OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED

ID/WG.137/71
24 November 1972

Original: ENGLISH

United Nations Industrial Development Organization

Symposium on the Development of the Plastics Fabrication Industry in Latin America

Bogotà, Colombia, 20 November - 1 December 1972

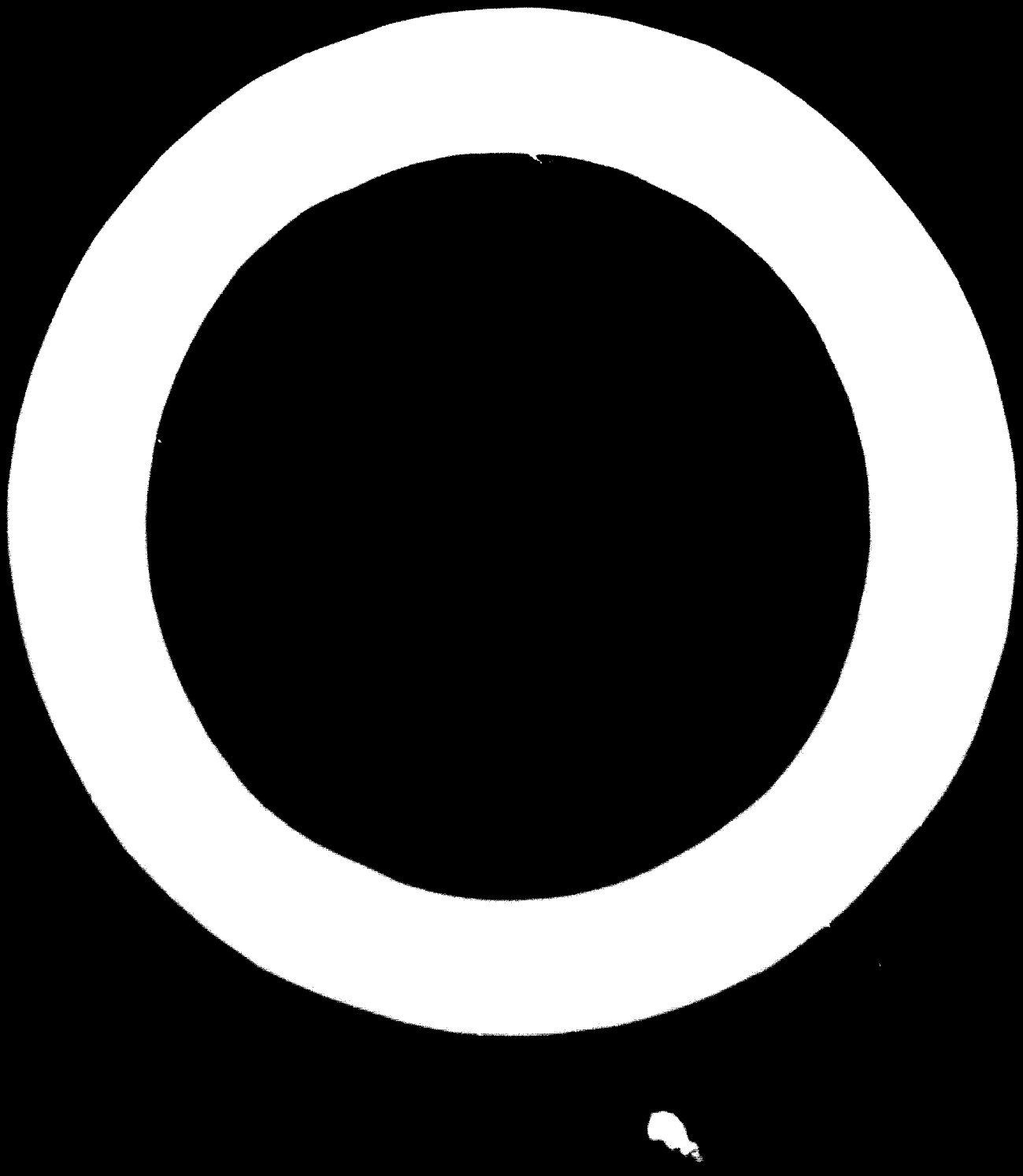
NEW TRENDS OF USING PLASTICS MATERIALS IN CONSTRUCTION[1/]

by

V. Ionita
Joint UNIDO/Romania Centre
Bucharest, Romania

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.73-182



1. INTRODUCTION

Regarding the future application of plastics in construction M. R. Hoswink considers that from 1983 onwards plastics materials will replace more than 50% of steel used at present and by the year 2000, when the world production of synthetic resins will reach about 1.8 million tons, the replacement will be 75% (1).

Until 1960, the use of plastic materials in construction was regarded with certain doubts (2,3), particularly with regard to durability and fire resistance. Construction legislation and the possibility of industry to meet the necessary demand requirements.

During the decade 1960-1970 researchers obtained a number of possibilities for advantageously using plastics in construction.

To facilitate the introduction of plastics in construction, the government of several countries subsidize research in order to reduce the consumption of traditional materials (wood or steel) and to increase the productivity of construction (4).

2. GENERAL ADVANTAGES OF PLASTICS

2.1 The exceptional "moulding capacity" a characteristic that allows the manufacture of products in a small number of technological stages at high yields.

2.2 Composite products can embody a variety of materials each contributing its special properties to the behavior of the complex. The best known plastics in this category are fiberglas reinforced polyesters.

2.3 In comparison with the traditional materials, reinforced plastic materials are three times lighter than steel, have good mechanical strength, may be opaque or transparent, can be easily coloured, are ressistant to chemical attach, and have excellent thermo-insulating qualities. They can also be used over a range of temperatures from -35°C and +80°C.

2.4 Reinforced plastics used as structural elements in construction have opened new possibilities of architectural expression.

3. Disadvantages of Plastics Materials

The application of plastics should be effected in the light of their particular qualities and with an understanding of their characteristics.

3.1 The elastic modulus of a plastic material is much lower than that of steel (reinforced plastics $0.63.10^5$ - $1.75.10^5$ Kg/cm^2, compared with steel 21.10^5 Kg/cm^2). These reduced values limit their application as structural elements, especially under severe stresses.

3.2 Another unknown factor for which solutions have to be found, relates to the rheological properties, resistance under load in time, as well as to the modulus variation with temperature.

3.3 In comparison with steel, reinforced plastics materials have low elasticity. Their elongation at break is in the order of 2% compared with mild steel which is the range of 35-40%.

Paradoxically, plastic materials are not plastic. They are elastic almost until break and their deformation range is very low. This, brittleness "has a negative influence on the capacity to absorbe energy." Stress concentrations cannot be countrebalanced by local deformations o erstressing leads to crushing and to visible detereorations of the structure.

3.4 The linear coefficient of elongation is 6 to 10 times higher than that of steel. This raises problems in jointing between elements.

3.5 Another problem associated with the use of plastics to which no concrete answer has yet been achieved, is fire resistance.

4. Achievements in the Construction of Walls for Insulating Buildings

For the exterior surfaces of the panels reinforced fibre glass plyesters or PVC sheets are generally used, together with other materials of a traditional source as concrete, asboconcrete steel, aluminum, splinter-proof glass, stone and for the exterior surfaces gypsum may be applied.

The interior of the panels functioning as re thermo-insulating layer, is made from plastics foam. Rigid polyurethane foams, cellular polystyrene, expanded PVC and phenolic foams are the most commonly used materials.

The commonly used panels are based on aluminium frame structure in USA, wooden structures in France and USSR, on steel in West Germany and of various synthetic materials in the United Kingdom. These wall panels weighing between 10 and 50 Kg/m^2 (as compared to 25 cm. brick wall that is weighing 500 Kg/m^2) are in general based on 3 m length sections and present outstanding heat insulating qualities.

For panels manufactured on a commercial scale, the proper selection of the adhesive is important, particularly for panels in which the thermal insulator has no adhesive properties, as in the case with expanded polyurethane foams. For polyester heat insulating panels, PVC (,8), epoxide resin (9) type adhesives with or without some screws for strengthening are advisable.

Some recent developments in this field have been achieved by the Shell group. They developed a series of isocyanaces under the trade names "Coradate" and "Carodol" which permit the formation of a foam with variable density through the section. These products, developed initially for the furniture industry are very light (50 Kg/m^3) and present adequate chemical strength (10,11).

In 1967 in London a 21-story building was made from sandwich type panels. The panels extremely light (about 10-12 Kg/m^2) were installed six at a time and the building was entirely completed in 40 weeks (12).

5. Plastics in Construction in Romania

In 1970, INCERC developed a prototype unit for manufacturing polymethylmethacrylate domes, and in 1969 the industrial production of sandwich panels with asbestos cement and polystyrene cores, having the trade name "Azbopen" started up. In 1971, at the enterprise Izolatonil in Bucharest, the production of reinforced

glass fibre polyester elements - spatial cabins for bathrooms and corrugated sheets commenced.

The Izolatonil enterprise in collaboration with INCERC, undertook a number of studies with a view to manufacturing reinforced fibre glass polyester casings and developing projects for various small constructions (booths for cooling drinks, small houses for camping and motels, etc.).

6. The Manufacturing Programme for Plastic Houses

Currently efforts are being made in order to establish methods of construction which should provide applications from standard elements, manufactured from synthetic plastics materials. Through periodic meetings, symposia and exhibitions it is hoped to extend international cooperation with a view to solving these problems by joint efforts.

Nowadays it can be stated that polymer type complex elements have by far exceeded the most optimistic prognosis.

If in 1947 the first corrugated sheets of glass fibre reinforced polyesters were manufactured, 7 years later at the House-Keeping Art Salon in Paris (1955) the first extensible house, completely made out of plastic and a small camping construction were presented. Currently more than 70 types of such constructions are known, some of which have been in use for more than 12-13 years.

The Industrial Technology Division of UNIDO within the research programme is examining the way in which plastics; the non-traditional building material; may influence the development of pre-fabricated elements in the future, namely mass production of low cost plastics houses.

This problem especially refers to the way in which the application of plastics in construction may assist the developing countries in solving their housing problems.

Efforts have been made in all countries to find solutions.

Considering the advantages offerred by the plastics materials in the field discussed and the unknown factors that are to be solved, it is necessary to establish a general research programmed where individual efforts of many countries are being coodinated. In order to solve this major problems of world-wide magnitude, especially in the developing countries, the construction of low price houses, at an adequate rate to meet the present and future requirements is vital. Recently, following the agreement concluded between the Secretariat of UNIDO and the Romanian Government, the joint UNIDO/Romania Centre was established for international cooperation in the field of chemical and petrochemical industries for the benefit of developing countries.

Within the work programmes for 1973-1974, the Committee of the joint UNIDO/ Romania Centre at their first session (Bucharest 16-20 October 1972) stated that among the activities that are to be fulfilled within these programmes, a pilot project for the production of low cost plastic houses, is to be carried out.

Some multinational companied have expressed their interest to collaborate under the aegis of UNIDO.

For the implementation of this project the following stages are proposed.

1. Preparation of a feasibility study.

2. Construction of a pilot plant for the production of 10 houses per day.

3. To set up an experimental village of 100 houses for studying and developing prototypes.

4. Locating experimental houses in different geographical and climatic environments to assess durability.

5. Production of plastics houses on commercial scale for developing countries.

It is foreseen that such a plastic house of 30 m^2 and weighting 1.5 tons, would cost 500 U.S. dollars.

The problems to be solved within this project are the following:

a. Standardization of prefabricated elements.

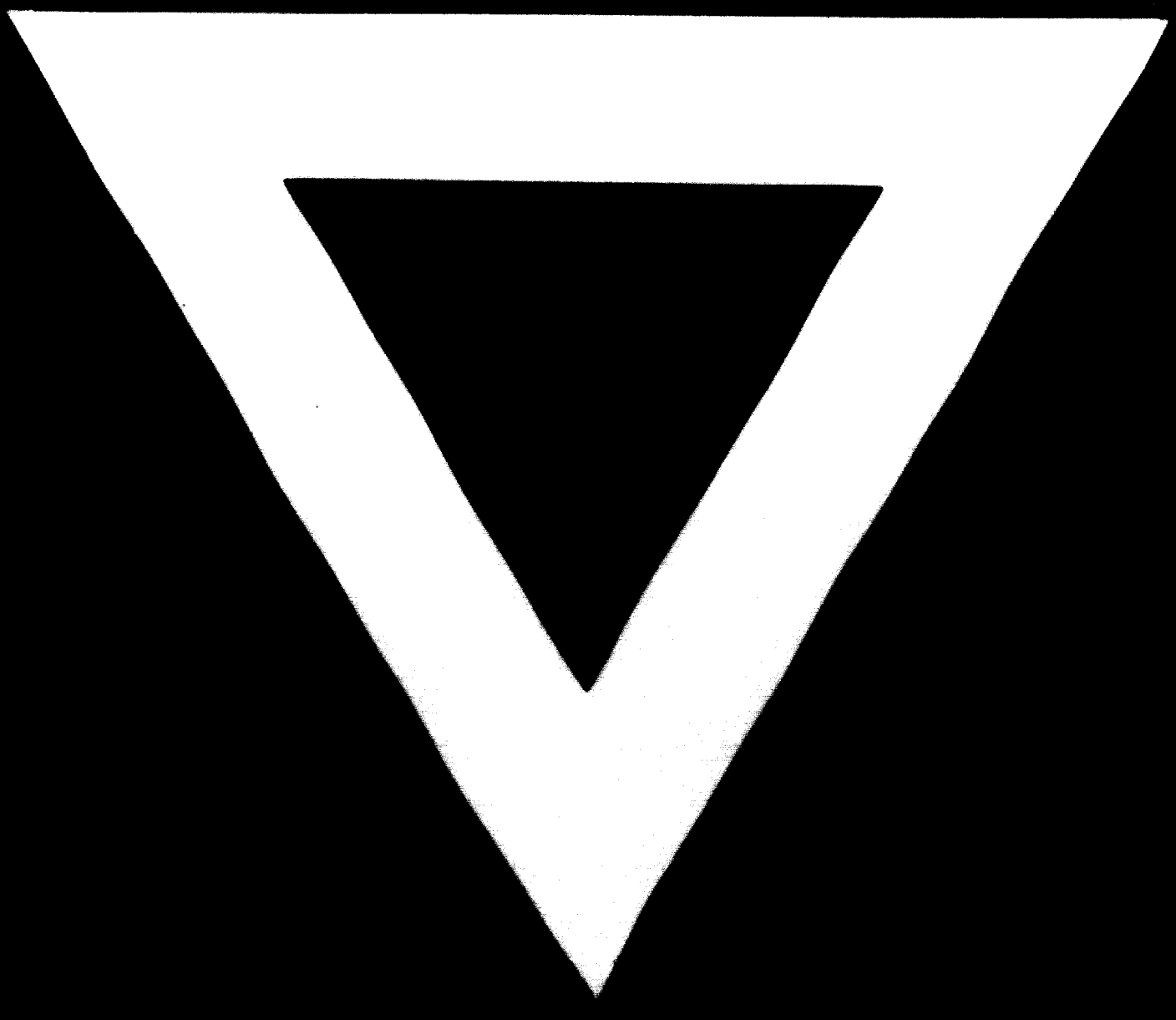
b. Establishing a system for preassembling prefabricated elements.

c. Analysis of the behaviour in time of plastics houses for different climatic areas.

d. Solving to the problems of fire resistance.

Naturally, only some of the problems to be solved are mentioned in this paper. Undoubtedly other problems will arise in implementing this programme.

We are of the opinion the best chance to solve these problems is by international cooperation, under the auspices of organizations as it is UNIDO.



2.8.74