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Rat Trap Bond Wall for Low Cost Material &High Strength

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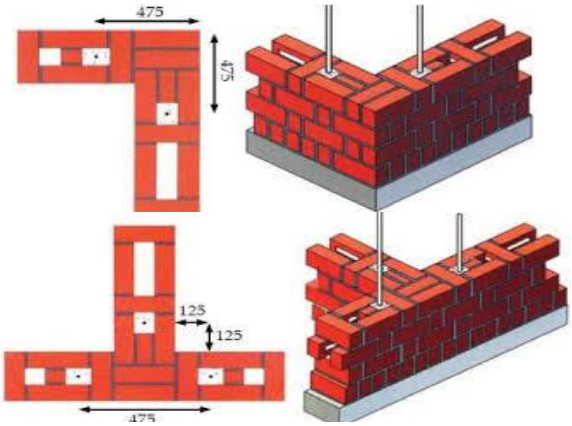
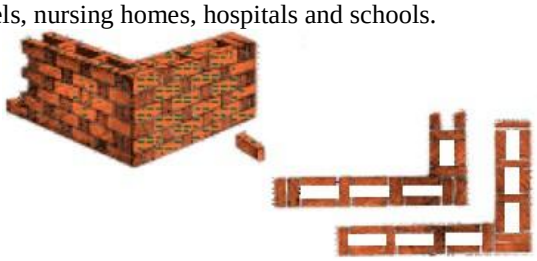


Abstract: ***The proposed investigation aims at investigating the structural strength or RAP TRAP BOND WALL, Presently in any masonry structure the use of English bond brick is one of material made from clay. Now a days it has become a costly material so it is better to use less bricks in constructing walls by using Rat trap bond. Use of Rat trap bond is profitable from point of view of its less costly, less energy intensive and more labour, intensive. RAT TRAP BOND becomes very appropriate,at present very few information are available regarding structural properties of Rat trap bond. Even Indian code of practices for masonry works is silent on Rat trap bond masonry work. In 1999. Urban housing shortages were found to 9.6 million units. In these days of increasing cost of construction, the dream of owning a house particularly for low income and middle income family is becoming a different reality.***

Keywords: RTBW, EBW, Low Cost Material, High Strength

1. Introduction

The economic success and advantage of masonry construction lies in the fact that in load bearing structure, it performs a variety of functions, namely, supporting loads, subdividing space, providing thermal and acoustic insulation, affording to fire and weather protection. The material is relatively chapter and durable, can provide infinite flexibility in plan from and offer an attractive external appearance. Furthermore, brickwork building can be constructed without heavy capital expenditure on the part of the builder. To make the best use of these inherent advantages, it is necessary to use masonry work in building in which floor area is subdivided into a large number of rooms of small or medium size and in which the floor plan is repeated in each storey throughout the height of the building. These conditions are met-with in residential buildings, hostels, nursing homes, hospitals and schools.



Side & Top View of Rat Trap Bond Wall

2. Objectives

To study the behavior of the *Rat-Trap Bond Wall* shown in figure.1 at both service load and ultimate load in comparison with the conventional *English Bond Wall*. Also to find the failure mode of the RAT-TRAP BOND WALL and to validate its *Low Cost Housing*.

Figure 1

Making rat TRP bond wall for low cost house

- To determine the load carrying capacity of masonry wall built in ENGLISH BOND and RAT-TRAP BOND WALL.
- To do comparative study between ENGLISH BOND and RAT-TRAP BOND WALL.
- To monitor the variation in stresses and strain during loading
- To observe the cracking pattern

3. Methodology

Laboratory Test of Material {Test of Bricks, Cement & Sand}

4. Observations and Findings

Loads on the Rat Trap Bond Wall & English Bond Wall Rat

Loads for Rat Trap Bond Wall:-

Sample No. 1, [Made of 1st - Class Bricks in Rat Trap Bond Wall]

Load applied on the specimen (wall):-

Loads Applied: 150KN, 200KN, 250KN. on the rat Trap Bond Wall

Observation

Dimension of the Wall =37''x26''x10''

Starting from 0 KN and increased up to 100kN, the sample showed sign of inconsiderable crack. And further gradual increase of loads to 150 KN, it was found that a 10'' long vertical hairline crack appeared originating from top at the right hand side end. And loading further up to 200KN, the hairline progressed down to the bottom of the specimen and affected the top course to show sign of crack. Loading further up to 250 KN, the hairline progressed down to the bottom of the specimen and affected the top course to show sign of crack.

Findings

The crack first started vertically in the joint b/w the 1st& 3rd headers at top from right hand side of wall and now, the vertically cracks are increasing top to bottom. (Figure: 1, 2 and 3)

Figure 1

Figure 2

Figure 3

Loads for English Bond Wall

Sample No. 1, [Made of 1st - Class bricks in English Bond Wall]

Load applied on the specimen (wall):

Loads Applied: 150KN, 200KN, 300KN AND 440KN on the English Bond Wall:-

Observation

Dimension of the Wall =41''x27''x10''. Starting load from 0KN to 150KN, we observed one hairline crack 6'' from back side of the wall. And further gradual increase of load to 200KN, we observed another crack 10'' from front right hand side. Again increasing load to 300KN, we observed a new crack 10'' on back side. Further gradual increase of load to 440 KN, we observed an 18" crack from right hand end top to bottom.

Finding

The crack first started vertically in the joint b/w 1st and 2nd stretcher, 2nd crack started vertically in joint b/w 1st, 2nd and 3rd stretcher, 3rd crack started vertically in the joint b/w 1st, 2nd and 3rd stretcher and 4th crack started vertically and horizontally in the joint b/w 1st ,2nd ,3rd and stretcher at frog side. (Figure : 6 & 7)

Figure 6

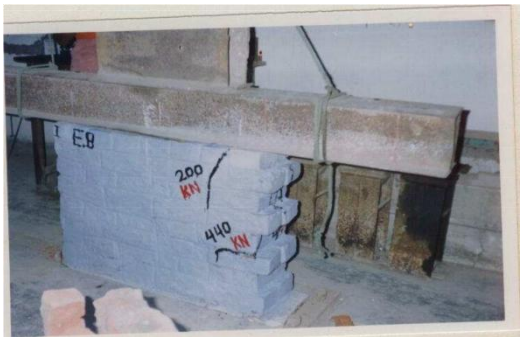


Figure 7

Statement showing stresses at ultimate load on Rat

Sample Tested in Lab Three Samples of Rat Trap Bond Wall and Three Samples of English Bond Wall:-

Table 1

Specimen Detail					Load in KN	
Wall	Samples	Length In Inches	Height In Inches	Breadth In Inches	Initial Crack	Final Crack
Rat Trap Bond Wall	Sample-No.-1	37''	26''	10''	150	250
	Sample-No.-2	38''	26''	10''	90	290
	Sample-No.-3	37''	26''	10''	100	300
English Bond Wall	Sample-No.-1	41''	27''	10''	150	440
	Sample-No.-2	41''	26''	10''	400	500
	Sample-No.-3	41''	27''	10''	160	400

Load for Initial and Final Crack for Rat Trap Bond Wall of 1st class bricks:-

Sample-no.-1

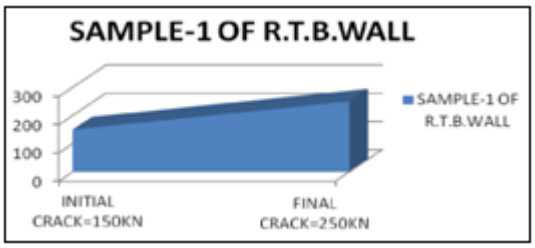


Chart 1

Load for Initial and Final Crack for English Bond Wall of 1st Class Bricks

Sample-No. 1

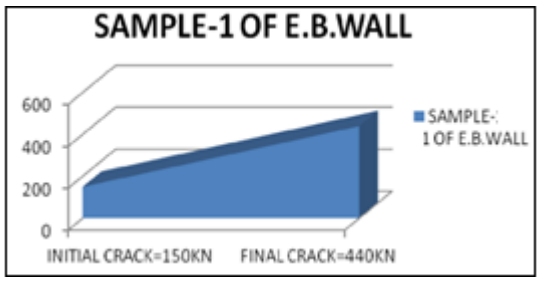


Chart 2

Consumption of Cement and Sand [Ratio 1:3] In Rat Trapbond Wall & English Bond Wall

[A] Rat Trap Bond Wall

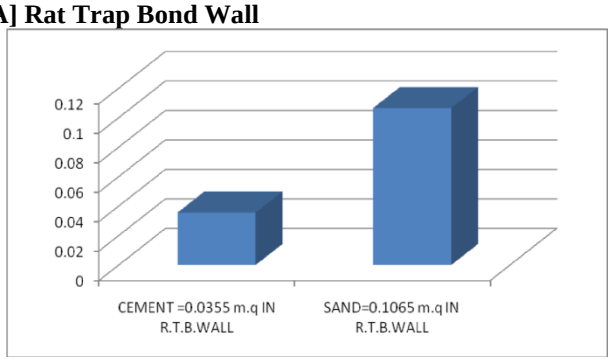


Chart 3

[B] English Bond Wall

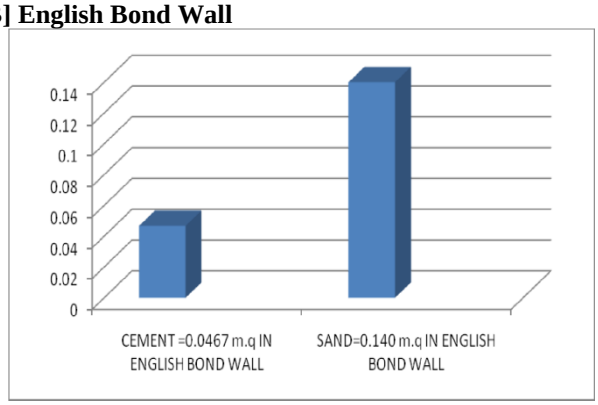


Chart 4

Cost Consumption of Cement and Sand [Ratio 1:3] In Rattrap Bond Wall & English Bond Wall:-

[A] Rat Trap Bond Wall

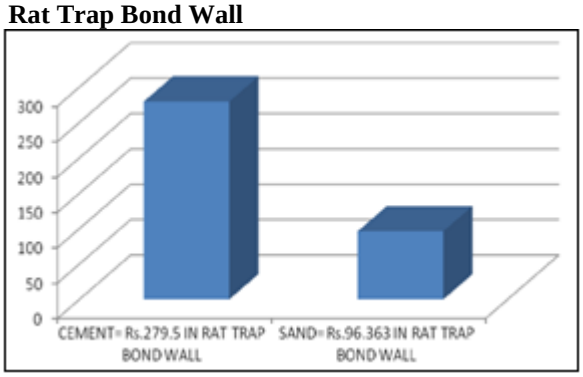


Chart 5

[B] English Bond Wall

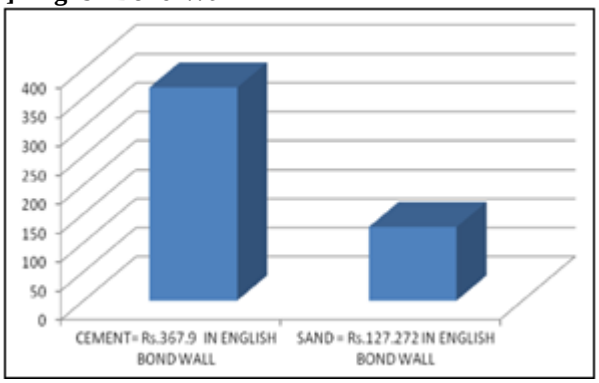


Chart 6

Cost Comparison of Cement and Sand in Rat Trap Bondwall and English Bond Wall:-

Rat Trap Bond Wall and English Bond Wall

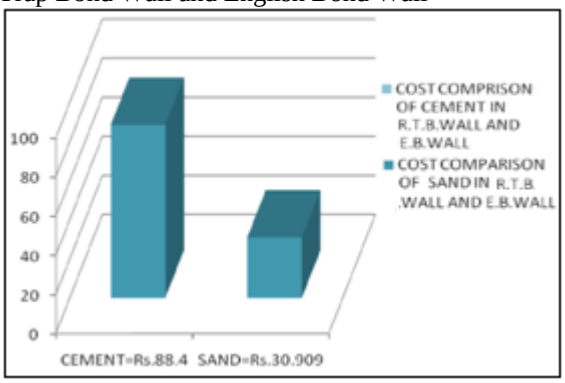


Chart 7

Comparison between English bond and rat trap bond wall table

English Bond	Rat Trap Bond Wall.
1. Headers and stretchers are laid in alternate courses.	1. Headers and stretchers are laid alternately in each course.
2. Strongest of the types of bonds.	2. Comparatively less strong for walls more than 30 cm thick.
3. Provides rough appearance.	3. Provides good appearance.
4. Absence of vertical joints in the structure.	4. Partly continuous vertical joints appear in the structure.
5. Special attention is not required for this bond.	5. Special attention is required for bond.
6. Progress of work is more.	6. Progress of work is less.
7. Costly, no brick bats are used.	7. Economical, as brick bats are used.

5. Calculation Data

Table No. [A]: Compressive Stresses/Crusing Strength in N/mm^2 (For Rat Trap Bond Wall)

Samples	Loads	Stresses=Load/Area	Compressive Stresses/Crusing Strength in N/mm^2
Sample-1	150KN	150000N/[37''X10'']	0.628 N/mm^2
	200KN	200000N/[37''X10'']	0.837N/mm^2
	250KN	250000N/[37''X10'']	1.O47 N/mm^2
Sample-2	80KN	80000N/[38''X10'']	0.326 N/mm^2
	90KN	90000N/[38''X10'']	0.367 N/mm^2
	195KN	195000N/[38''X10'']	0.795 N/mm^2
	290KN	290000N/[38''X10'']	1.183 N/mm^2
Sample-3	100KN	100000N/[37''X10'']	0.418 N/mm^2
	200KN	200000N/[37''X10'']	0.837 N/mm^2
	300KN	300000N/[37''X10'']	1.256 N/mm^2

Table No. [B]: Compressive Stresses/Crusing Strength in N/mm^2 (For English Bond Wall)

Samples	Loads	Stresses=Load/Area	Compressive Stresses/ Crusing Strength in N/mm^2
Sample-1	150KN	150000N/[41''X10'']	0.567 N/mm^2
	200KN	200000N/[41''X10'']	0.756 N/mm^2
	300KN	300000N/[41''X10'']	1.134 N/mm^2
	440KN	440000N/[41''X10'']	1.663 N/mm^2
Sample-2	400KN	400000N/[41''X10'']	1.512 N/mm^2
	500KN	500000N/[41''X10'']	1.890 N/mm^2
Sample-3	160KN	160000N/[41''X10'']	0.604 N/mm^2
	250KN	250000N/[41''X10'']	0.945 N/mm^2
	400KN	400000N/[41''X10'']	1.512 N/mm^2

New Table No. [C]:- Comparison's b/w RTBW & English Bond Wall for Compressive Stresses/Crusing Strength in N/mm^2

Samples	RTBW	EBW	Load In KN
Sample-1	1.047 N/mm^2	0.945 N/mm^2	250KN
	1.256 N/mm^2	1.134 N/mm^2	300KN
Sample-2	1.183 N/mm^2	1.096 N/mm^2	290KN
	1.631 N/mm^2	1.512 N/mm^2	400KN
Sample-3	1.256 N/mm^2	1.134 N/mm^2	300KN
	1.675 N/mm^2	1.512 N/mm^2	400KN

Graphically charts: Table-1 & Table-2

Table 1

Samples	RTBW	EBW	Load in KN
Sample-1	1.047 N/mm^2	0.945 N/mm^2	250KN
Sample-2	1.183 N/mm^2	1.096 N/mm^2	290KN
Sample-3	1.256 N/mm^2	1.134 N/mm^2	300KN

Line Graphically Chart: Table-1

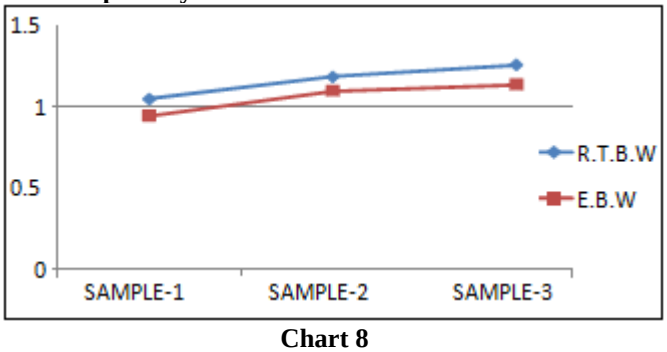


Chart 8

Area Graphically Chart: Table-1

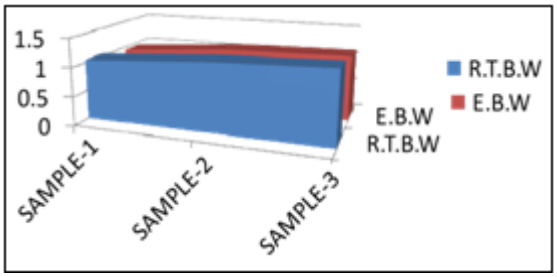


Chart 9

Column Graphically Chart: Table 1

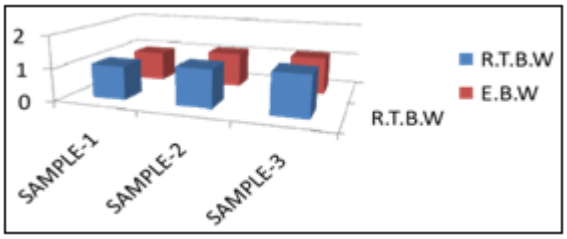


Chart 10

Table 2

Samples	RTBW	EBW	Load in KN
Sample-1	1.256 N/mm^2	1.134 N/mm^2	300KN
Sample-2	1.631 N/mm^2	1.512 N/mm^2	400KN
Sample-3	1.675 N/mm^2	1.512 N/mm^2	400KN

Line Graphically Chart: Table-2

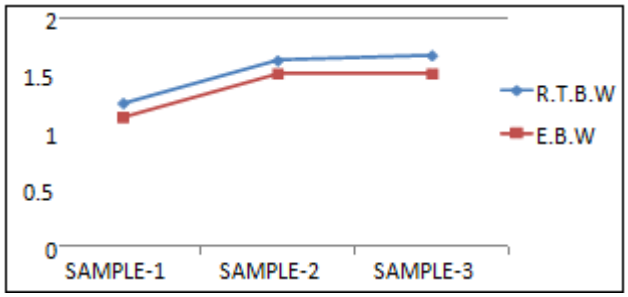


Chart 11

Area Graphically Chart: Table 2

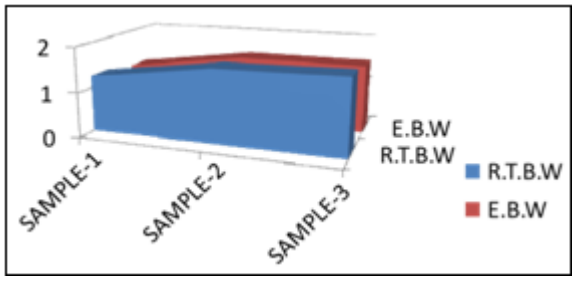


Chart 12

Column Graphically Chart: Table-2

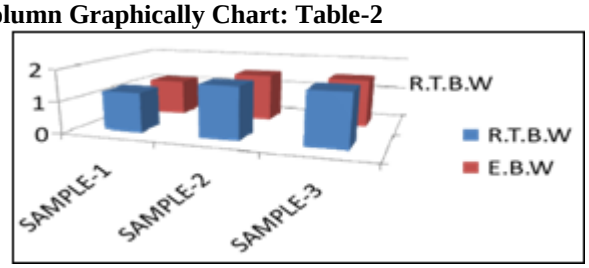


Chart 13

6. Benefits and Advantage

1) Better thermal performance with 20 % reduction in materials.
2) Environment friendly, maintenance free with concealed electrication.
3) Lesser seepage possibilities.
4) Reduced self load.
5) It is 25% cheaper than solid brick wall. [English Bond Wall]
6) Plastering of outside wall is not needed and acts as good thermal insulator.
7) 7.70% to 75% cement saved in rat trap bond wall other than English bond wall.

7. Conclusion

The rat-trap bond wall has 25% less dead weight than the English bond wall. It results in about 18% and 54% saving in the brick and cement mortar respectively.

The result shows that the rat-trap bond wall be safely employed for Low cost housing having two storeys with short span not exceeding 4.20 m=13.780' and with storey height not exceeding 3.0 m=9.843'using bricks having compressive strength not less than 5.69 n/sq.mm with h1 grade mortar ie, with cement mortar 1:3 the failure of the rat-trap bond wall is due separation of the two leaves of the wall caused by splitting of the header bricks, which fails primarily in shear.

The appearance of the initial crack will not be seen on the surface, it occurs in the header bricks. hence it does not give any warning of the possible failure of the wall.

The top layer bricks below the solid layer brick on-edge course-laid

For closing the opening at window sill and at floor level fails primary in flexure. Hence relatively higher strength bricks have to be used in the top course as compared to other courses.

References

[1] (CBRI) Centre Building Research Institute, Roorkee.
[2] Proceedings international seminar on low cost housing and alternative building materials by CBRI, Roorkee.
[3] Publications by HUDCO, India Habitat Centre, Lodhi Road, New Delhi.
[4] Publications by structural engineering research centre, Ghaziabad.

[5] Bhawan Nirman Nirdesh Pustika,Lok Jumbish Parishad, speed,
[6] Instruction manual to appropriate building system, development alternatives, New Delhi, 1993.
[7] Proposed Norms for Lok Jumbish at Kishanganj, Unpublished Report, daat, New Delhi, 1993
[8] IS: 1905-1987, (Indian Standard) code of practice for structural use of Unreinforced Masonry , Bureau of Indian Standards, Manak Bhavan, 9 Bahadur Shah Zafar Marg , New Delhi-110002.
[9] Mud, Technical Papers, International Conference on Mud Architecture at Trivandrum,
[10] Building system for Low Income Housing by A.K.Jain, management publishing company, Dehradun, India.
[11] Perspectives in technology,vol-3,mud blocks for housing,by Prof. K. S. Jagadish, Astra, i.i.sx., Bangalore, published by –KSCST, Bangalore.
[12] The Astram Soil Block Machine,a user manual for machine, by Astra, I.I.Sc., Bangalore.
[13] NBC (Part 4th, section -4)1970, structural design of Masonry,Bureau of Indian Standards, New Delhi.
[14] Reynolds and steedman, reinforced concrete designer's handbook (tenth edition),e and fn spon.
[15] Bihar Education Project Council, Beltron Bhawan, Shastrinagar, Patna-800023. [16.] Rushad, Syed Tabin, Rat Trap Bond, in Master of Science (Structural Engineering) thesis, January-2007.
[16] Sah, Hari Narayan, Comparative Study between walls constructed in conventional English bond and rat trap bond using cement mortar grade h/2 (1 Cement: 4 sand),in master of science (structural engineering) thesis, january-2007.
[17] Santhakumar, A.R, T.S.Lalitha (March 24-25, 1995), validation of rat-trap bond walls, ACCE workshop on cost reduction in construction, Building Technology Center, Anna University, Madras.

Website

[18] http://www.archifacts.co.uk
[19] http://www.ashraya.kar
[20] http://www.devalt.org
[21] http://www.archidev.org
[22] http://www.tifac.org.in/offer/tsw