FRP and ITS Applications in Asian Countries

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Abstract- **In order to meet the need for advanced infrastructure, innovative technologies and new materials started taking its shape in the construction industry. Every technology has its limitations. With structures becoming old there is a requirement of a technique to enhance the health of the existing structure. Including India, japan and China various professionals throughout the world are using fiber reinforced plastic (FRP) for solving issues through effective and cost friendly manner. In the field of civil engineering, use of FRP is limited to certain aspects only but it could be widespread. For countries like India it will boost the infrastructural development by reducing cost and saving money because of durability. With highly moist regions in coastal plane, northeastern parts and Himalayan region have large scope of use of FRP.**

Key terms- **Fibre Reinforced Plastic (FRP), Seismic zones, Retrofitting**

I. INTRODUCTION

Present enlarging economy, Infrastructure development is also growing with its full speed. Numbers of RCC and stone and brick Masonry structures are built across the world [1]. Among these constructed buildings there is a large number of those requiring technical corrections either because of wrong construction practices or change in purpose of use. Repairing and retrofitting of these structures for making these sound and efficient has a great opportunity for business. Lack of strength, stiffness, ductility and durability are some issues where structures require rehabilitation [2]. Need of strengthening during lifespan of any construction work are:

- Seismic retrofit in accordance with code
- Alteration in loading
- Wrong designing methods

Several methods are used for strengthening and repair works according to the requirements in the structures depending upon types and extent of damage.

Among Asian countries, India and china are the two largest economies. Both started the use of composite materials around mid-1980's but it has taken shape in 6th decade of 20th century. As the infrastructure development is the vital player for any countries development, these 2 Asian countries have also focused on the improvement of their infrastructure. For this they were using steels during 1950 and 1960's. But steel supply was not that much adequate. But the concern of these countries was maintenance and up gradation of the existing structures. The search for a material that is both lightweight and maintenance-free ends with fiber-reinforced plastic (FRP) For the purpose of retrofitting, both these countries has adopted FRP. FRP is a substitute to steel and even when exposed to worse environmental conditions they don't corrode. Japan is another country at the same time developing its infrastructure. Japan has also used FRP like India and china and has its own codes for designing [3].

FRP was earlier used for only aerospace and defense industries. But with time, decline in cost of production and improvement in performance , FRP is now the most trusted material in all industries including automotive , marine, aeronautic, and electrical engineering apart from civil engineering. However even till last decade of 20th century FRP was confined to only strengthening process of the damaged structures or existing structures in India [4]. In last years of 20th

century, field application of FRP could be only find out in India. However comparing to India , china's progress is far ahead and FRP industries are in better position today's. In china, works and research is now focusing on building new structures like bridges, cooling towers, hand-rails, walkways, platforms, etc. etc. in present time china has many new structures of FRP and they are being used in daily life. Use of FRP is now widespread and undoubtly has become the material of choice for civil professionals specially in applications where low weight and weather ability are important considerations [5].

II. FRP COMPOSITE

FRP is a composite material manufactured by using glass and polyester, having equal mechanical strength as steel but weight being half that of steel. Not only this, its density is also one-fourth of steel, but as mechanical properties are better, results in a superior strength-to-weight ratio. It can be any of thermoset or thermoplastic [6]. it consists of a reinforcement with a satisfactory length to thickness ratio. It has its best properties in direction of fiber placement unlike steel which has uniform properties in all direction. It consists of:

Epoxy : transferring stress between the reinforcing fibers is the main function of resins. It also act as a glue to hold the fibers together. Polyesters are one of most commonly used epoxy.

Reinforcement: it carries load and hence gives strength and stiffness

Fillers: it helps in filling of space in FRP to reduce the cost of expensive resin and giving smoothness and crack resistance.

Additives: it provides durability.

FRP are similar to that of RC.

FRP produced for structural engineering point of view consists of S more ingredients than just the ordinary traditional constituents: fiber and polymer resins.

III. PROS & CONS

FRP undergoes many merits and have superiority over the traditional materials like steel in terms of its strength, lifespan and ease of use. but it has some limitations too.

PROS

- Resistance against corrosion
- Young's modulus.
- Ease in transportation and installation
- Light weight yielding high strength to weight ratio.
- High resistance against fatigue
- Flexibility in length

CONS

- Low ductility value resulting in fickly plastic behavior
- High cost of material
- Less shear strength
- Lack of universal design code

IV. FRP IN ASIA

Among Asian countries, Japan has the greatest number of field applications of FRP. It also leads with the highest percentage of FRP reinforcement in concrete use. FRP sheet is the most common tool for upgradation retrofitting, seismic retrofitting as well as durability retrofitting. Strand grid, braid and rod configuration of FRP are present in Japan. In 1987 first practical applications of FRP was practiced. After that approx 200 practical application was made with use of FRP estimating to about 1million meter of FRP. Structures were mainly built across coastal and water channel structures because of demand of highly durable materials. There exists 2 code for designing of FRP structures in Japan

"Recommendation for design and construction of concrete structures using continuous fiber reinforcing materials (Research Committee on Continuous Fiber Reinforcing Materials 1997)"

"Recommendations for upgrading of concrete structures with use of continuous fiber sheets (Research Committee on Upgrading of Concrete Structures with Use of Continuous Fiber Sheet 2001)"

After Japan another Asian giant china has started research on FRP in 1958. This has helped china and they have their first FRP bridge around 1970. Till 1980 application of FRP in water tanks of buildings were common. Around mid-1990's systemic and planned study of FRP starts in 2003, "Technical specification for strengthening concrete structure with carbon fiber reinforced polymer laminate CECS-146" (CECS-146 2003), was published. CECS-146 contains the various technical specification for FRP and is used widely in china. Apart from this a national standard code "Standard

for FRP in Civil Engineering", is also getting prepared through various research institutes in china. China has consumption level of 2,00,000 MT of FRP.

India's FRP used is 30000 MT and this data is enough to show the lack of interest in this part of continent towards composite materials. composite materials are still a far away thing for Indian construction industry. Even though India has a large scope for FRP because of long coastal line, monsoonal season, Himalayan range the notable use of FRP can be noticed only after Gujarat earth quake in 2001. India still lacks with huge margin in FRP use compared to its 2 Asian neighbors. Many research works has started in India but still no specific design code is yet developed. Special and focused training is required for development of FRP market. North east, leh, laddakh, long coastal areas are the desired and suitable places for FRP applications.

V. CONCLUSION

EVEN THOUGH FRP use has upward graph in all the country but countries like India must learn to develop a market like china and Japan.. the confusion in use of FRP is merely because of lack of proper knowledge and proper systematic research.. India needs to have develop its own design codes and adopt FRP for its market. Being a developing country its important to use the capital wisely and development of FRP will be economical as it will not only increase the strength and durability of new structures but also can upgrade existing structures which will save time , effort and most important money of the country.

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