



UNDERSTANDING REGENERATIVE ARCHITECTURE THROUGH CASE STUDIES

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Abstract: - This paper is an attempt to understand, through case studies, designs and developments which aim to regenerate natural resources, to repair the cycles of nature throughout the course of their life and to achieve the ultimate goal of net positivity by addressing a few unquantifiable and intangible aspects. These aspects are part of the alternative and improvised school of thought which strives to bridge the gap between Green Buildings and Sustainability. The paper focuses on architecture which can repair the broken food chains, water and ecological cycles by going beyond the allotted site area to be a part of the natural, social, economic and communal network at the scale of the urban neighbourhood.

Keywords: Regenerative, Biodiversity, Sustainability, Green, hydrology, natural, local

I. INTRODUCTION

As the sustainability worldview becomes increasingly mechanist, the gaping holes in the concept of Green buildings become evident. The inability to measure efficiency accurately in values of carbon footprint and embodied energy, inability to measure well-being and comfort, inability to value and incorporate local skills and resources and over dependency on electro-mechanical systems- call for ecological worldview to devise a holistic solution which could bring the building sector truly in a symbiotic relationship with the natural world.

Focus of this ecological worldview should be to give back to nature what we have taken: in the same quantity and quality; on redefining efficiency in terms of effectiveness of the purpose of the development rather just the output; on uplifting quality of life of users by defining well-being in terms of their subjective response to climate, greenery, building aesthetics, connection to community and culture etc. The well-being should extend not just to humans but also to pets, strays and local biodiversity; on achieving self-sufficiency through reliance on local resources with focus on revitalising the same; on communication of the building's form with a wider audience by sending out a responsible message through display of simple greening strategies.[7], [8], [9]

II. CASE STUDY SELECTION PROCEDURE

The first criteria to select the case studies was the parcel size. Hence a small parcel of less than 2 acres, a medium parcel of 50-100 acres and a large parcel of more than 500 acres were fixed in order to study the relationship of the scope of re-generation by a development with its site area. The second criteria were the sites' contextual setting: urban-metropolitan, semi-urban and rural-forested. The idea was to understand the change in the regeneration pattern of a development with the change of its site settings.

III. CASE STUDIES

The first case study is IIT Bombay which is a large parcel type located in the heart of the metropolitan city of Mumbai. IIT Bombay is located in the lower slopes of the Western Ghats. The Western Ghats is an evergreen forested mountain range and is recognised by the world wild fund as one of the eight hotspots of biological diversity in the world.[3] The dense biodiversity of the western Ghats is also responsible for being a source of moisture for monsoon [4]. The tremendous recognition of IIT Mumbai as a green hub led to its selection as a case study. The development gained this fame after the "Study of the Biodiversity of Indian Institute of Technology Bombay Campus" by World Wide Fund for Nature -India, Maharashtra State Office, Mumbai, commissioned by Environment Advisory Committee, IIT-Bombay, Powai, Mumbai was published in 2009. The journey and metamorphosis of the IIT campus from a vast and barren parcel located on marshy lower slopes of the western Ghats to a thriving hotspot of biodiversity in the heart of suburban Mumbai is fascinating and inspiring. This campus not only became a link in expanding the western Ghats's biodiversity but also gave a breath of fresh air to noisy and polluted Mumbai.

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Fig1(a)Aerial photo pf IIT campus in 1972 [top] and 2003 [bottom](b) Pilot wetland project near Powai lake [2]

The second case study is the Biodiversity Training Institute in Sikkim. The state of Sikkim is one of the world’s ten most critical centres for biodiversity according to world wild fund and lies in the eastern Himalayas which is recognised as a mega-diversity centres of the planet. The continued pristine condition of the ecosystems, conservation ethos of the ethnic groups and sustainable development initiatives of a pro-environment government has resulted in the development of a training institute to impart the knowledge of preserving the mountain culture to the younger generations.[5] The design of this institute was realised jointly by Indian and international architecture firms, locals and state government experts. The resultant concept handles sustainability through its uniquely designed façade and sensitive planning in its effort to become a home for surrounding flora and fauna [6]. It becomes a link in not just the transfer of knowledge from the tribal groups to the urban population but also in giving a platform to the ethnic groups to display their skill, traditions and gain financial stability.

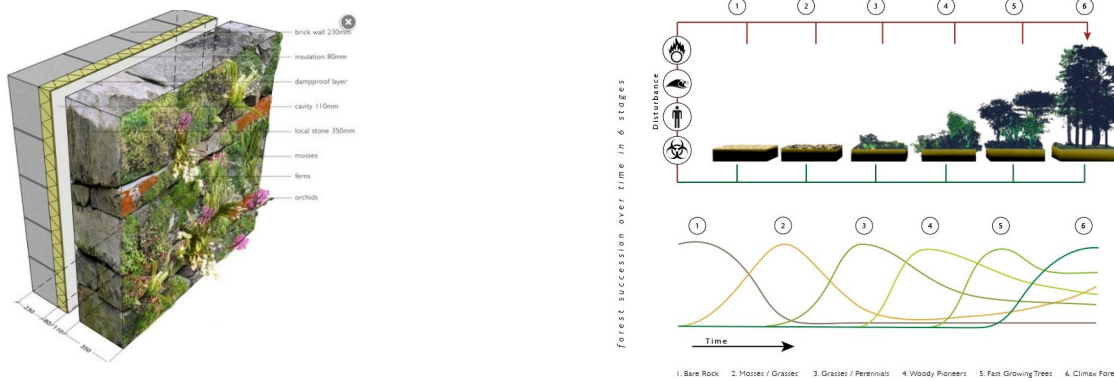


Fig 2 (a)Cross section of thermally insulated wall with vegetative exterior(b)The process of mosses growing into a forest.[6]

The third case study is unique in its extremely rural and sensitive setting. The Site is home to mangroves and being in the sub-equatorial climate zone- is very prone to flooding. This study was chosen to understand how large parcels can be built by avoiding massive land reclamation at flood prone zones [9]. The Greenfield university in built near Ho Chi Minh city at a site surrounded by rice field of the Mekong River basin which has a level of fish biodiversity that is rivalled only by the Amazon River basin [10]. This award-winning entry at the Global Holcim Awards for Sustainable Construction has left no stone unturned to minimise its impact on the site. The design is such that the footprint of the built is woven around the existing site features and trees. The spaces have been designed to be functional and comfortable on minimum required energy across three seasonal changes; this minimum energy is being generated through solarpanels, making the Campus truly green and sustainable [8].

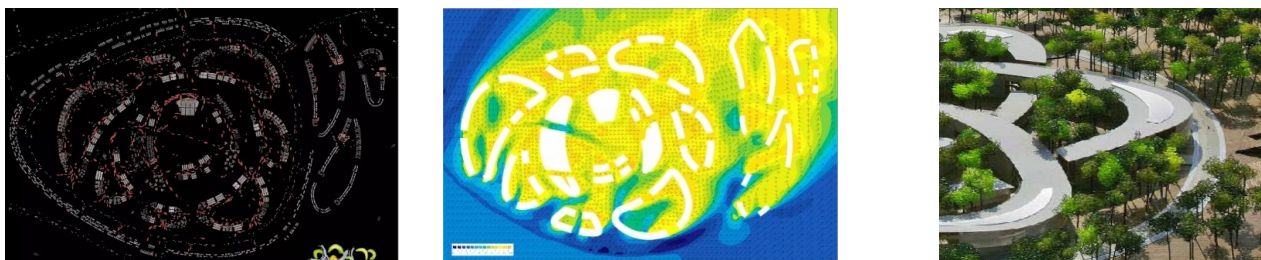


Fig 3 (a) Activity mapping on plan(b)Wind mapping using CFD (c)Block model showing structure embankmentand site trees [8]

S. no.	Case study	Built capital	Natural capital	Human Capital	Social Capital	Symbolic capital	Financial Capital
1	Indian Institute of Technology Mumbai, India 550 acres Public educational institute [1]	The site was a barren marsh at the lowermost slope of Western Ghats, currently is part of the neighbouring forest due to extensive plantation efforts by faculty and students.	The campus is home to 843 species of flora and fauna; 172 species of butterflies and many indigenous trees [1]. A constructed wetland 13m long, 3m wide and 0.8 m deep is responsible for filtering 30,000 L of sewage every day and releasing it back in the Powai lake to maintain the ecological balance, is developed in the campus. [2]	CURED (Can You Really Escape Diabetes) is a campus initiative by in the form of a Diabetes Camp targeted at the urban diabetic population of suburban Mumbai [14]	THE PCVC (Pratham Council for Vulnerable Children), 'Saksham', IAMPower Are three programs which run at IIT Bombay for rural women, small children and poor students wherein they are allowed to use campus facilities after academic hours to gain vocational training. [15][16][17]	The IITB campus launched the 'Green Campus Initiative' which addressed the on-campus issues of energy, water, bio-diversity, food and waste, climate and air, social outreach and land-management through a variety of design models and business models [18]. The initiative was adopted and repeated in 40 large educational institutes across the country in 11 cities by the end of 2015. [16]	-
2	Biodiversity Training Institute, Sikkim, India 1.25 acres Public educational institute [6]	Entire site is developed as a watershed development with the help and co-operation of the local urban and village community residing in the vicinity. [6]	Building façade allows mosses, ferns and orchids to grow on them. Roof supports a local herb and medicinal plant garden. Butterfly trail conservatory is home to 690 species of butterflies. site has two horizontal flow reed bed water treatment ponds and four rainwater catchment tanks: one for the institute and three others for the surrounding village population. [6]	The heavily forested site with its vegetative walls, butterfly garden, water ponds and herbal roof garden set in foggy conditions and overlooking Mt. Kanchenjunga is itself a surreal experience and has an immediate calming effect on the mind, body bringing an overall sense of well-being. [6]	the medium of training is through local experts with their vernacular knowledge along with national and international teachers. It gives a chance for the locals to come and be a part of the ongoing on site as well as be a part of the program	The institute is an initiative by the state government of Sikkim to conserve mountain environments and cultures. The planning and construction principals were developed jointly by the architecture firm <i>architecture brio</i> , Sikkim biodiversity conservation and forest management project, Japan International Co-operation Agency and the model is being repeated in various other projects like the Bird Park in West Sikkim & Himalayan Zoological Park Facility. [5]	The promotion of ecotourism through these projects targets tourists from all across the globe which has opened up income opportunities for the locals and the government. [5]
3	Greenfield University Campus, Ho Chi Minh City, Mekong Delta, Vietnam 40 acres. Educational institute [8]	Each school is given space outside the built to grow native trees which will take the shape of a forest collectively. The total number of trees will go up from what it was before the campus was built. [8]	Situated in one of the world's most biodiversity-rich systems, the university's layout includes each and every site tree. Each block is designed to slip in between existing trees. [8]	Extensive wind studies and temperature studies are overlapped with user activity mapping to achieve high thermal comfort spaces only by making use of moisture laden cool river winds. [8]	The interior social spaces are designed at junction points of various blocks, in the form of huge double height horizontal cut-outs which will induce the venturi effect, making them breezy. Use of movable furniture in circulation make them flexible [8]	To prevent on-site flooding, an embankment in the form of a periphery ring road is provided which runs all along the campus to stop the water from rushing into the campus. This concept is inspired by similar embankments found in rural Vietnam. This design feature can be repeated throughout the low-lying zones of the delta region. [8][9]	Local construction techniques and labour brought income options to the low-income rural population of the delta region [8][9]

Table 1: Case Study Analysis

Table 1 depicts how each case study was measured across six capitals which were chosen by the author as basic determinants of regeneration.

IV. DISCUSSION ON REGENERATION

The three case studies indicate the existence of developments which are not certified by any rating system but move beyond the standard notions of green and sustainability to stretch their set brief and program and reach out to a broader network of systems. Ecology, biodiversity networks and water form a major driver behind the systems of each case study in some way or the other. While IIT Bombay and Biodiversity Institute aspire to expand biodiversity and water networks, Greenfield University does its best to not disturb the existing hydrological and green networks before it starts to contribute towards the green expansion. All three case studies are embedded in their local context. IIT Bombay's filtration network was developed indigenously by its professors while Biodiversity Institute and Greenfield depended completely on local construction material, local labour and skills for construction. They have all created pathways of developments and income for the economically weaker sections residing in their vicinity while also keeping the embodied energy in transportation low.

The response to climate is a driving force of form design in all three case studies where in the buildings makes use of the sun, the wind, the natural landforms around the site and the ecology in their design. The spread out and porous structures of both IIT B and Green Field university is an effort to minimise mechanical air cooling and make use of natural cool breeze from the adjoining water bodies in their hot and humid climates while the Biodiversity Institute on the other hand makes use of insulation between double leaf of stone to keep the building packed in the cold and wet climate of Sikkim. [6][8][19]

The building form for each case study is unique to its context and tries to converse with its surroundings. This is achieved extremely well in the Greenfield University which advocates its theme of 'slipping into nature' [8]. The Biodiversity institute with its moss-covered walls sends out a clear message of an eco-sensitive zone [6]. The IIT building 's Main Building's elaborately grilled façade, folding-fan roof, and the open-worked concrete lattices at one end is the signature style of 1950s brutalist architecture in India brought by Architect Le Corbusier. [19]

The case studies aim to uplift societies and groups which are economically and socially weak and pay extra attention to human wellness and general health hence taking into consideration the unquantifiable and the uncertain.

V. LIMITATIONS

The parameters of a regenerative design are not set universally and we can find some gaps in these case studies as well.

The IIT Bombay building does not dwell into generating energy. Although it is designed for passive cooling and has on site waste recycling but its huge roof area can be utilised for generating electricity and attaining electricity self-sufficiency.

The Greenfield University, designed on concepts of passive cooling and natural light -takes the help of PV cells to generate electricity but it is still dependent on the grid hugely for cooling and air conditioning purposes. The Greenfield University also has a huge potential for generation of onsite energy through its hydrological connection which remains unexplored- possibly due to the dangers of flooding in the delta region.

The aspect of growing food on site is still untouched and none of the projects look into that.

VI. PROTOTYPING AND REPETITION

Biodiversity Training institute and Greenfield University are very special projects located in sensitive sites of rural contexts. While one is set in forests fringe of a hilly state, the other one is situated in a delta zone. The repetition of these projects is possible only in their context. The careful use of contours, stone masonry with insulation at the Biodiversity Training Institute and its take on biodiversity with its butterfly conservation can be done in large numbers all over the hills. This may generate magnificent results. The watershed development and reed bed filtering can reduce the load on water grids and utility infrastructure manifolds. It can work wonders in making village communities resilient in the face of natural calamities.

The embankment road of Greenfield University is a useful method which can be used in flood prone zones all across the world to protect sites from submerging. Designing windy courtyards and junction spaces can be adopted in hot humid climates all across the world if proper wind studies are done at concept stage itself.

IIT Bombay's take on biodiversity and hydrology can be repeated with ease across 100s of education institutes which basically constitute the extra-large parcels of a city. Its social initiatives and even the built capital can be repeated where in barren sites can be used to establish institutes which can give them a new life.

The question of food and energy remain unanswered in all the case studies which indicate that there is much more potential to push the concept of regeneration further. This also allows exploring integration and overlapping of systems in an exchange of flows and achieving synergy.

VII. CONCLUSION

The regenerative developments are beyond the set notions of market, economy and profits. They are prototypes of a thought of doing well. They become a part of a bigger movement, a bigger connection where they cease to exist as buildings but start thriving

as eco systems. These eco -system buildings are no longer linear in nature. The process of their birth to death is a cyclic process: where they co-exist in harmony with bigger eco-system of the Earth

Since these developments are far from being players in the market and economy, they need timely support by governments of the world to flourish and get replicated.

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