SYNOPSIS

Title: Strength of Hollow block masonry walls.

Introduction:

Masonry has been used as a basic construction material for public and residential buildings in the past several thousand years; from the tower of Babylon ,to the great wall of china, which is the only man made structure visible from the moon. A number of well preserved old masonry building still exist, proving that masonry can successfully resist loads and environmental impacts, therefore providing shelter for people and their goods for a long period of time, if adequately conceived and constructed.

Although some specific features have been invented during the course of time to improve the seismic behavior of masonry buildings , such as connecting stones, strengthening of the corners and wall intersection zones, as well as tying of the walls even today, masonry construction represents the most vulnerable part of existing building. This is not only in the case of developing or underdeveloped countries but it is also in the case of some of the developed countries of Europe and the USA.

Importance of the subject:

By means of experimental research , new data on the strength and stiffness degradation and deterioration ;ductility and energy dissipation capacity of different types of masonry can be obtained. The results of this investigation will make possible the improvement in masonry construction and result in the development of analytical models and mathematical tools for earthquake resistance verification and design of masonry for seismic loads.

Indian construction industry is one of the largest in terms of economic expenditure, volume of raw materials / natural resources consumed , volume of materials and products manufactured ;employment generated , environmental impacts etc. So with the usage of hollow blocks the **energy consumption** is low as compared to concrete and reinforced concrete (RC) structures which makes the hollow block masonry a very **cost effective** construction. Steel , cement ,glass, aluminium ,plastic and bricks etc are energy intensive materials ,commonly used for building construction and at times these materials are transported over great distances. So

extensive use of these materials can drain the energy resources and adversely effect the environment. As a result of which there is a need for adopting only energy efficient traditional materials like Clay for construction.

Hollow blocks have an excellent **thermal** property. The cavities in the blocks provide better **thermal protection** . These hollow blocks also do not need any external and internal **plastering** if proper construction methodology is adopted in manufacturing the blocks. The performance of these blocks increases with the increase in the number of hollow cores, which may or may not be filled in with some insulating materials .

Because of its less weight , the **dead load** of the structure is reduced and it is possible to increase the number of storeys of the building. With the use of hollow blocks (especially Clay hollow blocks) the **aesthetic** value of the building can also be increased and also they provide and acceptable degree of sound **insulation**.

Literature Survey:

*** Finite element analysis of interlocking mortarless hollow block masonry prism.**

Computers & Structures, Volume 86, Issue 6, **March 2008**, Pages 520-528 Waleed A.M. Thanoon, Ahmed H. Alwathaf, Jamaloddin Noorzaei, Mohd. Saleh Jaafar, Mohd. Razali Abdulkadir.

Interlocking mortarless masonry system has been developed as an alternative system for the conventional bonded masonry. This paper covers the analysis of interlocking mortarless hollow concrete block system subjected to axial compression loads using FEM. An incremental-iterative finite element code is written to analyze the masonry system till failure. The stress–strain relation obtained from test is employed and equivalent uniaxial strain concept is used to account for the material nonlinearity in the compression stress field. The developed program is also capable of simulating the nonlinear progressive contact behaviour (seating effect) of dry joint taking into account the block bed imperfection. The comparison shows a good agreement between the developed FE program and the experimental test results.

*** Development of an innovative interlocking load bearing hollow block system in Malaysia**

Construction and Building Materials, Volume 18, Issue 6, July 2004,

Pages445-454.

Waleed A Thanoon, Mohd Saleh Jaafar, Mohd Razali Abdul Kadir, Abang Abdullah Abang Ali, D.N Trikha, Amad M.S Najm

The paper describes the development of a new interlocking hollow block masonry system appropriate for load bearing masonry wall construction. The developed system is an alternative to the traditional bonded masonry system where the blocks in the wall are integrated through mortar layers. In the system developed, the blocks are stacked on one another and three-dimensional interlocking protrusions are provided in the blocks to integrate the blocks into walls. This paper includes the background, concept and procedure used to develop an efficient interlocking hollow block system, which may be used in the construction of load bearing walls. Twenty-one different block models have been investigated and analysed with respect to weight, bearing and shear areas, shape, ease of production, ability to accommodate vertical and horizontal reinforcing stabilising ties and efficiency of the interlocking mechanism under imposed loads. The blocks, developed under the name 'PUTRA BLOCK', have been used to construct a single-storey house at Universiti Putra Malaysia. The system provides a fast, easy and an accurate building system.

*** Laboratory-Based Productivity Study on Alternative Masonry Systems**

By J. Constr. Engrg. and Mgmt. Volume 129, Issue 3, pp. 237-242(ASCE), (May/June 2003) Issue Date: May/June 2003

This paper outlines relative productivity assessment of conventional and interlocking-block masonry with different construction methods. To measure the utilization of time by the members of the team, work sampling (adopting the 5 min rating technique) was used. The frequencies of occurrences of each work category, namely direct, indirect, and noncontributory, have been established. Due to the variation in the noncontributory work component for different methods of construction, the net output has been expressed as output per productive hour. Productivity enhancement of 80–120% was observed for dry-stacked masonry and

60–90% more for thin-jointed and mortar-bedded interlocking-block masonry than that of conventional masonry.

*** Compressive Strength Prediction of Hollow Concrete Block Masonry Prisms:**

By Mr. K. Ramamurthy, Mr. V. Sathish, and Mr. R. Ambalavanan, Structural Journal, January 1, 2000

The results of a systematic experimental investigation on 306 stretcher bonded concrete hollow block masonry prisms under axial compression for the influences of block-mortar strength combinations, block geometry, height to thickness ratio (h/t) of block, mortar bedding, and thickness of mortar joint. The test results were then used to derive a prediction relation for a rational assessment of the compressive strength of masonry prisms.

*** Reinforced concrete block masonry for faster and economic construction:**

By Ganesh N. Kamat , The Indian Concrete Journal ,July 1992.

The article describes reinforced concrete block (RCB) masonry construction ,which is based on the load bearing and shear wall concept of multi storeyed reinforced block masonry buildings. It is also discussed that , besides being economical , this technique of construction is simple and faster. The structures constructed with this technique exhibit enhanced fire resistance , and excellent acoustic and thermal properties. A few examples of the technique are highlighted .Also cost calculations and a typical design is included in the appendices.

*** Compressive Strength of Concrete Masonry Prisms:**

By Tariq S. Cheema and Richard E. Klinger, Journal Proceedings, January 1, 1986.

Experimental tests on prisms and constituent materials (mortar, grout, and hollow-core concrete blocks) were used to calibrate linearly elastic finite element models for hollow and grouted concrete masonry prisms. These finite element models were then used to develop simplified relationships which closely predict the compressive strengths and failure modes of prisms.

*** Behavior of Concrete Block Masonry Under Axial Compression:**

By Robert G. Drysdale and Ahmad A. Hamid, Journal Proceedings, June 1,1979.

The results of 146 axial compression tests of concrete block masonry prisms were reported. The results show that the strengths of grouted prisms are not affected

much by the mortar joint. The average compressive strength for grouted prisms was less than for similar ungrouted prisms indicating that the concept of superposition of the strengths of grout and the ungrouted prism is not valid. An explanation for this phenomenon is suggested which indicates that the incompatibility of the deformation characteristics for the grout and the block contributes to this result.

Proposed program:

The following programs are proposed in the project with respect to the title of the project.

i) Strength of the masonry walls:

The strength of masonry in compression is usually assessed by a program of testing masonry specimens. The masonry prisms are constructed using several courses of masonry units laid in mortor. Testing of masonry prisms is the simplest technique and is least expensive.

ii) The standard deviation:

The standard deviation is investigated for the various specimens of hollow block masonry units.

iii) Effect of Slenderness and eccentricity:

When the wall height increases , the slenderness introduces new failure modes. These modes of failure is proposed to be investigated by casting a scaled model and comparing it with casting of a full scale masonry units taking into account the slenderness. In addition to the slenderness , a wall may also suffer from eccentric loading . The eccentricity may happen either due to the non central nature of the vertical load or due to eccentricity caused by defective construction . The eccentricity of loading and the slenderness effects can combine to weaken the wall. The effects due to slenderness and eccentricity is proposed to be investigated.

iv) Influence of Reinforcement:

The reinforced concrete block masonry construction could not pick up early in India, mainly due to shortage of cement .However , with full decontrol, since when the cement is available in plenty, this method is taking a new dimension.

The method is speedy, sturdy and economical. It could be advantageously used for reconstruction and mass housing. In this project it is proposed to investigate the influence of reinforcement in hollow block masonry.

v) Interlocking of Hollow block masonry system:

The development of a new interlocking hollow block masonry system appropriate for load bearing masonry wall construction. The developed system is an alternative to the traditional bonded masonry system where the blocks in the wall are integrated through mortar layers. The developed system should provide a fast, easy and an accurate building system.

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