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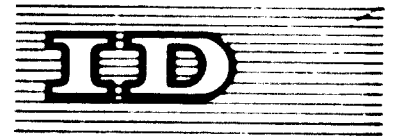
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Study Group on Production Techniques for the Use
of Wood in Housing under Conditions Prevailing
in Developing Countries

Vienna, 17 - 21 November 1969

REPORT OF THE STUDY GROUP ON
PRODUCTION TECHNIQUES FOR THE USE OF WOOD IN HOUSING UNDER CONDITIONS
PREVAILING IN DEVELOPING COUNTRIES ^{1/}

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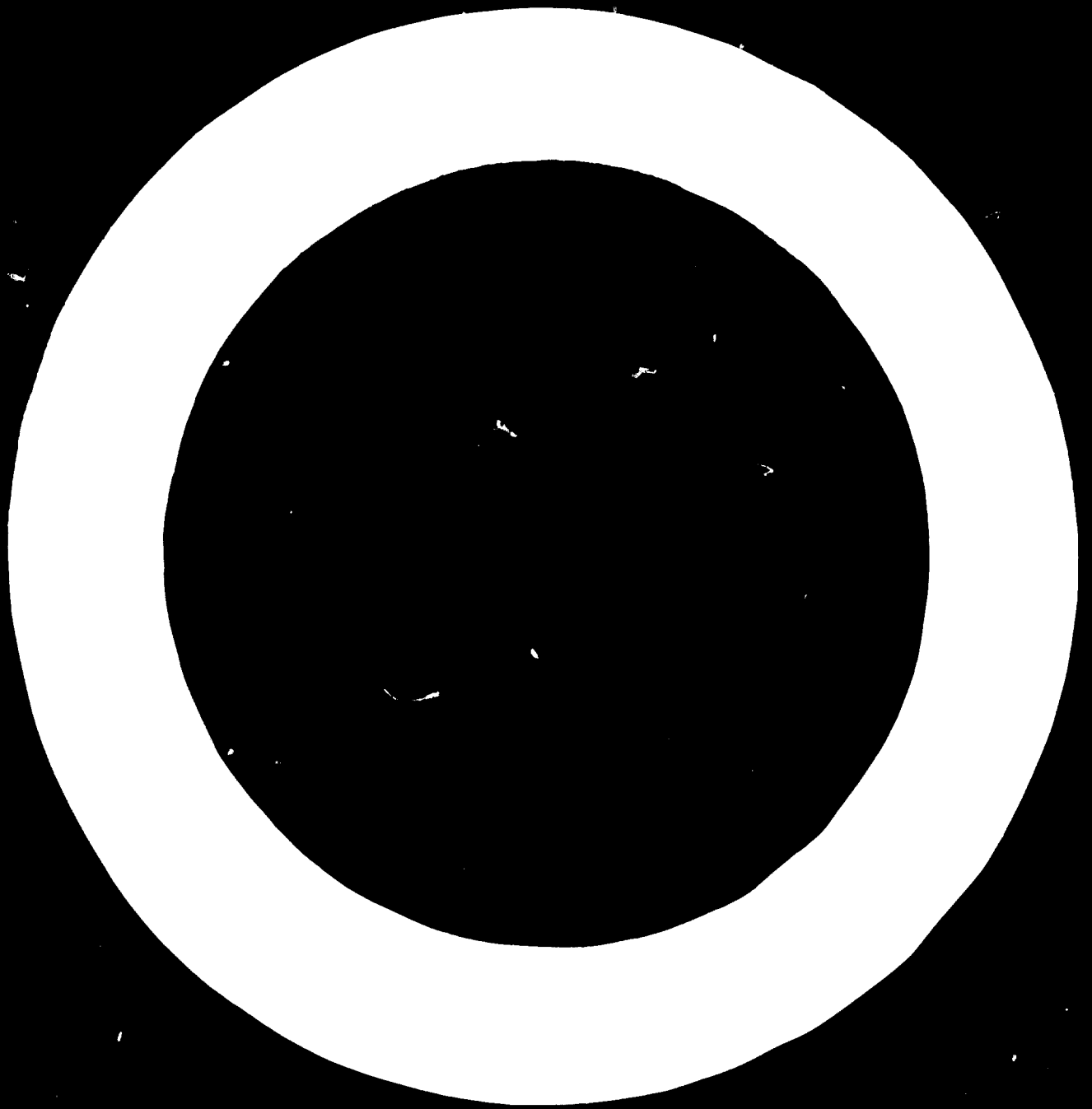
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INTRODUCTION

1. According to a recommendation^{1/} adopted at the International Symposium on Industrial Development, held in Athens in November - December 1967, UNIDO was requested, in co-operation with FAO and other appropriate United Nations bodies, to organize a study group to evaluate the role of wood-based products as building materials under the specific conditions prevailing in developing countries.
2. The preparations for this Study Group were made by UNIDO in collaboration with FAO and the UN Centre for Housing, Building and Planning, and its terms of reference were set out as:
 - (a) to analyse the existing practice in building techniques and to select the most appropriate methods for industrial production and construction of wooden houses in developing countries; and
 - (b) to present the role of wood in housing as compared with other building materials and to prepare recommendations which will contribute to the increased use of wood in housing in developing countries.
3. The Study Group met at the UNIDO Headquarters in Vienna from 17 to 21 November 1969.



CHAPTER 1

Present Situation in Developing Countries

4. Those participants familiar with conditions in developing countries spoke on the state of the housing industry in their country.

5. Africa:

Although wooden houses built in the traditional methods do exist, those constructed by industrial processes are as yet not common in the developing countries of Africa; however, a good start has been made in some countries.

6. Several speakers enumerated some of the reasons for this situation, and it appears that major difficulties facing this industry are apparent in spite of the quite favourable raw material situation.

7. Particularly in Kenya the secondary hardwoods are now of less importance because of the availability of plantations growing softwoods in increasing quantities.

8. It was also noted that good markets exist in Africa for the use of wood wool cement boards and it was noted with interest that a more economical process developed in Austria produces similar panels based on wood chips and not wood wool.

9. The main problems are:

- (a) traditional building materials (such as mud and bricks) used in rural areas are still acceptable and competing with wood;
- (b) consumer resistance to wooden houses under the present conditions in these countries;
- (c) due to the heterogeneity of the African forests the difficulties of using mixed and new species have not yet been solved. Although considerable work has been done, there remains work to be done on marketing these lesser known species locally and for the export markets, and their acceptance in housing.
- (d) the introduction of lesser known species is also hindered by the fact that in some countries the fees and Royalties paid to the Forest (Government) authorities is uniform, irrespective of the market value of the species concerned;
- (e) due to lack of standards and codes of practice and the use of mixed species it is necessary to use higher factors of safety than would be used for better known species covered by the standards available;
- (f) antiquated inherited building codes have so far hampered the development of wooden houses in urban areas. In certain countries it has been noted that the resistance of the building authorities to wooden houses is softening.

(g) the fact that in some countries sawnwood is produced in many small inefficient mills has created a tendency toward increased prices.

The timber produced is often badly cut and poorly graded;

(h) qualified labour is usually available only in the larger urban centres.

10. South America

In spite of an exceptionally serious housing shortage in South America, and the vast wood resources the sub-continent possesses, the acceptance of wooden houses is marginal.

11. In addition to most of the difficulties enumerated above, other problems are that:

(a) the poor construction methods used in the past in the construction of wooden houses have resulted in their premature deterioration, which has created a severe consumer resistance; Furthermore in many South American countries wooden houses were at no time accepted by the indigenous populations;

(b) in most tropical areas endowed with forests, the primary wood processing industry is perhaps not sufficiently developed to ensure the suitability of their products in wooden houses.

12. South East Asia

In Malaysia, the Philippines and Singapore, the houses utilizing considerable quantities of wood have a far larger market than in the two regions mentioned above. This can be attributed to the following reasons:

(a) the ready adoptions of the modern house building technology;

(b) their appreciation by the authorities that housing finance must be provided on an economic basis to the prospective occupier;

(c) wood is acceptable for houses in these areas because it is available at economic prices and also because the indigenous species are known to have natural resistance to fungal and insect attack;

(d) optimum design practice has led to the availability of adequate finance.

13. Many of the problems enumerated in Africa and South America, above, apply to the other developing countries in South East Asia as well.

CHAPTER 2

Technical and economic aspects of building materials used in conjunction with wood in developing countries

14. The Study Group took note of the paper prepared by the UN Centre for Housing, Building and Planning on Technical and Economic Comparisons between Wood and Other Building Materials Commonly Used in Tropical Regions (E/WG.4/1).
15. The Study Group discussed the position of wood as against other building materials, and dwelt upon two of these products related to wood, namely bamboos and wood wool board.
16. In discussing the use of bamboos, it appeared that in certain regions and for certain uses, especially in rural housing, bamboos are commonly accepted by the house owners. Its use is limited by the fact that satisfactory methods for joining it without undue loss in strength at the joint have not yet been devised for industrial production and not all species of bamboo can be satisfactorily treated against attack by insects. Several research institutes have worked on this subject and information is available. The work of ESCAPE and the UN Regional Housing Centres in Bandung and New Delhi on this subject was mentioned.
17. It was pointed out that certain species of bamboo have been used as reinforcing material in construction with concrete.
18. Another material which the Study Group believed was promising for use in housing, and merited further study, was the wood wool boards. It was pointed out that this material was as yet not very popular, but that its intrinsic properties, namely thermal and acoustic properties, as well as its resistance to fire, fungal and insect attack, coupled with its relatively low cost, would make it suitable for use in conjunction with wood in low-cost houses.
19. The Study Group recommended that UNIDO include the manufacture of wood wool boards as an agenda item in the meeting it will hold next year on production of panels from agricultural wastes and that research institutes proceed with the testing of species and bonding agents for use as raw materials in these boards.
20. Some participants recommended that the appropriate bodies in the United Nations System encourage and support the establishment of an effective international office to collect, catalogue and distribute information on housing research and developments throughout the world. This office would also compile and make available a list of Government, industrial and academic institutions currently conducting research and development in housing design and in building-materials research.

CHAPTER 3

Possibility of using tropical woods and their derivatives in building in developing countries

21. The Study Group took note of the paper prepared by the Centre Technique Forestier Tropical, Nogent-sur-Marne, France, entitled "Possible use of Tropical Woods and their Derivatives for building Purposes in Developing Countries" (ID/WL.A/4).
22. In discussing the technical characteristics, the general feeling was that in order to increase the utilization of wood, the rational testing of the lesser-known species and components made from them must be actively pursued, especially on the points pertaining to physical and mechanical properties; with regard to the durability of wood, the sapwood should not be regarded as a defect because of the possibilities of preservative treatment.
23. The increase in international demand for the more popular species of tropical hardwoods is creating a shortage of these species; it is therefore suggested that the species with similar properties be grouped and marketed for similar utilizations. The results of testing of other characteristics such as machining, drying and assembly should be taken into account in the grouping of species. The utilization of wood-based panels, namely particle board made from hitherto unutilized tropical woods, should be fully tested prior to their use in buildings.
24. Prices of timber have gone up substantially owing to increased extraction costs, making it vitally essential to start utilizing the lesser known species. The local utilization of these species in construction and furniture would furthermore lead to an increase of their acceptability on the overseas markets. It was felt that Government royalties and fees on these species should be lowered to facilitate their introduction. Furthermore, it was pointed out that exports could be developed by increasing the local use of the lesser known species, thus making available the better-known species for exports.
25. The present situation with respect to utilization of wood in building and the recommendations for its increased use that the Study Group believed are necessary were discussed at length.
26. In order to overcome the psychological resistance to the use of wood in housing the Group recommended that the following measures be taken:
 - (a) promotion of well-planned mass advertising should be consumer-oriented^{1/}
 - (b) demonstration units extensively using lesser known species should be erected and furnished and displayed in high density localities.

^{1/}A specific instance where the campaign was oriented to the housewives was pointed out to the group. It was particularly useful.

(c) the use of wood in prestige projects should be promoted.

27. Technical aspects were discussed and the following recommendations made:

- (a) governments should be urged to up-date codes of practice so as to allow the maximum utilization of wood, as has been successfully done in countries with temperate climates.
- (b) regional standardization of housing components and adequate quality control of raw materials should be developed by the Agencies of the United Nations system dealing with housing, in collaboration with the national bodies and industry, to facilitate the acceptance of these products.
- (c) manufacturers' associations should devote more attention to the dissemination of technical knowledge on available species and up-to-date design procedures.

28. To increase the acceptance of wood, aesthetical aspects pleasing to the end users should be actively pursued. It was felt that in many instances wooden houses were held in disfavour owing to the fact that the examples available were of poor design. The Study Group recommended that the United Nations and its agencies grant fellowships to production managers and designers to visit woodworking industries utilizing tropical species in developing countries to acquaint themselves with modern production and marketing techniques. The Study Group recommended that Administration should be urged to amend its policies particularly in respect to tenders, design of buildings and inspection of buildings and their components, so as to facilitate the use of timber. This will open the door to mass production and thus enable timber to compete with other materials.

29. The Study Group wishes to draw the attention of Administrations to the fact that unless the same financial facilities are accorded to construction using wood extensively rather than the present conventional construction methods, the use of wood in housing will be seriously curtailed.

30. The Study Group wishes to stress to the governments and manufacturers the importance of the introduction of industrial production methods with adequate quality control and attendant economies of scale so as to rationalize the price structure, resulting in lower prices.

31. Governments should be urged to devote even more attention to the training of skilled workers and wood technicians from the developing countries to operate successfully these wood processing industries either through technical assistance (for example by selecting experts to train local staff) or through fellowships.

32. Attention was drawn to the fact that surpluses of graduates in engineering and in science do exist, and it was recommended that endeavours be made to utilize their skills in other developing countries.

CHAPTER 4

Wood preservation in the developing countries

33. The Study Group took note of the paper prepared by Mr. V. R. Sonti of Calcutta, India, on "Wood Preservation for Tropical Climates" (II/WG.4/8).

34. Many aspects and methods for the preserving of timber from biological deterioration in all its forms, were discussed fully. Drawn from these discussions, the following important points emerged:

- (1) It was clear that the timber resources in developing countries would be largely wasted unless adequate preservative techniques and facilities are available for preserving the non-durable species.
- (2) It was noted that many tropical species which hitherto have not been used could be utilized successfully in construction work after a suitable preservation treatment. Some tropical species presently being used are found to be uneconomical owing to their sapwood having to be wasted. It was stressed that the sapwood could be utilized if suitably preserved.
- (3) It was noted that in some developing countries little work had been done to determine which tropical hardwood species could be preserved, and by what method.
- (4) It was further noted that in some other developing countries considerable amounts of work had been done in the direction of preservation of tropical timbers by all known methods and that such information was relatively unknown to other countries possessing these species. Hence a means for collecting and disseminating existing information should be devised.
- (5) It was noted that in developing countries where board products were manufactured, their use in construction could be considerably increased if suitably preserved.
- (6) Fire retarding processes for both wood and its derivatives are available, but their use is not common, due to the high cost of the treatment in many developing countries. In the opinion of the Study Group, the fire risk from timber in general was minimal. It was pointed out by many participants that fires hardly ever occurred in wooden buildings equipped with electrical installations which comply with prescribed regulations. The Study Group urges government bodies' manufacturers' associations of wooden houses and their components to ensure that electrical wiring, cooking and heating installations are carried out to safe and recognised standards.

- (7) It was seen, with the use of non-durable species, that with careful building and surface application, reasonable protection under normal conditions could be ensured against deterioration. It was agreed, that the most reliable process for the preservation of non-durable, permeable species and all sapwood, including bamboo, was the vacuum/pressure method, using fixed preservatives.
It was noted that other non-fixed preservatives could be cheaper, but that the matter of cost had to be considered over a period of time, rather than upon the basis of initial cost.
- (8) It was noted that in the developing countries, preservation which did not cover the full range of hazards of that country would ultimately tend to be costly in remedial repairs in the years to come.
- (9) Participants from developing countries, realizing that difficulties of transport and location of preservation plants exist in their countries, recommend the use of mobile pressure preservation plants to overcome these to a great extent.
- (10) Having in mind the good durability and resistance to insect and fungal attack of many wood species found in the developing countries, the Study Group recommends to government authorities and to lending and financing institutions within each country that, where species are well established and readily identified, a careful study be made to establish whether or not preservation is required for each specie in particular types of usage.

CHAPTER 5

Production techniques for wooden houses

35. The Study Group investigated the next item on the agenda, namely the production techniques for wooden houses. Three papers on this topic were presented, covering production aspects of timber-framed designs for on-site construction, precutting timber for wooden houses, and factory-built prefabricated wood houses using various methods.

36. These papers were: "Timber Framed Construction for Tropical Climates", prepared by Mr. Richard W. Blomquist of the Forest Sciences Laboratory, Athens (Georgia), U.S.A (II/WG.4)/2); "Precut Wooden Houses for Tropical Climates", prepared by Bruynzeel Suriname Houtmaatschappij N.V., Paramaribo, Suriname (II/WI. 43/7) and "Prefabricated Wooden Houses" prepared by Mr. Keijo Ruusanen of Jyväskylä, Finland (II/WI.43/5).

37. The wide acceptance of on-site timber-frame construction in a number of developed countries was emphasized. The recent work done by the US Forest Service in the design of low-cost wooden houses for rural populations was drawn to the attention of the participants.^{1/}

38. The Study Group believed that these designs incorporated useful ideas, some of which warrant serious consideration by developing countries. The use of pole-framed and wood-pier construction for wooden house construction was mentioned as being particularly suitable for hilly sites as it eliminated the need for costly foundations. Further advantages of these systems are that the elevation of the house facilitates regular inspection of the underside of wood floors, thus localizing at an early stage any fungal or insect attack. Furthermore, they ensure good ventilation around the floor structure, thus reducing its moisture and minimizing the possibility of decay. From a cost consideration, the pole or post construction gives larger usable area per plot, as the floor area of the lower level can be used for storage, or in hot climates in lieu of veranda, with no increase in the cost of the land or construction, while at the same time the increase in height above the ground level provides better air circulation through the living quarters.

39. Participants from African countries pointed out their need to utilize fully the small-dimension timber for cladding and other non-structural requirements in their designs; and well-fabricated finger jointed timber was being successfully introduced by them. This, it was agreed, will have great benefit in view of the general need for these countries to export prime-quality long-length timber.

40. In discussing the surface cladding of the frame it appeared that in many developing countries with low labour costs there is a tendency to use siding, sometimes narrow-tongue and grooved, instead of wood-based panels, due to economic reasons.

^{1/} Summaries of these designs are available from the Division of Information and Education, Forest Service, U.S. Department of Agriculture, South Building, Washington D.C. 20250, U.S.A.

41. The Study Group recommended that due consideration be given to training artisans to erect timber-framed houses prior to embarking on large-scale production of such houses. It was pointed out that effective quality control can be achieved more efficiently under factory conditions than in on-site construction. Participants believe that prefabrication is better suited to those countries with a considerable oversupply of unskilled labour and an insufficient number of skilled artisans, in spite of the increased capital requirements involved.

42. The Study Group wished to draw the attention of housing corporations and governmental authorities to the faster erection time and quicker occupancy of wood houses as compared with concrete block or other non-wood houses. It was recognized, however, that concrete blocks have economic and other advantages in some developing countries. It was pointed out that prefabrication not only ensures a quicker erection time but also reduces the possibility of damage due to rain and other weather elements before the house is fully enclosed.

43. The Study Group also investigated the relative merits of precutting the timber in factories for assembly on the site. The relative advantage of this method over the typical timber framing method on site is that it is possible to ensure greater precision in fit under factory conditions with increased mechanization and adequately-trained, low-skilled manpower under fully-qualified supervision. Precutting allows preselection of species and grades for each specific structural use, and also reduces transporting of materials that ultimately are wasted if cut on the job. The precut lumber should be effectively complemented by the supply to the site of all other components such as preassembled doors, windows, cabinetry and the necessary hardware, so as to achieve the maximum economy in the cost and time of erection. Proper packaging of the precut elements and related materials is essential to reduce damage and loss by pilferage. Proper identification of each component part by numbering with an accompanying manual is essential for effective erection of precut items. It must be borne in mind in choosing the precutting method that skilled workers are still necessary for the proper assembly of the components on the site.

44. In considering the prefabrication of wooden houses, four types were identified, namely: in-plant production of modular panels (such as for instance 4' x 8' units), large-size panels (such as spanning a complete wall) and a three-dimensional modular unit (comprising a fully assembled section of the house), and lastly the foldable modular system, (basically the same as the previous one but with a collapsible design).

45. The Study Group considered the design and production problems pertaining to the modular panel system and felt that this system is applicable to conditions in many developing countries for the following reasons:

- (a) it ensures the maximum possible flexibility in architectural design, while at the same time taking full advantage of in plant production, namely in respect to quality under well-controlled conditions, making possible the production of large outputs with semi-skilled workers;
- (b) handling of panels during shipping and assembly is relatively simple and does not require any mechanization;
- (c) panels damaged during transport and erection can be replaced at lower cost and more simply than in larger prefabricated units;
- (d) modular panels can be stocked for prompt sale and delivery; this is less practical than the other prefabricated systems envisaged;
- (e) the production of these modular panels requires but little extra investments over those needed for precastings.

46. Among the disadvantages of this method are the problems caused by the presence of a larger number of joints that have to be made weatherproof, ^{which} increases the on-site labour costs. The problems of laying electrical and plumbing installations through all components has to be borne in mind.

47. The next system to be studied was the large-panel construction method. The advantages of this system are less labour on site and fewer joints than the modular panel system.

48. However, the Study Group believes that, in the case of developing countries, the following disadvantages make this system less applicable to many of these countries. These are that:

- (a) this type is not as feasible for production, transport and erection under the conditions prevailing in many developing countries;
- (b) the far greater weight of these panels necessitates the utilization of heavy moving and lifting equipment, both in the plant and on site;
- (c) damage due to mishandling of these panels could be more frequent and would be more difficult and costly to repair.

49. The Study Group also considered the potentials of the three-dimensional modular units and believes that under the present conditions of developing countries, there are only very limited applications for this system. The main reservations were with respect to the unwieldy handling problems of these units in delivery and positioning on the site (except for use in large-scale urban development). The Group believes that this recently developed prefabrication technology might be applicable in the countries' future industrial development.

50. One participant pointed out the significant merits of the folding type of three-dimensional modular construction over the previous systems as this method allows for complete factory fabrication while facilitating the transport and handling problems involved, and at the same time minimizing on site erection.

51. The Study Group deliberated at length the relative merits of including in its Report specific recommendations on the choice of production techniques for the use of wood in houses in developing countries. It came to the conclusion that, owing to the very many factors that have to be considered before an investment in prospective investor in this industry could be made on the subject, and the wide spectrum of conditions in the developing countries elsewhere, it would abstain from making clear cut recommendations, while at the same time drawing the attention of the reader of their Report to the most important factors it believed should be considered prior to taking any decision on the subject.

These factors are:

- (a) size of market for the products to be manufactured and its location;
- (b) type of market, whether urban or rural;
- (c) continuous availability of raw materials in suitable species, quality and specification;
- (d) availability of sufficiently trained labour;
- (e) availability of transport facilities;
- (f) design requirements for the products to be manufactured, bearing in mind that the actual design envisaged should be acceptable not only to prospective utilizers but also to financing authorities;
- (g) soil conditions in the area where the products are to be marketed;
- (h) climatic conditions of the region, as they affect design, production and erection;
- (i) availability of equipment for production and facilities for its adequate maintenance;
- (j) method of marketing the product, including promotional aspects;
- (k) the necessity of training the staff in the required skill prior to start of production;
- (l) cost of materials, labour and overhead charges;
- (m) time required for completion related to urgency of occupancy;
- (n) capital available for the efficient operation of the plant utilizing the process chosen.

52. The Study Group also included in its consideration of production techniques the manufacture of joinery elements, and noted the study prepared by Messrs. J. Kim and J. Koukal of Prague, Czechoslovakia, on "Production of Joinery for Tropical Countries" (P/WG.49/6).

53. In reviewing these techniques, it was pointed out that the plants producing joinery in developing countries were utilizing techniques and equipment common throughout the world, and common to other secondary wood processing industries such as furniture.

54. It was felt that this paper gave much information, in a concise form, on production techniques and also included information on machinery used in the manufacture of joinery. It was suggested that this paper be given serious study by all interested in this topic in the developing countries.

55. The Group also discussed the need for visual and machine-stress grading of timber and timber products and suggested that developing countries give this subject extensive study as it was felt that machine stress grading would facilitate the use, in housing of a greater number of species in their countries to the best advantage.

56. The need of quality controls both in the production of sawn timber and manufactured items was highlighted. It was believed that much of the work would have to be done by the trade associations; nevertheless, it is considered essential that the Governments be requested to ensure the participation of all the pertinent trade and manufacturers associations in order to draft standards that would be enforceable, bearing in mind the present situation of the particular industry in the country concerned, until such time as the quality of these products would allow the introduction of IS standards.

57. In discussing the technical merits of the various production techniques many technical aspects were discussed. The Study Group wished to draw the attention of the industrialists in developing countries to the following, which emerged during the discussions and which it believes are not yet diffused in their countries.

58. Dehumidification of timber

Seasoning of timbers in many developing countries is always a problem, particularly in respect to the high cost of conventional seasoning kilns. It was strongly stressed that the possibilities of seasoning timber by dehumidification, should be investigated. Equipment necessary is not high in cost, as the chamber can be built easily at low cost. Furthermore, the process is simple to operate. Timber, particularly softwoods, can be seasoned from around 75 per cent moisture content to 15 per cent moisture content as rapidly as by conventional methods without any undue degrading.

59. Forced air drying (predrying technique)

Forced air drying is used for pre-drying timber, that is, to bring the moisture content of green timber down to 25 - 30 per cent moisture content before it is put into a high temperature kiln for final kilning.

60. A forced air drying chamber consists of 10 or more 72" fans, which are laid in the middle of the chamber. The rotation of the fans is reversed every 2 hours for the entire duration of the pre-drying. Steam coils are also installed in such a chamber but operate only at a very low temperature. The heat helps to bring down the moisture content of the timber more quickly. The chambers for forced air drying are made as big as possible, up to 240 cubic tons (of 50 cubic feet) per chamber, i.e. 340 cubic meters.

61. The quality of wood pre-dried by forced air drying is much better than that dried conventionally. Furthermore, forced air drying lowers time of seasoning of timber. The

method of stacking on bogies is just the same as for high temperature kilns and the same stacks can be moved to these Ratter kilns. It has been found that the cost of installing forced air drying chambers is not high, when steam is available on site.

62. Special construction for use in conjunction with prefabricated components

For countries producing plywood, beams with plywood webs and sawwood flanges can be produced either by nailing or by glueing. The advantages of this beam compared to those made from solid timber are: exact measures, no twisting or splitting, easy stress grading of the thin flanges and easy jointing. These beams could be used as structural units.

63. "Stressed skin" panels in which plywood skins on one or both sides of the rib take care of the load carrying and are tied together with solid or plywood beams. Such roof panels need only be supported on outside walls, thus enabling the quick roofing of houses.

64. Butt-end joining of studs and fabrication of studs from boards into patterns, through stapling of 2 boards, is being successfully produced in one country by stapling two 1" x 4" boards into one 2" x 4", using staggered stud staples.

65. Another method for utilizing small-size wood as posts, in the same country, uses four 1" x 3" planks nailed to form a 4" x 4" post. This constructed post is accepted by the local building authorities as equivalent to a solid 3" x 3" post.

66. Attention was drawn to the usefulness of mechanical lamination as an alternative to glue lamination under certain circumstances.

67. Surface finishing of exterior wood in houses

Because of the problems indicated by some representatives of developing countries concerning failures of conventional exterior paints on wood houses, the advantage of non-film-forming wood finishes were discussed. These are now widely and effectively used in North America, primarily on exterior softwood lumber and plywood for siding, weather board, or cladding. These finishes penetrate into the surface of the wood, but do not form a film over the surface. Hence there is no problem with lack of adhesion, or cracking of such films, as commonly encountered with conventional oil base exterior paints. A typical non-film forming finish is water-repellent preservative. This includes paraffin wax as the water repellent, pentachlorophenol as the preservative, boiled linseed oil (which tends to reduce accumulation of the preservative on the surface), and mineral spirits or other similar low-boiling petroleum hydrocarbons as the solvent. This is brushed or sprayed easily, and can be renewed every year or two with little cost or effort. A modification of this simple treatment is the pigmented natural finish, achieved by incorporating suitable colours in the above solution. This is a suitable means of providing a variety of attractive colours, allowing the natural grain of the wood to show.

68. A recent alternate means of providing water repellancy to preservative-treated wood is a proprietary process in the United Kingdom which incorporates a water repellent in emulsified form in conventional water-borne preservative treatments. This potentially could reduce dimensional changes and checking of the wood surfaces exposed during use to alternate wetting and drying.

69. The use of factory fabricated building components in the developing countries One of the most rapidly increasing and useful techniques for cost reduction and speeding up of erection time in mass housing projects or low-cost housing projects is the use of rans nail type of factory-fabricated roof trusses.

70. Using spiked metal connector plates specially developed for use in either tropical hardwoods or softwoods trusses can be made at a rate of up to 400 per 8-hour day, using a small unskilled labour force with only one skilled operative.

71. The use of this type of truss is not confined to large production runs of any single type or pitch or span of truss, due to the rapid and easy ability to alter the size, thereby enabling economic production runs of as little as ten trusses of any type, with span increases in as little as 1" increments up to 100 ft clear spans.

72. The metal connectors are placed on each side of the joints, and in hardwoods a pressure of up to 60 tons is required to press the connectors home. It should be noted that presently available connectors can only be applied by direct hydraulic pressure into dense hardwoods; as compared with the process of rolling connectors onto joints which has been found satisfactory with softwoods.

73. Because the members of these trusses are in the one plane a tropical hardwood truss of 16 metres span and 17 1/2 pitch, or use at 2 metre centres with an asbestos or corrugated iron roof, they will be only 7.5 cm thick and hence can be economically transported for considerable distance. Such a truss would weigh approximately 80 Kg and hence could be rapidly handled.

74. The use of such components reduces on-site losses from various causes, and a typical house roof can be erected in under one hour.

75. Use of sulphite waste from pulp mills as adhesives

A unique process, which will be commercialized in a large factory in Finland, has bonded chipped waste-wood with a sulphite waste residue obtained from sulphite pulp cooking in pulp factories. The board produced is fully resistant to exterior weathering conditions existing in developing countries.

CHAPTER 6

Recommendations made by the Study Group

76. The Study Group adopted the following recommendations:

I. Addressed to International Organizations:

- (a) The Study Group recommended that UNICE include the manufacture of agricultural fibre cement boards, similar to wood wool boards, as an agenda item in the meeting it will hold next year on production of panels from agricultural wastes and that research institutes proceed with the testing of species and bonding agents for use as raw materials in these boards.
- (b) Regional standardization of housing components and adequate quality control of raw material should be developed by the agencies of the United Nations System dealing with housing, in collaboration with the national bodies and industry, to facilitate the acceptance of these products.
- (c) The Study Group recommended that the United Nations and its specialized agencies grant fellowships to production managers and designers to visit woodworking industries utilizing tropical species in developing countries, to acquaint themselves with modern production and marketing techniques.
- (d) A means should be devised for the collection and dissemination of existing information on the preservation of tropical timber species by all known methods.

77. In the adoption of the report, the Study Group recommended that UNICE make it available to the following bodies in developing countries, over and above its normal channels of distribution: Industrial Development Corporations and Banks, National Housing Corporations, National Sawmiller and Timber Products Manufacturers' Associations, Forest Products and Building Research Institutes.

The participants from French speaking countries stressed to UNICE the necessity for the distribution of the report and the papers presented in the French language.

II. Addressed to Governments and Public Administrations in the Developing Countries:

78. (a) In order to overcome the psychological resistance to the use of wood in housing the Group recommended that the following measures be taken:
- (i) Demonstration units extensively using lesser-known species should be erected and furnished and displayed in high-density localities.
 - (ii) The use of wood in prestige projects should be promoted.
- (b) Governments should be urged to update codes of practice so as to allow the maximum utilization of wood, as has been successfully done in countries with temperate climates.

- (c) The Study Group recommended that Administration should be urged to amend their policies, particularly in respect to tenders, design of buildings, inspection of buildings and their components, so as to facilitate the use of timber.
- (d) Governments should be urged to devote even more attention to the training of skilled workers and wood technicians from the developing countries to operate successfully these wood processing industries, either through technical assistance (for example by delegating experts to train local staff) or through fellowships.
- (e) The attention of Governments was drawn to the fact that surpluses of graduates in engineering and in science exist in some developing countries, and it was recommended that endeavours be made to utilize their skills in other developing countries.
- (f) Government bodies should ensure that electrical wiring, cooking and heating installations in wooden houses are carried out to safe and recognized standards.
- (g) Government authorities and lending and financial institutions in developing countries that possess well-established and readily identified species should have careful studies made by specialized laboratories to establish whether or not preservation is required for each specie in particular types of usage.

III. Addressed to Industrialists in the Developing Countries

79. (a) In order to overcome the psychological resistance to the use of wood in housing the Study Group recommended that the promotion of well-planned mass advertising should be consumer oriented.
- (b) Manufacturers' associations should devote more attention to the dissemination of technical knowledge on available species and up-to-date design procedures.
 - (c) Manufacturers' associations of wooden houses and their components should ensure that electrical wiring, cooking and installations are carried out to safe and recognized standards.
 - (d) The use of mobile pressure preservation plants should be considered in order to overcome the difficulties of transport and location of wood preservation plants that exist in developing countries.
 - (e) Due consideration should be given to training of artisans to erect timber-framed houses, prior to embarking on large-scale production of such houses.

CHAPTER 7

Organizational matters

80. Opening of the Meeting

The meeting was opened by Mr. I. H. Abdel-Rahman, Executive Director of UNIDO, who made a statement which has been reproduced as Annex I to the present report.

81. Election of Officers

Mr. E. B. S. Scorer, Technical superintendant of Timsales Ltd., Nairobi, Kenya, was elected Chairman; Mr. Richard P. Blomquist, Project Leader, Housing Research, Forest Sciences Laboratory, Athens (Georgia), U. S. A. was elected Vice-Chairman and Mr. Venkate R. Sonti, Managing Director of ASCO-HICKSON Ltd., Calcutta, India was elected Rapporteur.

82. Adoption of the Agenda

The provisional agenda issued before the meeting was adopted and is reproduced below:

1. Opening of the meeting and adoption of agenda
2. Election of the chairman and rapporteur
3. Present conditions in developing countries
4. Comparison of wood and other building materials
5. Possibilities for use of wood and wood products for building in tropical climates
6. Wood preservation for tropical countries
7. Production techniques for wooden houses and their components:
 - (a) Timber framed construction for tropical climates;
 - (b) Precut wooden houses for tropical climates;
 - (c) Production of prefabricated wooden houses;
 - (d) Production of joinery.
8. Adoption of the report

83. However the Study Group decided to change its title from "Study Group on Production Techniques in Wooden Houses Under Conditions Prevailing in Developing Countries" to "Study Group on Production Techniques for the Use of Wood in Housing Under Conditions Prevailing in Developing Countries" as it felt that its mandate included also the increased use of wood in houses built with other building materials.

84. Attendance

Fourteen experts from the following countries were invited by UNIDO to participate in the meeting: Australia, Brazil, Czechoslovakia, Finland, France, India, Ivory Coast, Kenya, Malaysia, Netherlands (Suriname), Nigeria, Philippines, Thailand, and the United States of America. Fourteen observers from the following countries also attended: Austria, Belgium, Canada, Federal Republic of Germany, Romania, Sweden

and the United Kingdom of Great Britain and Northern Ireland. (The observer from the Federal Republic of Germany was also delegated by the European Confederation of Woodworking Industries). The Food and Agriculture Organization and the International Atomic Energy Agency also delegated observers.

The list of participants is reproduced in Annex II to this Report.

7. Adoption of the report

This report, as amended during the discussion, was adopted by the Study Group at its closing meeting held on 21 November 1969.

8. In the adoption of the report the Study Group recommended that UNIDO make it available to the following bodies in developing countries, over and above its normal channels of distribution: Industrial Development Corporations and Banks, National Planning Corporations, National Sawmiller and Timber Products Manufacturers' Associations, Forest Products and Building Research Institutes.

9. It is considered that this would materially assist in the increase of the use of wood in housing and that this process would encourage the governments, industries, institutions and individuals concerned in putting the recommendations into effect.

10. UNIDO was also requested to distribute the documents issued to all interested.

11. The participants from French-speaking countries stressed to UNIDO the necessity for the distribution of the report and the papers presented, in the French language.

12. Working papers and other documentary material

A check list of documents issued for this meeting is given in Annex III.^{1/}

^{1/}A limited number of copies of these documents are available and may be requested from the UNIDO Industrial Documentation Centre, P.O.B. 707, 1011 Vienna, Austria.

ANNEX I

Statement by the Executive Director

1. I would like to welcome you to Vienna to this meeting which has been convened by UNIDO in collaboration with EAO and the UN Centre for Housing, Building and Planning in New York.
2. This is the first meeting which UNIDO has arranged in the wood processing industries sector and we are happy to welcome you here today. I am sure some of you have already had contact with UNIDO in one capacity or another, in the preparation of this meeting or in other connections, but I take it that some of you may be having your first opportunity to see UNIDO and to collaborate with it. For both groups we welcome you in this occasion and we hope that your stay in Vienna will be pleasant and fruitful.
3. On this occasion I would like, a few words, to tell you that UNIDO is attempting to accomplish its main task of giving assistance to the developing countries in their field of industrialization. This is our objective and since we are a new organization, less than 4 years old, and less than 2 years here in Vienna, we are trying a variety of methods and your meeting here represents one of the means by which UNIDO is seeking to fulfil its objectives.
4. The branch which is the subject of your meeting, production of housing, including the utilization of available raw materials, is of basic importance to the developing countries. Of course it will not be of the same importance to every developing country, but certainly a large number of those countries will benefit from whatever recommendations or observations will come out of this meeting.
5. The type of recommendations or observations we expect from you certainly will be helpful to UNIDO and to the other United Nations agencies participating in this meeting, namely, EAO and the UN Centre for Housing, Building and Planning, and your final conclusions, I am sure, can also be addressed not to the United Nations agencies alone, but also to the developing countries themselves since, after all, they are the primary agents of action and we on the United Nations side, in the family of agencies, would only be able to help the developing countries inasmuch as they themselves act upon your recommendations and follow-up.
6. The guidance which will issue from your recommendations, whether of a technical form or of an economical or administrative form, I am sure, will be quite valuable to the developing countries. For our part, in UNIDO, we give particular stress to the technical and engineering aspects of the subject, to the adaptation of technology which is known in the advanced countries, and to how can it be best adapted to the conditions and resources available in the developing countries; and of course in addition to the adaptation of transfer of technology, there will be problems which exist only in the

developing countries and can only be solved there, including the situation of marketing and the small production, and of course also the priority that the subject of wooden houses would have. As I said, there will certainly be different priorities in each country.

7. Our method of action -our instrument of action-is essentially the technical assistance programme. We have developed in the last 2 or 3 years fairly large programmes of technical assistance and I am sure that your recommendations here could be put through the UNIDO machinery of technical assistance usefully in collaboration with the developing countries.

8. In the technical assistance approach as well, as in our research and studies we try to combine these two, research and technical assistance, to have some effective development in any particular branch.

9. I think it is too early at this moment to anticipate not only the recommendations which will come out of the meeting in one week, but also the follow-up that will come as a result of your recommendations.

10. I would like to say that we in UNIDO will give equal attention to the follow-up as to what happens during this meeting. We do not consider these meetings as events by themselves, but only as the starting point of a series of measures in collaboration with the developing countries within our own programme of research and studies and within our programme of technical assistance; and naturally, in the follow-up which comes, I hope there will be continued contact and collaboration with you in one form or another.

11. This is the general remark in which I would like, in conclusion, to welcome you again here and to thank you for accepting the invitation of UNIDO to this meeting and wish you^a pleasant stay in Vienna and am sure, that as a result of your work and since the developing countries will be interested in your recommendations, UNIDO will follow up, in collaboration with other United Nations agencies concerned, the outcome of your work. Thank you.

ANNEX II

LIST OF PARTICIPANTS

Mr. Pedro C. BERSOLA	Assistant to Chairman Presidential School Building Committee Manila, Philippines
Mr. Richard F. BLOMQUIST	Project Leader Housing Research Forest Sciences Laboratory Athens, Georgia (USA)
Mr. Suthep BULAKUL	Managing Director Stramit Board Co. Ltd. Bangkok, Thailand
Mr. Julien GUISCAFRE	Chef de la Division d'Essais et Emplois du Bois Centre Technique Forestier Tropical Nogent sur Marne, France
Mr. Miroslav KOUKAL	Chief of Institute for Developing Countries Timber Research and Development Institute Prague, Czechoslovakia
Mr. Julio I. KROEHNE	Wooden Houses Industrialist Sao Paulo, Brazil
Mr. Willem J. E. MONHEMIUS	Nigeria Sales Manager African Timber and Plywood (Nigeria) Limited Sapele, Nigeria
Mr. Kenneth Y. K. NG	Production Manager General Timber Processing Co. Kuala Lumpur, Malaysia
Mr. Charles C. POLLET	Architect Chief of Prefabricated Houses Department S.C.A.F. Abidjan, Ivory Coast
Mr. David E. S. SCORER	Technical Superintendent Timsales Ltd. Nairobi, Kenya
Mr. Venkata R. SONTI	Managing Director ASCU-HICKSON Ltd. Calcutta, India
Mr. John G. STOKES	Managing Director Automated Building Components (Aust.) Pty. Ltd. Victoria, Australia
Mr. Cornelius W. F. TEMPELAAR	Production Manager Bruynzeel Suriname Houtmaatschappij N.V. Paramaribo, Suriname

Mr. Keijo N. E. TIUSANEN

Director
Research and Development Department
Oy Wilhelm Schauman
Jyväskylä, Finland

OBSERVERS FROM SPECIALIZED AGENCIES

F.A.O.

Mr. Edward A. Gust-Arcton
Forestry Officer
(Woodworking Engineering)

Mr. Goetz Harnmüller
Trust Fund Architect

I.A.E.A.

Mr. Hong-hien Yuan
Division of Research and Laboratories

OBSERVERS NOMINATED BY MEMBER STATES

AUSTRIA

Mr. Erich HARTL
Mr. Hans HARTL
Mr. Gerhard SCHNIG

BELGIUM

Mr. Charles G. A. GOETHALS

CANADA

Mr. Alfred B. HINCHER
Mr. Robert W. MURRAY
Mr. Theodore G. WICKNIGHT
Mr. Jay G. ...

FED. REP. OF GERMANY

Mr. Günther HAASE ^{1/}

ROMANIA

Mr. Nicolae DIMITRESCU

SWEDEN

Mr. Anders EKLUND

UNITED KINGDOM

Mr. Lionel G. ...

^{1/} Also attending as observer delegated by the European Confederation of Woodworking Industries.

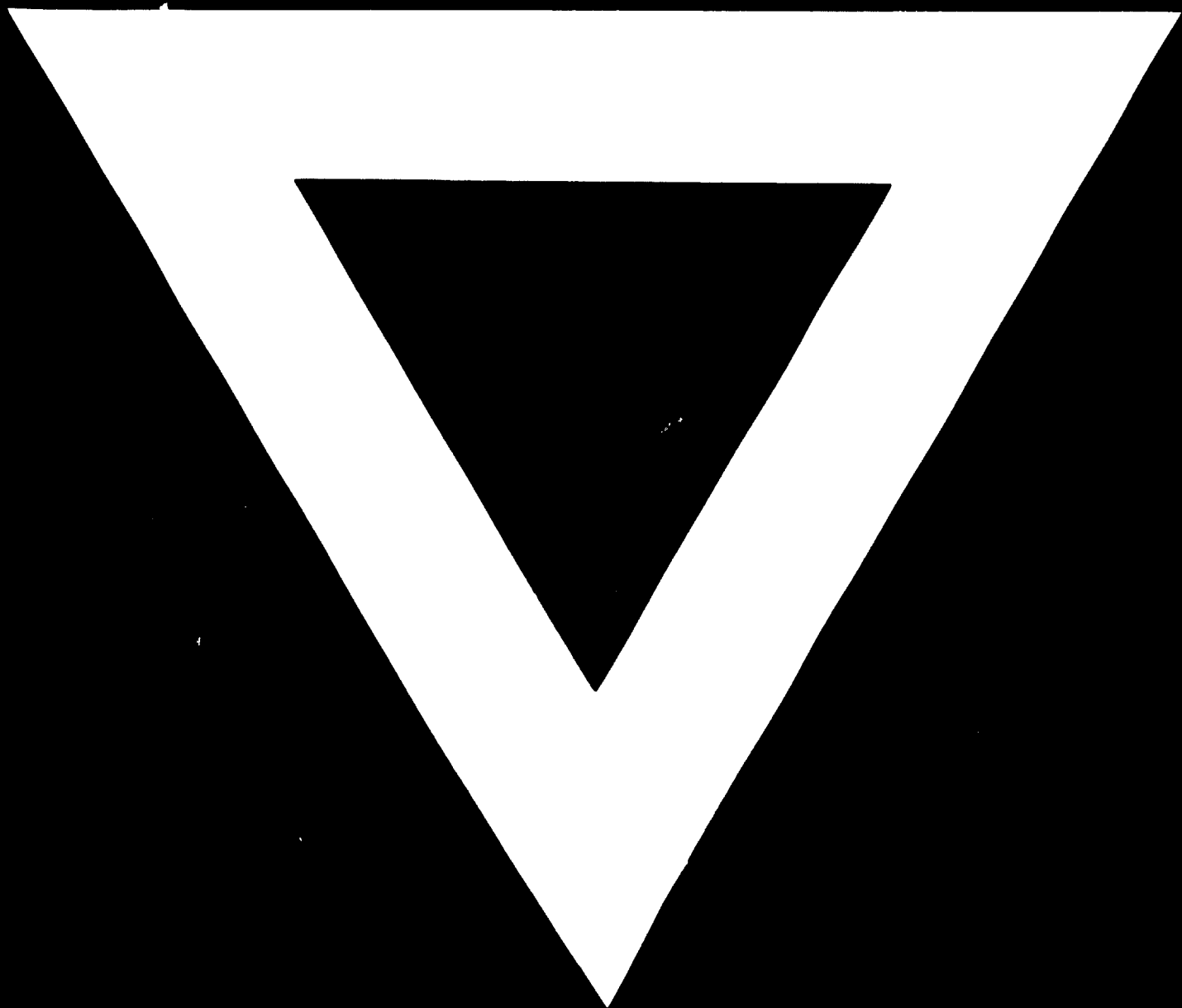
ANNEX III

Check of list of documents^{1/}

<u>Symbol</u>	<u>Title</u>
ID/WG.49/1	Provisional Agenda and Programme of Work
IL/WG.49/2	Timber Framed Construction for Tropical Climates Paper prepared by Mr. Richard E. Blomquist, Project Leader, Housing Research, Forestry Sciences Laboratory, Athens (Georgia), U.S.A.
ID/WG.49/3	Technical and Economic Comparisons between Wood and Other Building Materials Commonly Used in Tropical Regions. Paper prepared by the United Nations Centre for Housing, Building and Planning, United Nations Secretariat
ID/WG.49/4	Possible Uses of Tropical Woods and Their Derivatives for Building Purposes in Developing Countries Paper prepared by the Centre Technique Forestier Tropical Nogent-sur-Marne, France
ID/WG.49/5	Prefabricated Wooden Houses Paper prepared by Mr. Keijo Piusanen Director of Product Development Oy Wilh. Schauman AB, Jyväskylä Finland
ID/WG.49/6	Production of Joinery for Tropical Countries Paper prepared by Mr. Jan Bim, Chief Department for Long Range Planning General Directorate of State Wood-working Industries Prague, Czechoslovakia and Mr. Miroslav Koukal, Chief Institute for Developing Countries Timber Research and Development Institute Prague, Czechoslovakia
ID/WG.49/7	Precut Wooden Houses for Tropical Climates Paper prepared by Bruynzeel Suriname Houtmaatschappij N.V. Paramaribo, Suriname
ID/WG.49/8	Wood Preservation for Tropical Climates Paper prepared by Mr. V. R. Sonti, Managing Director Ascu Hickson Ltd. Calcutta, India
ID/WG.49/9	List of Participants
ID/WG.49/9/Add. 1	Adendum to the List of Participants
ID/WG.49/10	Report of the Study Group on Production Techniques for the Use of Wood in Housing

^{1/} A limited number of copies of these documents are available and may be requested from the UNIDO Industrial Documentation Centre, P.O.Box 707, 1010 Vienna, Austria





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