Slum Rehabilitation: Putting the 'Home' into 'Homeostasis'

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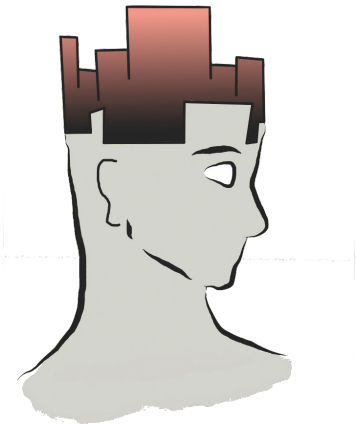

Ramit Debnath disucsses his research on the shortcomings of slum rehabilitation projects in Mumbai

Have you ever wondered how it feels to live in a 15 square meter room with six other family members, in dilapidated conditions, potentially for the rest of your life? This is the everyday reality for over half of the 19 million residents of Mumbai, India, who live in slums and government-assigned 'slum rehabilitation housing'. Such housing offers at most a single room - which functions as the kitchen, bedroom, living room and the playroom - with an attached bathroom.

The government employs these rehabilitation housing schemes to eradicate slums in rapidly urbanising cities like Mumbai. However, the schemes cause as many problems as they purport to solve.

Without proper ventilation and access to daylight, the 'shoe-box' housing design leads to chronic illness and affects general well-being of the occupants. A 2018 investigation by the Indian Institute of Technology, Bombay showed that people living in the lower floors of low-income tenement houses in Mumbai have higher healthcare-seeking activity due to lack of fresh air. A lack of governmental guidelines permits faulty urban design, such as narrow gaps between buildings that restrict active air exchanges, leading to increased indoor air pollution. The phenomenon of poor design harming public health is common in the developing world, especially in areas where a significant portion of the population depends heavily on government welfare schemes.

However, the poor urban design of the housing is not the only issue: the schemes are planned without regard for the socio-economic and cultural contexts of the people living in the slums. Rehabilitated occupants often choose to move back to their original slums, making the entire slum rehabilitation process highly inefficient. Why? So far, my research team and I at the Centre for Sustainable Development - part of the University of Cambridge's Department of Engineering - have found multiple reasons to explain why people return to the slums. For example, high upfront costs of household appliances cause economic distress. Moving to government-sponsored housing is a climb up the social ladder, and occupants buy expensive appliances like television sets, laptop computers, refrigerators and washing machines, to meet social expectations. Additionally, the poor quality of houses themselves causes distress. Poor design contributes to uncomfortable temperatures and social isolation in addition to poor indoor air quality. A lack of communal spaces causes occupants to feel lonelier and more anxious and drives them to find community back in their original slums.

An image captured through our infrared temperature sensors is shown below indicating the indoor temperature in the kitchen in one of Rabit's surveyed houses

The problems of rehabilitation housing need solutions that meet the socio-cultural and architectural needs of the occupants. The Global Energy Nexus for Urban Settlements (GENUS), for example, adopts an interdisciplinary approach - mixing engineering principles with social sciences and urban planning. Researchers across four primary departments - geography, engineering, architecture and business studies - bring ideas and methods from their different disciplines to investigate household energy usage across different social classes and its impact on shaping the process of urbanisation and the well-being of citizens in developing countries. The team of researchers include prominent figures from the Indian Institute of Technology Bombay in Mumbai, the Indian Institute for Human Settlement in Bangalore, and the University of Cape Town, South Africa. GENUS provides an active collaborative environment to exchange expertise and derive innovative solutions to real-life problems including slum rehabilitation and even poverty eradication in developing countries.

In collaboration with the Indian Institute of Technology, Bombay, and with the scholarship from the Gates-Cambridge Trust, I am investigating why slum rehabilitation projects in Mumbai are ineffective, focusing on factors that cause discomfort or distress. This discomfort and distress, which include the examples of financial strain, poor health, and social isolation, need to be understood through an interdisciplinary approach of architecture, urban planning, economics, psychology and engineering. The concept of 'homeostasis' from biological sciences helps to identify causes of discomfort

or distress. In the context of housing, homeostasis refers to the neutral state of occupant's comfort in their environment. My team and I hypothesised that achieving homeostasis will improve quality of life and foster sustainable development for the occupants living in slum rehabilitation housing. However, the factors that contribute to this state of comfort in real-life situations for slum housing are still unknown.

We have the slum rehabilitation housing complexes in Mumbai as our living laboratory. We started carrying out surveys and talking to the local people of the slum rehabilitation housing in Mumbai. We asked them why they feel discomfort or distress in their current living arrangements and if they think that is a cause for the ineffectiveness of the slum rehabilitation process. We are also installing environmental sensors in those households in order to understand the status of indoor air quality, temperature and humidity levels. It is important to measure these parameters to understand the root-cause of the conditions inside the slum rehabilitation housing. Data from these sensors has helped us in deriving accurate computer models of the conditions inside the slum rehabilitation houses, which has given us the flexibility to simulate an entire neighbourhood of these areas. Such modelling requires significant interdisciplinary knowledge of urban design, scientific computing, engineering and human comfort, and we are collaborating through interdisciplinary groups like GENUS to progress in our research.

I feel that talking to local people and understanding their attitude and emotions associated with their built environment in the slums is the most exciting part of the research. We adopted a working-backward methodology called 'backcasting' for conducting our surveys. Such backcasting methodology is widely used in energy and water policy research to derive countermeasures of possible undesirable events of future. It aids in improving the resilience of a system.

In our research, we work backwards through interviews and informal discussions on deriving solutions for a better quality of life in the slum rehabilitation housing. For example, we asked the occupants regarding their preferred solutions for improving the indoor air quality in their houses. Most of them responded that installing an exhaust fan would improve quality, however, they were more concerned about the associated rise in their monthly electricity bills and the maintenance of the fan. Therefore, working with the local people showed that a simple solution, such as an exhaust fan, could solve one of their problems, but it would add to their economic distress via higher electricity bills. Such findings defined the next steps of our research to investigate the cause of economic distress through the lens of people and their practices in their households.

Until now, researchers have studied discomfort or distress in occupants' surroundings based on the fundamental theories of human thermal comfort. Our interdisciplinary approach expands on this theory by integrating principles from urban design, social practise theory, and public health. I hope that our efforts will redefine sustainable urban planning for low-income settlements - and, ultimately, provide better homes for people who have been subjected to poorly-designed housing. Solutions to such real-life problems cannot be simulated in the lab - rather, solutions will come from fieldwork and collaboration. This is the real power of such an interdisciplinary approach β

Ramit Debnath is an MPhil in Engineering for Sustainable Development and is currently working on his PhD as a Gates Scholar @RamitDebnath. Artwork by Joseph Jones, photographs courtesy of Ramit Debnath

Narrow gaps between the buildings restrict active air exchanges, leading to increased indoor air pollution

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