MECHANICAL PROPERTIES OF POLYMER MODIFIED FERROCEMENT

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Abstract - In an effort to improve the performance of mortar, polymer is introduced into mortar. It has been reported that polymer-modified mortar (PMM) is more durable than conventional mortar due to higher strength. This research was carried out to establish the effects of polymer addition on compressive strength, flexural strength, modulus of elasticity of mortar and flexural strength and tensile strength values on polymer modified ferrocement samples with mortar of constant flow value. Two types of polymers were used i.e. SBR and VAE polymer. The mixes were prepared with polymer-cement ratio of 0%, 5%, 10%, 15% and 20% for each and a flow value of 110 +_ 5 is fixed for every mix of mortar.

The addition of polymer in the mortar results in reduction of w/c ratio for the mixes with constant flow value while mixes with same w/c ratio result in increase in flow value. The results indicated that the compressive strength of polymer modified mortar is lower than the unmodified mortar for constant w/c ratio after 7 and 28 days of wet curing days. The compressive strength of SBR polymer modified mortar increases but of VAE modified mortar decreases after 7 and 28 days at varied w/c ratio. The flexure strength increases for both mixes of the varied w/c ratio at the same flow value. The main aim of polymer addition is to increase the flexure or bending stress of conventional mortar. The modulus of elasticity of conventional mortar is higher than that of polymer modified mortar and the failure of conventional mortar was found more brittle and less deflection value as compared to the polymer modified mortar.

The flexure strength of ferrocement samples also increases on polymer addition for third point loading test. Polymer modification of cement paste increases its tensile and flexural strength and reduces its brittle nature. We will conclude by showing that future use of polymer modified cement composites will likely be in the area of durability and performance improvements of cement materials applied in thin sections.

Key Words: Polymer Modified Mortar, Flexural Strength, Tensile Strength, Modulus of Elasticity, Ferrocement

1.INTRODUCTION

Ferrocement is one of the relatively cementitious composite considered as a construction material. It is a type of thin walled reinforced concrete commonly consists of cement mortar reinforced with closely spaced layers of continuous and relatively small wire mesh (ACI 549R, 1997; ACI 549 2R, 2004). The closely-spaced and uniformly-distributed reinforcement in ferrocement, transforms the brittle material into a superior ductile composite. Thus, ferrocement has been regarded as highly versatile construction material possessing unique properties of strength and serviceability. Its advantageous properties such as strength, toughness, water tightness, lightness, durability, fire resistance, and environmental stability cannot be matched by any other thin construction material (Naaman, 1999).

In order to cope with the problem of thickness, one of the options currently suggested is to develop ferrocement elements. This technique provides not only the thickness but makes the element lightweight as well. Presently, it has gained attention to be used as an effective structural form in the building and construction industries.

Ferrocement construction form has distinct advantages over conventional structural sections, because it promises high stiffness and high strength to weight ratios. The introduction of materials such as ferrocement, for the materials like polymer modified mortars presents new possibilities in the design of construction.

Polymer-modified mortars (PMMs), using recently developed high grade redispersible polymer powders and aqueous polymer dispersions, have become popular construction materials in the world. This is because of their excellent performance and durability. PMMs are also considered to be able to become highly sustainable construction materials.

2. OBJECTIVE OF THE STUDY

I. To determine the workability of the fresh polymer modified mortar with different polymer cement ratio.

II. To determine the effect of polymer addition on water cement ratio while maintaining the same workability.

III. To obtain the compressive strength of ordinary mortar with polymer modified mortar with constant and varied water cement ratio.

IV. To obtain the flexure strength and modulus of elasticity of ordinary and polymer modified mortar with the varied water cement ratio.

V. To obtain the flexure strength, tensile strength and corresponding deflection or elongation of the polymer modified ferrocement beams.

3. LITERATURE REVIEW

FERROCEMENT: A COMPOSITE AND A MEMBER OF THE STRUCTURAL CONCRETE FAMILY

Cement-based composites are generally viewed as two-component materials: the cement-based matrix and the reinforcement. In fact, the matrix alone (which generally comprises cement, sand, water, and other additives) may be considered a composite by itself; while steel reinforcement is not a composite material. A composite is a material made of at least two different components, resulting in a synergism where the composite property of interest for a particular application is better than either of components taken separately. (Naaman, 2000).

Although ferrocement was the first type of reinforced concrete, today it is considered a member of the general family of structural concrete materials, or, using different terminology, of cement-based composites. The family includes conventional reinforced concrete, prestressed concrete, partially prestressed concrete, fiber reinforced concrete, and several of their combinations. The flow chart shown in Figure attempts to place ferrocement in this family and shows that each member can stand alone or in combination with other members. Applications where a combination of materials or concepts is used include, for instance, where ferrocement is applied as a jacket to confine reinforced concrete columns, or where discontinuous fibers are added to ferrocement to provide a hybrid composite with improved properties.

4. RESEARCH METHODOLOGY

In the previous chapter Literature review and gap had been discussed. On the basis of literature survey and objectives a suitable method is required for Precast Concrete System in this study. There are several statistical techniques available in research methodology, from them, Method Productivity Data Model (MPDM) and Construction Production Data Model(CPDM) has been used in this theoretical evolution for Precast Concrete Systems in which data may be collected and analyzed by statistical methods resulting in valid or, required intentions.

5. FINDINGS OF THE STUDY

The flexure strength of polymer modified ferrocement samples increases up to 15 %. This is due to the dry films made from VAE and SBR latexes increases sharply due to the bound acetate styrene content, and there is a positive correlation between the strength of the films and the flexural strength of SBR-modified mortars with polymer-cement ratios.

After 15 % the flexure strength of ferrocement samples decreases up to 20%. Both VAE and SBR Up to 15 % act to strengthen the mortar microstructure but a further increase in the polymer content ratio leads to discontinuities in the microstructure which reduces the flexure strength further. The deflection in the P.M.F beams increases with increase in load at the member. The result shows that the increase of polymer cement ratio up to 15 % increases the capacity of the member to take more loads.

The flexure and tensile strength of mortar increases due to both cement hydration and polymer phase formation (coalescence of polymer particles and the polymerization of monomers) proceed well to yield a monolithic matrix phase with a network structure in which the hydrated cement phase and polymer phase interpenetrate. In the polymer-modified mortar and concrete structures, aggregates are bound by such a co-matrix phase, resulting in the superior properties of polymer-modified mortar and concrete compared to conventional.

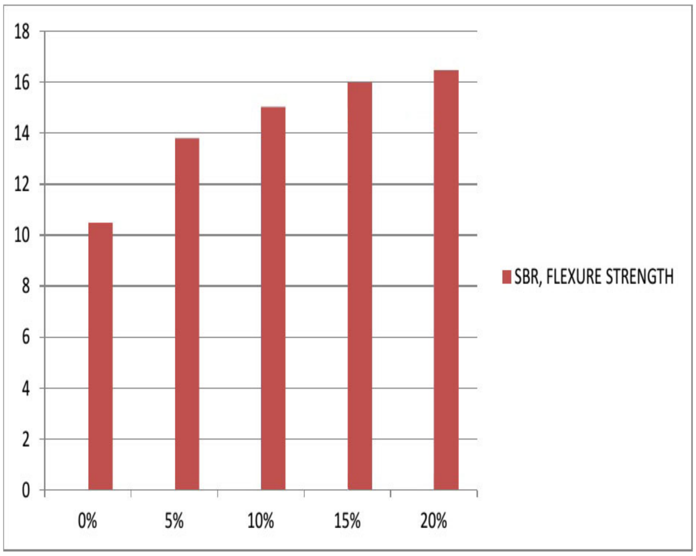

Figure 1-Flexure Strength Vs % Polymer for three layer mesh sample

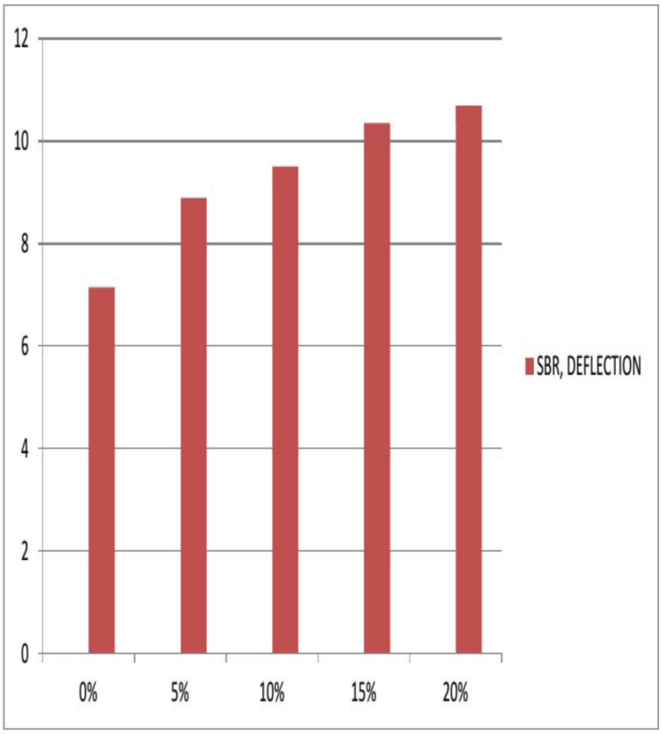

Figure 2- Deflection Vs % Polymer for three layered mesh Sample

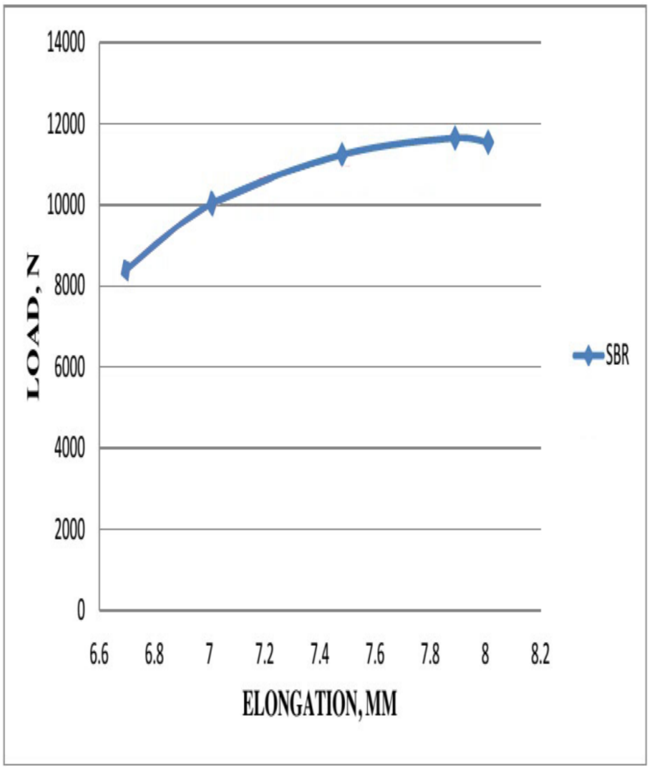

Figure 3- Load Vs Elongation for 3 layered polymer modified ferrocement beams

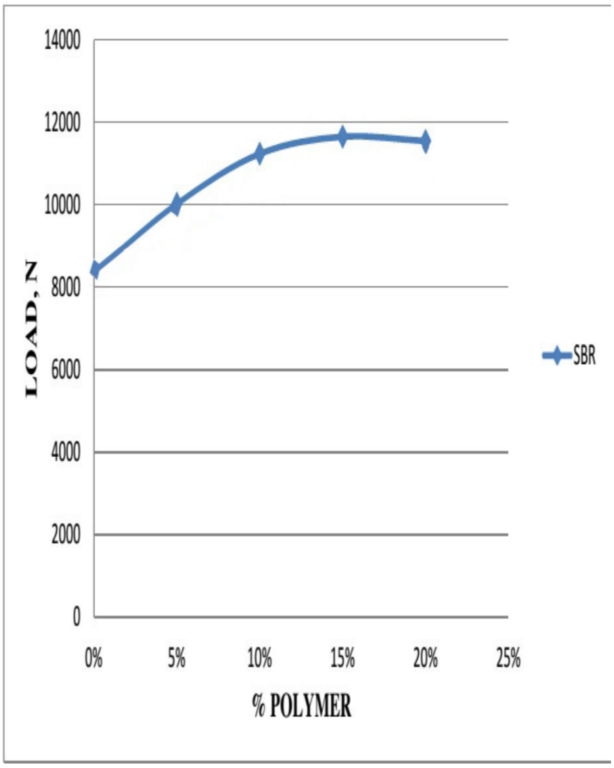

Figure 4- Load Vs Percentage Polymer for 3 layered polymer modified ferrocement beams.

6. CONCLUSIONS

The addition of VAE and SBR polymer in mortar increases the workability. At constant water cement ratio the workability can be increased up to 1.84 times at 15 to 20 % SBR addition.

The compressive strength of polymer modified cement decreases at constant water cement ratio. But at varied water cement ratio the compressive strength of polymer modified cement increases up to 10 % and then starts decreasing after 7 days.

At varied water cement ratio the compressive strength of VAE modified mortars decreases but the compressive strength of SBR modified mortars increases both after 7 and 28 days..

The flexure strength of both VAE and SBR modified mortars increases but after 15 % the flexure strength of VAE modified mortars starts decreasing.

Modulus of elasticity of SBR modified mortars increases with increasing in polymer content up to 10 % and then starts decreasing but modulus of elasticity of VAE modified mortars decreases with increase in polymer content in mortar.

The tensile strength of both VAE and SBR modified ferrocement samples increases with increase in polymer content. The elongation and load of three layered polymer modified ferrocement found more than the two layered.

SBR modified ferrocement beams take more load than VAE for both flexure and tensile strength.

7. REFRENCES

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