Strengthening rcc structure using composite fibre wraps construction essay

Although reinforced concrete and masonry buildings are successfully constructed worldwide every year, there are large numbers of concrete and masonry structures that deteriorate and become unsafe due to changes in loading, changes in use, or changes in configuration. Old structures designed for gravity loads are not able to withstand seismic forces and caused wide spread damages. Repair of these structures is often difficult, expensive, hazardous and disruptive to the operations of the building.

The use of advanced composite fibre-wrap is the new technique in the emerging market of structural rehabilitation industry. This paper describes the strengthening concepts and performance characteristics of the Advanced Composite System (ACS).

This may be attributed to various causes such as environmental degradation, design inadequacies, poor construction practices, lack of regular maintenance, revisions in code of practice, increase in loads due to change in usage of structure or unexpected seismic conditions.

The removal and transportation of large amounts of concrete and masonry material causes concentrations of weight, dust, excessive noise, and requires long periods of time to gain strength before the structure can be re-opened for service.

On the other hand, Fiber Reinforced Composite (FRC) materials,

originally developed for the aerospace industry, are being considered for application to the repair of buildings due to their low weight, ease of handling and rapid implementation. A major development effort is underway

to adapt these materials to the repair of buildings and civil structures. Appropriate configurations of fibre and polymer matrix are being developed to resist the complex and multi-directional stress fields present in building structural members.

Rationale for Research:

Question:

Aim:

Objective:

Advanced composite materials are referred to those composite materials developed and used in the aerospace industries. They usually consist of high performance fibres as reinforcing phases and polymers or metals as matrices. The fibres have very high stiffness and strength. However, the key to taking high properties of fibres is to embed them in a surrounding matrix, which acts as a support for the fibres, transfer applied loads to the fibres, and to form useful structural shapes.

It is evident that material advances have been the keys to significant technology breakthrough throughout the human history. Today we are in the midst of a new revolution triggered by the onset of advanced composite materials. This new class of materials is characterized by the marriage of quite diverse individual components that work together to produce capabilities exceeds those of their separate elements. Their unique properties make them the materials for major technological advances. It is believed that these materials will be critical to the economic trade in the twenty-first century.

The use of Fibre Reinforced Polymer Composites is a novel technique for repair and retrofitting of damaged structures. Fibre reinforced polymers [FRP] are rapidly being introduced into a wide variety of civil engineering applications.

It has also been shown that FRP reduces corrosion rates of reinforcing steel in concrete by minimizing the diffusion of chlorides (BERVER et al. 2001)

Fibre Reinforced Polymer Composites [FRPC] are being used widely in the retrofitting and strengthening of concrete structures. The use of FRPC is a novel technique for repair and retrofitting of damaged structures (Mukherjee, A. and Joshi, M. V., 2001). The method is fast emerging and replacing the conventional methods of repairs.

Will Composite Fibre Wrap be useful in Retrofitting and strengthening structural life.

Investigating Whether Composite Fibre Wrap will be useful in Retrofitting and Strengthening Structural Life or not.

Economic and social development places increasing demands on infrastructure, yet there are resource and budgetary limitations on the quantity of new construction. Rehabilitation of existing buildings, structures and facilities is therefore critical.

Concrete can be subjected to a number of deterioration processes.

Research Methodology:

Problems caused by reinforcement corrosion are recognised as a major limitation upon durability of many existing structures.

This situation provides both a challenge and an opportunity to the rehabilitation industry.

Due to the ageing of the infrastructures, repair and rehabilitation of damaged steel reinforced concrete structures using composite fibre wraps are increasingly becoming a topic of interest in the infrastructure community.

Types of Fibres

There are various types of fibres available in the market for wrapping technique. The following 3 are the most commonly used,

GLASS

ARAMID

CARBON

GLASS

Glass fibres are silica based glass compounds that contain several metal oxides which can be tailored to create different types of glass. (Nanni, Antonio (Ed. 1993) The main oxide is silica in the form of silica sand; the other oxides such as calcium, sodium and aluminium are incorporated to reduce the melting temperature and impede crystallization. Glass fibre is the most common fibre used in FRPC because its low cost, high strength, high chemical resistance, and good insulating properties. Despite being widely

used in marine applications, glass fibre is subjected to strength loss under moisture and load.

The most important grades of glass are:

E-glass: has low alkali content of the order of 2%. It is used for general purpose structural applications and is the major one used in the construction industry; it also has good heat and electrical resistance.

S-glass is a stronger and stiffer fibre with a greater corrosion resistance than the E-glass fibre. It has good heat resistance. The S-2-glass has the same glass composition as S-glass but differs in its coating. The S-2-glass has good resistance to acids such as hydrochloric, nitric and sulphuric acids.

ARAMID

Aramid has good resistance to abrasion and organic solvents (Nanni, Antonio (Ed. 1993) It has a high melting point and starts degrading at 500°C. It has good fabric integrity at elevated temperatures. But its main drawback is its sensitivity to acids and salts. It is also sensitive to ultraviolet radiation and prone to static build-up unless finished. The structural of the aramid fibres is anisotropic and gives higher strength and modulus values in its longitudinal direction compared with its transverse direction. Aramid is resistant to fatigue, both static and dynamic. It is elastic in tension but it behaves non-linearly in compression and in addition has a ductile compressive characteristic. The fibre possesses good toughness and damage tolerance properties.

CARBON

Carbon Fibre Reinforced Polymer (CFRP) is a more costly material than its counterparts also used in the construction industry: glass Fibre reinforced polymer (GFRP) and aramid Fibre reinforced polymer (AFRP), though CFRP is generally regarded as having superior properties. Carbon Fibre reinforced plastic has over the past two decades become an increasingly notable material used in structural engineering applications. Its use in industry can be either for retrofitting: to strengthen an existing structure, or as an alternative reinforcing to steel from the outset of a project. (Nanni, Antonio (Ed), 1993)

Since it is the most widely used Fibre in strengthening, the detailed explanation is given further. Studied in an academic context as to its potential benefits in construction, it has also proved itself cost-effective in a number of field applications strengthening concrete, masonry, steel and timber structures. Retrofitting has become the increasingly dominant use of the material in civil engineering, and applications include increasing the load capacity of old structures (such as bridges) that were designed to tolerate far lower service loads than they are to today, seismic retrofitting and repair of damaged structures. Retrofitting is popular in many instances as the cost of replacing the deficient structure can greatly exceed its strengthening using Carbon Fibre Reinforced Polymer (CFRP).

Out of all the about types Carbon is the most suitable type for Fibre Wrapping.

Structures:

Procedure of Fibre Wrapping

The procedure of wrapping requires skilled labour as it is not simple and the application is done in following four stages

Surface Preparation

Application of Primer

Application of Saturant

Laying of Sheets

The project is divided into six chapters and each of them is divided in accordance with the aim and respective objectives. Following is the brief description of the content in each chapter:

Chapter 1: Background Study

This chapter outlines the brief introduction to various causes such as environmental degradation, design inadequacies, poor construction practices, lack of regular maintenance, revisions in code of practice, increase in loads due to change in usage of structure or unexpected seismic conditions in the UK.

Chapter 2: Literature Review

This chapter deals with a new class of materials instrumental in reinforcing concrete. It gives a brief insight on the Fibre composites.

Chapter 3: Fibre Reinforced Polymer Composites(FRPC)

This Chapter describes the increasing use of FRPC in repairs of structures and also explains FRPC, its role in structural applications and its advantages in general.

Chapter 4: Composite Fibre Wraps

This chapter enlists and explains the different types of fibres available for fibre wrapping technique. It also includes the detailed procedure for fibre wrapping.

Chapter 5: Rehabilitation and Retrofitting using FRPC

This Chapter explains the role and action of using FRPC in repairs of old

Initial References:

Expected Outcome:

Risk Assessment:

Ethical Assessment:

structures, structural damages due to earthquakes, different methods

of strengthening concrete structures. It also describes the wrapping of a column in detail. There is lab testing for the old Structural materials.

Chapter 6: Conclusion and Recommendations

Lastly, in this chapter conclusion on the basis of the findings from the literature review and Material tested in Lab is discussed and recommendations are discussed.

Mukherjee, A. and Joshi, M. V., 2000. Recent advances in repair and Rehabilitation of structures with non metallic fibres. The Indian Concrete Journal

Berver, E. W., Fowler, D. W., and King, J. J. 2. (2001). “ Corrosion in FRP-wrapped concrete members.” Structural Faults and Repair 2001.

Ashbee, A., 1989. Fundamental principles of fibre reinforced composites Lancaster : Technomic Pub

GIBSON, R. F. “ Principles of composite material mechanics.” McGraw Hill, International edition, Engineering mechanics series, 1994.

Nanni, Antonio (Ed.), “ Fibre-reinforced-plastic (FRP) reinforcement for concrete structures : properties and applications” Amsterdam : Elsevier, 1993

From the above discussion it can be observed that the fibre reinforced polymer composites (FRPC) are a very attractive proposition for repair and upgradation of damaged concrete structures. Due to their many advantages their use in structural rehabilitation and retrofitting is increasing by the day. The evidence of FRPC used in the past few years stands proof for its merits in reinforcing concrete as well as its benefits

Over conventional strengthening techniques.

Appendix A

Appendix B

APPENDIX A

Activity Risk Assessment

To be attached to the Project Proposal

Academic Team: Designed Environment

Activity MSc Project/Dissertation

Name: ……Dhaval K Shah…….. Date: 03. 11. 2010

Testing of Old materials and strengthening it with carbon fibre wraps.

Description of

activity

Significant

Hazards

Does the activity involve;

Manual Handling?

Use of hazardous substances?

Use of work equipment?

Use of electrical appliances?

Use of Display Screen Equipment?

If ‘ yes’ then refer to appropriate policy for further action. See Health and Safety Policy at http://www2. ntu. ac. uk/safety/University%20Safety %20Policy%20Feb%202005. pdf

Adverse effects

(likely injury)

Me and Laboratory Incharge.

Persons at risk

If those at risk include students, specify the supervision arrangements (refer to policy document on supervision of students)

Student activities outside of normal area activities should be individually assessed and recorded on the student project assessment forms.

Gloves, Safety Glass and Laboratory Shirt to be wear when handling with Cement.

Control

measures

in place

If the control measures include the use of personal protective equipment then refer to the policy document in the safety manual.

Yes

No

Y

Are the risks adequately controlled?

If ‘ No’ specify

further action

required prior to

activity taking

place.

Person completing assessment: ……Dhaval K

Shah……

Position: ……MSc

Student……

APPENDIX B

Ethical Assessment

To be attached to the Project Proposal

Student __Dhaval K Shah___

Original Project title ____ Retrofitting & strengthening RCC Structure using

Composite Fibre Wraps

Delete one of the following two statements

This project will not involve human participants

This project will involve human participants and I attach a Joint Inter College Ethical Clearance Checklist (see VLE)

Signed ..... Date .....