Dr. Akhilesh Das Gupta Institute of Technology &
Management, New Delhi
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Message from Chairperson

The Department of Civil Engineering has always been a gem of Dr. Akhilesh Das Gupta Institute of Technology & Management. The perennial zeal of the Department has never left the achievements stagnant. The Department not only gives students the exposure to the regular engineering curriculum but also to the aspirations of today's corporate World, thus inculcating a professional aptitude in them.
The dedication of the faculty members has strengthened the learning process ensuring an environment of collaboration, experimentation, imagination and creativity. It is such a prodigious delight in watching the student's cutting edge in technical exploration, enhancing their analytical skills and brushing themselves up for the rapidly changing sector and establishing themselves as entrepreneurs and engineers.

The Department has always reached new heights and I am looking forward to more wonders and achievements. I wish the very best to the Department of Civil Engineering for the publication of the proceedings of International Conference on Sustainable Development and Recent Trends in Civil Engineering (ICSDRT-2022). The proceeding beautifully provides an overview of outcome of research in application of advanced techniques and computations in Civil Engineering done by researchers, developers and practitioners.

Mrs. Alka Das Gupta
Chairperson
BBD Group of Education

Message from President

I am extremely happy to witness the shaping up of the proceeding of International Conference on Sustainable Development and Recent Trends in Civil Engineering (ICSDRT-2022). A special mention to the Editorial Board, who were able to capture the noteworthy proceedings of the Civil Department of Dr. Akhilesh Das Gupta Institute of Technology & Management and were also able to present it in an alluring manner.
I thoroughly enjoyed myself going through researches done in the field of civil engineering, the technologies and innovations in the research papers of this conference. I hope students and faculty members find this proceeding as sound as, I did. I congratulate the Department and the Editorial Board for this achievement.

Mr. Viraj Sagar Das
President
BBD Group of Education

Message from CEO

Shri S. N. Garg
CEO, ADGITM

A teacher is a person who mends the mindset of a student, nurtures and wings it, on the other hand a student believes his teacher and gives his future in hands of his mentor. No responsibility is as big as molding a life. As CEO of Dr. Akhilesh Das Gupta Institute of Technology & Management, I ensure at every step to strengthen this teacher-student relationship.

Civil Engineering Department of the Dr. Akhilesh Das Gupta Institute of Technology & Management is another satisfying establishment I witness on a regular basis. There is nothing more gratifying than to see all the unstoppable avidity collected and preserved in this proceeding. This is a commendable work done by the sedulous team of all the faculty members. They were able to present not only the achievements of the department but also the inspiring examples which will galvanize the amateurs to achieve big than their dreams.

Message from Director

Prof. (Dr.) Sanjay Kumar
Director, ADGITM

"Engineering is not only the study of the technical subjects, but it is about living an intellectual life."

As the Director of Dr. Akhilesh Das Gupta Institute of Technology & Management, I strongly believe that education is not only about imparting knowledge but more about opening the individual's mind to self-expression. I saw an overwhelming response by the students not only in the technical domain but also in the branch of sports, arts, photography, music and a lot more. I am confident that with such a positive and progressive attitude they would be able to justify the credibility of the Department as well as the college by bringing laurels and accolades.

I am immensely proud to observe a team of such enthusiasts. The proceeding of International Conference on Sustainable Development and Recent Trends in Civil Engineering (ICSDRT-2022) of the Department of Civil Engineering, has been able to make a count of all the achievements, hard work and dedication of the faculty members. I wish them luck

Vision of the Institute

To produce globally competent and socially responsible technocrats and entrepreneurs who can develop innovative solutions to meet the challenges of 21st century.

Mission of the Institute

- To provide value-based education through multi-grade teaching methodologies and modern education facilities.
- To sustain an active partnership programme with industry and other academic institutes with an aim to promote knowledge and resource sharing.
- To conduct value-added training programme to enhance employability.
- To provide conducive environment for development of ethical and socially responsible technocrats, managers and entrepreneurs.

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To produce civil engineers equipped with excellent technical research and leadership skills for globally competent environment.

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INDEX

Analysis of Wind on Different Shape of High-Rise Structure

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***Abstract*— Availability of land is the big issue to avoid such issues different shape of high-rise structure are being constructed all around the world. There for their evolution to resist the wind effects are utmost important because of that numerical simulation is performed on different shape of high-rise structure. This paper presents the effect of wind on the different shape of tall buildings using Computational Fluid Dynamics (CFD), ANSYS CFX version 2020 R2 on a 1:200 length scale. The results show that pressure distribution is not exactly same but more or less same in nature for only windward wall of different building models. ANSYS CFX is being used. Following the simulation, near-field flow patterns around the bluff aerodynamics form are addressed, and aerodynamic mean pressure coefficients are compared to an international standard, which demonstrates good agreement with the results. The plan arrangement and size of the model have been discovered to have a direct impact on the wind pressure distribution on the windward face of all the models considered. On all three models, Face E has a substantial impact on pressure distribution. The pressure distribution on the windward and leeward faces of all the models is comparable.**

Keywords—l-shape, hexgon shape, pressure contours,CFD,Wind effect

I. INTRODUCTION

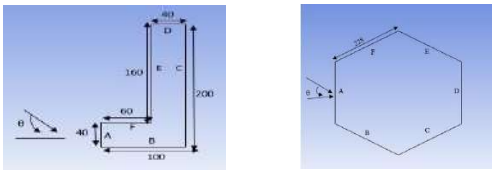
High-rise residential buildings have become more widespread in many cities as a result of increasing population and rising urbanisation, displacing broad regions of vernacular dwellings. These constructions are vulnerable to time-varying loads induced by winds, earthquakes, and other natural calamities, in addition to gravity loads. Tall buildings have a high sensitivity to wind excitation. .[1]–[5]. Chauhan and Ahuja [6] Due to the existence of two additional closely spaced tall buildings with a similar design, the height effects of interfering structures on wind pressure distribution on rectangular plan tall buildings were studied. . The configuration appears to have a significant impact on wind pressure distribution on the major building's faces, as well as the building's height. The total wind force is equal to the sum of windward pressure and leeward suction, but each of these has its own local impact. As a result, when planning for wind loading, the pressure coefficients and force coefficients for other buildings subjected to wind-induced loads, designers consult replated wind load standards. [7], [8], [17]–[20], [9]– [16]. Ahlawat and Ahuja [21] Wind tunnel studies were conducted on models of tall buildings with a "T" plan form to assess wind loads, and it was discovered that the wind flow patterns around the building are substantially influenced by the nearby buildings. Ahlawat and Ahuja [22] Using a wind tunnel test, an experimental investigation was conducted on tall structures with a "Y" plan shape, and it was discovered that the wind incidence angle affects wind pressure distribution. Paul and Dalui [23] Wind effects on cross-plan tall buildings were discussed. . Raj and Ahuja [24] Observed that base shear, base moments, and twisting moments are impacted by wind incidence angle and affected by cross- sectional shape in an experimental investigation on cross- shape tall buildings with varied cross-sectional forms. . Vafaeihosseini et al.[25] The most economical shape for tall structures is rectangle plan shape, according to researchers who employed computational fluid dynamics to investigate wind effects on high-rise buildings. Meena et al. [26] discussed the effects of wind on the bracing system used in various types of multi-storeyed steel buildings. Pal et al. [27] carried out a comparative study on square and fish plan shaped tall building of wind-induced mutual interference effect, maximum efficiency in terms of wind-induced mutual interference pressure, and base shear ix exhibited by square plan shaped model at full blockage condition. Verma et al. [28] analyzed the effects of wind load on tall building octagonal shape, using CFD simulation for 0^0,15^0 and 30^0 wind incidence angle, found that CFD can be used to predict wind-related phenomena on building and other types of structure. Nagar et al. [29] carried out an experimental study of wind-induced pressure on tall buildings of different shapes

from 0^0 to 90^0 wind incidence angle at an interval of 30^0, found that wind pressure decreases up to 60^0 wind incidence angle, "H" plan shaped building is subjected to a higher pressure than the square Model. Chandan and Kumar [30] discussed the numerical simulation of wind analysis of tall buildings using computational fluid dynamics. CFD can result in nearly wind tunnel experiments. CFD could analyze the complete domain study, better-visualized results, and cheaper than that of wind tunnel test. Bairagi and Dalui [31] discussed the aerodynamic effect on the setback of tall building using CFD simulation for 0^0 to 180^0 of wind incidence angle, high positive pressure developed in the setback of roof compared to the top roof due to high turbulence, maximum spectral density frequency developed at the extreme location of setback roof, where the turbulence is maximized. Mendis et al.[32] conducted wind tunnel testing on tall buildings discussed various parameters related to the design of a tall building. Roy et al. [33] did a critical review of wind load on high rise building with different configurations, wind pressure coefficient is maximum in case of square plan shaped building and minimum in case of circular plan shaped tall building, octagonal plan shaped building is with the sharp windward edge is more effective in reducing wind pressure coefficients than hexagonal plan shape of tall building with sharp wind ward edge. The wind forces acting on a building and the motion that arises are directly influenced by the shape of the building. By carefully designing the construction components and geometry of tall buildings, wind excitation is reduced and costs are reduced. Passive aerodynamics adjustments in the form of building shape are one of the most potent and adaptable construction approaches for considerably minimizing the impacts of wind forces by changing/altering the flow pattern around the buildings.

II. Numerical Analysis by ANSYS CFX

A. Model

For studying the influence of wind on various shape of high-rise structure two shape of building are considered in this study, the model is depicted in fig. 1



(a)

(b)

Fig.1 Models with Dimension

B. Boundary Condition

Every problem which are solved using the numerical simulation need to provide the definite boundary condition that is why in this study the boundary condition are taken from Meena et al. [34]. Such a huge dimensions are applied because of that no back formation occurred in the applied domain of virtual wind tunnel. The building is placed on the ground of the virtual wind tunnel and the building model is having the particular dimensions. The side wall and top are considered as fee slip wall while the ground is no slip wall

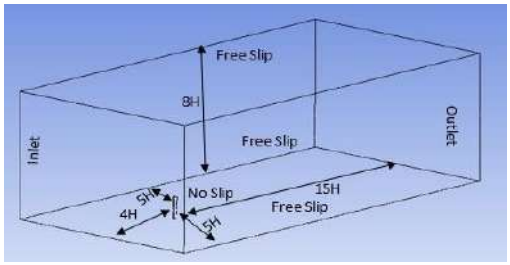
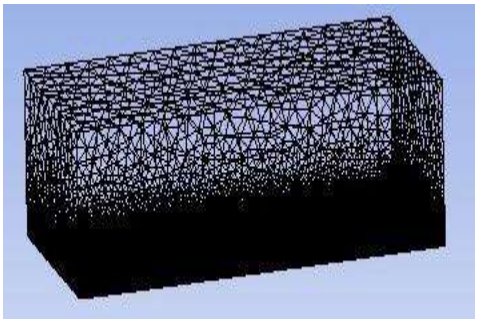


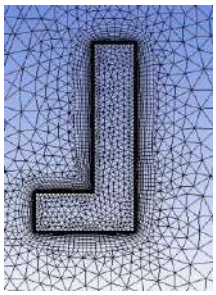
Fig.2 Computational Domain dimensions and boundary condition

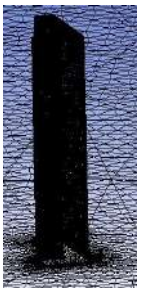
C. Meshing

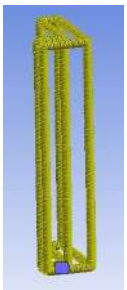
A good mesh may not result in an optimal solution, but a poor mesh will always result in a bad solution. Meshing is provided as shown in Fig.3, and inflation is provided. The effects of air in the separating zone are depicted in Fig.3 (b). Meshing is difficult to achieve since it is dependent on the intricacy of the problem. Because the governing equation cannot be applied to an arbitrary shape, the computer is unable to solve the simulation on the actual geometry shape. In defined volumes, mesh elements allow governing equations to be solved consistently and mathematically. (a) Full domain meshing, (b) building meshing, which is finer than the other meshing, and (d) edge meshing, which is supplied to avoid the anomalous flow. .



(a) Domain Meshing







(b) Inflation (c) Building Meshing (d) Edge meshing

Fig. 3 Meshing

III. Result and Discussion

Result of velocity profile, pressure contours and stream lines for various building shape is presented graphically in various plots in flowing sections.

A. Velocity Profile and Turbulent Profile

The Coriolis force and a pressure difference over a different section of the planet cause wind to blow. The formation of an atmospheric boundary layer near the ground is caused by the roughness of the ground. Due to ground impediments, the wind becomes extremely turbulent. The vertical profile of wind speed is determined by the degree of ground roughness and drag caused by local projections that oppose wind flow. The gradient height is the height at which the drag effects disappear, and the gradient velocity is the velocity at which the drag effects diminish. The height at which topography effects wind speed is known as the atmospheric boundary layer. The wind speed profile within the atmospheric boundary layer, as seen in Fig. 4, is determined by equation according to Power Law (1)

$$\frac{U}{U_H} = \left(\frac{Z}{Z_H}\right)^{\alpha} \quad (1)$$

Where U is the horizontal wind speed at an elevation Z; U_H is the speed at the reference elevation Z_H, which was 10 m/s; is the ground roughness parameter, which is 0.147 for terrain category 2; and Z_H is 1.0 m .

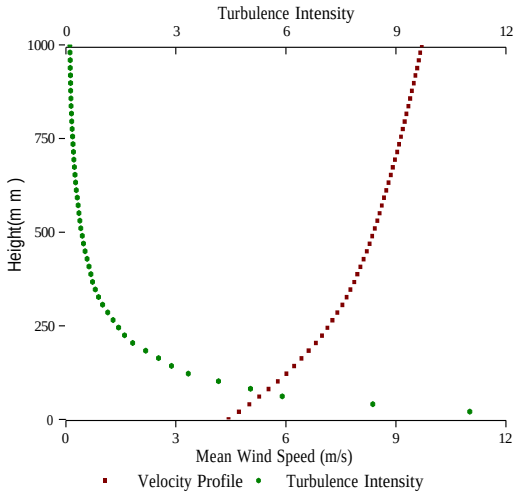


Fig.4 Velocity profile and Turbulent Intensity profile

Because of the friction between the surface and moving air, wind speed at the surface is quite low, as seen in Fig.4. This study's wind profile is identical to the wind profile described in ASCE 7 and earlier research in this area.

B. Pressure Contour

For Model A and B, the pressure on the windward face is positive. It is negative for a leeward face, as seen in Figs. 5 and 6. Figure 5 depicts the graphical representation of pressure on each face of the Model A, with the maximum pressure in the centre and decreasing in the corner region. The rest of model A's faces are under the influence of negative pressure, as shown in Fig.5. Face B's pressure distribution shows that it is lessening in magnitude as we move along the wind direction due to the suction created, while face D and face F have an almost identical pattern of pressure distribution, increasing as we move along the wind direction. Face E depicts how pressure distribution is affected by component size as illustrated in Figs. 5. Model B has the same pressure distribution pattern. Only the difference for face E is shown.

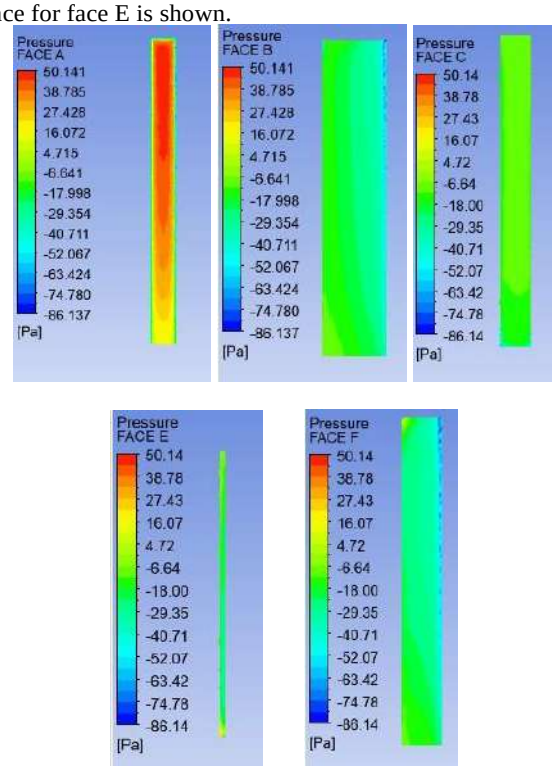
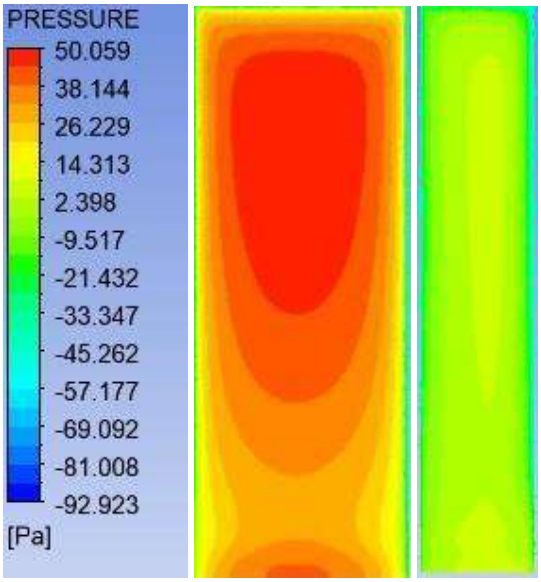
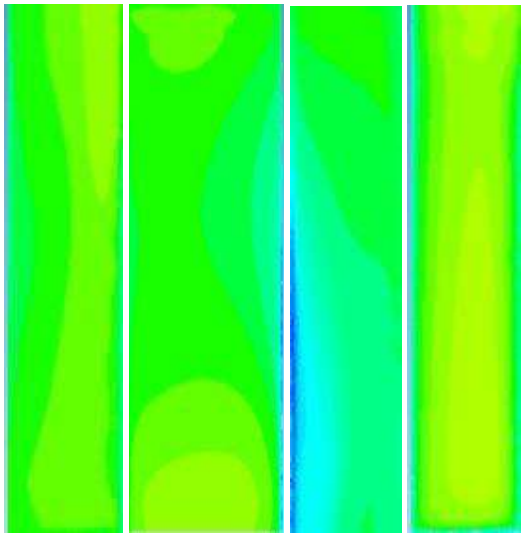


Fig.5 Pressure Contour on Building Model A



Legend FACE A FACE B

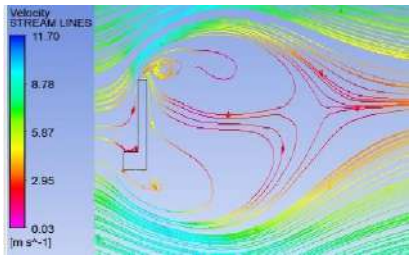


FACE C FACE D FACE E FACE F

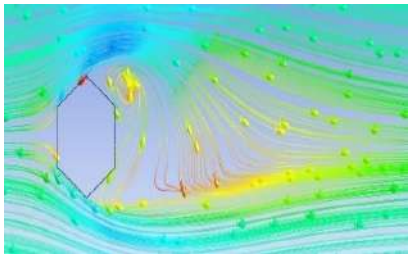
Fig.6 Pressure Contour on Building Model -B

C. Velocity Streamlines

A streamline is an imaginary line in a fluid whose tangent at any point represents the direction of the velocity of a fluid particle at that location. Because various flow patterns are observed for all models, and it is due to the variation in the plan shape of the building, the streamline for 0^0 wind incidence angle for model A and model B in the plan is shown in Fig. 7. In the wake zone, vortices are formed. On the leeward side of the building models, it will cause negative pressure. On the downstream side of building models for model A is having the vast recirculation zone of air can be seen. For a 0^0-wind incidence angle, the streamline is depicted in Fig. 7 in plan and Fig. 8 in elevation for all model buildings. The direction of streamlines is shown by the fish in Figures 7 and 8. And the colour scale indicates the velocity of streamlines, which is higher on the windward side than on the leeward side, and the vortices generated also depend on the side ratio of the building, with a larger recirculation zone on the leeward side of model A as shown in Fig. 7 and a smaller recirculation zone on the leeward side of model B as shown in Fig. 7.

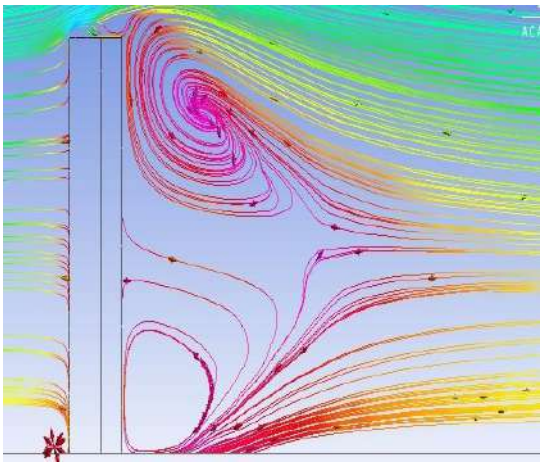


Leagend Model A

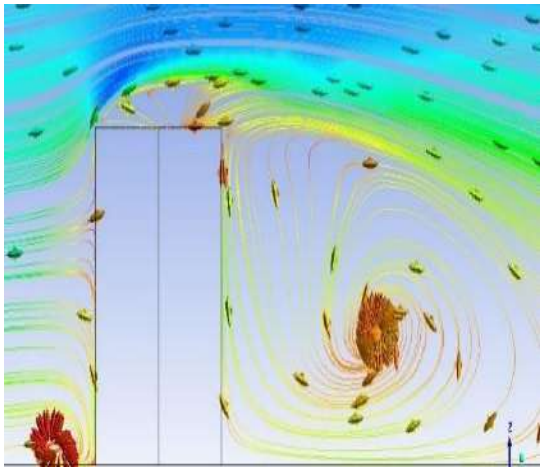


Model B

Fig. 7 wind flow patterns around the building model in plan



(A) Model A



(B) Model B

Fig.8 Wind flow patterns around the building models in Elevation

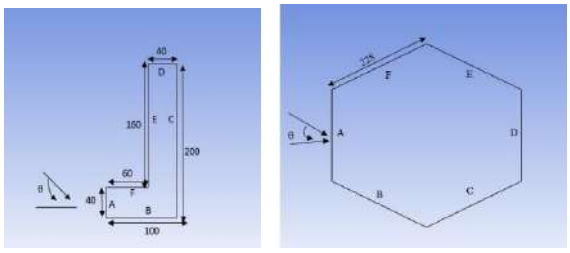
The various types of vortex shedding are depicted in Figure 8. CFD simulation is used on tall buildings to minimise the effect of wind, which is dependent on the shape of the building. Low-pressure zones are created when the river flows through the bluff bodies. In the wake region of buildings, vortex shedding occurs. When airflow moves through the building, it tends to diverge from the building's rear boundary. It spins into a vortex.

D. Pressure Coefficient

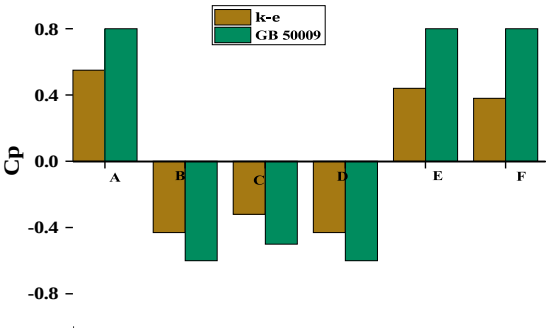
The mean pressure coefficient '$C_{p\ mean}$' is calculated from equation (2)

$$C_{p\ mean} = \frac{p - p_o}{\frac{1}{2}\rho U_H^2} \quad (2)$$

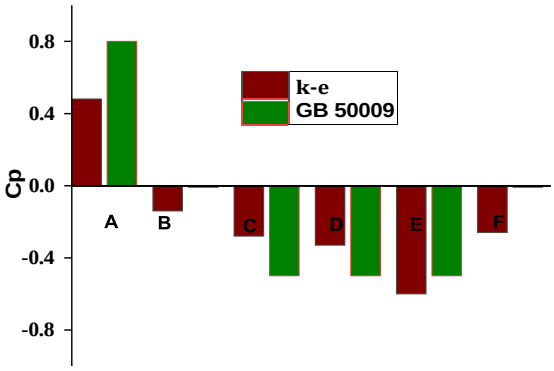
p . is the reference height static pressure, is the air density o (1.225 kg/m3), and,,$U_H^{\wedge 2}$. is the mean wind velocity at the building reference height.



Model-A Model-B



Pressure Coefficent on Mean Cp at model-A



Pressure Coefficent on Mean Cp at model-B

Fig. 9: Comparison of mean pressure coefficients on a different face of all Model between numerical result and GB 50009 (International Standard)

Figure 9 depicts the average Cp for all of the participants. Model, it can be deduced from Figure 9 that face A, E, and F are the only faces that are under the impact of positive pressure. The above figure illustrates that mean Cp values show a good agreement between numerical results and international standards, and model A, have nearly the same nature of pressure distribution in terms of positive and negative pressure coefficients. While for model-B it is clearly indicated that postive nature of pressure distribution is observed on the face-A while rest of the other faces is having the negative pressure distribution.

IV. Conclusions

In this work, the pressure contour, mean pressure coefficients, and velocity streamlines for the L-shape and hexagon building model are compared at 0^0 wind incidence angles. This research is simulated using the k-ε Model. The following are the primary findings of this study

- The goal of this study is to determine the pressure distribution on all sides of the building, and the pressure contour on all sides is reported in this paper.
- The suction on the leeward and side faces of the building models is significantly affected by changes in the side ratio of the building.
- Model A has a maximum pressure coefficient of 0.7 on windward face A and a minimum pressure coefficient of 0.65 on side face F.
- For both models, Face A always has positive pressure, whilst the other face always has negative pressure.
- The side ratio of building models affects the pressure distribution on Face E, with maximum pressure distribution for model C and minimum pressure distribution for model A.
- Faces E and F are the two sides of the same coin. For all three models, the pressure distribution on the windward face is nearly identical.
- The velocity streamlines are depicted in the plan and elevation using the figure.
- As with a boundary layer wind tunnel, the precision of the results is determined by meshing the geometry model and determining the flow physics.
- The development of vorticity, which displays high turbulence, can be seen in the wind pressure distribution on the leeward face of this study.

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The authors would like to express their appreciation to Dr. Manvendra Verma for his precious suggestions and motivation to complete this work on time. Delhi Technological University provided the resources and fund to conduct this study. Our sincere gratitude towards this institute.

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Numerical modelling of rainfall-induced landslide

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***Abstract*— During the monsoon season, landslides are a typical occurrence in the Indian Himalayan region, resulting in loss of life and property. Because these are new fold mountains, seepage is a major factor in slope instability during rainstorm events. In Himachal Pradesh, India, a rainfall-induced landslide was investigated using a transient seepage and slope stability model.was carried out in this work. The slope failure mechanism was investigated using transient analysis over a 30-day period with 10 mm/hr rainfall event. A seepage analyzing tool was used to model the slope profile, and seepage analysis was performed using the seep/w tool employing soil parameters based on field and laboratory data. SLOPE/W was used to evaluate slope stability using the saturation profile generated by seepage analysis. The findings demonstrate that the main cause of the landslide is a decrease in shear strength caused by an increase in soil moisture content induced by the establishment of positive pore water pressure between the slope's soil layers.**

Keywords— Rainfall induced landslide, numerical modelling, GeoStudio, factor of safety, seepage.

I INTRODUCTION

Landslides are the natural and unpredictable events that losses the life as well as engineering structures. Figure 1 shows the hazards zonation map of India that expose the area affected under the influence of landslide. These events can be minimized by the investigation of the failure patterns with the help of engineering tools like experimental investigation of slope failure [1]. Rainfall infiltration and runoff on the slope are the primary causes of landslides, as they compromise the slope's stability and diminish the slope's safety factor, resulting in the occurrence of landslides [2]. As a result of rainfall infiltration, the negative pore water pressure in the unsaturated zone decreases while the positive pore water pressure that induces the seepage force in the saturated zone increases, resulting in a decrease in the shear strength of the soil [3]. Transient seepage analysis is extremely important in the forecast of landslides caused by heavy rainfall. According to the definition, transient analysis is described as a time dependent analysis that is triggered by changes in the ambient circumstances that occur in both space and time [4], [5].

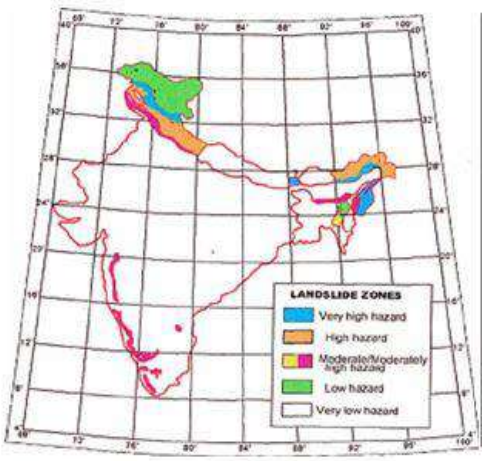

Fig. 1: Landslide hazard zonation map (Source: HPSDMA)

Numerous researchers have demonstrated that numerical modelling is an efficient and successful method for the examination of rainfall-induced landslide occurrences. [5] has performed a transient seepage and slope stability investigation for a landslide that occurred in the Indonesian province of Air Laya. [6] studied the behaviour of soil slope under different rainfall condition and proved the suitability of numerical tool. [7] carried out a seepage analysis on a multi-layered soil slope and investigated the fluctuation of the factor of safety with rainfall events. Although there are various methods available to predict the landslide but they are suitable for large region with very high error probability of false alarm [8]–[11].

Many researchers have employed numerical modelling tools to analyse rainfall-induced landslides, but only a small number of studies have been conducted in the Indian Himalayan region. In this study, To investigate the failure mechanism, seepage, and stability criterion of a recently occurred landslide, a numerical technique has been used to simulate the landslide.

STUDY AREA

A massive landslide occurred near the village of Kotrupi on National Highway- 154, the road between Mandi and Pathankot, Tehsil Padhar, District Mandi of Himachal Pradesh in the midnight of 12th-13th August, 2017.

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Fig. 2: Location Map of Kotrupi Landslide, Kotrupi, NH-154, District Mandi, H.P. (*Source: Google Earth*).

The study area is covered by the Survey of India Toposheet No. 53A/13 with the geographical coordinates: Latitude: N31º54‟37.60”, Longitude: E76º53”26.30”. The analysis of the satellite imagery obtained from Google Earth Pro depicts small scarps/cracks in the initial’s years of the twenty first century (Figure 2).

Description of Study area :

The area is located in the upper, inaccessible reaches of the main slide body, in the zone of the Main Boundary Thrust between the Siwaliks and Shali Group of rocks of the Dhramshala Group.. Carbonaceous shale, brick red shale and calcite dolomite rock were present in the landslide area. According to the report prepared by the geological survey of india, the length of the slope is 300 m with a height of 300 m. runout distance for the debris flow came to 1155 m. By performing laboratory test, the soil is classified as the fine-grained soil with dry density of 1.14 gm/cc, natural moisture content 10.35 %, cohesion 0.17 kg/cm^2 and friction angle is 47^O. figure 3 shows the distal view of landslide.

Fig. 3: Distal view of Kotrupi Landslide, Kotrupi, NH-154 (Source: Bhuvan)

Rainfall characteristics

As stated above that, the study area comes under the catchment area of Beas valley. Rainfall in this area is because of the S-W monsoon due to the Orographic mechanism. The S-W monsoon appears June-September along with maximum precipitation depth [12]. The precipitation data for the particular area were taken from regional center of the Indian Meteorological Department (IMD). Figure.4 shows the monthly rainfall variation.

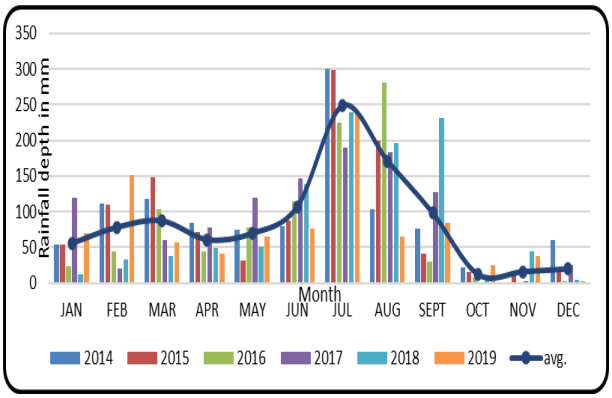

Fig. 4: Monthly precipitation variation

NUMERICAL MODELLING

An in-depth investigation was conducted in two stages. For starters, the slopes of homogeneous soil were examined for seepage. Following the seepage analysis, the slope stability analyses used the pore-water pressures obtained to calculate the slope's factor of safety, Fs.

Rainfall infiltration analysis

Seepage Analysis is a term used to describe the process of analysing seepage. In each parametric study, two steps were taken to complete the analysis. First, a seep-age analysis of the homogeneous soil slopes was carried out to determine their age. Using the porewater pressures determined from the seepage analysis, the slope stability analyses were performed in order to calculate the factor of safety, or Fs, of the slope. In the FEM (finite element) seepage model, The governing differential equation is the following partial differential equation for a two-dimensional transient water flow:(Eq.1) [13]–[16].

$$\frac{\partial}{\partial x}\left(k_x \frac{\partial H}{\partial x}\right) + \frac{\partial}{\partial y}\left(k_y \frac{\partial H}{\partial y}\right) + q = m_w^2 \gamma_w \frac{\partial H}{\partial t} \quad \text{.... (1)}$$

Where**:** "k_x = the coefficient of permeability in horizontal direction.; k_y = the coefficient of permeability in vertical direction.; H = the hydraulic head.; q = applied rainfall flux to the boundary.; m_w = the slope of the soil-water characteristic curve., and γ_w = the unit weight of water."

Stability analysis

In the slope stability analysis, the previously ignored negative pore-water pressure was taken into account using the unsaturated shear strength equation. In the second equation, Unsaturated shear strength can be calculated using the following equation:[17].

$$\tau = c' + (\sigma_n - u_a)tan\varphi' + (u_a - u_w)tan\varphi^b \quad \text{.... (2)}$$

Where: "The shear strength of unsaturated soil is defined as τ .; c' = effective cohesion.; $(\sigma_n - u_a)$ = net normal stress.; σ_n = total normal stress.; $(u_a - u_w)$ defined as matric suction.; u_w = pore-water pressure.; φ' defined angle of shearing resistance, and φ^b defined the angle expressing the rate of increase in shear strength relative to the matric suction. When the soil approaches saturation., φ^b it reaches an ultimate value of φ'."

The Bishop's simplified method was used to conduct the slope stability analysis., which was adopted. Fs, the safety factor, was calculated using this method because it requires less computational effort and takes shorter times than other, more rigorous approaches to do so. Bishop's simplified method of

slope stability analysis was carried out with the aid of the SLOPE/W software [18]. Transient seepage analyses were performed using SEEP/W. The pore-water pressures, u_w, obtained from the transient seepage analyses were exported to SLOPE/W, where they were incorporated into the slope stability analyses.

Geometry modelling

[3] conducted a parametric study involving eighty-four combinations of soil type, slope angle, rainfall intensity, slope height, and groundwater table depth. Following the study, two geometry models were created for use in the numerical analysis. Figure 5 is for slope stability analysis without rainfall condition, and figure 6 is with rainfall and drainage boundary condition.

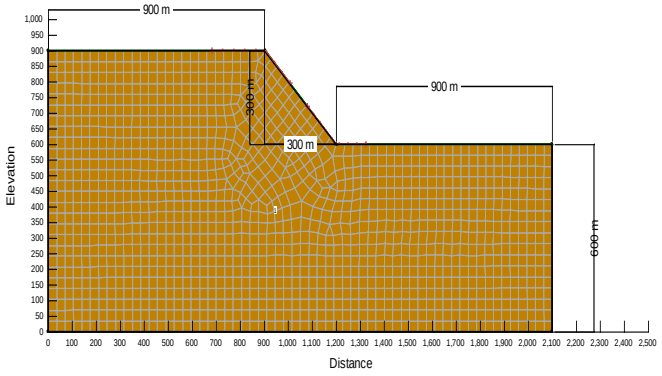

Fig. 5: Geometry of unsaturated slope before rainfall

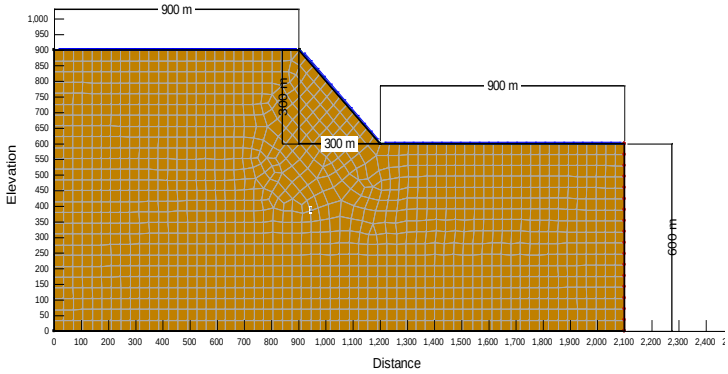

Fig. 6: Geometry of slope with rainfall

RESULTS & DISCUSSION

The simulation results after the analysis are discussed in this section. The unsaturated soil slope before the rainfall is analyzed to check the stability of slope. The factor of safety of unsaturated slope before the rainfall came to greater than 1 which justifies that the slope is stable on itself (Fig.7). figure 7 also shows the distribution of slip surfaces zone with respect to the corresponding factor of safety. The analysis also provides the critical slip failure surfaces which may undergoes with external factors. The critical slip surface can be taken as precautionary measures for design purposes to avoid any future failure by providing suitable stabilization techniques.

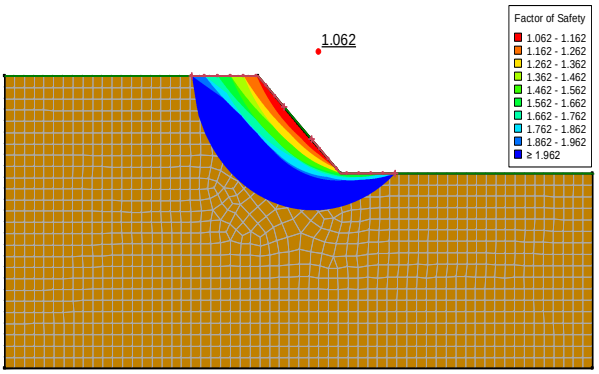

Fig. 7: Stability analysis of slope before rainfall

Further, the rainfall boundary condition is used in the analysis to determine the effect of rainfall infiltration and the change in the factor of safety. First and foremost, a seepage analysis has been performed in seep/w to quantify the development of pore water pressure in soil pores. The rainfall is assumed to be of a 10mm/hr intensity. Figure 8 shows the variation of pore water pressure on the slope height of 300 m for a time period of 30 days. The graph explains the pore pressure keeps on increasing with duration of rainfall.

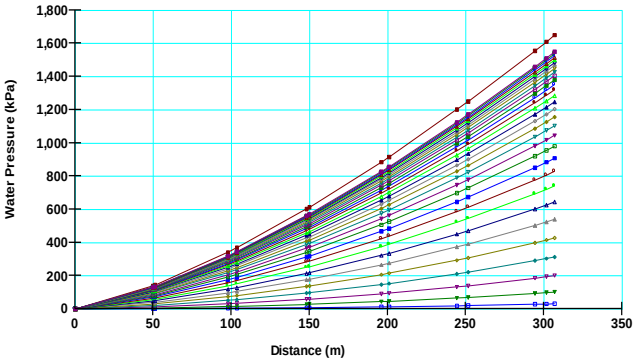

Fig. 8: Pore pressure distribution after rainfall

In the next step the pore water pressure results are sed in slope/w for the stability analysis. The factor of safety decreased to less than one (Fig.9), indicating that the shear force mobilised was much greater than the shear strength of the soil, resulting in the failure of the steep slope. Figure 9 also shows the contours of pore water presuure distribution with respect to elevation.

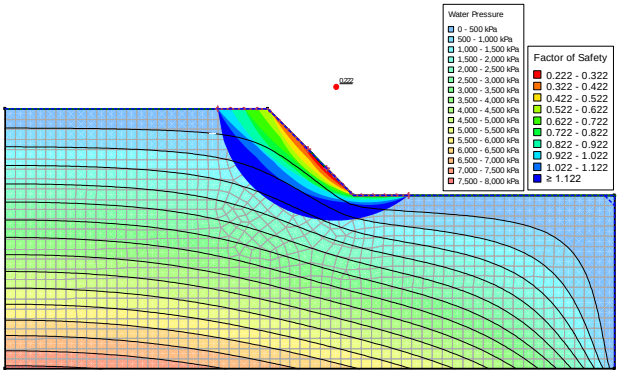

Fig. 9: Stability analysis of slope after rainfall

As a result of transient analysis Figure 10 shows the varriation of factor of safety with respect to time and it can be seen the facor of safety drastically varries for initial duration.

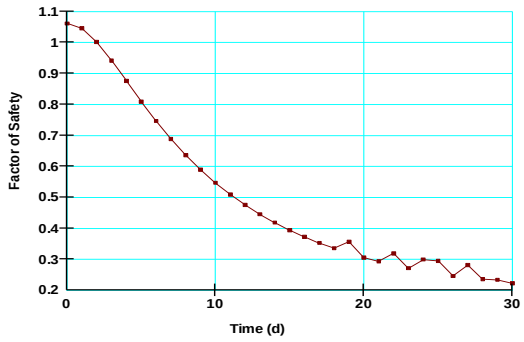

Fig. 10: Stability analysis of slope after rainfall

Figure 11 explains the sequential mechanism of rainfall induced landslide describing that water accumulation takes place between the soil layer through infiltration which in turn reduced the shear strength of soil layer causing the slope instability [19].

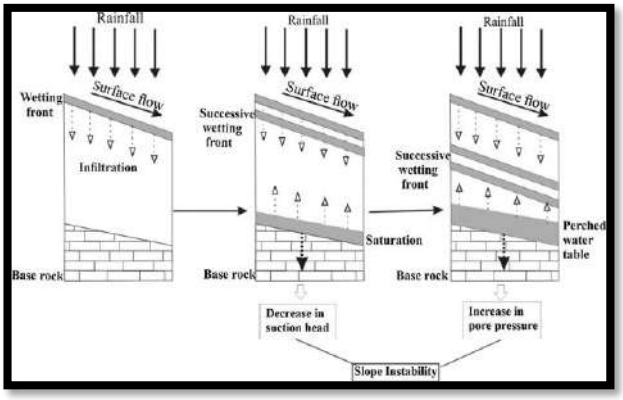

Fig. 11: A sequential schema of shallow landslide initiation [19]

CONCLUSION

In this study, a numerical analysis has been done to investigate the failure mechanism and effect of rainfall percolation. The results explains that the slope was stable before the application of rainfall but after the rainfall the factor of safety decreases below 1 indicating failure of slope. It has been observed that numerical simulation is in close agreement with physical conditions validating the use of numerical techniques in Indian Himalayan region for analysis purposes. Future researches can be done on the verification and validation of numerical model with the physical modelling results. Additionally, this research can be furthered with the numerical analysis of slopes under different material properties, slope geometry, and various rainfall intensities in order to analyse the variation in slopes.

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To Study Effect of Saline Water on Reinforced Steel & Its Preventive Measure

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Abstract — The study of this project is concerned about the corrosion of reinforced steel arising out of the salinity effect of water

The change in properties of reinforced steel due to corrosion are observed and various measures that can be taken to prevent its corrosion are dealt.

I. INTRODUCTION

Durability issues associated with concrete structures are some of the biggest problems the civil engineering community is facing today around the world. One of the most significant durability issues is the corrosion of steel reinforcement, which leads to rust formation, cracking, spalling, delamination and degradation of the structures. Although, steel is unlikely to corrode even if sufficient moisture and oxygen are available due to formation of a protective oxide film (passive film) in the highly alkaline environment, this passive film can be disrupted and corrosion initiated by carbonation, chloride induction, etc.

The causes of corrosion are the use of saline water at the time of mixing and curing and splashing of tides on the structures. The effect of corrosion on RCC comes in different ways like corrosion of rebars due to breaking of passive layer by chloride ions, deterioration of RCC like cracking of concrete etc. due to increased volume of reinforcement, reduction of pH due to acidic nature of saline water, exposure of rebars to the open atmosphere due to reduced cover caused by falling of surface concrete, etc.

ABBREVIATIONS

RCC : Reinforced Cement Concrete

PP :Casting in Pure Water & Curing in Pure Water

PS :Casting in Pure Water & Curing in Saline Water

SP :Casting in Saline Water & Curing in Pure Water

SS :Casting in Saline Water & Curing in Saline Water

SCM : Supplementary Cementitious Material

EPR : Epoxy Coated Rebars

OBJECTIVE OF THE STUDY

- To evaluate the effect of saline water on reinforcement.
- To find suitable and efficient preventive measures to reduce the rate of corrosion on reinforcement

II MATERIALS USED

- Longitudinal bars of 8mm diameter
- Stirrups of 8mm diameter at 100mm c/c
- Cement of 43 grade.
- Coarse aggregate of size 10-20mm
- Fine aggregate
- Saline water

Table 1: Saline water Composition

CHEMICAL	QUANTITY PER L (gm)
SULPHATE	0.06
SODIUM CHLORIDE	245
MAGNESIUM CHLORIDE	11
SODIUM SULPHATE	4.1
CALCIUM CHLORIDE	1.2
POTASSIUM CHLORIDE	0.7

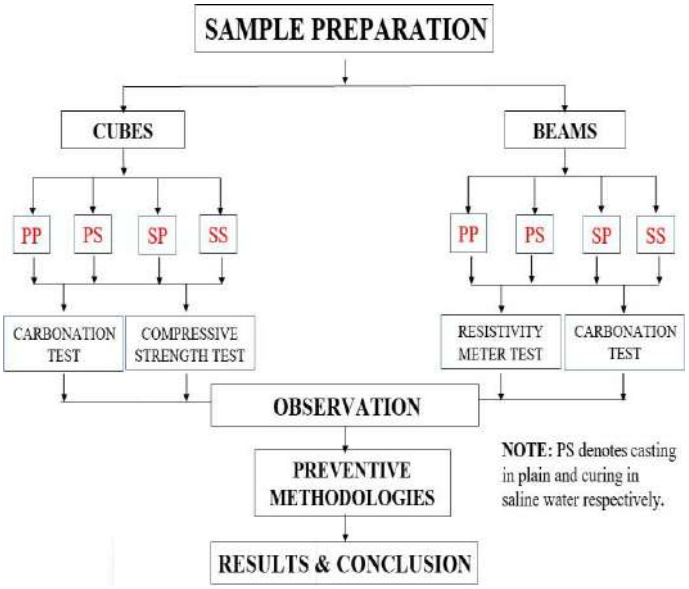
Table 2: Reinforcement Steel Composition

MATERIAL	PERCENTAGE
C	0.25
Si	0.8
Mn	1.6
P	0.045
S	0.045
Fe	97.25992

Table 3: Specimens

PARTICULARS	CUBES	BEAMS
Size	150*150mm	500*10*10cm
Concrete Grade	M20	M20
W/C Ratio	0.45	0.45
Bars	NA	4 longitudinal bars of 8 mm dia Stirrups of 8mm dia at 100mm c/c
Covers	NA	20mm

III METHODOLOGY



IV LAB TESTS

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

A. Material Test of Cement

Various tests were carried out cement to check its suitability for further construction works.

Table 4: Various Tests on Cement

S. NO.	TESTS	RESULTS
1.	Fineness Test	6%
2.	Consistency test	28%
3.	Initial setting test	22 min
4.	Final setting test	9 hrs
5.	Soundness test	8mm
6.	Compressive strength test	14N/mm2

Therefore, Cement tests show that the cement is suitable for the further construction of different components.

B Material Test of Aggregates

Table 5: Observation table for fineness modulus test of aggregate

SIEVE SIZE	WEIGHT RETAINED (gm)	CUMULATIVE WEIGHT RETAINED (gm)	CUMULATIVE % WEIGHT RETAINED (gm)
80	0	0	0
63	0	0	0
40	0	0	0
20	0	0	0
12.5	240	240	4.8
10	900	1140	22.8
6.3	2390	3530	70.6
4.75	610	4140	82.8
Pan	860	5000	100
Total	5000g		281

Hence, Fineness modulus of coarse aggregates is 2.81.

C Cube Tests

- Carbonation Test

Carbonation testing provides a means with which the inspector can determine the extent of carbon dioxide infiltration into the concrete. This can be done by phenolphthalein indicator.

$CO2 + H2O \rightarrow H2CO3$

$Ca(OH)2 + H2CO3 \rightarrow CaCO3 + 2H2O$

Table 6: Observation Table for Carbonation test

CUBE NO.	CASTING	CURING	RESULT
1	Plain water	Plain water	Colorless
2	Saline water	Plain water	Light pink
3	Extra saline	Plain water	Light pink
4	Plain water	Saline water	Pink
5	Saline water	Saline water	Dark pink

Therefore, on increasing salinity to extreme conditions, we found that the effect of carbonation goes on decreasing. This means salinity provides a barrier against the entry of atmospheric CO2.

Compressive Strength Test

This test is done to determine the compressive strength of cube after the 28 days of Curing of cubes. This test is done by the compression testing machine.

Table 7: Observation table of compressive strength test

CUBE NO.	LOAD AT WHICH CUBE BREAK (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	500	22.22
2	600	26.66
3	630	28
4	490	21.77
5	640	28.44

So, the result shows compressive strength is directly proportional to the content of salinity and its exposure in the cubes in its initial phases of lifespan although it can start reversing its effect with time.

D. Beam Tests

- Resistivity Meter Test

Resistivity meter test works on the principle of ohm's law that resistance is inversely proportional area (R=L/A). Now when corrosion is initiated, it will led to increase in the area of the reinforcement hence the resistance decreases as the results says.

Table 8: Observation table of resistivity meter test

BEAM NO.	CASTING	CURING	RESISTANCE BEFORE CASTING (MΩ)	RESISTANCE AFTER 14 DAYS OF CASTING (MΩ)	RESISTANCE AFTER 28 DAYS (MΩ)
1	Plain water	Saline water	1.7	1.67	1.30
2	Plain water	Plain water	2.3	1.5	0.74
3	Saline water	Saline water	2.4	1.4	0.63
4	Saline water	Plain water	3.9	2.1	0.93

Hence, resistance kept on decreasing with time after casting. More difference can be seen with beam of high salinity showing more corrosion is initiated.

- Carbonation Test

Table 9: Observation table for carbonation test

BEAM NO.	RESULT (OUTER SURFACE)	RESULT (INNER SURFACE)
1	Colorless	Pink
2	Colorless	Pink
3	Colorless	Pink
4	Colorless	Pink

Therefore, found negligible effect of carbonation inside the core of the beam and at the outer surface is severely effected.

V PREVENTIVE MEASURES

A. Various Preventive Measures

Rust and other corrosion forms can lead to safety issues and ruin the integrity of structures and supplies. Even routine maintenance to remove and repair corrosion can drive up costs and still not meet the requirements. However, there are a variety of measures we can take to minimize corrosion, like using:

- Epoxy coatings
- SCMs, e.g., Calcined Clay
- Inhibitors, e.g., Lime

B. Resistivity Meter Test after taking various Preventive Measures

Table 10: Observation table of resistivity meter test after taking various preventive measures

BEAM NO.	CASTING	CURING	PREVENTIVE MEASURE USED	RESISTANCE BEFORE CASTING (MΩ)	RESISTANCE AFTER CASTING (MΩ)
1	Saline	Saline	NA	1.36	0.81
2	Saline	Saline	Epoxy Coating	1.28	1.25
3	Saline	Saline	Calcined Clay	0.95	0.90
4	Saline	Saline	Lime	1.23	1.21

Observation table of resistivity meter test after various preventive measures

VI CONCLUSION

On behalf of our results we can conclude our study on the basis of following conclusions:

1) Corrosion can be detected using Ohm's law(R=L/A). Now when corrosion is initiated, it will led to increase in the area of the reinforcement hence the resistance decreases as the results says. This can be simply measures from resistance meter. As the result shows, resistance after some days of casting decreases from the initial one. This is because of initiation of corrosion inside the bars which increases their area and as a result resistance decreases. We can conclude that more is the difference of resistance from the initial one more is the initiation of corrosion inside the concrete.

2) Finer the material less will be the chloride and carbonation ingress. As we now the size of cement particle range between 10-20 micron. Now, if we use a material which is further more finer than this size then we are able to make concrete microstructure more dense. Hence reduces the pores inside the concrete and prevents the entry of chlorine and carbon-dioxide. Thus, making the concrete more resistance to foreign materials hence more corrosion resistance. For example, Calcined Clay suits best for this purpose as it size range between 2-4 micron.

3) Corrosion rate can be reduced using inhibitors. First of all we all need to accept the fact that the entire corrosion can't be eliminated, its rate can only be reduced. Now, if we are able to reduce the rate of corrosion upto the service life of an structure then we need not to worry about this.

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Digital transformation and internet of things for sustainable development

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***Abstract*— Every sphere of life is experiencing exponential growth in terms of innovation. The world has changed in previous some years by technological advancement and businesses talked about industrial revolutions. In the comparison of all the technologies, digital technologies have some special characteristics. Such as reprogram ability self- reference & data homogenization. It is estimated that its operations are accountable for 2.4 - 3 % of the global energy consumption with a predicted increase of 20% annually of the total consumption. Likewise, it could produce around 6-8% of the global carbon footprint by 2020. In contrast to its intensifying function of it regarding sustainability issues, the Internet of Things (IoT) is expected to provide broad possibilities of being a solution. United Nations Sustainable Development Goals (SGDs) provide its universally accepted version and targets against which the contribution of new technologies to sustainable development can be accessed. Digital technologies drive growth, connect people and help us protect the environment. The idea of long-term sustainability is also incorporated in the emerging World vision. In this paper, we will briefly discuss how IoT & digital transformations are helpful for sustainable development.**

Keywords—IoT, Digital transformation, sustainable development, environment, economy, society

I. INTRODUCTION

To achieve the 2030 agenda; the company's strategy, workforce, culture, technology, and structure to meet the digital expectation of customers, employees, and partners; should be fulfilled. This implies that digital technologies should be promoted, funded, and supported by policymakers only in as much as they contribute to broader Sustainable Development Goals. In this paper,three main terms are IoT, Digital Transformation, and Sustainability. If we briefly describe these terms, we get some information and the data mentioned below.

Sustainability is a complex, versatile and multidisciplinary concept. According to Johnston et al. (2007), around 300 definitions of sustainability vary regarding their meaning, purpose, and application area. As key elements of these different definition categories, Brown et al. (1987) identify:

1. The continued support of human life on earth.
2. Long-term maintenance of a stock of biological resources and the productivity of agricultural system
3. Stable human populations.
4. Limited growth economies.
5. An emphasis on small-scale and self-reliance.
6. Continued quality in the environment and ecosystems.

A frequently adopted approach to sustainable development is the so-calledTriple Bottom Line (TBL), also referred to as the three pillars of sustainability (Elkington, 1998). This view consists of three main areas: Environment, Economy, and Society.

Digitalization impacts all spheres of our lives. Digital transformation means profound changes in “all sectors of oureconomy, government, and society based on the large-scale adoption of existing and emerging digital technologies”. The Agenda 2030covers social, economic, and environmental dimensions of development. Digitalization could help in managing this process.

II STATISTICS DATA AND IMPORTANCE

To analyze digital transformation, there is no single correct phenomenon. One approach is a different aspect that goes from the change in value creation to the financial aspects. Another framework explains that to complete a digital transformation, it is important to align. By 2022, over 60 percent of global GDP will be digitized, with growth in every industry driven by digitally-enhanced offerings, operations, and relationships, according to IT advisory and research firm IDC.

The Agenda's comprehensiveness and the interlinking of the different Sustainable Development Goals (SDGs) require new knowledge and more intensive cooperation and exchange among the many traditional academic disciplines. Technology also has a role to play. It has grown at a phenomenal rate over recent decades, continuously innovating and finding ways to improve on processing power, data management, and utilization, connecting people and improving lives.The digital transformation of industry shifts for improvement in efficiency and effectiveness from the physical production process to the management of data involved in it. This process requires the integration of data - a standardized way to interpret and interface the data. This enables efficient communication and data exchange.

III STEPS AND SUGGESTIONS TO ACHIEVE UNITED NATIONSFIRST THREE SUSTAINABLE DEVELOPMENT GOALS

SDG – 1

With the help of IoT and DigitalTransformation and we can

-Accurately survey the percentage of poverty across the world because survey. we can include the type of poverty and the rate of poverty. Because of digitalization and IoT, this can be done very easily and quickly.

-After doing an accurate survey with the help of IoT and digital transformation we can create such a model or device which can show live availability and job post for employees on the website and as well as can provide smart digital banners and holdings on building or workplace where live data are presented for job and tasks. In survey work for employment, we can apply several filters and conditions according to region and countries conditions such as weather, geography, the population of the region, available resources, etc. And with the help of AI (Artificial intelligence), we can create that kind of job for reducing poverty.

-The basic reason for poverty is unemployment with the help of digital transformation everyone can work online easily at their convenience and get money or else People can quickly learn online with the help of electronic devices working on high-speed internet. And second, got a job easily.

-To reduce poverty, we should build a develop resonance to environment economic and social disaster with the help of digital transformation and artificial intelligence.

-We can mobilize resources with the help of digital transformation and IoT to end poverty.

-We can mobilize resources with the help of digital transformation and IoT to end poverty.

SDG – 2

-To achieve zero hunger there is one way to increase in production of raw material of food that means we should develop advanced technologies for the agriculture department with the help of digital transformation and IoT. For example, in the agriculture field, we should take the help of AI (artificial intelligence) to increase the speed of production. AI can work faster than humans in this given condition.

-Once we have enough raw material for food production, we should also include an in-manufacturing part for better quality and reduce the period.

-For the distribution of food packets, we can generate one code or a digital special card for poor people. By using this code people can get food packets from pre-installed vending machines at fixed intervals. By this, we can reduce hunger.

SDG – 3

- Here three segments are considered for wellbeing and good health care.

1. To improve mental health,
2. Easy access of medications
3. To control disease spread by mosquitoes improve mental health, we can create such a center in which digital assistance such as (Alexa, Google, Siri) will listen to people's doubts and give solutions from free install data and available huge data. We can also install some display screens in which according to people's problems they can recommend good books, audiobooks or articles.

- For easy access to medication Vikram dialogue user-friendly interface application that shows the availability of medicines and doctors by categories. In this application, they can also book an appointment and if a patient's condition is severe, they can also book and check home backup by a doctor. We can also develop some economical drones which are connected to mobile sim cards. This connection is for a particular region means nearby medical stores. Once a patient order medicine sim card will be tracked and medicines will be provided immediately from a nearby medical store

-To control mosquitoes, we can place sensors and roads where water is stuck or where.

III CONCLUSION

The digital transformation fundamentally impacts our economy, society, and environment. It is also in the new era, where it is still at the beginning of research and still has to be evaluated where a digitalization towards a digital transformation is a continuous improvement area that takes time to implement. Hance above data shows that transformationrequires both the organization and management to reflect on how to implement it to be as successful as possible. It will continue and become an important aspect for organizations in the future, and it is important for organizations to better understand how they can prepare for the digital transformation, what barriers there might be and what organizational changes are required. Implementing digital technology into all areas of business results in fundamental changes as to how the business operatesand how they deliver value to their customers. Digital technology and innovations are transforming our economy and society rapidly. These are two of the most powerful drivers for the future of business. And to harness these drivers, what business leaders need to do is to ensure seamless integration of Digital Transformation and sustainability. Whether it is the use of sustainable sources of raw material, using cleaner and renewable sources of energy in factories and data centers and agile supplies, digital transformation can be used in any way possible.

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Design strategies for net zero energy buildings: Way forward

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***Abstract*— The concept of Net Zero Energy Buildings (NZEB) have emerge as a trending topic of research to diminish the consumption of fossil energy in the building sector. NZEB is now visualize as the ultimate aim for the buildings design and has earned wide attention internationally. A NZEB is a building that produces as much energy as it consumes over a given period, usually one year. Energy efficient building technologies and design as well as on- site energy saving systems, like solar energy and waste recycling, all help to make building Net Zero Energy.**

India's cities are a reflection of a fast-developing nation on the earth. High energy consuming buildings and design that don't go hand in hand with the environment results in greenhouse gas emissions. So, the need of the hour is intelligent design for buildings in sync with local climate using resources efficiently for the future. This paper lay emphasis on the reassessment of most of the existing NZEB definitions and various design strategies to achieve Net Zero Energy.

Keywords—Net Zero Energy Building, Inexhaustible energy, Zero Energy Buildings, Design Strategies, Greenhouse gas

I. INTRODUCTION

About 41% of the total global energy is consumed by the buildings worldwide, which results in 21% of the carbon dioxide emissions. The consumption is expected to increase up to 50% by the year 2030. A total of 71% of electricity generated in country is consumed by the building sector itself. Studies indicate that for occupant's comfort like cooling and lighting, more than 50% of energy is used in the buildings [4]. To counteract the energy consumption and ever-increasing demands of these non-zero energy buildings, the building sector must introduce architectural designs and planning techniques [5]. A net zero energy building (NZEB) is a building with zero consumption of energy, i.e. the amount of energy produced on the site or off the site is equal to the total amount of energy utilized by the superstructure on yearly basis. These superstructures supply less greenhouse emissions to the atmosphere than similar non-zero energy buildings [1]. These net zero buildings put less impact on the climate and do not escalate the amount of greenhouse gases.

II. NEED OF STUDY

Apart from reducing greenhouse gases and eradicating the use of fossil fuels, there are a variety of other advantages that come from constructing a Net Zero Energy Building, namely:

• NZEB are 60-90% over energy efficiency baselines. This means that the project will save our company's money over the entire lifecycle of the equipment use. Towards energy and maintenance costs money won't have to be allocated.

• NZEB creates a safer and more intelligent buildings that further improves the stability and healthier environment for the people who uses it.

• Person is becoming educated on the necessity for energy saving practices, when he or she comes in contact with NZEB. For the entire world, NZEBs are considered as an educational tool.

III. OBJECTIVE

The objective of this paper is to analyse the role of urban planner for the reduction of fossil energy consumption in the building sector and;

• To develop and introduce advances in engineering sciences to move the nation towards net zero energy & high-performance buildings while maintaining healthy environment.

IV. LITERATURE REVIEW

This section comprises the review and reassessment of definitions, design strategies for NZEB and difference between ZEB and Green Building.

A. Reassessment of Definitions

A Net Zero Energy Building (NZEB), is a building with zero consumption of energy, i.e. the amount of inexhaustible energy created at the site or the inexhaustible energy off the site is equal to the total amount of energy utilized by the superstructure on yearly basis [4].

Apart from allocating the name "zero energy", there are various other definitions of this term, like what it means in usual practice, with a slight difference in the usage across different countries.

1) Net Zero Site Energy Buildings: In this type of NZEB, the amount of energy generated by on the site inexhaustible energy resources is counterbalanced by amount of energy utilized by the superstructure [2]. In the United States of America, "Net Zero Energy Building" generally refers to Net Zero Site Energy buildings as shown in Fig. 1.

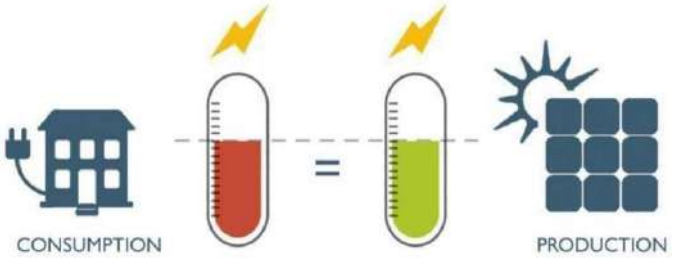

Fig. 1 Net Zero Site Energy Building

2) Net Zero Source Energy Building: In this type of NZEB, the building produces the same amount of energy that has to be used, together with the energy that will be utilized to transfer this energy to the superstructure. This building type also takes the account for losses during electricity generation and transmission as shown in Fig. 2. These NZEBs can generate more electricity than net zero site energy building [2].

Fig. 2 Net Zero Source Energy Building

3) Net Zero Cost Building: In Net Zero Cost Building, the price of purchasing energy is counterbalanced by the cash obtained from supplying current to the grid. This energy (current) is produced on-site as shown in Fig. 3 [4].

Fig. 3 Net Zero Cost Building

4) Net Zero Energy Emission Building: In this NZEB, superstructure is characterized as one with the net zero emissions. It is also called as the Zero Carbon Building (ZCB). In this, the carbon emissions produced at the on-site or at the off-site fossil fuels used are counterbalanced by the generation of in-situ inexhaustible energy resources [10].

B. Design Strategies for Net Zero Energy Buildings

There are many routes or strategies to attain the NZEB aims. But the most dominating of all the routes are: -

1) Passive Strategies: Passive strategies are those strategies in which architectural designs and planning techniques are introduced in order to diminish the buildings energy demands (for e.g.; cooling and heating load). Also, it is further divided in to following two categories:

a) Passive Sustainable Design: Passive Sustainable Design means taking in to account the superstructure's geographical (for e.g. altitude, latitude and longitude) and meteorological (for

e.g. sunshine duration, humidity, temperature and wind speed) components in order to reduce the buildings energy demands [2].

b) Energy Saving Techniques (EST): Energy Saving Technique means reinforcing the sealing and insulation capacities with the help of enhanced building materials (for e.g. recycled plastic, thermal insulation, straw bales, etc) in order to reduce the buildings energy demands [2]

2) Active Strategies: After diminishing the superstructure's energy demands with the help of passive strategies, the energy is now supplied through the active strategies, for instance Renewable Energy (RE). It is also further divided in to following two categories:

a) Renewable Energy (RE): It points to the energy attained from renewable sources for e.g. wind, geothermal energy, sunlight, etc [2].

b) Back-up system for Renewable Energy (RE): As a process of adjusting for the inconsistency of Renewable Energy due to the unforeseen circumstances in external climate (i.e. night, weather), the application of this system for RE is a necessary one [2].

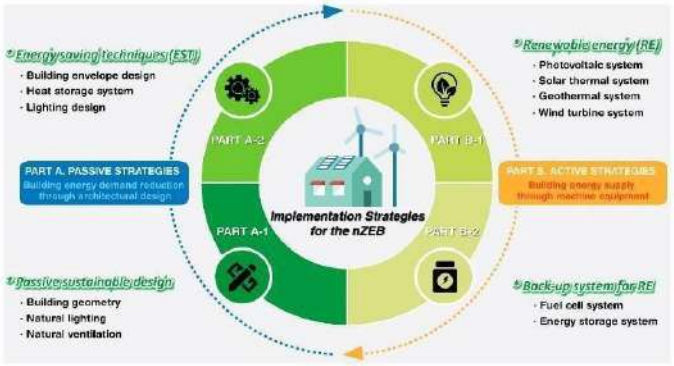

Fig. 4 Design strategies for Net Zero Energy Building [2]

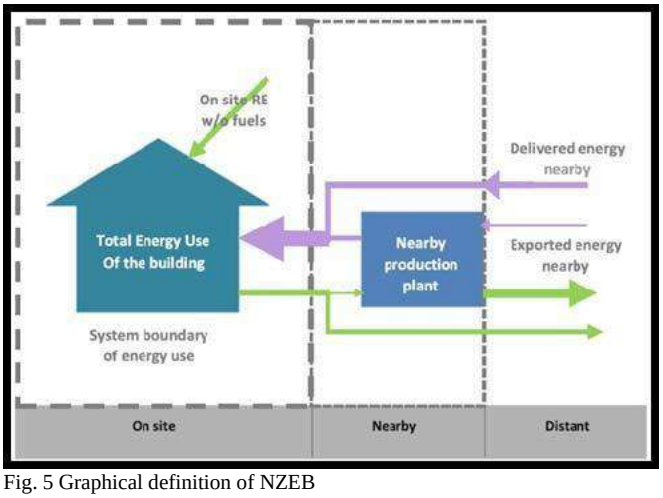

Fig. 5 Graphical definition of NZEB

C. Net Zero Energy Buildings in India

Indira Paryavaran Bhawan is the first on-site Net Zero Energy Building of India. It was inaugurated on 25 Feb 2014. Other NZEBs of India are:-

TABLE I. NET ZERO ENERGY BUILDINGS IN INDIA

S.No.	Name of Building	Location	Plot Area	Usage
1.	Indira Paryavaran Bhawan	New Delhi	9565 m^2	Office & Educational
2.	CEPT	Ahmedabad	498 m^2	Office & Educational
3.	Akshay Urja Bhawan	Panchkula, Haryana	5100 m^2	Office
4.	Sun Carrier Omega	Bhopal	918 m^2	Office-Private
5.	GRIDCO	Bhubaneshwar	15793 m^2	Office
6.	ECB	Noida, UP	891 m^2	Lab

D. Difference between Green Building and ZEB

The goal of sustainable architecture and green building is to diminish building's adverse effect on the environment and to use resources more efficiently. Reducing the use of energy and green-house gas emissions completely or very significantly for the whole service life of the superstructure, could be one of the key green-building aims of Zero Energy Buildings [6].

In diminishing waste or using recycled building materials ZEBs may not be considered "green" in all these areas. As compared with other "green", zero energy buildings generally are eco-friendly and have a significant less ecological impact on the life of buildings in contrast to those who requires fossil fuel and/or imported energy to meet the requirements of the occupants [8].

Holistic design principles must be applied by the planners and also they must harness the naturally occurring resources available, for example daylighting, passive solar orientation, night time cooling, thermal mass and natural ventilation, since the sensitivity and design challenges to a site that are required to methodically meet the energy demands of a superstructure and residents with renewable sources (wind solar, geothermal etc) [9].

V. CONCLUSION

With the advancement in Renewable Energy Sources, NZEBs are the future. The standards of NZEBs has been manifested to have climatic and economic benefits both, if embraced. More government incentives & building code regulations for the worldwide acceptance may be required for the ZEB technology. ZEB laws have been framed by many governments. For creating zero energy buildings, many

governments are also providing subsidies to individual and organizations. To significantly reduce the utilization of non-renewable sources and greenhouse emissions for the whole serviceability of the superstructure, NZEBs are the good solution. If all the people become aware and understand their responsibility towards reducing energy consumption, then the time is near that the aim of zero energy buildings would be achieved.

Based on the literature review, this paper reassesses different NZEB definitions, which might be helpful in defining a harmonized NZEB concept. Moreover, this paper discussed various different design strategies to achieve Net Zero Energy.

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Energy efficient buildings-A Review

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Abstract- The aim of this paper is to determine the consequences of utilizing different energy efficient techniques to make the building more energy saving and economical. Energy Efficient building is that building that seeks to lessen the negative environmental impact of the building & it's achieved by the installation of a number of the innovative techniques and using different energy saving parameters while designing. It's been find out from the studies performed in the past that a number of the techniques are very effective in making the building more energy-efficient & more nature friendly.

Keywords: - Smart Construction Techniques-Building Envelope, Energy-Efficient

I INTRODUCTION

One of the popular sayings in the relation to this is "The most sustainable energy is the saved energy".

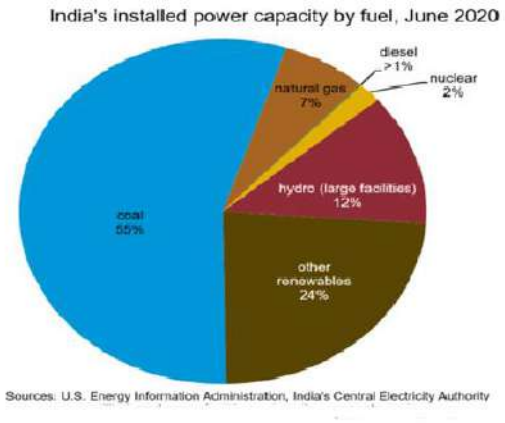
More than 90 per cent of occur time is spent in buildings i.e. either in the office or at home. Energy used in buildings (residential and commercial) accounts for a significant percentage of a country's total energy consumption. This percentage depends greatly on the degree of electrification, the level of urbanization, the amount of building area per capita, the prevailing climate, as well as national and local policies to promote efficiency.

Buildings consume energy at different levels in every stage of the life cycle. In an operating phase, a building with at least a 50-year lifespan, energy used for production of materials, transportation, and construction, "at least five times" as is required in the amount of energy use and operating phases.

A large part of the energy (35–60%) is used for heating, air-conditioning, ventilation, and artificial lighting at this stage.

The primary energy sources is usually the non-renewable sources like Petroleum(37%),Natural gas(29%),Coal(14%), Renewable energy (11%),Nuclear electrical power (9%).

In order to attenuate dependence on these sources, we should always use some new techniques to our building design which will ultimately results in much energy efficient building without decreasing the comfort & quality of living.



II LITERATURE REVIEW

Literature review is the summary and findings by study of various papers that are been published in the past in the same or much similar topic, Research papers supported the concept of Sustainable building, Green building, Energy efficient techniques & Smart Construction techniques and smart designing methods its comparison and other construction details.

Estimating the energy consumption and power demand of small power equipment in office buildings by A.C. Menezes, A.Cripps, R.A. Buswell, Jwright. [1] In this paper they highlighted that "Small power is a substantial energy end use in buildings, but also significantly contributes to internal heat gains." This paper details two models for estimating small power consumption in office buildings. The two models being utilized are:- Random sampling of

monitored data and Bottom-up approach to establish the required power demand and operational energy use. Technological advancements have allowed for higher efficiency computers, yet current working practices are demanding more out of digital equipment.

Sustainable building envelope design by considering energy cost and occupant satisfaction by Mickey H. Wu, Thomas S. Ng, Martin R. Skitmore [2] In this paper, a new multi-objective optimization model is developed for sustainable building design by considering the design objectives of cost and energy consumption minimization and occupant comfort level maximization.
In a case study demonstration, it is shown that the model can derive a set of suitable design solutions in term of life cycle cost, energy consumption and indoor environment quality so as to help the client and design team to gain a better understanding of the design space.

To Identify the HVAC Energy Savings through Chilled Beam Cooling Techniques by Mohammed Ubied Ali & Mohammed Ishaq[3] They stated that a completely effective HVAC system must also address many other indoor environmental issues that affect occupant comfort, productivity and health like ventilation air, air distribution, humidity control, noise levels, etc. they often find that chilled beam systems are the proper "green" solution for several buildings. There's also a full comfort and economy for the employment of active chilled beam systems over other of the more conventional systems choices. In India, chilled beam systems are proven and while successfully getting utilized in Europe since a decade. The chilled beam system promotes excellent thermal comfort, energy conservation, and efficient use of space due to the high heat capacity of water used as heat transfer medium. it's an energy efficient HVAC technology which works on dry cooling principle. Chilled beams system would be examined which could show energy conservation and has the potential to save lots of 30-40% HVAC energy consumption in a very standard Air conditioned Building scenario.

A Systematic Approach for the Thermal Design Optimization of Building Envelopes by Mohammad S. Al-homoud [4], Building design is a decision-making process in which decisions are made on the shape, orientation, and selection of the physical components of the building and their arrangements to achieve certain objectives. These decisions are usually constrained by certain limits – some of which are outside
the control of the designer.

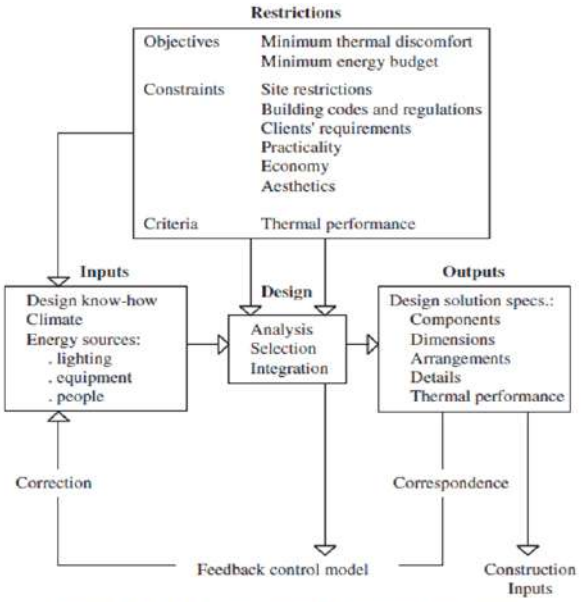


Figure 2. Structure of building thermal design optimization process.

Annual Energy Usage Reduction and Cost Savings of a School: End-Use Energy Analysis by Aiman Roslizar,1 M. A. Alghoul,2 B. Bakhtyar,3 Nilofar Asim,2 and K. Sopian2 [5], This study aims to analyse the energy usage of a primary school and identify the potential energy reductions and cost-savings. A preliminary audit was conducted, and several energy conservation measures were proposed. The energy conservation-measures, with reference to theMS1525:2007 standard, were modelled to identify the potential energy reduction and cost savings. This research is conducted in two stages. The first stage involves the analysis of the current energy usage of the school, which is indicative of its efficiency, and whether improvements can be made. Meanwhile, the second stage involves the proposal of several energy conservation measures. This section explains the data collection methods and the mathematical equations used in this study. The actual energy used by the school was 60 520.28kWh, which costs the school a total of RM 25 152.20, resulting in an energy intensity of 50.6

kWh/m2/year. It was determined that energy is being wasted via the operation of the electrical equipment in the school. This study showed that 11.6% energy reduction and cost saving can be achieved by implementing efficient energy usage practices. Apart from that, 9.1% energy reduction can also be achieved through the correct design and configuration settings for the lighting systems. Overall, this results in potential energy reduction and cost savings of up to 20.7%. The implementation of the mentioned energy conservation measures would also reduce the energy intensity from 50.8kWh/m2/year to 40.19kWh/m2/year, which is a significant achievement. Further energy studies on more schools in the country will provide us with a better understanding of energy usage conditions of schools in this
country and open up more opportunities for potential energy savings.

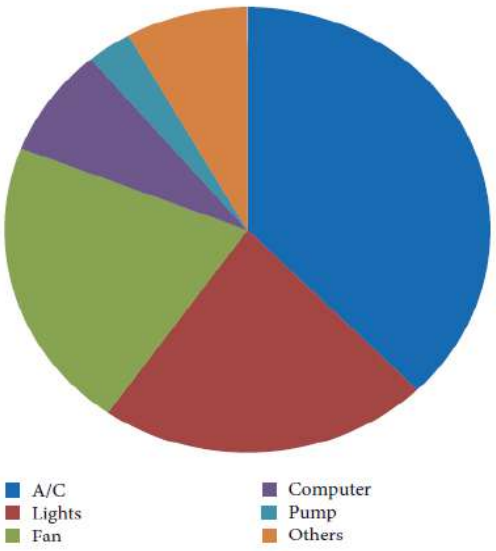
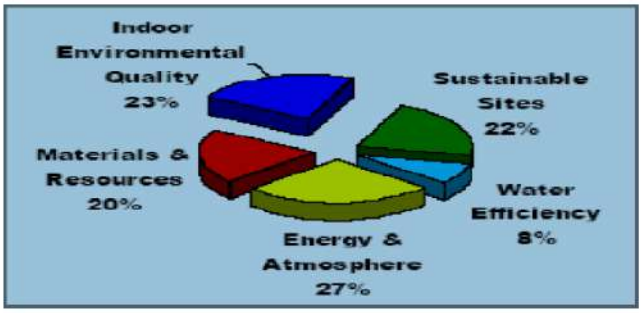


FIGURE 1: Distribution of electricity consumed by equipment in the school.

Concept and method for energy efficient building: an overview by Sanghsheel Ghodeshwar1, Mukesh Pandey2, Rakesh Gupta3**[6],** This Paper is dealing with the energy and comfort issue in residential and real estate sector without affecting the nature. This paper is concerning about energy and atmosphere, sustainable sites, indoor environment quality, water efficiency, material and resources, with adopting techniques like proper designing, orientation, using energy efficient materials, proper insulation with maximize the use of renewable resources and achieves various measures to save energy, resources as well environment health.



LEED credit criteria

Design of energy efficient building-survey by Prajakta S. Gurav1, Nandini S.Mayekar2, Monali B. Kamble3, Sayali M. Pinage4 ,Prof. A.D.Bhosale5**[7],**
This paper will help Indian villages and their residential buildings developed sustainable and green by implementing easy, simple and economic techniques.

Conventional Building	Energy Efficient Building
• In Conventional Building, there will be different room conditions depending on the changes in the environmental conditions. • The cost of construction of Conventional Building is comparatively lower than energy efficient building . • But in case of Conventional Building, a building service engineer and an architect is enough. • Energy Consumption is more as compared to energy efficient Building. • Salvage value is less.	• Energy efficient Building adjusts the inside functional aspects such as lighting, ventilation, air conditioning, etc. automatically with the changes in environmental conditions controlled by computer. • In a energy efficient building the security system, communication system, etc. are coordinated and automatically controlled by computer work station whereas in Conventional Building there is no work station. • While planning Energy efficient Building a building service engineer, an architect and hardware engineer is required. • Salvage value is more as many of the electronic devices are reusable

A Review of Recent Advances in Emerging Alternative Heating and Cooling Technologies by Mubarak Ismail, Metkel Yebiyo * and Issa Chaer[8]

This paper provides an up-to-date and comprehensive critical review and evaluation of recent advances in emerging alternative heating and cooling technologies that have the potential to reduce the environmental impacts of refrigeration in the RACHP sector. The paper highlights the basic working principle of operation, its main applications, the challenges and opportunities in penetrating the market. The paper also highlights further research and development needed to accelerate the development and adoption of these alternative refrigeration technologies by the sector.

Magnetic refrigeration works on the principle of exposing paramagnetic materials to a magnetic field generated, preferably, by rare earth magnets as they have a stronger magnetic field. Paramagnetic materials have a high susceptibility to magnetic fields. They don't retain the magnetic field when the external source is removed. They have paramagnetic properties due to the unpaired electrons, i.e., Magnesium, Lithium, Tantalum, etc.

New and Advanced Materials and Technologies in Ultralow-Energy Buildings by G. Y. Yun ,1 A. Kwok,2 K. Steemers,3 and W. T. Grondzik4 [9]

Ultralow-energy buildings are one successful approach to reducing carbon emissions in the building sector, attracting a growing interest worldwide. "e principles of ultralow-energy building emphasize a passive building design and high-performance heating, ventilating, and air-conditioning (HVAC) systems. Typical features include superinsulation, airtight envelopes, daylighting, high-performance windows, energy-efficient HVAC, and electrical lighting, which present significant technical challenges. For example, a low heat transfer coefficient of a passive building design, typically 0.10 to 0.15 W/(m2K), requires new and advanced materials for insulation in order to avoid unfeasibly thick construction. "e realization of zero energy buildings has sparked innovations in HVAC systems by applying new materials and technologies. New materials and technologies are also indispensable for high-performance windows because they require both a low thermal transmittance and a high total solar transmittance.

Analysis of Measures to Improve Energy Performance of a Commercial Building by Energy Modeling by Raviraj K, Nidhi Gupta, Harshendra N Shet.[10]

This paper investigates the methods to reduce the energy consumption of a commercial building by incorporating energy conservation techniques in the design stage of the building. By comparing the design buildings energy use with a baseline building, a percentage estimate of the energy savings can be obtained. Energy modeling tool e-Quest is used to model these energy conservation techniques in the building and to predict the energy savings. A comparative analysis of different energy conservation techniques is made to estimate the reduction in energy use.

III DISCUSSIONS:

-From the above literature it's clear that a lot of researchers have put their efforts to review the varied methods to find the ways to design the energy efficient building. The goal of our current work is to identify the advantages of energy efficiency and to penetrate into the methods and obstacles in obtaining energy efficiency and to use proper material and design in energy efficient building.

The new design approach must recognize the impacts of every design choice on the natural and cultural resources of the local, regional and global environments.

IV CONCLUSION

Construction technology is responsible for at least 40% of energy use in most of the countries.

Population growth and economic growth are the key factors in the development of infrastructure which leads to the growth in energy demand. Infrastructure development in line with the energy efficient building concept is the requirement of present days. Combinations of active and passive building control strategies are very useful to conserve significant energy. Need of energy conservation and control in climate change are now the world priority topics, therefore energy efficient building has been gaining popularity. Financial appraisal tools like payback period, net present value

and internal rate of return method also favor it. Indian Green Building Council (IGBC) and National Housing Bank (NHB) have signed a memorandum of on 13th July 2013 to offer home loans at lower interest rates for buying of certified green and energy–efficient homes. This MOU is a major initiative to promote the green homes concept in India and towards saving the earth.

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Experimental Study on Estimation of Porosity using MIP

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***Abstract*—The present study deals with the changes due to the addition of mineral admixtures such as wollastonite, fly ash and silica fume on the durability of concrete. The study have been carried out by using various w/c or w/ca ratios such as 0.55. Three different mineral admixtures were chosen and they were added in three different dosages I, II and III mixed thoroughly with the M25 designed concrete mix, cured for 7 days and 28 days and then tested. Dosage I consists of wollastonite or fly ash 10% plus 5% silica fume, dosage II consists of wollastonite or fly ash 15% plus 5% silica fume and dosage III consists of wollastonite or fly ash 20% plus 5% silica fume. The pore size distribution of concrete significantly affects the mechanical properties of the concrete or in other word reduction in the pore size distribution significantly increases the compressive as well as tensile strength of the harden concrete.**

Keywords—Wollastonite Micro Fiber, Fly Ash, Silica fume, permeability, porosity by MIP.

I. INTRODUCTION

Looking around the world, concrete structures are seen everywhere such as commercial to residential buildings to road, concrete is used as major material in construction because it helps to save our natural resources. The concrete has its importance in modern society which cannot be underestimated. As the availability of resource of concrete constituent product, concrete play an important role to the environment. Concrete is supposed to be in tune with the environment. Overall strength of harden concrete may be defined its ability to restrained against failure. It may be determined in many ways, such as compressive strength, tensile strength, shear strength and flexure strength. Lackness of durability in harden concrete is very common problem now a day. Permeability is very important measure which affects the durability of harden concrete. The estimation of permeability of concrete can be easy by the intrusion of some liquids, various gases and inbuilt deleterious matter such as carbon dioxide or chloride ions into the harden concrete. The permeability is one of that property of harden concrete which is mainly affects the life of reinforcement of concrete. Due to the adoption of various admixtures affects this durability property of concrete and as a result protects the reinforced bars in concrete from corrosion.

II. Review Study

Rakesh Kumar &B.Bhattacharjee (2002)

Various study have been made to judge the pore size characteristics and mechanical properties of cement based material with different dosages in various mix but all the models presented were found inadequate to give an optimum analysis on the relationship of durability and mechanical properties of cement based material.

Jun Lio & Qiwen Qiu et al. (2014)

Characterization of pore with cement paste with fly ash content was investigated by Micromeritics Auto Pore IV 9500. 480 mN/m is consider as surface tension value for mercury and solid sample with angle of contact is 130°. It is observed that when a fly ash concrete is submerge in water, the pore system of the fly ash based harden concert get disturbed by the reaction of fly ash and the water.

Shih-Wei Cho (2012)

This study employed the MIP test to examine the connective pore structure of mortar specimens and conclusion as follows-

Total mercury intrusion of the specimen increases alongside the w/c ratio.

The intrusion volume of pore size at a range of 10-10,000 nm shares the same trend. The calculated mercury intrusion of ITZ (Interface Transition

Zone) increases alongside w/c and the volume proportion of fine aggregate.

Tennis et al. (2004)

Investigates the value of porosities, as a result these values range from 15 to 25%. It proves that the durability property is a function of W/C ratio in the concrete mix and also affected by the method of compaction. ACI Committee 522 recommends a minimum of 10 psi of tempering or compaction to fill the void in concrete mix. As a result it was found that 0.27 and 0.30 is the most common W/C ratios for the cement based concrete mix.

Atis et al. (2004)

Concrete containing mineral admixtures requires longer duration of moist curing to fully activate their Pozzolanic activity. They found that the strength in compression of concrete with cement and silica fume cured at both 65 % and 100% relative humidity (RH). The strength in compression of SF added concrete mix cured at 65 percent RH was affected more than that of PCC and at average of thirteen percent lower than that of SF added concrete cured at 100% relative humidity.

Tennis et al. (2004)

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III. EXPERIMENTAL INVESTIGATION

Strength of concrete of a given proportion is affected very much by the degree of its compaction. Therefore it is desirable that the fresh concrete can be transported and placed without segregation and bleeding. The concrete can also be compacted and finished easily. This property of concrete is known as workability.

MATERIALS

The materials used in this investigation are Ordinary Portland cement, coarse aggregate of crushed rock with a maximum size of 20 mm & 10 mm, fine aggregate of clean river bed sand.

ADMIXTURES

In the present study, wollastonite micro fiber (WMF), fly ash (FA) and silica fume (SF) are used as a mineral admixture. These mineral admixtures used to partially replacement of cement in the concrete mix, to make an economical concrete mix.

Wollastonite Micro Fiber

Wollastonite micro fiber (WMF) having average length of 0.03mm, diameter 1.82µ and thus an aspect ratio of 16.5 was selected and incorporated in concrete/mortar by part replacing the OPC to judge the potential of this material with respect to the cement

Fly Ash

Fly ash is a byproduct from coal based thermal power plants. It has been generally considered a waste material in the past and disposal of which has posed numerous ecological and environmental problems.

Silica Fume

Silica fume is an industrial waste which finely divided particles. These fine particles are highly reactive. Mainly silica fume is produce by furnaces during the formation of silicon and aluminum and alloy.

Trial Mix

Since the number of mixes was more, they have been designated according to constituent material content. For ternary mixes the designations have been done in group of two mixes, having same wollastonite or fly ash content. Thus wollastonite mixes have been designated as CWS1-CWS3 for three percentage substitutions of wollastonite and substitutions silica fume. Likewise, fly ash ternary mixes have been designated as CFS1-CFS3.

In case of combined mixes the designations have been done on the basis of fly ash or wollastonite content, which varies from 10%-20% and silica fume was kept as 5%.

Table shows the various mixes, their designation, and the percentage of each material in the mix. For ternary combinations' studies, the

mixes were prepared by part replacing OPC by Wollastonite and silica fume @10%, 15%, and 20%. By admixing silica fume at the rate of equal 5% in these three Wollastonite replacements, three mixes have been prepared.

Similar is the case for fly ash admixed mixes. Therefore total six ternary mixes have been prepared, three each for Wollastonite and fly ash.

Table 8 Mixes chosen for the tests and their material composition

Mix Design of Concrete

The mix was designed to achieve a concrete grade of M25. The designed and adopted mix proportion was 1:1.7:3. A constant water- cement ratio of 0.55 was used.

Water	Cement	Fine Aggregate	Coarse Aggregate
186 kg/m3	338.20 kg/m3	577.39 kg/m3	1212.70 kg/m3

Porosity Test

It is a term which represents the porousness of solid material and more precisely called as the ratio of pore volume or volume of voids to the total volume by a solid material. Various methods have been developed for the evaluation of pore structure, one of them is **MIP.**

Mercury Intrusion Porosimetry (MIP) it is a technique used to determine porousness or pore structure, as defined by a pore size distribution or porosity, of any type of solid materials with pore diameters ranging from 3 nm to over 100 µm. Due intrusion of the mercury, there may be fall of mercury in the penetrometer. It is based on a principle and is similar to the mercury filling the pores. When the pressure is increased by some limit the total amount of intruded mercury increases as the mercury is forced into smallest pores. Determination of the pore size by mercury penetration is based on the principle which is the behavior of non-wetting liquids in capillaries pores. A liquid cannot spontaneously enter a smallest pore which has an angle of more than 90 degrees or wetting angle because of the surface tension (capillary depression).

Principle

A non-wettable liquid can enter porous medium only when external forced exerted by pressure. The estimation of porosity of solid can be estimated by providing non-wetting liquid into the specimen which is kept in a sample chamber by mean of exerting pressure and observing the volume of mercury consumed. The determination may precede either with pressure being raised in step wise manner and the mercury volume which intruded can be measured after an interval of time when equilibrium has been achieved or by raising the pressure in a continuous manner.

Mix Designation	**Percentage of material in mix**				**Paste composition C+F/WMF+S**
	Cement	**Fly ash**	**wollastonite**	**Silica fume**	
CC	100	-	-	-	100
CWS1	85	-	10	5	85+10+5
CWS2	80	-	15	5	80+15+5
CWS3	75	-	20	5	75+20+5
CFS1	85	10	-	5	85+10+5
CFS2	80	15	-	5	80+15+5
CFS3	75	20	-	5	75+20+5

Background

(Washburn, 1921), the mean pore diameter is calculating using the Washburn equation. The pressure applied to force mercury into a porous surface is given by:

$$P = (-4s.\cos\theta) / d$$

Where P = pressure head (m)
s = surface tension of water (N/m)
θ = contact angle (°n)
d = pore diameter (m)

IV. RESULTS & DISCUSSION

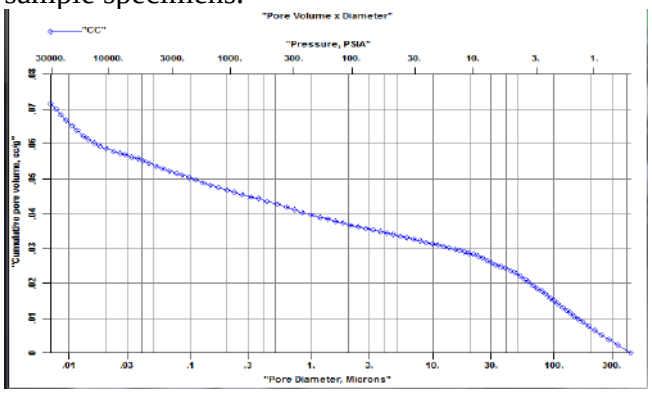
Test for pore size by MIP

To determine the pore size distribution of the conventional concrete with and without partially replacement of cement by mineral admixtures, test has been carried out in the laboratory by using MIP. In the results, the average pore diameter of various mix with different dosages of mineral admixture were calculated. Table shows the average pore diameter of various concrete mixes.

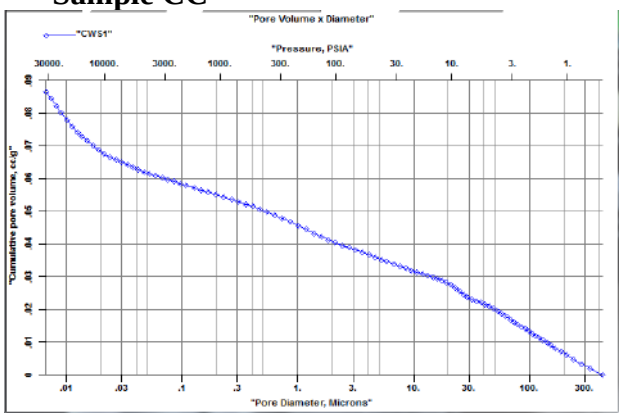
Table Average Pore Diameter of concrete at 28 days

Identification	Average Pore Diameter (micron)
CC	0.0490
CWS1	0.0407
CWS2	0.0362
CWS3	0.0282
CFS1	0.0370
CFS2	0.0351
CFS3	0.0269

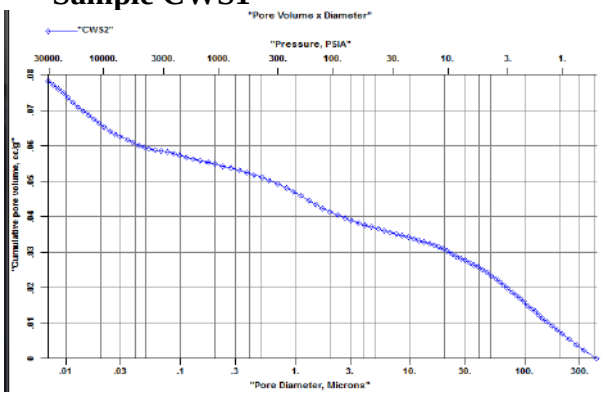
Following graph indicates the relation between volume of mercury intruded and the pore size of the sample specimens.



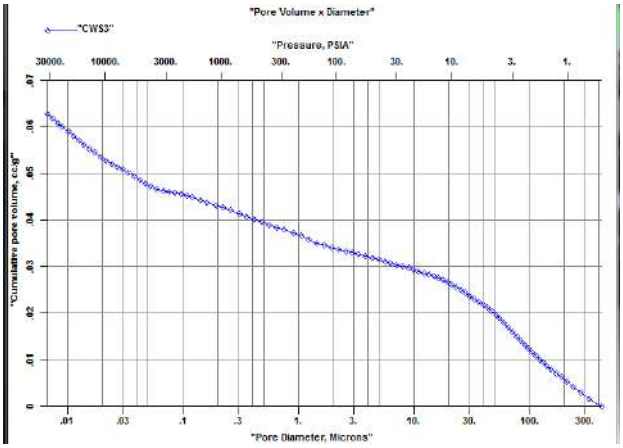
Sample CC



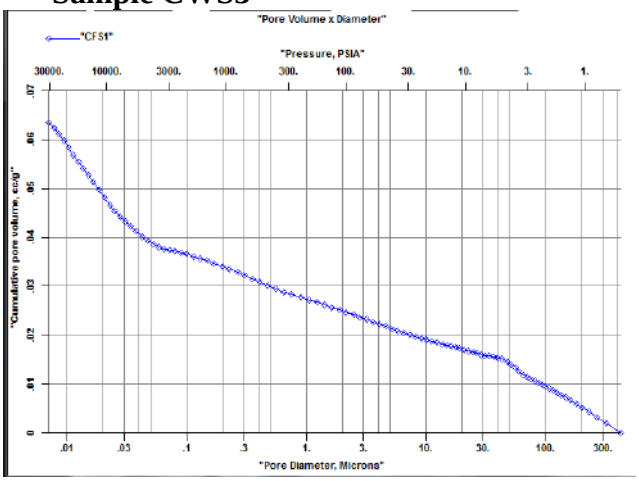
Sample CWS1



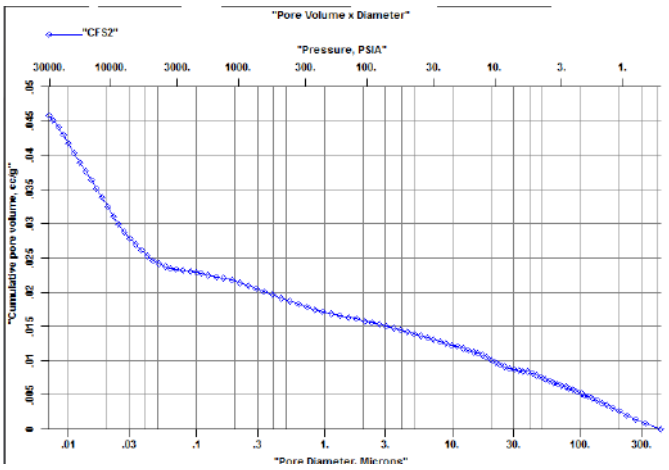
Sample CWS2



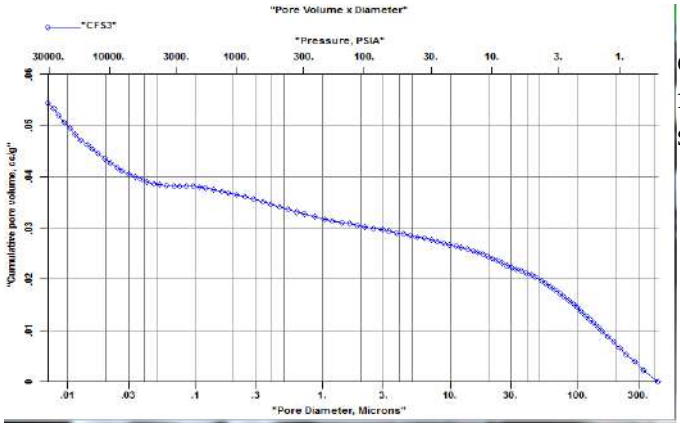
Sample CWS3



Sample CFS1



Sample CFS2



Sample CFS3

Effect of mineral admixtures (CWS & CFS) on average pore diameter of concrete

It is observed that the average pore diameter of convention concrete decrease with the increase in the percentage of the admixture in the mix. Decrease in average pore diameter of CC mix is found to be more in case of CFS3 as compare to all dosages of both the mineral admixtures. Similarly CWS3 produces more reduction in average pore diameter as compare with other dosages of admixtures.

V. SUMMARY

Plain concrete is strong in compression but is weak in tension**.** Even though the addition of admixtures significantly increases the strength of concrete, the development of micro cracks must be controlled to produce concrete with homogeneous tensile properties. The introduction of mineral admixtures is brought in as a solution to develop concrete to reduce permeability and enhance compressive, tensile and flexural strength and workability.

This study deals with the changes due to the addition of mineral admixtures such as wollastonite, flyash and silicafume on the workability, strength and durability of concrete. The workability studies have been carried out by using various w/c or w/ca ratios such as 0.55. Three different mineral admixtures were chosen and they were added in three different dosages I, II and III mixed thoroughly with the M25 designed concrete mix, cured for 7 days and 28 days and then tested. Dosage I consists of wollastonite or flyash 10% plus 5% silicafume, dosage II consists of wollastonite or flyash 15% plus 5% silicafume and dosage III consists of wollastonite or flyash 20% plus 5% silicafume.

The durability of concrete was studied by conducting water permeability test by steady state flow method in 7 and 28days cured concrete specimens.

VI. CONCLUSIONS

- The addition of admixtures reduces the co-efficient of permeability value as 50-60% for 7 days and 50-70% for 28 days depending upon the type of admixture used and its dosage added. This may be because of the reduction of pores present in the concrete due to better compaction by the addition of admixture. Out of these two admixtures used, flyash plus silicafume admixtures shows better performance than other admixtures in the permeability studies.
- The pore size distribution of concrete significantly affects the mechanical properties of the concrete or in other word reduction in the pore size distribution significantly increases the compressive as well as tensile strength of the harden concrete.
- The dosage of admixture usage is limited from 10% to 20% for Wollastonite and flyash, 5% for silicafume. Within this range, the increasing of admixture-cement ratio improves the various properties of concrete. As the mineral admixtures enhance concrete properties in terms of strength and durability, the end product is also suitable for aggressive environment.

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A Review on the Effective Use of Fiber in Concrete

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Abstract-In the recent past, development of "Infrastructure/Construction Sector" has now become the major source for the tremendous growth of the country. "Concrete Construction" in relation to other ways of construction is commonly considered as major source due to its effectiveness in strength and durability as well as its capability to regain strength after retrofitting. Therefore it was seen that for the value addition in the effective use of concrete had lead to the various researches on Concrete and its components. Concrete a very customary material is a combination of variety of ingredient of different property and structure which when mixed initially forms a paste and after a specified time of setting it attains its shape this can accurately be named as hardened concrete. Management of waste from various sources had increasingly lead to the use of valuable waste in the development of eco-friendly concrete so as to make the environment less polluting and also used to enhance the strength and durability of concrete. Various researches were been done in the historical past with the use of these waste named as pozzolan and fiber. By taking an overview of all the past research on the concrete with reinforced fiber a review is been done in this research paper. Concrete when meshed with fiber of different property and orientation in different proportion is named as Fiber Reinforced Concrete. The paper justifies the incorporation of fiber such as Natural Fiber, Metallic-Fiber and Organic-Fiber in concrete mix and also their effect on the structural as well as durability property of concrete.

Keyword: Concrete Construction, Retrofitting, Fiber, Fiber Reinforced Concrete, Durability.

I. INTRODUCTION:

Concrete being an adoptable material in today's civil engineering construction sector needs improvement in its strengthening as well as durability property. A material with no ductile behaviour and which is a combination of material with different properties is termed as Concrete. Depending upon the mode of failure it can be acknowledged that concrete is strong in compression phase as compared to its tension phase (weak phase) and so as improve the tensile property of concrete reinforcing steel bars are incorporated. These incorporated reinforcements have lesser tendency to arrest cracks which are induced with increase in stress. So to enhance the performance of concrete and to make it better and acceptable, there is a need to make concrete strong and capable of arresting crack at greater extent or at level of higher stresses. Therefore, the use fiber in today's concrete construction is considered to be the best and acceptable technique. The concrete with randomly and uniformly oriented fibers is said to be Fiber Reinforced Concrete (FRP). This research is done taken prerequisite researches on Fibers as base. In the last many decades fibers are used as reinforcement to concrete as in the extreme environment they possess higher durability as well as their homogeneity in concrete increases the cracking strength of concrete reinforced with fiber (Sam, 2016). Fibers that are used to enhance the property of

concrete can be classified as Natural Fiber, Metallic Fiber and Mineral Fiber. In broader sense they can be classified as Steel Fiber, Glass Fiber, Coir Fiber, Jute Fiber, Wool Fiber, and many more.

Figure 1: Fiber Reinforced Concrete

II. MATERIAL REVIEWED

a. **Metallic Fiber:** Fiber such as steel fiber which can further be classified fiber as Carbon-Steel-Fiber and Stainless-Steel-Fiber are composed of materials such as metal, plastic Coated metal. Factors like Spalling-damage, Shrinkage-induced cracking and corrosion can easily be eliminated with the use of steel fiber in conventional concrete (Hover, Eddie, & Psomas, 2017). With respect to the use of steel rebar in concrete, steel fiber are considered to be more durable, cost and time effective in severe environment conditions (Hover, Eddie, & Psomas, 2017). In earlier researches it was seen that 0-30 kg/m^3 of steel wire incorporated in ground slab with strength in between 30-40Mpa, it was seen that load-carrying capacity increases significantly (Aldossari, Alshannag, & Elsaigh, 2017)

Figure 2: Carbon Steel Fiber

Figure 3: Chopped Carbon Fiber

Figure 4: Carbon-Structural Fiber

b. **Mineral Fiber:** The fibers which can easily be extracted from electro-thermal method are termed as Mineral-Fiber (Larisa, Solbon, & Sergei, 2016). Glass Fiber and asbestos Fiber. With the addition to Glass Fiber in concrete it was seen that there was ductility is reduced drastically when exposed to natural condition weather (Shah, Ludirdja, Daniel, & Mobasher, 1988).

Figure 5: Chopped Glass Fiber

Figure 6: Milled Steel Fiber

c. **Natural Fiber:** Fiber with high tensile strength and low modulus of elasticity is termed as Natural fiber (TORGAL & JALALI, 2011). Along with a reinforcement to concrete Natural Fiber are also very advantageous as they are renewable, cost-effective, non abrasive, and don't show any negative effect to health and safety while processing and handling (Reis, 2006). According to (Ramakrishna & Sundararajan, 2005) the potential of Natural Fiber as reinforcement made the concrete to overcome the inert deficiencies of cementing material. Natural Fiber are categorized as shown below:

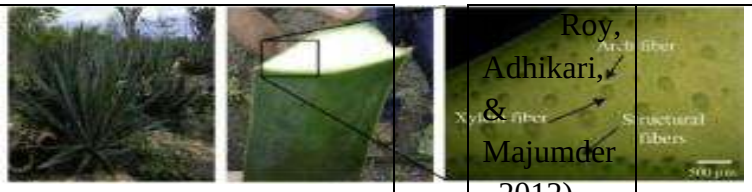
Figure 7: Different type of Natural Fiber

III. LITERATURE REVIEW:

Reference With	Fiber Category	Reviewed Conclusion
(Al-Oraimi & Seibi, 1995)	Natural Fiber	The investigation was done on concrete with addition of glass fiber and natural fiber in different proportion. The author concluded that incorporation of fiber lead to enhancement of concrete toughness as well as also showed improvement in impact resistance. The results noticed were such that the compressive strength of concrete with glass and natural fiber incorporation was comparatively less as compared to conventional concrete but both results were fair enough that they were indicating the importance to Fiber incorporation in concrete. In the introduction the author stated that the whole investigation was preceded by considering high strength concrete. Fiber in normal concrete may be not effective for pre-cracking behaviour of concrete but significantly have post-cracking effect.
(Aziz, Paramasivam, & Lee, 1981)	Natural Fiber	Fiber in concrete strengthens the concrete but there are certain factors which affects the fiber properties and indirectly the concrete. Author in his paper concluded some of the factors which are geometry, form surface and type of Fiber and also the property, design, mixing, placing, casting and curing of whole concrete. Also incorporation of fiber in concrete lead to decrease in workability of fresh concrete and this decrease is due to surface

		area and properties of fiber. There have been seen that natural fiber are also used in pre-cast products so as to reduce the impact of accidental damages.
Reference With	**Fiber Category**	**Reviewed Conclusion**
(SETHUNARAYANAN, CHOCKALINGAM, & RAMANATHAN, 1989)	Natural Fiber	Based on their easy availability of Natural Fiber as many of these are locally available in developing countries use of NFRC (Natural Fiber Reinforced Concrete) Is recommended by many researchers. Few researches have reported the log-term effect of fiber in beams made by concrete and it was concluded that with the increase in cycling loading there have been seen the increase in life of such beam. Natural Fibers in simple form are classified on the basis of vegetable and animal origin. The author concluded that the decay of fiber with time will lead to decrement in the strength of composite, so as to get the better strength throughout the service-life and so as to increase the durability pozzolans such as rice-husk ash and silica fumes should be taken as replacement to cement in Fiber reinforced concrete.
(Song & Hwang, 2004)	Steel Fiber	The author investigated the working of High-Strength Concrete with fiber incorporated in it. The fiber used was hooked-end steel fiber in proportion of 0.5%, 1%, 1.5%, 2%. After performing each and every test the research at last concludes that there was the increase in strength by incorporation of fiber and the maximum value was confirmed at 1.5% fraction where as there was a slight drop in strength at 2% but still greater when compared to non-fiberous concrete.
(Nataraja, Dhang, & Gupta, 1999)	Steel Fiber	For last 25 years there was a increase in use of steel fiber in concrete because of increasing productivity of steel fiber from various industries. Concrete structures like highway, airfield pavements, hydraulic structures, tunnel linings and many more are the current fields in which application of steel fibers are common. From many of the past researches it was acknowledged that many of the concrete properties such as resistance to crack, fatigue strength, impact strength, toughness and sapling were enhanced with the incorporation of steel fiber. The remark to the experimental investigation was as such: Properties of concrete like toughness and compressive strength were increased considerably and

		increment in both were directly proportional to the reinforcing index.
(Ali, Liu, Sou, & Chouw, 2012)	Coir Fiber	The author in his abstract mentioned that among all the natural fibers, coir fiber have highest toughness and should especially be used as reinforcement to maintain low cost of concrete and the preferred region is region with tropical earthquakes. The proportion of fiber added in concrete was 1%, 2%, 3% and 5% by mass of cement. According to him there are three forms in which coir fiber is available commercially and they are named as long fiber(bristle), relatively short fiber(mattress) and mixed fibers(decorated fibers). Taking physical examination of research in consideration it was suggested that for all assumed proportion the flexural
Reference With	**Fiber Category**	**Reviewed Conclusion**
(Asasutjarit, Hirunlabh, Khedari, Charoenvai, Zeghmati, & Shin, 2007)	Coir Fiber	According to the researcher, the fiber with thick meso-crap of coconut is termed as coir. Lignin in fiber works as a cementing agent, that is developed due to boiling and washing the fiber and this lignin binds the cellulose fiber together. Boiling and washing of coir fiber makes it tough and stiff. The research deals with the
		production of light-weight cement board with coconut-coir incorporated in it. The fiber in this research is boiled for 24hours and washed with water of ph 7. The experimental examining was done and it was concluded that pretreatment of coir fiber such as boiling and washing enhanced coir fibers mechanical and physical property.
(Banthia & Sappakittipakorn, 2007)	Steel Fiber	In this research experimental analysis was done taking steel fiber of different diameters say 0.8mm, 0.45mm and 0.4mm. The design was made for M-335 Grade concrete. The trend of steel incorporation was 0.25%, 0.50% and 0.75 for all three diameters and it was concluded that value of Compressive strength was higher at higher proportion of large diameter wire.
(Silva, Mobasher, & Filho, 2009)	Sisal Fiber	Sisal is a fiber extracted from sisal plant and sisal fiber for this research was extracted from sisal plant situated in city of Valente, Brazil. Leaf of Sisal plant consists of three different fibers which are named as structural, xylem and arch fiber as shown in figure below and hence said to have functionally graded composite structure. **Figure 8: Sisal plant**

		 When sisal fiber added to normal concrete then the composite showed high modulus and under both bending and tension stresses it shows multiple crack behaviour. The research also concluded that incorporation of sisal fiber lead to increase in energy absorption capacity and mechanical performance of concrete and in tension phase acts actively by bridging and arresting cracks.
(Silva, Filho, Filho, & Fairbairn, 2010)	Sisal Fiber	In the present research with the help of semi-automatic decorticator's fiber named sisal was extracted from sisal plant. The investigation was done on both CH free and PC composite and it was noticed by the author that at around 13mm for PC composite and 20mm for CH free composite of mid span deflection was occurred under bending of composite. 21Mpa and 23MPA were the Modulus of Rupture for PC composite and CH free Composite respectively and author acknowledged that the values were in same range.
Reference With	**Fiber Category**	**Reviewed Conclusion**
(Kundu, Chakrabor	Jute Fiber	The research emphasized on development of jute

Roy, Adhikari, & Majumder , 2012)		reinforced concrete by chemically modifying it, so as to make use of it in NP3 concrete pipes. For the purpose of making jute fiber chemically modified the author used two chemical named NaOH solution and carboxylated styrene butadiene copolymer emulsion and after treating jute fiber with these chemical it was kept at a temperature of 105°C in laboratory oven for 24 hours. The author in its conclusion stated the purpose of chemical modification and he commented that for the dispersion of fiber homogenously in concrete mix there is the need of making fiber surface hydrophobic. Jute being a fiber requires more water so tannin a water retarder is use in the concrete mix and it was observed that there was the significant improvement in the strength of concrete matrix.
(Zhou, Ghaffar, Dong, Oladiran, & Fan, 2013)	Jute Fiber	The experimental examining was done comparing JFR Cementitious Composite, blended with GGBS and PFA (Pulverized Fly Ash) and remark made was that with the addition of GGBS to JFRCC showed higher Compressive, Flexural and Split tensile as compared JFRCC with Pulverized Fly Ash. It was also noticed that

		toughness, CSIF (Critical stress intensity factor), and CSER (Critical Strain Energy Rate) were higher for JFRCC with GGBS as Compared to JFRCC with PFA and Plain concrete with Ground Granulated Furnace Slag. Considering the deterioration factor of Jute fiber, it was less with PFA concrete matrix as compared to GGBS concrete matrix.
(Dharan & Lal, 2016)	Polypropylene Fiber	The research incorporated the use of Polypropylene Fiber of different sizes in the concrete mix. It (Polypropylene Fiber) is the left over product of textile industry and is a type of synthetic fiber. The analysis was done on M30 and M40 grade of concrete and it was noticed that slump value tends to decrease with increase in the fiber content whereas both CS and STS attained higher value at 1.5% of fiber incorporation.

IV. CONCLUSION

With the knowledge of various Fibers and their properties along with their effect on concrete composite, the researchers for last many years are in search of suitable fiber additive. Some of them had reached to conclusion and some are in process. After reviewing plenty of research paper on working and effect of different fiber I have summarized their result and discussion in this review paper. Conclusion that can be made regarding the use of fibers in concrete is that fiber incorporation in concrete had made the concrete cost effective, durable, waste utilize and material with higher strength as compared to concrete with no fiber. It was seen that strength like compressive, split-tensile and flexural increases with addition of fiber of any type as when compared to plain concrete. With many of the advantages fiber incorporation shows decrease in slump value that is for making concrete pumpable it requires addition of super plasticizer. So at last it can be assumed that fiber incorporation is effective.

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Experimental investigation on the properties of Geopolymer concrete after replacement of river sand with the M-sand

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***Abstract*— Geopolymer concrete could be an alternative of the conventional concrete due their quality and performance in different conditions. In this study, to investigate the effect of river sand replacement to the stone-dust on the mechanical properties of the geopolymer concrete specimens. The specimens were cured in the oven at 60^0C 24 hours, and check the effect of replacement by the slump, density, compressive strength, splitting tensile, flexural strength, poison's ratio, elastic modulus, rebound strength and ultrasonic pulse velocity test. After the experimental investigation, it is concluded that the compressive strength, splitting tensile, and flexural strength increases with the replacement of river sand to stone dust in the mix design. The elastic modulus of river sand used specimens and stone-dust used specimens are 23.2GPa and 23.4GPa, respectively, after 28 days test. The rebound strength graph shows a similar pattern to the compressive strength of the specimens. The UPV of stone-dust specimens is slightly higher than river sand used specimens. The ultrasonic pulse velocity of stone-dust used specimens and river sand used specimens are 4.22km/sec and 4.16km/sec, respectively, after 56 days test.**

Keywords—Geopolymer concrete; Compressive strength; Mechanical properties; M-sand

I. INTRODUCTION

Concrete is a second largest material is used after the water in the whole world. In the present scenario, the sustainable development is very essential for the future. The natural resources are depleting continuously due to higher consumption or demand. In this section, the river sand is very essential component is used in the concrete as fine aggregates. The m-sand or stone-dust could be a best alternative to river sand as fine aggregates in the mix design of concrete. The quarry dust is used as fine aggregates would provide the better flexural strength than the river sand used concrete [1]. The m- sand is used in the concrete provides better gradation of aggregates and density [2]. Its usage in the concrete somewhat decreases in the workability than other [3]. It is pronounced by the various names like m-sand, quarry dust, and stone dust in the field. The stone-dust is used as fine aggregates at various places, it could be a good reform for the sustainable development in the construction industry. The manufactured sand used concrete provides better performance than the river sand used concrete [4–9].

In the present era, geopolymer concrete could be a perfect alternative of the conventional or portland cement concrete. Geopolymer concrete is an eco-friendly, economic, high performance, and durable because it uses the industrial solid wastes such as flyash, GGBFS, rice husk ash, and sugarcane bagasse ash etc. All those pozzolanic materials that are rich in in alumina and silica could be used in the GPC as biding materials [10]. The pozzolanic materials activated through the use of alkaline solution, which includes the sodium or potassium hydroxide and sodium or potassium silicate chemicals at a specific ratio. In the formation of geopolymer concrete, the geopolymerisation reaction occurs from initial fresh state to hardened state, it contains various phases of the reaction in the mechanism. The various factors affect the geopolymerisation reaction that could be pozzolans minerals composition, particle size, sodium or potassium hydroxide molarity, alkaline ratio, liquid to binder ratio, type of superplasticizer, curing types, curing duration etc. [11].

The geopolymer term is first time given by the Davidovits in 1978, it is a name of bonding occurred after the reaction [12,13]. The SNF-based

superplasticiser is best suitable for the geopolymer concrete in term of high performance [14], whereas the PCE-based superplasticiser is best suitable for self-compaction for conventional concrete [15]. The molarity of sodium hydroxide plays a vital role in the geopolymerisation reaction. So, it directly increases the strength of the specimens with the increment of the molarity, but up to an optimum point. The alkaline ratio consist the ratio between sodium silicate to sodium hydroxide that are also affects the reaction and increases or decreases the specimens strength and performance [16]. The flyash-to-GGBFS ratio varies the mechanical properties of the GPC specimens' due higher content of GGBFS presence forms the C-S-H bonds in the concrete whereas the geopolymer bonds are Na-A-S-H or other similar. The optimum point of GGBFS-to-flyash ratio also important for the long-term or durable properties [17]. Geopolymer concrete is not clearly follows lowers the water content in the concrete increases the strength of the specimen. The liquid-to-binder ratio are also very effective for geopolymerisation reaction. So, a limit of liquid is very essential to gain strength of the specimens. The optimum point of the liquid-to-binder ratio are found at 0.6 in the flyash-slag-based geopolymer concrete [18].

The curing types and curing period directly affects the mechanical strength or properties due slower and fasten the geopolymerisation reaction. The oven-cured specimens got the strength in the early ages than the ambient-cured specimens. The mechanical strength of GPC specimens increases with the curing period, the rise in strength is negligible after 48 hours [19–21]. In the oven-curing, the compressive strength increases with curing period, it shows negligible effects after the 12 hours curing [22]. It is suitable for better strength development to secure at an ambient temperature of more than

95 % relative humidity at room temperature for a more extended period before applying heat [23]. The temperature has an influence based on curing time. The curing at an increased temperature for 1 hour did not result in significant alterations in strength development, while lengthier treatment resulted in a significant acceleration of the response rate and an increase in early-age strengths [24].

The mechanical properties of the GPC or alkali- activated concrete are increased by using nanomaterials like calcium carbonate [25]. The geopolymerisation process was enhanced with a more extended curing period, resulting in increased compressive strength. Up to 24 hours of curing time, the rate of development in strength was high; beyond that, the growth in strength is only modest. As a result, the heat-curing duration does not need to exceed 24 hours [26]. Fog-cured samples have a more significant proportion of absorption. These phenomena might be connected to the geopolymer matrix's ability to retain water, resulting in a more open microstructure in this form of concrete [27]. Heat curing helps speed up the geopolymerisation procedure since compressive strength may be created early [28].

The oven-drying curing specimens generated 90% of the 28-day compressive strength at 3 days, whereas the ambient curing specimens attained 57–82%; nevertheless, the ultimate strength of the ambient curing specimens was somewhat more remarkable than the matching oven-drying cured specimens at 28 days. After 7 days, the rate of increase in compressive strength in oven-cured specimens is not noteworthy [29]. The geopolymer concrete highly resistant in durability parameters like acid attack, sulphate attack than the conventional concrete [30].

A. Materials

This section describes the raw materials properties after the preliminary testing. Flyash, GGBFS, Coarse aggregates, fine aggregates, sodium hydroxide, sodium silicate, superplasticiser and water are the basic raw materials were used in the mix design of GPC.

Table 1 depicts the mineral composition of the flyash and GGBFS. The mineral oxides those were presented in the flyash and GGBFS found through the x-ray fluorescence test. Class-c flyash were used in the mix design. It describes that the flyash is hollow and spherical in shape whereas the GGBFS is irregular. The XRD graph of flyash and GGBFS which shows that the amorphous nature of both. Sodium hydroxide and sodium silicate are used as alkaline activator in the mix design of GPC, and both are purchased from the market that are manufactured by the CDH pvt ltd. Delhi. The sodium hydroxide has 98% of minimum purity, whereas the sodium silicate is alkaline in nature. The SNF-based superplasticiser is used in mix design that are manufacture by the Fosroc chemicals. It is also called as SP Conplast 430.

Locally available stone dust is used as fine aggregates, whereas the 10mm and 20mm size coarse were used in the mix design of the GPC. The preliminary tests were conducted on both types of aggregates, to check the quality of the aggregates. The stone-dust is found in zone-2 and well-graded after the preliminary tests conducted on the stone dust, whereas the sand also found in the Zone II but it poorly graded. The gradation curve of both river sand and stone-dust, which shows that both are well-graded. The fineness modulus, specific gravity, water absorption, silt content, and bulk density of the stone-dust are

2.756, 2.62, 1.21%, 6%, and 1610kg/m^3, respectively. The fineness modulus, specific gravity, water absorption, crushing value, impact value, flakiness index, elongation index, and abrasion value of the coarse aggregates are 7.29, 2.79, .2%, 23%, 22%, 24%, 30%, and 8%, respectively. **Table 2** depicts the properties of river sand and stone-dust after the preliminary tests conducted on both in the laboratory. **Table 3** depicts the properties of coarse aggregates used in the mix.

II. EXPERIMENTAL PROGRAM

Experimental program includes the materials preliminary testing, mixing, casting, curing and tests setups.

Table 1 Chemical Composition

Minerals	**Flyash**	**GGBFS**
Silica (SiO2)	45.8	34.52
Alumina (Al2O3)	21.4	20.66
Lime (CaO)	13.7	32.43
Iron Oxide (Fe2O3)	12.6	.57
Magnesia (MgO)	1.3	10.09
Sulphate (SO3)	1.9	0.77
LOI*	0.1	0.3

LOI*- Loss of Ignition

Table 2 Properties of stone-dust and river sand

Test	River-sand	Stone-dust
Zone	Zone-II	Zone II
Grade	Poor graded	well graded
Fineness modulus	2.587	2.756 (medium sand)
Specific gravity	2.63	2.62
Water absorption	.43%	1.21 %
Silt content	0.2%	6 %
Bulk density	1596kg/m^3	1610 kg/m^3

Table 3 Properties of coarse aggregates

Test	Results
Fineness modulus	7.29
Specific gravity	2.79
Water absorption	0.2%
Crushing value	23%
Impact value	22%
Flakiness index	24%
Elongation index	30%
Abrasion value	8%

B. Mixing, Casting, and Curing

This section describes the mixing procedure, casting in different moulds samples and their curing type and duration. The mixing of the raw materials in the pan mixture for 10- 15minutes. **Table 4** depicts the raw materials content are used in the mix design of the GPC. The alkaline solution is made 20-24 hours before the mixing. After the mixing, the fresh concrete were tests for the workability, and after casted in the different mould samples. The three Types of specimens were made for the mechanical strength evaluation are as cube, cylinder, and prism shape as per the Indian Standard. The curing of the specimens was conducted in the oven at 60^0C for 4 hours to 72 hours.

Table 4 Mix Design of GPC

Material	**Quantity (kg/m^3)**
Flyash	303.75
GGBFS	101.25
Coarse Aggregates (20mm)	761
Coarse Aggregates (10mm)	508
Fine Aggregates/Stone dust	683
Sodium Hydroxide	46.28
Sodium silicate	115.72
Superplasticiser	4.05
Water	20.25

C. Tests Setups

All the experiments are conducted on the GPC mix on fresh stage or hardened form in the concrete laboratory.

The density is used to assess the chemical properties of GPC mix samples. Before the 28-day destructive inspection, the weight of cube samples is used to test the density of the mix design.

The GPC mix designs cubic samples of dimension 150mm*150mm*150mm are used to test the compressive strength of the specimens. The samples were tested in an axial loading mode on a Universal Testing Machine at a loading rate of 5.2kN/sec. The splitting tensile strength of cylindrical samples with diameters and heights of 150mm and 300mm is measured. In the Universal testing machine, transverse loads are applied to the cylinder to investigate the splitting tensile strength of the GPC cylinder specimens. The width, height, and length of the beam sample are 100mm, 100mm, and 500mm, respectively, for measuring the flexural strength of the GPC mix design. At the flexural testing machine, the beam specimen was subjected to a two-point load or flexural tensile test to determine the flexural strength of the GPC mix specimen. The cylindrical samples have a diameter of 150mm and a length of 300mm, and they would be used to measure the modulus of elasticity and poisons ratio of the GPC mix design. In the universal testing machine, the axial load is applied to the cylinder to analyze the vertical and horizontal strain of the GPC cylinder specimen to measure the modulus of elasticity and poisons ratio.

Those tests conducted in the laboratory and the field to detect the strength or quality without destruction are called non-destructive tests. The rebound test is based on the apparatus's check of surface hardness, and it is performed on cube samples 7days, 14days, 28days, 42days, and 56days after casting. It was carried out on all forms of sample cube and cylinder to measure the strength of the mixed sample.

The ultrasonic pulse wave frequency travels through the sample in the UPVT. The greater the UPV indicates, the greater the strength and efficiency of the GPC specimen. Two transducers, an electrical pulse generator, an amplifier, and an electronic timing unit, are used in the research apparatus. The ultrasonic pulse wave is sent through the transducers and electronic timing machine.

III. RESULTS AND DISCUSSION

The tests were conducted on a same mix design for mechanical properties tests. There are two types of samples were casted, in which river sand is replace by the stone-dust as fine aggregates in the mix design.

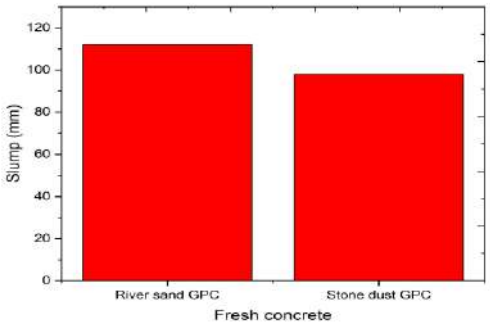

Figure 1 Graph of Slump

B. Density

The density of the GPC specimens decreases with the age of the concrete of both mix specimens. Fig.2 shows the slump variation of both mix specimens with the age of concrete. The stone-dust used specimens shows higher density than the river sand used specimens.

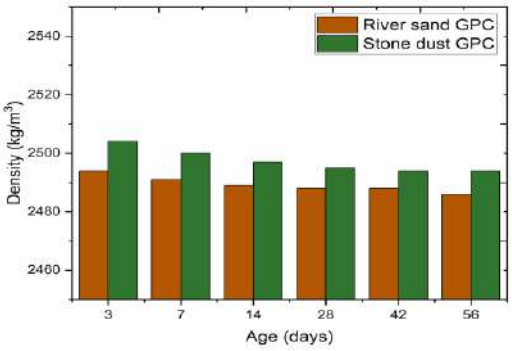

Figure 2 Graph of Density

A. Slump

The slump test is conducted on the fresh concrete to check the workability. Fig.1 shows the slump value of both concrete mixes. It shows that the workability of river sand used mix slightly higher than the stone-dust used mix.

C. Compressive Strength

The compressive strength of the GPC specimens increases with replacement of river sand to stone-dust specimens. Fig.3 shows the graph of compressive strength of both types' specimens at different days of testing. The specimens were tested at 7days, 14days, 28days, 42days, and 56days. The compressive strength of the stone-dust used specimens continuously higher than the river sand used specimens. The compressive strength of stone-dust specimens is slightly higher than river sand used specimens. the compressive strength of stone-dust used specimens and river sand used specimens are 36MPa and 35.5MPa, respectively, after 56 days test.

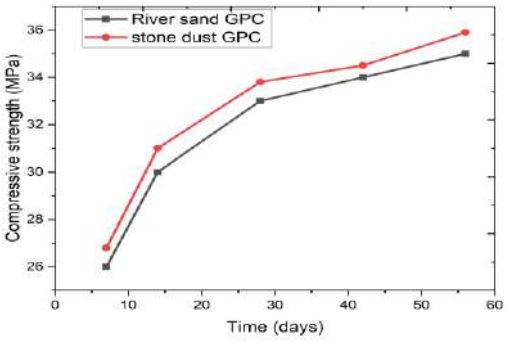

Figure 3 Graph of Compressive strength

D. Splitting Tensile Strength

The splitting tensile strength is also called indirect tensile strength. The splitting tensile of the GPC specimens increases with the replacement of river sand to stone-dust specimens. Fig.4 describes the graph of splitting tensile behaviour variation with river sand replacement to stone-dust. All the specimens cured at different curing periods were tested at 7days, 14days, 28days, 42days, and 56days. The splitting tensile strength of the stone-dust used specimens continuously higher than the river sand used specimens. The splitting tensile

of stone-dust specimens is slightly higher than river sand used specimens. The splitting tensile of stone-dust used specimens and river sand used specimens are 4.8MPa and 4.5MPa, respectively, after 56 days test. Around 95% splitting tensile found at 28days test in all curing period specimens.

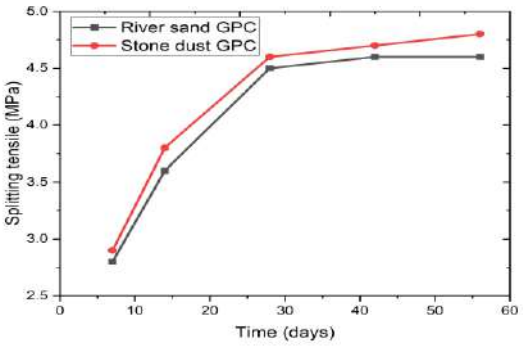

Figure 4 Graph of splitting tensile

E. *Flexural Strength*

The flexural strength is also called the modulus of rupture. It can determine through the test on the prism shape specimens in the flexural testing machine. Flexural strength shows a similar pattern to the indirect tensile strength. Fig.5 describes the graph of flexural strength behaviour variation with the river sand replacement to stone-dust. The flexural strength of the stone-dust used specimens continuously higher than the river sand used specimens. The flexural strength of stone-dust specimens is slightly higher than river sand used specimens. The flexural strength of stone-dust used specimens and river sand used specimens are 5.3MPa and 5.2MPa, respectively, after 56 days test.

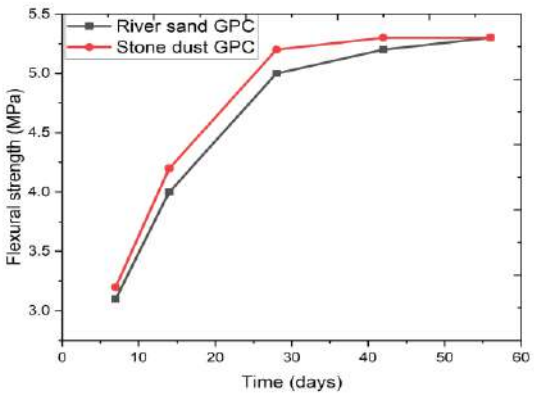

Figure 5 Graph of Flexural Strength

F. *Elastic Modulus and Poisons ratio*

The elastic modulus and poisons ratio was determined through the test conducted on the cylindrical specimens in the UTM, in which the load is applying in the longitudinal direction of specimens. Fig.6 describes the elastic modulus behaviour variation with the river sand replacement to stone-dust GPC specimens, and the elastic modulus increases with the replacement of river sand to stone dust. The elastic modulus and poisons ratio determine at 28days test of the specimens. The elastic modulus of river sand used specimens and stone- dust used specimens are 23.2GPa and 23.4GPa, respectively, after 28 days test.

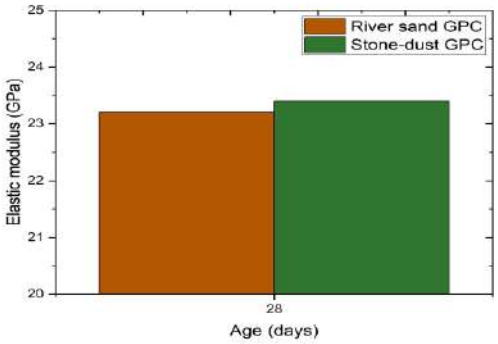

Figure 6 Graph of elastic modulus

G. *Non-destructive Tests*

The non-destructive tests are those tests that identify the GPC specimen's quality strength without causing any damage in the specimens. It includes the rebound strength test and UPVT.

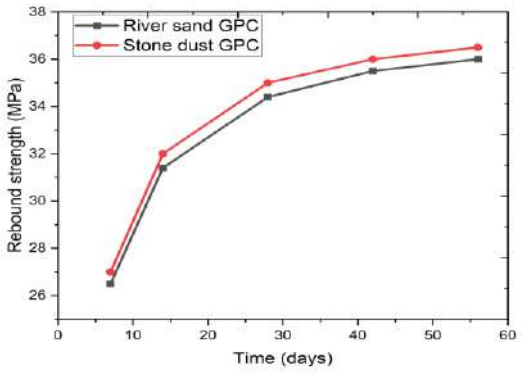

Figure 7 Graph of Rebound Strength

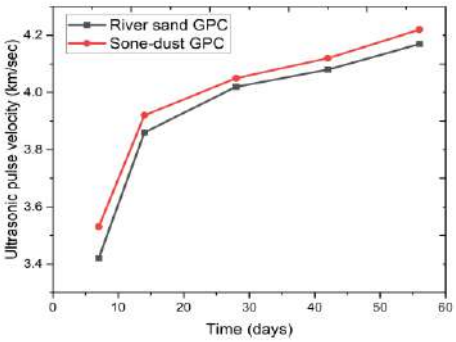

Figure 8 Graph of UPVT

1.) Rebound Strength

The rebound strength test identifies the strength of the concrete or other hard material based on indentation penetration conducted on the surface of the specimens. It needs a minimum of 9 penetration conduction on a single surface to identify the strength of the single specimen, and Fig.7 describes the graph of rebound strength behaviour variation with the river sand replacement to stone-dust GPC specimens. The rebound strength graph shows a similar pattern to the compressive strength of the specimens. All the specimens cured at different curing periods were tested at 7days, 14days, 28days, 42days, and 56days.

2.) UPVT

The UPVT is also non-destructive. It identifies the quality of the concrete specimens via note down the time passage or UPV passes through the specimens. It quickly identifies the cracks inside the specimens because the UPV decreases with the increment of the quality of specimens. Fig.8 describes the UPV behaviour variation with the river sand replacement to stone-dust. It shows a similar pattern to the rebound strength. All the specimens cured at different curing periods were tested at 7days, 14days, 28days, 42days, and 56days. The UPV of the stone-dust used specimens continuously higher than the river sand used specimens. The UPV of stone-dust specimens is slightly higher than river sand used specimens. The ultrasonic pulse velocity of stone-dust used specimens and river sand used specimens are 4.22km/sec and 4.16km/sec, respectively, after 56 days test.

The UPVT is also non-destructive. It identifies the quality of the concrete specimens via note down the time passage or UPV passes through the specimens. It quickly identifies the cracks inside the specimens because the UPV decreases with the increment of the quality of specimens. Fig.8 describes the UPV behaviour variation with the river sand replacement to stone-dust. It shows a similar pattern to the rebound strength. All the specimens cured at different curing periods were tested at 7days, 14days, 28days, 42days, and 56days. The UPV of the stone-dust used specimens continuously higher than the river sand used specimens. The UPV of stone-dust specimens is slightly higher than river sand used specimens. The ultrasonic pulse velocity of stone-dust used specimens and river sand used specimens are 4.22km/sec and 4.16km/sec, respectively, after 56 days test.

IV CONCLUSIONS

After the experimental investigation in the laboratory, the following conclusions are as follows:

- The workability of river sand used mix slightly higher than the stone-dust used mix. The stone-dust used specimens shows higher density than the river sand used specimens.
- The compressive strength, splitting tensile, and flexural strength of the stone-dust used specimens continuously higher than the river sand used specimens. The engineering strength of stone-dust specimens is slightly higher than river sand used specimens.
- The elastic modulus increases with the replacement of river sand to stone dust. The elastic modulus of river sand used specimens and stone-dust used specimens are 23.2GPa and 23.4GPa, respectively, after 28 days test.
- The rebound strength graph shows a similar pattern to the compressive strength of the specimens. The UPV of the stone-dust used specimens continuously higher than the river sand

used specimens. The UPV of stone-dust specimens is slightly higher than river sand used specimens. The ultrasonic pulse velocity of stone-dust used specimens and river sand used specimens are 4.22km/sec and 4.16km/sec, respectively, after 56 days test.

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Innovative Solutions of Structural System For Tall Building: A Review Paper

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Abstract- The present analysis for every under developing and developed countries is somewhere based on its infrastructure development. In the last few decades, tall buildings have become a world architectural phenomenon. The modern tendency toward lightweight and best performing designs has led, in recent years, to innovative structural systems for skyscrapers, able to integrate aesthetic and engineering aspects.Traditional structural systems have been progressively abandoned in favor of more efficient structures that allow new "design challenges," such as the search for increasing heights.

Keywords: - Diagrid, Tall Building, Irregular Buildings.

I INTRODUCTION

The shapes of buildings is very important for its aesthetic view like the Shukhov tower in Russia, CCTV headquarter China, MyZeil in Germany etc. but these buildings cannot be designed by sticking up with the old design practices. New concept introduced in the design practice one of them is the diagrid structural systems.

CCTV Headquarters China

II LITERATURE REVIEW

Literature review is the summary and findings by study of various papers that are been published in the past in the same or much similar topic, Research papers supported the concept of Tall Buildings and advanced studies.

Innovative structural solutions for Tall Buildings, University of naples federico II, 2015 by Elene Mele

A new study was made on Hexagrid which formulated a design procedure based on the homogenization criteria and in particular, on the definition of a "Representative Volume Element" (RVE). In future scope it was suggested that a new structural systems can also be proposed naming irregular.

A Study on Behavior of Structural Systems for Tall Buildings Subjected To Lateral Loads by Shruti Badami , M. R. Suresh

This paper describes an investigation has been This paper describes an investigation has been carried out to examine the most common structural systems that are used for reinforced concrete tall buildings under the action of gravity and wind loads. These systems include "Rigid Frame", "Shear Wall/Central Core", "Wall-Frame Interaction", and "Outrigger". The basic modeling technique and assumptions are made by "ETABS" Program, in 3-D modeling. Design considerations are made according to Indian Standards and concluded based on comparative study that, story drift is maximum in case of Rigid frame, and minimum in case of outrigger system.

'Lateral Loads Resisting Structural Systems Sustainability of Structural Systems", International Journal on Recent and Innovation Trends in Computing and Communication, 2016 by Girish Gaikwad, Saurabh Gaikwad
The structures suffer from lateral loads such as wind and earthquake more and more. So it becomes necessary or let's say that it becomes general rule in tall buildings to identify the proper structural systems for resisting lateral loads. Structural design of Taipei 101 was also studied. Choice needed for the selection of structural systems is directly or indirectly on the condition of the building is to be built. There will be always necessity for new structural system due to innovation in concrete technology.

Non-conventional Structural Patterns for Tall Buildings: From Diagrid to Hexagrid and Beyond by . Elena mele , Massimiliano Fraldi, Gian Maria Montuori, and Gianpaolo Perrella,
A classical homogenization-based micromechanical approach has been employed, by deriving sensitivity analyses and generalized stress-strain relationships for both regular and geometrically distorted irregular pattern units, the latter obtained by perturbing prescribed key geometrical features of the Representative Volume Element to control Voronoi morphologies and predict associated mechanical properties. On the basis of a simple stiffness criterion, a preliminary design procedure is proposed and applied to a tall building case study whose bearing skeleton is conceived on the basis of the investigated unconventional structural patterns.

Giulia Angelucci, Fabrizio Mollaioli, "Voronoi-Like Grid Systems for Tall Buildings", Sapienza University of Rome,Italy 2018

In the context of innovative patterns for tall buildings, Voronoi tessellation is certainly worthy of interest. It is an irregular biomimetic pattern based on the Voronoi diagram, which derives from the direct observation of natural structures. The paper is mainly focused on the application of this nature-inspired typology to load-resisting systems for tall buildings, investigating the potential of non-regular grids on the global mechanical response of the structure.

III OBJECTIVES

1. Due to the complexity of the structures, the most advanced engineering design techniques are needed in tall buildings.
2. Considering the irregular nature of structural patterns, the homogenized mechanical properties of the Voronoi patterns could be calculated only with a statistical approach.
3. The reliability of the design procedure can be investigated. This can known by preliminary results which shows a good performance of the tall building with a Voronoi structures.
4. Software for analysis and designing part can be used for Voronoi structures which can be compared to conventional methods.
5. The importance of this study will only increase in coming time as tall buildings are future of infrastructure.

IV METHODOLOGY

1. The general methodology is to model which ever grid as a continuous depleted medium, characterized by penalized mechanical Properties.
2. Using Representative volume element approach a structure can be modelled and behavior pattern can be seen.
3. The methodology for mechanical characterization and homogenization process of voronoi structural grid is to be proposed.
4. Basically the procedure consists in evaluating the effective axial and shear Moduli of the grid , which accounts for the geometric and elastic properties of structural members as Well as for geometrical patterns of the grid.
5. All the design parameters can be calculated using a softwares like ETABS, SAP 2000, and ANSYS.

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A Review on Building Performance Simulation Software to Enhance Energy Efficiency of New And Existing Building

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Abstract: Buildings consume nearly one third of the total annual electrical energy consumed in the country and are one of the largest contributors, second only to industrial sector to greenhouse gas emissions. Energy demand is expected to grow aggressively in the coming years with rising population and technology intensive lifestyles. So, to ensure that this demand is met in a sustainable way, it is necessary to make the buildings extremely energy efficient and curb the energy footprints associated with them. This can be achieved by using energy modelling/simulation for all the upcoming buildings and also for existing buildings to provide retrofitting measures to make them more energy efficient. The suitability of a given tool or software for energy simulation will vary depending on specific needs and circumstances. The factors which affect the suitability of the simulation tools for different buildings are the ease of data input interface, availability of results in graphical form and usability for code compliance. This paper discusses the various energy modelling/ simulation tools which are available today. The suitability of these tools according to the building type, the climate zone in which the building is located in and what major component of the building is to be simulated will be assessed.

Keywords: **Energy efficiency, simulation, energy modelling, building envelope, HVAC**

I. INTRODUCTION

Indian economy has expanded aggressively in the last few decades and it is poised for greater growth in the future. However, our progress is accompanied with unique local and global challenges. Rapid economic growth, urbanization and expanding population have imposed a great strain on energy supply resources. The need for smart, green, and sustainable cities is apparent from the Agenda 2030 for Sustainable Development, adopted in 2015 [6]. Buildings consume nearly one third of the total annual electrical energy consumed in the country and are one of the largest contributors, second only to industrial sector to GHG emissions. With about 70% of the buildings which will be required in 2030 yet to be built, this sector is going to drastically impact any efforts to contain GHG emissions [7]. Energy demand is expected to grow aggressively in the coming years with rising population and technology intensive lifestyles. India has committed to reduce emissions

intensity of the national GDP by 33% to 35% by 2030 from 2005 level [9]. Transformation of the building sector to the most advanced standards of building energy efficiency like Net Zero Energy Buildings (NZEBs) is crucial for achieving these targets.

In 2007, the worldwide urban population exceeded the rural population for the first time in history [5], as can be seen from Fig. 1. This demographic change started in the 1950s, with people migrating from rural to urban areas. The obvious reason for this was the availability of professional, social, economic, and personal growth opportunities the urban environments were offering. In 2014, 54 percent of the total world population was urban occupants. The world population along with those living in urban areas are expected to rise. Such an increase in population comes with substantial challenges and difficulties in urban environments, which will soon become incapable to meet the basic needs in a sustainable manner. One of such challenges is to be able to meet the ever-increasing energy demands of these urban environments. This calls for adopting the highest possible standards of energy efficiency and switching slowly to renewable energy sources. This demographic change in the scenario has resulted in growing inefficiency levels and calls for an overhaul of the urban environments by sustainable planning [4].

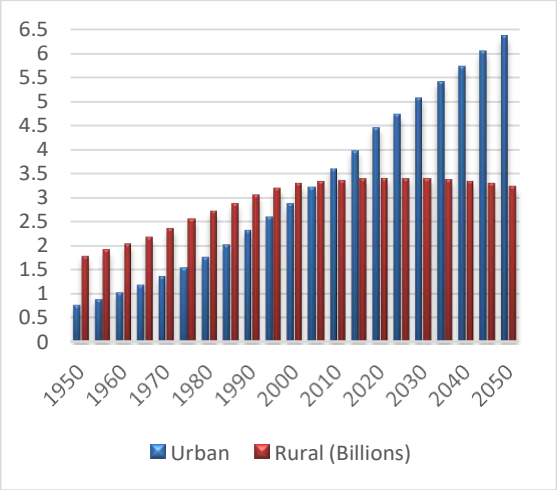

Fig. 1 Urban and rural population worldwide.

II. OBJECTIVE

This paper presents an overview of different software/tools which are available for energy modelling of buildings. The major components of a building which need to be assessed for energy efficiency are building form i.e. shape and orientation, building envelope i.e. window dimensions and wall to window ratio, internal loads i.e. lighting power density and plug loads, HVAC systems i.e. size, efficiency of system and the schedules of the building. Different softwares have different interfaces and calculation engines and work best only for some and not all the components listed above in a given set of environmental conditions.

This review is being carried out to find the major benefits and drawbacks of energy modelling softwares for different building components.

III. ENERGY MODELLING

An energy model is nothing else but a calculation engine accepting inputs such as geometry of the building, operation schedules, and system characteristics, to produce outputs like graphical performance comparisons and compliance reports. Energy modelling is helpful in energy efficient designing of a building because it is an iterative process, in which fundamental design parameters are addressed in initial models, and feedback on the performance of building form and orientation and how they will affect the buildings energy efficiency is provided as models develop. Just one percent improvement in the energy efficiency of HVAC systems adds up to millions of dollars in annual savings at the international level [1]. The guide to good practices in operating ICT devices [2] and actionable feedback from occupants [3] have shown the immense energy-saving potential of over 130,000 kWh and 311 kWh annually respectively.

The advantages of energy modelling are that it enables designer to articulate energy as a component of efficiency, assists in the development of building envelope taking into account insulation types, solar heat gain coefficients, and thermal properties, helps quantify potential reduction in energy use and associated greenhouse gas emissions, reduced and more predictable operating and maintenance costs, greater degree of occupant comfort due to better control of envelope radiant losses and gains and reduced infiltration, energy modelling

helps understand the impact of material choices on comfort [8].

Some of the disadvantages of energy modelling are that it is highly detailed and requires advanced skill, lack of staff dedicated to energy modelling, energy modelling takes time and resources, energy considerations may sometimes limit design decisions.

IV. REVIEW OF SOFTWARES

Today many different tools for energy modelling of buildings are available each having their own set of pros and cons. The suitability of a given tool or product varies according to specific needs and circumstances. While selecting a tool for a specific project, the things to be looked for in a tool before final selection are the ease of use of tool, the support for various passive design strategies in it. Time and cost required to work with the tool are also important factors to be considered. Interoperability remains another factor which cannot be ignored as the tool will have to work with already existing building design tools such as AutoCad and Revit etc. The types of inputs available and how does the tool accept them and in output how does the tool generate graphs, charts, comparative analysis or just numbers and it is also important how easy are outputs to understand. In the end, how accurate results are generated by the energy modelling tool should be given due consideration before arriving at the final selection of the tool.

Some of the tools which are available and widely used for different applications in energy modelling are DOE-2 (engine), EnergyPro, Green Building Studio (GBS), eQUEST, Energy Plus (engine), DesignBuilder etc. The details of each of these programs is discussed below and a comparison is done in Table 1.

DOE-2 is a calculation engine for Building Energy Modelling developed by Lawrence Berkeley National Laboratory, it calculates life cycle costs and energy performance of whole building projects. DOE-2.1E and DOE-2.2 are the two versions of this tool which are available. It provides detailed and hourly energy analysis for multiple zones of buildings of both simple and complex design. It supports simulation of buildings with fully mixed HVAC systems, such as variable air volume systems. However, this calculation engine is not frequently updated now and also requires a high level of user knowledge.

EnergyPro uses DOE-2.1E engine as an interface to carry out whole building energy modelling calculations and also for code compliance. In this program, the input and output forms are simple and easy to understand. However, it doesn't provide a 3D building model as a frame of reference to understand the code compliance reports and it isn't free to use.

Green Building Studio (GBS) links 3D CAD building designs AND Autodesk architectural building information models (BIM) with energy, water, and carbon analysis. It uses DOE-2.2 engine to calculate energy performance and generates geometrically precise input files automatically for major energy simulation programs. This is a cloud-based service using large capacity computing power to manipulate a variety of parameters. and get results quickly. However, the automatically generated details don't allow for manipulation of building components and it is also not free to use.

eQUEST is the most widely used graphic interface which uses DOE-2.2 engine. Its interactive graphics, wizards, parametric analysis, dynamic defaults, and rapid execution makes eQUEST able to conduct whole building energy simulation analysis. It has a schematic design wizard, a design development wizard, and a fully detailed input mode which address different user experience and expertise and it is also free to use. The building geometry can also be imported from other softwares, such as BIM. As eQUEST is freeware, support for software related questions is limited and online public fourms are required for that purpose.

Table 1

COMPARISON OF ENERGY MODELLING TOOLS

Modelling Tool	**Calculation Engine**	**raphic Interface for Front-EndInput**	**raphic Results Provided**	**appropriate for Early Design Phase**	**approved odelling**	**Freeware**
Energy Pro	DOE-2.1E	No	No	No	Yes	No
Green Building Studio (GBS)	DOE- 2.2	Yes	Yes	Yes	No	No
eQUEST	DOE- 2.2	Yes	No	Yes	Yes	Yes
Design Builder	EnergyPlus	Yes	Limited	Yes	Yes	No

EnergyPlus is a Building Energy Modelling tool for existing buildings, new construction, low-energy designs and conventional buildings. It provides better accuracy and enables analysis of complex building designs and mechanical systems. Many interfaces have been developed which are linked to the EnergyPlus engine to enable users to analyse radiant systems, natural ventilation, ground source heat pumps and complex HVAC systems with overall building design. It provides more detailed simulation results for newer system technologies and is a freeware. However, it is significantly slower when compared to other engines because of enhanced physical modelling details.

Design Builder offers an interactive and user friendly energy modelling environment. It can accommodate wide range of data such as environmental performance, internal comfort data, energy consumption, and HVAC component sizes. Sub hourly time steps are used for simulation to generate output. It is a simple and most intuitive

interface currently available for EnergyPlus engine. However, there is no import function for building geometry, so all the detailed modelling has to be done within the interface, it has limited ability for accurately simulating complex HVAC systems and it is not a freeware.

V CONCLUSIONS

After carrying out the above analysis of various tools available for energy modelling for buildings, we can conclude that all the energy modelling/simulation interfaces are based on some calculation engines which can be DOE- 2.2, DOE- 2.1E or EnergyPlus. EnergyPro can be used if only code compliance reports are to be generated as it doesn't provide 3D models. GBS can be used if accurate BIM models of buildings are to be simulated and for generating geometrically accurate input files for EnergyPlus. eQUEST maybe used when continuous energy modelling is required from the planning to the execution stage as details can be changed easily in its wizards. DesignBuilder is used for very detailed sub hourly energy performance analysis slower as it uses EnergyPlus engine. To be able to make our buildings more energy efficient and our planet more sustainable, awareness about energy modelling/simulation must be created among designers and engineers.

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Enhancing strength properties by including plastic waste in concrete mix: A review paper

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***Abstract* — With increase in intervention by humans the quality of environment has deteriorated in last few centuries. Plastic is one of the highly preferred man-made material because of its low production cost, durability and availability. Unfortunately, the plastic also has lowest possible decomposition rate due to this property the elimination of plastic from our environment is very difficult. Environmental activist is appalling to the society of reuse the waste plastic. Once such reuse can be done in building construction industries. In this paper various methodologies are studied that use different forms of various types of waste plastic such as PET, HDPE, UPVC, PP, etc. a comparison of various such plastic fibers is done. The observations clearly show that usage of plastic waste has a high potential in the building construction industry. This paper includes review about the effect of waste plastic on the various properties of concrete such as density, workability, compressive strength, flexural strength, splitting tensile strength, modulus of elasticity, permeability, absorbance resistance, etc.**

Keywords* — *Concrete properties, plastic waste, waste fibers construction industies.

I. INTRODUCTION

The plastic derives from the Greek word “plastikos”, meaning “being capable to shaped or molded”[1]. Plastic has low density, lightweight with good strength, long life, user-friendly designs, fabrication capabilities, and low cost are the major factors behind the extremely high growth of plastic products, due to these major benefits plastics have become an integral and inseparable part of human life [2]. With the largest population, China produced the largest quantity of plastic, at nearly 60 million tonnes. This was followed by the United States at 38 million tonnes, Germany at 14.5 million tonnes, and Brazil at 12 million tonnes every year. Being the world’s second-largest populated country, India generates around 5.6 million tonnes of plastic waste annually and India’s per capita consumption is 11 kg, according to the Federation of Indian Chambers of Commerce and Industry (FICCI) in 2017. As per Indian officials, plastics make about eight percent of total solid waste in India. Figure I shows plastic waste produced and its % contribution to solid waste for the major Indian cities. At the present Indian construction, industries consume about 328 million metric tonnes of cement annually and it is expected to reach about 580 million metric tonnes per annum in 2022. Figure II indicates the growth of volume consumption of cement in India for the last decade (i.e. FY2009 to FY2019). Concrete is made up of natural materials and the re-formation of natural resources beyond the control of mankind. As the demand for concrete increases, the serious question is raised on the quickly vanishing valuable natural sources[3]. So now it become a necessity to use various alternative materials other than natural along with conventional materials to reduce the quick and huge usage of natural sources. For counteracting these issues, a new concept was coined – Green concrete. It is prepared by using the various industrial waste product or waste materials along with conventional natural materials. Several various such wastes are already added and tested for different observations and their effects on various aspects of concrete properties [4].

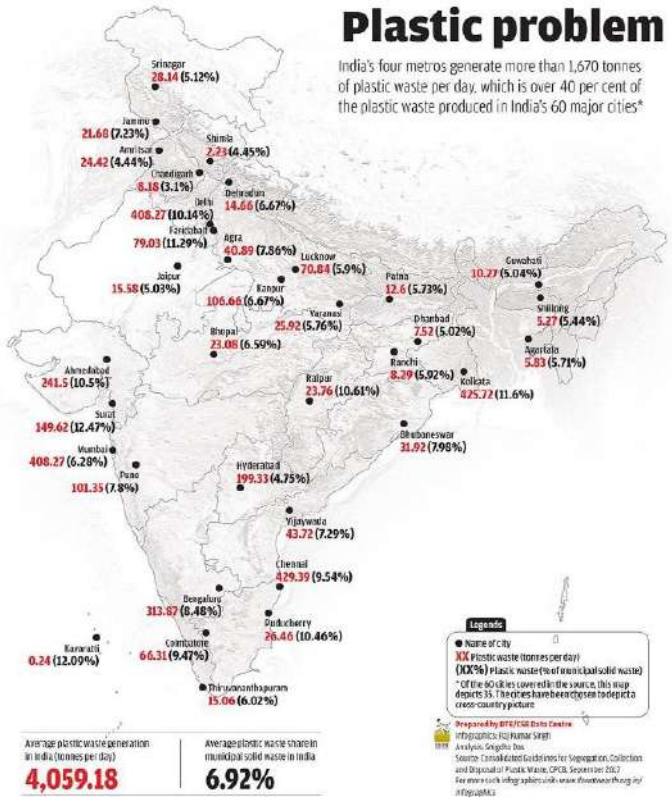

Fig. I. *Plastic waste generated by major Indian cities {Hyperlink "https://cdn.downtoearth.org.in/"} [18]*

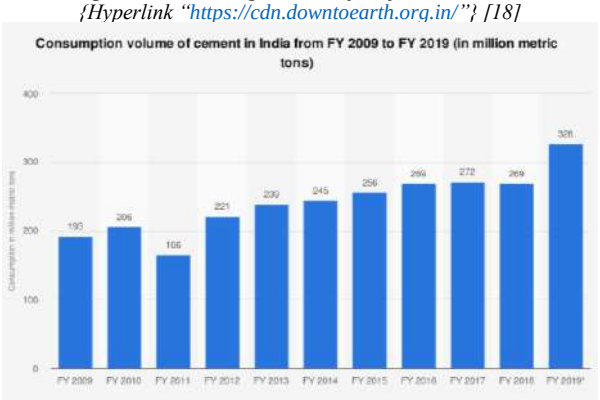

Fig. II. *Consumption volume of cement in India {Hyperlink "https://www.statista.com/"} [19]*

The plastic industry is one of the fastest-growing industries in the world. Plastic packaging substances are rejected as waste, after fulfilling their service. Plastics remain non-biodegradable for many years and create a great threat to the environment. Though the recycling of waste plastic is a possible option to reduce the threat, it required higher energy and vast manpower [5]. Since recycling, waste plastic requires all together with different technology and vast resources. Using waste plastic directly within the need of the concrete industry can be considered as a novel approach. As concrete industries utilize conventional resources [6]. Table I shows the mechanical characteristics of different fibers for fiber reinforced concrete (FRC) [7]. Different fibers such as steel, glass, carbon, nylon, etc. are described. Though, these fibers show good tensile strength their pre-processing overheads are more. On the contrary plastic fibers required straining which is far less expensive as compared to its peer fibers.

TABLE I. Mechanical characteristics of different fibers for FRC

Fiber Type	Equivalent dia. (µm)	Spec. wt. (10^3 kg/m^3)	Elastic modulus (N/mm^2)	Tensile strength (N/mm^2)	Ultimate strength (N/mm^2)
Steel	5-500	7.84	2,00,000	500-2000	0.5-3.5
Glass	9-15	2.60	70,000-80,000	2000-4000	2-3.5
Nylon	-	1.10	4000	900	13-15
Carbon	9	1.90	2,30,000	2600	1
Acrylic	18	1.18	14,000-19,500	400-1000	3
Poly-propylene	20-200	0.90	5000-7000	500-750	8

II. RELATED STUDY

The plastic consumed annually all over the world has been growing rapidly. In recent times, plastics are extremely used in the medical stream such as healthcare applications and artificial implants, water desalination and bacterial removal, other industries such as automotive, communication and electronics industry, etc.

Fresh concrete is simply a transient stage, but it is important to see that the quality, durability, and strength of concrete are truly influenced by the level of its compaction[8]. Fresh properties such as mix proportion and design, workability of fresh concrete, and early age properties are discussed. Usually, there is a relationship between strength and durability which means in other words to increase the durability of concrete we need to strengthen its properties. The main objective of this study is to compare fresh properties of concrete with or without plastics which are utilized as fine or coarse aggregates. Because of the difference in gravity of the sand (fine aggregate) and plastic aggregate, the method of volumetric design is adopted. Studies found that the shape and content of plastic concrete

directly affect the workability of concrete. Depending on the plastic content the workability decreases with an increase in plastic content. Every type of plastic aggregate (coarse or fine) resulted in a decrease in the density of concrete. This mainly happens due to the low gravity of plastic aggregate compares to the gravity of natural aggregate.

A suitable environmentally friendly alternative to sand must be found to match the huge demand from the concrete construction industry[9]. This paper deals with eleven concrete mixes that are evaluated for the study of the following: plastic material compositions, partial sizes, aspect ratios, and chemical treatments. By replacing 10% of waste plastic it has the potential to save 820 million tonnes of sand every year. For supporting efforts to limit the effects of sand dredging to reduce the sand demand in the construction industry. Generally, the replacement of the plastic into the concrete will result in a decrease in compressive strength and tensile strength. This happens because of the poor bonding of the surrounding matrix with plastic. The proposed material is cost-effective in the terms of production also the availability of the waste material is easily procured. Shredding A PET material is used to provide a feasible sand alternative. This paper also identifies future works such as bonding between matrix and plastic, use of chemical treatment to improve the bond.

Ensuring the reuse of waste plastic as a sand substitution aggregate in Iraq is shown[10]. Testing of the proposed material included performing slump, fresh density, dry density, compressive strength, flexural strength, and toughness indices. Two aggregates were studied. Fine aggregate represented the natural sand of Iraq and coarse aggregate represented natural crush stone. The dry density values with a curing age of 28 days exceed the range of dry density of structural lightweight concrete. Waste plastic may restrict the hydration of cement due to its water repellent properties. Overall curing ages of 3, 7, 14, and 28 days were applied to concrete mixtures. By increasing the waste plastic ratio, a decrease is observed in compressive strength and flexural strength. This will be demonstrated by adhesive strength between the surface of the plastic and cement paste.

Experimenting with discarded food packaging plastic for studying impact strength and durability properties of concrete reinforced with post-consumer metalized plastic waste (MPW) is shown[11]. Concrete is prone to develop micro-cracks due to a lack of protection against water and gas permeability. Results show that conventional concrete developed the initial and final cracking with a fewer number of blows than the concrete reinforced with the MPW fibres. MPW fibres effectively deal

TABLE II. Uses of plastics and recycled plastics (Recycling and Resource Recovery Council, 1994)

Name of Plastic	Description	Some uses of virgin plastic	Some uses of plastic made from recycled waste plastic
Polyethylene terephthalate (PET)	Clear tough plastic, may be used as a fiber	Soft drink and mineral water bottles, filling for sleeping bags and pillows, textile fibers	Soft drink bottles, (multi-layer) detergent bottles, clear film for packaging, carpet fibers, fleecy jackets
High density polyethylene (HDPE)	Very common plastic, usually white or coloured	Crinkly shopping bags, freezer bags, milk and cream bottles, bottles for shampoo and cleaners, milk crates	Compost bins, detergent bottles, crates, mobile rubbish bins, agricultural pipes, pallets, recycling crates
Un-plasticised Polyvinylchloride (UPVC)	Hard rigid plastic, may be clear	Clear cordial and juice bottles, blister packs, plumbing pipes and fittings	Detergent bottles, tiles, plumbing pipe fittings
Plasticized polyvinylchloride (PPVC)	Flexible, clear, elastic plastic	Garden hose, shoe soles, blood bags and tubing	Hose inner core, industrial flooring
Low density polyethylene (LDPE)	Soft, flexible plastic	Lids of ice-cream containers, garbage bags, garbage bins, black plastic sheet	Film for builders, industry, packaging and plant nurseries, bags
Polypropylene (PP)	Hard, but flexible plastic – many uses	Ice-cream containers, potato crisp bags, drinking straws, hinged lunch boxes	Compost bins, kerbside recycling crates, worm factories

Polystyrene (PS)	Rigid, brittle plastic. May be clear, glassy	Yoghurt containers, plastic cutlery, imitation crystal ''glassware''	Clothes pegs, coat hangers, office accessories, spools, rulers, video/CD boxes
Expanded Polystyrene (EPS)	Foamed, lightweight, energy absorbing, thermal insulation	Hot drink cups, takeaway food containers, meat trays, packaging	-

with stress distribution, to improve the fracture caused by sudden cracking. However, the acid penetrability reduce significantly during the drying process. Fibres act as an agent that protects the concrete from developing cracks. MPW fibres resist the expansion by developing a mesh-like structure in the mix. The experiments also demonstrated improvement of absorption of water due addition of MPW fibres. As the strength aspect, compressive strength marginally reduced up to a dosage of 1% but it shows improvement in splitting tensile and flexural strength of the concrete mix by adding MPW fibres [12]. It can be said that if MPW fibres are consumed in building construction, they can play a major role in the reduction of environmental pollution, along with increase strength, chemical resistance, and durability of concrete properties.

Plastic is a flexible, durable, and cheap material that is used in almost every industry for one purpose or the other [6]. The researchers made an effect to utilized shredded plastic bags as concrete additive materials. The concrete when added with waste plastic display less fluidity due to irregular shapes of particle. The workability decreases with the increasing amount and size of waste plastic. There was a declining density due to the same reason. A reduction in compressive strength was observed due to the weak transition between waste plastic and cement matrix. Another interesting observation was the imbalance of water to cement ratio caused the formation of voids and relatively weaker plastic resulted in decreased flexural strength. A time period of 28 days of curing with concrete specimen containing waster plastic, resulted in a reduction of modulus elasticity with increasing waste plastic content.

This paper represents some tests performed on concrete specimens reinforced with fibres made from waste polyethylene terephthalate (PET) bottles are reported [7]. By inculcating PET fibres as reinforcement for concrete to improve its tensile strength and compressive strength. A greater compressive and tensile strength limits the occurrence of macro or micro shrinkage cracks, which ultimately results in visible cracks. The paper investigates the density, workability, compressive and tensile strength of the concrete mixture when PE fibres are added. The high percentage of fibres despite improving concrete behaviour cannot be recommended as the concrete become less workable. This happens due to the circular fibres and their lesser adherence with concrete.

The decomposition rate of PET is slower compared to conventional reinforced concrete beams. The proposed method enhances the durability of concrete members by applying the concept of sustainability[13]. It is best when the waste plastic is recycled by using other materials to develop products with better properties. Plastic such as PET is used pretty much everywhere in a use-and-throw concept. The no corrosive nature of waste plastic results in more amount of solid waste accumulation than the actual recycling. The experiment was to obtain the best mixture in terms of workability and a target compressive strength of 35 MPa at 28 days. Interestingly with the increase of plastic fibres, the workability decreased by 63%. The enhancement in the ductility of beams was observed with an increase in waste plastic fibres. In other words, waste plastic fibres reduced shear failure for vertical reinforcement. The proposed method seams proposed in dealing with the problem of corrosion in steel stirrups of concrete beams.

An experimental study of M15 grade concrete to promote the use of plastic waste is shown[14]. Two concrete properties flexural strength and workability were taken into consideration. All M15 cubes were extracted from molds after 24 hours with a curing period of 7, 14, and 28 days. The results showed that workability reduced when plastic fibres were added. This happened because of fibers' resistance to the flow. However, the flexural strength increases up to 16% which ultimately

resulted in the enhanced flexural performance of the concrete mix.

The recommendation of lightweight waste plastic aggregates is high under seismic risk areas. In this study, the strength and durability of four different concrete mixtures cured for 90 days are shown[15]. The concrete mixture is divided into two categories: high cement content mixture and mixture with lightweight recycled aggregates. In this work, natural aggregate is replaced by recycled polypropylene and cork. The effects of replacing cement with supplementary cementing materials and replacing natural aggregate are not easily studied because the durability behaviour of all test pieces is difficult to predict. The carbonation depth is very low for all the specimens. It is also observed that all the concretes showed similar patterns of pours.

Combination of recycled plastic waste (RPW) and recycled crushed glass (RCG) as coarse aggregate in the concrete mixture is shown[16]. The main objective is to evaluate the coarse aggregate's feasibility as concrete in footpath construction. The result showed that the combination of RPW and RCG can be a prominent solution for recycling plastic waste and crushed glass in industrial applications. The experiment showed that un-confined compressive strength declasses with the increase in the % of a mixture of plastic and glass. The research also suggests uptake of water by capillary pipes also showed increased in the test samples.

Studies have reported that the incorporation of the plastic aggregates changes the failure behaviour of the concrete[17]. Compressive strength, durability, porosity is reviewed in this paper. However, flexural strength is not considered. The compressive strength is inversely proportional to the granulated waste plastic. It means that when the aggregate of granulated waste plastic is increased the compressive strength decreases. Along with the compressive strength, the water absorption and block density also decrease. However, from the experiments, the optimum mix ratio is to lie between 10% to 20%. The final showed that the blocks with 12% to 14% were considered as a replacement. From the observations, this method proves to be an alternative solution for waste plastic disposal and it can be used in construction materials in earthquake-prone zones.

TABLE III. Previous study on various concrete properties with waste plastic inclusion

Author	Type of Waste Plastic	Inclusion As	% of Inclusion (%)	Size of Particle (mm)	W/C ratio	Properties compared
[6]	-	Shredded Waste	0.5, 1.0, 2.0, 3 & 5	Length: 15-30 Width: 3-5	0.45	Workability, density, compressive strength, flexural strength, static modulus of elasticity, water permeability, abrasion resistance.
[9]	PET, HDPP, HDPE, PPF, PPS	Fine Aggregate	10	Dia.: 0.05-15	0.40	Compressive strength, tensile strength
[10]	Polyethylene and Polystyrene	Fine Aggregate	10, 15 & 20	Length: 0.15-12 Width: 0.15-4	0.53	Slump test, workability, fresh density, dry density, compressive strength, flexural strength, toughness test.
[11]	Polypropylene LDPE	Fibers (MPW)	0.5, 1.0, 1.5 & 2.0	1 x 5 x 0.8 1 x 10 x 0.8 1 x 20 x 0.8	0.45	Impact test, acid and sulphate resistance, chloride penetration test, permeability test.
[12]	Polypropylene LDPE	Fibers (MPW)	0.5, 1.0, 1.5 & 2.0	1 x 5 x 0.8 1 x 10 x 0.8 1 x 20 x 0.8	0.45	Workability test, compressive strength, splitting tensile strength, flexural strength.
[13]	PET Bottle	Fibers	0.5 to 1.5 with 0.25 increment	40 x 4 x 0.35	0.448	Slump test, compressive strength, splitting tensile strength, shear strength.
[14]	PET	Fibers	0.2 to 1.0 with 0.2 increment	-	0.55	Slump test, flexural strength
[15]	Polypropylene & cork	Aggregate	29.5 & 18.5 respectively	-	0.30	Compressive strength, elastic modulus, water penetration, carbonation depth, chloride ion penetration.
[17]	HDPE	Coarse Aggregate	5 to 20 with 5	12.5	0.8	Compressive strength, flexural strength, water absorption, block density,

III. SUMMARY

With the increase in the awareness of global conditions, there are numerous proposals given by the researchers to utilize manmade waste. Plastic is one of the widely used manmade materials. Due to its low decomposition rate, it becomes difficult to biodegrade plastic. This ultimately results in large dumping of the waste material especially plastic. Concrete properties such as workability, compressive strength, and flexural strength decrease with an increase of use waste plastic as a resistances are also improved. Yet there is a vast scope in the improvement of properties of concrete with the inclusion of plastic waste. Major benefits of inclusion waste plastic fibers in concrete are: reduction is the plastic waste, lesser production cost of concrete, and minimizing the structural degradation due to steel corrosion.

replacement of aggregates (fine or coarse) in the concrete mix.

The concept of sustainable buildings can be brought to reality by using waste plastic fibers in the concrete mixture of beams. For further studies, the properties of WPC need to be improved in terms of durability, flexural strength, compressive strength, and chemical resistance. One of the sub-categories of WPC is MPW which is also the most consume building material. Due to the short length of MPW fibers the durability and the impact

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Seismic Behaviour of RCC Buildings With & without Floating Columns

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***Abstract*—In present scenario construction of high rise building with floating column is a distinctive feature in urban India. As per IS: CODE-1893:2016 clause no-7.1, floating column construction is prohibited but there is no limitation and restriction for research work. The purpose of this research is to study seismic response of a building and to analyses and build the structure in which there will be less damages to the structure and its component under the excitation of earthquake. The paper deals with the studied based on the Indian Standard, IS codes 456 2000 and IS code 1893 2016. Finite element-based software like Etabs has been used, Response spectrum method have been used for analysis. The results have been obtained in terms of base shear, storey drift, time period etc.**

Keywords—floating column, sesimic analysis, base shear, storey drift, modal participation factor

II. INTRODUCTION

India is a developing country where population growth is increasing per year. Due to lack of space, increasing population and also for aesthetic view and functional requirements, Construction of high-rise buildings in urban cities are required to have column free space. For this purpose, the concept of floating columns is coming into the picture. The behaviour of a building during earthquakes depends critically on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. Earthquake exposes the weakness in structures. The structures, which may appear to be strong enough, may crumble like houses of cards during earthquake. Due to the ignorance of the seismic behaviour of the buildings, many wrong practices remain continued, till an earthquake exposes these. There are numerous examples enlisted in the damage reports of past earthquakes in which the cause of failure of reinforced concrete building has been irregularities in configurations. These buildings with floating columns have both in-plane and out of plane irregularities in strength and stiffness and hence are seismically vulnerable. This type of construction does not create any problem under vertical loading conditions. But during an earthquake a clear load path is not available for transferring the lateral forces to the foundation. Lateral forces accumulated in upper floors during the earthquake have to be transmitted by the projected cantilever beams. Overturning forces thus developed overwhelm the columns of the ground floor. Under this situation the columns begin to deform and buckle, resulting in total collapse. Therefore, there is a need to understand the seismic behavior of such building and to retrofit the existing buildings with floating columns so that they can withstand future probable earthquake generated forces.

III. WHAT IS FLOATING COLUMN?

Floating column is nothing but a vertical member or element that rests on a beam, but doesn't transfer load directly to the foundation. Generally, the columns rest on the foundation to transfer loads coming from slabs and beams, floating column acts as a point load on the beam and this beam transfers the load to the column below it, that beam is called a transfer beam. The use of floating columns is intended for an architectural view, site conditions and as much as possible area on a plot within, permissible bye laws. As far as analysis is concerned, the column is often assumed

pinned at the base and is therefore taken as a point load on the transfer beam. ETABS is used here to perform the analysis of these structure. Floating columns are competent enough to carry gravity loading but transfer girder must be of adequate dimensions (Stiffness) with very minimal deflection. When irregular features are included in buildings, a considerably higher level of engineering effort is required in the structural design and yet the building may not be as good as one with simple architectural features.

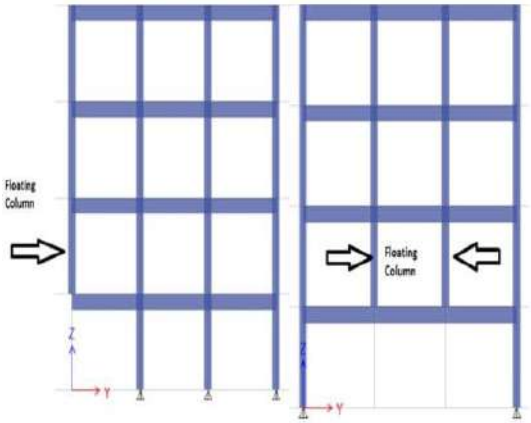

Fig. 1. Floating Column

IV. DESCRIPTION

A G+15 structure is considered in which a floating column is taken at ground and first level and it is analyzed for seismic zone-IV for the following cases:

Model A: No floating column, storey height at plinth level is 3m.

Model B: Floating column is provided at edge at ground floor, plinth level is 3m.

Model C: Floating column is provided at corner at ground floor, plinth level is 3m.

Model D: Floating column is provided at edge at ground floor, plinth level is 4m.

Model E: Floating column is provided at corner at ground floor, plinth level is 4m.

Model F: Floating column is provided at edge at first floor, plinth level is 3m.

Model G: Floating column is provided at corner at first floor, plinth level is 3m.

Model H: Floating column is provided at center at first floor, plinth level is 3m.

Model I: Floating column is provided at center at ground floor, plinth level is 3m.

V. METHODOLOGY

The methodology of the present study is summarized below in fig 2.

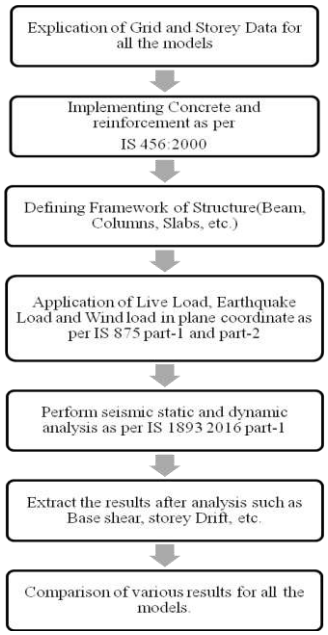

Fig 2. Flowchart describing the methodology of study

VI. BASIC PARAMETER

For modelling the structures as per study area, basic parameters were selected on the basis of design results and as per Is recommendations which are summarized below in the given table:

PARAMETERS	MODELS								
	A	B	C	D	E	F	G	H	I
PLAN DIMENSION	18X18 (m)	18X18 (m)	18X18 (m)	18X18 (m)	18X18 (m)	18X18 (m)	18X18 (m)	18X18 (m)	18X1 (m)
COLUMN SIZE	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X (mm)
BEAM SIZE	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X500 (mm)	500X (mm)
SLAB THICKNESS	150 (mm)	150 (mm)	150 (mm)	150 (mm)	150 (mm)	150 (mm)	150 (mm)	150 (mm)	150 (
MATERIAL PROPERTIES	FE500 & M30								
SUPPPORT CONDITION	FIXED	FIXED	FIXED	FIXED	FIXED	FIXED	FIXED	FIXED	FIXE
SOIL TYPE	MEDIUM (II)	MEDIUM (II)	MEDIUM (II)	MEDIUM (II)	MEDIUM (II)	MEDIUM (II)	MEDIUM (II)	MEDIUM (II)	MED (II)
SESISMIC ZONE (Z)	IV	IV	IV	IV	IV	IV	IV	IV	IV
ANALYSIS METHOD	RESPONSE SPECTRUM ANALYSIS								
RESPONSE REDUCTION FACTOR (R)	5	5	5	5	5	5	5	5	5
IMPORTANCE FACTOR (I)	1	1	1	1	1	1	1	1	1
LIVE LOAD	3 KN/m^2	3 KN/m^2	3 KN/m^2	3 KN/m^2	3 KN/m^2	3 KN/m^2	3 KN/m^2	3 KN/m^2	3 KN
FLOOR FINISH	1 KN/m^2	1 KN/m^2	1 KN/m^2	1 KN/m^2	1 KN/m^2	1 KN/m^2	1 KN/m^2	1 KN/m^2	1 KN

Table 1. Basic Parameters

VII. RESULTS AND DISCUSSION

The story drift is more in case of floating column structure in both X and Y directions as structure without floating column should be stiffer. Highest storey drift is observed in model D and Model E in X and Y directions respectively. The storey drift of the structure having floating column at first floor is less as compared to ground floor. Base shear of the structure having floating column is less and this is due to reduction in weight of column. It was observed that Model D shows least base shear indicating higher stiffness. Model A has lowest time period indicating higher frequency, as structure without floating column should be stiffer as compared to others. Model D and E has larger time

period or lower frequency which indicates that model D and Model E are more flexible.

1) Storey drift in X-direction:

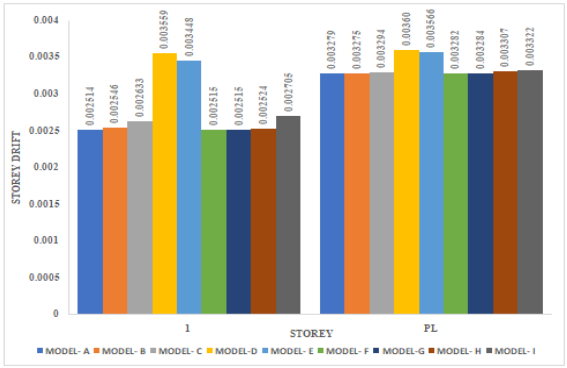

Fig. 3. Storey Drift in X Direction

2) Storey drift in Y-direction:

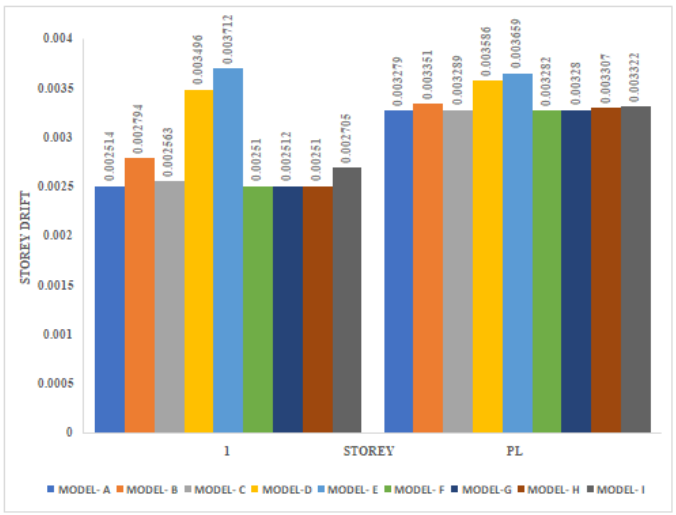

Fig. 4. Storey Drift in Y Direction

3) Base shear in X-direction:

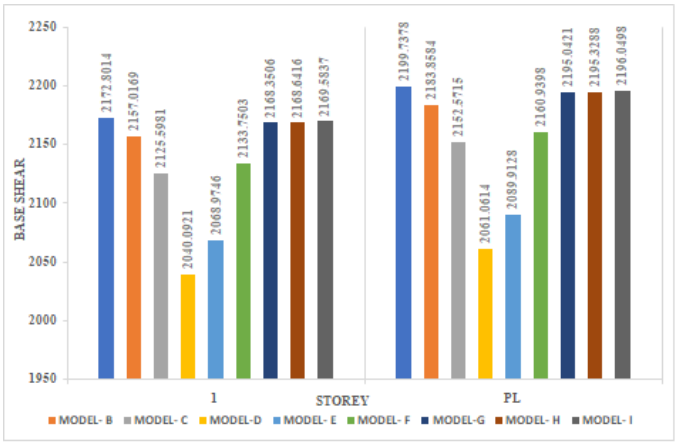

Fig. 5. Base Shear in X Direction

4) Base shear in Y-direction:

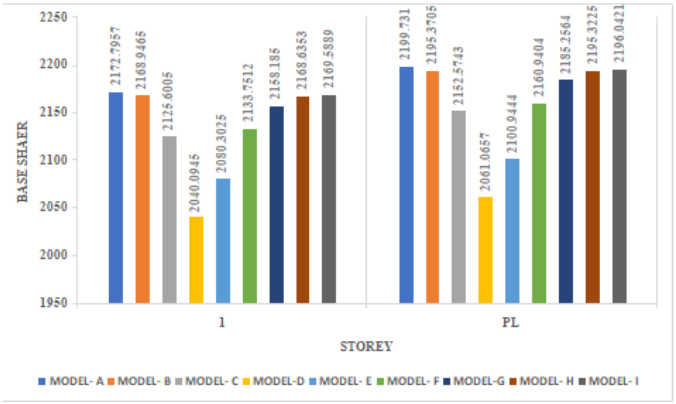

Fig. 6. Base Shear in Y Direction

5) Modal VS Time period:

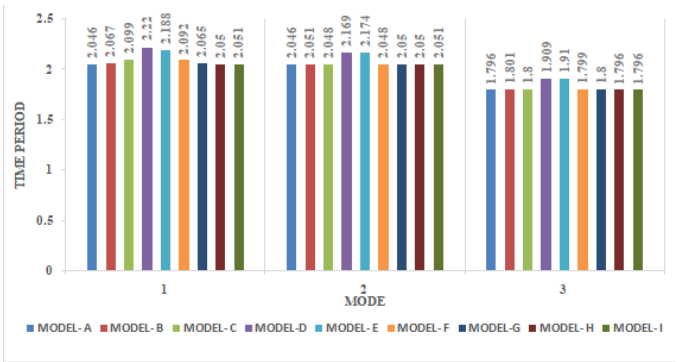

Fig .7. Mode Vs Time Period

VIII. CONCLUSION

All structures with and without floating column exhibit deflection within permissible limits as per IS 456:2000 recommendations. First two modes of all

the structures were torsional free which satisfy the criteria of IS 1893 2016 recommendations. Model D and Model E shows maximum storey drift, which shows that as the storey height increases structure with floating column becomes much more unsafe. Floating Column at first floor is much safer as compared to the floating column at ground floor.

Acknowledgment

We express our deep gratitude to **Ms. Aarushi Gupta,** Assistant Professor, Department of Civil Engineering, for her valuable guidance and suggestion throughout our project work. We are very thankful **Mr. Aashish Malik,** Project Coordinator, Departmental of Civil Engineering for his valuable guidance. We would like to thanks our Departmental In-charge **Ms. Shikha Sachan** for the constructive criticism throughout our Research Work. We are also thankful to **Prof. (Dr.) Sanjay Kumar**, Director, Dr. Akhilesh Das Gupta Institute of Technology and Management for providing us the facilities to carry out our project work efficiently.

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Effect of Sample Size on Fracture Property of Mild Steel Using ANSYS

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ABSTRACT: In this paper sample size on fracture toughness of mild steel is calculated based on ANSYS 16.0. Most engineering components and structures subjected to repetitive fluctuating load cycles due to which it contain some form of stress raisers that results from geometrical or metallurgical discontinuities. In most of the cases such components fail due to the phenomenon known as fatigue. Fracture toughness is an indication of the amount of stress required to propagate a pre-existing flaw. It is a very important material property since the occurrence of flaws is not completely avoidable in the processing, fabrication, service of a material or component.

Keywords: Iris Recognition, Visual Cryptography, Segmentation, Localisation, Visual Cryptography, Log Gaber Wavelet

I. INTRODUCTION

Fracture mechanics is a branch that deals with the study of propagation of cracks in materials and it plays an important role in designing especially for the components which are light weight and are subjected to high amount of loading and various amount of stresses. Steel is one of the major inventions that have helped mankind progress by leaps and bounds in many spheres. It is one of the most used and reused alloys in present scenario. Steel is now available in many grades and specifications. Mild Steel is essentially a form of Carbon Steel that has low Carbon content which imparts the steel in many physical and mechanical properties. It is used extensively for many Industrial applications including structural applications and constructions because of their properties. The material properties and mechanical characteristics of Mild Steel are crucial in deciding the area of application. These properties of the Mild Steel are determined by a series of tests. The popularity of mild steel in many industries is mainly because the material is easy to work with. The physical property of the mild steel is high malleability due to the low carbon content. Hence it can be moulded in any form. This property enables the mild steel to be formed into bars. Mild steel also have high ductility that implies the steel can be bent into any shape or form without breaking.

II. METHODS AND MATERIAL

A. Why Mild Steel?

In present scenario mild steel plays a very important material almost everywhere as it carries more load with less structural dimensions. The Strength of Steel per unit volume is high compared to concrete which will lead to lesser cross section dimensions and lesser dead weight. This will be advantageous for multi storey buildings and for structures resisting on weak soil Ductility is the property by virtue of which steel undergoes large deformation before failure due to these steel structures mostly do not fail suddenly.

B. Procedure

CAD drawings were formed for the shape of three point bend specimen with V notch of size wrt code ASTM 1820 and ASTM 399, were 150mm X 30mm X 20mm and 150mm X 30mm X 25mm here variation in thickness were done with width to crack ratio as (a/w) 0.5 as per codal provisions and were imported to ANSYS then it was modelled with and same amount of loading was applied which is 21kN. This load limit was calculated experimentally on MTS testing machine.

C. LITERATURE REVIEW

E 1820 – 99aStandard Test Method for Measurement of Fracture Toughness This standard is issued under the fixed designation E 1820; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (e) indicates an editorial change since the last revision or reapproval.

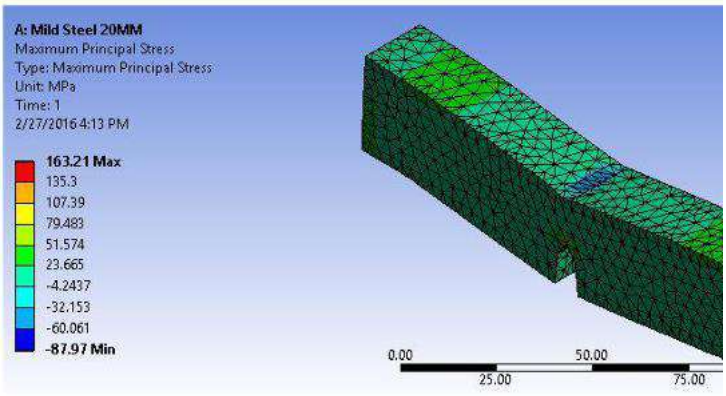
E 399 – 90 (Reapproved 1997) Standard Test Method for Plane-Strain Fracture Toughness of Metallic Materials. This standard is issued under the fixed designation E 399; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (e) indicates an editorial change since the last revision or reapproval. This standard has been approved for use by agencies of the Department of Defense.

Rostand Moutou Pitti · Claudiu Badulescu The crack characterization in a pre-cracked aluminium specimen is investigated in this study using the grid method. The images of this grid are analysed to provide the crack tip location as well as the displacement and strain fields on the surface of the specimen during a tensile test. Experimental data are used to calculate thee energy release rate with the compliance method.

Anderson, T. L. (1995). Fracture Mechanics, Fundamentals and Applications, CRC Press.

ANSYS (1995). With its combination of practicality, readability, and rigor that is characteristic of any truly authoritative reference and text, Fracture Mechanics: Fundamentals and Applications quickly established itself as the most comprehensive guide to fracture mechanics available.

Structural Analysis, Fracture Mechanics Ansys User manual. Manual which helps us to understand the software in more simple way with step wise procedure that allows us to use Ansys with less complications.



III. RESULTS AND DISCUSSION

1. It can be seen clearly that stresses taken by 20mm specimen is more than 25mm specimen for the same amount of loading.
2. Strain Energy for 25mm is less than that of 20mm.
3. Maximum Principle stresses were observed more in 20mm.
4. Also Fracture toughness parameter Stress intensity factor Kic for Mode I and Mode II was compared. Hence we can say that lesser is the surface area lesser are the chances of this material to fail this is

V. REFERENCES

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[4] E 1820 – 99a Standard Test Method for Measurement of Fracture Toughness

[5] Rostand Moutou Pitti • Claudiu Badulescu • Michel Grédiac Characterization of a cracked specimen with full-field measurements: direct determination of the crack tip and energy release rate calculation

Assessment of Water Quality Parameters of Bhalaswa Lake and Yamuna River (Delhi)

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***Abstract*— Water Pollution remains a challenging issue for the sustainable development of Yamuna River despite several policies measures like Yamuna Action Plan I and II. This paper is based on the assessment of water quality parameters of 14 km stretch length Yamuna River from Sonia Vihar to Kashmere Gate to analyze the water quality parameters at Upstream and Downstream of Wazirabad Barrage and also estimates Water Quality Index (WQI) for the Yamuna River at the Upstream and Downstream of Wazirabad Barrage by Using WQI describing the level of pollution in the river. The paper assesses the sustainability of the Yamuna River by analysing water quality parameters.**

To analyze the water quality parameters of Bhalaswa Lake in Delhi, for finding the possibilities of re-establishing it as water sports complex by which it could be decided whether the lake is suitable for recreational activities like water sports, boating, swimming, fishing etc. Results of the study indicated that lake water is highly contaminated and not suitable for recreational activities as it contains high amount of organic matter, slightly high pH, BOD is high as compared to given standards by CPCB for outdoor bathing. Finally, it discusses the water quality of Bhalaswa Lake and comprises the water quality with given standards.

Keywords—River pollution, Water Quality Index, Yamuna Action Plan

I INTRODUCTION

In recent years, the volume of wastewater produced in urban areas has increased substantially because of rapid growth in the human population, industrial production, and commercial activities, as well as changes in water consumption behaviour. In most urban areas in developing nations, excess wastewater is disposed of directly, or without effective treatment, into surface water bodies, resulting in their severe degradation; despite the adoption of countermeasures (Ismail and Abed, 2013; Purandara et al., 2011).

Surface water is far easier to reach, which is why this becomes the most common source of potable water. The main sources of raw water in Delhi are through the river Yamuna (surface water and Western Yamuna Canal WYC), the Ganga (Upper Ganga Canal), Bhakra-Beas storage, groundwater through tube wells and ranney wells (specially designed high-capacity wells named after its founder Leo Ranney). The estimated water availability of NCT of Delhi from surface water sources, mainly the Yamuna, the Ganga and the WYC is approximately 1150.25 million cubic meters (mcm). The river Yamuna contributes 723 mcm, which is surely a significant part of the total water requirement.

The rapid growth and the high population density in India have made the situation worse and out of control. Although there are many schemes and policies such as The Yamuna Action Plan phase I, II and III, an improvement is seemingly noticeable. River Yamuna enters the Delhi Stretch at the Palla Village and is exited from the Okhla Barrage.

Water Quality Index:-

Water quality depends on a number of physical, chemical and biological parameters and presenting data for all the parameters separately to the public is not feasible. So in order to turn this complex water

quality data into more understandable and accessible information for the public water quality index is calculated. Water Quality Index (WQI) is a number that seeks to express the overall quality of water combining various parameters over a given location and time.

WQI	Description
0-25	Excellent
26-50	Good
51-75	Bad
76-100	Very Bad
100 & above	Unfit for drinking

Table 1- Table is given by Brown at al. (1970), which gives the description of water quality status of WQI

A. *Abbreviations and Acronyms*

CPCB Central Pollution Control Board

DO Dissolved Oxygen

BOD Biochemical Oxygen Demand

COD Chemical Oxygen Demand

PH Potential of Hydrogen Scale

TSS Total Suspended Solid

TDS Total Dissolved Solid

EC Electrical Conductivity

NCT National Capital of Territory

DJB Delhi Jal Board

WQI Water Quality Index

YAP Yamuna Action Plan

II METHODOLOGY

B. *Study Area*

Bhalaswa Lake is a lake which is situated Bhalaswa, Delhi. It has an area of 92 hectares and length of the lake is around 1400m and maxi. Width is around 350m. It has the large depth therefore; Facultative decomposition of the organic matter is taking place. One side of the lake is surrounded by forest but on the other side it is having the Bhalaswa Dairy area. It is observed that they are dump their sewage waste in Bhalaswa Lake illegally. Lake is getting severely degraded because of the effluent coming from nearby diary and residential area of Bhalaswa. Lake is having pale yellow color, high organic matter and suspended matter at the edges of the lake. One of the major causes of pollution in Bhalaswa Lake is that, it's near to Bhalaswa landfill site. Water leaches from the solid waste and percolated through the landfill and mixes with the ground water.

Fig.1 Bhalaswa Lake

Yamuna River originates from the yamunotri glacier near Bandar Punch in Mussourie Range of lower Himalayas at elevation of about 6387m above from mean sea level (MSL) in western Uttrakhand. It is an important and a large length river. The total length of the Yamuna River from origin to confluence with Ganga at Prayagraj is 1376km. Day by day Yamuna River became one of the most polluted rivers in the world, especially around Delhi, the capital of India. Only 2% of the river length flows through Delhi between Wazirabad and Okhla. Sewage and industrial effluent is discharged into Delhi's drainage system. And that drains are

dumped into the Yamuna River. Around 76% of the total pollution load in the river contributes by the Delhi city.

Fig.2 Yamuna River in Delhi

C. *Sampling and Analysis Procedure*

The four locations were chosen for sampling in order to study the contribution of Delhi in polluting the River Yamuna. The Four locations chosen are:

1. Sonia Vihar: It is located near the Wazirabad Old Bridge. It is the upstream side of Wazirabad Barrrage.
2. Wazirabad Barrage: This location is chosen for sampling as here the river Yamuna water is stored at the upstream side. All the polluting waste streams fall into Yamuna After Wazirabad.
3. Signature Bridge: It is just after the wazirabad barrage but this point is chosen because, here only one of the major drains falls in the Yamuna River.
4. Kashmere Gate: Here some more small drains meets Yamuna River. The distance between the Sonia vihar and Kashmere gate is 14 km.

D. *Method of Sampling*

The sampling was done considering the guidelines of CPCB. Transparent bottles were used for sample collection. The bottles were washed, before sampling, with dilute acid followed autoclave. One sample at each site was collected from the middle of the channel of the stream. Samples were collected from below the surface area in human reach and mouth of bottle was directed toward the current to avoid collecting surface scum.

E. *Test Performed in Laboratory*

All samples were tested for various physical and chemical characteristics in the laboratory.

Temperature of water samples were measured immediately after sample collection. The color and odor of both the samples were detected using human observations of vision and smell.

pH was calculated using pH meter after calibration.

Fig.3 pH meter

Modified Winkler- Azide method was used to calculate DO levels in the river water samples. The sample was collected in 300mL BOD bottles using DO sampler. 1mL $MnSO_4$ followed by 1 mL alkali- iodine- azide reagent was added to the sample and mixed well. The precipitate was allowed to settle leaving the 150mL clear supernatant. 1 mL of concentrated H_2SO_4 was added and precipitate was mixed into the solution. 200mL of the solution is titrated against $Na_2S_2O_3$ solution using 2mL starch solution.

Fig.4 DO Test

Total hardness- Hardness refers to the presence of a high mineral content. Hardness test was done by titration of EDTA using EBT as an indicator. Hardness is caused by either magnesium and calcium carbonates or their sulfates and chlorides. Measured from mol/L or mmol/L units. It causes the formation of a white precipitation container surfaces, alter the taste of water, the formation of soap scum, etc.

Total dissolved solids- TDS test is done by simple evaporation. It is caused by inorganic salts and dissolved organic matter. TDS is measured from ppm units and measured by either gravimetric method or electrical conductivity analysis

Alkalinity- It is a measure of the ability of a water sample to neutralize strong acid. It is expressed as mg CaCO, per liter or micro equivalents. Alkalinities in natural waters usually range from 20 to 200 mg/L.

Turbidity- Turbidity test was done by Nephelometer test. Its max permissible value is 5 NTU. Turbidity is an extremely useful indicator that can yield valuable information quickly, relatively cheaply and on an ongoing basis. Measurement of turbidity is applicable in a variety of settings, from low-resource small systems all the way through to large and sophisticated water treatment plants.

Fig.5 Nephelometer Turbidity Test

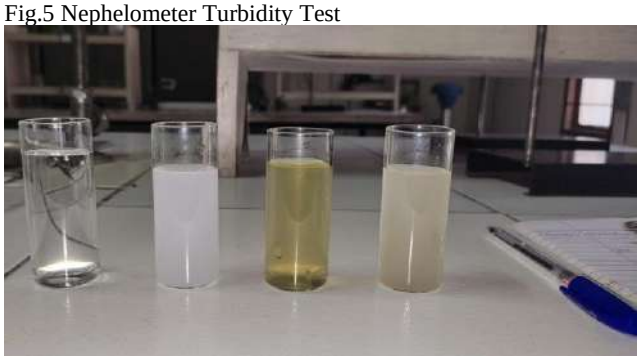


Fig.6 Nephelometric tubes

Chloride- Chloride test was done by titration method. It is a naturally occurring element that is common in most natural waters and is most often found as a component of salt or in some cases in combination with potassium or calcium. Chloride increases the electrical conductivity of water and thus increases its corrosivity.

Fig.7 Titration

F. ***Water Quality Index Calculation(WQI)***

After, the water quality parameters are selected based on its direct involvement in deteriorating water quality for human consumption which causes water-related health hazards. For the purpose of calculation of WQI of the groundwater and surface water, thirteen parameters such as pH, TDS, COD, BOD, TA, TH, Cl, SO_4, NO_3 have been selected. Weighed Arithmetic Index method by Brown et al. (1970) have been used for the calculation of WQI. It involves the following steps:

- In the first step, each of the thirteen parameters having been assigned a weight (AW_i) ranging from 1 to 5 depending upon their potential health effects when present in water and standards for the drinking water, recommended by World Health Organization (WHO), the Indian Council of Medical Research (ICMR), and Indian Standards Bureau (ISB) are considered for the computation of relative weights (RW).
- In the second step, relative weight of each parameter was calculated by using the following equation: RW ¼ AW_i ∑ of AW_i Here, RW is the relative weight, AW_i is the assigned weight of each parameter, and n is the number of parameters.
- In the third step, quality rating scale (Q_i) was calculated by dividing the concentration of each parameter except pH in each water sample with respect to its standard permissible value recommended by the BIS and then the following result was multiplied by 100.

$$Q_i = \sum (C_i\ S_i)* 100$$

- Quality rating scale for pH was calculated by Q is the quality rating scale, C_i is the value of each parameter obtained from the laboratory testing, Si is the recommended value of BIS of each parameter, and V_i is the ideal value for pH which is 7.0.
- Final step is the calculation of the sub-indices (SI_i) for each parameter by using the following equation:

$$SI_i = \sum RW\ Q_i$$

- The sub-indices value of each parameter was used to compute the WQI.

RESULTS AND DISCUSSION

G. YAMUNA RIVER

The samples were analysed for various physical and chemical parameters and readings so calculated are tabulated below in table.

Parameters	BIS (units)	Max. Permissible limit	Sonia Vihar	Wazirabad Barrage	Signature Bridge	Kashmere Gate
Colour	-	Max. 5 Hazen	Transparent	-	-	-
Odour	-	-	Agreeable	Agreeable	-	-
Appearance	Clear	Clear	Clear	-	-	-
Turbidity	NTU	5NTU (max.)	10	173	15	18
pH	Mg/l	6-8.5	6.8	7	7.19	8.3
TSS	Mg/l	-	180	460	320	240
TDS	Mg/l	500mg/l	1280	2620	1760	1820
Total Hardness	Mg/l	300mg/l	250	230	400	450
Chloride	Mg/l	250mg/l	90	140	390	340
Salinity	Mg/l	-	162.48	252.73	783.93	613.73
Alkalinity	Mg/l	200mg/l	50	60	115	150
DO	Mg/l	-	11.2	9.2	3	0
BOD	Mg/l	-	1.8	4.6	9.8	12.5

Table 2- Physiochemical characteristics of Yamuna River alongwith their values

- The concentration of DO is 11.2mg/l and 9.2mg/l at Sonia Vihar and Wazirabad Barrage respectively, and BOD values are also within permissible limit, which shows low pollution level in upstream side. DO concentration is 3mg/l at Signature Bridge and 0mg/l at Kashmere Gate which shows the adverse condition for aquatic life.
- WQI values are very high at Kashmere gate (112.23) which is unfit for human use.
- The Upstream side of Wazirabad barrage which is Sonia vihar and Wazirabad gives almost all the parameters in the permissible limits. The study shows that downstream of Wazirabad barrage like Signature Bridge and Kashmiri Gate obtain high pollution level in the river.

H. BHALASWA LAKE

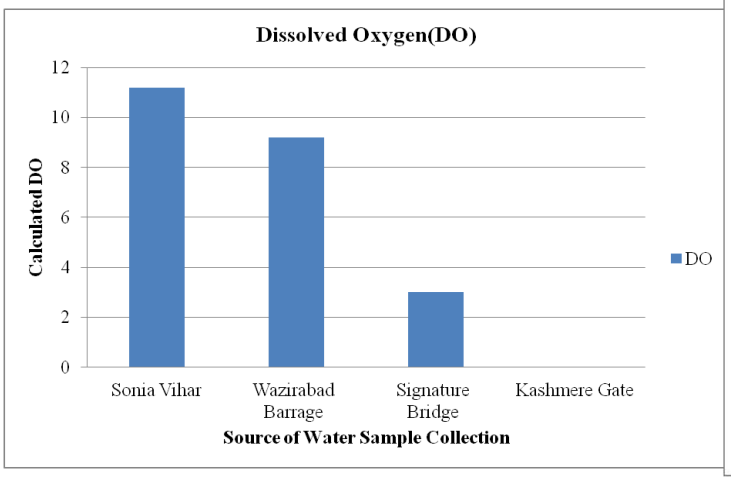
The samples were analysed for various physical and chemical parameters and readings so calculated are tabulated below in table.

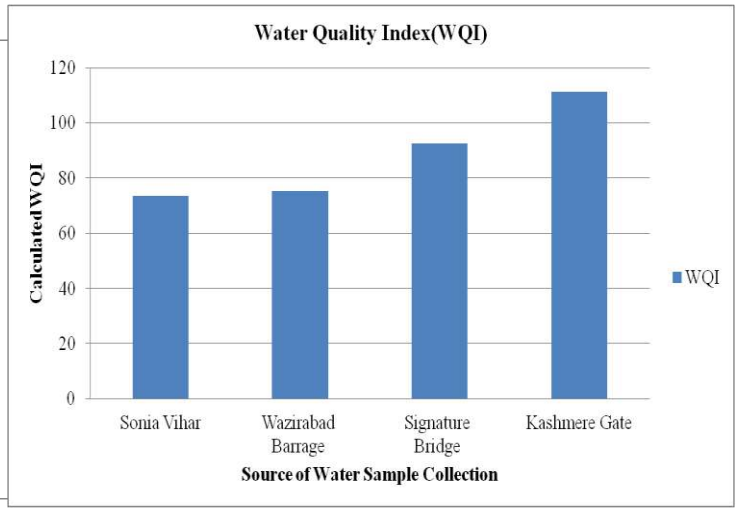
Parameters	BIS (units)	Max. Permissible limit	Sample 1	Sample 2	Sample 3	Sample 4
Odour	-	Max. 5 Hazen	Agreeable	-	Agreeable	Agreeable
Colour	-	-	Pale yellow	Pale yellow	Pale yellow	Pale yellow
Turbidity	NTU	5NTU (max.)	10	18	14	16
pH	-	6-8.5	7.66	7.25	7.37	7.57
TSS	Mg/l	-	280	180	140	140
TDS	Mg/l	500mg/l	2120	2000	2100	2160
Total hardness	Mg/l	300mg/l	600	550	310	450
Appearance	-	Clear	Clear	-	Clear	-
Chloride	Mg/l	250mg/l	790	890	740	770
Salinity	Mg/l	-	1425	1606	1335.73	1389
Alkalinity	Mg/l	200mg/l	250	255	235	245
D.O.	Mg/l	-	6.2	4.5	6	5.5
B.O.D.	Mg/l	3mg/l	8.2	12	6.9	8.7

Table 3- Physiochemical Characteristics of Bhalaswa Lake alongwith their values

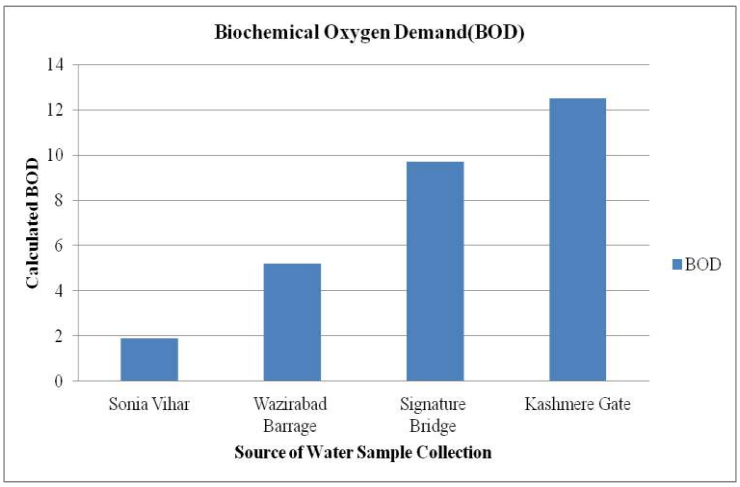
- Results revealed that the lake is organically polluted as the BOD concentration is 8.2 mg/l.
- Lake water is reported contaminated as the results show high concentration of Chloride. The value of Chloride ranged in lake water 740-880 mg/l. High concentration of Chloride also indicates presence of Sodium, Potassium and Calcium. The higher value of Chloride in water bodies is the evidence of pollution due to domestic sewage.

DO at Different Locations:-





BOD at Different Locations:-



WQI at Different Locations:-

III CONCLUSION

1) Results revealed that all important parameters of lake and some parameter of river beyond the permissible limits.
2) In case of Bhalaswa lake results revealed that it is organic polluted and nutrient enriched because of dumping of waste from Bhalaswa Dairy. It is necessary to prevent the effluent coming from the dairy and nearby residential colonies.
3) In case of Yamuna, the four locations of sampling have given a clear picture of Yamuna. The upstream side of Yamuna (i.e. Sonia Vihar, Wazirabad barrage) water given Dissolved oxygen, BOD under permissible limit. The downstream side of Yamuna after Wazirabad barrage which is Signature Bridge and Kashmere Gate has seen same adverse pollution due to dilution of waste water from Najafgarh drain.
4) This paper concludes that waste water of Najafgarh drain be treated before discharging it into the river.
5) The Upstream side of Wazirabad barrage which is Sonia vihar and Wazirabad gives almost all the parameters in the permissible limits. The downstream side of Wazirabad barrage like Signature Bridge and Kashmiri Gate obtain high pollution level in the river.
6) The Primary cause of Pollution with in 14 km stretch length from Wazirabad to

Kashmere gate is the addition of major drain i.e. Najafgarh drain without treatment.

7) Four locations of sampling gives a clear picture of Yamuna water pollution where at the first end sampling site the parameters such as Dissolved Oxygen, Chloride and Ammonia content has been under permissible limits, there is a different picture at the farther end of Yamuna at the Delhi stretch.
8) Yamuna River water has high concentration of Total Dissolved Solids (TDS) having maximum value of 2620 mg/ltr at Wazirabad Barrage, Chloride content having maximum value of 390 mg/ltr at Signature Bridge and Biochemical Oxygen Demand (BOD) having maximum value of 12.5mg/ltr at Kashmere Gate. Thus, it's not suitable for irrigation purposes. Some special treatment is required to bring TDS and Chloride Content under permissible limits prescribed by Bureau of Indian Standards (BIS) for Class E (irrigation supply).
9) WQI value at Kashmere gate is 112.23 which is very high and so unfit for human consumption and at Sonia Vihar, the value is 73.41, which is bad and so making it unfit for human consumption too.

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Investigation of fresh, mechanical, and impact resistance properties of rubberized concrete

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ABSTRACT - Rubberized concrete is ideal for applications that demand additional flexibility. Rubberized concrete provides more flexibility, impact resistance, and a lower unit weight than ordinary concrete. As a partial substitute for fine aggregate in concrete, six waste tire rubber crumb contents (0, 10, 15, 20, 25, and 30 percent) and particle sizes of 0.6-2.36 mm are utilized. Rubberized concrete's fresh, mechanical, and impact resistance characteristics are studied and found that by increasing the amount of rubber crumb in the mix, the fresh and mechanical characteristics are reduced. The energy absorption capacity of rubberized concrete increases with the increase of rubber crumb in concrete. However, the results aren't too concerning, up to a 15% rubber crumb replacement level.

Keywords - *Rubberized concrete; Fresh properties;* Mechanical Properties; Energy absorption capacity

I INTRODUCTION

Over the years, the disposal of waste tires increasing the issue continuously for the environment. Waste Rubber tires have a little scope of being recycled and mostly form a landfill and degrade the environment [1]–[3]. There is an excellent potential for the rubber to be used in concrete, thus saving the area from becoming a landfill, which means eco-friendly.

According to previous research, the utilization of rubber shreds in concrete enhanced the property of resistance to acid attack but decreased the compressive strength of RuC (Rubberized concrete) [4]. Due to the ability to absorb impacts, RuC has a better energy absorption capacity than standard concrete [5], [6]. Steel fibers have more negative impacts than polypropylene fibers in RuC [7]. The compressive strength of RuC after treatment with sodium hydroxide is slightly enhanced compared with ordinary concrete [8]. The inclusion of powder rubber in concrete showing better performance in terms of fresh and mechanical properties than rubber crumb, allowing up to 40% rubber replacement [9]. Six levels of rubber fiber (0, 5, 10, 15, 20, and 25%) are used for replacement of FA (Fine aggregate) and three w/c ratios (0.35, 0.45, and 0.55) and two stages of silica fume (5 and 10%) are used as partial replacement of cement. The compressive strength and MOE (Modulus of elasticity) decrease with increasing rubber fiber quantity [10]–[12]. The flexural strength of RuC decreases with increasing the quantity of rubber ash but increases with the increasing content of rubber fiber [13]. Waste tire rubber fiber can be used

to increase the impact resistance and ductility of concrete as a recycled material [14]. Crumb rubber as an FA reduces the concrete's compressive strength and abrasion resistance while greatly increasing its energy absorbing capacity [15]. The rubber substitution in concrete increases the damping potential, ductile performance and improves the energy absorption of self-compacting RuC compared to normal self-compacting concrete [16].

III Materials and testing

In this study, PPC (Portland pozzolana cement) JK Laxmi pro+, up to 30% replacement by fly ash-based, is used. The compressive strength of PPC is 44 MPa at 28 days. The standard consistency of the cement is obtained at 33%. Sp. Gr. of cement is found to be 2.97. PPC's initial setting time is 90 min, and the final setting time is 155 min. The soundness of PPC is tested by the Le-chatelier method, and cement expansion is noted at 3 mm.

FA in the form of stone dust is procured from a local material shop in Delhi, which falls in zone II with a finesse modulus is 2.75, Sp. Gr. is 2.62, and water absorption is 1.21%. Crushed rock as CA (Coarse aggregate) is also procured from a local material shop in Delhi, which has sp. Gr. of 2.79 at 28℃, water absorption is 0.2%, finesse modulus is 7.29, impact value is 26.3, and Loss Angeles Abrasion Value is 36.

Auramix 400 SP (Superplasticizer) based on polycarboxylate ether-based is used and obtained from Fosroc Chemical (India). SP's Sp Gr (Specific gravity) is 1.09, and P^H Value is 6. SP's optimum dosage and efficiency are determined from the marsh cone apparatus with a nozzle aperture diameter of 8 mm. The optimum dosage of SP is found to be 1.4%.

Rubber crumb is obtained from a local waste tire rubber factory with a particle size of 0.6 mm-2.36 mm. Rubber is a lightweight material because it's Sp. Gr. is 1.07. Rubber crumb is used as a partial replacement of FA. Rubber crumb particles are gained from the waste rubber tire after grinding in a mechanical grinder.

II Mix Proportion

The concrete mixes are prepared with a w/c ratio of 0.38 and a partial FA replacement by rubber particles with a 0-30% replacement level. The proportion of the mix design for the M40 grade of concrete is shown in Table 1. Machine mixing is adopted for the homogeneity of the concrete. First dry mixing of material is done for 2-3 minutes, then water and SP are mixed with materials. A mechanical vibrator is used for the compaction and uniformity of the concrete.

IV Testing program

Various tests are performed to find the concrete properties, such as compressive strength, split tensile strength, workability, density, and flexural strength. Three specimens are cast for each testing of concrete. The density of the concrete mixes is measured according to IS code (Indian standard code) [17]. The compressive strength and flexural strength of RuC are tested on a universal testing machine with 2000 tons capacity and an automatic controller with specimen size 150X150X150 mm for compressive strength and 100X100X500 mm [18] for flexural strength and compared with standard concrete. The examination for rebound impact loading is performed on 150 mm cube specimens. A steel ball weighing 300 gm is used to transmit impact energy from a height of 1.0 m to the specimens in the testing. "The initial and final

potential energies are denoted by $E_{p,ri,}$ and $E_{p,rf}$ respectively (the subscripts *p, ri,* and *rf* indicate potential energy at initial and final rebound stages, respectively), and can be calculated as follows" [19]:

$$E_{p,ri} = mgh_i \quad (1)$$

$$E_{p,rf} = mgh_f \quad (2)$$

where m = mass of steel ball (0.3 kg), h_i = preliminary height of steel ball (1.0 m), and h_f = height noted after a rebound.

The discrepancy between the final and initial potential energy is used to assess the energy absorption capacity of the concrete specimen $E_{p,r}$.

$$E_{p,r} = E_{p,ri} - E_{p,rf} \quad (3)$$

Table 1 Mix proportion for concrete

Mix no.	Cement (kg/m^3)	Fine aggregate (kg/m^3)	Coarse aggregate (kg/m^3)		R c repl (
			(20 mm)	(10 mm)	
R1	390	666	769.8	513.2	
R2	390	599.4	769.8	513.2	
R3	390	566.1	769.8	513.2	
R4	390	532.8	769.8	513.2	
R5	390	499.5	769.8	513.2	
R6	390	466.2	769.8	513.2	

V Results and discussion

A. *Workability*

At the time of batch mixing, 1.4% SP by the weight of cement is used to maintain the workability of concrete. The slump cone results are shown in Figure 1. The results show that RuC's workability decreases with increasing the quantity of rubber crumbs. The replacement level of rubber crumbs up to 30% can be used with reinforced concrete members, and no need to add extra SP for making the concrete workable. The rubber particles have a rough surface and lead to large undulations in concrete. The greater the rubber content in the mixture, the reduction in the value of the compaction factor would be the higher.

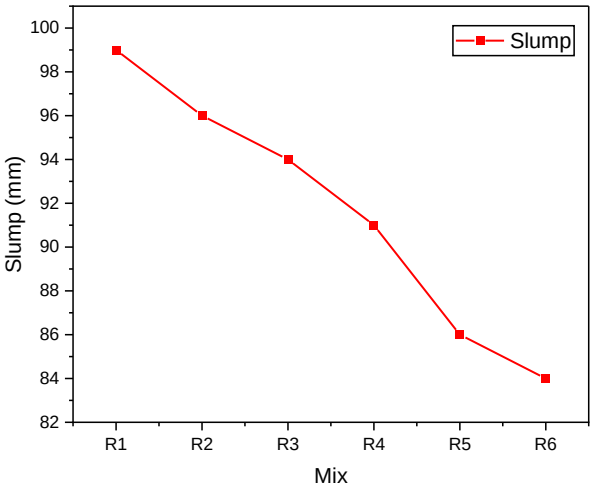

Fig. 1 Results of slump for all mixes

B. *Density*

The mix's density results are shown in Figure 2. The results show that the density of concrete mixtures decreases with increasing the quantity of rubber crumb in concrete. The rubber crumb has low sp gr than the FA, which is the reason for the decrement pattern in the density of RuC. The sp gr of natural FA is much higher than the waste tire rubber crumb, so the density of RuC will decrease. The appearance of entrapped air on rubber particles' rough surfaces could be another explanation for the decrement in the density of RuC [20], [21].

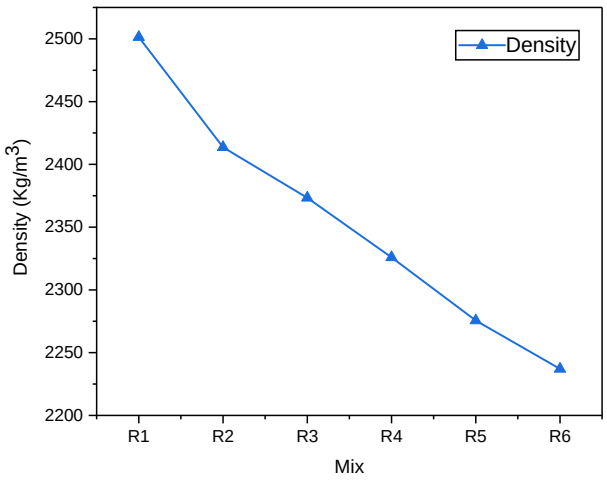

Fig. 2 Density of different mixes

C. Compressive strength

The compressive strength of the concrete mixes at 7, 14, and 28 days after casting is presented in Figure 3. The decrement in the compressive strength at 15% replacement level of rubber crumb is just 20.36% after 28 days of curing, and the compressive strength of the RuC is 40.12 MPa, which is suitable for the M40 classification. The compressive strength of RuC is not much affected at 15% replacement level of rubber crumb. The low adhesion between the rubber particle and the cement paste reduces the bonding, resulting in a declining trend in compressive strength at all ages. Rubber crumbs are softer and more elastically deformable than the cement matrix around them, indicating that the material stiffness of rubber and cement paste is incompatible. The above factors make it easier for cracks to form at the cement paste and rubber crumb interface, and the cracks' progression speeds up, reducing RuC's compressive strength.

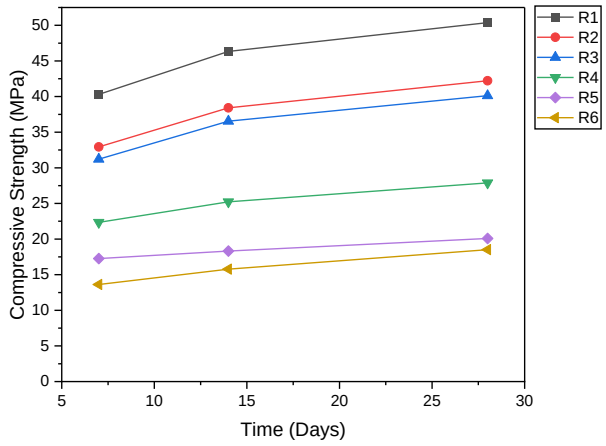

Fig. 3 Compressive strength of standard concrete and RuC

D. Split tensile strength

The split tensile strength results of the concrete mixes at 7, 14, and 28 days after casting are shown in Figure 4. In this study, at 15% replacement level of rubber crumb, the reduction is only 22.48% at 28 days of curing, and the split tensile strength is found to be 3.24 MPa. Due to weak bonding between rubber crumbs and cement, the RuC doesn't bear much tensile load than standard concrete, and the gaps between rubber crumbs and cement become larger quickly. The decrement in split tensile strength is 17-60% at 7-days, and 16-58% at 28 days.

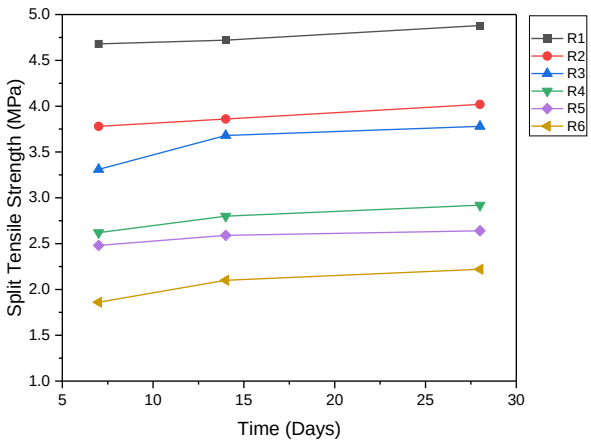

Fig. 4 Split tensile strength of standard concrete and RuC

E. Flexural strength

The flexural strength results of the concrete mixes at 7, 14, and 28 days after casting are shown in Figure 5. In this study, at 15% replacement level of rubber crumb, the reduction is 28% at 28 days of curing, and the flexural strength is found to be 4.00 MPa. The decrement in flexural strength is 18-59% at 7-days and 17-53% at 28 days at replacement level of rubber 0-30%. Since micro-crack forms when the post-peak region is reached and propagates after exceeding this stage in flexural strength testing, cracking may begin before the maximum load is applied.

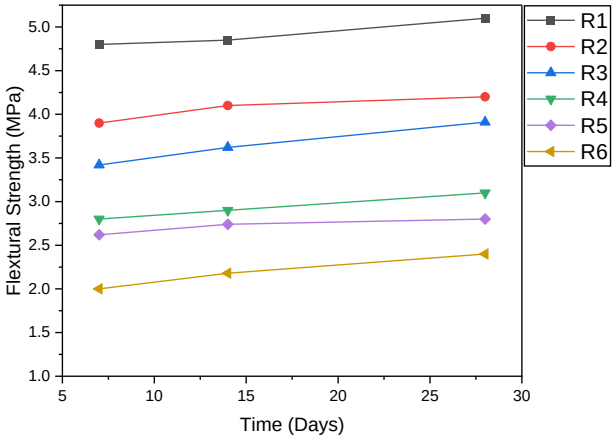

Fig. 5 Flexural strength of standard concrete and RuC

F. Impact resistance by rebound Test

The experimental setup is shown in Fig. 6(a), and Fig. 6(b) illustrates the impact energy absorbed by standard concrete and RuC in the rebound test. Based on the findings, it is discovered that increasing the amount of rubber in concrete increases resistance to the impact of RuC after comparing with standard concrete. The absorbed impact energy by RuC increases from 2.75 to 2.90 J with an entire 30% replacement of FA by rubber crumb in the concrete mix. The absorption of impact energy by the rebound test of the concrete increases from 2.56 to 2.82 J (0 - 10.156) by a 15% replacement level of rubber crumb in the concrete mix. This is a good development for RuC and is useful for the absorption of impact energy due to seismic loading.

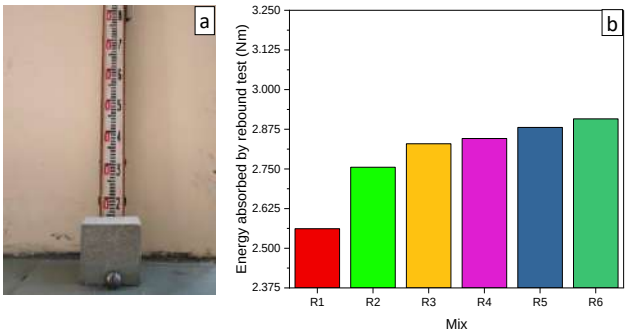

Fig. 6(a) Testing setup of Impact resistance by rebound test (b) Impact energy absorbed by the rebound of standard and RuC mixes

Conclusions

1. As a partial replacement of FA, Rubber crumb can be up to 15% without significant compressive strength loss.
2. The density of RuC decreases with the increasing replacement level and can be considered the semi-light weight of concrete. The density of RuC decreases due to low sp gr of rubber crumb.
3. The concrete's fresh and mechanical properties decrease with increasing the quantity of rubber crumb in concrete.
4. The impact resistance and the energy absorption capacity of the RuC improve when the rubber crumb is added to the concrete. These are the positive results of RuC, and it can absorb the impact energy by the seismic activities.

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Artificial neural network for predicting compressive strength of green concrete

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Abstract— **With its growing emphasis on sustainability, the construction industry is more interested in applying environmentally friendly concrete, also known as green concrete, in its construction projects. Among other benefits, concrete made with alternative or recycled waste material can reduce pollution and energy use, as well as lower the cost of concrete production. However, the impacts of these alternative materials on concrete properties have not been fully understood, which limits the wide applications of green concrete in practice. This study investigates the application of Artificial Neural Networks (ANN) to predict the compressive strength (CS) of concrete of the fly ash concrete mixtures which were prepared with 15, 25 and 35% fly ash by mass as the cement replacement at the ages of 14 and 28 days. The compressive strengths of fly ash based concrete obtained by experimental tests performed in various researches were used to develop the model. Portland cement content, fly ash content, aggregates content and water cement ratio were considered as input variables for developing the ANN model. The predicted results establish the accuracy and high prediction ability of the proposed model.**

I INTRODUCTION

G. Green Concrete

Utilization of green concrete in construction is increasingly adopted by the construction industry owing to the drawbacks of conventional concrete and the numerous inherent benefits of green concrete. The construction industry is the largest source of greenhouse gas emissions in the world, responsible for up to 50% of emissions. Therefore, replacing some materials with eco-friendly alternatives can help to reduce the carbon dioxide emission. The increasing demand for green concrete has been spurred by demand for high quality concrete products, desire of nations to reduce green-house gas emissions and the need for conservation of natural resources and limited landfill spaces.

Green concrete offers numerous environmental, technical benefits and economic benefits such as high strength, increased durability, improved workability and pumpability, reduced permeability, controlled bleeding, superior resistance to acid attack, etc. All these characteristics promote faster concrete production, reduction of curing waiting time, reduction of construction costs, early project completion, reduction of maintenance costs and increased service life of construction projects. The above said type of concrete

promotes sustainable and innovative use of waste materials and unconventional alternative materials in concrete. It is increasingly becoming a common element that can be used to help the construction industry achieve long-term sustainability, although the impact of these alternative or recycled waste materials on various concrete properties has not been fully understood.

The compressive strength of concrete is one of the most important mechanical properties in concrete design. The compressive strength is the maximum compressive stress that the concrete can sustain without fracture under a gradually applied load. It can be easily calculated from the failure load which causes the fracture divided by the cross-sectional area resisting the load and reported in megapascals in SI units.

2 Artificial Neural Network

ANN is a functional abstraction of the biological neural structure of the central nervous system. It consists of an interconnected group of artificial neurons and processes information using a connectionist approach. In most cases, it is an adaptive system that changes its structure based on external or internal information that flows through the network during the learning phase, usually used to model the complex relationships between inputs and outputs variables. ANNs have been widely used over the past few years to predict compressive strength. These methods can develop predictive models from experimental data, without a need for detailed knowledge of the underlying physical mechanisms.

There are mainly three layers which make the layout for the neural network model. The input layer comprises nodes that represent the input parameters or features in the data fed into a network model. The hidden layer has numerous neurons that operate on the weighted inputs and form a non-linear transformation on input variables using an activation function. The output layer comprises one or more output nodes that utilize an activation function to give the estimated output.

II METHODOLOGY

1 Research and data collection

After going through various relevant research papers, data sets from more than 35 tests of compressive strength carried out in various laboratories were collected and put together in a spreadsheet. Concrete containing fly ash and cement as full or partial replacement were considered. The input parameters that were chosen on the basis of their effect on the compressive strength of the concrete and their availability in the databases were cement content, fly ash content, water cement ratio, proportion of fine and coarse aggregates as shown in Table I.

TABLE I

Parameters	Description
Input variables	Cement content
	Fly ash content
	Proportion of fine aggregate
	Proportion of coarse aggregate
	Water cement ratio
Output variables	Compressive strength

3 Casting of specimens

OPC and fly ash conforming to Indian Standard IS 3812, Part 1 BIS 2003 and ASTM Standard C 39 were used in the investigation. Four mixtures each with OPC content were proportioned with water cement ratio as 0.40. The fly-ash concrete mixtures were then prepared with 0, 15, 25, 35% fly ash by mass as the cement replacement in each of the three control mixtures. Concrete mixtures with a water cement ratio of 0.40 did not require any superplasticizer for proper workability. Concrete cubes samples of 150 mm were cast to determine the compressive strengths at 14 days and 28 days.

4 Experimental testing

After 24 h of remaining under ambient laboratory conditions (temperature 23 ± 2° C), the specimens were demolded and cured under

in a tank until the age of testing. Cube specimens of all concrete mixtures were tested for compressive strength at ages 7 and 14 days. The testing was done with the help of a compression testing machine.

5 Training of ANN model

The data collected were divided into two parts with a ratio of 7:3, where 70% of data was used for generating the training dataset and 30% remaining data was used to generate the testing dataset. Secondly, a training dataset was used to build the ANN model in order to obtain accuracy and higher performance. Further, the predicted results were compared to experimental data (shown in Table II).

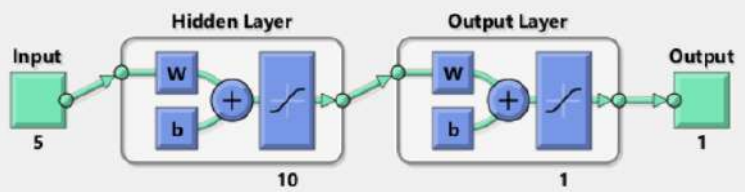


Fig. 1. Layout of neural network model

RESULTS AND DISCUSSIONS

Testing of materials

Fineness modulus of fine aggregates and coarse aggregates were found to be 2.93 and 2.07 respectively. In sieve analysis, 90% of the cement passed the sieve such that it is usable for the project. Consistency of the cement was 38%. And the initial setting time was 1:30 hrs.

H. Experimental testing

Cube specimens of all concrete mixtures with and without fly ash were tested for compressive strength at 14 days and 28 days of curing. In concrete incorporating fly ash, strength up to 28 days is mainly contributed by hydration of cement and pozzolanic reaction contributes to its long-term strength. From the test results, it can be seen that the compressive strength of concrete mixes with 15%, 25% and 35% fine aggregate replacement with fly ash were higher than the control mixes at both ages. It is evident that the compressive strength of all the mixes continued to increase with increase in age. This increase in strength is due to pozzolanic action of fly ash.

Analysis of predicitions

The values of best performance were equal to 0.879, 0.941, 0.932 for training, testing and validation phase of the developed model respectively. Fig. 2. shows the linear fit line and the equations for the training, testing and validation phases. The values of the statistical measures mentioned above establish the proper performance of the developed ANN model. Also, the best validation performance of 35.8368 is obtained at epoch 0 as shown in Fig. 4.

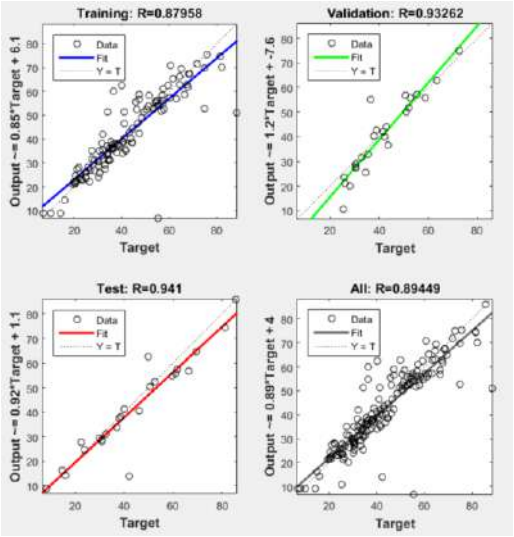
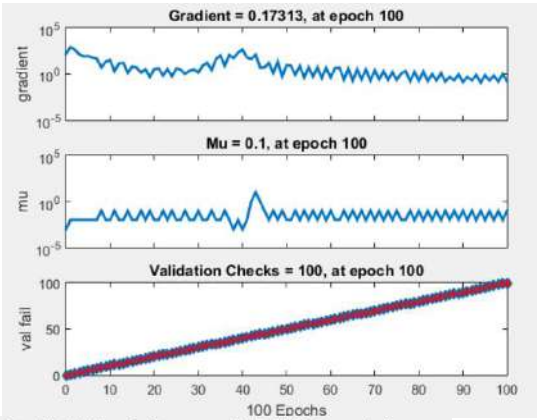


Fig. 2. Neural network model regression plot



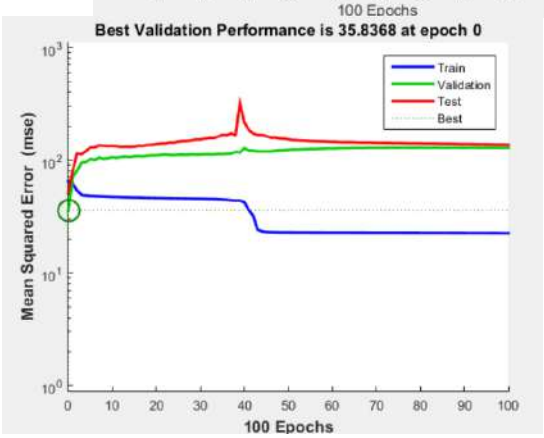


Fig. 3. Training state of model

Fig. 4. Training performance of model

TABLE II

Compressive strengths at 14 days		Compressive strengths at 28 days	
Obtained data	***Predicted data***	***Obtained data***	***Predicted data***
2.78	3.97	8.14	8.96
3.63	4.07	6.78	8.83
8.79	6.86	10	8.92
12.15	10.63	14.3	12.73

III CONCLUSION

There are mainly two aspects of this project. In this first part, the impact of fly ash on the compressive strength of the green concrete was examined. Here, the replacement of cement was done in the form of 15, 25 and 35% fly ash by mass in each of the three mixtures. In the second part, the artificial neural network was applied to build a model to obtain the 14 and 28 days compressive strength of this concrete type. Obtained results revealed that increasing the content of fly ash increased the early concrete strength. It was evident that the substitution of fly ash improved the strength at early ages. Moreover, an ANN model was made in order to predict the compressive strength of the green concrete incorporating fly ash. Computational tests including the mean squared error (MSE) and correlation coefficient (R), were conducted to prove the accuracy of the model. The Levenberg–Marquardt propagation technique proved to be the most effective and most reliable technique for the model. The experimental outputs i.e. compressive strengths of the concrete at 14 and 28 days were compared with the predicted results of the model, by the means of the four previously mentioned performance measurements. Average errors for both compressive strengths at 14 days and 28 days were found to be 5.12% and 2.87% respectively.

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Effect of waste tyre rubber in the concrete

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***Abstract*— This study determines the compressive strength performance of rubber concrete and disposal of waste tyre, which consists of 0%, 10%, 20% and 30% of the selected rubber content that is mixture of 60% crumbled and 40% powdered form. The rubber particles used in the experiments are made of the recycled tire. The rubber waste is not easy to decompose even after long period of treating in landfill. Partial replacement of rubber in fine aggregate can be a way to utilize only where strength requirement is very low. Casting of cubes and beams with m30 design mix. The specimens were cured in water for required number of days before testing. Results were clear for reduction in strength with increase in rubber content.**

Keywords—crumbled; aggregate; reduction

I INTRODUCTION

The vehicle tyres which are disposed to landfills constitute one important part of solid waste. Stockpiled tyres also present many types of health, environmental and economic risks through air, water and soil pollution. The tyres store water for a long period because of its particular shape and impermeable nature providing a breeding habitat for mosquitoes and various pests. Tyre burning, which was the easiest and cheapest method of disposal, causes serious fire hazards. Utilization of waste rubber tyres should minimize environmental impact and maximize conservation of natural resources. One possible solution for this problem is to incorporate rubber particles into cement-based materials. Waste rubber tyres can be shredded into raw materials for use in hundreds of crumb rubber products. The other part of the problem is that aggregate production for construction purpose is continuously leading to the depletion of natural resources. Moreover, some countries are depending on imported aggregate and it is definitely very expensive. For example, the Netherlands does not possess its own aggregate and has to import. This concern leads to a highly growing interest for the use of alternative materials that can replace the natural aggregates. Therefore, the use of recycled waste tyres as an aggregate can provide the solution for two major problems: the environmental problem created by waste tyres and the depletion of natural resources by aggregate production consequently the shortage of natural aggregates in some countries.

According to the Automotive Tyre Manufacturers Association (ATMA), in India, more than 92.2 million tyres of various categories were manufactured in year 2012-13. Based on an estimate, 60% of the waste tyres are disposed off via unknown routs. The raw materials in tyres include natural and synthetic rubber, carbon black, nylon, polyester and even kevlar cord, sulfur, oils and resins, and other chemicals. Tyre rubber with fiber and steel belting comprise the major elements of tyres currently being used. Of all the possible methods of tyre disposal, the creation of rubber crumb potentially offers the most effective environmental solution, because this is the material that can be used in a variety of other products.

Figure 1 rubber powder

Figure 2 crumbled rubber

II RESEARCH GAP

1. Depletion of natural resources by aggregate production.
2. Utilization of waste tyre rubber available in fields in huge quantity.

IV OBJECTIVE

1. To analyse the fresh and mechanical behaviour of concrete after replacing fine aggregate by waste powder and crumbled rubber.
2. To recommend the utilisation of waste rubber form in design mix as fine aggregate.

V MATERIAL USED

- Cement of 43 grade
- Fine aggregate
- Rubber crumbled and powder form
- Coarse aggregate 10mm-20mm
- Cube moulds

II ANALYSIS OF MATERIAL USED

1. Cement

Different tests were performed as result is shown in table 1.

Table 1 Properties of Cement

S.No.	Tests	Results
1.	Fineness Test	8%
2.	Consistency Test	28%
3.	Initial setting test	40min
4.	Final setting test	1hrs 20min
5.	Soundness test	2mm
6.	Compressive strength test	45N/mm2

Figure 3 cement tests

2. Fine aggregate

Fineness modulus test and readings are shown in table 2.

Table 2 Gradation of fine aggregates

Sieve size	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative % weight retained (gm)
80	0	0	0
63	0	0	0

40	0	0	0
20	0	0	0
12.5	240	240	4.8
10	900	1140	22.8
6.3	2390	3530	70.6
4.75	610	4140	82.8
Pan	860	5000	100
Total	5000g		281

Fineness Modulus of coarse aggregate is **2.81**

Figure 4 fine aggregate collection

3. Rubber aggregate

Fineness test was performes for determing the size of particles and the readings are shown in table 3.

Table 3 Gradation of rubber

IS SEIVE SIZE (mm)	WEIGHT RETAINED (gm)	% WEIGHT RETAINED	CUMULATIVE WEIGHT RETAINED (gm)	CUMULATIVE % WEIGHT RETAINED
4.75	0	0	0	0
2.36	94	37.6	94	37.6
1.18	56	22.4	150	60
0.6	26	10.4	176	70.4
0.3	44	17.6	220	88
0.15	18	7.2	238	95.2
Pan	12	4.8	250	100
Total	250			

Figure 4 fineness modulus test on rubber

VI RESULT AND DISCUSSION

1. Compressive strength test

Table 4

SAMPLE	PERCENTAGE CRUMB RUBBER (%)	3TH DAY COMPRESSION VALUES	7TH DAY COMPRESSION VALUES
1.	0%	11.2	22.4
2.	10%	10.3	19.4
3.	20%	8.1	16.3
4.	30%	7.2	13.4

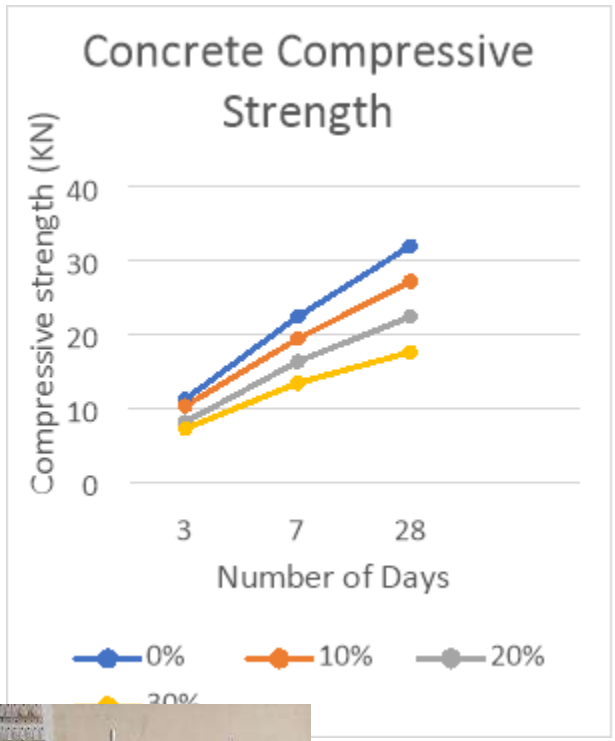
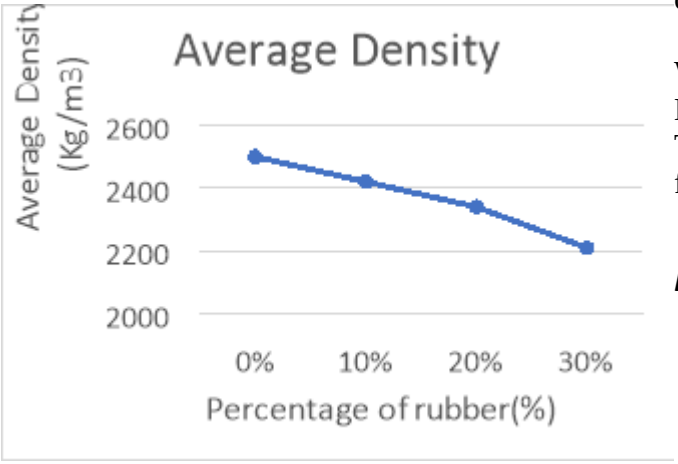


Table 5

SAMPLE	PERCENATAGE OF RUBBER (%)	AVERAGE DENSITY (kg/m^3)
1.	0%	2500
2.	10%	2420
3.	20%	2340
4.	30%	2210



Graph 2

VII CONCLUSION

On behalf of our result, we can conclude our study on the basis of following conclusions

1) Compressive strength of rubber concrete is decreasing with the increase in rubber content. As compared to 0% replacement of rubber in concrete, the concrete with 10%, 20% and 30% replacement of rubber to fine aggregate in concrete decreases the compressive strength of rubber concrete.
2) Density tests results shows that the density of rubber concrete decreases with increase in rubber content as increase in rubber also increases the volume of concrete.
3) Rubber concrete can be used at low strength demand structure like footpath, partition walls, stairs outside the houses over sewers and other low strength structures.

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Investigating The Effect of Various Fibers in Geopolymer Concrete

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Abstract — Fiber-reinforced geopolymer composites (FRGCs) were considered in terms of application in various areas. FRGCs are emerging as environmentally friendly materials, replacing cement in the construction industry. An alternative inorganic binder such as a geopolymer matrix promotes environmental awareness on releasing less CO2.Studies revealed that the production of one ton cement releases around one ton of CO2 to the atmosphere due to the calcinations of lime stone and combustion of fossil fuel. The inorganic matrix geopolymer is considered a greener cement for FRGCs.Fiber reinforced geopolymer concrete is relatively a new composite material in which fibers are introduced in the matrix as micro reinforcement to improve the strength properties. c. Geopolymer also has the ability to form a strong chemical bond with rock based aggregates.

I. INTRODUCTION

Concrete is the world's most versatile, durable and reliable construction material. Next to water, concrete is the most used material, which required large quantities of Portland Cement.

The demand for concrete as a construction material increases exponentially and thereby, there is an increase in the demand for the production of OPC(1).Ordinary Portland Cement production is the second only to the automobile as the major generator of carbon di oxide, which polluted the atmosphere. In addition to that large amount energywas also consumed for the cement production. To reduce these problems, it is necessary to find out an alternative material for cement. Many researches were carried out to find a replacement for cement(2). The demand for concrete as a construction material increases exponentially and thereby, there is an increase in the demand for the production of OPC. Hence, it is inevitable to find an alternative material to the existing most expensive, most resource consuming Portland Cement.

Geopolymer concrete is an innovative construction material which shall be produced by the chemical action of inorganic molecules(3). Fly Ash, a by-product of coal obtained from the thermal power plant is plenty available worldwide. Fly-ash is rich in silica and alumina reacted with alkaline solution produced aluminosilicate gel that acted as the binding material for the concrete. It is an excellent alternative construction material to the existing plain cement concrete. Geopolymer concrete shall be produced without using any amount of ordinary Portland cement.

ABBREVIATIONS

FRGC : Fibre Reinforced Geopolymer Concrete

GPC : Geopolymer Concrete
OPC : Ordinary Portland Cement
AS : Alkaline Solution
UTM : Universal testing machine

FA : Fine Aggregate
CA : Coarse Aggregate
IS : Indian Standard

II. OBJECTIVE OF THE STUDY

Objectives of the present study are written below:

- . To study and examine various research paper and collect proper information.
- .To determine the correct and specified mix design.
- .To find the proper ratio of both coir and steel fibres to attain maximum compressive strength.
- .To study the properties of Fly-ash in geopolymer concrete instead of OPC.
- .To find compressive strength using UTM.

The characterization of various materials used in this research was accomplished as per Indian and International codes.

1. **Fly Ash**

Class C fly ash is used in whole project, it originates from subbituminous and lignite coals. Its composition consists mainly of calcium, alumina and silica with a lower loss on ignition than OPC.

.

2. **Sodium Hydroxide** Used as alkaline solution
Molar Mass- 39.997g/mol
Density- 2.13g/cm3
Formula- NaOH
Boiling Point- 1388°C Grade- Industrial

3. **Sodium Silicate** Used as alkaline solution
State -Powdered
Packaging Type -HDPE BAGS Grade -industrial grade
Usage/Application -Detergent Raw material Formula -Na2SiO3
Purity-99%

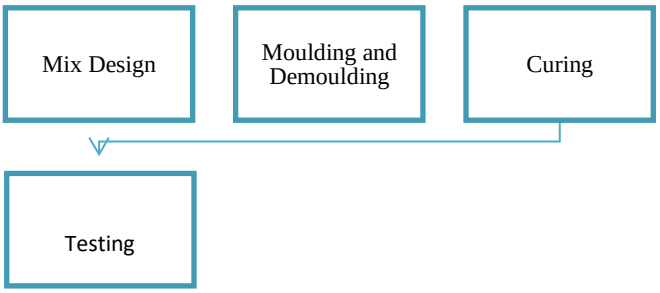
4. **Steel Fibre**

Length(mm)-30
Diameter(mm)-0.5 Aspect Ratio-60 Specific Gravity-7.8

5. **Coir Fibre**

Length(mm)-150-200
100% natural, Biodegradable,Made from infinitely replenishable resources .

III. METHODOLOGY



MIX PREPARATION

Description	**Quantity(kg)**
Fly-ash	1.518
NaOH	0.094
Water	1.101
Na2SiO3	0.4
Fine aggregate	2.31
Course aggregate	4.19

The fly ash and fine aggregates are mixed together in dry condition for about three minutes.

The coarse aggregates are mixed with the above said mixture under saturated-surface-dry condition and Crimped end steel fibers are added along with itand same for coir fibre. Then the AS (alkaline solution) is added to the dry mixture and the mixed continuously for another four minutes. Fresh concrete could be handled up to 90 minutes without any sign of setting.

IX. MIXING OF DRY MIXTURE

(i) Moulding and Demoulding of cubes

First we clean the moulds properly and oil them perfectly before making GPC. After this we fill moulds in 3 layer and tamping in mould continuously. After this we use vibrating table in the laboratory to compact the cube. Compacting the moulds are important because, after compaction the air voids in between are removed. Cubes are casted with 0.25% and 0.5% of steel fibre and coir fibre.

(ii) MOULDING OF CUBES

Demoulding of cubes were done after 48hours and some cubes after 72hours because of winter season. After demoulding, each cube should be marked with a legible identification on the top or bottom using a waterproof crayon or ink.

(iii) AMBIENT CURING OF CUBES

The specimens are cured under ambient condition at 25oC - 35oC. We have also tried Oven dry method but it was not compactable for our design mix, so we stick to ambient curing for

7 days, 14 days and 28 days.

X. CUBES UNDER AMBIENT CURING

(i) **Testing**

We have done compressive strength test on cubes after different interval of time.

(ii). COMPRESSIVE STRENGTH

The FRGPC cubes are cured for 7,14 and 28 days and tested, using compression testing machine of 1000kN capacity. The compressive load is gradually applied until the failure occurs.

Fig 3.11 Graph of Conventional GPC

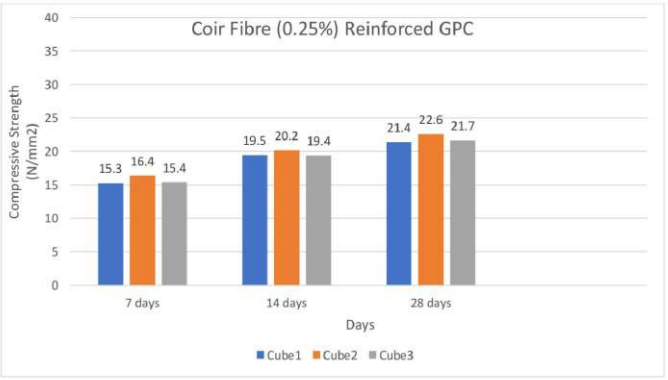


Fig 3.10 Graph of Coir Fibre(0.25%) Reinforced GPC

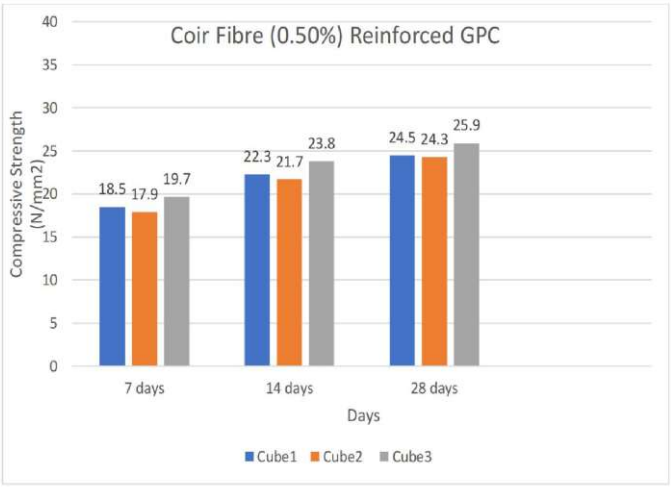
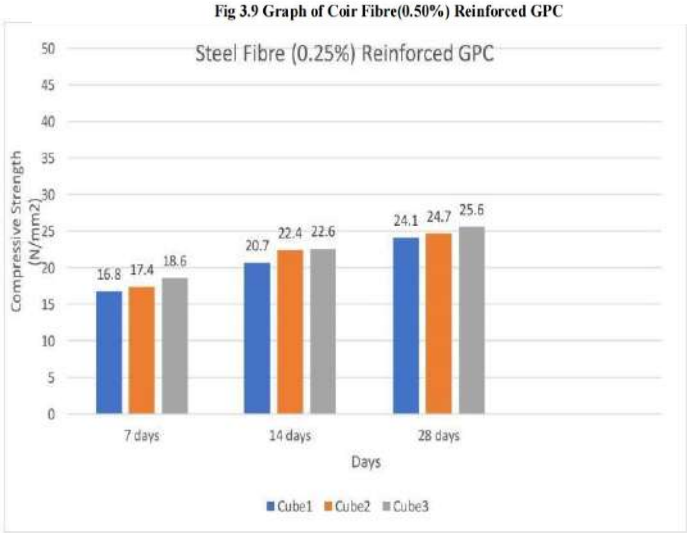
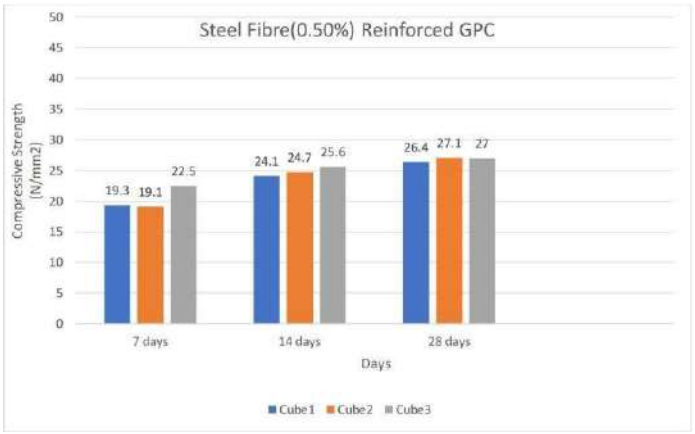


Fig 3.9 Graph of Coir Fibre(0.50%) Reinforced GPC





IV. CONCLUSION

Conclusions drawn from the result of fresh properties:

The mix proportion of M 25 grade of cement concrete is obtained from IS: 10262-2009.

In case of GPC, cement is completely replaced by fly ash. The mix proportion for geopolymer concrete compressive strength

16.20 N/mm2 is obtained.

- Theaverage compressive strength -(0.5%) Steel fibre Reinforced GPC cubes at 7, 14and 28 days are 20.3N/mm2,24.8N/mm2 & 27.2N/mm2 respectively
- **(**0.25%) Steel fibre Reinforced GPC cubes at 7, 14and 28 days are 17.6N/mm2, 21.9N /mm2 & 24.8N/mm2 respectively.
- **(**0.5%) Coir fibre Reinforced GPC cubes at 7, 14and 28 days are 18.7N/mm2, 22.60N/mm2 & 24.9N/mm2 respectively.
- **(**0.25%) Coir fibre Reinforced GPC cubes at 7, 14and 28 days are 15.6N/mm2, 19.7 N/mm2 & 21.9N/mm2 respectively.

Geopolymer concrete is more environmental friendly and has the potential to replace ordinary cement concrete in many applications.

- The purpose of this paper is to investigate the geopolymer concrete properties reinforced with hooked steel fibers and coir fibre.

- The compressive strength of the geopolymer concrete is highly influenced by the amount of CaO content in the fly ash. As the age of concrete increases, the compressive strength will also increases for all concrete.
- The longer the age of concrete improves the polymerisation process producing higher compressive strength of concrete. Other researchers also claimed that geopolymer concrete with steel fibers will reach its maximum strengthin less than 20 days. The GPC has good workability and cohesiveness and its setting time is more than OPC.

- Compressive strength of the FRGPC cured under ambient conditions, increases in value from 7 to 28 days.
- Crimped end steel fiber bond very well with GPC and also improves the compressive strength.
- The FRGPC possesses good compressive strength and well-suited to structural applications. Geopolymer also exhibit similar or superior engineering properties compared to cement.

V. Acknowledgment

We express our deep gratitude to **Mr. Ujjwal Sharma, Assistant Professor,** Department of Civil Engineering, for their valuable guidance and suggestion throughout our project work. We are very thankful **Mr. Aashish Malik**, Project Coordinator, Department of Civil Engineering for his valuable guidance.

We/I would like to thanks my/our Departmental In-charge Ms. Shikha Sachan for the constructive criticism throughout our/my Minor Project Work.

We/I are/am also thankful to **Prof. (Dr.) Sanjay Kumar,** Director, Dr. Akhilesh Das Gupta Institute of Technology and Management for providing us the facilities to carry out our project work efficiently .

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[12] IS Code – IS 10262:2009 (Concrete Mix Design)

[13] IS Code – IS 383:1970 (Specification of Coarse and FineAggregate for use in mass concrete)

[14] IS Code – IS 6491:1972 (Method of sampling fly-ash)

[15] IS Code – IS 2386:1963 (Test for aggregate for concrete)

[16] ISCode – IS 516:1959 (Methods of test for the strength of concrete)

Performance Evaluation of Agriculture waste basedon Self compaction Concrete

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Abstract — The main purpose of this project is the construction industry is to utilize the agricultural wastes at various proportions in concrete and evaluates the changes which comes in its fresh and hardened properties.

The performance of self-compacting concrete by properly utilizing the agricultural waste and to calculate the optimum quantities of wheat and rice husk ash which increases the fresh and hardened properties of self-compacting concrete. The proportions of wheat and rice husk ash which taken as partial substitution of portland pozzolana cement are 5%, 10%, 15% and 20%.

I. INTRODUCTION

Self-Compacting Concrete is a special type of concrete that can permeate and fill the gap of reinforcement and the corner of moulds without any desideratum of vibration and compaction during the placing process. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in sections with congested reinforcement. Considering lack of uniformity and complete compaction of concrete by vibration, researches at the university of Tokyo, Japan, starts developing SCC in the late 1980 and by 1990's they have develop and start the use of SCC that does not require vibration to achieving full compaction.

The production of Fly Ash Cement which is the major binder in SCC is energy intensive and emits a significant amount of carbon dioxide in the environment.

The application of SCC is predominantly a contribution towards enhancement of concrete technologically, economically and ecologically/socially. The incorporation of river sand in concrete affects natural resources and groundwater.

ABBREVIATIONS

SCC	:	Self Compaction Concrete
IS	:	Indian Standard
RHA	:	Rice Husk Ash
WSA	:	Wheat Straw Ash

SP : Super plasticizer
FA : Fine Aggregate
CA : Coarse Aggregate
UTM : Universal Testing Machine

OBJECTIVE OF THE STUDY

Objectives of the present study are presented as below:

- To analyse the effect and application of Rice husk and Wheat Straw in SCC.
- To determine the optimum content of RHA and WSA as cementitious material replacement.
- To improve the fresh and hardened properties of SCC.

II. MATERIALS FOR SCC

The characterization of various materials used in this research was accomplished as per Indian and International codes.

A. *Fly Ash Cement:*

Fly ash cement of grade 43 of class F was used.

B. *Agricultural Waste:*

The by-product which comes out at the end of agricultural activities. There are two types of agricultural waste which we have used in this project:

1) Rice Husk Ash: The ash formed during open field burning or uncontrolled combustion in industrial furnaces generally contains high silica.
2) Wheat Straw Ash: It was burned at a temperature of 600˚C at the factory. The resultant burn ash was passed through sieve no. 200, which was used for fly ash cement replacement.

C. *Coarse Aggregate:*

The aggregate which retained on 4.75mm IS sieve is used as coarse aggregate. Coarse aggregate having the maximum size of 20 mm was used. In addition to 20 mm size, 10 mm down size aggregates were also used. (Specific Gravity: 2.6 – 2.8)

D. *Fine Aggregate:*

The aggregate whose size is less than 4.75mm is used as fine aggregate. (Specific Gravity: 2.65)

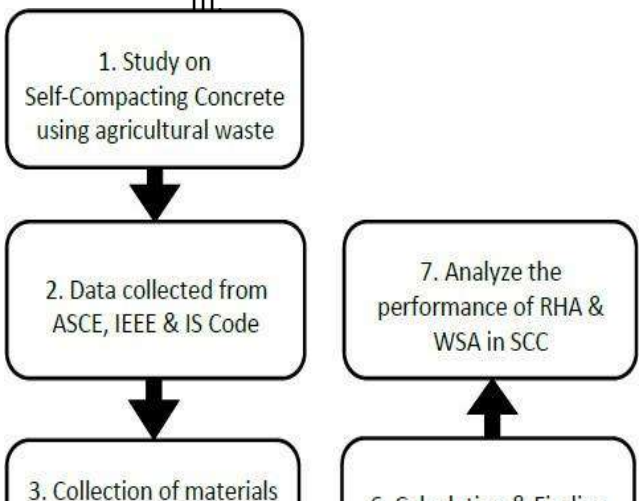
E. *Water:*

Water is the most important ingredient in concrete. The water used for making concrete should be clean and free from any detrimental impurities such as alkali, and acid etc.

F. *Super plasticizer:*

BASF Master Glenium 51 is used. It is a new generation admixture based on modified carboxylic ether was used to improve the workability of the mix. (Density: 1082-1142 kg/l).

III. METHODOLOGY



[114]

MIX PREPARATION

Mix Design for M-35 Grade SCC

MIX	FLY ASH CEMENT (kg/m3)	Coarse Aggregate (kg/m3)	Fine Aggregate (kg/m3)	Water	RHA or WSA	Super plasticizer
SCC	530	730	890	195	0	6
SCC5R	503	730	890	195	27	6
SCC10R	477	730	890	195	53	6
SCC15R	450	730	890	195	80	6
SCC20R	424	730	890	195	106	6
SCC5W	503	730	890	195	27	6
SCC10W	477	730	890	195	53	6
SCC15W	450	730	890	195	80	6
SCC20W	424	730	890	195	106	6

SCC mix of M35 Grade is prepared by using Nansu Method and IS 10262:2019 that is IS code of Indian Standard Code Recommendation Method of Concrete Mix Design.

In this proportioning, one mix of normal SCC is prepared. In the other 8 mixes, fly ash cement is partially replaced with agricultural waste, 4 each for WSA and RHA. In the mix proportioning,

fly ash cement is used as a binding material, river sand is used as a fine aggregate, 10 mm and 20 mm stones are used as coarse aggregate and BASF Master Glenium 51 is used as super plasticizer. The quantities of fly ash cement, fine aggregate, coarse aggregate and super plasticizer are constant. The relative percentage of rice husk ash and wheat straw ash are varying in each mix. The various proportions of RHA and WSA which is used in this project are 5%, 10% , 15% and 20%.

G. *Acceptance Test:*

After preparation of the mix, SCC is checked for Slump Test, T- 500mm and L-Box. The slump should be in the range of 600-800 mm. The T-500mm test should be in the range of 2-5 seconds. In L- Box test, the SCC should be in the range of 0.8-1. If the SCC is passed in all these fresh properties test, then after SCC is used for testing hardened properties like compressive strength and split tensile strength.

IV. (A) FRESH PROPERTIES OF SCC

Slump Flow:

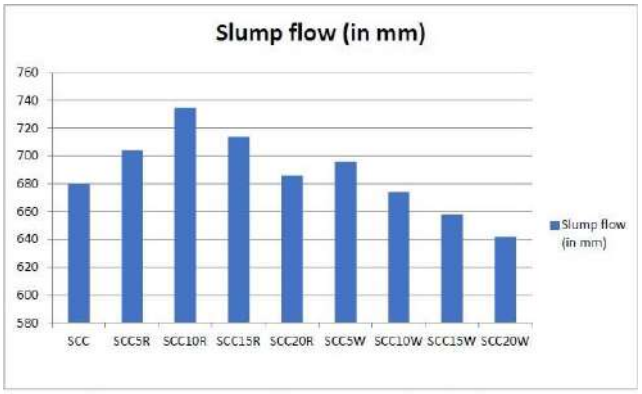


Fig 4.1 Variation in the slump flow at different proportions of RHA and WSA in SCC

This shows the outcomes of the slump flow test. It is coming in the range of 640-735mm. Therefore, it is coming in the SF2 class of the EFNARC classification 2005. The slump flow of varying agricultural waste i.e., RHA or WSA in SCC. The graph shows that the slump flow of SCC increases, when RHA is added up to 2.5% and then after, the slump flow decreases with the increase in the % of RHA. In case of wheat straw ash, the slump flow slightly decreases with increase in the % of WSA and then after, the slump flow drastically decreases with the decrease in the % of WSA.

I. T-500 mm test:

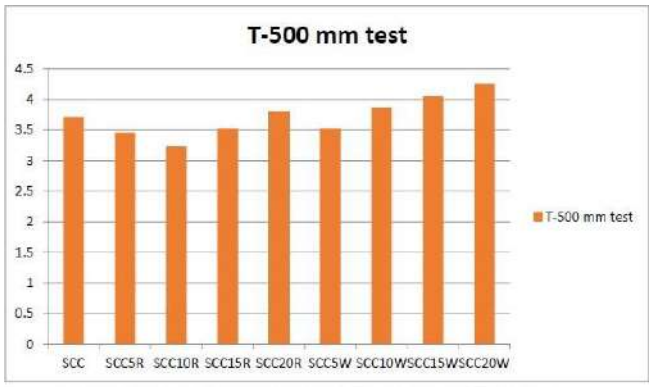


Fig 4.2 – Variation in the T- 500 mm flow time at different % of RHA or WSA in SCC

The T-500 mm is coming in the range of 3.23 - 4.26 sec. Therefore, according to EFNARC classification 2005, it comes in VS-2 class. It shows that T-500 mm value decreases with the increase in RHA up to 2.5% and the further increases with the increase in the % of RHA. In case of wheat straw ash, the T-500mm increases with the increase in the % of WSA.

J. L-Box:

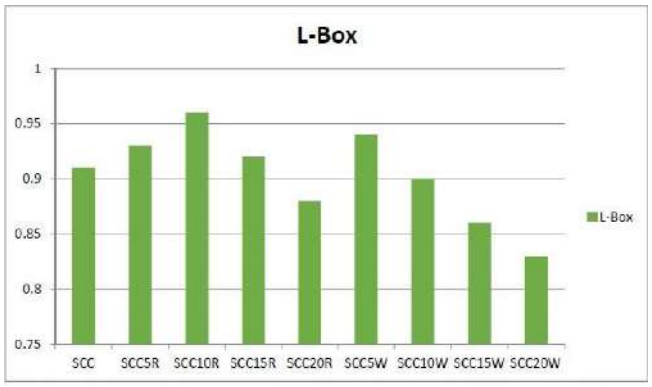


Fig 4.3 L-Box variation in the different proportions of RHA and WSA in SCC

This shows the results of the L-Box test. The L-Box value coming in the range of 0.83-0.96. According to the EFNARC recommendation 2005, the reading of L-Box lies in the range of 0.8-1. Therefore, it comes in the satisfactory limits. In this test, there is no blockage was observed when SCC is passing through reinforcing bars of the L-Box apparatus. It shows the variation in the value of blocking ratio with varying in the percentage of RHA or WSA. Fig 4.3. shows the L-Box values increases with the increase in the 5% of RHA up to 2.5%. and then it decreases with the increase in % of RHA. In case of SCC containing wheat straw ash, the L-Box decreases with the increase in the percentage of WSA. Fig 4.3 shows the graph of L-Box test.

(B) HARDENED PROPERTIES OF SCC

K. *Compressive Strength Test:*

Fig 4.4 represents the results of the compressive strength of the SCC. The compressive strength is coming in the range of 26.83 - 29.33 N/mm^2 after 7 days and 40.66 - 44.33 N/mm^2 after 28 days. The compressive strength of SCC decreases with the increase in % of RHA in both 7 and 28 days. In the case of wheat straw ash, the compressive strength of SCC increases with the increase in WSA up to 5% and then after, it decreases with increase in the % of wheat straw ash. Fig 4.4 shows the graph of the compressive strength test.

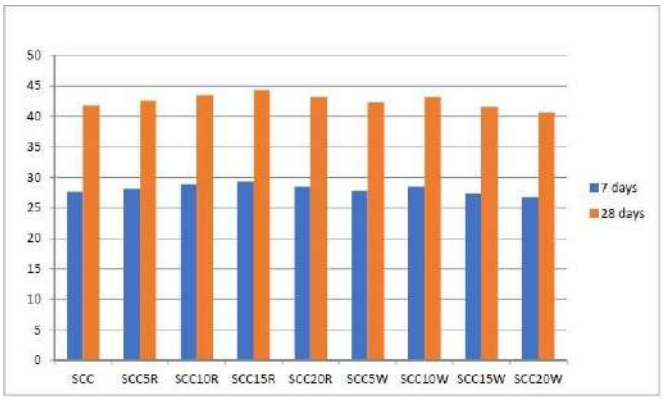


Fig 4.4 Compressive strength variation with different proportions of RHA or WSA in SCC

L. *Split tensile test:*

Fig 4.5 represents the results of the split tensile test of the SCC. It is coming in the range of 3.97 – 5.09 N/mm^2 after 28 days. The split tensile strength of SCC decreases with the increase in % of RHA after 28 days. In the case of wheat straw ash, the compressive strength of SCC increases with the increase in WSA up to 5% and then after, it decreases with increase in the % of wheat straw ash. Fig 4.5 shows the graph of the split tensile strength test.

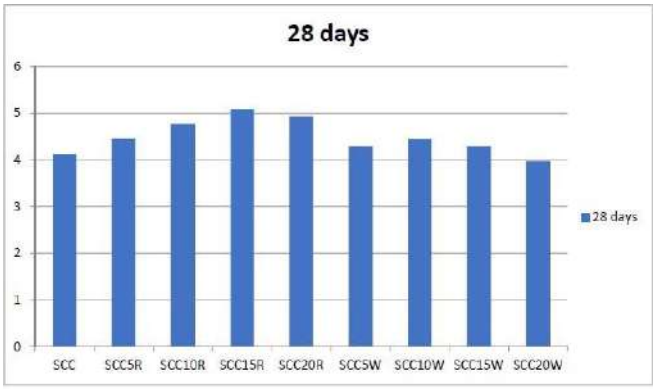


Fig 4.5 Split tensile variation with different proportions of RHA or WSA in SCC

M. Flexural Strength Test:

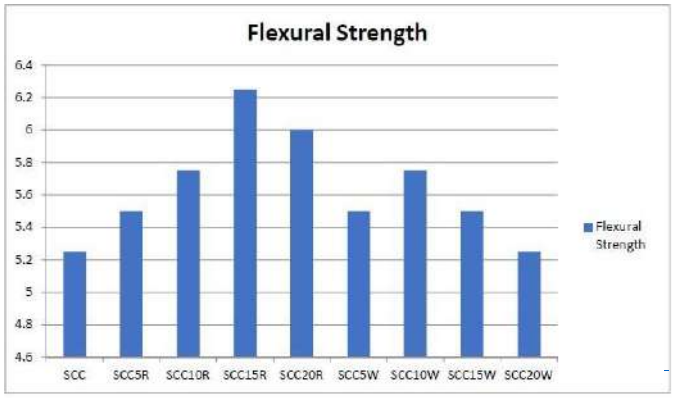


Fig 4.6 Variation in flexural strength with different proportions of RHA or WSA in SCC

Fig 4.6 represents the results of the flexural strength test of the SCC after 28 days. It is coming in the range of 5.25 to 6.25 N/mm^2 after 28 days. It increases with the increase in RHA up to 15 % after

28 days. In the case of wheat straw ash, the compressive strength of SCC increases with the increase in WSA up to 10% and then after, it decreases with increase in the % of wheat straw ash. Fig 4.6 showsthe flexural strength test of the SCC after 28 days.

V. CONCLUSION

1) The optimum content of slump flow, T-500 mm and L-Box of SCC are 10% and 5% in RHA and WSA respectively.
2) The optimum content of compressive, split tensile and flexural strength test of SCC are 15% and 10% in RHA and WSA respectively.
3) More SP is required for SCC having RHA and WSA more than 10%and 5% respectively in case of fresh properties and 15 and 10% in case of hardened properties.

Acknowledgment

We express our deep gratitude to Mr. Parasram Pandit, Assistant Professor, Department of Civil Engineering, for their valuable guidance and suggestion throughout our project work. We are very thankful Mr. Aashish Malik, Project Coordinator, Department of Civil Engineering for his valuable guidance.

We would like to thanks our Departmental In-charge Ms. Shikha Sachan for the constructive criticism throughout our Minor Project Work.

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Comparative Study on Design of Steel Structures and RCC Frame Structures Based on Column Span

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Abstract—**The development of infrastructure sector is taking place at an unprecedented rate and it demands suitable materials to have our structure safer, sustainable and economical.**

Steel construction has gained wide acceptance world wide as an alternative to RCC construction. However, this system is relatively new concept for the construction industry. Reinforced concrete members are used in the framing system for most of the buildings since this is the most convenient & economic system so far. However, for multi storeyed building this type of structure is no longer economic because of increased dead load, less stiffness, span restriction etc.

In the present work RCC and Steel structure options are considered for comparative study of G+2 and G+8 storey buildings which is situated in earthquake zone IV of IS 1893-2002 earth quake loading. Equivalent static method and Response Spectrum method of analysis are used for modeling of Steel and RCC structures. STAAD-pro V8i Finite element software is used. The dead load and live load are considered as per IS-875(part-1&2) and wind load is considered as per IS-875(part-3).

The results of this work show that the Steel Structures are the best solution for high rise structure as compared to R.C.C structure as shown for large span. Comparative study includes parameters such as displacement, axial force, shear force and bending moment.

Keywords—***RCC, Steel structure, Bending moment, Shear force, Axial Force, Displacement, STAAD–Pro, Comparative Study***

I. INTRODUCTION

The quality of life has improved a lot due to technological improvements. Hence, everyone wants a building to have maximum usable space which suites a multipurpose building requirements that includes office spaces, hotels, shopping complex etc. To achieve these functional requirements architects tends to provide a building plan which has a large column span than with short column span, considering the Seismic and wind loads acting on the building the cost of construction increases to withstand these forces acting on the building. Therefore one has to carefully choose the type of the structure which best suits the requirements and prudent to site conditions.

The comparative study on design of Steel structures and RCC frame structures based on their columns span will help us to choose the kind of construction which ideally suits the conditions and type of structure. This project's major aim is based on one key factor i.e. span of the column, which plays a major role along with the height of the building in design and analysis of a structure. The scope of this article is based on comparative study in both long and short span of columns. In this project the design & analysis of G+8 and G+2 RCC and Steel Structure are done.

The design involves load calculations manually and analyzing the whole structure by STAAD Pro.The design methods used in STAAD-Pro analysis are Limit State Design conforming to Indian Standard Code of Practice. In the comparison the columns were placed in a grid system while keeping the same size and height of the building (for both types of building). The study of design & analysis were performed on the building with the entire load applications i.e. (dead load, live load, Seismic load and wind load) and analysis type includes both Static and Dynamic analysis.

II. OBJECTIVE OF THE STUDY

Objectives of the present study are presented as below:

A. To evaluate the design and parameters for a G+2 and G+8 Steel and RCC structure with 6 m column span and12 m column span, and compare.

B. To compare the obtained results and conclude on valid and relevant basis. Comparison of the two models are made for a Residential building, using STAAD Pro

Parameter	Value
Column Size (in mm)	400x450
Primary Beam Size (in mm)	400x300
Slab Size (in mm)	125

III. PROJECT DETAILS

Building Details and Model Layouts for Steel and RCC Structure in STAAD-Pro software are as shown below:

A. Dynamic Analysis Model

Parameter	Value
Height of the building	29 m
Each Storey height	3 m
Plinth height	2 m
Parapet wall height	1.2 m
Grade of concrete	M35
Grade of Steel	Fe345
Grade of Rebar	Fe500
Soil Condition	Medium Soil
Seismic Zone	Zone IV
Wind Speed	47 m/s
Live Load	3 KN/m2
Floor finish load	0.6 KN/m3
Masonry wall weight	19 KN/m3
Importance Factor	1.2
Response factor for RCC	3
Response factor for Steel	5
Time Period for RCC	0.94 sec
Time Period for Steel	1.06 sec
Damping Ratio for RCC	5%
Damping Ratio for Steel	2%
Factor of safety	1.5
Dynamic Analysis	Response Spectrum Analysis

TABLE I. COMMON STRUCTURAL DETAILS FOR DYNAMIC ANALYSIS

Parameter	Value
Column Size (in mm)	850x850 (Plinth - 2nd Floor) 650x650 (3rd - 8th Floor)
Primary Beam Size (in mm)	600x750
Slab Size (in mm)	150

TABLE II. DETAILS OF LONG SPAN RCC STRUCTURE FOR DYNAMICANALYSIS

TABLE III. DETAILS OF SHORT SPAN RCC STRUCTURE FOR DYNAMICANALYSIS

Parameter	Value
Column Size (Hollow Square Section)	550x550x24
Primary Beam Size	ISWB-600
Deck Slab Size	125

TABLE IV. DETAILS OF LONG SPAN STEEL STRUCTURE FOR DYNAMICANALYSIS

Parameter	Value
Column Size (Hollow Square Section)	300x300x20
Primary Beam Size	ISMB-500
Deck Slab Size	100

TABLE V. DETAILS OF SHORT SPAN STEEL STRUCTURE FOR DYNAMICANALYSIS

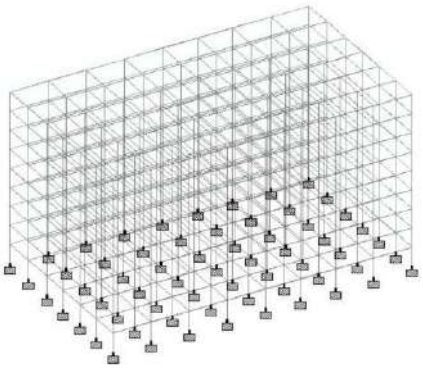

Fig. 1. Short span (6m) model on STAAD Pro for Dynamic Analysis

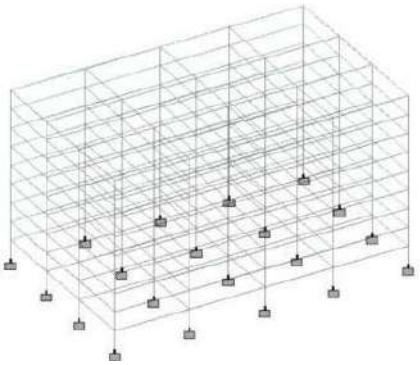

Fig. 2. Long span (12m) model on STAAD Pro for Dynamic Analysis

B. Static Analysis Model

Parameter	Value
Plan Dimension	12x42 m
Total height of structure	15 m
Height of each storey	4.5 m
Height of parapet	1.2 m
Size of beams at plinth level	1x0.3 m
Size of beam at floor level	1x0.3 m
Size of column	0.6x0.3 m
Thickness of the slab	0.150 m
Thickness of wall	0.230 m
Seismic Zone	IV
Wind speed	47 m/s
Importance factor	1.2
Zone factor	0.24
Floor finish	0.6 KN/m3
Live load	3 KN/m2
Grade of concrete	M30
Density of concrete	25 KN/m3
Damping ratio	5%
Grade of structural steel	Fe345
Concrete cover to reinforcement for slab	0.025 m

TABLE VI. DETAILS OF RCC STRUCTURE FOR STATIC ANALYSIS

Parameter	Value
Plan Dimension	12x42 m
Total height of structure	15 m
Height of each storey	4.5 m
Height of parapet	1 .2m
Size of beams at plinth level	ISMB-450
Size of beam at floor level	ISMB-450
Size of column	ISMB-500
Thickness of the slab	0.150 m
Thickness of wall	0.230 m
Seismic Zone	IV
Wind speed	47 m/s
Importance factor	1.2
Zone factor	0.24
Floor finish	0.6 KN/m3
Live load	3 KN/m2
Grade of concrete	M30
Density of concrete	25 KN/m3
Damping ratio	5%
Grade of structural steel	Fe345
Concrete cover to reinforcement	0.025 m

TABLE VII. DETAILS OF STEEL STRUCTURE FOR STATIC ANALYSIS

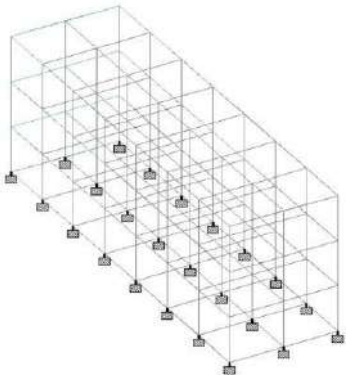

Fig. 3. Short span (6m) model on STAAD Pro for Static Analysis

IV. ANALYSIS

The buildings models are analyzed by using Staad-Pro V8i software. In RCC structure the beam and column is modeled as RCC beam element. In Steel structure the beam and column is modeled as Steel beam element. The different parameters such are displacement, maximum shear force, axial force and maximum bending moment. The dead load and live load are considered as per IS-875(part 1 &2) and wind load is considered as per IS-875(part 3). For earthquake loading IS:1893(Part1)-2002 is used.

V. RESULT AND DISCUSSION

A. Story Displacement for RCC and Steel

As observed, story displacement is less in case of RCC dueto higher stiffness of RCC.

B. Maximum axial forces for RCC and steel

The result depicts that the RCC structures have higher axial forces when compared to the Steel structure for long span as the member size ratio required for Steel structures decreases when the span of column is increased when compared to that of RCC Structure.

For Short Span the Axial force is less for RCC structure as the member sizes ratio which is required for structure is minimal when compared to that of Steel structure.

Analysis Parameters	Story Displacement (mm)		Shear Force (kN)		Bending Moment (kNm)		Axial Force (kNm)	
	RCC	*Steel*	*RCC*	*Steel*	*RCC*	*Steel*	*RCC*	*Steel*
Response Spectrum-X	146.6	150.1	1111.3	1019.7	2950.7	2597.9	22406.9	24659.4
Response Spectrum-Y	156.6	171.8	1348.2	1222.7	3245.6	3081.47		

TABLE VIII. RESULTS OF LONG SPAN MODEL OF DYNAMIC ANALYSIS

Analysis Parameters	Story Displacement (mm)		Shear Force (kN)		Bending Moment (kNm)		Axial Force (kNm)	
	RCC	*Steel*	*RCC*	*Steel*	*RCC*	*Steel*	*RCC*	*Steel*
Response Spectrum-X	368.2	372.8	297.7	271.4	790.9	691.4	15131.4	12722.9
Response Spectrum-Y	357.7	359.3	311.2	302.8	764.3	672.7		

TABLE IX. RESULTS OF SHORT SPAN MODEL OF DYNAMIC ANALYSIS

Analysis Parameters	Shear Force (kN)		Bending Moment (kNm)		Axial Force (kNm)	
	RCC	*Steel*	*RCC*	*Steel*	*RCC*	*Steel*
X-direction	152.2	141.2	555.9	534.6	2058.4	2192.3
Y-direction	18.7	16.2	306.8	295.8		

TABLE X. RESULTS OF SHORT SPAN MODEL OF STATIC ANALYSIS

C. Maximum shear forces for RCC and steel

From the analysis, we see that RCC has higher value of shearing forces as compared to steel.

D. Maximum bending moment for RCC and steel

The chart shows that the bending moment for Steel is less compared to RCC structure due to high tensile property of Steel. The bending moment is directly proportional to span of columns.

VI. CONCLUSION

It has been observed in the above study that the Steel structures performs better in longer span of columns when compared to RCC structures due to high tensile nature and high strength of steel. RCC Structure performs better in short span of columns due to its lower axial forces because of lower cross section sizes required for the structure members.

- Even though the bending moment of RCC structure is higher than steel structure for short span of columns, it is within permissible limit. Short span of RCC structure are more suitable for economical construction.
- Steel structure is vertically more stable than RCC structure in long span model due to its high strength to unit mass. It means the steel structure attracts less earthquake forces.
- Forces on the Steel structure decreases with increase in height of the building or increase in span of the column due to its lower weight requirement for the members when compared to RCC structure.
- Speedy construction techniques of Steel structures provide earlier opportunities to recoup the investment.
- Deflection in RCC structure is lesser as compared to steel due to lower stiffness and high ductility in steel.
- The maximum bending moment and shear force is more than the RCC structure and less than the steel structure.

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A Comparative Study of Hyperelastic Models in Ansys

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Abstract: Hyper elasticity refers to a constitutive response that is derivable from free elastic potential energy. Hyper elastic materials are widely used in different fields due to its unique Stress-Strain relationship and independent strain rate. Rubber is the common example for this kind of material and is most widely used due to their advantages like high elasticity, resistance, breaking strength, good wear, elongation, etc. In structural engineering, Hyper elastic material, elastomer have been used in dampers, conveyor belts, vibration isolation bearings or shock absorbers and impact absorbers. An increase of applications requires a better understanding of the mechanical behaviour of rubber-like materials, it is necessary to develop a basic understanding of the various hyper elastic models to be applied in ANSYS. The objective of this research paper is to study compare an determine various suitability of hyper elastic models in ANSYS.

Keywords: Hyperelasticity, Rubber, Elastomer

1. INTRODUCTION

Hyper elastic materials such as rubber are largely used for multiple structural applications in variety of industries ranging from tire to aerospace. The most alluring property of rubbers is that they can undergo large deformation under small loads and have the ability to retain initial configuration without substantial permanent deformation after load is removed. Also, their stress-strain behaviour is highly non-linear and a simple modulus of elasticity is no longer sufficient. Therefore, characterization of elastic behaviour of highly extensible, nonlinear materials is of great significance [4].

For a precise prediction of rubber behaviour, used in an assembly (e.g. flexible joint), by finite element simulation, it should be tested under same loading conditions to which original assembly will be subjected. The uniaxial tests are easy to perform and are well understood but uniaxial data alone does not produce reliable set of coefficients for material models, especially if the original assembly experiences complex stress states. Therefore, biaxial, planar (pure shear) and volumetric tests need to be performed along with a uniaxial tension test to incorporate the effects of multiaxial stress states in the model. For specific applications, the tailoring of rubber mechanical properties is carried out by the addition of various chemicals. Minor changes in chemical composition can alter mechanical properties significantly.

Therefore, it is essential to test a particular rubber composition and simulate through FEA to have an appropriate Strain Energy Function.

2. CONSTITUTIVE LAWS OF HYPERELASTICITY [2]

Consider the deformation of a rubber likesolid and denote F the local gradient of the deformation. The right and left Cauchy-Green deformation tensors, respectively C and B, aredefined by:

$$C = F^t F \text{ and } B = F F^t$$

C and B admit the three same principal invariants classically denoted I_1, I_2 and I_3 and given by: $I_1 = tr(C)$

$$I_2 = \frac{1}{2}[tr(C)^2 - tr(C)^2]$$

$I_3 = \det C$Stretch ratios that are defined as the square roots of the eigen values of C (equal to those of B) and are classically denoted as $(\lambda_i)_i$=1,3.

Using these ratios, principal invariants are reduced to: $I_1 = \lambda_1^2 + \lambda_2^2 + \lambda_3^2$

$I_2 = \lambda_1^{\,2}\lambda_2^{\,2} + \lambda_2^{\,2}\lambda_3^{\,2} + \lambda_3^{\,2}\lambda_1^{\,2}$

$I_3 = \lambda_1^{\,2}\lambda_2^{\,2}\lambda_3^{\,2}$

For large strain problems, two major stress tensors are classically defined: the true (or Cauchy) stress tensor σ and the nominal (or first Piola-Kirchhoff) stress tensor P. They are related by:

$$P = \det F \, \sigma \, F^{-t}$$

So according to the general theory of hyperelasticity, it is assumed that stress tensors derived from strain energy function, which is defined per unit of undeformed volume, depends on the strain tensor B and is classically denoted W. Consequently, stress tensors depend on both strain and an arbitrary scalar parameter p which can be determined with equilibrium equations:

$$\sigma = \frac{2B\partial W}{\partial B} - pI$$

$$P = \frac{\partial W}{\partial F} - pF^{-t}$$

the force-extension relation in uniaxial test and the force-shear displacement relation in shear test. It is described as:

$$W = C_1(I_1 - 3) + C_2(I_2 - 3)$$

where C_1 and C_2 are the two material parameters.

Advantage: This model defined in the above equation is a 2nd order material model, that makes it a better deformation predictor thatthe Neo-Hookean material model [7].

Limitations: This model is widely used for rubber parts in which deformation remains moderate (lower than 200%).

3.2 Neo-Hookean Model

The Neo-Hookean model 36 is the simplest physically based constitutive equation for rubbers. It matches the Mooney-Rivlin model with only one material parameter ($C_2 = 0$), but was derived from molecular chain statistics considerations.

$$W = \frac{1}{2} nkT (I_1 - 3)$$

In which n is the chain density per unit of volume, k is the Boltzmann constant and T is the absolute temperature.

3. HYPERELASTIC MODELS IN AVAILABLE ANSYS

In ANSYS, two types of hyper elastic material models are available and each model defines the strain energy function in a different way [1]. One is the phenomenological models which treat the problem from the viewpoint of continuum mechanics and stress-strain behaviour is characterized without reference to the microscopic structure. Other one is physically motivated models which consider the material response from the viewpoint of microstructure.

A brief review about the hyper elastic models available in ANSYS exploited is described [3] and compared in this study is as follow:

3.1 Mooney-Rivlin Model

The two parameters phenomenological model that works well for moderately large stains in uniaxial elongation and shear deformation. But it cannot capture the upturn (S-curvature) of

Advantage: This model was revealed in good agreement with tensile, simple shear and biaxial tests for deformation lower than 50%. Limitation: This model doesn't predict the increase in modulus at large strains [7].

3.3. Full Polynomial model

For isotropic and compressible rubber, polynomial model can be used.

3.4. Reduced Polynomial model

This model does not include any dependency on I_2. The sensitivity of strain energy function to variation in I_2 is generally much smaller than the sensitivity to variation in I_1. It appears that eliminating the terms containing I_2 from strain energy function improves the ability of the models to predict the behaviour of complex deformation states when limited test data is available. The Neo-Hookean form is first order reduced polynomial model [6].

Advantage: This model has best fitting among all the phenological model and presents most general mathematical formulation [10].

Limitation: this model has deficits when used outside the deformation range and also material parameters are difficult to determine [10].

3.5. Yeoh model

In 1993, Yeoh proposed a phenomenological model in the form of third-order polynomial based only on first invariant I_1. It can be used for the characterization of carbon-black filled

rubber and can capture upturn of stress-strain curve. It has good fit over a large strain range and can simulate various modes of deformation with limited data. This leads to reduced requirements for material testing. The Yeoh model is also called the reduced polynomial model and can be for compressible rubber.

Advantage: This model has showed a better fit to the experimental range of motion especially in non-linear region [8].

Limitation: It is necessary to use the superiorvalues of mechanical constants for a good experimental fit [8].

3.6. Ogden model

Proposed in 1972 by Ogden, this is also a phenomenological model and is based on principal stretches instead of invariants and proposed to derive W in terms of generalized strain. He expanded the strain energy through a series of real powers of (λi) i=1,3:This model proposed 6 parameters (N = 3) which leads to excellent agreement with simple tension, pure shear and equibiaxial tension data.

Advantage: This model is one of the most widely used for large strain problems (< 700%).

$$W = \sum_{n=1} N \frac{\mu n}{\alpha n} (\lambda^{\alpha n} 1 + \lambda^{\alpha n} 2 + \lambda^{\alpha n} 3 - 3)$$

The model is able to capture

rubber accurately for large ranges of deformation. Attention should be paid not to use this model with limited test data (e.g. just uniaxial tension). A good agreement has been observed between Ogden model and Treloar's experimental data for unfilled rubber for extensions up to 700%.

Also, it is highly usable for curve fitting typical S curve [7].

Limitation: The determination of material parameters leads to some difficulties in this model [7].

3.7. Arruda-Boyce model

Based on molecular chain network, it is also called Arruda-Boyce 8-chain model because it was developed based on representative volume (hexahedron) element where 8 chainsemanate from the centre to the corners of the volume. This is two parameters shear model based only on I_1 and works well with limited test data.

Advantage: It presents better agreement with experimental data for equi-biaxial extension. This model has strengths in modelling the hypereslastic material that is subjected to large stretches [9].

Limitation: In this model, the limiting network stretch must be greater than or equal to 1. Also, the incompressible parameter D1 cannot be zero [9].

3.8. The extended tube model

Kaliske and Heinrich introduced an inextensibility parameter δ and established a

new strain energy function in which the cross-link part is:

c upturn (stiffening) of stress-strain curve and

$$2 \quad 1-\delta^2(I_1-3) \qquad 1$$

Advantage: This model involves only four parameters and its derivation is physically motivated. Thus, the model matches the experimental data almost perfectly and it is valid for extrapolation [10].

Limitation: This model is very sensitive to the initial values of parameters used as the input

for fitting analysis. Therefore, in most cases only a good guess of parameters can guaranteea successful fitting result [10].

Validity and suitability of the hyper elastic models depend upon the application specifiersand the availability of experimental data [5]. Figure 1 provides a glimpse at comparison ofMooney-Rivlin, Arruda-Boyce and Odgen models with experimental data for a particular test. Based on such studies, suggestions are prepared for selecting hyper elastic model in Table 1

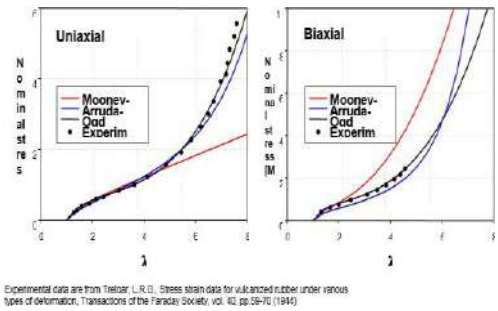

Figure 1 : Comparison of hyper elastic models

Table 1 : Applicability of hyper elastic models

Material Model	Applicable Strain Range
Neo-Hookean	<30%
Mooney Rivlin	30-200%
Polynomial	Function of order *N*; feasible to model up to 300%
Arruda Boyce	< 300%
Ogden	< 700%

4. CONCLUSION

It can be concluded that using a single Hyperelastic model is insufficient to predict the behaviour of these experiments in FEA simulations as each model has its on limitations. The preconditioning iteration, when applied to these simulations, shows very good agreement with the experiments, both qualitatively and quantitatively. The biaxiality test provides insight on which characterisation test is the most appropriate for curve fitting Hyperelastic models for a given analysis. Also, the level strain in the experimental data has to be estimated to select the appropriate ANSYS model and with the help of curve fitting it can be solved.

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Life Cycle Analysis In Construction Industry

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Abstract— Life Cycle evaluation (LCA) is a technique for assessing the capability environmental elements related to a product (or service) by means of compiling an inventory of relevant inputs and outputs, evaluating the potential environmental impacts. LCA is a systematic evaluation of the wishes and opportunities to lessen the environmental burdens related to power in Construction Industries. First, we used the Revit Architecture Software to create a model for our existing building. Then, this model was imported in an Energy Analysis Software called Design Builder which then was used to make certain necessary changes such as envelope properties, passive design change as per ICBC. Finally, by studying the changes LCA was achieved for the building. We hope that the research of this paper will add-on to the faster and better development of the LCA fields.

Keywords— Buildings, LCA, Energy, Life Cycle

I. INTRODUCTION

LCA has 3 additives, namely inventory analysis, impact analysis and development evaluation. stock evaluation is a technical, statistics extensive method of quantifying energy and raw cloth necessities, atmospheric emissions, waterborne emissions, solid wastes, and other releases for the whole lifestyles cycle of a product, bundle, method, material, or hobby. Qualitative aspects are high-quality captured in impact evaluation, even though it is able to be useful in the course of the stock to pick out those problems. inside the broadest experience, stock analysis starts with uncooked cloth extraction and continues via very last product intake and disposal.

The effect evaluation issue is a technical, quantitative, and qualitative process to represent and examine the results of the useful resource necessities and environmental loadings (atmospheric and waterborne emissions and stable wastes) recognized within the inventory level. This analysis addresses ecological and human fitness impacts ,useful resource depletion, and probable social implications inclusive of welfare. life cycle effect analysis does now not always try to quantify any precise actual influences related to a product or a process. instead, it seeks to establish a linkage among the product or method existence cycle and potential affects.

The improvement analysis component of LCA is a systematic evaluation of The improvement evaluation issue of LCA is a systematic evaluation of the needs and possibilities to reduce the environmental burdens associated with strength and uncooked material use, and waste emissions throughout the lifestyles cycle of a product, process or activity. This analysis may encompass quantitative and qualitative measures of improvements. It has no longer passed through a good deal research in comparison with the opposite two additives of LCA. The concept of LCA may be prolonged to incorporate the charges of the influences made through the environmental burdens. This extension opens new avenues for an inexperienced product development that is largely a price powerful one. The needs and opportunities to reduce the environmental burdens associated with energy and raw

II. PROBLEM STATEMENT

As we know that The Indian construction industry is the engine of the Indian economic system. The Indian production quarter is accountable for propelling the use of universal development as desirable infrastructure is the premise for all different tasks, and it enjoys prime attention from the government.

The Indian construction enterprise, in cost phrases, is expected to document a CAGR of 15.7% to attain $738.5 billion with the aid of 2022. It contributes a 55% proportion inside the metal industry, 15% in the paint industry, and 30% within the glass industry. By 2025, the construction business market in India is expected to emerge as the third-largest globally. Hence it is need of the hour to reduce the environmental impact of this sector at the same time. Which can only be faced with proper energy analysis and further its rectification.

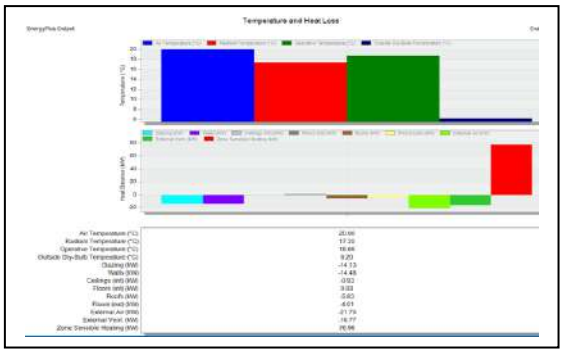
III. PROPOSED APPROACH

After the collecting the data from a hospital a base model was to be created in REVIT ARCHITECTURE as per the plan. Then it has to imported in DESIGN BUILDER. Then using software following tests were performed.

A. HEATING/COOLING TEST

The system through which we keep the temperature of a structure in check and do not allow to exceed its limits and these systems are efficient, environmental friendly, economical feasible and suitable for sustainable development. They promote use of renewable techniques and able to conserve significant amount of energy.

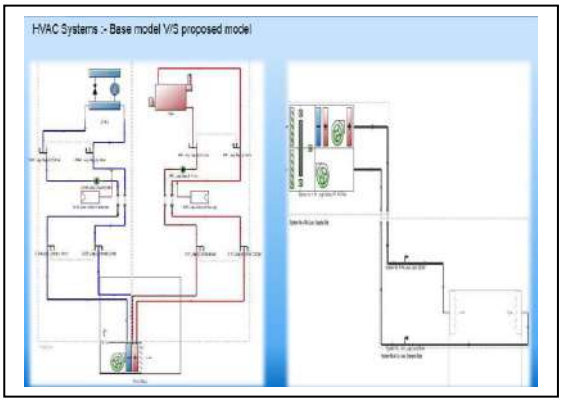
Fig 3.1 Heating Analysis of Base Model of Building



B. HVAC SYSTEM

HVAC stands for Heating, Ventilation, and Air Conditioning these systems are designed for moving air between indoor and outside areas, together with heating and cooling each residential and business buildings. they are the systems that preserve you warm and secure inside the wintry weather and feeling cool and fresh within the summer. They are also the systems that filter out and clean indoor air to hold you healthful and maintain humidity stages at most fulfilling consolation tiers.

Fig 3.2 HVAC system of Base Model of Building



C. ENERGY CONSUMPTION TEST

The energy consumed by infrastructure for providing different facilities. This standard provides the minimum requirements for energy-efficient design of most buildings, except low-rise residential buildings. It offers, in detail, the minimum energy-efficient requirements for design and construction of new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings, as well as criteria for determining compliance with these requirements.

Fig 3.3 Energy Analysis of Base Model of Building

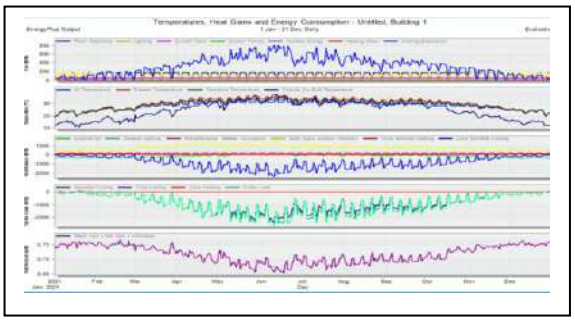
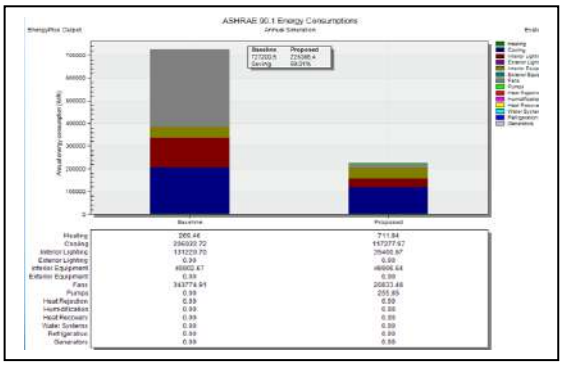


Fig 3.4 Energy Analysis of Base Model of Building



D. CARBON EMISSION TEST

Headings, or heads, are organizational devices that guide the reader through your paper. There are two types: component heads and text heads.

Fig 3.1 Carbon Analysis of Base Model of Building

Materials Embodied Carbon and Inventory	Area (m2)	Embodied Carbon (kgCO2)	Equivalent CO2 (kgCO2)
subtotal	17088.4	24119.2	24480.6
Constructions Embodied Carbon and Inventory	**Area (m2)**	**Embodied Carbon (kgCO2)**	**Equivalent CO2 (kgCO2)**
subtotal	6554.6	24119.24	24480.60
Glazing Embodied Carbon and Inventory	**Area (m2)**	**Embodied Carbon (kgCO2)**	**Equivalent CO2 (kgCO2)**
subtotal	598.5	7601.4	7601.4
Building Total	**7153.1**	**31720.6**	**32082.0**

IV. CONCLUSION

Reduction in energy consumption –We have reduced the energy consumption by 69% in Proposed model as compared to baseline model as we have seen in the energy consumption Comparison between base and proposed model. We have used solar panel and HVAC system . solar panel will generate electricity and saves a lot of energy. We have cover the rooftop with photovoltaic cell which has maximum potential to generate electricity up to 600kwh.

Reduction in carbon emission and environmental aspect:- By uses of sustainable energy we have reduced carbon emission. We have reduced material embodied carbon and inventory by 232316.5 kg CO2. The construction embodiment carbon and inventory by 232316.5 kg CO2 .The glazing embodied carbon by 3781.7 kg CO2. The inventory and building total by 236098.2 Kg CO2 in proposed building as compared to the baseline building.

Reduction in cost- The total construction cost of building is reduced by 452454.32 GBP(British pound sterling),Which is equivalent to 4.5 crore rupees. So by performing LCA we have achieved our objective that is Cost reduction, making the structure environmental friendly and making the structure sustainable eefficient design of most buildings, except low-rise residential buildings.

Thus we have achieved our objective of performing LCA in building using Appropriate software. We conclude that Life Cycle Analysis is undoubtedly the most robust way in this era to spot and minimize the environmental impact of any infrastructure.

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