

Lighting and Ventilation Issues in SRA Buildings

Ar. Ankur Kulkarni, Ar. Niranjhan Dhakshanamoorthy

Mumbai is one of the biggest metropolitan cities and capital of Maharashtra state with many slums varying in sizes. Every year millions of rupees are spent on resettling and rehabilitating slums to make Mumbai a sustainable living place, even for the marginal and below poverty line population. As per the official survey conducted by Mumbai in 1956, 8 percent of the total population was living in slums. According to the Census 2011, the Population was 1.24 crore. Out of this, 41.85% population is living in slums and the numbers are increasing day by day. It's been reported that around 6 percent of the total land holds nearly 60% of the total Mumbai population. Due to economic conditions, the slum-dwellers have to live under unhealthy and unsustainable conditions.



layout characteristics. This study asserts the fact that efficient daylighting and ventilation strategies are an important factor affecting human health conditions within a particular space.

FEW FACTORS AFFECTING THE LIVING CONDITIONS

Density - The Gross Density for residents is nowhere higher than 1,700 persons/hectare in Mumbai. This is despite not having enough land set aside for amenities and open spaces. This high demand created the need for the high-rise SRA Buildings. According to Doctor for You Association survey, The SRA buildings tend to lack in performance to meet the quality standard for living in terms of lighting and ventilation when packed close to each other. The major reason that contributed to this was the highly dense and compact buildings.

To overcome this crisis, SRA Schemes were launched by the Government of Maharashtra to facilitate Slum Rehabilitation Tenements, which was provided to the slum-dwellers for free. The objective of the government was achieved through these schemes successfully. Hence, the SRA formulated and implemented more of such schemes. Though the schemes achieve the objective of providing basic housing facilities

to the poor, the settlements developed for such schemes fail to improve the quality of life in such shelters. The majority of the SRA buildings have inadequate daylighting and natural ventilation. A survey conducted by MMRDA with Doctors for You Association stated that the occurrence of TB is strongly associated with the built environment of the houses and the layout of the buildings. The occurrence of TB was found to be least in colonies with a better built environment and

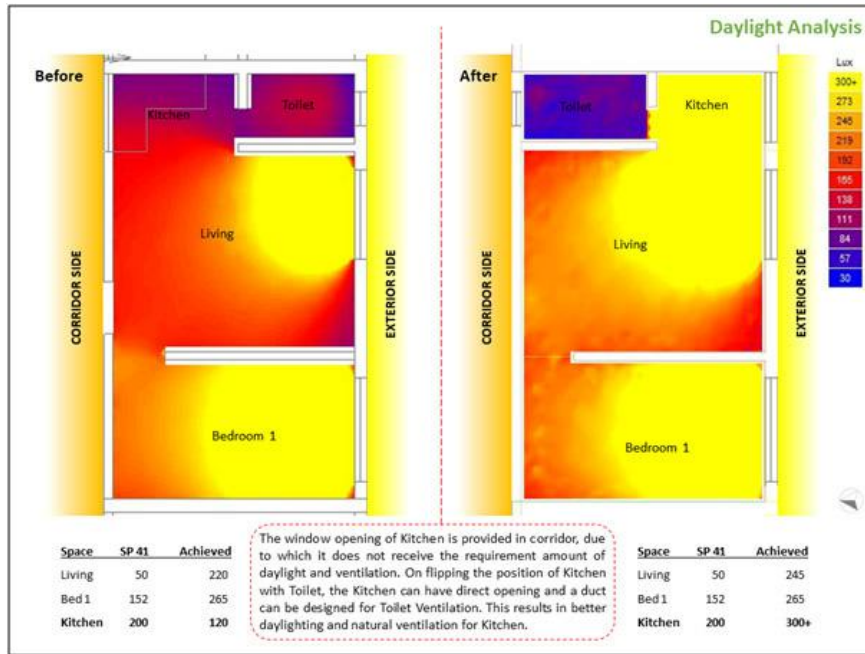


Figure 1. Daylight simulation for proper planning of Inner spaces.

Improper Planning – As such second to none, Improper Planning had been affecting the quality of the indoors. Negligence in spatial planning has affected the performance of the SRA Buildings. The compact arrangement of buildings in case of group developments has led to the shortcomings of natural light and ventilation. The distance between two buildings should be sufficient enough to allow light to penetrate deep to the ground floor and should also improve good air movement in and around the building. The spatial arrangement of the indoor spaces with inadequate fenestrations and openings for the rooms further aggravates the problem.

Lack of Openings towards the exterior open spaces results in cutting down the ventilation rate and lighting levels of the indoor spaces. Continuous ventilation in the kitchen area is a basic requirement of efficient designing. When there is inadequate or no fenestration provided, the air changes will not occur properly and the smoke from the kitchen will remain stagnant for a longer time. Providing openings for the kitchen towards the corridor was observed in many SRA projects as in figure 1. This led to the accumulation of bad odours in corridors, which has resulted in the standard myth that SRA Buildings are badly maintained and have foul-smelling corridors.

Interchanging the position of the Kitchen and Toilet will help to increase the lighting levels in the Kitchen. The ventilation rate inside the space also will be increased. The corridors in SRA building with flats covering on either side does not receive enough sunlight inside the space. In certain cases,

the corridor does not have an external wall or opening towards the open space.

WAYS TO MITIGATE

Coherence to norms - According to Doctor for You Association survey, there is a huge disparity between the housing provided by the Government and those built by the private firms. SRA and PAP project developers should follow NBC norms for the rehab buildings without any discrepancies.

The building designs should be tested against the standards of NBC. According to

NBC 2016, The recommended design sky illuminance values are 9000 lux for warm humid climate. For integration with the artificial lighting during daytime working hours, an increase of 500 lux in the recommended sky design illuminance for daylighting is suggested. This shows that outside the building there should be a minimum of 9000 lux should be achieved at the lower floor in the design to meet the sufficient lighting inside. Based on this, the gaps between the buildings should be simulated to check the minimum clear distance required to achieve the design sky illuminance values as in figure 2. According to SP 41, The daylighting levels inside the space should be met. The minimum daylighting levels required inside living, bedroom and kitchen are 50 lux, 152 lux and 200 lux respectively. According to NBC, the design should be checked for the minimum ACH achieved. This will ensure the minimum required standards for the dwellings are achieved. The minimum ACH required for bedroom is 2 – 4 ACH and for living is 3 – 6 ACH.

Design – Orientation of the building's longer façade along the North-South direction will reduce the heat gain inside the buildings (Figure 3). The total radiation received by the building mass will be reduced. The wind flow will be in near-parallel range with the building's longer axis and will increase the ventilation rate inside the building volume.

The spatial design should be efficiently planned by the architects and should meet the standards. Avoiding rooms and spaces without openings for daylight and ventilation is the best strategy. Maximizing the window

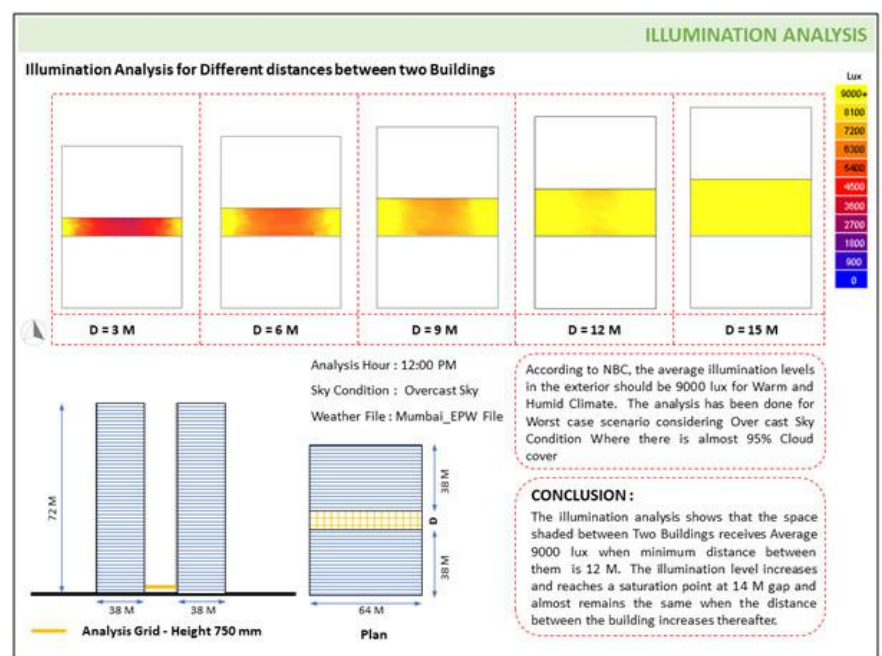


Figure 2. Illumination Analysis for Clear distance between two buildings.

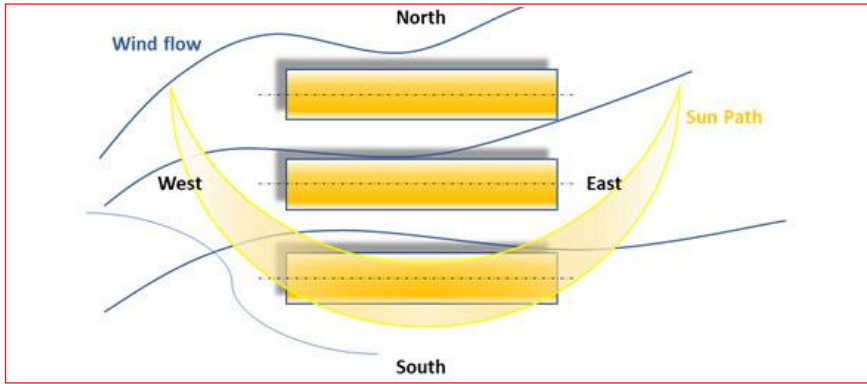


Fig 3. Building Orientation

the funnel effect. The addition of Internal Chowk inside the building volume increases the cross-ventilation rate of the building. The chowk induces the stack effect inside the building volume and draws air from the corridors and rooms. This will increase the fresh air rate inside the rooms.

Wing Walls – Wing walls are projections on the exterior to effectively enhance the natural ventilation inside the building space. This works based on the wind Recirculation regions characterized by low velocities. wind wall can be applied on the walls with two openings facing the exterior. When properly



openings for better intake of sunlight and better openable areas will ensure proper ventilation inside the space. Taking consideration of the surface reflectance of the interior surfaces and the Visual Light Transmittance (VLT) of the Window’s glazing will ensure the deep penetration of the light into the inner spaces. According to the norms, maintaining a proper clear distance between two buildings will ensure daylight availability at the lower floors and Better air movement.

Cross ventilation – Cross ventilation should be taken care of by providing windows on either side of the rooms which is seen to

be lacking in SRA Schemes. SRA buildings are mostly designed with one-sided ventilation. This affects the ventilation rate of the building space and circulates the air inside the space. Cross ventilation ensures that the building is naturally ventilated and improves the ACH. At least, Ventilator provision has to be given to improve the movement of air within the space as in figure 4.

Providing suitable opening sizes for windows should be taken care of by the architects. The introduction of Jaali instead of windows can act as an efficient feature to reduce the incoming air temperature due to

positioned, Wing walls produce high pressure and low-pressure regions on the inlet and outlet windows respectively. Hence, it draws in more wind even during low external wind velocity conditions.

Light Wells – Light well is an external space provided within the volume of a building to allow light and air to reach the dark or unventilated areas. Light wells are commonly characterized by the highly reflective surfaces. This can be achieved by applying a high reflective white paint coating in the inner wall surfaces. The VLT of the windows facing the light wells should be properly determined based on the light availability through the well. The provision of light wells will significantly improve the quality of the lighting and the rate of ventilation inside the building space. Thus, eliminating the dark and ventilated areas inside the building.

Solar Reflectors – Solar reflectors can be used to dramatically increase the lighting by penetrating it to deep down spaces which are shaded due to external factors. In the gaps between two SRA buildings which are closely packed, these reflectors can be used

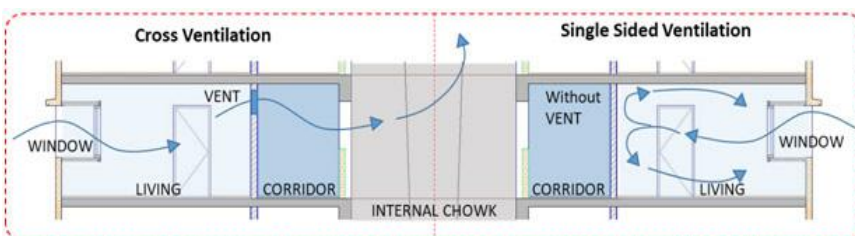


Figure 4. Cross ventilation and Single sided ventilation

BIBLIOGRAPHY

- [1] National Building Code, 2016.
- [2] T. V. K. S. Kumar, J. Chandrasekhar, S. K. Vasudevan and A. Balachandran, "An Analysis of Effect of Wing Walls on Natural Ventilation," Indian Journal of Science and Technology, 2015.
- [3] HOUSING, FSI, CROWDING AND DENSITIES Handbook.
- [4] SP 41: Handbook on Functional Requirements of Buildings, 1987.
- [5] D. F. You, "Studying the association between structural factors and tuberculosis in the resettlement colonies in M-East ward, Mumbai," 2018.
- [6] SHETH, A.Z., VELAGA, N.R. and PRICE, A.D.F., 2009. Slum rehabilitation in the context of urban sustainability: a case study of Mumbai, India. IN: Proceedings of SUE-MoT: 2nd International Conference on Whole Life Urban Sustainability and its Assessment, 22-24th April, Loughborough, UK.

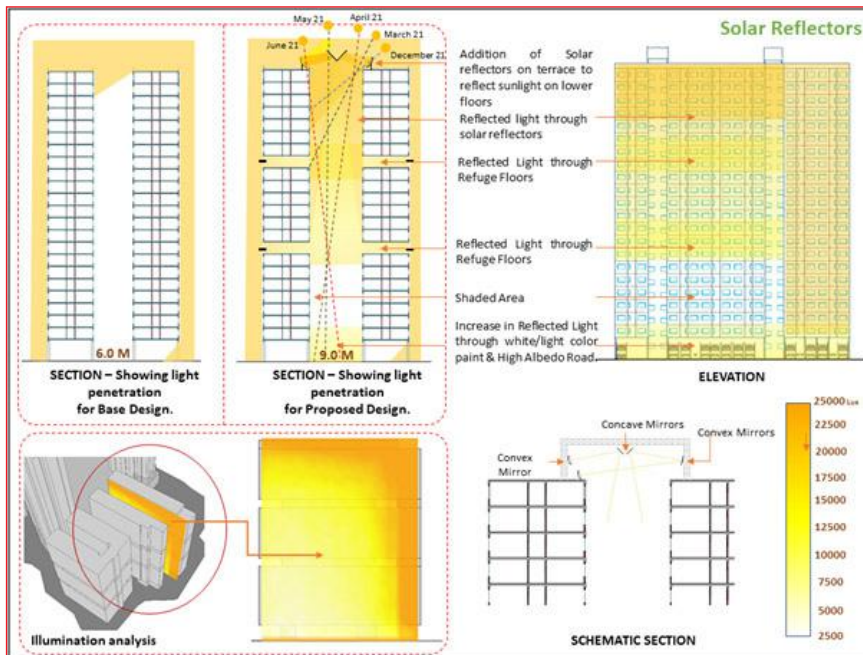


Figure 5. Solar reflectors between two closely packed Towers.

to light up the existing SRA buildings (as in figure 5) if they do not meet the sufficient amount of daylighting levels. With these reflectors installed on top of it, the ventilation shafts can also be lit to ensure a sufficient amount of lighting inside the corridors and spaces deep down the shafts.

Grills for Parapet – Provision of Grills or Punctured Designs in place of Solid handrails was found to be a better alternative. The area of openings on the exterior surface or surface facing internal chowk increases due to the provision of grills. This allows even better light to enter the building inner volume. While using light wells or Solar reflectors, the solid corridor railings can be replaced with punctured designs or Grills which allows light to pass through. This increases the efficiency of light wells and solar reflectors.

Through and Through Refuge – The refuge floor is used for the evacuation of the residents during the emergency scenarios. The refuge floor was mostly found to be open on one side only. By making the refuge floor through and through, the rate of wind flow can be improved. The wind flow was found to be even more streamlined and has improved as in figure 6. The refuge floors will act as buffer zones to break the low-pressure zones which are created at the leeward side of the building.

Large Openings – Continuously packed buildings tend to obstruct the movement of the wind. There should large openings in the building's volume to ensure wind flow in and around the buildings. Providing large openings/cut outs in the building will

streamline the flow of the wind (Figure 6). This will create an opening for the air to flow inside the building volume. This will improve the rate of ventilation inside the building spaces.

CONCLUSION

SRA buildings intend to serve the purpose of providing slum dwellers with housing and better living conditions. But in the current

scenario, the quality of the SRA settlements needs reconsideration. The existing buildings, which are not able to meet the quality standards, should be revived with mitigation measures. This can be prevented only by the conscious and judicious design of such dwellings. More emphasis has to be given to the lighting and ventilation by the architects to provide SRA dwellings with better living conditions in the future. **CIA**

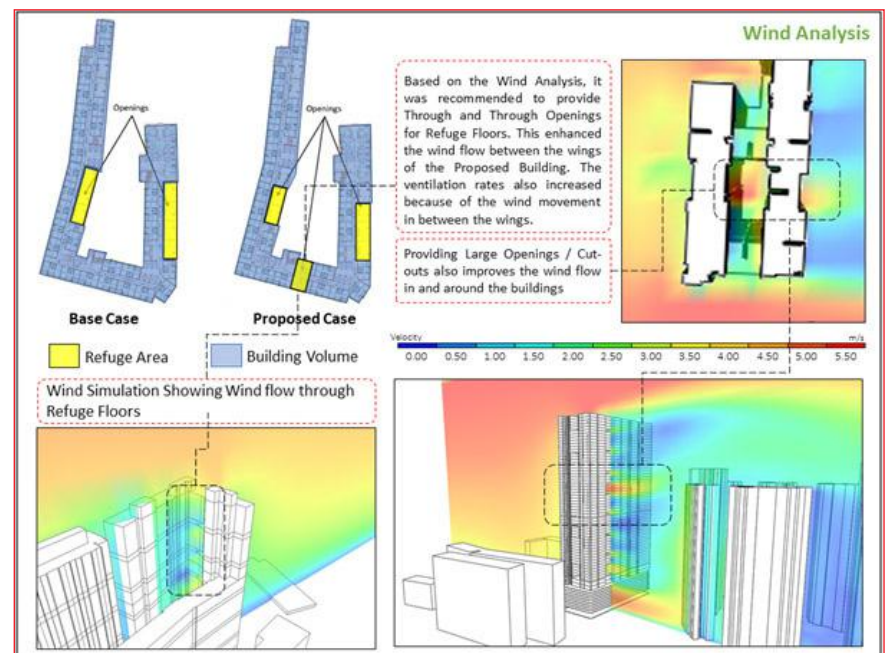


Figure 6. Addition of Through and Through Refuge Floors and Large openings in Building Volume.