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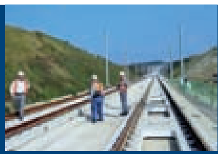

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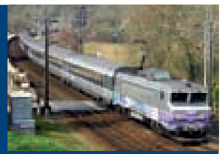

Railway Gazette
INTERNATIONAL

FFU synthetic sleepers offer material gains

SLEEPERS European railways and metro operators are slowly starting to adopt glass fibre-reinforced synthetic sleepers as a more durable alternative to wood.

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On May 29 2010 Hamburger Hochbahn installed a turnout constructed from FFU synthetic sleepers at its Farmsen depot. The event marked a further step in the gradual adoption of fibre-reinforced foam urethane sleepers outside Japan.

The turnout installed by HHA was prefabricated by Voestalpine subsidiary BWG using FFU sleepers supplied by Japanese company Sekisui Chemical. Because of the limited access to the worksite at Farmsen, the turnout was delivered to the depot in sections before being rapidly and precisely assembled from the prefabricated modules. After the ballast was relaid, the first trainsets were able to use the turnout.

High-strength material

FFU is a lightweight corrosion-resistant material formed of rigid-foamed urethane reinforced with endless glass fibres. It is a high-strength structural material, its weight is comparable to wood, and it is workable like wood, durable and water resistant. It has been used widely in railway construction, water supply and drainage systems, civil engineering applications, architectural designs, industrial production and aquaculture.

FFU is produced using a pultrusion process. A sheet of glass fibre threads is pulled through an extrusion press, coated with polyurethane and hardened at a high temperature to produce a high-grade, non-porous material. This is resistant to corrosion from chemicals deposited on the track by passing trains.

Trackform with FFU sleepers can be pre-fabricated to allow rapid installation at the worksite using conventional tools.

Common in Japan

Sekisui produced its first plastic sleeper in 1978 in response to a demand from Japanese railways for a material that was more resistant to weathering than wood. Plastic sleepers have been installed widely across the country since the mid-1980s, particularly on switches, turnouts, bridges and other projects where maximising maintenance intervals is a priority. FFU is also commonly used on bridges to support the trackform because of the limited access and constrained worksites. Japan's Railway Technical Research Institute has calculated that, on average, a synthetic sleeper could be expected to survive 100 million load cycles over a 50-year lifespan.

The first applications in Europe began in Austria in 2004, when Wiener Linien replaced the trackform on a bridge at Zollamtsbrücke. The metro operator believes that the FFU bearers should last for up to 50 years, whereas track renewal and corrosion protection now take place at 30-year intervals.

ÖBB Infrastruktur Betrieb installed its first FFU sleepers on the Austrian main line network in 2005, and the first application in Germany came in 2008, when Voestalpine installed a 74 m turnout with 136 sleepers in a private siding on the

Left: FFU sleepers can be cut using the same hand-held tools as wood.

Right: Synthetic sleepers have been in widespread use on Japanese railways since the mid-1980s.

Bayer ChemPark industrial railway near Leverkusen (RG 10.08 p776). EBA approval was achieved on July 8 2009, at which point DB Netz, München metro operator MVV and HHA all expressed an interest in testing FFU sleepers.

MVV sees a particular advantage in the superior electrical isulation properties offered by FFU, and it installed five sets of points with synthetic sleepers across its network at the beginning of 2010 to see whether there is any long-term safety benefits to be derived. DB Netz meanwhile sees FFU as a useful alternative for marshalling yard pointwork and curved track on bridges, where very precise sleeper dimensions may be required. Based on previous experience, ÖBB Infrastruktur Bau plans to install Sekisui's first FFU-sleepered double-slip crossing as part of the remodelling of Wien Hauptbahnhof later this year.

Endurance testing

A series of research projects over the past two years has provided more quantitative data on the performance of FFU in track applications. In 2008, Sekisui worked with Technical University of München to assess the durability of FFU over a sustained period. In the first experiment, 20 sleepers measuring 260 x 160 x 2 600 mm were subjected to 3 million load cycles replicating a 225 kN axleload (Table I).

Impact tests were also undertaken in accordance with DB Netz's track component procurement standards, and these showed that FFU sleepers withstood a far higher level of impact stress than wood, with only narrow indentations at maximum load (Table II). No distortions in the overall shape were detected, which implies that the sleeper should maintain track gauge even in the event of a derailment.

In 2008, ÖBB contracted the Technical University of Graz to undertake a life-cycle cost analysis comparing conventional bridge timbers with FFU. The results suggested a positive long-term return could be assumed based on a longer lifespan and the consequent reduction in maintenance. Furthermore, FFU offers potential savings in the initial capital investment for complex track components such as turnouts, switches and crossings. The Graz study concluded that a return on investment of between 1·35 and 1·55 could be expected. The study also suggested that the lifespan of FFU could be three to five times that of a wooden sleeper.

Key to the adoption of FFU is the speed and precision of the installation. FFU sleepers can be ordered to fit a specific requirement, and can be tooled down to a precision of just a few millimetres during production. The material is highly stable, ensuring that there is no deformation during delivery to the worksite. This also allows more rapid installation, whether on conventional track or on bridges using steel joists. FFU sleepers can be sheared using standard hand-held tools, and holes for rail fastenings can be drilled in the same way as wood, using the same tools. Furthermore, where sleepers are being replaced, the same fastenings can be re-used.

Table I. Railhead oscillation of FFU sleepers after 3 million load cycles *mm*

	Right base point	Left base point
Elastic oscillation	2·12	1·71
Residual oscillation	0·42	0·29

Technical University of München has undertaken rigorous static tests to determine the load-bearing characteristics of FFU sleepers.

The modular turnout with synthetic sleepers was installed at HHA's Farmsen depot in less than one day.

Table II. Comparison of FFU and wooden sleepers

Material	Pull-out strength *kN*	Maximum load *kN*	Notes
FFU	61	240	No flaws in flexural area
Wood	35	80	Collapse of flexural zone