ELEMENT METHOD OF COST CONTROL

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ABSTRACT

The 'Element method of Cost Control' introduces a hierarchical set of functional building elements. There are two groups of elements in building construction. The space delimiting elements are the elements, which are able to define spaces such as roofs, walls, floors etc. The space equipping elements are those, which furnish the space such as sanitary, electrical or air-conditioning elements. The elements are then sub divided into sub elements such as ground floor, curtain wall, internal wall etc.

The first step of this method is to define each and every element as independently as possible. Later it becomes feasible to select different solutions for sub-elements, without affecting the others. The main objective of this hierarchical system is to 'create the possibility to obtain a large variety of solutions by combining parts'.

The next step includes 'Codification'. Each and every item in the element is codified for the regularization of the method and for the application in a computer model. The items can comprise its values from an authorized database of cost. For example 'schedule of rates' can be used.

The analysis is carried out beginning from the database. This database is used in the elaboration of the spreadsheets of each sub element. The spreadsheet for every individual sub element comprises detailed specification from the detailed drawings. As rates are linked with the database, a 'Bill-of-Quantity' is easily deducted from the spreadsheets. If, following this estimation, the project is within the budgetary constraints, the process can continue with phases like preparing specification, calling for tender etc. If not, the problematic part of revising major options of the project parts (macro elements, elements, sub-elements) is eased down by changing certain values in the spreadsheets by changing certain specifications. As they are all linked to the database with unit rates for construction costs, the whole process takes only minutes.

The second important constraint other than budgetary, is the design constraint. The Architect's job is to decide between different design alternatives for a particular project and select the one, which is the best. Always the best one is not the most economical one. The presence of the spreadsheet allows the architect to develop designs and simultaneously check the effect on the total cost. In certain circumstances, it helps the architect to decide the best cost-effective design solution.

Another very important advantage of this element method is that it helps to make reliable predictions starting from the first phase of the design process and can be used when the project is being implemented. So cost - checking is not postponed for the time of completion of the project.

The advantage of making a model is that we can easily understand the links between other elements of construction such as time and production. The more all those aspects are integrated in one bigger model, the more specific the model becomes. As a consequence, the model will never be suited to another context. But it eventually serves two main purposes: to enhance the insights in all those cross-links and to stimulate the elaboration of integrated models appropriate for a given context.

Keywords: Element Method, Parametric models, Space delimiting elements, Space equipping elements, Codification, Budgetary constraint, Design constraint, Schedule of rates.

1- INTRODUCTION

On the globe, Bangladesh is situated in the eastern part of the South Asian sub-continent. The population of Bangladesh is 14.4 million with a growth rate of 1.73%. The majority is the rural population is scattered in the countryside, but the urban fraction is expected to constitute one-third of the total population in the first quarter of the twenty first century. From the mid-seventies, it has become apparent that a great surge towards urbanization is taking place and with it, a great deal of problems and challenges are being born. Among them one of the most important field is the field of housing and settlement. [1]

2- THE ROLE OF PRIVATE SECTOR IN URBAN DEVELOPMENT

The private sector is defined here as the whole range of profit-oriented construction companies, private developers and small-scale contractors of the informal sector. Between them, the private sector provides well over 85% of all housing and much of the land development in urban areas. It has been emphasized many times that the persistent lack of financial and technical resources in the public sector to carry out housing and urban development schemes at a significant scale calls for a much stronger involvement of the private sector. This has been countered by arguing that the private sector only operates for a profit. However this ignores the tremendous contribution of the informal sector, which despite all its faults of unpredictability, is often the only sector that provides housing and urban development for those with the lowest incomes.

Although construction is one of the most important aspects of the urban economy (because of its linkages to other parts of the economy, its multiplier effects and its impact on employment), there is little appreciation of the private informal construction sector in the National Development Plan. In urban areas, next to transportation, the construction sector should be reviewed as to its potential role in enabling shelter strategy.

At present, Government policy does not provide fiscal or other incentives to the private informal construction sector to offer its technical capacity for the provision of housing in low-income area developments. As a result, and because of existing standards and building regulations for formal sector housing, the formal private sector caters almost exclusively for the demands of the middle and mainly upper income households. The housing needs of the majority of middle and low-income groups remain unsatisfied by the formal private developers. Also, in cases of disputes, low-income households in particular are victims of fraudulent execution of construction contracts.

Appropriation measures to improve management of the industry, accompanied by fiscal incentives and the adoption of appropriate regulations for low-cost housing and serviced land development, could allow the informal private sector to take up the challenge of extending its services to meet the needs of low-income communities. This strategy appears more promising than offering forms of subsidies to low-income groups in order to make the present housing solutions of the private sector more affordable. Alternative such as the latter, would undoubtedly lead to distortions, with low-income clients bought out by more solvent groups. The idea of cost-conscious housing is one of those measures that can play a part in the whole process and element method of cost control is one of those methods which can contribute to policy makings for benefiting that huge informal private sector housing. [2]

3- ELEMENT METHOD OF COST CONTROL

We now move on from this global problem level to the micro level e.g. the building level. We can find that there are certain factors, which can be crucial in terms of cost and construction process. This was the starting point for the development and the implementation of a method of cost and time control that can help to make an efficient use of the available resources when we are concerned about building construction. The aim is to reduce cost without reduction of quality. The analysis of the background information of Bangladesh gave us the general frame for the development of a model that could be applied for low-income housing programs.

3.1 FUNCTIONAL ELEMENTS

The element method of cost control is carried out beginning from the functional elements, which could be sub divided into 2 groups, Space delimiting and Space equipping elements. Walls, Roofs, Floors etc. are space delimiting elements, while sanitary, electrical and air-conditioning etc. are space equipping elements.

In a later phase, all these elements, can be sub divided into sub elements for more detailed elaboration. By defining each element as independently as possible, it becomes feasible to select different solutions for sub elements, without affecting the others. The main objective of this hierarchical system is to 'create the possibility to obtain a large variety of solutions by combining parts'.

Codification is used to identify each element and sub element for regularisation of the method for the application in a computer model. It is proposed that, codes from 'Schedule of rates' for Bangladesh may be used as database [3]. It can be elaborately developed in future by further research.

3.2 COMPUTER APPLICATION

The analysis below tries to elaborate different steps of the method. The 'Schedule of Rates' is the database. An element (e.g. Foundation) is taken as an instant. The items of this element are chosen following standard materials common in use. In the organisation of the spreadsheets, we can identify 4 parts:

- The input Parameters
- The interim results
- The list of frequently used materials for each element: These elements are linked with the database of materials by the VLOOKUP function of MS Excel. This list is made in order to facilitate the calculation of each element, and by updating the database of materials, we can have this list automatically updated as well. This can result in saving of time, for the calculation of the cost per element. Besides, in this list, the ratios (quantity of material per unit of element) are calculated, based on the input parameters. This is an important tool for choosing different options. In this way, the ratio calculated, is the quantity of materials needed for production of 1 unit of the designed element.
- The extract zone: In this zone, the materials considered and other options are going to be shown. The unit rate as well as the total price of the element, the percentage of the prices for each material are also calculated. The analysis is carried out trying to find out the most suitable solution for the element for the particular project.

3.3 THE ELEMENTS

The different elements may be defined as Foundation, Floor on ground, Suspended floors, External wall, Internal wall, Roof etc. as mentioned earlier. The study in this article contains detail costing of only one element (i.e. Foundation) due

Ement Method + Database function

Case Foundation

Input Parameters

Equivalent Wdth	129.89
Equivalent Depth	6.73
Height	3
Number of floors	4

Out put Parameters

Area of 1 eq building
Perimeter

Sharred Columns	7
Own Columns	3
Wdth of sq footing (s	1.5m
Wdth of sq footing (a	2m
Depth of foundation	2.5m
Total Area of excvatior	210.00m^2
Area of extra depth	210.00m^2
Volume of excavation	525.00m^2
Sq Column Wdth	0.38m
Cross sectional area of	0.14m^2
Foundation height	0.3
Plinth level	0.5m
GB length	845
GB cross section	0.14

to shortage of space.

In this example, the element is defined as the minimum unit, which can be replicated in the project. It is assumed that a group of 10 buildings of 4 stories (one neighborhood block) is a replicable unit. So when an element is mentioned, it is a combination of 10 four-storied housing units.

3.4 FOUNDATION

In the analysis of this element, the input parameters have been applied taking into account the characteristic of this kind of projects for foundations. This means that the contractor received the land for construction after the developer delivered the land to the plot owner. The contractor in this way can settle the foundation at any level determined by the structural engineer. The grade beams had a fixed depth of –1.0 meters. The foundations were typical footing foundations with cast-in-situ concrete bases and grade beams.

4- CONCLUSIONS: CONTROLLING BUDGETARY RESTRICTION

The different building elements like foundations, floors, walls, suspended floors and roofs can be analysed using the element method as a tool for cost control. The spreadsheets can be organised in different parts for a better analysis of the elements. Ratios are especially useful in order to express the importance of one entity of a lower level with another of a higher level.

From the analysis it can be observed that each change in materials and size resulted in a change of the total cost of all elements. Different comparisons can also be made for each element of the project in order to compare different solutions. In this way, the element method proves to be an efficient tool for managing and controlling costs during the design process. [4]

4.1 APPLICATION OF ELEMENT METHOD IN THE DESIGN PROCESS INTRODUCTION

The objective of this part is to analyze and compare proposals for different designs of the housing units. Using the element method of cost control, we can analyze the design and improve on it so that total cost can be controlled by design only. We can also make evaluations from the economic and qualitative point of view and try to find out the most suitable option considering all these different variables. In this article, the original design is proposed to be a 110 m^2 plot. It is taken as a base and three alternative proposals are developed later. The layout of houses in street blocks of 10 (one neighborhood) had been analyzed. An attempt is made to minimize the cost but still maintaining optimum standards in order to make these houses affordable by the low and lower middle income people.

4.2 BUILDING LEVEL: COST ESTIMATION OF STREET BLOCKS OF 20 FOUR STORY UNITS

In order to obtain the objective as defined previously, an attempt has been made for a better arrangement of the layout. The spreadsheets of this building level are linked with the spreadsheets for different elements so that any changes in the elements can be directly reflected on the cost of the building.

4.3 ORIGINAL LAYOUT

The original layout followed the existing building rules. The 17.15m X 6.60m (110 m2) plot are designed with 20 plots making a street block. The setback rule is 1.5m from both front and back, but a balcony can be projected in the upper floors with 1m at the back and 1.5m in front. The staircase can be on the boundary level on any side. The setback for the sides is 0.8m. The sunshades can extend up to 0.5m from the building at any side. The main design criteria are to provide two bedrooms, one guest room, one living room, one dining space, which should be smaller than the living room. The bedrooms should be bigger than the dining space. There may or may not be an internal family space. Minimum of two self-sufficient toilets should be provided. The kitchen should have relation with the dining. The toilets, kitchen and the dining space should have external windows in the form of outer wall or open-to-sky internal void which should have a minimum dimension of 1.5 m. The toilets and kitchen should

Big Unit (110 m^2): on 17.15 x 6.60 sqm plot: Original Design

Input paraneters

Building (Equivalent of 10 units)		**Plot**		**Street Block**	
Wdth of 1 unit	5.1 m	Plot Wdth		6.6 Number of row	2
Depth	14.15 m	Plot Depth		17.15 Wdth of Strret//W	4.5m
Addition	92 sqm	No of Building sinar		10 Wdth of Street//D	4.5m
ExternalWall / W	102 m				
ExternalWall / D	283 m				
ExternalWall	385 m				
InternalWall	345.5 m				
Height	3 m				
Number of floors	4 nos				

Interim Results

Building (Equivalent of 10 units)			
Area	721.65 sqm	Lenght of Road//W	70.50m
Total Ext Wall	385.0 m	Lenght of Road//D	38.80m
Total Int Wal	345.5 m	Street Area//W	317.25m
Total Perimeter	385.0 m	Street Area//D	174.60m
Total Area	721.65 sqm	Total Circulation Area	491.85sqm
Equivalent Width	188.68 m	Residential Area	2263.8 sqm
Equivalent Depth	3.82 m	Total Are of Fragment	0.28 ha
Wdth Depth Eatio	49.33	St. Area W/ total Area	12%
ESRA	7.20 sqm	St. Area D/ total Area	6%
ESRS	2.68 m	Circulation / Total Area	18%
Ratio Internal Wall	1.44	Residental / Total Area	82%
Ratio External Wall	1.60	Built up / Residential	64%
Suspended Floor	2164.95 sqm	Total Dwelling Units	80 nos
		Total Floor Area	5773.2 sqm
		Circulation Density	396.64
		Net Population Density	2095.04

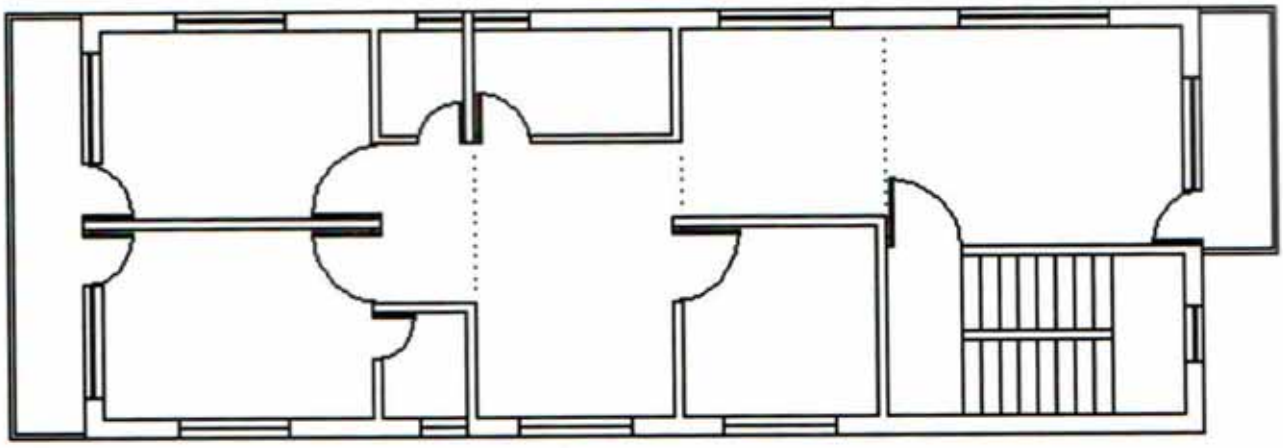
Cost Analysis for One Street block **million taka**

Cost	Element	Vulue	Price/Unit	Ratio	Price/sq m floor	Price/Element (mtk)	%	Reference
	Residential Land	1,275	tk/sq m	0.3921	499.96	0.7216	9%	
	Infrastructure/ Wincluding	5,000	tk/ m	0.0122	61.06	0.0881	1%	
	Infrastructure/ Dincluding	20,000	tk/ m	0.0067	134.41	0.1940	2%	
	Ground Floor	988	tk/sq m	0.2500	247.11	0.3566	5%	
	Foundation	858	tk/ m	0.2079	178.36	0.2574	3%	
	External Wall	1,023	tk/sq m	1.6005	1637.02	2.3627	30%	
	Internal Wall	863	tk/sq m	1.4363	1239.21	1.7886	23%	
	Suspended Floor	1,546	tk/sq m	0.75	1159.31	1.6732	21%	
	Roofs	1,289	tk/sq m	0.25	322.34	0.4652	6%	
		Including Land + Infrastructure			**5479**	**7.91**	**100%**	
		Excluding Land + Infrastructure			**4783**	**6.90**		

not face the livable space of the neighboring houses. Following these major criteria, the original design is made.

4.4 ALTERNATIVE 1

We have first considered the detailed cost of the original design and the space quality of different rooms. The dominant element was the outer wall, which was the highest in percentage of the total cost. As a first approach to search for an alternative, a proposal was made where the adjacent houses can share a portion of their external wall. For the sake of ventilation a standard of minimum 1.5m X 1.5m space were provided between houses, which can be taken as minimum standard for the row-houses for smaller plots of this size. As a result the amount of external wall was sufficiently reduced and internal wall increased. As the cost of internal wall is much less than the external wall, the change had great impact on the total cost. Also the foundation can be shared so the cost is reduced



Big Unit: 17.15 x 6.60 sqm: Alternative 1

Input paraneters

Building (Equivalent of 10 units)

Perimeter	316.60 m
Area	849.97 sqm
ExternalWall / W	162.62 m
ExternalWall / D	153.98 m
ExternalWall	316.60 m
InternalWall	407.54 m
Height	3 m
Number of floors	4 nos

Plot

Plot Wdth	
Plot Depth	
No of Build. in a row	

Street Block

6.60 No of Equiv. Build. per row	2
17.15 Width of Strret/W	4.5m
10 Width of Street/D	4.5m

Interim Results

Building (Equivalent of 10 units)

Area	849.97 sqm
Equivalent Width	152.74 m
Equivalent Depth	5.56 m
Width-Depth Ratio	27.45
ESRA	9.03 sqm
ESRS	3.00 m
Ratio Internal Wall	1.44
Ratio External Wall	1.12
Suspended Floor	2,549.90 sqm
	2.68 m
	1.44
	1.60
	2164.95 sqm

Lenght of Road//W	70.50m
Lenght of Road//D	38.80m
Street Area//W	317.25m
Street Area//D	174.60m
Total Circulation Area	491.85sqm
Residential Area	2263.8 sqm
Total Are of Fragment	0.28 ha
St. Area W/ total Area	12%
St. Area D/ total Area	6%
Circulation / Total Area	18%
Residental / Total Area	82%
Built up / Residential	75%
Total Dwelling Units	80 nos
Total Floor Area	6799.72 sqm
Circulation Density	396.64 m/ha
Net Population Density	2467.56

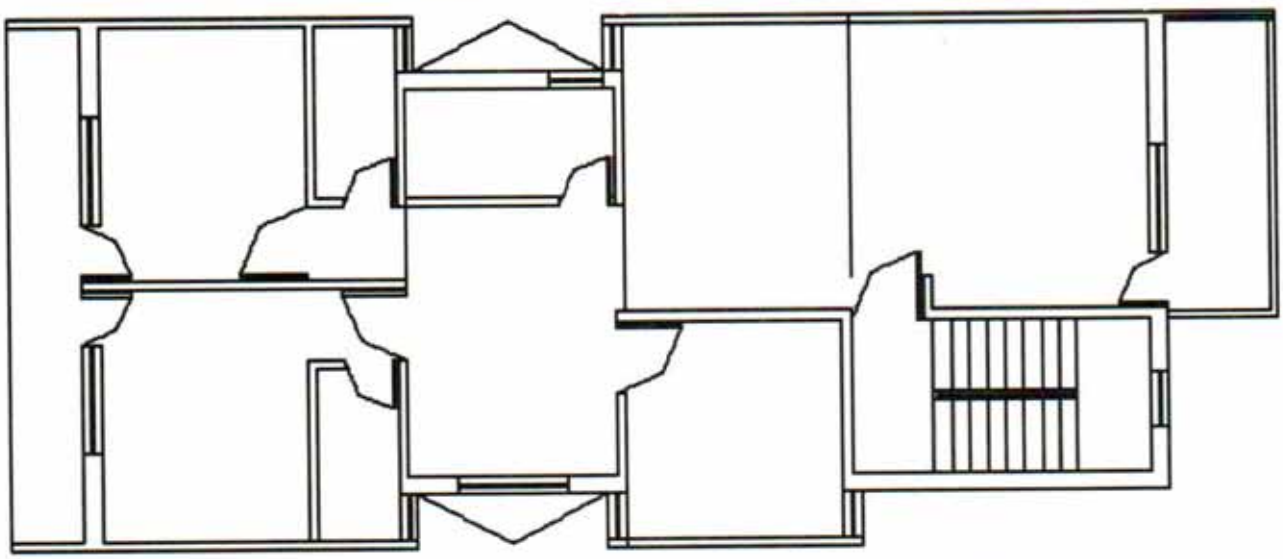
Cost Analysis for One Street block **million taka**

in that element also. In addition, we get bigger bedroom, living room and dining space as well as more usable toilet and kitchen spaces. All the necessary criteria for design were met. And still it gave a better solution in both cost and quality.

4.5 ALTERNATIVE 2

A second alternative is now suggested. As a development of the previous proposal, the toilets and kitchen were grouped as a service core. It greatly reduced the length of the supply and sanitary

Cost	Element	Vulue	Price/Unit	Ratio	Price/sq m floor	Price/Element (mtk)	%	Reference
	Residential Land	1,275	tk/sq m	0.3329	424.48	0.7216	9%	499.96
	Infrastructure/ Wincluding	5,000	tk/ m	0.0104	51.84	0.0881	1%	61.06
	Infrastructure/ Dincluding	20,000	tk/ m	0.0057	114.12	0.1940	2%	134.41
	Ground Floor	988	tk/sq m	0.2500	247.11	0.4201	5%	247.11
	Foundation	858	tk/ m	0.0585	50.16	0.0853	1%	178.36
	External Wall	1,023	tk/sq m	1.1175	1142.97	1.9430	24%	1637.02
	Internal Wall	863	tk/sq m	1.4384	1241.06	2.1097	26%	1239.21
	Suspended Floor	1,546	tk/sq m	0.7500	1159.31	1.9707	24%	1159.31
	Roofs	1,289	tk/sq m	0.2500	322.34	0.5480	7%	322.34
		Including Land + Infrastructure			**4753**	**8.08**	**100%**	
		Excluding Land + Infrastructure			**4163**	**7.08**		



pipes to the toilets and kitchen in the previous proposal, toilets were in both sides, so the required length of service pipes was much more. Here they were at one side and when two adjacent houses are arranged in a mirror image, the cost again reduces to half. One toilet is reduced in size but the other developments are significant. Moreover the cost has again been reduced considerably. (See bar diagram)

4.6 ALTERNATIVE 3

In alternative three, another significant improvement is made where two adjacent houses share one staircase. So the cost of a street block is reduced significantly (See bar diagram). The possibility of leaving a room in the ground floors as garage, store or shop, whichever applicable, improves the price of the land and also increases its rent. The typical floors still have 3 bedrooms and the other necessary spaces.

4.7 CONTROLLING DESIGN RESTRICTION

Comparing the first and the second, we can observe that a reasonable change in the rules of setback can provide better design and also minimize the cost. Comparing the later two, we can see a significantly better solution. The study enlightens the fact that housing and building standards should be capable of flexibility and follow the living standards of that income group of people for whom these houses are destined. There are shortages of spaces suitable for housing in the urban area and the row house concept still provides cost effective and better quality housing. For these standard housings, we can leave the luxury of setback from all sides and go for a reduced plot size, which will have the same floor area when adjacent houses

Big Unit: 17.15 x 6.60 sqm: Alternative 2

Input paraneters

Building (Equivalent of 10 units)

Perimeter	273.40 m
Area	949.19 sqm
ExternalWall / W	162.62 m
ExternalWall / D	110.78 m
ExternalWall	273.40 m
InternalWall	447.69 m
Height	3 m
Number of floors	4 nos

Plot

Plot Wdth	
Plot Depth	
No of Build. in a row	

Street Block

6.60 No of Equiv. Build. per row	2
17.15 Width of Strret/W	4.5m
10 Width of Street/D	4.5m

Interim Results

Building (Equivalent of 10 units)

Area	949.19 sqm
Equivalent Width	129.36 m
Equivalent Depth	7.34 m
Width-Depth Ratio	17.63
ESRA	10.55 sqm
ESRS	3.25 m
Ratio Internal Wall	1.41
Ratio External Wall	0.86
Suspended Floor	2,847.58 sqm

Lenght of Road//W	70.50m
Lenght of Road//D	38.80m
Street Area//W	317.25m
Street Area//D	174.60m
Total Circulation Area	491.85sqm
Residential Area	2263.8 sqm
Total Are of Fragment	0.28 ha
St. Area W/ total Area	12%
St. Area D/ total Area	6%
Circulation / Total Area	18%
Residental / Total Area	82%
Built up / Residential	84%
Total Dwelling Units	80 nos
Total Floor Area	7593.55 sqm
Circulation Density	396.64 m/ha
Net Population Density	2755.63

Cost Analysis for One Street block

Cost	Element	Vulue	Price/Unit	Ratio	Price/sq m floor	Price/Element (mtk)	%	Reference
	Residential Land	1,275	tk/sq m	0.2981	380.10	0.7216	9%	
	Infrastructure/ Wincluding	5,000	tk/ m	0.0093	46.42	0.0881	1%	
	Infrastructure/ Dincluding	20,000	tk/ m	0.0051	102.19	0.1940	2%	
	Ground Floor	988	tk/sq m	0.2500	247.11	0.4691	6%	
	Foundation	858	tk/ m	0.0523	44.92	0.0853	1%	
	External Wall	1,023	tk/sq m	0.8641	883.83	1.6778	20%	
	Internal Wall	863	tk/sq m	1.4150	1220.80	2.3176	28%	
	Suspended Floor	1,546	tk/sq m	0.75	1159.31	2.2008	26%	
	Roofs	1,289	tk/sq m	0.25	322.34	0.6119	7%	
			Including Land + Infrastructure		**4407**	**8.37**	**100%**	
			Excluding Land + Infrastructure		**3878**	**7.36**		

share walls between them. That also gives the opportunity to increase the number of plots in a given piece of land. In short, this way we can contribute in policy making.

CONCLUSIONS AND RECOMMENDATIONS

The analysis of different alternatives show how design can affect the cost of the house, how the selection of materials for the different elements influences the total cost of a building. The different alternatives in layout can affect the cost of a neighborhood as well. For example, due to sharing of walls of adjacent buildings, plot sizes can be reduced and subsequently plot numbers can be increased. So every single movement can affect the whole situation. Our goal is to find out as many determining factors as possible and work out their relationship as precisely as possible so that we can have more control of the whole process.

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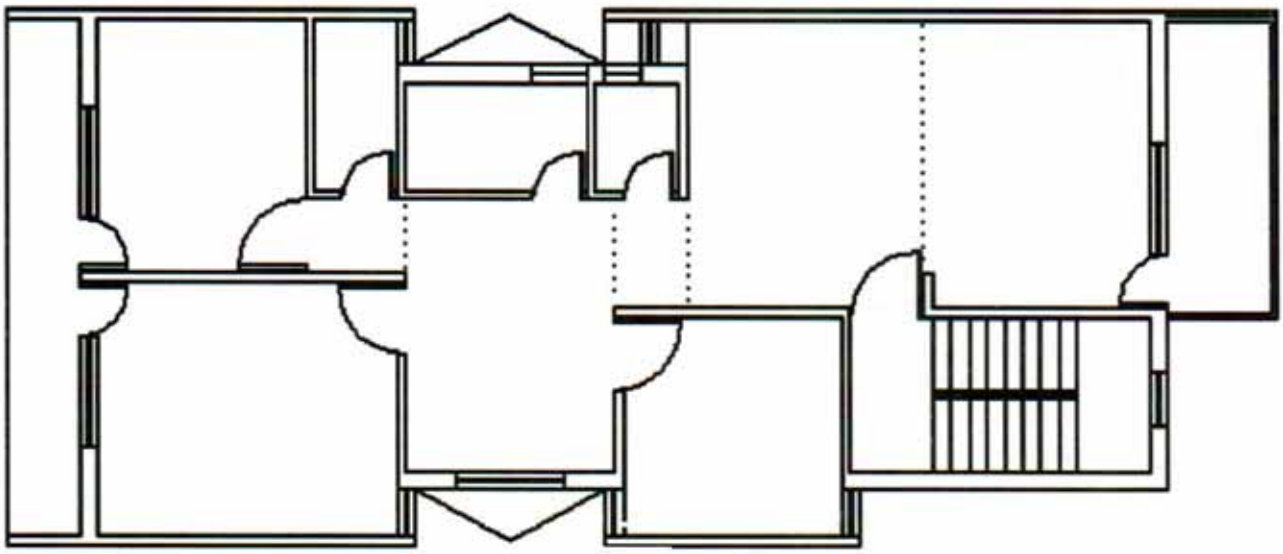


Big Unit: 17.15 x 6.60 sqm: Alternative 3

Input paraneters

Building (Equivalent of 10 units)

Perimeter	273.23 m
Area	874.15 sqm
ExternalWall / W	160.06 m
ExternalWall / D	107.96 m
ExternalWall	268.02 m
InternalWall	362.32 m
Height	3 m
Number of floors	4 nos

Plot

Plot Wdth	6.60
Plot Depth	17.15
No of Build. in a row	

Street Block

No of Equiv. Build. per row	2
Width of Strret/W	4.5m
Width of Street/D	4.5m

Interim Results

Building (Equivalent of 10 units)

Area	874.15 sqm
Equivalent Width	129.89 m
Equivalent Depth	6.73 m
Width-Depth Ratio	19.30
ESRA	12.28 sqm
ESRS	3.50 m
Ratio Internal Wall	1.24
Ratio External Wall	0.92
Suspended Floor	2,622.44 sqm

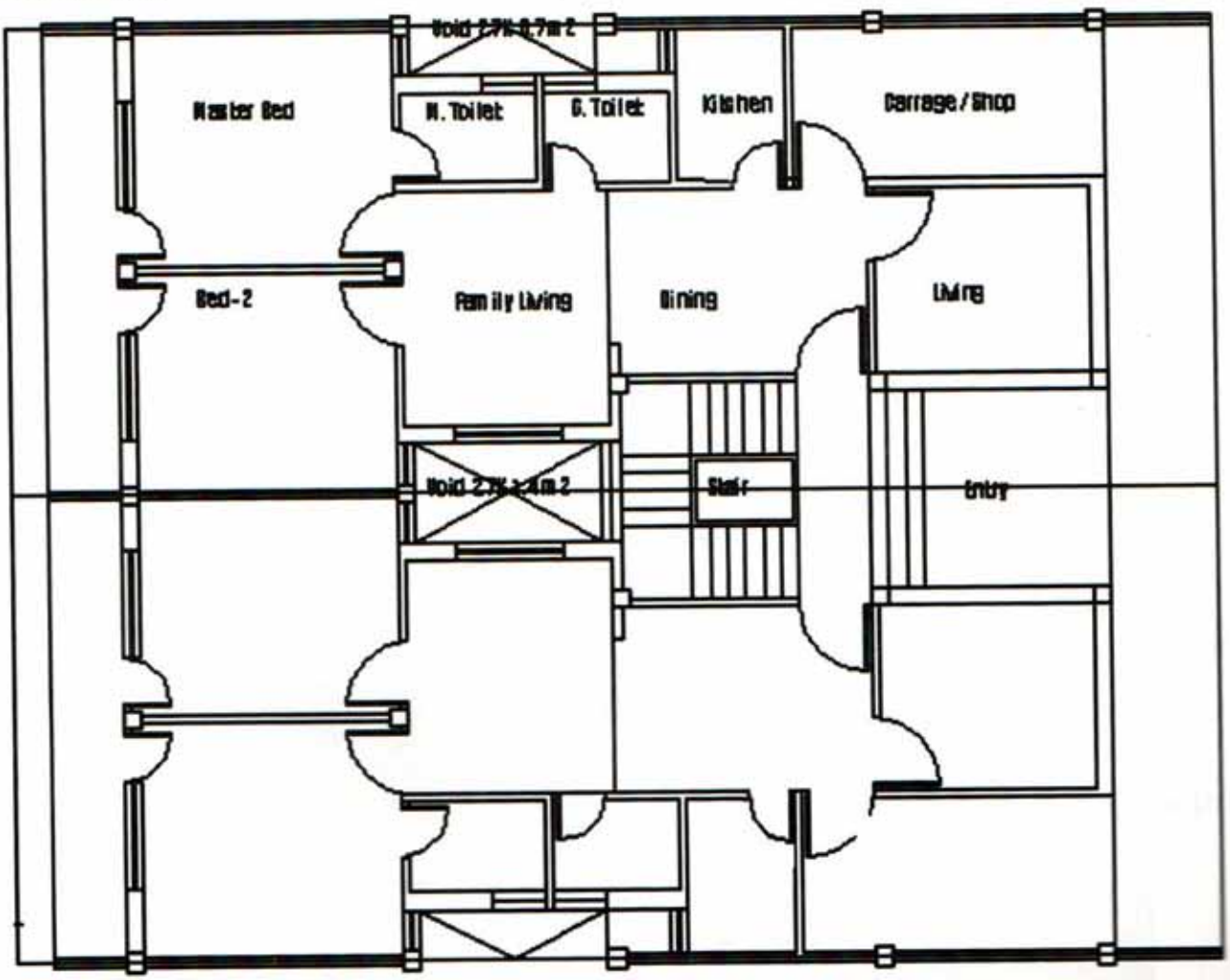
Lenght of Road//W	70.50m
Lenght of Road//D	38.80m
Street Area//W	317.25m
Street Area//D	174.60m
Total Circulation Area	491.85sqm
Residential Area	2263.8 sqm
Total Are of Fragment	0.28 ha
St. Area W/ total Area	12%
St. Area D/ total Area	6%
Circulation / Total Area	18%
Residental / Total Area	82%
Built up / Residential	77%
Total Dwelling Units	80 nos
Total Floor Area	6993.19 sqm
Circulation Density	396.64
Net Population Density	2537.76

Cost Analysis for One Street block **million taka**

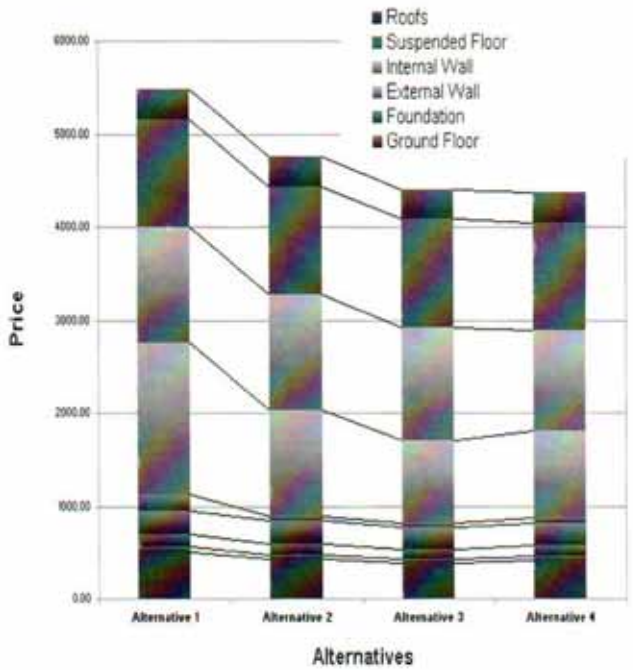
Cost	Element	Vulue	Price/Unit	Ratio	Price/sq m floor	Price/Element (mtk)	%	Reference
	Residential Land	1,275	tk/sq m	0.3237	412.74	0.7216	9%	
	Infrastructure/ Wincluding	5,000	tk/ m	0.0101	50.41	0.0881	1%	
	Infrastructure/ Dincluding	20,000	tk/ m	0.0055	110.97	0.1940	3%	
	Ground Floor	988	tk/sq m	0.2500	247.11	0.4320	6%	
	Foundation	858	tk/ m	0.0568	48.78	0.0853	1%	
	External Wall	1,023	tk/sq m	0.9198	940.80	1.6448	22%	
	Internal Wall	863	tk/sq m	1.2434	1072.82	1.8756	25%	
	Suspended Floor	1,546	tk/sq m	0.75	1159.31	2.0268	27%	
	Roofs	1,289	tk/sq m	0.25	322.34	0.5635	7%	
		Including Land + Infrastructure			**4365**	**7.63**	**100%**	
		Excluding Land + Infrastructure			**3791**	**6.63**		

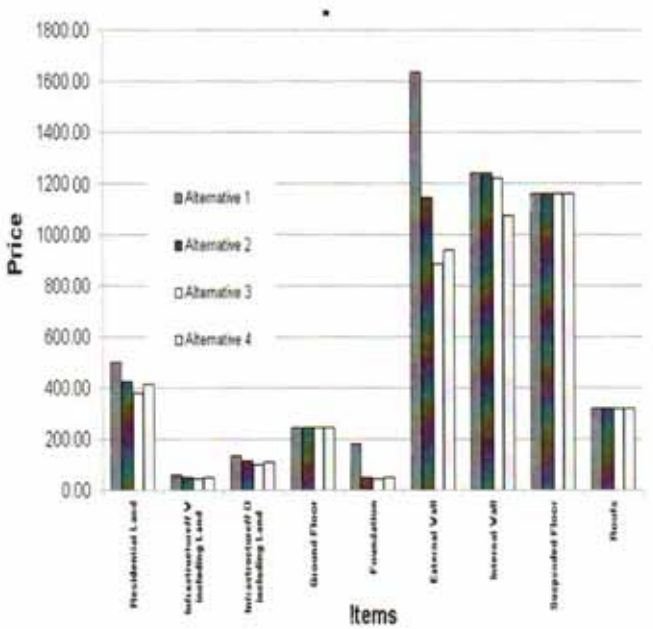
Plot Size: 12.15X 6.60 m2

Ground Floor Plan



Comparison	Original Design	Alternative 1	Alternative 2	Alternative 3
Residential Land	499.96	424.48	380.10	412.74
Infrastructure/ Wincluding	61.06	51.84	46.42	50.41
Infrastructure/ Dincluding	134.41	114.12	102.19	110.97
Ground Floor	247.11	247.11	247.11	247.11
Foundation	178.36	50.16	44.92	48.78
External Wall	1637.02	1142.97	883.83	940.80
Internal Wall	1239.21	1241.06	1220.80	1072.82
Suspended Floor	1159.31	1159.31	1159.31	1159.31
Roofs	322.34	322.34	322.34	322.34
	5478.78	**4753.39**	**4407.02**	**4365.27**





Element Method + Database Funcrtion

Case: Foundation

Input Parameters

Equivalent Width	129.89
Equivalent Depth	6.73
Height	3.00
Number of floors	4.00

Shared Co	7
Own Colum	3
Width of so	1.5 m
Width of so	2 m
Depth of fo	2.5 m
Total Area	210.00 m2
Area of ext	210.00 m2
Volume of	525.00 m2
Sq Column	0.38 m
Crpss Sect	0.14 m2

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