FERROCEMENT TECHNOLOGY

Applications

Various Applications of Ferrocement Explained in the booklet

TECHNOLOGICAL CONSULTANCY
OFFERED BY
FERROCEMENT SOCIETY (INDIA)

WHAT IS FERROCEMENT?

Ferro cement is a highly versatile form of mesh reinforced cement mortar that possesses unique quality of strength and serviceability. The major advantages of ferrocement construction are: the structures are thin and light, they can be easily precast and they are amenable to repairs in case of local damage. Ferrocrete is a super-strong building material that is composed of concrete and steel-like materials bonded together at the molecular level. Nearly every structure on most Imperial and New Republic worlds is built of this durable substance, and is the Star Wars equivalent of reinforced concrete.

Ferroconcrete, or ferrocrete, was a composite building material made from the combination of concrete and iron that was molecularly bonded to produce a substance with exceptional resistance to wear and tear. The material was used primarily in the construction of roads and walkways, but also for reinforced bunkers and building foundations.

In the real world, the Latin word for "iron" was ferrum, leading to the chemical symbol for iron being "Fe" and ironsmiths being known as "ferriers."

Some of the properties of ferrocrete are-

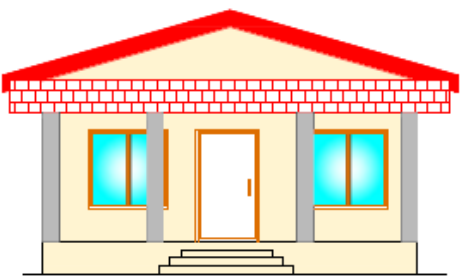
1. Consumption of cement generally 500 to 750 kg per M^3

2. Reinforcement

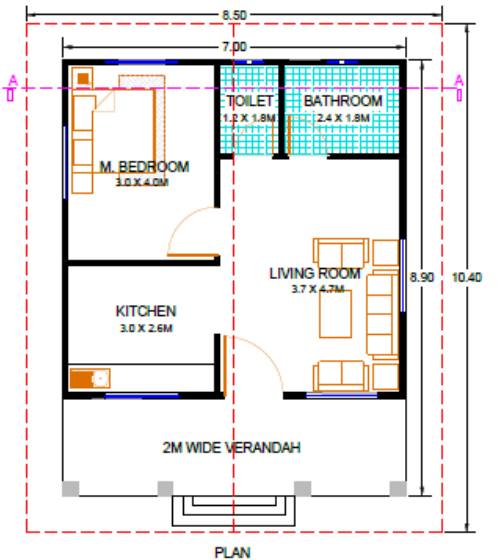
a) Wiremesh - woven : hexagonal, welded dia 0.5mm to 2.5mm, spacing 6mm to 75mm Consumption 350 - 500 kg per M^3.

b) Fibers - metallic, non-metallic - manmade & natural dia. 35g or 0.3 x 0.4 mm. Consumption 1 - 3%.

3. Cover to reinforcement - 2.5 mm to 5 mm - Cover to fibers - nil.
4. Fine aggregate - particle size 400 micron to 3mm.
5. No coarse aggregate.
6. Generally no shuttering.
7. Admixtures are mostly used for workability, high strength, antishrinkage, and waterproofing and pollution resistance.
8. Minimum dimension 10mm and maximum 60mm or so.
9. Homogenous isotopic material at the initial stage.
10. Fire resistant up to 750°C for a period of 48 hours or even more.
11. Dead weight of Ferrocement frame structure is 175 kg to 275 kg per M^3.
12. Uncracked section material generally. Generally not affected by carbonation, chloride penetration, etc. Autogenously healing should take place.



1) Banglow type ferrocement farm house: We give you plan and estimates for 1 BHK or 2 BHK small banglow farm house. This can be built with ferrocement walls and roofs. You can build your own house with our design and supervision. Or we suggest you constructors who are trained in ferrocement technology.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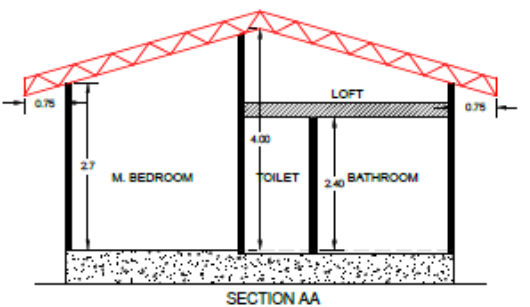
BATHROOM
2.4 X 1.8M
M. BEDROOM
3.0 X 4.0M
LIVING ROOM
3.7 X 4.7M
8.90
10.40
KITCHEN
3.0 X 2.6M
2M WIDE VERANDAH
PLAN

Sample plan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SECTION AA

2) Water Tanks and septic tanks: Ferrocement is most suitable for making durable and economic water tanks above your terraces or underground. Cylindrical shape is more popular. Ferrocement Society has already given consultancy for water tanks up to 13 lakh litres. The water tank can be covered with dome or conical cover slab. BIS code is available for water tanks up to 10000 lit.

3) Roofing channels: Ferrocement roofing channels can be precast and used for roofing. They are made with some overlap so that the joints are made water tight.

4) Precast ferrocement toilets: Precast ferrocement components are made in factories and assembled to make the toilet in remote areas or farms. Nut bolt system is adopted. Consultancy establishing such factory for design and precast components is offered by Ferrocement Society.

5) **Precast Building Components:** Buildings normally require chajjas above the doors and windows. Ferrocement precast manholes and manhole covers, chajjas can be used so as to make the construction fast. As such cast in situ lintels and formwork and time to set the concrete can be reduced. Kitchen Platforms with all components are also available. The partition walls in a house can be constructed with ferrocement to maximize the carpet area.

6) **Renovation of flats to increase carpet area**: Old constructed buildings had wall thickness from 300 to 450 mm. We take consultancy to make your flats bigger by reducing the wall thickness. We have converted 1 BHK flat to 2 BHK. Cupboards and shelves can be constructed using ferrocement walling. FS code for walling is already available. Light weight upper floors on old buildings are possible with ferrocement only. Terrace can be covered by this method to make it a room.

7) Attractive elevations: Many builders require attractive elevation of their buildings. We can construct any curved and difficult shapes using ferrocement. In Mumbai many builders design domes on the 18th floor to cover the water tanks. In court buildings PWD always requires different size domes. In Mosques, churches, temples architects need curved structures. We offer consultancy for such architects. Pergolas, slim vertical strips can also be constructed using ferrocement.

8) Entrance Gates of the township: Now a days, very elegant gates are designed for a township or even for gram panchayats. We can design and construct any curved of difficult shaped gates and portals. The security cabins can also be constructed with this portal. Monumental portals, symbols are also possible to construct using ferrocement technology.


9) Garden and landscaping: Ferrocement curved components can be used by the landscape designers. The curves can accurately be constructed to give a better look.

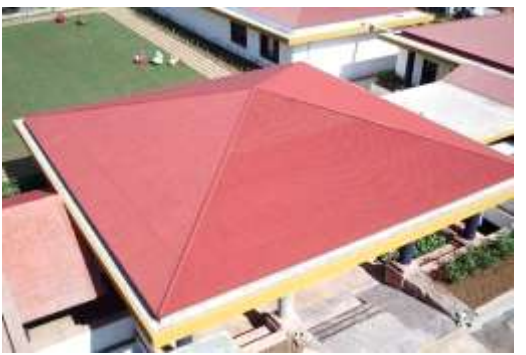
10) Retaining walls: Ferrocement retaining walls can be built with 50 mm thickness. The curve shaped walls give a better look. Builders can save 40% cost compared to RCC retaining walls.

11) Compound walls: Ferrocement compound walls can be constructed very speedily. They can be designed to suit the architecture of the surrounding and the existing building use.

12) Organic shaped sculptures: Caves or any organic shaped structure is possible in ferrocement. Hussain Caves in Ahmedabad(Gujarath) is the example.

Hussain–Doshi Gufa, Ahmedabad. Client, M. F. Hussain, Architect , Balkrishna Doshi, Structural Consultant- late Vishnu Joshi

13) Geodesic domes: Pyramids: Ferrocement slim walls can be used to construct very stable geodesic or pyramidal houses. As the material used is less, we can achieve economy in construction.



14) Water carrying Channels and Lining to canals: Water is very precious now. In order to achieve efficiency in channelized flow and minimise the leakages in the canals ferrocement channels or lining to canals is the ideal solution. PCC lining to irrigation canals has a life of 5 years and still it is not leak proof. But ferrocement lining is leak-proof and lasts for 60 years. Precast channels can be used in command area development works to carry the required discharge to

the fields. Egg shaped drainage gutters and sewage lines can also be constructed using ferrocement.

15) Water conservation dams: Ferrocement Society has developed arch type small dams and they are popular as BALCHANDRA BANDHARAs. About 12 such dams are already constructed in Maharashtra and Gujarath state. These dams are very simple to construct in remote areas. They can be fabricated in towns and carried to remote places. Chain type bandharas can be built on a long stream to achieve rise in the ground water table. The adjoining wells are benefitted and water conservation is successful. A separate book on such bandharas will be available from Ferrocement Society.

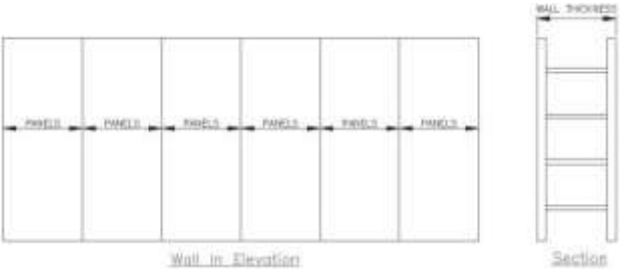
16) Rehabilitation of leaking dams: To stop leakages through the body of masonry dams, Ferrocement Waterproofing Course on the upstream face of the dam is useful. It is proposed to provide 40 mm thick ferrocement course on the dam face to provide a water tight

membrane which is anchored to the dam and becomes a part of the dam itself.

17) Rehabilitation of Old structures, C D Works: In British era they have built stone, brick masonary with arches and used lime mortar. Most of these structures have completed 100 years. Many bridges are now collapsing. Ferrocement can be used to strengthen such old aqueducts, bridges, culverts and many old buildings also. By jacketing with ferrocement layer load carrying capacity of the columns and walls can be increased. Government in PWD and WRD are aware of this technique.

18) Floating houses and resorts: Ferrocement floating platforms can be built to construct resorts or houses. Such platforms are also being used in big reservoirs for generating solar power. Such consultancy is being offered by Ferrocement Society.

19) Ferrocement Cavity walls and hollow floors: Constructions in ferrocement are made by filling under pressure thick and rich cement mortar in between tightly tied layers of fine wire meshes. "Stretched membrane techniques" are used for tying meshes and "Pressfill" method is used for casting mortar. Thin walled structures with wall thickness up to 50 mm are thus formed.



These walling units with double walling, jointed together by shear connector or by using stiffners like in built columns and grid beams are used to build houses or industrial structures. The various methods of construction of ferrocement cavity walls and floors are as follows:

a) Cast-in-situ double walling connected with shear connector in form of steel bars or in form of columns and beams.
b) Cast-in-situ thermally insulated walls and floors. **All-in-One method of Construction**.
c) Erecting and jointing at site, precast ferrocement walling and floor panels.

20) Replacement to formwork for RCC: Ferrocement thin walled elements are useful as substitute for timber formwork and centering plates for RCC framework. These ferrocement forms become a part of the member and add to its strength.

21) Precast wall panels: Future trends in ferrocement construction are as below. Consultancy service is available from Society.

a) **Full size panels**: Full wall size and full floor size ferrocement panels will be precast in factory and the site work will be to erect them and concrete the joints only.

Ferrocement paneled cavity walls with in-built columns and box sectioned hollow floors with in-built grid beams will be precast of the full size of wall and floor. The weight of these walls will be 30 to 40% of similar RCC elements. A 3x4 m ferrocement wall panel will weigh only 1800 to 2000 Kg.

b) **Ferrocement multistoried ribbed single wall panels**: Ferrocement single wall panels, with ribs can be cast for a height of two or three stories. These panels will be erected and jointed with plane surfaces facing outer sides of the room. The projecting ribs on the inner side of the room will be covered with ferrocement planks to form cavity walls.

c) **Large size ferrocement cored slabs-** Ferrocement plates of large size will be precast with ribs in both the directions. Two such plates will be laid one above the other with the ribs abutting each other. The bottom ribbed plates will be designed to take tension while upper plate will be designed as compression member. Their combination will form a hollow slab with cores of square size aligned in both directions. Due to high tensile strength of ferrocement, no prestressing is needed for these core slabs.

22) Water proofing using ferrocement: As the layer of ferrocement 30mm thick has a characteristic of imperviousness, leaking RCC building slabs can be treated with Ferrocement layer. Many swimming pools are also made water tight using ferrocement. Actually in 1849 boats were built with ferrocement. Such consultancy is offered by Ferrocement Society.

23) Foot bridges: Ferrocement can be used to build bridges. Foot bridges to cross the roads, railways and canals can easily be constructed using precast method also.

24) Road panels: Precast ferrocement panels with ribs can be manufactured in factory and they can be used to construct roads. This is a very fast construction method, as such will be popular for heavy traffic roads.

25) Enclosing the drainage nallas in city area: In metro cities open drainage nallas are the problems. Big diameter pipes are not available to enclose it. So Ferrocement Society has developed a method to cast very big size pipes and enclose the drainage gutter or nalla. Such big work is already done near Himali Society in Pune.

26) Bio gas Plants: Ferrocement bio gas plants are Eco friendly, Viable, Easy to erect, convenient technology, Space and time saving. So they become more popular.

27) Underground Ferrocement houses: Earth houses can be constructed easily by using ferrocement. The earth house is very cool, attractive and can be covered with lawns etc. Such house is already built near Pune.

Ferrocement Society (India) has done a lot of work in Design, Development and Construction of Large Size Structures in all fields of Civil Engineering. It has taken out Ferrocement from the Shackles of Laboratory investigations and developed its direct applications in fields for all types of structures.

The fields covered are-

1) Water and Soil retaining structures,
2) Buildings from foundations to roofs
3) Space structures like domes, pyramids, shells of all types- geometric or organic in shape.
4) Precast Spun pipes and cast-in-situ large size egg-shaped conduit of size 3600mm dia and 700m long
5) Large silos- capacity 750 cubic meters, Digesters- of capacity 420 cubic meters, settling tanks, effluent treatment plants for industries and communities
6) Arch faced dams- for spans of 30m and height water 2.0meters
7) Thermally insulated houses with inbuilt RCC frame-work embedded in Ferrocrete Cavity walls and Hollow floors – Built a Bungalow of 5000 sq ft plinth area
8) Earthquake resisting structures- Box like integrally cast structures with shear walls and stiffened diaphragms with wide-flange columns and beams embedded in cavity walls and hollow floors
9) Parabolic Linings to canals and rejuvenating of old culverts with internal ferrocrete lining.
10) Two storied Building on Black Cotton Soils on floating foundations
11) Retrofitting and rehabilitation of heritage structures

12) Precast walling and floor panels with joints as structural members like columns and beams

13) Precast ferrocrete forms as open boxes for columns, channel section for beams of spans 6 to 8 m, thin ribbed slabs as centering plates used as lost formwork for 30,000 sft of the fourth floor of a college building.

14) 30mm thick ferrocrete slab resting on ribs is provided for 5000 sft roof of a hospital building.

15) Petal tank 60ft dia and 18ft height with shell roof over it to store 1200 cubic meters of water.

16) Soil retaining walls of 6 to 10 m height and lengths varying from 100 to 200 meters

17) Innovative system of constructing structures, replacing conventional system of RCC framework with filler walls in it, is evolved in which saving of material, labour and time is more than 50%. One can earn carbon credits by using it. A number of buildings are built by using this system.

Additional "Feathers in Our Hat" are-

1) Subject of "Ferrocrete Technology" is introduced in University of Pune (India) at Graduate and Postgraduate level.

2) Number of ME and PhD students are working in projects of practical applications in field.

3) **Research work is undertaken on**

a) Ferrocrete to replace prestressed concrete with 3-D mesh reinforcement

b) Ferro-Geo-crete with Geopolymer Mortars as matrix to replace steel sections

c) Ferro-foam-crete with Foamed mortar a matrix to replace timber planks

d) Precast ferrocrete ribbed stiffened panels to build pavements overnight

e) Factory-on-wheels to manufacture precast products at the work site for mass-scale housing
f) Substitute for Portland Cement by use of Geopolymers.
g) Zero-friction high-strength pipes- plastic pipes out-coated with ferrocrete

4) Ferrocement Society has organized 5 National Conventions FS 2011, FS 2013, FS 2015, FS 2017 and FS 2019 in which about 160 papers from members all over India are presented and published in form of proceedings.

5) Work on Specifications for Ferrocrete is in progress-few of them are already published. BIS committee is formed for standardization of the ferrocement constructions.

6) Books on Ferrocrete Technology –

a) "A Green Revolution in Construction Industry- Ferrocrete Technology" by Dr B N Divekar-A book giving introduction of technology which can be easily understood by a common man - already published
b) "Ferrocrete technology –A Construction Manual" written by Dr B N Divekar - already published
c) Book on "Design of Ferrocrete Structures" by DR B N Divekar is published and available in Pune. In it, designs of Ferrocrete structures based on specific surface and volume fraction of meshes and split tensile strength of mortar are developed and used as the design parameters.
d) Writing of book on "Build with Ferrocrete" by Dr Divekar is in progress.

e) WRD Hand-book on "Ferrocrete Technology" is published by MERI, Government of Maharashtra under the guidance of Ferrocement Society.

f) Specifications of various ferrocrete items- drafting is in progress.

g) Do-it-yourself book to build a ferrocement home.

h) FS Code is published by Ferrocement Society.

i) Consultancy booklet for guidance of Architects and engineers.

j) All proceedings of National Conventions (Rs 1000 each)

7) Work-shops on Ferrocrete Technology with Demo – About 130 workshops are already organised in Engineering/Architecture Colleges and Government organizations. We undertake such workshops.

8) **Consultation is offered in Design and Construction of ferrocrete Structures.**

9) "India Ferrocement Information Center" is established with about 500 references and made available for research students.

10) Training programs for Entrepreneurs and Technicians are organized for corporate engineers and budding engineers. Design of ferrocement can be introduced by organizing such workshop in corporate companies.

11) Number of papers on ferrocrete technology are written and published by our members in national and international conferences.

Our Future Plans are:

1) To start a Research and Development Center, School of Ferrocement.

2) To bring all these developments made by Society on World Map of Ferrocement Technology

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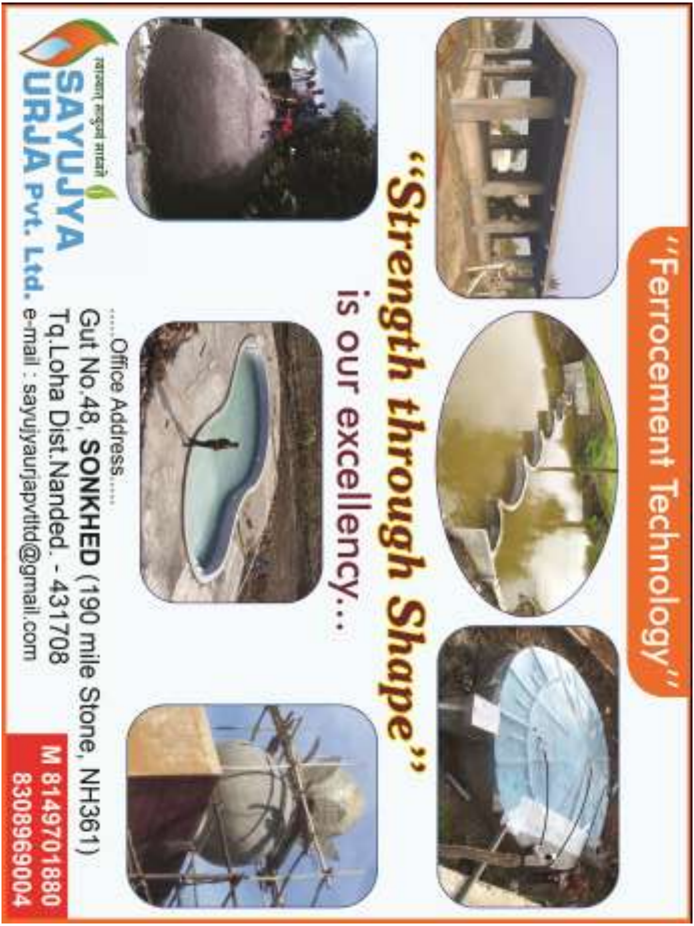
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"Strength through Shape"
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FERROCEMENT SOCIETY, INDIA

Formation of the Society in 2007 And registered under
Society Act 1860, Regd. No. Mah / 182 / 2008 / Pune, Dt. 29 Jan 2008
Trust Act 1950, Regd No. F- 23417 (Pune) dated 27 March 2008

INTERESTED IN MEMBERSHIP?

Outstation cheques shall not be accepted. Demand Draft may please be in favor of 'FERROCEMENT SOCIETY' payable at Pune. Online payment or payment in our account is possible by RTGS/NEFT/IMPS

Acc. Name- FERROCEMENT SOCIETY, Name of Bank- State bank of India, Erandwane Branch, Pune
Account Number- 00000036815801782,
IFSC code- SBIN0004618, MICR-411002010

Membership fees

Type of Membership		*for Members in*	
		India	*abroad*
a. Individual	Annual Member	INR 1000/-	US $ 60
b. Individual	**Life Member**		
	Age 18-35 (3 instalments 2000, 2000, 1000 can be paid)	INR 5000/-	US $ 500
	Age 35-58 (3 instalments 1500, 1500, 1500 can be paid)	INR 4500/-	US $ 450
	Age above 58	INR 3500/-	US $ 350
c. Corporate	Life Member	INR 50,000/-	US $ 5,000
d. Institutional	Life Member [IM]	25,000/-	US $ 2,500
e. Student	Student Member	INR 200/- (per year)	US $ 20 (per year)

Kerala Engineers and architects have constructed many ferrocement structures. Ferrocement Society had organized FS 2017 in Chenganaserry, Kerala in May 2017. Floating solar ferrocement panels, floating ferrocement resort is also available in Kerala.

FERROCEMENT SOCIETY

बांधकाम मार्गदर्शनासाठी अवश्य संपर्क करा

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या फेरोसिमेंट सोसायटीचे आपण सदस्य देखील होऊ शकता.

Donate Rs 10 for social cause

This booklet is printed and published for circulation to delegates and members, on behalf of the Ferrocement Society, by Shri P P Lele, Hon. Secretary, Ferrocement Society, Akashganga Society, Model colony, Pune 411 016. (16th January 2020)