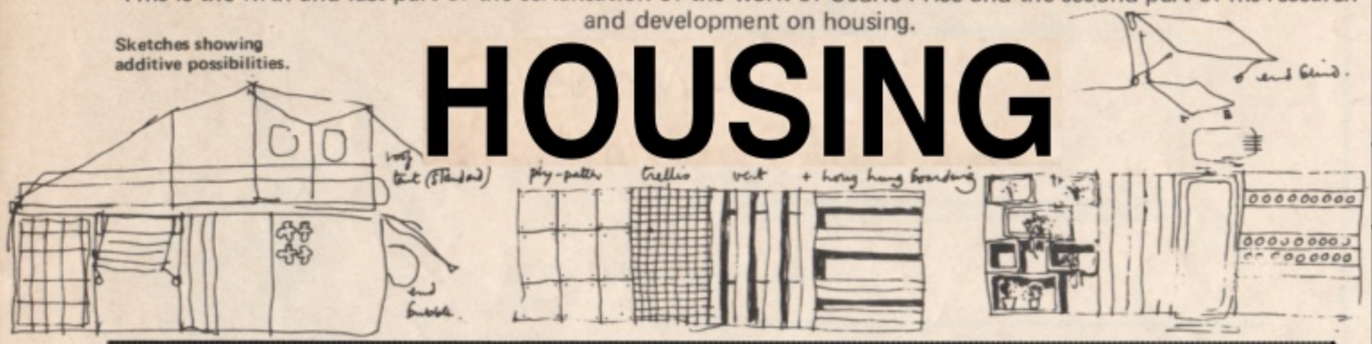
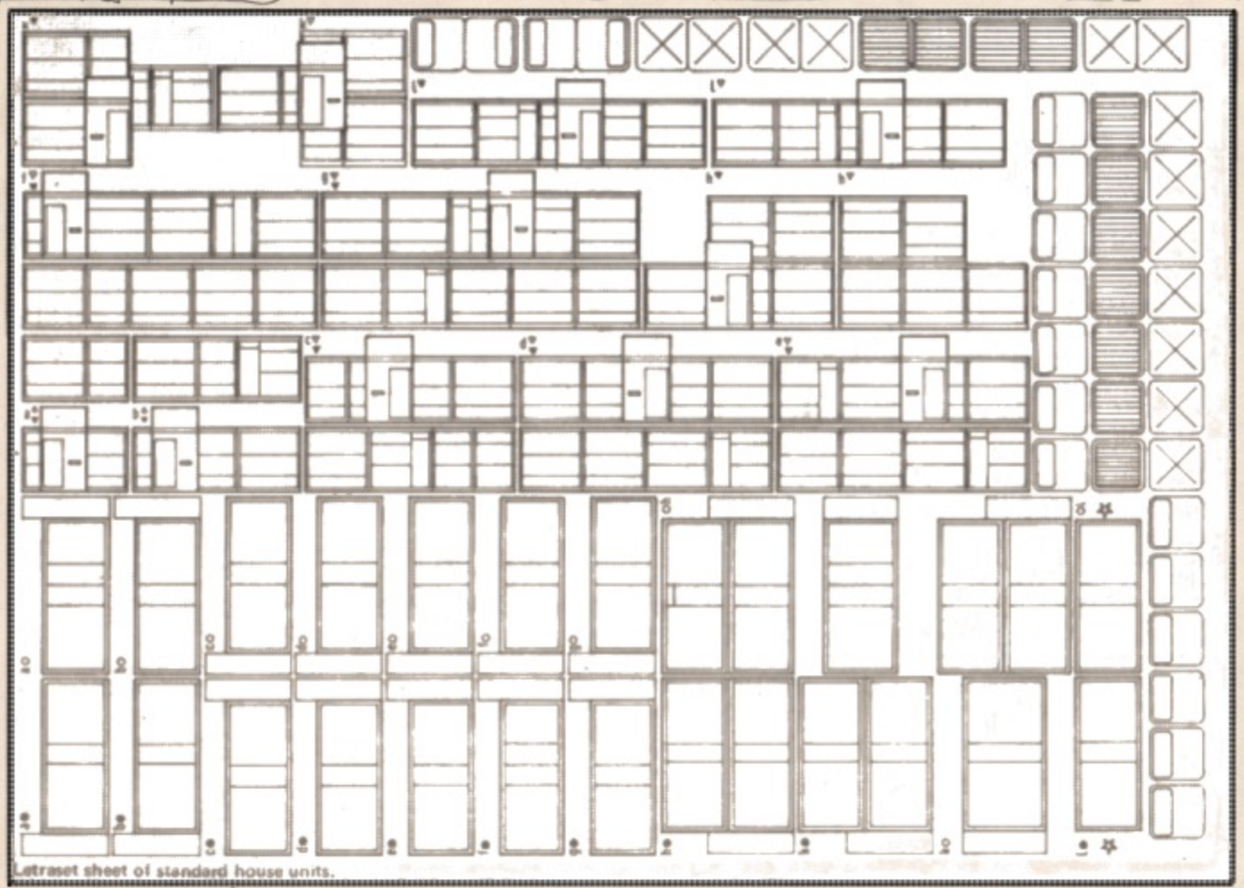
This is the fifth and last part of the serialisation of the work of Cedric Price and the second part of his research and development on housing.

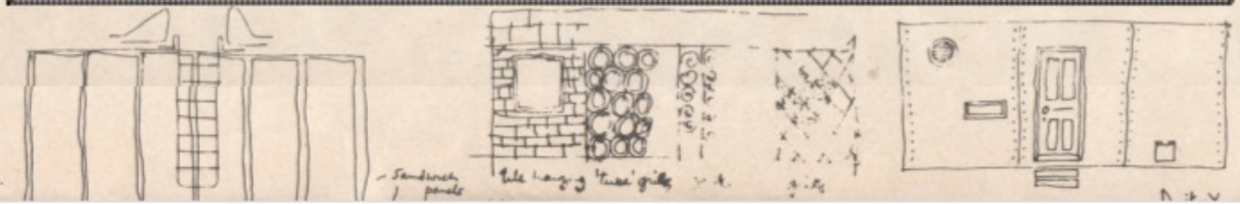
HOUSING

Sketches showing additive possibilities.





Letraset sheet of standard house units.



CEDRIC PRICE SUPPLEMENT 5 *

68+	81	A35	81	18

HOUSING RESEARCH Pt 2 (See Pt 1 AD Oct 1971 p.619-630)

The structure is such that only single or double decked enclosures can be constructed. Thus an immediate limitation is established both in the range of socially operational patterns and in collective/structural conglomerates i.e. the capacity to extend sideways at two fixed levels restricts the three dimensional possibilities to matchbox level. The vertical external skins of the initial models provide three planes of user activated variation, on the 'sides' of the houses. The sealed fully glazed external plane can be overlaid to choice. The end walls provide the main condition for volumetric extensions and major users planned openings. The various standard stores are self-supporting and capable of interlinking.

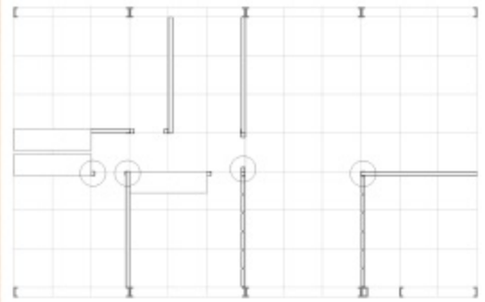
COMMENT

Although the roof can take average live loading and when decked can be used by people, I think there should be more investigation into varied height volumes — not possible in this scheme unless the entire unit is stood on end. (To be investigated). It will be interesting to see just how much voluntary customising is undertaken by the users.

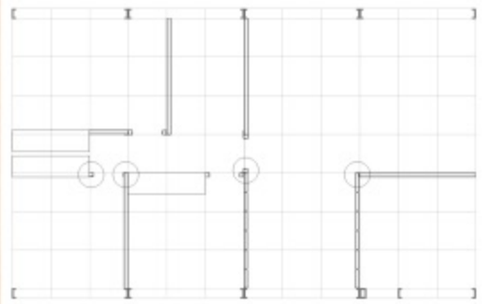
* (See also *AD* 10/70, *AD* 1/71, *AD* 6/71, *AD* 10/71).

RESEARCH DOCUMENT

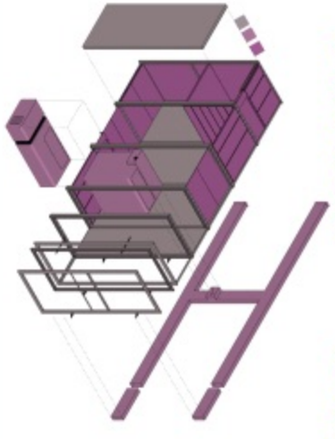
96lines 10pt



Alternative 1



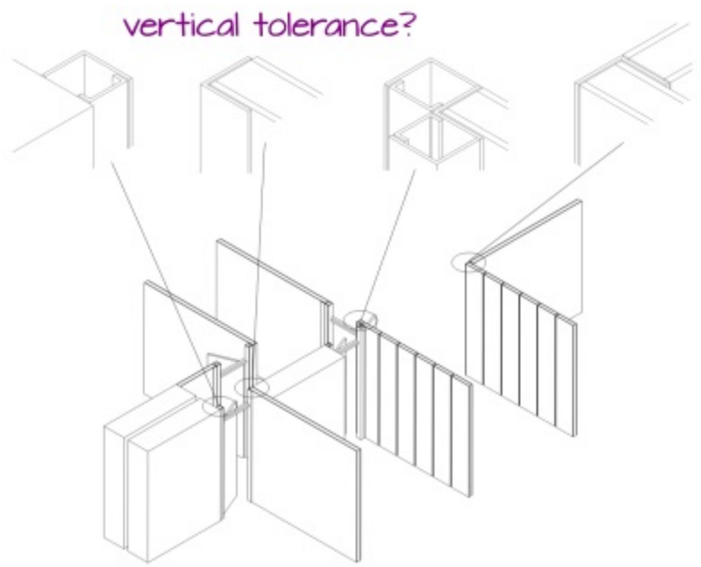
Alternative 2

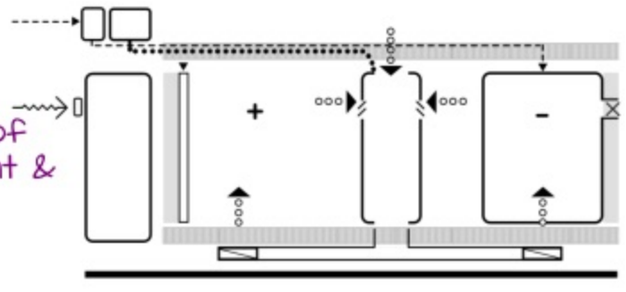


Isometric

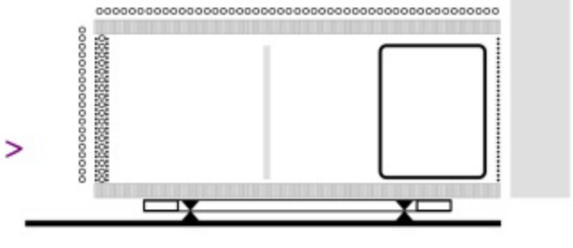
separation of service plant & equipment enables variable installation

oooo: plane of user control >





Cross section – servicing



Cross section – materials and components

The off-grid positioning of internal partitions enables mechanical fixing to main structural rings. The partitions have no additional structural use thus enabling the total removal of internal barriers if required.

The isometric indicates the major production separate of units — both structural and non structural. Thus the production of these separations would not need to be inter-related. It is likely the rate of replacement of the individual separations would vary considerably over 20-25 years.

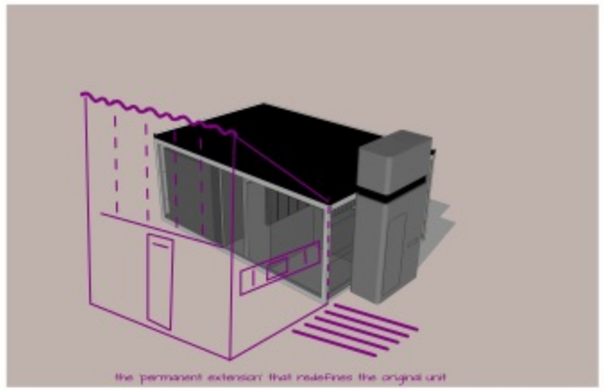
Obtaining an acceptable floor deflection was the major determinant of the size of the major steel rings. There is no structural continuity between the 'rings'. Each ring is full house width and 2 or 3 modules wide (m=900). The wet services are self contained and ventilated separately from the H plan air conditioning system. Waste outlets pass through a purpose made connection block with a variable intake gasket enabling the same waste connection to service any of the wet service units through a 360 range of positioning on plan.

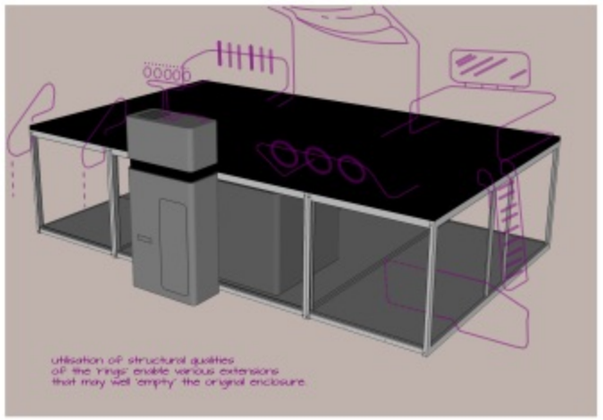
The air conditioning plant — a standard Lennox installation can be electrical or gas fired. The condenser unit is fixed on top of the porch unit which is itself a self contained structure requiring its own footing. The porch also contains the mains connection and meters which are displayed externally.

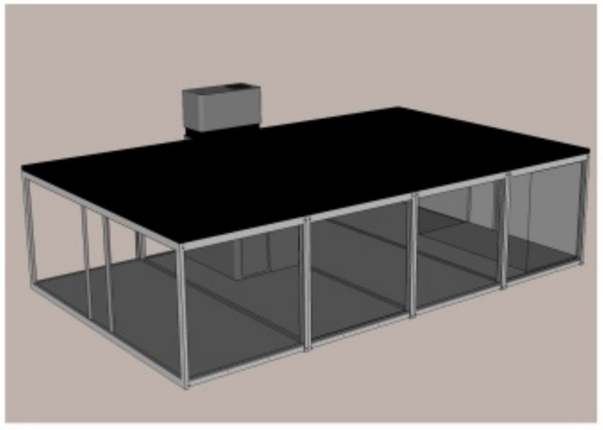
COMMENT

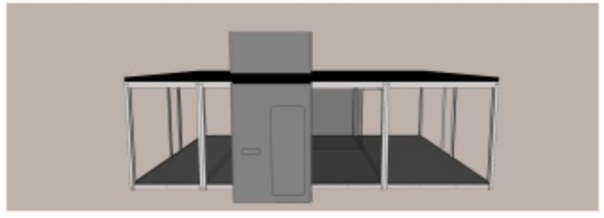
Although the full air conditioning can be afforded in the total cost and still meet the current cost yardsticks (stupid things), due to the fact that the building is totally sealed, its use has been questioned by several critics of this project. Obviously if the 'ends' are opened up the plant would be switched off.

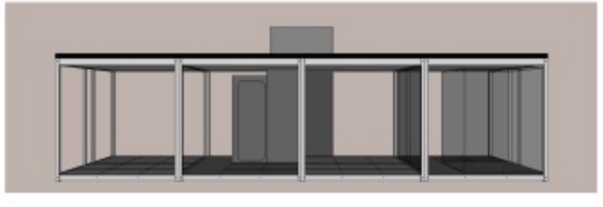
RESEARCH DOCUMENT











In site testing, it was decided to select two sites which in normal soft architectural environmental terms would be extremely dissimilar. The differences had to include:
Climate Air content Soil Natural and man made access National and regional siting
Population trends Employment prospects
Educational and social servicing
Physical servicing Income patterning

Rochdale (Deeplish) and the Thames near Tilbury (Muckingford) were selected. Although visually total opposites — the one a slum clearance and slum renewal area in a heavy industrial town, the other green fields and river marshes — the survey produced a large number of similar needs and shortages.

Both sites needed a new sewage system — one as replacement, one for the first time. More policemen, electricity and rapid transit feeds were also common needs. In effect those who would live at Deeplish could well say "We live here at present but may well move one day" while those at Muckingford could say "We want to live here but we don't know for how long". In planning terms the same degree of uncertainty has to be accommodated for both developments.

Stage 1 development for both sites shows a dependence on the existing surrounds and infrastructures. Stage 2 might never happen since the demand for individual land might fill the sites. (The site sensing methodology could be a continuous process, see Part 1, *AD* 10/71).

However, if it did happen, the resultant imbalance on the surrounding structures and services would be likely to cause the extension of the servicing initially intended for the new development to be poached or at least mirrored by the older surroundings — a good thing to happen. (See also NON-PLAN *AD* 5/69).

Stage 3 could well be a direct development of either Stages 1 or 2. Even in physical terms its valid extent cannot be fully charted in these drawings.

In both cases, it is likely that the existing environment would be 'played with' considerably — albeit with 'respect'. Stage 3+ is discussed later.

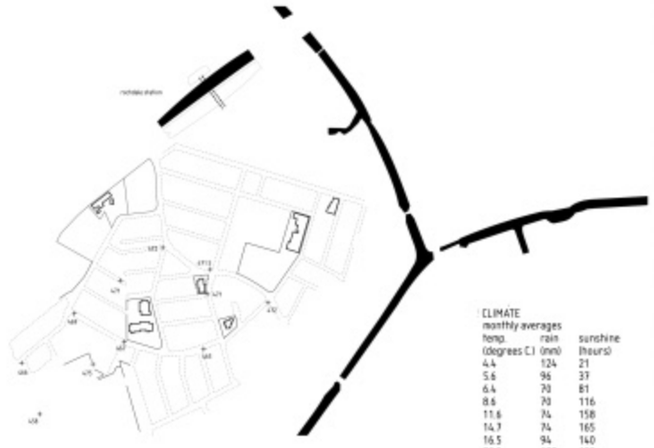
COMMENT

The chance of using either of these sites for a test bed has unfortunately reduced alarmingly with the arrival of the present Government.

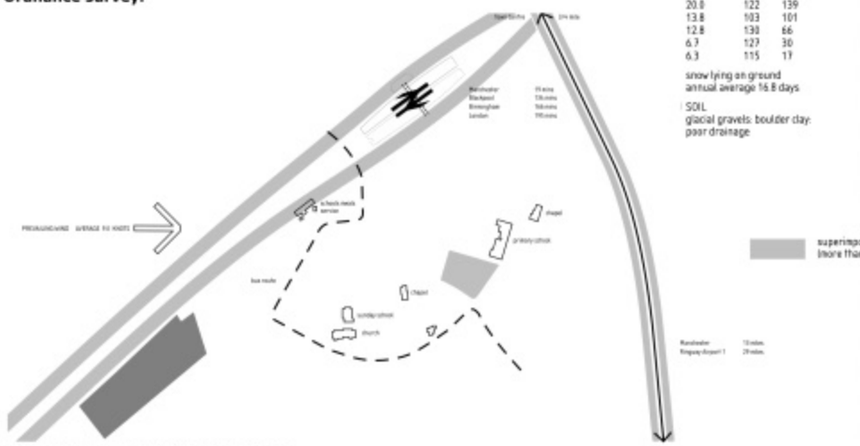
SITE A

27 AD 1/72

Aerial photo of Site A.



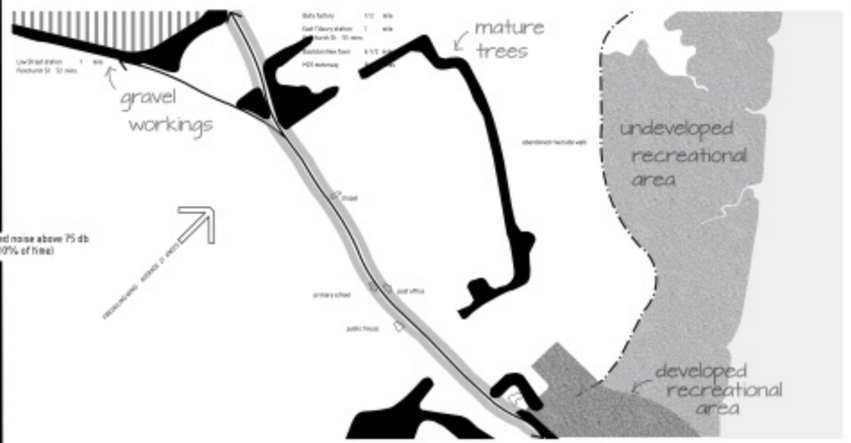
Ordnance survey.



Land use/communications/climate.

SITE B

Aerial photo of Site B.



RESEARCH DOCUMENT

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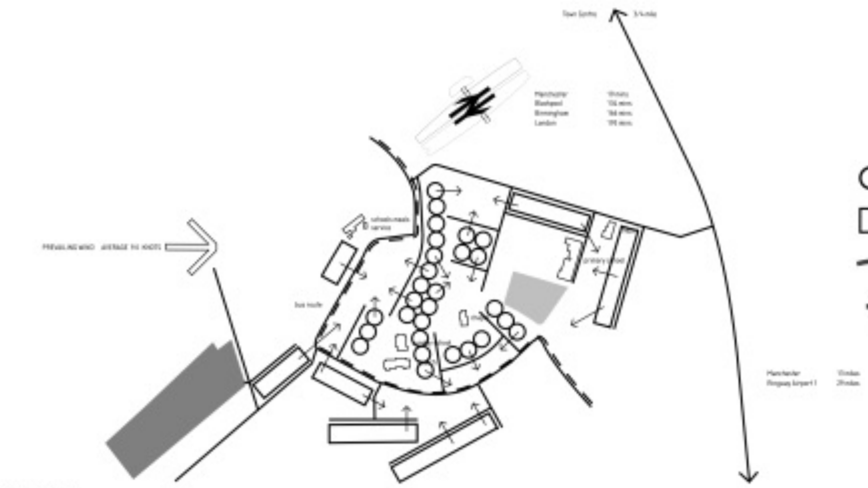
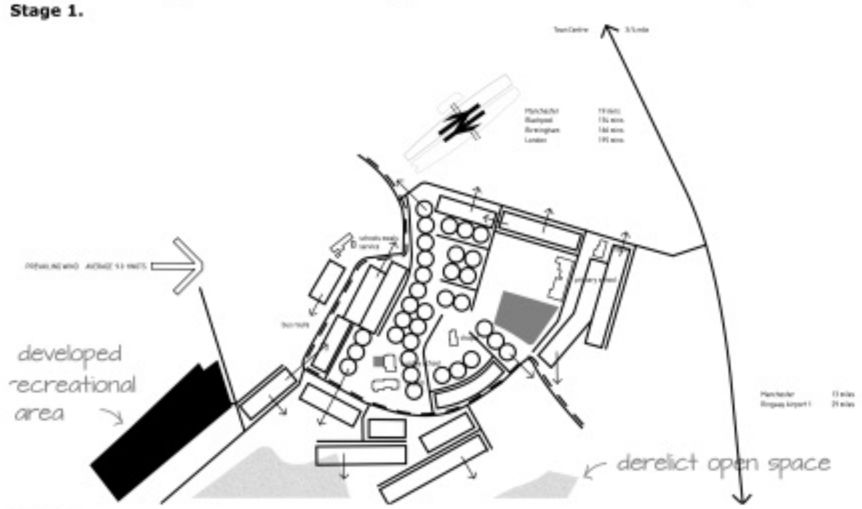
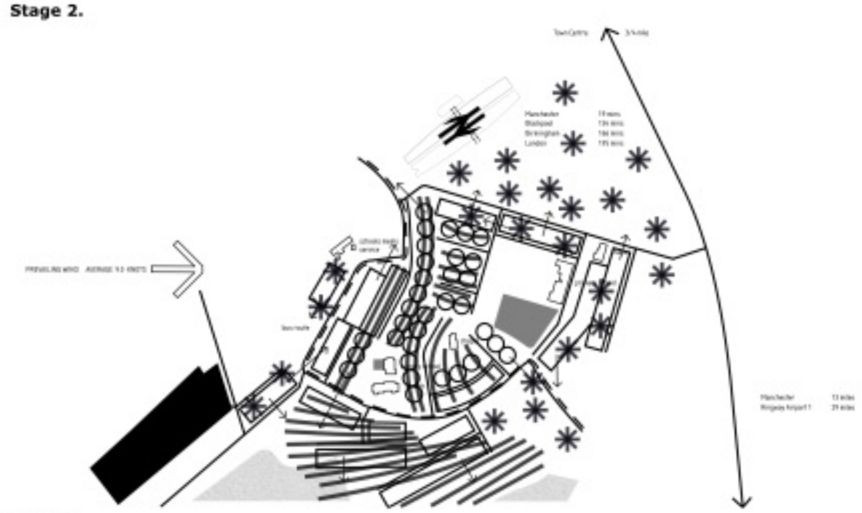


Stage 1.



Stage 2.



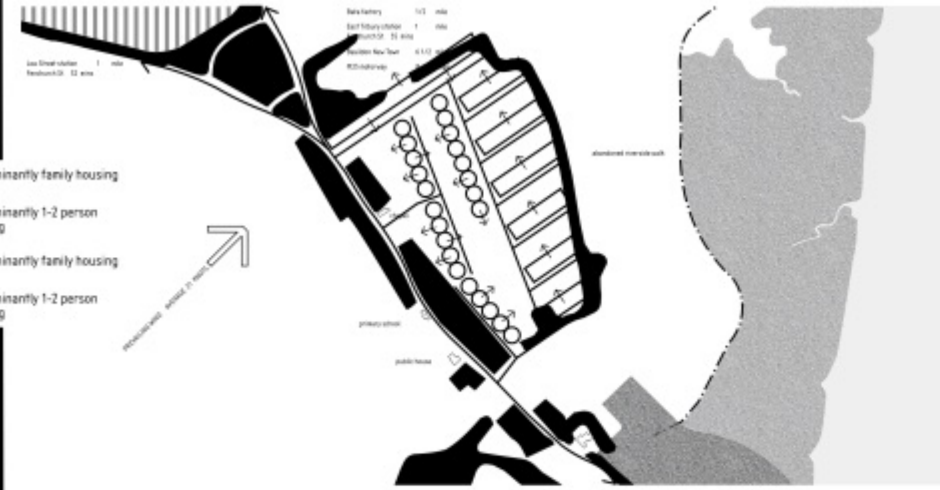
Stage 3.

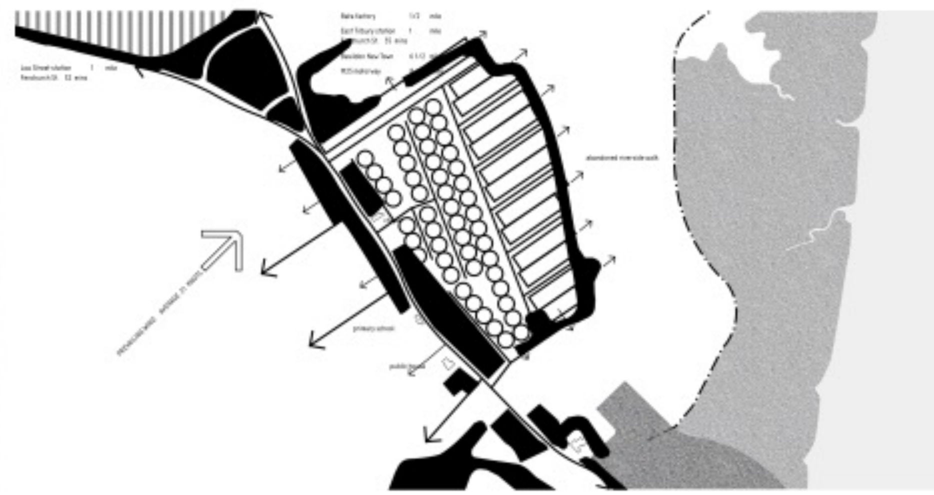
predominantly family housing

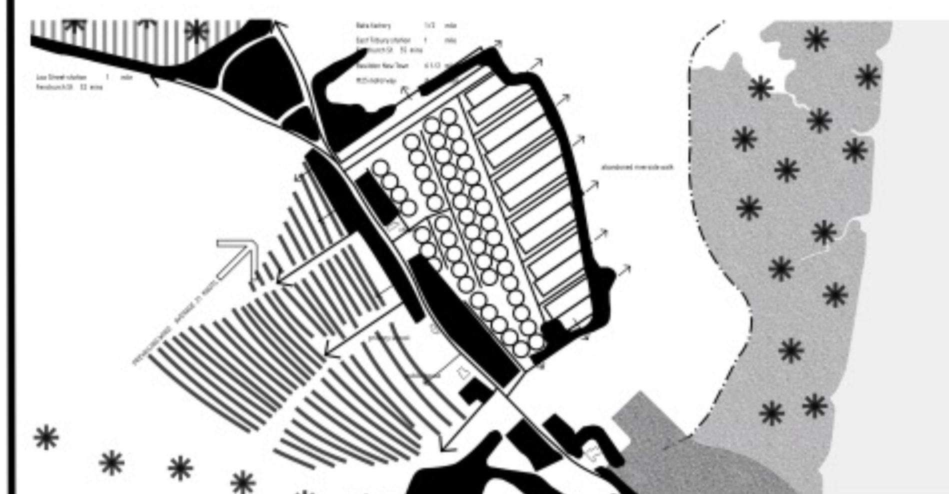
predominantly 1-2 person housing

predominantly family housing

predominantly 1-2 person housing







HOUSE TYPE	USAGE: INTERMITT. = PERMANENT & INT/PERM. =	OCCUPANTS: IMMEDIATE FAMILY = GROUP OF INDIVIDUALS = FAM/GROUP =	REASONABLE MAXIMUM No. OF OCCUPANTS: ADULTS	JUNIORS	SENIORS	VISITORS	TOTAL	DURATION OF ACTIVITY: DAY TIME	ALL TIME
A			2 3 1 1	1 — — —	— — — —	— — — 2	3 3 1 3		
B			2 4 2 2	2 — — —	— — — —	— — — 2	4 4 2 4		
C			2 5 2 2 2 2+1 3 2	3 — 1 — — 1	— — — — — 2	— — — — — 2	5 5 3 3 5 5		
D			2 6 2 2 2 2+1 3 3	3 — 2 2 — 2	2 — — — — 2	— — 2 — — 2	6 6 4 4 6 6		
E			2 6 2 2 2 2+1 3 3	2 — 2 2 — 2	2 — — — — 2	— — 2 — — 2	6 6 4 4 6 6		

	USAGE: INTERMITT. = PERMANENT & INT/PERM. =	OCCUPANTS: IMMEDIATE FAMILY = GROUP OF INDIVIDUALS = FAM/GROUP =	REASONABLE MAXIMUM No. OF OCCUPANTS: ADULTS	JUNIORS	SENIORS	VISITORS	TOTAL	DURATION OF ACTIVITY: DAY TIME	ALL TIME
F			2 7 2 2 5 2+2 3 3	3 — 3 2 — 3	2 — 1 — — 2	— 2 — — — 2	7 7 6 5 7 7		
G			2 8 2 2 6 2+2 3 3	4 — 3 2 — 4	2 — 1 — — 2	— 3 — — — 2	8 8 6 6 8 8		
H			2 7 2 2 5 2+2 3 3	3 — 3 2 — 3	2 — 1 — — 2	— 2 — — — 2	7 7 6 5 7 7		
K			2 7 2 2 6 2+2 3 3	3 — 3 2 — 3	2 — 1 — — 2	— 2 — — — 2	7 7 6 6 7 7		
L			2 8 2 2 5 2+2 4 4	4 — 4 3 — 4	2 — 1 — — 2	— 3 — — — 2	8 8 6 5 8 8		

Possible occupancy patterning.

Occupancy period of dwellings — proposed mathematical model

Assume that the occupancy period of dwellings can be approximately described by an equation of the form

$$\frac{dL}{dn} = 100\,a^2 n e^{-an}$$

where L is % leaving
n is years from commencement of tenancy
a is constant

The closest approximation to G.L.C. figures is given by

$$\frac{dL}{dn} = 2.89 n e^{-.17n}$$

This gives percentage remaining after n years (P%)

$$P = 17e^{-.17n}(n+5.88)$$

Comparison with G.L.C. figures for period of tenancy of remaining tenants in September 1967 is as follows:—

Period of Residence	*Calculated figure*	*Actual figure*
0-5 years	87,451	88,286
5-10 years	54,096	49,558
10-15 years	34,179	34,408
15-20 years	17,018	23,430

Average tenure = 11.75 years
50% turnover @ 9.9 years
Max. rate of leaving @ 5.88 years
Number of tenancies remaining after 60 years = .042% or 8 tenancies out of 20,000
Number of tenancies remaining after 80 years = .002% or 2 tenancies in 100,000
Number of tenancies remaining after 100 years = .00075% or less than one tenancy in a million

No. of houses still occupied by 1st tenant after 30 years	3.70%
No. of 1st tenancies terminating between 20-30 years	11.00%
No. of second tenancies (relet under 20 years) term. 20-30	26.78%
No. of second tenancies still in occupation at 30 years	12.53%
No. of houses let to 3rd (or more)tenants	45.99%

Based on one or two tenancies only

%	*Average Life*	*Product*
3.70	30	111.0
11.00	23.7	260.7
26.78	23.2*	621.3
12.53	30	375.9
		1368.9

* estimated
Average life 25.3 years

Housing needs projection: site A
(based on 1961 Census figures for Rochdale U.D. assuming static population)

STAGE 1

Year	*Average occupancy*	*Persons per dwelling* 1 2 3 4 5 6+	*Total Dwellings*
		No of dwellings	
1971	2.64	29 110 16 22 13 11	201
1996	2.75	29 96 18 24 14 12	193
2021	2.74	30 96 18 24 14 12	194

STAGE 2

Year	*Average occupancy*	*Persons per dwelling* 1 2 3 4 5 6+	*Total Dwellings*
		No of dwellings	
1971	2.64	47 181 27 35 21 18	329
1996	2.75	48 157 30 38 23 20	316
2021	2.74	50 157 30 38 23 20	318

Housing need projection: site B
(based on 1961 census figures for Thurrock U.D. assuming static population)

STAGE 1

Year	*Average occupancy*	*Persons per dwelling* 1 2 3 4 5 6+	*Total Dwellings*
		No of dwellings	
1971	2.79	34 82 9 33 28 5	191
1996	2.72	34 91 9 31 26 5	196
2021	2.67	34 98 9 29 25 4	199

STAGE 2

Year	*Average occupancy*	*Persons per dwelling* 1 2 3 4 5 6+	*Total Dwellings*
		No of dwellings	
1971	2.79	56 134 15 53 46 8	312
1996	2.72	57 148 14 50 43 8	320
2021	2.67	56 160 14 48 41 7	326

Variations produced in total number of households by various factors

1. All 18-23 year olds in single accommodation
   - *1. All children leave home one year earlier +3.58% house holds*
   - *2. Life expectancy increases by one year +1.79% "*
   - *3. Average marriage age increases 1 year +1.79% "*
   - *4. Children born later after marriage no change*

   (Mean persons/household 2.56).

2. All 18-23 year olds in double accommodation
   - *1. All children leave home one year earlier +2.00%*
   - *2. Life expectancy increases by one year +2.00%*
   - *3. Average marriage age increases 1 year no change*
   - *4. Children born later after marriage no change*
   - *5. All 18-23 year olds change to 1 person households +10.14%*

   (Mean persons/household 2.82).

An approximate comparison of average yearly total cost of family car and family house

Schedule of Running Costs.

Figures from AA Technical Services

1 Assume a new family car of 1100 cc
2 Assume that this car is traded in every 24 months for a new one.
3 Assume a mileage of 10,000 miles p.a.
4 Assume the following standing charges:

Car licence	£25.00
Insurance	Av. rates – Class A Policies
Driving Licence	£0.25 per annum
Depreciation	Assumes an economical running life of 80,000 miles at 10,000 miles p.a. 20% depreciation per year
Tyres	Estimated tyre life of 20,000 miles
Servicing	As recommended by manufacturers
Repairs and Replacements	Average labour charge of £1.50 per hour: repairs, replacements and renovations spread over 80,000 miles of life
Hire purchase Interest charges	@ 12% p.a. over 24 month period

5 Costs of car (adjusted to 1971) prices

	Keep car 2 years	Keep car 8 years
Tyres	£0.05	£0.11
Servicing	£0.12	£0.12
Petrol	£1.16	£1.16
Oil	£0.05	£0.06
Repairs	£0.30	£0.53
	£1.68	£1.98

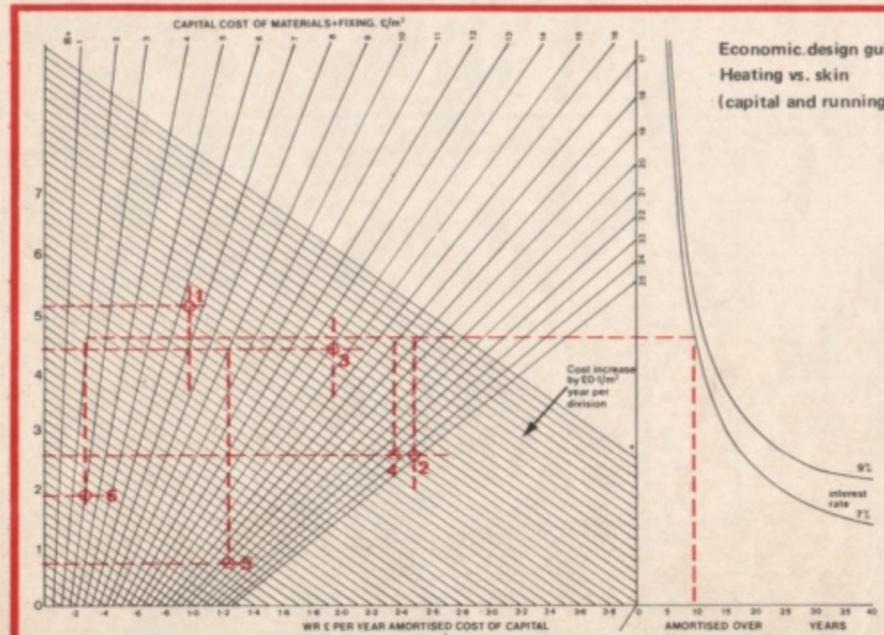
	Keep car 2 years	Keep car 8 years
x 10,000 miles £	168	198
Licence (tax)	25	25
Insurance	44	44
Garage	50	50
Depreciation	162	94
Hire purchase	32	24
	481	435

NB Hire purchase rate 22% on £324 over 2 years (for 2 yr), on £600 over 3 years (for 8 yr), + £150 balance @ 11% over 3 yrs (8 yr)
Say average annual cost £460

6 Cost of house of 70m² area costing £60/m² = £4,200
30 year mortgage @ 8½% = £390 pa
Heating etc £120 pa (Area + 10) x 1.5
Maintenance £41 pa £20 + (Area x 0.3)
Total cost £551

7 Cost of house of 60m² area costing £55/m² = £3,300
30 year mortgage @ 8½% = £306 pa

Heating etc	£105
Maint.	£ 38
	£449



Economic design guide.
Heating vs. skin
(capital and running costs).

Amortise @ 7% over 10 years

1. Single glazing – ¼"
   Cap. cost = £7/m²
   U value = 5 W/m²
2. Double glazing sealed units
   ¼" glass ½" air gap
   cap. cost £18/m²
   U value 2.5 W/m²
3. Double glazing
   ¼" glass 7" air gap
   cap. cost £14/m²
   U value 4.3 W/m²
4. Double glazing
   ¼"/plyglass 7" air gap
   cap. cost £17/m²
   U value 2.5 W/m²
5. Panels – Glasal, Asbestolux
   cap. cost £9.0/m²
   U value 0.7 W/m²
6. Ace panels – asbestolux
   cap. cost £2.0/m²
   U value 1.8 W/m²

1. Select interest rate and period of repayment.
2. Draw vertical from repayment period to interest line, then horizontal to meet capital cost of materials and fixing.
3. Draw vertical to meet horizontal from U-value.
4. Point of intersection gives amortised costs of material plus heating costs.

Housing research Subject headings.

Reports 1 & 2

1.1 Sites A & B – Enquiry check list

A Site characteristics
B Population statistics
C Servicing
D Physical communications
E Existing private and public buildings
F Finance

1.2 Sites A & B – Statistics

A Essex Development Plan
B Site acreages, densities, occupancy ratios
C Climatic data
D Dwelling standards, expenditure
E Climate and soil
F Population structure

1.3 Sites A & B – Research reports

V Housing needs projections
W Estimate size of families

2.1 Cost of dwellings as function of life

General
Long term considerations
Economic principles
With expanding stock
With annual repayments over life
Effect of interest rate

2.2 Existing cost figures

Conversion costs
Maintenance costs

2.3 Costs – Research Reports

Cost of dwellings as function of life and size (ref sites A & B)
MOHLG Cost yardstick (Ref sites A & B)

3.1 Mobility Considerations – Mathematical model

Occupancy period of dwellings
Occupancy mobility factor
Distribution of occupancy period
Optimum dwelling life

4.1 Environmental restraints & potential

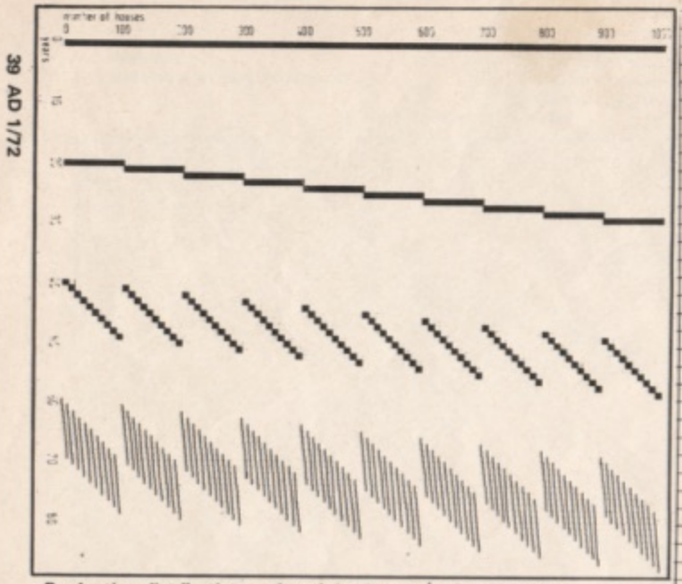
Drainage, sewage. Piped/wired services
Maintenance, Security
Site Sensing – Audio/Visual
Centralised v packaged material/power feed

5.1 Future variation to production method/runs

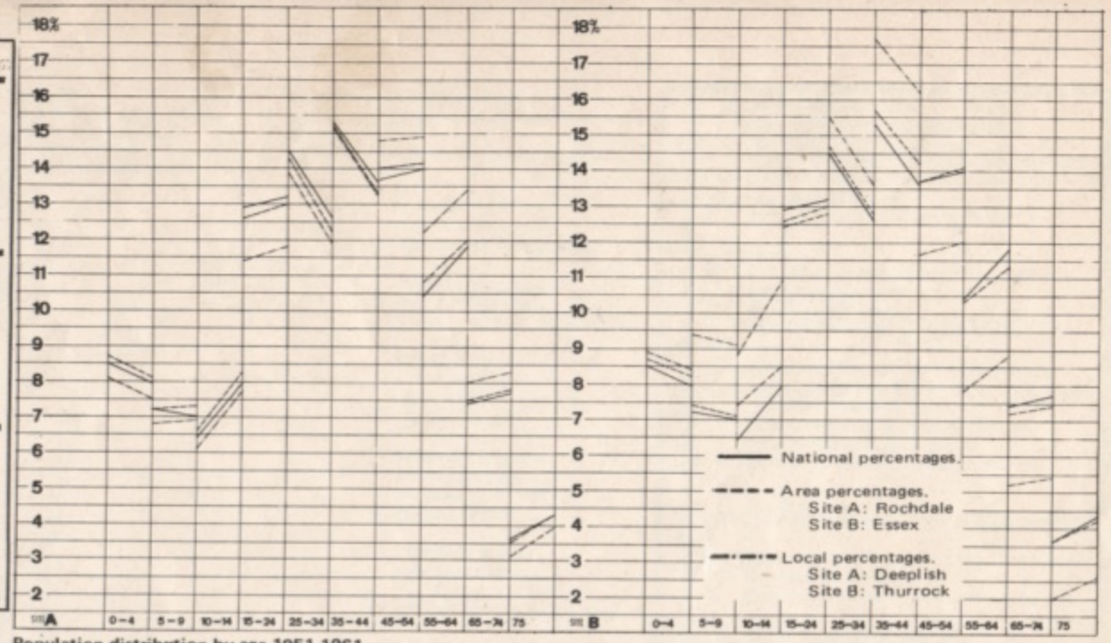
Future variation to housing/servicing ratio
Possible Content futures
Demolition/re-use/rehabilitation site/materials

RESEARCH DOCUMENT

39 AD 1/72



Production distribution — phased development of production enabling continuous development of parts and/or whole.



Population distribution by age 1951-1961.

Site: Muckingford.

Site: Rochdale.

RESEARCH DOCUMENT

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The strip plans of an earlier scheme for both sites show the equivalent of Stage 1. The extensive use of covered shelters was considered desirable in such tight development. Such shelters just as the screens and stores in future developments could be supplied by local authority, landlords etc. It is important to emphasise that in relation to shelters, stores and also direct extensions to the houses a rather standardised range has been shown graphically since it would be both futile and presumptious to indicate possible private financed and/or private built additions since these should vary considerably at any one time.

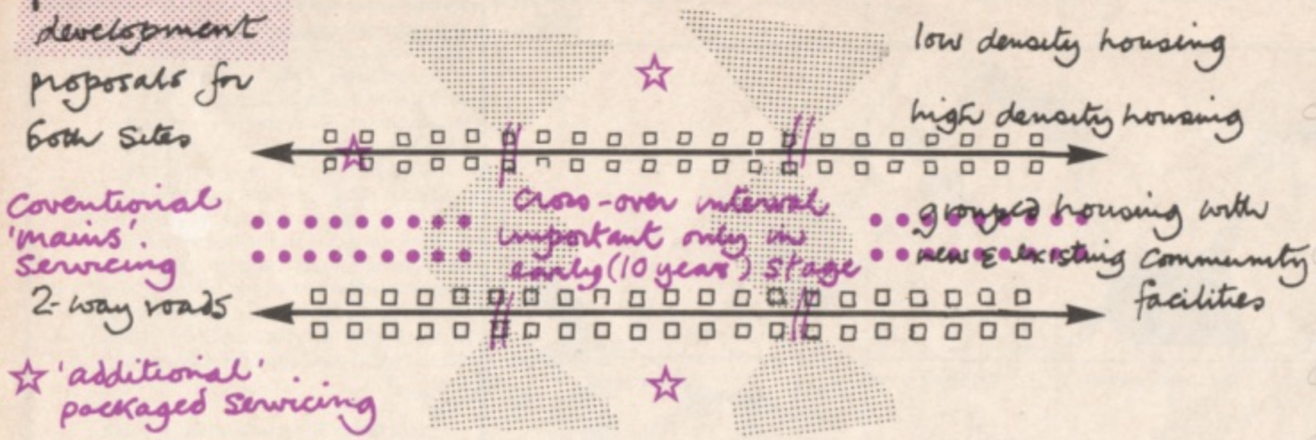
Stage 3+ is directly related to these earlier strips and again for convenience has adopted standardised graphic notations for additions and variations.

The major purpose is to indicate that should Stage 1 be retained for reasons mentioned earlier then it is likely that large areas of the original development – well within the depressingly long designed life of 20-25 years – may well be drastically re-used particularly if the Stage 3 type spread takes place. Such changes might well require the alteration of on or above surface physical services – roads, lighting, telephone, power (discussions have been started on overhead power supply) pneumatics etc. The adoption of sealed 'packaged' fixed life aerobic digestion plant for all stages of sewage servicing, centralised high level water tank storage, high (40-50m) artificial "moons" to replace street lamps and the extensive use of P.F.A. kerbless construction for secondary roads compares favourably in cost with present practice and enables the alteration of such services to be undertaken within the 'life' of 'served' structures while allowing the content and thus demand on such services to vary.

COMMENT

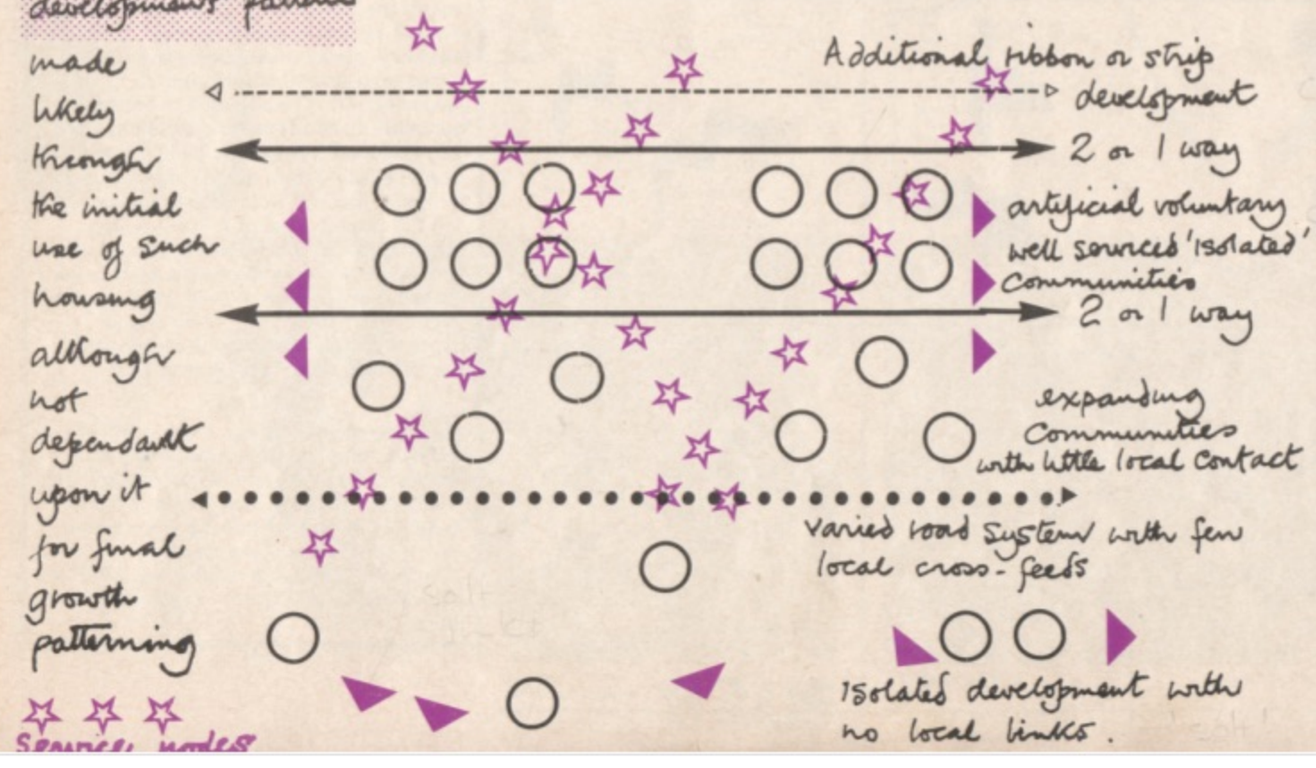
I consider there is, at any time, a limit to tinkering with one's house beyond which one looks for a new one. As such a limit may be reached far faster than 20 years it is valid to look at a re-use of existing structures as long as such re-use is less socially consolidating than the original use. i.e. The reverse of converting a flour mill into a home.

present development proposals for both sites



Short life housing must not demand the attention 'permanent' housing has forced. For example, Services, including secondary roads, must have an even shorter variable life than the housing. Thus eventually Wigan and Leyland could become a national park.

possible future development patterns made likely through the initial use of such housing although not dependant upon it for final growth patterning



CONCLUSIONS

1 The change over of production and assembly processes from one area and condition to another must be accommodated even during the socio/economic life of the first production run.
2 No unit should be related either to the pre-assumed "room-to-activity" equation or to enclosed areas per person. The latter is only politic in establishing equivalent cost yardsticks.
3 The value of determinable periods for re-use of land should be set against the initial cost of limited life housing.
4 The limiting of life must be designed in to both the structure (eg special structures with a fixed factor of safety on key structural areas incapable of maintenance) and to the use of land already ear-marked for future development of an opposed nature.
5 Maximum capacity for pre-use choice of nature of initial expenditure (eg site sensing procedure).
6 Maximum opportunity for occupants to mess around with the house combined with minimum need – on physical well-being terms – to do so. The right to idleness must not be sacrificed.
7 Political appetites for alteration in the user's mind of the status of housing must not be diluted or marred by economic pressures to ensure an assumed standard or form of housing.
8 The development of home learning, T.V. religion, facsimile telephones, preventive medicine, unmarried parents, E.S.P., enforced idleness, pensions by Giro and other good things may well produce an invisible community environment that looks like a lot of ordinary houses – and then they may go.

COMMENT

All that remains is to build the thing and to thank Lord Kennet for annoying me sufficiently constructively for me to start this in the first place. I do not consider the house sufficiently important – as opposed to the next meal – for everyone to have to develop an appetite and aptitude to build his or her own.

RESEARCH DOCUMENT

96lines 10pt

Village infil —
to exclude traffic
& justify a ruin

THE BUILT ENVIRONMENT
AS A NATURAL DEVELOPMENT RESOURCE

"After the lecture come up home
to meet Mum."

a rapid start to
new ribbon development

RESEARCH DOCUMENT

96lines 10pt

ACKNOWLEDGEMENTS

P.S. from the Editor of the C.P. supplements.

Dear Cedric

Thank God that's over! The hassle I've had getting all the bits together over the last year has been quite something – all those code numbers (they'll understand them now), getting those hand written comments on in time and all those thin drawings that didn't print properly.

But it was worth it. We've shown your stuff as it really is – the good stuff and the bad – (you must admit those private houses are best forgotten!) – it's knocked your standing as a SYAR – but then too much realism does that to all of them anyway (a good thing)

Some of it has been difficult to understand for me and, most probable, impossible for the readers; but then, as has often happened in the past, things tend to fit in as time goes by and we can see that you've been right all the time.

In AD last month Martin Pawley quoted Rem Koolhaas (who the hell is he?) as saying that you were a prince desperately trying to become a frog – I thought that was very true – a dandy who only wears grey, an art boy who suppresses style, a communicator who purposefully makes comprehension a task, breakfast of champagne and grouse at the Savoy and lunch with the freaks at Plum City and a real concern with the communal life style while leading a life of individuality.

But you've seen a lot of things no one else has seen, you've influenced a lot of good people and almost surreptitiously turned your hairy ideas into well researched feasibility and along into the mainstream of architectural thinking

Yours Peter Murray

Bibliography

Research on Potential of Advanced Technology for Housing – Architectural Research Laboratory Project, Aran Arbor, U.S.A.
Une Proposition pour l'Industrialisation de la Construction des Logements – Daniel Chunut, Annick Dottelonde, Henri Planacassagne, Rene Sarger – France.
The Effects of Ventilation and Building Design Factors on the Risk of Condensation and mould growth in dwellings – Building Research Station.
Consequences of Reducing House Building Time – Building Research Station.
Cumbernauld – A Household Survey and Report –
New Housing in South East England – The Housing Research Foundation.
Land Costs and Housing Development – National Building Agency.
The Next 10 Years – Chartered Surveyor March 1967, Tom Baron.
Council Housing Purposes, Procedures and Priorities – Min of housing and Local Government.
Building Economy – P. A. Stone.
The Economics of Housing – Lionel Needleman.
Housing Finance and Development – A. J. Merret and Alan Sykes.
Estimating Housing Needs – Alexander Block.
Social Trends – Government Statistical Service.
Houses and People. Hole and Attenburrow, BRS

Douglas Smith (Baker Wilkins and Smith, Quantity Surveyors)
63/61/A13: 63/52/AB5: 66/80/AD5
63/59/B12: 64/63/AB5: 62/32/A15
62/39/B1: 68/88/4A: 61/28/D5
62/35/D15: 61/51/D15: 68+/81/A35

Frank Newby (Felix J. Samuely and Partners, Consulting Engineers)
62/AB1: 63/61/A13: 63/59/B12
62/39/B1: 68/88/4A; 62/32/A15
63/52/AB5: 62/53/AB5: 61/28/D5
62/35/D15: 61/51/D15: 70/65/A35
58/26/D3: 69/94/A13: 68+/81/A35

Zisman Bowyer and Partners (H. V. & E. Consultants)
66/88/4A: 69/94/A13

Silk and Frazier, Quantity Surveyors
69/94/A13

Corrections

64/63/AB5 – Exchange Stages 2 and 3
68/88/4A – A for a. Reverse fire door detail
62/X15/D35 – Should read 62/35/D15
70/65/A35 – Should read 65/70/A35
68+/81/A35 – Prof D. Donnison – Micro-politics of Inner City. B.A.A.S. Conference 1971
Key to system
– mid-wall additive layer
– discontinuous partitions

CODE KEY

Date	Job No	CP assessment		

Letters – people
A Co-operating/participating
B Controlling
C Choosing/questioning
D Structuring

Numerals – Condition
1 Free-will time
2 Directed time
3 Learning/living
4 Survival/control
5 Quality of life

Endpiece

NOISE IS MUSIC TO HIS EARS

A man who loves noise was given permission yesterday to build a bungalow for himself between a new motorway and a railway line. Mr William Ellis, aged 42, has lived beside the railway line in Swanwick Lane, Swanwick, near Southampton, for 12 years in a house he also built himself. This was acquired through compulsory purchase by the local authority to make way for the M27.

Yesterday, the South Hampshire divisional planning committee agreed to his request to rebuild on his now smaller piece of land. Mr Ellis thinks the noise he will have to live with will be no greater than that he endures in his work as a concrete shutterer.

He said: "I love noise really. I don't know what I'd do if I had to go somewhere that was deadly quiet to live. I'd probably go mad. When I'm at work the noise is tremendous. But you get used to it. It's like background music, really."

Mrs Audrey Widdicombe, supporting the application at the planning committee meeting, said: "It is not a good place to live, but as the man chooses to live there himself I do not see it is going to harm anyone."

(see Site Sensing Kits, *AD*, 10/71)
Reprinted from The Guardian, Sept. 17, 1971