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INTERNATIONAL TRAINING COURSE ON
**MATERIALS DESIGN AND PRODUCTION PROCESSES
FOR LOW COST HOUSING**

FINAL REPORT

Organised by

International Centre for Science & High Technology, Trieste, Italy
A wing of UNIDO (Vienna)

in collaboration with

Regional Research Laboratory
Council of Scientific & Industrial Research
Trivandrum-695019, India.

TRIVANDRUM-695019 (INDIA)
March 27-31, 2001.

**INTERNATIONAL TRAINING COURSE ON MATERIALS DESIGN AND
PRODUCTION PROCESSES FOR LOW COST HOUSING
TRIVANDRUM-695019 (INDIA) March 27-31, 2001.**

Organised by International Centre for Science & High Technology, Trieste, Italy, in collaboration with Regional Research Laboratory, (Council of Scientific & Industrial Research), Trivandrum-695019, India.

FINAL REPORT

1.0 OBJECTIVES:

The workshop was organised with the following objectives:

1. To present the state of the art of the latest innovation technologies in the materials design sector and discuss the main aspects concerning the production cycle and the standardisation demands
2. To review the inorganic building materials production cycles based on clay ceramics and recycled industry by products, analysing their energy demand and effects on the environment.
3. To disseminate up to date information, knowledge and experience on design production testing and application of composite materials based on natural renewable sources
4. To promote and encourage the realization of networks and cooperation schemes between countries of the region for the adoption of appropriate and affordable technologies on low cost housing.
5. To disseminate updated information, knowledge and experience on design, production, testing and application of composite materials based on natural resources.
6. To promote the industrial use of environmentally friendly natural materials and propose new business opportunities by facilitating the transfer of technology in advanced and new materials while fostering South-South cooperation.

2.0 VENUE AND DATE:

The International Training course on Materials Design and Production Processes for Low Cost Housing was conducted at Regional Research Laboratory (Council of Scientific & Industrial Research, CSIR), Trivandrum-695019, India, during 27-31 March, 2001.

3.0 ORGANISATION:

The International Training Course was sponsored by the International Centre for Science & High Technology (ICS/UNIDO), Trieste, Italy and was organised by the Regional Research Laboratory (CSIR), at Trivandrum. This was also co-sponsored by Council of Scientific & Industrial Research, New Delhi, India, and Swiss Agency for Development and Cooperation (SDC). The Organising Committee consisted of representatives from ICS (UNIDO), and Dr. G. Vijay Nair, Director and senior colleagues of the Regional Research Laboratory. Dr. K.G.K. Warriar, Deputy Director, and Head, Ceramics Division was the Chief Coordinator. The organisation of the training course was fully done by a committee selected from the Regional Research Laboratory.

The invited speakers and the participants were identified together by the Coordinator (Indian side), but ICS was fully responsible for the final selection of the delegates and participants. The Regional Research Laboratory was in charge of all travel and logistic arrangements. All information regarding the workshop, prompt correspondence and communication, letters and references for Visa and finalising travel plan and arranging travel tickets in some cases, local assistance, transport from airport and back, hotel arrangements etc. were done by the local organising committee. In addition, arranging the conference hall, technical lectures, group discussions, visit to the Building Materials Company, local visits, the concluding session and compiling the recommendations, were the responsibility of the hosting institution, especially with the workshop coordinator and his team.

The important personalities who participated the course from India were, Dr. J. SenGupta, who represented Dr. TN Gupta, Director, Building Materials Technology Promotion Council (BMTPC), Director, Indian Plywood Research Institute, Deputy Director, Kerala Forest Research Institute, Director, Fly Ash Mission of the Government of India, Chairman & Managing Director (represented) of the Housing and Urban Development Corporation (HUDCO). The UNIDO RV-TIFAC, had also promised its participation.

4.0 FUNDING:

ICS (UNIDO) sponsored the workshop and approved US \$ 39,530.00, out of which US \$ 31,630.00 was received before the course. The ICS(UNIDO) funds is earmarked for the international and domestic travel and allowances for the selected participants/invited guests. The expenses towards the local hospitality, hall, and presentation facilities, telecommunication, transport, secretarial assistance during the workshop etc. were met by the host institute. Part of the expenses for the Proceedings of the workshop was met by funds raised from CSIR/SDC etc. *The final account of the Training Course is provided as appendix 1.*

5.0 LECTURES:

There were 24 lectures in total, out of which 12 were from outside India. All participants, however, were provided with opportunity to present their work and also on the activities of their respective organisations. Twelve lectures from the experts invited from abroad represented The Netherlands, Italy, Germany and Namibia. The

other twelve were from India. The participants were drawn from countries such as Sri Lanka, Bangladesh, Nepal, Malaysia, Indonesia, Philippines and from India. The experts and participants represented major R&D organisations, industrial consultation agencies, departments for international collaboration, academic institutions, financial organisations dedicated to housing and introduction of new building materials and technologies. Some of the speakers were selected based on their official capacity to help the follow up actions decided at the concluding session.

The Training Course lectures were spread over four full days with the fifth day for field visit. The first day was on materials modeling through software approach. The day also had a very interesting lecture on ancient architecture and the material needs for such constructions. Although it started as ancient Indian concept, it was clear that similar concepts for building plan existed in other Asian countries and even in Europe also. The second day was for clay processing with special reference to drying. The lecture by TNO experts discussed a simple drier design, which could be adopted for many of the developing countries. One lecture was on design of buildings in seismic prone areas. The third day was on waste materials recovery. Although many technological possibilities exist for utilisation of solid industrial and agricultural wastes, it is very much required as applicable in all the participant countries, to change the mind-set of the people using such materials. One example of success is China, in the area of utilisation of fly ash. The fourth day was mainly on the issue of state of the art in Bamboo in building construction. Nepal, Indonesia, Philippines and India are countries, which have wide use of bamboo. The lead lecture was by Prof. Bisanda (Namibia). The last day was field visit. *A complete list of lecturers is included in the list of participants provided as appendix 2.*

6.0 PARTICIPANTS:

The workshop was open to technical experts, scientists, architects, industrialists involved in building materials industry, environmental agencies, funding agencies engaged in promotion of housing, new building materials and technologies, and academic experts. There were 30 registered delegates and about ten invited attendees. In addition to the invited speakers, all the participants were provided an opportunity to share their expertise. There were also three discussion sessions where they could express freely their opinion, and share with others from the different countries. The sessions were very hectic, starting from 09.00 h and extending to 18.00h. A list of all the participants and invitees is presented as appendix 2. They represented countries such as Indonesia, Philippines, Malaysia, Sri Lanka, Bangladesh, Nepal, India, Italy, The Netherlands and Germany.

7.0 MATERIALS DISTRIBUTED:

There were sufficient materials distributed in order that all the information was available to the delegates/lecturers in advance. The registration kit consisted of a conference bag containing list of participants with their affiliation and contact addresses, a detailed programme sheet, an information sheet containing details of Thiruvananthapuram and copies of the information materials supplied by ICS (UNIDO). The most important document was the compiled volume of lecture material collected in advance from the participants on their respective organisations and the papers intended for presentation. The kit also included a pen, a scribbling pad

and a few colour ful brochures from the tourism department of India/Kerala State. A *sample course kit is enclosed in Appendix 2.*

8.0 PROGRAMME:

The Training Course was arranged from 09,00h till 18.00h every day, from 27 to 31 March. *The detailed programme sheet circulated to the delegates in the workshop kit is included in Appendix 2.* Most of the invited lectures were arranged in the forenoons, and presentation from the participants in the afternoon. There were three discussion sessions including the concluding session. In many cases, the discussion on the lectures exceeded in time for the discussion. All the lectures and discussions were recorded for future reference. All the participants were accommodated in a single hotel as suggested by ICS, and the stay included breakfast.

On the evening of 26 March, a welcome meeting was arranged at the hotel, where an introduction of the geographic, historical, scientific and cultural background of the host country, and the city of Thiruvananthapuram were described to the participants, by the coordinator. Director, Regional Research Laboratory (CSIR), welcomed the participants, and an informal introduction to the members of various committees for further contacts, if required for the participants, was made. The participants welcomed these arrangements, and they felt really comfortable. A programme on traditional dance of Kerala State was arranged on the evening of 28th followed by dinner. The validictory dinner was arranged on 30th evening. A formal visit to RRLT and exposure to the research and industrial activities of the building materials programme was arranged. A visit to the city of Trivandrum containing international beach, art and cultural centres, academic and research institutes, boating through the coconut tree rimmed back waters, all were arranged on 31st. The field visit also involved a visit of M/s Regal Tiles Limited, one of the leading building materials manufactures in the South of India.

Following the usual custom of this country, there was a formal inaugural function on 27th at 10.00h. Dr. Vijay Nair, Director of the Regional Research Laboratory, CSIR, Trivandrum presided over the meeting. Dr. K.G. Satyanarayana, Senior Deputy Director and Head, Metal Processing Division of the RRL welcomed the guests. Dr. KGK Warriar, Coordinator presented the theme of the training course. Professor Sergio Meriani, ICS Consultant, formally inaugurated the Course at 10.30 by "Lighting the Lamp". Mr. K. Muraleedharan Nair, scientist of the Ceramics division of the RRL proposed a Vote of Thanks. The inaugural function was well represented by the press and the video media and the whole function received a very wide coverage in the country through National News Papers and the national net work television.

9.0 FEED BACK:

A consolidated report has been made from the filled response sheet questionnaire supplied by ICS. In general, the response was very positive. However, a summary of the response received from the individual participants is attached as Appendix3.

10.0 VISITS:

Two visits were planned initially, (1) to a leading tile and brick manufacturer of this region and (2) a visit to the Regional Research Laboratory, for a formal meeting and discussion with the scientists involved in various developmental activities. The former one was very successfully done. The latter was not fully successful due to lack of time, however, many of the participants did visit the laboratory and held detailed discussion on their areas of interest. The various areas of activity at the Regional Research Laboratory are, ceramics, metals and alloys, polymers, agro processing, clays and clay minerals, and organic chemistry. The display of the various products were made, especially those related to building materials, such as light weight bricks and tiles with gradient porosity (from clay and coconut pith), chemical bonded laterite (alternate raw materials utilisation), vitrified tiles (value added terracotta products), "Tanslu" bricks (utilising chrome tannery sludge), flux bonded fly ash (incorporating ~90%) fly ash and tiles of various colours obtained by controlled reduction firing. The approach to the development of such products involved elements of high scientific inputs, and this was appreciated by all participants. There was also collaboration of TNO (Netherlands) in a few of the above developments. Some of the products were identified to have relevance to a few participating countries, and exchange of details of the process and possible technology transfer will be carried out in future. The visit to the tile factory was followed by a boat trip in the backwaters of Kerala, as already mentioned above. .

11.0 SOCIAL EVENTS:

A cultural evening was organised on the 28th followed by dinner to create an informal and relaxed occasion. A few of the local important officials were also invited. The organising committee members were accompanied by spouses. The cultural programme involved a few events in the traditional dance art of this region, which involve liberal facial expressions of emotions. The performing artist explained in English, the history and the relevance, and the details of what she is performing, and could be followed in full spirit, by the participants from the various countries.

A visit to the important places in the Thiruvananthapuram city, such as the art Gallery, Science Museum, the International Kovalam Beach, a boating through the back waters and a visit to a few shopping centres were arranged.

12.0 GROUP PHOTOGRAPH OF THE PARTICIPANTS OF THE WORKSHOP

A group photograph was taken involving the invited lecturers, participants, Workshop Coordinator, and Director of the Regional Research Laboratory, Trivandrum, the members of the local organising committee, and a copy is attached in the proceedings of the course. *Photographs of all relevant functions and the group photograph are also being included in the detailed proceedings of the workshop. However, a few of them are included as Appendix 3*

13.0 RESULTS:

The International Training Course on Materials Design and Production Processes for Low Cost Housing was successfully completed on 31st March, 2001. All the

participants had a feeling that the same was useful. The lectures were very informative and there were three group discussions. Particularly in the host country, many senior members from administrative as well as policy making bodies, from agencies for promotion of novel building materials and research directors participated and extended their views. Further, it was a real merit that a few of the leading building materials manufactures actively participated in this training course. As a follow up, a wide dissemination programme on the topic and of the ICS/UNIDO workshop is planned. The need for implementing the technologies already available in various countries, in their countries, as well as exchange of the available information between participating countries, were well realised during the workshop. Further, it was strongly felt that there is an increasing need to collaborate and for net work with in the south East Asian Countries and also with the developed countries from Europe, expanding the scope of development to more attractive technologies. In order to make convincing technologies, appropriate demonstration centres are very necessary to convince the industry and the end users for easy acceptance. Another necessity is the setting up of appropriate Training Centres to impart knowledge on the processes developed for processing of solid industrial wastes in building materials. Another important result of this course was the awareness to look at housing in totality, rather than on the various components. The materials, construction practices as well as the comfort of the people staying inside, are to be taken together. The industry should not restrict to one component, but should look as total requirement of building materials. The role of NGOs on the implementation of the novel cost effective technologies and quality materials and construction practices were realised, A very unexpected outcome was the need for incorporating consideration of the aspect of seismic resistant plans even in cost effective building sector. The need for use of locally available, energy efficient and low cost materials was fully recognised, although the extent of need may vary considerably from country to country. All these were discussed in the concluding session of the workshop held on 30th March.

14.0 COMMENTS & CONCLUSIONS:

The various lectures, presentation of the activities in housing in the participating countries and the discussions followed, lead to the main focal point of utilising efficiently the available local resources for housing. At the same time, the important fact was that the term low cost housing was rather less defined, this being really comparative in nature. The low cost is meant in less developed countries as a dwelling for protection from sun and rain, while in developed countries, the same is meant for the maximum comfort under reduced costs. Hence the level of 'Low Cost' depends on the country under reference. However, it was agreed unanimously that every country aspires a cost effective housing and therefore, the topic was discussed in detail. The discussions centred around the following points:

1. How best one can gather information on the available natural resources for use as building materials in each of the participating country.
2. How best the dissemination of information on the various technologies available in developed and developing countries can be made available in order to adopt the suitable ones in each of the participating countries.
3. How best the industrial/agricultural wastes available in each country could be made use of, with available technologies in any of the participating countries, for conserving natural raw materials in an energy efficient way.

- 7
4. How best the renewable sources for materials such as bamboo/natural fibres and minimum use of clays/ composites could be used in cost effective construction practices.
 5. How best it will be if a network information system be set p among the participating countries from the south East Asia and the developed countries in Europe coordinated by a central agency to establish south to south co-operation.
 6. How advisable it will be to set up a technology demonstration/materials testing /training Centre be set up in one of the target countries under support from UNIDO for the benefit of all the participating countries. This could function as a central place for cooperation and exchange of resource persons/ information dissemination centre in order to support such units already existing in most of the participating countries.
 7. Will Trivandrum, India be the ideal location capable to efficiently to coordinate the future developmental activities for the south to south cooperation. This point was unanimously agreed at the concluding session and was decided to present to ICS (UNIDO).

One of the most important factors, found uniformly in all the participating countries, is the concern on the responsibility of the producer of the waste, to find a suitable way of disposal. It was generally accepted that there should be participation of the Government, the producer of the waste, and the agency utilising the waste to useful building materials. In fact, the waste of one industry should be the raw material for another, so that the term 'Waste' should be erased from the context. This will help a long way in effective utilisation of such byproducts. The role ICS can play, in such attempts was also discussed.

The recommendations and proposals for future were discussed on 30th afternoon. There was a chance for all the participants to speak out their views. The representatives from India, and specially the brick and tile industry sector from Kerala, India, gratefully remembered the contribution ICS(UNIDO) had done for the benefit of this region. The ICS organised an International Workshop on Building Ceramics from Industrial Wastes in Trivandrum, during March 22-26 , where about six countries participated. There was a programme on waste based technologies in New Delhi also in March 1999. A team of building materials industry was led by RRL scientists to Modena (Italy) by invitation from ICS to attend a workshop on Best Available Technologies for ceramic and glass ceramic production in June-July, 2000. This was an eye opener for the Indian Brick and tile manufacturers. ICS (UNIDO) has now conducted this Training Course where 18 participants took part from developed and developing countries. The strong and continued support ICS has provided to the growth of the building industry and to the well being of the region were gratefully acknowledged by the organisers, as well as the participants. They look forward to a very effective progress in the years to come.

The details of the recommendations arrived at during the concluding session are provided below:

15.0 RECOMMENDATIONS OF THE WORKSHOP:

1. It is necessary to set up a target centre for coordinating the information dissemination system for available technology and implementation in the South East Asian Countries. The target centre will take initiative in providing a data bank consisting of the information on the various development and implementing (Governmental and Non-Governmental). The information from the developed countries also will be collected. This has been felt necessary since the information systems in the developing countries are not as developed as in the case of Europe.
2. Regional Research Laboratory, Trivandrum who has taken initiative in conducting UNIDO sponsored workshops/Training Course, has also the infrastructure requirements for coordinating the above activity. Therefore, RRL was identified as the target centre unanimously.
3. Area Specific workshops such as in drying/firing of clay products, waste recovery, natural materials/building materials with out firing etc. to be arranged separately in depth for the benefit of building materials manufactures, architects and research/development agencies in the various participating countries.
4. Great importance was provided for bamboo/ natural fibre based building materials in this training course. Most of the participating countries have the practice of using bamboo in construction. However, new ways of increasing the strength and durability of bamboo while in contact with other building materials such as mud, clay and cement need to be studied further. Therefore, an area specific workshop on Bamboo/natural materials should be organised by end of 2001 or in early 2002, preferably in any of the developing countries. Kerala, India has a very strong group on Bamboo utilisation.
5. Presentations from the various participants from the developing countries, made it clear that although each country has its own developmental programmes using the locally available material, there is a need for arranging demonstration facilities for novel processes developed in European countries or in any one of the developing country, in order that the same can be adopted more effectively. This centre should take up waste recycling also. For this, it is proposed that a technology demonstration centre for building materials be set up in Regional Research Laboratory, Trivandrum under the guidance and financial support of UNIDO.