

A Multilateral Design Methodology for Development Contexts:
a framework for the Dharavi Potters

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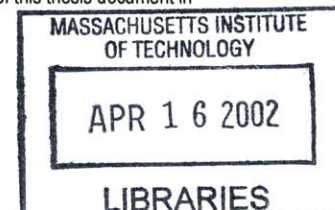
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Submitted to the Department of Architecture on January 18, 2002 in partial fulfillment of the requirements for the degree of Master of Architecture from the Massachusetts Institute of Technology

Abstract:

The migration from rural areas to urban environments, and the continuous growth of the current population has caused an increasing shortage of low-income urban housing in developing countries. In addition, the high cost of available housing has driven many in the lower income groups into squatter settlements in and along the periphery of urban developments. These squatter settlements are often the result of ineffectual and dysfunctional social and economic policy, compromised structures of governance, corrupt land markets, lack of equitable and humane regulation, and improper and inefficient finance scenarios. While poverty has many dimensions, urban poverty often has a broader meaning of cumulative deprivation, characterized by: squalid living conditions; risks to life and health from poor sanitation, air pollution, crime and violence, traffic accidents, and natural disasters; and the breakdown of traditional family and community safety nets. Rapid population increases within urban areas, crumbling infrastructure, growing inequalities between rich and poor, and insufficient urban services point to the need for a reevaluation of current models of urban development. Through an investigation of a multi-disciplinary approach to development, this project will identify the difficulties and potentials within the context of development in order to augment current design, planning, financing, and construction knowledge towards the creation of viable and sustainable architecture.

The Khumbar Wada potters' community in Dharavi, Mumbai will be utilized to illustrate the potential for multilateral approaches to go beyond the rhetoric that has compromised the discussion of architecture and its relationship to development work. The design will address development strategies and construction processes that express local conditions within the urban, architectural, and tectonic scales. Through the investigation and implementation of architectural infrastructure, the design will alleviate environmental, economic, and political constraints while accommodating local values. A potters' workshop will serve to illustrate the potential of a multilateral design methodology. This thesis aims to suggest a framework for decision-making that can be used across various sectors and at multiple scales and the physical implementation of infrastructure that allows for the creation of more humane environments.

Thesis Advisor: John E. Fernandez

Title: Assistant Professor Building Technology and Design

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pots drying on brick kiln - dharavi

Table of Contents

1.0 Introduction: The Challenge of Urban Development

- 1.10 A New Paradigm in Development
- 1.20 Research Need
- 1.30 Methodology
- 1.40 Values

2.0 Background: A Brief Review of Development

- 2.10 Case Studies
- 2.11 Grameen Bank
- 2.12 Citra Niaga
- 2.13 Kampung Improvement Program
- 2.20 Lessons Learned

3.0 Development Criteria

- 3.10 Governance
- 3.20 Economic
- 3.30 Environmental
- 3.40 Urban Design
- 3.50 Architectural Design
- 3.60 Building Materials

4.0 Context Analysis

- 4.10 Site: National and Regional Context
- 4.20 Community Context
- 4.30 Urban Criteria
- 4.31 Environmental
- 4.32 Urban Design
- 4.33 Architectural Design
- 4.34 Building Materials
- 4.35 Governance
- 4.36 Economic
- 4.40 Criteria Assessment
- 4.50 Assumptions

5.0 Urban Scenarios

- 5.10 Urban Scenario 1: Centralized Workshop
- 5.20 Urban Scenario 2: Polycentric Workshops
- 5.30 Urban Scenario 3: Multi-nodal Workshops
- 5.20 Urban Interventions
- 5.30 Phased Development
- 5.40 Program Elements

6.0 Architectural Concepts

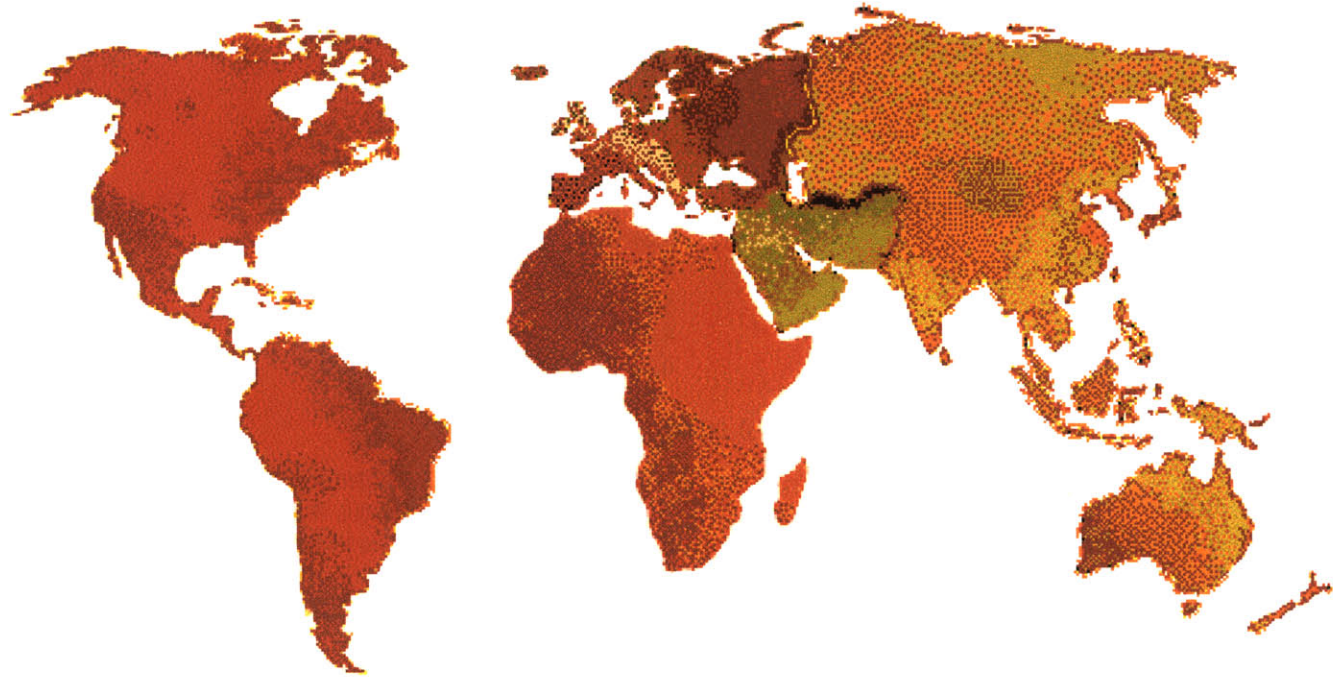
- 6.10 Architectural Typologies
- 6.11 Long House Typology: Shotgun House
- 6.12 Shophouse Typology
- 6.13 Structural Frameworks

7.0 Project Development

- 7.11 Scope of the live.workshop
- 7.20 Conceptual Design
- 7.21 Aggregate Growth
- 7.22 Program Scenarios
- 7.30 Schematic Design
- 7.31 Program Arrangement
- 7.33 Prototype Facades
- 7.34 Architecture as Infrastructure
- 7.40 Design Development
- 7.41 Appropriate Materials
- 7.42 Ceramics
- 7.43 Clay-Based Wall System

8.0 Conclusions and Implications

- Illustrations
- References



1.0 Introduction: The Challenges of Urban Development

By 2050, there will be over 9 billion people on earth. The developing world will account for 85% of the population, with the majority of population growth occurring in urban areas. (World Population Prospects, 2000). The 48 least-developed countries will nearly triple in size, from 658 million to 1.8 billion people (ibid). The rapid expansion of cities has caused major problems for city dwellers as well as for governments.. Noise, traffic congestion, air and water pollution and other environmental problems plague these cities while the explosive population growth has placed a huge strain on the ability of governments and municipal agencies to meet the needs of city dwellers. Amidst this, the urban poor display great strength, perseverance and ingenuity under the most dire of circumstances, and seek improvement of their lives through collective inventiveness and effort. Unfortunately, the urban poor continue to suffer disproportionately from failures in urban services and regulations governing land use. Insufficient services and restrictive regulations often further impede the poor from opportunities that would allow them to improve their circumstances. Rapid population increase, crumbling infrastructure, growing inequalities between rich and poor, and insufficient urban services point to the need for a reevaluation of current models of urban development (Drakakis-Smith, 2000).

Key issues facing sustainable urban development include developing entry points into settlements for architectural development projects, establishing criteria and guidelines for environmental conditions, determining the role of income-generating schemes, advancement of technological skills and production of craft, and empowerment of people through active change (Potter & Lloyd-Evans, 1998). However, major barriers to practicing sustainable construction include: corrupt governance with often entrenched colonial codes and standards, uncertain economic environment, lack of accurate data, lack of capacity of the construction sector, lack of interest or knowledge about sustainable issues, technological issues, and a lack of integrated research and multilateral design processes. It is the hypothesis of this project that through an analysis of current models of development and existing projects within the developing world, a new development paradigm will emerge

that will address the needs of the urban poor in a more holistic manner. The goal of this exploration was to articulate methods for the design of urban development projects that will address global issues of changing economies and social structures while fulfilling the particular needs of local communities and helping them to realize their social goals. The combination of social, political and economic needs should drive the production of urban development projects that are consistently unique, flexible and ecologically responsible. It is the aim of this thesis to promote a better understanding of the issues that drive design within a development context and how attention to the idea of space can create environments that reflect the cultural, social, and physical way in which communities live

1.10

A New Paradigm in Development

Why multilateral solutions?

Development projects in the past have concentrated on housing, sites and services, overall urban planning, economic opportunities, and large scale policy adjustments but have not developed in and of themselves as holistic strategies that incorporate multilateral approaches. Urban projects since the late 1980s have increasingly focused on policy reform and institutional change, delving deeper into issues of regulation, incentive systems, and the patterns of relationship – among local government, the private sector, informal organizations and households (Potter & Lloyd-Evans, 1998; Zanetta, 2001). However, as democratization, decentralization, and public-private partnership strengthen the communication and collaboration among these stakeholders, a more holistic approach to urban development is called for.

conditions in developing countries



Multilateral solutions seek to recognize cities as dynamic development arenas where the convergence of sectoral activities and collaboration among communities, levels of government, and other private and public sector institutions can create a microcosm of sustainable development practices (World Bank, 2000). Regionally focused multilateral approaches are necessary to establish a methodology for development in developing countries. Multi-disciplinary approaches allow for a new paradigm to emerge based on the interconnectedness of these varied disciplines and their affect on one another. Boundary-crossing efforts will allow for the input and participation from a diverse group of people, organizations and governments as well as ensure the relevance of the various disciplines within urban development. Strategies and processes that express local conditions and aspirations, control over resources, account for gender equity, and consider religious, ethical, and spiritual values should be integrated into all urban development schemes as part of an entire 'package'. Multilateral approaches to design should imply a vision – a set of principles – for policies, relations, and behaviors that over time, will result in social, institutional, and economic change.

Research Need:

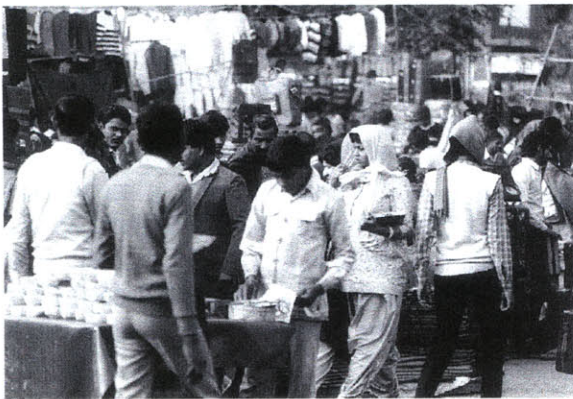
Why cities?

Between 1950 and 1975 the urban population of the Third World grew by 400 million and has since increased by a further billion. The rate of increase in low-income countries urban growth rate exceeds that of the developed world by more than five times (Drakakis-Smith, 2000). Within a generation the majority of the developing world's population will live in urban areas and the number of urban residents in developing countries will double, increasing by over 2 billion inhabitants (World Bank, 2000). Over the next two decades more than 95 percent of the population growth in developing countries will occur in urban areas. The unprecedented scale of this urbanization poses daunting requirements for countries with insufficient resources (ibid). While poverty has many dimensions, urban poverty often has a broader meaning of cumulative deprivation, characterized by: squalid living conditions; risks to life and health from poor sanitation, air pollution, crime and violence, traffic accidents, and natural disasters; and the breakdown of traditional family and community safety nets. Moreover, income equality is worsening in many urban areas, further excluding low-income groups from employment opportunities, basic services, political representation, and legal and social protection (ibid).

Although living conditions in many cities are often worse than those in the countryside, the perceived advantages of the city draws migrants to it, particularly in terms of economic opportunities. Urban migration occurs for several reasons. Unequal economic development in rural regions, shifts in agricultural production that result in landless farmers, and the perception of improved opportunities and facilities in the city continue to pull migrants into the city (ibid). For many migrants, life does improve in the city, or at least offers prospects for a better life. However, as urban populations increase, strained resources will only compromise the lives of urban dwellers further. Rapid population growth and the concentration of large scale development problems imply that urban areas should be the prime focus for development projects and strategies in the next century.

Why architecture as a tool for development?

"In a world with little respect for traditional structures, almost everything - from the operation of a company to the organization of a community to the order of our physical environment - can be approached as a design problem, in which new solutions must be sought to meet particular needs and specific contexts (Fisher, 200). While other countries and cultures have developed low income housing as an integral part of their urban fabric, in much of the developing world, low income housing is located at the edges, geographically and philosophically clustered together to mediate and control the lives of those that are less fortunate. Many squatter settlements reflect this social ideology. This economic policy and social agenda dismisses the possibilities of an activist architectural practice and has served to dictate inferior and problematic architectural form. And while this ideology has slowly begun to change in some places, many developing countries, such as India, have yet to fundamentally challenge the notion of inhumane low-income housing and its social and architectural implications. This project proposes a multilateral design methodology for development contexts that results in the establishment of development criteria and the creation of an architectural project. Although improving the actual physical conditions of dwellings is often a secondary issue to the inhabitant, the physical condition of the living units is important to the long-term well being of residents. Secure habitat is the very foundation of any transformation from poverty towards socialization within the larger urban context and contributes to the creation of constructive communities (ibid). By investigating and analyzing the issues that surround the lives of people within these settlements, I have developed a design methodology and strategies that will improve their lives through the development of an architectural framework that will enhance their environment, the creation of a central marketplace that will generate income, and through the creation of separated workshops which will alleviated environmental pollution.

urban street market, india

1.30

Methodology: *what was the process of discovery?*

Initially, this project did not have a clear methodology. It is important to state this because this project was one in which the goal was to discover and create a methodology **through the process of design**. This method deviates from the normal design project in which a design problem is given and the solution is arrived at through subsequent design iterations. Early on, a set of questions and criteria were established as a basis for discussion and evaluation at each phase of the design. The criteria were based on the idea of multilateral development and were considered the key issues and concepts needed to create a multilateral design methodology. The criteria served as a reference for making decisions throughout the design process. Once the criteria were established, a design project and methodology emerged from the new set of rules and characteristics. The methodology for this project was one in which the main premise was comprised of a set of core ideas and values which were constantly readdressed at each phase of design. Initial site surveys and interviews with key players in the development field in India as well as with local inhabitants in the Dharavi community served as background research to help develop the criteria, assess initial assumptions and to provide technical information for the development of the design.

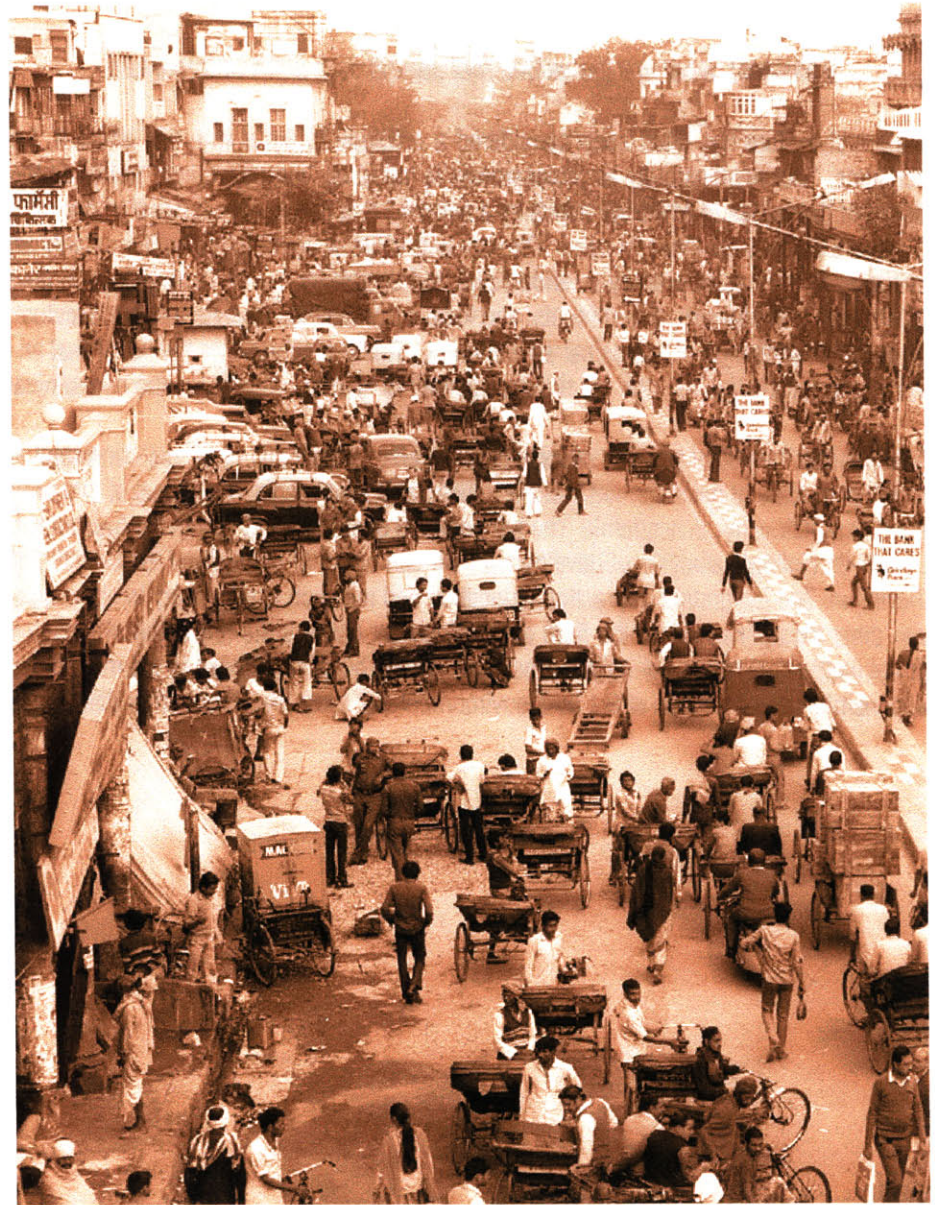
A summary of the initial methodology is as follows:

1. Interview players at all levels and in all sectors – government, private sector contractors and developers, NGO, miscellaneous research groups in order to regard their estimation of the ability for architectural initiatives and materials research to play a role in urban redevelopment projects of informal settlements.
2. Visit Dharavi and become familiar, on a first-hand basis, with the reality of slums in India and the issues that surround the lives of those who inhabit these settlements.
3. Become familiar with the reality of bringing into such a context a university-driven research-oriented project and assess the ways in which one could overcome obstacles.
4. Establish the site for the project and assess local conditions in order to more clearly form objectives and criteria for the project.
5. Survey the site; photograph the site; and gather plan and infrastructure information.
6. Determine the causal reasons behind the needs of the poor and interview people within the community in order to more clearly establish a set of goals and priorities for the community.
7. Through an analysis of the information gathered, determine criteria for the project, establish an entry point and design an architectural project that would satisfy requirements established.

Values: *what are the values that served as a point of departure?*

While architecture has often been considered a privilege to those who can afford it, I strongly believe that it is a basic human right. Thomas Fisher states that as architects, “Our responsibility as professionals is not to do ‘our own thing,’ but to do the right thing, to assert the common good over personal gain or expression, to represent the values to which we aspire as a culture.” It is this common belief in the value that architecture brings to our clients and to society at large that inspires me to explore options for those in need. The role and value of architecture within society and within development has been dismissed in recent decades. The failings of architects to fully assess, analyze, understand and design for low-income groups in developing countries has caused a dislike and distrust for those in profession by colleagues, practitioners, governments, and local communities. Despite this, architecture remains one of the few professions capable of enacting social change through the creation or change of a physical environment. This project reflects the belief that an activist architectural practice has the capacity to foster social, environmental, and economic change through the rigorous pursuit of healthy, adaptable, and economically sustainable design.

In addition to the social benefits of architecture, I also believe that clear and consistent research is needed in order to learn from our successes and our failures and to establish models of development that are holistic and sustainable. The nexus of this project lies in the basic belief that architecture should remain neither solely in the realm of practice, nor in academia. The full potential of architecture lies in the meeting of these two worlds and the potential that arises from this collaboration. Through a multi-disciplinary analysis of development we can begin to understand the benefits of each discipline and learn the value of each within the larger goal of poverty alleviation. The integration of practice, education and research is necessary to enhance our knowledge and our position within the field of development. Collaboration with other disciplines within the field of development ensures the relevance of design within development projects and also serves to reposition architects within a global market that caters not only to those with money but also to those in the most dire circumstances. If architects are to re-establish themselves as valued members responsible for the creation of the built environment, we must learn from other disciplines and work with others on collaborative efforts to improve the world around us.



major street in delhi, india

2.0 Background: A Brief review of Development

Over the past 50 years, changing perspectives toward the role of development has caused major shifts in policies, strategies, and focus within the field (Zanetta, 2001). After WWII organizations initially funded projects that were aimed at improving countries' economic infrastructure. Investment projects concentrated on energy and transport and large-scale infrastructure projects helped to advance and modernize countries in the developing world. Early development projects "reflected the neoclassical economic model predominant at the time" which assumed that: supplying the proper economic infrastructure could fuel economic growth; economic growth would eventually 'trickle down' to all layers of society resulting in a more equitable distribution of wealth; and that economic development would lead to political stability, allowing democracy to flourish in developing countries (Zanetta, 2001; Pakenham, 1973; David, 1986).

During the 1960s, lending shifted to the promotion of agriculture, a direct result of the numerous people who depended on it for their livelihood. Projects in the traditional sectors of energy and transport declined while the increase in agriculture-related projects reflected the central role of agricultural exports for developing countries (Zanetta, 2001). The direct involvement with local laborers and the small-scale nature of these projects caused a shift in the initial philosophy towards development. Organizations began to realize the complexities of development and became increasingly aware of the disparities between the generation and distribution of wealth (ibid). The reality of widespread poverty in developing countries altered the perception of the problem as well as the strategies toward poverty alleviation.

Criticisms during the sixties led to a rethinking of the traditional model of development, growth through economic development. Failures of earlier models and the increasing awareness of the large gap between developed and developing countries, caused a shift in the development paradigm. Lead in part by the World

urban settlements in mumbai

Bank, international agencies called for policies “toward poverty alleviation and the ‘basic needs’ approach, institutionalizing the concern about poverty and making it an intrinsic element in the basic definition of development” (Zanetta, 2001; Finnemore, 1997). The definition of development and its objectives were revised, expanding in scope to include not only aggregate growth but also the impact of income distribution (Zanetta, 2001). Fast population growth during the seventies led to lending schemes within the areas of health, education, micro-enterprise, and urban development (ibid). Employment generation programs and urban projects were implemented within cities to help meet the needs of an increasing population (ibid).

Reactive approaches to population growth led to housing, transport and service projects, sponsored by the public sector, and aimed at meeting the requirement for urban services. Urban projects during this period tended to focus on specific aspects of urban services, adapting a more sectoral approach to development, allowing for piecemeal delivery of services in the form of ‘sites and services’ projects (World Bank, 2000). A main breakthrough of this period was the recognition of unrealistic urban policies that sought to duplicate those of industrialized countries with little regard to local contexts (Zanetta, 2001). These policies included widespread slum clearance with the hopes of replacing them with higher-standard public housing, despite the scarcity of resources. Instead, organizations developed strategies focusing on low-cost solutions, adopting the ideas of John Turner who advocated self-help initiatives (Zanetta, 2001; Potter & Lloyd-Evans, 1988).

In the mid-1970’s slum upgrading was a predominant form of intervention which often provided basic improvements in water, sanitation, transport, lighting, drainage, solid waste collection, community social service facilities, and increase security of tenure (Potter & Lloyd-Evans, 1988). Evaluation of projects initiated in the 1970’s and 1980’s show that they succeeded in demonstrating the effectiveness of low-cost improvements as an alternative to the slum clearance policies initiated earlier by governments (World Bank, 2000). However, adequate maintenance and operation after projects were completed was difficult to ensure, mainly due to inefficient municipal governments. So, while these projects achieved their physical targets, they failed to be replicated on a larger scale and to affect policy change. While these efforts brought benefits; addressed issues of poverty, equality, and environmental risks; and helped to increase community pride, they failed to sufficiently recognize that sustainable urban development required an approach that is even more integrated – across the physical environment, infrastructure, finance, institutions, and social activities. (World Bank, 2000).

A more inclusive urban agenda in the 1980s recognized the growing complexities of urban development. Shelter and infrastructure projects began to decline at the same time urban operations on city-wide policy reform, institutional development, and high-priority investments started to emerge in an attempt to tackle the complexities of the sector (Jones & Ward, 1994). Development agencies responded by outlining a set of

policies that favor partnerships and integration between all the actors involved in development. Large integrated urban projects incorporated a variety of components such as shelter, infrastructure, waste, business, health and education. These types of projects were difficult to implement because they required cooperation from various local, regional, and national agencies. Ultimately, they lacked focus. However, these types of projects called again for a shift within the development paradigm, using them as lessons to be learned from.

The economic recession of the 1980s and 1990s once again caused a shift in the paradigm with organizations calling for economic development and macroeconomic performance at a national scale (Zanetta, 2001). These policies sought to recognize the potential of urban centers to contribute to the national economic growth of countries. Reform also recognized the role of municipal governments not as providers, but as “enablers” of growth (ibid). Projects helped to increase government’s institutional and technical capacity and also allowed for private participation in the delivery of services.

Today, the development paradigm is a mix of urban programs, macroeconomic stability, and poverty alleviation strategies. In the face of unprecedented urban growth, cities and towns continue to be at the forefront of strategies aimed at addressing issues of poverty and development opportunity. “Under this emerging paradigm, the objectives of the urban agenda have broadened significantly. Guided by a holistic view of cities, sustainability, livableness and good government seem to coexist on an equal basis with competitiveness, sound management and fiscal responsibility” (Zanetta, 2001; World Bank, 2000). The challenge for international organizations lies in the implementation of successful projects within the broader scope of development.

The shift through history of development paradigms, strategies, and implementation has taught us many lessons. From their examples we are able to assess the potential for small scale holistic interventions that go beyond the singular problem. From these lessons we are able to see that large scale investment that concentrates on the alleviation of a specific problem often does alleviate one condition, only to leave the remaining problems intact. Now, the potential of development projects lies in the ability to analyze and synthesize existing conditions, and to implement projects that attempt to foster creative, collaborative, and sustainable development. The goal of successful projects will be the analysis of methods and the creation of projects that fulfill established development criteria while respecting local conditions.

2.10 Case Studies

In order to more completely understand the role of development projects in alleviating poverty it was necessary to look at projects that have been completed or are currently ongoing. These case studies served to synthesize my beliefs in the capacity of projects to make a difference and also helped to refine the established criteria based on successes or failures within the projects. Three projects were chosen as examples within various categories. A multilateral approach called for the investigation of projects that dealt not only with architecture but also with finance, government, urban design, and building materials. For each project it was important to understand the objectives of each from the beginning and the method used to achieve their goals. Method and implementation varied, but all three effectively dealt with a variety of issues while maintaining the local context. These projects exemplify successful design based on a coherent set of goals and objectives. While there are countless examples of successes and failures within projects, these were chosen as examples for the creation, establishment, and implementation of goals and criteria.

structural system of basic units

2.11

Grameen Bank

The Grameen Bank has reversed conventional banking practice by removing the need for collateral and created a banking system based on mutual trust, accountability, participation and creativity. Founded in 1976, the bank provides credit to the poorest of the poor in rural Bangladesh, without any collateral and sees credit as a cost effective weapon to fight poverty (Steele, 1994). Credit also serves as a catalyst in the overall development of socio-economic conditions of the poor who have been kept outside the banking world on the grounds that they are poor and therefore not bankable. The rationale of this scheme posits that if financial resources can be made available to the poor on terms and conditions that are appropriate to them, millions of people will be able to identify and engage in viable income-generating activities.

The program is based on the voluntary formation of small groups of five people to provide mutual, morally-binding group guarantees in lieu of the collateral required by conventional banks (Steele, 1994). Loans are small, but are sufficient to finance the micro-enterprises undertaken by borrowers: rice husking; machine repairing purchase of rickshaws; buying of milk, cloth, pottery, etc. Subsequent loans are based on timely repayment. Women were given equal access to the schemes and as a result, they have raised their status, decreased their dependency on their husbands, improved their homes and the nutritional standards of their children and now make up 90 percent of the borrowers.

The Housing Loan Programme was initiated in 1984 after clients began to generate more income through small scale enterprise. Loans for the building of a house, or the improvement of one was given to clients in good standing. The Housing Programme proposes a basic house which can be modified or extended if resources permit it. The basic house has a usable floor of 20 square meters with 4 reinforced concrete columns manufactured by the bank (Steele, 1994). Eighteen corrugated metal sheets are bought with the loan money to cover the house with a simple pitched roof. Walls are filled in with local materials of the owners choice. While a basic plan exists, only the minimum requirements are enforced, including the installation of a latrine (Steele, 1994). While most houses are made of similar materials, no two houses look alike.

The success of this approach shows that objections to lending to the poor can be overcome if careful supervision and management are provided. Many of the misconceptions about lending to the poor, such as the inability to find employment, failure to repay loans, lack of savings, and interference of rural power structures have been dispelled by the widespread growth of the bank and its success. Success of the bank has increased incomes, reduced poverty, and made an impact on poverty alleviation at a national level.

completed house

aerial view of development



2.12

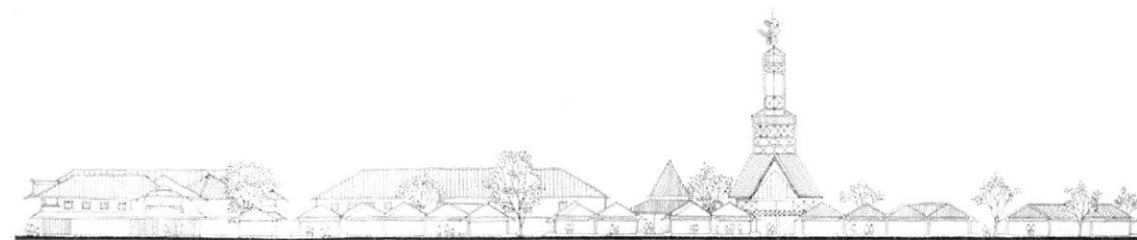
Citra Niagra

Located in Indonesia, Samarinda is situated on the banks of the Mahakam River and acts as a major timber center for the region. Along with offshore oil exploration, the city offers many economic opportunities and, despite the poor weather, continues to attract migrants seeking work. Increased populations and lack of resources have increased squatter settlements in and around the city, and lack of official work has forced many into informal employment. Street hawkers within the city increased in population from 1000 to 5000 in the span of 3 years (Steele, 1994). The Citra Niagra urban development project, a direct response to the choking lanes of Samarinda, was started in 1985 as the first commercial, non-housing rehabilitation program undertaken by the city (ibid). The project site covers 27 hectares and incorporates multiple levels of income within the project. The objectives of the scheme were stated from the beginning:

- the creation of a place where the rich and poor could mutually exist
- the accommodation of all economic levels of the population together with no segregation
- the creation of innovative, complex financing schemes through a mixture of 'cross subsidy', 'self-finance', 'self-generating funds', and 'resource financing'
- the creation of a mixed use and integrated development scheme consisting of housing, commercial and recreational facilities
- the division of the project into phases to make the financing viable

House-shop owners, kiosk-corner shops, and pavement-traders were all incorporated into the layout. Buildings were made with local materials and the various programs were differentiated through the various materials and design of the enclosure. The program was conceived of in three phases so that construction of one phase could be used to finance subsequent phases of the development. The project, situated in the center of the city, is a clear example of good planning; effective partnerships between government, local organizations, and residents; and architectural achievement.

village within a village



elevation of citra niagra

road before improvement

2.13

Kampung Improvement Program

A kampung, unlike a squatter settlement is a tight agglomeration of continuous and incrementally developed self-help housing built mostly on traditionally owned land (ibid). It is an indigenous concept of housing and community of various sizes, shapes, and densities, catering mostly to low and middle income families at various dwelling prices. The kampungs generate vast home industries ranging from manufacturing of leather, cloth, and metal to various foods and services. Like squatter settlements they are the result of urban expansion, increased population growth, and agglomeration of village (ibid). However, unlike squatter settlements, they are formally recognized as part of the urban housing system. This classic improvement program initiated in Indonesia by the World Bank and UNDP combined the efforts of the local and national government, extending improvements to some 50,000 hectares of unserved urban communities over 30 years and reaching an estimated 15 million people (Kenworthy, 1997). The goal of this program was to tailor upgrading schemes from site to site using community based organizations as project initiators.

The program is considered one of the best urban poverty relief programs in the world for several reasons (Urban Upgrading, 2001):

- low initial investment per person (US \$118 in Jakarta to US \$23 in smaller cities)
- sustainability in physical, social, cultural and economic terms- the concept has spread to 800 cities in Indonesia

The program is a neighborhood improvement program aimed at facilitating better roads, footpaths, drains, water supply, sanitary facilities, solid waster management and better social and educational conditions within the community (Kenworthy, 1997). The program is based on strong community participation, effective partnerships between the public sector and the community, and high levels of resourcing by the community in terms of funds and labor (ibid). The program has now gone through three phases since its inception. The first two phases concentrated on physical improvements while the third phase added a socioeconomic dimension to the plan for economic development. While the majority of improvement is infrastructure related, the program has also strengthened and enhanced local architecture, culture, and the traditional way of life. Evaluation of the project estimated that the program improved the urban environment, allowed for increased investments by residents, ensured sustainable water and sanitation services, strengthened local government capacity, empowered local residents, raised the status of women, and improved the quality of life for residents.

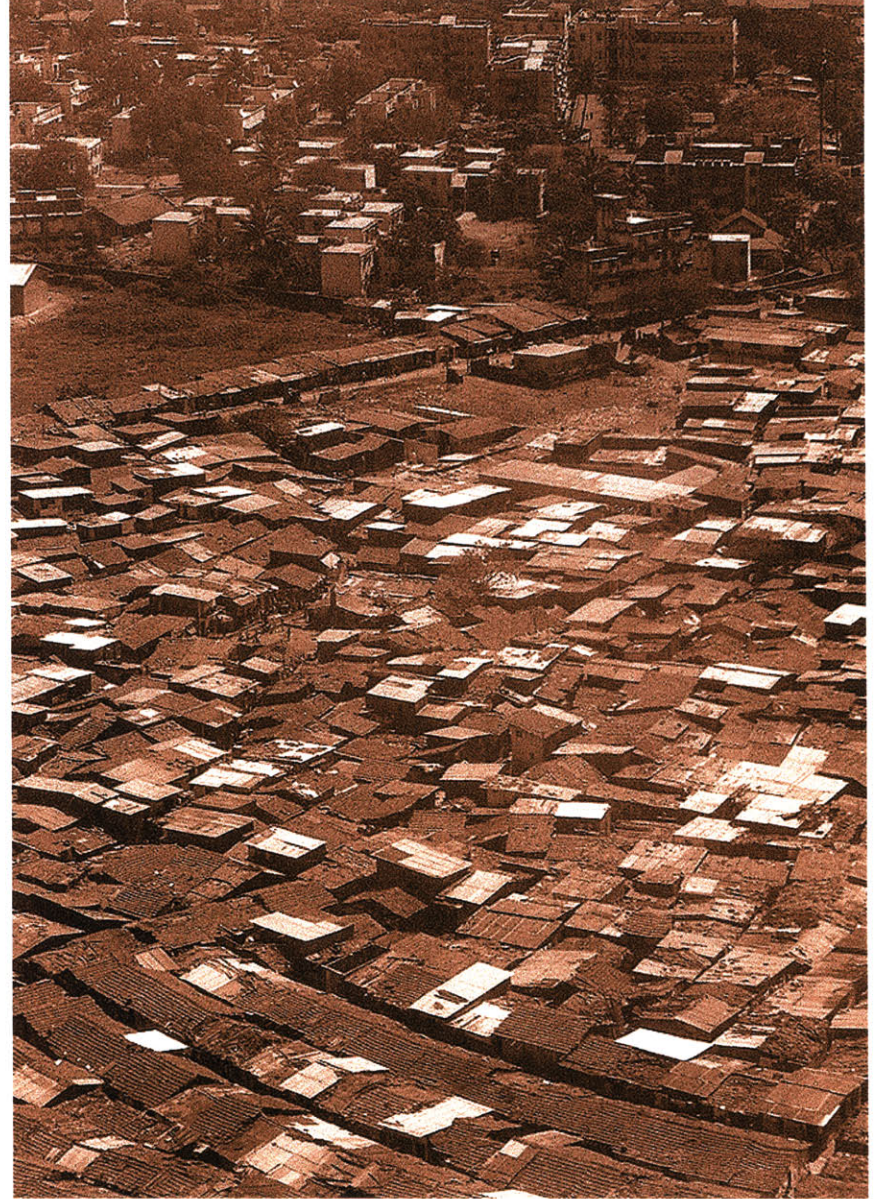
road after improvement program

Lessons Learned:

These examples each show a particular development strategy that has proven successful towards the creation of a thriving environment. While they range from economic to urban in scope and vary in scale, each one demonstrates that successful projects are those which allow for flexibility, respond to local contexts, and involve the various players in its creation and implementation of the project. The study of these projects allowed me to analyze development strategies and to more clearly develop my ideas and beliefs regarding the role of architecture within development and the specific creation of criteria for development projects. The lessons learned here are reflected in the following design project. Each phase of the design allowed for a reexamination of the precedents in order to carefully evaluate decisions and re-examine my objectives. The most important lessons learned from these precedents include:

- Clear objectives from the beginning are necessary in order to ensure achievement of goals
- Effective partnerships between government, local organizations, and residents are critical for success
- Projects must allow for flexibility within the scheme, and for various options for residents
- Community participation is vital to development, and gender equality must be insured
- With security and a small income, housing improvement does become a priority
- Small scale enterprise is a viable and important form of income generation

Each of these projects respects the unique characteristics of the site and the qualities inherent there. These examples addressed many of the issues concerning development projects and successfully created sustainable environments. These projects will served as a basis for the following design project.



aerial view of dharavi, mumbai

3.0 Development Criteria

The creation of development criteria for the project was necessary in order to arrive at a more specific methodology and a particular design solution. The criteria were formulated through an analysis and assessment of previous literature regarding development in developing countries, lectures on development projects completed, interviews with those in the development field, and personal experience in the implementation of low-cost housing solutions. New criteria was necessary in order to conceive of design within development differently from existing models. The criteria were established as a way in which to formulate a more coherent and cohesive project. Through the creation of criteria, primary objectives for successful development projects were established as goals to strive towards.

The list of criteria is not meant to be inclusive of the many issues surrounding development, but is used to inform and structure the following design proposal as a set of guidelines. Based on local conditions, criteria can change and should be re-evaluated within the local context. The criteria are grouped into six main categories: **governance, economics, environment, urban design, architectural design, and building materials**. Within each category, a list of specific goals for successful development projects is outlined.

Using the criteria as guidelines for all successive design initiatives, each category was examined for its potential to fulfill the design objectives outlined. Once a leading criteria was established, the design focused on successfully addressing the specific goals within that category. Subsequent categories became secondary or tertiary criteria and were acknowledged but not specifically addressed within the design. It is an assumption of this thesis that in no project will all criteria be addressed specifically with equal weight. Inherent in the design and development process is the need to prioritize and alleviate the most pressing needs first. Therefore, I have outlined objectives and determined a specific strategy based on the local context.

3.10**Governance:**

Improving urban conditions places big demands on urban governance and management. Good governance includes and represents all groups in the urban society – and accountability, integrity, and transparency of local government actions – in defining and pursuing shared goals. Governments should foster interaction and partnerships with residents, community-based and non-governmental agencies in participatory planning and public oversight of expenditures and service delivery. An important feature of these efforts should be an emphasis on underlying incentives for local government accountability and performance which are essential to combat problems of corruption (World Bank, 2000).

Policies or procedures that should be implemented through governance of a local area are:

- Radically improve the capacity of government at all levels to play an active role in sustainable development
- Actively form partnerships with players in all sectors; local governments, NGO's, international development agencies, and community groups and cooperatives
- Utilize the private sector where it can provide urban services more efficiently than the government
- Allow for greater accountability of local authorities in collecting and allocating resources
- Establish land tenure through policy that is approved and followed
- Evaluate the policies that regulate housing provision with an emphasis on quality, not quantity
- Utilize community participation at all major reform steps
- Allow for a system of checks and balances open to all within the development process

3.20**Economic:**

Urban areas account for a disproportionately high share of national economic production and are the main sources of economic growth in most countries, yet still, today close to a fifth of the people in the world survive on less than \$1 a day (World Bank, 2000b). Urban development contributes to national economic growth by allowing increasing returns to land, labor, and capital (World Bank, 2000)

During the 1990's the promotion of small-scale enterprises has been seen as an important development strategy in both developed and developing countries. The informal sector is recognized as playing an important role in the economies of developing countries. The role is one which provides housing, food and jobs for the poor and also often supports the formal activities of the urban society (Drakakis-Smith, 2000).

A clear understanding the economics at local and country scales – micro and macro levels - will allow for the development of economic strategies benefiting the local population. Communities should seek to:

- Enhance total wealth while using resources prudently
- Increase the competitiveness of a community's existing products (know the value of product, locally, regionally, internationally); expand markets (use product differentiation based on cultural or social factors)
- Add value along locally through processing; capture value that is added as the product travels through the market by the creation of vital partnerships
- Incorporate economic incentives to encourage sustainable development
- Help to diversify markets

3.30**Environmental:**

"In too many countries the philosophy is 'develop now and clean up later'" (Drakakis-Smith, 2000). Urban development can have both positive and negative implications for the environment. The balance depends on how it is managed. The environmental problems of urban areas – air, soil, and water pollution, noise, and traffic congestion – have direct and immediate implications for human health and safety, especially for the poor, and for business productivity. Worldwide, airborne particulates pollution has been associated with at least 500,000 premature deaths and up to 5 million cases of chronic bronchitis each year. Lead pollution can lead to premature deaths, reduced intellectual capacity in children and other health damage in cities. Microbial diseases due to poor sanitation and dirty water cost billions of dollars a year in lost lives and poor health, especially in the poorest cities. Another consequence of poorly managed urbanization is the settlement of unsuitable and risky locations such as floodplains and hillsides, which adds to the worsening human toll of urban disasters. Effective solutions must address broad issues, including transport demand, land use planning, industrial development and location, and household income growth and distribution (World Bank, 2000).

A greater understanding of the implications of the environmental hazards can lead to the:

- Establishment of better health related indicators
- Establishment of environmental quality standards and targets for environmental improvement
- Measurement and establishment of human comfort requirements, including reasonable indoor air quality, lighting efficiency and quality, and minimization of water
- Establishment and implementation of energy efficiency measures

Urban Design:

In recent years, catastrophic events in the developing world have reminded the architect, the planner and the local officials of the dangers of ignoring the full range of urban growing patterns that have arisen as a result of inadequate attention and resources directed at improving planning and housing conditions. Substandard design and construction has left a great number of the world's poor vulnerable to structural collapse, flooding, gale-force winds and other life-threatening conditions. The vast and improvised hill slums of Caracas, Rio de Janeiro, Lima, Mexico City and other dangerous settlements have led to catastrophic collapse from mud slides, earthquakes and other natural events (Rogers, 1997). The lack of proper planning has led to settlements located in known flood plains as is commonly seen in Bangladesh and China. The tragedies in Turkey and India of the past years attest to the continuing disregard for the most fundamental design, planning, and construction initiatives.

Successful initiatives in urban design strategies or project implementation should:

- Rethink city patterns to support the new model of development
- Create models for new patterns that are reflective of the traditions of the developing world
- Allow for ethnic, religious, and minority groups to maintain individual cultural identities and neighborhoods while integrating schemes into the larger community and urban fabric
- Create development that can coexist within the urban fabric
- Allow for the inclusion of community spaces and gardens
- Be accessible to all within the community

Architectural Design:

Many governments in developing countries have persistently refused to see the provision of adequate shelter as a priority within the development process. Low-cost housing provision, in particular, is considered to be resource absorbing rather than productive and often loses out to investment in industry or industrial infrastructure (Drakakis-Smith, 2000). Over the years the nature of this debate has evolved around how the various agencies involved in shelter provision can best be combined within the delivery system to improve accessibility by the urban poor to better housing (Potter & Lloyd-Evans, 1998). Based on the realization that the poor have positive objectives with regards to their own housing, self-help housing involves some sort of collaboration between public and private sectors (Potter & Lloyd-Evans, 1998). However, self-help housing involves the investment of what may be limited national resources and many governments remain skeptical about investing in what they still regard as social overhead (Drakakis-Smith, 2000).

In order to be effective, architectural strategies or projects should adhere to the following guidelines:

- New buildings and other construction should create sustainable built environments
- Designs must be of appropriate scale to the reality of existing conditions and density
- Buildings should not cost more than those produced of local materials
- Design should include the continuous re-evaluation of the physical context and of local values
- Designs should be flexible over time to support future user needs
- Designs should be innovative and build on local craft, and social, cultural, and religious tradition

Building Materials:

Current building industries in developing countries face immense and growing problems. Scarcity of finance, materials, and resources of all sorts plague these nations. Organized building activity has come to depend on industrialized products and systems, but the demands for these products greatly outweigh the supply, often causing delays, wastage, high prices and black marketeering. There is a growing need for alternative technologies that utilize locally available raw materials and local labor rather than scarce capital and foreign exchange. Alternative technologies are those technologies that are less capital intensive, relatively small in scale and scope, use simple production methods, and produce products with local materials for local use.

Building material research and implementation should:

- Reorient technology to efficiently use materials and energy
- Develop materials/technologies that are the least disruptive to the natural ecology of the earth
- Reduce the use of energy intensive materials like cement, steel, aggregates and aluminum
- Incorporate traditional materials and construction methods with modern processes and technologies
- New technologies should be self-sustaining and promote self-reliance
- Based on availability of local materials and skills
- Should satisfy acceptable performance requirements: durability, cost, acceptability, and maintenance requirements
- Should benefit the local economy and be income-generating in nature



map of maharashtra, india

4.0 Context Analysis: why here?

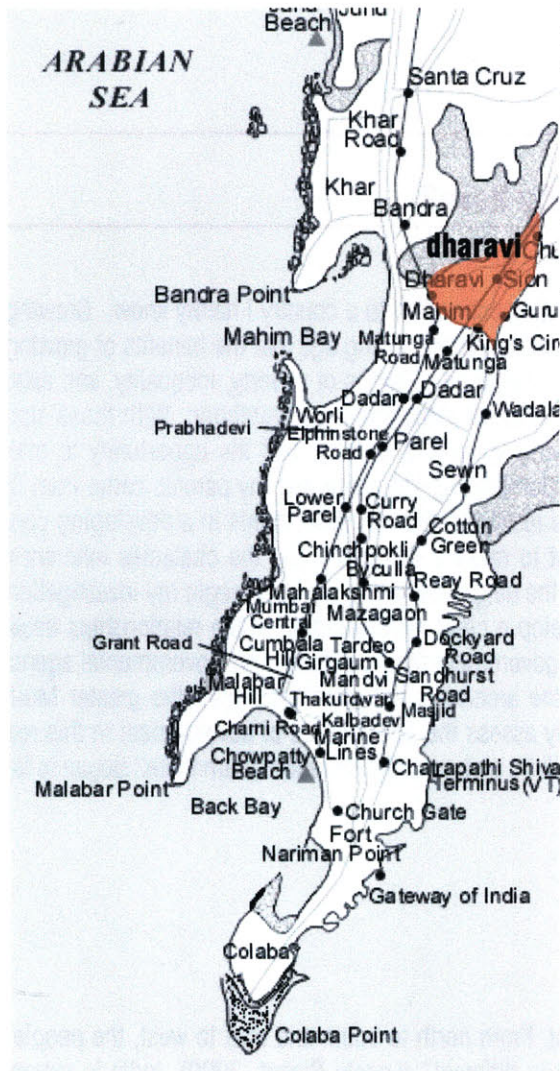
As the daughter of immigrants from India, I am undeniably connected to a country I hardly know. Growing up with stories and images of India in my mind, it was clear to me at a young age that the benefits of growing up in the United States were that of both privilege and of obligation. Stories of poverty, inequality, and extreme hardship under the most dire of circumstances were prevalent throughout my childhood. With those stories, came the understanding of privileges that I had growing up in this country, and the opportunity to make a difference. It was with the intention of more clearly understanding the place that my parents came from that I chose Mumbai, India as my site. Viewing firsthand the reality of informal settlements in a developing country I was able to assess the ability of a western architect to make a difference and the obstacles inherent with such an endeavor. Within Mumbai, I chose Dharavi as the neighborhood in which to begin my investigation for a particular community to work with. In order to develop a clear understanding of the relationships between **nation, city, and neighborhood**, I interviewed local government officials, local non-governmental agencies, community organizations, residents of Dharavi, and the architects and planners within the greater Mumbai region. These interviews were necessary for me to fully assess the possibilities of development in this region and were conducted to arrive at a more holistic and realistic picture of the situation. From there I began to target goals for redevelopment.

4.10

Site: *National and Regional Context*

India

"India, it is often said, is not a country but a continent. From north to south and east to west, the people are different, the languages are different, and the country is different" (Lonely Planet, 2000). India is extremely

greater mumbai region

diverse, in ethnicity, language, religion, geography, and economic and cultural status. While steeped in traditional culture and religion, India is also advancing quickly within the global economy. Currently, improving the living standards of the poor remains one of India's most pressing challenges. In the early 1950s, nearly half of India's population was living in poverty. Since then, poverty has been declining, though slowly, and vast disparities between and within India's 25 states persist. With a gross national product (GNP) per capita of US\$440 in 1999, India continues to have the highest concentration of poverty of any country, with more than 360 million people – about 36 percent of the population – living below the official poverty line. Based on an international poverty scale, India accounts for an estimated 40 percent of the world's poor (www.worldbank.org).

Mumbai

The city formerly known as Bombay, Mumbai is a place of opportunity, where rags to riches stories support the increasing draw to city life. Mumbai is the economic powerhouse and urban center of India with a growing population of almost 16 million. Mumbai is one of the world's densest cities and the world's 5th most polluted city. It is also home to the legendary Bollywood, the largest film industry in the world. It is a city of extreme glamour and wealth, and a city of extreme poverty. The metropolis covers 603 sq. km, and has a density of ~16,000 people per sq. km. Over 35% of these people live in squatter settlements on marginalized land. About 40% of the people live on 3.5% of the available land. With almost 300 families migrating daily to the city during peak periods, strains on already inadequate shelter and services continue to increase amounting to insurmountable social, political, environmental, and economic issues. (Bombay: The City Within)

*typical street in mumbai*



4.20

Community Context

Dharavi

Considered 'Asia's largest slum,' Dharavi is home to approximately 1 million people. Dharavi encompasses an area of about 600 acres in the northeast part of Mumbai. There are approximately 18,000 people per acre (Sharma, 2000). Because of Mumbai's constant expansion north, Dharavi, which was once a jungle on the edge of Mumbai, has now become the heart of the city. The area is divided into 5 major sections, Makund Nagar, Central area, Social Nagar, South area, and Southwest area. Dharavi's diversity in terms of cultural, religious, and ethnic communities is apparent throughout the area, however, it is Dharavi's entrepreneurial spirit that has made Dharavi what it is today: a thriving industrial community, where over 80% of the people are employed. As Dharavi continues to accept new migrants, the neighborhood is in a state of constant change, reinventing itself with each new wave of migrants. Dwellings in Dharavi range from kuccha (informal) to pucca (formal) houses, from concrete high-rises to roadside shacks. (Bombay: The City Within)



aerial view of Khumbarwada community



houses along the canal



brick kiln and pots



90 ft. road, dharavi

Khumbarwada - the potters

Khumbarwada, the potter colony, is spread over 12.5 acres on prime property in Dharavi (Sharma, 2000). Located near the Central Line railway tracks, at the intersection of 90ft. Road and 60ft, the community is strategically placed at the main intersection in Dharavi and between 2 railroad stations. This is a flourishing trade with lots of export, mainly to Indian communities abroad and the Far East. The community is composed of semi-permanent to permanent housing, in a semi-planned environment. The Khumbar have been living in this area for several generations and are still composed mainly of Khumbar from Gujarat in the north. The buildings reflect this genealogy, where up to 4 families live in one house.

4.30

Urban Criteria: *catalysts for change*

The development criteria established earlier were taken and applied to the conditions of the site that would result in a specific interventions. While previously established as a more generic set of criteria, the goal here was to try and figure out what the entry point to the community was and which criteria would allow for the development of an architectural intervention. The objectives of each category were maintained and used as guidelines for the further development of the criteria. By reapplying the criteria, I was able to reach a more specific level of detail. The criteria was used as a framework for discovering the particulars of the site and for determining the need and scope of the architectural intervention.

Environmental:

For each category, a specific set of questions were generated that allowed for a more specific investigation of the site and the establishment of necessary program for the site.

What are the main environmental issues, and what groups are the most affected by this?

What are the factors involved in production of various products, and what are the environmental hazards?

What are the toxins released and what effects do these particular toxins have on the environment, the people, the land, etc.

What are the possible scenarios for change, and what are the effects/implications of making these changes.

What, if any, changes have occurred, by whom, and how?

The transformation of the city from a colonial port to a megalopolis has led to urban environmental deterioration. Among Mumbai's major environmental issues are air pollution, slum proliferation, clean water, and sewage disposal. Over half of the city's population lives in squatter settlements, many of which have no access to clean water or proper sewage. The World Health Organization has ranked Mumbai among the world's most polluted cities, recording pollution levels three times higher than recommended safety levels. Anecdotes say, "breathing air in Mumbai is equivalent to smoking somewhere between 20 to 80 cigarettes a day, due to the high levels of nitrogen dioxide, sulphur dioxide and suspended particulate matter in the air" (Lonely Planet, 2000). Vehicle emissions alone produce two thirds of the urban pollution. Large numbers of cars, widespread use of adulterated fuel, badly maintained cars, and low emission standards increase pollution to dangerous levels. Poor air quality is compounded by the shortage of open space. As urban dwellers increase on any open land available, builders and politicians only help with the destruction of parks and mangroves, a natural feature of the habitat, a third of which have been destroyed by developers and pollution. While recycling remains a main employer among city dwellers, waste collection remains a prominent problem as evidenced by the numerous garbage piles in open spaces.

As a major center of industrial activity in the past decades, Dharavi went from undeveloped swampland to one of the densest neighborhoods in Mumbai. Home to part of the natural mangroves system in Mumbai, these areas have been filled in over time, and what was once the Mahim creek is now a polluted stream that trickles through Dharavi (Sharma, 2000). Destruction of the natural ecosystem by urban dwellers and pollution has forced the government to clear many of the informal shelters constructed near the creek, declare the land protected, and push industries such as the slaughterhouses and tanneries to the outskirts of town.

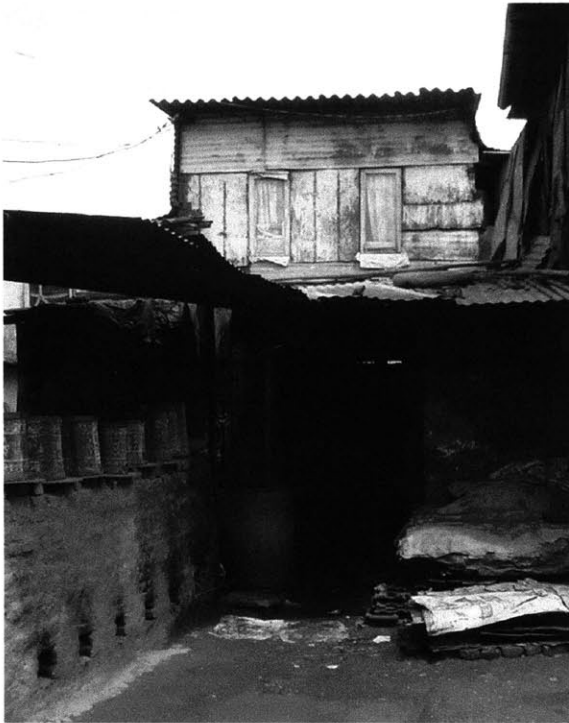
However, some tanneries still remain, and many other small-scale enterprises such as soap making, metalworking, and the firing of pots still continue to pollute Dharavi on a daily basis. In the Third World as a whole, most urban industrial pollution originates from small-scale enterprises, particularly those related to food processing, leather tanning, textile dyeing, various forms of metalworking and engineering. The reasons why small-scale industries contribute disproportionately are threefold. First, control measures tend to be directed to larger firms, and foreign companies. Second, control measures are often more expensive per production unit and beyond the means of most small firms. Third, small enterprise tends to use older and less efficient equipment that is more prone to pollute. Many small firms are illegal or semi-illegal in the way they operate, so there is little incentive for them to go clean (Drakakis-Smith, 2000).

The impact of overcrowding and poor ventilation is also exacerbated by indoor pollution, largely through the use of biomass fuel for heating and /or cooking. Bronchitis

60 ft. road, dharavi



typical house, khumbarwada



tends, therefore, to be more prevalent amongst those most frequently involved in these domestic activities – women and children (Drakakis-Smith, 2000). Doctors within the Khumbarwada community have attributed high cases of bronchitis to poor ventilation and to firing methods of the pottery. Because all kilns are used outdoors, interspersed throughout the community, fumes from the firing account for 30% of Dharavi's air pollution. In addition, 60% of the community suffers from some sort of respiratory disease in varying severity.

4.32

Urban Design:

What are existing plans and patterns of development?

How have these patterns changed over time? Are there places and times historically that I can draw from to yield similar conditions/examples/rationale and possible solutions?

Where is residential, production, retail, social, etc. located.

What are the main issues with regards to traffic, noise, pollution, movement patterns, etc.

Within Mumbai, large increases in population have resulted in informal settlements being located on any available land within the city. Squatter settlements have encroached on public and private land alike and increasingly demonstrate the lack of housing and planning issues within the city. As thousands flock to the city in search of jobs, lack of clear planning for these migrants have forced many to live illegally within the city, on illegal land, pavements, near railways, and on any land available. Dharavi was settled as swampy land that gradually became filled in with water over time. Land that was once inhabitable became suitable to build on over years of infill. However, without planning of any kind, the area developed haphazardly as a maze of small communities and groups as land was filled in. Today, Dharavi is a thriving community, but lacks any sort of proper planning provisions and continues to develop and change as new migrants arrive.

Within the Khumbarwada community initial planning of the 12.5 acres was done in the 1930s after a fire destroyed the entire community (Sharma, 2000). Each family was given a 15' x 60' plot of land with a single-story brick house. There were four main alleys in the community, each as wide as 30' at one point. However, encroachment into the alley, the gradual build up of housing and constant extensions have drastically altered the character and fabric of the community. While the houses here are much larger than in all of Dharavi, many are rented or occupied by multiple families. Within the community, the larger urban unit is the community block. The block is composed of 6-10 buildings that are grouped together in between smaller secondary alleys. The block is further divided into buildings, and also into units. There is little organization at the block level, but the groupings allow physical access to the community. Once inside the community, the interior is a maze, like much of Dharavi.

Architectural Design:

What are the social, cultural, and ideological motivations for the way in which people build, construct and situate their houses?

What is the typology of what exists, morphology?

What are the varieties of scales that exist on the site? What do they mean spatially and how do they affect the space around them?

What is the prevailing idea of space? How do people use it, what do they value?

How do people move in and through space, how do they occupy it?

Within the community, many of the houses are pucca (formal) dwellings. Built in the 1930s after a fire raged through the community, many residents own a one-story brick house on a typical lot (Sharma, 2000). The typical building is 15' x 60' plot totaling 900 s.f. for each family. This equitable division of lots was determined by the existing community which at the time was about 500. The community is now comprised of approximately 2000 families living in the same amount of area. Over time these buildings have been divided and sub-divided for the next generation of the family or as a means of extra income - renting to new migrants to the city. Also, as need for space increases, the homes have expanded up, adding lofts and second stories where necessary. Here the unit is not delineated by the structure that separates each building, but by the more cellular unit within an existing building. Many buildings house multiple generations of one family, thus the unit marks one family within a household and the spaces that they occupy.

Building Materials:

What is the material palette of building materials?

How are things built now, of what, where do they get material from?

Who builds the houses? Who pays for it?

What are the characteristics of the pottery trade? Can this trade be expanded or extrapolated?

What would make for a more successful product or a new product?

The building materials within Mumbai are as diverse as the people. Every material that is usable for construction is utilized, while there are also many materials whose traditional function is changed for the use of shelter. Metals, plastics, masonry, concrete, glass and woods are all used in varying forms. Plastic sheets serve as roofs while metal sheets serve as walls. The ingenuity of shelter solutions is abundant. In Dharavi, the majority of original buildings within the community are made of brick with plaster and are one-story. Buildings are built by both the families themselves and contracted to others. Over the years, as families have grown and requirements have change. Buildings have adapted as well, and lofts and second stories have been constructed, mostly from more impermanent materials such as wood, steel sheets, and plastic. The fragile nature of these second stories reflect the current government policy which only allows a maximum building height of 14'.

kilns during firing*typical alley within community***4.35****Governance:**

What is the structure of the current government system, and how does it work?
 What are the policies that deal with development, are they passive or aggressive, and in what way?
 Should the larger framework of the work be incorporated into current strategies?

There are three tiers of government effective in Mumbai; the Brihanmumbai Municipal Corporation (BMC), which runs city affairs; the Maharashtra Legislative Assembly and Legislative Council, which govern the state of Maharashtra; and the national government in Delhi to which six Mumbai MP's are elected. While considered one of the world's largest democracies, corruption, criminalization and self-interested party politics have drastically reduced voter confidence in the system of government. The BMC is the governing body of the city of Mumbai and is responsible for electricity supply, transport, schools, sewerage, water supply, housing and town planning. (Dwivedi and Mehrotra, 2000). Within Dharavi, local representatives maintain ties with government officials. Local community organizations, non-governmental organizations, and unions are all represented within Dharavi.

4.36**Economic:**

What is the economic reality of the situation?
 What are the relationships between work/family/land/money, etc.
 What does changing the economics of an existing market do to it, what are the implications?
 How long does a change in the economics take to result in a positive change?

Mumbai was founded as a trading town by the British in the late 1600s and has since remained the commercial capital of India. As the country's busiest port and largest financial center, it effectively remains the gateway of between India and the rest of the world. It is Mumbai's economic success that attracts so many from blighted rural lands. These migrants settle in the city, replenish the labor force and fuel the economic boom despite lack of housing and basic services. Despite overwhelmingly harsh conditions, most find some kind of work, although 70% of it occurs in the informal sector. Over the past few decades Mumbai has shifted from its manufacturing base to become a center for financial and commercial services. As Dharavi grew, industries such as tanneries sprang up near local butcheries. Metal work, soap making, and garment factories were set up where an abundance of labor was. Today, Dharavi is a thriving community where 80% of the people are employed. Dharavi's largest industries include finished leather goods, garments, pottery, and food.

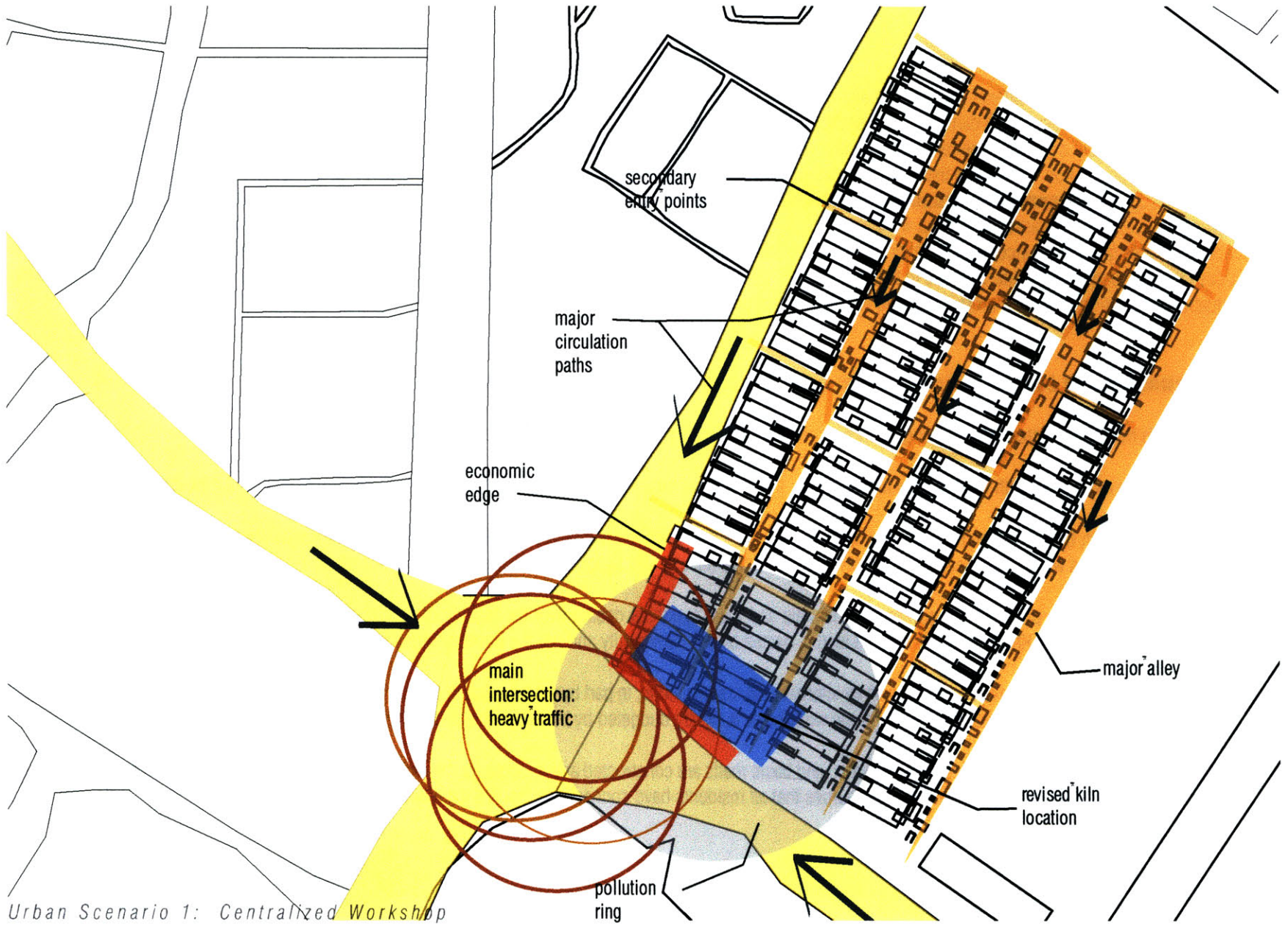
Criteria Assessment

Based on interviews with local residents and doctors and site observations, the main urban criteria to be addressed was environmental. The amount of air pollution caused by the firing of kilns resulted in damage to the environment and risked the health and safety of the community. The criteria were prioritized into a list of issues to be addressed at a variety of scales. The role of the project was given the main goal of addressing and curtailing the current levels of air pollution while maintaining cultural methods of production. A revised list of criteria determined primary and secondary criteria within the project. Primary criteria (these were the main criteria considered) consist of **environmental, urban design, architectural design, and material research**. Secondary criteria considered were **economic and governance** issues. It was my assessment that while the implementation of this project was able to improve upon living standards within the community, governance and economic issues, aside from income-generation, were issues that needed to be addressed on a larger scale involving local government and community groups. This project does not propose specific interventions in these areas, but outlines several key issues with regards to these criteria. It is the belief that a holistic understanding of the situation will help to arrive at a more integrated and successful project.

Assumptions: *based on the criteria, what are the assumptions inherent in the process?*

Based on the criteria listed, and knowing the reality of conditions within the Mumbai, this thesis assumes the following conditions:

1. Partnerships are formed with international aid agencies, the city, local organizations, and community groups to ensure successful development of the area.
2. Policies in which the government, local organizations, and the community are working together to ensure project success are in place. The community and local organizations will assume leadership of development while the city will support action previously sanctioned.
3. Security of Land is in place. While government officials and local residents debate over the legality of residence in Dharavi, this project assumes that land tenure is granted to the Khumbarwadas and the land is owned by the community and not the Bombay Municipal Corporation
4. Financing of the project is taken care of in part by international organizations, in part by the city, and in part by the residents. Previously determined percentages of contributions are in place and production of the workshops is tightly budgeted by the international organizations.
5. Infrastructure in terms of water, electricity, sewage, and basic roads are constructed and in place for the entire Khumbarwada community. While most residents of the area have these amenities, the project assumes that *all* residents have connections that are legal and provided by the city.



Urban Scenario 1: Centralized Workshop

5.0 Urban Scenarios: successfully addressing criteria

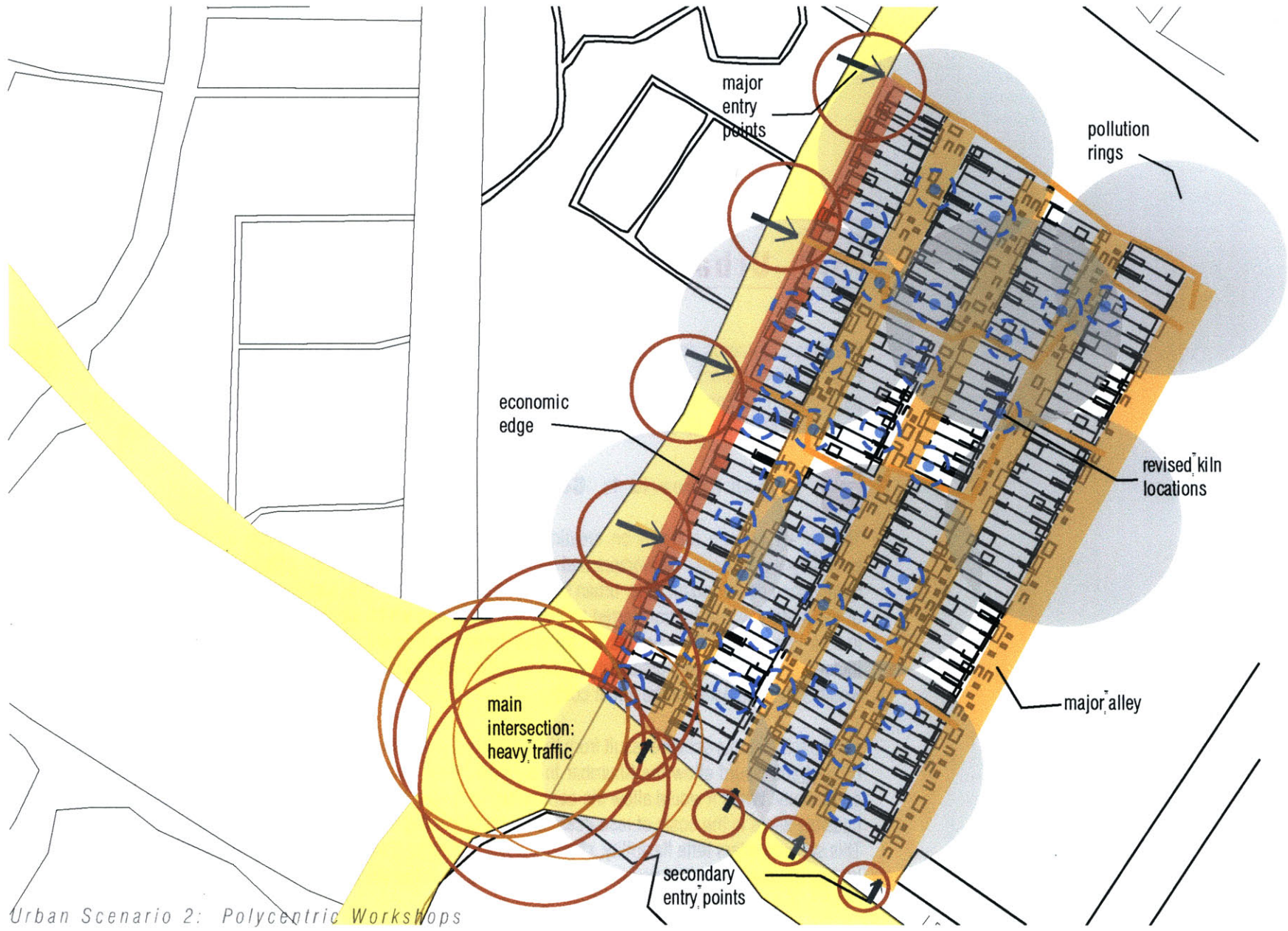
The urban scenarios developed were a way in which to explore the possibilities of solutions while assessing each of them against the criteria established. This exploration identified three schemes that built on existing patterns of developments. Each scheme was defined in terms of its flexibility, complexity, identity, and strategy toward the site. The initial criteria were also used in order to assess the success of each scheme.

5.11

Urban Scenario 1: Centralized Workshop

The initial scenario focused on creating a centralized workshop at the main intersection of the site. The workshop would house all workers and all kilns and contain retail on the ground floor. Existing kilns would be demolished or utilized for other urban structures such as toilets, green space, or outdoor seating. All production of the pottery would be transferred to the main workshop which would allow residents to free up space used in their homes for pottery production for other living requirements. Those responsible for making the workshop include local community organizations such as the local cooperative, local NGO's and local government which would subsidize some of the initial costs.

The benefits of this scheme result from the creation of a new typological structure on the site. Legal recognition of the trade would allow the Khumbar to practice freely, and the building would serve as a landmark for the community. While it would allow the community to control pollution, showcase their art, generate income, and possibly share in the costs of resources, the negative impacts to the current way of life far exceed the benefits. This scheme offers little flexibility, changes the urban form, does not allow for the Khumbar to work out of their home, and could result in usurped development rights to the land.



Urban Scenario 2: Polycentric Workshops

Urban Scenario 2: Polycentric Workshops

The second scenario focused on replicating the existing form of development. Currently, the kilns are interspersed throughout the site, located in each of the four alleys. Urban Scenario 2 grouped the existing collections of kilns into smaller groups which would alleviate some of the pollution and allow for smaller collectives to be formed within the community. This scenario involved creating nodes along primary and secondary means of travel which would replace the haphazard placement of workshops with a more meaningful arrangement. Several locations within the community which vary in size can respond to the unequal distribution of craftsmen as well as decrease travel and transport time. While this scenario offers a certain degree of flexibility to those in the community, it does little to curtail the existing pollution, and offers only remedial help. The proximity of the kilns to the houses would continue to widely disperse particulates. In addition, clearance for workshops would displace others. The creation of an 'interiority' of the site could allow for the possibility of community building and the creation of smaller workshops with their own identity.



Urban Scenario 3: Multi-nodal Workshops

Urban Scenario 3: Multi-nodal Workshop

The third scenario created a concentration within the middle of the site. Smaller collectives of kilns were formed at cross-grain intersections within the site along a spine that was created in the second alley. This scenario sought to develop a greater hierarchy within the site and to allow for the possibility of various urban activities to occur in the remaining alleys. This Scenario creates both multiple and unified communities. Small groups have the chance to make their own identities while still uniting with those around them. It offers a certain degree of flexibility to those in the community and close proximity to others in the business will allow for a more open community. The overall level of particulates would decrease by concentrating them within an identified zone. An interior zone could be created within the site allowing for a hierarchy to develop. The creation of a marketplace for the potters would increase income, serve as a landmark for them and increase opportunities for the community.



Urban street market, mumbai

Urban Interventions:

Street bazaars: throughout history, street bazaars have been the economic, cultural and social life of cities. From medieval times to today, both the diverse shop activities and the kaleidoscope of itinerant vendors, hawkers and peddlers have characterized these lively bazaars (Morris, 1994; Savage, 1992). Even today, modern bazaars in much of Asia still exude the same atmosphere as they did 50 years ago. Shopkeepers carry out every conceivable trade and sell an extraordinary variety of merchandise. The bazaars function well into the night, or only at night, setting up shop as customers leave work. The edges of the bazaar bleed in and out of shops, stalls, and streets, growing and shrinking over time. “The chaos and apparent disorder of the bazaar are precisely the qualities essential for the survival of vending – physical proximity between the seller and the buyer as well as the physical manifestation of incremental and laissez-faire growth of the marketplace” (Mehrotra and Dwivedi, 1995). Street bazaars are elements that are experienced as part of a city. They are sensuous experiences, in which the atmosphere is about more than the buying or selling of goods, it is about the smells, the sounds, the physical sensations of crowds, and the spectacle of all that is for sale (Savage, 1992). Bargaining, and the victory of a good buy, are intoxicating and invigorate the crowd as many barter for the best price. “In the urban context, the bazaar symbolizes energy, optimism, and a will to survive outside the formal system” (Mehrotra and Dwivedi, 1995).

A Potters Market for Dharavi: Historically, the urban bazaar has been the entry point for rural migrants, absorbing them and cushioning their transition into the city (Mehrotra and Dwivedi, 1995). The potters market for Dharavi seeks to create a focal point for the community, establish the trade within the city, and create an environment for economic, social and cultural activities. It is the hope that the market will develop into a lively bazaar over time, expanding and shrinking as time and space mediates.

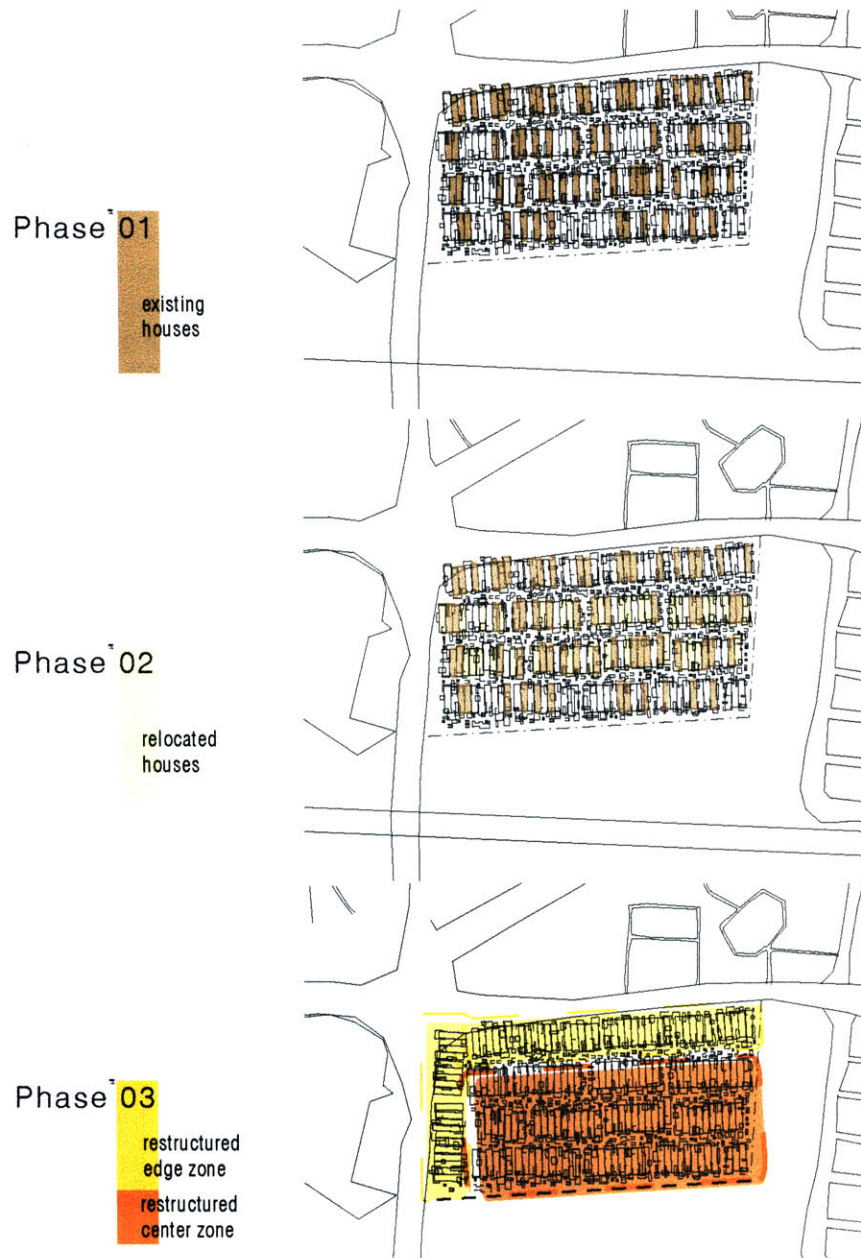
Conclusions: After examining each scenario based on the criteria established, it was concluded that the third scenario would be the most effective and beneficial to the community. The third scenario not only fulfilled the criteria in the most beneficial way but also created the possibilities for other urban activity to occur, in this case, the creation of a central potters market in Dharavi. The market, while not conceived as part of the original program originated from a process that examined the possible urban scenarios and the benefits of each. The market was a typology that resulted from an examination of the site and possibilities inherent in it.



vegetable market, china



floating market, thailand



5.30

Phased Development:

The past decades of development have shown that aggressive development packages are often financially and administratively difficult to maintain over time. Project completion often takes more time than anticipated and often results in a over-budget, poorly completed project.

Sequencing the phased development of the site takes place in 5 distinct phases that attempts to reorganize and strategize a way in which to approach development.

phase 1: community resettlement

An involuntary resettlement policy is needed that recognizes the practical realities of urban land markets and stakeholder politics. Relocation must take into account the different types of resettlement issues and appropriate variations in compensation in an urban context.

phase 2: relocation

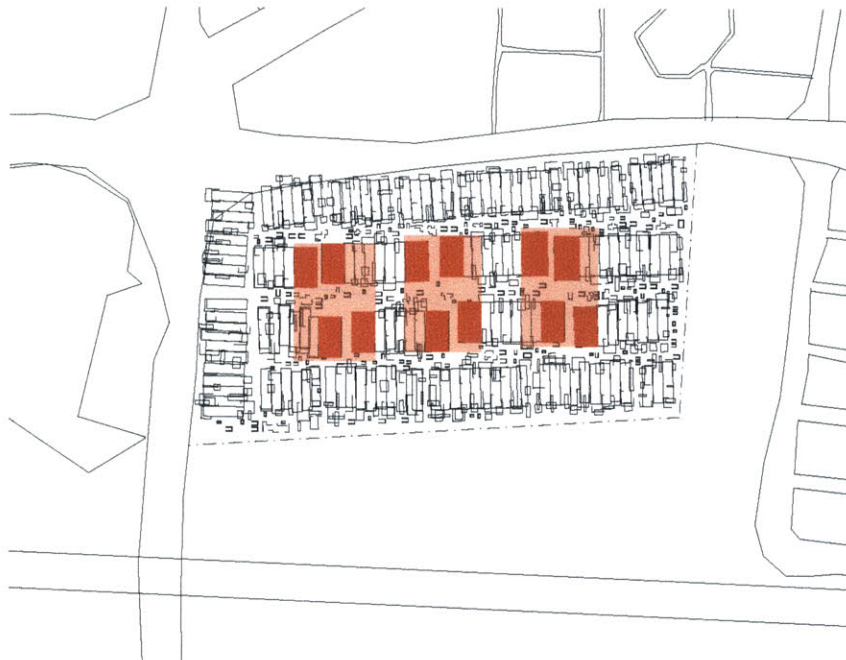
Reorganization of community by relocation of potters into center of site. Others are temporarily shifted to the existing transit camp and then shifted to remaining positions on outside of the site

phase 3: destination

Reorganization of the site to create distinct economic edges and to utilize the position of the site within the city to create a local 'destination'

Phase 04

industry
zones/
workshops



phase 4: industry

Creation of distinct industrial zones within the site through the grouping and insertion of workshops at cross-grain intersections.

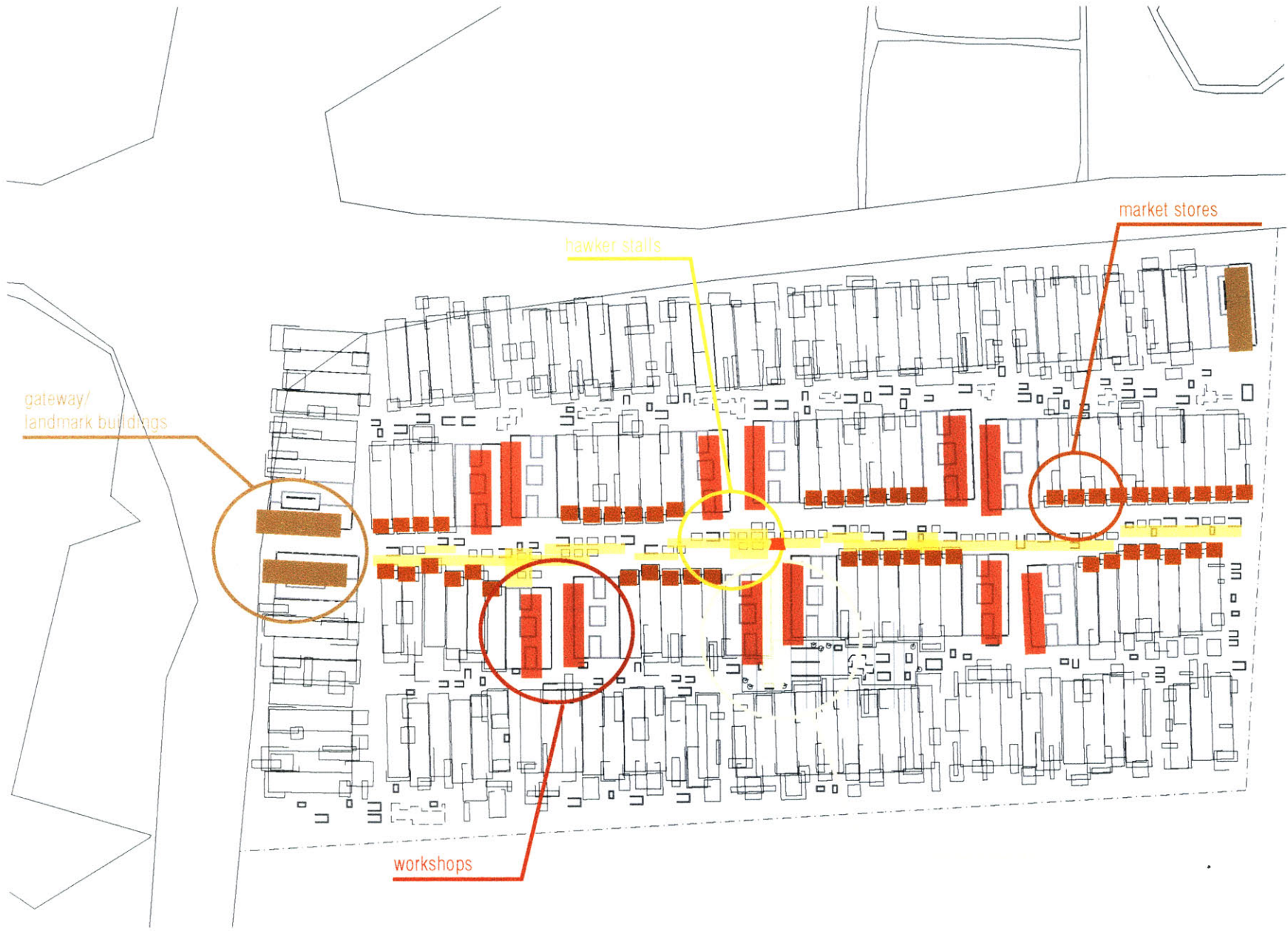
phase 5: marketplace

Creation of a marketplace within the community to increase economic options to all and to concentrate and showcase the particular craft of the potters. The marketplace will include the community and hawkers from outside the community.

Phase 05

landmark buildings
hawker stalls
market stores





Program Elements: what are the programmatic pieces that will be developed to directly improve the urban environment?

The phased development relies on the development and success of several key program elements. In order to develop a viable and lively market of which the residents have control, the key programmatic elements include:

1] gateway/landmark buildings

context: should signify main entrance to the market, create visual interest on the site, and reveal some hint of craft on site

form: should be a separate piece of architecture, separated from its surroundings but fit into context

materiality: should be a distinct architectural building and should respond to material cues on site, but not be derived from them

2] market stores

context: should be incorporated into the organization of the house with the possibility to exist as a separate organizational element, it should address the market facade and seek to create linkages across the marketplace

form: should be a form that is derived from the architecture of the house/workshops but be identifiable as a separate element within the composition

materiality: should use the same material language as the main building, but should exploit the material in a manner that is distinct or helps to reveal the function of the store

3] hawker stalls

context: should create a network which reveals a way in which to move through the market, should guide you through

form: should be a framework similar to the housing, but should be on a smaller, more intimate scale

materiality: should combine both new and existing materials, should use existing brick kilns for structure and build off them and new brick structures should display craft of both items and of the material

4] community gathering place

context: should strive to create an environment which is safe and open for children, it should seek to redefine the space that children occupy in this community and should develop a model for other communities in the area

form: should incorporate existing kiln structures into the creation of viable/interesting structures for children to inhabit and explore

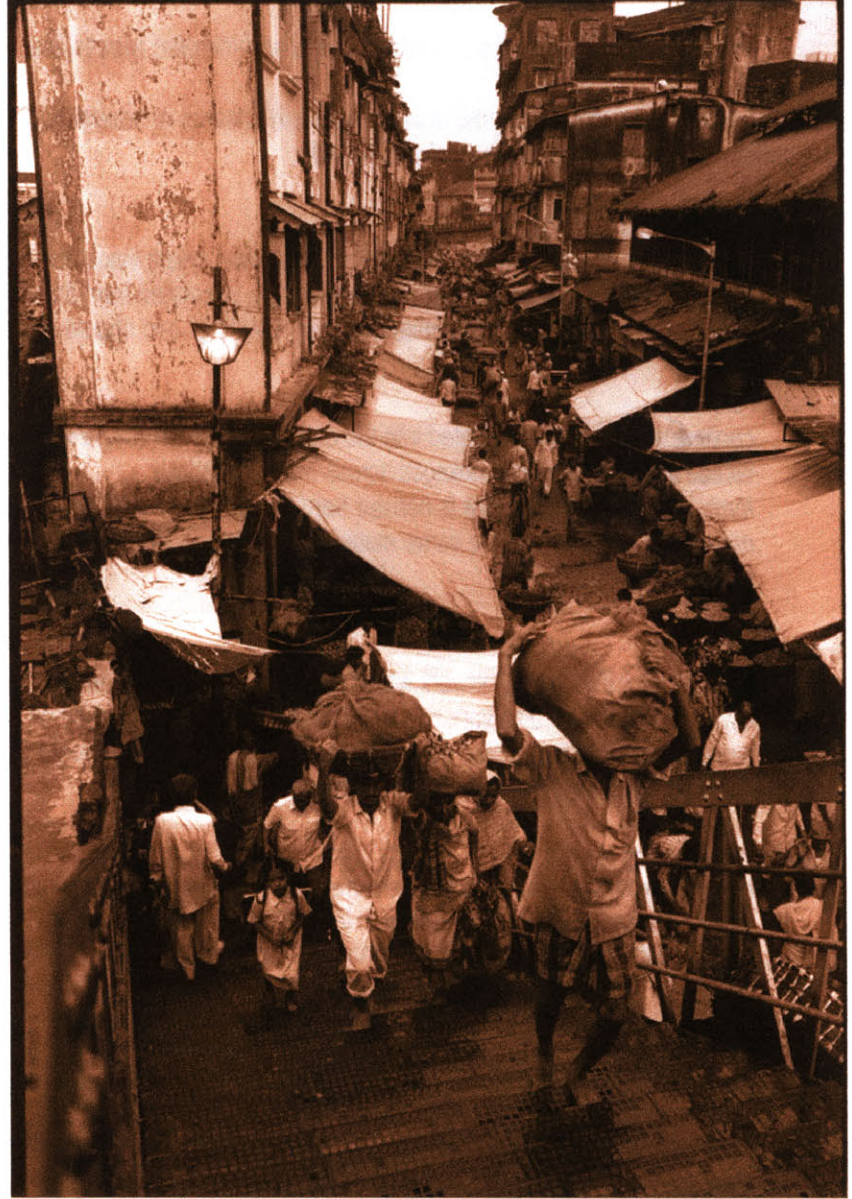
materiality: should use existing brick material structures and incorporate new/recyclable materials from the site

5] workshops

context: should strive to improve environmental conditions on the site and to organize the potters into a more collective community should seek to densify the site incrementally and serve as a catalyst for secondary phased projects

form: should be an element which establishes a new 'rationale' to the site in form and function, it should seek to establish a new order on which flexible and directed change can occur

materiality: should be a distinct architectural building but should use local materials and incorporate local methods of production into the final realization of the building



covered urban market in mumbai

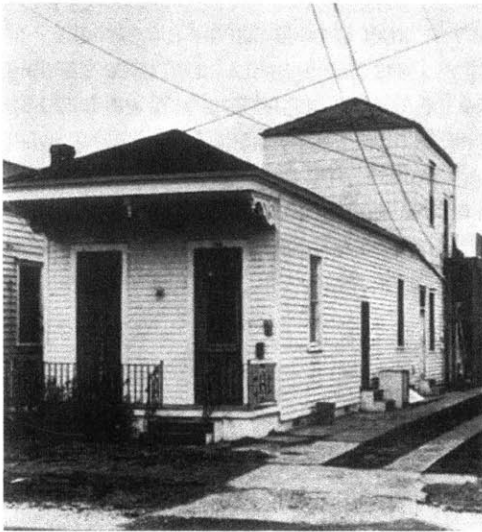
6.0 Architectural Concepts: precedent studies

The project specifically looked at two types of interventions within the community. Developed from the urban criteria, a potters market and a potter's workshop were the key programmatic elements further developed. A brief example or precedent of similar forms or projects precedes the actual project development. It was necessary to examine similar interventions or typologies in order to have a clear understanding of an antecedent. From this starting point, a more refined and successful intervention was made.

6.10

Architectural Typologies:

A brief examination of similar typological structures was necessary in order to understand the morphology of the components within the community. By studying similar typologies I was able to gain a better understanding of the type of structures on the site, the way in which they grew and the reasons behind structural and cladding decisions. Through the investigation of similar typologies, I was able to more clearly discern the most relevant aspects of each typology and began to see overlap with my own project. The multilateral approach I had determined called for a broader examination of typologies, including live-work scenarios, structural scenarios, single family housing and the aggregate growth of communities. Through this varied exploration, a clearer definition of criteria and space was then established with these examples in mind.

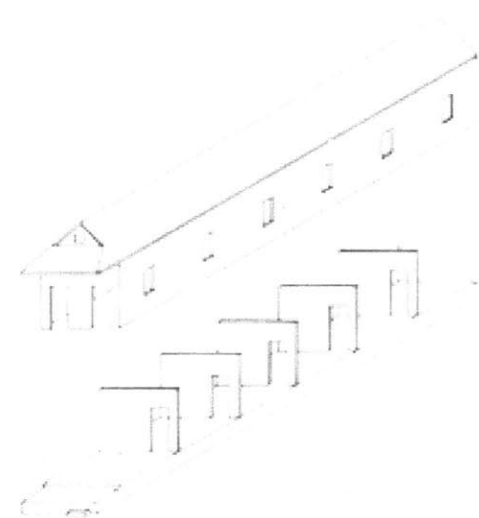
shotgun house, new orleans, la.*camel-back shotgun house, new orleans***6.11**

Long House Typology: Shotgun House

The Shotgun house type is a typical house type found in the south, particularly in New Orleans, LA. The large square blocks of the New Orleans city and the narrow lot divisions conditioned the development of a house form with one room aligned behind another. The name was derived from the idea that because the rooms were all aligned you could shoot a shotgun straight through the entire house and have it emerge from the end. Superstitions developed as a result of the perfect alignment. Spirits were thought to move through the house in the same way which later led to a plan with a shifting alignment of doors. The characteristics derived from this house type include:

- programmatic homogeneity
- residential condition
- intimate scale
- local materials

This house type is similar to those in the Dharavi community and led to an investigation in room transformations and programmatic flexibility.

*shotgun house plan**shotgun house exploded*

restored shophouses, singapore



6.12

Shophouse Typology:

Residences combined with commerce. In Southeast Asia, this ubiquitous typology was part of the vernacular landscape in urban centers and was essential to the image of the city (Savage, 1992; Chulasai, 25). This typology was repeated across the landscape, winding down long streets and alleys providing a “picture frame of human dimension in which the ever changing street activities could be fully appreciated” (Savage, 1992). These buildings had “a particular architectural characteristic: two or three story structures with a narrow frontage, approximately four meters wide, facing the street. Typically, the building is either detached or composed in row of several similar units” (Chulasai, 25). The shop owners lived above and conducted trade below. This type of arrangement was beneficial to the occupant for many reasons:

- Security – owner and family can watch over shop and goods at all times
- Hours of operation – because the family lives above, the store can be open for longer hours
- Help – family members can help during lunch and peak hours
- Savings – no expense is required to travel to work
- Safety – owners can watch over small children during the day

Over time, shophouse development has declined due to oversupply, newer urban developments, increasing land values, environmental problems at the street level, zoning laws, new building codes and lack of parking. However, these buildings still remain a prominent part of the urban landscape, and a vital typological example for live/work scenarios (Chulasai, 27). Although criticism of these buildings in recent years has fueled their decline, these buildings represent a typological structure born out of necessity for urban shopping facilities and the advent of live/work scenarios. Dual functionality, simplicity of form, adaptability over time, and economic benefits are a few of the many aspects of shophouses that merit their existence and necessity within the urban city (Chulasai, 30).

shophouse facades, singapore



The modern live/work house is a variation of the shophouse. Within Dharavi, most residents live and work in the same space. The Khumbar utilize all ground level space for the sale, production and storage of their craft. The characteristics derived from the shophouse include:

- programmatic variety
- urbanistic scale
- activity on street
- party wall condition

hillside housing, athens

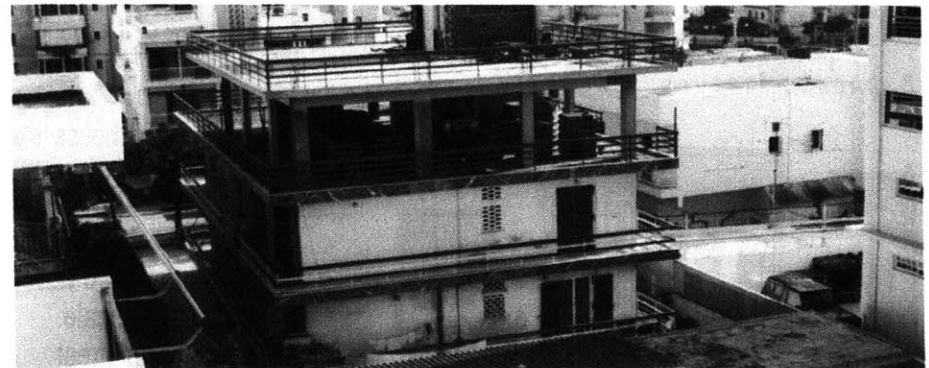
6.13

Structural Frameworks:

The Greek poly-katoikia [multi-residence] is the realization of the Corbusian domino system: **concrete frame, staircase, and elevator shaft**. It is a building type that offers simplicity of construction, economy, and durability, a prototype to be repeated to infinity. The program for the poly-katoikia though initially prescribed for housing, is a flexible construction system offering innumerable alternatives: housing, office, ministry, store, warehouse, manufacture, restaurant, etc. This is the pragmatic response to a real issue, the upgrading of the quality of life through a mass- yet private-housing system (Aesopos & Simeoforidis, 2001). The poly-katoikia, as an “open” building system, offers the maximum comfort possible within the minimum space.

Athens constitutes the over-ambitious transformation of a relatively small built environment into an urban hyper-concentration, through the continuous repetition of a unit, a process with minimum organization or programming, based on micro-scale: the poly-katoikia and the small-to-medium- sized contractor (ibid). This private urbanization process is implemented through the “antiparochi system [exchange of land for apartment surface]” as a form of direct democratization corresponding to the need for privately owned habitable space (ibid).

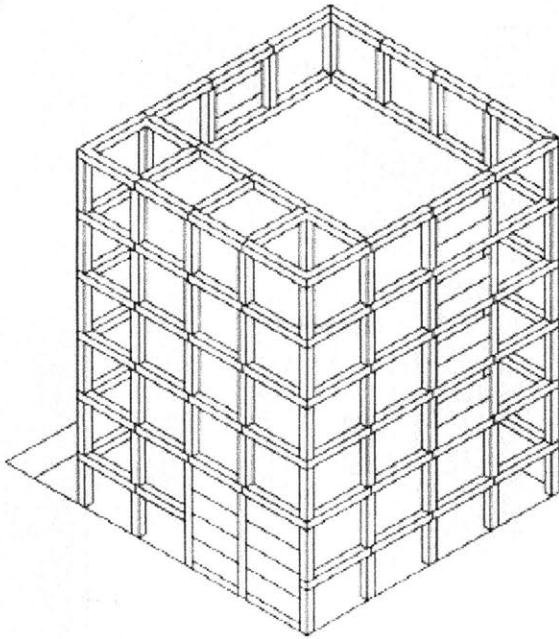
The poly-katoikia incorporates its own development since it is, simultaneously, the medium and the result. The lack of any organizing mechanism also shapes the expansion of the Greek city: the ‘scatter-shot’ pattern of the new poly-katoikia describes the random character of this self-organize process (ibid).

*poly-katoika house, athens*

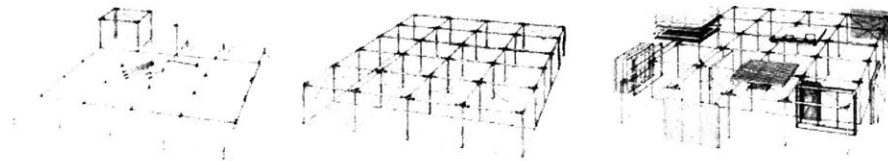
“The ordering effects of gravity are most easily recognized in the frame, which represents a function rather than any particular shape. ... Frameworks are singular entities created solely to organize support, resisting gravity's pull. ... Strictly speaking, the framework is not a principle of form but of arrangement. It is recognized more by its function of holding things in their proper place and relation than by any particular configuration or shape. Gravity always requires a technical response. The need to array parts functionally keeps us reinventing the framework, creating new shapes for it. The framework does not seek spatial identity. It has only a singular purpose: positioning related things in space” (Habraken, 2000).

The result of a framework is endless change. A framework merely poses a structure, within which there exists an endless array of possibilities. Innovation and change become derived from unplanned and barely regulated processes. The main characteristics inherent within a structural framework include:

- architecture of components
- programmatic flexibility
- material flexibility
- architectural adaptivity



structural framework with infill panels



assembly of components on a structural frame



perspective of market and live.workshops

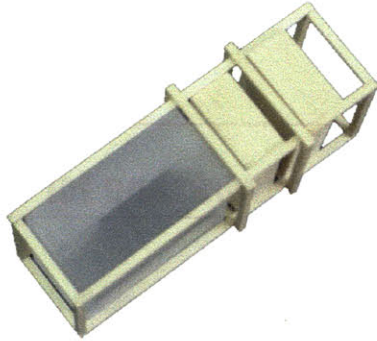
7.0 Project Development: a *live.workshop* for Dharavi

The architectural design was developed as a prototype to illustrate the methodology established. The design was conceived of as a schematic design that addressed a specific set of issues, but was not intended to be a complete design. The design was meant to show how one might develop an architectural project within the methodology. Through an analysis of the primary issues, the development criteria, and the urban scenarios, an architectural program was established. The *live.workshop* was intended to be a prototype design which would change with the needs of the residents, with further occupation, and over time. Throughout the process, the design project investigated the relationship between the frame and the programmatic flexibility needed. A framework was established which served to create a structural frame for the project, and allowed for programmatic flexibility within the building.

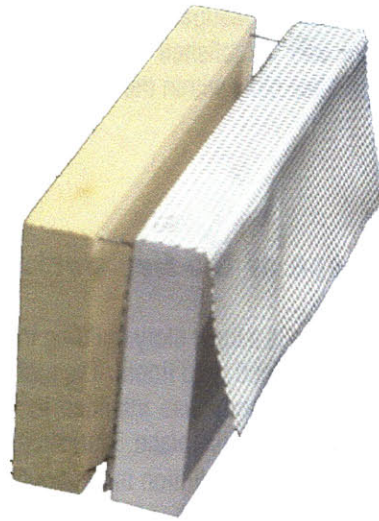
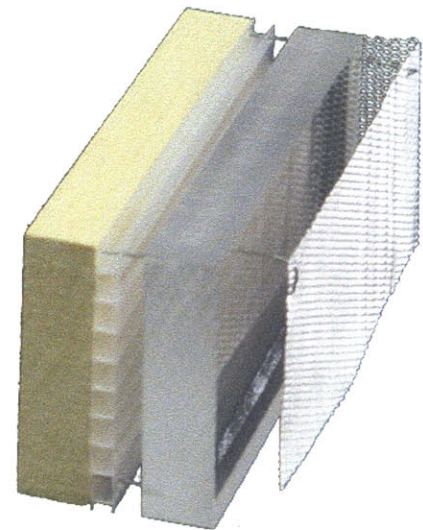
7.11

Scope of the *live.workshop*

The *live.workshop* is a three story building in which the pottery workshop occupies the first floor and residences occupy the second and third floors. The roof is partially enclosed, allowing for further occupation on the upper floors. The *live.workshop* was intended to house the pottery workshop and 2-6 families. Each workshop is situated in the main marketplace. Workshops are clustered together in groups of 4 in order to create nodes of activity and to alleviate pollution throughout the community.

flexible space concept model**7.20****Conceptual Design:** initial ideas and schemes

The conceptual design for the workshop focused on the controlling the amount of particulates released from the workshop. A separation of live and work programs was initially conceived as 2 distinct vertical blocks [model 2 &3]. A layer was inserted between the programs and acted as a “filter” for the workshop. These initial schemes led to a further development of the program and the flexibility of program within a fixed framework [model 1].

*single-layer environmental screen**double-layer environmental screen*

Aggregate Growth

In the course of the last two decades, cottages have multiplied along the Cote d'azur. They are fragile structures; a roof, four walls, a few objects inside. Their owners build them for their personal needs, without any overall plan, by successive additions. Constructed with diverse materials, raw or semi finished, they are located on hillsides or rocky areas near the inhabited zones. They shift to meet the environmental changes, without moving very far from their initial location (Rosa, 2001).

Conceived as shelters for fishing, beach visits, and domestic functions, they obey the logic of the mutations that made them. They are new forms of social aggregation linked to leisure activities, boating, and seaside dining. Today the cottages act as parasites on the major infrastructures that have transformed the coastline (ibid).

"In an unstable balance between public and private law, resource and refuse, demolition and rehabilitation, these cottages are not the sign of an economic or cultural poverty but rather the expression of a lifestyle which, through gradual aggregation, composes a community" (ibid).

These cottages are created and shaped by changing conditions of the existing lifestyles. External environmental conditions or personal needs allow these cottages to shift, expand, and contract when required. Rather than the imposition of a strict structure, they are allowed to breathe, to flow in and out of space. Much like the units of Dharavi, these also are born out of an additive and subtractive process that is constantly reinventing itself.

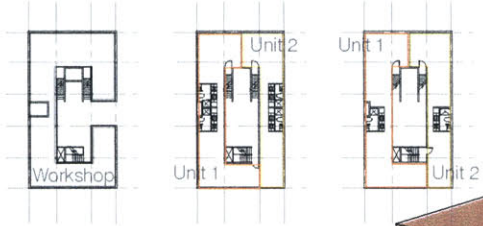
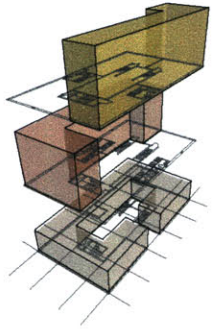
cote d'azur cottages



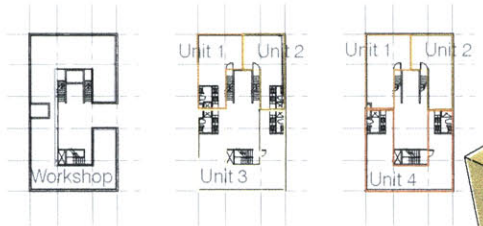
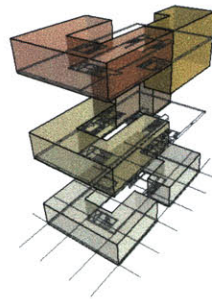
cote d'azur shoreline



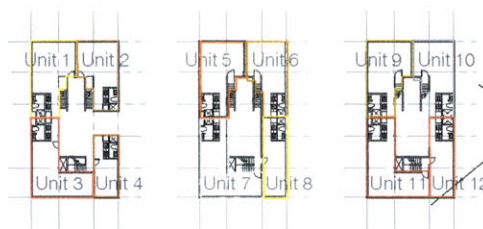
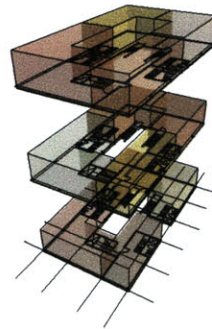
expansive hillside housing



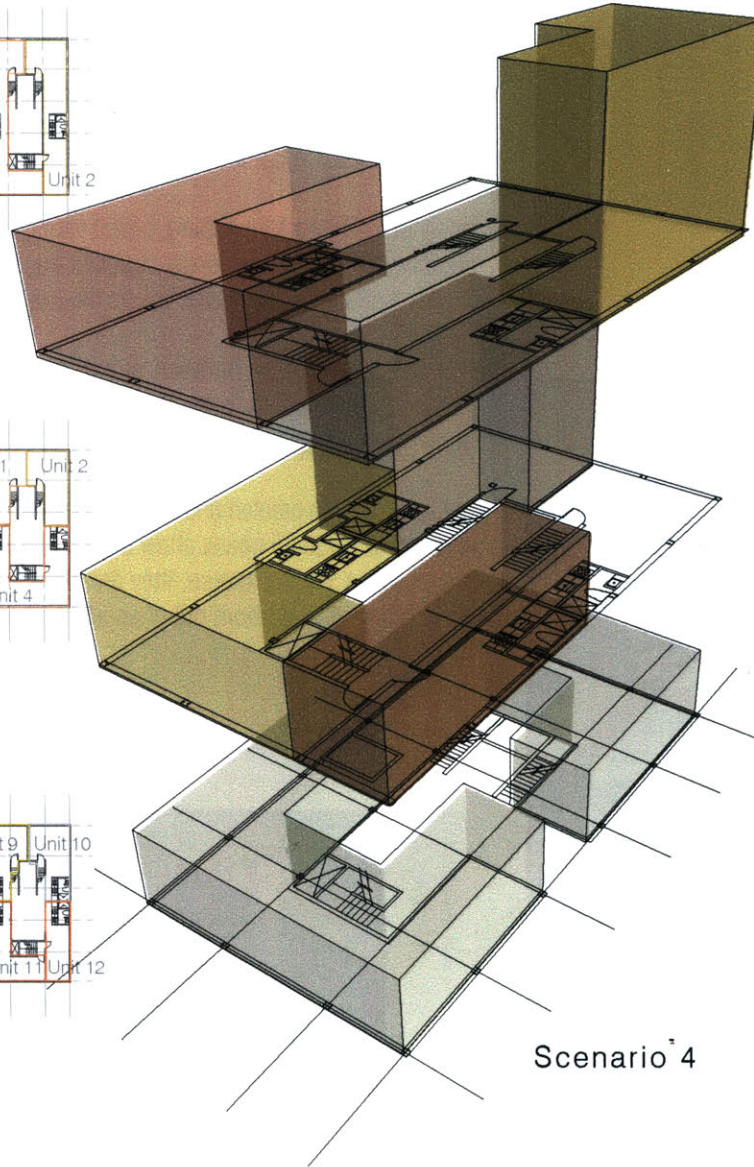
Scenario 1



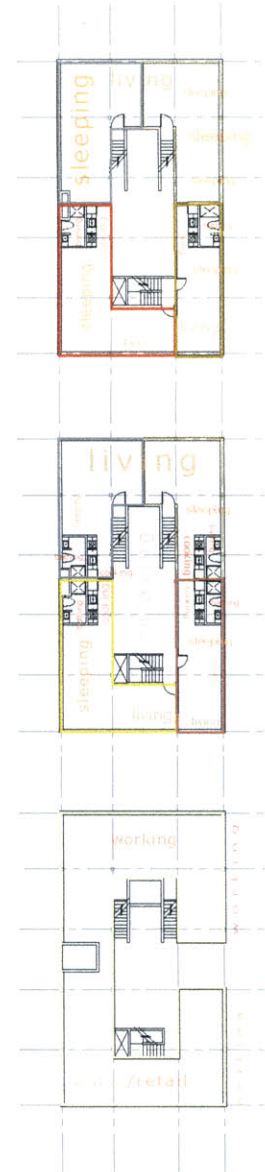
Scenario 2



Scenario 3



Scenario 4



Program Scenarios: *what is the vision for how the workshop might develop over time?*

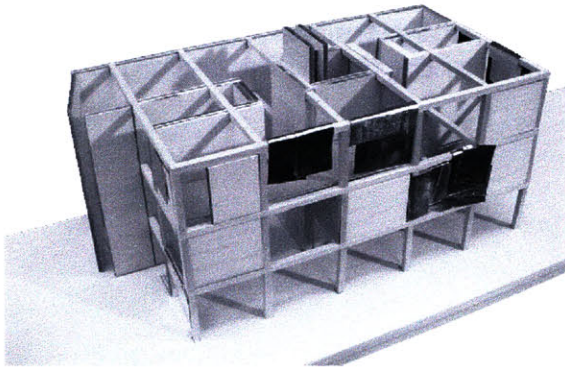
This investigation explored the variety of possibilities inherent in the use of a framework. In order to show how the building could respond to the changing needs of residents and the influx of migrants, a variety of program scenarios were proposed. Each scenario contains a different number of units with varying sizes. The scenarios also allow for the possibility of a fully residential building. The reason for exploring these possibilities was to show how the building could respond to varying conditions and to indicate that the design was only one of many possible iterations.

Scenario 1: Workshop on first floor, 2 duplex units

Scenario 2: Workshop on the first floor, 4 units - 2 duplex units and 2 single flats.

Scenario 3: No workshop, 12 individual flats for individual people or small families

Scenario 4: Workshop on the first floor, 4 units - 4 duplex units

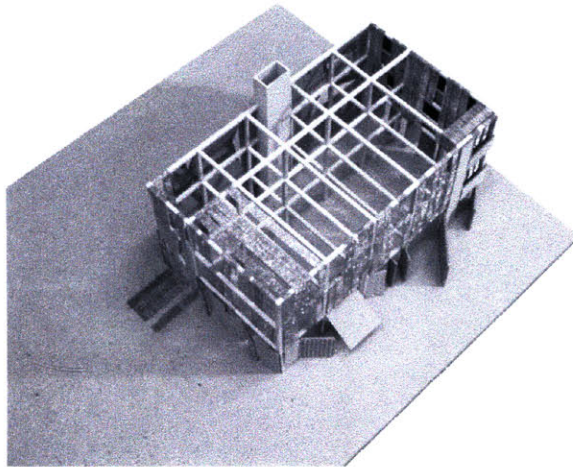
schematic framework with infill panels

7.30

Schematic Design:

Conceptual models and ideas were further investigated in the schematic design. In this phase, ideas were more fully developed to incorporate the reality of the site conditions. The schematic design addressed issues of scale, program, spatial scenarios, and treatment of the facade.

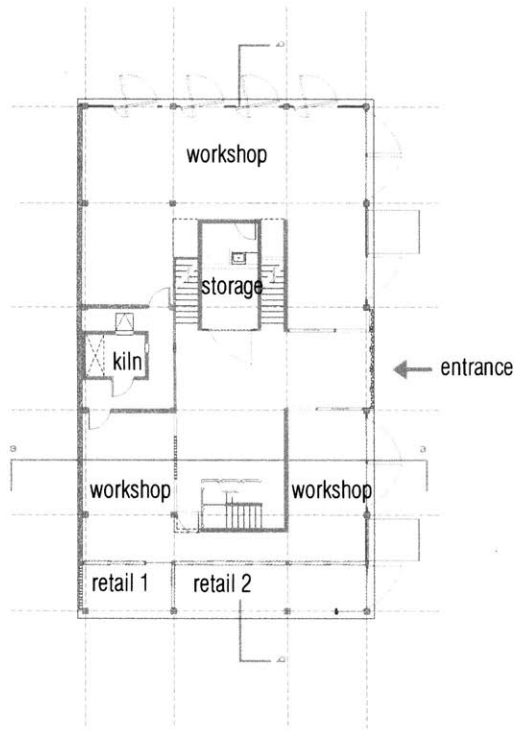
Schematic Model 1: This model explored the idea of the framework within the scale of the site, and used a variety of materials to indicate a various infill panels.

schematic framework with flexible skin

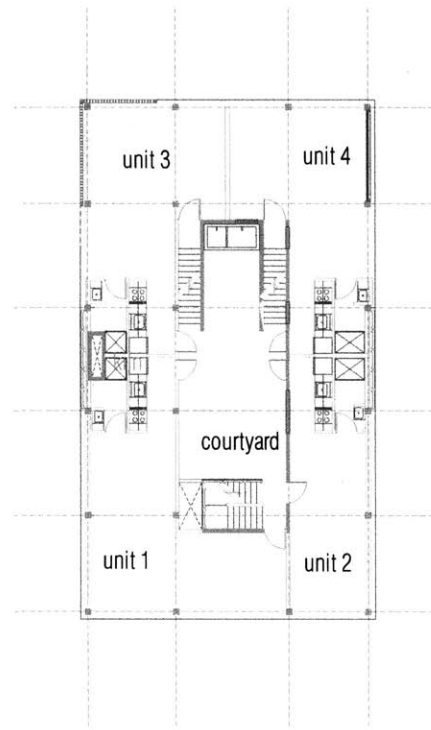
Schematic Model 2: This model continued to explore the framework and further explored the facade and how each edge would respond to the various site conditions of the market, the workshop, the residential edge, and the partywall.

Program Arrangement

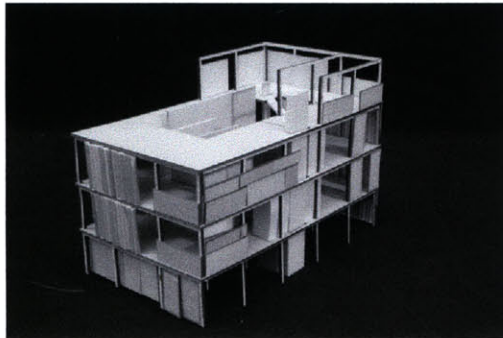
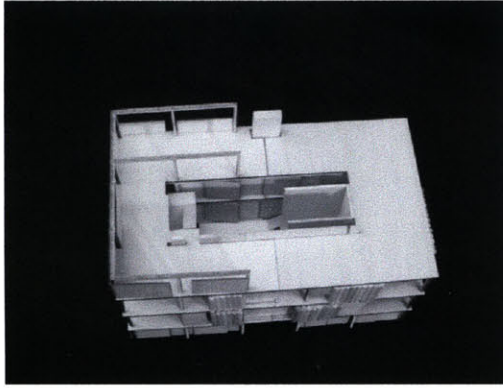
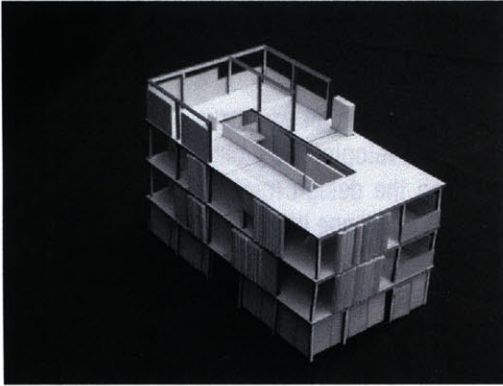
A single prototype design was made for this design. The purpose of developing the prototype was to suggest a way in which the design might be developed over time. The plans show one iteration of the design. While it has been shown that the very nature of a flexible framework allows for the reconfiguration of program, only one possible configuration is shown here. The plan outlines all major units and shows the division between live and work.



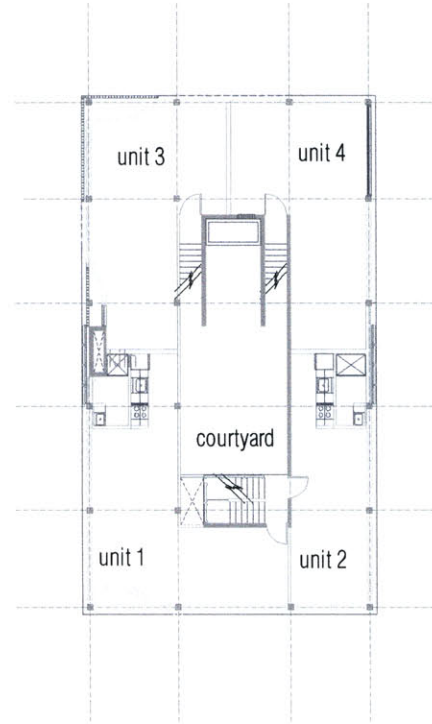
First Floor Plan



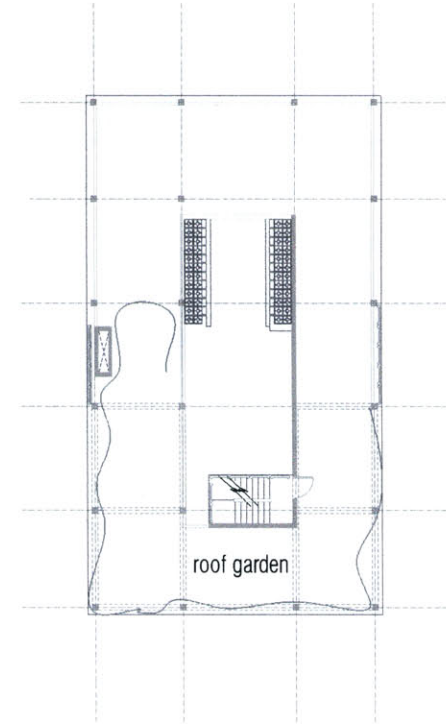
Second Floor Plan



exterior perspectives of live.workshop



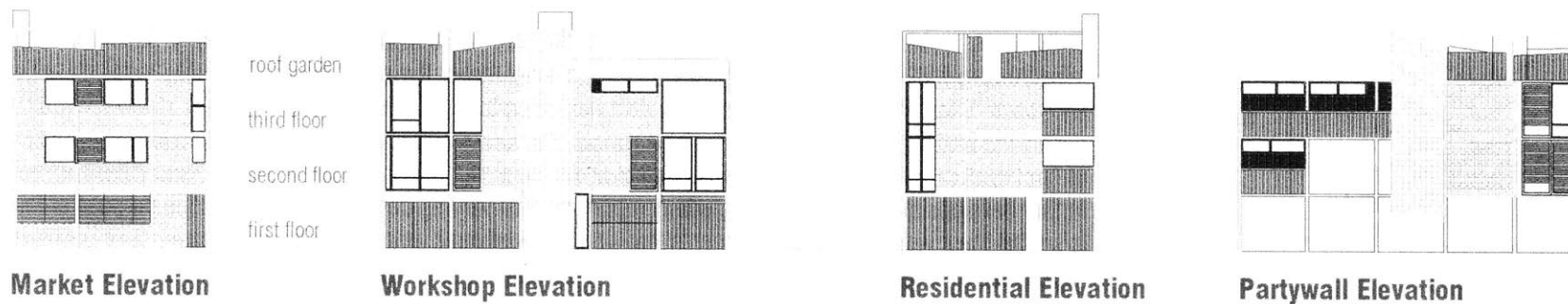
Third Floor Plan

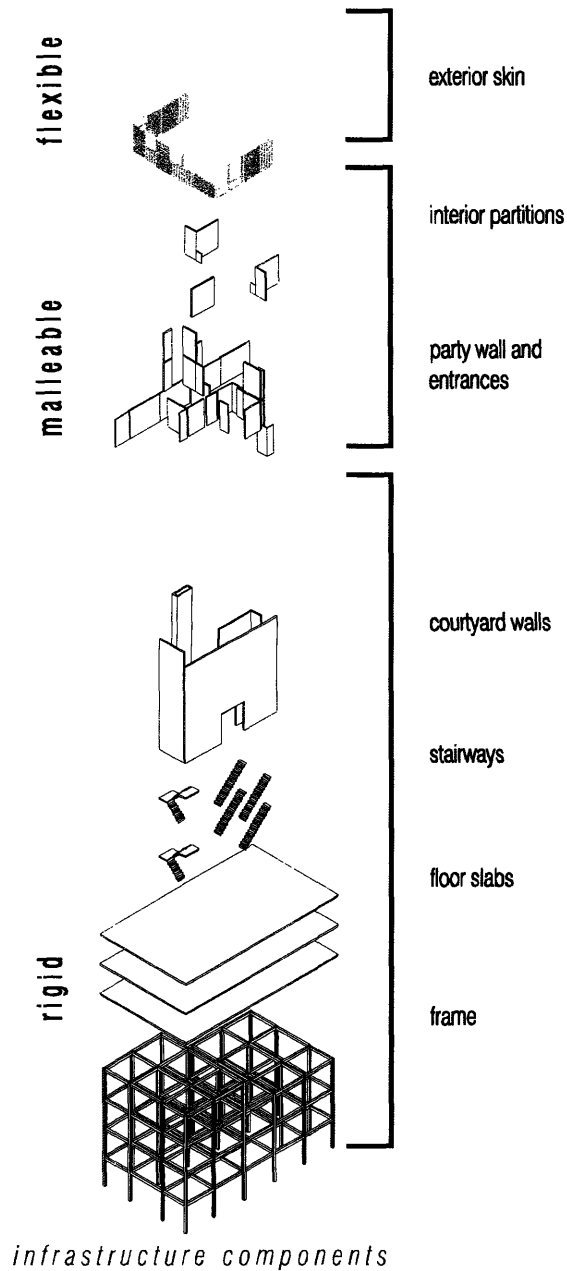


Roof Plan

Prototype Facades

A single prototype design was made for this design. The purpose of developing the prototype was to suggest a way in which the design might be developed over time. Below the elevations suggest how the design might develop into a pucca (formal) housing unit. The facades indicate the various material used, sheet metal, wood, and the clay wall system. The elevations suggest what the building might look like after 10-20 years when considerable investment has been put into the building. The elevations merely suggest a way in which the building could develop and serve to illustrate the potential facade covering created by the ceramic wall system.





7.34

Architecture as Infrastructure: *infrastructure 'packages'*

In-fra-structure: the underlying foundation or basic framework (as of a system or organization) (www.merriam-webster.com)

Although the term 'infrastructure' has been widely used since the 1950's, a universally accepted definition of the term has not yet emerged. Within the development field, the term has several connotations to a wide array of agencies and organizations around the world. However, in recent years, there has emerged a greater understanding of the term and a broader definition that incorporates physical as well as social aspects (UNCHS, 6).

For the purpose of this project, it was important to establish an operational definition of 'infrastructure'. This project is concerned with the aspects associated with physical infrastructure. "Physical (or economic) infrastructure is sometimes defined as providing services to property while social infrastructure provides services to people. A broader definition of physical infrastructural services incorporates those services provided where people live and work or provide links between places where people work, live and carry out other social, economic and cultural activities" (Neutze, 2000). Physical infrastructure often provides services as opposed to goods, where services commonly include water supply, sewerage, storm water drainage, solid waste disposal, roads, public transport, electricity, gas and telecommunications (ibid., 2000). Two criteria that distinguish physical from social infrastructure are location and the reliance on a fixed network. While other types of services may not rely on these criteria, physical infrastructure is a service that is provided at a particular location and one that relies on the presence of a fixed network to carry out that service (ibid., 2000). While there are other criteria that distinguish physical from social infrastructure, these two criteria will be used further in the development of an 'architectural infrastructure'.

In the past, architects have neglected to address the role of infrastructure as an integral part of design. Infrastructure within the development field has commonly meant the provision of electricity, water, sewage, and roads. Sites and service projects of the past neglected to provide any type of building, instead providing merely the land and the services needed on a typical site. One discovery of this project has been the invention of "architectural infrastructure." A direct product of the initial framework, the term "architectural infrastructure" further develops the framework to include components with varying degrees of flexibility. The purpose of this is so that there would be certain elements that would be delivered as part of a typical infrastructure package. If architecture is to be included within the realm of infrastructure, conventional divisions between disciplines must be overcome (Graham and Marvin, 2001). This thesis proposes that architecture can and should be

included within the realm of infrastructure, as part of the packaged delivery system. While entire housing projects are difficult to finance and maintain, the provision of architectural infrastructure would allow for minimum financing and minimum maintenance. Only the most necessary, and most difficult components would be provided, here, the superstructure, the stairs, and the floor slabs. The provision of these elements allow the residents to build as they need, expand when they can, and upgrade as they can afford it. The components of the building were divided into three categories.

flex-i-ble: characterized by a ready capability to adapt to new, different, or changing requirements (www.merriam-webster.com)

[results in architectural elements that are able to change with little effort by a few. material takes the form of light weight materials such as corrugated metal sheets and clay tiles that generate economic activities]

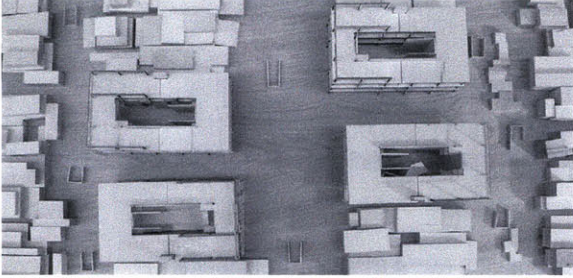
mal-le-a-ble: capable of being altered or controlled by outside forces or influences, having a capacity for adaptive change (www.merriam-webster.com)

[results in architectural elements that are able to change with some effort. materials take the form of medium-weight materials such as cast in place concrete panels, that can be constructed and erected by a few. structure related to elements in the building which could be allowed to change over time such as partition walls, courtyard walls, and roof.]

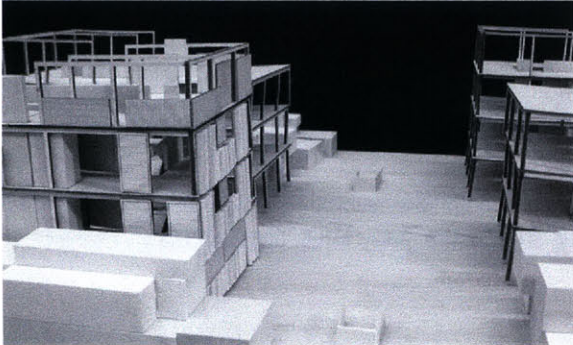
rig-id: deficient in or devoid of flexibility, appearing stiff and unyielding, having the outer shape maintained by a fixed framework (www.merriam-webster.com)

[results in architectural elements that are inherently rigid in materiality and formal qualities. elements are made of heavy materials: poured in place reinforced concrete. form of structure relates directly to the determined parts of the building, those that are the most basic in necessity: shear walls, party walls, stairs, cores]

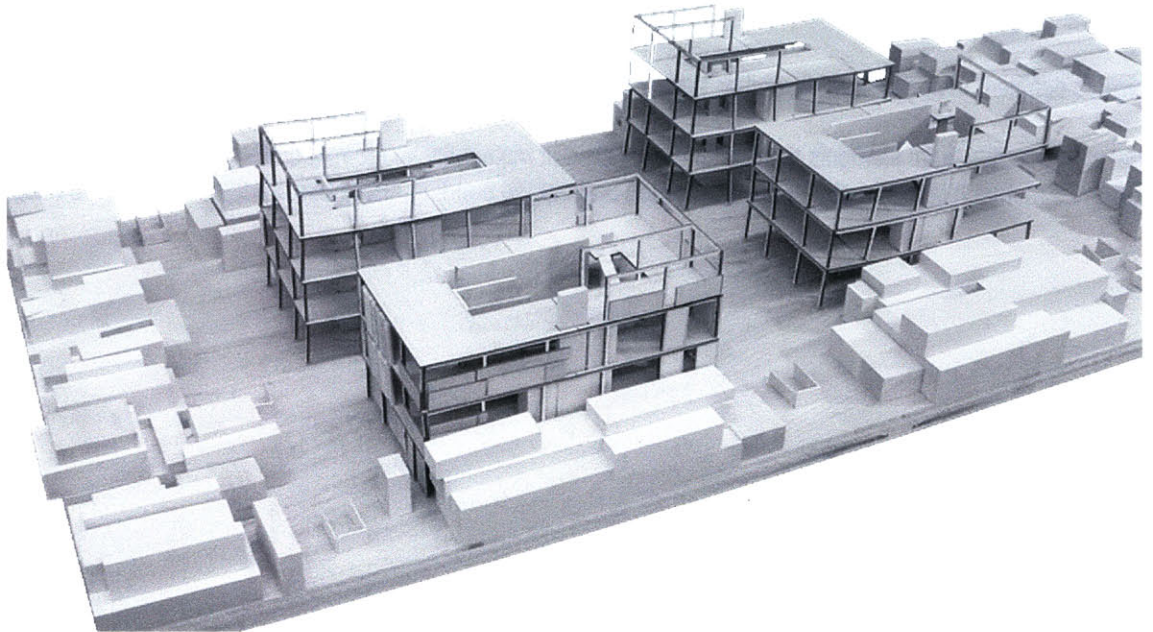
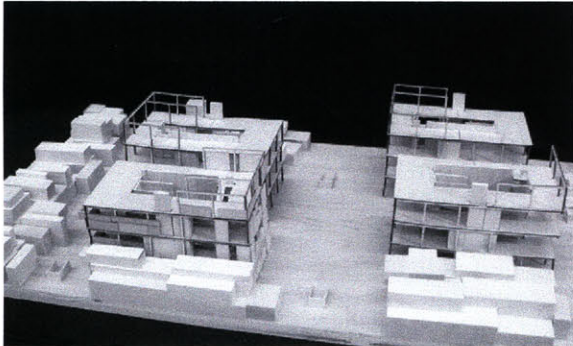
aerial view of final model



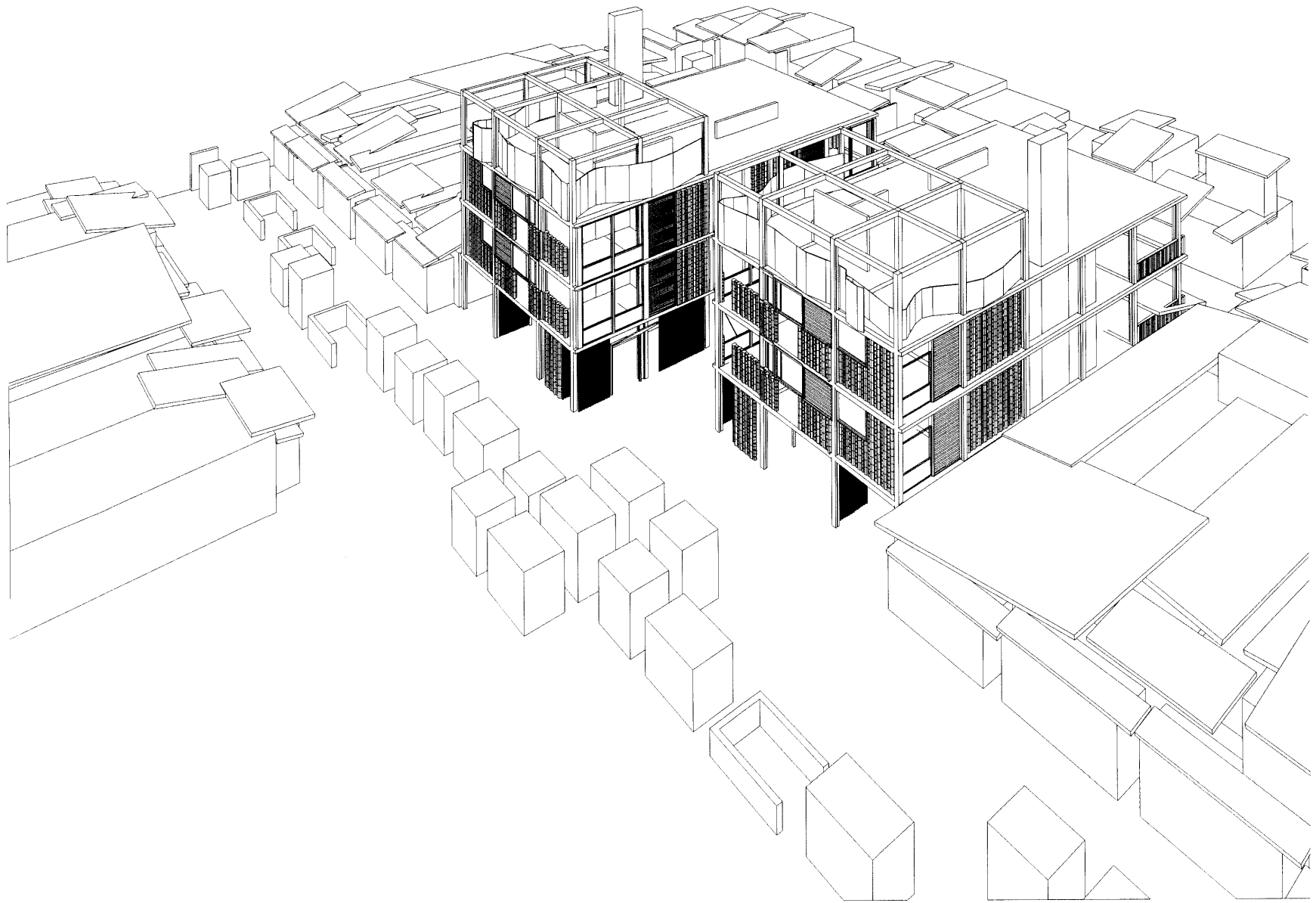
exterior perspective of marketplace



exterior perspective of live.workshops



overall perspective view of final model



aerial rendering of market and live.workshops

woman kneading clay for pots

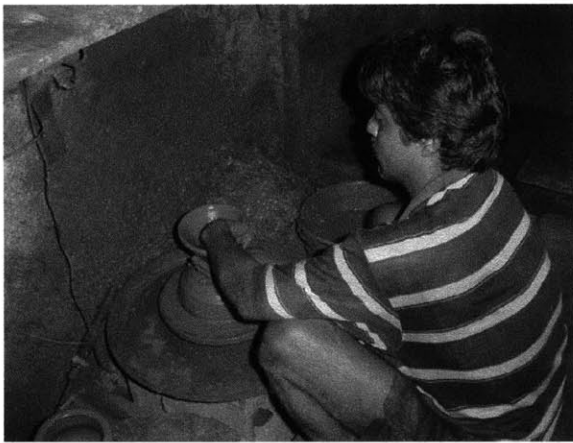


7.40

Design Development: development of wall system

Further development of the project resulted in the creation of a clay based wall system. The initial criteria had outlined the benefits of material research and the potential for income generating enterprise based on the existing craft. The long established craft and production methods were studied in order to understand the craft and their capabilities. Various types of pots were investigated in order to try and develop a more advanced clay based system that did not utilize mechanized processes. The Design Development section outlines the research into ceramics materials and proposes a variety of clay based wall systems that successfully fulfill the criteria for the community.

man throwing clay pot



throwing pots on manual wheel



arranging pots for drying



7.41

Appropriate Materials: building materials and micro-generating enterprise

Until now, most approaches to alleviating the problems within squatter settlements have relied on governments, large scale policy changes, or economic adjustments, which have often produced little benefit to the local communities, and have even adversely affected their daily lives and means of survival. However, recent projects have shown that participatory approaches, those that actively involve the community, are the most successful and long-lasting solutions. Involving the community accommodates the reality that should be clear to all practitioners: that those who will be responsible for executing the solutions must participate in problem-solving processes and must judge the validity of the solution before it is implemented. Many suggestions for community involvement have been proposed which advocate the development and production of small-scale technologies in rural areas. I am proposing to take this concept one step further by developing a sustainable building material that people within the communities can produce and distribute themselves, for the improvement of their own houses, for sale and distribution, and for generating income on a local level. Outlining strategies that will make these technologies both economically feasible and socially acceptable have been largely ignored but are necessary to the successful realization and implementation of these technologies. In addition, alternative technologies can provide solutions to problems where cost and sustainability are major issues. This research suggests alternative technologies, innovative construction techniques, and strategies for successful implementation of building innovation within the context the Khumbarwada community. The challenge for the development of appropriate technology lies in finding the right combination of an economically feasible technological product and a culturally and sociologically acceptable solution.

Several goals for this project have been identified:

- Alternative technologies should provide ways in which unsustainable construction practices can be replaced by methods based on the needs of local population and lateral technology transfers from the surrounding area.
- Developing these technologies in conjunction with production of local construction materials can be used to generate income for local laborers and micro-enterprise.
- Cost of production and market price should be comparable and competitive with possible substitutes or alternatives currently on the market.
- The design should reflect the particular needs of the local community, the context in which they live, and respond to cultural, social, and the physical aspects of their daily lives.

7.42

Ceramics:

Ceramic work is an integral part of life in India, particularly in the villages. The production of clay vessels in India is an ancient tradition dating back to 6,000 BC (Perryman, 21). Many of the forms, techniques, and traditions of making pottery still continue today, expressions of this traditional craft. A wide range of vessels is made from local clay, from water pots to decorative statues. In addition to clay vessels, clay and mud have been used for centuries in the production of mud houses, crop containers, livestock feeders, and earthen stoves (Perryman, 15).

Ceramics encompass a wide variety of materials making a concise definition almost impossible. However, one workable definition of ceramics is a refractory, inorganic, and nonmetallic material (American Ceramic Society, 2001). Ceramics can be divided into two classes: traditional and advanced. Traditional ceramics include clay products, silicate glass and cement, while advanced ceramics consist of carbides (SiC), pure oxides (Al₂O₃), nitrides (Si₃N₄), non-silicate glasses and many others (Baehr et. al, 1995). This project will deal with traditional ceramics, outlining their properties, and exploring options for the creation of advanced ceramic products for the Khumbarwada.

Properties: Ceramics offer many advantages compared to other materials. They are harder and stiffer than steel; more heat and corrosion resistant than metals or polymers; less dense than most metals and their alloys; and their raw materials are both plentiful and inexpensive (Baehr et. al, 1995). Ceramic materials display a wide range of properties that facilitate their use in many different product areas.

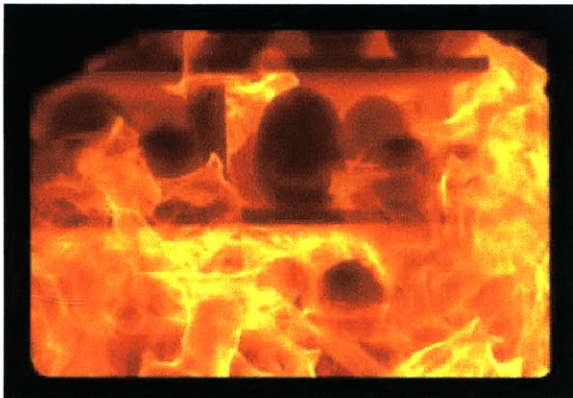
Ceramics have characteristics that enable them to be used in a wide variety of applications including:

- High heat capacity and low heat conductance
- Corrosion resistance
- Electrically insulating, semiconducting, or superconducting
- Nonmagnetic and magnetic
- Hard and strong, but brittle

(American Ceramic Society, 2001; Baehr et. al, 1995; Gupta, 300).

The properties investigated in this project were the thermal, mechanical, and structural properties and capabilities of ceramics. The most important thermal properties of ceramic materials are heat capacity,

kiln interior - firing pots



thermal expansion coefficient, and thermal conductivity (Baehr et. al, 1995). Many applications of ceramics, such as their use as insulating materials, are related to these properties.

Mechanical properties describe the way that a material responds to forces, loads, and impacts. Ceramics are strong, hard materials that are also resistant to corrosion (durable) (Baehr et. al, 1995). These properties, along with their low densities and high melting points, make ceramics attractive structural materials (American Ceramic Society, 2001).

Structural applications that take advantage of the mechanical properties of ceramics include the use of clay and cement as structural materials. Both can be formed and molded when wet but produce a harder, stronger object when dry. Most structural components are strong in compression, but weak in tension, a characteristic which must be taken into account when creating structural components or composites (Gupta, 89).

The principal limitation of ceramics is their brittleness, i.e., the tendency to fail suddenly with little plastic deformation (Baehr et. al, 1995). This is of particular concern when the material is used in structural applications because the ceramic breaks when too much force is applied.

Why ceramics: For years, ceramic materials were only useful in the making of pottery and other artwork primarily because of their brittleness and difficulty of manufacturing.

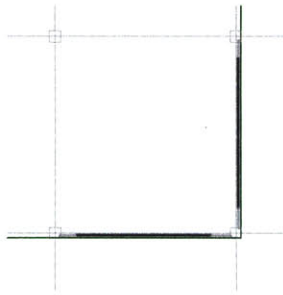
However, people's demands for advanced materials and structural composite components have created a high demand for ceramics. In addition, advances in technology and manufacturing have allowed for the creation of varied and complex materials, from silicon to ceramic fibers such as graphite (Baehr et. al, 1995).

In addition to high-tech composites, the construction industry, which encompasses areas such as commercial buildings, residential homes, highways, bridges, and water and sewer systems, utilizes ceramic materials in various products such as floor, wall and roofing tile, cement, brick, gypsum, sewer pipe, and glass.

In addition to the high demand for ceramic products, their sustainability as products makes them even more attractive from an environmental standpoint. Products that are derived from local craft use less industrialized construction processes and can be used to generate local income.



various forms made from thrown clay

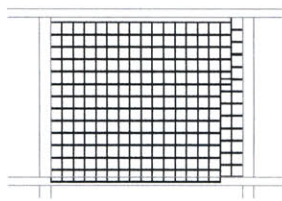


System 1

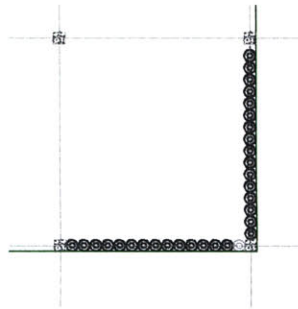
flat clay tiles

one interlocking joint

plan



elevation

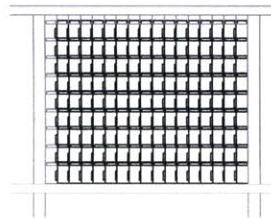


System 2

clay cylinders

two interlocking joints

plan



elevation



7.43

Clay-Based Wall System:

Because of the wide variety of products that can be made from clay, and the existing labor force, I decided to use clay as the primary material in the exploration of a new wall system. The creation of a new wall system was intended as an exploration of the possibilities inherent in local craft production. The study of ceramics and the execution of the wall system is used as an example of building material research and the possibilities for innovative design within local constraints.

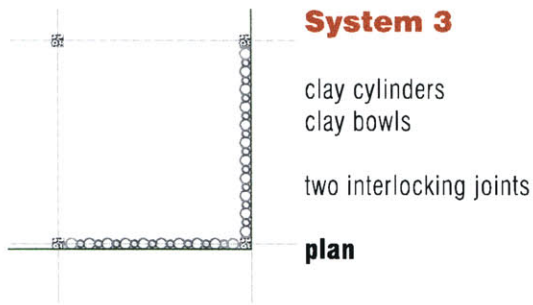
Initial research into ceramics allowed me to learn about the thermal, mechanical, and structural properties of ceramics. The development of the material, beyond the traditional pottery already produced, required an analysis of a wall system construction and application to the local material. Because thermal insulation was not a primary consideration for the wall system, only structural and mechanical methods of design were investigated.

Structural Improvement:

Material employed can often be improved by changing its structural characteristics. An increase in the tensile characteristics improves the material's ability to withstand stresses, particularly in the case of structures that are built of unreinforced masonry or adobe and have a low tensile strength. One way in which to increase a material's tensile strength is to create a composite material or reinforced material by introducing a second material of relatively high tensile strength. Another way to change the characteristics of a material is to alter its internal structure by heat or by introducing a chemical binder. However, these types of high-tech modifications should concentrate on improving the structural construction and the required level of technology since most local materials are used for particular reasons, such as low cost or workability.

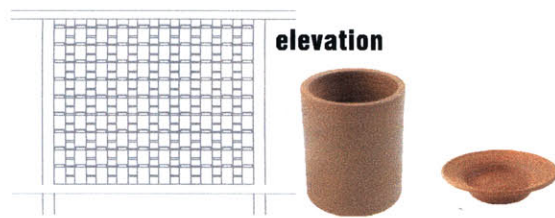
Mechanical Improvement:

An improvement in the mechanical connections between elements can be crucial improving a dwelling unit's resistivity to greater forces. The most primitive level of technology often displays only simple connections designed only to resist gravity. However a tied connection is a slightly more technologically and structurally advanced solution in which the elements are joined together in a way that can resist forces other than those introduced by gravity and therefore renders the whole structure more resistant to disaster forces. The most sophisticated type of connection is the moment connection in which the connected elements are rigidly joined; consequently the connected members act as a structurally homogenous unit.



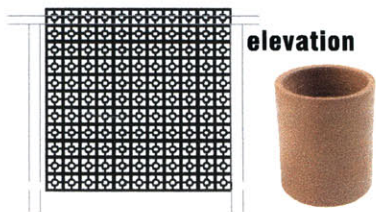
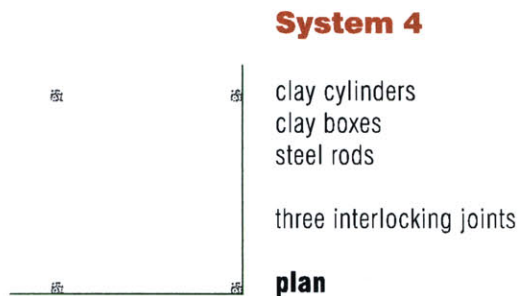
Material Targets: targets for the material were developed in order to arrive at a solution that fulfilled specific criteria

- Economically competitive: incremental cost per unit surface area
- Locally produced: decentralized production within the community
- Income-generating: additional or increased income for local families
- Small in scale: one person is capable of constructing system
- Utilizes local skill sets – no special skills required for construction



From these criteria, a 3-d clay-based tile was developed which could function as interior partitions, exterior envelope, and a roof covering. Within this project, the wall system was developed further as a series of exterior envelope conditions that responded to the particular context of the façade. The envelope conditions investigated were an exterior hung system, a typical infill system, and a recessed system.

The diagrams shown outline a number of possible façade systems that can be produced by the local community of craftsmen. Each façade type is derived from an extant type of pottery already produced locally. These systems make use of existing manufacturing capabilities for architectural ends.





rusted sheet-metal housing in dharavi

8.0 Conclusions and Implications

This investigation was meant to be a starting point for a body of work that would focus on the issues of urban development in developing countries. Although, at its conception, this thesis started out with much more focused goals - the creation of an appropriate material - it became clear to me through the process of research and investigation that the issues that surround the lives of these people are complex and multi-faceted. The original thesis was revised to reflect and incorporate the myriad of issues that encompass this problem. The focus shifted to the implementation of a methodology that would reflect the issues from a multilateral perspective.

The goal of this exploration was to articulate methods for the design of urban development projects that will address global issues of changing economies and social structures while fulfilling the particular needs of local communities. It is my belief that the combination of social, political and economic needs should drive the production of urban development projects that are consistently unique, flexible and ecologically responsible. The aim of this thesis was to promote a better understanding of the issues that drive design within a development context and how attention to the idea of space can create environments that reflect the cultural, social, and physical way in which communities live

From the beginning, this project was a process of discovery. The intentions were clear, in their objectives to ascertain the role of architecture within a development context and the possibility of multilateral approaches towards development projects. However, the method to arrive at conclusions was unclear. This project became the process of discovering a methodology toward achieving the goals outlined. Through rigorous development and definition of the criteria and the goals, I was able to establish a working criteria for successful development projects. From there, I analyzed the site, and with the criteria in mind, determined a set of guidelines that were

specific to the Dharavi settlement. From these guidelines, I was able to conceive of an architectural program that would achieve the goals outlined. The development of this program further reflected the criteria and intentions outlined in the beginning.

This investigation, while broad in scope, merely touched on the myriad of urban development issues. At each point in the investigation, topics or studies that were relevant to understand within the larger scope were identified briefly and explained with regard to their relevance to this project. While I could have delved more deeply into many of the issues, this investigation was meant to merely consider the issues at hand, and illustrate a possible design scenario given these considerations. The methodology that I discovered is clearly outlined in this book. From initial conception of ideas and criteria, it was important to consistently reevaluate the criteria at each phase of design. The establishment of criteria was meant to structure decisions and to allow me to discover the most appropriate interventions for the site. The establishment of criteria led to an analysis of the site and to a more clearly defined scope. Urban scenarios allowed me to investigate the site from multiple scales and arrive at an architectural intervention. The program was developed at a schematic level and the role of appropriate materials was further investigated. The methodology outlined in the book can be summarized as follows:

- Establish goals and objectives for project
- Establish criteria for project
- Determine site and analyze based on criteria
- Evaluate findings to determine the most appropriate intervention
- Develop intervention based on criteria
- Reevaluate design based on goals

While the intentions of this project were broad in their scope and largely idealistic, I felt it was important to touch on all the relevant aspects of urban development within the scope of what an architect could accomplish. The remaining questions unanswered by this thesis speak more about the limited time available for development and the many issues that surround this topic.

Ultimately, this project became my introduction to the field of development and allowed me to, first hand, experience the reality of these conditions and attempt to discover a way in which to deal with them from an architectural perspective. While not all of the investigations were as successful as others, I felt that the process of discovery was important and the lessons learned invaluable.

I continue to strongly believe that the role of architecture within the field of development is a critical one. Not only are we socially responsible for the built environment, but we also possess the capabilities to address these issues from many directions, synthesizing information and constraints into unique, flexible and sustainable design. As urban populations continue to grow in developing countries, it is our responsibility as architects, to promote, design, and discover interventions that address the criteria at hand, are responsible to the local culture, environment, and existing urban fabric, and seek to provide consistently good design.

Illustration Credits

Front Cover

Barbara Lloyd, Colours of India, 1988.

0.0 Contents

- pg. 2. Red clay tiles, Building Materials in India: 50 Years, A Commemorative Volume
- pg. 5. Various clay pots, Chavarria, Joaquim. The Big Book of Ceramics, 1994.
- pg. 6. Personal image from Dharavi, 2001.

1.0 Introduction

- pg. 8. World map. Maps courtesy of www.theodora.com/maps used with permission, 2001.
- pg. 10. Developing cities, Cities in Transition, 2000.
- pg. 12. Mahendra Sinh in Bombay: The Cities Within, 1998.

2.0 Background

- pg. 14. Bauwelt, December 1998.
- pg. 16. Bauwelt, December 1998.
- pg. 18. Grameen Housing Programme: Anwar Hossein in Architecture and Community Building in the Islamic World Today, 1994.
- pg. 19. Citra Niaga : Garry Otte in Architecture and Community Building in the Islamic World Today, 1994.
- pg. 20. Kampung Improvement Programme. Architecture and Community Building in the Islamic World Today, 1993.

3.0 Development Criteria

- pg. 22. Bauwelt, December, 1998.

4.0 Context Analysis

- pg. 26. Map of India. Jane Perryman, Traditional Pottery of India, 2000.
- pg. 28. Map of Mumbai from Perry-Castañeda Library Map Collection at: <http://www.lib.utexas.edu/maps/>
Bauwelt, December, 1998.

- pg. 29. Map of Dharavi, National Slum Dweller's Federation in Rediscovering Dharavi: Stories from Asia's Largest Slum, 2000.
Personal image from Dharavi, Mumbai 2001.
- pg. 30. Personal images from Dharavi, Mumbai (3) 2001.
- pg.32. Personal images from Dharavi, Mumbai (2) 2001.
- pg.34. Personal images from Dharavi, Mumbai (2) 2001.

5.0 Urban Scenarios

- pg. 42. Mahendra Sinh in Bombay: The Cities Within, 1998.
- pg. 43. Open-air-market net: The World Wide Guide to Farmers' Markets, Street Markets at: <http://www.openair.org/>

6.0 Architectural Concepts

- pg. 48. Bauwelt, December, 1998.
- pg. 50. Steven Holl in Pamphlet Architecture (2), 1982.
- pg. 51. George P. Landow. Restored Shophouses on Amoy Street, Singapore. at: <http://65.107.211.208/singapore/arts/architecture/shophouse/7.html>
Chulasai, Bundit. Bangkok: The Myth of Shophouses, 2001.
- pg. 52. Panos Kikkinias. Mutations (2), 2000.
- pg. 53. Detail v. 41, 2001.
Detail v. 41, 2001.

7.0 Project Development

- pg. 56. Personal images of concept models (3), 2001.
- pg.57. Elena Rosa in Mutations (3), 2000.
- pg.60. Personal images of schematic models (2), 2001.
- pg.62. Personal images of final workshop model (3), 2001.
- pg.66. Personal images of final model (4), 2001.
- pg. 68. Personal images from Dharavi (2), 2001.
- pg. 69. Building Materials in India (2), 1998.
- pg. 70. Clay pots, Joaquim Chavarria. The Big Book of Ceramics, 1994.
- pg. 71. Various clay pots, Joaquim Chavarria. The Big Book of Ceramics (3), 1994.

8.0 Conclusions and Implications

- pg. 74. Bauwelt, December, 1998.

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