Background

At the present time, “sustainable development” is a key issue in a wide range of fields, including production technology, life-cycle management and the use of natural resources. It is also one of the most challenging goals in the construction industry. This applies not only to the design of new structures but also to the management of the huge stock of existing structures. Bridge owners and authorities are currently dealing with a large number of structurally deficient and obsolete bridges. The main reasons for this include (1) aging and (2) higher load and intensity demands.

Two strategies could be considered when dealing with deficient bridges in networks; upgrading and replacement. Decisions about the strategy that is most suitable for the situation are usually based on extensive life cycle assessments and complex decision-making algorithms. Disruption of traffic is usually regarded as the most important factor affecting the decision-making processes, since the cost of the reduction in traffic flow can easily overtake the upgrading and replacement costs, especially in densely populated areas. The trend in the past few years has therefore been to develop upgrading and construction techniques which minimise the operation time and have a minimal effect on traffic flow. In this context, the use of fibre reinforced polymer (FRP) materials, together with an adhesive bonding technique, in the upgrading and construction of bridges has attracted a great deal of attention in recent years. The outstanding properties of FRP materials, such as high strength, high modulus of elasticity, light weight, corrosion resistance, enhanced fatigue life and tailorability of properties, have made them a suitable material for upgrading existing bridges. Moreover, the adhesive bonding technique suggests that the fatigue performance of upgraded or new structural members is improved. It is also far easier and faster in comparison with traditional joining methods.

The advantages of using bonded FRP composites to upgrade existing bridges compared with traditional methods include (1) lower imposed self weight, (2) less lane-closure time, (3) no need for heavy lifting machinery, (4) lower indirect costs and (5) less change in the appearance of the structure, e.g. important in the case of historical bridges.

Objectives

The objectives of this work package are **to develop new bridge strengthening and upgrading techniques and enhance existing ones focusing on minimizing traffic disruption and environmental disturbance in densely populated cities**. The strengthening techniques considered should:

- result in considerable reductions in lane closures, traffic disruption and thereby expensive traffic management costs
- be material independent both with reference to the bridge to be strengthened (concrete, steel, composite) and with respect to the material used (e.g. CFRP, GFRP, SRP),
- consider the long-term performance of the strengthening schedule and provide sustainable alternatives to existing traditional strengthening methods in terms of efficiency, durability and environmental friendliness.

Definition of the problem

Task 5.1 in this work package, in connection with deliverables D5.3 and D5.8, will identify the problems and restrictions generally related to the strengthening, repair and upgrading of bridges in densely populated areas. This will be carried out by a detailed mapping of the need for the strengthening, repair and upgrading of existing bridges. Experience from previous projects conducted by NCC, MOS and ACC regarding the bottleneck points in strengthening and repair processes will be included. This task also covers the state of the art knowledge regarding damage-diagnosis systems. Finally, this task will establish criteria for strengthening and repair methods to be implemented for bridges in densely populated areas.

Task 5.2 in connection with deliverable D5.20 will develop solutions and techniques with emphasis on the criteria identified in Task 5.1. The practical applications of the new techniques in direct relation to the management of urban construction processes will be shown. To assure proper market exploitation of the

project, results of this task will be presented in form of a toolbox including standardised refurbishment techniques of existing bridges.

The challenges in developing new techniques or improving the existing ones will be (1) reducing the strengthening operation time and lane closure, (2) reducing environmental disturbance on surrounding population, (3) long-term behaviour of the strengthening system and (4) efficiency and cost issues.

Outputs and deliverables

This work package includes three deliverables as follows.

- D5.3 (12): Needs for maintenance and refurbishment of bridges in urban environments
- D5.8 (24): Model for management of strengthening and repair for bridges
- D5.20 (36): Toolbox for flexible refurbishment of existing bridges

It should be mentioned that changes from the original description in DoW are possible, as long as these can be explained / justified and agreed by all partners. Major changes which may affect the other WPs should be avoided.