ISN 73461 PN-ABU-261

INTERTECT TRAINING SERVICES

SUPPORTING DISASTER AND EMERGENCY MANAGEMENT

February 8, 1993

BHM - Basic Health Management
8403 Colesville Road
Suite 805
Silver Spring, Maryland
20910

Attn: Suzanne Burgess

Suzanne,

Here is our report ready for distribution and review. We will send copies to:

Elliot Smith - Returned Peace Corps Volunteer now working for Cooperative Housing Foundation (he worked on the DASH project for 2 years.

Andy Coburn - He was one of the OXFAM reviewers along with Jolyon Leslie who saw the DBEP project in action in 1985

Mr. Abdo Seif - Programme Officer - UNDP Sana'a, Yemen - He worked with the EOR and DASH project.

Please send other copies to whomever you feel is suitable and forward any reviewer comments you receive to us. We will revise this copy based on comments received.

It has been a pleasure to work on the project and we look forward to working with you in the future.

As Always,

Steve & Jim

Steve Webster & Jim Good

150 EAST GILMAN ST. ■ MADISON, WI 53703 USA ■ tel 608-251-9440 ■ fax 608-251-9440

U.S. AGENCY FOR
INTERNATIONAL
DEVELOPMENT

MEMORANDUM

February 12, 1993

To: See Distribution

From: Gudrun Huden, FHA/OFDA/PMP

Subject: Second Case Study for the Shelter Sector Study

Attached is the Yemen case study for the "Evaluation of Post-Disaster Housing Education as a Local Mitigation Approach." This case study is the second of a larger project which will deal with disaster response and mitigation in Jamaica; St. Vincent/Dominica; Madagascar; Solomon Islands; and one Latin American country.

Since all of you have been intimately involved in disaster prevention, mitigation and preparedness (PMP) in the region and care about the issue of sustainability, we would be grateful for your review and comments. This report is clearly a draft, and Steve Webster and Jim Good plan to produce a final version after all the comments are received. **This case study is meant to stand by itself; lessons learned from the case study will be determined when all the case studies have been completed.**

The goals of the shelter sector study are to: (1) determine the usefulness of housing education/training as a means to achieve safer construction practice in high-risk, low-income communities; and (2) build a database of knowledge concerning prior OFDA-sponsored projects in the housing sector in order to determine whether they in fact performed as intended and to establish whether OFDA's project portfolio evolved on the basis of lessons learned.

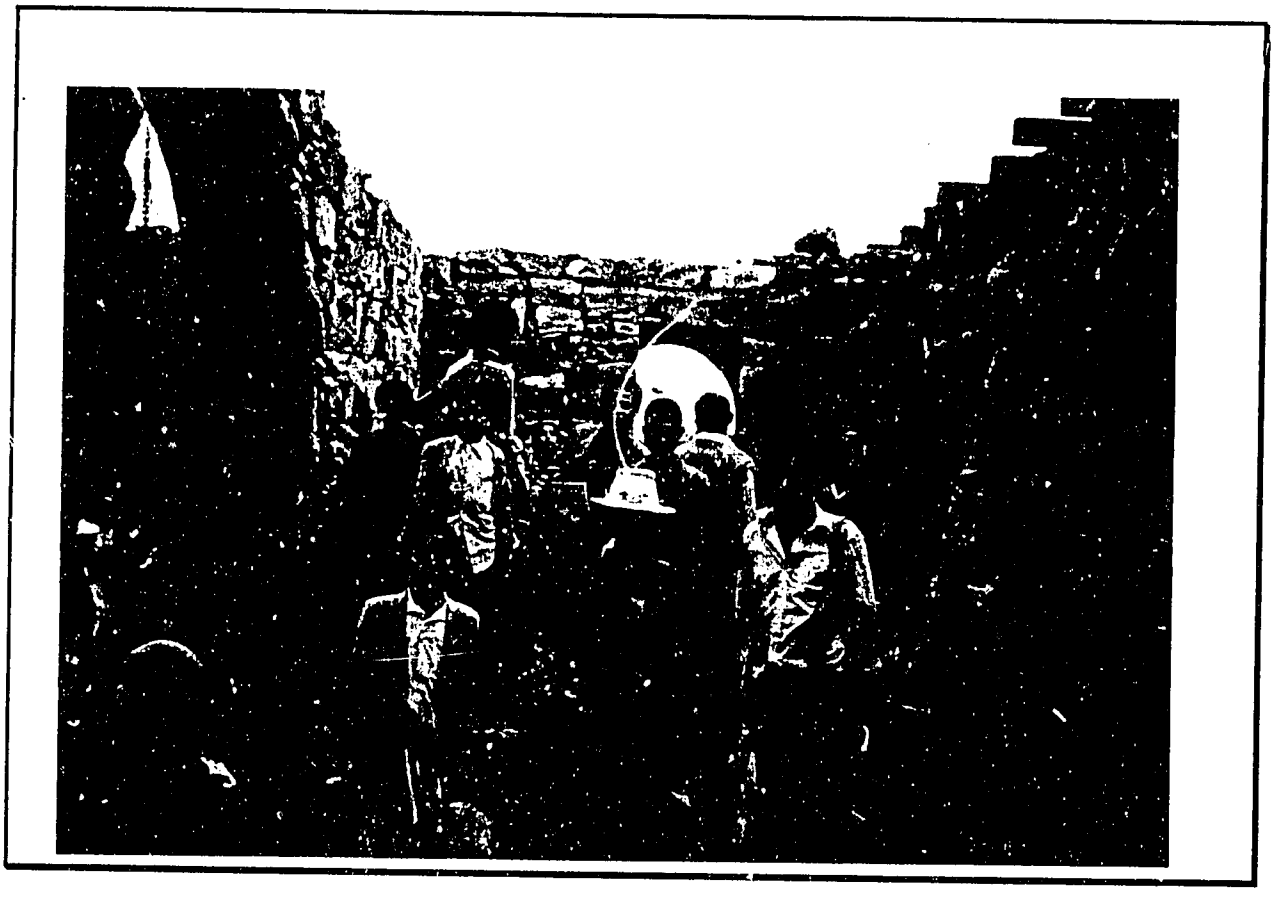
The objectives of the study are to: (1) determine the degree to which the skills and information taught in housing education/training projects have been used and adapted in the normal housing process of a community; (2) identify project components and approaches that appear to offer the best opportunity for effecting long-term local capacitation; (3) identify factors that constrain or act as obstacles to an effective training environment and to long-term self-sufficiency; and (4) produce a framework to guide decision-making for the design and implementation of future housing education programs to ensure to the greatest degree possible their acceptability and sustainability within the local community.

320 TWENTY-FIRST STREET, N.W., WASHINGTON, D.C. 20523

PN-ABU-261

HOUSING CONSTRUCTION PROGRAMS IN THE REPUBLIC OF YEMEN FOLLOWING THE 1982 DHAMAR EARTHQUAKE

Prepared as part of a project, Evaluation of Post-Disaster Housing Education as a Local Mitigation Approach, for BHM, Inc., under contract with the AID Office of U.S. Foreign Disaster Assistance, Washington, D.C. 20523



A CASE STUDY

James P. Good
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Madison, WI

Stephen A. Webster
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Draft for Review - January, 1993

It would be most helpful if you could get back to us with your comments within two weeks. OFDA's fax number 202 647-5269 and you can reach me at 202 647-7530 or Brad Michaels at 202 663-3166. Many thanks.

Distribution:
Ollie Davidson, FHA/OFDA/IDAC
Steve Dobberstein, PRE/H
Frank Miller, NE/ME/YOJ
Steven Sharp, PRE/H

cc: Barry Heyman, FHA/OFDA/PMP

List of Acronyms

BAC - Building Advice Center

BATC - Builder Advice and Traning Center

DASH - Dahmar Aided Self Help Reconstruction Project

DBEP - Dahmar Builder Education Project

EOR - Executive Office for Reconstruction

LDC - Least Developed Country

ROY - Republic Of Yemen

SCREAA - Supreme Council for the Reconstruction of Earthquake Affected Areas

UNCDF - United Nations Capitol Development Fund

YAR - Yemen Arab Republic

YFTC - Yemen Foreign Trade Commission

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1. EXECUTIVE SUMMARY

This study is an examination of the housing programs designed in the aftermath of the 1982 earthquake in the Republic of Yemen.

The earthquake measured 5.8 (Richter) and struck the Dhamar region of, what was then, North Yemen. This area is subjected to earthquakes on average every 20 years. Despite the fact that this was a relatively mild earthquake, the damage was severe resulting in approximately 2,000 deaths, 2,000 injuries, and nearly 25,000 homes destroyed and 17,000 damaged. The large number of destroyed and damaged house was attributed to the traditional construction patterns of Yemeni housing which are not built with earthquake strengthening mitigation techniques.

The government of the Yemen Arab Republic responded quickly by forming the Supreme Council for the Reconstruction of Earthquake Affected Areas (SCR). The SCR created the Executive Office for Reconstruction (EOR) to design, approve and administer housing reconstruction programs. These bodies received the reports of many international consultants. Consultants generally recommended a set of reconstruction and repair programs that incorporated construction mitigation techniques. The consultants recommended, based on existing Yemeni housing construction patterns, a self-help approach to the reconstruction.

In response, the SCR authorized two types of programs. They relied mainly on a contractor-built program consisting of large scale settlements in plateau areas and in mountain communities where sufficient numbers of homes combined with favorable sites conditions would allow construction economies of scale. In this program foreign construction firms eventually built 13,000 homes. For areas too remote for contractor-built housing the SCR developed a modified self-help project which built an additional 1,000 homes or 4% of the total number of houses built under official government construction programs. A modest repair and strengthening program was also developed for Dhamar City but the analysis of that program is beyond the scope of this study.

Arab donors (Saudi Arabia, Kuwait, Oman, and the UAE) supported the contractor-built program and the Netherlands, EEC, and USAID supported the self-help program. There is considerable dissatisfaction with the contractor built-homes. Many of the houses are still unoccupied due to being unsuitable to the Yemeni standards regarding size and privacy. The self-help program on the other hand built houses that are acceptable to the survivors.

The self-help programs stressed training of local builders. This emphasis was expected to have long term affects on Yemeni building practices such that construction practices would incorporate earthquake strengthening techniques.

Two self-help programs were organized. The first of these was supported by donors (Canadian, Aga Khan Foundation) and NGOs (OXFAM, Radda Barnen, CONCERN, and British Bazaar). These NGOs developed a limited builder education program known as the Dhamar Builder Education Program (DBEP). This program provided training to approximately 1,500 self-identified masons from Dhamar and surrounding villages. The training consisted of a two day course in varieties of strengthening techniques appropriate to current Yemeni building practices. It was not integrated in any significant way with existing Yemeni institutions.

A second, more ambitious program, the Dhamar Aides Self-help Programme (DASH) constructed 1,000 earthquake strengthened homes for survivors in three remote Yemeni mountain villages. This program used local masons and foremen and trained them in mitigation techniques. It was administered by the EOR with a Dutch firm DHV as implementing subcontractors. In 1988, EOR took over administration of the program from DHV.

In addition to classroom and hands-on training programs, both programs developed videos, manuals and model houses.

The impact of the DBEP project has been hard to assess. No records of the training were found. None of the materials designed for dissemination are currently in use. Very few individuals could remember the program or indicated they had participated. On the other hand, the nature of the approach - a one time, 2 day, limited exposure to training - would naturally be hard to track. Ten years after the training program is a long time. Evaluation reports and interviews with expatriate participants in the various programs support its influence.

The DASH Program experienced substantial delays due to problems in identifying beneficiaries, cash flow problems owing to the nature of the USAID contribution, and inadequate delivery of necessary materials. The DASH program was conducted in highly remote areas. Many DASH supported innovations were new to the culture. Few of these techniques were eventually adopted by local builders. As the construction goals fell behind, the long term training goal of the DASH project receded and was never fully realized. Masons and foremen used to build the DASH houses were trained but no widespread training took place. Nevertheless, there is evidence that the DASH program affected local building practices in the Dhamar region.

By comparing and contrasting these two Yemeni programs, the following lessons were learned:

1.The training program linked to a construction program had more influence on building methodologies than the short-term stand-alone training program.

2.Saturating the disaster area with a large number of model houses created a visible and lasting model of mitigated construction.

3.Construction materials (and innovations associated with their use) that were new to the culture were not routinely adopted by local builders. The programs should have intentionally created a local supply source of the materials if they expected them to be used. Program designers should have insured that innovations were affordable, as well.

4.The proposed innovations should have taken account of the evolution of building practices. Designs which reflected old/traditional building styles were not valued by homeowners desiring a "modern" house.

5.Programs which did not have a Yemeni "institutional home" were not continued after donor funds ceased.

6.The reconstruction programs should have been located within established ministries as programs of that ministry if they were to be continued on a long term basis.

7.The mitigation programs should have expanded their mandate to include influencing the government's preparedness plans.

8.Although videos and "user-friendly manuals" are favored as dissemination materials, cultural norms and practices regarding knowledge transfer rendered these materials useless. A mechanism to promote their use and insure their accessibility should have been created.

9.Demonstration project areas should have included non-destroyed yet vulnerable communities. Model houses could have been constructed in these areas as well.

10.Where sound data bases were developed and maintained regarding building innovations, program operating experience, and program participants program replication is possible. Without this institutional memory, new programs, for example in Al Udayn, will have to reinvented.

11.Evaluation and monitoring missions provided an important tool in keeping the project moving.

12.Summary evaluations should have attempted to assess goal accomplishment rather than extent and success of implementation.

13.Summary evaluations should be conducted up to ten years after a project to determine long-term impact and sustainability.

In the final analysis, the self-help programs were a modest component of the overall rebuilding process. The post disaster housing education programs had a limited impact on housing construction in the Republic of Yemen. The DASH program, in particular, had the most significant impact on the local building culture and on the government of the Republic of Yemen. The failure, however, to replicate parts of the program in other regions attests to the limited sustainability of the training approach used in the self-help programs. In part, this is a result of the difficulties of working within Yemeni cultural and geographical constraints. On the other hand, the homes built as a part of the self-help programs are highly valued by the citizens and serve as long term models of mitigation techniques.

2. INTRODUCTION

This study is part of a larger effort to identify factors affecting sustainability of mitigation innovations in selected post-disaster self-help housing programs worldwide. The conclusions and recommendations of this report will be blended with findings from other field investigations in Jamaica, other Caribbean island countries, Madagascar and other countries to be determined. Together, they will guide further policy and program development.

This study focuses on two rebuilding/education projects which were initiated after the 1982 Dhamar earthquake in the Yemen Arab Republic (YAR). These two projects were the Dhamar Builder Education Project (DBEP) supported by a consortium of NGOs including OXFAM, Radda Barnen and Concern and the Dhamar Aided Self-Help Reconstruction Program (DASH) which was supported by the Government of Yemen with assistance from the Governments of the Netherlands, the EEC, and the US. through the USAID.

A. Project Rationale

This study researched four basic questions:

1. Have the information and skills taught in these programs been adopted and or adapted into the day-to-day process of building and repairing masonry houses in Yemen?

2. Which components of the projects studied offer the best opportunities for long-term effect on the local building practice?

3. What were the major constraints faced by these training programs ?

4. What are the criteria to be used for designing future training programs that will make them acceptable and sustainable within the local community?

The investigators were James Good, A.I.A. and Stephen Webster, Ph.D. of Intertect Training Services of Madison, Wisconsin. Dr. Webster is a consultant in community development. Mr. Good's background is in architecture. Both are currently involved in training in disaster management and development and have significant on the ground disaster management experience.

Methodology

In order to conduct the site visit, initial contacts with Yemeni authorities were made while in the country on another unrelated mission. The consultants subsequently conducted a field visit to Yemen during the period 1-12 December, 1992. In preparation for the site visit, several documents written about the Yemen earthquake experience were read to develop a basic understanding of the two programs to be analyzed. As it turned out, these documents were only a part of the existing literature on the projects. The other documents were either uncovered during the site visit itself or were found through follow-up with persons identified during the site visit as international consultants and volunteers who participated in one way or another in the various housing programs created in the aftermath of the Dhamar earthquake.

The mission was well supported by the Government of Yemen through the offices of the Executive Office for Reconstruction (EOR) described later. Field interviews were conducted in the regions and villages where the programs being studied were active including Jabal As Sharq, Mahgrib Ans, Mehdinat, Dawran, and in Dhamar City. A trip was also made to Al Udayn where a recent earthquake had occurred in December, 1991. Additional interviews were conducted in Sana'a - the capital city.

Interviews were conducted with builders, masons, engineers, program administrators, homeowners, building suppliers, sheiks and other local officials, project beneficiaries and trainees.

The difficulty of conducting the field interviews should not be underestimated. The villages that participated in the self-help programs are highly remote areas with poor transport infrastructure, typically taking 2-3 hours of slow driving to negotiate the mountain terrain. In addition, neither consultant was Arabic speaking and thus required the services of a translator. Although the translator provided was very good, there were still significant impediments in conducting in-depth interviews.

Further complicating the field interviews is the nature of Yemeni society which is highly private. For instance, it is generally not possible to examine the insides of houses. If we were able to be invited into a house which we hoped to examine, we would be permitted no farther than the *mafrage*, a general meeting room closed off from the rest of the house. When we would enter a village, rather that villagers coming out to greet us curiously, village residents tended to stand in doorways or look out windows with interest but not with an invitation to come and talk. In several instances, interview subjects expressed concern to the translator about participating in the interview and were guarded in their responses. Although, the consultants took many photographs, the local driver and translator routinely counseled against taking photographs because villagers would see this as an intrusion of their privacy. During the site visit, civil disturbances broke out in several Yemeni cities due to rising prices and dissatisfaction with the government and the Executive Office for Reconstruction (EOR) went on strike in Dhamar.

B. Cultural and Political Context

The Republic of Yemen (ROY) is the result of the unification of the Yemen Arab Republic (YAR) with the People's Democratic Republic of Yemen. This unification was enacted in May, 1990 and a provisional government was created by merging the two previous administrations. This government was to govern for two years and then popular elections were to be held by November, 1992. Elections have been postponed but are scheduled for April, 1993.

Dhamar is located in what was North Yemen at the time of the earthquake. North Yemen was ruled by a long dynasty of Imams known for their policies that limited contact between Yemen and the western world. As late as 1962, the main gate to the City of Sana'a was locked at 6:00 p.m. Music and other forms of western culture were prohibited. A revolution in September, 1962 was followed by a period of civil unrest and in 1970 a stable government was established which pledged itself to a liberal political course based on democratic principles.

The mountainous areas around Dhamar are still governed to some extent by a system of local sheikdoms. Sheiks are chosen by fellow citizens and are powerful political figures now and were certainly powerful in 1982 also. In addition to sheiks, Yemeni villages are governed by a quasi-governmental authority known as Local Development Associations (LDAs). LDAs oversee the maintenance of roads and other infrastructure and have small roles in controlling commodity exports. The local commissioner or appointed head of the LDA is also a political figure who controls resources.

Yemen is a Least Developed Country (LDC) of approximately 14 million people located at the southwestern most end of the Arabian peninsula bordered by Saudi Arabia on the North and Oman on the east. The west and south are bordered by the Indian Ocean and Gulf of Aden. (see map next page)

In 1992, the estimated literacy rate was 45% for men and 10% for women. Life expectancy is 47 years and mortality is 132.8/1,000 live births. The GNP per capita is estimated at under $500 (US)

per year. From 1985-89 budget deficits in North Yemen averaged 17% of GDP and the balance of payment deficit averaged 11%.(UNICEF, 1992)

Yemen is still a predominantly agriculturally oriented economy. Much of the Dhamar area, especially the valleys (*wadis*) where the self-help projects were, is given over to the growing of qat - a local herb much desired by the Yemeni and the favored cash crop of Dhamar area farmers. The Dhamar area, like other areas of Yemen, was a primary exporter of male laborers to Saudi Arabia, Kuwait and other Gulf States and many families were dependent on remittances from these workers to sustain themselves and the local economy.

The earthquake affected regions, Dhamar and Al Udayn, are densely populated, generally mountainous areas comprised of a few small cities in the larger valleys and on the central plain, the balance being an almost continuous network of terraced mountainsides supporting small farms and pasture. (photo 1) Villages are found throughout the region blending into each other at the periphery so that the entire landscape is dotted with stone houses and terraces.

C. Architectural Traditions

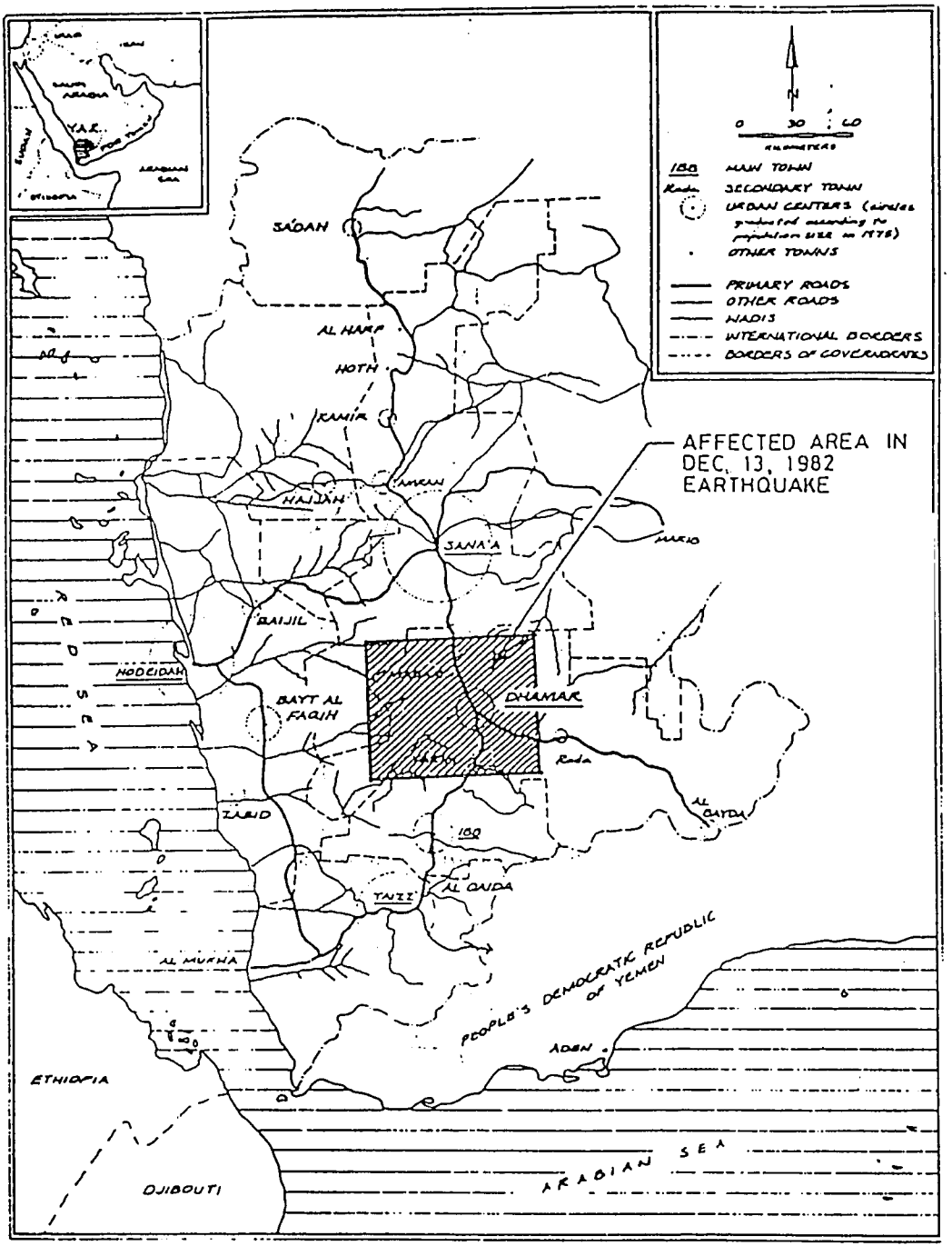
The typical architecture of the region varies according to the building materials at hand (either mud or stone), the age of the buildings, the degree of accessibility to markets, and naturally, the relative wealth of the community. In the plains and in the older part of the bigger cities (especially Sana'a) the predominant traditional building material is mud brick. In the more rugged mountainous areas the traditional building material is stone. In wealthier areas and where roads allow transport, concrete block has become the most typical building material. There is no uniform building code or inspection process currently operating in Yemen nor was there one at the time of the 1982 earthquake.

Although many mud brick houses were damaged in the earthquake (especially in the old quarter of Dhamar City) the main focus of this study is the traditional stone house. Many of the damaged mud brick houses in the city of Dhamar were found to be repairable after the earthquake. The repair of these houses was subsequently made a stand-alone component of the response effort called the Repair Program. This program was not studied in depth and is not analyzed in this report.

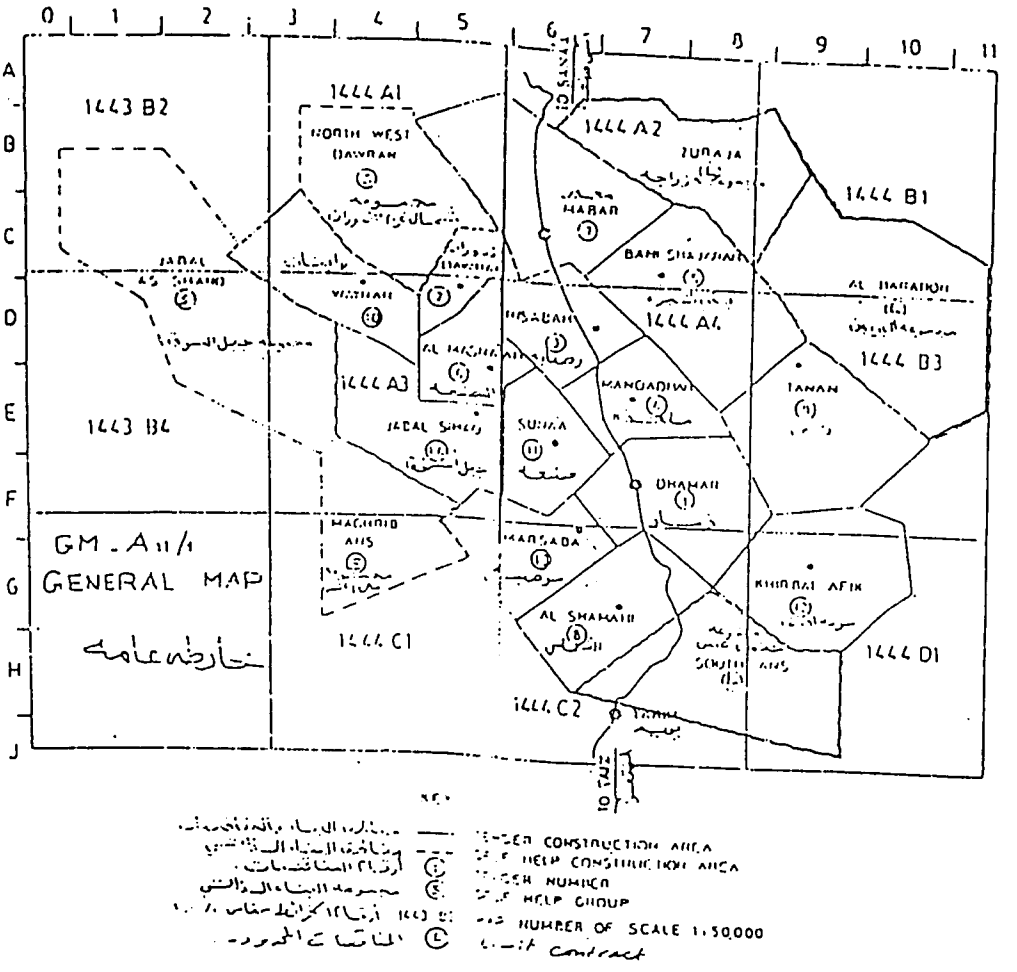
Traditional Yemeni stone houses were built for privacy and defense. Often situated on the highest point of extremely rugged terrain, these houses look like small stone fortresses. (photo 2) They have extremely thick, slightly tapering walls and heavy earthen roofs over timber joists. In the older houses these joists are tree trunks and branches "in the round" of varying sizes. Across these are smaller branches which form a platform for the piling on of earth 8 inches or thicker.

In addition to being heavy, these roofs are poorly tied into the walls they bear on. This lack of connectedness is the main cause of damage to these houses in earthquakes. In addition to the weak roof-wall connections, the connections between the stone wythes (inner and outer faces) themselves throughout the walls are quite weak. There is essentially no tensile reinforcement between walls at intersections and corners or even between the inner and outer wythes of the walls.

Many sources cite the fact that many of the older traditional houses did incorporate strengthening techniques. These had wood tie-beams built into the walls for horizontal reinforcement. These tie-beams were properly jointed and connected so that they developed continuous tensile reinforcement around the entire structure. It has only been in the last hundred years or so that this detail has disappeared from Yemeni home design. It is speculated that this arose from scarcity of wood.



REFERENCE MAP OF THE YEMEN ARAB REPUBLIC (Y.A.R.)



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Map of Earthquake Affected Area - Dhamar Governate

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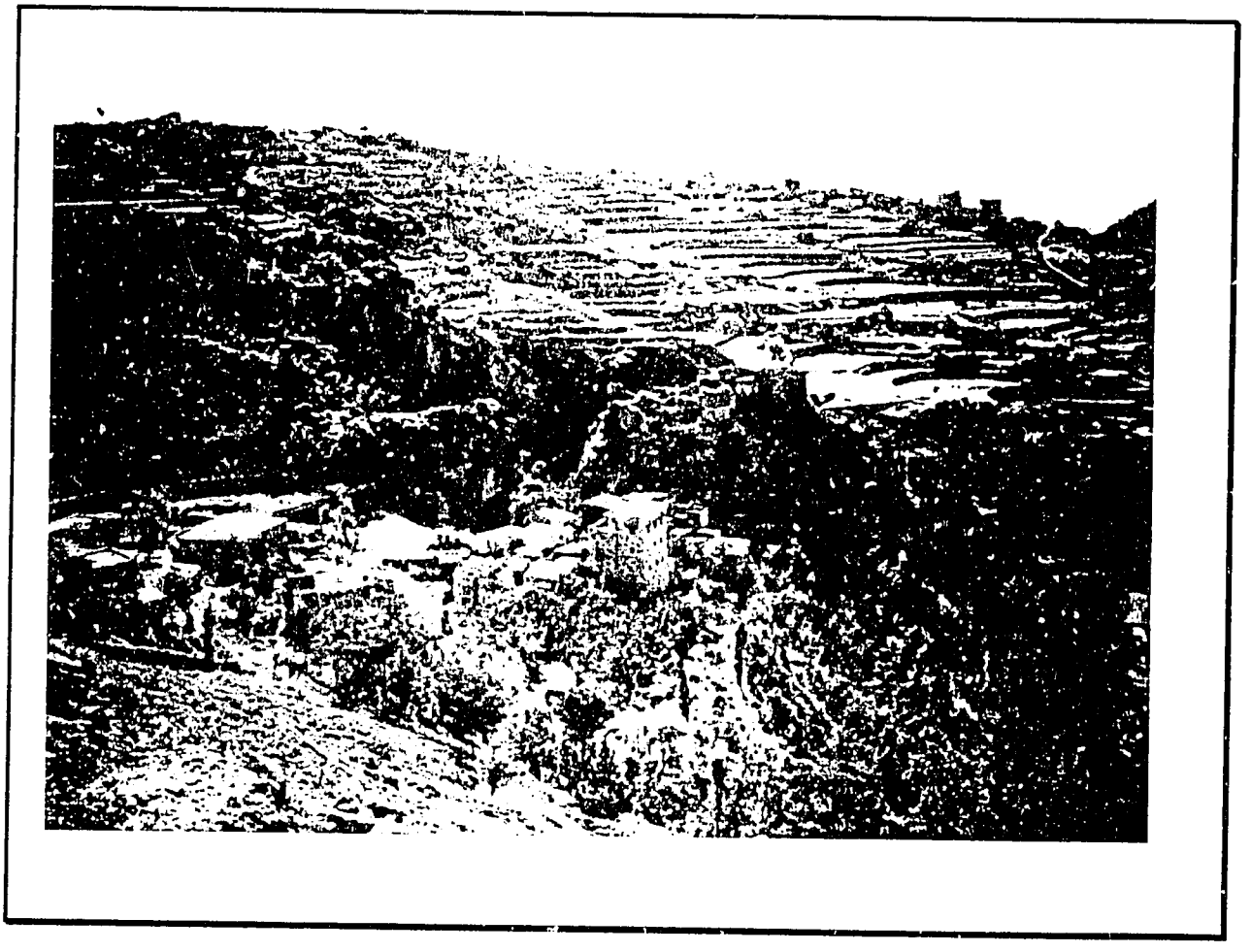


Photo Number 1

View of mountain-side villages and terraces typical of the Dhamar area.

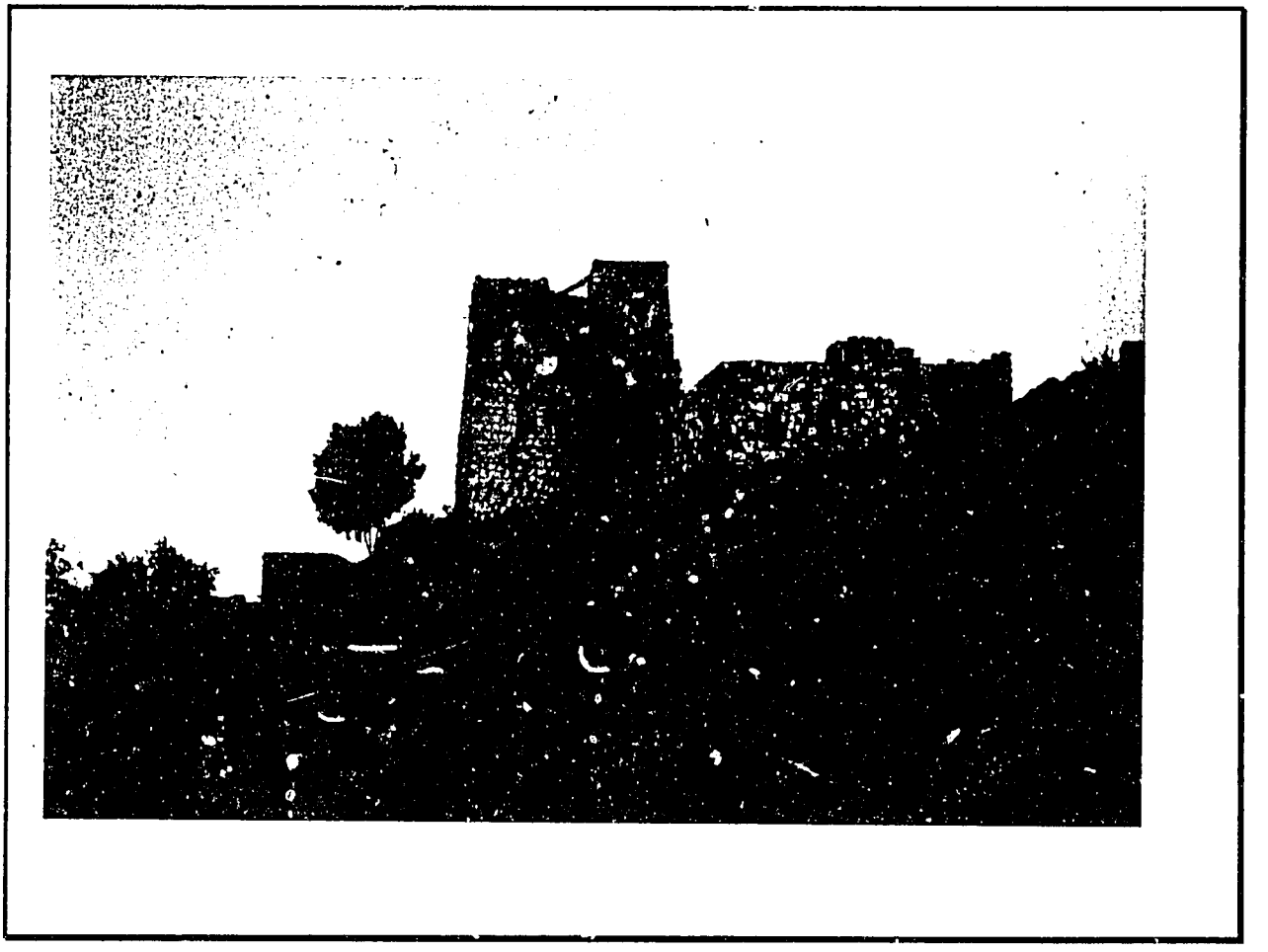


Photo Number 2

Traditional Yemeni house and landscape.

Outside Influences

By 1982 concrete block and steel reinforced concrete were already common building materials in Yemen. But these developments were almost universally limited to larger towns and those areas served by main roads. Rural areas around Dhamar were largely unaffected by these innovations due to their extremely inaccessible locations.

Techniques for using these materials came with the exposure to the West and modern building practices. One key source of exposure to new building techniques was from workers who returned from construction jobs abroad. Saudi Arabia was host to many Yemenis who worked there for years, often in construction, for the chance to travel abroad and to send home their salaries.

When these men returned relatively wealthy, they often returned to their home village and built new homes using the newer techniques learned abroad. The following interview is typical:

Returnee from Saudi in Old Dhamar City

This man had built his own home in Dahmar after returning to Yemen from Saudi Arabia in 1983. He presently works for the Yemeni Government in the area of food imports/exports. He had worked in Saudi in construction and had received training working on various projects including reinforced concrete structures.

His house was well designed and built. Several earthquake resistant features were incorporated. The walls were concrete block throughout instead of block corners with stone infill. The roof was tied to the walls properly and the end joists were attached to the interior ones by wood tie-backs or braces. There were three concrete perimeter beams in the outer walls, one at the floor level, one above the windows and one at the roof level.

The owner said that he himself had designed and built the house completely from his own experience without benefit of any reconstruction program.

Although the traditional technique varies from area to area depending on the type of stone found and some stylistic differences, there is a more or less typical construction of these houses which lives on today throughout the area. This technique produces a clean and square looking exterior jointing between the stones which is very tight but is, nonetheless, very vulnerable to seismic forces. (photo 3)

In this building style, stones are cut or broken to a roughly pyramidal shape with the base of the pyramid being the face of the block as it is seen in the wall, and the tapering tip being buried inside the wall in either mud or no mortar at all. This tapered shape makes the fitting of the face joints very easy as only the edges of the facing side must fit together neatly. The tapered sides never touch and therefore don't "hang up" on high spots thereby reducing the need for laborious chipping away of the stone sides.

This exterior wall of pyramidal stones is chinked with mud and smaller stones or rubble to keep the whole structure upright. Usually there is an inner wall which is similar to the outer though not as neatly fitted. The delamination of these two wall components often caused the complete collapse of the house during earthquakes. This was graphically represented by Mr. Thomas Copenhaver who was one of the USAID consultants who made a technical assessment of the earthquake damage in the first weeks after the event. (Fig.1).

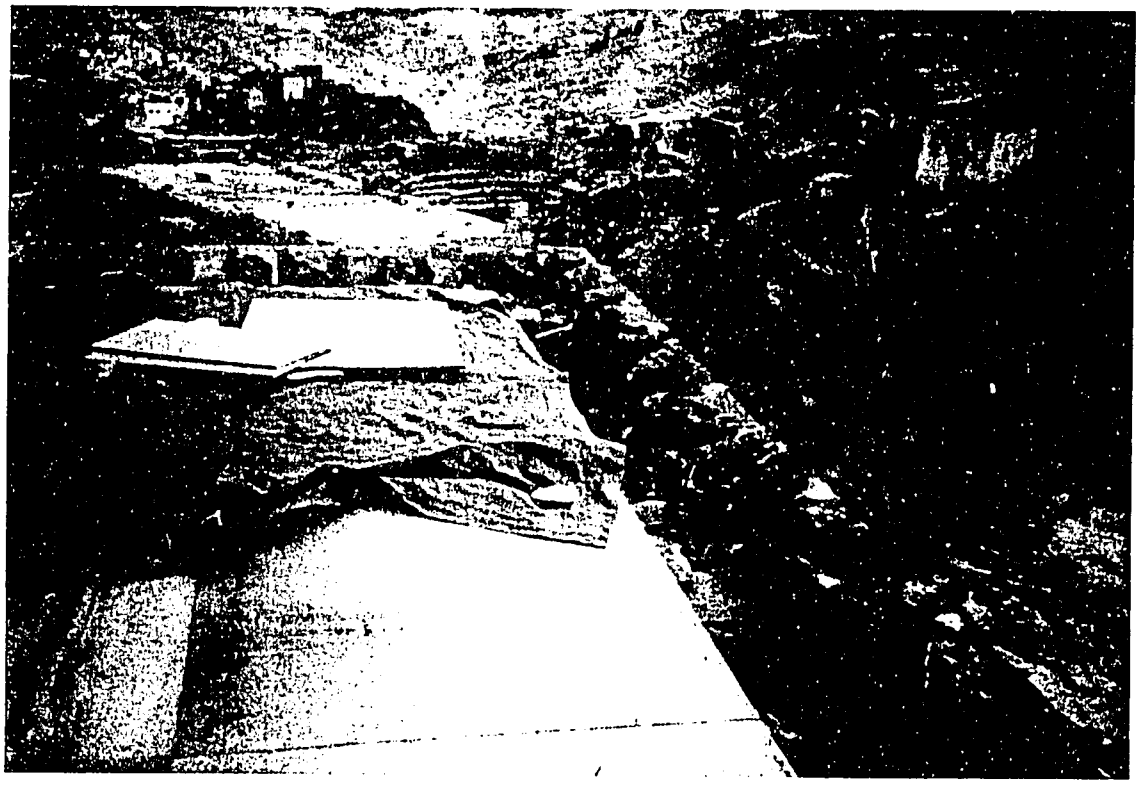


Photo Number 3

Top of a wall in new construction in Wathan town shows traditional use of pyramidal stones mixed with technological advance of plywood sheathing for the roof deck.

Other consultants, architects and engineers, along with Mr. Copenhaver, agreed, in general, that the following major building attributes primarily contributed to the vulnerability of the stone houses in the Dhamar region:

- heavy roofs and walls with poor tensile connections
- inadequate or shallow foundations built on small irregular stones
- pyramidal wall stones with no "through ties" to prevent delamination
- no continuous perimeter tensile reinforcement to help the structure stay together during seismic forces
- no "diaphragm action" or integrity in the roof structure

Concrete is a rather recent introduction to Yemen, although it is the only material used in new commercial buildings in urban areas. In this regard, the country's construction technology has changed rapidly. There were no cement plants in the country at the time of the Dhamar earthquake, but now there are 3. These plants still depend on imported paper bags from Russia because paper bags are not produced in Yemen. Dhamar City has 4 commercial concrete block making enterprises. Two of these are large hydraulic, semi-automated plants which make high quality blocks of several configurations. Two are small hand operated plants which generally produce a weaker but still serviceable block. The main fault of all of the block producers visited was the lack of any "curing" of the blocks with water or coverings. Blocks are simply left to sun dry, making for weaker units.

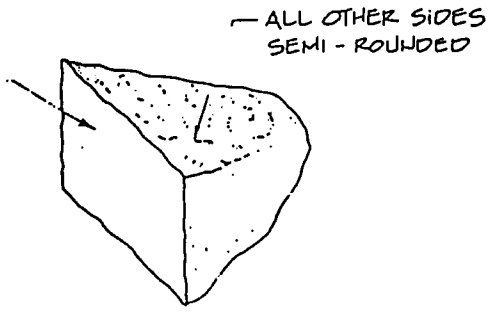
Cement is relatively expensive, costing 190 Yemeni Rials (YR) or approximately $5 US at current exchange rates per bag. Steel is very expensive at 15,500 YR per metric ton ($407 US). This cost, along with transportation costs make reinforced concrete too expensive for many rural Yemenis. On the other hand, stone is relatively abundant and working with stones is second nature to most rural Yemeni men. The traditional method of building is still strong in Yemen largely due to these cost constraints.

Building materials can be bought in Dahmar city from two or three suppliers. These have well stocked warehouses but only carry the basic building supplies that are commonly requested. This situation naturally perpetuates itself as people only use those materials available from these suppliers and become accustomed to only ask for those items that are likely to be stocked. The following interview sums up the role the building material suppliers play in building advice or innovation:

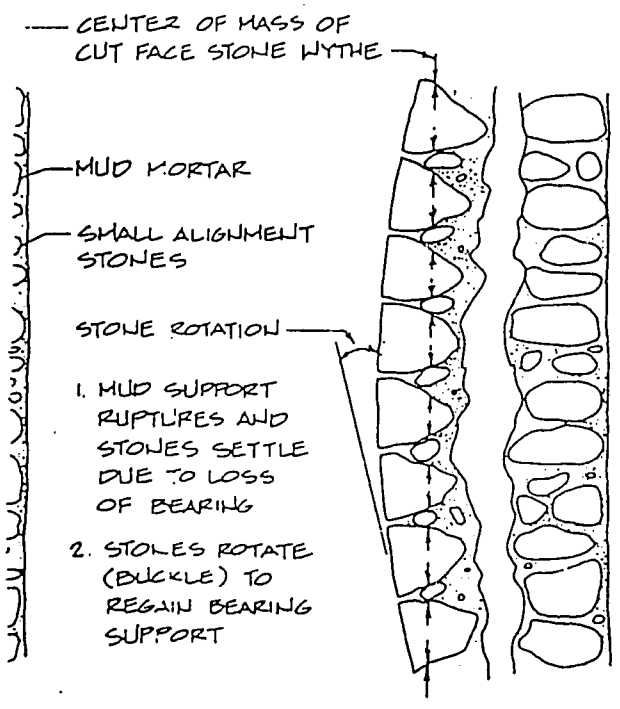
Building Supply Store Manager - Downtown Dhamar

The manager quoted prices for all of the materials he sold: steel (in six sizes of bar), plywood in two thicknesses, joists (one size only), cement, boards (one size only), and nails in three sizes. He was interested to know how much of which things we wanted and assured us that anything could be delivered in a matter of weeks. Prices fluctuated daily with a continuous gradual rise in overall prices.

He said that he never gave advice to anyone regarding what to buy or how to design their buildings. That was their own business, and his job was to sell them what they wanted.



TYPICAL CUT FACE STONE



ONE WALL

CUT FACE STONE WALL
DELAMINATED WITH BUCKLED
CUT FACE STONE WYTHE

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Figure 1

D. Description of the Dhamar Earthquake

Earthquakes are a regularly occurring phenomenon in the Republic of Yemen (ROY). One of the first earthquakes documented destroyed the famous Marib dam in 742. Earthquake frequencies and probabilities for the ROY have been underestimated, in part due to the relative isolation that the country experienced up to 1962. However, based on recorded and reconstructed data, it is estimated that the ROY experiences earthquakes, on average, every twenty years.

A major active oblique strike fault runs through the Dhamar area, extending to Raa'ba through the quaternary volcanic massif in the south; this system is intersected by a northeast - southwest fault trend. The area is affected by tensional tectonic forces resulting in faults and fractures.

On December 13, 1982 at 12:14 p.m. an earthquake of 5.8 magnitude (Richter) and VIII (MMS) struck the Dhamar region of the ROY. The epicenter of the earthquake was about 15 km. south of the town of Maabar. Tremors continued for a number of days. The biggest aftershock occurred on December 30, measuring 4.5 Richter, (Joint Mission report, pp.8-9).

Without doubt the earthquake was a major disaster in a country that ranks within the most 25 disaster prone countries in the world. The earthquake ranged over a 6,000 square kilometer area. Although the earthquake was not particularly strong, it caused major damage to buildings because of the vulnerable construction described above.

The mountainous area, combined with limited transportation and communication infrastructure, presented enormous obstacles for accurate estimation of total damage. Therefore, the existing literature documenting the extent of damage varies as indicated below. (fig. 2) These estimates varied on the order of 25% thus causing confusion in estimating the total required resources for reconstruction. It also pointed out the deficiencies of the assessment process.

Various Damage Estimates of Earthquake Damage and their Sources

Source	people killed	people injured	houses destroyed	houses damaged
UNDRO	1,600	1,400	25,000	17,000
DHV	2,000	2,000	15,000	25,000
EOR	2,000	2,000	20,000	20,000
Coburn and Leslie *			25,000	18,000

* Coburn and Leslie also note that 300,000 people were homeless

FIGURE 2

3. ASSESSMENT PHASE

The Yemen earthquake was an event that attracted major international attention and many assessment missions were undertaken sponsored by different donor and aid organizations.

A. World Bank

A joint assessment mission was undertaken under the auspices of the World Bank and the Government of Kuwait immediately following the earthquake. Their "Report of Earthquake Reconstruction Joint Mission" released on February 25, 1983, contained the following recommendations:

1. The YAR government must begin reconstruction efforts immediately to alleviate suffering of the local population. This program to entail three points:

- repairing and rebuilding houses and infrastructure (estimated to cost US 620 million)
- assist farmers with seasonal loans
- implantation of long-term development projects.

2. Since the YAR was in a difficult economic situation already, they would need massive foreign aid. Additionally, the mission described a three-phase approach to the reconstruction effort. The first phase (emergency phase) recommended:

- to conduct the inspection of damaged homes to determine safety,
- to provide technical advice given to those already rebuilding,
- to clear rubble,
- to identify new sites for completely destroyed villages, and
- to provide loans to farmers.

The second phase was to be the reconstruction phase, the intent of which would be to provide minimal earthquake-resistant shelter to the homeless. The third phase was described as the linking of the reconstruction program to the national development objectives of the YAR.

The mission's findings included the following:

- the earthquake activity in the region was settling down.
- regardless of the above, seismic activity in the region could reoccur at any time
- the main cause of the destruction was not so much the strength of the earthquake but rather the weakness of the local housing stock
- earthquake resistant dwellings could be constructed using the traditional building materials, in particular stones. Most of these materials can be retrieved from the rubble, provided a systematic clearance and propping scheme could be carried out to provide safe access to the collapsed buildings.

B. USAID

USAID reacted quickly by bringing in architect/engineer consultants to assess damage and prepare program proposals. Although there were others, the reports of two of these consultants are presented here in brief. They were prepared by John Aquirre AIA, Architect-Planner of Aquirre Associates, Inc., Rancho Verdes, CA and Mr. Thomas Copenhaver, R.C.E. of Sheladia Associates, Inc., Consulting Engineers.

The Aquirre report "Project Development and Support, Earthquake Rehabilitation - Construction Project No. 298-0035 Prepared for the Supreme Council for Reconstruction of Earthquake Affected Areas in the Yemen Arab Republic (SCR)" is a collection of ideas presented to both USAID and the SCR regarding their developing reconstruction programs. This report analyzes the design prepared by the Yemeni authorities for the new villages to be constructed throughout the affected area and points out technical problems of the individual house design. Alternative construction details are given as well.

The report is centered largely on the idea that "brick blocks" should be manufactured and used as the basis for the new houses. These brick blocks were conceived as structural tile with a unit size comparable to concrete block. The idea was brought forward after visiting a brickworks in Sana'a.

The conclusions of the report are interesting to note:

1. The [damage] survey should be completed as quickly as possible
2. The SCR should consider the use of traditional Yemeni design in the architecture of the model houses
3. The SCR should consider using locally available material as the construction material, such as soil cement bricks or clay brick blocks
4. All houses should have:
    a. continuous foundations
    b. continuous bearing walls
    c. foundation below grade
    d. jamb reinforcing at the wall openings
    e. single wythe masonry walls (one unit wide)
    f. bond beams (rim beams) of concrete
5. **The use of stone or rock foundations should be banned**
6. **The use of wood bond beams should be banned**
7. **The use of stone masonry walls should be banned**
8. **Require inspection during construction of all houses**
9. The SCR should consider the use of **computer aided drafting systems** in order to meet its architectural, village planning, and engineering deadlines

(emphasis added by authors)

Points 2 and 3 directly contradict points 5,6, and 7 as it is impossible to consider locally available materials and traditional design while banning stone. Also all of points 5-9 seem to be unrealistic and unachievable goals given the cultural and economic realities of Yemen.

Mr. Copenhaver's report, on the other hand, appears to have been quite useful and is the basis of many of the ideas which were ultimately adopted in the self-help programs as well as the strengthening and repair programs. His work accurately defines the problems of the traditional building style and gives clear, achievable designs for overcoming these weaknesses within the framework of traditional materials and technology.

In the Copenhaver document, "Earthquake Resistant Home Design - Yemen Arab Republic" published in January 1984, the problems are described, solutions proposed, and a set of drawings are included for use in interpreting the recommendations. Included in the 1984 report is a section from an earlier report (24 November, 1983), also by Copenhaver, that conceptualizes a reconstruction program based on self-help and minimum donor assistance for Dhamar province.

The self-help concept is proposed as the best solution for the region due to the fact that self-help is the tradition of the Yemeni people, and that at the time of the report many households were already engaged in the rebuilding of their homes. Copenhaver also noted that a pre-earthquake project was already functioning under the direction of OXFAM for the self-help construction of schools in the region.

Copenhaver also recommended subsidy schemes to provide incentives for the people to begin construction. It was suggested that this incentive should be in the form of contributed construction materials and the services of a technical advisor.

Another idea put forward was that of demonstration projects. In particular, schools, to be built using earthquake resistant technology, could serve as models for the entire village to see first-hand how the buildings should be improved. This idea was based on the on-going Radda Barnen/OXFAM project in the region which was paying 100% of material costs for the school projects. The same project offered technical advice (but no other assistance) for any new housing construction.

The report also considered the "ground rules" for offering such assistance and the need for cooperation with the sheiks and Local Development Associations (LDAs). In general, this scheme was very much community oriented rather than individual oriented. One recommendation was a statement of "goodwill between village inhabitants" in order to promote teamwork and assistance to the elderly or otherwise disadvantaged residents.

C. Government of the Yemen Arab Republic

In addition to immediate rescue and aid missions, the government responded promptly with the creation of the Supreme Council for Reconstruction of Earthquake Affected Areas (SCR) in January 1983, under the leadership of the vice-president. The SCR consisted of ministers from the Ministry of Works, Ministry of Municipalities and Housing, Ministry of Water Supply and Electricity, Central Planning Organization and the Union of Local Councils and the Cooperative for Development. A "scope of work" statement was issued by this body on March 28,1983.

A new office was created to handle the administration of the reconstruction effort. This was the Executive Office of the Supreme Council for Reconstruction of Earthquake Affected Areas (EOR). This new entity started collecting engineers and planners from the other ministries represented in the Supreme Council and became, in effect, a small ministry itself, devoted solely to the reconstruction effort. (photo 4)

EOR originally relied on assessments from the community-based LDAs. These, however, proved unreliable and were suspected of being biased based on local political and cultural conditions. One of the training engineers interviewed said that in almost every case there was some payment made by the beneficiary in order to be included in the assessment of which homes and homeowners would be accepted into the program. Several assessments were required to accurately determine who was a legitimate beneficiary. There were "rumors" that houses that had been listed by earlier assessment missions as destroyed by the earthquake had in fact been destroyed years before the earthquake. EOR subsequently conducted 4 separate total assessment missions and five in some areas to identify destroyed houses eligible for the various programs. Some of the homeowners interviewed who were still in the process of building their self-help homes cited the assessment process as the main reason for their late start:

On the road to Al Jumah with a qat farmer

This farmer had started his new DASH house only recently and was not finished. This new house was 2 meters away from a much bigger two story stone house which he had built unassisted after the 1982 Earthquake. He had no formal construction training of any kind.

The bigger house was in the traditional style with the usual lack of earthquake resistant features. Although beautiful, the house had no reinforcing ring of either wood or concrete. The walls were described by the builder as two-faced (double wythe) with the conical backsides of the stones resting on each other for strength. The walls were at least 50cm thick without through-stones tying the two wythes together.

The family's destroyed house was owned by his father who had died. This was the reason that he had difficulty qualifying as a beneficiary. The owner said that the house was for his brother. (photo 5)

A major issue for the assessment process was the concept of a "house". Traditional villages are composed of homes built over generations housing several kin families. However, assessment missions failed to account for this so that the "apartment or multi-family house" was not an

Photo Number 4

The EOR office compound in Dhamar City. This sub Ministry has been responsible for administration of the reconstruction program throughout the Dhamar area for the last 10 years.

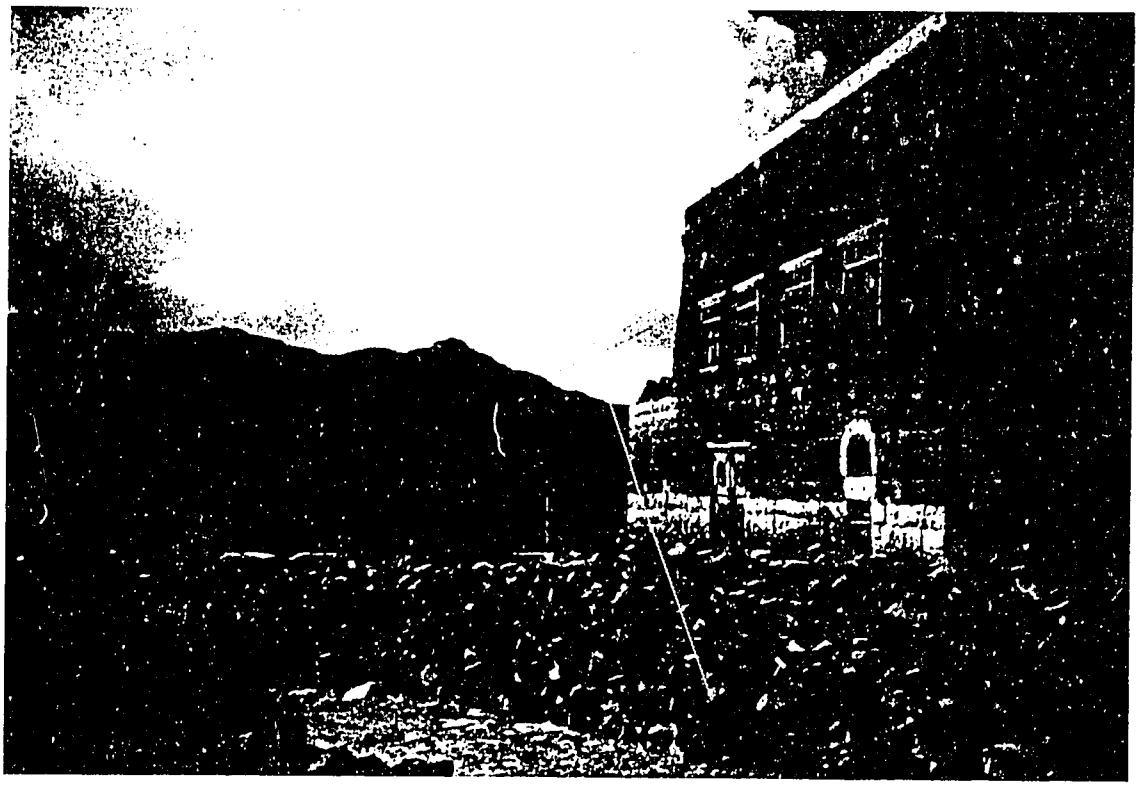

Photo Number 5

Large traditional stone house built after the earthquake with smaller DASH/EOR self-help house under construction nearby. The owner built the unstrengthened house for himself without assistance and has accepted the project house 9 years after the earthquake. He plans to have his brother live in the new house.

assessment category. This resulted in an ill-defined policy resulting in confusion over whether programs would provide a "new house for a destroyed house" or a "new house for a homeless family", (UNDRO, p.18)..

D. Other Mission Teams

The interest in the Yemen earthquake was significant in the "disaster" community. Coburn and Leslie note that, "within a month of the earthquake, a number of technical studies were begun on damage to buildings and generally (unsolicited) suggestions by technical specialists for reconstruction of housing including, in addition to the AID and World Bank mission, teams from HABITAT, Archtectes sans Frontieres, Arya et. al. for Rorkee University, the German government, and British Overseas Development Administration (Coburn and Leslie, 1985, p.2).

4. HOUSING RESPONSE

Although the focus of this report is the self-help program, it is first necessary to have an overview of the various housing reconstruction programs.

A. Overview

The first line of response to meet the housing needs was the survivors themselves. Government programs to construct destroyed housing did not get under way until the middle of 1983. In the self-help program no houses were started until 2.5 years after the earthquake. In fact, by the end of the third year, only 34 houses had been completed and 91 additional were under construction (DHV, Quarterly Report phase 3-2, Dec. 1985, p.1).

Various opinions existed on the desirability of reoccupying destroyed houses and whether or not the rubble was reusable. Consultants recommended that materials be reused but the government reports maintained that materials were not salvageable.

However, survivors in need of shelter adopted various approaches including tents and metal sheds (some of which are still in use). Others repaired their damaged houses or reconstructed homes using prevailing techniques and designs. No official data were gathered on the self-repair program but there was widespread evidence of its existence. A German mission in March, 1984 reported that in Jabal As Sharq 50% of the damaged houses were already repaired by the survivors. These repairs typically did not incorporate strengthening techniques.

Various international NGO's which had ongoing programs in the country at the time of the earthquake quickly responded with specialized programs for the reconstruction effort.

In February 1983, Concern, Radda Barnen, and OXFAM met to discuss the idea of a coordinated self-help reconstruction training program and identify what their roles in such a program might be. By March they had drawn up an outline for the "Dhamar Builder Education Project (DBEP) which proposed a set of Dhamar-based and mobile outreach training programs (described in section 5 below).

This program was endorsed by representatives of the YAR and the Coordinating Council of the Dhamar Local Development Associations in the same month. By April the construction of the Building Advice and Training Center (BATC) was under way in Dhamar. By mid year local masons were receiving training in mitigation techniques.

In May 1983 the Supreme Council for the Reconstruction of Earthquake Affected Areas announced a three point program of:

- building new houses by contractors
- self-help method
- repairing and strengthening cracked houses.

The total program goal was to reconstruct 25,000 damaged houses and repair 17,000 cracked houses (SCREAA, in Erdik, p.50).

In September 1983 the EOR outlined their official housing reconstruction program and policies. Even though they generally accepted the findings of the Joint Mission Report, the official program differed significantly from the proposal of the joint mission regarding a widespread self-help approach. According to the official reconstruction program, 13,000 houses were to be rebuilt under the contractor-built program; 12,000 houses through the self-help approach.

This work was to be carried out in phases:

Phase 1 - Housing repair program - 5 month survey period followed by implementation of repairs to be completed by the end of 1985

Phase 2 - New housing contractor built program - site selection and planning to be completed by SCR by November 1983 and all work complete by end of 1985

Phase 3 - Self-help programs to be started after the contractor-built program is underway but also to be completed by the end of 1985 (Coburn and Leslie, 1985, p.4)

In November 1983 a repair unit was established in Dhamar. In early 1984 a plan was proposed to the Supreme Council based on an AID mission. This program consisted of constructing belts around the cracked buildings with steel reinforced concrete bands at the floor levels in houses that had no perimeter beam of wood or concrete. Some of the older buildings did, in fact, have wooden ring beams around the perimeter of the house. In cases where these were improperly jointed (and therefore not continuous) they were improved by the addition of steel straps to tie the independent parts of the wooden ring together.

The strengthening program fell far short of its expectations. Originally designed as a phased program which would move to rural villages after finishing in Dhamar, the repair program set out to repair 2,294 houses in Dhamar City. By May 1992 1800 homes had been repaired (UNDRO, p.15). The program was never extended outside of Dhamar City.

The strengthening program originally aimed to strengthen damaged houses by placing concrete beams at the floor and roof lines on both the inner and outer faces of the wall. These beams would be connected through the wall at certain points to tie the inner and outer wythes together and prevent delamination. This scheme was ultimately simplified to the placement of the exterior strengthening beam only due to the difficulty in gaining entrance to the houses. The reality of the Yemeni concept of privacy would not allow this intrusion into inhabited houses.

To determine which areas would be contractor-built and which self-help, the government program exempted from the self-help plan all villages with more than 75% destruction and all villages with more than 25 dwellings destroyed,(Coburn and Leslie, 1985, p.4). Their rationale was that in these cases there would be insufficient labor available locally for the self-help approach. Further, it was noted that in the more remote regions, with fewer houses grouped together, and accessible only by very rough roads, tender offers on contractor-built housing would be extremely expensive. Therefore, it was decided to use the self-help approach only in those places the contractors couldn't get to easily.

B. Contractor-Built Housing

Clearly the need as perceived by the government was to construct many houses quickly. The slower self-help approach would be started only after other more efficient programs were already running. Therefore, the primary tool of the Yemeni government was a contractor built housing program By 1984, the contractor program had spread to 305 cities. By May 1992, 11,000 homes were built under this program element, (Coburn and Leslie, 1985, p.5)

Contracts were let to a mix of foreign and Yemeni construction companies and the program was paid for primarily with grants from neighboring and friendly countries, i.e. Saudi Arabia, the United Arab Emirates, Oman, and Kuwait as well as YAR funds.

There is considerable dissatisfaction with the contractor-built housing. The homes are built as a core house with earthquake resistant construction. In the mountains, the homes are usually sited in level areas where several can be built, this being in cultural opposition to the previous practice of building on isolated "peak" areas. In the large, formerly mud constructed villages on the plains, villages are laid out in grid designs of identical "core" houses. (photo 6)

Contracts under this program were slow to be implemented with several programs still not completed. Many of the completed houses are not occupied because they are found unsuitable to Yemeni cultural expectations regarding size, design, and siting which violates privacy norms. In general the contractor housing program is perceived as having extremely low beneficiary satisfaction, (SCREEA, in Erdik, p.51).

A qat farmer on the road between Dhamar and Dubah

This poor qat farmer built his own small house while waiting for his contractor built house to be finished. After completion of the Chinese contractor-built house the man still did not accept the new house and continued to live in the one he had built himself. He said that the family sometimes slept in the contractor built house but "lived" in the old house. Many of the houses in the contractor built compound were unoccupied.

This house, built completely on the owner's initiative without any outside assistance, was built on the traditional Yemeni plan. It had unbonded stone walls and an integral wood ring beam running around the perimeter of the wall between the top of the windows and the arched transoms (*caramarias*) He told us that the wood was put there to strengthen the house in the same way that some people use steel. "In fact wood is better than steel since it is easier to work with", he told us. Although properly placed in the wall, the wooden ring beam was poorly jointed and unattached at the corners providing no strengthening. The house foundation was set simply on the ground which was unlevel and rocky

In some cases, the local political problems caused by the contractor built houses are still unsolved. There are some houses (and entire "new towns") for which the keys have never been issued to the beneficiaries due to the trouble that this action might cause. An interview with Elliot Smith, a former Peace Corps Volunteer who lived in Wathan and ran a part of the DASH project, revealed the extent of the violence caused by the appropriation and reallocation of the land and houses in some of the contractor built schemes. He said that there were several instances of "shutouts and showdowns" which arose out of the conflict over the ownership of these houses. In some cases people were killed. The whole concept of the "new towns" was entirely inappropriate to the local culture and structures and did not fit into the local system of land tenure.

C. Self-help Projects

To implement the self-help objective, a program based on self-help concepts, funded by the Dutch, EEC, and USAID was designed and implemented (described more fully in Section 6 below). The program run successfully by the Dutch consultants, DHV, was known as the Dhamar Aided Self Help Reconstruction Project or DASH project. It is telling that the Yemen government, through the offices of the EOR ran the Contractor-built scheme directly, and the self-help scheme through expatriate consultants. It must also be remembered that the self-help program was only 10% of the size of the contractor-built program. Simply put, the self help programs, the focus of this study, were seen by the government as the less important of the two approaches.

The self-help program, apart from being seen as the lesser component of the reconstruction effort, was also seen somewhat differently by the EOR and the NGO's and consultants who ran them. From its inception, the OXFAM project was an "information-only program" designed to transfer earthquake resistant building technology to the local Yemeni builders. The DASH project also was originally conceived to have a long term goal of training and technology transfer. However, by 1986, when these self-help components of the reconstruction effort were presented at the Middle East and Mediterranean Regional Conference on Earthen and Low Strength Masonry Buildings in Seismic Areas (Ankara, Turkey, 1986), the aim of this program, as described by representatives of the EOR, was simply a way to fill the housing gap for those people who lived in areas unserviceable by the contractor-built housing plan, (SCREAA, in Erdik pp.52-53).

The advantages of the self-help method as described by the EOR spokesperson were:

- filling the gap that contractors couldn't fill
- reducing the cost of the housing through the contribution of the beneficiaries' labor
- using local labor helps develop a better trained labor force
- providing free materials reduces the cost of the new house to the beneficiary

The element of technology transfer is missing from this list of attributes. It wasn't seen as important from the government's point of view.

5. THE DHAMAR BUILDER EDUCATION PROGRAMME

A. Project Description

The Dhamar Builder Education Project (DBEP) was organized by several international NGO's under the leadership of OXFAM. It grew out of ongoing programs in the region and was designed as an information-only program with no monetary or material assistance provided to the beneficiaries.

The general thrust of the program was the education of men who were already involved in construction. These men would be trained in various strengthening approaches to be applied to the traditional architecture. Construction details and lectures were developed for mud brick, stone, block, and other construction types. The main objective was to present the builders with ideas on general strengthening concepts, so that they could logically incorporate them into their traditional form of building, regardless of materials or styles. The training was presented in the format of a two day, hands-on course. The typical two day agenda was as follows:

DAY 1

- introduction to the training center and the scope of the training
- page by page explanation of the manual (course booklet)
- slide show of typical earthquake damage and mitigation strategies

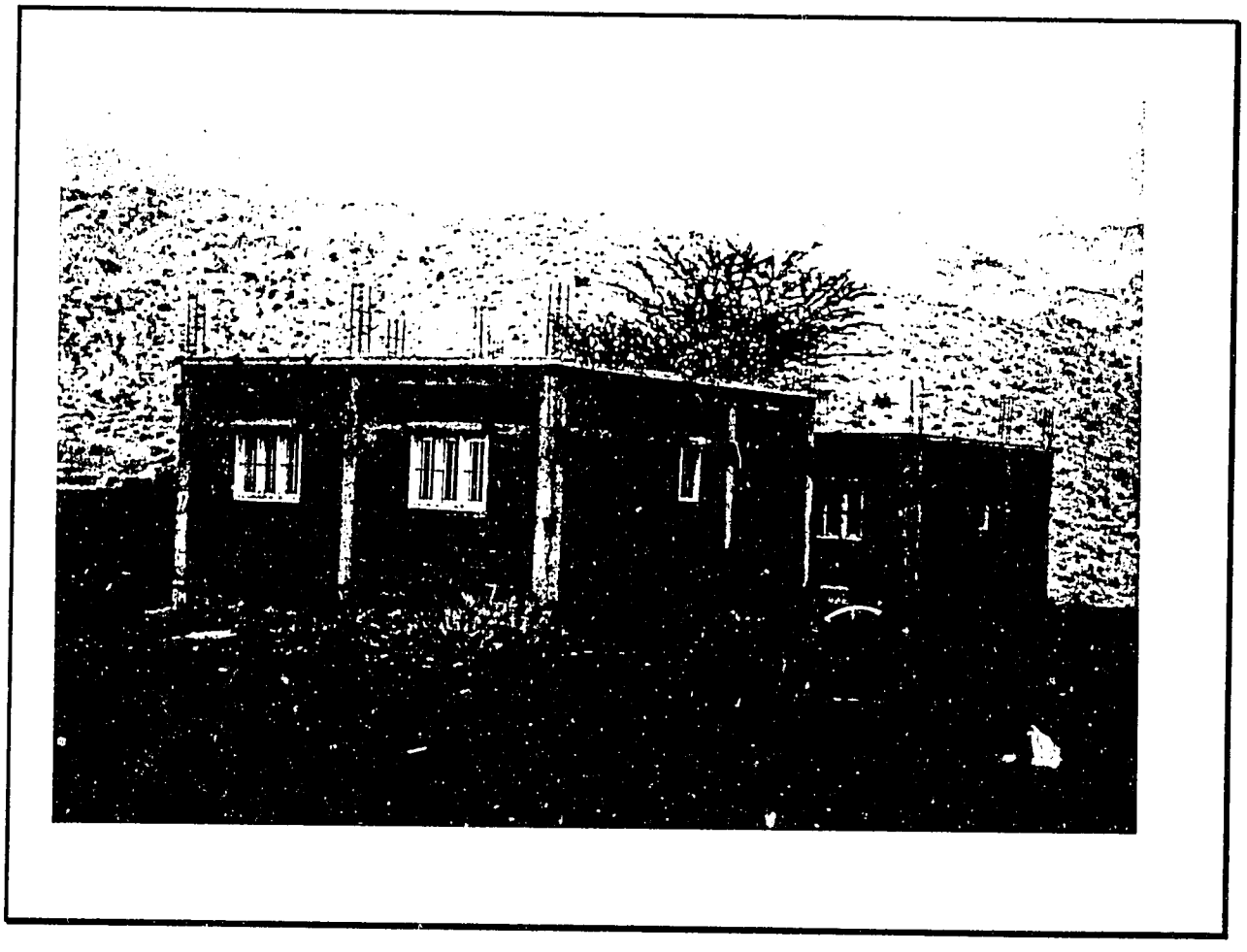

Photo Number 6

An example of the contractor-built houses. This group of 20 houses was completely uninhabited. The man living just adjacent to this "new town" who had built his own house while waiting for these units to be completed still hasn't moved in. He says that the family sometimes sleeps there.

- videos designed to illustrate reinforced construction techniques and the importance of advocating such reinforcement to homeowners
- demonstration of strengthening by referring to the model house under construction at the training site

DAY 2

- practical training with concrete block at the training site
- final exam covering all aspects of the course

On completion of the course, and with satisfactory performance on the final exam, trainees were issued certificates of completion. One person interviewed indicated that he had dropped out of the training and had not received a certificate. He indicated that he had already known the training content and his description of strengthening techniques indicated that he had mastered the content. Most trainees did receive the certificates and those interviewed remembered the course clearly:

DBEP program trainee in Dhamar City

This older graduate of the DBEP training program showed us the BATC now behind locked gates and used as a private dwelling.

This man was a mason prior to the DBEP project. He remembered the training quite well and mentioned the videotapes, books and the hands-on practical training conducted at the BATC.

He said the valuable part of the training was the hands-on work. He still had his training certificate at home, but couldn't imagine any real use for it. After completing the DBEP program he was hired for the repair program in Dhamar City.

He knew about methods of strengthening buildings without increasing the cost significantly, by use of through-wall tie stones, wood ring beams, and proper foundations.

The course booklet was prepared in "comic book" format with many freehand line drawings used to illustrate the various construction techniques being taught. The style of the drawings is a mix of architectural and freehand drawing techniques. Many of the drawings are shown in architectural axonometric views which are scalable and therefore useful to architects, but are distorted from the view one sees in perspective of normal sight. These drawings do, however, have the advantage of showing construction details more explicitly than perspective views.

One section of the booklet shows right and wrong ways to rebuild stone houses. Right and wrong details are provided for building siting, reinforcing steel rafter connections, and foundation details. (fig. 3)

The booklet gives recipes for the mixing of strong mortar and concrete, and many typical details for improving the strength of masonry buildings. These methods may be categorized as follows:

- Better foundations using larger stones, set deeper in the ground (not simply set on the ground)
- Bigger stones set in the wall to stretch across the entire wall thickness. These "tie stones" help keep the interior and exterior faces of the wall tied together.
- The continuous use of steel or wood tension reinforcement run horizontally through the wall to help prevent vertical cracking
- That windows be placed at least twice their horizontal dimension away from the corner

- Proper splicing of wood reinforcement to guarantee continuity of tension reinforcement
- Better connections between the roof rafters and the wall by use of steel "tie downs"

B. Project Growth and Cycle

Within four months of the earthquake the DBEP project was in full swing and the training center at Dhamar was under construction.

From the beginning the project was designed around three basic components:

- A building advice and training center (BATC) to be located in Dhamar City
- An education program to be offered as a short course at the BATC
- A mobile education unit (MEU) to travel to outlying villages

Since the DBEP program was a training program only, it was measured or monitored by the number of persons "trained". Thus, the DBEP Project Assessment of November 1985 states that 400 builders had been trained by the end of the first project agreement in May of 1984. By October of 1985, 820 masons from 190 different villages had been trained. Coburn and Leslie estimate that this number reflects about 24% of all builders in the area.

When the DASH program became fully operational (sometime in 1985) the DBEP project began to recede in importance and attention. Although this report does not present a clear chronology of the demise of the DBEP program, the general trend can be seen in the records still available in Yemen. It was extremely difficult to get documentation on the DBEP program. Only those personnel who were directly involved in the administration of the program could remember it. No record of the trainees was maintained after the program, and no library or collection of materials relating to the project was found. The site of the training was shown to the authors, but all that remains is the reinforced mud brick block structure and the BATC that were used as models and which currently are in a locked walled compound. (photo 7)

The only trainees that could be found to interview were those that had been hired on as staff of the EOR. Those that were interviewed could accurately relate mitigation techniques as taught in the program. Visits to villages which were under the program area, however, turned up no one with any memory of the program. Sheiks, district commissioners, masons, and laborers were all surprised to learn that such a program existed.

The local sheik - wadi settlement East of Dawran

This village in N.E. Dawran still had some houses under construction in the EOR run extension of the DASH program. There were collapsed houses mixed in with the standing with rubble strewn everywhere. There were still many structures made from corrugated steel sheets. Here and there were a handful of EOR self help houses in various stages of construction. Little progress had been made in the last 10 years.

The sheik invited us to his mafrage. The sheik explained that this town had received no assistance at all for more than 8 years. He was glad for the current assistance but said it was too little too late. He had never heard of any program to advise builders in better building techniques.

A pile of mud bricks was drying in the sun near his house. The sheik said no-one was building houses from this type of brick anymore. These were only for animal shelter with a corrugated metal roof.

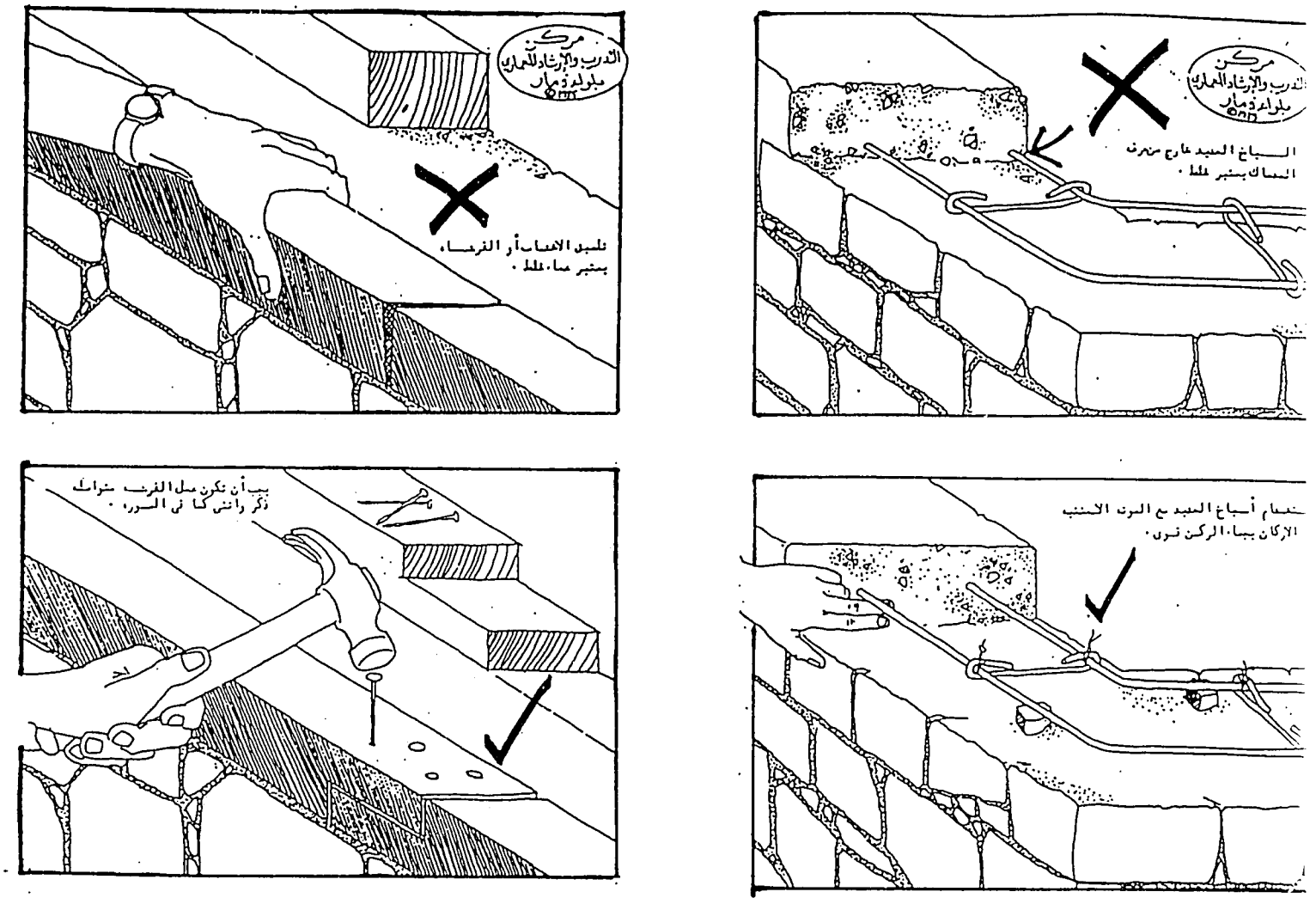
مركز
التدريب والإرشاد للعمارة
بلولة ذمار
تلبيد الأعشاب أو القرمة
يعتبر مساء خلط .
الباخ العيد خارج منزل
السماك يعتبر خلط .
يجب أن تكون مثل الفرجة متراك
ذكر وأنثى كما في الصورة .
استعمال أباخ العيد مع الوزن الأسفل
الأركان يجباء الركن نوى .

Figure 3

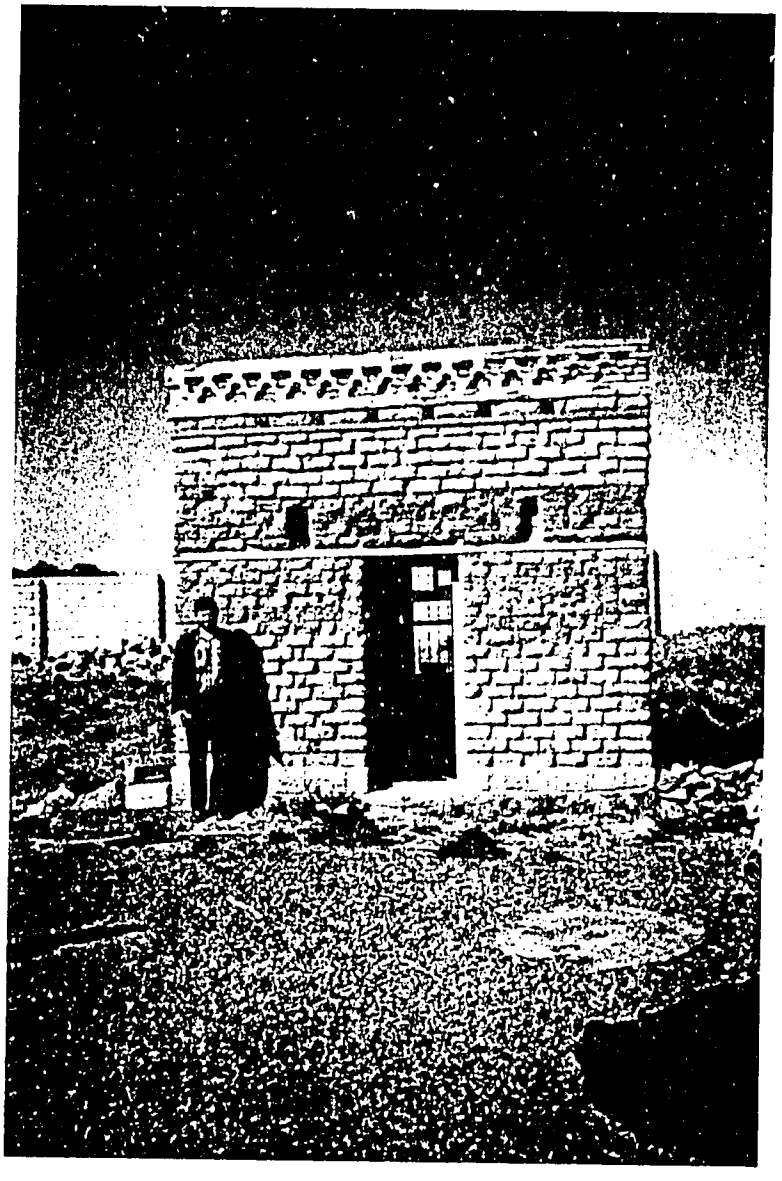

Photo Number 7

Mud brick demonstration house built in the Dhamar BATC under the DBEP program.

It is indicative of the EOR's regard for the project that no records exist in their offices of the program. The OXFAM office in Sana'a also had no record of the program although they did have the master copy of the training videos used in the program.

C. Main Participants

At the initial phase of the project, in March 1983, the roles and responsibilities of the various entities involved in the project were as shown below. (fig.4)

DBEP Roles and Responsibilities

YAR	site and construction labor for BATC and training staff
Concern	educational specialist, educational material, support and equipment for mobile education unit
Radda Barnen	project coordinator, materials for BATC construction
OXFAM	construction supervisor for BATC and subsequent training

Figure 4

Sources of the project's funding were from Concern, Radda Barnen, Oxfam, Dhamar LDA, SCR, Aga Khan Foundation, Canadian Embassy, and British Bazaar. The structure of the project at the

time is shown below. (fig.5) (Leslie, in Erdik, 1986, p.95)

DBEP Organizational Structure

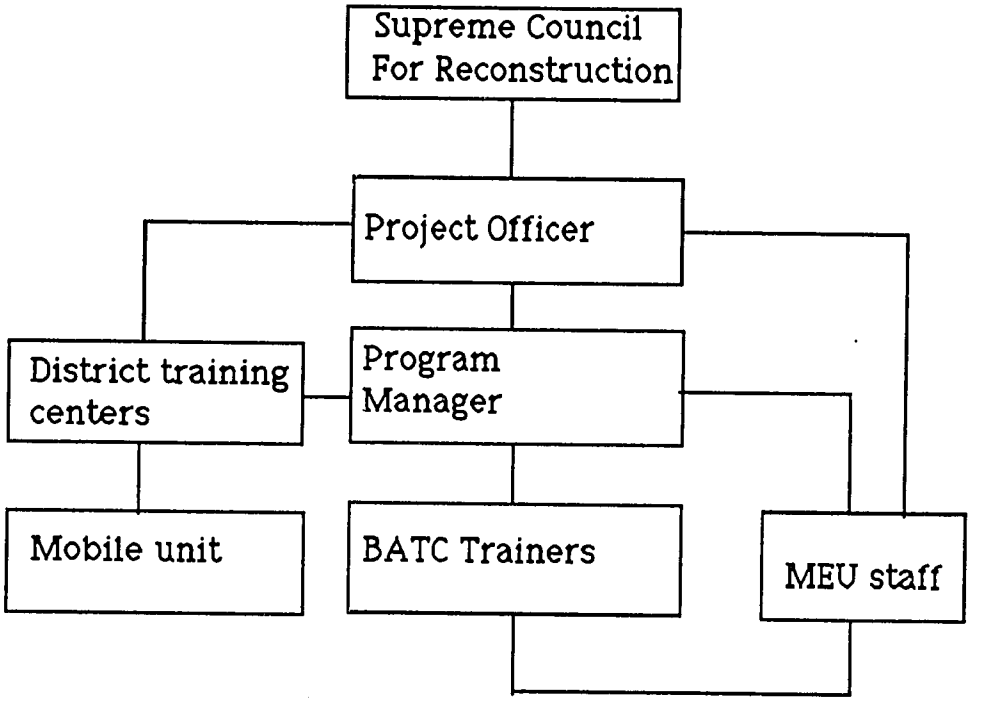

Figure 5

The organizations were all in the country at the time of the earthquake and were able to quickly implement their programs. Local staffers were recruited to fill the new positions created by the project.

The beneficiaries were of two types. The first was those people who were advised by the mobile unit on techniques to strengthen their houses on site. This aspect of the program, while perhaps the most useful, was nonetheless the most difficult to assess quantitatively. One of the original evaluators of the DBEP project claimed that more than 50% of the project was involved with on-site consultations and advice given to people involved in the rebuilding of their homes. This project was alone in the provision of this type of on-site advice.

The second type of beneficiary was those who actually attended the two-day training course held in Dhamar City. These men were recruited from the outlying areas by the MEU and scheduled for the formal training course. It is not clear what the criteria for their selection were.

The project had a stated goal of training established masons who would be trusted and hired by the local people and who would presumably be in the best position to affect building practices. Although this was the goal, it is unknown what percentage of the trainees were "established masons". In rural Yemeni society almost everyone is a mason to some degree, yet there are still

skilled individuals who work for others as master masons. These men are very localized and do not travel very far from their homes, usually serving only their own or neighboring villages.

D. Extent and Method of Dissemination

The program was concentrated in the Dhamar region only. However, it was mentioned by one of the Yemeni engineers involved with the program that some people had come from as far away as Aden for the course.

Dissemination was dependent upon the participants who received the educational programs from the DBEP project, i.e. those involved in the repair of their own houses, and those local "master or regular masons" recruited to attend the Dhamar 2 day training, carrying their "new methods" back to their home communities, demonstrating the techniques and therefore spreading the message to others.

The training methods for these two groups vary considerably and serve to point out one of the basic questions posed by this study, that is; is there value to written, illustrated, published training materials in societies that tend not to read or have access to published materials.

The OXFAM project designers spent a good deal of thought and effort on the crafting of their project materials and other visual aids. What was not considered was whether or not the whole concept of such printed materials would have any impact. The drawings and notes in the manual are clear and, according to the assessment by Leslie and Coburn (1985), were well understood. It must be remembered however, that in all cases the written material only augmented lectures and hand-on demonstrations.

The other main focus of the OXFAM training was the preparation of training videos. These were generalized scenarios of construction sequences. There were usually two or three characters discussing the pros and cons of the various strengthening techniques on the site of a house under construction. The videos were designed with an intentionally humorous element. Leslie, in his assessment, claims that the humorous elements were a very positive part of the program although the effectiveness of this was not assessable.

The visuals in the video were not clear enough to determine structural details. In some cases objects in the foreground obscured details that the characters were discussing.

Another video was more technical. This second tape showed various construction details in both drawings and close up camera footage of real houses under construction. This detail-by-detail presentation more clearly showed the strengthening techniques under discussion but this may have been offset by its relatively more boring nature.

Mr.Amer Ali Alsanabani at the EOR Office Compound Dhamar

Amer participated in the DBEP in 1985. He was hired by EOR to work in the repair program in Dhamar. He hopes to continue working for the Ministry of Planning after the EOR is dissolved.

He was a builder before the training. He remembered the videos and the hands-on training, but did not remember the book or manual. He still had his certificate from the training.

He remembered the training well and described mitigation techniques but couldn't say whether this knowledge was gained through the DBEP training or through his work in the repair program.

He knew appropriate answers for questions concerning the depth of foundations, concrete mix, and reasons for tying the walls together. He felt that much of what was taught was good but that many of the more costly innovations (steel and cement) were not being done today in the rural areas. He was unable to describe ways of strengthening the houses without spending additional money.

An interview with Engineer Habit in Dhamar clarified the size of the training program. He had been the main governmental counterpart to the DBEP program, and is currently the City Engineer. He told us that in all, 1500 persons were enrolled in the training program and approximately 960 certificates were issued.

6. THE DHAMAR AIDED SELF-HELP PROGRAM

As a response to the housing needs following the Dhamar earthquake, donors could choose between funding contractor built housing or self-help housing - the two program offered by the SCR. While most donors chose to fund what they perceived as efficient contractor built housing, the Kingdom of the Netherlands opted for the self-help program.

The Dhamar Aided Self-help Reconstruction Project commenced in December 1983 approximately one year after the earthquake. The project began with a contribution of DFL 4,792,800. With an additional EEC contribution (ECU 2,550,000), the DASH Project as it came to be known embarked on a project with two goals:

- short-term: provide shelter to the homeless
- long-term: transfer knowledge about improved building techniques

These goals were to be achieved through two program components:

- construction of about 180 houses
- construction of two building advice centers (BACs)
  (DHV, Program for Phase 2, Oct.1984, p.2)

A. The Start-Up Phase

The first nine month period was devoted to project design and management. The firm, DHV Consulting Engineers was appointed to organize and administer the project. The Housing Institute of Rotterdam was chosen to monitor and evaluate the project. The original project management team consisted of a project manager, construction engineer, training engineer, logistic officer, and administrative officer. These positions were filled by expatriate DHV staff. Counterparts were appointed by the EOR with the expectation that they would "learn by doing" and "do by learning". The functions of assistant construction engineers were to be filled by US Peace Corps volunteers.

During the initial period, staff were hired and preparatory operations were begun. By May 1984, an extensive library of materials related to self-help housing programs had been created and bibliographic citations compiled, (DHV, Project Documentation Report, May 1984).

During this period USAID agreed to join the program as of September 1, 1984. The US funds were in the form of a loan to the Yemeni government from the PL 480 Title One program and amounted to YR 70,765,000. In addition, the Dutch increased their contribution to DFL 8,500,000. These additional financial resources allowed a significant expansion of the program implementation phase.

Prototype houses were designed for the project based on the size of the contractor built houses. They were intended to be core houses in the sense that they could be added on to. This future addition was seen as vertical rather than horizontal as in the traditional Yemeni houses. The floor plan was about 50 meters square.

The houses were designed with several building innovations to make them resistant to earthquake forces:

- three continuous steel reinforced concrete beams in the perimeter walls
- reinforced concrete corners and door and window openings
- steel ties to connect rafters/joists to the bearing walls
- steel mesh used at walls parallel to joists to brace these walls

- cement mortar between stones
- single wythe square cut stone infill walls
- horizontal steel reinforcing in the stone coursing
- plastic sheeting over roof plywood for waterproofing

The administration of the project was also designed during this phase. The construction of the houses was divided into four phases or landmarks by which the contracts were to be paid down. The phases were as follows:

phase 1 - the foundation
phase 2 - the walls
phase 3 - the roof
phase 4 - completion and finishing

There were several model houses built as tests of the plan and as part of the training for the project staff. An additional use of these houses was the explanation of the program to potential beneficiaries and to the local authorities. Some of these became the Building Advice Centers (BACs) which were used as district offices of the project as well as staff quarters. (photo 8)

The administrative structure which was developed for the project was quite complex considering the relatively small number of houses to be built. Those involved with the project praised it on the simple merit of "getting something done" in a very difficult environment. A part of that success in getting the houses built rests with the administrative and support structure which was put into place to run the project. This structure was eventually simplified somewhat as a method of streamlining the operation . The early and revised organizational charts are shown below. (figures 6,7)

An extensive contracting procedure was developed which included contract approval by EOR, the beneficiaries, the sheiks and the local LDA. These contracts were used to insure that beneficiaries were qualified. Further they clearly specified respective roles and responsibilities. EOR administrators considered the contracts to be an important part of the process. They were used to carefully manage expectations.

To prepare for Phase 2, an evaluation mission was proposed to be carried out by a Turkish expert, Mr. Arioglu. Unfortunately he was unable to complete his mission and the evaluation mission was subsequently delayed.

Initial Program Constraints

In September 1984, DHV staff prepared an Implementation Constraint Report which was a self review of the first phase. This report outlines several important factors constraining policy choices:

Among findings in this report are the following:

- the relation between DHV and EOR is of the "principal and contractor" type. This was seen as producing friction with DHV "explaining, justifying, and reporting its activities".
- a lack of collaboration with other self-help projects, "OXFAM and United Nations Capital Development Fund (UNCDF)" and consultant efforts.(The mission by Mr. Arya from Rorkee University)
- a perceived priority commitment by EOR to the contractor-built housing program
- a true self-help concept with owners providing all the labor would be too great a cost for the beneficiaries compared to the limited contribution of the beneficiaries of the contractor built housing

- the project "does not as yet have any experience with the self-help concept"
- the project needs to be organized on a village level to ensure that enough houses are contracted to ensure feasibility
- the willingness of beneficiaries to participate in the project is still unknown but that project staff assume that "all villagers (under influence of their leaders) will agree to participate" in the self-help program.
- that difficulties were already apparent with the Yemeni Foreign Trade Corporation (YFTC) in getting necessary materials on the job but that project staff could not do the YFTC function
- that house designs needed to be adapted to reduce dependence on "brought in materials" (especially aggregate for concrete).
- that the size of the model house design (50 m2) was dictated by the EOR so that all beneficiaries would receive a similar house to those provided in the contractor-built program
- questions remained unanswered e.g. should large families get the same house as small families, should the ability of beneficiaries to contribute funds for a bigger house be allowed; should the impossibility of some potential beneficiaries to contribute physically or financially, e.g. widows and elderly, be taken into account.
- different building techniques were tried out, eventually settling on the U block design because of limited supervision needs and limited costs.
- selection of beneficiaries should rest with the EOR

Specifically regarding training, the report raised the following issues:

- close, extensive, and repetitive training remains necessary to achieve objectives
- limiting the project to mountainous areas does not allow demonstration of possible techniques for housing construction in the plateau area (where the epicenter was) with traditional materials
- the training proposals had not yet received approval of EOR
- that a choice had to be made from a range of training designs including: limiting training to the construction of houses as a consequence of the building activity; more training but still concentrated in the project area; informing the larger public about how to improve traditional techniques. The project staff noted the watershed nature of this decision because training had to be financed out of existing project funds. Thus, funds put into training could not go into house construction or "A Choice has to be made between helping 200, 300, or 400 families in the project area or an extended training program which might help hundreds or thousands of families in the long run".

Photo Number 8

DASH Builder Advice Center (BAC) in Dubah. This building has been given to the Local Development Association for their use.

DASH Project Organization Chart (after project extension)

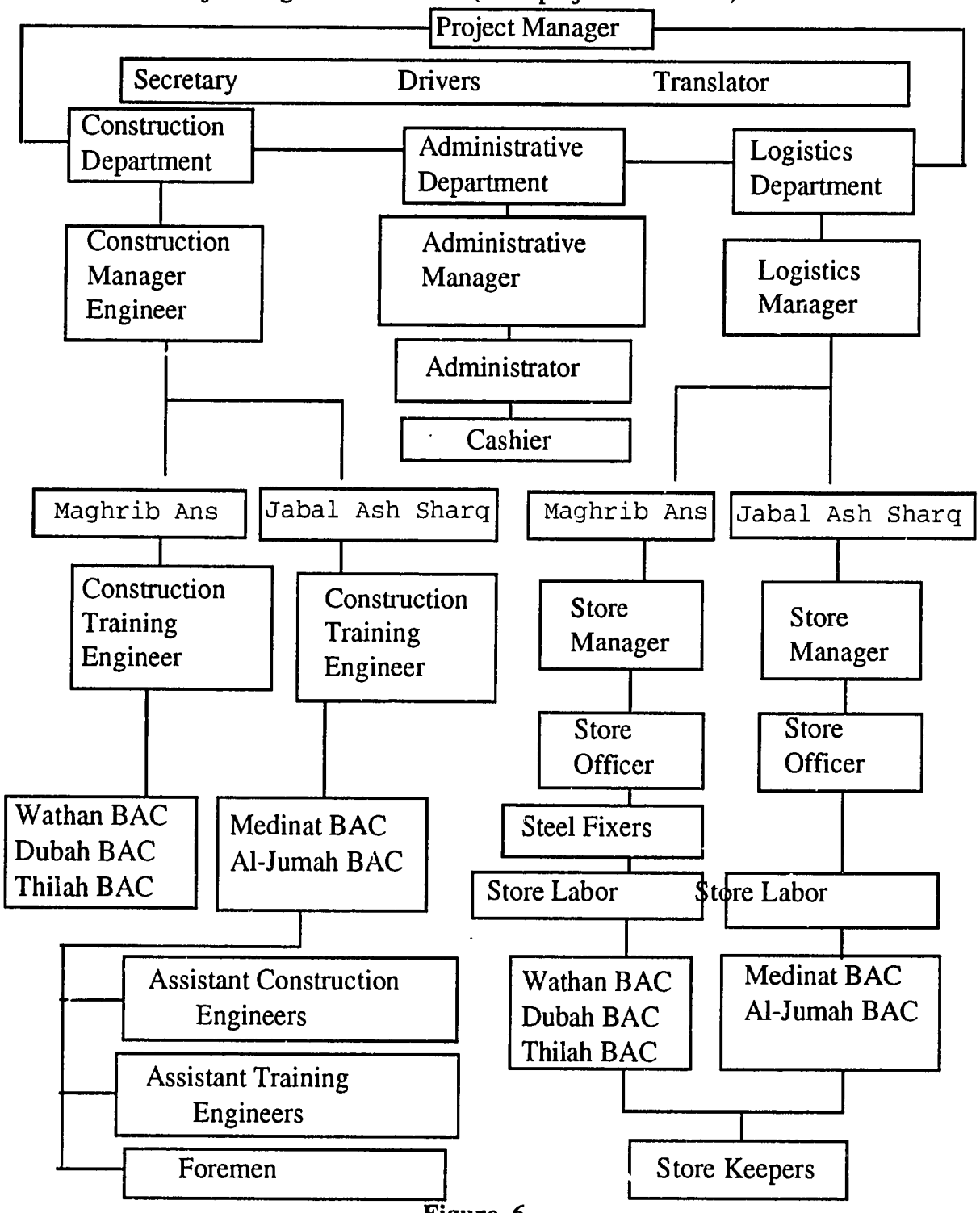

Figure 6

This organizational chart shows the extent and complexity of the project administration at the height of the projects activity. It was later simplified (reduced) to streamline administration and reduce cost.

Reduced Project Organization Chart

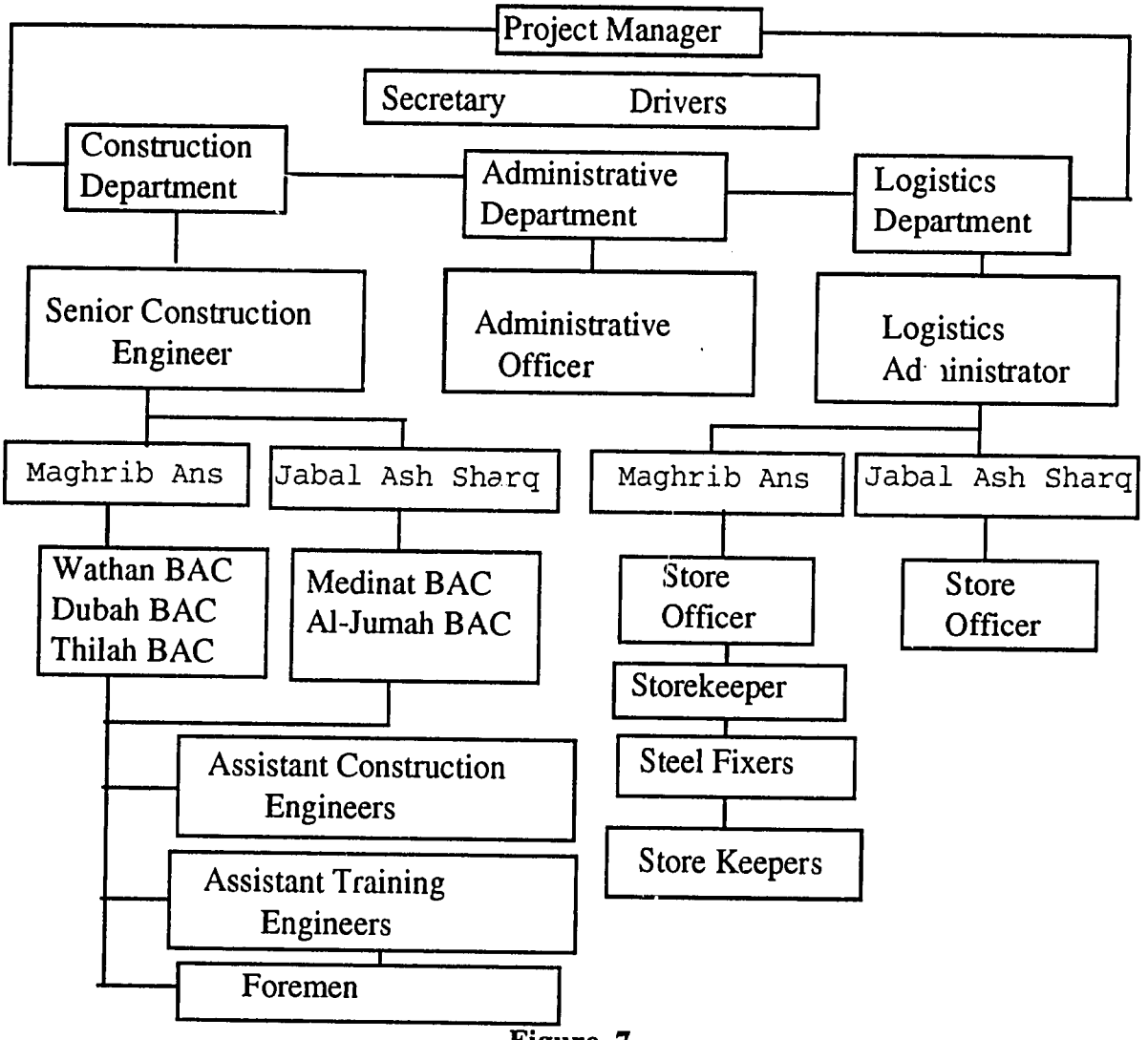

Figure 7

This is the reduced organizational chart for the DASH program instated to streamline the project administration.

B. Phase II

By October 1984 DHV staff had proposed a comprehensive "extension plan" to guide the training efforts. The narrative is included in Annex 2. This plan essentially focused on the training needs that were required to build the housing. These included information sessions with beneficiaries, training for foremen and masons, construction of prototype houses, posters, manuals and videos documenting building techniques. The design conceived of a nine month program with an estimated budget of 324,000 YR.

For Phase II, the program expansion resulting from the additional funds created tension between the two competing goals of construction and training. To balance the goals a proposal was made to introduce a semi pre-fabricated unit - the Nagron house - thus allowing 100 traditional and 100 pre-

fab houses to be built. "The construction of the improved traditional house (combined with the training program) should guarantee the long term objective, the construction of the semi pre-fab houses should guarantee the short term objectives.". (DHV, Program for Phase 2, Oct. 1984, p.2))

This experiment with the Nagron semi-prefabricated unit was a failure in almost every way. The house, thought to be a cheaper construction method, proved to be more expensive. Owners were generally unsatisfied with the units and complained that they were colder than their old houses.

Over the duration of the project only 67 of these houses were ever built. There was a plan to sell the unused components on the open market in Dhamar, but it is unclear what happened to the balance of the housing components. Almost ten years after their delivery many of the frames for these houses still lie unused and forgotten in the EOR compound in Dhamar. (photos 9, 10)

DHV planned an ambitious set of activities for Phase II, but by the end of Phase 2 Quarter 2 the project had bogged down. AID funds were not forthcoming, there were insufficient beneficiaries identified, and the YFTC had not successfully delivered the necessary materials. Some project staff took short leaves. The report concluded that training tools had been prepared, training sessions continued, but that construction activities on the third BAC and model houses had stopped and neither the self-help program or the repair program had started. (DHV Quarterly Report, Phase 2-2, Mar., 1985)

Major concern was expressed whether the beneficiaries would accept the self-help program because it had been rejected in the UNCDF sponsored Dawran program.

Potential beneficiaries were not clear at this point. Re surveying was conducted at the request of the local authorities, EOR, and DHV to determine if (1) homes listed as destroyed in the earthquake had actually been so and (2) whether houses were completely destroyed or repairable.

The program also suffered from fiscal problems. The USAID funds were difficult to access because several authorities were required to sign off on the disbursement and because disbursements could only be approved after purchase and not as an advance. Thus, DHV encountered a serious cash flow squeeze. They needed both foreign and local currencies but the unavailability of USAID local currency resulted in a drain on the foreign currencies of the Dutch and the EEC. In order to maintain momentum, DHV first borrowed from other Dutch projects and then from a commercial bank. When the financing sources were exhausted the project ceased construction activities. The project reports that "the trained construction workers have started seeking other jobs and the whole transport operation was brought to zero."

Nevertheless, during this period, with the expected availability of additional USAID funds, a major expansion of the project was proposed for the Jabal As Sharq area to construct 400 houses, 2 BACs and 4 model houses.

By the next quarter the project had reestablished itself and regained its momentum. Phase 2 -3 (May,1985) reports that 90 contracts had been signed and that expansion to Jabal Ash Sharq was approved. The report further concludes that, based on an assessment by AID consultant Copenhaver, the repair program should be de-emphasized because many homes assessed as repairable were not, (DHV Quarterly Report, Phase 2-3,p.4)

C. Phase Three

By September 1, 1985 construction had finally begun. Thirty-six self-help houses were under construction and 400 contracts had been signed. The Dutch evaluation mission was highly complimentary of the project, especially design components and beneficiary enthusiasm/acceptance

Photo Number 9

The Nagron house.

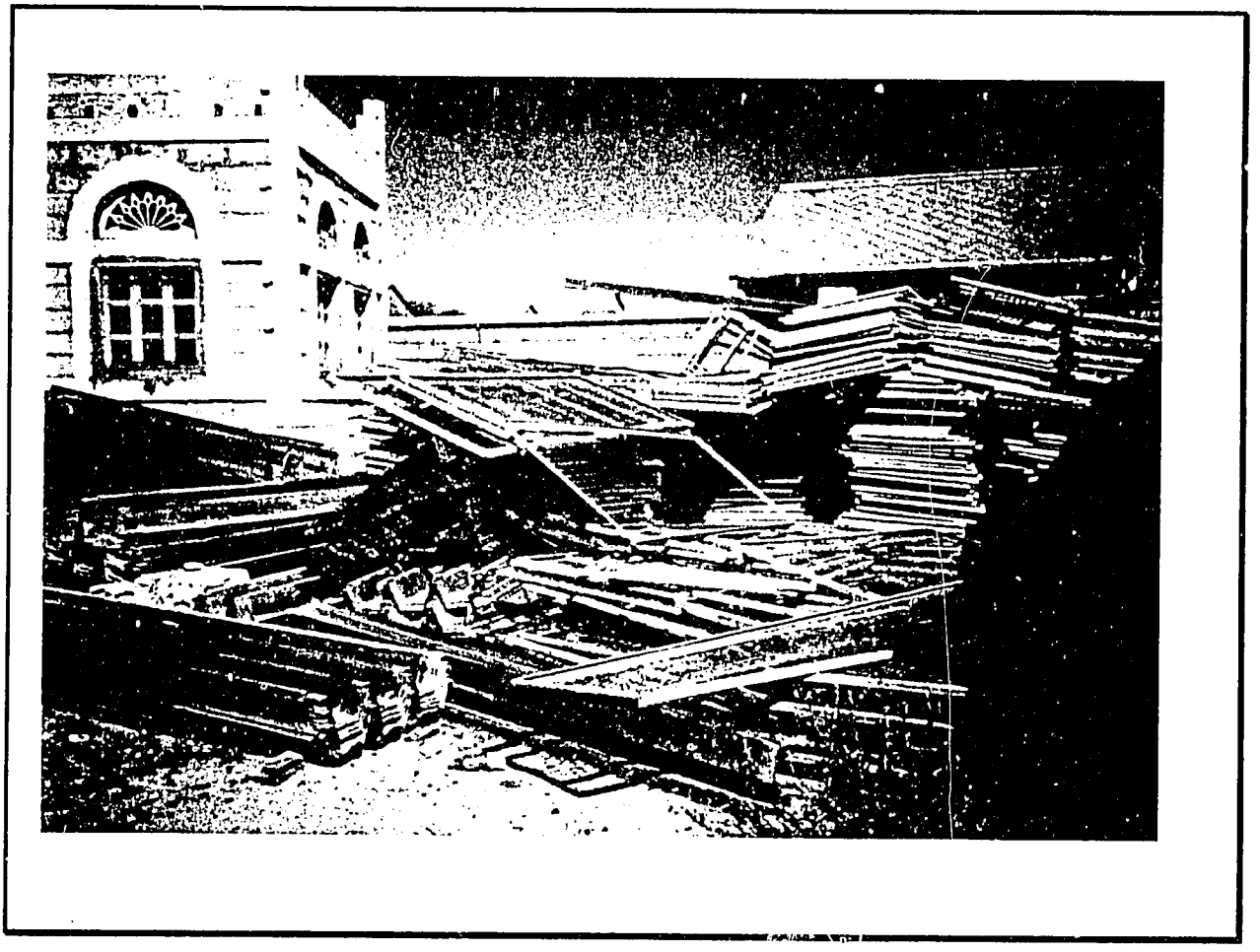

Photo Number 10

Nagron house components, in storage at the EOR compound in Dhamar City..

for the project, but the evaluation mission raised concern that the project was behind schedule noting that 105 houses should have been started. The mission advised that the project would take 21 months to complete, (DHV Quarterly Report, Phase 3-1, Sep. 1985, p.1)

The mission further noted that roads must be improved into project areas, that building techniques should be extended to schools and other local facilities and that efforts should be made to disseminate the project to "universities, technical schools, etc.". This was never done. An interview with the Dean of the College of Engineering at Sana'a University revealed that they had no record from the project of any type. They offered no course in earthquake resistant construction, but intimated that these issues were discussed in some of the other general engineering courses.

The report also noted that a 4th and 5th phase were approved for a total of 1,000 self-help houses over the life of the project. The phases of the project and the years they covered can be seen below. (figure 8) The progress of the actual house construction is shown over time also, (figure 9).

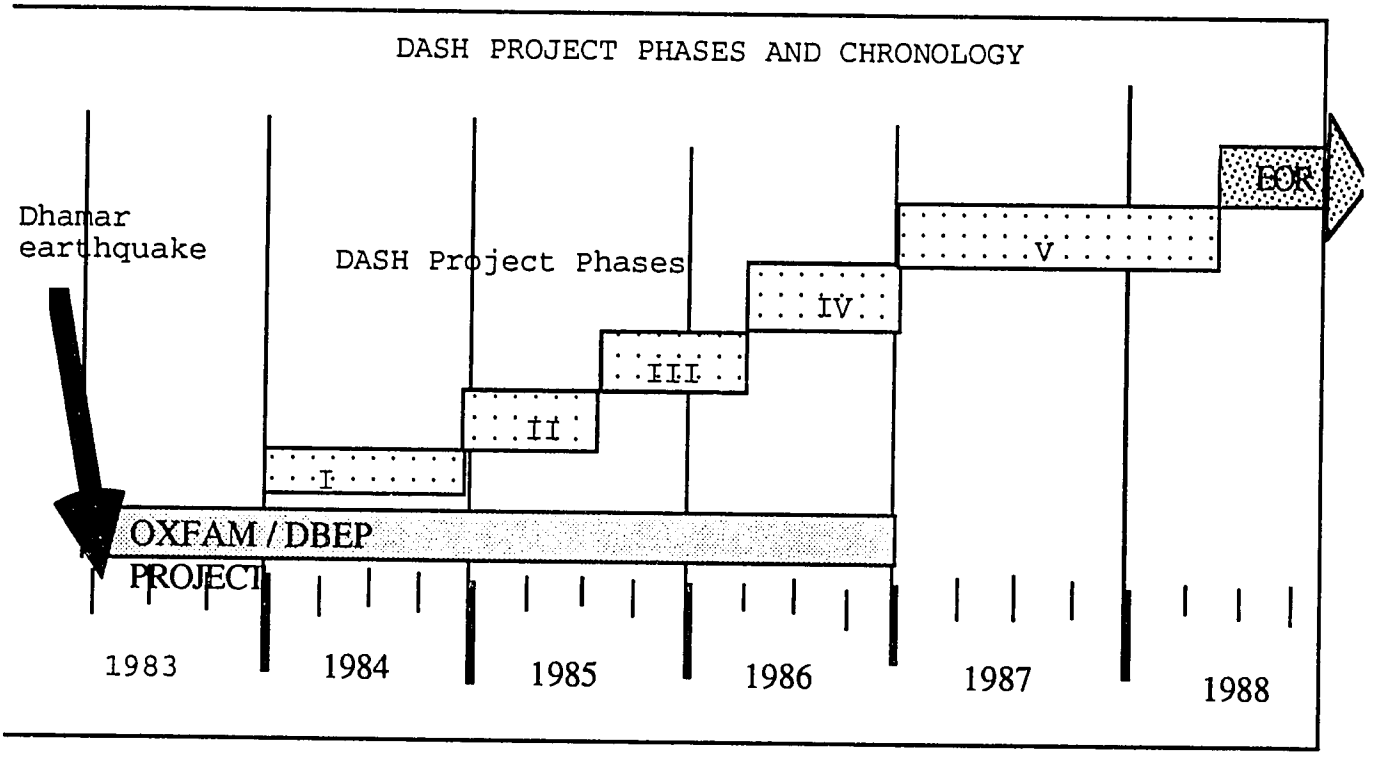

Figure 8

The training materials necessary for running the program had been prepared and were ready for continued activity in the implementation phase. But, the goal of "housing the homeless" was, in light of the pressure to build houses, given primacy over the long term goal of building a safer Yemen.

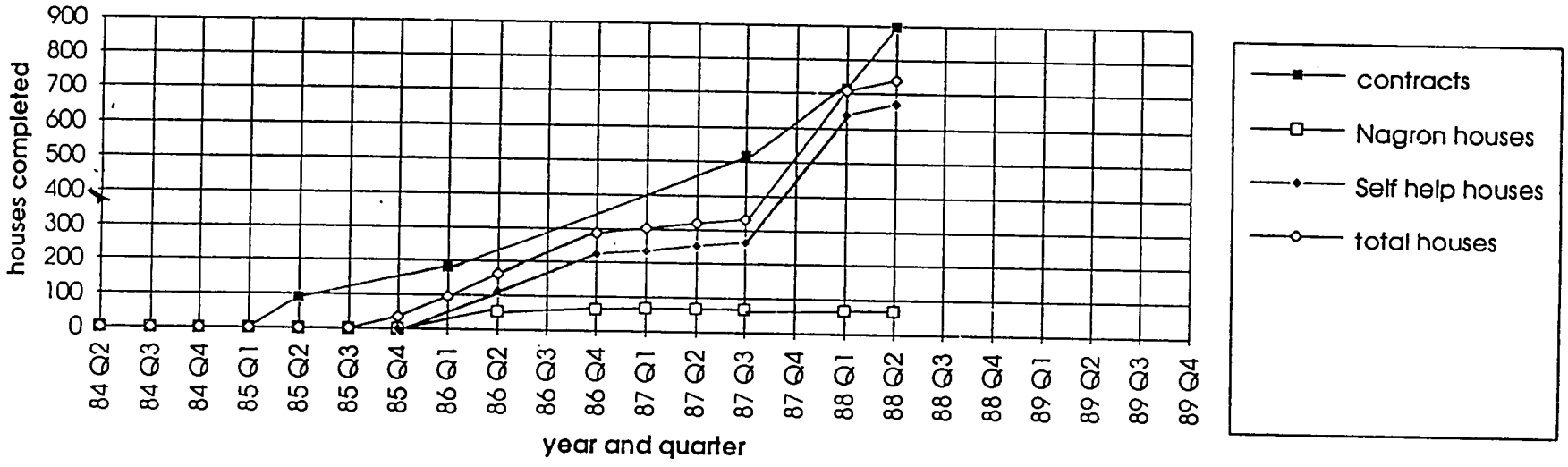
houses completed
900
800
700
600
500
400
300
200
100
0
84 Q2
84 Q3
84 Q4
85 Q1
85 Q2
85 Q3
85 Q4
86 Q1
86 Q2
86 Q3
86 Q4
87 Q1
87 Q2
87 Q3
87 Q4
88 Q1
88 Q2
88 Q3
88 Q4
89 Q1
89 Q2
89 Q3
89 Q4
year and quarter
contracts
Nagron houses
Self help houses
total houses

Figure 9

At year end, 1985 the quarterly report states, "The training of the beneficiaries and masons is going along with the construction of the self-help houses". A photo introduction shows why houses collapsed; at the beginning of each stage a film covering techniques in that stage is shown and a manual is given to the beneficiary and his mason. However, "most of the training takes place on the building site itself". The March 1986 report, in the section on training of beneficiaries and masons, carries the same identical two paragraphs from the previous quarter (a practice to be often repeated) evidencing that training initiatives were continuing to recede in importance.

During this phase DHV proposed, in response to the evaluation findings, an additional expenditure of 30 Million YR AID funds for construction of "services" (mosques, clinics and schools) - the training component to include a documentary film on earthquake resistant construction techniques, and preparation of lectures for teachers and students of technical schools. The proposal was eventually accepted but scaled down to 10 million YR.

D. Phase IV

The plan for Phases 4 & 5 note, "the construction component of the project has been given more attention during Phase three. Now self-help has seen to be successful concept (sic) the project intends to put more emphasis on training during the next two phases." The increased emphasis includes "a new series of lectures for the project staff (to which also outsiders can attend). These lectures are mainly meant as a refresher courses for project engineers and foremen. The project also intends to "follow more intensively the results of the training of the masons" and to provide "certificates" to the masons who have "proven to be sufficiently trained", (DHV, Program and Budget Phase 4 and 5, Mar., 1986). This training was well remembered by those interviewed:

Ex-EOR foreman in Dubah

Before the EOR/DASH program, this man was a local builder. He applied after learning of the program in his village. He was accepted (about 100 applied and 42 were accepted).He remembered his training as lasting 3 months. Videos and the hands on experience of assisting in the self-help housing program stood out in his memory of the training.

He had a good knowledge of the mitigation techniques incorporated in the DASH house design and felt that the house was a good model but said that the "U" blocks were not really important and that steel was the most important element of earthquake resistant design.

After working as a foreman for the EOR, he moved to Sana'a where he works for the Ministry of Transportation in an unrelated job as a road repair foreman. He happened to be back in Dubah visiting his family.

During the first quarter of Phase 4 ending June 1986, the project continued its planned activities but USAID funds and project materials again were slow to arrive resulting in a slowdown and eventual halt to the construction. The quarterly report noted that beneficiaries are supplying funds from their own resources to allow construction to proceed in the absence of project funds. An evaluation from the Netherlands and USAID was conducted during this phase and a comprehensive audit was conducted. During this quarter, Peace Corps volunteers began to leave the project due to a perception that they were being used as administrative aids rather that as technical experts. Their transition to use in the BACs as administrative support lead to the frustration. No evidence of expanded training was offered in the DHV project reports. The report's component on training repeats the same paragraphs mentioned earlier.

Near the end of 1986 an ambitious project was proposed by DHV to establish an Infrastructure and Social Services Project. This project would have given DHV responsibility for constructing schools, clinics, and water and sewer improvements. It was felt that such projects would broaden the dissemination of earthquake resistant construction techniques because of the high visibility of these public facilities. The proposal also recognized that the current training materials, i.e. lecture notes and training films were "strongly oriented towards project execution and thus not always suited for a wider public, which lacks direct involvement", (DHV, Infrastructure and Social Services, 1986, p.9)

By the end of Phase 4 on December 1, 1986, the project had completed 287 houses and an additional 278 houses were in some stage of construction. The project report noted that the project was now 7 months behind schedule and attributed most of the delay to the unavailability of construction materials. The report noted that for an 8 month period during 1985 and 1986 there was no construction activity due to a lack of funds and/or materials, (DHV Quarterly Report, Phase 4-3, Dec. 1986).

During this phase there was also a general increase in prices raising the cost of the homes. The evaluation mission and principal partners in the project held many discussions aimed at easing the materials bottleneck. The project was authorized to purchase materials on local markets instead of waiting for YFTC materials. YFTC experienced a lack of foreign exchange with which to purchase materials.

An auditors' report of the period March 1, 1986 - November 30, 1986, indicates that 22,253,202 YRs were spent with 8,285,723 (37%) going to project management and the rest to project execution. All USAID funds were allocated to project execution with Dutch and EEC funds paying for project management.

No mention was made of the training goals or progress on those goals, as staff were consumed with the construction component. The continued experience of delays in funds and materials was noted in an evaluation report as having an "adverse effect re: number of houses completed, but also the enthusiasm of beneficiaries and project staff.", (DHV, Interim Report, Evaluation, Dec., 1986, p.5).

E. Phase V

By the end of Phase 5 quarter 1, March 1, 1987, the project had fallen 9 months behind schedule. Only 303 of a planned 413 houses were completed.

The evaluation mission of December 1986 raised some criticism of the training component to date. The report notes that, "the emphasis in training so far has been on the technical aspects of the project. What has been neglected so far is the human factor and the organizational aspect. The knowledge gained could also be used for the contractor-built component". It was recommended that an additional video be made that showed unique aspects including:

- materials are transported by local people with small pickup trucks
- the organization in a village required to support the self-help project
- the enthusiasm of the beneficiary and the way he is executing and managing the construction of the project
- the impact of the project; other houses, mosques, etc. are using the same system
- the personal touches added to the houses

Further, "there are a lot of interesting aspects... which make this project different and more interesting than a contractor built housing project but the knowledge must be brought to the outside world. This is not all related to direct training on the sites, but the training component of this project had two main elements: training of the beneficiaries and masons on site, but also a transmission of knowledge component related to future project in the Yemen Arab Republic."

The aspect of the project's building technique spilling over to other building projects pointed out above was evidenced at least to a small degree in one of our interviews. One of the beneficiaries did in fact build a Mosque next to his home using the DASH concept. It was noted , however, that neither the house nor the Mosque followed all of the guidelines of the project. The vertical steel reinforcing in the corners was not used , nor were the "u" blocks used to form up the vertical corners and door jambs. It should also be noted that the Mosque was identical in size to the house. The interview which follows took place in Nagha town between Dahmar city and Dubah, Maghrib Ans:

Mr.Hamid Ali, a prosperous qat farmer in Nagha.

A beneficiary of the DASH program, this man's home was built on a modified plan from the standard DASH design. He had arranged for a larger house (10m x 10m compared to the standard 6m x 8m).

He also built a new mosque for his family and a second multi-purpose building all in the same compound. Both the mosque and his home were built with appropriate mitigation techniques, but the third building which was constructed as temporary shelter after the earthquake was built in the traditional way with pyramidal stones forming two wythes (although "temporary" this building showed signs of a long and heavily used future).

His only formal training was through the DASH project foreman and engineers. He didn't remember any printed materials or films.(photo 11)

There were also instances where even though the DASH project house was accepted and completed, the technology transfer was not accomplished. There are many examples of non-strengthened additions joined to the DASH houses. One interview with a group of men from a village which had been completely rebuilt follows:

On the road to Wathan - village men

A Group of men gathered in this small village completely relocated to this site after the earthquake. They were somewhat suspicious of our questions and answered with guarded responses. When asked about local skilled masons we were referred to the next town.

This small village had a mix of housing types, styles and sizes. There were some DASH houses standing next to post-earthquake, un-reinforced stone houses. One DASH house had a small dry-stacked stone addition with no reinforcing of any kind, (photo 12)

The men unanimously said they received no special training in construction after the earthquake and that they had generally learned from their parents and grandparents how to build their houses. None of the men present were owners of the DASH project houses.

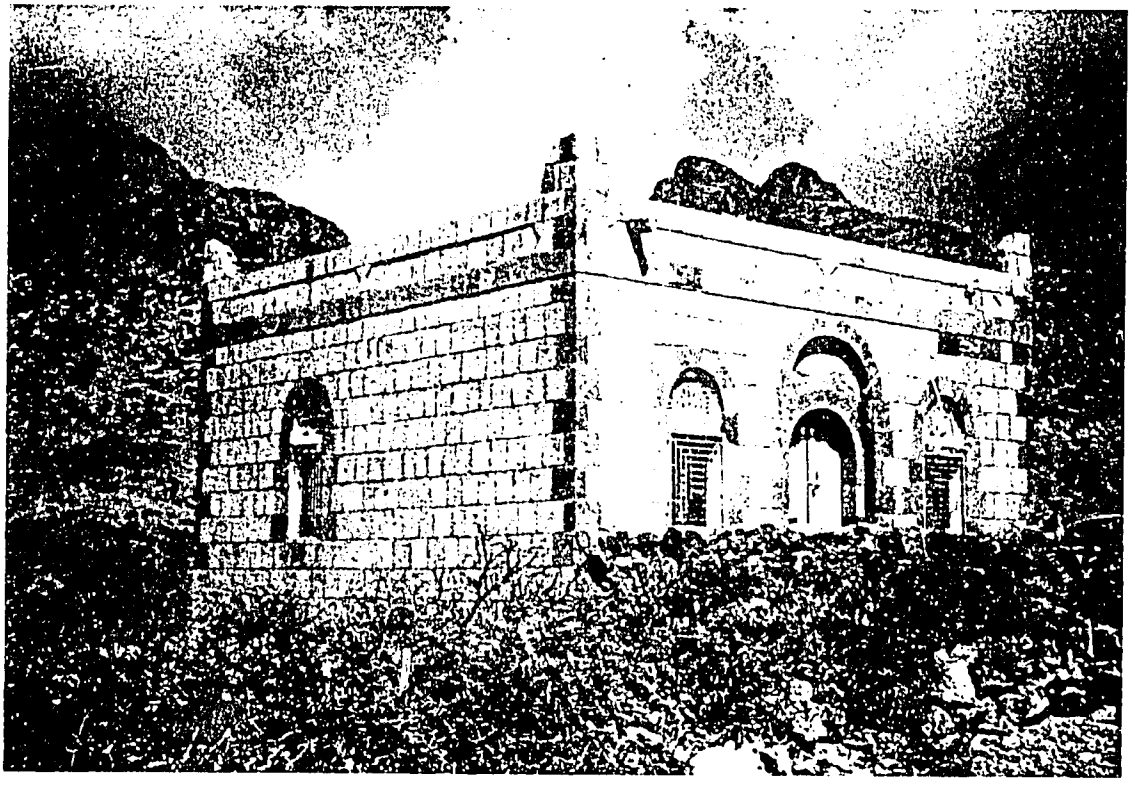

Photo Number 11

DASH homeowner's mosque built on the same plan as the DASH house.

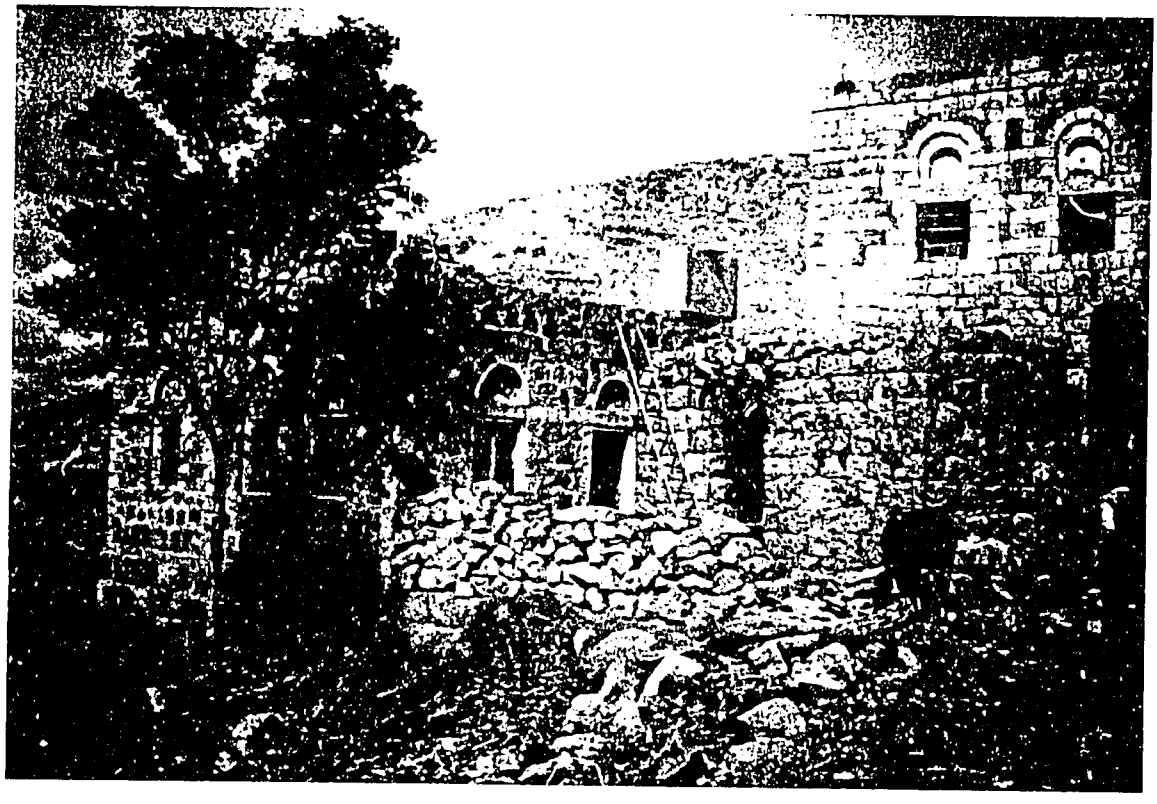

Photo Number 12

Unstrengthened addition (at right) built onto DASH house.

> The men noted that the DASH program was only for those with enough money to carry the 30% owners contribution. Those unable to pay or make other arrangements built on their own without incorporating earthquake resistant technology due to cost.

By the end of February 1987 a depressed project staff wrote a "non paper" declaring that "the project is in bad shape" the "standstill of activities means waste of management funds, serious frustrations and loss of credibility among the population in the project area and that DHV management is considering temporarily withdrawing a considerable part of the staff, to prevent the frustration from increasing." (DHV Quarterly Report, Phase 5-1, March 1987)

By June 1, 1987, construction was still stalled. Only 320 of a projected 615 houses have been completed and the project was now 13 months behind schedule.

The DHV report notes that the lack of materials could provide an opportunity to emphasize training aspects which are less dominant under normal production conditions. But, the report concludes, "the demotivation of all persons concerned (beneficiaries, masons, foremen and project team members) because the continued lack of materials and NO outlook for improvement, did not create the right atmosphere or stimulated enthusiasm to allow for a realistic approach to this objective." (DHVQuarterly Report, Phase 5-2, June 1987, p.7)

The evaluation mission proposed that if funding and material bottlenecks were not resolved by August 1, the management team should be reduced to the project manager and accountant and expatriates sent home until the project could again gain momentum. But, by August 1, materials were again available and project staff canceled previously booked flights and returned to work.

The September 1, 1987 report relates that the evaluation mission expressed disappointment that the recommended video film had not been produced. The project management related various reasons why this activity had not taken place.

By December 1988, construction activity picked up. But, the report notes that "in relation to the two project components (1) the construction of 1000 houses and (2) the transfer of knowledge of improved building techniques, the first component is visible, the second not yet. The techniques used in the project are not yet taken over by the population for other buildings. The information so far remains with the project."

In response, DHV proposed a comprehensive program designed to better disseminate project results. The proposal, known as the TIC (1988, DHV), or The Proposal for Training, Information and Communication Development was an ambitious, if late appearing attempt at dissemination.

The TIC document, written in response to evaluation criticisms regarding the lack of sustainability, acknowledges that DHV participation will end soon; that "no follow up programme exists"; and that project documents and a wealth of professional experience {become} inaccessible for future applications or further development". The TIC proposed a set of dissemination activities including:

- a personalized training program for staff seeking a permanent career in construction
- audiovisual, printed, and other media packages covering the technical and managerial aspects of the project
- a national and international network of specialists.
- a Yemeni team of experts with the ambition to establish a "National Centre".

The proposal outlined a number of activities and products for each objective. These were furthered packaged as small projects with budget estimates thus allowing a flexible implementation plan. Most of this plan was never implemented.

After review, it was decided to reserve a budget of 350,000 DFL for:

- improvement of construction manuals
- establishment of a reference library at the Sana'a University
- training of EOR staff in computer application(p2 5-5)

By the end of May 1988 the implementation of modified TIC recommendations was reported by DHV. The following percentages of completion of the task were noted:

ordering books for a reference library	40%
copying of DASH-instruction videos	100%
training of EOR staff in computers	20%
video-managerial aspects of DASH	10%

F. Project Termination

At this point, the project began to move into the termination phase. Seven hundred thirty eight houses or approximately 80% of the goal were completed. In February, 1988, with UNICEF funding, the project started seven modified traditional self-help houses to be used as health clinics. In February 1988 and again in June 1988 Yemeni staff were reduced as foremen, store-laborers and drivers were let go.

At this same time, the project reported significant unspent funds. Even after the completion of previously scheduled 910 houses, 8.0 million YR would still remain unspent. These funds created the opportunity to continue the project after the DHV contract was completed (31 August, 1988) and therefore EOR commenced plans to continue the project.

The project continued more or less in the same way it had been run with the help of DHV. The EOR staff continued to oversee the construction of the houses and to manage the supply of building materials. Beneficiaries continued to provide labor and some materials amounting to 30% of the total cost. Some changes were made, however, to the basic plan for simplification and to reduce cost. The main aspects of the EOR adaptations were:

- reducing the number of reinforcing beams in the wall from 3 to 2
- replacing the imported steel frames with locally produced wood units
- abandoning the "U-block"
- forming the concrete beams with wood form work
- abandoning the stone walls completely so that the final houses are all block

These changes have made the construction of the houses faster, but much of the aesthetic quality of the houses have been lost. (photo 13)

The final report on the DASH project was completed in March 1989. The report is complementary of the administration and construction aspects of the program while noting the significant impediments under which the project operated.

The report noted the effectiveness of the on-site training program in terms of the number of foremen, masons, and beneficiaries that had been involved with the construction program. The report further noted, regarding the sustainability of the program, that the EOR would continue the project especially in the "services area" generally and in more self-help housing in NW Dawran

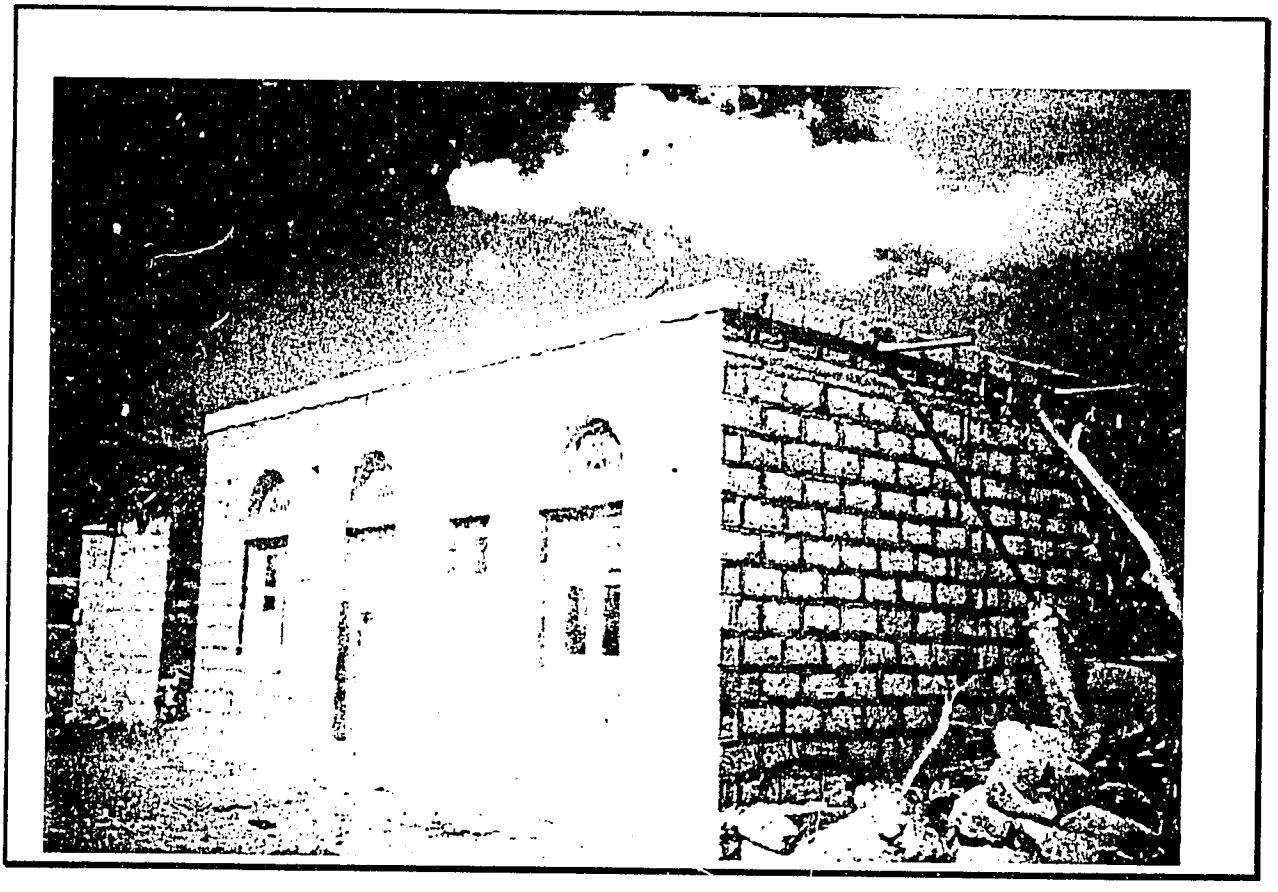

Photo Number 13

The EOR adaptation of the DASH house. This version of the self-help house is still being built today on roughly the same plan as the original DASH house. The stone infill walls have been abandonded as have the "U-blocks". Wood formwork for the reinforcing perimeter beam can be seen at the top of the wall. The imported steel door and window frames have been replaced with locally manufactured wood frames.

specifically. The report also noted a few examples of non-project construction projects that utilized project-derived mitigation techniques.

However, on the subject of long term impact on the Yemeni construction behavior, the report assigned responsibility to an, as yet unidentified, "Yemeni team of experts who have the ambition to establish a sort of National Centre for Research and Development of Earthquake Resistant Construction". The report concluded: "The short term objective...has been attained. The ... long term objective... is more difficult to assess."

7. FINDINGS

This section reports project findings for both the DBEP and DASH projects within the confines of the study's objectives.

A. DBEP Findings

1. The DBEP program, as remembered today through assessment records and reports, was a formal training program centrally organized and run through the BATC in Dhamar City. A second unrecorded part of the project offered on the spot building advice to people repairing or rebuilding their homes.

2. It was a relatively small scale, "stand alone", two day training program. It was not supported by other initiatives to help integrate the results of the training into the local systems of the culture and economy. As such, the only achievements of the project ever measured were the number of people trained and the number of certificates issued.

3. For the DBEP program to be successful in the long-term, individuals trained in the program must go back to their home villages or other areas in the country, continue to work as masons, confirm that the techniques taught were feasible, utilize those techniques and train others. In the case of the DBEP program there was not sufficient baseline data or project documentation to make this determination.

4. The program was initiated very quickly at a time when other initiatives were still being formulated. The program was the first and only program designed to respond to the immediate crisis at hand and to reach out to those who were "already on their ladders" rebuilding their damaged homes.

5. The program was based on sound technological principles. It was not specific to any particular innovation or material, but rather was a broad-based approach to the fundamentals of seismic strengthening techniques.

6. In order to reach out to remote areas of the affected area, the project utilized a mobile education unit (MEU). The MEU had the dual purpose of offering on the spot advice to those builders who were already at work, and of recruiting trainees from the outlying villages to come to the Dhamar training course.

7. The program was, to some extent, insulated from integration with the local or national government. Government had no stake in the project by way of staff or other monetary support. Although there was a liaison with the EOR, there was not really an active government counterpart to the project.

8. The program was not recorded in any permanent way for future consideration in Dhamar or for that matter in Yemen. Records were found outside of the country, except for the training

videotapes found in the Oxfam Sana'a office (it should be noted that the Oxfam staff did not know they had them and did not know what they were.)

B. DASH Findings

1. The DASH project appropriately identified achievable training and construction goals in the beginning of the project. However, as the project grew in size with the USAID funds and as the project fell behind due to cash flow problems, lack of materials, and delays in beneficiary identification and selection the construction goals became paramount. Training, besides what was required to build the houses, became a secondary goal. Although DHV acknowledged this in their reports and the various evaluation missions flagged this issue there was never any systematic effort to rectify this situation. When the TIC project finally was developed it was too late in the project cycle to make any difference.

2. Partly as a result of failure by the YAR to accept more widespread training goals, the training program defined its mission narrowly as the training required to build the DASH house. The introduction video explained the DASH program. The construction videos showed each stage of the construction of the DASH house. The printed materials also related to the building of the DASH house. These materials were not developed with widespread dissemination in mind. As a result, they are of limited use now and languish in the EOR locked resource room. There are no plans to utilize the training materials elsewhere. Further, since the EOR takeover of the building program, certain innovations, central to the DHV design, have been dropped rendering the videotapes and print materials even less useful.

3. The project was limited in scope to three mountainous regions around Dhamar City. This resulted in limited visibility for DASH projects and also limited the mitigated self-help demonstrations to remote areas. If model houses had been built in other regions of the country; if the self help method had been used in the larger plateau communities; or if high profile buildings like mosques and schools had been included in the project it would have been more effective in disseminating techniques.

4. In some ways, the project that evolved never was a widespread self-help project in the most direct sense. Owners only provided some funds and did not, in many cases, actually work to build their own house. There was no evidence of "community building" either in the sense of good feelings or in the sense of working on each others' houses. The project was a construction program with modest beneficiary participation.

5. Still, the project resulted in the construction of nearly 1,000 houses incorporating mitigation techniques. The fact that the EOR continued the project after DHV left is proof that there was some sustainability resulting from the project.

6. The project developed visual, auditory, and hands-on teaching tools but the "hands-on" approach was primary for masons and construction supervisors (foremen). The residual skills from the this approach remain with foremen and, presumably, many masons. However, many of the foreman have used the entrée into government service that EOR provided and have been transferred to non-construction related jobs in other Yemeni ministries. EOR itself is scheduled to be disbanded. On the positive side, EOR engineers have incorporated strengthening techniques in their approach to building design.

7. There is no apparent accessible repository of training materials. The University of Sana'a expresses no knowledge of the training materials. There is no special course in earthquake construction although they say they include mitigated design components in other courses.

8. Most of the non-native building innovations were not ultimately adopted into the building practices in the Dhamar area. These included the U block, plastic roof foil, widespread use of steel, etc. The u block design might have been better disseminated because it was cost effective and efficient. However, a project was never mounted to make the U block forming machines widely available. At the end of the project the was one crusted old U block machine at the compound and no evidence of other use.(photo 14)

9. Some of the innovations did penetrate the building culture especially increased use of steel in the corners and steel reinforced concrete ring beams at the top of the walls.

10. Evaluation missions played an important corrective role in the project. Evaluation missions by the Dutch monitors were regular and reasonably thorough. When findings were presented to authorities, steps were taken to overcome problems identified by the evaluators.

11. The DHV program was exceptionally well documented and analyzed by DHV staff. Quarterly reports and other project documents were thorough in presenting a picture of the evolution of the DASH project.

12. Widespread difficulties in identifying beneficiaries no doubt had negative impacts on the project. Assessment missions were re-done several times. However, EOR staff noted that they had learned much about assessment and were quite successful in adopting assessment techniques learned during the project to conduct a one time dependable assessment in Al Udayn. However, the nature of the Al Udayn swarm (where the tremors are felt nearly everyday as the earthquake moves along the fault line) renders the statement wrong since assessment at one phase fails to account for damage caused by future tremors.

13. PL 480 funds proved to be a challenging aid source. First, the funds were made available as local currency which limited what could be purchased with them. Second, the YAR treated the funds as a loan from the US. government. Therefore, they considered it their contribution rather than a US. contribution. Further, there were many sign-offs required by the Yemeni bureaucracy to disburse the funds. Finally, since the PL480 funds were in local currency they were highly subjective to the floating exchange rate. Generally, the contingencies surrounding the use of PL480 funds were not well thought through. It appears that DHV expected them to be handled much like Dutch and EEC funds which proved not to be the case. On the other hand, the USAID funds resulted in a major expansion of the construction aspects of the program.

14. There were limited economic spin-offs from the project. Some materials were purchased locally at different times during the project. The material transport system was locally based. The were cash payments to builders and EOR staff. No new production capacity was designed to support the project.

15. The nature of Yemeni culture was only insufficiently taken into account in the design of the DASH project. The beneficiary contract was useful in clarifying beneficiary selection because it included sign-offs by the local sheiks and the LDAs. However, the insular nature of Yemeni mountain communities and the inherent sense of privacy in Yemeni villages had a major negative impact on natural, i.e. homeowner to homeowner dissemination of mitigation innovation techniques.

Further, the primary mechanism in Yemen for imparting construction knowledge is the apprentice approach. As a result of this, skills, when acquired, are not routinely conveyed to competing masons and other construction personnel. One man interviewed put it this way- "If a man learns something to build better and this man makes his living by building, then why will he want to tell anyone else about it. It is his own business and it is to his advantage not to tell everyone how to do

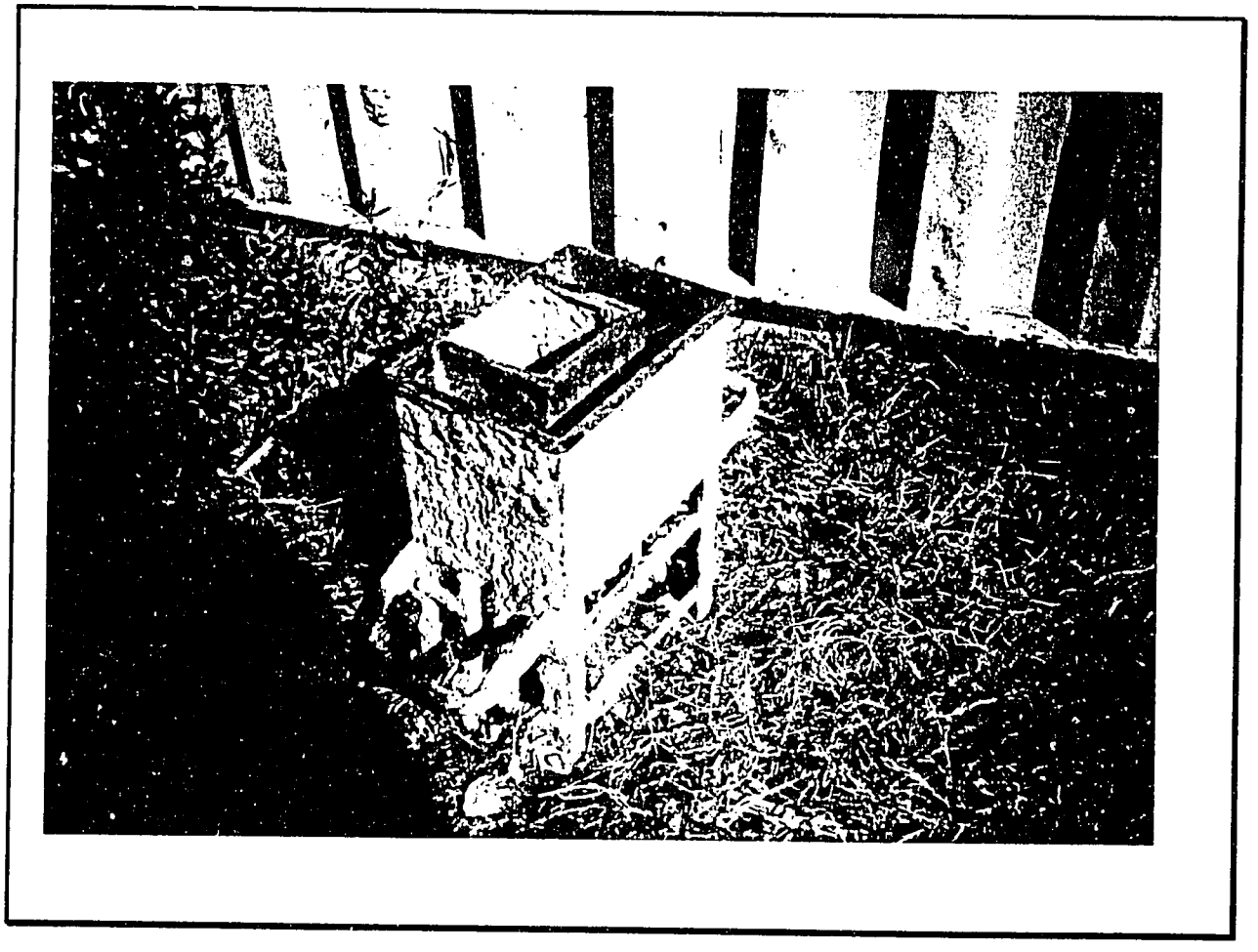

Photo Number 14

The only "U-block" machine left in Dhamar. It is broken.

his job." Finally, there are not established avenues for otherwise spreading building technique knowledge. For instance, material suppliers when asked whether they would provide consultation to a builder on mitigation techniques said that was not their role.

16. The costs associated with expatriate management of the project were significant. Management costs were about 30% of the total budget costs. The Dutch funds essentially paid for the management in hard currencies and the USAID funds paid for all the materials in Yemeni rials. EOR has proven capable of continuing the project after the expatriate managers left raising some question about how long expatriate management was necessary.

8. LESSONS LEARNED

Reference again here is made to the principal question guiding this study:

> ■What are the criteria to be used for designing future self-help housing training programs that will make them acceptable and sustainable within the local community?

The following addresses this question by discussing three major areas - sustainability, training program design, and administrative infrastructure. In general, these lessons are not project specific but rather result from comparing and contrasting the two Yemeni projects.

A. Sustainability

Designing programs that live on after the project ends is the goal of most development work. Several points stand out from the Yemen experience that provide guidance to designing sustainable mitigation programs.

The study of the Dhamar earthquake and the reconstruction programs which followed it point out the basic need to try to distinguish between logical and effective programs. A comparison of the DBEP training program and the DASH training components shows this difference between logical and effective approaches. The DBEP program was extremely logical. The program was operational while the people were beginning to rebuild. The formal Dhamar City training course presented a broad based non-specific approach featuring construction options which logically makes more sense than training based around one best specific technology. The trainees were drawn from the group of people most logically assumed to be able to change building practices (the established masons).

The assessment carried out by Coburn and Leslie (1985) cast the project in a positive light and ultimately decided that it was a success based on two points; first that the formal training program had been presented to about a thousand people, and second, that trainees could remember what they were taught. Although the study also tried to analyze the effects on buildings built after the training, the report is somewhat more tentative on this point.

Despite the logical approach outlined above in the DBEP program (and its positive assessment) its effectiveness is not confirmable. In fact, almost no signs could be found that the program had ever existed in the country. The only hard evidence that the program existed at all is to be found in archival reports and proceedings of conferences held outside of the country.

Visual inspection of areas built (and rebuilt) after the earthquake show some examples of improved building techniques. Those that did show continuous horizontal reinforcement bands in the walls were near DASH houses and those owners that could be interviewed indicated that they had built the houses that way due to other influences besides the DBEP Dhamar-based training or Mobile Education Unit.

In contrast to the logical format and broad based approach of the DBEP program, the DASH program would seem, at the outset, to be a very limited type of training only covering the technological aspects required to build one type of house. Further limiting its effectiveness is the fact that it was directed only to those directly involved in the program (something under 1,000 beneficiaries). Nonetheless, this program seems to have had real impact both on the region and, in particular, in the sub ministry that was created to administer the reconstruction program for the area on behalf of the Yemeni government. The DASH houses are striking examples of earthquake resistant construction that can be easily identified as models by everyone in the community. The government, in turn, used this program as a model for their own continuation of the self-help reconstruction project after the Dutch consultants left the country.

This assessment, carried out 10 years after the earthquake, indicates that the DASH program has been more sustainable than the DBEP program, and more effective. An assessment mission of this type carried out in 1985 would almost certainly have found the DBEP program more effective since the DASH program had not yet even built one house. Today however, it is only the DASH program which is remembered and copied. This is not to say that the DASH program could not have been better.

Another major issue affecting sustainability regards the construction innovations that are proposed in terms of their appropriateness and acceptability to the local citizens. Both projects, to some degree, proposed innovations that were unsustainable. The DASH project, nevertheless, was more susceptible to this problem that the DBEP project. Several of the important DASH innovations were never adopted into the Yemeni building culture. These included the U block design, the square cut stone for the one wythe wall, the use of roof foil and steel mesh, and the steel doors and windows.

The innovations were not accepted primarily because of cost and unavailability of materials. Leslie estimated that the use of steel in the DASH house added 15% to the cost of the house. As already discussed the U block design was not sustainable because no production capacity was ever developed. The roof foil and steel mesh are still considered exotic by Yemeni construction standards and are generally not available in the country.

When the EOR took over administration of the house they dropped stone and U block construction in favor of all block houses. Further they substituted wood door and window frames for the steel ones previously used.

The DASH project did stress the use of steel reinforcement. Although the project used two steel reinforced concrete bands, the innovation was adapted and now one steel band is commonly used.

The DASH project promoted one type of house design or what might be called a "cookie cutter" approach. The DBEP project on the other hand was based on teaching alternative construction designs depending on whether the builder was using wood, stone, block or mud. These innovations were more appropriate for local Yemeni building practices.

Even so, the DBEP project invested resources in teaching a building method that was outdated namely, mud construction. Assuming that people would build mud homes failed to account for the decreasing tendency to build with mud. Therefore, efforts placed in teaching mud construction were rarely put to use as the local population was already moving to block and stone. The mud house was the house of the past, not of the future. This is not a unique finding to the Yemen projects. Expatriate consultants are notorious for romancing traditional construction techniques and forgetting that construction practices evolve. This lesson is learned again here.

If programs are to have sustainability, their goals and methods must be adopted by local institutions. Both projects experienced difficulty in this area. The DBEP project was not formally associated with any Yemeni institution. As a result, when the project closed down, there was no one to take over the training function and apply it to other earthquake prone areas in the country as well as providing ongoing training in Dhamar. To the extent that there was dissemination from this project it was dependent on the seeds planted with the masons continuing to grow.

The DASH project was well connected to the Yemeni government. Unfortunately, the main association was with the EOR. The EOR was a time-limited creation of the SCR which itself had a mandate only for the Dhamar reconstruction. Thus, as EOR dissipates, the institutional memory of the project is lost. This is evidenced to some degree with the Al Udayn area where little of the knowledge gained in Dhamar is being disseminated to Al Udayn.

All development projects can be criticized for failing to account for cultural differences affecting sustainability. In this case the affects of cultural difference are most evident in the area of acceptable innovations described above and the effectiveness of different training methodologies which is discussed later.

The failure to incorporate the knowledge gained in Dhamar within the culture underscores the need for programs such as these to promote a preparedness as well as structural mitigation mentality. There is little evidence that the lessons learned in Dhamar have been incorporated into the overall disaster management policies of the country. In fairness to the Yemenis, this may be a result of the unification of North and South Yemen. It is remarked among disaster management professionals in Sana'a that the memory of both countries was wiped out at the time of unification leading to a lack of institutional memory and limited sustainability in development programs.

Still, there is no evidence that efforts were made to help the government focus on other earthquake susceptible areas in the country with the exception of the project for seismic monitoring.

B. Training Materials

One aspect of both the DASH and DBEP programs that can be compared almost directly are the training materials designed and used for the "technology transfer" aspect of the projects. In both cases booklets, models, video tapes, and full size model houses were used. These training approaches represent a mix of hands-on, visual, and auditory training.

The DBEP project designed and prepared a building manual that described in words and drawings how to build a house strong enough to withstand seismic forces. The drawings were clear and understandable and applied to many situations. The videos however, were not as clear or well thought out as the drawings.

The DBEP model house or BATCs were small buildings based on a variety of building styles and located both in Dhamar city and in outlying locations. Today, one of these buildings is located in the locked compound of a private residence. Another was destroyed within a year of its construction for a road widening project. Only a very few people today know the origin or use of these buildings. The extent to which they were copied in the first few years after the earthquake is not known, however, it can be assumed that the mud brick prototypes were poorly chosen and failed to recognize that this building technique was already dying in the country and would not be seen as "progressive".

The DASH builder's manuals were similar in style to the DBEP manuals and have almost identical drawing techniques and format except that they did not demonstrate "right and wrong" techniques. The main difference, however, is that the Dash materials are more a set of plans for building the DHV designed house rather than general training material. The details are explicitly aimed at

helping answer questions about how to build the "U block" and stone house as designed by the project. They are divided into the landmark phases of the building process that mark when payments can be paid to the builders. Even the DASH videos were designed around explaining the DHV house and its execution. Videos were shot in chapters related to the building phases mentioned above and are heavily detail oriented. They are made from footage of the actual construction of one of the self-help houses.

The DASH videos are very well made and clear but are only really useful as an aid in building the DHV houses or for explaining the project to others. The broader appeal of the DBEP videos seems more logical than the DASH videos but it must be noted that the DASH videos were much more easily found and in the hands of the EOR officials who might want to use them some day while the DBEP materials were found abandoned and uncataloged on a dusty shelf in Sana'a.

The capacity of the training materials to be useful after the project is over is a principal test of their sustainability. Although videos and user friendly manuals are the preferred training tools in the international community, the Yemen experience raises concern over their universal applicability. Most training in Yemen is apprenticeship oriented. Communities do not have "libraries" and vocational/technical schools. There is no evidence of the use of video players and most homes do not have bookshelves and other areas to keep and store manuals. In fact, the authors were not able to find any evidence of the presence of these manuals or videos in reconstructed communities. These "rational" teaching techniques did not prove sustainable.

Dissemination Issues

There are several lessons to be learned concerning the constraints to dissemination of training in Yemen. Applicability of these constraints to other countries or areas must be assessed on a case by case basis. These constraints fall into two general categories: cultural and geographical.

The cultural tradition of the Yemenis is one of family privacy. Traditional houses are designed for defense and privacy. Houses have rooms for visitors (the *mafrage*) and rooms for the family that outsiders do not see. This need for privacy has a natural tendency to keep new influences away. The home, being the center of this privacy, makes the intrusion of consultants or advisors on the rebuilding or repairing programs awkward at best. One of the reasons that the repair program for the standing and inhabited buildings was altered was due to this fact. The original strengthening scheme called for a reinforcing steel and concrete band beam to be cast on the inside and outside of the perimeter walls and occasionally tied together through the thickness of the wall to provide horizontal reinforcement and to keep the two wythes from delaminating. This approach was abandoned largely due to the difficulties associated with having to enter the houses to implement the strengthening techniques.

Just as the high regard for the privacy of the home keeps technological changes from outside out, this same privacy helps keep those who have information from sharing it with their neighbors.

The second issue constraining the dissemination of information is the extremely rugged terrain and difficulty of access to the areas where the self-help program was run. The fact that the program was designed to fill the housing gap in areas that were not economically viable for contractor built housing made it inaccessible for other builders as well. These sights are not on well traveled roads and are very insulated from their surrounding towns and villages by high mountains, lessening their usefulness as area models. Clearly, the DASH project, in particular, could have had widespread impact in other earthquake vulnerable areas of the country by building some demonstration houses in other areas than Dhamar.

Certificates

The DBEP project made the issuing of certificates an important part of its training program. In one of the quarterly reports of the DASH program certificates for successful trainees are also discussed, but it isn't known if these were ever issued. It is still unclear how much importance Yemeni society places on this type of credential. Some sources interviewed said that the certificates were highly sought after, while others have downplayed their value. These certificates were unsupported by any real value or advantage to the certificate holder other than identifying him as a course graduate. Many of the certificate holders complained that they needed work, not certificates. A preferential hiring program by the government for graduates might have had more impact than the certificate plan.

C. Administrative Issues

A final set of lessons learned are those resulting from the administrative implementation of the programs.

The DASH project, in particular, demonstrates the tendency for the "urgent" to take priority over the "important". This tendency has implications for tying education programs to construction programs. In most projects it is probable that the short term needs of shelter will usually take resources from the long term goal of changing building practices.

Certainly response time is critical in this type of reconstruction program. The DBEP program was on the spot, with an idea and prototype of their training program in hand at the time the earthquake struck. They quickly mobilized to give out information to those who almost immediately began to rebuild their damaged or destroyed homes. Conversely, by the time the DASH program built its first house, nearly three years had elapsed since the earthquake and many people had already rebuilt their homes without guidance.

The only way to achieve better response time is to have an ongoing mitigation program of some type in the area or at least in the country with a mandate for quick relocation and response in the event of disaster. This was more or less the case of the DBEP program but, as we have seen, its value was lessened by the fact that it was an insulated, non-integrated project with limited sustainability.

The importance of sound data base management is clearly demonstrated in these cases. On the one hand, the DASH project was thoroughly documented with an impressive series of quarterly reports. These reports greatly aided the analysis of the project even ten years after its inception. More importantly, they provide a good base from which to plan other programs. Should the Yemeni government wish to replicate the DASH project there would be ample documentation.

The DBEP program on the other hand, maintained very few records currently retrievable. Thus, not only was it difficult to find DBEP trained builders, it would also be difficult to recruit them for a future project. Further, the training videos and instructional materials are not available. What would have been more valuable would have been a permanent record of those persons trained, their home address, and their status in the community as laborer, mason's helper, farmer-mason, or master mason.

The importance of evaluation and monitoring, both for correcting project implementation and for long-term dissemination, is evident. The regular evaluation missions of the DASH provided an important leverage in developing responsive institutional commitment to the project. Further, the Yemen experience is currently of considerable interest to the international community. In addition to this project, a major report was recently prepared by UNDRO. Earlier reports were prepared for the EEC and the Dutch. The project has been described at professional meetings and in journals and other publications. Most of these reports are the result of evaluation missions commissioned to examine the impacts of the various Dhamar housing projects.

Evaluations can also be misleading though if they are oriented to the objectives of the project rather than targeted to the goals of the project. The goal of training should be to change the way people build, not simply to expose them to training. The DBEP evaluations should have more systematically assessed the degree to which trainees were utilizing new strengthening techniques.

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Dhamar Earthquake and Reconstruction Chronology

1982

December 13, 1982 - At about noon an earthquake of 5.8 Richter strikes Dhamar Governate. The epicenter is located at 15 km south east of the city of Dhamar with a focus depth of a10km. 2,000 people are killed (these mainly women and children) and another 2,000 injured. It is estimated that 40,000 houses were affected with 50% of these being completely destroyed. Total property damage is estimnated at $2 billion.

December 30, 1982 - Major aftershock destroys many buildings that were damaged in the first event.

1983

January 1983 - the Yemen Arab Republic (YAR) government forms the Supreme Council for the Reconstruction of Earthquake Affected Areas (SCREAA). This council consists of ministers from all concerned agencies including the Ministry of Works, Ministry of Municipalities and Housing, Ministry of Watersupply and Electricity, Central Planning Organization and the General Union of Local Councils and the Cooperative for Development.

February 1983 - Several non-governmental development organizations begin planning for a coordinated role in the reconstruction effort. Concern, Radda Barnen, and Oxfam meet to discuss their possible role in a self-help program for the reconstruction of individual homes.

February 25, 1983 - the "Report of Earthquake Reconstruction Joint Mission - Proposals for a Reconstruction Programme" is published. This report proposes among other things that : "Earthquake resistant dwellings can be constructed using the traditional building materials, in particular stones. Most of these materials can be retrieced from the rubble, provided a systematic clearance and propping scheme can be carried out to provide safe access to the collapsed buildings.

March 1983 - Concern, Radda Barnen and Oxfam draw up an outline of a self- help builder education project called the Dhamar Builder Education Project (DBEP). This plan proposed :
1. A Building Advice and Training Center (BATC) to be located in Dhamar city
2. An education program to be offered as a short course at the BATC
3. A mobile education unit to travel to outlying affected villages

March 1983 - YAR government endorses the DBEP program

March 28, 1983 - SCREAA and the President of YAR jointly identified their scope of their work in the reconstruction effort

April 3, 1983 - DBEP program begins construction of the BATC in Dhamar city.

May 1983 - YAR government officialy starts program of reconstruction to include 25,000 new houses to replace those destroyed and the repair of 17,000 "cracked" houses.

Circa May 1983(undated report) - "Project - USAID funded consultant John Aquirre A.I.A. proposes in his report to "ban stone foundations, ...Ban stone walls," and in general impose U.S. building codes and practices on the YAR.

November 1983 - the Repair Unit is created as a part of the Executive Office of the Supreme Council for Reconstruction.

November 24, 1983 - Another USAID funded consultant, Thomas Copenhaver submits his paper "Proposed Concepts for Reconstruction Programs Based Upon Self Help and Minimum Donor Assistance" which sets the themes and ideas later adopted by the Dutch consultants DHV.

December 1, 1983 - The contract period begins for the Dutch consultants DHV Consulting Engineers. Their project is called the Dhamar Aided Self-Help Program (DASH). THe program is funded largely by the Dutch governmentand others:

Netherlands -	DFL	8,300,000
EEC -	ECUs	2,550,000
USAID -	YR	70,765,000
YAR	in kind	

1984

January 1984 - "Earthquake Resistant Home Design - Yemen Arab Republic" is published by Sheladia Associates Inc. (Thomas Copenhaver) for USAID. This document further clarifies Copenhaver's earlier report and adds technical drawings and solutions for repairing the traditional Yemeni homes.

1985

August 1985 - Training manual entitled "Introduction to Earthquake Resistant Stone Construction in the Yemen Arab Republic" is published by DHV for the Executive Office for Reconstruction of Earthquake Affected Areas. It is a collection of theory and details pertinant to the reconstruction of stone houses as taught in a series of lectures for the DASH project staff.

November 1985 - the "Dhamar Building Education Project - Project Assessment is published by Jolyon Leslie and Andrew Coburn. Project is praised for "getting the message across" through appropriate media and techniques.

1986

March 1986 - SCREAA publishes their progress report showing percentage of houses completed in the self-help program (DASH):

Location	# of houses	% completed
Maghrib Ans	600	27%
Jabal Ash Sharq	400	5%
N.W. Dhawran	571	12.5%

August 31 - September 6, 1986 - International conference is held in Ankara Turkey called "Middle East and Mediterranean Regional Conference on Earthen and Low Strength Masonry Buildings in Seismic Areas" in which two papers are presented relating to the 1982 Dhamar Earthquake.

The first is "Reconstruction of Earthquake Affected Areas in the Yemen Arab Republic" praising the DASH project of the SCREAA. The second is the paper "Think Before You Build" by Jolyon Leslie praising the Oxfam project (DBEP)

1987

March 1987 - DBEP program formally ends by negotiations between Redd Barna and the SCREEA.

1988

February 10, 1988 Radda Barnen Annual Report for 1987 cites DBEP program as dead due to "various obstacles and difficulties".

August 31, 1988 - DASH program under direction of DHV Consulting Engineers officially ends.

1989

March 1989 - DHV final report is published.

1990

1991

November , 1992 - During this month an "earthquake swarm" begins in Al Udayn which will last through the time of Good and Webster's review in December of 1992.

December 9-11, 1991 - Technical seminar entitled Earthquakes and their effects on Development" is organized by the University of Sana'a. REccommendations made to keep the existing structure of the SCREAA and rename it the "Supreme Council for Pre- and Post-Disaster Management"

1992

December 1992 - SCREAA is dissolved.