

Appendix 8.3.3 Basin Characteristics

Appendix 8.3.3 Basin Characteristics

| Basin No. | Name of River | Catchment Area (km ²) | River Length (km) | Maximum Elevation (EL.n) | Minimum Elevation (EL.m) | Basin Slope |
|-----------|---------------|-----------------------------------|-------------------|--------------------------|--------------------------|-------------|
| 1. | Bhogate | 5.4 | 3.4 | 540 | 300 | 1/24 |
| 2. | Karekare | 5.2 | 6.7 | 510 | 300 | 1/37 |
| 3. | Ratu | 42.2 | 13.9 | 750 | 360 | 1/50 |
| 4. | Bhiman | 3.9 | 5.1 | 600 | 370 | 1/31 |
| 5. | Sukha | 2.1 | 4.2 | 630 | 360 | 1/17 |
| 6. | Sindhure | 2.1 | 2.9 | 750 | 470 | 1/10 |
| 7. | Kamala | 142.8 | 18.0 | 1830 | 420 | 1/29 |
| 8. | Phitting | 7.4 | 5.0 | 1080 | 465 | 1/10 |
| 9. | Buka | 13.4 | 6.7 | 1050 | 480 | 1/22 |
| 10. | Gadeuli | 31.6 | 11.5 | 1410 | 480 | 1/18 |
| 11. | Gwang | 12.9 | 5.5 | 1680 | 570 | 1/7 |
| 12. | Ardleri | 20.7 | 8.4 | 1950 | 480 | 1/6 |
| 13. | Nigauli | 21.0 | 8.0 | 1980 | 495 | 1/6 |
| 14. | Arubote | 17.3 | 10.0 | 1950 | 510 | 1/7 |
| 15. | Khahare | 4.4 | 4.3 | 1290 | 450 | 1/6 |
| 16. | Bhote | 16.9 | 12.2 | 1920 | 540 | 1/10 |
| 17. | Gangate | 19.2 | 9.5 | 2220 | 510 | 1/8 |
| 18. | Dhamile | 28.7 | 10.0 | 1130 | 510 | 1/18 |
| 19. | Sandi | 7.4 | 5.2 | 1200 | 530 | 1/8 |
| 20. | Ghyampe | 14.8 | 5.5 | 2175 | 630 | 1/4 |
| 21. | Manti | 17.0 | 8.5 | 2100 | 600 | 1/6 |
| 22. | Bhyakure | 22.3 | 7.5 | 2340 | 690 | 1/6 |
| 23. | Daune | 10.5 | 7.1 | 2220 | 900 | 1/6 |
| 24. | Narke | 18.1 | 8.9 | 2250 | 930 | 1/8 |
| 25. | Roshi | 410.7 | 42.0 | 2760 | 840 | 1/34 |

Appendix 8.3.4 Calculation of Design Floods
(1/100 & 1/150 years)

Appendix 8.3.4 Calculation of Design Floods (1/100 & 1/150 years)

| Basin No. | Name of River | (1) Catchment Area (km ²) | (2) River Length (km) | (3) Maximum Elevation (EL.m) | (4) Minimum Elevation (EL.m) | (5) Basin Slope | (6) Inflow Time (hr) | (7) Flood Flow Time (2)/12.6 | (8) Time Lag = t (6) + (7) | (9) 2/3 (24/t) | (10) Rt = 19.17 x (9) 11.66 x (9) | (11) Q100 = $\frac{f \cdot Rt \cdot A}{3.6}$ (m ³ /sec) | Q50 | Rainfall Record Employed |
|-----------|---------------|---------------------------------------|-----------------------|------------------------------|------------------------------|-----------------|----------------------|------------------------------|----------------------------|----------------|-----------------------------------|--|-------|--------------------------|
| 1. | Bhogata | 5.4 | 3.4 | 540 | 300 | 1/24 | 0.50 | 0.27 | 0.77 | 9.90 | 190 | 199 | 177 | |
| 2. | Karekare | 5.2 | 6.7 | 510 | 300 | 1/37 | 0.50 | 0.50 | 1.03 | 8.16 | 156 | 157 | 140 | |
| 3. | Ratu | 42.4 | 13.9 | 750 | 360 | 1/50 | 0.50 | 1.10 | 1.60 | 6.08 | 116 | 960 | 855 | |
| 4. | Bhiman | 3.9 | 5.1 | 600 | 370 | 1/31 | 0.50 | 0.40 | 0.90 | 8.93 | 171 | 130 | 116 | |
| 5. | Sukra | 2.1 | 4.2 | 630 | 360 | 1/17 | 0.50 | 0.33 | 0.83 | 9.40 | 180 | 74 | 66 | |
| 6. | Sindhure | 2.1 | 2.9 | 750 | 470 | 1/10 | 0.50 | 0.23 | 0.73 | 10.26 | 197 | 80 | 71 | |
| 7. | Kanala | 142.8 | 18.0 | 1,830 | 420 | 1/29 | 0.50 | 1.43 | 1.93 | 5.36 | 103 | 2,857 | 2,546 | |
| 8. | Phitting | 7.4 | 5.0 | 1,080 | 465 | 1/10 | 0.50 | 0.40 | 0.90 | 8.93 | 171 | 246 | 219 | |
| 9. | Buka | 13.4 | 6.7 | 1,050 | 480 | 1/22 | 0.50 | 0.53 | 1.03 | 8.16 | 156 | 406 | 362 | |
| 10. | Gadeuli | 31.6 | 11.5 | 1,410 | 480 | 1/18 | 0.50 | 0.91 | 1.41 | 6.62 | 127 | 779 | 694 | |
| 11. | Gwang | 12.9 | 5.5 | 1,680 | 570 | 1/7 | 0.50 | 0.44 | 0.94 | 8.69 | 166 | 418 | 372 | |
| 12. | Ardleri | 20.7 | 8.4 | 1,950 | 480 | 1/6 | 0.333 | 0.666 | 1.00 | 8.32 | 97 | 390 | 334 | |
| 13. | Nigauli | 21.0 | 8.0 | 1,980 | 495 | 1/6 | 0.333 | 0.635 | 0.968 | 8.50 | 99 | 405 | 347 | |
| 14. | Arubote | 17.3 | 10.0 | 1,950 | 510 | 1/7 | 0.333 | 0.794 | 1.127 | 7.68 | 301 | 258 | 258 | |
| 15. | Khanare | 4.4 | 4.3 | 1,290 | 450 | 1/6 | 0.333 | 0.674 | 0.674 | 10.82 | 126 | 108 | 93 | |
| 16. | Bhote | 16.9 | 12.2 | 1,920 | 540 | 1/10 | 0.333 | 0.968 | 1.301 | 6.98 | 81 | 267 | 229 | |
| 17. | Gangate | 19.2 | 9.5 | 2,220 | 510 | 1/8 | 0.333 | 0.754 | 1.087 | 7.87 | 92 | 343 | 294 | |
| 18. | Dhamile | 28.7 | 10.0 | 1,130 | 510 | 1/18 | 0.333 | 0.794 | 1.127 | 7.68 | 90 | 500 | 429 | |
| 19. | Sandi | 7.4 | 5.2 | 1,200 | 530 | 1/8 | 0.333 | 0.413 | 0.746 | 10.12 | 118 | 170 | 146 | |
| 20. | Giyampe | 14.8 | 5.5 | 2,175 | 630 | 1/4 | 0.333 | 0.437 | 0.770 | 9.90 | 115 | 332 | 285 | |
| 21. | Namti | 17.0 | 8.5 | 2,100 | 600 | 1/6 | 0.333 | 0.675 | 1.008 | 8.28 | 97 | 319 | 274 | |
| 22. | Bhyakure | 22.3 | 7.5 | 2,340 | 690 | 1/6 | 0.333 | 0.595 | 0.928 | 8.75 | 102 | 442 | 379 | |
| 23. | Daune | 10.5 | 7.1 | 2,220 | 900 | 1/6 | 0.333 | 0.563 | 0.896 | 8.95 | 104 | 213 | 183 | |
| 24. | Narke | 18.1 | 8.9 | 2,250 | 930 | 1/8 | 0.333 | 0.659 | 0.992 | 8.37 | 98 | 343 | 294 | |
| 25. | Roshi | 410.7 | 42.0 | 2,760 | 840 | 1/34 | 0.333 | 3.833 | 3.666 | 3.50 | 41 | 3,258 | 2,794 | |

Note: $Q = \frac{1}{3.6} \cdot f \cdot Rt \cdot A$ $Q =$ Peak Flood Runoff (m³/sec.)
 $f =$ Runoff Coefficient = 0.70
 $A =$ Catchment Area (km²)

460/24 = 19.17 mm
 280/24 = 11.66 mm

$$Rt = \frac{R24 \cdot 24}{24} \cdot \frac{2/3}{t}$$

| | 1/50 | 1/100 | Q50/Q100 |
|----------------|--------|--------|-----------------|
| Sindhuli Gadhi | 410 mm | 460 mm | 0.891 = 410/460 |
| Nepaltnok | 240 mm | 280 mm | 0.857 = 240/280 |

Appendix 8.5.1 Topographic Survey Area for Bridge Design
(1/500)

Appendix 8.5.1 Topographic Survey Area for Bridge Design (1/500)

| Section | Station | Name of Bridge | Topographic Survey Area Length x Width = Area m ² | |
|---------|------------------------|-----------------------|---|---------|
| I | 7 + 550 | Bhogate | 175 x 40 | = 7,000 |
| I | 7 + 950 | Karekare | 100 x 40 | = 4,000 |
| I | 8 + 050 | Gangate | 75 x 40 | = 3,000 |
| I | 12 + 400 | Ratu | 340 x 100 | =34,000 |
| I | 17 + 150 | Bhiman | 70 x 100 ^{1/} | = 7,000 |
| I | 17 + 450 | Karki | 50 x 100 ^{1/} | = 5,000 |
| I | 19 + 250 | Sukhe | 40 x 100 ^{1/} | = 4,000 |
| I | 28 + 050 | Shindhuse | 100 x 50 | = 5,000 |
| I | 28 + 750 | Kamala | 200 x 50 | =10,000 |
| I | 32 + 250 | Phitting | 80 x 50 | = 4,000 |
| I | 34 + 200 | Buke | 80 x 50 | = 4,000 |
| I | 34 + 950 | Gadeuli | 80 x 50 | = 4,000 |
| II-1 | 7 + 800 | Gwangu | 100 x 50 | = 5,000 |
| II-1 | 20 + 900 ^{2/} | - | - | - |
| II-2 | 37 + 650 | Ardleri | 150 x 50 | = 7,500 |
| II-2 | 0 + 300 ^{3/} | - | - | - |
| II-2 | 5 + 300 | Nigauli | 220 x 50 | =11,000 |
| II-2 | 10 + 700 | Arubote | 150 x 50 | = 7,500 |
| II-2 | 12 + 250 | Khahare ^{4/} | 100 x 50 | = 5,000 |
| II-2 | 19 + 700 | Gangate ^{4/} | 260 x 50 | =13,000 |
| II-2 | 21 + 550 | Dhamile | 250 x 50 | =12,500 |
| II-2 | 24 + 350 | Sandi | 80 x 50 | = 4,000 |
| II-2 | 32 + 900 | Ghyampe | 250 x 50 | =12,500 |
| II-3 | 1 + 250 | Manti | 120 x 50 | = 6,000 |
| II-3 | 7 + 200 | Bhyakure | 140 x 50 | = 7,000 |
| II-3 | 11 + 150 | Daune | 70 x 50 | = 3,500 |
| II-3 | 11 + 900 ^{2/} | - | 300 x 50 | =15,000 |
| II-3 | 13 + 600 | Narke | 80 x 50 | = 4,000 |
| II-3 | 18 + 950 | Roshi ^{5/} | 110 x 50 | = 5,500 |
| II-3 | 21 + 800 | Dabcha ^{5/} | - | - |
| | | | Total | 210,000 |

^{1/} Additional area for man-made river guide banks.

^{2/} Survey site for major structure.

^{3/} To be named.

^{4/} Survey site was divided into two site in the river.

^{5/} Bridge site under the possible alternative route.

Appendix 9.5.1 Pavement Design Calculation

Appendix 9.5.1 Pavement Design Calculation

1. Serviceability Index $P_t = 2.5$ (for major highway)

2. Traffic

18-kip (80 kN) single-axle load: 8.2 ton

- Initial ADT (1995) Sec. I 830 per day
 Sec. II $1/2 (714 + 735) = 725$ per day

- Projected 20 year ADT

| | 1995 | Annual Increase | 2000 | | 2010 | | 2015 |
|---------|------|-----------------|-------|------|-------|------|-------|
| Sec. I | 830 | 8.5% | 1,248 | 7.2% | 2,502 | 5.7% | 3,301 |
| Sec. II | 725 | 9.5% | 1,090 | 7.2% | 2,185 | 5.7% | 2,883 |

- Percentage of trucks including buses: 60%
 (based on 24 hours traffic volume)

- Average ADT for 20 year design period in both directions

$$\text{Sec. I} = 1/2 (830 + 3,301) = 2,066$$

$$\text{Sec. II} = 1/2 (725 + 2,883) = 1,804$$

- Average number of trucks per day for 20 year design period in one direction

$$\text{Sec. I} = 1/2 \times 2,066 \times 0.6 = 620$$

$$\text{Sec. II} = 1/2 \times 1,804 \times 0.6 = 540$$

- The total number of trucks in one direction for the 20 years design period

$$\text{Sec. I} = 620 \times 20 \text{ years} \times 365 \text{ days/year} = 4,526,000$$

$$\text{Sec. II} = 540 \times 20 \text{ years} \times 365 \text{ days/year} = 3,942,000$$

- Percentage of trucks excluding unloading: 80%

- An 18-kip (80 kN) axle equivalent rate per 1,000 trucks

$$= \left(\frac{P_i}{5}\right)^4 = \left(\frac{4.1}{5}\right)^4$$
$$= 0.452$$

- The 18-kip equivalent single axle loading for total loads during design period

Equivalent 18 Kip
single axle loads

$$\text{Sec. I} = 4,526,000 \times 0.452 \times 0.8 = 1,637,000$$

$$\text{Sec. II} = 3,492,000 \times 0.452 \times 0.8 = 1,425,000$$

3. Soil Support Value

The soil support value was determined using the chart showing relationship between soil support value and CBR (California Bearing Ratio) which was developed by Utah Department of Highway, USA from the results of the AASHO Road Test.

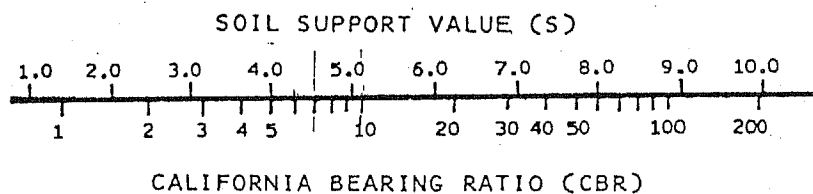


Fig. A.9.1 Correlation Between Soil Support Value and CBR, Utah Department of Highway

According to the test result of soil survey, CBR value for each section is assumed to be 15% for Section I and 8% for Section II respectively.

Therefore, soil support values are determined as follows:

Sec. I : 5.7

Sec. II: 4.8

4. Regional Factor

Regional factor that may be used as a value for pavement design are:

- Roadbed materials frozen to depth of 5" (130 mm) or more 0.2 to 1.0
- Roadbed materials dry summer and fall 0.3 to 1.5
- Roadbed materials wet spring thaw 4.0 to 5.0

1.5 of Regional factor is used for the design of this project taking into consideration relatively high rainfall due to monsoon.

5. Structural Number (SN)

The requirement Structural Number (SN) is obtained from the Fig. A2-2 Design Chart for Flexible Pavement as shown below:

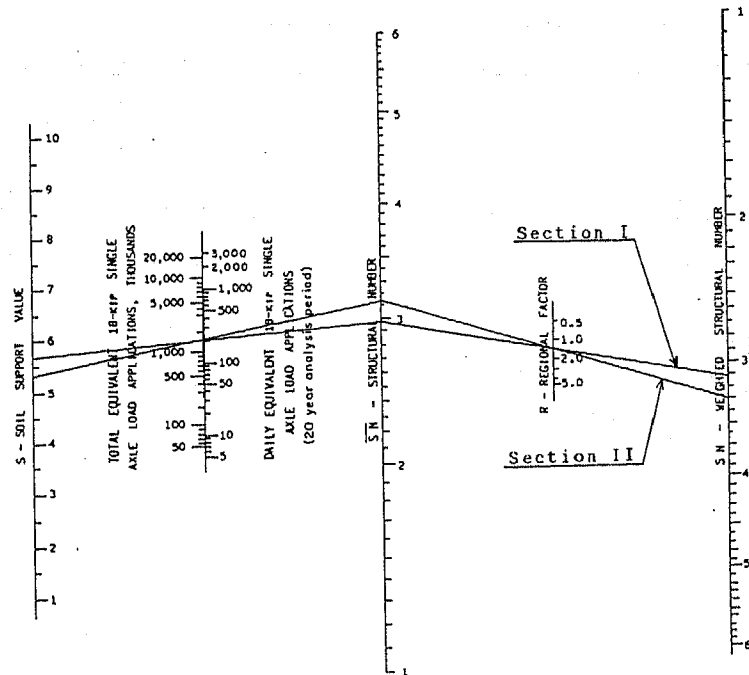


Fig. A.9.2 Design Chart for Flexible Pavements, Pt = 2.5

Sec. I $SN_I = 3.1$

Sec. II $SN_I = 3.5$

Based on the total required SN for the entire pavement above, suitable design is obtained by the following equation:

$$SN = a_1D_1 + a_2D_2 + a_3D_3$$

where, a_1, a_2, a_3 = layer coefficients representative of surface, base and subbase

D_1, D_2, D_3 = actual thickness, in inches, of surface, base, and subbase course, respectively.

6. Layer coefficient

Structural layer coefficient, established from AASHO Road Test Data and proposed by AASHO Committee on Design, are presented in Table A2-1.

7. Alternative Design

Based on the total required structural number (SN) as well as structural layer coefficients, alternative designs with variations in the thickness of the surface, base and subbase, and with various types of surface, base and subbase were carried out.

A layer coefficients are determined for each component material as follows:

| | <u>Coefficient</u> |
|-----------------------------------|--------------------|
| Surfact Course | |
| Plantmix (Asphaltic Concrete: AC) | 0.44 |
| Roadmix (DBST) | 0.20 |
| Base Course | |
| Crushed Stone | 0.14 |
| Subbase Course | |
| Sandy Gravel | 0.11 |

Four possible alternative designs which will satisfy the required structural number (SN) of 3.1 (Sec. I) and 3.5 (Sec. II) respectively are studied as shown in Table A2-2.

Table A.9.1

Structural Layer Coefficients Proposed by AASHO Committee on Design
October 12, 1961

| Pavement Component | Coefficient ^{/3} |
|---|---------------------------|
| Surface Course | |
| Roadmix (low stability) | 0.20 |
| Plantmix (high stability) | 0.44* |
| Sand Asphalt | 0.40 |
| Base Course | |
| Sandy Gravel | 0.07 ^{/2} |
| Crushed Stone | 0.14* |
| Cement-Treated (no soil-cement) | |
| Compressive strength @7 days | |
| 650 psi or more ¹ (4.48 MPa) | 0.23 ^{/2} |
| 400 to 650 psi (2.76 to 4.48 MPa) | 0.20 |
| 400 psi or less (2.76 MPa) | 0.15 |
| Bituminous-Treated | |
| Coarse-Graded | 0.34 ^{/2} |
| Sand Asphalt | 0.30 |
| Lime-Treated | 0.15-0.30 |
| Subbase Course | |
| Sandy Gravel | 0.11* |
| Sand or Sandy-Clay | 0.05-0.10 |

* Established from AASHO Road Test Data

/1 Compressive strength at 7 days.

/2 This value has been estimated from AASHO Road Test data, but not to the accuracy of those factors marked with an asterisk.

/3 It is expected that each state will study these coefficients and make such changes as experience indicates necessary.

Table A.9.2 Alternative of Pavement Layer

1 in. = 2.54 cm

| Alt. No. | | Thickness inch (cm) | | Layer Coefficient | = | SN |
|-----------------------------------|----------------------|------------------------|---|----------------------|---|-------------|
| 1. SECTION I (Required SN = 3.1) | | | | | | |
| 1-A | DBST Surface | 2 (5) | x | 0.20 | = | 0.40 |
| | Crushed Stone Base | 10 (25) | x | 0.14 | = | 1.40 |
| | Sandy Gravel Subbase | <u>12 (30)</u> | x | 0.11 | = | <u>1.32</u> |
| | Total | 24 (60) | | | | 3.12 |
| 1-B | AC Surface | 2 (5) | x | 0.44 | = | 0.88 |
| | Crushed Stone Base | 8 (20) | x | 0.14 | = | 1.12 |
| | Sandy Gravel Subbase | <u>10 (25)</u> | x | 0.11 | = | <u>1.10</u> |
| | Total | 20 (50) | | | | 3.10 |
| 2. SECTION II (Required Sn = 3.5) | | | | | | |
| 2-A | DBST Surface | 2 (5) | x | 0.20 | = | 0.40 |
| | Crushed Stone | 10 (25) | x | 0.14 | = | 1.40 |
| | Sandy Gravel Subbase | <u>16 (40)</u> | x | 0.11 | = | <u>1.76</u> |
| | Total | 28 (70) | | | | 3.56 |
| 2-B | AC Surface | 2 (5) | x | 0.44 | = | 0.88 |
| | Crushed Stone Base | 8 (20) | x | 0.14 | = | 1.12 |
| | Sandy Gravel Subbase | <u>14 (35)</u> | x | 0.11 | = | <u>1.54</u> |
| | Total | 24 (60) | | | | 3.54 |

Appendix 10.5.1 The Construction Cost for Each Section

Appendix 10.5.1 The Construction Cost for Each Section

Construction Cost for Section I

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|---------------|---------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 1,215 | 253 | 76 | 329 | 1,544 |
| 2. Earthwork | 11,348 | 2,566 | 784 | 3,350 | 14,698 |
| 3. Pavement work | 49,251 | 5,986 | 2,651 | 8,637 | 57,888 |
| 4. Drainage work | 40,729 | 7,584 | 663 | 8,247 | 48,976 |
| 5. Retaining wall work | 18,276 | 3,645 | 262 | 3,907 | 22,183 |
| 6. Slope protection work | 6,567 | 2,062 | 172 | 2,234 | 8,801 |
| 7. Rock shed work | - | - | - | - | - |
| 8. Road furniture | 2,992 | 391 | 26 | 417 | 3,409 |
| 9. Bridge work | 178,384 | 15,542 | 1,646 | 17,188 | 195,572 |
| 10. Miscellaneous work | 46,314 | 5,704 | 942 | 6,646 | 52,960 |
| Total (I) | 355,076 | 43,733 | 7,222 | 50,955 | 406,031 |
| II. Physical Contingency | 53,261 | 6,560 | 1,084 | 7,644 | 60,905 |
| III. Engineering Services | 40,603 | - | - | - | 40,603 |
| IV. Land Acquisition and compensation | - | 2,000 | - | 2,000 | 2,000 |
| Total | 448,940 | 52,293 | 8,306 | 60,599 | 509,539 |

Construction Cost for Section II-1

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|---------------|-----------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 4,381 | 912 | 274 | 1,186 | 5,567 |
| 2. Earthwork | 100,970 | 21,316 | 5,835 | 27,151 | 128,121 |
| 3. Pavement work | 74,493 | 10,555 | 4,203 | 14,758 | 89,251 |
| 4. Drainage work | 51,485 | 10,251 | 1,030 | 11,281 | 62,766 |
| 5. Retaining wall work | 142,958 | 35,564 | 4,061 | 39,625 | 182,583 |
| 6. Slope protection work | 49,400 | 8,755 | 1,120 | 9,875 | 59,275 |
| 7. Rock shed work | - | - | - | - | - |
| 8. Road furniture | 9,191 | 2,027 | 184 | 2,211 | 11,402 |
| 9. Bridge work | 145,448 | 8,331 | 913 | 9,244 | 154,692 |
| 10. Miscellaneous work | 86,749 | 14,657 | 2,643 | 17,300 | 104,049 |
| Total (I) | 665,075 | 112,368 | 20,263 | 132,631 | 797,706 |
| II. Physical Contingency | 99,761 | 16,856 | 3,039 | 19,895 | 119,656 |
| III. Engineering Services | 79,770 | - | - | - | 79,770 |
| IV. Land Acquisition and compensation | - | 3,000 | - | 3,000 | 3,000 |
| Total | 844,606 | 132,224 | 23,302 | 155,526 | 1,000,132 |

Construction Cost for Section II-2

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|---------------|---------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 3,330 | 694 | 208 | 902 | 4,232 |
| 2. Earthwork | 50,923 | 10,966 | 2,808 | 13,774 | 64,697 |
| 3. Pavement work | 52,029 | 7,373 | 2,936 | 10,309 | 62,338 |
| 4. Drainage work | 31,340 | 7,453 | 746 | 8,199 | 39,539 |
| 5. Retaining wall work | 101,683 | 23,456 | 2,475 | 25,931 | 127,614 |
| 6. Slope protection work | 70,503 | 10,487 | 1,680 | 12,167 | 82,670 |
| 7. Rock shed work | - | - | - | - | - |
| 8. Road furniture | 16,941 | 1,837 | 137 | 1,974 | 18,915 |
| 9. Bridge work | 199,742 | 12,018 | 1,092 | 13,110 | 212,852 |
| 10. Miscellaneous work | 78,974 | 11,143 | 1,812 | 12,955 | 91,929 |
| Total (I) | 605,465 | 85,427 | 13,894 | 99,321 | 704,786 |
| II. Physical Contingency | 90,820 | 12,814 | 2,084 | 14,898 | 105,718 |
| III. Engineering Services | 70,479 | - | - | - | 70,479 |
| IV. Land Acquisition and compensation | - | 4,000 | - | 4,000 | 4,000 |
| Total | 766,764 | 102,241 | 15,978 | 118,219 | 884,983 |

Construction Cost for Section II-3

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|----------------|------------------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 4,967 | 1,034 | 311 | 1,345 | 6,312 |
| 2. Earthwork | 103,627 | 22,625 | 6,531 | 29,156 | 132,783 |
| 3. Pavement work | 88,768 | 12,581 | 5,008 | 17,589 | 106,357 |
| 4. Drainage work | 62,007 | 12,120 | 1,196 | 13,316 | 75,323 |
| 5. Retaining wall work | 227,358 | 47,259 | 4,774 | 52,033 | 279,391 |
| 6. Slope protection work | 100,820 | 15,998 | 2,188 | 18,186 | 119,006 |
| 7. Rock shed work | 18,723 | 2,146 | 255 | 2,401 | 21,124 |
| 8. Road furniture | 11,663 | 2,691 | 250 | 2,941 | 14,604 |
| 9. Bridge work | 259,173 | 17,988 | 1,762 | 19,750 | 278,923 |
| 10. Miscellaneous work | 131,566 | 20,166 | 3,342 | 23,508 | 155,074 |
| Total (I) | 1,008,672 | 154,608 | 25,617 | 180,225 | 1,188,897 |
| II. Physical Contingency | 151,301 | 23,191 | 3,842 | 27,033 | 178,334 |
| III. Engineering Services | 118,890 | - | - | - | 118,890 |
| IV. Land Acquisition and Compensation | - | 3,000 | - | 3,000 | 3,000 |
| Total | 1,278,863 | 180,799 | 29,459 | 210,258 | 1,489,121 |

Detailed Construction Cost

Unit: NRs. 1,000

| Description | Section I | Section II-1 | Section II-2 | Section II-3 | Total |
|---|--------------|-----------------|-----------------|-----------------|-----------|
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 1,544 | 5,567 | 4,232 | 6,312 | 17,655 |
| 2. Earthwork | 14,698 | 128,121 | 64,697 | 132,783 | 340,299 |
| 3. Pavement work | 57,888 | 89,251 | 62,338 | 106,357 | 315,834 |
| 4. Drainage work | 48,976 | 62,766 | 39,539 | 75,323 | 226,604 |
| 5. Retaining wall work | | | | | |
| - Masonry work | 8,435 | 156,825 | 89,437 | 123,292 | 377,989 |
| - Concrete gravity wall | - | 17,199 | 9,158 | 25,418 | 51,775 |
| - Retaining wall | - | - | - | 899 | 899 |
| - Gabion wall | 9,251 | 5,649 | 21,079 | 25,147 | 61,126 |
| - Reversed T-wall | 4,497 | 2,910 | 7,940 | 104,635 | 119,982 |
| Sub-total | 22,183 | 182,583 | 127,614 | 279,391 | 611,771 |
| 6. Slope protection work | | | | | |
| - Strip sodding | 483 | 1,013 | 766 | 1,554 | 3,816 |
| - Seed spraying | 610 | 1,501 | 1,470 | 1,606 | 5,187 |
| - Spray application concrete | - | 23,445 | 62,112 | 64,313 | 149,870 |
| - Rock bolt and shotcrete | - | 15,321 | 10,214 | 15,321 | 40,856 |
| - Rock net | 2,540 | 10,243 | 5,524 | 23,292 | 41,599 |
| - Concrete frame | 5,168 | 7,752 | 2,584 | 12,920 | 28,424 |
| Sub-total | 8,801 | 59,275 | 82,670 | 119,006 | 269,752 |
| 7. Rock shed work | - | - | - | 21,124 | 21,124 |
| 8. Road furniture | 3,409 | 11,402 | 18,915 | 14,604 | 48,330 |
| 9. Bridge work | | | | | |
| - Major bridge | | | | | |
| PC simple T-beam | 105,033 | - | - | 99,835 | 204,868 |
| PC continous box | 62,169 | - | - | - | 62,169 |
| RC arch | - | - | 23,224 | 30,490 | 53,714 |
| Steel simple girder | - | 48,232 | 123,691 | - | 171,923 |
| Steel simple truss | - | - | - | 25,803 | 25,803 |
| Sub-total | 167,202 | 48,232 | 146,915 | 156,128 | 518,477 |
| - Medium and minor bridge | | | | | |
| PC simple T-beam | 24,335 | - | - | - | 24,335 |
| RC T-beam | 4,035 | 8,623 | - | - | 12,658 |
| RC slab | - | - | - | 1,595 | 1,595 |
| Steel girder | - | 78,049 | 25,380 | 90,773 | 194,202 |
| Steel H-beam | - | 19,788 | 40,557 | 30,427 | 90,772 |
| Sub-total | 28,370 | 106,460 | 65,937 | 122,795 | 323,562 |
| Total (9) | 195,572 | 154,692 | 212,852 | 278,923 | 842,039 |
| 10. Miscellaneous | 52,960 | 104,049 | 91,929 | 155,074 | 404,012 |
| Total (I) | 406,031 | 797,706 | 704,786 | 1,188,897 | 3,097,420 |

Detailed Construction Cost for Section I

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|---------------|---------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 1,215 | 253 | 76 | 329 | 1,544 |
| 2. Earthwork | 11,348 | 2,566 | 784 | 3,350 | 14,698 |
| 3. Pavement work | 49,251 | 5,986 | 2,651 | 8,637 | 57,888 |
| 4. Drainage work | 40,729 | 7,584 | 663 | 8,247 | 48,976 |
| 5. Retaining wall work | | | | | |
| - Masonry work | 6,534 | 1,728 | 173 | 1,901 | 8,435 |
| - Gabion wall | 7,957 | 1,260 | 34 | 1,294 | 9,251 |
| - Reversed T-wall | 3,785 | 657 | 55 | 712 | 4,497 |
| Sub-total | 18,276 | 3,645 | 262 | 3,907 | 22,183 |
| 6. Slope protection work | | | | | |
| - Strip sodding | - | 483 | - | 483 | 483 |
| - Seed spraying | 548 | 44 | 18 | 62 | 610 |
| - Rock net | 2,410 | 122 | 8 | 130 | 2,540 |
| - Concrete frame | 3,609 | 1,413 | 146 | 1,559 | 5,168 |
| Sub-total | 6,567 | 2,062 | 172 | 2,234 | 8,801 |
| 7. Rock shed work | - | - | - | - | - |
| 8. Road furniture | 2,992 | 391 | 26 | 417 | 3,409 |
| 9. Bridge work | | | | | |
| - Major bridge | | | | | |
| PC simple T-beam | 96,575 | 7,616 | 842 | 8,458 | 105,033 |
| PC continuous box | 55,993 | 5,688 | 488 | 6,176 | 62,169 |
| Sub-total | 152,568 | 13,304 | 1,330 | 14,634 | 167,202 |
| - Medium and Minor bridge | | | | | |
| PC simple T-beam | 22,292 | 1,798 | 245 | 2,043 | 24,335 |
| RC T-beam | 3,524 | 440 | 71 | 511 | 4,035 |
| Sub-total | 25,816 | 2,238 | 316 | 2,554 | 28,370 |
| Total (9) | 178,384 | 15,542 | 1,646 | 17,188 | 195,572 |
| 10. Miscellaneous work | 46,314 | 5,704 | 942 | 6,646 | 52,960 |
| Total (I) | 355,076 | 43,733 | 7,222 | 50,955 | 406,031 |

Detailed Construction Cost for Section II-1

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|---------------|---------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 4,381 | 912 | 274 | 1,186 | 5,567 |
| 2. Earthwork | 100,970 | 21,316 | 5,835 | 27,151 | 128,121 |
| 3. Pavement work | 74,493 | 10,555 | 4,203 | 14,758 | 89,251 |
| 4. Drainage work | 51,485 | 10,251 | 1,030 | 11,281 | 62,766 |
| 5. Retaining wall work | | | | | |
| - Masonry work | 121,196 | 31,993 | 3,636 | 35,629 | 156,825 |
| - Concrete gravity work | 14,452 | 2,378 | 369 | 2,747 | 17,199 |
| - Gabion wall | 4,859 | 769 | 21 | 790 | 5,649 |
| - Reversed T-wall | 2,451 | 424 | 35 | 459 | 2,910 |
| Sub-total | 142,958 | 35,564 | 4,061 | 39,625 | 182,583 |
| 6. Slope protection work | | | | | |
| - Stripe sodding | - | 1,013 | - | 1,013 | 1,013 |
| - Seed spraying | 1,350 | 108 | 43 | 151 | 1,501 |
| - Spray application concrete | 20,271 | 2,671 | 503 | 3,174 | 23,445 |
| - Rock bolt & shotcrete | 12,648 | 2,352 | 321 | 2,673 | 15,321 |
| - Rock net | 9,717 | 492 | 34 | 526 | 10,243 |
| - Concrete frame | 5,414 | 2,119 | 219 | 2,338 | 7,752 |
| Sub-total | 49,400 | 8,755 | 1,120 | 9,875 | 59,275 |
| 7. Rock shed work | - | - | - | - | - |
| 8. Road furniture | 9,191 | 2,027 | 184 | 2,211 | 11,402 |
| 9. Bridge work | | | | | |
| - Major bridge Steel simple girder | 45,669 | 2,371 | 192 | 2,563 | 48,232 |
| - Medium and minor bridge RC T-beam | 7,584 | 898 | 141 | 1,039 | 8,623 |
| Steel girder | 73,563 | 4,034 | 452 | 4,486 | 78,049 |
| Steel II | 18,632 | 1,028 | 128 | 1,156 | 19,788 |
| Sub-total | 99,779 | 5,960 | 721 | 6,681 | 106,460 |
| Total (9) | 145,448 | 8,331 | 913 | 9,244 | 154,692 |
| 10. Miscellaneous work | 86,749 | 14,657 | 2,643 | 17,300 | 104,049 |
| Total (I) | 665,075 | 112,368 | 20,263 | 132,631 | 797,706 |

Detailed Construction Cost for Section II-2

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|---------------|---------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 3,330 | 694 | 208 | 902 | 4,232 |
| 2. Earthwork | 50,923 | 10,966 | 2,808 | 13,774 | 64,697 |
| 3. Pavement work | 52,029 | 7,373 | 2,936 | 10,309 | 62,338 |
| 4. Drainage work | 31,340 | 7,453 | 746 | 8,199 | 39,539 |
| 5. Retaining wall work | | | | | |
| - Masonry work | 69,188 | 18,142 | 2,107 | 20,249 | 89,437 |
| - Concrete gravity wall | 7,698 | 1,263 | 197 | 1,460 | 9,158 |
| - Gabion wall | 18,131 | 2,870 | 78 | 2,948 | 21,079 |
| - Reversed T-wall | 6,666 | 1,181 | 93 | 1,274 | 7,940 |
| Sub-total | 101,683 | 23,456 | 2,475 | 25,931 | 127,614 |
| 6. Slope protection work | | | | | |
| - Strip sodding | - | 766 | - | 766 | 766 |
| - Seed spraying | 1,322 | 106 | 42 | 148 | 1,470 |
| - Spray application concrete | 53,704 | 7,076 | 1,332 | 8,408 | 62,112 |
| - Rock bolt and shotcrete | 8,432 | 1,568 | 214 | 1,782 | 10,214 |
| - Rock net | 5,240 | 265 | 19 | 284 | 5,524 |
| - Concrete frame | 1,805 | 706 | 73 | 779 | 2,584 |
| Sub-total | 70,503 | 10,487 | 1,680 | 12,167 | 82,670 |
| 7. Rock shed work | - | - | - | - | - |
| 8. Road furniture | 16,941 | 1,837 | 137 | 1,974 | 18,915 |
| 9. Bridge work | | | | | |
| - Major work | | | | | |
| RC arch | 20,702 | 2,375 | 147 | 2,522 | 23,224 |
| Steel simple girder | 117,098 | 6,092 | 501 | 6,593 | 123,691 |
| Sub-total | 137,800 | 8,467 | 648 | 9,115 | 146,915 |
| - Medium and minor bridge | | | | | |
| Steel girder | 23,974 | 1,269 | 137 | 1,406 | 25,380 |
| Steel H | 37,968 | 2,282 | 307 | 2,589 | 40,557 |
| Sub-total | 61,942 | 3,551 | 444 | 3,995 | 65,937 |
| Total (9) | 199,742 | 12,018 | 1,092 | 13,110 | 212,852 |
| 10. Miscellaneous | 78,974 | 11,143 | 1,812 | 12,955 | 91,929 |
| Total (I) | 605,465 | 85,427 | 13,894 | 99,321 | 704,786 |

Detailed Construction Cost for Section II-3

Unit: NRs. 1,000

| Description | Foreign Currency | Local Currency | | | Total |
|---|---------------------|-------------------|---------------|---------------|-----------|
| | | Local Currency | Duty & Tax | Sub- total | |
| I. Construction Cost | | | | | |
| 1. Site clearance and topsoil stripping | 4,967 | 1,034 | 311 | 1,345 | 6,312 |
| 2. Earthwork | 103,627 | 22,625 | 6,531 | 29,156 | 132,783 |
| 3. Pavement work | 88,768 | 12,581 | 5,008 | 17,589 | 106,357 |
| 4. Drainage work | 62,007 | 12,120 | 1,196 | 13,316 | 75,323 |
| 5. Retaining wall work | | | | | |
| - Masonry work | 95,358 | 25,074 | 2,860 | 27,934 | 123,292 |
| - Concrete gravity wall | 21,352 | 3,521 | 545 | 4,066 | 25,418 |
| - Retaining wall | 756 | 128 | 15 | 143 | 899 |
| - Gabion wall | 21,631 | 3,424 | 92 | 3,516 | 25,147 |
| - Reversed T-wall | 88,261 | 15,112 | 1,262 | 16,374 | 104,635 |
| Sub-total | 227,358 | 47,259 | 4,774 | 52,033 | 279,391 |
| 6. Slope protection work | | | | | |
| - Stripe sodding | - | 1,554 | - | 1,554 | 1,554 |
| - Seed sowing | 1,444 | 116 | 46 | 162 | 1,606 |
| - Spray application concrete | 55,606 | 7,327 | 1,380 | 8,707 | 64,313 |
| - Rock bolt and shotcrete | 12,648 | 2,352 | 321 | 2,673 | 15,321 |
| - Rock net | 22,098 | 1,117 | 77 | 1,194 | 23,292 |
| - Concrete frame | 9,024 | 3,532 | 364 | 3,896 | 12,920 |
| Sub-total | 100,820 | 15,998 | 2,188 | 18,186 | 119,006 |
| 7. Rock shed work | 18,723 | 2,146 | 255 | 2,401 | 21,124 |
| 8. Road furniture | 11,663 | 2,691 | 250 | 2,941 | 14,604 |
| 9. Bridge work | | | | | |
| - Major bridge | | | | | |
| PC-T | 91,794 | 7,258 | 783 | 8,041 | 99,835 |
| RC arch | 26,992 | 3,224 | 274 | 3,498 | 30,490 |
| Steel simple truss | 24,199 | 1,560 | 44 | 1,604 | 25,803 |
| Sub-total | 142,985 | 12,042 | 1,101 | 13,143 | 156,128 |
| - Medium and Minor bridge | | | | | |
| RC slab | 1,404 | 163 | 28 | 191 | 1,595 |
| Steel girder | 86,231 | 4,132 | 410 | 4,542 | 90,773 |
| Steel H | 28,553 | 1,651 | 223 | 1,874 | 30,427 |
| Sub-total | 116,188 | 5,946 | 661 | 6,607 | 122,795 |
| Total (9) | 259,173 | 17,988 | 1,762 | 19,750 | 278,923 |
| 10. Miscellaneous | 131,566 | 20,166 | 3,342 | 23,508 | 155,074 |
| Total (I) | 1,008,672 | 154,608 | 25,617 | 180,225 | 1,188,897 |

Appendix 11.3.1 Data Used for Estimating Workable Days

Appendix 11.3.1 Data Used for Estimating Workable Days

Monthly Rainy Day

| | Less than 1 mm | 1-9.9 mm | 10-24.9 mm | 25-49.9 mm | 50-99.9 mm | More than 100 mm |
|-----------|----------------------|-------------|---------------|---------------|---------------|------------------------|
| January | 2.1 | 1.7 | 0.4 | 0 | 0 | 0 |
| February | 2.6 | 2.1 | 0.4 | 0 | 0 | 0 |
| March | 3.9 | 3.0 | 0.8 | 0.1 | 0 | 0 |
| April | 7.9 | 5.8 | 2.0 | 0.1 | 0 | 0 |
| May | 12.3 | 8.2 | 3.2 | 0.7 | 0.2 | 0 |
| June | 15.9 | 8.6 | 4.1 | 2.2 | 0.9 | 0.1 |
| July | 23.0 | 12.2 | 6.3 | 3.4 | 1.0 | 0 |
| August | 21.0 | 10.7 | 6.6 | 3.0 | 0.8 | 0 |
| September | 14.8 | 8.4 | 4.7 | 1.3 | 0.3 | 0 |
| October | 5.3 | 4.1 | 1.0 | 0.3 | 0.1 | 0 |
| November | 0.9 | 0.4 | 0.4 | 0 | 0 | 0 |
| December | 1.3 | 1.1 | 0.1 | 0 | 0 | 0 |

Note: Average monthly rainy day (1976-1984) of Kathmandu airport.

Suspended Day

| | Less than 1 mm | 1-9.9 mm | 10-24.9 mm | 25-49.9 mm | 50-99.9 mm | More than 100 mm |
|------------------------|----------------------|-------------|---------------|---------------|---------------|------------------------|
| Excavation | 0 | 0.5 | 1.0 | 1.0 | 1.5 | 1.5 |
| Cutting and filling | 0 | 0.5 | 1.0 | 1.5 | 2.0 | 2.0 |
| Concrete work | 0 | 0 | 0.5 | 1.0 | 1.0 | 1.0 |

Workable Day

| | Excavation | Cutting & filling | Concrete |
|-----------|-------------------|-------------------|-------------------|
| January | 27 | 27 | 26 |
| February | 24 | 22 | 24 |
| March | 26 | 26 | 25 |
| April | 22 | 22 | 25 |
| May | 20 | 19 | 23 |
| June | (15) | (13) | 21 |
| July | (9) | (9) | 18 |
| August | (12) | (10) | 20 |
| September | 16 | 16 | 22 |
| October | 25 | 25 | 25 |
| November | 26 | 26 | 26 |
| December | 27 | 27 | 27 |
| Total | 213 (18/month) | 210 (18/month) | 282 (23/month) |

Note:

Earthwork; Three months from June to August are planned to be suspended month. No workable day due to Sunday is planned to be 3 days per months. The remaining Sunday is estimated at workable days as an overtime considering suspended months.

Concrete work; Concrete work will be done during dry and rainy seasons.

Appendix 11.4.1 Sindhuli Road Maintenance and Training
Center, Nepal

NG

Appendix 11.4.1 Sindhuli Road Maintenance and Training Center,
Nepal

1. Objectives

The center will be established for the following purposes.

- (1) Maintenance of the Sindhuli Road, 160 km in total.
- (2) Training to improve the level of the technical skills in Nepal on operation, maintenance and repair of construction machinery and mechanical earth works.
- (3) Construction of feeder roads.

2. Buildings and Facilities

(1) Administrative building (92 m x 16 m)

1. 1 x Job-site office
2. 2 x Staff room
3. 2 x Bookroom
4. 2 x Meeting room
5. 1 x Library
6. 1 x Locker room
7. 1 x Dining room
8. 1 x Kitchen, etc.

(2) School building (82 m x 16 m)

1. 4 x Classroom
2. 1 x Drafting room
3. 1 x Practice room

- (3) Workshop (39 m x 20 m)
 1. 3 x Practice bay
 2. 1 x Maintenance bay
- (4) Oil & grease storage (6 m x 8 m)
- (5) Parts storage (6 m x 12 m)
- (6) Miscellaneous articles storage (6 m x 10 m)
- (7) Car-washer shed (3 m x 5 m)
- (8) Car-washer area (oil water separator & sand separator)
- (9) Fuel & lubricant service facility
- (10) Area of concrete pavement: 2,800 m²
- (11) Area of asphalt pavement: 6,000 m²
- (12) Stock yard
 1. Pipe & reinforcing bar yard (20 m x 8 m)
 2. Asphalt emulsion yard (20 m x 25 m)
 3. Aggregate yard (15 m x 60 m)
 4. Area of asphalt pavement: 1,455 m²
- (13) Others (operation practice area, parking area, etc.)
- (14) Residence area
 1. Residence for managers & instructors: 20 houses
 2. Residence for staffs & trainees: 100 houses
 3. 1 x Administrative building
 4. Area of asphalt pavement: 4,650 m²
 5. Fence (640 m), etc.

Sub-Camp (Nepalthok)

(1) Office building

1. 1 x Job-site office (15 m x 7 m)
2. 1 x General manager's room (5 m x 5 m)
3. 1 x Combination dining & meeting room (10 m x 5 m)
4. 1 x Locker room
5. 1 x Shower bath room

(2) Workshop (2 x Maintenance bay)

1. 1 x Over-head crane (3 ton)
2. 1 x Hydraulic shop press (100 ton)
3. 1 x Lift block tool
4. 1 x Forklift (3 ton)
5. 1 x Car-washer
6. 1 x Air compressor
7. Others (Spare parts, etc.)

(3) Fuel & lubricant storage (20 m x 5 m)

(4) Stock yard

1. Pipe & reinforcing bar yard (10 m x 5 m)
2. Asphalt emulsion yard (15 m x 20 m)
3. Aggregate yard (15 m x 40 m)

(5) Area of asphalt pavement: 6,900 m²

(6) Area of concrete pavement: 2,200 m²

(7) Fence (590 m), etc.

(8) Residence area

1. Residence for managers: 3 houses
2. Residence for staffs: 16 houses

3. 1 x Administrative building
4. Area of asphalt pavement: 850 m²
5. Fence (390 m), etc.

3. Equipment & Tools

- (1) Workshop (repair capacity: up to 23-ton class tractor)

Practice bay

(A) Specialized bay

(Testing, and assembling and disassembling of component)

1. 1 x Over-head crane (2 ton)
2. 1 x Hydraulic cylinder repair stand
3. 1 x Hydraulic test stand
4. 1 x Injection pump tester, etc.

(B) Sheet metal bay

(Welding and sheet metal work)

1. 1 x Over-head crane (3 ton)
2. 1 x Hydraulic shop press (100 ton)
3. 1 x Surface plate
4. 1 x Arc welder
5. 1 x Gas cutting kit
6. 1 x Boring machine, etc.

(C) Chassis bay

(Checking, adjusting, trouble-shooting & dismounting of component)

1. 1 x Over-head crane (3 ton)
2. 1 x Lift block tool
3. 1 x Work bench, etc.

Maintenance bay

(Maintenance and repair of construction machinery,
assembling and disassembling of component)

1. 1 x Over-head crane (5 ton)
2. 1 x Lift block tool, etc.

(2) Field service

1. 1 x 4-ton truck w/3-ton crane
2. 1 x 2-ton truck w/2-ton crane (four-wheel drive type)
3. 1 x Engine arc welder
4. 1 x Compressor with engine
5. 1 x Gas cutting kit
6. 2 x General tool set
7. 1 x Lift block tool
8. Others (spare parts, etc.)

(3) Tools & apparatus

1. 4 x General tool set
2. 25 x Hand tool set
3. 1 x Special tool set (Engine)
4. 1 x Special tool set (Fuel)
5. 1 x Special tool set (Chassis)
6. 1 x Special tool set (Undercarriage)
7. 1 x Special tool set (Hydraulic)
8. 1 x Special tool set (others)
9. 1 x Transit
10. Others (Measuring instrument, etc.)

(4) Others

1. 1 x Forklift (5 ton)
2. 2 x Car-washer (cool & hot water)

4. Training

(1) Instructor

| | | |
|--------------------|---------------------|------------|
| Japanese expert: | FY 1992-93 ----- | 4 persons |
| | FY 1994 ----- | 5 persons |
| | FY 1995 ----- | 2 persons |
| Nepal counterpart: | FY 1994 ----- | 5 persons |
| | FY 1995 ----- | 8 persons |
| | After FY 1994 ----- | 10 persons |
| Nepal assistant: | FY 1992-93 ----- | 4 persons |
| | After FY 1994 ----- | 5 persons |

(2) Class

| | |
|---------------------|---|
| FY 1992-93 ----- | 1 class (Staff course) |
| After FY 1993 ----- | 3 classes (Staff, Operator, Mechanic course) |

(3) Number of trainees: 20 +/- 5 per class

(4) Training period

| | |
|--------------------------------|---------|
| Staff course ----- | 2 years |
| Operator/Mechanic course ----- | 1 year |

(5) Training materials

| | |
|---------------------------|-------------------------|
| 1. Audio visual set ----- | 1 x TV & video deck set |
| | 2 x Slide projector |
| | 2 x Over-head projector |
| 2. Cut model ----- | 1 x Engine |
| | 1 x Hydraulic pump |
| | 1 x Torque converter |

(7) Curriculum

| | Staff Course | | Operator Course | | Mechanic Course | |
|---|--------------|----------|-----------------|----------|-----------------|----------|
| | Lecture | Practice | Lecture | Practice | Lecture | Practice |
| 1. Technical skills of const. machinery | | | | | | |
| 1) Introduction | 2 | 2 | 1 | 1 | 1 | 2 |
| 2) Fundamentals of servicing work | 2 | 3 | 1 | 1 | 1 | 3 |
| 3) Servicing work by component | | | | | | |
| (1) Engine | 2 | 2 | 1 | 1 | 2 | 4 |
| (2) Power train | 2 | 2 | 1 | 1 | 2 | 4 |
| (3) Hydraulic system | 2 | 2 | 1 | 1 | 2 | 4 |
| (4) Electric equipment | 2 | 2 | 1 | 1 | 2 | 4 |
| 4) Welding & Sheet metal | 2 | 3 | 1 | 1 | 1 | 4 |
| 2. Operation | | | | | | |
| 1) Machine operation | 2 | 4 | 1 | 4 | 1 | 1 |
| 2) Mechanical earth works | 2 | 4 | 1 | 4 | 0 | 0 |
| 3) Maintenance | 2 | 4 | 1 | 3 | 1 | 1 |
| 3. Civil engineering activities | | | | | | |
| 1) Designing | 2 | 3 | 1 | 3 | 0 | 0 |
| 2) Management | 2 | 3 | 1 | 3 | 0 | 0 |
| 3) Method of earth works | 2 | 4 | 1 | 3 | 0 | 0 |
| 4. Method of guidance | | | | | | |
| 1) Planning of curriculum | 2 | 3 | | | | |
| 2) Teaching know-how | 3 | 8 | | | | |
| Total Credits | 31 | 49 | 13 | 27 | 13 | 27 |
| 1 credit = 35 hours/week | 80/2 years | | 40/1 year | | 40/1 year | |

5. Construction Machinery

| Items | Training | Sindhuli Road Maintenance | | Total |
|-------------------------------|----------|---------------------------|-------------------------|-----------|
| | | Main Camp (Bardibas) | Sub Camp (Nepalthok) | |
| (1) Bulldozer w/Ripper (23 t) | 1 | 1 | 1 | 3 |
| (2) Wheel Loader (1.5 m3) | 1 | 2 | 1 | 4 |
| (3) Motor Grader (3 m) | 1 | 2 | 1 | 4 |
| (4) Excavator (0.5 m3) | 1 | 1 | 1 | 3 |
| (5) Excavator (0.12 m3) | | 1 | 1 | 2 |
| (6) Trailer (25 t) | | 1 | | 1 |
| (7) Dump Truck (2 - 3 t) | | 4 | 2 | 6 |
| (8) Dump Truck (10 - 11 t) | | 4 | 2 | 6 |
| (9) Patrol Car | | 1 | | 1 |
| (10) Water Truck | | 1 | | 1 |
| (11) Truck Crane | 1 | | | 1 |
| (12) Tire Roller | | 1 | 1 | 2 |
| (13) Vibratory Roller | | 1 | 1 | 2 |
| (14) Macadam Roller | 1 | 1 | | 2 |
| (15) Asphalt Finisher | | 1 | 1 | 2 |
| (16) Asphalt Distributer | | 1 | 1 | 2 |
| (17) Road Stabilizer | | 1 | 1 | 2 |
| (18) Generator Set (60 kW) | | 1 | 1 | 2 |
| (19) Compressor (5 m3) | | 1 | 1 | 2 |
| (20) Mini-bus | | 1 | 1 | 2 |
| (21) Jeep | 3 | 5 | 3 | 11 |
| (22) Crushing Plant | | 1 | | 1 |
| Total | 9 | 33 | 20 | 62 |

Appendix 11.5.1 Major Component of Maintenance &
Training Center

Appendix 11.5.1 Major Component of Maintenance & Training Center

(1/3)

| Description | Quantity | Remarks |
|---|-----------------|-------------------|
| 1. Construction of Offices Houses | | |
| 1-1. Administrative Office | 1 unit | 90 m x 15 m |
| 1-2. School Building | 1 unit | 90 m x 15 m |
| 1-3. Workshop | 1 unit | 40 m x 20 m |
| 1-4. Storage (parts, oil, articles) | 3 units | 3@6m x 10 m |
| 1-5. Fuel & Lubricant Service Facility | 1 unit | |
| 1-6. Stockyard (materials, aggregate, etc.) | 3 units | |
| 1-7. Residence for managers & instructors | 20 houses | |
| 1-8. Residence for staffs & trainees | 100 rooms | |
| 1-9. Others (parking lot, etc.) | sum | |
| 2. Equipment & Tools | | |
| 2-1. Over-head crane | 5 units | 2 - 5 ton |
| 2-2. Hydraulic cylinder repair stand | 1 unit | |
| 2-3. Hydraulic shop press | 1 unit | 100 ton |
| 2-4. Lift block tool | 2 units | |
| 2-5. Compressor with engine | 1 unit | for field service |
| 2-6. Forklift | 1 unit | 5 tons |
| 2-7. Tools | sum | |
| 2-8. Others (welder, car washer, etc.) | sum | |
| 3. Training | | |
| 3-1. Class for staff, operator and mechanic courses | 3 classes | |
| 3-2. Number of trainees | 20 person/class | |

| Description | Quantity | Remarks |
|---|----------|---------------------|
| 3-3. Training Period | | |
| Staff course | 2 years | |
| Operator/Mechanic course | 1 year | |
| 3-4. Training material | | |
| Audio visual set | 2 sets | |
| Cut model | 1 set | |
| View model | 1 set | |
| Component | 4 sets | |
| 3-5. Training Category | | |
| Lecture for structure, function, system operation, etc. | | |
| Servicing practice for assembling, testing, welding, etc. | | |
| Operation practice for machine operation, maintenance, etc. | | |
| 3-6. Curriculum | | |
| Technical skills of construction machinery | | |
| Machine operation including maintenance, etc. | | |
| Civil engineering activities including design, management, etc. | | |
| 4. Construction Machinery for Training and Maintenance Work | | |
| Bulldozer w/Ripper (17 - 23 ton) | 3 units | 1 unit for Training |
| Wheel loader (1.5 m ³) | 3 units | - ditto - |
| Motor grader (3 m) | 3 units | - ditto - |
| Excavator (0.5 m ³) | 2 units | - ditto - |
| Excavator (0.12 m ³) | 1 unit | |
| Dump truck (10 ton) | 6 units | 1 unit for Training |
| Truck Crane (10 ton) | 2 units | - ditto - |
| Truck Crane (4 ton) | 2 units | for workshop |
| Tire roller | 1 unit | |

| Description | Quantity | Remarks |
|---------------------------------|----------|--------------------------|
| Vibration roller | 1 unit | |
| Macadam roller | 2 units | 1 unit for Training |
| Asphalt finisher | 1 unit | |
| Asphalt distributor | 1 unit | |
| Generator (60 kW) | 3 units | for office, residence |
| Compressor (5 m3) | 1 unit | |
| Water tanker | 2 units | |
| Crushing plant (50 - 70 ton/hr) | 1 unit | portable |
| Small asphalt plant (10 ton/hr) | 1 unit | |
| Trailer | 1 unit | |
| Jeep | 10 units | 3 units for Training |
| Mini-bus | 4 units | 2 units for Training |
| Others | sum | |
| Total | 51 units | |

Appendix 12.3.1 Basic Information for Unit Vehicle
Operation Cost Estimation

Appendix 12.3.1 Basic Information for Unit
Vehicle Operation Cost Estimation*

(1) Fuel Consumption Rates

| Vehicle Type | Representative Vehicle | Fuel Consumption Rate (ℓ/1000 km) | |
|---------------|----------------------------|-----------------------------------|--------|
| | | Gasoline | Diesel |
| Motor Cycle | Hero Honda | 33.33 | - |
| Passenger Car | TOYOTA Corrola (Delux) | 111.11 | - |
| Truck | 7-8 ton TATA | - | 222.22 |
| Bus | 63 Seater long Chasis TATA | - | 285.71 |

(2) Fuel Prices

(Unit: NRs/litter, in 1987 Price)

| Fuel Type | Retail Price | Duty and Tax | Economic Cost |
|---------------------|--------------|--------------|---------------|
| Gasolin MS 87 Octan | 12.84 | 6.79 | 6.05 |
| Diesel HSD Diesel | 7.46 | 1.89 | 5.57 |

* Source: TATA Company Kathmandu (Kalimati)
TOYOTA House Kathmandu (Lazimpat)
HERO Honda Company (Joti Bhawan)

(3) Oil Consumption Rate

| Vehicle Type | Representative Vehicle | Oil Consumption | |
|---------------|-------------------------------------|-----------------------|-----------------------------------|
| | | Type of oil used | Oil consumption Rate (ℓ/1,000 km) |
| Motor Cycle | Hero Honda | Engine Oil 30 - 40 | 2.00 |
| Passenger Car | TOYOTA Corrola (Delux) | Engine Oil 30 - 40 | 1.75 |
| Truck | 7-8 ton TATA | Diesel Oil 30 - 40 | 3.50 |
| Bus | 63 Seater long Chasis TATA | Diesel Oil 30 - 40 | 3.75 |

(4) Oil Prices

(Unit: NRs/litter, in 1987 Price)

| Oil Type | Retail Price | Duty and Tax | Economic Cost |
|---|--------------|--------------|---------------|
| Engine oil 30 - 40 (Gulf super duty) | 55.75 | 11.08 | 44.67 |
| Diesel oil 30 - 40 (Gulf super duty) | 54.63 | 10.96 | 43.67 |

(5) Index for Fuel and Engine Oil Consumption Rate by Speed Level

| Speed Level (km/h) | Index | | |
|-----------------------|-------------------------------|------------|------------|
| | Motor Cycle/ Passenger Car | Truck | Bus |
| 5 | 292 | 331 | 329 |
| 10 | 233 | 253 | 256 |
| 15 | 195 | 205 | 209 |
| 20 | 167 | 172 | 177 |
| 25 | 149 | 148 | 153 |
| 30 | 135 | 134 | 135 |
| 35 | 124 | 119 | 124 |
| 40 | 117 | 113 | 115 |
| 45 | 110 | 105 | 110 |
| 50 | 106 | 102 | 105 |
| 55 | 103 | <u>100</u> | 102 |
| 60 | 101 | 101 | <u>100</u> |
| 65 | <u>100</u> | 102 | 102 |
| 70 | 101 | 105 | 107 |
| 75 | 102 | 110 | 112 |
| 80 | 104 | 119 | 121 |
| 85 | 106 | 129 | 131 |

- Sources: 1) Kanto Engineering Office, "Fuel Consumption the Vehicle Running on Roads - The Review on the Reports of Survey on Vehicle Fuel Consumption" 1979 Japan.
- 2) M. Sano, "Fuel Consumption on Roads" Traffic Engineering Vol.14 No.2, 1979 in Japan.

(6) Vehicle Prices

| Vehicle Type | Representative Vehicle | Engine Capacity (cc) | Selling Price (NRs) | Price exclud. Taxes (NRs) | Remarks | |
|---------------|-----------------------------|----------------------|---------------------|---------------------------|---------|-------|
| | | | | | (Duty) | (Tax) |
| Motor Cycle | Hero Honda | 100 | 31,000 | 12,400 | 40% | 20% |
| Passenger Car | TOYOTA (Delux) Corolla | 1,300 | 559,000 | 160,000 | 150% | 100% |
| Truck | 7-8 ton TATA | 4,788 | 532,000 | 319,000 | 25% | 15% |
| Bus | 63 Seater long Chassis TATA | 4,788 | 670,000 | 395,300 | 26% | 15% |

(7) Annual Travel Distance and Salvage Value

| Vehicle Type | Representative Vehicle | Service Life (Years) | Annual Distance Travelled (thousand km) | Salvage Value of Vehicle (NRs) |
|---------------|-----------------------------|----------------------|---|--------------------------------|
| Motor Cycle | Hero Honda | 7 | 29.2 | - |
| Passenger Car | TOYOTA (Delux) Corolla | 10 | 29.2 | 20000 |
| Truck | 7-8 ton TATA | 8 | 36.5 | 30000 |
| Bus | 63 Seater long Chassis TATA | 8 | 36.5 | 30000 |

(8) Depreciation, Capital and Interest Cost

| Description | Motor Cycle | Passenger Car | Truck | Bus |
|---|-------------|---------------|---------|---------|
| (A) Initial Vehicle Cost (Economic Cost W.O Tire) | 12,400 | 160,000 | 319,000 | 395,300 |
| (B) Vehicle Use in Year | 7 | 10 | 8 | 8 |
| (C) Salvage Value | - | 20,000 | 30,000 | 30,000 |
| (D) Depreciation Value (A) - (C) | 12,400 | 139,767 | 289,331 | 365,300 |
| (E) Capital Recovery Factor (r = 12%) | 0.2191 | 0.1770 | 0.2013 | 0.2013 |
| (F) Annual Cost (D) x (E) | 2,717 | 24,739 | 58,242 | 73,535 |
| (G) Life Operation (km) | 204,400 | 292,000 | 292,000 | 292,000 |
| (H) Annual Operation (km) | 29,200 | 29,200 | 36,500 | 36,500 |
| (I) Distance-Related Cost $\frac{(D)/(B) \times 1/2}{(H)}$ (NRs/km) | 0.0303 | 0.2394 | 0.4954 | 0.6255 |
| (J) Annual Operation Hours (Hour) | 2,880 | 2,880 | 2,880 | 2,880 |
| (K) Time-Related Cost $\frac{(D)/(B) \times 1/2}{(J)}$ (NRs/Hr) | 0.3076 | 2.4271 | 6.2788 | 7.9278 |
| (L) Interest Charge $((F) - (D))/(B) - J$ (NRs/Hr) | 0.3285 | 3.7368 | 7.6653 | 9.6778 |
| (M) Capital Cost (K) + (L) (NRs/Hr) | 0.6361 | 5.1639 | 13.9441 | 17.6056 |

(9) Prices of Tire and Average Life Length of Tire

| Vehicle Type | Representative Vehicle | Number of Tires | Average Life (km) | Unit Price of Tire & Tube | | Share of Custom and Duty | |
|---------------|----------------------------|-----------------|-------------------|---------------------------|---------------------|--------------------------|-------|
| | | | | Retail Price (NRs) | Economic Cost (NRs) | (Duty) | (Tax) |
| Motor Cycle | Hero Honda | 2 | 18,000 | 600 | 300 | 40% | 10% |
| Passenger Car | TOYOTA (Delux) Corolla | 4 | 35,000 | 1,850 | 388.50 | 69% | 10% |
| Truck | 7-8 ton TATA | 6 | 30,000 | 9,000 | 2,160 | 66% | 10% |
| Bus | 63 Seater long Chasis TATA | 6 | 30,000 | 9,000 | 2,160 | 66% | 10% |

(10) Annual Repair and Maintenance costs

| Vehicle Type | Representative Vehicle | Annual Expenditure on Parts (excluding Tires) | | Annual Expenditure on Labor | | |
|---------------|---------------------------------------|---|----------------------|---------------------------------------|-----------------------------|---------------------------------|
| | | In terms of % of Initial Vehicle Price (1) | In terms of NRs. (2) | Labor hours for maintenance per annum | Wage rate per hours (NRs/h) | Labor cost per annum (NRs/Year) |
| Motor Cycle | Hero Honda | 5% | 680 | 8x6= 48 | 10 | NRs. 480 |
| Passenger Car | TOYOTA (Delux) Corolla (1300) | 5% | 8,000 | 24x6=144 | 10 | NRs.1,440 |
| Truck | 7-8 ton TATA | 10% | 31,900 | 28x6=168 | 10 | NRs.1,680 |
| Bus | 63 Seater Long Chasis TATA (L.P.0.55) | 10% | 39,500 | 28x6=168 | 10 | NRs.1,680 |

(11) Crew Cost

| Vehicle Type | Representative Vehicle | Crew Type | Monthly Income per person (NRs) | Annual Income per person (NRs) | Operation hours per day | Annual Operation hours | Remarks (if any) |
|---------------|---------------------------------------|-----------|---------------------------------|--------------------------------|-------------------------|------------------------|------------------|
| Motor Cycle | Hero Honda | - | - | - | 8 | 2,880 | |
| Passenger Car | TOYOTA (Delux) Corolla (1300) | Driver | 1,000 | 12,000 | 8 | 2,880 | |
| Truck | 7-8 ton TATA | Driver | 1,700 | 20,400 | 8 | 2,880 | |
| | | Assistant | 700 | 8,400 | 8 | 2,880 | |
| Bus | 63 Seater Long Chasis TATA (L.P.0.55) | Driver | 1,700 | 20,400 | 8 | 2,880 | |
| | | Assistant | 700 | 8,400 | 8 | 2,880 | |

(12) Estimation of Unit Vehicle Operating Costs
(Tire Cost, Maintenance Cost, Crew Cost and Overhead)

| Description | | Motorcycle | Passenger Car | Truck | Bus |
|-------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----------------------------|
| Tire (Set) | Price of a set | 300NRs x 2 = 600NRs | 388.5NRs x 4 = 1,554NRs | 2,160NRs x 6 = 12,960NRs | 2,160NRs x 6 = 12,960NRs |
| | Tire life in km | 18,000 km | 35,000 km | 30,000 km | 30,000 km |
| | Tire cost per km | 0.03333 NRs/km | 0.0444 NRs/km | 0.4320 NRs/km | 0.4320 NRs/km |
| Maintenance | Part cost (per year) | 620 NRs/Year | 2,988 NRs/Year | 31,900 NRs/Year | 39,500 NRs/Year |
| | Labour cost (per year) | 480 NRs/Year | 1,440 NRs/Year | 1,680 NRs/Year | 1,680 NRs/Year |
| | Total maintenance cost (per year) | 1,100 NRs/Year | 9,428 NRs/Year | 33,580 NRs/Year | 41,180 NRs/Year |
| | Annual Distance Traveled (km) | 29,200 km | 29,200 km | 36,500 km | 36,500 km |
| | Part cost per 1,000 km | 21.33 NRs | 273.56 NRs | 874.88 NRs | 1,083.01 NRs |
| | Labour cost per 1,000 km | 16.44 NRs | 49.32 NRs | 46.03 NRs | 46.03 NRs |
| | Total maintenance cost per 1,000 km | 37.67 NRs | 322.88 NRs | 920.91 NRs | 1,129.04 NRs |
| Crew Cost | Wage per hour (driver) | - | 4.167 NRs | 7.083 NRs | 7.083 NRs |
| | Wage per hour (Assistant) | - | - | 2.917 NRs | 2.917 NRs |
| | Total wage per hour | - | 4.167 NRs | 10.0 NRs | 10.0 NRs |
| Overhead* | 15% of total Vehicle Operating Cost | 15% of total Vehicle Operating Cost | 25% of total Vehicle Operating Cost | 25% of total Vehicle Operating Cost | |

* Percentages in this table are assumed based upon the existing study about the second east-west highway, the World Bank, 1986.

