Integrated programme: Commonly used Repair Dry fabric cutting volumes. It is estimated that there are approximately:

- 1930’s are deemed no longer capable of sustaining increased traffic
- In the need of structural repair or strengthening due to:
  - Worldwide
  - Solutions
  - Load
  - Concrete
  - Concrete fails
  - Many existing reinforced concrete structures are in urgent need of structural repair or strengthening due to:
    - deterioration and
    - growing load capacity demands.

In the UK alone, the vast majority of concrete bridges built since the 1930’s are deemed no longer capable of sustaining increased traffic volumes. It is estimated that there are approximately:

- 10,000 trunk road and motorway bridges;
- 150,000 local road bridges.

Advanced composites offer:
- Innovative and cost-effective design solutions
- Improved traditional repair methods and technologies
- Solutions specific to repair / strengthening project needs
- Prolonged life of existing reinforced concrete infrastructure

Why structural strengthening? Worldwide, many existing reinforced concrete structures are in urgent need of structural repair or strengthening due to:

- deterioration and
- growing load capacity demands.

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Experimental research methodology

A number of tests on realistically sized reinforced concrete elements are necessary in order to develop a reliable composite strengthening system.

Tests include:
- Material tests
- Structural tests
- Bond performance tests

Tested structural elements:
- Push-off specimens
- T-beams

Key parameters:
- Shear capacity of elements
- Load distribution and sharing between composite and concrete
- Composite bond length
- Size effect

Intermediate conclusions: Advanced composites contribute significantly to the ultimate shear capacity of reinforced concrete elements. Studied parameters greatly influence structural behaviour of strengthening systems.

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Future work

- Material testing of various carbon fibre-reinforced composites – sheets and bars
- Structural repair and testing of cracked control specimens using Tyfo® composites
- Testing of realistically sized T-beams using various shear-strengthening systems
- Investigation of various anchorage systems for shear-strengthening of T-beams
- Deep embedment shear-strengthening technique for comparison of different schemes
- Development of reliable mechanics-based design guidelines for shear-strengthening

Preliminary results

Commonly used assumption of load sharing in shear:

\[ V_{\text{ultimate}} = V_{\text{concrete}} + V_{\text{steel}} + V_{\text{composite}} \]

Typical structural behaviour in shear – push-off tests:

- Varying number of shear links
- Varying thickness of composite materials
- Bond length varying from short to fully wrapped
- Load distribution and sharing between components

Intermediate conclusions: Advanced composites contribute significantly to the ultimate shear capacity of reinforced concrete elements. Studied parameters greatly influence structural behaviour of strengthening systems.

Studied parameters:
- Varying number of shear links
- Varying thickness of composite materials
- Bond length varying from short to fully wrapped
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