# LECTURES NOTE

ESTIMATION & COST EVALUATION – II

5th SEMESTER

DIPLOMA (CIVIL ENGINEERING)

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# Th5. ESTIMATION & COST EVALUATION – II

| Name of the Course: Diploma in Civil Engineering | | | |
|---|---|---|---|
| Course code: | | Semester | 5th |
| Total Period: | 60 | Examination | 3 hrs |
| Theory periods: | 4P/week | Class Test: | 20 |
| Maximum marks: | 100 | End Semester Examination: | 80 |

**A. RATIONALE**

The course exposes the students to the techniques and best practices to prepare detailed estimates of roads, bridges, culverts, irrigation structures and PWD works.

**B. COURSE OBJECTIVES**

On completion of the course, students will be able to

1. Create detailed estimate of culverts and bridges
2. Prepare estimates of irrigation structures
3. Prepare estimates of a macadam road and a national highway in cutting and filling
4. Prepare detailed estimates for septic tank and soak pits
5. Prepare detailed estimates of miscellaneous works
6. Comprehend the management practices in Public Works Department
7. Interpret the building bylaws furnished by regulatory bodies

C. **TOPIC WISE DISTRIBUTION OF PERIODS**

| Chapter | Name of topics | Hours |
|---|---|---|
| 1. | Detailed estimate of culverts and bridges | 12 |
| 2. | Estimate of irrigation structures | 14 |
| 3. | Detailed estimate of roads | 12 |
| 4. | Detailed estimates of miscellaneous works | 12 |
| 5. | PWD accounts works | 10 |

**D. COURSE CONTENTS:**

**1. Detailed estimate of culverts and bridges**

1.1 Detailed estimate of a RCC slab culvert with right angled wing walls with bar bending schedule.

1.2 RCC Hume pipe culvert with splayed angled wing wall

**2. Estimate of irrigation structures**

2.1 Detailed estimate of simple type of vertical fall to given specification

2.2 Detailed estimate of drainage siphon to given specification.

**3. Detailed estimate of roads**

3.1 Detail estimate of a water bound macadam road

3.2 Detailed estimate of a flexible pavement in cutting / filling

3.2 Detailed estimate of septic tank and soak pit for 50 users

**4. Miscellaneous estimates**

4.1 Tube well, Piles and Pile cap, Isolated and combined footings.

**5. PWD Accounts works**

5.1 Works

5.1.1 Classification of work-original, major, petty, repair work, annual repair, special repair, quadrantal repair.

5.1.2 Concept of Method of execution of works through the contractors and department, contract and agreement, work order, types of contract, piece work agreement.

5.2 Accounts of works –

5.2.1 Explanation of various terms

Administrative approval, technical sanction, tender, preparation of notice inviting tender, quotations, earnest money, E-tendering, security deposit, advance payment, intermediate payment, final payment, running bill, final bill, regular and temporary establishment, cash, major & subhead of account, temporary advance (imprest money),supervision charges, suspense account, debit, credit, book transfer, voucher and related accounts .

5.2.2 Measurement book use & maintenance, procedure of marking entries of measurement of work and supply of materials, labour employed, standard measurement books and common irregularity

5.2.3 Muster roll : Its preparation & use for making payment of pay & wages

5.2.4 Acquittance Roll : Its preparation & use for making payment of pay & wages

5.2.5 Labour & labour report, method of labour payment, use of forms and necessity of Submission

5.2.6 Classification of stores, receipt / issue statement on standard form, method of preparation of stock account, preparation and submission of returns, verification of stocks, shortage and excess

5.3 Building BYLAWS and REGULATORY Bodies, Development authorities, types and their levels, RERA etc.

**E. SYLLABUS COVERGE UPTO INTERNAL ASSESSMENT**

Chapters 1, 2, 3

**F. RECOMMENDED BOOKS**

| Sl. No | Name of Authors | Titles of Book | Name of Publisher |
|---|---|---|---|
| 1 | M.Chakraborty. | Estimating,Costing,specification &Valuation in Civil Engineering | Published by author |
| 2 | B.N.Dutta. | Estimating &Costing | UBSPD |
| 3 | Birdi &Ahuja. | Estimating &Costing | Dhanpat Rai Publication |
| 4 | Latest Orissa PWD Schedule of Rates & Analysis of rates | | Govt. of Odisha |

# EST II

## 1. DETAILED ESTIMATE OF CULVERTS & BRIDGES

**CULVERT-** If the length of water way in a structure is less than 6m, then the structure is known as culvert. If the length of water way in a structure will be more than 6m & less than 30m, then the structure is known as minor bridge. If the length of water way in a structure will be more than 30m, then the structure is known as major bridge.

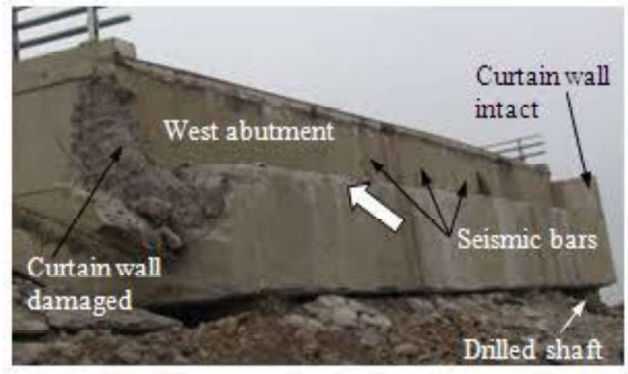
**ABUTMENT -** The end support of a bridge or culvert is known as abutment.

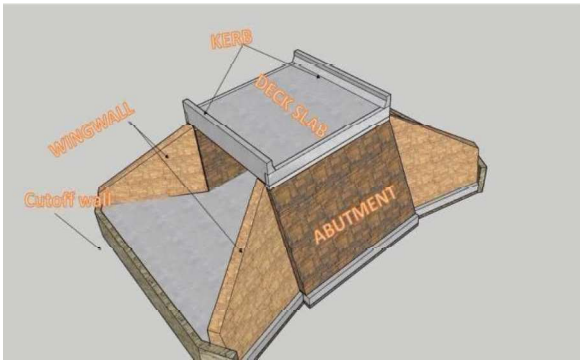
**WING WALL -** Wing wall is a retaining wall which retains the embankment.

**CURTAIN WALL -** Curtain wall are built up across the waterway of upstream or downstream or both side to protect our structure from erosion due to strong current of water flow.

**RETURN WALL -** A Return wall is a retaining wall which is built parallel to the road to retain embankment. Return wall is always provided in splayed wing wall not in straight wing wall.






**TYPES OF CULVERT -** Following are the different types of culvert generally used in construction:-

a) Pipe culvert (single or multiple)
b) Pipe arch culvert (single or multiple)
c) Arch culvert (single or multiple)
d) Box culvert (single or multiple)
e) Bridge or slab culvert

**Pipe Culvert -** Pipe culvert are the most common types of culvert widely used in rural are. In this culvert single or no of circular pipes are used to make a pipe culvert. The diameter of pipes varies from 1m to 6m. The pipe is made of concrete or steel. Pipe culvert is provided where the flow of water is very large.

**Pipe Arch Culvert -** This culvert is similar to the pipe culvert, but we use half circular pipes in this type of culvert. The pipe is made of concrete or steel. Pipe arch culvert is suitable for large water flow, but the flow should be stable.

**Arch culvert -** Arch culvert is similar to the pipe arch culvert but in arch culvert an artificial floor is provided below the arch. Here both artificial floor and arch are made of concrete. Steel arch culvert is also available but it is very expensive. Arch culvert is suitable for narrow water flow.

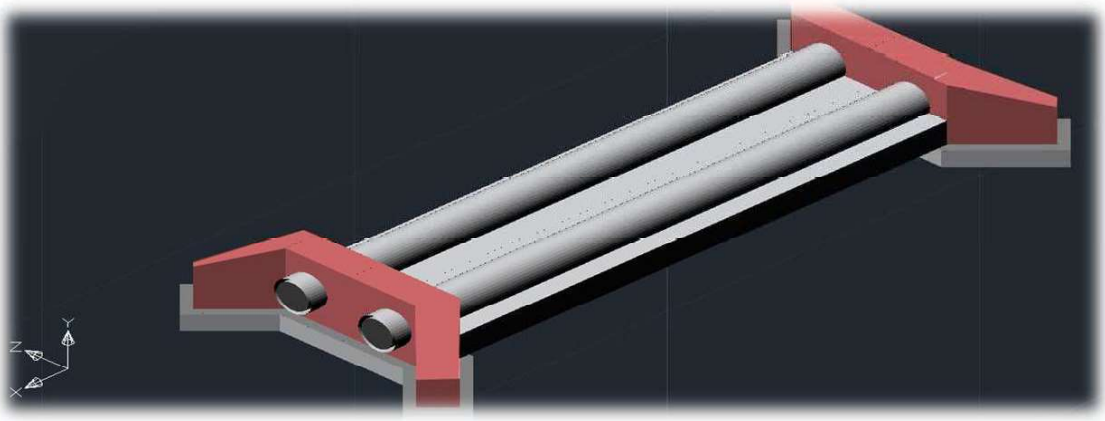
**Box culvert -** Box culvert is in rectangular shape and generally construct by reinforced concrete. Box culvert is suitable for heavy rainfall area. Box culvert is also provided where the velocity of water flow is more.

**Bridge culvert or slab culvert -** Bridge culverts are provided on canals or rivers for movement of vehicles. For this culvert a foundation is laid under the ground surface .This type of culvert is provided on canals and rivers.



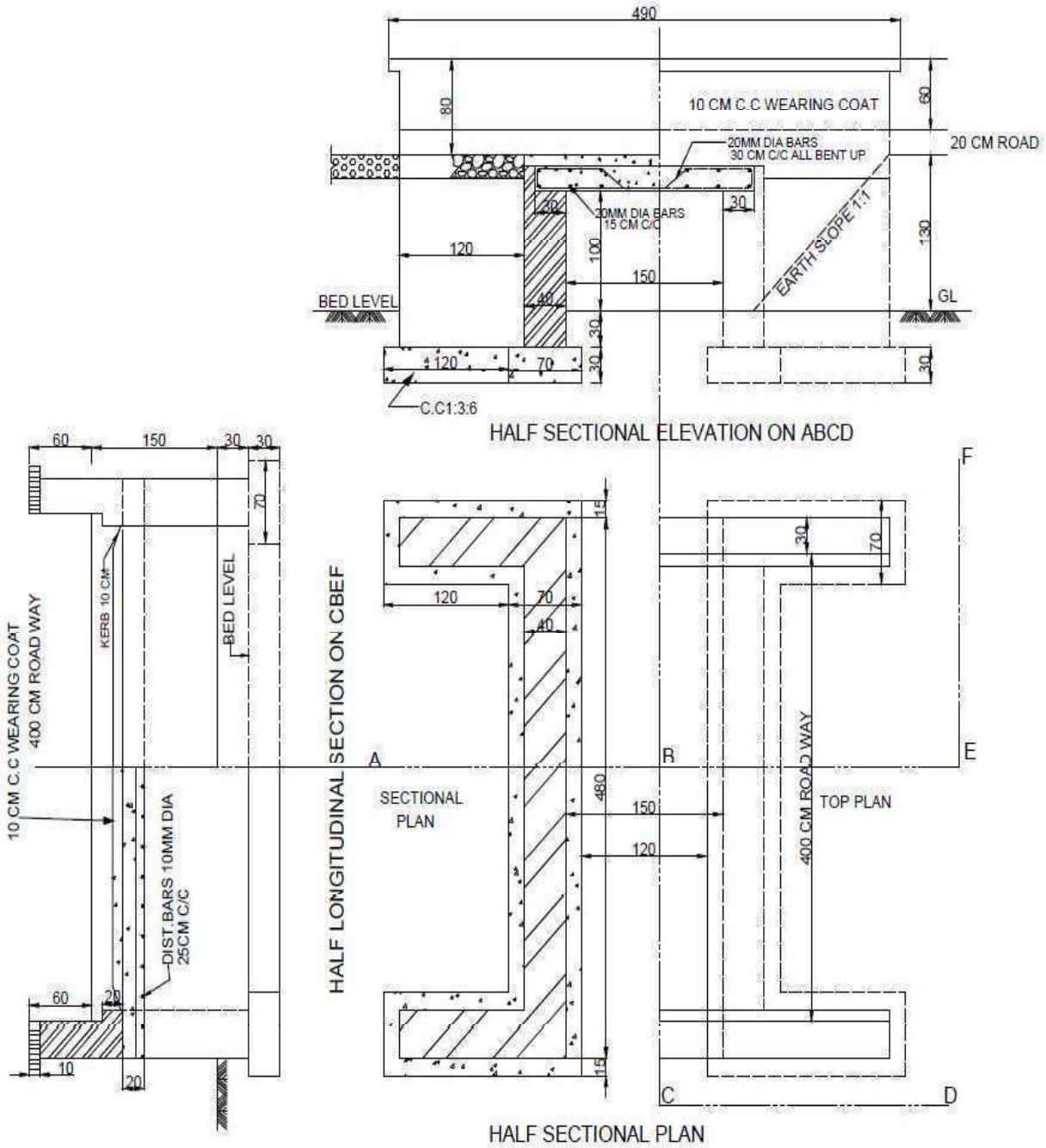

**Difference between plastering and pointing:-**

| Plastering | Pointing |
|---|---|
| • Plastering is applied in both inside and outside part of structure.<br>• After plastering the plastering surface become smooth and plain.<br>• In plastering more material is needed. | • Pointing is applied outside part only or any joint.<br>• After pointing the pointing surface may not be smooth and plain.<br>• In pointing less material is needed. |



## 1.1 Detailed Estimate of A RCC Slab Culvert with Right Angled Wing Walls.

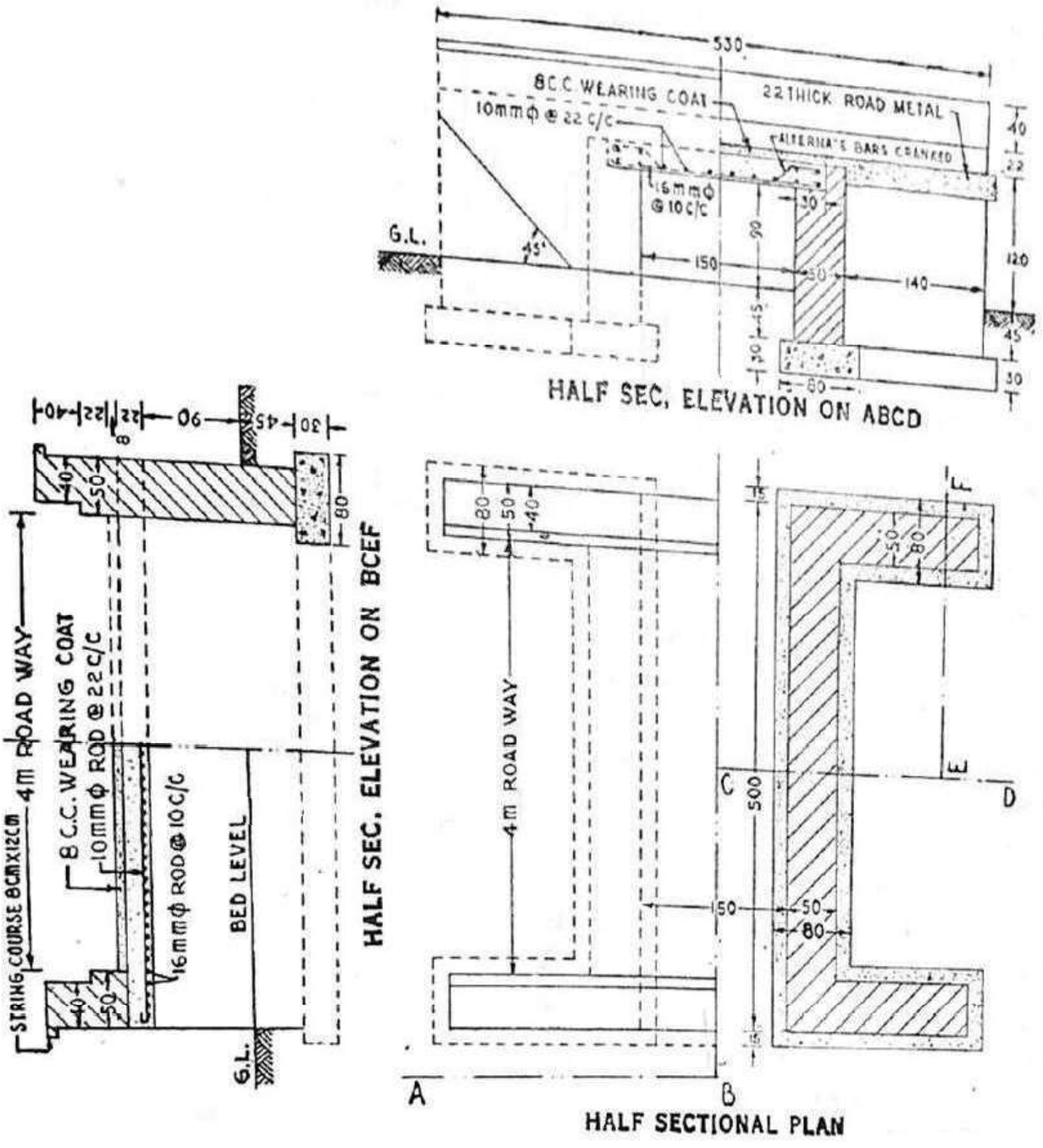
**Q)** Prepare a detailed estimate of a slab culvert of 1.50 metre span and 4.00 metre roadway from the given drawing. The general specifications are as follows: - Foundation concrete shall be of cement concrete 1:3:6 with stone ballast and coarse sand. Masonry shall be of first class brick work in 1: 4 cement coarse sand mortars. Slab shall be of R.C.C. 1:2:4 with reinforcement as per drawing. Exposed surface of brick masonry shall be cement pointed 1: 2. Road shall be provided with 10cm thick wearing coat of 1: 2: 4 cement concrete.



| Item No | Desription Of Item | No | Length(M) | Bredth(M) | Height(M) | Quantity | Unit | Explanotory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth work in Excavation in Foundation | | | | | | | |
| | Aboutment | 2 | 5.1 | 0.7 | 0.6 | 4.284 | CUM | L=4.8+0.15+0.15 |
| | Wing wall | 4 | 1.2 | 0.7 | 0.6 | 2.016 | CUM | H=0.3+0.3 |
| | | | | | TOTAL= | 6.3 | CUM | |
| 2 | Cement Contrete Work 1:3:6 in Foundation Wuth Stone Ballast & Course Sand | | | | | | | |
| | Aboutment | 2 | 5.1 | 0.7 | 0.3 | 2.142 | CUM | |
| | Wing Wall | 4 | 1.2 | 0.7 | 0.3 | 1.008 | CUM | |
| | | | | | TOTAL= | 3.15 | CUM | |
| 3 | First Class Brick Work In 1:4 Cement Mortar | | | | | | | |
| | Aboutment | 2 | 4.8 | 0.4 | 1.5 | 5.76 | CUM | H=1+0.3+0.2 |
| | wing Wall | 4 | 1.2 | 0.4 | 1.5 | 2.88 | CUM | |
| | Parapet Wall Up To Kerb | 2 | 4.7 | 0.4 | 0.3 | 1.128 | CUM | L=4.9-0.1-0.1 |
| | Paraprt Wall Above Kerb | 2 | 4.7 | 0.3 | 0.5 | 1.41 | CUM | H=0.2+0.1 |
| | Coping | 2 | 4.9 | 0.4 | 0.1 | 0.392 | CUM | H=0.6-0.1 |
| | | | | | TOTAL= | 11.57 | CUM | |
| | Deduction For Bearing Of R.C.C Slab | 2 | 4.8 | 0.3 | 0.2 | 0.576 | CUM | |
| | | | | NET TOTAL= | | 10.994 | CUM | |
| 4 | R.C.C Work 1:2:4 in Slab Excluding Reinforcement But Including Centring Shuttering | 1 | 4.8 | 2.1 | 0.2 | 2.016 | CUM | B=1.5+0.3+0.3 |
| 5 | Cement Concrete 1:2:4 Wearing Coat | 1 | 4 | 2.3 | 0.1 | 0.92 | CUM | B=2.1+0.1+0.1 |
| 6 | Cement Pointing With 1:2 Cement Mortar | | | | | | | |
| | Iner Face Of Aboutment | 2 | 4.8 | - | 1.1 | 10.56 | SQM | |
| | Face wall From 10 c.m Below G.L Of To Bottom of Coping | 2 | 4.7 | - | 2.1 | 19.74 | SQM | |
| | Iner Face Of Parapet Excluding Coping | 2 | 4.7 | - | 0.8 | 7.52 | SQM | |
| | Coping Iner Edge ,Top, Outer Edge & Bottom Edge | 2 | 4.9 | - | 0.7 | 6.86 | SQM | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Ends of Parapet . | | | | | | SQM | |
| | 40 c.m Wide | 4 | | 0.4 | 0.3 | 0.48 | SQM | H=0.2+0.1 |
| | 30 c.m Wide | 4 | - | 0.3 | 0.5 | 0.6 | SQM | |
| | Ends of Coping | 4 | - | 0.4 | 0.1 | 0.16 | SQM | |
| | Coping Outer Bottom Side Projection | 4 | 0.3 | 0.1 | - | 0.12 | SQM | |
| | | | | | TOTAL= | 46.04 | SQM | |
| | Deduction For Rectangular Opening | 2 | 1.5 | - | 1.1 | 3.3 | SQM | H=1+0.1 |
| | Slab Edge | 2 | 2.1 | - | 0.2 | 0.84 | SQM | L=1.5+0.3+0.3 |
| | Trangular pertion Below Earth Slope | 4 | 0.5 | 1.3 | 1.3 | 3.38 | SQM | |
| | | | | DEDUCTION TOTAL= | | 7.52 | SQM | |
| | | | | NET TOTAL= | | 38.52 | SQM | |
| 7 | Steel Bars Including Cutting ,Bearing In R.C.C Work 20 mm Dia Bars | | | | | | | |
| | Main Straight Bars | 17 | 2.38 | - | - | 40.46 | m | No=4.8-0.04*2/0.15+1 L=2.1-0.04*2+2*9*0.02 |
| | Main Bentup Bar | 16 | 2.5114 | - | - | 40.1824 | m | L=2.1-0.04*2+2*9*0.02+2*0.42*0.16 |
| | | | | TOTAL LENGTH= | | 80.6424 | m | |
| | weight | - | - | - | - | 199.23 | Kg | Weight= 400/162*80.6924 |
| | 10 mm Dia Distrubution Bar At | | | | | | | |
| | Bottom | 10 | 4.9 | - | - | 49 | m | No=2.1-0.04*2/0.2+1 |
| | Top | 4 | 4.9 | - | - | 19.6 | m | |
| | | | | TOTAL LENGTH= | | 68.6 | m | |

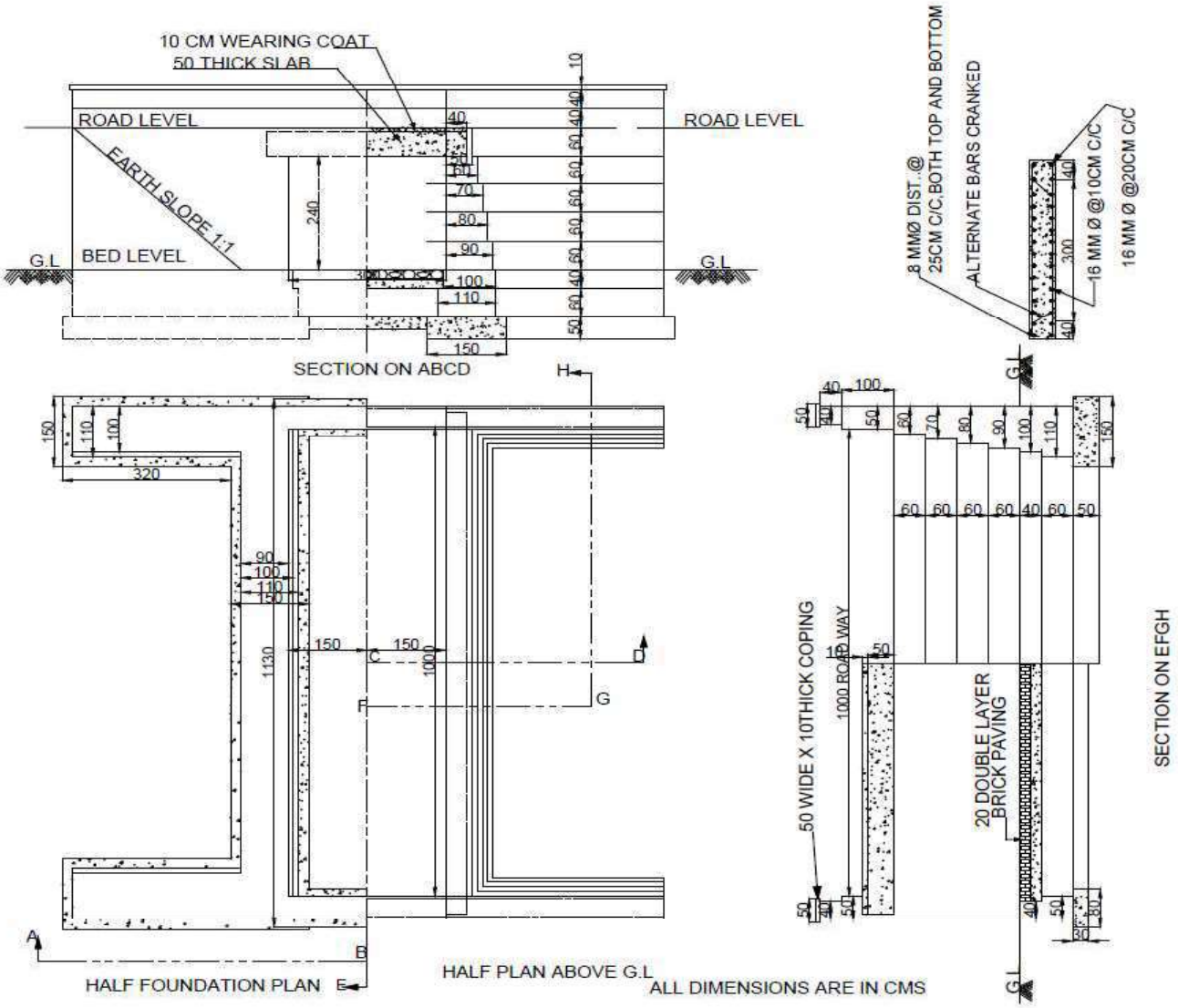
**Q)** Estimate of a simple Slab Culvert.- Prepare a quantity survey for a slab culvert of 1'5 m clear span and 4 m road way. The general specifications are as follows Foundation shall be of cement concrete 1:2:4. Brickwork shall be of 1st. class in cement mortar 1:4. Exposed surfaces of brick masonry shall be cement pointed 1:3 carried up to 15 cm below G. L. The exposed surfaces of R. C. C. shall be given a smooth finish during centring, and no plastering shall be allowed. The string courses shall be 8 cm deep and 12 mm thick with cement mortar 1:3 finished with neat cement.



| Item No | Desription Of Item | No | Length(M) | Bredth(M) | Height(M) | Quantity | Unit | Explanotory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth Work In Excavation In Foundation | | | | | | | |
| | Aboutment | 2 | 5.3 | 0.8 | 0.75 | 6.36 | CUM | L=5+0.15+0.15 |
| | Wing wall | 4 | 1.4 | 0.8 | 0.75 | 3.36 | CUM | H=0.45+0.3 |
| | | | | | TOTAL= | 9.72 | CUM | |
| 2 | Cement Contrete Work 1:3:6 in Foundation Wuth Stone Ballast & Course Sand | | | | | | | |
| | Aboutment | 2 | 5.3 | 0.8 | 0.3 | 2.544 | CUM | |
| | Wing Wall | 4 | 1.4 | 0.8 | 0.3 | 1.344 | CUM | |
| | | | | | TOTAL= | 3.888 | CUM | |
| 3 | First Class Brick Work In 1:4 Cement Mortar | | | | | | | |
| | Aboutment | 2 | 5 | 0.5 | 1.57 | 7.85 | CUM | H=0.45+0.9+0.22 |
| | wing Wall | 4 | 1.4 | 0.5 | 1.57 | 4.396 | CUM | |
| | Parapet Wall Up To Kerb | | | | | | | |
| | 50 c.m | 2 | 5.3 | 0.5 | 0.3 | 1.59 | CUM | H=0.22+0.08 |
| | 40c.m | 2 | 5.3 | 0.4 | 0.4 | 1.696 | CUM | |
| | | | | | Ttotal= | 15.532 | CUM | |
| | Deduction For Bearing of R.C.C Slab in Aboutment | 2 | 5 | 0.3 | 0.22 | 0.66 | CUM | |
| | | | | NET TOTAL= | | 14.872 | CUM | |
| 4 | R.C.C Work Excluding Reinforcement But Including Centring Shuttering | 1 | 5 | 2.1 | 0.22 | 2.31 | CUM | B=1.5+0.3+0.3 |
| 5 | 8c.m Cement Concrete Wearing Coat | 1 | 4 | 2.5 | 0.08 | 0.8 | CUM | B=1.5+0.5+0.5 |
| 6 | 8c.m *12 c.m String Course | 2 | 5.3 | - | - | 10.6 | M | |
| 7 | Cement Pointing With 1:3 Cement Mortar | | | | | | | |
| | Iner Face Of Aboutment | 2 | 5 | - | 1.05 | 10.5 | SQM | H=0.9+0.15 |
| | Face Wall | 2 | 5.3 | - | 1.89 | 20.034 | SQM | H=0.15+1.2+0.220.4-0.08 |
| | Iner Face & Top Of Parapet | 2 | 5.3 | - | 1.12 | 11.872 | SQM | H=0.22+0.1+0.4+0.4 |
| | Ends of Parapet . | | | | | | SQM | |
| | 50 c.m Wide | 4 | - | 0.5 | 0.3 | 0.6 | SQM | H=0.22+0.08 |
| | 40 c.m Wide | 4 | - | 0.4 | 0.4 | 0.64 | SQM | |
| | | | | | TOTAL= | 43.646 | SQM | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Deduction For Rectangular Opening | 2 | 1.5 | - | 1.05 | 3.15 | SQM | H=0.9+0.15 |
| | Ends of Slab | 2 | 2.1 | - | 0.22 | 0.924 | SQM | L=1.5+0.3+0.3 |
| | Trangular pertion Below Earth Slope | 4 | 0.5 | 1.2 | 1.2 | 2.88 | SQM | |
| | | | | DEDUCTION TOTAL= | | 6.954 | SQM | |
| | | | | NET TOTAL= | | 36.692 | SQM | |
| 8 | Steel Bars Including Cutting ,Bearing In R.C.C Work | | | | | | | |
| | 16 mm Dia Bars | | | | | | | |
| | Main Straight Bars | 26 | 2.308 | - | - | 60.008 | m | No=5-0.04*2/0.1+1 L=2.1-0.04*2+2*9*0.016 |
| | Main Bentup Bar | 25 | 2.4592 | - | - | 61.48 | m | L=2.1-0.04*2+2*9*0.016+2*0.42*0.18 |
| | | | | TOTAL LENGTH= | | 121.488 | m | |
| | weight | - | - | - | - | 191.951 | Kg | Weight= 1.58*121.488 |
| | 10 mm Dia Distrubution Bar At | | | | | | | |
| | Bottom | 11 | 5.1 | - | - | 56.1 | m | No=2.1-0.04*2/0.22+1 |
| | Top | 4 | 5.1 | - | - | 20.4 | m | L=5-2*0.04+2*9*0.01 |
| | | | | TOTAL LENGTH= | | 76.5 | m | |
| | Weight | | | | | 47.43 | Kg | Weight=0.62*76.5 |

**Q)** Detailed estimate of a RCC stepped culvert with stepped wing walls.

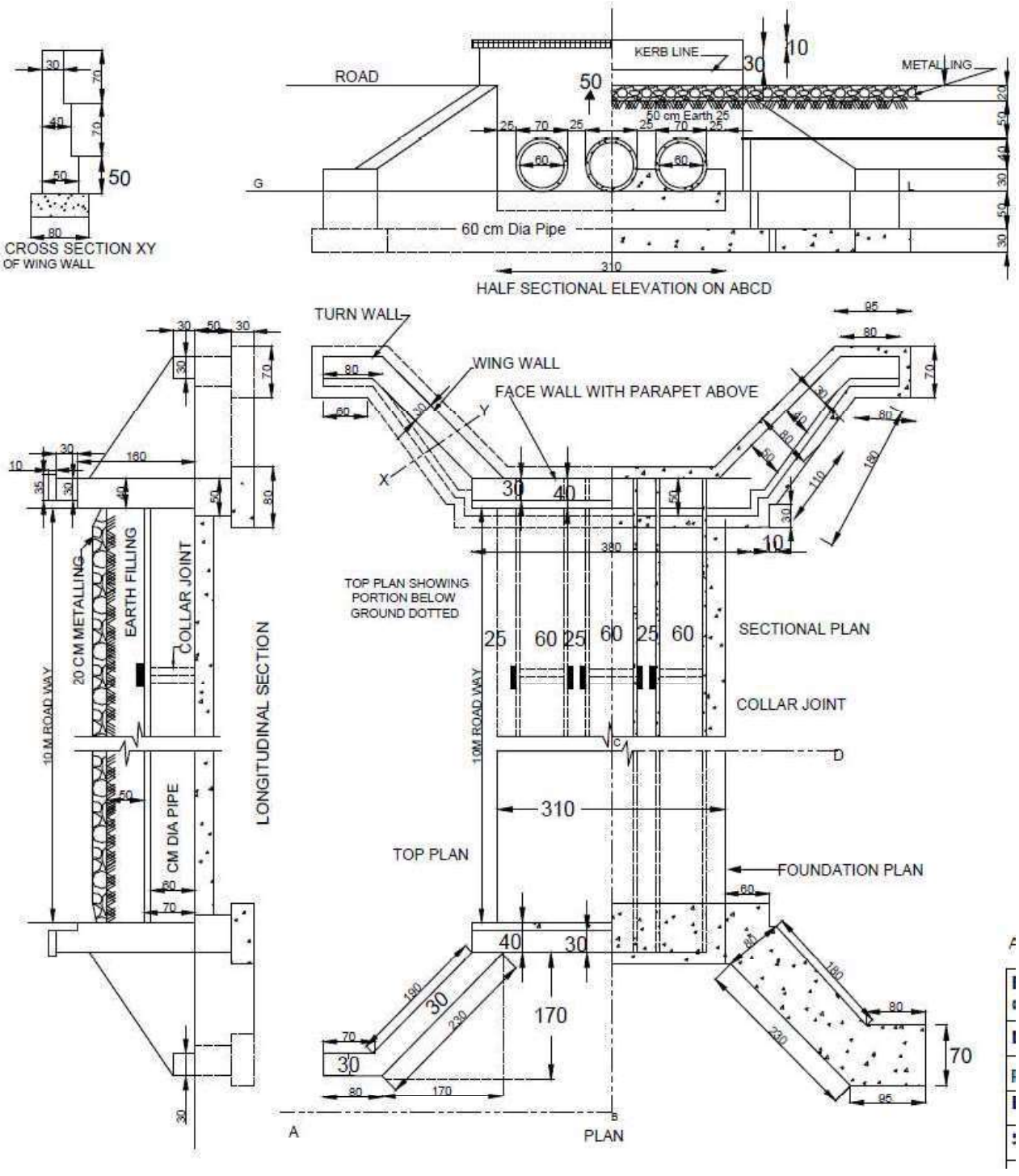


| Item No | Desription Of Item | No | Length(M) | Bredth(M) | Height(M) | Quantity | Unit | Explanotory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth Work In Excavation | | | | | | | |
| | Aboutment | 2 | 11.3 | 1.5 | 1.5 | 50.85 | CUM | H=0.5+0.6+0.4 |
| | Wing wall | 4 | 3.2 | 1.5 | 1.5 | 28.8 | CUM | |
| | Curtain Wall | 2 | 2.3 | 0.8 | 1.3 | 4.784 | CUM | L=3-0.05-0.05-0.1-0.1-0.2-0.2 |
| | Floor Between Aboutment & Curtain Wall | 1 | 2.3 | 9.6 | 0.4 | 8.832 | CUM | B=9.8+0.5*2+0.05*2+0.15*2-0.8*2 L=3-0.05*2-0.1*2-0.2*2 |
| | | | | | TOTAL= | 93.266 | CUM | |
| 2 | Cement Concrete Work In Aboutment | | | | | | | |
| | Aboutment | 2 | 11.3 | 1.5 | 0.5 | 16.95 | CUM | |
| | Wing Wall | 4 | 3.2 | 1.5 | 0.5 | 9.6 | CUM | |
| | Curtain Wall | 2 | 2.3 | 0.8 | 0.3 | 1.104 | CUM | |
| | Floor Between Aboutment & Curtain Wall | 1 | 2.9 | 10 | 0.2 | 5.8 | CUM | B=9.8+0.5*2-0.4*2 L=3-0.05*2 |
| | | | | | TOTAL= | 33.454 | CUM | |
| 3 | Brick Work In Aboutment | | | | | | | |
| | 110 C.M Wide | 2 | 10.9 | 1.1 | 0.6 | 14.388 | CUM | L=11.3-0.2-0.2 |
| | 100C.M Wide | 2 | 10.9 | 1 | 0.4 | 8.72 | CUM | |
| | 90C.M Wide | 2 | 10.8 | 0.9 | 0.6 | 11.664 | CUM | 10.9-0.05-0.05 |
| | 80C.M Wide | 2 | 10.8 | 0.8 | 0.6 | 10.368 | CUM | |
| | 70C.M Wide | 2 | 10.8 | 0.7 | 0.6 | 9.072 | CUM | |
| | 60C.M Wide | 2 | 10.8 | 0.6 | 0.6 | 7.776 | CUM | |
| | 50C.M Wide | 2 | 10.8 | 0.5 | 0.5 | 5.4 | CUM | H=0.6-0.1 |
| | Wing wall | | | | | | | |
| | 110C.M Wide | 4 | 3.2 | 1.1 | 0.6 | 8.448 | CUM | L=3.2+0.15-0.15 |
| | 100C.M Wide | 4 | 3.2 | 1 | 0.4 | 5.12 | CUM | |
| | 90C.M Wide | 4 | 3.25 | 0.9 | 0.6 | 7.02 | CUM | L=3.2+0.05 |
| | 80C.M Wide | 4 | 3.35 | 0.8 | 0.6 | 6.432 | CUM | L=3.25+0.15 |
| | 70C.M Wide | 4 | 3.45 | 0.7 | 0.6 | 5.796 | CUM | L=3.35+0.15 |
| | 60C.M Wide | 4 | 3.55 | 0.6 | 0.6 | 5.112 | CUM | L=3.45+0.1 |
| | 50C.M Wide | 4 | 3.65 | 0.5 | 0.5 | 3.65 | CUM | L=3.55+0.1 |
| | Parapet Wall 50 C.M Remaning | 2 | 11.3 | 0.5 | 0.5 | 5.65 | CUM | L=3.65*2+0.5*2+3 H=1-0.5 |
| | 40 C.M | 2 | 11.3 | 0.4 | 0.4 | 3.616 | CUM | |
| | Curtain Wall | | | | | | | |
| | 50 C.M | 2 | 2.7 | 0.5 | 0.6 | 1.62 | CUM | L=3-0.05*2-0.1*2 |
| | 40c.m | 2 | 2.9 | 0.4 | 0.4 | 0.928 | CUM | L=3-0.05*2 |
| | | | | | Ttotal= | 120.78 | CUM | |
| | Deduction For Bearing Of Slab | 2 | 10.8 | 0.4 | 0.5 | 4.32 | CUM | |
| | | | NET TOTAL= | | | 116.46 | CUM | |
| 4 | Double Layer Brick Paving | 1 | 10 | 2.9 | - | 29 | SQM | L=9.8+0.5*2-0.4 B=3-0.05*2 |
| 5 | R.C.C Slab | 1 | 10.8 | 3.8 | 0.5 | 20.52 | CUM | B=3+0.4+0.4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 6 | 10 C.M Wearing Coat | 1 | 9.8 | 4 | 0.1 | 3.92 | CUM | B=3+0.1+0.1 |
| 7 | Coping In Cement Concrete | 2 | 11.5 | 0.5 | 0.1 | 1.15 | CUM | L=3.65*2+0.5*2+3+0.1*2 |
| 8 | Cement Pointing Work | | | | | | | Assume 10 C.M Below G.L |
| | Iner Face Of Aboutment | 2 | 10.8 | - | 2.4 | 51.84 | SQM | |
| | Face Wall | 2 | 11.3 | - | 3.9 | 88.14 | SQM | L=3.65*2+0.5*2+3 H=0.1+0.6*5+0.4+0.4 |
| | Iner Face Of Parapet Wall | 2 | 11.3 | - | 0.9 | 20.34 | SQM | H=0.4+0.1+0.4 |
| | Ends of Parapet . | | | | | | | |
| | 50 c.m Wide | 4 | - | 0.5 | 0.5 | 1 | SQM | H=0.22+0.08 |
| | 40 c.m Wide | 4 | - | 0.4 | 0.4 | 0.64 | SQM | |
| | | | | | TOTAL= | 161.96 | SQM | |
| | Deduction For Rectangular Opening | 2 | 3 | - | 2.5 | 15 | SQM | |
| | Ends of Slab | 2 | 3.8 | - | 0.5 | 3.8 | SQM | L=3+0.4+0.4 |
| | Trangular Earth Slope | 4 | 0.5 | 3 | 3 | 18 | SQM | |
| | | | DEDUCTION TOTAL= | | | 36.8 | SQM | |
| | | | NET TOTAL= | | | 125.16 | SQM | |

## 1.2 RCC Hume pipe culvert with splayed angled wing wall.

**Q)** Prepare a detailed estimate of Hume pipe Culvert of three pipes each of 60 cm diameter from the given plan and elevations. Foundation concrete shall be of 1:4:8 cement concrete and brickwork shall be of first class in 1:6 cement sand mortar. Exposed surfaces shall be pointed with 1: 2 cement sand mortar.



| Item No | Description of Item | No | Length(M) | Breadth (M) | Height(M) | Quantity | Unit | Explanatory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth Work In Excavation Foundation | | | | | | | |
| | Face Wall | | | | | | | |
| | Rectangular Portion | 2 | 3.1 | 0.8 | 0.8 | 3.968 | CUM | H=0.5+0.3 |
| | Wing wall TriangularPortion | 4 | 1/2*0.8*0.6 | - | 0.8 | 0.768 | CUM | |
| | Wing Wall Trapezoidal | 4 | 2.05 | 0.75 | 0.8 | 4.92 | CUM | L=2.3+1.8/2 B=0.8+0.7/2 |
| | PortionTurn Wall | 4 | 0.88 | 0.7 | 0.8 | 1.9712 | CUM | L=0.95+0.8/2 |
| | Under Pipe | 1 | 3.1 | 9.5 | 0.15 | 4.4175 | CUM | B=10-0.2*2-0.15*2 |
| | | | | | TOTAL= | 16.0447 | CUM | |
| 2 | Cement Concrete Work In Abutment 1:4:8 | | | | | | | |
| | Face Wall | | | | | | | |
| | Rectangular Portion | 2 | 3.1 | 0.8 | 0.3 | 1.488 | CUM | |
| | Wing Wall Triangular Portion | 4 | 1/2*0.8*0.6 | - | 0.3 | 0.288 | CUM | |
| | Wing Wall Trapezoidal | 4 | 2.05 | 0.75 | 0.3 | 1.845 | CUM | L=2.3+1.8/2 B=0.8+0.7/2 |
| | PortionTurn Wall | 4 | 0.88 | 0.7 | 0.3 | 0.7392 | CUM | L=0.95+0.8/2 |
| | Under Pipe | 1 | 3.1 | 9.8 | 0.5 | 15.19 | CUM | H=0.15*0.7/2 |
| | | | | | TOTAL= | 19.5502 | CUM | |
| | Deduction For Semicircular Pipe | 3 | 9.8 | π\8 | 0.49 | 5.657 | CUM | |
| | | | | NET TOTAL= | | 13.8932 | CUM | |
| 3 | 1st Class Brick Work In 1:6 Cement Mortar | | | | | | | |
| | Face Wall | | | | | | | |
| | 50 C.M Wide | 2 | 4 | 0.5 | 0.5 | 2 | CUM | L=3.8+0.1+0.1 |
| | 40C.M Wide | 2 | 3.8 | 0.4 | 1.6 | 4.864 | CUM | |
| | Parapet Wall | | | | | | | |
| | 30 C.M Wide | 2 | 3.8 | 0.3 | 0.3 | 0.684 | CUM | |
| | Coping | 2 | 4 | 0.35 | 0.1 | 0.28 | CUM | L=3.8+0.1+0.1 |
| | Turn Wall | | | | | | | |
| | 40 C.M Wide | 4 | 0.775 | 0.4 | 0.5 | 0.62 | CUM | L=0.8+0.75/2 |
| | 30 C.M Wide | 4 | 0.75 | 0.3 | 0.3 | 0.27 | CUM | L=0.8+0.7/2 |
| | Wing Wall | | | | | | | |
| | 50 C.M Wide | 4 | 1.1 | 0.5 | 0.5 | 1.1 | CUM | |
| | 40 C.M Wide Straight Portion | 4 | 1.8 | 0.4 | 0.3 | 0.864 | CUM | |
| | 40 C.M Wide Sloping Portion | 4 | 1.8 | 0.4 | 0.2 | 0.576 | CUM | H=0.4/2 |
| | 30 C.M Wide | 4 | 1.9 | 0.3 | 0.35 | 0.798 | CUM | H=0.7/2 |
| | | | | | Ttotal= | 12.056 | CUM | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Deduction For Pipe Opening | 6 | π\4 | 0.49 | 0.4 | 0.923 | CUM | |
| | | | NET TOTAL= | | | 11.133 | CUM | |
| 4 | Hume Pipe Heavy 60 C.M Dia Including Collar Joint | 3 | 10.8 | - | - | 32.4 | M | L=10+0.4+0.4 |
| 5 | Cement Pointing With 1:2 Cement Mortar | | | | | | | 10 C.M Below G.L |
| | Face Wall Out Side | 2 | 3.1 | - | 1.5 | 9.3 | SQM | H=0.3+0.4+0.5+0.2+0.1 |
| | Face Wall Parapet | 2 | 3.8 | - | 0.5 | 3.8 | SQM | |
| | Out Side Parapet Inside | 2 | 3.8 | - | 0.6 | 4.56 | SQM | |
| | Coping Iner Edge,Top Edge,Outer Edge,Bottom | 2 | 4 | - | 0.6 | 4.8 | SQM | H0.1+0.35+0.1+0.05 |
| | Side Bottom Projection | 4 | 0.3 | 0.1 | - | 0.12 | SQM | |
| | Ends of Parapet | 4 | - | 0.4 | 0.2 | 0.32 | SQM | |
| | 40 C.M Wide | 4 | - | 0.3 | 0.3 | 0.36 | SQM | |
| | 30 C.M Wide | 4 | - | 0.35 | 0.1 | 0.14 | SQM | |
| | Coping | 4 | 2.3 | - | 0.95 | 8.74 | SQM | H=1.5+0.4/2 |
| | Wing Wall Vertical Face | 4 | 2.1 | 0.3 | - | 2.52 | SQM | L=2.3+1.9/2 |
| | Wing Wall Top Turn Wall | 4 | 1.8 | - | 0.4 | 2.88 | SQM | L=0.8+0.3+0.7 H=0.3+0.1 |
| | 3 Vertical Face | 4 | 0.75 | 0.3 | - | 0.9 | SQM | L=0.8+0.75/2 |
| | Top | | | | TOTAL= | 38.44 | SQM | |
| | Deduction For Pipe Opening | 6 | π\4 | 0.36 | - | 1.7 | SQM | |
| | | | NET TOTAL= | | | 36.74 | SQM | |

## Bar Bending Schedule

BAR BENDING SHEDULE

**Approximate of steel used in RCC structure =**

→ foundation / footing : 0.5% - 0.8% of total vol$^m$ of work.
→ for column = 0.8% - 4% of total vol$^m$ of work
→ Beam = 1% - 2% of total vol$^m$ of work.
→ lintel / slab = 0.7% - 1% of total vol$^m$ of work
→ Sunshejja = 0.5% of total vol$^m$ of work

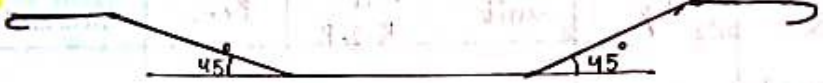
- concrete : weak in tension.
1. ductile - usko dabaa bhangi
2. Brittle - Sudha bhangi

→ Main bar is parallel to short span bar
→ Distribution bar is parallel to long span bar
→ In two way slab main bar is provided parallel to long span
→ In one way slab distribution bar is provide parallel to long span


(30° bentup bar)

- If $l_y/l_x$ greater than 2 → one way
- $l_y/l_x$ smaller than 2 → two way

$l_y$ = length of long span
$l_x$ = length of short span



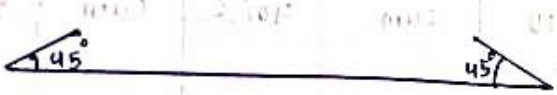

(45° bentup bar)

→ end anchorage bar

**End hook -**

Types -

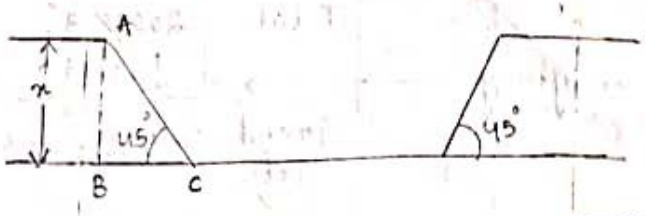
→ Anchorage

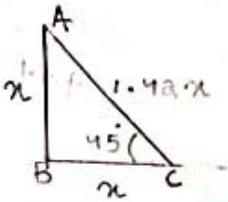



→ 45° Anchorage


→ 'L' Anchorage

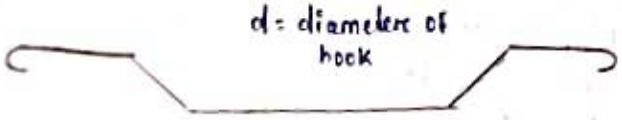
1. **for 45° bentup :-**




$\therefore AC = \sqrt{AB^2 + BC^2} = \sqrt{x^2 + x^2} = \sqrt{2x^2} = \sqrt{2}x = 1.42x$

**for hook :-**



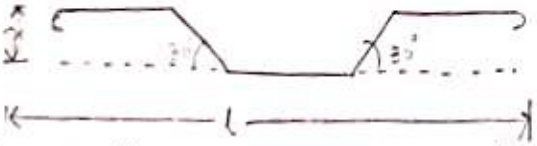

45° হুক inclind portion র cal$^n$ = 2x0.42
30° " " " র cal$^n$ = 2x0.27

Extra length for hook in one side = 9d

for 45° -

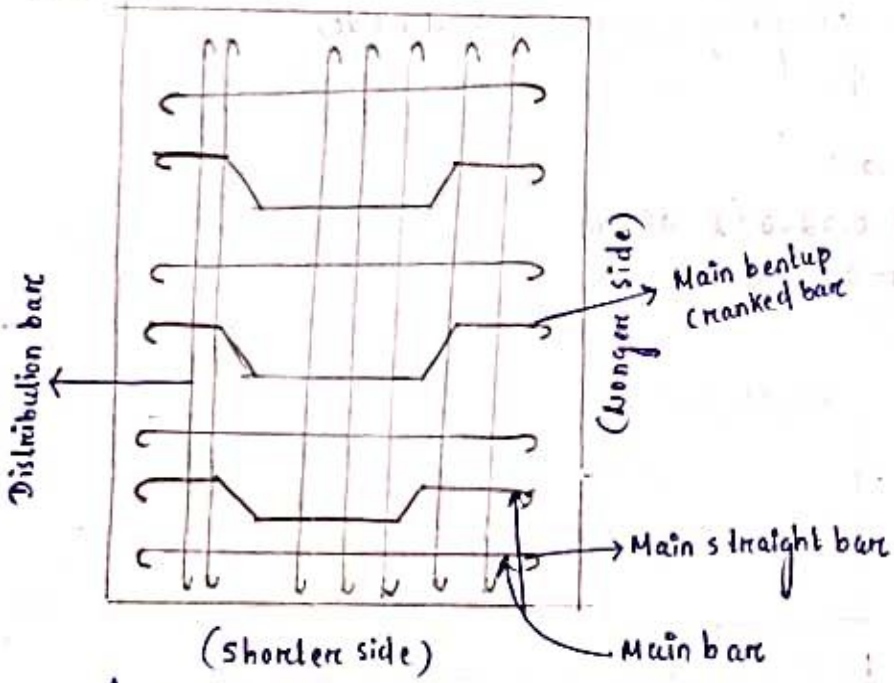

Total length = $L + 2 \times 0.42 \times x + 2 \times 9d$

for 90° -

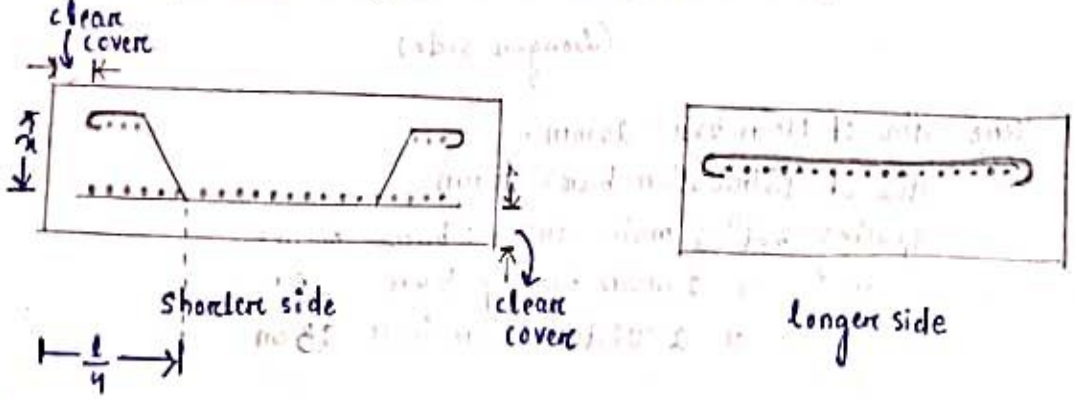



Total length = $L + 2 \times 0.27 \times x + 2 \times 9d$

**for slab -**




one way :- slab এর 2 side support
Two way slab - 4 side support



## Culvert 1

| Sl No | Description of items | No | Length | Breadth | Height | Quantity | Remark |
|---|---|---|---|---|---|---|---|
| 1. | 20 mm dia Main bar Straight | 17 | 2.38 | | | 40.46 (m) | No = $\left(\frac{4.8-0.04\times2}{0.15}\right)+1$ = 32.46 ≅ 33 |
| | Bent up | 16 | 2.51 | | | 40.16 (m) | L = 2.1 − (0.04 × 2) + 2 × 9 × 0.02 = 2.38 |
| | | | | | | 80.69 | Bent up |
| | | | $\frac{D^2}{162}$ | × L = | $\frac{20^2}{162}$ × 80.69 = 200 kg | | L = 2.38 + 2 × 0.42 × 0.16 = 2.51 |
| | | | | | | | = 2 quintal |
| | 10 mm dist. bar at bottom and top | 10 | 4.9 | | | 49 | |
| | | 4 | 4.9 | | | 19.6 | No = $\left(\frac{2.1-0.04\times2}{0.25}\right)+1$ |
| | | | | | Total | 68.6 m | = 9.08 ≅ 10 Nos. |
| | | | $\frac{10^2}{162}$ | × 68.6 | = 42.34 kg | | L = 4.8 − (0.04 × 2) + 2 × 9 × 0.01 |

## Culvert 2

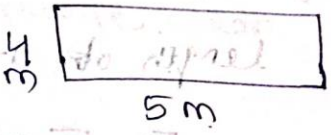
| Sl No | Description of items | No | Length | Breadth | Height | Quantity | Remark |
|---|---|---|---|---|---|---|---|
| | 16 mm ϕ bar Straight | 26 | 2.308 | | | 60.008 (m) | No = $\left(\frac{5-0.04\times2}{0.1}\right)+1$ = 50.2 = 51 Nos. |
| | Bent up | 25 | 2.459 | | | 61.475 (m) | L = 2.1 − 0.04 × 2 + 2 × 9 × 0.016 = 2.308 |
| | | | | | Total | 121.483 | L = 2.308 + 0.42 × 2 × 0.18 = 2.459 |
| | | | 1.58 kg/m = | | 1.58 × 121.483 = 191.943 kg | | |
| | 10 mm ϕ distribution bar Bottom | 11 | 5.1 | | | 56.1 (m) | No = $\frac{2.1-0.04\times2}{0.22}$ + 1 = 10.18 ≅ 11 Nos |
| | Top | 4 | 5.1 | | | 20.4 (m) | L = 5 − 0.04 × 2 + 2 × 9 × 0.01 |
| | | | | | Total | 76.5 | |
| | @ 0.62 kg/m | | 0.62 × | 76.5 | 47.43 kg | | |

## Bar Bending Question

1. The dimension of a RCC slab is 4.00m × 5.00m × 15 cm deep. reinforcement of 10 mm dia are placed in short span @ 15 cm c/c. of the total no. of bars, 17 nos. have been cranked and hooked at the ends. other rods are straight and hooked at the ends. To hold the cranked portion 4 nos. 8mm dia straight and hooked rods have been used. The 8mm dia rods have been used. The 8mm dia rods have been wed. The 8mm dia rods are placed in a direction of long span @ 20 cm c/c and all are straight and hooked at the ends. The covers are 1.5 cm at bottom and 3 cm on all sides. Assume any other dimension not given. Estimate the total weight of steel required for reinforcement of the slab.

Soln

* Main bar → short span → 10mm ϕ 15 cm c/c




- Distribution bar → 4 nos. 8mm dia

  long span → 8mm dia 20 cm c/c

  bottom cover = 1.5 cm = 0.015m.

  All sides — 3cm = 0.03 m

No of main bar = $\frac{5 - 0.03 \times 2}{0.15} + 1 = 33.93$

= 34

17 straight, 17 bent up.

Length of Main bar (Straight)

$= 4 - 0.05 \times 2 + 2 \times 9 \times 0.01 = 4.12\text{m}$

Weight $= \frac{10^2}{162} \times (17 \times 4.12) = 43.23\ \text{kg}$

Main bent up bar

$4.12 + 2 \times 0.42 \times (0.15 - 0.015 - 0.015)$

$= 4.22\text{ m}$

Weight $= \frac{10^2}{162} \times (17 \times 4.22) = 44.28$

Distribution bar

$$\text{No} = \frac{4 - 0.05 \times 2}{0.2} + 1 = 20.7 = 21$$

Length of distribution bar at bottom

$= 5 - 0.05 \times 2 + 2 \times 9 \times 0.08 = 5.084\text{ m}$

$W = \frac{8^2}{162} \times (21 \times 5.084) = 42.17\ \text{kg}$

At top

$W = \frac{8^2}{162} (21 \times 5.084) = 8.03\ \text{kg}$

Total weight of 10mm dia (Φ)

$43.23 + 44.28 = 87.51\ \text{kg}$

10 % wastage $= 87.51 \times \frac{10}{100} + 87.51$

$= 96.261\ \text{kg}$

Total weight of 8mm Φ

$42.178 + 8.034 = 50.21$

10 % wastage $= 50.21 + 50.21 \times \frac{10}{100}$

$= 55.231\ \text{kg}$

## 2. ESTIMATE OF RRIGATION STRUCTURES

**Fall -** A vertical drop which is provided to step down the canal bed and then it is continued with permissible slope is called canal fall structure or simply canal fall.

**Types of fall -** Followings are he different types of fall:-

a) Ogee falls
b) Rapid Fall
c) Stepped fall
d) Trapezoidal notch fall
e) Simple vertical drop fall or Sarada fall
f) Straight glacis fall
g) Montague type fall
h) English fall or baffle fall

**Cross drainage work -** Cross drainage work is a structure carrying a discharge of a stream across another stream.

Cross drainage work is of two types:-

1-A canal cross over a drain.
2-A drain cross over a canal.

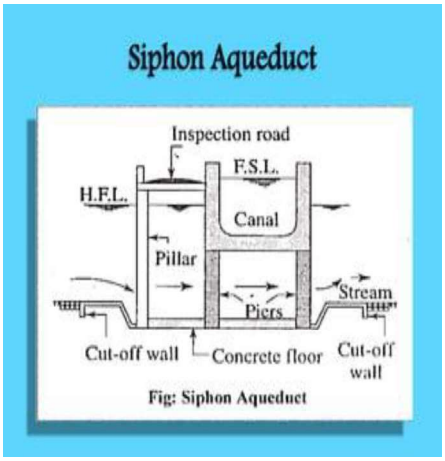
**1-A canal cross over a drain.**

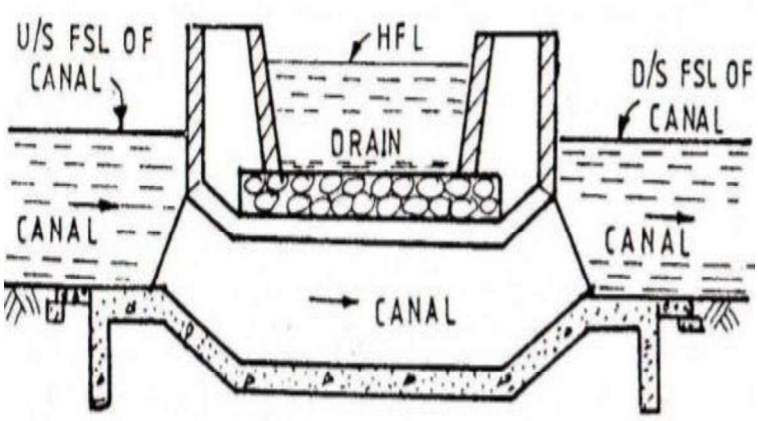
Drain

- In this CD work canal is carried over a natural drain.
- This type of structure is constructed when the size of drain is very large as compare to the canal.
- This type of structure is classified into 2 types:-Aqueduct & Siphon aqueduct.
- Due to the canal running perennially (Always contain water) we have to construct a road for the purpose of inspection, which is known as inspection road.
- When HFL (Highest Flood Level) of the drain is much lower than the bottom of canal, then we have to construct a CD structure, which is known as "AQUEDUCT".
- In aqueduct drain water flow freely under gravity.
- When HFL of the drain is much higher than the bottom of the canal, then we have to construct a CD structure which is known as "SYPHON AQUEDUCT".
- In siphon aqueduct drain water flow under a symphonic action.

**2-A drain cross over a canal.**

- In this CD work drain is carried over a canal.
- This type of CD structure is classified into two types;- Super passage & Siphon
- When FSL of a canal is much lower than the bottom of drain then we have to construct a CD structure is known as "SUPERPASSAGE"
- In super passage canal water flow freely under gravity.
- When FSL of canal is much higher than the bottom of the drain then we have to construct a CD structure known as "SIPHON".
- In siphon canal water flow under a symphonic action.




**Crossing works:** (aqueducts)

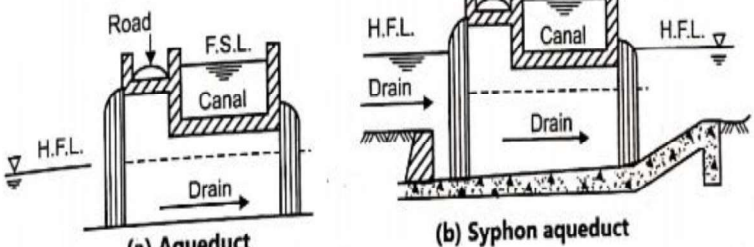
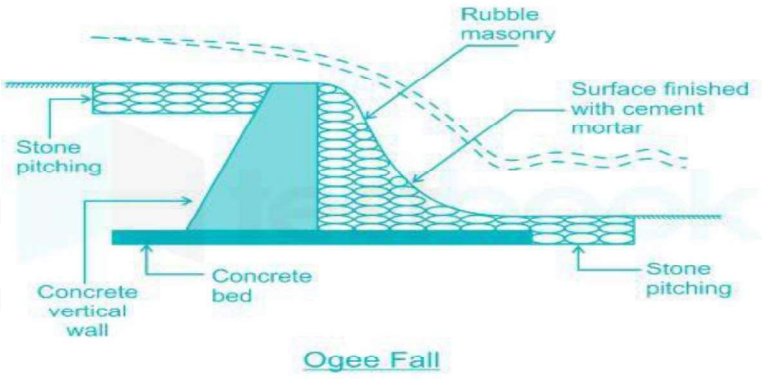
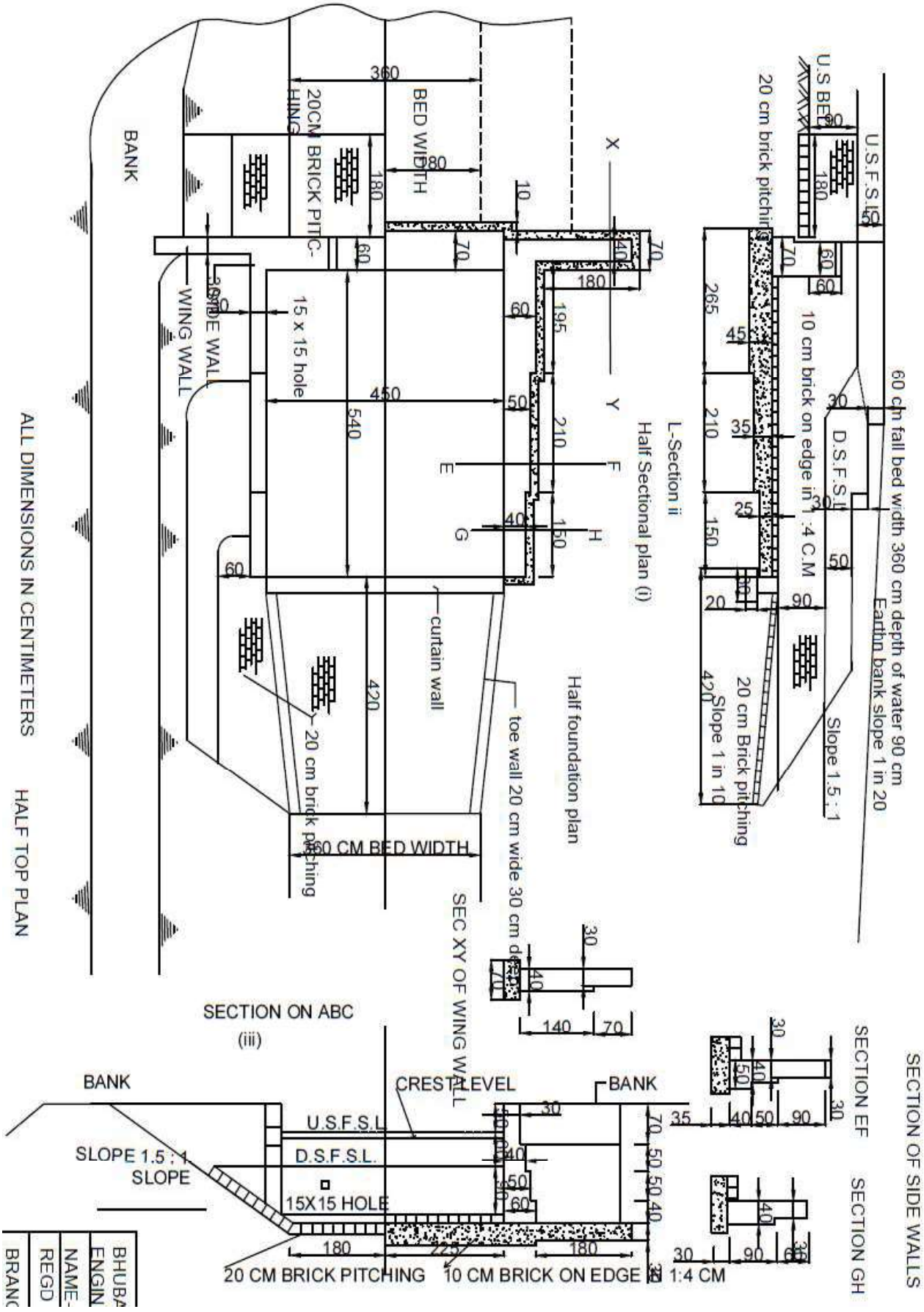



Fig. 6.11




Ogee Fall

## 2.1 Detailed Estimate of a Simple Type of Vertical Fall To Given Specification.

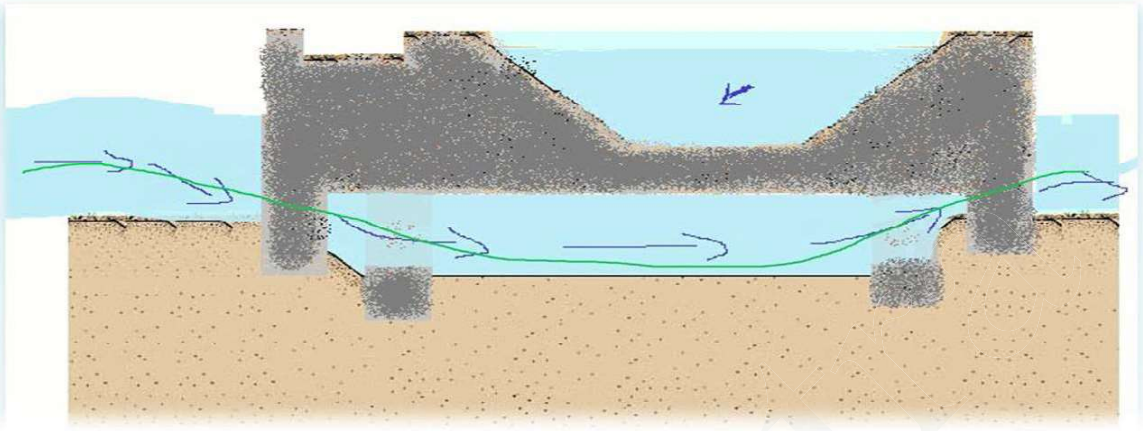


| Item No | Desription Of Item | No | Length(M) | Bredth(M) | Height(M) | Quantity | Unit | Explanotory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth Work In Excavation Foundation | | | | | | | |
| | Creast Wall,Side Wall & Floor Taken Together | | | | | | | B=4.5+0.6*2+0.15*2 |
| | i | 1 | 2.65 | 6 | 1.15 | 18.285 | CUM | H=0.3+0.4+0.45 |
| | ii | 1 | 2.1 | 5.8 | 1.05 | 12.789 | CUM | H=0.35+0.4+0.3 |
| | iii | 1 | 1.5 | 5.6 | 0.95 | 7.98 | CUM | H=0.25+0.4+0.3 |
| | Wing Wall | 2 | 1.8 | 0.7 | 1 | 2.52 | CUM | |
| | Curtain Wall | 1 | 4.5 | 0.6 | 1.2 | 3.24 | CUM | H=0.6+0.1+0.25+0.05+0.2 |
| | 20c.m Brick Pitching U.P Stream Bed | 1 | 1.8 | 3.6 | 0.2 | 1.296 | CUM | |
| | Sloping Side | 2 | 1.8 | 1.62 | 0.2 | 1.1664 | CUM | |
| | Down Stream Bed | 1 | 3.9 | 3.65 | 0.2 | 2.847 | CUM | |
| | Sloping Side | 2 | 3.1 | 1.98 | 0.2 | 2.4552 | CUM | |
| | Toe Wall | 2 | 3.9 | 0.2 | 0.3 | 0.468 | CUM | |
| | Trapizium Portion Above Toe Wall & Brick Pitching Up To Ground Level | 1 | 4.05 | 3.9 | 0.8 | 12.636 | CUM | |
| | Curved Portion | 2 | 1.14 | - | 0.2 | 0.452 | CUM | B=10-0.2*2-0.15*2 |
| | | | | | TOTAL= | 66.1346 | CUM | |
| | Deduction For Grove Of Creast Wall | 2 | 0.6 | 0.1 | 1.15 | 0.138 | CUM | |
| | | | | NET TOTAL = | | 65.9966 | CUM | |
| 2 | Cement Concrete Work In Foundation | | | | | | | |
| | Creast Wall,Side Wall,Floor Taken Together | | | | | | | |
| | i | 1 | 2.65 | 6 | 0.45 | 7.155 | CUM | |
| | ii | 1 | 2.1 | 5.6 | 0.35 | 4.116 | CUM | |
| | iii | 1 | 1.5 | 5.6 | 0.25 | 2.1 | CUM | |
| | Wing Wall | 2 | 1.8 | 0.1 | 0.3 | 0.108 | CUM | |
| | Curtain Wall | 1 | 4.5 | 0.6 | 0.2 | 0.54 | CUM | |
| | | | | | TOTAL= | 14.019 | CUM | |
| | Deduction For Groove Of Creast Wall | 2 | 0.6 | 0.1 | 0.45 | 0.054 | CUM | |
| | | | | NET TOTAL= | | 13.965 | CUM | |
| 3 | Brick Work | | | | | | | |
| | Creast Wall | | | | | | | |
| | 70 C.M | 1 | 4.5 | 0.7 | 0.4 | 1.26 | CUM | |
| | 60 C.M | 1 | 4.5 | 0.6 | 0.9 | 2.43 | CUM | |
| | 1st Step Side Wall | | | | | | | |
| | 60 C.M | 2 | 2.35 | 0.6 | 0.4 | 1.128 | CUM | L=1.95+0.4 |
| | 50 C.M | 2 | 2.35 | 0.5 | 0.5 | 1.175 | CUM | |
| | 40 C.M | 2 | 2.35 | 0.4 | 0.5 | 0.94 | CUM | |
| | 30 C.M | 2 | 2.35 | 0.3 | 0.7 | 0.987 | CUM | |
| | 2nd Step Side Wall | | | | | | | |
| | 50 C.M | 2 | 2.1 | 0.5 | 0.4 | 0.84 | CUM | |
| | 40 C.M | 2 | 2.1 | 0.4 | 0.5 | 0.84 | CUM | |
| | 30 C.M | 2 | 2.1 | 0.3 | 0.9 | 1.134 | CUM | |

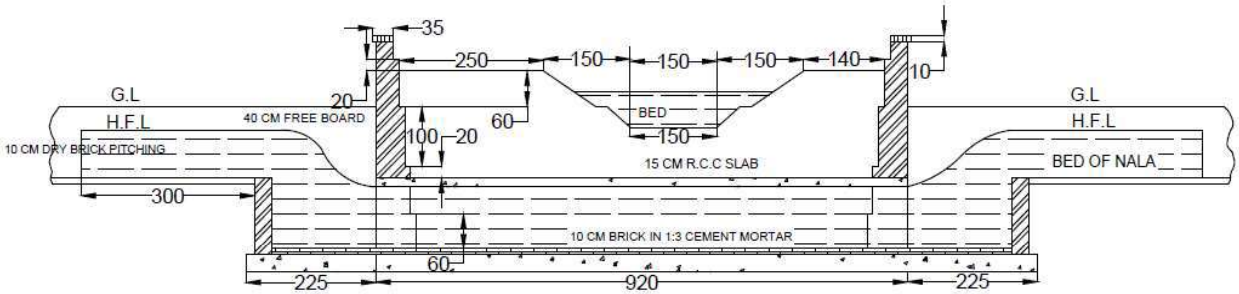
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3rd Step Side Wall | | | | | | | |
| | 40 C.M | 2 | 1.5 | 0.4 | 0.9 | 1.08 | CUM | |
| | 30 C.M | 2 | 1.5 | 0.3 | 0.6 | 0.54 | CUM | |
| | Wing Wall | | | | | | | |
| | 40 C.M | 2 | 1.8 | 0.4 | 0.4 | 0.576 | CUM | |
| | 40 C.M | 2 | 1.9 | 0.4 | 0.5 | 0.76 | CUM | |
| | 40 C.M | 2 | 2 | 0.4 | 0.5 | 0.8 | CUM | |
| | 30 C.M | 2 | 2.1 | 0.3 | 0.7 | 0.882 | CUM | |
| | Curtain Wall | 1 | 4.5 | 0.3 | 0.4 | 0.54 | CUM | |
| | Toe Wall | 2 | 3.92 | 0.2 | 0.3 | 0.4704 | CUM | |
| | | | | | Ttotal= | 16.3824 | CUM | |
| 4 | Brick On Edge Floor 1:4 Cement Mortar Inculding Pointing Floor | 1 | 5.4 | 4.5 | - | 24.3 | CUM | |
| 5 | Brick Pitching | | | | | | | |
| | Up Stream Bed | 2 | 1.8 | 3.6 | 0.2 | 2.592 | CUM | |
| | Side Slope | 2 | 1.8 | 1.62 | 0.2 | 1.1664 | CUM | |
| | Down Stream Bed | 1 | 3.9 | 3.65 | 0.2 | 2.847 | CUM | B=4.1+3.2/2 |
| | Down Stream Side Slope | 2 | 3.1 | 1.98 | 0.2 | 2.4552 | CUM | B=4.2+2/2 |
| | Curved Portion | 2 | 1.14 | - | 0.2 | 0.452 | CUM | |
| | | | | | TOTAL= | 8.3462 | CUM | |
| 6 | Cement Pointing Work 1:3 Cement Mortar Creast Wall | | | | | | | |
| | Out Side,Top & Inside | 1 | 4.5 | - | 2.4 | 10.8 | SQM | H=0.6+0.6+1.2 |
| | Side Wall Inner Face | | | | | | | L=1.95-0.15 |
| | i | 2 | 1.8 | - | 2 | 7.2 | SQM | H=0.9+0.6+0.5 |
| | ii | 2 | 2.1 | - | 1.7 | 7.14 | SQM | H=.4+0.5+0.9-0.1 |
| | iii | 2 | 1.5 | - | 1.4 | 4.2 | SQM | H=(0.9-0.1)+0.6 |
| | Side WallPortion Above Creast Wall | 2 | - | 0.6 | 0.8 | 0.96 | SQM | H=0.9+0.5-.6 |
| | Vertical Face Of Step | 4 | - | 0.3 | 0.3 | 0.36 | SQM | |
| | Vertical Face Of End | | | | | | | |
| | 40 C.M | 2 | - | 0.4 | 0.9 | 0.72 | SQM | |
| | 30 C.M | 2 | - | 0.3 | 0.6 | 0.36 | SQM | |
| | Top Of Side Wall | 2 | 6 | 0.3 | - | 3.6 | SQM | L=5.4+0.6 |
| | Top of Curtain Wall | 1 | 4.5 | 0.3 | - | 1.35 | SQM | |
| | Top Of Toe Wall | 2 | 3.92 | 0.2 | - | 1.568 | SQM | |
| | Wing Wall Top | 2 | 2.1 | 0.3 | - | 1.26 | SQM | |
| | Wing Wall Up Stream Side Trangular Portion Above Slope | 2 | 0.5 | 2.1 | 1.4 | 2.94 | SQM | |
| | | | | | TOTAL= | 41.198 | SQM | |

## 2.2 Detailed Estimate of Drainage Siphon to Given Specification.

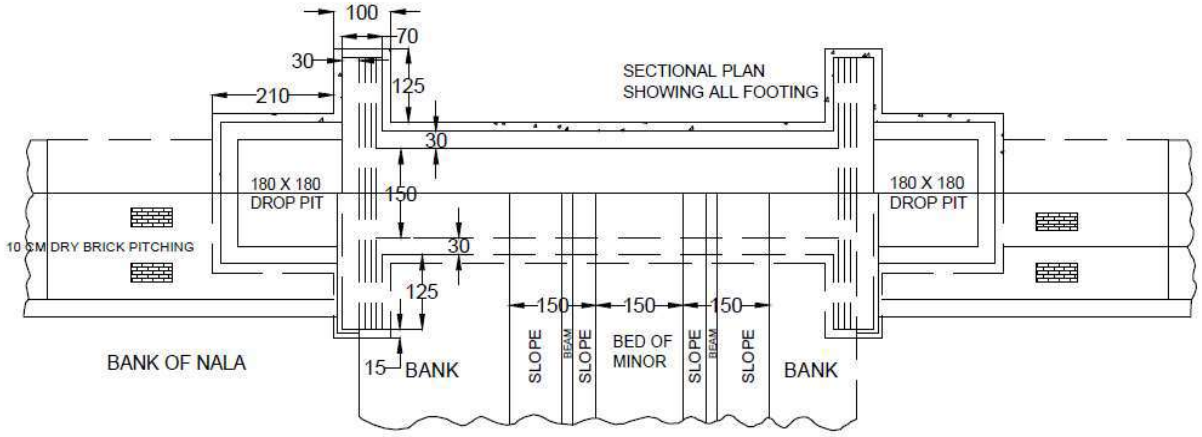
**Q)** Prepare a detailed estimate of a Drainage Siphon across a minor from the given drawing. Foundation concrete shall be of 1:4:8 cement concrete with brick ballast. All brickwork shall be of 1:4 cement mortars. Exposed surfaces of brickwork shall be struck pointed with 1:2 cement mortars. Brick pitching shall be of dry brick with straight over burnt bricks.



DRAINAGE SYPHON ACROSS A MINOR

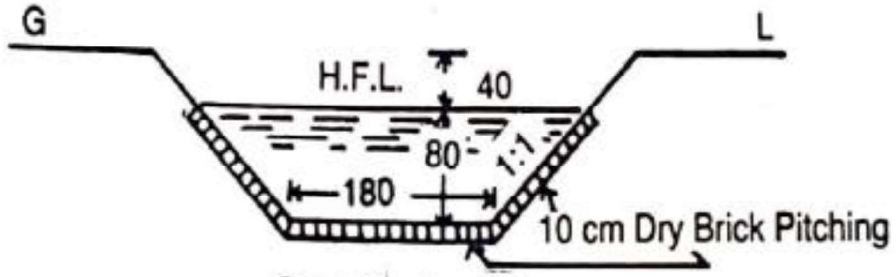



LONGITUDINAL SECTION

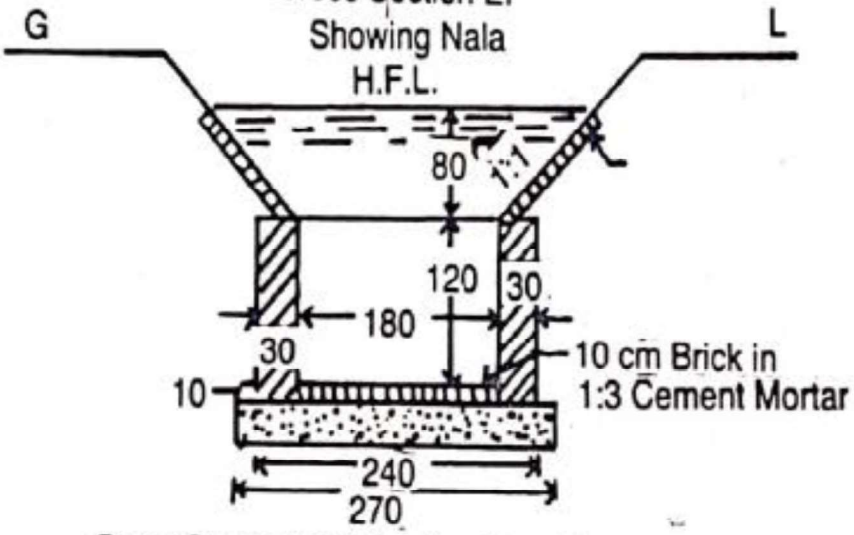



TOP PLAN

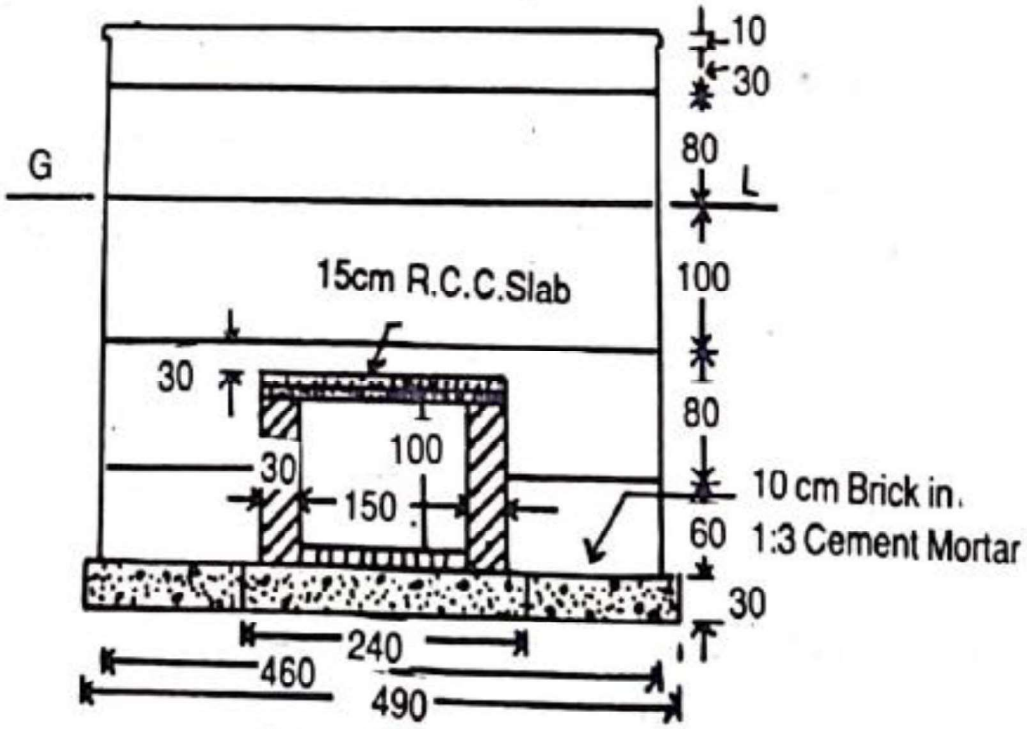
Cross Sections




Cross Section EF
Showing Nala




Cross Section CD Showing Drop Pit and Nala




Cross Section AB
Showing Duct and Wing Walls

| Item No | Desription Of Item | No | Length(M) | Bredth(M) | Height(M) | Quantity | Unit | Explanotory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth Work In Excavation In Foundation | | | | | | | |
| | Syphon Duct | 1 | 9.5 | 2.4 | 1.6 | 36.48 | CUM | L=9.2+0.15+0.15 B=1.5+03*2+0.15*2 |
| | Dropt Pit | 2 | 2.1 | 2.7 | 1.6 | 18.144 | CUM | H=1.2+0.1+0.3 |
| | Wing wall | 4 | 1.25 | 1 | 1.6 | 8 | CUM | L=1.1+0.15 |
| | | | | | TOTAL= | 62.624 | CUM | |
| 2 | Cement Contrete Work 1:4:8 in Foundation | | | | | | | |
| | Syphon Duct | 1 | 9.5 | 2.4 | 0.3 | 6.84 | CUM | |
| | Dropt Pit | 2 | 2.1 | 2.7 | 0.3 | 3.402 | CUM | |
| | Wing Wall | 4 | 1.25 | 1 | 0.3 | 1.5 | CUM | |
| | | | | | TOTAL= | 11.742 | CUM | |
| 3 | R.C.C Work | 1 | 9.2 | 2.1 | 0.15 | 2.898 | CUM | B=1.5+0.3+0.3 |
| 4 | Brick Work In 1:4 Cement Mortar | | | | | | | From AB Section |
| | Syphon Duct Side | 2 | 9.2 | 0.3 | 1.15 | 6.348 | CUM | H=1.05+0.1 |
| | Dropt Pit | | | | | | | |
| | Side Wall | 4 | 2.1 | 0.3 | 1.3 | 3.276 | CUM | H=1.2+0.1 |
| | Front Wall | 2 | 1.8 | 0.3 | 1.3 | 1.404 | CUM | |
| | Wing wall | | | | | | | |
| | 70 C.M Wide | 4 | 1.25 | 0.7 | 0.7 | 2.45 | CUM | H=0.6+0.1 |
| | 60 C.M Wide | 4 | 1.25 | 0.6 | 0.6 | 1.8 | CUM | |
| | Parapet Wall | | | | | | | |
| | 60 C.M Wide | 2 | 4.6 | 0.6 | 0.2 | 1.104 | CUM | |
| | 50 C.M Wide | 2 | 4.6 | 0.5 | 1 | 4.6 | CUM | |
| | 40 C.M Wide | 2 | 4.6 | 0.4 | 0.8 | 2.944 | CUM | H=0.6+0.2 |
| | 30 C.M Wide | 2 | 4.6 | 0.3 | 0.3 | 0.828 | CUM | |
| | Coaping | 2 | 4.7 | 0.35 | 0.1 | 0.329 | CUM | L=4.6+0.05+0.05 |
| | | | | | Ttotal= | 25.083 | CUM | |
| 5 | 10 C.M Thick Brick Floor 1:3 Cement Mortar | | | | | | | |
| | Syphon Duct | 1 | 9.2 | 1.5 | - | 13.8 | SQM | |
| | Dropt Pit | 2 | 1.8 | 1.8 | - | 6.48 | SQM | |
| | | | | | TOTAL= | 20.28 | | |
| 6 | 10 C.M Dry Brick Pitching | | | | | | | |
| | Bed Of Nala | 2 | 3 | 1.8 | - | 10.8 | SQM | |
| | Sloping Side | 4 | 3 | 1.13 | - | 13.56 | SQM | B=√0.8*0.8+0.8*0.8 |
| | | | | | TOTAL= | 24.36 | SQM | |
| 7 | Cement Pointing Work 1:2 Cement Mortar | | | | | | | |
| | Syphon Duct Side Wall Inner Side | 2 | 9.2 | - | 1.05 | 19.32 | SQM | |
| | Dropt Pit 3 Inner Vertical Face | 2 | 5.4 | - | 1.2 | 12.96 | SQM | |
| | Drop Pit Top | 2 | 6 | 0.3 | - | 3.6 | SQM | L=2.4+1.8+1.8 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Parapet Wall Inner Fcae & Outer Face Up To G.L | 2 | 4.6 | 1.7 | - | 15.64 | SQM | B=0.2+0.1+0.3+0.3+(0.3+0.2)+0.6 |
| | Coaping Inner ,Top ,Outaer Edge, Bottom Projection | 2 | 4.7 | 0.6 | - | 5.64 | SQM | H=0.1+0.35+0.1+0.05 |
| | Coaping Side Bottom Ends Of Parapet | 4 | 0.3 | 0.05 | - | 0.06 | SQM | |
| | 40 C.M Wide | 4 | - | 0.4 | 0.2 | 0.32 | SQM | |
| | 30 C.M Wide | 4 | - | 0.3 | 0.3 | 0.36 | SQM | |
| | Coaping | 4 | - | 0.35 | 0.1 | 0.14 | SQM | |
| | Parapet Trapizodial Portion | 2 | 0.5 | 6 | - | 6 | SQM | |
| | | | | | TOTAL= | 64.04 | SQM | |

# 3 DETAILED ESTIMATES OF ROADS

## 3.1 Detail estimate of a water bound macadam road

Lets suppose if we are asked to estimate the cost of construction of a one kilometer long and 3.5 meters wide water bound macadam road. This road has 20 cm base of 10 to 20 cm size stone boulders and 10 cm thick road metal of 1.5 to 3 cm size crushed stone.


Solution

| Description | Quantity | Unit | Rate | Amount (Rs) |
|---|---|---|---|---|
| Preparation, consolidation and dressing of sub grade | 3800 | $m^2$ | 20 | 20 x 3800 = 76000 Rs |
| supplying sub base materials and stacking at road sides | 1140 | $m^3$ | 210 | 210 x 1140 = 239400 Rs |
| Labour for spreading and consolidation of sub base materials | 1140 | $m^3$ | 200 | 200 x 1140 = 228000 Rs |
| supplying base materials and stacking at road sides | 525 | $m^3$ | 250 | 250 x 525 = 131250 Rs |
| Labour for spreading and consolidation of base materials | 525 | $m^3$ | 220 | 220 x 525 = 115500 Rs |
| Total Amount | | | | 790150 Rs |

### 3.1.2 Detailed estimate of a flexible pavement in cutting / filling

Cross-section of earthwork of road in banking or in cutting is usually in the form of trap and the quantity of earthwork may be calculated by the following methods:

Quantity or volume = Sectional area × Length.

Sectional area = Area of central rectangular portion + Area of two-side triangular portion

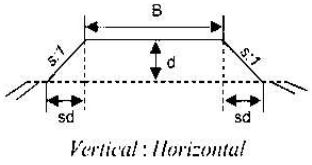
$=Bd+2(\frac{1}{2}\ sd \times d)\ Bd+sd^2$

S: 1 is the ratio of side slopes as horizontal: vertical. For 1 vertical, horizontal is s vertical, horizontal is sd. $=\text{Quantity}\ (Bd+sd^2) \times L$

**Lead & Lift –** Normally earthwork is estimated for 30 m lead and 1.5m lift for height or depth, and this distance of 30 m and the height of 1.5 m are known as normal lead and Lead and Lift-Normally earthwork is estimated for 30 m lead for distance and 1.5 mi different (higher) for every unit of 30 m lead and for every unit of 1.5 m lift. The earthwork Normal rate for earthwork is for 30 m lead and 1.5 m lift.

The quantity of earthwork may be calculated by the various methods of measurement out of which three methods are given below:-

- Mid-Sectional Area Method
- Mean Sectional Area Method
- Prismoidal Formula Method




*Vertical : Horizontal*

*1 : s*

*d : sd*

**Q. Reduced level (R.L.) of ground along the centre line of a proposed road from chainage 10 to chianage 20 is given below. The formation level at the 10th chainage is 107 and the road is in downward gradient of 1 in 150 up to the chainage 14 and then the gradient changes to 1 in 100 downward. Formation width of road is 10 meter and side slopes of banking are 2:1 (Horizontal Vertical). Length of the chain is 30 meter. Draw longitudinal section of the road and a typical cross-section and prepare an estimate of earthwork at the rate of Rs. 275.00% cu m.**

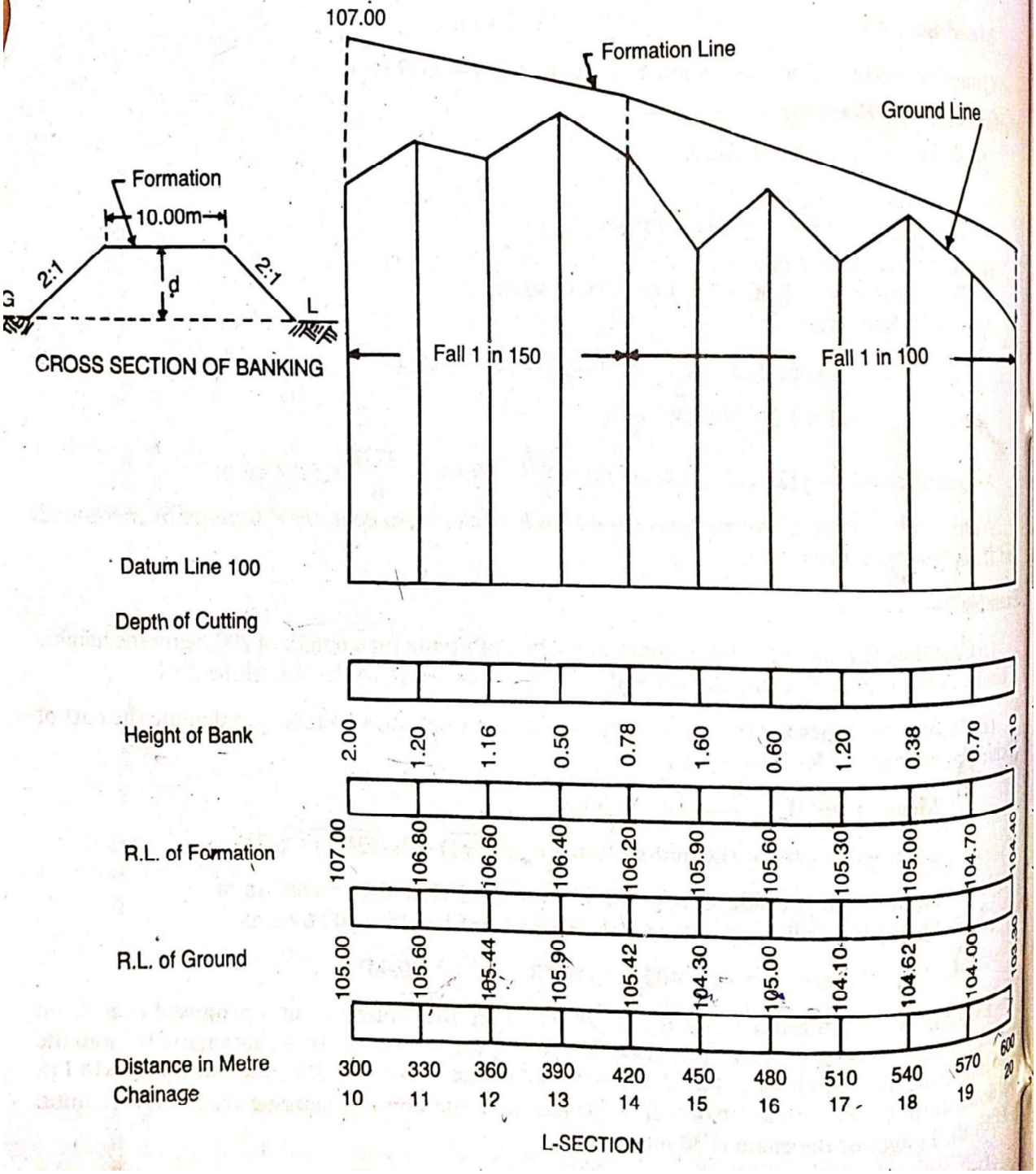
(*i*) Find also the area of the side slopes and the cost of turfing the side slopes at the rate of Rs. 60.00% sq. m.

| Chainage | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R.L. of ground | 105.00 | 105.60 | 105.44 | 105.90 | 105.42 | 104.30 | 105.00 | 104.10 | 104.62 | 104.00 | 103.3 |

R.L. of Formation 107.00.

Gradient Down gradient 1 in 150 ⟶ ⟵ Down gradient 1 in 100

*L=Section and Typical cross-section of the road are as given in Fig. 7-8.*



## Calculation of Quantities of Earthwork (Ex. 3)

B=10 m, s=2

| Stations or Chain-age m | Length m | Height or Depth *Diff. of G.L. and F.L.* m | Mean height or depth d m | Central area Bd $m^2$ | Side area $sd^2$ $m^2$ | Total sec. area $Bd+sd^2$ $m^2$ | Length in betw. stations L $m^2$ | Quantity $(Bd+sd^2)*L$ | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Banking $m^3$ | Cutting $m^3$ |
| 10 | 300 | 2.00 | — | — | — | — | — | — | — |
| 11 | 330 | 1.20 | 1.60 | 16.00 | 5.12 | 21.12 | 30 | 633.6 | — |
| 12 | 360 | 1.16 | 1.18 | 11.80 | 2.78 | 14.58 | 30 | 437.4 | — |
| 13 | 390 | 0.50 | 0.83 | 8.30 | 1.38 | 9.68 | 30 | 290.4 | |
| 14 | 420 | 0.78 | 0.64 | 6.40 | 0.82 | 7.22 | 30 | 216.6 | |
| 15 | 450 | 1.60 | 1.19 | 11.90 | 2.83 | 14.73 | 30 | 441.9 | — |
| 16 | 480 | 0.60 | 1.10 | 11.00 | 2.42 | 13.42 | 30 | 402.6 | — |
| 17 | 510 | 1.20 | 0.90 | 9.00 | 1.62 | 10.62 | 30 | 318.6 | — |
| 18 | 540 | 0.38 | 0.79 | 7.90 | 1.25 | 9.15 | 30 | 274.5 | — |
| 19 | 570 | 0.70 | 0.54 | 5.40 | 0.58 | 5.98 | 30 | 179.4 | — |
| 20 | 600 | 1.10 | 0.90 | 9.00 | 1.62 | 10.62 | 30 | 318.6 | — |

Total 3513.6 cu m

## ABSTRACT OF ESTIMATED COST (Ex. 3)

| Item No. | Particulars of items | Quantity | Unit | Rate Rs. P. | Per | Cost Rs. P. |
|---|---|---|---|---|---|---|
| 1 | Earthwork in banking ... | 3513.6 | cu m | 275.00 | % cu m | 9662.40 |
| | | | | | Total ... | 9662.40 |
| | | | | | Add 5% (3% for Contingencies and 2% for Workcharged Establishment) ... | 483.12 |
| | | | | | Grand Total ... | Rs. 10145.52 |

**Example 5.**—Prepare a detailed estimate for earthwork for a portion of a road from the following data :—

| Dist. in m | 0 | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1100 | 1200 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R.L. of ground | 114.50 | 114.75 | 115.25 | 115.20 | 116.10 | 116.85 | 118.00 | 118.25 | 118.10 | 117.80 | 117.75 | 117.90 | 119.50 |
| R.L. of Formation | 115 Upward gradient 1 in 200 up to 600 m → | | | | | | ←Downward gradient 1 in 400 | | | | | | |

Formation width of road is 10 metre side slope 2 : 1 in banking and 1½ : 1 in cutting. Adopt suitable rates.

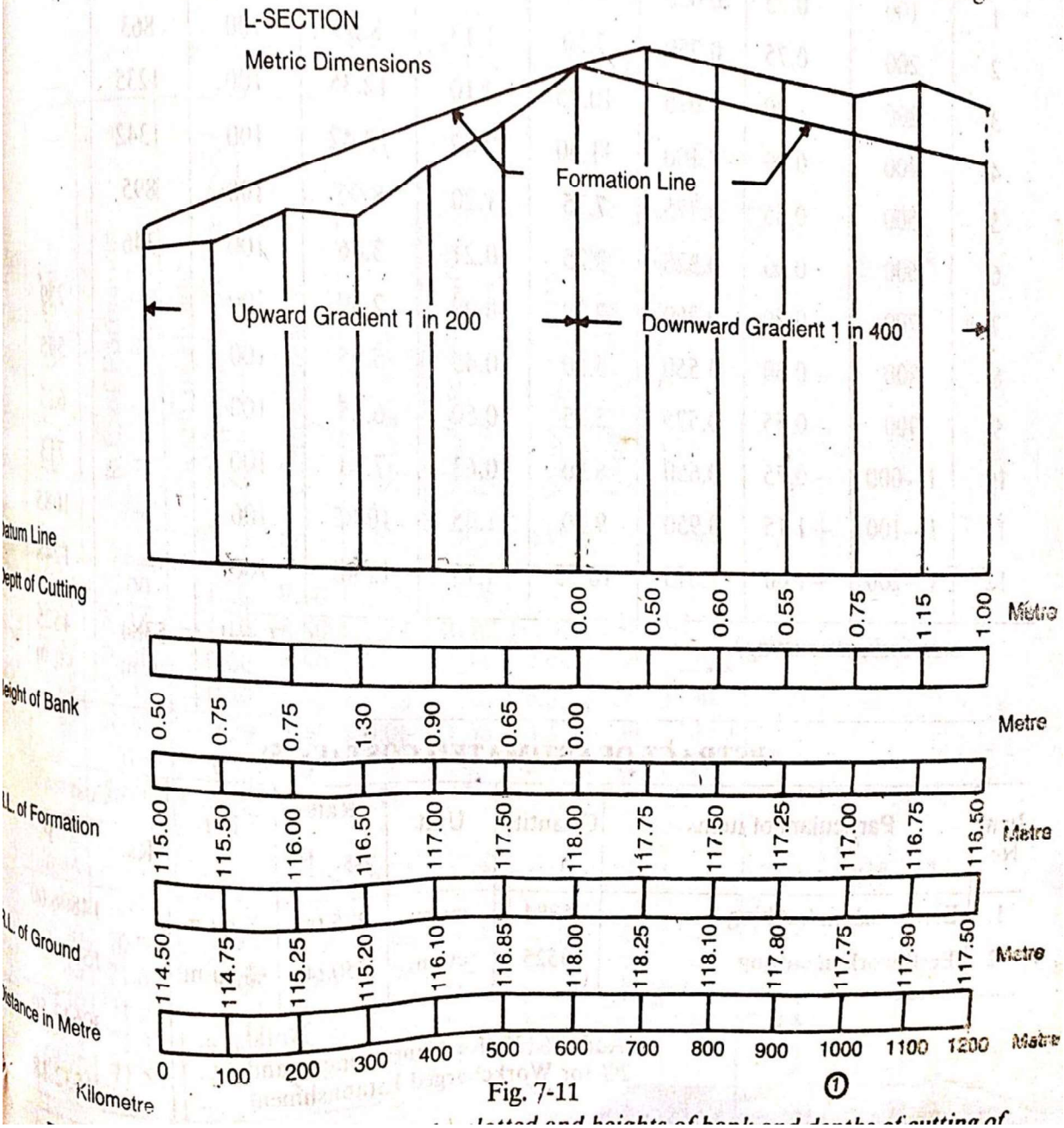



Fig. 7-11 ①

*...plotted and heights of bank and depths of cutting of*

## ESTIMATE OF EARTHWORK

### Calculation of Quantities (Ex. 5)

B = 10 m, s = 2 for banking, and s = 1½ for cutting

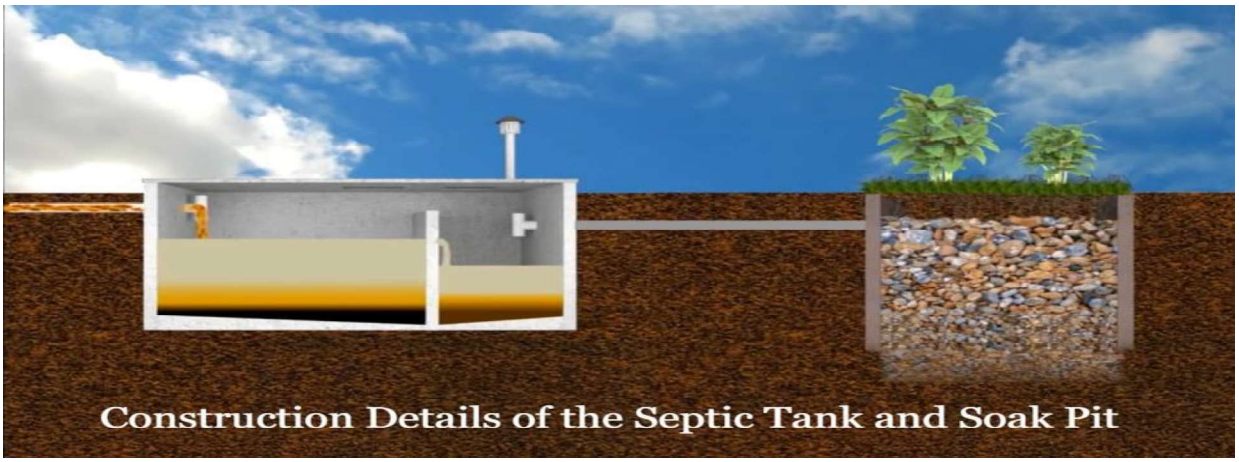
| Station | Distance *Km m* | Height or Depth *Diff. of G.L.* and F.L. | Mean ht.or Depth d m | Central area Bd m | Area of sides $sd^2$ $m^2$ | Total sec. area $Bd+sd^2$ $m^2$ | Dist. in betw. stations L m | Quantity $(Bd+sd^2)\times L$ Banking $m^3$ | Quantity $(Bd+sd^2)\times L$ Cutting $m^3$ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0.50 | — | — | — | — | — | — | — |
| 1 | 100 | 0.75 | 0.625 | 6.25 | 0.78 | 7.03 | 100 | 703 | — |
| 2 | 200 | 0.75 | 0.750 | 7.50 | 1.13 | 8.63 | 100 | 863 | |
| 3 | 300 | 1.30 | 1.025 | 10.25 | 2.10 | 12.35 | 100 | 1235 | — |
| 4 | 400 | 0.90 | 1.100 | 11.00 | 2.42 | 13.42 | 100 | 1342 | — |
| 5 | 500 | 0.65 | 0.775 | 7.75 | 1.20 | 8.95 | 100 | 895 | — |
| 6 | 600 | 0.00 | 0.325 | 3.25 | 0.21 | 3.46 | 100 | 346 | — |
| 7 | 700 | —0.50 | 0.250 | 2.50 | 0.09 | 2.59 | 100 | — | 259 |
| 8 | 800 | —0.60 | 0.550 | 5.50 | 0.45 | 5.95 | 100 | — | 595 |
| 9 | 900 | —0.55 | 0.575 | 5.75 | 0.50 | 6.25 | 100 | — | 625 |
| 10 | 1—000 | —0.75 | 0.650 | 6.50 | 0.63 | 7.13 | 100 | — | 713 |
| 11 | 1—100 | —1.15 | 0.950 | 9.50 | 1.35 | 10.85 | 100 | — | 1085 |
| 12 | 1—200 | —1.00 | 1.075 | 10.75 | 1.73 | 12.48 | 100 | — | 1248 |
| *(—sign indicate cutting)* | | | | | | | Total | 5384 cu m | 4525 cu m |

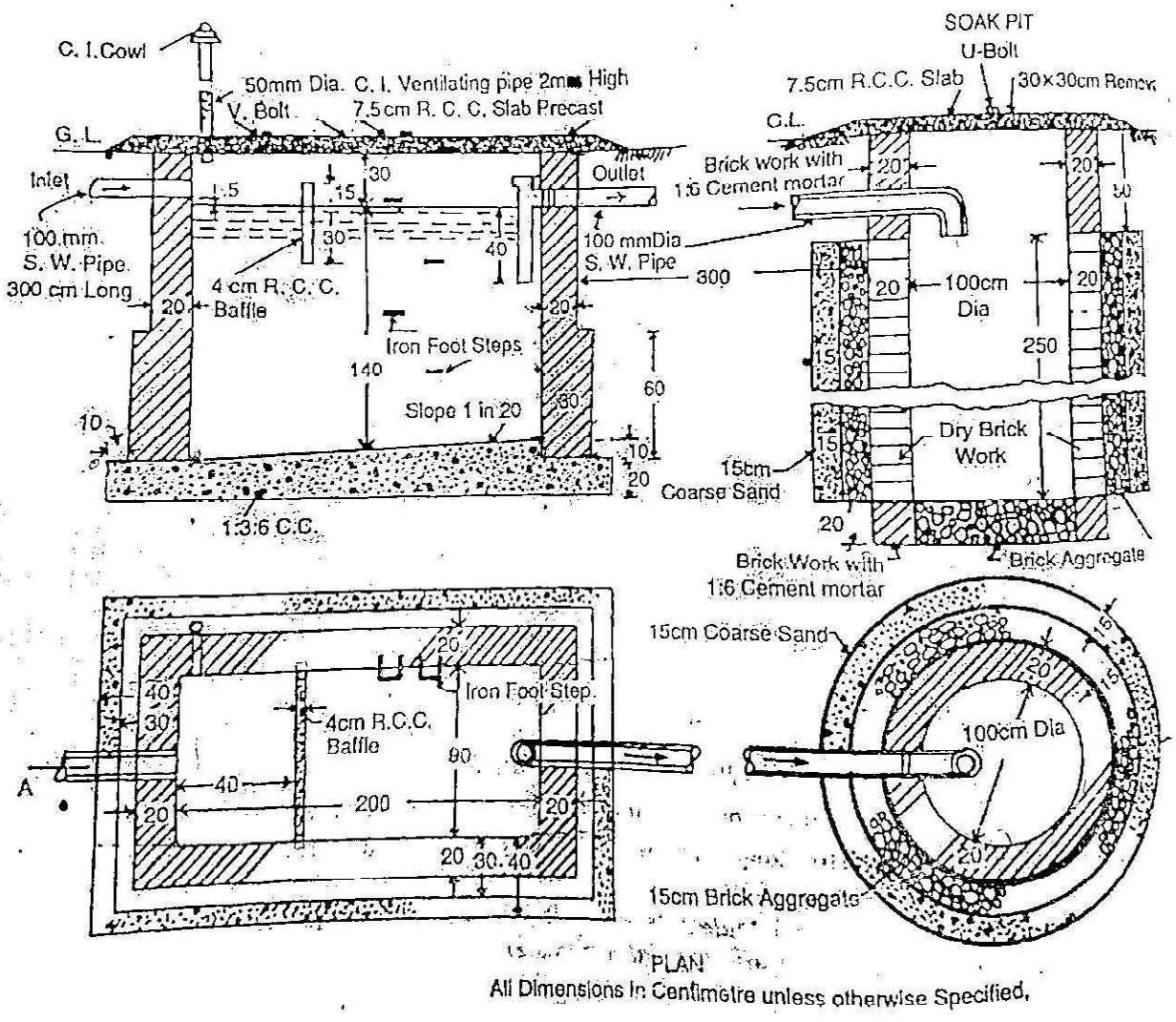
## ABSTRACT OF ESTIMATED COST (Ex. 5)

| Item No. | Particulars of items | Quantity | Unit | Rate Rs. P | Per | Cost Rs. | Cost P. |
|---|---|---|---|---|---|---|---|
| 1. | Earthwork in banking ... | 5384 | cu m | 275.00 | % cu m | 14806.00 | |
| 2 | Earthwork in cutting ... | 4525 | cu m | 350.00 | % cu m | 15837.50 | |
| | | | | | Total ... | 30643.50 | |
| | | | | | Add 5% (3% for Contingencies and 2% for Workcharged Establishment ... | 1532.18 | |
| | | | | | Grand Total ... | 32175.68 | |

## 3.2 Detailed Estimate of Septic Tank & Soak pit given Specification.

**Q)** Prepare a detailed estimate of a Septic tank with Soak-pit for 25 users from the given drawings, Septic tank shall be of first class brickwork in 1:4 cement mortar the foundation and floor and floor shall be finished with 20 mm cement plaster with 1:3 mortar mixed with standard water shall be of 1:3:6 cement concrete. Inside of septic tank shall be finished with 12 mm cement plaster proofing compound. Upper and lower portion of soak-pit shall be of second class brick work in 1:6 cement mortars and middle portion shall be of dry brickwork. Roof covering slabs and baffle shall be of precast R.C.C. The length of the connecting pipe from latrine seat may be taken as 3 metres.

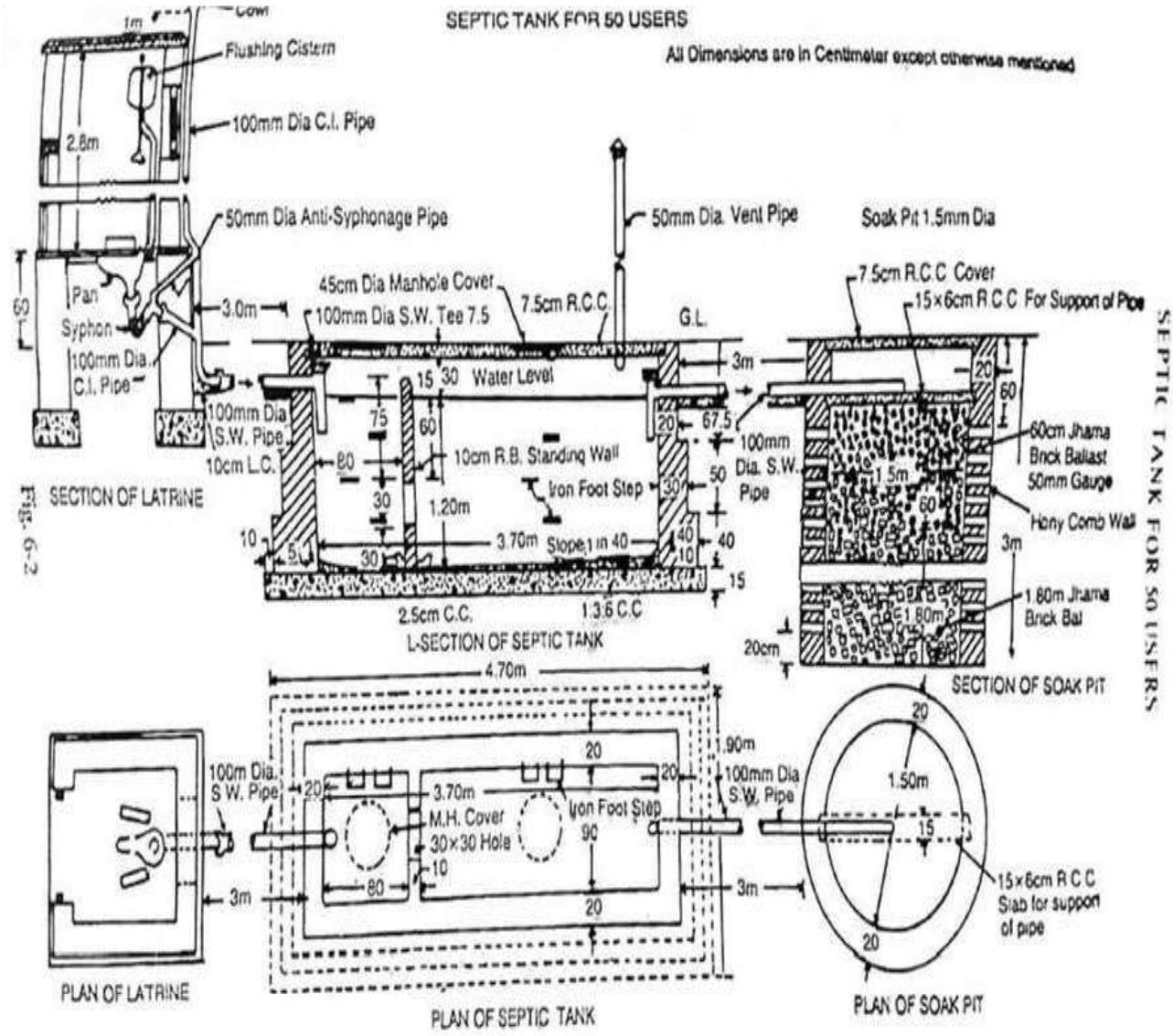


| Item No | Desription Of Item | No | Length(M) | Bredth(M) | Height(M) | Quantity | Unit | Explanotory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth Work In Excavation In Foundation | | | | | | | |
| | Septic Tank | 1 | 2.8 | 1.7 | 1.95 | 9.282 | CUM | L=2+0.3*2+0.1+0.4 B=0.9+0.3*2+0.1*2 |
| | Soakpit | 1 | π/4 | 2*2 | 3 | 9.424 | CUM | H=0.3+1.4+0.05+0.2 |
| | Soakpit Lower Portion | 1 | π/4 | 1.4*1.4 | 0.2 | 0.307 | CUM | |
| | | | | | TOTAL= | 19.012 | CUM | |
| 2 | Cement Contrete Work 1:3:6 | | | | | | | |
| | Septic Tank | 1 | 2.8 | 1.7 | 0.2 | 0.952 | CUM | |
| | Sloping Portion | 1 | 2 | 0.9 | 0.05 | 0.09 | CUM | H=0.1+0/2 |
| | | | | | TOTAL= | 1.042 | CUM | |
| 3 | 1st Class Brick Work In 1:4 Cement Mortar | | | | | | | |
| | Septic Tank | | | | | | | |
| | Long Wall | | | | | | | |
| | 30 C.M Wide | 2 | 2.6 | 0.3 | 0.6 | 0.936 | CUM | L=2+0.3+0.3 |
| | 20 C.M Wide | 2 | 2.4 | 0.2 | 1.15 | 1.104 | CUM | L=2+0.2+0.2 H=1.95+0.2 |
| | Short Wall | | | | | | | |
| | 30 C.M Wide | 2 | 0.9 | 0.3 | 0.6 | 0.324 | CUM | |
| | 20 C.M Wide | 2 | 0.9 | 0.2 | 1.15 | 0.414 | CUM | L=4.6+0.05+0.05 |
| | | | | | Ttotal= | 2.778 | CUM | |
| 4 | 2nd Class Brick Work With Cement Mortar 1:6 | | | | | | | |
| | Soakpit | 1 | π/4 | 0.96 | 0.7 | 0.527 | CUM | |
| 5 | 2nd Class Dry Brick | | | | | | | |
| | Soakpit | 1 | π/4 | 0.96 | 2.5 | 1.884 | CUM | |
| 6 | Precast R.C.C Slab | | | | | | | Assume 5c.m Insertion |
| | Septic Tank | 1 | 2.4 | 1.3 | 0.075 | 0.234 | CUM | B=0.9+0.2+0.2 L=2+0.2+0.2 |
| | Soakpit | 1 | π/4 | 1.4*1.4 | 0.075 | 0.115 | CUM | |
| | Baffle Wall | 1 | 0.9 | 0.04 | 0.45 | 0.0162 | CUM | L=0.9+0.05+0.05 B=0.3+0.15 |
| | | | | | TOTAL= | 0.3652 | CUM | |
| 7 | 12mm Cement Plaster 1:3 Septic Tank Inside | 1 | 5.8 | - | 1.7 | 9.86 | SQM | H=1.75+1.65/2 |
| 8 | 20 mm Cement Plaster 1:3 With Standard Water Proofing Compound In Floor Of Septic Tank | 1 | 2 | 0.9 | - | 1.8 | SQM | |
| 9 | 50 mm Size Brick Aggregate Out Side Of Soakpit | 1 | π/4 | 0.93 | 2.5 | 1.826 | SQM | |
| | Lower Portion | 1 | π/4 | 1*1 | 0.2 | 0.157 | SQM | |
| | | | | | TOTAL= | 1.983 | SQM | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10 | Course Snd Outer Side Of Soak pit | 1 | π/4 | 1.11 | 2.5 | 2.179 | SQM | |
| 11 | Iron Foot Steps | 4 | - | - | - | 4 | NOS | |
| 12 | S.W Tee Pipe 100mm Dia With One Leg 40c.m | 1 | - | - | - | 1 | NOS | |
| 13 | S.W Bend 100mm Dia | 1 | - | - | - | 1 | NOS | |
| 14 | 50mm Dia CI Ventilanting Pipe | 1 | 2 | - | - | 2 | M | |
| 15 | 50 mm Dia CI Cowl At Top The Ventilating Pipe | 1 | - | - | - | 1 | NOS | |
| 16 | 100mm Dia S.W Pipe Inlet End From Latrine 2 Septic Tank | 1 | 3 | - | - | 3 | M | |
| | Outer End From Septic Tank Two Soakpit | 1 | 3 | - | - | 3 | M | |
| | | | | | TOTAL= | 6 | M | |

Q) Prepare a detailed estimate of a Septic tank with Soak-pit for 50 users from the given drawings.




**Vent pipe -** a pipe above a waste pipe or soil pipe that allows gas to escape from the system.

**Cowl -** Cowl is provided at upper end of ventilating column to prevent blockage by nesting birds, Also it helps to escape out foul gases.

**Septic Tank -** A septic tank is a buried, watertight tank designated and constructed to receive and partially treat raw domestic sanitary wastewater. Heavy solids settle to the bottom of the tank while greases and lighter solids float to the top.

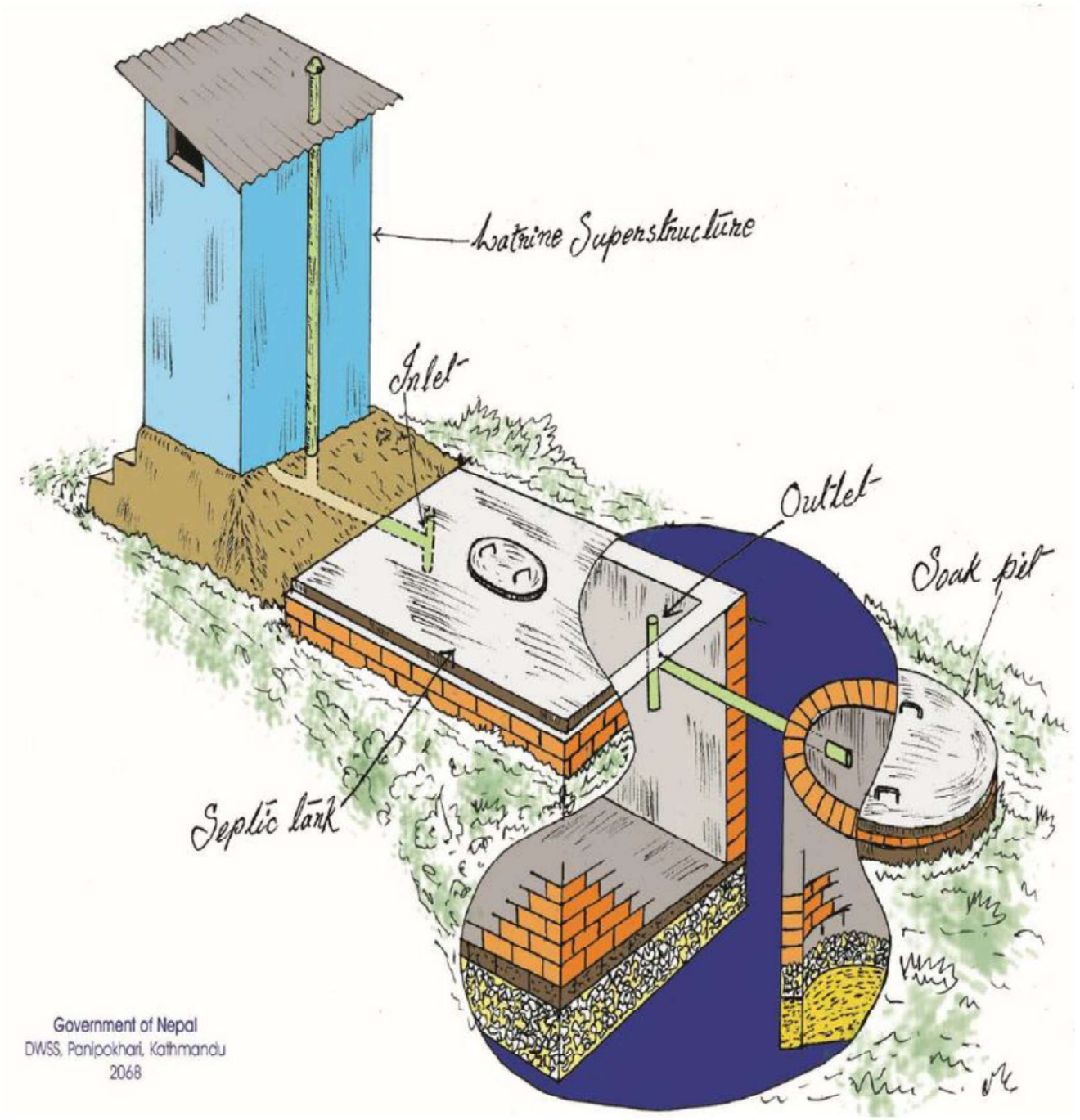
**Soak Pit -** A soak pit, also known as a soak away or leach pit, is a covered, porous-walled chamber that allows water to slowly soak into the ground.

**Baffle Wall -** The baffle sits inside the top of the tank, and all the waste water enters the tank underneath it. The baffle then acts almost like an upside down sieve, keeping all the solids and fats in the tank, and ensuring that only water can escape into the soak away system.

**Anti-siphon age pipe -** An extra pipe connected to the outlets of toilet seats of all the floors, the other end of which is exposed to atmosphere is called anti-siphon age pipe. These are provided to maintain water seal so that foul gases of the sewer line do not find entry in to the toilet/ bathrooms.

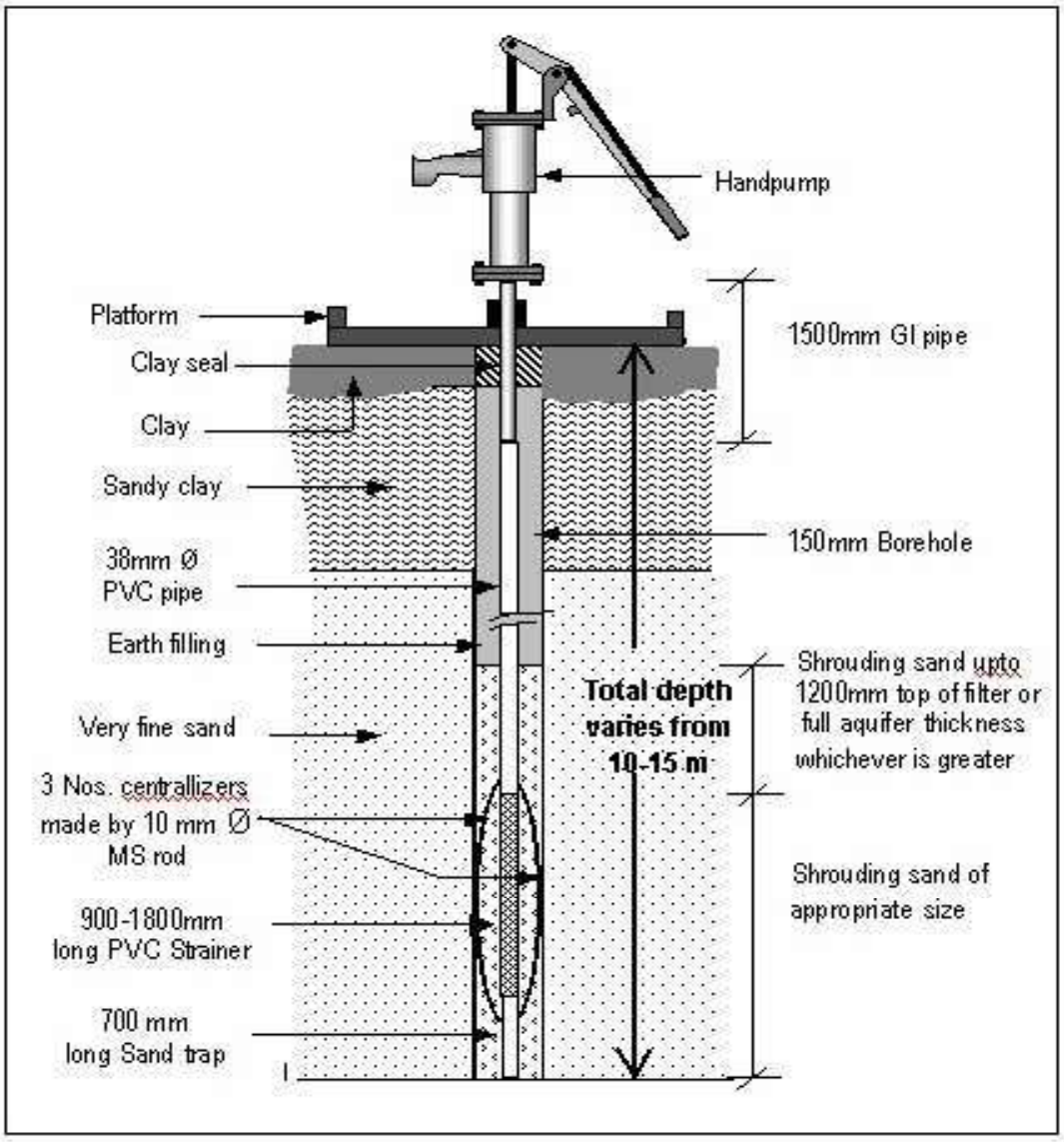
| Item No | Description Of Item | No | Length(M) | Breadth(M) | Height(M) | Quantity | Unit | Explanatory Note |
|---|---|---|---|---|---|---|---|---|
| 1 | Earth Work In Excavation | | | | | | | |
| | Septic TankSoak | 1 | 4.7 | 1.9 | 1.725 | 15.40425 | CUM | H=0.075+0.3+1.2+0.15 |
| | pit | 1 | π/4 | $(1.9)^2$ | 3 | 8.505 | CUM | DIA= 1.5++0.2+0.2 |
| | | | | | TOTAL= | 23.90925 | CUM | |
| 2 | Cement Concrete Work 1:3:6 | 1 | 4.7 | 1.9 | 0.15 | 1.339 | CUM | |
| 3 | Brick Work Septic tank | | | | | | | |
| | Long Wall | | | | | | | |
| | 40 C.M Wide | 2 | 4.5 | 0.4 | 0.4 | 1.44 | CUM | L=4.7-0.1-0.1 |
| | 30 C.M Wide | 2 | 4.3 | 0.3 | 0.5 | 1.29 | CUM | L=4.7-0.2*2-0.2*2 |
| | 20 C.M Wide | 2 | 4.1 | 0.2 | 0.675 | 1.107 | CUM | L=4.7-0.1*2-0.1*2-0.1*2 |
| | Short Wall 40 C.M Wide | 2 | 0.9 | 0.4 | 0.4 | 0.288 | CUM | |
| | 30 C.M Wide | 2 | 0.9 | 0.3 | 0.5 | 0.27 | CUM | |
| | 20 C.M Wide | 2 | 0.9 | 0.2 | 0.675 | 0.243 | CUM | |
| | | | | | TOTAL= | 4.368 | CUM | |
| 4 | R.C.C Work | | | | | | | |
| | Slab of septic tank | | | | | | | Asume Bearing Of Slab 10 C.M L=3.7+0.1+0.1 B=0.9+0.1+0.1 |
| | Soak pit | 1 | 3.9 | 1.1 | 0.075 | 0.321 | CUM | |
| | | 1 | π/4 | $(1.7)^2$ | 0.075 | 0.17 | CUM | DIA=1.5+0.1+0.1 |
| | R.C.C Support of Pipe in Soak pit | 1 | 1.7 | 0.15 | 0.06 | 0.0153 | CUM | L=1.5+0.1+0.1 |
| | | | | | TOTAL= | 0.5063 | CUM | |
| 5 | R.B Standing wall | 1 | 0.9 | 0.1 | 1.35 | 0.1215 | CUM | H=0.75+0.3+0.3 |
| 6 | 12mm Plastering Septic tank Inside | 1 | 9.2 | - | 1.5 | 13.8 | SQM | H=1.2+0.3 L=3.7*2+0.9*2 |
| | Standing wall both side | 2 | 0.9 | - | 1.35 | 2.43 | SQM | |
| | Top | 1 | 0.9 | 0.1 | - | 0.09 | SQM | |
| | | | | | TOTAL= | 16.32 | SQM | |
| 7 | Flooring of septic tank | 1 | 3.7 | 0.9 | - | 3.33 | SQM | |
| 8 | 2nd Class Brick Work Honey Comb Brick Work | 1 | π/4 | $(1.9)^2-(1.5)^2$ | 0.9 | 3.204 | SQM | $A=\pi/4*(1.9^2-1.5^2)$ |
| 9 | Jhama Brick Ballast 50mm | 1 | π/4 | $(1.5)^2$ | 0.6 | 1.06 | SQM | |
| 10 | Lower Portion Soak pit | 1 | π/4 | $(1.5)^2$ | 1.8 | 3.18 | SQM | |

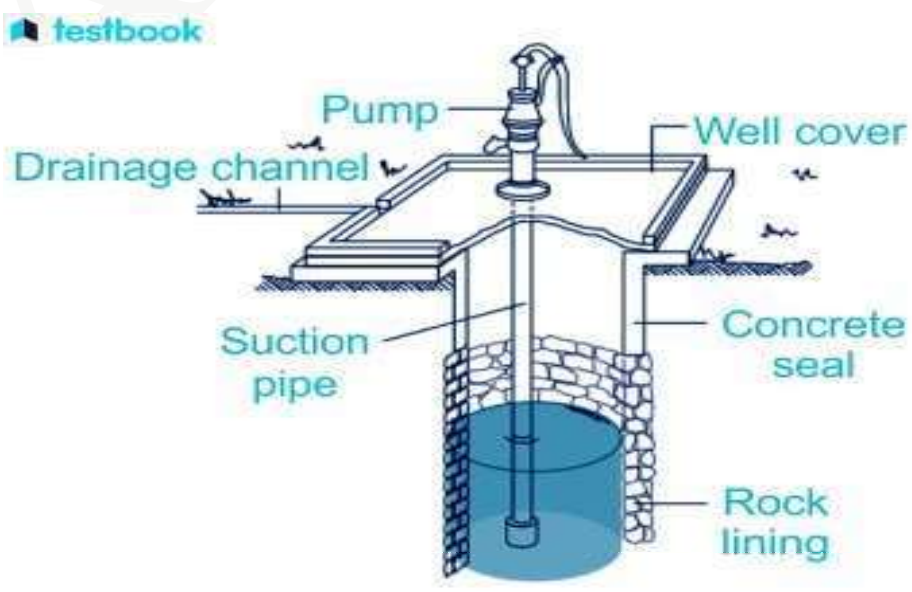
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 11 | 45C.M Dia Cover Septic tank | 2 | - | - | - | 2 | NOS | |
| 12 | Iron Foot Step | 8 | - | - | - | 8 | NOS | |
| 13 | Sanitary Connection | 1 | - | - | - | 1 | SET | |
| 14 | S.W Pipe 100mm Dia | 7 | - | - | - | 7 | NOS | |
| 15 | S.W Tee Pipe | 2 | - | - | - | 2 | NOS | |
| 16 | Vent Pipe 50mm Dia | 1 | - | - | 5 | 5 | NOS | |
| 17 | Cowl | 2 | - | - | - | 2 | NOS | |



## 4. MISCELLANEOUS ESTIMATES

### 4.1 Tube Well, Piles And Pile Cap, Isolated And Combined Footings.



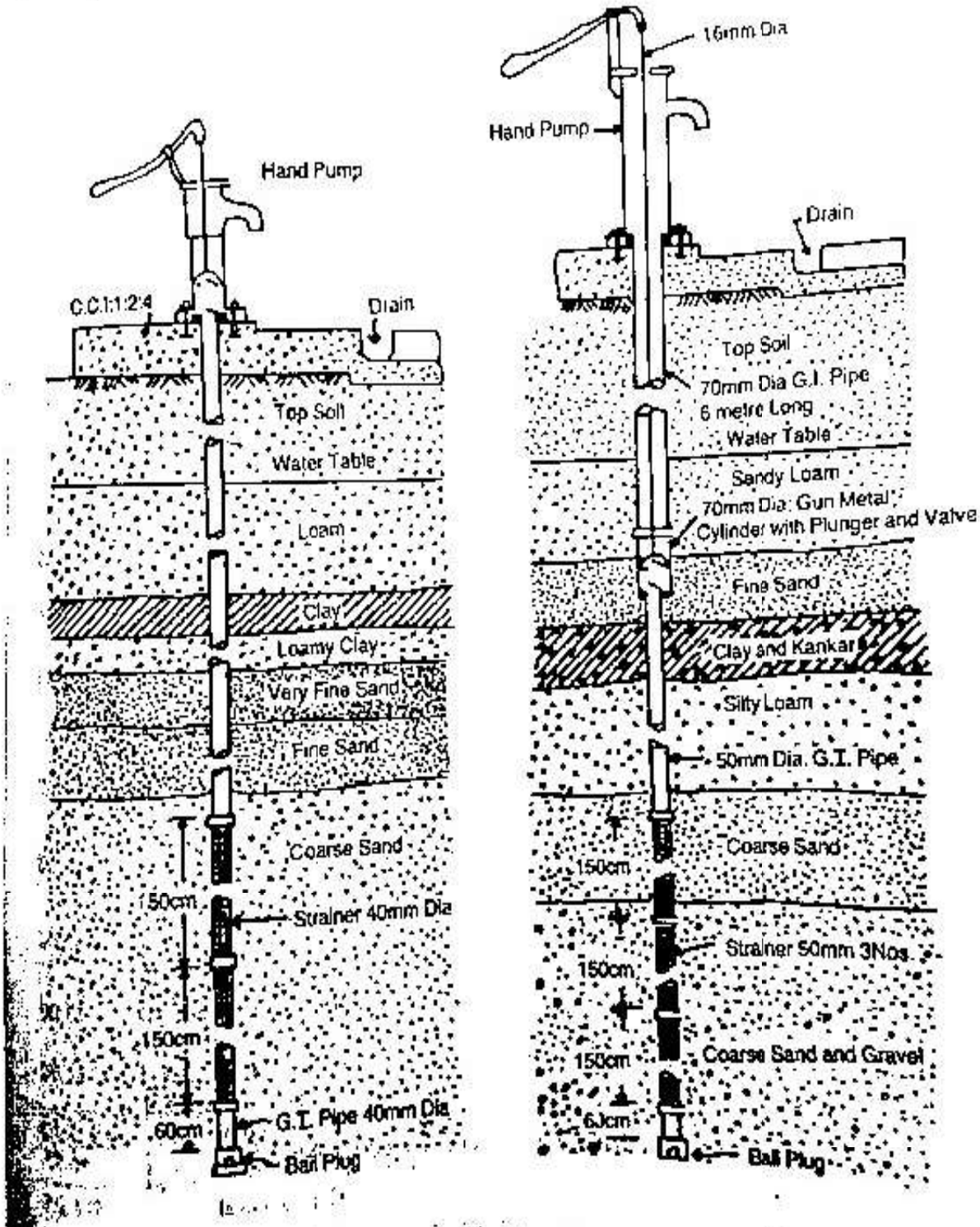



Fig. 6-18 Fig. 6-19

## ESTIMATE OF 40 MM DIA. TUBE WELL WITH ORDINARY HAND PUMP

**Example 9.**—Prepare an estimate of a 40 mm dia. tube well 40 metre deep from the given drawing (Fig. 6-18). The length of the strainer is 3 metre. Assume suitable rates.

| Item No | Desription Of Item | Quantity | Rate | Amount |
|---|---|---|---|---|
| 1 | 40mm Dia Pipe Including Suckets (20cm Above) | 37.2 | 250 | 9300 |
| 2 | 40mm Dia Strainer 1.5m Each | 2 Nos | 300 | 600 |
| 3 | Hand Pump Ordinary(No-4)Hand Pump | 1 Nos | 4000 | 4000 |
| 4 | Bail Plug | 1 Nos | 100 | 100 |
| 5 | Sockets 4 Nos Extra | 4 Nos | 50 | 200 |
| 6 | Transportation Of Manterial To Work Site | Lump Sum | 1000 | 1000 |
| 7 | Sinking- | | | |
| | 0-20 m | 20 | 100 | 2000 |
| | 20-30 m | 10 | 200 | 2000 |
| | 30-40 m | 10 | 300 | 3000 |
| 8 | Inserting Coarse Sand Souranding The Strainer Including Supply Of Sand | 1 Nos | 100 | 100 |
| 9 | Fixing & Ereeting Of Hand Pump In Position | 1 Nos | 500 | 500 |
| 10 | Cement Concrete Platfrom & Foundation Surface Finish Smooth | 1 Nos | 5000 | 5000 |
| 11 | Cement Concrete Drain 2m Long Finished Smooth | 2m | 2000 | 4000 |
| 12 | Pumping Out Water Till Clear Water Is Obtained | 1 Nos | 5000 | 500 |
| | | | TOTAL= | 32300 |

| Item No | Desription Of Item | Quantity | Rate | Amount |
|---|---|---|---|---|
| 1 | 50mm Dia G.I Pipe | 89.5 | 300 | 26850 |
| 2 | 70mm Dia G.I Ppie Housing Pipe (Assume 20 cm Above G.L) | 6.2 | 350 | 2170 |
| 3 | 50mm Dia 3 Nos Strainer 1.5m Each | 3 Nos | 350 | 1050 |
| 4 | Head Pump | 1 Nos | 4500 | 4500 |
| 5 | Bail Pipe | 1 Nos | 100 | 100 |
| 6 | Sockets Extra | 4 Nos | 50 | 200 |
| 7 | Transportation Of Manterial To Work Site | Lump Sum | 1000 | 1000 |
| 8 | Sinking- | | | |
| | 0-20 m | 20 | 75 | 1500 |
| | 20-35 m | 15 | 100 | 1500 |
| | 35-50 m | 15 | 125 | 1875 |
| | 50-65 m | 15 | 150 | 2250 |
| | 65-80 m | 15 | 175 | 2650 |
| | 80-95 m | 15 | 200 | 3000 |
| | 95-100 m | 15 | 225 | 1125 |
| 9 | Inserting Coarse Sand Souranding The Strainer Including Supply Of Sand | 1 Nos | 100 | 100 |
| 10 | Fixing & Ereeting Of Hand Pump In Position | 1 Nos | 500 | 500 |
| 11 | Cement Concrete Platfrom & Foundation Surface Finish Smooth | 1 Nos | 5000 | 5000 |
| 12 | Cement Concrete Drain 2m Long Finished Smooth | 2m | 2000 | 4000 |
| 13 | Pumping Out Water Till Clear Water Is Obtained | 1 Nos | 5000 | 500 |
| | | | TOTAL= | 59870 |

# 5. PWD ACCOUNTS WORKS

## 5.1 Works

### 5.1.1 Classification of work-original, major, petty, repair work, annual repair, special repair, quadrant repair.

**As per Nature of Work-**

**Original Work -** Any type of new construction work is known as original work. Example may be construction of new road, new bridge, new building etc.

**Repair Work -**

**A. Annual Repair Work:** The repair work which is taken up annually is known as annual repair work. Examples may be repairing of pot holes on the road, white washing/color washing/ painting of buildings etc.

**B. Special Repair Work:** Certain repair works which is taken up occasionally as & when required is known as special repair work. Examples may be repair of roads damaged during flood/earthquake, damaged pipe line or sewer line, repair to damaged plaster, replacement of doors or glass panes in buildings, patch repair of roads etc.

**C. Qudrantal Repair Work:** repair works taken up once in every 3 months in a year is known as qudrantal repair work. Examples may be cleaning of sewer lines in a building, repair of sanitary & electrical installations in a building etc.

**As per Amount of Work -**

1. Petty Work: Up to Rs. 50,000/-
2. Minor Work: More than Rs. 50,000/- & Up to Rs. 2, 00,000/-
3. Major Work: More than Rs. 2, 00,000/-

### 5.1.2 Concept of Method of execution of works through the contractors and department, contract and agreement, work order, types of contract, piece work agreement.

**Method of Execution of Works -**

**Departmentally-** In case of emergency/urgent nature of work, the department can execute the work by arranging labors and materials under their own supervision.

**Through Contractors -** Normally the works are executed through contractors who procure materials and engage the required labors under the supervision of departmental engineers.

**Various methods of carrying out the works -**

**Item Rate contract-** This contract is based on units put in place rather than a single price. The contractor quotes rates of individual items involved in a particular project. The payment is calculated at the specific quoted rate of individual items after taking measurement of the quantities executed by the contractor. This type of contract is normally utilized where the quantity of work cannot be established such as civil engineering construction projects where excavation of soil and rock are involved. The contractor is paid based on the units that have been put in place and verified by the owner. Unit Cost contracts provide more flexibility in discrepancies in field quantities and because of this; it is always used on heavy and highway construction contracts.

**Lump sum contract-** In a lump sum contract an owner agrees to pay a contractor a specified lump sum after the completion of work without work without a cost breakdown. After work no detailed measurements is required.

**Labour contract-** In this type of contract, the contractor quotes the rate for supplying labor only for execution of the work and gets payment for the labors actually engaged.

**Daily Labour or Muster Roll System-** When the work is carried out by the department directly by employing the daily labor such as masons, beldars, carpenters, coolies, blacksmiths,

plumbers etc. it is known as daily labor or muster roll system. All the materials required for the construction are issued from stores or purchased directly chargeable to the concerned work.

**Piece Work agreement-** It is the agreement for doing the work at the agreed rates, without reference to the total quantity of work or time. Such works or piece works up to Rs. 2000/- are got done through the contractors by piece work agreement.

**Scheduled contract-** It is like lump sum contract. Here the complete work as per plan and specifications is carried out by contractor for certain fixed amount as per agreement. The owner provides required information and contractor charges certain amount. This contract is suitable when the number of items is limited or when it is possible to work out exact quantities of work to be executed. The detailed specifications of all items of work, plans and detail drawings, security deposit, penalty, progress and other condition of contract are included in agreement. Though it is lump sum and scheduled contract, contractor will be paid at regular interval of 2-3 months as per progress of work on the basis of certificate issued by engineer in charge. A scheduled of rate is included in agreement for making payment of extra items.

**Cost plus percentage contract-** In cost plus percentage, the owner pays greater than 100 percent of the documented cost, usually requiring detailed expense accounting. In this type of contract, contractor is paid the actual cost of work plus certain percentage as profit. Various contract documents, drawing, specifications are not necessary at the time of signing the agreement. Contractor has to keep all records for cost of material and labor and contractor will be paid accordingly to engineer in-charge. This type of contract is suitable for emergency work like difficulties in foundation conditions, construction of expensive structure etc.

**Work order-** This method of getting the work done is employed for doing small works up to Rs.5000/-. This is a type of contract and is done without calling quotations or tenders. The work order is done on the prescribed terms and conditions of the department. Every department has printed work order books for doing such works.

## 5.2 Accounts of works

### 5.2.1 Explanation of various terms

**Administrative approval, technical sanction, tender, preparation of notice inviting tender, quotations, earnest money, E-tendering, security deposit, advance payment, intermediate payment, final payment, running bill, final bill, regular and temporary establishment, cash, major & subhead of account, temporary advance (imprest money),supervision charges, suspense account, debit, credit, book transfer, voucher and related accounts .**

**Administrative Approval-** This is an approval given by the competent authority of the parent department whose construction project work is to be taken up by the P.W.D. department. The parent department after ascertaining the funds position, technical feasibility of the project usually gives the approval. After getting the administrative approval the executing department proceeds for preparing detail drawings & estimates for actual execution.

**Technical Sanction-** This is a sanction usually accorded by the competent authority of the executing department i.e. P.W.D. after proper verification of detail estimate, detailed drawing and specification of the project. After getting technical sanction the executing authority of the department calls for tender process.

**Contingency budget-** A contingency budget is money set aside to cover unexpected costs during the construction process. This money is on reserve and not allocated to one area of the work, and simply "insurance" against other costs.

**Tender-** It is an offer in writing to execute some specified works or to supply some specified articles subject to certain terms and conditions like rates, time limits etc. Depending upon the type of contract, the tender may be lump-sum tender, item- rates tender, cost-plus tender, labor tender, demolition tender etc. Tenders who are always sealed in manner should be invited in the most open and public manner possible by advertisements in news papers or notices pasted in public places. The tenders after receiving date & time is over, is opened at the fixed time and date by the authorized officer in the presence of the intending contractors or their agents.

**Preparation of Notice inviting tender-** Tender notice is issued in the prescribed form for calling tenders for the construction works or supply works etc. in the prescribed form of the department.

Following particulars are given in the tender notice.

a. Name of the authority department inviting tenders.
b. Name of the work & its location.
c. Estimated cost.
d. Time of completion.
e. Cost of tender forms & condition of contracts.
f. Date, place & time of receiving & opening of tenders.
g. Earnest Money & Security money.
h. Validity of tender etc.

**Receiving of quotations-** Usually the tender form of quotations are received in the office notifying the tender notice up to a certain time and date which is given in the notice. Such quotations may be received by Registered post / drop box kept in the office for the purpose, the actual mode is notified in the notice.

**Earnest Money Deposit (EMD) -** It is the amount which accompanies the tender form while submitting it, which is usually 1% to 2% of the total estimated cost of the work. The main objective of collecting the EMD with the tender is as follows.

a. Restriction of unnecessary competition: If no EMD is collected, unnecessary competition will start. Those contractors who do not have any sound financial position to complete the work will submit their tenders at low rates, which may cause difficulties in completing the work.

b. Punishment: In case the contractor quotes lower rates, without intention of doing the work, the EMD shall be forfeited by the department as a punishment to such contractors.

c. Compensation: In case the lowest contractor refuses to do the work, the work can be allotted to the second lowest contractor. The EMD forfeited from the first contractor compensates to great extent the loss of the department. After accepting the tender of the qualified contractor, EMD of other contractors are refunded.

**Security Deposit (SD) -** After calling the tenders, they are scrutinized and the department accepts the reasonable tender usually the lowest. After accepting the tender the contractor whose tender is accepted is asked to deposit the SD which is usually 2.5 to 10% of the total estimated cost of the work. The main objective of SD is as follows.

a. Deposit for Loans: The SD serves as security against the materials or the plants and machineries supplied by the department to the contractor on loan.
b. b. Punishment: In case the contractor does not complete the work in time, uses inferior quality materials or has left the work incomplete, the SD amount is forfeited as punishment to the contractor as well as in view of getting compensation of the damages done by the contractor to the department.
c. When the contractor completes the work as per drawings, specifications and direction of the department within specified time, the SD is refunded to the contractor. Normally it is refunded

after the maintenance period which is usually six months after completion and handing over of the work.

**Advance Payment-** Advances to the contractors are as a rule prohibited, but in exceptional case it is permitted. Cases in which a contractor whose contract is for finished work, requires an advance on the security of materials brought to site, Divisional officers may, in such case make advances up to an amount not exceeding 25% of the current value of the materials, provided that they are of an imperishable nature. But the department people should be very sure that this advance amount will not put the department in trouble if the contractor leaves the work in between.

**On Account Payment-** On account payment may be done to the contractor as per actual measurements done in the field for the completed portion of the work as per the norms of the contract.

**Intermediate Payment-** Intermediate payments may be done to the contractor as per the terms & conditions of the contract basing on actual measurements in the field against the works done by the contractor. But it should not be the whole amount measured rather less percentage of actual measurement calculated. This type of payment is done subject to preparation of running bills.

**Final Payment-** Final payment is usually done to the contractor after successful completion of the work done and full measurements taken and checked by the competent authorities of the department and subject to preparation of final bill.

**Running Bill-** This is otherwise known as running account bill (Form No.26) which is used for all running and final payments to contractors and suppliers including cases where advance payments are proposed to be made or are already outstanding in respect of the same work against the contractor.

**Final Bill-** This is also known as first & final bill (Form No. 24) which is used for making payments both to contractors for work and to suppliers, when a single payment is made for a job contract on its completion. A single form may be used for making payments to several payees, if they relate to the same work and are billed for at same time.

**Regular & Temporary Establishment-** All the regular staff of the department is known as regular establishment and the staff assigned to a specific project for completion of the project is known as temporary establishment.

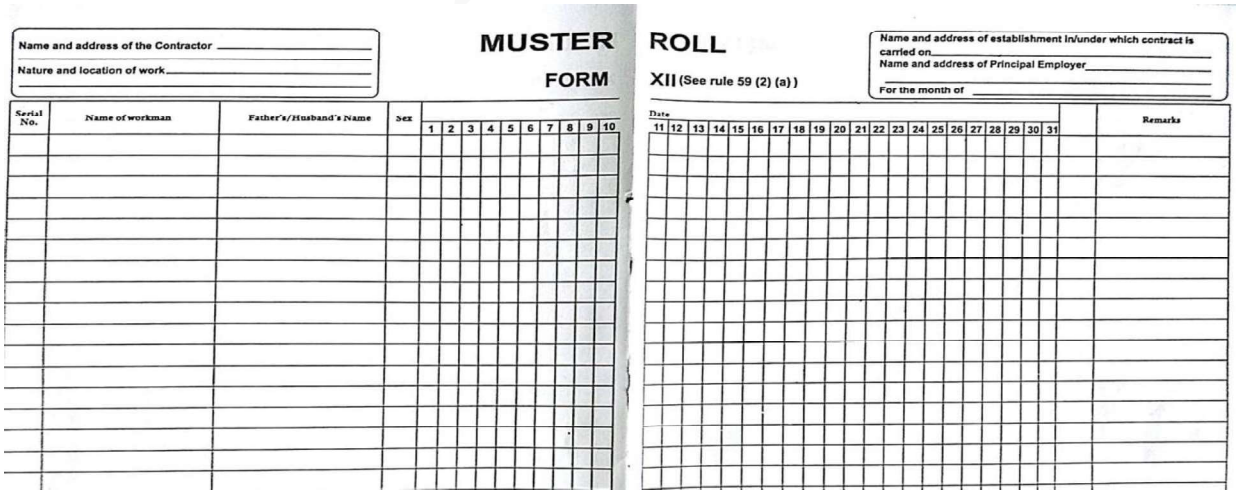
### 5.2.2 Measurement book use & maintenance, procedure of marking entries of measurement of work and supply of materials, labour employed standard measurement books and common irregularity.

**Measurement Book (MB) -** Payments to contractors and suppliers for all the work done by them which requires measurement are done on the basis of measurements recorded in a book known as Measurement Book (MB) in accordance with the rules. It is a very important account of record. Usually Junior Engineer (JE) who is actually assigned to supervise the quality & progress of the work is authorized to make the entry of detailed measurements of the work. He records all the measurements after completion of the work or interim as required and puts his dated signature in the book. The same is being check measured by his superior authorities time to time and they also put their dated signature in it. When the bill is prepared (running / final) the measurements are taken from this book.

**Standard Measurement Book (SMB) -** A set of measurement books which is used to maintain standard measurements-books of buildings in order to facilitate the preparations of estimates for periodical repairs are known as standard measurement book (SMB). Where such SMB are maintained, it is also permissible to utilize them for the purpose of preparing for contractor's bill for such repairs, so that it may not be necessary to take detailed measurements on each occasion.


### 5.2.3 Muster roll: Its preparation & use for making payment of pay & wages.

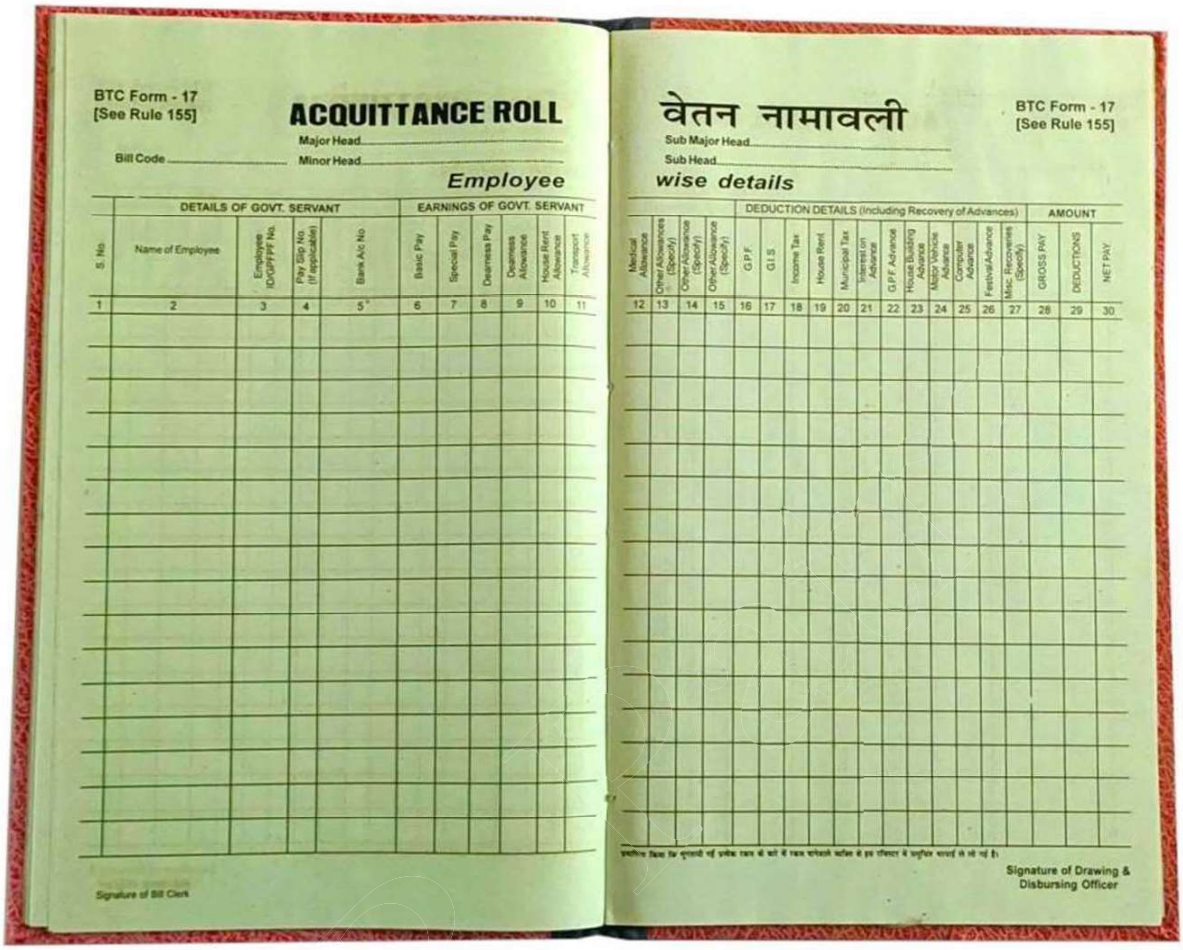
**Muster Roll-** The attendance of the laborers is maintained in a muster roll. The presence of each laborer in muster roll should be marked by the proper officer at the starting hour of the day. Periodic inspections by the higher authority are done to check the actual laborers working. On the basis of the muster roll payment is made to the laborers, weekly, fortnightly, monthly or at the completion of the work according to the requirement. In the muster roll names of the workers, designation, date of attendance, rate of wages, total amount due to each worker, signature of person taking the attendance, signature of the officer checking, making payment etc. are entered.




### 5.2.4 Acquaintance Roll: Its preparation & use for making payment of pay & wages.

**Acquaintance Roll -** The workers actually paid the due charges after signing in the acquaintance roll. In this roll the name of the worker, no. of days worked, rate of wage, total amount

received, signature or acquaintance of the worker are recorded. This is used as a paid voucher or bill in the department for official record of payments to the workers and is supported by the muster roll.



BTC Form - 17
[See Rule 155]

**ACQUITTANCE ROLL**

Major Head
Bill Code Minor Head
*Employee*

| | DETAILS OF GOVT. SERVANT | | | | EARNINGS OF GOVT. SERVANT | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sl. No | Name of Employee | Employee ID/GPF/PF No. | Pay Slip No. (If applicable) | Bank A/c No | Basic Pay | Special Pay | Dearness Pay | Deamess Allowance | House Rent Allowance | Transport Allowance |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Signature of Bill Clerk

**वेतन नामावली**

BTC Form - 17
[See Rule 155]

Sub Major Head
Sub Head
*wise details*

| | DEDUCTION DETAILS (Including Recovery of Advances) | | | | | | | | | | | | | | | AMOUNT | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Medical Allowance | Other Allowances (Specify) | Other Allowance (Specify) | Other Allowance (Specify) | G P F | G I S | Income Tax | House Rent | Municipal Tax | Interest on Advance | G.P.F. Advance | House Building Advance | Motor Vehicle Advance | Computer Advance | Festival Advance | Misc. Recoveries (Specify) | GROSS PAY | DEDUCTIONS | NET PAY |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |

Signature of Drawing & Disbursing Officer

### 5.2.5 Labour & labour report, method of labour payment, use of forms and necessity of Submission.

**Temporary Advance -** While a disbursing officer makes a remittance to a subordinate officer to enable him to make a number of specific petty payments on a muster roll or other voucher which has already been passed for payment, the amount remitted is known as temporary advance and accounted for as imprest. This account should be closed as soon as possible.

**Cash-** The term 'cash' as defined in the CPWD code includes legal coins, notes, cheques, deposit-at- call receipts of scheduled banks, drafts and payments on demand. Cash charges on works consist of payment to:

**a.** Labourers and members of the work- charged establishment, of their wages.

**b.** Contractors and others for work done or other services rendered.

The cost of materials procured specially for works is charged to the accounts of works by transfer credit to the purchases account, but payment to suppliers are governed by the same rules as payments to the contractors for work done.

**Major & Subhead of Accounts -** All the expenditure related to a work are known as major head of accounts. Further these expenditures are divided into different subheads as applicable. Examples may be as follows. Major head of accounts Subhead of accounts Construction of a building Material cost, labour cost, rent of tools & plants, supervision charges etc. Establishment charges- Salary, Allowances, Travelling expenses etc.

**Supervision Charges -** It is the amount kept in the estimate to meet the expenses towards supervision of the project work. Usually 5% amount on the cost of estimate is kept for this purpose.

**Debit -** Expenses made in executing the work is known as Debit.

**Credit -** Payments received for expense towards work is known as Credit.

### 5.2.6 Classification of stores, receipt / issue statement on standard form, method of preparation of stock account, preparation and submission of returns, verification of stocks, shortage and excess.

**Classification of Store:**

The PWD classify the stores into the following types;

1. Stock.
2. Machinery and equipment.
3. Road metal.
4. Materials charged to works.

**Stock-** Items of common use in construction work, such as bricks, aggregates, cement, steel, etc., are kept in the stock of a division and are issued as and when required for the execution of works.

The following are the advantages of keeping a stock of materials.

a. The procedure for the procurement of the same item is not repeated for different works.

b. The use of approved materials of the prescribed specifications is ensured.

'Stock' is a suspense head of account. When an item of stock is purchased, its cost is debited to the suspense head 'Stock'. When the item is issued for use in a work, the cost of the item issued is credited to the suspense, head 'Stock' and debited to the final head of the work concerned.

**Machinery and equipment-** The machinery equipment, vehicles, furniture and instruments required for use in construction works are known as machinery and equipment. The machinery and equipment are of two kinds.

a. General machinery and equipment. These are required for general use in the division

b. Special machinery and equipment. These are not required for general use in the division, but are procured for use in the specific works.

**Road metal-** A record of Road metal is kept in measurement books and claims for payment examined the basis of the recorded on measurements. Road metal is often kept by the road side before use and an account of its quantity is kept in the sub-divisional office in (Form 16), statement of receipts, issues and balance of road metal. Copies of these statements are submitted to the divisional office. Road metal found surplus, as a result of physical verification or otherwise should immediately be brought on account, treating it as a receipt, Shortage should be noted in the form of a remark in red ink and should be carried forward from month to month, until the discrepancy is set right by recovery, write-off or other means.

**Materials charged to works-** In addition to the charges falling under the main classes namely, cash and stock, there are other transactions affecting the cost of work. They may be charges incurred in other divisions or departments, materials received from them or services rendered by them or there may be cash receipts that are taken in reduction of expenditure in accordance with the rules.

**Issue of Stores Material-** Materials are issued from stock for the following purposes.

a. for use on works either by contractors or departmentally.

b. for dispatch to other subdivisions or departments.

c. for sale to contractors, employees and other outside parties.

**Bin Card-** This is a card, which is attached to each Bin, or the container for stores a record of all materials entering or leaving the bin and the balance of materials in hand is kept in this card.

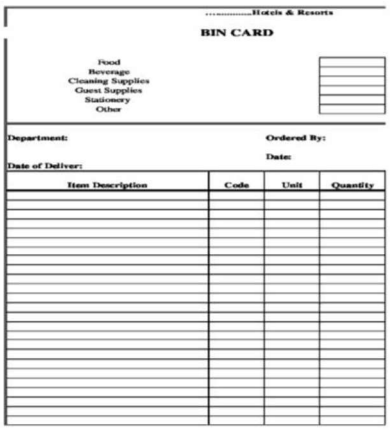
**BIN CARD**

Bill No .....
Material .....
Code No .....

Maximum Quantity .....
Ordering level .....
Minimum Quantity .....

Stores Ledger Folio .....

| Date | Quantity Received | Quantity Issued | Balance | Remarks |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |


.....Hotels & Resorts

BIN CARD

Food
Beverage
Cleaning Supplies
Guest Supplies
Stationery
Other

Department: Ordered By:

Date of Deliver: Date:

| Item Description | Code | Unit | Quantity |
|---|---|---|---|
| | | | |

**Certification of stocks, shortage and excess-** The stock is verified by the competent authority at least once in a year and physical position of the materials are checked with the stock register & bin card. Then the articles found in shortage or excess are recorded properly. Normally no steps are taken if found excess but the value of the stores found shortage or deficit should, however, not be debited to the relevant final head of account, but kept under 'Miscellaneous P.W. Advance' pending recovery or adjustment.

## 5.3 Building BYLAWS and REGULATORY Bodies, Development authorities, types and their levels, RERA etc.

The rules and regulation framed by town planning authorities covering the requirements of building, ensuring safety of the public through open spaces, minimum size of rooms and height and area limitation, are known as building bye-laws. Rules and regulations which largely regulate the building activity should be formulated to get disciplined growth of building and the better planned development of towns and cities.

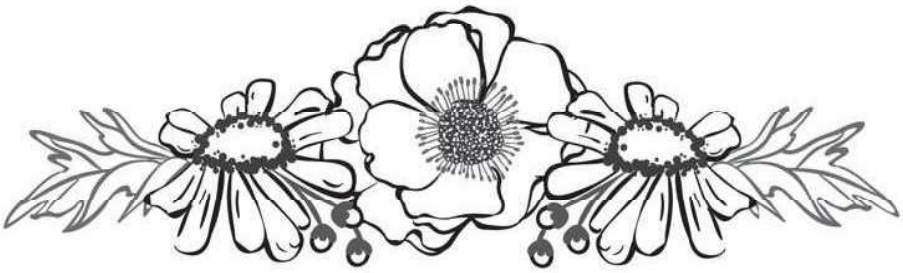
**Scope of building bye-laws -** Aspects of different type of building in building bye-laws:

1. Building frontage line.
2. Minimum plotting sizes.
3. Built up area of building.
4. Height of building.
5. Provision of safety, water supply, drainage, proper light and ventilation.
6. Requirement for off street parking space.
7. Size of structural element.

**Different types of area -**

a. Built up area
b. Plinth area
c. Floor area
d. Carpet area
e. Super built up area


**RERA -** Stands for Real Estate Regulatory Authority. The bill of the Parliament of India Act was passed on 10 March 2016 by the Rajya sabha. This act became effective on 1st May 2016. Being a regulatory body that ensures transparency, accountability, and protection of property buyers, it plays a crucial role in protecting the rights of the stakeholders at every step of the home-buying process. Under this authority, all the disputes related to real estate will be monitored, adjudicated, and arbitrated. A fast-track mechanism started through RERA for the settlement of real estate disputes.



# THANK YOU