Architectural devices

# Structural design and engineering for future buildings by unknown materials

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## Purpose of Research

Our laboratory conducts research to find new materials not often used as structural members of buildings, and use them as architectural structural materials.

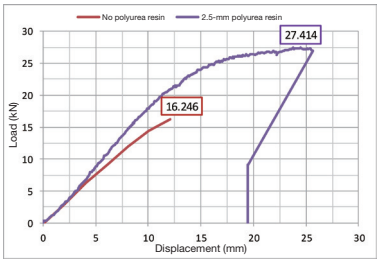
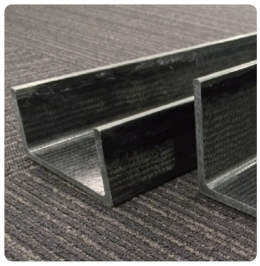
Usage as architectural structural materials

**(1) High-performance rope intertwined with high-strength aramid fiber**

**(2) Polyurea resin (synthetic resin coating)**

**(3) Carbon fiber reinforced plastic (CFRP)**

## Summary of Research

| Material | Outline | Key points | Usages, advantages and issues |
|---|---|---|---|
|  <br>**High-strength aramid fiber (para-aramid fiber)** |  <br>Used as a bracing member for timber framing | • High-strength aramid fiber is light and very strong in comparison with steel frames and other common structural members.<br>• High-strength aramid fiber is highly flexible and can withstand acid and alkali. | **Usage**<br>• Seismic reinforcement and maintenance<br>**Advantages**<br>• Lightness<br>• Outdoor usage is possible.<br>**Issues**<br>• Weight reduction of joint parts<br>• Jointing methods |
|  <br>**Polyurea resin (synthetic resin coating)** |  <br>**Relationship between load and displacement (timber)**<br>Comparison based on the thickness of polyurea resin | • Polyurea resin is very strong and elastic.<br>• The load-bearing capacity of a specimen with polyurea resin applied increases by up to 1.7 times compared with that of a specimen without polyurea resin applied. | **Advantage**<br>• Increased bending strength and deformation-following characteristic<br>**Issue**<br>• Reinforcement of timber and concrete block walls |
|  <br>**CFRP** | **Comparison of the physical values of CFRP and steel**<br>CFRP (NCF): Tensile strength (kN/mm²) 0.60; Specific gravity (kg/m³) 1550<br>Steel (SS400): Tensile strength (kN/mm²) 0.40; Specific gravity (kg/m³) 7850<br>* NCF: Non-crimp fabric | • The tensile strength of CFRP is 1.5 times that of steel.<br>• The specific gravity of CFRP is approximately one fifth that of steel.<br>• CFRP is light and very strong compared with steel. | **Advantage**<br>• Increased member strength<br>• Reduced fixed load<br>• Reduced seismic load<br>• Reduction of transportation and construction cost<br>**Issue**<br>• Methods of jointing members<br>• Usage in actual designs |

## Future Developments

Continuing research for practical use