Urban Generative and Sustainable Design Processes to Create Living Urban Form:
Case Study of a Courtyard Housing Design Competition

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Introduction

In 2007 the City of Portland sponsored an architectural competition to revive courtyard housing in the city. Their aim was to provide quality housing at densities higher than conventional detached housing. The Building Process Alliance team[1] decided to enter the competition. All team members were students or collaborators of Christopher Alexander at the University of California Berkeley and shared his theoretical framework and building methodology. The main aim of our work was to use generative and sustainable designing and making processes in creating courtyard housing with humane and harmonious qualities. It is for this reason that we decided to enter the competition; we felt that our team could work together and design a contemporary livable and sustainable courtyard housing project where people could have a sense of place and community.

Our team was aware of the tendency of such competitions to gravitate toward more attention-getting designs. In fact, one goal of our project was to test our assumption that our design would be overlooked. The results seemed to confirm this assumption. The team was experienced and qualified, and the design met the brief in a complex and humane way; yet it did not attract even an honorable mention. By contrast, the winning entries were extravagant and questionable on many grounds.

Outline of Competition Brief

The city of Portland wanted to solicit ideas for infill housing to provide higher density housing environments. The focus of the competition was to use the historic courtyard housing typology in providing an attractive housing option for families with children. They felt that courtyard housing could provide a livable setting for community interaction and a usable outdoor space while providing environmental sustainable benefits. The competition brief placed an emphasis on the creation of pedestrian-oriented spaces that needed to respect both the community and privacy of occupants' interaction.

Furthermore, the brief indicated that some of the important considerations that designers needed to pay attention to were child-friendly and safe outdoor spaces and the courtyard was supposed to provide comfortable settings for casual interaction between children and adults. There was also the need for indoor children play spaces, sufficient numbers of bedrooms, and accessible storage for strollers and bicycles.

As for housing affordability, the dwelling units needed to be affordable to low- to moderate-income households. The median sales price of a home in the Portland area was $282,500 (April 2007). $247,000 was the maximum amount considered to be affordable to a family of four earning the median family income of $66,900[2].

The city indicated that designers could use one of two infill sites. The first site was 100' wide by 100' deep and the housing program was to accommodate 4-10 units oriented to a shared courtyard, and provide one parking space per unit. The second site was 95' wide by 180' deep and was supposed to accommodate 7-17 units, oriented to a shared courtyard, and provide one parking space per unit.

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[2] Information provided by Portland Courtyard Housing Design Competition brief.

Portland Precedents

The design team, which consisted of six architects and designers, three of whom were living in Portland, met in Portland for several days and started their design investigation by visiting various courtyard housing projects which are a common and successful historic typology in Portland. The purpose of these site visits was to diagnose the degree of life present in these projects and observe the building patterns which contributed to that life. The team visited buildings in square lots (100' x 100') and rectangular lots (95'x180'). Most of the buildings visited were successful in integrating the courtyard space with the dwellings surrounding it and providing housing of high quality (Fig. 1)[3].

Fig. 1. Four examples of Portland courtyard housing precedents

Building Process Alliance Proposal

The BPA designed the project, which is titled "Courtyards Which Live", by using the following generative and sustainable principles: 1). Pattern language, 2). Unfolding design processes, 3). Form language, 4). Ecological design, 5). Carbon neutral building, 6). Ownership and perpetual affordability, and 7). Urban growth.

1. Pattern Language:

The pattern language theory was used as a programming tool to put together a courtyard housing pattern language[4]. The language included patterns from the book "A Pattern Language"[5], and also

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[3] All photos and sketches provided by BPA team unless otherwise noted.
[4] Some of the patterns include in the Pattern Language for Courtyard Housing were the following: Porch transition, Private outdoor space, Kitchen looking onto yard, Farmhouse kitchen, Bed alcoves, Quiet back area, Private outdoor

new patterns that were project specific and were derived from the particular needs described in the project brief. For example, the brief indicated that according to recent research, children needed safe, outdoor play areas close to their homes that can be easily supervised by parents. In addition, they indicated that outdoor spaces should be designed to accommodate a variety of play activities in both green and hard paved surfaces. So in response to the need for children to be outdoors and at the same time within view of their parents, we created the pattern "Front yard play area" which was the following:

Front Yard Play Area (Fig. 2) - Parents need to be able to see children while they play. But children need to be able to play outdoors, in an area that is not isolated. Therefore, create a small front yard area off the courtyard. Place the kitchen window nearby, so adults can monitor children. Make the floor finish hard so that children can play on and provide low green plantation.
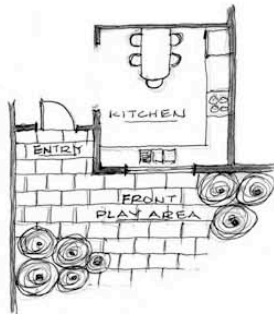

Fig. 2. Sketch of pattern 'front yard play area'

2. Generative Design Sequences:

Living environments, natural or human made, are created sequentially by the use of structure preserving and enhancing transformations. Generative processes have the ability to create living environments which are not image-based but are formed sequentially, step by step. At each step of the unfolding process the existing structure of space is further delineated and adapted within its context while retaining and enhancing its identity and wholeness. Therefore, we used generative design sequences for the design of the building, the design of interior spaces, the design of the courtyard, and the design of neighboring buildings at the urban scale. Below the author presents one of these processes, the generative courtyard housing design process.

**Generative Courtyard Housing Process:**

Our team decided to work on the square site which was 100 feet x 100 feet. The design process started with the delineation of the central courtyard and successively introduced the building volume, unit entrances, unit areas[6], unit layouts, terraces, adjacent growth and urban transformations and growth over time. Our aim, at each step of the process, was to preserve and enhance the existing wholeness of our project. Figure 3 indicates the major steps taken for the design unfolding of the project.

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space, Balconies, Private backspace, South roof garden, Community bike storage, Shared stairwells, Community storage and workshop, Pervious parking, Gross motor play area, Flex car stations, Shared electric vehicles, South facing courtyard, Main entrance, Gradients of outdoor spaces, Outdoor seating, Water fountain, Terrace vegetable garden, Children's puppet theater, Sandbox play area, etc.

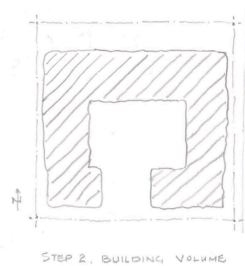[5] A Pattern Language, by Christopher Alexander et. al., New York, Oxford University Press, 1977.

[6] Total square footage of units: 6909 s.f. (no balconies or terraces included)
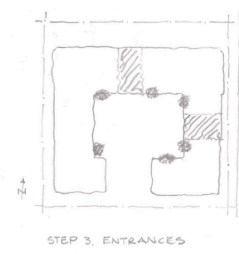Ground Floor = 3776 s.f.: (1) 3 Br. - 930 s.f. , (1) 3 Br. - 910 s.f., (1) 3 Br. - 900 s.f., (1) 1 Br. - 548 s.f., (1) 1 Br. - 488 s.f. Second Floor = 3133 s.f.: (1) 3 Br. - 1216 s.f., (1) 2 Br. - 1100 s.f., (1) 1 Br. - 817 s.f. (+Tower)
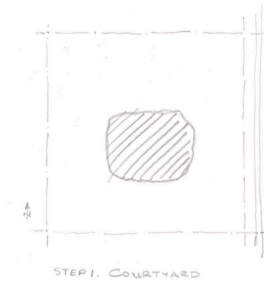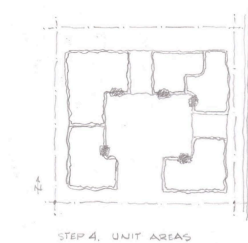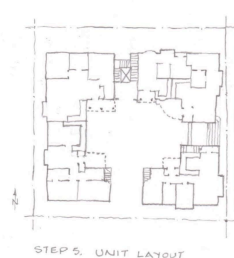
STEP 1. Courtyard
Place the courtyard

STEP 2. Building Volume
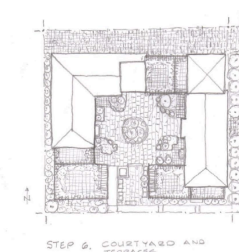Locate the volumes of the building
around the courtyard

STEP 3. Unit Entrances
Place entrances to create
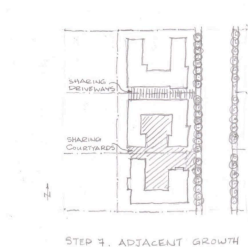life in the courtyard

STEP 4. Unit Areas
Place the individual units
relative to the entrances

STEP 5. Unit Layout
Create unit layout by starting
from kitchen and living room

STEP 6. Courtyard and Terraces
Embellish the courtyard and
terraces

STEP 7. Adjacent Growth
Consider adjacent growth of
buildings and sharing of
driveways and green spaces
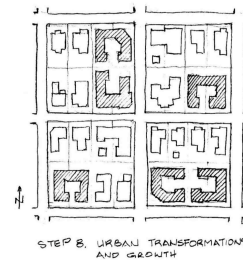
STEP 8. Urban Transformations and Growth
Infill courtyard buildings creating life at the
urban scale and unifying the neighborhood

Fig. 3- The courtyard housing generative design process, Step1-Step8.

3. Form Language:

Buildings of any town or region have particular forms and details which are governed by
geometrical characteristics and materiality. These building forms and details have arisen from
their particular building culture and they helped to create the local form language of a place.
Therefore, shape of buildings and open spaces, structural systems, construction systems and
materials, roofs, doors and windows, are just some of the characteristics that create local building
form languages. So if architects want to unify the built environment within a community and
create structures that have a sense of place and belonging, then they have to respect the local form
language and use it for the creation of their new structures. In our design proposal we
implemented the principle of form language. Our aim was to create an ordinary form language that
respected the neighboring structures and helped to further unify the local building environment.

Therefore, we used the following form characteristics which were derived from our research findings on Portland precedents:

       Shape of building – U-shape building form (fig. 4)
       Shape of open space - Rectangular or square courtyard (fig. 5)
       Local construction system – timber framing (fig. 6)
       Local exterior wall materials – stucco or horizontal wood board siding (fig. 7)
       Doors – wooden doors (fig. 7)
       Windows – grouping of wooden windows (fig. 6, fig. 7, fig. 9)
       Roof - sloped roofscape (fig. 8)
       Roof details – wide eaves and knee braces (fig. 9)

Fig. 4. U-shape building form

Fig. 5. Square shape courtyard

Fig. 6. Timber frame house

Fig. 7. Stucco finish, wooden doors and windows

Fig. 8. Sloped roofscape

Fig. 9. Roof details– wide eaves and knee braces

4. Ecological Design:

The competition brief placed particular attention on sustainability at the building and site scale. It proposed use of sustainable building technologies, resource conservation, and energy efficiency. Therefore, through our design we proposed the use of various ecological design patterns[7]. For example, we proposed that onsite storm water management and storm water runoff should be managed through various infiltration and storing systems such as planters (fig. 10), swales, permeable paving, eco roofs, and underground cisterns. We proposed that rainwater should be collected in a cistern and reused for toilet flushing and landscaping and all storm water should be filtered and infiltrated on-site. Furthermore, we proposed the used of low-flow toilets, faucets and showers and we aimed in reducing potable water and wastewater by 50%. We chose materials that were non-toxic and had high recycled content, with an emphasis on local production. Landscaping and on-site food production was to include fruit and nut trees. The terrace herb and vegetable gardens were to have a combination of low-irrigation natives and edible landscaping.

Fig. 10. Storm water infiltration planter

5. Carbon Neutral Building:

The aim of our team was to create a carbon neutral building. The energy use of the building was going to be 60% less than a conventional building and renewable energy generation was going to be employed to reduce carbon footprint by 80%. The building was to have a carbon footprint which was 30% that of a conventional building. It was supposed to use 60% less energy than Oregon energy code requires through a community ground source heat pump, advanced window glazing, structural insulated panels, heat recovery ventilation, passive solar design, and other strategies. The project was planned to generate almost 30% to 50% of its total energy needs from a

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[7] Ecological Design Patterns: Small footprint, High density, Open space, Woonerf, Walkable neighborhood, Alternative transportation, Pedestrian access, Courtyard community, Healthy restorative environment, Lower energy costs, Heat exchange, Radiant floors, Energy recovery ventilators, On demand hot water heaters, Energy star appliances, Compact fluorescent bulbs, Courtyard evaporative cooling, Deciduous trees, Edible landscape, Native landscape, Vegetative infiltration basins, Community recycling, Compost, Flexcar, Shared NEV's, Durability of materials and systems, Low-embodied energy materials, Recycled materials, Fly-ash concrete, FSC certified lumber, Operable FSC triple glazed windows, Natural ventilation, Flexible floor plans, Rainwater catchments and storage, Bio-swale, Dual flush toilets, Low-flow water heads, No voc finishes.

combined solar photovoltaic – solar thermal system and the remaining carbon footprint was going be offset with carbon credits, creating a carbon neutral building.

6. Ownership and Perpetual Affordability:

A sustainable land trust organization, operating as a non-profit developer, was supposed to own the land. Homes and improvements were to be owned by residents. An initial land subsidy was to be provided in exchange for 75% of property appreciation reverting to the sustainable land trust on sale and 25% remaining with owner. With our proposal, the owners of the units were to qualify for location efficient mortgages (LEMs) and energy efficient mortgages (EEMs), allowing quality materials and green technologies to be employed. A turnkey third-party provider was to own the project's solar array of 7kW allowing residents to buy energy at below-market rates. Oregon Department of Energy and Energy Trust incentives were to also aid project financing.

7. Urban Growth:

Our team made further use of generative design processes at the urban scale. We proposed "adjacent growth", where two neighboring buildings could share resources such as driveways, and connect open spaces to create bigger courtyards and form a larger whole. Furthermore, we proposed "urban transformations over time" the aim of which was the step-by-step evolution and growth of neighborhood complex to create harmonious and sustainable cities. Our aim was to conceal parking and create more walkable environments; create a variety of communal open spaces and gardens for children's play and food production; create mixed-use residential and light commercial; create a variety of unit types, sizes, and affordability so that to create a more diverse social neighborhood; create sense of community and identity through the architecture of buildings and open spaces that respond to Portland's geography and culture.

Design Outcome (fig. 11)

Through the use of generative and sustainable principles the final project unfolded gradually and came to life. The end result was not predetermined ahead of time but was the product of an unfolding process that used local patterns responding to the particular needs of the project. The form and details of our building was not image-based but respected the local form language and building culture and grew out of what was there before. The principles of ecological design, carbon neutral building, and ownership and perpetual affordability ensured the making of an environmentally and socially sustainable building. Lastly, the principle of urban growth ensured that the neighborhood will keep expanding and growing in a meaningful, humane, and sustainable way.

Fig. 11. Building Process Alliance design proposal

The Winning Proposals

For comparison, we present below some of the winning schemes (fig. 12). Some general remarks about these schemes, which indicate some of the shortcomings of these proposals, are the following:

1. Courtyards- Cars penetrate the site and interfered with the courtyard, contrary to the brief's requirements. Also, building massing and orientation prevents sun reaching the courtyard. The courtyard does not have a meaningful shape; it is a "left over space", and lacks at times the right degree of community and privacy.

2. Units – units do not have variety of size thus lucking affordability to families of various incomes. Most proposals have identical floor plans so they lack variety and individuality. Some units are too exposed to the public and therefore lacking needed privacy.

3. Building – most buildings have monolithic volumes and their forms do not respect the local forms. Materials and building detailing has nothing to do with the local building culture, thus lacking continuity and integration. For example, building fenestrations with too much glass surface ignore Portland's climatic conditions.

4. Neighborhood - most proposals do not deal with the urban scale. They are not proposing meaningfully connections to their neighboring buildings and open spaces. Some proposals ignore the street as a shared public realm. The buildings do not add to the sense of community and belonging as they have an aversion to precedents and have a universal character.

Fig. 12. Four of the winning design proposals[8]

Conclusion

Our team did not expect our humane design methodology to be noticed by the judges, and our proposal did not receive any positive or negative acknowledgments. The outcome of the competition highlighted two important, flawed aspects of contemporary methodology.

First, the focus of such competitions, like the profession as a whole, is on novel proposals rather than demonstrating humane re-generation and re-adaptation of housing typologies. Contemporary methodology disregards user needs, context, and local building culture developed through time. It has an aversion to precedents and relies on image-based proposals that are rooted in novelty and experimentation with unproven approaches. As a result, contemporary housing forms are focusing on stylistic solutions and thus fail in creating living spaces and thriving communities that will attract people because they are pleasurable, they have identity, and create a sense of belonging and ownership. This has profound implications for the ability to achieve truly sustainable architecture.

Second, contemporary design methodology and the profession are focusing on ecological and economical building sustainability but are ignoring for the most part social and humane building sustainability. Green building is succeeding modestly in conserving energy and resources but it is focusing primarily on innovation, change, and globalization. This view is helping to create novel and efficient buildings but fails again in truly creating living and socially equitable communities as a foundation for true sustainability.

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[8] Published on the website http://www.courtyardhousing.org/entries.html

There is a need, therefore, to integrate green building with humane building, where architects give more control to users in forming their own responsive environment, so that truly sustainable housing environments can be created. Architects should not focus upon pre-planned or standardized formal designs but deal with processes which can bring upon "wholeness" in the urban housing form. They should focus on city-making processes such as social interaction, site diagnosis, building densities, geometric unfolding of buildings and public open spaces, financial arrangements, cash flow, craft and construction, and construction management. The task of creating wholeness in the city can only be solved through local and unique designing and making processes where the urban form emerges through gradual, step-wise, unfolding processes similar to the organic processes employed in traditional city-building.