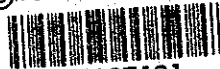


JICA LIBRARY



1104137(3)

24827

REPUBLIC OF KENYA



MINISTRY OF PUBLIC WORKS

DETAILED DESIGN STUDY

ON

THE NAIROBI BYPASS PROJECT

DETAILED CALCULATIONS

FOR QUANTITIES

VOL-3

SEPTEMBER 1992

Japan International
Cooperation Agency

The Permanent Secretary
Ministry of Public Works
P.O.Box 30260
NAIROBI

The Chief Engineer (Roads)
Ministry of Public Works
P.O.Box 30260
NAIROBI

国際協力事業団

24827

CONTENTS

I. SUMMARY

1. BOX CULVERTS

2. BRIDGES

II. DETAILED DESCRIPTIONS

1. BRIDGES ON THE MAIN ROADS

2. OVERBRIDGES

3. BOX CULVERTS

I. SUMMARY

1. BOX CULVERTS 1

2. BRIDGES 61 — 84

BOX CULVERTS

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | Road | Footpath | Drainage | TOTAL |
|----------|--|----------------|----------|----------|----------|---------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 5207.4 | 999.8 | 9673.0 | 15 880. |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | — | — | — | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 1 878.8 | 655.3 | 3609.5 | 6 144 . |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | 13 589.1 | 1375.4 | 7707.9 | 22672. |
| 7.05 | porous filter material behind abutment, wall. | m ³ | 976.1 | 200.8 | 810.8 | 1988. |
| 7.06 | selected granular fill for base. | m ³ | 680.7 | 821 | 797.5 | 1560. |

BILL OF QUANTITIES NO.23
PILING

| ITEM NO. | DESCRIPTION | UNIT | | | | |
|----------|--|------|--|--|--|--|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. | | | | |
| 23.02 | Move and set up each pile position. | No. | | | | |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m | | | | |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m | | | | |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | Road | FootPath | Drainage | TOTAL |
|----------|--|----------------|--------|----------|----------|--------|
| | BOX CULVERTS | | | | | |
| | Concrete: | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2746 | 41.2 | 272.3 | 558. |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 7821.6 | 646.2 | 6318.8 | 14787. |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | 4945.3 | 722.7 | 4207.1 | 9875. |
| | Formwork: | | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | — | — | — | — |
| 17.26 | As for item 17.25 but sloping. | m ² | — | — | — | — |
| 17.27 | As for item 17.25 but battered. | m ² | — | — | — | — |
| 17.28 | As for item 17.25 but vertical. | m ² | 6336.8 | 1344.6 | 4435.8 | 12117. |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2145.5 | 305.1 | 1549.9 | 40000. |
| 17.30 | As for item 17.29 but sloping. | m ² | — | — | — | — |
| 17.31 | As for item 17.29 but battered. | m ² | — | — | — | — |
| 17.32 | As for item 17.29 but vertical. | m ² | 3430.7 | 610.2 | 3412.2 | 7453. |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | — | — | — | — |
| 17.34 | As for item 17.33 but sloping. | m ² | — | — | — | — |
| 17.35 | As for item 17.33 but battered. | m ² | — | — | — | — |
| 17.36 | As for item 17.33 but vertical. | m ² | — | — | — | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 61.4 | 41.7 | 111.7 | 215. |
| 17.38 | As for item 17.37 but of diameter greater than 16mm. | tonne | 908.6 | — | 316.3 | 1225. |
| | Total | tonne | 970.0 | 41.7 | 428.0 | 1440. |

BILL OF QUANTITIES No.21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Road | Foot path | Drain age | TOTAL |
|----------|--|--|--------|-----------|--------------|--------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 7067.3 | 1344.1 | 56386 | 14 050. |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | | | | |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | | | | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | | | | |
| | joint filler | m ² 25 | | | | |
| | | m ² 20 | 3015 | 216 | 3882 | 711.3 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | | | | |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | | | | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 141.5 | — | — | 1415(—) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | | | | |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | | | | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | | | | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | | | | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | | | 196. | 196. |
| 21.15 | Provide and place 200mm dia. PVC drainage pipe. | No. | 18 | 12 | — | 30. |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 5225 | 197.0 | 8184 | 1538. |
| 21.14 | Dowel bar Movable 20mm dia. | No. | | | | |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | | | | |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 353.0 | 54.4 | 501.8 | 909.2 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | | | 550. 275. | 550. 275. |

Total of each boxes

BOXCULVERT FOR ROAD (VEHICLE)

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | NO 5 | NO 6 | NO 7 | TOTAL |
|----------|---|----------------|--------|--------|--------|--------|--------|--------|--------|---------|
| 7.01 | Excavation of foundation levels in soft materials. | m ³ | 582.3 | 451.0 | 1488.5 | 512.8 | 447.7 | 531.9 | 1143.2 | 5207.4 |
| 7.02 | E.O Item 7.01 at any location for excavation in hard materials. | m ³ | — | — | — | — | — | — | — | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 175.6 | 366.0 | 427.1 | 180.2 | 154.7 | 211.2 | 364.0 | 1878.8 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | 1609.4 | 1243.1 | 3906.1 | 1270.7 | 1205.5 | 1148.7 | 3205.6 | 13589.1 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | 124.9 | 99.4 | 235.9 | 98.7 | 96.4 | 91.9 | 228.9 | 976.1 |
| 7.06 | selected granular fill for base. | m ³ | 107.5 | 53.2 | 224.1 | 68.3 | 54.3 | 51.9 | 121.4 | 680.7 |

BILL OF QUANTITIES NO. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

ROAD

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | NO 5 | NO 6 | NO 7 | TOTAL |
|----------|--|----------------|--------|------|--------|-------|-------|-------|--------|--------|
| | BOX CULVERTS | | | | | | | | | |
| | Concrete: | | | | | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ² | 390 | 266 | 679 | 272 | 272 | 260 | 607 | 274.6 |
| 17.23 | Class 25/20 for structural concrete. | m ² | 1158.7 | 6975 | 2455.6 | 7932 | 6985 | 6704 | 13477 | 7821.6 |
| 17.24 | Provide UP2 finish to concrete surface. | m ² | 725.7 | 4996 | 1187.2 | 512.8 | 512.2 | 4900 | 1017.8 | 4945.3 |
| | Formwork: | | | | | | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | — | — | — | — | — | — | — | — |
| 17.26 | As for Item 17.25 but sloping. | m ² | — | — | — | — | — | — | — | — |
| 17.27 | As for Item 17.25 but battered. | m ² | — | — | — | — | — | — | — | — |
| 17.28 | As for Item 17.25 but vertical. | m ² | 951.1 | 7986 | 1476.4 | 783.9 | 784.6 | 2856 | 12566 | 6336.8 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 3230 | 2200 | 5050 | 227.0 | 227.0 | 2168 | 426.7 | 2145.5 |
| 17.30 | As for Item 17.29 but sloping. | m ² | — | — | — | — | — | — | — | — |
| 17.31 | As for Item 17.29 but battered. | m ² | — | — | — | — | — | — | — | — |
| 17.32 | As for Item 17.29 but vertical. | m ² | 374.7 | 3080 | 664.4 | 307.1 | 2990 | 764.5 | 713.0 | 3430.7 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | — | — | — | — | — | — | — | — |
| 17.34 | As for Item 17.33 but sloping. | m ² | — | — | — | — | — | — | — | — |
| 17.35 | As for Item 17.33 but battered. | m ² | — | — | — | — | — | — | — | — |
| 17.36 | As for Item 17.33 but vertical. | m ² | — | — | — | — | — | — | — | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | Tonne | 76 | 53 | 18.7 | 5.6 | 5.3 | 5.5 | 134 | 61.4 |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | Tonne | 122.0 | 886 | 271.1 | 89.7 | 84.6 | 82.4 | 1702 | 908.6 |
| | Total | Tonne | 1296 | 93.9 | 2898 | 95.3 | 89.9 | 87.9 | 1836 | 970.0 |

BILL OF QUANTITIES No. 21
MISCELLANEOUS

ROAD

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | NO 5 | NO 6 | NO 7 | TOTAL |
|----------|--|--|--------|--------|--------|--------|--------|--------|--------|---------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1024.1 | 780.1 | 1586.3 | 787.2 | 771.9 | 741.8 | 1375.9 | 7067.3 |
| 21.02 | Supply and install in position rubber seal bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | | | | | | | | |
| 21.03 | Supply and install in position rubber seal bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | | | | | | | | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | | | | | | | | |
| | joint filler | m ² 25 | | | | | | | | |
| | | m ² 20 | 32.9 | 21.9 | 95.6 | 22.9 | 22.7 | 22.7 | 82.8 | 301.5 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | | | | | | | | |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ² (m ²) | | | | | | | | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ² (m ²) | 196(-) | 147(-) | 334(-) | 141(-) | 150(-) | 143(-) | 304(-) | 1415(-) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | | | | | | | | |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | | | | | | | | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | | | | | | | | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | | | | | | | | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | | | | | | | | |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 | 2 | 4 | 2 | 2 | 4 | 2 | 18 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 62.2 | 52.6 | 117.2 | 51.0 | 51.0 | 48.6 | 139.9 | 522.5 |
| 21.14 | Drawl bar: Movable 20mm dia. | No. | | | | | | | | |
| 21.15 | Drawl bar: Fixed 40mm dia. | No. | | | | | | | | |
| 21.17 | Water stop 200mm wide waterstops as specified in the Drawings. | m | 35.3 | 30.1 | 80.4 | 31.4 | 31.1 | 31.1 | 113.6 | 353.0 |
| 20.18 | Provide 500mm thickness galton mesh. | m ² (m ²) | | | | | | | | |

BOXCULVERT FOR FOOTPATH (PEDESTRIAN)

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | | TOTAL | | |
|----------|---|----------------|-------|-------|-------|-------|--|--------|--|--|
| 7.01 | Excavation of foundation levels in soft materials. | m ³ | 220.1 | 305.8 | 220.1 | 253.8 | | 999.8 | | |
| 7.02 | E.O Item 7.01 at any location for excavation in hard materials. | m ³ | — | — | — | — | | — | | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 116.0 | 207.3 | 156.0 | 176.0 | | 655.3 | | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | 379.9 | 331.0 | 331.0 | 333.5 | | 1375.4 | | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | 55.5 | 48.3 | 48.3 | 48.7 | | 200.8 | | |
| 7.06 | selected granular fill for base. | m ³ | 22.6 | 19.8 | 19.8 | 19.9 | | 82.1 | | |

BILL OF QUANTITIES NO. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

FOOTPATH

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | TOTAL | | |
|----------|--|----------------|-------|------|-------|-------|-------|--|--|
| | BOX CULVERTS | | | | | | | | |
| | Concrete: | | | | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ² | 11.4 | 99 | 9.9 | 10.0 | 41.2 | | |
| 17.23 | Class 25/20 for structural concrete. | m ² | 175.7 | 1566 | 156.9 | 157.0 | 6462 | | |
| 17.24 | Provide WP2 finish to concrete surface. | m ² | 1982 | 1744 | 174.4 | 175.7 | 7227 | | |
| | Formwork: | | | | | | | | |
| | Provide, erect and afterwards dismantle and remove the forms specified below: | | | | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | — | — | — | — | — | | |
| 17.26 | As for Item 17.25 but sloping. | m ² | — | — | — | — | — | | |
| 17.27 | As for Item 17.25 but battered. | m ² | — | — | — | — | — | | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 3562 | 3296 | 331.0 | 327.8 | 13446 | | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 840 | 735 | 735 | 74.1 | 3051 | | |
| 17.30 | As for Item 17.29 but sloping. | m ² | — | — | — | — | — | | |
| 17.31 | As for Item 17.29 but battered. | m ² | — | — | — | — | — | | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 1680 | 1470 | 1470 | 148.2 | 6102 | | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | — | — | — | — | — | | |
| 17.34 | As for Item 17.33 but sloping. | m ² | — | — | — | — | — | | |
| 17.35 | As for Item 17.33 but battered. | m ² | — | — | — | — | — | | |
| 17.36 | As for Item 17.33 but vertical. | m ² | — | — | — | — | — | | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | Tonne | 12.4 | 9.7 | 9.7 | 9.9 | 41.7 | | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | Tonne | — | — | — | — | — | | |
| | Total | Tonne | 12.4 | 9.7 | 9.7 | 9.9 | 41.7 | | |

FOOTPATH.

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | TOTAL | | |
|----------|--|--|------|------|------|------|-------|--|--|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 3657 | 3258 | 3262 | 3264 | 13441 | | |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | | | | | | | |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | | | | | | | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | | | | | | | |
| | Joint filler | m ² 25 | | | | | | | |
| | | m ² 20 | 54 | 54 | 54 | 54 | 216 | | |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | | | | | | | |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | | | | | | | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | | | | | | | |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | | | | | | | |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | | | | | | | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | | | | | | | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | | | | | | | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | | | | | | | |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 | 4 | 4 | 2 | 12 | | |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 544 | 474 | 474 | 478 | 1970 | | |
| 21.14 | Dowel bar Movable 20mm dia. | No. | | | | | | | |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | | | | | | | |
| 21.17 | Water stop 200mm wide waterstops as specified in the Drawings. | m | 136 | 136 | 136 | 136 | 544 | | |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | | | | | | | |

BOXCULVERT FOR DRAINAGE (WATER)

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | NO 5 | | TOTAL |
|----------|---|----------------|--------|-------|--------|-------|--------|--|--------|
| 7.01 | Excavation of foundation levels in soft materials. | m ³ | 403.8 | 159.7 | 3240.7 | 840.1 | 5028.7 | | 9673.0 |
| 7.02 | E.O Item 7.01 at any location for excavation in hard materials. | m ³ | — | — | — | — | — | | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 141.8 | 55.0 | 1642.8 | 357.1 | 1412.8 | | 3609.5 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | 1074.1 | 573.1 | 1257.7 | 758.8 | 4044.2 | | 7707.9 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | 132.5 | 72.0 | 148.5 | 90.1 | 367.7 | | 810.8 |
| 7.06 | selected granular fill for base. | m ³ | — | — | — | — | 797.5 | | 797.5 |

BILL OF QUANTITIES NO. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

DRAINAGE

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | NO 5 | | | TOTAL |
|-------------|--|----------------|-------|-------|-------|-------|--------|--|--|--------|
| | BOX CULVERTS | | | | | | | | | |
| | Concrete: | | | | | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 363 | 142 | 41.7 | 24.7 | 155.4 | | | 272.3 |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 5068 | 232.2 | 761.8 | 433.3 | 4384.7 | | | 6318.8 |
| 17.24 | Provide WP2 finish to concrete surface. | m ² | 5285 | 205.1 | 638.4 | 379.9 | 2455.2 | | | 4207.1 |
| | Formwork: | | | | | | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | — | — | — | — | — | | | — |
| 17.26 | As for item 17.25 but sloping. | m ² | — | — | — | — | — | | | — |
| 17.27 | As for item 17.25 but battered. | m ² | — | — | — | — | — | | | — |
| 17.28 | As for item 17.25 but vertical. | m ² | 717.7 | 400.0 | 764.9 | 483.7 | 2069.5 | | | 4435.8 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 183.0 | 68.4 | 234.5 | 140.0 | 924.0 | | | 1549.9 |
| 17.30 | As for item 17.29 but sloping. | m ² | — | — | — | — | — | | | — |
| 17.31 | As for item 17.29 but battered. | m ² | — | — | — | — | — | | | — |
| 17.32 | As for item 17.29 but vertical. | m ² | 441.1 | 249.9 | 472.4 | 288.8 | 1960.0 | | | 3412.2 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | — | — | — | — | — | | | — |
| 17.34 | As for item 17.33 but sloping. | m ² | — | — | — | — | — | | | — |
| 17.35 | As for item 17.33 but battered. | m ² | — | — | — | — | — | | | — |
| 17.36 | As for item 17.33 but vertical. | m ² | — | — | — | — | — | | | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | Tonne | 27.1 | 12.0 | 11.9 | 13.9 | 46.8 | | | 111.7 |
| 17.38 | As for item 17.37 but of diameter greater than 16mm. | Tonne | — | — | 61.3 | 15.9 | 239.1 | | | 316.3 |
| | Total | Tonne | 27.1 | 12.0 | 73.2 | 29.8 | 285.9 | | | 428.0 |

BILL OF QUANTITIES No. 21
MISCELLANEOUS

DRAINAGE

| ITEM NO. | DESCRIPTION | UNIT | NO 1 | NO 2 | NO 3 | NO 4 | NO 5 | TOTAL |
|----------|--|--|------|-------|-------|------|--------|-------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 7909 | 392.1 | 958.1 | 5785 | 2919.0 | 56386 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | | | | | | |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | | | | | | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | | | | | | |
| | joint filler | m ² 25 | | | | | | |
| | | m ² 20 | 320 | 127 | 399 | 308 | 2728 | 3882 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | | | | | | |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ² (m ²) | | | | | | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ² (m ²) | | | | | | |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | | | | | | |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | | | | | | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | | | | | | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | | | | | | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 38 | 26 | 40 | 26 | 66 | 196 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | | | | | | |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 1580 | 864 | 1660 | 1020 | 3060 | 8184 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | | | | | | |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | | | | | | |
| 21.17 | Water stop 200mm wide waterstops as specified in the Drawings. | m | 659 | 322 | 714 | 437 | 2886 | 5018 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ²) | 100 | 90 | 90 | 80 | 190 | 550 |
| | | | 50 | 45 | 45 | 40 | 95 | 275 |

No.1 Box for Road

BILL OF QUANTITIES No.7
EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 + B2 | Total quantity | |
|----------|---|----------------|---------|----------------|--|
| 7.01 | Excavation of foundation levels in soft materials. | m ³ | — | 582.329 | |
| 7.02 | E.O Item 7.01 at any location for excavation in hard materials. | m ³ | — | — | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | — | 175.648 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | — | 1609.374 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | — | 124.909 | |
| 7.06 | selected granular fill for base. | m ³ | — | 107.463 | |

BILL OF QUANTITIES NO.23
PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 + B2 | Total quantity | |
|----------|--|----------------|--------------------------------------|----------------|--|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | | 39.005 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 579.735 + 578.944 | 1158.679 | |
| 17.24 | Provide B/F2 finish to concrete surface. | m ² | | 725.740 | |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | - | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | - | |
| 17.27 | As for Item 17.25 but battered. | m ² | | - | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 493.017 + 458.040 | 951.057 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 161.500 X 2 | 323.000 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | - | |
| 17.31 | As for Item 17.29 but battered. | m ² | | - | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 187.340 X 2 | 374.680 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | - | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | - | |
| 17.35 | As for Item 17.33 but battered. | m ² | | - | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | - | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 3180 + 3165 + 2 X 635 = 7.6 | 7.6 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 55 729 + 58048 + 2 X 4088 = 122.0 | 122.0 | |
| | Total | tonne | 129.6 | 129.6 | |

BILL OF QUANTITIES No. 21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1024.142 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | - |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | - - - - |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | - |
| | joint filler | m ² 25 | - |
| | | m ² 20 | 32.860 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | - - |
| 21.06 | Provide 50mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | - |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 19.598 (-) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | - |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | - |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | - |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | - |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | - |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 62.144 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | - |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | - |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 35.300 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | - - |

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 + B2 | Total quantity | |
|----------|--|----------------|---------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 450.959 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | — | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 366.013 | |
| 7.04 | Backfilling with selected material behind abutment,wall. | m ³ | _____ | 1243.058 | |
| 7.05 | porous filter material behind abutment,wall. | m ³ | _____ | 99.414 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 53.184 | |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|---|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation,setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick,Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B ₁ + B ₂ | Total quantity |
|----------|--|----------------|---------------------------------|----------------|
| | BOX CULVERTS | | | |
| | Concrete: | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | _____ | 26.592 |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 348.737 X 2 | 697.474 |
| 17.24 | Provide U/2 finish to concrete surface. | m ² | _____ | 499.620 |
| | Formwork: | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | _____ | — |
| 17.26 | As for Item 17.25 but sloping. | m ² | _____ | — |
| 17.27 | As for Item 17.25 but battered. | m ² | _____ | — |
| 17.28 | As for Item 17.25 but vertical. | m ² | 410.292 + 388.352 | 798.644 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 110.000 X 2 | 220.000 |
| 17.30 | As for Item 17.29 but sloping. | m ² | _____ | — |
| 17.31 | As for Item 17.29 but battered. | m ² | _____ | — |
| 17.32 | As for Item 17.29 but vertical. | m ² | 154.000 X 2 | 308.000 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | _____ | — |
| 17.34 | As for Item 17.33 but sloping. | m ² | _____ | — |
| 17.35 | As for Item 17.33 but battered. | m ² | _____ | — |
| 17.36 | As for Item 17.33 but vertical. | m ² | _____ | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 2109 + 2 X 521 = 5.3 | 5.3 |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2 X 40431 + 2 X 3874 = 88.6 | 88.6 |
| | Total | tonne | 93.9 | 93.9 |

BILL OF QUANTITIES No.21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 780.109 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | joint filler | m ² 25 m ² 20 | — 21.940 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 14.712 (-) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 52.600 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 30.100 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 | B2 | B3 | W | Total quantity |
|----------|--|----------------|----|----------|----|--------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | | 1435.930 | | 52.579 | 1488.509 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | | | | | - |
| 7.03 | Backfilling with selected material for excavation. | m ³ | | 411.302 | | 15.802 | 427.104 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | | | 3906.144 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | | | 235.872 |
| 7.06 | selected granular fill for base. | m ³ | | 216.229 | | 7.888 | 224.118 |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B ₁ | B ₂ | B ₃ | W | Total quantity |
|----------|--|----------------|----------------|----------------|----------------|--------|----------------|
| | BOX CULVERTS | | | | | | |
| | Concrete: | | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | | 63.927 | | 3.944 | 67.871 |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 772.309 | 827.368 | 797.236 | 58.640 | 2455.553 |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | | | | | 1187.160 |
| | Formwork: | | | | | | |
| | Provide, erect and afterwards dismantle and remove the Items specified below: | | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | | | | — |
| 17.26 | As for Item 17.25 but sloping. | m ² | | | | | — |
| 17.27 | As for Item 17.25 but battered. | m ² | | | | | — |
| 17.28 | As for Item 17.25 but vertical. | m ² | 427.978 | 400.608 | 565.367 | 82490 | 1476.443 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 164.200 | 182.240 | 158.560 | — | 505.000 |
| 17.30 | As for Item 17.29 but sloping. | m ² | | | | | — |
| 17.31 | As for Item 17.29 but battered. | m ² | | | | | — |
| 17.32 | As for Item 17.29 but vertical. | m ² | 197.040 | 218.688 | 190.272 | 58.400 | 664.400 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | | | | — |
| 17.34 | As for Item 17.33 but sloping. | m ² | | | | | — |
| 17.35 | As for Item 17.33 but battered. | m ² | | | | | — |
| 17.36 | As for Item 17.33 but vertical. | m ² | | | | | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 4833 472 | 5919 | 4895 975 | 1570 | 18.7 |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 88145 2616 | 82722 | 88957 7189 | 1512 | 271.1 |
| | Total | tonne | 96.1 | 88.7 | 102.0 | 3.1 | 289.8 |

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1586.305 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | joint filler | m ² 25 (B) (W) m ² 20 90.800 + 4.780 | — 95.580 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 33.352 (-) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 4 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 117.200 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m 73.800 + 6.600 | 80.400 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 + B2 | Total quantity | |
|----------|--|----------------|---------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 512.844 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | — | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 180.221 | |
| 7.04 | Backfilling with selected material behind abutment,wall. | m ³ | _____ | 1270.681 | |
| 7.05 | porous filter material behind abutment,wall. | m ³ | _____ | 98.662 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 68.256 | |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|---|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation,setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick,Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B ₁ + B ₂ | Total quantity | |
|----------|--|----------------|---------------------------------|----------------|--|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | | 27.169 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 396590 X 2 | 793.180 | |
| 17.24 | Provide WFZ finish to concrete surface. | m ² | | 512.760 | |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | — | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | — | |
| 17.27 | As for Item 17.25 but battered. | m ² | | — | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 403421 + 380521 | 783.942 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 113475 X 2 | 226.950 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | — | |
| 17.31 | As for Item 17.29 but battered. | m ² | | — | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 153525 X 2 | 307.050 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | — | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | — | |
| 17.35 | As for Item 17.33 but battered. | m ² | | — | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | — | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2x2147 + 2x677 | 5.6 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2x40749 + 2x4093 | 89.7 | |
| | Total | tonne | 95.3 | 95.3 | |

BILL OF QUANTITIES No. 21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 787.170 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | joint filler | m ² 25 m ² 20 | — 22.900 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 14.090 (-) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 50.988 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 31.400 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

BILL OF QUANTITIES No.7
EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B ₁ + B ₂ | Total quantity | |
|----------|--|----------------|---------------------------------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 447.659 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | — | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 154.688 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | _____ | 1205.470 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | _____ | 96.390 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 54.338 | |

BILL OF QUANTITIES NO.23
PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade _____ | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 + B2 | Total quantity | |
|----------|--|----------------|----------------------|----------------|--|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ² | ----- | 27.169 | |
| 17.23 | Class 25/20 for structural concrete. | m ² | 349.259 X 2 | 698.518 | |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | ----- | 512.160 | |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | — | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | — | |
| 17.27 | As for Item 17.25 but battered. | m ² | | — | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 403620 + 380930 | 784.550 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 113.475 X 2 | 226.950 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | — | |
| 17.31 | As for Item 17.29 but battered. | m ² | | — | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 149520 X 2 | 299.040 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | — | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | — | |
| 17.35 | As for Item 17.33 but battered. | m ² | | — | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | — | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 x 2170 + 2 x 471 | 5.3 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2 x 38513 + 2 x 3805 | 84.6 | |
| | Total | tonne | 89.9 | 89.9 | |

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|----------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 771.900 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | -- |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | -- -- -- -- |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thicketh 30 ^{mm} | -- |
| | joint filler | m ² 25 m ² 20 | -- 22.690 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | -- -- |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | -- |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 14.952 (-) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | -- |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | -- |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | -- |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | -- |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | -- |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 51.000 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | -- |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | -- |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 31.100 |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | -- -- |

BILL OF QUANTITIES No. 7
EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B ₁ + B ₂ | Total quantity | |
|----------|--|----------------|---------------------------------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 581.930 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | — | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 211.217 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | _____ | 1148.742 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | _____ | 91.854 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 51.914 | |

BILL OF QUANTITIES NO. 23
PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade _____ | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 + B2 | Total quantity | |
|----------|--|----------------|-----------------------|----------------|--|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | | 25.957 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 335.205 X 2 | 670.410 | |
| 17.24 | Provide WF2 finish to concrete surface. | m ² | | 489.960 | |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | - | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | - | |
| 17.27 | As for Item 17.25 but battered. | m ² | | - | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 142,800 X 2 | 285.600 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 108,375 X 2 | 216.750 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | - | |
| 17.31 | As for Item 17.29 but battered. | m ² | | - | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 393,579 + 370,889 | 764.468 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | - | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | - | |
| 17.35 | As for Item 17.33 but battered. | m ² | | - | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | - | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 2070 + 2 X 651 | 5.5 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2 X 374.36 + 2 X 3788 | 82.4 | |
| | Total | tonne | 87.9 | 87.9 | |

BILL OF QUANTITIES No. 21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 741.839 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickneth 30 ^{mm} | — |
| | joint filler | m ² 25 m ² 20 | — 22.690 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 14.280 (-) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 4 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 48.600 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 31.100 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

No.7 Box for Road

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 = B4 | B2 = B3 | W1 ~ W3 | Total quantity |
|----------|---|----------------|----------|---------|--|----------------|
| 7.01 | Excavation of foundation levels in soft materials. | m ³ | 1018.680 | | 51.412 36.563 36.503] = 124.478 | 1143.158 |
| 7.02 | E.O Item 7.01 at any location for excavation in hard materials. | m ³ | | | | - |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 324.167 | | 19.423 14.086 6.339] = 39.848 | 364.015 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | | 3205.583 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | | 228.885 |
| 7.06 | selected granular fill for base. | m ³ | 101.870 | | 6.664 4.704 8.134] = 19.502 | 121.372 |

BILL OF QUANTITIES NO. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 = B4 + B2 - B3 | W1 ~ W3 | Total quantity |
|----------|--|----------------|------------------------------------|--|----------------|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 50.935 | 3,332+2,352 + 4,067 50,646 + 34,487 | 60.686 |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 328,061 + 2 X 273,120 | + 60,162 | 1347.657 |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | | | 1017.775 |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | | - |
| 17.26 | As for Item 17.25 but sloping. | m ² | | | - |
| 17.27 | As for Item 17.25 but battered. | m ² | | | - |
| 17.28 | As for Item 17.25 but vertical. | m ² | 2 X 321,553 + 217,120 + 194,360 | 70,676 + 48,777 + 82,552 | 1256.591 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 X 111,350 + 2 X 102,000 | | 426.700 |
| 17.30 | As for Item 17.29 but sloping. | m ² | | | - |
| 17.31 | As for Item 17.29 but battered. | m ² | | | - |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2 X 148,030 + 2 X 135,600 | 51,536 + 24,437 + 59,812 | 713.045 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | | - |
| 17.34 | As for Item 17.33 but sloping. | m ² | | | - |
| 17.35 | As for Item 17.33 but battered. | m ² | | | - |
| 17.36 | As for Item 17.33 but vertical. | m ² | | | - |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 2116 + 759 2 X 1926 | 1570 1843 1129 | 13.4 |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2 X 46648 + 1602 2 X 35633 | 1413 1599 1065 | 170.2 |
| | Total | tonne | 175.0 | 8.6 | 183.6 |

BILL OF QUANTITIES No. 21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|-------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1 375. 862 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. joint filler | m ² thickness 30 ^{mm} m ² 25 m ² 20 68280 + 4.745 × 2 (B) (W) | — — 82. 782 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 30. 371 (—) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 139. 900 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m 93600 + [6.935 8.550 6.550 | 113. 635 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

No.1 Box for Footpath

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 = B2 | Total quantity | |
|----------|--|----------------|---------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 220.081 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | — | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 116.017 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | _____ | 379.937 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | _____ | 55.488 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 22.560 | |

BILL OF QUANTITIES NO.23

PIILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 = B2 | Total quantity |
|----------|--|----------------|---------------------|----------------|
| | BOX CULVERTS | | | |
| | Concrete: | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 5.673 | 11.346 |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 87.825 | 175.650 |
| 17.24 | Provide U2 finish to concrete surface. | m ² | | 198.240 |
| | Formwork: | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | — |
| 17.26 | As for Item 17.25 but sloping. | m ² | | — |
| 17.27 | As for Item 17.25 but battered. | m ² | | — |
| 17.28 | As for Item 17.25 but vertical. | m ² | 180.814 + 175.374 | 356.188 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 X 42.000 | 84.000 |
| 17.30 | As for Item 17.29 but sloping. | m ² | | — |
| 17.31 | As for Item 17.29 but battered. | m ² | | — |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2 X 84.000 | 168.000 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | — |
| 17.34 | As for Item 17.33 but sloping. | m ² | | — |
| 17.35 | As for Item 17.33 but battered. | m ² | | — |
| 17.36 | As for Item 17.33 but vertical. | m ² | | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 5380 2 X 832 | 12.4 |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | — | — |
| | Total | tonne | 12.4 | 12.4 |

No.1 Box for Footpath

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 365.707 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | joint filler | m ² 25 m ² 20 | — 5.440 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 54.400 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 13.600 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

No.2 Box for Footpath

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B ₁ = B ₂ | Total quantity | |
|----------|--|----------------|---------------------------------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 305.837 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | - | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 207.303 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | _____ | 331.048 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | _____ | 48.348 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 19.760 | |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 = B2 | Total quantity |
|----------|--|----------------|-----------------------|----------------|
| | BOX CULVERTS | | | |
| | Concrete: | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 4.972 | 9.944 |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 78.305 | 156.610 |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | | 174.440 |
| | Formwork: | | | |
| | Provide, erect and afterwards dismantle and remove the Items specified below: | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | — |
| 17.26 | As for Item 17.25 but sloping. | m ² | | — |
| 17.27 | As for Item 17.25 but battered. | m ² | | — |
| 17.28 | As for Item 17.25 but vertical. | m ² | 167.514 + 162.074 | 329.588 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 X 36.750 | 73.500 |
| 17.30 | As for Item 17.29 but sloping. | m ² | | — |
| 17.31 | As for Item 17.29 but battered. | m ² | | — |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2 X 73.500 | 147.000 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | — |
| 17.34 | As for Item 17.33 but sloping. | m ² | | — |
| 17.35 | As for Item 17.33 but battered. | m ² | | — |
| 17.36 | As for Item 17.33 but vertical. | m ² | | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 4.038 2 X 8.32 | 9.7 |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | | — |
| | Total | tonne | 9.7 | 9.7 |

No.2 Box for Footpath

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 325.807 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | - |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | - - - - |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | - |
| | joint filler | m ² 25 m ² 20 | - 5.440 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | - - |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | - |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | - |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | - |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | - |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | - |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | - |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | - |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 4 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 47.400 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | - |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | - |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 13.600 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | - - |

No.3 Box for Footpath

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 = B2 | Total quantity | |
|----------|--|----------------|---------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 220. 133 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | - | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 156. 046 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | _____ | 331. 048 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | _____ | 48. 348 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 19. 760 | |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B ₁ = B ₂ | Total quantity | |
|----------|--|----------------|---------------------------------|----------------|--|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 4.972 | 9.944 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 78.444 | 156.888 | |
| 17.24 | Provide WF2 finish to concrete surface. | m ² | | 174.360 | |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the Items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | — | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | — | |
| 17.27 | As for Item 17.25 but battered. | m ² | | — | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 168.222 + 162.782 | 331.004 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 X 36.750 | 73.500 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | — | |
| 17.31 | As for Item 17.29 but battered. | m ² | | — | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2 X 73.500 | 147.000 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | — | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | — | |
| 17.35 | As for Item 17.33 but battered. | m ² | | — | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | — | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 4.038 2 X 8.32 | 9.7 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | — | — | |
| | Total | tonne | 9.7 | 9.7 | |

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 326.160 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | joint filler | m ² 25 | — |
| | | m ² 20 | 5.440 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert cartageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 4 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 47.400 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 13.600 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

No.4 Box for Footpath

BILL OF QUANTITIES No.7
EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B1 = B2 | Total quantity | |
|----------|--|----------------|---------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | _____ | 253.761 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | _____ | - | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | _____ | 176.006 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | _____ | 333.549 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | _____ | 48.713 | |
| 7.06 | selected granular fill for base. | m ³ | _____ | 19.924 | |

BILL OF QUANTITIES NO. 23
PILING

| ITEM NO. | DESCRIPTION | UNIT | |
|----------|--|------|-------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. | _____ |
| 23.02 | Move and set up each pile position. | No. | _____ |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade _____ | m | _____ |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m | _____ |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B ₁ = B ₂ | Total quantity | |
|----------|--|----------------|---------------------------------|----------------|--|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 5.012 | 10.024 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 78.502 | 157.004 | |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | | 175.720 | |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | -- | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | -- | |
| 17.27 | As for Item 17.25 but battered. | m ² | | -- | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 166,624 + 161,184 | 327.808 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 X 37.050 | 74.100 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | -- | |
| 17.31 | As for Item 17.29 but battered. | m ² | | -- | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2 X 74.100 | 148.200 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | -- | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | -- | |
| 17.35 | As for Item 17.33 but battered. | m ² | | -- | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | -- | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 4136 2 X 804 | 9.9 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | | -- | |
| | Total | tonne | 9.9 | 9.9 | |

No.4 Box for Footpath

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 326.418 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | Joint filler | m ² 25 m ² 20 | — 5.440 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ² (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ² (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | 2 |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 47.758 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 13.600 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

No.1 Box for Drainage

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | $B_1 = B_4 + B_2 = B_3$ | $W_1 = W_2$ | Total quantity |
|----------|--|----------------|-------------------------|-------------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 258.420 | 2 X 72.705 | 403.830 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | — | — | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 115.640 | 2 X 13.089 | 141.818 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | — | — | 1074.145 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | — | — | 132.480 |
| 7.06 | selected granular fill for base. | m ³ | — | — | — |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 = B4 + B2 = B3 | W1 = W2 | Total quantity | |
|----------|--|----------------|----------------------------------|------------|----------------|--|
| | BOX CULVERTS | | | | | |
| | Concrete: | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 6.090 + 2 X 6.300 | 2X 5.777 | 36.334 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 103.370 + 2 X 106.500 | 2X 43.537 | 506.814 | |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | — | — | 528.467 | |
| | Formwork: | | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | | — | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | | — | |
| 17.27 | As for Item 17.25 but battered. | m ² | | | — | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 2 X 145.801 + 142200 + 135200 | 2 X 74.331 | 717.664 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 X 46.479 + 2 X 45.000 | — | 182.958 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | | — | |
| 17.31 | As for Item 17.29 but battered. | m ² | | | — | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2 X 87.000 + 2 X 90.000 | 2 X 43.556 | 441.112 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | | — | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | | — | |
| 17.35 | As for Item 17.33 but battered. | m ² | | | — | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | | — | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 x 5728 2 x 5603 | 2 X 2210 | 27.1 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | — | — | — | |
| | Total | tonne | 22.7 | 4.4 | 27.1 | |

No.1 Box for Drainage

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|-------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 790.863 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | joint filler | m ² 25 m ² 20 | — — |
| | | 21.00 + 2 × 5.502 (B) (W) | 32.004 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 38 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 158.000 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m 42.000 + 2 × 11.954 | 65.908 |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² 2 × 50.000 (m ³) 2 × 25.000 | 100.000 50.000 |

No.2 Box for Drainage

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | B ₁ = B ₂ | W ₁ = W ₂ | Total quantity |
|----------|--|----------------|---------------------------------|---------------------------------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 82.080 | 2 X 38.797 | 159.674 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | — | — | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 43.092 | 2 X 5.948 | 54.988 |
| 7.04 | Backfilling with selected material behind abutment,wall. | m ³ | — | — | 573.066 |
| 7.05 | porous filter material behind abutment,wall. | m ³ | — | — | 71.982 |
| 7.06 | selected granular fill for base. | m ³ | — | — | — |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|---|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation,setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick,Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

No.2 Box for Drainage

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B ₁ = B ₂ | W ₁ = W ₂ | Total quantity |
|----------|--|----------------|---------------------------------|---------------------------------|----------------|
| | BOX CULVERTS | | | | |
| | Concrete: | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 5,130 | 2 X 1,972 | 14. 204 |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 96,444 | 2 X 19,657 | 232. 202 |
| 17.24 | Provide W2 finish to concrete surface. | m ² | — | — | 205. 124 |
| | Formwork: | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | | — |
| 17.26 | As for item 17.25 but sloping. | m ² | | | — |
| 17.27 | As for item 17.25 but battered. | m ² | | | — |
| 17.28 | As for item 17.25 but vertical. | m ² | 156,504 + 151,864 | 2 X 45,836 | 400. 040 |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 + 34,200 | — | 68. 400 |
| 17.30 | As for item 17.29 but sloping. | m ² | | | — |
| 17.31 | As for item 17.29 but battered. | m ² | | | — |
| 17.32 | As for item 17.29 but vertical. | m ² | 2 X 102,600 | 2 X 22,332 | 249. 864 |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | | — |
| 17.34 | As for item 17.33 but sloping. | m ² | | | — |
| 17.35 | As for item 17.33 but battered. | m ² | | | — |
| 17.36 | As for item 17.33 but vertical. | m ² | | | — |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 4,965 | 2 X 10,34 | 12. 0 |
| 17.38 | As for item 17.37 but of diameter greater than 16mm. | tonne | — | — | — |
| | Total | tonne | 9.9 | 2.1 | 12. 0 |

No.2 Box for Drainage

BILL OF QUANTITIES No.21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 392.070 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | - |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | - - - - |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickneth 30 ^{mm} | - |
| | joint filler | m ² 25 m ² 20 4.640 + 2X4.023 (B) (W) | - 12.686 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | - - |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | - |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | - |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | - |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | - |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | - |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | - |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 26 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | - |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 86.400 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | - |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | - |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m 11.600 + 2X10.285 | 32.170 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² 2X45.000 (m ³) 2X22.500 | 90.000 45.000 |

No.3 Box for Drainage

BILL OF QUANTITIES No.7 EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | $B_1 = B_4 + B_2 = B_3$ | $W_1 = W_2$ | Total quantity |
|----------|--|----------------|-------------------------|-------------|----------------|
| 7.01 | Excavation of foundation levels in soft materials. | m ³ | 2837.785 | 402.874 | 3240.659 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | — | — | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 1482.375 | 160.389 | 1642.764 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | — | — | 1257.660 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | — | — | 148.500 |
| 7.06 | selected granular fill for base. | m ³ | — | — | — |

BILL OF QUANTITIES NO.23 PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 = B4 + B2 = B3 | W1 = W2 | Total quantity | |
|----------|--|----------------|--|------------|----------------|--|
| | BOX CULVERTS | | | | | |
| | Concrete: | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 9.065 2 X 7.350 | 2 X 4.442 | 41.714 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 179.635 2 X 145.650 | 2 X 55.626 | 761.822 | |
| 17.24 | Provide WF2 finish to concrete surface. | m ² | | | 638.378 | |
| | Formwork: | | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | | — | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | | — | |
| 17.27 | As for Item 17.25 but battered. | m ² | | | — | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 2 X 179.282 2 X 138.710 2 X 64.750 | 2 X 64.474 | 764.932 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | 2 X 52.500 | — | 234.600 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | | — | |
| 17.31 | As for Item 17.29 but battered. | m ² | | | — | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2 X 111.000 2 X 90.000 | 2 X 35.198 | 472.396 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | | — | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | | — | |
| 17.35 | As for Item 17.33 but battered. | m ² | | | — | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | | — | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 2311 2 X 1889 | 2 X 1752 | 11.9 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2 X 17305 2 X 13349 | — | 61.3 | |
| | Total | tonne | 69.7 | 3.5 | 73.2 | |

No.3 Box for Drainage

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|---|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 958.144 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. joint filler | m ² thickness 30 ^{mm} m ² 25 m ² 20 | — — 29,130 + 2 × 5,397 (B) (W) |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 40 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 166.0 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 46,500 + 2 × 12,427 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | 2 × 45,000 2 × 22,500 |
| | | | 90,000 45,000 |

No.4 Box for Drainage

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | $B_1 = B_3 + B_2$ | $W_1 = W_2$ | Total quantity |
|----------|--|----------------|-------------------|-------------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 657.400 | 2 X 91.370 | 840.140 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | — | — | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 299.400 | 2 X 28.868 | 357.136 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | — | — | 758.790 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | — | — | 90.090 |
| 7.06 | selected granular fill for base. | m ³ | — | — | — |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

No.4 Box for Drainage

BILL OF QUANTITIES No.17 CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B ₁ = B ₃ + B ₂ | W ₁ = W ₂ | Total quantity | |
|----------|--|----------------|--|---------------------------------|----------------|--|
| | BOX CULVERTS | | | | | |
| | Concrete: | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified: | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2 X 6125 + 7350 | 2 X 2549 | 24.698 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 121375 + 145650 | 2 X 22454 | 433.308 | |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | — | — | 379.874 | |
| | Formwork: | | | | | |
| | Provide, erect and afterwards dismantle and remove the Items specified below: | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | | — | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | | — | |
| 17.27 | As for Item 17.25 but battered. | m ² | | | — | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 2 X 128.208 + 129.000 2 X 43.750 | 2 X 49.127 | 483.670 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | + 52.500 | — | 140.000 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | | — | |
| 17.31 | As for Item 17.29 but battered. | m ² | | | — | |
| 17.32 | As for Item 17.29 but vertical. | m ² | | | 288.820 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | 2 X 75.000 + 90.000 | 2 X 24.410 | — | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | | — | |
| 17.35 | As for Item 17.33 but battered. | m ² | | | — | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | | — | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 3621 4392 | 2 X 1143 | 13.9 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2 X 5278 5293 | — | 15.9 | |
| | Total | tonne | 27.5 | 2.3 | 29.8 | |

No.4 Box for Drainage

BILL OF QUANTITIES No. 21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|---|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 578.496 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. joint filler | m ² thickneth 30 ^{mm} m ² 25 m ² 20 | — — 19.420 + 2 × 5.705 (B) (W) |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | — |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 26 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 102.000 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 31.100 + 2 × 12.643 |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | 2 × 40.000 2 × 20.000 |
| | | | 80.000 40.000 |

No.5 Box for Drainage

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | $B_1 = B_9 + B_2 = B_8 + B_3 \sim B_7$ | $W_1 + W_2$ | Total quantity |
|----------|--|----------------|---|--------------------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | $2 \times (416.897 + 463.219) + 5 \times 476.719$ | 2×442.456 | 5028.739 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | | | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | $2 \times (120.302 + 133.669) + 5 \times 136.669$ | 2×110.753 | 1412.793 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | 4044.210 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | 367.650 |
| 7.06 | selected granular fill for base. | m ³ | $2 \times (69.525 + 77.250) + 5 \times 47.250$ | 2×133.855 | 797.510 |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

No.5 Box for Drainage

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | B1 = B9 + B2 = B8 + B3 ~ B7 | W1 = W2 | Total quantity | |
|----------|--|----------------|--|-------------|----------------|--|
| | BOX CULVERTS | | | | | |
| | Concrete: | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | |
| 17.22 | Class 15/40 for blinding concrete on all structures. | m ³ | 2X(13230+14700) + 5X15300 | 2 X 11513 | 155.386 | |
| 17.23 | Class 25/20 for structural concrete. | m ³ | 2 X 382,050 + 2 X 424,500 + 5 X 517,500 | 2 X 92043 | 4384.686 | |
| 17.24 | Provide UF2 finish to concrete surface. | m ² | — | — | 2455.187 | |
| | Formwork: | | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | | |
| 17.25 | Horizontal formwork to achieve class F1 finish. | m ² | | | — | |
| 17.26 | As for Item 17.25 but sloping. | m ² | | | — | |
| 17.27 | As for Item 17.25 but battered. | m ² | | | — | |
| 17.28 | As for Item 17.25 but vertical. | m ² | 2(209478+165000) + 246,000 + 4 X 211,500 2(94,500 + 105,000) | 2 X 114,249 | 2069.454 | |
| 17.29 | Horizontal formwork to achieve class F2 finish. | m ² | + 5 X 105,000 | — | 924.000 | |
| 17.30 | As for Item 17.29 but sloping. | m ² | | | — | |
| 17.31 | As for Item 17.29 but battered. | m ² | | | — | |
| 17.32 | As for Item 17.29 but vertical. | m ² | 2(189000 + 210000) + 5 X 210,000 | 2 X 55,980 | 1959.960 | |
| 17.33 | Horizontal formwork to achieve class F3 finish. | m ² | | | — | |
| 17.34 | As for Item 17.33 but sloping. | m ² | | | — | |
| 17.35 | As for Item 17.33 but battered. | m ² | | | — | |
| 17.36 | As for Item 17.33 but vertical. | m ² | | | — | |
| 17.37 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 2 X 4949 2 X 5464 5 X 3286 | 2 X 4755 | 46.8 | |
| 17.38 | As for Item 17.37 but of diameter greater than 16mm. | tonne | 2 X 21410 2 X 19108 5 X 31604 | — | 239.0 | |
| | Total | tonne | 276.3 | 95 | 285.8 | |

BILL OF QUANTITIES No.21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|--------------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 2918.965 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | - |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | - - - - |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | - |
| | joint filler | m ² 25 m ² 20 | - - |
| | | 251.200 + 2 × 10.785 (B) (W) | 272.770 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | - - |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carageways. | m ² (m ²) | - |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ² (m ²) | - |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | - |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | - |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | - |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | - |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 66 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | - |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 306.000 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | - |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | - |
| 21.17 | Water stop 200mm wide waterstops as specified in the Drawings. | m | 249.600 + 2 × 19.480 |
| | | | 288.560 |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | 2 × 95.000 2 × 47.500 |
| | | | 190.000 95.000 |

BRIDGE

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | MOM. BASA | UHURU | RAIL. WAY | VEHICLE | | PEDESTRIAN | | TOTAL |
|----------|---|----------------|-----------|--------|-----------|---------|--------|------------|------|--------|
| | | | | | | NO 1 | NO 2 | NO 1 | NO 2 | |
| 7.01 | Excavation of foundation levels in soft materials. | m ³ | 432.1 | 364.8 | 2299.3 | — | 2011.8 | 465 | 1737 | 53282 |
| 7.02 | E.O Item 7.01 at any location for excavation in hard materials. | m ³ | 374.8 | 3955 | — | 402.4 | — | 574 | — | 1230.1 |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 4489 | 411.9 | 1514.0 | 2729 | 1447.7 | 68.2 | 1292 | 42928 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | 877.9 | 1073.7 | 1449.1 | 370.6 | 1210.4 | — | — | 4981.7 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | 56.1 | 70.7 | 82.6 | 21.2 | 666 | — | — | 2972 |
| 7.06 | selected granular fill for base. | m ³ | — | — | 101.0 | — | 743 | 95 | 99 | 194.5 |

BILL OF QUANTITIES No. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT | | | | | | | | |
|----------|--|------|---|---|---|---|-----|---|---|-----|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. | | | | | | | | |
| 23.02 | Move and set up each pile position. | No. | — | — | — | — | 96 | — | — | 96 |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m | — | — | — | — | 772 | — | — | 772 |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m | | | | | | | | |

BRIDGE

| ITEM NO. | DESCRIPTION | UNIT | MOM. BASA | UHURU | RAIL. WAY | VEHICLE | | PEDESTRIAN | | TOTAL | |
|---|--|-------|-----------|--------|-----------|---------|--------|------------|-------|--------|------|
| | | | | | | NO 1 | NO 2 | NO 1 | NO 2 | | |
| BRIDGES | | | | | | | | | | | |
| Concrete: | | | | | | | | | | | |
| Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | | | | | |
| 17.01 | Class 15/40 for blinding concrete on all structures. | m³ | 33.7 | 32.9 | 50.5 | 106 | 372 | 57 | 58 | 1764 | |
| | | | 2875.0 | | 1090.1 | | 89.3 | | | | |
| 17.02 | Class 25/20 for structural concrete. | m³ | 831.7 | 851.0 | 1192.3 | 364.9 | 725.2 | 38.8 | 50.5 | 4054.4 | |
| 17.03 | Class 30/20 for structural concrete. | m³ | 660.0 | 524.0 | 449.9 | 102.1 | 149.6 | 116.9 | 120.8 | 2123.3 | |
| 17.04 | Provide W2 finish to concrete surface. | m² | 1530.3 | 1322.4 | 1329.2 | 381.2 | 717.4 | 239.1 | 303.9 | 5823.5 | |
| 17.05 | Provide and place "dry pack mortar" as specified. | m³ | | | | | | | | | |
| Formwork: | | | | | | | | | | | |
| Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m² | | | | | | | | | |
| 17.07 | As for Item 17.06 but sloping. | m² | 26.4 | 26.4 | 5.5 | 27.5 | — | — | — | 85.8 | |
| 17.08 | As for Item 17.06 but battered. | m² | | | | | | | | | |
| 17.09 | As for Item 17.06 but vertical. | m² | 621.2 | 602.9 | 415.9 | 451.0 | 482.1 | 40.2 | 42.7 | 2656.0 | |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m² | 1058.3 | 837.8 | 679.8 | 217.7 | 316.7 | 151.9 | 183.6 | 3445.8 | |
| 17.11 | As for Item 17.10 but sloping. | m² | | | | | | 130.6 | 87.2 | 217.8 | |
| 17.12 | As for Item 17.10 but battered. | m² | | | | | | | | | |
| 17.13 | As for Item 17.10 but vertical. | m² | 2473.0 | 2157.0 | 2461.0 | 532.7 | 1071.0 | 154.3 | 192.1 | 9041.1 | |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m² | | | | | | | | | |
| 17.15 | As for Item 17.14 but sloping. | m² | | | | | | | | | |
| 17.16 | As for Item 17.14 but battered. | m² | | | | | | | | | |
| 17.17 | As for Item 17.14 but vertical. | m² | | | | | | | | | |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m² | | | | | | | | | |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 52.8 | 45.0 | 50.2 | 12.8 | 23.9 | 9.2 | 8.4 | 202. | |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 125.8 | 110.6 | 121.7 | 35.0 | 56.7 | 14.9 | 17.4 | 482. | |
| Total | | | tonne | 178.6 | 155.6 | 171.9 | 47.8 | 80.6 | 24.1 | 25.8 | 684. |

BRIDGE.

| ITEM NO. | DESCRIPTION | UNIT | MOM. BASA | UHURU | RAIL. WAY | VEHICLE | | PEDESTRIAN | | TOTAL |
|----------|--|--|---------------|---------------|-----------|---------------|---------------|------------|------|-----------------|
| | | | | | | NO 1 | NO 2 | NO 1 | NO 2 | |
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1639.6 | 1562.9 | 1364.4 | 5500 | 878.8 | — | — | 5995.7 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | 18 | 11 | — | 3 | 5 | — | — | 37 |
| | | No. 406 ^{mm} × 279 ^{mm} × 18 ^{mm} | — | — | 12 | — | — | — | — | 12 |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} | — | — | — | — | — | 4 | 4 | 8 |
| | | No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} | — | — | — | 6 | 10 | — | — | 16 |
| | | No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} | — | 22 | — | — | — | — | — | 22 |
| | | No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | 18 | — | — | — | — | — | — | 18 |
| 21.04 | Supply and install expansion joints as specified in the Drawings. joint filler | No. 432 ^{mm} × 203 ^{mm} × 65 ^{mm} | — | — | 12 | — | — | — | — | 12 |
| | | m ² thickness 30 ^{mm} | 36.5 | — | 32.6 | — | — | — | — | 69.1 |
| | | m ² 25 | — | 56.9 | — | 92 | 156 | — | — | 81.7 |
| | | m ² 20 | 62 | 3.7 | 13.4 | — | 22.7 | 63 | 63 | 586 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} | 340 | — | 313 | — | — | — | — | 653 |
| | | m 25 × 50 | — | 42.7 | — | 120 | 200 | — | — | 74.7 |
| 21.06 | Provide 50mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | (8826) 530 | (7211) 433 | — | — | — | — | — | (16037) 96.3 |
| 21.07 | As for Item 21.06 but to 50mm thick. | m ³ (m ²) | — | — | — | (1803) 131 | (2805) 245 | — | — | (4608) 376 |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | 42.2 | 42.2 | — | 1029 | 561 | — | — | 2434 |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — | — | 113.7 | — | — | — | — | 113.7 |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — | — | — | — | — | 1398 | 1420 | 2818 |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 8 | 6 | 8 | 6 | 6 | 4 | 6 | 44 |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 10 | 10 | 20 | 4 | 18 | — | — | 62 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — | — | — | — | — | — | — | — |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 34 | 43 | 80 | 12 | 56 | — | — | 225 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | 36 | 44 | 24 | 12 | 20 | 8 | 8 | 152 |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | 36 | 22 | 24 | 6 | 10 | — | — | 98 |
| 21.17 | Water stop 200mm wide waterstops as specified in the Drawings. | m | — | — | 21.7 | — | 346 | — | — | 563 |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — | — | — | — | — | — | — | — |

Mombasa Ju. Bridge

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | A ₁ = A ₂ | P ₁ = P ₂ | Total quantity |
|----------|--|----------------|---------------------------------|---------------------------------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 2 X 128,782 | 2 X 87,274 | 432. 112 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | 2 X 84,714 | 2 X 102,672 | 374. 772 |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 2X 112,559 | 2 X 111,881 | 448. 880 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | 877. 922 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | 56. 100 |
| 7.06 | selected granular fill for base. | m ³ | | | |

BILL OF QUANTITIES NO. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

Mombasa. Ju. Bridge

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | SUPER. | SUB | | | Total quantity |
|---|--|-------|----------|------------------------------------|------------------------|----------------------|----------------|
| | | | | A1 = A2 | WING(A1+A2) | P1 = P2 | |
| BRIDGES | | | | | | | |
| Concrete: | | | | | | | |
| Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | |
| 17.01 | Class 15/40 for bliding concrete on all structures. | m³ | — | 2 X 9.620 | — | 2 X 7224 | 33. 688 |
| 17.02 | Class 25/20 for structural concrete. | m³ | — | 2 X 217.863 + 20.400 + 3.060 | 78.088 + 80.727 | 2 X 106.847 | 831. 695 |
| 17.03 | Class 30/20 for structural concrete. | m³ | 660.000 | — | — | — | 660. 000 |
| 17.04 | Provide UF2 finish to concrete surface. | m² | 1053.390 | 102000 + 2 X 91500 | 14.140 + 14.560 | 2 X 81591 | 1530. 272 |
| 17.05 | Provide and place "dry pack mortar" as specified. | m³ | | | | | |
| Formwork: | | | | | | | |
| Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m² | | | 12.955 + 13.461 | — | 26. 416 |
| 17.07 | As for Item 17.06 but sloping. | m² | — | — | — | — | — |
| 17.08 | As for Item 17.06 but battered. | m² | | | 227.511 + 235.088 | 2 X 42.000 | 621. 159 |
| 17.09 | As for Item 17.06 but vertical. | m² | — | 2 X 37280 | — | 2 X 10.434 | 1058. 294 |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m² | 1037.446 | — | — | — | — |
| 17.11 | As for Item 17.10 but sloping. | m² | | | | | — |
| 17.12 | As for Item 17.10 but battered. | m² | | | | | — |
| 17.13 | As for Item 17.10 but vertical. | m² | 1586.753 | 2 X 316.856 | — | 2 X 126.274 | 2473. 013 |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m² | | | | | — |
| 17.15 | As for Item 17.14 but sloping. | m² | | | | | — |
| 17.16 | As for Item 17.14 but battered. | m² | | | | | — |
| 17.17 | As for Item 17.14 but vertical. | m² | | | | | — |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m² | | | | | — |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 37.7 | 2 X 3.428 = 6.9 | 2(498+494) = 2.0 | 2 X 3.102 = 6.2 | 52.8 |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 56.0 | 2 X 14.221 = 28.4 | 2(2953+3118) = 12.2 | 2 X 14.618 = 29.2 | 125.8 |
| Total | | tonne | 93.7 | 35.3 | 14.2 | 35.4 | 178.6 |

BILL OF QUANTITIES No. 21
MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity | |
|----------|--|--|-------------------|--|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1639.636 | |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | 18 | |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 50 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — — 18 | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | 36.450 | |
| | joint filler | m ² 25 | — | |
| | | m ² 20 | 6.180 | |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | 34.037 — | |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | 52.954 (882.570) | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — | |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | 42.200 | |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 8 | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 10 | |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — | |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 34.000 | |
| 21.14 | Dowel bar Movable 20mm dia. | No. | 36 | |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | 36 | |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | — | |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ²) | — — | |

Uhuru. Mo. Ju. Bridge

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | A1 = A2 | P | Total quantity | |
|----------|--|----------------|-----------|---------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 2X128.346 | 108.154 | 364.846 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | 2X133.463 | 128.592 | 395.518 | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 2X136.628 | 138.602 | 411.858 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | 1073.716 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | 70.741 | |
| 7.06 | selected granular fill for base. | m ³ | | | - | |

BILL OF QUANTITIES NO. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | SUPER | SUB | | | Total quantity |
|---|--|-------|----------|---------------------------------|---------------------------------------|---------|----------------|
| | | | | A1 = A2 | WING(A1+A2) | P1 = P2 | |
| BRIDGES | | | | | | | |
| Concrete: | | | | | | | |
| Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | |
| 17.01 | Class 15/40 for bliding concrete on all structures. | m³ | — | 2x 11.908 | — | 9.114 | 32. 930 |
| 17.02 | Class 25/20 for structural concrete. | m³ | — | 25.724 +3.858 2 x 270.227 | 158.815 | 122.131 | 850. 982 |
| 17.03 | Class 30/20 for structural concrete. | m³ | 523.959 | — | — | — | 523. 959 |
| 17.04 | Provide UF2 finish to concrete surface. | m² | 834.900 | 128.621 2 x 113.500 | 28.700 | 103.191 | 1322. 412 |
| 17.05 | Provide and place "dry pack mortar" as specified. | m³ | 0.141 | — | — | — | 0. 141 |
| Formwork: | | | | | | | |
| Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m² | — | — | — | — | — |
| 17.07 | As for Item 17.06 but sloping. | m² | — | — | 26.416 | — | 26. 416 |
| 17.08 | As for Item 17.06 but battered. | m² | — | — | — | — | — |
| 17.09 | As for Item 17.06 but vertical. | m² | — | 2 x 44.672 | 462.599 | 51.000 | 602. 943 |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m² | 824.350 | — | — | 13.403 | 837. 753 |
| 17.11 | As for Item 17.10 but sloping. | m² | — | — | — | — | — |
| 17.12 | As for Item 17.10 but battered. | m² | — | — | — | — | — |
| 17.13 | As for Item 17.10 but vertical. | m² | 1242.417 | 2 x 389.645 | — | 135.278 | 2156. 985 |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m² | — | — | — | — | — |
| 17.15 | As for Item 17.14 but sloping. | m² | — | — | — | — | — |
| 17.16 | As for Item 17.14 but battered. | m² | — | — | — | — | — |
| 17.17 | As for Item 17.14 but vertical. | m² | — | — | — | — | — |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m² | — | — | — | — | — |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 30.5 | 2 x 44.70 = 8.9 | 477 478 495 496 } = 2.0 | 3.6 | 45.0 |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 45.4 | 2 x 17.880 = 35.8 | 3090 2900 3102 3248 } = 12.3 | 17.1 | 110.6 |
| Total | | tonne | 75.9 | 44.7 | 14.3 | 20.7 | 155.6 |

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|-------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1562.867 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | 11 |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — — 22 — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thicketh 30 ^{mm} | — |
| | joint filler | m ² 25 m ² 20 | 56.873 3.708 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — 42.653 |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | 43.263 (721.050) |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | 42.200 |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 6 |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 10 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 42.873 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | 44 |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | 22 |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | — |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

Railway Bridge

BILL OF QUANTITIES No. 7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | A1 | A2 | P1= P2 | W1 ~ W3 | Total quantity |
|----------|--|----------------|---------|---------|-----------|-------------------------------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 792.461 | 623.250 | 2x152.694 | 291.945 149.670 136.546 | 2 299.260 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | — | — | — | — | — |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 564.956 | 422.898 | 2x66.672 | 208.864 113.808 70.174 | 1514.044 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | | | 1449.084 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | | | 82.630 |
| 7.06 | selected granular fill for base. | m ³ | 24.790 | 22.568 | 2x13.348 | 11.918 5.508 9.558 | 101.038 |

BILL OF QUANTITIES NO. 23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

Railway Bridge

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | SUPER | SUB | | | Total quantity | |
|---|--|-------|---------|----------------------------|----------------------------|---------------------------|----------------------------|----------|
| | | | | A1 | A2 | P1 + P2 | | W1 ~ W3 |
| BRIDGES | | | | | | | | |
| Concrete: | | | | | | | | |
| Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | | |
| 17.01 | Class 15/40 for blinding concrete on all structures. | m³ | — | 12.395 | 11.284 | 2 x 6.674 | 5.959+2.754 4.779 | 50.519 |
| 17.02 | Class 25/20 for structural concrete. | m³ | — | 14.203 2.130 376.081 | 14.203 2.130 353.714 | 103.0+106.0 | 99.573+41.150 +79.108 | 1191.292 |
| 17.03 | Class 30/20 for structural concrete. | m³ | 449.852 | — | — | — | — | 449.852 |
| 17.04 | Provide UF2 finish to concrete surface. | m² | 675.801 | 71.015 122.262 | 71.015 116.350 | 2x70.000 | 59.065+27.500 46.152 | 1329.160 |
| 17.05 | Provide and place "dry pack mortar" as specified. | m³ | 0.116 | — | — | — | — | 0.116 |
| Formwork: | | | | | | | | |
| Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m² | — | — | — | — | — | — |
| 17.07 | As for Item 17.06 but sloping. | m² | — | — | 5.490 | — | — | 5.490 |
| 17.08 | As for Item 17.06 but battered. | m² | — | — | — | — | — | — |
| 17.09 | As for item 17.06 but vertical. | m² | — | 49.600 | 214.539 | 2 x 37.000 | 35.040+14.040 +28.640 | 415.859 |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m² | 677.845 | — | — | 2 x 1.000 | — | 679.845 |
| 17.11 | As for Item 17.10 but sloping. | m² | — | — | — | — | — | — |
| 17.12 | As for Item 17.10 but battered. | m² | — | — | — | — | — | — |
| 17.13 | As for Item 17.10 but vertical. | m² | 926.243 | 108.600 | 363.700 | 172.000+185.000 | 178.618+83.840 +143.018 | 2461.019 |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m² | — | — | — | — | — | — |
| 17.15 | As for Item 17.14 but sloping. | m² | — | — | — | — | — | — |
| 17.16 | As for Item 17.14 but battered. | m² | — | — | — | — | — | — |
| 17.17 | As for Item 17.14 but vertical. | m² | — | — | — | — | — | — |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m² | — | — | — | — | — | — |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 24.4 | 5.745 1.109 1.081 | 4637 512 885 | 3418 +3490 =69 | 2002 1127 1728 | 50.2 |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 43.9 | 20.7 | 15516 2796 =183 | 14.592 +15.350 =299 | 4487 1416 3016 | 121.7 |
| Total | | tonne | 68.3 | 28.7 | 24.3 | 36.8 | 13.8 | 171.9 |

Railway Bridge

BILL OF QUANTITIES No.21 MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|------------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 1364.392 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} No. 406 ^{mm} × 279 ^{mm} × 18 ^{mm} | — 12 |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} No. 432 ^{mm} × 203 ^{mm} × 65 ^{mm} | — — — — 12 |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | 32.638 |
| | joint filler | m ² 25 | — |
| | | m ² 20 | 13.380 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | 31.300 — |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carrageways. | m ³ (m ²) | — |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | 113.700 |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 8 |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 20 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 80.021 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | 24 |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | 24 |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 21.700 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

No.1 Pedestrian Bridge

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | P1+P2+P3 | PS1 - PS2 | AS1= AS2 | Total quantity |
|----------|--|----------------|------------------------------|------------|-----------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 10.073 +10.229 + 6.629 | 2 X 5.189 | 2 X 4.610 | 46. 529 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | + 7.530 +12.912 | 2 X 9.552 | 2 X 8.928 | 57. 402 |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 4.813 +12.129 +13.837 | 2 X 11.473 | 2 X 7.258 | 68. 241 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | | - |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | | - |
| 7.06 | selected granular fill for base. | m ³ | 3 X 1408 | 2 X 0.968 | 2 X 1672 | 9. 504 |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

No. 1 Pedestrian Bridge

BILL OF QUANTITIES No. 17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | SUPER | | SUB | | | Total quantity |
|---|--|----------------|---------|------------|--|-----------|------------|----------------|
| | | | MAIN | STAIR-1' | P1 ~ P3 | PS1-PS1' | AS1 ~ AS1' | |
| BRIDGES | | | | | | | | |
| Concrete: | | | | | | | | |
| Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | | |
| 17.01 | Class 15/40 for blinding concrete on all structures. | m ³ | — | — | 3 X 0864 8.937 + 9.307 + 8.566 | 2 X 0.484 | 2 X 1.062 | 5.684 |
| 17.02 | Class 25/20 for structural concrete. | m ³ | — | — | — | 2 X 2.467 | 2 X 3.546 | 38.836 |
| 17.03 | Class 30/20 for structural concrete. | m ³ | 72.834 | 2 X 22.013 | — | — | — | 116.860 |
| 17.04 | Provide WF2 finish to concrete surface. | m ² | 137.520 | 56.700 | 3 X 7.500 | 2 X 4.000 | 2 X 7.200 | 239.120 |
| 17.05 | Provide and place "dry pack mortar" as specified. | m ³ | — | — | — | — | — | — |
| Formwork: | | | | | | | | |
| Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m ² | — | — | — | — | — | — |
| 17.07 | As for Item 17.06 but sloping. | m ² | — | — | — | — | — | — |
| 17.08 | As for Item 17.06 but battered. | m ² | — | — | — | — | — | — |
| 17.09 | As for Item 17.06 but vertical. | m ² | — | — | 3 X 5.000 | 2 X 3.200 | 2 X 9.400 | 40.200 |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m ² | 135.270 | 2 X 8.318 | — | — | — | 151.906 |
| 17.11 | As for Item 17.10 but sloping. | m ² | — | 2 X 65.321 | — | — | — | 130.642 |
| 17.12 | As for Item 17.10 but battered. | m ² | — | — | — | — | — | — |
| 17.13 | As for Item 17.10 but vertical. | m ² | 55.162 | 2 X 2.816 | 26.796 + 28.710 + 24.882 | 2 X 6.580 | — | 154.342 |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m ² | — | — | — | — | — | — |
| 17.15 | As for Item 17.14 but sloping. | m ² | — | — | — | — | — | — |
| 17.16 | As for Item 17.14 but battered. | m ² | — | — | — | — | — | — |
| 17.17 | As for Item 17.14 but vertical. | m ² | — | — | — | — | — | — |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m ² | — | — | — | — | — | — |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 6.9 | — | .521 .543 .491 = 1.6 1.271 1.321 1.221 | 2 X 1.67 | 2 X 1.86 | 9.2 |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 10.6 | — | = 3.8 | = 0.5 | — | 14.9 |
| Total | | tonne | 17.5 | — | 54 | 0.8 | 0.4 | 24.1 |

No.1 Pedestrian Bridge

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity | |
|----------|--|--|------------------|--|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | — | |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — | |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | 4 — — — | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — | |
| | joint filler | m ² 25 m ² 20 | — 6.268 | |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — | |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | — | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — | |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — | |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | 139.760 | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 4 | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — | |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — | |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 8 | |
| 21.14 | Dowel bar Movable 20mm dia. | No. | — | |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — | |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | — | |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — | |

No.2 Pedestrian Bridge

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | P1 ~ P4 + P51 | AS1 = AS2 | Total quantity | |
|----------|--|----------------|----------------------|-------------------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 4X29.778 + 21.146 | 24.519 + 8.928 | 173.705 | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | | | -- | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 4X23.703 + 17.781 | 13.155 + 3.422 | 129.170 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | -- | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | -- | |
| 7.06 | selected granular fill for base. | m ³ | 4X1.408 + 0.968 | 2X1672 | 9.944 | |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

No.2 Pedestrian Bridge

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | SUPER | | SUB | | | Total quantity |
|---|--|-------|---------|----------------------------|--|-------|---------------------------|----------------|
| | | | MAIN | STAIR:1:2 | P1 ~ P4 | PS1 | AS1 + AS2 | |
| BRIDGES | | | | | | | | |
| Concrete: | | | | | | | | |
| Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | | |
| 17.01 | Class 15/40 for bliding concrete on all structures. | m³ | — | — | 4 X 0.864 3 X 8.937 | 0.484 | 1.062 + 0.836 8.098 | 5.838 |
| 17.02 | Class 25/20 for structural concrete. | m³ | — | — | + 9.307 | 2.708 | + 3.546 | 50.470 |
| 17.03 | Class 30/20 for structural concrete. | m³ | 89.454 | 21.069 + 10.240 | — | — | — | 120.763 |
| 17.04 | Provide bf2 finish to concrete surface. | m² | 174.060 | 54.396 + 27.036 | 4 X 7.500 | 4.000 | 2 X 7.200 | 303.892 |
| 17.05 | Provide and place "dry pack mortar" as specified. | m³ | | | | | | |
| Formwork: | | | | | | | | |
| Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m² | | | | | | — |
| 17.07 | As for Item 17.06 but sloping. | m² | | | | | | — |
| 17.08 | As for Item 17.06 but battered. | m² | | | | | | — |
| 17.09 | As for Item 17.06 but vertical. | m² | | | 4 X 5.000 | 3.200 | 10.096 + 9.400 | 42.696 |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m² | 171.060 | 8.318 + 4.248 61.696 | — | — | — | 183.626 |
| 17.11 | As for Item 17.10 but sloping. | m² | — | + 25.543 | — | — | — | 87.239 |
| 17.12 | As for Item 17.10 but battered. | m² | | | | | | — |
| 17.13 | As for Item 17.10 but vertical. | m² | 69.862 | 2.816 + 1.920 | 3 X 26.796 + 28.710 | 8.408 | — | 192.104 |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m² | | | | | | — |
| 17.15 | As for Item 17.14 but sloping. | m² | | | | | | — |
| 17.16 | As for Item 17.14 but battered. | m² | | | | | | — |
| 17.17 | As for Item 17.14 but vertical. | m² | | | | | | — |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m² | | | | | | — |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 5.7 | | 3 X 5.21 + 5.43 = 2.1 3 X 1.271 + 1.321 = 5.1 | 0.2 | 1.86 2.26 = 0.4 | 8.4 |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 12.0 | | | 0.3 | — | 17.4 |
| Total | | tonne | 17.7 | | 7.2 | 0.5 | 0.4 | 25.8 |

No.2 Pedestrian Bridge

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity | |
|----------|--|--|------------------|--|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | — | |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | — | |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | 4 — — — | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thicketh 30 ^{mm} | — | |
| | joint filler | m ² 25 | — | |
| | | m ² 20 | 6. 268 | |
| 21.05 | Sealant for expansion joints. | m. 30 ^{mm} × 50 ^{mm} m 25 × 50 | — — | |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriageways. | m ³ (m ²) | — | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | — | |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | — | |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | — | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | 142. 000 | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 6 | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | — | |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — | |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | — | |
| 21.14 | Dowel bar Movable 20mm dia. | No. | 8 | |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | — | |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | — | |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — | |

No.2 Vehicle Bridge

No.1 Vehicle Bridge

BILL OF QUANTITIES No.7
EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | A1 = A2 | P | Total quantity | |
|----------|--|----------------|------------|--------|----------------|--|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | | | — | |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | 2 X 172460 | 57.522 | 402.442 | |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 2 X 120804 | 31.328 | 272.936 | |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | 370.598 | |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | 21.240 | |
| 7.06 | selected granular fill for base. | m ³ | | | — | |

BILL OF QUANTITIES NO.23
PILING

| ITEM NO. | DESCRIPTION | UNIT |
|----------|--|------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. |
| 23.02 | Move and set up each pile position. | No. |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m |

No.1 Vehicle Bridge

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | SUPER | Sub | | | Total quantity |
|----------|--|----------------|---------|---------------------------------|--------|---------------------------|----------------|
| | | | | A1 | P1 | A2 | |
| | BRIDGES | | | | | | |
| | Concrete: | | | | | | |
| | Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | |
| 17.01 | Class 15/40 for bliding concrete on all structures. | m ³ | | 3.848 | 2.914 | 3.848 | 10.610 |
| 17.02 | Class 25/20 for structural concrete. | m ³ | | 7200+1080 64.348 + 91.422 | 37.064 | 73.403 + 91.422 | 364.939 |
| 17.03 | Class 30/20 for structural concrete. | m ³ | 102.111 | — | — | — | 102.111 |
| 17.04 | Provide UF2 finish to concrete surface. | m ² | 216.360 | 13860+36000 +36.000 | 27.750 | 15.260 + 36.000 | 381.230 |
| 17.05 | Provide and place "dry pack mortar" as specified. | m ³ | 0.048 | — | — | — | 0.048 |
| | Formwork: | | | | | | |
| | Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m ² | | | | | — |
| 17.07 | As for Item 17.06 but sloping. | m ² | | 12.903 | | 14.623 | 27.526 |
| 17.08 | As for Item 17.06 but battered. | m ² | | | | | — |
| 17.09 | As for Item 17.06 but vertical. | m ² | | 19.520 +188.785 | 9.600 | 19.520 +213.567 | 450.992 |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m ² | 216.961 | — | 0.750 | — | 217.711 |
| 17.11 | As for Item 17.10 but sloping. | m ² | | | | | — |
| 17.12 | As for Item 17.10 but battered. | m ² | | | | | — |
| 17.13 | As for Item 17.10 but vertical. | m ² | 178.665 | 143.200 | 67.647 | 143.200 | 532.712 |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m ² | | | | | — |
| 17.15 | As for Item 17.14 but sloping. | m ² | | | | | — |
| 17.16 | As for Item 17.14 but battered. | m ² | | | | | — |
| 17.17 | As for Item 17.14 but vertical. | m ² | | | | | — |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m ² | | 1.611 2X .507 | | 1.611 2X .562 | — |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 6.4 | = 2.6 5363 2X2388 | 1.1 | = 2.7 5363 2X 3.670 | 12.8 |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 7.8 | = 10.2 | 4.3 | = 12.7 | 35.0 |
| | Total | tonne | 14.2 | 12.8 | 5.4 | 15.4 | 47.8 |

No.1 Vehicle Bridge

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity | |
|----------|--|--|------------------|--|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 550.009 | |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | 3 | |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | - - 6 - | |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickneth 30 ^{mm} m ² 25 m ² 20 | - 9.210 - | |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | - 12.000 | |
| 21.06 | Provide 50mm thick asphalt concrete surfacing on bridge and box culvert carriages. | m ³ (m ²) | - | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 13.071 (180.300) | |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | 102.900 | |
| 21.09 | Provide and erect in position parapet handrails to railwaybridge as detailed on the Drawings. | m | - | |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | - | |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 6 | |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 4 | |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | - | |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 12.000 | |
| 21.14 | Dowel bar Movable 20mm dia. | No. | 12 | |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | 6 | |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | - | |
| 21.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | - - | |

No.2 Vehicle Bridge

BILL OF QUANTITIES No.7

EXCAVATION AND FILLING FOR STRUCTURES

| ITEM NO. | DESCRIPTION | UNIT | A1 = A2 | P | W1 ~ W4 | Total quantity |
|----------|--|----------------|-------------|--------|-------------|----------------|
| 7.01 | Excavation of fundation levels in soft materials. | m ³ | 2 X 323.446 | 95.484 | 4 X 317.356 | 2011.800 |
| 7.02 | E.O Item 7.01 at anylocation for excavation in hard materials. | m ³ | | | | - |
| 7.03 | Backfilling with selected material for excavation. | m ³ | 2 X 226.926 | 49.578 | 4 X 236.076 | 1447.734 |
| 7.04 | Backfilling with selected material behind abutment, wall. | m ³ | | | | 1210.407 |
| 7.05 | porous filter material behind abutment, wall. | m ³ | | | | 66.552 |
| 7.06 | selected granular fill for base. | m ³ | 2 X 11.856 | 7.708 | 4 X 10.730 | 74.340 |

BILL OF QUANTITIES NO.23

PILING

| ITEM NO. | DESCRIPTION | UNIT | A1 = A2 | P | W1 ~ W4 | Total quantity |
|----------|--|------|-----------|-----------|-----------|----------------|
| 23.01 | Mobilization of all the necessary plant for the piling operation, setting up on the position of the first pile and removal on completion of the last pile. | L.S. | | | | |
| | | | (8.0m/no) | (8.5m/no) | (8.0m/no) | |
| 23.02 | Move and set up each pile position. | No. | 2 X 20 | 8 | 4 X 12 | 96 |
| 23.03 | Supply of steel pipe piles 500mm dia., 9mm thick, Grade | m | 320.0 | 68.0 | 384.0 | 772.0 |
| 23.04 | Driving piles of 500mm dia. including positioning and pitching. Include for cutting pile heads to correct level. | m | | | | |

No.2 Vehicle Bridge

BILL OF QUANTITIES No.17
CONCRETE WORKS

| ITEM NO. | DESCRIPTION | UNIT | SUPER | SUB | | | Total quantity |
|---|--|----------------|---------|-------------------------------|--------|--------------------------------|----------------|
| | | | | A1 = A2 | P | W1 ~ W4 | |
| BRIDGES | | | | | | | |
| Concrete: | | | | | | | |
| Provide, place and compact the following classes of concrete for insitu works as specified. | | | | | | | |
| 17.01 | Class 15/40 for bliding concrete on all structures. | m ³ | ———— | 2 X 5.928 12,000+1,800 | 3.854 | 4 X 5.365 | 37. 170 |
| 17.02 | Class 25/20 for structural concrete. | m ³ | ———— | + 2X 146.550 | 54.140 | 4 X 91.048 | 725. 232 |
| 17.03 | Class 30/20 for structural concrete. | m ³ | 149.579 | ———— | ———— | ———— | 149. 579 |
| 17.04 | Provide W2 finish to concrete surface. | m ² | 314.160 | 60,000 + 2X 56,000 | 38.000 | 4 X 48.300 | 717. 360 |
| 17.05 | Provide and place "dry pack mortar" as specified. | m ³ | | | | | |
| Formwork: | | | | | | | |
| Provide, erect and afterwards dismantle and remove the items specified below: | | | | | | | |
| 17.06 | Horizontal formwork to achieve class F1 finish. | m ² | | | | | — |
| 17.07 | As for Item 17.06 but sloping. | m ² | | | | | — |
| 17.08 | As for Item 17.06 but battered. | m ² | | | | | — |
| 17.09 | As for Item 17.06 but vertical. | m ² | ———— | 2X 29.160 | 22500 | 4 X 100.332 | 482. 148 |
| 17.10 | Horizontal formwork to achieve class F2 finish. | m ² | 314.721 | ———— | 2000 | ———— | 316. 721 |
| 17.11 | As for Item 17.10 but sloping. | m ² | | | | | — |
| 17.12 | As for Item 17.10 but battered. | m ² | | | | | — |
| 17.13 | As for Item 17.10 but vertical. | m ² | 271.985 | 2X 210.340 | 92.664 | 4X 71.412 | 1070. 977 |
| 17.14 | Horizontal formwork to achieve class F3 finish. | m ² | | | | | — |
| 17.15 | As for Item 17.14 but sloping. | m ² | | | | | — |
| 17.16 | As for Item 17.14 but battered. | m ² | | | | | — |
| 17.17 | As for Item 17.14 but vertical. | m ² | | | | | — |
| 17.18 | As for Item 17.14 but vertical and curved for circular columns. | m ² | | | | | — |
| 17.19 | Provide and fix in position high tensile steel reinforcement bars to BS 4461 of diameter equal to or less than 16mm. | tonne | 10.4 | 2 X 2851 = 5.7 2X 8.828 | 1.4 | 4 X 1595 = 6.4 4 X 4.715 | 23.9 |
| 17.20 | As for Item 17.19 but of diameter greater than 16mm. | tonne | 12.3 | = 17.7 | 7.8 | = 18.9 | 56.7 |
| Total | | tonne | 22.7 | 23.4 | 9.2 | 25.3 | 80.6 |

No.2 Vehicle Bridge

BILL OF QUANTITIES No.21

MISCELLANEOUS

| ITEM NO. | DESCRIPTION | UNIT | Total quantity |
|----------|--|--|-------------------|
| 21.01 | Supply and apply, in accordance to manufacturer's instructions waterproofing materials to top of bridge decks, approach slabs and all structural concrete surfaces in contact with fill material prior to backfilling. | m ² | 878.790 |
| 21.02 | Supply and install in position rubber pad bearings, fixed type as specified in the Drawings. | No. 432 ^{mm} × 203 ^{mm} × 18 ^{mm} | 5 |
| 21.03 | Supply and install in position rubber pad bearings, movable type as specified in the Drawings. | No. 229 ^{mm} × 152 ^{mm} × 56 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 37 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 46 ^{mm} No. 279 ^{mm} × 229 ^{mm} × 65 ^{mm} | — 10 — — |
| 21.04 | Supply and install expansion joints as specified in the Drawings. | m ² thickness 30 ^{mm} | — |
| | joint filler | m ² 25 m ² 20 | 15.610 22.748 |
| 21.05 | Sealant for expansion joints. | m 30 ^{mm} × 50 ^{mm} m 25 × 50 | — 20.000 |
| 21.06 | Provide 60mm thick asphalt concrete surfacing on bridge and box culvert carriages. | m ³ (m ²) | |
| 21.07 | As for Item 21.05 but to 50mm thick. | m ³ (m ²) | 24.543(280.500) |
| 21.08 | Supply and install flex beam guardrails including post, all in accordance with the Drawings. | m | 56.100 |
| 21.09 | Provide and erect in position parapet handrails to railway bridge as detailed on the Drawings. | m | — |
| 21.10 | Provide and erect in position parapet handrails to footbridges as detailed on the Drawings. | m | — |
| 21.11 | Provide and install 100mm dia. drain pipe through deck slabs. | No. | 6 |
| 21.12 | Provide and place 75mm dia. PVC weep holes. | No. | 18 |
| 21.16 | Provide and place 200mm dia. PVC drainage pipe. | No. | — |
| 21.13 | Provide and place 200mm dia. perforated pipe. | m | 55.200 |
| 21.14 | Dowel bar Movable 20mm dia. | No. | 20 |
| 21.15 | Dowel bar Fixed 40mm dia. | No. | 10 |
| 21.17 | Water stem 200mm wide waterstops as specified in the Drawings. | m | 34.600 |
| 20.18 | Provide 500mm thickness gabion mesh. | m ² (m ³) | — — |

II. DETAILED DESCRIPTIONS

1. BRIDGES ON THE MAIN ROADS

2. OVERBRIDGES

3. BOX CULVERTS

BILL OF QUANTITIES

BRIDGES FOR MAIN ROAD

MOMBASA ROAD JUNCTION BRIDGE ——— 1

UHURU MONUMENT JUNCTION BRIDGE — 13

RAILWAY BRIDGE ————— 24-47

MOMBASA - J U - BRIDGE

Super structure

1) Concrete, (Grade=30)

Girder slab and parapet

$$V = 10.981 \times 56.940$$

$$= 625.259 \text{ m}^3$$

$$\text{cross girder} = 1.325 \times 0.95 \times (0.60 \times 4 + 0.35 \times 3) \times 8$$

$$= 34.741 \text{ m}^3$$

$$\text{total} =$$

$$= 660.000 \text{ m}^3$$

$$\text{OF UF}_2 : A = 56.940 \times (17.0 + 15.0)$$

$$= 1053.390 \text{ m}^2$$

2) form work

$$\text{horizontal} A = 56.940 (\sqrt{1.10^2 + 0.15^2} \times 2 + 0.600 \times 9 + 1.325 \times 8)$$

$$= 1037.446 \text{ m}^2$$

$$\text{Vertical} A = 56.940 \times (0.20 + 0.95 + 1.10 \times 8 + 1.06 \times 2 + 0.86) \times 2$$

$$+ 0.950 \times 1.325 \times 8 \times 12$$

$$- (0.95 \times 0.60 \times 4 + 0.95 \times 0.35 \times 3) \times 2$$

$$= 1586.753 \text{ m}^2$$

3) Support

$$V = \{ (0.95 + 1.10) \times 1.10 + 1.10 \times 1.325 \times 8 \} \times 56.940$$

$$+ 5.80 \times 18.20 \times (56.940 - 0.800 \times 4)$$

$$= 6465.115 \text{ m}^3$$

4) Scaffold

$$V = (18.20 + 1.00) \times 56.940$$

$$= 1093.248 \text{ m}^3$$

5) Joint filler (t=30mm) expansion $\varnothing : = 17.00 \times 2 \times 1.0011$

$$= 34.037 \text{ m}$$

$$A = \{ (0.20 + 0.35) \times 1.10 + 1.10 \times 16.00 \} \times 2 \times 1.0011$$

$$= 36.450 \text{ m}^2$$

6) Asphalt

$$V = 0.06 \times (17.00 - 1.50) \times 56.940$$

$$= 52.954 \text{ m}^3$$

$$(882.570 \text{ m}^2)$$

7) Joint filler (t=20mm) — Parapet for verge and central reserve.

$$A = (0.352 \times 2 + 0.532) \times 5$$

$$= 6.180 \text{ m}^2$$

8) Guard rail (Abut) $\varnothing : = (10.40 + 10.70) \times 2$

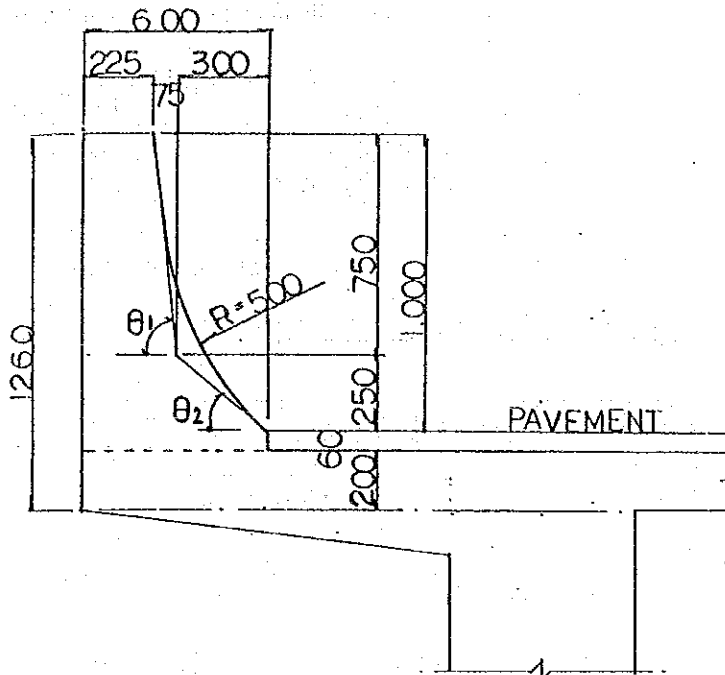
$$= 42.200 \text{ m}$$

* section of superstructure.

$$A = 0.352 \times 2 + 0.532 + (0.20 + 0.35) \times 1.10 + (1.30 \times 16.0 - 1.10 \times 1.325 \times 8) = 10.981 \text{ m}^2$$

SHAPE OF PARAPET OF MAIN ROAD

1) FOR VERGE



Section area

$$A = 0.60 \times 1.06 - \frac{1}{2} \times 0.075 \times 0.75 \\ - \frac{0.75 + 1.00}{2} \times 0.30 + 0.006 \\ = 0.352 \text{ m}^2$$

$$\theta_1 = \tan^{-1} \frac{0.750}{0.075} = 84^\circ 17' 22''$$

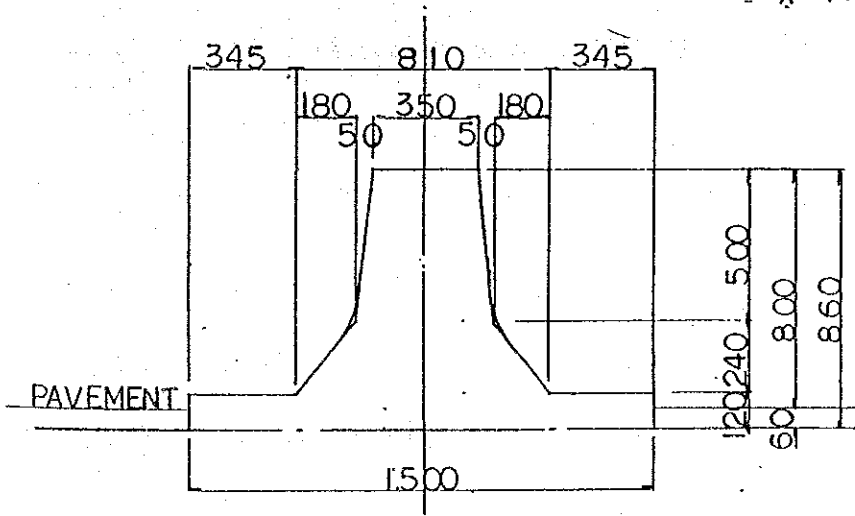
$$\theta_2 = \tan^{-1} \frac{0.250}{0.300} = 39^\circ 48' 20''$$

$$\theta = 44^\circ 29'$$

$$TL = R \cdot \tan \frac{\theta}{2} = 0.205 \text{ m}$$

2) FOR CENTRAL RESERVE.

$$A = 0.205 \times 0.50 - \pi \times 0.50^2 \times \frac{44.29'}{360} \\ = 0.006 \text{ m}^2$$



Section area

$$A = \frac{0.35 + 0.45}{2} \times 0.50 + \frac{0.45 + 0.81}{2} \times 0.24 + 1.50 \times 0.12 \\ = 0.532 \text{ m}^2$$

MOMBASA J U BRIDGE

Sub structure : $A_1=A_2$ (Main)

1) Concrete

$$V = 0.26 \times 0.60 \times 0.30 \times 2 + 18.30 (1.40 \times 0.30 + 1.10 \times 6.80 + 5.00 \times 0.80) = 217.863 \text{ m}^3$$

$$\text{OF UF}_2 : A = 18.30 \{ (5.00 - 1.10) + 0.30 + 0.80 \} = 91.500 \text{ m}^2$$

2) form work.

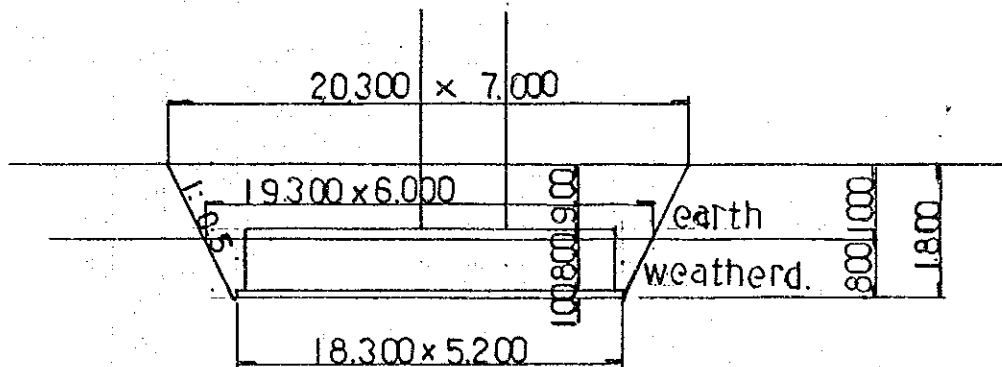
$$\text{Vertical } A = (0.30 + 0.60) \times 0.26 \times 2 \times 2 + (0.30 + 18.30) \times 1.40 \times 2 + (1.10 + 18.30) \times 6.80 \times 2 = 316.856 \text{ m}^2$$

$$\text{" (footing) } A = (5.00 + 18.30) \times 0.80 \times 2 = 37.280 \text{ m}^2$$

$$\text{3) Scaffold } V = 1.20 \{ (1.10 + 2.00) + (18.30 + 2.00) \} \times 8.20 = 230.256 \text{ m}^3$$

$$\text{4) base concrete } V = 5.20 \times 18.50 \times 0.10 = 9.620 \text{ m}^3$$

$$A = (5.20 + 18.50) \times 0.10 \times 2 = 4.740 \text{ m}^2$$



5) excavation

$$\text{earth } V = 1.00/6 \{ 6.00 \times 19.30 + 7.00 \times 20.30 + (6.00 + 7.00) (19.30 + 20.30) \} = 128.782 \text{ m}^3$$

$$\text{weatherd } V = 0.80/6 \{ 5.20 \times 18.50 + 6.00 \times 19.30 + (5.20 + 6.00) (18.50 + 19.30) \} = 84.714 \text{ m}^3$$

$$\text{remain } V = 9.620 + 18.30 \times 5.00 \times 0.80 + 18.30 \times 1.10 \times 0.90 = 100.937 \text{ m}^3$$

$$\text{back fill } V = 128.782 + 84.714 - 100.937 = 112.559 \text{ m}^3$$

A₁ - wing

1) concrete. $V = 1/2(8.455+8.413) \times 2.40 + 1/2(8.413+0.817) \times 7.70 \times 0.70 \times 2$
 $= \{55.777\} \times 0.70 \times 2$

= 78.088m³

= 14.140m²

OF. UP₂ : A = 10.10 × 0.70 × 2

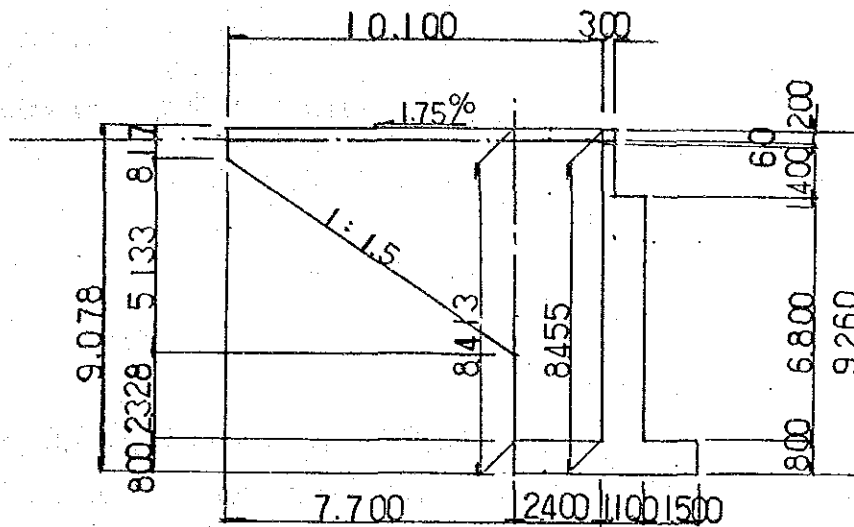
2) form work.

F₁ (vertical) $V = ※55.777 \times 2 \times 2 + 2 \times 0.70(0.817+2.328)$

= 227.511m²

F₁ (Sloping) $A = \sqrt{5.133^2 + 7.70^2} \times 0.70 \times 2$

= 12.955m²



A₂ - wing

1) concrete $V = 1/2(8.461+8.471) \times 2.40 + 1/2(8.471+0.865) \times 8.00 \times 0.70 \times 2$
 $= \{57.662\} \times 0.70 \times 2$

= 80.727m³

= 14.560m²

OF. UP₂ : A = 10.40 × 0.70 × 2

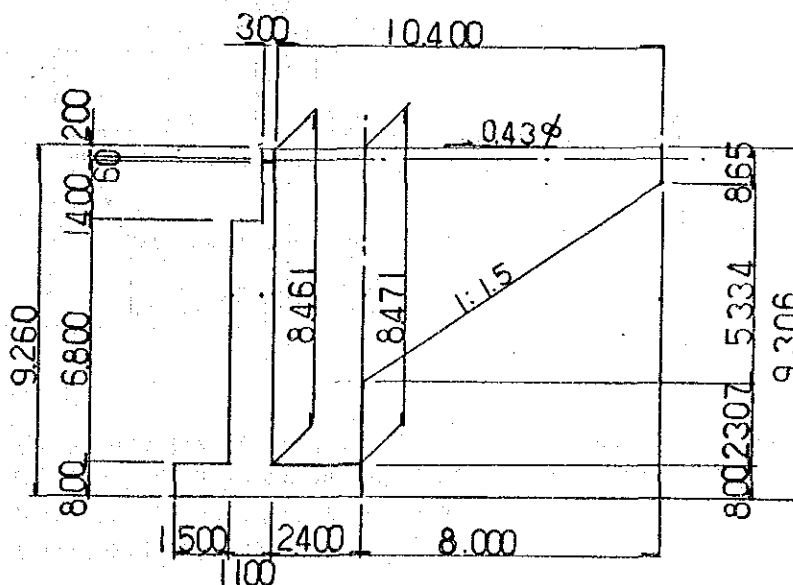
2) Form work.

F₁ : (vertical) $A = ※57.662 \times 2 \times 2 + (0.865+2.307) \times 0.70 \times 2$

= 235.088m²

F₁ : (Sloping) $A = \sqrt{5.334^2 + 8.00^2} \times 0.70 \times 2$

= 13.461m²



MOMBASA - JU - BRIDGE

Sub structure : P₁=P₂...Pier

1) Concrete :

| | | | |
|---------|-------------------------|---|----------------------|
| beam | V = 13.591 × 1.00 | = | 13.591m ³ |
| Pillar | V = 3.157 × 8.00 | = | 25.256m ³ |
| Footing | V = 17.00 × 4.00 × 1.00 | = | 68.000m ³ |

| | | | |
|--|---|---|-----------------------|
| total | = | = | 106.847m ³ |
| Of UF ₂ : A = 17.00 × 4.00 + 13.591 | | = | 81.591m ² |

2) form work.

| | | | |
|-------------|------------------------------------|---|-----------------------|
| horizontal | A = 13.591 - 3.157 | = | 10.434m ² |
| Vartical | A = 35.428 × 1.00 + 15.141 × 0.600 | = | 126.274m ² |
| " (footing) | A = (17.00 + 4.00) × 1.00 × 2 | = | 42.000m ² |

3) base concrete

| | | |
|-------------------------|---|---------------------|
| V = 17.20 × 4.20 × 0.10 | = | 7.224m ³ |
|-------------------------|---|---------------------|

" formwork

| | | |
|-------------------------------|---|---------------------|
| A = (17.20 + 4.20) × 0.10 × 2 | = | 4.280m ² |
|-------------------------------|---|---------------------|

4) Support

| | | |
|--------------------------------------|---|----------------------|
| V = (13.591 - 3.157) × (6.00 - 0.10) | = | 61.560m ³ |
|--------------------------------------|---|----------------------|

5) Scaffold

| | | |
|--|---|-----------------------|
| V = 1.20 {(0.80 + 2.00) + (17.00 + 2.00)} × 7.00 × 2 | = | 366.240m ³ |
|--|---|-----------------------|

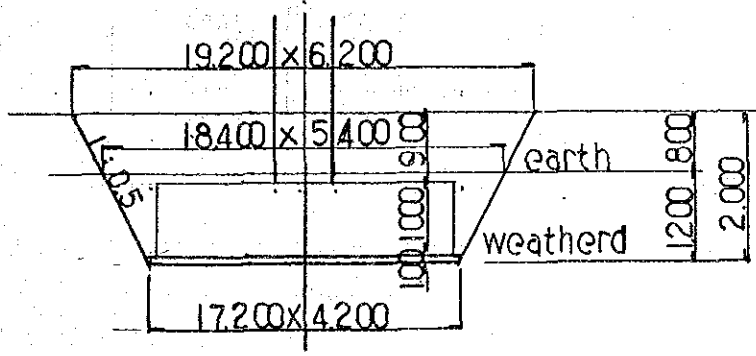
where: quantity of unit length

| | | | |
|--------|---|---|---------------------|
| Pillar | A = {0.800 ² - (0.10 ² × 4 - π × 0.10 ²)} × 5 | = | 3.157m ² |
| | ℓ R = π × 0.10 × 2 × 5 | = | 3.141m |
| | ℓ S = {0.800 × 4 - 8 × 0.10} × 5 | = | 12.000m |

| | | |
|-----------|---|---------|
| total ℓ = | = | 15.141m |
|-----------|---|---------|

| | | | |
|------|---|---|----------------------|
| Beam | A = 17.00 × 0.80 - (0.10 ² × 4 - π × 0.10 ²) | = | 13.591m ² |
| | ℓ R = π × 0.10 × 2 | = | 0.628m |
| | ℓ S = (17.00 + 0.80) × 2 - 8 × 0.10 | = | 34.800m |

| | | |
|-----------|---|---------|
| total ℓ = | = | 35.428m |
|-----------|---|---------|



6) excavation

| | | | |
|-----------|--|---|-----------------------|
| earth | V = 0.80/6 {18.40 × 5.40 + 19.20 × 6.20 + (18.40 + 19.20) (5.40 + 6.20)} | = | 87.274m ³ |
| weatherd | V = 1.20/6 {17.20 × 4.20 + 18.40 × 5.40 + (17.20 + 18.40) (4.20 + 5.40)} | = | 102.672m ³ |
| remain | V = 7.224 + 68.000 + 3.157 × 0.900 | = | 78.065m ³ |
| back fill | V = 87.274 + 102.672 + 78.065 | = | 111.881m ³ |

LIST OF REINFORCED BAR --- MOMBASA BR

[illegible]

LIST OF REINFORCED BAR --- MOMBASA Br

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|----------------|----------|--------|--------|------------|-------------|--------|--------|
| SUPERSTRUCTURE | | | | | | | |
| B 1-1 | Y32 | 10000 | 147 | 6.313 | 63.13 | 9280 | |
| 1-2 | " | 9750 | 98 | " | 61.55 | 6032 | |
| 1-3 | " | 8160 | 98 | " | 51.51 | 5048 | |
| 2 | Y32 | 10000 | 90 | " | 63.13 | 5682 | |
| 3-1 | " | 10000 | 225 | " | 63.13 | 14204 | |
| 3-2 | " | 8360 | 90 | " | 52.78 | 4750 | |
| 4 | Y25 | 12000 | 45 | 3.854 | 46.25 | 2081 | |
| 5-1 | Y25 | 5800 | 90 | " | 22.35 | 2012 | |
| 5-2 | " | 8000 | 90 | " | 30.83 | 2775 | |
| 6-1 | Y12 | 10000 | 180 | 0.888 | 8.88 | 1598 | |
| 6-2 | " | 5000 | 36 | " | 4.44 | 160 | |
| 6-3 | " | 4310 | 36 | " | 3.83 | 138 | |
| BO 1-1 | Y16 | 3380 | 792 | 1.579 | 5.34 | 4229 | |
| 1-2 | " | 960 | 792 | " | 1.52 | 1204 | |
| 2-1 | Y12 | 3250 | 846 | 0.888 | 2.89 | 2445 | |
| 2-2 | " | 840 | 846 | " | 0.75 | 635 | |
| 3 | " | 690 | 846 | " | 0.61 | 516 | |
| 62789 kg | | | | | | | |
| C 1-1 | Y25 | 10000 | 16 | 3.854 | 38.54 | 617 | |
| 1-2 | " | 6780 | 16 | " | 26.13 | 418 | |
| 2-1 | " | 10000 | 16 | " | 38.54 | 617 | |
| 2-2 | " | 8860 | 16 | " | 34.15 | 546 | |
| 3-1 | Y12 | 10000 | 16 | 0.888 | 8.88 | 142 | |
| 3-2 | " | 6270 | 16 | " | 5.57 | 89 | |
| CO 1-1 | Y12 | 2870 | 160 | " | 2.55 | 408 | |
| 1-2 | " | 840 | 160 | " | 0.75 | 120 | |
| 2957 kgk | | | | | | | |
| C 4-1 | Y25 | 10000 | 9 | 3.854 | 38.54 | 347 | |
| 4-2 | " | 6780 | 9 | " | 26.13 | 235 | |
| 5-1 | " | 10000 | 9 | " | 38.54 | 347 | |
| 5-2 | " | 8860 | 9 | " | 34.15 | 307 | |
| 6-1 | Y12 | 10000 | 12 | 0.888 | 8.88 | 107 | |
| 6-2 | " | 6270 | 12 | " | 5.57 | 67 | |
| CO 3-1 | Y12 | 2490 | 120 | " | 2.21 | 265 | |
| 3-2 | " | 600 | 120 | " | 0.53 | 64 | |
| 1739 | | | | | | | |
| Y32 | | | | 44996 | | | |
| Y25 | | | | 10302 | | | |
| Y20 | | | | 650 | | | |
| Y16 | | | | 17147 | | | |
| Y12 | | | | 20560 | | | |
| 93655 kg | | | | | | | |

LIST OF REINFORCED BAR ---MOMBASA---A1= A2

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|----------|----------|--------|--------|------------|-------------|--------|--------|
| P | 1 Y12 | 2000 | 240 | 0.888 | 1.78 | 427 | |
| | 2 " | 540 | 123 | " | 0.48 | 59 | |
| | 3 " | 18580 | 10 | " | 16.50 | 165 | |
| | 4 " | 400 | 27 | " | 0.36 | 10 | |
| 661 kg | | | | | | | |
| A | 1 Y32 | 5000 | 59 | 6.313 | 31.57 | 1863 | |
| | 2 " | 6000 | 58 | " | 37.88 | 2197 | |
| | 3 Y25 | 4030 | 59 | 3.854 | 15.53 | 916 | |
| | 4 " | 3030 | 58 | " | 11.68 | 677 | |
| | 5 " | 7800 | 62 | " | 30.06 | 1864 | |
| | 6 Y16 | 1450 | 123 | 1.579 | 2.29 | 282 | |
| | 7 " | 18720 | 5 | " | 29.56 | 148 | |
| | 8 Y20 | 18860 | 22 | 2.466 | 46.51 | 1023 | |
| | 9 Y25 | 19040 | 22 | 3.854 | 73.38 | 1614 | |
| | 10 Y12 | 1210 | 135 | 0.888 | 1.07 | 144 | |
| | 11 Y16 | 7720 | 4 | 1.579 | 12.19 | 49 | |
| 10777 kg | | | | | | | |
| E | 1 Y12 | 1140 | 56 | 0.888 | 1.01 | 57 | |
| | 2 " | 17180 | 2 | " | 15.26 | 31 | |
| 88 kg | | | | | | | |
| F | 1 Y25 | 3660 | 117 | 3.854 | 14.11 | 1651 | |
| | 2 Y20 | 2770 | 62 | 2.466 | 6.83 | 423 | |
| | 3 Y25 | 3050 | 117 | 3.854 | 11.75 | 1375 | |
| | 4 Y20 | 4040 | 62 | 2.466 | 9.96 | 618 | |
| | 5 Y16 | 18720 | 33 | 1.579 | 29.56 | 975 | |
| | 6 " | 19240 | 4 | " | 30.38 | 122 | |
| | 7 " | 5390 | 4 | " | 8.51 | 34 | |
| | 8 Y12 | 1030 | 8 | 0.888 | 0.91 | 7 | |
| | 9 " | 1950 | 139 | " | 1.73 | 240 | |
| 5445 kg | | | | | | | |
| S | 1 Y16 | 2880 | 112 | 1.579 | 4.55 | 510 | |
| | 2 Y12 | 17200 | 11 | 0.888 | 15.27 | 168 | |
| 678 kg | | | | | | | |
| Y32 | | | | 4060 kg | | | |
| Y25 | | | | 8097 kg | | | |
| Y20 | | | | 2064 kg | | | |
| Y16 | | | | 2120 kg | | | |
| Y12 | | | | 1308 kg | | | |
| | | | | 17649 kg | | | |

LIST OF REINFORCED BAR---MOMBASA-A1---WING

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|--------|---------|
| W | 1 | Y16 | 11070 | 2 | 1.579 | 17.48 | 35 |
| | 2 | Y32 | 11710 | 4 | 6.313 | 73.93 | 296 |
| | 3 | " | 7350 | 15 | " | 46.40 | 696 |
| | 4 | " | 3850 | 8 | " | 24.31 | 194 |
| | 5 | Y20 | 3670 | 23 | 2.466 | 9.05 | 208 |
| | 6 | " | 11100 | 4 | " | 27.37 | 109 |
| | 7 | " | 7170 | 15 | " | 17.68 | 265 |
| | 8 | " | 3670 | 8 | " | 9.05 | 72 |
| | 9 | " | 9150 | 8 | " | 22.56 | 180 |
| | 10 | " | 3360 | 25 | " | 8.29 | 207 |
| | 11 | " | 4500 | 5 | " | 11.10 | 55 |
| | 12 | Y16 | 9090 | 8 | 1.579 | 14.35 | 115 |
| | 13 | " | 3300 | 25 | " | 5.21 | 130 |
| | 14 | " | 11060 | 2 | " | 17.46 | 35 |
| | 15 | Y12 | 1480 | 36 | 0.888 | 1.31 | 47 |
| | 16 | Y16 | 1040 | 34 | 1.579 | 1.64 | 56 |
| | 17 | " | 1040 | 27 | " | " | 44 |
| | 18 | Y32 | 2740 | 4 | 6.313 | 17.30 | 69 |
| | 19 | " | 3880 | 22 | " | 24.49 | 539 |
| | 20 | " | 2500 | 4 | " | 15.78 | 63 |
| | 21 | Y12 | 800 | 50 | 0.888 | 0.71 | 36 |
| | | | | | | | 3451 kg |
| | | | | | | | |
| Y32 | | | | 1857 kg | | | |
| Y20 | | | | 1096 kg | | | |
| Y16 | | | | 415 kg | | | |
| Y12 | | | | 83 kg | | | |
| | | | | | | | 3451 kg |

LIST OF REINFORCED BAR---MOMBASA--A2---WING

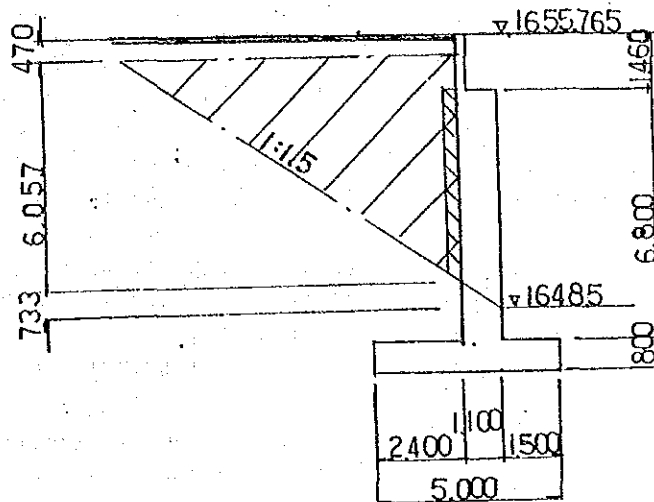
| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|---------|--------|
| W | 1 | Y16 | 11370 | 2 | 1.579 | 17.95 | 36 |
| | 2 | Y32 | 11820 | 6 | 6.313 | 74.62 | 448 |
| | 3 | " | 7190 | 14 | " | 45.39 | 635 |
| | 4 | " | 3850 | 8 | " | 24.31 | 194 |
| | 5 | Y20 | 3670 | 24 | 2.466 | 9.05 | 217 |
| | 6 | " | 11220 | 6 | " | 27.67 | 166 |
| | 7 | " | 7010 | 14 | " | 17.29 | 242 |
| | 8 | " | 3670 | 8 | " | 9.05 | 72 |
| | 9 | " | 9180 | 8 | " | 22.64 | 181 |
| | 10 | " | 3420 | 26 | " | 8.43 | 219 |
| | 11 | " | 4500 | 5 | " | 11.10 | 55 |
| | 12 | Y16 | 9120 | 8 | 1.579 | 14.40 | 115 |
| | 13 | " | 3360 | 26 | " | 5.31 | 138 |
| | 14 | " | 11300 | 2 | " | 17.84 | 36 |
| | 15 | Y12 | 840 | 37 | 0.888 | 0.75 | 28 |
| | 16 | Y16 | 1040 | 35 | 1.579 | 1.64 | 57 |
| | 17 | " | 1040 | 28 | " | " | 46 |
| | 18 | Y32 | 2740 | 5 | 6.313 | 17.30 | 87 |
| | 19 | " | 3880 | 22 | " | 24.49 | 539 |
| | 20 | " | 2500 | 4 | " | 15.78 | 63 |
| | 21 | Y12 | 800 | 54 | 0.888 | 0.71 | 38 |
| | | | | | | 3612 kg | |
| | | | | | | | |
| Y32 | | | | 1966 kg | | | |
| Y20 | | | | 1152 kg | | | |
| Y16 | | | | 428 kg | | | |
| Y12 | | | | 66 kg | | | |
| | | | | | | 3612 kg | |

LIST OF REINFORCED BAR---MOMBASA-PIER

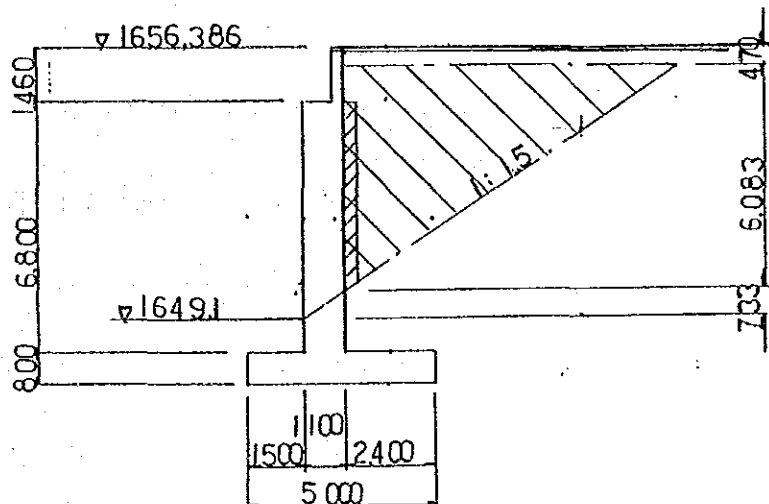
| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|-----------|----------|--------|--------|------------|-------------|----------|--------|
| (A) = (B) | | | | | | | |
| B | 1 | Y25 | 19410 | 12 | 3.854 | 74.81 | 898 |
| | 2 | " | 17730 | 12 | " | 68.33 | 820 |
| | 3 | Y20 | 18910 | 6 | 2.466 | 46.63 | 280 |
| | 4 | Y16 | 2650 | 111 | 1.579 | 4.18 | 464 |
| | 5 | " | 890 | 111 | " | 1.41 | 157 |
| | 6 | Y12 | 890 | 58 | 0.888 | 0.79 | 46 |
| | | | | | | 2665 kg | |
| C | 1 | Y32 | 8050 | 140 | 6.313 | 50.82 | 7115 |
| | 2 | Y16 | 3270 | 205 | 1.579 | 5.16 | 1058 |
| | 3 | Y12 | 890 | 110 | 0.888 | 0.79 | 87 |
| | | | | | | 8260 kg | |
| F | 1 | Y20 | 5580 | 113 | 2.460 | 13.76 | 1555 |
| | 2 | Y16 | 4320 | 59 | 1.579 | 6.82 | 402 |
| | 3 | Y25 | 19480 | 27 | 3.854 | 75.08 | 2027 |
| | 4 | " | 18480 | 27 | " | 71.22 | 1923 |
| | 5 | Y16 | 17900 | 6 | 1.579 | 28.26 | 170 |
| | 6 | " | 4360 | 10 | " | 6.88 | 69 |
| | 7 | " | 2340 | 176 | " | 3.69 | 649 |
| | | | | | | 6795 kg | |
| Y32 | | | | 7115 kg | | | |
| Y25 | | | | 5668 kg | | | |
| Y20 | | | | 1835 kg | | | |
| Y16 | | | | 2969 kg | | | |
| Y12 | | | | 133 kg | | | |
| | | | | | | 17720 kg | |

MOMBASA — ABUTMENT

A1 --- BACK-FILL



A2 --- BACK-FILL



BACK-FILL

$$A1 : V = \frac{1}{2} \times 6.057^2 \times 1.5 \times (18.30 - 0.70 \times 2) = 465.0 \text{ m}^3$$

$$A2 : V = \frac{1}{2} \times 6.083^2 \times 1.5 \times (\quad) = 469.0 \text{ "}$$

$$= 934.0 \text{ "}$$

UNURU MONUMENT BRIDGE

Super structure

1) Concrete (Grade=30)

$$\text{Girder slab } V = 12.993 \times 37.950$$

$$= 493.084 \text{ m}^3$$

$$\text{cross girder } V = 0.950 \times (0.60 \times 3 + 0.35 \times 2) \times 1.30 \times 10$$

$$= 30.875 \text{ m}^3$$

total

=

$$= 523.959 \text{ m}^3$$

$$\text{Of } UF_2 : A = 37.95 \times (20.50 + 1.50)$$

$$= 834.900 \text{ m}^2$$

2) form work

$$\text{horizontal } A = 37.95 \times (\sqrt{0.15^2 + 1.05^2} \times 2 + 0.60 \times 11 + 1.30 \times 10)$$

$$= 824.350 \text{ m}^2$$

$$\text{Vartical } A = 37.95 \times (0.20 + 0.95 + 1.10 \times 10 + 1.06 \times 2 + 0.86) \times 2$$

$$+ 0.95 \times 1.30 \times 10 \times 8$$

$$- (0.95 \times 0.60 \times 3 + 0.95 \times 0.35 \times 2) \times 2$$

$$= 1242.417 \text{ m}^2$$

3) Support

$$V = 37.95 \times \{(0.95 + 1.10) \times 1.05 + 1.30 \times 1.10 \times 10\}$$

$$+ 5.50 \times 21.70 \times \{38.000 - (1.00 \times 2 + 0.80) \times 1.0403\}$$

$$= 4812.024 \text{ m}^3$$

4) Scaffold

$$V = (21.70 + 1.00) \times 37.95$$

$$= 861.465 \text{ m}^3$$

5) expansion

$$= 20.50 \times 1.0403 \times 2$$

$$= 42.653 \text{ m}$$

expansion filler ($t=30 \text{ mm}$)

$$A = \{(0.20 + 0.35) \times 1.05 + 1.10 \times 19.60\} \times 1.0403 \times 2$$

$$= 56.873 \text{ m}^2$$

6) Joint filler ($t=20 \text{ mm}$)

$$A = (0.352 \times 2 + 0.532) \times 3$$

$$= 3.708 \text{ m}^2$$

(Parapet)

7) Asphalt ($t=60 \text{ mm}$)

$$A = 0.06 \times (20.50 - 1.50) \times 37.95$$

$$= 43.263 \text{ m}^3$$

$$(721.050 \text{ m}^2)$$

8) Guard rail (Abut)

$$= (10.40 + 10.70) \times 2$$

$$= 42.200 \text{ m}$$

* section of superstructure.

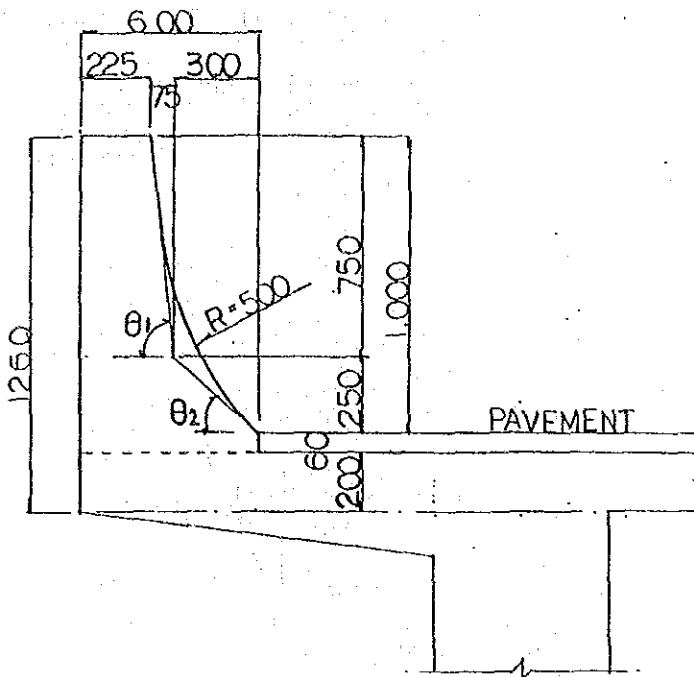
$$A = \{(0.20 \times 0.35) \times 1.05 + 1.30 \times 19.60 - 1.10 \times 1.300 \times 10\}$$

$$+ 0.352 \times 2 + 0.532$$

$$= 12.993 \text{ m}^2$$

SHAPE OF PARAPET OF MAIN ROAD

1) FOR VERGE



Section area

$$A = 0.60 \times 1.06 - \frac{1}{2} \times 0.075 \times 0.75 \\ - \frac{0.75 + 1.00}{2} \times 0.30 + 0.006 \\ = 0.352 \text{ m}^2$$

$$\theta_1 = \tan^{-1} \frac{0.750}{0.075} = 84^\circ 17' 22''$$

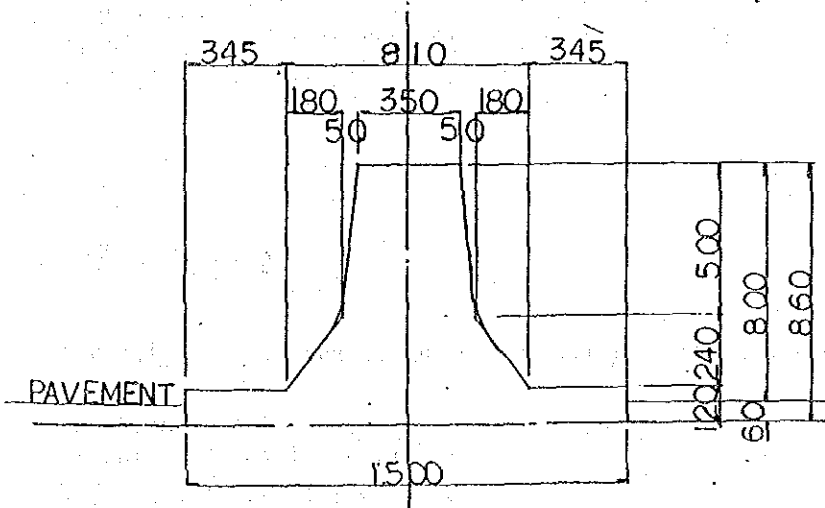
$$\theta_2 = \tan^{-1} \frac{0.250}{0.300} = 39^\circ 48' 20''$$

$$\theta = 44^\circ 29'$$

$$TL = R \cdot \tan \frac{\theta}{2} = 0.205 \text{ m}$$

2) FOR CENTRAL RESERVE.

$$A = 0.205 \times 0.50 - \pi \times 0.50^2 \times \frac{44.29'}{360} \\ = 0.006 \text{ m}^2$$



Section area

$$A = \frac{0.35 + 0.45}{2} \times 0.50 + \frac{0.45 + 0.81}{2} \times 0.24 + 1.50 \times 0.12 \\ = 0.532 \text{ m}^2$$

UNUNRU NONUMENT JU BRIDGE

Sub structure : $A_1 = A_2$ (Main)

1) Concrete

$$V = 0.16 \times 0.626 \times 0.30 \times 2 + 22.70 (1.40 \times 0.30 + 11.00 \times 6.80 + 5.00 \times 0.80) = 270.227 \text{ m}^3$$

$$UF_2 : A = 22.70 \{ (5.00 - 1.10) + 0.30 + 0.80 \} = 113.500 \text{ m}^2$$

2) formwork.

Vertical $A = \{ (0.30 + 0.60) \times 0.26 \times 2 \times 2 + (0.30 + 21.70) \times 1.40 \times 2 + (1.10 + 21.70) \times 6.80 \times 2 \} \times 1.0457 = 389.645 \text{ m}^2$

" (footing) $A = (5.00 + 21.70) \times 0.80 \times 2 \times 1.0457 = 44.672 \text{ m}^2$

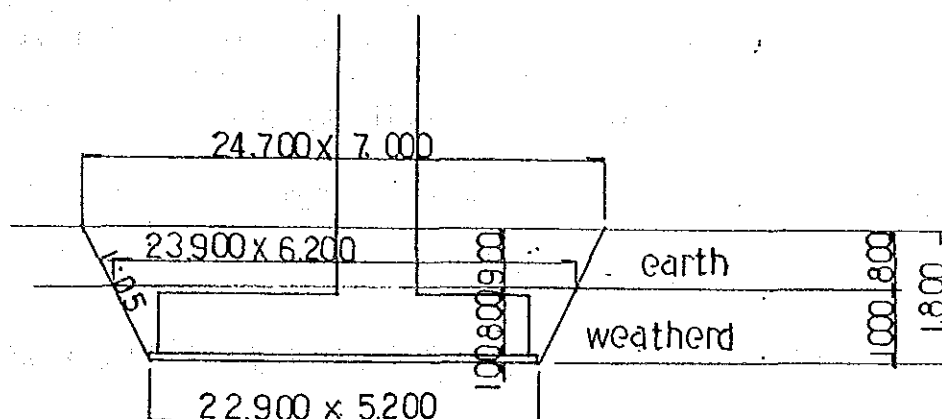
3) Scaffold

$$V = 1.20 \{ (1.10 + 2.00) + (21.70 + 2.00) \} \times 8.20 \times 1.0457 = 275.763 \text{ m}^3$$

4) base concrete

$$V = 5.20 \times 21.90 \times 0.10 \times 1.0457 = 11.908 \text{ m}^3$$

$$A = (5.20 + 21.90) \times 0.10 \times 2 \times 1.0457 = 5.667 \text{ m}^2$$



5) excavation

earth $V = 0.80/6 \{ 6.20 \times 23.90 + 7.00 \times 24.70 + (6.20 + 7.00) (23.90 + 24.70) \} = 128.346 \text{ m}^3$

weathered $V = 1.00/6 \{ 5.20 \times 22.90 + 6.20 \times 23.90 + (5.20 + 6.20) (22.90 + 23.90) \} = 133.463 \text{ m}^3$

remain $V = 11.908 + 22.70 \times 5.00 \times 0.80 + 22.70 \times 1.10 \times 0.90 = 125.181 \text{ m}^3$

back fill $V = 128.346 + 133.463 - 125.181 = 136.628 \text{ m}^3$

wing : $A_1 = A_2$

Material of this wing is apply quantity of mombasa wing

$\therefore (A_1 + A_2)$

1) Concrete $V = 78.088 + 80.727 = 158.815 \text{ m}^3$

OF. $UF_2 : A = 14.140 + 14.560 = 28.700 \text{ m}^2$

2) formwork .

F_1 (vertical) $A = 227.511 + 235.088 = 462.599 \text{ m}^2$

F_2 (sloping) $A = 12.955 + 13.461 = 26.416 \text{ m}^2$

UNURU MONUMENT JU BRIDGE

Sub structure P₁ : Pier

1) Concrete

| | | | |
|---------|-------------------------------------|---|----------------------|
| beam | $V = \pi \times 17.191 \times 1.00$ | = | 17.191m ³ |
| Pillar | $V = \pi \times 3.788 \times 5.00$ | = | 18.940m ³ |
| footing | $V = 21.50 \times 4.00 \times 1.00$ | = | 86.000m ³ |

| | | | |
|---|---|---|-----------------------|
| total | . | = | 122.131m ³ |
| UF ₂ : A = 21.50 × 4.00 + 17.191 | | = | 103.191m ² |

2) form work.

| | | | |
|-------------|--|---|-----------------------|
| horizontal | $A = \pi \times 17.191 - \pi \times 3.788$ | = | 13.403m ² |
| Vertical | $A = \pi \times 44.428 \times 1.00 + 18.170 \times 5.00$ | = | 135.278m ² |
| " (footing) | $A = (21.50 + 4.00) \times 1.00 \times 2$ | = | 51.000m ² |

3) base concrete

| | | |
|-------------------------|---|---------------------|
| V = 21.70 × 4.20 × 0.10 | = | 9.114m ³ |
|-------------------------|---|---------------------|

" formwork

| | | |
|---|---|---------------------|
| $A = (21.70 + 4.20) \times 0.10 \times 2$ | = | 5.180m ² |
|---|---|---------------------|

4) Support

| | | |
|--|---|----------------------|
| $V = \pi \times (17.191 - 3.788) \times (6.10 - 0.10)$ | = | 80.418m ³ |
|--|---|----------------------|

5) Scaffold

| | | |
|--|---|-----------------------|
| $V = 1.20 \{ (0.80 + 2.00) + (21.50 + 2.00) \} \times 6.00 \times 2$ | = | 378.720m ³ |
|--|---|-----------------------|

where. quantity of unit length

| | | | |
|--------|--|---|-----------------------|
| Piller | $A = \{ 0.800^2 - (0.10^2 \times 4 - \pi \times 0.10^2) \} \times 6$ | = | $\pi \times 3.788m^2$ |
| | $\phi R = \pi \times 0.10 \times 2 \times 6$ | = | 3.770m ² |
| | $\phi S = \{ 0.800 \times 4 - 8 \times 0.10 \} \times 6$ | = | 14.400m ² |

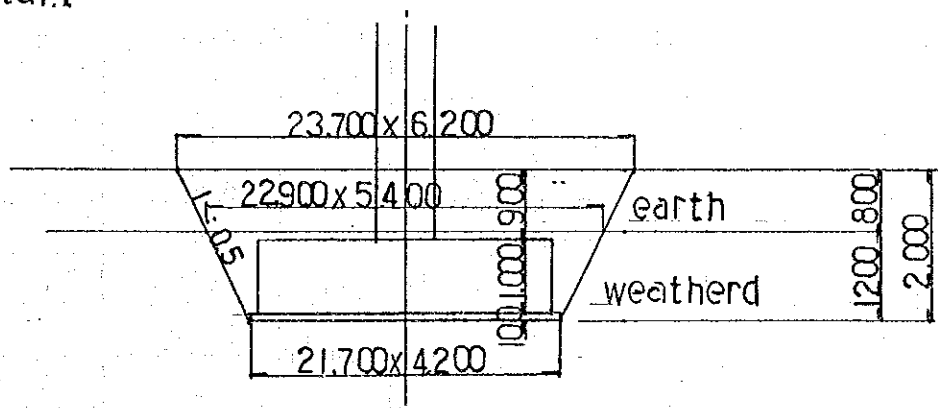
total. $\phi =$

$$= \pi \times 18.170m$$

| | | | |
|------|---|---|------------------------|
| Beam | $A = 21.50 \times 0.80 - (0.10^2 \times 4 - \pi \times 0.10^2)$ | = | $\pi \times 17.191m^2$ |
| | $\phi R = \pi \times 0.10 \times 2$ | = | 0.628m |
| | $\phi S = (21.50 + 0.80) \times 2 - 8 \times 0.10$ | = | 43.800m |

total. $\phi =$

$$= \pi \times 44.428m$$



6) excavation

| | | | |
|-----------|--|---|-----------------------|
| earth | $V = 0.80/6 \{ 22.90 \times 5.40 + 23.70 \times 6.20 + (22.90 + 23.70) (5.40 + 6.20) \}$ | = | 108.154m ³ |
| weathered | $V = 1.20/6 \{ 21.70 \times 4.20 + 22.90 \times 5.40 + (21.70 + 22.90) (4.20 + 5.40) \}$ | = | 128.592m ³ |
| remain | $V = 9.114 + 86.000 + \pi \times 3.788 \times 0.80$ | = | 98.144m ³ |
| back fill | $V = 108.154 + 128.592 - 98.144$ | = | 138.602m ³ |

LIST OF REINFORCED BAR --- UHURU-Br

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|----------------|----------|--------|--------|------------|-------------|--------|--------|
| SUPERSTRUCTURE | | | | | | | |
| S 1-1 | Y16 | 10000 | 222 | 1.579 | 15.79 | 3505 | |
| 1-2 | " | 5500 | 222 | " | 8.68 | 1972 | |
| 1-3 | " | 8130 | 222 | " | 12.84 | 2850 | |
| 2-1 | Y12 | 6090 | 222 | 0.888 | 5.41 | 1201 | |
| 2-2 | " | 6500 | 222 | " | 5.77 | 1281 | |
| 2-3 | " | 8500 | 222 | " | 7.55 | 1676 | |
| 3-1 | Y20 | 10000 | 14 | 2.466 | 24.66 | 345 | |
| 3-2 | " | 5500 | 14 | " | 13.56 | 190 | |
| 3-3 | " | 8410 | 14 | " | 20.74 | 290 | |
| 4-1 | Y16 | 6370 | 14 | 1.579 | 10.06 | 141 | |
| 4-2 | " | 8500 | 14 | " | 13.42 | 188 | |
| 4-3 | " | 8410 | 14 | " | 13.28 | 186 | |
| 5 | " | 2900 | 34 | " | 4.58 | 156 | |
| 6 | " | 1730 | 250 | " | 2.73 | 683 | |
| 7-1 | Y12 | 10000 | 348 | 0.888 | 8.88 | 3090 | |
| 7-2 | " | 5000 | 116 | " | 4.44 | 515 | |
| 7-3 | " | 4070 | 116 | " | 3.61 | 418 | |
| | | | | | | 18687 | kg |
| | | | | | | | |
| K 1 | Y12 | 1380 | 250 | 0.888 | 1.23 | 308 | |
| 2 | " | 1340 | 250 | " | 1.19 | 298 | |
| 3 | " | 1360 | 250 | " | 1.21 | 304 | |
| 4 | " | 510 | 250 | " | 0.45 | 113 | |
| 6 | " | 1150 | 250 | " | 1.02 | 255 | |
| 7 | " | 1040 | 250 | " | 0.92 | 230 | |
| 8 | " | 1880 | 125 | " | 1.67 | 209 | |
| 9 | " | 640 | 125 | " | 0.57 | 71 | |
| 10-1 | " | 10000 | 72 | " | 8.88 | 639 | |
| 10-2 | " | 5000 | 24 | " | 4.44 | 106 | |
| 10-3 | " | 4070 | 24 | " | 3.61 | 86 | |
| | | | | | | 2619 | kg |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

LIST OF REINFORCED BAR ---UHURU Br

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|----------------|----------|--------|--------|------------|-------------|--------|---------|
| SUPERSTRUCTURE | | | | | | | |
| B 1-1 | Y32 | 10000 | 177 | 6.313 | 63.13 | 11174 | |
| 1-2 | " | 7300 | 118 | " | 46.08 | 5437 | |
| 2 | " | 10000 | 55 | " | 63.13 | 3472 | |
| 3-1 | " | 10000 | 165 | " | 63.13 | 10416 | |
| 3-2 | " | 6620 | 110 | " | 41.79 | 4597 | |
| 4-1 | Y25 | 10000 | 110 | 3.854 | 38.54 | 4239 | |
| 4-2 | " | 4800 | 110 | " | 18.50 | 2035 | |
| 5-1 | Y12 | 10000 | 132 | 0.888 | 8.88 | 1172 | |
| 5-2 | " | 4740 | 88 | " | 4.21 | 370 | |
| | | | | | | | |
| BO 1-1 | Y16 | 3800 | 638 | 1.579 | 5.34 | 3407 | |
| 1-2 | " | 460 | 638 | " | 1.52 | 970 | |
| 2-1 | Y12 | 3250 | 682 | 0.888 | 2.89 | 1971 | |
| 2-2 | " | 840 | 682 | " | 0.75 | 512 | |
| 3 | " | 690 | 682 | " | 0.61 | 416 | |
| | | | | | | | |
| | | | | | | | 50188 |
| | | | | | | | |
| C 1-1 | Y25 | 10000 | 12 | 3.854 | 38.54 | 462 | |
| 1-2 | | 6350 | 24 | | 24.47 | 587 | |
| 2-1 | | 10000 | 12 | | 35.84 | 462 | |
| 2-2 | | 6980 | 24 | | 26.90 | 646 | |
| 3-1 | Y12 | 10000 | 12 | 0.888 | 8.88 | 107 | |
| 3-2 | | 5520 | 24 | | 4.90 | 118 | |
| CO 1 | | 2870 | 150 | | 2.55 | 383 | |
| 2 | | 840 | 150 | | 0.75 | 113 | |
| | | | | | | | 2878 kg |
| | | | | | | | |
| C 4-1 | Y25 | 10000 | 6 | 3.854 | 38.54 | 231 | |
| 4-2 | " | 6350 | 12 | " | 24.47 | 294 | |
| 5-1 | " | 10000 | 6 | " | 38.54 | 231 | |
| 5-2 | " | 6980 | 12 | " | 26.90 | 323 | |
| 6-1 | Y12 | 10000 | 8 | 0.888 | 8.88 | 71 | |
| 6-2 | " | 5520 | 16 | " | 4.90 | 78 | |
| CO 3 | " | 2630 | 100 | " | 2.34 | 234 | |
| CO 4 | " | 600 | 100 | " | 0.53 | 53 | |
| | | | | | | | 1515 kg |
| | | | | | | | |
| | | | | Y32 | 35096 kg | | |
| | | | | Y25 | 9510 kg | | |
| | | | | Y20 | 825 kg | | |
| | | | | Y16 | 14058 kg | | |
| | | | | Y12 | 16398 kg | | |
| | | | | | 75887 kg | | |

LIST OF REINFORCED BAR ---UHURU---A1=A2

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|----------|--------|
| | | | | | | | |
| P | 1 | Y12 | 2000 | 300 | 0.888 | 1.78 | 534 |
| | 2 | " | 670 | 147 | " | 0.59 | 87 |
| | 3 | " | 23390 | 10 | " | 20.77 | 208 |
| | 4 | " | 410 | 35 | " | 0.36 | 13 |
| | | | | | | 842 kg | |
| A | 1 | Y32 | 5000 | 75 | 6.313 | 31.57 | 2368 |
| | 2 | " | 6000 | 72 | " | 37.88 | 2727 |
| | 3 | Y25 | 4080 | 75 | 3.854 | 15.72 | 1179 |
| | 4 | " | 3080 | 72 | " | 11.87 | 855 |
| | 5 | " | 7850 | 77 | " | 30.25 | 2329 |
| | 6 | Y16 | 7720 | 4 | 1.579 | 12.19 | 49 |
| | 7 | " | 1490 | 153 | " | 2.35 | 360 |
| | 8 | " | 23670 | 5 | " | 37.37 | 187 |
| | 9 | Y25 | 24300 | 22 | 3.854 | 93.65 | 2060 |
| | 10 | Y16 | 23670 | 22 | 1.579 | 37.37 | 822 |
| | 11 | Y12 | 1250 | 175 | 0.888 | 1.11 | 194 |
| | | | | | | 13130 kg | |
| E | 1 | Y12 | 1180 | 71 | 0.888 | 1.05 | 75 |
| | 2 | " | 22150 | 2 | " | 19.67 | 39 |
| | | | | | | 114 kg | |
| F | 1 | Y25 | 3750 | 147 | 3.854 | 14.45 | 2124 |
| | 2 | Y20 | 2880 | 77 | 2.466 | 7.10 | 547 |
| | 3 | Y25 | 3110 | 153 | 3.854 | 11.99 | 1834 |
| | 4 | Y20 | 4180 | 77 | 2.466 | 10.31 | 794 |
| | 5 | " | 23950 | 18 | " | 59.06 | 1063 |
| | 6 | Y16 | 23670 | 15 | 1.579 | 37.37 | 561 |
| | 7 | " | 24150 | 4 | " | 38.13 | 153 |
| | 8 | " | 6 | 4 | " | 0.01 | 0 |
| | 9 | " | 1150 | 8 | " | 1.82 | 15 |
| | 10 | Y12 | 1960 | 176 | 0.888 | 1.74 | 306 |
| | | | | | | 7397 kg | |
| S | 1 | Y16 | 2880 | 143 | 1.579 | 4.55 | 651 |
| | 2 | Y12 | 22150 | 11 | 0.888 | 19.67 | 216 |
| | | | | | | 867 kg | |
| Y32 | | | | 5095 kg | | | |
| Y25 | | | | 10381 kg | | | |
| Y20 | | | | 2404 kg | | | |
| Y16 | | | | 2798 kg | | | |
| Y12 | | | | 1672 kg | | | |
| | | | | 22350 kg | | | |

LIST OF REINFORCED BAR---UHURU--A2---WING

A)

RIGHT

| MARK | DIAMETER | LENGTH | NUMBER | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|-------------|----------|--------|--------|------------|-------------|--------|--------|
| W 1 | Y16 | 11150 | 2 | 1.579 | 17.61 | 35 | |
| 2 | Y32 | 11700 | 6 | 6.313 | 73.86 | 443 | |
| 3 | " | 7130 | 14 | " | 45.01 | 630 | |
| 4 | " | 3980 | 8 | " | 25.13 | 201 | |
| 5 | Y20 | 3800 | 23 | 2.466 | 9.37 | 216 | |
| 6 | " | 11250 | 6 | " | 27.74 | 166 | |
| 7 | " | 7100 | 14 | " | 17.51 | 245 | |
| 8 | " | 3800 | 8 | " | 9.37 | 75 | |
| 9 | " | 9140 | 8 | " | 22.54 | 180 | |
| 10 | " | 4500 | 5 | " | 11.10 | 55 | |
| 11 | " | 3470 | 25 | " | 8.56 | 214 | |
| 12 | Y16 | 9080 | 8 | 1.579 | 14.34 | 115 | |
| 13 | " | 3450 | 26 | " | 5.45 | 142 | |
| 14 | " | 11230 | 2 | " | 17.73 | 35 | |
| 15 | Y12 | 840 | 37 | 0.888 | 0.75 | 28 | |
| 16 | Y16 | 1040 | 54 | 1.579 | 1.64 | 89 | |
| 17 | " | 1060 | 8 | " | 1.67 | 13 | |
| 18 | Y32 | 2690 | 5 | 6.313 | 16.98 | 85 | |
| 19 | " | 3580 | 22 | " | 22.60 | 497 | |
| 20 | " | 3000 | 5 | " | 18.94 | 95 | |
| 21 | Y12 | 800 | 54 | 0.888 | 0.71 | 38 | |
| 3597 kg | | | | | | | |
| Y32 1951 kg | | | | | | | |
| Y20 1151 kg | | | | | | | |
| Y16 429 kg | | | | | | | |
| Y12 66 kg | | | | | | | |
| Σ 3597 kg | | | | | | | |

B)

LEFT

| MARK | DIAMETER | LENGTH | NUMBER | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|-------------|----------|--------|--------|------------|-------------|--------|--------|
| W 1 | Y16 | 11300 | 2 | 1.579 | 17.84 | 36 | |
| 2 | Y32 | 11850 | 6 | 6.313 | 74.81 | 449 | |
| 3 | " | 7290 | 14 | " | 46.02 | 644 | |
| 4 | " | 3980 | 8 | " | 25.13 | 201 | |
| 5 | Y20 | 3800 | 23 | 2.466 | 9.37 | 216 | |
| 6 | " | 11250 | 6 | " | 27.74 | 166 | |
| 7 | " | 7100 | 14 | " | 17.51 | 245 | |
| 8 | " | 3800 | 8 | " | 9.37 | 75 | |
| 9 | " | 9140 | 8 | " | 22.54 | 180 | |
| 10 | " | 4500 | 5 | " | 11.10 | 55 | |
| 11 | " | 3350 | 25 | " | 8.26 | 206 | |
| 12 | Y16 | 9080 | 8 | 1.579 | 14.34 | 115 | |
| 13 | " | 3450 | 26 | " | 5.45 | 142 | |
| 14 | " | 11230 | 2 | " | 17.73 | 35 | |
| 15 | Y12 | 840 | 37 | 0.888 | 0.75 | 28 | |
| 16 | Y16 | 1040 | 54 | 1.579 | 1.64 | 89 | |
| 17 | " | 1060 | 8 | " | 1.67 | 13 | |
| 18 | Y32 | 3220 | 5 | 6.313 | 20.33 | 102 | |
| 19 | " | 4420 | 22 | " | 27.90 | 614 | |
| 20 | " | 3000 | 5 | " | 18.94 | 95 | |
| 21 | Y12 | 800 | 54 | 0.888 | 0.71 | 38 | |
| 3744 kg | | | | | | | |
| Y32 2105 kg | | | | | | | |
| Y20 1143 kg | | | | | | | |
| Y16 430 kg | | | | | | | |
| Y12 66 kg | | | | | | | |
| Σ 3744 kg | | | | | | | |

LIST OF REINFORCED BAR --- UHURU-A1---WING

A) RIGHT

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|---------|--------|
| W 1 | Y16 | 10860 | 2 | 1.579 | 17.15 | 34 | |
| 2 | Y32 | 11760 | 6 | 6.313 | 74.24 | 445 | |
| 3 | " | 7290 | 13 | " | 46.02 | 598 | |
| 4 | " | 4000 | 7 | " | 25.25 | 177 | |
| 5 | Y20 | 3820 | 23 | 2.466 | 9.42 | 217 | |
| 6 | " | 11120 | 5 | " | 27.42 | 137 | |
| 7 | " | 7150 | 14 | " | 17.63 | 247 | |
| 8 | " | 3820 | 8 | " | 9.42 | 75 | |
| 9 | " | 9110 | 8 | " | 22.47 | 180 | |
| 10 | " | 4500 | 5 | " | 11.10 | 55 | |
| 11 | " | 3480 | 25 | " | 8.58 | 214 | |
| 12 | Y16 | 9050 | 8 | 1.579 | 14.29 | 114 | |
| 13 | " | 3420 | 25 | " | 5.40 | 135 | |
| 14 | " | 11090 | 2 | " | 17.51 | 35 | |
| 15 | Y12 | 740 | 36 | 0.888 | 0.66 | 24 | |
| 16 | Y16 | 1040 | 53 | 1.579 | 1.64 | 87 | |
| 17 | " | 1060 | 7 | " | 1.67 | 12 | |
| 18 | Y32 | 3220 | 5 | 6.313 | 20.33 | 102 | |
| 19 | " | 4420 | 21 | " | 27.90 | 586 | |
| 20 | " | 3000 | 3 | " | 18.94 | 57 | |
| 21 | Y12 | 800 | 50 | 0.888 | 0.71 | 36 | |
| | | | | | | 3567 kg | |
| | | | | | | | |
| Y32 | | | | 1965 kg | | | |
| Y20 | | | | 1125 kg | | | |
| Y16 | | | | 417 kg | | | |
| Y12 | | | | 60 kg | | | |
| | | | | | | 3567 kg | |

B) LEFT

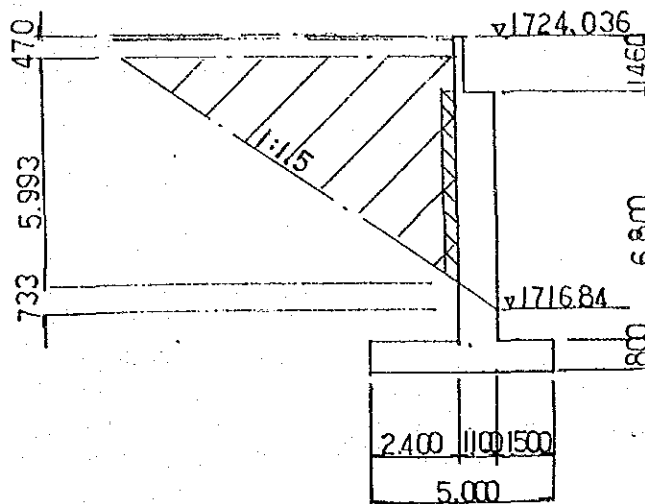
| | | | | | | | |
|-----|-----|-------|----|---------|-------|---------|--|
| W 1 | Y16 | 11030 | 2 | 1.579 | 17.42 | 35 | |
| 2 | Y32 | 11430 | 6 | 6.313 | 72.16 | 433 | |
| 3 | " | 6960 | 13 | " | 43.94 | 571 | |
| 4 | " | 4000 | 7 | " | 25.25 | 177 | |
| 5 | Y20 | 3820 | 23 | 2.466 | 9.42 | 217 | |
| 6 | " | 11120 | 5 | " | 27.42 | 137 | |
| 7 | " | 7100 | 14 | " | 17.51 | 245 | |
| 8 | " | 3820 | 8 | " | 9.42 | 75 | |
| 9 | " | 9110 | 8 | " | 22.47 | 180 | |
| 10 | " | 4500 | 5 | " | 11.10 | 55 | |
| 11 | " | 3380 | 24 | " | 8.34 | 200 | |
| 12 | Y16 | 9050 | 8 | 1.579 | 14.29 | 114 | |
| 13 | " | 3420 | 25 | " | 5.40 | 135 | |
| 14 | " | 11090 | 2 | " | 17.51 | 35 | |
| 15 | Y12 | 740 | 36 | 0.888 | 0.66 | 24 | |
| 16 | Y16 | 1040 | 53 | 1.579 | 1.64 | 87 | |
| 17 | " | 1060 | 7 | " | 1.67 | 12 | |
| 18 | Y32 | 2580 | 5 | 6.313 | 16.29 | 81 | |
| 19 | " | 3560 | 21 | " | 22.47 | 472 | |
| 20 | " | 3000 | 3 | " | 18.94 | 57 | |
| 21 | Y12 | 800 | 50 | 0.888 | 0.71 | 36 | |
| | | | | | | 3378 kg | |
| | | | | | | | |
| Y32 | | | | 1791 kg | | | |
| Y20 | | | | 1109 kg | | | |
| Y16 | | | | 418 kg | | | |
| Y12 | | | | 60 kg | | | |
| | | | | | | 3378 kg | |

LIST OF REINFORCED BAR ---UHURU-PIER

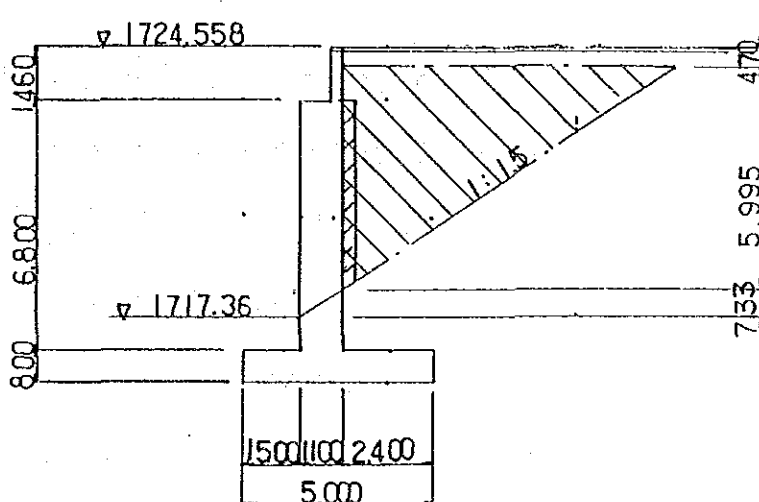
| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|----------|----------|--------|--------|------------|-------------|--------|---------|
| B | 1 | Y25 | 24790 | 12 | 3.854 | 95.54 | 1146 |
| | 2 | " | 23110 | 12 | " | 89.07 | 1069 |
| | 3 | Y20 | 24110 | 6 | 2.466 | 59.46 | 357 |
| | 4 | Y16 | 2650 | 141 | 1.579 | 4.18 | 589 |
| | 5 | " | 890 | 141 | " | 1.41 | 199 |
| | 6 | Y12 | 890 | 70 | 0.888 | 0.79 | 55 |
| 3415 kg | | | | | | | |
| C | 1 | Y32 | 7050 | 168 | 6.313 | 44.51 | 7478 |
| | 2 | Y16 | 3270 | 204 | 1.579 | 5.16 | 1053 |
| | 3 | Y12 | 890 | 108 | 0.888 | 0.79 | 85 |
| 8616 kg | | | | | | | |
| F | 1 | Y20 | 5580 | 143 | 2.466 | 13.76 | 1968 |
| | 2 | Y16 | 4320 | 73 | 1.579 | 6.82 | 498 |
| | 3 | Y25 | 24850 | 27 | 3.854 | 95.77 | 2586 |
| | 4 | " | 23860 | 27 | " | 91.96 | 2483 |
| | 5 | Y16 | 22960 | 67 | 1.579 | 36.25 | 218 |
| | 6 | " | 4360 | 10 | " | 6.88 | 69 |
| | 7 | " | 2340 | 220 | " | 3.69 | 812 |
| 8634 kg | | | | | | | |
| Y32 | | | | | | | 7478 kg |
| Y25 | | | | | | | 7284 kg |
| Y20 | | | | | | | 2325 kg |
| Y16 | | | | | | | 3438 kg |
| Y12 | | | | | | | 140 kg |
| 20665 kg | | | | | | | |

UHURU - ABUTMENT

A₁ --- BACK-FILL



A₂ --- BACK-FILL



BACK-FILL

$$A_1 : V = \frac{1}{2} \times 5.993^2 \times 1.5 \times (22.70 - 0.732 \times 2) = 572.0 \text{ m}^3$$

$$A_2 : V = \frac{1}{2} \times 5.995^2 \times 1.5 \times (22.70 - 0.727 \times 2) = 572.5 \text{ m}^3$$

$$= 1144.5 \text{ m}^3$$

RAILWAY BRIDGE

Super structure

1) Concrete (Grade=30)

$$\text{Girder slab } V = 7.439 \times 56.790$$

$$= 422.460 \text{ m}^3$$

$$\text{cross girder } V = 1.050 \times (0.60 \times 4 + 0.35 \times 3) \times 1.15 \times 5 \times 1.3151$$

$$= 27.392 \text{ m}^3$$

total

=

$$= 449.852 \text{ m}^3$$

$$\text{OF UF}_2 : V = 11.90 \times 56.79$$

$$= 675.801 \text{ m}^3$$

2) form work

$$\text{horizontal } A = 56.79 \times (\sqrt{0.20^2 + 1.125^2} \times 2 + 0.65 \times 6 + 1.15 \times 5)$$

$$= 677.845 \text{ m}^2$$

$$\text{Vartical } A = 56.79 \times (0.20 + 1.20 \times 6) \times 2$$

$$+ 1.15 \times 1.05 \times 5 \times 12 \times 1.3151$$

$$- (1.05 \times 0.60 \times 4 + 1.05 \times 0.35 \times 3) \times 2 \times 1.3151$$

$$= 926.243 \text{ m}^2$$

3) Support

$$V = 56.79 \times \{(1.40 + 1.20) \times 1.125 + 1.15 \times 1.20 \times 5\}$$

$$+ 5.80 \times 11.90 \{56.850 - (1.00 \times 2 + 0.50) \times 2 \times 1.3151\}$$

$$= 4027.907 \text{ m}^3$$

4) Scaffold

$$V = (11.90 + 1.00) \times 56.790$$

$$= 732.591 \text{ m}^3$$

5) expansion

$$= 11.90 \times 1.3151 \times 2$$

$$= 31.300 \text{ m}$$

expansion filler (t=30mm)

$$A = \{2 \times 0.20 \times 1.51 + 0.20 \times 1.125 + 9.65 \times 1.20\} \times 1.3151 \times 2$$

$$= 32.638 \text{ m}^2$$

6) Handrail

$$= 56.850 \times 2$$

$$= 113.700 \text{ m}$$

* section of superstructure.

$$A = \{0.20 \times 1.51 \times 2 + 0.20 \times 1.125 + 9.65 \times 1.40 - 1.20 \times 1.15 \times 5\}$$

$$= 7.439 \text{ m}^2$$

RAILWAY BRIDGE

Sub structure - A₁ ABUT

1) Concrete.

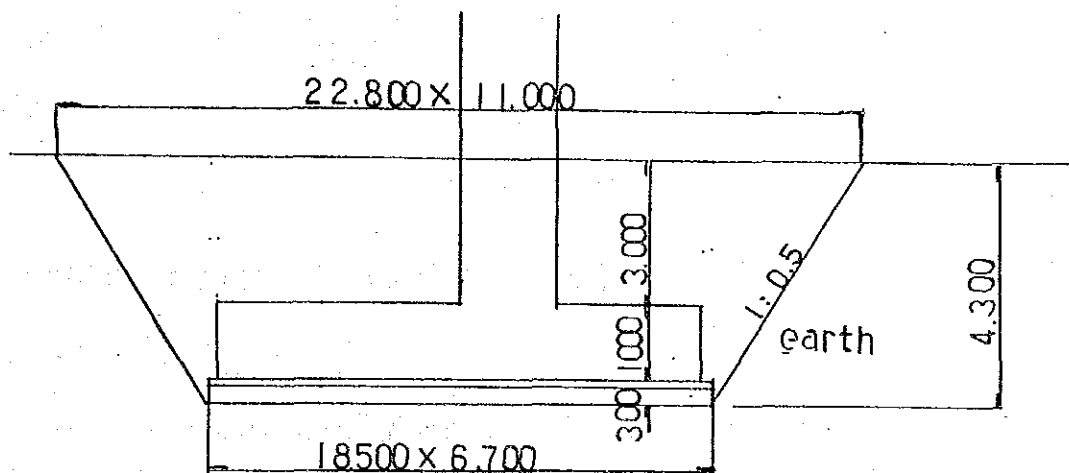
| | | |
|------|---|-------------------------|
| wing | $V = 0.50 \times 3.20 \times 1.0353 \times 2 \times 10.50$ | $= 34.786 \text{ m}^3$ |
| main | $V = (0.30 \times 1.50 + 1.30 \times 9.00 + 6.50 \times 1.00) \times 18.30$ | $= 341.295 \text{ m}^3$ |

| | | |
|------------------------|--|-------------------------|
| total | $=$ | $= 376.081 \text{ m}^3$ |
| OF UP ₂ : A | $= (6.50 - 1.30 + 1.00 + 0.30) \times 18.30 + (0.50 \times 3.20 \times 1.0353) \times 2$ | $= 122.262 \text{ m}^2$ |

2) form work.

| | | |
|--------------------|--|-------------------------|
| F ₁ (V) | $A = (6.50 + 18.30) \times 1.00 \times 2$ | $= 49.600 \text{ m}^2$ |
| F ₂ (v) | $A = ((0.30 + 18.30) \times 1.50 + (1.30 + 18.30) \times 9.00) \times 2$ | $= 408.600 \text{ m}^2$ |

| | | |
|-------------------|-------------------------------------|------------------------|
| 3) base concrete | $V = 6.70 \times 18.50 \times 0.10$ | $= 12.395 \text{ m}^3$ |
| 4) " (crusherran) | $V = 6.70 \times 18.50 \times 0.20$ | $= 24.790 \text{ m}^3$ |



5) excavation

| | | |
|-----------|---|-------------------------|
| earth | $V = 4.30/6 \{18.50 \times 6.50 + 22.80 \times 11.00 + (18.50 + 22.80)(6.70 + 11.00)\}$ | $= 792.461 \text{ m}^3$ |
| remain | $V = 12.395 + 24.790 + 18.30 \times 6.50 \times 1.00 + 1.30 \times 3.00 \times 18.30$ | $= 227.505 \text{ m}^3$ |
| back fill | $V = 792.461 - 227.505$ | $= 564.956 \text{ m}^3$ |

Sub structure $P_1 (P_2)$: Pier

| | | | |
|---------|--------------------------------------|-------------------|----------------|
| beam | V = $\times 7.00 \times 1.00$ | = 7.000 | m ³ |
| Pillar | V = $\times 6.00 \times 5.50 (6.00)$ | = 33.000 (36.000) | m ³ |
| footing | V = $14.00 \times 4.50 \times 1.00$ | = 63.000 | m ³ |

total = 103.000 (106.000) m³
 OF UF₂ : A = 14.00 × 4.50 + 7.000 = 70.000 m³

horizontal $A = 2.00 \times 0.50 = 1.000 \text{ m}^2$
 Vertical $A = \cancel{\text{X}} 29.000 \times 1.00 + \cancel{\text{X}} 26.000 \times 5.50 (6.00) = 172.000 (185.000) \text{ m}^2$
 " (footing) $A = (14.00 + 4.50) \times 1.00 \times 2 = 37.000 \text{ m}^2$

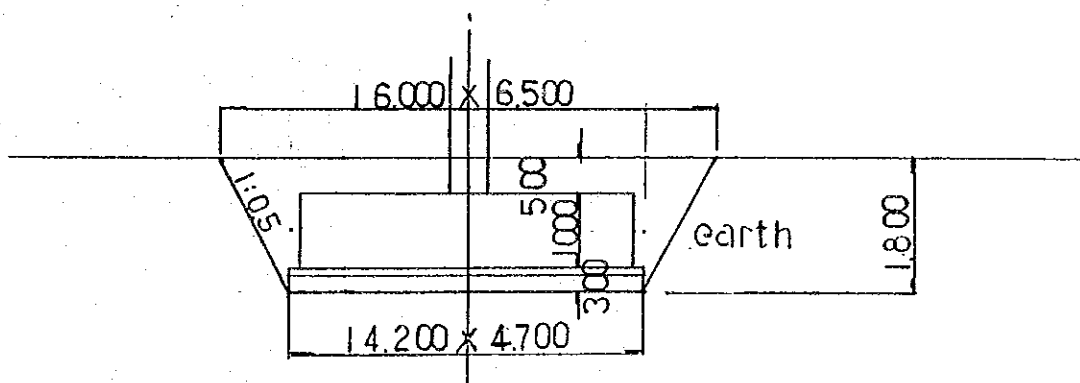
formwork $A = (14,20 + 4,70) \times 0,10 \times 2$

$$V = 2.00 \times 0.50 \times (6.00 - 0.10) = 5.90 \text{ m}^3$$

6) Scaffold $V = 1.20 [(0.50 + 2.00) + (14.00 + 2.00)] \times 6.00 \times 2 = 266.40 \text{ m}^3$

Piller $\left\{ \begin{array}{l} A = 6,00 \times 0,50 \times 2 \\ \quad = 6,000 \text{ m}^3 \\ L = (6,00 + 0,50) \times 2 \times 2 \\ \quad = 26,000 \text{ m} \end{array} \right.$

Beam $\left\{ \begin{array}{l} A = 14.00 \times 0.50 = 7.000 \text{ m}^2 \\ D = (14.00 + 0.50) \times 2 = 29.000 \text{ m} \end{array} \right.$



| | | |
|-----------|---|-------------------------|
| earth | $V = 1.80/6 \{14.20 \times 4.70 + 16.00 \times 6.50 + (14.20 + 16.00)(4.70 + 6.50)\}$ | $= 152.694 \text{ m}^3$ |
| remain | $V = 63.000 + 6.674 + 13.348 + \frac{1}{2} 6.000 \times 0.50$ | $= 86.022 \text{ m}^3$ |
| back fill | $V = 152.694 + 86.022$ | $= 66.672 \text{ m}^3$ |

RAILWAY BRIDGE

Sub structure A2 - ABUT

1) concrete.

main $V = (0.30 \times 1.50 + 1.30 \times 8.00 + 6.00 \times 1.00) \times 18.000 = 303.300 \text{ m}^3$

wing $V = (2.70 \times 9.70) \times 0.50$
 wing $+ \{1/2(9.70 + 9.43) \times 2.70 + 1/2(6.564 + 0.967) \times 7.30\} \times 0.70$
 $+ (26.190) \times 0.50 + \{53.313\} \times 0.70 = 50.414 \text{ m}^3$

total $= 353.714 \text{ m}^3$
 OF. UF₂ : $A = 18.00(6.00 - 1.30 + 1.00 + 0.30) + 2.70 \times 0.50 + 10.00 \times 0.70 = 116.350 \text{ m}^2$

2) form work.

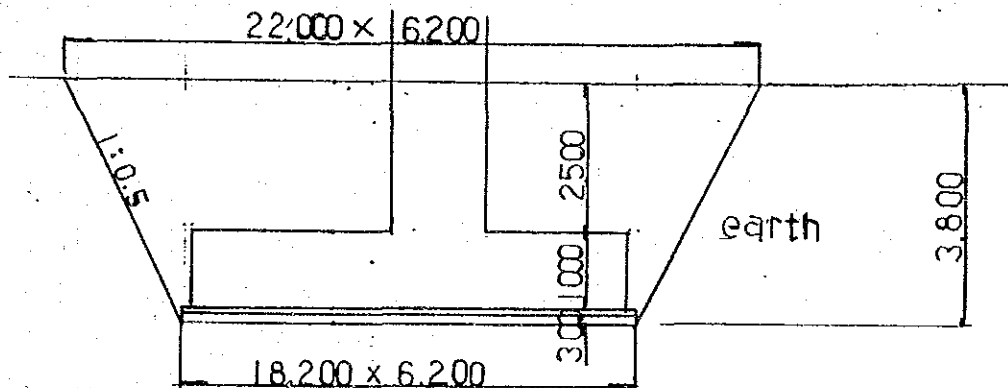
F₂ (V) $A = (0.30 + 18.00) \times 1.50 \times 2 + (1.30 + 18.00) \times 8.00 \times 2 = 363.700 \text{ m}^2$

F₁ (V) $A = (6.00 + 18.00) \times 1.00 \times 2 + 26.190 \times 2 + 53.313 \times 2$
 $+ 0.50 \times 9.70 + 0.70(0.967 + 2.866) = 214.539 \text{ m}^2$

F₁ (sloping) $A = 0.70 \times \sqrt{7.30^2 + 2.866^2} = 5.490 \text{ m}^2$

3) base concrete $V = 6.20 \times 18.20 \times 0.10 = 11.283 \text{ m}^3$

4) base (curusherran) $V = 6.20 \times 18.20 \times 0.20 = 22.568 \text{ m}^3$



5) excavation

earth $V = 3.80/6 (18.20 \times 620 + 22.00 \times 1000 + (18.20 + 22.00)(620 + 1000)) = 623.250 \text{ m}^3$

remain $V = 11.283 + 22.568 + 6.00 \times 18.00 \times 1.00$
 $+ 1.30 \times 18.00 \times 2.50 = 200.352 \text{ m}^3$

backfill $V = 623.250 - 200.352 = 422.898 \text{ m}^3$

LIST OF REINFORCED BAR --- RAILWAY BR

[illegible]

LIST OF REINFORCED BAR---RAILWAY--A1

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|----------|--------|
| P | 1 Y12 | 2000 | 284 | 0.888 | 1.78 | 506 | |
| | 2 " | 550 | 143 | " | 0.49 | 70 | |
| | 3 " | 18590 | 12 | " | 16.51 | 198 | |
| | 4 " | 410 | 33 | " | 0.36 | 12 | |
| | | | | | | 786 kg | |
| A | 1 Y32 | 5000 | 73 | 6.313 | 31.57 | 2305 | |
| | 2 " | 6000 | 68 | " | 37.88 | 2576 | |
| | 3 Y25 | 6420 | 73 | 3.854 | 24.74 | 1806 | |
| | 4 " | 5420 | 68 | " | 20.89 | 1421 | |
| | 5 " | 11070 | 75 | " | 42.66 | 3199 | |
| | 6 Y16 | 10620 | 6 | 1.579 | 16.77 | 101 | |
| | 7 " | 1690 | 143 | " | 2.67 | 382 | |
| | 8 " | 18730 | 36 | " | 29.57 | 1065 | |
| | 9 Y25 | 19050 | 36 | 3.854 | 73.42 | 2643 | |
| | 10 Y16 | 18730 | 4 | 1.579 | 29.57 | 118 | |
| | 11 Y12 | 1410 | 281 | 0.888 | 1.25 | 351 | |
| | | | | | | 15967 kg | |
| E | 1 Y12 | 1170 | 137 | 0.888 | 1.04 | 142 | |
| | 2 " | 18590 | 2 | " | 16.51 | 33 | |
| | | | | | | 175 kg | |
| F | 1 Y25 | 5390 | 141 | 3.854 | 20.77 | 2929 | |
| | 2 Y20 | 3580 | 75 | 2.466 | 8.83 | 662 | |
| | 3 Y25 | 4150 | 143 | 3.854 | 15.99 | 2287 | |
| | 4 Y20 | 4820 | 75 | 2.466 | 11.89 | 892 | |
| | 5 Y16 | 18730 | 50 | 1.579 | 29.57 | 1479 | |
| | 6 " | 1310 | 14 | " | 2.07 | 29 | |
| | 7 " | 19210 | 6 | " | 30.33 | 182 | |
| | 8 " | 6890 | 6 | " | 10.88 | 65 | |
| | 9 Y12 | 2550 | 136 | 0.888 | 2.26 | 307 | |
| | | | | | | 8832 kg | |
| S | 1 Y16 | 2880 | 115 | 1.579 | 4.55 | 523 | |
| | 2 Y12 | 18590 | 11 | 0.888 | 16.51 | 182 | |
| | | | | | | 705 kg | |
| Y32 | | | | 4881 kg | | | |
| Y25 | | | | 14285 kg | | | |
| Y20 | | | | 1554 kg | | | |
| Y16 | | | | 3944 kg | | | |
| Y12 | | | | 1801 kg | | | |
| 計 | | | | 26465 kg | | | |

LIST OF REINFORCED BAR---RAILWAY-AI---WING

A)

RIGHT

| MARK | DIAMETER | LENGTH | NUMBER | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|---------|--------|
| W 1 | Y16 | 3740 | 6 | 1.579 | 5.91 | 35 | |
| 2 | " | 4770 | 30 | " | 7.53 | 226 | |
| 3 | " | 3740 | 6 | " | 5.91 | 35 | |
| 4 | " | 4770 | 30 | " | 7.53 | 226 | |
| 5 | " | 12380 | 11 | " | 19.55 | 215 | |
| 6 | Y12 | 12180 | 11 | 0.888 | 10.82 | 119 | |
| 7 | Y16 | 860 | 10 | 1.579 | 1.36 | 14 | |
| 8 | " | 870 | 35 | " | 1.37 | 48 | |
| 9 | " | 1240 | 5 | " | 1.96 | 10 | |
| 10 | " | 3020 | 29 | " | 4.77 | 138 | |
| 11 | " | 2500 | 5 | " | 3.95 | 20 | |
| 12 | Y12 | 610 | 43 | 0.888 | 0.54 | 23 | |
| | | | | | | 1109 kg | |
| | | | | | | | |
| Y16 | | | | 967 kg | | | |
| Y12 | | | | 142 kg | | | |
| 計 | | | | 1109 kg | | | |

B)

LEFT

| | | | | | | | |
|-----|-----|-------|----|---------|-------|---------|--|
| W 1 | Y16 | 3740 | 6 | 1.579 | 5.91 | 35 | |
| 2 | " | 4770 | 30 | " | 7.53 | 226 | |
| 3 | " | 3740 | 6 | " | 5.91 | 35 | |
| 4 | " | 4770 | 30 | " | 7.53 | 226 | |
| 5 | " | 12380 | 11 | " | 19.55 | 215 | |
| 6 | Y12 | 12180 | 11 | 0.888 | 10.82 | 119 | |
| 7 | Y16 | 860 | 10 | 1.579 | 1.36 | 14 | |
| 8 | " | 870 | 35 | " | 1.37 | 48 | |
| 9 | " | 1190 | 5 | " | 1.88 | 9 | |
| 10 | " | 2430 | 29 | " | 3.84 | 111 | |
| 11 | " | 2500 | 5 | " | 3.95 | 20 | |
| 12 | Y12 | 610 | 43 | 0.888 | 0.54 | 23 | |
| | | | | | | 1081 kg | |
| | | | | | | | |
| Y16 | | | | 939 kg | | | |
| Y12 | | | | 142 kg | | | |
| 計 | | | | 1081 kg | | | |

LIST OF REINFORCED BAR---RAILWAY-PIER

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|--------|----------|
| (P) | | | | | | | |
| B | 1 | Y25 | 16350 | 4 | 3.854 | 63.01 | 252 |
| | 2 | " | 6000 | 4 | " | 23.12 | 92 |
| | 3 | Y20 | 15150 | 6 | 2.466 | 37.36 | 224 |
| | 4 | Y16 | 2360 | 31 | 1.579 | 3.73 | 116 |
| | 5 | " | 600 | 31 | " | 0.95 | 29 |
| | 6 | " | 880 | 12 | " | 1.39 | 17 |
| | | | | | | | 730 kg |
| C | 1 | Y32 | 7650 | 240 | 6.313 | 48.29 | 11590 |
| | 2 | Y16 | 6860 | 96 | 1.579 | 10.83 | 1040 |
| | 3 | " | 1540 | 240 | " | 2.43 | 583 |
| | | | | | | | 13213 kg |
| F | 1 | Y25 | 6100 | 71 | 3.854 | 23.51 | 1669 |
| | 2 | Y16 | 4820 | 71 | 1.579 | 7.61 | 540 |
| | 3 | Y20 | 16320 | 19 | 2.466 | 40.25 | 765 |
| | 4 | Y12 | 14640 | 19 | 0.888 | 13.00 | 247 |
| | 5 | Y16 | 14950 | 4 | 1.579 | 23.61 | 94 |
| | 6 | " | 4860 | 6 | " | 7.67 | 46 |
| | 7 | " | 2280 | 196 | " | 3.60 | 706 |
| | | | | | | | 4067 kg |
| Y32 | | | | 11590 kg | | | |
| Y25 | | | | 2013 kg | | | |
| Y20 | | | | 989 kg | | | |
| Y16 | | | | 3171 kg | | | |
| Y12 | | | | 247 kg | | | |
| | | | | | | | 18010 kg |

LIST OF REINFORCED BAR --- RAILWAY-PIER

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|--------|----------|
| (P2) | | | | | | | |
| B | 1 | Y25 | 16350 | 4 | 3.854 | 63.01 | 252 |
| | 2 | " | 6000 | 4 | " | 23.12 | 92 |
| | 3 | Y20 | 15150 | 6 | 2.466 | 37.36 | 224 |
| | 4 | Y16 | 2360 | 31 | 1.579 | 3.73 | 116 |
| | 5 | " | 600 | 31 | " | 0.95 | 29 |
| | 6 | " | 880 | 12 | " | 1.39 | 17 |
| | | | | | | | 730 kg |
| C | 1 | Y32 | 8150 | 240 | 6.313 | 51.45 | 12348 |
| | 2 | Y16 | 6860 | 100 | 1.579 | 10.83 | 1083 |
| | 3 | " | 1540 | 252 | " | 2.43 | 612 |
| | | | | | | | 14043 kg |
| F | 1 | Y25 | 6100 | 71 | 3.854 | 23.51 | 1669 |
| | 2 | Y16 | 4820 | 71 | 1.579 | 7.61 | 540 |
| | 3 | Y20 | 16320 | 19 | 2.466 | 40.25 | 765 |
| | 4 | Y12 | 14640 | 19 | 0.888 | 13.00 | 247 |
| | 5 | Y16 | 14950 | 4 | 1.579 | 23.61 | 94 |
| | 6 | " | 4860 | 6 | " | 7.67 | 46 |
| | 7 | " | 2280 | 196 | " | 3.60 | 706 |
| | | | | | | | 4067 kg |
| Y32 | | | | 12348 kg | | | |
| Y25 | | | | 2013 kg | | | |
| Y20 | | | | 989 kg | | | |
| Y16 | | | | 3243 kg | | | |
| Y12 | | | | 247 kg | | | |
| | | | | | | | 18840 kg |

LIST OF REINFORCED BAR --- RAILWAY-A2

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|----------|--------|
| | | | | | | | |
| P | 1 | Y12 | 2000 | 236 | 0.888 | 1.78 | 420 |
| | 2 | " | 550 | 115 | " | 0.49 | 56 |
| | 3 | " | 18290 | 2 | " | 16.24 | 32 |
| | 4 | " | 410 | 28 | " | 0.36 | 10 |
| | | | | | | 518 kg | |
| A | 1 | Y32 | 5000 | 60 | 6.313 | 31.57 | 1894 |
| | 2 | " | 6000 | 57 | " | 37.88 | 2159 |
| | 3 | Y25 | 5430 | 60 | 3.854 | 20.93 | 1256 |
| | 4 | " | 4430 | 57 | " | 17.07 | 973 |
| | 5 | " | 9210 | 62 | " | 35.50 | 2201 |
| | 6 | Y16 | 9070 | 6 | 1.579 | 14.32 | 86 |
| | 7 | " | 1690 | 119 | " | 2.67 | 318 |
| | 8 | " | 18430 | 27 | " | 29.10 | 786 |
| | 9 | Y25 | 18750 | 27 | 3.854 | 72.26 | 1951 |
| | 10 | Y16 | 18430 | 4 | 1.579 | 29.10 | 116 |
| | 11 | Y12 | 1410 | 182 | 0.888 | 1.25 | 228 |
| | | | | | | 11968 kg | |
| E | 1 | Y12 | 1170 | 56 | 0.888 | 1.04 | 58 |
| | 2 | " | 18290 | 2 | " | 16.24 | 32 |
| | | | | | | 90 kg | |
| F | 1 | Y25 | 4380 | 117 | 3.854 | 16.88 | 1975 |
| | 2 | Y20 | 3580 | 62 | 2.466 | 8.83 | 547 |
| | 3 | Y25 | 4150 | 119 | 3.854 | 15.99 | 1903 |
| | 4 | Y20 | 4300 | 62 | 2.466 | 10.60 | 657 |
| | 5 | Y16 | 18430 | 39 | 1.579 | 29.10 | 1135 |
| | 6 | " | 1350 | 12 | " | 2.13 | 26 |
| | 7 | " | 18910 | 6 | " | 29.86 | 179 |
| | 8 | " | 6390 | 6 | " | 10.09 | 61 |
| | 9 | Y12 | 2360 | 193 | 0.888 | 2.10 | 405 |
| | | | | | | 6888 kg | |
| S | 1 | Y16 | 2880 | 112 | 1.579 | 4.55 | 510 |
| | 2 | Y12 | 18290 | 11 | 0.888 | 16.24 | 179 |
| | | | | | | 689 kg | |
| Y32 | | | | 4053 kg | | | |
| Y25 | | | | 10259 kg | | | |
| Y20 | | | | 1204 kg | | | |
| Y16 | | | | 3217 kg | | | |
| Y12 | | | | 1420 kg | | | |
| 計 | | | | 20153 kg | | | |

LIST OF REINFORCED BAR --- RAILWAY-A2---WING

A)

RIGHT

| MARK | DIAMETER | LENGTH | NUMBER | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|------|----------|--------|--------|------------|-------------|---------|--------|
| W 1 | Y16 | 10960 | 2 | 1.579 | 17.31 | 35 | |
| 2 | Y25 | 11420 | 9 | 3.854 | 44.01 | 396 | |
| 3 | " | 7140 | 12 | " | 27.52 | 330 | |
| 4 | Y20 | 4310 | 9 | 2.466 | 10.63 | 96 | |
| 5 | Y25 | 4390 | 24 | 3.854 | 16.92 | 406 | |
| 6 | Y20 | 11320 | 9 | 2.466 | 27.92 | 251 | |
| 7 | " | 7220 | 12 | " | 17.80 | 214 | |
| 8 | " | 4310 | 9 | " | 10.63 | 96 | |
| 9 | " | 11380 | 10 | " | 28.06 | 281 | |
| 10 | " | 5000 | 5 | " | 12.33 | 62 | |
| 11 | " | 3920 | 22 | " | 9.67 | 213 | |
| 12 | Y16 | 11190 | 10 | 1.579 | 17.67 | 177 | |
| 13 | " | 3960 | 23 | " | 6.25 | 144 | |
| 14 | " | 10000 | 2 | " | 15.79 | 32 | |
| 15 | " | 1090 | 22 | " | 1.72 | 38 | |
| 16 | " | 1050 | 20 | " | 1.66 | 33 | |
| 17 | " | 1070 | 10 | " | 1.69 | 17 | |
| 18 | Y25 | 2500 | 4 | 3.854 | 9.64 | 39 | |
| 19 | " | 3650 | 26 | " | 14.07 | 366 | |
| 20 | " | 3000 | 4 | " | 11.56 | 46 | |
| 21 | Y12 | 810 | 50 | 0.888 | 0.72 | 36 | |
| | | | | | | 3308 kg | |
| | | | | | | | |
| Y25 | | | | 1583 kg | | | |
| Y20 | | | | 1213 kg | | | |
| Y16 | | | | 476 kg | | | |
| Y12 | | | | 36 kg | | | |
| | | | | | | 3308 kg | |

B)

LEFT

| | | | | | | | |
|-----|-----|-------|----|--------|-------|--------|--|
| W 1 | Y16 | 3240 | 2 | 1.579 | 5.12 | 10 | |
| 2 | " | 3220 | 10 | " | 5.08 | 51 | |
| 3 | " | 4260 | 52 | " | 6.73 | 350 | |
| 4 | " | 11230 | 9 | " | 17.73 | 160 | |
| 5 | Y12 | 11030 | 9 | 0.888 | 9.79 | 88 | |
| 6 | Y16 | 860 | 8 | 1.579 | 1.36 | 11 | |
| 7 | " | 1400 | 5 | " | 2.21 | 11 | |
| 8 | " | 3020 | 26 | " | 4.77 | 124 | |
| 9 | " | 2500 | 5 | " | 3.95 | 20 | |
| 10 | " | 870 | 32 | " | 1.37 | 44 | |
| 11 | Y12 | 610 | 30 | 0.888 | 0.54 | 16 | |
| | | | | | | 885 kg | |
| | | | | | | | |
| Y16 | | | | 781 kg | | | |
| Y12 | | | | 104 kg | | | |
| | | | | | | 885 kg | |

LIST OF REINFORCED BAR---RAILWAY---RETAINING-WALL (C1)

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|---------|----------|--------|--------|------------|-------------|--------|--------|
| W | 1 | Y25 | 5430 | 66 | 3.854 | 20.93 | 1381 |
| | 2 | " | 4750 | 33 | " | 18.31 | 604 |
| | 3 | " | 8660 | 1 | " | 33.38 | 33 |
| | 4 | Y20 | 5490 | 69 | 2.466 | 13.54 | 934 |
| | 5 | Y16 | 850 | 68 | 1.579 | 1.34 | 91 |
| | 6 | " | 1000 | 1 | " | 1.58 | 2 |
| | 7 | " | 830 | 3 | " | 1.31 | 4 |
| | 8 | " | 1090 | 25 | " | 1.72 | 43 |
| | 9 | " | 21030 | 7 | " | 33.21 | 232 |
| | 10 | " | 15310 | 9 | " | 24.17 | 218 |
| | 11 | " | 5750 | 10 | " | 9.08 | 91 |
| | 12 | Y12 | 21120 | 7 | 0.888 | 18.75 | 131 |
| | 13 | " | 15750 | 9 | " | 13.99 | 126 |
| | 14 | " | 6000 | 10 | " | 5.33 | 53 |
| | 15 | " | 700 | 107 | " | 0.62 | 66 |
| 4009 kg | | | | | | | |
| F | 1 | Y20 | 3250 | 58 | 2.466 | 8.01 | 465 |
| | 2 | " | 2870 | 24 | " | 7.08 | 170 |
| | 3 | " | 3790 | 58 | " | 9.35 | 542 |
| | 4 | " | 1780 | 24 | " | 4.39 | 105 |
| | 5 | " | 2850 | 10 | " | 7.03 | 70 |
| | 6 | " | 2460 | 5 | " | 6.07 | 30 |
| | 7 | " | 5050 | 1 | " | 12.45 | 12 |
| | 8 | " | 3120 | 10 | " | 7.69 | 77 |
| | 9 | " | 1770 | 2 | " | 4.36 | 9 |
| | 10 | " | 2500 | 4 | " | 6.17 | 25 |
| | 11 | Y16 | 21500 | 2 | 1.579 | 33.95 | 68 |
| | 12 | " | 12500 | 2 | " | 19.74 | 39 |
| | 13 | " | 20950 | 10 | " | 33.08 | 331 |
| | 14 | " | 13940 | 6 | " | 22.01 | 132 |
| | 15 | " | 5590 | 4 | " | 8.83 | 35 |
| | 16 | " | 17890 | 2 | " | 28.25 | 57 |
| | 17 | Y20 | 1630 | 2 | 2.466 | 4.02 | 8 |
| | 18 | " | 4460 | 2 | " | 11.00 | 22 |
| | 19 | Y16 | 1010 | 13 | 1.579 | 1.59 | 21 |
| | 20 | Y12 | 1750 | 70 | 0.888 | 1.55 | 109 |
| 2327 kg | | | | | | | |
| K | 1 | Y12 | 3100 | 29 | 0.888 | 2.75 | 80 |
| | 2 | " | 3120 | 9 | " | 2.77 | 25 |
| | 3 | " | 10800 | 4 | " | 9.59 | 38 |
| | 4 | " | 2850 | 4 | " | 2.53 | 10 |
| 153 kg | | | | | | | |
| Y25 | | | | 2018 kg | | | |
| Y20 | | | | 2469 kg | | | |
| Y16 | | | | 1364 kg | | | |
| Y12 | | | | 638 kg | | | |
| | | | | 6489 kg | | | |

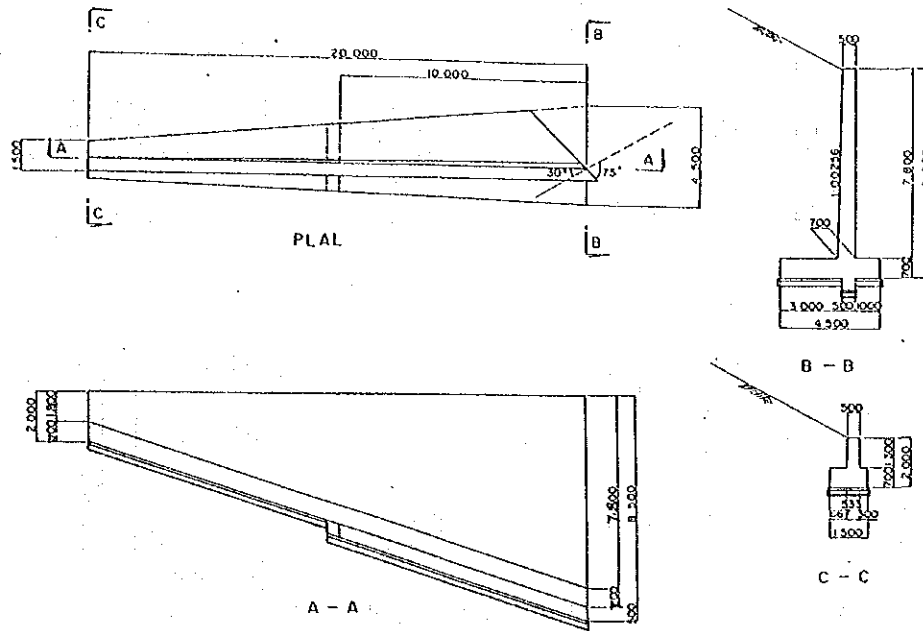
LIST OF REINFORCED BAR---RAILWAY--RETAINING-WALL(2)

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|---------|----------|--------|--------|------------|-------------|--------|--------|
| W | 1 | Y20 | 4880 | 34 | 2.466 | 12.03 | 409 |
| | 2 | " | 3200 | 17 | " | 7.89 | 134 |
| | 3 | Y16 | 4820 | 34 | 1.579 | 7.61 | 259 |
| | 4 | " | 860 | 34 | " | 1.36 | 46 |
| | 5 | " | 11820 | 2 | " | 18.66 | 37 |
| | 6 | Y20 | 9880 | 4 | 2.466 | 24.36 | 97 |
| | 7 | " | 5170 | 18 | " | 12.75 | 230 |
| | 8 | Y12 | 9870 | 4 | 0.888 | 8.76 | 35 |
| | 9 | " | 5170 | 18 | " | 4.59 | 83 |
| | 10 | Y16 | 930 | 22 | 1.579 | 1.47 | 32 |
| | 11 | " | 850 | 4 | " | 1.34 | 5 |
| | 12 | Y12 | 710 | 46 | 0.888 | 0.63 | 29 |
| 1396 kg | | | | | | | |
| F | 1 | Y20 | 2600 | 51 | 2.466 | 6.41 | 327 |
| | 2 | Y16 | 1390 | 34 | 1.579 | 2.19 | 74 |
| | 3 | Y20 | 1740 | 51 | 2.466 | 4.29 | 219 |
| | 4 | Y16 | 2220 | 34 | 1.579 | 3.51 | 119 |
| | 5 | " | 9880 | 6 | " | 15.60 | 94 |
| | 6 | " | 4800 | 5 | " | 7.58 | 38 |
| | 7 | " | 10000 | 1 | " | 15.79 | 16 |
| | 8 | " | 5660 | 1 | " | 8.94 | 9 |
| | 9 | " | 9900 | 1 | " | 15.63 | 16 |
| | 10 | Y12 | 9880 | 5 | 0.888 | 8.77 | 44 |
| | 11 | " | 4300 | 5 | " | 3.82 | 19 |
| | 12 | " | 10000 | 1 | " | 8.88 | 9 |
| | 13 | " | 5660 | 1 | " | 5.03 | 5 |
| | 14 | " | 9900 | 1 | " | 8.79 | 9 |
| | 15 | Y16 | 930 | 12 | 1.579 | 1.47 | 18 |
| | 16 | Y12 | 1550 | 43 | 0.888 | 1.38 | 59 |
| 1075 kg | | | | | | | |
| K | 1 | Y12 | 3670 | 17 | 0.888 | 3.26 | 55 |
| | 2 | " | 4870 | 4 | " | 4.32 | 17 |
| 72 kg | | | | | | | |
| Y20 | | | | 1416 kg | | | |
| Y16 | | | | 763 kg | | | |
| Y12 | | | | 364 kg | | | |
| | | | | 2543 kg | | | |

LIST OF REINFORCED BAR---RAILWAY--(RETAINING-WALL (3))

| MARK | DIAMETER | LENGTH | NUMBAR | UNITWEIGHT | PIECEWEIGHT | WEIGHT | REMARK |
|---------|----------|--------|--------|------------|-------------|--------|--------|
| W | 1 | Y25 | 5380 | 54 | 3.854 | 20.73 | 1119 |
| | 2 | " | 3500 | 27 | " | 13.49 | 364 |
| | 3 | Y20 | 5360 | 54 | 2.466 | 13.22 | 714 |
| | 4 | Y16 | 860 | 53 | 1.579 | 1.36 | 72 |
| | 5 | " | 870 | 1 | " | 1.37 | 1 |
| | 6 | " | 17830 | 2 | " | 28.15 | 56 |
| | 7 | " | 16400 | 4 | " | 25.90 | 104 |
| | 8 | " | 13360 | 8 | " | 21.10 | 169 |
| | 9 | " | 5040 | 13 | " | 7.96 | 103 |
| | 10 | Y12 | 16420 | 4 | 0.888 | 14.58 | 58 |
| | 11 | " | 13410 | 8 | " | 11.91 | 95 |
| | 12 | " | 5230 | 13 | " | 4.64 | 60 |
| | 13 | Y16 | 830 | 4 | 1.579 | 1.31 | 5 |
| | 14 | " | 920 | 25 | " | 1.45 | 36 |
| | 15 | Y12 | 720 | 84 | 0.888 | 0.64 | 54 |
| 3010 kg | | | | | | | |
| F | 1 | Y20 | 2240 | 75 | 2.466 | 5.52 | 414 |
| | 2 | Y16 | 1280 | 51 | 1.579 | 2.02 | 103 |
| | 3 | Y20 | 1680 | 75 | 2.466 | 4.14 | 310 |
| | 4 | Y16 | 1760 | 51 | 1.579 | 2.78 | 142 |
| | 5 | Y20 | 3480 | 6 | 2.466 | 8.58 | 51 |
| | 6 | Y16 | 1890 | 4 | 1.579 | 2.98 | 12 |
| | 7 | Y20 | 2250 | 8 | 2.466 | 5.55 | 44 |
| | 8 | Y16 | 3140 | 3 | 1.579 | 4.96 | 15 |
| | 9 | " | 16440 | 6 | " | 25.96 | 156 |
| | 10 | " | 12310 | 2 | " | 19.44 | 39 |
| | 11 | " | 5710 | 2 | " | 9.02 | 18 |
| | 12 | " | 15900 | 1 | " | 25.11 | 25 |
| | 13 | " | 9350 | 1 | " | 14.76 | 15 |
| | 14 | " | 16850 | 1 | " | 26.61 | 27 |
| | 15 | Y12 | 16300 | 5 | 0.888 | 14.47 | 72 |
| | 16 | " | 9350 | 1 | " | 8.30 | 8 |
| | 17 | " | 16710 | 1 | " | 14.84 | 15 |
| | 18 | " | 12170 | 2 | " | 10.81 | 22 |
| | 19 | " | 5710 | 2 | " | 5.07 | 10 |
| | 20 | " | 15760 | 1 | " | 13.99 | 14 |
| | 21 | Y16 | 1030 | 12 | 1.579 | 1.63 | 20 |
| | 22 | Y12 | 1750 | 67 | 0.888 | 1.55 | 104 |
| 1636 kg | | | | | | | |
| K | 1 | Y12 | 2900 | 27 | 0.888 | 2.58 | 70 |
| | 2 | " | 7880 | 4 | " | 7.00 | 28 |
| 98 kg | | | | | | | |
| Y25 | | | | 1483 kg | | | |
| Y20 | | | | 1533 kg | | | |
| Y16 | | | | 1118 kg | | | |
| Y12 | | | | 610 kg | | | |
| | | | | 4744 kg | | | |

RAILWAY BRIDGE (W1) RETAINING WALL



(W1) RETAINING WALL

1) concrete

$$V = \frac{1}{2} \left\{ \frac{1}{2}(0.50+0.70) \times 7.80 + \frac{1}{2}(0.50+0.533) \times 1.30 \right\} \times 20.00 + \frac{1}{2}(4.50+1.50) \times 0.70 \times 20.00 + 0.50^2 \times (10.00+3.00) = 99.573 \text{ m}^3$$

UF₂

$$A = \left\{ \frac{1}{2}(4.50+1.50) - \frac{1}{2}(0.70+0.533) + 0.50 \right\} \times 20.00 + 0.50(10.00+3.00) = 59.065 \text{ m}^2$$

2) form work.

$$F_1 (V) \quad A = (20.00 \times 2 + 1.50 + 2.80) \times 0.70 = 35.040 \text{ m}^2$$

$$F_2 (V) \quad A = \frac{1}{2}(7.80+1.30) \times 20.00 \times 2 + \frac{1}{2}(0.50+0.533) \times 1.20 = 178.618 \text{ m}^2$$

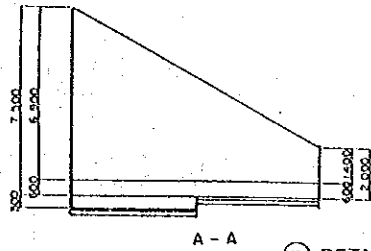
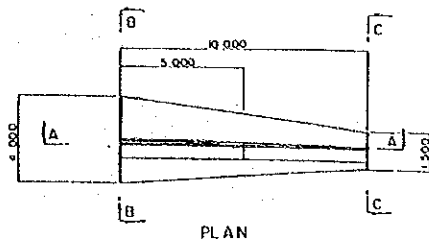
$$3) \text{ base concrete} \quad V = \frac{1}{2}(4.50+1.70) \times 20.20 \times 0.10 = 5.959 \text{ m}^3$$

$$4) \text{ base (curusherran)} \quad V = \frac{1}{2}(4.50+1.70) \times 20.20 \times 0.20 = 11.918 \text{ m}^3$$

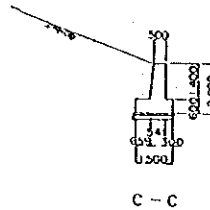
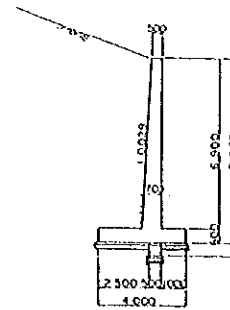
$$5) \text{ joint filler} \quad V = \frac{1}{2}(0.50+0.70) \times 7.80 = 4.620 \text{ m}^3$$

$$6) \text{ water stop} \quad Q = 7.500 \text{ m}$$

(W2) RETAINING WALL



(W2) RETAINING WALL



1) concrete.

$$V = \frac{1}{2} \{ (6.90 + 1.40) \times 0.56 + (4.00 + 1.50) \times 0.60 \} \times 10.00 + 0.50^2 \times 5.00$$

$$= 41.150 \text{ m}^3$$

UP₂

$$A = \{ \frac{1}{2} (4.00 + 1.50) - 0.62 + 0.50 \} \times 10.00 + 0.50 \times 5.00$$

$$= 27.500 \text{ m}^2$$

2) form work.

$$F_1 (V) \quad A = (10.000 \times 2 + 1.50 + 2.30) \times 0.60$$

$$= 14.040 \text{ m}^2$$

$$F_2 (V) \quad A = \frac{1}{2} (6.90 + 1.40) \times 10.00 \times 2 + 0.52 \times 1.40$$

$$= 83.840 \text{ m}^2$$

3) base concrete $V = \frac{1}{2} (4.20 + 1.70) \times 10.20 \times 0.10$

$$= 2.754 \text{ m}^3$$

4) base (curusherran) $V = \frac{1}{2} (4.20 + 1.70) \times 10.20 \times 0.20$

$$= 5.508 \text{ m}^3$$

5) joint filler $A = 0.60 \times 6.90$

$$= 4.140 \text{ m}^2$$

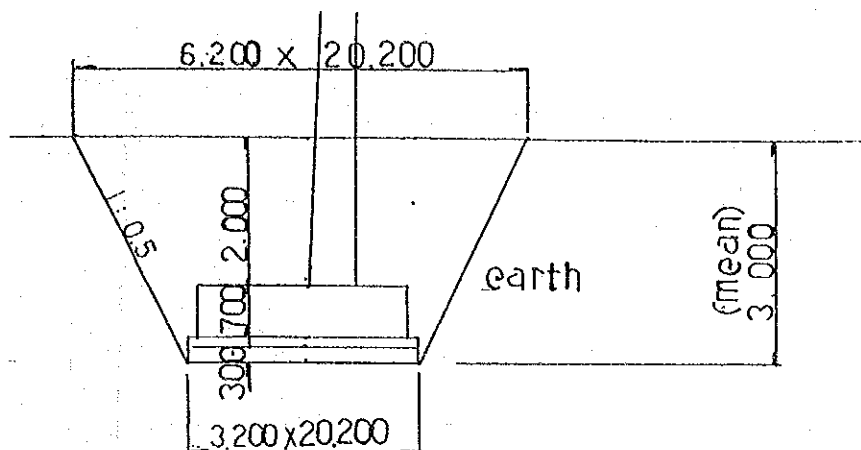
6) water stop $=$

$$= 6.600 \text{ m}$$

where $\ast \frac{1}{2} \left(\frac{0.50 + 0.70}{2} + \frac{0.50 + 0.541}{2} \right) = 0.560 \text{ m}$

RAILWAY BRIDGE - (W₁) and (W₂)

(W₁)



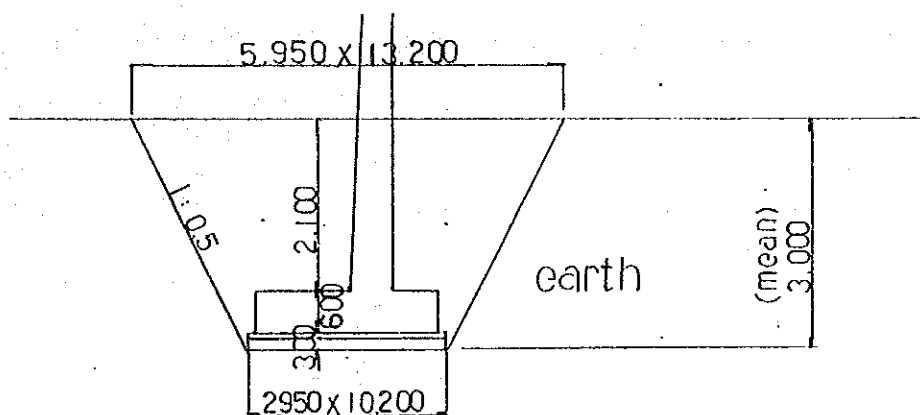
7) excavation
earth

$$V = 3.00/6 \{ 3.20 \times 20.20 + 6.20 \times 23.20 + (3.20 + 6.20)(20.20 + 23.20) \} = 291.945 \text{m}^3$$

remain
backfill

$$V = 5.959 + 11.918 + 1/2(4.50 + 1.50) \times 20.00 \times 0.70 + 0.558 \times 2.00 \times 20.00 = 83.081 \text{m}^3$$

(W₂)



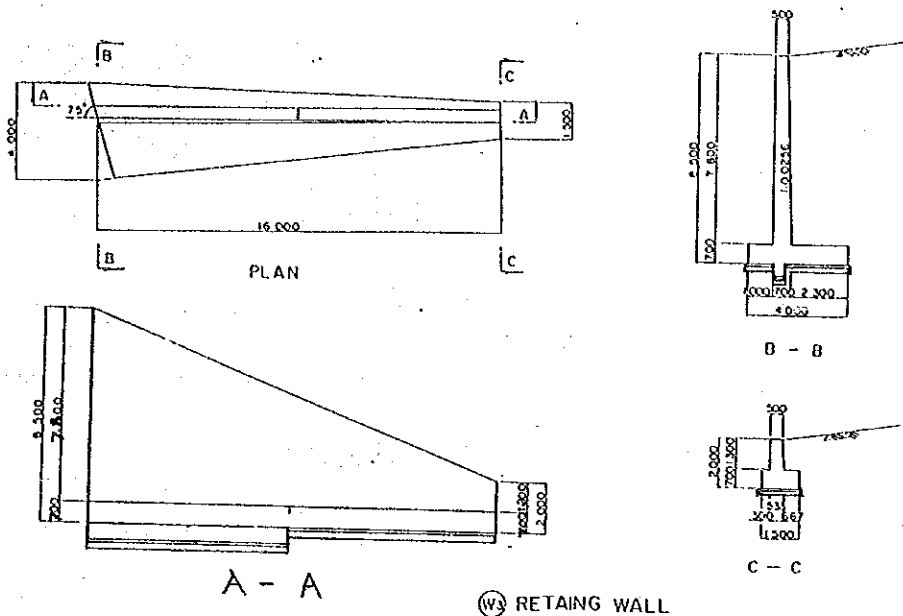
7) excavation
earth

$$V = 3.00/6 \{ 2.95 \times 10.20 + 5.95 \times 13.20 + (2.95 + 5.95)(10.20 + 13.20) \} = 149.670 \text{m}^3$$

remain
backfill

$$V = 2.754 + 5.508 + 1/2(4.00 + 1.50) \times 10.00 \times 0.60 + 0.60 \times 2.10 \times 10.00 = 35.862 \text{m}^3$$

(W3) RETAINING WALL



(W3) RETAINING WALL

1) concrete.

$$V = \frac{1}{2} \{ (0.50 + 0.70) \times 7.80 / 2 + (0.50 + 0.531) \times 1.30 / 2 \} \times 16.00 + \frac{1}{2} (4.00 + 1.50) \times 0.70 \times 16.00 + 0.50^2 \times 8.00 = 79.108 \text{ m}^3$$

$$UF_2 : A = \{ \frac{1}{2} (4.00 + 1.50) - \frac{1}{2} (0.70 + 0.531) + 0.50 \} \times 16.00 + 0.50 \times 8.00 = 46.152 \text{ m}^2$$

2) form work.

$$F_1 (V) \quad A = (16.00 \times 2 + 1.50 + 2.30) \times 0.70 = 28.640 \text{ m}^2$$

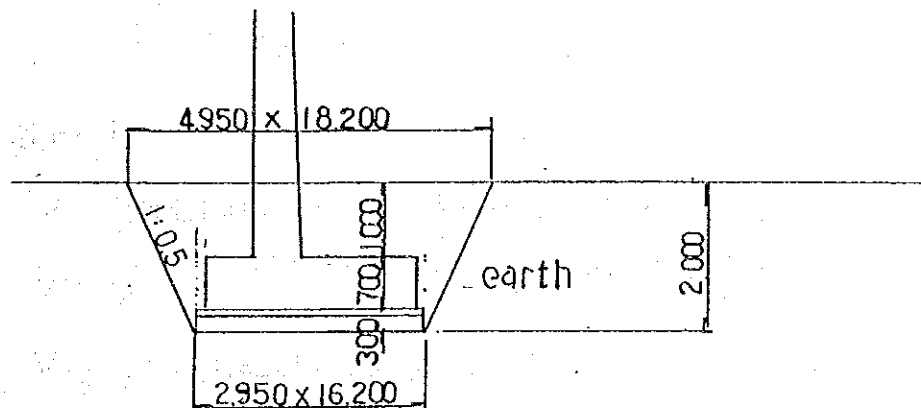
$$F_2 (V) \quad A = \frac{1}{2} (7.80 + 1.30) \times 16.00 \times 2 + \frac{1}{2} (0.50 + 0.531) \times 1.20 = 143.018 \text{ m}^2$$

$$3) \text{ base concrete} \quad V = \frac{1}{2} (4.20 + 1.70) \times 16.20 \times 0.10 = 4.779 \text{ m}^3$$

$$4) \text{ base (curusherran)} \quad V = \frac{1}{2} (4.20 + 1.70) \times 16.20 \times 0.20 = 9.558 \text{ m}^3$$

$$5) \text{ joint filler} \quad A = \frac{1}{2} (0.50 + 0.70) \times 7.80 = 4.620 \text{ m}^2$$

$$6) \text{ water stop} \quad = 7.500 \text{ m}$$



7) excavation

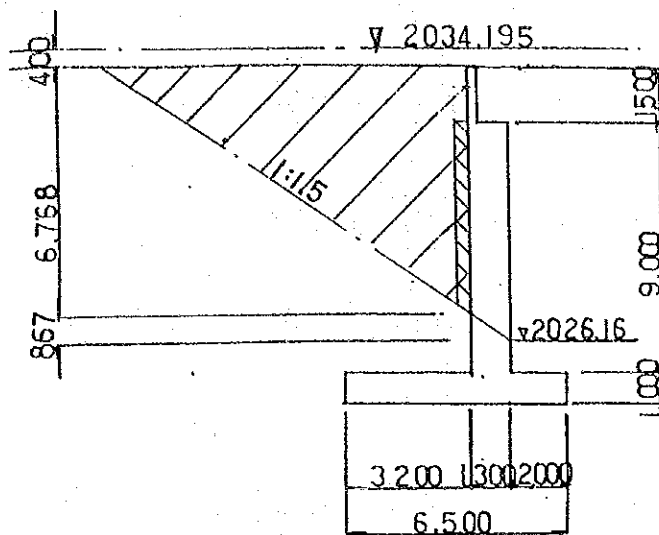
$$\text{earth} \quad V = 2.00 / 6 \{ 2.95 \times 16.20 + 4.95 \times 18.20 + (2.95 + 4.95) (16.20 + 18.20) \} = 136.546 \text{ m}^3$$

$$\text{remain} \quad V = 4.779 + 9.558 + \frac{1}{2} (4.00 + 1.50) \times 16.00 \times 0.70 + 0.558 \times 1.00 \times 16.00 = 66.372 \text{ m}^3$$

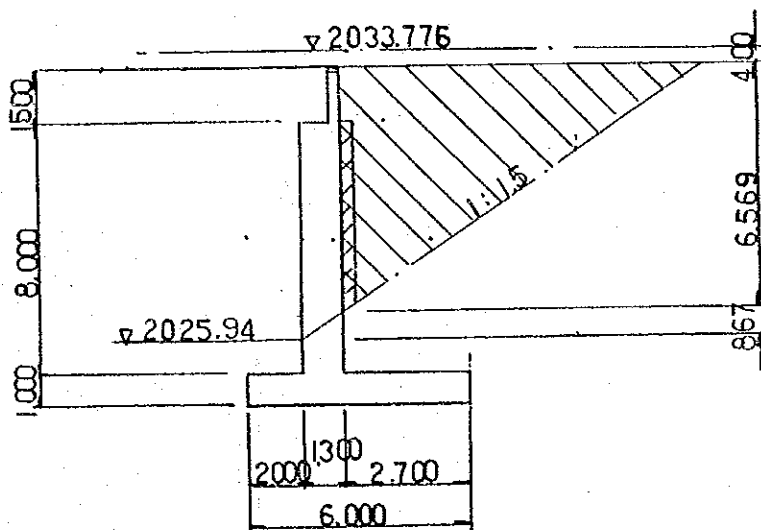
$$\text{backfill} \quad V = 136.546 - 66.372 = 70.174 \text{ m}^3$$

RAILWAY - ABUTMENT

A1 --- BACKFILL.



A2 --- BACK-FILL



BACK-FILL

$$A1 : V = \frac{1}{2} \times 6.768^2 \times 1.5 \times (18.30 - 0.517 \times 2) = 593.2 \text{ m}^3$$

$$A2 : V = \frac{1}{2} \times 6.569^2 \times 1.5 \times (18.00 - 0.517 - 0.724) = 542.4 "$$

$$W1 : V = \frac{1}{2} \times 3.450^2 \times 1.5 \times 20.00 = 178.6 "$$

$$W2 : V = \frac{1}{2} \times 3.050^2 \times 1.5 \times 10.00 = 74.4$$

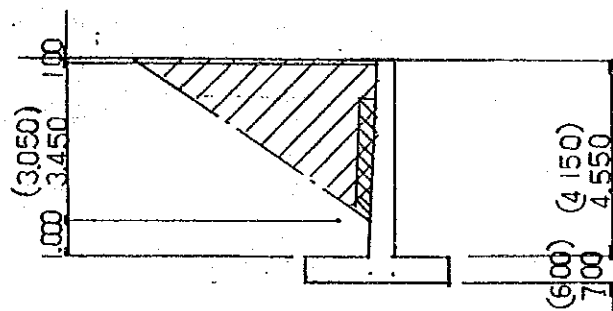
$$W3 : V = \frac{1}{2} \times 3.450^2 \times 1.5 \times 16.00 = 142.9$$

$$= 1531.5$$

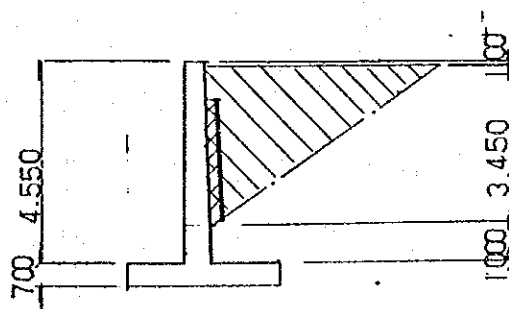
RAILWAY - ABUTMENT

RETAINING --- BACK-FILL

W_1 (W_2)



W_3



MOMBUSA, Ju. BRIDGE

porous drainage $A = 17.00 \times 5.50 \times 2 (\times 0.300)$ $= 187.000 \text{ m}^2$ 56.100 m^3
 perforated pipe $L = 17.00 \times 2$ $= 34.000 \text{ m}$
 drain pipe($\phi 75 \text{ mm}$) $N = (17.00 / 5.00 + 1) \times 2$ $= 10 \text{ N}$

UHURU MONUMENT, Ju. BRIDGE

porous drainage $A = 20.50 \times 1.0457 \times 5.50 \times 2 (\times 0.300)$ $= 235.805 \text{ m}^2$ 70.741 m^3
 perforated pipe $L = 20.50 \times 1.0457 \times 2$ $= 42.873 \text{ m}$
 drain pipe($\phi 75 \text{ mm}$) $N = (20.50 \times 1.0457 / 5.00 + 1) \times 2$ $= 10 \text{ N}$

Railway bridge

porous drainage $A = (6.77 - 1.50 - 0.30) \times 17.264 + (6.57 - 1.50 - 0.30) \times 16.757$
 $+ 2.45 \times 20.00 + 2.15 \times 10.00 + 2.45 \times 16.00 (\times 0.300)$ $= 275.432 \text{ m}^2$ 82.630 m^3
 perforated pipe $L = 17.264 + 16.757 + 20.00 + 10.00 + 16.00$ $= 80.021 \text{ m}$
 drain pipe($\phi 75 \text{ mm}$) $N = (17.264 / 5.00 + 1) + (16.757 / 5.00 + 1) + (20.00 / 5.00 + 1)$
 $(10.00 / 5.00 + 1) + (16.000 / 5.00 + 1)$ $= 20 \text{ N}$

B.Q 21.01 Waterproofing materials

Mombasa Ju. bridge

$$\text{super structure: } A = 56.940 \times 17.00 + 17.00 \times 3.00 \times 2 \times 2 = 1171.980 \text{ m}^2$$

$$\begin{aligned} \text{sub " A1: } A &= (18.30 - 2 \times 0.70) \times 8.20 \\ &\quad + (8.455 + 8.413) \times 2.40 + (8.413 - 2.328 + 0.817) \times 7.70 = 232.208 \text{ "} \\ \text{A2: } A &= (18.30 - 2 \times 0.70) \times 8.20 \\ &\quad + (8.461 + 8.471) \times 2.40 + (8.471 - 2.307 + 0.865) \times 8.00 = 235.448 \text{ "} \end{aligned}$$

$$\text{total} = 1639.636 \text{ m}^2$$

Uhuru monument Ju. bridge

$$\text{super structure: } A = 37.95 \times 20.50 + 20.50 \times 3.00 \times 2 \times 2 = 1023.975 \text{ m}^2$$

$$\begin{aligned} \text{sub " A1: } A &= (22.70 - 2 \times 0.70 \times 1.0403) \times 8.20 \\ &\quad + (8.455 + 8.413) \times 2.40 + (8.413 + 2.328 + 0.817) \times 7.70 = 267.826 \text{ "} \\ \text{A2: } A &= (22.70 - 2 \times 0.70 \times 1.0403) \times 8.20 \\ &\quad + (8.461 + 8.471) \times 2.40 + (8.471 - 2.307 + 0.865) \times 8.00 = 271.066 \text{ "} \end{aligned}$$

$$\text{total} = 1562.867 \text{ m}^2$$

Rail way bridge

$$\text{super structure: } A = 56.790 \times 11.90 + 9.00 \times 1.3151 \times 3.00 \times 2 \times 2 = 817.832 \text{ m}^2$$

$$\begin{aligned} \text{sub " A1: } A &= (18.30 - 2 \times 0.50 \times 1.03528) \times 10.50 \\ &\quad + 0.50 \times 10.5 \times 3.20 \times 1.03528 \times 2 = 216.068 \text{ "} \end{aligned}$$

$$\begin{aligned} \text{" " A2: } A &= \{18.00 - (0.50 + 0.70) \times 1.03528\} \times 9.50 + 2.70 \times 9.50 \times 0.50 \times 1.03528 \\ &\quad + \frac{1}{2} (9.70 + 9.43) \times 2.70 + \frac{1}{2} (6.564 + 0.967) \times 7.30 = 225.792 \text{ "} \end{aligned}$$

$$\begin{aligned} \text{W1~W3: } A &= \frac{1}{2} (7.70 + 1.20) \times 16.00 + \frac{1}{2} (1.20 + 7.70) \times 20.00 \\ &\quad + \frac{1}{2} (1.20 + 7.70) \times 10.00 = 204.70 \text{ "} \end{aligned}$$

$$\text{total} = 1364.392 \text{ m}^2$$

Approach slab 200mm × 3.000m

Mombasa, Ju, bridge

approach slab

$$\begin{aligned}\text{concrete: } V &= 3.00 \times 0.20 \times 17.00 \times 2 &= 20.400 \text{ m}^3 \\ \text{UF2 } A &= 3.00 \times 17.00 \times 2 &= 102.00 \text{ m}^2 \\ \text{joint, filler } A &= 0.20 \times 17.00 \times 2 &= 6.800 \text{ m}^2\end{aligned}$$

Sub, structure

$$\begin{aligned}\text{concrete: } V &= 0.30 \times 0.30 \times 17.00 \times 2 &= 3.060 \text{ m}^3 \\ \text{form work } A &= (0.30 + 0.30) \times 17.00 \times 2 &= 20.400 \text{ m}^2\end{aligned}$$

Uhuru moment Ju bridge

approach slab

$$\begin{aligned}\text{concrete: } V &= 3.00 \times 0.20 \times 20.50 \times 1.0457 \times 2 &= 25.725 \text{ m}^3 \\ \text{UF2 } A &= 3.00 \times 20.50 \times 1.0457 \times 2 &= 128.621 \text{ m}^2 \\ \text{joint filler } A &= 0.200 \times 20.50 \times 1.0457 \times 2 &= 8.574 \text{ m}^2\end{aligned}$$

Sub, structure

$$\begin{aligned}\text{concrete: } V &= 0.30 \times 0.30 \times 20.50 \times 1.0457 \times 2 &= 3.858 \text{ m}^3 \\ \text{form worle } A &= (0.30 + 0.30) \times 20.50 \times 1.0457 \times 2 &= 25.724 \text{ m}^2\end{aligned}$$

Railway bridge

approach slab

$$\begin{aligned}\text{concrete: } V &= 3.00 \times 0.20 \times 9.00 \times 1.3151 \times 2 &= 14.203 \text{ m}^3 \\ \text{UF2 } A &= 3.00 \times 9.00 \times 1.3151 \times 2 &= 71.015 \text{ m}^2 \\ \text{joint filler } A &= 0.20 \times 9.00 \times 1.3151 \times 2 &= 4.734 \text{ m}^2\end{aligned}$$

Sub, structure

$$\begin{aligned}\text{concrete: } V &= 0.30 \times 0.30 \times 9.00 \times 1.3151 \times 2 &= 2.130 \text{ m}^3 \\ \text{form work } A &= (0.30 + 0.30) \times 9.00 \times 1.3151 \times 2 &= 14.203 \text{ m}^2\end{aligned}$$

MORTAR OF SHOE --- THE CALCULATION BE ABRIDGE TO A LITTLE.

