CLAY BRICK ROADS IN GUYANA*

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Summary

Current design methods for clay brick roads in Guyana were reviewed. The performance of existing roads using these design methods was evaluated. Recommendations were made on the basis of this evaluation for improved design methods.

1. INTRODUCTION

There is evidence of clay being used in road construction in Guyana as early as the 1790's. The clay bricks initially used arrived as ballast in boats coming from Europe taking back sugar and other commodities, but subsequently it is likely that clay bricks used in later roads were produced in small factories in Guyana.

The initiation in Guyana of Burnt Earth as a road construction material appears to have been around 1815. Most Guyanese are familiar with the features old burnt earth roads such as dusting in the dry season and erosion and potholing in the wet season. The burnt earth road has now virtually disappeared as a public road but still exists extensively in some sugar areas as access roads into the sugar cane fields.

In 1978 the company of Terrence Fletcher & Associates Limited was engaged by the Guyana National Engineering Corporation to develop guidelines related to the design, construction, and maintenance of roads in Guyana using clay bricks. These guidelines were developed and implemented and since then nearly 70,000 square metres of secondary roads, side walks, parking areas and hard standings have been constructed using clay bricks. The objective of this paper is to examine the performance of some of these facilities in the light of existing design methods for clay brick roads and to make tentative recommendations for improved design methods in the future.

The total length of roads and vehicular trails in the National Provincial and Urban Systems of Guyana amounts to 8,821 km. Of this amount just over 800 km are paved roads. The major proportion of the paved roads is surfaced with bituminous materials while a very small proportion is surfaced with Portland Cement concrete. At this point in time the total length of paved roads which is surfaced with clay bricks would be approximately 5-7 km.

2. DESIGN

2.1 Design Methodology

It was not possible to determine from available literature a rational and scientific design methodology that could be applied to the design of clay brick roads, taking into account factors such as traffic type and intensity, soil conditions, materials characteristics, quality of clay bricks, climatic conditions and design life. As a result attempts were made to adapt two different pavement design methods in the development of a rational design for clay brick roads. One method was based on the Corps of Engineers CBR design curves for 18,000 pounds Equivalent Axle Loads. In the other approach a combination of the AASHO Design Method and the elastic theory related to a three layer system was applied.

Both methods were reviewed and considered in the light of judgment of limited past experience. Subsequently design curves were developed (See Figure 1). The Design Period of the road was assumed to be 20 years.

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2.2 Subgrade Soils

It was decided in developing a pavement design for roads in Guyana using clay bricks to limit the geographical area to be considered to the coastal and near inland locations. This area encompasses nearly 90% of the population of Guyana and would therefore be representative of most of the situations where clay brick roads would be applicable. Within the area subgrade soils would generally be silty clays. Ground water conditions would tend to be variable with seasonal fluctuations between 0 and 1.5 metres.

2.3 Embankment and Side Slopes

2.3.1 Flood Levels

It was ensured that the formation level for the top of the embankment was at a satisfactory height in relation to highest flood levels. Criteria concerning high levels in relation to formation levels were as follows:-

> The finished level of the crown of the road shall not be less than one foot (30 cm) above the high flood level. The high flood level is considered to be the highest flood level likely to be experienced within the particular area for the design life of the road.

2.3.2 Side Slopes

The design required that side slopes should be built at a stable angle to the horizontal but it was also necessary for them to be effectively protected by appropriate materials so as to prevent erosion. They should also be well drained. Figure 2 shows typical cross-sections and details for proposed embankments and side slopes.

3. CONSTRUCTION

3.1 General

Since drainage, embankment, subgrade and subbase construction generally follow standard practice for bituminous surfaced roads, it is not proposed to discuss these phases of construction.

3.2 Curbs

Although it has generally been accepted that curbs can be constructed from precast concrete elements, there has been a tendency to construct clay brick curbs insitu.

3.3 Base Course

After placing the white sand base course it has been the general practice to compact it dry with a steel wheel manually operated vibrator compactor. From experience it has been established that adequate compaction of the base course is extremely important in the satisfactory performance of the finished road.

3.4 Surface

As mentioned before the surface will generally be of herringbone design laid either flat or on edge. Before construction of the surface commences, the base will have to be finally compacted and shaped to the correct camber preferably using a screed board. Bricks should be laid as close as possible to each other and gently tapped into position with a wodden mallet. Bricks close to the edge of the curb should be carefully cut so that they can be neatly fitted into place.

After placing of the bricks has been completed, interstices between individual bricks should be completely filled with white sand.

A team consisting of a brick layer and four assistants should be able to lay approximately 2,000 bricks or 65 square yards (54 square metres) of surface in one day.

3.5 Costs

An analysis of current costs for the construction of a clay brick road consisting of a silty clay subgrade, 2 feet

(0.6 metre) of compacted white sand, and a 16 foot (5 metres) wide carriageway, with a surface consisting of a layer of clay bricks laid flat in a herring-bone formation, reinforced concrete curbs, and 2 foot (0.6 metre) wide clay shoulders is as follows:-

Description	Cost G$ per sq. yd. of surface
Subgrade Preparation	3.00
Embankment Fill	32.00
Clay Brick Surface — Materials	18.00
Clay Brick Surface — Labour	6.00
Road Curbs	10.00
Total	69.00

Note:-

The total cost of 69.00 Guyana Dollars per square yard is equivalent to 50.00 Suriname Guilders per square metre.

4. INVENTORY

Table I shows the location, year completed and areas constructed in clay brick roads, parking areas and pedestrian walkways in various parts of Guyana between 1979 and 1982.

Table II shows a regional distribution of completed clay brick roads and hard standings in Guyana over the same period. From these Tables it will be seen that a total of nearly 80,000 square yards (67,000 square metres) of roadway and hard standings have been completed to date. It will also be seen that more than 60% of all clay brick construction to date is concentrated in the Georgetown area and on the East Coast Demerara. It is also interesting to note that in 1982 more bricks were used in road construction than for all the previous years put together. It would appear that the use of clay bricks in road construction is becoming increasingly popular in Guyana. There is no doubt that the current economic situation in the country contributed significantly to this trend.

5. PERFORMANCE

5.1 General

It is proposed to discuss the performance of clay brick roads in Guyana in general terms but before doing this it would be useful to look briefly at the traffic characteristics for the roads in question. Attention will be paid only to the Demerara Harbour Bridge Approaches and Village Roads.

In the case of the Demerara Harbour Bridge Approaches average daily traffic is of the order of 1200 motor vehicles including about 125 trucks in each direction. In the east bound direction these vehicles are concentrated on a single lane and this represents the worst possible traffic wheel loading for clay brick roads in Guyana. For this condition the traffic has been estimated to be equivalent to about thirty 18,000 pounds axle load applications.

Average traffic on Village Roads built of clay bricks would not be expected to be greater than 100 vehicles per day, and the number of equivalent 18,000 pounds axle load applications under these circumstances can be expected to be of the order of 5.

5.2 Demerara Harbour Bridge Approaches

Generally speaking, the approaches to the Demerara Harbour Bridge which are approximately 5,000 square metres in surface area have performed satisfactorily over the last 4 years. Cost of maintenance of the surface has been minimal averaging less than G$ 0.50 per square metre per year. In the east bound land, because of concentrated wheel loading, rutting has occurred and has currently resulted in a pair of longitudinal depressions about 15 cm deep in the wheel tracks. This is corrected periodically by lifting the bricks, reshaping the white sand base course and replacing the bricks. It is felt that all that is necessary at this time to provide significantly longer life to this land is a 7.5 cm thick sand clay base course interposed between the white sand course and the clay brick surface.

5.3 Village Roads

Several access roads linking the main highway to specific villages have been constructed using clay bricks over the villages have been constructed using clay bricks over the past 3 or 4 years. These roads carry a mixture of traffic including cars, trucks, tractors and carts and the average traffic is about 100 vehicles per day. It has been observed that although the general surface has performed satisfactorily, there have been isolated edge failures which appear to be due to insufficient shoulder width. It is suggested that shoulders should be a minimum of one metre wide.

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TABLE I

CLAY BRICK ROADS IN GUYANA

INVENTORY OF COMPLETED ROADS AND HARD STANDINGS

PROJECT NAME	LOCATION	ZONE	YEAR COMPLETED	SURFACE AREA		SURFACE THICKNESS	
				SQ. YD.	SQ. M	IN	CM
DEN AMSTEL SELF HELP ROAD	DEN AMSTEL	WCD	1979	5,500	4583	2.0	5.1
INTERNAL ROAD – GUYSOCO DIAGNOSTIC CENTRE	OGLE	ECD	1979	400	333	2.0	5.1
DEMERARA HARBOUR BRIDGE APPROACHES	PETER'S HALL	EBD	1979	6,000	5000	2.0	5.1
WOMEN'S HOUSING PROJECT ROAD	CANE GROVE	ECD	1979	600	500	2.0	5.1
GNS SPORTS CENTRE ACCESS ROAD	PLN THOMAS	GTN	1979	600	500	2.0	5.1
CUMMINGS STREET SIDEWALK	GEORGETOWN	GTN	1979	125	104	2.0	5.1
SEVEN BEDS ROAD	INDUSTRY	ECD	1980	5,000	4167	2.0	5.1
RUIMVELDT AVENUE CONNECTION	RUIMVELDT	GTN	1980	500	417	2.0	5.1
PORT MOURANT MARKET – HARD STANDING	PORT MOURANT	COU	1980	800	667	2.0	5.1
GOLDEN GROVE HOUSING PROJECT ROAD	GOLDEN GROVE	ECD	1980	2,000	1667	2.0	5.1
SECTION OF CEMETERY ROAD, LOOUISA ROW	GEORGETOWN	GTN	1980	100	83	2.0	5.1
GNSLC – BAY NO 2	LA PENITENCE	GTN	1981	400	333	4.5	11.4
GOEDVERWAGTING ACCESS ROAD	GOEDVERWAGTING	ECD	1981	2,389	1991	2.0	5.1
BENN-KIRTON HOUSING PROJECT ACCESS ROAD	RUMIVELDT	GTN	1981	300	250	2.0	5.1
GNSCL – BAY NO 1	LA PENITENCE	GTN	1982	400	333	4.5	11.4
GLC – SAPIL HARD STANDING FOR ROLL STOCK	FARM	EBD	1982	3,500	2917	4.5	11.4
GUYANA TRANSPORT SERVICES LTD HARD STANDING	RUIMVELDT	GTN	1982	18,449	15374	2.0	5.1
HOUSING PROJECT NEXT TO ABC HOUSES	RUIMVELDT	GTN	1982	600	500	2.0	5.1
BEST HOSPITAL INTERNAL ACCESS ROADS	BEST	WCD	1982	5,778	4815	2.0	5.1
MAINSTAY RESORT ACCESS ROADS	MAINSTAY	ESS	1982	4,000	3333	2.0	5.1
MANCHESTER ACCESS ROAD	MANCHESTER	COU	1982	4,400	10000	2.0	5.1
BATA INTERNAL ROADS	BETERVERWAGTING	ECD	1982	400	333	2.0	5.1
COLLINGEN WORKSOJP INTERNAL ROADS	COLLINGEN	ECD	1982	10,610	8842	2.0	5.1
COLLINGEN WORKSHOP HARD STANDING	COLLINGEN	ECD	1982	130	108	4.5	11.4

TABLE I (CON'T.)

PROJECT NAME	LOCATION	ZONE	YEAR COMPLETED	SURFACE AREA		SURFACE THICKNESS	
				SQ. YD.	SQ. M	IN	CM
FOODCROP PROGRAMME MARKETING CENTRES	CHARITY	ESS	1982	544	453	2.0	5.1
	PARIKA	WCD	1982	1,143	953	2.0	5.1
	SUPENAAM	ESS	1982	1,755	1463	2.0	5.1
	MIBICURI	COU	1982	1,285	1071	2.0	5.1
	ACQUERO	ESS	1982	240	200	2.0	5.1
	HOSORORO	ESS	1982	1,119	933	2.0	5.1
	KURU KURURU	EBD	1982	1,466	1222	2.0	5.1
GPSU SPORTS COMPLEX	GEORGETOWN	GTN	1982	447	373	2.0	5.1
PNC PARTY HEADQUARTERS	SOPHIA	GTN	1982	2,800	2333	2.0	5.1
ATLANTIC GARDENS WALKWAYS	MONTROSE	ECD	1982	413	344	2.0	5.1

TABLE II
CLAY BRICK ROADS IN GUYANA
REGIONAL DISTRIBUTION OF COMPLETED ROADS AND HARD STANDINGS

YEAR COMPLETED	LOCATION							TOTAL
	GTN	ECD	EBD	WCD	WBD	COU	ESS	
1979	725	1000	6000	–	5500		–	13225
1980	600	7000	–	–	–	800	–	8400
1981	700	2389	–	–	–	–	–	3089
1982	22696	11553	4966	6921	–	–	7658	53794
TOTAL	24721	21942	10966	6921	5500	800	7658	78508

NOTE

QUANTITIES EXPRESSED IN SQUARE YARDS

GTN	GEORGETOWN
ECD	EAST COAST DEMERARA
EBD	EAST BANK DEMERARA
WCD	WEST COAST DEMERARA
WBD	WEST BANK DEMERARA
COU	CORENTYNE COAST
ESS	ESSEQUIBO

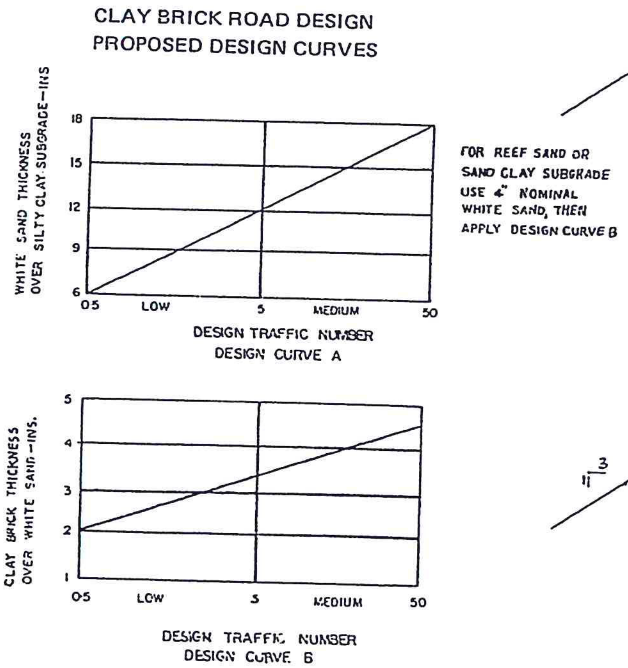

FIGURE 1

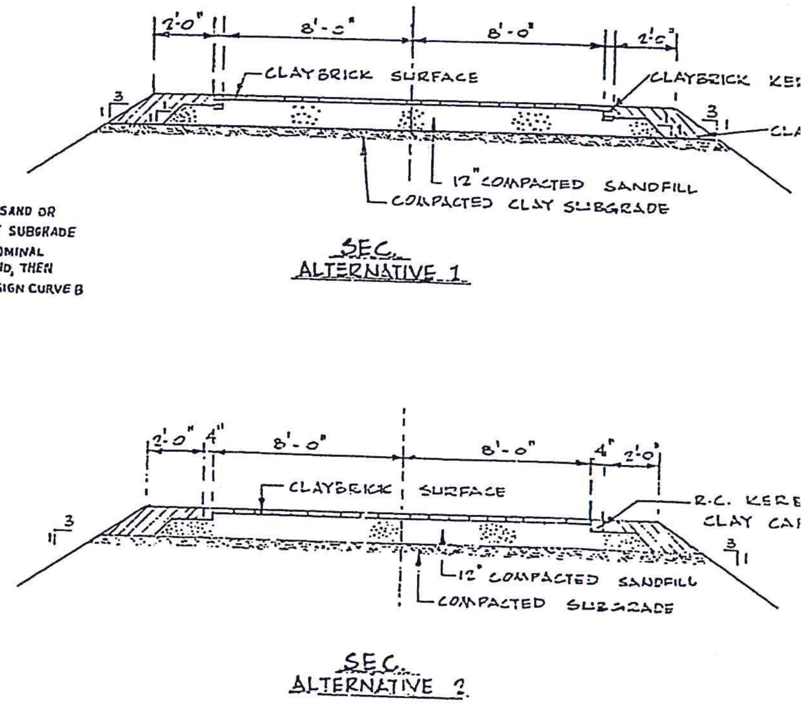

FIGURE 2

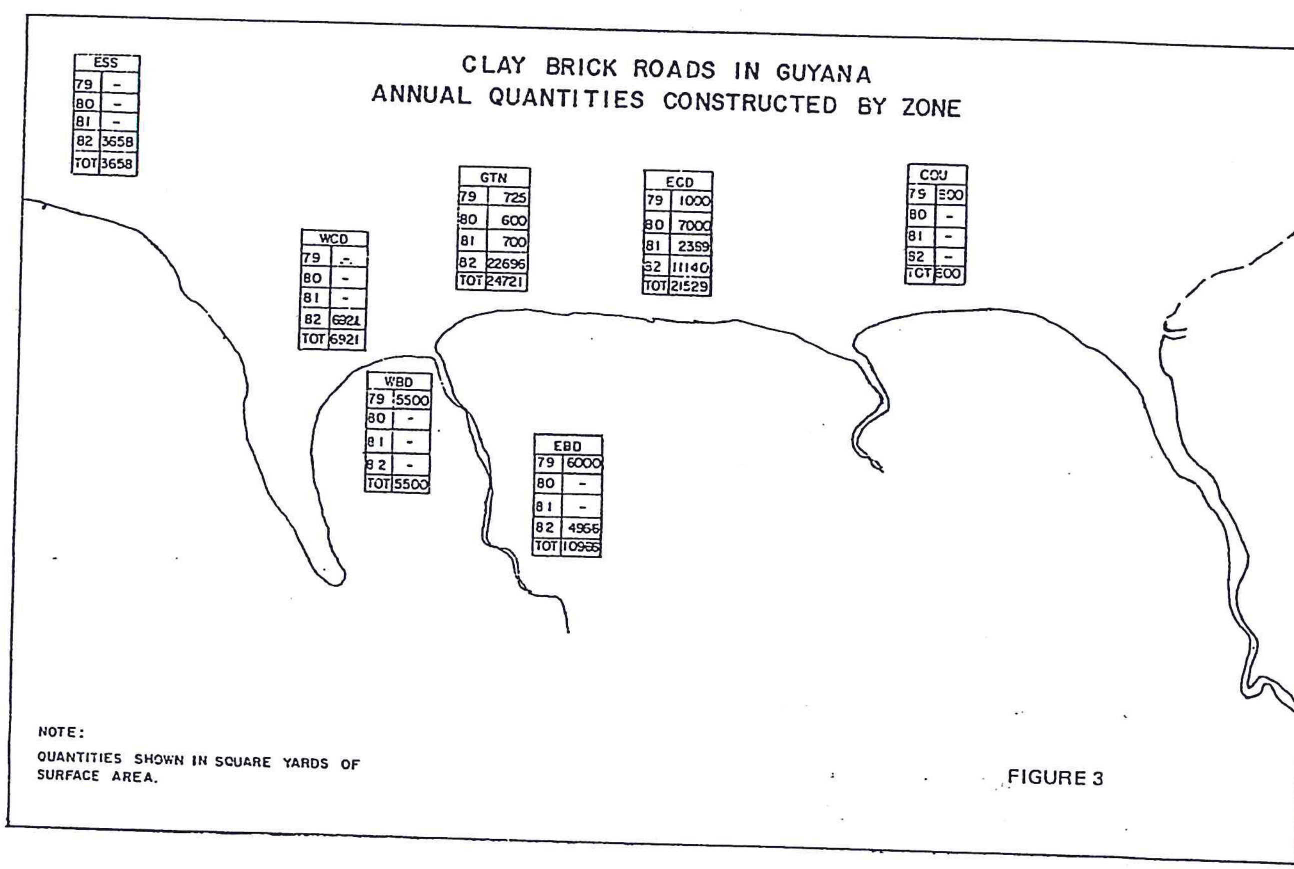

FIGURE 3