

# A STORY OF PERFORMANCE AND DURABILITY

## Testing 27-year-old Sika® CarboDur® Plates

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## 1 ABSTRACT

This document presents the tensile test results of 27-year-old Sika® CarboDur® plates found at EMPA (Zürich). The results are compared to the original tensile tests performed in May 1997.

## 2 INTRODUCTION

Sika started to study the use of composite materials in construction in the 1980s. The first documented application of Sika pultruded carbon fiber plates was done on a wooden bridge in Switzerland around the end of the 1980s and beginning of 1990s. The bridge, located in Sins, was designed by Joseph Ritter and built in 1807.



*Sins bridge (Switzerland) - First application of Sika FRP system*

Before and after the first application of pultruded plates, Sika performed several experimental campaigns for the development and the full characterization of the FRP properties. Most of these campaigns were conducted at EMPA (Swiss Federal Laboratories for Materials Science and Technology), with Professor Urs Meier, a pioneer in the use of FRP in construction.

After every experimental campaign, there were some leftover plates. In October 2023, a roll of Sika® CarboDur® plates was found at EMPA, stored in an indoor environment for years and completely covered with dust.

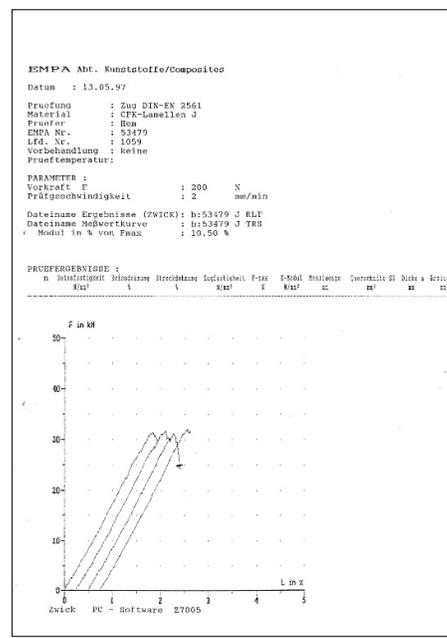
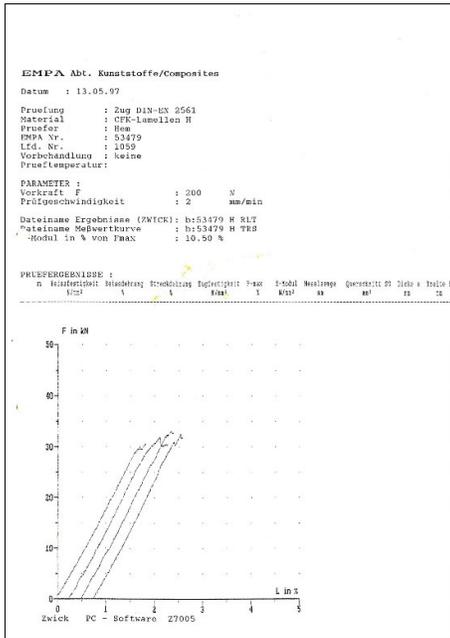
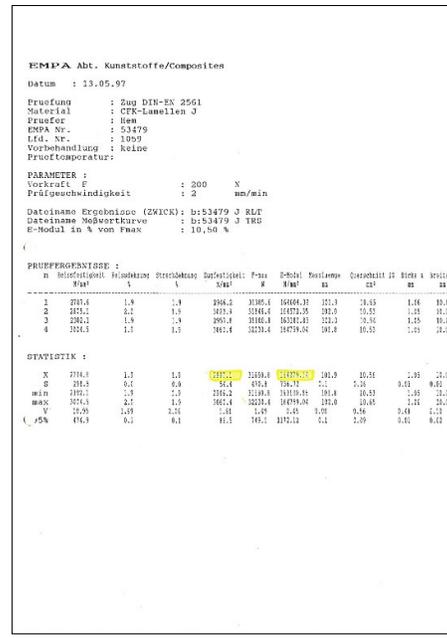
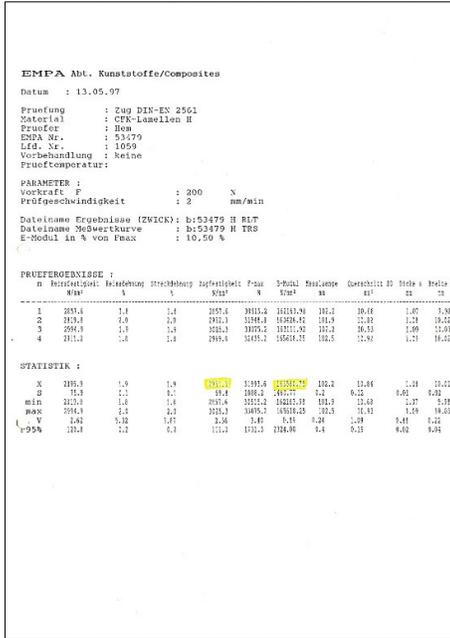
Upon cleaning the roll, it was identified as a Sika® CarboDur® pultruded plate 50 mm wide and 1 mm thick, produced in March 1996. The Sika triangle, although slightly faded, was still visible.



*Sika® CarboDur® 50mm wide and 1 mm thick, produced in March 1996*

### 3 TENSILE TESTS

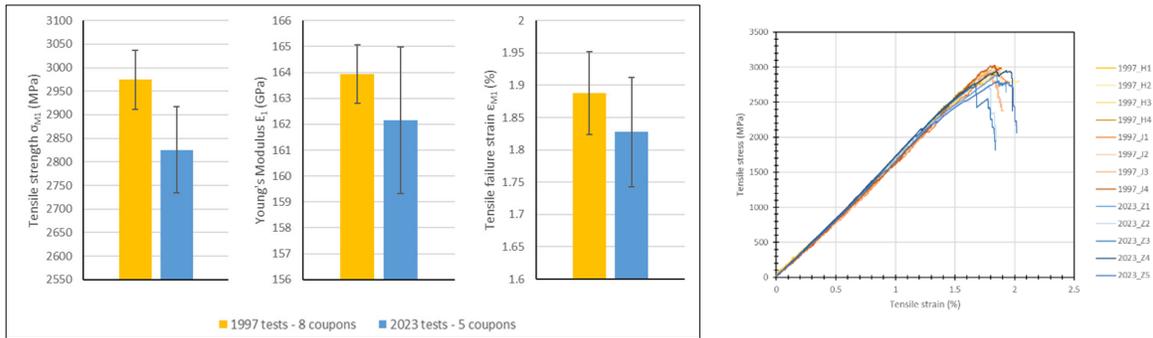
EMPA did extensive documentary research and found the original test reports of the tensile tests performed on the plates. The plates were originally tested on May 13<sup>th</sup> 1997. Two different batches were tested, with a total of 8 specimens (4 per batch).



Sika® CarboDur® tensile tests report – May 13<sup>th</sup> 1997

In October 2023, in collaboration with Dr. Zafiris Triantafyllidis and Prof. Dr. Giovanni P. Terrasi of EMPA, five specimens of the 1996 roll were tested, and the results were compared to those obtained in 1997.





Sika® CarboDur® tensile tests comparison

| Year | No. of tests | Tensile strength $\sigma_{M1}$ (MPa) |          |              | Young's Modulus $E_1$ (GPa) |          |              | Tensile strain at peak load $\epsilon_{M1}$ (%) |          |              |
|------|--------------|--------------------------------------|----------|--------------|-----------------------------|----------|--------------|---|----------|--------------|
|      |              | Ave.                                 | St. Dev. | % diff.      | Ave.                        | St. Dev. | % diff.      | Ave.  | St. Dev. | % diff.      |
| 1997 | 8            | 2974.1                               | 62.8     |              | 164.2                       | 1.1      |              | 1.888   | 0.064    |              |
| 2023 | 5            | 2825.3                               | 91.8     | <b>-5.00</b> | 162.1                       | 2.8      | <b>-1.29</b> | 1.820   | 0.097    | <b>-3.59</b> |

27 years after the production and 26 years after the previous tests, Sika® CarboDur® plates showed a minimal variation in **tensile strength of -5.0 %**, a negligible variation in the **modulus of elasticity of -1.3%** and a variation of **-3.6% for the maximum strain**.

**These numbers demonstrate the performance over time of our plates and shows the astonishing stability of the mechanical properties after almost three decades from the production.**

**Furthermore, it was observed that the plates exhibited perfect elastic behaviour. Despite being rolled for over 27 years, they returned to a perfectly straight shape after unrolling, showing no memory shape effect.**

## 4 CONCLUSION

Pultruded carbon fiber plates have been extensively used in the construction industry for over 3 decades. Their performance and behaviour are well-documented in scientific literature.

Durability and consistency of performance over time are key topics frequently discussed with consultants and owners.

The test results on Sika® CarboDur® plates, showed in this article, performed 27 years after production, demonstrate a remarkable stability in mechanical properties, confirming the exceptional quality of our products.

## 5 ACKNOWLEDGMENTS

Thanks to **EMPA** and the **Laboratory for Mechanical Systems Engineering** and in particular to Dr. Zafiris Triantafyllidis and Prof. Dr. Giovanni P. Terrasi for their contribution.

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## 6 KEY WORDS

#wearesika #buildingtrust #beyondtheexpected #carbodur #sikacarbodur #frp #empa

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