CHAPTER IV
RESEARCH RESULTS:
COLLABORATION BETWEEN THE
ARCHITECTURAL-DESIGN PROCESS AND REEARCH

This chapter will present findings from analyzed data into thematic units, according to established two hypotheses. First, design research as an investigative domain within the design process is carried out in the co-development of problems-solutions. Second, if design and research are cooperative each other in the design process, there might be "design dialogues" able to link design and research. Results will reveal how the process of design can collaborate with research.

The term design research in architectural design refers to the acts of design investigations with the aim of fulfilling what a designer wants to know about design specifics involving with the design project and tasks. In this way, design inquiries/problems are emerged, leading to conducting design research so as to search for relevant information, to explore prospective possibilities, and to generate novel, concrete ideas toward design solutions. Results of design research can be put into design actions only if a designer launches design challenges, namely problems that need design research as modes of design inquiry to figure out the solution, a creative design proposal. Dialectics between problems and solutions draw research spaces into the process of design. As a series of problems-solutions continue on designing from programming to a final proposal, research spaces can take place in the process in order to resolve design conjectures in concrete levels. As design and research convey a dichotomy in design thinking, a cooperative layer of visions, that is a design dialogue, is mandatory to make collaboration. Design research taking place is involved with problem-framing as well as design visions and approaches. In this context, design research in architectural design arises from investigative design actions with purposes in several levels: programming, sustainability, spatial typology, and environmental symbols and tectonic.

Three following sections will present findings from assessing two main research hypotheses: 1) design inquiry of the co-developments between problems-solutions; 2) research space within the design process; and 3) design dialogues: bridging design visions toward research. The first topic will exhibit how three different groups of participants conduct design thinking and actions based upon the process of the co-development between problems-solutions model. As follows, the second topic

intends to reveal inductive patterns of design research cooperating with the architectural-design process by means of comparing a series of design developments from three different groups of participants. The final topic will show clusters of design visions that potentially direct design research, whose outcomes in turn enable to contribute to design.

1. Design Inquiry of the Co-Developments of Problems-Solutions

This section aims to assess the first hypothesis whether research can collaborate within the design process on a model of the co-development between problems-solutions. The architectural-design processes and thinking on this model were conducted and collected throughout the projects of three different groups of designers to recognize how design research is embedded into the architectural-design process (appendix A, B, C).

Based upon an assumption of "design as research," architectural design does not only rely upon a designer's subjectivity, but also turns out to be cooperative, progressive acts of integrating design visions, learning design situations and constraints, and most importantly investigating the novel, appropriate proposal responsive to design tasks. Architectural design, in this context, is the evolving process. Design inquiry thus progresses in a series of the co-evolution of design spaces between problem space and solution space, as Maher[1] and Dorst and Cross[2] suggest, both of which are gradually co-developed together in concrete levels toward the final creative proposal. In this context, design exploration, namely *research space*, can take up an important role in-between problems and solutions in order to figure out design possibilities as well as to understand and reframe problems, specifically integrated with data processing.

From observations of three different groups of designers' processes, there are similar and different research conducts during design development among groups. As all designers receive design tasks or briefs defined as an initial problem and challenge, they make an attempt to understand and explore the assignments with generic and specific views to set design goals, concepts, conjectures, or problem-framing as an initial solution. This initial solution establishes the next problem as well as directions of the design process and research as a road map of design inquiry. Designers advance their research into investigating architectonic possibilities and examining conjectures in more objective lines of thought with personal ideas integrating with relevant information. This course of design research affects problem refinement or re-framing problems in further steps. In the final phase of design

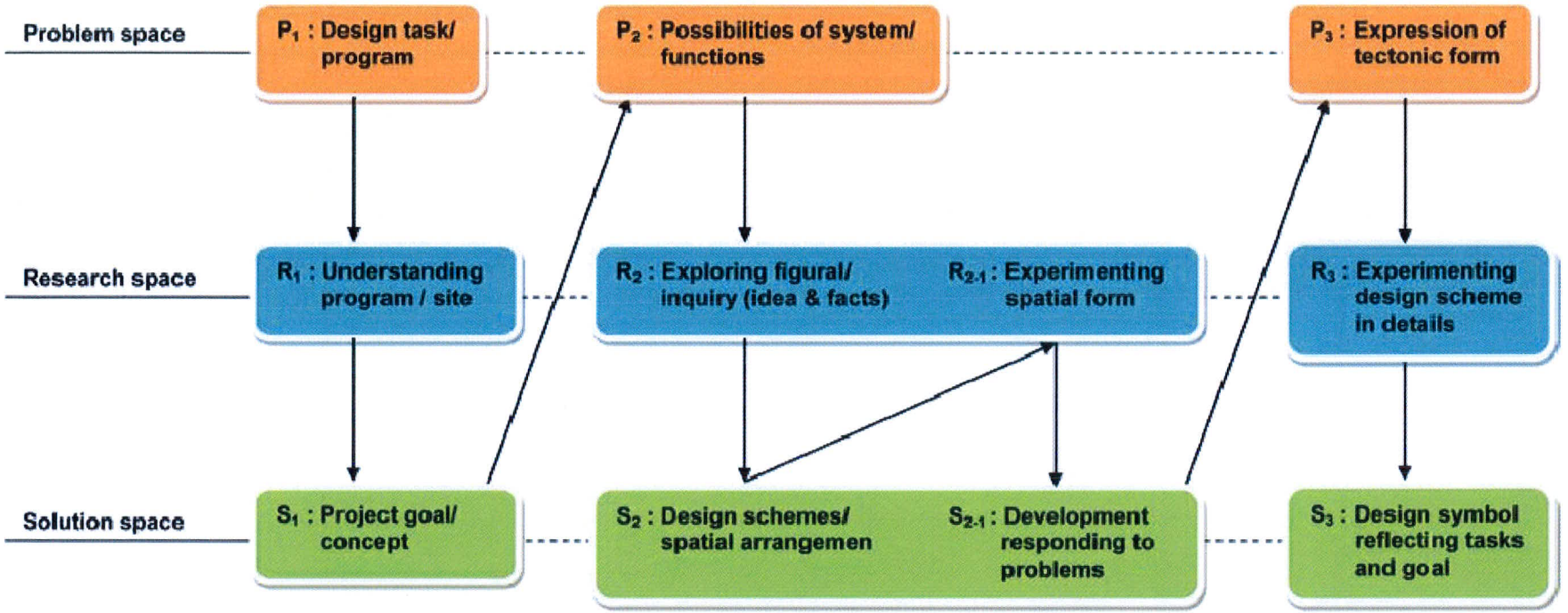
development, re-framed problems in critical elements and details are mainly concerned to investigate tectonic form, that is, to present design symbols. As design solutions and problems are developed in more tangible levels, design research, in this light, becomes the acts of design exploration functioning with design methods that aim to ultimately improve a design proposal as well as clarify problems.
With parallel lines of the process, there is also a distinction between professional architects and architecture students in approaching to design research. Professional architects mostly draw upon more design visions to direct problem-framing, research, and working methods to meet design goals than novice students operate research into the process. Architecture students tend to employ agendas related to programmatic contents and sites to begin research.

1.1 Third-Year Students' Design Process

To observe successions of the third-year architecture students' design process, the design brief including design assignment, the site, requirements, and conditions was given; its task was to create the eco-adaptable community serving for a youth camp and a shelter for flooding evacuation. Third-year students' processes were recorded in a model of the co-development of problems and solutions (see Appendix A).

Third-year students began to recognize the given program and task as an initial problem (P_1) that needed to be understood in more clear sense of physical systems and relationships of sustainability to the site. At this point, the first research (R_1) was initiated with the aims of searching for design goals and figuring out the key concept to carry out throughout the project. Third-year designers usually investigated related case studies, site analysis, and functional relationships in terms of ecological concerns. They employed different ecological strategies to organize their approach to the task. Some decided to explore ecological systems such as water treatment and waste management, and then created recycling, environmental systems integrating with site constraints. Others focused on diverse users' analysis which affected a distinction of programmatic relationships for their own project. Some emphasized the search on cultural concepts to reflect regional connections. In this stage of research, all design students made an attempt to find out their projects' solutions in order to reach specific, design goals and concepts (S_1) that would be advanced into developed problems.

Figure 4.1: The third-year architecture students' design process collaborating with research in the co-development of problems-solutions model.



P_N = Problem space development

R_N = Research space development

S_N = Solution space development

The initial solutions obtained from understanding of the program would motivate focused research questions or further problems on investigating "possibilities of systems and functions" (P_2). This research phase highlighted physical exploration, that is, formal experimentation of spatial organization (R_2) cooperative with defined concepts and collected data. It can be also observed that designers employed a variety of methods—sketches, diagrams, drawings, model-making—available for "processing" design ideas and obtained data. This stage of research was taking a greater time than any other inquiry phases because it was great deals of design inquiry to generate a figural conjecture (S_2). Thus, designers had a tendency to divide physical investigation into two sub-phases: 1) schematic inquiry; and 2) spatial form experiment ($R_{2\text{-}1}$) for design development ($S_{2\text{-}1}$).

As third-year students constructed their individual, design schemes in concrete degrees through figural research, these design conjectures had impacts on further developed problems on "expression on tectonic form" (P_3). In other words, design schemes manipulated what possible design agendas designers could better conduct further exploration in details and symbolic proposition of design (R_3) to manifest the vibrant image of the design concept. However, it is to be noted that design students who carried on the tectonic form research were likely to achieve an acceptable and comprehensive design proposal. Some designers decided to explore structural and elemental concerns while others focused on investigating socio-cultural spaces. All designers who reached this stage of research seemed to explore design symbols with sustainability tasks in mind. The solution in this research phase aimed to create a design symbol (S_3) reflecting the project's formal configuration on the identified design goal and concept.

In addition, it is significant to mention that successful projects (assessed from scores received from design jury committees) show continuity of the co-development of problems-solutions process. Design problems and solutions were gradually improved from abstract to concrete levels of the design inquiry by means of research as design modes to figure out what an acceptable design proposal could be responsive to the design task and concept. Moreover, an evolution of the relationship between a previously defined solution and the next design problem could be found in successful projects as shown in Figure 4.1. Conversely, unsuccessful projects lack chains of both problems-solutions progressions and responses to design tasks and the core of design ideas.

1.2 Fifth-Year Architecture Students' Design Process

The design process of fifth-year architecture students is more distinctive than other groups of participants in that fifth-year students' design thesis embodies creating their own unique programs as design assignments and designing responsive to the program. Both programming and designing are correlated in terms of architectural creativity, thereby considered as the inclusive design process (see Appendix B).

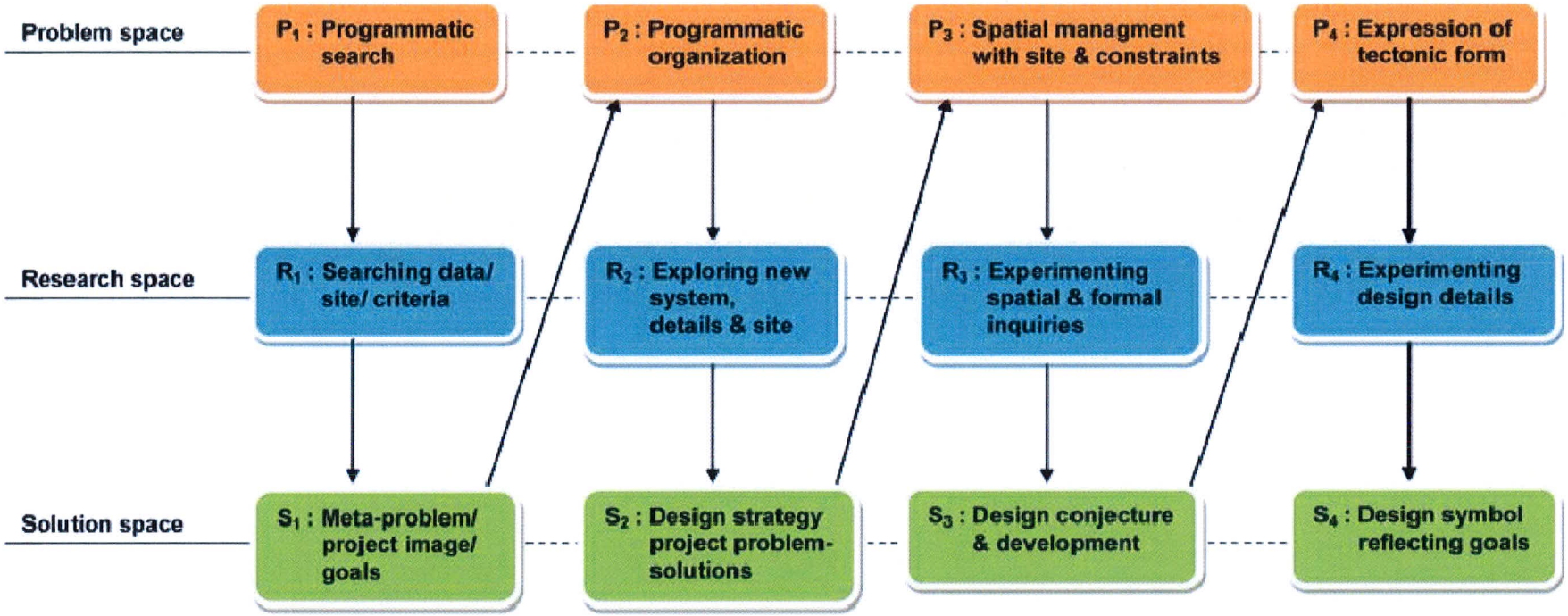
As fifth-year students held thesis proposals containing unsettled ideas at hand, most of them concentrated their projects on building typologies whereas the others focused on the selected sites to find out what possible programs would enhance specific locations. As shown in Figure 4.2, programmatic searches (P_1) were an initial problem. Fifth-year students began to conducts archival search for relevant contents: case studies, documents, coding, and site constraints; all materials had been analyzed, criticized, and structured (R_1). In this stage, designers were inclined to be overwhelmed with a lot of information; thus, they needed methods such as diagrams to organize data in order to form programmatic concepts (S_1).

Programmatic concepts or "project images" arisen from the beginning research, in turn, established a *meta-problem*,[3] namely a high-level, design problem of de-composing ordinary building types into a new architectural typology. For example, a design task of a new complex to serve catholic lifestyles in urban contexts makes challenges beyond just designing a monastery, but generates design problems to creatively find out a combination between a monastery and public spaces.

Programming meta-problems lead to inquiries of programmatic organizations (P_2). Fifth-year students explored novel programmatic systems, the site, and elements (R_2) so as to construct distinctive functional relationships suitable to site constraints, site selection based on concepts, activities, and area requirements in terms of volumes. This research phase of the programmatic conjecture depended upon methods such as diagrams, drawings, model-making as designing had to use these modes. These design modes helped designers to evidently visualize the project toward "design strategies" (S_2): setting the goal, the projects' critical problems, and a design principle (distinguished in some cases).

Individual design strategies arranged a quest on "spatial management" (P_3) with site conditions and set criteria. Exploring zonings of the positive-negative spatial relationship, sequence of spaces, volumes, and orders with regard to users, architectural and environmental operative mechanism, and specific topography was accumulated and envisioned through design methods (R_3) in order to generate physical forms, conjectures, and design development (S_3).

Figure 4.2: The fifth-year architecture students' design process collaborating with research in the co-development of problems-solutions model.



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Similar to the third-year students' process, design development in design theses helped to define focused problem on "expression on tectonic form" (P_4). Different thesis projects, in the tectonic research, aimed to experiment symbolic details and elements (R_4) on distinctive approaches with design methods to simultaneously construct and check figural configuration. Some projects were explored on spatial and formal arrangements responding to constraints as others were investigated concerning structural configuration related to topographic contexts. Some projects decided to experiment mechanism of the key spatial units, reinforcing project concepts. These tectonic experiments of all thesis projects intended to manifest designed, environmental symbols (S_4) reflecting unique design goals.

In addition to a continuous development between problems and solutions, the process can be discerned that if design problems are complex, a designer is likely to investigate solutions in chunks, especially in searches for physical conjectures and development, from forming a whole scheme to refining a tangible, design image.

The finding, moreover, shows that to create a creative design program relies not only upon gathering raw data but also on stimulating project concepts or design agendas to control information inputs as well as *processing* relevant data into a synchronized framework of the emerging program.

1.3 Professional Architects' Design Process

Professional architects' design tasks were diverse in project scales from interior spaces, domestic domains, to complex projects. However, their design processes were carried on through architecturally design thinking of problems-solutions relationship. Professional architects tended to initiate the process of design with individual design visions or conceptual challenges (see Appendix C).

Even if architects did not define design briefs given from clients as design problems, they used design tasks/assignments as the beginning position, so called an initial problem (P_1), needed to be comprehended and figured out toward an original design problem. As shown in Figure 4.3, architects began the primary research (R_1) with particular visions or design-team interpretation to the assignments in an attempt to understand these following issues:

1. Systems of the program: activity relationships, hierarchical orders, and sequences.
2. Case-studies: analysis to construct design criteria.
3. Constraints: sites, contexts, time.

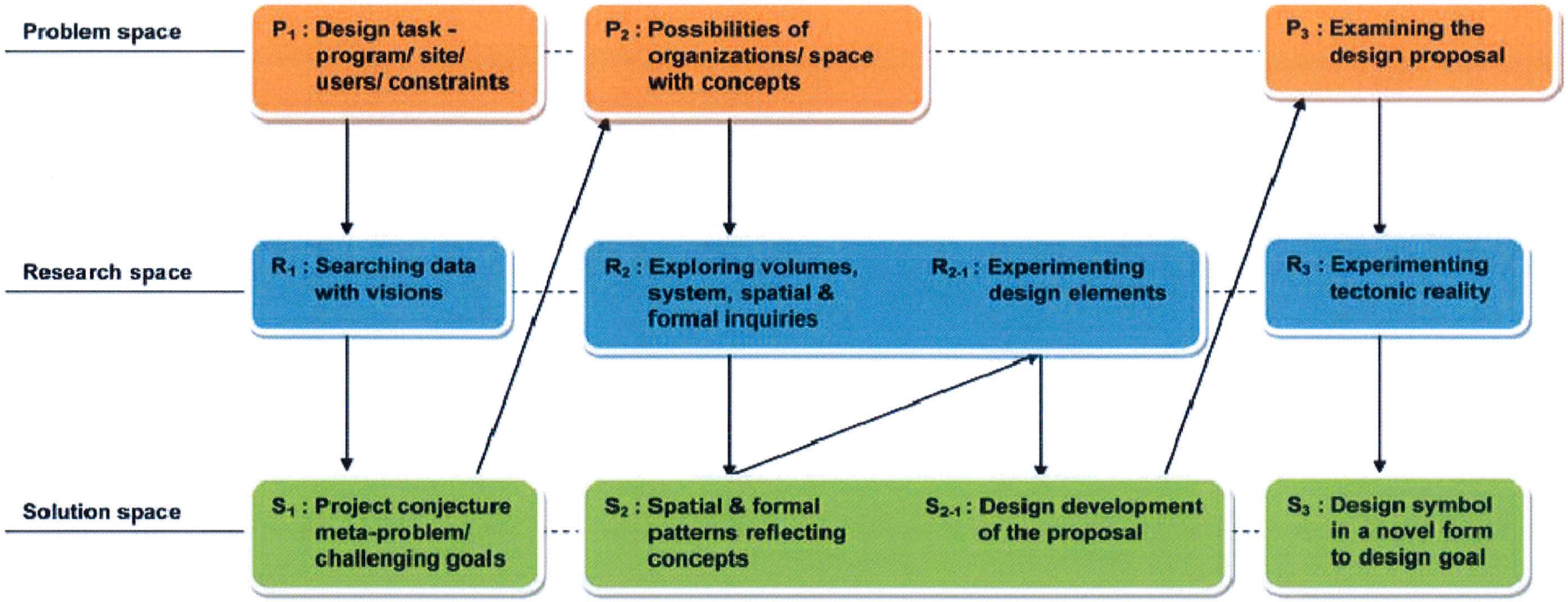
Professional designers took serious research and discussion on this stage to discover critical design agendas, a project concept/goal, or meta-problems (S_1). In this light, design concepts/goals systematized an organized image of the project, leading to design problems.

An original design problem-framing was more likely to emerge out of the initial solution: the project concepts, design ideas, and challenges. It was concentrated on exploring design possibilities in physical forms (P_2). In this research stage, most designers emphasized constructing fundamental design conjectures (R_2): spatial organization and management, spatial sequences, and positive-negative relations of forms, all of which depended on particular design frameworks such as spatial adaptations and interpenetrations, flexible boundaries, and modular materials. Exploring design conjectures was conducted by means of typical design methods available for processing specific data, communicating images with designers, and presenting ideas. Designers moved forward to experiment design conjectures and crucial, architectural elements ($R_{2\text{-}1}$) to improve design development. The further figural experiment was to make sure that design proposals ($S_{2\text{-}1}$) expressed design concepts and responded to design tasks and goals in tangible ways.

Professional designers, in addition, developed an advanced problem on examining tectonic form (P_3). Designers mainly focused on experimenting tectonic reality (R_3), after design development, for critical elements, design details, and the construction process to ensure whether prospective design achieved appropriately environmental expression and functions in which designers were speculating. Architects tended to experiment tectonic research by building mock-ups to be tested in real situations. Rather than acknowledgement of design effects, comprehensive, design proposals presenting symbols (S_3) can come out of this progress.

From findings, design inquiry in the architectural-design process is comprised of three major, interconnected components: design problems, research space, and solutions. The design process begins when designers recognize a design task or goal, namely, an initial design problem, such as a design mission that a designer receives it from a client or a given program that students have to carry out a design proposal. Design research is initiated to "propose" a design solution when design problems arise from designers' queries. A proposed solution lends itself to frame the next problem with visions, that is, responding to Cross's notion that a designer tends to frame design problems with particular view.[4] In this context, research space turns into significant, design modes to develop solutions, which in turn affect refine and reframe further problem space in more definite, concrete ways.

Figure 4.3: The professional architects' design process collaborating with research in the co-development of problems-solutions model.



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2. Research Space within the Design Process

Research space, from findings, is simply defined as the investigative realm among a series of the problem-solution evolution. It manifests itself as active domains of exploring design matters to be resolved, in order to improve design solutions. Research space, in turn, lies in the critical performance inclusive of searching relevant data, organizing and incorporating information into concepts, and experimenting configuration throughout design inquiry within the process, as shown in Table 4.1.

Research space not only conducts searches for relevant data and knowledge to the project but also seeks to generate new platforms of environmental design by way of integrating searched information with specific, design ideas. In this way, research always cooperates with working *design methods/tools* for processing design inputs. New collected knowledge needs to be analyzed, synthesized, and collaborated with appropriate modes of design. This collaboration gives rise to design decision-making, alternatives, or solutions responsive to established problems and more critical refinement of design in depth. Research space requires two-fold constituents;

1. Searching and interpreting new pertinent knowledge/information, and
2. Abilities to synthesize a creative set of constructive forms—criteria, concepts, spatial systems, and symbolic configuration—immersed into design.

Research space consequently acts as design inquiries, an experimentation in which design situations and inputs must be organized and incorporated into concepts through design modes, thereby contributing to constructs of physical, environmental conditions and relationships, images, and forms.

From comparative design activity findings of three groups of participant designers, research space can be categorized into a series of three episodes within the design process of the co-development of problems-solutions:

1. Understanding criteria and formulating design goals.
2. Exploring design possibilities and generating proposals.
3. Examining reality.

These three design situations of research space are interrelated in sequence of the design process (Table 4.1) to enhance design inquiry as a *creative learning process of environmental-making*, which develops design activity from problematic situations, abstract ideas, conjectures, to concretely creative environments.

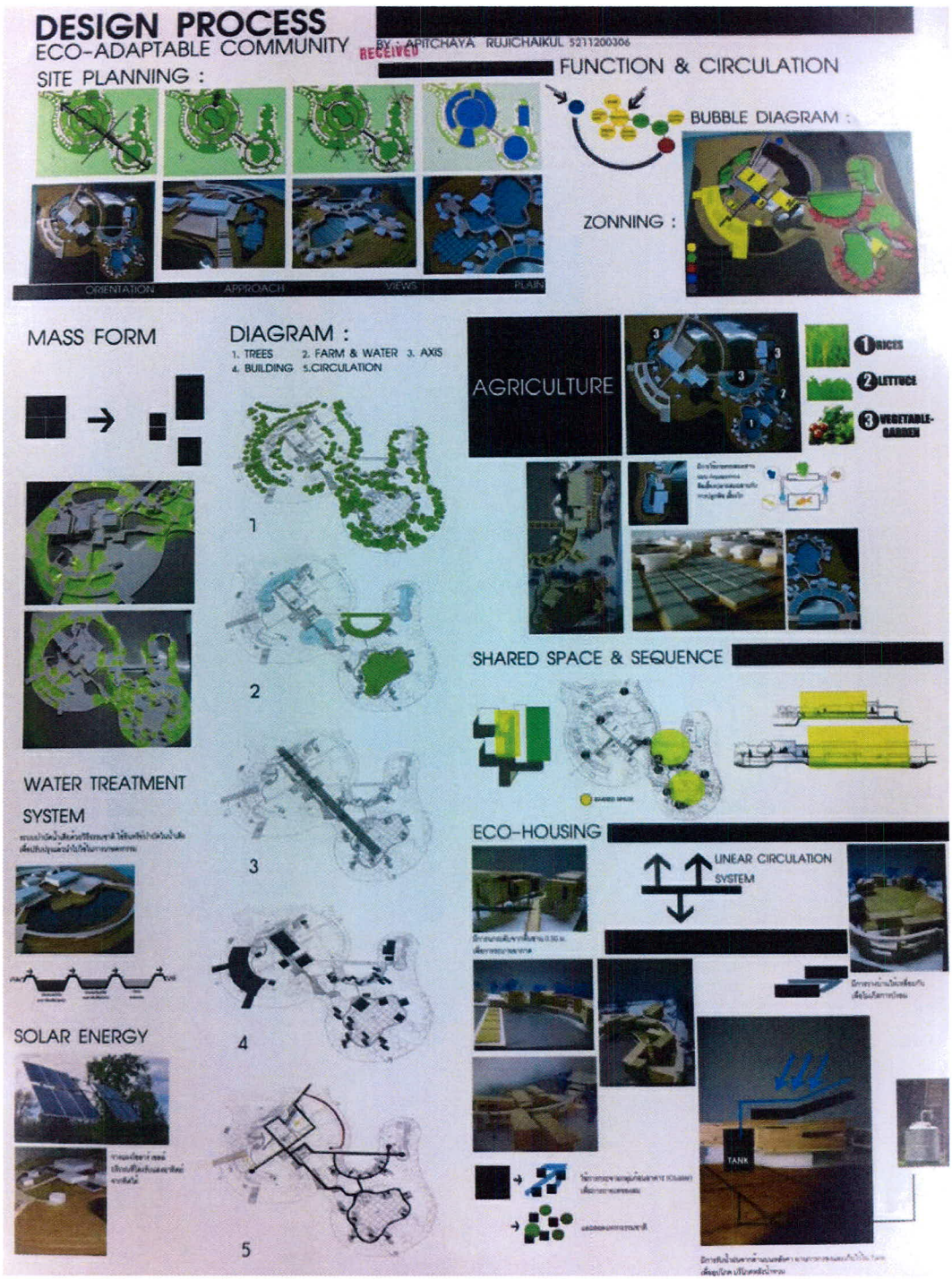
Table 4.1: Comparative research space in the design process of the co-development of problems-solutions.

3rd year students' research	5th year students' research	Professional designers' research	Episodic research space
Understanding program, constraints, cases, and the site in relation to tasks to generate the project concept	Programmatic search: archival gathering, case analysis, constraints, site selection through setting up meta-problems Investigating design strategy: problem-framing and the schematic solution	Critically understanding tasks with design visions or challenges leading research: site insight, constraints, case analysis, and criteria to frame the concept and problems, including a project image	**Understanding criteria and formulating design goals**
Exploring schematic design: systems and activity arrangements related to the concept, discovery of spatial forms with ideas and concerned information	Exploring conjectures with site conditions: spatial and formal configuration responsive to problems and set criteria combined with new data and ideas	Exploring design solutions: spatial organization and management Constructing design proposals: spatial and formal configuration and orders/elements as well as processing relevant sets of data	**Exploring design possibilities: generating proposals**
Experimenting elements and details reflecting specific environmental symbols to concepts and design tasks	Experimenting critical, spatial volumes to present key concepts, agendas, users Discovering architectonic symbols related to the sites	Investigating critical elements suitable to design problems Testing detail configuration, materials, construction methods manifesting challenges through symbols	**Examining reality**

2.1 Associations between Problems, Research Space, and Solutions

While thematic categories of research space are evidently observed, associations between a series of problem-research-solution development grow to be noteworthy. The more continuous the design process reveals, the more successful, acceptable design is demonstrated in a comprehensive level (Figure 4.4). In other words, connections between problems, research space, and solutions evolve one another in creative inquiries. However, a portion of the problem-solution pair and research taking place does not promise an acceptable solution, but progressive chains between problem-solution pairs seem critical to the design process's refinement and conducting research space. In particular, after being pursued through research space, design solutions will have an effect toward refining design problems in coherently solid levels as long as the co-development of problem-solution keeps on in progress. Otherwise, design research and the whole process cannot develop the design proposal in a comprehensively critical form due to inconsistency in inquiries.

Figure 4.4: The third-year architecture student's whole design process of the *Eco-Adaptable Community* Project. It shows continuity of design inquiry from conducting site analysis, formulating design concept and ecological idea, generating zoning and spatial relationships in figural forms, to exploring detail design of the housing.
[Source: the third-year architecture student from the *Eco-Adaptive Community* Project (see Table A-4 in Appendix A).]



Whenever designers receive design briefs/programs, they take a given limited time to make design task as clear as possible. Designers first make an attempt to *understand design criteria* by means of considering involved information and constraints to the project: case studies, site analysis, and examination of other latent contexts as primary modes of research. In more critical projects, designers integrate individual design visions/challenges as an initial conjecture of design with research processing and information interpretation in this stage (Figure 4.5). Subsequently, designers begin to form a project framework and agendas that will guide the search for more focused knowledge and ways to *formulate a design goal and concept.*

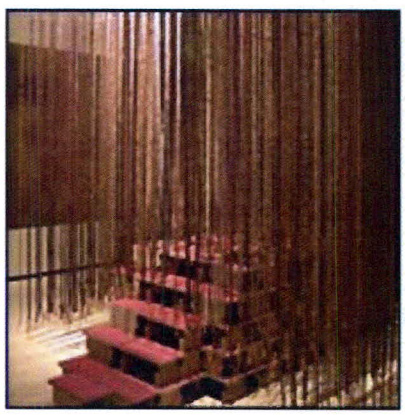
Uncovering the operational process at first sight, a design goal, concept, and meta-problem further (re)frames a design problem that needs to be figured out to get into a design conjecture in the stage of *exploring design possibilities* by means of figural research. At this phase, designers tend to employ several design modes: sketching, drawing, model-making with the intention to generate a design proposal of physical responses to a particular set of design problems, criteria, and concepts (Figure 4.6, 4.7, 4.8). Moreover, designers utilize these design modes that lend themselves to communicating constructed images with designers, themselves.

As a design proposal is more evident in design progress, it has an effect on problem-framing of tectonic configuration in a phrase of *examining reality* to make sure of which design effects will be taking place in the future environment. Designers are inclined to employ modes of detail drawing and model-making, including building mock-ups in the case of architects. The tectonic experiment aims to build the comprehensive design proposal manifesting environmental symbols of the design goals and concepts established.

Merely collecting raw data in research space cannot facilitate programming and designing. This situation was found in several cases of novice designers who tended to struggle with overwhelming data and could not execute research efforts with design. Unstructured, searched data not related to design questions became worthless in design inquiry and development. Novice architecture students in many cases wished to construct programs and design solutions from untreated data. On the other hand, professional architects mostly take a stance on the notion of "design to direct research." This conception is corresponding to the *conjecture/analysis* model in way that a primary, design hypothesis and scheme is revised through supportive research. As a result, designers accomplishing research implementation seem to focus on specific agendas and ideas as *design visions* as the first design principle to primarily tackle with problems and proceed to research.

Figure 4.5: Research through case studies. With a client's brief and a concept of the container and spatial contradiction directing research, a designer used case studies from 1) an installation art of artist Montien Boonma as an inspiration to express sense of the container as much as transparent lightness and 2) the Scarpa's inter-corporation project as a model of revelation of multi-layers of elements. Incorporation of both cases drives the design concept toward design development of tectonic.
[Source: a designer's data from the *Munchu*'s Fashion Shop design process (see Table C-4 in Appendix C).]

1) An installation art of artist Montien Boonma.



2) The Scarpa's inter-corporation project.

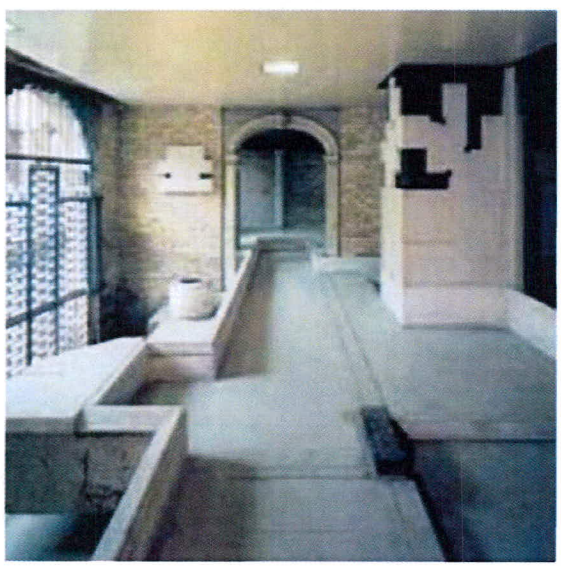


Figure 4.6: Sketching as research and communication modes. The designer used a sketch to initially inquire the relationship between building and spatial configuration and the site including topographic levels responding to the concept of the views outside in and of concealing service.
[Source: the fifth-year architecture student with the *Plastic Surgery Resort* Thesis Project (see Table A-1 in Appendix A).]

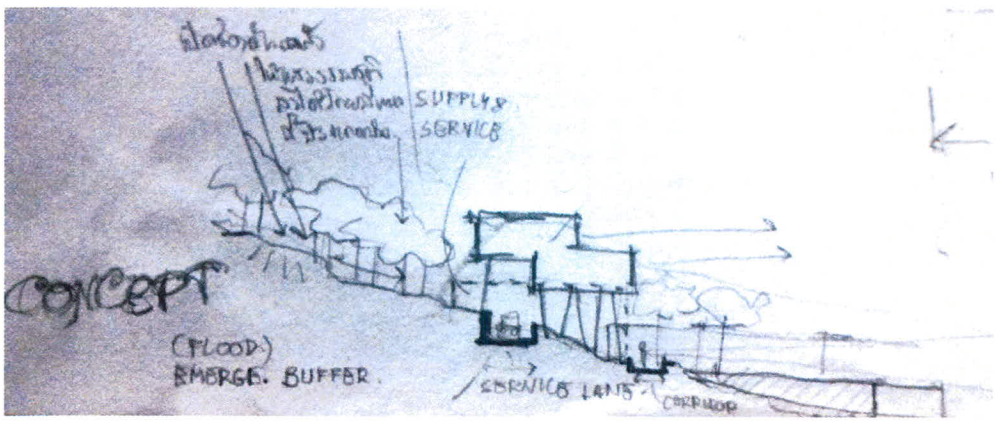
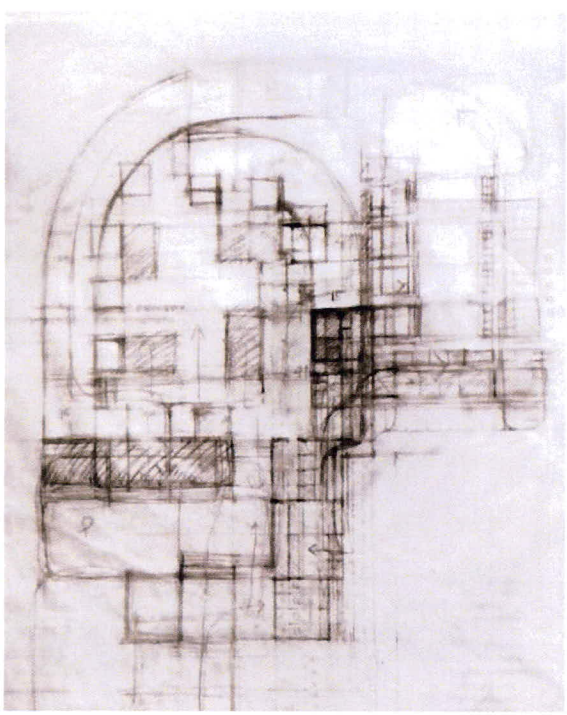


Figure 4.7: Drawing and model-making as research and communication modes. The designer employed planning drawings to investigate spatial organization as well as model-making to physically explore functional relationships in a variety of levels.
[Source: the fifth-year architecture student with the *Association for the Prevention of Cruelty to Dogs and Welfare, Bangkok* Thesis Project (see Table B-2 in Appendix B).]



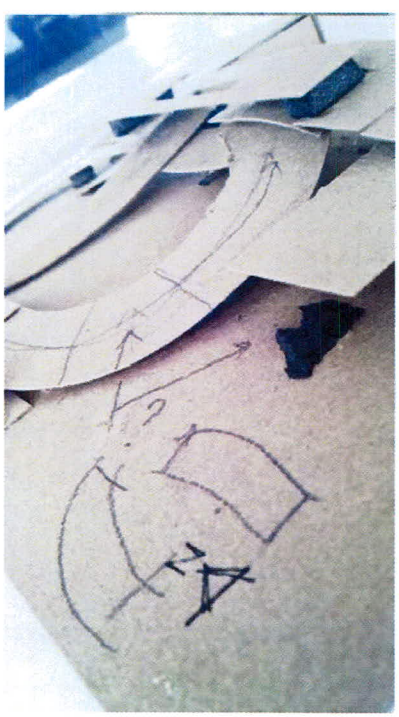
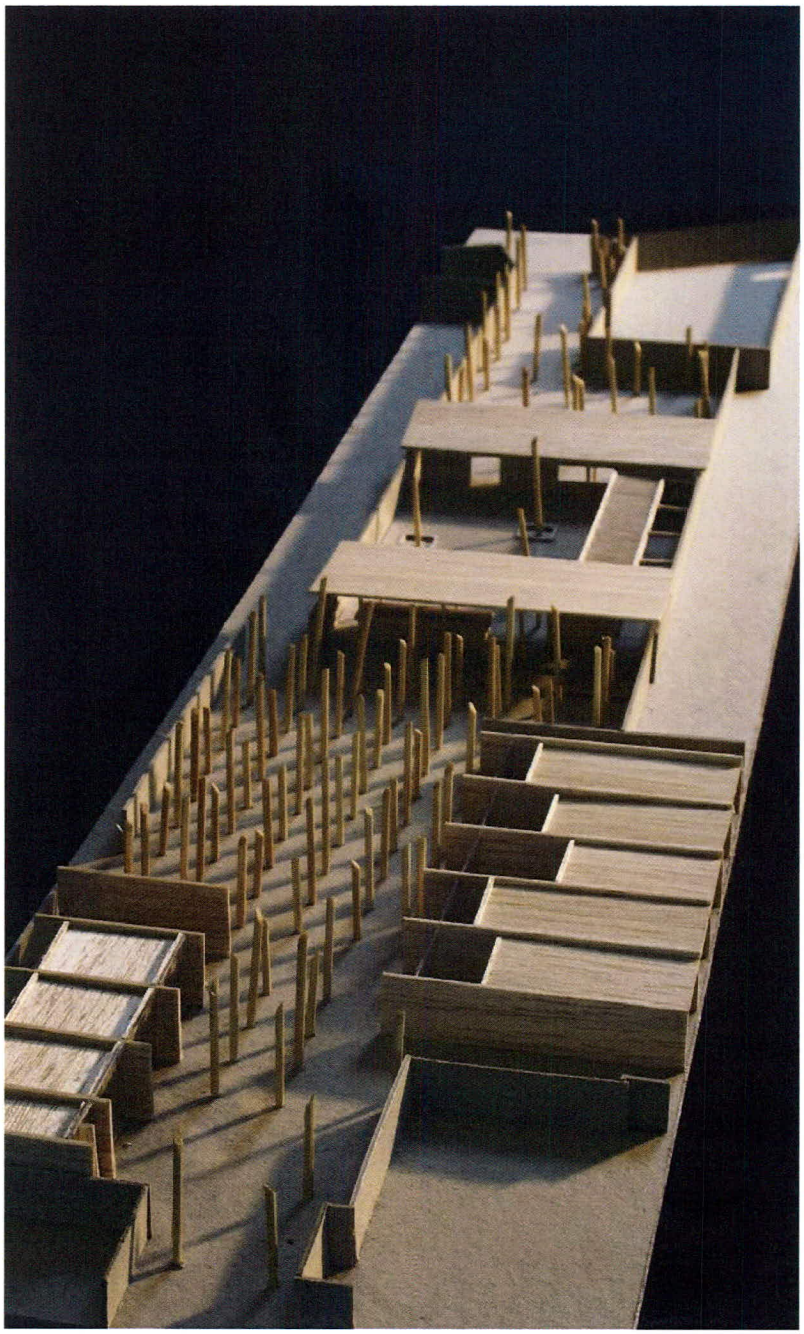


Figure 4.8: Model-making as physical spatial research. The designer built a physical model to inquire spatial sequences and adaptations along the site, making sure of environmental configuration and spatial compositions.
[Source: the architect from *Sala Phuket* (see Table C-2 in Appendix C).]



3. Design Dialogues: Bridging Design Visions toward Research

This section is to examine the second hypothesis that aims to determine design factors playing the vital roles so as to bridge research with design. With the assumption of "design as research," a designer's insights and design methodology come to cooperate with each other to construct the suitable design response to tasks. In this context, designers' specific visions and agendas toward a design goal grow to be vital catalysts that encourage research directions and questions to be figured out. In turn, design queries that has been searched and explored can be implemented in terms of design intelligibility.

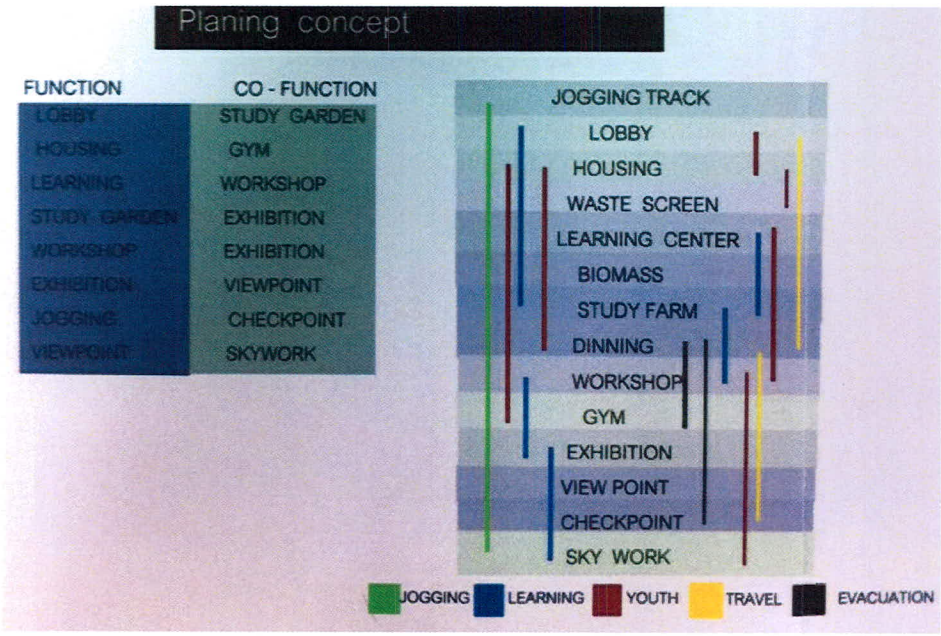
Design dialogues as challenging visions: new functionalities, contextualization, spatiality, or structure and construction manipulate design questions, research directions, and conjecture-making. In other words, design dialogues are significantly relevant to inquiring progressions of design challenges and understandings that can strengthen environmental design and creativity as a new proposal to design tasks. Design dialogues can operate within several levels of challenges, from which four thematic agendas emerge out of the findings: *programming*, *sustainability*, *spatial typology,* and *tectonics*.

3.1 Programming

In general, programming lies in the architectural-problem construct, that is, involving information-processing and data-structuring based on given inputs. Programming also implies data interpretations incorporating design challenges into creating novel relationships of building types, spatial organizations, and environmental functionalities.

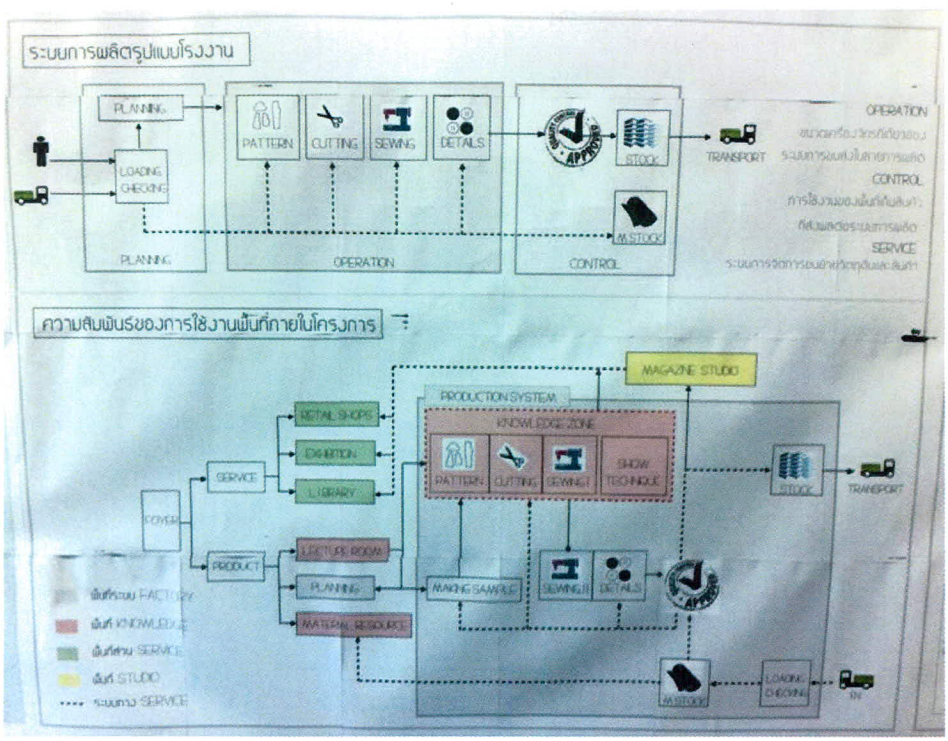
Challenging novel relationships depends upon focused agendas: activity collaborations, specific users, and the site and contextual constraints, all of which need to be processed in interrelated ways. In this way, programming develops into meta-problems—beyond setting up design requirements—to be figured out toward critical strategies for designing. Because architectural-design projects tend to embody specific agendas of the site, contexts, and particular users, their programing and problems are likely to be comparatively different than existing, building typologies. New factors and constraints of the site, contexts, and users encourage designers to think of *re-programming* design conditions of the environment, that is, uniquely to the place. Architectural programming is not the determination of requirements, but the active construct of environmental-problem structuring and creative conditions posing designing.

Figure 4.9: Re-grouping hierarchy of activities. The designer re-categorized new functional relationships according to spatial distributions to different groups of users, as semi-public realms. Spatial distributions lead to functional-pairing associative to weaving loop-planning, thereby reflecting formal configuration of the project.
[Source: the third-year architecture student from the *Eco-Adaptive Community* (see Table A-2 in Appendix A).]



For instance, collaboration between additional activities to serve particular users and contexts and designated functions needs to be resolved in a new way. Research on activity collaboration, as observed, turns out to be the primary aim in programming. Activity collaboration refers to *re-structuring* a variety of functions into novel relationships of how possible architecture will perform in creative modes (Figure 4.9). *Re-structuring* the program is conceivably congruent to design motivations; design thinking and research are initiated on new spatial volumes, indeterminacy of spaces for the prospective future, spatial relationships beyond the existing, and site analysis oriented to agendas. Programming in collaboration with design agendas raises inquiries for spatial re-organization and arrangements with unique project-driven conditions and topography of the site, contributing to designing creatively figural configuration (Figure 4.10).

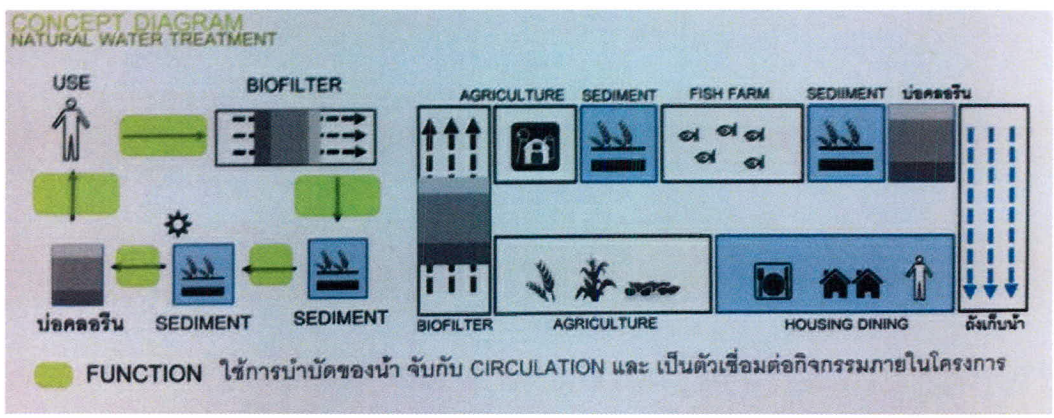
Figure 4.10: Re-structuring the building typology's functional process. Specific users' conditions usually affect an investigation of how well the building will function; especially, the relationships of functional-processing have effects on spatial organization and formal volumes. In this case, the designer re-structured a clothing factory's system toward a new creative fashion center.
[Source: the fifth-year architecture student from the *Prototype of Clothing Fashion Creation Center* Thesis Project (see Table B-4 in Appendix B).]

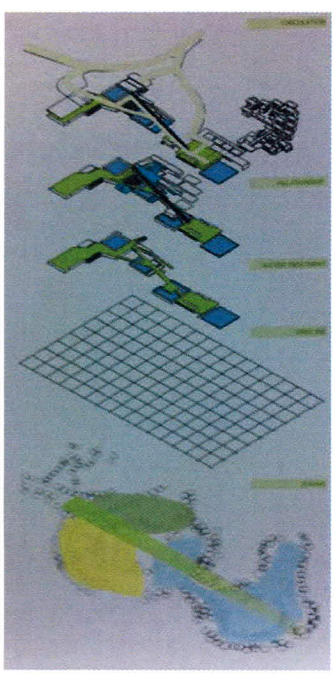


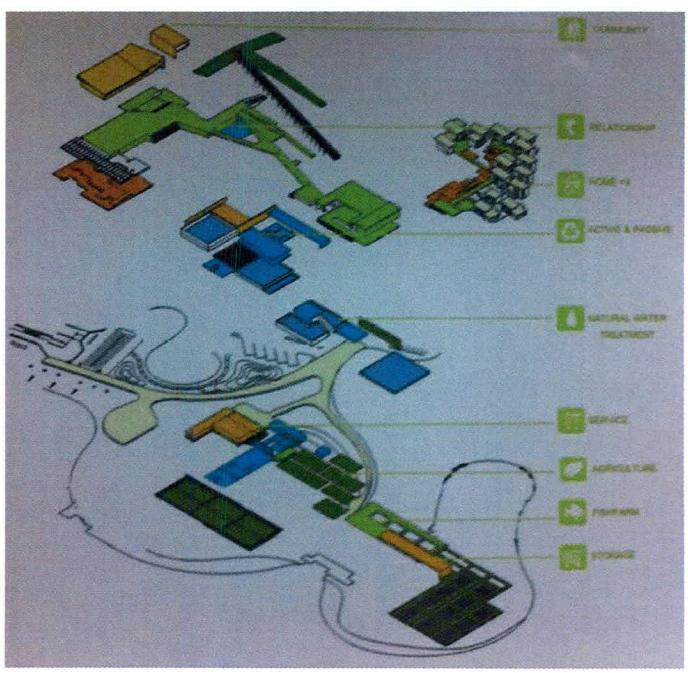
3.2 Sustainability

Design for sustainability, in this context, denotes the environmental creation for reinforcing ecological and anthropological systems, both of which induce formal articulation embedded into the place. Sustainable design is always connected to the site and topographical conditions. Ecological and societal agendas, in this light, are inclined to lead the designer to find out a new, environmental systematic scheme and spatial management integrating with site considerations and ecological systems.

Figure 4.11: The defined, water treatment system indicating an association of functionalities. [Source: the third-year architecture student from the *Eco-Adaptive Community* Project (see Table A-1 in Appendix A).]







There are tendency for designers to define sustainable agendas in particular: water treatment, waste management, recycling systems, and social interactions in order to pilot inquiries and design. The sustainable design vision determines research on investigating ecological diagrams of management in association with natural resource treatment, recycling systems, users' behavior, the site constraints, and design tasks. Determinate ecological diagrams discharge a promise on spatial management of new activity relationships as a diversity of functions are incorporated into the whole defined environmental system (Figure 4.11). In this way, architectural functionalities are intrinsically immersed into ecological systems.

Rather than ecological concerns, socio-cultural approaches significantly encourage design investigations in terms of morphological patterns of planning and undesignated spaces for social interactions. In addition, sustainability concepts challenge exploration of innovative forms articulating into tectonics of architectural forms supportive for recycling natural resource. The tectonic experimentation on sustainability can contribute to generating living, building-skins implementation and socio-cultural, spatial interlocks that strengthen definite design goals on sustainability.

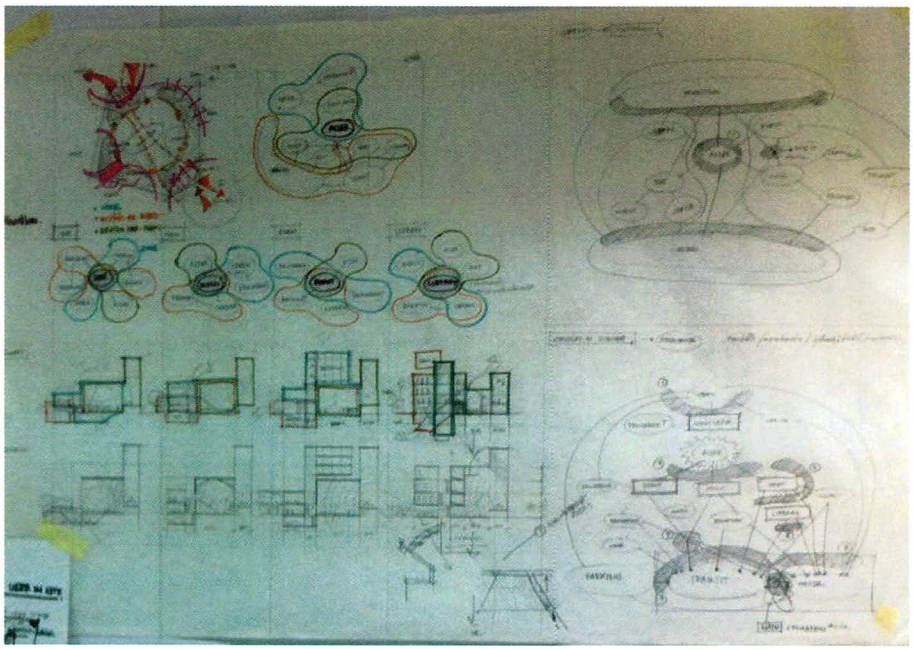
3.3 Spatial Typology

Spatial typology refers to environmental reference to a pre-existing source; it "provides types against which new design concept can be modified or evolved."[5] In this context, spatial typology denotes classification of existing spaces, building types, and urban configurations in terms of functionalities and characteristics. Spatial typology is able to raise design challenges in a significant design strategy to which design inquiry of existing spatial forms can possibly evolve a new environmental design. Design challenges on spatial typology are capable of generating uniquely phenomenal links with history, traditions, and culture.

Inquiries on urban determinant have effects on the development of spatial typology in relation to the context. Research upon the continuity of urban transitions into the project, as observed, can create characteristic modification of building types: spatial relationships, the quality of volumes, and formal patterns in the programming process (Figure 4.12). Integrating spatial typology of urban spaces and transitions into programmatic spaces, after being investigated in scales, sequences, and orders, results in reconstructing relationships between determinate functions and undesignated urban configurations. Existing urban forms and communal orders such as grid blocks and particular users' gathering patterns, moreover, might determine distinctive patterns of spatial rhythms such as the weaving concept of the positive-

negative relationships between buildings and flexible open spaces. Emerging spatial typology from inquiring urban determinant makes creative environmental blends, as possible, in generating an evolved formal configuration into the specific environment.

Figure 4.12: A construct of spatial relationships and volumes. Based upon urban conditions, the designer made an attempt to evolve new spatial volumes and relationships by means of overlaying functional layers in linear sequence to find out possibly simplified connections. [Source: the fifth-year architectural student from the *Unity Church* Thesis Project (see Table B-5 in Appendix B).]



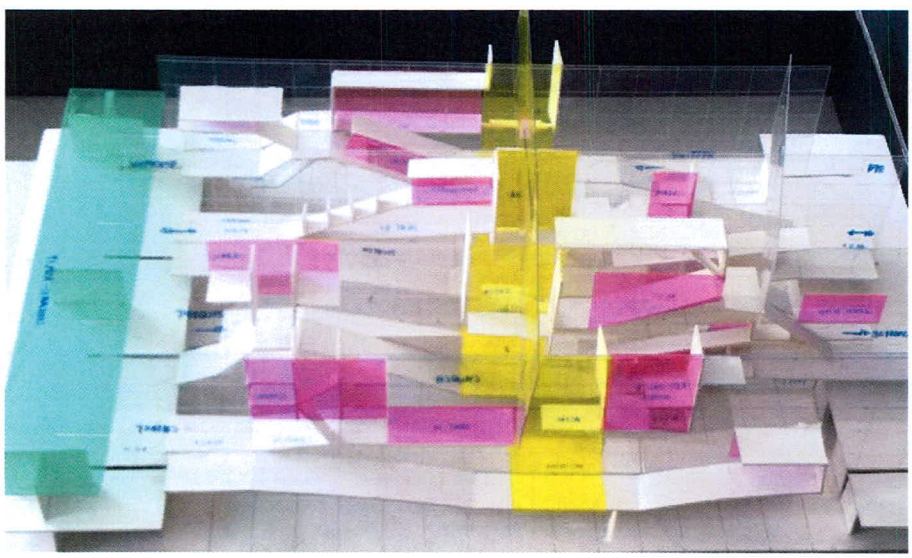
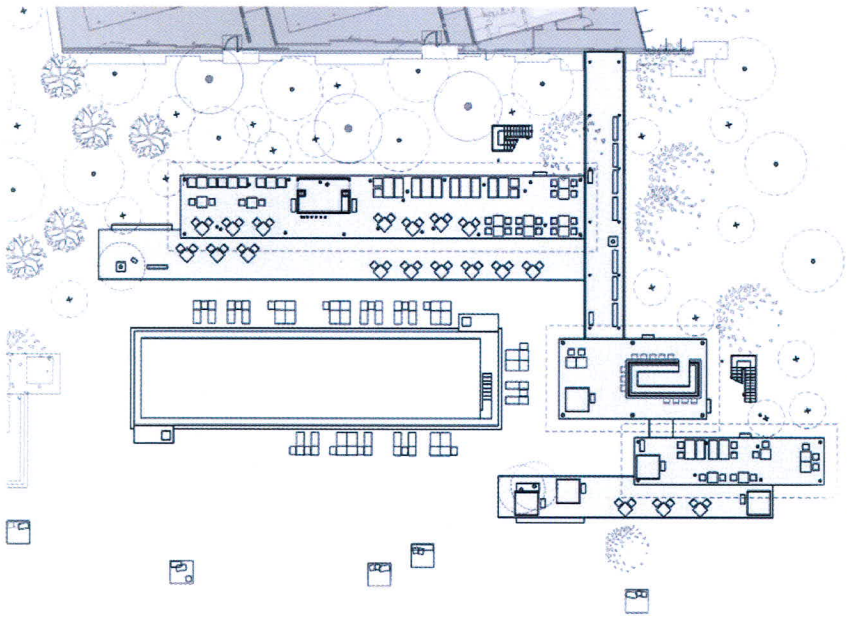
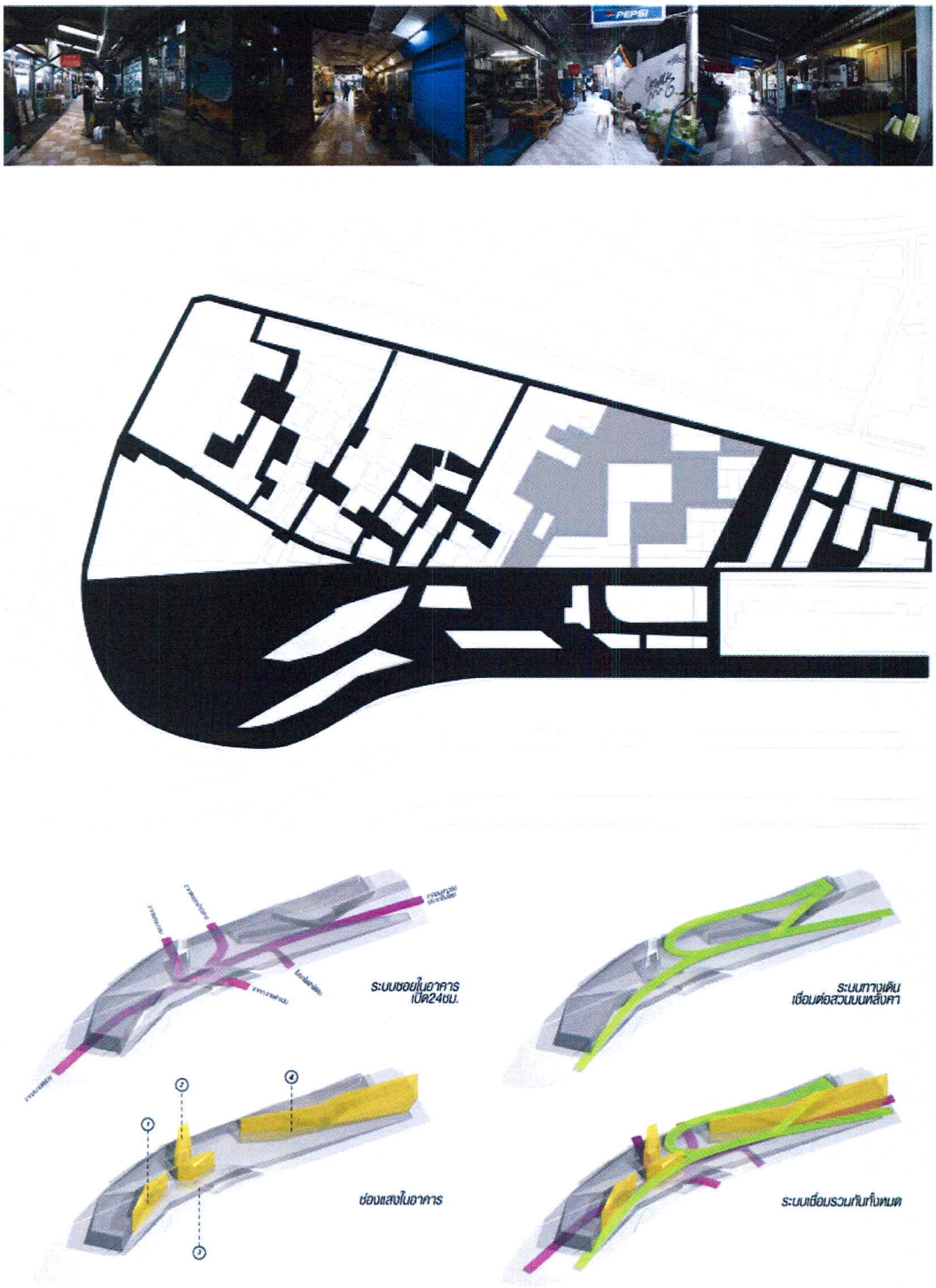


Figure 4.13: Planning of the *Sala Phuket'* s restaurant. Planning was extended in linearity along the beach, available for views out to the sea rather than normal planning design. [Source: the designer of *Sala Phuket* (see Table C-2 in Appendix C).]



In addition to urban determinant, the topographic context is able to encourage exploring functional mechanism and configuration. Spatial orientation related to the context for broadening views toward the outside scenography, for instance, challenges normal spatial typology by means of investigating rearrangement of new spatial patterning providing users to most experience the prospects (Figure 4.13). With complex site levels, scenographic considerations for advancing spatial-oriented forms can lead to research on complex integration between *served* functions for scenery and hidden *servant* systems. Research for functional juxtapositions between *served* spaces and *servant* systems cooperates with re-configuring new functional mechanism related to topographic levels (Figure 4.6). Re-configuring spatial-contextual relations between the *served* and the *servant* leads to characteristic spatial typology and organization reuniting the particular environment into the location.

Figure 4.14: The design process of spatial experimentation. With the programmatic challenge for competition and the site, the designer reinterpreted alley systems defining Thai public space against a gigantic plaza to be implemented into spatial continuity and environmental flow from physical surroundings, thereby creating the novel configuration of continuity. [Source: the designer from the *King Plaza* Competition (see Table C-5 in Appendix C).]



Cultural and historical contexts are moreover devoted to research implementation toward design. Spatial typologies of existing cultural spaces and historical environments lie in the essential core of the design vision through characteristic and elemental reinterpretation. Discovery of the intrinsic nature of cultural-spatial typology proves significant to demonstrate the design goal as a place as presenting itself in the distinguishable sites. The reinterpreted mechanism of spatial typology is implanted into spatial configuration in programming and conjectures (Figure 4.14). In addition, historical precedents representing local roots are attentive to inquiry to de-compose spatial characters toward an advance of contemporary spaces and forms: sequences, scales, and elemental patterns, namely, *referencing reconstructs.*

3.4 Tectonics: Logic of Assembly

The term tectonics is simply defined as "art of construction" as Frampton relates tectonics to architecture in terms of symbolic manifestation of construction in balance with technological demands and natural, social, cultural needs.[6] Tectonics in architecture today refers to all forms of the making of architectural construction.[7] In this context, a design challenge on tectonic forms ascertains *logic of assembly* related to constraints such as timing and programming.

Modular systems as essentials to architectural construction are concerned to tectonic formal inquiries. After consideration of the design brief and constraints, limitation of construction scheduling and a location becomes critical challenges on what the designer considers them to be design problems. In this view, material modules and the construction process is evidently raised toward tectonic inquiry in relation to design thinking and methods. With tectonic inquiry, the relationship of the solid-void system, for instance, is examined in parallel to planning arrangement regarding appropriate, material modules and dimensions (Figure 4.15). A material-coordinate assembly is tested in a tectonic vision.

In addition to constraints, another tectonic challenge on modular systems arises from programmatic concepts. For example, the flexibility of modular spaces in juxtaposition drives tectonic thinking of spatial-shifting and boundaries. Modular spaces are obligatory to programmatically and geometrically investigate minimum volumes of space within which mandatory functions and mechanism are contained. Moreover, functional associations between modular spaces need to be solved in terms of the possibility of adaptable relations. With flexibility situations, tectonics of the movable layers is experimented to discover how optional the sub-divisive assembly of modular spaces offers dynamic adaptability of the whole (Figure 4.16).

Figure 4.15: Solid-void exploring sketches with material modules.
[Source: the designer from the *Munchu's Fashion Shop* (see Table C-4 in Appendix C).]

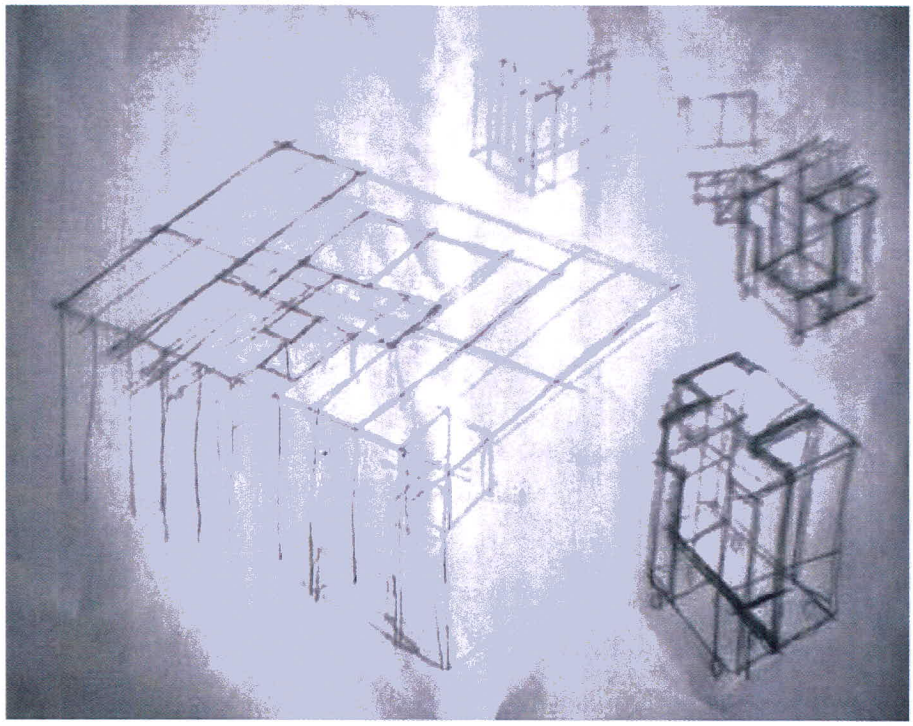
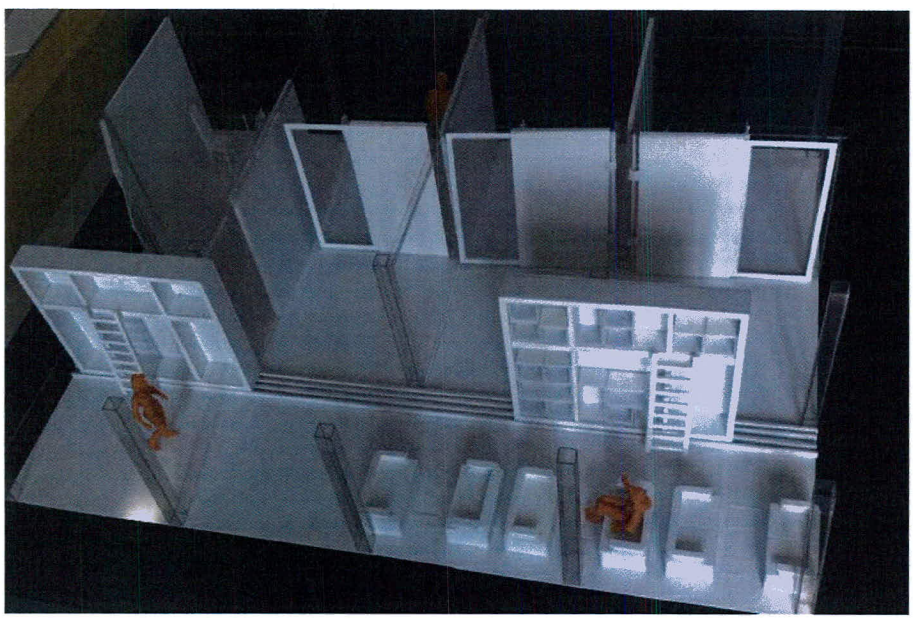


Figure 4.16: Exploration of spatial volumes' flexibilities through movable partitions.
[Source: the fifth-year architecture student from the *Prototype of Clothing Fashion Creation Center* Thesis Project (see Table B-4 in Appendix B).]



Tectonic challenges, on this view, drive design research of the principle of spatial assembly. Design visions on tectonic thinking induce design experiments on spatial constructs appropriate to definitely coordinate systems for a response to key constraints and design agendas.

All four emerging modes of design dialogues: programming, sustainability, spatial typology, and tectonics offer the designer opportunities to steering design research, questions, and problem-framing related to environmental design. In conjunction with clarified design visions, research can be connected to architectural design through a intensive design dialogue and comprehensively critical thinking as the whole in progress. Therefore, design dialogues prove significant as design frameworks make architectural-design inquiry systematically critical.

4. An Overview of Research Collaboration with Design Inquiry

Findings unfold that design research as investigative domains, namely "research space" operative with the design process in the relationships between problem space and solution space. Research space is mandatory to design aims to develop concrete design solutions as critical as creatively responsive to proposed problems. Research space therefore collaborates with design challenges that lead architectural-design inquiry.

Based upon the first-hypothesis examination, design research can collaborate with the architectural-design process in relation to a progressive model between problems and solutions, so called the *co-development of problems-solutions*. Within this model, "research space" performs as design inquiries via various design tools among problem space and solution space, in order to figure out design solutions, which in turn refine design problems. Research space cooperating with the design process functions as these key roles of 1) understanding criteria and formulating design goals, 2) exploring design possibilities: generating proposals, and 3) examining reality.

Research is associated with design through "design dialogues," based on the second-hypothesis examination. Design dialogues are viewed as creative visions or challenges in which the designer utilizes them to channel design investigations and to embody environmental configurations. On impartial views, four approaches of design visions: programming, sustainability, spatial typology, and tectonics can enthusiastically encourage designers to investigate creative forms of architectural design that depend upon problem-solving by means of design research.

5. Notes

1. Mary Maher, Josiah Poon, and Sylvie Boulanger, "Formulizing Design Exploration as Co-Evolution: A Combined Gene Approach," in *Advances in Formal Design Methods for CAD*, eds. Gero, J. and Sudweeks, F. (London: Chapmen and Hall), 1996.
2. Kees Dorst and Nigel Cross, "Creativity in the Design Process: Co-Evolution of Problem-Solution," in *Design Studies*, Vol. 22, No. 5, 2001, pp. 425-37.
3. See Greg Bamford, "From Analysis/Synthesis to Conjecture/Analysis: A Review of Karl Popper's Influence on Design Methodology in Architecture," in *Design Studies*, Vol. 23, 2002, pp. 245-61.
4. Nigel Cross, *Design Thinking*, (UK: BERG), 2011, pp. 75-79.
5. Tom Porter, *Archispeak: An Illustrated Guide to Architectural Terms*, (UK: Spon Press), 2004, pp. 200-01.
6. See Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, (Cambridge: The MIT Press), 2001.
7. See Tom Porter in *Tectonics*, pp. 187-88.