



UNIVERSITY OF NAIROBI  
HOUSING RESEARCH AND DEVELOPMENT UNIT

P. O. BOX 30197 NAIROBI KENYA TELEPHONE 27441 EXT. 212 TELEGRAMS VARSITY

LOW COST HOUSING BUILDING COST INDEX  
(Building costs and building cost index  
for a two roomed low cost house)

Peter A. Erkelens M.Sc. (Civ. Eng.)  
Research Fellow.

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AUTHOR: PETER A. ERKELENS, RESEARCH FELLOW.

Housing Research and Development Unit,  
University of Nairobi,  
P.O. Box 30197,  
Nairobi, Kenya

Abstract:

This publication contains a complete break down of quantities of building materials and building costs of a two roomed house for the self-help developer. The second part of the report discusses how a low cost housing building cost index can be established. This is done along the same lines as the building cost index for residential buildings by the Kenya Central Bureau of Statistics.

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Bill of quantities by P.H. Fox and G. Ochola.

Editing By J.K. Kateregga

Typing by Margret Buliba

<u>Table of contents.</u>	<u>Page.</u>
1. Introduction	1.
2. Summary and recommendations	2.
3. Description of the two roomed low cost house	3.
4. Estimate of building costs	6.
5. Weighing of materials - and labour costs	7.
6. Building cost index	10.
7. Summary of findings and conclusions	13.
8. Appendix I. Bills of Quantity court yard	14.
II. Bills of Quantities 2 roomed low cost house	15.
III. Building cost in remote areas	26.
IV. Specification of the amount of building materials	27.
V. Low cost residential input indicators	29.
VI. Material and labour inputs as percentages of total expenditure	31.
VII. Residential building cost index	32.
VIII. Comparison of building cost index for the three phases of construction	33.
9. References	34.

## 1. INTRODUCTION

The Housing Research and Development Unit is often requested to provide cost information on low cost houses.

This publication is meant to provide such information to an extent. The two roomed house type is taken from the report low income house types for Kenya (Ref. 1). This type plan is one of the most possible low cost houses, which can be built in accordance with the existing Building Code (Ref. 2), using concrete blocks and corrugated galvanised iron sheets.

This report also contains a fully documented Bill of Quantities (BQ) meant for the self-help developer. This BQ formed the basis for the calculation of a low cost building cost index and follows the same methodology as the Central Bureau of Statistics (CBS applies for the calculation of the residential building cost index for middle and high cost housing).

It is hoped that this low cost housing building cost index (which has to be updated at regular intervals) will be of help for the self-help developer in establishing the rising building costs.

## 2. SUMMARY AND RECOMMENDATIONS

The CBS publishes quarterly a building cost index for residential buildings (Middle and High Cost Housing). In this report a standard low cost two roomed house built in accordance with the Building Code was taken as the basis for the calculation of a low cost building cost index.

This two roomed house was analysed in terms of costs. The weightings of the different materials costs, labour costs and building costs formed the input for the calculation of a low cost housing building cost index and materials cost index. The rates are based on an average contract size of 10 pairs of houses. These indices were also calculated in case of phased development of the house.

It was found that the building cost index is the same for the house constructed in phases or at once. The building cost index is lower than for residential buildings. Though the materials are different for a middle cost house to a certain extent it was found that the materials cost indices as provided by the CBS could also be used for the low cost housing index.

It was found that the labour cost index of the CBS does not represent the actual situation in the building industry and is in fact too low.

### Recommendations

The CBS should carry out more research into the development of the building materials costs specially for low cost housing, e.g. galvanized corrugated roofing sheets are not included in the materials cost index.

The so called "non permanent" materials like mud bricks, stabilised soil blocks, wattle etc. should be included in the quarterly publication of the building cost index.

The labour cost index (as published by the CBS) should be made more in line with the actual situation. This will also provide a more accurate building cost index.

### 3. DESCRIPTION OF THE TWO ROOMED LOW COST HOUSE

The two roomed low cost house consists of a multi-purpose room of  $12\text{m}^2$ , a bedroom of  $9\text{m}^2$ , a kitchen, a shower, a toilet and an open splash area. (See fig. 1, 2, and 3).  
(Source: Low Income House Types for Kenya, Ref: 1).

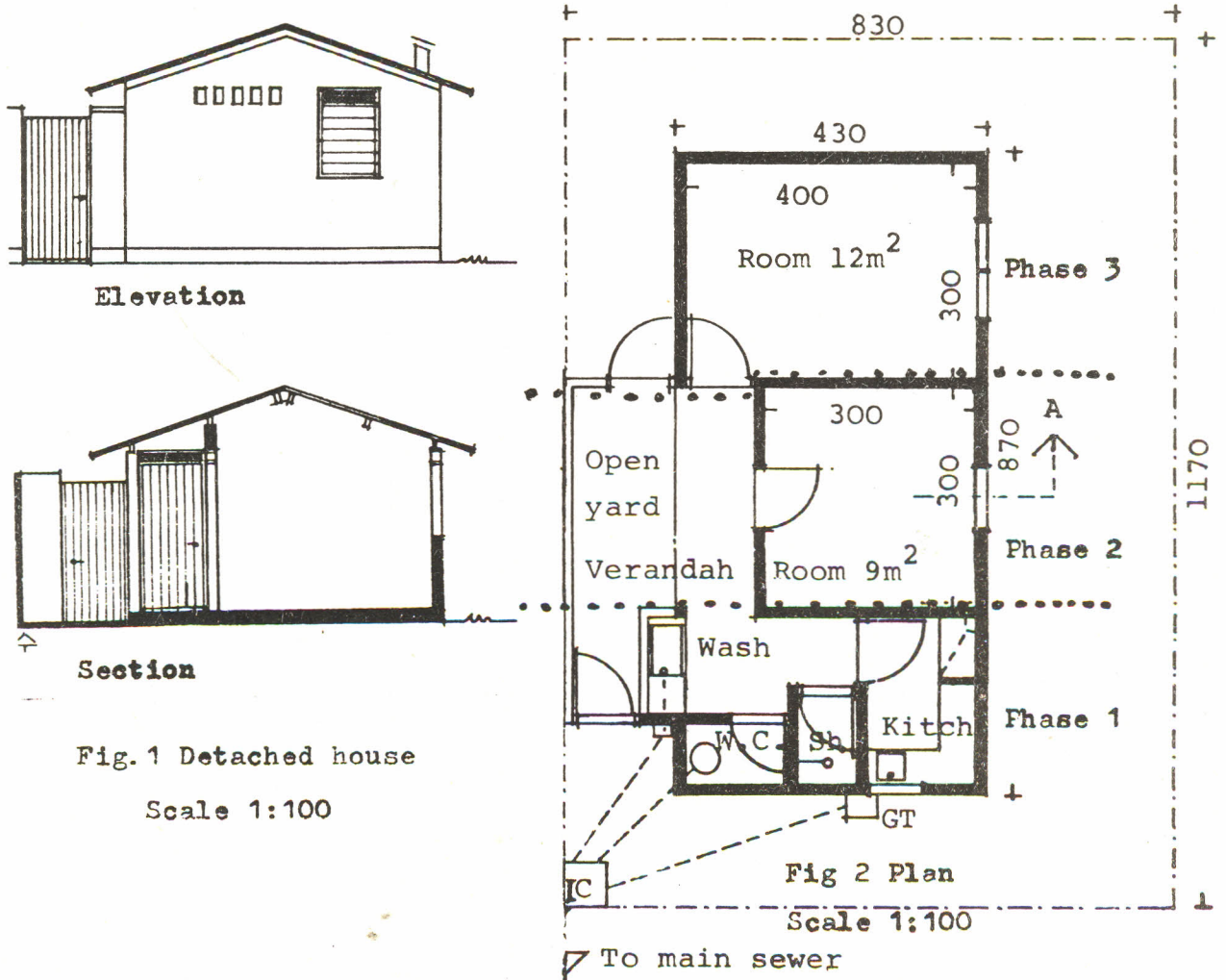


Fig.1 Detached house  
Scale 1:100

Fig 2 Plan  
Scale 1:100

The following describes briefly the materials and conditions applied to this house:

Site: Assuming flat area.

Foundation: Concrete strip (150 by 450mm; 1:3:6 mix).

Concrete block sub-walling (3 courses), 140mm concrete blocks.

Bagwashing to external surface (150mm above ground level).

Stone filling, (200mm under floor).

Floor slab, (75mm concrete, 1:3:6 mix).

Soil conditions are assumed to be of medium quality.

- Walls:** 140mm solid concrete blocks for external and load bearing walls 90mm concrete solid blocks for internal walls (toilet walls, wash place).  
Cement mortar, (1:5 mix).  
Bagwash on walls.
- Roofing:** Timber purlins, Podo or Cypress (50 by 100mm).  
Corrugated galvanised iron-sheets (26 gauge).  
Galvanised nails.  
Galvanised ridge cover.  
Verge-board (gable only).
- Windows:** Timber frames (38 by 78mm).  
Glass louvres with metal frames.  
Mosquito gauze wire to cover ventilation part only.
- Doors:** Door shutter ledged and braced with rim lock.
- Painting:** Oil painting to wood work with wood primer.
- Kitchen:** One water tap provided.  
ENAMELED iron sink.  
Concrete cooking slab and work top.  
Metal cooking hood.  
Metal ventilation pipe.
- W.C.:** Cistern, Low level Eastern type w.c. pan with high level cistern.
- Shower:** Shower head and closing valve.
- Wash Area:** Concrete slab with built in sink (concrete) with one tap.
- External:** Necessary drains, gully traps and inspection chambers.  
Water is provided from the public main at the plot boundary.

(see also appendices I and II for more detailed information.)

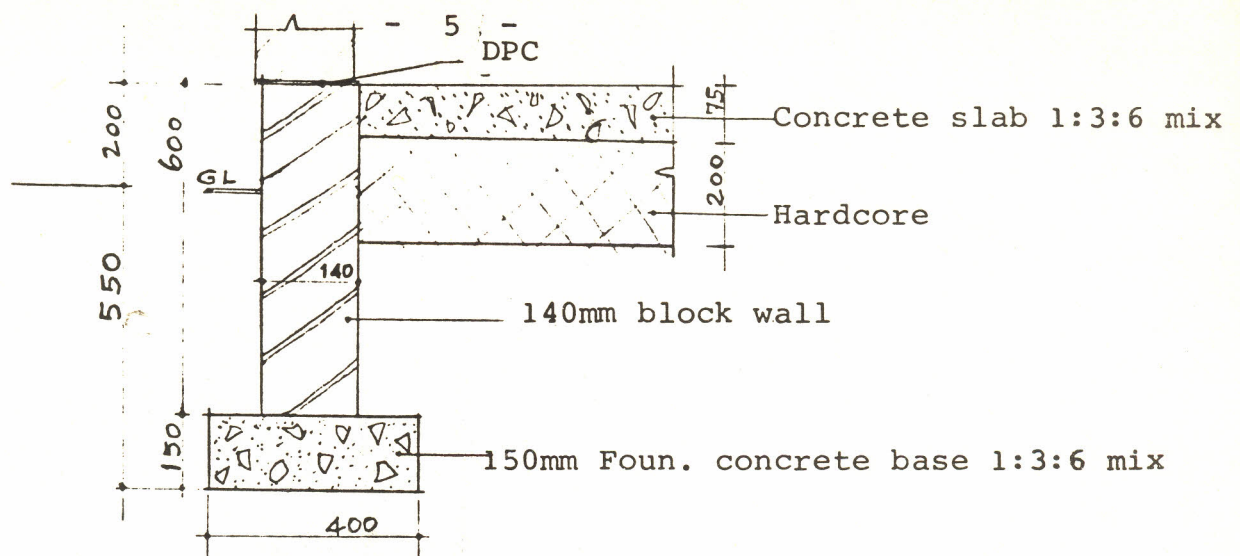


Fig. 3 Detail of foundation structure.

### Improvements

As can be seen from above the materials were kept as simple as possible and so was the detailing of the house.

If, however, improvements are wanted the following options may be considered:

- the use of paint instead of bagwash,
- cement screed as pavement on the unfinished concrete floor,
- a fenced courtyard (this option is costed in appendix I),
- provision for electric connections.

### Phased construction

For site and service projects (for which this house type is very suitable) the construction of this house can be either completed in one time but (and that is done more often) it can also be completed in phases. (This is indicated in fig. 2.) These phases are:

Phase 1. The construction of a wet core, consisting of a toilet, shower, kitchen and splash area.

Phase 2. The construction of the bedroom of  $9\text{m}^2$ .

The already existing wall of the core unit can now also be used as a wall for this room.

Phase 3. The construction of the multi-purpose room of  $12\text{m}^2$ . Here the wall of the  $9\text{m}^2$  bedroom can be used.



#### 4. ESTIMATE OF THE BUILDING COSTS

The cost estimates of the house contain only the on-plot costs. Furthermore it is assumed that this house is situated in Nairobi and that the City Council provides for the main sewer and water main in front of the plot. Also the price of land is not taken into consideration.

Appendix II contains an exhaustive BQ for this house and also makes a distinction in case of phased development.

The rates are based on an average contract size of 10 pairs of houses and on competitive tenders of contracts between KShs.0.5 million and 2 million in Nairobi, December 1979. For a single built house the rates will be higher, while for a number of 20 and more the repetition effect will cause the rates to go down.

The rates cover the cost of materials, labour, profit overhead and maintenance.

The Bill of Quantities show the amount for preliminaries as 7.5% of the total costs. These preliminaries are City Council water connection fees, pumping of the trenches, bonds, insurances, site office, storage sheds etc.

Contingencies can be added at the discretion of the user. The rates will be changing in due time but for the weighing of the different materials costs and labour costs this is not important.

The BQ shows the building costs for the different phases of the contractor-built house are:

Phase 1	KShs.14,975.00	(56%)
Phase 2	KShs. 5,587.00	(21%)
Phase 3	KShs. 6,140.00	(23%)
Total	KShs.26,702.00	(100%)

In case of fully self-help construction these amounts may be reduced by 25%, being labour costs.

For estimating building costs in remote areas appendix III provides some figures.

Appendix IV shows a complete list of the quantities of building materials required for the construction at one time and in case of a phased construction.

The HRDU has for sale extra copies of this BQ for the self-help builder.

## 5. WEIGHING OF MATERIALS - AND LABOUR COSTS

For the development of a building cost index for low cost housing the documentation from the CBS (Ref: 3) was used as a guide.

The main 'constituents' of the composite index of construction costs detailed in that CBS document are the cost indices on residential buildings (middle and high cost housing) and non residential buildings respectively and on the civil engineering work.

The price of a structure is made up of the cost of materials, labour, overhead and profits. The applied method of measuring changes in the construction costs is based on estimates of changes in the costs of each of these constituent items. This approach is based on the assumption that the average units of construction work produced, are homogenous so long as the proportions of materials, labour, overhead and profits in a structure are constant all over the time.

For the implementation of the CBS method, two major exercises had to be carried out with the BQ (appendix II).

- (i). Separation of preliminaries, costs of materials, labour, profits, etc. and
- (ii). rearranging of the materials and labour under input indicators.

1. The CBS building cost index is only built up of materials costs and labour costs. Preliminaries, overhead, profits, depreciation and maintenance costs were deleted, since variations in these are not necessarily a consequence of price changes (sometimes it is due to different management methods).

The omission of these factors, as it is felt by the CBS, would not affect the reliability of the building cost index.

Because the costs of materials and labour account for about 80 percent of the total expenditure.

The deduction of the preliminaries from the BQ of the low cost house results in a reduction from KShs.26,702.00 to KShs.24,861.00.

Calculations showed that the profit (+ overhead, maintenance, etc.) in the BQ was in the order of KShs.3,443.00 (13.8% of KShs.24,861.00). The net amount of KShs.21,418.00 covers only direct labour and building materials costs.

3. The second exercise was to rearrange the materials - and labour cost from the BQ under the input indicators as used by the CBS for residential buildings. These input indicators are:

Materials: sand, aggregate, cement, concrete blocks, hardcore filling, reinforcing mild steel rods, timber/doors, hardware/windows, paints, glass, roofing materials, plumbing and sanitary fixtures.

Labour: unskilled, semi-skilled and skilled labour.

Appendix V shows how the different building materials of this two roomed house were grouped under these indicators. Indicators deleted were: for floor tiles and electrical systems. Furthermore no distinction could be made between the various skilled, semi-skilled and unskilled labourers.

After these two exercises the weighing factors could be established. These are shown in Table 1. This table shows comparisons of the CBS residential building cost index. It can be seen that the material input is 72.50% while the labour input is 27.50% of the total.

Along the same lines the weighing factors were derived for the three phases. (Appendix VI.)

Table 1. Material and labour inputs in absolute figures and as a percentage of total expenditure, grouped under input indicators of CBS.

Input indicator	Completed low-cost house		CBS, residential building weight %
	in K.Shs.	Weight %	
Sand	560.00	2.61	4.6
Aggregate	425.00	1.98	5.6
Cement	2,211.00	10.32	10.0
Concrete blocks	4,047.00	18.90	6.0
Hardcore filling	276.00	1.29	1.5
Floor tiles	-	-	5.2
Reinforcing mild steel	34.00	0.16	3.0
Timber	460.00	2.15	7.12
Doors	805.00	3.76	1.78
Hardware	653.00	3.05	0.90
Windows	210.00	0.98	3.60
Paints	286.00	1.34	8.2
Glass	253.00	1.18	1.0
Roofing materials	2,203.00	10.29	4.10
Drainage waste & w.s.	1,696.00	7.92	2.73
Trapped gully	329.00	1.54	0.37
Sanitary fixtures	1,085.00	5.06	4.65
Electrical installation	-	-	5.2
All materials	15,533.00	72.52	75.6
Labour	5,885.00	27.48	24.4
Total	21,418.00	100%	100%

6. BUILDING COST INDEX

The development of the cost indices for the different input indicators is shown in Appendix VII. This covers the period 1972 - 1980<sup>+</sup>.

For the calculation of the materials cost index the following has to be done (according to the CBS):

- Multiply the weighings of each of the indicators with its relevant cost index (see resp. table 1 and appendix VII).
- Add these products.
- Multiply the obtained sum with the factor  $100:72:50 = 1.379$ .

The figure obtained is then the materials cost index.

Table 2 shows this index for a number of years and also the residential materials cost index.

Year	Low cost house	Residential buildings	Difference
1972	100.	100.	-
1973	114.5	116.6	2.1
1974	143.2	155.9	12.7
1975	164.1	183.7	19.6
1976	174.3	190.3	16.
1977	193.6	211.7	18.1
1978	225.9	233.7	7.8
1979	268.5	270.3	1.8
1980	294.2	289.4	5.2

Table 2. Comparison of building materials cost index for low cost housing and residential buildings.

The labour cost index for low cost housing is the same as for residential housing as long as it is assumed that the ratios of skilled, semi-skilled and unskilled labour are the same.

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<sup>+</sup> December of each year, except for 1980 for which March is taken.

Year <sup>+</sup>	Labour cost index
1972	100.
1973	109.7
1974	123.1
1975	138.1
1976	152.2
1977	159.0
1978	159.0
1979	175.8
1980	175.8

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Table 3. Labour cost index for residential buildings  
Source CBS.

The building cost index can be obtained by adding up the material cost index and the labour cost index, (multiplied respectively with 0.7250 and 0.2750).

The following table shows this index for low cost houses and for residential buildings.

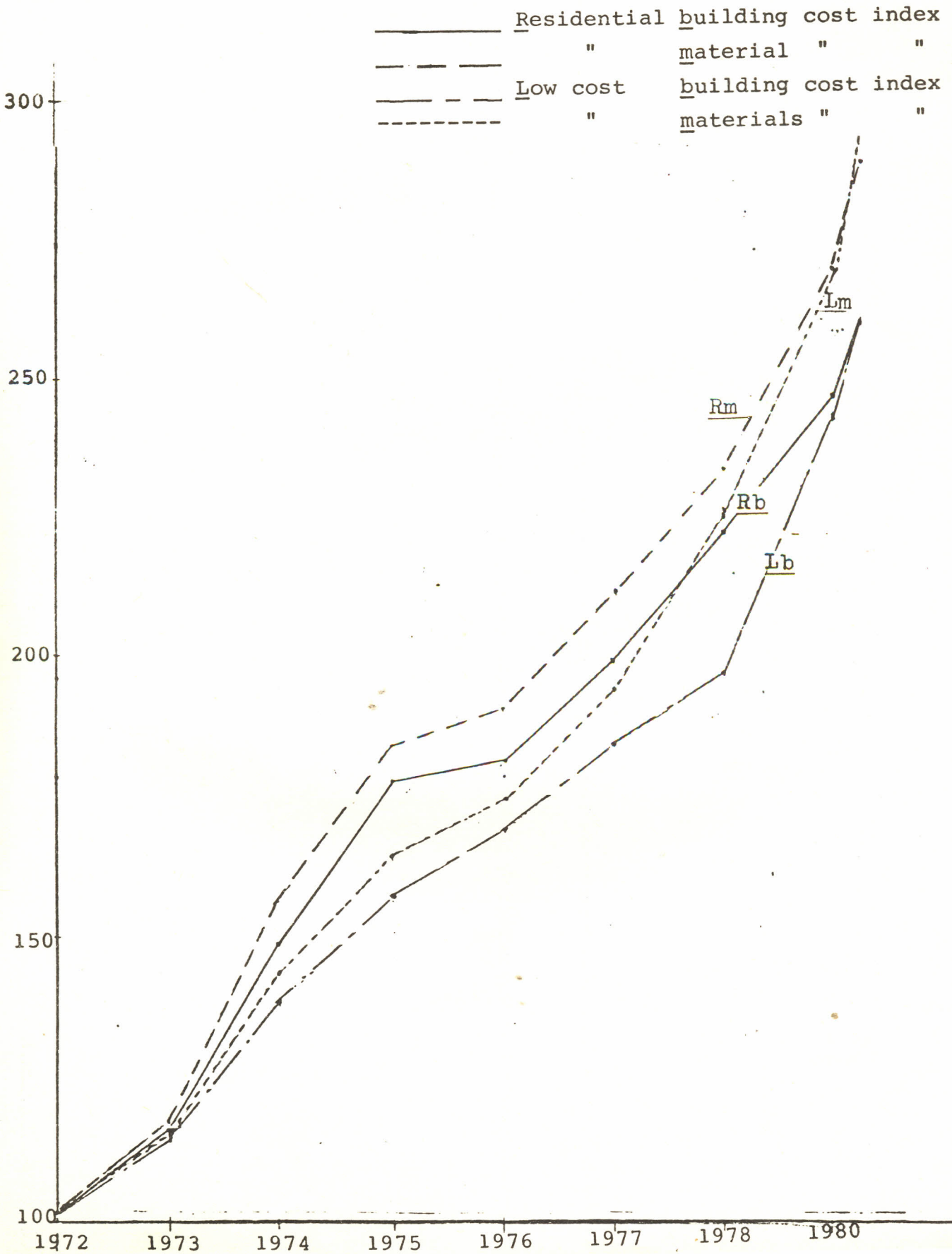
Year <sup>+</sup>	Low Cost House	Residential Buildings	Difference
1972	100.	100.	-
1973	113.2	114.9	1.7
1974	137.8	148.1	10.3
1975	156.9	177.6	20.7
1976	168.6	181.0	12.4
1977	184.0	198.9	14.9
1978	207.3	223.8	16.5
1979	242.9	247.2	4.3
1980	261.5	261.7	+0.2

Table 4. Building cost index for low cost housing and residential buildings.

Fig. 4 shows the building cost index and building materials cost index for both low cost housing and residential buildings.

<sup>+</sup>December of each year, except for 1980: March.

Fig. 4. Building cost index and materials cost index for (middle and high cost) residential houses and low cost houses.



## 7. FINDINGS AND CONCLUSIONS

### Building cost index:

By comparing the building cost index for low cost housing and middle and high cost housing (residential buildings) (see fig. 4) it can be seen that the building cost index for the former was 1.7 - 20.7 points lower over the period 1973 - 1979. In March 1980 these two indices are about the same.<sup>+</sup> For a future development nothing can be said.

### Material cost index:

The same fig. shows that the materials cost index follows the same pattern as the building cost index.

### Labour cost index:

It was assumed that this index was the same for both housing types. However, the index as such does not confirm with the reality. The CBS seems to use the Gazetteed wages only, which are far below the actual situation. In the authors opinion the building cost index is at a far higher level than officially published by the CBS. However, due to lack of other adequate data it was necessary to use this index.

### Building cost index for phased development

Appendix VIII shows the building cost indices for the different phases. Statistical calculations show that these are not significantly different for the three phases are the whole construction. Therefore it may be noted that the development of the building cost index for the construction as a whole is also applicable for the phased construction.

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<sup>+</sup> The reason for this is that for some basic materials like concrete blocks and roofing the materials cost indices went up considerably. As these two components form 29% of the total cost for low cost housing and only 10% for residential middle and high cost housing the impact is tremendous.



Bill of Quantity  
Courtyard.

Appendix I.

Item	Quant.	Un.	Rate KShs.	Total KShs.
<u>COURTYARD</u>				
There are three options, each option to be combined with: Frame ledged and braced batten doors including all fitting and frame fastening iron mongery.	2	No.	260/-	520/-
Finishing: Prime and paint 3 coats enamel on wood surface.	8.6	SM	16/-	137/6
<u>OPTION 1</u>				
Fence 2m high above ground level: 50mm GMS posts (6 nos. 2.50m each), c.t.c. 1.0m).	15	LM	58/	870/-
Capped ends.	6	No	35/-	210/-
Concrete bases 400 x 400 x 150 mm incl. excavation.	6	No	60/-	360/-
50 x 50mm cypress rail clamped to GMS posts.	15	LM	6/25	93/75
100 x 25mm cypress vertical boarding.	66	LM	6/25	412/50
Finishing: Prime and paint 3 coats enamel on wood surface	20.5	SM	16/-	328/-
Galvanized steel surfaces of fence posts.	24	SM	16/-	384/-
Total				2658/25
<u>OPTION 2.</u>				
100 x 25mm timber battens at at 150mm centre fixed to 50 x 50mm rails, fixed to 100m diameter fencing posts at 1.0m c.t.c. (length 2.5m).	66	LM	6/25	412/50
	15	LM	6/25	93/75
	6	No	15/-	90/-
Nails, galvanized	2	Kg.	5/-	10/-
Finishing: Prime and paint 3 coats enamel on wood surface.	20.5	SM	16/-	328/-
Total				934/25
<u>OPTION 3</u>				
Cedar posts c.t.c. 1.0m long 1m + iron wire.	6	LM	10/-	60/-
	6	LM	0/16	1/-
Total				61/-

Bills of Quantities.  
Two roomed low cost house.

Appendix II.

Phase	Item	Quant.Un.	Rate <sup>+</sup> KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
1 23	<u>SUBSTRUCTURE</u> Foundation work including up to Damp Proof Course (DPC).  Excavate over site 150mm deep to remove vegetable soil and wheel and deposite, spread and level on site as directed.	41.4 SM	3/-	124/20	37/20	43/50	43/50
1 2 3	Excavate foundation trench commencing from reduced level 400mm deep and not exceeding 1.5m deep, measured from ground level. Backfill trench-edge, ram and compact.	6.3 CM	31/-	195/30	86/8	49/60	58/90
1 2 3	Load and remove excess soil from excavation to a given tip, not exceeding 100m from excavation.	2 CM	5/-	10/-	4/50	2/50	3/-
1 2 3	Compact trench bottom to receive concrete foundation.	15.5 CM	0/35	5/42	2/45	1/40	1/57
1 2 3	Concrete 1:3:6 in foundation slab 15cm thick 20mm aggregates, well compacted and cured.	2 CM	400/-	800/-	360/-	200/-	240/-
1	Construct 90mm solid concrete block walling upto DPC in 1:5 cement mortar.	3.5 SM	55/-	192/50	192/50		
	Substructure sub-total (page 1):			1328/-	684/-	297/-	347/-
	+) All rates 1 December 1979.						

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
	<u>SUBSTRUCTURE (ctd);</u>							
1 2 3	Construct 140mm solid concrete block walling up to DPC in 1:5 cement mortar	18	SM	66/-	1188/-	402/60	376/-	409/-
1	Provide and lay 90mm wide DPC to B.S. Specification to 90mm wall.	6	LM	4/-	24/-	24/-	-	-
1 2 3	Provide and lay 140mm DPC to B.S. Specification to 140mm wall.	30	LM	6/-	180/-	62/40	54/60	61/80
1 2 3	200mm hardcore rammed and compacted including blinding to surface to receive concrete floor slab.	33	SM	12/-	396/-	102/-	150/-	144/-
1 2 3	Cast 75mm thick concrete floor slab 1:3:6, mix 20mm aggregates, well compacted and cured and steel trowelled smooth.	33	SM	35/-	1155/-	298/-	437/-	420/-
2	Thickening of yard edge with concrete (150 x 200mm)	3	LM	12/-	36/-		36/-	
	Substructure subtotal (page 2):				2979/-	889/-	1054/-	1035/-
	(page 1):				1328/-	698/-	297/-	347/-
	Substructure total				4307/-	1573/-	1351/-	1382/-

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
	<u>SUPERSTRUCTURE.</u>							
1 2 3	Construct 140mm concrete block wall in 1:5 cement sand mortar to support structure.	64	SM	63/-	4032/-	1450/-	1200/-	1382/-
1	Construct 90mm concrete block wall in 1:5 cement sand mortar to support structure.	12.4	SM	48/-	595/-	595/-		
1	Column for roof support near wash place, 140 x 390 standard concrete block column.	2	LM	20/-	40/-	40/-		
3	100 x 150mm cypress lintel (over door room 12m <sup>2</sup> )	1	LM	12/50	12/50			12/50
2	140 x 140mm precast concrete lintel (over door room 9m <sup>2</sup> ).	1	LM	40/-	40/-		12/40	
	Superstructure total:				4720/-	2085/-	1240/-	1395/-

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
	<u>ROOF.</u>							
1 23	Provide gauge 26 Galvanized Corrugated Iron Sheets (CGI) and fix with galvanized twisted roofing nails.	50	SM	56/-	2800/-	784/-	1008/-	1008/-
1 2 3	Provide and fix gauge 26 GCI ridge cover, girth 254mm and fix with galvanized twisted roofing nails.	9.3	LM	17/-	158/1	46/75	52/70	58/65
1	Cut and fix roofing around flue including cement filler. Flue 170mm diameter.	1	No	20/-	20/-	20/-		
1 23	Provide and fix 100 x 50mm cypress purlins to walls to receive roof covering.	56	LM	12/50	700/-	200/-	250/-	250/-
1	Provide and fix 125 x 125mm verge board. Priming, knotting and stopping with painting separately. Fixed at ends of purlins.	9.2	LM	8/-	73/50	73/50		
	Roof total:				3752/-	1124/-	1312/-	1316/-

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase KShs.
	<u>DOORS</u>							
123	Frame ledged and braced door shutters together with frames including horizontal frame at transome height above floor for fan light in cypress timber. Sizes 830 x 2000mm.	3	No	233/-	699/-	233/-	233/-	233/-
1	WC + shower ditto doors 700 x 2000mm.	2	No	225/-	450/-	450/-		
123	Rimlock for doors.	3	No	90/-	270/-	90/-	90/-	90/-
1	Provide and fix iron bolt 150mm in shower and WC.	2	No	8/-	16/-	16/-		
1 23	Provide and fix pairs 100mm steel hinges 5 doors, 7.5 pairs.	7.5	Prs	14/-	105/-	63/-	21/-	21/-
	Doors total:				1540/-	852/-	344/-	344/-

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
	<u>WINDOWS + GLAZING</u>							
123	Provide and fix 75 x 38mm cypress window frames planned and cut to sizes, plugged.	13	LM	8/-	104/-	32/-	32/-	40/-
123	Provide and fix 75 x 38mm cypress planned and cut to sizes. Mullion and transomes.	4	LM	8/-	32/-	19/-	6/50	6/50
123	Nylon glass mosquito gauze mesh above windows and doors.	0.6	SM	78/-	46/0	13/-	13/-	20/-
123	Cypress timber beading (20 x 12mm) for mosquito mesh.	14	LM	1/-	14/-	4/-	4/-	6/-
123	Provide and fix 4 pairs of metal adjustable louvre frames for 6 glass blades 150mm.	4	No	75/-	300/-	75/-	75/-	150/-
3	Provide and fix 792 x 150mm x 3.5mm louvre glass blades with rubbed edges.	9.5	LM	20/-	190/-			190/-
12	Provide and fix 611mm x 150mm x 3.5mm louvre glass blades with rubbed edges.	7.5	LM	20/-	150/-	75/-	75/-	
	Windows total:				836/-	218/-	206/-	412/-

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
	<u>PLUMBING</u>							
1	Kitchen, Enamelled kitchen sink and waste fitting.	1	No	500/-	500/-	500/-		
1	" ½ brass bid tap.	1	No	90/-	90/-	90/-		
1	WC, provide and fix low level wc Eastern type wc suite squatting type with high level cast iron cistern.	1	No	1000/-	1000/-	1000/-		
1	Shower, shower head, Galvanized mild steel (GMS).	1	No	50/-	50/-	50/-		
1	" ½ stop cock (control valve).	1	No	25/-	25/-	25/-		
1	Washplace, ½" brass bib tap.	1	No	90/-	90/-	90/-		
1	Tubing, 12mm GMS tubing class B.	11	LM	16/-	176/-	176/-		
1	12 x 12 x 12 Tee.	3	No	10/-	30/-	30/-		
1	12mm bends.	7	No	10/-	70/-	70/-		
1	12mm stop cock (near meter)	2	No	25/-	50/-	50/-		
1	Waste, 50mm GMS deep seal gulley trap and connection and grating to shower floor outlet.	1	No	130/-	130/-	130/-		
1	32mm GMS trap and cleaning eye from washing sink and from kitchen sink.	2	No	65/-	130/-	130/-		
	Sub total Plumbing (page 7):				2341/-	2341/-		



Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
1	Plumbing (ctd). (waste) 12mm GMS overflow 400cm long with bend and connection to cistern (WC).	1	No	25/-	25/-	25/-		
1	32mm GMS waste pipe from two sinks to gulley trap.	2	LM	34/-	68/-	68/-		
1	32mm bends.	4	No	30/-	120/-	120/-		
1	<u>Drains</u> , 100mm gulley trap, grating, concrete surround and curb. (near kitchen and wash place).	2	No	170/-	340/-	340/-		
1	50mm GMS waste pipe laid in hardcore from shower-gulley trap.	1	LM	58/-	58/-	58/-		
1	Bends.	2	No	60/-	120/-	120/-		
1	100mm large radius cast bend in WC outlet (from WC to outside of house).	1	No	100/-	100/-	100/-		
1	100mm pitch fibre pipe laid and jointed in trench (from house to manhold).	8	LM	75/-	600/-	600/-		
1	Excavate trench 900mm deep.	8	LM	20/-	160/-	160/-		
1	Manhole, internal size 600 x 450mm and 100m deep to be covered with medium duty cover.	1	No	650/-	650/-	650/-		
1	Allow for cutting away and making good for plumbing and waste installation.	Item	-	250/-	250/-	250/-		
1	Allow for testing of plumbing and drainage.	Item	-	100/-	100/-	100/-		
	Plumbing sub total (page 8):				2591/-	2591/-		

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase1 KShs.	Phase2 KShs.	Phase3 KShs.
	(Plumbing and drainage ctd)							
1	<u>Worktop</u> , precast and fix to kitchen a work top and cooking slab of 75mm thick reinforced concrete, with steel fabric mesh reinforcement.	2	SM	109/-	218/-	218/-		
1	Provide for sink opening.	1	No	10/-	10/-	10/-		
1	Provide and construct 90mm standard concrete block bearer walls.	2	SM	84/-	168/-	168/-		
1	<u>Flue</u> , provide and fix GMS cooking hood of overall size 700 x 500mm.	1	No	250/-	250/-	250/-		
1	GMS flue 100 x 150mm with 4 angles plus 24 SWG sheeting.	1	LM	292/-	292/-	292/-		
1	GMS flue capping 200 x 250mm.	1	No	50/-	50/-	50/-		
1	<u>Wash area</u> , provide and fix as washing bench a 75mm precast reinforced concrete slab with steel fabric mesh reinforcement with built in concrete sink 600 x 1500 x 75mm.	1	No	500/-	500/-	500/-		
	Sub total (page 9):				1488/-	1488/-		
	Sub total (page 8):				2591/-	2591/-		
	Sub total (page 7):				2341/-	2341/-		
	<b>Total plumbing and drainage:</b>				<b>6420/-</b>	<b>6420/-</b>		

Phase	Item.	Quantity	Unit	Rate KShs.	Total KShs.	Phase 1 KShs.	Phase 2 KShs.	Phase 3 KShs.
	<u>FINISHINGS/PAINTING</u>							
1 2 3	Fairface and bagwash to walling.	143	SM	18/-	2574/-	1170/-	648/-	756/-
1 2 3	Fairface to edge of concrete bed.	3	SM	20/-	60/-	28/-	14/-	18/-
1	Cement sand rendering to walls.	11	SM	20/-	220/-	220/-		
1	Prime and paint three coats enamel on wood surfaces: verge board.	2.2	SM	16/-	35/20	35/20		
123	Doors (rooms and kitchen).	9.9	SM	16/-	159/-	53/-	53/-	53/-
1	Doors (WC, shower).	5.6	SM	16/-	90/-	90/-		
123	Frames of doors.	3	SM	16/-	48/-	16/-	16/-	16/-
1	Frames doors (WC, shower).	1.9	SM	16/-	31/-	31/-		
1 2 3	Window frames.	2.95	SM	16/-	47/-	15/-	13/-	19/-
	Finishings total:				3264/-	1658/-	744/-	862/-

Bill of Quantities

Collection.

Item.	Total		Phase 1		Phase 2		Phase 3	
	KShs.	%	KShs.	%	KShs.	%	KShs.	%
Substructure (page 1, 2).	4307/-	16.1	1573/-	10.5	1351/-	24.2	1382/-	22.5
Superstructure (page 3).	4720/-	17.7	2085/-	13.9	1240/-	22.2	1395/-	22.7
Roof (page 4)	3752/-	14.1	1124/-	7.5	1312/-	23.5	1316/-	21.4
Doors (page 5).	1540/-	5.8	852/-	5.7	344/-	6.2	344/-	5.6
Windows + Glazing (page 6).	836/-	3.1	218/-	1.5	206/-	3.7	412/-	6.7
Plumbing (page 7, 8, 9).	6420/-	24.0	6420/-	42.9	-	-	-	-
Finishings/ painting (page 10).	3264/-	12.2	1658/-	11.0	744/-	13.3	862/-	14.0
Add 7.5% preliminaries <sup>+</sup> )	1863/-	7.0	1045/-	7.0	390/-	7.0	428/-	7.0
<b>Total</b>	<b>26702/-</b>	<b>100.0</b>	<b>14975/-</b>	<b>100.0</b>	<b>5587/-</b>	<b>100.0</b>	<b>6140/-</b>	<b>100.0</b>
Percentages	100		56		21		23	

+)  
City water main connection costs,  
pumping of trench, bonds, insurances,  
site hut, etc.

Appendix III.

Table 5. Building cost in remote area's extra percentages.

June 1980.

Location	Extra % of building cost compared with Nairobi.
Busia	10
Garsen	20
Hola	30
Isiolo	15
Kakamega	5
Kisii	10
Kitui	15
Lamu	45
Lodwar	40
Lokitaung	65
Malindi	5
Mandera	90
Maralal	30
Marsabit	60
Moyale	80

Source: Gazettee of Kenya Cement prices and National Housing Corporation Handbook.

Specification of the amount of building materials.

Appendix IV.

Materials	Unit	Amount Phase 1+2+3	Amount Phase 1	Amount Phase 2	Amount Phase 3
Concrete	CM	4.75	1.8	1.45	1.5
Blockwalls 90mm	SM	17.9	17.9	-	-
140mm	SM	83.	30.1	24.7	28.2
Mortar					
Damp proof 90mm	SM	6.	6.	-	-
course 140mm	SM	30.	10.4	9.1	10.5
Hardcore	CM	6.6	1.7	2.5	2.4
Cypress 100x50mm	LM	57.	16.	20.	21.
Verge board	LM	9.2	9.2	-	-
Roof GCI 26g.	SM	50.	14.	18.	18.
GCI ridge	LM	9.3	2.75	3.10	3.45
Doors ledged and braced	No.	3.	1.	1.	1.
Shower, WC doors	No.	2.	2.	-	-
Rimlock	No.	3.	1.	1.	1.
Iron bolt	No.	2.	2.	-	-
Steel hinges	No.	15.	9.	3.	3.
Cypress windows	LM	17.	6.4	4.8	5.8
Mosquito gauze mesh	SM	0.6	0.17	0.17	0.26
Louvre frames	No.	4.	1.	1.	2.
Louvre glass bl.	LM	17.	3.75	3.75	9.5
Enamelled Kitchen sink	No.	1.	1.	-	-
½" brass bib tap	No.	2.	2.	-	-
WC sq. type + cist.	No.	1.	1.	-	-
Shower head gms.	No.	1.	1.	-	-
½" stop cock	No.	3.	3.	-	-
12mm GMS tubing	LM	11.	11.	-	-
12x12x12 T	No.	3.	3.	-	-
12mm bends	No.	7.	7.	-	-
50mm GMS deep	No.	1.	1.	-	-
Seal gulley trap					
32mm g.t. cleaning eye	No.	2.	2.	-	-
12mm GMS overflow	No.	1.	1.	-	-
32mm GMS wastepipe	No.	2.	2.	-	-
32mm bends	No.	4.	4.	-	-

Materials	Unit	Amount Phase 1+2+3	Amount Phase 1	Amount Phase 2	Amount Phase 3
100mm Gulley trap	No.	2.	2.		
50mm GMS waste pipe	No.	1.	1.		
Bends	No.	2.	2.		
Cast iron bend 100mm radius	No.	1.	1.		
100mm pitch Fibre pipe	LM	8.	8.		
Manhole 600x450mm	No.	1.	1.		
GMS cooking hood	No.	1.	1.		
flue capping		1.	1.		
flue		1.	1.		
Bagwash	SM	143.	65.	36.	42.
Fairface to edge of concrete	SM	3.	1.4	0.7	0.9
Cement sand rend	SM	11.	11.	-	-
Prime and paint	SM	25.55	14.95	5.05	5.55

Appendix V.

Low cost residential input indicators

The CBS has grouped materials and labour under input indicators for (middle and high cost) residential buildings. Most of these indicators can also be used for the low cost housing building cost index.

The numbers before the indicators correspond with the numbers of the input indicators of the CBS.

1. Cement, 2. Sand, 3. Aggregate.

It has been assumed that the applied concrete mixture is 1:3:6 by volume.  $1\text{m}^3$  concrete contains:  $0.195\text{m}^3$  of cement,  $0.585\text{m}^3$  sand and  $1.17\text{m}^3$  of aggregate. This concrete is used for the foundations, floor slab, lintel, work top in wash area and kitchen, and a reinforcement of the yard edge. For bagwash, 1 bag of cement will be used per  $7\text{m}^2$ .

For cement sand rendering; mixture 1:4 and 20mm thick. All the materials containing sand/cement/aggregate were split according to the above ratio's. Except concrete blocks which are a separate input indicator.

4. Concrete blocks.

For concrete blocks the amount of blocks per  $\text{m}^2$  wall is 12.5 blocks for both 140 and 90mm block walling. (Metric size blocks.)

5. Hardcore filling.

Hardcore is applied in a layer of a minimum of 200mm and is assumed to weigh 1500kg. per  $\text{m}^3$ .

7. Reinforcing mild steel rods.

Reinforcement steel is only applied in the worktops as a wire mesh. The weight is 2.2kg. per  $\text{m}^2$  mesh.

8 (i) Timber.

Timber includes timber for the windows, purlins, lintel etc. and is expressed per long metre.

8 (ii) Doors.

This includes the braced and ledged doors and the flush doors.

9 (i) Hardware.

This indicator contains besides rimlocks, hinges and door furniture also the GMS cooking hood of the kitchen.



9 (ii) Windows.

The steel louvre frames were grouped under this indicator. While the real timber frames were grouped under timber.

10. Paints.

Three coats of enamel paint on wood. Assumed 15<sup>2</sup>m per litre. (1 coat).

11. Glass.

3.5mm clear sheet glass for the louvre blades.

12. Roofing materials.

The CBS input indicator for residential housing doesn't contain GCI sheeting. The civil engineering input indicator for hardware contains this indicator and will therefore be applied further. This input indicator will contain: GCI sheeting gauge 26, GCI ridge and nails.

13 (i). Drainage, waste and water service.

This indicator contains: brass bib tap, stop cocks, water tubing, GMS trap, overflow, waste pipe and manhole.

13 (ii). Trapped gully.

50mm deep seal gully trap and two 100mm gully traps.

13 (iii). Sanitary fixtures.

Contains a low level WC suite squatting type with cistern, GMS shower head, and an enamelled kitchen sink.

15. Labour.

No split up was done for labour as the information was not available.

N.B. Input indicator 6 has been deleted as this is for floor tiles.

Appendix VI.

Table 6. Material and labour inputs as percentages of total expenditure (weights) for the three phases of construction.

Input Indicator	Complete House Weighed	Phase 1 Weighed	Phase 2 Weighed	Phase 3 Weighed
Sand	2.61	2.34	3.08	2.89
Aggregate	1.98	1.80	2.36	2.09
Cement	10.32	9.12	12.21	11.66
Concrete blocks	18.90	15.24	23.33	24.07
Hardcore filling	1.29	0.59	2.38	2.05
Reinforcing mild steel	0.16	0.28	-	-
Timber	2.15	1.33	3.26	3.18
Doors	3.76	3.95	3.72	3.37
Hardware	1.34	1.39	1.31	1.05
Glass	1.18	0.45	1.25	2.90
Roofing materials	10.28	5.28	17.60	16.23
Drainage, waste and water service	7.91	14.0	-	-
Trapped gully	1.53	2.72	-	-
Sanitary fixtures	5.06	8.97	-	-
Electrical installations	-	-	-	-
All materials	72.50	71.97	73.45	73.35
Labour	27.50	28.03	26.55	26.65
Total	100.	100.	100.	100.

## RESIDENTIAL BUILDING COST INDEX

Appendix VII.

Input	1972 Dec		1973 Dec		1974 Dec		1975 Dec		1976 Dec		1977 Dec		1978 Dec		1979 Dec		1980 March	
	Index	incr.	Index	incr.	Index	incr.	Index	incr.	Index	incr.	Index	incr.	Index	incr.	Index	incr.	Index	incr.
SAND	100	-	107.7	7.7	115.4	7.7	173.1	57.7	173.1	-	184.6	11.5	230.8	46.2	230.8	-	250.0	19.2
AGGREGATE	100	-	100.0	-	105.9	5.9	117.1	11.8	129.4	11.7	176.5	47.1	264.7	88.2	294.1	29.4	294.1	-
CEMENT	100	-	106.3	6.3	150.8	44.5	185.2	34.4	185.2	-	208.3	23.1	208.3	-	227.8	19.	243.2	15.9
CONCRETE BLOCKS	100	-	100.		137.5	37.5	140.9	3.4	158.9	18.	174.1	15.2	267.0	92.9	278.6	12.6	320.5	41.9
HARDCORE FILLING	100	-	105.5	5.5	111.2	5.7	166.7	55.5	166.7	-	277.8	118.9	333.3	56.3	388.9	55.6	388.9	-
REINFORCING M.S. RODS	100	-	192.3	92.3	296.3	104.	346.2	49.9	311.5	34.7	306.9	-4.6	339.2	32.3	404.6	65.4	438.5	33.9
TIMBER	100	-	110.	10.0	160.4	50.4	186.1	25.7	200.4	14.3	213.5	13.1	213.5	-	213.5	-	213.5	-
DOORS	100	-	190.4	90.4	220.0	29.6	246.4	26.4	236.5	-9-9	307.9	71.4	307.9	-	307.9	-	307.9	-
HARDWARE	100	-	140.2	40.2	164.	23.8	210.0	46.	268.2	58.2	316.1	47.9	312.7	.3.4	334.5	21.8	338.8	4.3
WINDOWS	100	-	110.0	10.	119.7	9.7	157.3	37.6	157.3	-	157.3	-	188.7	31.4	225.0	36.3	225.0	-
PAINTS	100	-	107.1	7.1	155.5	48.4	222.2	66.7	227.2	-	222.2	-	222.2	-	285.3	63.1	285.3	-
GLASS	100	-	116.2	16.2	136.6	20.4	136.6		158.9	12.3	177.5	18.6	162.7	-14.8	176.4	13.7	176.4	-
ROOFING MATERIALS	100	-	113.4	13.4	130.6	30.6	137.3	6.7	147.0	9.7	149.9	-	149.9	-	269.2	119.3	337.6	68.4
DRAINAGE, WASTE & WATERSERVICE	100	-	120.4	20.4	111.7	-8.7	153.9	42.2	167.7	13.8	177.9	10.1	177.9	-	250.8	72.9	256.3	8.5
TRAFFIC GULLIES	100	-	125.0	25.	140.0	15.	141.7	1.7	166.7	15.	166.7	-	183.3	16.6	216.5	33.2	216.5	-
SANITARY FIXTURES	100	-	117.9	17.9	156.2	38.3	159.6	3.4	162.4	2.8	164.4	2.	200.4	36.	309.4	109.	322.8	13.4
MATERIALS TOTAL	100	-	-	-														
LABOUR:	100	-	109.7	9.7	123.8	14.1	138.1	14.3	152.2	14.1	159.0	6.8	159.0	-	175.8	16.8	175.8	-
LOW COST: RESIDENTIAL BUILDING COST INDEX:	100	-																

\* INDEX OBTAINED FROM CIVIL ENGINEERING COST INDEX FOR HARDWARE.

Appendix VIII.

Table 7. Comparison of building cost index for the three phases of construction 1972-1980.

Year <sup>+</sup>	Completed House	Phase 1.	Phase 2.	Phase 3.
1972	100.	100.	100.	100.
1973	113.2	115.2	110.9	110.6
1974	137.8	137.4	138.9	138.3
1975	156.9	158.	156.1	155.1
1976	168.7	170.1	167.4	166.5
1977	184.1	184.9	184.	182.5
1978	207.4	205.6	210.6	209.4
1979	243.9	244.	245.1	242.4
1980	262.	259.	268.	265.

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<sup>+</sup>December of each year, except for 1980 for which March is taken.

9. References

- (1). Olesen F., Low Income House Types for Kenya. Housing Research and Development Unit, University of Nairobi, June 1979.
- (2). Government Printer, Building Code. The Local Government (Adoptive et al). Grade II Building Order 1968,
- (3). Central Bureau of Statistics. Construction Cost Index. Ministry of Finance and Planning, Kenya, December 1975.
- (4). Central Bureau of Statistics. Statistical Abstract 1978, and 1979. Ministry of Finance and Planning, Kenya.
- (5). Central Bureau of Statistics. Economic Survey 1978. Ministry of Finance and Planning, Kenya.
- (6). Ball, K.J. Construction Guide Lines Manual, National Housing Corporation.
- (7). Eygelaar J. Rising Building Costs for Low Cost Housing, Housing Research and Development Unit, University of Nairobi, November 1974.
- (8). Personal Communications April 1980:  
Central Bureau of Statistics  
National Housing Corporation  
Ministry of Housing and Social Services.