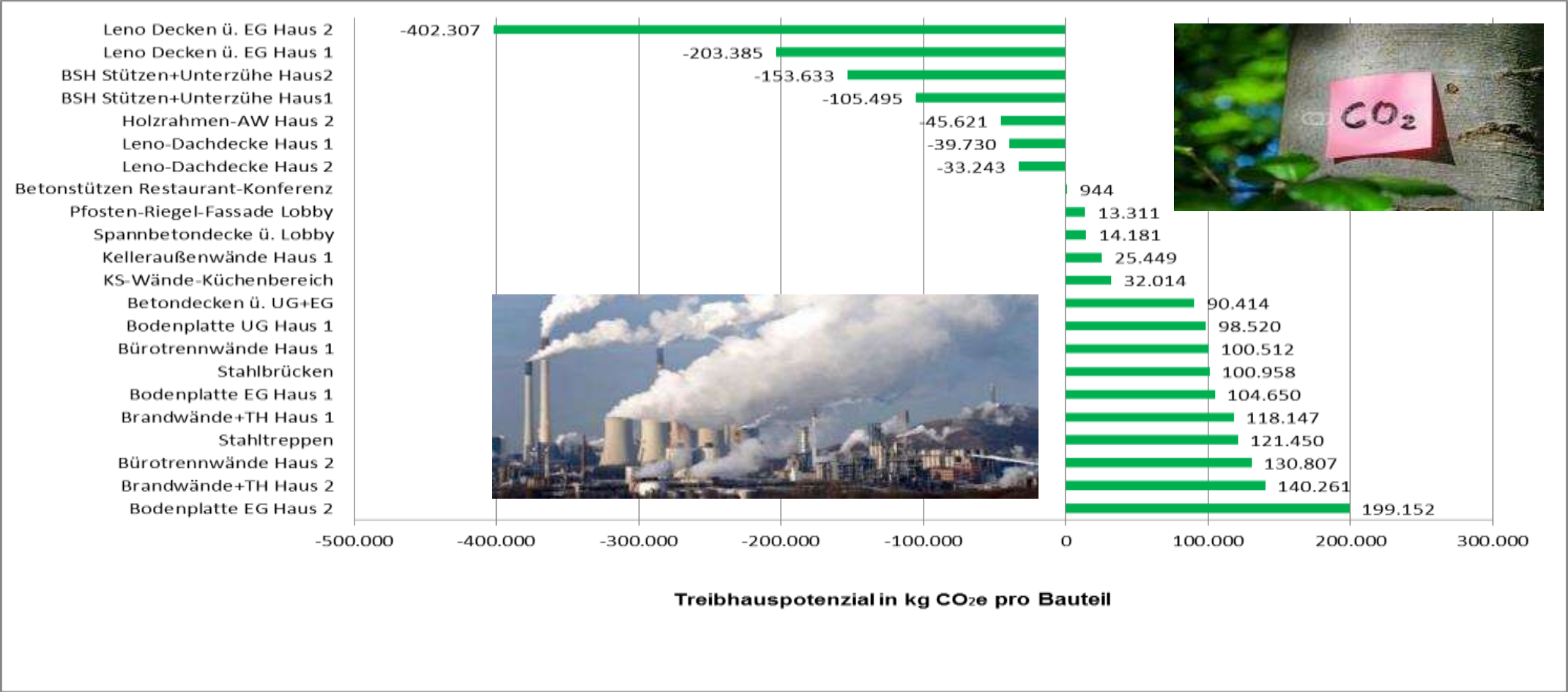
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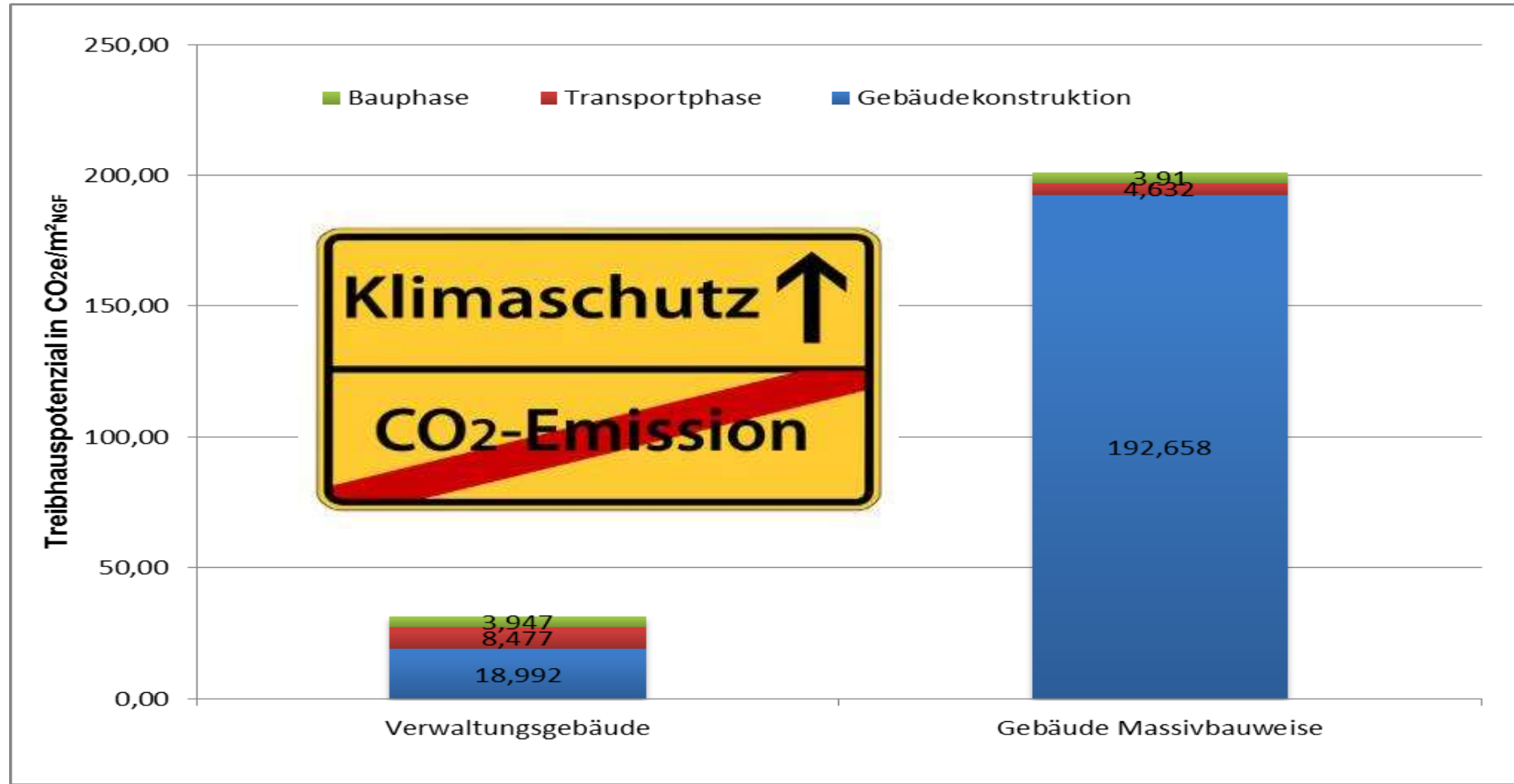
CO2 BALANCE – BUILDING STRCUTURE



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Officebuilding Passivhouse

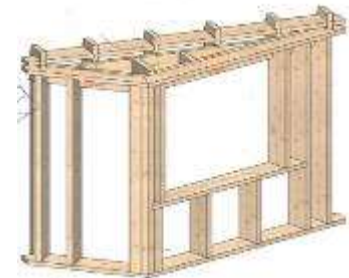
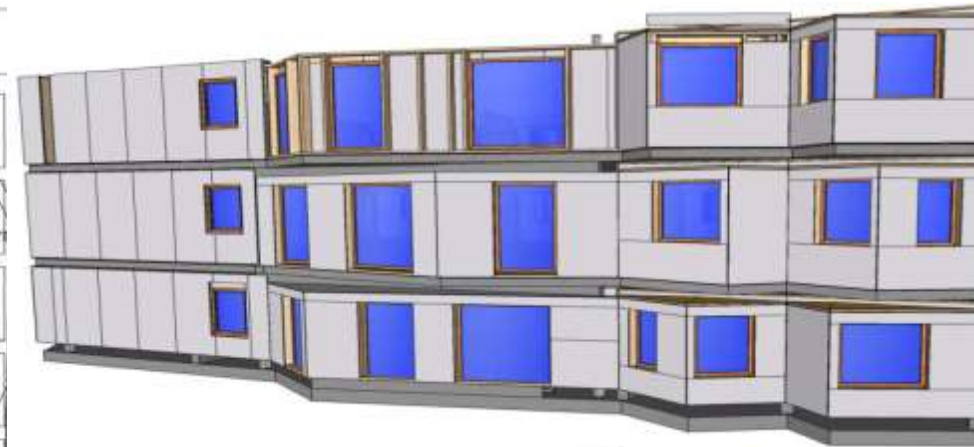
CO2-BALANCE TOTAL COMPARISON



STUDENT HOUSING ADLERSHOF, BERLIN/GER



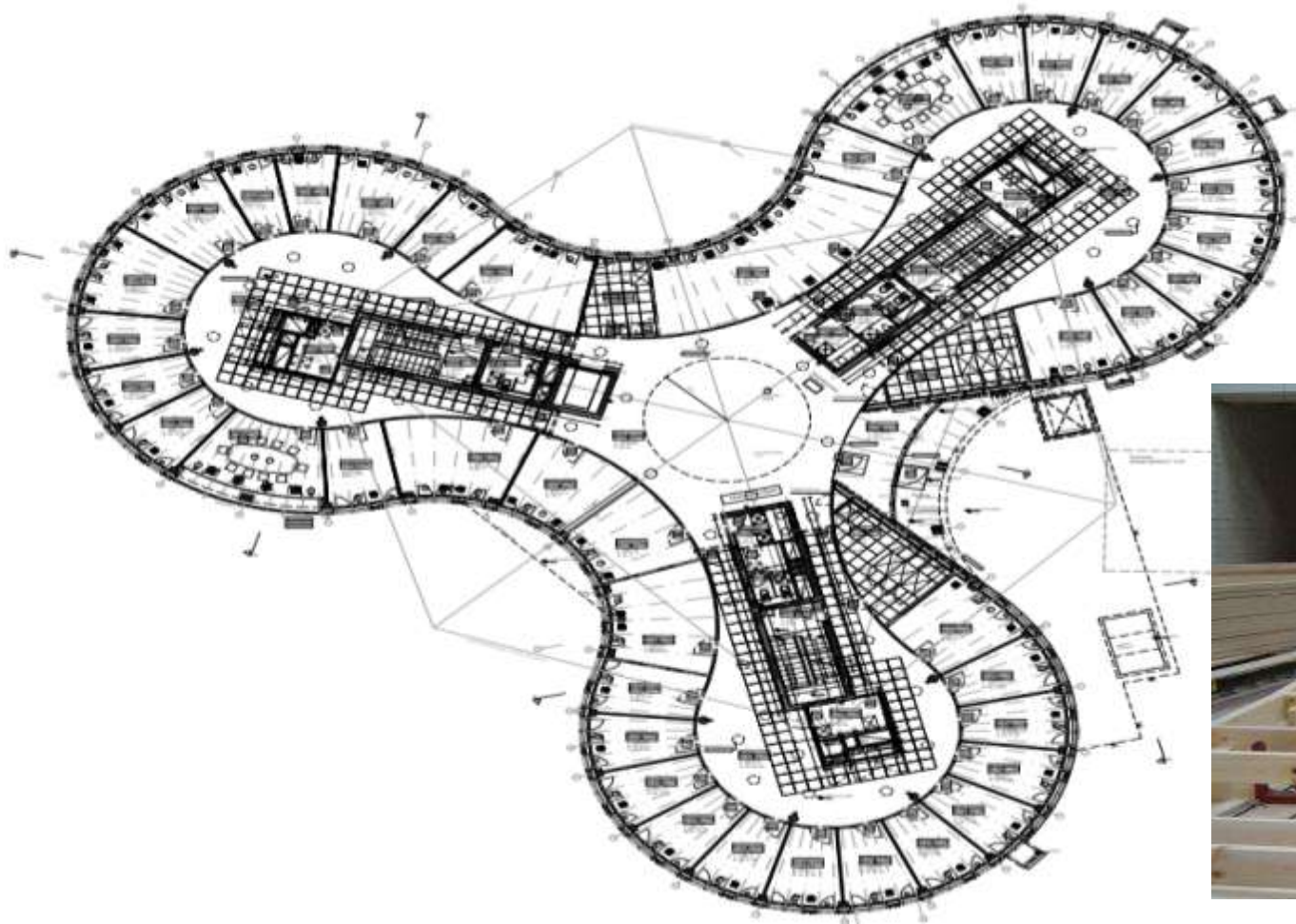
STUDENT HOUSING ADLERSHOF, BERLIN/GER



PIC OFFICE, POTSDAM/GER



PIC OFFICE, POTSDAM/GER



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ELEPHANT HOUSE ZOO ZÜRICH/CH



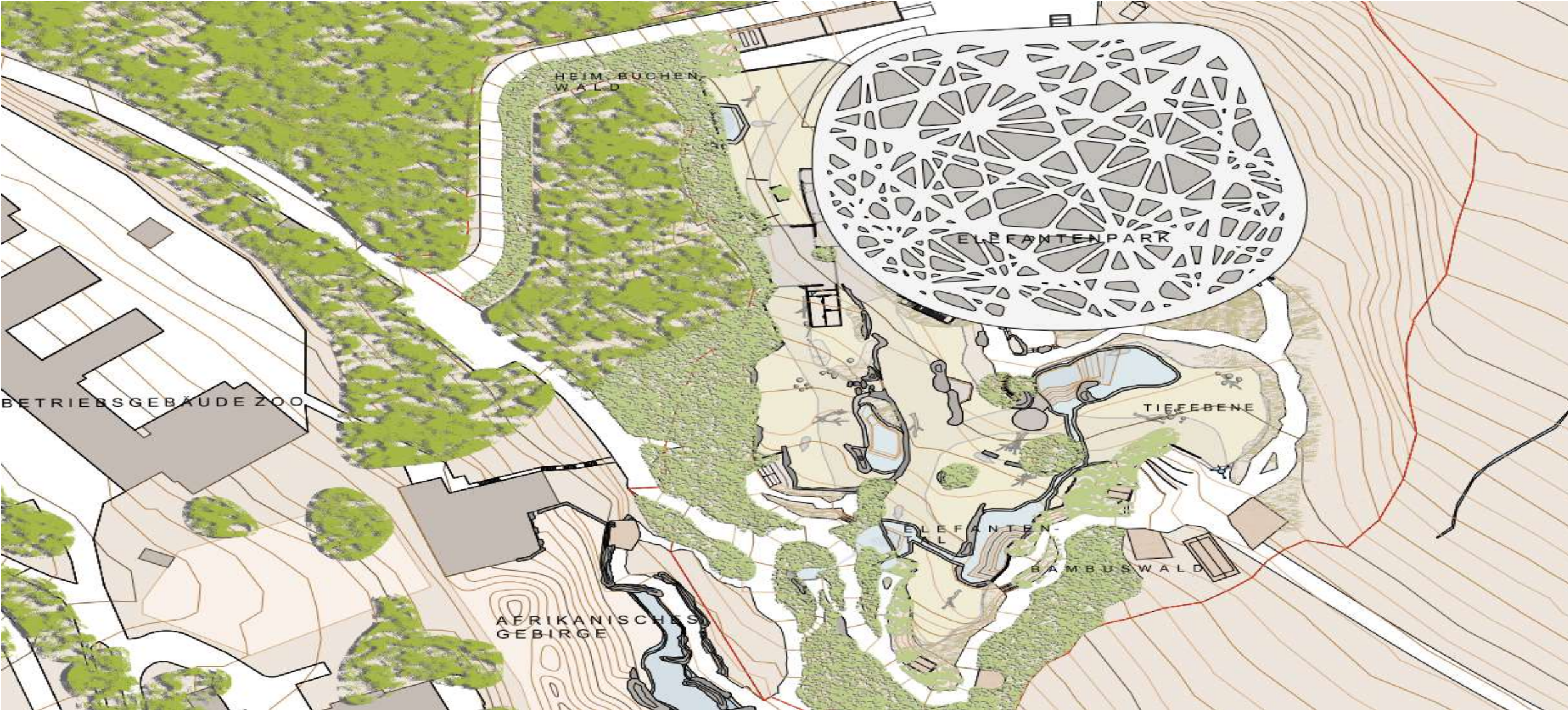


**MEHR PLATZ FÜR
DIE GRÖSSTEN.**

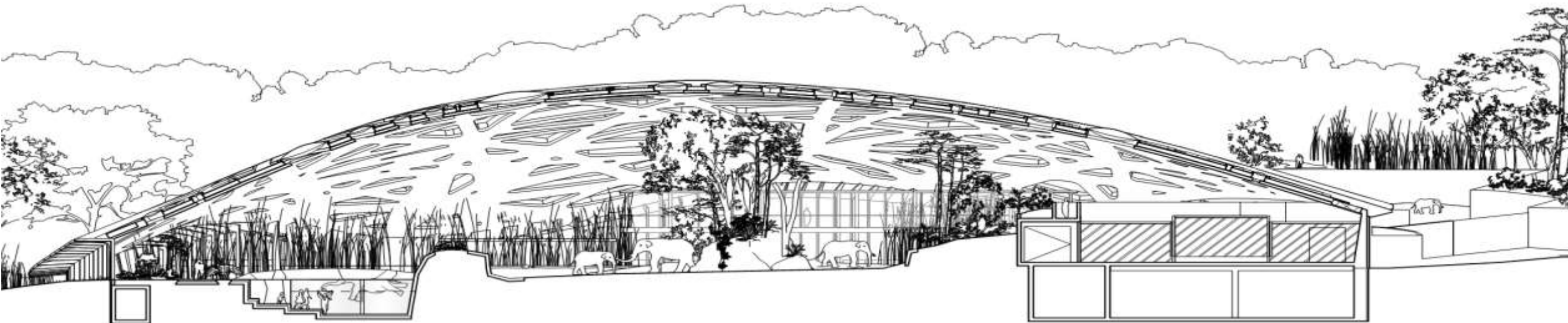
SPENDEN SIE FÜR DEN NEUEN
ELEFANTENPARK: PC80-804-4

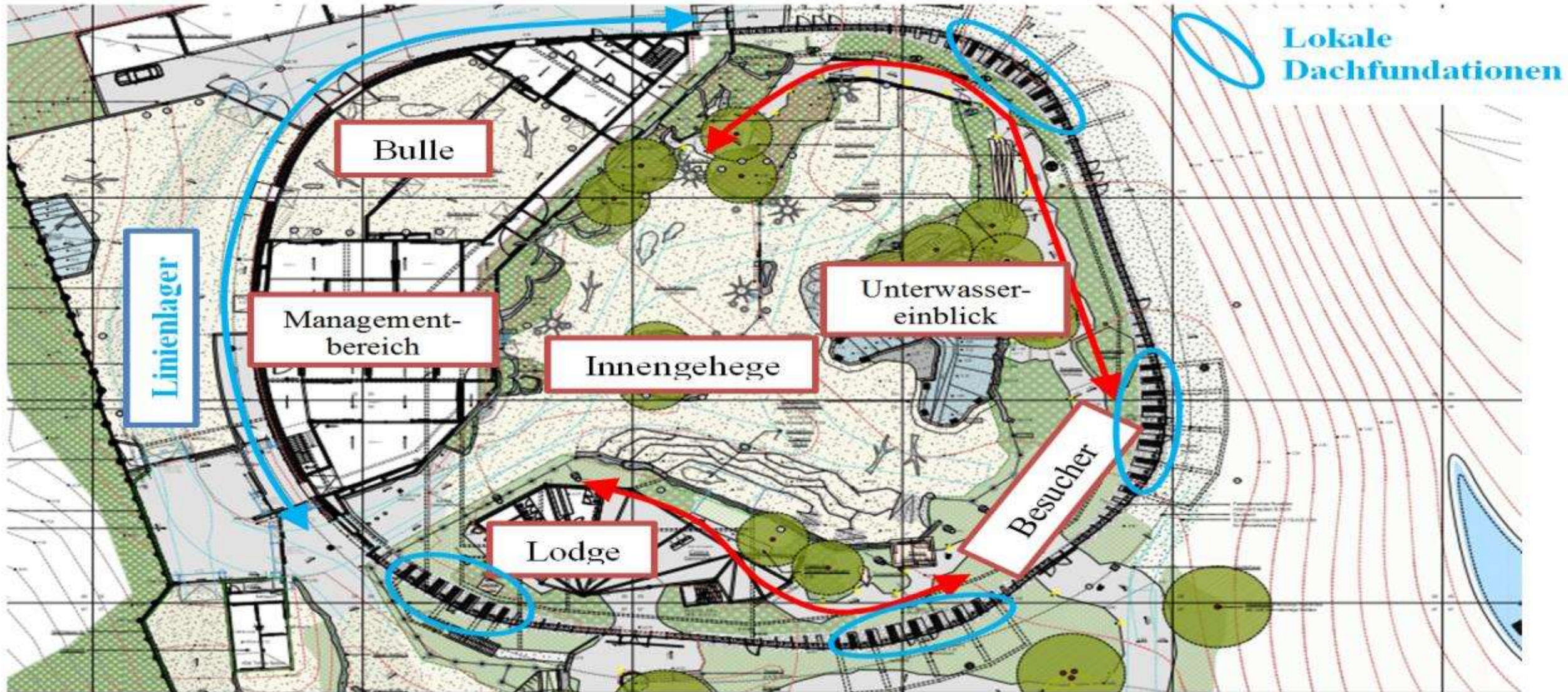
zooh!

Partner
Zürcher Kantonsbank **apo** **MIGROS**











Biegen der Brettsper Holzplatten auf Baustelle



Verebnung Freiform

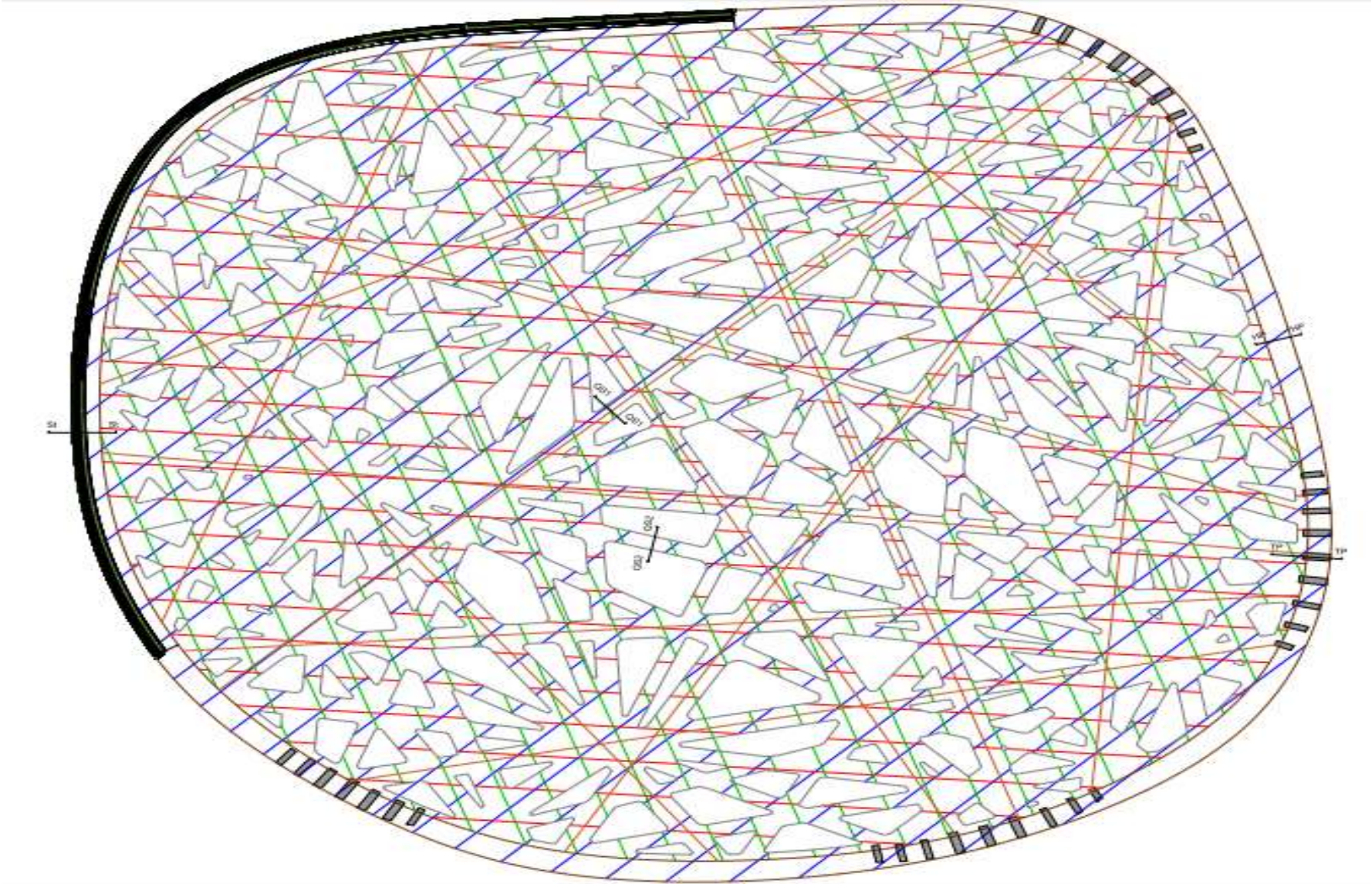


Nägel als duktiles Verbindungsmittel
unabhängig vom Kraftfaserwinkel

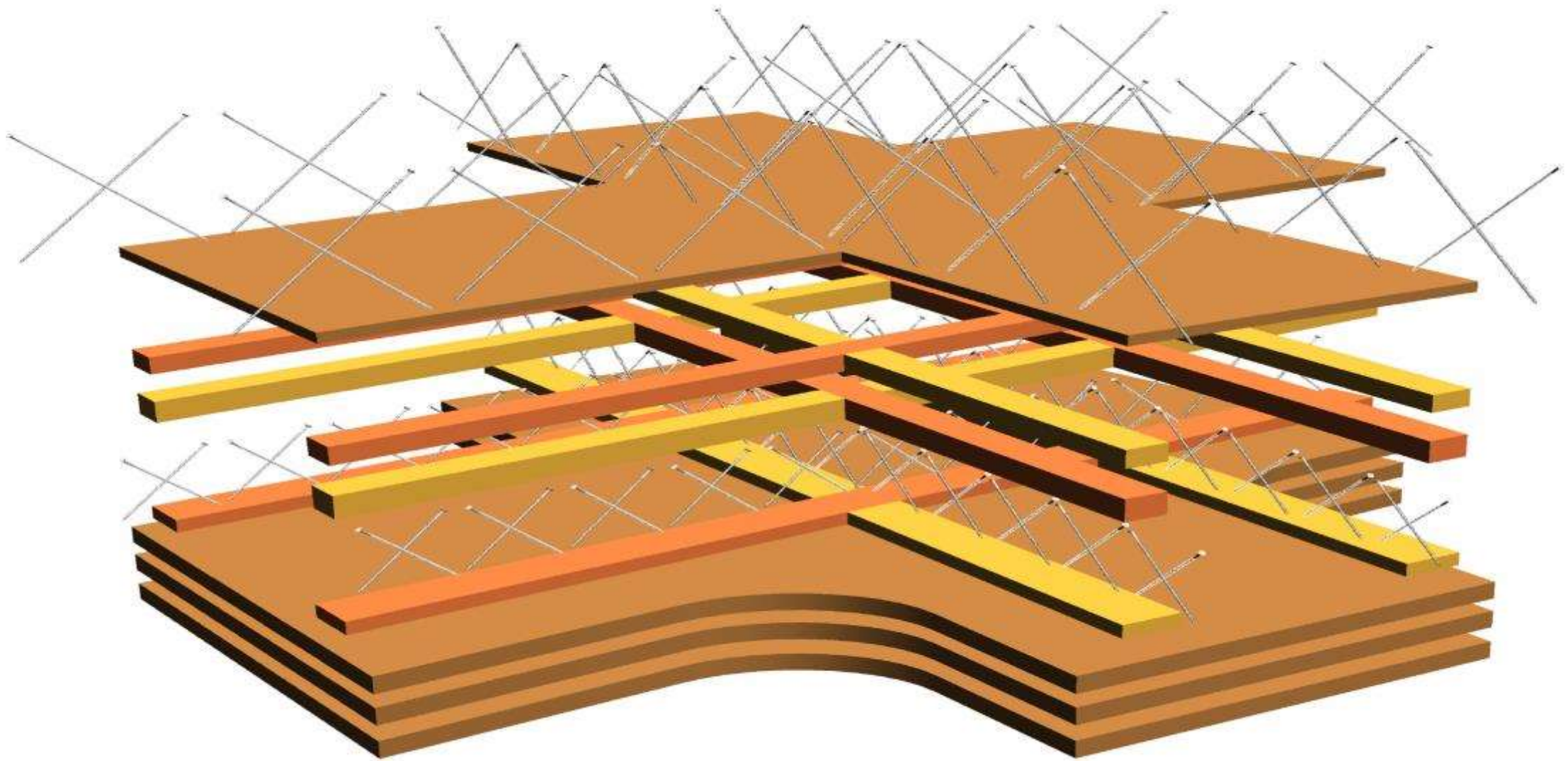
SNA 5

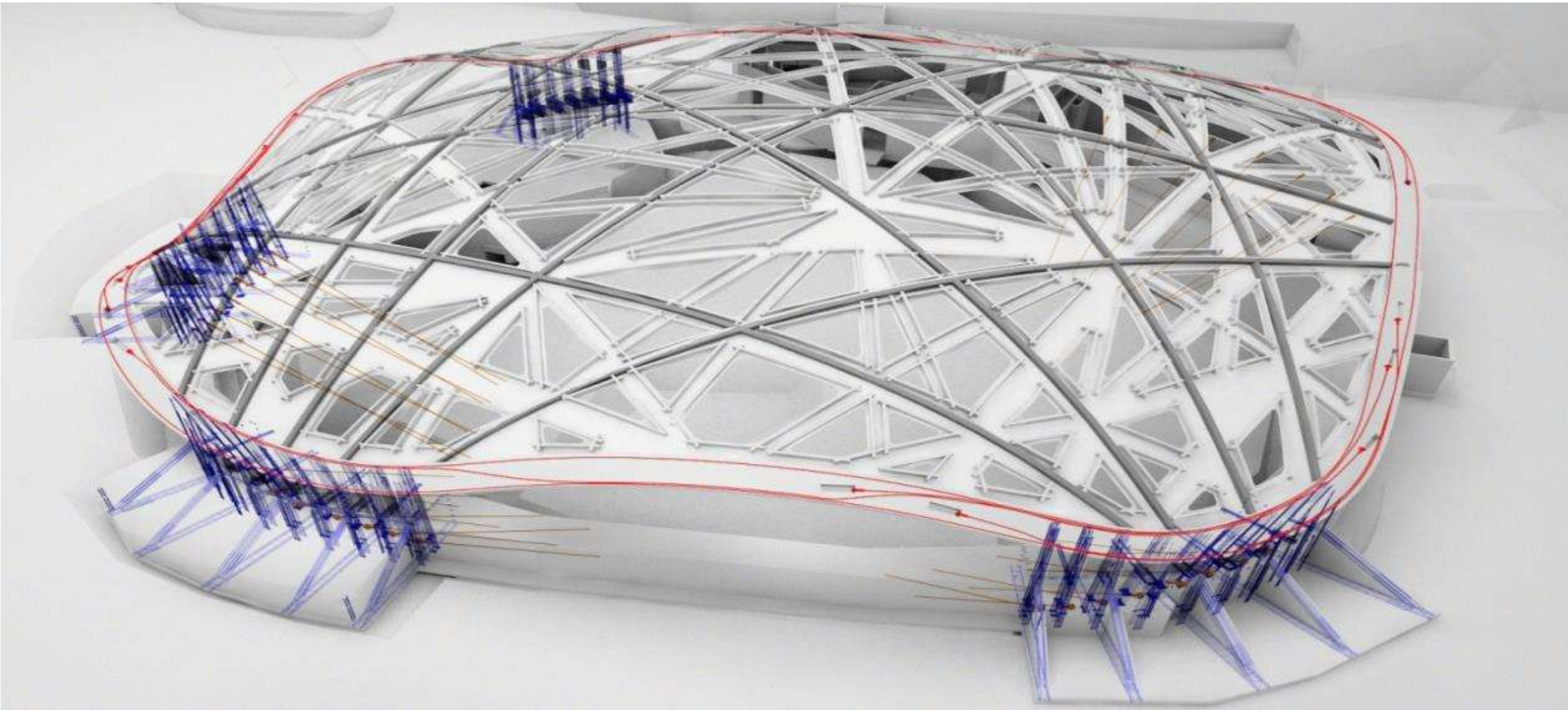


Nachgiebiger Verbundträger mit Vollgewindeschrauben

















Flächige Nagelverbindung





Vorspannung Ringbalken

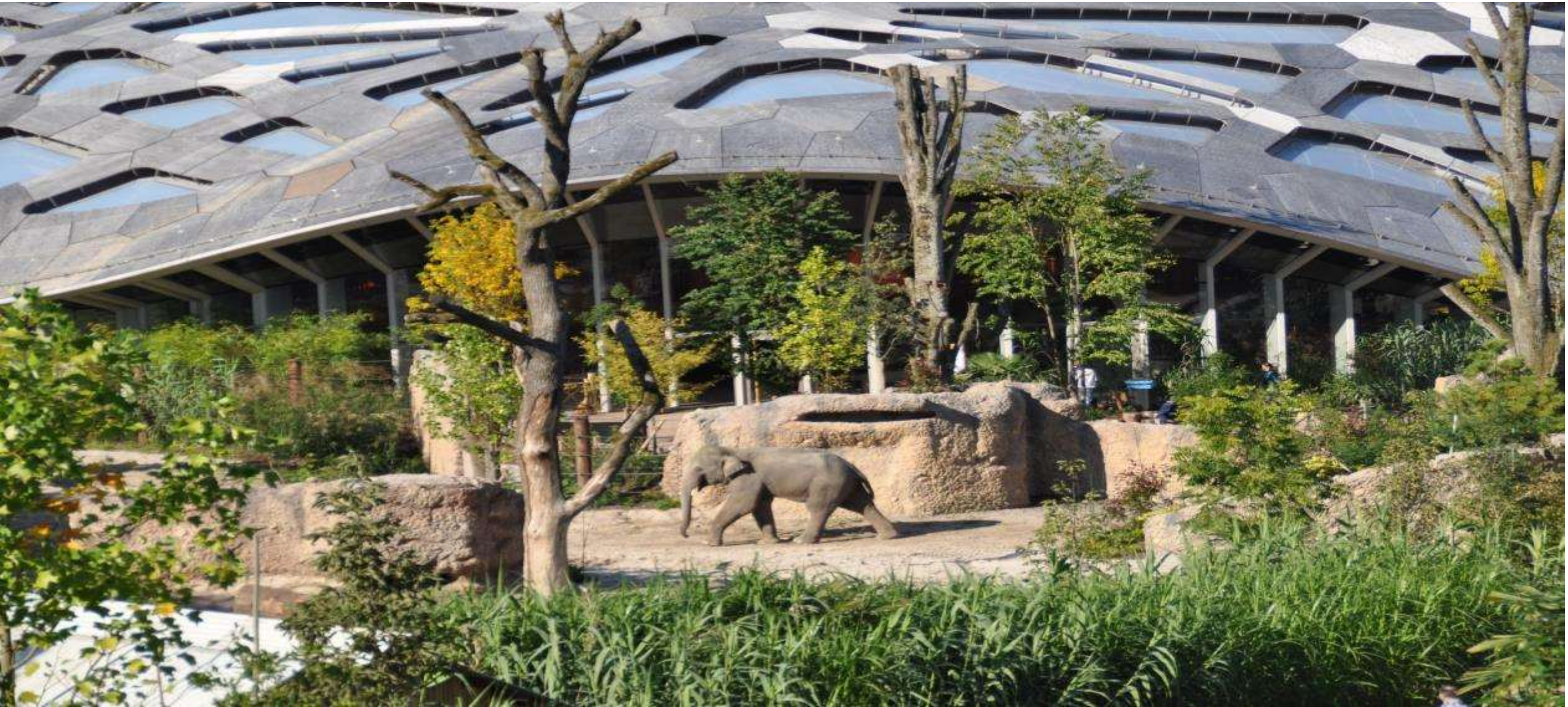














RESIDENTIAL HIGH RISE „BOB TREE“, BERGEN/NO



RESIDENTIAL HIGH RISE „BOB TREE“, BERGEN/NO



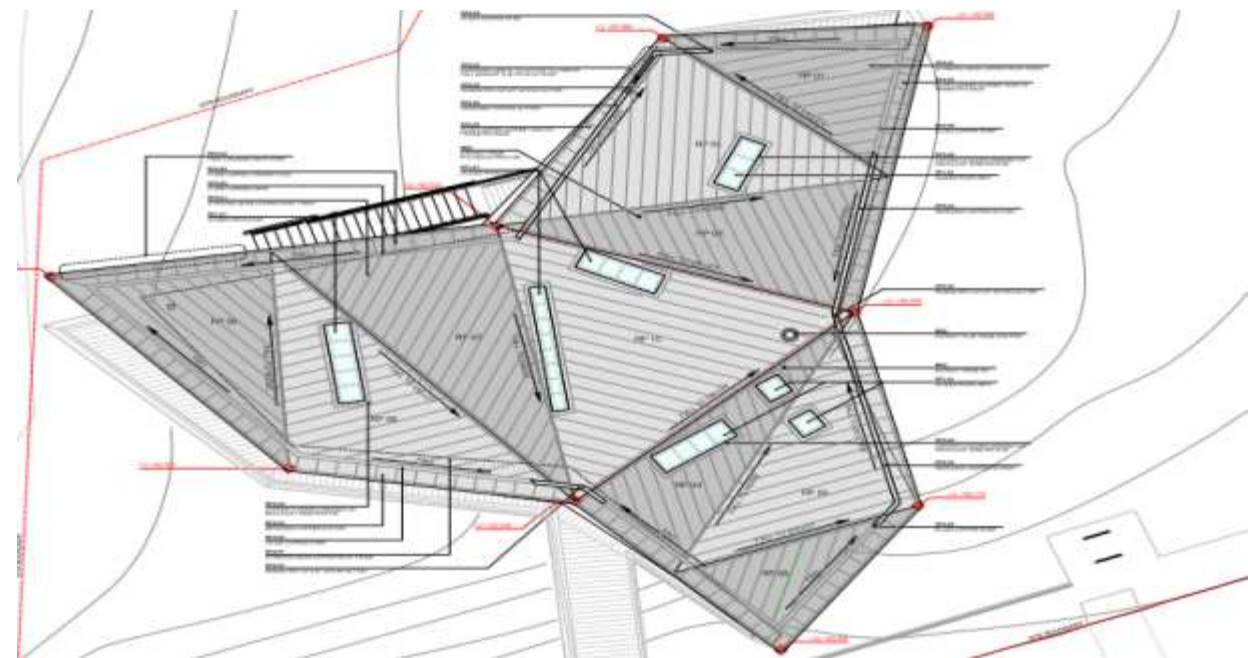
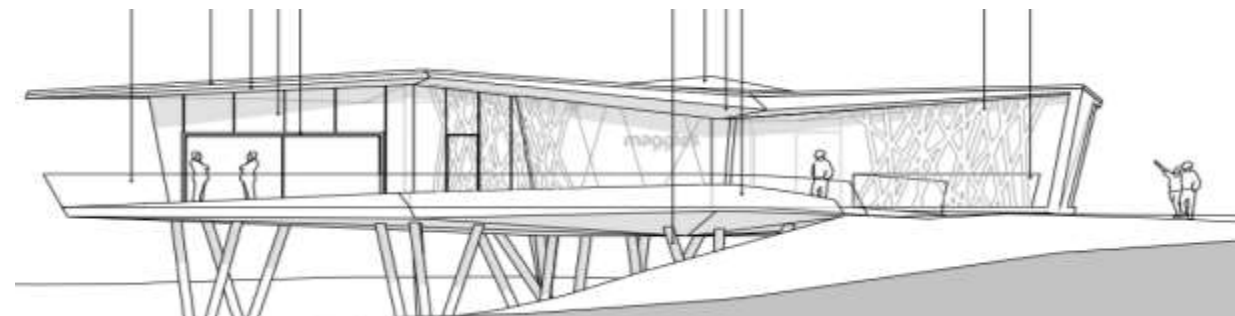
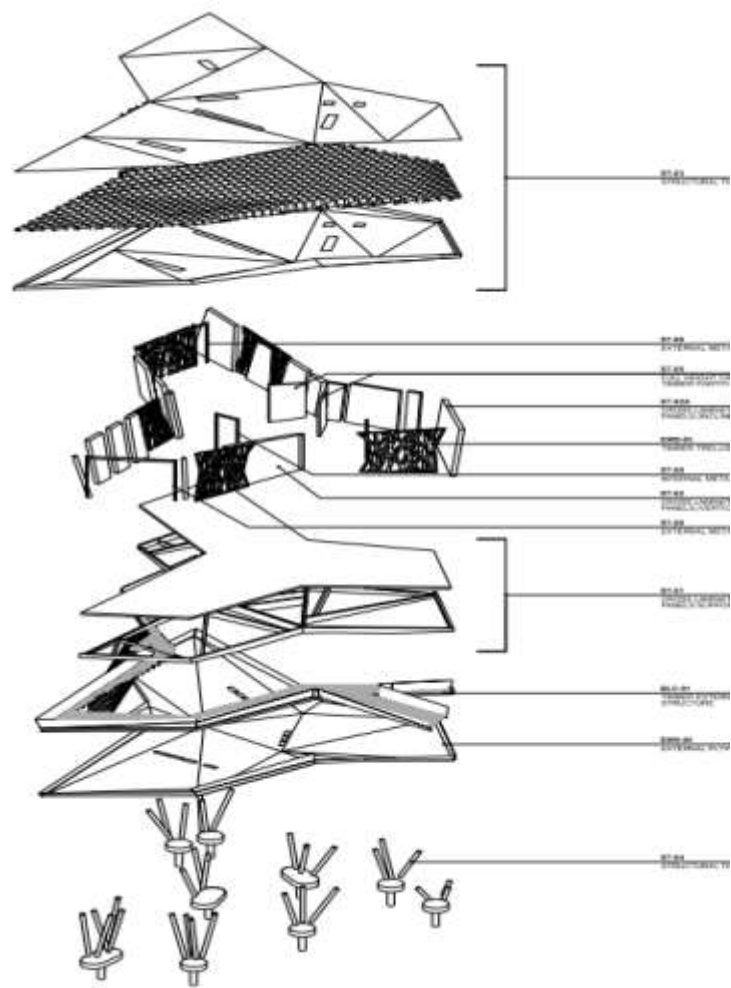
RESIDENTIAL HIGH RISE „BOB TREE“, BERGEN/NO



MAGGIES CENTRE, OXFORD/UK



MAGGIES CENTRE, OXFORD/UK



MAGGIES CENTRE, OXFORD/UK



**GLULAM FRAME
CLT FLOOR & WALLS
LVL ROOF CASSETTES**



BUILDING A LIVABLE CITY OF TOMORROW

Timber Projects for Redefining Mobility in the Age of IoT

CITES & MOBILITY BECOME INTERCONNECTED



Quelle: Prof. Thomas Weber, Vorstand Daimler Konzernforschung

TIMBER CREATES A NEW URBAN LIVING SPACE IN CITIES



LONDON – FUTURE OF MOBILITY



Quelle: www.theguardian.com/artanddesign/architecture-design-blog/2014/jan/02/norman-foster-skycycle-elevated-bike-routes-london

**FOCUS ON JUST ONE „MOBILITY NODE“
THAT CONNECTS WITH EXISTING SERVICES / INITIATIVES**

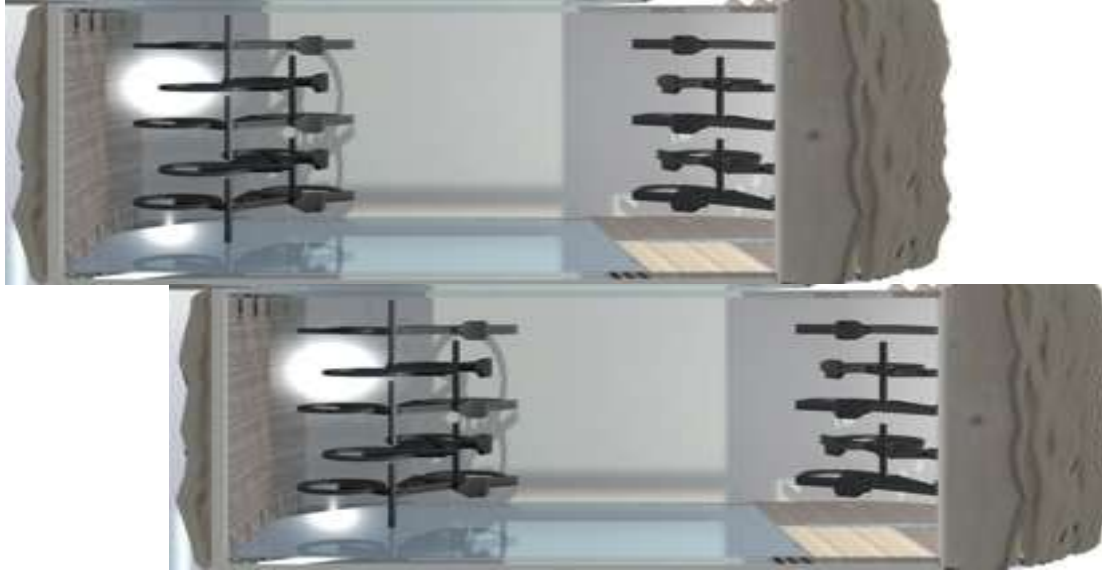


CHARGE & SECURE PEDELECS IN VARIOUS PLACES



TWO VERSIONS

Double
20 Bikes



Single
10 Bikes



INCREASE AIR QUALITY & MAKE YOUR CITY MORE SILENT BY REDUCING CAR TRAFFIC / CO2



=



MAKE A HILLY TERRAIN FLAT – FOR ALL

30% slope



athletics, sports amateurs

0% slope



children, elderly people & more

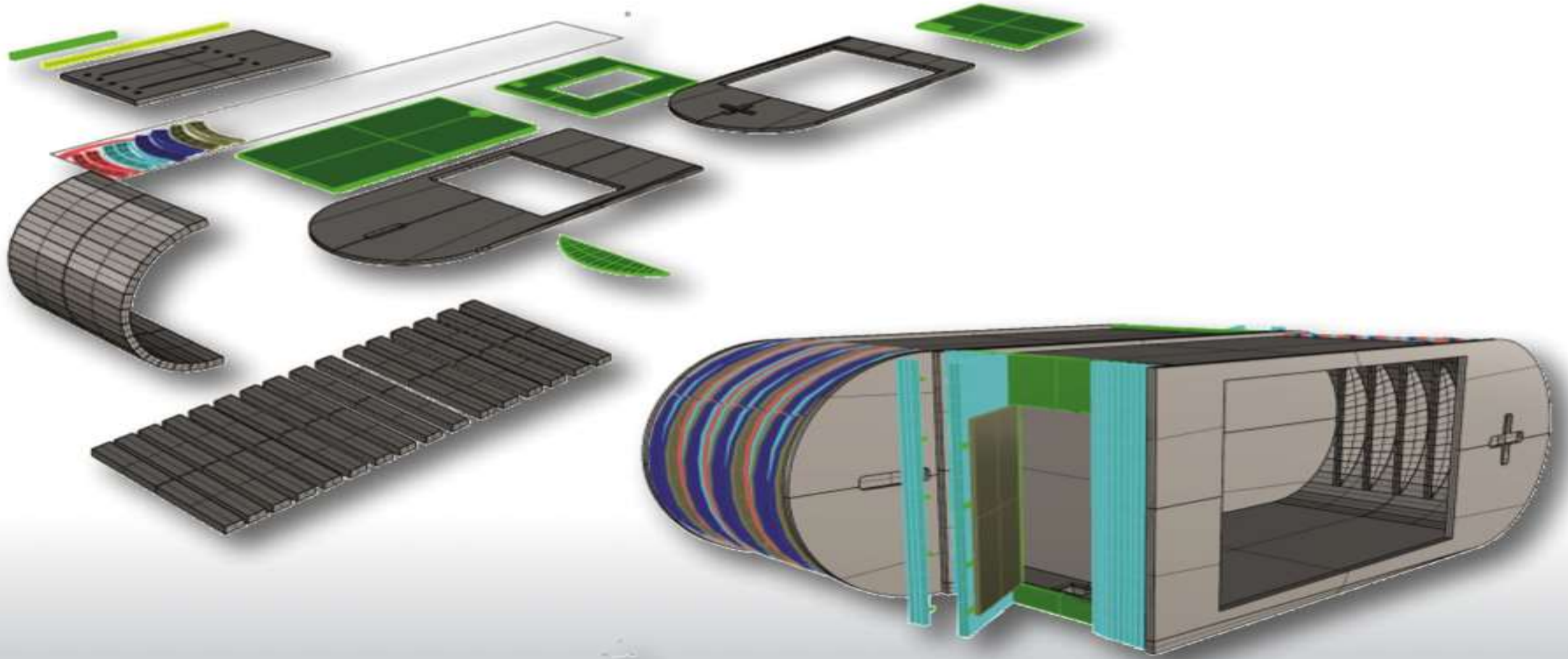
RECONNECT NATURE WITH CITIES



SIMPLE TRANSPORT – MOVE WHEN NECESSARY



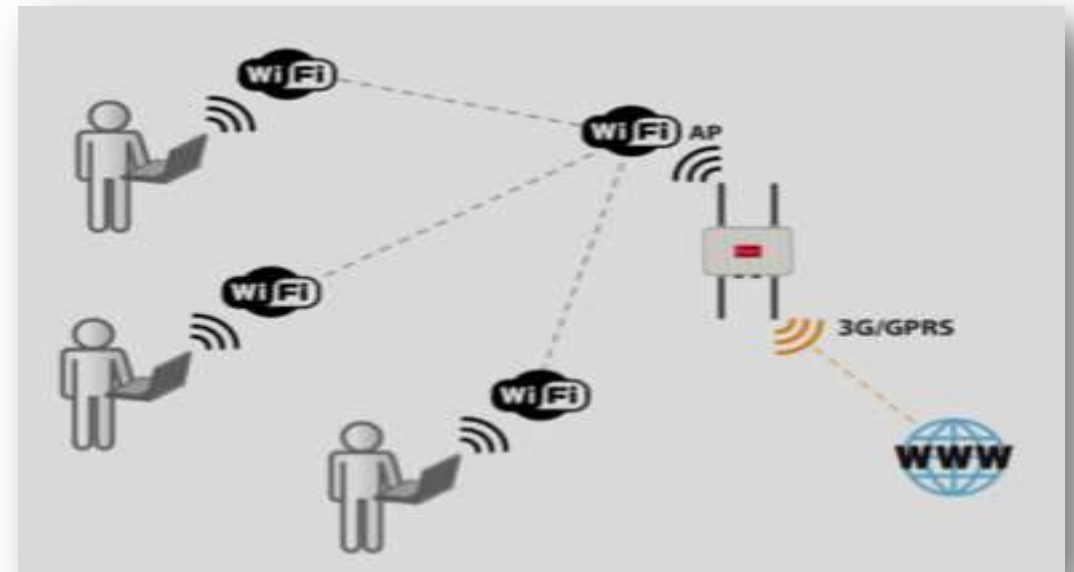
INDUSTRIAL DESIGN & PRODUCTION WITH BIM/5D



LOCAL PEOPLE PRODUCE WITH LOCAL MATERIALS



PLATFORM FOR NEW INFRASTRUCTURE - AIR-QUALITY MEASUREMENTS, WIFI HOTSPOTS...



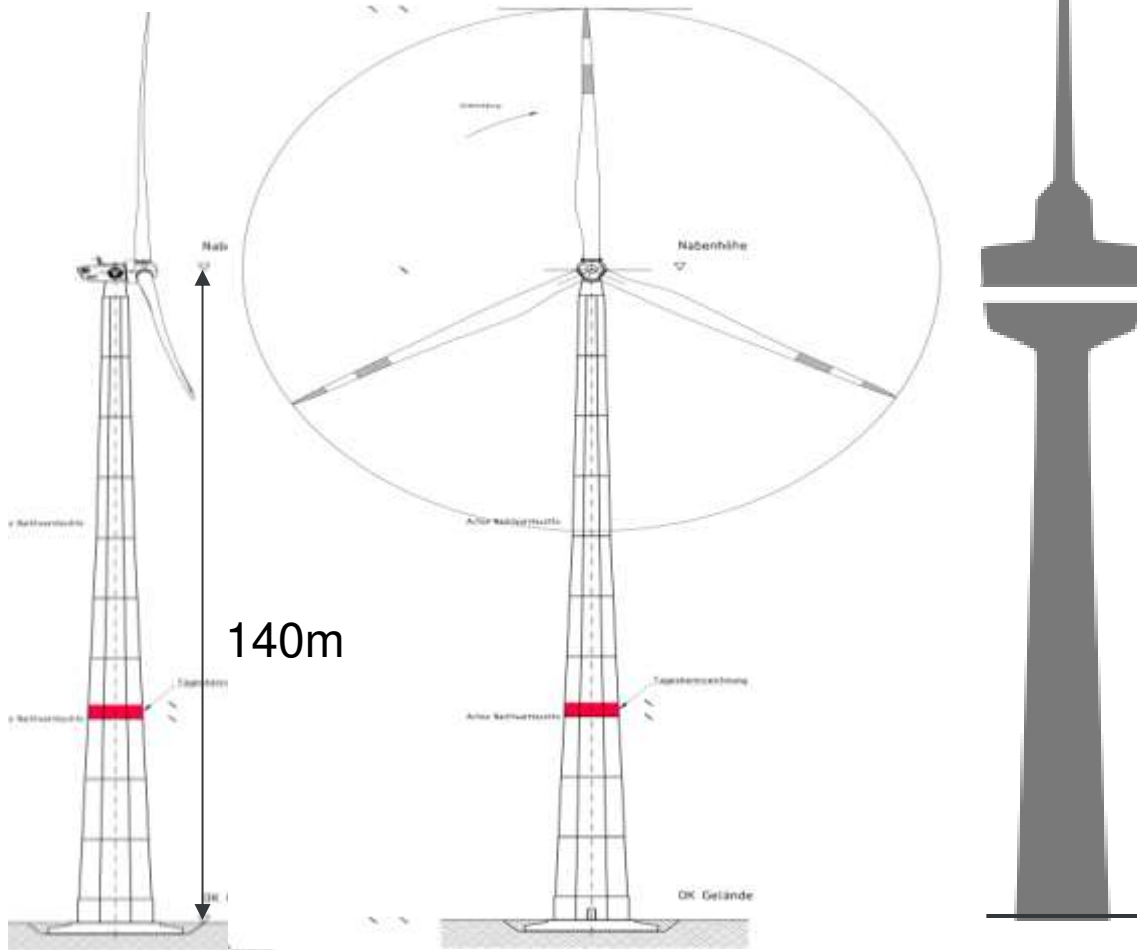
CHARGE ELECTRIC CARS



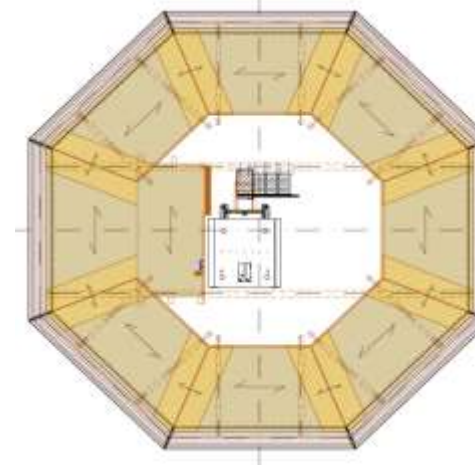


WIND ENERGY TOWER

SYSTEM OVERVIEW



SECTION

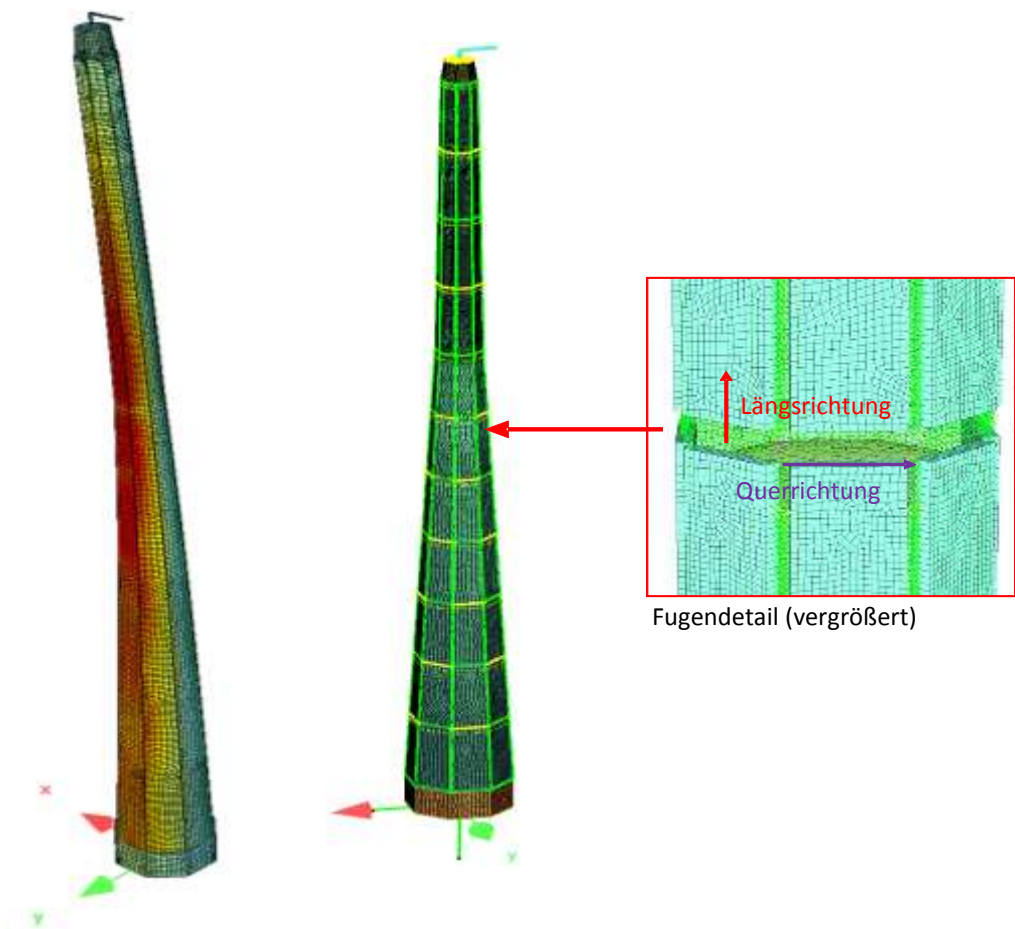


TIMBER TOWER

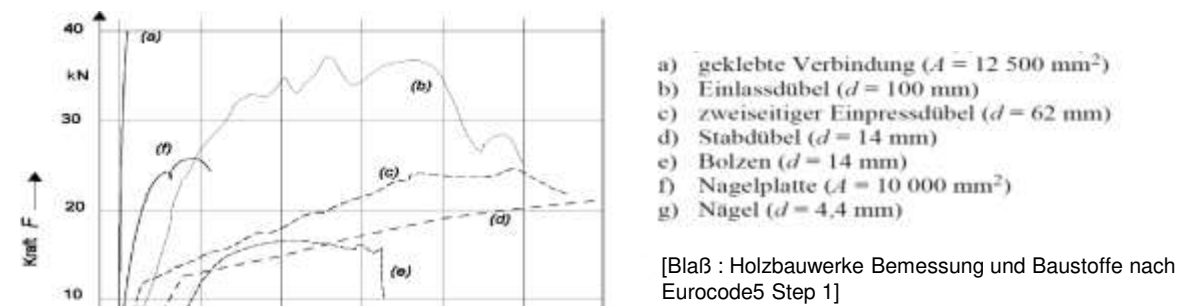
- Total 9 octagonal cross sections
- 6 sections 13 m
- 3 sections 17 m
- 2 different wall build ups

DYNAMIC DESIGN AND CONNECTIONS

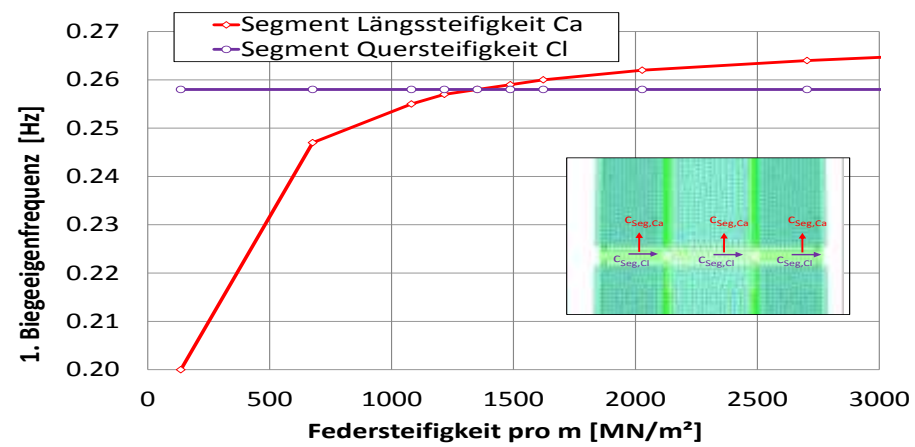
OVERVIEW SYSTEM



DEFORMATION UNDER LOAD



RESULT



Timber on the right way up



HoHo
Wien

Project Development

„the other way“

Idea

Feeling

Philosophy



Idea

Feeling

Philosophy

Vision

Engineered timber - a unconventional property

open minded Investor
ambitious project developer
new Viena quarter
Highly profesional team
Long term design and development
Early integration of building authority

Firmness, energy and highly engineered
timber technolgy will make the project
happen.



Anyone who has a new idea is
a crank until the idea strikes
(Mark Twain)

Idea

Feeling

Philosophy

Evolution

Thinking wood new, is the slogan

Targeting the next step in timber design, being determined to show what is possible in timber. Making the HoHo Viena the latest showcase of timber construction today.

The new quarter of Viena
19.500 sqm rental space
84 m high timber hybrid skyscraper
60 Mil. Euro Investment
Start on site spring 2016



*Nothing in the world is as powerful as an idea whose time has come .
(Victor Hugo)*



Idea

Feeling

Philosophy

Wood

Sustainable material

High load bearing capacity

vs. low weight,

Stability and elasticity

Flexible usable

Wood has fallen into oblivion

Economic and ecological
advantages

Substantial building material for
high rise buildings



*There are always the
simplest ideas ,
have extraordinary
success .(Leo N. Tolstoi)*



Idea

Feeling

Philosophy

Internal Space

Core idea

Visible timber surface in all internal spaces

Sensible feeling of timber

Wood is cosy, haptic, it is nature brought into our living spaces

Wood has positive influence on internal climate

Flexible floor plans

Long term use

Structured facade



*You can teach people anything .
You can help them discover it within themselves to them only .(Galileo Galilei)*

Idea

Feeling

Philosophy

All under one roof

*Business space with attitude –
work and consume with style*

Sales and retail areas

Work life balance

Added value

Using the building as a marketing element



*With other people ,
together we can
achieve more together
than alone. (Dalai
Lama)*

The elements

...the balance between the elements has
priority, the interaction between human and
environment

Idea

Feeling

Philosophy

AIR

WOOD

METAL

EMPTINESS

WATER

EARTH

FIRE

APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

*Imagine it is end of work ..
...and nobody wants to go home*



Idea

Feeling

Philosophy



17.-22. OG



APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

Idea

Feeling

Philosophy



10.-16. OG



APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

Idea

Feeling

Philosophy



5.-9. OG



APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

Idea

Feeling

Philosophy



4. OG



APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

Idea

Feeling

Philosophy



3. OG



APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

Idea

Feeling

Philosophy



1.-2. OG



APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

Idea

Feeling

Philosophy



EG



APARTMENT

HOTEL

BUSINESS

BEAUTY

WELLNESS

RESTAURANT

HEALTH

Idea

Feeling

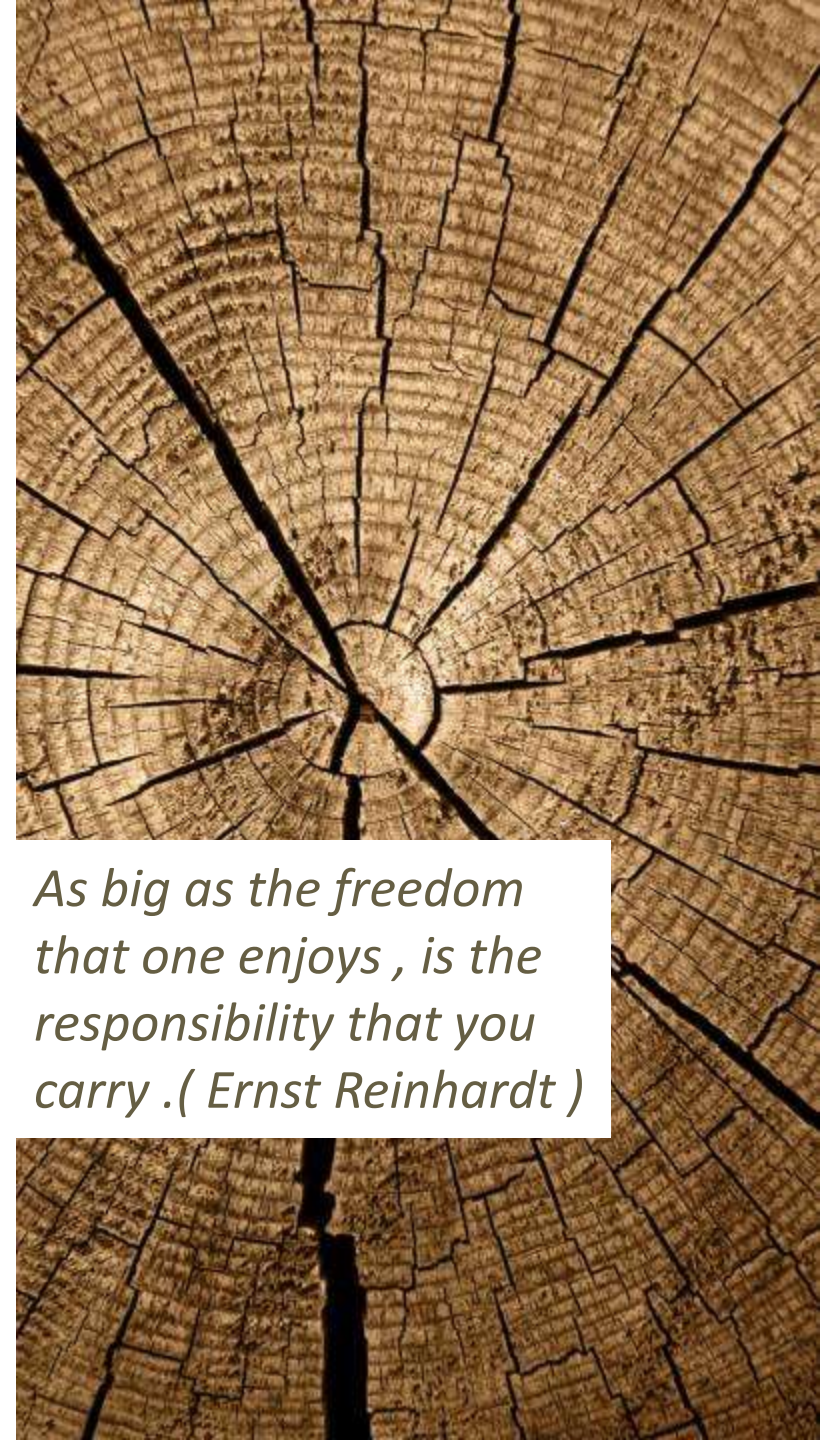
Philosophy

Wood

sustainable

- Saving resources
- Carbon saved 2.800 Tons
- Primary energy saved 300.000 MWh

.



*As big as the freedom
that one enjoys , is the
responsibility that you
carry .(Ernst Reinhardt)*

Idea

Feeling

Philosophy

Energy Concept

- Save carbon
- Energy supply
- Energy saving



*I do not concern myself
with what has been done .
What interests me is what
needs to be done .(Marie
Skłodowska Curie)*

Idea

Feeling

Philosophy

Puls

For timber industry

For investors

For user

Wood has character

Wood is timeless

*Wood .. building material of the
future*





HoHo

Wien



HoHo Wien

25.000m² BGF
24 storeys
84m high

Investor
cetusBaudevelopment



Architect:
RLP Rüdiger Lainer + Partner

Engineer:
Richard Woschitz



Fire safety:
Alexander Kunz



M&E:
Ronald Mischek ZT GmbH



URBAN DESIGN



Urbane Partitur Altes Flugfeld Aspern,
RLP Rüdiger Lainer + Partner

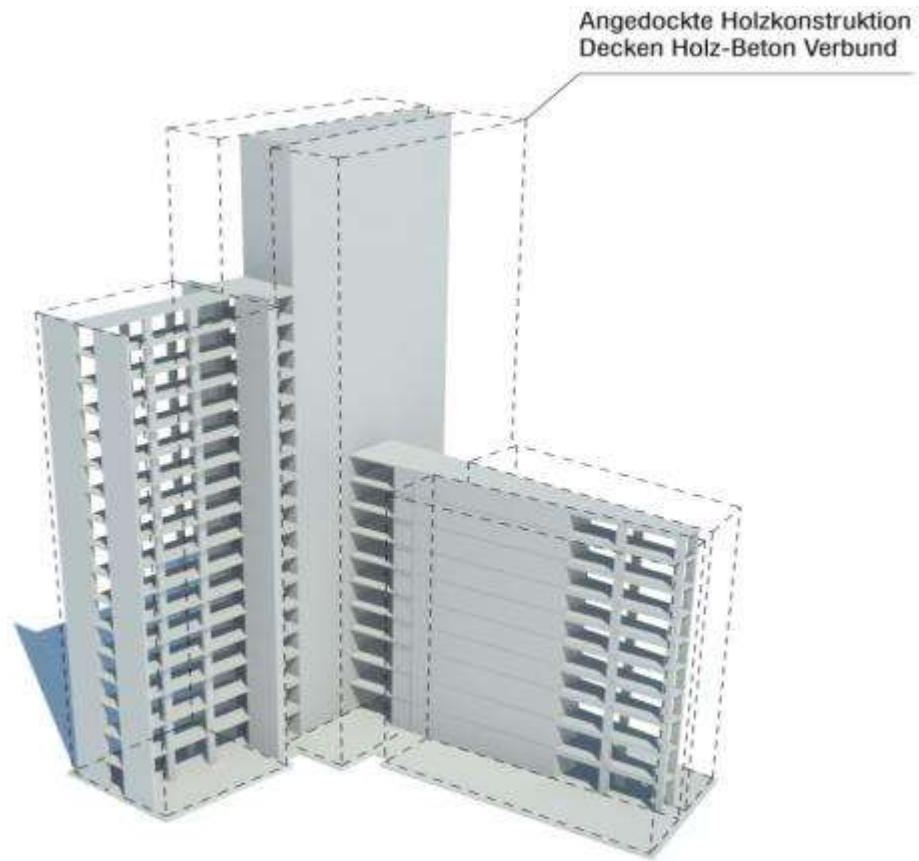


Masterplan Flugfeld Aspern 2007



Structure

Hybrid Structure

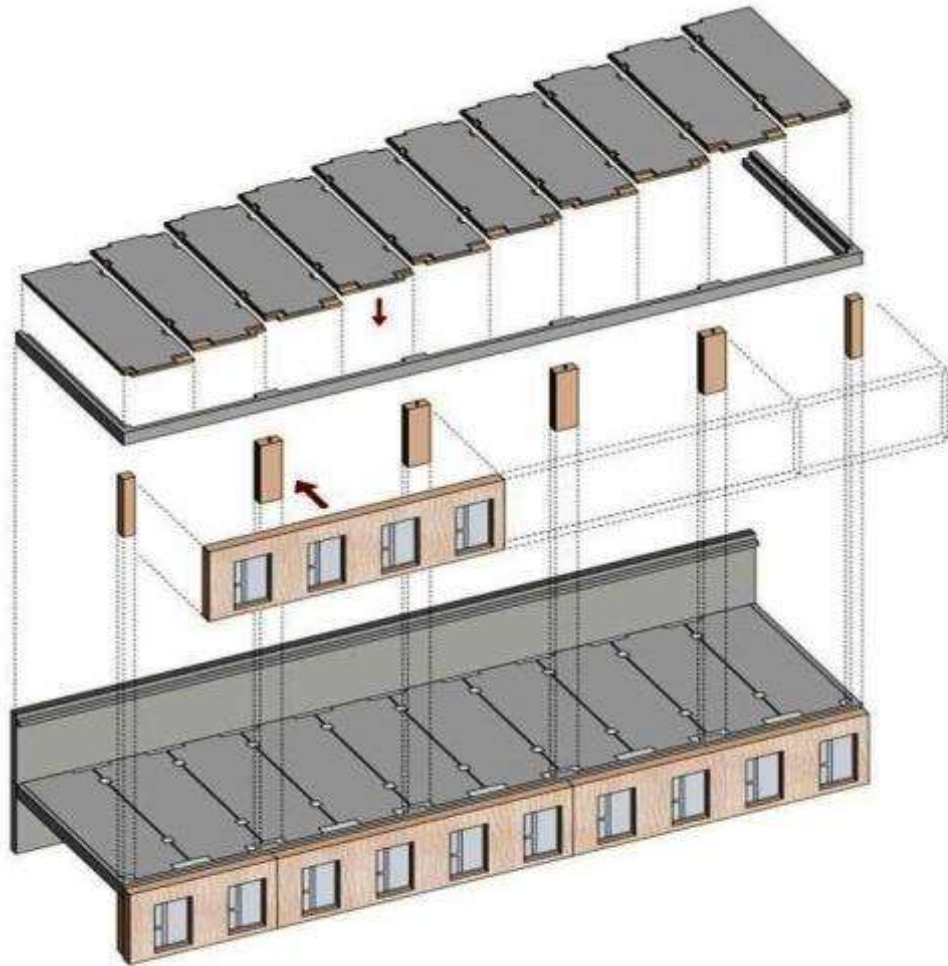


Betonkern



Holzkonstruktion Angedockt

Construction Elements

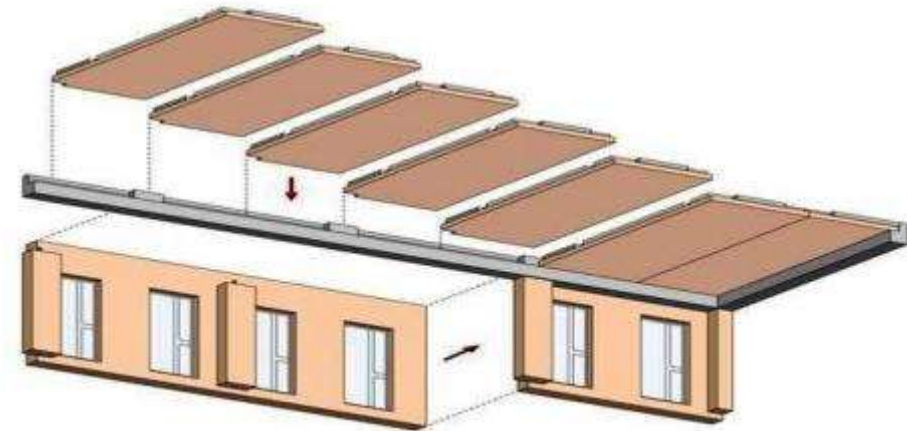


ELEMENTE

- ④ **DECKENELEMENTE**
Schubsteife Verbindung der FT Deckenelemente mittels lokaler Vergussausparungen und Klappisen
- ③ **RANDTRÄGER**
Kraftschlüssiger Verbund mit Decke und Stütze über Vergussbereiche
- ② **STÜTZE MIT FASSADENELEMENT VERBUNDEN**
mit vertikaler Zugverankerung durch eingeklebte Eisen und Verguss im Hüllrohr / Randträger
- ① **FASSADENELEMENT SANDWICH**

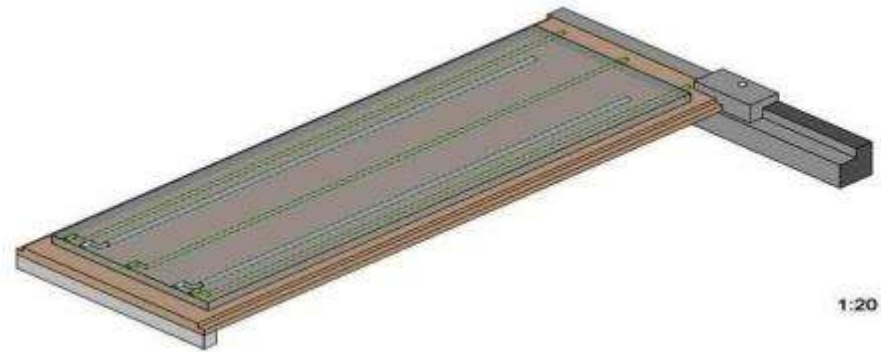
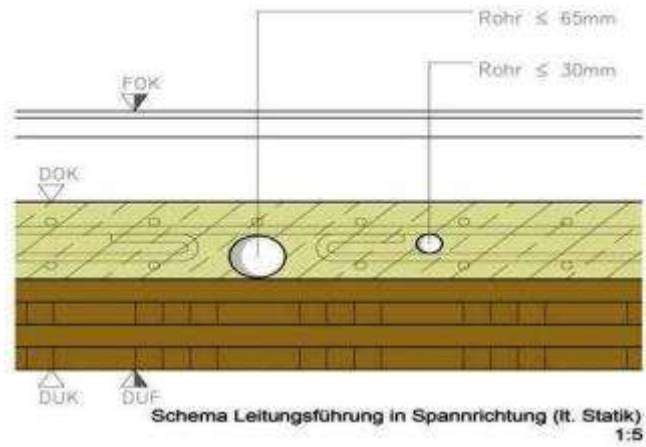
MONTAGE

STÜTZE MIT AUSSENWAND ALS ELEMENT VERSETZT

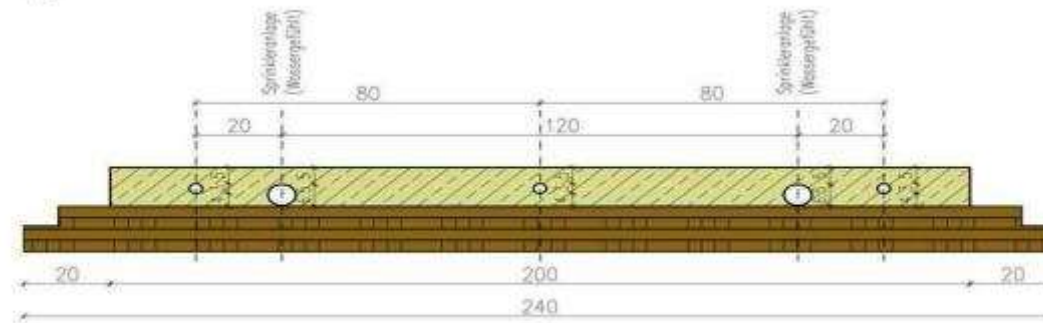


Building Process

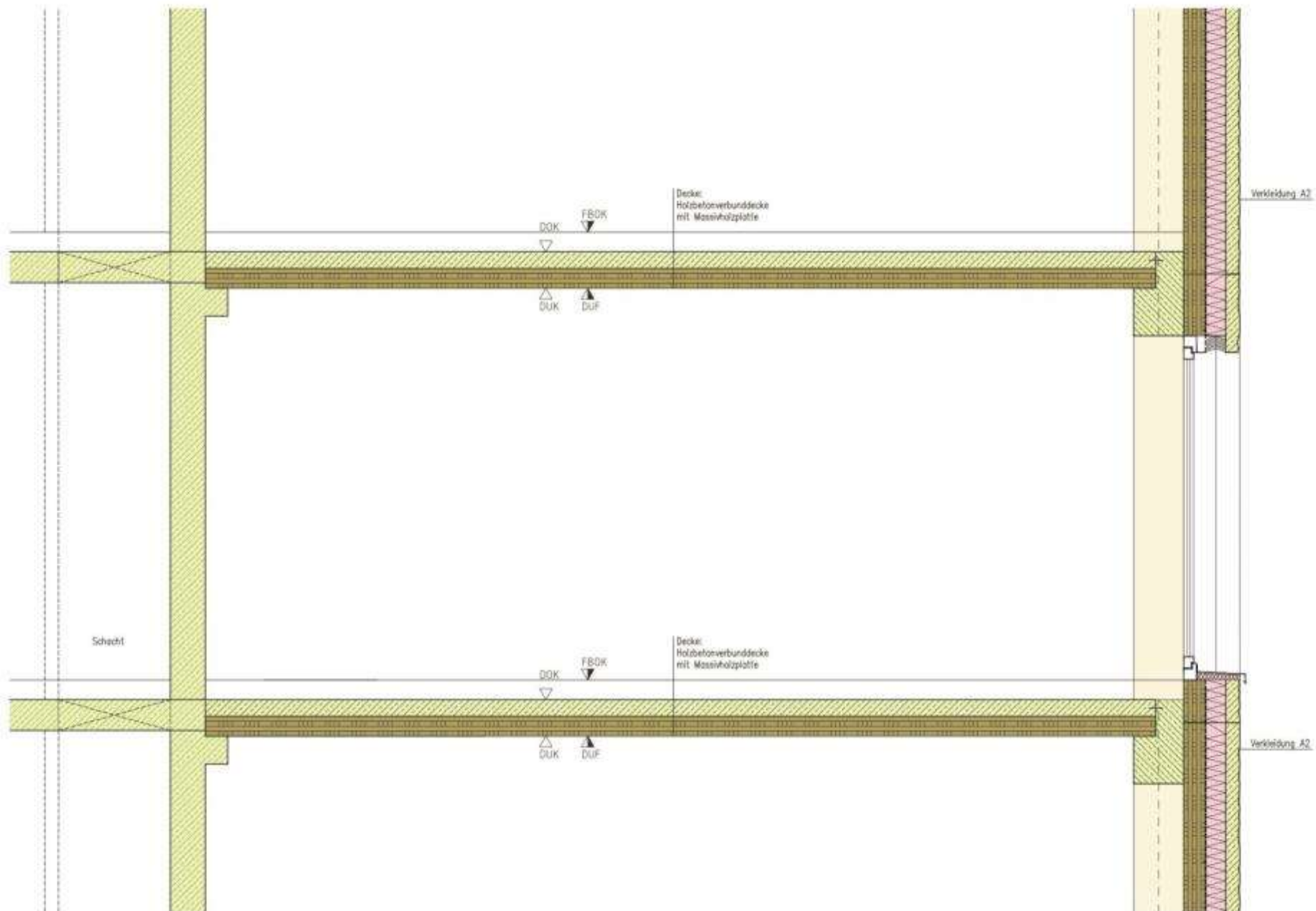
Prinzip Leitungsführung

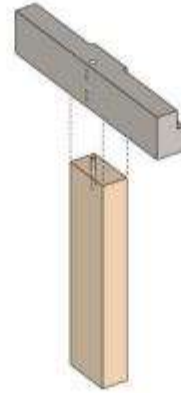


Prinzip Leitungsführung in Fertigteil HVD



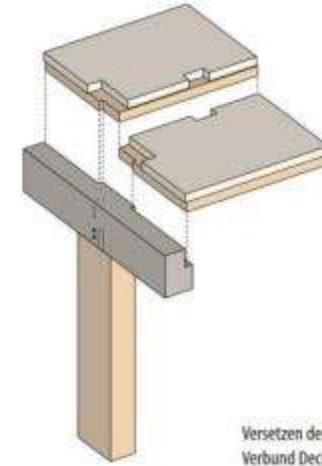
Prinzip Leitungsführung in Fertigteil HVD
Schnitt 1:10





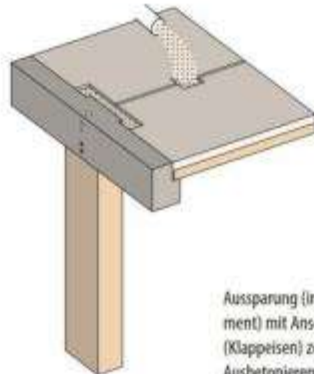
1.1. Durchlaufender FT Randträger mit Hüllrohr wird auf Stützen (mit eingeklebter Gewindestange) aufgelegt.
1.2. Zugverbindung wird durch Vergießen der Gewindestange im Randträger (Hüllrohr) hergestellt

① STÜTZE + RANDTRÄGER



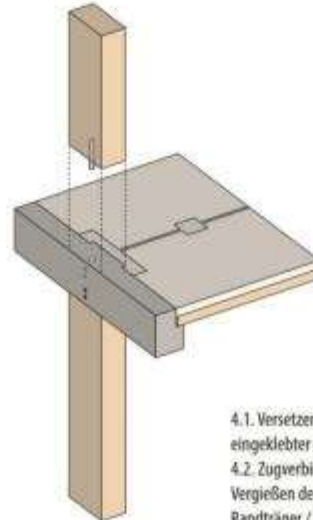
Versetzen der FT Holz-Beton Verbund Deckenelemente

② DECKENELEMENTE



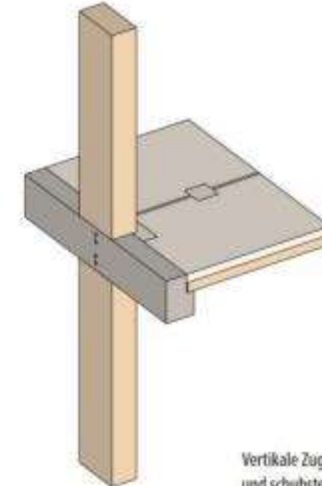
Ausparung (im Deckenelement) mit Anschlussbewehrung (Klappseisen) zum nachträglichen Ausbetonieren

③ BETON VERBINDUNG



4.1. Versetzen der Stütze mit eingeklebter Gewindestange
4.2. Zugverbindung wird durch Vergießen der Gewindestange im Randträger / Hüllrohr hergestellt

④ STÜTZE



Vertikale Zugverankerung Stützen und schubsteife Decken hergestellt

⑤ FERTIGER KNOTENPUNKT

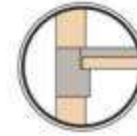


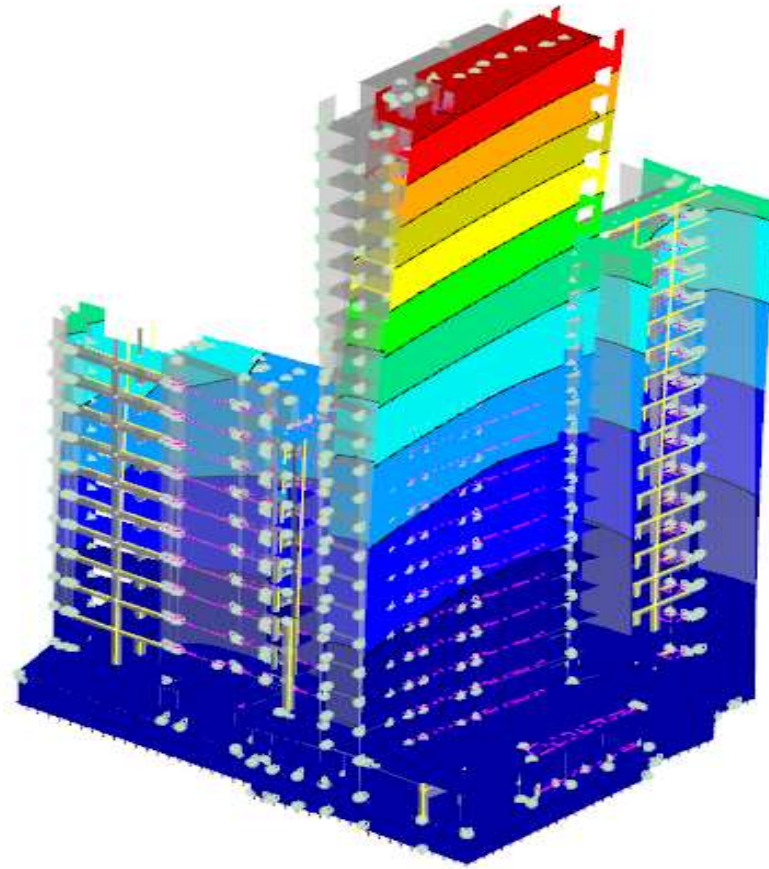
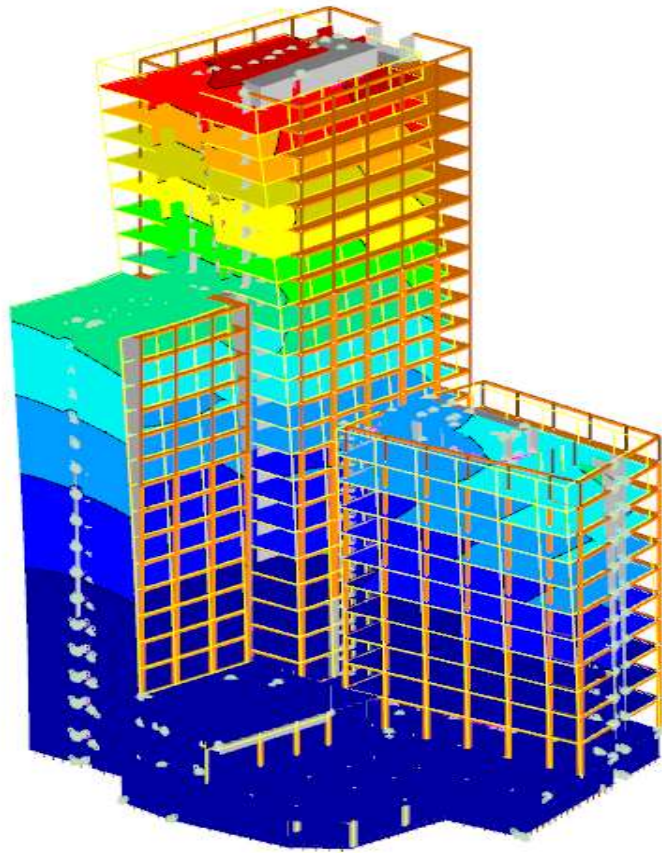


Bild 1: Versuchsaufbau nach Abbrand



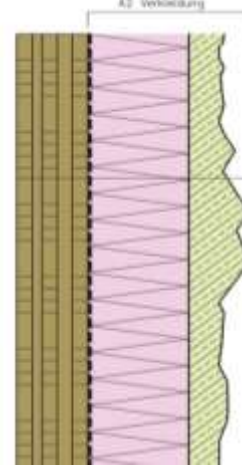
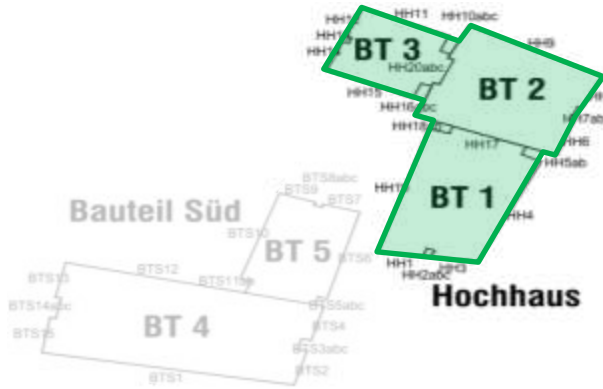
Bild 2: Versagensbild (Schubversagen Holzfaser)

Design Study

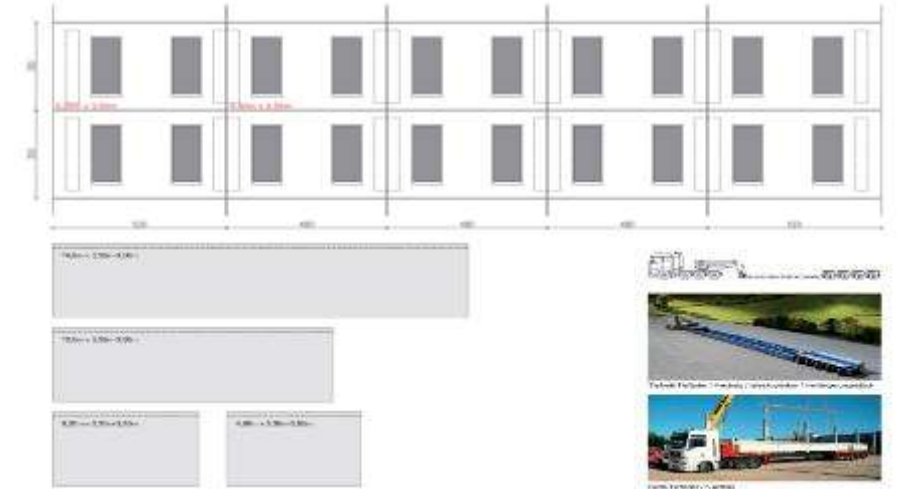


Facade

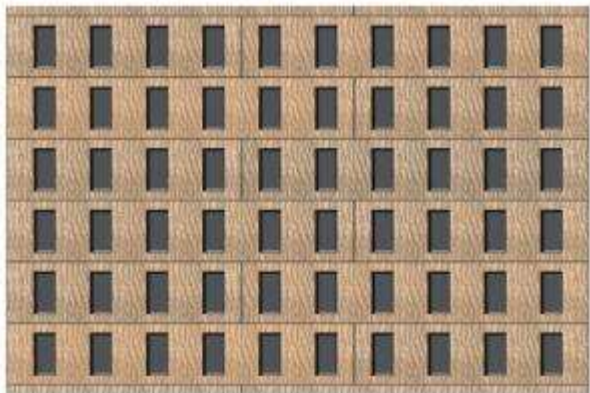
Light weight concrete on timber composite panel



© Rüdiger Lainer+Partner



Facade „tree bark structure“



© Rüdiger Lainer+Partner

Wooden Windows including shading



Examples



Huttenhofer T30



Iglesia in Wiesbaden



Roussillon



© Rüdiger Lainer+PartnerRinde

Facade

Larch timber batten

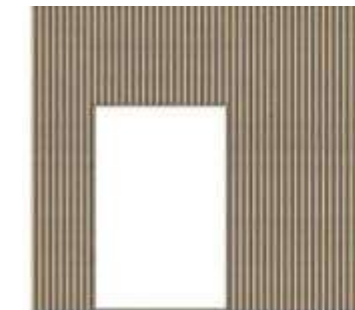
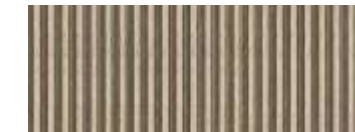


Fassade RLP



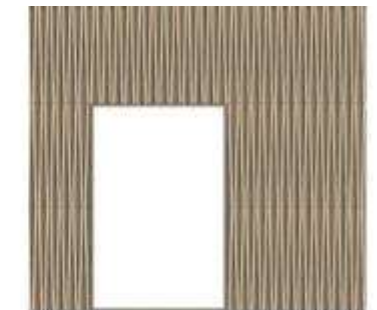
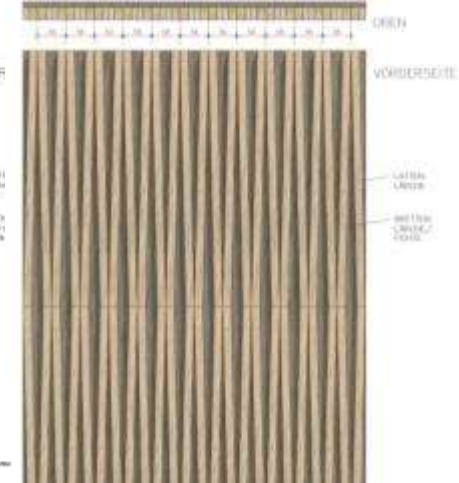
Options

vertical

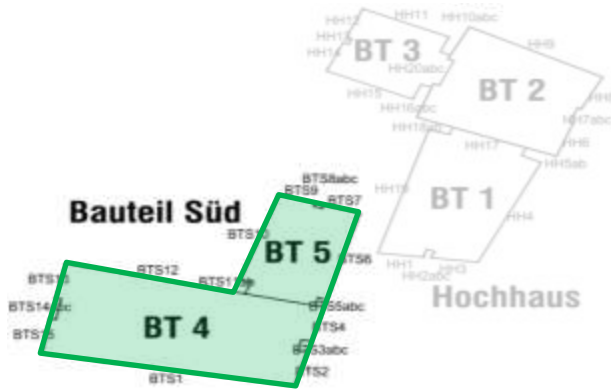


WANDSEITE

Rhombic structure



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- Thank you !
- Questions ?



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michael.keller@zueblin.de

This concludes The American Institute of Architects
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