

# TS3 THINKING IN CONCRETE - BUILDING WITH TIMBER

Fast and climate-friendly construction with TS3 technology



**TS3**

Timber Structures 3.0

# THINKING IN CONCRETE - BUILDING WITH TIMBER

## Content

<b>1</b>	<b>TS3-technology</b>	<b>4</b>
1.1	What is TS3?	4
1.2	Your advantages with TS3	4
<b>2</b>	<b>Advantages of timber construction</b>	<b>10</b>
<b>3</b>	<b>Engineering and planning</b>	<b>11</b>
3.1	Introduction	11
3.2	System separation, a strong point	11
3.3	Floor thicknesses	12
3.4	Sound insulation	12
3.5	Fire behavior	13
3.6	The TS3 joint	14
3.7	Column joints	15
3.8	TS3 training	15
<b>4</b>	<b>Planning and construction process</b>	<b>16</b>
4.1	Introduction	16
4.2	The planning process	16
4.3	The construction process	17
4.4	Benefits during the construction phase	18
4.5	Quality assurance	18
<b>5</b>	<b>Construction costs</b>	<b>19</b>
<b>6</b>	<b>Recycling management</b>	<b>20</b>
<b>7</b>	<b>Casting resin</b>	<b>21</b>
7.1	Production	21
7.2	Emissions	21
7.3	Recycling of residual materials	21
<b>8</b>	<b>Contact</b>	<b>22</b>
8.1	Contact persons	22
8.2	Tender	22
8.3	Visit of reference projects	22
<b>9</b>	<b>Notes</b>	<b>23</b>



**1.1 What is TS3?**

TS3 technology uses a bending-resistant cast resin to join cross-laminated timber panels at the ends to form large solid timber panels with the dimensions of the floor slab. This makes the cross laminated timber panels statically load-bearing in two directions, so that no beams or load-bearing walls are required, only columns. The columns can be freely positioned according to the floor plan of the building.

What was previously only possible with concrete can now also be achieved with timber in the same dimensions, widths and thicknesses thanks to TS3. TS3 concretes with timber.

**1.2 Your advantages with TS3**

**Columns, slabs, done!**

With TS3 technology, timber floor slabs can be realized without the use of beams or linear supports. Thanks to this innovative construction method, generous rooms are created without disturbing elements, which considerably expands both the architectural design freedom and the possible uses.



Apartment building Fasanenhof, Frenkendorf



Apartment building Unterhueb, Zollikerberg



Commercial building Handl, Haiming Tirol

**Powerful cantilevers**

Thanks to TS3, large overhangs and projections can be implemented without additional load-bearing elements. This allows maximum design freedom and creates open, generous spaces.



Apartment building Wehntalerstrasse, Zürich



Apartment building Unterhueb, Zollikerberg

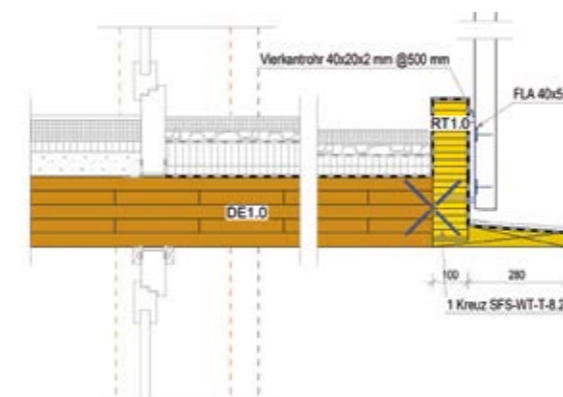


Pavillon Hirschenbad, Langenthal

Now classic reinforced concrete buildings in timber

**No cantilever connections**

With CLT, you can build from the hot to the cold plane without interruption. This allows you to implement energy-efficient and sustainable building projects and save money.



Apartment building Fasanenhof, Frenkendorf



**Free floor plan design**

Thanks to TS3 technology, linear supports are no longer required, which allows maximum flexibility in floor plan design. The use of a single solid wood slab the size of the floor plan creates versatile options for individual room concepts.

**Same support structure as concrete**

TS3 offers the same support structure as concrete. This allows design planning to be maintained and familiar construction processes to be used, while still benefiting from the advantages of timber construction.



**Apartment building Breitenegg, Kölliken**  
kathrinsimmen Architekt:innen  
ETH SIA



**Extension of the school building Hort, Richterswil**

**Ideal for extensions**

Because timber weighs only about one-fifth of concrete, it is the ideal building material for additions. In addition, one third of the of solid wood ceilings can be attributed to insulation. can be added. The allowed and often scarce total height is used for room height and not for insulation.



**Apartment building Fasanenhof, Frenkendorf**

**Additional income due to space efficiency**

When TS3 ceilings are used, the exterior walls are usually also constructed with sustainable products. Due to better insulating properties, the wall thickness can be reduced by about 50mm compared to conventional superstructures. The result is more living space with the same external dimensions, which can be rented or sold.

**Free forms/architectural freedom and aesthetics**

With TS3 technology, impressive architectural solutions can be realized. Thanks to the filigree design you get generous spaces without disturbing cross beams that could detract from the aesthetic appearance. Complex and free forms are also possible. This results in maximum flexibility in architectural design.



**Public bath Hopfräben, Brunnen**



**Pavillon Lokstadt, Winterthur**



**Semiramis V-Zug, Zug**

**Free choice of surface**

With TS3, different wood surfaces can be selected for the floor slabs, creating an individual and attractive appearance. Design your building projects according to your ideas and take advantage of the diversity and naturalness of timber.



**Apartment building Blümlimattweg, Thun**



**Conversion flexibility**

The load-bearing structure allows for versatile use of the space, which can be easily adapted to different requirements. From residential and office spaces to public buildings, TS3 offers a high degree of flexibility in the design of use. Non-load-bearing walls can be easily inserted or adapted at a later stage.

**Commercial building Handl, Haiming Tirol**



### Columns freely choosable

The column grid and the materialization of the columns can be freely selected. This flexibility enables a customized room design and creates a wide range of design options.



Apartment building Fasanenhof, Frenkendorf



Roofing of the playground, Goldach

### For all building types

The versatility of TS3 technology enables efficient and sustainable construction in various applications such as residential, commercial and public buildings. The flexibility of the system opens up numerous possibilities and offers solutions for different building projects.



Detached house, Lachen



Apartment building, Buchs



Public bath Hopfräben, Brunnen



Commercial building Handl, Haiming Tirol



Apartment building Fasanenhof, Frenkendorf



Commercial building Handl, Haiming Tirol



Commercial building Handl, Haiming Tirol



Shelter Jurastrasse, Aarau



School building Feld 1, Richterswil



Children and youth center, Zuchwil





**Living health**  
Timber buildings can breathe, feel warm and radiate comfort.



**Ecology**  
The raw material of wooden buildings permanently stores CO<sub>2</sub> and grows in the region.



**Construction time**  
Wooden buildings are not only erected in record time, the calculated construction costs are much more accurate and no drying time is required.



**Lightweight**  
Timber has only 20% of the weight of concrete, you save a lot of building material in the foundation.



**Sustainability**  
Timber grows back and can be reused.



**Less construction site noise**  
Around five times fewer construction site trips, significantly less noise when erecting the building and reduced dust pollution.



**Maintenance costs**  
Wooden buildings require less heating energy due to the higher surface temperature.



**Lifetime**  
Timber is durable and timber buildings live for many hundreds of years. Cross laminated timber panels are reused or resold when deconstructed. You buy your building material only once and use it several times.



**Versatility**  
Thanks to the versatility of timber, almost any conceivable façade cladding and shape is possible, which is why more and more builders and architects are choosing timber as the material for their flagship buildings.

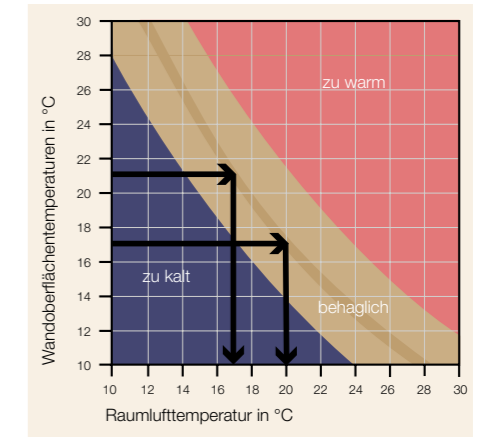
**3.1 Introduction**

Engineering and planning are even easier with TS3 technology than with reinforced concrete, because you draw neither formwork nor reinforcement plans, but only a large, homogeneous timber slab. The homogeneity of the components thereby reduces the number of component layers and thus also the complexity in planning and execution. The solid design benefits sound insulation and temperature storage and automatically regulates the moisture balance in the building.

The higher surface temperature compared to reinforced concrete reduces heating costs. Because the smaller the difference between the surface temperature of the walls, floors and ceilings and the air temperature, the more comfortable it is in a room. That's why we feel comfortable in timber buildings with good thermal insulation - even at slightly lower room temperatures. This allows buildings to be more energy-efficient. In addition, timber has a perceived higher surface temperature than concrete, steel or glass, which further increases the sense of well-being.

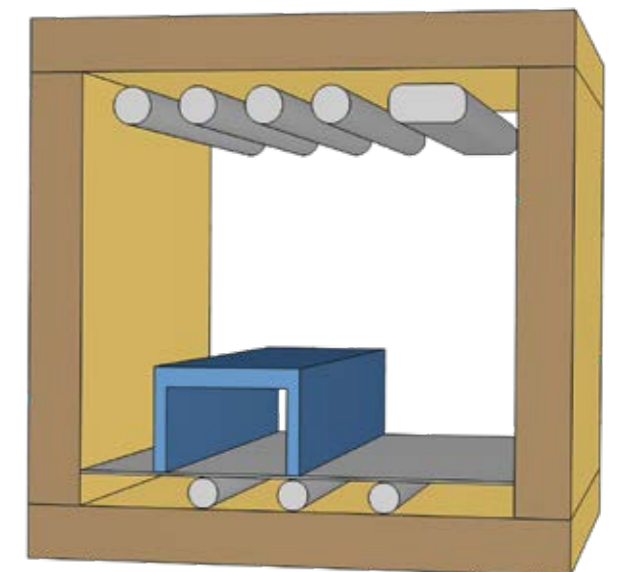
The cross-laminated timber panels arrive on site in visible quality on request and do not need to be reworked. However, timber can also be glazed or painted in any color. So if you don't want a wood look, you can have the visible wood surfaces painted white, for example, and still have all the advantages of timber as a building material.

With reinforced concrete ceilings, expensive and complex cantilever slab connections are needed for the transition between the cold and hot sides. Not so with timber: Thanks to the good thermal insulation properties of timber, load-bearing components can be led from the inside to the outside without interruption. With slim roller blinds, the shading of window fronts is possible without any problems.



**3.2 System separation, a strong point**

The installations are routed below or above the cross-laminated timber ceiling. In this way, systems with different service lives are consistently separated from one another. Electrical installations, water and heating lines are laid in the floor structure. Larger duct cross-sections, such as for sanitary and ventilation systems, are routed in suspended ceilings in the access zones. For ceiling lighting, power cables are routed above the exposed wood ceiling and enter the apartment at the correct location. This eliminates the need for pointing work on the building and guarantees a beautiful appearance of the ceiling.





### 3.3 Slab thicknesses

A TS3 slab can be designed analogously to a reinforced concrete flat slab. The following table gives the required slab thickness for point-supported CLT slabs depending on the span and the live load.

At [www.ts3.biz/configurator](http://www.ts3.biz/configurator), these slab thicknesses are shown with possible superstructures. The exact layer structure of the CLT slab must be defined by the engineer as part of the design.

Furthermore, a dynamic TS3 configurator is available. This allows you to draw your floor plan, define live loads, select floor superstructures and define the joint arrangement and obtain a preliminary design for the cross laminated timber panel.



Static ceiling configurator

Load capacity Spans [m]

q [kN/m <sup>2</sup> ]	4x4	5x4	5x5	6x4	6x5	6x6	7x5	7x6	7x7	8x6	8x7	8x8	9x7	9x8	9x9
2	180	200	220	240	240	270	270	270	300	310	340	350	380	400	420
3	180	210	230	250	250	270	280	280	300	320	350	360	390	410	430
4	200	220	260	270	270	280	300	300	310	350	360	370	400	420	440
5	220	230	270	270	270	280	320	320	330	360	370	380	410	420	440

Column Grid

Span [m]: 4x4

Live Load Q [kN/m<sup>2</sup>]: 2

With Floor Construction (minimum requirements for airborne and impact sound)

Thickness (mm)	
Floor Covering	15
Anhydrit Screed incl. Separation Layer	55
foofall sound insulation	30
Elastic Bound Gravel Layer incl. Separation Layer	60
CLT incl. Assembly (TS3-Technology)	180
<b>Total</b>	<b>340</b>

Deformation of Slab

Maximum deformation for serviceability load case with quasi-permanent loads (with creep): 12.8 mm

### 3.5 Sound insulation

Good living quality requires effective airborne and impact sound insulation. With professional planning and execution, wooden buildings made of cross laminated timber offer the best sound insulation properties. Due to the higher mass of the CLT elements, very good airborne and impact sound behavior is achieved in combination with other component layers. For this to be successful, sound insulation must be taken into account from the start of planning. Sound insulation is crucial for the well-being of building users, whether in the office or in the home.

With TS3 and an appropriate floor structure, all sound insulation requirements according to SIA can be achieved. The TS3 support structure is compatible with all commercially available floor constructions in timber construction.

In the TS3 online configurator, the floor structures meet the minimum requirements of SIA SN 520 181:2020 ( $D_i \geq 52$  dB,  $L' \leq 53$  dB).

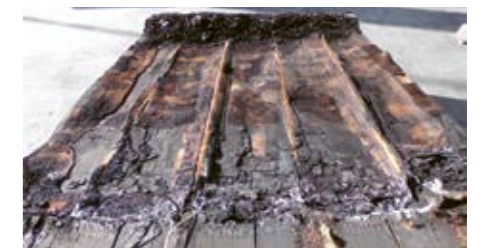


### 3.5 Fire behavior

Today's timber construction meets the same fire protection standards as reinforced concrete buildings. A major advantage is that timber burns predictably and retains its load-bearing capacity for a long time thanks

to the protective carbon layer. Because timber buildings are safe, since 2015 it has been permitted in Switzerland to build high-rise buildings, hospitals and hotels in timber construction.

CLT elements are characterized by their high fire resistance of REI 30-90. Through additional surface treatment or encapsulation, it is possible to realize hardly combustible - non-combustible components.

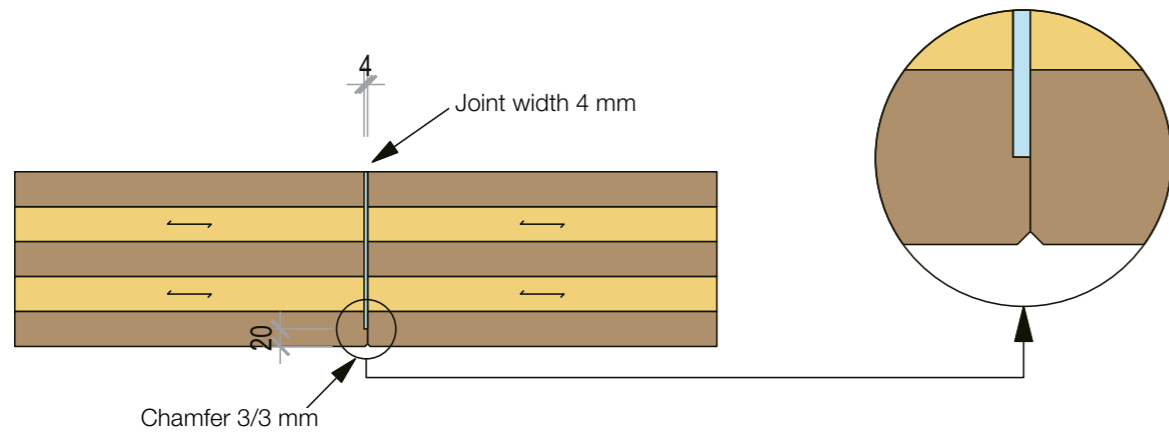


To test the fire resistance of the TS3 joint, a CLT panel with 4 joints was set on fire. It can be clearly seen that the TS3 joint had burned less deeply than the timber itself. Drip formation, cracks or other weaknesses of the material were not present. Proof by means of residual cross-section is also permissible for the TS3 joint.

At EMPA, another test specimen was burned under load. The target was REI-60, after 69 minutes the panel gave way. The higher REI-90 requirement can also be achieved with TS3 without further ado.



**3.6 The TS3 joint**



**Technical description**

With the TS3 joint, the CLT panels are installed to fit each other exactly. To obtain a joint width of 4 mm, the panels are cut back by 4 mm to the lowest layer in a second formatting step (residual height at least 20 mm). The joint is finished at the CLT plant or at the finishing plant with sealing tapes (white) and segmenting tapes (anthracite).

**Aesthetics**

The TS3 joint is formed with a chamfer at the bottom. As a result, the joint is hardly visible and the chamfer forms a shadow joint, which allows even small height tolerances to be accommodated.



The TS3 connection at Fasanenhof, Frenkendorf



Potting TS3 connection on site with casting equipment

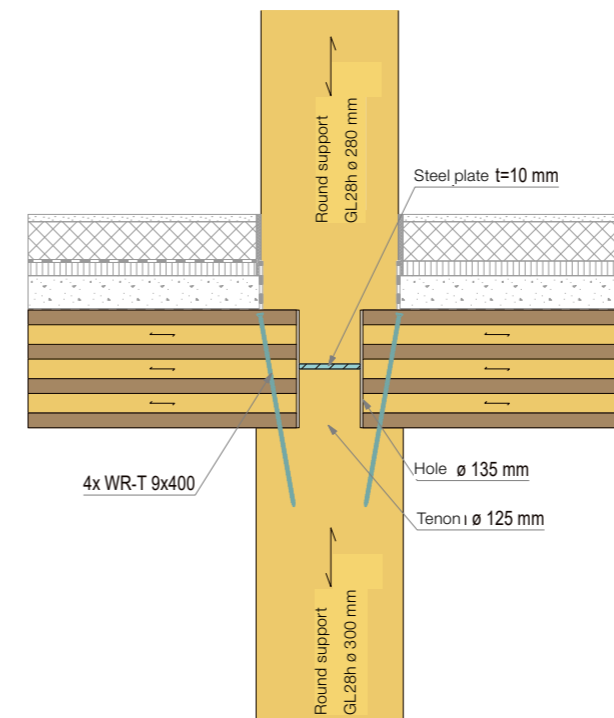
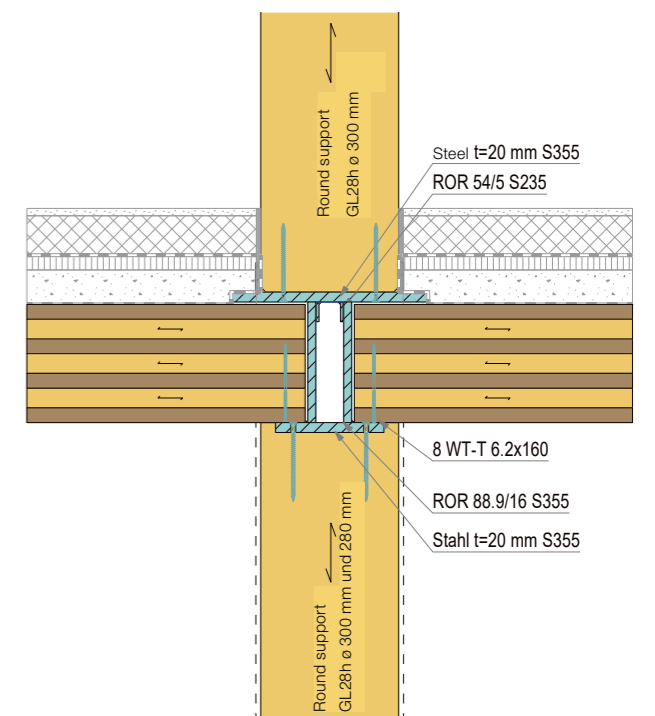
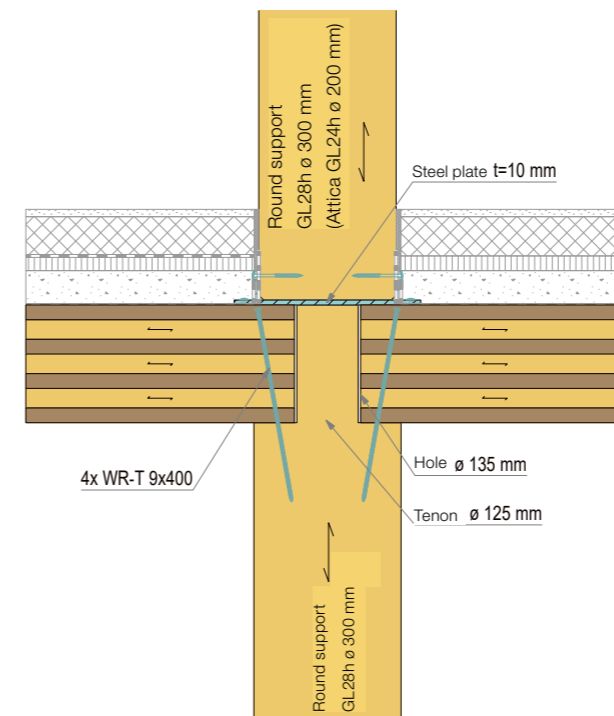
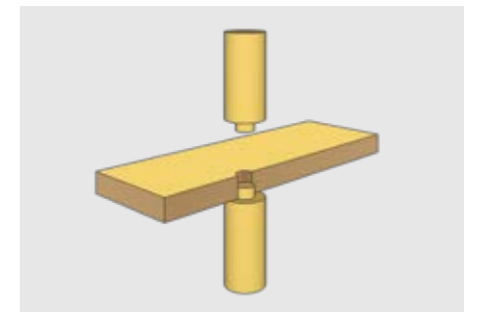


**3.7 Column joints**

The supports are a design element and can be adapted in shape and material. Metal and concrete columns are also possible without further modification.

The transfer of vertical loads from upper floors through the slab without squeezing the CLT panel by pressure perpendicular to the grain is of great importance. Depending on the transfer material used, the solution

looks different. The simplest option is wooden supports, which are tapered at the tenons. In this way, the CLT slab rests on the shoulder. The load from the upper floors is transferred directly through the column. A thin steel plate between them allows the full compressive strength to be used parallel to the grain of the timber.



**3.8 TS3 Training**

For architects and engineers, we offer e-learning courses on the Moodle cloud digital learning platform. All courses consist of tutorial videos, exercise materials and self-tests. The basic course is free of charge and is aimed at architects and all interested parties. It lasts about one hour and is the basis for the „Structural analysis and design“ course. With our e-learning modules, you will become a professional in dealing with the new building material.





**4.1 Introduction**

TS3 AG supports all architects and engineers in planning. During execution, TS3 is responsible for the work around the TS3 connection and works in an advisory capacity and as a subcontractor for the executing company. After appropriate training, the services for the TS3 connection can also be partially or completely taken over by the executing company. The necessary materials are supplied by TS3 AG.

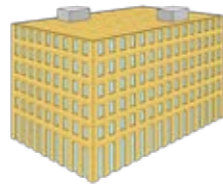
Due to the similarity to the dimensioning of a reinforced concrete ceiling, also solid construction engineers can dimension TS3 ceilings with our support. Due to the high degree of prefabrication in timber construction, assembly times are short, and thanks to dry construction, drying time is also eliminated. A TS3 solid wood ceiling is assembled from panels that are as large as possible to minimize the

number of joints and crane pulls. The available panel sizes vary from producer to producer, but are 3.50 x 16 m maximum. Up to approximately eight slabs can be laid per hour. Thus, with a slab size of 3 x 12 m, up to 290 m2 of slabs can be created in one hour. Overall, this reduces the construction time by weeks to months, depending on the size of the project.

**4.2 The planning process**

**Architecture**

Design in concrete - build in timber: The design and planning of TS3 building components are the same as for buildings made of reinforced concrete, since TS3 floor areas carry multi-axial loads.



**TS3**

TS3 offers architects on-site support, consulting and visits of reference objects. We also carry out feasibility analyses.

**Engineering**

**(TS3 partner company)**  
The design of the building project including the TS3 building components is carried out by a timber construction or civil engineer.



**TS3**

TS3 provides training, consulting and support to engineers in specific cases. We provide support in the design and costing of the slabs. We help you to optimize slab layout and answer questions about execution plans or production of the slabs.

**Tender**

The TS3 building components are usually put out to tender by the engineer, various construction companies apply.



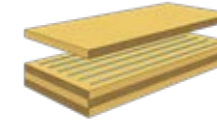
**TS3**

TS3 provides you with tender texts and supports you in all matters. With our many years of experience with CLT, we support you in the right selection, quality and pricing.

**4.3 The construction process**

**Production CLT**

**(CLT manufacturer)**  
The cross laminated timber boards are produced according to the quality specifications of TS3. The joinery is carried out by the manufacturer or by a further processor.

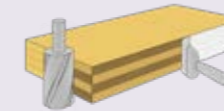


**TS3**

TS3 supports the production of CLT by optimizing the panel layout and checking the joinery plans. We ensure efficient material utilization and optimal production processes.

**TS3 pretreatment**

**(TS3/TS3 partner company)**  
Pre-treatment is carried out directly after the joinery process. This step is performed by a TS3 licensee.

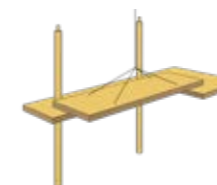


**TS3**

Training and certification of TS3 licensees and on-site support ensure the quality of pretreatment. Refresher courses and a continuous improvement process ensure constant further development.

**Assembly**

**(Timber constructor)**  
The timber constructor carries out the erection and assembly work. He knows the quality specifications for a smooth process on the construction site.

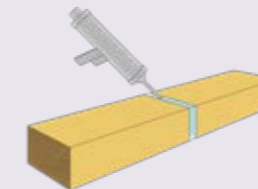


**TS3**

TS3 offers close guidance, comprehensive support and reliable support for the timber construction company in all matters relating to TS3.

**TS3 joint casting**

**(TS3/TS3-partner company)**  
A TS3 application technician joins the cross laminated timber panels by joint grouting. Depending on the size of the project, the appropriate application method is chosen.

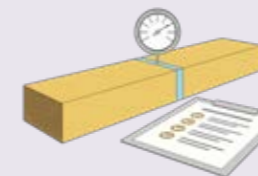


**TS3**

TS3 provides training, certification and refresher courses for TS3 licensees to ensure the quality of joint grouting work. A continuous improvement process and comprehensive on-site support are part of our commitment.

**Quality assurance**

**(TS3/TS3-partner company)**  
TS3 performs end-to-end quality assurance from the pretreatment of the joining surfaces to the potting and curing of the casting resin.



**TS3**

TS3 attaches great importance to quality assurance and guarantees that the TS3 joint meets the highest standards. Through rigorous testing, regular inspections and extensive training, we ensure the reliability of our product.



#### 4.4 Advantages during the construction phase

##### Reduced construction site noise

By reducing noise emissions, we contribute to a better quality of life in the neighborhood and promote harmonious coexistence during the construction process.

##### Fast assembly with prefabricated components

Industrial manufacturing processes enable up to half a year earlier handover of keys for your construction project. Benefit from additional revenue through earlier rental or sale of your property.

##### Simplified construction site logistics

Usually, a mobile pneu crane is sufficient for the construction of your timber building. The fast assembly enables the storage of building material within the building. This is a great advantage, especially when space is limited.

##### High quality work by qualified carpenters

The shell construction is done by carpenters from one source, without subcontractors. This means less coordination effort and more safety for you.

##### Dry construction

All structural components are dry-installed, minimizing the risk of moisture damage.

##### Clean construction site

Dust emissions are reduced to a minimum.



**Thanks to minimal temporary support, subsequent trades can start their work even before joint grouting.**



**Due to the higher weight of reinforced concrete slabs, many more structural columns are necessary.**

#### 4.5 Quality assurance

TS3 performs end-to-end quality assurance from the pretreatment of the joining surfaces to the potting and curing of the casting resin. The following parameters are checked in a continuous process:

- Joining surfaces after cutting of the CLT slabs
- Surfaces after pretreatment
- Filling quantities of the casting resin
- Temperatures during casting and during the curing process
- Creation of a test specimen during joint grouting and testing in the test laboratory



## 5 Construction costs

### Timber construction cheaper than solid construction

We often hear that timber construction is more expensive than solid construction. But is it true?

The climate is changing, it will get hotter in the long term. Around a quarter of all CO2 emissions come from the building sector, half of which is attributable to new construction. Can we still afford not to build with timber?

After all, one cubic meter of timber sustainably stores around one ton of CO2. In contrast, the manufacturing process of cement consumes around 500 kg of CO2 per cubic meter of cement. Every building component that is built with timber stores CO2 and at the same time reduces its emissions. When granting mortgages, many banks and insurers already reward homeowners who build in a CO2-reduced manner, for example with a reduced interest rate and/or assume the certification costs for Minergie/GEAK. This trend will become even stronger.

### Dismantling instead of demolition, a financial investment?

An often forgotten fact is the short, real useful life of new buildings. They are used for just 50-70 years or even less before they are demolished and replaced by larger structures. This is despite the fact that the building fabric is usually still in very good condition. Demolition costs a lot of money. The material has to be separated, sorted and processed. Much of it is burned or ends up in a landfill. The relevant legal regulations regarding demolition waste have become more and more stringent, which means that in the future, disposal is likely to become even more expensive than it already is today. Why are demolition costs not a factor in your construction project?

TS3 has a very good solution with cross laminated timber. TS3 ceilings are not demolished, but disassembled and reinstalled. The future builders reuse them on site or sell them. This is true sustainability and a good investment.

### Fast installation, less construction noise and more safety

Timber construction is erected at record speed. The prefabricated elements are transported to the construction site and assembled directly. This means significantly less construction noise for your neighbors, because fewer trips are necessary and construction is generally much quieter. Construction site logistics are also a challenge, especially in cities. Timber construction has many advantages here. In the case of prefabricated buildings, it is usually sufficient to use a pneumatic crane, which is driven up for individual construction sections.

The dry construction method also eliminates waiting times for drying out. Your work is completed up to half a year earlier. This means additional income for you as the building owner.

In addition, you have a significantly lower risk of moisture-related building damage.

### The much-discussed costs and the forgotten benefits

The construction costs are in the foreground when making a decision. From a certain level of quality, timber construction is at

least as expensive, often even cheaper than solid construction.

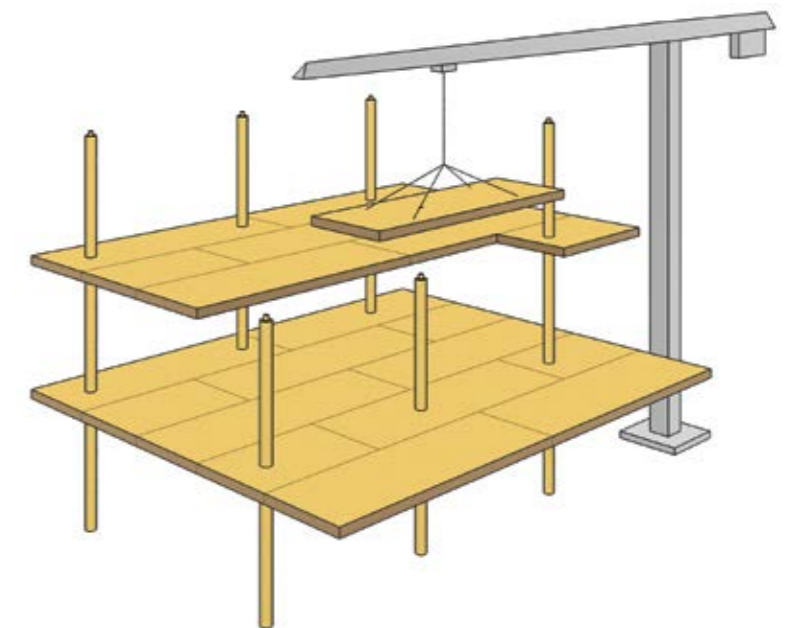
We have made this experience and it is in line with various studies that clearly show this.

What is often forgotten with all the costs is the benefit that a wooden house has. Wooden buildings do not need to be heated as much to maintain a comfortable room temperature. Over the life of the building, this can save a considerable amount of money in operating costs.

Timber has great properties, for example, low thermal conductivity. As a result, wood surfaces heat up less in the summer and distribute heat evenly. Most people find this a pleasant indoor climate.

People generally feel more comfortable in a wooden house, which has positive effects on health, sleep and mood.

So, especially in urban settlement areas, for example in rental apartments, tenants are willing to pay a higher rent for a wooden building. The vacancy rate is likely to be lower and, depending on the neighborhood, new wooden buildings have unique selling points that must be taken into account on the revenue side.





The building sector accounts for around 40% of CO2 emissions worldwide. About half of this relates to the construction of buildings, the other half to their operation. This shows how important it is to select building products and materials carefully. Only by avoiding climate-damaging building materials such as steel and concrete can the construction sector make a decisive contribution to climate protection. The Swiss building and infrastructure park even has great potential as a temporary CO2 sink if it is constructed from CO2-absorbing building materials. Because timber is „best practice“ today, the SIA recommends the use of timber in its position paper. Another problem is construction waste. According to the Federal Office for the Environment (FOEN),

84% of all waste comes from the construction industry. Every second, more than 500 kg of construction waste is generated throughout Switzerland. The circular construction industry is highly interesting from an ecological and financial point of view. Floor slabs made of cross laminated timber panels with TS3 technology are particularly well suited for circular construction. If the building is to be deconstructed, these slabs can simply be cut open in the desired format and transferred to a new life cycle. In a sense, builders pay for the building material only once and can reuse it multiple times. In addition, the CO2 remains stored for longer.

Large format TS3 slabs can be easily cut open and are ideal for reuse, as we have seen, as implemented by us.



Re-use example



**7.1 Production**

The 2C PUR casting resins PT 192 and CR 192 consist of one component resin and one component hardener. When the two components react in a 2:1 ratio, polyurethane compounds are formed. These products are not available on the open market and can only be purchased exclusively from TS3 Timber Structures 3.0 AG. The product-specific characteristic data in detail can be found in the technical data sheet (TDS) and the material safety data sheets (MSDS).



**7.2 Emissions**

After the complete reaction of the two components, the cured casting resin does not release any harmful substances for humans, animals or the environment. Thanks to this starting point, we can bond the natural building material timber or cross-laminated timber boards with TS3 in a sustainable and environmentally friendly manner. We are also pleased to refer to the bonding of cross laminated timber, which is carried out in almost all production facilities with a 1-component polyurethane adhesive: free of solvents, formaldehyde and VOCs. The casting resins are Minergie-ECO suitable and listed with ecobau.



**7.3 Residual material recycling**

Any residual materials from the TS3 system solution are material-separated and recycled. TS3 components are suitable for reuse (see chapter 6), non-recyclable residual waste can be disposed of with normal household waste or at a collection point for waste wood.

including cast resin, can be safely incinerated in controlled incinerators. When wood is burned, the same amount of CO2 is emitted as was stored in the timber during the tree's growth. This closes the carbon cycle of the natural product timber.

Since the amount of TS3 cast resin in the wood composite is very low, wood components bonded with TS3 technology,









Timber Structures 3.0 AG  
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