Reinforced concrete construction low and medium rise residential engineering

Contents

Masonry is referred to brick and masonry building started twenty thousand old ages ago in the “ Stone Age ” and through history people used clay to construct their houses by drying the clay in the Sun boulder clay it is hardened and form clay masonry.

They used masonry in edifice Bridgess, domes, and churches. In the 18th century a great betterment was made to masonry building particularly in span design and the parabola was so invented, furthermore 18th century saw a great end product of Fe and new methods of production were invented. Cast Fe columns and beams were made to back up a brick floor, but masonry building was taking the lead in immense building undertakings and edifices. (Crozier, 1999)

During this clip apprehension of stuffs was their chief aim and mathematical analysis of constructions. Analyzing the thrust line and doing certain it remains in the in-between tierce of the masonry component cross subdivision. In the early of the 19th century masonry Bridgess and viaducts were constructed to back up the railroads spread outing. (Crozier, 1999)

The latter of 19th century reinforced concrete was developed and applied scientists found that it is easier to construct Bridgess utilizing reinforced concrete than masonry and gives them more flexibleness in determining the Bridgess. Masonry edifices was still used in edifices but due to its ‘ immense wall thickness was non preferred in high edifices, for illustration a edifice can

be six narratives with a wall of two metres thickness which was non economical and takes a batch from the edifice country. (Crozier, 1999)

At this clip masonry was used in other ways as for illustration facing of immense country of steel frames and ornaments for the outer Skelton of a strengthened concrete edifice. Later applied scientists started to larn more about masonry and started to develop its ‘ structural design, by this development the wall bearing masonry was used to develop residential edifices with smaller thickness with figure of narratives up to fifteen. Engineers understood the construct of organizing plastic flexible joints and how of import are articulations between elements. (Crozier, 1999)

1. 2 Types of tonss subjected on masonry constructions

Masonry walls are similar to concrete which is designed and built to transport merely compaction forces and they are weak on the tenseness side, that ‘ s why sidelong tonss cause a immense menace on masonry edifice (wind burden and temblors) there are two chief types of tonss ; lasting like dead burden, semi permanent as unrecorded burden and transeunt burden as temblors and air current burden.

Engineers developed the strengthened masonry building to take down the hazard of tensile forces subjected to masonry edifices, moreover interior decorators studied the agreement of bricks in planar walls to increase the strength of the bricks in defying lasting and semi-permanent tonss. (Crozier, 1999)

Tonss reassigning in masonry elements is a chief aim for the interior decorator to develop a lasting and safe construction, hence a interior

decorator must guarantee a figure of load waies through the construction to guarantee safety if accidently any back uping component is damaged for illustration, when a column accidently destroyed a new load way must be offered for reassigning tonss through beams. (Crozier, 1999)

1. 3 Examples on masonry constructions

Brown County Jail

Figure 1. 3. 1: The brown county gaol (1902) in USA

picsBridge [Alcantara] . gif

Figure 1. 3. 2: Bridge at Alcantara in Spain (105 AD) (Crozier, 1999)

picsVault. gif

Figure 1. 3. 3: Masonry Vault (Crozier, 1999)

hypertext transfer protocol: //encrypted-tbn1. gstatic. com/images? q= tbn: ANd9GcQgJ8uWsOgEf1UbK3fmDyFrFIJZzuAUH7iygAUr_ycLHa9pQRF48g

Figure 1. 3. 4: Giza pyramids (2560 BC)

1. 4 Advantages and Disadvantages of masonry building

Advantages

Disadvantages

When good designed provide attractive, lasting and lasting construction.

Masonry need a batch of really skilled labor to complete the occupation which might non be unlike concrete where really skilled labor is non of import.

When constructed there is no demand for completing with daubing or scraping.

Load bearing dividers and floors must all be done on the same clip that is why applied scientists are ever on a really critical way unlike steel and concrete.

Great pick for cladding as it provides a good conditions protection, and great sound, and thermic insularity and fire opposition.

Masonry can be cracked easy through colony of foundation on unstable dirt.

Peoples prefer masonry because it is warm and friendly unlike concrete.

As mentioned before masonry is weak in tenseness and can non manage strong sidelong tonss like air current and temblors

Masonry has assortments of units and sizes depending on the masonry construction needed to be built.

Masonry is difficult to clean unlike concrete.

Masonry provides an economical option to concrete in burden carrying and provides cladding to big country such as mills made of steel frames.

Masonry is really critical in detailing to guarantee safety and to be economical.

Masonry is fast in edifice and with skilled labors it can be finished faster than concrete.

Table 1. 4. 1: Advantages and Disadvantages of masonry building (Crozier, 1999)

2) Materials and signifiers of masonry: –

2. 1 Structural signifiers of masonry

-There are assorted types of masonry structural signifiers as wharfs which are designed to transport merely compaction force and they form as a portion of the wall. Single foliage wall which is a planar wall made of hollow or solid masonry in different alliances and thicknesses and has different types as heterosexual and zigzag foliage wall, steel are aligned horizontally in bed articulations and vertically in nucleuss of the hollow masonry. (Crozier, 1999)

Figure 2. 1. 1: Planar wall type (Crozier, 1999)

-Diaphragm walls which consists of two brick walls with a traversing beam and can be reinforced or unreinforced depending on the subjected tonss. (Drysdale, Hamid, Baker, 1999)

Figure 2. 1. 2: Diaphragm wall (Drysdale, Hamid, Baker, 1999)

-Cavity walls are two same or different brick walls spaced and connected to each other wall ties made of steel and the pit is so filled with grout and support to organize the wall. (Crozier, 1999)

Figure 2. 1. 3: Pit wall (Crozier, 1999)

-Veneer walls which chiefly resists sidelong burden are formed to brick wall connected from its ‘ dorsum with concrete or lumber frame utilizing steel ties. (Drysdale, Hamid, Baker, 1999)

Figure 2. 1. 4: Veneer wall (Crozier, 1999)

-Columns are perpendicular member built with either clay bricks or concrete blocks, they are designed to transport compaction forced and built as a separate member from the wall. Column can be unreinforced if it is merely subjected to perpendicular tonss, but in instance of flexing on any of its ‘ chief axis support is indispensable. (Drysdale, Hamid, Baker, 1999)

Figure 2. 1. 5: Masonry columns (Drysdale, Hamid, Baker, 1999)

-Masonry beams are horizontal member used to transport tonss upon an gap or a header which will be discussed subsequently. Masonry beams are ever reinforced to be able to defy tensile forces which come from flexing minutes as in concrete, headers are constructed utilizing particular types of concrete masonry units or concrete hollow blocks and so grouted over the support. (Drysdale, Hamid, Baker, 1999)

Figure 2. 1. 6: Masonry beams (Drysdale, Hamid, Baker, 1999)

2. 2 Materials and masonry units used in masonry building

-There are different types of masonry units used in building depending on the construction and the burden applied from the construction or from nature. Get downing by basic which is the clay masonry which can be solid with howitzer or cored with support and grout, clay masonry is clay dried by fire and left to indurate which comparatively produce high compressive strength. Clay bricks can be found as solid or as hollow. Clay brick may be reinforced to increase its ‘ capacity to defy compressive tonss. (ECP 204, 2005)

Compressive strength for solid and hollow clay bricks

Type

Solid clay brick

Hollow clay bricks

dimensions (millimeter)

Length

Width

Height

Length

Width

Height

Millimeter

millimeter

millimeter

millimeter

millimeter

millimeter

250

120

60

235

120

250

250

120

65

A

A

A

250

120

95

A

A

A

250

120

115

A

A

A

250

120

130

A

A

A

Compressive strength (N/mm^2)

Average five bricks

one brick

Average five bricks

one brick

Load bearing bricks

Not less than 8

Not less than 7

Not less than 2. 5

Not less than 2

Non burden bearing solid brick

Not less than 4

Not less than 3. 5

Non burden bearing perpendicular hollow brick

Not less than 4

Not less than 3. 5

Non burden bearing horizontal hollow brick

Not less than 3

Not less than 2. 5

Based on the Egyptian codification of pattern (ECP 204, 2005)

Table 2. 2. 1: compressive strength for solid and hollow clay bricks

-Concrete units which is merely made of sand, sum, cement and H2O and its ‘ compressive strength can change depending on the natural stuffs used, and size of the block and it is comparatively high. It can be found as solid or hollow, and can be reinforced to transport tenseness tonss or to increase the compaction opposition. Concrete unit has high compressive strength but by adding mortar the compressive strength of the whole prism lessenings. (ECP 204, 2005)

Compressive strength for solid and hollow concrete blocks

Type

Solid concrete brick

Hollow concrete block

dimensions (millimeter)

Length

Width

Height

Length

Width

Height

millimeter

millimeter

millimeter

millimeter

millimeter

millimeter

250

120

60

400

100

200

250

120

120

400

120

200

250

120

200

400

120

250

A

A

A

400

200

200

A

A

A

400

250

200

Compressive strength (N/mm^2)

A

Average 10 bricks

one brick

Average five bricks

one brick

burden bearing solid units

7

5. 6

7

5. 6

burden bearing hollow and cored units

5

4

5

4

Non burden bearing solid units

2. 5

2

2. 5

2

Non burden bearing hollow and cored units

2

1. 6

2

1. 6

Based on the Egyptian codification of pattern (ECP 204, 2005)

Table 2. 2. 2: compressive strength for solid and hollow concrete blocks

-Mortar is a really of import type of stuffs used in masonry building ; howitzer is made of cement, calcium hydroxide, sand and H2O. It is used as a adhering stuff between the masonry units and besides it is a good conditions dielectric. Mortar has different thicknesses depending on the design, but it is largely to be used with 10 millimeters thickness. Mortar is really weak in tenseness therefore under tenseness tonss transcending the tenseness capacity of both the bricks and howitzer (prism) failure occur in howitzer by dividing of howitzer joint manner before a failure occurs in the brick. (ECP 204, 2005)

Mortar constituents per centums and compressive strength

Mortar figure

Mortar constituents per centum with regard to volume

Average compressive strength after 28 yearss (N/mm^2)

Portland cement or Blended cement

Hydrated calcium hydroxide

Sand (measured when hydrated and non compacted)

1

1

From 0. 0 to 0. 25

From 2. 25 to 3. 00 times the entire volume of cement and calcium hydroxide

15

2

From 0. 25 to 0. 5

10

3

From 0. 5 to 1. 25

5

4

From 1. 25 to 2. 5

2

Based on the Egyptian codification of pattern (ECP 204, 2005)

Table 2. 2. 3: Mortar constituents per centums and compressive strength

-Grout is composed of cement, sand, sum and H2O, grout fills the nucleuss and pits of the masonry units to increase its ‘ gross country, and increase strength of masonry. Grout besides may be used to organize a bond between masonry units and steel support and it has a minimal compressive strength of 14 (N/mm^2) . (ECP 204, 2005)

Grout types, constituents per centums and compressive strength

Grout Type

Grout constituents per centum with regard to volume

A

A

Cement per centum with regard to mass

Hydrated calcium hydroxide

Aggregate per centum

Size of the biggest sum (millimeter)

Minimum compressive strength

Small

Large

(N/mm^2)

Grout for little thickness boulder clay (50 millimeter)

1

0. 0 to 0. 1

2. 25 to 3. 0

—

5

Bigger than 14

Grout for big thickness bigger than (50 millimeter)

1

0. 0 to 0. 1

2. 25 to 3. 0

1. 0 to 2. 0

19

Based on the Egyptian codification of pattern (ECP 204, 2005)

Table 2. 2. 4: Grout types, constituents per centums and compressive strength

Reinforcement signifier a great importance in masonry building procedure, it can extremely increase the strength of masonry, extremely resist tensile emphasiss that may happen from non homocentric tonss and besides controls masonry checking in suited conditions. Reinforcement is placed on the hollow units and so filled with grout to organize the bond. The lone concern from uniting steel with masonry is corrosion, therefore it is extremely recommended to plate the steel bars with anti corrosion stuff to

forestall this procedure from happening. The maximal diameter of steel bars used in masonry building is 20 five millimeters. (ECP 204, 2005)

2. 3 Headers

masonry constructions is different signifier reinforced concrete constructions ; the chief elements transporting burden in concrete constructions are columns, beams slabs and foundation, brick walls in concrete constructions act as a covering stuffs between columns and they do non take part in transporting burden with the mentioned elements in antonym of masonry constructions where tonss are chiefly carried through the burden bearing walls, hence gaps (headers) in these walls may cut down the ability of the wall to transport applied burden and may take to prostration of the construction. To acquire to a decision loads applied on the headers must be good taken into consideration.

A header beam is the solution to transport the tonss coming from the upper ain weight of the wall burden, tonss applied from the upper roof and floors and the header ain weight. Lintel beam is largely designed as a simple beam and which transfer loads to the supports. Lintel beams does non transport the whole burden upon it due to the transportation of tonss through the wall in an arched way to be more specific the arced action, hence headers carry a triangular burden upon it of 40 five grades, if the vertex of the burden trigon is located within the wall, hence the tonss of the masonry side will be neglected and the lone tonss carried are the header ain weight and the triangular burden of the wall above, but if the vertex of the trigon is upon the wall tallness and extended to the roof therefore the header must transport the full burden above it. (Drysdale, Hamid, Baker, 1999)

Figure 2. 3. 1: Lintel burden distribution (Drysdale, Hamid, Baker, 1999)

2. 4 Types of masonry building

2. 4. 1 Unreinforced masonry: –

Unreinforced masonry is merely building masonry elements without utilizing neither reinforcement steel bars nor steel stirrups. Unreinforced masonry is chiefly used in low seismal parts where sidelong tonss are little furthermore unreinforced masonry can be merely used in the building of low and medium rise edifices to take down the consequence of air current tonss subjected on the construction as the instance of the current research paper. The thickness of the wall of the unreinforced masonry is of import for the location of the thrust line. Unreinforced masonry are chiefly subjected to compressive perpendicular tonss and this rely on the high compressive strength of different types of masonry units on the other manus tensile emphasiss may happen which may do the masonry to cleft and so neglect, hence tensile strength of masonry must be higher than applied tensile burden. (Drysdale, Hamid, Baker, 1999)

2. 4. 2 Reinforced masonry: –

Reinforced masonry is merely adding support bars and steel stirrups to masonry units. Reinforcement is chiefly used to defy flection tenseness and shear therefore the alliance of steel bars is of import, normally perpendicular steel bars are used in masonry wall to defy tenseness force produced from flexing minute and horizontal steel bars are used to defy shear. Reinforced masonry is chiefly used in medium to high seismal parts due to steel that is strong in defying tenseness forces. Grout is an of import component is

reinforced masonry, and it is poured in the nucleuss of masonry units to environ support and execute a strong bond between steel bars and masonry unit. (Drysdale, Hamid, Baker, 1999)

3) Behaviour and design methodological analysis of masonry: –

3. 1 Physical belongingss of masonry units

Masonry units have different forms and sizes depending on the demand of building, but largely they are rectangular form with length, breadth and tallness and they are laid on its ' length dimension analogue to the in plane of the wall and it is called stretcher, the perpendicular front side is called the face and the two perpendicular side are called terminals and the side which is used for puting masonry units on it is called the top. Length and tallness of masonry are ever standard and the lone variable dimension is the breadth of the brick, howitzer used for adhering bricks together largely has a standard thickness of 10 millimeters and is placed on the top, bottom and ends side of the brick and is called howitzer articulations, Areas used for howitzer arrangement are called bedclothess and has two types ; face shell bedding which is the covering of merely the face shell with howitzer and full bedclothes which to cover the entire gross country with howitzer. Not all masonry bricks are solid ; bricks are found as cored or hollow units as in the instance of concrete hollow blocks which consists of cells which are the hollow units, face shell which is the parts of the opposite faces of the cells, terminal webs which are the parts at the terminal of the block and cardinal web which is between the cells. A block may be called solid if the grade of solidness is 70 five per centum or more and are called hollow if it is less than

seventy five per centum, grade of solidness is the net country of the block divided by the gross country multiplied by hundred. (Drysdale, Hamid, Baker, 1999)

Figure 3. 1. 1: Masonry unit labels (Drysdale, Hamid, Baker, 1999)

3. 2 Behaviour of masonry prism under axial compaction

3. 2. 1 Prism features and behavior

As to understand the behavior of masonry elements under axial compaction burden as the instance of the current research paper, traveling through research lab trials is the best and effectual manner to exemplify assorted behaviors. Masonry elements are composed of masonry units such clay or concrete, adhering component such as howitzer, grout and when needed support these elements form an orthotropic behavior which means that mechanical belongingss are different through the axis of symmetricalness of masonry component unlike concrete which have the same belongingss on each axis and this is called isotropic. (Drysdale, Hamid, Baker, 1999)

Axial compaction trial is made on prisms which is one unit length and midst and can be built at several highs of two, three or four units and every bit mentioned before with howitzer articulations of 10 millimeters between the units, normally it is aligned in stack bond which means that units are placed on the same way. Prisms are tested to find the axial compressive strength of masonry on a smaller graduated table which is so used for making tabular arraies used for design, and prisms is tested on a machine that applies perpendicular burden to the prism boulder clay failure occurs and so compressive strength is so measured. (Drysdale, Hamid, Baker, 1999)

Figure 3. 2. 1. 1: Masonry prism (Drysdale, Hamid, Baker, 1999)

Prisms under axial perpendicular compaction have two manners of failure relation to the tallness. The first manner of failure is conelike shear and this happens when the prism tallness is two times the thickness of masonry unit, but this type of failure does non go on in existent masonry component such as a masonry wall because the tallness of the wall to the thickness is different.

The 2nd manner of failure is perpendicular checking through masonry prism and this happens when utilizing four to five bricks height which will be the same manner of failure that happens in a masonry wall. Masonry unit under perpendicular compaction normally tries to deform laterally and therefore it will be subjected to biaxal tenseness, but howitzer under same instance of lading attempts to spread out from all way but masonry unit of higher strength than howitzer prevent it from deforming and executing triaxial compaction which leads howitzer to burthen more compressive burden than its ‘ capacity. When the compressive burden additions mortar signifiers tensile emphasiss on the masonry unit taking to perpendicular clefts on masonry unit and this is typically what happens on burden bearing masonry wall with full bedded country. (Drysdale, Hamid, Baker, 1999)

Figure 3. 2. 1. 2: Forces moving on masonry prism (Drysdale, Hamid, Baker, 1999)

Adding grout to masonry hollow units increases the strength because of grout transporting portion of the compressive burden applied to the prism, on the other manus grout put a great menace to prism strength due different

stuff belongingss between masonry unit and grout, uncomplete grout compression which will make spreads between grout and plastic shrinking which is the fast H2O loss of grout surface before puting which leads to clefts and this is due to moo skilled labor and deficiency of measurings taken earlier and through grout arrangement. These factors can take grout to bring forth sidelong forces on the unit which will take to the failure of the prism before it reaches the full compressive capacity. (Drysdale, Hamid, Baker, 1999)

3. 2. 2 Prism and factors impacting strength

There are several factors impacting the strength of the masonry units and therefore the strength of the prism. These factors depend on the tallness of the specimen, dimensions and strength of the unit and adhering stuff (howitzer) , and strength of the grout being used. These factors may ensue in increasing or diminishing the strength of prisms of different types of units under perpendicular compaction burden, hence taking into consideration these factors will take to a precise measurement of the compressive strength and capacity.

The tallness of the unit plays an of import function in finding the strength of prism, as mentioned before there are two manners of failure which depends on the tallness of the prism that depends on the unit height hence trials showed that increasing the tallness of the unit decreases the sidelong distortion of it and this due to the addition of weight and dimensions of the unit which will do it more stiff, more over when the unit strength increases the prism strength additions and hence the prism compressive strength shows an addition, on the other manus high strength clay bricks does non

consequence much the strength of the prism unlike concrete blocks. One may see that the lone of import parametric quantity of the masonry unit is the compressive strength, unluckily this is non the right instance ; tensile strength is of the same importance because as mentioned before failure through perpendicular clefts in prisms and walls occurs due to tensile emphasiss formed on the unit due to mortar enlargement, hence tensile capacity of the unit limits the failure of the prism. (Drysdale, Hamid, Baker, 1999)

Hollow and cored units made of concrete and clay influences the unit strength and therefore the prism strength. Solid units ' compressive strength is higher than hollow units and this due to the uniformly distributed compaction emphasiss on the entire country (gross country) of the solid unit unlike hollow units of similar dimension ; emphasiss due to perpendicular compaction are distributed merely on the net country (country of nucleuss subtracted from gross country) which leads to a lower compressive capacity of the unit, more over howitzer bedded country which carries portion of the compressive burden of the prism will diminish in instance of hollow or cored units and hence the prism compressive strength will diminish, trials showed that a lessening of 15 per centum of the stratified country will act upon a lessening of 40 five per centum on the perpendicular subdivisions defying compaction emphasiss. (Drysdale, Hamid, Baker, 1999)

Adhering stuff is one of the most of import parametric quantities impacting the prism strength. Mortar strength influence the strength of the prism by increasing it to a bound, on the other manus utilizing howitzer of high

strength more than needed for guaranting a lasting construction will non consequence much the prism strength and will impact negatively on the lastingness and strength of the construction. high strength units normally covers over the howitzer strength, howitzer is ever formed on site of building, hence low skilled labor may non guarantee the precise workability needed of howitzer used in building. (Drysdale, Hamid, Baker, 1999)

Mortar thickness as mentioned before is normally 10 millimeters and increasing the thickness of howitzer normally happens on building sites due to moo skilled labor, hence clay masonry prism is affected by diminishing the compressive strength due to different stuff belongingss, on the other manus concrete prisms is non much affected by the addition of howitzer thickness due to their similar stuff belongingss, hence to get the better of this struggle a standardized thickness is used. Face shell bedding in hollow or cored unit increases the compressive strength of the prism due to the lower tensile forces produced on the masonry unit. (Drysdale, Hamid, Baker, 1999)

3. 2. 3 Stress and strain of masonry

Figure 3. 2. 3. 1: Stress strain curve of masonry stuffs (Drysdale, Hamid, Baker, 1999)

The upper figure shows the perpendicular emphasis and strive behavior for types of masonry stuffs which are units, howitzer and prism. It is evidently seen that masonry units can manage big sums of perpendicular compaction emphasiss due to the applied burden with little sum of perpendicular strain and so a sudden toffee failure occurs when making the maximal strain.

Mortar can manage smaller sum of perpendicular compaction emphasiss than the unit and a larger sum of perpendicular strain. To acquire to a decision howitzer perpendicular distortion is bigger than that of the unit for the same value of perpendicular emphasis as illustrated in the above figure. When uniting both howitzer with units a proving prism is formed, the figure above shows that a prism can manage smaller sums of perpendicular compaction emphasis than the unit itself and this shows why the unit compressive strength is larger than the prism. (Drysdale, Hamid, Baker, 1999)

Trials on prisms showed that concrete and clay masonry have a nonlinear behavior on the emphasis and strain curve. Trials showed that concrete masonry strain in bigger than that of clay masonry and analyzing the behavior of masonry showed that for different types of howitzers the scope of strain found is near to the strain scope of concrete which is from (0. 002-0. 003) and this shows that masonry behavior is the same as concrete under perpendicular compaction burden. To acquire to conclusion masonry is a strong and economic replacing for concrete with regard to bearing of compaction tonss. (Drysdale, Hamid, Baker, 1999)

3. 3 Manners of failure of masonry walls

3. 3. 1 Failure of masonry wall under perpendicular compaction burden

As discussed before in perpendicular compaction prism trial, failure of masonry prism is similar of that of masonry wall. Under perpendicular compaction burden transcending the ultimate compaction capacity of the masonry component, perpendicular clefts occurs due to the enlargement of

howitzer executing tensile emphasiss on the masonry unit, perpendicular clefts is the first measure of failure, and when the masonry component reaches beyond the ultimate capacity perpendicular splitting occurs on the masonry wall taking to a complete prostration or failure. (Crozier, 1999)

Degree centigrades: UsersMitryDesktopScreenshot_2012-11-30-13-37-53-1. png C: UsersMitryDesktopScreenshot_2012-11-30-13-37-53-2. png

Figure 3. 3. 1. 1: Failure of masonry wall under perpendicular compaction (Crozier, 1999)

To be more practical this type of failure occurs due to concentric perpendicular tonss which means that compaction burden passes through the Centre of gravitation (CG) and this instance does non of all time go on in existent pattern, hence due to the borders of the slab rotary motion on the wall face an eccentricity of burden occurs and the burden becomes bizarre which means that there is a horizontal distance between the burden and the Centre of gravitation of the masonry wall called eccentricity (vitamin E) . The eccentricity induce flexing minute on the masonry wall making a compaction failure on the masonry component inside face, and when the tensile capacity of the wall is exceeded on the member outside face a failure occurs which is clasping. This shows that non merely the compressive strength of the masonry component is of import, but besides the tensile strength, hence a minimal eccentricity is ever put into consideration by the applied scientist to get the better of such failures. (Crozier, 1999)

3. 3. 2 Masonry shear wall failure

To be more specific this treatment is on unreinforced concrete masonry shear wall subjected to sidelong tonss such as air current burden. A masonry shear wall act as a cantilever that is chiefly fixed from the base and its ‘ terminals are free and subjected to uniform sidelong burden, to analyze the failure manners of a shear wall, a behavior of the shear wall must be studied with research lab trials on specimens, chiefly shear failure occurs due to the combination of compressive tonss and shear emphasiss induced by sidelong tonss, more over bed articulations are the merely subjected articulations to shear emphasiss in the masonry shear wall, hence failure ever occurs in the bed articulation. When the compressive emphasiss normal to the bed articulation due to perpendicular burden is smaller than shear emphasiss parallel to the bed articulation due to sidelong burden, hence stealing of bed articulation occurs and hence shear failure occurs, on the other manus if the compaction burden is increased comparative to shear emphasiss, faux pas and splitting of bed joint occurs. (Crozier, 1999)

Figure 3. 3. 2. 1: failure manner of a prism under shear (Drysdale, Hamid, Baker, 1999)

When sidelong tonss (air current) are subjected to a shear wall it performs tenseness force on the close side of the wall which is the air current ward and compaction force on the far side which is the downwind ward, hence forestalling tenseness failure from happening on the air current ward side a suited sum of dead burden (ain weight of shear wall) must be put into consideration to set the shear wall in a province of equilibrium. In pattern due to sidelong tonss an overturning minute is induced and with low axial

compaction tonss, shear walls are subjected to three chief types of failures ; clefts occur due to tension failure and so followed by diagonal cleft through the wall length, and the toe is subjected to compaction failure, and every bit mentioned before stealing of howitzer articulation occur and this is called slithering failure. (Crozier, 1999)

Figure 3. 3. 2. 2: Shear failure of masonry wall (Crozier, 1999)

3. 3. 3 Masonry wall failure due to flexing

Walls are subjected to flexure and this due to eccentricity of perpendicular compaction tonss as mentioned before and sidelong forced. There are two chief types of bending failures which are horizontal bending and perpendicular bending, testes has proved that masonry perpendicular bending strength is much higher than that of the horizontal bending. The behavior of flexing on any masonry component depends on the perpendicular or horizontal supports.

Horizontal bending occurs when the supports are led on the perpendicular sides of the component and bending occurs in plane. Mortared prepend articulations which are the perpendicular sides of the masonry units bedded with howitzer are the chief ground of horizontal bending due to the bond between the unit and the howitzer, form and dimensions of the units and prepend articulations strength in tenseness, hence failure occurs through the mortared prepend articulation and it is called toothed failure. (Crozier, 1999)

Wall H

Figure 3. 3. 3. 1: Horizontal bending failure of masonry wall (Crozier, 1999)

Vertical bending occurs when the supports are led on the horizontal sides of the component and bending occurs out of plane. This type of failure occurs at 50 per centum of wall tallness and this is due to rotary motion of along the bed articulations of the wall due to sidelong tonss. Combined both perpendicular and horizontal bending due to supports found on both perpendicular and horizontal sides can take to a manner of failure of rotary motion along bed articulations with clefts formed diagonally through the full wall. (Crozier, 1999)

Wall V

Figure 3. 3. 3. 2: perpendicular bending failure of masonry wall (Crozier, 1999)

3. 4 Design equations

All design equations that are traveling to be discussed in this subdivision are based on the Egyptian codification of pattern for design and building of masonry wall (ECP 204-2005) . This subdivision represents design equation and restriction for unreinforced and reinforced masonry elements with regard to allowable compressive emphasiss, allowable eccentricity of perpendicular tonss, allowable tensile emphasiss and allowable shear emphasiss.

3. 4. 1 Unreinforced masonry: –

3. 4. 1. 1 Allowable compressive emphasiss

Allowable compressive emphasiss in unreinforced masonry walls depend on slenderness ratio, bizarre tonss, characteristic compressive strength (f ‘ m) , effectual country of masonry wall cross subdivision and burden combinations. Allowable compressive emphasiss must non transcend neither (Fa) for homocentric instance of lading nor (Fb) for lading due to flexing minute. In instance of masonry walls subjected to both compressive emphasiss due to concentric tonss and flexing minute or bizarre burden, hence there are two conditions that must be taken into consideration. (ECP 204, 2005)

1-

2- P

-is the deliberate compressive emphasis on the wall due to concentric burden (N/)

– is the allowable compressive emphasis on the wall due to concentric burden (N/)

– is the deliberate compressive emphasis on the wall due to flexing minute (N/)

– is the allowable compressive emphasis on the wall due to flexing minute (N/)

-P is the intentional compaction burden (Newton)

– is the burden which induces clasping due to Euler clasping equation (N)

The undermentioned equations province the computation of (Fa) , (Fb) and (Pe) that the deliberate compressive emphasiss must non transcend.

3-

4-

5-

-f ‘ m is the characteristic compressive strength of the wall (N/)

-h is the effectual tallness of the wall (millimeter)

-r is the radius of rotation in the plane perpendicular to the applied burden ( ) (millimeter) where (A) is the transverse sectional country in contact with howitzer

-Em is the modulus of snap of masonry wall (N/) where (Em= 700f ‘ m) for clay masonry and (Em= 900f ‘ m) for concrete masonry

-e is the eccentricity of perpendicular burden (millimeter)

-I is the 2nd minute of country or minute of inactiveness ( )

As mentioned before eccentricity is the distance from the centre of gravitation of the wall to the perpendicular applied burden, therefore the Egyptian codification of pattern bounds the mentioned distance to an extent of non bring oning tensile emphasis greater than the allowable stated by the codification as to forestall failure to happen. (ECP 204, 2005)

Slenderness ratio is calculated through the undermentioned equation [ ] which explains the ratio of the effectual tallness to the effectual length multiplied by the slenderness coefficient where [ ] which explains the ratio of effectual length or effectual tallness whichever is bigger to the radius of rotation and this coefficient is used to account the arrested development of the terminal supports, furthermore to find the effectual tallness and the effectual length the codification states that they are the distances from the centre lines of the perpendicular and horizontal supports. As stated by the Egyptian codification of pattern slenderness ratio must non transcend a value of 90. (ECP 204, 2005)

3. 4. 1. 2 Allowable tensile emphasiss

Masonry is weak in tenseness and strong in compaction, hence working with unreinforced masonry elements depend on compaction burden and restricting tenseness burden that is induced by flexing minute in the out of plane of the wall, hence the Egyptian codification of pattern put restrictions for allowable tensile emphasiss that must non be exceed found in table (3-1, ECP 204-2005) . There are two state of affairss that tensile emphasiss are non allowed and tensile capacity is considered to be zero in masonry edifices which are tensile emphasiss resulted from homocentric burden and shear walls. (ECP 204, 2005)

3. 4. 1. 3 Shear emphasiss

Shear forces induce shear emphasiss on masonry component that when combined with perpendicular compaction emphasiss that may bring on flexing minute may take to failure of the masonry wall as discussed before,

therefore the Egyptian codification of pattern set restrictions for the applied shear emphasis as non to transcend the allowable. The computation of shear emphasis due to an applied shear force is done through the undermentioned equation. (ECP 204, 2005)

a) Walls subjected to shear force and flexing minute perpendicular to plane of the wall

1-

– Q is the deliberate shear emphasis (N/)

– Second is the first minute of country ( )

– Q is the design shear force (Newton)

– B is the effectual breadth of the cross subdivision (millimeter)

– It is the minute of inactiveness ( )

-Calculated shear emphasis is so limited by the Egyptian codification of pattern by non transcending the smallest value of the undermentioned equations.

2- (N/)

3- (N/)

4- 0. 5 (N/)

– = 0. 2 (N/) for ungrouted running bond wall

= 0. 32 (N/) for grouted running bond wall

= 0. 08 (N/) for stack bond wall

– Nitrogen is the perpendicular burden applied on the shear surface (Newton)

– An is the net country subjected to the perpendicular burden ( )

B) Walls subjected to shear force and flexing minute horizontally

5- & lt ; smaller of

6- (N/)

7- 0. 5 (N/)

3. 4. 2 Reinforced masonry: –

This subdivision concentrates about the design of strengthened masonry constructions where tensile capacity is ignored for masonry ; on the other manus steel support is responsible for bearing tensile emphasiss that are subjected to masonry component due to tonss in the in plane and out of plane.

3. 4. 2. 1 Allowable tensile emphasiss in reinforcement steel bars

1- For distorted steel bars (Fs= 0. 5 Fy a‰¤ 165) (N/)

2- For steel wires (Fs= 0. 5 Fy a‰¤ 200) (N/)

3- For smooth steel bars and stirrups (Fs= 0. 4 Fy a‰¤ 140) (N/)

– Degree fahrenheit is the allowable tensile emphasis (N/)

– Fy is the steel output strength (N/)

3. 4. 2. 2 Allowable compressive emphasiss in reinforcement steel bars

-Compression opposition is ignored in the support bars if it is non fixed from the sides to forestall it from clasping, spot if it is fixed from the sides therefore the undermentioned equation is used to cipher the allowable compressive emphasiss. (ECP 204, 2005)

4- Fsc= 0. 4 Fya‰¤ 165 (N/)

– Fsc is the allowable compressive emphasis (N/)

3. 4. 2. 3 Allowable compressive tonss in masonry

To cipher the allowable compressive burden for masonry with disregarding steel compaction opposition refer to allowable compressive tonss and stress equations of unreinforced masonry that was discussed earlier, and for masonry columns or reinforced masonry bearing wall where steel support is fixed the allowable compressive burden can be calculated through the undermentioned two equations. (ECP 204, 2005)

5- Pa= ( ) (1- ( ) for a‰¤

6- Pa= for

– Dad is the allowable homocentric compressive burden (Newton)

– Ast is country of longitudinal steel bars (

3. 4. 2. 4 Calculate tensile emphasiss on strengthened masonry due to flexing minute

-Calculate the tensile stresses on strengthened masonry rectangular subdivision due to flexing minute for masonry and steel support from the undermentioned equations. (ECP 204, 2005)

7-

8-

9- k=

10- J = 1-

– is the deliberate compressive emphasis on the maximal storytellers of the cross subdivision due to flexing minute (N/)

-is calculated tensile emphasis on the support steel due to flexing minute (N/)

-b is the wall breadth (millimeter)

-d is the effectual deepness from the face subjected to compaction to the centre of steel support subjected to tensile emphasiss (millimeter)

-M is the flexing minute subjected on the subdivision

-n is the ration of the steel modulus of snap to masonry modulus of snap (n=)

– is the ratio between steel country to the net country of the masonry cross subdivision

-As is the country of steel subjected to tenseness.

3. 4. 2. 5 Deliberate shear emphasiss

11- Q =

-q is the deliberate shear emphasis (N/)

-b is the effectual breadth of the wall (millimeter)

-Q is the shear force subjected on the wall (Newton)

3. 4. 2. 6 Allowable shear emphasiss

-It is non necessary to utilize shear support in the component if the deliberate shear emphasis (Q) does non transcend the allowable shear emphasis ( ) . (ECP 204, 2005)

12- a‰¤ 0. 3 (N/)

13-

14-

15-Ast=

– Equations 13 and 14 are used for walls subjected to flexing minute and shear force in plane (shear walls and masonry beams)

– is Allowable shear emphasis (N/)

– Meter is the maximal bending minute on cross subdivision (N-mm)

– Ast is the country of steel stirrups)

– Second is the distance between the stirrups (millimeter)

4) Reinforced masonry building as opposed to reenforce concrete building: –

Masonry building as mentioned before started 100s of old ages ago before applied scientists and scientists invented reinforced concrete. Reinforced concrete constructions are lasting and have high compressive and tensile strength due to the strong bond between concrete and support, hence reinforced concrete has high strength in bearing high air current and temblor tonss. Reinforced concrete stuffs are cement, aggregative, sand, H2O and support and they are available in most if non all the markets around the universe, and on the other manus masonry constructions are lasting and lasting and have high compressive strength and low tensile strength if it is unreinforced. Furthermore masonry stuffs are masonry units, steel support if needed and howitzer which is composed of cement, hydrated calcium hydroxide, sand and H2O. To compare masonry to reenforce concrete with regard to clip, stuffs and labor ; traveling through building stairss and processs of both types of constructions is a must.

The current research paper concentrates chiefly on residential edifices in low and medium rise compounds, hence air current and temblor force per unit areas are limited, hence unreinforced and strengthened masonry are this

research paper chief aims and to be more specific burden bearing masonry wall. Load bearing masonry walls are types of masonry elements used to transport perpendicular compaction tonss. Load bearing masonry building stairss are digging for foundation alliance and arrangement made of strengthened concrete followed by insulating plants utilizing bitumen, 2nd measure is the burden bearing wall composed of masonry units either clay, concrete or burden bearing facade units which does non necessitate any daubing or coating bonded together with howitzer and units are aligned chiefly in running bond and erected in several highs, 3rd measure is the strengthened concrete slab constructed in three stairss which are wooden smashing, steel alliance and concrete pouring, concluding measure is the coating which consists of electrical work, healthful work, shocking and outside and inside daubing if needed.

Reinforced concrete building stairss are soil diggings for strengthened concrete foundation alliance and pouring followed by insulating plants utilizing bitumen, 2nd measure is wooden signifiers or shattering for steel alliance and concrete pouring of columns, 3rd measure is wooden signifiers for steel alliance and concrete pouring of beams, 4th measure is reinforced concrete slab which is constructed on strengthened concrete beams, concluding measure is the coating which consists of electrical work, healthful work, shocking and outside and inside daubing.

4. 1 Time of completion

Masonry and concrete building are used all over the universe, depending on the type of construction and part of building. In Egypt concrete is taking over most if non all the constructions built, hence masonry building is non good

known due to several instances that will be discussed subsequently. The information that is traveling to be provided in this subdivision is based on self probe from “ Alrwad Company for Construction ” .

As discussed antecedently ; building processs are non the same for concrete and masonry, furthermore masonry showed a faster public presentation in building as opposed to concrete. Masonry with regard to clip is fast due to the unnecessary signifier work, non being of beams and column in burden bearing walls, steel support can diminish the clip consumed if designed and placed with alternate manner, to be more specific steel has two types of basic alliances, which are perpendicular and horizontal alliances of steel bars, hence to diminish the clip consumed in steel alliance, a method of joint support can be used which is a steel mesh of horizontal bars of lower limit of two and inclined or perpendicular bars are laid on the horizontal bars welded together and set as on unit on the bed articulations of the units and so covered with howitzer, this type of support is really effectual in diminishing clip ingestion as non the same instance if perpendicular and horizontal steel bars are used.

hypertext transfer protocol: //constructionmanuals. tpub. com/14043/img/14043_229_1. jpg

Figure 4. 1. 1: Joint support method (Joint support, 2013)

Excluding the slab and foundation building which is common between masonry and reinforced concrete building processs, a masonry edifice crew is divided into three chief specialisations ; unit alignment worker, steel alliance worker and howitzer commixture worker. The most of import worker

is the unit placing worker where the clip of completion is depending on the sum of blocks that this worker can put per twenty-four hours, to be more specific a worker can put one to one and a half three-dimensional metres per twenty-four hours for illustration if the unit dimensions are 40 centimeters length, 20 centimeters width and 20 centimeters height, therefore a worker can put ninety four units a twenty-four hours (volume of one block = 0. 4×0. 2×0. 2 = 0. 016, figure of blocks = = 94 blocks/day) . This shows that clip in masonry building depends on the worker attempt, steel alliance techniques and size of the work.

On the other manus a concrete crew is divided into five chief specialisations ; signifier worker, steel alliance worker, concrete blending worker on site if ready mix concrete is non used, concrete pouring worker, grating and mechanical vibrator worker. Form work worker can accomplish one and half three-dimensional metres daily, steel alignment worker can aline three 100 kgs of steel day-to-day and concrete worker can pour any volume of ready mix concrete in few hours, hence utilizing ready mix concrete pouring is a factor of diminishing clip ingestion. Columns and beams do non be in burden bearing masonry constructions, hence these two elements consume clip due to edifice of wooden signifiers, steel alliance and concrete pouring. The chief type of work that consumes clip in strengthened concrete building is the signifier work which does non be in masonry burden bearing building, signifier work may be done utilizing either wood or steel signifiers and must be good fixed, more over all other building works completion clip depends on the signifier work completion.

Comparison between reinforced concrete and reinforced masonry building

with regard to clip

A

A

A

Reinforced concrete constructions

Reinforced burden bearing masonry constructions

A

Elementss

work stairss

Work included

Quantity / Day

Work included

Quantity / Day

1

Foundations

a) Form work

Yes

1. 5

M^3/day

Yes

1. 5

M^3/day

A

A

B) Steel alliance

Yes

300

KG/day

Yes

300

KG/day

A

A

degree Celsius) Concrete pouring

Yes

Unlimited

—— —— ––

Yes

Unlimited

—— —— ––

2

Column

a) Form work

Yes

1. 5

M^3/day

No

—— —— ––

—— —— ––

A

A

B) Steel alliance

Yes

300

KG/day

No

— — –

— — –

A

A

degree Celsius) Concrete pouring

Yes

Unlimited

— — –

No

— — –

— — –

3

Radio beams

a) Form work

Yes

1. 5

M^3/day

No

—— —— ––

—— —— ––

A

A

B) Steel alliance

Yes

300

KG/day

No

—— —— ––

—— —— ––

A

A

degree Celsius) Concrete pouring

Yes

Unlimited

—— —— ––

No

—— —— ——

—— —— ——

4

Slabs

a) Form work

Yes

1. 5

M^3/day

No

—— —— ——

—— —— ——

A

A

B) Steel alliance

Yes

300

KG/day

No

—— —— ——

—— —— ——

A

A

degree Celsius) Concrete pouring

Yes

Unlimited

—— —— ——

No

—— —— ——

—— —— ——

5

Load bearing walls

a) Unit alliance

No

—— —— ——

—— —— ——

Yes

1. 5

M^3/day

A

A

B) Mortar arrangement

No

— — –

— — –

Yes

Unlimited

— — –

A

A

degree Celsius)