

Development of Fire Exit Brick using Waste Candle Wax



N. Anuja, A. Senthil Kumar, M. Manikandan, G.Yogesh

Abstract: Fire Exit Brick is a structural building material having sufficient crushing strength and it is generated from the combination of Waste Wax and Granite Powder. The aim of this research is to create a brick which is provided in the outer periphery of the windows and door to hold it. During the time of fire, these bricks will lose its strength and creates a fire escape pathway by just pushing the doors and windows towards outer side to save the people from fire accidents without affecting the structural aesthetic look at low manufacturing cost. It also helpful for the fire fighters to rescue the people from the fire.

Keywords: Granite Powder, wax, fire exit, Crushing strength, Water Absorption, efflorescence.

I. INTRODUCTION

Fire accident is a misfortune that could be either man-made or natural. Fire accident occurs frequently and cannot be controlled easily, but sometimes results in severe loss of life and property. According to the National Fire Protection Association (NFPA), the five most common reasons of fire occurrence in commercial buildings are: Cooking equipment may cause fire because of high cooking temperature, usage of flammable oil and lubricant and excited nature of kitchen. In healthcare facilities, cooking equipment which is responsible for 65% of fires to occurs, 61% in restaurants, 38% in educational institutions, 29% in office properties, 13% stores and mercantile properties. Heating equipment like furnace, boiler, radiators leads to fire when it is subjected to overheating and which is responsible for 14% of fire to occur in industrial or manufacturing industries, 11% in offices, 9% in eateries, 5% in healthcare facilities. Electrical and lighting equipment create fire due to defective wiring, overloaded circuits, loose connections, damaged fuses and imbalanced electrical loads that leads to overheating or sparks that ignite a fire, and which is responsible for 12% of fires in offices, 10% in stores and mercantile, 9% in restaurants, 5% in healthcare facilities.

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Smoking materials like cigarettes can start fire if it is not disposed properly which is responsible for 9% of fires in offices, 7% in restaurants, 5% in healthcare facilities. Intentional fire is the one that occurs as the result of the deliberate misuse of a heating source and which is responsible for 36% of fires in educational institutions, 10% in offices, 6% in healthcare facilities, 4% in restaurants.

II. FIRE SAFETY MEASURES

Fire safety is a fundamental consideration while designing a building and management. Fire safety measures can be assessed with the help of the checklist listed below:

1. Provide adequate means of escape: The sufficient escape routes is the first rule of fire management in the building, in accordance with its scale and occupancy. According to National Building Code (NBC) 2005, specifies the number, size and location of exists and provide a detailed set of guidelines for construction, maintenance and operating building of all types. It also ensures that additional staircase, stairwells should be provided for office occupiers with the provision of adequate ventilation also it is and free of obstacles in order to be effective in case of emergency.

2. Outline clear pathways to exit doors: According to National Building Code (NBC) 2005, specifies the person maximum travel distance should not be more than 7.5m for dead end and 15 m for basement of office building in order to access a fire exit.

3. Install smoke detection systems: According to international building codes, smoke and heat detecting automatic fire alarming system are mandatory elements in building to spot out the fires.

4. Maintaining smoke suppression systems: The usage of proper fire extinguishers like Ammonium Dihydrogen Phosphate is the one of the best solution to extinguish all class of fire and smoke suppression using Magnesium Hydroxide and Ammonium Trihydrate that helps to retard as well as to suppress the fire in the building.

III. PROBLEM ASSOCIATED IN BUILDING DURING FIRE

Lack of fire escape (A way out leading to an escape route having panic bar hardware provided on the door) way and improper ventilation in the building tends very hard for people to escape from the fire and create more problematic for fire fighters to rescue the people who are trapped inside the fire. Provision of more exit way in the building will affects the aesthetic look of the building and increases the cost of construction.



IV. FIRE EXIT BRICK

Fire Exit Brick is the structural building material having sufficient strength for crushing and it is generated by adding waste wax to Granite Powder. The inclusion of wax content in the brick, will deform or lose the strength of the brick when it is subjected to high temperature of more than 100°C due to its deforming property in extreme temperatures.

This brick can be used as a replacement for commercial brick material around the periphery of the windows and doors. Figure 1 (a) and (b) represent the design of Fire Exit Brick used in the outer periphery of the windows and doors, the shaded colour represents the fire Exit Wax Brick, and which will lose its strength when it subjected to fire having temperature more than 100°C. During the time of fire, the doors and windows are easily pushed out, which creates a Fire Exit Way will around the building. Therefore, Fire Exit Window and Door will be created which is very much helpful to escape from the building who are trapped inside the building and it is also possible for fire fighters to rescue the people who stuck inside the building without affecting the structure.

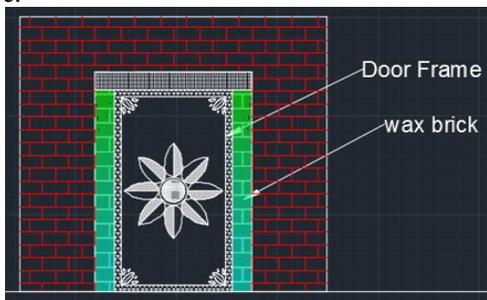


Figure 1(a) Fire Exit Brick used around the door frame

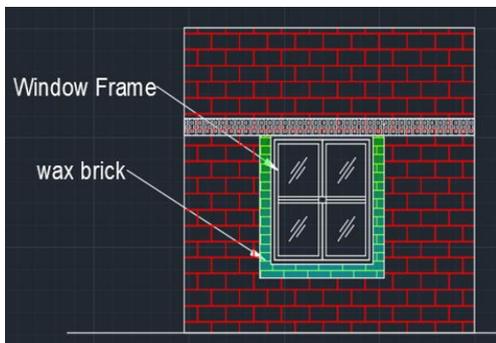


Figure 1(b) Fire Exit Brick used around the window Frame

V.MATERIALS USED

Fire Exit Bricks can be made using the major ingredient of Granite Powder, which is a by-product obtained during the cutting of Granite rock. Figure 2 represents the Granite Powder image. Specific Gravity of Granite Powder is around 2.27 which is affordable to used it as a building material.



Figure 2 Granite Powder

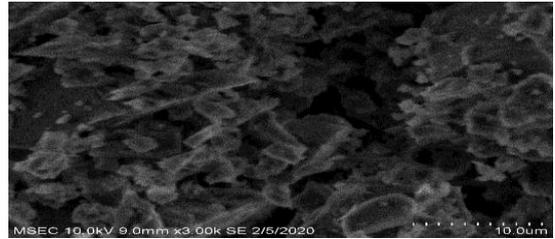


Figure 3 SEM image of Granite Powder

Scanning Electron Microscopic test has been conducted for Granite Powder to determine the physical properties such as size, shape and bonding of the material and results shows that the particles are of size 20µm approximately and irregular in shape. The particles are found to be closely spaced which gives good bonding of particles to occur each other.

VI. PREPARATION

The preparation process of Fire Exit Brick includes mixing 600 grams of waste wax get melted in a pan using hot pan apparatus then 3000 grams of granite powder was added to the melted wax and it is mixed thoroughly. After obtaining the required workability it was poured into a brick steel mould and later compacted uniformly using a rod and surface finishing is done using the trowel then the brick was removed from the mould and kept without disturbing for few minutes to harden. Figure 4 represents the prepared fire exit brick.



Figure 4 Fire Exit Brick

VII. EXPERIMENTAL TESTING

Based on IS 3495 (Part I) 1992, the brick has been tested and the tests involved are:

1. Crushing Strength
2. Water Absorption
3. Efflorescence

Crushing Strength:

Crushing Strength is defined as the ultimate load at which the failure of the bricks occurs. Figure 5 depicts the crushing strength setup of brick in compression testing machine of capacity 1000KN.

Table 1: Crushing Strength of Fire Exit Brick

Sample	Crushing Strength (MPa)
1	7.54
2	7.56
3	7.5



Figure 6 Crushing Strength of Fire Exit Brick

The final Crushing strength of Fire Exit Brick is 7.5N/mm².

Water Absorption And Efflorescence Test:

The Brick code IS 3495 (Part I) 1992 precise that the water absorption should not be greater than 20% by total weight when it is immersed in water for 24 hours. The result shows that it has zero water absorption as well as zero efflorescence value, due to the presence of wax content in the brick.



Figure 6 Water Absorption Test

VIII. RESULTS AND DISCUSSION

The result shows that the crushing strength of fire exit brick as 7.5/mm² and It has zero water absorption and as well as zero efflorescence value. The cost of production of this fire exit brick is comparatively lesser than the conventional brick material and the manufacturing process is quite simple and less time consuming because of its faster setting time.

IX. CONCLUSION

It is observed that the usage of wax content in the brick will have phase changing property during fire.

- It can be used as a fire exit brick with the sufficient crushing strength of 7.5 N/mm².
- The mix proportion of 5:1 of granite powder and wax to obtain a consistent fresh mix.
- The brick has zero water absorption and no efflorescence value.
- Further addition of wax content in the brick leads to the reduction in crushing strength whereas decrease of wax content affects the workability as well as the time consumed by the bricks to melt.

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AUTHORS PROFILE



Dr. N. Anuja is currently working as an Assistant Professor in the Department of Civil Engineering, Mepco Schlenk Engineering College (Autonomous), Sivakasi. She completed her B.E (Civil Engineering) in Government College of Engineering, Tirunelveli and M.E (Construction Engineering and Management) in St.Xaviers' Catholic College of Engineering, Nagercoil.

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