

‘Beltola Lilies’ – A Solution of Housing for Lower Income People and Introduction of A Module for Flooded Areas

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Abstract: The paper analyses the issues faced by a minuscule area of a slum habitat in Dhaka city, Bangladesh. The area of the slum worked upon, the “Beltola Bostee”¹, faces major problems of frequent flooding when the households of the area become unfit to live in. Hence, the inhabitants of this area shift to share other households, overcrowding the already cramped living quarters. The idea of “Beltola Lilies” emerges as an attempt to resolve the problem and provide the best possible solution. The “Beltola Lilies” is conceived as a modular accommodation that stands on ground during the dry season, but floats on water during floods, providing the inhabitants a healthy, organised, productive and cost-effective solution for housing. Built with inexpensive and indigenous materials, requiring minimum effort in construction and maintenance, having low energy needs and being sufficiently livable, it promises to address and eradicate some of the current dwelling problems in the slums that exist all over the country.

Key words: Slum, Flood, Household, Indigenous materials, Dwelling problem, EPS, Beltola Lilies, Modules.

1. INTRODUCTION

Housing or shelter for the poor is indeed one of the key issues of urban areas. The UN-Habitat estimates that between 800 million to a billion people live in urban slums (Hacker, 2013; UN-HABITAT, 2008). The abrupt expansion of

¹Bostee - The Bengali word for Slum.

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urban slums, predominantly in supply-deprived countries, is an acute challenge for social and public policies. Inflexible explanations of slums are constricted for the diverse and vigorous attribute of slum populations.

To depict, define and prototype urban slum structure at an operative perseverance, a methodical and flexible approach is essential to plan, deploy and monitor intrusions at the limited and general level. In countries like Bangladesh where eviction of slum dwellers -- for lack of proper funding, resources, institutional guidance, implementation of rules and the ever growing uncontrolled population -- is not only tedious but expensive to the point of being nearly impossible, steps need to be taken to instead rehabilitate the slum dwellers in the same place, which they have occupied either spontaneously or for lack of options, by providing a solution of modular living units that serves their purpose, organises the slum area and provides better living condition.

To find work opportunities and to mitigate hunger problem, the urban poor had no choice but to live in the much degraded slums and squatter settlements. Located at Darus Salam in Mirpur under Ward no 10, "Beltola Bostee" is one of the comparatively smaller slums in Dhaka city. After partition of British India in 1947, the newly formed Pakistan government acquired this area, along with the nearby larger slum of "Kallyanpur Pora Bostee", for rehabilitation of the Bihari community² [1,2]. Gradually, over the years, the underprivileged, shelter-less people of the country started to occupy this government-owned vacant land.. The victims of the devastating flood of 1988 gathered in this area for survival. From then on this slum began to expand and is now densely populated. The slum residents are involved in numerous occupations such as day labourers, garment workers, rickshaw/van pullers, bus and truck drivers/helpers, cleaners, household workers and petty business entrepreneurs.

In 1996, the House Building Research Institute (HBRI), under the Ministry of Housing and Public Works, gave an eviction notice to the slum dwellers. The dwellers moved the High Court Division of Supreme Court, with the help of Dr. Kamal Hossain³, and managed to stop eviction. The Coalition for Urban Poor (CUP) also extended their hand in support of their continued stay in the

²The Bihari community is also referred to as *Muhajirs* (defined by the Census of Pakistan, 1951, "a person who has moved into Pakistan as a result of partition or fear of disturbances connected therewith"), Indian-Bangladeshi, non-locals, non-Bangladeshi, stranded Pakistanis or Urdu speaking people. The International Convention on Biharis held in Geneva in 1982 referred to them as non-Bangladeshi or stranded Pakistanis. See Chowdhury (1992: 296).

³Dr. Kamal Hossain (born 20 April 1937) is a Bangladeshi [jurist](#), statesman, politician and [freedom fighter](#). After the independence of Bangladesh, Hossain served as the Minister of Law (1972–1973), [Minister of Foreign Affairs](#) (1973–1975) and Minister of Petroleum and Minerals (1974–1975). One of his earliest tasks as Minister of Law was the drafting of the [Constitution of Bangladesh](#) which was completed in 1972.

area. However, the slum dwellers were evicted on December 21st, 2003 by the government agencies, with written notice being served on them only a day prior to the eviction.. Many slum-dwellers were evicted forcibly using heavy bulldozers under supervision of the police force.

Subsequently, a landmark decision of the High Court Division of the Supreme Court established that slum evictions cannot be carried out without prior written notice as mandatorily required by the law. The slum residents are now better informed and more organised in responding to eviction. Some national and international organizations have also played supportive roles including social, educational and health services through sponsors, micro-credit, aid and awareness programs. Some renowned organizations such as Asian Centre for Human Rights (ACHR), United Nations Development Program (UNDP), European Union (EU), Water Aid Bangladesh (WAB), Islamic Foundation, Dustha Shasthya Kendro (DSK), Plan Bangladesh, and Bandhan Society are providing services to the dwellers of these slums [11].

2. THE CURRENT SITUATION

The Beltola Bostee covers a land area of 2.3 acres. (Fig. 1) The total population slum is approximately 1236 people, living in 300 households,. with an average of 4.12 persons / household. When children of any family are married off,



Figure 1: Top view of Beltola Bostee, current situation. (Source: Google Earth)



Figure 2: Slum habitats flooded and at an unused state.

they generally leave the previous home and move to a new house of their own. But, they tend to remain within the area, making the area denser. These new households are mostly located near the water body adjacent to the slum, and, thus, get flooded during the heavy monsoons (Fig. 2), forcing the inhabitants to move back with their parents or other relatives, leading to even more crowding in the central area.

As the population increase grew out of hand, living conditions started to deteriorate even further. Hence rose a call for a more logical and implementable solution that could both address the rising scarcity of healthy and hygienic dwelling spaces and also avoid the unnecessary, expensive and apparently impossible process of eviction. A study of the current situation helped gain a clearer perspective towards the solution.

3. BELTOLA LILIES: A STEP TOWARDS DWELLING SOLUTIONS FOR THE BELTOLA BOSTEE

The first step towards the solution was the identification of the main issue. What stood out among all the problems was the fact that many households remain flooded for the greater part of the year. The primary answer pointed towards the possibility of introducing floating structures, inspired also from

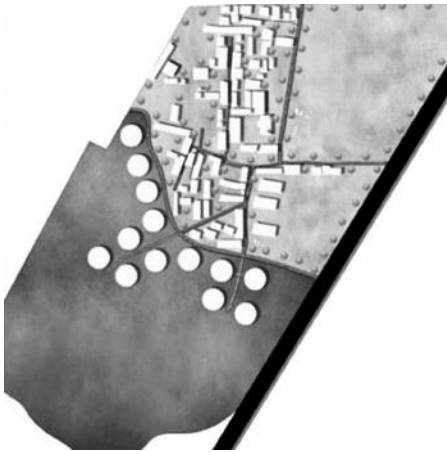


Figure 3: Top view of Beltola Lilies.

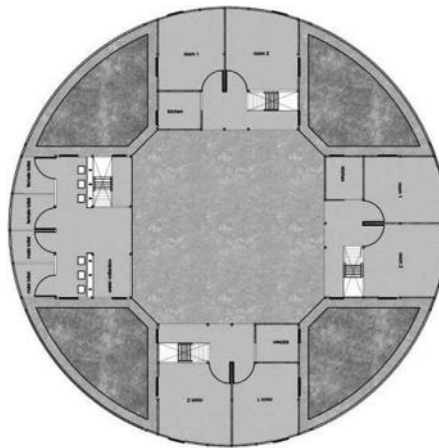


Figure 4: Plan of a single unit.

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traditional structures in many waterfront areas. In Vietnam [6] and in Holland [7,8] people float on houseboats. Dwelling on stilts are not uncommon even in Dhaka especially in the fringe areas. The concept of the modular housing system was derived from the Water Lily, which is the national flower of Bangladesh and commonly seen in this country. The shape of the flower allows it to stay steadily afloat on water. It is from this shape that the form of the proposed dwelling modules, named “Beltola Lilies”, is derived.

Each of the housing units or modules of the “Beltola Lilies”, accommodate six families in two floors. Each of the living units consists of two bedrooms and a kitchen, considered adequate for the usual family of 4 to 5 members, including children. The living units are placed around a central court, which opens up at the top level. Figure 3 and Figure 4 can be consulted for detailed understanding of the circulation and functional arrangement.

Each floor is also provided with a common service block that includes the following facilities: (i) Two separate toilets, one each for males and for females; (ii) Three separate wash and shower area each for male and for female; (iii) Six water collection points; (iv) Garbage disposal

The living and service units are placed along the edges and the central area acts as a courtyard of sorts, which is in line with the rural or traditional housing system of Bangladesh. The courtyard opens up to the sky to allow lighting and ventilation within the living units. The whole module is shaped and designed as such that it can stay as steady as possible while floating on water.

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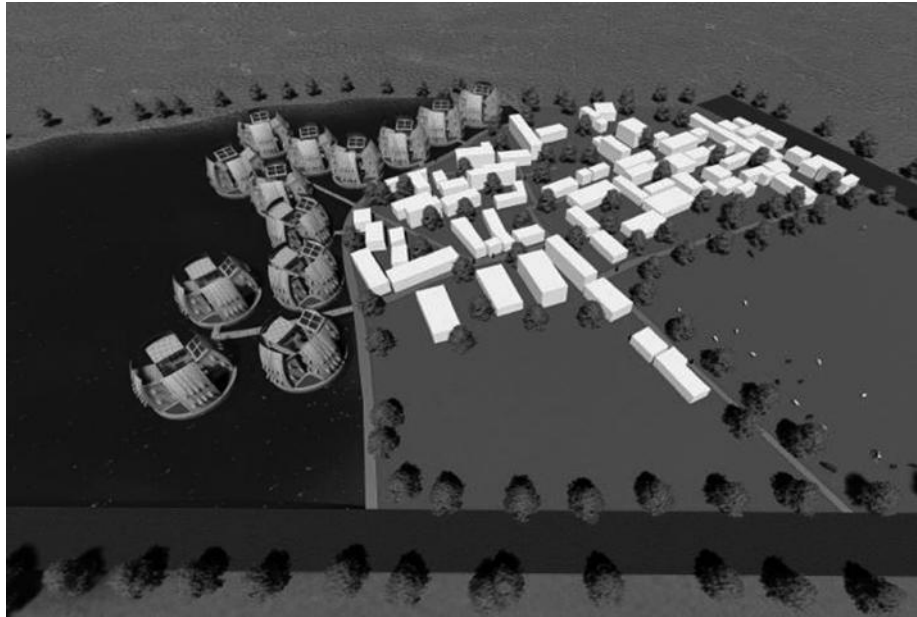


Figure 5: Aerial view of Beltola Lilies.

The entire area is connected and accessed via floating platforms, acting as bridges over the water when flooded (Fig. 5 and Fig. 6). The semicircular and mildly vaulted facades allow the wind flow to pass without much hindrance so as to create minimum pressure and friction on the module.

The ventilation solutions are provided in such a way that requires very little or no use of mechanical devices - this is complimentary to the inhabitants' capability for expenditure. The open design allows proper wind circulation and also relieves dwellers from the feeling of being cramped, that a small slum house usually provides. To provide artificial lighting, solar panels are installed on the roof of the service block (Fig. 7).

Concentrating six families into a single unit provides better lifestyle - by organizing the supplies they receive, better security and social communication. But most prominently, it reduces the problem of scarcity of space and low living standards. The intermediate spaces between two living units function as green spaces where small kitchen gardens can be maintained, and a domestic animal such as a cow or goat can be kept. The opening on the very top of the unit is lined with bamboos (Guangyu Wang, 2008; Rao, 2014) to act as a platform for harvesting vegetables such as gourd, pumpkin, green-beans, pea etc. that grow on creepers (Fig. 8). All these, to a certain extent, provide further cost reduction and improvement of lifestyle.

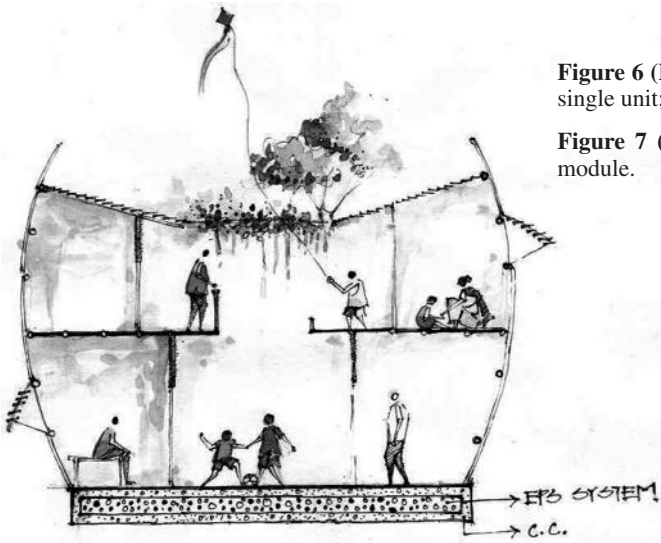
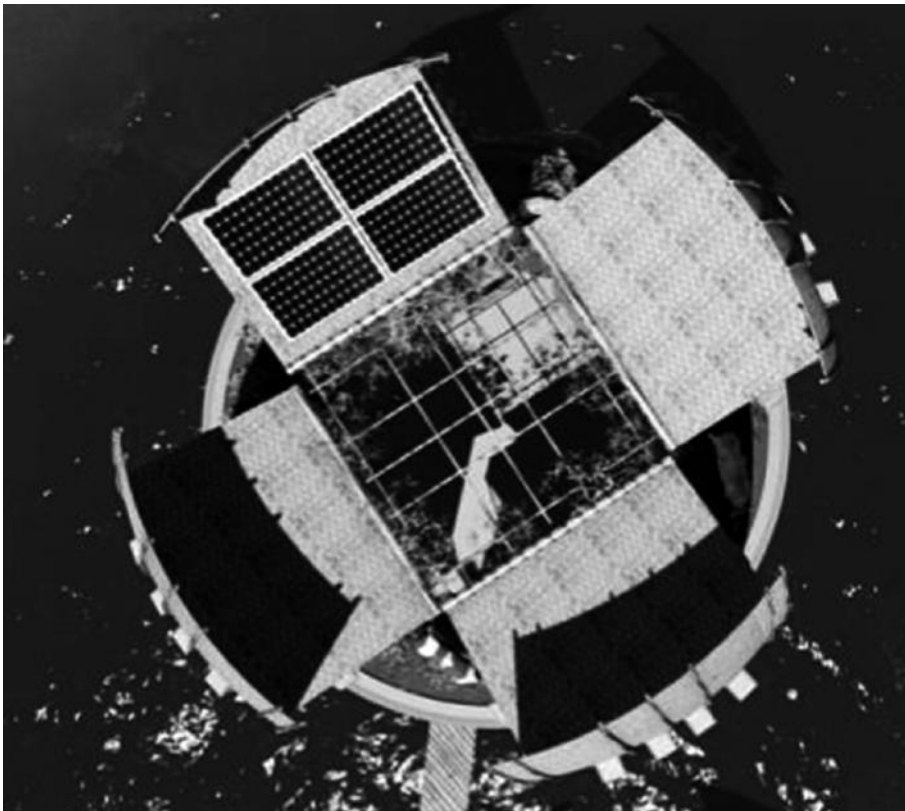


Figure 6 (Left): Sectional view of a single unit;

Figure 7 (Bottom): Top view of a module.

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Figure 8: View of the Courtyard



Figure 9: Detail of a window.

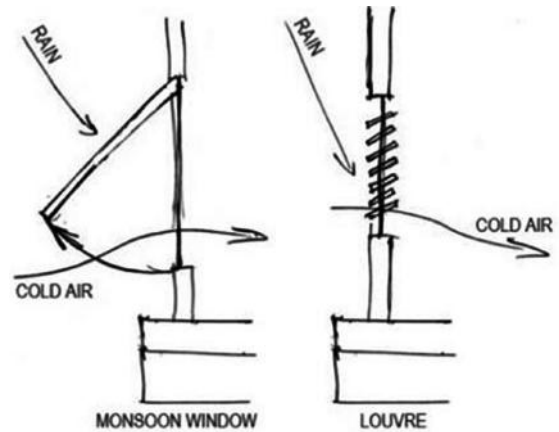


Figure 10: Wind flow pattern through windows.

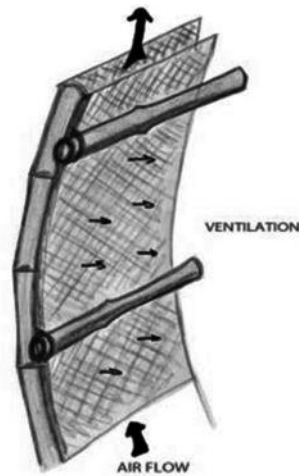
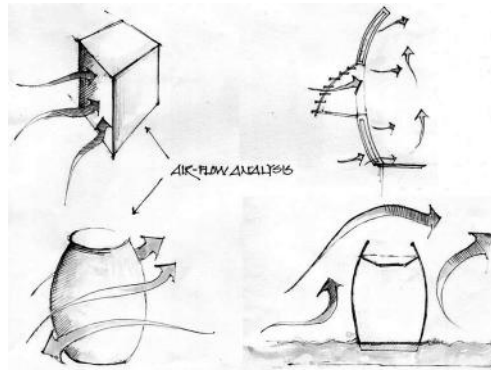
As has been mentioned before, the primary goal of these floating dwelling modules was to suit the users' income level and be as cost effective as possible. Therefore, the ventilation system had to be carefully integrated into the design in order to maximize the use of natural ventilation. The curved shape of the

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Figure 11 (Right): The round form allows easy flow of wind during usual and floating situation.

Figure 12 (Below Left): Curved facade facilitates wind inflow.

Figure 13 (Below Right): Perforated indigenous façade material.



façade invites the colder wind from bottom and the opening at the top level allows the warmer air to be released. The window opening and its louvers are designed in a way to obstruct passage of rain while allowing free flow of wind (Fig. 9 and Fig.10). A constant change of air is made possible inside the unit due to its curved shape and orientation of window openings. The curved shape also ensures that the wind does not put pressure on the module and bends easily around it (Fig. 11 and Fig. 12), also allowing the unit to remain steady even when floating on water. The façade material is also chosen in consideration of this matter. The use of a porous material -- Bamboo slat -- allows the air to seep in, while the using a double layer keeps out the rain water and heat. Also, the cavity between the two layers provides another air flow channel that cools down the unit further (Fig. 13).

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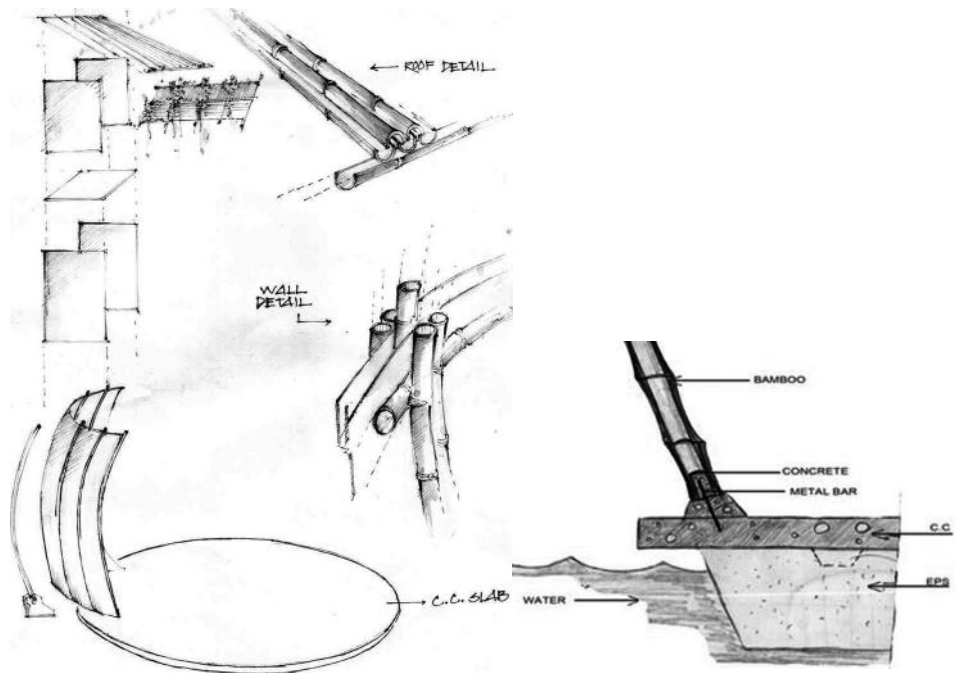


Figure 14 (Left): Junction joint diagram of a single unit; **Figure 15 (Right):** The EPS System

The other major design concern of the proposed solution was an appropriate structural system. The solution had to meet three criteria -- that the structure should be sufficiently lightweight to stay afloat, it should be steady even though floating and, at the same time, it should be of as less a cost as possible. The choice was narrowed down to the application of the 'EPS System'. EPS or Expanded Polystyrene is a thermoplastic, closed-cell, lightweight, rigid-foam plastic. People benefit daily from products manufactured from polystyrene plastic, including thermal insulation for construction applications and cushion packaging for industrial and consumer applications. The low thermal conductivity, high compressive strength and excellent shock absorption properties of EPS make it an ideal material for the application demand for which it is used [5,11], in this case as the filling for supporting the concrete base of the module (Fig. 14).

The benefits of EPS systems are many. It is lightweight, versatile, sanitary, energy efficient, involves easy implementation and, most of all, is cost effective. The manufacture of EPS foam uses less energy than that used in the manufacture of paper-based alternatives. EPS foam products have never been manufactured with chlorofluorocarbon (CFCs), and although EPS foam



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Figure 16: A single dwelling module.

does not bio-degrade, it is benign to the environment and provides a stable fill material as earth, rock or concrete. As it is readily available and can be easily implemented, it negates the need of long term construction and in this process the modules can be built in minimum time at minimum cost [5,11]. For the posts, bamboos are used. Bamboo is yet another low-cost, indigenous material which can be easily combined with the EPS and the concrete base (Fig. 15). The finished module is quite as steady on water as it is on ground (Fig. 16).

4. EPS FOUNDATION DEPTH CALCULATION

The Archimedes Principle states that the buoyant force on a submerged object is equal to the weight of the fluid that is displaced by the object. Since the weight of water is 62.4 lb/ft^3 [9], the depth of the foundations was calculated by finding the dead load and live load of the entire structure. The weight of the structure per square foot divided by the weight of water equals the depth to which the house will be submerged when floating. The average weight of bamboo is generally considered to calculate a dead load of 55 lb/ft^2 for each dwelling, and a live load of 50 lb/ft^2 [9].

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Table 1: EPS Foundation Depth Calculation

D. L. of dwelling: 55 lbs/sq.ft.	L.L. on 1st floor: 20 lbs/sq.ft.
D. L. of foundation: 52 lbs/sq.ft.	L.L. on 2nd floor: 20 lbs/sq.ft
	L.L. on roof: 10 lbs/sq.ft
	L.L. on open space: 10 lbs/sq.ft
<hr/>	
Total Dead Load: 107 lbs/sq.ft	Total Live Load: 60 lbs/sq.ft

Total Load / Weight of Water = Minimum Depth of Foundation

$$167 / 62.4 = 2.67\text{ft}$$

As a safety consideration, a foundation depth of 3ft should be applied.

5. CONCLUSION

Overall, this idea of modular slum units can be put into effect in the current conditions without needing too much effort. Even the slum-dwellers themselves can take part in this easy and efficient construction system. As it is built with indigenous and low-cost materials, requires minimum effort in construction and maintenance, has low energy needs and is sufficiently livable, it has the promise to eliminate some of the dwelling problems of the slums that exists country wide. The module, though designed for one particular area, can be applied to similar areas with necessary modifications. The adoption of this idea can effectively put an end to a lot of feuds among slum dwellers and the authorities over eviction and allow the inhabitants to lead a secure, healthy and a much better lifestyle.

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