# REPORT OF THE EXPERT PANEL CONSTITUTED BY THE MINISTER OF STATE FOR WORKS AND HOUSING FOR EVOLVING GUIDELINES FOR REDUCTION IN THE COST OF BUILDINGS

GOVERNMENT OF INDIA

MINISTRY OF WORKS & HOUSING

NIRMAN BHAVAN NEW DELHI

# REPORT OF THE EXPERT PANEL CONSTITUTED BY THE MINISTER OF STATE FOR WORKS AND HOUSING FOR EVOLVING GUIDELINES FOR REDUCTION IN THE COST OF BUILDINGS

Government of India
Ministry of Works & Housing
Nirman Bhavan, Maulana Azad Road
New Delhi

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## INTRODUCTION

A meeting was convened by the Minister of State for Works and Housing on 14th September, 1976 to consider the possibilities of effecting economy in the cost of building construction in general and public housing in particular. In the meeting, it was decided that the possibilities of reducing the cost through diligent planning, use of rational specifications and local and new materials, adoption of new construction techniques and through better construction management practices, should be studied in depth and guide lines prepared for adoption by the construction agencies. For this purpose, an Expert Panel consisting of the following was constituted :-

1. Shri N.K. Prasad — Chairman
   Joint Secretary(Works)
   Ministry of Works & Housing
   and Chairman, HUDCO
   New Delhi

2. Shri R. Gopalaswamy
   Joint Secretary(Housing)
   Ministry of Works & Housing
   New Delhi

3. Shri V.R. Vaish
   Engineer-in-Chief
   Central P.W.D.
   New Delhi

4. Prof. Dinesh Mohan
   Director
   Central Building Research Institute
   Roorkee

5. Prof. G.S. Ramaswamy
   Director
   Structural Engineering Research Centre
   Madras

6. Dr. H.C. Visveswaraya
   Director
   Cement Research Institute
   New Delhi

7. Shri B.S. Krishnamachar
   Director General
   Indian Standards Institution
   New Delhi

8. Shri B.R. Govind
   Director (Designs)
   Military Engineering Services
   New Delhi

9. Shri P.M. Apte
   Chief (Projects)
   Housing & Urban Development Corporation
   New Delhi

10. Shri G.C. Mathur — Convenor
    Director
    National Buildings Organisation
    New Delhi

The Panel at its first meeting held on 21st September 1976, set up three sub committees to go into the following matters :-

(a) Optimisation of land use and economical space planning;

(b) Augmentation of building materials and their optimal use;

(c) Rationalisation of specifications and new techniques

The composition of the sub committees is given in Annexure I.

The reports of the sub committees were considered by the Panel which held in all six meetings. The Panel took useful guidance from the reports of some of the Expert Groups set up earlier such as the Committee on Plan Projects, the Bhatia Committee Report etc.

The Panel acknowledges with thanks the assistance rendered by :

Central P.W.D.

Shri O.P. Mittal, Chief Engineer
Shri T.S. Vedagiri, Chief Engineer
Shri S.C. Kapoor, Chief Engineer
Shri S.C. Gupta, Superintending Engineer
Shri R.C. Manchanda, Senior Architect

Central Building Research Institute, Roorkee

Shri T.N. Gupta, Assistant Director
Shri J.S. Sharma, Scientist

Indian Standards Institution

Shri A. Simha, Director (Civil Engineering)

Military Engineering Services

Shri G.R. Mirchandani, Superintending Engineer

Structural Engineering Research Centre, Madras

Dr. A.G. Madhava Rao

Cement Research Institute

Dr. S.K. Chopra, Principal Scientist
Dr. C. Raj Kumar, Scientist

Town & Country Planning Organisation

Shri J.L. Parashar, Additional Town & Country Planner

National Buildings Organisation

Shri K.K. Khanna, Joint Director(Designs)

The Panel received suggestions from certain individuals. These were duly considered. The Panel is grateful to them.

The Panel is also grateful to all the research, development and execution agencies associated with the work of the Panel.

0. APPROACH

0.1. Construction accounts for nearly 50% of the plan outlay. Nearly half of this expenditure goes towards housing and building including buildings for factories, warehouses, offices, schools, hospitals etc.

0.2. Schemes for buildings and housing have to go through the following stages :-

(a) Finalising the users' requirements and planning of the building;

(b) Structural design and specifications; and

(c) Execution

0.2.1. Each stage mentioned above has considerable potential for cost reduction. For example, considerable cost reduction can be achieved by :

(i) Planning of the requirements in detail at the very beginning and rationalising them;

(ii) Reducing ancilliary areas;

(iii) Providing multiple use of the facilities;

(iv) Standardisation of repetitive items;

(v) Increasing planning efficiency by making the same built-up area yield much larger useful area.

0.2.2. At the stage of structural design and specification also there is scope for cost-reduction through new design and construction techniques, optimising structural members and drawing up a specification which is functional and economical, and use of local materials.

0.2.3. At the stage of execution, economy can be effected by proper programming and efficient review so that the men, materials and machinery are fully utilized and time and cost over-runs are reduced substantially.

0.3. It can, thus, be seen that housing and building lend themselves to a fair degree of cost optimisation. Several studies in this direction

have been made by the Committee on Plan Projects of the Planning Commission. The Committee had brought out special reports on the following types of buildings :

1. Residential buildings;
2. Multi-storeyed office buildings;
3. School buildings;
4. Storage structures;
5. Industrial townships.

0.4. These reports contain valuable recommendations regarding factors to be taken note of at the different stages of evolution of the project. The reports also prescribe various norms to be adopted at the planning and design stage. The CBRI and the NBO have also brought out similar reports on schools etc.

0.5. In the light of the above, the Panel discussed the subject of cost-reduction under the following heads :

(a) Optimisation of land use;

(b) Functional design of buildings

(c) Optimal use of building materials and their augmentation

(d) Rationalisation of specifications and use of new techniques of construction

(e) Improved management of projects

(f) Training and professional development.

The conclusions and recommendations of the panel are given in the subsequent chapters.

1. OPTIMISATION OF LAND USE

1.1. Buildable land in cities is very valuable and at the same time, it is limited. Even in cities where over-crowding has not yet become a problem, the pressure of population, will soon, make spaciousness a thing of the past. Pressure of population, on agricultural land is no less heavy. To divert a lot of agricultural land towards building is also not a good policy. It is necessary, therefore, that all planners should strive and make the optimum use of available land. The Housing Agencies have a major responsibility in this matter. Optimum utilisation of land, consistent with the provision of a good environmental conditions conducive to the growth of the life of the community, is a desideratum, which all housing agencies must place before themselves.

In constructing houses from public funds, the public housing agencies, should avoid plotted development and single storeyed construction, as far as possible. However, where sites and services programmes and low cost single row housing with only one room, have to be provided due to financial constraints, the scope for expansion of such houses by at least one more room, should be kept open. The community facilities and services like water supply and drainage should be planned accordingly.

For many of our major cities, master plans have been drawn up. These plans prescribe overall densities to be achieved in various zones and thus provide a guideline to construction agencies in optimising the use of land. However, these are overall densities for the total area and higher densities in one and lower in another, if so required, can be provided without disturbing the general average for the area prescribed in the master plan.

For low income housing, the ISI has been considering certain proposals regarding optimum utilization of land by providing high densities without sacrificing the environmental conditions. The Panel considered these proposals in consultation with Town & Country Planning Organisation and came to the conclusion that within a small cluster of 250 to 400 houses of 20 to 40 sq.mt. sizes, the following densities are achievable for different storeys and can be adopted in towns for which master plans do not exist. It must be mentioned however, that in making this recommendation the Panel has taken into account repetitive houses of the same size within a limited pocket, exclusive of the main or peripheral road.

Recommended Densities with buildings of different storeys.

| No. of Storeys | Density of dwelling units/hectare | |
|---|---|---|
| | Plinth area 20 sq.mt. | Plinth area 40 sq.mt. |
| 1. (G.F.) | 130 | 85 |
| 2. | 250 | 170 |
| 3. | 300 | 225 |
| 4. | 350 | 260 |
| 5. | 400 | 300 |

The methodology for computing the densities for optimum utilization of land in a case like this is given in Appendix II which may serve as a broad guide to the planners.

Notes:

(a) These densities assume a ground coverage not exceeding 35% and an average of 5 persons per dwelling unit

(b) These densities include provision for open spaces, convenience-shopping, nursery school, and all internal roads & pathways, but do not include peripheral roads around the cluster. Amenities like primary school, health centre, shopping centre, community centre, post office, public park will be required only where more than one such clusters are grouped together. In that case, the density will automatically go down.

Similarly in a cluster having a mix of different types of houses, the densities indicated above will undergo a change.

The Panel recognises that topographical conditions and constraints like high tension wires, railways, ditches, drains etc., might make it difficult to achieve the recommended densities in full. However, notwithstanding these constraints, the panel feels that 75% of the above densities should be adopted as the minimum limit.

1.2. Road and Path-ways

The width of roads should have a definite relationship with the volume and type of traffic expected in the housing complex. While the width of individual roads will have to be designed, taking the above into consideration the Panel recommends that :-

(i) The area under roads and path-ways in such housing projects should normally not exceed 20% of the total land area of the project.

(ii) Access to the dwelling units, particularly where motorised vehicles are not normally expected should be by means of paved foot paths with a right of way of 6 metres and a paved path of 2 metres only. The right of way should be adequate to allow for the plying of emergency vehicles and also for road side drains and plantation.

1.3. Open Spaces:

The Panel recommends that open spaces in a cluster should be designed as a hierarchy of spaces of various levels which should be functional. The smaller spaces around or between the buildings should, as far as possible, serve as tot-lots. The larger open spaces should serve social and recreational purposes. Odd shaped and 'left over' spaces should be avoided.

## 2. FUNCTIONAL DESIGN OF BUILDINGS

2.1. Sizeable reduction in construction cost is possible if sufficient attention is given to the rationalisation of space requirements and functional planning of such requirements. This aspect has been studied in detail by a few high level committees in the past; notable amongst those is the work of the 'Committee on Plan Projects' of the Planning Commission which through specialised Panels had studied in depth the planning of residential buildings, school buildings, townships in general and with particular reference to industrial townships, multi-storeyed office buildings, etc. The National Buildings Organisation has carried this work further to cover other types of buildings such as primary schools, etc., which form an integral part of any residential township or neighbourhood. The Panel recommends that the recommendations contained in the Reports mentioned above be properly studied and adopted by the Planners for deriving maximum advantage at the planning stage of buildings and other facilities.

2.2. For the benefit of Planners, some of the important considerations which shall be taken cognisance of at the planning stage of different types of buildings are listed in the following paras.

2.2.1. Residential Buildings:

The utility of the accommodation depends not only on what is given, but how it is planned. The following standards provide a good guide in planning the different spaces within a residential building :

| | Load bearing construction | Framed construction |
|---|---|---|
| (a) Living space, i.e., floor areas of living, dining and bed rooms | 47 - 50% | 49 - 54% |
| (b) Service space covered by kitchen, bath and W.C., etc. | 15 - 20% | 14 - 19% |
| (c) Horizontal circulation space - passage and verandahs | 10 - 12% | 9 - 11% |
| (d) Vertical circulation space - stair cases and lifts | 4 - 7% | 3 - 6% |
| (e) Walls and columns space | 15 - 17% | 12 - 14% |

It will be a good idea, if authorities inchargc of designing residential buildings indicate on the plan the break up of the built up area into different categories mentioned abovc. Any variation from the limits suggested above should be justified. This will ensure proper space utilisation which is considered to be an important factor contributing to economy and efficiency.

The ratio of the useful space in a house to the plinth area is a good index of planning efficiency. Endeavour should, therefore, be made to obtain as high a ratio by reducing to the minimum the circulation space and the area under the walls.

External access corridors infringe upon the privacy of dwelling units and are also costly. Dwelling units upto 4 storey should be grouped around one staircase giving access to all the units from the stair-landing.

The circulation area including staircase, external corridor should not exceed 3 sq.mts/unit where 4 dwelling units are grouped around a staircase and 5.5 sq.mts/unit when two units are grouped around a staircase. The width of stair-cases and exits shall conform to those stipulated in the N.B.C. for fire safety.

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The internal circulation space for giving access to various rooms in a house should be as little as possible and long internal passages should be avoided. The space distribution, enclosure sizes and location of openings should be so organised as to achieve optimum structural spans and sizes of structural members.

All wet core units (toilets and kitchen) in a dwelling unit should be grouped together to achieve economy of plumbing and services. Wherever shafts are provided to carry vertical services pipes, their size should be in accordance with the National Building Code. Single stack system should be adopted wherever conditions permit.

The dwelling units may be so designed that the overall wall length for each unit is minimised. Too many off-sets in walls which increase construction cost should be avoided. Repetition of same plan on all floors results in economy in construction cost. Therefore, every possible effort should be made to achieve it.

In dwelling units where balconies are provided on the upper floors or in areas where it is not customary to sleep on the terraces, regular staircase access to the terrace should not be provided, thus eliminating the staircase room and the parapet walls. For the purposes of servicing the overhead tanks, a trap door and a ladder may be provided.

Where access to the terrace is not given to the residents, the roof slabs should be laid to slope so as to eliminate rain water pipes. Spouts may be provided with proper flooring on the ground below so that there is no erosion due to the water falling from it. This arrangement can be followed in areas of little or moderate rain fall.

In heavy rainfall areas, sloping roofs should be preferred. Adequate arrangements may be made for draining off the water by providing drain water pipes etc.

The height of the plinth on the ground floor should be kept as 20 cms above surrounding ground level in areas that are well drained and where water table is not high.

The clear ceiling height of habitable rooms may be kept 2.75 m and in high altitude areas and places where climatic conditions do not require provision of ceiling fans, this may be reduced to 2.4 m. Building bye-laws should be amended, wherever necessary, to facilitate this reduction in ceiling heights.

2.2.2. Primary Schools:

The classrooms should be planned to accommodate 40 students. Considering the seating arrangement, teaching space and associated circulation, an area of 1.11 sq.m. per child in a class room is recommended. The area of the classroom thus works out to be 44.53 sq.m. The size 610 x 730 cms of classroom for efficiency of teaching and learning as recommended by Kendriya Vidayalaya Sangathan and Ministry of Education and Social Welfare, Government of India for community schools should be adopted.

Classrooms should be planned in a manner that few of these may be combined providing large areas for activities like team teaching, group discussions or combined lectures. Further economy in overall space of a school can be effected by intensive utilisation of educational space and minimisation of non-educational or auxiliary spaces.

Special rooms should be designed to serve as a big classroom with feasible partition and also for general science and display of crafts etc. The furniture should be moveable and light to allow flexibility for quick re-arrangements of space. A floor area of 600 sft (55 sq.mt.) is recommended for such room.

Sanitary facilities should be according to the IS Standards. An area of 0.6 to 1.2 hectares should be adequate for a primary school (300-600 enrolment) with playground facilities.

2.2.3. Multi-storeyed Office Buildings:

The letable office space or carpet area should be of the order of 60 to 70% of the built-up area.

An area of 500 sft (46.451 sq.m.) is considered sufficient for Committee room

Scales of sanitary units should be according to the IS Specifications.

A clear corridor width of 6 to 7 ft (1.8 to 2.1 m) should be adequate for all purposes.

It is economical to construct independent light structures for garrages and cycle sheds provided sufficient land is available.

A height of 10'-6" (3.35 m) from floor to floor is adequate.

2.3. Residential buildings, primary schools, etc., are of repetitive character and can lend themselves to certain amount of standardisation.

2.4. It will be good if different departments develop typical plans for various facilities such as residential units, primary schools, health centres, etc., based on the recommendations contained in the various reports mentioned above.

2.5. Though standardisation of plans would be difficult to achieve due to site conditions, orientation, etc., it is nevertheless possible to standardise some of the components which go into the building. The doors and window shutters, for example, could be standardised and they should not be of more than four sizes. The recommended sizes are 700 mm/800 mm and 1000 mm. The height shall be 1.8 m. The number of doors in a residential house should preferably not exceed the number of enclosed spaces plus 2.

2.6. In dry hot climates the area of windows in a room should not exceed 10% of the floor area of the room, while in hot humid climates it should not exceed 17% of the floor area.

## 3. OPTIMAL USE OF BUILDING MATERIALS AND THEIR AUGMENTATION

3.1. Materials account for 65 to 75% of the total value of construction. The success of construction programmes, therefore, depend, to a great extent, on the development of the building material industry. Experience shows that in spite of best efforts put in by the planners, the country had to face shortages of essential construction materials like cement, steel, bricks and timber many times during the post-independence period. This generally resulted in pushing up the prices of materials and consequently the construction cost. This has also resulted in an increase in the gap between the housing needs in relation to the population growth and what can be constructed with the available funds. Now that the Government is giving top priority to the construction of dwellings for the economically weaker section of the population, the supply position of building materials has to be looked into and suitable action taken to augment the production of such materials, rationalise the use of scarce materials like cement, steel and timber and popularise the use of substitute and new materials of construction.

A critical assessment of the present production level of different types of building materials and Fifth-Five Year Plan targets at this mid-plan period has led to the following pragmatic approach for houses and buildings up to four storeys :-

(i) Substitute conventional materials in short supply like cement and steel etc., by traditional building materials like lime, bricks etc., or materials which require smaller financial and infrastructural resources and are labour intensive.

(ii) Rationalise the use of cement, steel, bricks, timber etc., in order to conserve these materials.

(iii) Augment the supply of building materials presently in use with technical and technological innovations suggested by the different R&D and other organisations.

(iv) Step up the production of conventional and new materials by establishing new building materials industries.

The above measures are likely to reduce building cost and increase the productivity of houses and buildings.

3.2. Under the circumstances mentioned above, the Panel makes the following recommendations with regard to construction materials :-

3.2.1. Cementing Materials

(a) In order to conserve portland cement, portland pozzolana cement meeting the requirements of IS:1489-1967 could be used for all types of concrete except where high early strength is required.

(b) In regions where tried and proven materials such as calcined gypsum etc., and lime gypsum mixes are locally available at competitive prices, these could be used in areas not likely to be directly exposed to moisture, say for plastering of internal walls.

3.2.2. Mortars

Composite cement lime mortars should be preferred over straight cement mortars wherever lime as per IS:712-1973 is available and the composite mortars are competitive. This will result in conservation of portland cement.

Lime pozzolana mortar as per IS:4098-1967 and lime sand mortars should be used for masonry subjected to medium and low stresses respectively.

3.2.3. Concrete:

Where mass scale use of concrete is required :

(i) Design mix concrete should be used instead of nominal concrete mix to conserve cement and ensure better quality

(ii) Pozzolana such as fly-ash, reactive surkhi of standard quality, if available locally, should be used as an ingredient of such concrete to save portland cement upto 20 per cent.

3.2.4. Reinforced Steel:

Use of high strength deformed bars for reinforced cement concrete construction should be preferred to the use of mild steel bars in order to conserve steel. However, for shorter spans, mild steel bars should be used.

3.2.5. Bricks and Stones:

Wherever good quality bricks are available, with crushing strength of not less than 70 Kg per sq.cm., single brick load bearing masonry should be used for buildings upto 4 storeys in height. Bricks may also be used for jack arch and for brick panel construction.

In areas where sand-lime brick (IS:4139-1967) is available, its use is recommended, provided it is economical.

Depending on availability and local costs, precast stone block masonry, laterite block masonry should be used. Stone slabs, if available at competitive rates, can be used for roofing, flooring and lintels.

3.2.6. Concrete blocks:

In places where good quality bricks are not available, solid or hollow blocks of cement concrete may be used. For prefabricated constructions use of cellular concrete blocks is also recommended subject to availability and economy.

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3.2.7. Tiles:

Except where it is functionally inappropriate, burnt clay flooring tiles, where available, should be used in place of cement concrete for reducing cost.

3.2.8. Timber:

Apart from species such as Teak, Seasham, Sal (often designated as primary species), other species of timber (generally recognised as secondary) should be used for doors and windows provided these have been seasoned and treated.

3.2.9. Plastic Pipes:

Light and heavy density polythylene and PVC pipes could be used for cold water supply system in unexposed locations depending upon the availability of pipes.

3.3. With regard to augmentation of building materials, certain proposals are already under consideration of the Planning Commission, but no concrete steps have so far been taken to translate these proposals into practice. The Panel recommends that the following proposals already under consideration of the Planning Commission should be vigorously pursued and action taken to give practical shape to these, as early as possible :

(i) Establishment of plants for producing standard quality dry-hydrated lime. A large number of large sized plants are required to be set up. To start with about 10 plants with capacity of 15,000 tonnes each could be established.

(ii) Stepping up of production of portland pozzolana cement, so as to produce at least 1.5 million tonnes of this type of cement every year. The possibility of making it available at a cost lower than ordinary portland cement should be looked into.

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(iii) The production of portland blast furnace cement be stepped upto six million tonnes per year for increasing availability.

(iv) Establishment of plants to manufacture calcined clay pozzolana wherever large deposits of suitable clays are available. To start with fifteen plants, each of 10,000 tonnes capacity per year may be set up.

(v) Steps be taken to make available quality flyash, in dry state.

(vi) Ready mixed concrete plants be set up in metropolitan centres where heavy and sustained programme of building activity justifies this. In such plants wherever possible, portland cement may be conserved by use of pozzolana upto 20 per cent.

(vii) In regions where naturally occuring aggregates are not available, establishment of plants for manufacturing sintered fly-ash and bloated clay and foam clay light weight aggregate be considered.

(viii) Establishment of sand - lime brick plants and cellular concrete plants in areas where good quality of bricks are not available. Ten sand-lime-brick plants each of 20 million unit capacity may be set up. Similarly, cellular concrete plants with capacity each of them equivalent to 60 million bricks are recommended for consideration.

(ix) Establishment of integrated plants for manufacturing seasoned and treated timber and joinery from secondary species. Ten integrated units of 3000 c.m. each may be set up.

## 4. RATIONALISATION OF SPECIFICATIONS AND USE OF NEW MATERIALS AND TECHNIQUES OF CONSTRUCTION

4.1. There is scope for cost reduction by rationalisation of specifications of various items and components which constitute construction work. The Panel considered the possibility of evolving standard specifications on regional basis. It is, however, felt that this was not possible as even within a specified region, there would be wide variations in specifications due to factors such as differences in layout of the dwelling units or other facilities, availability of local materials, methods of construction adopted, etc. It was, therefore, decided to evolve guideline specifications which should be applicable for all types of construction upto 4 storeys in height.

4.2. In drafting these specifications, the factors relating to economy in cost of construction as well as reduction in the use of costly and scarce materials have been given due consideration. The main emphasis has been on the increased use of local materials and such specifications and construction techniques that have proved to be technically acceptable for mass application and the adoption of which leads to reduction in the consumption of materials like cement, steel and timber. A number of new techniques which are at various stages of development both in the laboratory and the field have also been considered in detail while formulating these* with a view to giving necessary scope to the designer to make the proper choice taking into account the varying conditions relating to availability of materials, their quality, performance requirements, level of technological development and types and skills of labour available in the locality and other site conditions that normally influence construction work. These specifications are given in the Annexure III.

* specifications. The specifications provide for different alternatives

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4.3. New Techniques:

In the past two decades a number of new concepts and techniques have been introduced in the methods of design and construction. Some new materials have also come out in the market. The process of adopting these concepts, techniques and materials on a mass scale was discussed in detail. Realising the need for pilot and experimental studies, it is strongly recommended that the following drill is invariably followed before new concepts and techniques are recommended for wider adoption by construction agencies :-

(i) Pilot studies in Laboratory

(ii) Experimental construction and evaluation of performance characteristics relating to functional requirements like structural safety, serviceability, fire safety, rigidity, liveability and impact on cost and time of construction.

(iii) Preparation of working codes of practice.

(iv) Preparation of National Standards Codes.

4.4. Pilot studies in laboratories should cover all aspects of functional requirement of a new technique or material and bring them out clearly for the information of the engineering profession. The new technique or material should then be adopted in experimental construction either under the experimental scheme of NBO or otherwise to find out their performance under field conditions. The evaluation of performance under field conditions should be carried out by an expert group consisting of representatives of the research institutes, NBO, ISI and construction agencies, the impact of these on time and cost must be correctly assessed.

4.5. The job of preparation of working code of practice can be entrusted to the NBO who can get such a code of practice prepared by a Committee

consisting of the representatives of the research organisation concerned, ISI and the major construction agencies. Once such a working code is prepared, new concepts/techniques/materials can be adopted on a wider scale. After the working code is in operation for some period, the National Standards/Specifications can be prepared by the ISI.

4.6. The concepts and techniques listed below have been viewed in the light of the drill mentioned above and further action has been suggested by the Panel.

4.7. (a) Techniques which have passed through all the four stages and recommended for adoption on a mass scale.

(i) Under reamed piles

This has gone through all the four stages. The Panel recommends its adoption wherever black cotton soil or low bearing capacity soils are met with and where conventional foundation will not be suitable and or may be costly.

(ii) Single-brick load bearing walls

This comes under the category of calculated brick masonry and is permitted by the National Building Code. This has been adopted for construction upto four storey successfully. This, however, requires bricks of crushing strength of 70 $Kg/cm^2$ onwards depending on the location and the size of openings, spans of rooms and the mortar used. Wherever such bricks are available, this is recommended for adoption. Half brick walls can also be used as internal load bearing walls, where these can carry the load as per Indian Standards. However, in seismic areas strengthening arrangements should be provided, as suggested in the relevant IS Codes.

(iii) Single stack system of plumbing

This is permitted by the National Building Code. The technique should be used when conditions for its adoption are satisfied. However, in two or more storeyed construction, precautions to avoid flooding of ground floor fittings in case of chokage (which would be very objectionable in this case, as compared to normal plumbing) should be taken.

(b) Techniques which are in advanced second stage and recommended for large scale field trials under guided conditions with a view to evolving a working code of practice.

(i) Precast channel units

(ii) Precast cored units

(iii) Waffle : funicular shell system/doubly curved shell units

(iv) Precast cellular concrete slab units

(v) Thin lintels

(vi) Precast stone blocks masonry, in places where stone is available.

Experimental construction with these units has been done by some construction agencies. The evaluation of their performance characteristics is in progress. After the results are evaluated and the working code is prepared, these techniques can be adopted on a wider scale. Till then, adoption of these in some more works is recommended.

(c) Techniques recommended for experimentation in the field for obtaining feed back and review, where necessary.

(i) Precast RCC Solid planks

(ii) Reinforced brick panels with partial precast RC Joists.

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(iii) Precast RC Joists and hollow clay or concrete block system.

(iv) Precast slab units using hollow clay blocks for floors and roofs

(v) Precast waffle units for structural floors and roofs.

These are in the process of being adopted in certain experimental construction and some more experimental work is necessary before the structural and functional adequacy could be evaluated and working code prepared. The Panel recommends that construction agencies may try these on experimental projects in close collaboration with the research organisations. There should be feed-back arrangement with the research units so that the field problems are properly taken note of and the methods perfected.

(d) Techniques which are in the development stage and recommended for experimental construction.

(i) Reinforced 'L' panels for sloping roofs

(ii) Brick funnicular shells

Pilot studies have been done. Work on 2nd stage mentioned above is to be undertaken.

5. IMPROVED MANAGEMENT OF PROJECTS

5.1. Construction management has now developed into a fullfledged science with its own techniques and methodology. It aims at optimising the use of available resources and getting the work executed within the prescribed time and specified cost according to quality criteria stipulated. A wide array of the industrial engineering and management techniques are to be adopted for proper planning of the work site, increasing productivity of men and machines, improving the handling and arrangement of materials and instituting a proper system of management information for purposeful coordination and control.

5.2. The techniques like method study, linear programming, simulation, etc., have been successfully adopted in production management. However, application of these in construction management has been slow even in advanced countries. In India the construction industry itself is not organised and these advanced techniques have not found adequate application. Considering, however, the fact that construction accounts for 50% of the plan layout, the need for stepping up the pace of introduction of these techniques in construction management needs no special emphasis.

5.3. Planning of the work site and the arrangement of operation within, alone can constitute a subject for detailed study. In the construction operations, transport forms a major element. The aim of management must be directed to minimise this. This can be done by application of techniques of flow charts, travel charts, activity analysis, etc., which will lead to proper siting of materials and introduction of some mechanised and/or semi-mechanised devices for handling, conveyance, etc.

5.4. Productivity of men and machines is an important factor to be reckoned with in construction management. Improvement of this factor

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should be the chief aim of construction management. This, however, requires the application of different techniques of work study, institution of incentives - both monetary and otherwise - improvement of human relationship etc. Various items of work such as concreting, brick work, mixing of concrete, etc. lend themselves to considerable improvement through proper sequencing of operations, rational ganging of labour, minimising forced idleness and modification in the methods of work. Similarly, optimisation of equipment utilisation is another subject which deserves detailed study. By these it is possible to improve productivity of men and machines and achieve substantial saving in construction costs.

5.5. Another aspect of construction management which deserves attention is the control of works at site. This includes programming, reporting of progress and taking timely corrective measures to avoid time and cost over-runs. Several techniques such as 'Critical Path Method','Line of Balance', 'Production Line Techniques', etc., are available. The proper use of these will lead to better programming of works and purposeful coordination and control. This will also help in proper budgeting of materials and the arrangement for their timely supply which will consequently avoid or/at least minimise the build-up of inventories.

5.6. The cost on construction supervision varies from 15 to 40% taking into account the supervisory effort put in both by the construction agencies and the clients or promoters. There is scope for reducing this by systemising the work at site and instituting proper system of control and fixation of responsibility at different levels of site supervision.

5.7. It can thus be seen that construction management offers a good scope for cost reduction, but it entails the application of many techniques which are still new to this industry. There is a great need for training the supervisory staff in the application of these techniques. Panel, therefore, recommends that training in construction management should be imparted to in-service engineers, architects and builders at all levels by conducting training courses, seminars, etc.

5.8. The Panel also recommends that institutional arrangement for training in construction management should be organised by setting up a national centre for Construction Management which would undertake training and consultancy work in several fields connected with the construction industry. In this connection, the Panel noted that as a result of the recommendations made at Seminar held in New Delhi in November, 1975 which was organised by the I.L.O. in collaboration with the Ministry of Works and Housing, the Government of India had accepted in principle the proposal to set up a national centre for training and consultancy in Construction Management with the assistance of I.L.O. The Panel recommends that this be pursued urgently and the institutional arrangements made without further loss of time.

## 6. TRAINING AND PROFESSIONAL DEVELOPMENT

The construction agencies involved in the building trade employ a very large number of engineers, architects, etc., at various levels. Even though steps are generally taken at the time of entry into service, to see that these architects, engineers possess certain basic minimum qualifications as per the standards laid down by the construction agencies, technological advances are so fast that it is necessary to keep engineers and architects abreast with the latest developments in techniques and new building materials. Further, in the course of their work they come across various practical problems and their experience must be shared with others. Apart from the engineers and architects, the actual builders i.e., contractors and craftsman etc., also need to be brought upto date.

Keeping the above in view, the panel makes the following recommendations :-

### 6.1. In-service training:

The Panel noted that realising the importance of in-service training, major construction departments have already set up suitable training cells in their organisations, for example, Railways have a staff College at Baroda, MES have a staff college at Kirkee (Poona) and CPWD have a training Cell. Some of these may require to be strengthened and made more board-based. This may be done on as required basis. However, these institutions or cells serve the limited purpose of training one's own staff based on one's own requirement, talent and experience. It is necessary that at the national level there should be some effort to pool the knowledge, and experience of different organisations and to provide a forum for exchange and dissemination of this knowledge.

Some sort of a staff college either as an adjunct of the construction management Institute, if set up, or as an independent body is required.

6.2. Specialisation:

The Panel also feels that each construction agency should assess whether it has a reasonable number of specialists in fields in which its activities are mainly concentrated. If not, it should take steps to get a certain number of its officers trained in the various Engineering Colleges/IITs in the country and create a pool of specialists.

6.3. Builder's Training:

The Panel noted that the bulk of the construction work is being got done by the various construction agencies through contracting firms/ builders. It is, therefore, necessary that the builders are also actively associated with the training programme. It has been observed that certain construction agencies have made it obligatory on the part of builders to employ properly trained technical staff in the execution of construction works of certain magnitude and value. The Panel recommends that this system should be adopted uniformly by all construction departments - which will help to ensure better quality work.

6.4. Training of Craftsmen:

As regards training of building craftsmen, the Panel noted that the Directorate General of Employment and Training is responsible for imparting institutional training in IITs and apprenticeship training programmes. There are 356 Industrial Training Institutes all over India in the various States imparting/Craftsman Training Scheme. So far, the Building Constructor Trade of two years duration relating to the building industry has been introduced in 15 States only under the Craftsman Training in ITIs. The total number of seats introduced in respect of

/institutional training(ITI training) which comes under the

this trade is 432 out of which the number of trainees enrolled are 188. The allied trades relating to the building construction industry, namely, plumber, electrician, wireman and carpenter have been introduced in almost all the ITIs.

From the data available in the DGET about the utilisation of the training programmes on these trades, the Panel noted that the number of seats sanctioned for building trades are not fully utilised. In case of plumber and carpenter, the utilisation is about 80 per cent and 60 per cent respectively. The reason for low utilisation is obvious.

(i) In our country the trade of mason or carpenter is hereditary. They do not look towards training institutions for acquiring skill;

(ii) The stipend offered to the trainees is inadequate. It is even less than the minimum wages of unskilled labour;

(iii) The trainees do not get suitable employment as the building industry does not give preference in the employment because they consider that the trainees have acquired knowledge and not the proficiency;

(iv) The trainees, after the training, do not like to work as a carpenter or a mason as they like to have a white collar job.

6.4.1. In order to make the training programme attractive, the following suggestions are made :-

(i) The stipend should be increased;

(ii) Arrangement should be made with reputed contractors to allow the Institutes to give on-the-job training to their students at their work-sites. If the trades in question are covered by the Apprenticeship Act, then the contractor would be obliged to give some stipend. However, this may not be adequate. Hence, the difference between the stipend

payable at the Institute during training and the stipend under the Apprenticeship may be given by the Government as a part of the stipend payable during training. Where the Apprenticeship Act is not in vogue, the stipend may first be negotiated with the contractor in question on the ground that the trainees will be working for them while earning, but if this is not possible or the stipend agreed to by the contractor is not adequate, the institute should make good the difference.

(iii) Contractors employing trained personnel may be given due weightage by the construction agencies at the time of registration.

(iv) All construction organisations should be advised to give preferance to properly trained craftsmen.

(v) The syllabus for the courses on building trades should be reviewed to make these job oriented.

6.5. Apprenticeship Scheme under the Apprentices Act 1961:

The Apprenticeship Training is on-the-job training exposing the trainee to the actual work situation and the apprentices engaged under the same are covered by the provisions of the Apprentices Act 1961. The following trades directly relevant to the Building Construction Industry have so far been designated under the Apprentices Act 1961 :-

(a) Brick Mason/Building Contractor

(b) Bricklayer

The training periods in respect of (a) is for three years whereas for (b) it is for one year. Besides, the trades of Electrician, Wireman, Plumber, Carpenter, which are allied trades relating to the Building Industry, have also been designated under the Apprentices Act 1961. The training period for all these trades is three years. The Panel noted

that the utilisation of the seat under the scheme has been roughly 33 to 50 per cent of the total seats allocated, except for the course of electrician where it is more than 80 per cent. One reason for low response is that the duration of the apprenticeship is too long. Perhaps none of the workers would like to remain only as apprentice for such a long time. The duration of apprenticeship in comparatively simple trades, should be reduced. period

6.6. Training of Craftsman in new Techniques:

The Research Organisations, when they develop any new technique, try this out in the field in collaboration with the construction agencies. It is necessary that at the stage of trial, craftsmen employed by the construction agency in question, should be trained in the proper application of the new techniques. The research organisation in collaboration with the construction agency will have to take the lead in this matter. The construction agency should keep a list of the craftsmen trained in the new techniques with their full particulars and when the field level experiment passes to the next phase of wider application, the research organisation should be able to guide the new entrepreneurs to the agency which had collaborated in the experiment and the latter can, if called upon to do so, furnish particulars of the craftsmen trained in the technique. Efforts should be made by the Research Organisation, directly also to impart similar training on a pilot basis in other areas where the new techniques are taken up for adoption.

## 7. CONCLUSIONS

The subject of economy in building construction is a very vast subject. The points dealt with in the foregoing chapters can and in reality have become the subject matter of various detailed studies. The time at the disposal of the Panel was very limited. Moreover, its job was to draw up a set of guidelines which could be easily read, digested and put into practice. The Panel has tried to do this to the best of its ability. Similar recommendations have been made in the past also by various Committees. What is important is that these should be put into practice. The Government departments and the public housing agencies should take a lead in the matter. The NBO as an Important Wing of the Ministry should keep a watch over the extent of the adoption of the recommendations by the various bodies. If necessary, it should bring together people working in various construction organisations and make them accept the idea that unless cost reduction, through the various methods which have already been tried out, is accepted as a policy, it will not be possible for the country to quickly provide the much needed houses and other buildings required by the community. We urge the Government to see that follow up action is taken promptly.

Sd/-
(N.K. Prasad)

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|---|---|---|
| Sd/- | Sd/- | Sd/- |
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| Sd/- | Sd/- | Sd/- |
| (B.R. Govind) | (P.M. Apte) | (G.C. Mathur) |

ANNEXURE I

## COMPOSITION OF SUB-COMMITTEES

### (a) Sub Committee on Optimisation of land use and economical Space Planning

1. Shri P.M. Apte, Chief (Projects) HUDCO New Delhi — Chairman
2. Shri A. Simha Director (Civil Engineering) Indian Standards Institution New Delhi
3. Shri T.N. Gupta Scientist C.B.R.I. Roorkee
4. Shri S. Manchanda Senior Architect Central P.W.D. New Delhi

### (b) Sub-Committee on Augmentation of Building Materials and their optimal use

1. Dr. H.C. Visveswaraya Director Cement Research Institute New Delhi — Chairman
2. Dr. S.K. Chopra Deputy Director Cement Research Institute New Delhi
3. Shri S.C. Kapoor Chief Engineer Central P.W.D. New Delhi

4. Shri A. Simha
   Director (Civil Engineering)
   Indian Standards Institution
   New Delhi

5. Shri G.C. Mathur
   Director
   National Buildings Organisation
   New Delhi

(c) Rationalisation of Specifications and New Materials and techniques

1. Shri G.C. Mathur — Chairman
   Director
   National Buildings Organisation
   New Delhi

2. Shri B.R. Govind
   Director (Designs)
   Military Engineering Service
   New Delhi

3. Shri S.C. Gupta
   Supdt. Engineer,
   Central P.W.D.
   New Delhi

4. Shri J.S. Sharma
   Scientist
   C.B.R.I.
   Roorkee

ANNEXURE II

OPTIMUM DENSITY ESTIMATES FOR ONE HECTARE LAND AND D.UNITS WITH 20 SQ.MTS. PLINTH AREA

| Sl. No. | Density D.units/ Hectare | No. of floors | Total D.Us. | D.Us. on G.F. | Land Utilisation requirements in Hects. Residential use | Open space | Roads | Nursery | Convenient shopping | Total | ± difference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | 130 | 1 | 130 | 130 | 0.52 | 0.15 | 0.20 | - | - | 0.87 | + 0.13 |
| 2. | 250 | 2 | 250 | 125 | 0.375 | 0.328 | 0.20 | 0.1 | 0.007 | 1.01 | - 0.01 |
| 3. | 300 | 3 | 300 | 100 | 0.300 | 0.45 | 0.15 | 0.1 | 0.01 | 1.01 | - 0.01 |
| 4. | 350 | 4 | 350 | 88 | 0.255 | 0.52 | 0.10 | 0.1 | 0.01 | 0.985 | + 0.015 |
| 5. | 400 | 5 | 400 | 80 | 0.24 | 0.6 | 0.10 | 0.1 | 0.01 | 1.05 | - 0.05 |

TABLE - II

OPTIMUM DENSITY ESTIMATES FOR ONE HECTARE LAND & D.UNITS WITH 40 SQ.MTS. PLINTH AREA

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 85 | 1 | 85 | 85 | 0.68 | 0.120 | 0.2 | - | - | 1.00 | ± 0 |
| 2. | 170 | 2 | 170 | 85 | 0.51 | 0.254 | 0.2 | - | - | 0.964 | + 0.036 |
| 3. | 255 | 3 | 225 | 75 | 0.45 | 0.330 | 0.15 | - | 0.007 | 0.937 | + 0.063 |
| 4. | 260 | 4 | 260 | 65 | 0.39 | 0.39 | 0.10 | 0.1 | 0.01 | 0.99 | + 0.01 |

NOTE:
1. Open space requirement is estimated at 0.3 hectare per 1000 persons
2. Road area varies between 10 to 20% of the site area
3. One Nursery School of 0.1 hectare is provided for 1500 population
4. Shopping needs are estimated at 4 shops (0.007 hectares) per 1000 population.

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ANNEXURE III

GUIDE LINE SPECIFICATIONS FOR BUILDING SCHEMES
FOR LOAD-BEARING WALL CONSTRUCTION UPTO 4 STOREYS

Foundations:

Lime concrete 40 mm nominal size stone/over burnt brick aggregate and 40 percent mortar comprising of 1 lime putty/1 surkhi:1 sand OR Cement Concrete 1:5:10 (1 cement:5 sand:10 graded stone/over burnt brick aggregate 40 mm nominal size)or as per structural design requirement of Indian Standards. Where materials of superior quality are available and it is possible to obtain a 28 days compressive strength of 30 Kg per sq.cm. with leaner cement concrete mixes the same may be permitted.

2. Masonry in foundations and plinth:

(a) Brick work/random rubble masonry with hard stone/stone block masonry in lime mortar 1:1:1 (1 lime:1 surkhi:1 sand) or in cement lime mortar 1:2:9 (1 cement:2 lime putty:9 sand) or in cement mortar 1:6 (1 cement:6 sand) or as per structural design requirement in accordance with Indian Standards. Where materials of superior quality are available and it is possible to obtain a 28 days compressive strength of 30 Kg per sq.cm. with leaner mixes of cement mortar, the same may be permitted.

Note: (i) Where flyash of approved quality as per IS:3812(Pt.III)-1966 is marketed and quality control can be ensured, masonry work may be done in cement flyash and sand mortar 1:3.5:6.5 (1 cement; 3.5 flyash:6.5 sand)

(ii) Where sand is very fine, admixture of coarse and fine sand may be used to get fineness modulus of 1.5.

(iii) In seismic areas strengthening arrangements as required by the National Building Code may be provided.

3. Damp Proof Course:

(a) 25 mm thick cement concrete 1:2:4 (1 cement:2 coarse sand:4 graded stone aggregate 10 mm nominal size) painted on top with a coat of blown bitumen 85/40 or 85/25 using 1.7 Kg per sq.m

Note: Where sub-soil water level is low, damp proofing coarse can consist of 15 mm thick cement sand 1:6 plaster over masonry work painted on top with a coat of blown bitumen 85/40 or 85/25 using 1.7 Kg per sq.m

4. Masonry in superstructure:

(a) Brick work/random rubble masonry with hard stone/stone block masonry with lime mortar 1:1:1 to 1:1:2 (1 lime:1 surkhi:1 sand to 1 lime:1 surkhi:2 sand) or cement lime mortar 1:2:9 (1 cement: 2 lime putty:9 sand) and/or cement mortar 1:6 (1 cement:6 sand) and/or as per structural design requirement in accordance with Indian Standards. Where materials of superior quality are available and it is possible to obtain a 28 days compressive strength of 30 Kg per sq.cm. with leaner mixes of cement mortar, the same may be permitted.

Note: (i) Where flyash of approved quality as per IS:3812(Pt.III)-1966 is marketed and quality control can be ensured, masonry work may be done in cement flyash and sand mortar 1:3.5:6.5 (1 cement: 3.5 flyash:6.5 fine sand)

(ii) Where sand is very fine, admixture of coarse and fine sand may be used to get fineness modulus of 1.5

(iii) In seismic areas strengthening arrangements as required by the National Building Code may be provided.

5. Filling in plinth:

Filling with excavated earth finished with 7.5 cm thick layer of sand on top.

6. Flooring:

(a) Base concrete under floor in ground floor. 80 mm thick lime concrete or cement concrete of same mix as used in foundation concrete.

(b) Top layer: Top layer shall consist of

i) Flat brick tiles laid with 12 mm thick joints grouted with mortar and finished with 12 mm thick plaster of cement mortar (1:4) in ground floor of low cost housing (not suitable in areas like w.c., bath and kitchen).

ii) Burnt clay flooring tiles (IS:1478-1969)

iii) Stone slabs as locally available

iv) Timber flooring

v) Cement concrete/mosaic terrazo tiles flooring to be provided when it is not possible to adopt any of the above alternative specifications on functional and cost considerations.

7. Door and Window Frames:

(a) i) 40x40x5 mm MS Tee or 45x30x5 mm angle iron for doors and 35x35x5 mm MS Tee or 40x30x5 mm angle iron for windows.

Note: For all types of houses as far as possible mild steel Tee or angle iron frames shall be provided.

1. If due to special reasons, wooden frames have to be provided, the sizes will be as below

(a) Wooden frames for windows of all sizes will be 75x60 mm. Door frames of all sizes 100x60 mm. In case of fly proof shutters, the size of door frames shall be 120x60 mm. These shall be made from locally available seasoned timber.

2. Reinforced cement concrete precast chowkhats or stone chowkhats where available and considered suitable on functional and cost considerations, the same can also be adopted.

3. In case of houses meant for EWS, door frames can be omitted altogether, where possible.

(b) Door Shutters:

Panelled or battened and framed door shutters of thickness 35 mm for shutters of width of 900 mm or more and 30 mm thickness for shutters of width 800 mm and less made from locally available seasoned timber.

Note: The shutters shall have 15 mm thick panels except in case of veneer board panels which can be 12 mm thick

(c) Window shutters:

Same as door shutters but of thickness 30 mm. Fly proof shutters can be provided where required functionally.

(d) Door and window fittings:

Oxidised iron/black Japan fittings

Note: Aluminium fittings can be used in special circumstances when necessary

8. Plastering:

(a) External: 12 mm thick cement lime plaster 1:2:9 to 1:1:6 depending upon intensity of rainfall and quality of bricks

(b) Internal: 12 mm thick or 15 mm thick in case of rough surface of single brick walls or stone masonry with

i) Lime:Sand 1:3 to 1:2
ii) Lime:Surkhi:sand 1:1:2 to 1:1:1
iii) Lime:flyash:sand 1:1:2 to 1:1:1
iv) Lime:surkhi 1:2
v) Where good lime is not available and where functionally needed cement lime mortar 1:1:6 to 1:2:9 may be used.

Note: 1. External plaster need not normally be provided on stone work and only pointing shall be provided with lime or cement lime mortar.

2. In regions of low rainfall, if the bricks are of reasonably good quality, only pointing may be done externally with lime or cement lime mortar.

3. In areas subjected to continuous wetting such as bath rooms and kitchens, mortar for plastering used should be of comparatively greater strength.

4. Where plain cement sand mortar 1:6 is economical and functionally suitable, the same can also be used.

9. Surface treatment:

(a) Interior:

White/colour washing 3 coats on all internal walls and ceilings

(b) Exterior:

Colour wash 2 coats over a base of white washing

Note: Distemper and cement based paint can be used in special cases if considered necessary

10. Roofing/floors:

i) Stone slabs on timber or precast RCC joists

ii) Brick Tiles on RCC or timber joists

iii) Timber floors

iv) Jack arches with RCC joists

v) Brick-cum-concrete composite (Madras Terrace) floor or roof

vi) Reinforced brick or reinforced brick concrete slabs

vii) Various types of precast units such as channel units, cored units, cellular units with RCC joists, hollow concrete/clay blocks with precast RCC/pre-stressed joists, doubly curved shells, RCC solid planks, R.B. panels and waffle units for spans more than 6 m.

viii) Sloping roofs using Mangalore tiles, Allahabad tiles, slates or shingles over wooden trusses.

ix) CGI/AC sheet roofs over wooden trusses

x) Reinforced cement concrete slabs.

Note: 1. For floors and roofs, stone slabs or tiles on timber/RCC joists, jack arches, Madras terrace or other specifications which require only small quantity of cement and steel should be preferred where suitable materials are available. Sloping roofs with tiles, slates or shingles should be adopted in regions where these materials are economically available and where their use is suitable for local climatic conditions.

2. Where precast RCC units are functionally and structurally suitable and where their use will result in economy, they may be used in preference to cast-in-situ RCC construction. However, these techniques are still in developmental stage and a reference may be made to the remarks under new techniques and materials portion of this report.

3. Where local materials mentioned above are not economically available or do not meet the functional requirement of any particular building RCC construction may be adopted.

11. Roof terracing:

(a) For hot and arid regions:
10 cm thick (average)mud phuska consolidated laid to slope not flatter than 1 in 50 with 25 mm mud gobri plaster and flat brick tiles (25 mm thick) grouted in cement mortar 1:3 + 5 percent crude oil by weight of cement over painted roof slab with hot blown bitumen 85/40 or 85/25 (A coat of white washing could be given to the roof) or 5 cm thick (average) lime concrete with brick aggregate and 50 percent lime mortar 1:2 (1 lime:2 surkhi) finished with gur and belgiri over painted roof slab with blown bitumen 85/40 or 85/25.

(b) Heavy rainfall areas:
Sloped RCC slabs or joists and slab with 50 mm lean concrete on top.

12. Plumbing:

1. Plastic pipe may be used for Low Cost Housing Scheme in unexposed situations

2. Unmetered water supply system with common over-head tanks may be used.

3. Single stack system of plumbing where building bye-laws permit and where conditions for its adoption are satisfied.

13. Electrical Installation:

1. Surface wiring on wooden battens shall be provided as far as possible

2. When conduit wiring is essential PVC conduits may be used, if available.

No.N-16012/11/76-PS
Government of India
Ministry of Works and Housing

.....

Dated New Delhi the 13th Oct., 1977

To

Secretaries in charge of Housing and
Urban Development - of all State Govts.
and Union Territory Administrations.

.....

Sub:- Report of the Expert Panel for evolving Guidelines for reduction in the cost of building - Recommendations thereof.

.....

Sir,

Construction accounts for nearly 50 per cent of the Plan outlay. Out of this nearly half goes towards housing and building. There is considerable potentional for cost reduction in each stage of the scheme of housing and building construction, like planning, structural design and specifications, and execution. In September, 1976, the Govt. of India constituted an Expert Panel to make an in-depth study of the possibilities of achieving reduction in building cost and to suggest suitable guidelines for the purpose. The Panel submitted its report to the Govt. of India in November, 1976.

2. The Panel recommended cost reduction under the following heads:-

(i) Optimisation of land use.

(ii) Functional design of buildings;

(iii) Optimal use of building materials and thoir augmentation;

(iv) Rationalisation of specifications and use of new techniques of construction;

(v) Improved managament of projects; and

(vi) Training and professional development.

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3. Buildable land in cities is very limited, and the growing population makes it imperative that the available land should be put to optimum use consistent with provision of good environmental condition conducive to the growth ot the life of the community. The Panol has recommended a density of 130 to 400 dwelling units of 20 sq.m. plinth area, and 85 to 300dwelling units of 40 sq.m. plinth area, per hectare, for different storeys, with suitable roadways and path ways and open spaces for recreational purposes.

4. Sizeable economy in construction cost can be achieved by rationalisation of space requirements and functional planning of various types of buildings such as residential buildings, school buildings, multi-storeyed office buildings, etc. The economical space norms given in the report of the Panel should be adopted.

5. The success of construction programmes depends largely on the development of building materials industry, as building materials account for 65 to 75 per cent of construction cost. To achieve economy it is necessary to conserve scarce materials by use of substitute materials like portland pozzolana cement instead of portland cement, composite cement-lime-mortars instead of straight cement mortar, design mix concrete instead of normal concrete mix, high strength deformed bars instead of mild steel bars etc.

6. Rationalisation of specifications and adoption of new techniques and materials are important factors in achieving economy in construction cost. Similarly, improved scientific management of construction projects leads to optimum utilisation of available resources and timely execution of works within specified costs. It is essential that in service training in the techniques of modern construction management is imported to engineers architects and builders at all levels. Training of craftsman is also essential.

7. The Govt. of India have accepted the recommendations made by the Panel in respect of the above subject except item 6 above regarding training and professional development, which is still under its consideration.

8. It would be observed from the recommendations made in the report that all the construction agencies both in public and private sector, State Governments/Central Govt./ Union Territories/Architects/Planners, etc. are required to implement the various recommendations made and to adopt the guidelines suggested in the report.

----3/-

9. It is therefore, requested that immediate action may be taken to implement tho recommendations of the Expert Panel. A monitoring agency may be set up in your department to watch the progress of implementation of the recommendations. A report on the action taken may kindly be sent to this Ministry (with copy to the Director, National Buildings Organisation, 'G' Wing, Nirman Bhavan, New Delhi-11).

10. Necessary action with regard to the remaining recommendation in respect of item 6 above is being taken by the Govt. of India. As and when a decision is taken on this recommendations, it will be communicated to the State Govts. etc.

11. Your requirement, if any, for extra copies of the report may please be sent to Director, National Buildings Organisation, Nirman Bhavan, New Delhi-11 directly.

12. The receipt of this communication may please be acknowledged.

Yours faithfully,

Sd/-
( A.P.Jain )
Under Secretary to the Govt. of India

Copy to:-

1. Director, NBO, New Delhi(with 10 spare copies).
2. Works Div.
3. UD Division.