

ii. Total cost of the project with Details of Budget (Recurring and Non recurring):

S. No.	Name of the equipments/materials	Amount (Rs)
1.	Controlled permeability formwork (CPF) liner	20,000
2.	Accelerated corrosion test apparatus	60,000
3.	Half-cell potential measurement tester	15,000
4.	Plywood and other materials	5,000
5.	Chemicals	10,000
Total amount (Rs)		1,10,000.00

iii. An abstract, describing the background, objectives, methodology of the proposed project:

ABSTRACT

'Green Concept' has become the order of the day. Rapid urbanisation has compromised with environmental protection. Countries, like India where the state of population explosion coupled with urbanisation and globalisation of economy policies have resulted in serious damages to environment. Today we are under tremendous pressure to device ways and means of curtailing the environmental damages. In construction industry the steel (rebar) corrosion is a major concern. The coastal region, like Puducherry the intensity of problem due to rebar corrosion is very acute. Improvement of durability of concrete cover zone to extend service-life for reinforced concrete structures is a very important issue. Control of corrosion will lead to significant costs reduction in the overall maintenance and improving the living conditions inside the buildings. Controlled Permeability Formwork (CPF) is one of the few technique developed recently for improving the concrete surface zone. This technique reduces the near surface water/binder ratio and reduces the sensitivity of the concrete to poor site curing, can improve the durability of concrete structures by enhancing the quality of concrete surface zone the overall performance of RCC structures.

BACKGROUND OF THE PROPOSED PROJECT

The construction industry is the biggest industry in India, of course next to agriculture. Further, next to water concrete is the most consumed commodity by the human being. Therefore, every step towards improving the quality of concrete will make it greener and greener. 'Durable Concrete' is synonymous with 'Green Concrete', because every ton of cement being produced result in equal amount of CO₂ let out to the atmosphere. Similarly, steel production leads to enormous amount of CO₂ emission.

Therefore, the modern civil engineers have greater responsibility than the yesteryear civil engineers. Apart from strength and performance requirement one has to select the materials and develop construction techniques such that the reinforced concrete becomes highly durable and hence the structure stands longer and longer.

Steel in concrete is usually in a non-corroding, passive state. Generally, the pH of concrete is about 12 to 13, which will ensure complete protection of steel. However, steel-reinforced concrete is often used in severe environments where sea water or de-icing salts are present lead to the damage of the passive layer and hence corrosion of reinforcement is bound to occur.

Corrosion results in the formation of rust, which has more than six times the volume of the original steel. This causes hoop stress around the rebars leading to breakage of the concrete cover. Further, when reinforcement corrodes, the formation of rust leads to a loss of bond between the steel and the concrete and subsequent cracks, spalling and delamination of cover concrete. If left unchecked, reduction in the cross sectional area of steel reduces the structural capacity and the integrity of the structure.

The first defense against corrosion of steel in concrete is quality and adequate concrete cover to the reinforcing bars. Quality concrete has water-cement ratio (w/c) that is low enough to slow down the penetration of aggressive agencies responsible for rebar corrosion. The water-cement ratio is an important factor in governing the durability of concrete and should always be the lowest value possible. Unfortunately, on the interface between concrete and the formwork the water-cement is bound to be on the higher side leading to less durable skin. However, the interior concrete will be in a better state of strength and durability.

The surface quality of the concrete is very important, because it would decide the durability performance of concrete structures. Durability distress in the external surfaces of structures is related to the corrosion of reinforcement. The controlling parameters for this distress are the quality of the cover concrete and the depth of cover.

There are a number of techniques and methodologies have been developed to fight against rebar corrosion like metallurgical method, corrosion inhibitors, coating to reinforcement, cathodic protection and epoxy/zinc coating to re-bars and coating to concrete surface. All the techniques are passive in nature. The passive technique has a number of limitations.

All concretes cast against wood or steel in the concrete cover zone, have a reduced cement content and increased water/cement ratio (i.e. less dense and more porous) compared to concrete

located beyond the reinforcement. Within the core of any structural element the matrix is generally denser and of better quality compared to the surface as a direct result of the concrete compaction. This compaction process drives excess mix air and water within the cover zone towards the formed surfaces.

In the proposed study, it has been decided to use a special type liner to be fixed on the interior face of formworks. This liner has the capacity to drain the excess water and the air from the interface of concrete. This will eventually lead to reduced water-cement ratio, higher cement content due to which both strength and durability of the concrete skin will be enhanced. This type of special formwork is named as Controlled Permeability Formwork (CPF).

OBJECTIVES

- To study and compare the strength characteristics of conventional concrete and concrete made using CPF liner.
- To study and compare the durability characteristics and surface quality of conventional concrete and concrete made using CPF liner.
- To study and compare the rebar corrosion behaviour of conventional concrete and concrete made using CPF liner.

METHODOLOGY

- Strength characteristics of concrete will be conducted with suitable arrangement of CPF liner in the concrete cube moulds. Strength variation will be studied for a period of at least six months.
- Durability characteristics, such as resistance of concrete against aggressive chemicals will be studied for a prolonged duration. In addition, the surface characteristics, such as water absorption, abrasion resistance, and surface hardness of concretes will be studied.
- Accelerated rebar corrosion test on various concrete specimens will be studied.

ix. Details of the project proposal including the state-of-art of the subject, the work already done in this area in India/abroad and defining clearly the objectives and methodology and year phasing of the project:

This CPF liner is very recently introduced in a few countries, like USA, UK etc. The characteristics of concrete made using this liner has not yet been reported in a comprehensive manner. The manufacturers make some claim on the advantages of using the liner. No

comprehensive study or research has been reported on this area till date, excepting a few reports on the advantages of CPF liner developed for commercial purposes.

In India it is no where tried or marketed even. It is totally a new concept to Indian consumers and Indian construction industry. Therefore any advancement made on this area will enhance the our knowledge on concrete durability.

Social relevance and usefulness of the project:

Repair of reinforced cement concrete (RCC) structures is multi-million dollar business worldwide. The need to improve concrete quality and durability is an economic and environmental necessity. Among various distress in RCC, corrosion of rebars is the major concern. It is reported by the Financial Express in 2004 that the expenses incurred by the Indian government to fight the steel corrosion is Rs. 36,000 crore business.

Regions like Puducherry the steel corrosion is common major problem. Every step towards improving the steel corrosion control is great contribution to the society at large.

The use of CPF liner is going to escalate the construction cost slightly. But by far the most advantageous benefit is the enhanced durability and increased service life of the structure which leads to reduced life cycle cost and above all distress free RCC structure will preserve peace of mind of the end user.

Brief Bio-data

Principal Investigator:

Name:

S. KOTHANDARAMAN

Present Position:

Professor
Department of Civil Engineering
Pondicherry Engg. College
Puducherry – 605 014

Details of Education:

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| • B. E. | <i>Madras University</i> | I Class | 1981 |
| | Civil Engg. | | |
| • M. E. | <i>Bharathiar University</i> | I Class | 1986 |
| | Structural Engg. | | |
| • Ph. D. | <i>Pondicherry University</i> | --- | 1999 |