

IDRC - Lib.

99942

File:
88-1045-CC

2.1.42

SHALE BRICK PRODUCTION (EGYPT)

EVALUATION REPORT - OCTOBER 1992

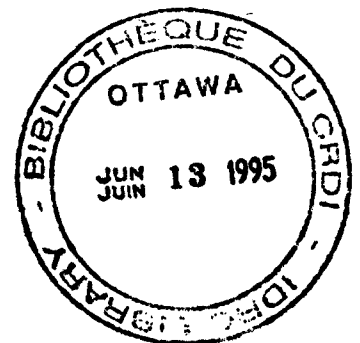
Prepared for

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

IDRC FILE 3 - P - 88 - 1045

by

John I. Glanville, P.Eng.
Faculty of Engineering
University of Manitoba
Winnipeg

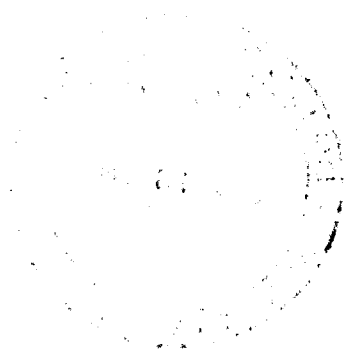


ARCHIV
691.31(621)
GS

CONTENTS

Introduction

- A. Research Methodology
- B. Contribution to Egyptian Research Capability
- C. Participating Research Institutions
- D. Collaboration
- E. Training Activities
- F. Achievements
- G. Impact on Development
- Concluding Comments
- Acknowledgements



- Appendix I - Photographs
- Appendix II - Terms of Reference

INTRODUCTION

Brick is one of the most basic building materials in Egypt, especially for low-cost housing, and, until recent decades, silt from the Nile river was the most suitable material for the production of bricks. However, the annual renewal of silt from river flooding ceased with the construction of the dam at Aswan, and the burgeoning population of Egypt rendered the arable land along the banks of the Nile an increasingly valuable resource for agricultural purposes, while at the same time the demand for housing, and consequently for brick, increased accordingly.

Because of the necessity of retaining the arable land along the Nile for agricultural purposes, Nile silt rapidly became unsuitable for brick production and the Egyptian Government placed a ban on its use for that purpose. As a consequence, other local resources were sought for exploitation as raw material suitable for brick production.

The most abundant alternative materials are shale and sand. However, these materials by themselves are unsuitable for brick production but the potential of using shale in combination with other materials, such as sand, was recognised, and in 1988 The International Development Research Centre (IDRC) in Ottawa approved a proposal to develop a small-scale technology to produce acceptable burnt bricks using shale as the basic raw material, the specific objectives being:

- to carry out the characterization studies of shale; and
- to establish the process and production parameters adaptable to the existing brick plants for the production of low-cost burnt bricks using shale.

Participating partners in this research and development are the General Organization for Housing, Building and Planning Research (GOHBPR) in Cairo and the National Research Council (NRC) in Ottawa. The team of researchers from the former organization is headed by Dr. M.R.H. Ramez, and that from the latter by Dr. V. W. Ramachandran.

The project has proceeded through the stages of scientific and technical research and development to brick production utilizing the technology at a number of plants.

In 1991, three years from grant approval, IDRC commissioned an independent evaluation, this being the subject of the present report. The report is based on:

- a review of the 1988 Project Proposal and related files at the IDRC office in Ottawa in June 1991;
- a meeting with Dr. Ramachandran at his NRC office in June 1991;
- an examination of the first (1989/90) and second (1990/91) annual reports prepared by GOHBPR in collaboration with NRC
- meetings with Dr. Ramez and his staff at GOHBPR in September 1992;
- a tour of the GOHBPR facilities in Cairo; and
- a tour of four brick production plants in the Giza and El-Saaf areas.

This evaluation report follows the general format outlined in the Terms of Reference (Appendix II) of the Consultancy Contract. While all terms are addressed, particular attention is paid to item f) that deals with practical accomplishments. Photographs of bricks in production are included in Appendix I.

A. RESEARCH METHODOLOGY

The research methodology followed in this project is appropriate. From the scientific characterization studies of shale, sand and grog, using techniques such as differential thermal analysis, x-ray diffraction, thermo-mechanical analysis and thermogravimetric analysis, and technical studies such as analyses for particle size distribution, shrinkage and swelling characteristics and plasticity, through to technical studies of various mix proportions and final strength tests of the fired brick, the sequence of development has been logical. These various tests and their results are provided in detail in the GOHBPR/NRC reports to IDRC. The project has both scientific and technical merit in that it has proceeded from a scientific analysis of materials individually unsuitable for brick production, integrating these results in a technical investigation that has led to the production of brick of adequate quality.

While the combining of materials for brick production is not a novel concept, the high degree of unsuitability of the shale being used in this project gives it an element of uniqueness and information is being shared with the British Ceramics Institute (Dr. T. West specifically) and other similar institutions. Information derived from the project has reportedly been incorporated into other techno-economic studies and reports by GOHBPR.

B. CONTRIBUTION TO EGYPTIAN RESEARCH CAPABILITY

A number of research topics that form part of this project had not previously been undertaken in Egypt: investigation into the calcination of clay; the use of admixtures in brick production; the specific use of acetic acid as an admixture. These topics and the important melding of scientific and technical research teams have all contributed to research capability. Furthermore, the project has provided research topics that have led to Ph.D. and M.Sc. degrees, in itself a valuable contribution.

C. PARTICIPATING RESEARCH INSTITUTIONS

GOHBPR is clearly well qualified to undertake this project. The research team under Dr. Ramez consists of eight scientists with doctoral qualifications and seven technical assistants at various stages in their development, some in their doctoral program. Areas of expertise include: geology, rock mechanics, mineralogy, ceramics, chemistry of salts, efflorescence, corrosion, and calcium silicate reactions; computer programming and analysis; and technical shrinkage, swelling and strength testing. However, while adequate for present purposes, much of the equipment is old and in need of replacement.

NRS is an appropriate institution for a collaborative project, and requires no evaluation in this report.

D. COLLABORATION

From my discussions with Dr. Ramachandran at NRC in 1991 and with Dr. Ramez and his GOHBPR colleagues this year, the climate of collaboration has been excellent. Most of the research work has been done at GOHBPR with confirmatory and complementary testing at NRC. This division of labour has been logical since relatively large quantities of material from a variety of sources have been studied.

E. TRAINING ACTIVITIES

Training activities and the dissemination of information are not listed among the specific objectives listed on p2 of the Proposal, although they are referred to under item V "Utilization of Research Results" on p4.

Since the Egyptian Government has placed a ban on the use of Nile silt for brick production, brick producers have been seeking alternative sources of raw materials. Enquiries are being directed to GOHBPR who are able to provide information on the location of alternative sources and to recommend suitable shale/sand mixes. GOHBPR also provides information regarding methods of ensuring that the correct proportions are maintained, and provides on-site assistance.

In view of the ban on the use of Nile Silt and since the use of inappropriate mixes of materials leads to a poor product with a high degree of wastage, training activities and the dissemination of information is driven by necessity and is reportedly successful.

F. **ACHIEVEMENTS**

The overall objectives of this project, as taken directly from p2 of the 1988 Proposal, are as follows:

- (a) to carry out the characterization studies of shale; and
- (b) to establish the process and production parameters adaptable to the existing brick plants for the production of low cost burnt bricks using shale.

These objectives are stated more specifically under item III "Methodology", pp2 and 3 of the Proposal.

As stated on p2 of the 1990/91 GOHBPR/NRC report to IDRC, the objectives were planned to be accomplished in three phases, as follows:

- Phase I**
 - Sample selection and characterization.
 - Preliminary studies on the effect of non-plastic additives on the technological properties of shale/clay.
- Phase II**
 - Modification of the plasticity of Egyptian shale/clay.
 - Improvement in the drying behaviour of moulded articles.
 - Decreasing the available chlorides in the clays and the fired product.
 - Following the quality of the fired product throughout, by means of physical, chemical and mechanical testing.
- Phase III**
 - Semi-pilot scale implementation of results.
 - Recommendations.

GOHBPR has identified a large number of sources of shale in the general vicinity of the brick plants, identifying each and conducting extensive characterization studies. The considerable variation in material properties between the various deposits appear to be well studied and documented.

There are a large number of variables involved in the successful production of burnt brick. In addition to the variation in the properties of the shale itself, there is the salt content of the material, the proportions of the shale/sand (and/or other additive) mix, and firing temperature. The project appears to have progressed to the point where bricks of acceptable quality can be produced.

Visits to four brick plants in the Giza and El-Saaf areas, from a small-scale plant with little automation to a larger-scale plant with a fair degree of automation, and capacities varying from 1000 to 4000 units per hour, revealed a wide range of quality of brick. While the quality of the brick would not generally be acceptable on the Canadian market, it would appear that it is comparable to or better than the silt brick previously produced.

Phases I and II identified by the GOHBPR/NRC reports have largely been completed and Phase III is well under way. However, in view of the complexity introduced by the large number of variables, additional work is still required in "fine tuning" the mixes and firing temperatures. Further work into the use of additives, acetic acid showing potential, should be undertaken.

G. IMPACT ON DEVELOPMENT

In view of the ban on the use of Nile silt in brick production, a burgeoning population and the consequent increase in the demand for housing, this project was very timely. An acceptable product using previously unacceptable raw materials has been developed. One major concern that does not relate to the quality of brick so much as to air equality remains to be addressed. That is, the pollution produced through the use of crude oil as the fuel for firing the kilns. This is a serious problem that will have to be addressed in the near future.

CONCLUDING COMMENTS

Although brick production and construction have been practised for millennia, it is only with high quality materials and in well-developed technology that the process is relatively static. Utilization of new materials, or the development of a technology that utilizes lower quality materials requires considerable research.

The main objectives of the project have been accomplished although further "fine-tuning" is required, and work should be continued for the production of higher quality units.

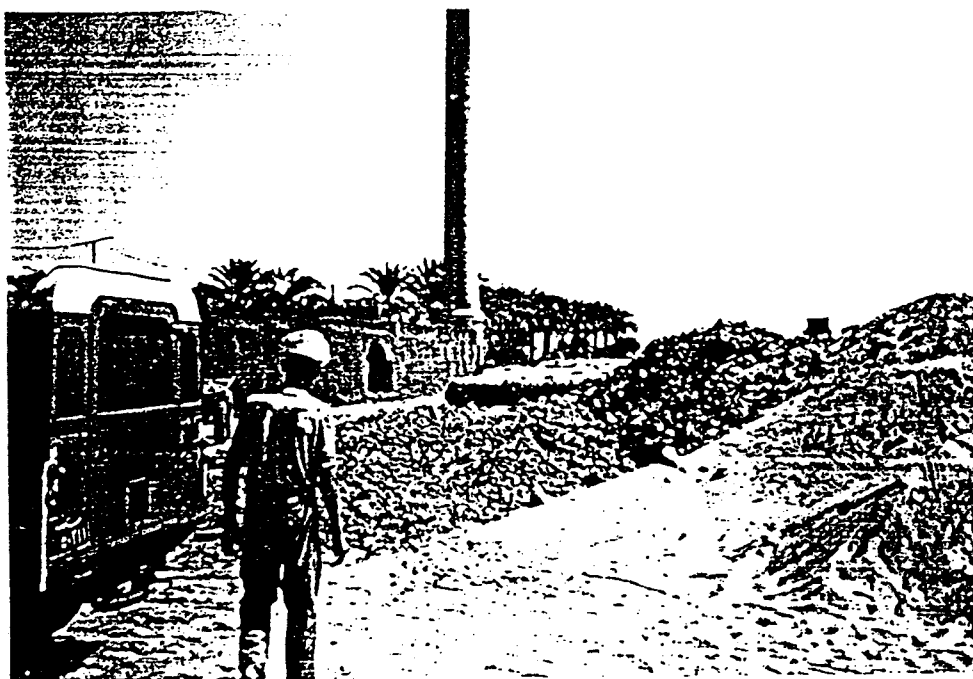
As a footnote to this evaluation, and in light of the very recent report of earthquake damage in Cairo, I would like to add that, although brick masonry buildings are as prone as others to earthquake damage, masonry can be used effectively in the design of earthquake-resistant structures. It is likely that Egypt would benefit from some support in the structural design of masonry buildings with earthquake resistance.

ACKNOWLEDGEMENTS

The cooperation of Dr. Ramez and his staff at GOHBPR, and Dr. Ramachandran at NRC, is gratefully acknowledged.

APPENDIX I

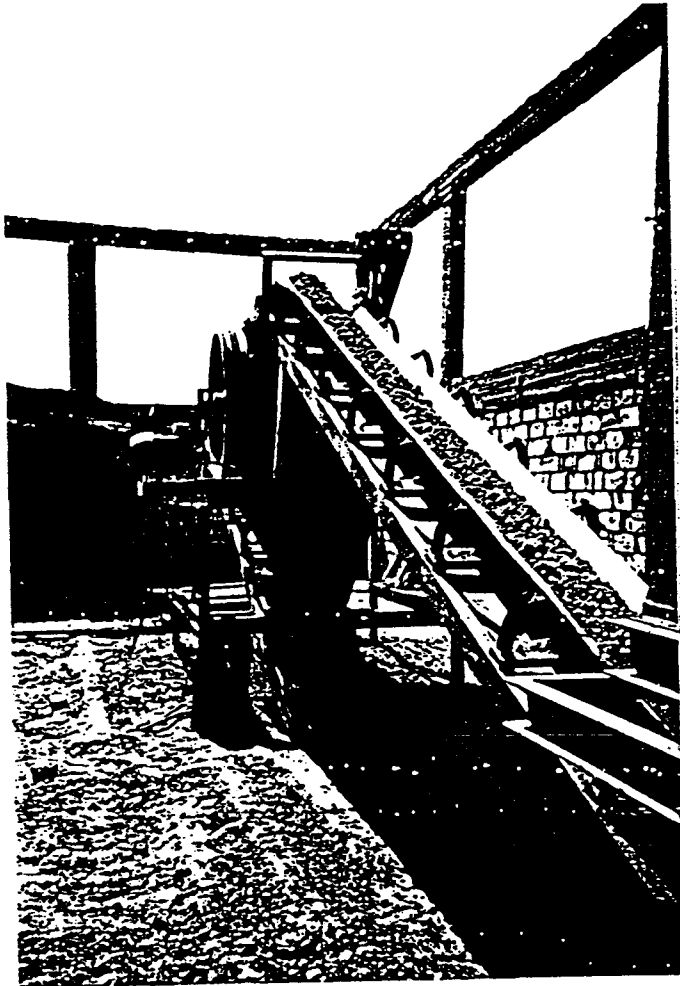
Photographs.



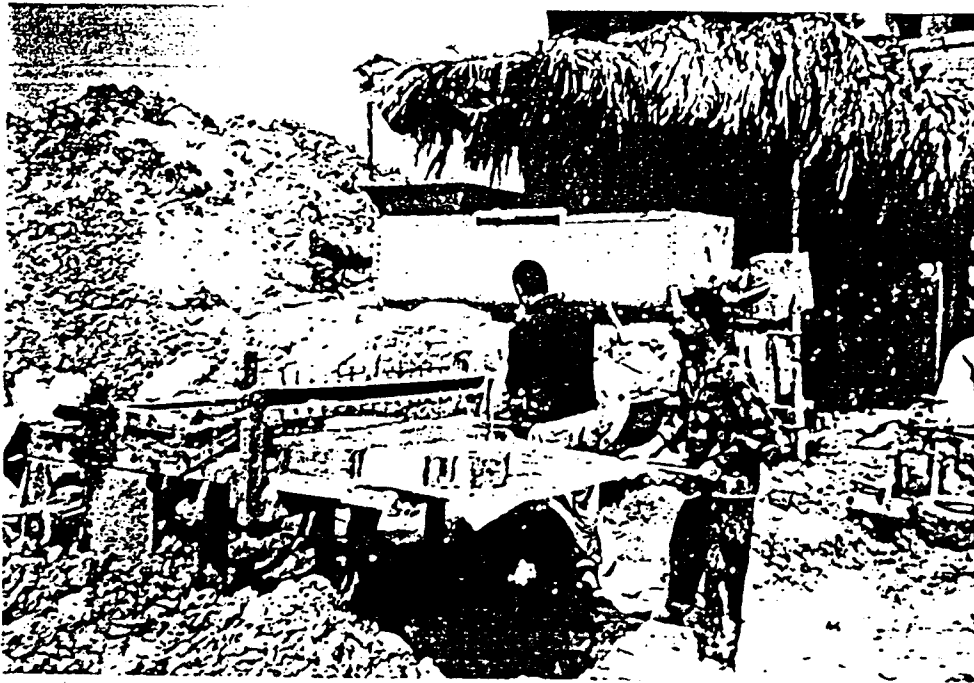
Stockpile of ingredients.



Hand mixing. (left)



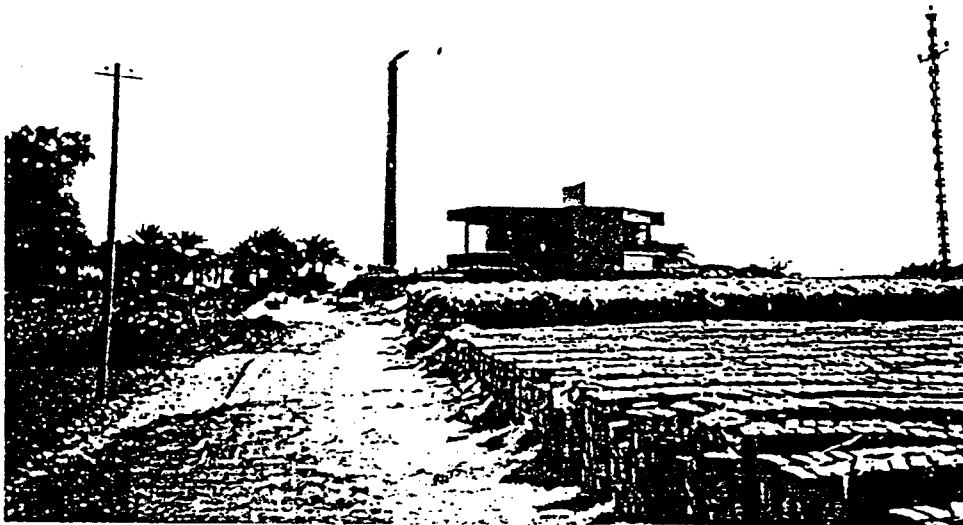
Conveying dry mix.



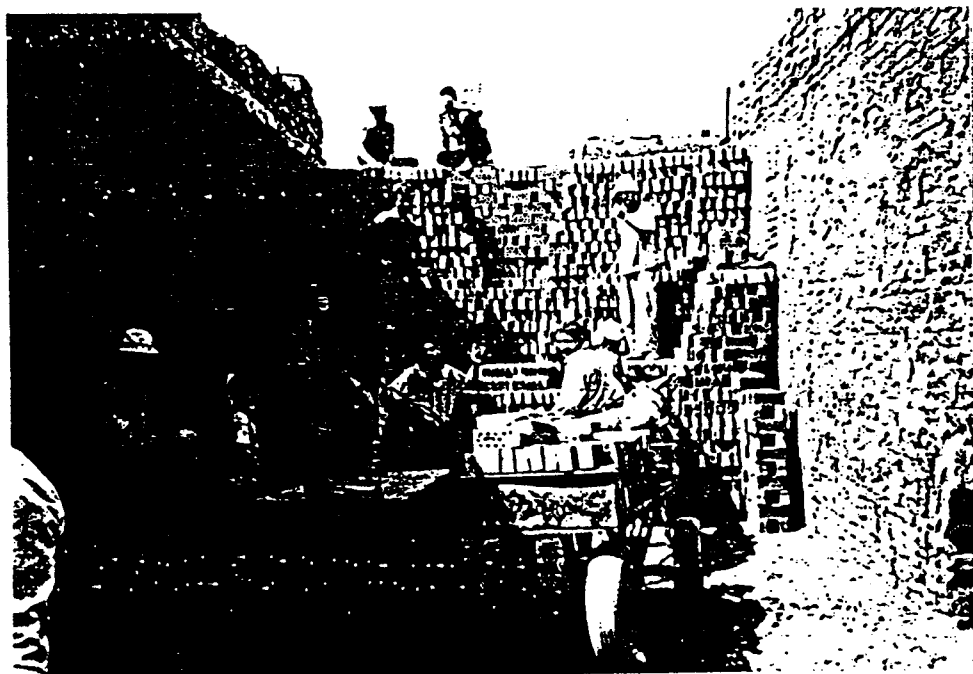
Mixing and extrusion (small plant).



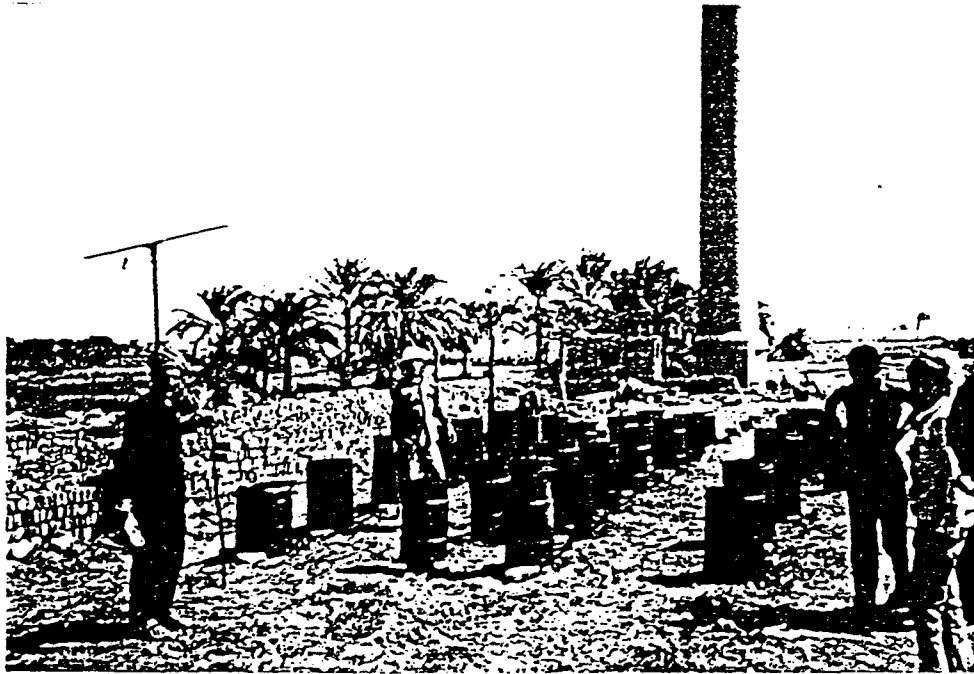
Extrusion, cutting and removal (larger plant).



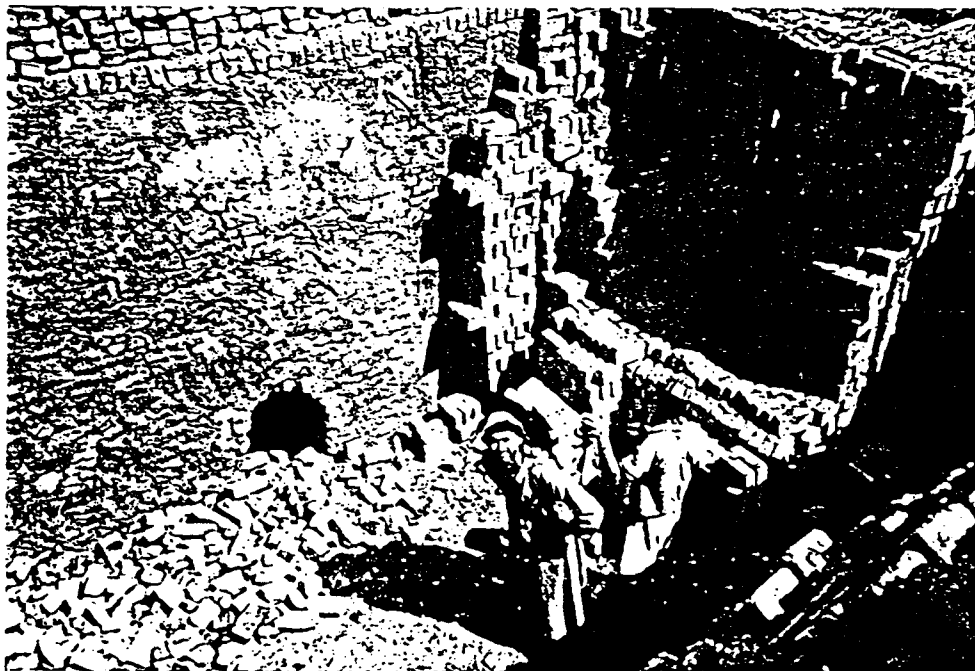
Drying beds.



Loading the kiln with raw brick.



Fuelling the kiln with crude oil from above.



Unloading fired bricks.

APPENDIX II

Terms of Reference

1. Terms of Reference

Under this contract, the services required of you are as follows:

- a) an evaluation of the research methodology: scientific/technical merit; novel approach being pursued in terms of brick development. In particular, how do the novel aspects of the research differ from what is done by other researchers in the field, and how do they differ from similar research funded by IDRC and/or by other research funding agencies? How will the proposed research, in its essence and in terms of objectives and methodology, bring the known technology one step ahead of its previous knowledge level? Stated briefly, what is the essence of the novelty, innovation, or what are the special features of the research work undertaken which should, if successful, bring scientific and/or technical knowledge one step ahead?
- b) an evaluation of the project contribution in building up the research capacity and capability of the recipient institution in the countries concerned;
- c) an evaluation of the research institutions and research participation. Have they supported the project(s) in an adequate way?
- d) a review of the quality of the face to face collaborative aspects of the projects; the technical assistance content versus the collaborative aspect; the relationship between partners; their mode of collaboration and contribution to the overall execution and results of the projects;
- e) an evaluation of training activities for the utilization of the technical research results through dissemination, popularization and other means;
- f) an evaluation of the achievements of each project vis-a-vis their objectives;
- g) the impact of these projects on development;
- h) as well as the project by project evaluation described above, EES requires an overall evaluation of the approach to shelter problems via brick technology development. Is the approach chosen correct and appropriate in the case of each of the projects and in general? If so, why? If not, why not and how could it be made more appropriate?