

## **RTRI test report on FFU synthetic sleepers after 30 years in service.**

Yuya Oikawa, Dr. Günther Koller

FFU was installed for the first time in 1980. Since then more than 1,400 km of track have been installed at switches and bridges in more than 16 countries. The newest installations happend at Network Rail track for the first time in September 2014 on two of their bridges, in spring 2015 Infrabel installed one bridge and in Toulouse two switches have been installed at Tisseo track.

This report summarizes the results of field surveys and physical property tests on FFU synthetic short sleepers and FFU synthetic bridge sleepers after 30 years in service (hereinafter referred to as the "short sleepers" and the "bridge sleepers", respectively) that RTRI (Railway Technical Research Institute) conducted on behalf of SEKISUI CHEMICAL CO.,LTD.

### FIELD SURVEYS AT TWO LOCATIONS

#### Bi-block or short sleepers

were tested at the Kanmon Tunnel at the inbound area of the Sanyo Main Line within the jurisdiction of Kyushu Railway Company.

The total number of sleepers installed in 1980 was 74 sleepers (37 pairs continuously installed), with dimensions of 120 mm thick x 240 mm wide x 590 mm long. The alignment is straight and the (uphill) gradient is 22 ‰. 60-kg rails and gate-type rail fasteners are used.

The passing tonnage per year is 18.9 million tons; per day around 52.000 tonnes and over the last 30 years 580 million tons.

The data of the track maintenance records of the Kyushu Railway Company for the sections in which the short sleepers were installed showed as follows:

- 1984: Replaced tie plates
- 1985: Replaced rails
- 1991: Replaced rails
- 1996: Replaced rails
- 2002: Replaced rails
- 2005: Replaced tie plates

The survey results showed that after 15, 20, 25, and 30 years in service the short sleepers exhibited no cracks and warping, no changes in the colour of the surface layer, and no loose screw spikes. Furthermore, the tie plates were in good fastened condition. Since the sleepers were of the side-embedded type, the end faces of bonded portions were observed from the ditch side and the result was that no damage such as peeling or cracks and also no loose sleepers were observed. The short sleepers were in good fixed condition. A total of 11 short sleepers after 30 years in service was sampled from the right rails No. 12, Nos. 26 to 29, No. 31, No. 32, and Nos. 34 to 37.

specimens used to conduct the tests were the same as those used to conduct the bending fatigue tests.

Considerations: If the results of FFU sleepers in service after 30 years are compared to the results of bending fatigue tests on the bridge sleepers after 15 years in service and on the new synthetic sleepers, it is clear that the strength of the bridge sleepers under the bending fatigue tests is on a declining trend. The stress on the bridge sleepers came to  $77.8 \text{ N/mm}^2$  and that of the new synthetic sleepers came to  $94 \text{ N/mm}^2$ . This demonstrates that the strength deteriorated by  $16.2 \text{ N/mm}^2$  in a period of 30 years. However, since the results of the tests on the bridge sleepers after 15 years in service exhibited a  $78.9 \text{ N/mm}^2$  stress that was rarely different from the results of the tests conducted this time, no noticeable deterioration in the strength was observed. Furthermore, if it is assumed that the axle load applied to the Shinkansen was  $170 \text{ kN}$  and the bridge sleepers were subjected to repeated stress due to train passage at the frequency equivalent to that for sleepers in service for a period of 50 years (i.e., the originally estimated durability), the fatigue fracture-resistant strength of the bridge sleepers after 30 years in service came to about  $74.8 \text{ N/mm}^2$ . This greatly exceeds the stress tolerance normally generated on bridge sleepers, i.e.,  $25 \text{ N/mm}^2$ .

Consequently, the current FFU bridge sleepers will offer very good service in the coming two decades.



Picture 3: FFU switch sleeper – Japan



Picture 4: FFU bridge sleepers on Shinkansen track - Japan

### Conclusion

As 30 years have passed since synthetic sleepers were installed on commercial lines, RTRI conducted field surveys and physical property tests on the short sleepers installed in the Kanmon Tunnel and bridge sleepers installed on the Miomotegawa Bridge, and evaluated the performance of the said sleepers. As a result, the short sleepers and the bridge sleepers tested showed that they will perform well in service within the coming two decades.

### References:

[1] RTRI, Follow-up Survey on FFU Synthetic Sleepers after 30 Years in Service