Parametric Study of Simple and Improved Structure on Basis of Architectural Improvement Analysis Leading to Implementation of Green Building Technologies

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Abstract: **Looking at today's infrastructure on an overall basis it is very obvious that the higher the amount of comfort the infrastructure tend to provide to its users, higher is the cost. Materials, planning, designing, architecture & engineering all have grown to incur a very high cost when it comes to provide the best of designs in terms of looks, aesthetics and sustainability. But then if we persuade analytically upon the issues of costing at a higher rate in terms of infrastructure, by using resources that are available to us through nature coupled with providing designs in a way that both these things could be achieved in the most economical ways possible along with ensuring a well-built structure therefore, not compromising on quality at all. The paper hereby, deals with the aspects of the same thereby showing a detailed analysis using software and comparing normal vs improved designs on basis of light entrance, heat reduction, aerodynamics and dust reduction.**

Key words **– light entrance, heat reduction, aerodynamics, green building, air circulation**

I. INTRODUCTION TO THE PROPOSED STRUCTURE

It is quite visible from the above done survey that a little bit of greenery can make a huge lot of difference therefore the main aspect of the structure being proposed over here takes into consideration green building technologies into its construction as well as performance after proper construction is done. The proposed structure has a roof full of grass for efficient heat control apart from which the slab is built in a way that turbulence of wind could be reduced due to improper flow over the structure. Turbulence can cause to creation of spoiled atmosphere outside the house making it uncomfortable to take leisure sitting and resting on the terrace or somewhere outside but nearby the house. The house also can be having efficient water harvesting and efficient electricity usage control by implementing some of the very basic technologies into existence i.e. solar panels & rain water harvesting system. Therefore, summing up the whole thing proves to be a whole package completely satisfying all the basic green building criteria thereby proving to be worth implementing.

II. SURVEY OF EXISTING STRUCTURES IN THE WORLD

Sr. No.	Description	Photograph
1.	The world's first Green building, The towers of cedars, Switzerland	 

2.	Suzlon energy pune.	
3.	Biodiversity conservation plant Bangalore	
4.	Druk white lotus school, laddakh	
5.	Rajiv Gandhi international airport, Hyderabad	

III. AN OVERVIEW OF PROPOSED STRUCTURE

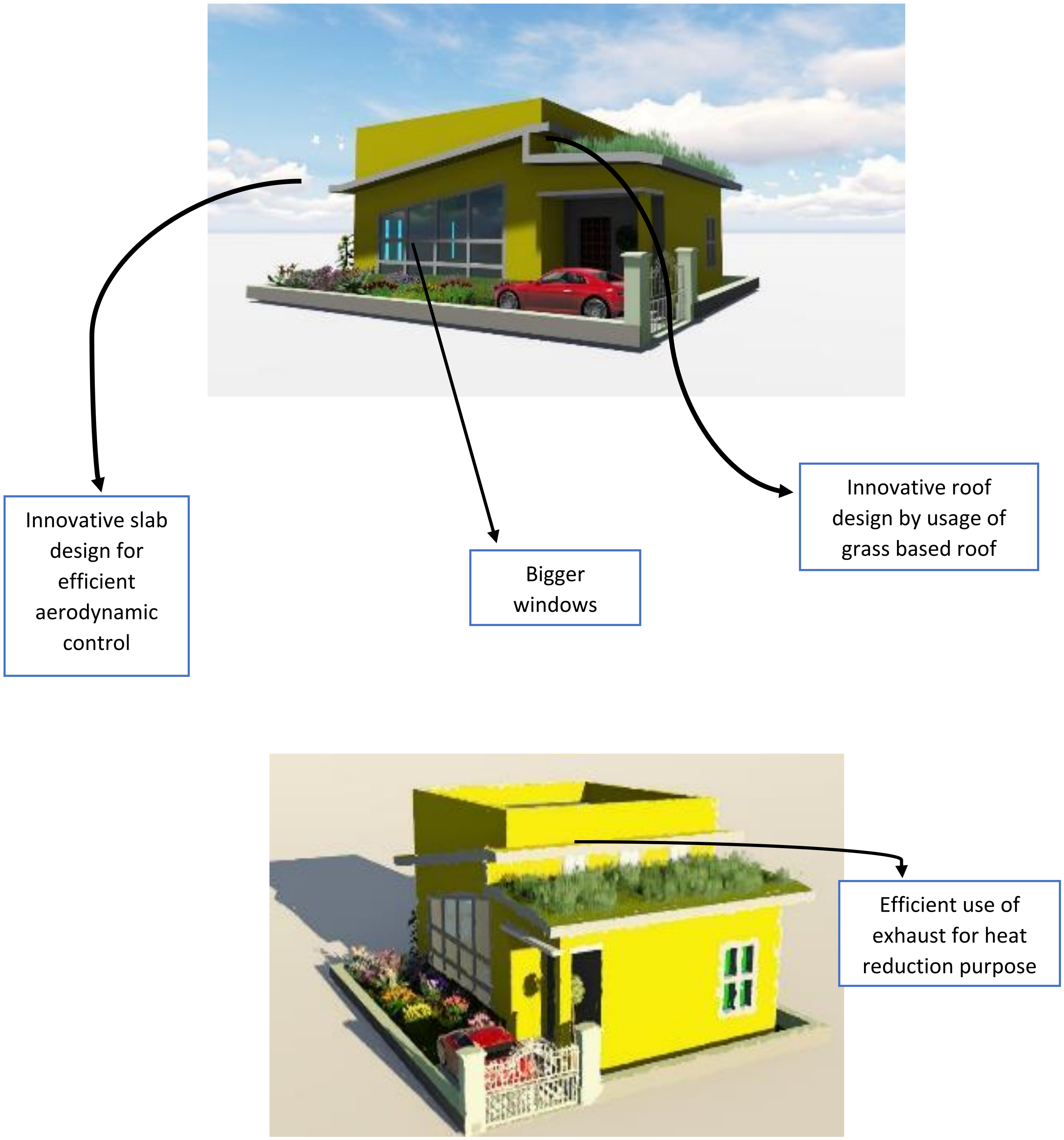


FIG 1: - Proposed structure perspective view

IV. ELEVATION PLANS FOR THE STRUCTURAL DESIGNS TO BE COMPARED AND STUDIED OVER HERE

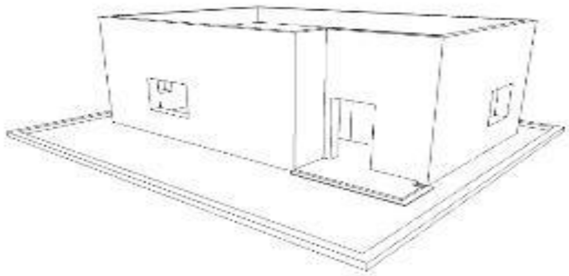


FIG 2: - Elevation view of normal structure

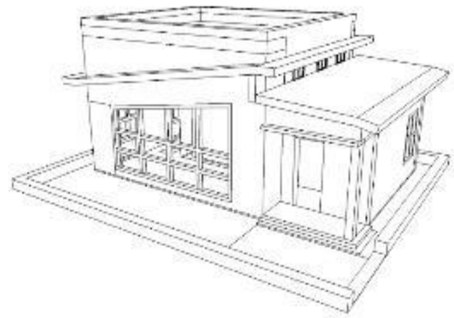


FIG 3: - Elevation view of improved structure

The above provided elevation view of both the structures will now be compared on basis of improvements in light entrance, heat reduction, dust settlement and aerodynamics.

4.1 Daylight entrance

The process of comparison here would be done by doing simulation analysis on to the plan view using certain daylight factor so as to see the overall intensity of the heat induced at different places when daylight enters through the window. The visibility of intensity would be in form of contours in the simulation

Smaller Windows

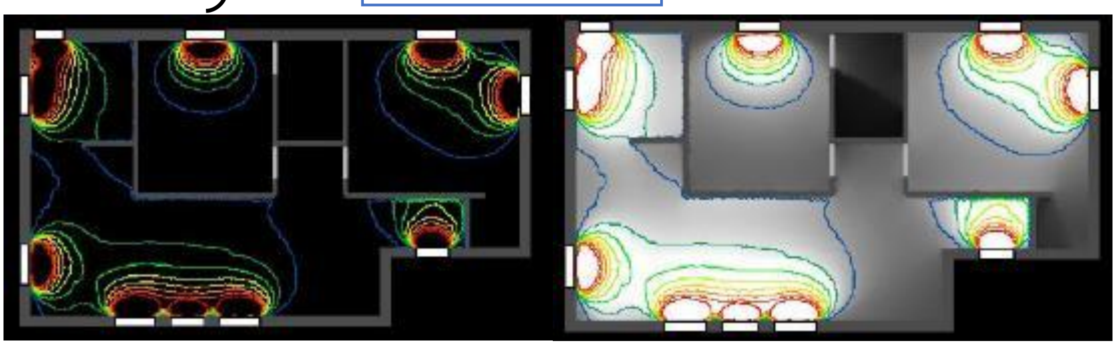


FIG 4: - Simulation of daylight for normal plan

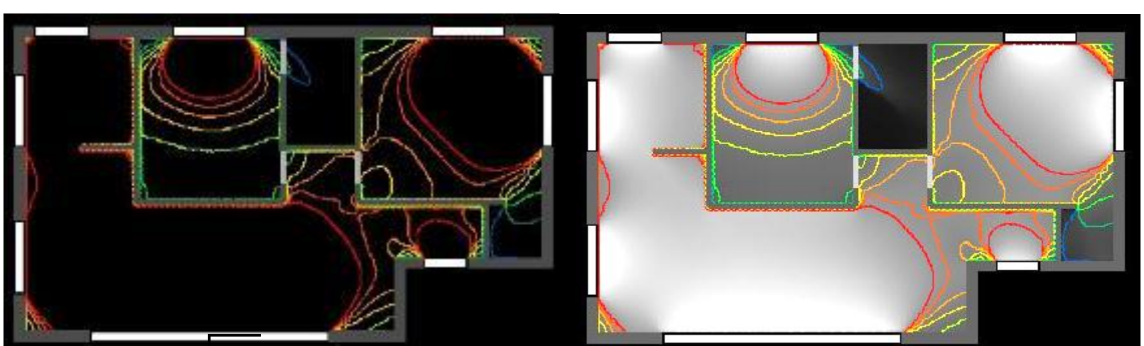


FIG 5: - Simulation of daylight for improved plan

Larger Windows

Daylight factor for different shades.

It could be observed very well over here that comparatively larger windows tend to entertain more daylight as compared to smaller windows. The major point of this analysis is that in walls a lot of place remains unutilized putting in small sized windows which could be easily used for providing windows of larger size therefore reducing electricity cost as daylight could be used at the most.

Red contours show up more heat intensity as it is simulated near the window the point where daylight starts entering the colors get into lighter shades in form of light red, yellow and green which happens due to reduction in heat intensity as and when the light starts spreading inside the house. The corresponding light intensities considered over here for analysis purposes are given in the below figure

An overall improvement of **22%** in terms of daylight entrance via efficient usage of bigger windows is estimated out of the analysis.

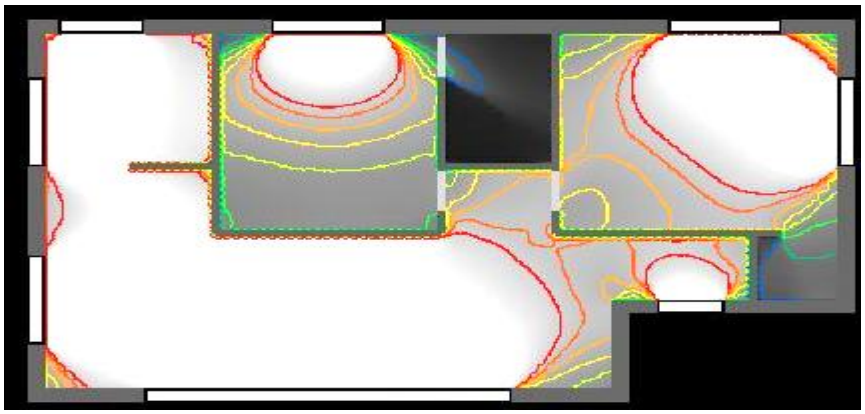


FIG 7: - Simulation of daylight by using light colored and glossy tiles

The overall daylight entrance and effects increases to a **42%** if glossy and light-colored tiles and materials are used as these materials tend to reflect light and not absorb them therefore increasing the intensity by continuously undergoing light reflection process.

4.2 Heat transfer simulation

On basis of the above analysis done upon daylight entrance if a heat transfer simulation is done it is estimated that heat signatures significantly increase over allowing more entrance of light as can be seen in the below simulations

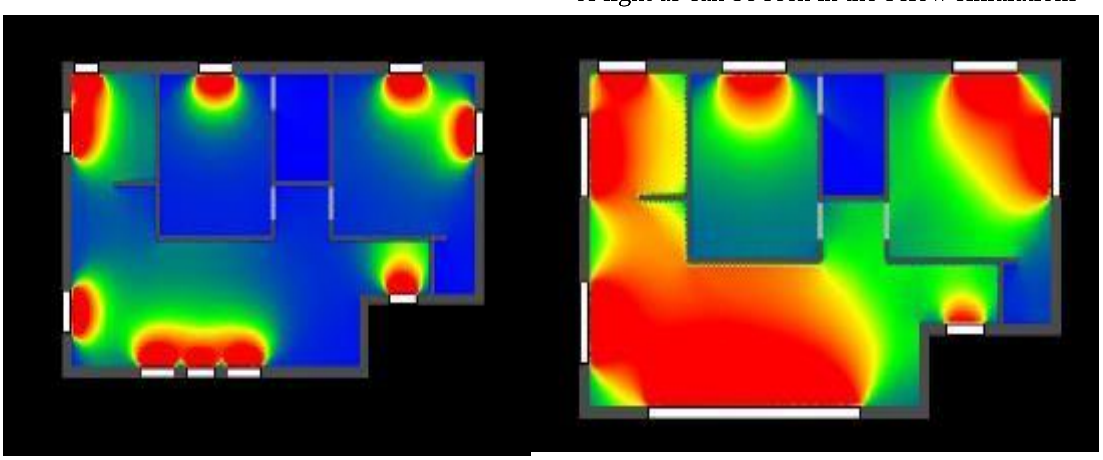
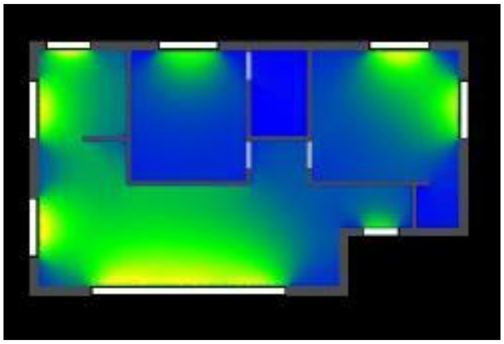


FIG 8: - Simulation of heat transfer for improved plan v/s normal plan

There is a reduction of about **20%** in terms of coolness when larger windows are provided in comparison to smaller windows.

After adding of ventilations near by the grass roof it can be seen that a way could be easily provided to take the heat out of the house and increase the coolness to **32%** which is visible from the below given simulation diagram.



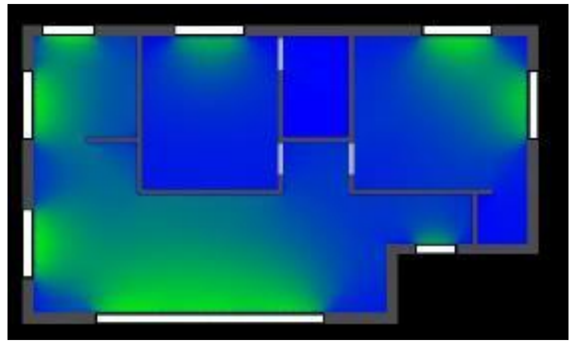


FIG 9: - Simulation after usage ventilation near the roof FIG 10: - Simulation after usage ventilation + grass roofing near the roof

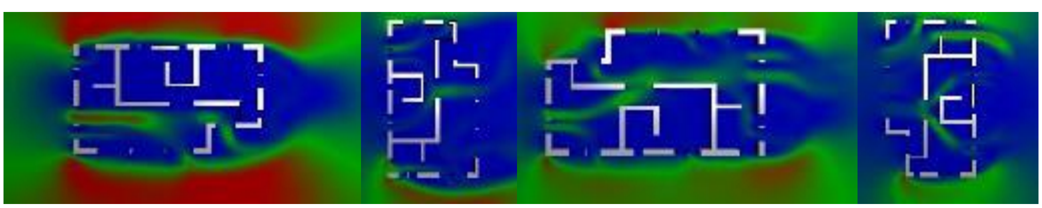
It could be observed here that green light is more in quantity in comparison to other shades as the shade describe good amount of coolness rate in reference to the daylight factors described above.

Apart from this as shown in the proposed structural elevation the roof is covered with grass which does decrease the temperature a lot when seen using simulations. Apart from adding aesthetics, it also helps in reducing the atmospheric heat which tend to enter inside the house, therefore helping to enter cooled down air. The coupling of grass and ventilation windows provide up to **85%** cooling without even reducing the intensity of daylight getting entered inside the house due to implementation of larger windows and at the same time providing a soothing effect to the people living inside.

It is visible that shades observed here in the simulation are much lighter which shows efficient heat balance on proper implementation of grass roofing plus ventilation windows.

4.3 Air circulation / ventilation comparison via simulation analysis

(a) (b) (c) (d)



(1) (2) (3) (4)

If we look at corresponding figures (a,b,c,d) above which is a CFD analysis performed upon a house of normal plan we can see that air is not flowing in a way where it could increase comfort at the same time decrease the usage of air conditioners and fans wherein if we compare. The same when seen looked after for figures (1,2,3,4) it could be seen that the results are totally opposite a numerical analysis done in the below given table proves the same.

Sr. No.	Natural Air direction	Normal Planning (Fresh air circulation in 1 Hour)	Improved Planning (Fresh air circulation in 1Hour)
1	X	26%	60%
2	Y	56%	160%
3	+X	18%	68%
4	+Y	62%	206%

TABLE 1: - Air circulation / ventilation numerical analysis

4.4 Pressure and aerodynamics

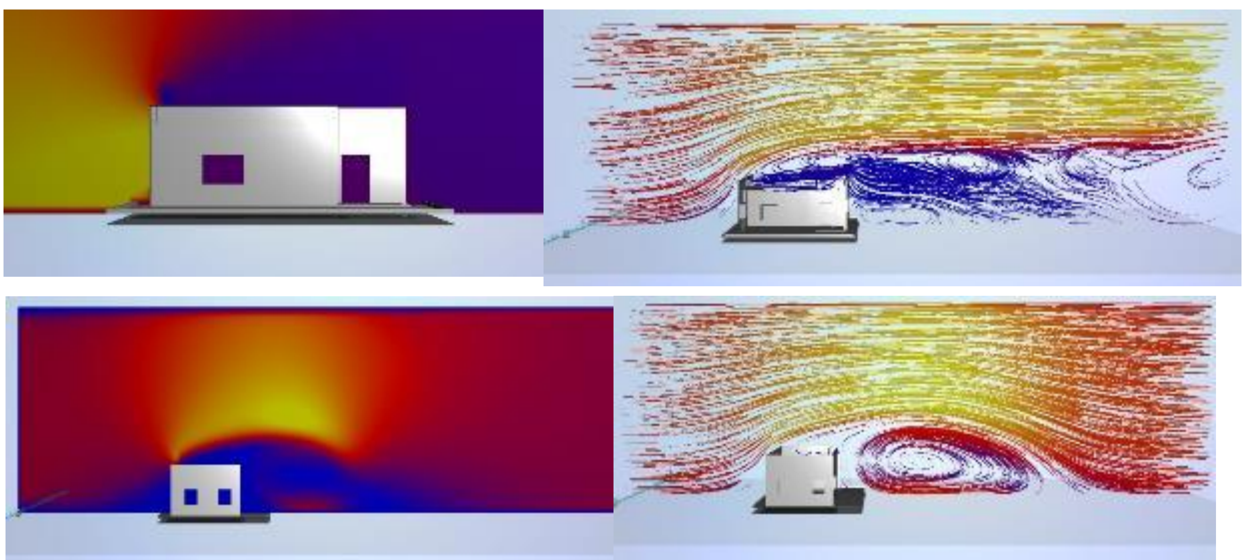
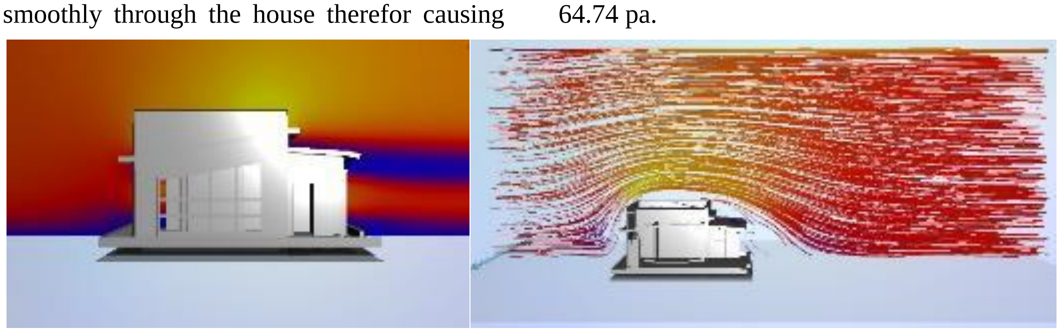


FIG 10: - Simulation for pressure and aerodynamics on a normal structure

Due to inefficient and simpler design of the structure it can be very well seen that turbulence is getting created at different points. This because the air coming from left to right (assumed direction for CFD analysis) is not getting a part to actually move smoothly through the house therefor causing vortexes out of the air which is stable around the house. These processes the dust towards the house also it pushes the hot air towards the house causing inconvenienceto the residents the maximum air pressure in front and side view is observed to be 64.74 pa.



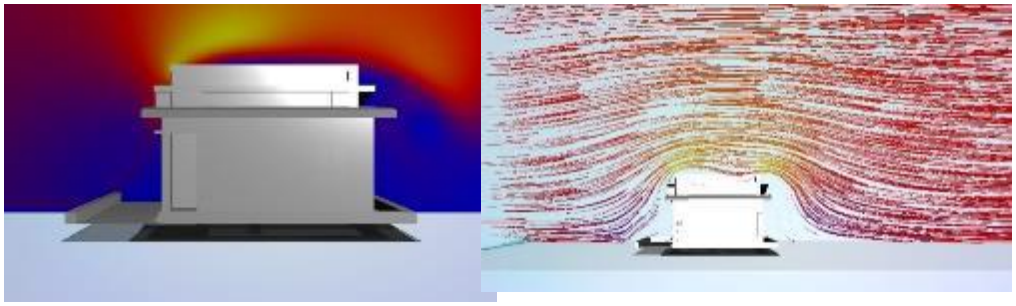


FIG 11: - Simulation for pressure and aerodynamics on improved structure

The above figures show how an improved design can entertain a very smother movement of air without causing any sort of turbulence therefore getting rid of all the ill effects caused due to turbulence i.e. inefficient design of structure

The analysis done above also help us understand the behavior of dust settlement on the structure where for improved design due to efficient air movement the settlement is considerably less in comparison to inefficient design

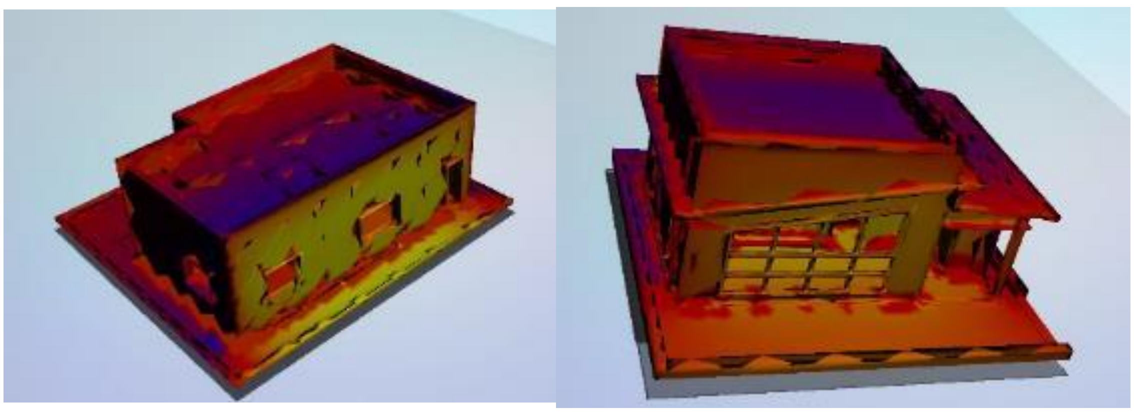


FIG 12: - Simulation for pressure and aerodynamics on improved structure

The dust settlement for the normal design is 2.2 mm / month in comparison to 1.6mm / month in improved design.

V. CONCLUSION

From the above studies it could be concluded that just utilizing the given resources in the structure effectively by the means of proper deigning and architecture a lot could be achieved and that too in a much feasible form. Simple design inputs tend to improve the structure's aesthetics along with ensuring full proof performance in terms of comfort and sustainability.

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