

Proposed Fire Evacuation Plan for Developing Commercial Unit Using Building Information Modelling

¹Manish Baviskar and ²Abhishek Singh

¹Student and ²Assistant professor

¹Town and Country planning Section, Civil Engg Department,

¹SOET Sandip University Nashik, Maharashtra, India

Abstract— Flame departure is a standout amongst the most significant pieces of reaction techniques if there should be an occurrence of flame. Brisk and simple departure plans can help the clients of influenced zone as well as help firemen in basic leadership to control the flame. It is need of time to discover and utilize new propelled strategies rather than regular systems for crisis methods. Building Information Modelling (BIM) is the way toward making 3D insightful model of structure or structure which is utilized and investigated by specialists of different fields. Reason for this examination is to express the utilization of BIM to design crisis techniques and the board in the event of Fire fiasco. For this reason 'EATON India Innovation center ' is chosen as a contextual analysis. 3D BIM model of this structure is created with the utilization of Autodesk Revit 2018 programming with the end goal of study. This model can be helpful for arranging and portraying of 3D fire clearing plans.

Keywords— Building information modelling, Revit-360,3D BIM model, Fire evacuation and escape plan.

I. INTRODUCTION

Debacle implies a disaster or peril or mishaps on greater scale with grievous results and might be common or synthetic, which makes significant harm property, life and condition. It has a nature and greatness which isn't in the limit of human capacity or association of the related region (definition as indicated by Disaster Management Act 2005, Government of India) Fire or combustion is the process of burning. It is a chemical reaction initiated by presence of heat energy in which a substance combines with oxygen in the air and the process is accompanied by emission of energy in the form of heat, light and sound. We know that the continuation of fire needs continuous supply of heat, fuel and oxygen in the buildings. Therefore we must concentrate about these three factors. The supply of oxygen is common and continuous from the atmosphere; Fire Accident is an unplanned or unexpected event in the building environment. The second factor of, fire causes, or sources of ignition in buildings are of two types, the first one is human error type fire, and the second one is appliances type fire. The human error type's fires are children playing with matches, rubbish burning, smoking and intentional fire. The appliances types' fires are electrical appliances, gas appliances, other fuel appliances, acetylene and liquefied gas, solid fuel appliances and other specified causes fire. The survey and study reveals that human error types fire are the main causes of fire in the buildings. The modern materialized society all activities depends on fuel consumption and energy utilization based, most of the energy utilization processes are fire based. This fire based activities has become the main source of fire accident in buildings for most of the time. The third factor of fuel supply based on the nature, quantity and the arrangement of fire load or the combustible materials, which is stored in side of the building.

The major causes of accidents are related to the unique nature of the industry, human behavior, difficult work – site conditions and poor safety management, which results in unsafe work methods, equipment and procedures. Safety is considered as an important function to be used against un-necessary loss of property, injury or death. Preventing occupational injuries and illness should be a primary concern of all employers. The concept of safety culture is especially done in dangerous industries, such as the nuclear industry and off-shore oil industry. The construction industry is regarded as a dangerous industry due to two characteristics; primarily, employees are separated by sites. Although regulations and plans are available, they still have to make decision by themselves when facing specific problems. Secondly, employees in the construction industry move among the companies, sites, and positions more frequently than those in their traditional industries. Because of these two characteristics, while the promotion of safety management and working condition is achieved in a manner that is used by several industries to consciously improve safety performance, they are inadequate in the construction industry. This is due to the two above said characteristics of the work force. One of the reasons is that in the construction industry, safety performance is more relevant to the human factors.

II. Background

A. Disaster management

To manage all parts of calamities fiasco the board, a handy utilization of accessible assets is required. It is rehearsed so as to decrease the destructive impacts everything being equal, including calamities. Fiasco the board incorporates preplanning, reaction, alleviation and recuperation in different periods of calamity.

Phases (4 R) of disaster management are as below.

- Disaster Readiness
- Disaster Response
- Disaster Relief
- Disaster Recovery

Numerous rules and distributions are accessible for Disaster the executives. Calamity the board perhaps means to evade debacles from occurring. A decent methodology ought to be created to ease the outcomes and impacts of any crises. An arrangement ought to be of developing sort over the long haul, and more information ends up accessible.

B. Fire disaster and management

Truth is told, from antiquated occasions, fire has been favoring and revile for mankind. The flame still continues being the most ruinous peril to life and property over our country. Flame is quick, self-continuing oxidation technique joined by the outflow of warmth and light. Flame needs three components for its reality: fuel, warmth and oxidizer. A fire can happen at whatever point, at wherever, may be at home or at workplace or in a hotel or in a mending office or visible to everyone places like theaters, malls, thus on. Flame can break out anyplace as structures over the ground like structures, underground like mines or on ground like timberland fire. It can happen in any condition. It tends to be abrupt and unusual. Like firestorms can broke out in light of both, normal or by artificial mishaps.

In 'Point of convergence of Fire Statistics 2018' by "Committee Technique International de balancing activity et d'extinction de Feu" (CTIF) and International Association of Fire and Rescue Services, estimations on fire events for 55 countries over the world for the time period of 2012-2016 is given. Figure 2.1 shows the dissemination of assessed passing from fire, heat and hot substances wherever all through the world per hundred thousand tenants. Agreeing Figure 2.2 of this report India best the summary for 'Scattering of surveyed casualty from fire, heat and hot substances consistently by W.H.O. with 51,222deaths consistently where second spot holder is Russia with 14,592 casualties for every year.

According to the measure by National Crime Records Bureau (NCRB), that every ONE HOUR nearly 38 PERSONS were slaughtered in India in light of unnatural disasters in the midst of the year 2015. The NCRB data in like manner reveals that in India on an ordinary 50 individuals pass on reliably on account of flame mishaps and it has expanded to 55 out of 2017 as indicated by Fire and Security Association of India. No expansive data is open in India on the money related setbacks suffered on account of blazes and impacts. Regardless, according to one measure, about Rs. 2000 - 3000 crores are lost every year due to flares and impacts.

Table 1: No of deaths in various countries due to fire

Country	No of deaths due to fire
Indonesia	1439
Ghana	1480
Algeria	1522
Bangladesh	1701
Thailand	1626
kenya	1858
Iran	2068
Mozambique	2142
Uganda	2208
South Africa	2256
Sundan	2666
Cote de ivore	2688
USA	2938
Angola	3243
Pakistan	3821
Congo	5142
Ethopia	5156
Nigeria	10138

China	10380
Russia	14592
India	51222
Chad	1099
Japan	1366
Brazil	1389

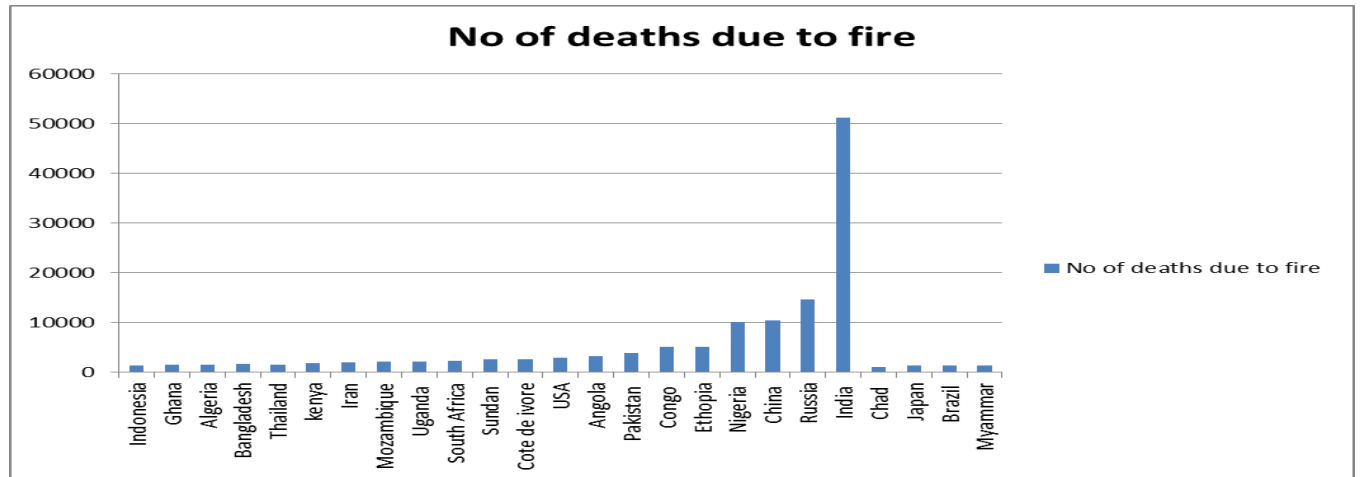


Fig. 1. Distribution of estimated deaths from fire, heat and hot substances (WHO 2015)

III. Study Area and data sets

A. Study Area

Figure 1 shows the study area chosen for the study, Pune is also called Poona, the official name until (1978), is the second largest city in the Indian state of Maharashtra, after Mumbai. It is the ninth most populous city in the country with an estimated population of 3.13 million. Along with its proudly extended city limits Pimpri Chinchwad and the three cantonment towns of Pune, Khadki and Dehu Road, Pune forms the urban core of the eponymous Pune Metropolitan Region (PMR). According to the 2011 census, the urban area has a combined population of 5.05 million while the population of the metropolitan region is estimated at 7.27 million. Situated 560 meters (1,837 feet) above sea level on the Deccan plateau on the right bank of the Mutha River, Pune is also the administrative headquarters of its namesake district. In the 18th century, the city was the seat of the Peshwas, the prime ministers of the Maratha Empire and so was one of the most important political centers on the Indian subcontinent. Pune is ranked the number one city in India in the ease of living ranking index.

The city is considered to be the cultural capital of Maharashtra. It is also known as the "Oxford of the East" due to the presence of several well-known educational institutions. The city has emerged as a major educational hub in recent decades, with nearly half of the total international students in the country studying in Pune.[33][34] Research institutes of information technology, education, management and training attract students and professionals from India and overseas. Several colleges in Pune have student-exchange programmes with colleges in Europe.

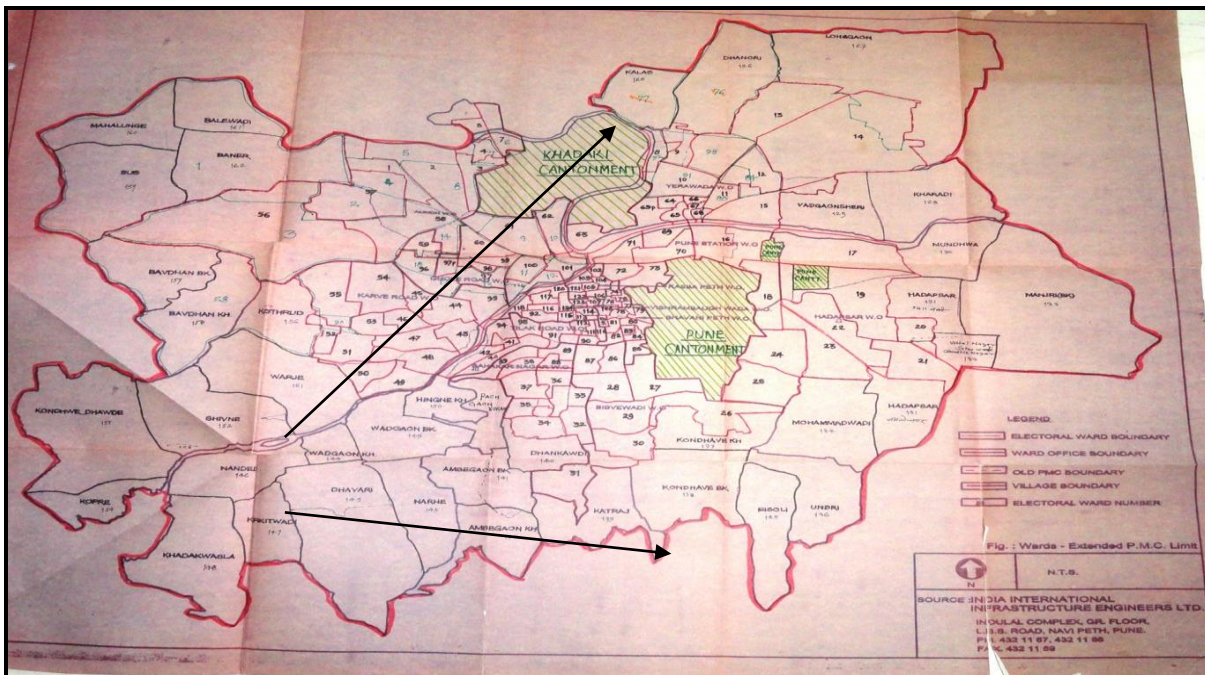


Fig. 2. Study area



Fig. 3. Location of EATON India Innovation Center Hadapsar, Pune (Site)

Name of the Site	- Eaton India Innovation Centre
Location of the Site	- Building B6 & B7, S1 & S2, MagarpattaSEZ Entrance, Magarpatta, hadapsar, Pune, Maharashtra-411028
Design Team	- Principle Consultant – S.W.Mone and Associates
Owner and developer	- Eaton India Pvt.Ltd
Builder	- Eaton India Pvt.Ltd.
Architect	- S.W.Mone and Associates
Structural Engineers	- S.W.Mone and Associates
Cost of the project	- 2.20 cr.
Site Area	- 1.35 acre
Present Condition	- External development has been completed and civil and Interior work for Internal cell areas been in under process.

Entire project is constructed considering the LEED requirements and used lot of sustainable materials to build it. G+1 Proposed Building having variety of cell areas for innovation of products and it's Purely a Innovation centre.

B. Problem Statement

- Name of the Site-Eaton India Innovation Centre
- Location of the Site-Building B6 & B7,S1 & S2,Magarpatta SEZ Entrance,Magarpatta, Hadapsar, Pune, Maharashtra – 411028.
- G+1 Proposed Building having variety of cell areas for innovation of products and its Purely a Innovation centre
- Design Team - Principle Consultant – S.W.Mone and Associates
- Owner and developer-Eaton India Pvt.Ltd
- Builder- Eaton India Pvt.Ltd.
- Architect-S.W.Mone and Associates
- Structural Engineers-S.W.Mone and Associates
- Cost of the project-2.20 cr.
- Site Area-1.35 acre
- Present Condition-External development has been completed and civil and Interior work for Internal cell areas been in under process.
- Entire project is constructed considering the LEED requirements and used lot of sustainable materials to build it.

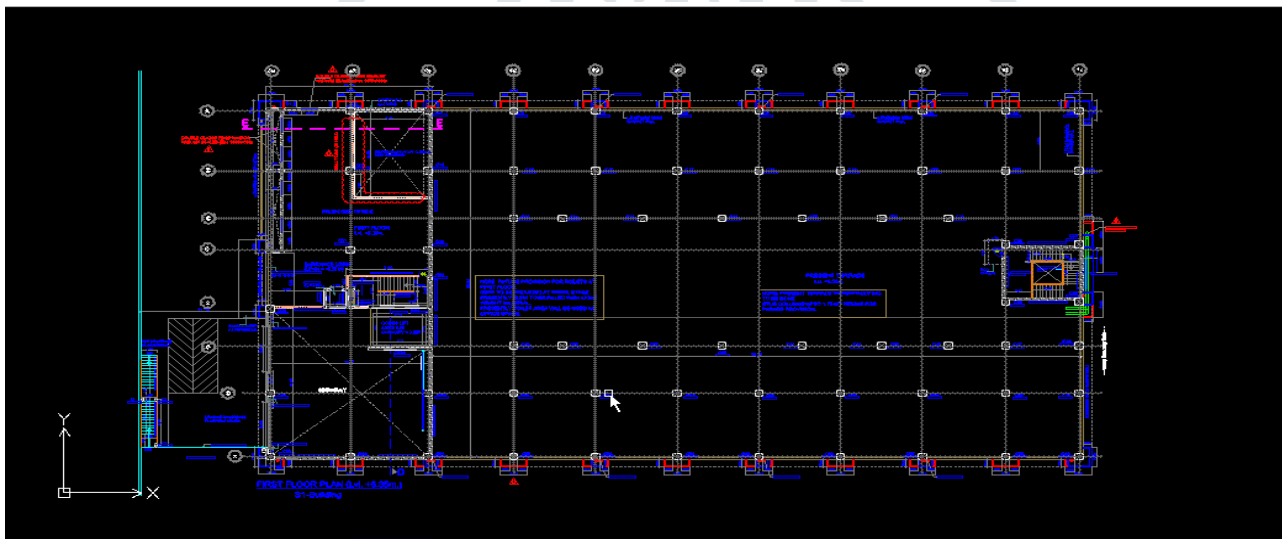


Fig. 4. Layout Plan

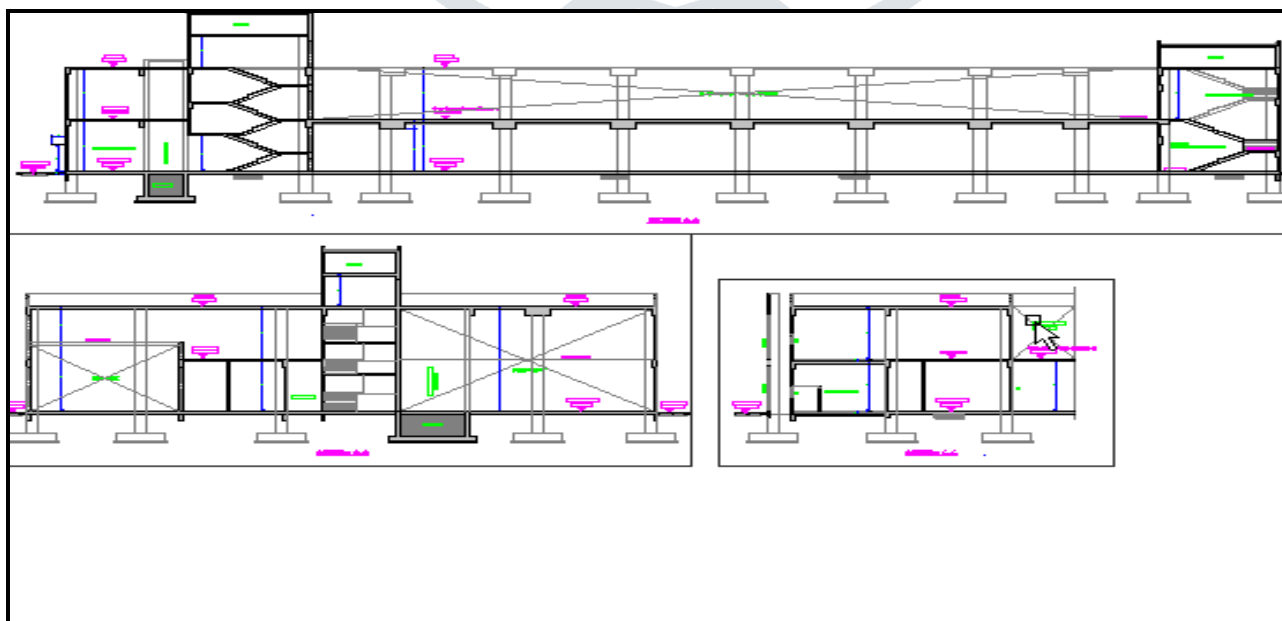


Fig. 5. Elevation Plan

C. Development of BIM model and fire evacuation plan

Compositional or building information is required for creating 3D show dependent on BIM for flame departure arranging amid crisis. With some increasingly other information, very clear design plan inside most limited time can be accomplished and created, which will likewise contain important data required for the security building inhabitants if there should arise an occurrence of crisis departures. This contains: choosing the most limited courses between every individual room ways to closest escape stair way, area of accessible flame security gear, numbers and names of rooms, subtleties of openings, for example, windows and entryways, number of different alterations assuming any. To finish the BIM model of the flame departure plan, it is important to utilize floor plans with the previously mentioned information.

For arrangement of crisis departure plans, floor plans of individual floors were utilized as a base. First the 2D clearing plans were made. For this reason most limited and conceivable break courses for every unit are considered and estimated. Areas of closest staircases were recognized. At that point by coordinating this information clearing plans for every floor are readied. These plans incorporate most limited getaway courses for all units, conceivable departure courses for all units, area everything being equal and current area of onlooker. Figure 6.3 is a case of 2D escape plans of every individual floor.

3D departure plans are created dependent on these 2D designs as it were. 3D plans are made by reconciliation of 3D BIM model of EATON INDIA INNOVATION CENTER and every individual units most limited getaway way. Walkthroughs are made for every single unit's fundamental entryway till the last leave entryway of structure. This clearing plans can be extremely useful for ordinary guests and representatives. As these plans incorporate crisis clearing situations, conceivable choices which can help in basic leadership, areas of security hardware like flame doublers, fire hose and so forth. These plans will be more effective than ordinary traditional 2D designs as they are in 3D which will help in better comprehension of structure.

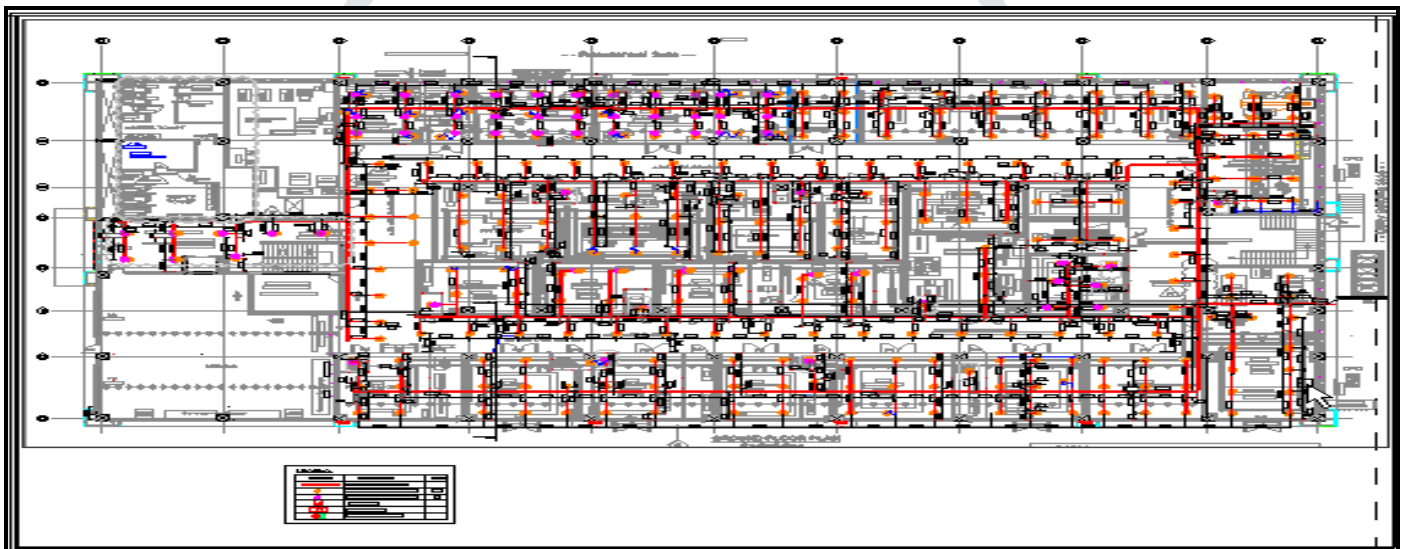


Fig. 6. Final as built drawing of ground floor lab plan.



Fig. 7. Various walkthrough images of fire evacuation plan

IV.RESULTS AND DISCUSSION

By utilizing the accessible stock information and engineering plans BIM show for 'EATON India Innovation Center' is made. At that point results are inferred as in four sections.

Initial segment, a 3D insightful BIM model of Eaton India Innovation Centre, for local groups of fire-fighters as stock information which can be utilized for crisis reaction arranging, peril zone investigation or counterfeit drills. Local group of fire-fighters can utilize this model in two different ways. As a crisis readiness information (before crisis) and reaction arranging (amid or after emergency).Emergency readiness contains conceivable fake drills arranging and executing it. What's more, reaction arranging contains help in basic leadership with earlier information of security gear (fire hydrants, fire hose, quenchers, clearing courses, wellbeing arrangement of structure,), unsafe zones/zones, any new adjustments in structure/building, conceivable passage and ways out to complete the departures and so on.

Second part contains 2D escape plans (figure no.7.6 to 7.19) for ordinary guests. This arrangement demonstrates most brief break course and conceivable departure courses for each room which can be followed if there should arise an occurrence of crisis. This arrangement contains floor shrewd plans with briefest and conceivable departure courses appeared red lines just as places of security gear and markers.

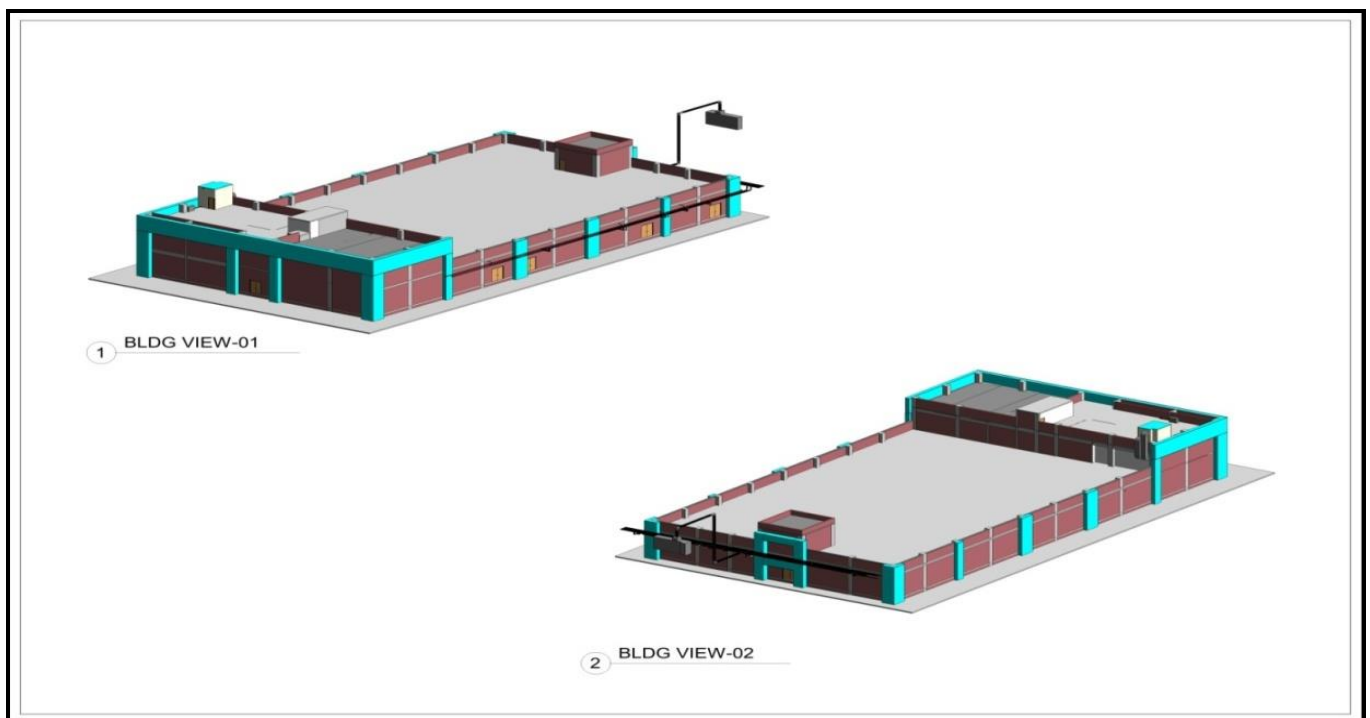


Fig. 8. 3D BIM Model of EATON India Innovation Center.

V. Conclusions

As by everyday life we can see that fire incidents happens like each day. Passing's and misfortunes brought about by them are galactic. Out of which in such episodes most causalities happens because of wasteful departures.

There this investigation centers on conceivable progressions in such crisis and clearing methods. Furthermore, the arrangement found for it, is BIM. This investigation proposes a working 3D shrewd physical model of a structure which can be utilized for such circumstances. This examination likewise presents conceivable employments of such models and future extension.

BIM Fire departure models can be utilized by enterprises just as by government to do crisis reaction and moderation arranging. As we realize that in development industry BIM models for proposed assembling is getting to be vital. Government or related ventures can straightforwardly utilize these models to design proficient crisis arranging strategies. Along these lines utilization of BIM models for arranging of departure courses can be both effective and affordable.

IV.ACKNOWLEDGMENT

I would also like to thank to all the faculty members of the department for their valuable guidance and support during the course of my work. Also I would like to thank all my friends who have directly or indirectly helped me in my project work.

References

- [1] Marcelo Franco Porto, José Ricardo Queiroz Franco, Lucas Vinícius Ribeiro Alves "BIM as a Structural Safety Study Tool in Case of Fire - BIMSCIP".

- [2] L. Sanchesa, J. G. F. Abdallab, M. A. S. Hippertc" BIM as support for design process with fire safety regulations"
- [3] Moshood Olawale Fadeyi, Sustainable Infrastructure Engineering (Building Services) Programme, Singapore Institute of Technology, 10, Dover Drive, Singapore 138683, Singapore Received 18 November 2016; received in revised form 18 July 2017; accepted 30 August 2017
- [4] Marcelo Franco Porto, José Ricardo Queiroz Franco, Lucas Vinícius Ribeiro Alves " BIM as a Structural Safety Study Tool in Case of Fire - BIMSCIP"
- [5] Johan Norén , Mattias Delin, Fredrik Nystedt " Fire protection engineering in a BIM environment"
- [6] Shih-Hsu Wanga Wei-Chih Wangb1 Kun-Chi Wangb Shih-YuS hihb "Applying building information modeling to support fire safety management "This work designs a BIM-based model to support fire safety management of buildings
- [7] Dong-Ha Ryu.(2016)[8]" A risk expression system design plan to construct an integrated assistance process for disaster response
- [8] Lee, Kang-Hun. (2016)[19]"Effective risk map data service plan through web and app system link"
- [9] M. Kobes, I. Helsloot, B. Vries, de, J.G. Post" Building safety and human behavior in fire : a literature review"
- [10] Yalcin, G." 3D city modeling with Oblique Photogrammetric Method"2015.
- [11] Wang, S. H."Applying building information modeling to support fire safety"2015.
- [12] Ruppel, U."Designing a BIM-based serious game for fire safety evacuation simulations"2011.
- [13] Urban infrastructure resilience to fire disaster: An overview by Gernay, T. 2016
- [14] Using BIM model for Fire Emergency Evacuation Plan. In MATEC Web of Conferences (Vol. 146, p. 01012). EDP Sciences by Stančík, A.2018

