PARAMETRICISM: INDIAN SOCIAL NEED IN COMPLEXITY AND CHAOS

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Abstract. Indian society living in its physical context and administrative boundaries is complex. The contemporary built environment imitating perceived advance technology where development is purely measured by material consumption is chaos. The present approach to meet dynamic and diverse demands emerging from the complexity and economical boom is fragmented and superficial. The challenge is to find order – the hidden patterns - through an approach that analyzes and interprets the complexity with the holistic vision to offer contextual variety inclusive of qualitative richness in the existing chaos. Considering that Parametricism is based on algorithms and mathematics it is generally understood as quantification where as it is also important to understand its qualitative impact. The paper is an inquiry on qualitative gains of Parametricism that helps shaping society in Indian context.
This is demonstrated by bringing forward understanding on qualitative gains of Parametricism exemplified with an academic exploration and inter-relating them with Indian examples to showcase the opportunities.

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. 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. India has become one of the biggest consumer markets where there is huge dumping of goods 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. The development is measured purely by material consumption and expressed as imitation of form and style rather than true understanding of methods, tools and relevant issues offered by advanced technology. This scenario is referred to as chaos. Benefits of economical growth and technology has not translated into any quality services, availability of housing for the under privileged mass of rural population, to resolve issues of administration and policy making for urban development. There is loss of quality and experimentation that supports simultaneity of diverse demands, appropriateness of technology to offer variety and distribute the benefits amongst the society. The challenge is to question the present scenario.

Architecture in India has evolved over centuries beginning from Vernacular followed by Colonisation to Modernism and Post-modernism. Contemporary Indian architecture is going through the era of information revolution. The question is how to break this fake imagery of attractive packaged products, specific beliefs and develop a deep understanding of logic and reasoning to create homogenous heterogeneity for Indian society? How to couple the cumulative wisdom of traditional architecture with present demands of the information era? The search is to find an approach that analyses and interprets the complexity with a holistic vision and offers contextual variety having qualitative richness. To find an inclusive approach that offers a framework which keeps all the concise information yet flexible, adaptive and responsive to the changing socio-economic demands and its consequences to offer quality living environment? Some of the methods that have emerged from the technological revolution, if contextualised and understood for their content, may be able to suggest directions. The paper inquires in the qualitative gains of Parametricism to answer these questions.

2. 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 where as in India it is still in its infancy. For example, 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. Other demonstrated by Centre for Sustainable Environment and Energy (CSEE) of India is the first zero energy building. Based on parametricism, CSEE also 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, as explained by Patrik Schumacher, Parametricism can recognise, measure and simulate the complex patterns similar to Complexity theory and Frei Otto's research. It helps analyzing and appreciating the underlying logic and rationality and regenerate the seemingly chaotic patterns. Not only that, 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-Dimension.

Parametricism is valid at all scales, macro to micro, which means urban design, urban planning and policy making to architecture, interior design and product design. However its strength is directly related to the scale as it resolves complex issues more efficiently since "It aims at maximum emphasis on continuous differentiation, visual amplification of differentiated logics and aesthetic elegance of ordered complexity." (Schumacher, 2009, pp 14–24). These methods to find most appropriate solutions are similar to the processes in nature. Its associated system of correlation allows necessary deviation at any particular stage in design process and could use the same to amplify the initial differentiation. It offers a flexible frame work that makes and executes precise and intricate correlations between the whole to parts incorporating 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 gains of Parametricism which has the ability to transform built environment and society.

3. Tested cases based on Parametricism

3.1. B_MOTION: THE LIVING BRIDGE, GRONINGEN

B_motion-the living bridge, the urban extenstion of Groningen, The Netherlands, demonstrate an associated system of correlations that allows deviations and intricate correlation between whole to parts building morphology at all levels where qualitative shifts are carried forward to detail articulation. To perform this, the author and team applied parametrics to analyse the data collected from the site and used them to find urban solutions and form generation.

The data collected from site (figure 1) was used it to create an urban field and establish system of static and dynamic attractos/reppelors in the emergent vector field for multiagent system (MAS) simulation done in Virtools 4.3. The data consisted of population per household, age group, employed/unemployed/students percentage, number of vehicles owned per household, number of boats passing per minutes through the canal. Two simulations at macro and micro level were run based on origin-destination route search and self-organization principle respectively. The agents reacted positively or negatively from the static an dynamic attractors and repellents based on values assigned for its potentials. Results of simulations were then linked to the related functions.

These determined the pedestrian and bicycle connection between the city and the site (macro) and programmatic requirements and its distribution on site (micro) in the form of point-cloud (figure 2).

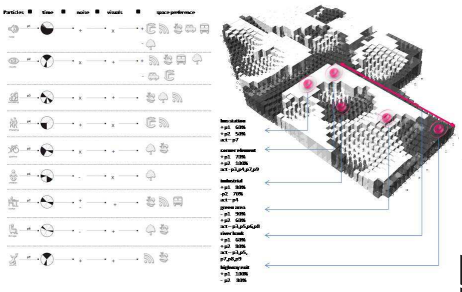

Figure 1. 3D diagram: data representation

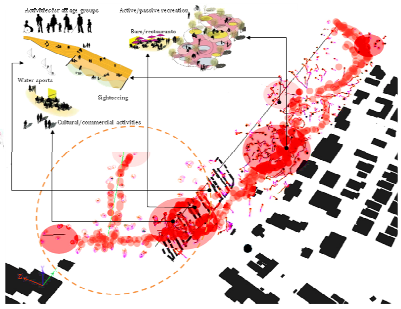

Figure 2. Point-cloud

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. 3]. The construction possibility was tested through a scale prototype based on folding principle which turned out to be extremely stable leading to the manufacturing opportunitiy in sheet material.

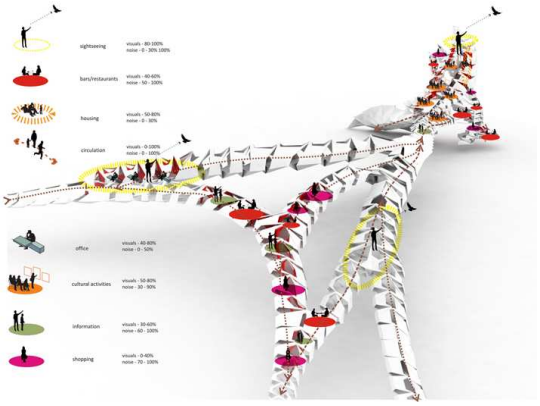

Figure 3. Architectural proposal (final form)

4. Indian context

To present the entire range of demands today would require a compilation of book size; therefore the paper brings forward some examples that have a sensitive approach towards society and immense potential which can be further explored through Parametricism. These examples recognize, appreciate and implement the qualitative aspects with respect to chaos.

4.1. HOUSING

Gandhi-nu-gam (Gandhi's village), Ludiya, Kutch redevelopment of villages provided housing, social structure, economic restructuring, amenities and facilities provision as well as resource management through participatory process involving people and community. The aim was to retain the livelihood, craft and local architecture which is the identity of the place.

A simulation kit made of Styrofoam board and cardboard was used for interaction between designer and community. The primary design was based on site features, access, orientation and programmatic requirements as understood from surveys [Fig. 4]. Users reorganized their plots on the simulation kit and were allowed to change as per their choices of location on

site, neighbors, and clusters based on kinship and customs [Fig. 5]. 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.

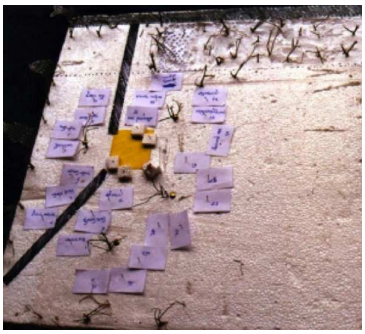

Figure 4. Primary Design

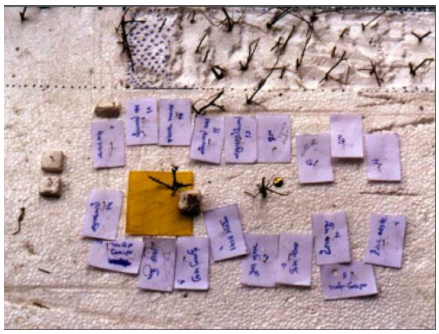

Figure56. Design after end user inputs

Replacing the Styrofoam board simulation kit with computational simulation would have allowed visualizing the changes made 3-dimentionally which is stronger and faster communication experience. It would also restrict those changes which try to overrule the basic consideration of climate, open space distribution and scale of neighborhood which were incorporated later by the designer. These restrictions in real-time would communicate the reasons to the end user. The simulation results could be directly transferred to the design proposal and construction drawings without any time and information gap in the interactive process.

4.2. 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 [Fig. 6]. 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.

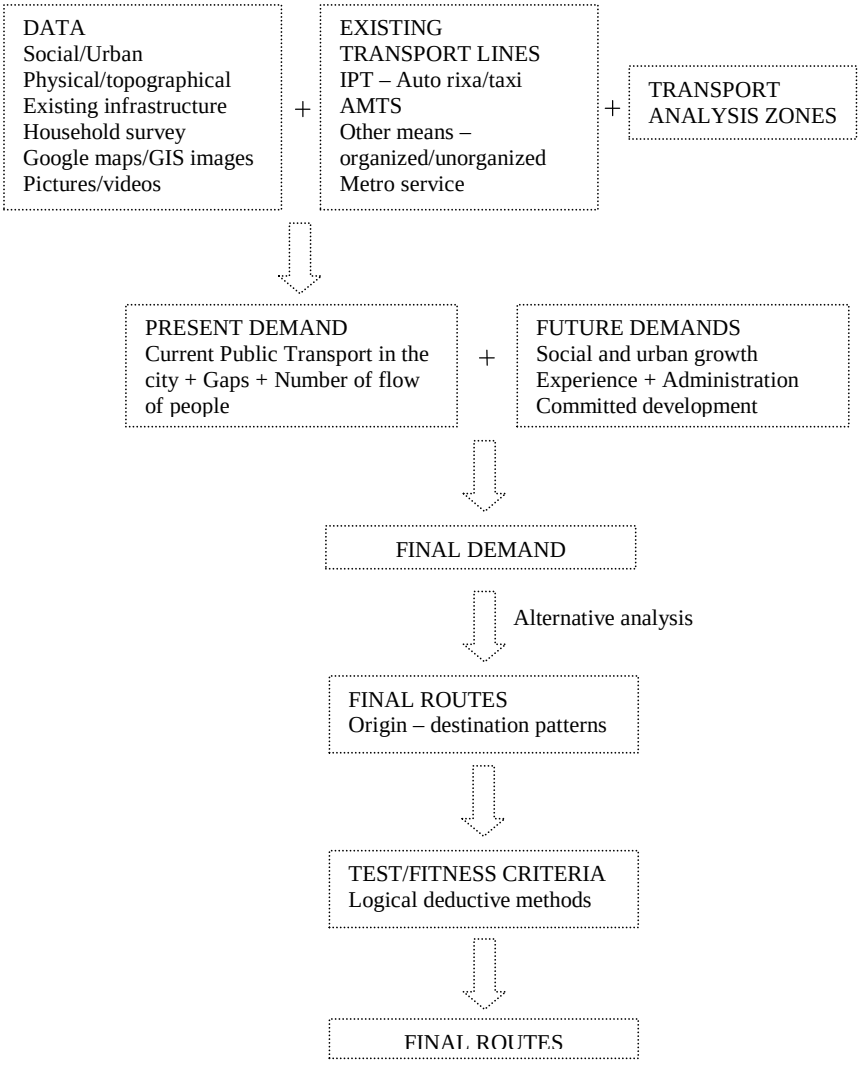

Figure 6. Design process BRTS, Ahmedabad using Emme 3 (Transport modelling engine)

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.

The 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. A detailed contextual inventory including physical, topographical, cultural, social, urban and infrastructure can be produced separately as done by GIS Factory for Rajkot municipal corporation, India and shall be provided to all kinds of design and development works. 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, 3-dimensional 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. Such systematic and accurate data bases are more reliable and easy to update by feeding additional information of a 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. The future demands, the input for final demand calculation, mostly depend on personal opinion of designer and local authority. This can be rationalized through parametric tools and accurate numbers can be speculated for final route search. 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.

4.3. POLICY MAKING AND ADMINISTRATION

When it comes to master planning and urban design projects, Parametricism involves operation in hierarchy of economical, political and administrative boundaries. In that case it 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 sixty centimeters weather sheds. Rather, these decisions should be made based on the analysis of weather simulations which will not give specific solutions by differentiating zones taking into account exact location and its climatic conditions.

The detail inventory inclusive of intense information help the local corporation firstly to generate revenue, in case of Rajkot five lacs unaccounted properties, which are now registered and fall under property tax laws. Secondly the system is absolutely transparent and accessible between the government and the people.

All such information models when linked at city or national level, one can also analyze and interpret urban flux and patterns for optimum use of scarce resources and its management. The use of Parametricism will lead to adherence to the by-laws without compromising with the qualitative requirements of the built environment.

5. Conclusion

Integrating this cumulative wisdom and intelligence of computational tools can evolve into holistic wisdom inclusive of quality, aesthetic and performative gains to coexist in present and future Indian complexity and chaos in more rational and prudent way. This is precisely the *gain* of Parametricism – the need - in Indian complexity and chaos. The explorations show that the deep understanding and application of Parametricism helps distributing economic and technological advancements at social level. This cumulative intelligence helps in organizing and incorporating vast amount of data that is variable and hence left out of purview of designer’s considerations. It can precisely find the demands such as housing, infrastructure development and so on. For mass housing, simulations make

better participatory experience leading to acceptance of social variables as parameters of design. It formulates programmatic requirements, its distribution on site and continuous differentiation leading to build form variation and enhancement from macro to micro level. In case of transport planning, it is effective at alternate route search using complete updated scenario in real time and makes rational choices reducing risk factor, controls cost overrun by reducing unknown parameters and access to necessary stage in case of failure. And it is effective for administration and policy making at master planning and urban design guidelines which aims public health and development. It also helps reforming policies/building-by-laws.

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