FFU® Synthetic Sleeper
For over 70 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 23,000 employees; the company generates a combined annual turnover of approximately 8.85 billion Euros (as at 2016).

Sekisui has extensive experience in polymer technology and is constantly developing innovative products.
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 "Public Infrastructure and Environmental Technology" 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.
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 wood 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 wood 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.

### Timeline of FFU® railway sleepers

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>Okouchi prize and award of the Directorate General of Japan’s Research and Development Agency for the development of FFU synthetic wood</td>
</tr>
<tr>
<td>1979</td>
<td>Deming prize for high level and comprehensive quality control</td>
</tr>
<tr>
<td>1980</td>
<td>Field trials of FFU railway sleepers at the bridge over the Miomonte river and in the Kanmon tunnel</td>
</tr>
<tr>
<td>1985</td>
<td>Examination of test sleepers by Japan’s Railway Technical Research Institute. Results are outstanding, FFU synthetic wood is adopted as the standard sleeper by Japanese National Railways (JNR).</td>
</tr>
<tr>
<td>1996</td>
<td>Japan’s Railway Technical Research Institute retests sleepers from the field trials of 1980. An extrapolation over 100 million load cycles leads to a forecast lifespan of more than 50 years.</td>
</tr>
<tr>
<td>2004</td>
<td>Austria</td>
</tr>
<tr>
<td>2007</td>
<td>Japan</td>
</tr>
<tr>
<td>2008</td>
<td>Germany</td>
</tr>
<tr>
<td>2009</td>
<td>Germany</td>
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<td>2010</td>
<td>Germany</td>
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<tr>
<td>2011</td>
<td>Austria</td>
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<tr>
<td>2012</td>
<td>Germany</td>
</tr>
<tr>
<td>2004</td>
<td>Austria</td>
</tr>
<tr>
<td>2014</td>
<td>Switzerland</td>
</tr>
<tr>
<td>2015</td>
<td>Belgium</td>
</tr>
<tr>
<td>2016</td>
<td>France</td>
</tr>
<tr>
<td>2017</td>
<td>France</td>
</tr>
<tr>
<td>2018</td>
<td>Norway</td>
</tr>
<tr>
<td>2019</td>
<td>UK</td>
</tr>
<tr>
<td>2020</td>
<td>France</td>
</tr>
<tr>
<td>2021</td>
<td>Sweden</td>
</tr>
<tr>
<td>2022</td>
<td>Germany</td>
</tr>
<tr>
<td>2023</td>
<td>UK</td>
</tr>
<tr>
<td>2024</td>
<td>Ireland</td>
</tr>
</tbody>
</table>
FFU® synthetic sleeper technology

FFU synthetic sleeper is manufactured using a pultrusion-extrusion 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 synthetic wood profile 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 FFU synthetic wood blanks are non-porous and can be cut to any length up to 12 metres.

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 synthetic wood sleeper behaves just like a wooden sleeper.

**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** 100%

**Availability of track system** maximum 35 years in daily use

**Reference track** in excess of 1,400 km

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**Correlation Bending load – load cycles**

- FFU synthetic sleeper
- Beech sleeper

**Corresponds to approx. 50 years use on Shinkansen HSL.

Load cycles

- 100 million load cycles
Since 1985 extensive testing of the FFU synthetic sleeper material has been carried out in the course of 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 on the basis of 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 wood on the railway infrastructure of Germany. The following tests were carried out by the university:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Unit</th>
<th>Beech new</th>
<th>FFU synthetic sleeper new</th>
<th>FFU synthetic sleeper 10 years</th>
<th>FFU synthetic sleeper 15 years</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>[kg/m³]</td>
<td>750</td>
<td>740</td>
<td>740</td>
<td>740</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Bending resistance</td>
<td>[kN/cm²]</td>
<td>8</td>
<td>14.2</td>
<td>12.5</td>
<td>13.1</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Bending modulus</td>
<td>[kN/cm²]</td>
<td>710</td>
<td>810</td>
<td>800</td>
<td>816</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Compressive resistance</td>
<td>[kN/cm²]</td>
<td>4.0</td>
<td>5.8</td>
<td>6.6</td>
<td>6.3</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Shear resistance</td>
<td>[kN/cm²]</td>
<td>1.2</td>
<td>1.0</td>
<td>0.95</td>
<td>0.96</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Hardness</td>
<td>[kN/cm²]</td>
<td>1.7</td>
<td>2.8</td>
<td>2.5</td>
<td>2.7</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Impact bending resistance + 20°C</td>
<td>[J/cm²]</td>
<td>20</td>
<td>41</td>
<td>-</td>
<td>-</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Impact bending resistance - 20°C</td>
<td>[J/cm²]</td>
<td>8</td>
<td>41</td>
<td>-</td>
<td>-</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Water absorption</td>
<td>[mg/cm³]</td>
<td>137</td>
<td>3.3</td>
<td>-</td>
<td>-</td>
<td>JIS Z 2101</td>
</tr>
<tr>
<td>Electrical insulation resistance dry</td>
<td>[Ω]</td>
<td>6.6x10⁸</td>
<td>1.6x10⁻¹⁸</td>
<td>2.1x10⁻¹⁸</td>
<td>3.6x10⁻¹²</td>
<td>JIS K 6852</td>
</tr>
<tr>
<td>Electrical insulation resistance wet</td>
<td>[Ω]</td>
<td>5.9x10⁴</td>
<td>1.4x10⁸</td>
<td>5.9x10¹⁰</td>
<td>1.9x10⁹</td>
<td>JIS K 6852</td>
</tr>
<tr>
<td>Rail spike extraction force</td>
<td>[kN]</td>
<td>25</td>
<td>28</td>
<td>28</td>
<td>23</td>
<td>RTRI</td>
</tr>
<tr>
<td>Rail screw extraction force</td>
<td>[kN]</td>
<td>43</td>
<td>65</td>
<td>-</td>
<td>-</td>
<td>RTRI</td>
</tr>
</tbody>
</table>
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

Proof that the material’s technical characteristics remain constant was evident after 1.28 million load cycles performed at an increased temperature of 48°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. After two tests at the same spot, the FFU synthetic wood showed merely the pattern of a "wheel flange". 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.

To analyse behaviour at low temperatures, FFU sleepers were put into storage at -20°C. The ensuing test showed that, even at extremely low temperatures, the fibres of FFU synthetic wood remain free of brittleness.

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.
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 wood 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 liquid synthetic resin. A plug of FFU synthetic wood 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.

Methods of repair

![Repair methods diagram](image-url)
FFU synthetic wood 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.
Working on the project

FFU synthetic wood can be processed in the conventional way just like natural wood. Standard tools can be used to drill holes in, saw, mill or chisel rail sleepers of synthetic wood. 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 in force must be adhered to.

The specific weight of FFU 74 synthetic wood is approximately 740 kg/m³, 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.
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
DB AG | 1,200 m of ballasted track on a bridge in Naumburg
FFU synthetic wood is installed quickly, competently and accurately by professional railway operating companies and construction companies.

In 2016 a respectable number of railway operating companies are already using FFU synthetic wood on more than 1,400 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 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.
FFU synthetic wood’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 wood 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 wood. 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 wood 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.
Employees at Deutsche Bahn (German Federal Railways) say that, even after two years, switches installed with FFU synthetic wood sleepers lie in the ballast bed “as if installed yesterday”, and that sleepers in the frog area behave completely elastically and are thus still in the correct position. They say the transition from the track on concrete sleepers into the switch with FFU sleepers is completely trouble-free and perfect as a result.

When FFU synthetic wood is used, environmentally harmful impregnation, annoying odours and severe weathering processes are unknown.
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 $10 \times 26 \times 260$ cm (suburban railway) and $12 \times 26 \times 260$ 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 synthetic wood 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.

<table>
<thead>
<tr>
<th>Bore hole diameter /drill</th>
<th>Extraction force [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 mm / Steel drill</td>
<td>56.8</td>
</tr>
<tr>
<td>20 mm / Steel drill</td>
<td>52.7</td>
</tr>
<tr>
<td>20 mm / Wood drill</td>
<td>49.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Synthetic sleeper (h=100mm) after endurance test</th>
<th>Elastic rail head deflection</th>
<th>Plastic rail head deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support 1</td>
<td>Support 2</td>
<td>Support 1</td>
</tr>
<tr>
<td>3 million load cycles</td>
<td>1.60 mm</td>
<td>1.60 mm</td>
</tr>
</tbody>
</table>
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 $V \geq 200$ km/h. No damage to the sleeper could be established during the fatigue test of 2 million load cycles.
The resilient deflection after two million load cycles was only 0.25 mm greater than at the start of the test. Moreover, it was noticed that deformation was almost constant throughout the entire fatigue test, i.e. no signs of fatigue occurred.

The fatigue-pressure test under the rail support was carried out on the basis of DIN EN 13230-2 (concrete sleepers). A load of 150 kN was selected for the fatigue test. This corresponds to an axle load of 250 kN and a train speed $V < 200 \text{ km/h}$. A static load of $1.2 \times 150 \text{ kN} = 180 \text{ kN}$ was applied before the fatigue test. After the fatigue test the static load was increased to $2 \times 150 \text{ kN} = 300 \text{ kN}$. Using ribbed plate Rph 1 with the dimensions 160 mm x 345 mm the fatigue test was carried out.
under the rail support on two sleepers (height 120 mm). A 5 mm thick intermediate plate of synthetic material was also installed under the ribbed plate. The first sleeper was subjected to 5 million load cycles and the second to 2 million load cycles.

A deflection of 4.8 mm was registered after 5 million load cycles under a load of 150 kN.

The extraction tests were conducted on the basis of EN 13481-2 Appendix A on 12 sleeper screws Ss 8-140 and synthetic sleepers with a height of 120 mm. The load was increased gradually until the screw was extracted. The result for sleeper screw Ss 8-140 was an average extraction force of 57 kN (standard hole diameter of 19 mm) and 51 kN (standard hole diameter of 20 mm) respectively. Extraction forces in earlier sleeper screw extraction tests on wooden sleepers of 16 cm construction height were around 35 kN (see research report no. 1687 of 30.06.1997 [2]).
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 synthetic wood sleepers in ballasted track in 2012.
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.
At its initial trial back in 1980, bi-block sleepers of FFU synthetic wood were installed on a ballastless track segment in a tunnel. The initial test results from 1985 confirmed the outstanding material properties of FFU synthetic wood.

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 wood 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 wood is 100% recyclable. These aspects make for safer railway crossings and offer the certainty of a substantially longer functionality.

Within just one hour an old crossing can be removed and a new one of FFU synthetic wood installed. Train services can be resumed immediately thereafter and the crossing released for traffic again.
Calmmoon Rail

Rail web noise protection
Calmmoon Rail is a very effective technology for sustained reduction of noise emissions right at their source. 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 2014 more than 80 km of track on the Deutsche Bahn network will have been fitted with Calmmoon Rail. According to information from DB AG, the overall noise level of the rail infrastructure has been reduced by 3 dB on average.

Calmmoon

noise dampening plates
Calmmoon consists 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.
RAILWAY TECHNOLOGY

State of the Art