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(2)

Inception report

and

Report on the formulation of the workshop

February 1989

Disaster preparedness and rehabilitation in Binh Tri Thien Province, Vietnam

VIE/85/019

CHUYỂN GIAO KỸ THUẬT XÂY DỰNG NHÀ CHỐNG GIÓ BÃO
DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES

Report N°1

Inception report

and

Report on the formulation of the workshop

February 1989

Development Workshop

Viện Thiết Kế Nhà Ở - Công Trình Công Cộng, Hànội
Institute For Housing and Public Building Design
Xí Nghiệp Thiết Kế Khảo Sát Xây Dựng, Huế
Institute For Building Investigation and Design

GRET

PREFACE

This report constitutes (a) **the inception report** and (b) the **report on the formulation of the workshop**, referred to in the Terms of Reference for the Technical Assistance Sub-Contract, UNCHS, June 1988.

It covers the points that have been discussed with our counterpart Vietnamese staff and the staff of the UNDP regarding the project; the data that has been collected and provided during the preliminary field mission; and the formulation of subsequent stages in the project.

Development Workshop:
* PO Box 1834 Guelph, Ontario N1H 7A1, CANADA.
* BP 10 Montayral, 47500 Fumel, FRANCE

GRET (Groupe de Recherche et d'Echanges Technologiques)
* 213, rue la Fayette, 75010 Paris, FRANCE

VIE/85/019

CHUYEN GIAO KY THUAT XAY DUNG NHA CHONG GIO BAO O TINH BINH TRI THIEN

DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES, BINH TRI THIEN PROVINCE

VIETNAM

DISASTER PREPAREDNESS AND REHABILITATION IN BINH TRI THIEN PROVINCE

VIE/85/019

SUB PROJECT No. 3.

DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES

REPORT No. 1

Comprising the following combined documents:

(a) INCEPTION REPORT
(b) REPORT ON THE FORMULATION OF THE WORKSHOP.

February 1989

Development Workshop

VIEN THIET KE NHA O - CONG TRINH CONG CONG, HANOI
INSTITUTE FOR HOUSING & PUBLIC BUILDING DESIGN
XI NGHIEP THIET KE KHAO SAT XAY DUNG, HUE
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CONTENTS

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1. SUMMARY

The following key points and proposals have been agreed during the Preliminary Field Analysis Mission:

* The organization of the Phase 1 workshops has been revised. The programme will start with the Policy Makers' seminar, and be followed by the workshops for the Technicians and the Builders.

* Phase 1 workshop activities will take place in Vietnam between the 3rd May and the 17th June. These dates are subject to the installation of the equipment for the project, and the purchase of the building materials prior to starting the input.

* Because of the timing of the rainy season and the New Year Holiday, the proposed start of the Phase 2 workshops is rescheduled for February 15th 1990.

* Detail of the Phase 2 workshops will be finalized during and immediately after the Phase 1 workshop, in order to benefit from the experience acquired.

* The first demonstration building (Phase 1) will be a 2 classroom school in Phu Loc District in the south of Binh Tri Thien (BTT) province; the second demonstration building (Phase 2) will be a peoples' library in Quang Trach District in the north of BTT province. The Institute of Building Investigation and Design of BTT province (IBID) hope to be able to build two additional demonstration buildings. With reference to Annexe V, paragraph 1, of the Sub-project contract document, a more detailed proposal regarding additional buildings will be made following the construction of the first prototype and thus benefitting from this experience.

* Participation in the Phase 1 seminar/workshops will be as follows:
  - policy makers' seminar: 30 people;
  - technicians' workshop: 25 people;
  - builders' workshop: 30 builders.

IBID is requesting subsistence support from the UNDP for the participants, and particularly for builders who would otherwise be earning.

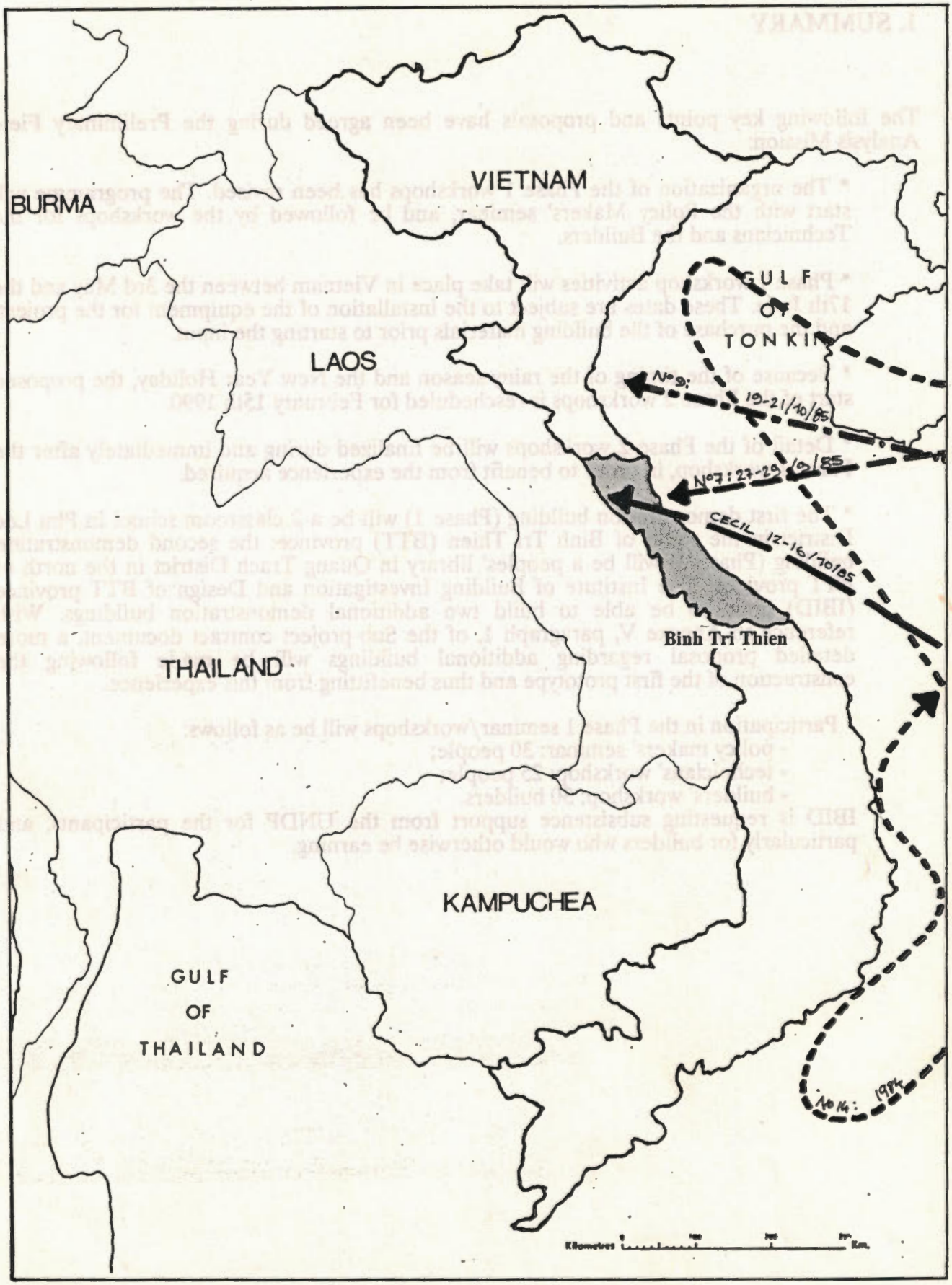


Fig. 1. Paths of the 1985 typhoons. (IBID, Binh Tri Thien Province)

2. BACKGROUND TO THE SUB-PROJECT

2.1. TYPHOON DAMAGE IN BINH TRI THIEN PROVINCE

In October 1985 two strong typhoons struck the province of Binh Tri Thien, central Vietnam. (See Figure 1: 1985 typhoon paths.) The authorities reported quite severe damage: 875 persons dead, 49,000 houses destroyed, 230,000 houses damaged, 2,600 classrooms destroyed or damaged, 6 hospitals and 250 health centres damaged. In recent years other typhoons have caused extensive losses in the province. Losses have been significant not only because of loss of life and injury, but also because of the cost of replacing damaged buildings.

2.2. THE UNDP PROGRAMME OF ASSISTANCE

After the 1985 typhoons, Binh Tri Thien province and the government of Vietnam requested assistance from the UNDP, and following a UNCHS assessment mission in 1986, a proposal was made to provide assistance to the building sector, as part of a three project package to the region. This comprised three sub-projects: Sub-Project No.1 "Improvement of flood/typhoon warning to Binh Tri Thien province"; Sub-Project No.2 "Telecommunication facilities for typhoons/flood forecasting and warning in Binh Tri Thien province"; and Sub-Project No.3 "Demonstration of storm resistant building techniques in Binh Tri Thien province".

2.3 SUB-PROJECT NO. 3 "DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES"

The overall objectives of Sub-Project No. 3 are to define and initiate the process by which identified simple and low cost methods for improving the resistance of houses and small community buildings to typhoons can be disseminated and integrated into current building practice in Binh Tri Thien province, and particularly amongst local and self-help builders. Whilst technical know-how is available amongst qualified technicians in the Government institutions, this knowledge of suitable storm-resistant building techniques is not available to individual builders in the province. The vulnerability of buildings is also increasing as people move away from traditional building techniques using tried and tested methods and materials, and build instead "transition" houses with a mixture of imported and traditional techniques and materials. Lack of the appropriate technical knowledge, and in some cases the use of poor materials, contribute particularly to the vulnerability of the "transition" house.

The project is therefore concerned with an exchange of information between technicians and builders, and the communication of techniques to the people in the province most directly concerned with domestic building. At the same time, the project aims to raise institutional awareness of the steps that need to be taken to develop public awareness of storm-resistant building techiques.

2.4. THE APPROACH

To meet these objectives, Development Workshop and GRET, at the invitation of UNCHS, are organising a programme in Binh Tri Thien involving a series of workshops for policy makers, building technicians, and local builders; the construction of demonstration buildings; and the development of communication material aimed at the general public and at decision-makers in Vietnam.

The programme is divided into two phases. The first phase takes place in May and June 1989. It includes a seminar for policy makers in Binh Tri Thien, and theoretical and practical workshops for both the technicians and the builders in the southern part of the province.

During this phase a two-classroom primary school will be built by the workshop participants. The purpose of this phase is to demonstrate a technique of information exchange and training, and to develop with the participants the methods and material to be used in future workshop programmes run by the province's local technicians. The second phase will take place in February 1990, and will repeat the cycle of seminars and workshops, as well as the construction of a second demonstration building in the north of the province. The materials developed through the experience of the first phase will be handed over to the Vietnamese technicians, and the latter will run the phase two training workshop for builders, under the guidance of Development Workshop and GRET.

3. THE PRELIMINARY FIELD MISSION

3.1. OBJECTIVES OF MISSION

The initial stage in initiating the project has involved a three-week mission to Vietnam (undertaken by J. Norton) from the 18th January to the 11th February. The objectives of this preliminary field analysis mission have been threefold:

* to establish a working contact with our Vietnamese counterparts and with the staff of the UNDP in Hanoi;

* to examine the institutional set-up and the geographic, technical, and socio-economic factors which have a bearing on the detailed formulation of the project;

* on the basis of the accepted Development Workshop/GRET proposal, to formulate and agree on the programming and organization of the project, and in particular to develop in greater detail the organization and programming of the Phase 1 workshops and seminars.

3.2. ITINERARY AND TIMING OF THE MISSION

The start of the overall project activities and the timing for the preliminary field mission was delayed one week from the earlier programmed date (12th January 1989) pending the receipt of the sub-contract documents in France. The preliminary mission for Development Workshop/GRET has now been undertaken by John Norton from the 18th January until the 11th February 1989. During the mission discussions have taken place in Hanoi with the representatives of the Ministry of Construction concerned with the project, and with the staff of UNDP and the CTA for UNCHS in Hanoi. One week has been spent in the Binh Tri Thien province, during which visits were made to buildings and settlements in the districts of Hué, Huong and Phu Loc in the southern part of the province. (See Figure 2). Whilst in Hué daily working sessions were conducted with the staff of the Institute of Building Investigation and Design (IBID), Binh Tri Thien province.

At the start of the mission there was concern that the Vietnamese New Year holiday, Tet, on the 5th, 6th and 7th of February would affect the mission. This has proved not to be the case, and on the contrary the time has been used most beneficially on the design of the first demonstration building and the project programming, allowing further discussion in Hanoi after the Vietnamese holiday. The timing of the mission has however highlighted the importance of taking the Tet holiday into consideration for the programming of the Phase 2 workshops at the start of 1990.

In Hanoi, the Institute for Housing and Public Building Design have indicated that they would like to see the organization of a National Seminar based on the work that is to be done in Binh Tri Thien province, to be held in Hanoi at the end of the present project programme. It was agreed that this does not form part of the present project undertaking, and is a proposal which should be discussed at a later stage in the current project.

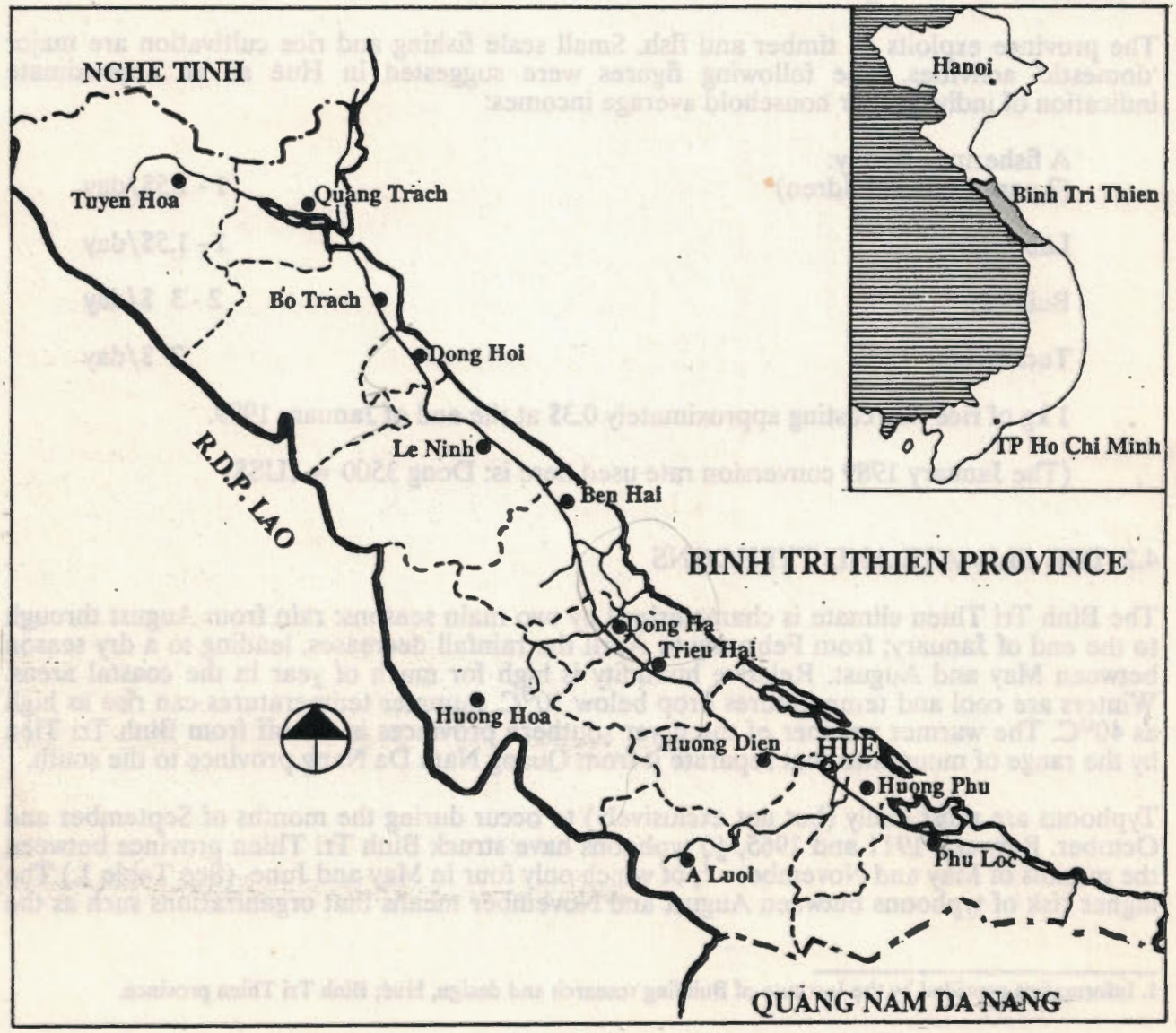


Fig. 2. The Province of Binh Tri Thien, Vietnam

4. CONTEXT

4.1. PHYSICAL CONDITIONS AND ECONOMIC ACTIVITY

The SR of Vietnam is situated between latitude 8 and 23 and covers 331,700 km2. Of the population of 62 million, 80% live in rural areas. The country has 40 provinces sub-divided into 466 districts. Binh Tri Thien province is one of the largest and is situated at the centre and narrowest part of Vietnam, stretching some 300km from north to south. (Figure 2.) It is divided into 14 districts, with a population density that varies between less than 50 per km2 in the inland areas and over 100 km2 in much of the fertile coastal plain. This coastal plain, for the most part quite narrow, is backed by hills and mountains, largely wooded. It is essentially in the coastal plain that the effects of typhoons and cyclonic storms are felt. The coastal plain is exposed to flooding in the low lying areas closest to the open sea.

Apart from the provincial capital, Hué, and the smaller towns of Dong Ha and Dong Hoi, most of the population live either in small villages or in scattered loose groupings of houses amongst the paddy fields. In addition many fishermen families still live on their boats moored on the rivers and coastal lagoons. Both at sea and more recently on land the fishermen's 'settlements' are amongst those most at risk from storms.

The province exploits its timber and fish. Small scale fishing and rice cultivation are major 'domestic' activities. The following figures were suggested in Hué as an approximate indication of individual or household average incomes:

A fisherman family: (2 parents, 2-3 children)	1 - 1.5$/day
Labourer:	1 - 1.5$/day
Builder:	2 - 3 $/day
Technician:	2 $/day

1 kg of rice was costing approximately 0.3$ at the end of January 1989.

(The January 1989 conversion rate used here is: Dong 3500 = 1US$)

4.2. THE CLIMATE AND TYPHOONS

The Binh Tri Thien climate is characterized by two main seasons: rain from August through to the end of January; from February to April the rainfall decreases, leading to a dry season between May and August. Relative humidity is high for much of year in the coastal areas. Winters are cool and temperatures drop below 10°C. Summer temperatures can rise as high as 40°C. The warmer weather of the dryer southern provinces is cut off from Binh Tri Tien by the range of mountains that separate it from Quang Nam Da Nang province to the south.

Typhoons are most likely (but not exclusively) to occur during the months of September and October. Between 1911 and 1965, 40 typhoons have struck Binh Tri Thien province between the months of May and November [1], of which only four in May and June. (See Table 1.) The higher risk of typhoons between August and November means that organizations such as the

1. Information provided by the Institute of Building research and design, Hué; Binh Tri Thien province.

IBID, concerned with shelter, devote much of their energy during this period towards making existing buildings secure, and thus have less time for other activities.

MONTHLY AVERAGE FREQUENCY OF TYPHOONS, BTT PROVINCE: 1911 TO 1965							
May	Jun	Jul	Aug	Sep	Oct	Nov	Total
2	2	3	4	14	11	4	40

Table 1.

There have been no major typhoons since 1985, the year in which Binh Tri Tien province experienced three major typhoons in quick succession, with little time to recover between each storm (Typhoon No.7 - 27 to 29 Sept; Typhoon No.8 Cecil - 12 to 16 Oct; and Typhoon No.9 - 19 to 21 Oct).

4.3. BUILDING IN BINH TRI THIEN PROVINCE

The majority of buildings in Binh Tri Tien province are small private dwellings with adjoining buildings for kitchens, selling, workshops and animal sheds. Apart from contemporary major public buildings (notably in Hué) many of the local public facilities use forms and building methods similar to those used in the smaller domestic building, and from the point of view of storm resistance, present similar strengths and weaknesses, the most significant of which will be discussed below.

The consistency between small domestic building techniques and those used for larger scale and public building is particularly evident in the traditional buildings - the King's Palace in Hué, and the buildings at the Mausoleum of Tu Duc are in effect like very large houses and use the same timber frame structures which have been proved to be storm resistant through many years experience. This type of construction, which uses a large amount of timber, is now estimated by IBID to be almost as costly as the masonry and reinforced concrete structures which represent the most favoured current domestic building styles in Binh Tri Thien province. The departure from traditional building techniques is thus in part due to the increased cost of good quality timber.

For the purpose of this sub-project at least four main categories of house construction (and of many rural public facilities) can be identified:

(a) the traditional building;

(b) the transition house with a mixture of techniques and materials;

(c) the 'Binh Tri Thien modern' house.

(d) basic shelters primarily of organic materials.

It is particularly on the transition house that the Sub-project focuses.

A detailed analysis of the different building types and their strengths and weaknesses relative to typhoons will be carried out as part of the Phase 1 and Phase 2 workshops.
The following comments summarise the key features of these buildings.

The traditional building

The house structure consists of wooden posts and beams, where in most cases the span of the beams is short. The structure can be divided into two types: a central unit where the beams are substantially dimensioned, and side units which use smaller profiles of wood. Increasing the size of the house means increasing the number of units rather than the span between posts. The whole wooden structure is held together by carefully executed mortise and tenon joints, and it is the combination of good jointing and the multiples of small structural units which give the traditional buildings their structural stiffness and integrity. Between the structural elements the walls are filled in with a variety of materials, including wattle and daub (torchis); fired bricks; timber cladding; door and window openings. (Figure 3.)

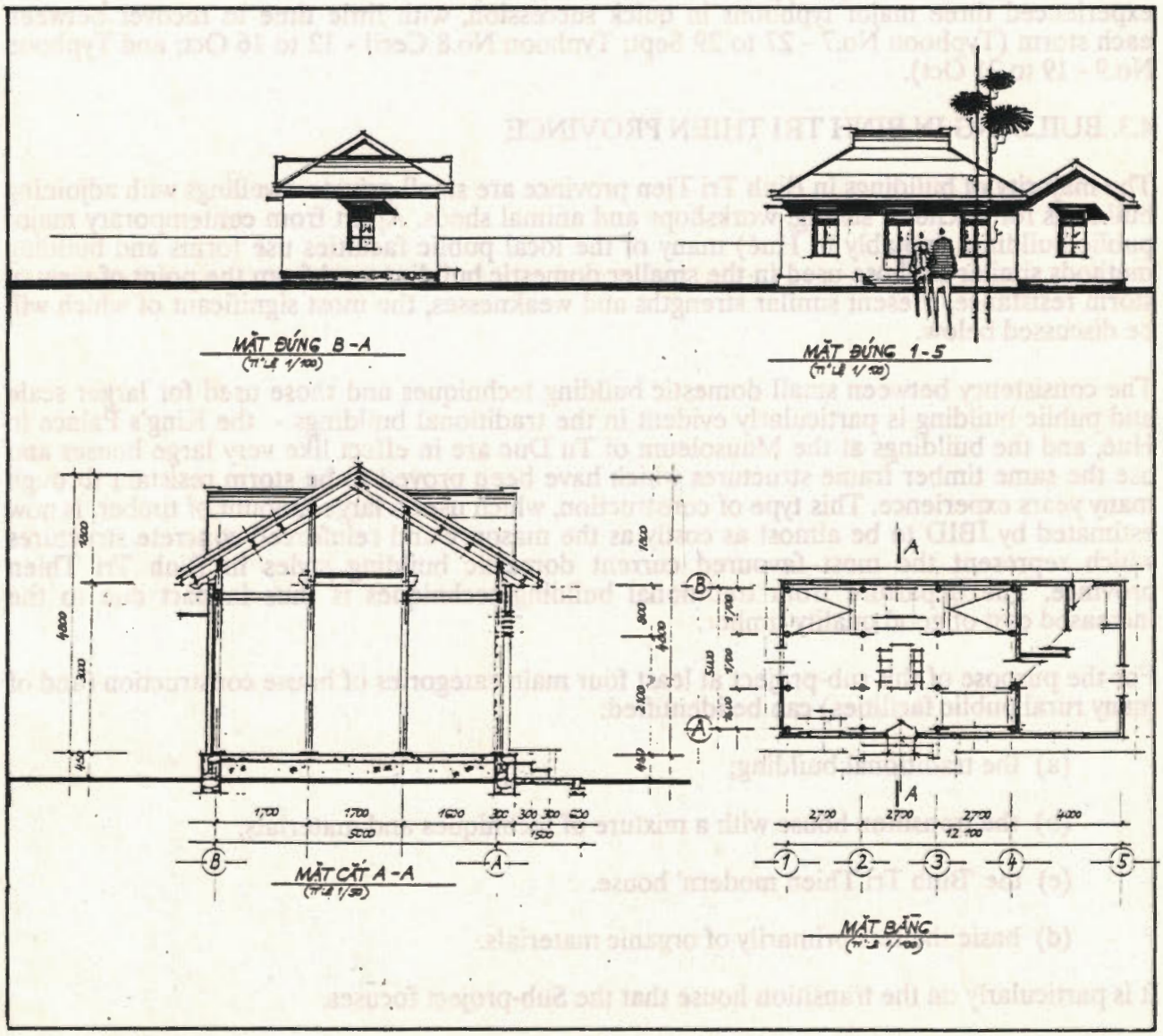


Fig. 3. Traditional House, Binh Tri Thien (Surveyed by IBID)

The roof frame depends on the supporting columns below each major joint. Figure 3 shows the plans and sections of a typical traditional house. The roof is quite steep (in most cases the slope is probably more than 30^{o}). On many of the traditional buildings the roof has hipped ends, which help to provide structural stiffness in the roof frame, and which present less obstruction to high winds. Roofs on older buildings were often covered with flat or slightly curved plain tiles where benefit is gained from the large amount of overlap so that each tile is weighed down by the tiles above it, thus better resisting the lifting effects of high winds. Machine made tiles are also common. Roofs are alternatively in many instances thatched. (Figure.4.)

In most of the examples seen in and around Hué the main house has an annexe attached to one side of it, the structure of which is at right angles to that of the main house.

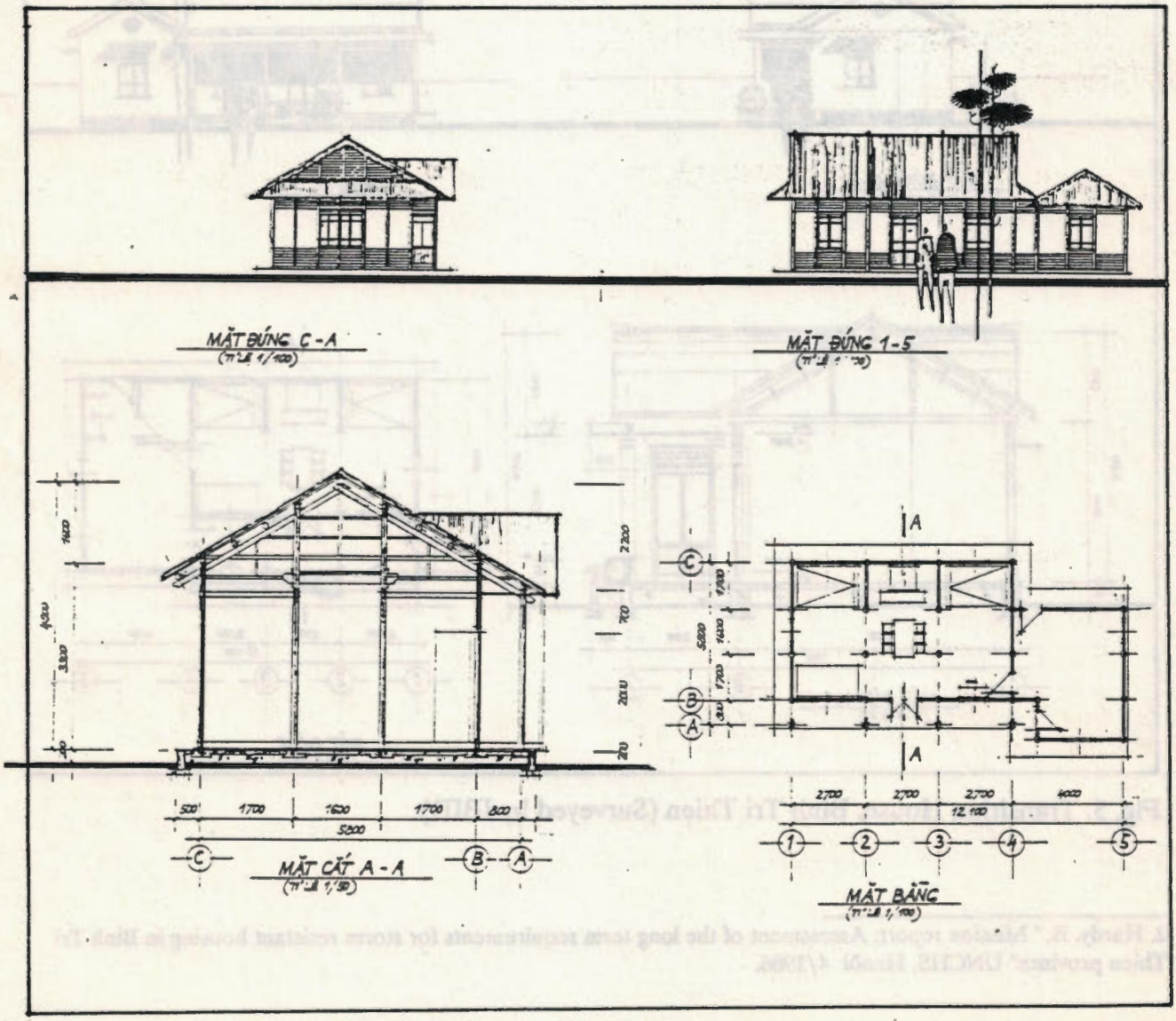


Fig. 4. Traditional House with Thatch, Binh Tri Tien (Surveyed by IBID)

The transition house

The transition houses resemble the traditional house in plan - a main room to which is attached a transverse annexe. In front of the main house there is nearly always a covered veranda. The annexe is frequently less well built than the main house.

The transition house (Figure 5.) combines traditional and new techniques of building and materials. In many cases the timber frame has been replaced by slender load-bearing masonry walls. Reinforced concrete posts and beams are also common. [2] Corrugated iron is often used for the covering, or machine made tiles. Gable-end roofs are more common than hipped, and the roof pitch appears to be less steep. The covering of the veranda is frequently of a different material to that of the main roof covering; but in addition, roof covering on the visible side of the house was also observed in some cases to be more substantial than on the rear slope.

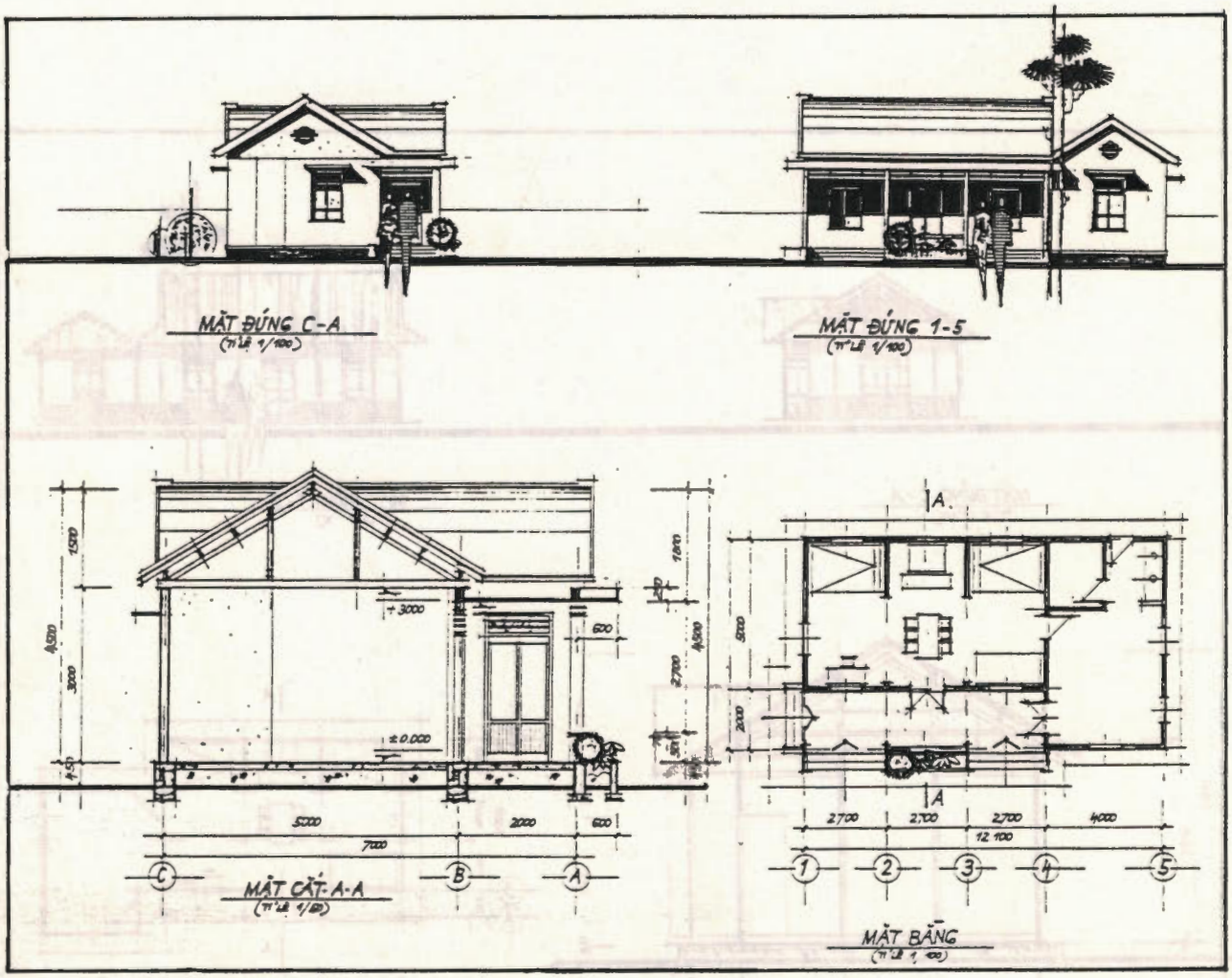


Fig. 5. Transition House, Binh Tri Thien (Surveyed by IBID)

2. Hardy. B. " Mission report: Assessment of the long term requirements for storm resistant housing in Binh Tri Thien province" UNCHS, Hanôi 4/1986.

Because of the hybrid nature of these houses, a simple classification is not possible. However, from preliminary observations made during the time in Binh Tri Thien province, several characteristics related to the storm resistance of the transition house do emerge:

* The construction of many of these houses is an ongoing process, where the desired end result is probably a version of the 'Binh Tri Thien modern' house (see below). For example, the veranda often has reinforced concrete posts supporting a corrugated iron roof which will, means permitting, be replaced later by a flat reinforced concrete roof. Meanwhile, the veranda roof, subject to great positive and negative pressure, is at high risk during a storm.
The evolutive nature of house building means inevitably that poor quality materials may be used in parts of the house, and poor detailing and jointing occur where incompatible materials meet. Thus one of the difficulties of the transition house is to achieve structural integrity in what may not be perceived by the owner as the definitive version of the building.

* In many cases the central posts which supported the roof frame in the traditional house are no longer used. The roof frame rests on the perimeter wall, and now requires a substantial and heavy bottom horizontal member to the 'truss'. The joint between the roof frame and the top of the wall is also often very weak. Roof structures are also inadequately braced. There is scope for improving both the economy and the strength of the roof.

* In a number of houses it was noted that the masonry walls are thin and thus lack stiffness. The top of the wall does not always have a ring beam, although more commonly there is a ring beam at the lintel level of openings, some 50cms below the top of the wall. The gable end wall also represents a point of weakness.

* The fixing of doors and shutters in masonry openings is often weak. In many instances there is no secure means of closing the openings.

* Difficulties in affording good quality materials are apparent in the majority of the transition houses. There is a considerable use of waste and scrap material for walls and roofing.

* As observed in the mission undertaken by B. Hardy,[*3] the departure from traditional building techniques and materials has resulted in poor design and construction techniques when using less familiar materials. In addition, similar shortcomings exist in the production of materials, and particularly in lime/sand block making.

The 'Binh Tri Thien modern' house

This is similar in plan layout to the previous types, (Figure 6.) but most often consists of a reinforced concrete frame, with brick infill, a tiled roof on the main structure and a reinforced concrete flat roof over the veranda. Significant advantages over the 'transition house' is the development of the reinforced concrete veranda roof, and the use of more substantial materials for the construction of the annexe - seen in the example here as an integral part of the building. The storm resistance of these buildings still, however, depends greatly on (a) the quality of materials that have been used, and (b) the quality of building

3. Idem.

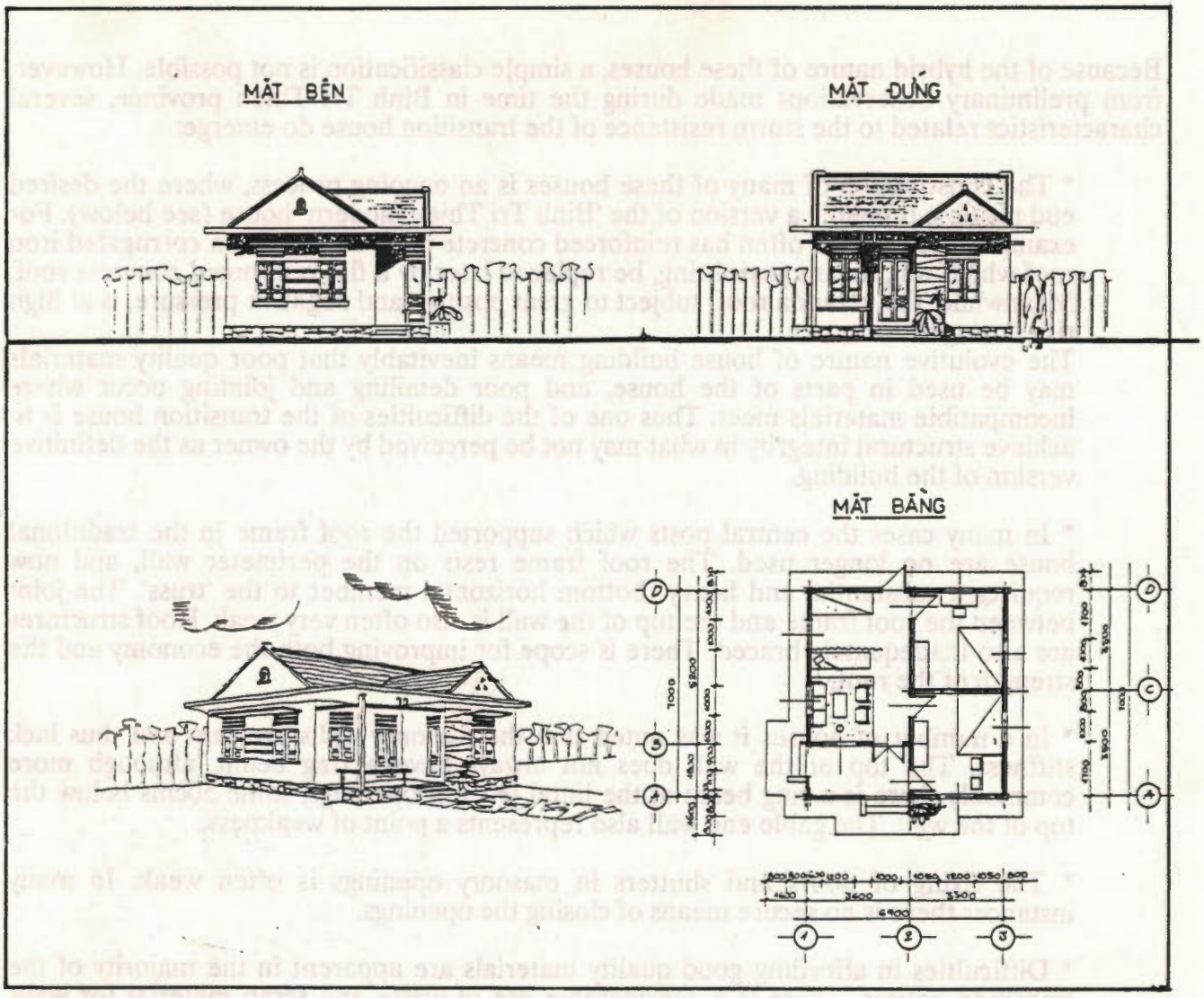


Fig. 6. Binh Tri Thien "modern", Surveyed by IBID

work. This will particularly be the case where the house has evolved from a less substantial 'transition house' as described above.

Basic shelters primarily of organic materials

Many dwellings can be classified neither as 'traditional' nor 'transition' buildings, but consist instead of pole structures, covered with thatch, or, more rarely, bitumen coated roofing felt or old corrugated sheeting, and with walls that in most cases are also thatched with rice straw, or of bamboo matting plastered with mud. The dwellings that were examined were all on the edge of the lagoon in Phu Loc district, the homes of fishing families who had previously lived on their boats. Reports from UN missions undertaken shortly after the 1985 typhoons say that this type of building was very extensively damaged [4], but quickly repaired with local resources.

4. Idem.

Building materials.

The majority of materials used in construction, including cement, are produced in the province.

Table 2 gives a list of materials and prices as indicated by the IBID.

MATERIAL COTS (Actual) Jan. 89

N	MATERIAL	UNIT	PRICE	
			DONG(VN)	USD
1	NATIONAL CEMENT	TON	480000	137.14
2	LOCAL CEMENT	TON	400000	114.29
3	POWDER LIME	TON	120000	34.29
4	LIME FOR THE WASH	TON	150000	42.86
5	DRESSED LIME	TON	157500	45.00
6	CHOPPED STONE 40x20x10	UNIT	1000	0.29
7	RUBBLE STONE	m3	49000	14.00
8	GRAVEL 1-2 cm	m3	45000	12.86
9	GRAVEL 2-4 cm	m3	44000	12.57
10	GRAVEL 4-6 cm	m3	42000	12.00
11	SAND	m3	52500	15.00
12	BRICK 22x11x6	UNIT	200	0.06
13	BRICK 20x10x5	UNIT	150	0.04
14	BLOCK 30x20x12	UNIT	600	0.17
15	FLOORING BRICK (CEMENT)	UNIT	450	0.13
16	TILE	UNIT	300	0.09
17	CORRUGATED IRON	m2	6000	1.71
18	CORRUGATED FIBRE	m2	4500	1.29
19	THATCH	kg	200	0.06
20	WOOD OF THE 1st QUALITY	m3	900000	257.14
21	WOOD OF THE 2nd QUALITY	m3	850000	242.86
22	WOOD OF THE 3rd QUALITY	m3	800000	228.57
23	WOODEN BOARD OF THE 1st QUALITY	m3	1000000	285.71
24	WOODEN BOARD OF THE 2nd QUALITY	m3	950000	271.43
25	WOODEN BOARD OF THE 3rd QUALITY	m3	900000	257.14
26	BAMBOO 8-10 cm DIA	m	1000	0.29
27	RATTAN	m	100	0.03
28	LONG BAMBOO HURDLE FOR SHELTER	m2	2500	0.71
29	STEEL	TON	2500000	714.29
30	WIRE	kg	5000	1.43
31	NAILS	kg	4000	1.14
32	ROPE	m	500	0.14

DIRECTOR OF THE SUB-PROJECT No 3
(VIE /85/019C)

Eng. NGUYEN SI VIEN

Some of the materials deserve a preliminary comment: during the Phase 1 and Phase 2 Workshops there will be a throrough analysis of available materials.

Roofing materials:

Roof tiles are manufactured in the province. Although provision is made in the form of the tile for a hole to be pierced on the lower underside of the tile through which a wire can be passed to stop the tile from lifting in a storm, this hole is not made. This makes secure fastening of the tile difficult. In the future the producers need to be encouraged to rectify this omission.

Thatching panels measuring 120cms long by about 70cms high are made with rice straw. Changes in the rice species is reducing the length of straw from 100 to nearer 60 cms, and thus reducing the possibility of achieving a thick durable thatch coat on the roof. Fresh straw is available in June and July.

Masonry and binders:

Sand/lime blocks are hand moulded using a ratio of 4 parts sand to 1 part lime. The quality observed is generally poor, uneven in form and sand content. These blocks are laid with the narrowest face down in many instances.

Lime is produced in the villages from sea shells burnt with coal in small pits.

5. ORGANIZATION OF THE SUB-PROJECT

5.1 THE INSTITUTIONAL FRAMEWORK

Under the auspices of the Ministry of Construction in Hanoi, and the People's Committee of Binh Tri Tien province, the Vietnamese counterparts responsible for the Sub-Project are:

(a) In Binh Tri Thien province:
The Vice President of the People's Committee of the Province of Binh Tri Thien (Overall Project Director)

The Institute of Building Investigation and Design (IBID), Binh Tri Thien province (Sub-Project No.3. Director)

(b) In Hanoi:
The Institute of Housing and Public Building Design (IHPBD), Ministry of Construction (MOC).

During meetings in Hué there was concern, because of the distance from Hanoi, about communication between UNDP (and by extension Development Workshop/GRET), and the organizations involved in the project in Binh Tri Thien province. It is particularly important that documents quickly reach the project counterparts in BTT. The following procedure was clarified by UNDP. Project documents from Development Workshop/GRET will be transmitted to the UNDP office in Hanoi, who will in turn transmit them to the following organizations:

- the Ministry of Construction, Hanoi; and through the MOC, the Institute of Housing and Public Building Design (IHPBD);
- the Provincial Director of the overall project in BTT;
- the Institute of Building Investigation and Design in BTT;
- AIDRECEP, Hanoi;

5.2. LINK TO THE OTHER SUB-PROJECTS.

As has been noted above (paragraph 2.2), Sub-Project No.3 is part of a three project package for the Binh Tri Thien province. Although coordinating the start-up of these three Sub-Projects has resulted in some delays, there is now no apparent further reason why programming of the other sub-projects should have an effect on the programming and operation of Sub-Project No.3. This does not preclude any effort to promote cooperation between the sub-projects, and the provincial directors of the other Sub-Projects have been invited to follow the development of Sub-Project N^{O} 3.

5.3. COMMENTS AND REVISIONS TO THE OVERALL PROGRAMMING OF THE SUB-PROJECT

Overall programming

During meetings in Hanoi and in Binh Tri Thien province the overall programming of the project was discussed. The IHPBD and IBID expressed the hope that the Phase 2 workshops could be completed sooner than January 1990. Examination of the work that needs to be done on the preparation of project media following the Phase 1 workshops, the normal demands on the IBID and local builders during the typhoon season, and the duration of the

rainy season in Binh Tri Thien province (during which IBID advise that it is not a suitable time to run a training programme) have all, however, indicated that it would be more realistic to postpone the start of the Phase 2 workshops until February 15th 1990, thus allowing the Phase 2 workshop to start immediately after Tet (Vietnam New Year Holiday).

This postponement has formally been requested in writing by IBID.

In order better to accommodate the time needed for the construction of the first demonstration building during the Phase 1 workshop (not originally included in the Development Workshop/GRET project proposal timetable), and for the greater involvement of Binh Tri Thien decision makers in the development of the project, it was agreed that the order of seminars and workshops in the Phase 1 programme (originally envisaged as the technicians' and builders' workshops followed by the policy-makers' seminar) should be revised as follows:

1. policy makers' seminar;
2. technicians' workshop;
3. builders' training workshop.

The technicians' and builders' workshops will run concurrently with the construction of the first demonstration building.

These changes are shown in the revised project timetable, and do not effect the overall timetable. For greater detail see Section 6: "ORGANIZATION OF THE PHASE 1 WORKSHOPS", below.

It was also jointly agreed that the detailed programming of the Phase 2 workshops and more developed decisions about the second demonstration building would be made during and after the Phase 1 period in May and June 1989, and thus benefit from the collective experience gained during Phase 1 activities.

The demonstration buildings

In Hué it was agreed with IBID and M. Thang from the IHPBD in Hanoi that the demonstration buildings should ideally be small public buildings which will thus have a practical function and attract visitors. Using the US$40,000 which is available for the construction of prototypes, IBID would ideally like to build at least four demonstration buildings if the budget allows, of which at present only two will be under the supervision of Development Workshop/GRET.

IBID proposes the following building types and locations, of provisionally which the first two will be linked to technicians' and builders' training programmes organized by Development Workshop/GRET:

Demonstration building No. 1: Primary School at Loc Dien, Phu Loc District.
Demonstration building No. 2: People's library at Quang Thuan, Quang Trach District.
Demonstration building No. 3: Primary School at Hai An, Trieu Hai District.
Demonstration building No. 4: House at Thuy Truong -Truong An, Hué District.

Figure 7. shows the location of the proposed buildings. The sites for all four buildings have been surveyed by IBID. With reference to the Sub-Project special clauses, Annexe V, paragraph 1, final decisions about the design and programming of demonstration buildings

(other than the first one at Loc Dien) will be made during or after the Phase 1 workshop. This is particularly necessary because of fluctuations and uncertainties about building costs.

Location of the training workshops

The Phase 1 workshops will be at Hué and Loc Dien in the Phu Loc District.
The Phase 2 workshops will be in the area of the Quang Trach District.

5.4. RELATED WORK ALREADY DONE BY IHPBD AND IBID

Both the IHPBD and IBID have already undertaken work which will contribute to the project. In 1988 IHPBD organized and ran a short seminar for technicians in the BTT province on typhoons and typhoon resistant design. For this, they prepared 52 A2 size panels explaining the problem of typhoons and some of the techniques which can be used in building design to mitigate the risk, and two small illustrated guides. This provides an invaluable base of material in Vietnamese.

In BTT province, IBID have surveyed both traditional, transition and BTT modern houses (details of which are produced in this report) and prepared climatic data for the south, centre and north of the province.

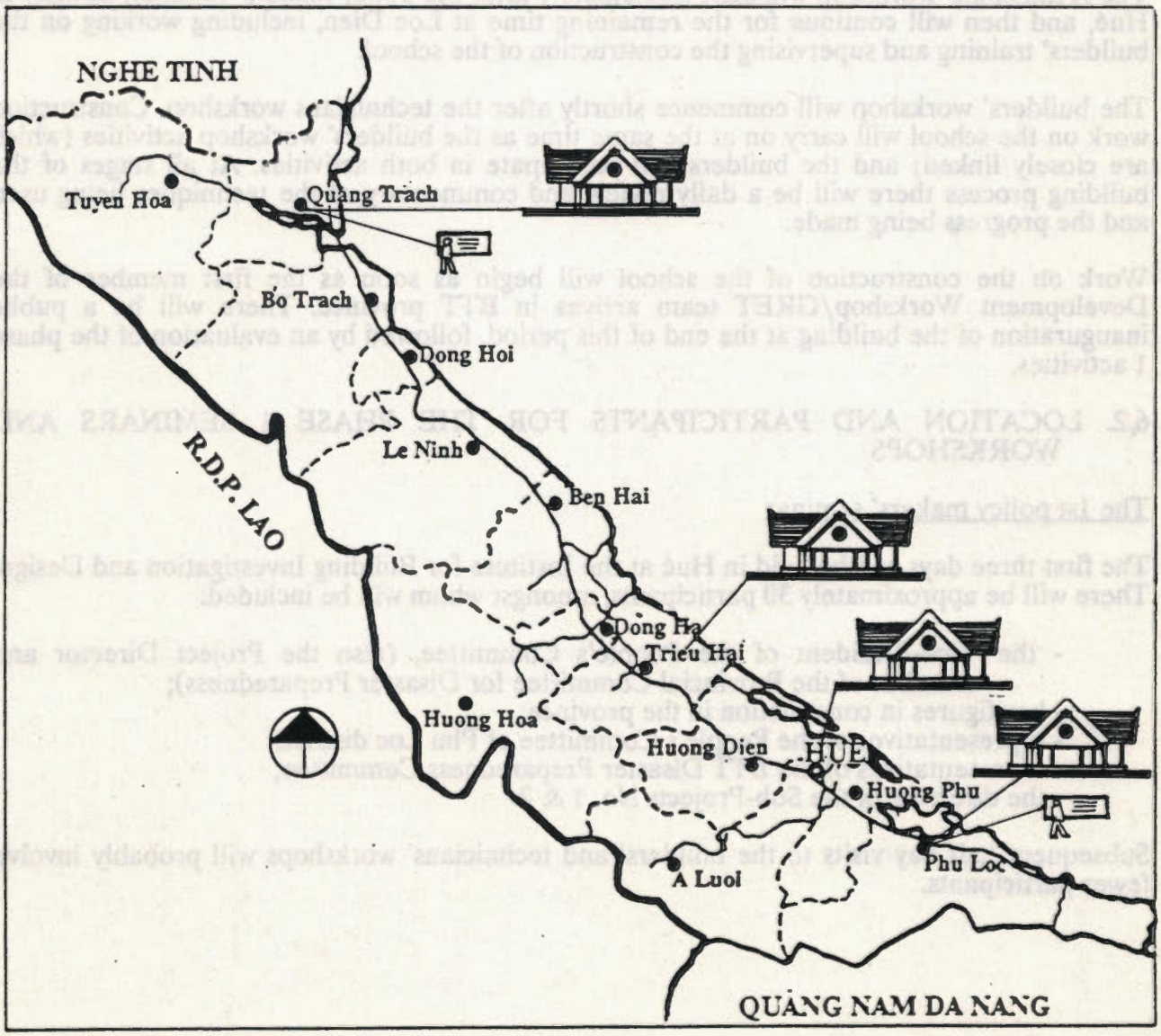


Fig. 7. Location of demonstration buildings and workshops.

6. ORGANIZATION OF PHASE 1 WORKSHOPS

6.1. THE WORKSHOP TIMETABLE

The revised timetable for the Phase 1 seminar and workshops is shown in Table 3. The Phase 1 inputs will commence on the 3rd May, subject to all equipment and building materials being already available and, where relevant, working. A minimum of time will be necessary for practical discussions in Hanoi. Development Workshop/GRET activities in Binh Tri Thien will commence on or as soon as possible after 6th May. The Phase 1 Development Workshop/GRET activities in Binh Tri Thien will end in mid June. Except at the start and the finish, Development Workshop/GRET will have two experts in Vietnam.

The policy makers seminar is divided into two parts:

(a) a three day seminar to launch the programme and develop approaches to dissemination of information about storm resistant building techniques;

and:

(b) follow up half-day sessions at Loc Dien during the ensuing weeks, to enable policy makers to observe and comment on the workshop activities.

The technicians' workshop will start immediately after the policy makers' seminar, initially in Hué, and then will continue for the remaining time at Loc Dien, including working on the builders' training and supervising the construction of the school.

The builders' workshop will commence shortly after the technicians workshop. Construction work on the school will carry on at the same time as the builders' workshop activities (which are closely linked) and the builders will participate in both activities. At all stages of the building process there will be a daily review and commentary of the techniques being used and the progress being made.

Work on the construction of the school will begin as soon as the first member of the Development Workshop/GRET team arrives in BTT province. There will be a public inauguration of the building at the end of this period, followed by an evaluation of the phase 1 activities.

6.2. LOCATION AND PARTICIPANTS FOR THE PHASE 1 SEMINARS AND WORKSHOPS

<u>The 1st policy makers' seminar</u>

The first three days will be held in Hué at the Institute for Building Investigation and Design. There will be approximately 30 participants, amongst whom will be included:

- the Vice-President of the People's Committee, (also the Project Director and member of the Provincial Committee for Disaster Preparedness);
- key figures in construction in the province;
- representatives of the People's Committee of Phu Loc district;
- representatives of the BTT Disaster Preparedness Committee;
- the directors of the Sub-Projects No. 1 & 2.

Subsequent half day visits to the builders' and technicians' workshops will probably involve fewer participants.

Table 3. The Phase 1 Workshop Timetable.

TIME		ADMIN	POLICY	TECHNICIANS	BUILDERS'	BUILDING
MONTH	DAY	PLANNING	SEMINAR	WORKSHOP	WORKSHOP	CONSTRUCTION
MAY	3 Wed	JN arrive Hanoi				
	4 Thu	Meetings in				
	5 Fri	Hanoi				
	6 Sat	JN to HUE				
	8 Mon	GC arrive HANOI				
	9 Tue			Check facilities	Check facilities	Lay-out School
	10 Wed					Start
	11 Thu					Foundations
	12 Fri					Check materials
	13 Sat					
	15 Mon		Policy Seminar			
	16 Tue		Policy Seminar			
	17 Wed		Policy Seminar			
	18 Thu			Technicians		
	19 Fri			Wk'shop starts		
	20 Sat			in HUE		
	22 Mon			Technicians	Builders'	
	23 Tue			Wk'shop	workshop	
	24 Wed			continues	starts	
	25 Thu			in HUE	in Loc Dien	
	26 Fri			and Loc Dien		
	27 Sat		1/2 day			
	29 Mon				Builders'	
	30 Tue			Wkshop	workshop	
	31 Wed			mainly Loc Dien	continues	
JUNE	1 Thu			with Building		
	2 Fri			Supervision		
	3 Sat		1/2 day			
	5 Mon					
	6 Tue			Supervise		
	7 Wed			building		
	8 Thu			work		
	9 Fri		INAUGURATION	INAUGURATION	INAUGURATION	INAUGURATION
	10 Sat					
	12 Mon	EVALUATION				
	13 Tue					
	14 Wed					
	15 Thu					
	16 Fri					
	17 Sat	END DW/GRET INPUT				

The 1st technicians' workshop

This will be held (a) at the Institute for Building Investigation and Design in Hué, and (b) out at the site of the Demonstration Building at Loc Dien, which is also where the training of builders will take place. There will be approximately 25 participants, including the following:

- professionals from the Institute;
- architects, civil engineers and building technicians working in the districts of the province.

For the first workshop, participants from the Hué region and the southern part of the province will have preference over those who work in the north of the province.

The 1st builders' training workshop

This will be held at Loc Dien, on the same site as the demonstration building. There will be approximately 30 participants, who will come from neighbouring districts.

It has been stressed that the participants (a) must be actively involved in the practical work of building, (i.e. not administrators) and (b) should represent both builders who are employed by the government and those who work privately on individual domestic building. To facilitate the participation of builders who would otherwise be earning by working, IBID is to request UNDP for subsistence and loss of earnings support for these participants.

Each participating builder must bring his own building tools.

IBID will now prepare a list of the participants, including a statement of where they work and who for.

6.3. STAFF FOR THE PROJECT

Annexe 3 shows the names and qualifications of staff already allocated to the project from the IHPBD in Hanoi and the IBID in Hué.

According to the list of personnel to be allocated to the project by the Government of Vietnam, the services of an additional draughtsman and a graphic artist (full-time) still need to be made available. IBID will provide the secretarial services required for the project.

It was also agreed that the two full-time interpreters (English - Vietnamese) would be provided during the times that Development Workshop/GRET experts are in Vietnam.

IBID is also responsible for providing the labour required on their building and training site at Loc Dien.

6.4. FACILITIES

For the Phase 1 seminars and workshops, in Hué IBID has one large hall able to seat 120 people, and a smaller room for working groups for at least 30 people. In addition, substantial office space is being provided for the Development Workshop/GRET team, for the draughtsman and technicians working on the project, and for the computer and photocopying machine.

The workshop activities in Loc Dien will take place in an uncompleted school building, consisting of two large classroom spaces (undivided) roofed with tiles. This is immediately adjacent to the site of the 1st Demonstration building, and there is in addition ample space for other small practical training activities (wall building etc.). There are wells on the site, and it has been agreed that additional wells will be dug before the start of the workshop to ensure a good water supply. Storage space is available on the site as well.

The People's Committee of Phu Loc have agreed to provide chairs and tables for the workshop, and this same furniture will then be used in the new school once it is finished. In addition, a blackboard needs to be provided. There is at present no electricity on the site. In the event that electricity is needed for teaching/presentation purposes, Phu Loc, ten minutes away, has a cultural centre which can be used.

6.5. EQUIPMENT

IBID has visibly little equipment of its own. It can borrow video projection equipment for showing films. At present it makes use of a computer in another organization in Hué.

The arrival and installation of the equipment ordered for the project by UNCHS is critical in allowing the start of the Phase 1 seminar and workshops. IBID have been asked to confirm to Development Workshop/GRET via the UNDP when the equipment is in place and functioning.

For the Phase 1 activities the equipment supplied by UNCHS for the use of its experts working on the project will need to be in Hué. It should however be noted that the Phase 2 activities will be taking place in the north of the province and the same equipment will need to be transported to a suitable location near the Phase 2 activities for the duration of these latter seminars and workshops.

In addition to equipment available in Hué, during the visit to Phu Loc it was ascertained that almost every district has its own video projection equipment (PAL/SECAM). In Phu Loc there are five sets distributed amongst the district's villages, and these can be used by the project.

6.6. ENGAGEMENTS AND PREPARATION ACTION

For the preparation of the Phase 1 workshop period, it was agrred that the following action was necessary, some of which has now been carried out:

* At the end of the Preliminary Field Analysis mission, Development Workshop/GRET submitted the estimated m^2 requirements for bamboo matting for the 1st Demonstration building, to IHPBD, in order that IBID can proceed straight away with buying bamboo.

* Development Workshop/GRET have sent the drawings, quantities and spending limit documents concerning the 1st Demonstration building, to UNDP, who will now in turn transmit them to the IHPBD and IBID as agreed. Receipt and approval of these documents will be notified by the IHPBD in writing to UNDP who will confirm to Development Workshop/GRET by telex.

* IBID will notify Development Workshop/GRET (via UNDP telex) once the building materials for the demonstration building are purchased and delivered; they

will also notify Development Workshop/GRET when the equipment ordered by UNCHS is installed and working.

* Phu Loc People's Committee have agreed to provide the tables and chairs (or benches) for use in at the Loc Dien workshop site. There should be sufficient furniture for at least 60 people (combined participants of builders' and technicians' workshops, and Development Workshop/GRET). In addition, a blackboard will be necessary.

* A reliable water supply will be arranged for the Loc Dien site, if necessary by digging a new well.

* The building in which it has been agreed that the workshop discussions will take place at Loc Dien will need to be cleared (of blocks, etc.).

6.7. THE 1ST DEMONSTRATION BUILDING

Function and choice of material.

The 1st demonstration building will be a primary school at Loc Dien. The site already has one two-classroom framed building in extremely bad condition and close to collapse, and the foundations half finished for an additional classroom.

The agreed proposal for the demonstration building will include two new classrooms, a small office and a storage space. The standard dimensions for the classrooms have been given as 5m x 7m. The total built areas including a veranda on one side will be approximately 120m^2.

A preliminary design and choice of materials and siting has been made with the staff of IBID. The plans and elevations for the building are shown in Annexe 4. The site is some 4 to 5m above the lagoon water level, and according to IBID, does not flood.

The classrooms will be built with a timber frame structure and infill panels of bamboo wattle plastered with a sand/lime render. The roof will be covered with machine made tiles on a wood framework. The choice of these materials for the largest part of the building has been made on the following basis:

* many of the buildings in the area are timber framed structures, and at present have a number of weaknesses against storms for which stronger techniques can be demonstrated;

* the use of timber frame and wattle and daub infill panels for the walls most closely corresponds to the poorer type of construction being used in the area;
* the machine made tile roofs at present have a number of weak points; at the same time they are probably the most popular roofing material.

The office and store room is to be built at right angles to the classrooms, and in the same relationship of the annexe to the main building in the smaller house plans. The walls will be in masonry blockwork. It was agreed that the use of a second material would extend the benefit of the demonstration. The choice of blockwork was made on the following basis;

* blocks are commonly used in the area; the design of masonry walls and the quality of blockwork are at present in many instances weak;
* masonry construction, in fired brick, in dressed stone and in sand/lime blocks, would appear to be the favoured wall construction for those who can afford it.

The Bill of Quantities for the purchase of materials is included in Annexe 5.

It is intended that the building, in addition to its normal school function, will serve as a refuge during storms. This is important since the buildings used by the fishermen's families in the immediate vicinity are in most cases extremely fragile.

Development of the demonstration building design

On the basis of the preliminary design work undertaken with IBID, the detail design of the building has been developed by Development Workshop/GRET during the Preparation Stage in France. The plans and material quantities for the building have been sent by Development Workshop/GRET to UNDP Hanoi. Following approval by IHPBD and IBID, IBID will proceed with the purchase of those materials which need to be available before the Phase 1 workshops begin.

Whilst the tight timetable for the purchase of materials and the start of building work requires that the building plans are developed at this stage, it is nevertheless the intention to involve the technicians, and the builders in decisions concerning the final details of construction.

Programming and financial procedures for the 1st demonstration building

At the same time as sending the plans and material quantities for Loc Dien School, Development Workshop/GRET will also send its authorization for the spending limit on purchases for this first building. This limit is presently agreed at US $6,500 for the purchase of materials for the 1st demonstration building. Additional costs will be incurred for labour, estimated at 30% of the total cost. Budgetting for the remaining demonstration buildings in the programme will be established in the light of a careful analysis of the costs of this first building.

On receipt of the approved plans and quantities, IBID will proceed with buying the remaining materials and then invoice UNDP again for reimbursement. The procedure for repayment from UNDP has been clearly explained to IBID.

ANNEXE 1: PEOPLE CONTACTED DURING THE FIRST MISSION

ANNEXE 1: PEOPLE CONTACTED DURING THE FIRST MISSION

1. Ministry of Construction

Nguyen Thu	Deputy Minister of Construction
Nguyen Manh Kiem	Deputy Minister of Construction

In the Department of International Cooperation, Hanoi

Le Doan Phach	Head of the Department
Tran Dinh Ha	Official

In the Institute of Housing and Public Building Design, Hanoi

Nguyen Hien	General Director
Truong Nguyen Man	Technical Director and Sub-Project Director
Tran Duc Nhuan	Architectural Director
Luu Tien Pham	Engineer
Cung Dinn Tien	Official
Giap Dinh Lieu	Official
Nguyen Tan Van	Head architect, Sub-Project VIE/85/019
Dang Huu Thong	Head engineer, Sub-Project VIE/85/019
Hoang Vinh Thang	Head engineer, Sub-Project VIE/85/019

In the Institute of Building Investigation and Design of Binh Tri Thien province (and working on VIE/85/019)

Nguyen Si Vien	Director
Dang Mon	Head, Research & Development Section
Ngo Tuan Minh	Designer
Nguyen Duc Thang	Head, Admin. and Planning Section
Vo Van Binh	Designer
Pham Huu Hanh	Translator

In the Institute of Design of Quang Nam Dan Nang province

Le Minh Triet	Director

2. The People's Committee of Binh Trio Thien province

Pham Ba Dien	Vice-President of the province, General Director of Project
Le Vien Cong	Vice-President of the province
Le Duc Duong	Official, Foreign Affairs Office
Nguyen Huu Ngo	Official
Vo Hoai Tan	Director, Sub-Project No.1
Nguyen Van Sac	Director, Sub-Project No.2
Nguyen Viet	Engineer, Sub-Project No.2

In the People's Committee of Phu Loc, Binh Tri Thien province

Nguyen Van Tinh	Vice-president

3. UNDP, Hanoi

Marylene Spezzati	Assistant Resident Representative
Albert J. Schmied	Chief Technical Advisor, UNCHS Hanoi

ANNEXE 2: DOCUMENTS RECEIVED FROM IBID AND THE IHPBD

ANNEXE 2: DOCUMENTS RECEIVED FROM IBID AND THE IHPBD

Documents received from the IHPBD, Hanoi:

1. Ngoe Nha Va Gio Bao: two manuals on storm resistant building techniques.
2. Cau Tao. Kien Truc: construction details produced by IHPBD.

Documents received from IBID:

1. Plans and sections and quantities for 4 house types in BTT province.
2. Climatic data for the north, centre and south of BTT.
3. List of building material costs.
4. Site plans for the demonstration buildings.
5. Truss details for 6m span.
6. Set of photos of 1985 typhoon damage.

Also received one copy of the Phu Loc monthly newspaper.

ANNEXE 3: VIETNAMESE STAFF FOR THE PROJECT

ANNEXE 3: VIETNAMESE STAFF FOR THE PROJECT

DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES
VIE/85/019
SUB-PROJECT No 3

LIST OF PERSONNEL
INSTITUTE OF BUILDING INVESTIGATION AND DESIGN
(BINH TRI THIEN PROVINCE)

N	NAME	OCUPATION	PRESENT POSITION	FUNCTION	PARTICIPANT TIME
1	NGUYEN SI VIEN	Civil Engineer	Director of the institute	Director of the Sub-project No 3	Part - time
2	DANG MON	Civil Engineer	Head of seetion	Structural engineer Construction instructor	Full - time
3	NGO TUAN MINH	Civil Engineer	Designer	Estructural engineer construction instructor	Full - time
4	NGUYEN DUC THANG	Architect	Head of seetion	Admin. and Planning	Part - time
5	VO VAN BINH	Technician	Designer	Designer - Draughtsman	Full - time
6	PHAN HUU HANH	Translator		English translator	Part - time
7	DOAN PHUC	Driver		Driver	Full - time
8	TRAN HUU CHUT	Driver		Driver	Full - time

DIRECTOR OF THE PROJECT VIE/85/019

DIRECTOR OF THE SUB-PROJECT NO 3
(VIE / 85 / 019C)

Eng. NGUYEN SI VIEN

DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES
VIE/85/019
SUB-PROJECT No 3

LIST OF PERSONNEL
INSTITUTE OF HOUSING AND PUBLIC BUIDING DESIGN
(MINISTRY OF CONSTRUCTION)

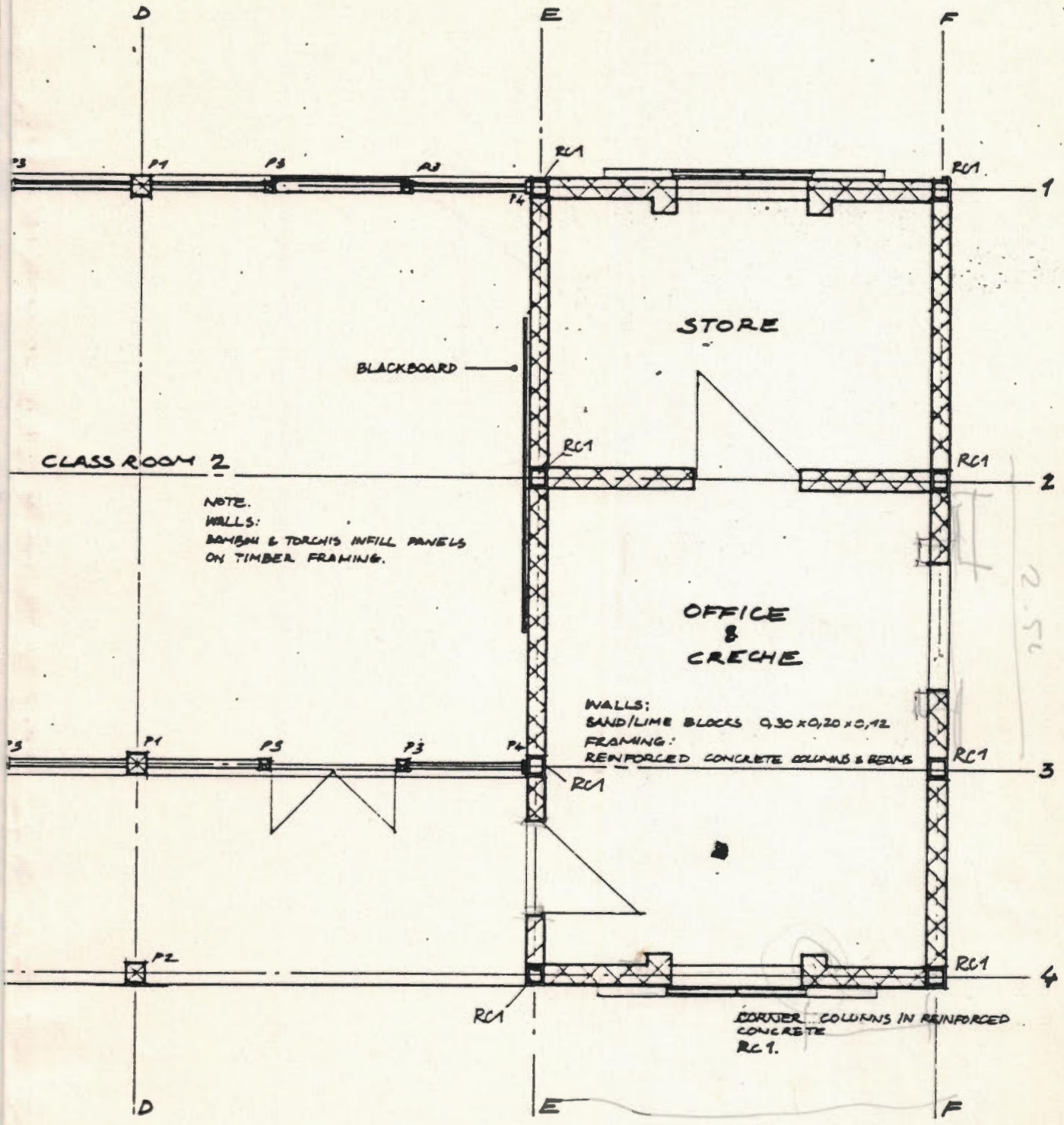
N	NAME	OCUPATION	PRESENT POSITION	FUNCTION	PARTICIPANT TIME
1	TRUONG NGUYEN HAN	Civil Engineer	Vice-Director	Coordinator	Part - time
2	NGUYEN TAN VAN	Architect	Head architect	Architectural designer	Full - tiee
3	DANG HUU THONG	Doctor candidate	Head engineer	Estructural designer	Part - tiae
4	HOANG VINH THANG	Master of Engineering	Head engineer	Estructural designer	Full - tiae

GERENAL DIRECTOR OF
THE PROJECT VIE/85/019

DIRECTOR OF THE HOUSING
AND PUBLIC BUILDING DESIGN

DIRECTOR OF THE SUB-PROJECT NO 3
(VIE / 85 / 019C)

ANNEXE 4: PLANS SECTIONS AND ELEVATION FOR THE FIRST DEMONSTRATION BUILDING



Institute for Housing Design & Public Building, Hanoi

Institute for Building Investigation and Design, Hue

SCHOOL AT LOC DIEN, PHU LOC DISTRICT

Title: FLOOR PLAN

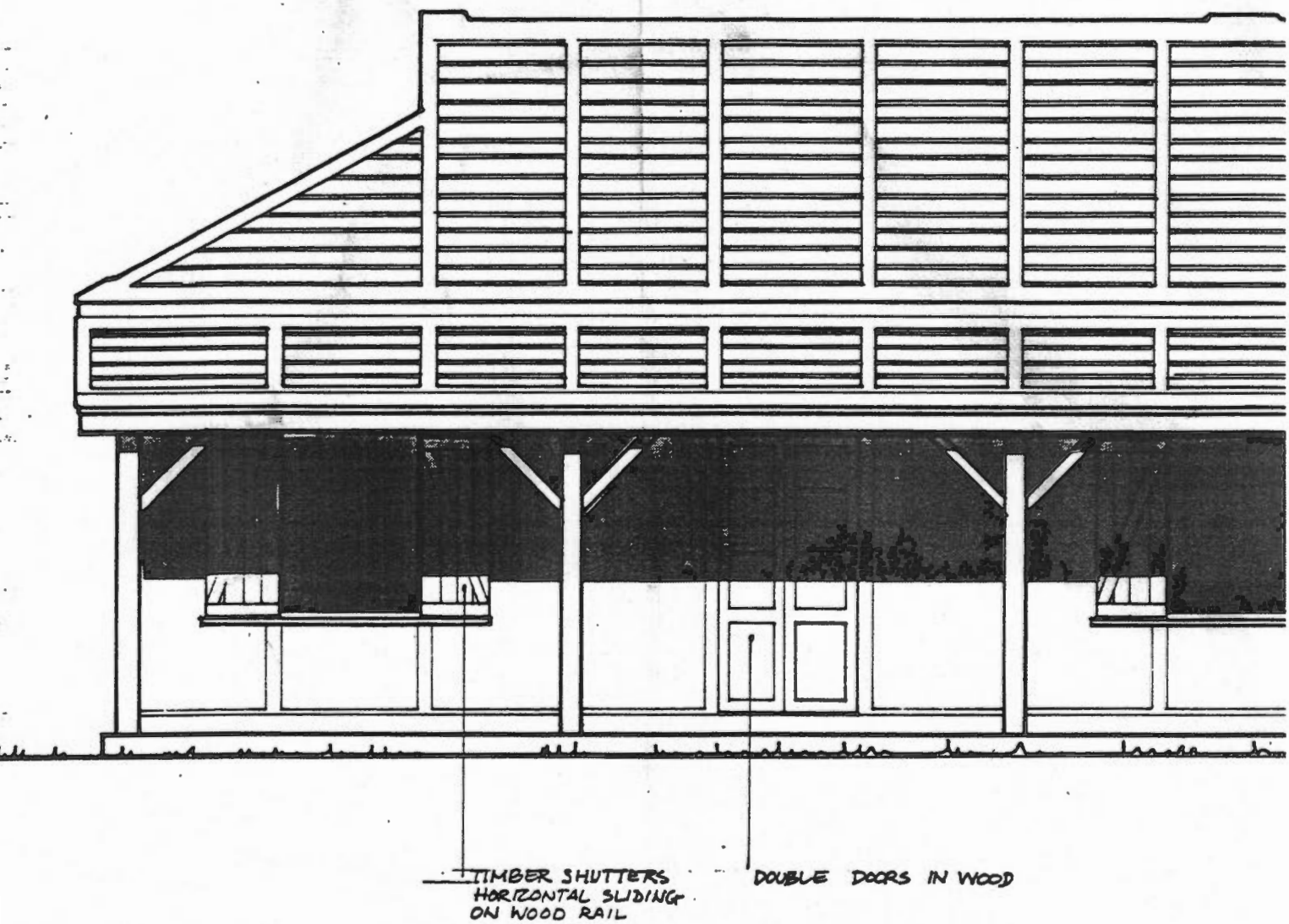
Drawing No: 1 Date: 27 Feb. 89 Version: 1

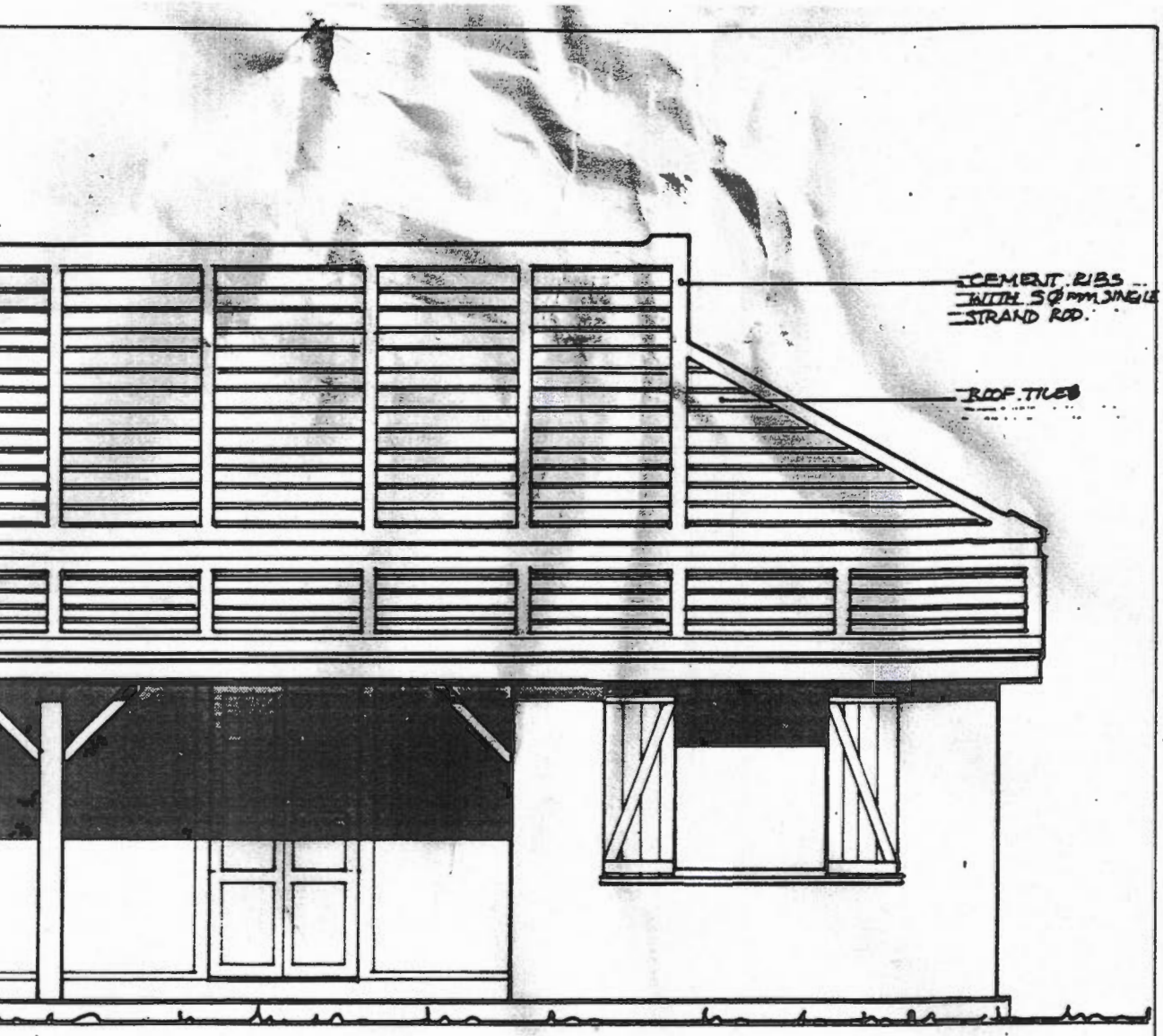
Development Workshop

GRET

DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES, (VIE/85/019)

BINH TRI THIEN PROVINCE, VIETNAM


TIMBER SHUTTERS
HORIZONTAL SLIDING
ON WOOD RAIL
DOUBLE DOORS IN WOOD



SCALE METRES 0 1 2 3 4

stitute for Housing Design & Public Building, Hanoi

tute for Building Investigation and Design, Hue

SCHOOL AT LOC DIEN, PHU LOC DISTRICT

Title: ELEVATION - MAIN FACADE

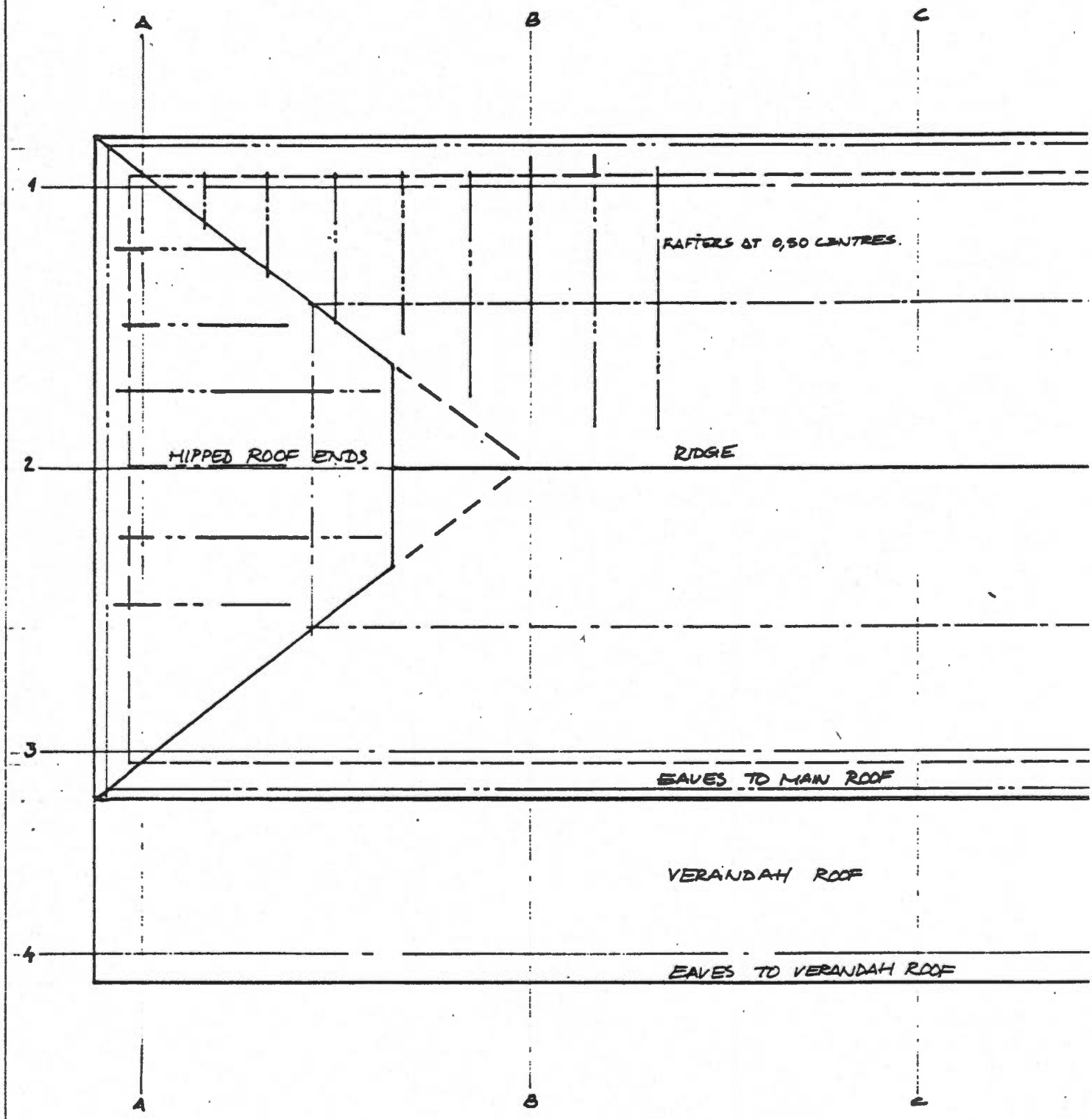
Drawing No: 2 Date: 27 Feb 89 Version: 1

evelopment Workshop

GRET

DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES, (VIE/85/019)

BINH TRI THIEN PROVINCE, VIETNAM


A
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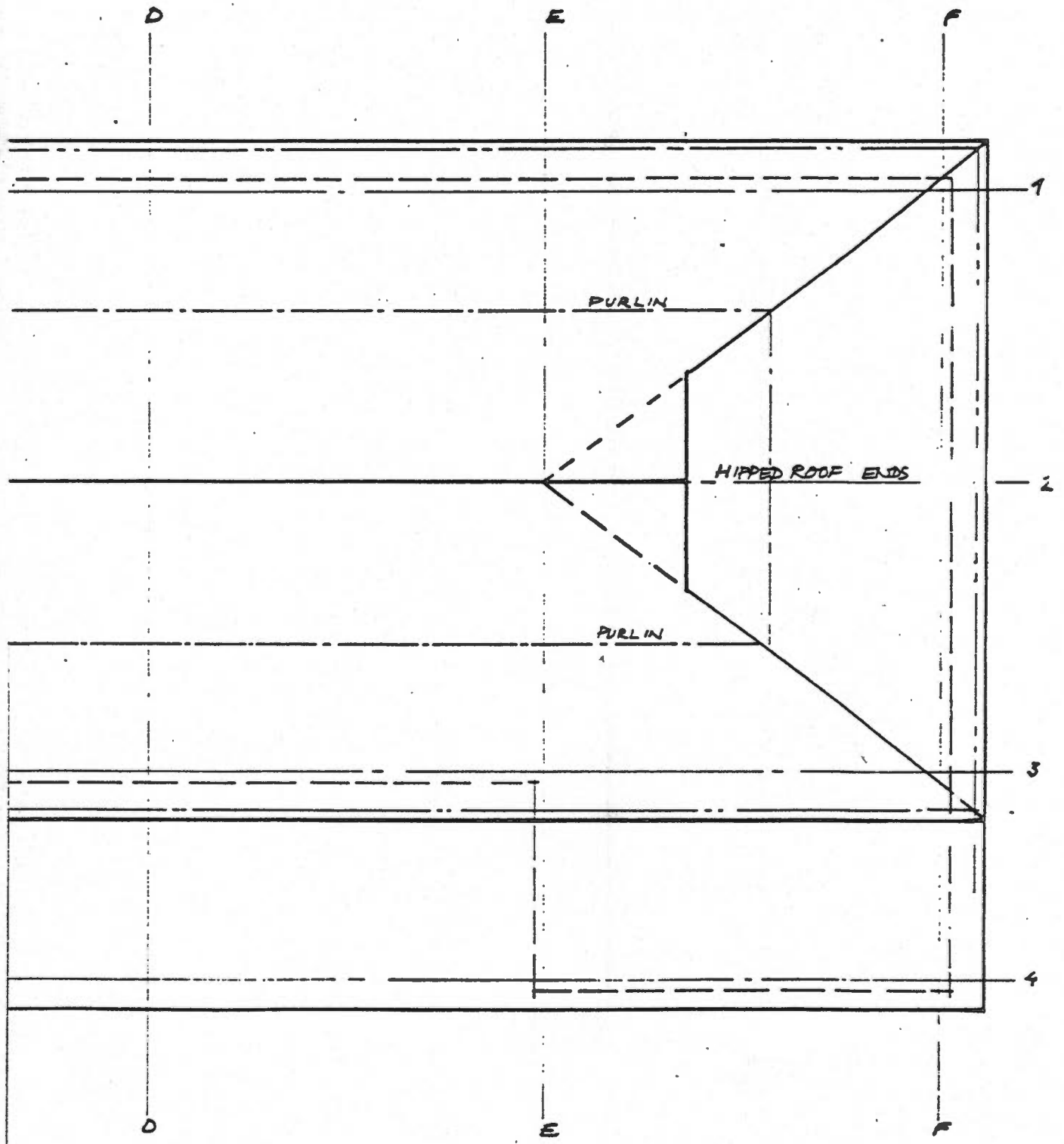
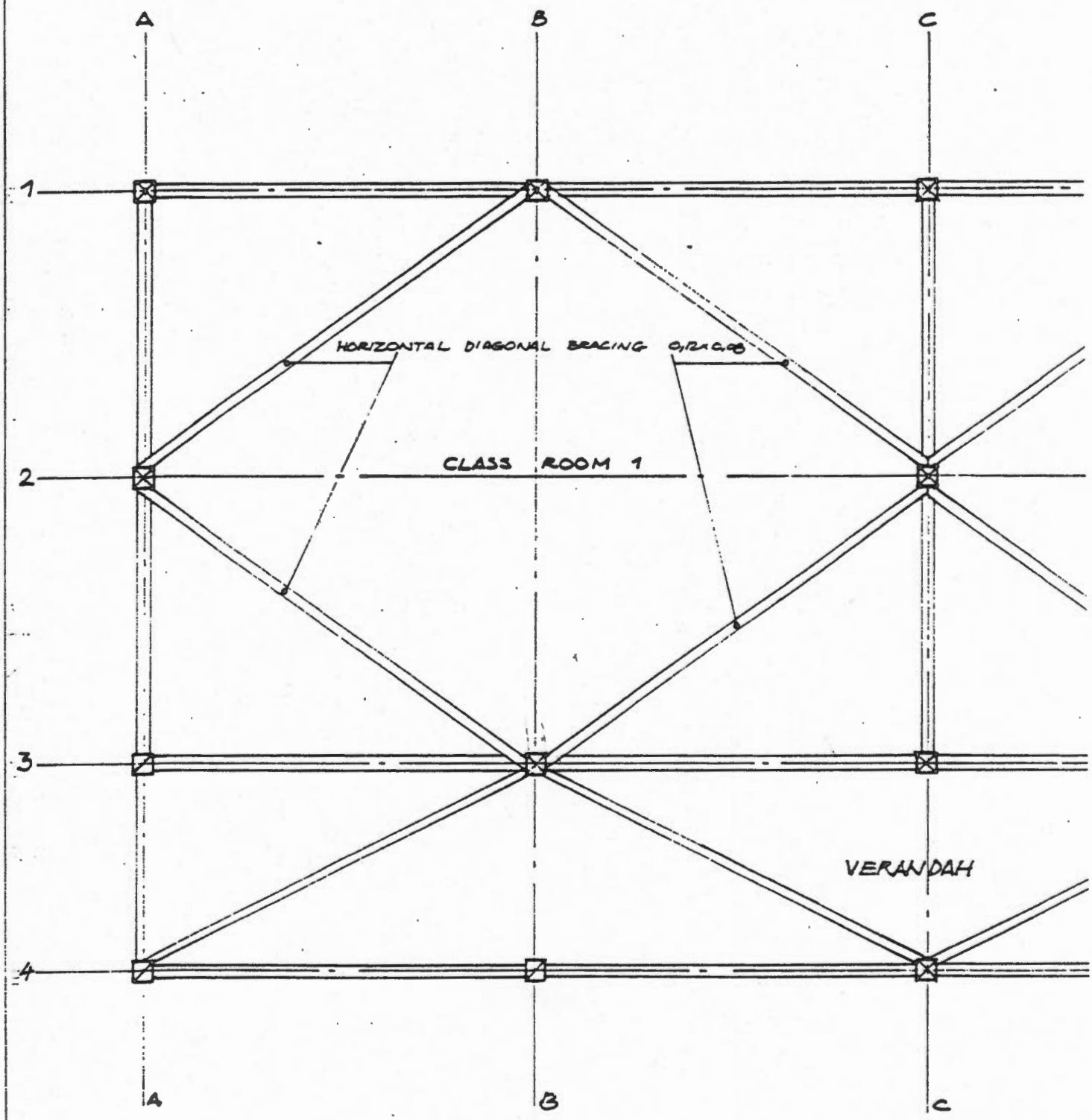
4
RAFTERS AT 0,50 CENTRES.
HIPPED ROOF ENDS
RIDGE
EAVES TO MAIN ROOF
VERANDAH ROOF
EAVES TO VERANDAH ROOF
A
B
C



Institute for Housing Design & Public Building, Hanoi Institute for Building Investigation and Design, Hue	SCHOOL AT LOC DIEN, PHU LOC DISTRICT Title: ROOF PLAN Drawing No: 6 Date: 27 Feb 89 Version: 1
Development Workshop GRET	DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES, (VIE/85/019) BINH TRI THIEN PROVINCE, VIETNAM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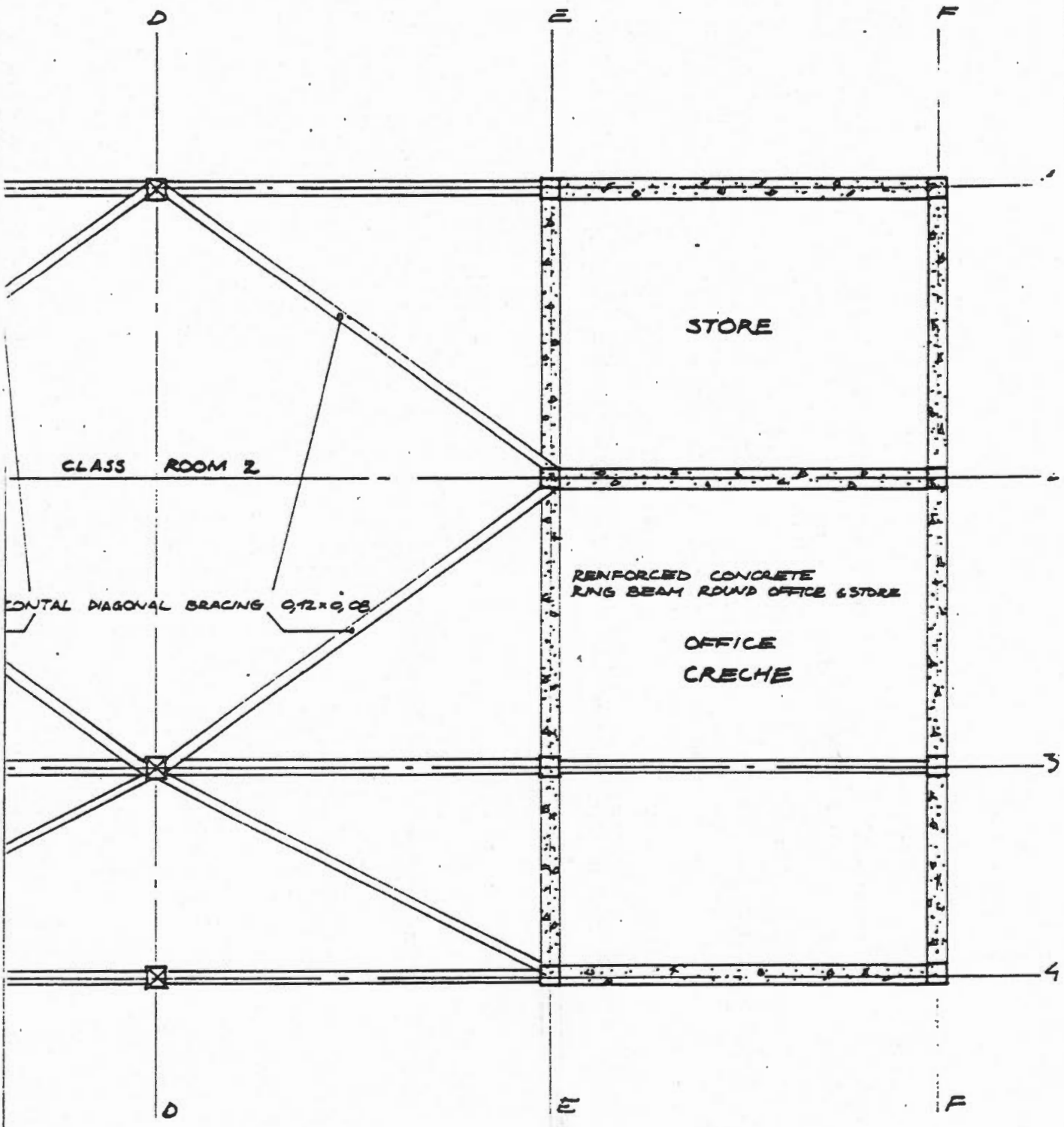
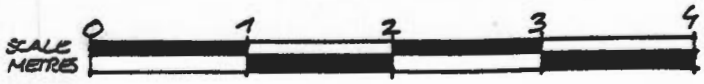
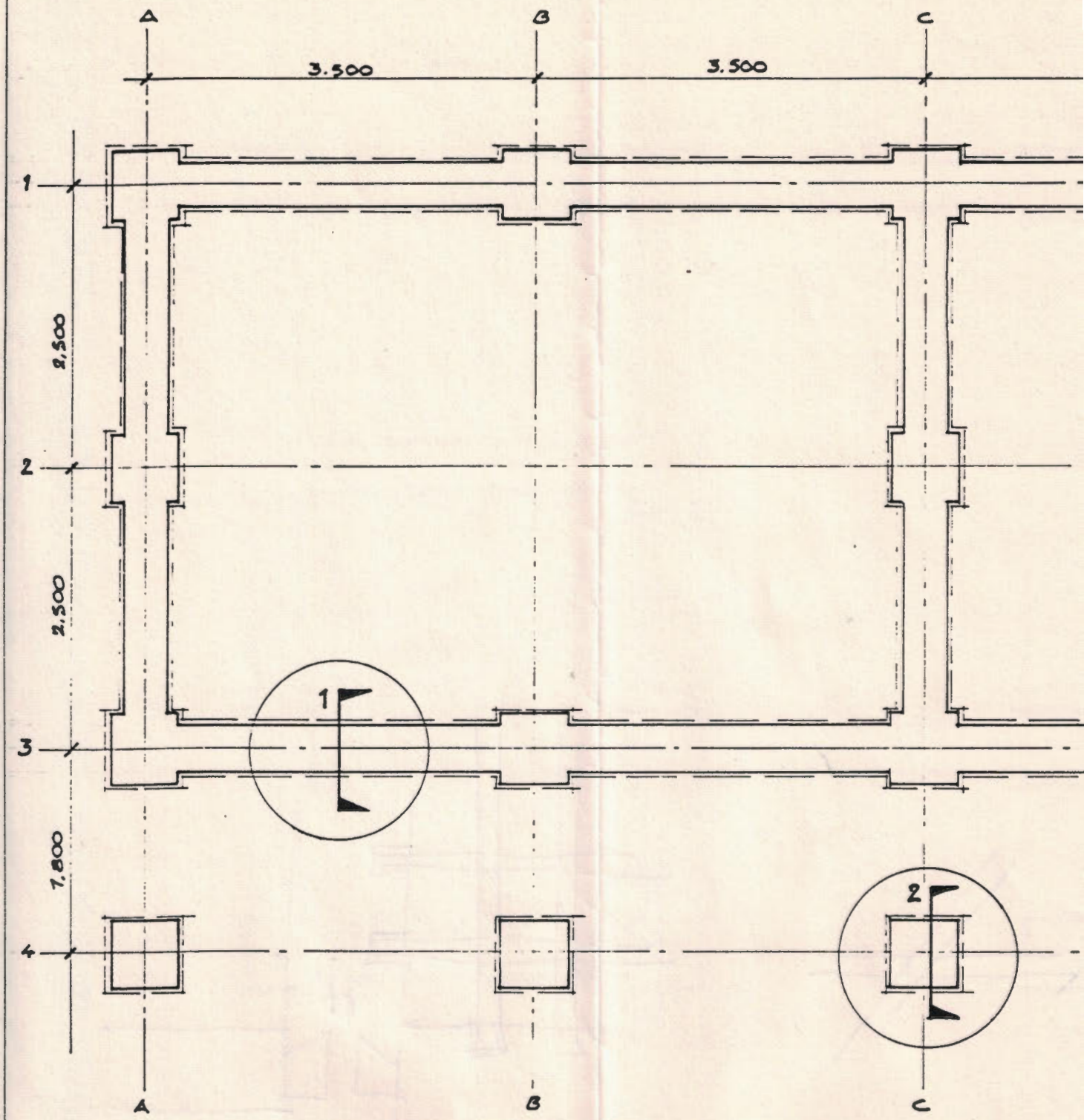
HORIZONTAL DIAGONAL BRACING @RAFTER
CLASS ROOM 1
VERANDAH
A
B
C





Institute for Housing Design & Public Building, Hanoi Institute for Building Investigation and Design, Hue	SCHOOL AT LOC DIEN, PHU LOC DISTRICT Title: PLAN. HORIZONTAL BRACING IN ROOF Drawing No: 5 Date: 27 Feb 89 Version: 1
Development Workshop GRET	DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES, (VIE/85/019) BINH TRI THIEN PROVINCE, VIETNAM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2,500
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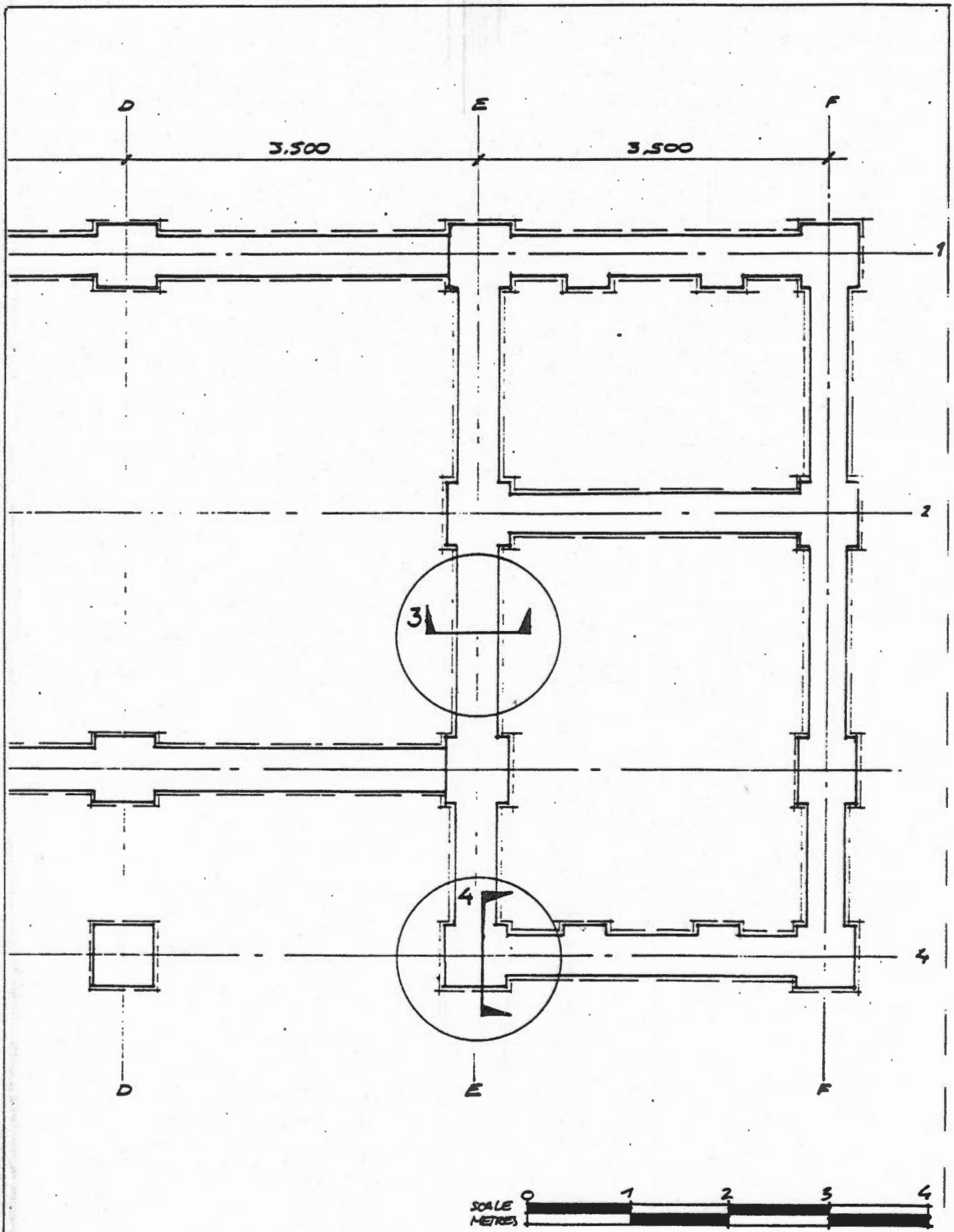
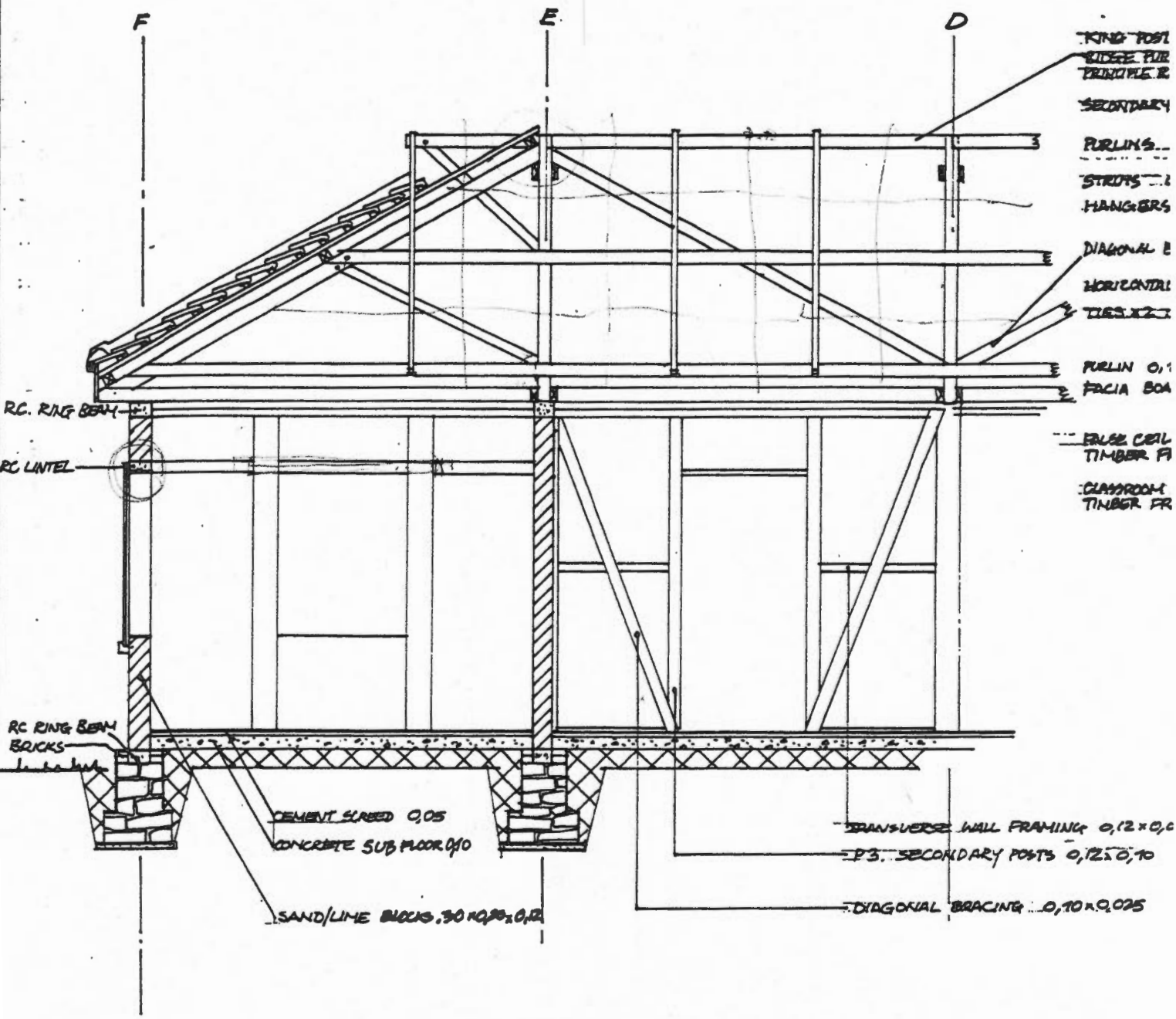
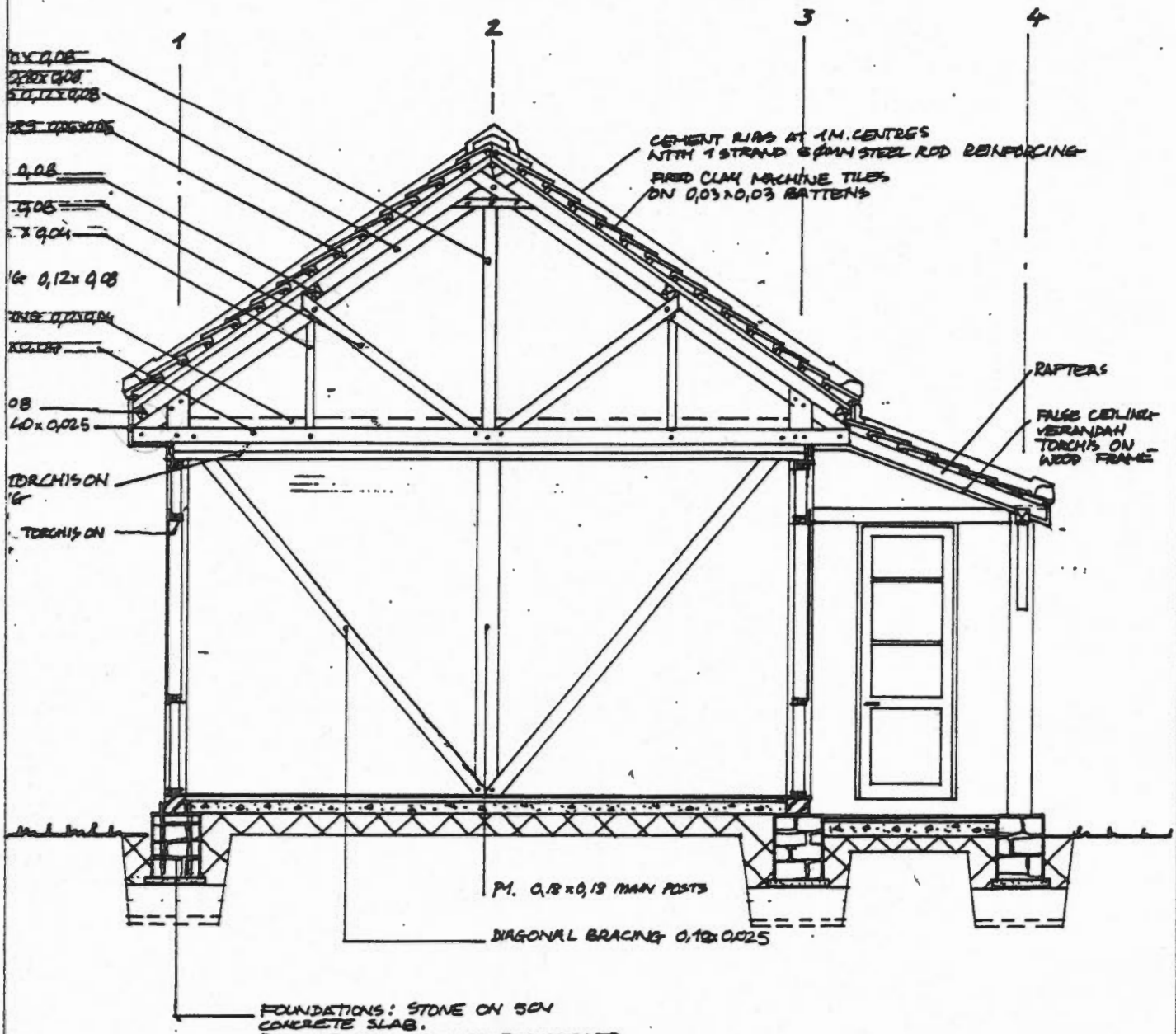


SCALE METRES 0 1 2 3 4

Institute for Housing Design & Public Building, Hanoi Institute for Building Investigation and Design, Hue	SCHOOL AT LOC DIEN, PHU LOC DISTRICT Title: FOUNDATION PLAN Drawing No: 4 Date: 27 Feb 89 Version: 1
Development Workshop / GRET	DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES, (VIE/85/019) BINH TRI THIEN PROVINCE, VIETNAM


F
E
D
KING POST
RIDGE PUR
PRINCIPLE R
SECONDARY
PURLINS
STRUTS
HANGERS
DIAGONAL B
HORIZONTAL
TIES
PURLIN 0,1
FACIA BOA
FALSE CEIL
TIMBER FR
CLASSROOM
TIMBER FR
R.C. RING BEAM
RC LINTEL
RC RING BEAM
BRICKS
CEMENT SCREED 0,05
CONCRETE SUB FLOOR 0,10
SAND/LIME BLOCKS .30 x 0,20 x 0,12
TRANSVERSE WALL FRAMING 0,12 x 0,0
P3. SECONDARY POSTS 0,12 x 0,10
DIAGONAL BRACING 0,10 x 0,025

SECTION B-B



FOUNDATIONS: STONE ON 30CM CONCRETE SLAB. BELOW POSTS, 0,20×0,20 REINFORCED CONCRETE WITH BRICK ENCLOSURE LOOPED 10mm REINFORCEMENT FOR FIXING OF MAIN POSTS. ADDITIONAL DETAILS WILL BE DEVELOPED FOR FOUNDATIONS.

SECTION A-A.

SCALE METRES 0 1 2 3 4

Institute for Housing Design & Public Building, Hanoi

Institute for Building Investigation and Design, Hue

SCHOOL AT LOC DIEN, PHU LOC DISTRICT

Title: SECTIONS

Drawing No: 3 Date: 27 Feb 89 Version: 1

Development Workshop

GRET

DEMONSTRATION OF STORM RESISTANT BUILDING TECHNIQUES, (VIE/85/019)

BINH TRI THIEN PROVINCE, VIETNAM

1ST DEMONSTRATION BUILDING
PRIMARY SCHOOL AT LOC DIEN, PHU LOC DISTRICT

PLANS AND MATERIAL QUANTITIES

ANNEXE 5: MATERIAL QUANTITIES FOR THE FIRST DEMONSTRATION BUILDING

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION				ORDER QUANTITIES
1D : Office ring beam				
Note: bricks 20 x 10 x 5 cm				
bricks/mortar 50% of 0.764 (see 1C)			0.382	
materials	bricks (3 parts)		0.287	287 bricks
	mortar (1 part)		0.096	
	sand/m3	1.10 m3		0.1 m3 sand
	cement/m3	300 kg		28.7 kg cement
concrete 50% of 0.764 (see 1C)			0.382	
materials	sand/m3	0.40 m3		0.2 m3 sand
	gravel/m3	0.80 m3		0.3 m3 gravel
	cement/m3	300 kg		114.6 kg cement
Reinforcement in ring beam				
	length	x number	x kg	
(a) side walls				
(8mm steel)	4.00	6 (3 x 2)	0.395	9.5 kg 8mm steel bar
(b) transverse walls				
(8mm steel)	7.50	4 (2 x 2)	0.395	11.9 kg 8mm steel bar
(c) links @ 30cm centres				
(5mm steel)	0.10	78 (42 + 36)	0.154	1.2 kg 5mm steel bar
1E : Damp proof course [bitumen]				
Level 2 foundation surface area (see 1C) -				
			27.6 m2	27.6 m2 bitumen

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION						ORDER QUANTITIES
1F : Foundation column bases						
Note: Calculated by deduction from total volume of column base.						
	depth	x length	x width	x number	= total m3	
(i) total volume	0.50	0.40	0.40	22	1.760	
(ii) concrete in column bases	0.50	0.20	0.20	22	0.440	
(iii) reduction - ring beam (calculated in 1D)	0.10	0.40	0.40	8	0.128	
(a) concrete in column bases see (ii) above					0.440	
materials	sand/m3	0.40 m3				0.2 m3 sand
	gravel/m3	0.80 m3				0.4 m3 gravel
	cement/m3	300 kg				132.0 kg cement
(b) bricks used as shuttering						
Note: bricks 20 x 10 x 5 cm						
use (i), less (ii) + (iii)					1.192	
materials	bricks (3 parts)				0.894	894 bricks
	mortar (1 part)				0.298	
	sand/m3	1.10 m3				0.3 m3 sand
	cement/m3	300 kg				89.4 kg cement
Reinforcement						
	length	x number	x kg			
(a) fixing of timber columns to foundations (2 per column)						
(10mm steel)	1.40	28 (14 x 2)	0.617			24.2 kg 10mm steel bar
(b) starter bars for base to RC columns in office						
(10mm steel)	1.40	32 (8 x 4)	0.617			27.6 kg 10mm steel bar
(c) links @ 30cm centres						
(5mm steel)	0.60	32 (8 x 4)	0.154			3.0 kg 5mm steel bar

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION					ORDER QUANTITIES
2. FLOORS					
2A : Concrete sub floor					
	depth	x length	x width	= total m3	
(a) class 1	0.10	6.80	4.80	3.264	
(b) class 2	0.10	6.80	4.80	3.264	
(c) office	0.10	3.30	2.30	0.759	
(d) store	0.10	3.30	4.10	1.353	
(e) verandah	0.10	14.00	1.80	2.520	
total				11.160	
materials	sand/m3	0.40 m3			4.5 m3 sand
	gravel/m3	0.80 m3			8.9 m3 gravel
	cement/m3	200 kg			2232.0 kg cement
2B : Sand cement screed (option)					
	depth	x length	x width	= total m3	
(a) class 1	0.05	6.80	4.80	1.632	
(b) class 2	0.05	6.80	4.80	1.632	
(c) office	0.05	3.30	2.30	0.380	
(d) store	0.05	3.30	4.10	0.677	
(e) verandah	0.05	14.00	1.80	1.260	
total				5.580	
materials	sand/m3	1.10 m3			6.1 m3 sand
	cement/m3	300 kg			1674.0 kg cement

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION					ORDER QUANTITIES
3. WALLS					
Note: blocks 30 x 20 x 12 cm					
3A : Blockwork below frame walls					
length x number + length x number = m. length					
3.3 x 8 + 2.8 x 4 = 37.60					125 blocks
				total m3	
	mortar			0.26	
	sand/m3	1.10 m3			0.3 m3 sand
	cement/m3	300 kg			79 kg cement
3B : Blockwork office walls					
Wall area less openings					
height x length (- openings m2) = total m2					
2.8 x 26 - 8 = 64.80					1446 blocks
				total m3	
	mortar	(146 x 0.2)/4 =		3.24	
	sand/m3	1.10 m3			3.6 m3 sand
	cement/m3	300 kg			972 kg cement
3C : RC columns in office					
	height	x length	x width	x number = total m3	
(a) concrete					
	2.95	0.20	0.20	6 0.708	
	2.45	0.20	0.20	2 0.196	
(b) lower ring beam and lintels					
	1.50	0.20	0.15	2 0.090	
	6.60	0.20	0.15	1 0.198	
(c) main ring beam					
	13.10	0.20	0.15	1 0.393	
total				1.585	
materials	sand/m3	0.40 m3			0.6 m3 sand
	gravel/m3	0.80 m3			1.3 m3 gravel
	cement/m3	300 kg			475.5 kg cement

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION				ORDER QUANTITIES	
reinforcement					
	length	x number	x kg		
(a) columns					
(10mm steel)	3.25	24	0.617	48.1 kg	10mm steel bar
	2.75	8	0.617	13.6 kg	10mm steel bar
(b) ring beam					
(8mm steel)	22.70	2	0.395	17.9 kg	8mm steel bar
(c) links @ 30cm centres					
(5mm steel)	0.60	60	0.154	5.5 kg	5mm steel bar
	0.60	16	0.154	1.5 kg	5mm steel bar
	0.60	75	0.154	6.9 kg	5mm steel bar
3D : "Torchis" walls					
Surface area = 78.25 m2					
bamboo wattle				80.0 m2	bamboo (already ordered)
mud/straw plaster					
surface area x depth = m3					
80	0.05		4		
straw/m3	70 kg			280.0 kg	straw
clay/m3	1.5 m3 dry earth			6.0 m3	dry earth
lime/sand plaster					
2 layers @ 80m2 x 2cm = m3					
160	0.02		3.2		
1 layer @ 80m2 x 1cm = m3					
80	0.01		0.8		
total lime/sand			4.0		
sand/m3	1.1 m3			4.4 m3	sand
lime/m3	350 kg			1400.0 kg	lime

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION						ORDER QUANTITIES
3E : Wall framework - vertical elements						
	length	x width	x depth	x number	= total m3	TIMBER
(a) main posts (P1)						
	3.40	0.18	0.18	10	1.102	10 posts 3.4 x 0.18 x 0.18
(b) verandah posts (P2)						
	2.60	0.18	0.18	4	0.337	4 posts 2.6 x 0.18 x 0.18
(c) secondary posts (P3)						
	2.80	0.12	0.10	18	0.605	18 posts 2.8 x 0.12 x 0.10
(d) wall batten (P4)						
	2.80	0.12	0.05	3	0.050	3 posts 2.8 x 0.12 x 0.05
total					2.094	
3F : Wall framework - horizontal elements						
Note: See detail for identification of elements						
	length	x width	x depth	x number	= total m3	
(a) floor plates (see detail in doorway)						
	3.30	0.12	0.05	8	0.158	8 plates 3.3 x 0.12 x 0.05
(b) floor plates (transverse walls)						
	2.80	0.12	0.05	4	0.067	4 plates 2.8 x 0.12 x 0.05
(c) horizontal framing for "torchis"						
side panel						
	1.00	0.12	0.05	16	0.096	16 posts 1.0 x 0.12 x 0.05
panel with opening						
	1.20	0.12	0.05	14	0.101	14 posts 1.2 x 0.12 x 0.05
transverse wall framing						
	1.10	0.12	0.05	16	0.106	16 posts 1.1 x 0.12 x 0.05
(d) secondary wall plates below roof frame						
	3.30	0.12	0.025	8	0.079	8 plates 3.3 x 0.12 x 0.025
	2.80	0.12	0.025	4	0.034	4 plates 2.8 x 0.12 x 0.025
(d) primary wall plates below roof frame						
side walls						
	3.30	0.12	0.05	8	0.158	8 plates 3.3 x 0.12 x 0.05
transverse walls						
	2.80	0.12	0.05	4	0.067	4 plates 2.8 x 0.12 x 0.05
verandah						
	3.30	0.15	0.05	4	0.099	4 plates 3.3 x 0.15 x 0.05
diagonal struts below verandah						
	0.95	0.10	0.08	8	0.061	8 plates 0.95 x 0.10 x 0.08
total					1.0262	

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION						ORDER QUANTITIES
3G : Bracing in walls						
Note: See sections						
	length	x width	x depth	x number	= total m3	TIMBER
(a) bracing on side walls						
	3.20	0.10	0.025	16	0.128	16 braces 3.2 x 0.10 x 0.025
(b) bracing on transverse walls						
	3.80	0.12	0.025	4	0.046	4 braces 3.8 x 0.12 x 0.025
total					0.174	
4. ROOF FRAME						
4A : Primary trusses						
	length	x height	x width	x number	= total m3	
(a) ties (2 per truss)						
	5.75	0.12	0.04	8	0.221	8 ties 5.75 x 0.12 x 0.04
(b) principal rafter (2 per truss)						
	3.75	0.12	0.08	8	0.288	8 rafters 3.75 x 0.12 x 0.08
(c) king post						
	2.00	0.10	0.08	4	0.064	4 posts 2.00 x 0.10 x 0.08
(d) hangars						
	1.25	0.08	0.04	8	0.032	8 hangars 1.25 x 0.08 x 0.04
(e) struts						
	2.00	0.10	0.08	8	0.128	8 struts 2.00 x 0.10 x 0.08
(f) ridge ties (2 per truss)						
	0.70	0.08	0.04	8	0.018	8 ties 0.70 x 0.08 x 0.04
total					0.751	
4B : Secondary truss on hip ends						
	length	x height	x width	x number	= total m3	
(a) diagonal rafters to corners						
	5.30	0.12	0.08	4	0.204	4 rafters 5.3 x 0.12 x 0.08
(b) central rafter						
	4.40	0.12	0.08	2	0.084	2 rafters 4.4 x 0.12 x 0.08
(c) struts from diagonal rafters						
	2.50	0.10	0.08	4	0.080	4 struts 2.50 x 0.10 x 0.08
(d) ties to corners						
	4.90	0.12	0.04	8	0.188	8 ties 4.90 x 0.12 x 0.04
total					0.556	

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION						ORDER QUANTITIES
4C : Purlins and ridge						
	length	x height	x width	x number	= total m3	TIMBER
(a) ridge						
	13.00	0.10	0.08	2	0.208	2 ridges 13.0 x 0.10 x 0.08
(b) purlins						
	14.50	0.10	0.08	2	0.232	2 purlins 14.5 x 0.10 x 0.08
	3.00	0.10	0.08	2	0.048	2 purlins 3.0 x 0.10 x 0.08
(c) purlins at eaves (main roof)						
	18.20	0.10	0.08	4	0.582	4 purlins 18.2 x 0.10 x 0.08
	5.70	0.10	0.08	4	0.182	4 purlins 5.7 x 0.10 x 0.08
total					1.253	
4D : Main roof						
	length	x height	x width	x number	= total m3	
(a) rafters						
	3.50	0.06	0.05	48	0.504	48 rafters 3.5 x 0.06 x 0.05
	4.40	0.06	0.05	8	0.106	8 rafters 4.4 x 0.06 x 0.05
(b) battens (calculated as 18.4 x 15 x 2)						
	555.00	0.03	0.03		0.500	555 m battens 0.03 x 0.03
(c) facia board						
	30.20	0.40	0.025		0.302	1 board 30.2 x 0.40 x 0.025
	18.40	0.25	0.025		0.115	1 board 18.4 x 0.25 x 0.025
total					1.526	
4E : Verandah and office extension						
	length	x height	x width	x number	= total m3	
(a) rafters						
	2.00	0.12	0.08	16	0.307	16 rafters 2.0 x 0.12 x 0.08
(b) battens (calculated as 18.4 x 8)						
	150.00	0.03	0.03		0.135	150 m battens 0.03 x 0.03
(c) facia board						
	18.40	0.25	0.025	1	0.115	1 board 18.40 x 0.25 x 0.025
	1.70	0.25	0.025	2	0.021	2 boards 1.70 x 0.25 x 0.025
total					0.578	

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION						ORDER QUANTITIES
4F : Diagonal bracing in roof/hangers						
	length	x height	x width	x number	= total m3	TIMBER
(a) diagonal bracing in roof						
	4.00	0.12	0.08	3	0.115	3 braces 4.0 x 0.12 x 0.08
(b) horizontal bracing in roof						
	4.80	0.12	0.04	6	0.138	6 braces 4.8 x 0.12 x 0.04
(c) hangers						
	1.25	0.08	0.04	6	0.024	6 hangers 1.25 x 0.08 x 0.04
(d) horizontal bracing in verandah						
	4.00	0.12	0.04	4	0.077	4 braces 4.00 x 0.12 x 0.08
total					0.354	
5. ROOF COVERING						
5A : Tiles						
	rows	x length	= total m			
	35	18.5	647.5			
	tiles/m	6		=	3885	4000 tiles
5B : Ridges						
			total m			
			27.0			
	ridge tiles/m	2.5		=	67.5	70 ridge tiles
5C : Cement						
	length	x width	x height	x number	= total m3	
(a) ribs						
	3.50	0.12	0.10	24	1.008	
	4.40	0.12	0.10	4	0.211	
(b) ridges						
	27	0.12	0.10		0.324	
total					1.543	
	sand/m3	1.10 m3				1.7 m3 sand
	cement/m3	300 kg				463.0 kg cement
5D : Reinforcing bar in roof ribs (single strand 5mm diameter)						
	length	x kg	x number	= total kg		
(a) vertical ribs						
	3.5	0.154	38	20.482		
(b) horizontal ribs						
	18.5	0.154	5	14.245		
(c) verandah (vertical)						
	2.0	0.154	16	4.928		
total				39.655		
			x	1.1		
total + 10%				43.621		43.6 kg single strand 5mm rod

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION						ORDER QUANTITIES
6. FALSE CEILING						
6A : Ceiling joists						
	length	x depth	x width	x number	= m3	TIMBER
	5.00	0.06	0.05	10	0.150	10 joists 5.00 x 0.06 x 0.05
	17.30	0.06	0.05	3	0.156	3 joists 17.30 x 0.06 x 0.05
	2.00	0.06	0.05	16	0.096	16 joists 2.00 x 0.06 x 0.05
total					0.4017	
6B : Ceiling						
					m2	
(a) rooms					86	
(b) verandah					28	
total					114	114 m2 bamboo (already ordered)
6C : Clay/straw infill						
	surface area	x depth	= m3			
	114	0.05	5.7			
	straw/m3	70 kg				399.0 kg straw
	clay/m3	1.5 m3 dry earth				8.6 m3 dry earth
6D : Lime/sand plaster						
	2 layers @ 114m2	x 2cm = m3				
	228	0.02	4.56			
	total lime/sand		4.56			
	sand/m3	1.1 m3				5.0 m3 sand
	lime/m3	350 kg				1596.0 kg lime

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

MATERIAL QUANTITIES - CALCULATION	ORDER QUANTITIES
7. OPENINGS	
7A : Window shutters	
(a) shutters for 9 windows (2 horizontal sliding panels)	
height x width x depth x number = total m3	
1.60 x 1.20 x 0.02 x 9 = 0.346	9 shutters 1.60 x 1.20 x 0.02
(b) bracing	
length x width x depth	
25.8 x 0.10 x 0.02 = 0.052	25.8 m braces 0.10 x 0.02
(c) rails	
length x height x depth x number	
2.3 x 0.08 x 0.05 x 18 = 0.166	18 rails 2.3 x 0.08 x 0.05
total 0.563	
7B : Ironmongery	
To be designed/purchased during workshop.	
7C : Doors	
height x width x number	
(a) double doors	
2.20 x 1.10 x 2	2 doors 2.20 x 1.10
(b) single doors	
2.20 x 0.80 x 2	2 doors 2.20 x 0.80
8. MISCELLANEOUS	
8A : bolts	
160 bolts 10 mm x 25 cm	160 bolts 10mm diameter x 25cm
8B : nails	
90 kg	90 kg nails

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

SUMMARY SHEET	TOTAL ORDER QUANTITIES
	31 m3 sand
	12 m3 gravel
	7649 kg cement
	2996 kg lime
	10.4 m3 stone
	1181 bricks
	1572 blocks
	114 kg 10mm steel bar
	39 kg 8mm steel bar
	18 kg 5mm steel bar
	44 kg single strand 5mm 0 reinforcing
(already ordered)	194 m2 bamboo
	679 kg straw
	15 m3 dry earth
	4000 tiles
	70 ridge tiles
	2 doors 2.20 x 1.10
	2 doors 2.20 x 0.80
(see detailed sheets for dimensions to be ordered)	9 m3 timber
	160 bolts 10mm diameter x 25 cm
	90 kg nails
	30 m2 damproofing

SCHOOL CLASSROOMS DEMONSTRATION BUILDING, LOC DIEN, PHU LOC DISTRICT contd.

TOTAL ORDER QUANTITIES	COST/unit	COST
31 m3 sand	15	$472.18
12 m3 gravel	12.57	$153.92
7649 kg cement	0.13714	$1,049.01
2996 kg lime	0.03429	$102.73
10.4 m3 stone	14	$145.78
1181 bricks	0.04	$47.22
1572 blocks	0.17	$267.20
114 kg 10mm steel bar	0.71429	$81.09
39 kg 8mm steel bar	0.71429	$28.05
18 kg 5mm steel bar	0.71429	$12.94
44 kg single strand 5mm 0 reinforcing	1.43	$62.38
194 m2 bamboo	0.71	$137.74
679 kg straw	0.06	$40.74
15 m3 dry earth	0	$0.00
4000 tiles	0.09	$360.00
70 ridge tiles	0.09	$6.30
2 doors 2.20 x 1.10	20	$40.00
2 doors 2.20 x 0.80	20	$40.00
9 m3 timber	242.86	$2,252.90
160 bolts 10mm diameter x 25 cm	???	
90 kg nails	1.14	$102.60
30 m2 damproofing	???	
	TOTAL	$5,402.76