" The Professionals who are facing up to the responsibilities of designing man's environment in a technologically and sociologically orientated world it is imperative that construction cost be handled in both creative and controlled manner. " (1)

Cost Control in Architectural design

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1.0 Introduction

In the design and construction of buildings today the building clients demand that greater attention be paid to cost efficiency in design. This need for financial control and the building to be completed within, a definite time and cost frame work is due to, continually rising cost of building, restraints in the money borrowed and high interest rates, all making effective cost control that more important.

2.0 Need for cost control

Designing within a predetermined budget looking after the interests of the client is a part of Architects professional service. If the architect is to achieve this goal it is vital that effective cost control procedure be implemented from inception, and throughout the design process. That is control being part of the design, with the budget being made to work for and not against. It is difficult to be creative when there are cost constraints but it is equally rewarding if the design is wihin the cost frame work. But in the past and in the present, architects in practice has had a reputation "cost wise" of usually exceeding the specified targets. Thus making Cost control an important element in the design process, if effectively implemented at design stage it will avoid redesign, the reduction of quality and standard of building elements, when the tenders are high and avoids the abandonment of the project.

and an unhappy client. Cost control thus, ensures the architect and the client the final tender figure to be within the cost targets and the completion of the building in time resulting in better design of building and most important a satisfied client. Cost control in architectural design can be divided into two stages,

1. Pre-contract cost control
2. Post-contract cost control

For effective cost contro both aspects are equally important. The method and the form of control are often dictated by the type of development and the client, and the Architect should be able to assess the degree of control according to clients requirement at the inception.

For example: In the design of a single dwelling house owner will have a clear picture of the amount and the type of accommodation required and the price he is prepared to pay, but requirements may tend to be more expensive than was what is affordable due to having preconceived ideas of decorative features if collected from varied house magazines which he may request, not being aware of the cost implications of such changes. Here the architect should be able to advise the client on the alternative of finishes and fitting available or afternvtive design layouts so that the client is within the budget as well as get best value for money.

Hence the Architect has to take excessive care and skill in the design of such projects and keep the client informed of the necessary cost implications so as not to exceed the budget. In the case of a client, who is an housing estate developer his aim is to provide maximum number of units at a reasonable price to the buyers. Here the architect should be aware of the current trends in the market and give the client alternative economic layout of reasonable standard and quality in the design of houses, at the lowest possible price. An architect dealing with local authority development will be faced with a form of cost control where the authority may have limited expenditure due to a loan from the Government. Here strict control of expenditure should be exercised in the design. In commercial and industrial form of development the architect deals with the type of client who will erect, the building for investment or sale demanding that initial construction costs, maintenance costs be kept to a minimum.

Whichever is the type of development the implementation of cost control procedure in Architectural Design is important if the Architect is to be well informed of the cost implications of all his design decisions. It allows him to give client good value for money and a building which is soundly constructed of good aesthetic appearence well suited to perform the functions for which it is required and giving a balanced distribution of available funds between the various parts of the building.

3.0 The past

In analysing the past work of the Architects specially with reference to housing whether it was single or multiple development it was found that there were many instance of cost over-runs in the client budgets. This had created mistrust among the prospective clients with regard to the architects efficiency to design within a predetermined budget the Architects indiciplined attitude towards spending clients money and the difficulty of keeping with in the expenditure for such cost over runs with the client.

It is important to investigate the reasons for Such Cost over-runs but here the Author would like to state that in this paper, she has identified the reasons for such over runs only upto pre-contract stage, but for a complete analysis, both stages in the design process the pre, and the post, contract stages should be considered as both are equally important.

Set down below are some of the reasons for cost over-runs in the past

3.1 Insufficient knowledge of cost control procdeure

3.2 Lack of team work.

3.3 Lack of understanding that cost control should start at the beginning of architectural services and continue right up to completion of the building.

3.4 Use of inappropriate technology.

3.5 Use of inappropriate materials.

3.1 Insufficient knowledge on cost control Procedure

Good cost control requires understanding of the tools and the processes available for control. A store house of data and information on the costs of materials, and contraction of past projects within the architectural practice. It also requires trained and intelligent personnel who could use them.

However, in many practices, control of cost begins too late due to lack of understanding of above and the misconception that handling of cost is not so much a part of design but of estimating where the quantity surveyor or the estimater prepares the bill of quantity at the end of design stage. This often results in a bill of quantity with the construction cost of the building higher than the expected or the agreed amount and a surprised architect. At this time the fact that the architect has already completed all the phases of his work from initial sketch design to the detail design of the project upto the preparation of tender document finds that it is too late to re-design due to lack of time and money. He takes the only alternative available. That is to reduce to a minimum, the standards and the quality of finishes ending up with a substandard building that we see today.

3.2 Lack of team work

The architect is the leader of the design team. It is he who receives the commission to design and supervise the erection of the building. The necessary specialist knowledge for a design of a building is great and needs specialist advice on special design problems. For example, a structural engineer is needed to design the frame of the building while a mechanical and electrical engineer is needed for the design of services and a quantity surveyor on advice on costs.

Therefore the total responsibility of the cost of a building should be shared by the people who participate in the design and construction process.

In many instances it is found that in the formulation of the budget, advice is not sought from the other members of the team. The Architect tends to do the initial design of the project without any form of costly advice or the many alternatives that may be present for his design in the form of design variable, Construction systems, finishes materials and most important the lack of knowlegee he cost implications of his design decisions. The only possible cost he may prepare is the initial preliminary estimate which may not be even referred to in the design process, thus all leading to a high tender price at the bidding stage. Therefore for effective cost control and to avoid redesign or cutting down quality, it is important that when decisions are being made in the detail design stage, on 'Design specifications, Construction Systems, Materials, it should be developed with the awareness of the design team so as to avoid cost over runs, that may have occured in the past.

3.3 Lack of understanding of the necessity for cost control during design

Most Architects assume that cost planning and cost control means that it is a mere estimation of the tender sum at the end of detail design stage. But it goes more deeper than that, the object of designing within cost does not necessarily mean cutting down standards and eventually a cheap building. But it means the knowledge of the cost implication of each part of the building where by each design decision is analysed and costed and final decision made so as to maintain a good relationship between cost, quality, use appearance and finally to provide the value required within the required Budget. For an economic evaluation the architect should be aware of the various factors that affects the costs, they are:

3.3.1 Land use
3.3.2. Plan shape, spatial relationship and circulation
3.3.3. Size
3.3.4. Storey height
3.3.5. Constructional systems
3.3.6. Services
3.3.7. Finishes

3.3.1 Land use

Each site has its own peculiar features which can have a considerable effect on the total cost of the development. The architect in his initial design stage should take into account the economical use of the site. Due consideration should be given to the location of site, contours, ground conditions, landscape and relation of the site to the other environments around. The ratio of site value to the cost of building should always be considered to secure most profitable use. The position of existing services should be taken into account as it may influence the site costs. If the site is contoured the design should make use of the levels to avoid high cost of cutting levelling and transporting of soil.

The architect should also endevour to produce aeconomic layout achieving the required density, proper spacing of dwellings whether it may be individual or apartment type. Proper use of access and other design considerations should be taken into account to give an overall economic planned layout. It is due to the inadequate considerations given by the Architect on these matters, that one sees, totally unrelated to environment and badly designed uneconomical buildings today. It may be also pointed out that due to the lack of consideration for these above factors, the Architect commences his initial design with a handicap of a cost increase.

3.3.2 Plan shape, storey height, spatial relationships, circulation, fenestrations, constructional systems, 3.3.7 finishes and services

The cost of buildings are influenced by various factors. They fall in to two categories. Design variables and structural variables. Above are, such variables that affect the cost aspects of any design at the very inception of the design process. It is important that the architect considers these factors in his design. For example in the design of the building many variations in costs can occur due to various shapes, the building may take when enclosing the required space. As a general rule the simpler the shape of the building lower is its unit cost. That is its cost per square meter or cost per square foot. When the building becomes longer and narrower and the outline more complicated and irregular, the perimeter/ floor area ratio increases thus increasing the unit cost. This increase is due to the extra work involved in a complicated setting out, extra due to increase in site works such as extra excavations and foundations. additional brick work, finishes, roofing all adding up to an increase. Thus it is important for the architect to be aware of the cost implications due to changes in various shapes of the building so that he may adopt the best possible shape to give good value for the money.

Another factor that influences an increase in cost, is the variation in strocy height. The componants of the building that will be affected by such variations are the heights of walls and partitions together with their finishes and decorations. The cost increase will also be due to complicated constructional system that may have to be used, increase due to hoisting of materials, and an increase due to increase in foundations to support the extra dead load.

Inadequate thought given to design of circulation shape within a building is another factor that leads to increase in costs. Circulation space is regarded as dead space in economic terms as it cannot be used for a profitable purpose. Therefore the architect in his design should aim at reducing the circulation space to a minimum for an a economical design.

Fenestrations or projections that may be used by an architect as a decorative feature also lend it self to an increase in costs. This again is due to additional constructional methods, additional finishes. Therefore it is important, that the architect in using these judge whether it is for a decorative feature or for environment protections, make a proper economic evaluation.

In addition to design economy, for cost efficiency in design the architect should also consider structural economy. This involves the use of different constructional systems and the quality and type of materials used. This will be dealt in detail later. But it is important that the architect gives adequate thought and do a carefull study of the available systems for erection of the building to give the quality required with in the allowable budget.

The object of designing within cost does not necessarily mean cutting down standard or quality. It is simple to reduce the cost if the standard of construction and finishes in the building or the amount of space is reduced. But it does not then become an economic design. An economic design involves reduction in costs without reduction in amenity. To acheive economy in design both cost and value should be jointly considered. Value is derived from function and appearence. Together this should be judged against cost. In this judgement the architect should be able to evaluates the cost implications of the various design and structural variables such as plan shape, size, storey height, fenestrations, constructional system and any other building characteristics and arrive at the best possible solution. In arriving at this solution he should also consider the various building shapes that have different aesthatic and social value and markatiablity. Such values are a question of Personal judgement and cannot be costed. But it is an important aspect in the design. Therefore when the architect arrives at a solution to the design he should be able to strike a balance between the available costs and such values.

When one appraises the buildings designed and constructed today with reference to residential development it is seen that adequate thought has not been given to the above factors. One sees extremes. For example whether it is an individual dawelling multiple dewelling, single storey or high rise, built by private or public sector one finds number of designs and forms of building totally unrelated to function and environment. Form, finishes and Decorations used for personal esteem at the cost of clients resources. On the other hand one sees building where the cost have being cut down, sacrificing the quality and standrd resulting in uneconomical layout and cheap looking building. The reason being the architect not giving adequate thought to the design variables during design process, and the lack of understanding of the importance of cost control during design process, thus ending up in cutting down quality finishes at the completion of the design stage, at the bidding stage or at the construction stage to be with in the allowable cost. This results in sub standard buildings unhappy clients and dissatisfied tenants.

Therefore it is important for the architect to realise, the continous influence of the cost of the building project and make a careful appraisal of the way the building is to be used, function to be formed so that effective control could be implemented to provide most economic building and the value required with in the allowable cost.

3.4 Inappropriate use of technology

Use of inappropriate technology have lead to cost over runs in the building projects in the past. This is due to the architect not giving adequate thought to the use of right type of technology available for different componants of the building. For example, In the design of the superstructure. if a framed construction is used instead of a load bearing brick work construction where the design and site needs, could have been satisfied by a load bearing brick work construction, the unnecessary use of the frame construction leads to increase in cost due to the cost of cement steel and formwork as against bricks and mortar. Similarly in the design of the substructure if adequate investigations have not been made of the conditions below ground, or the necessary soil test made, and the architect design an inapproprinte foundation system, this may lead to additional costs due to the possibility of encountering rock during excavations water conditions requiring pumping or may also lead to failure in the foundation system resulting in unneccessary cost involved in rectification. What ever, may be the reasons it is up to the architect to secure knowledge at the inception of design, of the underground conditions, site conditions, availability of skilled labour up to date specification of materials and its availability, techniques and construction systems, so that proper technology related to the design could be used, to give the greatest economy to meet the allowable cost. The mechanical electrical system should also be designed to suit to appropriate technology available, so that the mistakes of the past could be avoided.

3.5 Use of inappropriate materials

Use of material by the architect in his design fall into two categories. The material that is used for bulk construction work and the material used for decorative and aesthatic purposes. This may be either for exterior or the interior finish, what ever the category of material use, the cost is influenced by it. It is important to the architect during the design process when decisions are being made with regard to the type of materials to be used, in construction or finishes to consider, the availability of material in the market, comparative advantage of materials, economic conditions, regional difference in costs and use of material labour availability, durability and maintenance. In economic design minimising the quality of materials or choosing those with the minimum cost is not the criteria. It is the proper evaluation and use of the suitable material in the right context and use its characteristic to its fullest advantage, which is important "It is wasteful to use material with qualities over and above what is required in the given situation" (2.) "For example a study of design of some multi storey flats in Britiain indicated that concrete was often used below its full capacity and in some cases three times as much concrete was used as was necessary (3.)

In the design of building already constructed today we see how the characteristic of material have not been fully expolited or how material that is not really suitable have been used just for the sake of appearence. This is due to the architects failure to understand the economics of material and the lack of knowledge to incoporate it in the design process thus making him resort to cutting down the quality of finishes when the bids are too high.

4.0 Cost control techniques and tools

In order to apply cost control in the architectural process the architect should be aware of the principle of cost control. Cost control means the cost should be within clients own predetermined budget or be within the budget submitted by the architect and approved by the client. Once the budget has been established all architects work thereafter must be controlled in cost. That means once the detail design is complete and costed it should not exceed the required budget. If it exceeds the only alternative is to reduce the cost. This could be done either by complete redesign or reducing the standard of fitting and finishes. On the other hand if the design proves to be cheaper it is difficult to improve space requirements and layout without complete redesign or add expensive finishes and fittings giving poor value for money. Therefore it is important to have systems and tools for cost control to aid the architect throughout the design process up to completion of the project. Some such techniques available are the cost planning techniques. "Cost planning establishes the needs, set out the various solutions and the cost implications of these solutions and finally produces the cost of the project. At the same time a sensible relationship is maintained between cost quality utility and appearence (5.)

There are two basic methods of cost planning used. One is called the elemental target cost planning and the other comparative cost planning.

In the first method the sketch designs are prepared and the total cost obtained by some approximate estimating method. These may be unit cost, volume cost or cost per square foot method. Even though these method are used for easy and convenience they are not an accurate form of arriving at budget and should be used with caution and can only be used as a preliminary guide. More accurate methods should be used later in the detail design. Once the total cost of the work is obtained the building is broken into various elements of construction and each element is allocated a cost, based on cost analysis of previously erected building of similar type. The total of the targets not exceeding the predetermined budget. Cost checks are made against these targets through out development of the design thus incorporating a progressive costing technique. This establishment of a cost frame work helps all design diciplines to know their ilimitations and indicates to them the possible materials, methods, systems, available.

In the second method that is in comparative cost planning, there is no fixed budget like the first system. Instead a cost study is made showing the various alternative ways in which the architect could evolve his, design. It enables the architect to select a combination of alternatives which will satisfy the financial. functional and aesthatic requirements.

Which ever technique is used the formulated cost plan becomes a method of rereence to the architect At the initial schematic stage it becomes a realistic first estimate developing into a more organised statement as the design develops. Each area of componant of the building scrutinized and finalished. It outlines to the design team how the finances are to be distributed, and enables the architect to see the cost effects of his design dicisions.

The above refers to more common form of cost control that is used in the architectural process. But other forms of costs control exists one such technique is the technique of cost in use which provides measure of the total or ultimate cost of a building. It can be used by both architect and planners in design or planning solutions. The tools or aids available for cost control also include use of computers where can be used for storing, analysing cost data that is needed.

Also computers can be used to test the computer representation of the reality which will give more accurate results than the manual methods of cost control used. Building cost indici is another form of tool which will help the designer to know the price variations that occur in the tenders of building at different times. It also helps to up date the cost data

Therefore the use of cost planning techniques and tools enables the cost to be established before final design decisions are made and cost effect of each decision made by the architect before it is implemented. It guides the designer in achieving a proper balance of expenditure, on each part of the building and to assist him in obtaing good value for money. (5)

5.0 The Economic of Residential Development

Due to overall housing shortage, lack of finances, restricted budget, mounting pressure to limit costs, the architect in residential development should give adequate thought to cost control procedure in Building Design. The Architect involved in design of mass housing, faces the problem of not knowing the user. He is faced with the design of number of dwelling types such as individual dwellings, high rise apartments and flats of varying size and physical characteristics with a number of spatial requirements. He is also expected to achieve good housing standards yet at the same time secure economical designs and layouts. To achieve this goal it is important that architects in residential development apply cost planning and cost control technique in their design process to secure maximum value for money. This will lead to cost conscious building design which seems to be lacking in the residential development today. Therefore by applying cost control in design the architect is able to acquire the required housing density, full use of land, the cost effect of using blocks of varying heights plan area and shape, secure satisfactory daylighting, privacy, access and the economical use of a site, than producing the cheap unsightly housing development that we see in the urban and rural landscape, making cost control in architectural process that much more important.

6.0 Conclusion

"Cost consideration are among the basic considerations the architect must deal with. He is under a profound responsibility to see that the clients budget is adhered to and that the project is built within the cost forecast. (6)

"The client who gives the architect a free hand with money is very rare."7. Therefore cost control in Architectural design is a very definite part of the professional service that the architect must render his client.

"Failure to perform carefully in this area is not more excusable than providing inadequate mechanical facilities or not putting hardware on doors." (8)

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