AID 1020-24 (10-59)

AGENCY FOR INTERNATIONAL DEVELOPMENT (A.I.D.)

PROJECT AUTHORIZATION

1. PROJECT NUMBER	3. COUNTRY	4. AUTHORIZATION NUMBER
925-15-999-301	Interregional - ENGR	ENGR 0003

2. PROJECT TITLE
Development of Engineering Standards and Criteria for the Usage of Laterite, Lateritic Soils and Other Problem Soils in Connection with the Construction of Roads, Highways and Airfields

5. AUTHORIZATION DATE
02/10/71

6. PROP DATED
01/29/71

7. LIFE OF PROJECT

a. Number of Years of Funding: 7
Starting FY 1967; Terminal FY 1974

b. Estimated Duration of Physical Work
After Last Year of Funding (in Months): 18

8. FUNDING BY FISCAL YEAR (in U.S. $ or $ equivalent)	DOLLARS		P.L. 480	LOCAL CURRENCY Exchange Rate: $1 =			
				U.S. OWNED		HOST COUNTRY	
	GRANT	LOAN	CCC + FREIGHT	GRANT	LOAN	JOINTLY PROGRAMMED	OTHER
Prior through Actual FY 1970	643,000					110,000 *	
Operational FY 1971	50,000						
Budget FY 1972	300,000					**	
B + 1 FY 1973	60,000						
B + 2 FY 1974	35,000						
B + 3 FY							
All Subsequent FY's							
TOTAL	1,088,000						

9. DESCRIBE SPECIAL FUNDING CONDITIONS OR RECOMMENDATIONS FOR IMPLEMENTATION, AND LIST KINDS AND QUANTITIES OF ANY P.L. 480 COMMODITIES

* - $110,000- Thailand, $50,000 (1,000,000 Baht)
Ghana, $60,000 (67,200 New Cedi)

** - Implementation of Phase III, Latin America is contingent upon results of Reconnaissance Survey (FY 1971) to evaluate on-site country-by-country general soils problems and to determine the appropriate headquarters locations (soils laboratory, central location etc.) and local currency support requirements.

10. CONDITIONS OF APPROVAL OF PROJECT

(Use continuation sheet if necessary)

11. Approved in substance for the life of the project as described in the PROP, subject to the conditions cited in Block 10 above, and the availability of funds. Detailed planning with cooperating country and drafting of implementation documents is authorized.

This authorization is contingent upon timely completion of the self-help and other conditions listed in the PROP or attached thereto.

This authorization will be reviewed at such time as the objectives, scope and nature of the project and/or the magnitudes and scheduling of any inputs or outputs deviate so significantly from the project as originally authorized as to warrant submission of a new or revised PROP.

A.I.D. APPROVAL	CLEARANCES	DATE
F. J. Vernon	DFMiller AFR/CDF/ENG (Draft)	11/6/70
SIGNATURE	RFreeman AFR/CDF (Draft)	11/6/70
	DShear AFR/DP (Draft)	11/6/70
	MVogel EA/ENGR (Draft)	11/9/70
	CBreecher EA/DP (Draft)	11/10/70
XXA Director of Engineering	SATaubenblatt EA/CDF (Draft)	12/14/70
TITLE	XACONDMWilson LA/DR (Draft)	12/18/70
2/10/71	[illegible]ler LA/DP (Draft)	[illegible]
DATE		

BEST AVAILABLE COPY

NON-CAPITAL PROJECT PROPOSAL

INTERREGIONAL PROJECT

AID/Washington, Office of Engineering, Transportation

PROJECT TITLE: Development of Engineering Standards and Criteria for the Usage of Laterite, Lateritic Soils, and Other Problem Soils in Connection with the Construction of Roads, Highways, and Airfields

PROJECT NO.: 925-15-999-301 Original: X

SUBMISSION DATE: JAN 29 1971

OBLIGATION SPAN: FY 1967 - 1974

LIFE OF PROJECT COSTS:

FY 1967 - 1970	Phases I & II $643,000	+ Local Costs of $50,000 equiv. Thailand 60,000 equiv. Ghana
FY 1971	50,000	
FY 1972	300,000	Phase III Latin America
FY 1973	60,000	
FY 1974	35,000	

NON-CAPITAL PROJECT PAPER

Development of Engineering Standards and Criteria for the Usage of Laterite, Lateritic Soils and Other Problem Soils in Connection With the Construction of Roads, Highways, and Airfields

I. PROJECT SUMMARY

A. Introduction

It is the intent of this program that by basic and applied engineering investigations, tests and analyses, laterite, lateritic soils, expansive soils (black cottons) and other problem soils may be clearly defined and specific usage criteria developed to relate these soils to current and probable uses in the construction field. It is the further intent of this engineering development program that by testing, analysis, evaluation and other defined or presently undefined means, certain critical soils and aggregates used in the construction of rural roads, highways, highway structures, buildings, plants, earth dams, dikes, embankments and fills may be specifically defined. This will assure timely and economical use in all countries where soils usage problems have occurred in construction and engineering applications. Development of specific and economically acceptable usage criteria will be accomplished concurrently with the testing and analysis. These investigations, tests and analyses will be by means presently used in the state of the art or by means developed specifically for this program and will clearly define the parameters so that engineers may reliably, economically and advantageously specify these materials for construction purposes on a worldwide basis.

II. OBJECTIVES

The primary objectives of this program are as follows:

A. 1. An engineering definition of laterite, lateritic soils and expansive soils and other problem tropical soils such as plastic clays, sands, etc.

2. A classification system for above soils.

3. An evaluation of the engineering characteristics of these soils, in accordance with the several classifications which may be established, determining the range of physical, chemical and geological conditions for each classification.

4. Review and establish standard methods, or develop new or modified methods of testing, for such materials, for design and construction control.

B. 1. The most suitable designs and construction methods for the stabilization of lateritic materials, expansive soils, tropical plastic clays, and other troublesome soils included under this would be assisting selected Highway Departments in the construction of test roads.

2. Review selected local Highway Departments road design and construction criteria, and as applicable, propose modifications thereto (including pavement design and analysis, standard specifications, etc.) in connection with the usage of laterite, lateritic soils, expansive soils and other problem soils such as tropical plastic clays, sands, etc.

C. Definition and extent of B.1. and B.2. are contingent upon completion of part A.1. through 4. above.

D. Studies of soils in other A.I.D. regions or countries will be conducted as a basis for further intensive research as the program in Africa is developed. The contractor will make such studies at the direction of A.I.D.

E. Determine the significance and potential application of the analysis test findings to other uses for those problem soils and aggregates investigated, such as, but not limited to, : foundations for highway structures, buildings, earth dams, dikes and embankments.

III. PROJECT COMPONENTS

The implementation of this program is in three major parts. Phase I South East Asia (Thailand), Phase II Africa (Ghana) and Phase III Latin America (Proposed). Phase I South East Asia has been completed. Phase II Africa will be completed by the end of November 1970 with two soils seminars to be held (1) Ghana (2) East Africa the last week of January and the first week of February 1971.As the result of expressed interest by the majority of missions in Latin America, a soils reconnaissance survey is proposed for FY 1971. Recommendations developed by this reconnaissance will identify the appropriate central location and laboratory and other facilities available for the Phase III Latin America soils program. With central location and

necessary facilities identified, the program will be announced early FY 1972 in the Commerce Business Daily for interested Consultants and Institutions. Based on a Description of the Program (attached as Annex 1) a contract will be awarded. In Phases I and II the program is being accomplished by a combination of Engineering firms and Institutions. Additionally Engineers and Soils Scientists will be used to tie the various reports and findings together and develop criteria and usage manuals for the design of roads, highways, airfields, embankments and other similar type structures.

JUSTIFICATION

This critical soils program was established and funded by A.I.D. ($643,000 through FY 1970) based upon the following facts:

1. U. S. Engineers and Constructors are required for the accomplishment of Capital Projects financed by A.I.D. loans.

2. * There is no known data or criteria available describing the design limits (including testing procedures) or primary soils such as laterite and lateritic soils and expansive soils for construction of roads, highways, airfields, etc. in tropical areas.*

3. There have been a number of project failures involving the use of these soils; most prominent is the Khmer American Friendship Highway in Cambodia which failed because of misuse of available materials (Laterites). Almost 9 million dollars were expended by A.I.D. (Grant) in corrective design and construction actions.

4. Procedures to compensate the borrower for design failure by U. S. engineers using these soils for construction are not now known or available.

*Inquiries were made to the Bureau of Public Roads, Army Corps of Engineers, Air Force Engineers, Navy Facilities Command, and meetings were held with members of the Highway Research Board of the National Academy of Science in the U. S. and to well-known soils laboratories such as the British Road Research Laboratories London, England (Dr. J. D. Millard), Central Road Research Laboratory, New Delhi, India (Prof. Sita R. Mehra, Director) Materials Research Laboratory, Nairobi, Kenya (Mr. N. B. Harley), and Central Laboratory of Bridges and Roads, Paris, France (Mr. J. Bonitzer, Chief Engineer).

The complete lack of information relating to the use of laterite and lateritic soils is further stated in Phase I Contractor's "Literature Review on Laterites" dated December 1967 by the following statement:

"IN SUMMARY, THERE IS NOT SUFFICIENT EVIDENCE EXISTING IN THE LITERATURE TO JUSTIFY ANY CONCLUSIONS AS TO THE PERFORMANCE OF LATERITES IN THE PAVEMENT STRUCTURE."

In the Spring of 1965 a committee composed of Transportation (Highway) Engineers from each of the four regional bureaus (later expanded to include the Vietnam Bureau) was formed to investigate the problem of developing engineering design criteria for the construction of roads, highways, airports and similar structures, by utilizing available and appropriate tropical soils. A program titled "Development of Engineering Standards and Criteria etc." was developed. This program was presented to the A.I.D. Research Advisory Committee (RAC) on March 31, 1966. RAC accepted and approved the program; however, as an engineering program rather than a research program. O.Y.B. 1967 non-regional funds were made available to ENGR for the accomplishment of Phase I South East Asia (Thailand) and an agreement PIO/T was reached with the Government of Thailand (Thai Highway Department) to provide laboratory facilities, local labor and other local costs. Dr. Sirclok then Director of the Thai Highway Department was quite enthused with the program and was instrumental in having the Government of Thailand appropriate $50,000 equivalent for local costs.

Through appropriate A.I.D. procurement regulations a joint venture of Woodward,Clyde, Inc., Materials Research & Development Inc., Miller-Warden & Western with consultants from the University of California and the California Highway Department, was selected to accomplish Phase I South East Asia. This phase was completed in October 1969. The final report has been received and has been widely distributed to both A.I.D. engineers, local country engineers and to private consultants. The findings as described in the report are now being used to determine the strength of soils and to design pavement structures.

Phase II Africa (Ghana) was funded as a non-regional project for FY 1968. Lyon Associates, Inc., with Drs. Peck, Eades, Deere, Thornburn, Ireland and Cording of the Engineering School of the University of Illinois were selected as consultants to accomplish this Africa phase of the program. The final report will be in French as well as English to accommodate both French and English speaking engineers in Africa. Phase II is scheduled to be completed in November 1970 with two-three day seminars for African engineers; one the last of January 1971 in Ghana and the second proposed for the first of February 1971 in Nairobi.

Phase III, Latin America, is proposed for FY 1972. The L. A. Mission engineers have evidenced considerable interest in the program for L. A.

Letters describing the program were sent to each L. A. Mission Engineer and the replies indicate that there is a great need for such a program. (Sample ENGR letter and replies are attached).

At the conclusion of the entire program (Phases I, II & III) the soils testing procedures, classification methods, design criteria and other pertinent information developed will be categorized, combined where practicable and an engineering usage manual for these tropical soils will be developed. It is not now known to what extent the tropical soils of South East Asia and Africa are similar or compatible nor whether the same testing, classification or design procedures can be used. By the same token nothing is known of the characteristics of the L. A. soils; therefore, one or more usage manuals may be required. These final manuals will be printed in English, French, Spanish and Portugese as appropriate.

Life of Project Costs

The estimated total costs of the Soils program are as follows:

Phase I South East Asia (Thailand) - Completed FY 1967 - 68-69

$277,228	U. S.
50,000	equivalent Thailand
$327,228	Total

Phase II Africa (Ghana due for completion November 1970 - FY 1968-69-70

$366,000	U.S.
60,000	equivalent Ghana
$426,000	Total

FY 1971	Phase III Latin America Reconnaissance Survey FY 1971 -	$40,000
	Phase II Africa (Ghana) Estimated wind up costs FY 1971 -	$10,000
FY 1972	Phase III Latin America Engineering/Institutional Contract	$300,000
FY 1973	Phase III Latin America Contract	$60,000
FY 1974	Phases I, II & III Final evaluation, development of Usage (Testing, classification and design) Manual(s)	$35,000

Implementation of Phase III Latin America is contingent upon results of Reconnaissance Survey (FY 1971) to evaluate on-site country-by-country general soils problems and to determine the appropriate headquarters locations (soils laboratory, central location etc.) and local currency support requirements.

A.I.D. Interest in Developing Design Criteria for Roads, Highways, Airfields and Allied Structures

In providing loan assistance for Capital projects to developing countries, A.I.D. is vitally concerned that the American consultants engaged to design and supervise these projects be completely knowledgeable in the use of local soils and materials. Until the beginning of this program no such information has been available to either local or U. S. engineers. The end result of this program will be definitive usage manuals for the design of roads, highways, airfields, etc. for the use of local soils, and in effect an A.I.D. wide technical assistance program in the full meaning and intent of the Foreign Assistance Program.

World Wide Interest in This Soils Program

Considerable interest on a world-wide basis has been developed. In the course of traveling through the various countries of Africa the soils scientists are collecting many samples of soils, their test results and in numerous cases, unpublished technical papers pertinent to the program. The British Road Research Laboratories have become interested in the program and have contributed data from former British colonies; the French Portugese have done the same. For the first time a concentrated effort is being made to identify, classify, establish test procedures and establish design criteria for these widely used but little known soils. In this country many private consultants as well as other government agencies have evidenced great interest in the program and have requested and received technical reports generated by the A.I.D. program.

Alternative Strategies

A. Strategy I - Continue as planned.

Phase I South East Asia Completed.

Phase II Africa Underway

Phase III Latin America Proposed

B. Strategy II - Complete and consolidate Phases I and II and abandon efforts for Latin America.

UNITED STATES AID MISSION TO NICARAGUA
AGENCY FOR INTERNATIONAL DEVELOPMENT
AMERICAN EMBASSY
MANAGUA, D. N., NICARAGUA, C. A

Managua, D.N., June 4, 1970

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Department of State
Washington, D.C. 20523

Dear Mr. Williams:

Reference is made to your letter of December 3, 1969, regarding the studies of lateritic soils.

I turned the South East Asia report and a copy of your letter over to the Highway Department and requested their comments and suggestions. I have just received their reply, prepared by the Chief of the Materials Section, which is translated as follows:

"After having carefully read the paper entitled, "Engineering Studies of Lateritic Soils in Connection with the Construction of Highways and Airfields", I have the pleasure to inform you that I found it to be an extensive investigation about this type of soil, which presents many difficulties in the construction of highways.

"These soils are frequently found in Nicaragua, especially in the Atlantic Zone, where they predominate, and we have very little experience with their behavior in highway and airfield construction. Owing to the fact that the actual tendency is to integrate the Atlantic Zone, with the Pacific Zone by means of highways, it is very important to carry out a detailed investigation of the behavior of these soils before we initiate a construction program in the Atlantic Zone.

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"Consequently Nicaragua must carefully take into consideration the programs of investigation of lateritic soils."

As a matter explanation the Atlantic Zone of Nicaragua is practically undeveloped. The Rama Road is the only overland link with the West and that ends at the river port of Rama, some 70 kilometers from the main coastal city of Bluefields.

In the Pacific Zone the major soils problem in highway construction is with the expansive clays, known locally as Sonsoquite. Shrinkage cracks in these soils down to a depth of 20 feet are not uncommon at the end of the dry season.

With the lateritic soils in the Atlantic and Sonsoquite in the Pacific, Nicaragua would definitely benefit from a Latin American Study. Assuming that other Latin American countries in the Tropics have similar problems, logistics would probably dictate the location of a base for the team. In this respect I would suggest that Panama would be a logical choice.

I regret the delay in the reply but did want to submit the comments of the local Highway Department. Hoping that the above information will be of value, I remain,

Sincerely yours,

Carl M. Forsberg

Carl M. Forsberg
General Engineering Officer

c.c. BJWatkins, LA/DR/ENG

CMF/cb

November 21, 1969

Mr. Albert L. Best
Chief Engineer
U. S. A.I.D. Mission
c/o American Embassy
Buenos Aires, Argentina

Subject: Report Engineering Study of Laterite and Lateritic soils in Connection With Construction of Roads, Highways, and Airfields - Phase I - South East Asia (Thailand)

Dear Mr. Best:

As you probably know the laterites and lateritic soils are commonplace throughout the tropical world and in many places are the primary material for road building. Where they are properly classified and used, they produce good and serviceable roads, airfields, embankments, etc. but in many cases they have been improperly used sometimes just because they are red. Since there has been significant failure and so little is really known about these soils, A.I.D. has undertaken a world-wide program to investigate, classify, and develop procedures to enable the field engineer to safely and economically use these abundantly placed soils.

The first phase of the program has just been completed in South East Asia (Bangkok) by Woodward-Clyde and Associates, Miller-Warden-Western, Inc., and Materials Research and Development, Inc. I am enclosing a copy of their final report for your information. We will a little later reduce this report to a usage manual. The second phase of this program is now underway in Africa at the Buildings and Roads Research Institute, Ghana Academy of Sciences at Kumasi, Ghana. Lyon Associates of Baltimore, Maryland with Drs. Peck, Eades, Deere, Cording, Ireland and Thornburn of the School of Engineering, University of Illinois are conducting the Africa wide phase of the program. This

second phase is scheduled for completion in October 1970 and will include investigation of the expansive clays (black cotton soils) as well as the laterites.

The third phase if undertaken, would include Latin America. We have proposed that such a program be started in FY 1971. To fill you in on the extent and depth of this program I am enclosing a copy of the African scope of work "Description of the Program" for your review and comment. The laterites in their various forms are abundant in Latin America and are widely used in the construction of roads, airfields, etc.; however, I have no knowledge at all regarding any problems you may be having with the laterites - cotton soils or other problem tropical soils. In order for us to move ahead with a Latin America soils program, a number of questions must be answered such as - are you having soils problems; if so, what are they and what kinds of soils are involved? And if the concensus of opinion is that there are problems and the program is needed - where do we base the team? Similar prior information was obtained from many of the Africa Missions and their continued active participation provides considerable input to the program. To date fifteen (15) of the African countries have been visited by the project soils engineers.

You will notice in the Africa "Description" that we are based in the Laboratory of the Ghana Buildings and Roads Research Institute (BRRI) in Ghana. In South East Asia we were based in the Royal Thai Highway Laboratory in Bangkok. In each case we provided needed additional lab equipment that became a permanent part of each lab. Also we furnished two jeep wagons that will revert to the Mission of the home base. In addition, the Thais put up $50,000 and the Ghanians $60,000 equivalent for local costs. In each case we will leave well organized and adequately equipped soils laboratories.

Your candid opinions, suggestions and comments will be of great value in determining the value of moving ahead with a Latin American program. I am looking forward to hearing from you on this subject. If you plan to be in Washington, please stop in and we can discuss the possibilities.

Sincerely yours,

/s/ Ashby Williams, Jr.

J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering

Enclosures: (As Stated)

ENGR:JAWilliams:pb:11/21/69

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UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT
MISSION TO GUYANA
P.O. BOX 25
65 MAIN STREET
GEORGETOWN, GUYANA

March 6, 1970

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Department of State
AID/Washington, D.C. 20523

Dear Mr. Williams:

Subject: Report - Engineering Study of Laterite and Lateritic Soils in Connection with Construction of Roads, Highways, and Airfields - Phase I - South East Asia (Thailand)

The subject report which you forwarded to this office has been reviewed extensively by the various officials of the Ministry of Works and Hydraulics. As you can see by the enclosed copy of a letter from Mr. Allsopp, Deputy Chief Officer, they are very interested in having a similar study made for Guyana.

From my own observations and experience in Guyana, I am of the opinion that such a study would be of great value to Guyana in the future road construction programs. In addition to the laterite as a main source of surfacing material, as expressed in Mr. Allsopp's letter, it is my belief - that the clays that predominate in the coastal and riverain areas are heavy in laterite composition.

I have had considerable experience working with Woodward-Clyde and Associates in California and feel that they are particularly well qualified in this field and hope that they will be continuing on the project if it is continued in South America.

I cannot make any commitment as to financial participation on the part of the local Government if Guyana is selected as the location for the study. I do feel, however, that the technical people are sufficiently interested in such a study that high priority would be given by the Government of Guyana to financial participation in the project.

I thank you for the copy of the report and trust that you will keep us advised as to any further developments in the project.

Sincerely yours,

Marvin W. Brigham
Chief Engineer

Kingston,
P.O.
GEORGETOWN

Guyana

5th March, 1970.

Dear Mr. Brigham:

I have received the report entitled "Engineering Study of Laterite and Lateritic Soils in Connection with Construction of Roads, Highways and Airfields" Phase I-South East Asia(Thailand). It is very interesting and the reason for my delay in commenting on it is that I have been quite absorbed in studying it in detail. In addition, while I was in Thailand two years ago, I had the opportunity of seeing some of the work which was being done there at the time.

For us in Guyana, Laterite is a very important material and indeed has been used as the only surfacing material for our roads in the far interior. In our planning of the road connecting Georgetown with Brazil, we have considered that Laterite is the main surfacing material which will be used on a stretch of some 200 miles or more. In my recent visit to Brazil with the Former Minister of Trade and Industry, the road connections on the Brazilian side were discussed and some work inspected and I was interested to note that their plans also included the use of Laterite to surface their roads. In the vast area of South Guyana and North Brazil, adjacent to the Guyana border, it is clear to me that Laterite will be a very useful material in road and airfield construction for many years to come. You will therefore appreciate the reason for my interest in the Laterite study and my anxiety to scrutinise the report from Thailand.

I think the report is a good start to the research venture, but it seems to me that quite a lot more needs to be done in filling in the framework erected by the study. In our Laterite areas there is usually such a large amount of white sand, naturally existing, that the Laterite when spread over the sand as a surface is sometimes mechanically stabilised by it, due to the action of traffic, and a reasonably good surface results. We are interested in the stabilisation process where Laterite is concerned and I hope that Guyana will be seen as a good area for another phase of the research programme. I can testify to our need to use this material from the engineering point of view, but have not discussed other implications such as finance and supporting staff. We have a small laboratory which is very heavily committed to an intensive 1970 programme and if we become involved in a study such as this then we would certainly need to expand our facilities or perhaps even build a new laboratory. Such problems could cause financial difficulty, but I feel that while expressing my enthusiam for the research programme I should also mention some of our limitations, not the least being shortage of funds.

I should like to discuss this matter with you further and whatever happens I hope that I can keep in touch with the progress of the study whenever it might be conducted. If you can give me some up-to-date information on the work in Ghana I should be most grateful.

Dallas Fowler, who was once here in Guyana with U.S.A.I.D. sent me a copy of his comments on the study. While I was in Thailand we discussed the possibility of having Guyana as a base for one phase of the study so he knows of my interest.

Yours faithfully,

P.A.D. ALLSOPP
Deputy Chief Officer,
Ministry of Works, Hydraulics & Supply.

Mr. Marvin W. Brigham
Chief Engineer
U.S.A.I.D. Mission
65 Main Street
GEORGETOWN.

AGENCY FOR INTERNATIONAL DEVELOPMENT
USAID - RIO DE JANEIRO
APO NEW YORK, 09676

February 25, 1970

Mr. J. Ashby Williams, Jr.
Chief Transportation Division
Office of Engineering
Agency for International Development
Washington D.C. 20523

Subject: Report Engineering Study of Laterite and Lateritic Soils in Connection with Construction of Roads, Highways and Airfields - Phase I - South East Asia (Thailand)

Dear Mr. Williams:

This is a very delayed acknowledgment of your letter of November 25th on the above subject. Since about that time this Mission has been in the process of reorganizing our Highway Division with a new PASA division chief and at the same time getting the implementation started on 3 highway loans that have been giving us numerous problems.

Your letter presents problems for which I have very little background and I will have to depend upon others to make the judgments. To date, they haven't had the time to study the report and I am not sure just when they will, but in the meantime I can answer your specific questions: (1) "are you having soil problems and if so, what are they and what kind of soils are involved?" My BPR/PASA team tells me we have not been having any particular soils problems on the road construction projects which we have been involved in to date. On only one road have we used laterites and they tell me that on that one, by carefully selecting the materials they were able to avoid problems.

I plan to be in Washington at the start of home leave about the middle of April and at that time I will be glad to discuss the subject with you. Presently we have no one working in the National Department of Highways but we hope in the next several months to have a second PASA team working there dedicated to technical assistance and we will then be in a much better position to gain an understanding about their problems as related to lateritic soils. The acceptance which this new BPR team receives in DNER might also give us a clue as to the cooperation which might be expected from the Brazilian government on a regional study such as the one suggested.

Both Mr. Louis Berger and my Deputy Jay Carter have told me of your great interest in this project.

Sincerely,

Wyman R. Stone
Chief, Engineering & Natural Resources Office

UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT
U. S. AID MISSION TO PANAMA

#70-1337

P. O. Box "J"
Balboa Canal Zone

February 24, 1970

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International
Development
Washington, D. C. 20523

Subject: Report Engineering Study of Laterite and Lateritic Soils in Connection with construction of roads, highways and airfields - Phase 1 - South East Asia (Thailand)

Dear Mr. Williams:

We have reviewed the subject report, and do feel that the availability of such literature on soils generally, and lateritic soils in particular, will contribute to better planned and implemented projects. We are pleased to know that a third phase of this study is now under consideration for Latin America, and do urge that it be undertaken.

Due to the limited transportation program in Panama, our soils problems and information are also limited. Most of the current projects are located within the Panama City metropolitan area, and consist of short sections employing relatively sophisticated construction methods. Problems are dealt with individually, but no pattern has emerged. We do, however, have several feasibility studies dealing with rural road networks for the interior provinces where cursory soil investigations profess a wide use of lateritic soil for embankment construction as well as surfacing. Further study of such soils would no doubt enable its better utilization.

Panama City is centrally located and could very well serve the purpose of accommodating a team of engineers for the third phase. Laboratory facilities exist at the local University and could be made available. Panama is a country with a small land area, and a somewhat limited road network. The classification of varied types of soils is limited accordingly.

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The IDB has more or less assumed the external financing of road construction. As a result, we feel that the Government of Panama may not be in a position to contribute funds to cover local costs, as did Thailand and Ghana, on this type of AID financed work.

We will be glad to provide further information, as you may request, and are prepared to assist in every way possible.

Sincerely yours,

Charles S. Stevens

Charles S. Stevens
Chief Engineer

c.c. Mr. P. S. O'Shaughnessy
Chief Engineer
USAID/Bogota

AGENCY FOR INTERNATIONAL DEVELOPMENT

MISION ECONOMICA DE LOS ESTADOS UNIDOS EN LA REPUBLICA DE CHILE

CASILLA 13120 - SANTIAGO - CHILE

February 11, 1970

Mr.
J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Washington, D.C. 20523

Dear Ashby:

The difference in quality of reply now to your letter of November 24, 1969 about lateritic soils, and what I could have provided by return mail is not very noticeable. We have, however, tried to explore the matter officially through the Highway Dept. of GOC, and they made contacts with the University of Chile soils laboratory before responding to our inquiries.

Quite briefly, Chile has no laterite problems. There is a highway from Arica to Puerto Montt, known by the names of Panamerican Highway or the Longitudinal Highway. Its length is roughly 3,000 km., representing 2/3 of the length of the country. The southern third of Chile is essentially a maritime province now served by sea and air but without much in the way of roads. Between Arica and Puerto Montt the presence of good rock and gravelly soil in abundance almost all the way belies much in the way of highway foundation problems, except in swampy areas close to the sea, such as near Valdivia.

According to the Highway Department there is little need to be concerned about lateritic soils as a highway foundation material, but they are interested academically in sending engineers for specialist training in the subject. (See translation attached of their letter of January 26, 1970). While this stated interest does not necessarily tie in to your present plans, it may be of future interest.

With best personal regards,

Sincerely,

Carl

Carl A. Cramer
Chief Engineer

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TRANSLATION

MINISTERIO DE OBRAS PUBLICAS Y TRANSPORTES
DIRECCION GENERAL DE OBRAS PUBLICAS
DIRECCION DE VIALIDAD
CHILE

DEPARTAMENTO CONSTRUCCION
SECCION LABORATORIO

DV. DC. SL. No. 51

LA FLORIDA, 26 JAN. 1970

Señor Roberto Rojahelis:

With reference to your inquiry on surveys made in Chile on laterite and lateritic soils, it is a pleasure for me to inform you of the following: I consider that a general study on specific soils is useful for those countries in which this soil prevails.

Unfortunately in Chile we have all types of soils and we have been obliged to try to have all the necessary elements to investigate the problems that are present in every project in all parts of the country. Therefore we are trying to recruit specialized personnel to support these investigations within our needs.

I take the liberty of suggesting that for us it would be more useful to send our engineers to be trained in California, Michigan or others states with advanced techniques on these matters.

I will be very grateful if you can inform this Division about any available scholarships for our engineers.

Very truly yours,

(Signed) Manuel J. Rodriguez O.
Ingeniero
Dirección de Vialidad

AL Señor Roberto Rojahelis
U.S. Agency for International Development
Alameda Bernardo O'Higgins No. 1146
Santiago

AID MISSION TO DOMINICAN REPUBLIC

AMERICAN EMBASSY
SANTO DOMINGO, DOMINICAN REPUBLIC

FOR U. S. CORRESPONDENTS:
U. S. AID MISSION
SANTO DOMINGO
DEPARTMENT OF STATE
WASHINGTON, D. C. 20521

February 10, 1970

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Washington, D. C. 20523

SUB: Engineering Study of Laterite.

Dear Ashby:

Thank you for your letter and the fine report.

Our soil problem here is Caliche. All early roads were built using Caliche without regard to plasticity, consequently a tremendous maintenance problem exists. It is by far the cheapest subbase type material we have but without careful classification it is not usable effectively. Anything you might have regarding usage of Caliche would be appreciated. We rarely make any attempt to use lateritic soil but we do have lots of black cotton soil to overcome.

We have urged Public Works to initiate a study of Caliche, but to date nothing has moved. Santo Domingo would be the most central location for a laboratory as it is in the Caliche belt. Facilities for a laboratory can be found here, however with elections coming up in May it is rather doubtful that anyone would be in a position here to try and start anything before fall.

In the fall a proposal might be sent to Secretary Michel Lulo Gitte, Secretary of Public Works and Communications, Santo Domingo, outlining the benefits of such a study and we could discuss it with him.

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Thanks again for the report. We would like to have a revised copy when it is reproduced. Sorry it has taken so long to respond.

Sincerely yours,

H M Bixby

Howard M. Bixby
Chief Engineer

Agency for International Development
UNITED STATES AID MISSION TO PARAGUAY
AMERICAN EMBASSY
ASUNCION – PARAGUAY
Cable Address: USAID-ASUNCION

OFFICIAL

February 9, 1970

Mr. J. Ashby Williams, Jr.
Chief Transportation Division
Office of Engineering - Room 4524A
Agency for International Development
Washington, D.C. 20523

Subject: Report Engineering State of Laterite and Lateritic Soils

Dear Mr. Williams:

I have received a memo from Mr. Buenaño, copy of which is attached, and have talked to the De Leu Cather soils people (Mr. Donald Welch of H.O. Golder and Associates Ltd., Cooksville, Ontario) who did the soils work for their study of the Chaco road here in Paraguay, financed by I.D.B. While the soils in the Chaco according to Mr. Welch, are not lateritic, they are very fine clay or sand and are real problem soils. Similar soils exist in the Argentine Chaco and in Entre Rios. Copies of the Paraguay Chaco report must be available to you through I.D.B. Mr. Welch says that extensive testing was carried out on these soils, and they came up with lime or cement stabilization for base course. There must be considerable information in their report. He apparently is of the opinion that a program of test sections should be initiated before a major construction program is started, but it seems that I.D.B. is convinced of the urgency of construction. Certainly more study and testing would be profitable.

The same applies to the similar soils in the Argentine Chaco and in Entre Rios, Argentina. Louis Berger did a lot of work in Entre Rios - see his Feasibility Study for Zarate - Brazo Largo and Route 14, available through LA/ENG.

If facilities for laboratory are available in Brazil, say Sao Paulo, this would seem to be a good base. While laterite soils may not be a major problem in the Argentina-Paraguay-Uruguay Region, problem soils there certainly are, mainly the fine clay and fine sands found in the Chaco, Entre Rios, and Corrientes, as well as Buenos Aires Province. In writing the scope of work it is suggested that the Contractor's attention be called to the

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UNITED STATES GOVERNMENT

Memorandum

: Mr. Albert L. Best, Chief Eng. Reg. AFU DATE: February 4, 1970

: E.R. Buenaño, USAID Local Reg. Eng.

ECT: Engineering Study of Laterite and Lateritic Soils.

In answer to your letter of January 22, 1970 please find enclosed copy of letter sent to you by Mr. J. Ashby Williams Jr., Chief Transportation Division, Office of Engineering, AID/W of November 21, 1969 together with pertinent attachments and previous correspondence on the subject matter.

As indicated, the world-wide scope of these studies makes it imperative, that Phase III be undertaken for Latin America and there can be no doubt that the countries involved would be highly interested in this undertaking. Vialidad Nacional, to my mind, would probably contribute with transportation and some laboratory technicians for the northeastern area. However, as you are aware, Vialidad Nacional is very short on competent personnel, to the extent that detailed final studies and design on Route 14 have recently been contracted with seven different Argentine consultants, on the basis of the AID-financed Louis Berger report. This includes soil studies and location of borrow-pits of materials for each section.

Perhaps the best way to implement the program would be to start with Brazil and follow with Argentina and Paraguay. I understand that Brazil has made a good deal of investigations on lateritas, owing to the extent of their occurrence. Misiones and northeastern Corrientes are but an extension of the so-called "Escudo de Brasilia". Other problem soils are to be found, as you well know, in the clayey soils of Entre Rios.

As to the "tierra colorada" in Misiones, trouble arises not only when it rains, but also from seepages and close ground water levels. Vialidad Nacional limits to 3% the allowable water content for subbase and base courses. Apart from this, compaction is reduced and held at a point of "equilibrium", since over-compaction will induce a sponge-like effect when water is absorbed, causing expansion of the soil.

Apart from Vialidad Nacional, the provinces of Corrientes and Misiones should be interested in a thorough study of these soils. Account should also be taken of the imminent construction of the international airport at Iguazú, although I am not sure what kind of soils are to be encountered at the proposed location of this facility.

Mr. Grand is expected back in Buenos Aires on February 12. Should you need more detailed information on the subject, please let me know.

c.c. Mr. Peter M. Cody, Director USAID/Asunción
Mr. Stanley I. Grand, AID Aff. Off./Buenos Aires

BEST AVAILABLE COPY

UNITED STATES OF AMERICA
AGENCY FOR INTERNATIONAL DEVELOPMENT
MISION ECONOMICA DE LOS ESTADOS UNIDOS EN LA REPUBLICA DE COLOMBIA
AMERICAN EMBASSY - BOGOTA, COLOMBIA

February 6, 1970

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Washington, D. C., 20523

Subject: Report on Engineering Study of Laterite and Lateritic Soils in Connection with Construction of Roads, Highways and Airfields - Phase I - South East Asia (Thailand)

Dear Mr. Williams:

We have reviewed the subject report and our opinion is that the engineering studies were well planned and executed. The amount of information collected and its presentation in the report will be of much use for future engineering projects.

We are pleased to know that expansive clays were included in the second phase of the program now under way in Africa. A suggestion for your consideration in the third phase studies is that vehicle operation and maintenance be provided by the contractor instead of by the host government.

There are quite serious soil problems in some areas in Colombia, resulting from the need to use local materials for highway construction. This is specially true in the northern part of the country, close to the Atlantic coast. There are many kilometers of highways constructed on subgrades of expansive clays, mainly because select soils or other materials of better quality are not available.

One of the most recent examples of failure due to expansive clays occurred in the 140-kilometer "Cordialidad" highway between Cartagena and Barranquilla. The pavement was destroyed, and although the highway was reconstructed on the basis of a modified design, some sections of the new pavement have already cracked.

Other examples of construction deficiencies resulting from the use of expansive clays are:

	Approximate Length, Km
Cereté - Lorica	30
Cereté - Planeta Rica	50
Cerritos - Calamar	50
Ponedera - Puerto Giraldo	20
Planeta Rica - La Ye	60
Cali - Puerto Tejada	30
Chiriguaná - El Copey	100

We have some problems with hallosyte soils which are found frequently in the central part of the country. The natural water content is very high, and tropical conditions make it difficult to dry out these materials so that the optimum content for appropriate compaction can be obtained. In these cases it has been necessary to adopt special control methods for compaction instead of the conventional modified Proctor.

As recent examples we have the Pereira Airport (financed by counterpart funds) and the 50-kilometer Armenia-Pereira highway, where the substantial sections of the pavement were destroyed before the road was completed.

The Popayán-Timbío section of the Panamerican Highway, which has been recently constructed, is in an area where hallosyte soils prevail. To date, there have been no problems in this section.

Lateritic soils are found frequently in the Cauca and Nariño departments and in some other areas like the road between Bogotá and Villavicencio and between Puerto Leguízamo-La Tagera. However, we have not had personal experience with the soils in these areas.

Due to its geographical situation Colombia might be considered as an ideal base for the team that would conduct the third stage studies. Colombia has several well-organized consulting firms, and the Ministry of Public Works is a well-known agency for the counterpart effort.

If you believe that further information on the lateritic soils is necessary to justify the third-stage studies, we can take up this matter with various Colombian agencies. Please advise.

We will be very glad to assist you in any specific questions that you may have.

Sincerely yours,

P. S. O'Shaughnessy
Chief Engineer

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P. S. - We would appreciate receiving another copy of the First-Phase report, if such is available.

cc: Mr. Charles Stevens
Chief Engineer, USAID
P. O. Box J
Balboa, Canal Zone

Mr. Karl O. Kohler, Jr.
Chief Engineer, LA/CD/ENGD
AID/Washington, 20523

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Agency for International Development
UNITED STATES AID MISSION TO PARAGUAY
AMERICAN EMBASSY
ASUNCION - PARAGUAY
Cable Address: USAID-ASUNCION

OFFICIAL

February 4, 1970

Mr. J. Ashby Williams Jr.
Chief Transportation Division
Office of Engineering - Room 4524A
Agency for International Development
Washington, D.C. 20523

Subject: Report Engineering Study
Laterite and Lateritic Soils

Dear Mr. Williams:

This is further to Mr. Cody's letter of January 27, 1970. I have spoken with Engineer Pettengill, Chief of Pavements Section, Vialidad MOPC about your projected study program here. He shows considerable interest and indicated that he thought MOPC would be able to furnish transportation and the use of their present soils laboratory and technicians for the study to be done here in Paraguay. This laboratory was set up by Palmer and Baker to service the Airport Construction work, and was taken over by MOPC.

As far as Argentina is concerned, I have not yet received your letter and the report addressed to me there. It probably was delayed in the Christmas rush. I have written to ask for comments from Engineer Buenaño, who in my absence on extended TDY here in Paraguay, will consult with the local Vialidad people to see what cooperation they would be willing to furnish. The need for the study there is great. They have a big construction program planned. I am sure they will be keenly interested and that they, too, will be ready and willing to furnish transportation and laboratory facilities and technicians, perhaps even local funds if necessary. Louis Berger's people are familiar with the laboratory facilities available there. I shall investigate further and advise you on my return to Buenos Aires later this month.

In Uruguay the need for the study is also great. I will investigate interest in Uruguay in furnishing transportation or laboratory facilities.

I look forward to perusing the report and other information attached to your letter when I receive it.

Sincerely,

Albert L. Best
Chief Engineer Regional
Argentina, Paraguay, Uruguay

February 2, 1970

Mr. Charles B. Jones
Chief Regional Engineer, ROCAP
c/o American Embassy
Guatemala City, Guatemala

Dear Mr. Jones:

Thank you for your letter of 21 January 1970 regarding our Laterite study Phase I, South East Asia (Thailand) and expressing your interest in this project. I am forwarding three (3) copies of the report as requested.

I will be out of the country until the week of February 23, 1970 but would welcome the opportunity to exchange views and visit with you when I return. Please call my office upon your arrival so that we may get together. You can reach me at 632-8397.

Sincerely yours,

J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering

Enclosures: (As Stated)

ENGR:PLBullock:2/2/70

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GALERIAS ESPAÑA
Telephones: 64872-3-4-5
Plazuela España, Zona 9.
Cable: ROCAP/Guatemala City

ROCAP

DEPARTMENT OF STATE,
AGENCY FOR INTERNATIONAL DEVELOPMENT
Regional Office, Central America and Panama Affairs
Guatemala City, Guatemala, C. A.

21 January 1970

Mr. J. Ashby Williams, Jr.,
Chief, Transportation Division,
Office of Engineering,
Agency for International Development,
Department of State,
Washington, D.C. 20523

Dear Mr. Williams:

This will acknowledge your letter of 5 December 1969, and receipt of the report, titled: Report Engineering Study of Laterite and Lateritic Soils in Connection With Construction of Roads, Highways and Airfields - Phase I - South East Asia (Thailand).

Your letter, the description of the program and the report of the first phase of the study are of considerable interest to Al Van Dyke (my Assistant) and me. Al will carry the responsibility of investigating the need for a study of construction soils in Central America, the development of a program if appropriate, and other matters relative to the location of such a study team and use of existing laboratory facilities.

Brown & Root Overseas, Inc., are doing considerable work here in Guatemala. They are the Consulting Engineers on the El Rancho/Cobán Highway, being financed by AID/CABEI Integration Funds. Their Assistant Manager here is Engr. Jorge Erdmenger, a highly specialized soils engineer. He received his Masters Degree in Civil Engineering from Ohio State in 1956, majoring in soils mechanics. He made an important study, titled: The Behavior of Volcanic Soils in Highway Construction, which was published in the proceedings of ASCE in 1962. Engr. Erdmenger is now reviewing the first phase report as well as the Description of the Program. He has indicated great interest in the possibility of such a project being established in Central America, and has promised his assistance, not only in developing the proper scope of work, but in the location of suitable laboratories.

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Mr. J. Ashby Williams, Jr. 21 January 1970

The Consulting Engineering firm of Baltodano/Echandi/Lara (San José/Costa Rica) are also working on an AID/CABEI financed project in Costa Rica (El Coco/San Ramón Highway). This firm is one of the best in Central America, and Engr. Manrique Lara (member), is an outstanding Soils Engineer. He received his Masters Degree in Civil Engineering from Ohio State in 1958. He has been a professor at the University of Costa Rica; and also is greatly interested in the proposed project study within the Region.

We propose to contact other consulting engineers, Government highway engineers and others in an effort to develop a proper scope of work, and locate the study center in the most suitable location from the stand point of representative soil conditions, and of obtaining the most active support and most suitable physical plant(s) for the study.

We are assuming that you desire us to assist in furthering the project study in Central America and Panama. In this connection, we need three more first phase reports.

It appears likely that in Central America and along the west coast of South America, that the investigation of the characteristics, use, and control of volcanic soils would be of more importance than a study of laterites.

I will be in Washington in late February and early March 1970, and will call on you to exchange views regarding the study.

We wish to assure you of our interest in this project.

Best personal regards,

Charles B. Jones
Chief Regional Engineer

AGENCY FOR INTERNATIONAL DEVELOPMENT
UNITED STATES OF AMERICA A. I. D. MISSION
TO EL SALVADOR
C/O AMERICAN EMBASSY
SAN SALVADOR, EL SALVADOR, C. A.

February 3, 1970

J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Washington D. C. 20523

Dear Mr. Williams:

I have read the report "Engineering Study of Laterite and Lateritic Soils in Connection with Construction of Roads, Highways, and Airfields" which you forwarded to me with your letter of November 28, 1969. I have also talked to representatives of local private soils laboratories and the head of the GOES highway department soils laboratory concerning laterite, lateritic soils, and other problem soils in El Salvador.

Generally, few problems have been encountered in El Salvador in the construction of base and sub-base in roads. Most of the all-weather roads have been built in the southern two-thirds of the country, where abundant aggregate is available in the massive or gravel form. Most of this aggregate is naturally stable or is easily mixed to furnish an excellent sub-base or base.

It is recognized that there are some soils in the southern two-thirds of El Salvador that contain sesquioxides of aluminum and iron. However, it is apparent that the content of these ingredients in the borrow used in road construction is not sufficient to warrant special consideration or treatment. Of all the persons contacted, none confirmed the existence of laterite or plinthite in El Salvador as defined in the Thailand report.

The director of the highway department soils laboratory, Sr. Edgar Parker, did not feel that a study in El Salvador similar to the Thailand Laterite Study would be very beneficial to El Salvador at this time. However, he did state that in 5 to 10 years from now, increasing road construction in the northern third of the country might require special studies of the properties of road construction material in that area.

About the only problems with soils in El Salvador seem to

be those of a structural nature. Over the years, continuing deposits of volcanic ash, and cinder from volcanic eruptions, subsequent erosions and sedimentations of these deposits, and organic material deposited between eruptions causes stratification of varying strengths in the geologic substructure. The extensive use of boring equipment has lessened the danger posed by this stratification.

The soils laboratory of the highway department is now involved in the nationwide survey of mineral resources. This survey is financed and sponsored by the West German Government and the United Nations. The director of the laboratory stated that this study is already absorbing much of the GOES resources which would be the host government's contribution, in a study similar to that outlined in the Ghana Laterite Study Scope of Work.

On the basis of the above information, I recommend that phase three be located in a country other than El Salvador.

Sincerely yours,

Joseph R. Marceny

Joseph R. Marceny
General Engineer

JRM/dec

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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering

DATE: February 2, 1970

FROM : John K. Chattey
Chief Engineer, USAID/Peru

SUBJECT: Comments on "Engineering Study of Laterite & Lateritic Soils in Connections with Construction of Roads, Highways, & Airfields - Phase I - Southeast Asia"

Attached is our reply to your request for comments on the subject report. Please excuse our delay in replying. Mr. John H. Frazier, our BPR highway engineer, was on home leave and upon his return he was busy with our highway problem, which has been troubling us for a long time.

Attachment: 2 copies of subject memo

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Mr. John K. Chattey
Chief Engineer/USAID

Mr. John H. Frazier
Highway Transportation
Adviser Engineer/USBPR
Comments on "Engineering Study of Laterite and Lateritic Soils in Connection with Construction of Roads, Highways & Airfields, Phase I, Southeast Asia.

My experience in highway construction has been limited to one main area of Perú, the area bordering the jungle and mountainous area in northern Perú. I have observed highways already built elsewhere, such as the Trans Andean Central Highway to Pucallpa. In none of these areas have I observed soils that meet the description "Lateritic" as given in the report.

In conversations with construction personnel who have worked in Southeast Asia, they have been emphathic in saying that they have encountered nothing in Perú resembling lateritic soils of the type found in Southeast Asia. They did remember well, however, the problems they had with lateritic soils in those countries.

It is my opinion, therefore, that an engineering study such as this would have limited value in Perú. I am not familiar with the southern part of Perú, but am led to believe in conversations with others that lateritic soils, if they occur, are not a problem in that area.

One of the most interesting parts of the report was that dealing with design of pavements. I disagree with the general philosophy used in pavement design in the report which assumes that a less developed country such as Thailand should not utilize designs having higher safety factors which reduce the maintenance factor during the pavement's life. Perhaps Thailand has a well organized maintenance program and can afford this type of expenditure rather than a costlier original construction. My experience in Bolivia and Perú indicates the opposite, however. Poorly organized and supported maintenance programs in those countries endanger even a well designed pavement; therefore I believe that in such cases a more realistic approach would be to design a facility as free of maintenance as one can afford.

The pavement design used for the base and surfacing is an adaptation of the common U.S. practice in many states of converting all traffic to equivalent wheel loads and applying empirical methods of converting this number to a total pavement thickness, basing the conversion for the most part on tolerable deflections under load.

USBPR/JHFrazier:rcb 30/1/70

Agency for International Development
UNITED STATES AID MISSION TO PARAGUAY
AMERICAN EMBASSY
ASUNCION - PARAGUAY
Cable Address: USAID-ASUNCION

UNCLASSIFIED

January 27, 1970

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering, Room 4524A
Agency for International Development
Washington, D.C. 20523

Dear Mr. Williams:

In a recent conversation with Louis Berger, he mentioned to me a letter of November 25, 1969, which you wrote to various USAID Directors or Engineers regarding a proposed project in Latin America to study problems of road construction using lateretic soils. While we have no indication of having received the letter in USAID/Paraguay, Mr. Berger made a copy available to me and I should like to express our interest in AID/W moving forward with such a project, since Paraguay badly needs to develop low cost farm-to-market and improved roads that will not require excessive amounts of maintenance.

While I am quite sure that the Government of Paraguay will not be able to provide the local costs to support such a project, I think Paraguay could profit indirectly by such a project based in Brazil, particularly if the project were to study soils in Parana and Matto Grosso similar to those in Paraguay. Hopefully, it might also be possible for the project to conduct studies within Paraguay.

I would appreciate being informed of any decisions made to move forward with the program in Latin America, and would also appreciate a copy of the study made in South East Asia.

Sincerely yours,

Peter M. Cody

Peter M. Cody
Director

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AGENCY FOR INTERNATIONAL DEVELOPMENT

UNITED STATES A.I.D. MISSION TO COSTA RICA

U.S.A.I.D.
UNITED STATES EMBASSY
SAN JOSE, COSTA RICA

December 30, 1969

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Department of State
Washington, D. C. 20523

Subject: Report Engineering Study of Laterite and Lateritic Soils in Connection With Construction of Roads, Highways and Airfields - Phase I - South East Asia (Thailand)

Dear Ashby:

This is a belated acknowledgment of your letter dated November 26, 1969 with which you transmitted a copy of the subject report recently completed by Woodward-Clyde and Associates, Miller-Warden-Western, Inc. and Materials Research and Development, Inc.

This is a comprehensive and valuable report and I regret that the pressure of end-of-the year matters has not made it possible for me to study it in detail as yet. It is of particular interest as I was in Bangkok at the time the first phase of the program was being undertaken in South East Asia. I note that the second phase is now under way in Ghana, Africa and that a third phase, if undertaken, would include Latin America.

Before I can comment further on the report or on the value of moving ahead on a Latin America program it will be necessary for me to study the report further and, especially, its applicability to local conditions. I shall give the subject closer attention at the first opportunity.

Sincerely yours,

Charles N. Strong

Charles N. Strong
Chief Engineer
USAID/Costa Rica

CNS:fc

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UNITED STATES AID MISSION TO ECUADOR
AGENCY FOR INTERNATIONAL DEVELOPMENT
c/o AMERICAN EMBASSY
QUITO, ECUADOR

CABLE ADDRESS USAID
PHONE No. 521-100

December 29, 1969

ENG-69-828

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Washington, D. C. 20523

Dear Mr. Williams:

With further reference to your letter of November 28, 1969 and my reply of December 11, 1969, on the subject of proposed studies of laterite and lateritic soils in Latin-America, I have just received a reply to my request for comments made to TAMS, the Ministry of Public Works' Consultant on our highway program in Ecuador.

TAMS' Project Manager Sexton A. Olin's comments are quoted as follows:

> "This is in answer to your letter ENG-69-782 regarding proposed studies on laterite and lateritic soils in Latin-America. During the time we have acted as Consultants to the Ministry of Public Works of Ecuador, both in Highway Studies and in Construction, we have not encountered laterite and/or lateritic soils. However we have had problems with expansive clays and silts of alluvial origen. These materials are prevalent in the first thirty kilometers of the Durán-Cochancay Road and the Section Durán-Yaguachi of the Durán-Babahoyo Road. We have also had some trouble with soils of volcanic origen (ashes) on the Cajabamba-Las Monjas Road."

ENG-69-828
December 29, 1969

This corraborates the opinion expressed in my December 11, 1969 letter.

Sincerely yours,

L. Sterling Hedgpeth
Chief Engineer

AGENCY FOR INTERNATIONAL DEVELOPMENT
UNITED STATES A. I. D. MISSION TO GUATEMALA
AMERICAN EMBASSY
GUATEMALA CITY, GUATEMALA, C. A.

December 19, 1969

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
A.I.D./Washington 20523

Dear Mr. Williams:

Thank you for your letter of December 1, 1969 and the report on lateritic soils. Your program to investigate, classify and develop procedures for the use of laterites as well as other problem soils sounds interesting as well as valuable.

Guatemala, as far as I have been able to determine, does not use lateritic soils as primary material for road building. Road construction in the central highlands is accomplished by using soils and rock of volcanic origin, along the lowlands of the Pacific Coast crushed river rock is used and in the jungle area of the Peten, in northern Guatemala, treated calcareous clays are used.

Information gathered by the Guatemalan Highway Department and the Bureau of Public Roads during the construction of the Pan American Highway indicates that three basic types of construction material, of volcanic origin, were used. They are described as follows:

1. Vesicular and Columnar Basalt

   Abrasion loss 13%, Specific Gravity 2.75, Absorbtion 1.4%. Has high mechanical stability but lacks cementation. Is used as sub-base and base with sand as a filler.

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2. Volcanic Cinders

Color red and black, Abrasion loss 46%. Non-plastic, 90 to 100 #/ft.^{3}. Looks very much like Arizona Cinders. Used as sub-base and base with sand as filler. Only angular cinders are used.

3. Pumice Sand

Color pink, yellow and white. Specific Gravity $\pm$ 2.35, 20 to 30% passes No. 200 sieve. Degrades readily during construction. Although these fine graded pumice sands do not meet standard specifications for base course, the material is abundant in Guatemala and coupled with the fact that the material is non-plastic, special efforts to find favorable solutions to its wide use in highway construction are justified. A comprehensive study of the "Behavior of Volcanic Soils in Highway Construction" by Jorge Ernesto Erdmenger was published in the Journal of the Construction Division of the ASCE. September 1962.

Black soil described as being similar to "Black Cotton" soils was reported in only one location on the Pan American Highway.

In a feasibility study report by Louis Berger, calcareous clays and clay loams originating from the descomposition of limestone are reported to form most of the Peten Caribbean lowlands. AASHO Group A-7 clays are elastic, subject to considerable volume change and have low support capacity. Stabilizing of these soils with quicklime appears to be the only practical solution, in the opinion of the consultant.

That is a general picture of our soils situation here in Guatemala. During our last rainy season unusually heavy rains cause considerable damage to the central highlands road system. Among the hardest hit was the Pan American Highway which had dozens of fill failures and was covered with hundreds of landslides from one end of

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Guatemala to the other. The area with most of the fill failures was west-central Guatemala. This area used pumice sand as fill almost exclusively.

Many studies have been made, of the composition and behavior of Volcanic Soils, by the Guatemalan Government as well as the Bureau of Public Roads over the past ten years. It is obvious from the problems they are having with the Pan American Highway that they still don't have all the answers. I would suggest that it be included in your list of soils to be studied in Latin America.

Very truly yours,

Robert E. Davis

Robert E. Davis
General Engineer

RED:ame

UNITED STATES AID MISSION TO ECUADOR
AGENCY FOR INTERNATIONAL DEVELOPMENT
c/o AMERICAN EMBASSY
QUITO, ECUADOR

December 11, 1969

CABLE ADDRESS USAID
PHONE No. 521-100

ENG-69-780

Mr. J. Ashby Williams, Jr.
Chief, Transportation Division
Office of Engineering
Agency for International Development
Washington, D. C. 20523

Dear Mr. Williams:

We were interested in the contents of your letter of November 28, 1969 concerning studies being made in different countries of laterite and lateritic soils in connection with the construction of roads, highways and airfields.

The Southeast Asia (Thailand) report has been received and will be studied with interest as time permits. However, the African scope of work "Description of the Program", which you said you were enclosing, was not received. We would appreciate a copy.

We have had some soils problems on our large highway construction program in Ecuador but I believe, in view of the "induration" characteristic of laterite, that the materials involved were alluvial clays and not lateritic soils. My travels over Ecuador indicate that laterites do not abound here. One of our principal problems is the abundance of very friable conglomerates which are giving us continual landslide problems on our steep cuts in the mountains. In contrast, on my highway work in Liberia, Africa, we used laterite extensively for subbase and base course material and high laterite cuts stood nearly vertical without erosion or landslide problems.

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I am forwarding a copy of your letter to TAMS, the Ministry of Public Works' consultant on our highway program, asking for their comments on this matter, since they are closer to the details of the situation than I am. Upon receipt of their reply I will further advise you.

Sincerely yours,

L. Sterling Hedgpeth
Chief Engineer