5.6.14.1 Capacity and Location

Capacity of OHSR shall be calculated by Mass curve method keeping in view the realistic availability of Electricity and water supply hours. Two number typical mass curves are enclosed at annexure K as sample for different types of conditions of availability of electricity. The tank shall be located such that the minimum residual pressure at the remotest point in the village is at least 12 mts. If elevated lands are available at a reasonable distance, ground level reservoirs can be proposed for storage of water. If such location is not available, an elevated service reservoir can be proposed with staging such that it gives a minimum residual pressure of 12 mts after counting for loss of head during peak hours due to simultaneous opening of the all the taps on the distribution system

The staging height of the tank shall be such that, a minimum residual pressure of 12m of water is maintained at the farthest/ highest point in the distribution system. The staging height of reservoir is normally kept at 15m (Generally the staging height varies between 15m to 35m). It is desirable to locate the reservoir at the highest point in the village so that the staging height is minimized. The overhead water tanks should be made of Reinforced Concrete and can have shapes preferably circular and intze type.

TABLE

5.6.14.2 Pipe Connections for Inlet, Outlet, Scour, Over Flow etc.

The inlet pipe to the over head service reservoir OHSR shall be preferably of the same diameter as the pumping main feeding the tank and the inlet shall be taken above the maximum water level of the tank. The outlet from the OHSR shall be equal to the diameter of the first pipeline in the distribution system starting from the OHSR. The outlet shall be placed atleast 150mm above the floor level/ bottom of the OHSR.

The overflow pipe shall be equal in diameter to the inlet pipe so that the water coming into the reservoir and overflowing quantity will be equal. The overflow pipe is located with its invert at maximum water level of the OHSR.

The scour/ washout pipe in the OHSR will be located at the lowest point in the floor of the OHSR. It is desirable to lead off both the overflow water and the scour-washout water

Towards the nearest drain the hence these two pipes must be located adjacent to each other.

Sometimes the overflow pipe and scour (washout) pipe are joined to the same chamber near the OHSR at ground level and later drained by a single gravity pipe to the nearest available drain. At times the overflow water will be wasted for long periods due to lack of communication between pump house and water tank locations. To avoid such wastage the overflow pipe of the OHSR is joined to the outlet pipe of the OHSR so that the overflow water is used in the distribution system instead of wasting.

It is desirable to provide bell mouths for inlet, outlet and overflow pipes to ensure smooth flow and strainers to the outlet pipe to ensure that no undesirable particles enter

distribution system. The overflow and scour pipes are also provided with strainers at the termination points in the masonry chamber to avoid entry of insect etc.

Vertical piping provided for reservoir for inlet, outlet, and scour cum overflow should be cast iron double flanged pipes. The flanges shall be machined to ensure that the pipes are true to plumb and the joints with bolts and nuts are leak-proof. All the pipes entering the tank and coming out of the tank shall be located at the floor of the tank. It is desirable tokeep the puddle flanges in the floor slab of the OHSR before concreting. However, while embedding the same, care must be taken to ensure that the flanges are true to plumb so that the vertical pipes connected to the OHSR are also plumb. Sometimes it may be necessary to fix the flanges after the concreting of the floor slab is done. In such cases it is suggested that suitable grouting compounds may be used to ensure that no leakage occurs through the floor slab at pipe locations.

5.6.15 House Service Connections

The supply from the main pipeline to the individual houses is made through a house service connection. For a house service connection, ferrule is used on the main line either to control the flow or for permanent disconnection. The ferrule is sufficiently throttled to deliver required flow at the contemplated pressure. The size of the ferrule shall be 1/8inch and also be less than the diameter of the connecting pipe. In case of main pipe being GI, gunmetal or bronze ferrules are screwed onto GI pipe. If the main pipe is of PVC, special screwed saddles are fixed onto the pipe. In addition, a stop cock will be provided in the beginning of house connection pipe to control the supply or to facilitate temporary disconnection.

Sometimes the connecting pipe to the consumer house may pass through a drain then there is a possibility of the contamination with drain water through any leakage in the consumer pipe. If the consumer pipe is with GI, it may corrode over a period of time and allow the wastewater into the main pipeline. Further the PVC consumer pipes also may be damaged when exposed in the drain portion, which may cause similar contamination. Hence it is recommended that the casing pipe be provided around the consumer pipe when drain is tobe crossed.

5.6.16 Treatment of water

The drinking water required to the community shall conform to the relevant clauses so as minimize health hazards to the community. The water supplied shall be free from pathogenic organisms, clear, palatable and fee from undesirable taste and odour, of reasonable temperature, neither corrosive nor scale forming and free from minerals which could produce undesirable physiological effects.

Water safety and quality are maintained through water treatment, disinfection and prevention of pollution and contamination. Rural water supplies are normally disinfected using bleaching powder, which makes the water wholesome. However, it will be necessary to search for sources of contamination and prevent such contamination of drinking water

supplies. Surface run off comes into contact with wastes containing pathogenic bacteria or the storage reservoirs may get inflows of domestic sewage and or industrial effluents. Contamination from domestic waste can enter the raw water sources such as borewells or open wells. Casing pipes for sufficient depth can prevent such entry of wastes into borewells. Watertight seining has to be proposed for sufficient depth to prevent entry of such wastes into the open wells.

Harmful wastes can also enter the water distribution systems through cross connections or back-siphonage conditions. A systematic sanitary survey can be undertaken to identify the sources of contamination and preventive measures taken where necessary.

5.6.16.1 Disinfection Plant

Disinfection of water shall be carried out using chlorine or silver ionization based plant.

a) Silver Ionization Process

The Silver ionization is a cold sterilization process using special silver electrodes which discharge silver ions into the water by means of low power direct electric current. As the water passes through the sealed chamber, metallic ions are generated to purify the water. The microscopic action of the ions with bacteria are twofold. First, the bacteria are destroyed through a change in their enzyme processes. The ions maintain a stable sanitizer residual in the water until they are used up by this process.

FIGURE

Major Benefits

- Effective protection against reinfection after sterilization
- Conservation of the water is maintained over prolonged storage periods
- The process ensures constant disinfection of conduits and storage tanks
- The silver ionization process entails no risk of corrosion in pipes or storage tanks
- The treated potable water is completely tasteless and odourless
- Silver ions are non-volatile and retains their residual effect within a wide temperature range
- No moving parts in the unit ensure long system life and keep maintenance to a minimum

b)Disinfection by Chlorination

Chlorination has become the most common type of drinking water disinfection. It should be noted that it is designed to kill harmful organisms, and generally does not result in sterilewater(freeofallmicroorganisms). Twotypesof processesaregenerally used – hypochlorination, employingachemicalfeedpumptoinjectacalciumorsodium hypochlorite solution, and gas chlorination, using compressed chlorine gas.

Hypochlorination. Calcium hypochlorite (Bleaching Powder) is available commercially in either a dry or wet form. High-test calcium hypochlorite (HTH), the form most frequently used, contains about 30% available chlorine. Because calcium hypochlorite granules or pellets are readily soluble in water and are relatively stable under proper storage conditions, theyareoften favoured overotherforms. Figurebelowshowsatypical hypochloriteinstallation.

Sodium hypochlorite is available in strengths from 1.5% to 15%, with 3% available chlorine as the typical strength used in water treatment applications. The higher the strength of the chlorine solution, the more rapidly it decomposes and the more readily it is degraded by exposure to light and heat. It must therefore be stored in a cool location and in a corrosion resistant tank. Typically, 30 minutes of chlorine contact time is required for optimal disinfection with good mixing. Water supply treatment dosages are established on the basis of maintaining a residual concentration of chlorine in the treated water.

Water-based solutions of either the liquid or the dry form of hypochlorite are prepared in predetermined stock solution strengths. Solutions are injected into the water supply using special chemical metering pumps called hypochlorinators. Positive displacement types are the most accurate and reliable and are commonly preferred to hypochlorinators employing other feed principles (usually based on suction). Positive-displacement-type hypochlorinators are readily available at relatively modest costs. These small chemical-feed pumps are designed to pump (inject under pressure) an aqueous solution of chlorine into the water system. They are designed to operate against pressures as high as 100 psi, but may also be used to inject chlorine solutions under ambient (atmospheric) or negative head conditions.

Hypochlorinators come in various capacities ranging from 3.8 to 227 l/day. Usually, the pumping rate is manually adjusted by varying the stroke of the pump's piston or diaphragm. Once the stroke is set, the hypochlorinator accurately feeds chlorine into the system at that rate, maintaining a constant dose. This works well if the water supply rate and the output of the pump are fairly constant (needed)?

FIGURE

5.7 SOLID WASTE MANAGEMENT SYSTEMS

Solid Waste Management is one of the essential obligatory functions of the Local Bodies. This service is falling too short of the desired level of efficiency and satisfaction, resulting in problems of health, sanitation and environmental degradation. Barring a few progressive municipal corporations in the country, most local bodies suffer due to non-

availability of adequate expertise and experience, thereby the solid waste is not properly handled resulting into creation of environmental pollution and health hazards.

When solid waste is disposed off on land in open dumps or in improperly designed landfills (e.g. in low lying areas), it causes the following impact on the environment.

a. Ground water contamination by the leachate generated by the waste dump
b. Surface water contamination by the run-off from the waste dump
c. Bad odour, pests, rodents and wind-blown litter in and around the waste dump
d. Generation of inflammable gas (e.g. methane) within the waste dump
e. Fires within the waste dump
f. Erosion and stability problems relating to slopes of the waste dump
g. Epidemics through stray animals
h. Acidity to surrounding soil and
i. Release of greenhouse gas

5.7.1 Objective of Solid Waste Management

The objective of solid waste management is to reduce the quantity of solid waste disposed off on land by recovery of materials and energy from solid waste. This in turn results in lesser requirement of raw material and energy as inputs for technological processes.

Effective solid management systems are needed to ensure better human health and safety. They must be safe for workers and safeguard public health by preventing the spread of disease. In addition to these prerequisites, an effective system of solid waste management must be both environmentally and economically sustainable.

Environmentally sustainable: It must reduce, as much as possible, the environmental impacts of waste management.

Economically sustainable: It must operate at a cost acceptable tocommunity.

An effective waste management system includes one or more of the following options:

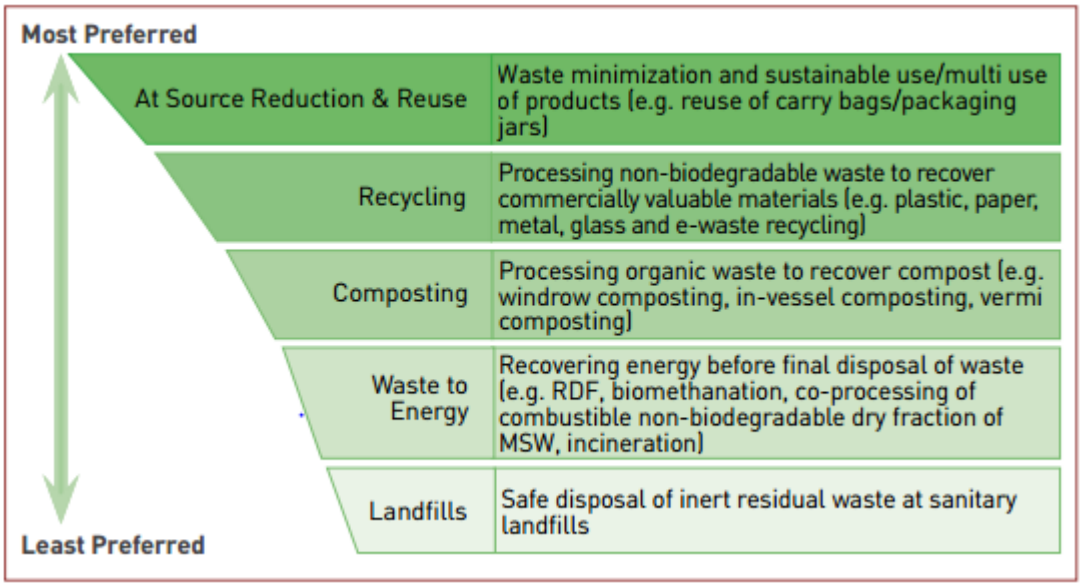
a. Waste collection and transportation.
b. Resource recovery through sorting and recycling i.e. recovery of materials (such as paper, glass, metals) etc. through separation.
c. Resource recovery through waste processing i.e. recovery of materials (such as compost) or recovery of energy through biological, thermal or other processes.
d. Waste transformation (without recovery of resources) i.e. reduction of volume, toxicity or other physical/chemical properties of waste to make it suitable for final disposal.
e. Disposal on land i.e. environmentally safe and sustainable disposal in landfills.

5.7.2 Quantification and Composition of Waste

Quantity and nature of waste created in area shall be assessed before planning a waste management scheme for the particular area. Waste moving through the system should be quantified at multiple locations to assess the actual quantities of waste available for processing and direct disposal. Waste generated from households, markets, and other commercial establishments and institutions should be quantified. Estimating future waste generation quantities and composition is critical for developing SWM plan. Planning horizons for SW processing, treatment, or disposal projects typically extend to 20–30 years, depending on the nature of the facility. Forecasting future SW generation is dependent on various factors, such as:

1. Future population forecasts;
2. Anticipated lifestyle changes; and
3. Change in socio-economic profile of the LB.

Population projection is dependent on factors governing future growth and development in the considered jurisdiction. Growth in all development sectors should be considered. Per capita waste generation rates are to be established for each city for planning waste management schemes. SW composition and characteristics vary considerably within a local body. Daily, seasonal, and temporal fluctuations are usually observed. Solid waste is heterogeneous in nature and consists of varied waste fractions.



5.7.3 Source Segregation

The SWM Rules, 2016 defines segregation as sorting and separate storage of various components of solid waste namely biodegradable wastes including agriculture and dairy waste, non-biodegradable wastes including recyclable waste, non-recyclable combustible waste, sanitary waste and non-recyclable inert waste, domestic hazardous wastes, and construction and demolition wastes.

Segregating waste at source ensures that waste is less contaminated and can be collected and transported for further processing. Segregation of waste also optimizes waste

processing and treatment technologies. It results in high proportion of segregated material that could be reused and recycled, leading to less consumption of virgin material.

5.7.4 Functional elements of waste management system

Waste Generation: Waste generation encompasses activities in which materials are identified as no longer being of value (in their present form) and are either thrown away or gathered together for disposal.

Waste Handling, Sorting, Storage, and Processing at the Source: Waste handling and sorting involves the activities associated with management of wastes until they are placed in waste storage containers for collection. Handling also encompasses the movement of loaded containers to the point of collection. Sorting of waste components is an important step in the handling and storage of solid waste at the source. Processing at the source involves activities such as backyard waste composting.

Collection: The functional element of collection includes not only the gathering of solid wastes and recyclable materials, but also the transport of these materials, after collection, to the location where the collection vehicle is emptied. This location may be a material processing facility, a transfer station, or a landfill disposal site.

Sorting, Processing and Transformation of Solid Waste: Sorting often includes the separation of bulky items, separation of waste components by size using screens, manual separation of waste components, and separation of ferrous and non-ferrous metals. Transformation may be done by a variety of mechanical (eg. shredding), thermal (e.g. incineration without energy recovery) or chemical (e.g. encapsulation) techniques.

Transfer and Transport: The functional element of transfer and transport involves two steps: (i) the transfer of wastes from the smaller collection vehicle tothe larger transport equipment and (ii) the subsequent transport of the wastes, usually over long distances, to a processing or disposal site.

Disposal: The final functional element in the solid waste management system is disposal. Today the disposal of wastes by landfilling or uncontrolled dumping is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from Materials Recovery Facilities (MRFs), residue from the combustion of solid waste, rejects of composting, or other substances from various solid waste-processing facilities.

5.7.5 Decentralized Waste Management Systems

Decentralized community level waste management systems are preferred to centralized waste management solutions under certain circumstances. Decentralized waste management systems or community level waste management systems reduce the burden of handling large volumes of SW at a centralized location, with corresponding reduction in costs of transportation and intermediate storage. Some of the advantages of decentralized waste management include the following:

- Decentralized systems allow for lower level of mechanization than the centralized solutions, and provide job opportunities for informal workers and small entrepreneurs.
- Decentralized options can be tailor made for the local waste stream, climate, social, and economic conditions.
- Decentralized systems reduce the cost incurred for the collection, transportation, and disposal of waste by the ULBs.

However, LBs should be aware of some of the limitations of decentralized waste management such as the following:

- difficulty in obtaining land in many urban areas;
- difficulty in maintaining scientific and hygienic conditions due to lack of sufficient space and training and capacity of workers;
- uncertain quality of end products; and
- difficulty in ensuring economic viability of the system, especially when qualified staff is required.

Collection of recyclables at the community level, preferably through involvement of the informal sector, and management of organic waste through home composting systems and community level composting systems are preferred.

5.7.6 Bio degradable waste management

Biodegradable waste includes any organic matter in waste which can be broken down into carbon dioxide, water, methane or simple organic molecules by micro-organisms and other living things using composting, aerobic digestion, anaerobic digestion or similar processes. In waste management, it also includes some inorganic materials which can be decomposed by bacteria.

Decomposition and stabilization of organic waste matter is a natural phenomenon. Composting is an organized method of producing compost manure by adopting this natural phenomenon. Compost is particularly useful as an organic manure which contains plant nutrients (Nitrogen, Phosphorous and Potassium) as well as micro nutrients which can be utilized for the growth of plants .When used in conjunction with chemical fertilizers optimum results are obtained.

Biodegradable waste can be decomposed in two ways;

i. Aerobic decomposition

ii. Anaerobic decomposition.

5.7.6.1 Aerobic methods

Such decomposition process takes place in the presence of air. In this process aerobic bacteria act on the complex organic matter and break it down into nutrients. In this process primarily carbon-dioxide is produced. Some bacteria in the Pseudomonas species and Bacillus species help in aerobic degradation. eg. Windrow composting, aerated static pile composting and in-vessel composting, vermi-culture etc. In the aerobic process the utilisable product is compost.

5.7.6.1.1 Composting

Solid waste (SW) primarily consists of organic, inorganic, and inert fractions. Under natural conditions, the organic fraction of waste continually decomposes, accompanied by a strong foul odour and production of gases, which are predominantly methane or CO2depending on the aerobic condition of the decomposing mass. Vectorinfestation during the natural decomposition is a common phenomenon.

Composting is a process of controlled decomposition of the organic waste, typically in aerobic conditions, resulting in the production of stable humus-like product, i.e., compost. Considering the typical composition of wastes and the climatic conditions, composting is highly relevant in India and should be considered in all Solid Waste Management (SWM) concepts. Composting of the segregated wet fraction of waste is referred. Mixed waste composting, with effective and appropriate pretreatment of feedstock, may be considered as an interim solution; in such cases, stringent monitoring of the compost quality is essential. Composting is an environmentally beneficial waste recycling mechanism and not a waste disposal mechanism.

Composting can be carried out in two ways i.e., aerobically and an-aerobically. During aerobic composting aerobic micro-organisms oxidize organic compounds to Carbon dioxide, Nitrite and Nitrate. Carbon from organic compounds is used as a source of energy while nitrogen is recycled. Due to exothermic reaction, temperature of the mass rises. During anaerobic process, the anaerobic micro organisms, while metabolising the nutrients, break down the organic compounds through a process of reduction. A very small amount of energy is released during the process and the temperature of composting mass does not rise much. The gases evolved are mainly Methane and Carbon dioxide. An anaerobic process is a reduction process and the final product is subjected to some minor oxidation when applied to land.

5.7.6.1.1.1 Benefits of Composting

- The real economic benefits of compost use include improved soil quality, enhanced water retention capacity of soil, increased biological activity, micronutrient content, and improved pest resistance of crops.

- Composting minimises or avoids GHG emissions from anaerobic decomposition of organic waste (such as in a large unturned heap).
- Composting increases the design life of other waste management facilities.
- Stringent design requirements and associated costs for catering to management of leachate from organic waste decomposition may be reduced in those landfills that do not receive organic waste.
- Compost is particularly useful as organic manure; it contains macronutrients (nitrogen, phosphorous, and potassium) as well as micronutrients. When used in conjunction with chemical fertilisers, optimum results are obtained.
- The use of compost reduces the dependency on chemical fertilizers for agricultural operations. When used as a soil amendment, compost reduces the need for water, fertilisers, and pesticides. Compost acts as a soil conditioner, therefore supporting the long-term fertility of soil.
- Compost may be used to revitalise vegetation habitats and add lifeto marginal, impoverished soils and waste lands.
- Compost may also be used as a bio matrix in remediation of chemicalcontaminants and as a remediated soil in contaminated sites; composthelps in binding heavy metals and other contaminants, reducingleachate and bio-absorption.

5.7.7 Non-bio degradable waste management

5.7.7.1 Material recovery facility

The SWM Rules, 2016 defines “Materials Recovery Facility” (MRF) as a facility where non-compostable solid waste can be temporarily stored by the local body or any other entity mentioned in rule 2 or any person or agency authorized by any of them to facilitate segregation, sorting and recovery of recyclables from various components of waste by authorized informal sector of waste pickers, informal recyclers or any other work force engaged by the local body or entity mentioned in rule 2 for the purpose before the waste is delivered or taken up for its processing or disposal; Material recovery starts at the primary level, by households who segregate recyclables like newspapers, cardboard, plastics, bottles, etc. from waste to sell such material to local recyclers, scrap dealers or haulers. Waste pickers pick up parts of this waste to earn their living. Well-segregated recyclables can directly be transferred to a processing site or to the recyclable market depending on local conditions.

5.7.7.2 Recycling

Recycling plays a vital role in reducing the quantity of waste, increasing resource recovery and minimising the financial and environmental burden of SWM. Solid Waste Management (SWM) Rules, 2016 defines recycling as “the process of transforming segregated solid waste into a new product or a raw material for producing new products.” Further, it also states that “arrangement shall be made to provide segregated recyclable

material to the recycling industry through waste pickers or any other agency engaged or authorized by the urban local body for the purpose." Recycling is a preferred waste management strategy after source reduction and reuse. Recycling systems should be adopted before planning for any waste processing or treatment facilities.

5.7.7.2.1 Advantages of Recycling

Recycling diverts a significant fraction of municipal, institutional and bulk waste from being dumped or disposed in landfills. This results in saving of scarce resources as well as reducing environmental impacts and the burden of waste management on public authorities. If appropriate market mechanisms are established, recycling can generate revenues, contributing to the overall cost recovery for municipal solid waste service provision

For the LB:

- Reduces waste volume.
- Cost savings in collection, transportation and disposal.
- Longer life span for landfills.
- Reduced environmental management efforts.

For the economy:

- Reduction of imports of raw materials, fertilisers etc. and hence foreign currency required.
- Livelihood opportunities for recyclers in the recycling industry.

For the environment:

- Sustainable use of resources
- Reduced amount of waste going to storage sites and reducedrequirement of land.
- Reduced environmental impacts including impacts of climatechange.

5.7.7.3 Incineration

Incineration is a waste treatment process that involves combustion of waste at very high temperatures, in the presence of oxygen temperatures of about 800 degree C and above and results in the production of ash, flue gas and heat. Incineration is feasible for unprocessed or minimum processed refuse besides for the segregated fraction of the high calorific waste. The potential for energy generation depends on the composition, density, moisture content and presence of inert in the waste. In practice, about 65 to 80 % of the energy content of the organic matter can be recovered as heat energy, which can be utilized either for direct thermal applications, or for producing power via steam turbine generators. Besides the potential for energy use, incineration of municipal waste helps to reduce landfill volumes. Incineration is an option especially where other better options of processing of waste are not feasible and land for landfilling and other waste processing methods is scarce.

5.7.7.4 Construction and demolition waste (c & d waste)

Construction and demolition and other inert waste may be utilized for making bricks, pavement blocks, construction materials such as aggregates etc. Ward level debris deposit sites should be created. Containers could be provided at such locations, and a small collection charge could be levied for receiving such waste and transporting it for disposal. Rates may be prescribed for such collection by the LB, and contracts could be given for managing such sites.

LBs must make serious efforts to utilise C&D waste and should motivate the private sector to set up processing plants. Profitable use of C&D waste will minimise the cost of managing such waste and requirement for valuable landfill space, besides giving employment opportunities to unemployed youth. It will also save natural resources and reduce the use of virgin soil.

5.7.7.5 E-waste

E-waste or waste electrical and electronic equipment (WEEE) includes surplus, obsolete, or broken electrical or electronic devices. Its quantum is increasing yearly, and disposal of e-waste is becoming a global environmental and public health issue. Currently applied processes for recycling WEEE are largely unscientific and environmentally unsound, hence posing serious health threats. It will be a challenge to reorganize the recycling of WEEE to establish recycling methods that protect both workers and the environment.

5.7.8 Slaughter House

Slaughtering is normally done by small scale animal dealers or slaughter house contractors or meat stall owners. They usually bring animals to slaughter houses and take away meat, hide, bones and other valuable materials.There are various central Acts/Rules and guidelines which necessitate streamline of the facilities, systems and protocols of operation of slaughter houses. The Prevention of Cruelty to Animals Rules, 2001 is the important legislation in this regard.

Local bodies are responsible for providing sufficient facilities for slaughtering of animals. Though, slaughtering facilities are provided in many Local Bodies, especially Urban Local Bodies, their hygienic condition is generally very poor. The animals are usually slaughtered in open space by crude method in an unhygienic environment. One reason for the spread of certain diseases among the public may be due to slaughtering the animals in unhygienic environment and distributing contaminated meat. Mixing of meat with viscera, blood and other evisceration waste is a common practice and thereby chances of contamination of meat are very high in most of these places.

Waste especially solid waste are used to bundle in gunny bags are usually thrown on the bank of major roads, open spaces and water bodies. Therefore, there is urgent necessity for segregation of waste and resource recovery from slaughter house waste.

People are looking for good quality meat processed in neat and clean environment. Accordingly the slaughtering of animals should be done inside the slaughter houses which are having required basic facilities. LSGIs are responsible for the construction and maintenance of slaughter house and for ensuring distribution ofgood quality meat to the people.

5.7.8.1 Basic Requirements as per BIS Guideline

Guideline applicable to Slaughter House is specified as guideline titled 'Basic Requirement for an Abattoir' -IS 4393-1979 and it was reaffirmed in 2005. Salient provisions in the guideline is given in the following Table.

Basic Requirements as per BIS Guideline (IS 4393-1979)Reaffirmed in 2005

<table>
<tr><th>Sl. No.</th><th>Particulars</th><th>Specification</th></tr>
<tr><td>1</td><td>Location</td><td>Outside or on the periphery of city or town, away from airport, near to market, availability ofwater, electricity, sewage disposal facility</td></tr>
<tr><td>2</td><td>Layout Plan</td><td>Essential Facilities includes resting place, facilities for ante-mortem, facility for humane slaughter, flaying, dressing and washing of carcasses, hanging carcasses, handling of by-product, inspection of edible meat, laboratory, staff welfare, isolation of sick animals, water supply and meat vending facility</td></tr>
<tr><td>3</td><td>Rails for carcasses</td><td>Rails with hooks of suitable rest proof metal and hookes and rail should be cleaned and sterilized</td></tr>
<tr><td>4</td><td>Height of rail</td><td><table><tr><th>Operation</th><th>Large Animal</th><th>Small Animal</th></tr><tr><td>Bleeding</td><td>4500 - 5000 mm</td><td>2200 - 3000 mm</td></tr><tr><td>Dressing</td><td>3200 mm</td><td>2000 - 2200 mm</td></tr></table>Falling slope of 10mm per metre for gravity rail</td></tr>
</table>

5.7.8.2 Design Parameters

Classification : General classification for slaughter house followed in national level is given in the following Table

Classification of Slaughter House

Sl. No.	Class of Slaughter House	Number of Animals Slaughtered per Day
1.	Large scale	> 200 large animals or > 1000 goat or sheep / day
2.	Medium scale	50-100 large animals or 300-1000 goat / sheep / day
3.	Small scale	< 50 large animals or

		< 300 goat or sheep / day

In Kerala, very few LSGIs are having requirement of slaughtering more than 20 large animals per day. In most of the Grama Panchayats, number of large animals slaughtered per day is normally less than 5.

5.7.8.3 Land Requirement

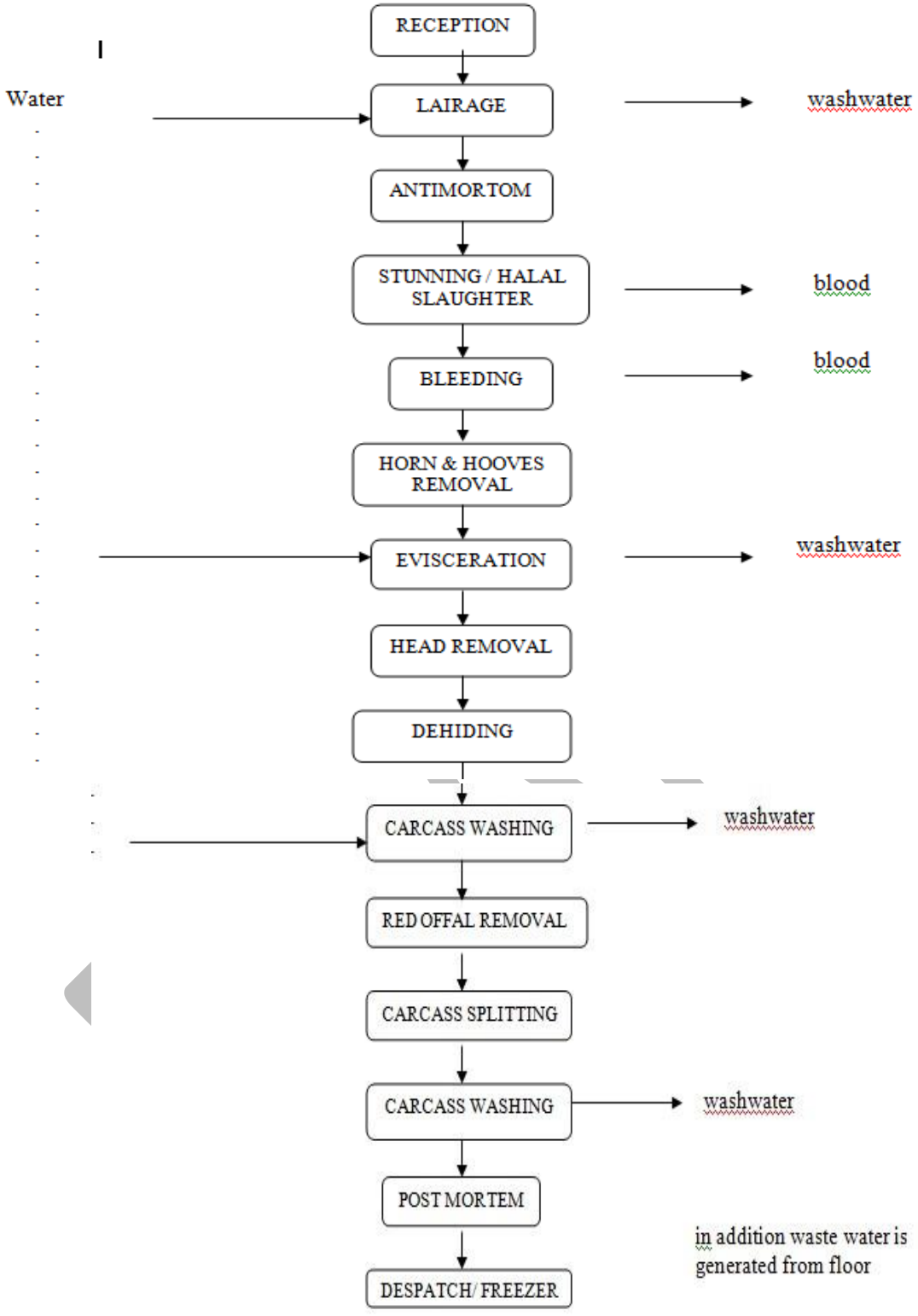
In Kerala, land is a major constraint, hence minimum land shall be made set apart for setting up of slaughter house. Land selected should be preferably level and dry, so that construction and waste disposal cost can be minimized. Road connectivity is essential to the project site for transportation of animals to the slaughter house and meat and other items back. It is better to construct the slaughter house near to the market, and if there is no market, a meat stall may be opened as far as near to the slaughter house in order to minimize transportation costs.

Basic land requirement and basic facilities required for a slaughter house for slaughtering 5 – 10 large and 20 small animals are given below**:**

- A minimum of 50 cents of land.
- Level and dry land, rectangular or square shape is preferred.
- Location shall be outside or on the periphery of a city or town and shall be away from an Airport (IS 4393-1979).
- Road connectivity to the area is essential.
- Potable water, electricity and proper hygiene sewage disposal facilities should be ensured.
- More land area, if available, is preferable and it can be used for buffer zone and green belt development.

5.7.8.4 Slaughter House Process Flow Chart

Process flow chart for a Modern Slaughter House is given here. Main emphasis is to segregate waste at different stages and to recover resources from it. Use of water should be minimum in order to reduce quantity of waste water from slaughter house.



Process Flow Chart for a Modern Slaughter House

Construction and maintenance of modern slaughterhouse which is having sufficient Waste Management Facilities are inevitable for maintaining societal hygiene in urban and rural areas. There are specific guidelines/ legislations prescribing basic minimum facilities to be provided in a slaughterhouse. The Prevention of Cruelty to Animal Rules 2001, the

Kerala Municipality Act 1994, the Kerala Panchayat Raj Act 1994 and Water (Prevention and Control of Pollution) Act 1974 Act are the major legislations, which are applicable and insisting for minimum facilities to be provided in a modern slaughterhouse.

SECTION- 6

6. ESTIMATE PREPARATION AND SANCTIONS

6.1 ESTIMATES

Estimate is the basic document that explains technical aspects of public works both in quantitative and qualitative manner. Estimate prepared on a public work in the LSGI shall be considered as a public document to assure transparency on public works in accordance with the philosophy of decentralized governance and development.

6.1.1 Preparation of estimates

The estimates are to be prepared in conformity with the design and drawings prepared by the Assistant Engineer (AE)or under the supervision of the Assistant Engineer and in adherence to the directions of the Chief Engineer of Local Self Government Department (CE,LSGD), standard Codes, relevant GOs, and Circulars.

An estimate shall contain:

a) Estimate Report explaining the nature and necessity of work including the location, salient features of the work, specifications/ data/ Schedule of Rates/ Cost Index adopted, justification for Observed Data & Market Rates, availability of land, etc.
b) Site Plan
c) The Plan, Design, and level sheet wherever necessary
d) Soil Investigation Report if necessary
e) Structural Design if necessary. Structural Designs prepared by Consultants shall be got approved by the aided/ Government Engineering Colleges/ any agency authorized by the Government.
f) Detailed Estimate. (i.e. measurements, quantities, abstract showing the estimated cost of each item and total cost of the work)

The estimate shall be prepared using the PRICE software developed by NIC. The software contains provision for data preparation with schedule of rates and local market rate, provisions for online submission and approval of estimates and other features. The software shall be updated as and when required.

6.1.2 Types of Estimates

The different types of estimates are:

a) Preliminary Estimate
b) Detailed Estimate

c) Recast Estimate
d) Working Estimate
e) Supplementary Estimate
f) Revised Estimate

a) Preliminary Estimate.

Preliminary estimate shall be submitted ~~for works costing up to Rs. 2.00 crore, beyond which detailed estimate shall be submitted~~ in order to accord administrative sanction for all works. All works shall be initiated only through a preliminary estimate. This is prepared to form a reasonably accurate idea of the probable expenditure and also the essential features of the work.

Preliminary estimates for works shall be prepared by the Assistant Engineer based on site inspection with the help of Overseer and based on Schedule of Rates in force. The Assistant Engineer shall verify the provisions and ensure that they are adequate before forwarding it to his superior officer for issuing project/administrative sanction.

The preliminary estimate must contain a report, giving information on all aspects of the work for satisfactory completion, with specifications, and justification for the work. It must also include the details of site conditions, with site plan and layout drawings. The Preliminary Project Report (PPR) for Administrative Sanction should contain the following:

i. Docket Sheet
ii. Site plan
iii. Typical plans/ cross sections (standard drawings of proposed work)
iv. Preliminary Estimate
v. Land Availability/ certificate

In the case of works exceeding TS powers of Superintending Engineer detailed estimate is required for which competent authority shall approve an investigation estimate.

b) Detailed Estimate

Detailed estimate shall be submitted in order to accord Technical sanction for all works. This shall be prepared after detailed investigation of the site by the concerned authority assisted by subordinate officers and on the basis of detailed designs and specifications for the work including source of supply and cost of different materials, cost of labour, hire charges of tools and plant, if any etc. Proper care shall be bestowed on the preparation of a detailed estimate so that it reflects as faithfully as possible the cost of work as can be foreseen at that time.

Detailed estimates for works shall be prepared by the Assistant Engineer and the Overseer based on approved layout and designs and on the Schedule of Rates in force. ~~Actualconveyance shall be adopted for all estimates.~~A transit walk should be conducted by the Engineer in charge along with the local people in full stretch and views and interaction of the local people shall be recorded.

Detailed checking of the estimate shall be done only in the office of TS Issuing Authority. Intermediate officers shall record their views and suggestion in the docket sheet accompanying the estimate. All estimates received in an office shall be forwarded to the higher offices within seven days, if the estimate amount exceeds the power of sanction. Subordinate technical staff shall obtain written orders of the head of office before effecting corrections other than arithmetical errors in the detailed estimate.

The detailed estimate for a work consists of seven parts, viz.-

i. A docket sheet covering the estimates
ii. A report containing the following particulars:-
    - The justification for the work.
    - The location of the work or works concerned and the available approaches to the same.
    - Salient features of the proposal.
    - The total cost
    - If, after completion any operating cost is likely to be involved, the approximate cost of operation.
    - The extent of land acquisition and problems if any connected with such acquisition.
    - The approximate time required for completion.
    - Any special problems regarding execution of the work.
    - The economic aspects of the scheme, i.e., the cost as compared with benefits derived.
    - A detailed realistic programme chart for execution
    - A certificate signed by the Assistant Engineer that the provisions included are essentially required
    - A report regarding any locally available material usable for the construction, dismantled useful material and quantity shall be mentioned
iii. Plans and designs of Works
iv. Details of quantities of different items of work involved based on the design and drawings.

    Normally every item included in the estimate shall conform to the relevant clauses of standard specification for road and bridge works of MoRD/ MoRTH published by Indian Roads Congress in the case of roads and bridges and to the National Building Code in the case of buildings. Where items, which are not covered by standard specification are involved, the description of the item shall be full and clear.
v. A data sheet showing the estimated unit rate for the different items of work.
    - For road and bridge works:-The estimate shall be prepared as per the Standard Data Book for the analysis of rates (MoRTH/ MoRD) published by IRC.
    - For buildings: - The estimate shall be prepared as per relevant IS codes, National Building Code 2005 and the Kerala Municipal/Panchayath Building Rules.

    For work done through contract agency, the data shall make a provision for contractor's profit as a percentage (as per prevailing rules) of the net cost of the items

less cost of departmental materials, if any, supplied. If items not included in the schedule of rates are included in an estimate, the data for unit rate shall be worked out based on the market rate for the item or its components. The market rate shall be ascertained by making local enquiries in the most suitable manner found expedient.~~The district average conveyance shall be adopted for preparing estimates of all works.~~

vi. An abstract giving the description of the different items involved and the total quantities, the unit rate and the cost of each item. To the total of the several items as per this abstract 2.5% is added to cover the cost of contingencies. This abstract shall also give the total quantities of materials to be arranged for as departmental supply, if any.

vii. Costing towards mitigation of environmental damages shall also be included, if any. either as a part of civil work (5- 7 % of cost of work) or as a separate item of BOQ.

As far as possible lump sum rules (LS) shall be avoided in a detailed estimate except for petty items the total of which shall not exceed 5% of the estimate. LS provision is also permissible in case of items whose details cannot be foreseen at the time of preparation of the detailed estimate or where it is proposed to work out the details later on. In such cases working estimates shall be prepared against these lump sum provisions as soon as the details can be known, before the LS are operated on. Such working estimates will be treated as part of the detailed estimate.

c) Recast Estimate

It may sometimes happen that after the estimate for a work has been technically sanctioned but before it is taken up for execution some changes are found necessary in the estimate for the work. In such cases a fresh estimate may be prepared and got sanctioned in cancellation of the originally sanctioned estimate. This fresh estimate is called a recast estimate and is dealt with as if it is an original estimate. If however, before a recast estimate is prepared some expenditure has been incurred in an originally sanctioned estimate, then this procedure cannot be followed and instead a revised estimate shall be prepared and got sanctioned.

d) Working Estimate

A working estimate is intended to give the details of the works and the cost thereof, which are to be carried out against a LS provision made in an estimate. Normally therefore, the working estimate shall not exceed the amount of LS provision in the estimate for the main work. If however, it is not possible to limit the cost of the works included in the working estimate to the LS provision, care shall be taken when sanctioning the working estimate that the overall excess is within the powers of the authority sanctioning the working estimate.

Working estimates shall be prepared with the same care as in the case of detailed estimate. It shall be as realistic as possible. If the works as per the working estimate are to be entrusted to the contractor for the main work, then the rates to be included in the working estimate shall be his quoted rates for agreed-items and rates worked out as per his

agreement for allied and extra items. In cases where a different agency can be entrusted with the works as per the working estimate, the rates to be adopted shall be based on the schedule of rates prevalent at the time of preparation of the working estimate and on the market rates where there is no schedule item.

In respect of projects, working estimates shall be sanctioned by subordinate officers only after consultation with the authority under the control of the project, to whom a copy of the sanctioned working estimate shall also be sent. Each working estimate shall be treated as a detailed estimate for exercising the powers of sanction.

e) Supplementary Estimate

Any development or extension of a work though necessary while the work is in progress which is not fairly contingent on the work as first sanctioned must be converted to a supplementary estimate. In effect this supplementary estimate is an original estimate for the additional works consequent on the development or extension of a project or work under execution. Administrative sanction shall therefore be obtained for the supplementary estimate from the same authority, which sanctioned the original estimate even if the cost can be met from savings in the original estimate. The competent authority in this case is the authority that is empowered to accord administrative sanction to the work as a whole, i.e., including original and supplementary estimates.

The following particulars shall be invariably furnished when submitting supplementary estimates for sanction.

i. A full report of the circumstances justifying the need for the supplementary estimate.
ii. The amount of the original estimate and the amount of supplementary estimates already sanctioned, if any, and the amount of the supplementary estimate for which sanction is sought. Each supplementary estimate to any original estimate shall be numbered consecutively as first supplementary estimate, second supplementary estimate and so on for easy identification.
iii. The supplementary estimate shall be prepared in the same manner as an original work and all details and drawings furnished.

When a supplementary estimate is sanctioned the original estimate amount stands enhanced to the extent of the amount of the supplementary estimate.

f) Revised Estimate

A revised estimate must be prepared and got sanctioned:

i. When there are deletions, additions or alterations to the scope of the work as originally sanctioned needing revised administrative sanction.
ii. When there are major structural alterations from the design as originally sanctioned.
iii. When the cost of a work is likely to exceed by more than 5% of T.S amount.

The revised estimate shall not be kept waiting till the work is completed or reaches an advanced stage of completion but shall be prepared and got sanctioned as soon as any of

the above two conditions are anticipated during, the course of execution of work. A revised estimate will consist of-

i. A variation statement indicating briefly the nature and reasons for the main variation and the financial effect of the variations.
ii. A comparative statement giving the quantities, rates and amount of the items as per original estimate and as per the revised estimate with the reasons for the variation of each item. It is not necessary that the comparative statement shall repeat such items of the original estimate, which are not affected by the revision, but these items shall be grouped together under the several heads as per the estimate and noted as unaffected. The affected items shall be shown in detail in the comparative statement.
iii. The basis for sanction of revised estimate shall be T.S amount.

Sl. No.	Original PAC	Assistant Executive Engineer	Executive Engineer	Superintending Engineer
1	15 lakhs and below	5% / Rs. 5000 whichever is less	10% / Rs. 10000 whichever is less	15% / Rs. 25000 whichever is less
2	Above 15 lakhs but equal to and below 45 lakhs	-	5%	10%
3	Above 45 lakhs but equal to and below 200 lakhs	-	-	5%

All Revised Estimates exceeding the above limits may be submitted to the Chief Engineer for approval. In the case of works exceeding within 5% of the TS, no Revised Estimate is required but workslip should be prepared. For each item 25% excess can be sanctioned by the implementing officer.

6.2 SCHEDULE OF RATES

Delhi Schedule of Rates and CPWD/ MoRD/ MoRTH specifications shall be followed while preparing the estimate for works.

6.2.1 Data Book

MORTH and MORD data as per IRC Guide lines for roads and CPWD data and National Building Code for buildings shall be adopted.

6.2.2 Plinth Area Rate

The plinth area rates shall also be taken from DSR Plinth Area Rates.

6.2.3 Local Market Rate

The Executive Engineer, PWD Buildings of each district shall fix local market rates for materials and labour. These rates shall be followed by for preparing local market rate justification estimate for tender approval. The justification estimate shall also include 10% contractors profit and 5% overhead charges. The justification estimate if any, shall be submitted to the tendering authority directly by the Assistant Engineer before the date of opening of tenders.

6.3 SANCTIONS

The estimate for any work requires the following sanctions before it is taken up for execution.

a) Administrative sanction
b) Financial sanction
c) Technical sanction

a) Administrative Sanction

This is the sanction accorded by the Local Body concerned or Government authorising to take up a particular work at a particular cost and in a particular location.

After the project proposals are received, the appropriate authority vested with power of Administrative Sanction will issue the Administrative sanction. The mode of execution of the work shall also be decided by the AS authority.

If a work for which Administrative Sanction is given is not taken up within the year in the case of local body and within 5 years in the case of government, then the sanction automatically lapses. Even during the period of currency of the Administrative Sanction viz. 5 years, if at any time detailed estimate is prepared the cost is found to exceed the amount of Administrative Sanctionby more than 15%, then fresh Administrative Sanction shall be obtained. This is not applicable if the excess is due to revision of Schedule of Rates alone.

b) Financial Sanction

The LSGIs shall accord Financial Sanction before starting execution and tendering process of a public work.

c) Technical Sanction.

In all cases, the competent authority on the basis of detailed project report accords technical sanction. It implies that the competent technical authority is satisfied about the suitability of the work to meet the requirement, its structural soundness and about the quantities, specifications and rates of the different items of work, which will be involved in completing the work.

The TS issuing authority shall take into consideration the views and comments recorded by the intermediate officers and effect changes if required before issuing TS.

Technical Sanction shall be issued only based on the Administrative Sanction for the work and the amount of Technical Sanction for any work shall not exceed the amount of Administrative Sanction. Before Administrative Sanction is issued availability of funds shall be ensured for execution of the work. The following are the usual sources of funds for execution of works in a local body.

i. Annual Plan of Local Bodies
ii. Legislative Assembly Constituency – Asset Development Scheme (LAC-ADS)
iii. Member of Legislative Assembly – Special Development Fund (MLA-SDF)
iv. Natural Calamity Flood Relief Works (NCFRW)
v. Member of Parliament Local Area Development Scheme (MPLADS)
vi. Hill Area Development Authority (HADA)
vii. Integrated Watershed Management Plan (IWMP)
viii. Priority Works in Local Areas
ix. Scheduled Caste Corpus Fund
x. Kerala Local Government Service Delivery Project (KLGSDP)
xi. World Bank
xii. Own Funds of Local Body
xiii. NirmalPuraskar
xiv. Basic Services for Urban Poor (BSUP)/ ISHDP
xv. NABARD
xvi. Drought
xvii. Western Ghats Development Project
xviii. SarvaShikshaAbhiyaan
xix. RGPSA and other Centrally Sponsored Schemes

The detailed project report for all major works should necessarily contain the preparatory documents such as the environmental impact assessment report and / or the environmental management plan and/ or the special environmental conditions to the contract, if required.

Technical Sanction for an estimate shall be issued through PRICE or in the approved form only. Technical Sanction powers of all officers will be revised periodically, considering the rise in prices of various commodities used.(Delegation of Powers)

Before according Technical Sanction to a work relating to another Department, the plans shall be got countersigned by the head of the concerned department or such Officer who may be delegated with power for this purpose. In respect of minor works costing within the TS powers of Executive Engineer such countersignature is not necessary, provided the sketch plan has been approved along with the Administrative Sanction and no substantial variation has been made from the sketch plan.

ISSUE OF TECHNICAL SANCTION

Kerala .....Department

Name of Division
Name of Sub Division
Name of Section
Name of Work
Amount of Estimate
Reference to Administrative Sanction
Register Number and date of estimate
Source of funds
Duration in which work has to be executed

Estimate enclosed as briefly described above is sanctioned as register number .....
..... dated .....

Signature of Engineer

In the case of estimate of electrical and electronics works, TS shall be obtained from the competent Engineer of the Electrical Wing of the Public Works Department or any other authority approved by the Government. In the case of Corporations having electrical Overseers, the SE of the Corporation can issue TS up to 10 Lakhs.

An Estimate for which Administrative and Technical Sanction has been obtained shall be treated as a public record. Upon requisition its copy shall be issued to the citizens after realising the fees fixed by the RTI Act 2005.

6.3.1 Technical Sanction Register

In every office where technical sanctions are accorded, a register in the approved form shall be maintained. Each estimate sanctioned in a financial year shall be numbered consecutively and entered in the register.

Technical sanctions given to working estimates need only be noted against the sanction given for the main work originally and need not be given a separate number and noted in the register. When technical sanction is issued for a revised estimate and a fresh number is given for this estimate then the fact that the original estimates stands cancelled shall be noted against the original sanction. Correspondingly, there shall be one entry in revised sanction quoting the original estimate. When the supplementary estimate is sanctioned, the original technical sanction shall be cancelled and fresh technical sanction issued including the supplementary estimate.

While issuing Technical Sanction, the availability of funds will be examined and the source of funds shall be noted in the sanctions.

7. MODE OF EXECUTION

At the beginning of a financial year, the LSGIs shall prepare a priority list of the public works intended to be executed and also decide the mode of execution of each public works which are to be taken up in that financial year. Public work which involves skilled labour work and machinery shall be executed through contractors. The work involving unskilled labours shall be executed through a committee of beneficiaries of the project. For works having AS amount greater than or equal to 5.00 lakhs, the mode of execution shall be e-tendering. The execution of public works of Central or State government schemes shall be done as per the guidelines issued by the Central or the State Government in this regard.

Public works can be executed by any one of the following methods.

1. Tendering
2. Quotation
3. Beneficiary Committee
4. Accredited Agencies
5. Departmentally/ Direct Execution
6. Deposit Work

The mode of execution of works shall be decided based on the nature of work and time available for the completion of the work.

1	Tender	Piece work contract
		Item Rate contract
		Lump sum Contract
		Percentage Rate Contract
2	Beneficiary Committees (BC)	Committee constituting from the Beneficiaries
		Executive Committee of PTA, Hospital Management Committee, Anganwadi Management Committee, Padasekhara Committee etc., shall act as BC
3	Accredited Agencies(AA)	Execute through approved Labour Contract Co-operative societies, COSTFORD, Kerala State Nirmiti Kendra etc.
4	Direct Execution	Execution by the LSGIs
5	Deposit Works	Through public undertaking Departments: KWA, KSEB etc.

Before arranging a work there should be

- Administrative Sanction
- Technical Sanction
- 100% possession of hindrance free land.

If there is a time lag of one year between the date of preparation of the estimate and the date of tender of a work, it is necessary to verify whether any changes have occurred necessitating modification to the provisions in the estimate. If the modifications required are only minor, the officer competent to enter into contract may invite tenders on the basis of the sanctioned estimate. Otherwise the estimate shall be recast and tenders invited on that basis.

7.1 TENDER

When the LSGI concerned decide to execute a public work through tender, the Implementing Officer for public works shall invite the tender.

7.1.1 Piece Work Contract:

Under this method the Piece-worker merely agrees to execute specific items of work at specific rates without reference to total quantity or time.

7.1.2 By Item Rate Contract:

In this contract the total approximate quantities of the respective items of work and the time of completion are specified and the contractual obligations cover the rate, the approximate quantities involved and the time of completion. In the case of Item Rate Tenders, only quoted rate of each item shall be considered. Any tender containing percentage rates quoted shall be liable to rejection. Rates quoted shall be accurately filled-in, so that there is no discrepancy in the rates written in figures and words. However, if a discrepancy is found, the rates written in words will prevail. The item rate contract shall be followed for the works costing above 5 lakhs.

7.1.3 Lump Sum Contract:

Here the total cost of the completed works as per drawings and specifications and the time of completion form the essence of the contract. In adopting this contract the drawings and specifications must be full and complete in order to prevent claims arising for variations due to any ambiguity in them. Cases may, however, arise where some modifications to the designs or specifications are found necessary due to site conditions or other reasons. The bidder shall assess, evaluate &convince himself that the amount quoted by him is adequate. The department will not entertain any extra claim for such modification within the scope of the work, during execution. This method shall be adopted only in unavoidable circumstances where the situation warrants.

7.1.4 Percentage Rate Contract:

In this type of contract the departmental rates for the different items of working an estimate are published and the contractor quotes his rate at a percentage above, or below or at par the estimate rates so published. Only a single percentage applicable to all the items is quoted and this percentage rate is applicable to extra items, if any, found necessary during construction. Other conditions of contract are similar to those applicable to schedule contracts.

A modification of this type of contract is when, instead of estimate rates for a work, the schedule of rates is published and the contractor is asked to quote a percentage above, below or at par, the schedule of rates so published. Since neither the total quantity of work nor the time is specified, this modified form of percentage rate contract can be applied to piecework contracts only.

7.1.5 Performance Based Maintenance Contract

A Performance Based Maintenance Contract (PBMC) is a lump sum contract of all ordinary maintenance activities (Standard Jobs) in which the contractor is paid a set monthly/quarterly premium irrespective of the amount of work required to keep the road or building safe and defect-free. It becomes the contractors responsibility, without separate direction from the Department, to keep the road/ building condition to a specified standard and period and he may incur some financial penalty if he fails to achieve this standard. Part of the contract requirement is use of specialized equipment specifically for road maintenance, and there are limited provisional works for larger repairs/resurfacings. This system shall be adopted only for major works on roads/Buildings, which satisfy minimum standards as per norms. ~~The road or buildings to be included in this contract shall be decided by the Chief Engineer.~~ The contract shall be valid for minimum period of 5 years beyond the defects liability period. If necessary an initial rehabilitation work shall be done before arranging PBMC.

The most appropriate form of contract shall be decided upon in individual cases before inviting tenders. The authority competent to accord technical sanction to the estimate is the authority which will decide whether the work is done departmentally or through contract. In the latter case, the authority will also decide upon the form of contract.

7.1.6 Tender procedure

The bids (tenders) are open to all registered contractors in PWD/ LSGD or recognized organizations, under State Govt. or Govt. of India irrespective of registration status and who fulfill the qualification criteria in the bid document in respect of prequalification tenders as per provision in the bidding document. For works costing up to the TS powers of Superintending Engineer Standard Bidding Document (Minor) shall be followed. For works costing above TS powers Superintending Engineer standard bidding document (major) for post qualification and prequalification shall be followed.

For work costing above Rs. 5 crores prequalification tender shall be followed. The requirement for prequalification shall be prescribed in the bidding document. For externally aided projects, norms of the concerned financing agencies shall be followed for arranging the works.

7.1.7 Performance appraisal of contractors

Such a record of appraisals over the years will serve as a useful tool while taking decision about award of works to that particular contractor and also while renewing the registration. Failures of work carried out by the contractor during the defect liability period and a quality index assigned to those works during quality audits should find a place in the proforma. Such a proforma will be filled by each EE with whom the contractor is working, countersigned by the Superintending Engineer concerned and submitted to the Chief Engineer. The proforma should be filled up each year and all such reports of a particular contractor may be kept in a single file to be available whenever needed.

7.1.8 Time of completion

The time required for completion of a work, shall be carefully assessed based on scientific parameters and indicated in the tender schedule. The seasonal variations, cost of works, probable time required for procuring materials, the sequence of operation contemplated and such other limiting factors as having a bearing on the progress of the work shall be taken into account while fixing the time of completion. Time of completion shall be reckoned from the date of handing over of site.

7.1.9 Advertisement of tenders

The detailed tender notice shall be published in the following manner, mentioned in following Table

Sl No	Work Cost Limits	Nature of Publication	Minimum Time Between Publication of Notice and Submission of Tender
1	up to 5 lakhs	Website of LSGI/ Notice board of Division/ Subdivision/ Section/ nearby section offices/ nearby PWD/ Irrigation offices	7 days
2	Up to TS powers of EE's	e- Tendering LSGD/LSGI website, 1daily Malayalam newspaper with wide circulation in and nearby district	7 days

3	Up to TS power of SE's	e- Tendering LSGD/LSGI website, 2 daily Malayalam newspapers in state with wide circulation	7 days
4	Over SE's powers	e- Tendering LSGD/LSGI website, 2 daily Malayalam and 1 daily English newspaper with wide circulation in state	10 days

Note: *Midday and Evening dailies shall not be considered as newspapers for this purpose.*

The notice inviting tenders shall be published on the notice board of the LSGIs, institutions of LSGIs, Grama Kendras and the website of LSGD/ LSGI and also a window notice shall be published in newspapers. Window publication is adopted to reduce the advertising expense and hence detailed notices shall be published in the government website and in the notice board of the LSGI. When sending window publication notice, sufficient time prescribed shall be allowed for the publication to appear in the newspaper well ahead of the last date of tender.

The detailed notice inviting tenders shall include:

i. The name and details of work
ii. The time within which the work shall be completed
iii. Probable Amount of Contract (PAC)
iv. Cost of tender form
v. Place from which tender form can be obtained
vi. Last date and time of acceptance of tender
vii. To whom tender shall be submitted
viii. Time at which and place where tenders shall be opened
ix. The amount of Earnest Money Deposit (EMD)
x. Category of contractors from whom tender will be invited
xi. Type of tender; whether it is percentage rate/ item rate etc

Cost of Tender form/ Tender fee

Cost of Work	Cost of Tender form/ Tender fee
Upto Rs. 5,00,00	Rs. 300
Above Rs.50,000 up to Rs.10 Lakh.	0.2 % of cost of work subject to a minimum of Rs. 500 and maximum of Rs. 2000
Above Rs. 10 lakh –Upto Rs. 1 crore	Rs. 2500

Above Rs.1 crore – up to Rs. 2 crore	Rs. 5000
Above Rs. 2 crore – upto Rs. 5 crore	Rs. 7500
Above Rs. 5 crore - up to Rs. 10 crore	Rs. 10,000
Above Rs. 10 crore	Rs. 15,000

In case of postponement of sale and receipt of tender, proper notice for the same should be posted in web site of LSGD and should be published in the same manner as that of original notice and the stipulation on time limit will apply in case of postponement also. The tender forms shall be priced as per rates fixed by Government from time to time.

Copies of bid documents shall be serially numbered 1, 2, 3, etc. and the pages and drawing of each document shall also be serially numbered. These documents shall be made available in the office of the authority publishing the tender notice. In the case of e-tender, the bid documents shall be downloaded from the web site. In such cases the cost of bid documents shall be remitted by demand draft along with the submission of the tender.

The bid documents shall contain the following:-

a) A complete set of approved architectural and structural drawings.
b) Complete specification of work to be done and the materials to be used or reference to item of the standard specification followed by the department or I.S.I. in respect of each item of the tender schedule.
c) A schedule of quantities of various items of the work.
d) Time fixed for completion of work or parts thereof. The time for completion of work shall be carefully assessed and fixed. This shall take into account the seasonal variations, probable time required for procuring materials, the sequence of operations contemplated, and such other limiting factors having a bearing on the progress of the work.
e) List of materials proposed to be issued departmentally and the recovery rates.
f) List of departmental tools and plant to be hired out and the hire rates.
g) General conditions of contract current in LSGD and special conditions if any applicable to the particular case.

The bid documents for a percentage rate contract will be same as listed above, except that in the schedule of quantities, the estimate rates will be noted in words and in figures and the contractor called upon to quote his percentage above, or below or at par the estimate rates. As only a single percentage is to be quoted this need not be written against individual items but must be written at the bottom of the schedule in words and in figures.

In the case of piecework contract, the tender notice may be of a simple form specifying the place of work, the facilities available, the items of work to be done and the specifications to be followed.

If the modified percentage rate contract is to be adopted for piecework contract, the above notice shall also contain the concerned schedule of departmental rates and the contractor shall be called upon to quote his rate at a percentage above, below or at par the schedule of rates so notified.

In the case of item wise contracts the schedule shall contain only the specification for items and quantities. The contractor shall be called upon to quote the workable rate for each item in the schedule.

7.1.10 Pre-Bid Meeting

There shall be a pre-bid meeting with those bidders who choose to attend as mentioned in the bid notice.

a) **Pre-bid meetings are to be held for works costing above TS Powers of Superintending Engineers.** It is possible that there could be difference in the understanding of the bidders and the tendering on certain crucial issues; some errors or oversights in the tender documents could go unattended; some oversights in the tender documents could go unattended; some disputes could arise later on during execution.

b) Date of this meeting should be declared in the tender notice and should be after the tender forms have become available to contractors. The sale of tender forms should be kept open at least for 10 days after issuance of clarifications and a corrigendum to tender documents if any, as a result of the pre-bid meeting.

c) The pre-bid meeting should be ~~held at the level of the Chief Engineer for large works and even at a higher level for very large works costing above Rs.20 crores.The officers who are to execute the work i.e the concerned Executive Engineer, the Deputy Chief Engineer etc must attend the meeting.~~conducted by the tender inviting authority irrespective of the estimate PAC. The controlling officers of the officer who is to execute the work i.e the concerned Assistant Executive Engineer or the Executive Engineer or the Superintending Engineer must attend the meeting. The contractors should be made to feel free to ask all their doubts and seek clarifications and make suggestions for betterment of the work. All their queries should be recorded in the minutes of the meeting which must invariably be drawn up and issued.

d) If any clarification is issued on the spot, it should appear in the minutes. Certain queries may require detailed consideration and may lead to modification of the tender document or the work proposal. All such clarification should be prepared after obtaining orders from the competent authorities and meticulously issued in a tabular form. Corrigendum to tender documents should be issued to all those who have purchased the form already or should be uploaded in the website where the original tender is uploaded. The minutes of the meeting, the clarification and the corrigendum

should all be attached to the tender forms issued thereafter. The contractors should be asked to sign all these when submitting their bid.

7.1.11 Submission of bid documents

7.1.11.1 Bid Security (Earnest Money)

Earnest money is the financial guarantee of the bidder and is collected to ensure serious participation in the bidding process and this amount will be returned soon after finalizing the lowest bidder.

a) to abide by the terms of the tender till decision on the tender or the expiry of the firm period whichever is earlier and

b) to execute the agreement to carryout the work as per conditions of the contract if his tender is accepted.

Rate of EMD

Cost of Work	Amount of EMD
Upto Rs.2 crore	2.5% of the project cost, subject to a maximum of Rs. 50,000
Above Rs. 2 crore – upto Rs. 5 crore	Rs. 1 lakh
Above Rs. 5 crore –upto Rs. 10 crore	Rs. 2 lakh
Above Rs. 10 crore	Rs. 5 lakh

Each tender shall be accompanied by an earnest money deposit in such form and manner as prescribed in the tender notice. The rates of Earnest Money Deposit for works shall be 2.5% of the estimated probable amount of contract. Earnest money may be produced in one or other of the following forms:

a) Chalan receipt from a Government treasury, the chalan being countersigned by an authorized departmental officer where tenders are to be received.

b) Draft on a Scheduled Bank/ Nationalised Bank made payable to the officer who invites tenders.

c) Deposit at call on a Schedule Bank/ Nationalised Bank pledged in favor of the officer inviting tenders.

d) National Savings Certificate or Kisan Vikas Patra

e) ~~Cash remittance is not normally accepted. The officer receiving the tenders may, if he considers necessary, relax this rule and permit cash being received in special cases.~~

f) Bank Guarantee from Nationalised Banks shall also be accepted.

Note:

a) In the case of piece work contract the condition regarding Earnest Money Deposit shall be waived.

a. Payment of Earnest Money Deposit is also waived in respect of organizations, which are exempted by Government to that effect.

7.1.11.2 Bid Documents

The tender document shall include:

a) Notice Inviting Tender/ Invitation for Bidders (IFB)
b) Instruction to Bidders
c) General Conditions of Contract and Special Conditions, if any
d) General Information of the Project
e) General Technical Specifications and Special Technical Specifications, if any
f) Schedule of Quantities (Tender Schedule)
g) Architectural and structural drawings, if necessary
h) Forms and Other Relevant Information (including Environmental Management Plans in case of major projects)
i) List of Mandatory Tests
j) Preliminary Agreement

Note: -

a) When special conditions are introduced by the department in bid documents for a particular work, the same shall be got approved by the next higher authority of the officer inviting tenders.

b) In the case of piecework contract, the bid documents shall consist of the details regarding location, items of work or supplies for which rates are called for, rate of progress to be maintained, and form of tender together with any other special conditions found necessary.

c) All documents must be self-explanatory. However if any bidder seeks clarification on any matters in a tender document there is no objection for the officer accepting tenders to give clarification needed, provided this does not in any way alter or modify, what is stated in the bid documents. If in any special case such clarification, which may have the effect of modifying what is stated in the bid documents, is found necessary and unavoidable, then such clarification shall be included in the bid documents and intimated to those bidders who have already purchased tenders before the issue of such clarification.

d) For items not included in the data book, standard specifications shall be prepared and incorporated in BOQ.

e) Agreement authority shall disclose the environmental issues of the project during the pre-bid meeting

f) The pages and drawings of each set of bid documents shall be numbered continuously. The total number of pages of the ~~documents and the number of drawing sheets forming part of the~~ bid documents shall be indicated on the cover sheet. Only one copy of the tender form shall be issued to one person marked as original. However, additional copies may be sold marked as 'Duplicate' at specified prices. Duplicate copies will not be accepted in place of original tender. When a tender document is sold, the name and address of the person to whom it is sold shall be entered in the front cover page of the documents under the dated initials of the person authorised to sell the document. Bid documents sold to one party are not transferable to another.

g) It is necessary that the competent authorities in token of approval signs all pages, correction slips and other corrections and modifications made in the bid documents. A slip showing such corrections and modification shall be attached to the tender document before issue. The bidder shall not make any addition, deletion or correction in any of the bid documents. If he has any reservation, the details thereof shall be sent in a separate letter along with the tender.

7.1.11.3 Submission

It is important that the contractor shall examine the site condition and satisfy himself of the availability of materials at nearby places, difficulties which may arise during execution etc. before submitting the tender for the work.

a) Sealing and Marking of Tender

The bidder shall seal the tender with all relevant forms duly filled and bound and put in a separate envelope duly marking on the envelope the following

i. Name of work with Tender No.
ii. PAC
iii. The concerned Circle, Division, Sub-division and section as the case may be

b) The envelope shall be addressed to the concerned officer inviting tender

c) The tender shall be sent by registered post or speed post so as to reach the officer inviting tender before last date of receipt, sufficiently early.

The tenders shall be received up to the time fixed for receipt of tenders and all tenders shall be kept in safe custody of the authorized officer.

7.1.11.4 Late Bids

Any tender received by the employer after the deadline prescribed will be returned unopened to the bidder.

7.1.11.5 Tenders by Post

All tenders for works shall be received only by Registered/Speed Post of India Post. Postal delays shall not be considered as mitigating factor for late submission.

7.1.12 Opening of tenders

The tenders shall be opened at the appointed time, in the presence of such of the bidders or their agents who may choose to be present. If the officer who is to open the tender is on leave, on tour or otherwise engaged, there shall be standing arrangement by which a senior subordinate officer is authorized to open the tender on his behalf at the appointed time and place. In case the opening date is declared a holiday, the tenders shall be opened on the next working day at the same hours and place as specified in the original notification. The postponement due to declared holiday will not be applicable to submission of bids under e-tendering.

On opening the tender, the tenders for works which are to be opened on that day shall be serially numbered work-wise indicating also the total number of tenders received for each work. The numbers shall be written on the facing of envelope and also on the sheet of the corresponding tender after opening eg. if 5 tenders are received the first shall be numbered 1/5, the second 2/5 as so on. The officer opening the tender shall scrutinize the tender for any correction, omission etc. If any tender is found defective in any respect, the fact shall be noted in the tender.

In case of percentage rate tender, the officer shall read out the percentage quoted. In case of item rate tender, the total tendered amount either for the whole work or for each section and any additional conditions, which a bidder has specified along with his tender, shall be readout.

If there is difference between the rates quoted in figures and in words the rates quoted in words will alone be considered for tabulation and the officer will note in the tender in his own hand the rate to be considered for evaluation of tenders. In case more than one rate is quoted in tender, the lowest shall be considered for evaluation. If there are mistakes in the amount for individual items or the total contract amount arrived at by a tender the correct total figure arrived at based on quantities for individual items and the rates quoted by the bidder will only be considered for evaluation of tenders. The officer opening the tenders shall invariably record the date and initial all the corrections in each tender. He shall also put his dated initial on all pages of the tender whether they contain or do not contain corrections or over writings etc.

In case where there are corrections or overwriting on a page either in words or in figures or in both, the number of such corrections and over writings shall be indicated by separate serial numbers. The corrections/over writings shall be numbered as 1,2,3 etc. The total number of such corrections and overwriting shall be clearly mentioned at the end or each page of the tender and the sum total in the last page with the dated attestation of the officer. When there is no correction or overwriting in a page, the fact shall be noted in that page under the initials of the officer.

Any ambiguity in units or rates quoted by the bidder shall be clearly marked on the concerned page of the tender by the officer opening the tender. Where a bidder has omitted to quote the rate in figures or in words, the officer opening the tender on the concerned page of the tender at the time of opening the tender shall record the omission.

When a bidder has omitted to quote rate for one or more items, the tender shall be considered incomplete and shall be rejected. After the tenders have been opened the bidders or their agent present shall be asked to sign in the tender register in token of their having been present at the time of opening the tenders.

7.1.13 Register of Tenders

All the tenders received shall be entered in a register of tenders ~~in form given in Appendix 2000B~~ as and when they are received and their disposal watched till the contract is settled.

Register of Tenders

Sl No:
Tender Number:
Tender Opening Date& Time:
Name of Work:
PAC & EMD:

No.	Name & Address of Tenderer	Regitration no. of Tenderer	Details of EMD	Quoted rate/ percentage excess or deduction in case of percentage rate contract/ total quoted amount of contract as entered in the tender in case of schedule rate contract and LS contract (in words & figures)	Signature of Contractor or representative present	Remarks

Here enter the nature of final disposal of the tender:

Signature of Engineer

7.1.14 Consideration and Tabulation of Tenders

The officer inviting tenders may condone minor defects if any and allow the tender to be included for tabulation. Such minor defects include:

a) Omission to sign or include all or any of the plans with tender.
b) Failure to produce the original chalan for remittance of E.M.D provided in its place the temporary receipt given from the treasury is produced and the original chalan is produced before the evaluation of tender is completed.
c) Omission to total the different appendices.

d) Failure to initial all or any of the pages provided he has signed in all the pages containing the rates and in the page in which the tender offer is made.
e) Failure to write rates in figures against-one or more items of the tender, provided the rates for such items are unambiguously written in words.

The discretionary power of the officer opening the tender will be utilized to protect the interest of the Government. A tabulation statement of the acceptable tender with a note on the merits of each shall be prepared and scrutinized by the Tender Inviting Authority and submitted to the local body for consideration and approval.

7.1.15 Negotiation after Opening of Tender

There shall be no negotiation after opening of tenders.

7.1.16 Approval of Tender Excess

Normally tender excess is not allowed in the department. If the quoted PAC exceeds the estimate PAC, the tendering authority shall reject the tender and retender the work .

7.1.17 Acceptance of Tenders / Quotation

The LSGI reserves the right to reject or approve the tenders. The lowest tender/ quotation shall be accepted for every work. But, after scrutinizing the tenders submitted, the LSGI can reject a tender, if the previous history of the bidder is not satisfactory.

The tender / quotation shall be rejected in the following cases also.

a) Tender / quotation with additional conditions
b) Tender / quotation with quoted PAC less than 75% of the estimate PAC.

Opened tenders shall be tabulated by the tendering officer and with the remarks of the tendering officer it shall be placed before the LSGI for final approval. The authority shall take the decision within ten days from the date of opening of the tender. If the authority feels that it will not be desirable to accept the lowest tender, the next higher tender may be accepted by rejecting the lowest one, after recording the reasons.

Single tender shall not be accepted in normal cases, but in certain cases, it can be accepted, if the tendering authority feels that no advantage is likely to be secured in inviting fresh tenders for the work and if there is time limitation.

7.1.18 Firm Period

The firm period of a tender is the period from, the date of opening of the tender to the date upto which the offer given in the tender is binding on the bidder. The firm period is fixed as the maximum time required within which a decision can be taken on the tender and order of acceptance issued in writing to the bidder which shall not exceed two months in the normal course. The consideration of tenders and decision there on shall be completed well before the date of expiry of the firm period noted in the tender so that the letter of

acceptance is sent before the expiry of the firm period. If delay is anticipated, the officer who invited the tenders shall get the consent of the lowest two bidders for extending the firm period by one month or more as required. In case the lowest or any bidder refuses to extend the firm period that tender cannot be considered. All officers concerned with the consideration of tenders, shall deal with them expeditiously to settle the contract before the expiry of the firm period.

7.1.19 Selection Notice

After it is decided to accept a tender, selection notice in the form of letter of acceptance as per bidding documents shall be issued to the bidder by the tendering authority within seven days or before the expiry of firm period whichever is earlier. The officer who is competent to enter into the contract shall send this notice through registered post/courier service/e-mail. The date of registration shall be the date of acceptance of the tender irrespective of the date when the communication is actually delivered to the bidder. In urgent cases, acceptance of a tender can also be communicated by telegram/ and or SMS to be followed by selection notice in proper form. In such cases, the date of filing of the telegram / sending the SMS shall be the date of acceptance of the tender. Copy of the notice shall also be sent to the subordinate officer under the control of the work. In the selection notice the selected contractor will be notified to execute an agreement within a maximum period of fourteen days from the date of acceptance of the tender. Fine at the rate of 1% of contract amount subject to a minimum amount of Rs. 1000 and a maximum amount of Rs. 25,000 shall be levied if agreement is not executed within ten days after the notified period of fourteen days.

The successful bidder shall execute the agreement within 14 days or with fine within next 10 days from the date of selection notice. In case of failure to execute the agreement within this period, tendering authority shall cancel the offer of contract forfeiting the EMD and taking such other actions as mentioned in the bidding document. After canceling, the offer of contract in the above case, the tendering authority may negotiate with the next lowest bidder and award the work to him if he expresses his willingness in writing to execute the work at the accepted rate of the default bidder. Otherwise the work will be re-tendered.

7.1.20 Performance Guarantee

Performance Guarantee, the amount collected at the time of executing contract agreement, will be 5% of the contract value (agreed PAC) and the deposit will be retained till the expiry of defect liability period (Appendix). Atleast fifty percent (50%) of thisdeposit shall be collected in the form of Treasury Fixed Deposit and the rest in the form of Bank Guarantee or any other approved forms.

7.1.21 Additional Performance Guarantee

Additional Performance Guarantee is the additional amount to be deposited for unbalanced price, i.e., for works quoted below estimate rate. The collection of additional

deposits is a disincentive to the bidder who offers to execute a work below estimated rate and this will induce the contractor to quote a rate equal to or higher than estimate rate. Additional Performance Guarantee shall be deposited for all works quoted below upto 10% (works quoted between 11% to 25% below estimate rate) of the estimate rate.

7.1.22 Release of Bid Security

The Bid Security (EMD) will be released to the selected bidder after he furnishes the above Performance Security Deposit or Bank Guarantee and duly enters into the contract.

7.1.23 Withdrawal of tenders

Once the tender is submitted a bidder cannot withdraw his tender or make any modifications not acceptable to the Department. Any contravention of the above will entail forfeiture of the earnest money.

If the Department for any reason fails to issue selection notice to a bidder before the expiry of the firm period, or extended firm period mutually agreed to, his tender will stand nullified automatically unless revived by mutual consent.

Note: -A Selection notice will be valid if it is sent by registered post on or before the date of expiry of the firm period or extended firm period.

7.1.24 Waiving of tender calls

In appropriate case, powers have been delegated to various officers to waive tender calls as indicated in Section 200. (Appendix) In case it has been decided to resort waiving of tender calls. It shall be done subject to the powers delegated in this regard.

7.1.25 Splitting up tenders:

Generally splitting up of works for the purpose of limiting to the expenditure to the powers delegated shall not be resorted to. However it may sometimes be more expedient to split and award a work to different contractors with a view to expeditious completion and or on grounds of economy. In such cases the officer competent to enter into contract for the whole work shall decide the manner in which the work may be split up and also whether separate tenders may be invited for the different split up portions of the work or a single tender for the whole work may be invited indicating therein the manner of splitting up proposed. In the latter case when evaluating the tenders the alternative of splitting the work among different contractors, or awarding more than one split up item to the same contractor, shall be examined, taking into consideration the speed of completion and the cost. The tender notification shall specify that the department reserves the right to split the contract in the manner given in the notice and calls for the time of completion of individual parts as well as for the whole work. Splitting shall not be resorted to if it is not provided for in the tender notice.

Splitting of works shall be resorted to only with the approval of the authority, who has accorded Administrative Sanction for the subject work.

7.1.26 Limited tender

Limited tender shall be adopted for works of most urgent nature relating to V.V.I.P. visits, natural calamities or other reasons, which are to be completed in the minimum time. This type of tender is necessitated also for security reasons and for maintaining secrecy. In this type of tender, the schedule shall be sold only to intending bidders included in a list of selected contractors maintained for the purpose by the Executive Engineer based on the performance certificate of the contractor, ~~as on 1st April. The list shall be reviewed once every two years before 15th April.~~ The provisions relating to waiving of tender called shall be applicable in this case also.

7.1.27 E-tendering

The process of inviting, accepting and processing tenders and communicating through the medium of Internet is termed as E-tendering. The e-tendering system facilitates complete tendering process from advertising tender notice to the placing of the contract. This includes the exchange of all relevant documents in electronic format. E-tendering shall have the following processes:

All the contractors shall be separately registered for E-Tendering. The officers competent to invite tenders publish the tender notices in the official web site of e-tendering. The tender notice will be published along with the documents, which are usually termed as Bid documents.

Contractors, registered for E-Tendering, shall download the tender notice and bid documents and can submit tenders online which shall remain strictly confidential. The cost of tender forms shall be paid online and the proof shall be submitted along with the bid documents. At the appointed time the competent authority can open tenders online using a private key. Further processing of tenders and issuing selection notice to the successful tenderer shall be done online. E-payment is envisaged under e-tendering as per which payment of works done shall be credited to the bank account of the contractor instead of issuing cheques.

7.2 QUOTATION

The award of contract shall be made after obtaining sealed competitive quotations in case of emergency as per delegation of powers for waiving of tender calls fixing a period of three days from the date of publication of quotation notice. The quotations need not be published in newspapers, but shall be published in the notice boards of all Section, Subdivision and Division offices in the locality. Earnest Money Deposit as per clause shall be remitted in both the above cases. However cost of quotation schedule is exempted. For works of most urgent nature such as those relating to V.V.I.P visits, restoration for natural disasters, rectification works for road breaches and blocks failure of structures and leakage of water supply and sewage lines and works of similar nature if the competent authority feels that the above mode of arrangement would delay the rectification work, he shall obtain negotiated quotation and award the work to the lowest bidder, considering the

arrangement as waiving of tender calls. While exercising this power, the concerned officer will report the details to the immediate superior officer.

When tenders have been called for a work and there is no response or all the tenders received are unsatisfactory and have to be rejected, and it is considered that a call for further tenders will be futile or if the work is of an urgent nature, the officer, who is competent to accept the tender may invite sealed competitive quotations. In case it is not possible to obtain any quotations as above he shall obtain negotiated quotations and award the work to the lowest bidder. In either case, such an action to award the work to the lowest bidder shall not be considered as waiving of tender call.

7.3 EXECUTION OF PUBLIC WORKS THROUGH BENEFICIARY COMMITTEES

The execution of public works which do not require technical expertise, skilled labours and machinery like earthwork, earth filling, etc can be entrusted with the Beneficiary Committees if the local body committee decides so.

7.3.1 Formation of Beneficiary Committees (BCs)

i. The Implementing Officer (IO) concerned for Public Works and the respective ward member/councilor shall jointly convene a meeting of the people of the locality who are beneficiaries due to the implementation of the works.
ii. Date and time, venue and agenda of the meetings shall be clearly informed through a printed notice to the Beneficiaries of the area through the elected representative since the elected representative will have the exact knowledge of the beneficiaries. The said notice shall be distributed to all beneficiaries and displayed in publically.
iii. The meeting shall be presided over by the President/Chairperson/Mayor or Elected Member of the concerned ward or division.
iv. The meeting shall elect an Executive Committee (BC) from the beneficiaries, consisting of not more 15 members and not less than 7 members of which one third shall be women. If the project is meant for the Scheduled Caste (SC) or Scheduled Tribe (ST) the BC shall include members from the SC or ST population respectively. The Chairman or the convener should be from the respective population. It shall be in concurrence with the Oorukoottam if the BC is constituted by the ST population.
v. Chairperson and Convener shall be elected from the BC.
vi. When to remove the Chairperson and Convener, the IO shall convene meeting explained as above.
vii. The elected member or officers of the LSGIs shall not act as a convener, chairperson or member of the beneficiary committee.
viii. The BC shall include a technical person also.
ix. The IO for the public works or his representative shall explainall details and specifications of the proposed works. IO shall specifically detail:
    - Technicalities of the concerned works
    - Duration of the work

- Machine and tolls required
- Materials required
- Number of labourers required

x. A joint account shall be opened in an approved bank in the names of the Convener and the Chairman of the BC as per the Bank norms.

xi. All transactions shall be done only through this account.

7.3.2 Implementation of Work

The Executive Committee Convener of the BC shall enter into an agreement with the LSGI in conformity with the GO for due performance and completion of work undertaken by the BC(Appendix 3.1). A bond signed by the committee members shall be given to the LSGI by entrusting the Convener to enter into such agreement as mentioned above. The agreement shall contain the clause that if the execution and completion of work is not satisfactory, the LSGI can terminate the BC and arrange the work by other modes of execution at the risk and cost of the BC. The risks and costs shall be realised jointly and severally from the members of the beneficiary committee including the convener and the chairman (Appendix 3.2)

In the case of BCs such as Parent Teachers Association (PTA), Anganwadi Management Committee (AMC), Padasekhara Committee etc,the agreement shall be furnished based on the decision taken by the Executive Committee concerned.

The total expenditure of the work executed by the beneficiary committee shall not exceed the Estimate amount. BC shall be engaged to do works as per prevailing government orders. Proper identification of the Convener and the members of the BC shall be ensured by the ward member/ councilor of the LSGIs as he/she is more familiar with the beneficiaries of the work.

After signing the agreement, the IO shall handover the site and all documents such as Estimate (prepared in vernacular) and drawing and shall give proper direction for executing the work. The BC shall meet regularly to evaluate the work and decide the future activities and minutes of the meeting shall be entered in the minutes book. All actions taken by the BC for the execution of the work and income and expenditure details shall be recorded in the minutes book.

After executing the agreement, an amount of 25% of the estimate or Rs 100,000(One lakh), whichever is less may be given in advance to the BC, with proper guarantee, after verifying whether the materials equal to the advance sanctioned has been supplied at the site. Proportionate portion of advance sanctioned shall be deducted from the part bills given to the BC and the remaining portion of advance amount shall be deducted from the final bill. After completing the work the executive committee shall meet, scrutinize the account and approve the accounts of the income and expenditure.

Cash bill or receipt of every purchase shall be submitted along with the minutes book and muster roll after the completion of the work. If voluntary service is included in any

of the work the number of persons taking part in it and the quantity of work should be prepared and kept separately. The list of the voluntary workers shall also be prepared. If the BC is hiring any machine, a voucher of the rent shall also be submitted. Payment shall be made only on receipt of the all bills and receipts.

If the work cannot be completed within the stipulated time due to default on the part of the BC, a fine equal to 1% of the estimate PAC subjected to a minimum of Rs. 1000/- and a maximum of Rs. 10,000 may be imposed on the BC.

The estimate for beneficiary works shall be prepared excluding CP, but including taxes except Income Tax. Income Tax should be deducted from the bill of the BC work.

7.4 ACCREDITED AGENCIES (AA)

It is the responsibility of the LSGIs to ensure that the Accredited Agencies selected have valid accreditation for undertaking Public Works in the LSGI's area. Estimate shall be prepared including contractor's profit by the AA. However, the Income Tax (2%) must also be included in the estimate and deducted from the bill but the Value Added Taxes, Services Charge and other Taxes, Contribution to the Construction Workers Welfare Board Fund, Management Charges, Estimate preparation charges (If it is applicable) should be included in the estimate separately. Such amount shall be estimated over and above estimate as per rates in vogue.

All basic procedures for preparing plan, design and estimate shall be applicable for the AAs also. However, if the AA is executing a public work by applying alternate technology, the estimate shall be prepared by the competent Engineers of the AA. Such estimate shall be based on data and specifications held by the AA. But the total outlay of the work shall not exceed the general approved estimate prepared as per the Schedule of Rate in force in LSGIs. Such works shall be measured and check measured by the Engineers of the agency. The LSGI Engineers has the right to inspect the site from time to time to ensure the quality and quantity of the work if required.

Other than alternate technology, the AA shall adhere to all procedures strictly for undertaking public works in LSGIs. An AA shall be entrusted with a public work without having procedures for tender, submission of EMD and Security Deposit. An agreement shall be signed between the LSGI and the AA prior to starting public works.

7.5 DIRECT EXECUTION

This method is adopted in case where no contractor is available or where for other reasons, it is found more suitable. It includes all special schemes as desired by the LSGIs and shall be done based on prevailing government orders or circulars.

i. When any work is executed by the LSGIs directly, the total expenditure of such work shall not exceed the total amount of estimate prepared or Market Rate Estimate published by PWD whichever is less.

ii. If the LSGI is satisfied that the total cost of the estimate is likely to exceed the estimated cost due to the increase in rates of the local price of the materials and

labour charge such excess expenditure not exceeding 5% of the estimated cost may be sanctioned by the LSGIs.

iii. Such excess expenditure exceeding 5% of the estimated amount may be sanctioned by the LSGIs which gave the original sanction along with the previous sanction of the LSGIs.

iv. When any work is done by daily labour, the daily wages as decided by the LSGI not exceeding the estimate rates shall be paid on nominal muster roll.

v. The muster roll shall be kept separately for each category of labourers and the wages shall be given daily, weekly, fortnightly or monthly, as the case may be.

vi. No labourer shall muster for a continuous period exceeding 179 (one hundred and seventy nine) days.

vii. When works are executed by the LSGI directly, the LSGIs shall expend the subscription towards the Construction Workers' Welfare Fund, Sales tax, Income tax and Service Tax (wherever necessary) apart from the estimate amount and such amount shall be included in the total cost of work.

viii. In case of execution of work by the LSGIs directly, bills and other accounts shall be kept separately and they shall be given for scrutiny to any citizen on requisition.

ix. Collection/Procurement of construction materials, appointing the labourers etc. shall be done under the responsibility of the Secretary / implementing officer.

x. If necessary a technical expert can be appointed for supervising the work in the salary of skilled labourer. The engineer or the overseer of the LSGI concerned shall record the names of the labourers employed in the work, their age, address, rates of salary and attendance in the muster roll strictly.

xi. Procurement of materials shall be done as per procedures in the Procurement Manual force in LSGI

xii. The Engineer responsible for the LSGI shall supervise, take measurement and prepare bill.

7.6 DEPOSIT WORKS (FOR PRIVATE PARTIES)

In the case of deposit works for private parties before plans and estimates are prepared and made available to the party, centage at 2.5 % shall be got deposited. To start with an approximate figure of cost may be assumed for the estimate and the 2.5 % centage realised based on this approximate figure subject to adjustments after estimate is prepared. In case the work is carried out by PWD, the estimate shall include a total centage of 12.5% including the 2.5% for preparation of plan and estimate. Technical Sanction, for the estimate may be given by the officers of the Department subject to the limit of their powers after the following conditions are satisfied.

- The party accepts the Estimate.
- Deposits the estimate amount (including centage).
- Undertakes to make additional deposit to the extent necessary in the case the estimate amount is exceeded during actual execution.

In the case of works undertaken for quasi government organisations and Government of India works it is not necessary to insist on 2.5% prior to preparation of estimate provided the quasi government organisation agree to pay the percentage after the estimate is finalised. It is, however, necessary to insist on fulfilment of conditions above before the estimate is technically sanctioned and work arranged.

SECTION- 8

8. CONTRACT MANAGEMENT

All officers concerned with the supervision, management and control of contract works shall thoroughly familiarize themselves with the general and special conditions of contract, the technical details and specifications of the work. The officer who has executed a contract agreement shall be responsible for the proper execution of the work as per specifications in accordance with the conditions of contract. There shall be advance planning of each item of work to keep up the progress of work specified in the agreement. For this advanced methods in planning and management techniques shall be adopted.

This planning shall be done in accordance with the schedule of work and the time frame fixed for the project, by the Assistant Engineer or Assistant Executive Engineer or Executive Engineer in respect of contracts entered into by them. The contractor shall abide by the planning schedule of the concerned authority and direction of the field Engineers. All preliminaries such as removal of hindrances like underground cables, pipelines, electric posts, etc., shall be completed before the award of contract. Difficulties if any shall be brought to the notice of the head of departments concerned or to government. Where delay is anticipated, the matter shall be brought to the notice of the authority who executed the agreement so that the date of commencement may be fixed suitably in consultation with the contractor.

8.1 Agreement

The agreement for the work shall be got executed by the Contractor with the Agreement Authority in the form prescribed in the bidding document after the award of contract within the period specified in the selection notice and duly entered into the register of agreement.

Register of Agreements

SlNo	Date ofagreement	Agreement No/ Supplemental agreeme	Nameofwork	Name of contractor	PAC	Date ofcompletion/ Extended Date of	Extension / Extra item Sanctioning Order	Remarks	Signature

		nt No				Completio n	and date		
1	2	3	4	5	6	7	8	9	10

The agreement shall include:

a) Original tender, plan and all accompaniments thereof.
b) Acceptance letter from the authority awarding the contract together with copies of correspondence, if any referred therein.
c) Accepted schedule with conditions of contract.
d) Agreement in stamp paper to the prescribed value.
e) The MoRTH/MoRD/CPWD or the relevant BIS/NBC codes shall also be considered as part of the bid documents though individual copies are not attached to such contract documents and the contractor shall comply with relevant BIS/NBC codes and CPWD/ MoRD/MoRTH Specifications.

In the case, of agreements executed in Divisions, Sub divisions and Sections the officer who executes the agreement will himself be the principal disbursing officer and therefore the custodian of such agreements. Attested copies of agreements executed in the higher offices shall be forwarded to the subordinate officers responsible for execution of works and preparation of bills.

The physical custody of all original agreements executed in the Division ~~and the Circle office~~ will be with the Divisional Accountant of the Division. In the case of Agreements executed in Sub Divisions ~~the physical custody of the original agreement will be with the Head Clerk~~ and in Sections with the clerk or overseer concerned in the absence of clerk. The custodian shall keep a register of all original agreements in the form given in Appendix 2000F.

This register and the concerned original agreements shall be handed over and acknowledgement obtained in the register at the time of relinquishing of charge by the custodian officer. ~~Original tenders other than the accepted one shall be retained in the office of the accepting authority for a period of one year after the award of contract, and destroyed thereafter.~~

The accepted rates shall remain firm during the contract period. For works for which TS is issued by the Chief Engineer and having time of completion more than 18 months and for multiyear projects, the rates shall remain firm during the contract period ~~and subject to adjustments as per price adjustment clause prescribed in the bidding document.~~

If a work has to be urgently carried out on account of natural calamities and other emergent reasons, such as VVIP/VIP visits, the officer who is competent to arrange the work shall do so through contract agencies in accordance with the provisions in the Manual and if it is not feasible through other systems like piecework system, departmental execution or such other means as may be found most expedient (after getting approval from the competent authority). In such a situation, he may send immediately communication to the

superior officer by the fastest possible means and immediately thereafter seek confirmative approval of competent authority. After arranging the work, sanction of the competent authority shall be obtained for the expenditure on the work and the manner of execution.

8.2 Contractor's authorized agent

The contractor shall if possible, be present himself at the site of work. In case this is not possible, he shall appoint an authorized agent who shall be present at the site of work. The agent so appointed shall be responsible to act on behalf of the contractor in all matters as far as the contract is concerned except to sign agreements or to receive payments. Contractor shall engage a qualified engineering personal if prescribed in the conditions of the bidding document.

8.3 Handing Over the Site

After executing the agreement, the contractor or his authorized agent shall take over the site from the Assistant Engineer within ten days and commence the work immediately. If the contractor does not turn up, the acknowledgement form for handing over of site duly signed by the Assistant Engineer shall be sent to the contractor through registered post and it shall be deemed that the contractor has taken over the site from the date of posting. The contractor shall sign an acknowledgement in the form given in **Appendix** or his authorized agent while the site is taken over by the contractor. If the Assistant Engineer is not the agreement authority, he shall submit copy of acknowledgement to the agreement authority, without delay. ~~For roads works in case the entire area is not available to be handed over at one stretch, the site shall be handed over in stages according to availability. In such cases, the program of construction shall be so phased as to fit in the availability of land and contractor shall accept the program so prepared.~~ The officer under the control of the work shall see that the contractor complies with the conditions regarding use and care of site.

8.4 Working Drawings

For all works except maintenance, it may be necessary to supply working drawings giving full details of the work. Such working drawings may be prepared by the Site Engineers of the contractor and may be adopted with the approval of the officer who has executed the agreement. Where, however, there is substantial variation contemplated from what is provided for in the original design, modifications shall not be approved, except with the approval of the authority who gave technical sanction to the estimate. Wherever necessary, approved working drawings may be made to form part of the contract.

8.5 Setting Out of Works

Before starting any work, the work shall be set out on the ground as per approved plans. The responsibility for setting out a work is that of the contractor as per terms of contract. It is however necessary that the setting out is checked and approved by the

departmental Officers. This shall be done by the Assistant Engineer ~~for works within his T.S. Powers~~ and the Assistant Executive Engineer in other cases. If in the course of checking, the Assistant Engineer or the Assistant Executive Engineer feels that the advice of any higher authority is necessary he shall refer the matter to such higher authority and abide by his instructions. ~~The Agreement Authority may~~ In the case of major works, ~~direct that~~ the setting out shall be got checked and approved by ~~an officer of rank higher than that of an~~ Assistant Executive Engineer. All benchmarks and setting out marks to be adopted for a work shall be of a permanent nature.

It is desirable to have more than one benchmark and these shall be properly interconnected to enable checking on a future date. The position of these benchmarks and setting out marks shall be shown in a sketch drawn in the field book and the work spot order book.

8.6 Approval of Foundations

Works for which the Assistant Engineer/ Assistant Executive Engineer executes agreement, all foundations have to be approved by the concerned officer. If any advice regarding the bearing capacity or adequacy of a foundation is required then the Assistant Engineer/Assistant Executive Engineer shall refer the matter to the Executive Engineer who shall take a final decision in the matter, immediately after it is brought to his notice. For works, agreements for which are executed by an officer higher than the rank of an Assistant Executive Engineer, the Executive Engineer shall inspect and approve the foundation. If he feels that a change is required in the foundation of a work for which estimate is technically sanctioned by a higher authority, he shall refer the matter to the authority that sanctioned the estimate, which will be finally competent to order a deviation. The Assistant Engineer/Assistant Executive Engineer shall inform Executive Engineer of any change required as above through consultation or a note on the changes required which shall be submitted directly. The Executive Engineer shall take a decision himself or refer the matter to the Superintending Engineer or Chief Engineer through discussions and similar notes. In any case, a decision on the change shall be taken in the minimum time possible, so that the program for completion is not affected.

In case of well foundations of bridges, the concerned ~~Superintending Engineer~~ Executive Engineer shall approve the plugging/ seating. ~~Where a work contains several sub items, the Executive Engineer may delegate the responsibility of inspecting and approving the foundation of some minor items to the Assistant Executive Engineer concerned, provided such minor items are independent structures and will not affect the safety of the main structure concerned or the work as a whole.~~

8.7 Quality control

Every work has to be properly supervised to ensure that it is carried out in accordance with the required specifications. Effective supervision shall be insisted for maintaining quality of all items of work. Where there is no specification for a particular item described in the schedule, the specification of the item in the MoRD/ MoRTH/ NBC as the case may be,

or the Indian Standard Specification shall be adopted. Every officer and subordinate controlling the construction of the work shall be fully conversant with these specifications. Any deviation from the standards prescribed shall be reported forth-with by the Assistant Engineer to the Assistant Executive Engineer. The Overseer under the control of a work shall be responsible for maintaining quality of all items of work. They are bound to act according to the duties and responsibilities laid to them as detailed in section 200. It will also be the duty of the Assistant Engineer and other inspecting officers to check the quality of works to see that the specifications are properly followed. If any bad work is noticed even though passed by a subordinate officer, it shall be ordered to be removed forth with, at the cost of the contractor. Important items like R.C.C. in works above T.S. powers of Assistant Engineer shall be carried out only in the presence of the Assistant Executive Engineer. The Assistant Executive Engineer may delegate supervision of small items of R.C.C. work like lintels, covering slab, sunshade and other similar items to Assistant Engineer, in case he is unable to be present at the time of concreting. Plain cement concrete works for levelling course, side drains and other similar items shall be done in the presence of the Overseer in charge. However, plain concrete works for major structures shall be done only in the presence of the Assistant Engineer. In all major works, the Executive Engineer shall decide, the items, which are to be done in his presence. Quality control shall be effected as per the provisions of Quality Control. Certificates as required shall also be insisted.

- A list of mandatory tests should be prepared and attached with the tender documents
- ~~Test Registers should be issued to all officers under the control of the work by Executive Engineer.~~
- Test Reports of all mandatory tests should be submitted along with the final bill of the work.

8.7.1 Sub Standard Work

If any work done is found defective or not in accordance with the specification, the Engineer under the control of the work may order its removal and re-construction or its rectification is deemed fit. The contractor is bound to carry out such removal and re-construction or rectification at his cost. The Engineer shall refer the matter to the agreement authority, who will decide whether to accept reject or rectify the same. In case it is decided to be accepted, the agreement authority will also decide the rate at which the work may be accepted.

8.8 Issue, use and care of departmental materials

No departmental materials shall be issued to the contractor from the department. Bitumen required for the work shall be issued from the department for works costing up to TS powers of the Superintending Engineer.

8.9 Work spot order book

For all works exceeding TS powers of Assistant Executive Engineer a work spot order book shall be maintained in the prescribed form in Appendix 2100B at the site of work. The following instructions shall be followed in maintaining work spot order book.

i. Each page of the book shall be machine numbered. The books shall be serially numbered and a register of work spot order books shall be maintained in the Section office.
ii. The Overseer under the control of the supervision of the work shall be responsible for the safe custody and maintenance of the book issued to him for a particular work.
iii. The Overseer at site shall record in the Work spot order book, the day-today progress of the work; procurement of materials, inspecting officers shall record their remarks and instructions in the work spot order book.
iv. The work spot order book shall invariably be perused and initialed with date by the Assistant Engineer in charge, during his inspection, irrespective of whether he has any remarks to offer or not.
v. The work spot order book shall not be treated as a substitute for measurement book or field book.
vi. The orders issued by the inspecting officers shall be recorded in the work spot order book. If such orders are beyond his competence, the officer issuing the orders shall address the appropriate authority and obtain ratification. The instructions and orders issued through the work spot order book will be binding on the departmental subordinates at site. The Overseer shall submit copies of the instructions to the Assistant Engineer. The Assistant Engineer shall communicate copies of instructions to be complied with by the contractor to him in writing.

8.10 Progress report

The Progress reports of works are very important for Department and Government, which enables them to monitor progress of work and to complete the work in time so as to fulfill the commitment to the public. The field officer concerned shall give maximum effort to avoid unnecessary delays in the execution of works and shall report the progress of works to the department, without fail.

The Executive Engineer shall review progress of ~~(the)other~~ works monthly, the Superintending Engineer quarterly and the Chief Engineer half yearly. Conferences and their observations shall be recorded in the minutes, which shall be forwarded to all subordinate officers. The Physical and Financial progress of each work shall be analyzed in detail with the concerned field officer and bottlenecks, if any, discussed and remedial measures suggested for speedy execution of the work.

8.11 Safety provisions

The Overseer under the control of a work shall ensure that all safety provisions given in Appendix 2100D applicable to the work are complied with. He shall arrange to take corrective steps wherever required. The inspecting officers shall also examine whether such provisions are adhered to.

8.12 Labour

As per the provisions of the Contract Labour Regulation and Abolition Act 1970, the Implementing Officer is considered to be the principal employer of labour in respect of those employed by the contractors carrying out the work under him. It is therefore the duty of the Implementing Officer and his subordinate officers under the control of the works to ensure that the labour laws are properly complied with.

8.13 Extension of time

Time shall be considered as the essence of contract except in the case of piecework contract. ~~The contractor shall submit a chronological programme for execution of each stage of work before executing agreement which shall be examined by the agreement authority and the approved programme form part of the agreement~~. If it is found that contractor is not adhering to the approved programme fine shall be imposed / contract terminated as contemplated in the Standard Bidding Document. If however the failure of the contractor to complete the work on the stipulated date is due to any departmental delays or due to design and construction problems faced during execution, then he may apply for extension of time through the Assistant Engineer before the expiry of the period of completion. This shall follow the procedure of the Bidding Document. Every such application shall be properly enquired into by the Assistant Engineer /Assistant Executive Engineer under the control and a report with recommendation shall be submitted in proforma given in Appendix 2100F to the authority who executed the agreement.

The extension of time of completion that can be granted at a time shall not exceed 25% of the original time or six months whichever is less. The maximum extension that can be granted for a work shall be limited to half the original time of completion.

8.13.1 Fines for Extension of Time of completion

The Contractor is bound to complete the work within the stipulated period as per the agreement. When the contract period has to be extended wholly or partly due to default on the part of the contractor, the Agreement Authority may sanction extension of time after imposing fine prescribed in the bidding document.

It is also open to the agreement authority to refuse sanction to a modified program or extension of time if such modification or extension is wholly or partly due to default on the part of the contractor. The agreement authority may in such cases cancel the contract and arrange the balance work following the procedure laid down in the General Conditions of contract / standard bidding document and rearrange the work within ninety days from the date of order of termination.

Application for extension of time from the contractor shall in all cases be made before the expiry of the time of completion as per agreement. The Assistant Engineer shall submit the application received from the contactor to Assistant Executive Engineer with his remarks / recommendations regarding the genuineness of the reasons stated by the

contractor. If the contractor fails to make such application in time as mentioned above the contract will stand terminated on the expiry of the time of completion stipulated in the agreement including extension already sanctioned. In case there is no default on the part of the contractor the termination will not attract any penalty. When there is default on the part of the contractor, he shall he liable for penalties as per general conditions of contract for termination.

The contractor shall not execute any work as per the agreement after the expiry of the time of completion unless the agreement authority duly sanctions extension of time. If any work is carried out by the contractor in contravention to this, the same shall be treated as unauthorised and no payment will be made for such work. The department will also have the right to claims from the contractor, cost of dismantling and removing such unauthorised works. Departmental officers shall be responsible for the delay in completion of a project if the delay is attributed due to lapses on their part.

Fines for extension of time

Period	Rate of Fine
First Extension	1% of the PAC subject to a minimum of Rs. 1000/- and maximum of Rs. 50000/-.
Beyond First Extension	2% of the PAC subject to a minimum of Rs. 2000/- and maximum of Rs. 100000/-

8.14 Date of Completion of Work

The date of completion of a work is the date of last measurements taken by the concerned Assistant Engineer/contractor on completion of work. A completion certificate in the prescribed proforma along with the as built drawings of the work shall be submitted to the TS authority with copies to the superior officers. Final bill will be paid only after completion is certified by the competent authority.

8.15 Completion Certificate

After the construction is complete in all respects, including provision of all service connections, the site must be returned to the parent department. The Assistant Engineer shall submit the completion certificate as per Appendix 4.13 along with as built drawings to the higher officers for approval. The final drawing must also include layouts of water supply and drainage system. Detailed drawings of electric connections, electronic and communications systems shall also be handed over.

CERTIFICATE OF COMPLETION OF WORK

Name of Work :
Name of contractor :
Contract Agreement No. and date :

Supplemental Agreement No. and date :

Certified that the works as per the above contract agreement and supplemental agreements have been completed in all respects on ……The certificate does not however absolve the contractor from any of the liabilities for which he is responsible as per terms of the contract.

Engineer

8.16 Suspension of works

If, in the course of execution of work, circumstances arise necessitating the suspension of the work in whole or part, the agreement authority may order suspension of the work in accordance with the provisions in the general conditions of contract. However, before ordering such suspension, the agreement authority shall consider all alternatives for different and speedy execution of the work and order suspension only if it is inevitable. The period of suspension shall be kept to the absolute minimum required.

8.17 Foreclosure

Cases may arise where a work or part of it may have to be abandoned after the contract agreement for the same is executed. In such cases foreclosure shall be ordered by the agreement authority immediately after the decision is taken regarding abandonment of a part or whole of the work and further action taken in accordance with the provisions in the general conditions of contract. In such cases the contractor will not be eligible for any claim other than extension of time of completion to the extent of suspension period.

8.18 Termination of contract in case of death, insanity or insolvency

If the contractor is an individual or a proprietary concern and the individual or the proprietor dies, becomes insane or insolvent, the agreement authority has to satisfy himself whether the legal heirs or legal representatives of the contractor are capable of carrying out and continuing the work, and if they are willing, he may entrust the balance portion of the work to such legal heir or representative on a fresh agreement on the same terms and conditions as in the original agreement. In other cases the agreement authority shall cancel the contract in respect of the incomplete portion of the work and rearrange the work otherwise without any penalty or damage to either party on account of such cancellation and rearrangement. All liabilities due to government arising under the contract up to the date of death of contractor shall be realized from the estate of the contractor.

8.19 Termination - default by contractor

As per general conditions of contract, the agreement authority has the power to cancel the contract and arrange the work otherwise in the event of default by the contractor. The agreement authority in exercising the power vested with him shall follow the procedure outlined in the general conditions of the contract. The damages and penalties

provided there in and applicable to the particular contract shall also be realised in accordance with the general conditions of contract.

8.20 Compensation for delay / liquidated damage

1) If the contractor fails to maintain the required progress as per conditions of contract or to complete the work and clear the site on or before the contract or extended date of completion, he shall, without prejudice to any other right or remedy available under the law to the Employer on account of such breach, pay to the employer as liquidated damages an amount calculated @ 0.1% (zero point one percent) of the contract price of the work for every week of delay subject a maximum of 10% of the contract price.
2) The amount of compensation may be adjusted or set-off against any sum payable to the contractor under this or any other contract with the government. In case, the contractor does not achieve a particular milestone mentioned in the conditions of contract or the re-scheduled milestone(s), the amount shown against that mile stone shall be withheld, to be adjusted against the compensation levied at the final grant of extension of time.
3) Withholding of this amount on failure to achieve the completion of work or of milestones shall be automatic without any notice to the contractor.

8.21 Termination of contract

The department can terminate the contract and rearrange the work at the risk and cost of contractor in the following cases

i. If the contractor does not turn up for starting the work within the specified period to take charge ofthe site after executing the agreement.
ii. If the contractor does not show the proportionate progress during the extended period of time of completion.
iii. If the contractor abandons the work after executing a portion without genuine reason and does not resume or complete it even after specific direction from the Department.
iv. Fails to make application for extension of time of completion in time.
v. The licence of the contractor whose work has been terminated shall be cancelled with immediate effect and shall be barred from quoting for another work for a minimum period of five years. Contract licence shall not be renewed in his name or different name of a binamy.
vi. A company or person or firm once terminated shall be disqualified from participating in any tender in his name or by using a different name or binamy. There shall also be a fine and forfeiture of deposits.

8.21.1 Realisation of Loss on Account of Termination

An amount equal to 30% of the cost of the remaining works at agreed rates of the terminated contract shall be recovered from the defaulted contractor towards the risk and cost. The contractor shall be directed to remit the risk and cost amount within three months. There is no need to wait till the work is arranged alternatively through another contractor and the total loss sustainable due to the default of the original contractor is assessed. Such loss, if any, shall be realised after completion of the work. If he fails to remit the amount within this periods following steps can be adopted for realisation of loss. The amount can be realised from the following.

- EMD / Security
- Bill amount / retention if any due to the contract.
- Any dues from department to the contract
- Bank Guarantee / Performance Guarantee or By filling civil suit against the contractor

8.21.2 Revoking of Termination

The contract for a work on terminated by the agreement authority can be revoked by the immediate superior officer if the contractor expresses his willingness at later date to complete the balance work. But performance guarantee of 30% of the balance work to be completed shall be deposited. This performance guarantee shall be released only on completion of the work. In such case the contractor is bound to do the work at the originally agreed rates for which agreement authority shall execute a supplemental agreement with balance schedule and fresh time of completion.

8.21.3 Rearrangement of Work after Termination

The procedure to minimize the loss to government on account of termination of contract shall be as incorporated in the general and special conditions of contract. Rearrangement of works should be done as expeditiously as possible and there should not be any substantial changes in the specification of balance works re-arranged.

8.22 Settlement of disputes and differences

The agreement authority as well as the contractor shall follow the procedure contained in the relevant clause in the general conditions of the contract for settling the disputes arising out of the execution of the contract.

8.23 Handing over work and site on completion

On completion of a work, the contractor shall hand over the completed work with asbuilt drawings to the Assistant Engineer concerned after removing all debris, balance materials, temporary construction etc., and cleaning up the site. The Assistant Engineer shall hand over when the work is intended for the use of any other Department or agency, the completed works along with a set of completion drawings to the concerned officer of that Department/ Agency.

9. EXECUTION OF WORKS

9.1 GENERAL

All works shall be executed based on the specification of MoRTH/ MoRD for road works and CPWD/National Building Code for building works. The Assistant Engineer is the first responsible engineering officer at the site of any construction work like buildings, bridge, roads, etc., who looks after day to day working of the project. The efforts taken & the strict supervision on his part have direct relation to the quality of work. He shall therefore get conversant with various aspects of execution of work, to discharge the duties efficiently. The Assistant Engineer can depute one or more Overseers to a work site for the effective supervision and proper quality control.

9.1.1 Handing Over Site

The Assistant Engineer will hand over the site to the contractor as specified in section 8.3 of contract management.

9.1.2 Study of Documents by the Contractor

The basic document related to work is the estimate. Therefore it shall be thoroughly studied for its scope and provisions. The relevant valid drawings shall also be studied and understood properly. The tender documents and specifications of items must be clearly understood. The provision in the contract document and schedule shall be studied in respect of time of completion, cost escalation, defect liability, progress schedule, quantities and its rates mentioned. The specifications relevant to the schedule of items shall also be referred.

The site may be inspected for locating site office, storage sheds, batching plant, casting yard, labour camp etc. fixed. Source and availability of construction materials like sand, aggregates, cement, steel etc. also to be ascertained. A detailed work program shall be set up on the basis of availability of plant, material, manpower etc. for the smooth progress and completion of work.

9.1.3 Site Office

The contractor shall set up site office and a permanent board shall be erected at the site displaying the details of the work including estimate cost, contract amount, period of contract, scheduled date of completion of work, name of contractor etc. The following details shall be available in the site office at all times.

a) Drawings

All drawings like plan, elevation, layout plan, sections, R.C.C. layout, alignment plan etc. shall be maintained in site office. Such plans are required for daily reference and during the inspection of higher officers. These drawings shall be properly preserved. Such drawings shall bear the signatures of officers approving such drawings, to avoid use of any other

drawing. Outdated or superseded drawings shall be clearly marked as such and removed from the site. Also all drawings in CD may be kept at the office.

b) Estimate & Tender

Copy of the technically sanctioned estimate shall be kept in site office under custody of Assistant Engineer for reference. Similarly, the agreement copy containing all documents shall be kept at site for study and guidance.

c) Other Registers

Some other registers are also required to be maintained by the contractor like dewatering, record for foundation, labour attendance/ wages register, hindrance register, work sport order book etc.

d) Instruments to be kept at Site office

Essential instruments for execution of work shall be kept at site or carried along with if possible. The Asst. Engineer / Overseer shall take care for proper calibration of the instruments and their safe custody in case of departmental instruments. If there is loss/theft of any instrument, in that case the cost of instrument can be recovered from Assistant Engineer / Overseer.

The instruments to be kept are Dumpy Level, Theodolite,Vernier Caliper and Tapes. Tapes are required to be carried always for checking measurements. Generally, following tapes shall be available.

- Metallic tape 15 m &-30 m.
- Steel tape lm, 15 m, 30m.
- Cloth tape 15m, & 30 m.

In addition each Asst. Engineer / Overseer must carry a 3 m. steel tape and a calculator in his pocket at all times. The following tools are also helpful in execution.

- hammer and peg
- chisel
- brush
- Nylon string
- 1 m straight edge + wedge
- Spirit level
- 1m meter square template
- Chalk
- Clip board
- File folder
- Torch with batteries
- Sign board

- Red & green flag (for road works)
- Hard hat
- Reflector clothing/ Safety coat
- Umbrella/ raincoat

e) Tools and Plants

Necessary modern instruments, tools and plants shall be used for speed and quality work wherever possible.

9.1.4 Safe Construction Practices

Public safety as well as safety of the workforce is of utmost importance. In case of buildings the provisions of Part 7 of National Building Code 2005 shall apply. For roads and bridges refer IRC SP 55

9.1.5 Environmental Considerations

For all construction activities, provisions of environmental aspects in the codes and manuals shall be followed. All necessary clearances at the local, state and national levels shall be obtained prior to the start of work, if necessary.

9.1.6 Quality Assurance of works

For all construction activities the provisions of quality manual published by State PWD shall be followed.

9.1.7 Clearing and Grubbing

Before any construction starts the site must be cleared of debris. All materials including trees, grass, vegetation, crops and structures, which fall within the construction area, must be removed. All stumps and roots need to be removed (grubbed out) and the holes/ hollows left must be cleared and filled with compacted suitable filling materials. Existing structures that have to be demolished shall be done as per the provision of Section 5 of Part 7, National Building Code 2005.

Materials obtained during clearing are to be stacked in such place and in such manner as may be ordered by the Assistant Engineer and the ground shall be left in a perfectly clear condition. All serviceable materials obtained on clearing shall be the property of Government. These shall be disposed of as per existing rules without damage to the environment.

9.1.8 Layout of the Work

After having cleared the site, fix up permanent benchmarks, guide reference pillars, and transfer the alignment with the help of reference pillars fixed at site during the location survey. The layout shall be done correctly to true lines, dimensions and locations as per approved drawings. The junction pillars beyond layout area shall be erected marked,

painted and maintained throughout for reference. It shall be crosschecked for right angles, diagonals etc. The Assistant Executive Engineer/ Executive Engineer shall approve all layouts.

9.1.9 Excavation and Approval of Foundation

All excavation shall be done as per MoRD/ MoRTH/ NBC & CPWD specification. The Assistant Executive Engineer shall approve all excavations.

9.1.10 Excavation for Structures

Excavation for structures shall consist of the removal of material for the construction of foundations for buildings, bridges, culverts, retaining walls, headwalls, cut off walls, pipe culverts and other similar structures, in accordance with the requirements of these specifications and the lines and dimensions shown on the drawings or as indicated by the Assistant Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary sheeting, shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstructions, necessary for placing the foundations; trimming bottom of excavations; backfilling and clearing up the site and the disposal of all surplus materials.

Old curiosities, relics, coins, minerals and any other item of archeological importance found on excavation or pulling down shall be the property of the Government. Shall any ancient masonry or other old work of interest be opened up, or any religious edifice or relic be involved in removal or destruction in the execution of a work, a clear report on the matter shall be sent to Government through the Chief Engineer and orders obtained before the demolition or removal of such works or relics. Regarding the disposal of old curiosities, the Assistant Executive Engineer shall consult the District Collector.

9.1.11 Dewatering and Protection

Normally, open foundations shall be laid dry. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The Contractor shall take all precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property.

9.1.12 Preparation of Foundation:

The bottom of foundation shall be leveled both longitudinally and transversely or stepped as directed by the Assistant Engineer. Before footing is laid, the surface shall be slightly watered and rammed. If, during inspection, it is found that the contractor has over excavated the foundation in excess by what is shown in the drawings, he shall not be allowed to refill this with earth but, the additional excavation shall be got filled up by

concrete or masonry of such proportions as decided by the AssistantEngineer. No extra cost is payable to the contractor on this account.

When rock or other hard strata is encountered, it shall be freed of all soft and loose material, cleaned and cut to a firm surface either level and stepped as directed by the Assistant Engineer. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Assistant Engineer. When foundation piles are used, the excavation of each pit shall be substantially completed before beginning pile-driving operations therein.

9.1.13 Public Safety:

All trenches and foundation pits shall be securely fenced and provided with proper caution signs and marked with red lights/ reflectors at night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from IS: 3764. It shall be the responsibility of the above is vested with the contractor.

9.1.14 Backfilling

Backfilling shall be done with approved materials after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface in layers not exceeding 150 mm compacted thickness. The compaction shall be done with the help of suitable equipment such as mechanical tamper, rammer, plate vibrator etc., after necessary watering, so as to achieve a density not less than the field density before excavation.

9.1.15 Excavated Materials

Excavated materials need to be assessed for their suitability. Suitable materials shall be used when required for works. The excavated materials can be temporarily stockpiled, but must cause no damage to services or property. Quantity of such materials shall be deducted from the total quantity executed. Any excess suitable material, which is not required for the construction of the works or any material classified as unsuitable is the property of Department. The contractor shall stockpile these materials separately, as directed, or place the material in an approved location at site. Such material shall be disposed of by auction. To be suitable as fill material the soil must not contain any vegetable matter.

9.1.16 Borrow Pits

The borrow pits, if any required, shall be kept as drained as possible. It shall be made only at the specified distance from the proposed structure. It shall not be cut opened where they might:-

a) affect the stability or safety of the highway, or any railway or other structures, which may be present.

b) prevent natural or artificial drainage or irrigation.
c) damage adjacent property or future expansion plans for the highway.

After the correct layout is marked, cross checked and approved the excavation for foundation starts. Before starting excavation, it is necessary that ground levels are taken correctly and recorded in level book and the foundation plan. The levels at all junctions of building shall be taken at a large number of points.

Unauthorised entries to site shall be prohibited. The contractor shall obtain proper license for explosives and flammable materials whenever they are required to be stored at site and proper magazines as per rules must be insisted on.

9.1.17 Formwork

The concrete acquires exact shape of the mould in which it is placed. For good concrete work, shuttering, centering and concreting operations are three important things. It is therefore important that principle of sound design, erection of the shuttering are strictly followed. Any negligence on this account may lead to mishaps resulting in loss of human life and Government money.

The provisions of clause 11 of IS 456:2000 shall be followed for formwork. The plan of the formwork proposed to be employed by contractor shall be obtained and examined by the Assistant Executive Engineer. If such plans are not satisfactory to the Assistant Executive Engineer, the contractor shall be asked to make such changes in them as may be required.

The formwork shall be robust and strong and the joints shall be leak-proof and must be properly sealed. The number of joints in the formwork shall be kept to a minimum by using large size panels. Formwork shall be designed to withstand the load due to placing of concrete, in case of ready mixed concrete (RMC).

9.1.18 Forms/ moulds

In designing forms/ moulds, concrete shall be treated as a fluid weighing 2400 Kg. per cubic metre in addition a live load of 700 Kg. per square metre shall also be considered. Forms shall be so designed and constructed that they may be removed without injury to the concrete. Blocks and bracings shall be removed with the forms and in no case shall any portions of the wood forms be left in the concrete. The forms must be so constructed, set and maintained that the finished concrete shall be of the form and dimensions shown on the plans and true to lines and levels. Allowance for the deflection of forms and for shrinkage and settlement of staging or centering in addition to the allowance for dead loads, and camber, as shown upon the plans shall be provided.

Forms used subsequently shall be thoroughly cleaned and shall be free from bulge, splits or warps. In case of compaction of concrete by vibration, the forms shall be so designed as to withstand the effects of vibration. The formwork shall be coated with an approved release agent that will effectively prevent sticking/ coating the reinforcement and

will not stain the concrete surface. Lubricating oil(machine oils) shall not be used for this purpose.

The forms shall remain in place for the period required as per clause 11.3 of IS 456 2000. The foregoing specification for forms shall also apply to steel forms. The sheets used shall be of such thickness that the forms will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Steel forms, which do not present a smooth surface or line up properly, shall not be used. Special care shall be exercised to keep steel forms free from rust, grease or other foreign matter, which will discolour the concrete.

Broadly, the following steps shall be observed

i. Proper design of centering system for all dead & live loads that is approved by competent engineer.
ii. Proper use of shuttering & centering material. Centering shall be of steel props & beams (telescopic), shuttering with waterproof ply board (preferably laminated on one side) & steel centering plates.
iii. The erection shall be done carefully. The ground on which it is to be supported shall be firm even during rains. The supports shall be adequately braced.
iv. After erection, the Assistant Engineer and Assistant Executive Engineer shall check it for dimension, line, level & safety.
v. The centering shall be removed only after the minimum prescribed curing period is over.

9.1.19 Scaffolding

Scaffolding is the responsibility of contractors, but the departmental officer must ensure that the scaffolding provided is adequate and properly fixed together and strengthened so that workmen and others using them can carry on work safely.

9.1.20 Shuttering and Centering Work

The Engineer in charge shall insist the contractor to use screw jacks or hardwood wedges to take up any settlement in staging or centering either before or during the placing of the concrete. All staging and false work shall be built on foundations of sufficient strength to carry the load without deformation. On stable soils, like rock, shale, stiff clay and sands free from scour, wooden/ steel plates/ concrete base may be used for safely distributing the loads spread footings may be used and its size shall be determined by the load to be supported. In other locations, the formwork shall be supported on piles. The piles shall be spaced and driven to support the required loads without settlement

Special measures in the design of formwork shall be taken to ensure that it does not hinder the shrinkage of concrete. The soffit of the formwork shall be so designed as to ensure that the formwork does not restrain the shortening and/or hogging of beams during pre-stressing. Any cut outs or openings provided in any structural member to facilitate erection of formwork shall be closed with the same grade of concrete as the adjoining structure immediately after removal of formwork ensuring watertight joints. Provision shall

be made for safe access on, to and about the formwork at the levels as required. Close watch shall be maintained to check for settlement/ displacement of formwork during concreting. Any settlement of formwork during concreting shall be promptly rectified. Water used for curing shall not be allowed to stagnate near the base plates supporting the staging and shall be properly drained.

9.1.21 Removal of Shuttering Centering:

Normally, side shuttering of column, beam faces is removed after 24 Hours. However, the centering shall be removed only after the prescribed period. While removing centering, care shall be taken to avoid injuries to the labourers or staff working there. Particular care shall be taken while removing shuttering below cantilever slab/ beams etc. Unless sufficient counter weight for the cantilever portion is developed the centering shall not be removed. If proper sequence of removal of props is not followed, the beam or truss may collapse due to wrong support pattern.

9.1.22 Ladder

Necessary ladders with handrails must be provided in accordance with the clause 14.3 of part 7 of NBC for supervision and inspection of the official during execution and safety of the workers.

9.1.23 Materials

a) **Cement**

Cement to be used in the works shall conform to clause 5.1 of IS 456: 2000. Bagged or bulk cement which has partially set or which contains lumps of caked cement must be rejected. The use of cement reclaimed from discarded or used bags is not permitted. Any cement stored for a long time needs to be tested before its use.

b) **Aggregate**

It includes both fine and coarse aggregates and shall comply with the requirements of IS 383

Coarse Aggregates: Coarse aggregate shall consists of clean, hard, strong, dense, nonporous crushed stones, crushed gravel , natural gravel or other approved inert materials. These shall not consist of pieces of disintegrated stones, soft, flakey, elongated particles, salt, alkali, vegetable matter or other deleterious material. Coarse aggregates having positive alkali-silica reaction shall not be used. Coarse aggregate shall conform IS 383 and tests for conformity shall be carried out as per IS 2386 Parts I to VIII.

Fine Aggregates: It consists of natural sand or crushed stones or gravel or combination thereof. They shall be clean and shall not contain mica or other deleterious material in such quantities as to reduce the strength and durability of the concrete or to attack the embedded steel. It also conform to IS 383.

c) **Water**

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may cause deterioration to concrete or steel. It shall conform to requirements of clause 5.4 of IS 456:2000. Potable water is generally considered satisfactory for mixing concrete. Mixing and curing with seawater shall not be permitted.

d) **Admixtures**

The admixtures for concrete shall be as per clause 5.5 of IS 456:2000.

e) **Reinforcement**

Reinforcements shall be as per clause 5.6 of IS 456:2000. The schedule & drawing of reinforcement shall be correctly prepared as per the design and got approved. The cutting length & bending schedule shall be drawn in a correct manner to be understood by the site supervisor. Some principles to be followed are

i. The laps shall be staggered.
ii. Extra care is needed during concreting at the crowded locations of reinforcement for good results.
iii. Cover shall be ensured by use of proper cover blocks of concrete.
iv. Cover shall be maintained during concreting.
v. Reinforcement in case of projection like canopies to be maintained at its correct location (i.e. top) during concreting.
vi. The bars placed shall be measured and recorded properly by Assistant Engineer and checkmeasured by Assistant Executive Engineer before concreting.
vii. Wherever required, the bars shall be treated for protection from corrosion, particularly in coastal areas and areas prone to industrial and environmental pollution.

f) **Bricks**

Burnt clay bricks shall conform to the requirements of IS: 1077, except that the minimum compressive strength when tested flat shall not be less than 8.4 Mega Pascal for individual bricks and 10.5 MPa for average of 5 specimens. They shall be free from cracks and flaws and nodules of free lime. The brick shall have smooth rectangular faces with sharp corners and emit a clear ringing sound when struck. The size may be according to local practice with a tolerance of ± 5 per cent.

g) **Stones**

Stones shall be of the type specified. It shall be hard, sound, and free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used. IS 1127 shall be adopted for the dimensions of natural building

stones. The crushing strength of building stones when tested as described in IS 1121 shall have a minimum value of 350 Kg/cm^2

Following IS codes give specification for various stones used for construction.

Lime Stone	IS 1128
Granite	IS 3316
Marble	IS 1130
Sand Stone	IS 3622
Laterite	IS 3620

h) **Storage of Materials at Site**

Materials shall be stored as described in IS 4082

i) **Approval of Materials**

All materials shall be got approved by the Assistant Engineer or Assistant Executive Engineer concerned as the case may be and job mix formulae / Mix design shall be got approved by the concerned Executive Engineer. For this the relevant details have to be submitted at least 20 days ahead of the planned start date.

9.1.24 Job Mix Formula/ Mix Designs

The contractor shall submit the job mixing formula / mix design before the commencement of work. While establishing the job mix formula, the contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mixture and its different ingredients satisfy the physical and strength requirements. Approval of the job mix formula shall be based on independent testing by the Engineer for which the contractor shall furnish samples of all ingredients of the mix as required by the Engineer. The approved job mix formula shall remain effective unless and until a revised job mix formula is approved. Shall a change in the source of materials be proposed; a new job mix formula shall be forwarded to the Executive Engineer for approval before the placing of the material.

9.1.25 Concreting

Concrete proportioning shall be as per clause 9 of IS 456:2000. Nominal mix concrete may be used for M15 or lower. Design mix is adopted for higher grades. Concreting under special conditions shall be as per clause 14 of IS 456:2006

Mixing of concrete shall be as per clause 10.3 of IS 456:2000. The transportation, placing, compaction and curing of concrete shall be as per clause 13 of IS 456: 2000

9.1.25.1 General Precautions

i. The mixing proportion shall be achieved correctly by using weigh batching or volumetric method.

ii. Concrete shall be thoroughly mixed and then immediately transported and placed without segregation and before the initial setting time. Retarding chemicals can be used for delaying the initial setting, if required.
iii. Concrete shall be well compacted, immediately on placing with vibrators. Over or under compaction shall be avoided. Care shall be taken where reinforcement is heavy in narrow sections. The finished surface shall be re trowelled after initial set to avoid surface cracks.
iv. The curing must begin after the final set but not later than 24 Hrs. The date of concreting shall be written by paint on column/ beam faces, after removal of shuttering for easy reference. Curing shall continue for 28 days. When maintaining of proper curing is difficult, curing compounds shall be used. To conserve water, fine sprayers shall be used for curing the sides & bottoms.
v. At least three cubes shall be taken from the working mix prescribed for day's concreting and their record shall be maintained. These cubes shall be tested in the government approved laboratory on due dates and proper cognizance of results shall be taken. In case of abnormal results the fact shall be immediately brought to notice of the superior officers.

9.1.26 Visit of Higher Officers for Inspection

Generally, important road, bridge & building works shall be inspected by higher levels officers. During such visits, the relevant information, plans, estimates, drawings etc. shall be made available for ready reference. At such times the plans are displayed properly, progress reports/bar charts are properly updated for targets/ achievements. All the quality control registers should be kept ready. Detailed Project Report, copy of the agreement etc. are to be kept handy in proper form. A short note in the form of work memo should be prepared highlighting the salient features, progress, bottlenecks, expenditure and future plans etc. The movement paths for inspection of roads, bridge & building sites are to be clearly marked, to avoid repetition and confusion in movements. These opportunities shall be utilized for seeking guidance, highlighting achievements, difficulties and shortfalls and its reasons etc. for spot decision or follow up decision. The inspecting officers shall record their comments in the work spot order book and circulate the inspection note as per Appendix 2200 A to all concerned for follow up action

9.1.27 Verification of Quantity by the Chief Technical Examiner:

Earth work in all works exceeds 1000 Cum and the quantity of any aggregate supplied for Road work exceeds 100 cum, the Assistant Executive Engineer shall report by e-mail or fax to Chief Technical Examiner in the proforma given in Appendix 2200B so as to verify the reported quantity. Earth work and usage of stacked materials can be used only after the verification or on completion of three working days from the date of sending the messages.

In case of urgency the Executive Engineer shall super-check the full quantity and give sanction to proceed with the work.

In road works involving multi layer pavements powered by the level measurements initial level with proposal for subsequent layers shall be reported to the CTE without resorting to reporting of final levels of intermediate levels.

9.2 CONSTRUCTION OF ROADS

This section provides a guideline to the correct construction practices and procedures for use on road works. Throughout the site, the area where the works are being done, the contractor is responsible for supplying all the necessary signs and other equipment to ensure the smooth and safe flow of traffic. The construction shall be carried out in a safe and controlled manner to prevent damage to vehicles and the general public from construction equipment, materials and activities.

9.2.1 General

- Before any construction, the roadway must be cleared of all vegetation and trees, including uprooting.
- Cross sections shall be taken prior to any excavation works.
- Finalize cross section of the alignment and levels prior to excavation.
- All construction works must be carried out in as safe as possible.
- Excavated materials, if suitable, shall be used wherever possible in the works.
- Provision has to be made for drainage of the temporary and permanent works.
- Soil containing vegetable matter shall not be used as fill material.
- Borrow pits shall not affect the stability of the road, or any other structure.

9.2.2 Setting Out

The working Bench Marks tied with the Reference Bench Mark, wherever necessary, shall be established before commencement of the work. The working Bench Marks shall be at the rate of four per km and also at or near all drainage structures over-bridges and underpasses. An up-to-date record of all bench marks including approved adjustments, if any, shall be maintained by the Assistant Engineer. The lines and levels of formation, side slopes, drainage works, carriageways and shallers shall be carefully set out and frequently checked during construction, care being taken to ensure that correct gradients and cross sections are obtained everywhere.

In order to facilitate the setting out of the works, the centerlines of the carriageway must be accurately established based on the investigation report, in every 30 m or less intervals in plain and rolling terrains and 20m intervals in hilly terrain and in all curve points with marker pegs and chainage boards. On construction reaching the formation level stage, the centerline shall be set out again to avoid any deviation from the approved centre line. No reference peg or mark shall be moved or withdrawn and no earthwork or structural work

shall commence until the centre line has been referenced and approved by the Assistant Engineer.

9.2.3 Public Utilities

The Assistant Engineer shall collect necessary details of the affected services like water pipes, sewers, oil pipelines, electric lines and posts, telephone lines, cables, gas ducts etc owned by various authorities including Public Undertakings and Local Authorities. He shall do this by collecting necessary details of such utilities in the site or in consultation with the concerned departments and joint inspection wherever necessary. The location shall be finalized during the tender stage and utilities are to be shifted before the commencement of the work. The improvement and upgradation of the roads are important for the community; hence all departments/authorities must co-operate to shift the utilities in time.

9.2.4 Clearing of Site:

Clearing of site by dismantling old bridges and culverts and existing pavements shall be as per MoRD/ MoRTH.

9.2.5 Excavation

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways in accordance with the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. Excavation for road works shall conform to the specifications of MoRD/MoRTH. It shall include the hauling and stacking of or hauling to sites of embankment and subgrade construction, suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Assistant Engineer.

9.2.6 Classification of Excavated Material

The excavated materials shall be classified as specified in MoRD/ MORTH.

9.2.7 Authority for Classification

The classification of excavation shall be proposed by the Assistant Engineer and got approved by the Assistant Executive Engineer.

9.2.8 Road Formation in Cutting

Where hard strata are available, and the formation level is below existing ground level, excavation shall be done with due consideration of the stability of slopes. Benching may be resorted to wherever necessary and other suitable slope protection provided. In case of rocks the provisions of MoRD/MoRTH shall apply.

9.2.9 Supply of Materials for Road Work

Aggregate supply required for any roadwork shall be from reliable source. The materials shall conform to the specifications in MoRD/ MORTH and shall be stacked as provided in MoRD/MoRTH.

All aggregates required for road work shall be properly stacked in stacking areas near the plant or on the road side in such a manner as not to interfere with traffic. Before the stacking is done the stacking area shall be examined to see that it is level and dimensions of the stockpiles and the Engineer shall approve their location.

Materials supplied for work during dry season shall be utilized not later than 15 days and if any contamination occurs, shall be rectified by the contractor at his own cost. Aggregates shall not be stacked until it has been thoroughly screened to gauge and free from all earth, rubbish, vegetable matter and other foreign materials. If necessary, aggregates shall be washed and allowed to drain for at least 72 hours. When ready, it shall be stacked at nearest available places. When aggregate supplies for renewal and for patchwork are both to be supplied for the same reach of a road, these shall be stacked on opposite sides.

The contract unit rates for different sizes of coarse aggregate, fine aggregate and stone filler shall be paid in full for collecting, conveying and stacking or storing at the site including full compensation for:

- All royalties, fees, rents where necessary;
- All leads and lifts; and
- All labour, tools, equipment and incidentals to complete the work to the Specifications.
- All necessary testing of material, both initial, to approve the source, and regular control testing thereafter.

Aggregates shall be stacked in heaps of regular cross section. The deposition shall commence at one end of the proposed road and be carried continuously to the other end. No road material in excess of requirements shall be stacked in that stretch. Any excess quantity shall be removed to where it is required, before the materials in that reach are measured.

If sufficient land with not available for stacking in the stretch and / or if safety consideration demands, the stacking of materials can be permitted in suitable stacking yards with prior permission from the Assistant Engineer. Stacking place shall be noted in the M book, if it is stacked away from the side of the proposed reach.

All aggregates shall be measured by the Assistant Engineer and check measured by Assistant Executive Engineer before it is spread. After check measurement, each stack shall he marked by whitewash or otherwise to prevent the possibility of it being measured again. This shall be reported to the Chief Technical Examiner for verification of quantities as per section 2213.

During the time the aggregate is supplied and stacked, there shall be frequent inspections by the Overseer as well as by Assistant Engineer to guard against stacks being formed over heaped up earth or debris.

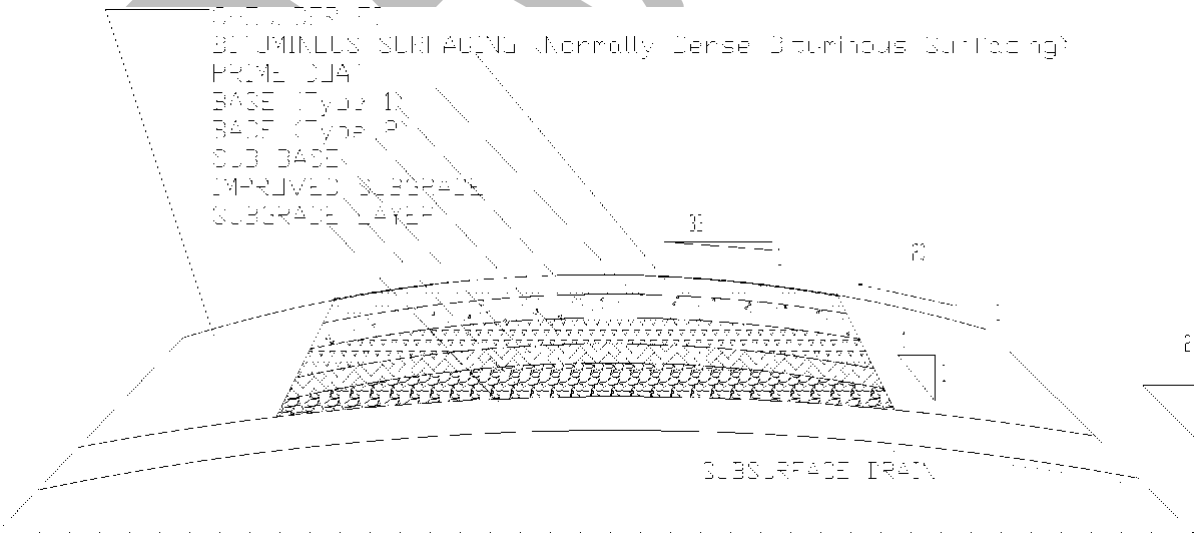
9.2.10 Road Machinery

As a matter of policy modern machineries shall be used for all public works and the same should be encouraged Mechanization of road construction is not only necessary for speedy construction but also for overall economy and for achieving the desired quality of the finished job. Starting from grubbing or site clearance, the road construction machinery can be deployed at all stages of construction till completion of the project. The requirement of appropriate machinery for excavation of different operation of road construction is given in Appendix 2200C. The expected output of machines is given in Appendix 2200D.

9.2.11 Embankment Construction

- All fill materials must be free from vegetable matter and other deleterious material must be approved as suitable.
- The material shall be of an appropriate nature and at moisture content that permits compaction to form a stable layer.
- Generally embankments shall be constructed in 150 mm compacted layers parallel to the finished grade of the road.
- For each completed layer the density shall be checked.
- Any soft areas must be rectified before further material is placed. Each earthworks layer requires to be approved before the next layer can be started.

All embankments, subgrades, earthen shallers and miscellaneous backfills shall be constructed in accordance with the lines, grades, and cross-sections as directed by the Assistant Engineer. It shall follow the specification as per clause 305 of MORTH



Not to Scale Figure 4.1 Pavement Layers

9.2.12 Sub Grade

The sub grade is the layer of embankment immediately below the pavement. This may be undisturbed local material or may be soil excavated elsewhere and placed as fill. In either case it has to be prepared to give added strength. All subgrade material must be free of vegetable matter. The material also needs to be of a type and moisture content that it can be compacted to form a stable layer. If the material in the subgrade level is found to be unsuitable, this must be excavated and replaced with suitable material, which shall then be compacted. The subgrade must be prepared over the full width of the embankment, including the shallers. This is generally carried out in lengths of greater than 100 metres. In some cases to maintain traffic, part width working may be necessary. If this is the case it is vital that the full width of the embankment meets the subgrade material and compaction requirements. When the road is to be placed on existing material, this shall be fully loosened to a depth of 150 mm below the subgrade level. Any lumps shall be removed or broken up to be less than 50 mm in size. The subgrade must be compacted uniformly by use of adequate and appropriate compaction equipment. The material shall be at moisture content close to optimum moisture content throughout the layer so that it can be compacted to produce a dense compacted layer. Generally the compaction shall begin at the outer edges of the embankment and by rolling in a longitudinal direction gradually progress towards the centre so that each section receives equal compaction.

9.2.13 Drainage

The surface of the embankment/ subgrade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding. For this, surface drains and subgrade drains shall be provided.

a) Surface drains

Drains shall follow generally the slope of road. Surface drains shall be excavated to the specified lines, grades, levels and dimensions to the requirements of MoRD/MoRTH Specifications for Road and Bridge works.

b) Sub grade Drains

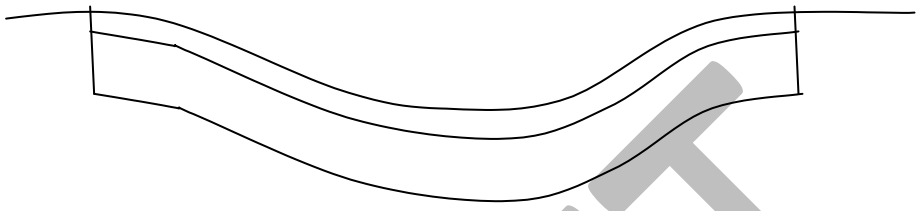
Sub grade drains are constructed to ensure that water in the pavement, which would weaken the road, is allowed to drain away. Subgrade drains shall be extended to the edge of the embankment with drains on opposite sides of the road being staggered. In case of roads with minimal longitudinal fall it is often better to install subgrade drains longitudinally at the edge of the road pavement, see Figure 4.1

The excavation for subgrade drains shall be filled with clean sand or gravel or GSB, which contains no vegetable matter, silt or clay. The backfill must be compacted by hand ramming and struck off level with, or slightly above, the finished subgrade level. The finished backfill must be immediately covered with an approved separator material. The separator material is normally specified and will be woven rot proof fabric, geo-textile membrane or perforated heavy duty polythene sheeting. The separator material shall extend 150mm beyond the edges of the drain on all exposed faces. Any joints in the fabric shall overlap by at least 150mm. Materials over the drain shall be placed by hand for at least

100mm above the separator membrane prior to rolling either the pavement or the shaller materials.

C) Dips/ Chappath

In places where culverts are not feasible for cross drainage works, dips/ chappath can be provided. It shall be given a minimum length of 3- 5m, depending on the depth of dip, so as to avoid sudden breaking of vehicles. It shall be given sufficient base course with DR paving formed to the profile of the dip, with a minimum of 10 cm thick wearing course of M20 mix.



9.2.14 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shallers /verge/road bed and side slopes to conform to the alignment, level, cross-sections and dimensions as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain. When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

Service cross ducts using 50- 100 mm PVC pipes shall be provided for service utilities like water supply, communication lines, KSEB lines etc at suitable intervals. In case of special ducts for KSEB cables are required, that also can be provided during construction of roads.

9.2.15 Sub Base

a) Granular Sub Base

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross -sections as directed by the Assistant Engineer.

b) Cement Treated Soil Sub-Base/Base

This work shall consist of laying and compacting a sub-base/base course of soil treated with cement/ lime/ other suitable materials, treated soil etc on prepared subgrade/sub-base, in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections as directed by the Engineer.

9.2.16 Base Course (Non Bituminous)

The following are the base courses (Non Bituminous) usually provided for road works

- Water Bound Macadam Sub -Base / Base
  Sub Base Course: Normally consists of at least one layer of grading I or II materials.
  Base course: Base course is done using Grade III material.
- Crusher-Run Macadam Base
- Crushed Cement Concrete Sub-Base/Base
- Wet Mix Macadam Sub -Base/Base

a) Water Bound Macadam Sub -Base / Base

WBM may be used as Sub Base as well as Base course and also surface course of rural roads. This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly prepared subgrade/ sub-base/ base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as directed by the Engineer.

It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

b) Crusher-Run Macadam Base

This work shall consist of furnishing, placing and compacting crushed stone aggregate sub-base and base courses constructed in accordance with the requirements set forth in this Specification and in conformity with the lines, grades, thicknesses and cross-sections as directed by the Engineer,

c) Crushed Cement Concrete Sub-Base/Base

This work shall consist of breaking and crushing the damaged cement concrete slabs and recompacting the same as sub-base/base course in one or more layers. Where specified, it shall also include treating the surface of the top layer with a penetration coat of bitumen.

d) Wet Mix Macadam Sub -Base/Base

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared subgrade/sub -base/base or existing pavement as the case may be. The material shall be laid in one or more layers as necessary to lines, grades and cross -sections as directed by the Engineer. The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be increased to 200 mm upon approval of the Engineer.

9.2.17 Bituminous Base and Surface Courses

a) General

Bituminous pavement courses shall be in accordance with Specifications of MoRD/ MoRTH. The use of machinery and equipment mentioned in various Clauses of these Specifications is mandatory, and for more details Manual for Construction and Supervision of Bituminous Works may be referred.

b) Laying Trials

Once the plant trials have been successfully completed as per MoRD/ MoRTH, and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid, and compacted all in accordance with the MoRD/ MoRTH Specifications.

c) Key Points

- Dense bituminous surfacing should be done only after the approval of material and job mix formula by the Assistant Engineer
- Samples of the material along with laboratory test results shall be submitted to the Engineer at least 14 days in advance of a proposed material's use. If approved, the contractor shall then carry out trial mixes. This shall also be tested and approved. No dense bituminous surfacing can occur until both the job mix formula and the trial sections have been approved.
- Thereafter all asphalt work is required to follow the approved Job Mix formula and the procedures established by the approved trials.
- The surface upon which the bitumen or bituminous mixture is to be placed must be thoroughly cleaned immediately before the bitumen or mixture is placed.
- Bituminous materials shall be placed only when the surface is dry, when rain does not appear imminent and when the prepared road bed is in a satisfactory condition.
- The entire surface to be primed must be covered evenly. The sprayer shall be cleaned and calibrated to ensure the required rate of spray is achieved. Depending on the nature of the surface to be primed, a light application of water just prior to priming may be beneficial to aid penetration of the bituminous material.
- No bituminous mixtures shall be placed until the prime coat has dried.
- Tack coat may need to be applied to make the road surface sticky prior to the bituminous carpeting layer being placed.
- For Primer Seals and Bitumen Surface Treatments the aggregate must be spread and rolled into bitumen immediately after spraying, preferably rolling shall be by multi tyre rollers.
- Each day dense bituminous surfacing is laid, three Marshall specimens shall be prepared and tested as ASTM D 2041

- Samples to be collected from either the plant or the laid mat, as directed by the Engineer. Samples shall also be taken each day to determine the mix composition (Extraction of bitumen test and grading),
- All equipment proposed to be used by the Contractor are in good condition and operated by competent and experienced operators
- Dense bituminous surfacing must be thoroughly compacted as soon as the material will support the roller without undue displacement or cracking. Excess use of water on the roller drums is to be avoided as this cools the asphalt mat.
- The surface of the mixture after compaction must be close and tight, and free from dragging cracks. Any mixture that is defective shall be removed and replaced with fresh hot material, which shall be compacted immediately.
- After final rolling, samples shall be cut from areas of bituminous surface for checking density and thickness at specified intervals. Where samples have been taken, fresh material must be placed and thoroughly compacted.

d) Surface Preparation

Prime coat shall be provided as per Clause 502 and tack coat as per clause of MoRD/ MoRTH specifications.

9.2.18 Base Course (Bituminous)

The different types of bituminous base course are as follows

- Bituminous Macadam
- Bituminous Penetration Macadam
- Dense Graded Bituminous Macadam

9.2.18.1 Bituminous Macadam

This work shall consist of construction in a single course having 50mm to 100mm thickness or in multiple courses of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these specifications. Bituminous macadam is more open graded than the dense graded bituminous materials.

9.2.18.2 Bituminous Penetration Macadam

A penetration Macadam is a compacted layer of coarse aggregates into which bituminous binder is introduced. The binder penetrates in to the layer through the voids and binds the stone aggregates. A layer of small aggregates, called key aggregates, is spread on the surface and rolled so as to fill in the surface voids in the coarse aggregate layer. A seal coat is provided to make the surface more impervious to water. This type is commonly used in remote areas where it is difficult to transport mixing and laying equipment. It can also be used as a temporary emergency material to repair a pavement damaged by rains and floods.

9.2.18.3 Dense graded Bituminous Macadam

It may be used as base/binder and profile corrective courses. Apart from Bituminous Macadam, the only difference is being that the stone aggregates are more closely graded. As a result, the resultant mixture is denser. DBM is also intended for use as road base material. This work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50mm to 100mm.

9.2.19 Surface (wearing) Course

The following are the surface (wearing) courses usually adopted.

- Semi dense Bituminous Concrete (SDBC)
- Bituminous Concrete (BC)
- Surface Dressing
- Open grade premix carpet
  - Open grade premix carpet using Penetration Bitumen or Cutback.
  - Open grade premix carpet using cationic bitumen emulsion
- Mastic Asphalt
- Close graded/ Mixed Seal Surfacing (MSS)

9.2.19.1 Semi Dense Bituminous Concrete

This clause specifies the construction of Semi Dense Bituminous Concrete, for use in wearing/binder and profile corrective courses. This work shall consist of construction in a single or multiple layers of semi dense bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25mm to 100mm in thickness.

9.2.19.2 Bituminous Concrete

This clause specifies the construction of Bituminous Concrete, for use in wearing (also used as profile corrective courses) especially for heavily trafficked highways. This work shall consist of construction in a single layer (30mm to 100mm in thickness) of bituminous concrete on a previously prepared bituminous bound surface.

9.2.19.3 Surface Dressing

This work shall consist of the application of one coat or two coats of surface dressing, each coat consisting of a layer of bituminous binder sprayed on a previously prepared base, followed by a cover of stone chips rolled in to form a wearing course to the requirements of these Specifications. Surface Dressing is used in the case of relatively lightly trafficked roads over gravel or other untreated road bases. It shall be noted that surface dressing is a thin treatment and does not enhance the structural strength of the pavement. If the existing road surface is full of irregularities and undulations, it does nothing to improve riding quality. Design of Surface Dressing may be referred to in the Manual for

Construction and Supervision of Bituminous Works.The materials to be used, construction operations, surface finish and quality checks and opening to traffic shall be as per the specifications of MoRD/ MoRTH.

9.2.19.4 Open Grade Premix Carpet

9.2.19.4.1 Open-graded Premix Surfacing using Penetration Bitumen or Cutback.

This work shall consist of the preparation, laying and compaction of an open-graded premix surfacing material of 20 mm thickness composed of small-sized aggregate premixed with a bituminous binder on a previously prepared base, in accordance with the requirements of these Specifications, to serve as a wearing course.

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9.2.19.4.2 Open graded premix surfacing using cationic bitumen emulsion

This work shall consist of the preparation, laying and compaction of an open graded premix surfacing of 20 mm thickness composed of small-sized aggregate premixed with a cationic bitumen emulsion on a previously prepared surface, in accordance with the requirements of the relevant Specifications of MoRD/ MoRTH, to serve as a wearing course.

9.2.19.5 Mixed Seal Surfacing

This work shall consist of the preparation, laying and compaction of a close-graded premix surfacing material of 20 mm thickness composed of graded aggregates premixed with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course. Close graded premix surfacing shall be of Type A or Type B as specified in the Contract documents.The materials to be used, construction operations, surface finish and quality checks and opening to traffic shall be as per the specifications of MoRD/ MoRTH.

9.2.19.6 Mastic Asphalt

This work shall consist of constructing a single layer of mastic asphalt wearing course for road pavements and bridge decks. Mastic asphalt is an intimate homogeneous mixture of selected well graded aggregates, filler and bitumen in such proportions as to yield a plastic and voidless mass, which when applied hot can be trowelled and floated to form a very dense impermeable surfacing. Its consistency is such that it flows like a viscous fluid at temperatures of around 175^0 C to 210^0 C but, on cooling to normal temperatures; it solidifies in to a dense mass. Thus its construction requires no compacting effort. Because of its superior properties, it is used as a wearing course material for heavy duty pavements, city streets carrying high volume of traffic, bus stops where heavy tangential forces are expected, junctions where cornering stresses are predominant.

9.2.20 Seal Coat

This work shall consist of the application of a seal coat for sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall (camber). Seal coat shall be of either of the two types specified below:

- Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chips.
- Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

The materials to be used, construction operations, surface finish and quality checks and opening to traffic shall be as per the specifications of MoRD/ MoRTH.

9.2.21 Bituminous Cold Mix (Including Gravel Emulsion)

Bituminous Cold Mix consists of a mixture of unheated mineral aggregate and emulsified or cutback bitumen. This Specification deals only with plant mix (as opposed to mixed- in-place). Bituminous cold mixes are used in situations where hot mix plants are not readily available, including for work in remote areas and maintenance operations. Two types of mix are considered, namely,

- Designed Cold Mix
- Recipe Cold Mix.

The Design Mix procedure shall be used unless the Engineer specifically approves the Recipe Mix procedure.

9.2.22 Concrete Pavement

a) Semi-rigid Pavement Construction

Semi- rigid pavement is a concrete sub base having a wearing course over it. In case of rural roads the wearing coarse have a thin bituminous surface. Semi-rigid pavements are also used as a Sub base for making cement concrete pavement. Generally, the following types are used for Semi-rigid pavement construction.

- Dry Lean Cement Concrete. (DLC)
- Cement Fly Ash Bound Macadam
- Lime Fly Ash Concrete
- Lime Fly Ash Bound Macadam

However, Dry Lean Cement Concrete (DLC) is most commonly adopted.

9.2.22.1 Dry Lean Cement Concrete (DLC)

The work shall consist of construction of dry lean concrete sub base for cement concrete pavement in accordance with the requirements of the specifications and in conformity with the lines, grades and cross-sections.

9.2.22.3 Cement Concrete Pavement

The work shall consist of construction of unreinforced, dowel jointed, plain cement concrete pavement in accordance with the requirements of the specifications and in conformity with the lines, grades and cross sections shown on the drawings.

The materials to be used, construction operations, surface finish and quality checks and opening to traffic shall be as per the specifications of MoRD/MoRTH.

9.2.23 Shallers

9.2.23.1 General

Shaller gives adequate side support to the pavement and also drains off surface water from the carriageway to the roadside drain. The work shall consist of constructing shaller on either side of the pavement in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections.

Shaller may be of selected earth/ granular material/ paved conforming to the requirements of MoRD/ MoRTHclauses. Paved shallers shall consist of sub-base, base and surfacing courses, and materials for the same shall conform to relevant Specifications of the corresponding items. Where paved or hard shallers are not provided, the pavement shall be provided with brick/stone block edgings. The bricks shall conform to Clause 1003 of these Specifications.

9.2.23.2 Shoulder Width

Width of the shoulder shall vary from 1 m to 2.5 m be as directed by the Assistant Engineer.

9.2.23.3 Construction Method

The sequence of operations shall be such that the construction of paved shaller is done in layers each matching the thickness of adjoining pavement layer. Only after a layer of pavement and corresponding layers in paved and earth shaller portion have been laid and compacted, the construction of next layer of pavement and shaller shall be taken up.Where the materials in adjacent layers are different, these shall be laid together and the pavement layer shall be compacted first. The corresponding layer in paved shaller portion shall be compacted thereafter, which shall be followed by compaction of earth shaller layer. The adjacent layers having same material shall be laid and compacted together.During all stages of shaller (earthen/ hard/ paved) construction, the required cross fall shall be maintained to drain off surface water.

9.2.24 Culverts

A culvert is a structure that allows water to flow under a road, railroad, trail, or similar obstruction from one side to the other side. Typically embedded so as to be surrounded by soil, a culvert may be made from a pipe, reinforced concrete or other material. A culvert

may be a bridge-like structure whose length between the inner faces of dirtwalls is less than 6.0m and designed to allow vehicle or pedestrian traffic to cross over the waterway while allowing adequate passage for the water.

Culverts are mainly of two types, Pipe Culverts and Slab Culverts. The width of culvert shall be equal to the formation width of the road. It shall be generally situated on the straight alignment of the road. If the road has a gradient the same shall be maintained for deck slab of the culvert.

Culverts must be properly sized and installed, and protected from erosion and scour. The culvert type and shape selection is based on a number of factors including requirements for hydraulic performance, limitation on upstream water surface elevation, and roadway embankment height. The waterway required for the culvert is designed in such a manner that the estimated discharge can be passed with a low velocity, e.g. 1.5 m/sec and the HFL is adequately below the bottom of deck.

9.2.24.1 Pipe Culverts:

Pipe culvert is often used as a cross drainage work on a road, when the discharge through the culvert is small, and when there is no defined channel. Pipe culverts are widely used culverts and rounded in shape. The culverts may be of single in number or multiple. If single pipe culvert is used then larger diameter culvert is installed. If the width of channel is greater than we will go for multiple pipe culverts. They are suitable for larger flows very well. The diameter of pipe culverts ranges from 1 meter to 6m. These are made of concrete or steel etc. Their prices are very competitive and they are very easy to install. As with other culvert types, the selection of the culvert will depend on hydraulic design and other factors that might affect their performance and suitability. This is the preferred one on urbanized areas and is the one usually used to manage storm sewer systems.

According to IS: 458, concrete pipes are classified as non-pressure (NP) and pressure pipes (PP). There are four types of non-pressure pipes (NP1 to NP4), and three types of pressure pipes (P1 to P3). Generally, reinforced concrete non-pressure pipes designated as NP3 (heavy duty) are used for culverts. The minimum diameter of the pipe used for a culvert is 600mm. However, it is desirable to use pipes of 1200mm for fills upto 3.5m and 1800mm for fills over 3.5m to facilitate inspection and cleaning and to avoid blocking of the vent by debris. The minimum fill over the top of the pipe is 600mm. The backfilling should be done carefully and the soil thoroughly ramped, tamped or vibrated in layers of 150mm thickness. No traffic should be permitted to go over the pipeline unless the fill over the pipe is atleast 600mm. When the fill is small, it is preferable to provide headwalls at the ends of the road formation width to retain the earth. If the fill is large, it is not economical to provide high headwalls for retaining deep overfills. Instead, the length of the culvert should be increased suitably so that the embankment, with its natural side slopes, is

accommodated without high retaining walls. In either case, splayed wing walls may be provided along with the headwalls at the end.

Bedding: The bedding must be even and uniform, projecting rock faces and boulders must be removed before forming the bedding. The thickness of bedding layer shall be minimum 75 mm. The bedding material shall be well graded sand or granular material passing 75 mm sieve. For heights of fill greater than 4 m, continuous concrete cradle bedding may be used. The mix shall not be leaner than M150 concrete and the pipes shall be laid in position before the concrete has set.

Laying: Start Laying from the outlet and proceed towards the inlet ensuring the specified lines and grade. The minimum longitudinal slope shall be 1 in 1000. Where two or more lines of pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm.

9.2.24.2 RCC Slab Culverts:

Reinforced concrete slab culverts are economical for spans upto about 8.0m, though the slab bridge type can be used for spans upto about 10m. The thickness of the slab and hence the dead load are quite considerable as the span increases. However, the construction is relatively simpler due to easier fabrication of formwork and reinforcements and easier placing of concrete. The deck slab should be designed as a one-way slab to carry

the dead load and the prescribed live load with impact and still to have stresses within the permissible limits.

Depending on the scour characteristics of the bed material, open foundations with or without erosion proof bed flooring is generally adopted. In general, concrete footing shall rest over good stratum at a depth of about 1.5m below the lowest bed level. Bed flooring where provided shall consist of stone pitching set in cement mortar 1:3 or two layers of brick on edge set in cement mortar 1:3. These shall be laid over 150 mm thick foundation concrete M15.

9.2.24.3 RCC Box Culverts

These are economical in such cases where either the depth of foundation is more than 4 m below bed level or where the total embankment is very high and are suitable for a situation where the catchment area is more than 40 hectares. Box section of height less than 2m X 2m is not practicable to implement.

Box culverts are in rectangular shape and generally constructed by reinforced concrete. Reinforced concrete rigid frame box culverts are used for square or rectangular openings with spans upto about 4m. The height of vent rarely exceeds 3m. The top of the box section can be at the road level or can be at a depth below road level with a fill depending on the site conditions. These are used to dispose rain water. So, these are not useful in the dry period. They can also be used as passages to cross the rail or roadway during dry periods for animals etc. Because of sharp corners these are not suitable for larger velocity. Box culverts can also be provided in multiple numbers. The most challenging part of installing this type of culverts is that you generally will need to have a dry surface in order to install the culvert, so dewatering or diversion of the water will be needed to complete the installation.

Box culvert single

Box culvert multiple