UNIVERSITY OF PUNE

Syllabus for "Ferrocement in Architecture" (Elective for B.Arch.)

Teaching Scheme Theory: 4 Hrs / week: Exam Scheme: Paper 100 marks

Section I

Unit 1: What is ferrocement?

a) Definition. Basic concept like behavior similar to steel or timber section, bond increase due to small diameters. Homogeneous and Ductile materials, Comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement. Special types of ferrocement. Ferrocement as substitute for conventional building materials. Typical characteristics and their applications. Reduced cross sectional size of members due to inherent properties. Potential of ferrocement for architectural solutions. Limitations – cost, skilled labour, Strict supervision structural stability

b) Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants.

c) History of ferrocement and its use by various architects and engineers such as Renzo Piano, Pier Luigi Nervi, V D Joshi, B V Doshi etc.

Unit 2: Mechanical properties and construction methods:

a) Mechanical properties and typical features affecting design. Properties under static and dynamic loading. Shrinkage and creep. Testing of ferrocement.

b) Methods of designing and constructing ferrocement structures. Standardizing method of construction. Planning the work. Fabricating skeleton, tying meshes and mortaring. Curing. Maintenance. Protective surface treatments. Damages and repairs to ferrocement structures.

Unit 3: Strength through shape and design:

a) Strength through shape. Design of structure based on form and shape. Structural concepts of different forms, Geometry of shapes Forms in nature. Various structural forms and their behavior. Typical strengths of different materials. Comparative study of various forms.

b) Design of ferrocement structures. Design, analysis and optimization. Special design considerations for ferrocement. Typical features of ferrocement affecting design. Conventional design methods like working stress, load factor, applied to ferrocement. Design based on equivalent area method for compression, tension and flexural members. Specific surface method and crack control method, Design of structures subjected to membrane stresses. Design of shaped structures in ferrocement like stiffened plates, arch faced walls, stiffened cavity walls and hollow floors and beams. Design of forms like 'T', 'U' 'T' '+' 'L'.

Section II

Unit 4: Cost analysis and ferrocement in Building construction.

a) Cost analysis: Factors governing cost analysis. Special considerations for ferrocement structures. Modes of measurement. Cost comparison with conventional construction. Specifications for ferrocement structures. Drafting site inspection and Supervision. Quantity analysis of material and labour for ferrocement items. Cost and value of ferrocement construction.

b) Ferrocement in building construction. Ferrocement in foundations, walls, floors roofs. Ferrocement single wall construction. Design and construction of houses with cavity walls, hollow floors and hollow beams. Staircases and other building accessories. Earthquake resisting structures. Special characteristics of ferrocement to resist shock loading. Design and construction of quake proof structures.

Unit 5: Hydraulic and soil retaining structures in ferrocement:

a) Hydraulic structures. Why ferrocement? Water retaining structures. Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating.

b) Soil retaining structures. Why ferrocement? – Cost reduction, simple and quick construction, simple design. Types of retaining walls and their comparison with ferrocement arch faced wall. Design and method of fabrication and casting. Ferrocement counterfort retaining wall. Ferrocement containers for storing granular materials.

c) Decorative uses, - Interior , Landscaping. Use in retrofitting Rehabilitation, Building repairs, Water-proofing.

Unit 6: Space structures and precast products:

a) Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries. Their Geometry, concepts of structural stability like slenderness, buckling, deflections, anchorages.

b) Precast ferrocement products: Why ferrocement for precasting? Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements. Modular Planning with precast elements. Mass-scale housing, Engineered housing.

Termwork: Journal reporting practicals based on testing of properties of raw materials and ferrocement in laboratory and field. Demo of Ferrocement construction. Architectural Design of a simple structure using ferrocement. Report of at least two site visits.

Books and sites recommended:

1) State-of-the-art report and guide for Design, Construction and Repairs of Ferrocement; ACI committee Report. No ACI549R- 88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA

2) Ferrocement; Authors: B R Paul and R P Pama. Published by International Ferrocement Information Centre. A.I.T.Bangkok, Thailand.

3)Ferrocement and laminated cementitious composites; Author: A E Naaman. Publisher: Techno-press, Ann Arbor, Michigan, U S A.

4)Ferrocement- Materials and applications; Publication SP 61, A C I Detroit. U S A

5) Ferrocrete Technology- A Construction Manual. Author: Dr B N Divekar. Published by the Author.

6) Chapter 1 titled 'Ferrocement' by S P Shah and P N Balaguru. in book 'Concrete Technology and Design Vol II; Editor; R N Swamy.

7) Proceedings of International Symposiums on 'Ferrocement and thin reinforced composites.- Ferro 1 to Ferro 11'. Available with International Ferrocement Information Centre, A I T Bangkok, Thailand

8) Application Manual of Cost Effective and Innovative Building Techniques; Anjali Kalamdani & Kiran Kalamdani; KIMAYA; PUNE; 13 5 2010

9) Fantastic Ferrocement: Fantastic Ferrocement: for Practical, Permanent Elven Architecture, Follies,Fairy Gardens and other Virtuous Ventures Paperback; Mr Peter James Harris (Author) Paperback: 102 pages; Publisher: CreateSpace Independent Publishing Platform (September 28, 2012); Language: English; ISBN-10: 1479340146; ISBN-13: 978-1479340149

10) http://www.alternativebuilder.com/ferrocement.html

11) Nervi, Pier Luigi – Ferrocement, Its characteristics and potentials. Library Translation no. 60. Cement and concrete Association London, July 1956. 17pp

12) FS Code- for walls. Published by Ferrocement Society, India

13) Proceedings of FS 2011, FS 2013, FS 2015 by Published by Ferrocement Society, India