“Technical Research and Development for Road Policy Quality Improvement”
Study Summary

No.	Title	Principal Researcher
No.2022 - 6	Application of recycled carbon fiber to reinforcement of concrete structures	Gifu Univ. Prof. M. Kunieda

The research and development project aims to contribute to society by making effective use of recycled carbon fiber from CFRP waste, and to extend the lifespan of repaired concrete structures by using recycled carbon fiber (ReCF) reinforcement. The reinforcement was applied to reinforcing of joint in bridge overlay repair.

1. Backgrounds and Objects

The use of carbon fiber reinforced plastics (CFRP), which takes advantage of its characteristics of light weight, high strength, and high durability, is accelerating in industries such as the automobile and aircraft. There are, however, concerns that large amounts of CFRP waste will be generated in the future. It would be desirable for the road sector to contribute to this social issue. In the road sector, not only extending the lifespan of repaired concrete structures but also reducing the environmental impact are required. In this research and development project, reinforcement for repair of concrete structures was manufactured by recycled carbon fiber (ReCF) from CFRP waste generated from other sectors.

2. Activities in Research Period

This research and development project consists of three phases: (1) development of splicing technology, (2) development of resin impregnation technology, and (3) development of forming technology into a net shape.

3. Study Results

(1) Development of strand splicing technology

Figure 1 shows developed splicer for ReCF, and succeeded in producing a continuous strand. Furthermore, braided ReCF using three strands was succeeded, as shown in Fig. 2.

(2) Development of resin impregnation technology

Resin impregnation manner in order to improve adhesion to concrete and adhesion at the intersections when processing into a net was obtained. The spliced and continuous strands were immersed in resin placed in a tray for about 15 seconds, after which excess resin was removed using multiple rollers, and the strands were thermally dried (about 130°C) in a drying tube for about 1 minute, then naturally dried indoors for about 20 minutes, and wound up on a bobbin. As shown in Fig. 3, strength of the strands was confirmed by a tensile test, and the strength was improved by resin impregnation.

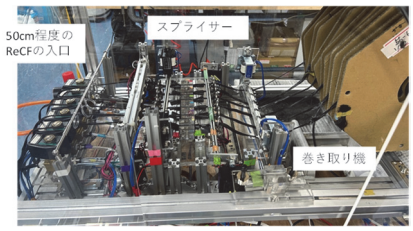

Fig. 1 Developed splicer

Fig. 2 Spliced strand

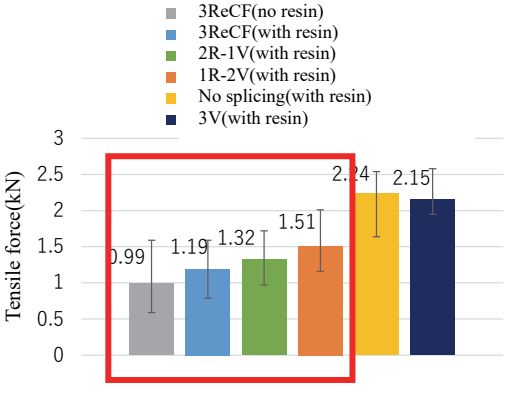

Fig. 3 Tensile strength

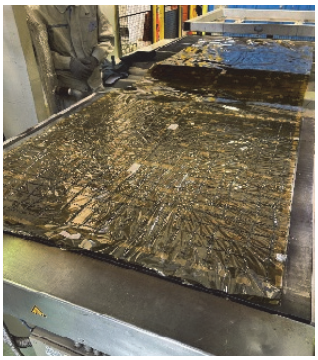

Fig. 4 ReCF net after hot press

Fig. 5 On site application for bridge overlay

(3) Development of a net-like reinforcement material
A net-like reinforcement material as shown in Fig. 4 was manufactured using a batch-type hot press, and it was clarified that it can be applied to the joints of bridge overlay repair as shown in Fig. 5.

4. Papers for Presentation

(1)Hewei XU, **Minoru KUNIEDA**, Hiroshi MORITOMI: Tensile Property of Recycled Carbon Fiber Strand for Concrete Reinforcement, 11th International Conference on Fiber-Reinforced Polymer (FRP) Composites in Civil Engineering, Brazil, pp.266-275, 2023(review paper)

(2)Hewei XU, **Minoru KUNIEDA**, Hiroshi MORITOMI : Evaluation of Tensile Strength of Recycled Carbon Fiber Strand with Joint, Proc. of Concrete Scenarios, pp.1-6, 2023(review paper)

(3)Hewei XU, Masanobu KURITA, **Minoru KUNIEDA**, Hiroshi MORITOMI : Tensile Strength of Recycled Carbon Fiber Strand with Joint, Proc. of the Japan Concrete Institute, pp. 1567-1572, 2024(review paper)

5. Study Development and Future Issues

The ReCF strands developed through this research and development project are limited in thickness. Its reinforcing effect was about the same as that of D6 rebar, but it has also high corrosion resistance. It is expected to be applicable to repair applications with small cover under severe environmental conditions such as chloride induced damage. It is, however, necessary to consider the development of equipment for mass production and cost estimates.

6. Contribution to Road Policy Quality Improvement

In recent years, in order to address the issue of re-deterioration after repairs, it is essential to extend the lifespan of repaired structures, so it is necessary to use reinforcement materials with high corrosion resistance. In addition, in order to ensure the performance of road structures, it is also necessary to consider not only structural safety but also environmental aspects, and this technology can contribute to environmental friendly society.

7. References, Websites, etc.

None