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CEMENT DEVELOPMENT AND RESEARCH CENTRE*,

TURKEY.

DP/TUR/72/034.

Technical report: Winter concreting

Prepared for the Government of Turkey by the
United Nations Industrial Development Organisation
executing agency of the United Nations Development Programme

Based on the work of G.M. Idorn, expert in cement and concrete research

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Explanatory notes

The following abbreviations are used in this report:

IFU - The Industrialization Fund for Developing Countries:
Established as a non-profit, self-governing Institution for advancing Danish international development aid.

DCI - The Danish Concrete Institute:
Established as a non-profit, self-governing educational institute to advance professional training in concrete construction and technology in Denmark and abroad.

ABSTRACT

This is the report of a mission to Turkey undertaken as part of the United Nations Development Programme (UNDP) project "Cement Development and Research centre" (UP/TUR/72/034) of which the United Nations Industrial Development Organisation (UNIDO) is the executing agency. Under the provisions of the project the expert carried out his mission from 16th - 22nd July, 1978. His duty was to propose actions for transfer and implementation of knowledge on winter concreting to Turkey through actions by the Turkish centre. It also proved appropriate to follow up on his 1976-expert mission regarding establishing of concrete research and technology programmes at the centre.

Winter concreting transfer to Turkey can increase cement use, accelerate housing development and create employment potentials. The transfer depends upon a major national effort over a number of years.

The completion and commencement of operation of the concrete laboratory is urgently needed for the launching of programmes on winter concreting and in other important topics of concrete technology development in Turkey. The items from the abstract of the 1976 mission report by the expert are therefore still largely valid, inter al. due to the concurrent expansion of concrete uses. Equipment for the concrete laboratory, which is available in Turkey, shoul' now be bought and made operational.

Some general conditions for winter concreting are referred to.

Danish experiences, since government efforts to introduce winter concreting commenced in 1951, are summarized. An ongoing revision of the Danish recommendations to be issued in a new publication is mentioned.

Basic conditions for winter concreting in Turkey are briefly referred to. It is proposed that:

1. The expert performs a feasibility study of the technical/economic conditions for transfer and implementation of winter concreting in Turkey, preferably together with the future chief concrete engineer from the Turkish centre.

2. The said chief concrete engineer visits Denmark for training with the running Danish program (consultance, courses), provided acceptance by the Danish authorities concerned.

3. The new Danish Concrete Institute (DCI) be asked to arrange for a winter concreting course at the Turkish centre, when § 1 and 2 above are realized, and the revised Danish recommendations are published. Accept from DCI required.

4. The expert be asked to offer management assistance to the Turkish centre to implement the scheduled technology education where most profitable for the Turkish building development.

The findings of the mission further suggest the following major activities to be launched:

5. Negotiations by centre representatives with the DCI and Danish Industrialization Fund for developing countries (IFU) on arrangement of courses at the centre in four other topics of concrete technology and development.

6. Assistance by expert to arrange workshop at Turkish centre for identification of needs for the future work of the concrete technology department of the center.

7. Advisory assistance by expert to management of Turkish centre on strategy, planning and implementation etc. of future centre activities.

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I. FINDINGS

This is the report of a mission to Turkey undertaken as part of the United Nations Development Programme (UNDP) project "Cement Development and Research Centre" (DP/TUR/72/034) of which the United Nations Industrial Development Organisation (UNIDO) is the executing agency. Under the provisions of the project the expert carried out his mission from 16th to 22nd July, 1978. His duty was to propose actions for transfer and implementations of knowledge on winter concreting to Turkey through actions by the Turkish centre. In accordance with the local representatives he also found it suitable to follow up on his 1976-expert mission regarding the establishing of concrete research and technology programmes at the centre, inter al because this is a prerequisite for the realisation of effective winter concreting programmes.

A. Winter concreting

To transfer the technology for the making of concrete in cold and even very cold climates to Turkey could result in longer annual building seasons per year and thereby faster accomplishment of housing and industry development programmes, improved employment for the labour forces, and improved operations and logistic conditions for the cement industry. Many countries in the Northern Hemisphere have found winter concreting exceedingly profitable for these reasons, and some maintain annual government support for continuous application of the necessary means and precautions.

Denmark has in particular run major research and implementation programmes. The expert has been much involved herein and is at present co-responsive for a revision of the winter concreting technology-recommendations, this revision being based upon extensive research, executed under his leadership. Relevant Danish research and practice has also contributed to the international technology development in this field, and is continuing to do so.

The problems concerning the making of concrete in cold seasons originate from the simple fact that the processes which provide the strength of hardening concrete are very slow at low temperatures, and

that young concrete without sufficient strength having developed, will be permanently damaged or destroyed if the water in it is exposed to freezing. This is because the freezing of water is accompanied by volume-expansion, i.e. internal pressures generate during ice-formation.

Concrete being made in moderately cold weather (above 0 oC) must therefore be protected against loss of its internal heat (which develops during the hardening) and may need to be provided with extra external heat, and its strength development must be carefully monitored and performance loading not induced before sufficient strength has been recorded.

Concrete being made in severe winter climates (below 0 ^{o}C) must be made with preheated fresh concrete, protected against loss of heat during hardening, and thereby also effectively secured against early freezing. External heating is most often required.

Implementation of winter concreting therefore require means and knowledge for

1. The making of quality concrete at normal climate conditions (above +10 ^{o}C).
2. The use of air-entrainment for protection against frost-damage both to the young and the hardened concrete.
3. Effective insulation of the hardening concrete against heat loss and also protective insulation of materials, equipment etc. against freezing.
4. Preheating of concrete materials and fresh concrete, e.g. with steam, and during hardening, e.g. with electricity, coal-furnaces, infrared radiation etc.
5. Effective monitoring of the induced precautions based upon knowledge about how to optimize and control the technology.

Winter concreting in Denmark

To give a background for evaluating a Turkish programme on winter concreting a few remarks on the Danish experiences are appropriate:

Denmark covers about 40.000 km^2. Population is 5 mill. inhabitants. Cement consumption is about 400 kg/capita/year. Climate is moderate, northern temperate. 60% cement consumption is by ready mix industry, and can be delivered heated in winters. 10% of cement consumption is in prefab-industries and 20% in concrete-products. These two categories of

productions take place in factories unimpeded by climates, and erection at building sites is less sensitive to winter climate than is the making of the concrete itself.

Building and construction projects can get extra winter precautions refunded by the government. Public works are often requested to be continued throughout, if not preferably made, during the winter season. The government keeps an advisory and education scheme going annually.

This established practice commenced with extensive research and development projects, which were multisponsored by all interested parties, in 1951-1956, and initiated by large government fundings. 3-6 research professionals plus assistance were involved in the research, the expert being one of the professionals.

A winter concreting recommendation was published in 1953 and followed up by courses, supplementary writings etc.

Denmark arranged the international 1956-RILEM Conference on winter concreting and since then strong ties have been maintained with international research. The concrete research laboratory, Karlstrup, under management of the expert, broadened and deepened the research in the 60'ies and early 70'ies, so that the hardening process and strength development in concrete now can be designed and be monitored "on line" at any temperature level and for any kind of working conditions, it be high or low temperature environments.

On this basis the Danish 1953-recommendations are now being revised and a new publication is foreseen in the fall 1978. The expert is co-responsible for this project.

The effects of this technology in Denmark has been practically removal of seasonal closing down of building projects (except under singularly bad conditions), elimination of the climate as a reason for seasonal non-employment, levelling out of cement consumption over the whole year and, totally, higher cement consumption.

The costs encompassed the development of a generally qualified level of the technology for concrete making, the research and implementation programmes, the annual government subvention, promotion etc.

The reasons for the success with these investments by industries and government in common have been the firm commitments to long-term programmes and successions of coherent projects in accordance with changing needs.

Winter concreting in Turkey

Broadscale introduction of winter concreting in Turkey could offer considerable national benefits like those described above. Even partial prolongations of the building seasons, e.g. one month in autumn and one month in spring in reasonably moderate winter climate regions, could significantly accelerate national building programmes and increase employment and cement consumptions.

The technology knowledge, which is required for the making of concrete under winter conditions, would also apply more broadly as a means for advancing concrete building and construction programmes, and would thus match with national demands for effective utilisation of the increasing cement production.

Moreover, a national move for winter concreting as a part of broader building and construction schemes, would be an incentive to cement consuming industries for investments in prefabrication of concrete and cement products, ready mix concrete etc. These techniques offer improved flexibility of production/storage/supply planning than does conventional building-site concepts, and are thus suitable elements of an "all season building" policy.

The introduction of winter concreting in Turkey will require considerable investments in education of technical staff and professionals, and will thus absorb a certain fraction of the available resources. This is because the necessary technical precautions must be effectively applied so as to avoid losses of materials and to ensure performance dependability of the concrete concerned. Also the investments in heating and insulation means require planned investments and commitments to reasonable utilisation.

A selective and stepwise campaign, based upon a feasibility study, on where to begin and how much to invest and achieve e.g. over the first five years of actions, is therefore necessary. As shown e.g. by Danish experience, a long-term national policy must be envisaged, involving a consensus for the development between the government and the executing parties. The Turkish centre should be in a unique position to be delegated a central planning and operational function both with regard to the assembling of existing knowledge from other countries, and concerning the planning and execution of the transfer and implementation in Turkey.

The following categories of activity are recommendable issues of a winter concreting campaign for Turkey:

1. Immediate steps to familiarize Turkish concrete technologists with the available knowledge in Denmark.
2. Feasibility studies as to where and how transfer and implementation in Turkey should begin according cost/benefit evaluations.
3. Long-term education/research program to secure adjustments of the technology required so as to fit with Turkish conditions.

The following procedures for the launching of a campaign are proposed:

1. The study should preferably involve the future chief concrete engineer at the Turkish centre. The expert will offer to make a feasibility study of winter concreting conditions, technical and economical, in Turkey. This will require 14 days expert stay in Turkey and 14 days work in Denmark by the expert. Spring 1979 is proposed.
2. The said Turkish chief concrete engineer should visit Denmark one month for participation in Danish course and consultant-service as offered by Danish Government to the builders in Denmark. The expert will assist in applying for acceptance from Danish authorities. Spring/Fall 1979 is proposed.
3. The Danish Concrete Institute (DCI) will arrange courses at the Turkish centre in 1979 on winter concreting in accordance with the revised Danish recommendations. Special negotiations between the Turkish centre and DCI/IFU are required.

In order to make such initial actions accepted and used by the concrete engineering sector in Turkey it is necessary to launch broad and continuous campaigns, including publications, use of those first trained engineers as follow-up teachers, introduction of economical

rewards to those firms in industry and engineering who will pioneer winter concreting in practice (including advance of ready-mix and precast concrete industrial development, manufacturing and winter supply of high-quality cement etc.)

4. The expert will offer advisory assistance to the management of the Turkish centre for the preparation and realisation of a five years plan for the advance of winter concreting in Turkey, comprising proposals for incentives to industry and engineers etc., and estimates of efforts, costs and earnings. Assistance is to be planned in detail if of interest. Realisation in 1979 is proposed.

B. PROJECT STATE OF AFFAIRS/CONCRETE LABORATORY

The erection of the concrete laboratory has progressed since 1976 but less than the raw materials and chemical departments and the administration sector.

The equipment has been further specified by experts in 1977 and 1978.

The system-laboratory proposed in the 1976 mission report is still found the most suitable choice of assembled instruments. Postphonement of purchase of some of the most complicated and heavy equipment is still recommended as in 1976 mission report. Emphasis is recommended to be on integration of concrete technology research with investigations requiring equipment and knowledge from the cement- and raw materials laboratory.

The opening for employment of the future concrete technology department head (chief concrete engineer) is an urgent need. The educational service of the concrete laboratory is an urgent need at the commencement, more than its function as a testing laboratory.

C. FUTURE WORK OF THE CONCRETE DEPARTMENT

The remaining erection and purchase and installation of equipment is now accessible to the future chief engineer as far as the hard-ware is concerned. Expert assistance from Denmark can still be provided for a final purchasing and running-in phase, but will be most effective as assistance to the future chief.

The recommendations regarding the future activities of the concrete department in the expert mission Dec. 1976 report are still valid as present recommendations, with appropriate adjustments of dates etc. The opening of staff employment is now considered urgent as basis for planning winter concreting programmes and other projects that can lead to increased cement consumption by advancing the national in quality concrete as an indispensable factor in the general development.

As further support to the initiation of this development the following proposals are found recommendable:

a. Expert service from Denmark to education courses

The new Danish Concrete Institute (DCI), jointly with the Danish Industrialization Fund For Developing Countries (IFU) is prepared to negotiate that DCI plan and help to execute four courses for the Turkish centre in 1979 besides the course in winter concreting mentioned above. The topics are proposed to be:

1. Elementary concrete technology.
2. Admixtures.
3. Durability
4. Modular system buildings in precast concrete.

Each course:	15 hours lecturing +
	10 hours laboratory work. (negotiable)
Language:	English
Attendants:	Turkish civil engineers. Min. 10 per course
Fee to Turkish center	15-20000 TL plus accomodation per attendant, but inclusive books etc. (negotiable).
Fee to DCI:	To be negotiated.
Sponsor:	UNIDO and/or to be negotiated.

A long-term cooperation with the aim to create a joint-venture middle-east concrete technology school at the centre could also be negotiated. Such a school should issue concrete technology specialist-diploma to those passing a select series of courses.

A delegation from the Turkish centre is invited to visit DCI/IFU during the fall season 1978 to negotiate these matters.

b. Expert to arrange for workshop on future concrete activities

The expert is willing to assist in planning and execution of a 3-days seminar in Ankara comprising:

1. The centre management.
2. The future concrete chief engineer.
3. Selected Turkish professors.
4. Selected contractors, consultants.
5. Selected foreign experts.

The workshop should aim at achieving a consensus regarding the future work of the concrete technology department.

Time: Early 1979 if concrete chief engineer installed.

Work involved: Expert + chief engineer - 14 days preparation in Denmark plus 14 days total work in Turkey, including management of seminar.

Narrative of workshop to be published by the Turkish centre.

Supplementary expert service to implementation of workshop results can be supplied.

c. Expert advisory service on Management and Planning for Director of Centre.

If desired by the Turkish government the expert will negotiate advisory service on management and operations of the Turkish centre towards its service to the engineering and its research sector, including building up of its international status and contacts, e.g. by arrangement of conferences, publication policy, scholarships projects, etc.

A three years arrangement might be found suitable to ensure continuity in the first phase of this building up. Annual programmes are then to be specified, budgetted, and financed.

II. RECOMMENDATIONS

A. Winter concreting

1. The expert offers to prepare a feasibility study of winter concreting conditions in Turkey, preferably together with the future chief engineer of the concrete department of the Turkish centre, so as to facilitate implementation of the technology knowledge to be transferred. 14 days stay in Turkey plus 14 days work in Denmark is proposed during spring 1979.

2. The Turkish chief concrete engineer is recommended, when employed, to visit Denmark on a one month scholarship for participation in on-going Danish winter-concreting programmes. (Acceptance from relevant Danish Authorities must be applied for). The fall season 1979 is proposed (if action is not immediately possible for winter season 1978/1979).

3. The Danish Concrete Institute (DCI) and the Danish Industrialization Fund for Developing Countries (IFU) will negotiate to arrange winter concreting courses in 1979 at the Turkish centre on the basis of revised Danish winter concreting recommendations.

4. The expert offers to assist the Turkish centre with the planning of a substantial five years campaign for the advance of winter concreting in Turkey, inclusive estimate of efforts, costs, benefits, and needed commitments for encouragements from the government to pioneering responses from engineering practice.

B. Project state of affairs, concrete laboratory

5. The system laboratory equipment proposed in the 1976 expert mission report is still found recommendable.

6. The purchase of the most complicated and heavy equipment can be postphoned for the advantage of the purchase of specified equipment.

7. The integration of the work of the concrete laboratory with the activity of the cement departments is recommendable.

8. The opening for employment of a chief concrete engineer is urgent.

9. The initial need for the service of the concrete department is primarily on the education side, less on the testing of concrete products, big elements etc.

C. Future work of the concrete department

10. Expert service from the Danish DCI/IFU to organizing 4 courses for Turkish concrete engineers in 1979 at Turkish centre on:

    1. Elementary concrete technology.
    2. Admixtures.
    3. Durability.
    4. Modular system-buildings in precast concrete

    is proposed to be negotiated. A long-term joint venture arrangement to make the Turkish centre as a Middle-East concrete specialist diploma school can be negotiated.

11. A visit by a delegation from the Turkish centre to Denmark for is proposed to be arranged during the fall season 1978.

12. The expert offers to assist in planning a workshop early in 1979 for interested parties in Turkey regarding the future work of the concrete department of the Turkish centre.

13. The expert offers to supply advisory service on management and planning of engineering service and research, including contacts etc.

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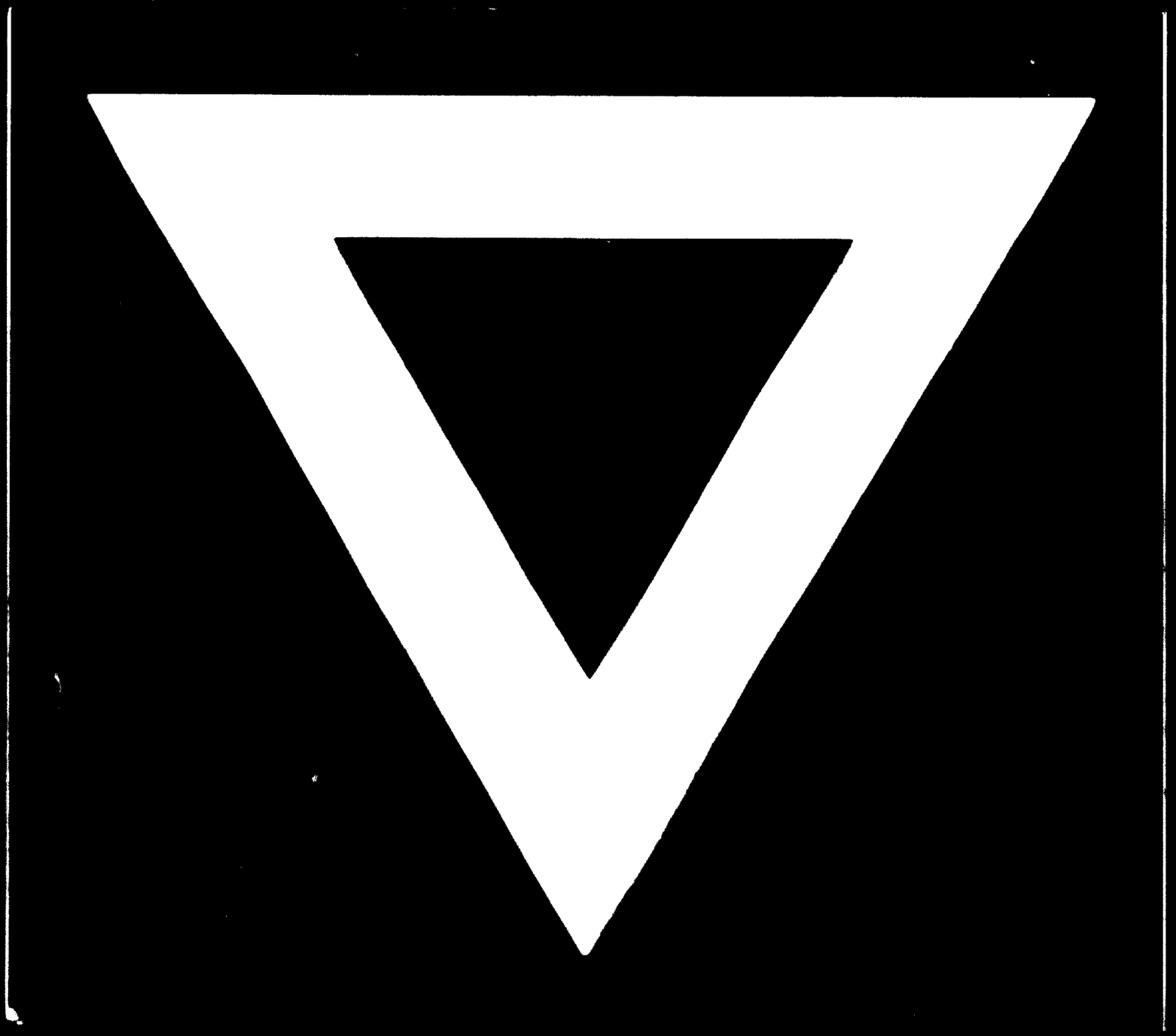

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