FFU™ Synthetic Sleeper it works

RAILWAY TECHNOLOGY

State of the Art

Annual turnover SEKISUI CHEMICAL CO., LTD.

[Billion EUROS]

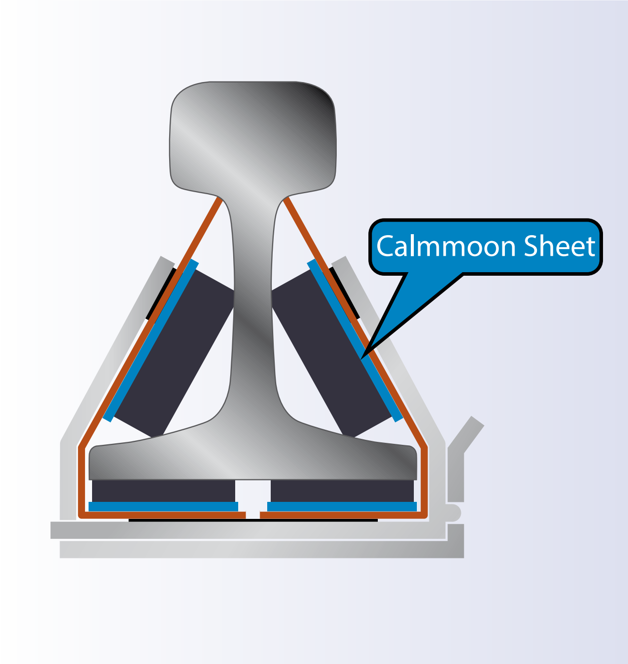
2019	9.26
2020	8.66
2021	9.49

exchange rate 1 Euro = 122 Yen

For over 75 years the SEKISUI CHEMICAL GROUP has been one of the world‘s leading producers of synthetic products.

SEKISUI CHEMICAL is represented worldwide with more than 200 subsidiaries and around 26,500 employees; the company generates a combined annual turnover of approximately 9.5 billion Euros (as at 2021).

SEKISUI has extensive experience in polymer technology and is constantly developing innovative products.



SEKISUI CHEMICAL CO., LTD.

SEKISUI CHEMICAL is split into three main business areas. The "Housing" segment produces well over 10,000 prefabricated houses every year for the Japanese market, each equipped to a superior quality level. Every house is individually built to the customer's specific needs and meets the most up to date standards as regards energy efficiency.

The "High-Performance Plastics" segment covers many industrial applications including laminated safety glass foil for windscreens and architectural glass, cross-linked polyolefin foams for use in vehicle construction and many more industrial applications. The "Medical Engineering" segment offers a wide range of pharmaceuticals, diagnostic products and medical equipment. Further business areas within this segment manufacture fine chemicals, special chemicals and industrial adhesive tapes and foils.

The "Urban Infrastructure & Environmental Products Company" segment is concerned primarily with the creation of environmentally friendly technologies for pipe rehabilitation and very successfully produces wide dimension piping made of glass-fibre-reinforced plastic. This area is rounded off by an extensive range of industrial piping systems, building products and the railway engineering segment.

1980	Japan | Field trials at Miomote River Bridge and Kanmon Tunne
1985	Japan | Technical analysis conducted by „Railway Technical Research Institute (RTRI)
	FFU synthetic sleeper becomes standard sleeper at JNR - Japanese National Railways
2003	Taiwan | Turnout projects with Taiwan High Speed Rail (THSR)
2004	Austria | First bridge projects with FFU in Europe
2008	Australia | First bridge and switch projects | 38 t axle load
2011	Germany | DBAG | First bridge project in Vilsbiburg
	Japan | FFU after 30 years in service were evaluated, RTRI confirmed 50 year life time
	United States | First bridge projects
2012	Germany | DBAG | two switches in Würzburg train station with 70,000 each
	Indonesia | P.T. Kai | Bridge project field test
	Netherlands | ProRail | 3 bridge projects
2014	Switzerland | First switches and bridge projects
	Great Britain | Network Rail | two bridge projects with long timber w/h/l = 42/38/750 cm
2015	Belgium | Infrabel | First bridge project
	France | Tisseo Toulouse | two switches in slab track
2016	Norway | BaneNor | First bridge project
	Great Britain | London Underground | First bridge project
	Myanmar | Myanma Railways | First turnout projects
2017	France | RATP | Switches with FFU 100 for the new M14 line
	Sweden | SL Bridge in Stockholm
	Germany | Final EBA approval from 10 cm height and up to 230 km/h
	Ireland | First bridge project
2018	Italy | First bridge project
	United States | New York City Transit | bridge projects
	Spain | First turnout project
	Vietnam | Ho Chi Minh City Metro | first turnout projects
2019	Great Britain | Network Rail | Newark Crossing | Baulks W/H/L = 700/380/16,000 mm
	Singapore | Singapore Mass Rapid Transit | First turnout projects
	Philippines | Manila Metro Rail | First turnout projects
2020	Finland | FFU as anti-vibration sleeper
2021	Spain | ADIF field trials bridge, switch, tunnel
	Great Britain | Network Rail Approval Timber Bridge
2022	Denmark | First bridge project

Timeline of FFU™ synthetic sleeper

As the national railway network expanded, Japanese National Railways (JNR) noticed from internal records that around 70% of the wooden sleepers used at that time had to be replaced regularly due to weathering. To guarantee a rail network capable of high performance with, as far as possible, continuous and failure-free operation, collaboration began with SEKISUI CHEMICAL CO. LTD. on developing a railway sleeper made of long-lasting, durable and low-maintenance synthetic material, which should have to meet the highest demands. As long ago as 1980, the partners installed the newly developed FFU synthetic sleeper in a field trial on a bridge supporting structure as well as in a tunnel on the high-speed Shinkansen network. Five years later some of the FFU sleepers used in the trial were removed and examined thoroughly. The outcome of the trial revealed that the FFU sleepers exhibited a highly positive behaviour during continuous use.

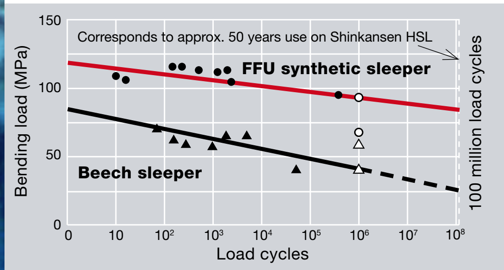
The quality and load-bearing capacity of the sleepers tested differed in no way whatsoever from new sleepers of FFU. Therefore JNR has been using synthetic sleepers as standard in regular operation since 1985, with highly satisfactory results. Further investigations were carried out in 1996 by the supervisory authority, Japan's Railway Technical Research Institute (RTRI), on FFU sleepers from the 1980 test sections.

The gratifying result:
FFU sleepers have an expected service life of more than 50 years. This was confirmed again in 2011 in a further examination by RTRI on FFU sleepers already 30 years old by this time. The implementation of the first project in Europe commenced in 2004. The international standard ISO 12856-1 for plastic railway sleepers came into force in March 2014.

Fiber reinforced
Foamed
Urethane

Service life in excess of 50 years
Density 740 kg/m3, as for wood
Machinability as for wood
Electrical conductivity very low
Chemical resistance very high
Lifecycle costs minimal
Maintenance costs minimal
Custom manufacture to millimetre precision
Recycling up to 100%
Availability of track system maximum
More than 40 years in daily use
Reference track in excess of 1,800 km

Correlation
Bending load – load cycles



FFU™ synthetic sleeper technology

FFU synthetic sleeper is manufactured using a pultrusion technique. Continuous glass-fibre strands are soaked in polyurethane and a composite of the materials is obtained by curing at a raised temperature.

The production process is kept running by a drawing tool that draws the profile of FFU synthetic sleeper out of the curing tool.

This guarantees uniformly high quality of the ISO-certified production with unvarying material properties. By virtue of the manufacturing process, the blanks of FFU synthetic sleeper are non-porous and can be cut to any length up to 9 meters.

Therefore FFU offers the customer far greater certainty of the material behaviour in practical use when compared to natural wood. Significantly better technical characteristics also allow better optimisation of the cross section – a huge advantage, especially in the area of railway bridges.

Since FFU has a closed cell structure, it does not absorb any water. It also exhibits very high chemical resistance to oils, lubricants and pollutants. In the ballast bed the underside of the FFU synthetic sleeper behaves just like a wooden sleeper.

Properties		Unit	Beech new	FFU synthetic sleeper				Standard
				new	10 years	15 years	30 years	
Density		[kg/m³]	750	740	740	740	740	JIS Z 2101
Bending resistance		[kN/cm²]	8	14,2	12,5	13,1	11,7	JIS Z 2101
Bending modulus		[kN/cm²]	710	810	800	816	816	JIS Z 2101
Compressive resistance		[kN/cm²]	4,0	5,8	6,6	6,3	6,0	JIS Z 2101
Shear resistance		[kN/cm²]	1,2	1,0	0,95	0,96	0,93	JIS Z 2101
Hardness		[kN/cm²]	1,7	2,8	2,5	2,7	2,4	JIS Z 2101
Impact bending	+ 20°C	[J/cm²]	20	41	-	-	-	JIS Z 2101
resistance	- 20°C	[J/cm²]	8	41	-	-	-	JIS Z 2101
Water absorption		[mg/cm²]	137	3,3	-	-	-	JIS Z 2101
Electrical insulation	dry	[Ω]	$6,6x10^{7}$	$1,6x10^{13}$	$2,1x10^{12}$	$3,6x10^{12}$	$8,2x10^{11}$	JIS K 6852
resistance	wet	[Ω]	$5,9x10^{4}$	$1,4x10^{8}$	$5,9x10^{10}$	$1,9x10^{9}$	-	JIS K 6852
Rail spike extraction force		[kN]	25	28	28	23	22	RTRI
Rail screw extraction force		[kN]	43	65	-	-	-	RTRI

Technical characteristics

Since 1985 extensive testing of the FFU synthetic sleeper material has been carried out during various approval procedures. In 2008 the Technical University of Munich undertook the material testing of sleepers with a 16 cm construction height. FFU was tested based on applicable European standards. The FFU synthetic sleepers tested had to partly fulfil the requirements imposed on concrete sleepers. The Technical University's report turned out extremely positive for FFU in all areas. Based on these favourable results, the Federal Railway Authority granted approval in 2009 to operational trials for the safe use of railway sleepers of FFU synthetic sleeper on the railway infrastructure of Germany. The following tests were carried out by the university:

- Vibration fatigue test
- Tensile force in sleeper screw
- Sleeper screw extraction test
- Impact test
- Electrical resistance
- Static testing in centre of sleeper
- Fatigue testing in centre of sleeper
- Static compressive test
- Static deflection tests at low temperature R = RT and R = -10°C

The extraction test on sleeper screws yielded an average extraction force of 61 kN.

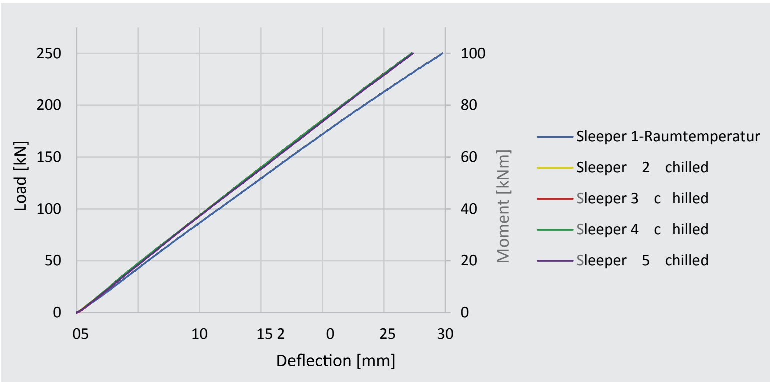
The impact test intended to simulate derailing was carried out with a shock load of a 500 kg mass dropped from a height. Even after this derailing simulation the FFU sleeper remained dimensionally stable, which guarantees track gauge is maintained in the event of a derailment.

In the static test in the middle of the FFU sleeper, an applied force of 240 kN did not damage the sleeper. By comparison, a wooden sleeper failed through fracturing at only 80 kN.
The fatigue test was carried out in the centre of the sleeper under extremely critical test conditions. After 2.5 million load cycles the change in elastic deflection was merely 0.4 mm. No discernible signs of fatigue occurred.

The fatigue test under the sleeper bed was performed in the most unfavourable conditions such as poor track geometry, uneven distribution of loads through the rails, stiff rail supports and high dynamic extra burden for a wheel-set force of 250 kN. Without exception, the FFU sleeper passed the test, there was no damage of any kind, even after two million load cycles.

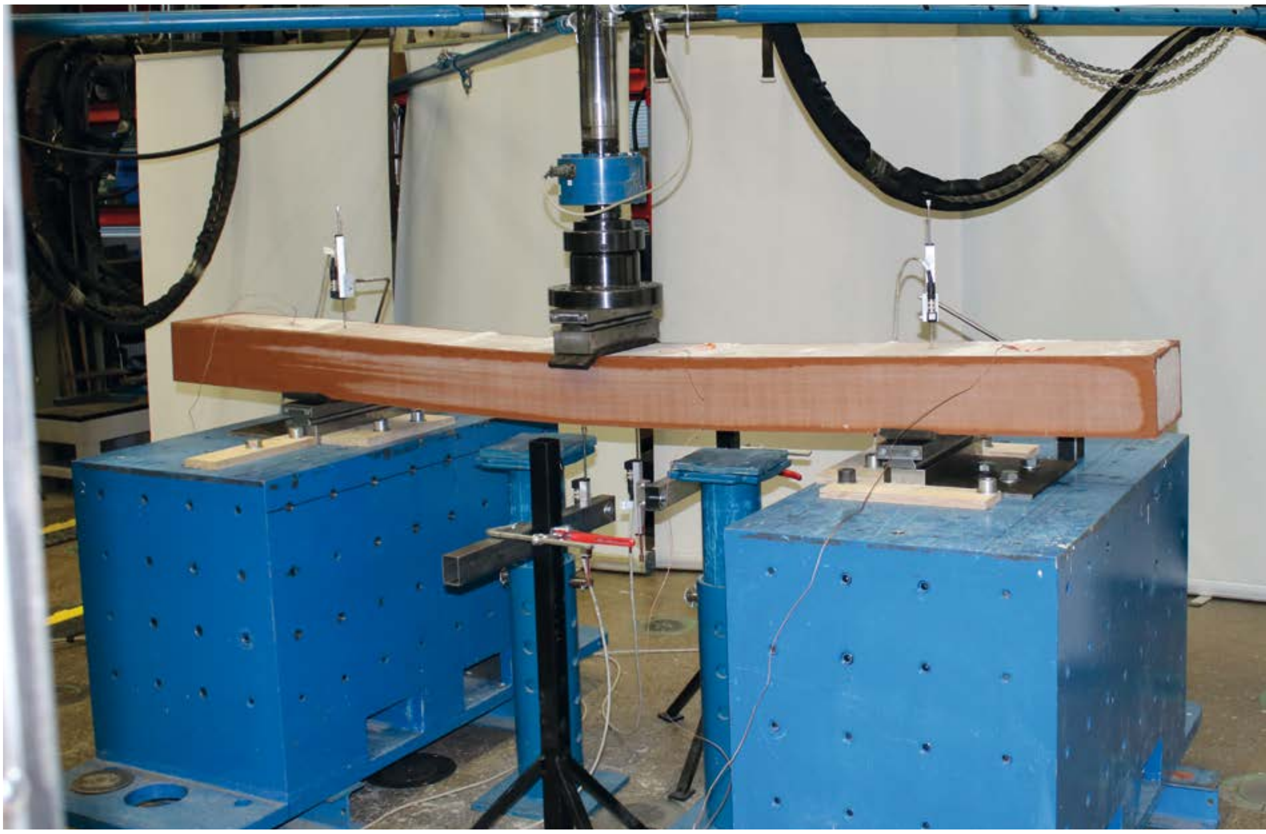
Minus 65 degrees Celsius test

In March 2020, the Technical University of Tampere in Finland performed a static bending test on FFU synthetic sleepers at room temperature and at a FFU sleeper temperature of up to minus 65°C. The result was that no damage to the sleeper was found with a span of 1.5 m and a maximum load of 250 kN.

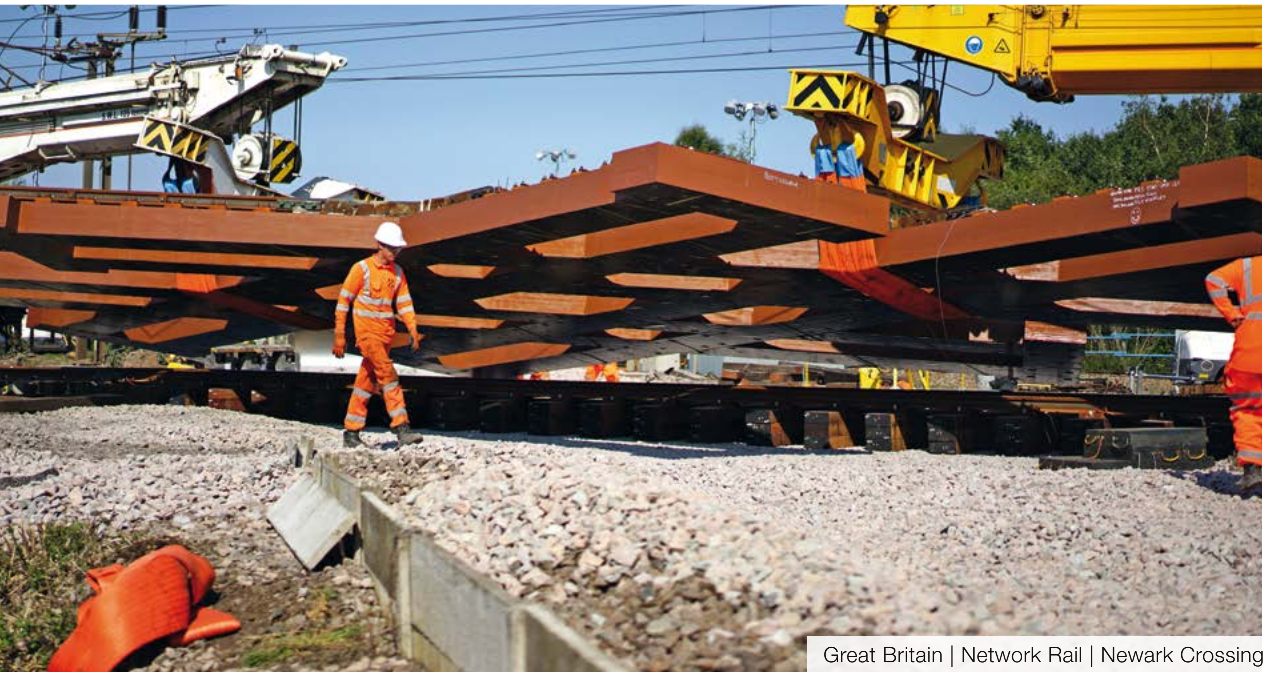


The FFU sleepers behave linearly elastically both at room temperature and at minus 65 degrees Celsius.

Result according to the TU Tampere, the sleeper is outstanding because to date all the materials they have tested have failed under these test conditions.



Germany | DB AG | Rendsburgerbridge



Great Britain | Network Rail | Newark Crossing

Approvals by World Railways

In 2009 FFU got the temporary approval from the German Railway Authority EBA for field tests. In 2017 this approval was changed to a final one. On March 3rd, 2022, Federal Railway Office extended it by another 5 years for use on the railway infrastructure in Germany.

In Switzerland the temporary approval was given to FFU in 2014 and was changed to a final one in 2019.

In the Netherlands FFU was approved in 2015 for the use at ProRail track. The EC certificate was given to FFU in 2016 by EBC Eisenbahn Cert – a member of the railway authority of Germany.

For the use in Sweden FFU got its certification in 2017.

In 2018, FFU Synthetic Railway Sleepers were specified in Design of Transom issued by Transport for NSW, Australia.

In Great Britain the final product acceptance was given to FFU synthetic sleeper technology in 2021. All tests for the Italian approval from RFI have been finished positive in 2021.

ADIF in Spain started its testing at a bridge, switch and tunnel section in 2020/21.

Repairing with Quickfiller/polyester resin - 30 minutes curing time

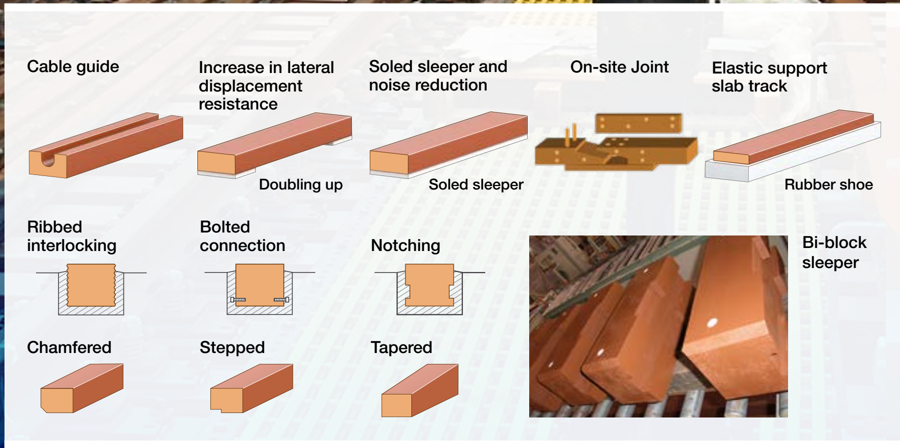
Repair method with FFU dowel and resin - 4 hours curing time

Methods of repair

If during working on FFU sleepers on site, bore holes have been made deficiently, in the wrong place or of the wrong size, FFU synthetic sleeper technology offers two different quick and easy methods of repair without impairing the quality of the material.

In the first method, the defective bore hole is re-profiled, cleaned and then filled with a 2-component polyester resin with glass fibres, After a curing time of just 30 minutes a new correctly positioned hole offset by just a few millimetres can be made in the original repaired hole.

In the second method, the defective bore hole is cleaned and filled with Quickfiller/polyester resin.
A FFU dowel is then inserted.
Curing takes about four hours for this method, so only then can a new bore hole be made at the repaired spot.



Customised production ex works

FFU synthetic sleepers can be manufactured and supplied ex works to the most precise customer requirements.

This allows a noticeable reduction in:
- Adjustments to the project
- The duration of track possessions
- The cost of site logistics
- Preparation expenditure

The following customised productions are possible:
- Doubling up for superelevation
- Milled grooves
- Bridge sleeper bore holes
- Sleeper screw bore holes
- Milling of support bearers
- Milling for boom bracing
- Milling of rivets
- Sanding of the surface
- Doubling up of transverse displacement

The prefabricated FFU synthetic sleepers on the customer order are already clearly marked in the factory in accordance with the laying plan.

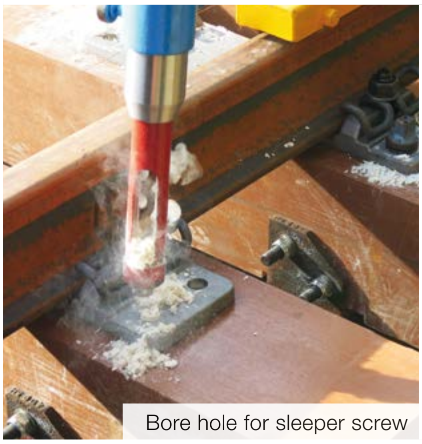
This allows installation to proceed at the predetermined position with certainty.

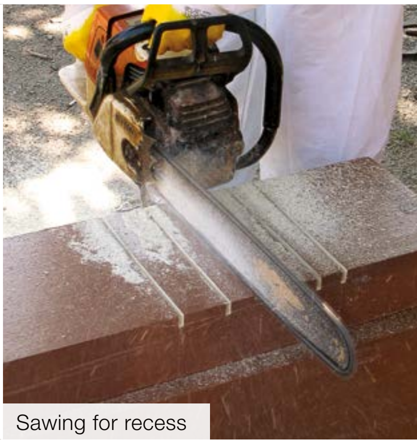
If the gradient of an existing bridge structure needs to be recreated, the individual bridge sleepers of FFU can be manufactured to the different heights with millimetre accuracy.

USA | New York City Transit


Chiselling out the recess


milling


Bore hole for sleeper screw


Sawing for recess


Chiselling out the recess

Working on the project

FFU synthetic sleepers can be processed in the conventional way just like natural wood. Standard tools can be used to drill holes in, saw, mill or chisel FFU synthetic sleeper. Persuasive features of FFU compared to natural wood are greater hardness and almost total freedom from pores. The lifespan of the tools used can be easily optimised by using WIDEA tools or tools for machining steel.

During project machining of FFU synthetic sleeper, attention must be paid to heat build-up on tools. This can be handled very efficiently by a slight reduction in speed and feed rate. By doing so, one also prevents the glass fibres melting due to overheating.

At any rate, the work procedures and the FFU working guidline in force must be adhered to.

The specific weight of FFU 74 is approximately 740 kg/m^3, so it offers the same advantages as natural wood for transportation to the worksite.

Dimensional stability together with milled grooves and doubling up work already carried out at the factory allow on-site work to be performed with speed, precision and certainty. The work effort and periods of track possession can be optimised so that the track is soon available again for train operation.

Special bedding of
FFU synthetic sleeper on open
steel support structure

PT Kerata Api Indonesia | Cilame-sasaksaat bridge

Belgium | Infrarail | balance bridge

Railway bridges

FFU synthetic sleepers can be used on railway bridges technically and commercially just the same as conventional natural wood. Moreover, installing FFU sleepers on railway bridges has significant additional benefits for bridge construction due to:

- Extremely long service life
- Highest resistance to weathering
- Same dead weight of bridge
- Maintaining the visual appearance
- Constant static system
- Following of gradients
- Homogeneity of bridge sleepers
- Use of normal means of fastening
- Use of identical tools
- Free from insecticides
- Short track possessions
- Increased railway safety
- Dimensional stability
- Full-surface support on the bridge bearers
- Homogeneous special cross sections
- Very good technical characteristics
- High availability of track
- Reduced maintenance effort
- Reduced maintenance costs

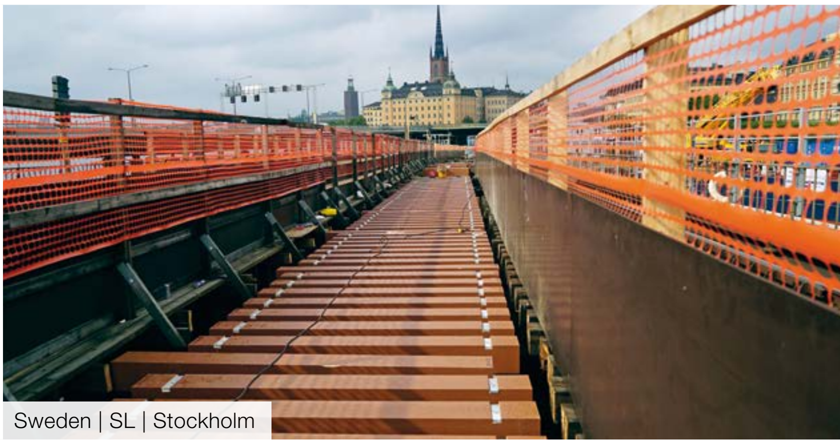
LCC of TU Graz confirmed economics

Great Britain | Network Rail | Ashford

Australia | Minnamurra railway bridge – 38 t axle load

Norway | BaneNor | Fidjetun bridge

Switzerland | SOB | Hurdener bridge



Sweden | SL | Stockholm

FFU synthetic sleeper is installed quickly, competently and accurately by professional railway operating companies and construction companies.

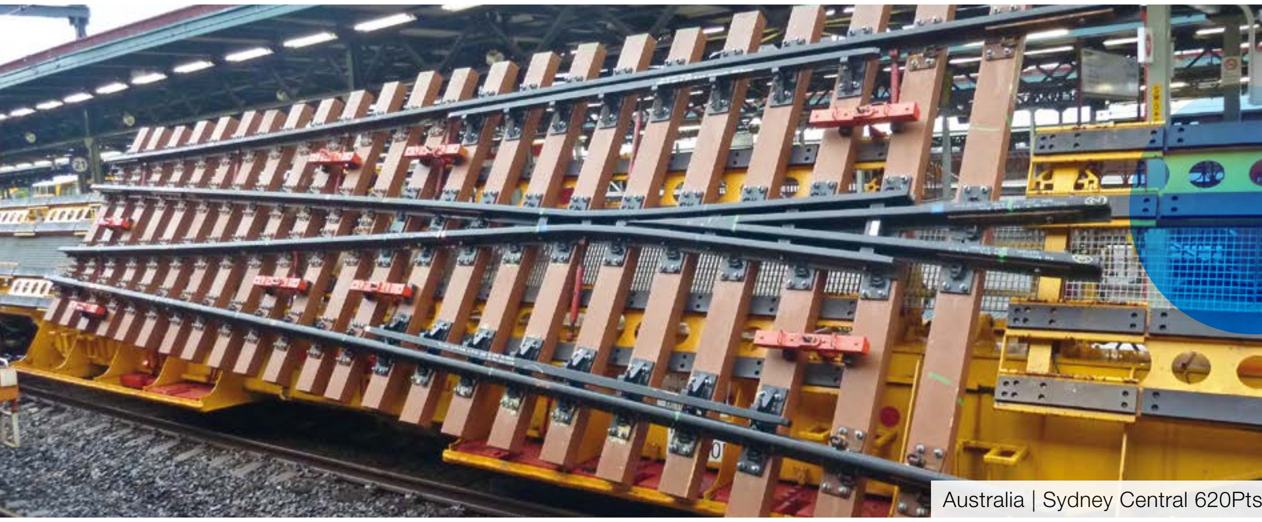
In 2022 a respectable number of railway operating companies are already using FFU synthetic sleepers on more than 1,800 km of track worldwide.

Since 2004 FFU synthetic sleepers have been used on projects in Europe, always to the complete satisfaction of customers. Maximum availability and safety of the track network is a primary goal for the majority of railway operating companies.

At the same time, maintenance intervals for bridge supporting structures are to be observed, e.g.:

- Corrosion protection after about 30 years
- Rail replacement after about 30 years
- Constructional steelwork after about 50 years
- Replacement of FFU bridge sleepers after about 50 years

With these target figures, prolonged track closure leading to interruption of services does not need to be instigated by the railway operator until 50 years are up.



Australia | Sydney Central 620Pts

Japan | JR East | Tokyo Station

Switch systems

FFU synthetic sleeper's very good elastic material behaviour, significantly longer lifespan, high electrical insulation properties and strong resistance to chemical attack, make it the preferred choice for use in switches. It also wins over particularly on switch systems where the operator is regularly confronted with high costs and maintenance expenditure. On top of this, FFU synthetic sleepers can be produced to any desired length and thus overall offer a multitude of advantages for use on switches:

- Good interlocking with ballast
- Long-term elastic material behaviour in the cross frog region
- Gauge reliability after derailing
- Dimensional stability after derailing
- Long-term safety in rail fastening
- Excellent resistance to weathering
- No absorption of water
- Excellent resistance to chemicals
- Unaffected by grease
- No environmental impact from chemical impregnation
- Free from insecticides
- Rapid methods of repair
- Doubling up / Increased transverse stabilisation
- Use of standard means of fastening
- Use of standard tools
- Short track possessions
- Improved railway safety
- Very good technical characteristics
- High availability of the switch system
- High electrical resistance / insulation

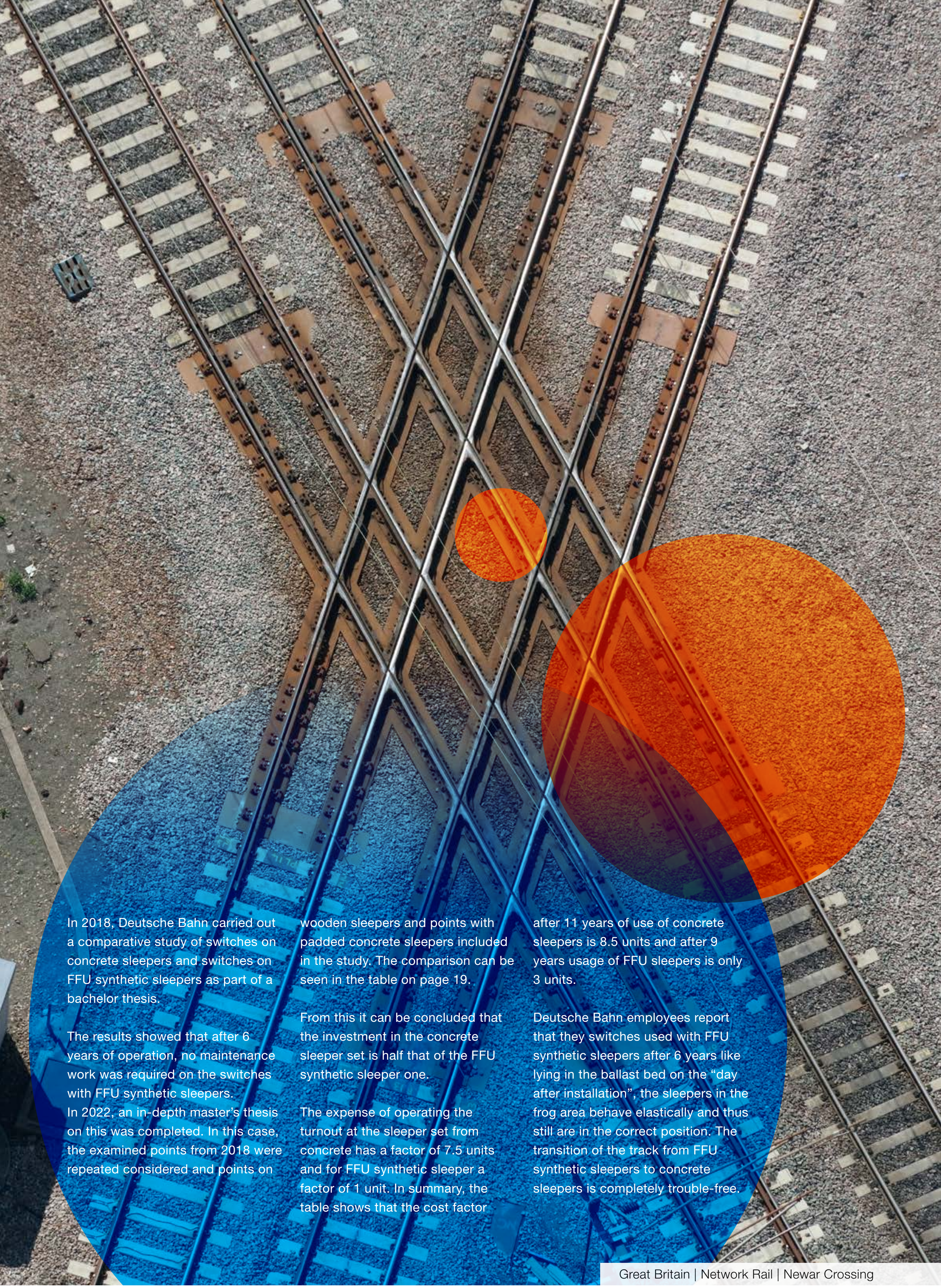
Due to its numerous advantages FFU synthetic sleeper is the preferred choice for switch systems in a ballast bed or on ballastless track systems, with rubber shoes generally being used in the latter case. Dimensional stability and resultant positional stability when assembling switches

in the factory are intriguing aspects of FFU synthetic sleeper. Rapid and reliable factory assembly of switches demands only very brief commitment of capacity in the switch factory.

Switch systems built with FFU synthetic sleepers have a weight comparable to natural wood (approx. 740 kg/m³) and offer enormous advantages in transportation and installation logistics. A pre-existing substructure equipped with wooden sleepers can be continued unaltered with FFU synthetic sleepers.

Based on many years experience, FFU synthetic sleeper exhibits the same advantages as natural wood previously did with regard to elastic behaviour of the track in the area of the switch system. But in the frog area and in connections to existing track, FFU exhibits significantly better elastic material behaviour compared to wood and thus guarantees far more harmonious wheel movement on the rails and track superstructure.

France | RATP | Paris metro M14



In 2018, Deutsche Bahn carried out a comparative study of switches on concrete sleepers and switches on FFU synthetic sleepers as part of a bachelor thesis.

The results showed that after 6 years of operation, no maintenance work was required on the switches with FFU synthetic sleepers.
In 2022, an in-depth master's thesis on this was completed. In this case, the examined points from 2018 were repeated considered and points on wooden sleepers and points with padded concrete sleepers included in the study. The comparison can be seen in the table on page 19.

From this it can be concluded that the investment in the concrete sleeper set is half that of the FFU synthetic sleeper one.

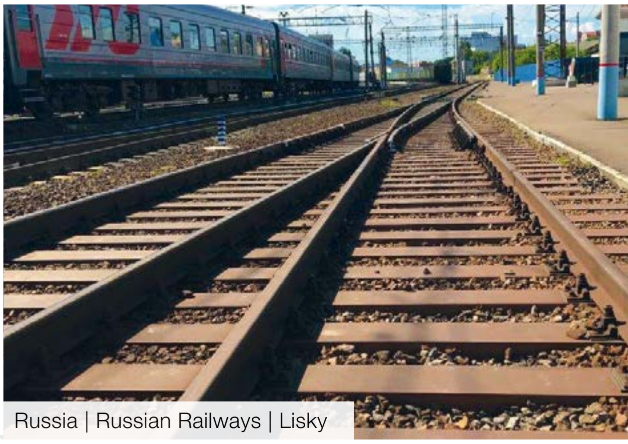
The expense of operating the turnout at the sleeper set from concrete has a factor of 7.5 units and for FFU synthetic sleeper a factor of 1 unit. In summary, the table shows that the cost factor after 11 years of use of concrete sleepers is 8.5 units and after 9 years usage of FFU sleepers is only 3 units.

Deutsche Bahn employees report that they switches used with FFU synthetic sleepers after 6 years like lying in the ballast bed on the “day after installation”, the sleepers in the frog area behave elastically and thus still are in the correct position. The transition of the track from FFU synthetic sleepers to concrete sleepers is completely trouble-free.

Great Britain | Network Rail | Newar Crossing

Australia | Hornsby Junction Sydney

Switzerland | BLS AG | Aeflingen



Russia | Russian Railways | Lisky

Sleeper material	Wood	Concrete	FFU 74
Type of switch	ABW-54-500-1:12-r-Fz-H	EW54-500-1:12-l-Fz-B	EW-54-500-1:12-l-Fz-K
Year of installation	6/1995	7/2010	9/2012
Year of investigation	2021	2021	2021
Time of operation [years]	26	11	9
Load tonnes per day	45,000	55,000	37,000
Design speed	80 km/h	60 km/h	60 km/h
Branch speed	60 km/h	40 km/h	60 km/h
Trains per day	114	88	90
Approx. Investment switch change without sleepers (in relative units)	9 to 10	9 - 10	9 - 10
Investment sleepers for switch (in relative units)	1	1	2
Maintenance expenses (units)	**4**	**7.5**	**1**

Fatigue test under the rail support

Vibration fatigue test

Sleeper screw Ss-8 – diameter 24 mm	
Bore hole diameter /drill	Extraction force [kN]
19 mm / Steel drill	56.8
20 mm / Steel drill	52.7
20 mm / Wood drill	49.6

Synthetic sleeper (h=100mm) after endurance test	Elastic rail head deflection		Plastic rail head deflection	
	Support 1	Support 2	Support 1	Support 2
3 million load cycles	1.60 mm	1.60 mm	0.45 mm	0.15 mm

FFU™ flat sleeper | Technical characteristics

At 12 cm construction height, the world's thinnest "synthetic composite sleeper" (as of 2013) received positive test results in autumn 2013 for main line railways (22.5t) for speeds v < 200 km/h from the testing body for transportation route construction at the Technical University Munich.

The tests were carried out on FFU synthetic sleepers with dimensions 10 x 26 x 260 cm (suburban railway) and 12 x 26 x 260 cm (main line railway). In consultation with the EBA (German Railway Authority) and DB AG the following investigations were to be carried out on the FFU synthetic sleepers:

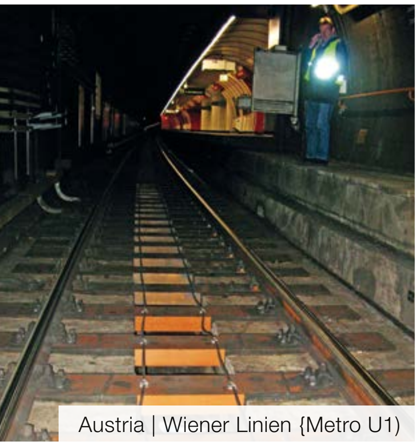
1. Behaviour of the sleeper under vertical and horizontal loads in the vibration fatigue test. Support in the ballast bed on the basis of DIN EN 13481-3.
2. Static and dynamic testing of synthetic sleepers based on DIN EN 13230-2.
3. Extraction test on sleeper screws according to DIN EN 13481-2.

In the vibration fatigue test a maximum elastic deformation of 0.23 mm and a maximum permanent deformation of 0.18 mm was registered under the ribbed plate after 3 million load cycles. The horizontal displacement (resilient and permanent) of the ribbed plates was on average around 0.6 mm.

In order to investigate sleeper behaviour when subjected to bending load, static tests were conducted on the centre of the sleeper in line with DIN EN 13230-2. The support spacing was 1.5 m and load plate width was 100 mm. With a load of 70 kN the deflection of the sleeper (height 120 mm) is 15 mm.

A fatigue test of 2 million load cycles was conducted in the centre of the sleeper based on DIN EN 13230-4. The load applied was initially up to 65 kN. The fatigue test then ensued with a torque of 23 kNm. This torque corresponds to an axle load of 250 kN and train speed V ≥ 200 km/h. No damage to the sleeper could be established during the fatigue test of 2 million load cycles.

Extraction test



Austria | Wiener Linien {Metro U1)

Switzerland | RhB | Tavanasa

Austria | Wiener Linien | Längenfeldgasse

Track sleepers | Switch sleepers

The German Federal Railway Authority (EBA) and the Swiss Federal Transportation Office granted approval in 2014 for the use of flat sleepers on the respective railway networks.

In the course of close collaboration with the staff of Deutsche Bahn it was found that bottlenecks requiring very costly maintenance repeatedly arise in the rail network. This is especially the case in places where the construction height of the ballast under the current sleepers is no longer adequate or where man-made structures above or below the railway line restrict the kinematic envelope of the railway.

DB has communicated in writing its positive experience with this type of railway sleeper on line sections carrying up to 100,000 load tonnes per day.

FFU applications in 10 cm and 12 cm construction height

10 cm height

Since 2008 the Vienna Wiener Linien have been routinely installing FFU sleepers with a construction height of 10 cm. The track of tram line 31 on the Floridsdorf bridge consists of 10 cm high FFU sleepers with a direct fastening. A total of 1,600 metres of track was built with FFU.

Since a large part of the Vienna underground network consists of polyurethane sleepers and these have reached their life expectancy, a long-term programme is currently under way to replace these sleepers with FFU synthetic sleepers. This is primarily in ballastless track and in heavy and light mass-spring systems in tunnels.

In Germany transport operator Bogestra built a switch with 10 cm high FFU synthetic sleepers in ballasted track in 2012.

Wiener Linien | Direct fastening of 10 cm construction height FFU on the Floridsdorf bridge over the Danube in Vienna

<u>12 cm height</u>

Southeast Bavaria Railway has installed these at overpasses of agricultural and other roads. Near Hanover, sleepers with a height of 12 cm have been installed on a Deutsche Bahn train line carrying 100,000 load tonnes every day. After 18 months there was confirmation in writing that the sleepers fully meet the expectations and requirements of the train operator.

In Switzerland, the Rhaetian Railway installed the first 12 cm sleepers at an agricultural road overpass in Tavanasa in 2014. This occurred after the BAV (Federal Transportation Office) in January 2014 approved operational trials on the use of FFU synthetic sleepers of construction heights of 12 cm and up, including in tunnels where wooden sleepers are used.

Environment & Safety

In December 1994, „Japan Food Research Laboratories“ examined the use of FFU in drinking water. The result was positive and has allowed the use of FFU in drinking water projects ever since.
This proof was required for approval by the German Federal Railway Authority.

Experience with a wide range of plastic sleepers in the railway sector has shown that these technologies differ significantly from one another in terms of their quality, their technical characteristics, and their technical material behaviour. For this reason, railway specialists from many countries have presented these differences in the ISO standard 12856-1(2014) by classifying the materials into types.

As those responsible for the railways are aware, these differences are evident in the procurement and, more importantly, in the safety of daily railway operations, in the technical durability, reliability and subsequently in the availability of the track systems.

FFU synthetic sleepers have been used uniquely and successfully in continuous railway operation since 1980 and have the most positive laboratory tests and test results on the market.

The patented construction made of endless glass fibre strands guarantees the highest level of safety and reliability in daily use on the railways.

In many countries around the world, FFU synthetic sleeper has therefore set the „standard“ for the reliable use of plastic sleepers on bridges, switches and special projects.

Italy | Ferrovia Nord | Ponte Ticino


FFU chips for R-FFU


Anchor walls from K-FFU


Abrasion resistance plate from K-FFU


R-FFU produced from small FFU chips

Sustainability & Recycling

FFU synthetic sleepers installed after the first field tests in 1980 are still fully functional and reliable in daily use.

The life expectancy of 50 years predicted by the RTRI (Railway Technical Research Institute) in 1996 and again in 2011 will be reached in 2030.

Railway operators already know that the existing reliability of FFU allow them to use the product beyond this period.

Likewise, after the expansion at the end of the predicted/practical life expectancy, FFU offers railway operators the opportunity to use the sleepers on the track for much more years by simply reconditioning them.

Waste, drill cuttings, shavings, etc generated during the production of FFU have been recycled. This partly at SEKISUI CHEMICACL CO.LTD. itself or by returning it to the recycling system in Japan.

Since 2011, SEKISUI CHEMICAL CO. LTD. has been internationally awarded several times a year by organizations that provide ratings and awards for corporate sustainability.

This encourages SEKISUI CHEMICAL CO.LTD. in its international responsibility towards nature and humanity and allows the company to develop and implement ever more sustainable and environmentally friendly processes, technologies, and procedures.

Great Britain | Network Rail | level crossing

Austria | OEBB | foot bridge

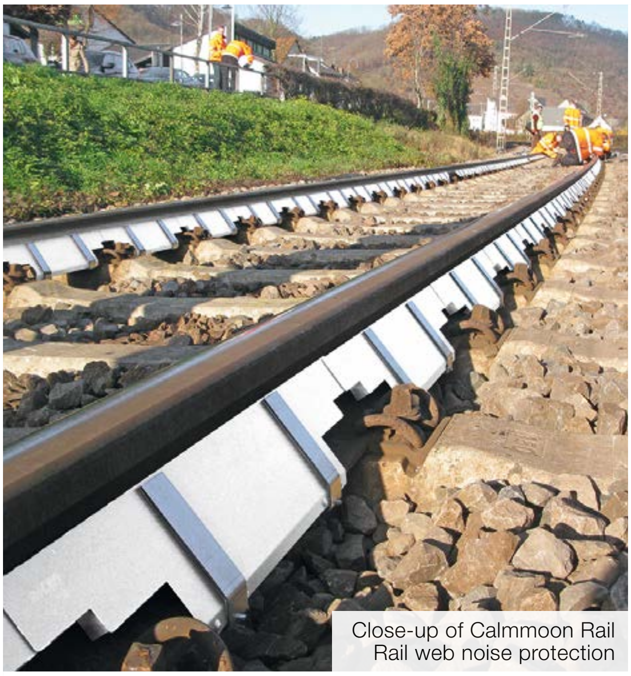
Special projects and profiles

At its initial trial back in 1980, bi-block sleepers of FFU synthetic sleeper were installed on a ballast-less track segment in a tunnel. The initial test results from 1985 confirmed the outstanding material properties of FFU synthetic sleeper.

In the past, level crossings on branch lines were generally built with wooden sleepers. The rapid weathering of wood, severe loading from agricultural and forestry vehicles and equipment and at the same time the need to maintain adequate safety for pedestrians crossing meant that wooden constructions had to be repaired or replaced within a very short space of time. In contrast to wood, FFU synthetic sleeper is an almost pore-free material that absorbs no moisture, needs no environmentally harmful chemicals (adherence to environmental and water protection) and proves to be extremely weather resistant. In addition to an above-average life expectancy, FFU synthetic sleeper is up to 100% recyclable. These aspects make for safer railway crossings and offer the certainty of a substantially longer functionality.

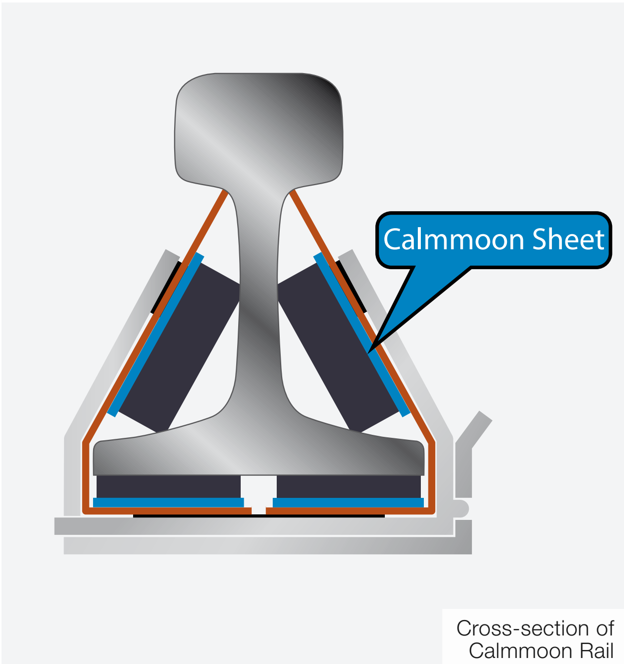
A special project with very large dimensions was the diamant crossing in Newark. Here 8 FFU beams with the dimensions w/h/l = 700/380/16,000 mm were produced and installed.

Japan | JR East | Takanawa Gateway St. | Sound Absorption Walking Board



Close-up of Calmmoon Rail
Rail web noise protection

Calmmoon Rail
on the network of Deutsche Bahn



Cross-section of
Calmmoon Rail

1.3 mm Calmmoon as noise
dampening plate for bridge sound deadening

Calmmoon Rail

Rail web noise protection
Calmmoon Rail is a very effective technology for sustained reduction of noise emissions directly at the source as well as an effective temperature protection of up to 7°C accourding ETH Zurich. The effectiveness of Calmmoon Rail has already been verified in several series of practical trials as well as independently by Deutsche Bahn. By the end of 2021 more than 80 km of track on the Deutsche Bahn network will have been fitted with Calmmoon Rail. According to DB AG from 2012, the most economical and effective technology on the market.

Calmmoon

Calmmoon
noise dampening plates
consist of a sound and vibration suppressing synthetic resin layer bonded to a sheet steel covering. Calmmoon is thin and strongly sound attenuating and so unites the virtues of a flexible and easy to install noise control system. By virtue of its high adhesive power and effective sound deadening, Calmmoon is finding increasingly wide use in quiet zones of commercial aircraft and high-speed trains, in shipbuilding (especially cruise ships and larger passenger ferries), as sound-deadening cladding for steel bridges, and for industrial air conditioning systems and compressors.

SEKISUI

Headquarters
SEKISUI CHEMICAL CO., LTD.
Performance Materials Division UIEP
2-10-4 Toranomon, Minato-ku,
Tokyo 105-8566 JAPAN
Email: railway_team_tyo_pmd@sekisui.com

Branch in Europe
SEKISUI CHEMICAL GmbH
Roßstraße 92
D-40476 Düsseldorf
Phone: +49-(0)211-36977-0
Fax: +49-(0)211-36977-31
Email: contact@sekisui-rail.com
www.sekisui-rail.com

FFU™ SINCE 1980

RAILWAY TECHNOLOGY

State of the Art

Status 2022