

SCIENCE

The problem in crowded cities

A noted town planning expert says densely packed apartments need to spread out. s ananthanarayanan reports

LAST Friday, architect and town planner Shrish Patil spoke on "Life between Buildings — the use and abuse of FSI" at the Observer Research Foundation in Mumbai. This foundation is a think tank that arranges talks by persons with insight and experience in matters of interest. Narayana Murthy, who spoke on "Skilling India's young workforce", Deepak Gadhiya, engineer and entrepreneur, who discussed "Solar Enterprise through Solar Energy", and Sreerup Raychaudhuri, professor at the Tata Institute of Fundamental Research, who spoke on the significance of detecting the Higgs Boson, were among many other presenters.

Shrish Patil is a civil engineer who was with the Mumbai Metropolitan Regional Development Authority and the Mumbai Heritage Conservation Committee and was among those who first imagined and later implemented the New Bombay project. He is also on the board of the Indian Institute for Human Settlements in Kengeri, Bengaluru. Erudite and soft-spoken, Patil led the audience through a primer on the issues that arise when dwelling spaces are created — particularly the need to support residents when they step out of the dwelling. The talk was largely about Mumbai but the principles are the same for any Indian city.

Floor Space Index or Floor Area Ratio, as it is known the world over, is the ratio of the built-up area in a plot of land to the area of the plot. Local administrations, considering the need to provide water, electricity and sewage services, put a limit (or ceiling may be more appropriate) on how much dwelling area a builder can construct on a given plot. An increase of the FSI is welcomed by builders as they can sell more flats, and is equally welcomed by flat buyers as it would increase availability in the best areas and, hopefully, bring down prices. The ratio is between 1.3 and 3.8 in Indian metros. This compares with the Far in many cities around the world but is far lower than the figure in New York or Singapore — CBD. Patil started with the context of Far as

City	FAR
Sao Paulo	1
Mumbai	1.33
Chennai	1.5
Delhi	1.2 to 3.8
Amsterdam	1.9
Venice	2.4
Paris	3
New York	15
Singapore — CBD	12 to 25



A Mumbai street scene.



A Manhattan street scene.



Shrish Patil.

In the context of a Far of 15 in Manhattan and 1.3 in Mumbai, Patil displayed pictures of street scenes in Manhattan and Mumbai. It was a Mumbai that Mumbai, with the lower Far, seemed to have more crowded streets? He noted that cities and even different parts of cities differed dramatically in layout and the use of space. To understand how a city should be developed, planners and residents needed to consider traditional space use, the number of floors in dwellings and the number of people who used these spaces.

Thinking in terms of Far puts the emphasis on the available dwelling area and, hence, the area available for each resident. A more communicative measure, Patil said, was to consider not the area available but the level of crowding, particularly out there in the street. The difference between Manhattan and Mumbai, which affected street crowding, lay in the number of people using the dwelling space that the Far allowed. In Manhattan, a typical flat of 100 square metres was occupied by, say, two persons. But in Mumbai, a 25 square-metre flat was home to five persons. Over a hectare, this translates to 200 persons in Manhattan and 2,000 in Mumbai. During the day, a large part of these people were out on the street, shopping for essentials, for leisure, travelling to or from work, or at work. And Manhattan, with its lower crowding, except in the busiest portion, had the use of an

underground Metro network! Patil explained that there were three factors that contributed to crowding in the streets. While the number of persons in a unit street area amounted to **Street Crowding**, the factors responsible were: **Internal Crowding** or the number of persons in a unit built-up area, the **Plot Factor**, or the area for building per unit street area and the **FSI**, which was the built-up area per unit plot area meant for building. And the relationship was: $SC = ICF \times PF \times FSI$. This translates into: We can see that built-up area and plot area cancel

$$\frac{\text{Persons}}{\text{Street area}} = \frac{\text{Persons}}{\text{Built-up area}} \times \frac{\text{Plot area}}{\text{Street area}} \times \frac{\text{Built-up area}}{\text{Plot area}}$$

out on the right hand side to give us the left hand side. We are now dealing with the three factors that determine crowding. The first is the number of people that live in a flat of a given area. We have seen that there are 10 times more in Mumbai than in Manhattan. The second is how land is allocated for residential buildings, compared to the street area. The ratio is worse than Manhattan in most of Mumbai. As for the third factor, which is FSI, one could say the increase of FSI would lead to a lowering of internal crowding. But in reality, it would lead to an inflow of population, leaving IC unchanged. The figures, in fact, compare like this.

Region	Internal crowding	FSI	Plot factor	Street crowding
Midtown Manhattan	296	16.4	1.26	5,986
Manhattan East side	180	7.29	1.67	2,190
Mumbai	638 to 3,116	1.12 to 0.73 to 2.84 (not mentioning Malabar Hill, where it is 4.71 because of Raj Bhavan)	1.086 to 5,182 (most areas being towards the higher number)	

Well, street crowding in the worst area in Mumbai compares with midtown Manhattan, where they have an FSI as high as 16.4 and also the relief of high-speed underground Metro railway. But the bulk of Mumbai, with an FSI just 1.12 to 3.66, is still as bad as the second busiest part of Manhattan. It is clear that there are too many people in Mumbai for the available residence, street, market, office or park area. (The IC and SC figures for Singapore are not available.) With the number of residents, which is the population, not under the control of the town planner, Patil saw a review of the rent control laws which, at present, discourage investment in housing for tenancy, as one way to go. He is skeptical about public housing or free housing and believes in legislation for **inclusive housing**, or the obligation of all new construction to set aside floor space for low cost housing. For this, as well as for investment in housing, there is the need to allocate more land for the purpose. This would amount to providing access to open

spaces in the vicinity of cities. But Patil saw the hand of builders' lobbies in diverting state funding to the kind of infrastructure that did not address this need and, instead, sustained the shortage of housing, and hence high prices. "And," he quipped to conclude his talk, the World Bank would like us to increase the FSI in Mumbai!"



A Singapore street scene.

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Emerging clues

tapan kumar maitra explains the occurrence of diseases that result from defects in the protein-folding process

BEFORE they can perform their normal functions, polypeptide chains must be properly folded. More than a dozen human diseases have been traced to defects in this folding process. Among the best known is Alzheimer's disease, the memory disorder that affects one in 10 Americans over 65 years old. The symptoms of Alzheimer's arise from the degeneration of brain cells associated with at least two abnormalities — intracellular tangles of a polymerised form of a microtubule accessory protein called tau and extracellular amyloid plaques containing fibrils built from a small protein called amyloid-β (Aβ). Evidence that Aβ might be the primary cause of Alzheimer's emerged in the early 1990s when it was discovered that some hereditary forms of the disease are triggered by mutations in a plasma membrane precursor protein called APP, whose cleavage gives rise to Aβ. The mutant APP gives rise to a misfolded form of Aβ that aggregates into long fibrils, creating the amyloid plaques that accumulate in the brain and cause loss of mental function by killing surrounding neurons.

Although this genetic evidence points to the importance of amyloid plaques, most individuals who develop Alzheimer's do not inherit mutations in the precursor APP, and as a result they produce a normal version of Aβ. Normal Aβ molecules remain soluble and, hence, harmless in most individuals, and yet in some people these same Aβ molecules aggregate into fibrils that accumulate and form amyloid plaques. While the reason for such behaviour is not clearly understood, a clue has emerged from the discovery that people inheriting different forms of a protein called apolipoprotein E (apoE) have differing risks of developing Alzheimer's. ApoE functions primarily in cholesterol transport, but tiny amounts are also associated with amyloid plaques in the spaces between nerve cells. The mechanism by which apoE exerts its effect on Alzheimer's is not clear, but two general possibilities have been proposed. One is that apoE directly enhances the build-up of amyloid plaques outside nerve cells by disrupting the normal folding of Aβ and/or interfering with its removal from the intercellular space. The other possibility is that apoE delivers cholesterol to nerve cell membranes, producing a cholesterol-rich environment that enhances the cleavage of APP into Aβ. Some support for this idea has come from the discovery that the enzymes involved in converting APP to Aβ reside in cholesterol-rich regions of the plasma membrane.

Our growing understanding of the relationship between amyloid plaques and Alzheimer's will hopefully hasten the development of effective treatments. It has already been shown that animals can be protected against amyloid build-up using experimental treatments such as: (a) enzyme inhibitors that block the cleavage of APP into Aβ; (b) antibodies that dissolve amyloid plaques or prevent their formation; or (c) Aβ-containing vaccines that stimulate the immune system to clean up plaques and/or prevent Aβ deposits. Such vaccines can even protect mice with Alzheimer's symptoms from further memory loss, providing hope that this devastating illness will be conquered in the not-too-distant future.

Abnormalities in protein folding also lie at the heart of a group of brain-wasting genetic disorders that include scrapie in sheep and "mad cow disease" in cattle. Stanley Prusiner, who received a Nobel Prize in 1997 for his pioneering work in this field, has proposed that these diseases are transmitted by infectious, protein-containing particles called prions. Because prions do not appear to contain DNA or RNA, Prusiner formulated a unique theory to explain how prions might transmit disease by causing the infectious spread of abnormal protein folding. According to this theory, a prion protein (designated PrP^{Sc}) is simply a misfolded version of a normal cellular protein (designated PrP^C). When the misfolded PrP^{Sc} encounters a normal PrP^C polypeptide chain in the process of folding, it causes the normal polypeptide to fold improperly. The resulting, abnormally folded protein triggers uncontrolled muscle movements and eventual death.

Because the presence of even a tiny bit of prion protein can progressively trigger the folding of a cell's normal PrP^C polypeptide chains into more and more improperly folded PrP^{Sc} prion protein, this scenario allows prions to reproduce themselves without the need for nucleic acid.

Even more surprising has been the discovery of different "strains" of prions that cause slightly different forms of disease. When scientists mix tiny quantities of different PrP^{Sc} strains in separate test tubes with large amounts of the same, normal PrP^C polypeptide, each tube produces more of the specific PrP^{Sc} strain than was initially added to that tube. This ability to identify different strains of prions has allowed investigators to show that more than 100 people in Britain have become infected with mad cow protein by eating meat derived from diseased cattle, resulting in a fatal, human form of mad cow disease known as variant Creutzfeldt-Jakob disease, or vCJD. Almost 200,000 infected cattle have been destroyed in the UK to try to halt its spread, but more people may eventually die from this disease as a result of having ingested tainted beef over the past two decades.

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Left with no option

Solar energy becomes lifeline for power-starved Bihar but cheap and inferior equipment dominate the market, writes ankur paliwal

DAILY wage-earner Bijendra Sao is fussing about in Patna's Exhibition Road, shopping for his daughter's dowry. The doting father wants the best he can afford — a solar panel that can power two Compact Fluorescent Lamps and a table fan. What better gift to give in a state that suffers a perpetual power crisis? And what better place to shop than the world's biggest off-grid solar market that does an annual business of Rs 500 crore?

Sao is spoilt for choice here. This one-kilometre stretch has numerous narrow bylanes that cater to the energy needs of people with all pocket sizes. Solar lanterns and streetlights, besides panels of all makes and sizes, are hoarded in matchbox-sized shops. A 75-watt panel can cost from Rs 2,500 to Rs 10,000.

After half an hour of hectic negotiations, Sao pays Rs 3,200 for a 75-watt panel that has a two-year warranty. He is lucky, for a warranty is hard to get with under-warranted panels. These do not give as much power as they promise. A 75-watt panel of a standard brand would have cost at least Rs 7,000.

The flourishing solar market is the result of the green rally Bihar faces. The state needs 3,500 MW but supplies only 1,595 MW through self-generation and by procuring it from other states, says Rajmohan Jha, deputy director of the Bihar Renewable Energy Development Agency. The shortfall makes the state a perfect market for off-grid energy products, he adds.

"Bihar gets 300 days of good sunlight in a year. It has off-grid photovoltaic potential of 7,300 MW," says Sudhir Kumar of the World Institute of Solar Energy, a non-profit organisation in Pune. No wonder it has quietly replaced the expensive diesel generated power option with solar energy and became the third largest solar user in the country, according to the 2011 Census. The state government, however, has shown little interest in encouraging solar energy and has

never initiated a programme for rooftop off-grid solar power. In 2011, it formulated a renewable energy policy that approved 175-MW grid-connected solar projects. But the policy has no clarity on off-grid solar. "This is why few entrepreneurs have shown any interest," says Harish K Ahuja of Moser Baer, a solar panel manufacturer. No work has been initiated under the Centre's Remote Village Electrification Programme, which started in 2004. The programme promises its beneficiaries subsidised rooftop off-grid solar systems. "If the government has a programme that promises subsidised solar equipment, people with low purchasing power will not



A garment shop in Jandaha, Vaishali, has hoarded the much-in-demand solar panels.

have to buy underwarranted equipment," says Ahuja. Trying to compete in the thriving Exhibition Road market, companies are taking solar equipment closer to villages. Every block in all the 38 districts of the state has its own solar Exhibition Road, says Ramadheer Singh, a retailer at Jandaha block in Vaishali district. Every shop, be it for clothes or stationery, also stocks solar equipment.

"Panels manufactured by TBP are the cheapest and sell the most, despite being underwarranted and without warranty," says Bachchu Singh, a retailer at Jandaha. A 75-watt TBP panel, the name of which sounds similar to that of the well-known Tata BP, may give only 30 watts, yet it gives tough competition to Tata BP that offers a 20-year warranty.

"I don't care if the panel gives me less power than it promises. It suits my pocket and I get as much power as I require," says daily wage earner Saroj Kumar, who lives in Jagdeeshpur village in

Vaishali. A good quality panel is beyond his reach. Earlier, he would pay Rs 100 every month for a diesel generator to illuminate a 10-watt CFL for four hours and to charge his mobile phone. This works out to Rs 85 per unit, perhaps the highest per unit energy cost in the country. At present,



Solar equipment stocked at a bylane in Patna's Exhibition Road.

his panel is working well. But not all have such happy stories to narrate. When Rakesh Rai bought a cheap solar panel in Jagdeeshpur for Rs 3,500 a year ago, it could illuminate a CFL and, at times, a table fan. Six months later, the CFL gives dim light for not more than an hour. "The panel is not charging properly," he says. Rai is back to using kerosene for light that costs around Rs 200 per month. "I cannot complain because I bought the panel knowing it was of poor quality," he says.

The solar market in Bihar is flooded with under-warranted panels made in Hyderabad and Mumbai. "We tell companies what we need — cost, wattage and warranty years. We can choose the brand name. It could be your name, for instance," says a dealer requesting anonymity. Hyderabad-based Surana Ventures is one such company. Says its Incubator, the Union ministry of new and renewable energy has accredited Surana Ventures to make panels under the Jawahar Nehrú National Solar Mission.

Fifty per cent of the state's solar market is captured by those who make inferior equipment. A retailer in Patna can sell 50 cheap panels even on a bad day. In the past five years, Tata BP's monopoly over the solar market has dropped by almost 70 per cent, says Piyush Agrawal, a dealer in Exhibition Road. "Consumers are being openly duped. If they know that a 75-watt panel gives only 40 wattage, they will buy a good quality 40-watt panel at almost the same price,

and it will even have warranty," he says. "In villages, retailers push for under-warranted panels because they get high profit margins," says Anand Kumar, senior sales executive at Tapan Solar Energy Pvt Ltd, a Delhi-based solar manufacturer that sells equipment in Bihar.

Bad experiences with solar power can lead to the misconception that solar energy is faulty, fear some renewable energy experts. "This may affect its acceptance in future," says Manish Ram, a renewable energy analyst with Greenpeace India, an NGO. It recently released a report that presented Bihar as a model state for decentralised renewable energy systems. Ram says the government should ensure that all panels adhere to the standards set by the Union ministry of new and renewable energy.

"But the standards apply only to panels supplied under government programmes. Thus, we have no control over the market," says a Bihar Renewable Energy Development Agency official on condition of anonymity.

Those who have the money buy good quality panels. Raj Kumar runs a confectionery shop from his house at Salha village in Vaishali. A year ago, he bought an 80-watt Luminous panel with a 10-year warranty for Rs 6,000. It lights a 15-watt CFL in his shop and two 10-watt CFLs and an 18-watt fan at home. "It is good to buy panels with warranty. At least it can get replaced if it stops functioning. It also gives the promised power," he says.

The power shortage in the state has meant profit for some. Jagdeep Kumar of Araria village in Vaishali is not very rich. He thought of a novel idea that could earn him some bucks. After saving for two years and borrowing some money from friends, he bought six 80-watt Tata BP panels and created a small grid on his rooftop. The grid brightens up the lives of 50 households every evening. For four hours, each house can light an 80-watt CFL. Jagdeep charges them Rs 75 every month. He expects to recover the Rs 1 lakh installation cost in about five years.

At present, what Bihar desperately needs is a strong policy push that provides off-grid energy solutions, says Kumar of the World Institute of Solar Energy. Without it, cheap solar markets like the one in Exhibition Road are the only hope for the power-starved state. Good or bad, it's what people have learnt to depend on.

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