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GUIDE FOR PREPARATION OF ESTIMATE  
FOR RIVER VALLEY PROJECTS

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# *Indian Standard*

## GUIDE FOR PREPARATION OF ESTIMATE FOR RIVER VALLEY PROJECTS

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Projects, BDC 50 : P-3

SHRI H. B. KULKARNI	Public Works Department, Government of Maharashtra
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**INDIAN STANDARDS INSTITUTION**  
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**NEW DELHI**

# *Indian Standard*

## GUIDE FOR PREPARATION OF ESTIMATE FOR RIVER VALLEY PROJECTS

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 18 September 1968, after the draft finalized by the River Valley Projects, Estimates and Progress Reports Sectional Committee had been approved by the Civil Engineering Division Council.

**0.2** River valley projects are being investigated, planned and reports prepared by different authorities. Estimates form an important part of the report since they affect viability or otherwise of the project. In order that different alternatives of the same project or different projects similarly situated may be suitably compared it is necessary to have uniformity in the method of estimation of different components of the project as also in the various projects.

**0.3** In an estimate it is necessary to see that all of the essential components or items are included and none such item is scantily estimated. With this view, therefore, lists of items, though not very exhaustive, in the various types of structures are indicated so that they may serve as check lists. It is possible that all items mentioned herein may not be relevant to every project report or estimation in details thereof may not be justified for smaller sized projects but the details listed would be useful as a general guide.

**0.4** The degree of details into which various components of the project should be estimated depends upon the magnitude of the project, its importance in relation to any inter-state problems involved and the finality to which alternative designs have been prepared and economies worked out. While it may not be possible to recommend limits as to the costs of the projects based on which to estimate the components in the requisite details, it can be termed as good practice to estimate the various components in as much details as possible except where the structures are large in numbers and similar in type just as canal structures for which adequate cost data of already constructed structures in that area are available.

**0.5** In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by deriving assistance from the following publications:

INDIA. MINISTRY OF IRRIGATION AND POWER. CENTRAL WATER AND

**POWER COMMISSION.** Report of the rates and cost committee, Part 1. 1956.

**INDIA. MINISTRY OF IRRIGATION AND POWER. CENTRAL WATER AND POWER COMMISSION.** Handbook of earth moving machinery. 1960.

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## 1. SCOPE

**1.1** This standard enumerates the different items for estimating the cost of various components of the project and the project as a whole with reasonable accuracy.

## 2. INTRODUCTION

**2.1** Under this item brief description of the following should be given:

- a) Outline of the scheme.
- b) Salient features covering the following:
  - 1) Head works:
    - i) Main and auxiliary dam, dykes, etc;
    - ii) Spillway;
    - iii) Energy dissipation devices;
    - iv) Outlet works and in-take structures; and
    - v) Diversion structures, such as barrage, weir and regulator.
  - 2) Main canal and branches with masonry structures.
  - 3) Distributaries.
  - 4) Power appurtenances. This may include the following:
    - i) Water conductor systems, balancing tank and forebay;
    - ii) Surge tank;
    - iii) Penstocks;
    - iv) Power house;
    - v) Power equipment;
    - vi) Switch yard;
    - vii) Transmission lines; and
    - viii) Sub-stations.
  - 5) Navigation channels and locks.
  - 6) Water carrier systems for municipal, domestic or industrial water supplies.
  - 7) Nature of strata met with or traversed.
  - 8) Rail head and communications.
  - 9) Mode of construction and extent of mechanization for main items.
  - 10) Main materials of construction indicating sources of supply.

### 3. COMPOSITION OF UNITS

3.1 The project works may be grouped into the following units:

- a) *Unit I* — Head works including main dam and auxiliary dam, dykes, spillway, outlet works, energy dissipation devices, barrage, weir, regulator including intake structures and diversion works.
- b) *Unit II* — Main canals, branches, and distributaries inclusive of all pucca works.
- c) *Unit III* — Hydroelectric installation given below:
  - 1) Power plant and appurtenant works:
    - i) Civil works, and
    - ii) Power equipment.
  - 2) Transmission lines.
  - 3) Sub-stations.
- d) *Unit IV* — Navigation works.
- e) *Unit V* — Water supply works.

### 4. ACCOUNTS CLASSIFICATION

4.1 Each unit and if necessary each sub-unit, should be covered under the following minor heads classified as direct and indirect charges.

4.1.1 *Direct Charges* — These shall include the following:

- I — Works,
- II — Establishment,
- III — Tools and plant,
- IV — Suspense, and
- V — Receipts and recoveries on capital account.

4.1.2 *Indirect Charges* — These shall include the following:

- a) Capitalized value of abatement of land revenue, and
- b) Audit and account charges.

4.2 **The Provisions Under I** — Works will be sub-divided under the following detailed heads:

- A — Preliminary
- B — Land
- C — Works
- D — Regulators and measuring devices
- E — Falls ( for canals only )
- F — Cross drainage works ( for canals only )



- G — Bridges ( for canals only )
  - H — Escapes ( for canals only )
  - I — Navigation works
  - J — Power plant appurtenances ( Civil Works )
  - K — Buildings
  - L — ( for canals only ):
    - i) Earthwork, and
    - ii) lining
  - M — Plantations
  - N — Tanks and reservoirs
  - O — Miscellaneous
  - P — Maintenance
  - Q — Special tools and plant
  - R — Communications
  - S — Power plant and electrical system
  - T — Water supply works
- Losses on stock and unforeseen

**4.3** When, for major projects, the estimates are to be prepared on the basis of the decimal system of cost classification, the numerical account numbers to be adopted are given in Appendix A for guidance.

## **5. PROGRAMME**

**5.1 Programme of Work** — Quantity of work of major items should be indicated structure-wise by charts. This may not be necessary for small projects where general programme of work by items will be indicated.

## **6. ABSTRACT OF COST**

**6.1 Detailed Abstract of Cost** — To work out the total cost of the project in detail the cost of various units given in 3 should be compiled in a tabular form according to the various sub-heads indicated in 4.

**6.2 General Abstract of Cost** — On the basis of the detailed abstract of cost as in 6.1 a general abstract of cost for the whole project tabulating all the units together may be compiled by minor and detailed heads ( the same as total in the last column of the table to be prepared as given in 6.1 ).

## **7. DETAILED ESTIMATES OF COSTS FOR HEAD WORKS**

**7.1** The various items under minor and detailed heads for which estimates should be prepared are indicated from 7.2 to 7.13. Explanatory notes regarding the basis of provisions should be given for each item.

**7.2 A — Preliminary** — The following are the different heads:

- a) Expenditure incurred on previous investigations;
- b) Detailed surveys for final location;
- c) Contour survey for reservoir basin ( including establishment of permanent bench marks );
- d) Geological surveys and geophysical surveys;
- e) Hydrological and meteorological surveys including establishment of rain-gauge and discharge gauge stations and their running charges;
- f) Investigations for foundations;
- g) Investigation for availability of construction materials;
- h) Construction of access roads to facilitate investigations;
- j) Model experiments;
- k) Preparation and printing of project reports;
- m) Vehicles for transport of inspecting officers for site investigation;
- n) Camp equipment;
- p) Preliminary soil tests, establishing soil-testing laboratory; and
- q) Consultant's fee ( including charges for any preliminary design work or advice ).

**7.3 B— Lands** — The two main items under this sub-head are acquisition and rehabilitation.

**7.3.1 Land Acquisition** — The probable rate for acquisition of different types of lands should be enquired from and got certified by the district revenue, forest or other competent authorities. Compensation needs to be paid for the items given in **7.3.1.1**.

**7.3.1.1 Acquisition**

- a) Land acquisition for works and that coming under submergence;
- b) Structures, such as buildings, stables, temples and wells based on plinth area rate at present day cost, less value of usable materials;
- c) Standing crops;
- d) Trees;
- e) Archaeological monuments, if any; and
- f) Prospective mineral deposits, if any.

NOTE — The following charges are to be included under appropriate items mentioned above:

- 1) Rent for the use of the land,
- 2) Interest charges on the amount of award for the period between taking over possession of the land and the date of award,
- 3) Solatium charges for compulsory acquisition, and
- 4) Legal charges.

**7.3.1.2 Relocation** — Relocation of communications like **r**ank railways, telegraph lines, transmission lines, etc.

**7.3.2 Rehabilitation** — For rehabilitating displaced persons, the following provisions are required to be made:

- a) Acquisition of lands for new village sites and allotment of plots to the villagers at suitable rates;
- b) Making the acquired land fit for habitation, and providing facilities, such as village roads, wells, school buildings, post offices, dispensaries, places of worship and monuments; and
- c) Providing free transport for conveyance of dismantled materials and household materials from the old village sites to the new village sites.

**7.3.3** In addition to the actual cost of acquisition and rehabilitation, charges for the following are to be added:

- a) Labour and materials for demarcation and joint measurements of lands and other properties, and
- b) Establishment charges for land acquisition and rehabilitation and other departmental staff.

## **7.4 C— Works**

**7.4.1 Head Works** — The various components of which the head works is composed are given below:

- a) *Dam* — The components are given below:
  - 1) Earthen and rock-fill,
  - 2) Masonry, and
  - 3) Concrete.
- b) *Spillway*
- c) *Energy dissipation works*
- d) *Outlets* — The components are given below:
  - 1) irrigation,
  - 2) Power,
  - 3) Water supply, and
  - 4) Scour sluices.
- e) *Pickup weir|barrage|head regulator*

**7.4.2 Main Dam** — Main dams are of the types given in 7.4.2.1 and 7.4.2.2.

**7.4.2.1** Earth dam and rock-fill dam will include the following:

- a) Care of the river during construction including such items as coffer dams and diversion tunnels.

b) *Foundations* — These shall include the following:

- 1) Site clearance.
- 2) *Excavations* — The excavations are for:
  - i) stripping for dam seat;
  - ii) stripping for blanket;
  - iii) cut-off trench; and
  - iv) longitudinal, cross and toe drains.
- 3) Dewatering arrangements
- 4) Foundation treatment ( drilling and grouting ) :
  - i) Drilling in rock or in soil with casing;
  - ii) Grouting ( cement, bentonite, chemicals );
  - iii) Cement concrete pad for grouting or for cut-off wall or for both; and
  - iv) Other treatments.
- 5) Pile driving.
- 6) *Foundation drainage* — This shall consist of:
  - i) drilling drainage holes, and
  - ii) making drainage and grouting tunnels.
- 7) Filling cut-off trench with selected impervious material:
  - i) from excavated material, and
  - ii) from borrow area.

c) *Dam*

- 1) Earthwork ( in core, shell, random zones and upstream blanket ) :
  - i) Impervious,
  - ii) Semi-pervious, and
  - iii) Pervious ( total to be indicated separately for excavated material and borrow area ).
- 2) Filter ( sloping or horizontal at downstream toe of hearting ) of selected media.
- 3) Filling longitudinal, cross and toe drains, etc, with drainage materials, like sand, gravel or spalls and rubble.
- 4) Downstream rock toe:
  - i) from excavated material, and
  - ii) from quarries.
- 5) Upstream slope protection.
- 6) Downstream slope protection.
- 7) Relief wells, drainage blankets, etc.

- 8) Parapet wall:
  - i) Masonry or concrete with coping,
  - ii) Railing, and
  - iii) Wheel guard stones ( see Note ).
- 9) Roadway over top of dam.
- 10) Gauge posts.
- 11) Instrumentation.
- 12) Laying open jointed pipes.
- 13) Manholes.

NOTE—Rock-fill dam will include dumped rock-fill of different grades and in different zones.

#### 7.4.2.2 *Masonry dam*

- a) Diversion works during construction, such as coffer dams and tunnels.
- b) *Foundations:*
  - 1) Clearing site.
  - 2) Dewatering in foundations.
  - 3) Excavation for approach and tail channels, divide walls, guide walls and main dam, in:
    - i) overburden of soft strata,
    - ii) overburden of hard strata, and
    - iii) hard rock.
  - 4) Preparation of dam seat.
  - 5) Cement grouting including curtain and consolidation grouting.
  - 6) Drilling holes:
    - i) for grouting,
    - ii) for drainage, and
    - iii) for anchor rods.
  - 7) Anchor rods.
- c) *Dam*
  - 1) Masonry for:
    - i) hearting;
    - ii) upstream face;
    - iii) downstream face ( non-overflow section and overflow section );
    - iv) divide wall;
    - v) parapets; and
    - vi) galleries, adits and other openings.

- 2) Cement concrete in:
  - i) foundation;
  - ii) divide wall;
  - iii) parapets; and
  - iv) galleries, adits and other openings.
- 3) Form work ( if not included in rate for concrete ) for items mentioned in 2.
- 4) Reinforcement steel.
- 5) Drilling for anchors,
- 6) Anchor rods.
- 7) Instrumentation.
- 8) Joints and seals.
- 9) Drilling and grouting of masonry.
- 10) Porous pipe for drainage.

**7.4.2.3 Concrete dam** — The following shall be the heads:

- a) Diversion works during construction, such as coffer dams and tunnels.
- b) Foundations [ items same as under 7.4.2.2 (b) ].
- c) Dams.
  - 1) Cement concrete in:
    - i) hearting ( with or without plumbs );
    - ii) upstream facing;
    - iii) downstream facing which shall include the overflow section and the non-overflow section;
    - iv) divide wall;
    - v) parapet;
    - vi) drainage gallery, adits and other openings; and
    - vii) any other structures.
  - 2) Form work ( if not already included in rate for concrete ) for items mentioned in (1) above.
  - 3) Reinforcement steel.
  - 4) Drilling for anchors.
  - 5) Anchor rods.
  - 6) Instrumentation.

**7.4.3 Spillway** — The spillway structure may generally be of masonry or of concrete and the items, therefore, are respectively the same as for masonry

or concrete dam. Following additional items need to be estimated:

- a) Cement concrete for:
  - 1) bridge piers,
  - 2) bridge beams and slabs, and
  - 3) tunnel lining.
- b) Miscellaneous items of bridge like bearings.
- c) Tunnel excavation.
- d) Crest gates with hoisting equipment and hoist bridge.
- e) Stop logs for crest gates, and lifting arrangement.

**7.4.4 Energy Dissipation Works** — Same items as for concrete/masonry dam with the addition of cement concrete or masonry or both for:

- a) apron,
- b) floor blocks, and
- c) end sills and chute blocks.

**7.4.5 Outlets** — This will include the following:

- a) Excavation in soil and rock.
- b) Cement concrete:
  - 1) in foundation;
  - 2) for conduit bottom slabs, walls and top slab or arch, cut-off collars, etc;
  - 3) for hoist tower walls, beams, floor slabs, etc; and
  - 4) for blockouts.
- c) *In-take structures* — This will include the following items:
  - 1) Excavation in soils and rock;
  - 2) Foundation treatment;
  - 3) Cement concrete for foundation, and for piers and abutments;
  - 4) Masonry for guide walls of approach channel;
  - 5) Trash rack including racking arrangement;
  - 6) Gates with auxiliary equipment; and
  - 7) Reinforcement steel.
- d) Reinforcement steel.
- e) Joints and seals.

- f) Drilling and grouting.
- g) Gates and hoisting arrangement.
- h) Miscellaneous items, such as air vent, operating cabin, ladder and flooring.
- j) Steel lining.

**7.5 I — Navigation Works** — This forms separately a subsidiary project in itself requiring construction of various items and procurement of equipment given below:

- a) Excavating any inter-connecting channels;
- b) Construction of wharfs, quays, jetties, locks, etc; and
- c) Dredging operations.

**7.6 J — Power Plant** — This shall include intake structures, tunnels, power canal and tail race channel, surge shaft, penstocks, power house, generating plant, switchgear, transmission lines, etc.

**7.6.1 In-take Structures** — [ Same items as given under 7.4.5 (c) ].

**7.6.2 Tunnels ( Including Cut and Cover Section )** — The following are the items:

- a) Excavation in rock:
  - i) Open cut, and
  - ii) Tunnel ( including temporary supports, where necessary ).
- b) Rock bolts and permanent supports.
- c) Ventilation.
- d) Drainage.
- e) Cement concrete for lining.
- f) Steel lining.
- g) Reinforcement steel.
- h) Drilling and grouting.
- j) Gates and ancillaries where required.

**7.6.3 Power Channel and Tail Race Channel** — The following are the different heads:

- a) Excavation.
- b) Embankment.



- c) Lining with cement concrete in bed and sides with drainage pipes and valves.
- d) Pucca works for:
  - 1) cross drainage,
  - 2) escapes,
  - 3) meter flume,
  - 4) bridges, and
  - 5) balancing tank.

**7.6.4 Surge Shaft** — The items under this head are given below:

- a) Excavation;
- b) Cement concrete lining;
- c) Drilling and grouting;
- d) Miscellaneous items, such as ladder, bolts, etc;
- e) Reinforcement steel; and
- f) Grating.

**7.6.5 Penstocks** — The following are the different items:

- a) Excavation.
- b) Cement concrete for:
  - 1) bed,
  - 2) anchor blocks, and
  - 3) intermediate supports.
- c) Steel pipes for:
  - 1) straight rings,
  - 2) reducers,
  - 3) bends,
  - 4) wye pieces, and
  - 5) penstock valves.

**7.6.6 Power House** — The following are the different items:

- a) Excavation in:
  - 1) soil, and
  - 2) rock.
- b) Concrete for:
  - 1) foundations,
  - 2) sub-structure,

- 3) superstructure, and
- 4) turbines and generators support.
- c) Masonry for superstructure.
- d) Scroll casing.
- e) Draft tube lining.
- f) Bulkhead gates, crane and hoisting equipment.
- g) Power house crane.
- h) All necessary items for building work.

**7.6.7 Generating Equipment** — The following items under this head may be given:

- a) Turbine with accessories;
- b) Generators, exciters and other accessories; and
- c) Erection and commissioning.

**7.6.8 Power transformers, switchgears and all ancillary equipment, such as circuit breakers, control and relay panels, and protection equipment.**

**7.6.9 Power Cables and Control Cables**

**7.6.10 Transmission Lines**

**7.6.11 Sub-stations and Their Equipment**

## **7.7 Workcharged Establishment and Contingencies**

### **7.8 K — Buildings**

**7.8.1** Requirement of buildings for execution of the project depends upon whether the works are to be carried out departmentally or on contracts.

**7.8.2** All buildings may be estimated on plinth area basis giving description as to the type of construction.

**7.8.3** The buildings may be classified as follows:

- a) Non-residential buildings:
  - 1) Permanent, and
  - 2) Temporary.
- b) Residential buildings:
  - 1) Permanent, and
  - 2) Temporary.

**7.8.3.1 Residential building** — Buildings for all officers and staff engaged on site of work should be provided as necessary.

**7.8.3.2 Non-residential buildings** — These shall include:

- a) office buildings,
- b) testing laboratory,
- c) rest houses and field hostels,
- d) workshops,
- e) stores,
- f) sheds, and
- g) other service buildings which shall include:
  - 1) hospitals or **dispensaries** or both;
  - 2) welfare centre;
  - 3) police station;
  - 4) schools;
  - 5) post offices, telegraph and telephone offices;
  - 6) community centre;
  - 7) generating house or sub-station;
  - 8) canteens;
  - 9) co-operative stores and markets;
  - 10) bus stop;
  - 11) public utility; and
  - 12) bank and treasuries.

**7.8.4 Other Items Chargeable to Buildings** — These shall include the following:

- a) Land development (levelling and filling);
- b) Colony roads;
- c) Lawns and gardens;
- d) Fencing;
- e) Service connections, such as water supply, sanitation and electrification.

**7.9 M — Plantations** — This item provides for establishing of avenues, trees, arboriculture, etc.**7.10 O — Miscellaneous** — The main items to be considered are given below:

- a) Capital cost of:
  - 1) electrification;
  - 2) water supply, purification and distribution; and
  - 3) sewage disposal and storm water drainage works.

- b) Maintenance and service. This will include the following items:
- 1) Electrification;
  - 2) Water supply, purification and distribution work;
  - 3) Sewage disposal and storm water drainage works;
  - 4) Recreation;
  - 5) Medical assistance;
  - 6) Post offices, telephone and telegraph offices;
  - 7) Security arrangement;
  - 8) Transport vehicles; and
  - 9) Fire fighting equipment.
- c) Other items as given below:
- 1) Visits of dignitaries;
  - 2) Technical record, photographic record;
  - 3) Inaugural ceremonies, etc;
  - 4) Compensation to workmen;
  - 5) Boundary pillars and stones, distance marks and bench marks;
  - 6) Power supply;
  - 7) Anti-malaria measures;
  - 8) Model and exhibits;
  - 9) Testing laboratory and equipment; and
  - 10) Railway siding.

**7.11 P — Maintenance** — This sub-head provides for the maintenance of the works during construction. Various items to be considered are:

- a) head works,
- b) buildings, and
- c) roads on work site and colony.

**7.12 Q — Special Tools and Plants** — The special tools and plants required may be divided into the following:

- a) Drilling and grouting equipment,
- b) Transport,
- c) Pumping equipment,
- d) Electrical equipment,
- e) Workshop equipment,

- f) Construction plant,
- g) Compaction equipment,
- h) Air compressors, and
- j) Miscellaneous equipment.

**7.12.1 *Drilling and Grouting Equipment*** — These consist of the following:

- a) Compressed air distribution system;
- b) Diamond drills;
- c) Core drilling machine with prime mover;
- d) Wagon drills;
- e) Jack hammers;
- f) Pavement breakers; and
- g) Grouting equipment like grout mixers, pumps, etc.

**7.12.2 *Transport Equipment*** — These consist of the following:

- a) Trucks of 5 to 20 ton capacity;
- b) Motorized tanker ( 3 636 to 9 090 litre capacity );
- c) Trailers;
- d) Pneumatic tyred tractors;
- e) Jeeps, cars, station wagons, pick ups;
- f) Station wagons;
- g) Ambulances;
- h) Pick up vans;
- j) Railway locomotive and rolling stock; and
- k) Buses.

**7.12.3 *Water Supply ( Works and Dewatering Arrangement )***

**7.12.4 *Electrical Equipment*** — The following items come under this category:

- a) Generators,
- b) Motors, and
- c) Flood lights.

**7.12.5 *Compaction Equipment*** — These consist of the following:

- a) Road rollers ( 8 to 12 tons ),
- b) Sheep foot rollers,
- c) Pneumatic tyred rollers ( 20 to 50 tons ), and
- d) Vibratory rollers.

**7.12.6 Construction Plant** — Under this the following plant for concreting and ancillary works is included:

- a) Crushers, classifiers;
- b) Washing and cleaning plants for aggregates;
- c) Batching plants;
- d) Refrigerating plants;
- e) Screening plants;
- f) Reclaiming plants;
- g) Belt conveyor;
- h) Cranes, wagons, cement silos and cement pumping plant;
- j) *SURKHI*/pozzolana manufacturing plant;
- k) Concrete mixers;
- m) Mortar mills;
- n) Portable vibrators ( pneumatic, diesel, petrol, etc ); and
- p) Tram lines and related equipment.

**7.12.7 Earth Moving Equipment** — The following may be considered:

- a) Shovels and draglines;
- b) Scrapers ( motorized and tractor drawn );
- c) Overhead and crawler front-end loaders ( tyred and tractor type );
- d) Crawler tractors, dozers and rippers;
- e) Wheeled tractors, dozers and rippers;
- f) Motor graders;
- g) Carriers, such as bottom dumpers, rear dumpers, and side dumpers
- h) Belt loaders, elevating grader;
- j) Tippen trucks;
- k) Trenchers; and
- m) Wheeled excavators.

**7.12.8 Miscellaneous Equipment** — The following may be considered:

- a) Hoists;
- b) Pulley block, lifting tackle, gantries;
- c) Winches;
- d) Mobile cranes; and
- e) Other lifting machines.

**7.12.9 Workshop and Ancillary Equipment**

**7.12.9.1** This will cover equipment for the following sections:

- a) Foundry shop;
- b) Smithy shop;
- c) Machine shop;
- d) Structural shop;
- e) Welding shop;
- f) Fitting and assembling shop;
- g) Tyre retreading shop;
- h) Carpentry shop;
- j) Paint shop;
- k) Millwright shop;
- m) Galvanizing shop, and
- n) Field repair shops, such as carrier repair shop, tractor repair shop, auto shop, pipes and pumping shop, and drill and bit repair shop.

**7.12.9.2** Based upon the quantities of different types of works to be carried out, the nature of materials, type and extent of borrow area and programme of constructions and different types of machinery required should be estimated.

**7.13 R — Communications** — Under this sub-head of work, following items should be provided for:

- a) Construction of the main approach road to dam site;
- b) Construction of quarry roads;
- c) Construction of temporary roads in the works area;
- d) Construction of temporary or permanent river crossings; and
- e) Railways, bridges, connecting roads, water-ways and air strips.

## **8. MAIN CANAL AND BRANCHES**

**8.1** The sub-heads for this work are given below:

- A — Preliminary
- B — Land
- D — Regulators
- E — Falls
- F — Cross drainage
- G — Bridges
- H — Escapes
- K — Buildings

- L — Earthwork including lining
- M — Plantation
- O — Miscellaneous
- P — Maintenance
- Q — Special tools and plant
- R — Communications

**8.2 A — Preliminary** — The items under this sub-head are the following:

- a) Command survey ( contouring );
- b) Detailed alignment survey ( cross-sectional survey );
- c) Establishing and fixing bench marks;
- d) Taking trial pits or trenches and trial bores for foundation investigation of structures;
- e) Preparing jeepable roads during surveys;
- f) Taking auger bores for soil survey of command area;
- g) Collecting soil samples for soil survey;
- h) Field tests for soil classifications; and
- j) Workcharged establishment ( overseer, technical assistant, attendants, etc ).

**8.3 B — Land** — This item is similar to 7.3 ( B-land for head works ).

**8.4 D — Regulator, E — Falls, F — Cross Drainage Works, G — Bridges and H — Escapes**

**8.4.1** On canal system a number of structures of these types are required. Costs of these structures are mainly dependent upon the size of the canal and size of the cross drainage ( in case of only F — Cross drainage works ). Hence costs of these structures may be related to the discharges of the canal and of the *NALLA*.

**8.4.2** Based on the cost data of the structures already constructed for the river valley projects in the state in recent times, cost curves can be drawn. Cost of the structures of the project indicated from such cost curves may be corrected for any general variation in rates after construction of these structures.

**8.5 L — Earthwork** — This sub-head covers the following items needed for constructing the canal system:

- a) Excavation.
- b) Embankment from:
  - 1) excavated material, and
  - 2) borrow areas.



- c) Lining ( if proposed for the entire central section or restricted to rocky cuts only ).
- d) Pitching.
- e) Miscellaneous items, such as construction of drains, inspection path and service road.

**8.6** The works under the following sub-heads required for main canals and branches are the same as for the headworks except for variation in requirement:

- a) K—Building.
- b) M—Plantation will include plantation along main and branch canal and should include maintenance and protection for 2/3 years.
- c) P—Maintenance.
- d) R—Communications.
- e) O—Miscellaneous.

**8.7 Q — Special Tools and Plants** — The items of machinery required may be related as given in 7.12.

**8.8 Distributaries and Minors** — Cost of this sub-head is generally worked out on the basis of area to be irrigated/gross commanded area. If necessary, data are available from other projects in the region with comparable features; otherwise approximate estimate of a channel of average condition should be prepared and the rate per area worked out.

## 9. FOREIGN EXCHANGE REQUIREMENTS

**9.1** This shall include total foreign exchange requirement and its phasing.

## 10. ANALYSIS OF RATES

**10.1** River valley projects have generally to be constructed in out of the way places. Any schedule of rates as worked out by any other agencies may not, therefore, be strictly applicable in the preparation of cost estimates. Moreover, huge constructions like these are now-a-days mostly mechanized, for which, rates have to be worked out for the particular types of plant and machinery proposed to be employed. As such, detailed analysis should be made and supplied with the project estimate for major items of works like excavations, concrete, masonry, earthfill, stone pitching, tunnelling, lining, steel supports in tunnels, etc.

**10.2** While presenting the analysis of rates, amongst other things, the following basic information should invariably be supplied:

- a) Whether the work is proposed to be done departmentally or through contractors;

- b) Extent to which mechanized construction is contemplated;
- c) Basic labour rates;
- d) Basic rates of materials like cement, steel, etc, at site of works; whether these will be supplied by the department to the contractors, and if so, at what rates;
- e) Specification of works, location, etc;
- f) Distance of rail head, quarries and borrow areas ( leads of other materials involved in the construction );
- g) Classification of earthwork, lead and lift involved; and
- h) Type of machinery to be employed and its costs.

**10.3** In drawing up the analysis of rates for works to be done by machinery, it would be necessary to first work out the hourly used rates of machines which would include:

- a) Depreciation of the machine;
- b) Cost or account of repairs and maintenance;
- c) Cost of fuel or electricity, oil and lubricants: and
- d) Labour charges.

**10.3.1** The life of each type of machine considered in working out the depreciation should be indicated. The percentage of depreciation taken for the cost of repairs and maintenance should be mentioned. The consumption and price of fuel or electricity, oil and lubricants should be given. In computing the labour charges, the non-working period should be kept in view.

## **A P P E N D I X   A**

( *Clause 4.3* )

### **NUMERICAL ACCOUNT NUMBERS FOR DECIMAL SYSTEM OF COST CLASSIFICATION**

#### **A-1. CLASSIFICATION OF ACCOUNTS**

**A-1.1** The accounts are classified broadly into the following two categories:

- a) *Permanent Account* — Items which will appear both in the project

estimates as well as in the completion report of the project which shall include works, special tools and plants, first cost, establishment, ordinary tools and plants, etc.

- b) *Suspense or Clearing Accounts* — Items which are to be charged to project cost account ultimately. These shall be opened during the construction phase and closed before the completion report is prepared. This shall include special tools and plant ( operation ) and clearing accounts.

## A-2. ALLOCATION OF NUMBERS

**A-2.1** The following main or stem accounts have been allotted numbers from 100 to 999 as given below:

<i>Main or Stem Accounts</i>	<i>No.</i>
Works	100-399
Special tools and plant ( first cost )	400-499
Establishment, ordinary tools and plant, suspense, etc	500-599
Special tools and plant operation	600-699
Clearing accounts	700-799

**A-2.2** The above arrangement has been proposed in such a manner that while account numbers 100 to 599 will alone appear in the project estimates and in the completion reports of the projects, thereby working up to the total costs of the projects the other account numbers 600-699 may be opened and closed during the construction phase of the projects. These may represent the clearing accounts, such as those for collection of materials, erection and dismantling of machinery, as also operation costs of plant and machinery, all of which will get reduced periodically by transfer to the works in the section 100-599. There will be no ' plus ' or ' minus ' provision for them in the project estimates.

**A-2.3** It may be mentioned here that by adopting the numbering system given under 2.1, there will be no deviation from the existing Public Works Department's accounting procedures, while there will be considerable benefit by way of saving time and effort required for writing out the titles elaborately.

## A-3. KEY GROUPS

**A-3.1** In Table 1 to 5 a comprehensive breakdown of the ' key groups of main or stem ' account numbers has been given.

**A-3.2** It may be mentioned that not all these accounts or the sub-accounts will be required on any but the largest projects. It may appear enough in some cases to stop with decimalization to two stages, and in certain others, to go further down to more places; but to whatever extent it may be necessary in individual projects to expand the numbering system it shall be ensured that the same symbol or account number with decimals is used in all projects for the identical type of work or functions so that the costs and rates obtained for them are comparable without special efforts being made to reconcile the two sets of figures.

#### **A-4. CONCRETE DAM CLASSIFICATION**

**A-4.1** Detailed classification for a concrete dam is given in Tables 6 to 10.

#### **A-5. EARTH DAM CLASSIFICATION**

**A-5.1** Detailed classification for an earth dam is given in Table 11.

TABLE 1 TYPICAL MASTER CLASSIFICATION OF COST ACCOUNTS FOR RIVER VALLEY PROJECTS

( Clause A-3.1 )

Name of the project.....

PERMANENT ACCOUNTS  
( 100-599 )SUSPENSE OR CLEARING ACCOUNTS  
( 600-999 )

I Works	II Establishment, III Tools and Plant, IV Suspense, and V Receipts & Recoveries		Special Tools and Plant	Clearing Accounts
	Special Tools & Plant, First Cost	Establishment, Tools and Plant		
<p>In public works accounts, this will include all items which remain as such till the project is completed without distribution to permanent features ( including camps, villages, their first cost and operation charges )</p> <p style="text-align: center;">100 - 399</p> <p>1 — Works ( except Q — special tools and plants )</p>	<p>Temporary construction plant and machinery which will ultimately be removed, sold or abandoned upon completion of the project includes credit for resale or salvage value and cost of additions and improvements</p> <p style="text-align: center;">400 - 499</p> <p>Q — Special tools and plants</p>	<p>Includes all expenditure on account of pay and allowances of officers and establishment connected with the project, ordinary costs and plant acquired for the general use of project suspense items, recoveries as also indirect charges, such as capitalized value of abatement of land revenue and the cost of audit and accounts establishment</p> <p style="text-align: center;">500 - 599</p>	<p>Plant-operation ( suspense accounts for the operation of construction plant and equipment to be cleared monthly to permanent accounts )</p> <p style="text-align: center;">600 - 699</p>	<p>( Works suspense estimates, such as for collection of materials for works, supply of air, pumping, erection and dismantling of machinery, etc, to be cleared monthly to permanent accounts )</p> <p style="text-align: center;">700 - 799</p>
<p>100 Surveys</p> <p>101 Investigation studies and collection of data</p> <p>110 Permanent acquisition of private land</p> <p>111 Temporary acquisition of private land</p> <p>130 Reservoirs</p> <p>140 Concrete dam</p> <p>141 Masonry dam</p> <p>142 Earth dam</p> <p>240 Power house — sub-structure</p> <p>241 Power house — superstructure</p> <p>260 Power generation equipment</p> <p>261 Step up station equipment</p> <p>262 Auxiliary electrical equipment</p> <p>263 Miscellaneous power plant equipment</p> <p>310 Permanent residential buildings</p> <p>312 Permanent office buildings</p> <p>330 Demarcation pillars, stones, and distance marks</p> <p>335 Electric supply to camp ( See Table 2 for complete details )</p>	<p>400 Exploratory equipment</p> <p>401 Power generation equipment</p> <p>402 Excavation equipment</p> <p>403 Hauling equipment</p> <p>404 Concrete plant</p> <p>405 Air compressors</p> <p>410 Heavy transport vehicles</p> <p>411 Workshop equipment</p> <p>412 Rolling stock</p> <p>413 Manufacturing plants ( See Table 3 for complete details )</p>	<p>500 Control board</p> <p>501 Project manager/chief engineer</p> <p>502 Special officers/consultants</p> <p>503 Superintending engineer/directors</p> <p>510 Executive establishment</p> <p>530 Scientific instruments and drawing materials</p> <p>531 Ordinary plant &amp; machinery</p> <p>532 Tools</p> <p>536 Office furniture</p> <p>550 Purchases</p> <p>551 Stock</p> <p>552 Miscellaneous public works advances</p> <p>554 Workshop suspense</p> <p>570 Receipts and recoveries on capital account</p> <p>580 Capitalized value of abatement of land revenue</p> <p>590 Audit and accounts charges ( See Table 4 for complete details )</p>	<p>600 Operation of exploratory equipment</p> <p>601 Operation of power generation equipment</p> <p>602 Operation of excavation equipment</p> <p>603 Operation of hauling equipment</p> <p>604 Operation of concrete plant</p> <p>605 Operation of air compressors</p> <p>610 Operation of heavy transport vehicles</p> <p>611 Operation of workshop equipment</p> <p>612 Operation of rolling stock</p> <p>613 Operation of manufacturing plants ( See Table 5 for complete details )</p>	<p>Collection and supplies of materials ( stone, sand, etc )</p> <p>Supply of air</p> <p>Pumping</p> <p>Erection and dismantling charges of plants</p> <p>( Individual numbering and classification of estimates may be left to the projects )</p>

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**TABLE 2 DETAILED BREAKDOWN UNDER ITEM 'WORKS'**  
**100-399**

( Clause A-3.1, and Table 1 )

100	Surveys	
101	Investigation studies and collection of data	
102	Design studies, preparation of plans, estimates and reports	
103	Pay of consultants and specialists	
104	Training of engineers	
105	Cost of model experiments	
	<b>Open</b>	
109	Printing of project reports, estimates, design reports and bulletins	
110	Permanent acquisition of private land	
111	Temporary acquisition of private land	
112	Acquisition of Government land	
113	Compulsory land acquisition charges	
114	Cost of land acquisition establishment	
	<b>Open</b>	
120	Compensation for property ( houses, gardens, wells, trees, standing crops, etc )	
121	Relocation of roads and bridges	
122	Relocation of railways and railway bridges	
123	Relocation of other structures and improvements	
124	Rehabilitation of displaced persons	
	<b>Open</b>	
129	Deduct: Sale proceeds of wood, buildings, materials, etc	
130	Reservoirs	
	<b>Open</b>	
140	Concrete dam	
141	Masonry dam	
142	Earth dam	
143	Rock-fill dam	
	<b>Open</b>	
147	Weir	
	<b>Open</b>	
149	Barrage	
150	Auxiliary concrete dam	
151	Auxiliary masonry dam	
152	Auxiliary earth dam	
153	Auxiliary rock-fill dam	
154	Other structures ( retaining walls, minaret tower, pavilion, gaugewell, tunnels, inter-connecting reservoirs )	
	<b>Open</b>	
160	Overflow gravity spillway	} if separately estimated for
161	Syphon spillway	
162	Tunnel spillway	
163	Other types of spillway	

( Continued )

**TABLE 2 DETAILED BREAKDOWN UNDER ITEM 'WORKS'**  
100-399 — *Contd*

	<b>Open</b>
170	Irrigation sluice and gates
171	Other special purpose sluices and outlets
172	Penstock and its gates
	<b>Open</b>
175	Spillway gates
176	River outlet sluice gates
177	Under sluice gates
178	Emergency spillway gates
	<b>Open</b>
180	In-take works for hydro power
181	Water conductor system ( hydraulic works for power )
	<b>Open</b>
190	Head regulators
191	Cross regulators
	<b>Open</b>
195	Falls with bridges
196	Falls without bridges
	<b>Open</b>
200	Aqueducts with side bridges
201	Aqueducts without side bridges
	<b>Open</b>
204	Super-passages
	<b>Open</b>
206	Drainage syphons
207	Canal syphons
	<b>Open</b>
209	Level crossings
210	Railway bridges
211	National highway bridges
212	State highway bridges
213	District road bridges
214	Village road bridges
	<b>Open</b>
219	Other bridges
220	Escapes
	<b>Open</b>
230	Main canal

( *Continued* )



**TABLE 2 DETAILED BREAKDOWN UNDER ITEM 'WORKS'**  
100-399 — *Contd*

	<b>Open</b>
240	Power house sub-structure
241	Power house superstructure
	<b>Open</b>
250	Permanent telephone system
251	Permanent lighting system
	<b>Open</b>
260	Power house equipment ( generation equipment )
261	Step-up station equipment
262	Auxiliary electrical equipment
263	Miscellaneous power plant equipment
264	Grid sub-station equipment
	<b>Open</b>
270	Transmission lines
	<b>Open</b>
284	Distribution sub-station equipment
	<b>Open</b>
286	Mains
287	Services
288	Meters
289	Public lighting
290	Distribution lines
	<b>Open</b>
300	Navigation works
	<b>Open</b>
310	Permanent residential buildings
311	Temporary residential buildings
312	Permanent office buildings
313	Temporary office buildings
314	Workshop, stores and other utility buildings
315	Schools, hospitals, etc
316	Rest houses, hostels, inspection bungalows
	<b>Open</b>
320	Plantations
	<b>Open</b>
330	Demarcation pillars, stones and distance marks
331	Forming roads in camp area

( *Continued* )

**TABLE 2 DETAILED BREAKDOWN UNDER ITEM 'WORKS'**  
100-399 — *Contd*

332	Research station and laboratories
333	Making models
334	Temporary telephone system
335	Electric supply to camp
336	Water supply and conservancy arrangements
337	Labour welfare and workmen's compensation
338	Security and fire fighting arrangements
339	Sanitary arrangements
	<b>Open</b>
343	Running of hospitals and dispensaries
344	Malaria prevention and other public health measures
345	Running charges of inspection vehicles, boats and launches
346	Photography, publicity and printing
347	Running of schools
348	Foundation stone laying, and other inauguration ceremonies
	<b>Open</b>
353	Insulating oil system
354	Air-conditioning of the control room
355	Grounding system
356	Miscellaneous protection, guards, key-system, signs, etc
357	Testing of equipment for power generation
	<b>Open</b>
360	Maintenance of buildings
361	Maintenance of roads
362	Maintenance of railways
363	Maintenance of works
	<b>Open</b>
370	Railway lines and sidings
371	New roads
372	New water-ways
	<b>Open</b>
380	Soil conservation
	<b>Open</b>
390	Losses on stock
	<b>Open</b>

**TABLE 3 DETAILED BREAKDOWN UNDER ITEM 'SPECIAL TOOLS AND PLANT (FIRST COST)' 400-499**

( Clause A-3.1, and Table 1 )

400	Exploratory equipment
401	Power generation equipment
402	Excavation equipment
403	Hauling equipment
404	Concrete plant ( mixing, hauling and placing )
405	Air compressors
406	Dewatering and water supply pumps
407	Marine equipment
408	Miscellaneous heavy equipment
409	Miscellaneous light equipment
410	Heavy transport vehicles
411	Workshop equipment
412	Rolling stock
413	Manufacturing plants

**Open**

**TABLE 4 DETAILED BREAKDOWN UNDER ITEM 'ESTABLISHMENT, ORDINARY TOOLS AND PLANT' 500-599**

( Clause A-3.1, and Table 1 )

500	Control board
501	Project manager/chief engineer
502	Special officers/consultants
503	Superintending engineer/director
504	Other officers

**Open**

510	Executive establishment
511	Medical establishment
512	School establishment

**Open**

514	Other establishment
-----	---------------------

**Open**

530	Scientific instruments and drawing materials
531	Ordinary plant and machinery

( Continued )

**TABLE 4 DETAILED BREAKDOWN UNDER ITEM ' ESTABLISHMENT, ORDINARY TOOLS AND PLANT ' 500 - 599 — Contd**

532	Tools
533	Navigation plant
534	Camp equipage
535	Livestock
536	Office furniture
	<b>Open</b>
550	Purchases
551	Stock
552	Miscellaneous public works' advances
553	London stores
554	Workshop suspense
	<b>Open</b>
570	Receipts and recoveries on capital account
	<b>Open</b>
580	Capitalization of abatement of land revenue
	<b>Open</b>
590	Audit and accounts charges
	<b>Open</b>

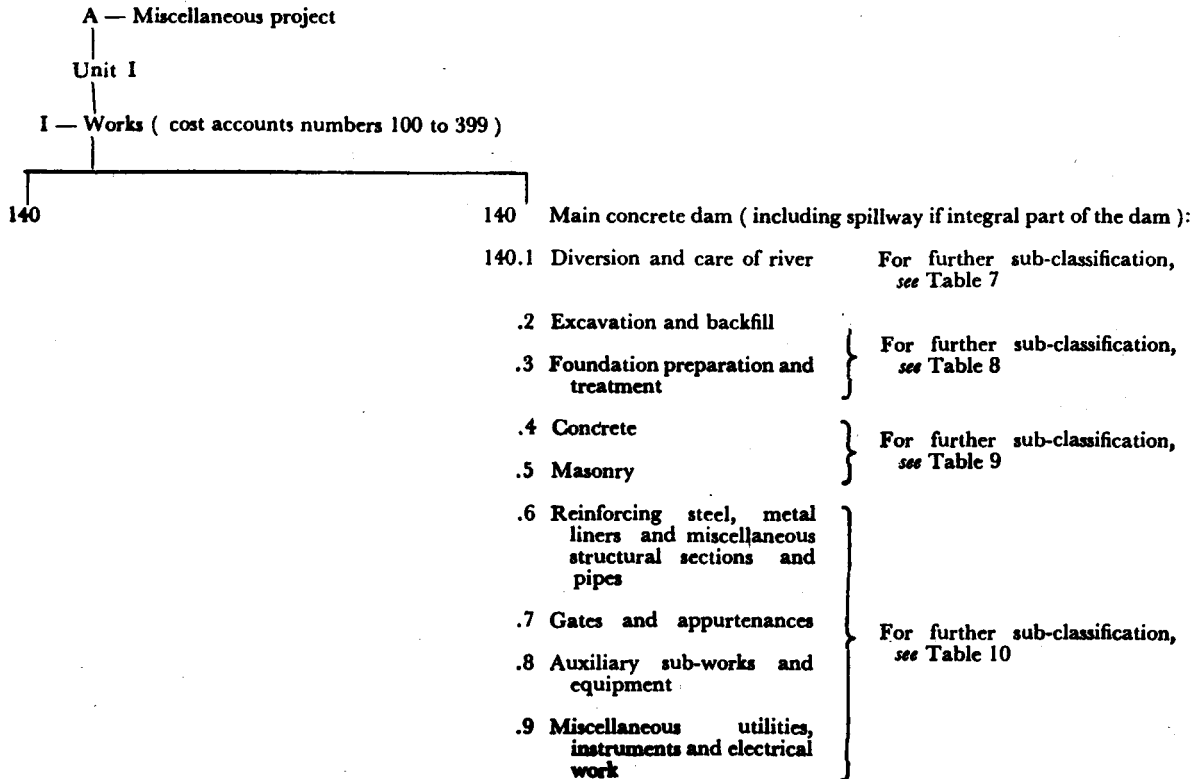
**TABLE 5 DETAILED BREAKDOWN UNDER ITEM ' SPECIAL TOOLS AND PLANT ( OPERATION ) ' 600 - 699**

( Clause A-3.1, and Table 1 )

600	Operation of exploratory equipment
601	" " power generation equipment
602	" " excavation equipment
603	" " hauling equipment
604	" " concrete plant ( mixing, hauling and placing )
605	" " air compressors
606	" " dewatering and water supply pumps
607	" " marine equipment
608	" " miscellaneous heavy equipment
609	" " miscellaneous light equipment
610	" " heavy transport vehicles
611	" " workshop equipment
612	" " rolling stock
613	" " manufacturing plants
	<b>Open</b>

**TABLE 6 DETAILED CLASSIFICATION FOR CONCRETE DAM**

( Clause A-4.1 )



**TABLE 7 DETAILED CLASSIFICATION OF 140 ' CONCRETE DAM '**

(140.1 Diversion and Care of River)

( Clause A-4.1, and Table 6 )

140	Main concrete/ masonry dam	.121 Preparation of surface and preliminary work	.111 Preparation of surface and preliminary work	
	140.1 ( Diversion and care of river )	.122 Cut off	.112 Sheet piling ( including driving & pulling )	
	140.11 Cellular sheet pile coffer dam	.123 Place and remove earthfill	.113 Cell fill ( placing and removing )	.131 Preparation of surface and other preliminary work
	140.12 Earth or rock-fill coffer dam	.124 Place and remove rock-fill	.114 Cribwork cut-off arm	.132 Cut off
		.125	.115 Grouting	.133 Concrete or masonry wall ( including dismantling )
		.126 Slope protection	.116	.134 Place or removal-fill ( if any )
		.127 Filter blanket	.117	.135 Grouting
		.128 Operation and maintenance	.118 Operation & maintenance	.136
		.129 Flood costs	.119 Flood costs	.137
	.13 Masonry or concrete coffer dam			.138 Operation & maintenance
	.14 Timber crib coffer dam			.139 Flood costs
		.141 Preparation of surface and preliminary work		
		.142 Crib construction		
		.143 Crib filling		
		.144 Removal of cribs and fill		
		.145 Grouting		
		.146 Connections to store and completed work		
		.147		
		.148 Operation & maintenance		
		.149 Flood costs		
	.15 Any other type of coffer dam			

.16 Diversion channels and tunnels

- .161 Alignment, shafting, and other preliminary work
- .162 Excavation and backfill ( including shoring and supports )
- .163 Concrete & masonry
- .164 Gates and appurtenances
- .165 Grouting ( consolidation )
- .166 Auxiliary structure and equipment ( valve chamber, tower, trash racks, etc )
- .167 Final closure
- .168 Operation and maintenance
- .169 Flood costs ( if any )

- .1631 Lining concrete
- .1632 Other concrete
- .1633 Masonry

- .1621 Clearing and grubbing
- .1622 Earth excavation
- .1623 Rock excavation
- .1624 }  
to } Unclassified excavation
- .1628 }  
.1629 } Rock-filling and grouting  
rip rap

} Including hauling and disposal

.17 Unwatering

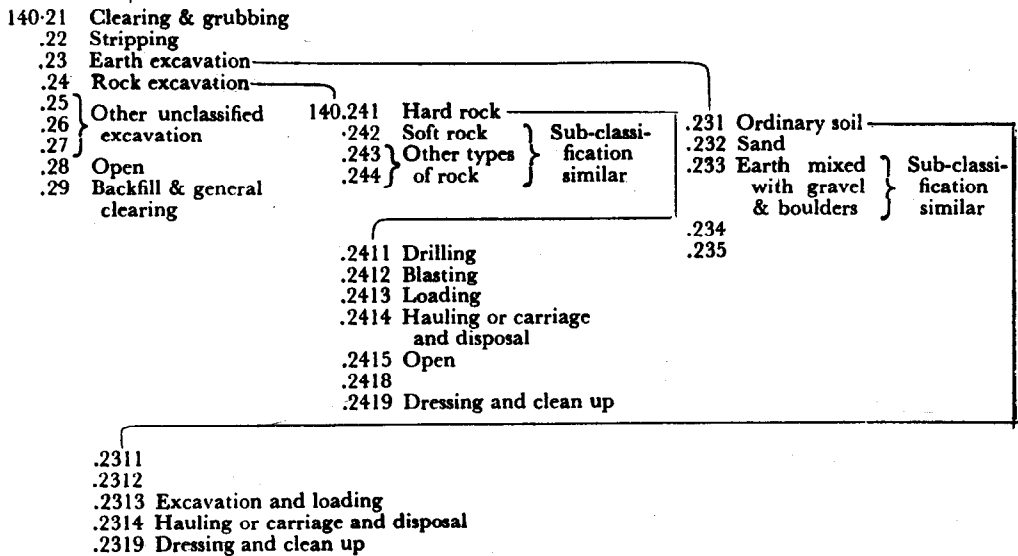
- .171 Shared cost of pumps and appurtenances
- .172 Operation of pumps and the system
- .173 Construction of sump wells and drains
- .174 Miscellaneous expenditure

.18 Break water and other miscellaneous appurtenances

.19 Deduct costs chargeable to other works

**TABLE 8 DETAILED CLASSIFICATION OF 140 ' CONCRETE DAM '**  
 ( 140.2 Excavation and Backfill 140.3 Foundation Preparation and Treatment )  
 ( Clause A-4.1, and Table 6 )

140 Main concrete/  
 masonry dam  
 140.2 Excavation and  
 backfill





140.3 Foundation preparation and treatment

- 140.31 Surface treatment
  - .32 Drilling grout and drainage holes
  - .33 Pipes and fittings
  - .34 Seam washing
  - .35 Cement grouting
  - .36 } Clay, chemical or
  - .37 } other grouting
  - .38 Treatment of cavities and fault zones
  - .39 Special foundation drains, relief wells, etc
- .321 } Different diameter  
to } percussion drill holes  
.324 }
- .325 } Different diameter  
to } core drill holes  
.329 }
- .351 Low pressure grouting ( consolidation )  
.352 High pressure grouting ( curtain )

TABLE 9 DETAILED CLASSIFICATION OF 140 ' CONCRETE DAM '

( 140.4 Concrete, 140.5 Masonry )

( Clause A-4.1, and Table 6 )

140 Main concrete/masonry dam

140.4 Concrete

140.41 Class A ( mass concrete )

.42 Class B ( intermediate concrete-heavy  
walls, piers, etc ).43 Class C ( thin walls, beams, columns  
and such difficult sections )

.44 Class D ( pumcrete )

.45 Class E ( concrete )

.46

.47 } Open for other types

.48 }

Similar sub-classification

.411 Cement and aggregates

.412 Mixing

.413 Hauling, placing and vibrating

.414 Cleaning, curing and finishing

.415 Form work and staging

.416 Reinforcing steel

.417 Cooling aggregates and concrete

.418 Electric lighting and miscellaneous charges

.419 Open

140.5 Masonry

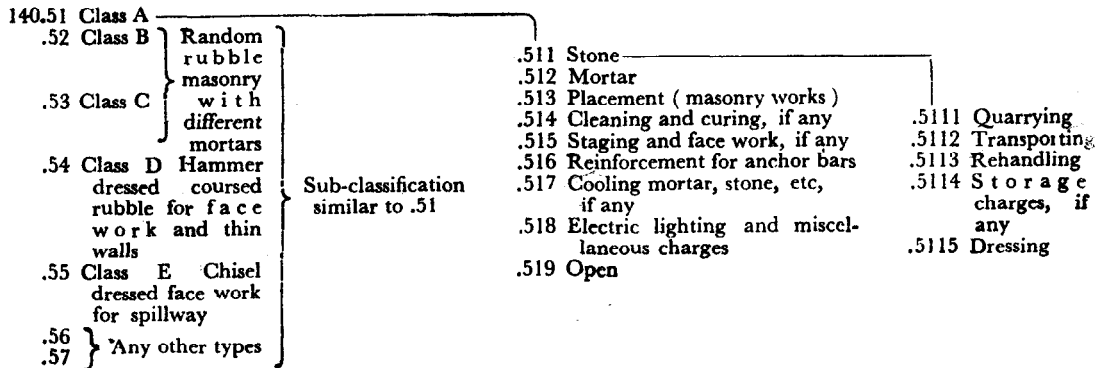


TABLE 10 DETAILED CLASSIFICATION OF 140 'CONCRETE DAM'

( 140.6, 140.7, 140.8 and 140.9 )

( Clause A-4.1, and Table 6 )

140	Main concrete/ masonry dam				
140.6	Reinforcing steel, metal liners, miscellaneous structural sec- tions and pipes			.611 First cost .612 Transportation and storage .613 Bending and fixing including cost of binding wire, welding, etc	
	140.61 Reinforcing steel* (if com- monly accounted for)				
	.62 Metal liners for spillway tunnels, sluices, etc				
	.63 to .69 } Miscellaneous structural sections and pipes				
				.631 First cost	.621 First cost
				.632 Transportation and storage	.622 Transportation and storage
				.633 Erection or fixing	.623 Erection
.140.7	Gates and appur- tenances (spillway)				
	140.71 Sluice gates				
	.72 Crest gates				
	.73 Sluice emer- gency gates	} Sub-classifica- tion will be similar		.711 Gate frames, guides and other embedded parts	} Including handling and erection
	.74 Crest emer- gency gates or stop logs			.712 Gates and seals	
	.75 Trash way gates			.713 Gate operating equip- ment	
	.76 Flash boards			.714 Handling and erection ( if commonly done )	
	.77 Trash racks				

140-8 Auxiliary works  
and equipment

- 140.81 Cranes, hoists and auxiliaries
- .82 Elevator powers, elevators, stairs, wells, etc
- .83 Road on top of dam
- .84 Spillway bridge and gate operation platform
- .85 Stilling basins, grade walls, bed and bank protective works, etc, in spillway portion
- .86 Special divide walls, training walls and other works forming integral parts of the dam but separately estimated for
- .87 Expansion and contraction joints, water-proofing and internal drainage
- .88 Crane and gate storage houses
- .89 Open

- .871 Water stops
- .872 Grouting of joints
- .873 Grouting of mass concrete
- .874 Grouting of masonry
- .875 Porous tile or formed drains
- .876 Filter backing to training walls to facilitate drainage
- .877 Drainage sumps and pumps

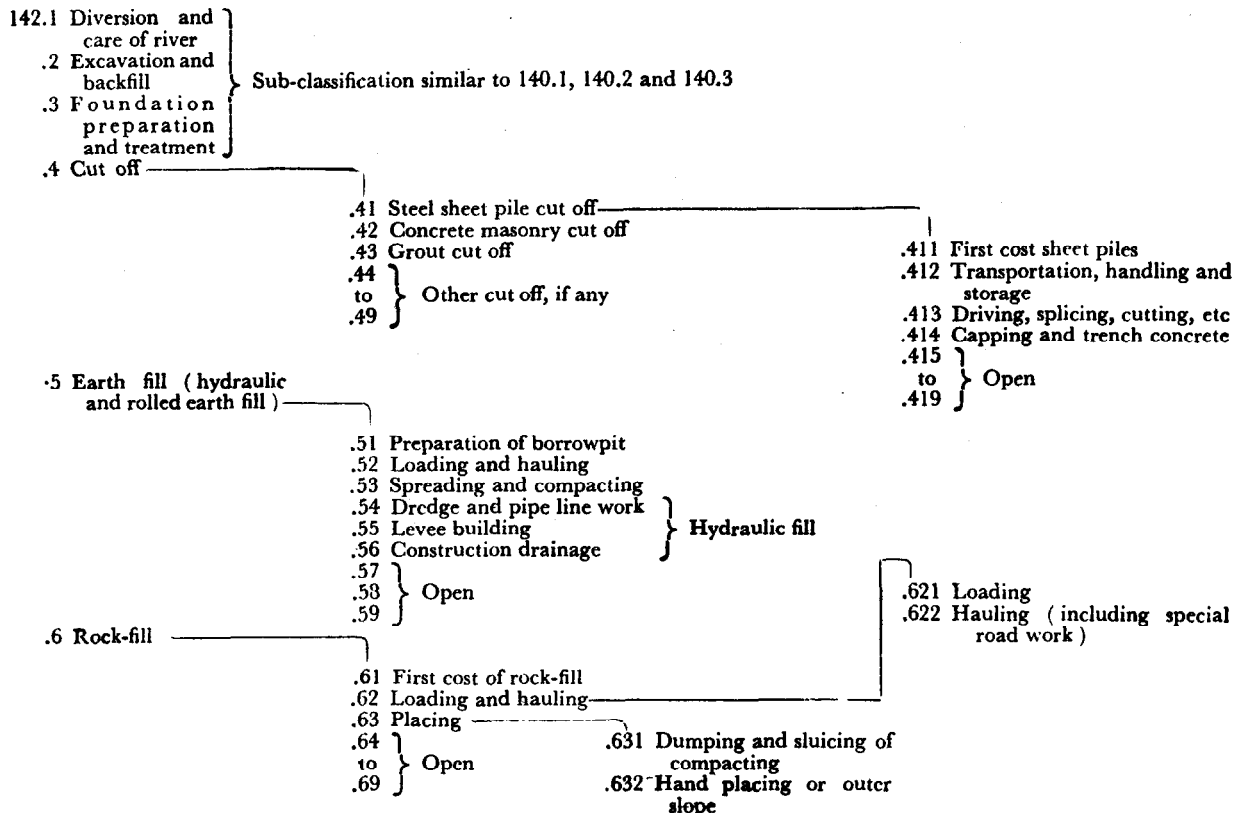
140-9 Miscellaneous utilities, instruments and electrical works

- 140.91 Embedded and other measuring instruments and devices
- .92 Permanent lighting and ventilation, including air-conditioning, if any
- .93 Miscellaneous metal work for ladders, steps, gratings, metal protective edges, etc
- .94 Parapets, handrails, architectural works
- .95 Parking lanes and miscellaneous utilities like parks, benches, guard and control room, sanitary fittings, permanent telephones, etc
- .96 Power supply and distribution arrangement, and control wiring
- .97
- .98 Open

\*This head should be used when reinforcing steel for all types of concrete is commonly accounted for. Normally, reinforcements should be provided under a particular type of concrete.

**TABLE 11 DETAILED CLASSIFICATION FOR EARTH DAM**

( Clause A-5.1 )



**.7 Filter blanket and internal drainage**

- .71 Trench filters**
- .72 Horizontal blanket filters**
- .73 Sloped blanket filters**
- .74 Pipe or tile feeder drains**
- .75 Main drains for final disposal**
- .76 Sumps, manhole & auxiliaries**
- .77** } Open
- .78** }
- .79** }

**.8 Slope protection and surface drainage**

- .81 Gravel blanket**
- .82 Pitching or rip rap**
- .83 Concrete or masonry facing**
- .84 Bituminous facing**
- .85 Timber facing**
- .86 Metal facing**
- .87 Turfing or grassing**
- .88 Surface drainage arrangements**
- .89 Open**

**.9 Auxiliary structures, utilities instruments and electrical work**

- .91 Embedded and other measuring instruments and devices**
- .92 Power supply, lighting and telephone**
- .93 Auxiliary work like slope ladders, retaining walls, special protective works, etc**
- .94 Road on top of dam, parapet, handrails and architectural works**
- .95 Parking lanes and miscellaneous utilities like parks, benches, guard room, etc**
- .96** } Open
- to** }
- .99** }

# INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

## Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

## Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>

## INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones: 26 60 21, 27 01 31

Telegrams: Manaksanstha

### Regional Offices:

Telephone

Western : Novelty Chambers, Grant Road	BOMBAY 400007	89 65 28
Eastern : 5 Chowringhee Approach	CALCUTTA 700072	27 50 90
Southern : C. I. T. Campus	MADRAS 600113	41 24 42
Northern : B69, Phase VII	S.A.S. NAGAR (MOHALI) 160051	8 78 26

### Branch Offices:

'Pushpak' Nurmohamed Shaikh Marg, Khanpur	AHMADABAD 380001	2 03 91
'F' Block, Unity Bldg, Narasimharaja Square	BANGALORE 560002	22 48 05
Gangotri Complex, Bhadbhada Road, T. T. Nagar	BHOPAL 462003	6 27 16
22E Kalpana Area	BHUBANESHWAR 751014	5 36 27
5-8-56C L.N. Gupta Marg	HYDERABAD 500001	22 10 83
R 14 Yudhister Marg, C Scheme	JAIPUR 302005	6 98 32
117/418 B Sarvodaya Nagar	KANPUR 208005	4 72 92
Patliputra Industrial Estate	PATNA 800013	6 28 98
Hantex Bldg (2nd Floor), Rly Station Road	TRIVANDRUM 695001	32 27