Annex A2.7

Laboratory Analysis Data of Borrow-Pit Samples

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ENSAYES DE SUELOS

MEJORAMIENTO Y REHABILITACION

| ENSAYE | 639-93 | 640-93 | | <u> </u> |
|-----------------------------|--------------|-----------|-------|----------|
| MUESTRA | . 1 | 2 | | |
| ESTACION | 31 | +100 Der. | | |
| CAPA DE | | San Luis | | |
| PROFUNDIDAD | | | | |
| SONDEO | | | | |
| IAPA DE REFERENCIA | D-1 | D-1 | | |
| GRA: | NULOMETRIA | | | |
| QUE PASA TAMIZ: 3" | | | · · · | |
| 2" | · | | | |
| 1 1/2" | | | | |
| 1" | | | | |
| 3/4" | 100 | 100 | | |
| 3/8" | 97 | 98 | | |
| No.4 |]] | 92 | | |
| No.10 | 1 | 84 | | |
| No.40(a) | | 56 | | |
| No.200(b) | 25 | 24 | | |
| ELACION DE FINOS:(b)/(a) | | | | |
| | DE ATTERBERG | | | |
| LIMITE LIQUIDO | _ | | | |
| INDICE DE PLASTICIDAD | NP | NP | | |
| CLA | SIFICACION | | | 11 |
| CLASIFICACION H.R.B. | A-2-4(0) | A-2-4(0) | | |
| CLASIFICACION DE CASAGRANDE | | | | |
| | ADICIONALES | | | |
| HUMEDAD NATURAL (%) | 9.0 | 9.7 | | |
| | | | | |
| | | | | |
| | | | | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| Proyecto_DE | EJORAMIENTO E CARRETERAS | Y REHABILIT | ACION Carino | MASAYA T | 'IPITAPA | |
|--|---|-------------|-----------------|---------------------------|---------------------------|------------------------------------|
| Ensaye No. | 639-93 | | Efectuad | lo por: R.O. | | |
| Nuestra No | . 1 | (| Calculo | М.В. | Cotej6_ | |
| Fuento del | Material | BANCO SAN | LUIS | | | |
| | _ | | EFERENCIA: | | | |
| | | | | | | |
| MALIS | IS GRANUL | OMETRICO I | DE MATERIA | L QUE PASA | ramiz de 3/4 | |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 100 | 97 | 91 | 81 | 53 | 25 |
| I.Imito lia | uido - | | Indice do | Plasticidad | a N P | |
| | | | | ivalente de | | |
| Clasticac | LOIL HARVE | | BQQ | it A a Tell CG. GG. | Arena | |
| | | | | | | |
| Tipo de Pr | ueba emplo | cada | PROCTOR EST | ANDAR | | |
| Peso Volum | . Seco Mai | kimo | | • | 167 | 6 Kgs/m ³ |
| | | | | | | |
| Humedad Op | tima | | | | | 18.3 |
| Numedad Op | tima | PRUEBAS | 5 DE C.B.F | R. SATURADO | | |
| Humedad Op | | | | R. SATURADO DINAMICA | | |
| | Compactac | | | | 95 | |
| Nótodo de (| Compactac: ctación | ion emplea | | DINAMICA | | 18.3 |
| Método de (% de Compa | Compactac ctación . Seco (Ko | ion emplea | | DINAMICA 90 | 95 | 18.3 |
| Nótodo de (% de Compa Peso Volum | Compactac ctación . Seco (Ko urado | ion emplea | | DINAMICA 90 1508 | 95 1592 | 18.3 |
| Nótodo de (% de Compa Peso Volum C.B.R. Sat | Compactac ctación . Seco (Ko urado to (%) | ion emplea | | DINAMICA 90 1508 20 | 95 1592 40 | 18.3 t 100 1676 62 |
| Nótodo de (% de Compa Peso Volum C.B.R. Satu Hinchamien | Compactac ctación . Seco (Ko urado to (%) | ion emplea | | DINAMICA 90 1508 20 0.031 | 95 1592 40 0.039 | 18.3 t 100 1676 62 0.031 |
| Nótodo de (% de Compa Peso Volum C.B.R. Satu Hinchamien | Compactac ctación . Seco (Ko urado to (%) Saturación | ion emplea | | DINAMICA 90 1508 20 0.031 | 95 1592 40 0.039 | 18.3 t 100 1676 62 0.031 |
| Método de (% de Compa Peso Volum C.B.R. Satu Hinchamien Tiempo de (| Compactac ctación . Seco (Ko urado to (%) Saturación | ion emplea | | DINAMICA 90 1508 20 0.031 | 95 1592 40 0.039 | 18.3 t 100 1676 62 0.031 |
| Método de () % de Compa % de Compa Peso Volum C.B.R. Satu Hinchamien Tiempo de () | Compactac ctación . Seco (Ko urado to (%) Saturación | ion emplea | | DINAMICA 90 1508 20 0.031 | 95 1592 40 0.039 | 18.3 t 100 1676 62 0.031 |
| Método de () % de Compa Peso Volum C.B.R. Satu Hinchamien Tiempo de () | Compactac ctación . Seco (Ko urado to (%) Saturación | ion emplea | | DINAMICA 90 1508 20 0.031 | 95 1592 40 0.039 | 18.3 t 100 1676 62 0.031 |
| Mótodo de () % de Compa Peso Volum C.B.R. Satu Hinchamien Tiempo de () | Compactac ctación . Seco (Ko urado to (%) Saturación | ion emplea | | DINAMICA 90 1508 20 0.031 | 95 1592 40 0.039 | 18.3 t 100 1676 62 0.031 |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analiais y Control de Calidad de Materiales de Construccion

| METORAMI | NTO Y REHABILIT | ACTON | | · | |
|------------------|-----------------|---------------|--------------------------|-------------|--|
| royecto DE CARRE | | | AYA-TIPITA | PA | |
| nsaye No. 640-93 | | Efectuado | por: R.O. | | |
| uestra No. 2 | | | | | |
| uente del Mater: | lal BANG | CO SAN LUIS | | | and the state of t |
| | MAP/ | A DE REFERENC | IA: D-I | | |
| | | · | 11722 - 244-1 | | |
| AMALISIS GRAM | NULOMETRICO DI | MATERIAL (| QUE PASA | TAMIZ DE 3/ | '4" |
| Tamiz 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| · que pasa 100 | 98 | 92 | 84 | 56 | 24 |
| | | | | - W N | <u> </u> |
| imite liquido | | | | | |
| lasificación H.I | R.B. A-2-4(0) | Equiv | alente de | Arena | |
| | | | | | |
| 'ipo de Prueba e | sheolar | DROCTOR FOR | IND AD | . <u> </u> | |
| 'eso Volum. Seco | | PROCTOR ESTA | MDAK | 16 | 07 Kgs/m ³ |
| | | | | | 22.2 |
| umedad Optima | | | | · | 22.2 |
| | PRUEBAS | | | | |
| látodo de Compac | | 1 | AMICA | 1 | 1 300 |
| de Compactació | | 9 | | 95 1527 | 1607 |
| 'eso Volum. Seco | (Kas/m, | | | | |
| .B.R. Saturado | | 1 | 2 | 27 | 42 |
| linchariento (%) | | 0 | .031 | 0.024 | 0.031 |
| Hempo de Satura | ción (horas) | | 96 | 96 | 96 |
| | | | | | |
| BSERVACIONES: | | | | | • |
| | | | | | • |
| | • | | | | |
| r | | | | | |
| | | | | | |

(1.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ENSAYES DE SUELOS

MEJORAMIENTO Y REHABILITACION DE

| ENSAYE | 637-93 | <u> </u> | 638-93 | | _ |
|-----------------------------|-----------|-------------|--|-------------|----------|
| MUESTRA | 1 | | 2 | | <u> </u> |
| ESTACION | | 115+500 D | er. | | |
| CAPA DE | | Banco San | Jacinto | ļ | |
| PROFUNDLDAD | | | | | <u> </u> |
| SONDEO | | | | <u> </u> | |
| MAPA DE REFERENCIA | D-2 | <u> </u> | D-2 | <u> </u> | |
| GRANU | LOMETRIA | | | | |
| QUE PASA TAMIZ: 3" | 88 | <u> </u> | | <u> </u> | |
| 2" | 83 | | 100 | | |
| 1 1/2" | 7.7 | | 96 | | |
| 1" | 75 | | 93 | | _ |
| 3/4" | 72 | | 90 | | |
| 3/8" | 62 | | 78 | | _ |
| No.4 | 51 | | 65 | <u> </u> | |
| No.10 | 42 | | 53 | | |
| No.40(a) | 24 | | 33 | | |
| No.200(b) | , " | | 18 | | |
| ELACION DE FINOS:(b)/(a) | | | | | |
| LIMITES DE | | | | · | |
| LIMITE LIQUIDO | | | | | |
| INDICE DE PLASTICIDAD | NP | | NP | | |
| | FICACION | | · | | |
| CLASIFICACION H.R.B. | A-1-a(0) | | A-1-b(0) | | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES AD | ICIONALES | | · · · · · · · · · · · · · · · · · · · | | |
| HUMEDAD NATURAL (%) | 10.7 | | 8.4 | | |
| | | | | | |
| | | | | | |
| | | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| , Lo A e c t o DE WE T | | REHABILITA | | ELICA-LA CRUZ | DE LA INDIA | |
|--|------------|----------------|---------------------------------------|---------------|---------------|------------------------|
| insaye No. | 637-93 | | _Efectuado | por: R.O. | | |
| luestra No. | 1 | C | alculoM | .В. | Cotej | 5 |
| 'uente del | | • | | | - | |
| · | | MAPA DE R | EFERENCIA: D | -2 | | |
| | · | | | | | |
| MALISI | S GRANULO | METRICO D | E MATERIAL | QUE PASA 1 | AMIZ DE 3, | /4 m |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| . que pasa | 7.2 | 62 | 51 | 42 | 24 | . 11 |
| | : | | | | | |
| imite liqu | ido | . | Indice de | Plasticidad | <u> </u> | i. |
| lasificaci | .on H.R.B. | A-1-a(0) | Equi | valente de | Arena | · |
| ************************************** | | <u> </u> | · · · · · · · · · · · · · · · · · · · | | | |
| 'ipo de Pru | oba emplo | nada | DD COMOD | ECTANDA D | | |
| 'eso Volum. | | | PROCIOR | ESTANDAR | 1 | 764 Kgs/m ³ |
| !umedad Opt | <u> </u> | | | | | 16.3 |
| :unedad Opt | . 11:10 | · | | | | 10.5 |
| | <u></u> | | DE C.B.R. | | | |
| ićtodo de C | | ion emplea | do DINAMI | | | |
| de Compac | | / 3 | | 90 | 95 | 100 |
| eso Volum. | | 12/E/ | 1 | 588 | 1676 | 1764 |
| .B.R. Satu | ırado | | | 15 | 28 | 40 |
| inchamient | | | 0. | 016 | 0.024 | 0.016 |
| 'iempo de S | aturación | n (horas) | | 96 | 96 | 96 |
| | | | | | | |
| BSERVACION | ES: | | | | | • |
| | | | | | | |
| | | | | | | |
| | | | | | • | |
| | | | | * | | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| MEJORAMIEN' | O Y REHABILITACI | ON | . · · · · · · · · · · · · · · · · · · · | | |
|--------------------|----------------------|---------------|---|--------------|--------------------|
| Proyecto DE CARRET | · | | | | · |
| Ensaye No. 638-9 | | | | | <u> </u> |
| Nuestra No. 2 | Ca | lculo M | .В. | Cotejo | |
| Fuente del Mater | ial <u>BANCO SAN</u> | JACINTO | | | ì |
| | MAPA DE RE | FERENCIA: D- | 2 | | |
| : | | | | | * |
| AMALISIS GRAI | NULOMETRICO DE | MATERIAL | QUE PASA | TAMIZ DE 3/4 | |
| Tamiz 3/ | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa 90 | . 78 | 65 | 53 | 33 . | 18 |
| | | | | , N P | |
| Limite liquido | | | | | · -1 |
| Clasificación H. | <·В·A-1-b(0) | VIUDA | alente de | arena | |
| | | | | · | |
| Tipo de Prueba e | npleada PH | ROCTOR ESTAND | AR | | |
| Peso Volum. Seco | Maximo | | | 1605 | Kgs/m ³ |
| Humedad Optima | | · | · | | 20.8 |
| | PRUEBAS | DE C.B.R. | SATURADO | **···· | |
| Método de Compac | tación emplead | lo DINAMICA | | | |
| % de Compactació | 1 | 9 | 0 | 95 | 100 |
| Peso Volum. Seco | (Kạs∕m³ | 14 | 45 | 1525 | 1 605 |
| C.B.R. Saturado | _ | 16 | | 37 | 58 |
| Hinchamiento (%) | | 0. | 043 | 0.039 | 0.063 |
| Tiempo de Satura | ción (horas) | 96 | | 96 | 96 |
| | | | • | | |
| OBSERVACIONES: | | | | • | |
| | • | | | | |
| | | | | | - |
| , | | | | | |
| | | | | | |

Annex A2.8

Laboratory Analysis Data of Sub-soil Samples

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ROYECTO: MEJORAMIENTO Y REHABILI TERAS. | | | | | |
|--|----------------|----------|----------|------------|--|
| ensay e | - | 582-93 | 583-93 | 584-93 | |
| MUESTRA | | 11 | 1 | 1 | <u> </u> |
| ESTACION | • | 60+850 | Izq. | | ······································ |
| CAPA DE · · | Asfáltica | Base | Sub-Base | Terraceria | <u> </u> |
| PROFUNDIDAD (cms) | 0-3 | 3-30 | 30-80 | 80-150 | |
| SONDEO | 1 | 1 | 1 | 1 . | |
| MAPA DE REFERENCIA | | E-1 | E-1 | E-1 | |
| GI | RANULOMETRIA | | <u> </u> | | |
| % QUE PASA TAMIZ: 3" | | | | | |
| 2" | Carpeta | | | | · |
| 1 1/2" | Asfáltica | 100 | | | · |
| 1" | | 99. | | | · |
| 3/4" | | 98 | | | |
| 3/8" | | 90 | 100 | 100 | <u></u> |
| No.4 | 4 | 72 | 95 | 97 | |
| No.10 | | 59 | 86 | 92 | |
| No.40(a) | i | 33 | 55 | 71 | |
| No.200(b) | | 16 | 30 | 43 | |
| RELACION DE FINOS:(b)/(a) | | | | | |
| LIMITE | S DE ATTERBERG | | | | |
| LIMITE LIQUIDO | | 26 | | 42 | |
| INDICE DE PLASTICIDAD | - | 1 | NP . | 10 | |
| | LASIFICACION | | | | |
| CLASIFICACION H.R.B. | | А-1-b(0) | A-2-4(0) | A-5(2) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| | S ADICIONALES | | | | |
| HUMEDAD NATURAL (%) | - | 14.8 | 18.5 | 53.0 | |
| | | | | | |
| | | | | | |
| | | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analiais y Control de Calidad de Materiales de Construccion

| Proyecto_CI | JORAMIENTO ' | Y REHABILIT <u>A</u> CERAS | Carino NANE | AIME-GUANACA | STE | - |
|---------------------------------|---------------|-------------------------------|---------------|--------------|--------------|--------------------|
| Ensaye No. | 584-93 | | Efectuado | por: R.O. | | |
| | | | alculó M.E | | Cotejő | |
| Fuente del | | | | | | · |
| | | FERENCIA E- | | | | |
| | | | - | | | |
| ANALIS | IS GRANULO | METRICO D | E MATERIAL | QUE PASA T | AMIZ DE 3/4° | |
| Tamiz | 3/4 | 3/8 | ¥ , | 10 | 40 | 200 |
| % que pasa | 100 | 100 | 97 | 92 | 71 | 43 |
| | | | | | | |
| Limite liqu | uido <u>:</u> | 42 | Indice de P | lasticidad | : 10 | <u>i.</u> . |
| Clasificac | ion H.R.B. | A-5(2) | Equiv | alente de | Arena | |
| | | | | | | |
| Tipo de Pri | ueba emplo | eada: Pr | óctor Estánda | ır . | | |
| Peso Volum | . Seco Mai | cimo: | | | 1430 | Kgs/m ³ |
| Humedad Op | tima : | | : | | 25.8 | 8 |
| | | PRUEBAS | DE C.B.R. | SATURADO | | |
| Método de (| Compactaci | ión emplea | do din | AMICO | | |
| % de Compa | ctación | | 9 | 0 | 95 | 100 |
| Peso Volum | . Seco (Ko | /s/m ³ | 128 | 37 | 1359 | 1430 |
| C.B.R. Sati | urado | | 4 | | 12 | 21 |
| Hinchamiento (%) 0.75 0.82 0.65 | | | | | 0.82 | 0.65 |
| | | | | | 0.0 | 06 |
| Tiempo de l | Saturación | (horas) | 9 | 16 | 96 | . 96 |
| Tiempo de l | Saturación | (horas) | 9 | 16 | 90 | . 90 |
| Tiempo de l | | | | 16 | 90 | . 30 |
| | | h (horas) | | | | . 90 |
| | | | | | 90 | 90 |
| | | | | | 90 | 90 |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| PROYECTO: MEJORAMIENTO Y REHABIT | | CAMINO: G | UANACASTE- | CATARINA | |
|----------------------------------|--------------|-----------|--------------|----------|--|
| ENSAYE | - | 585-93 | 586-93 | 587-93 | |
| MUESTRA | t e | 2 | 2 | 2 | |
| ESTACION | | 46+000 Iz | | | |
| CAPA DE | | | Sub-base | Terracer | a |
| PROFUNDIDAD (cms) | | 5-25 | 25-75 | 75-150 | |
| SONDEO | 2 | 2 | 2 | 2. | |
| MAPA DE REFERENCIA | J E-2 | E-2 | E-2 | E-2 | |
| | ANULOMETRIA | | . 1 | | |
| % QUE PASA TAMIZ: 3" | | | | | |
| 2" | Carpeta | | | | |
| 1 1/2" | Asfáltica | | | | |
| 1" | | 100 | | | |
| 3/4" | | 99 | | | |
| 3/8" | | 91 | 100 | | |
| No.4 | | 76 | 95 | 100 | |
| No.10 | | 59 | 85 | 94 | |
| No.40(a) | | 26 | 54 | 62 | |
| No.200(b) |) | 10 | 29 | 36 | <u> </u> |
| ELACION DE FINOS:(b)/(a) | | | | | |
| LIMITES | DE ATTERBERG | · | | | |
| LIMITE LIQUIDO | | - | - | 38 | |
| INDICE DE PLASTICIDAD | <u></u> | NP | NP | 8 | |
| CI | ASIFICACION | | · | · | |
| CLASIFICACION H.R.B. | | A-1-b(0) | A-2-4(0) | A-4(0) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| | ADICIONALES | | . | | |
| HUMEDAD NATURAL (%) . | | 13.6 | 33.5 | 48.8 | |
| | | | | | ······································ |
| | | | | | · · · · · · · · · · · · · · · · · · · |
| | | | | <u> </u> | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| | TIME | | | | | |
|-----------------------------|------------------------------|-------------|----------------|-------------|-------------|--|
| ME. Proyecto <u>Cl</u> e | JORAMIENTO Y ON DE CARRET | | | NACASTE-CAT | ARINA | |
| Ensaye No. | | | | | | A |
| Muestra No | . 2 | C | alculo M.B | | | |
| Fuento del | Material | km 46+000 |), | | | |
| | MAPA DE REF | ERENCIA: E- | 2 - | | | |
| | | · | | | | |
| ANALIS | IS GRANULO | METRICO D | E MATERIAL | QUE PASA 1 | TAMIZ DE 3/ | 4* |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 100 | 100 | 100 | 94 | 62 | . 36 |
| | 20 | | | | | 177 |
| Limite liqu | ıido <u>38</u> | · , | Indice de P | lasticidad | l8 | |
| Clasificaci | | | | | | |
| | | | | | | and the state of t |
| mi do Dec | | PRO | CTOR ESTANDAR | | | |
| Tipo de Pru | | aua . | CI OIC BO III. | | | |
| Peso Volum. | | imo: | | | 1.5 | 22 Kgs/m ³ |
| Humedad Opt | cina ; | | | | 22 | .7 |
| | | PRUEBAS | DE C.B.R. | SATURADO | | |
| Método de C | Compactaci | 5n emplead | do DINAMICO | | | |
| % de Compac | rtación | | 90 | 0 | 95 | 100 |
| Peso Volum. | . Seco (Ka | s/m3 | 13 | 370 | 1446 | 1522 |
| | | | | | | |
| C.B.R. Satu | irado | | 1: | 9 | 27 | 35 |
| C.B.R. Satu Hinchamient | | | 1 | 9 | 27 | 35 |
| | to (%) | (horas) | 96 | | 27 96 | 35 |
| Hincharient | to (%) | (horas) | | | | |
| Hincharient | to (%) Saturación | | 90 | | | |
| Hinchamient Tiempo de S | to (%) Saturación | (horas) | 90 | | | |
| Hinchamient Tiempo de S | to (%) Saturación | | 90 | | | |
| Hinchamient Tiempo de S | to (%) Saturación | | 90 | | | |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO INFORME DE ENSAYES DE SUELOS

| NSAYE | | 588-93 | 589-93 | 590-93 | |
|-----------------------------|--------------|----------------|----------|------------|-------|
| UESTRA | _ | 3 | 3 | 3 | : |
| STACION | . 1 | 41+000 1 | Der. | | *. |
| APA DE | Asfáltica | Base | Sub-Base | l'erraceri | ì |
| ROFUNDIDAD (cms) | 05 | 5-20 | 20-90 | 90-150 | |
| ONDEO | 3 | 3 | 3 | 3 | |
| APA DE REFERENCIA | E-2 | E-2 | E-2 | E-2 | , |
| GRAN | ULOMETRIA | | | | |
| QUE PASA TAMIZ: 3" | | | | ig: | |
| 2" | Carpeta | - | | | |
| 1 1/2" | Asfáltica | | | | _ ~~~ |
| 1" | | 100 | | | |
| 3/4" | | 97 | 100 | | |
| 3/8" | | 80 | 97 | 100 | |
| No.4 | | 59 | 89 | 76 | |
| No.10 | | 28 | 54 | 53 | |
| No.40(a) | | 12 | 29 | 35 | |
| No.200(b) | | | | | |
| LACION DE FINOS:(b)/(a) | | | | | |
| LIMITES 1 | DE ATTERBERG | | | | |
| IMITE LIQUIDO | | · - | - | 33 | |
| NDICE DE PLASTICIDAD | | NP | NP | 4 | |
| . CLA: | SIFICACION | | | - | |
| CLASIFICACION H.R.B. | | A-1-b(0) | A-2-4(0) | A-2-4(0) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES | ADICIONALES | | | | |
| HUMEDAD NATURAL (%) | | 15.1 | 24.8 | 42.2 | |
| | | | | | |
| | | | | | |
| | | | | | |
| DBSERVACIONES: | · | | | · | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| arino GU | ANACASTE-CATA | RINA | |
|------------|--|--|--|
| | | | and the state of t |
| | | Cotejő | |
| | | | |
| | | | |
| | | | ······································ |
| MATERIAL | QUE PASA I | 'AMIZ DE 3/4' | 4 |
| 4 | 10 | 40 | 200 |
| 100 | 76 | 53 . | 35 ⁻ |
| | | | |
| | | | 11 |
| Equi | valente de | Arena | |
| | | | |
| OR ESTANDA | AR | | |
| | | 1540 | Kgs/m ³ |
| | | 23.3 | \$ |
| E C.B.R. | SATURADO | | |
| | | - | |
| | 90 | 95 | 100 |
| 1. | 386 | 1463 | 1540 |
| 20 |) | 29 | 38 |
| 0. | . 07 | 0.14 | 0.11 |
| 96 | 6 | 96 | 96 |
| | | | |
| | | | |
| 2% | | | |
| | arino_GUA fectuado culó_M.1 zq.(Entrac MATERIAL 4 100 dice de Equi COR ESTANDA E C.B.R. DINAN 1.2 20 0. | arino GUANACASTE-CATA fectuado por: R.O. culó M.B. Ezq.(Entrada a San Juan MATERIAL QUE PASA T 4 10 100 76 dice de Plasticidad Equivalente de COR ESTANDAR E C.B.R. SATURADO DINAMICO 90 1386 20 0.07 96 | Culó M.B. Cotejó (Izq. (Entrada a San Juan de Oriente) MATERIAL QUE PASA TAMIZ DE 3/4 4 10 40 100 76 53 dice de Plasticidad: 4 Equivalente de Arena COR ESTANDAR 1540 23.3 E C.B.R. SATURADO DINAMICO 90 95 1386 1463 20 29 0.07 0.14 96 96 |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ENSAYE | | 591-93 | 592-93 | 593-93 | |
|-----------------------------|---------------------------------------|-----------|--------------|-----------|-------------|
| MUESTRA | | 4 | 4 | 4 | |
| ESTACION | | 36+000 Iz | | | |
| CAPA DE | (| | | Terraceri | a |
| PROFUNDIDAD (cms) | 1 | 3-25 | 25-55 | 55-150 | <u></u> |
| SONDEO | 4 ' ' | 4 | 4 | 4 | |
| MAPA DE REFERENCIA | E-3 | E-3 | E-3 | E-3 | |
| | ANULOMETRIA | | | <u> </u> | ····· |
| % QUE PASA TAMIZ: 3" | | | | | |
| 2" | | 100 | | | |
| 1 1/2" | : | 95 | | | |
| 1" | | 92 | 100 | | |
| 3/4" | | 91 | 99 | | |
| 3/8" | | 87 | 96 | | |
| No.4 | | 78 | 88 | 100 | |
| No.10 | • • • • • • • • • • • • • • • • • • • | 63 | 78 | 98 | |
| No.40(a) | | 30 | 43 | 79 | |
| No.200(b) | i i | 10 | 21 | 37 | |
| ELACION DE FINOS:(b)/(a) | | | | | |
| LIMITE | DE ATTERBERG | | | | |
| LIMITE LIQUIDO | | - | - | - | |
| INDICE DE PLASTICIDAD | | МP | ΖP | NP | |
| C | LASIFICACION | | | | |
| CLASIFICACION H.R.B. | | A-1-b(0) | A-1-b(0) | A-4(0) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAY E | S ADICIONALES | | | | |
| HUMEDAD NATURAL (%) | | 11.5 | 35.9 | 42.1 | |
| | | | | | |
| | | | | | |
| | | | ! | | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| | CION DE CARR | REHABILI- RETERAS. | | | | |
|---|--|---|--|---------------|---------------------------------------|--|
| Ensaye No | 593-93 | · | Efectuado | por: R. | 0. | |
| Muestra No. | 4 | Ca | lculó M. | В. | Cote | J 6 |
| Fuente del | Material_ | Est. km 36+0 | 00 Izq. | | | |
| , | | MAPA DE REFE | RENCIA: E-3 | | · · · · · · · · · · · · · · · · · · · | |
| | | | | | | |
| ANALISI | S GRANULO | METRICO DE | MATERIAL (| QUE PASA | TAMIZ DE | 3/4* |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 100 | 100 | 100 | 98 | 7 9 | . 37 |
| ************************************** | | | | | | |
| Clasificaci | on H.R.B. | A-4(0) | Equiva | alente de | Arena | |
| | | | | alente de | Arena | |
| Tipo de Pru | eba emple | ada: PROCT | | alente de | | 1650 Kgs/ 1 |
| Tipo de Pru Peso Volum. Humedad Opt | eba emplo Seco Máx | ada: PROCT | | alente de | | |
| Tipo de Pru Peso Volum. | eba emple Seco Mäx ima: | ada: PROCT | OR ESTANDAR | | | 1650 Kgs/ 1 |
| Tipo de Pru Peso Volum. Humedad Opt | eba emple Seco Máx ima: | ada: PROCT imo: PRUEBAS: | OR ESTANDAR DE C.B.R. | SATURADO | | 1650 Kgs/ 1 |
| Tipo de Pru Peso Volum. Humedad Opt Método de C | eba emple Seco Máx ima: Compactaci | ada: PROCT imo: PRUEBAS on emplead | OR ESTANDAR DE C.B.R. | SATURADO | | 1650 Kgs/ 1 |
| Tipo de Pru Peso Volum. Humedad Opt Método de C | eba emple Seco Máx ima: compactaci tación | ada: PROCT imo: PRUEBAS on emplead | OR ESTANDAR DE C.B.R. | SATURADO | | 1650 Kgs/ 1 |
| Tipo de Pru Peso Volum. Humedad Opt Método de C % de Compac Peso Volum. | eba emple Seco Max ima: empactaci tación Seco (Kø | ada: PROCT imo: PRUEBAS on emplead | OR ESTANDAR DE C.B.R. O DINAMICO 90 | SATURADO | 95 | 1650 Kgs/ 19.5 |
| Tipo de Pru Peso Volum. Humedad Opt Método de C % de Compac Peso Volum. C.B.R. Satu | eba emple Seco Max ima: compactaci tación Seco (Ko | ada: PROCT imo: PRUEBAS on emplead | OR ESTANDAR DE C.B.R. (O DINAMICO 9(148) | SATURADO 0 | 95 1568 | 1650 Kgs/r 19.5 100 1650 |
| Tipo de Pru Peso Volum. | eba emple Seco Máx ima: compactaci tación Seco (Ko | ada: PROCT imo: PRUEBAS on emplead s/m³ | OR ESTANDAR DE C.B.R. O DINAMICO 94 148 | SATURADO 0 | 95 1568 25 | 1650 Kgs/r 19.5 100 1650 35 |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ENSAYE | <u></u> | 594-93 | 595-93 | 596-93 |
|-----------------------------|----------------|-------------------|----------|------------|
| MUESTRA | 1 ' | 5 | 5 | 5 |
| ESTACION | 1 ' 1 | 35 <u>+</u> 600 D | er. | |
| CAPA DE | Asfáltica | Base | Sub-Base | Terracería |
| PROFUNDIDAD (cms) | 0-4 | 4-30 | 30-65 | 65-150 |
| SONDEO | 5 | 5 | 5 | 5 |
| MAPA DE REFERENCIA | D-1 | D-1 | D-1 | D-1 |
| GF | ANULOMETRIA | | | |
| % QUE PASA TAMIZ: 3" | | | | |
| 2" | Carpeta | 100 | | |
| 1 1/2" | Asfáltica | 95 | | |
| 1" | | 93 | | |
| 3/4" | | 91 | 100 | |
| 3/8" | | 85 | 99 | 100 |
| No.4 | | 75 | 94 | 99 |
| No.10 | · } i | 62 | - 86 | 86 |
| No.40(a) | | 29 | 61 | 60 |
| No.200(b) | | 10 | 32 | 37 |
| RELACION DE FINOS:(b)/(a) | | | | |
| LIMITE | S DE ATTERBERG | | · | |
| LIMITE LIQUIDO | | | _ | 44 |
| INDICE DE PLASTICIDAD | | NР | NP | 7 |
| C | LASIFICACION | | | |
| CLASIFICACION H.R.B. | | A-1-b(0) | A-2-4(0) | A-5-(1) |
| CLASIFICACION DE CASAGRANDE | | | | |
| ENSAYE | S ADICIONALES | | | |
| HUMEDAD NATURAL (%) | | 8.4 | 21.4 | 31.0 |
| | | | | |
| | | | | |
| | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| | | V DELLARTIT | | | | |
|--|--|---------------------------------------|--------------------------------------|---------------------------------------|--------------------------|-----------------------------------|
| Proyecto M | EJORAMIENTO ACION DE CAR | RETERAS. | Camino MAS | AYA-TIPITA | PA | |
| Ensaye No. | 596-9 | | Efectuado | por: R.O | * | |
| Muestra No | . 5 | Ca | lcul6 M. | В. | Cote | jó |
| Fuento del | | | | · · · · · · · · · · · · · · · · · · · | | |
| | ************************************** | MAPA DE | REFERENCIA: 1 | D-1 | | |
| | | · · · · · · · · · · · · · · · · · · · | | | | |
| ANALIS | IS GRANULO | METRICO DE | MATERIAL | QUE PASA | TAMIZ DE | 3/4" |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 100 | 100 | 99 | 86 | 60 | 37 |
| | | | | | | |
| Limite liqu | | | | | | *, |
| Clasificac | ión H.R.B. | A-5(1) | Equiv | alente d | e Arena | |
| | | | | | | • |
| | | | | | | |
| Tipo de Pro | ueba emplo | ada: PROCTO | R ESTANDAR | | | |
| Tipo de Pro Peso Volum | | | R ESTANDAR | | 1 | 318 Kgs/m ³ |
| | . Seco Mäx | | R ESTANDAR | | 1. | 318 Kgs/m ³ 36.7 |
| Peso Volum | . Seco Mäx | cimo: | R ESTANDAR DE C.B.R. | SATURADO | | |
| Peso Volum | . Seco Máx tima: | PRUEBAS | DE C.B.R. | | | |
| Peso Volum | . Seco Máx tima: Compactaci | PRUEBAS | DE C.B.R. |) | | |
| Peso Volum Humedad Op | . Seco Máx tima: Compactaci ctación | PRUEBAS | DE C.B.R. | 0 | | 36.7 |
| Peso Volum Humedad Op Método de G | . Seco Máx tima: Compactaci ctación . Seco (Ko | PRUEBAS | DE C.B.R. (| 0 | 95 | 36.7 |
| Peso Volum Humedad Op Método de G & de Compac Peso Volum | . Seco Máx tima: Compactaci etación . Seco (Ko | PRUEBAS | DE C.B.R. SO DINAMICO | 0 | 95 1252 | 36.7 100 1318 |
| Peso Volum Humedad Op Método de G t de Compac Peso Volum C.B.R. Satu | . Seco Max tima: Compactaci ctación . Seco (Ko urado to (%) | PRUEBAS on emplead | DE C.B.R. 8 0 DINAMICO 90 1186 | 0 | 95 1252 13 | 36.7 100 1318 19 |
| Peso Volum Humedad Op Método de G & de Compac Peso Volum C.B.R. Satu Hincharien | . Seco Max tima: Compactaci ctación . Seco (Ko urado to (%) | PRUEBAS on emplead | DE C.B.R. 90 DINAMICO 90 1186 6 0.31 | 0 | 95 1252 13 0.29 | 36.7 100 1318 19 0.22 |
| Peso Volum Humedad Op Método de G & de Compac Peso Volum C.B.R. Satu Hincharien | Seco Máx tima: Compactaci ctación Seco (Ko urado to (%) Saturación | PRUEBAS of emplead of (horas) | DE C.B.R. 90 1186 6 0.31 96 | 0 | 95 1252 13 0.29 | 36.7 100 1318 19 0.22 |
| Peso Volum Humedad Ope Método de G % de Compac Peso Volum C.B.R. Satu Hincharien Tiempo de 8 | Seco Máx tima: Compactaci ctación Seco (Ko urado to (%) Saturación | PRUEBAS on emplead | DE C.B.R. 90 1186 6 0.31 96 | 0 | 95 1252 13 0.29 | 36.7 100 1318 19 0.22 |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ROYECTO: MEJORAMIENTO Y REHABILI CARRETERAS | - | 597-93 | 598-93 | 599-93 | |
|--|--------------|---------------------------------------|--------------|-----------|---|
| ENSAY E | i i | 6 | 6 | 6 | |
| MUESTRAESTACION | 1 | 44+700 Iz | q. | | |
| CAPA DE | Asfáltica | Base | Sub-Base | Terraceri | a |
| PROFUNDIDAD (cms) | 07 | 7-27 | 27-80 | 80-150 | |
| SONDEO | 6 | 6 | 6 | .6 | |
| MAPA DE REFERENCIA | E-4 | E-4 | E-4 | E-4 | |
| GRA | NULOMETRIA | | | | |
| % QUE PASA TAMIZ: 3" | | | | 3. | |
| 2" | Carpeta | | | | |
| 1 1/2" | Asfáltica | ٠. | | | |
| 1" | | 100 | | _ | |
| 3/4" | 1 1 | 98 | 100 | | |
| 3/8" | | 90 | 99 | | |
| No.4 | i l | 78 | 90 | 100 | |
| No.10 | 1" | 62 | 75 | 100 | |
| No.40(a) | 1 | 25 | 44 | 95 | |
| No.200(b) | | 10 | 24 | 82 | |
| RELACION DE FINOS:(b)/(a) | | | | | |
| LIMITES | DE ATTERBERG | | ' . | | |
| LIMITE LIQUIDO | | _ | - | 79 | |
| INDICE DE PLASTICIDAD | | NP | NP | 50 | |
| CLA | SIFICACION | | | . | |
| CLASIFICACION H.R.B. | | A-1-b(0) | A-1-b(0) | A-7-5(20) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES | ADICIONALES | · · · · · · · · · · · · · · · · · · · | | | - |
| HUMEDAD NATURAL (%) | | 9.4 | 25.6 | 25.4 | |
| | | | | | |
| | | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analiais y Control de Calidad de Materiales de Construccion

| | TO DAME THOUSAN | DEUARTI I | | · | | to the second se |
|--------------------------|------------------------------|---|-------------------|--------------|-------------|--|
| Proyecto TA | JORAMIENTO Y CION DE CARR | ETERAS. | Carino | ASAYA-TIPITA | ?A | ** |
| Ensaye No. | 599-93 | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | _Efectuado | por: R.O. | | |
| Muestra No | • 6 | Ca | alculo | М.В. | Cotejő | |
| Fuente del | Material_ | Est. Kn | ı 44+700 Izg | 4 | | |
| | M | APA DE REFER | RENCIA: E-4 | | | |
| | | | | | | |
| ANALIS | IS GRANULO | METRICO DE | MATERIAL | QUE PASA | PAMIZ DE 3/ | 4 4 |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 100 | 100 | 100 | 100 | 95 | . 82. |
| | | | | | | |
| Limite liqu | uido: 79 | | Indi ce de | Plasticidad | 3 : 50 | |
| Clasificac | ión H.R.B. | A-7-5(20) | Equi | valente de | Arena | ·: |
| | | | | | | · |
| Min do Day | | D. D. | POCTOR FSTA | NIDA R | | |
| Tipo de Pr Peso Volum | | | 1001011 1011 | | 1.7 | 20 27-1-3 |
| | | LIEO . | | | 13. | 28 Kgs/m ³ |
| Humedad Op | tima : | | | | | 28.5 |
| | | PRUEBAS | DE C.B.R. | SATURADO | | |
| Método dè | Compactaci | on emplead | do DINAMIC | 0 | | |
| % de Compa | | | | 90 | 95 | 100 |
| Peso Volum | . Seco (Kạ | rs/m ³ | | 1195 | 1262 | 1 328 |
| C.B.R. Sat | urado | | | 1.0 | 2.0 | 3.0 |
| Hinchamien | to (%) | | | 11.38 | 13.28 | 16.0 |
| Tiempo de | Saturación | (horas) | | 96 | 96 | 96 |
| | | | | | | |
| OBSERVACIO | NES: | | | n.c. 121 | | |
| | | HUMEDA | D NATURAL: 2 | LD.4% | | |
| | | • | | | | |
| | | • | | | | • |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ENSAYE | - | 600-93 | 601-93 | 602-93 | |
|-----------------------------|--------------|---------------------------------------|----------|----------|----------|
| MUESTRA | į. | 7 | 7 | 7 | |
| ESTACION | 4 | 22+500 De | | | |
| CAPA DE | Asfáltica | Base | Sub-Base | Terracer | a |
| PROFUNDIDAD (cms) | 0-2 | 2-20 | 20-118 | 118-150 | |
| SONDEO | .7 | 7 | 7 | 7 | |
| MAPA DE REFERENCIA | E-5 | E-5 | E-5 | E-5 · | |
| GR | ANULOMETRIA | | | | |
| % QUE PASA TAMIZ: 3" | | | | i i | |
| 2" | Carpeta | | | | |
| 1 1/2" | Asfáltica | 100 | | | |
| 1" | i | 96 | | | |
| 3/4" | | 89 | 100 | 100 | |
| 3/8" | | 74 | 97 | 99 | |
| No.4 | | 60 | 88 | 94 | · |
| No.10 | | 48 | 71 | 79 | <u> </u> |
| No.40(a) | | 21 | 42 | 49 | |
| No.200(b) | | 8 | 21 | 33 | |
| RELACION DE FINOS:(b)/(a) | . | , | | | |
| LIMITES | DE ATTERBERG | · | , | | ~~~ |
| LIMITE LIQUIDO | | | | 51 | |
| INDICE DE PLASTICIDAD | | NP | NP | 6 | · |
| CI | ASIFICACION | | | | |
| CLASIFICACION H.R.B. | | A-1-a(0) | A-1-b(0) | A-2-5(0) | |
| CLASIFICACION DE CASAGRANDE | | | <u>.</u> | | |
| ENSAYES | ADICIONALES | y s. 55 : 1 -5 | , | · | |
| HUMEDAD NATURAL (%) | | 4.9 | 17,4 | 45.7 | |
| | | | | | |
| | | _ | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| 1.0 | C YOU ANT ENTO | Y REHABILI | · · · · · · · · · · · · · · · · · · · | | | |
|--------------------------|----------------|--------------|--|--------------|--|--------------------|
| Proyecto $\frac{M}{T_i}$ | CION DE CA | RRETERAS. | _Carino | SAN BENITO-1 | IPITAPA | |
| Ensaye No. | | | | | | |
| Muestra No | | | | | | j ර <u> </u> |
| Fuente del | Material | : EST. KM | 22+500 Der | * | | |
| | | MAPA DE REFI | ERENCIA: E- | 5 | | |
| | | | ······································ | | | |
| ANALIS: | IS GRANULO | OMETRICO D | E MATERIA | L QUE PASA | TAMIZ DE | 3/4* |
| Tamiz | 3/4 | 3/8 | Ý | 10 | 40 | 200 |
| % que pasa | 100 | 99 | 94 | 79 | 49 | 33 |
| | | | | | | |
| Limite liqu | | | | | | Ý _{.j} . |
| Clasificaci | lon H.R.B. | A-2-5(0) | Equ | ivalento de | e Arena | |
| | | | | | | |
| Tipo de Pri | ieba emplo | eada: PF | ROCTOR ESTAN | IDAR | <u>,</u> | |
| Peso Volum. | Seco Máx | cimo: | | | | 1165 Kgs/m³ |
| Humedad Opt | ina : | | | | ······································ | 41.0 % |
| | · | PRUEBAS | DE C.B.R | . SATURADO | | |
| Método de o | Compactaci | on emplea | do DINA | MICO | | |
| % de Compac | tación | | | 90 | 95 | 100 |
| Peso Volum. | Seco (Ko | s/m3 | | 1049 | 1107 | 1165 |
| C.B.R. Satu | ırado | | | 10 | 14 | 18 |
| Hinchamient | o (%) | | | 0.34 | 0.27 | 0.15 |
| Tiempo de S | aturación | (horas) | | 96 · | 96 | 96 |
| | | | | | | |
| OBSERVACION | ES: | MEDAD NATURA | L: 45.7% | | | |

(I,M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO INFORME DE ENSAYES DE SUELOS

| CARRETERAS. | | | | | |
|-----------------------------|--------------|--|----------|------------|----|
| ENSAYE | _ | 603-93 | 604-93 | 605-93 | |
| MUESTRA | | 8 | 8 | 8 | |
| ESTACION | | 30+000 Iz | <u> </u> | | |
| CAPA DE | l | Base | Sub-Base | Terraceria | |
| PROFUNDIDAD (cms) | 0-5 | 5-25 | 25-80 | 80-150 | |
| SONDEO | 8 | 8 | 8 | 8 | |
| MAPA DE REFERENCIA | | E-6 | E-6 | E-6 | |
| GRA | NULOMETRIA | , | | | |
| % QUE PASA TAMIZ: 3" | | | | | |
| 211 | Jarpeta | | | i, | |
| 1 1/2" | Asfáltica | 100 | | | |
| 1" | | 93 | | | |
| 3/4" | | 86 | | 100 | |
| 3/8" | | 74 | 100 | 99 | |
| No.4 | | 56 | 96 | 94 | |
| No.10 | 1 | 42 | 85 | 83 | |
| No.40(a) | ł 1 | 20 | 60 | 58 | |
| No.200(b) | | 9 | 31 | 30 | |
| RELACION DE FINOS:(b)/(a) | | | | | |
| LIMITES | DE ATTERBERG | | | | |
| LIMITE LIQUIDO | | - | - | | -1 |
| INDICE DE PLASTICIDAD | | NP | NP | NP | |
| CLA | SIFICACION | | | | |
| CLASIFICACION H.R.B. | | A-1-a(0) | A-2-4(0) | A-2-4(0) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES | ADICIONALES | -, - | | | |
| HUMEDAD NATURAL (%) | | 5.5 | 18.2 | 24.4 | |
| | | | | | |
| | | | | | |
| | | ······································ | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| ME | JORAMIENTO | Y REHABILI- | | M DEMAND | | artinologica de la companya de la c |
|------------------------|---------------------------------------|---------------|------------|--|--|--|
| | | RETERAS. C | W | | | * |
| Ensaye No. | 605-93 | . E | tectuado | por: R.O. | | |
| | | | | B. | Cotejó | |
| | - | Est. km 30+ | | | ر د د د د د د د د د د د د د د د د د د د | |
| | | APA DE REFERE | NCIA: E-6 | ************************************** | | |
| ANALIS | IS GRANULO | METRICO DE 1 | MATERIAL | QUE PASA I | AMIZ DE 3/4" | e de la composição de l |
| Tamiz | 3/4 | 3/8 | Ý | 10 | 40 | 200 |
| <pre>\$ dne basa</pre> | 100 | 99 | 94 | 83 | 58 | 30 |
| Limite liq | uido: | - Inc | dice de 1 | Plasticidad | N.P. | |
| | | | | | Arena | |
| | | | | | | |
| | | PD ∩(| CTOR ESTAN | DΔR | | · |
| Tipo de Pro | | aua. | SIOR ESTAN | | | |
| Peso Volum | · · · · · · · · · · · · · · · · · · · | ilmo: | | | 1432 | Kgs/m ³ |
| Humedad Op | tima : | | | | - | 24.2 |
| | | PRUEBAS D | | | | |
| Método de (| Compactaci | on empleado | DINAM | ICO | | |
| % de Compa | ctación | | | 30 | 95 | 100 |
| Peso Volum | . Seco (Kợ | s/m3 | 12 | 89- | 1360 | 1432 |
| C.B.R. Satu | ırado | | 1 | 0 | 25 | 40 |
| Hinchamien | to (%) | | 0. | 13 | 0.09 | 0.05 |
| Tiempo de 8 | Saturación | (horas) | .9 | | 96 | 96 |
| | | | | | | |
| OBSERVACION | NES: | | | | | |
| | HU | MEDAD NATURAL | : 24.4% | | | |
| | | | | | | |
| | | | | | | |
| | | | | • | | |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO INFORME DE ENSAYES DE SUELOS

PROYECTO: MEJORAMIENTO Y REHABILITACION DE CAMINO: MANAGUA-TIPITAPA CARRETERAS. 606-93 607-93 ENSAYE 9____ 9 MUESTRA 17+000 Der ESTACION CAPA DE Asfáltica Base Terracería PROFUNDIDAD (cms) 0-3 3-20 20-150 9 9 .9 SONDEO E-7 MAPA DE REFERENCIA E-7 E-7 GRANULOMETRIA % QUE PASA TAMIZ: 3" 2" Carpeta 100 1 1/2" Asfaltica 99 100 1 ** 88 99 3/4" 77 96 3/8" 89 61 No.4 48 73 No.10 57 34 No.40(a)_____ 14 31 No.200(b)____ . 5 17 RELACION DE FINOS:(b)/(a) LIMITES DE ATTERBERG LIMITE LIQUIDO NP INDICE DE PLASTICIDAD NΡ ____CLASIFICACION A-1-a(0) | A-1-b(0)CLASIFICACION H.R.B. CLASIFICACION DE CASAGRANDE ENSAYES ADICIONALES 18.7 4.0 HUMEDAD NATURAL (%)

OBSERVACIONES:

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| ProvectoMEJ | | • | | | | |
|--|---------------------------------------|---------------|--------------------|--------------|-------------------|---|
| 110,0000 | ORAMIENTO Y | REHABILITA (| Carino HA | NAGUA-TIPITA | APA | |
| Ensaye No. | N DE CARRET 607-93 | | Efectuado | por: R.O. | | |
| Muestra No. | 9 | Ca: | lculo M.B | t | Cotejő | Markey page - makka ka o mark i - mak ng a gayay - may ng aga a mara ma - mag ang |
| Fuente del | Material_ | MAPA DE REFER | ENCIA: E-7 | | | |
| | · | · | | | | |
| | | | =3 04-2 | | | |
| ANALISI | S GRANULO | METRICO DE | MATERIAL | QUE PASA | TAMIZ DE 3/ | ₹ \$ |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 96 | · 89 | 73 | 57 | 31 | 1.7' |
| | | | | | _ MD | |
| Limite líqu Clasificaci | | | | | | Y.: |
| Clasificaci | On n.K.r. | | EQUIV | alente de | Arena | |
| | | | | | | |
| Tipo de Pru | ieba emple | ada PROC | TOR ESTANDAL | R | | |
| Peso Volum. | Seco Max | imo | | | 153 | 38 Kgs/m³ |
| Humedad Opt | :ina | | | | 14. | .0 |
| | : | PRUEBAS I | DE C.B.R. | SATURADO | | |
| Método de C | | | | | | |
| the second state of the second se | .carpac taci | on empleado | DINAM | ICA | | |
| % de Compac | | on empleado | DINAM 9 | i | 95 | 100 |
| % de Compac Peso Volum. | tación | | 1 | 0 | 95 1461 | 100 |
| | tación Seco (Kợ | | 9 | 0 84 | | |
| Peso Volum. | tación Seco (Kợ trado | | 9 133 | 0 84 | 1461 | 1538 |
| Peso Volum. | tación Seco (Kợ trado to (%) | rs/m³ | 9 133 | 0 84 0 0 .0 | 1461 36 | 1538 |
| Peso Volum. C.B.R. Satu Hincharient | tación Seco (Kợ trado to (%) | rs/m³ | 9 138 | 0 84 0 0 .0 | 1461 36 0.0 | 1538 |
| Peso Volum. C.B.R. Satu Hincharient | tación Seco (Kourado co (%) | rs/m³ | 9 138 | 0 84 0 0 .0 | 1461 36 0.0 | 1538 |
| Peso Volum. C.B.R. Satu Hinchamient Tiempo de S | tación Seco (Kourado co (%) | rs/m³ | 9 138 | 0 84 0 0 .0 | 1461 36 0.0 | 1538 |
| Peso Volum. C.B.R. Satu Hinchamient Tiempo de S | tación Seco (Kourado co (%) | rs/m³ | 9 138 | 0 84 0 0 .0 | 1461 36 0.0 | 1538 |
| Peso Volum. C.B.R. Satu Hinchamient Tiempo de S | tación Seco (Kourado co (%) | rs/m³ | 9 138 | 0 84 0 0 .0 | 1461 36 0.0 | 1538 |

(I,M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ENSAYE | - | 608-93 | 609-93 | | |
|-----------------------------|--|-------------|------------|------------------|--------------|
| MUESTRA | | 10 | 10 | | |
| ESTACION | · · · · · · · · · · · · · · · · · · · | -000 Der. | | | |
| CAPA DE | The state of the s | Base | ferracería | | |
| PROFUNDIDAD (cms) | | 4-24 | 24-150 | | |
| SONDEO | 10 | 10 | 10 | | |
| MAPA DE REFERENCIA | J E-8 | E-8 | E-8 | | |
| GI | RANULOMETRIA | | | , | |
| % QUE PASA TAMIZ: 3" | | 100 | 100 | | |
| 2" | Carpeta | 94 | 94 | r _e . | |
| 1 1/2" | Asfáltica | · 92 | 86 | <u> </u> | |
| 1" | | 83 | 60 | | |
| 3/4" | | 7.6 | 43 | | |
| 3/8" | | 59 | 34 | | |
| No.4 | | 47 | 26 | | |
| No.10 | | 38 | 21 | | |
| No.40(a) | | 19 | 15 | | |
| No.200(b) | | 88 | 10 | | |
| RELACION DE FINOS:(b)/(a) | | | | | |
| LIMITE | S DE ATTERBERG | | | | |
| LIMITE LIQUIDO | | | 51 | | |
| INDICE DE PLASTICIDAD | | NP | 10 | | |
| C | LASIFICACION | | 1 | · | |
| CLASIFICACION H.R.B. | | A-1-a(0) | A-2-5(0) | | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYE | S ADICIONALES | | | - | |
| Humedad Natural (%) | | 3.0 | 23.9 | | |
| | | | | | |
| | | | | | |
| | | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| ALC: Y | TODANIENTO V | REHABILITAC | T/NS! | | · · · · · · · · · · · · · · · · · · · | |
|---|--|--|-----------------------|--|---------------------------------------|---------------------------------------|
| Proyecto DE | | | | ICA-LA CRUZ | DE LA INDIA | ~ |
| Ensaye No. | | | | | | |
| Muestra No | | · · | | | Cotejő | |
| Fuente del | Material_ | MAPA DE REF | ERENCIA: E-8 | | | |
| | | | | | | |
| | | | | | | |
| ANALISI | S GRANULO | METRICO DE | MATERIAL | QUE PASA | TAMIZ DE 3/ | 4* |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 43 | 34 | 26 | 21 | 15 | 10 |
| | | | | | | |
| Limite liqu | | | | and the second s | | 1-1 |
| Clasificaci | .on H.R.B. | A-2-5(0) | Equiva | alente de | Arena | · · · · · · · · · · · · · · · · · · · |
| | ······································ | · · · · · · · · · · · · · · · · · · · | | | | |
| Tipo de Pru | eba emple | ada par | OCTOR FSTANDA | ı D | | |
| Peso Volum. | | | OCION ESTANDA | rv | , | Kgs/m ³ |
| Humedad Opt | ina | | | | 1551 25. | · |
| <u> </u> | | ······································ | | | | - |
| | | PRHEBAS I | OP C B R C | 22 7777 25 25 | | |
| Método de C | ompactaci | | DE C.B.R. S | SATURADO | | |
| Método de C | | | DINAMICA | | 95 | 1 100 |
| Método de C % de Compac Peso Volum. | tación | on empleado | |) | 95 1473 | 100 |
| % de Compac | tación Seco (Kơ | on empleado | D DINAMICA 90 | 96 | 95 1473 54 | 100 1551 66 |
| % de Compac Peso Volum. | tación Seco (Ka rado | on empleado | DINAMICA 90 | 96 | 1473 | 1551 |
| <pre>% de Compac Peso Volum. C.B.R. Satu</pre> | tación Seco (Kợ: rado :o (%) | ŏn empleado s/m³ | D DINAMICA 90 133 0.2 | 96 | 1473 54 | 1551 |
| <pre>% de Compac Peso Volum. C.B.R. Satu Hinchamient</pre> | tación Seco (Kợ: rado :o (%) | ŏn empleado s/m³ | D DINAMICA 90 133 0.2 | 96 9 | 1473 54 0.28 | 1551 66 0.20 |
| <pre>% de Compac Peso Volum. C.B.R. Satu Hinchamient</pre> | tación Seco (Kon rado co (%) aturación | ŏn empleado s/m³ | D DINAMICA 90 133 0.2 | 96 9 | 1473 54 0.28 | 1551 66 0.20 |
| % de Compac Peso Volum. C.B.R. Satu Hinchamient Tiempo de S | tación Seco (Kon rado co (%) aturación | ŏn empleado s/m³ | D DINAMICA 90 133 0.2 | 96 9 | 1473 54 0.28 | 1551 66 0.20 |
| % de Compac Peso Volum. C.B.R. Satu Hinchamient Tiempo de S | tación Seco (Kon rado co (%) aturación | ŏn empleado s/m³ | D DINAMICA 90 133 0.2 | 96 9 | 1473 54 0.28 | 1551 66 0.20 |
| <pre>% de Compac Peso Volum. C.B.R. Satu Hinchamient Tiempo de S</pre> | tación Seco (Kon rado co (%) aturación | ŏn empleado s/m³ | D DINAMICA 90 133 0.2 | 96 9 | 1473 54 0.28 | 1551 66 0.20 |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ENSAYE | | 610-93 | 611-93 | 612-93 |
|-----------------------------|--------------|--------------|----------|------------|
| MUESTRA | | 11 | 11 | 11 |
| ESTACION | | 117+000 | | |
| CAPA DE | Asfáltica | Base | Sub-Base | Terraceria |
| PROFUNDIDAD (cms) | | 6-22 | 22-38 | 38-150 |
| SONDEO | 11 | 11 | 11 | 11 |
| MAPA DE REFERENCIA | J E9 | E-9 | E-9 | E-9 |
| GR. | ANULOMETRIA | | 4 | • • |
| % QUE PASA TAMIZ: 3" | | | | |
| 2" | Carpeta | 100 | | 1.g |
| 1 1/2" | Asfáltica | · 93 | 100 | 100 |
| 1" | | 93 | 97 | 99 |
| 3/4" | | 93 | 97 | 99 |
| 3/8" | | 86 | 92 | 98 |
| No.4 | | 73 | 74 | 94 |
| No.10 | i | 58 | 62 | 90 |
| No.40(a) | | 28 | 38 | 79 |
| No.200(b) | 1 | 9 | 19 | 68 |
| ELACION DE FINOS:(b)/(a) | | | | |
| | DE ATTERBERG | | | |
| LIMITE LIQUIDO | | edba | 29 | 48 |
| INDICE DE PLASTICIDAD | | NP | 3 | 20 |
| CL | ASIFICACION | | | |
| CLASIFICACION H.R.B. | | A = 1 - b(0) | A-1-b(0) | A-7-6(12) |
| CLASIFICACION DE CASAGRANDE | | | | |
| ENSAYES | ADICIONALES | | | |
| HUMEDAD NATURAL (%) | | 10.1 | 25.1 | 36.9 |
| • | | | | |
| | | | | |
| | | | | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| ProyectoDE | ORAMIENTO 'CARRETERAS | | | ICA-LA CRUZ | DE LA INDIA | - |
|---|--|--|--|-----------------------|---------------------|--|
| Ensaye No. | | | the state of the s | | | |
| | | | | | Cotejó | All the state of t |
| Fuente del | Material | MAPA DE RI | EFERENCIA: E- | 9 | | |
| | | | | | | |
| | | · · · · · · · · · · · · · · · · · · · | · | | | |
| AMALISI | S GRANUL | OMETRICO DI | E MATERIAL | QUE PASA | TAMIZ DE 3/4 | n |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 99 | 98 | 94 | 90 | 79 | 68. |
| Limite liqu | ido 48 | | Indice de F | lasticidad | i 20 | 1. |
| Clasificaci | | and the second s | • | | | |
| | | | | | | |
| | | | | | | |
| Tipo de Pru | eba emplo | eada Pi | ROCTOR ESTAND | AR | | |
| Peso Volum. | Seco Mai | cimo | | | 1455 | Kgs/m ³ |
| Humedad Opt | ina | | | | 27.7 | 8 |
| | | ם אמינונים י | | חת מפוזיית בפ | | |
| | | LINOEDHO | DE C.B.R. | DUICIUNDO | | |
| Método de C | Compactac | | | | | |
| Método de C | | | | A | 95 | 100 |
| | tación | ion emplead | do DINAMIC. | A | 95 1382 | 100 |
| % de Compac | tación Seco (Ko | ion emplead | do DINAMIC. | A 0 | | |
| % de Compac Peso Volum. | tación Seco (Ko trado | ion emplead | do DINAMIC. 9 13 | 0 10 | 1382 | 1455 |
| % de Compac Peso Volum. C.B.R. Satu | tación Seco (Ko Irado to (%) | ion emplead | do DINAMIC. 9 13 | 0 0 10 .2 .68 | 1382 | 1435 |
| Peso Volum. C.B.R. Satu | tación Seco (Ko Irado to (%) | ion emplead | 9 13 4 1 | 0 0 10 .2 .68 | 1382 4.8 1.79 | 1455 5.6 2.37 |
| Peso Volum. C.B.R. Satu | tación Seco (Ko irado :o (%) aturación | ion emplead | 9 13 4 1 | 0 0 10 .2 .68 | 1382 4.8 1.79 | 1455 5.6 2.37 |
| % de Compac Peso Volum. C.B.R. Satu Hincharient Tiempo de S | tación Seco (Ko irado :o (%) aturación | ion emplead | 9 13 4 1 | 0 0 10 .2 .68 | 1382 4.8 1.79 | 1455 5.6 2.37 |
| % de Compac Peso Volum. C.B.R. Satu Hincharient Tiempo de S | tación Seco (Ko irado :o (%) aturación | ion emplead | 9 13 4 1 | 0 0 10 .2 .68 | 1382 4.8 1.79 | 1455 5.6 2.37 |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ENSAYE | | 6:3-93 | 614-93 | 615-93 | |
|-----------------------------|---------------|-----------|----------|----------|-------------|
| MUESTRA | · | 12 | 12 | 12 | |
| ESTACION | | 126+000 I | er. | | |
| CAPA DE | Asfáltica | Base | Sub-Base | Terracer | ia |
| PROFUNDIDAD (cms) | 0-5 | 5-23 | 23-47 | 47-150 | |
| SONDEO | 12 | 12 | 12 | 12 | |
| MAPA DE REFERENCIA | J E-9 | E-9 | E-9 | E-9 | · |
| GRA | NULOMETRIA | | <u> </u> | | |
| % QUE PASA TAMIZ: 3" | | 100 | | | |
| 211 | Carpeta | 96 | | ų | |
| 1 1/2" | | 81 | | | |
| 1" | | 66 | 100 | | |
| 3/4" | | 61 | 99 | | |
| 3/8" | | 49 | 95 | 100 | |
| No.4 | | 37 | 87 | 97 | |
| No.10 | | 28 | 78 | 93 | |
| No.40(a) | | 13 | 52 | 66 | |
| No.200(b) | | 5 | 30 | 33 | |
| RELACION DE FINOS:(b)/(a) | <u> </u> | | | | |
| LIMITES | DE ATTERBERG. | | | | |
| LIMITE LIQUIDO | | - | <u>-</u> | 36 | |
| INDICE DE PLASTICIDAD | | NP | NΡ | 7 | |
| CL | ASIFICACION | | | | · |
| CLASIFICACION H.R.B. | | A-1-a(0) | A-2-4(0) | A-2-4(0) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES | ADICIONALES | | | | |
| HUMEDAD NATURAL (%) | | 8.5 | 19.7 | 25,7 | |
| | | | | | |
| | | | | | |
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Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| with the second section of the section of the second section of the section of the second section of the section of t | | | | | | |
|--|---------------------------------------|---------------------|------------------------|--|-------------|-------------------------------|
| ProyectonE | JORAMIENTO Y CARRETERAS | REHABILITACIO Ca | N arino <u>teli</u> | CA-LA CRUZ | DE LA INDIA | |
| | | E | | | | |
| | | Cal | | В. | Cotejó | |
| Fuento del | Material_ | MAPA DE REFERE | NCIA: E-9 | | | |
| | | | | | | - |
| | | | | روستان بروستان و موروستان و المستور و ا - | <u> </u> | |
| ANALIS | IS GRANULO | METRICO DE M | ATERIAL | QUE PASA | TAMIZ DE 3/ | 4 * |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 100 | 100 | 97 | 93 | 66 | 33 |
| | | | | | | |
| | | 36Ind | | | | |
| Clasificac | ion H.R.B. | A-2-4(0) | Equiv | alente de | Arena | |
| | | | | | | - |
| Tipo de Pro | ueba emplo | eada PROC | TOR ESTAND |)AR | | |
| Peso Volum | | | | e | | 1551 Kgs/m³ |
| Humedad Opt | tima | | | | | 22.1 |
| | | PRUEBAS DI | C.B.R. | SATURADO | | |
| Método de (| Compactac. | ión empleado | | | | |
| % de Compa | ctación | | 9 | 0 | 95 | 100 |
| Peso Volum | . Seco (Ko | rs/m3 | 13 | 396 | 1 47 3 | 1551 |
| C.B.R. Sati | urado | | 18.0 | | 34.0 | 50.0 |
| Hincharien | to (%) | | 0. | 19 | 0.20 | 0.26 |
| Tiempo de S | Tiempo de Saturación (horas) | | | | 96 | 96 |
| | | | | | | |
| OBSERVACION | TES: | | | | | |
| Į. | | | | | - | |
| | . T. decil Berl 4 | | | | · | |
| | · · · · · · · · · · · · · · · · · · · | • | | | | |
| · | | | | | | • |

(I,M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

| ENSAYE | | 616-93 | 617-93 | | |
|-----------------------------|--------------|----------|---------------------------------------|---------------------------------------|---------------------------------------|
| MUESTRA | - | 13 | 13 | | |
| ESTACION | | 134+000 | Der. | | |
| CAPA DE | 1 . | Base | Terracería | | |
| PROFUNDIDAD (cms) | 0-6 | 6-22 | 22-150 | | |
| SONDEO | 13 | 13 | 13 | | |
| MAPA DE REFERENCIA | | E-10 | E-10 | • | |
| GRA | NULOMETRIA | | 4 | | · · · · · · · · · · · · · · · · · · · |
| % QUE PASA TAMIZ: 3" | | | | 1., | |
| 2" | Carpeta | 100 | | | |
| 1 1/2" | Asfáltica | 88 | | | · · · · · · · · · · · · · · · · · · · |
| J., | | 80 | | | |
| 3/4" | | 78 | 100 | | |
| 3/8" <u>.</u> | | 69 | 97 | | |
| Мо.4 | | 60 | 39 | | |
| No.10 | | 5.2 | 80 | | |
| No.40(a) | 1 | 30 | 59 | · · · · · · · · · · · · · · · · · · · | |
| No.200(b) | | 11 | 40 | | |
| ELACION DE FINOS:(b)/(a) | | | | | |
| LIMITES | DE ATTERBERG | · | | | |
| LIMITE LIQUIDO | | | | · · · · · · · · · · · · · · · · · · · | |
| INDICE DE PLASTICIDAD | | УР | NP | | |
| CL | ASIFICACION | | · · · · · · · · · · · · · · · · · · · | | ···· |
| CLASIFICACION H.R.B. | | A-1-b(0) | A-4(0) | | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES | ADICIONALES | | · · | | · |
| HUMEDAD NATURAL (%) | | 7.3 | 36.8 | | |
| | | | | | |
| | | | | · | |
| | | | | | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| Proyecto MEJ | ORAMIENTO ' | Y REHABILITA | ACION Carino _{TELI} | CA LA CRUZ I | DE LA INDIA | |
|----------------------------|--------------|--------------|---------------------------------------|--|-------------|--|
| Ensaye No | | | | | | |
| Muestra No. | 13 | C | alculó N | 1.B. | Cotejó | |
| Fuento del | Material_ | MAPA DE RE | EFERENCIA: E-1 | 0 | | National Control of the Control of t |
| | | | | | | |
| ANALISI | s granulo | METRICO D | E MATERIAL | QUE PASA 1 | AMIZ DE 3/ | 4* |
| Tamiz | 3/4 | 3/8 | Ý | 10 | 40 | 200 |
| % que paso | 100 | 97 | 89 | 80 | 59 | . 40 . |
| Limite liqu | ido <u>-</u> | | Indice de P | lasticidad | N.P. | r . |
| Clasificaci | ón H.R.B. | A-4(0) | Equiv | alente de | Arena | |
| Tipo de Pru Peso Volum. | | | PROCTOR ESTA | NDAR | | Kgs/m³ |
| Humedad Opt | | | · · · · · · · · · · · · · · · · · · · | | 11.5 | .5 |
| <u> </u> | | המונים | DE C.B.R. | C) MINARO | | |
| Método dè C | ompactaci | | | ······································ | | gallanda and and an and an |
| % de Compac | | | 9 | 1 | 95 | 100 |
| Peso Volum. | Seco (Kạ | s/m3 | 106 | 52 | 1121 | 1180 |
| C.B.R. Satu | rado | | 2.5 | .0 | 40.0 | 54.0 |
| Hincharient | ० (१) | | 0.0 |)47 | 0.047 | 0.047 |
| Tiempo de S | aturación | (horas) | 96 | | 96 | 96 |
| | | | | | | |
| OBSERVACION | ES: | | • | | | |
| | | | | | | |
| | | | • | | - | |
| | | • | | | | , |

(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO INFORME DE ENSAYES DE SUELOS

| ENSAYE | *** | 618-93 | 619-93 | | |
|-----------------------------|--------------|-----------|--------------|------|----------|
| MUESTRA | | 1.4 | . | | |
| ESTACION | | 143+750 I | er. | | |
| CAPA DE | Asfáltica | Base | Terraceria | | |
| PROFUNDIDAD (cms) | | 5-20 | 20-150 | : | |
| SONDEO | 14 | 14 | 14 | | |
| MAPA DE REFERENCIA | | E-10 | E-10 | | |
| GRA | NULOMETRIA | | + | | |
| % QUE PASA TAMIZ: 3" | | | | ŕ: | |
| 2" | Carpeta | 100 | | | ļ |
| 1 1/2" | E = | 97 | | | ļ |
| 1" | | 86 | | | |
| 3/4" | | 77 | 100 | | |
| 3/8" | | 57 | 97 | | |
| No.4 | | 45 | 87 | | <u> </u> |
| No.10 | | 36 | 82 | 1.02 | <u> </u> |
| No.40(a) | | 16 | 63 | | |
| No.200(b) | | 7 | 45 | | |
| RELACION DE FINOS:(b)/(a) | | | .5 | | |
| LIMITES | DE ATTERBERG | , | | | |
| LIMITE LIQUIDO | | - | | | |
| INDICE DE PLASTICIDAD | | NP | NP | | |
| | SIFICACION | | | | |
| CLASIFICACION H.R.B. | | A-1-a(0) | A-4(0) | | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| | ADICIONALES | | | | |
| HUMEDAD NATURAL (%) | | 3.9 | 37.8 | | |
| , | | | | | |
| | | | | | |
| | | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

| ME.1 | ORAMIENTO Y | REHABILITA | CION | · · · · · · · · · · · · · · · · · · · | | A Principal of the Control of the Co | |
|--------------|---------------------------------------|---------------------------------------|------------------------|---------------------------------------|--|--|--|
| Proyecto MEJ | | | | | | | |
| Ensaye No | 619-93 | | Efectuado | por: R.O | La de la companya de | the second secon | |
| Muestra No. | 14 | Ca | alculó M. | В, | Cotejá | | |
| Fuento del | Material_ | MAPA DE R | EFERENCIA: E- | -10 | | | |
| | | | | | | | |
| | | · · · · · · · · · · · · · · · · · · · | | | | | |
| ANALISI | S GRANULO | METRICO DE | MATERIAL | QUE PASA | TAMIZ DE 3/ | , Ý m | |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 | |
| % que pasa | 100 | 97 | 87 | 82 | 63 | 45 | |
| Limite liqu | ido | 1 | ndice de P | lasticida | d _{N.P} | r _e . | |
| Clasificaci | on H.R.B. | A-4(0) | Equiv | alente de | Arena | • • • • | |
| | | | | | | | |
| | · · · · · · · · · · · · · · · · · · · | | | | | | |
| Tipo de Pru | · | | PROCTOR | ESTANDAR | | | |
| Peso Volum. | Seco Max | imo | | | | 1205 Kgs/m ³ | |
| Humedad Opt | ima | | | | | 23.8 | |
| | | PRUEBAS | DE C.B.R. | SATURADO | | THE PARTY WAS AND ADMINISTRATION OF THE PARTY ADMINISTRATION OF THE PARTY AND ADMINISTRATION OF THE PARTY AND ADMINISTRATION O | |
| Método de C | ompactaci | on emplead | lo _{DINAMICA} | | | | |
| % de Compac | tación | | 1 | 0 | 95 | 100 | |
| Peso Volum. | Seco (Kạ | s/m3 | 108 | 35 | 1145 | 1205 | |
| C.B.R. Satu | rado | | 18. | 0 | 31.0 | 44.0 | |
| Hincharient | ० (%) | | 0.1 | .5 | 0,23 | 0.21 | |
| Tiempo de S | Tiempo de Saturación (horas) | | | | 96 | | |
| | | | | | | | |
| OBSERVACION | ES: | | | | | | |
| | | | | | | | |
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(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ENSAYES DE SUELOS

| CARRETERAS. ENSAYE | | 620-93 | 621-93 | 622-93 | |
|-----------------------------|-------------|----------|----------|--------------|--------------|
| MUESTRA | _ | 15 | 15 | 15 | |
| ESTACION | | 159+000 | zg. | | |
| CAPA DE | Asfáltica | Base | Sub-Base | Terracer: | a |
| PROFUNDIDAD (cms) | 0-5 | 5-35 | 35-60 | 60-150 | |
| SONDEO | 15 | 15 | 15 | 15 | |
| MAPA DE REFERENCIA | E-11 | E-11 | E-11 | E-11. | |
| GRANU | LOMETRIA | | · | | |
| % QUE PASA TAMIZ: 3" | | | | 7.6 | |
| 2" | Carpeta | 100 | 100 | 67 | |
| 1 1/2" | Asfáltica | 93 | 96 | 60 | |
| <i>I</i> | | 78 | 90 | 55 | |
| 3/4" | | 69 | 84 | 50 | |
| 3/8" | | 57 | 70 | 41 | |
| No.4 | | 4.6 | 53 | 32 | |
| No.10 | | 39 | 41 | 26 | |
| No.40(a) | | 19 | 20 | 14 | |
| No.200(b) | | 12 | 12 | 8 | |
| RELACION DE FINOS:(b)/(a) | | . · | <u></u> | | |
| LIMITES DI | E ATTERBERG | · | · | | |
| LIMITE LIQUIDO | · | 29 | 38 | 47 | |
| INDICE DE PLASTICIDAD | | 10 | 14 | 13 | |
| CLAS | IFICACION . | · | | | |
| CLASIFICACION H.R.B. | | A-2-4(0) | A-2-6(0) | A-2-7(0) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES A | DICIONALES | | | | · |
| HUMEDAD NATURAL (%) | | 7.9 | 8.3 | 23.9 | |
| | | | | | |
| | | | | | |
| · | | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analiais y Control de Calidad de Materiales de Construccion

INFORME DE PRUEBAS DE C.B.R. SATURADO

| ME Proyecto DE | JORAMIENTO Y CARRETERAS. | REHABILITA | CION Carino TELI | CA-LA CRUZ D | E LA INDIA | |
|-------------------|-----------------------------|------------|---------------------|---------------------------------------|-------------|--|
| Ensaye No. | | | | | | |
| Muestra No. | . 15 | Ca | lculó M. | В. | Cotejó | |
| Fuente del | =- | MAPA DE | REFERENCIA: | E-11 | | |
| | | | | | | |
| ANALISI | s Granulom | ETRICO DE | MATERIAL | QUE PASA T | AMIZ DE 3/4 | , H |
| Tamiz | 3/4 | 3/8 | ţ | 10 | 40 | 200 |
| % que pasa | 50 | 41 | 32 | 26 | 14 | 8 |
| Limite liqu | • | • | | | | |
| Clasificac | Lon H.R.B | A-2-7(0) | Equiv | valente de | Arena | |
| <u> </u> | | | | | | |
| Tipo de Pri | ieba emplea | da | PROCTOR FST | ANDAR | | |
| Peso Volum | | | FROOTON HOLE | <u> </u> | 1 605 | Kgs/m ³ |
| Humedad Op | | | | | 20. | 5 |
| | · · | PRUEBAS | DE C.B.R. | SATURADO | | Section to the section of the sectio |
| Método de (| Compactació | | | | | |
| % de Compa | | | | | 95 | 100 |
| Peso Volum | . Seco (Kợs | 5/m3 | 14 | 45 | 1525 | 1605 |
| C.B.R. Sat | urado | | 14 | .0 | 25.0 | 37.0 |
| Hinchamien | to (%) | <u> </u> | 0. | 31 | 0,38 | 0.32 |
| Tiempo de | Saturación | (horas) | | 16 | 96 | 96 |
| | | | | | | |
| OBSERVACIO | NES: | | | | | |
| | • | | | | | |
| | | | | | | |
| | | • | | | | |
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(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ENSAYES DE SUELOS

| PROYECTO: MEJORAMIENTO Y REHABILITA CARRETERAS. | | CAMINO: TEI | ICA-LA CRU | Z DE LA | INDIA |
|--|-------------|-------------|------------|-------------|-------|
| ENSAYE | - | 623-93 | 624-93 | | |
| MUESTRA | - | 16 | 16 | | |
| ESTACION | | 167+200 | er. | | |
| CAPA DE | Asfáltica | Base | Terracería | | |
| PROFUNDIDAD (cms) | 0-4 | 4-36 | 36-150 | | |
| SONDEO | 16 | 16 | 16 | | |
| MAPA DE REFERENCIA | E-11 | E-11 | E-11 | , | |
| GRAN | ULOMETRIA | | | | |
| % QUE PASA TAMIZ: 3" | | | 100 | <u>. 63</u> | |
| 2" | Carpeta | | 90 | | |
| 1 1/2" | Asfáltica | 100 | 83 | | |
| 1" | | 96 | 72 | | |
| 3/4" | | 92 | 66 | | |
| 3/8" | | 78 | 51 | | |
| No.4 | j . | 66 | 39 - | | |
| No.10 | | 53 | 33 | | |
| No.40(a) | | - 21 | 21 | | |
| No.200(b) | i i | 9 | 14 | | |
| RELACION DE FINOS:(b)/(a) | · | | | | |
| LIMITES I | E ATTERBERG | | | | |
| LIMITE LIQUIDO | i | - | 37 | | |
| INDICE DE PLASTICIDAD | | NP | 16 | | |
| | SIFICACION | | - | · · | |
| CLASIFICACION H.R.B. | | A-1-b(0) | A-2-6(0) | | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| | ADICIONALES | | | : | |
| HUMEDAD NATURAL (%) | | 6,1 | 7.9 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| OBSERVACIONES: | | | | | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

INFORME DE PRUEBAS DE C.B.R. SATURADO

| ME | JORAMIENTO | Y REHABILITA | CION | | | - |
|--|---------------------------------------|--|---|--|--------------|--|
| Proyecto DE | | | | ELICA-LA CRUZ | DE LA INDIA | |
| Ensaye No. | | | | | | |
| Muestra No. | | and the second s | | | | |
| Fuento del | Material_ | MAPA DE | REFERENCIA+ | F-11 | | |
| | | | · | nt, to the colored control of the colored colo | | |
| | | | | | | |
| ANALISI | S GRANULO | METRICO DE | MATERIAL | QUE PASA ! | CAMIZ DE 3/ | '4 * |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 66 | 51 | 39 | 33 | 21 | 14 |
| Limite liqu | ido | 371 | indice de | Plasticidad | 116 | r. |
| Clasificaci | | | • | | | |
| | · · · · · · · · · · · · · · · · · · · | | · · · · · · · · · · · · · · · · · · · | | | |
| | | | | | | |
| Tipo de Pri | | | | PROCTOR ESTA | · | |
| Peso Volum. | Seco Max | imo | <u> </u> | | | 2 Kgs/m ³ |
| Humedad Opt | ina | | ··· ·································· | | 13. | , 4 |
| | | PRUEBAS | DE C.B.R. | SATURADO | | |
| Método de C | Compactaci | on emplead | lo _{DINAM} | ICA | | |
| % de Compac | tación | | | 90 | 95 | 100 |
| Peso Volum. | . Seco (Ka | s/m³ | 1 | 631 | 1721 | 1812 |
| C.B.R. Satu | ırado | | 1 | 8.0 | 28.0 | 40.5 |
| Hinchamient | o (%) | | | 0,20 | 0.31 | 0.20 |
| Tiempo de 8 | Saturación | (horas) | | 96 . | 96 | 96 |
| and the second s | | · · · · · · · · · · · · · · · · · · · | - | ······································ | | THE STATE OF THE S |
| OBSERVACION | VES: | | | | • | |
| | | | | | | |
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SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ENSAYES DE SUELOS

MEJORAMIENTO Y REHABILITACION

| | | T | 1 404 00 | T (22 22 T | |
|-----------------------------|-------------|-----------|-----------------|---|-------------|
| NSAYE | | 625-93 | 626-93 | 627-93 | |
| UESTRA | | 17 | 17 | 17 | <u></u> |
| STACION | | 177+800 | | | |
| APA DE | Asfaltica | Base | Sub-Base | Terraceria | a |
| ROFUNDIDAD (cms) | 0-4 | 4-28 | 28-68 | 68-150 | |
| ONDEO | 17 | 17 | 17 | 17 | |
| APA DE REFERENCIA | E-12 | E-12 | E-12 | E-12 | |
| GRANULO | OMETRIA | , | | | |
| QUE PASA TAMIZ: 3" | | | 100 | | |
| 2" | Carpeta | 100 | 96 | r, | |
| 1 1/2" | Asfáltica | 94 | 90 | 100 | ···· |
| 1" | | 87 | 86 | 99 | |
| 3/4" | | 80 | 83 | 98 | · |
| 3/8" | | 67 | 72 | 93 | |
| No.4 | · • | 54 | 50 | 75 | |
| No.10 | | 46 | 43 | 72 | |
| No.40(a) | | 1.7 | 18 | 62 | |
| No.200(b) | 1 | . 8 | 10 | 56 | |
| CLACION DE FINOS:(b)/(a) | | , | | | |
| LIMITES DE | ATTERBERG . | | | | |
| INITE LIQUIDO | | 23 | 27 | 57 | |
| NDICE DE PLASTICIDAD | | 4 | 8 | 24 | |
| | ICACION | | - | · & · · · · · · · · · · · · · · · · · · | - |
| CLASIFICACION H.R.B. | | A-1-a(0) | A-2-4(0) | A-7-5(12) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES ADI | CIUNALES | | ·· | · • · · · · · · · · · · · · · · · · · · | |
| HUMEDAD NATURAL (%) | | 9.2 | 8.1 | 33.2 | |
| | | | | | |
| | | | | | |
| | | | | | |
| OBSER VACIONES: | | I <u></u> | <u> </u> | .1 | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

INFORME DE PRUEBAS DE C.B.R. SATURADO

| ME | ORAMIENTO | Y REHABILITA | CION | | | Continue and a second s |
|-------------|------------------------|------------------|--|--|--|--|
| Proyecto DE | | | | | | IRO |
| Ensaye No | | | | | | ************************************** |
| Muestra No. | 17 | | | | Cotej6_ | and the proportional transport and the property of the propert |
| Fuente del | ${	t Material}_{	t -}$ | Km | 177+800 Der | | | ر روز چاندان او در |
| | <u> </u> | Ma | pa de Refere | ncia: E-12 | · · · · · · · · · · · · · · · · · · · | and the second s |
| | | <u> </u> | | and a second | | |
| ANALISI | S GRANULO | METRICO DE | E MATERIAL | QUE PASA | TAMIZ DE 3/ | ₫ ™ |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % gue pasa | 98 | 93 | 75 | 72 | 62 | 56 |
| Limite liqu | ido57 | I | îndice de l | Plasticida | ıd24 | 1 |
| Clasificaci | on H.R.B | A-7-5(12) | Equi | valente de | Arena | * . <u>.</u> |
| | | | و و المحمد ا | | The state of the s | |
| | | | | ······································ | | ngagagagaga ayang sagaran sa sa Sababbayan |
| Tipo de Pru | eba emplo | eada | PROCTOR EST | ANDAR | | |
| Peso Volum. | Seco Max | cimo | | | 1 | 442 Kgs/m ³ |
| Humedad Opt | ina | | | | 2. | 5.5 |
| | | PRUEBAS | DE C.B.R. | SATURADO | | |
| Método de C | ompactac | ion emplead | o DINAM | ICA | | |
| % de Compac | tación | | | 90 | 95 | 100 |
| Peso Volum. | Seco (Ko | rs/m3 | 1 | 298 | 1370 | 1442 |
| C.B.R. Satu | rado | : | | 2 | 5 | 7 |
| Hinchamient | o (%) | - 1-7 | 2 | .50 | 2.88 | 2.87 |
| Tiempo de S | aturación | (horas) | | 6 | 96 | . 96 |
|) | | | | ************************************** | And the Corp. A Miles of the least of the demand on the grant property projecting a grant page of specifying seems | COMPANY AND STREET, ST |
| OBSERVACION | ES: | | | | | |
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SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ESSAYES DE SUELOS

MEJORAMIENTO Y REHABILITACION

| ENSAYE | - | 628-93 | 629-93 | 630-93 | |
|-----------------------------|--------------|----------|--------------|-----------|---------------------------------------|
| MUESTRA | 1 | 18 | 18 | 18 | |
| ESTACION | | 183+300 | Der. | | |
| CAPA DE | Asfáltica | Base | Sub-Base | Terraceri | a |
| PROFUNDIDAD (cms) | 0-5 | 5-25 | 25-50 | 50-150 | |
| SONDEO | 18 | 18 | 18 | 18 | |
| MAPA DE REFERENCIA | E-12 | E-12 | E-12 | E-12 | |
| GR. | AHULOMETRIA | | | | |
| % QUE PASA TAMIZ: 3" | | | | 100 | |
| 2" | 1 | 100 | 100 | 88 | |
| 1 1/2" | | 96 | 97 | 81 | |
| 1" | | 87 | 78 | 79 | |
| 3/4" | | 78 | 76 | 78 | |
| 3/8" | | 67 | 66 | 73 | ., |
| No.4 | 1 1 | 57 | 54 | 62 | |
| No.10 |]] | 48 | 46 | 56 | ·· |
| No.40(a) | 1 1 | 20 | 28 | 38 | |
| No.200(b) | | 10 | 20 | 24 | · |
| ELACION DE FINOS:(b)/(a) | | , | | | |
| LIMITES | DE ATTERBERG | | · | | |
| LIMITE LIQUIDO | | - | 43 | 31 | |
| INDICE DE PLASTICIDAD | | NP | 20 | 11 | |
| CL | ASIFICACION | | <u> </u> | · | |
| CLASIFICACION H.R.B. | | A-1-a(0) | A-2-7(1) | A-2-6(0) | |
| CLASIFICACION DE CASAGRANDE | | | | | |
| ENSAYES | ADICIONALES | | | | |
| HUMEDAD NATURAL (%) | | 6.9 | 10.2 | 16.1 | |
| • | | | | | · · · · · · · · · · · · · · · · · · · |
| _ | | | | | |
| | | | | | |

Estudios Geotecnicos para Construcciones Verticales y Horizontales, Analisis y Control de Catidad de Materiales de Construccion

INFORME DE PRUEBAS DE C.B.R. SATURADO

| MEJOF | RAMIENTO | Y REHABILITA | ACTOX | | | |
|----------------|----------|---------------------------------------|---------------------------------------|--------------|---------------|--|
| Proyecto DE CA | | | | A CRUZ DE LA | INDIA-SAN ISI | DRO |
| Ensaye No. 63 | 30-93 | | Efectuad | o por: R | .0. | |
| Muestra No | 18 | C | alculó | М.В. | Cotejő | |
| Fuente del Ma | | | | | | |
| | | Mapa d | e Referenc | a: E-12 | | |
| | | | | | | ************************************** |
| ANALISIS | GRANULC | METRICO DI | MATERIA | L QUE PASA | TAMIZ DE 3/ | 4 # |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 78 | + 73 | 62 | 56 | 38 | . 24 . |
| | | | | | | |
| Limite liquid | | | | | | Ē _g z. |
| Clasificación | H.R.B. | A-2-6(0) | Equ | ivalente de | Arena | · · · · · · · · · · · · · · · · · · · |
| | | | ······ | | | |
| Tipo de Prueb | a emplo | ada Pl | ROCTOR ESTA | NDAR | | |
| Peso Volum. S | | | · · · · · · · · · · · · · · · · · · · | | 1 | 795 Kgs/m³ |
| Humedad Optim | a | | - | | | 15,2 |
| | | PRUEBAS | DE C.B.R | . SATURADO | | |
| Método de Com | pactaci | · · · · · · · · · · · · · · · · · · · | | IAMICA | | |
| % de Compacta | ción | | | 90 | 95 | 100 |
| Peso Volum. S | eco (Ka | s/m3 | 1. | 516 | 1705 | 1795 |
| C.B.R. Satura | do | · · · · · · · · · · · · · · · · · · · | 12 | ? | 22 | 33 |
| Hinchariento | (%) | · · · · · · · · · · · · · · · · · · · | 0. | 087 | 0.134 | 0.071 |
| Tiempo de Sat | uración | (horas) | | | 96 | 96 |
| | | | | | | |
| OBSERVACIONES | : | | | | | |
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(I.M.S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ENSAYES DE SUELOS

| ESPAYE | | 631-93 | 632-93 | 633-93 | 634-9 |
|-----------------------------|------------------|----------|--------------|--------------------|--|
| ERSAYE | | 19 | 19 | 19 | 19 |
| MUESTRA | | 190+000 | Der | | |
| ESTACION | Asfáltica | | Sub-Base | Terraceri | a Terrace |
| CAPA DE | 0-4 | 4-29 | | Mejorada 63-120 | 120-16 |
| PROFUNDIDAD (cms) | 19 | 19 | 19 | 19 | . 19 |
| SONDEO | E-13 | E-13 | E-13 | E-13 | E-13 |
| | NULOMETRIA | <u></u> | | | |
| % QUE PASA TAMIZ: 3" | NO BOTTE I WATER | | | 100 | 100 |
| • | Carpeta | | | 9:9 | 94 |
| 2" 1 1/2" | Asfáltica | 100 | 100 | 97 | 91 |
| | 11010101 | 87 | 97 | 81 | 89 |
| 3/4" | | 78 | 93 | 76 | 84 |
| | 1 | 64 | 88 | .62 | 70 |
| 3/8" | | 53 | 80 | 42 | 47 |
| No.4 | | 47 | 68 | 35 | 43 |
| No.10 | | 25 | 31 | 24 | 33 |
| No.40(a) | | 12 | 16 | 18 | 25 |
| No.200(b) | · | 3 | | | |
| RELACION DE FINOS:(b)/(a) | | | ļ | | |
| LIMITES | l l | 21 | 23 | 37 | 40 |
| LIMITE LIQUIDO | | 21 | 4 | 15 | 22 |
| INDICE DE PLASTICIDAD | OTDI CACTON | - 3 | 4 | . 1) | |
| | SIFICACION | A-1-a(0) | A-1-b(0) | A-2-6(0) | A-2-6(1) |
| CLASIFICACION H.R.B. | | A-1-a(0) | K-1-0(0) | R-2-0(0) | H-2-0(1 |
| CLASIFICACION DE CASAGRANDE | ADICIONALEC | | | ļ | |
| | ADICIONALES | 3.1 | 3.6 | 9,0 | 23.5 |
| HUMEDAD NATURAL (%) | | J 6 L | | | 20,5 |
| | | | | | ······································ |
| | | | | | |
| | | | | | · · · · · · · · · · · · · · · · · · · |

Estudios Geotecnicos para Construcciones Verticules y Horizontales, Analisis y Control de Calidad de Materiales de Construccion

INFORME DE PRUEBAS DE C.B.R. SATURADO

| ME | JORANIENTO Y | REHABILITAC | TON | | <u> </u> | ************************************** |
|--|---|---|---------------------------------------|-----------------------|--------------------------|--|
| Proyecto DE | | | | | | 1 |
| Ensaye No. | 634-93 | · · · · · · · · · · · · · · · · · · · | Efectuado | por: | 3.0. | |
| Nuestra No | | Ca | alculó M | (B . | Cotej6 | NOTE: TO COME DE SERVE AND |
| Fuente del | Material | | Km 190+000 |) | | |
| | | <u>Mar</u> | oa de Referen | cia: E-13 | | |
| | <u></u> | | · · · · · · · · · · · · · · · · · · · | | | • |
| ANALIS | IS GRANULO | OMETRICO DI | E MATERIAL | QUE PASA | TAMIZ DE 3/ | '4 × |
| Tamiz | 3/4 | 3/8 | 4 | 10 | 40 | 200 |
| % que pasa | 84 | . 70 | 47 | 43 | 33 | 25 |
| | | | | | | |
| Limite liqu | ildo4 | 40 | Indice de I | Plasticida | d22 | ş';· |
| Clasificac | lón H.R.B. | A-2-6(1) | Equiv | zalente de | Arena | |
| | · · · · · · · · · · · · · · · · · · · | | · · · · · · · · · · · · · · · · · · · | | | |
| mino do Pri | soba emple | anda DD | | | | |
| TTDO 00 5T0 | | | ΟΓΤΟΡ ΕςΤΑΝΊ | ላ ፓ | 4 | |
| | | | OCTOR ESTAND | AR | | 682 Kag/m3 |
| Peso Volum | . Seco Mi | | OCTOR ESTAND | AR | <u> </u> | 1682 Kgs/m ³ |
| | . Seco Mi | | OCTOR ESTAND | AR | <u> </u> | 1682 Kgs/m ³ |
| Peso Volum | . Seco Mi | ximo | DE C.B.R. | | <u> </u> | |
| Peso Volum | . Seco Mai | kimo PRUEBAS | DE C.B.R. | | <u> </u> | |
| Peso Volum Humedad Opt Método de G | . Seco Mintina Compactaci ctación | PRUEBAS | DE C.B.R. | SATURADO | <u> </u> | |
| Peso Volum Humedad Opt | . Seco Mintina Compactaci ctación | PRUEBAS | DE C.B.R. | SATURADO ICA 90 | 14 | 4.0 |
| Peso Volum Humedad Opt Método de G | . Seco Mai tima Compactac: ctación . Seco (Ko | PRUEBAS | DE C.B.R. | SATURADO ICA 90 | 95 | 100 |
| Peso Volum Humedad Opi Método de G % de Compac Peso Volum | . Seco Mai tima Compactac: ctación . Seco (Ko | PRUEBAS | DE C.B.R. do DINAM | SATURADO ICA 90 | 95 1598 | 100 |
| Peso Volum Humedad Opi Método de G % de Compac Peso Volum C.B.R. Satu | . Seco Maintana Compactaci ctación . Seco (Kontrado to (%) | PRUEBAS ion emplead os/m ³ | DE C.B.R. do DINAM | SATURADO ICA 90 | 95 1598 14 | 100 1682 24 |
| Peso Volum Humedad Ope Método de G % de Compag Peso Volum C.B.R. Satu Hinchamien | . Seco Maintana Compactaci ctación . Seco (Kontrado to (%) | PRUEBAS ion emplead os/m ³ | DE C.B.R. do DINAM 1514 4 0.84 | SATURADO ICA 90 | 95 1598 14 0.63 | 100 1682 24 0.69 |
| Peso Volum Humedad Ope Método de G % de Compag Peso Volum C.B.R. Satu Hinchamien | Eseco Mai tima Compactac: ctación Seco (Ko urado to (%) | PRUEBAS ion emplead os/m ³ | DE C.B.R. do DINAM 1514 4 0.84 | SATURADO ICA 90 | 95 1598 14 0.63 | 100 1682 24 0.69 |
| Peso Volum Humedad Opi Método de G % de Compac Peso Volum C.B.R. Satu Hinchamien Tiempo de S | Eseco Mai tima Compactac: ctación Seco (Ko urado to (%) | PRUEBAS ion emplead os/m ³ | DE C.B.R. do DINAM 1514 4 0.84 | SATURADO ICA 90 | 95 1598 14 0.63 | 100 1682 24 0.69 |
| Peso Volum Humedad Opi Método de G % de Compac Peso Volum C.B.R. Satu Hinchamien Tiempo de S | Eseco Mai tima Compactac: ctación Seco (Ko urado to (%) | PRUEBAS ion emplead os/m ³ | DE C.B.R. do DINAM 1514 4 0.84 | SATURADO ICA 90 | 95 1598 14 0.63 | 100 1682 24 0.69 |
| Peso Volum Humedad Opi Método de G % de Compac Peso Volum C.B.R. Satu Hinchamien Tiempo de 8 | Eseco Mai tima Compactac: ctación Seco (Ko urado to (%) | PRUEBAS ion emplead os/m ³ | DE C.B.R. do DINAM 1514 4 0.84 | SATURADO ICA 90 | 95 1598 14 0.63 | 100 1682 24 0.69 |

(1,M,S.)

SECCION DE SUELOS, PAVIMENTO Y CONCRETO

INFORME DE ENSAYES DE SUELOS

MEJORAMIENTO Y REHABILITACION

| | | · | · · · · · · · · · · · · · · · · · · · | - | |
|-----------------------------|-------------|--|--|--------------|--------------|
| ENSAY E | | 635-93 | 636-93 | · | |
| MUESTRA | | 20 | 20 | | |
| ESTACION | | 197+500 | Der. | | <u> </u> |
| CAPA DE | | Base | Terracería | | |
| PROFUNDIDAD (cms) | 0-5 | 5–17 | 17-150 | | |
| SONDEO | 20 | 20 | 20 | | |
| MAPA DE REFERENCIA | E-13 | E-13 | E-13 | | |
| GRAN | ULOMETRIA | · | | | |
| % QUE PASA TAMIZ: 3" | 1 | | | ··· | |
| 2" | Carpeta | 100 | | <u> </u> | |
| 1 1/2" | Asfáltica | 98 | | | |
| 1" | | 82 | | | |
| 3/4" | | 72 | | | |
| 3/8" | | 60 | 100 | | |
| No.4 | i i | 49 | 98 | | |
| No.10 | | 41 | 90 | | |
| No.40(a) | | 22 | 55 | | |
| No.200(b) | 1 | 10 | 28 | | |
| ELACION DE FINOS:(b)/(a) | | , | | | |
| LIMITES D | E ATTERBERG | | | | |
| LIMITE LIQUIDO | | 25 | 36 | | |
| INDICE DE PLASTICIDAD | | 2 | 3 | | |
| | IFICACION | | <u> </u> | | |
| CLASIFICACION H.R.B | | A-1-a(0) | A-2-4(0) | | |
| CLASIFICACION DE CASAGRANDE | | <u>, </u> | | | |
| | DICIONALES | | · | | |
| HUMEDAD NATURAL (%) | | 4.6 | 8.2 | | 1 |
| | | | | | |
| | | : | | | |
| | | | | | 1 |
| | | | <u> </u> | | |

Estudios Geolecnicos para Construcciones Verticales y Horizontales, Analtais y Control de Calidad de Materiales de Construccion

INFORME DE PRUEBAS DE C.B.R. SATURADO

| | | REHABILITA | | | | | |
|--|------------|-------------------|--------------------|--------------|----------------|-----------------------|--|
| Proyecto_ <u>D</u> | CARRETERAS | S | _Camino_ <u>LA</u> | CRUZ DE LA I | NDIA-SAN ISIDI | RO | |
| Ensaye No. | 636-93 | | _Efectuado | por: R.O. | | | |
| Muestra No. | . 20 | С | alculó | 1.B. | Cotejó_ | | |
| Fuente del | Material | к м 197+50 | 0. | | | | |
| | | MAPA DE RI | EFERENCIA: E- | -13 | | | |
| | | | | · | | | |
| AMALISI | S GRANULO | METRICO D | E MATERIAL | QUE PASA T | AMIZ DE 3/4 | ļ N | |
| Tamiz 3/4 3/8 4 10 40 200 | | | | | | | |
| % que pasa | 100 | ·100 | 98 | 90 | 55 | . 28 . | |
| Limite liqu | nido 36 | | Indice de | Plasticidad | 3 | r _e : | |
| Clasificaci | | | | | | | |
| ************************************** | | | | | | - | |
| | | | | | | | |
| Tipo de Pru | eba emplo | eada PRO | CTOR ESTANDA | R | | | |
| Peso Volum. | Seco Mili | cimo | | | 15 | 97 Kgs/m ³ | |
| Humedad Opt | ina | | | | | 18.5 | |
| <u></u> | | PRUEBAS | DE C.B.R. | SATURADO | | | |
| Mátodo de C | Compactaci | | | | , | | |
| % de Compac | tación | | | 90 | 95 | 100 | |
| Peso Volum. | | s/m3 | 1 | 437 | 1517 | 1597 | |
| C.B.R. Satu | ırado | | 1 | 18 | 37 | 56 | |
| Hinchamient | o (8) | | 0 | . 047 | 0.055 | 0.039 | |
| Tiempo de S | aturación | (horas) | | 96 | 96 | 96 | |
| ************************************** | | | | | | | |
| OBSERVACION | ES: | | | | • | | |
| | | | | | | | |
| | • | | | | | | |
| | | • | | | | | |
| | | | | | | | |

Annex A5.1

Intersection Signal Calculation

Applicable standard

"Planning and design of at-grade intersection – Fundamental edition edited by Traffic Engineering Research Institute" was used as the applicable standard regarding intersection signal calculation, and the line of thought of right-turn traffic in Japan was considered as replaced by left-turn traffic in this nation.

The applicable standard stated above was observed regarding the method for signal calculation in concrete, and in addition, examination was made so that intersection saturation degree will not exceed 0.9.

conditions setup

Various correction factors in the signal calculation were setup as indicated below.

1) Basic value of saturated traffic stream rate

Straight forward: 2,000 PCU

Right-turn: 1,800 PCU Left-turn: 1,800 PCU

PCU: Passenger car unit

- 2) Correction by large-size vehicle mixing rate: The correction factor is calculated by applying the large-size vehicle mixing rate against the planned traffic flow volume at each entry section.
- 3) Calculation of resident quantity and resident length: The mean vehicle head interval was determined as 6.0 m x 1.5 = 9.0 m using 1.7 as the passenger car conversion factor of large-size vehicles and by converting all of large-size vehicles into passenger cars. Therefore, resident length = resident quantity x 6.0 m x 1.5.

Setup of cases in signal calculation

1) Examination in the case of maintenance of the status quo

In the case where the future planned traffic flow volume is applied under the current lane composition, intersection saturation degree becomes 1.234 and exceeds 0.9, which is the limit that permits signal processing. It was therefore concluded that the future traffic flow volume cannot be processed with the current lane composition.

2) Examination that permits signal processing

The intersection that permits signal processing was examined with two cases of different structure, that is, at-grade intersection and grade separation, that permit signal processing setup.

For both of at-grade intersection and grade separation, optimum plans were examined with the number of lanes, etc. increased, and with various case studies implemented using whether there is an influence over the intersection regarding crossing pedestrians or not as an index of each examined case.

The traffic flow volume in the right-turn channel was excluded from the planned traffic flow volume in the signal calculation assuming that it does not exert influence over the intersection saturation degree. (Right-turn is always permitted.)

Regarding the traffic flow volume that comes up to the elevated section (between Managua and Masaya) in the grade separation plan, the following conditions were setup and the premise that the elevated section is used to the most possible extent (to the full traffic capacity) was used.

* Calculation of traffic capacity (permitted traffic capacity Cc) of elevated section

Cc = 2,500 PCU x various correction factors

Correction values

Correction by lane width:

Correction value = 1.00 from W = 3.5 > 3.23

Correction by lateral clearance:

Correction value = 1.00 from W = 1.5 > 0.75

Correction by roadside condition: Not considered

Correction by mixture of large-size vehicles:

Correction value = 0.91 under vertical plan i = 6%, mixing rate 4%

Cc = 2,500 PCU x 0.91 = 2,275 PCU is obtained and it is larger than 1,736 PCU, which is the spot traffic volume of the straight forward plan. It means that all of the straight forward traveling vehicles in the Managua-Masaya direction can be entirely processed with the elevated section. But since it is considered that the at–grade section is also used, the planned traffic flow volume of the straight forward section was determined assuming that 10% of the straight forward traveling vehicles make use of the at–grade section.

Annex A5.2

DESIGN OF FLEXIBLE PAVEMENT

I. Design Sections

This appendix describes the tickness design of flexible pavement (Asphalt Concrete Pavement) for the object roads of the Project based on the AASHTO Guide for Design of Pavement Structures 1986.

(1) Roadbed Resilient Modulus and Design CBR

The bearing capacities of subgrades are expressed in terms of the roadbed resilient modulus $\rm M_R$ in the AASHTO method and of the CBR values in the Japan Road Association method.

In the later case, design CBR is estimated from CBR test values by the following equation:

Design CBR = Average CBR - (Max.CBR-Min.CBR)/C

where,

C: Factor shown below

Factors to Determine Design CBR

| Number of Tested CE | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | >10 | |
|------------------------|------|------|------|------|------|------|------|------|------|--|
| С | 1.41 | 1.91 | 2.24 | 2.48 | 2.67 | 2.83 | 2.96 | 3.08 | 3.18 | |

On the other hand, roadbed resilient modulus \mathbf{M}_{R} can be estimated from its relationship with the design CBR established in the AASHTO method.

(2) Design Sections

The design was prepared for the design sections of the Table A5-1.

Table A5-1 Design Sections for Pavement Design

| Design Section /Station Number | Sampling Station ^(*1) | CBR test(%) | Design CBR(%) |
|-----------------------------------|----------------------------------|-------------|--------------------|
| Section Managua - Mas | aya: (Est 0+000 – Est 25+ | 900) | |
| No. 0 | | | 20 ^(†2) |
| Section Masaya - Nanda | aime: (Est 0+000 Est 27- | +200) | |
| No. 4 No. 3 | 4+640 9+600 | 25 29 | |
| No. 3 No. 2 | 14+400 | 29 27 | 25 |
| No. 1 | 20+900 | 12 | 12 |
| Section Masaya - Tipitaj | oa: (Est 0+000 - Est 21+9 | 25) | |
| No. 5 No. 6 | 7+550 16+700 | 13 2 | 13 |
| Section Tipitapa - San B | enito (Est 0+000 -Est 16+ | 000) | |
| No. 7 No. 8 | 3+780 11+250 | 14 25 | 20 |
| Soction Tinitana Mana | gua (Est 0+000 –Est 4+30 | Λ) | |
| No.9 | 1+800 | 36 | 36 |
| Section Telica - San Isid | ro (Est 0+000 -Est 95+76 | 0) | |
| No.10 No.11 | 8+200 14+700 | 54 4.8 | 54 |
| | 23+470 | 34 | 34 |
| No.12 | | | |
| No.13 | 31+630 | 40 | 40 |
| No.14 | 41+130 | 31 | 31 |
| No.15 | 55+520 | 25 | 25 |
| No.16 | 64+460 | 2 <u>8</u> | |
| No.17 No.18 | 74+400 79+820 | 5 22 | • |
| No. 19 | 86+470 | 14 | 14 |
| No.20 | 94+050 | 37 | 37 |

^(*1) CBR test location Refer to Figure 4-4-1 (Chapter 4) (*2) Assumed value from the CBR test results carried by the MCT of Nicaragua.

II. Common Conditions for Design Sections

(1) Time constraints

| *** | Analysis period | = | 20 | years |
|-----|------------------------------------|----|----|--------|
| | Stages for construction | == | 2 | stages |
| _ | Maximum performance period | == | 15 | years |
| _ | Performance period of second stage | == | 5 | years |

(2) Traffic

- Traffic forecast (ADT) in representative sections refer to Table A5-2.

Table A5-2 Traffic Forecast (ADT) in Representative Sections

| | | | | and the second | | | | the second second second |
|---------------------|-------|--------------------|-----|----------------|------------|-------|----------|--------------------------|
| Section | Year | Passen- ger car | | Large Bus | Pick up | Truck | Trailler | Total |
| San Benito-Tipitapa | 1993 | 763 | 99 | 332 | 1,562 | 1,153 | 312 | 4,221 |
| | 2000 | 1,095 | 96 | 349 | 1,943 | 1,526 | 323 | 5,332 |
| | 2010 | 1,851 | 138 | 562 | 2,551 | 2,229 | 409 | 7,740 |
| Tipitapa-Managua | 1993 | 1,101 | 176 | 370 | 1,622 | 1,121 | 318 | 4,708 |
| | 2000 | 2,216 | 219 | 461 | 2,425 | 1,649 | 379 | 7,349 |
| | 2010 | 3,104 | 270 | 657 | 2,844 | 2,227 | 429 | 9,531 |
| Managua-Km8 | 1993 | 11,829 | 636 | 1,142 | 5,579 | 1,628 | 757 | 21,571 |
| | 2000 | 16,552 | 623 | 1,189 | 6,771 | 2,093 | 609 | 27,837 |
| | 2010 | 27,811 | 878 | 1,906 | 8,880 | 3,007 | 1,034 | 43,516 |
| Km8-Ticuantepe | 1993 | 4,673 | 374 | 882 | 3,521 | 1,394 | 780 | 11,624 |
| | 2000 | 6,539 | 366 | 918 | 4,273 | 1,792 | 833 | 14,721 |
| | 2010 | 10,987 | 516 | 1,472 | 5,604 | 2,575 | 1,065 | 22,219 |
| Ticuantepe-Coyotepe | 1993 | 4,673 | 374 | 882 | 3,521 | 1,394 | 780 | 11,624 |
| | 2000 | 6,539 | 366 | 918 | 4,273 | 1,792 | 833 | 14,721 |
| | 2010 | 10,987 | 516 | 1,472 | 5,604 | 2,575 | 1,065 | 22,219 |
| Coyotepe-Masaya | 1993 | 4,780 | 420 | 894 | 3,714 | 1,592 | 784 | 12,184 |
| | 2000 | 7,273 | 451 | 1,001 | 4,908 | 2,165 | 883 | 16,681 |
| | 2010 | 11,596 | 596 | 1,520 | 6,148 | 3,013 | 1,088 | 23,961 |
| Masaya-Catarina | 1993 | 1,066 | 81 | 299 | 826 | 673 | 390 | 3,335 |
| | 2000 | 1,504 | 76 | 305 | 1,044 | 852 | 412 | 4,193 |
| | 2010 | 3,046 | 136 | 548 | 1,646 | 1,403 | 542 | 7,321 |
| Catarina-Guanacaste | 1993 | 702 | 29 | 127 | 474 | 413 | 245 | 1,990 |
| | 2000 | 982 | 29 | 126 | 618 | 516 | 253 | 2,524 |
| | 2010 | 1,941 | 74 | 251 | 1,099 | 884 | 347 | 4,596 |
| Guanacaste-Nandaimo | 91993 | 731 | 29 | 127 | 499 | 427 | 245 | 2,058 |
| | 2000 | 1,010 | 26 | 126 | 632 | 523 | 250 | 2,567 |
| | 2010 | 1,707 | 38 | 202 | 861 | 790 | 309 | 3,907 |
| Masaya-Tipitapa | 1993 | 107 | 46 | 12 | 193 | 198 | 4 | 560 |
| | 2000 | 609 | 80 | 48 | 544 | 373 | 23 | 1,677 |
| | 2010 | 734 | 85 | 83 | 635 | 438 | 50 | 2,025 |
| Telica-San Isidro | 1993 | 59 | 17 | 50 | 97 | 51 | 3 | 277 |
| | 2000 | 147 | 19 | 81 | 267 | 150 | 34 | 698 |
| | 2010 | 262 | 25 | 130 | 375 | 241 | 40 | 1,073 |

- Directional distribution factor
- Lane distribution factor

- = 0.50
- = 0.50 (2lanes)
- Estimated 18kip equivalent single axle load (ESAL) applications for the year 2000 refer to Table A5-3.

Table A5-3 Calculation of the ESAL Aplications

| | - | | | T | raffic Vo | lume & E | SAL | ··············· | *************************************** | |
|----------------|---------------------------|--------------------|---------------|----------------|---------------|----------------|----------------|-----------------|---|----------------------|
| Year | | Passen- ger Car | Micro Bus | Large Bus | Pick- Up | Truck | Trailer | Total | Design Traffic | Cumulated Traffic |
| | Weigth (ton) Coef.ESAL | 2.00 0.001 | 2.00 0.001 | 12.00 0.98 | 2.00 0.001 | 13.50 1.55 | 37.00 2.34 | A | Ax365 (10°ESAL) | (10°ESAL) |
| (a) <u>M</u> a | nagua-Mas | aya | | | | | | | | |
| 2000 | veh/day ESAL | 16,552 17 | 623 .0 | 1,189 1,170 | 6,771 7 | 2,093 3,248 | 609 1,423 | 27,837 5,865 | 2.14 | 2.14 |
| 2010 | veh/day ESAL | 27,811 28 | 878 0 | 1,906 1,876 | 088,8 9 | 3,007 4,667 | 1,034 2,416 | 43,516 8,996 | 3.28 | 29.80 |
| 2015 | veh/day ESAL | 27,811 28 | 878 0 | 1,906 1,876 | 8,880 9 | 3,007 4,667 | 1,034 2,416 | 43,516 8,996 | 3.28 | 46.30 |
| 2020 | veh/day ESAL | 27,811 28 | 878 0 | 1,906 1,876 | 8,880 9 | 3,007 4,667 | 1,034 2,416 | 43,516 8,996 | 3.28 | 62.70 |
| (b) <u>M</u> a | asaya-Nand | <u>aime</u> | | · | | - | | | | |
| 2000 | veh/day ESAL | 1,010 1 | 26 2 | 126 124 | 632 1 | 532 826 | 250 584 | 2,576 1,523 | 0.56 | 0.56 |
| 2010 | veh/day ESAL | 1,707 2 | 38 2 | 202 199 | 861 1 | 790 1,226 | 309 722 | 3,907 2,151 | 0.785 | 7.38 |
| 2015 | veh/day ESAL | 1,707 2 | 38 2 | 202 199 | 861 1 | 790 1,226 | 309 722 | 3,907 2,151 | 0.785 | 11.30 |
| 2020 | veh/day ESAL | 1,707 2 | 38 2 | 202 199 | 861 1 | 790 1,226 | 309 722 | 3,907 2,151 | 0.785 | 15.20 |
| (c) <u>M</u> a | saya-Tipita | <u>pa</u> | | | | | | | | |
| 2000 | veh/day ESAL | 609 1 | 80 0 | 48 47 | 544 1 | 373 579 | 23 54 | 1677 681 | 0.25 | 0.25 |
| 2010 | veh/day ESAL | 734 1 | 85 0 | 83 82 | 635 1 | 438 680 | 50 117 | 2025 879 | 0.321 | 3.13 |
| 2015 | veh/day ESAL | 734 1 | 85 0 | 83 82 | 635 1 | 438 680 | 50 117 | 2025 879 | 0,321 | 4.74 |
| 2020 | veh/day ESAL | 734 1 | 85 0 | 83 82 | 635 1 | 438 680 | 50 117 | 2025 879 | 0.321 | 6.34 |
| | | | | | | | | | | |

(Table 5-3-c Calculation of the ESAL Aplications)

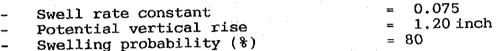
| | | | | Ti | raffic Vo | lume & E | SAL. | | • | |
|-----------------|---------------------------|--------------------|---------------------------------------|---------------|---------------|----------------|---------------|----------------|--------------------|----------------------|
| Year | | Passen- ger Car | Micro Bus | Large Bus | Pick- Up | Truck | Trailer | Total | Design Traffic | Cumulated Traffic |
| | Weigth (ton) Coef.ESAL | 2.00 0.001 | 2.00 0.001 | 12.00 0.98 | 2.00 0.001 | 13.50 1.55 | 37.00 2.34 | A | Ax365 (10°ESAL) | (10°ESAL) |
| (d) <u>Ti</u> g | oitapa-San E | <u>lenito</u> | | | | · . · . | | | | |
| 2000 | veh/day ESAL | 1,095 1 | 96 0 | 349 343 | 1,943 2 | 1,526 2,368 | 323 755 | 5332 3469 | 1.27 | 1.27 |
| 2010 | veh/day ESAL | 1,851 2 | 138 0 | 562 553 | 2,551 3 | 2,229 3,459 | 409 956 | 7,740 4,973 | 1.82 | 17.00 |
| 2015 | veh/day ESAL | 1,851 2 | 138 0 | 562 553 | 2,551 3 | 2,229 3,459 | 409 956 | 7,740 4,973 | 1.82 | 26.00 |
| 2020 | veh/day ESAL | 1,851 2 | 138 0 | 562 553 | 2,551 3 | 2,229 3,459 | 409 956 | 7,740 4,973 | 1.82 | 35.10 |
| (e) <u>Tir</u> | oitapa-Mana | gua | | | | | | | | |
| 2000 | veh/day ESAL | 2,216 2 | 219 0 | 461 454 | 2,425 2 | 1,649 2,559 | 379 886 | 7,349 3,903 | 1.42 | 1.42 |
| 2010 | veh/day ESAL | 3,104 3 | 270 0 | 657 646 | 2,844 3 | 2,227 3,457 | 429 1,003 | 9,531 5,111 | 1.87 | 18.10 |
| 2015 | veh/day ESAL | 3,104 3 | 270 0 | 657 646 | 2,844 3 | 2,227 3,457 | 429 1,003 | 9,531 5,111 | 1.87 | 27.40 |
| 2020 | veh/day ESAL | 3,104 3 | 270 0 | 657 646 | 2,844 3 | 2,227 3,457 | 429 1,003 | 9,531 5,111 | 1.87 | 36.80 |
| (f) <u>Tel</u> | ica-San Isid | ro | · · · · · · · · · · · · · · · · · · · | | | | ····· | | | |
| 2000 | veh/day ESAL | 147 0 | 19 0 | 81 80 | 267 0 | 150 233 | 34 79 | 698 392 | 0.1430. | 143 |
| 2010 | veh/day ESAL | 262 0 | 25 0 | 130 128 | 375 0 | 241 374 | 40 93 | 1,093 596 | 0,218 | 1.98 |
| 2015 | veh/day ESAL | 262 0 | 25 0 | 130 128 | 375 0 | 241 374 | 40 93 | 1,093 596 | 0.218 | 3.07 |
| | veh/day | 262 | 25 | 130 | 375 | 241 | 40 | 1.093 | | |

(3) Reliability

| _ | Design reliability for each stage | = | 90 % |
|---|-----------------------------------|-----|--------|
| _ | Design reliability for two stages | = | 95 % |
| | Overall standard deviation | == | 0.45 |
| | Standard normal deviate | · = | -1.645 |

(4) Environmental Impacts

There is not enough data to differ the environmental impacts between the design sections. The following average values which were assumed for the entire length of the roads.



- Environmental serviceability loss for swelling conditions considered refer to Figure A5-1.

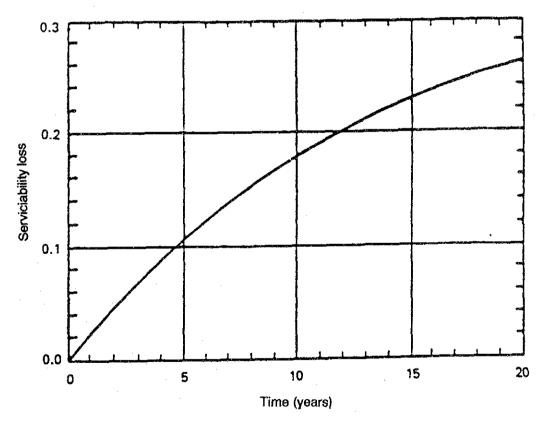


Figure A5-1 Environmental Serviceability Loss for Swelling Conditions Considered

(5) Serviceability

- Initial serviceability = 4.6 - Terminal serviceability = 2.5 - Overall design serviceability = 2.1

(6) Pavement Layer Materials Characterization

| - | Asphalt Concrete (at 68°F) | EAC | =4 | 100,000 | psi |
|-----|----------------------------|-----|----|---------|-----|
| - | Granular Base (CBR>80) | EBS | = | 30,000 | psi |
| ••• | Granular Subbase (CBR>30) | ESB | = | 15,000 | psi |

(7) Layer Coefficient

| - | Asphalt Concrete | a, | = | 0.42 |
|---|------------------|-----|---|------|
| - | Granular Base | a, | = | 0.14 |
| | Granular Subbase | a į | = | 0.11 |

(8) Drainage Coefficient

| - | Granular | Base | m, | = | 0.90 |
|---|----------|---------|----|---|------|
| - | Granular | Subbase | m, | = | 0.90 |

III. Pavement Thickness Design

1. Managua-Masaya Road (Km 0+000 - Km 25+900)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 15,000 psi (Design CBR=20)

(2) Initial Stage Design

- Serviceability loss due to traffic 1.87 1.07×10^{7} 18 kip ESAL Initial structural number (SN) 3.81 Asphalt concrete surface thickness =2.99/0.42=7"inches = 15.00 cm (=6.0")2.48 $SN = 0.42 \times 6$ Base course thickness =(3.83-2.48)/(0.14x0.9)=10.7inches = 30.00 cm (=11.8")
- No subbase course

(3) Second Stage Design (Overlay)

| _ | Serviceability loss due to traffic, | | |
|---|---|---|----------------------|
| | $PSI_{rp}=2.1 - 0.04$ | = | 2.06 |
| _ | 18 Kip ESAL | = | 4.92x10 ⁶ |
| _ | Initial structural number (SNo) | = | 3.81 |
| - | SN | = | 3.38 |
| _ | Remaining life factor (F _{RL}) | | |
| | R _. =32% (original SN=3.81, Pt=2.5) | | |
| | $N_{\rm c}=15.31\times10^6 \text{ (PSI}_{\rm ro}=2.06)$ | | |
| | R _{iv} | = | 0.68 0.83 |
| | $\mathbf{F}_{\mathbf{p}}^{\mathbf{y}}$ | = | 0.83 |
| - | Pavement condition factor (C) | = | 0.82 |
| _ | Effective SN of the original pavement | | |
| | at overlay (SN _{vef}) | | |
| | SN=C_xSNo=0.82x3.81 | = | 3.13 |
| | $SN_{OL}^{xerr} = S\hat{N}_{v} - (F_{RL}xSN_{xeff})$ | | |
| | =3.81-(0.83x3.13) | = | 0.78 |
| - | Asphalt concrete overlay thickness | | |
| | =0.78/0.42=1.86inches | = | 5.00 cm |
| | (=2.0") | | |
| | | | |

(4) Summary

| Initial Stage | | | |
|-------------------------------|---|----|----|
| Asphalt Concrete | = | 15 | cm |
| Granular Base | = | 30 | cm |
| Second Stage (after 15 years) | | | |
| Asphalt Concrete Overlay | × | 5 | cm |

- 2. Masaya-Nandaime Road (Km 0+000 Km 27+200)
- 2.1 Masaya-Nandaime: Sub-Section (Km 0+000 Km 15+300)
 - (1) Effective Roadbed Soil Resilient Modulus
 - MR = 14,000 psi (Design CBR=25)
 - (2) Initial Stage Design
 - 1.87 Serviceability loss due to traffic 2.62x10⁶ 18 kip ESAL Initial structural number (SN) 3.16 Asphalt concrete surface thickness =2.42/0.42=5.8inches $= 15.00 \, \mathrm{cm}$ (=5.9")2.48 $SN_{=}0.42x6$ Base course thickness $= 15.00 \, \mathrm{cm}$ $=(3.17-2.48)/(0.14\times0.9)=5.48$ inches (=5.9")
 - No subbase course
 - (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic, PSI_{TR}=2.1 - 0.04 = 2.06- 18 kip ESAL = 1.17×10^6 - Initial structural number (SNo) = 3.16- SN = 2.78
 - Remaining life factor (F_{RL}) R_{Lx}=32% (original SN=3.16, Pt=2.5) N_{Lx}=3.43×10⁶ (PSI_{TR}=2.06)

 $R_{Ly} = 0.65$ $F_{CL} = 0.83$

- Pavement condition factor (C_x) = 0.82

- Effective SN of the original pavement
 at overlay (SN_{xeff})
 SN_{xeff} = C_xxSNo=0.82x3.16

 $SN_{xeff} = C_x SNO = 0.82 \times 3.16$ = 2.59 $SN_{OL} = SN_{C} - (F_{EL} x SN_{xeff})$ = 0.63

- Asphalt concrete overlay thickness =0.63/0.42=1.5inches = 5.00 cm (=2.0")

(4) Summary

Initial Stage
Asphalt Concrete = 15 cm
Granular Base = 15 cm
Second Stage (after 15 years)
Asphalt Concrete Overlay = 5 cm

2.2 Masaya-Nandaime: Sub-Section (Km 15+300 - Km 27+200)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 11,000 psi (Design CBR=12)
- (2) Initial Stage Design
 - Serviceability loss due to traffic 1.87 2.63×106 18 kip ESAL Initial structural number (SN) 3.45 Asphalt concrete surface thickness =2.42/0.42=5.77inches $= 15.00 \, \mathrm{cm}$ (=5.9") $SN_{=}0.42x6$ 2.48 Base course thickness $=(3.48-2.48)/(0.14\times0.9)=7.94$ inches $= 20.00 \, \text{cm}$ (=7.87")
 - No subbase course
- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic, $PSI_{TR}=2.1-0.04$ = 2.06 - 18 kip ESAL = 1.17x10⁶ - Initial structural number (SNo) = 3.45 - SN = 3.00 - Remaining life factor (F_{RL}) $R_{Lx}=32$ % (original SN=3.45, Pt=2.5) $N_y=3.65x10^6$ (PSI_{TR}=2.06)
 - $F_{RL}^{vy} = 0.83$ Pavement condition factor (C_x) = 0.82
 - - =3.00-(0.83x2.83) = 0.65 Asphalt concrete overlay thickness =0.65/0.42=1.55inches = 5.00 cm

2.83

(4) Summary

(=2.0")

| Initial Stage | | | • |
|-------------------------------|----------|----|----|
| Asphalt Concrete | = | 15 | cm |
| Granular Base | <u> </u> | 20 | Cm |
| Second Stage (after 15 years) | | | |
| Asphalt Concrete Overlay | = | 5 | cm |

- 3. Masaya-Tipitapa Road (Km 0+000 Km 21+925)
- 3.1 Case No.1: Roadbed material from Station No.5 (Km 7+550)
 - (1) Effective Roadbed Soil Resilient Modulus
 - MR = 11,000 psi (Design CBR=13)
 - (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 1.10x10⁶
 - Initial structural number (SN) = 3.00
 - Asphalt concrete surface thickness =2.07/0.42=4.9inches = 12.00 cm (=4.7") SN =0.42x4.7 = 1.98
 - $SN_1=0.42x4.7$ = 1.98 - Base course thickness =(3.00-1.98)/(0.14x0.9)=8.09inches = 20.00 cm (=8.0")
 - No subbase course
 - (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic, PSI_{IR}=2.1 - 0.04 = 2.06 - 18 kip ESAL = 4.81x10⁵
 - Initial structural number (SNo) = 3.00 - SN = 2.65
 - Remaining life factor (F_{RL}) $R_{Lx} = 22\%$ (original SN=3.00, Pt=2.5) $N_{y} = 1.941.37 \times 10^{6}$ (PSI_{TR}=2.06)

 $R_{Ly} = 0.65$ $F_{Ri} = 0.73$

- Pavement condition factor (C_x) = 0.77
- Effective SN of the original pavement at overlay (SN_{xeff})

 $SN_{\text{xeff}} = C_{\text{xSNO}} = 0.77 \times 3.00 \qquad = 2.31$

 $SN_{ol} = SN_{y} - (F_{gl} \times SN_{xeff})$ = 2.65-(0.73×2.31) = 0.96

- Asphalt concrete overlay thickness =0.96/0.42=2.29inches = 6.00 cm (=2.4")

(4) Summary

Initial Stage
Asphalt Concrete = 12 cm
Granular Base = 20 cm
Second Stage (after 15 years)
Asphalt Concrete Overlay = 6 cm

3.2 Case No.2: Roadbed material from Station No.6 (Km 16+700)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 3.300 psi (Design CBR=2)
- (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 1.10x10⁶ - Initial structural number (SN) = 4.55
 - Asphalt concrete surface thickness =2.07/0.42=4.9inches = 15.00 cm (=5.9")
 - $SN_{=}0.42x4.7 = 1.98$
 - Base course thickness = (4.57-2.48)/(0.14x0.9)=16.58inches = 40.00 cm (=15.8")
 - No subbase course
- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic,
 - $PSI_{TR} = 2.1 0.04$ = 2.06 - 18 kip ESAL = 4.84×10⁵
 - Initial structural number (SNo) = 4.56 - SN = 4.00
 - Remaining life factor (F_{RL}) R_L=32% (original SN=4.56, Pt=2.5) N_L=1.69x10⁶ (PSI_{TR}=2.06)
 - $R_{Ly} = 0.71$ $F_{Ri} = 0.83$
 - Pavement condition factor (C_x) = 0.82
 - Effective SN of the original pavement
 - at overlay (SN_{xeff}) SN_{xeff} = C_xSNo=0.82x4.56 = 3.74
 - $SN_{OL}^{xeff} = SN_{V} (F_{PL} \times SN_{xeff})$ = 4.00-(0.83x3.74) = 0.90
 - Asphalt concrete overlay thickness =0.90/0.42=2.15inches = 6.00 cm (=2.4")
- (4) Summary
 - Initial Stage
 Asphalt Concrete
 - Asphalt Concrete = 15 cm Granular Base = 40 cm
 - Second Stage (after 15 years)
 Asphalt Concrete Overlay = 6 cm

4. Tipitapa-San Benito (Km 0+000 - Km 16+000)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 13,000 psi (Design CBR=20)

(2) Initial Stage Design

- Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 6.05x10⁶ - Initial structural number (SN) = 3.68 - Asphalt concrete surface thickness =2.76/0.42=6.6inches = 15.00 cm (=5.9") SN₁=0.42x6 = 2.48 - Base course thickness =(3.71-2.48)/(0.14x0.9)=9.76inches = 25.00 cm (=9.84")
- No subbase course

(3) Second Stage Design (Overlay)

| - | Serviceability loss due to traffic, | | |
|---|---|------------|----------------------|
| | $PSI_{R} = 2.1 - 0.04$ | = | 2.06 |
| - | 18 Kip ESAL | = | 2.72×10^{6} |
| - | Initial structural number (SNo) | = | 3.68 |
| _ | SN | = , | 3.24 |
| _ | Remaining life factor (F_{RL}) $R_{tx}=32$ % (original SN=3.69, Pt=2.5) $N_{ty}=8.57\times10^6$ (PSI _{TR} =2.06) | | |
| | R_=32% (original SN=3.69, Pt=2.5) | | |
| | $N_{\rm c} = 8.57 \times 10^6 \text{ (PSI}_{\rm m} = 2.06)$ | | |
| | $R_{i,j}$ | = | 0.68 |
| | $oldsymbol{	ext{R}_{	ext{	iny}}}{	ext{	iny}}$ | <u></u> | 0.83 |
| | Pavement condition factor (C,) | == | 0.82 |
| - | Effective SN of the original pavement | | |
| | at overlay (SN _{xel}) | | |
| | $CN = C vCN_0 = 0$ $9.2v2$ 6.0 | - | 3 03 |

at overlay (SN_{xeff}) $SN_{xeff} = C_x SNO = 0.82x3.69$ = 3.03 $SN_{CL} = SN_{CL} - (F_{RL} x SN_{xeff})$ = 0.73

- Asphalt concrete overlay thickness =0.73/0.42=1.74inches = 5.00 cm (=2.0")

(4) Summary

| Initial Stage | | | |
|-------------------------------|----|----|----|
| Asphalt Concrete | = | 15 | CM |
| Granular Base | = | 25 | CM |
| Second Stage (after 15 years) | | | |
| Asphalt Concrete Overlay | == | 5 | CM |

Tipitapa-Managua (Km 0+000 - Km 4+300) 5.

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 16,000 psi (Design CBR=36)
- (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.876.39x10⁶ 18 kip ESAL Initial structural number (SN) 3.46 Asphalt concrete surface thickness =2.78/0.42=6.6inches $= 15.00 \, \mathrm{cm}$ (=5.9") $SN = 0.42 \times 6$ 2.48 Base course thickness $=(3.49-2.48)/(0.14\times0.9)=8.02$ inches $= 25.00 \, \text{cm}$
 - No subbase course

(=9.84")

- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic, $PSI_{TR} = 2.1 - 0.04$ 2.06 2.80×106 18 Kip ESAL Initial structural number (SNo) 3.46 3.00 Remaining life factor (F_{RL}) R = 32% (original SN=3.46, Pt=2.5) $N_{\kappa} = 8.89 \times 10^6 \text{ (PSI}_{18} = 2.06)$ 0.68 0.83 Pavement condition factor (C,) 0.82 Effective SN of the original pavement
 - at overlay (SN_{xeff}) 2.84
 - SN = C xSNo=0.82x3.46 SN = SN (F xSN xeff) = 3.00-(0.83x2.84) 0.64 Asphalt concrete overlay thickness
 - 5.00 cm =0.64/0.42=1.53inches (=2.0")
- (4) Summary

| Initial Stage | | | |
|-------------------------------|----|----|----|
| Asphalt Concrete | == | 15 | CM |
| Granular Base | == | 25 | cm |
| Second Stage (after 15 years) | | | |
| Asphalt Concrete Overlay | = | 5 | cm |

- 6. Telica-San Isidro (Km 0+000 Km 95+760)
- 6.1 Telica-San Isidro: Sub-Section (Km 0+000 Km 16+800)
 - A. Case No.1: Roadbed material from Station No.10 (Km 8+200)
 - (1) Effective Roadbed Soil Resilient Modulus
 - MR = 18,000 psi (Design CBR=54)
 - (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 7.14×10⁵ - Initial structural number (SN) = 2.38 - Asphalt concrete surface thickness =1.93/0.42=4.6inches = 10.00 cm (=3.9") SN₁=0.42×4 = 1.68
 - Base course thickness =(2.42-1.68)/(0.14x0.9)=5.87inches = 15.00 cm (=5.9")
 - No subbase course
 - (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic,
 - $PSI_{R} = 2.1 0.04$ = 2.06 - 18 kip ESAL = 3.26×10⁵
 - Initial structural number (SNo) = 2.38 - SN = 2.05
 - Remaining life factor (F_{RL}) R_{bs}=22% (original SN=2.38, Pt=2.5) N_b=9.19×10⁵ (PSI_{Bs}=2.06)

 $R_{Ly} = 0.64$ $F_{xy} = 0.73$

- Pavement condition factor (C_x) = 0.77
- Effective SN of the original pavement

at overlay (SN)

SN = CxxSNo=0.77x2.38 = 1.83

SN = SN = (F ySN)

 $SN_{Ol}^{\text{xeff}} = SN_{\bullet} - (F_{\text{RL}} \times SN_{\text{xeff}})$ $= 2.05 - (0.73 \times 1.83)$ = 0.71

Asphalt concrete overlay thickness =0.71/0.42=1.69inches = 5.00 cm (=2.0")

(4) Summary

Initial Stage
Asphalt Concrete = 10 cm
Granular Base = 15 cm
Second Stage (after 15 years)
Asphalt Concrete Overlay = 5 cm

- B. Case No.2: Roadbed material from Station No.11 (Km 14+700)
- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 5,000 psi (Design CBR=5)
- (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 7.14x10⁵
 - Initial structural number (SN) = 3.75
 - Asphalt concrete surface thickness =1.93/0.42=4.6inches = 15.00 cm (=5.9")
 - $SN_{,}=0.42x6$ = 2.48
 - Base course thickness =(3.77-2.48)/(0.14x0.9)=10.24inches = 25.00 cm (=9.84")
 - No subbase course
- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic,
 - $PSI_{TR} = 2.1 0.04$ = 2.06 - 18 kip ESAL = 3.26x10⁵
 - Initial structural number (SNo) = 3.73
 - $SN_{\nu} = 3.31$
 - Remaining life factor (F_{RL})
 R_L=32% (original SN=3.73, Pt=2.5)
 N_{*}=10.1x10⁵ (PSI_{TR}=2.06)
 - $R_{Ly} = 0.67$ $F_{RL} = 0.83$
 - Pavement condition factor (C_x) = 0.82
 - Effective SN of the original pavement at overlay (SN_{vet})
 - at overlay (SN) SN = CxxSNo=0.82x3.29 = 3.05 SN = SN = (F xSN)
 - $SN_{\alpha}^{xen} = SN_{y} (F_{pl} \times SN_{xen})$ = 3.29 - (0.83×3.05) = 0.75
 - Asphalt concrete overlay thickness =0.75/0.42=1.79inches = 5.00 cm (=2.0")
 - (4) Summary
 - Initial Stage
 - Asphalt Concrete = 15 cm Granular Base = 25 cm
 - Second Stage (after 15 years)
 Asphalt Concrete Overlay = 5 cm

6.2 Telica-San Isidro: Sub-Section (Km 16+800 - Km 30+400)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 16,000 psi (Design CBR=34)
- (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 7.14x10⁵ - Initial structural number (SN) = 2.49
 - Asphalt concrete surface thickness =1.93/0.42=4.6inches = 10.00 cm
 - (=3.9")SN=0.42x4 = 1.68
 - Base course thickness =(2.53-1.65)/(0.14x0.9)=6.98inches = 20.00 cm (=7.9")
 - No subbase course
- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic,
 - $PSI_{TR} = 2.1 0.04$ = 2.06 18 kip ESAL = 3.26x10⁵
 - Initial structural number (SNo) = 2.49
 - $-SN_{v} = 2.15$
 - Remaining life factor (F_{RL}) R_L=22% (original SN=2.49, Pt=2.5) N_N=9.32x10⁵ (PSI_{IR}=2.06)
- $R_{Ly} = 0.65$ $F_{CI} = 0.73$
- Pavement condition factor (C_x) = 0.77
- Effective SN of the original pavement
 - at overlay (SN_{xeff}) $SN_{xeff} = CxxSNo=0.77x2.49$ = 1.91
 - $SN_{ol}^{xeff} = SN_{ol} (F_{Rl}xSN_{xeff})$ = 2.15-(0.73x1.91) = 0.76
- Asphalt concrete overlay thickness =0.76/0.42=1.80inches = 5.00 cm (=2.0")
- (4) Summary
 - Initial Stage
 Asphalt Concrete = 10 cm
 Granular Base = 20 cm
 Second Stage (after 15 years)
 Asphalt Concrete Overlay = 5 cm

6.3 Telica-San Isidro: Sub-Section (Km 30+400 - Km 32+500)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 17,000 psi (Design CBR=40)
- (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 7.14x10⁵
 - Initial structural number (SN) = 2.43
 - Asphalt concrete surface thickness =1.93/0.42=4.6inches = 10.00 cm (=4.0")
 - $SN_{=}0.42x4 = 1.68$
 - Base course thickness = $(2.48-1.65)/(0.14\times0.9)=6.58$ inches = 20.00 cm (=7.87")
 - No subbase course
- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic, PSI_{TB}=2.1 - 0.02 = 2.06
 - 18 kip ESAL = 3.26×10^5 - Initial structural number (SNo) = 2.43
 - SN_y = 2.09 - Remaining life factor (F₋)
 - Remaining life factor (F_{RL}) $R_{LX}=22\%$ (original SN=2.43, Pt=2.5) $N_{N}=9.27\times10^{5}$ (PSI_{IR}=2.06)
- $R_{ty} = 0.64$ $F_{zz} = 0.73$

= 10 cm

cm

20

- Pavement condition factor (C₂) = 0.77
- Effective SN of the original pavement
 - at overlay (SN_{xeff}) $SN_{xeff} = CxxSNo = 0.77x2.43$ = 1.87
- $SN_{OL}^{xell} = SN_{J} (F_{RL} x SN_{xell})$ = 2.09-(0.73x1.87) = 0.72
- Asphalt concrete overlay thickness =0.72/0.42=1.71inches = 5.00 cm (=2.0")
- (4) Summary
 - Initial Stage
 Asphalt Concrete
 Granular Base
 - Second Stage (after 15 years)
 Asphalt Concrete Overlay = 5 cm

6.4 Telica-San Isidro: Sub-Section (Km 32+500 - Km 41+800)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 15,000 psi (Design CBR=31)
- (2) Initial Stage Design
 - Serviceability loss due to traffic = 1.87 - 18 kip ESAL = 7.14x10⁵ - Initial structural number (SN) = 2.55 - Asphalt concrete surface thickness =1.93/0.42=4.6inches = 10.00 cm (=4.0")
 - $SN_1 = 0.42 \times 4$ = 1.68
 - Base course thickness = $(2.59-1.65)/(0.14\times0.9)=7.46$ inches = 20.00 cm (=7.87")
 - No subbase course
- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic,
 - $PSI_{R}=2.1 0.04$ = 2.06 - 18 kip ESAL = 3.26x10⁵
 - Initial structural number (SNo) = 2.55
 - $SN_{y} = 2.21$
 - Remaining life factor (F_{RL}) R_{Lx}=22% (original SN=2.55, Pt=2.5) N_x=9.36x10⁵ (PSI_{TR}=2.06)
 - $R_{Ly} = 0.65$ $F_{CI} = 0.73$
 - Pavement condition factor (C) = 0.77
 - Effective SN of the original pavement
 - at overlay (SN_{xeff}) $SN_{xeff} = CxxSNo=0.77x2.55$ = 1.96
 - $SN_{\text{ol}}^{\text{xen}} = SN_{\text{ol}} (F_{\text{RI}} \times SN_{\text{xen}})$ = 2.21-(0.72×1.96) = 0.78
 - Asphalt concrete overlay thickness =0.78/0.42=1.86inches = 5.00 cm (=2.0")
- (4) Summary
 - Initial Stage
 - Asphalt Concrete = 10 cm Granular Base = 20 cm
 - Second Stage (after 15 years)
 Asphalt Concrete Overlay = 5 cm

Telica-San Isidro: Sub-Section (Km 41+800 - Km 56+400) 6.5

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 12,000 psi (Design CBR=25)

(2) Initial Stage Design

- Serviceability loss due to traffic 1.87 7.14x10⁵ 18 kip ESAL 2.75 Initial structural number (SN)
- Asphalt concrete surface thickness =1.93/0.42=4.6inches = 10.0 cm (=4.0")
 - $SN_{=}0.42x4$ 1.68
- Base course thickness $= 25.00 \, \mathrm{cm}$ =(2.78-1.65)/(0.14x0.9)=8.97inches (=9.84")
- No subbase course

(3) Second Stage Design (Overlay)

- Serviceability loss due to traffic, PSI_{IR}=2.1 - 0.04 18 kip ESAL 2.06 3.26x10⁵ 2.75 Initial structural number (SNo) 2.42
- Remaining life factor (F_{RL}) R_{Lx}=22% (original SN=2.75, Pt=2.5) $N_{\rm t} = 9.3 \times 10^5 \ (PSI_{\rm TR} = 2.06)$

0.65 0.73

0.87

- 0.77
- Pavement condition factor (C_x) Effective SN of the original pavement

at overlay (SN_{xeff}) SN_{xeff}=CxxSNo=0.77x2.75 2.12

 $SN_{ol}^{xen} = SN_{y} - (F_{RL} x SN_{xen})$ = 2.42 - (0.73 x 2.12)

Asphalt concrete overlay thickness 6.0 cm =0.87/0.42=2.07inches (=2.25")

(4) Summary

Initial Stage = 10 cm Asphalt Concrete Granular Base 25 CM Second Stage (after 15 years) Asphalt Concrete Overlay 6 cm

Telica-San Isidro: Sub-Section (Km 56+400- Km 92+500) 6.6

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 11,000 psi (Design CBR=14)

(2) Initial Stage Design

- Serviceability loss due to traffic 1.87 7.14x10⁵ 18 kip ESAL 2.83 Initial structural number (SN) Asphalt concrete surface thickness
 - =1.93/0.42=4.6inches $= 10.00 \, \mathrm{cm}$ (=4.0") $SN_1=0.42x4$ 1.68
- Base course thickness $= 25.00 \, \mathrm{cm}$ $=(2.85-1.65)/(0.14\times0.9)=9.52$ inches (=9.84")
- No subbase course

(3) Second Stage Design (Overlay)

- Serviceability loss due to traffic, PSI_R=2.1 - 0.04 18 kip ESAL 2.06 3.26x10⁵
- Initial structural number (SNo) 2.83 2.50 SN
- Remaining life factor (F_{RL}) $R_{ix} = 22\%$ (original SN=2.83, Pt=2.5) $N_{\text{N}} = 9.2 \times 10^5 \text{ (PSI}_{\text{TR}} = 2.06)$
 - 0.65 $\mathbf{F}_{\mathsf{RL}}^{\mathsf{L}}$ 0.73
- 0.77 Pavement condition factor (C_j)
- Effective SN of the original pavement
 - at overlay (SN_{xeff}) SN_{xeff}=CxxSNo=0.77x2.83 2.18 $SN_{OL}^{xen} = SN_{y} - (F_{RL} \times SN_{xeff})$ = 2.50 - (0.73 x 2.18)
- Asphalt concrete overlay thickness =0.9/0.42=2.14inches 6.0 cm (=2.25")

(4) Summary

Initial Stage Asphalt Concrete Granular Base

10 cm25 cm

0.90

Second Stage (after 15 years) Asphalt Concrete Overlay

CM

6.7 Telica-San Isidro: Sub-Section (Km 92+500 - Km 95+760)

- (1) Effective Roadbed Soil Resilient Modulus
 - MR = 16,000 psi (Design CBR=37)
- (2) Initial Stage Design
 - 1.87 Serviceability loss due to traffic 18 kip ESAL 7.14x10⁵
 - Initial structural number (SN) 2.49
 - Asphalt concrete surface thickness $= 10.00 \, \text{cm}$ =1.93/0.42=4.6inches
 - (=4.0")SN = 0.42x41.68
 - Base course thickness =(2.53-1.65)/(0.14x0.9)=6.98inches $= 20.00 \, \text{cm}$ (=7.87")
 - No subbase course
- (3) Second Stage Design (Overlay)
 - Serviceability loss due to traffic, $PSI_{TB}=2.1 - 0.04$
 - 2.06 18 Kip ESAL 3.26x105
 - 2.49 Initial structural number (SNo)
 - 2.15
 - Remaining life factor (F_{RL}) $R_{ix}=22\%$ (original SN=2.49, Pt=2.5) $N_{\nu} = 9.32 \times 10^5 \text{ (PSI}_{10} = 2.06)$
 - R_{Ly} 0.65 0.73

5 CM

- Pavement condition factor (C) 0.77
- Effective SN of the original pavement at overlay (SN_{xeff})
 SN_{xeff} = CxxSNo=0.77x2.49
 SN_{xeff} = SN_y (F_{RI}xSN_{xeff})
 = 2.15-(0.73x1.92)
 - 1.92
 - 0.76
- Asphalt concrete overlay thickness 5.00 cm =0.76/0.42=1.80inches (=2.0")
- (4) Summary
 - Initial Stage
 - Asphalt Concrete 10 cm Granular Base 20 Cm
 - Second Stage (after 15 years) Asphalt Concrete Overlay

Annex A5.3(1) Maintenance Cost

| Ano | Tramo | Actividad | Unidad | Cantidad | Coslos (C\$) |
|--|-------------------------------------|--------------------------------------|--------|---------------------------------------|-----------------|
| A CONTRACTOR OF THE PARTY OF TH | Global | Tratamiento Superficial | m9 | 33,253,38 | |
| | Telica-Malpaisillo | | | · · · · · · · · · · · · · · · · · · · | 523,000,00 |
| 1988 | Masaya-Granada | | | | 345,365,944,50 |
| | Emp.San Isidro-Limite Region II | | | | 131,663,299.19 |
| | Rivas - San Jorge | Tratamiento Superficial | m3 | 10,200.00 | |
| | Region I | Tralamiento Superficial | | | |
| | Kukamonga - Esteli | Tratamiento Superlicial | km | 17.50 | |
| | Yalaguina - El Espino | Tratamiento Superficial | km | 34.90 | |
| | Yalaguina - Ocotal | Tratamiento Superficial | km | 20.00 | |
| | Masaya Niquinohomo | Nivelacion y Conformacion | km | 10.00 | |
| | Masaya-Catarina | Nivelacion y Conformacion | km | 4.00 | .,, |
| | Veracruz Masaya | Nivelacion y Conformacion | km | 7.00 | |
| | Masaya-El aceituno | Nivelacion y Conformacion | | | |
| | Motel Las Flores/Las Flores | Nivelacion y Conformacion | km | 3.00 | |
| | El Jicaral-Telica | Tratamiento Superficial | km | 61.00 | |
| | Managua-Masaya | Sello astattico | km | 15.80 | |
| | Tipitapa-Masaya | Bacheo | km | 22,00 | |
| | Carretera vieja a Tipitapa | Bacheo | km | 13.00 | |
| | Masaya-Granada | Revestimiento | km | 8,00 | |
| | Nandaime-Pica Pica | Tratamiento Superficial | km | 15.00 | |
| | Nandaime-Jinotepe | Tratamiento Superficial | km | 2,00 | |
| | Masaya-Guanacaste | Revestimiento | km | 29.65 | |
| | San Benito-Las Canoas | Tratamiento Superficial | km | 16.00 | |
| | Emp. San Isidro-El Jicaral | Tratamiento Superficial | km | 8.00 | |
| | San Benito-Empalme Boaco | Tratamiento Superficial | km | 39.00 | |
| | Tipitapa-Los Novios | Revestimiento | km | 4.00 | |
| | Acceso camino Loma Linda-San Isidro | Conformacion | km | 5.00 | |
| | Calles de Esteli | Tratamiento Superficial | km | 4.50 | |
| 1989 | | Tratamiento Superficial | m2 | 102,179.00 | |
| | | Revestimiento | m3 | 28,330.00 | |
| | Region II | Sello | m2 | 65,000.00 | · · · · · · · · |
| | | Bacheo Superficial | m3 | 4,950,23 | |
| | · | Bacheo Profundo | m3 | 825.50 | • |
| | | Nivelacion y conformacion de hombros | m3 | 301,887.00 | |
| | | Bacheo Superficial | m3 | 1,923.05 | |
| | | Bacheo Profundo | m3 | 218.00 | |
| | Region III | Sello Asfaltico | m2 | 146,700.00 | |
| | | Tratamiento Superficial | m2 | 309,943.40 | |
| | | Revestimiento Asfaltico | m2 | 11,953.74 | |
| | | Nivelacion y conformacion de hombros | m2 | 48,346.00 | |
| | | Bacheo Superficial | m3 | 3,953.69 | |
| | | Bacheo Profundo | m3 | 693.50 | |
| | Region IV | Tratamiento Superficial | m2 | 151,830,00 | |
| | " | Revestimiento Astattico | m3 | 28,384.20 | |
| | | Nivelacion y conformacion de hombros | m3 | 82,813.00 | |
| | | Bacheo Superficial | m3 | 1,417.50 | |
| | | Bacheo Profundo | m3 | 738.70 | |
| | Region V | Tratamiento Superficial | m2 | 7,204.66 | |
| | | Revestimiento | m3 | 450.00 | |
| | | Nivelacion y conformacion de hombros | m2 | 320,200.00 | |

Annex A5.3(2) Maintenance Cost

| Λno | Tramo | Actividad | Unidad | Cantidad | Costos (C\$) |
|------|---|--------------------------------------|--------|--------------|---|
| | | Bacheo Superficial | m3 | 1,151.66 | |
| | | Bacheo Profundo | m3 | 936.36 | |
| | Region VI | Selio Astaltico | m2 | 143,350.00 | |
| | _ | Tratamiento Superficial | m2 | 384.017.00 | |
| | | Revestimiento Asialtico | m2 | 878.00 | |
| 1989 | | Nivelacion y conformacion de hombros | m2 | 49,000,00 | |
| | | Bacheo Superlicial | m3 | 14,442.11 | |
| | | Bacheo Profundo | m3 | 3,287.57 | |
| | Total | Sello Asfaltico | m2 | 360,810.00 | |
| | | Tratamiento Superficial | m2 | 2,027,916.40 | |
| | | Revestimiento Astaltico | m3 | 70.160.00 | |
| | · | Nivelacion y conformacion de hombros | m2 | 844,246,00 | |
| | | Bacheo Superficial | m3 | 500,43 | |
| | Region I | Bacheo Profundo | m3 | 15.50 | |
| | | Sello Astaltico | m2 | 71,012.00 | |
| | | Tratamiento Superficial | m2 | 313,345.00 | |
| | | Bacheo Superficial | m3 | 2,695.00 | |
| | Region II | Bacheo Profundo | m3 | 1,691.00 | |
| | | Sello Asfaltico | m2 | 231,000.00 | |
| | · | Tratamiento Superficial | m2 | 16,515.00 | |
| | Telica-El Jicaral | Revestimiento | km | 510.00 | |
| | Tipitapa-Masaya | | km | 22.00 | |
| | San Benito-El Lago | Revestimiento | km | 6.70 | |
| | Nandaime-El Ratro | Revestimiento | km | 5.20 | |
| | San Isidro-El Jicaral | Revestimiento | km | 5.00 | |
| | Tipitapa - Masaya | Tratamiento Superficial Simple | km | 22.00 | |
| 1990 | Xiloa-Tipitapa-Victoria de Julio-Veracruz | Tratamiento Superficial Simple | km | 32.50 | |
| | | Bacheo Superficial | m3 | 2,899,44 | |
| | Region III | Bacheo Profundo | m3 | 85.00 | ····· |
| | - · · · · · · · · · · · · · · · · · · · | Sello Astattico | m2 | 312,409.00 | |
| | | Tratamiento Superficial | m3 | 11,656.00 | |
| | | Bacheo Superficial | mЗ | 2,247.50 | |
| | Region IV | Bacheo Profundo | m3 | 38.00 | - · · · · · · · · · · · · · · · · · · · |
| | | Sello Astaltico | m3 | 6,291.00 | |
| | | Tratamiento Superficial | m2 | 49,000.00 | |
| ÷ | | Bacheo Superficial | m3 | 1,509.60 | |
| | Region V | Bacheo Profundo | m3 | 579.50 | |
| | Ť | Sello Asfaltico | m2 | 435,342.00 | |
| | , | Revestimiento Superficial | m3 | 69.00 | |
| | | Bacheo Superficial | m3 | 2,001.00 | |
| | Region VI | Bacheo Profundo | m3 | 3,077.00 | |
| | | Sello Asfaltico | m2 | 114,213.00 | |
| | | Revestimiento Superficial | m3 | 2,534.00 | |

Annex A5.3(3) Maintenance Cost

| Ano | Tramo | Actividad | Unidad | Cantidad | Costos (C\$) |
|--|-----------------------------------|---|--------|------------|--|
| Antigodica de la Carlo de Car | CONSOLIDADO | | | | |
| | Ocolal - Las manos | Tratamiento Superficial | km | 28.00 | |
| | Kukamonga - Yalaguina | Tratamiento Superficial | km | 26,90 | |
| | Chinandega - Villa 15 de julio | Tratamiento Superficial | km | 33,00 | |
| | Telica - El Jicaral | Mantenimiento mayor | km | 11.00 | |
| | Acceso a Puerto Sandino | Tratamiento Superficial | km | 10.00 | TO THE SECOND CONTRACTOR OF THE SECOND SECON |
| | La Virgen - Sapoa - Penas Blancas | Revestimiento Astaltico | km | 7.50 | |
| 1990 | Diriamba - Casares | Revestimiento astattico y | | | |
| | | Tratamiento Superficial | km | 10,10 | |
| | Jinotepe - San Marcos | Revestimiento Asfattico | km | 2.00 | |
| | Jinotepe - Diriamba | Revestimiento Astaltico | km | 3.00 | |
| | Jinotepe - Grajinan | Revestimiento Asfaltico | km | 8.00 | |
| | La Palma - Santo Tomas | Tralamiento Superficial | km | 26.00 | |
| | San Francisco - Empalme Boaco | Tratamiento Superficial | km | 11.80 | |
| | Sebaco - Las Calabazas | Tratamiento Superficial | km | 15.00 | |
| | San Isidro - El Jicaral | Revestimiento Astaltico | km | 19.80 | |
| | Telica-El Jicaral | | km | 8.00 | 186,875.54 |
| | Managua-Masaya | | km | 16.00 | 15,019.37 |
| | Nandaime-San Caralampio | | km | 5,00 | 216,327,06 |
| | Masaya-Granada-Nandaime | | km | 18,00 | 103,999.94 |
| | San Isidro-El Jicaral | Mano de obra intensiva | km | 20.00 | 32,468,00 |
| | San Isidro-El Jicaral | Otros | km | 19.00 | 19,086.44 |
| | CONSOLIDADO | | 1 | | |
| | Todas las regiones | Bacheo superficial | m3 | 4,819.40 | |
| | | Bacheo profundo | m2 | 4,587.20 | |
| | | Tratamiento superficial | m2 | 124,038.50 | |
| | | Revestimiento Asfaltico | m3 | 18,490.90 | |
| | | Sello Asfaltico | m2 | 3,471.00 | |
| | | Bacheo superficial | m3 | 504.30 | |
| | Region | Bacheo profundo | m3 | 87.20 | |
| | region | Tratamiento superficial | | 35,192.00 | |
| | Region II | Bacheo Superficial | m3 | 351.50 | |
| | region ii | Revestimiento Asfaltico | m3 | 3,535,30 | |
| | | | 1 | 171.10 | |
| 1991 | D | Bacheo superficial | | 182.60 | |
| 1991 | Region III | Bacheo profundo Revestimiento Astaltico | m3 | 2,298.00 | |
| | | | m3 | 1.007.50 | |
| | D N/ | Bacheo superficial | m3 | 172.50 | · · · · · · · · · · · · · · · · · · · |
| | Hegion IV | Bacheo profundo | m3 | | |
| | | Revestimiento Asfaltico | m3 | 708.00 | |
| | <u></u> | Bacheo superficial | m3 | 1,109,30 | |
| | Region V | Bacheo profundo | m3 | 161.80 | |
| | | Tratamiento superficial | m2 | 88,486.00 | |
| | | Revestimiento Asfaltico | | 11,736,00 | |
| | | Bacheo superficial | m3 | 1.760.50 | |
| | Region VI | Bacheo profundo | | 3,983.00 | |
| | | Revestimiento Asfaltico | m3 | 213.60 | |
| | <u> </u> | Sello Astaltico | | 3,471.60 | |

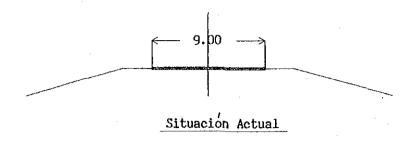
Annex A5.3(4) Maintenance Cost

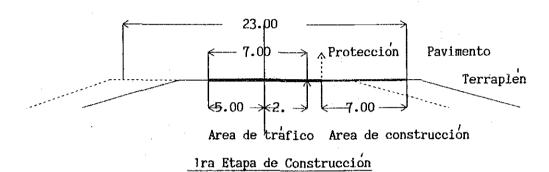
| Λno | Tramo | Actividad | Unidad | Cantidad | Costos (C\$) |
|------------|--------------|--------------------|--------|----------|--------------|
| ********** | Region I | Bacheo Superficial | m3 | 225.56 | 157.544.67 |
| | | Bacheo Prolundo | m3 | 200.97 | 98,004.83 |
| | Region II | Bacheo Superficial | m3 | 658,91 | 593,308.91 |
| | Region III | Bacheo Superficial | m3 | 721.42 | 431,409.16 |
| | Region (V | Hacheo Superticial | m3 | 1,060,84 | 710,093.92 |
| | Region V | Bacheo Superficial | m3 | 756.88 | 765,602.30 |
| 3 | Region VI | Bacheo Superficial | m3 | 368.56 | 297,457.56 |
| | | Bacheo Profundo | m3 | 15.00 | 8,721.75 |
| | Total (1992) | Bacheo Superficial | m3 | 3,792.17 | 2,955.416.52 |
| | | Bacheo Profundo | m3 | 215.97 | 106,726.58 |
| | Region I | Bachieo | | | 276,093.82 |
| | Region II | Bacheo | | | 429,348.61 |
| | Region III | Bacheo | | | 939,783.12 |
| | Region IV | Bacheo | | | 1,363,889.04 |
| • | Region V | Bacheo | | | 416,087.49 |
| | Region VI | Bacheo | | | 37,579.87 |

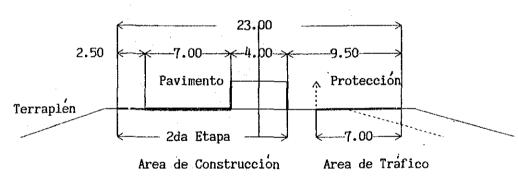
Precios Unitarios de Otras Empresas 1993

| Actividad | Unidad | Region | Region II | Region III | Region IV | Region V | Region VI | Region ZE-1 | Promedio |
|---|-------------|--------|-----------|------------|-----------|----------|-----------|-------------|----------|
| | | ENCOSE | | ENCONS-3 | FCODIN | EICMEP | ENG | | |
| Caminos Pavimentados | | | | | | | | | |
| Bacheo superficial | m3 | 782.33 | 887.56 | 710.13 | 873.45 | 1,134.00 | 852.63 | 00.0 | 873.35 |
| Bacheo Profundo | E E | O | 720.00 | 0.0 | 550.00 | 384.02 | 431.10 | 00.00 | 500.89 |
| Limpieza y Rectificacion de cunetas | Έ | 0.0 | 0.00 | 00.0 | 387.18 | 00.00 | 368.01 | 00.00 | 377.60 |
| Limpieza de Alcantarillas y Cajas | Ξ | 0.00 | 0.00 | 0.00 | 00.0 | 0.00 | 15.83 | 0.00 | 15.83 |
| Tratamiento superficial simple | m2 | 0.00 | 0.00 | 11,50 | 0.00 | 0.00 | 0.00 | 0.00 | 11.50 |
| | m3 | 0.00 | 0.00 | 670.00 | 00.0 | 0.00 | 0.00 | 000 | 670.00 |
| Mano de Obra Intensiva | | | | | | | | | |
| Limpieza y Rectificacion de cunetas | ĸw | 426.27 | 510.00 | 103.41 | 387.18 | 419.39 | 363.28 | 00.00 | 369 09 |
| Limpieza y Rectificacion cunetas revestidas | E | 8.39 | 0.00 | 3.52 | 0.00 | 3.58 | 11.0 | 0,0 | (0) |
| Limpieza de Alcantarillas y Cajas | Ε | 22.21 | 22.26 | 12.26 | 17.63 | 14.31 | 15.83 | 0.00 | 17.25 |
| Limpieza del derecho de via | e c | 584.46 | 809.57 | 564.98 | 785.19 | 891.62 | 1,190.90 | 0.00 | 804.45 |
| | m3 | 12.55 | 0.00 | 00.0 | 0.00 | 00:00 | 0.00 | 0.00 | 12.55 |
| Mamposteria | 33 33 | 0.0 | 0.00 | 608.29 | 000 | 00'0 | 0.00 | 0.00 | 608.29 |
| Adicion de mamposteria | E E | 500.76 | 0.00 | 0.00 | 865.00 | 0.00 | 00.00 | 00.0 | 683.19 |
| Caminos No Pavimentados | | | | | | | | | |
| Nivelacion y conformacion | m2 | 0.42 | 0.34 | 0.27 | 0.26 | 0.42 | 0,40 | 000 | 0.35 |
| Nivelacion y conformacion | 3 2 3 | 0.19 | 0.20 | 0.12 | 0.12 | 0.13 | 0.28 | 0.13 | 0.17 |
| Revestimiento | n3 | 30.45 | 32.31 | 33.35 | 32.00 | 32.72 | 32.50 | 31.86 | 32.17 |
| Bacheo no asfaltico | m3 | 0.00 | o 8 | 00.0 | 0,00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Limpieza y Rectificacion de cunetas | Æ | 426.27 | 510.00 | 103.41 | 387.18 | 419.39 | 368.00 | 31.00 | 360.61 |
| Limpieza de Alcantarillas y Cajas | E | 0.00 | 21.26 | 12.26 | 00.0 | 13.90 | 11.89 | 00.0 | 14.85 |
| Reparacion de alcantarillas de madera | E | 0.00 | 00.00 | 00'0 | 0.00 | 00:00 | 0.00 | 1,458,37 | 1,458.37 |
| Mamposteria | E | 0.00 | 453.58 | 00.0 | 685.60 | 0.00 | 0.00 | 0.00 | 659,59 |
| Reparacion Puente de madera | Ö. | 5.78 | 0.00 | 00.0 | 00'0 | 0.00 | 0.00 | 7.72 | 5.75 |
| Limpieza de alcantarillas y puentes | н. Ч. | 00.0 | 0.00 | 00.0 | 00'0 | 0.00 | 0.00 | 11.71 | 11.71 |
| Descapote de banco | m3 | 2.87 | 391,00 | | 389.00 | 347.00 | 0.0 | 315.00 | 349.00 |
| Colocacion de alcantarilias | ε | 0.0 | 791.16 | 00'0 | 00'0 | 0.00 | 0.00 | 0.00 | 791.15 |
| Limpieza de cause | ٤ | 0.00 | 0.00 | | 10.59 | 0000 | 00.0 | 00.00 | 10.59 |
| Excavacion no clasificada | S E | 4.25 | 0.00 | 00.0 | 3.99 | 88 | 0.0 | 00.00 | 4.12 |
| Nivelacion y conformacion compactada | m2 | 0.00 | 0.00 | | 0.00 | 1.62 | 1.56 | 0.00 | 1.59 |

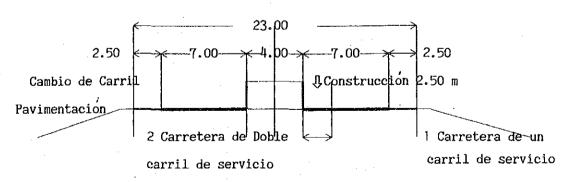
Annex A5.4 Construction Procedure for Widening



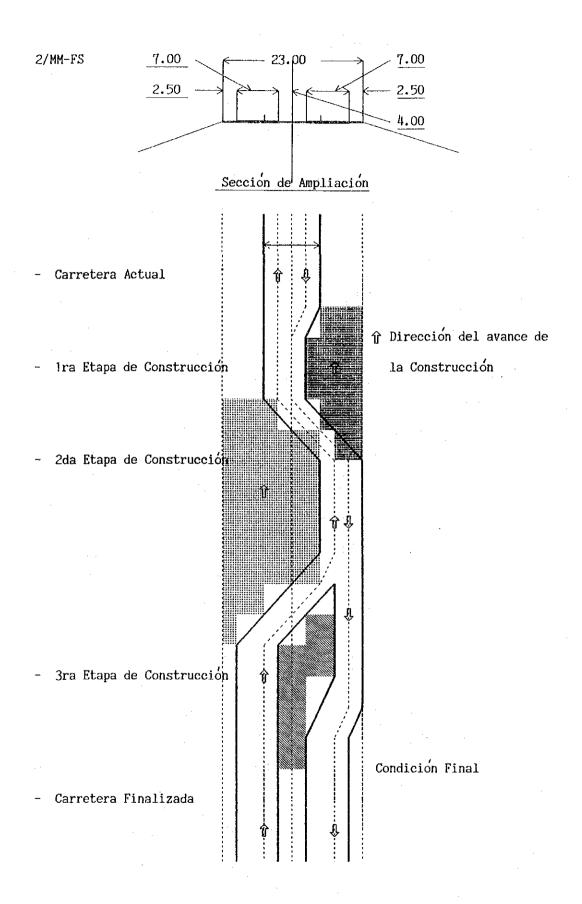




2da Etapa de Construcción



3ra Etapa de Construcción



Annex A6.1 Flow of Benefit and Cost(Project-1)

| | • | | | | | <u>(C\$1,000-)</u> |
|------|--------------|-------------|-------------|-------------|---------------|--------------------|
| YEAR | | COST | | BENEFIT | | CASH FLOW |
| | CONSTRUCTION | MAINTENANCE | TIME SAVING | VOC SAVING | MAINTENANCE | • |
| | COST | COST | | | COST SAVING | |
| 1997 | 22,508.00 | | | | | -22,508.00 |
| 1998 | 31,651.00 | | | | | -31,651.00 |
| 1999 | 13,404.00 | | | | | -13,404.00 |
| 2000 | | 89.00 | 24, 923. 76 | 17,518.86 | 1,617.00 | 43,970.62 |
| 2001 | | 89.00 | 25, 874. 83 | 19,665.64 | | 45,451.46 |
| 2002 | | 89.00 | 26,825.89 | 21,812.41 | | 48,549.30 |
| 2003 | | 89.00 | 27,776.96 | 23, 959. 19 | | 51,647.14 |
| 2004 | | 89.00 | 28,728.02 | 26, 105, 96 | | 54,744.98 |
| 2005 | | 89.00 | 29,679.09 | 28, 252. 74 | 1,617.00 | 59,459.83 |
| 2006 | | 89.00 | 30,630.16 | 30, 399, 51 | | 60,940.67 |
| 2007 | | 89.00 | 31,581.22 | 32,546.29 | ધ | 64,038.51 |
| 2008 | | 89.00 | 32,532.29 | 34,693.06 | | 67, 136. 35 |
| 2009 | | 89.00 | 33, 483. 35 | 36,839.84 | | 70, 234, 19 |
| 2010 | | 89.00 | 34, 434. 42 | 38,986.61 | 1,617.00 | 74,949.03 |
| 2011 | | 89.00 | 34, 434. 42 | 38, 986, 61 | | 73, 332, 03 |
| 2012 | | 89.00 | 34, 434. 42 | 38,986.61 | | 73,332.03 |
| 2013 | | 89.00 | 34, 434. 42 | 38,986.61 | | 73, 332. 03 |
| 2014 | | 6, 255.00 | 34, 434. 42 | 38, 986, 61 | | 67,166.03 |
| 2015 | | 89.00 | 34, 434, 42 | 38, 986, 61 | 1,617.00 | 74,949.03 |
| 2016 | | 89.00 | 34, 434. 42 | 38,986.61 | | 73,332.03 |
| 2017 | | 89.00 | 34, 434. 42 | 38,986.61 | - | 73, 332.03 |
| 2018 | | 89.00 | 34, 434. 42 | 38,986.61 | | 73, 332, 03 |
| 2019 | | 89.00 | 34, 434. 42 | 38,986.61 | | 73, 332. 03 |
| | 67,563 | | | | IRR = | 46.00 |
| | | | | | NPV = | 256,409.16 |
| | | | | | B/C = | 5.56 |
| | | | | | DISCOUNT RATE | 12.00 |
| | | | | | | (%) |

Annex A6.1 Flow of Benefit and Cost(Project-2)

| | | | | <u> </u> | | (C\$1,000-) |
|------|--------------|-------------|-------------|-------------|-------------|--------------|
| YEAR | | COST | | BENEFIT | | CASH FLOW |
| | CONSTRUCTION | MAINTENANCE | TIME SAVING | VOC SAVING | MAINTENANCE | |
| | COST | COST | | | COST SAVING | |
| 1997 | 24,920.00 | | | | | -24, 920.00 |
| 1998 | 34,710.00 | | | | · | -34,710.00 |
| 1999 | 23, 124. 00 | | | | | -23, 124.00 |
| 2000 | | 89.00 | 27, 252, 24 | 19, 243, 54 | 1,617.00 | 48,023.78 |
| 2001 | | 89.00 | 28, 339. 22 | 20, 124. 60 | | 48, 374. 82 |
| 2002 | | 89.00 | 29,426.20 | 21,005.66 | | 50, 342.86 |
| 2003 | | 89.00 | 30, 513, 18 | 21,886.72 | | 52,310.90 |
| 2004 | | 89.00 | 31,600.16 | 22,767.78 | | 54, 278. 94 |
| 2005 | | 89.00 | 32,687.14 | 23,648.84 | 1,617.00 | 57,863.98 |
| 2006 | | 89.00 | 33,774.12 | 24, 529. 89 | | 58, 215, 01 |
| 2007 | | 89.00 | 34,861.10 | 25,410.95 | | 60, 183, 05 |
| 2008 | | 89.00 | 35,948.08 | 26, 292. 01 | | 62, 151.09 |
| 2009 | | 89.00 | 37,035.06 | 27, 173. 07 | | 64, 119. 13 |
| 2010 | | 89.00 | 38, 122. 04 | 28,054.13 | 1,617.00 | 67,704.17 |
| 2011 | | 89.00 | 38, 122, 04 | 28,054.13 | 1 | 66,087.17 |
| 2012 | | 89.00 | 38, 122, 04 | 28,054.13 | | 66,087.17 |
| 2013 | | 89.00 | 38, 122. 04 | 28, 054. 13 | | 66,087.17 |
| 2014 | | 6,255.00 | 38, 122, 04 | 28, 054. 13 | į | 59,921.17 |
| 2015 | | 89.00 | 38, 122, 04 | 28, 054. 13 | 1,617.00 | 67,704.17 |
| 2016 | | 89.00 | 38, 122, 04 | 28, 054. 13 | : | 66,087.17 |
| 2017 | ŀ | 89.00 | 38, 122. 04 | 28,054.13 | | 66,087.17 |
| 2018 | 1 | 89,00 | 38, 122. 04 | 28, 054. 13 | | 66,087.17 |
| 2019 | | 89.00 | 38, 122, 04 | 28, 054. 13 | | 66,087.17 |
| | 82,754 | | • | | IRR = | 41.97 |
| | | | : | | NPV = | 235, 530, 13 |
| | | | | | B/C = | 4.48 |

DISCOUNT RATE

12.00

Annex A6.1 Flow of Benefit and Cost(Project-3)

| | | | | | | (C\$1,000-) |
|------|---------------|-------------|-------------|-------------|---------------|-------------|
| YEAR | a da la compa | COST | | BENEFIT | | CASH FLOW |
| | CONSTRUCTION | MAINTENANCE | TIME SAVING | VOC SAVING | MAINTENANCE | |
| | COST | COST | · | | COST SAVING | |
| 1997 | 13,874.00 | | 1 | | | -13,874.00 |
| 1998 | 38, 149.00 | } | | | | -38,149.00 |
| 1999 | 32,958.00 | | | | | -32,958.00 |
| 2000 | | 183.00 | 17,710.62 | 15,311.06 | 3, 298, 00 | 36, 136, 68 |
| 2001 | | 183.00 | 19,839.50 | 16,916.14 | } | 36,572.64 |
| 2002 | | 183.00 | 21,968.38 | 18,521.22 | | 40, 306.60 |
| 2003 | | 183.00 | 24,097.26 | 20, 126, 29 | | 44,040.56 |
| 2004 | | 183,00 | 26, 226, 14 | 21,731.37 | | 47,774.52 |
| 2005 | | 183.00 | 28, 355. 03 | 23, 336, 45 | 3, 298.00 | 54, 806. 48 |
| 2006 | | 183.00 | 30, 483, 91 | 24,941.53 | | 55, 242, 43 |
| 2007 | | 183.00 | 32,612.79 | 26, 546, 61 | | 58,976.39 |
| 2008 | | 183.00 | 34,741.67 | 28, 151.68 | | 62,710.35 |
| 2009 | | 183.00 | 36,870.55 | 29,756.76 | | 66,444.31 |
| 2010 | | 183.00 | 38,999.43 | 31,361.84 | 3,298.00 | 73,476.27 |
| 2011 | | 183.00 | 38,999.43 | 31,361.84 | | 70, 178. 27 |
| 2012 | | 183.00 | 38,999.43 | 31,361.84 | · | 70, 178. 27 |
| 2013 | | 183.00 | 38,999.43 | 31,361.84 | | 70, 178. 27 |
| 2014 | | 10,571.00 | 38,999.43 | 31,361.84 | | 59, 790, 27 |
| 2015 | | 183.00 | 38,999.43 | 31,361.84 | 3,298.00 | 73, 476. 27 |
| 2016 | | 183.00 | 38,999.43 | 31,361.84 | | 70, 178. 27 |
| 2017 | | 183.00 | 38,999.43 | 31,361.84 | | 70, 178. 27 |
| 2018 | | 183.00 | 38,999.43 | 31,361.84 | | 70, 178. 27 |
| 2019 | | 183.00 | 38,999.43 | 31,361.84 | | 70, 178. 27 |
| | 84, 981 | | | | IRR = | 38.43 |
| | | • | | | NPV = | 213, 504.80 |
| | | | | | B/C = | 4.10 |
| | | | | | DISCOUNT RATE | 12.00 |
| | | | | | | (%) |

Annex A6.1 Flow of Benefit and Cost(Project-4)

| | | | | | | (C \$ 1,000-) |
|------|--------------|-------------|-------------|------------|---------------|----------------------|
| YEAR | | COST | | BENEFIT | | CASH FLOW |
| | CONSTRUCTION | MAINTENANCE | TIME SAVING | VOC SAVING | MAINTENANCE | |
| | COST | COST | | | COST SAVING | × 40. |
| 1997 | 0.00 | | | | | 0.00 |
| 1998 | 0.00 | | | | | 0.00 |
| 1999 | 11,549.00 | | | | | -11,549.00 |
| 2000 | | 45.00 | 1,805.77 | 1,625.68 | 404.00 | 3, 790, 45 |
| 2001 | | 45.00 | 1,834.61 | 1,661.62 | | 3,451.23 |
| 2002 | | 45.00 | 1,863.44 | 1,697.57 | | 3,516.01 |
| 2003 | | 45.00 | 1,892.28 | 1,733.51 | { | 3,580.79 |
| 2004 | j | 45.00 | 1,921.12 | 1, 769. 45 | | 3,645.57 |
| 2005 | | 45.00 | 1,949,96 | 1,805.40 | 404.00 | 4, 114, 35 |
| 2006 | | 45.00 | 1,978.79 | 1,841.34 | 1 | 3,775.13 |
| 2007 | | 45.00 | 2,007.63 | 1,877.28 | | 3,839.91 |
| 2008 | | 45.00 | 2,036.47 | 1,913.22 | | 3,904.69 |
| 2009 | | 45.00 | 2,065.30 | 1,949.17 | [[| 3,969.47 |
| 2010 | | 45.00 | 2,094.14 | 1,985.11 | 404.00 | 4, 438. 25 |
| 2011 | | 45.00 | 2,094.14 | 1,985.11 | [| 4,034.25 |
| 2012 | | 45.00 | 2,094.14 | 1,985.11 | | 4,034.25 |
| 2013 | | 45.00 | 2,094.14 | 1,985.11 | | 4,034.25 |
| 2014 | | 1,431.00 | 2,094.14 | 1,985.11 | i | 2,648.25 |
| 2015 | | 45.00 | 2,094.14 | 1, 985. 11 | 404.00 | 4, 438. 25 |
| 2016 | | 45.00 | 2,094.14 | 1,985.11 |) | 4.034.25 |
| 2017 | | 45.00 | 2,094.14 | 1,985.11 | ŀ | 4,034.25 |
| 2018 | <u> </u> | 45.00 | 2,094.14 | 1,985.11 | | 4,034.25 |
| 2019 | | 45.00 | 2,094.14 | 1,985.11 | | 4,034.25 |
| | 11,549 | | | | IRR = | 31.90 |
| j | | | | | NPV = | 11,908.56 |
| | | <u> </u> | | | B/C = | 2.38 |
| | | | | | DISCOUNT RATE | 12.00 |

12.00 (%)

Annex A6.1 Flow of Benefit and Cost(Project-5)

| | | | | | İ | (C\$1,000-) |
|------|--------------|-----------------|-------------|-------------|---------------|-------------|
| YEAR | | COST | | BENEFIT | | CASH FLOW |
| | CONSTRUCTION | MAINTENANCE | TIME SAVING | VOC SAVING | MAINTENANCE | |
| | CO21 | COST | | | COST SAVING | <u> </u> |
| 1997 | 31,350.00 | | | | | -31,350.00 |
| 1998 | 79,540.00 | | | | | -79,540.00 |
| 1999 | 73,897.00 | | | | | -73,897.00 |
| 2000 | | 685.00 | 19,018.91 | 15, 125, 79 | 6,119.00 | 39, 578, 70 |
| 2001 | | 685.00 | 20,761.19 | 16,369.03 | | 36,445.22 |
| 2002 | | 685.00 | 22,503.47 | 17,612.26 | [| 39,430.74 |
| 2003 | | 685.00 | 24, 245. 76 | 18,855.50 | | 42,416.25 |
| 2004 | | 685.00 | 25,988.04 | 20,098.73 | | 45,401.77 |
| 2005 | | 685.00 | 27,730.32 | 21,341.97 | 6,119.00 | 54,506.29 |
| 2006 | + | 685.00 | 29, 472.60 | 22,585.21 | | 51,372.81 |
| 2007 | <u> </u> | 685.00 | 31,214.88 | 23,828.44 | [] | 54,358.33 |
| 2008 | 1 | 685.00 | 32,957.17 | 25,071.68 | | 57, 343.84 |
| 2009 | | 685.00 | 34,699.45 | 26,314.91 | 1 | 60,329.36 |
| 2010 | | 685.00 | 36,441.73 | 27,558.15 | 6,119.00 | 69, 433, 88 |
| 2011 | | 685.00 | 36, 441.73 | 27, 558. 15 | 1 | 63, 314.88 |
| 2012 | | 685.00 | 36, 441.73 | 27,558.15 | 1 | 63,314.88 |
| 2013 | | 685.00 | 36, 441. 73 | 27, 558. 15 | 1 | 63, 314, 88 |
| 2014 | | 26,012,00 | 36,441.73 | 27, 558. 15 | 1 | 37,987.88 |
| 2015 | | 685.00 | 36, 441, 73 | 27,558.15 | 6,119.00 | 69, 433. 88 |
| 2016 | | 685.00 | 36,441.73 | 27,558.15 | | 63,314.88 |
| 2017 | | 685.00 | 36,441.73 | 27, 558. 15 | [[| 63, 314.88 |
| 2018 | | 685.00 | 36,441.73 | 27,558.15 | | 63,314.88 |
| 2019 | | 685. <u>0</u> 0 | 36,441.73 | 27,558.15 | | 63,314.88 |
| | 184,787 | | | | IRR = | 21.07 |
| | | | | | NPV = | 120, 357.58 |
| | | | | <u> </u> | B/C = | 1.80 |
| | | | | | DISCOUNT RATE | 12.00 |

A6-5

Annex A6.1 Flow of Benefit and Cost(Project-6)

| | | | | • | | (C\$1,000-) |
|------|--------------|-------------|-------------|------------|---------------|----------------------|
| YEAR | | COST | | BENEFIT | | CASH FLOW |
| | CONSTRUCTION | MAINTENANCE | TIME SAVING | VOC SAVING | MAINTENANCE | |
| | COST | COST | | | COST SAVING | |
| 1997 | 28,083.00 | | | | | -28,083.00 |
| 1998 | 82, 158.00 | | | | | -82, 158.00 |
| 1999 | 92,786.00 | | | | | -92,786.00 |
| 2000 | | 1,009.00 | 6,847.31 | 4,774.48 | 7,329.00 | 17,941.79 |
| 2001 | | 1,009.00 | 7,306.71 | 5, 104. 71 | ŀ | 11,402.42 |
| 2002 | | 1,009.00 | 7,766.12 | 5, 434. 93 | ` | 12, 192. 05 |
| 2003 | | 1,009.00 | 8, 225. 52 | 5, 765. 16 | | 12,981.68 |
| 2004 | | 1,009.00 | 8,684.93 | 6,095.38 | | 13,771.31 |
| 2005 | | 1,009.00 | 9, 144. 33 | 6,425.61 | 7.329.00 | 21.889.94 |
| 2006 | * | 1,009.00 | 9,603.73 | 6,755.83 | | 15, 3 <u>5</u> 0. 56 |
| 2007 | · | 1,009.00 | 10,063.14 | 7,086.06 | | 16, 140, 19 |
| 2008 | | 1,009.00 | 10, 522. 54 | 7,416.28 | | 16,929.82 |
| 2009 | | 1,009.00 | 10,981.95 | 7,746.51 | | 17,719.45 |
| 2010 | | 1,009.00 | 11,441.35 | 8,076.73 | 7,329.00 | 25,838.08 |
| 2011 | | 1,009.00 | 11,441,35 | 8,076.73 | | 18,509.08 |
| 2012 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2013 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2014 | | 34, 152, 00 | 11,441.35 | 8,076.73 | | -14,633.92 |
| 2015 | | 1,009.00 | 11,441.35 | 8,076.73 | 7,329.00 | 25, 838, 08 |
| 2016 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2017 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2018 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2019 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| | 203, 027 | | | | IRR = | |
| | | | | | NPV = | • |
| | | | | | B/C = | |
| | | | | | DISCOUNT RATE | |
| | | | | | | (%) |

'

Annex A6.1 Flow of Benefit and Cost(Project-7)

| | | | | • | | (C\$1,000-) |
|------|--------------|-------------|--|------------|---------------|--------------|
| YEAR | | COST | ************************************** | BENEFIT | | CASH FLOW |
| | CONSTRUCTION | MAINTENANCE | TIME SAVING | VOC SAVING | MAINTENANCE | |
| . • | COST | COST | <u></u> | | COST SAVING | |
| 1997 | 18,815,61 | | | | | -18,815.61 |
| 1998 | 55, 045, 86 | | | ! | | -55,045.86 |
| 1999 | 62, 166, 62 | | | | | -62, 166, 62 |
| 2000 | | 1,009.00 | 6,847.31 | 4,774.48 | 7,329.00 | 17,941.79 |
| 2001 |] | 1,009.00 | 7,306.71 | 5, 104, 71 | , | 11,402.42 |
| 2002 | 1 | 1,009.00 | 7,766.12 | 5,434.93 | | 12, 192, 05 |
| 2003 | | 1,009.00 | 8, 225. 52 | 5,765.16 | | 12,981.68 |
| 2004 | | 1,009.00 | 8,684.93 | 6,095.38 | | 13,771.31 |
| 2005 | | 1,009.00 | 9, 144. 33 | 6,425,61 | 7,329.00 | 21,889.94 |
| 2006 | İ | 1,009.00 | 9,603,73 | 6, 755. 83 | | 15, 350. 56 |
| 2007 | } | 1,009.00 | 10,063.14 | 7,086.06 | | 16,140.19 |
| 2008 | | 1,009.00 | 10, 522, 54 | 7,416.28 | | 16,929.82 |
| 2009 | | 1,009.00 | 10,981.95 | 7,746.51 | | 17,719.45 |
| 2010 | | 1,009.00 | 11,441.35 | 8,076.73 | 7,329.00 | 25,838.08 |
| 2011 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2012 | 1 | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2013 | | 1,009.00 | 11,441.35 | 8,076,73 | | 18,509.08 |
| 2014 | | 34, 152. 00 | 11,441.35 | 8,076.73 | | -14,633.92 |
| 2015 | | 1,009.00 | 11,441.35 | 8,076,73 | 7,329.00 | 25,838.08 |
| 2016 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2017 | } | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2018 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| 2019 | | 1,009.00 | 11,441.35 | 8,076.73 | | 18,509.08 |
| | 136,028 | | | | IRR = | |
| | | | | , | NPV = | • |
| | L | | | | B/C = | 0.77 |
| | | | | | DISCOUNT RATE | 12.00 |

(%)

A6-7

Annex A6.2 Repayment Schedule(Project-1)

(1000 cordobas)

| | | 70 . | D i | 701 |
|-------|-----------|----------|-----------|-----------|
| | | Return | Return | Tota1 |
| YEAR | Loan | for | for | |
| | | Interest | Principal | Repayment |
| 1997 | 31,900.00 | 2,552 | | 2,552 |
| 1998 | 45,102.00 | 6,160 | | 6,160 |
| 1999 | 19,030.00 | 7,683 | | 7,683 |
| 2000 | | 7,683 | 2,845 | 10,528 |
| 2001 | | 7,455 | 3,073 | 10,528 |
| 2002 | | 7,209 | 3,319 | 10,528 |
| 2003 | | 6,944 | 3,584 | 10,528 |
| 2004 | | 6,657 | 3,871 | 10,528 |
| 2005 | | 6,347 | 4,181 | 10,528 |
| 2006 | | 6,013 | 4,515 | 10,528 |
| 2007 | | 5,651 | 4,876 | 10,528 |
| 2008 | | 5,261 | 5,267 | 10,528 |
| 2009 | | 4,840 | 5,688 | 10,528 |
| 2010 | | 4,385 | 6,143 | 10,528 |
| 2011 | | 3,894 | 6,634 | 10,528 |
| 2012 | | 3,363 | 7,165 | 10,528 |
| 2013 | | 2,790 | 7,738 | 10,528 |
| 2014 | | 2,171 | 8,357 | 10,528 |
| 2015 | | 1,502 | 9,026 | 10,528 |
| 2016 | | 780 | 9,748 | 10,528 |
| 2017 | | | | |
| 2018 | | | | • |
| 2019 | | | | |
| | | | | |
| Total | 96,032 | 99,338 | 96.032 | 195,370 |
| | | | | |
| | | | 1 00 | |

Annex A6.2 Repayment Schedule(Project-2)

(1000 cordobas)

| | | | | (1000 Cordonas) |
|----------|-----------|----------|-----------|-----------------|
| | | Return | Return | Total |
| YEAR | Loan | for | for | • |
| | | Interest | Principal | Repayment |
| 1997 | 27,412.00 | 2,193 | | 2,193 |
| 1998 | 38,181.00 | 5,247 | | 5,247 |
| 1999 | 25,436.40 | 7,282 | | 7,282 |
| 2000 | | 7,282 | 2,697 | 9,980 |
| 2001 | | 7,067 | 2,913 | 9,980 |
| 2002 | | 6,834 | 3,146 | 9,980 |
| 2003 | | 6,582 | 3,398 | 9,980 |
| 2004 | | 6,310 | 3,669 | 9,980 |
| 2005 | | 6,017 | 3,963 | 9,980 |
| 2006 | · | 5,699 | 4,280 | 9,980 |
| 2007 | | 5,357 | 4,622 | 9,980 |
| 2008 | | 4,987 | 4,992 | 9,980 |
| 2009 | * | 4,588 | 5,392 | 9,980 |
| 2010 | | 4,157 | 5,823 | 9,980 |
| 2011 | • | 3,691 | 6,289 | 9,980 |
| 2012 | · | 3,188 | 6,792 | 9,980 |
| 2013 | | 2,644 | 7,335 | 9,980 |
| 2014 | | 2,057 | 7,922 | 9,980 |
| 2015 | , | 1,424 | 8,556 | 9,980 |
| 2016 | | 739 | 9,240 | 9,980 |
| 2017 | | | | |
| 2018 | | | | <u> </u> |
| 2019 | | | | |
| Total | 91,029 | 93,345 | 91,029 | 184,374 |
| <u> </u> | D . 00/ D | | 1 00 | C Dind |

Annex A6.2 Repayment Schedule(Project-3)

(1000 cordobas)

| | | | • | \ |
|-------|-----------|------------------|-----------|-----------|
| | | Return | Return | Total |
| YEAR | Loan | for | for | |
| | | Inter <u>est</u> | Principal | Repayment |
| 1997 | 19,700.00 | 1,576 | | 1,576 |
| 1998 | 53,921.00 | 5,890 | | 5.890 |
| 1999 | 47,163.00 | 9,663 | | 9,663 |
| 2000 | | 9,663 | 3,579 | 13,241 |
| 2001 | | 9,376 | 3,865 | 13,241 |
| 2002 | | 9,067 | 4,174 | 13,241 |
| 2003 | | 8,733 | 4,508 | 13,241 |
| 2004 | | 8,373 | 4.869 | 13,241 |
| 2005 | | 7,983 | 5,258 | 13,241 |
| 2006 | · | 7,562 | 5,679 | 13,241 |
| 2007 | | 7,108 | 6,133 | 13,241 |
| 2008 | | 6,617 | 6,624 | 13,241 |
| 2009 | | 6,088 | 7,154 | 13,241 |
| 2010 | | 5,515 | 7,726 | 13,241 |
| 2011 | | 4,897 | 8,344 | 13,241 |
| 2012 | | 4,230 | 9,012 | 13,241 |
| 2013 | • ! | 3,509 | 9,733 | 13,241 |
| 2014 | ' | 2,730 | 10,512 | 13,241 |
| 2015 | | 1,889 | 11,352 | 13,241 |
| 2016 | | 981 | 12,261 | 13,241 |
| 2017 | | | | ľ |
| 2018 | | | | |
| 2019 | | | | |
| Total | 120,784 | 121,450 | 120,784 | 242,234 |

Annex A6.2 Repayment Schedule(Project-4)

(1000 cordobas)

| | | Dadana | Dotum | Total |
|-------------|-----------|----------|-----------|-----------|
| ALTD | 1 | Return | Return | lotar |
| YEAR | Loan | for | for | D |
| | | Interest | Principal | Repayment |
| 1997 | 0.00 | 0 | | 0 |
| 1998 | 0.00 | 0 | | 0 |
| 1999 | 16,251.00 | 1,300 | | 1,300 |
| 2000 | | 1,300 | 482 | 1,782 |
| 2001 | · | 1,262 | 520 | 1,782 |
| 2002 | | 1,220 | 562 | 1,782 |
| 2003 | | 1,175 | 607 | 1,782 |
| 2004 | | 1,127 | 655 | 1,782 |
| 2005 | | 1,074 | 707 | 1,782 |
| 2006 | | 1,017 | 764 | 1,782 |
| 2007 | | 956 | 825 | 1,782 |
| 2008 | | 890 | 891 | 1,782 |
| 2009 | | 819 | 963 | 1,782 |
| 2010 | | 742. | 1,040 | 1,782 |
| 2011 | Ì | 659 | 1,123 | 1,782 |
| 2012 | | 569 | 1,213 | 1,782 |
| 2013 | | 472 | 1,310 | 1,782 |
| 2014 | | 367 | 1,414 | 1,782 |
| 2015 | · . | 254 | 1,527 | 1,782 |
| 2016 | 1 | 132 | 1,650 | 1,782 |
| 2017 | | | | |
| 2018 | } | | | |
| 2019 | | | | |
| 3314 | | | | |
| Total | 16,251 | 15,336 | 16,251 | 31,587 |
| | - DOY D | | | |

Annex A6.2 Repayment Schedule(Project-5)

(1000 cordobas)

| | | Return | Return | Total |
|-------|------------|----------|-----------|-----------|
| YEAR | Loan | for | for | |
| | | Interest | Principal | Repayment |
| 1997 | 44,302.00 | 3,544 | | 3,544 |
| 1998 | 111,966.00 | 12,501 | | 12,501 |
| 1999 | 105,064.00 | 20,907 | | 20,907 |
| 2000 | | 20,907 | 7,743 | 28,650 |
| 2001 | | 20,287 | 8,363 | 28,650 |
| 2002 | | 19,618 | 9,032 | 28,650 |
| 2003 | | 18,896 | 9,754 | 28,650 |
| 2004 | | 18,115 | 10,534 | 28,650 |
| 2005 | | 17,272 | 11.377 | 28,650 |
| 2006 | | 16,362 | 12,287 | 28,650 |
| 2007 | | 15,379 | 13,270 | 28,650 |
| 2008 | • | 14,318 | 14,332 | 28,650 |
| 2009 | | 13,171 | 15,479 | 28,650 |
| 2010 | | 11,933 | 16,717 | 28,650 |
| 2011 | | 10,596 | 18,054 | 28,650 |
| 2012 | | 9,151 | 19,498 | 28,650 |
| 2013 | | 7,591 | 21,058 | 28,650 |
| 2014 | • | 5,907 | 22,743 | 28,650 |
| 2015 | | 4,087 | 24,562 | 28,650 |
| 2016 | | 2,122 | 26,527 | 28,650 |
| 2017 | | | | * |
| 2018 | | | | |
| 2019 | | | | |
| Total | 261.332 | 262,665 | 261,332 | 523,997 |
| | | | | |

Annex A6.2 Repayment Schedule(Project-6)

(1000 cordobas)

| | | Return | Return | Total |
|-------|------------|----------|-----------|-----------|
| YEAR | Loan | for | for | |
| ·. | | Interest | Principal | Repayment |
| 1997 | 39,361.00 | 3,149 | | 3,149 |
| 1998 | 115,314.00 | 12,374 | | 12,374 |
| 1999 | 132,183.00 | 22,949 | | 22,949 |
| 2000 | | 22,949 | 8,499 | 31,448 |
| 2001 | | 22,269 | 9,179 | 31,448 |
| 2002 | | 21,534 | 9,914 | 31,448 |
| 2003 | | 20,741 | 10,707 | 31,448 |
| 2004 | | 19,885 | 11,563 | 31,448 |
| 2005 | | 18,960 | 12,488 | 31,448 |
| 2006 | | 17,961 | 13,488 | 31,448 |
| 2007 | | 16,882 | 14,567 | 31,448 |
| 2008 | | 15,716 | 15,732 | 31,448 |
| 2009 | | 14,458 | 16,990 | 31,448 |
| 2010 | | 13,098 | 18,350 | 31,448 |
| 2011 | | 11,630 | 19,818 | 31,448 |
| 2012 | | 10,045 | 21,403 | 31,448 |
| 2013 | ٠ | 8,333 | 23,115 | 31,448 |
| 2014 | | 6,484 | 24,964 | 31,448 |
| 2015 | | 4,486 | 26,962 | 31,448 |
| 2016 | | 2,329 | 29,119 | 31,448 |
| 2017 | | | | |
| 2018 | | | | |
| 2019 | | <u> </u> | | |
| Total | 286,858 | 286,231 | 286,858 | 573,089 |

Annex A6.2 Repayment Schedule(Project-7)

(1000 cordobas)

| | | Return | Return | Total |
|-------|-----------|----------|-----------|-----------|
| YEAR | Loan | for | for | |
| | | Interest | Principal | Repayment |
| 1997 | 26,371.87 | 2,110 | | 2,110 |
| 1998 | 77,260.38 | 8,291 | | 8,291 |
| 1999 | 88,562.61 | 15,376 | | 15,376 |
| 2000 | | 15,376 | 5,695 | 21,070 |
| 2001 | · | 14,920 | 6,150 | 21,070 |
| 2002 | | 14,428 | 6,642 | 21,070 |
| 2003 | | 13,897 | 7,174 | 21,070 |
| 2004 | | 13,323 | 7.747 | 21,070 |
| 2005 | | 12.703 | 8,367 | 21,070 |
| 2006 | | 12,034 | 9,037 | 21,070 |
| 2007 | | 11,311 | 9,760 | 21,070 |
| 2008 | | 10.530 | 10,540 | 21,070 |
| 2009 | | 9.687 | 11,384 | 21.070 |
| 2010 | | 8,776 | 12,294 | 21,070 |
| 2011 | | 7,792 | 13,278 | 21,070 |
| 2012 | | 6,730 | 14,340 | 21,070 |
| 2013 | | 5,583 | 15,487 | 21,070 |
| 2014 | | 4,344 | 16,726 | 21,070 |
| 2015 | | 3,006 | 18,064 | 21,070 |
| 2016 | | 1,561 | 19,509 | 21,070 |
| 2017 | | | | |
| 2018 | | | | ' |
| 2019 | | | | |
| Total | 192,195 | 191,775 | 192,195 | 383,970 |

Annex A6.3 Relation between Running Speed and Consumption of Fuel

| | | | | | • | (litros/km) |
|--|---|--|--|--|--|---|
| Velocidad (Km/hr) | Vehículos de pasajeros | Micro bus | Bus | Pick-up | Camión mediano | Camión pesado |
| 50505050505050505050505050505050505050 | 0.451 0.393 0.340 0.302 0.277 0.255 0.236 0.219 0.207 0.198 0.190 0.186 0.182 0.177 0.175 | 0.483 0.433 0.400 0.355 0.329 0.307 0.286 0.254 0.254 0.238 0.238 0.231 0.251 0.262 | 0.527 0.503 0.463 0.428 0.377 0.3751 0.329 0.281 0.285 0.285 0.318 | 0.408 0.374 0.335 0.307 0.252 0.291 0.243 0.225 0.208 0.202 0.203 0.205 0.205 0.216 | 0.463 0.433 0.400 0.356 0.329 0.286 0.268 0.254 0.234 0.234 0.236 0.238 | 0.519 0.492 0.483 0.404 0.376 0.352 0.326 0.293 0.293 0.280 0.273 0.268 0.276 0.280 0.298 |

Annex A6.4 VOC Saving by Fuel consumption saving in 2000 and 2010 by Project Section

| ess-1-1 (k =8 -Co) | | Fue) Cone (witou | -i :: | | | raî lau iw) | th) | | |
|---|--|--|--|---|---|--|--|---|---|
| | ken | 2000 | 2010 | 2000 | | 2000 | 1 1 | 2000 | 2010 |
| assencer car vicao bus | 13.6 | 0.2132 0.2013 | 0, 2350 0, 2540 | 6, 539 388 | 10, 297 518 | 0. 1805 0. 2385 0. 2845 | 0. 1987 0. 2430 | 1,627,152 83,368 | 3, 194, 837 160, 559 |
| ICK-UP | 13.0 | 0.3213 | 0.3497 | 918 4, 273 | 1, 472 5, 604 | 0, 2845 | 0. 2977 0. 2070 | 511, 182 | 581, 320 1, 493, 304 |
| NUCK RAILER | 13.6 | 0.2813 | 0. 2840 0. 3249 | 1, 792 833 | 2 578 | 0. 2385 0. 2715 | 0. 2430 0. 2789 | 310, 263 185, 503 | 801, 241 372, 689 |
| KARLEN | 13.6 13.6 13.6 13.6 13.8 | 0. JVVO | V. 02.40 | | | | lotel | 2, 884, 597 | 8, 664, 030 |
| | , | | | | | | | | |
| Dage-1-2 (Coyote | c a Waxaya | įi | | | | i Sanyasan | | | |
| | | (wito | ⊾/kan ut} | | 5010 | Fuel Con (sri | th) | 2000 | |
| | km | 2000 | 2010 | | | | | | |
| Passenger Car Vitoro Bus | 20 | 0.2132 | 0. 2350 0. 2840 | 7, 273 451 | 11,598 598 | 0, 1805 | 0, 1987 0, 2430 0, 2977 0, 2070 0, 2430 0, 2789 | 505, 679 21, 818 | 942, 165 51, 818 |
| BUS PICK-UP TRUCK | 3.8 | 0.3213 | 0.3497 0.2421 | 1,001 4,908 | 1, 520 6, 148 | 0. 2945 | 0, 2977 | 57, 013 : 164, 056 | 187, 724 457, 750 |
| TRAILER | 3.6 | 0.2813 | 0.2840: | 2, 165 | 3,013 | 0. 2385 | 0.2430 | (04, 738 54, 943 | 261, 95 108, 37 |
| (Witch | ; | 0.3000 | | | | | Total | 909, 245 | 1,987,610 |
| , .,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | ¿ | · | | | | ļ | | |
| | | i | | | | <u>.</u> | ļ | | |
| Casa 2(Ticitace | -Meneyum) | Fuel Com | a./km | | | Fuel Con | na. /km | | |
| | kra | (wito | ut) 2010 | 2000 | 2010 | (wi 2000 | th) 2010 | 2000 | 2010 |
| PASSENGER CAR | | 1 | 0. 2272 | | | | | 83,051 | 161, 118 |
| KIORO BUS BUS | 4.3 | 0. 2538 0. 3124 | 0. 2762 0. 3396 | 219 #RI | 3, 104 270 657 | Ø. 2418 Ø. 2958 | 0. 2524 0. 3108 | 8, 315 18, 434 | 15, 418 45, 470 |
| PICK-UP THIXK | 4.3 | 0.2157 | 0.2352 | 2, 425 1, 649 | 2,844 3,221 | 0.2058 | 0.2147 | 58, 741 47,552 | 139, 968 127, 155 |
| TRAILER | 4.3 | 0. 2925 | 0.2762 0.3168 | 379 | 429 | 0.2772 | 0.2909 | 13, 917 | 20, 51 |
| | | | | | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | Total | 208,009 | 515,64 |
| | | | | ******************************* | | | | | |
| Cene-3-1 (Meanya | Catarina | i) Fuel Con | s./ka | | | Fuel Con | ės./kom | | |
| | len | #119 | л) 2010 | 2000 | 2010 | (w) 2000 | th) 2010 | 2000 | 2010 |
| DIEGGESTS A.S. | | | | | 3, 104 | | 0. 1924 | 116,089 | 290, 57 |
| Passenger Car Vitoro Bus | 8.6 8.6 | 0, 2011 0, 2474 | 0.2123 0.2802 | 76 : | 270 | 0.234 | 0. 2390 | 4.895: | 26, 42 |
| BLS Pick-up | 8.6 8.6 | 0,2474 0,3038 0,2107 | 0.3200 0.2213 | 305 1, 044 | 657 2,844 | 0.202 | 0. 2934 0. 2038 | 27, 500 43, 754 | 84, 120 238, 920 |
| TRUCK TRAILER | 8.6 8.6 | 0,2474 | 0.2602 0.2998 | 852 412 | 2,227 429 | | 0. 2398 · 0. 2751 | 54, 871 38, 454 | 217, 91 50, 51 |
| : ··· · · · · · · · · · · · · · · · · · | | | | | | | Total | 285, 582 : | 914, 475 |
| | | | | | | | ļ | | *************************************** |
| Cese-3-2 (Ceteri | ne Olemec | aste) | | 2000 | | Fiel C- | e. // | •••••• | |
| | ; <u>;</u> | (wito | u) | 2000 | 2010 | (wi | th) | 2000 | 2010 |
| | | | | | | | | , | |
| Passenger Car Micro Bus | 9.3 | 0.2474 | 0. 2123 0. 2602 | 987 29 | 1, 941 74 | 0. 185 0. 234 0. 285 0. 202 0. 234 0. 285 | 0. 1924 0. 2398 | 81, 967 2, 020 | 200, 551 7, 831 |
| BUS Prox-up | 9.3 | 0.3039 | 0.3200 | 126 - 6(8 : | 251 1,089 | 0.285 0.202 | 0.2934 - | 12, 285 28,008 | 34, 75. 99, 84 |
| BUS Pick-UP Truck Trailer | 9.3 9.3 | 0. 2474 0. 2844 | 0.2602 0.2996 | Cea | 804 347 | 0.234 | 0. 2398 0. 2751 | 35, 937 25, 638 | 93, 54 44, 18 |
| | | ************ | | | | | Total | 185, 753 | 480, 708 |
| | i i | *** | | | | İ | <u> </u> | ··· · · · · · · · · · · · · · · · · · | |
| Cone 3-1(Quanac | aste Mand | hime) | | | | E-1 A- | | | ······································ |
| | | (wito | r) | | Ania. | (vi | łh) | 2000 | |
| | , | 2000 | ZUIU | 2000 | 2010 | 2000 | 2010 | 2000 | ZVIV |
| | | 0. 2011 0. 2474 | 0. 2123 0. 2602 | 1, 010 28 | 1, 707 38 | 0.185 | 0.1924 | 84, 304 1, 811 | 178, 373 4, 021 |
| Passenger Car Nioro Bus | 9. 3 9. 3 | 0.2024 | 0.3200 | 128 632 | 202 861 | 0.285 | 0.2934 | 12, 265 28, 643 | 27, 966 78, 72 |
| Passenger Car Nioro Bus Bus Pior-IP | 9.3 9.3 9.3 9.3 | 0.7107 | | | 790 | 0.234 | 0.2398 | 38, 424 | 83,590 |
| PASSENGER CAR NICRO BUS 9US PICK-UP IRUCK TRAILES | 9.3 9.3 9.3 9.3 9.3 | 0.2107 | 0.2602 | 260 | 244 | 0.765 | | | 32,341 |
| Passenger Car Vicoro Bus Pus Picor-Lip Truck Traditer | 9.3 9.3 9.3 9.3 9.3 | 0. 2107 0. 2474 0. 2844 | 0. 2802 0. 2996 | 573 250 | 309 | 0.265 | fotal | 188, 700 | 409, 52 |
| Passenger Car Higro Bus Bus Piok-up Higgs Trailer | 9.3 9.3 9.3 9.3 9.3 | 0. 2107 0. 2474 0. 2844 | 0. 2602 0. 2996 | 573 250 | 309 | 0.285 | 0.2751 Total | 188, 700 | 409, 521 |
| Passenger Car Higro Bus Bus Piok-up Higgs Trailer | 9.3 9.3 9.3 9.3 9.3 | 0. 2107 0. 2474 0. 2844 | 0. 2802 0. 2996 | 523 250 | 309 | 0.265 | 0. 2751 Total | 188, 700 | 409, 527 |
| Passenger Car Higro Bus Bus Piok-up Higgs Trailer | 9.3 9.3 9.3 9.3 9.3 | 0. 2107 0. 2474 0. 2844 0. 2844 ps) Fuel Core (witos | 0. 2802 0. 2996 L/len t) | 250 | 309 | 0.285 | fotal fotal ss/ks th) | 188, 700 | 409, 521 |
| PASSEMBER CAR MICRO BUS BUS BUS BUS TRAILER TRAILER Case 3-4 (Coyoto | 9.3 9.3 9.3 9.3 9.3 9.3 | os) Fuel Cont (wito | rt) | | | Fuel Con | &∟/kos th) | | |
| PASSEMBER CAR MICRO BUS BUS BUS HICK-UP HICK TRAILER Case 3-4 (Coyoto | 9.3 9.3 9.3 9.3 9.3 9.3 | os) Fuel Cont (wito | rt) | | | Fuel Con | &∟/kos th) | | |
| PASSEMBER CAR MICRO BUS BUS BUS HICK-UP HICK TRAILER Case 3-4 (Coyoto | 9.3 9.3 9.3 9.3 9.3 9.3 | os) Fuel Cont (wito | rt) | | | Fuel Con | &∟/kos th) | | |
| PASSEMBER CAR MICRO BUS BUS BUS HICK-UP HICK TRAILER Case 3-4 (Coyoto | 9.3 9.3 9.3 9.3 9.3 9.3 | os) Fuel Cont (wito | rt) | | | Fuel Con | &∟/kos th) | | |
| PASSEMBER CAR MICRO BUS SUS SUS FIDIT-UP RICICK TRAILER Casser 3-4 (Coyoto | 9.3 9.3 9.3 9.3 9.3 9.3 | os) Fuel Cont (wito | rt) | | | Fuel Con | &∟/kos th) | | |
| PASSEMBER CAR MITONO BUS BUS PROCK TRAILER CASSEMBER CAR MITONO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 | 0-5) Fuel Core (witex 2000 0. 2011 0. 2474 0. 3038 0. 2107 0. 2474 0. 2844 | 0. 2123 0. 2602 0. 3200 0. 3200 0. 3200 0. 2602 0. 2602 0. 2802 | 2000 509 80 48 544 373 23 | 2010 734 85 83 635 438 50 | Fuel Con (eri 2000 0, 185 0, 234 0, 285 0, 202 0, 234 0, 265 | 6. /los th) 2010 0. 1924 0. 2398 0. 2398 0. 2398 0. 2398 0. 2751 Total | 2000 119,703 13,120 11,421 58,058 61,173 5,467 288,541 | 2010 178, 586 21, 181 27, 085 135, 85 109, 149 486, 817 |
| PASSEMBER CAR MITONO BUS BUS PROCK - LP TRUCK TRAILER CASSEMBER CAR MITONO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 | 0-5) Fuel Core (witex 2000 0. 2011 0. 2474 0. 3038 0. 2107 0. 2474 0. 2844 | 0. 2123 0. 2602 0. 3200 0. 3200 0. 3200 0. 2602 0. 2602 0. 2802 | 2000 509 80 48 544 373 23 | 2010 734 85 83 635 438 50 | Fuel Con (eri 2000 0, 185 0, 234 0, 285 0, 202 0, 234 0, 265 | 6. /los th) 2010 0. 1924 0. 2398 0. 2398 0. 2398 0. 2398 0. 2751 Total | 2000 119,703 13,120 11,421 58,058 61,173 5,467 288,541 | 2010 178, 586 21, 181 27, 082 135, 856 109, 145 14, 145 496, 817 |
| PASSEMBER CAR MITONO BUS BUS PROCK - LP TRUCK TRAILER CASSEMBER CAR MITONO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 | 0-5) Fuel Core (witex 2000 0. 2011 0. 2474 0. 3038 0. 2107 0. 2474 0. 2844 | 0. 2123 0. 2602 0. 3200 0. 3200 0. 3200 0. 2602 0. 2602 0. 2802 | 2000 509 80 48 544 373 23 | 2010 734 85 83 635 438 50 | Fuel Con (eri 2000 0, 185 0, 234 0, 285 0, 202 0, 234 0, 265 | 6. /los th) 2010 0. 1924 0. 2398 0. 2398 0. 2398 0. 2398 0. 2751 Total | 2000 119,703 13,120 11,421 58,058 61,173 5,467 288,541 | 2010 178, 586 21, 181 27, 082 135, 856 109, 145 14, 145 496, 817 |
| PASSEMBER CAR MITONO BUS BUS PROCK LP TRACK TRACKER TRACER PASSEMBER CAR MITONO BUS BUS PROCK-UP TRACER | 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 | 0.2011 0.2011 0.2014 0.3038 0.2074 0.3038 0.2107 0.2474 0.2844 | . /km n) 2010 0. 2123 0. 2602 0. 3203 6. 2213 0. 2607 0. 2996 | 2000 503 50 50 54 54 573 22 | 2010 734 85 81 635 430 50 | Fuel Con (eri 2000) 0, 185 0, 234 0, 285 0, 202 0, 234 0, 265 | es./km th) | 2006 119,703 13,120 11,021 58,058 61,173 5,467 288,541 | 2010 178, 566 21, 181 27, 085 135, 656 109, 144 14, 999 496, 813 |
| PASSEMBER CAR MITONO BUS BUS PROCK LP TRACK TRACKER TRACER PASSEMBER CAR MITONO BUS BUS PROCK-UP TRACER | 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 | 0.2011 0.2011 0.2014 0.3038 0.2074 0.3038 0.2107 0.2474 0.2844 | . /km n) 2010 0. 2123 0. 2602 0. 3203 6. 2213 0. 2607 0. 2996 | 2000 503 50 50 54 54 573 22 | 2010 734 85 81 635 430 50 | Fuel Con (eri 2000) 0, 185 0, 234 0, 285 0, 202 0, 234 0, 265 | es./km th) | 2006 119,703 13,120 11,021 58,058 61,173 5,467 288,541 | 2010 178, 566 21, 181 27, 085 135, 656 109, 144 14, 999 496, 813 |
| PASSEMBER CAR MITONO BUS BUS PROCK LP TRACK TRACKER TRACER PASSEMBER CAR MITONO BUS BUS PROCK-UP TRACER | 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 | 0.2011 0.2011 0.2014 0.3038 0.2074 0.3038 0.2107 0.2474 0.2844 | . /km n) 2010 0. 2123 0. 2602 0. 3203 6. 2213 0. 2607 0. 2996 | 2000 503 50 50 54 54 573 22 | 2010 734 85 81 635 430 50 | Fuel Con (eri 2000) 0, 185 0, 234 0, 285 0, 202 0, 234 0, 265 | es./km th) | 2006 119,703 13,120 11,021 58,058 61,173 5,467 288,541 | 2010 178, 566 21, 181 27, 085 135, 656 109, 144 14, 999 496, 813 |
| PASSEMBER CAR MITONO BUS BUS PROCK LP TRACK TRACKER TRACER PASSEMBER CAR MITONO BUS BUS PROCK-UP TRACER | 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 9, 3 | 0.2011 0.2011 0.2014 0.3038 0.2074 0.3038 0.2107 0.2474 0.2844 | . /km n) 2010 0. 2123 0. 2602 0. 3203 6. 2213 0. 2607 0. 2996 | 2000 503 50 50 54 54 573 22 | 2010 734 85 81 635 430 50 | Fuel Con (eri 2000) 0, 185 0, 234 0, 285 0, 202 0, 234 0, 265 | es./km th) | 2006 119,703 13,120 11,021 58,058 61,173 5,467 288,541 | 2010 178, 566 21, 181 27, 085 135, 656 109, 144 14, 999 496, 813 |
| PASSEMBER CAR MITORO BUS BUS PROT-UP RECEN TRAILER CASSE-3-4(Copote MITORO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 16,0 16,0 16,0 16,0 | (witco 0. 2011 0. 2014 0. 2038 0. 2107 0. 2474 0. 3038 0. 2107 0. 2474 0. 7844 0. 7844 0. 2474 0. 3038 0. 2107 0. 2474 0. 3038 0. 2107 0. 2474 0. 3038 | 2010 2010 0.2123 0.2602 0.3203 0.2602 0.3203 0.2607 0.2999 2010 2010 0.2123 0.2602 0.3200 0.2123 0.2606 | 2000 603 60 60 54 54 873 221 2000 1,095 949 1,943 1,578 1,578 373 | 2010 734 85 61 61 635 430 50 2010 1,851 360 2,551 7,239 | Fuel Con 2000 (97 2000) 185 (97 202) 202 (97 205) 203 (97 205) 203 (97 200) 203 (| 6. /lca 110 2010 0. 1924 0. 2396 0. 2398 0. 2398 0. 2398 10. 2151 Total 0. 1924 0. 2398 0. 2398 0. 2398 0. 2398 0. 2398 0. 2398 | 2000 119,703 13,120 14,021 58,058 61,173 5,467 268,541 2000 167,245 11,503 151,498 11,503 151,498 | 2010 178, 5% 21, 1813 22, 2013 133, 855 109, 14 14, 993 496, 812 2010 329, 035 25, 177 398, 722 495, 793 88, 690 |
| PASSEMBER CAR MITORO BUS BUS PROT-UP RECEN TRAILER CASSE-3-4(Copote MITORO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 16,0 16,0 16,0 16,0 | (witco 0. 2011 0. 2014 0. 2038 0. 2107 0. 2474 0. 3038 0. 2107 0. 2474 0. 7844 0. 7844 0. 2474 0. 3038 0. 2107 0. 2474 0. 3038 0. 2107 0. 2474 0. 3038 | 2010 2010 0.2123 0.2602 0.3203 0.2602 0.3203 0.2607 0.2999 2010 2010 0.2123 0.2602 0.3200 0.2123 0.2606 | 2000 603 60 60 54 54 873 221 2000 1,095 949 1,943 1,578 1,578 373 | 2010 734 85 61 61 635 430 50 2010 1,851 360 2,551 7,239 | Fuel Con 2000 (97 2000) 185 (97 202) 202 (97 205) 203 (97 205) 203 (97 200) 203 (| 6. /lca 110 2010 0. 1924 0. 2396 0. 2398 0. 2398 0. 2398 10. 2151 Total 0. 1924 0. 2398 0. 2398 0. 2398 0. 2398 0. 2398 0. 2398 | 2000 119,703 13,120 14,021 58,058 61,173 5,467 268,541 2000 167,245 11,503 151,498 11,503 151,498 | 2010 178, 5% 21, 1813 22, 2013 133, 855 109, 14 14, 993 496, 812 2010 329, 035 25, 177 398, 722 495, 793 88, 690 |
| PASSEMBER CAR MICHO BUS BUS PRICE-UP TRACER TRACER CASCC-3-4(Copolo TRACER PASSEMBER CAR MICHO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 21,9 21,9 21,9 | (mito) 2000 (mito) 2000 (mito) 0. 2011 (0. 2474 (0. 2474 (0. 2474 (0. 2604 (mito) 2000 (mito) 0. 2011 (0. 3038 (0. 2107 (0. 2344 (0. 2344 (mito) (mit | 2010 0. 2123 0. 2602 0. 3200 0. 3200 0. 2213 0. 2602 0. 2299 0. 2010 2. 2010 2. 2010 0. 2020 0. 2223 0. 3200 0. 2223 0. 3200 0. 2223 0. 3200 0. 2223 0. 3200 | 2000 503 00 48 544 573 22 2000 1,095 99 349 1,543 1,523 | 2010 734 85 83 83 83 430 50 2010 1,851 562 2,551 7,229 | Fuel Con (700) 0, 185 (0, 234 (0, 285 | 6. /los 11) 2010 0. (924 0. 2336 0. 2336 0. 2338 0. 2358 10. 2751 Total 2010 0. 1824 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 1. 2388 0. 2388 1. 23 | 2006 119, 763 13, 120 14, 021 58, 058 61, 173 5, 467 263, 541 2000 167, 248 11, 503 58, 543 151, 498 167, 248 17, 608 617, 721 | 2010 178, 596 21, 191 27, 096 135, 656 109, 144 14, 693 496, 817 2010 320, 035 35, 173 390, 722 495, 723 496, 723 496, 723 896, 702 896, 600 |
| PASSEMBER CAR MICHO BUS BUS PRICE-UP TRACER TRACER CASCC-3-4(Copolo TRACER PASSEMBER CAR MICHO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 21,9 21,9 21,9 | (mito) 2000 (mito) 2000 (mito) 0. 2011 (0. 2474 (0. 2474 (0. 2474 (0. 2604 (mito) 2000 (mito) 0. 2011 (0. 3038 (0. 2107 (0. 2344 (0. 2344 (mito) (mit | 2010 0. 2123 0. 2602 0. 3200 0. 3200 0. 2213 0. 2602 0. 2299 0. 2010 2. 2010 2. 2010 0. 2020 0. 2223 0. 3200 0. 2223 0. 3200 0. 2223 0. 3200 0. 2223 0. 3200 | 2000 503 00 48 544 573 22 2000 1,095 99 349 1,543 1,523 | 2010 734 85 83 83 83 430 50 2010 1,851 562 2,551 7,229 | Fuel Con (700) 0, 185 (0, 234 (0, 285 | 6. /los 11) 2010 0. (924 0. 2336 0. 2336 0. 2338 0. 2358 10. 2751 Total 2010 0. 1824 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 1. 2388 0. 2388 1. 23 | 2006 119, 763 13, 120 14, 021 58, 058 61, 173 5, 467 263, 541 2000 167, 248 11, 503 58, 543 151, 498 167, 248 17, 608 617, 721 | 2010 178, 596 21, 191 27, 096 135, 656 109, 144 14, 693 496, 817 2010 320, 035 35, 173 390, 722 495, 723 496, 723 496, 723 896, 702 896, 600 |
| PASSEMBER CAR MITORO BUS BUS PRIORI-UP TRACK TRACER COMMON 3-4 (Copyoto TRACER PASSEMBER CAR MITORO BUS BUS BUS PRACLER TRACER PASSEMBER CAR MITORO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 21,9 21,9 21,9 | (mito) 2000 (mito) 2000 (mito) 0. 2011 (0. 2474 (0. 2474 (0. 2474 (0. 2604 (mito) 2000 (mito) 0. 2011 (0. 3038 (0. 2107 (0. 2344 (0. 2344 (mito) (mit | 2010 0. 2123 0. 2602 0. 3200 0. 3200 0. 2213 0. 2602 0. 2299 0. 2010 2. 2010 2. 2010 0. 2020 0. 2223 0. 3200 0. 2223 0. 3200 0. 2223 0. 3200 0. 2223 0. 3200 | 2000 503 00 48 544 573 22 2000 1,095 99 349 1,543 1,523 | 2010 734 85 83 83 83 430 50 2010 1,851 562 2,551 7,229 | Fuel Con (700) 0, 185 (0, 234 (0, 285 | 6. /los 11) 2010 0. (924 0. 2336 0. 2336 0. 2338 0. 2358 10. 2751 Total 2010 0. 1824 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 1. 2388 0. 2388 1. 23 | 2006 119, 763 13, 120 14, 021 58, 058 61, 173 5, 467 263, 541 2000 167, 248 11, 503 58, 543 151, 498 167, 248 17, 608 617, 721 | 2010 178, 586 21, 181 21, 082 135, 654 135, 654 14, 695 466, 817 2010 320, 033 320, |
| PASSEMBER CAR MITORO BUS BUS PRIORI-UP TRACK TRACER COMMON 3-4 (Copyoto TRACER PASSEMBER CAR MITORO BUS BUS BUS PRACLER TRACER PASSEMBER CAR MITORO BUS BUS BUS BUS BUS BUS BUS BUS BUS BUS | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 21,9 21,9 21,9 | (mito) 2000 (mito) 2000 (mito) 0. 2017 (0. 2474 (0. 2474 (0. 2474 (0. 2600 (mito) 2000 (mito) 0. 2011 (0. 3038 (0. 2107 (0. 2344 (0. 2344 (mito) (mit | 2010 0. 2123 0. 2602 0. 3200 0. 3200 0. 2213 0. 2602 0. 2299 0. 2010 2. 2010 2. 2010 0. 2020 0. 2223 0. 2000 0. 2213 0. 2000 0. 2213 0. 2000 | 2000 503 00 48 544 573 22 2000 1,095 99 349 1,543 1,523 | 2010 734 85 83 83 83 430 50 2010 1,851 562 2,551 7,229 | Fuel Con (700) 0, 185 (0, 234 (0, 285 | 6. /los 11) 2010 0. (924 0. 2336 0. 2336 0. 2338 0. 2358 10. 2751 Total 2010 0. 1824 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 1. 2388 0. 2388 1. 23 | 2006 119, 763 13, 120 14, 021 58, 058 61, 173 5, 467 263, 541 2000 167, 248 11, 503 58, 543 151, 498 167, 248 17, 608 617, 721 | 2010 178, 586 21, 181 21, 082 135, 654 135, 654 14, 695 466, 817 2010 320, 033 320, |
| PASSEMBER CAR MICHO BUS BUS PROT-UP INCUR ITRALIER CAMES 3-4 (Copote ITRALIER PASSEMBER CAR MICHO BUS BUS BUS PROT-UP ITRUCK TRALIER PASSEMBER CAR MICHO BUS BUS BUS PROT-UP ITRUCK PROTO BUS BUS PROT-UP ITRUCK | 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 9,3 21,9 21,9 21,9 21,9 21,9 21,9 21,9 21,9 | (mito) 2000 (mito) 2000 (mito) 0. 2017 (0. 2474 (0. 2474 (0. 2474 (0. 2600 (mito) 2000 (mito) 0. 2011 (0. 3038 (0. 2107 (0. 2344 (0. 2344 (mito) (mit | 2010 0. 2123 0. 2602 0. 3200 0. 3200 0. 2213 0. 2602 0. 2299 0. 2010 2. 2010 2. 2010 0. 2020 0. 2223 0. 2000 0. 2213 0. 2000 0. 2213 0. 2000 | 2000 503 00 48 544 573 22 2000 1,095 99 349 1,543 1,523 | 2010 734 85 83 83 83 430 50 2010 1,851 562 2,551 7,229 | Fuel Con (700) 0, 185 (0, 234 (0, 285 | 6. /los 11) 2010 0. (924 0. 2336 0. 2336 0. 2338 0. 2358 10. 2751 Total 2010 0. 1824 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 0. 2388 1. 2388 0. 2388 1. 23 | 2006 119, 763 13, 120 14, 021 58, 058 61, 173 5, 467 263, 541 2000 167, 248 11, 503 58, 543 151, 498 167, 248 17, 608 617, 721 | 2010 178, 596 21, 191 27, 096 135, 656 109, 144 14, 693 496, 817 2010 320, 035 35, 173 390, 722 495, 723 496, 723 496, 723 896, 702 896, 600 |

Annex A6.5 VOC Saving by Fixed Cost Saving in 2000 and 2010

| | PASSENGER | MICRO | BUS | PICK-UP | TRUCK | TRAILER | TOTAL |
|---------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | CAR | BUS | | | | | FIXED COST |
| * * * * * * * * * * * * * * * * * * * | TOYOTA | TOYOTA | ATOYOTA | TOYOTA | TOYOTA | GM | SAVING |
| | EL40L-AEMDS | BB42L-BRMRS | BLUE BIRD | YN85L-PRMRS | DA116L-H3 | CC7H042 | <u> </u> |
| FIXED COST / HOUR | 0.00 | 13.41 | 21.87 | 10.30 | 17.84 | 18.16 | |
| TIME SAVING IN 200 | 00 | | | | | | |
| | | | | 1.00 | | | 1 |
| PROJECT-1 | 1.226,400 | 53, 290 | 95,630 | 536.185 | 188,340 | 55,480 | } |
| PROJECT-2 | 1,349,770 | 57,670 | 104, 390 | 588,015 | 203,670 | 58, 400 | |
| PROJECT-3 | 548,960 | 36, 135 | 82,855 | 408,800 | 207,320 | 72,270 | |
| PROJECT-4 | 36,865 | 4,745 | 7,665 | 44, 165 | 33,945 | 6,935 | ļ. |
| PROJECT-5 | 512, 460 | 32,485 | 89,060 | 453, 330 | 275,940 | 88, 330 | |
| PROJECT-6 | 88,695 | 730 | 51,465 | 152, 935 | 81,395 | 13,505 | ļ |
| PROJECT-7 | 88,695 | 730 | 51,465 | 152,935 | 81,395 | 13,505 | |
| TIME SAVING IN 201 | | | | | | | |
| | 1 | | | | | | |
| PROJECT-1 | 1,757,110 | 77,745 | 123,005 | 676, 345 | 303, 315 | 86,140 | 1 |
| PROJECT-2 | 1,972,095 | 84, 315 | 136,875 | 743,870 | 325,945 | 89,790 | l |
| PROJECT-3 | 1, 366, 195 | 80,665 | 189,070 | 751,900 | 418, 290 | 129,210 | |
| PROJECT-4 | 41,975 | 5,475 | 10, 585 | 45, 260 | 33,945 | 5,110 | |
| PROJECT-5 | 1,089,890 | 62,050 | 178, 485 | 740,950 | 506,620 | 136,510 |) |
| PROJECT-6 | 156, 585 | 17. 155 | 81,760 | 220, 825 | 133,955 | 16,425 | |
| PROJECT-7 | 156, 585 | 17, 155 | 81,760 | 220,825 | 133, 955 | 16, 425 | 1 |
| FIXED COST SAVING | | <u> </u> | | | | | |
| 11142 0001 2111111 | T | | ···· | | | | |
| PROJECT-1 | 0 | 714,619 | 2,091,428 | 5, 522, 706 | 3,359,986 | 1,007,517 | 12,696,25 |
| PROJECT-2 | 0 | 773, 355 | 2, 283, 009 | 6,056,555 | 3,633,473 | 1,060,544 | 13,806,93 |
| PROJECT-3 | Ŏ | 484,570 | 1,812,039 | 4,210,640 | 3,698,589 | 1, 312, 423 | 11,518,26 |
| PROJECT-4 | ŏ | 63, 630 | 167,634 | 454,900 | 605, 579 | 125,940 | 1,417,68 |
| PROJECT-5 | 1 0 | 435, 624 | 1,947,742 | 4,669,299 | 4,922,770 | 1,604,073 | 13,579,50 |
| PROJECT-6 | Ŏ | 9,789 | 1, 125, 540 | 1,575,231 | 1,452,087 | 245, 251 | 4, 407, 89 |
| PROJECT-7 | ľ | 9, 789 | 1, 125, 540 | 1, 575, 231 | 1,452,087 | 245, 251 | 4, 407, 89 |
| FIXED COST SAVING | | 0, 100 | 1,120,010 | 1,070,001 | 1, 100, 00. | | |
| TIME COOL DIVING | 1. 2010 | | | | | | |
| PROJECT-1 | 0 | 1,042,560 | 2,690,119 | 6,966,354 | 5,411,140 | 1,564,302 | 17,674,47 |
| PROJECT-2 | Ů | 1,130,664 | 2,993,456 | 7,661,861 | 5,814,859 | 1,630,586 | 19, 231, 42 |
| PROJECT-3 | | 1, 130, 004 | 4, 134, 961 | 7,744,570 | 7, 462, 294 | 2.346.454 | 22,769,99 |
| PROJECT-4 | 0 | 73, 420 | 231, 494 | 466, 178 | 605, 579 | 92, 798 | 1,469,46 |
| PROJECT-5 | 0 | 832,091 | 3, 903, 467 | 7,631,785 | 9,038,101 | 2, 479, 022 | 23, 884, 46 |
| PROJECT-6 | | 230, 049 | 1, 788, 091 | 2, 274, 498 | 2, 389, 757 | 298, 278 | 6,980,67 |
| PROJECT-7 | 0 | 230, 049 | 1, 788, 091 | 2,274,498 | 2, 389, 757 | 298, 278 | 6,980,67 |
| I MODEOT I | <u> </u> | 400,043 | 1,100,031 | 4,614,430 | 2,000,101 | 200,610 | 0,000,01 |

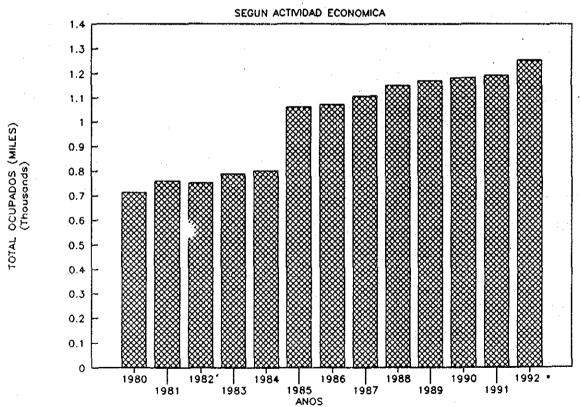
Annex A6.6 Population Relating to Economic Activity

(MILES)

| | | | | | · | | | 4.0 | | | | | |
|--|-------|-------|-------|-------|-------|---------|---------|---------|---------|---------|---------|---------|---------|
| ACTIVIDAD ECONOMICA | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 19901 | 1991 | 1992 * |
| Agricultura, Sulvicultura, Casa y pesca | 275.5 | 295.5 | 281.4 | 301.6 | 304.1 | 375.5 | 373.0 | 382.6 | 385.1 | 387.5 | 400.1 | 415.41 | 453.6 |
| Industria Manufacturera | 97.0 | 99.7 | 85.8 | 89.7 | 89.9 | 162.5 | 166.0 | 169.8 | 178.0 | 188.7 | 188.7 | 188.2 | 192.0 |
| Explotacion de Minas y Canteras | 5.2 | 4.9 | 3.5 | 3.9 | 3.0 | 8.4 | 8.6 | 8.8 | 9.0 | 9.6 | 9.6 | 9.0 | 9.0 |
| Electricidad.gas y agua | 5.6 | 5.9 | 6.4 | 6.6 | 6.7 | 9.3 | 9.8 | 10.0 | 10.6 | 10.3 | 10.3 | 10.3 | 10.7 |
| Construction | 14.5 | 15.9 | 14.0 | 15.2 | 15.6 | 35.3 | 36.1 | 36.9 | 37.9 | 31.2 | 31.2 | 30.2 | 39.3 |
| Comercio | 110.0 | 117.3 | 102.1 | 103.1 | 101.0 | 155.5 | 158.8 | 165.8 | 173.4 | 182.3 | 182.31 | 195.5 | 203.7 |
| Transporte.Almacenamiento y Comunicaciones | 24.0 | 25.6 | 27.7 | 28.2 | 27.2 | 36.8 | 37.7 | 38.5 | 41.9 | 42.6 | 42.6 | 42.6 | 44.4 |
| Establecimiento financiero y seguros | 7.9 | 8.5 | 8.8 | 9.1 | 13.9 | 22.1 | 22.6 | 23.0 | 25.2 | 24.7 | 24.7 | 24.7 | 24.7 |
| Servicios Comunales y Sociales | 126.1 | 132.7 | 164.4 | 166.9 | 165.4 | 179.3 | 183.1 | 193.4 | 214.8 | 221.6 | 221.6 | 182.7 | 186.5 |
| Gobierno Central | 47.5 | 54.2 | 58.3 | | 74.8 | 76.0 | 77.0 | 78.0 | 75.5 | 71.3 | 72.31 | 93.5 | 91.1 |
| TOTAL OCUPADOS | 713.3 | 760.2 | 752.4 | 789.1 | 801.6 | 1,060.7 | 1,072.7 | 1,106.8 | 1,151.4 | 1,169.8 | 1,183.4 | 1,192.1 | 1,255.0 |

* PRELIMINAR FUENTE: SPP - DGNV (1980-1984) y MITRAB (1985-1992)

POBLACION ECONOMICAMENTE ACTIVA



Annex A6.7 Conversion Factor

1. Foreign Portion

$$(0.7 \times \frac{1}{1.26} + 0.3 \times \frac{1}{1.1}) = 0.82832 (F)$$

2. Construction cost(Local Portion)

$$\frac{1}{1.04 \times 1.15} = 0.83612 \text{ (C/L)}$$

3. Construction cost(Foreign Portion)

$$\frac{1}{1.04 \times 1.15} \times (F) = 0.69258 (C/F)$$

4. Engineering cost(Local Portion)

$$\frac{1}{1.04 \times 1.1} = 0.87413 \text{ (E/L)}$$

5. Engineering cost(Foreign Portion)

$$\frac{1}{1.04 \times 1.1} \times (F) = 0.72406 (E/L)$$

6. Overlay Cost (Foreign 55 %, Local 45 %)

$$0.45 \times 0.83612(C/L) + 0.55 \times 0.69258(C/F) = 0.75713$$