

Ardfix for Non-Through Applications

Betontex® Ardfix® Anchoring System: Non-Through Applications

Ardea Ltd, through continuous research, has developed an innovative connection and anchoring system named Ardfix®, which significantly improves the behavior of the structural members in shear strength by bonding and anchoring the **Betontex® (FRP) Systems**. Ardfix® is applied as a part of the (FRP) System related to structures made of reinforced concrete, wood or masonry. It consists of a combination a uni-directional and pultruded rods of carbon fiber (ELIPS).

The (FRP) Systems work properly when there is a good and effective adhesion between the composite material and the surface, which relates to resins characteristics and to the correct installation of the FRP System. A common problem is the detachment of the fabric when there are load values much lower than the tensile strength. In order to eliminate this problem Ardea Ltd has studied and created a method to improve the link between the composite materials and the substrate. After conducting series of experiments the results indicated that the use of connections (bolts) type Ardfix® as fixed anchors is a very suitable and effective method in preventing the detachment of the fabrics by changing the mechanism of delamination failure in marginal state resistance to fracture of the reinforcement due to exceeding the tensile strength.

FRP System Design Characteristics

The Betontex® FRP System for the reinforcement of constructions should be designed to meet specific criteria, which for each project are specified by the designer and/or the engineer and according to the relevant regulations. The design should be based on satisfying equilibrium equations and reconcile deformations to provide the required strength and functionality specified by the regulations, taking into account the mechanical properties of the material. The engineers of EM4C together with the ones of Ardea Ltd are available to provide any assistance on the characteristics of the applications of Betontex® FRP Systems and any information about our products

Installation

This instruction booklet is not one for planning and implementation. The design and implementation should be executed by skilled engineers and technicians. Thus the experience of the applicators and the continuous supervision considered absolutely necessary to ensure good installation and performance.

Implementation Steps

The general application process has the following steps (the final design characteristics of each system defers and depends on its needs):

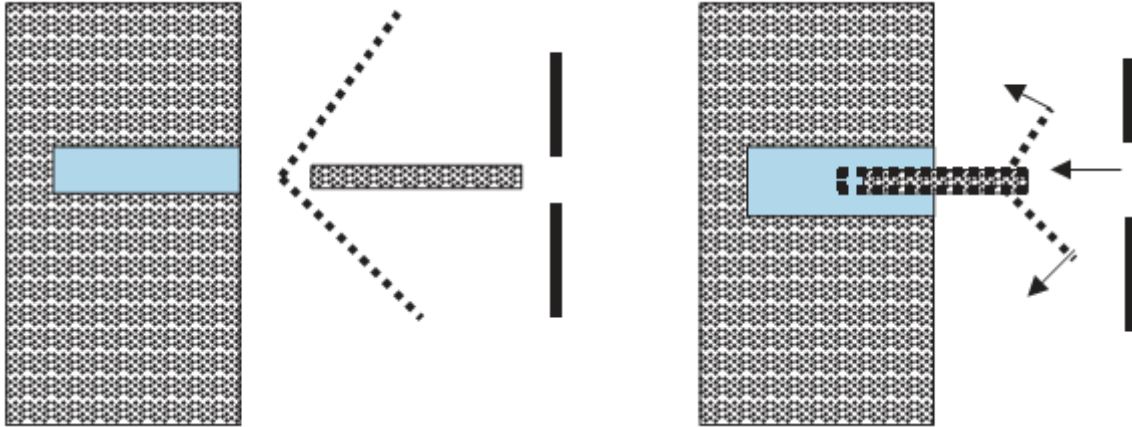
Surface Preparation

1. Drilling of holes approximately 2/3 of the width of the structural element according to the design that specifies the exact locations and the size of the holes. For the installation of a rod Betontex® Elips (F8) is necessary to drill a hole with a diameter of 16 mm. In case of a rod Betontex® Elips (F10) the necessary size of the drilled hole is of a diameter of 18 mm.
2. Proper preparation of the substrate in order to remove loose and deteriorated parts, repair with mortars, configure the surface flatness and clean the area of application. It is necessary that the final surface to be completely smooth and flat without cracks and gaps in order to achieve optimal and consistent adhesion of the fiber. The restoration of concrete or cracks can be made with the use of high strength mortars or epoxy resins of high density or by injecting epoxy resin, respectively.
3. Insert in the holes the epoxy resin Betontex® RC or the fireproof resin Betontex® IPN, according to the required type and quantity for the installation of the rod.
4. For each rod, a strip of fabric reinforcement Betontex® GV 330 U-HT STRIP width and 5 cm length must be used covering the rod having a length twice the depth of the hole plus 30 cm (Example: For a beam width of 40 cm, the rod length = $0.66 \times 40 = 26,67$ or 25 cm. The total length of strip = $2 \times 25 + 2 \times 15 = 90$ cm).

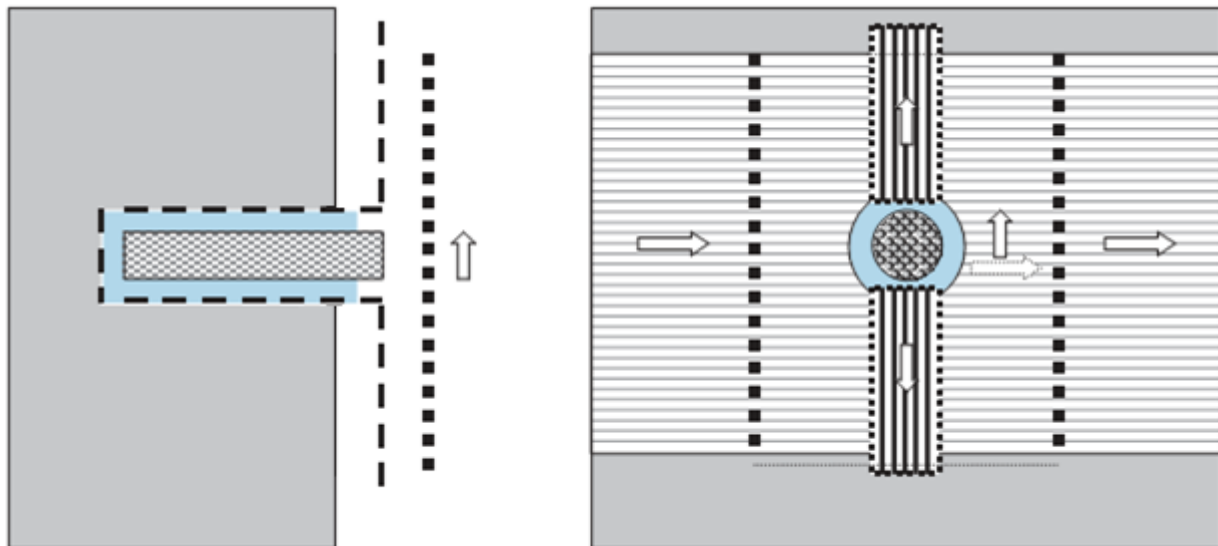
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Infuse the strip of fabric with the appropriate resin (most common: RC 02 or RC 02/3 or IPN 02), and insert the covered rod (F8 or F10) into the hole. The two edges of the strip are protruding at a length of 15 cm. Cut, unfolded and glue properly the two ends of the strip on the prepared substrate structural member.

- Applied on the side of the glued ends of the strip a square piece of fabric Betontex[®] GV 330 U-HT (most common: 50 cm x 50 cm) with the direction of fibers perpendicular to the direction of the fibers of the (FRP) system that will be applied on the top of the Ardfix[®].



- After the installation of the Ardfix[®] apply the required longitudinal reinforcement layers, as they have been determined by the study, in the side of the component / member, using epoxy resin Betontex[®] RC or fireproof resin Betontex[®] IPN. The final assembly is shown in pictures below.



Calculation of the allowable load per anchor:

For each anchor, taken in to consideration the armed strip tape Betontex GV330 U-HT, the allowable load can be calculated:

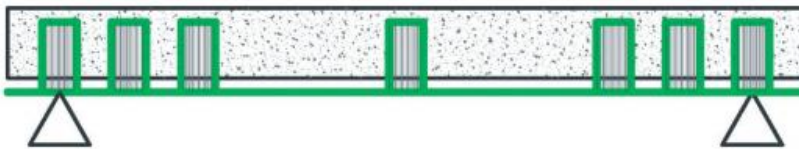
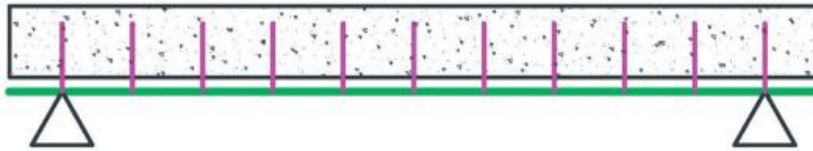
Thickness:	$d = 0,177 \text{ mm}$
Width:	$l = 40 \text{ mm}$
Cross Section of Anchor:	$l \times d = 40 \text{ mm} \times 0.177 = 7 \text{ mm}^2$
Permissible load per anchor:	$F_s = 7 \text{ mm}^2 \times 163 \text{ Kg/mm}^2 = 1.141 \text{ Kg}$

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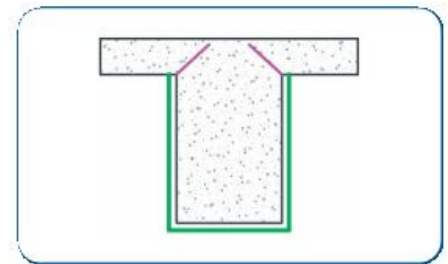
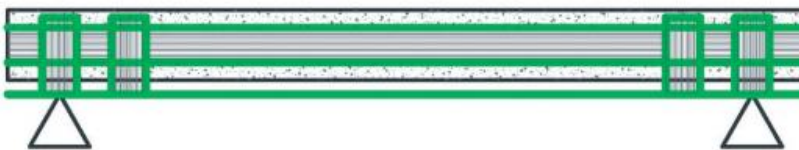
For safety reasons the contribution of the extruded rod that is positioned in the hole is ignored. The load related to the adhesion of the anchor, assuming a value of allowable load in shear at the surface of the interface between anchor, resin and concrete $t_{int.f} = 3 \text{ MPa}$ (30 Kg/cm^2), can be calculated as follows:

Surface interface = $4 \text{ cm} \times 15 \text{ cm} = 60 \text{ cm}^2$

Load on the surface of the interface = $A \times t_{int.f} = 60 \text{ cm}^2 \times 30 \text{ Kg/cm}^2 = 1.800 \text{ Kg} \gg F_s = 1.141 \text{ Kg}$
(this load is higher than the allowable load of the anchor).



Trave in CA con rinforzo longitudinale e rinforzo a taglio realizzato con tessuti Betontex® (passo da calcolare)



Packaging / Storage / Shelf Life

Betontex® fabrics are available in rolls 50 m long by up to 100 m and a width of 10 cm to 100 cm depending on the type of fabric (the rolls can be cut into desired lengths multiples of 5 m). The bars Betontex® Elips are available in packs of 20 pieces in lengths of 1,5 m. Fabrics and bars are packed to reduce wear on transportation. They must be stored horizontally in a dry, shady and dry place at temperatures lower from $+40^\circ \text{ C}$. In proper storage conditions the shelf life can reach up to 10 years from the date production.

Certificates / Approvals / Standards

- The Ardea Ltd with continuous research and development and cooperation with European institutions and approved universities has become a series of necessary certificates (Certificate of Compliance) which provided upon request.
- The material safety data sheets (Material Safety Data Sheets, MSDS) that provide health information and safety on the safe handling, storage and disposal of products provided on the website of Ardea Ltd.

Application Instructions

1. The system connection and anchoring Ardfix® can be applied to substrates of reinforced concrete, masonry and wood.
2. The system connection and anchoring Ardfix® can be used in conjunction with epoxy resins Betontex® RC or fire resistant resins Betontex® IPN. For more information please see the Betontex Technical Brochure.
3. The carbon fibre fabrics are maintain their dimensional stability due to structural glass fiber net (Ardea® Thermo-Welding Technology), that makes the fabrics resistant to mishandling allow them to be folded

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and be cut very ease without suffering of any damage. The fabrics could be cut with the use of a regular size scissor or cutting knife, without wasting of material. During storage avoid folding the fabrics.

4. It is not recommended the application of fabric strips longer than 5 m. Long layers could be created with successive layers with an overlapping length of 15 cm.
5. During the application of Ardfix[®], the holes and the substrate must be cleaned by the use of a professional blower.
6. For rods Betontex[®] Elips F8 is necessary to drill holes with s diameter of 16 mm.
7. For rods Betontex[®] Elips F10 is necessary to drill holes with a diameter of 18 mm.
8. The Betontex[®] GV 330 U-HT STRIP is usually produced in rolls of 300 m long and in standard width of 5 cm.
9. The square pieces of the Betontex[®] GV 330 U-HT (usually 50 cm x 50 cm) are made by the installer using a roll of 50 cm width.

Comments

The Ardea Ltd has many years of experience in the field of composite materials and their applications in the construction sector. Thanks to design innovative products and methods it can provide solutions for complex problems that are difficult to treat with traditional methods.

The shipping labels contain: name of manufacturer, name of item, date of manufacture, number of lot, quantity and dimensions.



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