The Role of Handcrafted Building Detailing and Ornamentation in the Design Build Process

KYRIAKOS PONTIKIS
Intercollege

INTRODUCTION

In traditional building production master-builders and their craftsmen were actively involved in the making of their buildings, elevating construction into an art form and creating structures of timeless quality. Today, building technology has changed design and production. Advanced design software allows architects to design and detail interior and exterior spaces while away from the construction site. This distances them from building production that is left exclusively to the builders. Thus, the architects input and participation during construction is mostly a "passive" one, making sure that contractors follow drawings and specifications. Moreover, contemporary buildings are produced in a mechanistic fashion where technology is the goal and not the means to harmonious architecture.

For example, prefabrication, standardization and uniformity of components and materials can help in terms of efficiency, speed and cost but often produce spaces, details and ornament that are devoid of fine adaptation and sensitivity towards the whole. In order to eliminate most of these problems and create a more humane environment the author proposes an integrated design build process. In this process the architect will be actively involved in the making of the building and will employ handcrafted construction techniques to create special building details and ornaments that will add to the character and identity of the building.

The author would like to clarify three things. First, when he refers to handcrafted details and ornaments he does not mean that the entire building will be handcrafted. What he means is that a small number of building elements will be handcrafted and these operations will take only a small part of the construction budget, approximately 7%. Second, the author does not claim that the handcrafted approach to building is universally better for all kinds of buildings, a statement that would exclude other potentially exciting developments taking place in architectural technology like, for example, "smart skins" for buildings. Third, he would like to note that handcrafted techniques are not limited to ones made exclusively by hand and are labor intensive. For example, traditional marble floors with hundreds of pieces were very labor intensive. Today they can be made with the help of computerized equipment that can cut thousands of marble pieces within hours. Thus, labor-intensive operations can become more affordable today.

Furthermore, the author would like to add that when he refers to humane quality he means the quality that exists in buildings, gardens, neighborhoods, and other manmade things that make people feel more comfortable and creates in them a feeling of ownership and a sense of belonging.

THEORETICAL FRAMEWORK

Design build methodologies are supported by various architectural curriculums in the United States. For example, Steve Badanes' (1997) design build approach to buildings focuses on energy efficiency and on how environmental issues affect the building form. He is in the mainstream tradition of vernacular, sustainable building and some of his work is also abstract. The rural design build studio established by the late Samuel Mockbee (1997) designs and builds low cost houses in Alabama for the poor. The main aim of this work is to investigate and implement low-cost housing techniques. John Connel (1997), founder of Yestemorrow Design Build School in Vermont is also designing and building small-scale projects, focusing primarily in the self-help aspect of the design and build process.

Christopher Alexander's (1996) theoretical framework and building methods also advocate an integrated design and construction process. Alexander supports that "wholeness" and "order" exist in the built environment as a geometric quality and that this quality is dependent upon the building process that generates it. The more integrated the design and construction processes are, and the more involved the architect is in the making process, the higher the humane quality will be. The building process he proposes, in order to get the optimum results, is one where the designer is also the builder or the construction manager and carries construction responsibility. Furthermore, he supports a construction technology that is flexible, efficient and "user friendly" and uses the most modern methods of fabrication. The active involvement of the architect in the building process, however, can potentially create difficulties and create problems of time and cost, issues for which Alexander's' methods have been criticized by other authors.

This paper presents three case studies of buildings designed by the author[1], which were produced using Alexander's theoretical framework. The first building is the Korinthos apartment building in Cyprus. The other two buildings are the Greek Orthodox Church in Santa Rosa, California, and the Saint Andrews church in Olathe, Kansas. The aim of this work was to create buildings of humane quality, see the extent to which handcrafted detailing and ornamentation contributed towards this quality and also deal with problems of time and cost.

METHODOLOGY

The design build method employed was the same in all three buildings. The architect was the designer and also the construction manager of the building. Chronologically Korinthos apartment building and Santa Rosa church were designed and built at the same time while Saint Andrew's church was built right after the completion of the other two projects.

The methodology and testing of hypothesis presented below was employed only on the Korinthos apartment building, which was used by the author as a case study for his doctoral dissertation.[2] The other two churches were professional projects and are presented here as case studies to further support and enhance the research.

The first hypothesis was that the active participation of the architect in the building process and the continuous improvement and refinement of spaces and handcrafted details and ornaments could contribute towards the increased humane quality of the building. The method employed to test the first hypothesis was a research survey[3] conducted with the apartment owners.

The second hypothesis was that this integrated design and construction process and the handcrafted details produced could be implemented without increasing the allocated construction cost and time of the building. The method used for testing this hypothesis was a comparative method of analysis. The Korinthos apartment building cost and time were compared with those of six other apartment buildings governed with same or very similar parameters.[1]

The three case studies are presented below. Each one starts with some information about the project and continuous with the presentation of the handcrafted construction techniques employed for the making of some special building entities.

CASE STUDY # 1
KORINTHOS APARTMENT BUILDING

The Korinthos apartment building[5] in Nicosia, Cyprus is a small, six unit – three bedroom building with a subterranean

Fig. 1. The Korinthos apartment building.

parking (Fig. 1). The building was designed by the author and built with a small group of subcontractors under his management, while getting the users actively involved in the building process. The building has cast-in-place reinforced concrete superstructure with in-fill terracotta block walls, finished with plaster and stucco. In order to create a memorable character to the building I designed a small number of unique handcrafted details. Some of these details were integral to the structure and were made out of concrete, and some others were ornaments made out of concrete or other materials. During construction I was daily at the site making adjustments and small changes to improve the quality of the building spaces and entities. While doing this I made sure I did not increase the construction costs

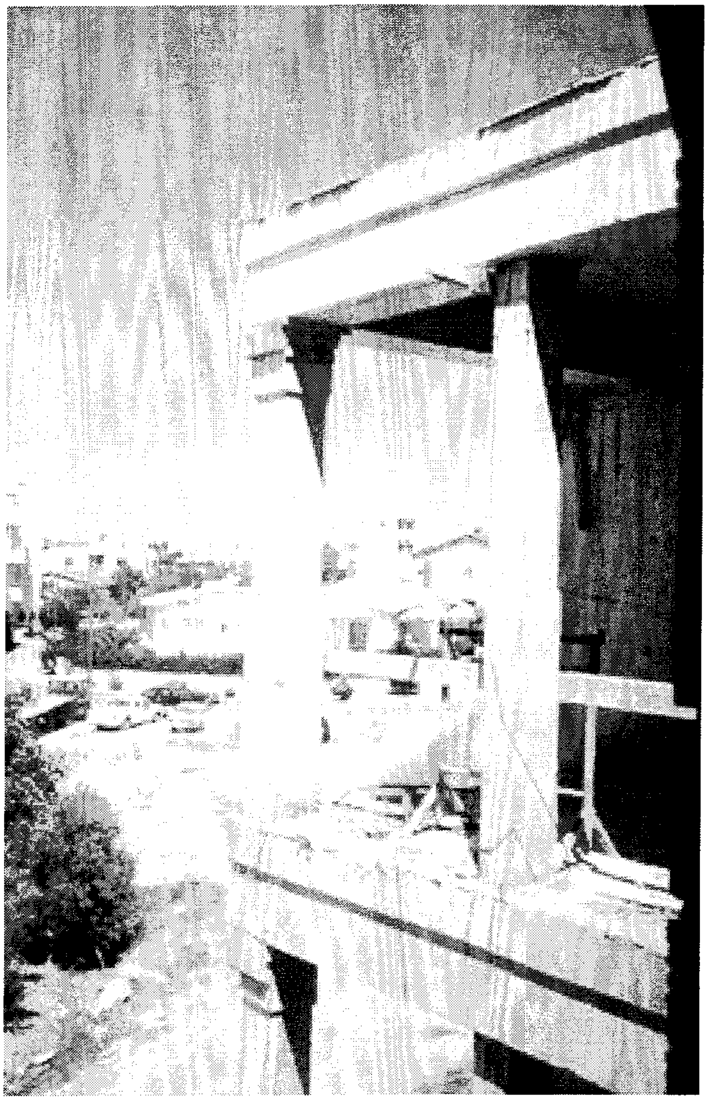

Fig. 2. Corner concrete column.

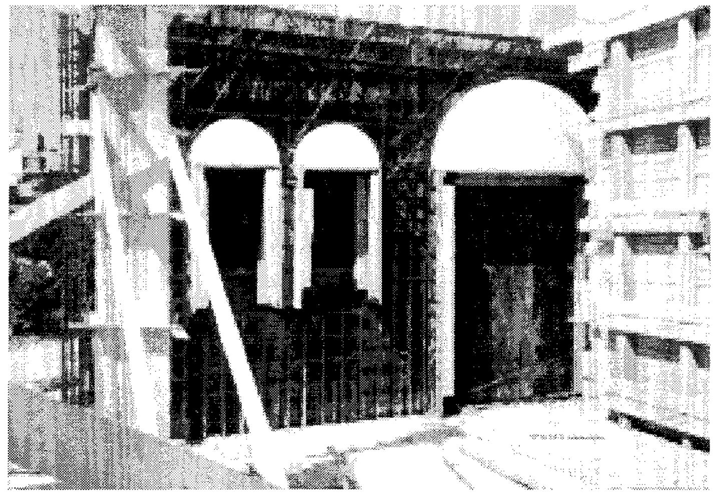

Fig. 3. The entrance arcade.

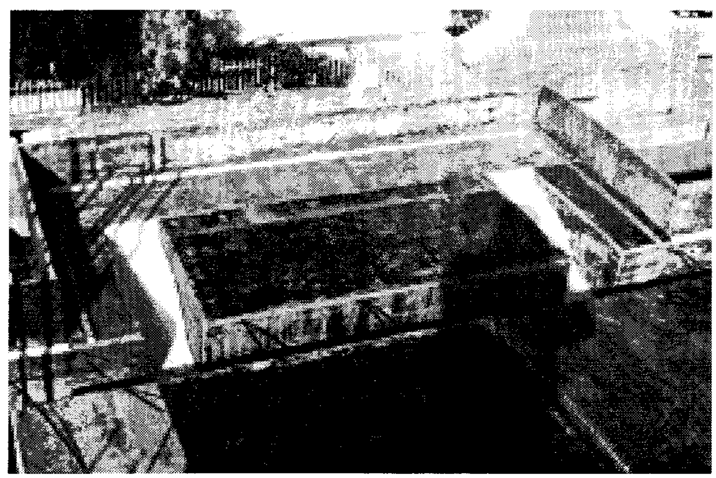

Fig. 4. Balcony formwork and polystyrene inserts for brackets.

or delayed the construction schedule. Some of these special details were the following:

1. Ornamented columns and beams

The superstructure of the building was "expressed" by moving the in-fill walls 10 centimeters further back from the concrete edge. This detail was integral to the structure. I also created some details in beams and corner columns (Fig. 2) by using plywood inserts or wood cutouts. Other concrete elements like arches and brackets were achieved by inserting pieces of polystyrene into the formwork (Fig. 3, 4).

2. Exterior concrete tiles

Early in the design process of the building I had a vision of concrete tiles (Fig. 5) covering the exterior walls at the upper level of the building. The terracotta color tiles had a daisy, a traditional Cypriot motif, and the gray ones had no ornament. I built the tiles full scale in wood and plasticine and then constructed the rubberized forms where the tiles were going to be poured. Then I found the right concrete mixture and proceeded to make the tiles (Fig. 6) and installed them on the building with the assistance of a subcontractor.

The construction and installation of the tiles took about one percent of the building's budget, which was a very small investment in terms of giving an identity, character and uniqueness to the building.

3. Concrete handrails and flower-boxes

Concrete handrails were constructed at verandah locations. First, a mock up was built to determine the proper details and dimensions. Then the formwork was constructed, polystyrene inserts and steel reinforcement were put in place and the concrete was poured. The same technique was used for the concrete flower boxes (Fig. 7).

Fig. 5. Tiles at entrance arcade.

Fig. 6. The author making tiles.

4. Handmade glazed tiles

For the number outside each apartment's door (Fig. 8) we provided a glazed tile, which was made by a local artist.[7] The tiles were made at a cost of £5 each while metal ones commercially available cost £10 each.

5. Color of the building

The original color vision of the building was gray, light terracotta, and light yellow. I began experimenting with these colors at the east side of the building (Fig. 9) and left them on

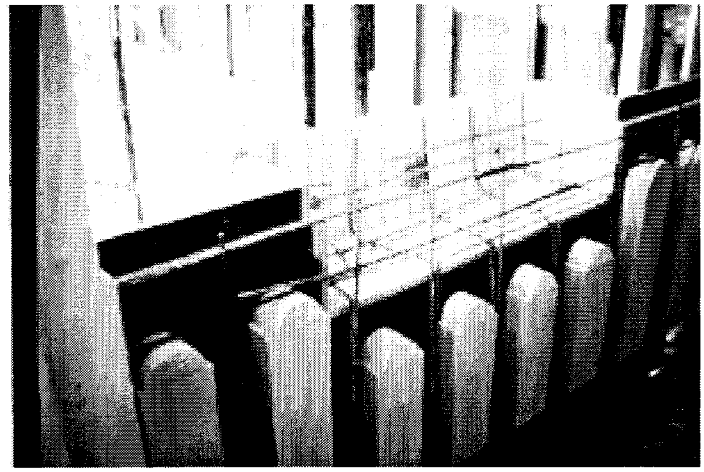

Fig. 7. Handrail and flower-box formwork with polystyrene inserts.

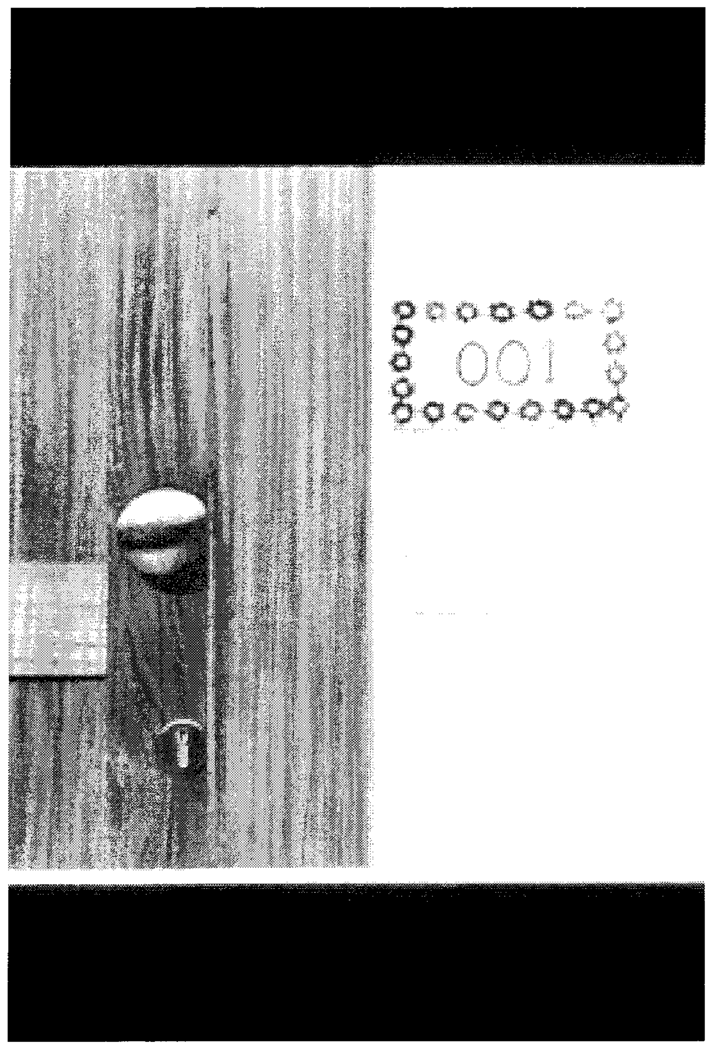

Fig. 8. Ceramic handmade tile with number.

for a few days. I realized, however, that these colors were not doing very much for the building. The only color I felt comfortable with was the light yellow. I decided that the exposed superstructure should be white to "bring out" the details. I painted it so and did some more testing with the yellow color by introducing a touch of red. After many experiments I decided on a specific "yellow-peach" color and I instructed the painting subcontractor to again paint part of the building at the east side. It was apparent that the combination of the above colors was working very well and we proceeded to apply them on the building.

Fig. 9. Color testing on the east side of the building.

CASE STUDY # 2
THE GREEK ORTHODOX CHURCH IN SANTA ROSA

The Christian Orthodox Church in Santa Rosa had a traditional design of a cruciform building plan, with a dome as requested by the client.[8] The budget of the building was low and we needed to come up with simple and economical solutions that would help to create a building of high integrity and beauty. Similar handcrafted processes used on the Korinthos apartment building were also used for this church. We also performed the construction management of the building and therefore had the flexibility to improve the spaces and details of the building during construction. The building system used was cast in place reinforced concrete superstructure with cmu walls and heavy timber roof structure. Some of the special and unique entities constructed in this building were:

1. Dome panels

The dome was supported on a drum, which consisted of concrete columns and concrete panels with window openings (Fig. 10). The concrete columns were cast in place and the panels were precast on the ground and then elevated by a crane and placed in between the columns. The panels were to have an arched configuration and also an exterior colored diamond surface.

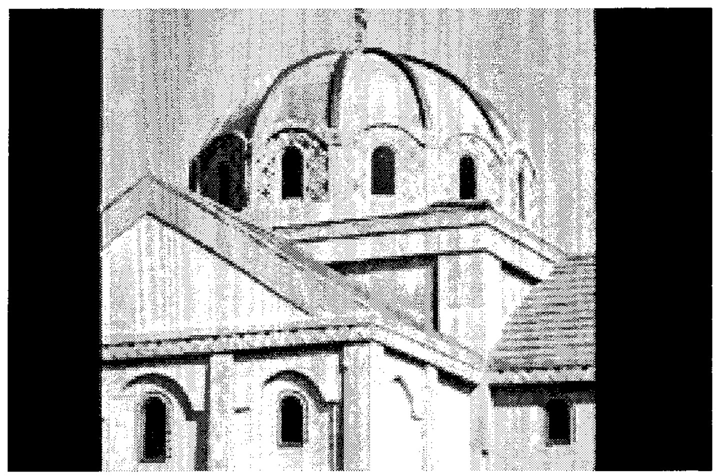

Fig. 10. Dome with concrete drum.

Therefore, special formwork needed to be constructed for these panels and polystyrene cutouts to be attached on the formwork. Once the concrete was poured and dried, the polystyrene was removed and ceramic tiles were cut and put in place (Fig. 11).

2. Plinth wall with cmu and brown sandstone

The building had a strong base, which was constructed out of cmu. In order to make the wall more interesting and introduce more variety and color we decided to use brown sandstone (Fig. 12). We started by having sandstone as the first course base and then continued with alternating courses of stone and cmu. The base wall was approximately six feet tall and was terminated with a cast in place concrete cap.

3. Concrete columns, beams, and arches

The building's superstructure was reinforced concrete. Columns, beams, and interior arches were cast in place concrete. Extreme care was taken for the construction of formwork for these elements. Steppings and reveals of concrete (Fig. 13) were constructed with the use of wood, plywood and polystyrene

Fig. 11. Concrete panels.

Fig. 12. The plinth wall.

inserts. The chamfered edges of columns were constructed with the use of plastic pipes and wood trims.

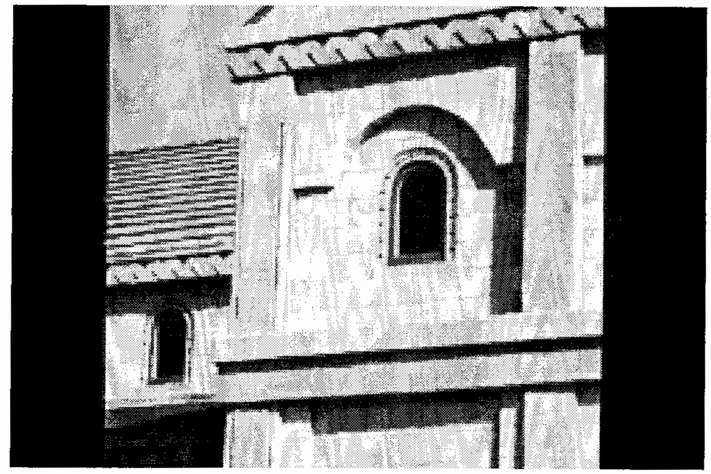

Fig. 13. Exterior view of transept.

4. Concrete window frames

The window frames at the clerestory level were made out of concrete (Fig. 14). They were precast on the ground and then lifted into place. Their formwork (Fig. 15) was also specially made with wood.

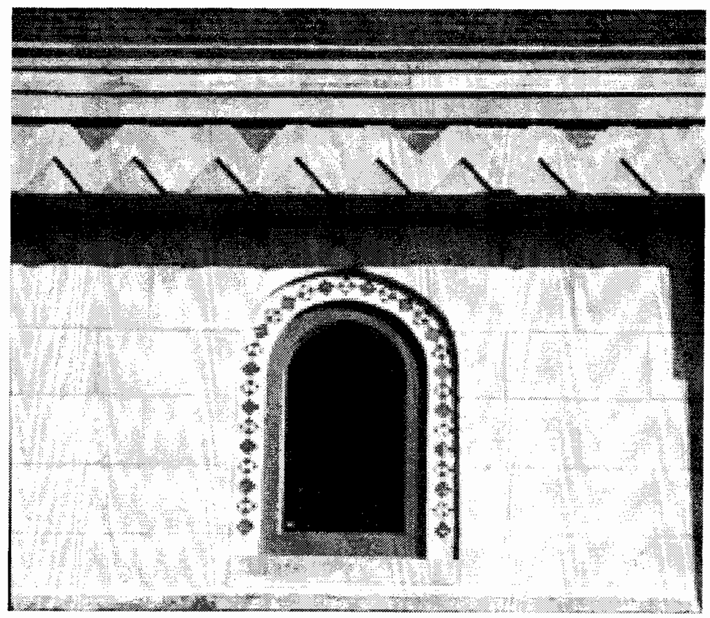

Fig. 14. Concrete beams and window frames.

The small-scale perimeter diamond details were constructed from wood inserts, which were placed in the form prior to concrete casting. These details were hand painted with brown and red color.

CASE STUDY # 3
SAINT ANDREW'S CHURCH IN KANSAS

In the construction of the Saint Andrew's church in Kansas we used two innovative construction methods, which were very

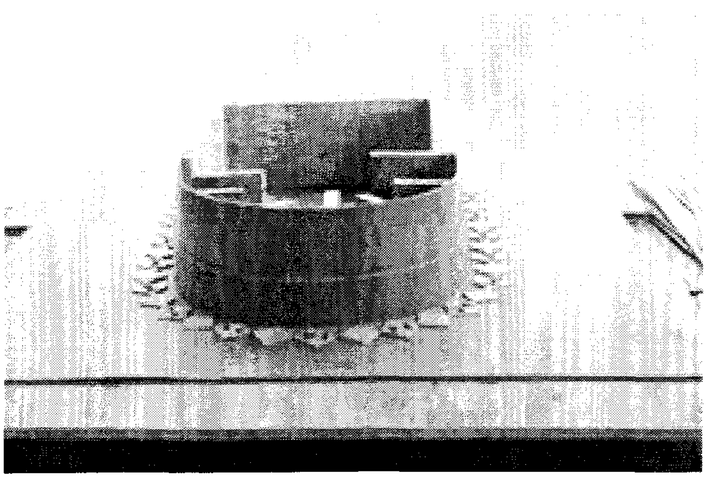

Fig. 15. Formwork of window frame.

challenging. One was the construction of pre-cast reinforced concrete trusses that were used in the sanctuary and the other one was the straw bale construction that was used for the walls of the hearth room. Within these elements there were hand-crafted details that helped to reduce their scale and make more interesting structures.

1. Concrete trusses

Early in the design process we decided that the sanctuary was the most important space of the building and we wanted to create a structure with strong presence (Fig. 16).

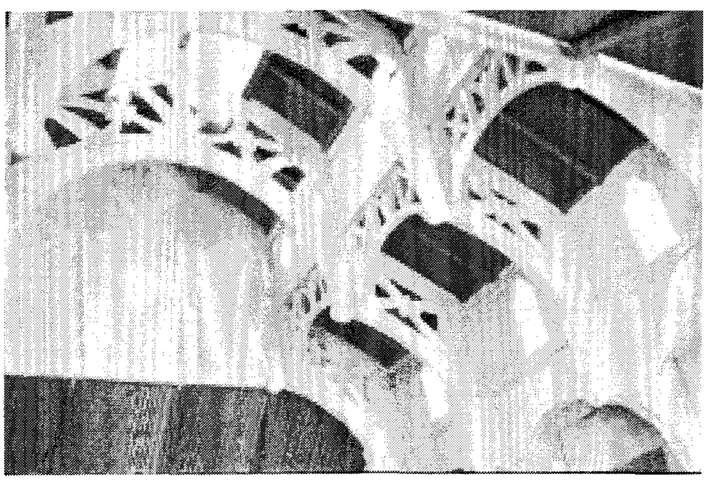

Fig. 16. Wood model of trusses in the sanctuary.

The client needed a sanctuary approximately 60 feet wide and 65 feet long with no columns. Therefore, we came up with the design of concrete trusses, which needed to be about 60 feet tall to be in good proportion with the open space. The inside web concrete members of the truss were to represent abstract angel figures. The design, engineering and construction of these trusses proved to be an extremely challenging endeavor.[9] The formwork was built on the ground, the steel reinforcement was installed and the concrete was sprayed. Special steel attachments were devised so that when the cranes lifted the trusses (Fig. 17) in place they would not break due to out of plane forces. Once the trusses were in place, scaffolding was erected and the transverse smaller trusses used for lateral bracing were constructed. Then, the wooden roof structure and walls were installed and the remaining building operations took place.

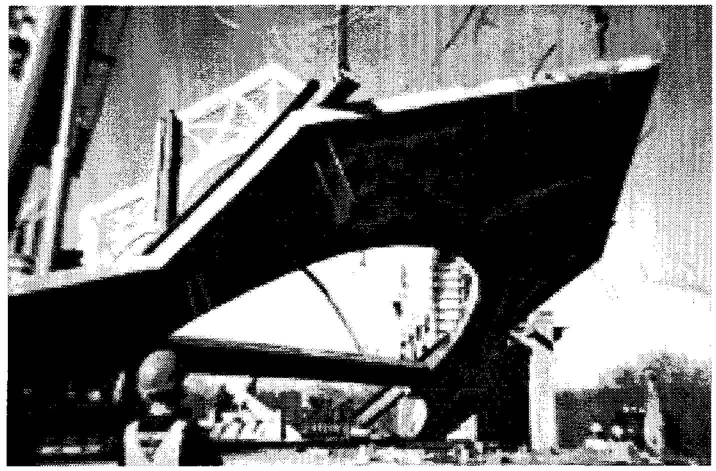

Fig. 17. Lifting of precast reinforced concrete truss.

2. Straw bale walls

The hearth room of the building was actually the entrance room to the sanctuary and it needed to have a warm and

Fig. 18. Spraying the gunite on the straw bale walls.

welcoming feeling. The project had a low budget and we decided to experiment with straw bale construction – an economical building system. This provided thick walls for shelves and window seats. The solidity of these walls also provided the feeling we wanted for the room. The bales were 24 inches wide, were stacked on a concrete slab and received steel reinforcement at both sides. The steel reinforcement was anchored in the concrete slab. The bales then received a three-inch gunite concrete layer at both sides (Fig. 18), which was trowel to a smooth finish. At the top of the walls we constructed a perimeter reinforced concrete bond beam, which tied together the two external layers of gunite. The bond beam received the loads of the wood structure above, which housed the office of the priestess.

RESEARCH SURVEY OF THE KORINTHOS APARTMENT BUILDING

A research survey[10] was performed to determine whether the participation of the architect in the building process and the continuous improvement and refinement of building spaces, details and ornaments contributed towards the humane quality of the building. The owners[11] were asked questions on aspects of design, construction, building quality and identity, and the extent of community and privacy of their apartments. To the question, "Why did you decide to buy this apartment?" the majority said they liked the building and mentioned the architectural design, layout, uniqueness and identity of the building as the major determinant factors. To the question, "Which are the elements that create an identity to the building" all the interviewees indicated that the handmade details helped to create a feeling of identity and belonging to the building.

BUILDING CONSTRUCTION TIME AND COST

Six other contemporary apartment buildings in Nicosia, with "similar variables"[12] to the Korinthos apartment building were selected to perform a cost and time comparison.[13] Four apartment buildings had a cost higher than the Korinthos apartment building and two had a lower cost. The average cost of the six apartment buildings was three percent higher than the cost of the Korinthos apartment building.[14] Therefore, the integrated design and construction process was implemented within the cost of contemporary apartment buildings. In terms of time, the Korinthos apartment building took 20 months to be constructed while the average construction time of the other six buildings was 16 months. The delay was due to the subcontractors who often showed up on the site very late. This problem can be resolved if the developing company is building more projects simultaneously and most subcontractors will be working almost exclusively for the developer. If we subtract four months of delays caused by the subcontractors then the construction time of the Korinthos apartment building is the same as the other buildings. This could lead one to interpret that the new process can be implemented within contemporary time constraints.

Both owners of the churches built in the U.S. increased the scope of their projects and thus increased the budget and construction duration. The clients approved the increased budgets and both projects finished as budgeted. The construction duration of the Christian Orthodox church was originally 14 months and was increased to 16 months. This delay was primarily because the client has changed the roof finish of the dome to copper. The construction duration of the Saint Andrews church was originally 15 months and was increased to 21 months. This extension of construction duration was primarily because two subcontractors, the concrete and electrical, had defaulted. Also, some exterior works needed to be redesigned so that to reduce the cost and finish the building on budget.

FINANCIAL VIABILITY OF CONSTRUCTION MANAGEMENT

In Cyprus the majority of developers do not allocate much money for the construction management of their projects. Therefore, the construction management performed on this type of buildings is very limited and has a negative effect on the built quality. On the Korinthos apartment building the construction management fee offered by the developing company, since it was provided on an experimental basis, was very low – approximately 5% of the construction budget. In order to increase this fee and make the service viable I proposed a financial plan to the developer, which leads me to believe that when employed, will resolve this financial problem. The construction management fee offered by construction companies in Cyprus is approximately 13-15% of the construction cost.

The construction management fee for the Greek Orthodox Church was 20% and for the Saint Andrews Church was 22%. Therefore, the service for these two projects was viable since the construction management service rendered in the United States is compensated in the range of 18-22% of the construction cost.

FINDINGS ON THE HANDCRAFTED DETAILS

In working on these three projects and implementing the design build process I have concluded the following points pertaining to the making of handcrafted entities:

1. Pursue planning permit with sensitivity.

Certain new or innovative construction methods, elements, or details can make planning and also building officials very nervous. Therefore, one needs to be very sensitive in how he presents his designs and the amount of detailing he shows. For example, the planning department felt very nervous about the handmade tiles of the building and asked us to remove them from the design. We insisted in building them and once building construction was completed planning officials congratulated us on these tiles.

2. Employ economical building techniques.

The special building entities we want to create need to be economical so they can be built within the budget of the project and are not considered expensive extras. Therefore, we need to be very inventive, use cheap materials, reduce labor cost, and use efficient technology to make these details and ornaments. For example, in all three projects we use extensively cast-in-place concrete, a very cheap material, along with wood and polystyrene inserts to create various details and ornaments.

3. Minimize mock-ups and experimentation.

The participation of the architect in construction and the various mock-ups and experiments can cause delays to the subcontractors and the work schedule. Therefore, the architect has to make decisions in a timely manner, and keep an eye on the critical path. Also the experimental aspect of construction can make clients very nervous. Therefore, one needs to be close to their clients, educate them about the process and find ways of convincing them about the work. For example, the developer of the Korinthos apartment building was very nervous about the concrete handmade tiles and handrails and wanted to eliminate them. Therefore, we had to build part of these elements first to prove that they would before we were given the permission to complete their construction.

4. Allocate 15% of the budget for contingencies.

In the apartment building we had used 8% of the construction cost for contingencies and on the churches we used 10%. We still had a difficult time managing cost so it is advisable to allocate 15% of the budget for contingencies. For example, at the end of the Saint Andrew's church construction we run out of money and the exterior works, some of which contained some special detailing, were extremely simplified. If we had a higher contingency then we could have done a lot more with that money.

5. Simplify design and detailing.

Oftentimes interesting and elaborate details can be very difficult and costly. One has to be able to simplify their design and come up with more economical solutions. This should be achieved in a timely manner, preferably prior to construction, and the *alternate solution should still serve the original design intent.* For example, at the apartment building the original design of concrete columns and handrails was complicated and we simplified it so that they could be constructed within the allocated budget.

6. Allocate approximately 7% of the budget for handcrafted details and ornaments.

When you distribute the budget to the various operations allocate approximately 7% of the budget to the special handcrafted details and ornaments. A higher budget will be difficult to be accepted by the client and anything lower might not be enough to create the appropriate intensity and quality needed by the building. In the apartment building and the Greek Orthodox Church we used approximately 7% of the budget for the special entities. In the Saint Andrews church we used close to 12% and this increase was primarily due to the construction of the concrete trusses.

7. Accept some roughness as part of the humane quality.

Some roughness can occur in some building details and ornaments and that roughness should be accepted as part of the process that adds to the humane quality of the building. Roughness does not mean bad craftsmanship. For example, the hand-made concrete tiles that I produced for the apartment building were not exactly identical in terms of shape and color. They had slight variations and it is this unevenness that contributed to their increased quality.

8. Avoid risky construction methods and techniques in projects with low budgets.

It is best to avoid using risky construction methods and techniques in projects where there is not much money. A new process of making might take a long time to figure out and also consume more resources than originally expected or allocated for. This can cause time delays and cost overruns, which can be detrimental to the project. For example, in the Saint Andrew's Church the concrete trusses was a very challenging and difficult operation that had caused the default of two concrete subcontractors and delayed the construction of the building.

IMPLICATIONS OF THE STUDY

The integration of design and construction and the making of handcrafted details are vital for creating buildings with humane quality and identity. These details create a uniqueness and identity to the building needed by the users to experience an increased sense of ownership and belonging.

The technology used on the Korinthos apartment building was flexible and efficient technology well known to local subcontractors. The special handcrafted details, if we exclude the hand-made concrete tiles, were relatively easy details to construct.

On the Christian Orthodox Church a lot of detailing went on the superstructure of the building especially on the drum of the dome and also the columns, beams, arches, etc. The technology used was also flexible and efficient and allowed the production of many handcrafted details.

The most challenging construction technology took place on the Saint Andrew's Church involving the construction of the reinforced concrete trusses and the construction of straw bale walls. These technologies deviated from the original intent of our technology principle supporting the use of efficient and inexpensive construction techniques. This deviation, however, provided a lot of interest and excitement but caused us a lot of additional work, added expense and great risk taking.

The active participation of the architect on the site and its financial viability is of paramount importance. The majority of architects who follow the mainstream practice might find this set up of architect/construction manager very difficult to implement. There are other options in between, though, which can bring good results. For example, the architect might devise certain important details for each of his projects and get actively involved in only these sub-projects. This will not be very difficult to do since many architects who design in a standard way and have good relationships with contractors and subcontractors can do this as a small percentage of the contract. It is not new – although presently, not common – to do this.

Therefore, the architect's active participation in construction using various options, along with the use of current and future technologies, will contribute the most to the production and craft of humane and harmonious buildings.

ILLUSTRATIONS

Fig. 1. The Korinthos apartment building. Photo by the author.

Fig. 2. Corner concrete column. Photograph by the author.

Fig. 3. The entrance arcade under construction. Photograph by the author.

Fig. 4. Balcony formwork and polystyrene inserts for brackets. Photograph by the author.

Fig. 5. Tiles at entrance arcade. Photograph by the author.

Fig. 6. The author making tiles. Photograph by Eleni Pontikis.

Fig. 7. Handrail and flower-box formwork with polystyrene inserts. Photograph by the author.

Fig. 8. Ceramic handmade tile with number. Photograph by the author.

Fig. 9. Color testing at the east side of the building. Photograph by the author.

Fig. 10. Dome with concrete drum. Photograph by Marc C. Darley.

Fig. 11. Concrete panels. Photograph by Cullen Burda.

Fig. 12. The plinth wall. Photograph by Cullen Burda.

Fig. 13. Exterior view of transept. Photograph by Marc C. Darley.

Fig. 14. Concrete beams and window frames. Photograph by Marc C. Darley.

Fig. 15. Formwork of window frame. Photograph by Cullen Burda.

Fig. 16. Wood model of trusses in the sanctuary. Photograph by Cullen Burda.

Fig. 17. Lifting of precast reinforced concrete truss. Photograph by Cullen Burda.

Fig. 18. Spraying the gunite on the straw bale walls. Photograph by Cullen Burda.

REFERENCES

Alexander, Christopher (1996). The Nature of Order, Berkeley: Center for Environmental Structure.

Connel, John (1997). Homing Instinct. New York: Warner.

Mockbee, Samuel (1997). "Mockbee Mission", *Architecture*, January. 49-50.

Piedmont-Palladino, Susan and Alden, Mark Brand (1997). 25 Years of Jersey Devil Architecture. New York: Princeton Architectural Press.

ENDNOTES

[1] The first building was designed by the author alone and the other two buildings were designed by the author and his associate Gary Black with the assistance of Cullen Burda.

[2] The author did his Ph.D. studies in architecture at the University of California, Berkeley. His major advisor was Christopher Alexander and his two minor advisors were Gary R. Black in structures and William Ibbs in construction management. His Ph.D. dissertation is titled, *Apartment Building Process: The Design and Construction of the Korinthos Apartment Building in Cyprus*. Ph.D. Dissertation, University of California, Berkeley, December 1998.

[3] The main aim of the survey was to determine whether the Korinthos Apartment Building had achieved an increased humane quality in comparison to other contemporary apartment buildings in Cyprus. The questionnaire was prepared by myself and was approved by my advisor, Professor Christopher Alexander.

[4] For example, all the buildings chosen for comparison were in the same geographical location, they were of the same approximate size, they had the same number of floors, they were constructed with the same develop-design-build procurement method, they were all completed at the same time, etc.

[5] For a detail account of the design and construction of the building see the author's dissertation: Apartment Building Process: The Design and Construction of the Korinthos Apartment Building in Cyprus. University of California, Berkeley, 1998.

[6] Cost control was exercised partly by allocating approximately 8% of the budget on contingencies and using that money when needed.

[7] The artist who made the tiles was Maria Vasiliou.

[8] For detailed design of this building see: Gary R. Black and the author. *Synthesis of 21st Century Engineering with Traditional Architectural Form: the Art of Making in the Design of a Greek Orthodox Church in America*. IASTE, proceedings, Volume Seventy-Two/ IASTE 72-94, 67-88. 1994.

[9] Gary R. Black was also the structural engineer of the project and engineered the trusses. Gary had engineered similar trusses at the shelter for the homeless in San Jose, which though were much smaller in size and scale. His knowledge in this method of construction was very valuable to the project.

[10] The detailed questionnaire and answers of the survey can be provided upon request. The questionnaire was prepared by the author and approved by his Ph.D. advisor.

[11] The owners of the apartments looked at other contemporary apartments before deciding on the Korinthos building. For this reason they were good candidates for assessing the humane quality of this building.

[12] The apartment building variables, which were use to choose the six apartment buildings for comparison, were the following:

a. Location – all buildings were located in Nicosia

b. Time – the buildings were constructed at the same time period

c. Plot area – they were constructed in a plot area of 550 m2 to 600 m2

d. Size – they were of similar building area (830 m2 to 880 m2)

e. Floors – they have three floors, two dwellings at each floor.

f. Parking – entrance level (pilotis) or subterranean parking (six cars)

g. Construction system – they used the same construction system (reinforced concrete frame, in-fill block walls, stucco and plaster)

h. Specification finishes – they had same or similar specifications finishes and items.

i. Develop/design/build – that they were designed and constructed by an individual entity for developing purposes.

[13] Comparison of apartment building Construction Cost (£/m2) and Construction Time (months)

Apartment Buildings	Actual Cost	Factored Cost	Actual Time	Factored Time
Korinthos	245	245	20	20
CyField	190	235	12	12
Pelekanos	230	260	18	19
Barbas	245	260	14	15
Lemka	260	270	18	18
Meletiou	245	255	16	17
Miliotis	205	235	15	16

The Korinthos apartment building has used the most expensive finishes of all the buildings compared. The factored cost is the adjusted one, made after the cost difference of the specification finishes is taken into account.

The Korinthos apartment building has a subterranean parking, which has added approximately six weeks to the duration of construction. The factored time is the adjusted one, made after the construction duration of the parking structure was taken into account.

[14] The average construction cost of the six apartment buildings was 253 £/m2 and the construction cost of the Korinthos apartment building was 245 £/m2.

[15] Small-scale developers build two or three small projects a year. To keep their expenses to a minimum they hire one construction supervisor who manages all projects and in addition this person works on sales, finance, and other aspects of the business.