

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

**TENDER FOR HORTICULTURE AND LANDSCAPING WORK
AT THE CAMPUS
FOR
INDIAN INSTITUTE OF MANAGEMENT UDAIPUR,
AT VILLAGE BALICHA, UDAIPUR.**



TECHNICAL SPECIFICATIONS

SUB HEAD: 0.0

GENERAL

GENERAL

0.1 Reference mentioned herein shall be applicable to all sections to the extent the context permits and are intended to supplement the provisions in the particular section. In case of any discrepancy/ deviation, the provisions in the particular section shall take precedence.

0.2 The rates for all items of work unless clearly specified otherwise shall include cost of all labour, materials and other inputs involved in the execution of the items.

0.3 INTERPRETATIONS

0.3.1 The Tender authority shall be the sole deciding authority as to the meaning, interpretation and implications for various provisions of the specifications. His decision in writing shall be final.

0.3.2 Wherever any reference is made to any Indian Standard, it shall be taken as reference to the latest edition with all amendments issued thereto. In the event of any variation between the detailed specifications and the Indian Standard, the former shall take precedence over the latter.

0.3.3 General Notes: All the works are to be carried out as per latest specifications of CPWD/MES/Indian Railways/State PWD, and relevant IS Codes

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR
unless otherwise specified in BOQ. Measurements of all the items of work will be done as per IS 1200 with its latest revisions. Unless otherwise specified the rates of various items will be for all heights, leads and lifts.

0.4 DEFINITIONS

The following terms and expressions in the specifications shall have the meaning or implication hereby assigned to them unless otherwise specified elsewhere.

0.4.1 Contractor: The Contractor shall mean the individual or firm or company whether incorporated or not, undertaking the works and shall include the legal personal representatives of such individual or the persons composing such firm or company, or the successors of such individual or firm or company and the permitted assignees of such individual or firm of company.

0.4.2 Engineer-in-Charge: The 'Engineer-in-Charge' means the person appointed by NU who shall supervise and be in-charge of the work.

0.4.3 Site: The 'site' shall mean the land/ or other places on, in, into or through which the work is to be executed under the contract or any adjacent land, path or street through which the work is to be executed under the contract, or any adjacent land, path or street which may be allotted or used for the purpose of carrying out the contract.

0.4.4 Store: The 'store' shall mean the place of issue of materials.

0.4.5 IS: The standards, specification and code of practices issued by the Bureau of Indian Standards.

0.4.6 Best: The word 'best' when used shall mean that in the opinion of the Tender Authority, there is no superior material/ article and workmanship obtainable in the market and trade respectively. As far as possible the standard required shall be specified in preference to the word 'best'.

0.5 FLOOR AND LEVELS

0.5.1 Building

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

0.5.1.1 Floor 1 shall mean plinth level of respective area of individual building. The floors above floor 1 shall be numbered in sequence as floor 2, floor 3 and so on. The number shall increase upwards.

0.5.1.2 Floor level: For floor 1, top level of finished floor shall be the floor level and for all other floors above floor 1, top level of the structural slabs shall be the floor level.

0.5.1.3 Plinth level: Floor 1 level

0.5.2 Special Structures

0.5.2.1 For structures like retaining walls, wing walls, chimneys, over head reservoirs/ tanks and other elevated structures, where elevations/ heights above a defined datum level have not been specified and identification of floors cannot be done as in case of building. Level, at 1.2 m above the ground level shall be the floor 1 level as well as plinth level. Level at a height of 3.5 m above floor 1 level will be reckoned as floor 2 level and level at a height of 3.5 m above the floor 2 level will be floor 3 level and so on, where the total height above floor 1 level is not a whole number multiple of 3.5 metre. Top most floor level shall be the next in sequence to the floor level below even if the difference in height between the two upper most floor levels is less than 3.5 meters

0.6 FOUNDATION AND PLINTH

The work in foundation and plinth shall include: shall mean plinth level of respective area of individual building

(a) For buildings and basements: All works upto respective plinth level or upto floor 1 level.

(b) For abutments, piers and well staining: all works upto 1.2 m above the bed level:

(c) For retaining wall, wing walls, compound walls, chimneys, over head reservoirs/ tanks and

Other elevated structures: All works upto 1.2 metre above the formation ground level

(d) For reservoirs/ tanks (other than overhead reservoirs/ tanks): All works upto 1.2 metre above the formation ground level:

0.7 MEASUREMENTS

0.7.1 in booking dimensions, the order shall be consistent and in the sequence of length, width and height or depth or thickness.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

0.7.2 Rounding off: Rounding off where required shall be done in accordance with IS: 2-1960. The number of significant places rounded in the rounded off value should be as specified.

0.8 MATERIALS

0.8.1 Samples of all materials to be used on the work shall be got approved by the contractor from the Engineer-in-Charge/Design consultant/Client well in time. The approved samples duly authenticated and sealed shall be kept in the custody of the Engineer-in-Charge till the completion of the work. All materials to be provided by the contractor shall be brand new and as per the samples approved by the Engineer-in-Charge.

0.8.2 Materials obtained by the contractor from the sources approved by the Client shall be subjected to the Mandatory tests. Where such materials do not conform to the relevant specifications, the matter shall be taken up by the Engineer-in-Charge for appropriate action against the defaulters. In all such cases, necessary documents in original and proof of payment relating to the procurement of materials shall be made available by the contractor to the Engineer-in-Charge.

0.8.3 Samples, whether submitted for approval to govern bulk supplies or required for testing before use and also the sample of materials bearing 'Standard mark,' if required for testing, shall be provided free of cost by the contractor. All other incidental expenditure to be incurred for testing of samples e.g. packaging, sealing transportation, loading, unloading etc. except testing charges shall be borne by the contractor.

0.8.4 The materials, supplied by the Client shall be deemed to be complying with the specifications.

0.8.5 Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric effects due to rain, sun, wind and moisture to avoid deterioration.

0.8.6 Materials like timber, paints etc. shall be stored in such a way that there may not be any possibility of fire hazards. Inflammable materials and explosives shall be stored in accordance with the relevant rules and regulations or as approved by Engineer-in-Charge in writing so as to ensure desired safety during storage.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

0.8.7 The unit weight of materials unless otherwise specified shall be reckoned as given in IS: 1911-1967.

0.9 SAFETY IN CONSTRUCTION

0.9.1 The contractor shall employ only such methods of construction, tools and plant as are appropriate for the type of work or as approved by Engineer-in-Charge in writing.

0.9.2 The contractor shall take all precautions and measures to ensure safety of works and workman and shall be fully responsible for the same. Safety pertaining to construction works such as excavation, centering and shuttering, trenching, blasting, demolition, electric connections, scaffolds, ladders, working platforms, gangway, mixing of bituminous materials, electric and gas welding, use of hoisting and construction machinery shall be governed by relevant safety codes and the direction of Engineer-in-Charge

0.10 ABBREVIATIONS

The following abbreviations wherever they appear in the specifications, shall have the meaning or implication hereby assigned to them:

Mm	:	Millimeter
Cm	:	Centimeter
M	:	Meter
Km	:	Kilometer
$Mm^2/sqmm$:	Square Millimeter
$Cm^2/sqcm$:	Square centimeter
$Dm^2/sqdm$:	Square decimeter
M^2/sqm	:	Square meter
$Cm^3/$ cubic cm	:	Cubic centimeter
$Dm^3/$ cubic dm	:	Cubic decimeter
M^3/cum	:	Cubic meter
MI	:	Milliliter
Kl	:	Kilolitre
Gm	:	Gram
Kg	:	Kilogram
Q	:	Quintal

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

T	:	Tonne
Fps system	:	Foot pound second system
°C	:	Degree Celsius temperature
Fig	:	Figure
Re/Rs	:	Rupee/ Rupees
No	:	Number
Dia	:	Diameter
AC	:	Asbestos cement
CI	:	Cast Iron
GC	:	Galvanized corrugated
GP	:	Galvanized plain
GI	:	Galvanized iron
PVC	:	Polyvinyl chloride
RCC	:	Reinforced cement concrete
SW	:	Stone ware
SWG	:	Standard wire Gauge

SUB HEAD: 0.1
CARRIAGE OF MATERIALS

**DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR
LIST OF BUREAU OF INDIAN STANDARD CODES**

S. No.	I. S. No.	Subject
1.	IS 4082	Stacking & storage of construction materials and components at site – Recommendations
2.	IS 1141	Seasoning of Timber – Code of Practice

01 CARRIAGE OF MATERIALS

01.0 GENERAL

The carriage and stacking of materials shall be done as directed by the Engineer-in-Charge. Any tools and plants, required for the work shall be arranged by the Contractor. The carriage of materials includes loading anywhere within site or within a lead of 50 meters outside the site, unloading and stacking anywhere within site and within a lead of 50 meters outside the site.

01.1 RESPONSIBILITY FOR LOSS OR DAMAGE

Loading, carriage, unloading and stacking shall be done carefully to avoid loss or damage to the materials. In case of any loss or damage, recovery shall be affected from the Contractor at twice the Client issue rates of the materials. If the Client issue rates of the materials are not available then the recovery shall be affected at twice the prevailing market rates as determined by the Engineer-in-Charge.

01.2 MODE OF CARRIAGE

Depending upon the feasibility and economy, the Engineer-in-Charge shall determine the mode of carriage viz. whether by mechanical or animal transport or manual labor.

01.3 LEAD

01.3.1 All distances shall be measured over the shortest practical route and not necessarily the route actually taken. *Route other than shortest practical route may be considered in cases of unavoidable circumstances and as approved by Engineer-in-Charge along with reasons in writing.*

01.3.2 Carriage by manual labor shall be reckoned in units of 50 meters or part thereof.

01.3.3 Carriage by animal and mechanical transport shall be reckoned in one km unit.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Distances of 0.5 km or more shall be taken as 1 km and distance of less than 0.5 km shall be ignored. However, when the total lead is less than 0.5 km, it will not be ignored but paid for separately in successive stages of 50 meters subject to the condition that the rate worked on this basis does not exceed the rate for initial lead of 1 km by mechanical/ animal transport.

01.4 GENERAL CONSIDERATION FOR STACKING AND STORAGE

01.4.1 Planning of Storage Layout

For any site, there should be proper planning of the layout for stacking and storage of different materials, components and equipment with proper access and proper maneuverability of the vehicles carrying the material. While planning the layout, the requirements of various materials, components and equipment at different stages of construction shall be considered. The storage & stacking check list is given in Table. For further details refer IS- 4082.

01.4.2 Material shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work.

01.5 PROTECTION AGAINST ATMOSPHERIC AGENCIES

Materials stored at site, depending upon the individual characteristics, shall be protected from atmospheric actions, such as rain, sun, winds and moisture to avoid deterioration.

01.6 PROTECTION AGAINST FIRE AND OTHER HAZARDS

01.6.1 Materials like timber, coal, paints, etc. shall be stored in such a way that there may not be any possibility of fire hazards. Inflammable materials like kerosene and petrol shall be stored in accordance with the relevant rules and regulations so as to ensure the desired safety during storage. Stacks shall

Not be piled so high as to make them unstable under fire fighting conditions and in general they shall not be more than 4.5 m in height. The provisions given in IS 13416 (part 5) shall be followed.

01.7 STACKING AND STORAGE OF MATERIALS

01.7.1 Cement

01.7.1.1 in case cement is received in bags. Cement shall be stored at the work

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

site in a building or a shed which is dry, leak proof and as moisture proof as possible. The building or shed for storage should have minimum number of windows and close fitting doors and these should be kept closed as far as possible.

01.7.1.2 Cement shall be stored and stacked in bags and shall be kept free from the possibility of any dampness or moisture coming in contact with them. Cement bags shall be stacked off the floor on wooden planks in such a way as to keep about 150 mm to 200 mm clear above the floor. The floor may comprise of lean cement concrete or two layers of dry bricks lay on well consolidated earth. A space of 600 mm minimum shall be left all-round between the exterior walls and the stacks.

In the stacks the cement bags shall be kept close together to reduce circulation of air as much as possible. Owing to pressure on the bottom layer of bags sometimes 'warehouse pack' is developed in these bags. This can be removed easily by rolling the bags when the cement is taken out for use. Lamed bags, if any should be removed and disposed of.

01.7.1.3 The height of stack shall not be more than 10 bags to prevent the possibility of lumping up under pressure. The width of the stack shall be not more than four bags length or 3 meters. In stacks more than 8 bags high, the cement bags shall be arranged alternately length-wise and cross-wise so as to tie the stacks together and minimize the danger of topping over. Cement bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received; a label showing date of receipt of cement shall be put on each stack to know the age of cement.

01.7.1.4 For extra safety during the monsoon, or when it is expected to store for an unusually long period, the stack shall be completely enclosed by a water proofing membrane such as polyethylene, which shall close on the top of the stack. Care shall be taken to see that the waterproofing membrane is not damaged any time during use.

01.7.1.5 Cement in gunny bags, paper bags and polyethylene bags shall be stored separately.

01.7.2 in case cement is received in drums

These shall be stored on plane level ground, as far as possible near the concrete mixing

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

place. After taking out the required quantity of cement, the lid of the drum shall be securely tied to prevent ingress of moisture.

01.7.3 in case cement is received in silos

The silos shall be placed near the concrete batching plant. Proper access shall be provided for the replacement of silos.

01.7.4 Different types of cements shall be stacked and stored separately.

01.8 BRICKS

01.8.1 Bricks shall be stacked in regular tiers as and when they are unloaded to minimize breakage and defacement. These shall not be dumped at site.

01.8.2 Bricks stacks shall be placed close to the site of work so that least effort is required to unload and transport the bricks again by loading on pallets or in barrows. Building bricks shall be loaded or unloaded a pair at a time unless palletized. Unloading of building bricks or handling in any other way likely to damage the corners or edges or other parts of bricks shall not be permitted.

01.8.3 Bricks shall be stacked on dry firm ground. For proper inspection of quality and ease in counting the stacks shall be 50 bricks long, 10 bricks high and not more than 4 bricks in width, the bricks being placed on edge, two at a time along the width of the stack. Clear distance between adjacent stacks shall not be less than 0.8 m. Bricks of each truck load shall be put in one stack.

01.8.4 Bricks of different types, such as clay bricks, clay fly ash bricks, fly ash lime bricks, sand lime (calcium silicate) bricks, auto-clave bricks etc. shall be stacked separately. Bricks of different classification and size consideration (such as, conventional and modular) shall be stacked separately. Also bricks of different types, such as, solid, hollow and perforated shall be stacked separately.

01.9 BLOCKS

01.9.1 Blocks are available as hollow and solid concrete blocks, hollow and solid light weight concrete blocks, autoclaved aerated concrete blocks, concrete stone masonry blocks and soil based blocks.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

01.9.2 Blocks shall be unloaded one at a time and stacked in regular tiers to minimize breakage and defacement. These shall not be dumped at site. The height of the stack shall not be more than 1.2 m. The length of the stack shall not be more than 3.0 m, as far as possible and the width shall be of two or three blocks.

01.9.3 Normally blocks cured for 28 days only should be received at site. In case blocks cured for less than 28 days are received, these shall be stacked separately. All blocks should be water cured for 10 to 14 days and air cured for another 15 days; thus no blocks with less than 28 days curing shall be used in building construction.

01.9.4 Blocks shall be placed close to the site of work so that least effort is required for their transportation.

01.9.5 Blocks manufactured at site shall be stacked at least for required minimum curing period as given in 0.01.9.3.

01.9.6 The date of manufacture of the blocks shall be suitably marked on the stacks of blocks manufactured at factory or site.

01.10 FLOOR, WALL AND ROOF TILES

01.10.1 Floor, wall and clay roof tiles of different types, such as, cement concrete tiles (plain, colored and terrazzo) and ceramic tiles (glazed and unglazed) shall be stacked on regular platform as far as possible under cover in proper layers and in tiers and they shall not be dumped in heaps. In the stack, the tiles shall be so placed that the mould surface of one faces that of another. Height of the stack shall not be more than one meter. During unloading, these shall be handled carefully so as to avoid breakage.

01.10.2 Tiles of different quality, size and thickness shall be stacked separately to facilitate easy removal for use in work. Tiles when supplied by manufacturers packed in wooden crates shall be stored in crates. The crates shall be opened one at a time as and when required for use.

01.10.3 Ceramic tiles and clay roof tiles are generally supplied in cartons which shall be handled with care. It is preferable to transport these at the site on platform trolleys.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

01.11 AGGREGATES

01.11.1 Aggregates shall be stored at site on a hard dry and level patch of ground. If such a surface is not available, a platform of planks or old corrugated iron sheets, or a floor of bricks, or a thin layer of lean concrete shall be made so as to prevent contamination with clay, dust, vegetable and other foreign matter.

01.11.2 Stacks of fine and coarse aggregates shall be kept in separate stock piles sufficiently removed from each other to prevent the material at the edges of the piles from getting intermixed. On a large job, it is desirable to construct dividing walls to give each type of aggregates its own compartment. Fine aggregates shall be stacked in a place where loss due to the effect of wind is minimum.

01.11.3 Unless specified otherwise or necessitated by site conditions stacking of the aggregates should be carried out in regular stacks. The suggested sizes for stacks are as follows:

Sl. no.	Material	Size of Stack (in m)		
		Length	Breadth	Height
(I)	Soling stone	5.0	2.0	0.50
		Or 5.0	1.0	0.50
(ii)	Coarse aggregates	2.0	2.0	0.50
		Or 5.0	5.0	1.00
		Or 5.0	1.0	0.50
(iii)	Fine aggregates	2.0	2.0	0.50
		Or 5.0	5.0	1.00
		Or 5.0	1.0	0.50

01.12 FLY ASH

Fly ash shall be stored in such a manner as to permit easy access for proper inspection and identification of each consignment. Fly ash in bulk quantities shall be stored in stack similar to fine aggregates as specified in 1.11 to avoid any intrusion of foreign matter. Fly ash in bags shall be stored in stacks not more than 10 bags high.

01.13 STEEL

01.13.1 For each classification of steel, separate areas shall be earmarked. It is

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

desirable that ends of bars and sections of each class be painted in distinct separate colors.

01.13.2 Steel reinforcement shall ordinarily be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. It is desirable to coat reinforcement with cement wash before stacking to prevent scaling and rusting.

01.13.3 Bars of different classification, sizes and lengths shall be stored separately to facilitate issues in such sizes and lengths so as to minimize wastage in cutting from standard lengths.

01.13.4 In case of long storage, reinforcement bars shall be stacked above ground level by at least 150 mm. Also in coastal areas or in case of long storage a coat of cement wash shall be given to prevent scaling and rusting.

01.13.5 Structural steel of different classification, sizes and lengths shall be stored separately. It shall be stored above ground level by at least 150 mm upon platforms, skids or any other suitable supports to avoid distortion of sections. In coastal areas or in case of long storage suitable protective coating of primer paint shall be given to prevent scaling and rusting.

01.14 ALUMINIUM SECTIONS

Aluminum sections of different classification, sizes and lengths shall be stored separately, on a level platform under cover. The aluminum sections shall not be pulled or pushed from the stack nor shall be sided over each other, to protect the anodizing layer.

01.15 DOORS, WINDOWS AND VENTILATORS

01.15.1 General

While unloading, shifting handling and stacking timber or other lignocelluloses material based, metal and plastic door and window frames and shutters, care shall be taken that the material is not dragged one over the other as it may cause damage to the surface of the material particularly in the case of decorative shutters. The material should be lifted and carried preferably flat avoiding damage of corners or sides.

01.15.2 Metal and plastic doors, windows and ventilators shall be stacked upright (on their sills) on level ground preferably on wooden battens and shall not come in contact

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

with dirt and ashes. If received in crates they shall be stacked according to manufacturer's instructions and removed from the crates as and when required for the work.

01.15.3 Metal and plastic frames of doors, windows and ventilators shall be stacked upside down with the kick plates at the top. These shall not be allowed to stand for long in this manner before being fixed so as to avoid the door frames getting out of shape and hinges being strained and shutters drooping.

01.15.4 During the period of storage all metal doors, windows and ventilators shall be protected from, loose cement and mortar by suitable covering such as tarpaulin. The tarpaulin shall be hung loosely on temporary framing to permit circulation of air to prevent condensation.

01.15.5 All timber and other lignocelluloses material based frames and shutters shall be stored in a dry and clean covered space away from any infestation and dampness. The storage shall preferably be in well ventilated dry rooms. The frames shall be stacked one over the other in vertical stacks with cross battens at regular distances to keep the stack vertical and straight. These cross battens should be of uniform thickness and placed vertically one above the other. The door shutters shall be stacked in the form of clean vertical stacks one over the other and at least 80 mm above ground on pallets or suitable beams or rafters. The top of the stack shall be covered by a protecting cover and weighted down by means of scantlings or other suitable weights. The shutter stack shall rest on hard and level ground.

01.15.6 If any timber or other lignocelluloses material based frame or shutter becomes wet during transit, it shall be kept separate from the undamaged material. The wet material may be dried by stacking in shade with battens in between adjacent boards with free access of dry air generally following the guidance laid down in IS 1141.

01.15.7 Separate stacks shall be built up for each size, each grade and each type of material. When materials of different sizes grades and types are to be stacked in one stack due to shortage of space, the bigger size shall be stacked in the lower portion of the stacks. Suitable pallets or separating battens shall be kept in between the two types of material.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

01.16 ROOFING SHEETS

0.01.16.1 Roofing sheets shall be stored and handled in such a manner as not to damage them in any way.

01.16.1 Plain and corrugated asbestos cement sheets shall be stacked horizontally to a height of not more than one meter on a firm and level ground, with timber or other packing beneath them. If stacked in exposed position, they shall be protected from damage by the winds. Asbestos cement sheets of same variety and size shall be stacked together. Damaged sheets shall not be stacked with sound materials. All damaged sheets shall be salvaged as early as possible.

01.16.2 Corrugated galvanized iron sheets and aluminum sheets shall be stacked horizontally to a height of not more than 0.5 m on a firm and level ground, with timber or other packing beneath them. To protect them from dust and rain water, these shall be covered with tarpaulin or polyethylene sheets.

01.16.3 Plastic sheets and glass reinforced plastic (GRP) sheets shall be stacked under a shed to a height of not more than 0.5 m on a firm and level ground with timber or other packing beneath them.

01.17 GYPSUM BOARDS, PLYWOOD, FIBREBOARD, PARTICLE BOARD, BLOCK BOARD, NON ASBESTOS CEMENT BOARDSETC.

01.17.1 These boards shall be stored flat in a covered clean and dry place. Different sizes and types of each of these boards shall be stacked separately.

The board shall be stacked on a flat platform on which a wooden frame shall be constructed with 50 mm x 25 mm battens in such a way that it will give support to all four edges and corners of the boards with intermediate battens placed at suitable intervals to avoid warping.

The boards shall be stacked in a solid block in a clear vertical alignment. The top sheet of each stack shall be suitably weighed down to prevent warping wherever necessary.

The boards shall be unloaded and stacked with utmost care avoiding damage to the corners and surface. In case of decorative plywood and decorative boards, the surfaces of which are likely to get damaged by dragging one sheet over another it is advisable

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

that these are lifted as far as possible in pairs facing each other.

01.18 GLASS SHEETS

01.18.1 It is important that all glass sheets whether stored in crates or not shall be kept dry. Suitable covered storage space shall be provided for the safe storage of the glass sheets. In removing glass sheets from crates, great care shall be taken to avoid damages. The glass sheets shall be lifted and stored on its long edges against a vertical wall or other support with the first sheet so placed that its bottom edge is 25 mm from the vertical support. The stacks shall be of not more than 25 panes and shall be supported at two points by fillets of wood at 300 mm from each end. The whole stack shall be as close and as upright as possible.

The glass sheets of different sizes, thickness and type shall be stacked separately. The distance between any two stacks shall be of the order of 400 mm.

01.19 CAST IRON, GALVANIZED IRON AND ASBESTOS CEMENT PIPES AND FITTINGS

0.01.19.1 The pipes shall be unloaded where they are required when the trenches are ready to receive them.

01.19.2 Storage shall be done on firm, level and clear ground and wedges shall be provided at the bottom layer to keep the stack stable.

01.19.3 The stack shall be in pyramid shape or the pipes length-wise and cross-wise in alternate layers. The pyramid stack is advisable in smaller diameter pipes for conserving space in storing them. The height of the stack shall not exceed 1.5 m.

01.19.4 Each stack shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible.

01.19.5 Cast iron detachable joints and fittings shall be stacked under cover separately from the asbestos cement pipes and fittings.
0.01.19.6 Rubber rings shall be kept clean, away from grease, oil heat and light.

01.20 POLYETHYLENE PIPES

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

01.20.1 Natural polyethylene pipe should be stored under cover and protected from direct sunlight. However, black polyethylene pipes may be stored either under cover or in the open.

01.20.2 Coils may be stored either on edges or stacked flat one on top of the other, but in either case they should not be allowed to come into contact with hot water or steam pipes and should be kept away from hot surface.

01.20.3 Straight lengths should be stored on horizontal racks giving continuous support to prevent the pipe taking on a permanent set.

01.20.4 Storage of pipes in heated areas exceeding 27^o C should be avoided.

01.21 UNPLASTICIZED PVC PIPES

01.21.1 The pipe should be given adequate support at all times. Pipes should be stored on a reasonably flat surface free from stones and sharp projections so that the pipe is supported throughout its length. In storage, pipe racks should be avoided. Pipe should not be stacked in large piles, especially under warm temperature conditions as the bottom pipes may distort, thus giving rise to difficulty in jointing. Socket and spigot pipes should be stacked in layers with sockets placed at alternate ends of the stacks to avoid lopsided stacks.

01.21.1.1 It is recommended not to store pipe inside another pipe.

01.21.1.2 On no account should pipes be stored in a stressed or bent condition or near the sources of heat.

01.21.1.3 Pipes should not be stacked more than 1.5 m high. Pipes of different sizes and classes should be stacked separately.

01.21.2 The ends of pipe should be protected from abrasion particularly those specially prepared for jointing either spigot or socket solvent welded joints or shouldered for use with couplings.

01.21.3 In tropical conditions, pipes should be stored in shade. In very cold weather, the impact strength of PVC is reduced making it brittle and more care in handling shall be exercised in wintry condition.

01.21.4 If due to unsatisfactory storage or handling a pipe becomes kinked, the

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

damaged portion should be cut out completely. Kinking is likely to occur only on very thin walled pipes.

01.22 BITUMEN, ROAD TAR, ASPHALT, ETC.

01.22.1 All types of bitumen, road tar, asphalt, etc, in drums or containers shall be stacked vertically on their bottoms in up to 3 tiers. Leaky drums shall be segregated. Empty drums shall be stored in pyramidal stacks neatly in rows.

01.23 WATER

01.23.1 Wherever water is to be stored for construction purposes this shall be done in proper storage tanks to prevent any organic impurities getting mixed up with it.

01.24 OIL PAINTS

01.24.1 All containers of paints, thinners and allied materials shall preferably be stored in a separate room on floors with sand cushions. The room shall be well-ventilated and free from excessive heat, sparks of flame and direct rays of sun. The containers of paint shall be kept covered or properly fitted with lid and shall not be kept open except while using. The containers of paints have expiry date marked by the manufacturers, which should be highlighted so as to facilitate use of paint within due period.

01.25 SANITARY APPLIANCES

01.25.1 All sanitary appliances shall be carefully stored under cover to prevent damage. When accepting and storing appliances, advance planning shall be made regarding the sequence of removal from the store to the assembly positions. Supporting brackets shall be so stored as to be readily accessible for use with the appliances.

01.26 OTHER MATERIALS

01.26.1 Small articles like nails, screws, nuts and bolts, door and window fittings, polishing stones, protective clothing, spare parts of machinery, linings, packing, water supply and sanitary fittings, electrical fittings, insulation board, etc, shall be kept in suitable and properly protected store rooms. Valuable small material such as, copper pipes and fittings shall be kept under lock and key.

01.27 MEASUREMENTS

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Length, breadth and height of stacks shall be measured correct to a cm. The quantity shall be worked out in cubic meter correct to two place of decimal. The volume of stacks shall be reduced by percentages as shown against each for looseness in stacking to arrive at the net quantity for payment. No reduction shall be made in respect of articles or materials for which mode of payment is by length or weight or number.

01.27.1 Earth

01.27.1.1 In loose stacks such as cart loads, lorry loads, etc. – 20%

01.27.1.2 In fills consolidated by light mechanical machinery – 10%

01.27.1.3 In fills consolidated by heavy mechanical machinery but not under OMC (Optimum Moisture Content) – 5%

01.27.1.4 In fills consolidated by heavy mechanical machinery at OMC – Nil

01.27.1.5 Consolidated fills in confined situation such as under floors. etc. – Nil

01.27.2 Other Materials

01.27.2.1 Manure or sludge – 8%

01.27.2.2 Moore, building rubbishes Lime and sand – Nil

01.27.2.3 Stone metal, 40 mm nominal size and above – 7.5%

01.27.2.4 Course aggregate/ stone metal below 40 mm nominal size – Nil

01.27.2.5 Soling stone/ Boulder 100 mm and above – 15%

01.27.2.6 Excavated rocks – 50%

01.28 RATE

The rate for carriage of materials is inclusive of all the operations described above

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

OTABLE 01.1

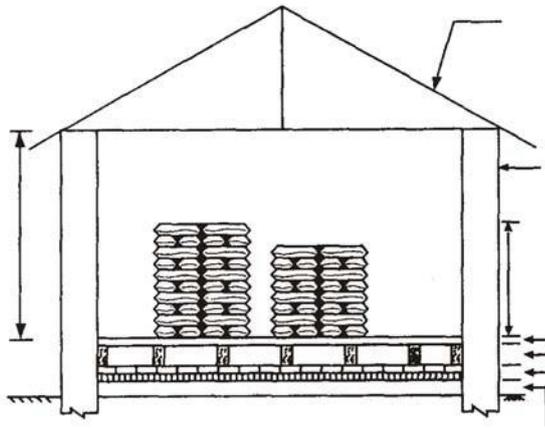
Storage and Stacking Check List

Sl. No.	Material/Component	Base			Stack				Type of Cover			
		Firm Level Ground	Hard Floor	Off Floor	Heaps	Tiers	Flat	Vertical	Open	Open but covered	Under shed	
1.	Cement			√		√						√
2.	Stone and Aggregates											
(a)	Stones, aggregates, fly ash and cinder	√			√				√			
(b)	Veneering stones	√				√		√	√			
3.	Bricks and Blocks	√				√			√			
4.	Tiles											
(a)	Clay and concrete floor, wall and roof tiles	√				√	√		√			
(b)	Ceramic tiles		√			√	√					√
5.	Steel	√					√		√			
6.	Aluminum Sections		√				√					√
7.	Door, windows and Ventilators		√					√				√
8.	Roofing Sheets											
(a)	AC	√				√	√		√			

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(b)	GI and Aluminum Sheets	✓				✓	✓			✓	
(c)	Plastic Sheets			✓		✓	✓				✓
9.	Boards like Plywood, Particle Boards, Fiber Boards, Blackboards and Gypsum Board			✓		✓	✓				✓
10.	Glass Sheets		✓					✓			✓
11.	CI, GI and AC Pipes & fittings										
(a)	Pipes	✓				✓	✓		✓		
(b)	CI and GI fittings		✓				✓				✓
(c)	AC Fittings		✓				✓		✓		
12.	Polyethylene Pipes			✓		✓	✓				✓
13.	Unplasticised PVC Pipes	✓				✓	✓		✓		
14.	Bitumen, Road Tar, Asphalt, etc in Drums	✓				✓			✓		
15.	Oil Paints		✓			✓					✓
16.	Sanitary Appliances			✓			✓				✓

**DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR
TYPICAL SKETCH FOR CEMENT GODOWN**

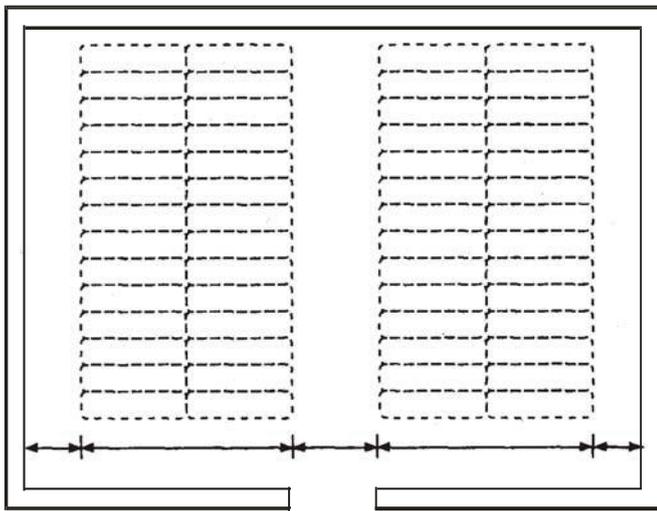


A.C. or G.I. SHEET OR ANY KIND OF WEATHER PROOF ROOF

LOAD BEARING WALL

1400
MAX 10 BAGS

SECTION



- A = Planks
- B = Wooden Battens
- C = 150 Dry Bricks in two Layers or Lean Cement Concrete
- D = 150 Consolidated Earth

Fig. 1.1: Typical Arrangement in Cement

SUB HEAD: 0.2
MORTARS

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

LIST OF MANDATORY TESTS

<i>M a t e r i a l</i>	<i>C l a u s e</i>	<i>T e s t</i>	<i>F i e l d/ l a b o r a t o r y t e s t</i>	<i>T e s t p r o c e d u r e</i>	<i>M i n. q u a n t i t y o f m a t e r i a l f o r c a r r y i n g o u t t h e t e s t</i>	<i>F r e q u e n c y o f t e s t i n g</i>
1	2	3	4	5	6	7
W a t e r	02 . 1 . 1	(I) pH Value (ii) Limits of Acidity (iii) Limits of Alkalify (iv) Percentage of solids (a) Chlorides (b) Suspended matter (c) Sulphates (d) Inorganic	Lab Lab Lab Lab Lab Lab Lab	IS 3025	-	Water from each source shall be got tested before the commencement of work and thereafter once in every three months till the completion of the work. Water from municipal source need be tested only once in six months. Number of Tests for each

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

		solids (e) Organic solids				source shall be 3
C e m e n t	02	(a) Physical requirement				
	.1	(I) Fineness	Lab	IS	Each lot	Every 50 tones or part thereof. Each brand of cement brought to site shall be tested as per this frequency.
	.2	(ii) Soundness	Lab	4031 (Part II) IS		
		(iii) Setting time	Lab	4031 (Part III) IS		
		(Initial & Final) (iv) Compressive strength	Lab	4031 (Part V) IS		
	(v) Consistency of standard cement paste	Lab	4031 (Part VI) IS			
S a n d	02	Organic impurities	Field	Appendix 'A'	20 cum	Every 20 cum or part thereof or more frequently as decided by Engineer-in-Charge.
	.1	Silt Content	Field	Appendix C	20 cum	

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

	.3					
	.2					
	02	Particle size distribution	Field or Laboratory as decided by the Engineer-in-charge	Appendix B	40 cum	40 cum or part thereof
	.1	a,b,c,d				
	.3					
	.4	& e				

Sand	0	Bulking of Sand	Field	Appendix D	20 cum	Every 20 cum or part thereof or more frequently as decided by Engineer-in-Charge.
	2.1.3.5					
Fly Ash	0	Total chloride in percent by mass, max.	Lab	IS 12423	10 cum	Every 10 cum or part thereof or more
	2.1.5 & 0	Loss of ignition in percent by mass, max.	Lab	IS 1727	10 cum	Frequency as decided by Engineer-in-charge
	2.1.5.1					
	1					

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

		Fineness, specific surface in m^2/kg	Lab /field	Blaine's permeability method	10 cum	-do-
		Compressive strength at 28 days in N/mm^2 , Min.	Lab .	-	10 cum	Only in cases when fly ash is used as pozzolana in cement

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

LIST OF BUREAU OF INDIAN STANDARD CODES

S. No.	I.S. No.	Subject
1	IS 269	Specification for 33 grade ordinary Portland cement
2	IS 383	Specification for coarse and fine aggregate from natural source for concrete.
3	IS 455	Specification for Portland slag cement.
4	IS 460 (Part I)	Specification for test sieves: wire cloth test sieves.
5	IS 650	Specification for standard sand for testing of cement
6	IS 1269	Specification for 53 grade ordinary Portland cement
7	IS 1344	Specification for claimed clay Pozzolana.
8	IS 1489	Specification for Portland pozzolana cement
9	IS 1542	Specification for sand for plaster
10	IS 1727	Methods of Test for Pozzolana materials
11	IS 2116	Specification for sand for masonry mortar.
12	IS 2250	Code of practice for preparation and use of masonry Mortar.
13	IS 2386 (Pt-I)	Method of test for aggregate for concrete (Particle size and shape)
14	IS 2386 (Pt-II)	-Do- Estimation of deleterious materials and organic impurities.
15	IS 2386 (Pt-III)	-Do- Specific gravity, density, voids, absorption and bulking.
16	IS 3025	Method of sampling and test for water
17	IS 3406	Specification for masonry cement.
18	IS 3812 (Part I)	Specification for flyash for use as pozzolana in cement mortar and concrete
19	IS 3812 (Part II)	Specification for flyash for use as admixture in cement mortar and concrete
20	IS 4031 (Part I) to (Part XIII)	Method of Physical test for hydraulic cement
21	IS 4032	Method of chemical analysis of Hydraulic cement.
22	IS 8041	Rapid hardening Portland cement.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

23	IS 8042	Specification for white cement
24	IS 8043	Hydrophobic Portland cement
25	IS 8112	Specification for 43 grade ordinary Portland cement
26	IS 11652	Woven HDPE sacks for packing cement
27	IS 11653	Woven polypropylene sacks for packing cement
28	IS 12174	Jute synthetic union bags for packing cement

02 MORTARS

GENERAL

Desirable properties of mortars for use in masonry are:

- (a) Workability
- (b) Water retentively
- (c) Rate of stiffing
- (d) Strength
- (e) Resistance to rain penetration
- (f) Durability

02.1 MATERIALS

02.1.1 Water

02.1.1.1 Water used for mixing and curing shall be clean and free from injurious quantities of alkalis, acids, oils, salts, sugar, organic materials, vegetable growth or other substance that may be deleterious to bricks, stone, concrete or steel. Potable water is generally considered satisfactory for mixing. The Ph. value of water shall be not less than 6. The following concentrations represent the maximum permissible values: (of deleterious materials in water).

(a) **Limits of Acidity:** To neutralize 100ml sample of water, using phenolphthalein as an indicator, it should not require more than 5ml of 0.02 normal Noah. The details of test shall be as given in IS 3025 (part 22).

(b) **Limits of Alkalinity:** To neutralize 100ml sample of water, using mixed indicator, it should not require more than 25ml of 0.02 normal H₂SO₄. The details of tests shall be as given in IS 3025 (part 23).

(c) **Percentage of Solids:** Maximum permissible limits of solids when tested in accordance with

IS 3025 shall be as under: Organic 200mg/ liter Inorganic 3000 mg/ liter Sulphates 400 mg/ liter Chlorides 2000 mg/ litre. for concrete not contain embedded steel and 500 mg./ltr. for reinforced concrete work. Suspended matter 2000 mg/ liter

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

The physical and chemical properties of ground water shall be tested along with soil investigation and if the water is not found conforming to the requirements of IS 456-2000, the tender documents shall clearly specify that the contractor has to arrange good quality water for construction indicating the source.

02.1.1.2 Water found satisfactory for mixing is also suitable for curing. However, water used for curing shall not produce any objectionable stain or unsightly deposit on the surface.

02.1.1.3 Sea water shall not be used for mixing or curing

02.1.1.4 Water from each source shall be tested before the commencement of the work and thereafter once in every three months till the completion of the work. In case of ground water, testing shall also be done for different points of drawdown. Water from each source shall be got tested during the dry season before monsoon and again after monsoon.

02.1.2 Cement

02.1.2.1 The cement used shall be any of the following grades and the type selected should be appropriate for the intended use.

- (a) 33 grade ordinary Portland cement conforming to IS 269.
- (b) 43 grade ordinary Portland cement conforming to IS 8112.
- (c) 53 grade ordinary Portland cement conforming to IS 12269.
- (d) Rapid hardening Portland cements conforming to IS 8041.
- (e) Portland slag cement conforming to IS 455.
- (f) Portland Pozzolana cement (flash based) conforming to IS 1489 (Part 1).
- (g) Portland Pozzolana cement (claimed clay based) conforming to IS 1489 (part 2).
- (h) Hydrophobic cement conforming to IS 8043
- (I) Low heat Portland cement conforming to IS 12600.
- (j) Sulphate resisting Portland cement conforming to IS 12330
- (k) White cement conforming to IS 8042

Different types of cement shall not be mixed together. In case more than one type of cement is used in any work, a record shall be kept showing the location and the types of cement used.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

02.1.2.2 Caution in Use of Cement Grade 53 in Construction: Because of the faster hydration process, the concrete releases heat of hydration at a much faster rate initially and release of heat is the higher in case of Grade. 53. The heat of hydration being higher, the chances of micro-cracking of concrete is much greater. Thus, during initial setting period of concrete, the higher heat of hydration can lead to damaging micro-cracking within the concrete which may not be visible at surface. This cracking is different from shrinkage cracks which occur due to faster drying of concrete in windy conditions.

The situation can be worse when we tend to increase the quantity of the cement in the concrete with a belief that such increases are better for both strength and durability of concrete. Thus, it is very essential to be forewarned that higher grade cement specially grade 53 should be used only where such use is warranted for making higher strength concrete and also where good Quality Assurance measures are in place, by which proper precaution are taken to relieve the higher heat of hydration through chilling of aggregates or by proper curing of concrete. There are instances where higher grade cement is being used even for low strength concrete, as, mortar or even for plastering. This can lead to unnecessary cracking of concrete/ surfaces.

Another issue to be cautioned against is the tendency of the manufacturers to project Grade 53 cement as stronger cement, whereas Grade 33 or 43 are enough to produce the concrete of desired characteristic strength. The scenario of method of production of cement by various manufacturers should also be kept in mind while ordering various grades of cement. The ability to produce cements of particular fineness get fixed by the machinery installed by the manufacturers, and thus the ability to produce other various grades of cement by a particular manufacturer also gets limited. Whereas tendency today is to supply the consumer what he orders for by the manufacturers by simply stamping such grades on the bags. Thus, it is often observed that cement bags marked as grade 33 or 43 may really be containing cements of much higher grade.

02.1.2.3 Compressive Strength: Compressive strength requirement of each type of cement for various grades when tested in accordance with IS 4031 (part 6) shall be as under:

Sample	Strength in N/mm^2 not less than for
--------	--

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Age at testing	Gr. 33	Gr.43	Gr. 53
72 + 1 hr	16	23	27
168 + 2 hrs	22	33	37
672 + 4 hrs	33	43	53

02.1.2.4 Setting Time: Setting time of cement of any type of any grade when tested by Vicar Apparatus method described in IS 4031 shall conform to the following requirement:

- (a) Initial setting time: Not less than 30 minutes
- (b) Final setting time: Not more than 600 minutes

02.1.2.5 Supply : The cement shall be packed in jute sacking bags conforming to IS 2580, double hessian bituminized (CRI type) or woven HDPE conforming to IS 11652. Woven polypropylene conforming to IS 11653, jute synthetic union conforming to IS: 12174, or any other approved composite bags, bearing the manufacturer's name or his registered trade mark if any, with grade batch no. and type of cement, with date of manufacturing of batch of cement.

Every delivery of cement shall be accompanied by a producer's certificate conforming that the supplied cement conforms to relevant specifications. These certificates shall be endorsed to the Engineer-in-Charge for his record.

Every consignment of cement must have identification marks on packages indicating date of manufacturing grade and type of cement batch no. etc. Cement brought to works shall not be more than 6 weeks old from the date of manufacture.

Effective precautionary measures shall be taken to eliminate dust-nuisance during loading or transferring cement.

02.1.2.6 Stacking and Storage: Cement in bags shall be stored and stacked in a shed which is dry, leak proof and as moisture-proof as possible. Flooring of the shed shall consist of the two layers of dry bricks laid on well consolidated earth to avoid contact of cement bags with the floor. Stacking shall be done about 150 to 200 mm clear above the floor using wooden planks. Cement bags shall be stacked at least 450 mm clear off the walls and in rows of two bags leaving in a space of at least 600 mm between two consecutive rows. In each row the cement bags shall be kept close together so as to

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

reduce air circulation. Stacking shall not be more than 10 bags high to avoid lumping under pressure. In stacks more than 8 bags high, the cement bags shall be arranged in header and stretcher fashion i.e. alternately lengthwise and crosswise so as to tie the stacks together and minimize the danger of toppling over.

A typical arrangement for storing and stacking of cement is shown in Fig. 1. Of sub-head of Carriage of Materials. Different types of cement shall be stacked and stored separately.

Cement bags shall be stacked in a manner to facilitate their removal and use in the order in which they are received.

For extra safety during monsoon, or when cement is expected to be stored for an unusually long period, each stack shall be completely enclosed by a water proofing membrane, such as polyethylene, which shall cover the top of the stack. Care shall be taken to see that the water proofing membrane is not damaged at any time during use.

Storage of cement at the work site shall be at the contractor's expense and risk. Any damage occurring to cement due to faulty storage in contractor's shed or on account of negligence on his part shall be the liability of the contractor.

02.1.3 Fine Aggregate

02.1.3.1 Aggregate most of which passes through 4.75 mm IS sieve is known as fine aggregate. Fine aggregate shall consist of natural sand, crushed stone sand, crushed gravel sand stone dust or marble dust, fly ash and broken brick (Burnt clay). It shall be hard, durable, chemically inert, clean and free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or

pellets and harmful impurities e.g. iron pyrites, alkalis, salts, coal, mica, shale or similar laminated materials in such form or in such quantities as to cause corrosion of metal or affect adversely the hardening, the strength, the durability or the appearance of mortar, plaster or concrete. The sum of the percentages of all deleterious material shall not exceed 5%. Fine aggregate must be checked for organic impurities such as decayed vegetation humps, coal dust etc. In accordance with the procedure prescribed in Appendix 'A' of Mortar.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

02.1.3.2 Silt Content: The maximum quantity of silt in sand as determined by the method prescribed in

Appendix 'C' of Mortar shall not exceed 8%.

Fine aggregate containing more than allowable percentage of silt shall be washed as many times as directed by Engineer-in-charge so as to bring the silt content within allowable limits for which nothing extra shall be paid.

02.1.3.3 Grading: On the basis of particle size, fine aggregate is graded in to four zones. The grading when determined in accordance with the procedure prescribed in Appendix 'B' of Mortar shall be within the limits given in Table 02.1 below. Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron IS sieve, by a total amount not exceeding 5 per cent, it shall be regarded as falling within that grading zone.

TABLE 02.1

Fine Aggregates

IS Sieve	Percentage passing for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 microns	5-20	8-30	12-40	15-50
150 microns	0-10	0-10	0-10	0-15

Note 1: For crushed stone sands, the permissible limit on 150 micron sieve is increased to 20 per cent. This does not affect the 5 per cent allowance permitted in 02.1.3.4 (e) (1) applying to other sieves.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Note 2: Allowance of 5% permitted in 02.1.3.4 (e) (1) can be split up, for example it could be 1% on

Each of three sieves and 2% on another or 4% on one sieve and 1% on another.

Note 3: Fine aggregate conforming to Grading Zone IV shall not be used in reinforced cement concrete unless tests have been made to ascertain the suitability of proposed mix proportions.

Note 4: Sand requiring use for mortar for plaster work shall conform to IS 1542 and for masonry work shall conform to IS 2116.

02.1.3.4 Type and grading of fine aggregate to be used shall be specified. It shall be coarse sand, fine sand, stone dust or marble dust, fly ash and surkhi. Use of sea sand shall not be allowed, unless otherwise specified.

(a) Coarse sand shall be either river sand or pit sand or a combination of the two. It shall be clean, sharp, angular, and gritty to touch and composed of hard siliceous material. Its grading shall fall within the limits of grading zone I, II, III of Table 02.1. Grading of sand shall conform to IS 2116 for use in Masonry work.

(b) Fine sand shall be either river sand or pit sand or a combination of the two. Its grading shall fall within the limits of Grading zone IV of Table 02.1. Grading of sand shall conform to IS 1542 for use in plaster work.

(c) Stone dust shall be obtained by crushing hard stones or gravel. Its grading shall fall within the limits of grading Zone, I, II, or III of Table 02.1.

(d) Marble dust shall be obtained by crushing marble. Its grading shall fall within the limits of Grading

Zone IV of Table 02.1. Grading of Marble dust for use in Mortar shall be as per following table.

Grading of Marble Dust

IS Sieve	Percentage Passing
10 mm	100
4.75 mm	95-100
2.36 mm	95-100
1.18 mm	90-100
600 micron	80-100

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

300 micron	15-50
150 micron	0-15

(e) *Sand for Masonry Mortar and for Plaster*- Sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. Sand shall be hard durable, clean and free from adherent coating and organic matter and shall not contain the amount of clay, silt and fine dust more than specified as under.

Deleterious Material: Sand shall not contain any harmful impurities such as iron, pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shale in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar. The maximum quantities of clay, fine silt, fine dust and organic impurities in the sand / Marble dust shall not exceed the following limits:

(1) Clay, fine silt and fine dust when determined in accordance within IS 2386 (Part II). In natural sand or crushed gravel sand & crushed stone sand

(2) Organic impurities when determined in accordance with IS 2386 (Part II) Not more than 5% by mass Color of the liquid shall be lighter than that indicated by the standard specified in IS 2386 (Part II) Grading of sand for use in masonry mortar shall be conforming to IS 216 (Table 02.2 below). Grading of sand for use in plaster shall be conforming to IS 1542 (Table 02.2 below):

TABLE 02.2

Grading of Sand for use in Masonry Mortar and Plaster

<i>Grading of sand for use in masonry mortar</i>		<i>Grading of sand for use in plaster</i>	
<i>IS Sieve Designation</i>	<i>Percentage passing by mass</i>	<i>IS Sieve Designation</i>	<i>Percentage passing by mass</i>
10 mm	100	10 mm	100
4.75 mm	100	4.75 mm	95 to 100
2.36 mm	90 to 100	2.36 mm	95 to 100

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

<i>Grading of sand for use in masonry mortar</i>		<i>Grading of sand for use in plaster</i>	
<i>IS Sieve Designation</i>	<i>Percentage passing by mass</i>	<i>IS Sieve Designation</i>	<i>Percentage passing by mass</i>
1.18 mm	70 to 100	1.18 mm	90 to 100
600 micron	40 to 100	600 micron	80 to 100
300 micron	5 to 70	300 micron	20 to 65
150 micron	0 to 15	150 micron	0 to 50

Note: For crushed stone sands, the permissible limit on 150 micron IS Sieve is increased to 20%, this does not affect the 5% allowance as per IS 2386 (Part 1).

02.1.3.5 Bulking: Fine aggregate, when dry or saturated, has almost the same Volume but dampness causes increase in volume. In case fine aggregate is damp at the time of proportioning the ingredients for mortar or concrete, its quantity shall be increased suitably to allow for bulk age, which shall be determined by the method prescribed in Appendix 'D' of Mortar. Table 02.3 gives the relation between moisture content and percentage of bulking for guidance only.

TABLE 02.3

<i>Moisture content % age</i>	<i>Bulking % age (by volume)</i>
2	15
3	20
4	25
5	30

02.1.3.6 Stacking: Fine aggregate shall be so stacked as to prevent dust and foreign matter getting mixed up with it as far as practically possible. Marble dust in dry condition shall be collected in bags and properly staked so as not to form lumps, suitable arrangements shall be made to protect it from moisture similar to those adopted for stacking of cement bags.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

02.1.3.7 Measurements: As the fine aggregate bulks to a substantial extent when partially wet, measurements shall be taken when the stacks are dry or appropriate allowance made for bulking.

02.1.4 Broken Brick (Burnt Clay) Fine Aggregate

02.1.4.1 Broken Brick (Burnt Clay) Fine Aggregate, also known as Surkhi, shall be made by grinding well burnt (but not under or over burnt) broken bricks as specified in IS 3068-1986. It shall not contain any harmful impurities, such as iron pyrites, salts, coal, mica, shale or similar laminated or other materials in such form of quantity as to adversely affect hardening, strength, durability or appearance of the mortar. The maximum quantities of clay, fine silt, fine dust and organic impurities in surkhi (all taken together) shall not exceed five per cent by weight. The particle size grading of surkhi for use in lime mortars shall be within the limits specified in Table 02.4.

TABLE 02.4

<i>IS Sieve Designation</i>	<i>Percentage passing (by wt)</i>
4.75 mm	100
2.36 mm	90-100
1.18 mm	70-100
600 microns	40-100
300 microns	5-70
150 microns	0-15

02.1.4.2 Stacking: Surkhi shall be stacked on a hard surface or platform so as to prevent the admixture of clay, dust, vegetation and other foreign matter. It shall be also protected from rain and dampness and kept under adequate coverings.

02.1.4.3 Measurements: Surkhi shall be measured in regular stacks in cubic meters. Alternatively it may be measured by weight when supplied in bags.

02.1.5 Fly Ash

Fly ash is finely divided residue resulting from the combustion of pulverized coal in boilers. Fly ash is the pulverized fuel ash extracted from the flue gases by any suitable process such as cyclone separation or electrostatic precipitation. The ash collected from

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

the bottom of boilers is termed as bottom ash. Fly ash is finer than bottom ash. Siliceous fly ash (ASTM Class F) containing calcium oxide less than 10% by mass is normally produced from burning anthracite or bituminous coal and possesses pozzolana properties. Calcareous fly ash (ASTM Class C) is produced by burning lignite or sub-bituminous coal and contains calcium oxide more than 10% by mass; the content could be as high as 25%. This fly ash has both hydraulic and pozzolana properties. It shall be clean and free from any contamination of bottom ash, grit or small pieces of pebbles. It is obligatory on the part of supplier/ manufacture that the fly ash conforms to the requirements if mutually agreed upon & shall furnish a certificate to this effect to the purchaser or his representative.

02.1.5.1 Characteristics: The physical requirements of fly-ash shall be as specified in Annexure 'E' of Mortar. The chemical properties of fly ash shall be as per IS 3812 (part 1 & 2) depending on the usage.

02.1.5.2 Stacking: Fly ash shall be protected from dirt collecting on it.

02.1.5.3 Measurements: Fly ash shall be measured in regular stacks in cubic meters. Alternatively it may be measured by weight when supplied in bags.

02.2 PREPARTATION OF MORTARS AND ITS GRADE

02.2.0 Grade of Masonry Mortar

The grade of masonry mortar will be defined by its compressive strength in N/mm^2 at the age of 28 days as determined by the standard procedure detailed in IS 2250.

02.2.0.1 For proportioning the ingredients by volume, the conversion of weight into volume shall be made on the following basis:

(a) Burnt Clay Pozzolana	860 Kg/cum
(b) Coarse Sand (dry)	1280 kg/cum
(c) Fine sand (dry)	1600 kg/ cum
(d) Fly Ash	590 kg/ cum

For details of grades and criteria for selection of Masonry mortars see Appendix 'F' of Mortar.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

02.2.1 Cement Mortar

02.2.1.1 This shall be prepared by mixing cement and sand with or without the addition of pozzolana in specified proportions as per Appendix 'F of Mortar'.

02.2.1.2 Proportioning: Proportioning on weight basis shall be preferred taking into account specific gravity of sand and moisture content. Boxes of suitable size shall be prepared to facilitate proportioning on weight basis. Cement bag weighting 50 kg shall be taken as 0.035 cubic meter. Other ingredients in specified proportion shall be measured using boxes of size 40 x 35 x 25 cm. Sand shall be measured on the basis of its dry volume in the case of volumetric proportioning.

02.2.1.3 Mixing

02.2.1.3.1 The mixing of mortar shall be done in mechanical mixers operated manually or by power as decided by Engineer-in-Charge. The Engineer-in-Charge may, however, permit hand mixing at his discretion taking into account the nature, magnitude and location of the work and practicability of the use of mechanical mixers or where item involving small quantities are to be done or if in his opinion the use of mechanical mixer is not feasible. In cases, where mechanical mixers are not to be used, The contractor shall take permission of the Engineer-in-Charge in writing before the commencement of the work.

(a) *Mechanical Mixing:* Cement and sand in the specified proportions shall be mixed dry thoroughly

In a mixer. Water shall then be added gradually and wet mixing continued for at least three minutes. Only the required quantity of water shall be added which will produce mortar of workable consistency but not stiff paste. Only the quantity of mortar, which can be used within 30 minutes of its mixing, shall be prepared at a time. Mixer shall be cleaned with water each time before suspending the work.

(b) *Hand Mixing:* The measured quantity of sand shall be leveled on a clean masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being

turned over and over, backwards and forwards, several times till the mixture is of a uniform color. The quantity of dry mix which can be used within 30 minutes shall then be mixed in a masonry trough with just sufficient quantity of water to bring the mortar to a stiff paste of necessary working consistency.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

02.2.1.4 Precautions: mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

02.2.2 Cement Fly ash Sand Mortar

02.2.2.1 This shall be prepared by mixing cement, fly ash and sand in specified proportions as per Appendix G of Mortar. Mixing shall be done in a mechanical mixer (operated manually or by power) unless otherwise permitted by the Engineer-in-Charge in writing. The Engineer-in-Charge may, however, permit hand mixing at his discretion, taking into account the nature, magnitude and location of the work and practicability of the use of mechanical mixer or where items involving small quantities are to be done or if in his opinion the use of mechanical mixer is not feasible. In case, where mechanical mixer is not to be used, the contractor shall take permission of the Engineer-in-Charge in writing before the commencement of the work.

02.2.2.2 Proportioning: Proportioning on weight basis shall be preferred taking into account specific gravity of Fly Ash, sand and moisture content. Boxes of suitable size shall be prepared to facilitate proportioning on weight basis. Cement bag weighting 50 kg shall be taken as 0.035 cubic meter. Other ingredients in the specified proportions shall be measured using boxes of suitable sizes. Sand and fly ash shall be measured on the basis of their dry volume in the case of volumetric proportioning.

02.2.2.3 Mixing

(a) *Mechanical Mixing:* Sand and fly ash in the specified proportions shall be mixed dry in a mixer and then the specified quantity of cement shall be added and mixed dry thoroughly. Water shall then be added gradually and wet mixing continued for at least one minute. Water shall be just sufficient to bring the mortar to the consistency of a workable paste. Only the quantity of mortar which can be used within 30 minutes of its mixing shall be prepared at a time.

(b) *Hand Mixing:* The measured quantity of sand and fly ash shall be mixed dry on a clean masonry platform before adding specified quantity of cement to it. The resulting mixture of cement, sand and fly ash shall then be mixed thoroughly being turned over and over, backward several times till the mixture is of a uniform color. The quantity of dry mix which can be used within 30 minutes shall then be mixed in a clean watertight masonry trough with just sufficient quantity of water, to bring the mortar to a stiff paste of necessary working consistency.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

02.2.2.4 Precautions: Shall be same as specified in 02.2.1.4.

APPENDIX 'A'

TEST FOR ORGANIC IMPURITIES

The aggregate must also be checked for organic impurities such as decayed vegetation humus, coal dust etc.

What is called the color test is reliable indicator of the presence of harmful organic matter in aggregate, except in the area where there are deposits of lignite.

Fill a 350 ml clear glass medicine bottle up to 70 ml mark with a 3% solution of caustic soda or sodium hydroxide. The sand is next added gradually until the volume measured by the sandy layer is 125 ml. The volume is then made up to 200 ml by addition of more of solution. The bottle is then stoppered and shaken vigorously and allowed to stand for 24 hours. At the end of this period, the color of the liquid will indicate whether the sand contains a dangerous amount of matter. A colorless liquid indicates clean sand free from organic matter. A straw colored solution indicates some organic matter but not enough to be seriously objectionable. Darker color means that the sand contains injurious amounts and should not be used unless it is washed, and a retest shows that it is satisfactory.

Add 2.5 ml of two per cent solution of tannic acid in 10 per cent alcohol, to 97.5 ml of three per cent sodium hydroxide solution. Place in a 350 ml bottle, fix the stopper, shake vigorously and allow standing for 24 hours before comparison with the solution above the sand.

Note: A three per cent solution of caustic soda is made by dissolving 3 g of sodium hydroxide in 100 ml of water, preferably distilled. The solution should be kept in a glass of bottle tightly closed with a rubber stopper. Handling sodium hydroxide with moist hands may result in serious burns. Care should be taken not to spill the solution for it is highly injurious to clothing, leather, and other materials.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

APPENDIX 'B'

TEST FOR PARTICLE SIZE (SIEVE ANALYSIS)

Apparatus: Perforated plate sieves of designation 10 mm, 4.75 mm and fine mesh sieve of designation

2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron should be used.

The balance or scale shall be such that it is readable and accurate to 0.1 per cent of the weight of the test sample.

Sample: The weight of sample available shall not be less than the weight given in the table below. The sample of sieving shall be prepared from the larger sample either by quartering or by means of a sample divider.

TABLE SHOWING MINIMUM WEIGHTS FOR SAMPLING

Maximum size present in substantial proportions (mm)	Minimum weight of sample for sieving (Kg)
10	0.5
4.75	0.2
2.36	0.1

Test Procedure: The sample shall be brought to an air-dry condition before weighing and sieving. This may be achieved either by drying at room temperature or by heating at a temperature of 100 degree to 110 degree centigrade. The air dry sample shall be weighed and sieved successively on the appropriate sieves starting with the largest. Care shall be taken to ensure that the sieves are clean before use.

Each sieve shall be shaken separately over a clean tray until not more than a trace passes, but in any case for a period of not less than two minutes. The shaking shall be done with a varied motion, backwards and forwards, left to right, circular clockwise and anti-clockwise, and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions. Materials shall not be forced through the sieve by hand pressure, but on sieves coarser than 20 mm, placing of particles is permitted, Lumps of fine material, if present may be broken by gentle pressure with

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

fingers against the side of the sieve. Light brushing of underside of the sieve with a soft brush may be used to clear the sieve openings.

Light brushing with a fine camel hair brush may be used on the 150 micron IS sieve to prevent segregation of powder and blinding of apertures. Stiff or worn out brushes shall not be used for this purpose and pressure shall not be applied to the surface of the sieve to force particles through the mesh.

On completion of sieving the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

Reporting of Results: The results shall be calculated and reported as:

(a) The cumulative percentage by weight of the total sample passing each of the sieves, to the nearest whole number:

Or

(b) The percentage by weight of the total sample passing one sieves and retained on the next smaller sieve, to the nearest 0.1 percent.

APPENDIX 'C'

TEST FOR SILT CONTENT

The sand shall not contain more than 8% of silt as determined by field test with measuring cylinder. The method of determining silt contents by field test is given below:

A sample of sand to be tested shall be placed without drying in a 200 ml measuring cylinder. The volume of the sample shall be such that it fills the cylinder up to 100 ml mark

Clean water shall be added up to 150 ml mark. Dissolve a little salt in the water in the proportion one tea spoon to half a liter. The mixture shall be shaken vigorously, the last few shakes being sidewise direction to level off the sand and the contents allowed settling for three hours.

The height of the silt visible as settled layer above the sand shall be expressed as a percentage of the height of sand below. The sand containing more than the above allowable percentage of silt, shall be washed so as to bring the silt contents within allowable limits.

APPENDIX 'D'

BULKING OF FINE AGGREGATES/SAND (FIELD METHODS)

Two methods are suggested for determining the bulking of sand/fine aggregate. The procedure may be suitably varied, if necessary. Both depend on the fact that the volume of inundated sand/fine aggregate is the same if the sand/fine aggregate were dry.

Method -1: Put sufficient quantity of sand loosely into a container until it is about two-third full. Level off the top of the sand and push a steel rule vertically down through the sand at the middle to bottom, measure the height. Suppose this is 'X' cm.

Empty the sand out of the container into another container where none of it is lost. Half fill the first container with water. Put back about half the sand and rod it with a steel rod, about 6 mm in diameter, so that its volume is reduced to a minimum. Then add the remainder and level the top surface of the inundated sand. Measure its depth at the middle with the steel rule. Suppose this is 'Y' cm.

The percentage of bulking of the sand due to moisture shall be calculated from the formula: Percentage bulking = $(X/Y - 1) \times 100$

Method-2: In a 250 ml measuring cylinder, pour the damp sand, consolidate it by staking until it reached the 200 ml mark.

Then fill the cylinder with the water and stir the sand well (the water shall be sufficient to submerge the sand completely). It will be seen that the sand surface is now below its original level. Suppose the surface is at the mark of Yml, the percentage of bulking of sand due to moisture shall be calculated from the formula.

Percentage bulking= $(200/Y - 1) \times 100$

APPENDIX 'E'

PHYSICAL REQUIREMENTS OF FLY ASH

<i>Sl. No</i>	<i>Characteristics</i>	<i>Requirement of Fly Ash</i>	
		<i>For use as Pozzolana</i>	<i>For use as admixture in Cement Mortar and concrete</i>
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
(i)	Fineness- Specific surface in m ² /kg by Blaine's permeability method, min	320	200
(ii)	Lime reactivity – average compressive strength in N/mm ² Min	4.5	-
(iii)	Compressive strength at 28 days in N/mm ²	Not less than 80 per cent of the strength of corresponding mortar cubes.	-
(iv)	Soundness of autoclave test expansion of specimens, per cent, max	0.8	0.8
(v)	Particles retained on 45 micron IS sieve (wet sieving) in percent maximum	34	50

APPENDIX 'F'

CRITERIA FOR SELECTION OF MASONRY MORTARS

(a) The selection of masonry mortars from durability consideration will have to cover both the loading and exposure condition of the masonry. The masonry mortar shall generally be as specified below in (b) to (g).

(b) In case of masonry exposed frequent to rain and where there is further protection by way of

Plastering or rendering or other finishes, the grade of mortar shall not be less than 0.7 MM but shall preferably be of grade MM2. Where no protection is provided, the grade of mortar for external wall shall not be less than MM2.

(c) In case of load bearing internal walls, the grade of mortar shall preferably be MM 0.702 or more for

High durability but in no case less than MM 0.5.

(d) In the case of masonry work in foundations laid below damp proof course, the grade of mortar for use in masonry shall be as specified below.

(i) Where soil has little moisture, masonry mortar of grade not less than MM 0.7 shall be used.

(ii) Where soil is very damp, masonry mortar of grade preferably MM 2 or more shall be used. But in no case shall the grade of mortar be less than MM 2.

(e) For masonry in building subject to vibration of machinery, the grade of mortar shall not be less than MM 3. (f) For parapets, where the height is greater than thrice the thickness, the grade of masonry mortar shall

Not be less than MM3. In case of low parapets the grade of mortar shall be the same as used in the wall masonry.

(g) The grade of mortar for bedding joints in masonry with large concrete blocks shall not be less than MM 3. (h) The compressive strength shall be determined in accordance with the procedure given in IS 2250.

(i) While mixing the pozzolana material like fly ash in mortars Ordinary Portland cement only shall be use.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Grade of Masonry Mortar (IS 2250)

(Clause 02.2.0)

Sl. No.	Grade	Compressive strength at 28 days in N/mm^2	Cement	Pozzolana (Fly Ash)	Sand
1	MM 0.7	0.7 to 1.5	1	---	8
2			1	0.4*	10
3	MM 1.5	1.5 to 2.0	1	---	7
4			1	0.4*	8.75
5	MM 3	3.0 to 5.0	1	----	6
6			1**	0.21	4.2
7			1	0.4*	7.5
8			1	----	5
9	MM 5	5.0 to 7.5	1	0.4	6.25
10			1	0.4	5
11			1	----	4
12	MM 7.5	7.5 & above	1**	0.2*	2.1
13			1	---	3
14			1	0.4	3.75

Note:

* Pozzolana of minimum lime reactivity of 4 N/MM²

** This ratio by volume correspondence approximately to cement pozzolana ratio of 0.8:0.2 by weight. In this case, only ordinary Portland cement is to be used (see IS 269). Specifications for ordinary rapid hardening and low heat Portland cement (Third revision).

Note: Compressive strength shall be determined in accordance with the Appendix -A- IS 2550.

SUB HEAD: 3.0
EARTH WORK

LIST OF BUREAU OF INDIAN STANDARD CODES

<i>S. No.</i>	<i>I.S. No.</i>	<i>Subject</i>
1	IS 632	Gamma - BHC (Lindane) emulsifiable
2	IS 1200 (Pt 1)	Method of measurement of earth work
3	IS 1200 (Pt-27)	Method of measurement of earth work (by Mechanical
4	IS 4081	Safety code for Blasting and related drilling
5	IS 4988 (Part IV)	Excavators
6	IS 6313 (pt-II)	Anti-Termite measures in buildings (pre -
7	IS 6313(pt.-III)	Anti-Termite Measures in Buildings for existing
8	IS 6940	Methods of test for pesticides and their
9	IS 8944	Chlorpyrifos emulsifiable concentrates
10	IS 8963	Chlorpyrifos - Technical specifications
11	IS 12138	Earth moving Equipment's

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

DEFINITIONS

Deadmen or Tell Tales: Mounds of earth left undisturbed in pits dug out for borrowing earth **Burjis:** Short pillars of brick/ stone having top surface finished with cement plaster for marking etc. **Formation or Profile:** Final shape of the ground after excavation or filling up.

Foul condition: Filthy and unhygienic conditions where physical movements are hampered such as soil mixed with sewage or night soil.

Lead: All distances shall be measured over the shortest practical route and not necessarily the route actually taken. Route other than shortest practical route may be considered in cases of unavoidable circumstances and approved by Engineer-in-charge along with reasons in writing.

Carriage by manual labour shall be reckoned in units of 50 metres or part thereof.

Carriage by animal and mechanical transport shall be reckoned in one km. unit. Distances of 0.5 km. or more shall be taken as 1 km. and distance of less than 0.5 km. shall be ignored. However, when the total lead is less than 0.5 km., it will not be ignored but paid for separately in successive stages of 50 metres subject to the condition that the rate worked on this basis does not exceed the rate for initial lead of 1 km. by mechanical/animal transport.

Lift: The vertical distance for removal with reference to the ground level. The excavation up to 1.5 metres depth below the ground level and depositing the excavated materials upto 1.5 metres above the ground level are included in the rate of earth work. Lifts inherent in the lead due to ground slope shall not be paid for.

Safety rules: Safety rules as laid down by the statutory authority and *as provided in National Building Code (NBC) shall be followed.*

GENERAL SPECIFICATIONS OF EARTHWORK

1.1 CLASSIFICATION OF SOILS

1.1.0 The earthwork shall be classified under the following categories and measured separately for each category:

(a) **All kind of soils:** Generally any strata, such as sand, gravel, loam, clay, mud, black cotton murrum, shingle, river or nallah bed boulders, siding of roads, paths etc. and hard core, macadam surface of any description (water bound, grouted tarmac etc.), lime concrete mud concrete and their mixtures which for excavation yields to application of picks, shovels, jumper, sacrifiers, ripper and other manual digging implements.

(b) **Ordinary rock:** Generally any rock which can be excavated by splitting with crow bars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and unreinforced cement concrete below ground level.

If required light blasting may be resorted to for loosening the materials but this will not in any way entitle the material to be classified as 'Hard rock'.

(c) **Hard rock:** Generally any rock or boulder for the excavation of which blasting is required such as quartzite, granite, basalt, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

(d) **Hard rock (blasting prohibited):** Hard rock requiring blasting as described under (c) but where the blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, use of rock hammers and cutters or any other agreed method.

1.2 ANTIQUITIES AND USEFUL MATERIALS

1.2.1 Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-Charge and shall be the property of the Government.

1.2.2 Any material obtained from the excavation which in the opinion of the Engineer-in-Charge is useful shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

1.3 PROTECTIONS

1.3.1 Excavation where directed by the Engineer-in-Charge shall be securely barricaded and provided with proper caution signs, conspicuously displayed during the day and properly illuminated with red lights *and/or written using fluorescent reflective paint as directed by engineer in charge* during the night to avoid accident.

1.3.2 The Contractor shall take adequate protective measures to see that the excavation operations do not damage the adjoining structures or dislocate the services. Water supply pipes, sluice valve chambers, sewerage pipes, manholes, drainage pipes and chambers, communication cables, power supply cables etc. met within the course of excavation shall be properly supported and adequately protected, so that these

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

services remain functional. However, if any service is damaged during excavation shall be restored in reasonable time.

1.3.3 Excavation shall not be carried out below the foundation level of the adjacent buildings until underpinning, shoring etc. is done as per the directions of the Engineer-in-Charge for which payment shall be made separately.

1.3.4 Any damages done by the contractor to any existing work shall be made good by him at his own cost. Existing drains pipes, culverts, overhead wires, water supply lines and similar services encountered during the course of execution shall be protected against damage by the contractor. The contractor shall not store material or otherwise occupy any part of the site in manner likely to hinder the operations of such services.

1.4 SITE CLEARANCE

1.4.1 Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of one metre above ground level and rubbish removed up to a distance of 50 metres outside the periphery of the area under clearance. The roots of trees and saplings shall be removed to a depth of 60cm below ground level or 30 cm below formation level or 15 cm below sub grade level, whichever is

Lower, and the holes or hollows filled up with the earth, rammed and leveled. Excavated earth shall be used to conserve top-soil for horticultural purposes. Before initiating any civil work, topsoil of 30cm depth shall be removed and stacked in part of the site as demarcated in drawing, levelled and neatly dressed.

1.4.2 The trees of girth above 30 cm measured at a height of one metre above ground shall be cut only after permission of the Engineer-in-Charge is obtained in writing. The roots of trees shall also be removed as specified in 2.4.1. Payment for cutting such trees and removing the roots shall be made separately.

1.4.3 Existing structures and services such as old buildings, culverts, fencing, water supply pipe lines, sewers, power cables, communication cables, drainage pipes etc. within or adjacent to the area if required to be diverted/removed, shall be diverted/dismantled as per directions of the Engineer-in-Charge and payment for such diversion/dismantling works shall be made separately.

1.4.4 in case of archaeological monuments within or adjacent to the area, the contractor shall provide necessary fencing around such monuments as per the directions of the Engineer-in-Charge and protect the same properly during execution of works. Payment for providing fencing shall be made separately.

1.4.5 Lead of 50 m mentioned in the 'Schedule of Quantities' is the average lead for the disposal of excavated earth within the site of work. The actual lead for the disposal of earth may be more or less than the 50 m for which no cost adjustment shall be made in the rates.

1.4.6 Disposal of Earth shall be disposed of at the specified location or as decided by the Engineer-in-Charge. The contractor has to take written permission about place of disposal of earth before the earth is disposed of, from Engineer-in-Charge.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

1.5 SETTING OUT AND MAKING PROFILES

1.5.1 A masonry pillar to serve as a bench mark will be erected at a suitable point in the area, which is visible from the largest area. This bench mark shall be constructed as per Fig. 1.1 and connected with the standard bench mark as approved by the Engineer-in-Charge. Necessary profiles with strings stretched on pegs, bamboos or 'Burjis' shall be made to indicate the correct formation levels before the work is started. The contractor shall supply labour and material for constructing bench mark, setting out and making profiles and connecting bench mark with the standard bench mark at his own cost. The pegs, bamboos or 'Burjis' and the bench mark shall be maintained by the contractor at his own cost during the excavation to check the profiles.

1.5.2 The ground levels shall be taken at 5 to 15 metres intervals (as directed by the Engineer-in-Charge) in uniformly sloping ground and at closer intervals where local mounds, pits or undulations are met with. The ground levels shall be recorded in field books and plotted on plans. The plans shall be drawn to a scale of 5 metres to one cm or any other suitable scale decided by the Engineer-in-Charge. North direction line and position of bench mark shall invariable be shown on the plans. These plans shall be signed by the contractor and the Engineer-in-Charge or their authorized representatives before the earth work is started. The labour required for taking levels shall be supplied by the contractor at his own cost.

1.6 BLASTING

Blasting shall be prohibited for any kind of work.

1.7 EXCAVATION IN ALL KINDS OF SOILS

1.7.1 All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating lead.

1.7.2 During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

1.7.3 in firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping, sloping or shoring to be done for excavation deeper than 2 metres.

1.7.4 The excavation shall be done true to levels, slope, shape and pattern indicated by the Engineer-in-Charge. Only the excavation shown on the drawings with additional allowances for centering and shuttering or as required by the Engineer-in-Charge shall be measured and recorded for payment.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

1.7.5 In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming. If the excavation for foundation is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/defective spots at the bed of the foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

1.7.6 While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excavation is done to a depth greater than that shown on the drawing or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required to be pitched, the back -filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

1.7.7 In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

1.7.8 In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, additional filling wherever required on the account shall be done by the contractor at his own cost.

1.7.9 The excavation shall be done manually or by mechanical means as directed by Engineer-in-charge considering feasibility, urgency of work, availability of labour /mechanical equipment's and other factors involved. Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor any extra payment will be made on this account.

1.8 EXCAVATION IN ORDINARY/HARD ROCK

1.8.1 All excavation operations shall include excavation and 'getting out' the excavated matter. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge or excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the item of excavation stating lead.

1.8.2 During the excavation, the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or under cutting shall not be done.

1.8.3 Where hard rock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Charge in writing for resorting to the blasting operations. Blasting operations shall be done as specified in para 2.6 and chiseling shall be done to obtain correct levels, slopes, shape and pattern of excavation as per the drawings or as required by the Engineer-in-Charge and nothing extra shall be payable for chiseling.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

1.8.4 Where blasting operations are prohibited or are not practicable, excavation in hard rock shall be done by chiseling.

1.8.5 In ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be generally adopted. Where blasting operations are not prohibited and it is practicable to resort to blasting for excavation in ordinary rock, contractor may do so with the permission of the Engineer-in-Charge in writing but nothing extra shall be paid for this blasting. Blasting shall be done as specified in para 2.6.

1.8.6 If the excavation for foundations or drains is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge. The excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/ defective spots at the bed of foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge.

1.8.7 In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling with earth duly watered, consolidated and rammed.

1.8.8 In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, filling wherever required on this account shall be done by the contractor at his own cost.

1.8.9 Only the excavation shown on the drawings or as required by the Engineer-in-Charge shall be measured and recorded for payment except in case of hard rock, where blasting operations have been resorted to, excavation shall be measured to the actual levels, provided the Engineer-in-Charge is satisfied that the contractor has not gone deeper than what was unavoidable.

1.8.10 The excavation shall be done manually or by mechanical means as desired by Engineer-in-Charge considering feasibility, urgency of work, availability of labour /mechanical equipment's and other factors involved Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor any extra payment will be made on this account.

1.9 EARTH WORK BY MECHANICAL MEANS

Earth work by mechanical means involves careful planning keeping in view site conditions i.e. type of soil, nature of excavation, distances through which excavated soil is to be transported and working space available for employing these machines. The earth moving equipment should be accordingly selected.

The earth moving equipment consists of excavating and transporting equipment. Excavating equipment's may be further classified as excavators and tractor based equipment's.

1.9.1 Excavators

Excavators generally used at site are as follows:

- (i) **Dipper-shovel:** It is used for excavating against a face or bank consisting of open-top bucket or dipper with a bottom opening door, fixed to an arm or dipper stick which slides and pivots on the jib of the crane. It is suitable for excavating all clay

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

chalk and friable materials and for handling rock and stone. However, it is not suitable for surface excavation for which a skimmer is used.

- (ii) **Backhoe:** It is similar to face shovel except that the dipper stick pivots on the end of the jib and the dipper or bucket works towards the chassis and normally has no bottom door but is emptied by swinging away from the chassis to invert the bucket. It may be designed to carry both a front-mounted bucket loading mechanism and a rear mounted backhoe. It is mainly used to excavate trenches and occasionally used for the excavation of open areas such as small basements.

In the backhoe mode the bucket lifts, swings and discharges materials while the undercarriage is stationary. When used in the 'loader' mode, the machine loads or excavated through forward motion of the machine, and lifts, transports and discharges materials.

- (iii) **Skimmer:** This arrangement is similar to the face shovel except that in this case the bucket slides on rollers directly along the jib and thus has a more restricted movement. It is used for surface excavation and leveling in conjunction with transport to haul away the excavated material.
- (iv) **Dragline:** It is usually fitted with a long slender boom or jib and the bucket, which in operation faces towards the machine and has no door, is supported by cable only as on a crane. It works from the side of the excavation at normal ground level and is used for excavating large open excavations such as basements when the depth is beyond the limit of the boom of a backhoe. It is commonly used for open cast mining operations.
- (v) **Clamshell:** It consists of two hinged half-buckets or jaws pivoted to a frame which is suspended by cable from a long jib of an excavation. The grab is used for deep excavations of limited area on all types of soil except rock. Crane and Grab is a variant of this type of equipment.

1.9.2 Tractor-based Equipment

It is a self-propelled crawler or wheeled machine used to exert a push or pull force through mounted equipment. It is designed either as attachments to normal tracked or wheeled tractors or as machines in which the earth moving attachments and the tractor are designed as a single integrated unit. A tractor, which is hydraulically operated, can be rigged as:

- (i) **Loaders :** It is used for loading, light dozing, scraping and grabbing operations, lifting and transporting the materials (loose earth, rubble, sand, gravel aggregate etc) at various sites through forward motion of the machine.
- (ii) **Tractor Shovel:** This consists of a tipping bucket at the front attached by strong pivoted arms or booms to the frame of the machine. It is used for stripping top soil, excavating against a face, bulldozing and for loading spoil or loose materials. It is similar to crawler dipper-shovel.
- (iii) **Trench Digger:** It operates on the same principle as a backhoe excavator except that the bucket is controlled by hydraulic rams instead of cables and pulleys.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(iv) **Scraper** : Scrapers provide unique capability to excavate, load, haul and dump materials.

Scrapers are available in various capacities by a number of manufacturers with options such as self – loading with elevators, twin engines or push-pull capability. They are cost effective where the haul distance is too long for bulldozers, yet too short for trucks. This distance typically ranges from 120 m to 1200 m; however, the economics should be evaluated for each project.

Scraper has an open bowl with a cutting edge positioned between the axles, which cut, loads, transports, discharges and spreads through forward motion of the machine. Loading through forward motion of the machine can be assisted by a powered mechanism (elevator) fixed to the scraper bowl.

(v) **Bulldozer and Angle-dozer**: The most common equipment used for clearing and leveling activities is a bulldozer. The terms bulldozer is used to define a tractor mounted with a dozing blade.

The bulldozer consists of a rectangular steel blade with renewable cutting edge set at right angles (capable of only tilting but not angling) to the direction of travel and attached by steel arms to the side frames of a crawler tractor. It may be used for excavating natural soil or for moving loose soil or debris, which is pushed forward as the tractor forces it ahead.

(vi) **Angledozer** is capable of both tilting and angling

1.9.3 Transporting Equipment

This implies horizontal movement primarily but it can involve some vertical movement too.

(i) **Dumpers**: These are self-propelled wheeled machines, having an open body. It is designed for the transport of excavated materials and consists of a shallow tipping hopper or skip mounted on a wheeled chassis, such as, power barrow, dumper, multi-skip dumpers, high discharge dumpers, dump truck, etc. These can be rear dump, side dump or bottom dump.

(ii) **Vibratory Roller**: It is a single Drum Vibratory Roller for compaction of embankments, etc. The smooth drum version is for compaction of granular and mixed soil. The sheep foot Roller consists of a hollow cylindrical steel drum or drums on which projecting feet are mounted. These feet penetrate into the fill as a roller moves forward and cause compaction. The geometry of the foot may be sheep, club pyramid, cone or cylinder foot. Such rollers are employed for compaction (densification) of cohesive and semi-cohesive soils.

1.10 FILLING

1.10.1 The earth used for filling shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish.

1.10.2 Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 metre vibratory power roller shall be used to consolidate the filing unless otherwise directed by Engineer-in-charge. The top and sides of filling shall be neatly dressed. The contractor shall make good all

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

subsidence and shrinkage in earth fillings, embankments, traverses etc. during execution and till the completion of work unless otherwise specified.

1.10.3 COMPACTION AND CONSOLIDATION OF EARTH

Consolidation of Earth to be achieved up to 95% proctor Density of Earth.

1.11 MEASUREMENTS

1.11.1 The length and breadth of excavation or filling shall be measured with a steel tape correct to the nearest cm. The depth of cutting or height of filling shall be measured, correct to 5 mm, by recording levels before the start of the work and after the completion of the work. The cubical contents shall be worked out to the nearest two places of decimal in cubic metres.

1.11.1.1 In case of open footings up to the depth of 1.5 metres, all-round excavation of 30 cm. beyond the outer dimension of footing shall be measured for payment to make allowances for centering and shuttering. Any additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment.

1.11.1.2 In case of open footings/Rafts at a depth of more than 1.5 metre, all-round excavation of 75 cm shall be measured for payment to make allowance for centering and shuttering. Additional excavation beyond this limit shall be at the risk and cost of the contractor and shall not be measured for payment.

1.11.2 In case the ground is fairly uniform and where the site is not required to be leveled, the Engineer-in-Charge may permit the measurements of depth of cutting or height of filling with steel tape, correct to the nearest cm. In case of borrow pits, diagonal ridges, cross ridges or dead-men, the position of which shall be fixed by the Engineer-in-Charge, shall be left by the contractor to permit accurate measurements being taken with steel tape on the completion of the work. Deduction of such ridges and dead men shall be made from the measurements unless the same are required to be removed later on and the earth so removed is utilized in the work. In the latter case nothing extra will be paid for their removal as subsequent operation.

1.11.3 Where ordinary rock and hard rock is mixed. The measurement of the excavation shall be made as specified in 1.11.1 and 1.11.2 the two kinds of rock shall be stacked separately and measured in stacks. The net quantity of the two kinds of rocks shall be arrived at by applying deduction of 50% to allow for voids in stacks. If the sum of net quantity of two kinds of rocks exceeds the total quantity of the excavated material, then the quantity for each type of rock shall be worked out from the total quantity in the ratio of net quantities in stack measurements of the two types of rocks. If in the opinion of the Engineering-in-charge stacking is not feasible, the quantity of ordinary and hard rock shall be worked out by means of cross-sectional measurements.

1.11.4 Where soil, ordinary rock and hard rock are mixed, the measurements for the entire excavation shall be made as specified in 1.11.1 and 1.11.2. Excavated materials comprising hard rock and ordinary rock shall be stacked separately, measured, and each reduced by 50% to allow for voids to arrive at the quantity payable under hard rock and ordinary rock. The difference between the entire excavation and the sum of the quantities payable under hard rock and ordinary rock shall be paid for as excavation in ordinary soil or hard soil as the case may be.

1.11.5 Where it is not possible or convenient to measure the depth of cutting by recording levels as specified in 1.11.1 quantity of excavation shall be worked out from filling. The

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

actual measurements of the fill shall be calculated by taking levels of the original ground before start of the work after site clearance and after compaction of the fill as specified and the quantity of earth work so computed shall be reduced by 10% in case of consolidated fills and by 5% in case the consolidation is done by heavy mechanical machinery to arrive at the net quantity of excavation for payment. No such deduction shall, however, be made in case of consolidation by heavy mechanical machinery at optimum moisture content, or when the consolidated filling is in confined situations such as under floors.

1.11.6. Recording Measurements for Earth Leveling Work

1.11.6.1 Level Books: In case of leveling operations and earthwork, measurements are required to be recorded in level books in addition to Measurement Books. The Level Books should be numbered, accounted for and handled like Measurement Books.

1.11.6.2 Preparatory Works: Before starting the earth work, following steps should be taken:

- (1) Original ground levels should be recorded in the Level Book in the presence of the contractor or his authorized representative, and should be signed by him and the authorized representative of Engineer in charge who records the levels. All the local mounds and depressions should be indicated clearly in the drawing and the field Level Book and should be checked by the authorized representative of Engineer in charge before the leveling work is started.
- (2) A suitable baseline should be fixed with permanent masonry pillars at distances not exceeding 150 metres to provide a permanent reference line for facilitating check work. The base line (s) should be entered in the Level Book with co-ordinates. These baselines should be maintained till the final payment for the work has been made.
- (3) While recording the levels, it should be ensured that the circuit is closed by taking final levels of the starting point or any other point, the R.L. of which was previously determined.
- (4) Plans showing initial levels, location of bench marks and reduced levels, should be prepared and signed by both the parties and attached to the agreement before commencement of the work.

1.11.6.3 Test Check of the Levels

- (1) The authorized representative of Engineer in charge should exercise test check.
- (2) The test check of the levels should be carried out independently by authorized representative of Engineer in charge, and the readings should be recorded in the prescribed Level Book in red ink against the old levels which should be neatly scored out wherever necessary. If the test check carried out reveals serious mistakes in the original levels, these should be taken or re-taken and re-checked.
- (3) The test check carried out by authorized representative of Engineer in charge should be as representative as possible for the entire work done.
- (4) On completion of work, the levels should again be recorded in the Level Book and the contractor's signatures obtained. These levels should also be test checked by the authorized representative of Engineer in charge to the same extent as indicated in (1) within one month of the date of completion of the earth work, and according to the procedure as laid down in the case of initial levels as indicated above.
- (5) The formation levels as per final execution of the work should be compared with the proposed

Formation levels and the work got rectified within permissible tolerance.

1.11.6.4 Payment of Leveling Work

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

- (1) Every running bill and the final bill should be paid on the basis of levels.
- (2) Intermediate payments can, however, be made on the basis of borrow pit measurements. The authorized representative of Engineer in charge should take care that the quantities thus assessed are not in any case more than the actual work done.

1.11.6.5 Large Scale Leveling Work

- (1) In case of large scale leveling work involving both cutting and filling, an accurate site plan should be prepared before the work is commenced. The portions requiring cutting and filling shall then be divided into squares and corresponding squares into filling, which are complementary to the squares in cutting given the same number.
- (2) A table may be written upon the plan showing leads involved between the various complementary squares. This would form a lead chart for the work to be done.
- (3) Before the work of leveling is commenced, the lead chart shall be checked by the authorized representative of Engineer in charge in the presence of the contractor or his authorized representative, and his signatures shall be obtained on the same. This should form an integral part of the contract and should be duly signed by both the integral parties before commencement of the work.
- (4) The quantity payable for earthwork shall be lower of the quantity derived from cutting or filling.

The payment for lead shall be based on lead chart prepared in the aforesaid manner.

1.11.6.6 Import of Earth: In case of earth to be imported, the area from where the earth is to be imported, should be pre-determined wherever possible before the start of the work, and wherever feasible, the average lead should be worked out and stipulated in the tender. After this is determined, initial levels of the area to be filled should be recorded. The levels should be properly checked during the progress of work and on completion.

1.12 RATES

1.12.1 Rates for Earthwork shall include the following:

- (a) Excavation and depositing excavated material as specified.
- (b) Handling of antiquities and useful material as specified on 1.2. (c) Protection as specified in 1.3.
- (d) Site clearance as specified in 1.4.
- (e) Setting out and making profiles as specified in 1.5.
- (f) Forming (or leaving) dead – men or 'Tell Tales' in borrow pits and their removal after measurements.
- (g) Bailing out or pumping of rain water from excavations. (h) Initial lead of 50 m and lift of 1.5 m.
- (i) Blasting operations for hard rock as specified in 1.6.

1.12.2 No deduction shall be made from the rate if in the opinion of the Engineer-in-charge, operations specified in 1.12.1 (b) to (h) are not required to be carried out on any account whatsoever.

Item 2.9.1 Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-incharge.

(a) Ordinary rock

1 This shall comprise:

- (a) Excavation exceeding 1.5 m in width and 10 sqm on plan and exceeding 30 cm in depth.
- (b) Excavation for basements, water tanks etc.
- (c) Excavation in trenches exceeding 1.5 m in width and 10 sqm on plan.

2 Excavation shall be done as specified in 1.8 and 1.9 of general specifications of earthwork.

3 Measurements shall be done as specified in 1.11 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

4 Rates shall be as specified in 1.12 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

Item 2.9.3 Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-incharge.

(b) Hard rock (blasting prohibited)

1 This shall comprise:

- (a) Excavation exceeding 1.5 m in width and 10 sqm on plan and exceeding 30 cm in depth.
- (b) Excavation for basements, water tanks etc.
- (c) Excavation in trenches exceeding 1.5 m in width and 10 sqm on plan.

2 Excavation shall be done as specified in 1.8 and 1.9 of general specifications of earthwork.

3 Measurements shall be done as specified in 1.11 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

4 Rates shall be as specified in 1.12 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Item 2.7.1 Excavation work by mechanical means (Hydraulic excavator)/ manual means in foundation trenches or drains (not exceeding 1.5m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soils as directed, within a lead of 50 m.

(a) Ordinary rock

EXCAVATION IN TRENCHES FOR FOUNDATIONS AND DRAINS (ORDINARY)

1 This shall comprise excavation not exceeding 1.5 m in width or 10 sqm on plan and to any depth in trenches (excluding trenches for pipes, cables, conduits etc.) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.

2 Excavation shall be done as specified in 1.8 and 1.9 of general specifications of earthwork.

3 Measurements shall be done as specified in 1.11 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

4 Rates shall be as specified in 1.12 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

Item 2.7.3 Excavation work by mechanical means (Hydraulic excavator)/ manual means in foundation trenches or drains (not exceeding 1.5m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soils as directed, within a lead of 50 m.

(b) Hard rock (blasting prohibited)

EXCAVATION IN TRENCHES FOR FOUNDATIONS AND DRAINS (HARD ROCK)

1 This shall comprise excavation not exceeding 1.5 m in width or 10 sqm on plan and to any depth in trenches (excluding trenches for pipes, cables, conduits etc.) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.

2 Excavation shall be done as specified in 1.8 and 1.9 of general specifications of earthwork.

3 Measurements shall be done as specified in 1.11 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

4 Rates shall be as specified in 1.12 of general specifications of earthwork except disposal of unserviceable material anywhere within the premises.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Item 1.1.4 Carriage of materials by mechanical transport including loading, unloading and stacking earth.

Earth upto 1km

Item 1.1.4 Carriage of materials by mechanical transport including loading, unloading and stacking excavted rock.

Excavted rock upto 1km

Item 2.27.1 Surface dressing of the ground including removing vegetation and in- equalities not exceeding 15 cm deep and disposal of rubbish, lead with in 50 m Lead and lift up to 1.5 m.

JUNGLE CLEARANCE

Jungle clearance shall comprise uprooting of rank vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth upto 30 cm measured at a height of one metre above the ground level. Where only clearance of grass is involved it shall be measured and paid for separately.

1 Uprooting of Vegetation

The roots of trees and saplings shall be removed to a depth of 60 cm below ground level or 30 cm below formation level or 15 cm below sub-grade level, whichever is lower. All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled. Trees, shrubs, poles, fences, signs, monuments, pipe lines, cable etc., within or adjacent to the area which are not required to be disturbed during jungle clearance shall be properly protected by the contractor at his own cost and nothing extra shall be payable.

2 Stacking and Disposal

All useful materials obtained from clearing and grubbing operation shall be stacked in the manner as directed by the Engineer-in-Charge. Trunks and branches of trees shall be cleared of limbs and tops and stacked neatly at places indicated by the Engineer-in-Charge. The materials shall be the property of the Government. All unserviceable materials which in the opinion of the Engineer-in-Charge cannot be used or auctioned shall be removed up to any distance outside the periphery of the area under clearance. It shall be ensured by the contractor that unserviceable materials are disposed of in such a manner that there is no likelihood of getting mixed up with the materials meant for construction.

3 Clearance of Grass

Clearing and grubbing operation involving only the clearance of grass shall be measured and paid for separately and shall include removal of rubbish up to any distance outside the periphery of the area under clearance.

4 Measurements

The length and breadth shall be measured correct to the nearest cm and area worked out in square metres correct to two places of decimal.

5 Rates

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

The rate includes cost of all the operation described above.

Item 4.7.1 Providing and fixing up to floor five level precast cement concrete solid block in any shape or patten as per the drawing, including hoisting and setting in position with cement mortar 1:3 (1 cement : 3 coarse sand), cost of required centering, shuttering complete :
1:1½:3 (1 Cement: 1½ coarse sand(zone-III) : 3 graded stone aggregate 20 mm nominal size) for planter

5.0 GENERAL

Reinforced cement concrete work may be cast-in-situ or Precast as may be directed by Engineer-in- Charge according to the nature of work. Reinforced cement concrete work shall comprise of the following which may be paid separately or collectively as per the description of the item of work.

- (a) Form work (Centering and Shuttering)
- (b) Reinforcement
- (c) Concreting: (1- Cast-in-situ), (2 - Precast)

5.1 MATERIALS

5.1.1 Water, cement, fine and coarse aggregate shall be as specified under respective clauses of chapter 02 mortars.

5.1.2 Fly Ash admixed cement concrete (FACC) and fly ash Blended cements in Cement Concrete (PPCC) in RCC structures.

5.1.2.0 Fly ash Blended Cements conforming to IS 1489 (Part I) may be used in RCC structures as per guidelines given below :

5.1.2.1 General

(i) IS 456- 2000 Code of Practice for Plain and Reinforced Concrete (as amended up to date) shall be followed in regard to Concrete Mix Proportion and its production as under :

(a) The concrete mix design shall be done as "Design Mix Concrete" as prescribed in clause-9 of IS 456 mentioned above.

(b) Concrete shall be manufactured in accordance with clause 10 of above mentioned IS 456 covering quality assurance measures both technical and organizational, which shall also necessarily require a qualified Concrete Technologist to be available during manufacture of concrete for certification of quality of concrete.

(ii) Minimum M -25 grade of concrete shall be used in all structural elements made with RCC both in load bearing and framed structure.

(iii) The mechanical properties such as modulus of elasticity, tensile strength, creep and shrinkage of fly ash mixed concrete or concrete using fly ash blended cements (PPCs) are not likely to be significantly different and their values are to be taken same as those used for concrete made with OPC.

(iv) To control higher rate of carbonation in early ages of concrete both in fly ash admixed

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

as well as PPC based concrete, water/binder ratio shall be kept as low as possible, which shall be closely monitored during concrete manufacture.

If necessitated due to low water/binder ratio, required workability shall be achieved by use of chloride free chemical admixtures conforming to IS 9103. The compatibility of chemical admixtures and super plasticizers with each set OPC, fly ash and /or PPC received from different sources shall be ensured by trials.

(v) In environment subjected to aggressive chloride or sulphate attack in particular, use of fly ash admixed or PPC based concrete is recommended. In cases, where structural concrete is exposed to excessive magnesium sulphate, flyash substitution/content shall be limited to 18% by weight. Special type of cement with low C3A content may also be alternatively used. Durability criteria like minimum binder content and maximum water /binder ratio also need to be given due consideration in such environment.

(vi) Wet curing period shall be enhanced to a minimum of 10 days or its equivalent. In hot & arid regions, the minimum curing period shall be 14 days or its equivalent.

5.1.2.2 Use of Fly ash Admixed Cement Concrete (FACC) in RCC structures

There shall be no bar on use of FACC in RCC structures subject to following additional conditions.

(i) Fly ash shall have its chemical characteristics and physical requirements etc. conforming to IS 3812 (part I & II) and shall be duly certified.

(ii) To ensure uniform blending of fly ash with cement in conformity with IS 456, a specific facility needs to be created at site with complete computerized automated process control to achieve design quality or with similar facility from Ready Mix Concrete (RMC) plants.

(iii) As per IS 1489 (Part-I) maximum 35% of OPC by mass is permitted to be substituted with fly ash conforming to IS 3812 (Part -I) and same is reiterated.

(iv) Separate storage for dry fly ash shall be provided. Storage bins or silos shall be weather proof and permit a free flow and efficient discharge of fly ash. The filter or dust control system provided in the bins or silos shall be of sufficient size to allow delivery of fly ash maintained at specified pressure to prevent undue emission of fly ash dust, which may interfere weighing accuracy.

5.1.2.3 Use of Fly Ash Blended Cements in Cement Concrete (PPCC) in RCC Structures

(i) Subject to General Guidelines detailed out as above, PPC manufactured conforming to IS 1489 (Part-I) shall be treated at par with OPC for manufacture of Design Mix concrete for structural use in RCC.

(ii) Till the time, BIS makes it mandatory to print the %age of fly ash on each bag of cement, the certificate from the PPC manufacture indicating the same shall be insisted upon before allowing use of such cements in works.

(iii) While using PPC for structural concrete work, no further admixing of fly ash shall be permitted.

5.2 FORM WORK (CENTRING & SHUTTERING)

5.2.1 Form Work

Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

be used as runners.

(b) Assembly of beam head over props. Beam head is an adopter that fits snugly on the head plates of props to provide wider support under beam bottoms.

(c) Only steel shuttering shall be used, except for unavoidable portions and very small works for which 12 mm thick water proofing ply of approved quality may be used.

5.2.3.4 Form work shall be properly designed for self weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 metres, the prop may be provided in multi-stages. A typical detail of multistage shuttering is given in Fig. 5.9.

5.2.3.5 Camber: Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 250) or as directed by the Engineer-in-Charge, so as to offset the subsequent deflection, For cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the Engineer-in-Charge.

5.2.3.5.1 Typical arrangement of form work for 'beams, columns and walls' are shown in Figures 5.1 to 5.8 and form secured by wall ties is shown in Fig. 5.3.

5.2.3.6 Walls : The form faces have to be kept at fixed distance apart and an arrangement of wall ties with spacer tubes or bolts is considered best. A typical wall form with the components identified is given in Fig. 5.1, 5.2 & 5.3. The two shutters of the wall are to be kept in place by appropriate ties, braces and studs, some of the accessories used for wall form are shown in Fig. 5.3.

5.2.3.7 Removal of Form work (Stripping Time) : In normal circumstance and where various types of cements are used, forms, may generally be removed after the expiry of the following periods:

<i>Type of Form work</i>	<i>Minimum period Before Striking Form work</i>	<i>Minimum period Before Striking Form work for OPC 43 grade</i>	<i>Minimum period Before Striking Form work for PPC</i>
(a) Vertical form work to columns, walls, beams	16-24 h	16-24 h	24-36 h
(b) Soffit form work to slabs (Props to be refixed immediately after removal of formwork)	3 days	3 days	4 days
(c) Soffit form work to beams (Props to be refixed immediately after removal of formwork)	7 days	7 days	10 days

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(d) Props to slabs: (1) Spanning upto 4.5m (2) Spanning over 4.5m	7 days 14 days	7 days 14 days	10 days 20 days
(e) Props to beams and arches: (1) Spanning upto 6m (2) Spanning over 6m	14 days 21 days	14 days 21 days	20 days 30 days

Note 1: For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. Generally If Portland pozzolana or low heat cement or OPC with direct addition of fly ash has been used for concrete, the stripping time will be 10/7 of the period stated for OPC with 43 grade cement above.

Note 2: The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

Note 3: For rapid hardening cement, 3/7 of above periods for OPC 33 grade will be sufficient in all cases except for vertical side of slabs, beams and columns which should be retained for at least 24 hours.

Note 4: In case of cantilever slabs and beams, the centering shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength.

Note 5: Proper precautions should be taken to allow for the decrease in the rate of hardening that occurs with all types of cement in cold weather and accordingly stripping time shall be increased.

Note 6: Work damaged through premature or careless removal of forms shall be reconstructed within 24 hrs.

5.2.4 Surface Treatment

5.2.4.1 Oiling the Surface : Shuttering gives much longer service life if the surfaces are coated with suitable mould oil which acts both as a parting agent and also gives surface protections.

A typical mould oil is heavy mineral oil or purified cylinder oil containing not less than 5% pentachlorophenol conforming to IS 716 well mixed to a viscosity of 70-80 centipoises.

After 3-4 uses and also in cases when shuttering has been stored for a long time, it should be recoated with mould oil before the next use.

The second categories of shuttering oils / leavening agents are Polymer based water soluble Compounds. They are available as concentrates and when used diluted with water in the ratio of 1:20 or as per manufacturer specifications. The diluted solution is applied by brush applications on the shuttering both of steel as well as ply wood. The solution is applied after every use.

5.2.4.2 The design of form work shall conform to sound Engineering practices and relevant IS codes.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

5.2.5 Inspection of Form Work

The completed form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position.

Proper form work should be adopted for concreting so as to avoid honey combing, blow holes, grout loss, stains or discoloration of concrete etc. Proper and accurate alignment and profile of finished concrete surface will be ensured by proper designing and erection of form work which will be approved by Engineer-in-Charge.

Shuttering surface before concreting should be free from any defect/ deposits and full cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.

5.2.5.1 Erection of Form Work (Centering and shuttering): Following points shall be borne in mind while checking during erection.

(a) Any member which is to remain in position after the general dismantling is done, should be clearly marked.

(b) Material used should be checked to ensure that, wrong items/ rejects are not used.

(c) If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.

(d) (i) The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground.

(ii) Sole plates shall be properly seated on their bearing pads or sleepers. (iii) The bearing plates of steel props shall not be distorted.

(iv) The steel parts on the bearing members shall have adequate bearing areas.

(e) Safety measures to prevent impact of traffic, scour due to water etc. should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.

(f) Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and stability of form work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened.

(g) The stacked materials shall be placed as catered for, in the design.

(h) When adjustable steel props are used. They should:

1. be undamaged and not visibly bent.
2. have the steel pins provided by the manufacturers for use.
3. be restrained laterally near each end.
4. have means for centralizing beams placed in the forkheads.

(i) Screw adjustment of adjustable props shall not be over extended.

(j) Double wedges shall be provided for adjustment of the form to the required position wherever any settlement/ elastic shorting of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightened/ clamped down after adjustment to prevent shifting.

(k) No member shall be eccentric upon vertical member. (l) The number of nuts and bolts shall be adequate.

(m) All provisions of the design and/or drawings shall be complied with. (n) Cantilever supports shall be adequate.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

- (o) Props shall be directly under one another in multistage constructions as far as possible.
- (p) Guy ropes or stays shall be tensioned properly.
- (q) There shall be adequate provision for the movements and operation of vibrators and other construction plant and equipment.

(r) Required camber shall be provided over long spans.

(s) Supports shall be adequate, and in plumb within the specified tolerances.

5.2.6 Measurements

5.2.6.1 General : The form work shall include the following:

(a) Splayed edges, notching, allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing, striking and removal.

(b) All supports, struts, braces, wedges as well as mud sills, piles or other suitable arrangements to support the form work.

(c) Bolts, wire, ties, clamps, spreaders, nails or any other items to hold the sheathing together.

(d) Working scaffolds, ladders, gangways, and similar items.

(e) Filletting to form stop chamfered edges of splayed external angles not exceeding 20mm wide to beams, columns and the like.

(f) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete.

(g) Dressing with oil to prevent adhesion and

(h) Raking or circular cutting

5.2.6.2 Classification of Measurements : Where it is stipulated that the form work shall be paid for separately, measurements shall be taken of the area of shuttering in contact with the concrete surface. Dimensions of the form work shall be measured correct to a cm. The measurements shall be taken separately for the following.

(a) Foundations, footings, bases of columns etc. and for mass concrete

(b) Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.

(c) Suspended floors, roofs, landings, shelves and their supports and balconies.

(d) Lintels, beams, plinth beams, girders, bresssummers and cantilevers.

(e) Columns, pillars, piers, abutments posts and struts.

(f) Stairs (excluding landings) except spiral staircase.

(g) Spiral staircases (including landings).

(h) Arches, Domes, vaults, shells roofs, arch ribs, curvilinear shaped folded plates

(i) Extra for arches, domes, vaults exceeding 6 m span other than curvilinear shaped

(j) Chimneys and shafts.

(k) Well steining.

(l) Vertical and horizontal fins individually or forming box, louvers and bands.facias and eaves board

(m) Waffle or ribbed slabs.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(n) Edges of slabs and breaks in floors and walls (to be measured in running metres where below 200 mm in width or thickness).

(o) Cornices and mouldings.

(p) Small surfaces, such as cantilevers ends, brackets and ends of steps, caps and boxes to pilasters and columns and the like.

(q) Chullah hoods, weather shades, chajjas, corbels etc. including edges and

(r) Elevated water reservoirs.

5.2.6.3 Centering, and shuttering where exceeding 3.5 metre height in one floor shall be measured and paid for separately.

5.2.6.4 Where it is not specifically stated in the description of the item that form work shall be paid for separately, the rate of the RCC item shall be deemed to include the cost of form work.

5.2.6.5 No deductions from the shuttering due to the openings/ obstructions shall be made if the area of each openings/ obstructions does not exceed 0.4 square metre. Nothing extra shall be paid for forming such openings.

5.2.6.6 Form work of elements measured under categories of arches, arch ribs, domes, spiral staircases, well steining, shell roofs, curvilinear folded plates & curvilinear eaves board, circular shafts & chimneys shall not qualify for extra rate for circular work.

5.2.6.7 Extra for circular work shall be admissible for surfaces circular or curvilinear in plan or in elevation beyond the straight edge of supporting beam in respective mode of measurement. However, there may be many different types of such structures. In such cases, extra payment shall be made judiciously after deducting areas where shuttering for circular form work is not involved.

5.2.7 Rate

The rate of the form work includes the cost of labour and materials required for all the operations described above.

5.4 CONCRETING

5.4.0 The concrete shall be as specified under chapter 4 concrete work. The proportion by volume or by the weight of ingredients shall be as specified.

5.4.1 Consistency

The concrete which will flow sluggishly into the forms and around the reinforcement without any segregation of coarse aggregate from the mortar shall be used. The consistency shall depend on whether the concrete is vibrated or hand tamped, it shall be determined by slump test as prescribed in sub-head "concrete" under workability – requirement.

5.4.2 Placing of Concrete

5.4.2.1 Concreting shall be commenced only after Engineer-in-Charge has inspected the centering, shuttering and reinforcement as placed and passed the same. Shuttering shall be clean and free from all shavings, saw dust, pieces of wood, or other foreign material and surfaces shall be treated as prescribed in 5.2.4.

5.4.2.2 In case of concreting of slab and beams, wooden plank or cat walks of chequered

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

MS plated or bamboo chalties or any other suitable material supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of deposition without disturbing the reinforcement in any way. Labour shall not be allowed to walk over the reinforcement.

5.4.2.3 In case of columns and wall, it is desirable to place concrete without construction joints. The progress of concreting in the vertical direction, shall be restricted to one metre per hour.

5.4.2.4 The concrete shall be deposited in its final position in a manner to preclude segregation of ingredients. In deep trenches and footings concrete shall be placed through chutes or as directed by the Engineer-in-Charge. In case of columns and walls, the shuttering shall be so adjusted that the vertical drop of concrete is not more than 1.5 metres at a time.

5.4.2.5 During cold weather, concreting shall not be done when the temperature falls below 4.50C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone.

5.4.2.6 During hot weather precaution shall be taken to see that the temperature of wet concrete does not exceed 38°C. No concrete shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer-in-Charge.

5.4.2.7 It is necessary that the time between mixing and placing of concrete shall not exceed 30 minutes so that the initial setting process is not interfered with.

5.4.3 Compaction

It shall be as specified in sub-head of Concrete Work of this specification.

5.4.3.1 Concrete shall be compacted into dense mass immediately after placing by means of mechanical vibrators designed for continuous operations complying with IS 2505, IS 2506, IS 2514 and IS 4656. The Engineer-in-Charge may however relax this condition at his discretion for certain items depending on the thickness of the members and feasibility of vibrating the same and permit hand compaction instead. Hand compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement, embedded fixtures, and into corners of the form. The layers of concrete shall be so placed that the bottom layer does not finally set before the top layer is placed. The vibrators shall maintain the whole of concrete under treatment in an adequate state of agitation; such that de-aeration and effective compaction is attained at a rate commensurate with the supply of concrete from the mixers. The vibration shall continue during the whole period occupied by placing of concrete, the vibrators being adjusted so that the centre of vibrations approximates to the centre of the mass being compacted at the time of placing.

5.4.3.2 Concrete shall be judged to be properly compacted, when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. When this condition has been attained, the vibrator shall be stopped in case of vibrating tables and external vibrators. Needle vibrators shall be withdrawn slowly so as to prevent formation of loose pockets in case of internal vibration. In case both internal and external vibrators are being used, the internal vibrator shall be first withdrawn slowly after which the external vibrators shall be stopped so that no loose pocket is left in the body of the concrete. The specific instructions of the makers of the particular type of vibrator used shall be strictly complied with. Shaking of reinforcement for the purpose of compaction should be avoided. Compaction shall be completed before the initial setting starts, i.e. with 30 minutes of addition of water to the dry mixture.

5.4.4 Construction joints

5.4.4.1 Concreting shall be carried out continuously upto the construction joints, the position and details of which shall be as shown in structural drawing or as indicated in Fig. 5.26 or as directed by Engineer-in-Charge. Number of such joints shall be kept to minimum. The joints shall be kept at places where the shear force is the minimum. These shall be straight and shall be at right angles to the direction of main reinforcement. Construction joints should comply with IS 11817.

5.4.4.2 In case of columns the joints shall be horizontal and 10 to 15 cm below the bottom of the beam running into the column head. The portion of the column between the stepping off level and the top of the slab shall be concreted with the beam.

5.4.4.3 When stopping the concrete on a vertical plane in slabs and beams, and approved stop board (see Fig. 26C) shall be placed with necessary slots for reinforcement bars or any other obstruction to pass the bars freely without bending. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stopboard. Inclined or feather joints shall not be permitted. Any concrete flowing through the joints of stopboard shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set.

5.4.4.4 When the work has to be resumed, the joint shall be thoroughly cleaned with wire brush and loose particles removed. A coat of neat cement slurry at the rate of 2.75 kg of cement per square metre shall then be applied on the roughened surface before fresh concrete is laid.

5.4.5 Expansion Joints

Expansion joints shall be provided as shown in the structural drawings or as indicated in Fig. 5.10 to 5.25 or as directed by Engineer-in-Charge, for the purpose of general guidance. However it is recommended that structures exceeding 45 m in length shall be divided by one or more expansion joints. The filling of these joints with bitumen filler, bitumen felt or any such material and provision of copper plate, etc. shall be paid for separately in running metre. The measurement shall be taken two places of decimal stating the depth and width of joint.

5.4.6 Curing

After the concrete has begun to harden i.e. about 1 to 2 hours after its laying, it shall be protected from quick drying by covering with moist gunny bags, sand, canvass Hessian or any other material approved by the Engineer-in-Charge. After 24 hours of laying of concrete, the surface shall be cured by ponding with water for a minimum period of 7 days from the date of placing of concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather condition.

5.4.7 Finishing

5.4.7.1 In case of roof slabs the top surface shall be finished even and smooth with wooden trowel, before the concrete begins to set. **Sprinkling of dry cement while finishing shall not be resorted to.**

5.4.7.2 Immediately on removal of forms, the R.C.C. work shall be examined by the Engineer-in-Charge, before any defects are made good.

(a) The work that has sagged or contains honey combing to an extent detrimental to structural safety or architectural concept shall be rejected as given in para 5.4.9.4 for visual inspection test.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(b) Surface defects of minor nature may be accepted. On acceptance of such a work by the

Engineer-in-Charge, the same shall be rectified as follows:

1. Surface defects which require repair when forms are removed, usually consist of bulged due to movement of forms, ridges at form joints, honey-combed areas, damage resulting from the stripping of forms and bolt holes, bulges and ridges are removed by careful chipping or tooling and the surface is then rubbed with a grinding stone. Honey-combed and other defective areas must be chipped out, the edges being cut as straight as possible and perpendicularly to the surface, or preferably slightly under cut to provide a key at the edge of the patch.

2. Shallow patches are first treated with a coat of thin grout composed of one part of cement and one part of fine sand and then filled with mortar similar to that used in the concrete. The mortar is placed in layers not more than 10mm thick and each layer is given a scratch finish to secure bond with the succeeding layer. The last layer is finished to match the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.

3. Large and deep patches require filling up with concrete held in place by forms. Such patches are reinforced and carefully dowelled to the hardened concrete.

4. Holes left by bolts are filled with mortar carefully packed into places in small amounts. The mortar is mixed as dry as possible, with just enough water so that it will be tightly compacted when forced into place.

5. Tiered holes extending right through the concrete may be filled with mortar with a pressure gun similar to the gun used for greasing motor cars.

6. Normally, patches appear darker than the surrounding concrete, possibly owing to the presence on their surface of less cement laitance. Where uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of white Portland cement to the patching mortar, the exact quantity being determined by trial.

7. The same amount of care to cure the materials in the patches should be taken as with the whole structure. Curing must be started as soon as possible, after the patch is finished to prevent early drying. Damp Hessian may be used but in some locations it may be difficult to hold it in place. A membrane curing compound in these cases will be most convenient.

(c) The exposed surface of R.C.C. work shall be plastered with cement mortar 1:3 (1 cement : 3 fine sand) of thickness not exceeding 6 mm to give smooth and even surface true to line and form. Any RCC surface which remains permanently exposed to view in the completed structure, shall be considered exposed surfaced for the purpose of this specification.

Where such exposed surface exceeding 0.5 sqm in each location is not plastered with cement mortar 1:3 (1 cement : 3 fine sand) 6 mm thick, necessary deduction shall be made for plastering not done.

(d) The surface which is to receive plaster or where it is to be joined with brick masonry wall, shall be properly roughened immediately after the shuttering is removed, taking care to remove the laitance completely without disturbing the concrete. The roughening shall be done by hacking. Before the surface is plastered, it shall be cleaned and wetted so as to give bond between concrete and plaster.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

RCC work shall be done carefully so that the thickness of plaster required for finishing the surface is not more than 6 mm.

(e) The surface of RCC slab on which the cement concrete or mosaic floor is to be laid shall be roughened with brushes while the concrete is green. This shall be done without disturbing the concrete.

5.4.8 Strength of Concrete

The compressive strength on the work tests for different mixed shall be as given in Table 5.5 below:-

TABLE 5.5

<i>Concrete Mix (Nominal Mix on Volume basis)</i>	<i>Compressive Strength in (Kg/ sq cm)</i>	
	<i>7 days'</i>	<i>28 days'</i>
1:1:2	210	315
1:1.5:3	175	265
1:2:4	140	210

5.4.9 Testing of Concrete

5.4.9.0 Regular mandatory tests on the workability of the fresh concrete shall be done to achieve the specified compressive strength of concrete. These will be of two types

(a) Mandatory Lab, Test

(b) Mandatory Field Test

Results of Mandatory Field Test will prevail over mandatory Lab. Test.

5.4.9.1 Cube Test for Compressive Strength of Concrete - Mandatory Lab Test :

Mandatory tests shall be carried out as prescribed in Appendix A of Chapter 4.

5.4.9.2 Additional Test : Additional test, if required, shall be carried out as prescribed in Appendix B of Chapter 4.

5.4.9.3 Slump Test : This test shall be carried out as prescribed in sub-head 4 of concrete.

5.4.9.4 Visual Inspection Test : The concrete will be inspected after removal of the form work as described in para 5.4.7.2 The question of carrying out mandatory test or other tests described in Appendix A and B (para 5.4.9.1 and 5.4.9.2) will arise only after satisfactory report of visual inspection.

The concrete is liable to be rejected if:

(i) It is porous or honeycombed as per para 5.4.7.2 (a).

(ii) Its placing has been interrupted without providing a proper construction joint.

(iii) The reinforcement has been displaced beyond tolerance specified or construction

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

tolerances have not been met.

However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the Engineer-in-Charge at the risk and cost of the contractor.

5.4.10 Standard of Acceptance – for Nominal Mix

5.4.10.1 Mandatory Lab. Test : For concrete sampled and tested as prescribed in Appendix A of Chapter 4, the following requirement shall apply.

5.4.10.2 Out of six sample cubes, three cubes shall be tested at 7 days and remaining three cubes at 28 days.

5.4.10.3 7 days' Tests

Sampling: The average of the strength of three specimen shall be accepted as the compressive strength of the concrete provided the variation in strength of individual specimen is not more than $\pm 15\%$ of the average. Difference between the maximum and minimum strength should not exceed 30% of average strength of three specimen. If the difference between maximum and minimum strength exceeds 30% of the average strength, then 28 days' test shall have to be carried out.

Strength: If the actual average strength of sample accepted in para 'sampling' above is equal to or higher than specified strength upto $\pm 15\%$ then strength of the concrete shall be considered in order.

In case the actual average strength of sample accepted in the above para is lower than the specified or higher by more than 15% then 28 days' test shall have to be carried out to determine the compressive strength of concrete cubes.

5.4.10.4 28 days' Test

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30% the Engineer-in-Charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 130% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30% then strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-Charge (see para 5.4.13.2).

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however the Engineer-in-Charge so desires, he may order additional tests (See Appendix B of Chapter 5) to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the contractor.

5.4.10.5 Acceptance Criteria of Field Test (Additional Test – Not Mandatory)

(A) Preparation of Standard Test Cubes for calibration of Rebound Hammer at site

(a) In the beginning the standard test cubes of the specified mix shall be prepared by field units before undertaking any concrete work in each project.

(b) At least 18 standard cubes necessary for formation of one specimen of specified mix, shall be cast by site staff well in advance. From these 18 cubes any 3 cubes may be selected at random to be tested for crushing strength of 7 days. The crushing strength obtained should satisfy the specified strength for the mix as per specification or agreement. If the strength is satisfactory then the remaining cube will form the standard samples for calibration of rebound hammer. In case of failure, the site staff should totally reject the samples and remove them also and then make another set of samples by fresh mixing or alternatively, out of the remaining 15 cubes, 3 cubes will be tested on 28 days. If the 28 days' tests are found satisfactory then remaining 12 cubes will form the standard sample for calibration at 28 days' strength otherwise all samples shall be rejected and whole procedure repeated to form a fresh specimen. All the results shall be recorded in a register.

(c) No concreting will be allowed unless the standard specimen cubes are obtained.

The criteria for acceptance and calibration of hammer will be 28 days' strength. The 7 days' strength is only to facilitate the work to start.

(d) No work (for the concrete cast between 8th and 28th day) shall be allowed to be paid unless

28 days' cube strength is obtained. For the concrete cast between 8th and 28th day, the decision to make the payment may be taken by the Engineer-in-charge on the basis of existing criteria. Concrete work will be rejected if 28 days' strength falls short as per acceptance criteria. No further work will be allowed till the acceptable standard cubes are obtained.

(e) *Frequency*: it will be once in each quarter or as per the direction and discretion of Engineer- in-Charge. Whenever the acceptance criteria is changed or concrete mix or type of cement is changed or Engineer-in-Charge feels it necessary for recorded reasons with the approval of the authority according to technical sanction, fresh specimen shall be prepared.

(B) Calibration of Hammer

(a) Simultaneously, same three cubes to be tested on 28 days as referred in para A (b) above shall be used to correlate the compressive strength of their concrete with rebound number as per procedure described in para 5.2 of the IS 13311 (Part 2) "Indian standard for non- destructive testing of concrete Method of test by rebound hammer which is given below in para B (b). The average of values of the rebound number (minimum readings) obtained in respect of same three cubes passing on 28 days' work test shall form the datum reference for remaining cubes for the strength of cubes.

(b) The concrete cubes specimens are held in a compression testing machine under a fixed load, measurements of rebound hammer taken and then compressive strength determined as per IS 516. The fixed load required is of the order of 7 N/mm² when the impact energy of the hammer is about 2.2 NM.

If the specimen are wet cured, they should be removed from wet storage & kept in the laboratory atmosphere for about 24 hours before testing.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Only the vertical faces of the cubes as cast should be tested for rebound number. At least nine readings should be taken on each of the three vertical faces accessible in the compression testing machine when using rebound hammers. The points of impact in the specimen must not be nearer than 20 mm from the edge & should not be less than 20 mm from each other. The same points must not be impacted more than once.

(c) The rebound number of hammer will be determined on each of the remaining (18-3-3=12) cubes. Whenever the rebound number of hammer of any individual cube varies by more than +25% from the datum readings referred to in para B (a) above, that cube will be excluded and will not be considered for standard specimen cubes for calibration. It must be ensured that at least 8 cubes out of 12 that is 66.67% are within the permissible range of variation of rebound number i.e. +25% or otherwise whole procedure shall have to be repeated and fresh specimen prepared.

These 8 cubes will form one standard sample in the beginning before commencement of work and shall be kept carefully for the visiting officers who will calibrate their hammers on these cubes.

(d) This calibration will be done by field staff with their hammer and then chart of calibration giving the details of the average readings, date & month of casting, mix of the concrete etc. shall be prepared and signed by Engineer-in-Charge and will be duly preserved for future reference as and when required.

(C) Preservation of Cubes at site

Standard sample cubes cast shall be carefully preserved at site under the safe custody of AE or his representative for making them available together with the charts, to the officers of QCTA/CTE or any other senior departmental officer, during their inspection of the work. They will calibrate their hammer on these cubes if required.

(D) Testing at Site

(D-1) Testing Equipments

(D-2) Testing will be done generally by non-destructive methods like rebound hammers etc.

Each field Division/ Sub Division/ Unit will purchase rebound hammers and keep them in working order at work site. The testing will be done only by hammers which are duly calibrated.

(D-3) The relative strength of actual field work will be tested with reference to strength of these standard cubes and calibration charts of a hammer for determining the rebound number on the field work. The hammer will be used as per manufacturer's guidelines at various locations chosen at random. The number of location/reading on each wall, beam or column etc. shall not be less than 12. All the readings should be within the +25% range of values prescribed in calibration chart normally. However, reading indicating good strength will be when it is at par with calibrated value or between 100% & 125% and very good if more than 125% any value between 100% & 75% of calibrated value shall be considered satisfactory. Values from 75% to 50% shall be considered for payment at rates reduced on prorata basis. The concrete indicating rebound number less than 50% of calibrated value shall be rejected and not paid for.

(E) Acceptance of Field Tests and Strength

If the relative strength of actual field work is found satisfactory considering the calibration charts with reference to the standard cube test kept at site, the representative work will be considered satisfactory. If the work is considered below satisfactory, the same will be dealt

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

as stated in para D-3 above.

(F) 7 days' Strength in Rare Cases only

Normally cube crushing strength on 28 days' test shall form the basis of acceptance. However in rare cases of time bound projects/ urgent repairs 7 days' cube test strength criteria may be adopted on similar lines using 7 days' standard test cubes and calibration graphs/ curves/ charts for 7 days' in lieu of 28 days' and testing work done at 7 days'.

(G) Precautions

(G-1) The testing shall be done generally as per guidelines of manufacture of the apparatus and strictly in accordance with the procedure laid down in clause 6 of IS 13311 (Part 2): Indian Standard for Non-Destructive Testing of Concrete - Method of Test by Rebound Hammer.

(G-2) The rebound hammers are influenced by number of factor like type of cement aggregate, surface conditions, moisture content, age of concrete & extent of calibration of concrete etc. hence care shall be taken to compare the cement, aggregate etc. and tested under the similar surface conditions having more or less same moisture content and age. However effect of age can be ignored for concrete between 3 days & 3 months old.

5.4.11 Measurements

5.4.11.1 Dimensions shall be measured nearest to a cm except for the thickness of slab which shall be measured correct to 0.5 cm. The areas shall be worked out nearest to 0.01 Sq. mt. The cubical contents shall be worked out to nearest 0.01 cubic metre.

5.4.11.2 Reinforced cement concrete whether cast-in-situ or pre cast shall be classified and measured separately as follows.

- (a) Raft, footing, bases of columns and mass concrete etc. all work up to plinth level, column up to plinth level, plinth beams.
- (b) Wall (any thickness) including attached pilasters, buttresses plinth and string course, fillets, column, pillars, piers, abutments, post and struts etc.
- (c) Suspended floors, roofs, landings and balconies.
- (d) Shelves
- (e) Chajjas
- (f) Lintel, beams and bressummers.
- (g) Columns, pillars, piers, abutments, posts and struts.
- (h) Stair-cases including waist or waist less slab but excluding landing except in
- (i) below.
- (i) Spiral stair-case (including landing).
- (j) Arches, arch ribs, domes and vaults.
- (k) Chimneys and shafts.
- (l) Well steining.
- (m) Vertical and horizontal fins individually or forming box, louvers and facias.
- (n) Kerbs, steps and the like.
- (o) String courses, bands, coping, bed plates, anchor blocks, plain window sills and the like.
- (p) Mouldings as in cornices, window sills etc.
- (q) Shell, dome and folded plates.
- (r) Extra for shuttering in circular work in plan.

5.4.11.3 Work under the following categories shall be measured separately. (a) Rafts, footings, bases of columns etc. and mass concrete.

(b) All other items upto floor two level.

(c) From floor two level to floor three level and so on.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(d) R.C.C. above roof level shall be measured along with R.C.C. Work in floor just below.

5.4.11.4 No deduction shall be made for the following:

(a) Ends of dissimilar materials (e.g. Joists, beams, post, girders, rafter, purlins, trusses, corbels steps etc.) upto 500 sq cm in cross-section.

(b) Opening upto 0.1. sqm.

Note: In calculating area of openings upto 0.1 sqm the size of opening shall include the thickness of any separate lintels or sills. No extra labour for forming such openings or voids shall be paid for.

(c) The volume occupied by reinforcement.

(d) The volume occupied by water pipes, conduits etc. not exceeding 25 sq cm each in cross sectional area. Nothing extra shall be paid for leaving and finishing such cavities and holes.

5.4.11.5 Measurement shall be taken before any rendering is done in concrete members. Measurement will not include rendering. The measurement of R.C.C. work between various units shall be regulated as below:

(a) Slabs shall be taken as running continuously through except when slab is monolithic with the beam. In that case it will be from the face to face of the beam.

(b) Beams shall be measured from face to face of columns and shall be including haunches, if any, between columns and beam. The depth of the beam shall be from the bottom of slab to the bottom of beam if beam and slab are not monolithic. In case of monolithic construction where slabs are integrally connected with beam, the depth of beam shall be from the top of the slab to the bottom of beam.

(c) The columns measurements shall be taken through.

(d) Chajjas along with its bearing on wall shall be measured in cubic metre nearest to two places of decimal. When chajjas is combined with lintel, slab or beam, the projecting portion shall be measured as chajjas, built in bearing shall be measured as per item of lintel, slab or beam in which chajja bears.

(e) Where the band and lintels are of the same height and the band serves as lintel the portion of the band to be measured as lintel shall be for clear length of opening plus twice the over all depth of band.

5.4.12 Tolerances

Subject to the condition that structural safety is not impaired and architectural concept does not hamper, the tolerances in dimensions of R.C.C. members shall be as specified in the drawings by the designer. Whenever these are not specified, the permissible tolerance shall be decided by the Engineer-in-Charge after consultations with the Designer, if necessary.

When tolerances in dimensions are permitted, following procedure for measurement shall apply.

(a) If the actual dimension of R.C.C. members do not exceed or decrease the design dimensions of the members plus or minus tolerance limit specified above, the design dimensions shall be taken for the purpose of measurement.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(b) If the actual dimensions exceed the design dimensions by more than the tolerance limit, the design dimensions only shall be measured for the purpose of payment.

(c) If the actual dimensions decrease more than the tolerance limit specified, the actual dimensions of the RCC members shall be taken for the purpose of measurement and payment.

(d) For acceptance of RCC members whose dimensions are not exactly as per design dimensions, the decision of Engineer-in-Charge shall be final. For the purpose of payment, however, the clarification as given in para a, b & c above shall apply.

5.4.13 Rate

5.4.13.1 The rate included the cost of materials and labour involved in all the operations described above except for the cost of centring and shuttering.

5.4.13.2 On the basis of mandatory lab tests, in case of actual average compressive strength being less than specified strength but upto 70% of specified strength, the rate payable shall be in the same proportion as actual average compressive strength bears to specified compressive strength.

Example:

1. Average compressive strength in 80% of specified strength. Rate payable shall be 80% of agreement rate.

2. In case average compressive strength is less than 70% of the specified strength, the work represented by the sample shall be rejected.

3. However, on the basis of mandatory field tests, where they prevail, the rates of the work represented by samples showing actual compressive strength less than specified strength shall be worked out as per para 5.4.10.5 (D-3) above. In addition, Engineer-in-charge may order for additional tests (see Appendix 'B' of chapter 5) to be carried out at the cost of contractor to ascertain if the portion of structure where in concrete represented by the samples had been used, can be retained on the basis of these tests. Engineer-in-Charge may take further remedial measures as necessary to retain the structure at the risk and cost of the contractor.

5.4.13.3 Where throating or plaster drip or moulding is not required to be provided in RCC chajjas, deduction for not providing throating or plaster drip or moulding shall be made from the item of R.C.C. in chajjas. The measurement for deduction item shall be made in running metres correct to a cm of the edge of chajja.

5.4.13.4 No extra payment for richer mix which projects into any member from another member during concreting of junctions of beams and columns etc. will be made except to the extent structurally considered necessary and when so indicated in the structural drawings. The payment for work done under items of different mixes shall be limited strictly to what is indicated in the structural drawings.

5.5 PRECAST REINFORCED CONCRETE

5.5.1 General Requirements

Precast reinforced concrete units such as columns, fencing posts, door and window frames, lintels, chajjas, copings, sills, shelves, slabs, louvers etc. shall be of grade of mix as specified and cast in forms or moulds. The forms/ moulds shall be of fiber glass or of steel sections for

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

better finish. Provision shall be made in the forms and moulds to accommodate fixing devices such as nibs, clips, hooks, bolts and forming of notches and holes. The contractor may precast the units on cement or steel platform which shall be adequately oiled provided the surface finish is of the same standard as obtained in form. Each unit shall be cast in one operation.

5.5.2 Concrete used for precasting the units should be well proportioned, mixed, placed and thoroughly compacted by vibrations or tamping to give a dense concrete free from voids and honey combing.

5.5.3 Precast articles shall have a dense surface finish showing no coarse aggregate and shall have not cracks or crevices likely to assist in disintegration of concrete or rusting of steel or other defects that would interfere with the proper placing of the units. All angle of the precast units with the exception of the angles resulting from the splayed or chamfered faces shall be true right angles. The arises shall be clean and sharp except those specified or shown to be rounded. The wearing surface shall be true to the lines. On being fractured, the interior of the units should present a clean homogeneous appearance.

5.5.4 The longitudinal reinforcement shall have a minimum cover of 12 mm or twice the diameter of the main bar, whichever is more, unless otherwise directed in respect of all items except fencing posts or electric posts where the minimum cover shall be 25 mm.

5.5.5 Curing

After having been cast in the mould or form the concrete shall be adequately protected during setting in the first stages of hardening from shocks and from harmful effects of frost, sunshine, drying winds and cold. The concrete shall be cured at least for 7 days from the date of casting.

5.5.6 The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled.

5.5.7 Marking

Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

5.5.8 Precast units shall be stored, transported and placed in position in such as manner that they will not be overstressed or damaged.

Item 5.22A.6 Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto and above plinth level.

Thermo-Mechanically Treated bars of grade Fe-500D or more for planter.

5.3 REINFORCEMENTS

5.3.1 General Requirements

Steel conforming to para 5.1.3 for reinforcement shall be clear and free from loose mill scales, dust, loose rust, coats of paints, oil or other coating which may destroy or reduce bond. It

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.

5.3.1.1 Assembly of Reinforcement : Bars shall be bent correctly and accurately to the size and shape as shown in the detailed drawing or as directed by Engineer-in-Charge. Preferably bars of full length shall be used. Necessary cutting and straightening is also included. Overlapping of bars, where necessary shall be done as directed by the Engineer-in-Charge. The overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or $1\frac{1}{4}$ times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the dia. of such bars with two strands annealed steel wire of 0.90 mm to 1.6 mm twisted tight. The overlaps/splices shall be staggered as per directions of the Engineer-in-Charge. But in no case the overlapping shall be provided in more than 50% of cross sectional area at one section.

5.3.1.2 Bonds and Hooks Forming End Anchorages: Reinforcement shall be bent and fixed in accordance with procedure specified in IS 2502, code of practice of bending and fixing of bars for concrete reinforcement. The details of bends and hooks are shown below for guidance.

(a) *U-Type Hook*

In case of mild steel plain bars standard U type hook shall be provided by bending ends of rod into semicircular hooks having clear diameter equal to four times the diameter of the bar.

Note: In case of work in seismic zone, the size of hooks at the end of the rod shall be eight times the diameter of bar or as given in the structural drawings.

(b) *Bends*

Bend forming anchorage to a M.S. plain bar shall be bent with an internal radius equal to two times the diameter of the bar with a minimum length beyond the bend equal to four times the diameter of the bar.

5.3.1.3 Anchoring Bars in Tension : Deformed bars may be used without end anchorages provided, development length requirement is satisfied. Hooks should normally be provided for plain bars in tension. Development length of bars will be determined as per IS: 456.

5.3.1.4 Anchoring Bars in Compression : The anchorage length of straight bar in compression shall be equal to the 'Development length' of bars in compression as specified in IS: 456. The projected length of hooks, bend and straight lengths beyond bend, if provided for a bar in compression, shall be considered for development length.

5.3.1.5 Binders, stirrups, links etc. : In case of binders, stirrups, links etc. the straight portion beyond the curve at the end shall be not less than eight times and nominal size of bar.

5.3.2 Welding of Bars

Wherever facility for electric **arc welding** or **gas pressure welding** is available, welding of bars shall be done in lieu of overlap. The location and type of welding shall be got approved by the Engineer-in-Charge. Welding shall be as per IS 2751 and 9417.

5.3.3 Placing in Position

5.3.3.1 Fabricated reinforcement bars shall be placed in position as shown in the drawings or as directed by the Engineer-in-charge. The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire 0.9 to 1.6 mm

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

thickness twisted tight to make the skeleton of the steel work rigid so that the reinforcement does not get displaced during deposition of concrete.

Tack welding in crossing bars shall also be permitted in lieu of binding with steel wire if approved by Engineer-in-Charge.

5.3.3.2 The bars shall be kept in correct position by the following methods:

(a) In case of beam and slab construction pre-cast cover blocks in cement mortar 1:2 (1 cement : 2 coarse sand) about 4x4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcements.

(b) In case of cantilevered and doubly reinforced beams of slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 m or at shorter spacing to avoid sagging.

(c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them: or with block of cement mortar 1:2 (1 cement: 2 coarse sand) of required size suitable tied to the reinforcement to ensure that they are in correct position during concreting.

(d) In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates shall be used as directed by Engineer-in-Charge.

5.3.3.3 Tolerance on Placing of Reinforcement : Unless otherwise specified by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances:

Tolerance in spacing

(a) For effective depth, 200 mm or less +10 mm

(b) For effective depth, more than 200 mm + 15 mm

5.3.3.4 Bending at Construction Joints : Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position care should be taken to ensure that at no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameter for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

5.3.3.5 Cover : The minimum nominal cover to meet durability requirements shall be as under:-

<i>Exposure</i>	<i>Nominal Concrete cover in mm not less than</i>
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

- Note**
- 1 For main reinforcement upto 12 mm diameter bar for mild exposure the nominal cover may be reduced by 5 mm.
 - 2 Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by + 10 mm.
 - 3 For exposure condition 'severe' and 'very severe' reduction of 5 mm may be made, where concrete grade is M35 and above.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

- Nominal cover to meet specified period of fire resistance shall not be less than as given in Table 16A of IS 456.

5.3.4 Measurement

Reinforcement including authorized spacer bars and lappages shall be measured in length of different diameter, as actually (not more than as specified in the drgs.) used in the work nearest to a centimetre and their weight calculated on the basis of standard weight given in Table 5.4 below. In case actual unit weight of the bars is less than standard unit weight, but within variation, in such cases weight of reinforcement shall be calculated on the basis of actual unit weight. Wastage and unauthorized overlaps shall not be paid for. Annealed steel wire required for binding or tack welding shall not be measured, its cost being included in the rate of reinforcement.

Where tack welding is used in lieu of binding, such welds shall not be measured. Chairs separators etc. shall be provided as directed by the Engineer-in-Charge and measured separately and paid for.

TABLE 5.4
Cross Sections Area and Mass of Steel Bar

<i>Nominal Size</i>	<i>Cross sectional Area</i>	<i>Mass per metre Run Kg.</i>
6	28.3	0.222
8	50.3	0.395
10	78.6	0.617
12	113.1	0.888
16	201.2	1.58
20	314.3	2.47
25	491.1	3.85
28	615.8	4.83
32	804.6	6.31
36	1018.3	7.99
40	1257.2	9.86

Note: These are as per clause 6.2 of IS 1786.

5.3.5 Rate

The rate for reinforcement shall include the cost of labour and materials required for all operations described above such as cleaning of reinforcement bars, straightening, cutting, hooking bending, binding, placing in position etc. as required or directed including tack welding on crossing of bars in lieu of binding with wires.

Item 6.2.2 Brick work with common burnt clay modular bricks of class designation 7.5 in foundation and plinth in:

Cement Mortar 1:6 (1 cement : 6 coarse sand).

BRICKS/BRICK TILES/BRICK BATS/MECHANIZED AUTOCLAVE FLY ASH LIME BRICK

1.0 Material

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Bricks used in the masonry may be of the following type.

(a) The **Common Burnt Clay Bricks** shall conform to IS:1077 and shall be hand moulded or machine moulded. They shall be free from nodules of free lime, visible cracks, flaws warpage and organic matter, have a frog 100 mm in length 40 mm in width and 10 mm to 20 mm deep on one of its flat sides. Bricks made by extrusion process and brick tiles may not be provided with frogs. Each brick shall be marked (in the frog where provided) with the manufacturer's identification mark or initials.

(b) **Fly Ash Lime Bricks (FALG Bricks):** The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. The bricks shall be solid and with or without frog on one of its flat side.

Fly Ash: Fly ash shall conform to IS 3812.

Note: This item will be operated only for load bearing structure up to 2 storeys and for non-load bearing walls 23 cms thick for multi-storeyed buildings.

Bottom ash used as replacement of sand shall not have more than 12% loss on ignition when tested. **Sand:** Deleterious materials, such as clay and silt in the sand shall preferably be less than 5%. **Lime:** Lime shall conform to class 'C' hydrated lime of IS 712.

Additives: Any suitable additive considered not detrimental to the durability of bricks may be used.

(C) **Clay Fly Ash Bricks:** The clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and color. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

(d) **Calcium Silicate Bricks:** The bricks shall conform to IS 4139. The Calcium silicate bricks shall be sound, compact and uniform in shape. Bricks shall be free from visible cracks, warpage, organic matter, large pebbles and nodules of free lime. Bricks shall be solid and with or without frog. The bricks shall be made of finely grounded sand siliceous rock and lime. In addition limited quantity of fly ash conforming to IS 3812 may be used in the mix. These bricks are also known as Fly Ash Sand Lime bricks in the construction industry.

(e) **Tile Brick:** The bricks of 4 cm height shall be moulded without frogs. Where modular tiles are not freely available in the market, the tile bricks of F.P.S. thickness 44 mm (1-3/4") shall be used unless otherwise specified.

(f) **Brick Bats:** Brick bats shall be obtained from well burnt bricks.

(g) **Mechanized Autoclave Fly Ash Lime Brick:** These bricks shall be machine moulded and prepared in plant by appropriate proportion of fly ash and lime. The autoclave fly ash bricks shall conform to IS 12894. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with or without frog, and of 100/80 mm in length, 40 mm width and 10 to 20 mm deep one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

uniform in shape and color. Fly ash shall conform to IS 3812 and lime shall conform to class 'C' hydrated lime of IS 712.

1.1 Dimensions

The brick may be modular or non-modular. Sizes for both types of bricks/tiles shall be as per Table

4.1. While use of modular bricks/tiles is recommended, non-modular (FPS) bricks/tiles can also be used where so specified. Non-modular bricks/tiles of sizes other than the sizes mentioned in Table 4.1 may also be used where specified.

TABLE 4.1

Type of Bricks/ Tiles	Nominal Size mm	Actual Size mm
Modular Bricks	200 × 100 × 100 mm	190 × 90 × 90 mm
Modular tile bricks	200 × 100 × 40 mm	190 × 90 × 40 mm
Non-modular tile bricks	229 × 114 × 44 mm	225 × 111 × 44 mm
Non-modular bricks	229 × 114 × 70 mm	225 × 111 × 70 mm

1.2 Classification

Bricks/Brick tiles shall be classified on the basis of their minimum compressive strength as given below:

TABLE 4.2

Class Designation	Average compressive strength			
	Not less than		Less than	
	N/mm ²	(kgf/cm ²)	N/mm ²	(Kgf/cm ²)
12.5 (125)	12.5	(125)	15.0	150
10 (100)	10	(100)	12.5	125
7.5 (75)	7.5	(75)	10	100
5 (50)	5	(50)	7.5	75
3.5 (35)	3.5	(35)	5.0	50

The bricks shall have smooth rectangular faces with sharp corner and shall be uniform in color and emit clear ringing sound when struck.

(**Note:** Upper limits specified in Table 4.2 are for calculating the average compressive strength in accordance with Appendix B of Chapter 6).

1.3 Sampling and Tests

Samples of bricks shall be subjected to the following tests:

(a) Dimensional tolerance.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

- (b) Water absorption.
- (c) Efflorescence.
- (d) Compressive strength.

1.3.1 Sampling: For carrying out compressive strength, water absorption, efflorescence and dimensional tests, the samples of bricks shall be taken at random according to the size of lot as given in Table 4.3 below. The sample thus taken shall be stored in a dry place until tests are made. For the purpose of sampling, the following definition shall apply.

(a) *Lot:* A collection of bricks of same class and size, manufactured under relatively similar conditions of production. For the purpose of sampling a lot shall contain a maximum, of 50,000 bricks.

In case a consignment has bricks more than 50,000 of the same classification and size and manufactured under relatively similar conditions of production, it shall be divided into lots of 50,000 bricks or part thereof.

(b) *Sample:* A collection of bricks selected for inspection and/or testing from a lot to reach the decision regarding the acceptance or rejection of the lot.

(c) *Defective:* A brick failing to meet one or more of the specified requirements.

1.3.2 The samples shall be taken as below:

(i) **Sampling from a Stack:** When it is necessary to take a sample from a stack, the stack shall be divided into a number of real or imaginary sections and the required number of bricks drawn from each section. For this purpose bricks in the upper layers of the stack shall be removed to enable units to be sampled from places within the stack.

Note: For other methods of sampling i.e. sampling in motion and sampling from lorries or trucks, IS: 5454 may be referred.

Scale of sampling and criteria for conformity for visual and dimensional characteristics:—

Visual characteristics: The bricks shall be selected and inspected for ascertaining their conformity to the requirements of the relevant specification.

The number of bricks to be selected from a lot shall depend on the size of lot and shall be in accordance of Col. 1 and 2 of Table 4.3 for visual characteristics in all cases and dimensional characteristics if specified for individual bricks.

(ii) **Visual Characteristics:** All the bricks selected above in accordance with Col. 1 and 2 of Table

4.3 shall be examined for visual characteristics. If the number of defective bricks found in the sample is less than or equal to the corresponding number as specified in Col. 3 of Table 4.3 the lot shall be considered as satisfying the requirements of visual characteristics, otherwise the lot shall be deemed as not having met the visual requirements.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

(iii) **Dimensional Characteristics:** The number of bricks to be selected for inspecting the dimensions and tolerance shall be in accordance with Col. 1 and 4 of Table 4.3. These bricks will be divided into groups of 20 bricks at random and each of the group of 20 bricks thus formed will be tested for all the dimensions and tolerances. A lot shall be considered having found meeting the requirements of dimensions and tolerance if none of the groups of bricks inspected fails to meet the specified requirements.

TABLE 4.3
Scale of Sampling and Permissible Number of Defectives for Visual and Dimensional Characteristics

<i>No. of dimensional bricks in for the lot bricks</i>		<i>For characteristics specified for individual bricks</i>	<i>For characteristics group of 20</i>
<i>No. of bricks to be selected</i>		<i>Permissible no. of defective in the sample</i>	<i>No. of bricks to selected</i>
<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>
2001–10000	20	1	40
10001–35000	32	2	60
35001–50000	50	3	80

Note: In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer-in-Charge.

(iv) **Scale of Sampling and Criteria for Physical Characteristics:** The lot which has been found satisfactory in respect of visual and dimensional requirements shall be next tested for physical characteristics like compressive strength, water absorption, efflorescence as specified in relevant material specification. The bricks for this purpose shall be taken at random from those already selected above. The number of bricks to be selected for each of these characteristics shall be in accordance with relevant columns of Table 4.4.

TABLE 4.4
Scale of Sampling for Physical Characteristics

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

<i>Lot size</i>	<i>Sample size for compressive- Sieve strength, water absorption and efflorescence</i>	<i>of defectives for efflorescence</i>	<i>Permissible No. Warpage Sample Permissible Size No of defects</i>	
<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>	<i>(5)</i>
2001—10000	5	0	10	0
10001—35000	10	0	20	1
35001—50000	15	1	30	2

Note: In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Engineer-in-Charge.

(v) A lot shall be considered having satisfied the requirements of physical characteristics if the condition stipulated here in are all satisfied.

(a) From the test results for compressive strength, the average shall be calculated and shall satisfy the requirements specified in relevant material specification.

Note: In case any of the test results for compressive strength exceeds the upper limit for the class of bricks, the same shall be limited to the upper limit of the class for the purpose of averaging.

(b) Wherever specified in the material specification, the compressive strength of any individual bricks tested in the sample shall not fall below the minimum average compressive strength

Specified for the corresponding class of brick by more than 20 per cent.

(c) From the test results for water absorption, the average for the bricks in the sample shall be calculated and shall satisfy the relevant requirements specification in material specification.

(d) The number of bricks failing to satisfy the requirements of the efflorescence specified in the relevant specification should not be more than the permissible no. of defectives given in Col.

3 of Table 4.4.

1.3.3 Dimensional Tolerances: The dimensions of, modular bricks when tested as described above as per procedure described in Appendix A of Chapter 6 shall be within the following limits per 20 bricks or locally available size as approved by Engineer-in-charge.

(a) For modular size

Length 7320 to 3880 mm (3800 ± 80 mm)

Width 1760 to 1840 mm (1800 ± 40 mm)

Height 1760 to 1840 mm (1800 ± 40 mm) for 90 mm high bricks

760 to 840 mm (800 ± 40 mm) for 40 mm high bricks

(b) For non modular bricks

Length 4520 to 4680 mm (4600 ± 80 mm)

Width 2240 to 2160 mm (2200 ± 40 cm)

Height 1440 to 1360 mm (1400 ± 40 mm) for 70 mm high bricks

640 to 560 mm (600 ± 40 mm) for 30 mm high bricks

Brick Tiles

760 to 840 mm (800 ± 40 mm) for 40 mm high brick tiles

In case of non-modular bricks, % age tolerance will be $\pm 2\%$ for group of 20 numbers of class 10 bricks, and $\pm 4\%$ for other class of bricks.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

1.3.4 Compressive Strength: The bricks, when tested in accordance with the procedure laid down in Appendix B of Chapter 6 shall have a minimum average compressive strength for various classes as given in Table 4.2. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any individual brick tested exceeds the upper limit specified in Table 4.2 for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified in Table

4.2 For the purpose of calculating the average compressive strength.

1.3.5 Water Absorption: The average water absorption of bricks when tested in accordance with the procedure laid down in Appendix C of Chapter 6 shall be not more than 20% by weight.

1.3.6 Efflorescence: The rating of efflorescence of bricks when tested in accordance with the procedure laid down in Appendix D of Chapter 6 shall be not more than moderate.

1.4 Sewer Bricks

1.4.1 Sewer bricks are intended for the lining of walls, roofs and floors of sewers used for ordinary sanitary (domestic) sewage. The general practice in the country is also to utilize common building bricks

In the construction of sewers which is not satisfactory. However, these sewer bricks may not be suitable for sewers dealing with industrial effluent (sewage) for which the use of acid resistant bricks in accordance with IS 4860 may be considered. Sewer bricks shall conform to IS 4885.

1.4.2 Dimensions and Tolerances

Dimensions: The standard sizes of the sewer bricks shall be as follows:

<i>Length mm</i>	<i>Width mm</i>	<i>Height mm</i>
190	90	90
190	90	40

For sewers of special shapes, such as the oval sewers, the bricks may have to be suitable tapered to conform to the radii of curvature of the arches and barrels and sides of sewers.

Tolerance: The permissible tolerance on the dimensions specified in 1.4.2 shall be as follows:

<i>Dimensions mm</i>	<i>Total tolerance for 20 bricks mm</i>
190	± 80

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

90	± 40
40	± 40

1.4.3 Compressive Strength: The average compressive strength obtained on a sample of sewer bricks when tested in accordance with the procedure laid down in IS 3495 (Part I) shall be not less than

17.5 N/mm² (175 kgf/cm² approximately) and the individual strength of any brick shall be not less than

16 N/mm² (160 kgf/cm² approximately).

1.4.4 Water Absorption: The average value of water absorption for five bricks after 24 h cold water immersion test when tested in accordance with IS 3495 (Part 2) shall not exceed 10 per cent of the average dry weight of the brick and the absorption for any individual brick shall not exceed 12 per cent.

1.4.5 Efflorescence: When the bricks are tested in accordance with the method laid down in IS 3495 (Part 3), the rating of efflorescence shall not be more than 'slight'.

1.5 Burnt Clay Perforated Building Bricks

1.5.1 General Quality: The bricks shall be made of suitable clay and shall be thoroughly burnt at the maturing temperature of clay. They shall be free from cracks, flaws and nodules of free lime. They shall have rectangular face with sharp straight edge at right angle. They shall be of uniform color and texture. These bricks generally should conform to IS 2222.

1.5.2 Dimensions and Tolerances: The standard size of burnt clay perforated bricks shall be as follows:

	<i>Length (L) mm</i>	<i>Width (W) mm</i>	<i>Height (H) mm</i>
Modular	190	90	90
Non Modular	230	110	70

The permissible tolerances on the dimensions shall be as follows:

<i>Dimension mm</i>	<i>Tolerance mm</i>
70, 90	± 4
110, 190	± 7
230	± 10

Note: The tolerances specified above shall apply to measurements on individual bricks.

1.5.3 Perforations: The area of perforation shall be between 30% and 45% of the total area of the corresponding face of the bricks.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

The perforation shall be uniformly distributed over the surface. In the case of rectangular perforations, the larger dimension shall be parallel to the longer side of the brick. The shorter side of the perforation shall be less than 20 mm in case of rectangular perforations and less than 25 mm diameter in case of circular perforations.

The area of each perforation shall not exceed 500 mm².

The thickness of any shell shall not be less than 15 mm and that of any web not less than 10 mm.

1.5.4 Compressive Strength: The bricks when tested in accordance with the procedure laid down in

IS 3495 (Parts 1 to 4) shall have a minimum average compressive strength of 7 N/mm² on net area.

The compressive strength of any individual brick tested shall not fall below the minimum compressive strength specified for the corresponding class of bricks. The lot shall then be checked for next lower class of brick.

1.5.5 Water Absorption: The bricks when tested in accordance with the procedure laid down in IS

3495 (parts 1 to 4): after immersion in cold water for 24 hours water absorption shall not be more than 20 percent by weight.

1.5.6 Efflorescence: The bricks when tested in accordance with the procedure laid down in IS 3495 (Parts 1 to 4) shall have a rating of efflorescence not more than 'slight'.

1.5.7 Warpage: The bricks when tested in accordance with the procedure laid down in IS 3495 (parts

1 to 4) the average warpage shall not exceed 3%.

2 BRICK WORK

2.1 Classification

The brick work shall be classified according to the class designation of bricks used.

2.2 Mortar

The mortar for the brick work shall be as specified, and conform to accepted standards. Lime shall not be used where reinforcement is provided in brick work.

2.3 Soaking of Bricks

Bricks shall be soaked in water before use for a period for the water to just penetrate the whole depth of the bricks. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. The bricks required for masonry work

Using mud mortar shall not be soaked. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

Note I: The period of soaking may be easily found at site by a field test in which the bricks are soaked in water for different periods and then broken to find the extent of

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

water penetration. The least period that corresponds to complete soaking will be the one to be allowed for in construction work.

Note II: If the bricks are soaked for the required time in water that is frequently changed the soluble salt in the bricks will be leached out, and subsequently efflorescence will be reduced.

2.4 Laying

2.4.1 Bricks shall be laid in English Bond unless otherwise specified. For brick work in half brick wall, bricks shall be laid in stretcher bond. Half or cut bricks shall not be used except as closer where necessary to complete the bond. Closers in such cases, shall be cut to the required size and used near the ends of the wall. Header bond shall be used preferably in all courses in curved plan for ensuring better alignment.

Note: Header bond shall also be used in foundation footings unless thickness of walls (width of footing) makes the use of headers impracticable. Where thickness of footing is uniform for a number of courses, the top course of footing shall be headers.

2.4.2 All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, shall be removed with a wire brush and surface wetted. Bricks shall be laid on a full bed of mortar, when laying, each brick shall, be properly bedded and set in position by gently pressing with the handle of a trowel. It's inside face shall be buttered with mortar before the next brick is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow space are left inside the joints.

2.4.3 The walls shall be taken up truly in plumb or true to the required batter where specified. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Vertical joints in the alternate course shall come directly one over the other. Quoin, Jambs and other angles shall be pro- pearly plumbed as the work proceeds. Care shall be taken to keep the perpends properly aligned within following maximum permissible tolerances:

- (a) Deviation from vertical within a storey shall not exceed 6 mm per 3 m height.
- (b) Deviation in verticality in total height of any wall of building more than one storey in height shall not exceed 12.5 mm.
- (c) Deviation from position shown on plan of any brick work shall not exceed 12.5 mm.
- (d) Relative displacement between load bearing wall in adjacent storeys intended to be vertical alignments shall not exceed 6 mm.
- (e) A set of tools comprising of wooden straight edge, masonic spirit levels, square, 1 metre rule line

And plumb shall be kept on the site of work for every 3 masons for proper check during the progress of work.

2.4.4 All quoins shall be accurately constructed and the height of brick courses shall be kept uniform. This will be checked using graduated wooden straight edge or storey rod indicating height of each course including thickness of joints. The position of damp proof course, window sills, bottom of lintels, top of the wall etc. along the height of the wall shall be marked on the graduated straight edge or storey rod. Acute and obtuse quoins shall be bonded, where practicable in the same way as square quoins. Obtuse quoins shall be formed with squint showing three quarters brick on one face and quarter brick on the other.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

2.4.5 The brick work shall be built in uniform layers.

No part of the wall during its construction shall rise more than one metre above the general construction level. Parts of wall left at different levels shall be raked back at an angle of 45 degrees or less with the horizontal. Tothing shall not be permitted as an alternative to raking back. For half brick partition to be keyed into main walls, indents shall be left in the main walls.

2.4.6 All pipe fittings and specials, spouts, hold fasts and other fixtures which are required to be built into the walls shall be embedded, as specified, in their correct position as the work proceeds unless otherwise directed by the Engineer-in-Charge.

2.4.7 Top courses of all plinths, parapets, steps and top of walls below floor and roof slabs shall be laid with brick on edge, unless specified otherwise. Brick on edge laid in the top courses at corner of walls shall be properly radiated and keyed into position to form cut (maru) corners as shown in Fig 4.4. Where bricks cannot be cut to the required shape to form cut (maru) corners, cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) equal to thickness of course shall be provided in lieu of cut bricks.

2.4.8 Bricks shall be laid with frog (where provided) up. However, when top course is exposed, bricks shall be laid with frog down. For the bricks to be laid with frog down, the frog shall be filled with mortar before placing the brick in position.

2.4.9 In case of walls one brick thick and under, one face shall be kept even and in proper plane, while the other face may be slightly rough. In case of walls more than one brick thick, both the faces shall be kept even and in proper plane.

2.4.10 To facilitate taking service lines later without excessive cutting of completed work, sleeves (to be paid separately) shall be provided, where specified, while raising the brick work. Such sleeves in external walls shall be sloped down outward so as to avoid passage of water inside.

2.4.11 Top of the brickwork in coping and sills in external walls shall be slightly tilted. Where brick coping and sills are projecting beyond the face of the wall, drip course/throating (to be paid separately) shall be provided where indicated.

2.4.12 Care shall be taken during construction that edges of jambs, sills and projections are not damaged in case of rain. New built work shall be covered with gunny bags or tarpoulin so as to prevent the mortar from being washed away. Damage, if any, shall be made good to the satisfaction of the Engineer-in-Charge.

2.4.13 Vertical reinforcement in the form of bars (MS or high strength deformed bars or thermo-mechanically treated bars as per direction of Engineer-in-Charge), considered necessary at the corners and junction of walls and jamb opening doors, windows etc. shall be encased with cement mortar not leaner than 1:4 (1 cement : 4 coarse sand), or cement concrete mix as specified. The reinforcement shall be suitably tied, properly embedded in the foundation and at roof level. The dia. of bars shall not be less than 8 mm and concrete grade shall be minimum 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).

2.4.14 In retaining walls and the like, where water is likely to accumulate, weep holes, 50 to 75 mm square shall be provided at 2 m vertically and horizontally unless otherwise

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

specified. The lowest weep hole shall be at about 30 cm above the ground level. All weep holes shall be surrounded by loose stones and shall have sufficient fall to drain out the water quickly.

Note : Work of providing loose stone will be payable extra.

2.4.15 Work of cutting chases, wherever required to be made in the walls for housing G.I. pipe, CI pipe or any other fixtures shall be carried out in various locations as per guidelines given below :

(a) Cutting of chases in one brick thick and above load bearing walls.

(i) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided.

(ii) The depths of vertical chases and horizontal chases shall not exceed one-third and one-sixth

of the thickness of the masonry respectively.

(iii) When narrow stretches of masonry (or short length of walls) such as between doors and windows, cannot be avoided they should not be pierced with openings for soil pipes or waste pipes or timber joints, etc. Where there is a possibility of load concentration such narrow lengths of walls shall be checked for stresses and high strength bricks in mortar or concrete walls provided, if required.

(iv) Horizontal chases when unavoidable should be located in the upper or lower one-third of height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one metre in length. Where unavoidable, stresses in the affected area should be checked and kept within the permissible limits.

(v) Vertical chases should not be closer than 2 m in any stretch of a wall. These shall be kept away from bearings of beams and lintels. If unavoidable, stresses in the affected area should be checked and kept within permissible limits.

(vi) Masonry directly above a recess, if wider than 30 cm horizontal dimension) should be supported on lintel. Holes in masonry may be provided up to 30 cm width and 30 cm height without any lintel. In the case of circular holes in the masonry, no lintel need be provided for holes up to 40 cm in diameter.

(b) Cutting of chases in half brick load bearing walls.

No chase shall be permitted in half brick load bearing walls and as such no recessed conduits and concealed pipes shall be provided with half brick thick load bearing walls.

(c) Cutting of chases in half brick non-load bearing wall:

Services should be planned with the help of vertical chases. Horizontal chase should be provided only when unavoidable.

2.5 Joints

The thickness of all types of joints including brick wall joints and cross joints shall be such that four course and three joints taken consecutively shall measure as follows:

(i) In case of modular bricks conforming to IS 1077 specification for common burnt clay buildings bricks, equal to 39 cm.

(ii) In case of non-modular bricks, it shall be equal to 31 cm.

Note: Specified thickness of joints shall be of 1 cm. Deviation from the specified thickness of all joints shall not exceed one-fifth of specified thickness.

2.5.1 Finishing of Joints: The face of brick work may be finished flush or by pointing. In flush finishing either the face joints of the mortar shall be worked out while still green to give a finished surface flush with the face of the brick work or the joints shall be squarely raked out to a depth of 1 cm while the mortar is still green for subsequently

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

plastering. The faces of brick work shall be cleaned with wire brush so as to remove any splashes of mortar during the course of raising the brick work. In pointing, the joints shall be squarely raked out to a depth of 1.5 cm while the mortar is still green and raked joints shall be brushed to remove dust and loose particles and well wetted, and shall be later refilled with mortar to give ruled finish. Some such finishes are 'flush', 'weathered', ruled, etc.

2.6 Curing

The brick work shall be constantly kept moist on all faces for a minimum period of seven days. Brick work done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

2.7 Scaffolding

Scaffolding shall be strong to withstand all dead, live and impact loads which are likely to come on them. Scaffolding shall be provided to allow easy approach to every part of the work.

2.7.1 Single Scaffolding: Where plastering, pointing or any other finishing has been indicated for brick work, single scaffolding may be provided, unless otherwise specified. In single scaffolding, one end of the put-logs/pole shall rest in the hole provided in the header course of brick masonry. Not more than one header for each put-log/pole shall be left out. Such holes shall not be allowed in the case of pillars, brick work less than one metre in length between the openings or near the skew backs of arches or immediately under or near the structural member supported by the walls. The holes for putlogs/poles shall be made good with brick work and wall finishing as specified.

2.7.2 Double Scaffolding: Where the brick work or tile work is to be exposed and not to be finished with plastering etc. double scaffolding having two independent supports, clear of the work, shall be provided.

2.8 Measurements

2.8.1 Brick work shall be measured in cubic metres unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.01 sq mtrs and the cubic contents shall be worked out to the nearest 0.01 cubic metres.

2.8.2 Brick work shall be measured separately in the following stages:

- (a) From foundation to floor one level (Plinth level)
- (b) Plinth (floor one) level to floor two level
- (c) Between two specified floor levels above floor two level

Note : (i) Brick work in parapet walls, mumty, lift machine room and water tanks constructed on the roof upto 1.2 m height above roof shall be measured together with the corresponding work of the floor next below.

2.8.3 No deductions or additions shall be done and no extra payment made for the following :

Note : Where minimum area is defined for deduction of an opening, void or both, such areas shall refer only to opening or void within the space measured.

(a) Ends of dissimilar materials (that is, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc.); up to 0.1 m² in section;

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

- (b) Opening up to 0.1 m^2 in area (see Note);
- (c) Wall plates, bed plates, and bearing of slabs, chajjas and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;
- (d) Cement concrete blocks as for hold fasts and holding down bolts;
- (e) Iron fixtures, such as wall ties, pipes upto 300 mm diameter and hold fasts for doors and windows; and
- (f) Chases of section not exceeding 50 cm in girth.
- (g) Bearing portion of drip course, bearing of moulding and cornice.

Note : In calculating area of an opening, any separate lintel or sills shall be included with the size of the opening but end portions of lintel shall be excluded. Extra width of rebated reveals, if any, shall also be excluded.

2.8.4 Walls half brick thick and less shall each be measured separately in square metres stating thickness.

2.8.5 Walls beyond half brick thickness shall be measured in multiples of half brick which shall be deemed to be inclusive of mortar joints. For the sizes of bricks specified in 1.1, half brick thickness shall mean 100 mm for modular and 115 mm for non-modular bricks.

Where fractions of half brick occur due to architectural or other reasons, measurement shall be as follows :

- (a) up to 1/4th brick-actual measurements and
- (b) Exceeding 1/4 brick-full half bricks.

2.8.6 String courses, projecting pilasters, aprons, sills and other projections shall be fully described and measured separately in running metres stating dimensions of each projection.

2.8.7 Square or rectangular pillars shall be measured separately in cubic metres in multiple of half brick.

2.8.8 Circular pillars shall be measured separately in cubic metres as per actual dimensions.

2.8.9 Brick work curved on plan shall be measured like the brick work in straight walls and shall include all cutting and wastage of bricks, tapered vertical joints and use of extra mortar, if any. Brick work curved on plan to a mean radius not exceeding six metres shall be measured separately and extra shall be payable over the rates for brick work in straight walls. Nothing extra shall be payable if the mean radius of the brick work curved in plan exceeds six metres.

2.8.10 Tapered walls shall be measured net as walls and extra payment shall be allowed for making tapered surface for brick work in walls.

2.8.11 Brick work with brick tiles shall be measured and paid for separately.

2.9 Rate

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

The rate shall include the cost of materials and labour required for all the operations described above except the vertical reinforcement and its encasement in cement mortar or cement concrete. The rate shall also include the following :

- (a) Raking out joints or finishing joints flush as the work proceeds;
- (b) Preparing tops of existing walls and the like for raising further new brick work.
- (c) Rough cutting and waste for forming gables, splays at eaves and the like.
- (d) Leaving holes for pipes upto 150 mm dia. and encasing hold fasts etc.
- (e) Rough cutting and waste for brick work curved in plan and for backing to stone or other types of facing.
- (f) Embedding in ends of beams, joists, slabs, lintels, sills, trusses etc.
- (g) Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc. in or on walls if not covered in respective items and
- (h) Leaving chases of section not exceeding 50 cm in girth or 350 sq cm in cross-section.
- (i) Brick on edge courses, cut brick corners, splays reveals, cavity walls, brick works curved on plan to a mean radius exceeding six metres.

Item 13.5.1 15 mm cement plaster on rough side of single or half brick wall of mix: 1:4 (1 cement: 4 coarse sand)

CEMENT PLASTER

The cement plaster shall be 15 mm thick as specified in the item.

1 Scaffolding

For all exposed brick work/stone work/RCC work/tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

Note : In case of special type of brick work/stone work/ RCC work, scaffolding shall be got approved from Engineer-in-charge in advance.

2 Preparation of Surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

particles cleaned off and care shall be taken that none of the retarders is left on the surface.

3 Mortar

The mortar of the of mix : 1:4 (1 cement: 4 Coarse sand) using coarse sand described in the item shall be used. For external work and under coat work, the fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

4 Application of Plaster

4.1 Ceiling plaster shall be completed before commencement of wall plaster.

4.2 Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 5 × 5 cm shall be first applied, horizontally and vertically, (marking as thiya) at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and side ways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive troweling or over working the float shall be avoided.

4.3 All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required as per drawing and as directed by engineer in charge shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

4.4 When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of wall and not nearer than 15 cm to any corners or arrises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arrises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

No portion of the surface shall be left out initially to be patched up later on. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

5 Thickness

Where the thickness required as per description of the item is 15 mm the average thickness of the plaster shall not be less than 15 mm whether the wall treated is of RCC or brick or stone.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

6 Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer-in-Charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

7 Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds. Finishing rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required as per drawing and as directed by engineer in charge.

8 Precaution

Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

(i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling, frame, stone wherever required horizontally or vertically, by a thin straight groove 10 mm not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green or required as per drawing and as directed by engineer in charge.

(ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150 mm wide

chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

Or

To prevent surface cracks appearing addition of synthetic Polyester triangular fiber of length 6 mm, effective diameter 10-40 microns and specific gravity of 1.34 to 1.40 in cement plaster/mortar by using 125 gms. of synthetic Polyester triangular fiber for 50 Kgs. cement used in cement mortar as per directions of Engineer-in-Charge. For providing and mixing synthetic Polyester triangular fiber payment shall be made separately.

9 Measurements

9.1 Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal.

9.2 Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

9.3 The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted. No separate payment for groove in plaster at any junction and any level.

9.4 The following shall be measured separately from wall plaster. (a) Plaster bands 30 cm wide and under
(b) Cornice beadings and architraves or architraves moulded wholly in plaster.
(c) Circular work not exceeding 6 m in radius.

9.5 Plaster over masonry pilasters will be measured and paid for as plaster only.

9.6 A coefficient of 1.63 shall be adopted for the measurement of one side plastering on honey comb work having 6 x 10 cm. opening.

9.7 Moulded cornices and coves.

(a) Length shall be measured at the centre of the girth.

(b) Moulded cornices and coves shall be given in square metres the area being arrived at by multiplying length by the girth.

(c) Flat or weathered top to cornices when exceeding 15 cm in width shall not be included in the

girth but measured with the general plaster work.

(d) Cornices which are curved in their length shall be measured separately.

9.8 Exterior plastering at a height greater than 10 m from average ground level shall be measured separately in each storey height. Patch plastering (in repairs) shall be measured as plastering new work, where the patch exceed 2.5 sqm. extra payment being made for preparing old wall, such as dismantling old plaster, raking out the joints and cleaning the surface. Where the patch does not exceed 2.5 sqm in area it shall be measured under the appropriate item under sub head 'Repairs to Buildings.'

9.9 Deductions in measurements, for opening etc. will be regulated as follows:

(a) No deduction will be made for openings or ends of joists, beams, posts, girders, steps etc. upto

0.5 sqm in area and no additions shall be made either, for the jambs, soffits and sills of such openings. The above procedure will apply to both faces of wall.

(b) Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals, jambs, soffits sills, sills, etc. of these openings.

(i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.

(ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is unplastered, deduction shall be made from the plaster or pointing on the side of the frame for the doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

(iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.

(c) For opening exceeding 3 sqm in area, deduction will be made in the measurements for the full opening of the wall treatment on both faces, while at the same time, jambs, sills and soffits will be measured for payment. In measuring jambs, sills and soffits, deduction shall not be made for the area in contact with the frame of doors, windows etc.

10 Rate

The rate shall include the cost of all labour and materials involved in all the operations described above with tools and scaffolding as required.

Item 11.27 Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.

1 Kota Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-in-Charge. When brought at site, the colour of the stone shall be fairly uniform. It shall be ensured that the stones to be used in a particular work shall not differ much in shade or tint from the approved sample.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required as per drawing or as instructed by the Engineer-in-Charge. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

2 Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 25 mm as specified in the description of the item. Tolerance of ± 2 mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

3 Preparation of Surface and Laying

3.1 Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement: 4 coarse sand).

3.2 The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12 mm. The thickness of the bedding mortar shall be to match the finished level of flooring as per drawing or as instructed by the Engineer-in-Charge.

3.3 The slabs shall be laid in the following manner:

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already paved buttered with grey cement, with admixture of pigment to match the shade of the Kota Stone slabs as given in the description of the item. The thickness of the joints should be minimum as possible.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1 mm.

Due care shall be taken to match the grains and colour of slabs which shall be selected judiciously having uniform pattern of Veins/streaks or as directed by the Engineer-in-Charge.

3.4 The slabs shall be matched in pattern as shown in drawings or as instructed by the Engineer-in-Charge.

3.5 Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

3.6 Kota Stone slabs flooring shall also be laid in combination with other stones and/or in simple regular pattern/design as described in item of work and/or drawing or as directed by the Engineer-in-Charge.

4 Curing, Polishing and Finishing

4.1 The day after the slabs are laid all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shape of the topping of the wearing layer of the tiles. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat with a view

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

to protect the surface from abrasive damage and fill the pin holes that may exist on the surface.

4.2 The floor shall then be kept wet for a minimum period of 7 days. Slight unevenness at the meeting edges of slabs shall then be removed by fine chiseling and finished. The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit block (No. 60). Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered joint with a thin coat of grey mixed with pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No. 120). It shall then be covered joint with a thin coat of grey mixed with pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear.

4.3 The final grinding with machine fitted with the finest grade grit blocks (No. 320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor, as ordered by the Engineer-in-Charge.

4.4 For small areas or where circumstances so require, hand grinding/polishing with hand grinder may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used:

1st grinding — coarse grade stone (No. 60)
Second grinding — medium grade (No. 80)
Final grinding — fine grade (No. 120)

In all other respects, the process shall be similar as for machine polishing.

4.5 After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woollen rags). The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

4.6 If any slab is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished.

The finished floor shall not sound hollow when tapped with a wooden mallet.

5 Measurements

Kota stone flooring shall be measured in square metre correct to two places of decimal. Nothing extra shall be paid for laying the patta or residue in rmt. Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for laying the floor at different levels in the same room. Nosing shall not be measured and paid for extra. No separate payment for groove in mortar at any junction of stone and wall/floor at any level.

6 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above. No extra shall be paid for making special type of pattern/design/flowers

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

as per drawings. No deductions shall be made in rate even if flooring is done without any pattern/design

Item 13.48.1 Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications :

Two or more coats applied on walls @ 1.25 ltr/10 sqm over and including one coat of Special primer applied @ 0.75 ltr /10 sqm

1 Material

The paint shall be Acrylic smooth exterior paint of make such as Asian Paints, Nerolac, Berger or equivalent, as approved.

Acrylic Exterior Emulsion is a high performance premium water based, long lasting exterior paint, with UPF (Ultimate Paint Formula). It is formulated to suit the extreme tropical conditions of high rainfall, humidity and heat. The product is based on Silicon modified pure Acrylic polymer and hence it forms a tough and flexible protective film, with an excellent bonding to the substrate, which gives Excellent Dirt Pick-up resistance and Excellent Sheen. All in One Acrylic Exterior Emulsion contain a unique combination of surface protectants, which are released slowly over a long period of time. This actively helps not only to prevent the fungal and algae growth, but also ensures constant surface activity against these irritants for a long period.

This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

2 Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. Wash thoroughly with water and allow to dry. In case of fungus affected area apply a liberal coat of Fungicidal Solution. Allow it to react for minimum 6-8 hrs. This ensures proper adhesion of the new paint system The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced.

3 Application

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-charge shall be followed meticulously.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

Base coat of water proofing cement paint primer of make such as Asian Paints, Nerolac, Burger or equivalent, as approved. Self priming done thinning by 100% by volume with water. Allow it to dry for 3-4 hours, apply Acrylic Exterior Emulsion paint of two or three coat as required. Allow it to dry for 4-6 hours in between coats.

4 Precautions

- 1) Refer to the MSDS for Acrylic Exterior Emulsion" for safety measures & precautions.
- 2) Store in well ambient conditions, ventilated locations & away from the source of ignition and fire.
- 3) Keep away from children.
- 4) In case of eye / skin contact wash with plenty of water.
- 5) Inhalation / Injection is dangerous. In either case, move to fresh air & consult medical practitioners.
- 6) Do not apply when ambient temperature might drop to level below 10°C within 4 hrs of application.
- 7) New plaster should be allowed to cure for minimum 4 weeks.
- 8) Avoid extra thinning for better results.
- 9) Do not use universal stainers. Stir well paint before application.
- 10) The container must be tightly closed when not in use. Stir well and strain before use.
- 11) Use safety equipments like rubber or polythene gloves, safety goggles / glasses & face mask.

The specifications in respect of scaffolding, protective measures, measurements and rate shall be as described in painting.

5 Measurements

The length and breadth shall be measured correct to a cm. The area shall be calculated in sqm (correct to two places of decimal), except otherwise stated. Small articles not exceeding 10 sq. decimetre (0.1 sqm) of painted surfaces where not in conjunction with similar painted work shall be enumerated. Measurements shall be taken for the work actually done with deductions for all openings and However, no deduction is to be made for the grooves provided as specified.

6 Rates

The rates shall include the cost of all labour and materials involved in all the operations described above with tools and scaffolding.

Item 2.13: Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling pit with mixture of good soil and farm yard manure after mixing it in 2:1 proportion (2 parts of good soil : 1 part of farm yard manure), flooding with water, filling

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

with earth if necessary, watering and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed (cost of farm yard manure and good earth to be paid for separately) Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by EIC

Item 2.14.1: Digging holes in ordinary soil and refilling the same with the excavated earth mixed with manure or sludge in the ratio of 2:1 by volume (2 parts of stacked volume of earth after reduction by 20% : 1 part of stacked volume of manure after reduction by 8%) flooding with water, dressing including removal of rubbish and surplus earth, if any, with all leads and lifts (cost of manure, sludge or extra good earth if needed to be paid for separately) : Holes 1.2 m Dia and 1.2 m deep

Item 2.10.1 Grassing with selection No. 1 grass including watering and maintenance of the lawn for 60 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed (the grass and earth shall be paid for separately). In rows 5 cm apart in both directions

Item RA01: Supplying, Stacking & Grassing with Paspalum notatum (PANO) grass including watering and maintenance of the lawn for 60 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed (the grass and earth shall be paid for separately). In rows 5 cm apart in both directions

Item RA02: Supplying, Stacking & Grassing with Zoysia japonica tinuifolia (ZOJA.T) grass including watering and maintenance of the lawn for 60 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed (the grass and earth shall be paid for separately). In rows 5 cm apart in both directions

Close Turf shall be a live grass sod or mat at least 300mm square with a well-developed root system growing in a minimum of 25mm soil bed, free from stones or extraneous roots, cut mechanically or by hand to give an extra thickness and texture. A sample of

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

one square meter of Turf shall be submitted to the Landscape Architect for approval before Turf is brought in for use on site.

The source of the material shall be stated by the Contractor. Turf shall be free from weeds, fungus, pest or disease and contamination or pollutants. Turf sods shall be kept moist and in shade and shall be planted within 24 hours after lifting.

In extremally dry weather, the turf must be kept well-watered at the nursery or turf farm in order to keep full green leave structure. Dry, brown or wilting grass turf will be rejected and growth or recovery on site will not be permitted.

Close turfing materials are to be obtained from a bona-fide horticultural source or private landowner. No turf is to be removed from unauthorized locations, roadside, riverbanks or private property without permission of the owner. The Contractor is to inform source of all turf delivered to the site before any turf is laid.

Rake the topsoil mix area to a smooth and uniform grade free of any slight mounds or depressions to achieve a uniformly flat surface. Re-grade any depressions or humps that may occur until a satisfactory grade is achieved.

The area to be turfed is to be brought to a fine tilth by approved mechanical means or by hand raking. Any stones over 25mm in diameter shall be removed from the site. Watering of the area shall be carried out to produce a moist condition of the soil and to consolidate the soil. If consolidation occurs to produce any areas with topsoil depths less than 100mm these areas shall have extra topsoil spread to produce finished levels.

Fertilizer shall be applied to all areas to be turfed prior to turfing at the rate of 40gm per square meter, evenly spread over the whole area and lightly worked into the soil.

Close turf sods shall be laid onto the surface of the prepared ground with leaf turfs upwards, butt jointed as closely as possible to achieve a uniform cover. The turf shall be laid off planks working over turves previously laid. The whole area is then to be top dressed with finely sifted topsoil mix to give an evenly smooth surface. The finished close turfing shall be lightly compacted by treading or with a wooden beater to ensure even coverage and compaction.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Watering shall take place over the area that has been turfed immediately after planting. Watering shall be undertaken by use of a fine spray to avoid disturbance of soil particles. Close Turfing shall be only ached as complete after the growth of an even sward is evident. Any areas not covered by green healthy grass to the satisfaction of the Landscape Architect within 28 days after turfing shall be re-laid as specified at the Contractor's own expense.

For the period of 28 days after turfing the vegetative cover shall: evenly cover at least 90% of the areas with leaves and spreading shoots of specified grass variety be free of perennial weeds or disease be healthy and vigorous and showing a strongly developed root system

Should there be any settlement due to lack of even compaction this will be corrected by application of topdressing of finely sifted soil to maximum depth of 25mm. If the depression is greater than 25mm the grass in the affected area shall be lifted, the depression filled with sifted topsoil, lightly compacted and the affected area re-turfed as specified. These operations shall be done as often as necessary to produce an even and smooth surface free from bumps and hollows.

All close turfing operations shall be carried out from wooden planks or plywood boards, with the workers moving away from completed turfed areas, raking any compressed soil or footprints before laying of sods. All access onto soil areas shall be on wooden boards or plywood sheets. Areas compacted by working are to be re-cultivated and re-laid.

The following operations are to be carried out as often as required to achieve the specified quality of turf.

Cutting before Completion shall be carried out as necessary to keep the grass to a maximum height of 30mm.

Watering shall be carried out as often as necessary before Completion to allow a satisfactory green sward to develop over the whole close turfed area.

One fertilizer application per month is to be carried out for before Completion.

Topdressing as specified as often as required to establish smooth even grades and levels free of hollows.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

If compaction or consolidation takes place or hard passing or baking of the soil occurs, the soil areas are to be well watered first and lightly loosened by mechanical means such as spiking, slitting or hollow tinning using approved equipment.

Completed close turfed areas are to be kept in a weed free insect free, fungus free and tidy condition until Completion (that is start of maintenance period).

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item 2.35: Supplying & Stacking of Selection No.1 Grass at site fresh & free from weeds having proper roots in green including loading, unloading, carriage and all taxes paid etc. and as per direction of officer in charge.

Item 2.2: Supplying and stacking of good earth at site (earth measured in stacks will be reduced by 20% for payment). Good earth shall consist of a free draining organic soil from horizons less than 300mm from the original surface, of a workable crumbly and lump free loamy character and shall contain no grass or weed growth of any kind or other foreign material or stones exceeding 25mm in diameter. Total stone content shall be no greater than 5% by volume. A 1 liter sample with back up soil test data is required before supply, to be approved by EIC. Soil should conform to the following parameters: pH 5.5 - 7.8, Electrical conductivity 1:2.5 (w/v), Soil-water extract not exceeding 1500 micromho/cm, Soil texture Sand (0.05 - 2.00mm) Max. 75% Min. 20%, Silt (0.002 - 0.05mm) Max. 60% Min. 5%, Clay (less than 0.002mm) Max. 30% Min. 5%. Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required for supply and stacking of good earth.

Good earth shall consist of a free draining organic soil from horizons less than 300mm from the original surface, of a workable crumbly and lump free loamy character and shall contain no grass or weed growth of any kind or other foreign material or stones exceeding 25mm in diameter. Total stone content shall be no greater than 15% by volume. A 1 liter sample with back up soil test data is required before installation, or mixing.

The following criteria shall be tested at an approved laboratory before use on site

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

pH 5.5 - 7.8

Electrical conductivity (1:2.5 (w/v) Soil-water extract) not exceeding 1500 micromho/cm

Soil texture

Sand (0.05 - 2.00mm)	Max. 75% Min. 20%
Silt (0.002 - 0.05mm)	Max. 60% Min. 5%
Clay (less than 0.002mm)	Max. 30% Min. 5%

The earth shall be stacked at site in stacks not less than 50 cm high and of volume not less than 3.0 cum.

Measurements:

Length, breadth and height of stacks shall be measured correct to a cm. The volume of the stacks shall be reduced by 20% for voids before payment, unless otherwise described. The rate shall include the cost of excavating the earth from areas lying at distance not exceeding one km. from the site, transporting the same at site breaking of clods and stacking at places indicated. The rate shall also include royalty if payable. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item 2.25: Supplying and stacking of well decayed cow dung manure (cattle manure measured in stacks will reduced by 8% for Payment). Manure shall be well composted, dried, well screened good quality in powdered form. Manure, shall be free from soil clods, fresh mung grass, and dry. Sample will be approved by EIC. Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required for supply and stacking of good earth.

Contractor shall supply only well composted, dried, well screened good quality Farm Yard Manure in powdered form. Farm Yard Manure, shall be free from soil clods, fresh mung grass, and dry. Sample will be approved by Landscape Architects.

The following criteria shall be tested at an approved laboratory before use on site

pH 5.5 - 7.8

Electrical conductivity (1:2.5 (w/v) Soil-water extract) not exceeding 1500 micromho/cm

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

It shall be transported to the site in lorries with efficient arrangement to prevent spilling enroute. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

Measurements

Length, breadth and depth of stacks shall be measured correct to a cm. The volume of the stack shall be reduced by 8% for looseness in stacking and to arrive at the net quantity for payment. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item 2.39.1: Complete maintenance of the plantation area i.e. lawn trees, shrubs, hedge, flower beds, foliages, creepers etc. including hoeing, weeding pruning replacement of plants, gap filling, watering, mowing of lawn, grass cutting by lawn mower and brush cutter , removal of garden waste, applying insecticide, pesticide & fertilizers(whenever required) top dressing of lawn with good earth and manure and maintenance of other garden related works as directed by EIC (Cost of Good Earth, Manure, Fertilizer, Insecticide , Pesticide, will be provided by the Institution & other T & P material/articles shall be provided by the contractor, as per yard stick 1Mali per acre (5 years)

For Shrubs, Trees, Palm, Groundcover & Creepers :

The Contractor shall water all trees, palms, shrubs, ground cover, rooted shoots, herbaceous plants and other planting areas as often as necessary to keep the ground moist all around and to the full depth of the roots of the plants to a minimum depth of saturation of:

100mm for groundcover

300mm for shrubs

750mm for trees

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Fresh water only shall be used for the landscape. Water shall be supplied to the Contractor from agreed points on the site. However, it will be only to necessary for the Contractor to supply his own means of transport from the watering points to the plant beds. An inspection of watering requirements is to be made by the Contractor at least two times a week in dry weather.

Water shall be supplied using an approved hose or sprinkler or with an automated irrigation system so as not to cause compaction or wash-outs of the soil or loosening of plants. The Contractor shall immediately make good any such damage, soil erosion or outwash and plants loosened by erosion are to replanted or if damaged, replaced.

All plant beds are to be kept in a weed free condition with a weeding operation once a month. All weeds, stones and rubbish collected from this operation shall be removed from the site to a tip to be found by the Contractor. Herbicides may not be used on this site unless a specific application in writing is made by the Contractor with full back up data on the performance of the chemicals and the particular need for the chemicals use. Approval will in all cases be subject to the Landscape Architect's decision.

After weeding, at least once per month the soil surface is to be lightly broken up between plants using a pronged fork. Taking care not to disturb the root systems. Maximum depth 100mm. After forking the soil loose, the mulch and loosened soil are to be raked to give an even re-distribution of the mulching materials.

Firming up and adjusting of stakes/ties shall be carried out monthly to ensure that the trees and shrubs are firmly held in the ground. If required guy ropes or tree pits shall be adjusted, tightened or loosened. If tree ties or ropes are rubbing the bark of the trees, the ties are to be taken off and retied. Any damaged branches are to be carefully pruned and the wounds sealed.

All protective fencing is to be maintained and kept in good condition and in position until the end of the maintenance period.

Trees shall be pruned if dead, rotten or crossed branches are present or to maintain a clear stem up to the specified height using the methods described below. Tree pruning is to be reviewed monthly.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

All shrubs and ground covers are to be reviewed monthly and pruned as and when required during the Maintenance Period to promote bushy growth and good flowering characteristics. The shrubs shall be checked and all dead wood, broken, damaged or crossed branches shall be cut back, depending on species. Pruning and removal of branches is to be carried out using sharp clean implements to give a clean sloping cut with one flat face. Ragged edges of bark or wood are to be trimmed with a sharp knife.

Pruning for all plants shall be carried out as follows:

- Pruning is to be done with the cut just above and sloping away from an outward facing health bud.
- Removal of branches is to be done by cutting flush with the adjoining stem and in such a way that no part of the stem is damaged or torn.
- Ragged edges of bark are to be trimmed with a sharp knife.
- Any cuts or wounds over 25mm diameter are to be painted with an approved sealant after trimmed.
- All pruning to be cleared up and removed from site after pruning.

All hedges, mat forming herbaceous plants and ground cover plants shall be clipped with shears as often as necessary (at least monthly) to maintain a tidy appearance. Tall hedges are to be cut to forms shown on the drawings. Fertilizer is to be applied to clipped areas around 1-2 weeks after clipping.

Selective pruning of flowering plants shall be done where special flowering characteristics are required such as for Ixoras, Hibiscus, Allamanda where flowering takes places on twig ends. Heavy clipping must not be used for these species since this will remove future flower buds. Selective pruning by clipping non flowering twigs and leaving flowering twigs is necessary for these plants, and this operation must be done by experienced workers.

The Contractor shall allow for monthly fertilizer operations during the Maintenance Period. An approved slow release fertilizer shall be applied to each plant at the rate of 50gm per shrub and 200gm per tree, one month after planting and thereafter monthly. After spreading the fertilizer around the base of the plant the granules shall be lightly forked into the soil, and the plant well-watered. Herbaceous and ground cover areas shall receive 25mm of approved soil conditioner, evenly spread and mixed with 50gm/m² of approved slow release fertilizer, evenly spread over entire area and lightly forked into the soil to break up the top layer, and the area well-watered on a month by month basis.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

The horticultural requirements of different plants or areas may involve variations to those techniques (such as the use of organic liquid fertilizers for sensitive plants) and variations in method will be authorized as required.

Heavy feeding plants such as Canna, Heliconia and Lantana shall be dressed with a 25mm mulch of approved organic compost or similar approved compost every 2 months, lightly forked in around the base of the plants.

Additional mulching layer, 25mm deep to be spread and forked in overall planted areas at 3 monthly intervals.

The Contractor shall make regular weekly checks to ensure that the plant material is insect and pest and fungus free. No pesticides may be used unless approval from the Landscape Architect is given from the Contractor stating the chemical intended for use; concentration, spraying programme and including full technical details of the product.

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

For Lawn :

The Contractor shall mow all lawn areas using approved cutting equipment to maintain a close sward to a height of not less than 20mm and not more than 30mm for all grass types. Mowing shall be carried out generally weekly, except in dry weather and grass shall not be allowed to flower between cuts. Weekly inspections are to be made to ensure adequate planning of grass cuts to suit growth and weather conditions. All clippings to be gathered up and removed.

All grass areas are to be watered by means of sprinklers during dry weather as often as is required to keep the grass green and the soil moist. The Contractor shall provide hoses and sprinklers for use from water points provided by others. Weekly inspections are to be made to determine the need for water and, in dry weather watering must be done to moisten the soil to a depth of 100mm.

Fertilizer of NPK value 10-15-15 or similar approved be spread at a rate of 40gm/sqm over all grass areas at monthly intervals, using approved spreading equipment to give an

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

overall even spread. Grass areas that have been fertilized shall be watered if no rain falls within 24 hours.

The Contractor shall apply topdressing of not more than 15mm depth fine sand and granulated compost raked and spread evenly over the lawn areas. The next topdressing shall be applied only after the grass has grown through to a movable height.

There shall be at least two applications of topdressing during the maintenance period, to be directed by the Landscape Architect. If depressions or bumps over 25mm deep or high in turf areas during the maintenance period these are to be levelled out by lifting the turf and raising the soil level with sand/compost mix or trimming to level grades, followed by re turfing.

Grass areas are to be kept free of weeds, annual grasses, fungus and insect attack and free of stones or other debris throughout the maintenance period as often as is required. All chemicals used shall be to the approval of the Landscape Architect. Assessment of these operations is to be prepared on the basis of the weekly maintenance inspection chart.

If compaction or consolidation takes place or hard passing or baking of the soil occurs, the soil areas are to be well watered first and lightly loosened by mechanical means such as spiking, slitting or hollow tinning using equipment approved by the Landscape Architect.

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item RA03: Supply and application of Geosynthetic Drainage with two filtering nonwoven geotextiles having a "W" configuration as longitudinal parallel

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

channels. Minimum thickness to be 7.2mm, with two filtering UV stabilized polypropylene nonwoven geotextile of minimum thickness of 0.75mm having pores of 150 micron and tensile strength of 8.0 kN/m and having plane flow capacity of 2.1 L / (m.s) at hydraulic gradient of 1.0 & 20 kPa pressure ,tensile strength of 18 kN/m , with mass per unit area of 740 gsm, as per drawing and directed by EIC. Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by EIC

Geosynthetic drainage membrane shall conform to BIS standards. It shall conform to the following specifications:

Composite properties

Tensile strength: 18kN/m

Elongation : 35%

CBR puncture resistance: 3300N

In plane water flow: 2.1 lt / ms @ hydraulic gradient 1.0 & 20kPa pressure

Thickness: 7.5mm

Polypropylene Geotextile filter properties

UV stabilized

Thickness: 0.75mm

Pore size: 150 microns

Tensile strength: 8.0 kN/m

Permeability: 50 lt / sqm-sec

Installation

The geotextile should be laid such that the roll is opened along the slope if applicable.

The composite must be kept flat – no lumps or undulations - to prevent ponding.

All joints need to be precisely executed.

Base on which geotextile is to be laid must have an adequate slope.

Sufficient outlets must be provided at frequent intervals.

Where cutting is required, a sharp cutter must be used such that the different layers are not peeled off.

Where geotextile has to be joined to another part, 100mm of overlap must be maintained.

Overlap must be fixed with a tape at intermittent intervals

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Exposed edges of the composites can be finished by peeling back the geotextile filter by (say) 75mm, trimming back the exposed core and folding this flap around the edge of the composite.

Alternatively, wrap any spare geotextile lengths around exposed edges.

Once unwrapped, the products should be completely covered with fill within 14 days to avoid exposure to UV radiation.

While filling on top of the geotextile, care must be taken to ensure that large stones are not allowed to damage the surface of the geotextile filter(s).

Measurement

Geotextile shall be measured as installed, accurate to the nearest metre in each dimension. Rate shall be in square metres. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item 2.50: Providing & fixing of White River (Stone) Pebbles size of 2" to 2.50" dia in natural colour at site of work including loading, unloading, carriage and all taxes paid etc. and as per direction of officer in charge.

White pebbles sourced from river beds shall only be supplied. Pebbles shall be laid by placing them individually on soil as directed by EIC

Measurement shall be by weight: quintals of pebbles installed

Item MR01: Supply of Shrubs - well developed, well branched - 3-4 branches each having 4-5 leaves, preferably in bloom, in polybag of 30x20cm size, disease free and development (height 0.75-0.9m) Shrubs are woody perennials of generally multi stemmed and bushy habit ranging from 3 - 4.5m down to 500mm height. Shrubs shall have no less than three main stems and shall be well balanced and bushy, with strongly developed fibrous root systems, and shall be pruned in advance as required to achieve the specified height tolerances. Branches shall break from the base of the plant just above the root collar, and shall be well furnished with leaves right down to ground level. Supply shall include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agro-net, watering & maintenance at stacking area until planted as directed by EIC

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Item MR02: Supply of Trees - well developed, well branched crown - 4-6 branches each having 4-5 leaves, well developed (Poly bag size - 30"x 30", min. stem diameter 50mm and height as specified) Trees shall be large size nursery grown trees pruned during growth to produce a tight well rounded head and a straight stem clear of leaves or twigs. Trees shall be at least two years old, as certified by the nursery. Trees shall be 70-100 mm circumference stem when measured 1.0m from ground level and shall have a clear straight stem of minimum 1.2m. The head shall be well balanced and rounded and contain at least four main branches with a well-developed secondary branch system and a defined central leader that has not been pruned, giving a minimum overall height of 1.5m at the time of planting. Root-ball dimensions : diameter 750mm x 750mm deep minimum. Branching/leaf spread 1.5 - 1.8m diameter. Pruning at the time of removal from the nursery will not be permitted. In dry weather conditions, trees are to be sprayed with approved Anti-transpirant. Trees shall have a strong fibrous root system. Supply shall include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agro-net, watering & maintenance at stacking area until planted as directed by EIC

Item MR03: Supply of Palms - well developed, well developed, disease free (Poly bag size - 18"x 18") Palms shall have heights as either 1.2m-1.5m. For single stemmed palms, the clear trunk height shall be at least 80% of specified height, and stem girth shall be of dimension normally found for palms for the stem height and species specified. Acceptable tolerances to variations in stem height shall be +200mm or -200mm from the height specified in the Bills of Quantities. The heads of palms shall be well balanced with at least 7 leaves and a healthy growing apical shoot all free from pest and disease. Root-ball dimensions shall be 450mm diameter x 450mm depth. Supply shall include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agro-net, watering & maintenance at stacking area until planted as directed by EIC

Item MR04: Supply of Ground covers / creepers - well developed, min. 0.15m high, in polybag of 5"x7" size, disease free. All groundcover species shall be evenly balanced to allow equal growth in all directions. Plants shall have fully

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

developed roots and leaves. Rooted cuttings will not be accepted. All plants to be container grown. Supply shall include labour & equipment cost of loading, unloading, transport to site, storage & stacking within site in area protected from dust using temporary agro-net, watering & maintenance at stacking area until planted as directed by EIC

The plants supplied should be as per following specification in addition to specification mentioned in descriptions:

1. The plants should be full of fresh and healthy foliage.
2. The plants should be free from insect, pest and disease.
3. Plant should be healthy and vigorous growth
4. The height of the plants will be measured from top of the pots.
5. The plants should be well settled and should not be newly shifted.
6. The plants should be true to the variety and named Variety should be tagged.
7. Moss stick used should be made on plastic pipe.
8. Moss stick should be straight and properly fixed in the pot.
9. The rejected plants materials should be removed from the site immediately.
10. Moss stick should be covered with the plants in case of plants supplied with moss stick.
11. The Plant should be well established and good spread.
12. Good earth and manure used for filling the pot/poly bag free from any inert material and mixed to proper ratio.
13. Pot/ Poly bag used for filling the plants should be proper size good quality not damaged.
14. There should be proper drainage in pots for plants.
15. The flowering plants should also have proper flowering and should be true to the variety.
16. All plant should have the tendency of growth and should not be stunted type.
17. There should be no stagnation of water in the pots

Heights of plants shall be as per descriptions in bill of quantities

Measurement shall be in numbers of plants installed on site.

Item 2.57.2: Plantation of Trees, Shrubs, and Hedge at site i/c watering and removal of unserviceable material's as per direction of officer in charge (excluding cost of plant & water) Item includes all royalty, equipment, labour,

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

**loading, unloading, and carriage upto any lead & lift required as directed by EIC
- SHRUBS plant**

**Item 2.57.1: Plantation of Trees, Shrubs, and Hedge at site i/c watering and removal of unserviceable material's as per direction of officer in charge (excluding cost of plant & water) Item includes all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by EIC
- TREES plant**

Item MR05: 'Providing & laying exposed Precast Glass fiber reinforcement concrete with 6MPa Tensile Strength, 30 mm Thk (Recommended for Furniture in Public Use) Planter and lifting to all heights & erecting and placing in its final position complete in all respect as per the approved drawings and as directed by engineer in charge. The rates includes the cost of admixtures & necessary equipment's for pre-casting of panel, curing tanks/curing of precast panel by means of water sprinklers/steam curing etc., cost of providing and maintaining living tools, tackles and necessary cranes/hoists etc.(For Approximate size of Planter up to 1.20 (L) x 0.60 (W) x 0.45 (H) x 0.03(Thickness))

Planters supplied should have smooth & sharp finish without any bulging, should be adequately sun-dried to be free of paint odour, and should not have any fibers visible. Sample shall be approved by EIC before supplying the required quantity.

Measurement shall be in Nos. of planters supplied and installed.

Item 9.111: Providing and fixing Bamboo jaffery/ fencing consisting of superior quality 25 mm dia (Average) half cut bamboo placed vertically and fixed together with three numbers horizontal running members of hollock wood in scantling of section 50X25 mm, fixed with nails and G.I wire on existing support complete as per direction of Engineer-in-charge, for running creepers

Jaffery shall be installed on site as per description in Bills of Quantities and instructions of EIC

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Measurement shall be in square meters of jaffery installed

Item MR06: Supply and Grassing with Vettiver grass at 9 Slips per Sqmt in grid spacing in between coir geotextile including watering and maintenance for the slope stabilization for 180 days or more till the grass forms a thicket, sapling with atleast 5-6 blades / leaves & well developed root system, in 4"x5" polybag, disease free, and development including excavation upto 150mm deep where required, including all royalty, equipment, labour, loading, unloading, and carriage upto any lead & lift required as directed by Engineer-in-Charge

Vettiver grass supplied must be atleast 0.5m high with 5-6 blades and well grown root system within 4"x5" polybags, and atleast 6 months old. Vetiver should be planted across the slope on 30cm x 30cm grid, starting from top of slope towards downward.

The first row should be planted on the top edge of the slope. The bottom row should be planted at the bottom of the slope. Between these rows, vetiver should be planted as specified above.

In dry weather, water every day during the first two weeks after planting and then every second day. Water twice weekly until the plants are well established. Mature plants require no further watering.

During the first month after planting, replace all plants that fail to establish or wash away. Continue inspections until the plants are suitably established.

DAP or NPK fertilizer should be applied at the beginning at 100g per square meter.

Measurement

Measurement shall be in square meters of vetiver planted at 30cmx30cm grid spacing. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item 2.28: Preparation of mounds of various size and shape by available excavated / supplied earth in layers not exceeding 20 cm in depth, breaking

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

clods, watering of each layer, dressing etc., lead upto 50 meter and lift upto 1.5 m complete as per direction of Officer-in-charge. Details of cost for 10 cum

Soil excavated at the site etc., shall be collected and spread over areas marked on the drawings or as directed by the Engineer-in-Charge. Mounds shall be developed in layers of 10cm thickness, over which watering and rolling shall be done to compact them before the next layer is laid. The finished level of the hillock should be such that it shall accommodate 300 mm. compacted layer of mixture of good quality loamy, sandy loam soil and screened Cow dung manure.

Soil filling shall be done in layers only. Each layer shall be watered and well compacted, so that there are no air pockets or loose soil.

Final grading of the mounds shall be done in such a way as to allow free movement of lawn mower all over the hillock.

Any deformity/settling of soil in the mounds will be rectified immediately during the course of work at no extra cost whatsoever.

Measurements shall be cubic metres, using dimensions in each direction, accurate to the nearest centimetre. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item MR07: Providing and laying non-pressure NP2 class (light duty) R.C.C. pipes vertically in tree-pits complete as directed by EIC including supply of all material, labour and equipment upto any lead and lift, 900mm Dia RCC pipe

Cement concrete pipes shall be installed in tree-pits along roads and near structures as shown in contract drawings to prevent tree roots from damaging constructed areas.

Precast cement concrete pipes of diameter as specified in contract drawings shall be supplied conforming to IS 458.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Contractor shall unload the pipes on location of laying only just before laying is about to begin, and trench is prepared. Contractor shall unload the pipes with great care. Any crack and chipping shall not be accepted, and Contractor shall replace the pipe at his own cost. Contractor shall lay the pipe using pulley mechanism such that the pipe is absolutely vertical, checked with plumb line. Contractor shall level the pipe such that its finished level matches that shown in contract drawings.

Contractor shall refill the outside portion of the trench manually with excavated soil with great care not to disturb the laid pipe. Filling shall be done in layers 100 mm thick, and light tamping shall be done such that the pipe is not disturbed. Contractor shall keep checking the level and alignment of the pipe periodically with plumb line and correct any errors found.

Precast cement concrete pipes shall be measured in length just before laying, accurate to the nearest centimeter. This work shall include transport, loading, installation and soil filling around the pipe. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item RA03: Staking of trees, palms and large shrubs using quadra-pod staking made of 4 Nos Bamboo 25 mm Dia 2.5 meter long, fixed 0.3m in the soil and joined at 2/3 height of plant stem using jute rope, fixed to plant using rubber sheath; plant stem to be covered with gunny / jute cloth at fixing point to prevent damage, complete including supply of all material, labour and equipment, upto any lead and lift as directed by EIC

Trees :

Trees shall be large size nursery grown trees pruned during growth to produce a tight well rounded head and a straight stem clear of leaves or twigs. Trees shall be at least two years old, as certified by the nursery. Trees shall be 100 - 120mm circumference stem when measured 1.0m from ground level and shall have a clear straight stem of minimum 1.5mm. The head shall be well balanced and rounded and contain at least four main branches with a well-developed secondary branch system and a defined central leader that has not been pruned, giving an overall height of 2.1 - 2.5 at the time of planting. Pruning at the time of removal from the nursery will not be permitted. In dry weather conditions, trees are to be sprayed with approved Anti-transpirant. Root-ball dimensions : diameter

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

500mm x 300mm deep minimum. Branching/leaf spread 1.5 - 1.8m diameter. Trees shall have a strong fibrous root system.

Palms :

All palms shall be single stem. Single Stem Palms shall have clear straight trunks of heights as stated in the Bill of Quantities as measured from the root collar to the base of the lowest leaf sheath. The stem girth shall be of dimension normally found for palms for the stem height and species specified.

Acceptable tolerances to variations in stem height shall be +200mm or -200mm from the height specified in the Bills of Quantities.

The heads of palms shall be well balanced with at least 7 leaves and a healthy growing apical shoot all free from pest and disease. Root-ball dimensions shall be 750mm diameter x 600mm depth and a stem height of 2.0 meters.

Shrubs :

Shrubs are woody perennials of generally multi stemmed and bushy habit ranging from 3 - 4.5m down to 500mm height. Shrubs shall have no less than three main stems and shall be well balanced and bushy, with strongly developed fibrous root systems, and shall be pruned in advance as required to achieve the specified height tolerances. Branches shall break from the base of the plant just above the root collar, and shall be well furnished with leaves right down to ground level. All plants are to be container grown in containers of suitable dimensions for the species.

Herbaceous Plants are non-woody perennials usually of a clump forming habit. Plants shall have a well-developed main stem or stems with good symmetry, a healthy root system, free from pest or disease. Clumps of herbaceous plants shall include rhizomes, corms, tubers or roots and soil undisturbed by lifting with evidence of growing shoots emerging above soil level. All herbaceous plants are to be grown in containers unless specified as being produced by alternative method.

Groundcover plants are low growing, 500mm or less, or prostrate shrubs or herbaceous plants whose habit is to totally cover the soil. All groundcover species shall be evenly balanced to allow equal growth in all directions. Plants shall have fully developed roots and leaves. Rooted cuttings will not be used. All plants to be container grown.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Rooted shoots of certain spreading ground cover plants shall be used only where specified, planted as 'sprigs' as opposed to established plants in soil. Plants shall be rooted shoots and shall have at least one shoot of the minimum dimensions stated in the Schedule of Works and evidence of vigorous root growth. Recent cuttings with no root development shall not be acceptable.

Climbers are plants whose growth habit is to climb upwards by means of twinning stems, tendrils or clinging roots. Plants shall be grown to reach the recommended size using stocks no less than one year old, and no more than five years old at the time of the start of the contract. Plants shall have at least two leader shoots up to the recommended height and a vigorous root system. All plants to be container grown.

Cultivation of the completed soil mix beds shall take place only when the seeding or planting operations can begin immediately after cultivation. No cultivation shall be undertaken in weather or ground conditions in which operations may destroy soil structure or where soil mix has not been approved by the Landscape Architect.

Cultivation shall be by approved mechanical or manual means to a depth of 250mm for Ground Cover and 450mm for Shrubs to provide an even, weed free texture.

After cultivation, stone picking from the surface of soil areas shall be carried out such that all stones and lumps exceeding 50mm in diameter are collected. All stones, weeds and rubbish brought up shall be removed from the site to a tip to be found by the Contractor.

Ground cover, rooted shoot and herbaceous beds are to have 25mm solid conditioner spread over the entire area and well forked in to the top 250mm of soil during cultivation. This operation is separate from the mulching specified.

All plants shall be planted to accommodate the spreading root system of the plant to the same soil depth as in the nursery and shall be well watered before removing them from containers. Plants are to be positioned upright and the soil firmed around the roots.

Planting shall be carried out in accordance with the schedule of plants and drawings supplied. The number of each species and variety shall be evenly distributed over the area as indicated on the drawings.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

For large areas the outer rows are to be set out first to ensure the correct shape to the bed is established. The remaining plants are then to be evenly distributed to cover the planting area. The Landscape Architect is to be notified in advance if there are too many or too few plants to fill the area required and an assessment of setting out adjustments will be directed accordingly.

Setting out of plants is to be completed and approved before planting into the soil bed can commence.

Small shrubs, ground cover and herbaceous plants shall be planted in pockets formed by a trowel or spade. The pocket shall be deep enough and wide enough to accommodate the root of the plant. The sides and base of the pocket shall be loosened and the plant roots lightly loosened from the root-ball. The plant shall be placed upright in the pocket and firmed into the ground by backfilling and treading or hand pressure.

The topsoil in areas to receive rooted shoots shall be brought to a fine tilth 75mm deep by approved mechanical means or hand raking. Approved slow release fertilizer shall be applied evenly over the area at a rate of 40gms per square meter and shall be lightly raked into the surface. Rooted shoots shall be firmly bedded into the soil at 75mm centers with each shoot spread on the topsoil surface, separated from adjacent shoots. The area shall be top-dressed with finely sifted topsoil/compost mix as approved by the Landscape Architect to lightly cover the rooted shoots after laying. The ground shall then be firmed by lightly treading or hand pressure around the roots, taking care not to damage the shoots, to ensure good contact with the soil. Watering shall take place immediately after planting, using a fine spray. The firmed up area is to be tightly cultivated after completion of this operation to leave an even tilth before mulching.

Shrub pits for large and medium shrubs, feature plants and climbers shall be excavated to 150mm wider on either side than the root spread, and to a depth of 150mm deeper than the root depth and shall not be less than 300mm x 300mm x 450mm deep.

The bottom 150mm of the pit is to be forked loose prior to backfilling. Backfill material shall be topsoil Mix A for backfilling purposes. The Contractor shall note that for planting into turf areas, where topsoil has not been spread topsoil mix will be required for backfilling purposes.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Climber pits shall be 150 - 200mm away from the supporting structure with the roots spread away from the wall or adjacent supporting structure. The climbing plants shall be trained through the wire mesh with leading shoots directed upwards and tied.

Pits for shrubs and feature plants in planters shall be excavated to 150mm wider on either side than the root spread and to a total depth of the root-ball. The bottom of the pit shall be lightly formed, prior to planting taking care not to damage the terrain layer below.

After planting shrubs the area is to be watered immediately to bed the shrubs in. Once the water has percolated away and left the surface relatively dry the soil area is to be lightly forked to loosen the surface and leave an even soil tilth.

Before backfilling, imported topsoil and sand is to be thoroughly mixed with soil conditioner and organic fertilizer as specified for Topsoil Mix.

The tree pit shall be backfilled with the Soil Mix to a depth which will allow soil, after settlement to match surrounding ground level. The filled pit shall be watered and allowed to settle. After settlement soil levels shall be topped up as required.

The center of the backfilled tree pit shall be excavated large enough to allow placing of the root-ball, and to allow even compaction all round during backfilling. After careful removal of the container or wrapping, the root-ball of trees shall be placed carefully in the pit, and soil replaced gradually into the pit. The soil is to be consolidated during backfilling in layers to ensure that the plant is firmly held in the ground and that voids are not left around the roots. Care shall be taken during planting to avoid damage to the root system, branches or leaves.

After careful removal of the container or wrapping, the root-ball of the roots of shrubs and climbers shall be placed carefully and the soil replaced gradually in the pit. The soil is to be consolidated during backfilling in layers to ensure that the plant is firmly held in the ground and that voids are not left around the roots. Care should be taken during planting to avoid damage to the root system, branches or leaves.

Stakes shall always be used when planting Category B2, Category A, single stem palms and for tall shrubs when directed by the Landscape Architect. Stakes shall be in sawn timber of an approved type and be carried out according to the size of plant to be supported. The types of approved staking methods are:

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Tripod or Quadro-pod staking for palms and trees

Three or four stakes each 50 x 50mm section shall be positioned equidistantly around the tree and firmly driven into the ground at angles of between 30 - 40 degrees from the vertical. The inner ends of the stakes shall extend beyond the tree stem by not more than 150mm and shall not be higher than 300mm below the lowest branch. The tree stem shall be wrapped in gunny sacking at the point where the tree stakes are to be fastened in order to prevent bark damage. The stakes shall be neatly and firmly fastened to the tree stem using rubber hose or cord. String is not to be used. The stakes are to be adjusted and the position of the protective wrapping is to be altered up or down every month. The gunny sack wrapping is to be sprayed with an approved horticultural pesticide.

Climber wires for training climbing plants against walls shall be approved lightweight PVC mesh, fixed at 600mm intervals to screw eyes supplied under the sub contract. Maximum mesh coverage shall be 180mm high x 240mm wide. The climbing plants shall be trained through the wire mesh with the shoots directed upwards and tied.

After planting all plants are to be thoroughly watered using enough water to soak the ground all around the root-ball. After watering and the water has percolated away leaving the surface relatively dry the soil is to be lightly cultivated to give an even soil tilth.

After completion of planting and watering and light cultivation operations a 50mm deep layer of approved mulch shall be spread and forked in overall cultivated planting areas. Around each tree and palm and around the base of each climber, additional mulch is to be applied to a 50mm depth to a diameter of 600mm. Mulching is to be done within 2 days of completing planting and watering in.

After a period of settling in of at least one month, all pit planted materials shall be fertilized with an approved slow release fertilizer at the rate of:

Trees : 250gm per tree

Shrubs/climbers: 50gm per plant

Ground Cover/Herbaceous/ Rooted Shoots: 100gm per square meter spread around the base of the plants

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

All fertilized areas are to be watered immediately after fertilizer application.

The Contractor shall take all necessary precautions to prevent or eradicate any outbreak of disease or insect attack.

Where planting is to be carried out in areas of turf, the turf shall be carefully cut to the size of the tree or shrub pit, rolled and stored for re-use, being kept moist and in shade. After planting the turves shall be re-laid around the base of the plant. The Contractor shall replace at his own expense, any turves which are damaged during planting operations.

The contractor shall be responsible for protecting all planted areas. If it is necessary for the Contractor to erect protective fencing, the Contractor shall be responsible for keeping the fencing in position and in good repair until the end of the maintenance period. Fencing proposals shall be submitted to the Landscape Architect for approval. Post and string fences shall not be acceptable.

After planting and prior to the onset of the maintenance period, the Contractor shall be responsible for carrying out all necessary measures to ensure that the plant material thrives and becomes established and that the landscape areas are kept in a clean and tidy condition.

The Contractor shall allow for carrying out the following maintenance operations when necessary prior to the onset maintenance period:

- Replacement of dead/missing plants
- Grass cutting around trees
- Watering
- Cultivation and loosening of soil
- Weeding
- Pruning and clipping
- Firming up and adjusting stakes and ties
- Eradication of pest or insect attack
- Topdressing and mulching
- Fertilizing

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

The Contractor shall be responsible for replacing any plants which fail to survive as a result of inadequate maintenance operations, poor workmanship or poor quality of plant material prior to completion.

The Completion Certificate will not be issued until all plants scheduled on the Drawings and Schedule of Works are installed in a healthy condition in the manner specified.

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Measurement

Measurement for pit preparation of tree and single stemmed palm pits shall be in numbers.

Measurement for pit preparation of shrubs and other plants shall be in square metres, accurate to the nearest metre.

Measurement for planting all plants shall be in numbers.

Measurement for staking shall be in number of plants staked.

The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item MR08 : Supply and Installation of GeoGrid of Macafferri / Garware / Maharshee / JMJ Brand comprise biaxial geogrids manufactured from select grades of high tenacity, high molecular weight, and low carboxyl end group polyester yarn to ensure high strengths, low creep and excellent durability. The yarns are formed into a dimensionally stable grid structure with uniform apertures, using an advanced weft insertion warp knitting process and are then given a tough and durable polymeric coating to enhance dimensional stability, resistance to installation damage and durability. GeoGrid 60 x 60 KN & including installation.

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

Geogrid shall consist of biaxial grids manufactured from polyester yarn of high tenacity, high molecular weight, low carboxyl end group. Geogrid shall conform to following properties:

Property		Test Method	TGB-60	
Ultimate tensile strength ¹ (kN/m)	MD	ASTM D 6637 EN ISO -10319	60	
	CD		60	
Elongation at break ² (%) (Tolerance ± 4)	MD		13	
	CD		13	
Tensile strength at 2 % strain (kN/m) ²	MD		11	
	CD		9.5	
Tensile strength at 5 % strain (kN/m) ²	MD		20	
	CD		17	
Aperture size (mm)			MD x CD	25 x 25

1 Minimum average roll value 2 Typical value MD – Machine Direction CD – Cross Direction.

<i>Standard Roll Dimensions</i>	Roll length (m)	50 / 100
		Roll width (m)

Area where geogrid is to be installed shall be cleaned of any debris and loose soil. Geogrid shall be unrolled from top to bottom, starting about 1m away from top and anchored at both ends as well as intermediately as per manufacturer's specifications.

Measurement

Measurement shall be in square meters of area covered on site by geo-grid. This work shall include transport, loading, installation and soil filling around the pipe. The rate includes the cost of all materials, equipment, labour, carting, loading & unloading, removal of debris to local specified within the site, involved in all the operations described above.

Item 18.7.3 Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes SDR 11, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge. for External work (a) 25 mm dia

Item 18.7.2 (b) 20 mm dia

MATERIAL : The pipes shall be CPVC (Chlorinated Poly Vinyl Chloride) material for hot & cold water supply piping system with pipes as per CTs SDR -11 at a working pressure of

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

320 PSI at 23 deg C and 80 PSI at 82 deg. C, using G.I fittings i.e. Tees, Elbows, Couples, Unions, Reducers, Brushing etc. including transition fittings (connection between CPVC & Metal pipes / GI) i.e. Brass adapters (both Male & Female threaded and all conforming to ASTM D-2846 with only CPVC solvent cement conforming to ASTM F-493, with clamps / structural metal supports as required /directed at site including cutting chases & fitting the same with cement concrete / cement mortar as required, including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of manufacturer & Project Manager. Pipes from 65 mm to 150 mm dia shall be Schedule 40 for CWC & Schedule 80 for HWS / HWR. All pipes inside the buildings and where specified, outside the building shall be CPVC pipes tubes conforming to IS 15778:1996 .Specific Gravity ASTM D 792 at 23oC should be 1.55 as specified. With Tensile Strength as per ASTM D 638 at 23oC should be 55N/mm².

1.1 JOINING PIPE & FITTINGS

a. Cutting

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

b. Deburring/ Beveling

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fitting during assembly.

c. Fitting Preparation

A clean dry rag/cloth should be used to wipe dirt and moisture on the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

d. Solvent Cement Application

Only CPVC solvent cement confirming to ASTM-F493 should be used for joining pipe with fittings. CPVC schedule 40 & 80 heavy bodied CPVC solvent cement only should be used confirming to ASTM-F493.

e. Assembly

After applying the solvent cement on both pipe and fitting socket, pipes should be insert into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approx.) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous, remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set & cure times shall be strictly adhered to as per the below mentioned table:

Minimum Core prior to pressure testing at 150 psi

SI.No.	Ambient Temperature during Core period	Pipe Size	
		½" to 1"	1.¼" to 2"
1	Above 15 deg C	1 Hr	2 Hrs
2	4 – 15 deg C	2 Hrs	4 Hrs
3	Below 4 deg C	4 Hrs	8 Hrs

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

f. Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi (10 Bar) for minimum 24hrs. During pressure testing the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using coupler.

g. Transition of CPVC to Metals

When making a transition connection to metal threads, special brass/plastic transition fitting (Male & Female adopters) should be used. Plastic threaded connection should not be over torque hard tight plus one half turn should be adequate.

h. Threaded Sealants

Teflon tapes shall be used to make threaded connection leak proof.

i. Hangers & Supports

For horizontal runs, support should be given at 3 ft (90 cms) intervals for diameter of 1" and below and at 4 ft (1.20 mtr) intervals for larger size. Hangers should not have thrown or sharp edges which come in contact with the tubing and shall be of GI.

Support should be as per the below mentioned table:

SI. No	Size of Pipe	21 ⁰ C	49 ⁰ C	71 ⁰ C	82 ⁰ C
	Inch	Ft	Ft	Ft	Ft
1	1/2"	5.5	4.5	3.0	2.5
2	3/4"	5.5	5.0	3.0	2.5
3	1"	6.0	5.5	3.5	3.0
4	1 1/4"	6.5	6.0	3.5	3.5
5	1 1/2"	7.0	6.0	3.5	3.5
6	2"	7.0	6.5	4.0	3.5

SCHEDULE - 40							
Recommended Support spacing (in feet)							
Nom. Pipe Size		Temperature °C					
(In)	(mm)	23	38	49	60	71	82
2 1/2	65	7 1/2	7	7	6 1/2	6	3 1/2
3	80	8	7	7	7	6	3 1/2
4	100	8 1/2	7 1/2	7 1/2	7	6 1/2	4
6	150	9 1/2	8	8	7 1/2	7	4 1/2
8	200	9 1/2	8	8	7 1/2	7	5

SCHEDULE - 80							
Recommended Support spacing (in feet)							
Nom. Pipe Size		Temperature °C					
(In)	(mm)	23	38	49	60	71	82

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

2 ½	65	8	7 ½	7 ½	6 ½	4 ½	4
3	80	8	8	7 ½	7	4 ½	4
4	100	9	9	8 ½	7 ½	5	4 ½
6	150	10	9 ½	9	8	5 ½	5

j. All special fittings and accessories like internally or externally threaded brass adaptors, ball valves, globe valves, unions, diaphragm valves, butterfly valves, etc shall be made of CPVC by licensee.

k. The CPVC solvent cement used for installing CPVC piping systems shall conform to ASTM F493. Pipes from ½" up to 2" pipes and fittings, a single step medium bodied CPVC solvent cement should be used. For CPVC pipes and fittings upwards of 2", a primer shall be used followed by a heavy bodied solvent cement conforming to ASTM F493. PVC solvent cement should not be used.

l. **Concealed Plumbing:** All internal concealed plumbing for water supply shall be done with CPVC pipes. The pipes & fittings shall conform to CTS (Copper Tube Size) SDR-11 as per ASTM D2846. All pipes and fittings from ½" up to 2" shall come under this category. Medium body CPVC solvent cement conforming to ASTM F493 should be used for joining pipes to fittings.

m. **External Plumbing:** All external plumbing for water supply and distribution shall be done with CPVC pipes. The CPVC pipes above 2" for external water supply lines shall conform to ASTM F441 CPVC Schedule 40 & 80 pipe and will be the CPVC brand. The fittings above 2" size shall conform to ASTM F438 (Schedule 40 CPVC fittings) or ASTM F 439 (Schedule 80 CPVC fittings). All threaded CPVC fittings shall conform to ASTM F437 (threaded CPVC fittings schedule). Heavy bodied CPVC solvent cement shall be used along with a primer. IPS brand primer and heavy bodied CPVC solvent cement only should be used conforming to ASTM F493. All external CPVC pipes shall be coated with a water based acrylic paint emulsion for enhanced UV protection.

n. **Installation procedure:** All parameters pertaining to the installation of CPVC plumbing system such as cutting, joining, support spacing, expansion loops, insulation, type of support, special connections, etc. shall be as per the manufacturer's specifications.

Item 18.17.1 Providing and fixing Gun metal gate valve / garden hose ball valve with lever handle of approved quality (screwed end). Conforming to Manufacturers Standards. The installation shall be to the satisfaction of the Engineer in Charge. (a) 25 mm dia

1. **Material:** All valves shall be of gun metal suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. Valves shall either be of

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Check valves shall conform to Indian Standard IS:776 and non-return valves

2. **Workmanship:** The valve shall be fixed to the pipe line in position as indicated in the drawing and as directed by the Engineer-In-Charge.

TESTING: The valve and the joints shall be tested to a minimum hydraulically pressure of 10kg/sq.cm for a duration of two hours or as per testing clause of piping work. The testing shall be done along with the testing of pipe line. The leaky joints shall be rectified to the satisfaction of the Engineer-in-Charge.

3. Mode of Measurement:

a. Supplying and fixing Non Return Valve of specified diameter.

b. All necessary labour, material and use of tools.

c. **MODE OF MEASUREMENT:** The measurement shall be for each unit of non-return valve fixed. CPVC MTA, making screw or flange joint etc. shall be measured under the relevant items

Item RA04 Complete maintenance of the plantation area i.e. lawn trees, shrubs, hedge, flower beds, foliages, creepers etc. including hoeing,weeding pruning replacement of plants, gap filling, watering, mowing of lawn, grass cutting by lawn mover and brush cutter , removal of garden waste, applying insecticide, pesticide & fertilizers(whenever required) top dressing of lawn with good earth and manure and maintenance of other garden related works as directed by EIC / Institute This item shall be operated only after complete campus horticultural development and all plants have survived their development period or completion of defect liability period.This item shall be renewable on annual basis after completion of first year of maintenance, and institute shall have right to deny renewal without assigning any reason whatsoever.

(a) For first year

Item RA05 (b) For second year

Item RA06 (c) For third year

Item RA07 (d) For forth year

Item RA08 (e) For fifth year

Complete maintenance of the plantation area i.e. lawn trees, shrubs, hedge, flower beds, foliages, creepers etc. including hoeing, weeding pruning replacement of plants, gap filling,

DEVELOPMENT OF PERMANENT CAMPUS OF IIM UDAIPUR

watering, mowing of lawn, grass cutting by lawn mover and brush cutter , removal of garden waste, applying insecticide, pesticide & fertilizers(whenever required) top dressing of lawn with good earth and manure and maintenance of other garden related works as directed by EIC / Institute. Material supplied by contractor as per requirement. This item shall be operated only after complete campus horticultural development and all plants have survived their development period or completion of defect liability period. This item shall be renewable on annual basis after completion of first year of maintenance, and institute shall have right to deny renewal without assigning any reason whatsoever. Keep following minimum persons for maintenance mali 4 nos for planters and 4 nos for shrubs each day for the year.