

RESTORATIVE DESIGN

by

William Edward Penniman

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ABSTRACT

The design challenge for this thesis project is to evaluate the socio-cultural influences of Modern design on the city and people of Chandigarh, India, identify a human need to address and design socially relevant housing for them in current architectural vernacular

The project began with on-site evaluation of the living conditions and people of Chandigarh. Current housing standards and lifestyles were researched photographically and textually through evaluation of thesis projects found at the Chandigarh School of Architecture library. Interviews with local citizens provided the tool for assessment of a need to be addressed. Input from individuals regarding this need and cultural implications with precedent were researched within the setting. From there architectural design evaluation and development methods were applied from the base of study materials accumulated in the Architecture program at MSU. Sketches, models, and graphics developed were reviewed regularly with the advisor group and crit sessions were completed as prescribed. Research with conclusions and material decisions were condensed into the thesis book and reviewed by professors. The building design was then compiled graphically by various means. Models, hand drawings and computer generated graphics were combined for final presentation boards.

In concept for the design, application of culturally appropriate elements of material and form that are accepted by current residents will be used to create an individual identity for the residence that is unique yet a community fit. The proposal is not to copy the universal design type or ideals of Le Corbusier applied to Chandigarh, but to counterbalance it with a focus on individuality as a basis for design expression.

ABSTRACT (CONTINUED)

People, enrichment of their lives and creation of place and belonging, are the heart of this project, not to erase the past, but to move forward in the present from where they have arrived. Saying this in a different way, it would be to present the project as a 21 Century “modern” design, using materials from the “Modernist” vernacular to create a place for celebration of cultural roots while reshaping perception of individual worth for some within the culture.

Le Corbusier's High Court Building



These images represent the diversity of people and efforts expended at Chandigarh to make a place to work, live and carry on the necessary functions of civilization. Celebrated architecture, survival housing and all the architectural expression in between represent adaptation of the people of India making the “City Beautiful” their home in the 21st Century.



Housing of the poor on outskirts of Chandigarh

Having traveled through numerous countries and cities around the world, I observed that a consistent value of architecture is that it provides identity, place and belonging. In the world of architectural design Chandigarh, India, was innovative in form and purpose. During my study abroad semester from Montana State University, I formed distinct impressions about the city through interaction with the local population stimulating an internal conversation about how architecture influences social and cultural expression. Visual, physical and psychological feedback created questions about the architecture, design ideals of the Modern Movement, Le Corbusier's design intent and how they affected the sociocultural setting of Chandigarh. The design ideals of Le Corbusier embodied inclusion of all levels of society within an architectural framework of a simplified form of building typology that was meant to signify and implant the collective as social ideal. Disregard of past norms and culture was deliberate, creating a living experience in which its occupants were unaware of the social implications on their traditional living experience. Chandigarh was conceived and birthed as a model city by Corbu's design team. As such the city has become a target for both criticism and praise throughout the social and cultural shift of the architectural landscape since inception of its design. Both the architecture and urban planning have come under critical inspection during the last fifty years, examining their effects on the lives of people, their identity and cultural expression.

The ongoing sociocultural critique from varied sources in addition to my own observations, form the basis for questioning the success of the large scale Modernist experiment at Chandigarh. The expressed concern of these sources, which I share, is related to observation of the loss of indigenous cultural identity in the way Chandigarh is shaped. The rigidity of form, spatial arrangement, and transportation systems with divisions between government and populace, often called t-square and triangle planning, effectively separated people from one another. The cumulative design effect resulted in culture and individuals being diminished in a "new culture" rather than participants in the enlightened social structure Le Corbusier envisioned. In view of local, social, political, economic and design factors currently at work in Chandigarh, can a place of identity and belonging that is seen as "Indian" by its occupants and embraced as a place of belonging, be introduced into this Modernist design experiment called Chandigarh? This thesis project proposes to seek a culturally and socially relevant design solution for a marginalized people that provides a place of belonging as a micro environment within the greater existing architectural and sociocultural environment.

²Sarosh Anklesaria, *Chandigarh: Vision and Reality*, Architecture Week, Sept. 2004, P. C3.1

Abstract

The birth of India set the stage for the Chandigarh experiment:

The birth of India as a nation in 1950 resulted in enthusiastic embracing of new goals and ideas. Defined as a sovereign, socialist, secular, democratic republic, India's leader, Pandit Nehru, envisioned Chandigarh as a model city. The break from the past embodied in this view fit hand in glove with the ideals of some modernists and was expressed in the enthusiasm of the new leader; (Correa, 197-202)

“Pandit Nehru on his first visit to the city remarked: let it be the first large expression of our creative genius flowering on newly earned freedom.”³

The socialistic aspirations of the new government embraced the concept of the collective and common ownership of public spaces found in Corbu's modern ideals. The classic division of authority and populace manifest in placement of the governmental buildings presented a sense of stability and power, an attractive proposition for the new government. Hopeful that Chandigarh's planning could create the catalyst for a cultural and social shift the government under Nehru's leadership attempted to redefine India. However as seen in the criticism of Charles Correa, Chandigarh fell short of the goal.

“Certainly Chandigarh as a town plan never was the brave new world that Nehru presumed it to be. Far from being a futuristic city, it isn't even a contemporary one. It is positively feudal in its ironclad separation of rulers and ruled, in the caste-ridden pattern of sectors.”⁴

The architectural design and city planning in use there not only failed to unite the lower working class with upper and middle classes but was unsuccessful in providing affordable housing for the lowest classes. The ideals of the new government as a socialist democracy that guided decisions for Chandigarh has barely survived the religious, sectarian and cultural divisions within the county. The “city beautiful” Chandigarh which was intended to be as a portent of the future and model for scores of new cities across India has proven to be less than ideal. ;

“Like their prototype, (Chandigarh) all of these new towns assume a middle-class pattern of living totally unrelated to the actual income profile of the population; thus many of the sectors in Chandigarh have two or three families crowding into single dwelling units, and thousands of desperate squatters have eked out miserable crevices for themselves all over the city.”⁵

³A Road Guide to Chandigarh, TTK Healthcare Limited-Publications Division, Chennai, India, 2005, P.4

⁴Charles Correa, *Chandigarh: The View from Benares*, (Essay from LeCorbusier, by Halle Brooks, Princeton University Press, Princeton, New Jersey, 1987) P.200

⁵Ibid P. 199

Modernist social ideals applied to Chandigarh:

Though the design work manifest in Chandigarh under the tutelage of Le Corbusier began in the 1950's its design roots are drawn from the diverse ideas of the Modernist Movement. The ideals from the period included removal of historic political power structure, concepts of God, good and evil, rejection of past forms, functions and norms of society and architecture with a goal of universality and establishment of the collective as an end product. The movement's architecture was often defined by simplicity of form through the removal of all culturally relevant detail while minimizing the building elements that separated man from nature.

The movement was emboldened by enthusiasm that governmental and social problems of the past could be overcome by the raising up of the working class. Some, like the Italian Futurists advocated radical destruction of past social constructs, others, like Le Corbusier, saw new city planning as a way of securing his objective of affecting social behavior. This objective and his focus on the collective possibly relate most directly to his disregard of the existing culture of India at Chandigarh and provides the basis for indifference demonstrated towards its individual citizens. The tool of architecture in the hands of the design team was applied to remove differences in neighborhood, social status, identity, religion, class and caste. The resulting architectural language was one of sameness and uniformity, lacking visible individuality of expression which is one of the aspects leading to this evaluation of the effects of Chandigarh's planning on its populace.

Investigation continues to support the premise that the design of the city has produced a "missing" cultural differential between the common Indian living experience and that of Chandigarh's population. In *Chandigarh Revisited*, Joseph Giovannini addresses what is "missing";

"What is missing are the crowds, thick enough in many cities to be environments of people. Even in Chandigarh's commercial zone, avenues are so wide that the stores lining the arcades on either side hardly relate. In a country where people like to live in close physical proximity the tight spacial structure of village India and housed for extended families seems to propel the national psyche -- Chandigarh embodies an organizational tactic based on the zoned separation of functions imported from foreign garden city principles."⁶

⁶Joseph Giovannini, *Chandigarh Revisited, Architecture, Washington, D.C. July 1987, volume 86, P.42*

Abstract

Planners of Chandigarh:

Initial planning was contracted to Albert Mayer of the United States with Matthew Nowicki as his representative. Nowicki had investigated thoroughly the vernacular building traditions of India that had evolved over the centuries to handle the monsoons, heat and dust in preparation for the project. Albert Mayer had designed the initial planning of the city blocks and roads based upon garden city ideas. The Death of Nowicki in a plane crash in Egypt in 1950 lead to Le Corbusier's appointment as head architect.

Historical notes point to Le Corbusier having a singular plan dependent upon incorporating his ideas of the radiant city into the plan for Chandigarh. Local problems with material supplies, lack of artisans and cost of concrete eliminated the possibility of incorporating high rise housing and businesses building concepts. This seems to be the explanation for most of his interest and creativity being given to the design of the four monumental governmental buildings while leaving development of housing for the masses to his design team. Three of these buildings were completed giving him a visibility that attributed the entire city design to him. However, overall he was actually on site for short periods of time delegating design of a majority of present buildings in the public sector to his cousin Pierre Jeanneret, English architects, Maxwell Fry and Jane Drew along with a team of nine Indian Architects. Le Corbusier also revised Mayer's initial master plan, leaving the original street layout proposal and super block/sector design intact. (Anklesaria, 1-2)

But, as Norman Evenson comments looking back upon Chandigarh:

“As to what LeCorbusier might have produced in Chandigarh had he been involved in the initial planning, one may only speculate. Certainly it would be hard to find an environment more alien to his characteristic urban vision. The means for large-scale mechanized transport did not exist, economic factors and technical limitation would make high-rise buildings unfeasible, and both climate and traditional living patterns militated against apartment housing. The principle building material of the city was to be brick, with reinforced concrete a luxury to be used only in major buildings. Although early drawings by LeCorbusier show attempts to insert high-rise buildings into the governmental complex and the commercial center, there was no possibility at the time for such structures to be realized.”⁷

⁷Norma Evenson, *Yesterday's City of tomorrow Today*, (essay from LeCorbusier, by Halle Brooks, Princeton University Press, Princeton, New Jersey, 1987) P.242

Planning of Chandigarh:

The following examples of the planning and architecture of Chandigarh reveal issues that mitigated against creation of a sense of place and identity relating to the people of India. The first of these explored is the rigid sector design with city divisions. The super blocks or sectors were planned to have a singular focus where each group of occupants had all of their own basic services, stores, schools, and parks. The idea of this was to create a community or collective of people within each sector. All of those within the sector were expected to view themselves as a single cultural entity without class division. These sectors were planned to accommodate differing numbers of occupants from 5,000 in primary, central blocks to 25,000 residents in those further from center of the city. Housing types were mixed to integrate the sector's (communities's) populations.

Circulation planning for traffic was designed on a system called S-7 road layout. Broad S-1 main roads with boulevards were for moving large amounts of traffic, probably due to the futuristic ideals of the industrial city, forward thinking but not functional in terms of Indian people and lifestyle at the time the city was built. The S-2 roads which ran parallel to and beside S-1 main roads were planned to provide access to shopping and services. The additional width further separated people from easy gathering in community life. Road systems decreased in size restricting traffic in greater degrees as they moved into residential areas but widely separated access points increased walking and travel distances between residences and services.

Separation of services into individual sector shopping "strip malls" lessened competition at the street level, integral to the rich cultural mixing of people in other Indian cities, reducing social activity and personal interaction between residents further adding to loss of cultural expression among residents. Separations created by the city sector plan did not create new social groups they only served to fragment the lives of people as economic classes and families were confined to small areas of the type of housing they could afford, having to travel between sectors by rickshaw or taxi to interact socially.

The planning created an essentially western city that required vehicular travel to function. Current trends of vehicle ownership and mobility are beginning to fill the city's road system that was fifty years ahead of its time in this design provision, a realized value of the planning. The cultural shift to a western type urban driving society also helps separate and individualize activities even more today than before, continuing to run contrary to the cultural and family heritage that is inherent in the identity of Indian people. Their culture which was rich in multitudes of people interacting in public market spaces and at religious settings was significantly altered as the physical behavior of the people of Chandigarh responded to the imposed planning and ideals of Le Corbusier and company.

Abstract

“Functionally, neither the city nor the buildings were a success. The city failed in its provision of an adequate system of movement either for the pedestrians or for the vehicles. It also failed to sustain an adequate social life in its provision of services or facilities. It was neither generous or controlling enough to accommodate persisting old uses or energizing new ones. The result became chaotic”⁸

Inhabitants were frustrated in finding group identity in Chandigarh as social venues throughout the city were initially identical, producing a type of social monotony. Markets which were spread throughout the city sectors and were as separated as the individuals, failed to create dynamic avenues for social interaction that were inherent in markets across India. Walking, initially a cultural necessity, was impractical due to size of sectors further reducing interaction. A majority of parks which are abundant are cultivated in such a manner that the soccer and cricket are not accepted within their boundaries, an apparent result of the rigidity of planning. As a place for gathering the openness of these parks deters people from use due to the heat of the climate. With monuments and roses as the main attractions, though extensive, their sameness and foundation on historically European ideals offers little cultural enticement to the city’s residents.

Two non-designed parks have become public destinations and places for gathering. Both have developed organically, free from rigidity of form and sterility of sameness. One is the Sukna Lake, where the park and beach with food and activity attractions developed organically over time. The other is the world famous Rock Gardens, initiated and designed by visionary and contemporary local Indian artist Nek Chand. This recreation area is also organic in form, rich in variety and successfully reductive of climatic conditions, making it a place of identity, social interaction and cultural expression where the brilliant colors of India are boldly displayed by its multitude of visitors. To address this dimension of social life, aspects of the functionality of these parks will be evaluated for inclusion in interior courtyard planning.

Visitors, residents, and tourists continue to view and adapt to the venues and attractions of the city as does its place in the architectural history of India. Though Chandigarh provided the architectural and historical world with a model for evaluation and criticism, today Chandigarh announces itself as:

“A grand success story in the annals of modern architecture, it is 114 sq. km. of invigorating aesthetics. It combines elegant architecture forms with wide tree-lined avenues, green belts and gardens and offers a pleasant living experience to its residents and visitors.”⁹

⁸Alexander Tzonis, *Le Corbusier - The poetics of Machines and metaphor*, Pizzoli Internaional, N.Y. 2001, P. 212

⁹*A Road Guide to Chandigarh*, TTK Healthcare Limited-Publications Division, Chennai, India, 2005, P.4

Abstract

Occupation of the constructed spaces proved to be an act of necessity rather than of individual identification. In the early days most of the housing was occupied by government employees with subsidized rents. Re-identification of individual homes is being established as the current economy provides the ability to remodel the flats and homes displaying personal preference, with renewed detail and color, enriching the fabric of the city and creating a place and sense of belonging for the individual. Personalization of homes and branding of shopping mall businesses is providing long ignored individual identity for Chandigarh's citizens and businesses.

Having a personalized place of belonging is one missing element identified as a need in Chandigarh. The intention of the project is in creating a place distinctly owned by its residents in place of the built environmental norm effected by the existing architectural planning. The population is currently seeking individual expression in architectural language and change in culture, adopting and embracing a Western lifestyle. The large retired population attracted to the city holds onto the old ways but pressure for change is increasing in every "sector" of life. The possibility of introducing new social setting and living accommodation are greater than ever before, framing the possibilities for greater acceptance of women's roles. The pictures below illustrate architecturally the winds of change In Chandigarh. It is these winds of change that this thesis project seeks to capitalize upon both in design and for, future acceptance of the women residents for whom a dwelling is being planned.



Typical housing block in Chandigarh, 2005 as created by the design team and as constructed.

Example of current redefinition of home facades creating a personalized identity of space.



Program & People

Program space - conditions:

- Local code requirements and hiring practices require the services of servant staff. Housing provided is normally minimal or nominal accommodation, providing a bathroom and one room for living. To meet this requirement the program will provide housing of the same quality as that of the residents and with space adequate for 4 but expecting the accommodations to house 2 families of perhaps up to 10 people. Servants will be considered staff.
- Access for deliveries and garbage will be pedestrian entry as both services are provided by vendors with bicycle rickshaw carts.
- Mail delivery will be through the business office.
- Security will be consistent with community practices that include security walls at perimeter of site and security personnel. Program space will be within the security envelope.
- Management will consist of a director, secretary and board. Staff will consist of cooks, gardener/maintenance, and security guards, counseling and medical personnel will be on call. The residents will do their own laundry and cleaning. Laundry machine quantity is 5 with typical covered clothes hanging area.
- Public rest rooms will be provided on the ground level, public spaces, for male and female visitors. Three toilets for female anticipating attendance of seminar's in assembly area, 1 for males.
- Fitness area will house equipment for up to 10 pieces of exercise equipment.
- The media center will include large screen television, wireless computer access with computers for use, music center, blackberry, I-phone.
- The all-purpose room will double as counseling, medical and private meeting space.
- Conference space will be used for seminars, training, classes, indoor recreation and public events.
- Courtyard space is to have enough open space to gather all occupants in one area but with semi private area to accommodate 5-10 people.
- Parking space required by code is 1 per flat. Most vehicles are placed within the security wall of residences. The program will accommodate 12 cars within the security wall.
- Program spaces will be layered from public to private, with public on ground level. The office, reception, all purpose room and waiting spaces will be clustered near public access point, followed by conference and training space. The media center will be placed for easy access to second level quarters. Dining and kitchen will be placed similarly for ease of access by residents and guests at conference and training space. Residential space will be on second floor with single and double apartment space closest to the office for guest usage. Quad resident spaces will occupy first floor space. Servant/staff quarters may be on ground level or split between ground level and first floor.

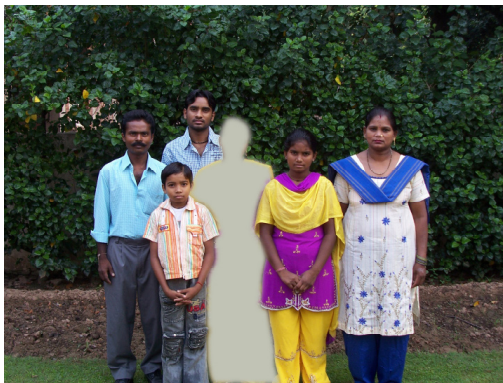
Program space:

Living accommodation for 51 single women.

- 12 living suites for 4 women each, area 1,200 sq.ft. each, total 14,400 sq.ft.
Each suite consists of 4 bedrooms. Kitchenette, small dining area and living/sitting room are shared by the 4 residents. Each suite will have access to terrace or patio space. Bathrooms shared by 2 women, 2 bathrooms per suite. Each bathroom includes toilet, sink and shower.
- 1 living suite for 2 women, 720 sq.ft., combination guest room and placement suite. Shared kitchenette/dining, sitting areas and terrace are similar to living suite above.
- 1 single occupant living flats. 560 sq.ft., combination guest room and placement suite. Suite/flat contains kitchenette/dining sitting area w/small terrace.
- Common dining and kitchen area for communal dining, seating up to 60 people, 1200sq ft. Space includes seated dining with tables and chairs
- Common media center, 320 sq.ft. includes television, computer stations, comfortable seating, small serving bar with microwave and U.C. Refrigerator,
- Conference and training space, 1500 sq.ft. Provides chair seating for 150 people.
- Recreation/fitness room, 400 sq ft., includes exercise equipment, floor mats and misc. moveable equipment to accommodate 10 people.
- Common laundry w/outdoor drying (covered clothes line) area, 200 sq.ft. Area includes folding tables and ironing space, may be staff operated.
- Office and waiting room 160 sq.ft. for manager and secretary.
- Utility room, 120 sq.ft.
- Public rest rooms, 300 sq.ft. Located on main floor to serve conference and gathering room, visitors, residents and staff using community spaces.
- All purpose room for medical visitations, 120 sq.ft. Room doubles as place for on site counseling, private medical counseling, and small private meetings.
- Servant quarters, 1000 sq.ft. Space meets city set aside code requirements for public housing, can accommodate up to 4 staff/servants or two families (typical). Space includes bathroom and small kitchen space.
- 15% additional space for circulation and janitorial service = 2775 sq.ft.
- Courtyard, 1600 sq.ft.
- Parking for 12 cars, 2,400 sq.ft.
- Total footage = 23,775 sq.ft.
- Lot size = 22,500 Square Feet

Program & People

The analysis of sociocultural factors in the city of Chandigarh lead to a search for a target group, by this writer, for whom restoration to a place of belonging could be valuable. Interviews with local women pointed to a group of women in the human family who in every respect have been treated as outcasts in a society that claims to have removed the stigmas that created them. The necessity for creating cultural accommodations that restored individual value, provided a family setting and immersed the outcast into the city fabric became a focus. Investigations pointed to the necessity of inclusion of the poor or marginalized to create a setting that is more representative of local cultural conditions. In the process of discovery concerning the needs of women's shelters in India, there is evident multiplicity of people and programs, governmental and private, dealing with poor and unwed pregnant women. What has been found is a hidden group of outcasts for whom there is no provision. This group is of middle and upper-class women who have found themselves rejected by both family and society. Poor women who have social stigma are more accepted by the poor than are these of more affluent families. The stigma of having a daughter who has broken social boundaries increases as the social standing of the family increases. Families completely detach themselves from their daughters. The social stigmas against family that bring separation include; being a runaway, becoming a widow, divorced, rejection of planned marriage, religion changes, and other actions that families consider shameful. Simply causing embarrassment to the family may be sufficient grounds for family rejection.



Indian family picture above, with daughter at right



Family rejections include severing of all communication, removal of dowry, disinheritance from family holdings and business, and separation from all social connections related to the family. These women are often well educated, sometimes skilled professionals. In being forced to live in public rentals they are subjected to unwanted male attention as soon as it is found that they are single. They continually feel threatened even in their own homes. Because of the isolation many lead a far more hopeless existence than those of their poor counterparts. In the case of changing religious preference the isolation is increased with persecution.

The greatest need for many of these women is security. Following that is need for privacy, comfortable setting, place for social interaction, recreation, fitness, and access to confidential counseling and medical services. Acceptance with love is their greatest human need beyond the physical setting. For some, job training is essential and provision for conference and growth seminars is vital for keeping relevant to the world at large. The intent for a women's residence is to provide space in such a way that the residents can be fulfilled in their need for family and social interaction. Insertion into an area of the city that is generally safe and more affluent will hopefully gradually increase acceptance of these hidden outcasts as they go about their business within the community. Amenities, such as shopping, business and education facilities within walking distance are considerations. The women value having a place to live that is safe, without the suggestive stares and sexual comments of the Indian male. Provision of servant quarters is not simply for convenience of or for catering to upper class women but as a means of connection to less fortunate individuals with emphasis toward uplifting them as well and giving greater opportunity to them to migrate upward in the culture. Essentially this is to make a way for residents to give back to others the grace they have received in this home. The overall goal is to create space and setting that are conducive to restoration and wholeness of individuals. This design is about a culturally sensitive response to needs of individuals that is direct related to living well today rather than for a futuristic vision. It is for a place of belonging today.

Through the writer's interviews with counselors of women the following profile for architecture of belonging was created. Psychological profiles for these women of Chandigarh suggests that for both safety and for cultural reasons the residence should not drastically stand out from the architecture of the area. A beautiful landscape setting, color, social area, exquisite and innovative setting, practical and technically advanced interiors would significantly enhance the perceived value of residents, generate creativity within and public interest from without. The exterior created environment being familiar relates to current cultural setting, even celebrating its uniqueness and speaking of acceptance, but with interiors speaking of reaching out to new possibilities.

Philosophical Perspective

Beginning with a world view that believes in the value of the individual, favoring the encouragement to creative endeavor and financial success amid religious freedom and respect with honesty is a central idea. Building up individuals is a one person at a time work, much different than the expressed ideals applied to Chandigarh. The collective as an idea from that experiment, which seems to have merit, did not appear to embrace individual values as a tenet. Perhaps the collective idea was not the problem but human nature is such that it failed to reach greater heights of social and cultural acceptance and care for one another implied when simply subjected to a structural design framework as it was conceived for Chandigarh. Legislation could have been added to produce such values through control and modification of human behavior and thereby satisfy the collective goal. Such external controls can be successful in modifying behavior. However, it is part of this perspective that the internal controls attached to individual preference and choice produce more creative, long lasting social interaction. To provide a place of belonging for a marginalized group as an offering of personal security and identity is a means for engaging voluntary life enhancement that contains possibilities for greater community acceptance. In this case the group chosen is not able to recreate what it has lost and has been bound to a diminished lifestyle of separation and isolation. The isolation is individual but common experientially as they are made to join the culture as outcasts allowed to participate in daily activities but without the luxury of belonging.

Human values from our cultural history suggest that there is no difference between male or female, Greek nor Jew, slave or free, that all are equally valuable as human, a religious value that we embrace in our secular society. If in fact this is a universal human assessment the subjects of this thesis project require opportunity, as equals to those by whom they were marginalized, for restoration as individuals. A place where one who has been rejected or marginalized to no longer be outcast is essential for restoration of identity, security, wholeness and emotional healing. In fact from this perspective, the basis for daring the inclusion of the individual women in a residence, can be found in the age old proverb that true religion is in caring the widow and orphan. Those who have been rejected by their families have become orphans of society and truly some of them are widows. They are in many ways more “poor” than those in the slums, but it is in living, enjoyment, family, friendships, faith and security.

Whether these outcasts are Hindu, Muslim or Christian, the focus of this project is upon creation of a place of belonging. The greater part of creation of this living environment lies in restoration of a sense of being in a familial setting, creating a space for cultural expression to be celebrated rather than forcing a cultural ideal upon them. Culture is inherent within the residents themselves to be accommodated, and celebrated, not created through an artificial environment. The discussion of placing people within existing culture in a forward looking position where they adapt to the winds of change is found in the dialog from the Tjibaou Cultural Center’s press booklet.

In the cultural center project for preservation of Kanak history at Noumea the Tjibaou Cultural Center designed by Renzo Piano and envisioned by Jean-Marie Tjibaou sought to find an architectural means of conceptualizing the identity of Kanak culture. Jean-Marie's conception of cultural identity was to see it as an unfolding journey, moving beyond the past. His approach to this was to utilize tradition within the framework of current events to position Kanak people where they could see their identity developing in the present and future. "Our Identity lies ahead of us"¹¹ is one of Jean-Marie Tjibaou's most famous statements quoted in the press booklet edited for the opening of the center. This is perhaps a defining statement of purpose for creating a place of belonging for the women of Chandigarh, in a single word, opportunity.

In many nations the culture is being rapidly transformed by the youth, western fashion and values, television, movies and technology, ideas and fears. In stating this the writer acknowledges that the current, visible expression of architecture, philosophy, religion, and culture is being pressed upon for change. Daily, new expressions, definitions of language, style, gender roles, communication and information press upon tradition and culture. This writer has come to consider that placing the systems of this project on the cusp of advanced technology is the best way to position its residents for the coming change. In the rush to embrace western ways of life, tradition and culture will be thrown overboard to speed the ship of prosperity to a hopeful destination. The qualitative program of this residence needs to be positioned for adoption of changing lifestyles while taking on the role of preservation of cultural heritage as part of this philosophical perspective. The position is that people who are secure or have an identity that is grounded in their past yet have hope for the future are best suited to overcome the effects of personal and social marginalization. It is said that hope springs eternal, and that there is substance in hope that sustains the human soul. This residential project can be the change agent, through its programs and built environment, that offers a new beginning for hope restored.

¹¹Jean-Marie Tjibaou, From press booklet edited by ADCK Cultural Director, Emmanuel Kasarherou, Tjibaou's Cultural Center, May, 1998, p. 30

Conclusion:

After researching comments on Chandigarh, interviewing local residents and after personal evaluation of sociocultural factors, the findings substantiate the initial impressions from visiting the city. There is a significant difference in cultural vitality between Chandigarh and other Indian cities. It is also evident that this difference was to some degree a consequence of the short term development process originating from a singular design source outside the immediate cultural setting. This fact is clarified more by understanding that other cities of India developed as a product of long term growth within the existing cultural framework. In the process of evaluation the consideration arose as to whether this differential was a real or perceived injustice to the people and culture, leading to a question of the value of recapturing or trying to recapture what was lost and whether a new design could propose to do culturally what the old did not.

It is obvious that a singular piece of architecture could not produce a cultural shift and probably not even be used as visual mouthpiece to proclaim some new paradigm in thinking. Nor could it create the interactive venue necessary to recreate the lively cultural climate of Delhi and other Indian city markets where one engages the richness of India. The question arises as to whether there would be any value in trying to do so? In the research on the Tjibaou Center, Jean-Marie Tjibaou, discovered there is no way back to recover the past, making two related statements; “Our identity lies ahead of us.” and “The return to tradition is a myth.”¹²

Seen in terms of Chandigarh, the work of Le Corbusier and design team has become assimilated into the living environment of the people, creating Chandigarh’s sociocultural atmosphere of today. The opening quote by Jim Richards, in *Hassan Fathy*, sums up the position with which this thesis has come into agreement; “In solving human problems one must not remove one’s self too far from the human individual.”¹³ It is necessary to give credit to Le Corbusier’s visionary effort to create an environment which would meet and sustain, for the average person, the best intentions of the idea of collective. The project environment desired here would generate a different response to a similar idea, one of community, a place of belonging with individual emphasis that becomes an inclusion of Indian culture speaking of hope and a future.

“The Utopian vision to create an improved environment led to an urge,to create a better-ordered future, thus destroying also the familiar background which makes people feel at home in town and country. The value of continuity was forgotten. It was left to a later generation to rediscover the social and cultural necessities of weaving the new into the old.”¹⁴

¹²Jean-Marie Tjibaou, From press booklet edited by ADCK Cultural Director, Emmanuel Kasarherou, Tjibaou’s Cultural Center, May, 1998, P. 30

¹³ Jim Richards, *Hassan Fathy*, Architectural Press Ltd. , London 1985, P. 11

¹⁴ Ibid, P.11

In concept for the design, application of culturally appropriate elements of material and form that are accepted by current residents will be used to create an individual identity for the residence that is unique yet a community fit. The proposal is not to copy the universal design type or ideals of Corbu previously acknowledged, but to counterbalance it with a focus on individuality as a basis for design expression.

This is proposed to be accomplished with the use of common materials reformed or used in a new manner that creates a shift from the universal use of common elements in a singular form to creation of a distinctive persona for this project. Use of a common material in a new manner or fashioning in a new form for identification, with community acceptance, is vital for constructing a forum for residents to see themselves valued, unique persons.

A similar emphasis applies to development of interior space where color becomes a tool for creating individualization that is capable of becoming an identity factor making possible a sense of belonging for residents. Use of color is a part of identification with and endorsement of India's culture. In keeping with the idea of creation of space that engenders belonging; interior spaces put forward elements of interactive expression by residents that provide a changing visual landscape with their personal involvement. Use of technologies is supplementary to producing space that is physically comfortable in a difficult climate as part of a living arrangement that is desirable for gathering and living where residents feel like interacting. Featuring space to enhance social programs for enjoyment and personal development is inherent in space planning as a venue for restoration of the crowd rich interactive quality of Indian social life. Sense of belonging, social interaction, comfort, creative atmosphere, health and security are values sought for design of this place of refuge.

People, enrichment of their lives and creation of place and belonging, are the heart of this project, not to erase the past, but to move forward in the present from where they have arrived. Saying this in a different way, it would be to present the project as a 21 Century "modern" design, using materials from the "Modernist" vernacular to create a place for celebration of cultural roots while reshaping perception of individual worth for some within the culture.

Precedent Studies

YWCA Women's Housing, Chandigarh, India



This YWCA is in Chandigarh running a program for single women. The location is within a residential area and close to college and university campuses. A walking park lies just beyond the boundary of the yard. Scale of living environment is economy level for basic needs and minimal accommodation. The structure suffers from many of the local problems related to buildings. Wiring is substandard, rooms are hot, without air conditioning, with necessity to leave doors and windows open for ventilation. The perpetual dust in the air requires daily cleaning. Security is provided by guards at the gate to the compound. The grounds are manicured but provide little in the way of comfortable outdoor space. All factors considered the women accepted to this residential setting work to find ways to stay beyond their initial need. They become attached much more for the sense of belonging and security than for quality of facility which is acceptable.

In the program, training and educational opportunities are presented. Occupants are free to participate in events and classes but are required to clean their own space and to participate in group cooking and dining schedule. The event space provided is attractive for small community events and is rented on provisional basis to the public. The program is managed by a director with a staff and is varied according to perceived need. Confidential counseling is available on request. Primarily occupants are young single women and many are students with limited income. By visiting this facility it was possible to see both program and place while reviewing program for this thesis project.



Pictures by author, 2008

Hubertus House
Amsterdam by:
Aldo Van Eyck



The above example is the Hubertus House in Amsterdam, designed by Aldo van Eyck. A residence inserted into the fabric of existing monochromatic architectural facade is for single parents with children. The Rainbow of colors used as one passes from the street front to rooms was intended to create an intimate living environment for the occupants. Roof gardens were employed with the idea that the children could participate and pick fresh flowers to continue to bring in and celebrate color in the living spaces. As the first colors were applied to the exterior at the street front, citizens criticized the project. Over time and as they could see the progressive rainbow of color applied as one moved into the building, the public was won over, eventually affectionately calling it the “mother house”.

This project suggests the idea of using color in an otherwise monochromatic architectural street facade. Comparing the open nature of Dutch society to the closed classes of India it is clear that such a statement would be detrimental to the inhabitants. However the idea of using a broad color palette to provide unique interior space prevails and continues as part of the study.

Hubertus house commentary: “Van Eyck’s work lies in line with that important tradition of humanitarian modernism central to 20th century Dutch architecture. The 6-storey Hubertus House cannot be viewed in isolation although its social success is clearly a result of the way its particular design was carried out. It is concerned with the spirit and the establishment of a comfortable scale for the building of this type and size-an open ‘home’ for single parents and their children-with the creation of an non-stressful environment, in a block that seems to say ‘house’.”¹⁵

Precedent Studies

Hundertwasser-Haus
Vienna, Austria-designed by:
Friedensreich Hundertwasser



The Hundertwasser-Haus, called a hallucinogenic public housing project, by Patrick Brown, built in Vienna, designed by Austrian painter Friedensreich Hundertwasser. This project considered by some to be the most interesting architectural dialogue in Vienna, is informative to this project in its creative use of green roof and terrace spaces, along with creative use of color. The response of tenants is noteworthy. They are enchanted with the building, commenting that the non-linear, non-level construction has enhanced the creativity of the children living within the project. The people identify with the housing in terms of fond ownership. The house contains adventure rooms that are unique and experiential.

The connection of this project is related to discovery and acknowledgement that many are the ways to create space which residents choose to claim as their own. If it is creative, experiential and inviting while culturally relevant, the tenants will adapt, individualize and accept opportunity for belonging. The public will have its opinion but the occupants will bear the identity as their own.

'C'est formidable," writes a visitor. "It reminds me of the earthquake in South America," writes another. "This is Bauhaus," writes a third. "Hundertwasser for President," writes a fourth.¹⁶

Picture from [image.google.com](https://www.google.com)

¹⁶Patrick Leigh Brown, *Eccentric Viennese Housing Project Lures Tourists*, NY Times, Jan. 8, 1987

Hope House, by: Studio Mumbai Architects



This project for uplifting individuals and creating a safe inviting living environment for the youth of Calcutta's red light district embodies values sought for the thesis project. It relates to family, safety, education, expression of art as well as to the environment of India.

Kids with Cameras has a plan to help more children like those portrayed in *Born into Brothels*. With your help, we will build Hope House (Asha Niwas), a nurturing home where up to 150 children from Calcutta's red light district can come to live, learn, and grow. The children who live in Hope House will receive a free, first-rate education through high school, courtesy of the Buntain Foundation, which owns and operates 80 schools in India. The Buntain Foundation will also manage and staff the home.

Hope House will serve as a safe haven, offering support services and programs that will help these children develop the strength and skills to change their own circumstances while remaining connected to their families. Art will play a central role – as it did in the film – assisted by nature: there will be artists-in-residence and gardens to tend. A college fund is also part of the plan. The home will be designed and staffed so as to make the children feel they are living in a cluster of family homes – a far cry from the squalid rooms and chaotic conditions of the congested red light district. The idea is to develop a model "home" that can be replicated elsewhere. Studio Mumbai Architects is designing the home pro bono. Other donated services include: engineering (Price & Myers) and landscaping (Pocock Design Environment Limited).¹⁷

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Picture from kids-with-cameras.org/school/

¹⁷Kids With Cameras, kids-with-cameras.org

The Marika Alderton House, Yirrkala Community,
Eastern Arnhem Land, Northern Territory, Australia,
Glenn Murcott, Architect, 1995



The Glenn Murcott house designed for Aboriginal housing in the Northern Territory of Australia, known as the Marika-Alderton House, encounters climate issues similar to Chandigarh as well as seeking to relate to cultural values of Aboriginal people. The main issue dealt with in the design was addressing the hot, humid, tropical climate with ventilation and shading for passive cooling to provide comfort and sustainable living. Murcott's design replaces poorly ventilated, uncomfortable masonry boxes provided by the government. The plan utilizes manual systems to control air and sun shading. He presents the production of the houses as prefabricated to overcome local labor and material conditions. Placement of sleeping quarters responds to sun orientation with work areas placed for use in the cool of morning. The positive aspects of this plan are that it responds to occupant activities in consideration of climatic factors. Weight of materials and separation from heat sink of the earth around it allowing it to cool quickly. The cultural sensitivity is limited to the provision of living space that is comfortable and mitigates the natural elements successfully.

India

The 7th largest country in land area with a culture 4,500 years old and evidence of first known permanent settlements that are 9,000 years old is the host site for this thesis project. India is home to over 1 billion people, making it the second most populated country in the world, with mega cities like Delhi's nearly 14 million residents. Chandigarh, the city of the specific site has about 2 million residents. The country has a diverse geography with much of India lying between the Tropic of Cancer and the Equator. The geography ranges from the slopes of the Himalayas in the north to low-lying coastal deltas by way of the Gangetic plain where the Ganges river drains the southern slopes of the Himalayas. Geographical diversity is mirrored in its diverse cultural and religious heritage.

India is host to 6 major climate sub-types, alpine, arid, semi-arid, humid subtropical, tropical wet and dry and tropical wet. Its four seasons are winter, summer, monsoon and post-monsoon. Because of the Himalayan climactic barrier all of India is considered tropical with Chandigarh classified as humid sub-tropical.

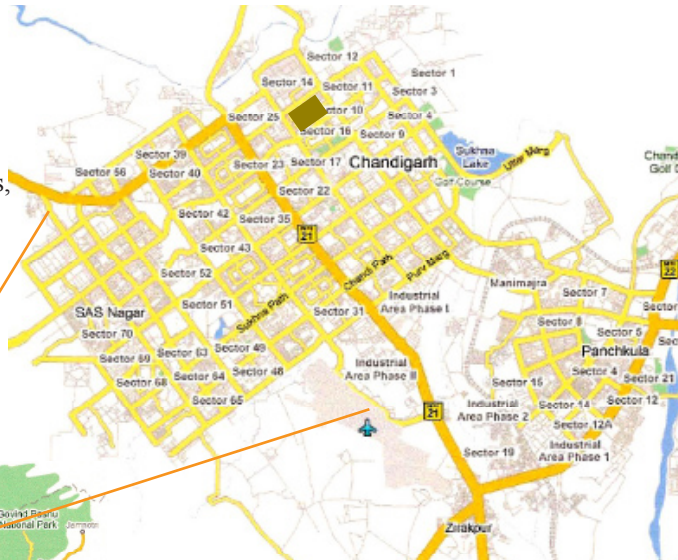


India:

One of the fastest growing economies in the world became a republic in 1950. It claims itself to be defined as a sovereign, socialist, secular, democratic republic that is open to all who come. The dividing of India, called partitioning, into states brought about the necessity for a capital city between the two states of Haryana and Punjab. The birth of Chandigarh was the result beginning in 1953. The partition proceeded along lines of spoken language. The state of Haryana, meaning the “abode of God” has the third highest per capita income in India. Ninety three of the top Fortune 500 companies, corporate offices and production bases are in the state of Haryana.



Regional map of New Delhi and Chandigarh area

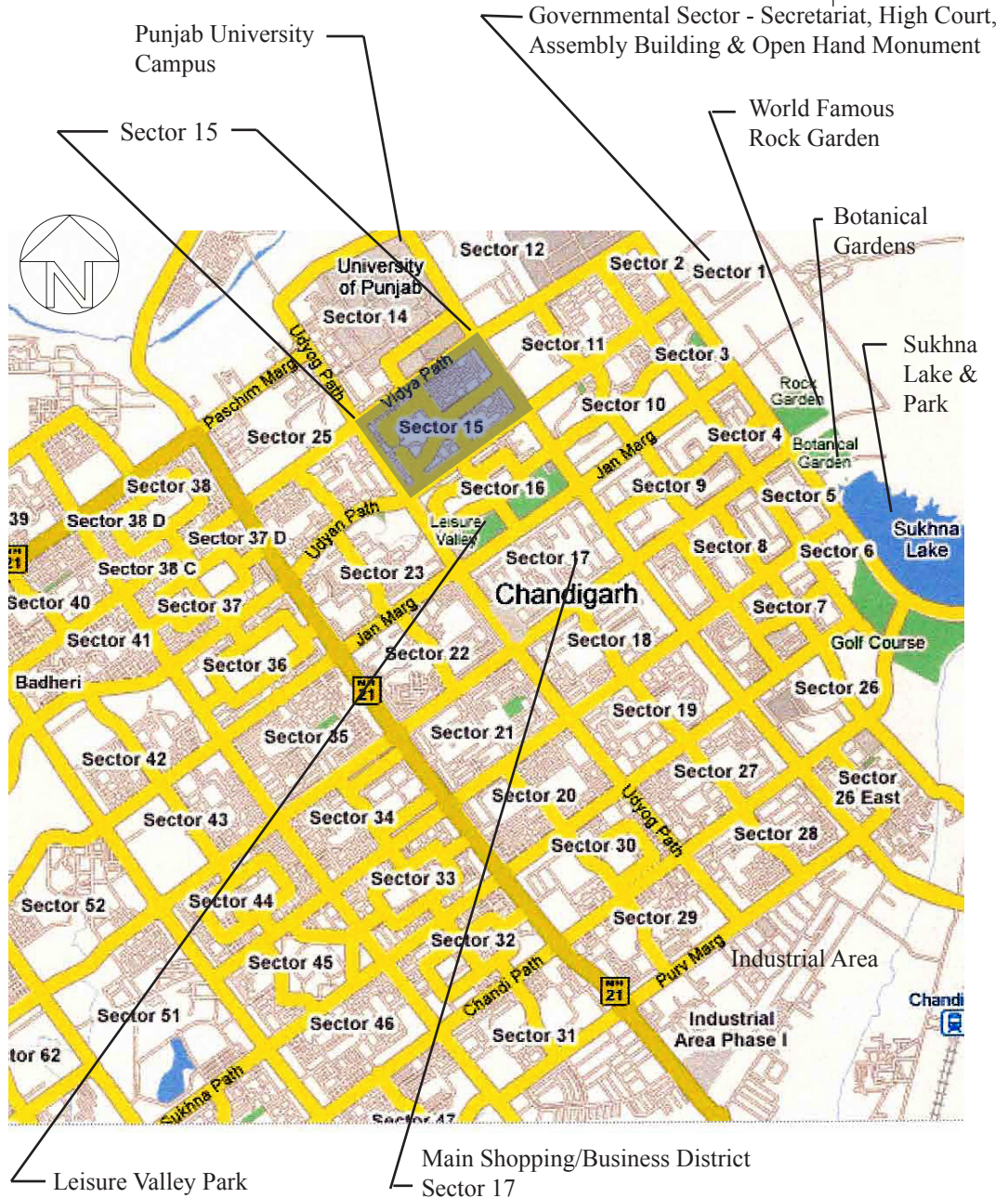


City map of Chandigarh

Punjab, the sister state to Haryana, is considered to be the “poor cousin”. The name “Punjab” means land of five rivers, much of which remains in agricultural service. Agriculture is the largest industry of Punjab. The two states provide more than a diversity of language, they provide a rich diversity of cultural influence on their capital city, Chandigarh.

City of Chandigarh sector map:

Site Analysis



Maps from Google Maps website

Site Analysis

The regional elevation reveals the proximity of the Shivalek foothills and Himalaya Mountains to Chandigarh. These are major factors in the climate and water availability of the city. The ability for a semi-tropical climate to exist above the 40th parallel is due in a major part to the blocking power of the Himalaya's. The mountains cut off cold weather and storms from the north and provide for mild temperatures in winter to linger over all of north central India. The foothills called Shivalek are visible from the city but not a subject of scenic orientation as humidity and dust in the air make them invisible most of the time, the value of their presence being unseen.

River drainage of the foothills passes North of Chandigarh providing for the filling of Sukhna Lake and is part of the city's estimated available yearly water supply, currently less than the demand. Lands surrounding the city are productive areas for fresh fruit and vegetables adapted to the hot, humid climate with its monsoon summer rains. Sales of farm goods contributes to the quality of living and economy of the local population.

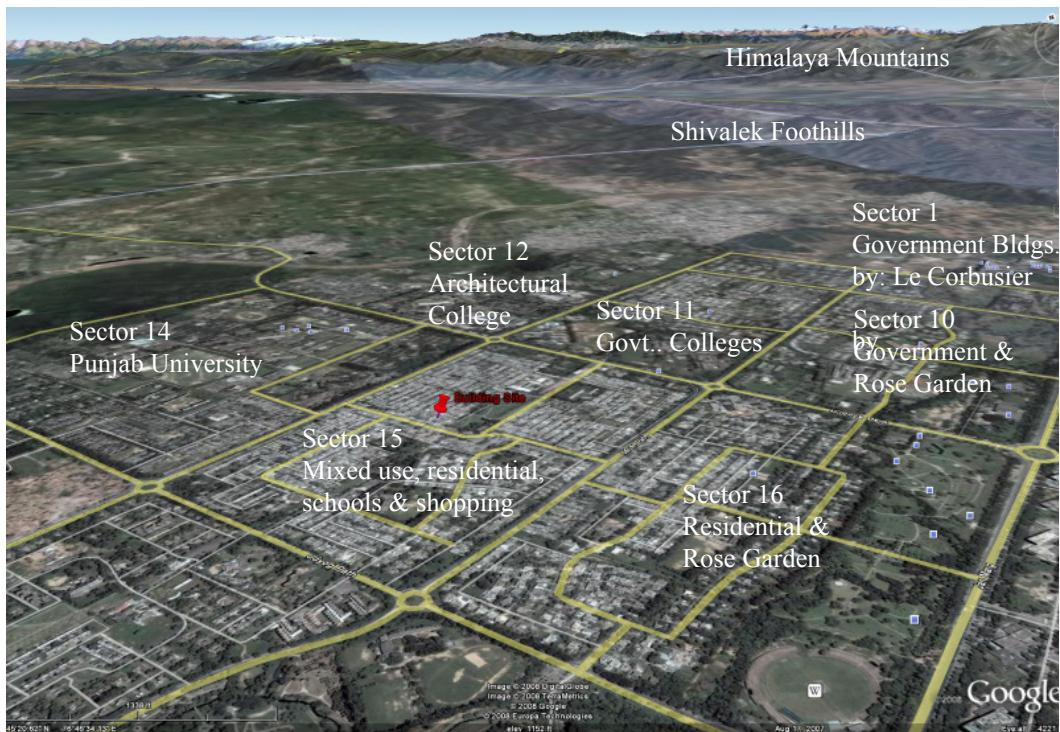


Photo from Google Earth



Street and Walking Plan - Sector 15



Site Analysis



The park system of Chandigarh is extensive, forming the “backbone” of the city running northeast to southwest axis. Several parks are within easy walking distance of the site. Public participation is generally limited to walking trails or walkways with a few park areas set aside for soccer and cricket with a sport stadium for competition sports. Parks are well manicured and full of bougainvillea, roses, trees and flower gardens with artistic monuments in most of them. Small housing parks have swings but are mostly unused and function as overflow community parking for weddings. Typically, city park usage is sparse with few walking, sitting or jogging. The low use could be in part because of their distance from pedestrian access of general population or because city boulevards are as much a park as the parks.



Pictures by author, 2008



Building Site Neighborhood Proximity



Site plan above illustrates housing density, parking and proximity to shopping and park. Planned density for Sector 15 was for 5,000 residents. As such it is one of the lowest density parts of the city as well as location for larger, single family housing. Residents consist of single and extended families or mid and upper incomes. This sector is also considered one of the safest sectors in the city.

At left is picture of typical street level shops with second floor office/business space. Parking as pictured is typical, normally ordered chaos.

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Photo from Google Earth

Picture by author, 2008

Site Analysis

- residents
- schools
- parks
- shopping
- hostel

Building site
Lot 152
150'x150' total

Street was not
developed as
thoroughfare,
remains 2 lane

Booths: Intended
for temporary shops
now is small shop-
ping area

Red Cross
community
center



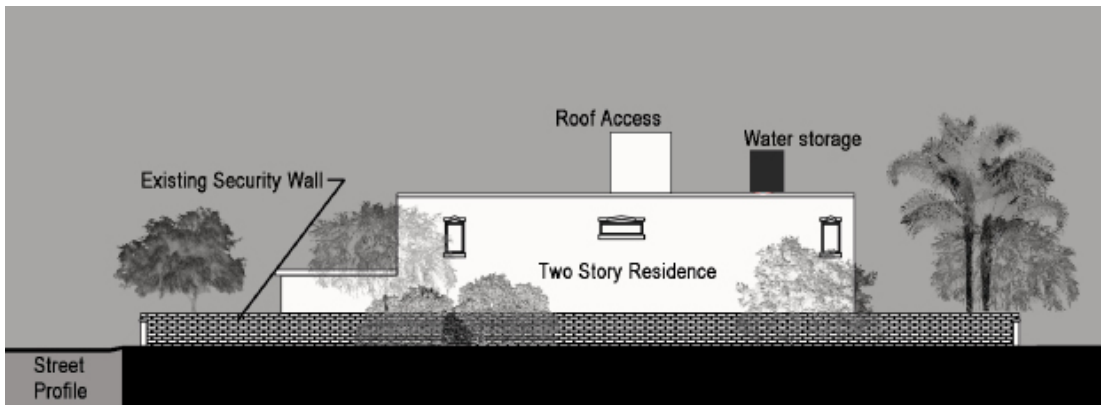
Sector 16
Rose Garden &
Sector 17
main shopping
center

1200 meters

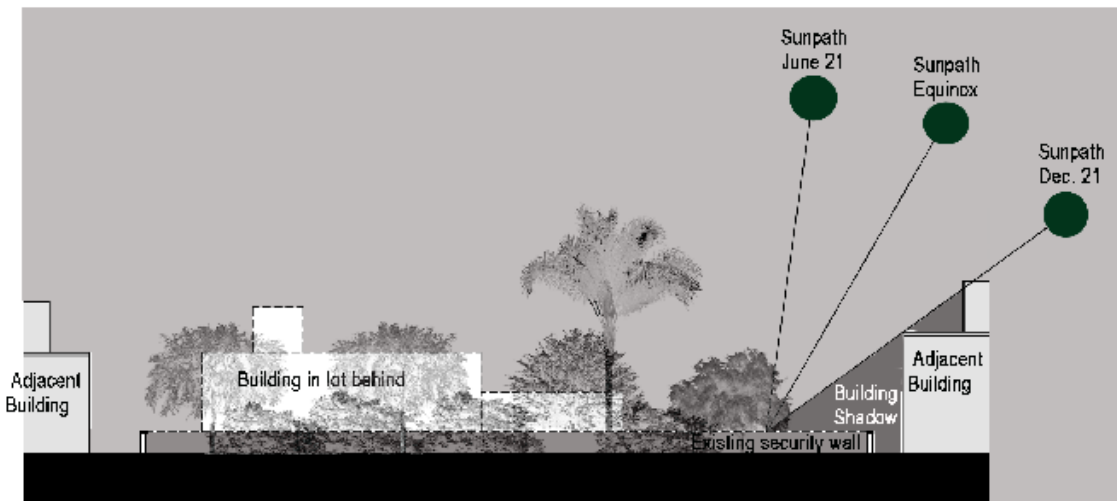
Shopping
Strip
Mall

Building Site Super Block #15 Plan

Picture from Chandigarh Tourist Guide Map; indiamapsservice.co.in

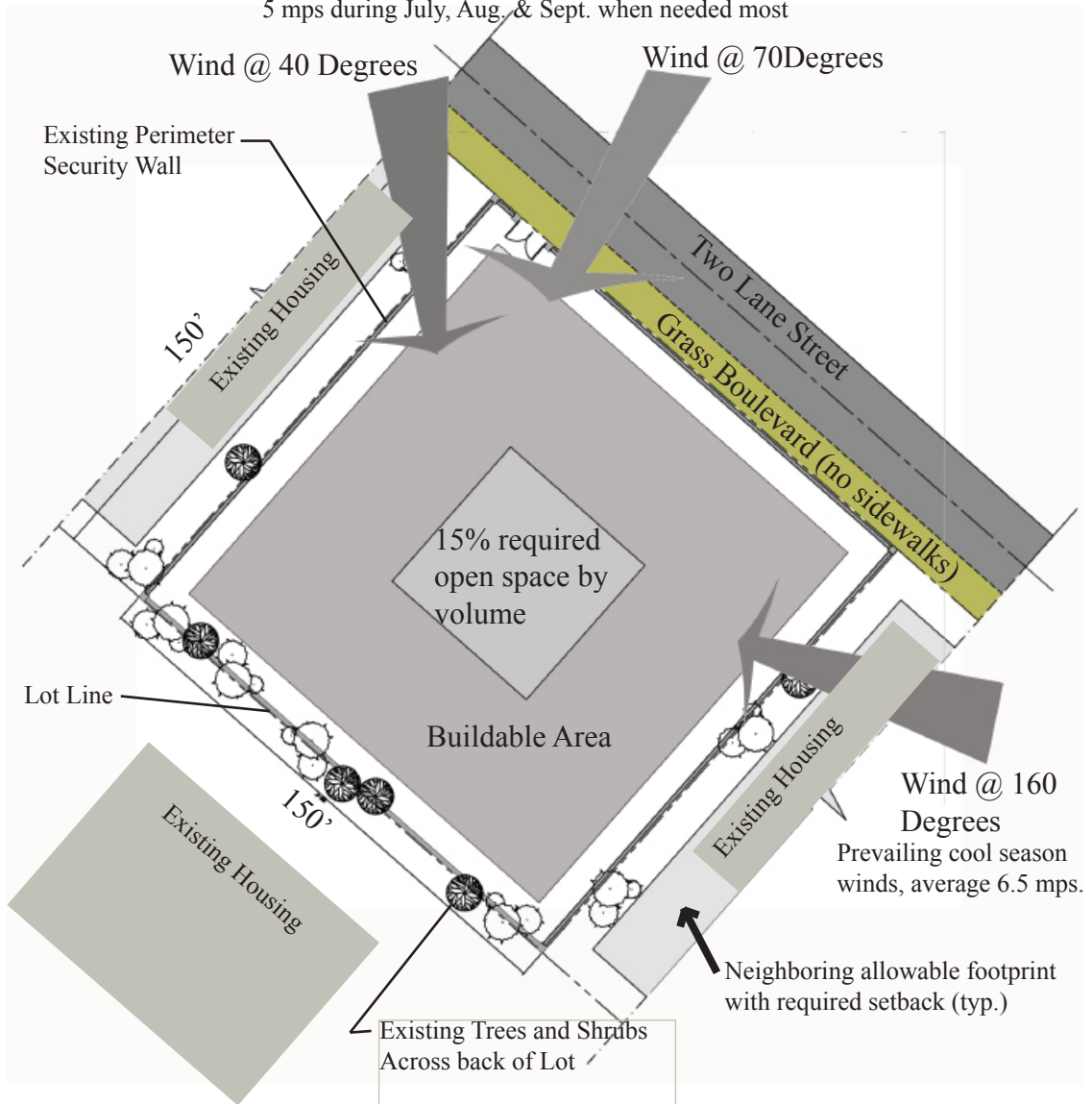


Site Section Looking Northwest



Site Section Looking Southwest

Prevailing breezes during hot humid months.
Average wind speed is 6.5 mps but drops to
5 mps during July, Aug. & Sept. when needed most



Site Plan - Sector 15 - Chandigarh



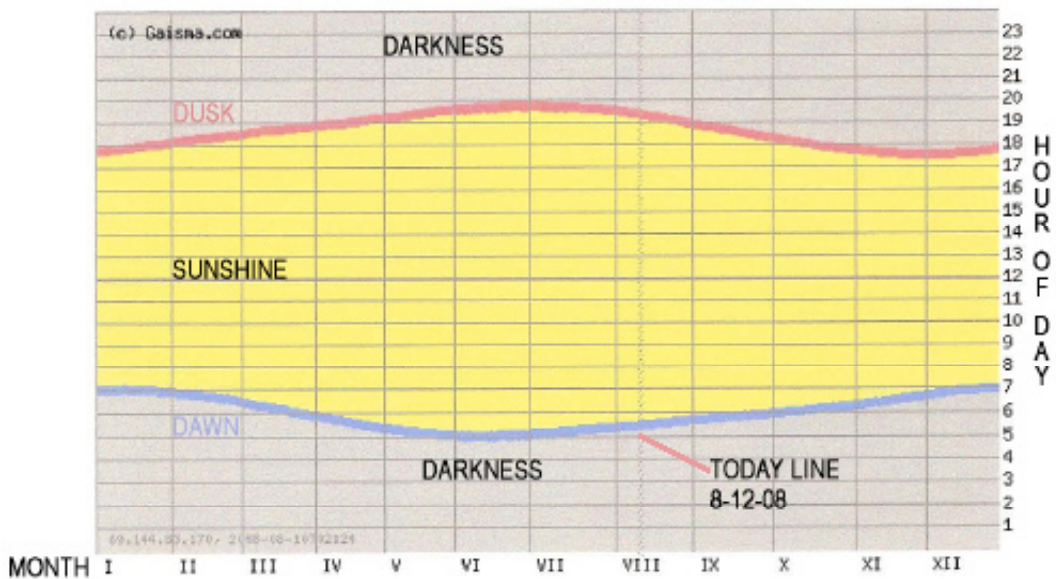


Site Analysis

Site climate information:

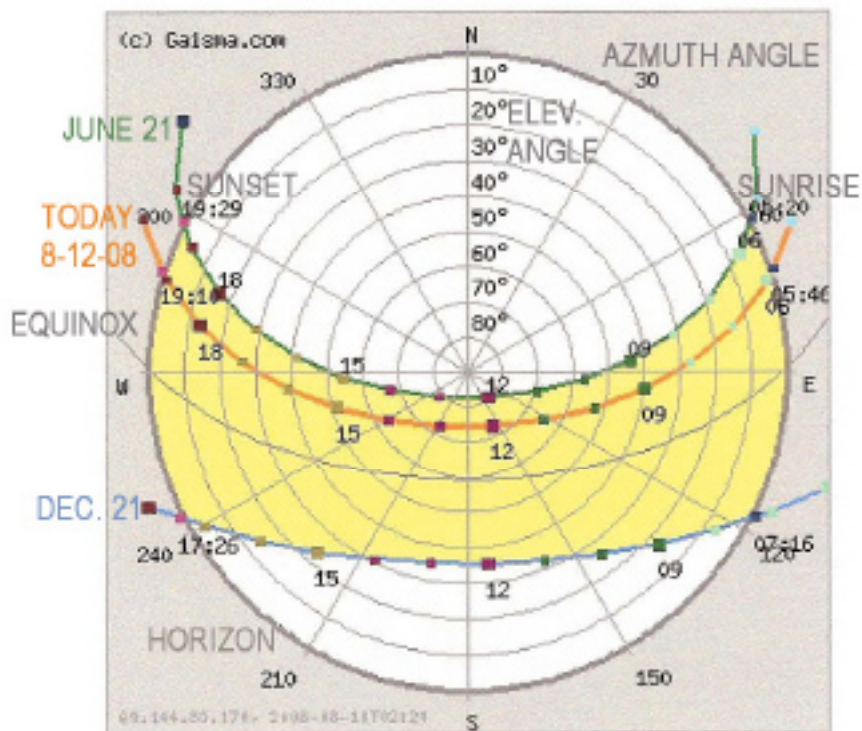
The climate of Chandigarh is classified as semi- tropical continental monsoon, one of the six major climate sub-types present in the country of India. There are four seasons - winter, summer, monsoon and post monsoon. The latitude is 30 degrees 17 minutes north latitude and 76 degrees 16 minutes east longitude giving a minimum of 11 hours and maximum of 15 hours of daylight. Altitude is 330 meters above sea level. The distance from my home in Bozeman is about 11,000 kilometers. Chandigarh is in a high seismic activity zone 4.

Chandigarh, India - Sunrise, sunset, dawn and dusk times for the whole year - Gaisma

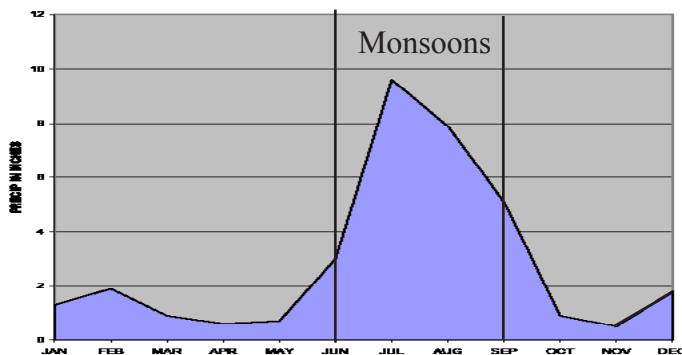


Chandigarh, India - Sun path diagram

Site
Analysis



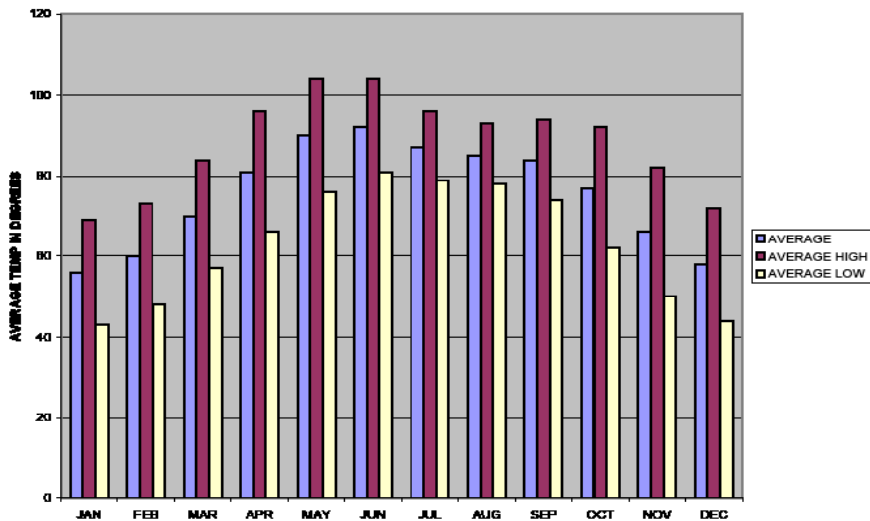
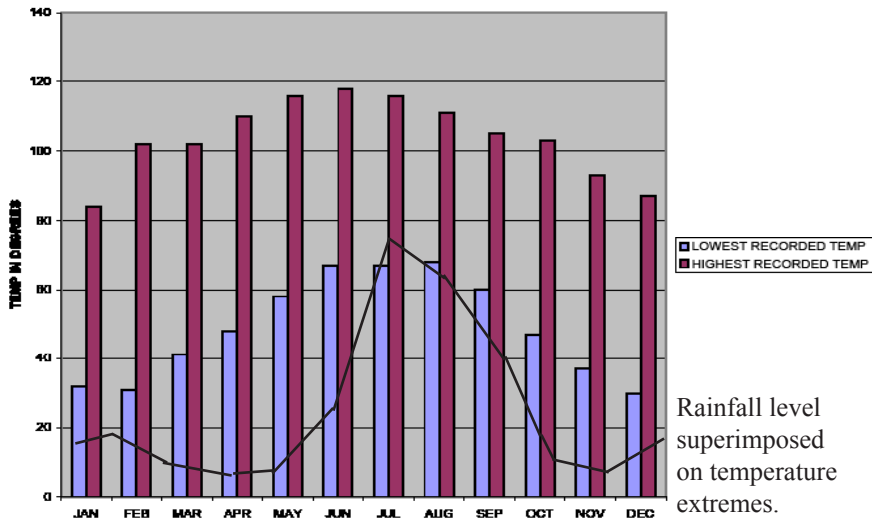
Average total rainfall is 110 cm. or about 43 inches



Rainfall extremes range from less than 1 inch in April and November to 4 to 9 inches for the three month monsoon season from June thru August.

Site Analysis

Records and averages of temperature and precipitation
for Chandigarh, India



Insolation:

The monthly average of the total solar radiation incident on a horizontal surface at the surface of the earth for a given month averaged for that month over a twenty two year period from July 1983 -June 2005. Potential total solar gain in kilowatt output for a year average is 1,803 kilowatts per square meter. Minimum monthly output is 99 kilowatts per square meter and maximum monthly output average is 214 kilowatts per square meter.

Insolation, kWh/m ² /day	3.28	4.00	5.08	6.22	6.89	6.44	5.21	4.74	5.12	5.04	4.05	3.18
Clearness, 0 - 1	0.58	0.57	0.59	0.62	0.62	0.57	0.47	0.45	0.56	0.67	0.67	0.60
Temperature, °C	-2.41	-1.06	3.14	8.51	13.33	15.74	15.77	15.09	12.61	8.06	4.37	0.71
Wind speed, m/s	6.86	6.78	6.61	6.47	6.92	6.89	5.22	4.76	5.39	6.44	7.02	7.16
Precipitation, mm	58	43	43	16	26	90	334	281	174	28	11	21
Wet days, d	2.5	2.6	2.3	1.1	1.8	4.6	10.3	10.2	4.5	1.0	0.7	1.4

These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center

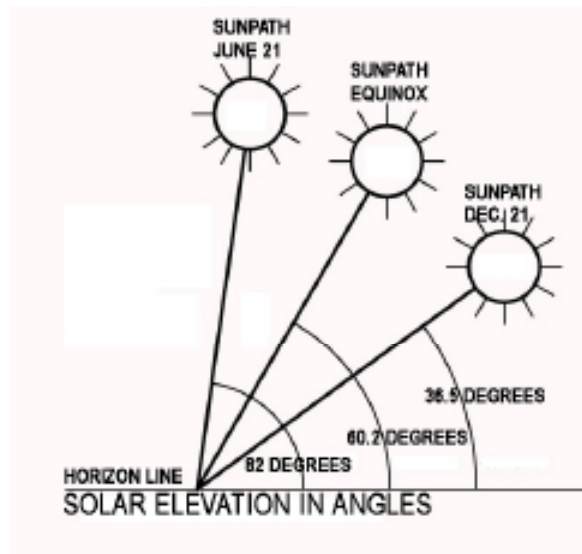
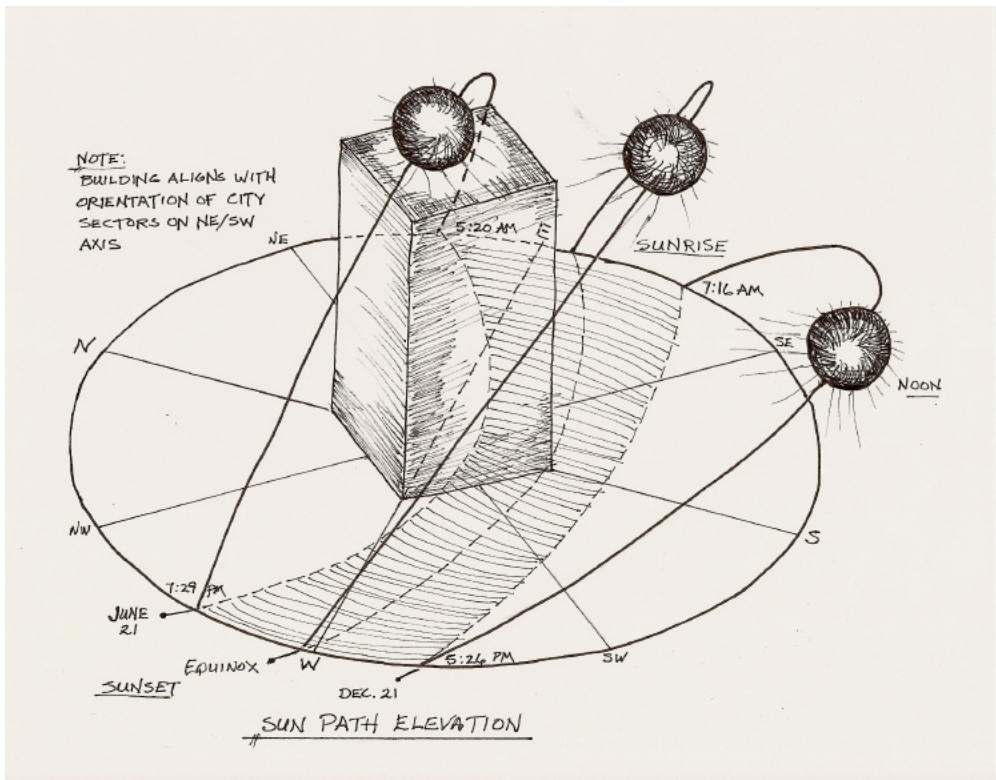
Wind generation:

Current small wind generators begin at a minimum of 8 m/s wind speed rendering the available winds inadequate for power production.

Water capture:

Total yearly rain totals of 110cm or about 43inches per year provide adequate resources for rain water storage and reuse systems. This will be considered for both cooling, green roof irrigation and other watering usage. This may be combined with a grey-water recycling system for overall conservation. Movement of water to roof storage to provide system pressure may be accomplished by small photovoltaic powered pumps.

Site Analysis



The chosen site surroundings are a mix of single family residents, business, park and educational facilities, signifying the location as a hub of intellectual activity. Its location provides opportunity for continued education, jobs in the educational and business sector, with basic shopping within walking distance. The sector is considered to be one of the safest for residents. Close proximity of a public park provides for outdoor activity. These factors contribute to convenience for the individual occupants but the real meaning of the site for the women occupants is “this is a safe place”, a place of refuge.

The site is significant in its position to educational facilities and placement in more socially affluent neighborhood in that the well educated and student population are sources for progressive cultural acceptance of women and women’s roles in public. This greater acceptance comes with a duality in the treatment of women. As stated before, women are disenfranchised from family for various reasons, yet are also respected for their ability and success in business affairs. The latter is the social value we seek to capitalize on behalf of the single working women for whom we are designing a place of belonging. The former is a stigma that time, education and positive role models may overcome. For this project the re-engineering of the family and customs that would be necessary to prevent women from being cast out of families would be a hopeful future development not a goal for social engineering through the project.

Environmentally this project portends to add to the water supply shortage inherent in the watershed/water table availability of the city. Yearly supplies are estimated as being at 60-70% of water requirements for the city. The city is currently investing in water recapture systems. This project would mitigate impact through water capture and recycle systems utilizing the average 43 inch rainfall. Power is subject to outages as the infrastructure is behind in meeting demand. Increasing use of AC and lighting power for a growing number of residents is pressing on the government to find new sources for electric generation. For our part the project would utilize the available insolation to produce electrical power with power storage and self generation capabilities. Roof gardening is to be employed to reduce cooling requirements and provide food supplies for the home as well as for recreational gardening by residents. Passive cooling, local materials, and renewable products will be used to lessen the environmental impact.

Site analysis, soft:

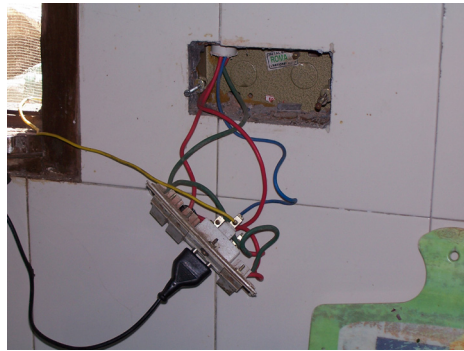
Beginning from the outside to inside, most residences have a perimeter wall for security. Walls are generally local brick and concrete with some being finished with smooth white plaster. Security features at top of walls includes broken glass, concertina wire or walls are of significant height to block entry. Street edges are natural, not edged with curb and gutter. Edges from street to security walls are maintained by lot owners and are either grass or grass with short hedges and flowers. The presence of gardeners with single family homes provides the means for manicured streetscapes. Perimeter walls are punctuated with walk-in and drive in gates with concrete aprons leading to auto parking and sidewalk access to homes. Garages are nonexistent. Courtyard grounds are parklike with a mix of fruit and shade trees, roses and small bushes with short lawn throughout. The trees are not used for building shade, though large enough, instead they are used simply to create a pleasing park effect. Residents prefer for their houses to be seen rather than shaded. Fronts of homes generally open onto a marble or stone patio area for sitting but are seldom used.

Single family homes have one or two room shacks with bathroom in a corner of the yard for servant living accommodations. These are given for services including lights and water, a value of about 10,000 RS. (Rupees) which is fairly significant income for lower level income families. An additional 2,000 RS, about \$50 per month salary is added as wages. This is the servants home, raising families of 3 or 4 or more children within the tiny spaces. Servants are allowed to grow gardens primarily for cooking use for home owners, but get to reap part of the harvest for their own use. Servant quarters are common for homes and required spaces by city codes for apartment complexes.

Homes are poured concrete or concrete and brick walls with flat roofs. The roofs generally only house large water tanks for solar heated water and storage for when power is out, which is often with rolling blackouts and power fluctuations. Most homes have power modulator/backup systems to deal with the power inconsistencies. Electrical systems are generally poor and compromised with burnt outlets, wires hanging from boxes and overloaded circuits.



Typical servant quarters



Commonly seen electrical deficiencies

Most houses have windows and doors with wood trim and wood doors with screens. Wood is not used for exterior structure due to termite activity and termite resistant treated wood is unavailable. Windows and door are left open much of the year. Fans are most common for cooling residents followed with single room air-conditioners for sleeping. The summer heat which can be oppressive, reaching 116 degrees Fahrenheit, dissipates slowly from the concrete walls and roof making late dining and bedtime a necessity. Most days are hazy with a mix of humidity and dust, obscuring views of nearby foothills. Dust accumulates daily with the open windows and doors necessitating floor sweeping or washing by servants. Most of the floors are marble or tile so everything is washable. Central AC is just coming into new malls. Heating systems are room type plug-in heaters, but houses are often very cold in winter as there are occasional lows at the freezing level and walls are uninsulated concrete or brick and mortar. Heat pump/AC systems would make great replacements for the straight AC systems due to the mild average temps in winter. Clothes dryers are nonexistent along with dish washers. Water heating is done in part in the black roof storage tanks that provide house water supply. These are transitioning from round black poly tanks to fiberglass tanks shaped like airplanes, horses and birds. Apartment (flats) kitchens are often planned without space for refrigerators so the refrigerators sit in the dining rooms. The flat roofs often leak in the monsoon season and are a chronic problem throughout the city. Stairways are without railings or have only single handrail on the open side.

The normal day begins with tea @ 7 or 8 AM with tea and biscuit, then breakfast, followed by work around 10AM. Most stores are open around then but may be closed intermittently or open late and closed early, generally around 7PM. Afternoon tea may close the shop. Dinner is a family event served anywhere from 8-10 PM. Stores sometimes close over lunch. If a store is not open when you need it just come back in an hour or so. The poor people seem to be generally up and about shortly after daylight possibly relating to the long walking distances of the sectors. Cars are wiped down daily by independent contractors who come by on the street calling out their services or one has regulars. Regular is a non-specific term as they show up most of the time. Fresh fruit vendors and garbage pickup is done with bicycle carts making daily rounds. And most every place has a uniformed guard, who watches the place, opens doors for clients and makes up a kind of street community of greeters. Traffic is brisk throughout the day with close encounters continuously, seeming like the nature of Indian cultural expression of close and crowded public interaction. Parking is like driving where 2 lane roads are made into 3 to 5 lanes of traffic. In shopping areas cars are parked diagonally with a row of cars parked lengthwise behind them. The latter are left in neutral so people can push them out of the way to gain access to or leave the diagonal spots. Like the interaction of people, cars are often parked in all manner of directions, generally facing the same direction, with motorcycles, scooters and bicycles intermixed, an illustration of traditional cultural intensity.

Site Analysis

The climate, trades and technical realities of Chandigarh dictate some adjustments in ideal functionality of state of the art systems. Passive forms and low maintenance, durable systems are best suited for use. The rolling power outages and under supply of water resource point to the value of photovoltaic systems and water capture and reuse as being valuable options. The high incidence of rainfall makes water capture attractive. Natural ventilation is a highly documented necessity for the location. External shading, use of mass to reduce heat transmission, green roof technology, and courtyard creation are all ancient means of heat mitigation considered. Average wind speeds below 8 m/s make wind generation an unusable option as 8 m/s is the threshold speed for current technology. Insolation rates and the minor amount of sun angle variation make solar power generation highly attractive. The complexity and maintenance of power storage systems make grid interactive systems more plausible as the visible evidence points to poor maintenance as a common problem that is symptomatic of cultural lethargy toward repairs.

Parking space needs to be within the compound for vehicle security. As a part of keeping the green appearance of the courtyard permeable paving options that allow for grass to grow and rainwater to percolate into the soil through parking surfaces are a preferred option. Grey water capture is bypassed due to higher level of maintenance, but dual flush toilets will be integrated into the plans as they are common to the area. Solar water heating is a city requirement generally accomplished simply with black polypropylene tanks on roof surfaces but we will consider other means of water heating and storage that is still passive. Dehumidification is being considered as an option to assist in cooling and water capture if ducting can be small for the system and the system is not complicated.

Most homes in Chandigarh have no heating system. Supplemental heat is supplied by portable electric room heaters. Temperatures down to zero degrees centigrade on occasion and average lows around five degrees Centigrade make sleeping a chilly affair in winter. Room air conditioning units are the most common residential AC systems. If these were simply equipped with heat pumps the cold could be easily mitigated. Central heat/AC heat pump type systems are considered but weighing against these is the cultural adaptation to opening spaces to the outdoors around the clock rendering such systems ineffective by lifestyle. Creating natural ventilation is more suited to the lifestyles. Green space with trees and shrubs and solar shading barriers with low re-radiation into interiors is an ideal addition to the planning. Courtyard shading and water features are considered as part of enhancement of the living environment.

According to the resource, *Building in Tropical Climate*, the authors identify insulation, shading and ventilation as the top three considerations for sustainable building. They list traditional time-tested factors for building as; having a rectangular plan, maintaining a narrow building width indoor, having pass through ventilation, use of verandas and deep roof shading as the most relevant passive strategies.

Site Analysis

A final area to explore is to provide a sense of belonging in the monochromatic structures presented in the architectural façade whereas the trees and plants of India are as rich in color as is the clothing and art of the people. The preceding color palette is taken from samples of Indian culture and art work of Le Corbusier. The India palette is taken from a group of young people celebrating dance in the Rock Garden, a favorite place for cultural gathering outside the original city, and from historic Mughal art. The bottom palette group is from Le Corbusier's own artwork and is surprisingly rich and similar to the Indian color group of Chandigarh. This thesis will look to introduction of color as an integral part of adapting living spaces to Indian culture. Indian architect Sarosh Anklesaria writes in a 2001 Architecture week article quoting a comment by architect Madhu Sarin concerning color and design in the city, saying;



Mughal Art

“In her epic text, *Urban Planning in the Third World*, The Chandigarh Experience, written two decades back, architect Madhu Sarin says, ‘What is lacking in the preoccupations of all these great planners is any direct consideration for the material reality of the people for whom they were designing these splendid creations. As a city, Chandigarh lacks the vitality, noise and charisma of most Indian towns and cities, where the streets and bazaars are dynamic places of public gathering, filled with mystic, color and allure. Chandigarh, by comparison is sterile and lacking soul.’”¹⁰

Youth celebrating in dance at Chandigarh Rock Garden.



Le Corbusier's artwork.
moma.com



Picture by author, 2005

¹⁰Sarosh Anklesaria, *Chandigarh: Vision and Reality*, Architecture Week, Sept. 2004, P. C3.1

Art Picture by; www.decorative-paintings.com, Mughal art, Taj Mahal and Gwalior Fort pictures from Wikipedia.com

INDIAN COLOR PALETTE



The design intent behind the organization of the Indian color palette is for adaptation of interior spaces according to values for their human acceptability and comfort while embracing the color vitality of Indian culture. The color palette from Le Corbusier’s painting is for comparison of richness of expression a link that he could have explored between his work and Indian culture. Both are valued by the human eye and mental imagery for connection to life. This color palette will not be applied to the exterior of the design due to an expressed concern by professional psychologists and local women interviewed. Both clearly stated it is not in the best interests for the home’s exterior to be in visually highlighted for their safety.

LeCORBUSIER PAINTING COLOR PALETTE



Parking area paving system:

Turf and Grass Pavers Grid System

Turf / Grass pavers are environmentally friendly in another area, which is the grid system. The grid system is made from plastic, and most companies use 100% recycled plastic material in the production of the grids. Other grass pavers are made from concrete material.

A major benefit of grass and turf pavers is that they allow the drainage of storm water back into the underground soil. Grass and turf pavers are environmentally friendly, for the storm water runoff is recycled, rather than going into our waterways.

Product by: Boddington Ltd.

www.boddington-ltd.com/civil/grasspavers



Potable water storage

Potable water roof storage is a requirement of Chandigarh city codes. This storage provision circumvents electrical power outages in residential units. The slightly warmed water is often used without water heating backup provision. In all except the coldest months the cold showers are quite refreshing and reduce need for constant electrical power for to maintain stored hot water temperatures. Small wall mounted electric water heaters that heat about five gallons of water at a time are the primary backup source for hot water. These are turned on as only as demand requires hot water.

Water Storage Vertical Double Layer Tank

Leveraging on our cutting edge technology we are able to manufacture and provide optimum quality water storage tanks. We use rotomoulding machine in the production process of tanks. Our wide gamut of tanks is available in double and triple wall construction. Our water storage tanks are available with ISI and non ISI marks. Our tanks being highly insulated avoids heat or cold transfer from outside.

Our wide array of water storage tanks are manufactured using latest technology. Our maximum range of tanks is ISI certified for their performance and quality. Water storage tanks we offer are widely appreciated for their corrosion resistance, leak proof and hygienic nature. Our water storage range includes the following:

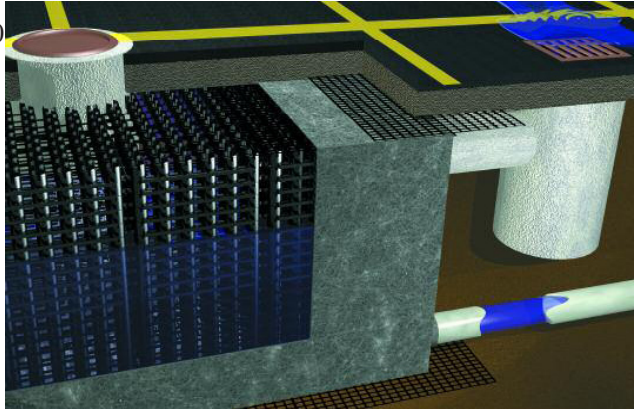


www.diplast.in

Rainwater capture system

Rainstore3 is an underground detention, retention, or water harvesting system used to store storm water under parking lots, landscaping, or small structures. Its 40"-square, modular structure has cell depths of 4", stackable to 8.2' (25 units high). Assemblies store 250 gal/m³. Rainstore3 is made from 100% recycled HDPE or polypropylene with varying amounts of post-consumer and post-industrial content. Rainstore3 is an underground detention, retention, or water harvesting system used to store storm water under parking lots, landscaping, or small structures. Its 40"-square, modular structure has cell depths of 4", stackable to 8.2' (25 units high). Assemblies store 250 gal/m³. Rainstore3 is made from 100% recycled HDPE or polypropylene with varying amounts of post-consumer and post-industrial content.

Invisible Structures, Inc.
1600 Jackson St., Ste. 310
Golden, CO 80401
Phone: 303-233-8383
Toll-free: 800-233-1510
Fax: 800-233-1522



www.invisiblestructures.com

Runoff storage benefits include usage for toilet flushing, pond or fountain supply, supplemental garden roof irrigation and use as passive cooling reservoir. This type provides simplicity of maintenance and installation ease.

Water reuse is limited in this semitropical climate as rainfall is generally adequate for plant growth and is excessive in terms of runoff containment. Estimated gallon usage for outdoor cleaning, plant watering, water feature resupply and toilet flushing is estimated at 10,000 gallons per month and is accommodated by a 6 meter x 6 meter x 1.2 meter deep assembly. The high humidity of Chandigarh contributes to the low rates of evaporation and plant transpiration which in turn reduces need for resupply of available water.

Brilliance Solar Commercial Systems



Maximize Existing Structures

Solar electric power is one of the best ways to maximize the efficiency of commercial and industrial buildings, carports, and open spaces. Easily installed on rooftops, building facades, or ground-mount structures, solar provides building owners with the opportunity to self-generate some or all of their annual energy needs.

The area of India belonging to Chandigarh is rated by GE Energy at 115-125 average monthly KWH, AC production per 100 sq. ft.

of roof area. Preliminary project planning is to use the south facing back wall to create the solar collection area. To supply power for a 24,000 KWH per month estimated power usage a total surface area requirement would 2,400 sq. ft. with a .89 efficiency on a 21/12 pitch surface angle facing south. Taking maintenance of a storage system into account the current choice is to go with a grid interactive system. The collection panels are planned to be placed into a wall frame that acts as design grid as well as providing a shading wall for the southern exposure.



www.geenergy.com



Solar water heating system



www.solargenix.com

The Winston Series CPC Collector from Solargenix Energy is a residential and commercial solar water-heating system. The basic system is comprised of 12 small compound parabolic collectors (CPC) which focus light onto absorber tubes through which heat-transfer fluid is piped. One to three collectors are commonly used for residential solar water-heating systems, depending on the size of the hot water storage tank. A roof-integrated thermosiphoning configuration is possible with new construction. The collectors carry a 10-year warranty. The system's heat exchanger, SOLPAC, is also available as a separate item. Coupled with one or more solar collectors, it prepackages the components needed to convert existing electric or gas water heaters into solar water-heating systems.

Supplemental heating and cooling system for apartments.



www.carrier.com

This product requires feasibility cost study in comparison to central system. The ability to control individual room environment is attractive and is a common part of the existing living experience in Chandigarh. Passive ventilation and shading are the primary sources of cooling for the apartments.

Ultimate Packaged Terminal Unit For In-Room Comfort

The low-noise 52P Performance Packaged Terminal Air Conditioner packs 7,200-14,500 BTUH of cooling and heating power. With its slim profile and easy controls, it's our most energy efficient in-room PTAC unit.

Dehumidification system

Bry-Air's MiniPAC® dehumidifier is the ideal dehumidification solution for smaller facilities in need of reliable humidity control or mold and mildew protection. The MiniPAC® can be installed as a stand-alone unit, or attached to any central air conditioning system to enhance the system's dehumidification capability. A small, yet powerful unit that combats the effects of moisture is ideal for a wide variety of applications.

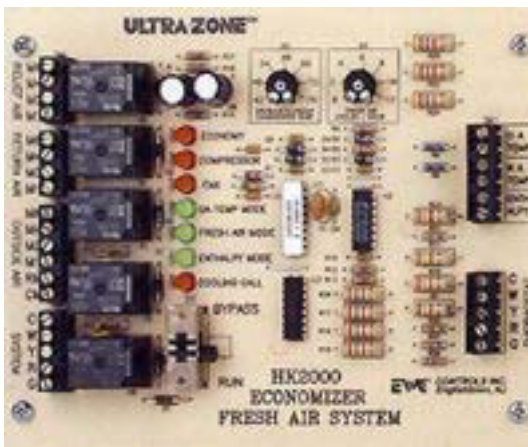
MiniPAC® Industrial Dehumidifier

MiniPAC® is a Reg TM of Bry-Air (Asia) Pvt. Ltd.

Dehumidification is an important factor in sub-tropical climate setting for comfort sensibility. Ability to use passive cooling strategies is compromised by high humidity conditions. Coupled with integrated system controls, comfort levels are maintained successfully in a complex multilevel temperature environment.



www.bry-air.com



www.ewccontrols.com

HK2000 Fresh Air / Economizer
EWC Controls, Inc.

The Ultra-Zone HK2000 Fresh Air and Economizer panel from EWC helps minimize HVAC loads while maintaining indoor comfort levels and providing controlled air changes. EWC makes a wide range of HVAC zone controls for commercial and residential applications with multi-stage, dual-fuel, and heat pump compatibility. The company also provides a range of dampers, pressure regulators, registers, diffusers, and thermostats.

Applied Technology

Occupancy sensor

Occupancy-Based Energy Management
Energex Inc.

Energex provides sensor-based HVAC and lighting energy management applications for hotels and commercial buildings. Using infrared occupancy sensing with logic control software, the system switches to "conservation" mode when no occupancy is detected for 30 minutes. Room temperature is restored within five minutes when occupancy occurs. HVAC and lighting costs may be reduced by as much as 45%, according to the manufacturer, while contributing to increased equipment life and noise reduction. Savings are highly dependent on occupancy patterns. A two-year warranty is offered. The Energex technology has been tested and approved by organizations such as BC Hydro, NYSERDA, PG&E, and Quebec Hydro, according to Energex Inc.



www.energexinc.com



Water Saving Toilet

VitrA Commercial 1.0 GPF Toilet
VitrA USA

The VitrA commercial 1.0-gallon-per-flush toilet uses the Sloan FlushMate IV® pressure-assist flushing system to remove 800 grams of solids per flush (about 230 grams per liter) under third-party MaP testing. This toilet has an elongated bowl and can be installed to be ADA compliant (17" high) with use of the recommended seat.

www.vitra-usa.com

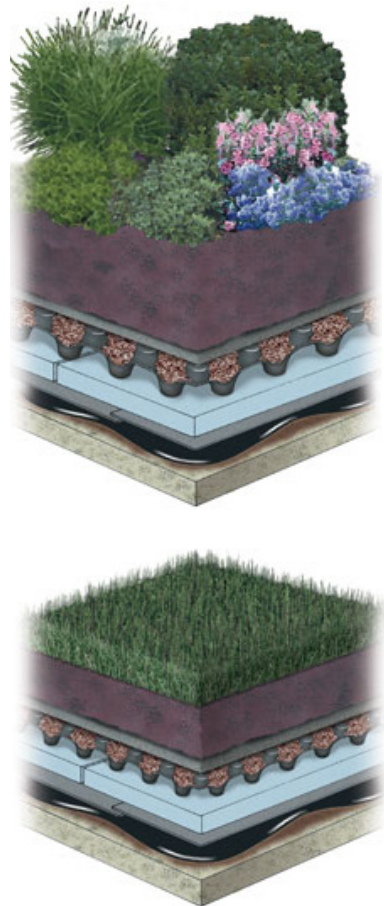
Green roof system

Hydrotech's Garden Roof® Assembly allows the design professional to transform virtually any flat or sloped roof into a landscaped environment. Designed as a lightweight, low profile system, the Garden Roof Assembly can be safely installed on roof and plaza decks not engineered to handle the heavy load requirements of a traditional green roof. And because the assembly incorporates Hydrotech's Monolithic Membrane 6125®, a proven roofing/waterproofing membrane, the building owner can be assured of a water-tight structure.

The landscape possibilities with intensive green roofs are virtually limitless. They are intended for recreational, sporting and leisure purposes and are often indistinguishable from natural gardens in appearance. Hydrotech's Lawn and Intensive Garden Roof® Assemblies follow the same design concept as an extensive Garden Roof. However, the drainage/retention layer is usually deeper and filled with expanded aggregate to provide greater water storage and to support a greater depth of growing media. The depth of the intensive growing media, which contains a greater amount of organic matter than an extensive blend, will generally dictate the type and size of plants that can be grown.

Intensive green roof designs usually consist of a mixture of hard and soft landscaping. It is therefore important that the selected drainage/retention layer can support any type of landscape – from roadways and paths, to soil and trees, so as to permit excess water to drain unobstructed underneath. The water retention capacity of the Hydrotech drainage/retention layers is used to assist with the irrigation of the plants – it is not a substitute for an irrigation system, which should always be installed within either the intensive or lawn Garden Roof Assembly.

With the provision of servant/maintenance employees the use of roof area for food production is part of the environmental control, provision for quality food for tenants and for productive use of rainfall. This also offers potential for tenant involvement and fulfillment.



www.hydrotechusa.com

Code Analysis

Section 302- use and Occupancy Classification

Occupancy group: Residential R-2, Dwelling Units

Table 301.3.2 – No required separation between units.

Section 503 – General Building Heights and Areas

Maximum of 16,000 sq.ft. per floor, up to 4 stories allowed

Section 602.3 – Construction Classification

Type 3 – Non-combustible exterior walls with interior of any material permitted.

Sections 701, 801 and 901 are application of fire rated materials and assemblies.

Section 907.2.1.2 – smoke detectors required on ceiling or wall outside of separate sleeping areas, in each sleeping room and in each story within dwelling units.

Section 1004

Table 1004.1.2 –	<u>Number of occupants</u>
Exercise room – 50 sq.ft. gross per person	8 people
Kitchen – 200 sq.ft. gross per person	2 people
Library/media – 50 sq.ft. net per person	6 people
Residential - 200 sq.ft. gross per person	65 people
Assembly w/o fixed seating – 7 sq.ft. per person	142 people
Dining w/ tables and chairs – 15 sq.ft. per person	66 people
Business office/conference – 100 sq.ft. per person	3 people
Staff/servant quarters – 200 sq.ft. per person	5 people
<u>Mechanical room – 300 sq.ft. per person</u>	<u>1 person</u>
Total occupancy	300 people
Maximum occupancy for any floor	220 people

Section 1005 – Egress Width

Minimum egress widths required:

Maximum floor occupancy is 220 people – door width = 33”

Total Occupancy above first floor is 70 – egress width for stairs is 44”

Minimum door width out of areas is 36” or greater

Table 1005.1 Maximum occupancy of 300 – egress for doors is 60” total

Section 1007.2 – Egress

Area of refuge:

Requirement – 1 wheelchair space 30x48 required for each 200 occupants

Space provided for 1 on second level within stair enclosure

Section 1008.1.5.1

Landing size:

Requirement not less than 44” length in direction of travel.

Minimum clear landing length is 68”

Section 1009.1

Stair Width:

Minimum width is 44”

Section 1009.3 – Stair treads and risers – 11” tread w/6” risers

Roof Access is by stair to enclosed space.

Section 1013.3

Common path of egress travel:

Length of common path of travel shall not exceed 100’

Section 1014

Exit and exit access doorways:

2 Exits required for an occupant load of over 50 people

Section 1015

Exit access travel distance:

Maximum distance is 250” w/sprinkler system

Section 1016.3

Corridors:

Maximum corridor dead end distance is 20’ in occupancy areas

Table 1016.1 Corridor fire resistance rating 0.5 hour for R-2 sprinklered

Section 1018.1

Number of exits:

Occupant load of 1-500 requires 2 exits

Code Analysis

Section 1023

Exit discharge:

Exits shall discharge directly to the exterior of the building at grade.

Exit discharge shall not re-enter a building. Exception: A maximum of 50% of the number and capacity of the exit enclosures are permitted to egress through areas on the level of discharge (with provisions) 1023.1.3 all portions of the egress path are protected by sprinkler systems.

Section 1024.2

Assembly main exit:

Not required under occupant load of 300

Section 1106

Parking:

1-25 spaces requires 1 handicapped space in parking scheme.

Section 1108.2.2.1

General seating:

With capacity of assembly area of 101-300 = 5 wheelchair spaces.

Section 1109.2.1

Unisex toilet:

None required by occupancy.

Section 1116.

Seismic; Zone 4

Section 2901

Plumbing:

2902.1 Minimum number of required plumbing fixtures.

Required 1 male water closet per 125 males

Required 1 female water closet per 65 females

Required 1 lavatory per 200 for both male and female.

1 kitchen per dwelling required

1 automatic clothes washer connection per 20 dwelling units.

Chandigarh, city code requirements:

Apartment minimum sizes:

- Efficiency = 380 sq.ft.
- 1 bedroom = 550 sq.ft.
- 2 bedroom = 720 sq.ft.
- 3 bedroom = 900 sq.ft.
- 4 bedroom = 1120 sq.ft.

General occupancy:

One person per 80 sq.ft. of living area.

Servant space:

Not less than 10% of # of main living units.

Balcony:

Minimum 3 sq. m. = coffee table space for 2

Open space:

Minimum required is 15% of lot area.

Setback:

Required lot setbacks = 3 meters
Height limit = 10 meters = 32.8 feet

Parking:

Required 1 car per flat over 25 sq.m. floor space.

Windows:

Minimum window area = 10%

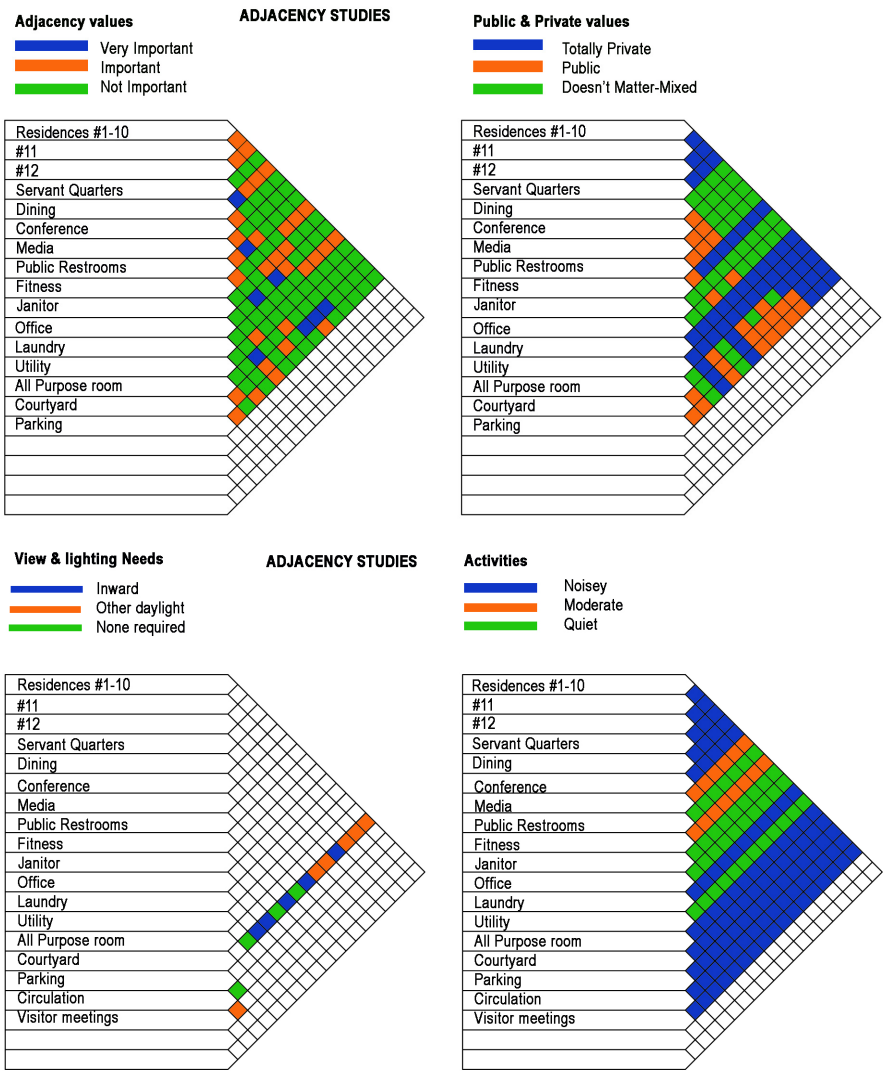
Project Development

In the process of plan development this author took one last look at the thesis idea and its foundation for relating to the creation of a place of belonging for its proposed residents. Research of the subject of creating identity through place lead to a book edited by James S. Duncan titled *Housing and Identity, Cross Cultural Perspectives*. In this writing was a study of identity and environment corroborating conclusions relating to the current state of social and cultural conditions in Chandigarh, India. The idea that an improved living situation poised for acceptance by the community as a new setting for a marginalized group has a hopeful prospect in the current economic and social atmosphere under way in Chandigarh. The article in the book by Amos Rapoport concludes that the current trends toward a westernized culture that is based upon accomplishment and ownership of houses with material possessions is more open to new people, new social settings and changing relationships with women than traditional cultures.

A second thought presented is that when traditional roles and acceptance within the family structure are missing identity related to one's environment, living setting, is important in forming a new identity. "If the identity is not known either internally or externally and if many of the systems described above are lacking, then place identity, which communicates social identity becomes very important."¹⁸ Rapid cultural change produces opportunity for giving identity through belonging. Thus encouraged, investigation of form and space proceeded as illustrated on the following pages.

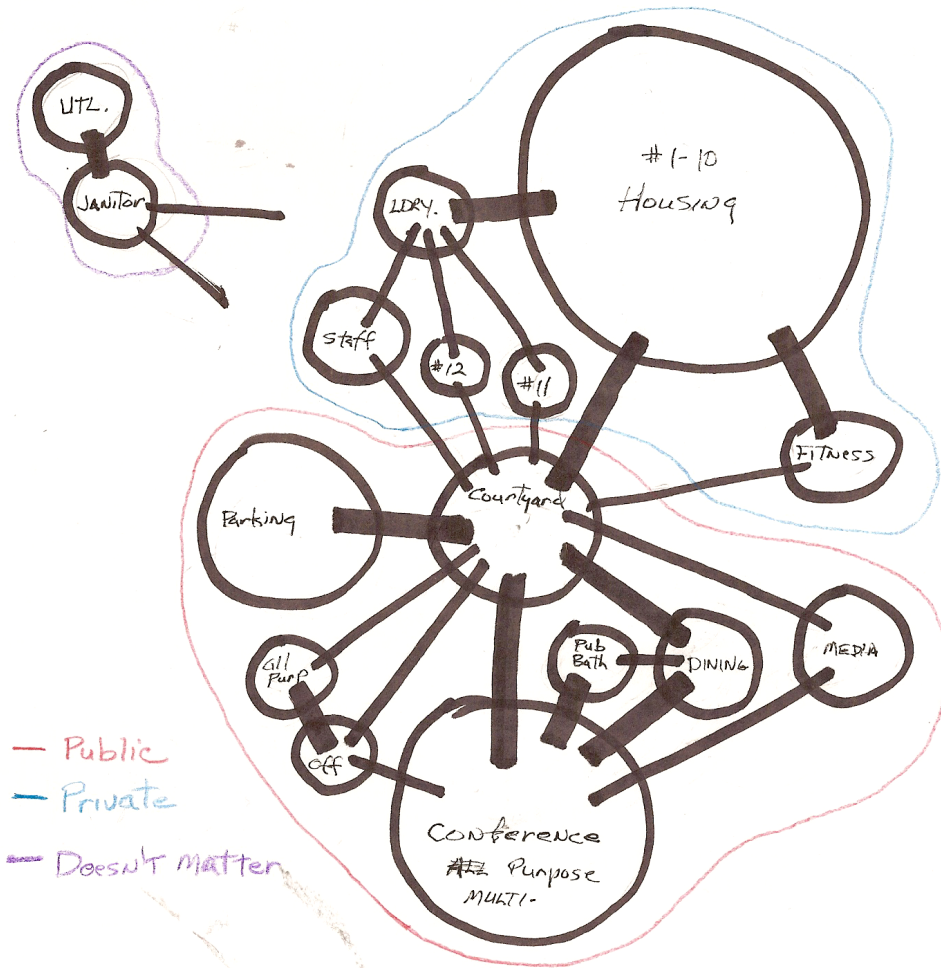
¹⁸ James S. Duncan, *Housing and Identity, Cross Cultural Perspectives*, Holmes & Meier Publishers, Inc. New York, New York, 1982, P. 16

The design process is initiated for this project through design implementation tools. The first of these applied is a space adjacency study documented by the following graphs and organizational study sketches. Adjacency graphs were developed to look at views, activities, adjacency strengths and public and private relationships.



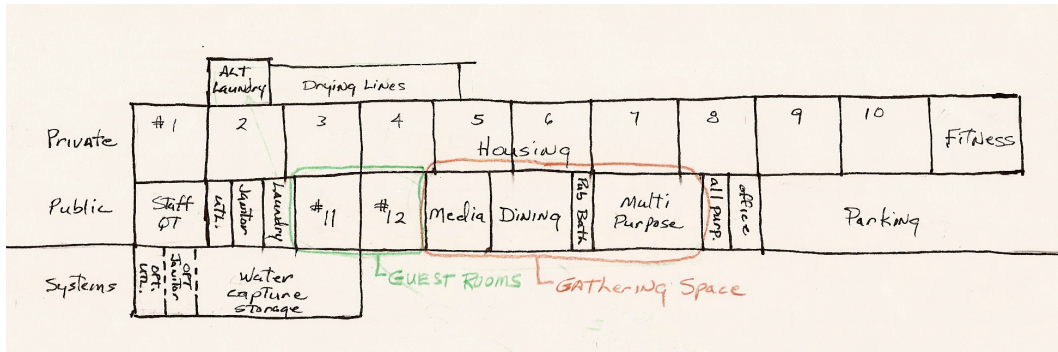
Project Development

Bubble diagrams exploring interaction between spaces reveals the complexity of space relationships in the program. This is pictured through application of size representations of program space elements. The diagram illustrates conditions for placement of spaces and function leading to categorization of space priorities. The complex interaction diagrams revealed secondary groupings of spaces that increased freedom to reorganize groupings related to use adjacencies.

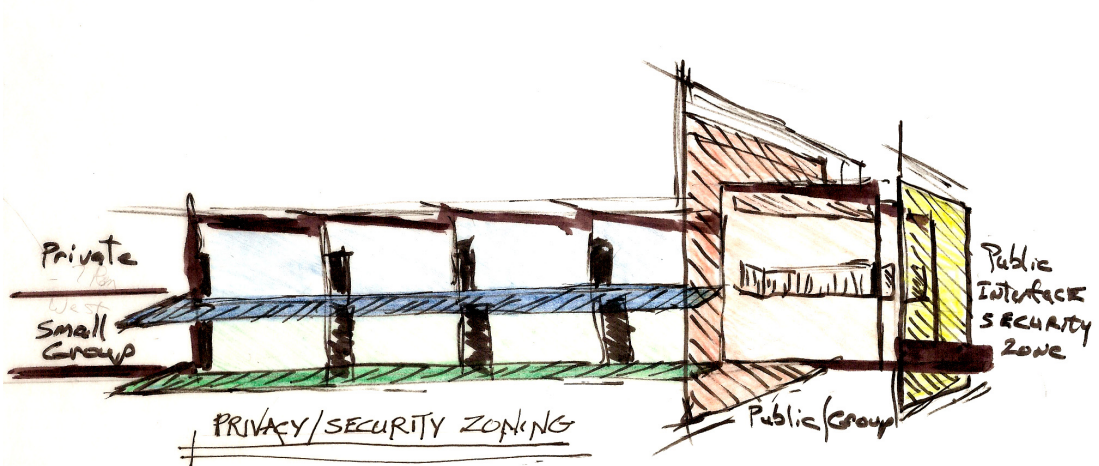


Project Development

Relationships discovered in the first two analysis are reorganized in a rectilinear diagram of spatial organization modeling volumes of space in consideration of vertical space requirements based on site constraints.

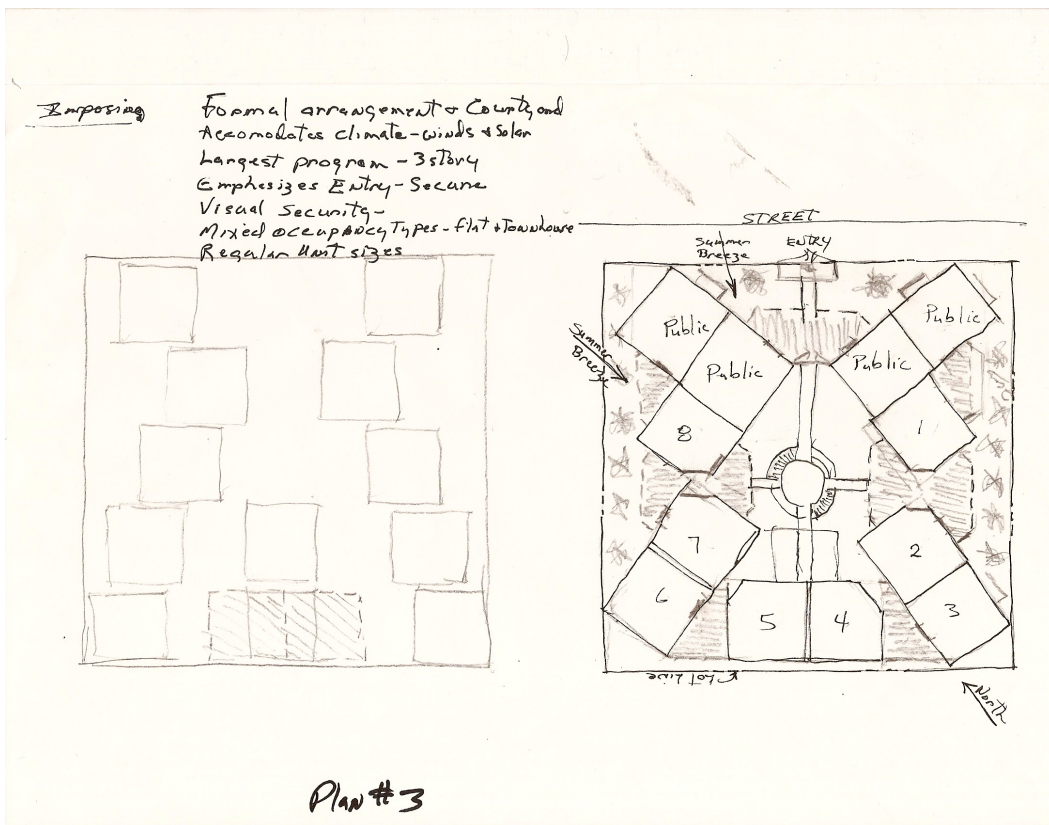


Space relationships illustrated by area zoning

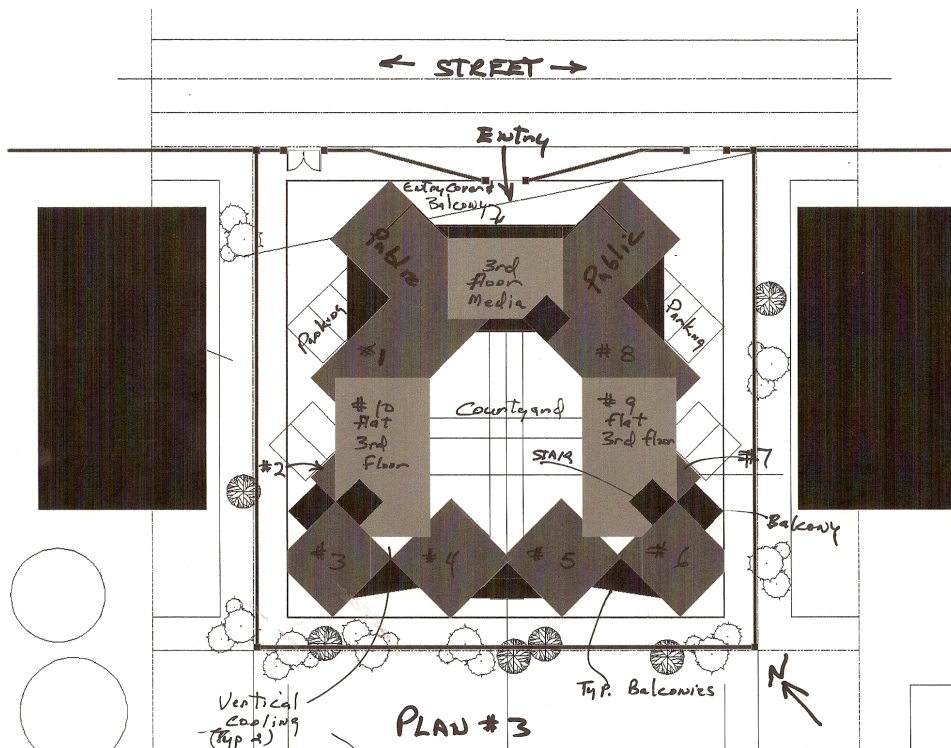


Project Development

The third phase of spatial organization was to apply adjacency studies and preliminary program size allocations to a study of organizational principles. Space allocations were organized according to the program requirements and applied to a lot plan. Typical organizational systems were tested. The spaces were placed and reorganized through the use of centralized, linear, radial, clustered and grid systems. The following illustrations represent plan 3 chosen for development from these trial organizations.



Plan three development



Plan three elevation development sketch

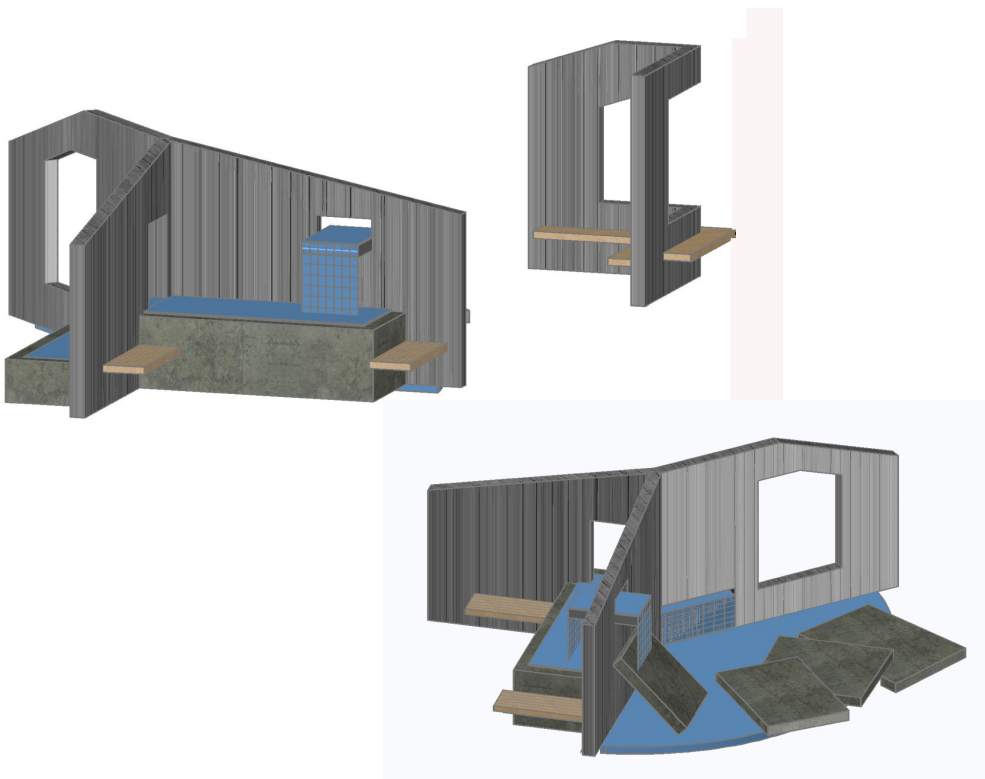


Project Development

Plan three courtyard development sketches

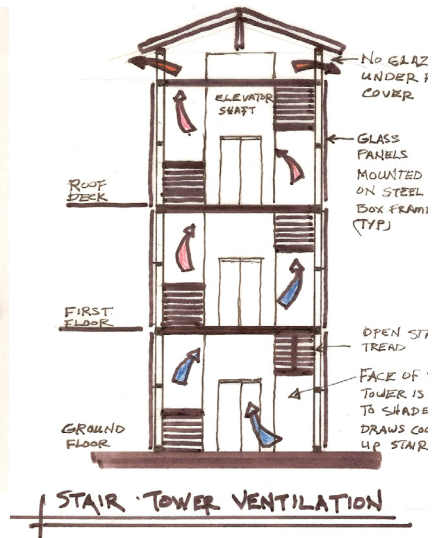
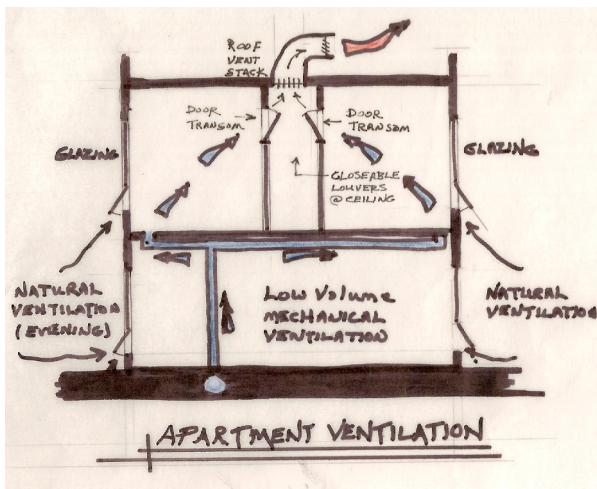
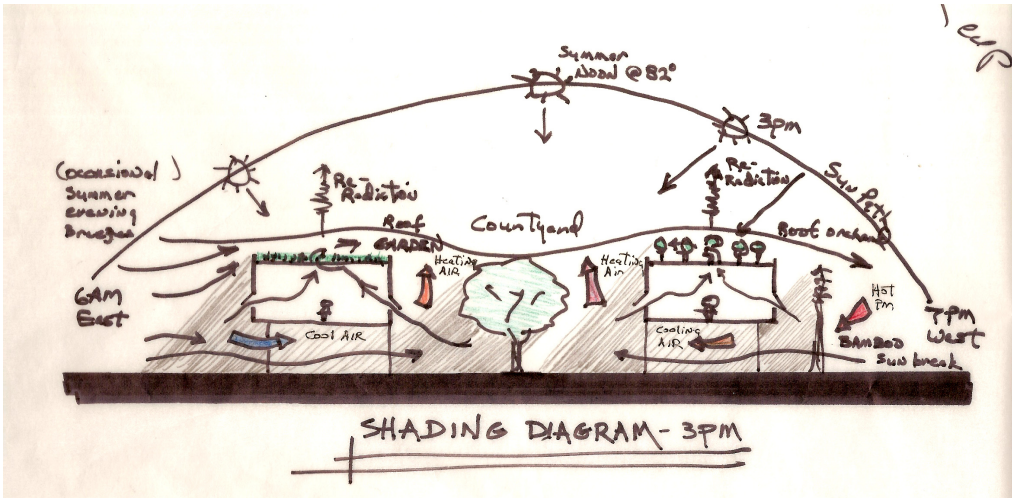


Plan three courtyard development of fountain and conversation sculpture



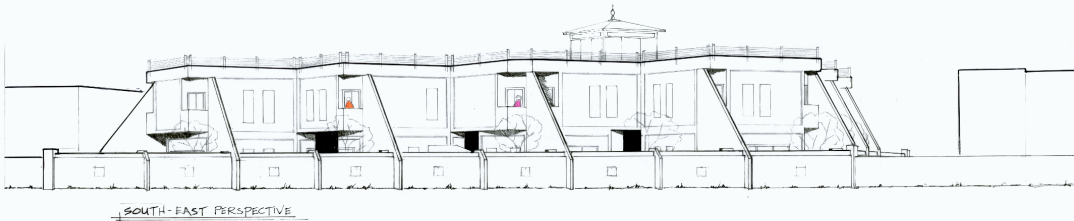
Project Development

Plan three diagrams of ventilation and climatic effects in section and elevation



Final Design

On the following pages the final design submission will be presented beginning with hand sketches of elevation perspective drawings.



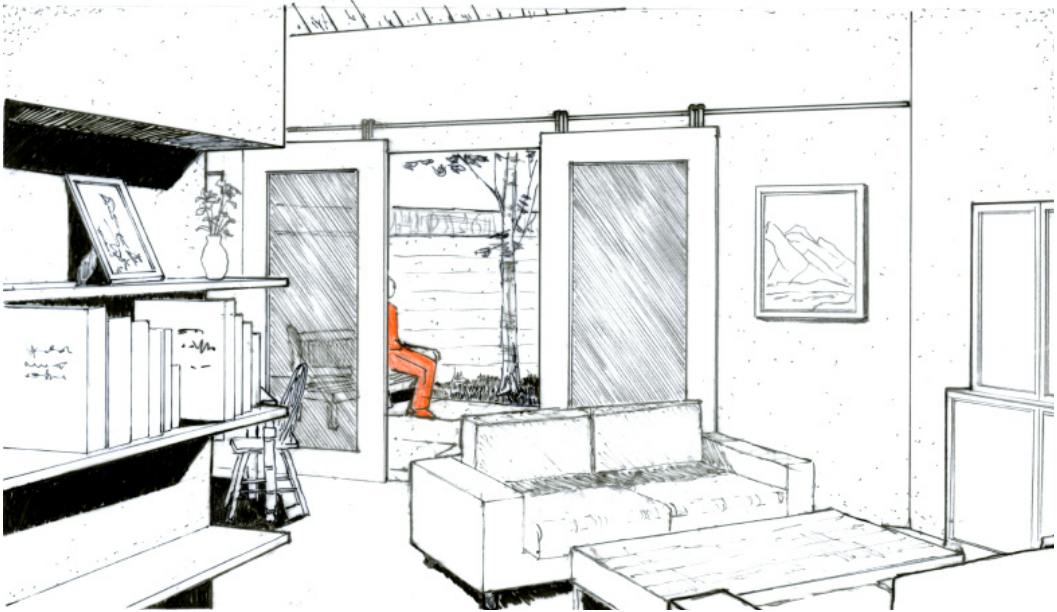
Private meeting courtyard
perspective with
sitting sculpture

Courtyard perspective with fountain



Final Design

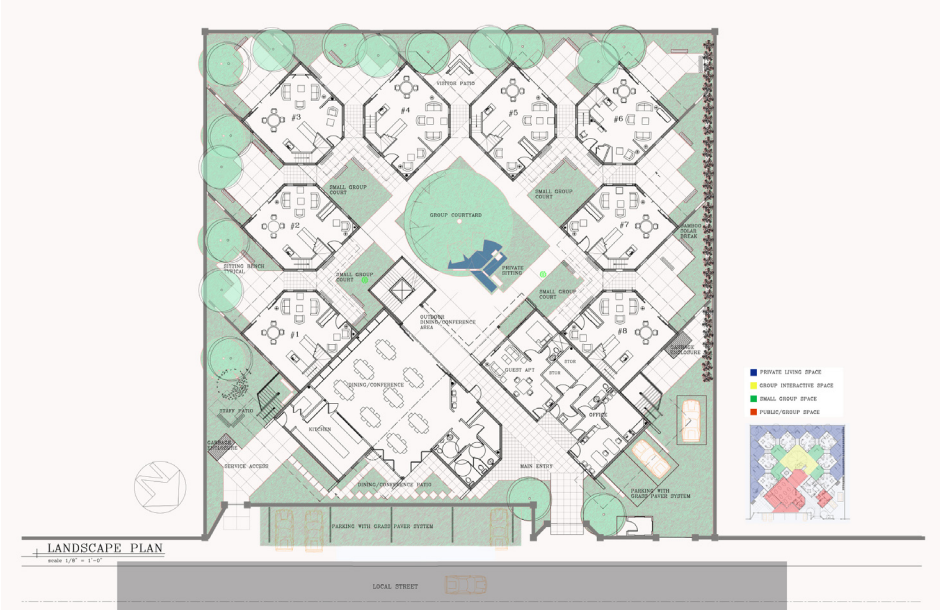
Residential living room perspective



Group dining room perspective - looking into courtyard



Ground floor plan and landscape plan

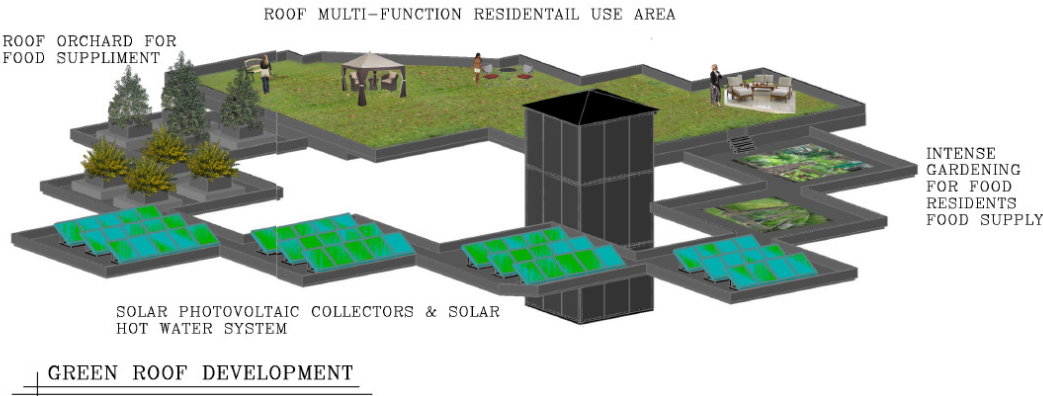


First floor plan

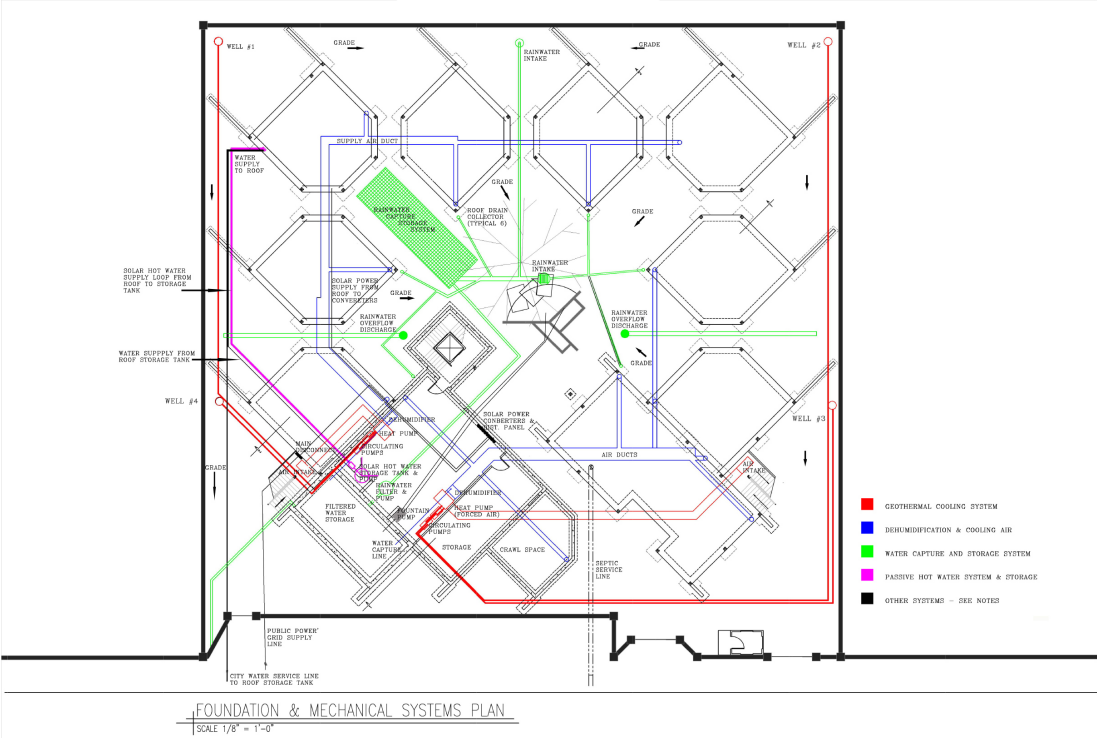


Final Design

Green roof schematic plan



Mechanical systems plan



Building and courtyard section A-1



BUILDING SECTION A-1
SCALE 1/8"=1'-0"

Building and courtyard section A-2



BUILDING SECTION A-2
SCALE 1/8"=1'-0"

1. Jim Richards, *Hassan Fathy*, Architectural Press Ltd. , London 1985, P. 11
2. Sarosh Anklesaria, *Chandigarh: Vision and Reality*, Architecture Week, Sept. 2004, P. C3.1
3. *A Road Guide to Chandigarh*, TTK Healthcare Limited-Publications Division, Chennai, India, 2005, P.4
4. Charles Correa, *chandigarh: The View from Benares*, (Essay from LeCorbusier, by Halle Brooks, Princeton University Press, Princeton, New Jersey, 1987) P.200
5. Ibid P. 199
6. Joseph Giovannini, *Chandigarh Revisited, Architecture, Washington, D.C. July 1887, volume 86, P.42*
7. Norma Evenson, *Yesterday's City of tomorrow Today*, (essay from LeCorbusier, by Halle Brooks, Princeton University Press, Princeton, New Jersey, 1987) P.242
8. Alexander Tzonis, *Le Corbusier - The poetics of Machines and metaphor*, Pizzoli International, N.Y. 2001, P. 212
9. *A Road Guide to Chandigarh*, TTK Healthcare Limited-Publications Division, Chennai, India, 2005, P.4
10. Sarosh Anklesaria, *Chandigarh: Vision and Reality*, Architecture Week, Sept. 2004, P. C3.1
11. Jean-Marie Tjibaou, From press booklet edited by ADCK Cultural Director, Emmanuel Kasarherou, Tjibaou's Cultural Center, May, 1998, p. 30
12. Ibid, p.30
13. Jim Richards, *Hassan Fathy*, Architectural Press Ltd. , London 1985, P. 11
14. Ibid, p.11
15. Dennis Sharp, *Twentieth Century Architecture; A visual History*, Facts on File, New York, 1991
16. Patrick Leigh Brown, *Eccentric Viennese Housing Project Lures Tourists*, NY Times, Jan. 8, 1987
17. Kids With Cameras, kids-with-cameras.org
18. James S. Duncan, *Housing and Identity, Cross Cultural Perspectives*, Holmes & Meier Publishers, Inc., New York, 1982, P. 16

1. *Le Corbusier*, Edited by H. Allen Brooks, Princeton University Press, Princeton, New Jersey, 1987. Essay's by: Reyner Banham, Tim Benton, H. Allen Brooks, Alan Colquoun, Charles Correa, Norma Evenson, Kenneth Frampton, Daniele Pauly, Vincent Scully, Peter Serenyi, Jerzy Soltan, Manfredo Tafuri, Stanislaus Von Moos, Andre Wogenscky, and iannis Xenakis.
2. T.R. Hamzah & Yeang Sdn. Bhd., *Hamzah & Yeang; Bioclimatic Skyscrapers*, Elipsis, London, 1994
3. Daniel E. Williams, FAIA, *Sustainable Design: Ecology, Architecture, and Planning*, John Wiley & Sons, Inc. Hoboken, N.J., 2007
4. G.Z. Brown & Mark DeKay, *Sun, Wind & Light; Architectural Design Strategies*, Second Edition John Wiley and Sons, N.Y., 2001
5. Dennis Sharp, *Twentieth Century Architecture: A Visual History*, Facts on File, N.Y. 1991
6. Charles Ramsey, *Architectural Details: Classic Pages from Architectural Graphic Standards 1940-1980*, John Wiley and Sons, N.Y., 1992
7. Joo-Hwa & Boon-Lay Ong, *Tropical Sustainable Architecture: Social and Environmental Dimensions*, Elsevier, 2006
8. Article by: Kerri Henderson, *The marika Alderton House*, [www.architecture.uwaterloo.ca/faculty_projects, #20076950](http://www.architecture.uwaterloo.ca/faculty_projects/#20076950)
9. Chandigarh School of Architecture, <http://cca.nic.in/introduction.htm#top>
10. Joseph Giovannini, *Chandigarh Revisited*, Architecture, July 1997,
11. Richard Padovan, *Towards Universality: Le Corbusier, Mies + DeStijl*, Routledge, London & N.Y. 2002
12. Architecture For Humanity, *Design Like You Give a damn*, Metropolis Books, 2000
13. College of Architecture, Thesis Projects:
 #1097 Rahul Shaoma, The villa's Luxury Residence
 #1044 Dhearaj Bansal, High Rise Apartments, 2007
 # 1038 Atit Kumar, Mixed Use Housing, 2006
14. Tim Benton, *The Villas of Le Corbusier*, Yale University Press, New Haven, Conn. 1987
15. Sagar Jagdish, *Architecture & Urbanism: 50 Years of the Idea*, A+U, May 1999, h.5 (244) P. 129-135
16. Jim Antoniou, *Chandigarh; Once The Future City*, Architectural Review, Volume 213, Issue 1273, 03-2003
17. Bernice Murphy, *Centre Cultural Tjibaou; A Museum and Arts Center Redefining New Caledonia's Cultural Heritage*, Humanities Research, Vol. 9 No.1, 2002
18. McGraw Hill Construction, *Product News for Design & Construction Professionals*, Vol. 18, No. 10, Nov. 2008
19. J.M. Richards, I. Serageldin, D. Rastofrer, *Hassan Fathy*, Architectural Press Ltd. London, 1985,

1. www.sjenergy.com - consumption calculator
2. [www. bella-dura.com](http://www.bella-dura.com) - polypropylene fabric
3. www.beenergy.com - Brilliance pre-packaged photovoltaic systems
4. www.invisiblestructures.com - Rainwater capture and storage systems
5. www.solarbenix.com - Solar water heating system
6. [www. carrier.com](http://www.carrier.com) - Heat pump/AC units
7. www.bry-air.com - Dehumidification system
8. www.ewccontrol.com - HVAC controls
9. www.energexinc.com - Occupancy sensors
10. vitra-usa.com - 1 gpm toilet
11. indiamapsservice.co.in - India maps
12. <http://cca.nic.in/introduction.htm#top> - Chandigarh School of Architecture
13. www.anu.edu.au/hre/publications - Indigenous Australian Architecture