PARAMETRICISM: INDIAN SOCIAL NEED TO FIND ORDER IN COMPLEXITY AND CHAOS

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Abstract. India is a pluralistic, multilingual and multiethnic society living within a hierarchy of economic, political and administrative boundaries which is here referred as ***complexity***. Economic boom and information technology has given rise to dynamic and diverse demands. Social complexity and demands translate themselves in the built environment where development is measured purely by material consumption and expressed as imitation of perceived advanced technology; this is referred to as ***chaos.*** The challenge is to find an approach that analyzes and interprets the complexity with a specific vision to offer contextual variety inclusive of qualitative richness; is ***'to find order'*** in the existing chaos.
Parametricism can recognize measure and simulate this complexity, analyze and appreciate the underlying logic and rationality as well as reveal the complex order of the seemingly chaotic patterns. It aims for maximum emphasis on continuous differentiation, visual amplification of differentiated logics and aesthetic elegance of ordered complexity. It also allows precise formulation and execution of intricate correlations between the whole to parts and build morphology at all levels. Because of these reasons Parametricism is not limited to aesthetic and performative gains, it also creates ***qualitative gains.*** Therefore, Parametricism is ***'the need'*** for the contemporary Indian society.

Keywords. Parametricism, complexity, chaos

1. Introduction

India is one of the most dynamic countries in the world. It is the second most populous country with 1.2 billion people making it the biggest democratic nation. It is a pluralistic, multilingual and multiethnic society.

To create a built environment for 1.2 billion people in such a diverse context involves numerous parameters like individual's life style, cultural background, social requirements, geographical conditions, etc. all of whom live in a hierarchy of economical, political and administrative boundaries, referred to as **complexity.**

As it is true for any society, economy plays a major role in changing the level of complexity. During the last decade of the 20th century India has gone through a major economic transition becoming one of the fastest growing countries in the world. However, despite great economic growth, there are several challenges such as poverty, illiteracy, corruption and inadequate public health care in the society. The gap among the rich and poor is increasing in multiples which even questions survival and demand for the basic facilities for less privileged mass of rural populations. Economic boom and information technology have given rise to dynamic and diverse demands that ranges from the basic need of housing and infrastructure to the most sophisticated technology dependent and iconic built environments. Social complexity and diverse demands translate themselves in the built environment where development is measured purely by material consumption and expressed as imitation of perceived advanced technology; this is referred to as ***chaos*.**

This paper presents how Parametricism helps in shaping the present and speculates future of Indian built environment. This is demonstrated by presenting theory and tested cases based on Parametricism, inter-relating them with Indian examples to showcase opportunities.

2. Indian architecture phases

Historic cities in India represent a direct response to the complexity of their time. Cities were allowed to grow organically within defined boundaries based on commonly understood rules of social and spatial hierarchy. Urban fabric and infrastructure planning rules were set to achieve efficiency and optimize resources. The built form had qualitative richness emerging from its complexity, availability of local materials and construction techniques. This was the era of differentiation, variation and customization. Along the timeline, India's built environment reflects strong foreign influences such as Persian, various European colonies and British Raj. The post-independence era for India looked for world knowledge to create a new image on world map. This brought Modernism in India. Modernism was based on reductionist principles, straight lines and rigid orthogonal and undifferentiated grids, imposed to build urban India. Modernism promoted universality, standardization of materials as well as technology and mass production which took away the richness offered by traditional vernacular architecture. Therefore, Modernism failed. The decades of 1970 and 80

were the years of self realization and reinventing contemporary India. This era questioned modernism and reflected on heritage that brought back pluralism – Postmodernism. It encouraged intellectual thinking of esoteric, recognized diversity, initiated interactive design methods between design and people as well as numerous experiments with local material and construction techniques. It was remarkable but fragmented and did not address core problems. Rather, it pulled only elements of formal expression and resulted in cardboard like fake structures.

Contemporary Indian architecture is an era of *information revolution*. Due to an economic boom, greater foreign influence and the information revolution, India has become one of the biggest consumer markets where there is huge dumping of mass with no connection between demand and supply. At times the gap is also because of individual's (designer/developer) beliefs and interests. The only motto is 'To Sell' by means of packaging and marketing which has resulted an arbitrary conglomeration of images, ideas, perceived advance technology, design elements, materials and so on to attract people. There is loss of quality and experimentation that supports simultaneity of diverse demands and appropriateness of technology to offer variety. **The challenge is to question the present scenario to find an approach that analyzes and interprets the complexity with a specific vision and offers contextual variety having qualitative richness; *'to find order'* in the existing chaos.** The need is to break this fake imagery of attractive packaged products, specific beliefs of theories/groups/designers and develop a deep understanding of logic and reasoning to create homogenous built environments for contemporary Indian society. To achieve this, the need is to couple the cumulative wisdom of traditional India while integrating additional demands of the information era and vision for the future. The need is an approach that keeps all this information in a single entity and offers a framework which is flexible, adaptive and responsive to the changing socio-economic demands and its consequences.

3. Parametricism - qualitative gain

Parametricism is now a fully mature approach based on inclusive principles and the concept of differentiating fields. Aesthetic and performative gains of Parametricism are accepted and appreciated worldwide as well as in India where it is still in its infancy. SOM explored parametrics to derive visual continuity/discontinuity through the external envelope of The Park Hotel, Hyderabad. It was achieved by creating a gradient of perforation and embossing in metal sheets using a digital fabrication technique which revived *'jali'* of traditional architecture. Centre for Sustainable Environment and Energy (CSEE) of India explored parametricism to design the first zero

energy building at unit level and made critical evaluations of the impact of the energy conservation building code of India on commercial building through energy simulation models in five different Indian cities with different climatic conditions.

Beyond aesthetics and performance, Parametricism can recognize measure and simulate this complexity, analyze and appreciate the underlying logic and rationality and reveal the complex order of seemingly chaotic patterns. It also allows urban environments to reconfigure in different time scales through real-time simulations and visualizations. These abilities make it a powerful tool to **analyze, interpret and represent the complexity**, while also offering opportunity to observe changing conditions in 3-D. It is valid at all scales: urban design and planning, architecture, interior design and product design. Its **strength is directly related to the scale:** larger the scale of project more profound it is to respond to programmatic complexity. It aims at **maximum emphasis on continuous differentiation, visual amplification of differentiated logics and aesthetic elegance of ordered complexity.** It is an **associated system of correlation that allows deviation** and uses it to amplify the acceleration of initial differentiation via continuous differentiation, versioning and iteration to find most appropriate solutions similar to the processes in nature. It does not impose any compensatory adaptation. It also allows precise formulation and execution of **intricate correlations between the whole to parts and build morphology** at all levels including performance, aesthetics and qualitative shifts. In an extremely sensitive parametric model when quantitative changes are added to existing parameters such as objects, ambient and observer, it triggers qualitative shifts. These qualitative shifts further offer the possibility to carry forward the idea until the detail articulation. These are **the Qualitative gain of Parametricism.**

4. Tested cases based on Parametricism

4.1. KARTAL-PANDIK MASTER PLAN (ZAHA HADID ARCHITECTS)

Kartal-Pandik master plan, Turkey, a mixed use urban development of 55 hectares with 6 million square meter gross buildable area comprising all programmatic requirements of a city. The designers took incoming circulation lines as input and used Maya's hair dynamic tool to find the major roads which resembled Frei Otto's minimized detour network [Fig. 1]. A lateral element was added to find a hybrid detour network and deformed urban grid which gave the layout. Simultaneously, two block typologies – towers and perimeter blocks, each a generative component - allowed wide range of phenotype variation. Each block inversely correlated height with plot size therefore courtyards morph with internal atria whereas the smaller

the plot, the taller the block. Blocks were split to add secondary path networks which were coupled with height accentuation at junctions. Although starting from two distinct block type, overall rhythm is achieved due to the relationship between global height regulation and local height dependency on the parcel size.

Figure 1. Route network

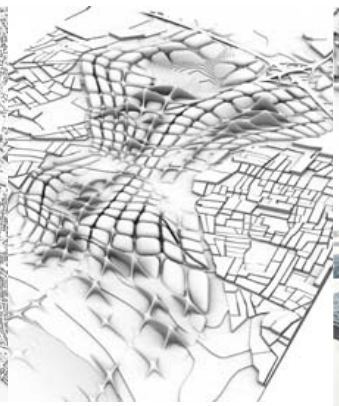

Figure 2. City-space

Figure 3. Tectonic details

The ordered complexity replaces the older planned developments and disorienting visual chaos of unregulated city expansions [Fig. 2]. This advantage of coherently differentiated city-space invites political and private stake-holders. The relationship between urban and architecture is carried forward to tectonic details like facade differentiation, coordination of landscape and public spaces and correlation of secondary path system with the disposition of internal navigation systems [Fig. 3]. The design and detail of the urban field was completed by a single design team using parametric tools and strategies.

4.2. B_MOTION: THE LIVING BRIDGE, GRONINGEN

Unlike the previous example, “B_motion-the living bridge”, the urban extenstion of Groningen, The Netherlands, applied parametricism to analyse the data collected from the site, used to find urban solutions and form generation.

The information collected [Fig. 4] was used it to create an urban field and establish static system of attractos/reppelors in the emergent vector field for multiagent system (MAS) simulation done in Virtools 4.3. This simulation based on self-organization principle, determined the pedestrian and bicycle connection between the city and the site, programmatic requirements and its distribution on site in the form of point-cloud [Fig. 5].

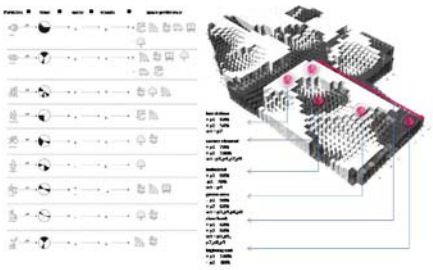

Figure 4. 3D diagram: representation of data

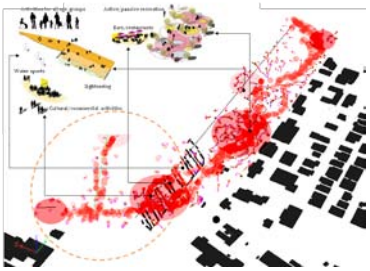

Figure 5. Point-cloud.

First attempts to transalate point-cloud to geometry involved association of a specific stage of kelidocyclus module and its scaling depending on the distance between points (agents). This failed because it created extremely complex junctions and an overall unstable structure. Therefore a second strategy was applied over the selected area. Functional and structural requirements guided the algorithms to itterate simulation for further refinement. This demonstatrates the the flexibility and adaptability of approach in case of failure.

A frame system enhanced with two frames and two connecting elements made a fully functional and structurally stable component, thus creating a vertebrae tubular system with structural integrity. The association of analized data to final outcome is maintained by environment responsive structure through openings towards light and visual potentials and wall thickness towards noise level. The same component has been translated to generate towers, gradually changing the functions between walls, floors and ceilings [Fig. 6]. The construction possibility was tested through a scale prototype based on folding principle which turned out to be extremely rigid and stable leading to the manufacturing opportunitiy in sheet material.

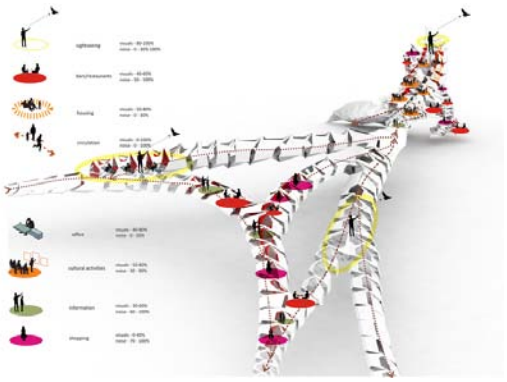

Figure 6. Architectural proposal (final form).

5. Indian examples

To present the entire range of demands today would require a compilation of book size; therefore the paper bring forward examples that link sensitive approach towards society and Parametricism to certain level.

5.1. HOUSING

Gandhi-nu-gam (Gandhi's village), Ludiya, Kutch exploits interaction between designer and community via a simulation kit made of Styrofoam board and cardboard. The primary design was based on site features, access, orientation and programmatic requirements as understood from surveys. Users reorganized their plots on the simulation kit as per their choices of location on site, neighbors, and clusters based on kinship and customs. A new layout was then made by the architect based on user feedback, incorporating consideration for climate, open space distribution and scales of neighborhood. The simulation kit was once again taken to the site and plots pegged for the villager's understanding and available space. After this on site exercise, each villager was allowed their preferred location, neighbors and arrangement of *bhungas* (local house forms) on plots; from this point on the layout was frozen.

This finalized arrangement was then translated to working drawings ready for construction. Construction of each unit was done by the owner and his family which resulted in a variety and richness of expression in terms of culture and lifestyle, most suitable construction material and technique for its context.

Aranya Housing, Indore is an indigenous and integrated development of planning for economically weaker section through close interaction of a multidisciplinary team of professionals. A user friendly design approach was employed to implement urban solutions. Considerable calculations went in to work out the sewage network. A continuous negotiation between natural slope versus required slope, pipe diameter – minimize the cut and fill ratio gave an innovative concept of connecting 18 toilets to one manhole with a trunk line in alternative rows ultimately yielding 40% cost saving.

To bring house form variation, a *kit of elements* approach was used where a permutation and combination of building elements were exercised by users making their own choice on a standard plan. These elements included railing, staircase, doors and balconies in brick, stone, cement and steel. Once again the end user was involved in construction process.

5.2. INFRASTRUCTURE DEVELOPMENT

Bus Rapid Transit System (BRTS), Ahmedabad implemented in the last decade is one of the successful examples of transportation planning. The BRT cell at the Center for Environment Planning and Technology (CEPT), Ahmedabad, developed a unique approach for urban transport. It used alternate analysis. Critical input for the process included primary data such as Social/urban, physical, existing infrastructure and demand assessment using surveys (mostly household), Google maps and GIS images,

photographs and videos. Origin-destination patterns were established based on primary input through alternate analysis. Alternate analysis used specialized software (Emme 3) that provides various alternatives. These alternatives were tested by logical deductive methods. A final choice of route was still based on ground condition, intuition and certain amount of risk. Design work such as road design, junction design and pavement design abased on physical data was then done for the proposed route.

The state/government got involved at implementation stage as the client. The plan/design were not necessarily followed exactly same as proposal. Many modifications were required due to site conditions and in the public domain; changes were also made due to political/ external pressure. To cater several unknown parameters throughout the process, the project was normally overestimated whereas in case of any failure, team had to start all over again. In the end solutions were provided that had acceptability for a wide range of stakeholders.

5.3. DETAIL DATA INVENTORY THROUGH DIGITALIZATION

Most recently, Municipal Corporation **Rajkot** (one of the smallest cities in the State of Gujarat) commissioned GIS Factory to **digitally document a 150 sq km area**. This is one of the first initiatives of its kind in India. The aim was to produce a detailed contextual inventory including physical, topographical, cultural, social, urban and infrastructure. Topographical information consisted of GIS maps plus super imposed total station surveys to correct GIS map errors which produced exact information at 5 meter grid density and contour survey of the terrain at every 50cm level difference. Urban data included demarcation of plots, its subdivision (if any as property rights), exact building foot print, number of floors defining the owner, 3D land-use through extensive photography of each property showing the present use. Social surveys recorded population count, occupation, number of working members of the family and general life style. The existing Infrastructure was also recorded. Entire trunk lines below ground including sewage, rainwater drain and water supply pipe with detailed dimensions of pipes, slopes, junctions and location of man holes were marked precisely. Telecommunication lines, lamp post with detail indexing and street furniture added to this information plus entire road cross-section marking paved/unpaved areas, its material specification, location of trees and other physical objects.

This intense information help the corporation firstly to generate revenue as it showed 500000 unaccounted properties, which will now be registered and fall under property tax laws. Secondly it made the system transparent between the government and the people.

6. Synthesis and future speculation

Indian examples selected here recognize, appreciate and implement the qualitative aspects versus chaos. Integrating this cumulative wisdom with computational tools evolves in holistic approaches inclusive of aesthetic and performative gain for present and future Indian demands. This is precisely **the *gain* of Parametricism in Indian complexity and chaos.**

In the case of **Mass Housing,** replacing the Styrofoam board simulation kit with computational simulation would allow visualizing the changes made 3-dimentionally much faster and better. It would also restrict those changes which try to overrule the basic consideration of climate, open space distribution and scale of neighborhood which was incorporated later by the designer. Using data interpretation as done in B_motion -the Living Bridge project, it would also generate programmatic requirements and its distribution on site in case of Aranya housing. This can be further developed in the Kartal-Pandik master plan layout to gain a strong association of layout, cluster, unit, social facilitates and infrastructure. The harmony of built environment created by variation of building elements can further be enhanced through digital fabrication techniques and integrating performance criteria.

Transport planning team already uses vast amount of digital information to be processed in special software. However, this primary data is generated in ways that takes a lot of energy, time and resources. This can be done separately as shown in Rajkot and be provided to all kinds of design and development. Such systematic and accurate data bases are more reliable and easy to update by feeding additional information from new proposal or any changes in the existing scenario. Such detail updated inventory would be useful for accountability and estimation reducing the number of unknown parameters related to an existing scenario. It would also help finding/updating alternate routes with respect to the update of the database. Parametricism offers a systematically defined process where each step is traceable so that in case of failure problems can be fixed at necessary stage and one does not have to start from scratch, as shown in B_motion- the Living Bridge project.

In addition to the above listed examples, when it comes to **master planning and urban design projects,** parametricism involves operation in hierarchy of economical, political and administrative boundaries. In that case Parametricism positively helps in policy making and reforming building by-laws. For example, building by-laws of Ahmedabad control all three parameters for building volume – ground cover (45%), FSI and number of floors (four) for low-rise buildings, which results in nothing but boxes of buildings with stilt parking all over the city. Building volume

control resulting from computation of individual parameter would give designers the opportunity to create better living condition. Another example here is law regarding balconies being recently changed. They are not free of FSI and not allowed at floor level. This has left no opportunity for people to come out of buildings, which is the life-style due to climatic reasons. It also resulted in less protected openings having only 60cms weather sheds. Rather, these decisions should be made based on the analysis of weather simulations which will not give specific solutions by making differentiating zones taking into account exact location and its climatic conditions.

When all these information models are linked at city or national level, one can also analyze and interpret urban flux and patterns. **Parametricism challenges the existing chaos and promises a holistic approach inclusive of aesthetic, performance and qualitative gain in Indian complexity.** Parametricism is valid at every scale by building over the cumulative wisdom. For mass housing – better participatory process, formulation of programmatic requirements, its distribution on site and continuous differentiation leading to build form variation and enhancement from macro to micro level. In the case of transport planning – Alternate route search using complete updated scenario in real time and make rational choices reducing risk factor, controls cost overrun by reducing unknown parameters and access to necessary stage in case of failure. Whereas for master planning and urban design guidelines – making and reforming policies/building-by-laws.

Acknowledgements

I shall keep it for next stage.

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