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The response of Critical regionalism to contextual changes over time in South-east Asian Tropical residential architecture – A case study of Singapore

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Abstract: In today's age of Globalization, the revival of a culture's heritage through architecture is a means to resuscitate local identities and promote a psychological sense of belonging. However, the last thing we need today is another thoughtless revisit into tradition or in an attempt to be a part of the Global village, employ a Globalized architecture which would only result in buildings that would struggle to adapt to the changed environmental, social, economic or even political context. Hence Critical Regionalism; where the architecture has to evolve over time to have any validity. This paper focuses on the response of Critical Regionalism through time and changing context for residential architecture in the Tropical region of South-east Asia, with specific focus on Singapore. It traces the translation of Regionalistic principles into the high-rise, high-density housing model with the help of a case study of the Bedok Court Condominium in Singapore. The case study is followed by a theoretical discussion of what the new age Critical Regionalism has to incorporate in order to be successful, with the help of the theories of Singaporean architect Tay Kheng Soon and a ventilation Case study of Hong Kong.

Key phrases: Critical Regionalism, Singapore, vertical translation, Bedok court condominium, Tay Kheng Soon

1. INTRODUCTION

As the world's environmental status has been forcibly brought into the limelight by the evident disastrous effects of Climate Change and Global warming, the design of the built environment is being critically rethought. Moreover, the shift from the identity destroying "International style" of architecture to the resuscitation of local identities is being seriously considered. One possible approach could be to draw

influences from architectural heritage and tradition and apply them in a contemporary context. Critical Regionalism is one such concept that puts Regionalism and Revival of architectural heritage in perspective and makes it contextually appropriate. It opposes a blind revisit into tradition and encourages a critical rethinking of traditional practices and application where suitable in conjunction with the contextual changes. What was suitable a few decades ago is rendered redundant in the present day because the context has undergone changes, predominantly environmental, through the years. Spacious low-rise private residences with open plans and courtyard concepts which were successful strategies to maximize ventilation and provide thermal comfort in early Tropical architecture, do not function similarly in the congested and space deprived cities of today. With post-colonial economic growth and development of urban centres, the population in the urban areas grew and space became a rapidly decreasing commodity. This resulted in the vertical growth of residential architecture. The strategies of climate responsive architecture that had many precedents in its low-rise *avatar*, had to be translated vertically. The other side to the same coin was the contextual change brought about by Globalization and with it the thoughtless mass reproduction of the so-called International style of architecture that favoured mechanically conditioned glass skyscrapers. The result was energy-guzzling and local identity destroying buildings that not only did not respond to the climate, but also had an adverse effect on it. The International style is the anti-thesis of Critical Regionalism. In the past, where Critical Regionalist architecture in the Tropics, strived to keep the sun and rain away, nowadays the sun and rain are treated as useful resources that could be harnessed to make a positive contribution to the architecture. Moreover, buildings today, have to be designed to stand the test of future climate change. Thus, Critical Regionalism in the Tropics for residential architecture, since its inception as a concept up until today can be classified as (1) low-rise open-planned individual residences, (2) vertical high-rise, high-density housing, (3) mixed-use, high-density technology driven urban developments. This paper would endeavour to trace the Vertical translation of Critical Regionalist architecture and analyze the practical viability of the environmental aspect of the concept through a case study of the Bedok Court Condominium in Singapore and conclude with a brief discussion of the new-age Critical Regionalism.

2. CRITICAL REGIONALISM

“Critical Regionalism emerged as an architectural concept in the early 1980s” (Eggner, 2002, p. 228). It celebrates the essential paradox of according to Paul Ricoeur “how to become modern and to return to sources; how to survive an old, dormant civilization and take part in a universal civilization” (Foster H., 1983,

p.16).Tzonis and Lefaivre (2001, p.6-9) refer to a speech by Lewis Mumford who observes that, “Human regionalism is not a matter of using the most available local material or construction neither is it in conflict with the universal.” He argued that “Regional insight has to be used to defend us from the international style”. If Critical Regionalism is looked at as an architectural movement then as a scholar, Eggner(2002, p.235) observes “it was but another symptom or victim of the inevitable universalizing tendencies it warned against”. However, as a concept that varies with regional context, Critical Regionalism boils down to doing what is right in that circumstance for that project and region.

2.1. Tropical regionalism/Critical tropicalism

Lefaivre and Tzonis (2001) have identified the difference between Tropical architecture and Tropicalist architecture. The traditional definition of Tropical architecture since the late 18th century according to them has been an architecture that is adapted to the tropical climate. However, they reckon that after the Second World War, some architects in the region recognized the narrow scope of this definition and started to critically rethink about it. They realized that the conception of architecture should go beyond mere “sun shading and ventilation devices” and should also be “an extension of the mind, a cognitive tool that expresses the values of a particular people and time in the way that film, art and music do.” This critical rethinking, they believe, is what distinguishes Tropical architecture from Tropicalist architecture.

The two major driving forces of Tropicalist architecture are Postcolonialism and Globalization. Both these factors directly deal with issues of identity in vastly different ways. While, on one hand these countries have to strive to shed their colonial identity and try to revive their indigenous identities and heritage, on the other hand they have to make an effort to be part of the ‘Global village’ and hence adopt international standards and a globally recognizable identity.

Hence, Critical Tropicalism; where elements are not incorporated just to appease the International style or to reiterate one’s blind faith in tradition, but because they are appropriate to the context. Another factor that is a direct consequence of Globalization is urban development and urban population growth which has had an effect on the tendencies of residential architecture and has posed the problem of housing for the increased population flow in urban centres. In rapidly growing cities, this would be a critical aspect for which a solution has to be sought, while still dealing with critically retaining regionalist principles. This is important since, as the world is plunged deeper into the model of a ‘Global village’, local identities would get more and more

obsolete which would be catastrophic in that it would mean a civilization lost.

2.2. Critical regionalism in South-east Asian Tropical Residential Architecture – a movement of adaptation

Post-colonialism, the political agendas of different Tropical countries differed in terms of whether they decided to revive their indigenous architecture or in an effort to be globalised, mimic the architecture of the West.



Fig 1– Singapore skyline resembles a city in the West

(Image source: <http://www.uimages.org/tag/singapore/>)

In countries like Singapore which have had an accelerated economic progress from the outset, and also a political agenda that favoured Westernization and becoming a Global city, high-rise architecture in general and multi-storey high-density public housing was the norm from an early date (Fig 1). Critical Regionalism in this era had to be rethought to suit vertical development. Other Tropical countries with slower economic progress and which are less Globalised like Indonesia, where population densities are high, but horizontal development has been predominantly the norm have to rethink about accommodating the increasing population in vertical developments.

3. CRITICAL REGIONALISM IN SINGAPORE – VERTICAL TRANSLATION

Critical Regionalism in Singapore takes on another dimension owing to density and space availability issues and its race towards becoming a Global city which is in turn related to national identity. The political agenda of Singapore has hardly ever been to establish a link between the history of Singapore and its identity.

“With rapid development since the 1970s, Singapore has been transformed by highways, modern shopping malls and high-rise buildings. Rural *kampongs* and old buildings in historic Chinatown have made way for new retail, commercial

and residential development (Huang 2001). When tourism arrivals dipped in 1983 followed by a period of stagnant growth, Singapore's loss of cultural appeal was regarded as the chief cause. In a policy U-turn, urban planners started to focus on Singapore's architectural heritage and urban demolition gave way to conservation and restoration." (Bell D, 2006, p.69)

3.1. The Housing situation in Singapore

Statistics show that,

"84% of the population of Singapore live in public housing units produced by the Housing Development Board (HDB), most of them high-rise apartments. Of the remainder 11% live in private high-rise condominiums. Only 5% mainly from the affluent strata of Singapore society, live in so-called landed properties and enjoy the use of private garden (Bay, 2004, p.333)."

In such a case, the regionalist principles that were applied in the past to low-rise residences would have to be adapted to high rise buildings, to make it sensible for the context; in other words, make it Critical Regionalist. Applying the concepts of Critical Regionalism, while taking the problems of density into consideration, is the major challenge in Singapore. It can be safely said that, precedents from history for such an endeavour are nil. A pragmatic approach was required to physically realize the concept. One such approach was made in the period between 1982 and 1985, when the Bedok Court Condominium was designed by the architect Cheng Jian Finn.

4. CASE STUDY

The Bedok Court Condominium in Singapore designed by the architect Cheng Jian Finn was analysed as being the best representative of the translation of Critical Regionalism into a vertical development in Singapore. A discussion of the elements that have to be incorporated in the new age Critical Regionalist architecture with help from theories of Tay Kheng Soon concludes the paper. Before getting into the analysis of the case studies, a brief insight into the typical climate in the Tropical region would be useful in order to identify the environmental determinants of an architecture that is climate responsive in this region.

Climate in the Tropical region – "Although there are dry areas, the zone is characterized mostly by a typically year-round climate that is hot, humid and steamy with high rainfall and great similarities in vegetation." (Tzonis and Lefaivre, 2001) At first glance, the primary concern of the architect in designing in such a climate would have to be minimizing solar gains, maximizing ventilation and dealing with the heavy

rainfall through materiality and forms. In addition, the social and psychological effects of the climate on the users also have to be dealt with. The climate thus, cannot be considered in isolation because in the tropical region, the climate has an effect on the life and work of the people (Bay and Ong, 2006). Creating comfortable and liveable environments that the users can psychologically relate to and at the same time feel like they are living in a modern world and still respond to the extreme climatic conditions is the challenge.

4.1. The Bedok Court Condominium, Singapore



Fig 2 - forecourts and verandas incorporated vertically (Image source: <http://www.ply-studio.com>)

The architect, Cheng Jian Finn was inspired by the traditional features of the Malay Kampong house such as the entrance veranda and translated them as modern forecourts (Fig 2) to incorporate them in a high rise condominium. This was a three-pronged solution, in as much as resolving the issues of national identity; climate control viz. maximising ventilation, providing shade, providing thermal comfort; and providing for social interactions and a sense of community. A socio-climatic analysis of the building was undertaken by Joo Hwa Bay to assess the function of the forecourts in the building. The environmental analysis of this building helped appreciate and learn from a successful bio-climatic approach to a high-rise, high-density residential building which includes all the features of a Critical Regionalist design.

4.1.1. Design

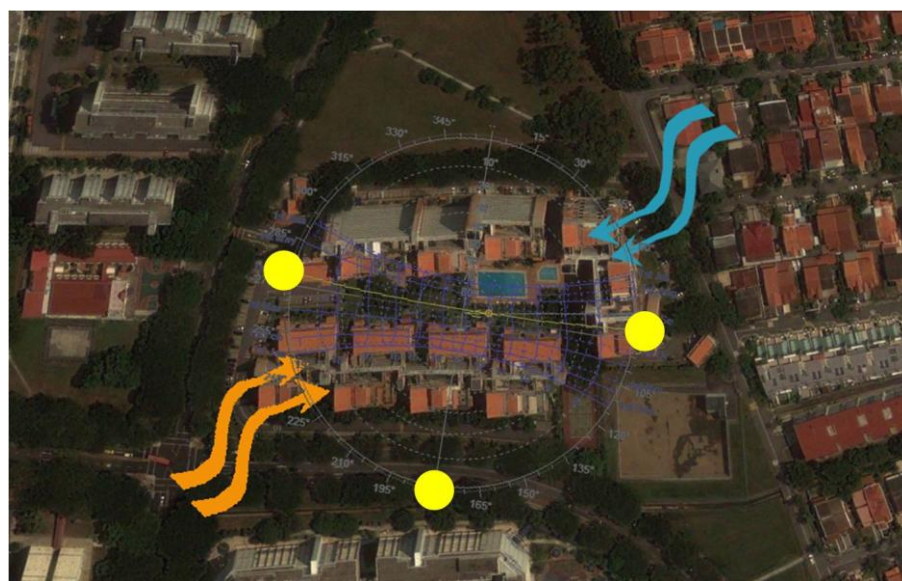


According to the architect, Cheng Jian Finn, “his inspiration came from his first-hand experience of the kampongs in Singapore. He wanted to recreate the relaxed friendly atmosphere and strong sense of community and security found in this setting

Fig 3 - A traditional *Kampong* house with a forecourt (Image source: Bay, 2004)

(Bay, 2004). Each Kampong house had a forecourt (Fig 3) which was the centre of social activities and provided a visual connection to the street where people could greet each other and breed familiarity and a sense of belonging. “The architect also wanted to design high-rise apartments, where each resident could own a ‘piece of green’ and a ‘house’ in the sky.” Cheng’s intention was to give the residents an opportunity to feel like they were living in a ‘landed property’, which is not easily achievable in land scarce Singapore, while still being part of a high rise building. Cheng was also highly “influenced by the writings of Jane Jacobs (Jacobs, 1962) and by her assertion that the modern city needs a vital street life.” The forecourts and the long corridor linking the different forecourts in front of the dwellings helped achieve this goal as everybody had an opportunity to meet and greet their neighbours as they passed along their forecourts on the corridor ‘street’ (Bay, 2004).

A socio-climatic survey was conducted by Joo Hwa Bay, which deduced that the forecourts were found to be the most used and comfortable spaces according to the residents and has been referred to wherever appropriate.



South - South-west winds North - North-east winds

Fig 4 - Google image of Bedok court condominium with micro-climatic details (Image source: Google Earth)

4.1.2. Fenestration and Cross-section:

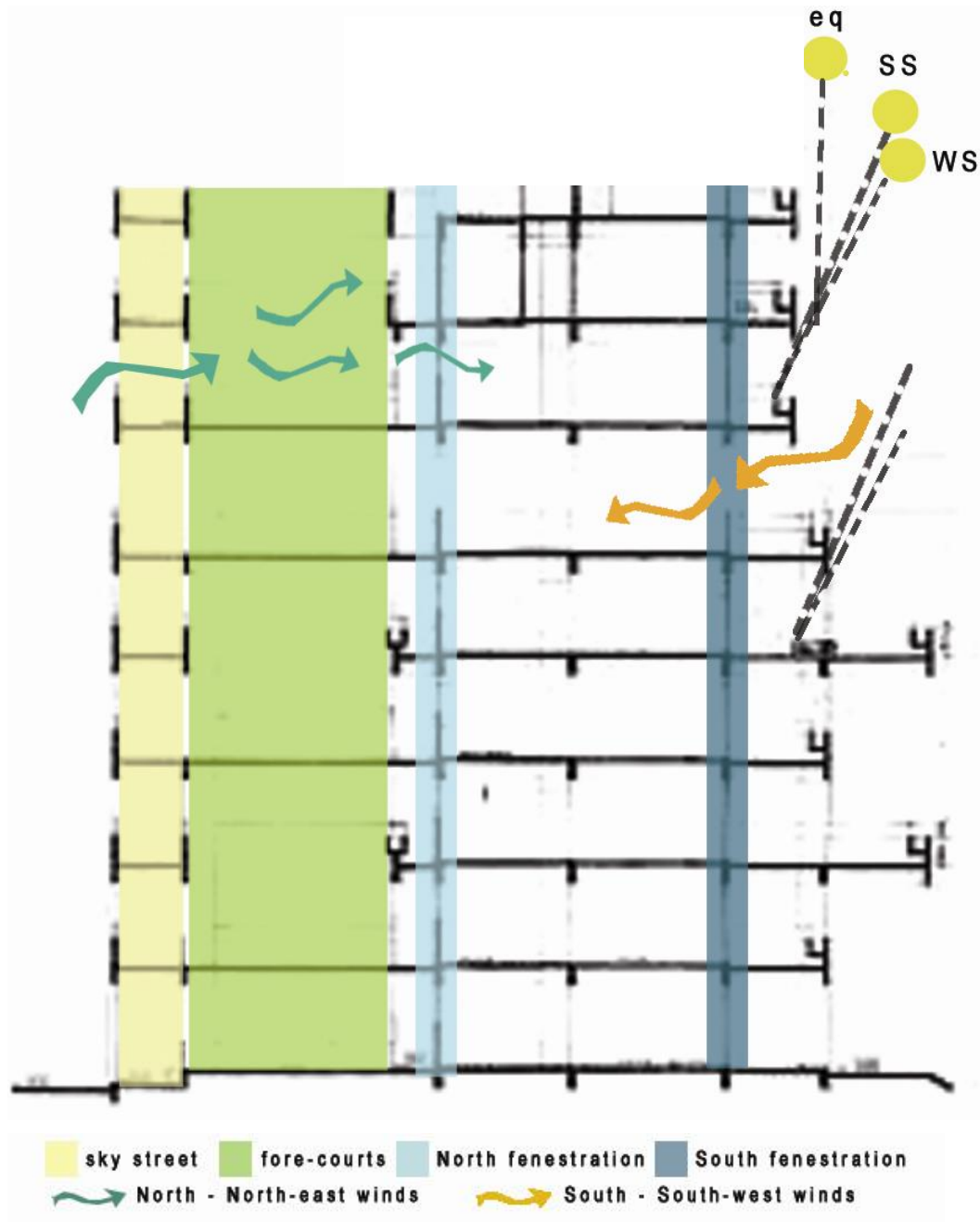


Fig 5 - Cross-section of Block 1 of Bedok court Condominium (Image source: Obtained and modified from Bay, 2004)

- The circulation corridor towards the North that connects all the forecourts to the individual apartment and acts as the communal sky street(Fig 6)

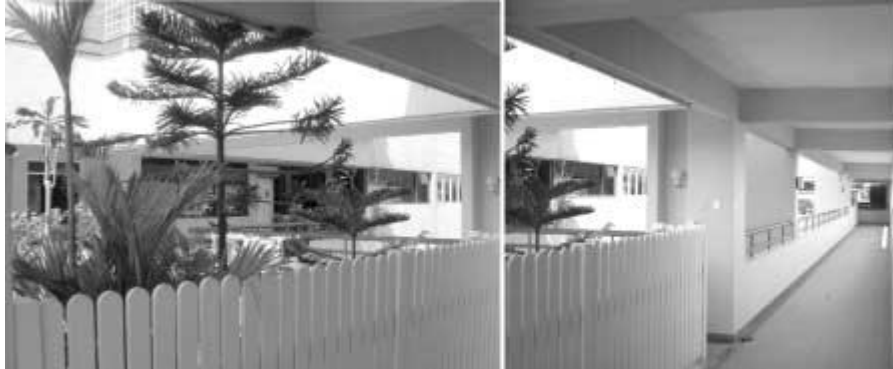


Fig 6 - the communal sky street(Image source: Bay, 2004)



Fig 7 - vegetation in the forecourt as seen from the open-to-sky void (Image source: <http://www.ply-studio.com>)



Fig 8 - individual fore-courts for each dwelling (Image source: <http://www.ply-studio.com>)

Individual semi-open forecourts that mimic the semi-open space in front of the traditional Malay Kampong houses, are double-height in some places (Fig 8).

These spaces are large enough for social activities and entertaining guests. According to the Socio-climatic survey conducted by Bay, the residents preferred this space over the interior of the apartment as being the most desirable space in the apartment. They also identified with the space as being their Kampong and there was a distinct sense of “belonging and ownership”. Most of the residents did not have any issues related to the lack of privacy, which was an initial concern of the architect.

Each apartment is open on the North and South sides through fenestration that is indirectly lit and ventilated. There are balconies on the South into which the bedrooms open and the living spaces open into the forecourts on the South (Fig 7). The East and

west have no fenestration.

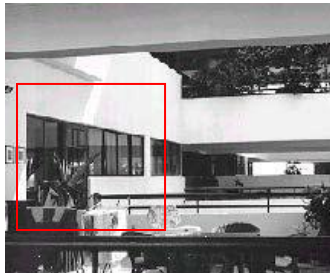


Fig 9 - fenestration facing the fore-court (Image source: Bay, 2004)

The fenestration facing the forecourts towards the South, are openable French windows that provide light and ventilation to the living spaces (Fig 9). The forecourt drives the North-eastern winds through the windows to ventilate the living spaces within.



Fig 10 - Fenestration on the south (Image source: Bay, 2004)

The fenestration facing the South again consists of French windows that open into balconies that serve the bedrooms and also provide cross-ventilation to the living spaces (Fig 10). These catch the South-west winds. The balconies on the South also act as overhangs to the windows and successfully prevent solar penetration during solar noon on the Equinox, Summer Solstice and Winter solstice.

Thus, the design intent was established and then the next step was the practical quantitative analysis of the performance of the building.

4.2. Daylighting analysis

The survey on daylighting comfort levels in the forecourts conducted by Bay (2004) showed that

the majority of the respondents (80%) found them slightly too bright (1), comfortable (0), to slightly dim (-1) for a range of daylighting levels from 50 lux to almost 6000 lux [17]. In a sense, the daylighting levels in such semi-open spaces were quite high, receiving a lot of daylighting from the diffuse sky. Only a small percentage (less than 5%) reported that they felt the lighting was very dim or very bright. That means that daylighting levels were reasonably acceptable to the majority of the respondents.

A daylighting analysis was conducted using the Ecotect software which revealed that the interior of the apartments were partly daylit while the forecourt was over-lit which is expected from a semi-open space and corroborated the findings of the Bio-climatic

survey.

4.3. Thermal analysis

One apartment each on the ground floor, the 9th floor and the 20th floor was analysed using the Bentley TAS software by the author to determine the thermal performance of the interior of the apartments and the semi-open forecourts.

Boundary conditions: The internal conditions were set to a naturally ventilated residence with no heating or cooling and with inter-zonal air movement from the forecourts into the interior spaces. The dry bulb temperatures of the spaces were compared for the hottest day of the year which is on April 23rd when the temperature ranges from a minimum of 27°C to a maximum of 33.8°C at 2pm for the time period between 9am and 3pm when the temperature and discomfort is maximum. The winds in April are light and variable but there is maximum wind from the North-east direction. The RH on April 23rd is between 56% and 94%. The comfort range of temperature for a Tropical climate is between 23°C and 29°C.

4.3.1. Testing for Comfort conditions:

All three floors were first analysed to see for what percentage of the year the spaces are under comfort conditions with respect to temperature. From the bar charts below, it can be seen that the external temperature is within the comfort range for 83% of the year, as is the forecourt, in all three cases. The temperature in the interior spaces of the ground floor, intermediate floor and topmost floor apartment units are in the comfort range for 80%, 78% and 75-78% of the year respectively (Chart 1, 2 and 3)

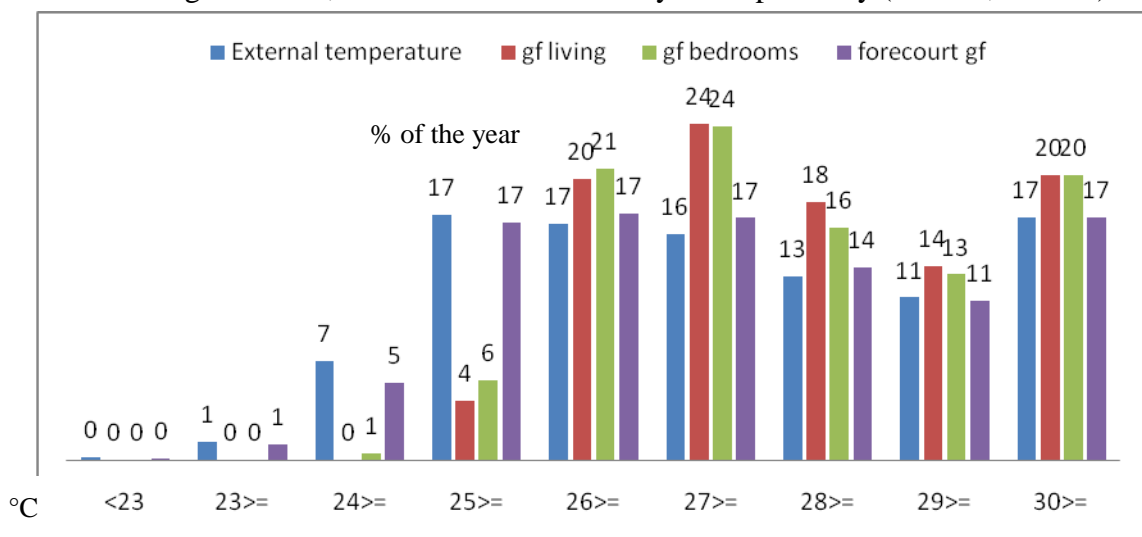


Chart 1 – Percentage of the year within the comfort range of temperature for an apartment on the Ground floor (Source: TAS analysis)

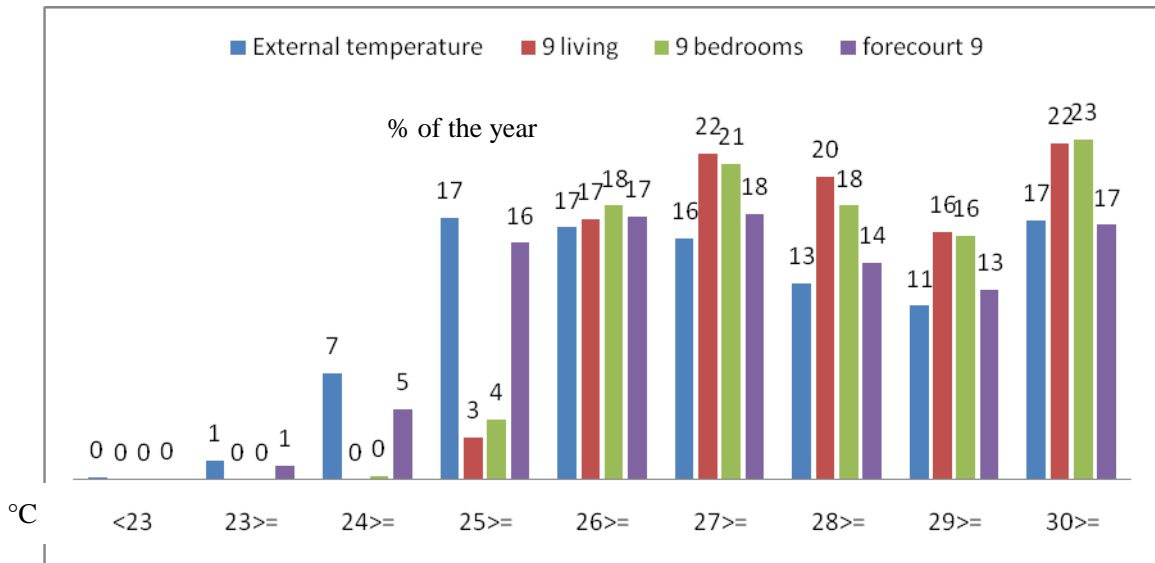


Chart 2 - Percentage of year within the comfort range of temperature i.e. 23-29°C in an apartment on an intermediate floor (Source: TAS analysis)

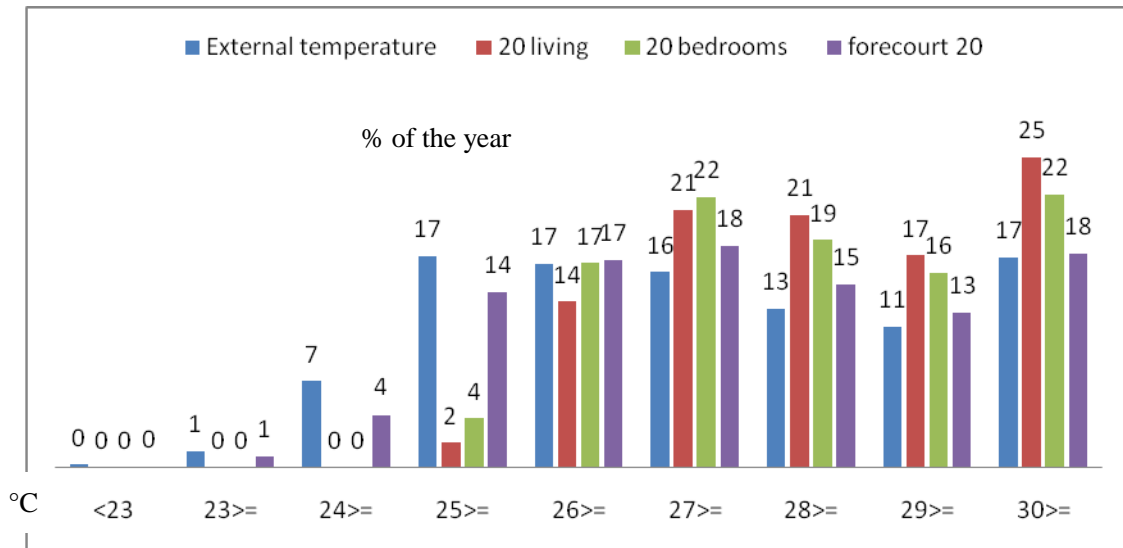


Chart 3 - Percentage of year within the comfort range of temperature i.e. 23-29°C in an apartment on the twentieth floor (Source: TAS analysis)

The performance of the interior spaces with respect to thermal comfort conditions is not satisfactory as they are not within comfort range for a higher percentage of the year than the outside. The thermal performance is worse in the intermediate floor than the ground floor and is the worst in the twentieth floor. The interior spaces thus, do not work efficiently to provide thermal comfort. However, the forecourts being semi-open spaces perform relatively better than the interior of the apartments.

4.3.2. Comparison of the thermal performance of spaces in three different floors

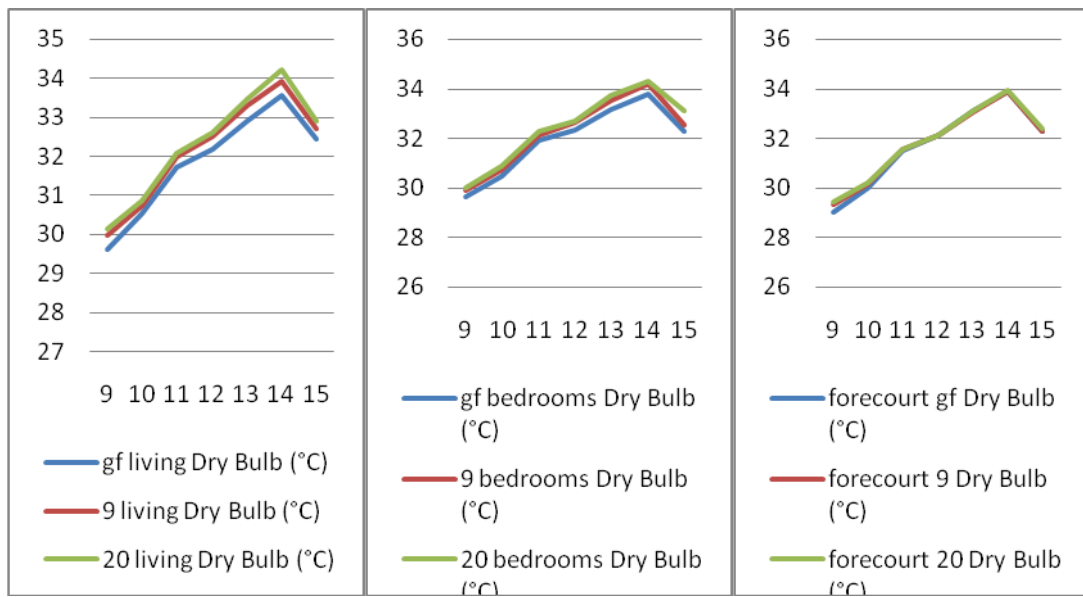


Chart 4 - Comparison of the thermal performance of the living rooms, bedrooms and forecourts respectively on the three floors under study between 9am and 3pm on the hottest day (Source: TAS analysis)

The above graphs (Chart 4) show that the thermal performance, on the hottest day, during the most uncomfortable time period between 9am and 3pm, of the spaces in the apartment on the ground floor is better than that of the intermediate and the topmost floors. The topmost floor performs the worst. The forecourts perform similarly in all the three floors but are relatively more thermally comfortable than the interior of the apartment on the intermediate and topmost floors.

The apartment on the topmost floor is the most thermally uncomfortable space as compared to the ground floor and the intermediate floor. Since the spaces have varying degrees of thermal comfort, the users have the choice of moving to a space that's more comfortable to them; the preferred space being the forecourt since it is well-ventilated and vegetated, providing comfort when it is most required.

The results of Bay's survey corroborate the results of the quantitative thermal analysis in as much as proving that the forecourts are found to be thermally favourable as compared to the interior spaces.

4.4. Conclusions drawn from the case of the Bedok Court Condominium in Singapore

The design successfully adopted strategies from the traditional architecture and achieved the intended sense of community and belonging that the Kampong houses of the past garnered. The fact that the most important aspect of the design, which was the forecourts for every individual apartment, after which the development was named, is considered the most desirable location in the apartment and is used for multiple functions, marks the success of the design. It is evident that, even though the environmental analysis proves that the thermal and daylighting performance of the condominium are not completely satisfactory, psychological and social factors of community living and familiarity gain the upper-hand in this case, which is why the residents still found the forecourts comfortable. This proves that the vertical translation of traditional open spaces, which are the fore-courts in this case, can work successfully, from a design point of view, to create an environment that the residents can connect with. However, apart from these factors, the thermal performance of the building leaves much to be desired. This could be attributed to the fact that Singapore, like most other urban centres, has been at the receiving end of the effects of Climate change, urban population influxes, and space congestion, due to which even a successful design like the Bedok court which does not rely on mechanical air conditioning, would deteriorate in its performance with time. With foreseeable changes in the climate and environmental conditions, there is a need for a holistic approach to design that goes beyond the individual building and indulges the urban setup as a whole. This is the age of environmental planning at an urban scale to ensure that all buildings are working in tandem with each other and the environment and not against each other or the environment.

5. NEW AGE CRITICAL REGIONALISM

The Singaporean architect Tay Kheng Soon whose work revolves around the principles of Critical regionalism, observes in his essay in the book titled Tropical architecture (Tzonis and Lefaivre, 2001) that there is a requirement for rethinking Tropical architecture at the city planning level. He goes on to state that the pioneering Tropical design ideas of the past viz. Le Corbusier's sun breakers and open-plan buildings, are "dysfunctional in the dense and polluted city centres of the mega-cities of the tropics". He goes on to elaborate the importance of taking the dust, noise and pollution aspects into consideration while designing in today's cities, which is why old Tropical design ideas are no longer applicable. The issues of Urban heat Island come into play while designing in city centres, where it has been found that the

temperature is at least 3-4° C higher than the open suburbs. “The closeness of big, concrete and steel buildings creates a canyon effect in which heat is accumulated and reradiated between the surfaces and building masses and the temperature is raised.” (Tzonis and Lefaivre, 2001) Buildings that are not designed keeping in mind this difference in temperature due to congestion, existing buildings and pollution, will fail to provide the required comfort to its users.

Deciphering the solutions for a new age Critical regionalism, pointers can be adopted from these theories of Tay Kheng Soon and from a case study on the importance of ventilation in an urban scenario in Hong Kong. These pointers include:

- a) High-density, high-rise Mixed use developments
 - b) Environmental design considerations especially maximising ventilation
 - c) Harnessing the abundant sun and rain for energy conservation and generation and critically applying traditional passive design strategies but embracing new solutions
- a) High-density, high-rise Mixed use developments

According to Tay Kheng Soon in the same essay (Tzonis and Lefaivre, 2001), “ in the context of dense urban environments in the tropics, if ‘tropical architecture’ is to be an appropriate concept, then the achievement of comfortable building conditions can only be realized in groups of appropriately designed buildings.” He goes on to declare that single buildings cannot achieve tropical comfort characteristics through natural means. This can be realized by designing mixed-use developments and Tay Kheng Soon experimented with these concepts in two innovative housing and commercial mixed-use projects in the late 60s and early 70s namely the People’s park Complex(1967-70) and Woh Hup(1973) (Fig 11).



Fig 11 – Left - The Woh Hup, Right – The people’s park complex

The aim in these projects was to “recreate traditional forms of urban community in conditions of extreme density”. In the Woh Hup, the architect experimented with the concept of mixing uses with transport links that would form an introverted city where everything is connected with emphasis on movement achieved by the “multiplication of blocks along the urban street serving as connectors throughout the tropical city”. It was a futuristic concept of “interconnected internal cool spaces as well as the external sheltered urban and communal spaces, serving as platforms for mass rapid transit stations, bus stops and activity nodes.” Apart from this urban perspective, the residential towers at Woh Hup were so designed as to maximise cross-ventilation in each apartment, “efficiently catching the sea breeze and eliminating the need for air-conditioning.” Though the Woh Hup was not physically realized in its entirety, both the People’s park complex and Woh Hup were pioneering solutions to the problems of Tropical architecture (Tzonis and Lefaivre, 2001).

The approach would involve all aspects of urban life, mainly movement and transportation which should be so planned that their need is reduced and not thought of after the need is created. Minimising transportation would minimise the amount of time spent outdoors in uncomfortable thermal conditions and in turn reduce dependency on automobiles and thus reduce pollution. Soon also believes that the successful workings of the Tropical rainforest should be replicated in the city, with heavy planting of buildings and promoting biodiversity in mixed-use developments. Establishing a symbiotic relationship between the building and its immediate environment, be it the built environment or the natural environment, is the key.

b) Environmental design considerations especially maximising ventilation

The basic thumb rules of environmental design should be followed but in an urban scale, like orientation of the streets along the predominant wind direction so as to drive the wind, as according to Soon, it is important to use “every bit of wind movement in the tropics” to achieve thermal comfort; “creating a tight weave of urban spaces rather than allowing broad roads and open spaces to ensure that public spaces are shaded by buildings and are so orientated as to funnel wind”; vertical planting on buildings etc. (Tzonis and Lefaivre, 2001)

The importance of the wind in the Tropics is further established in a case study of air ventilation assessment in Hong Kong (Ng Edward et. al, 2011) which is the most densely populated city in the world. They in their research paper have referred to Hsie & Ward (2006) who believe that “Increasing the provision of fresh air in cities and subsequently enhancing the health and comfort of the civilian in indoor and outdoor

spaces, altering air temperature and also alleviating dispersion of pollutant are considered to be the beneficial facts of considering wind force and natural ventilations in urban planning strategies and ultimately one of the main drivers of sustainability.”

A set of qualitative guidelines were put forth by this study (Ng Edward et. al, 2011) which included the following considerations:

1. Creating an air path with roads, streets and public spaces through which the wind can circulate and reach inner parts of urban areas dominated by high-rise buildings
2. Orienting street grids along the prevailing wind direction
3. Linking open spaces to form breezeways or ventilation corridors with low-rise buildings along these corridors
4. Maximizing air penetration by aligning the longer frontage of buildings parallel to the wind direction and introducing setbacks and open spaces where appropriate.
5. Buildings along waterfronts should be designed such that they do not block the sea/land breezes.
6. Designing podiums in large buildings such that they form ventilation corridors to drive air along the prevailing wind direction and create air-flow at pedestrian level.
7. Building heights should be varied so as to allow movement of wind by decreasing the heights of the buildings towards the wind direction.
8. “Adequate wind gaps preferably at a face perpendicular to the prevailing wind should be provided between building blocks to enhance the air permeability.”
9. Increasing shading and greenery by planting tall trees along the roads, forming canopies, vertical planting on buildings, promoting bio-diversity etc.
10. Projecting horizontal obstructions like elevated walkways can block the wind and should be avoided. (Ng, Edward et. al., 2011)

These guidelines can be put to use in Tropical cities at the planning level where the climatic conditions are such that thermal comfort can only be achieved by allowing air flow and putting the prevailing wind to good use.

- c) Harnessing the abundant sun and rain for energy conservation and generation and critically applying traditional passive design strategies but embracing new solutions

Moreover, elements that were considered a bane to architecture in the Tropics like the sun and rain, in today’s context and with the current technology, Soon (Tzonis and Lefaivre, 2001) believes that it is no longer a criterion to keep them away and it is an age where harnessing the abundant sun and rain through the design is the more appropriate approach. The solution lies in embracing new technology and inventions like “new building materials, energy efficient systems, and solar energy powered

appliances” (Tzonis and Lefaivre, 2001) that would enhance the performance of regionalistic strategies and make a positive contribution to the environment. New research and inventions in thermal comfort and environmental sustainability has opened up a whole world of possibilities; for example, “a research project by Dr. Rao at the National University of Singapore has demonstrated that providing a thin film of water on the surfaces of a building will reduce the cooling load by as much as 25%.” (Tzonis and Lefaivre, 2001). This is just an example of the number of new solutions available from new research. The abundant natural elements can be used to work to the benefit of user comfort and the environment in general and modern passive solutions and strategies can harness these elements to make them work efficiently.

The Bedok court Condominium had in its design incorporated most of the aforementioned strategies but in a limited scale. It was designed as a group of buildings with a combination of multi-storey and high rise buildings with passive design strategies adopted from tradition. What it lacked was improved and modern passive design solutions and a broader design sensibility. Active facades, insulation etc. could be incorporated to improve its thermal performance.

5.1. Conclusions drawn from Tay Kheng Soon’s theory

Regionalism today, surpasses vernacularism and architectural degeneration. Today’s urban regions, demand the sensible use of space and a critical approach suited to high-density developments. Principles of environmental design that were successful on their own in the past, cannot work in the same way at present in the wake of the effects of climate change. They need to be supported by pragmatic interventions and technology driven systems in order for them to perform satisfactorily. Concepts of mixed use developments not only tackle issues of space, transport, holistic environmental solutions but also enhance community living by promoting social interactions. New developments should be raised in groups of buildings that support rather than hinder each other in their environmental functioning. The designs should incorporate traditional features not as superficial attachments but in the forms of the buildings where appropriate or in the use of principles and elements that would form an integral part of the design. Resisting technological advancement in blind favour of regionalistic principles will only lead to worsening of the situation when these principles have not adapted to the changed context.

6. OVERALL CONCLUSION

It has been established through this paper that in today's context of global climate change and energy depletion, the low-rise residential model which was the predominant typology of Critical Regionalist residential architecture, would fail to perform as desired in an urban scenario. The vertical translation of traditional principles used in Tropical architecture like open and semi-open spaces, as in the case of the Bedok Court Condominium, where traditional fore-courts are incorporated in a high-rise development, succeeds in terms of providing a sense of community. Even though, it also takes the aspect of driving the much needed ventilation through these open and semi-open spaces into consideration, the design fails to provide the required thermal comfort, due to the unilateral approach of focussing on the particular site alone. It could also use new methods of passive design and renewable energy solutions to enhance its performance.

In gist, what is required in today's context is the widening of this same approach as the Bedok court condominium into a larger urban fabric that would incorporate groups of buildings, the roads/streets in between them, public open spaces, transport links etc. and the use of technology to supplement the design to tackle new urban issues of urban heat island, global warming etc. The critical use of the technology so that it not only supports the design to enhance its performance but also has a positive contribution to the environment by using lesser energy or generating energy for creating a self-sufficient building. Promoting mixed use developments, reducing the need for transport, promoting bio-diversity, providing scope for enhanced communal interactions to avoid the creation of hostile environments, learning from past mistakes of thoughtless incorporation of global trends etc. is the need of the hour. This could have an implication of a universal solution with no sense of identity which would defeat the purpose of Critical regionalism. Every piece of architecture should be deeply rooted to its place and should belong in its context. Tay Kheng Soon describes it as "the challenge in the ecological age is to conceptualize the integration of human creations in the context of nature." The solution lies in working in conjunction with nature and not against it and similarly working in conjunction with the site, the climate, the context, the people, their culture and the time and at the same time acknowledging and embracing new strategies and technologies to play a supporting role in the efficient functioning of the design.

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