Container Corporation of India Ltd.

Engineering Matters

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Infrastructure of an ICD includes:

- Paved Container Yard
- Administration Building
- Rail Siding
- Warehouse
- Parking
- Gate Complex
- Service Bldgs.- Canteen, toilet, Workshop, Substation, Fire Fighting, etc.

Paved Container Yard

Administrative Building

Rail Siding

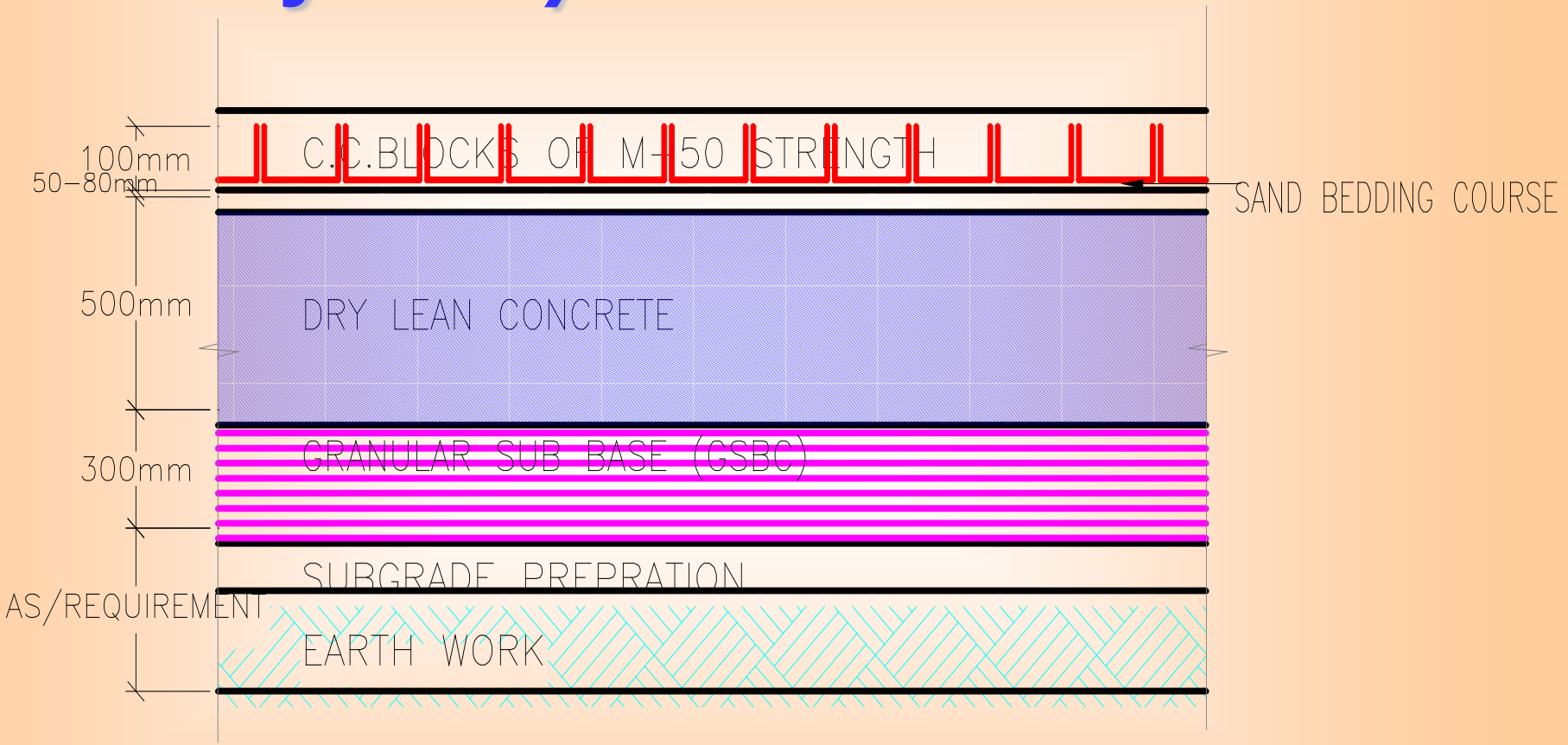
Warehouse

Types of Paved Container Yard

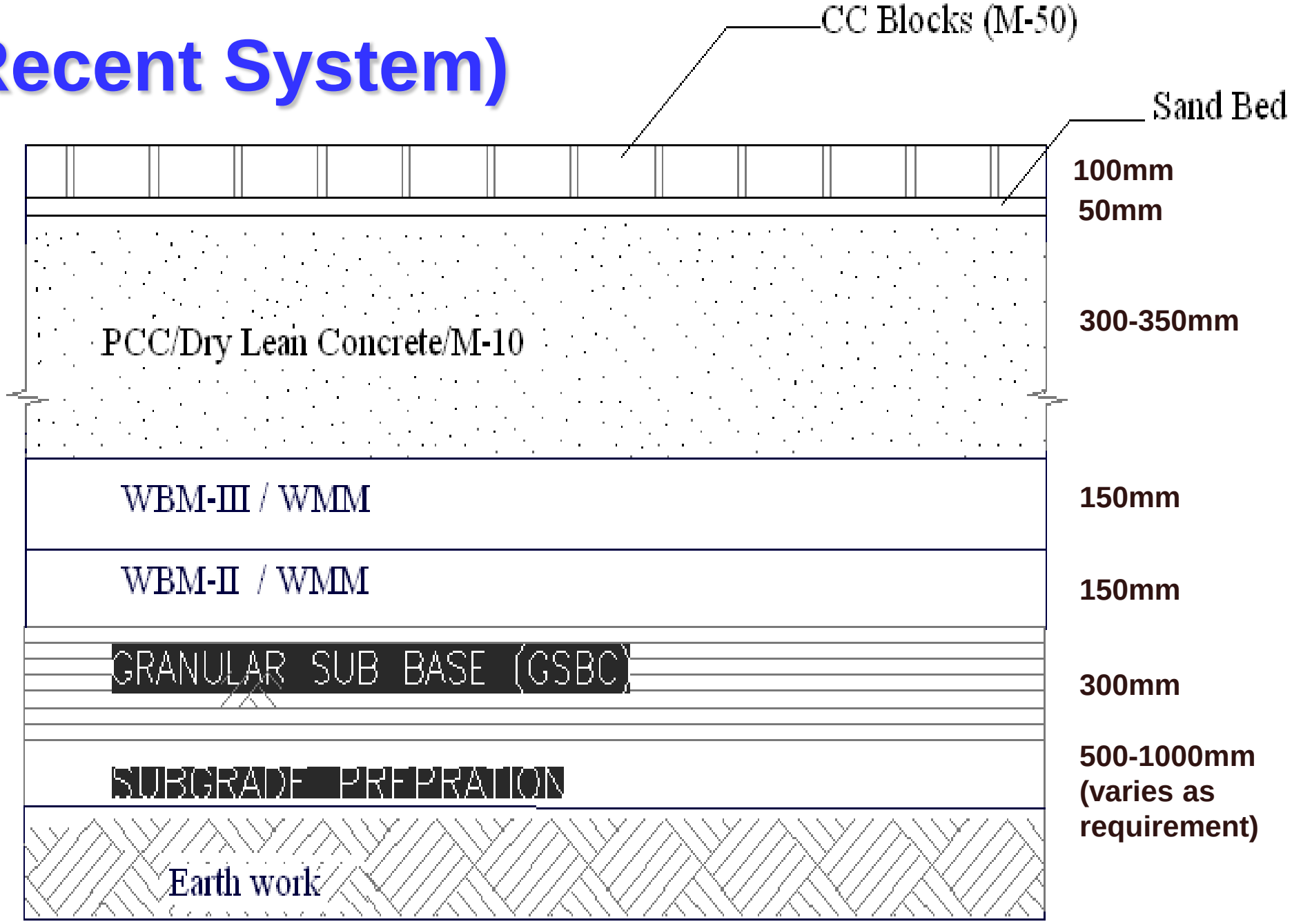
1. C.C. Block Pavement
2. CC Pavement
3. Bituminous Pavement
4. Pavement Quality Concrete (PQC) Pavement

CC Block Pavement

SECTION OF CC BLOCK PAVEMENT (Earlier System)



(Recent System)



What is M-50 Grade CC Block

- M-50 Grade CC Block is a block made up of cement, sand & aggregates mixture using paver block manufacturing machine. M-50 specifies the grade of the concrete mix wherein 'M' denotes mix & '50' denotes the strength of the concrete i.e. 50 KN/mm^2.

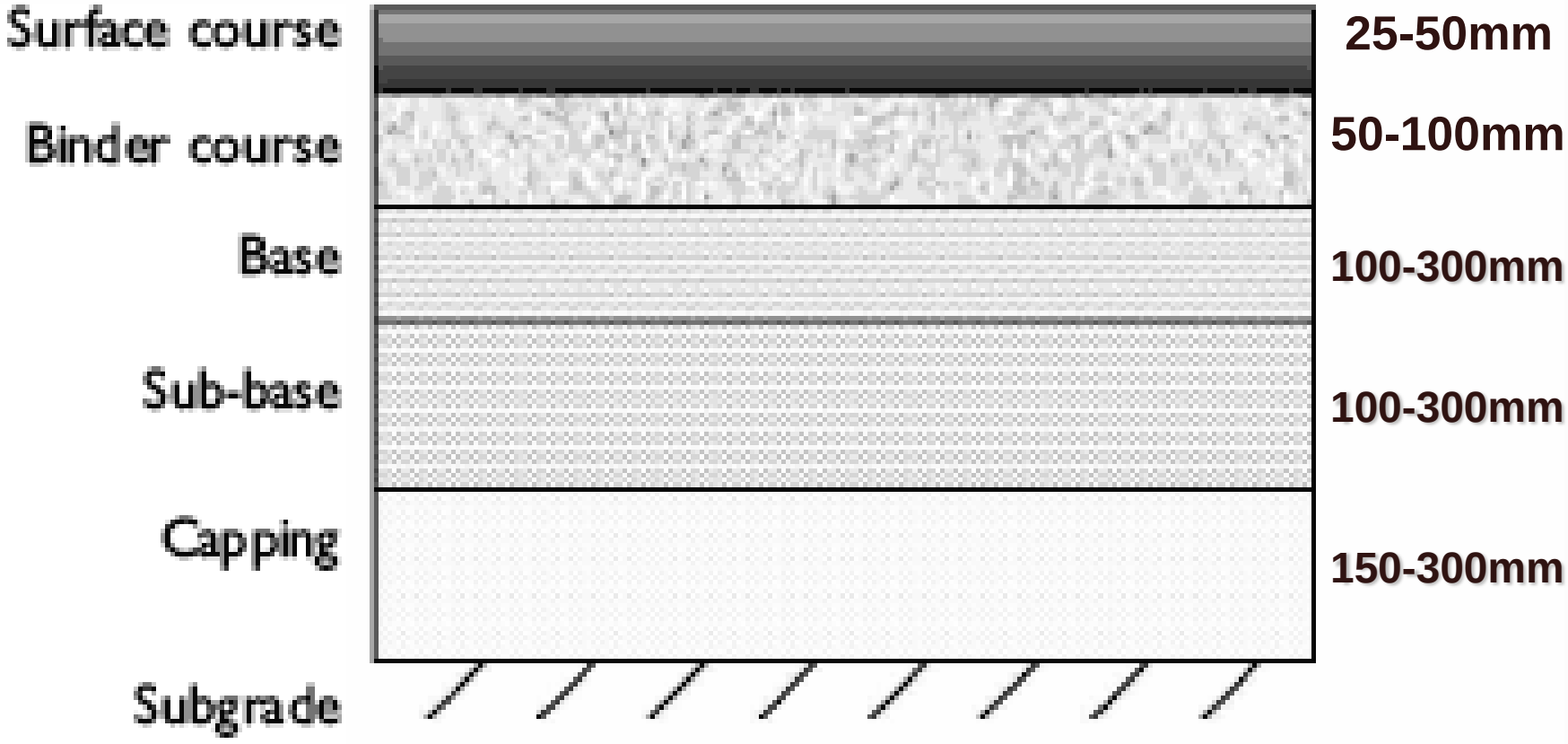
- The strength of the block is checked by using strength testing machine.

What is M-50 Grade CC Block

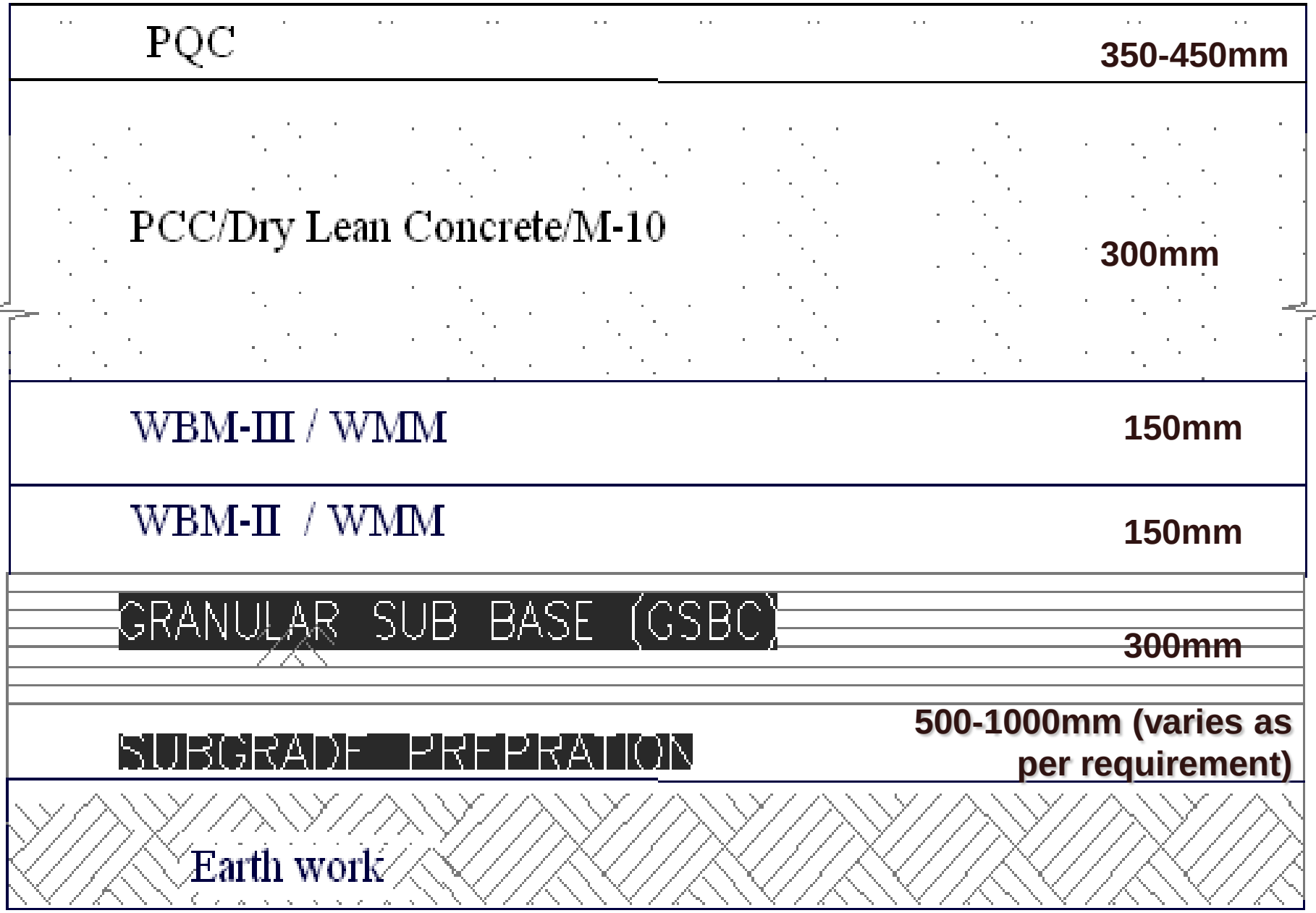
- **Different grades of concrete mix are utilized for different purposes based upon their strength e.g. M-20 to M-30 grades CC blocks are sufficient for footpath works and M-50 grade CC blocks are used for heavy duty vehicles.**

Bituminous Pavement

Bituminous Pavement



PQC Pavement


PQC
350-450mm
PCC/Dry Lean Concrete/M-10
300mm
WBM-III / WMM
150mm
WBM-II / WMM
150mm
GRANULAR SUB BASE (GSBC)
300mm
SUBGRADE PREPRATION
500-1000mm (varies as per requirement)
Earth work

Steps in Construction

q PQC Pavement:

It covers the following activities:

- Ø **Selection, Testing and Acceptance of all incorporated Materials for PQC.**
- Ø Design of Mixes for PQC and Trials, Acceptance etc.
- Ø Details of Plant, Equipment / Machinery as required in execution of PQC.

Contd…

- Batching, Mixing, Transporting, Placing, Finishing and Curing of Concrete for PQC.
- Mechanized Texturing and Curing operation for PQC.
- Joint Cutting and application of Joint Sealing compound as approved.
- Quality Assurance and Control Checks during operation and post concreting.

What is Rain Water Harvesting?

- **Rain water Harvesting is the accumulating and storing of water for reuse.**
- **The principle of collecting and using precipitation from a catchment surface.**

Contd…

Why Rain Water Harvesting ?

- Surface water is inadequate to meet our demand and we have to depend on ground water.
- To arrest ground water decline and augment ground water table.
- To conserve surface water runoff during monsoon.
- To reduce soil erosion.
- Due to rapid urbanization, infiltration of rainwater into the sub-soil has decreased drastically and recharging of ground water has diminished.

Contd…

Rain water harvesting techniques:

- **Roof top rain water harvesting.**
- **Surface runoff harvesting.**

Contd…

Elements of Roof Top Rain Water Harvesting *Contd...*

- **Catchments:** The roof of the house/building is used as the catchment for collecting rain water. The style construction and material of the roof effect its suitability as a catchment, roofs made of corrugated iron sheet, asbestos sheet, Tiles or Concrete can be utilized for harvesting the rain water.

- **Gutters:** Gutters are channels fixed to the edges of roof all around to collect & transport the rainwater from the roof. Gutters can be made in semi-circular and rectangular shape with cement pipe, plain galvanized iron sheet, PVC pipes, bamboos etc. Use of locally available material reduce the overall cost of the system.

- **Conduits:** Conduits are pipelines or drains that carry rain water from the catchment or rooftop area to the harvesting system Conduits can be of any material like polyvinyl chloride (PVC) or galvanized iron (GI), materials that are commonly available.

Elements of Roof Top Rain Water Harvesting

- **Filters:** The filter unit is a container or chamber filled with filter media such as coarse sand, charcoal, coconut fiber, pebbles & gravels to remove the debris & dirt from water that enters the tank. The filter unit is placed over the storage tank or separately. It may be of Ferro cement filter unit, Aluminum, Cement rings or Plastic bucket etc.

- **Storage/Recharge pits:** Recharge pits are constructed for recharging the shallow aquifer. These are constructed 1 to 2 m, wide and to 3 m. deep which are back filled with boulders, gravels, coarse sand.

Contd…

Operation and Maintenance: *Contd…*

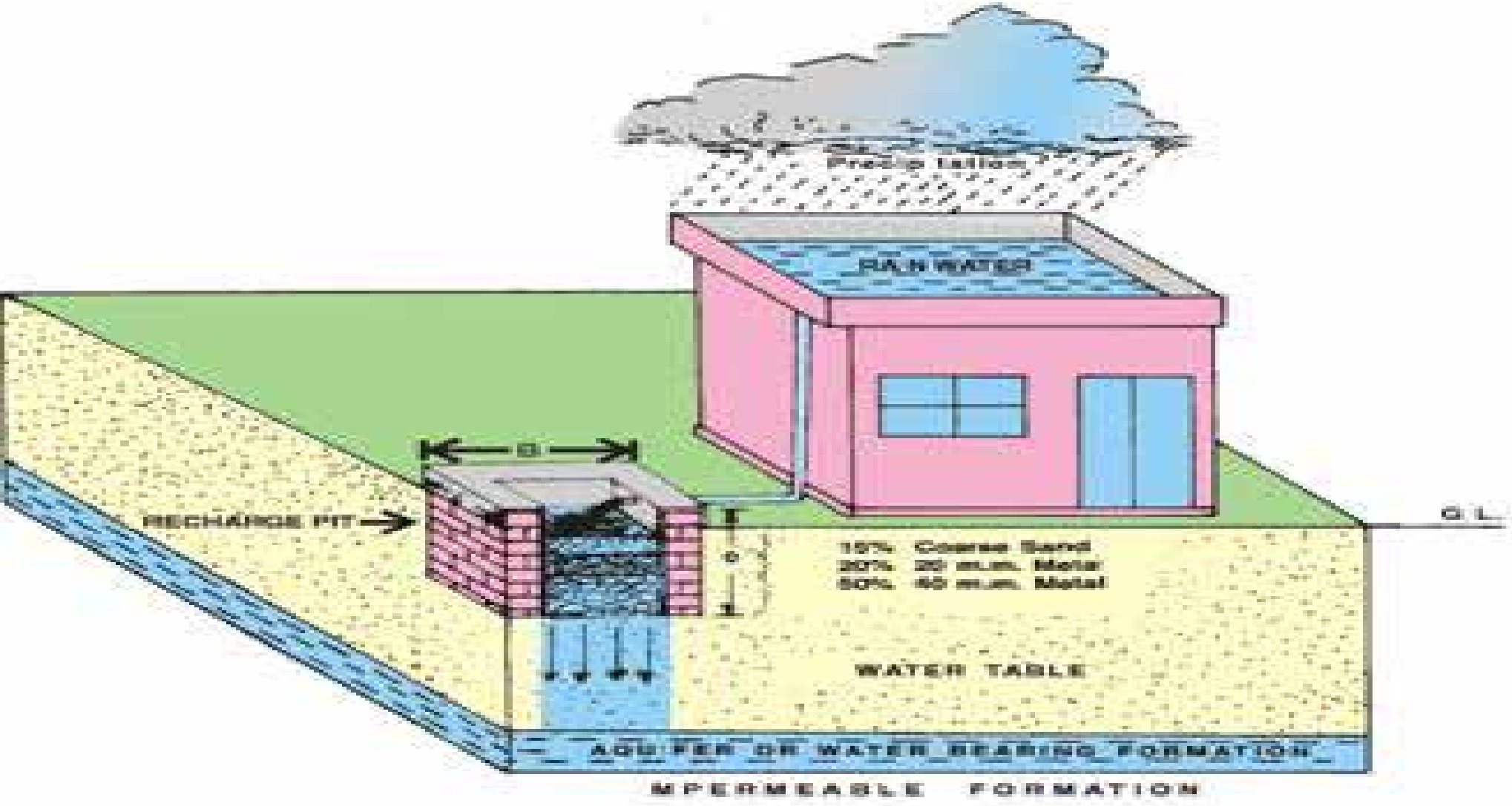
- **Proper operation and maintenance of rainwater harvesting systems helps to protect water quality in several ways. Regular inspection and cleaning of catchment, gutters, filters and tanks reduce the likelihood of contamination. Water from other sources should not be mixed with that in the tank.**

- **It is extremely important to maintain the rainwater harvesting systems regularly for high quality performance. Following aspects should be taken care of:**

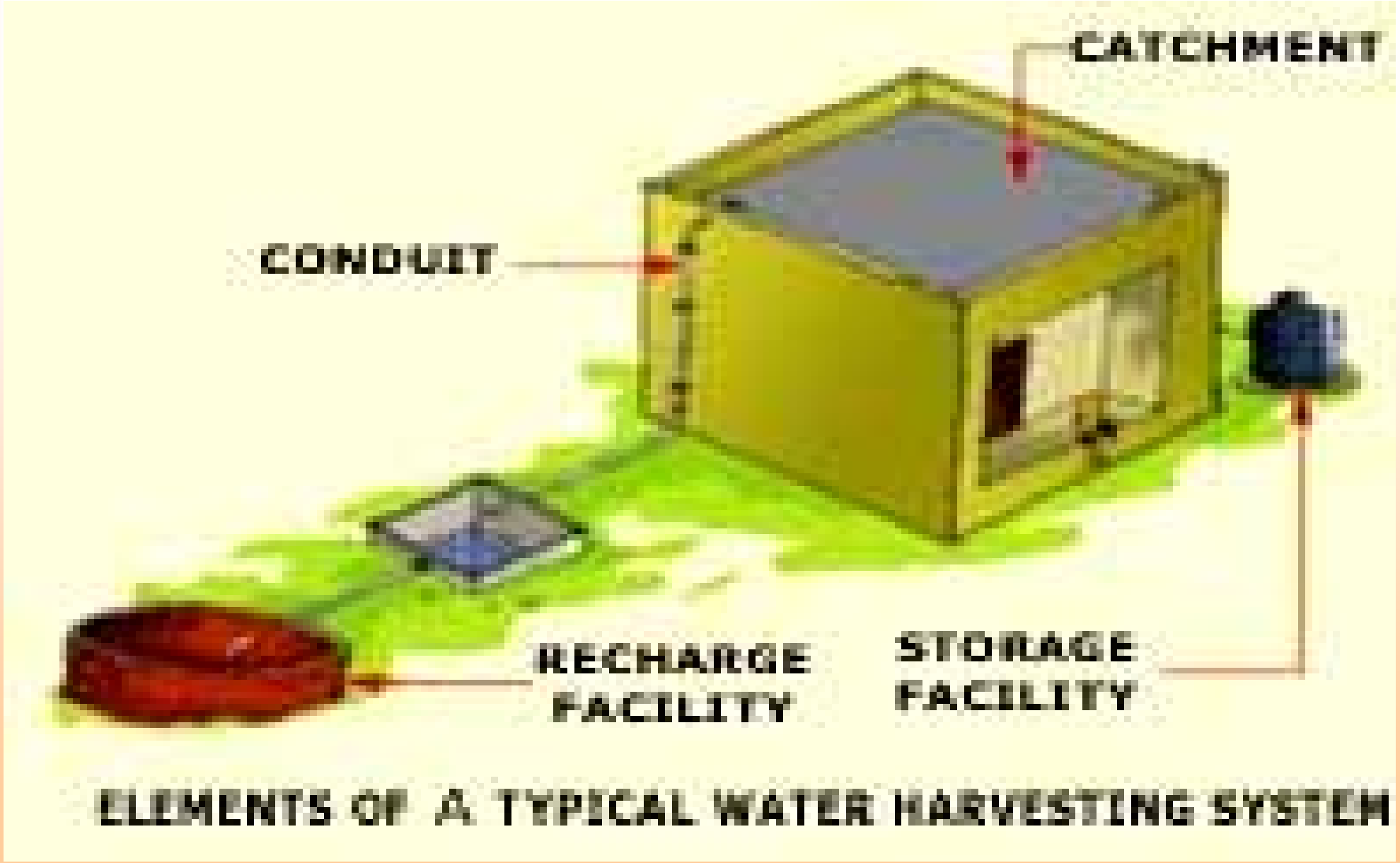
1) **Just before the arrival of monsoon, the rooftop/ catchmet area has to be cleaned properly.**

2) **The roof outlet on the terrace should be covered with a mesh to prevent entry of leafs or other solid waste into the system.**

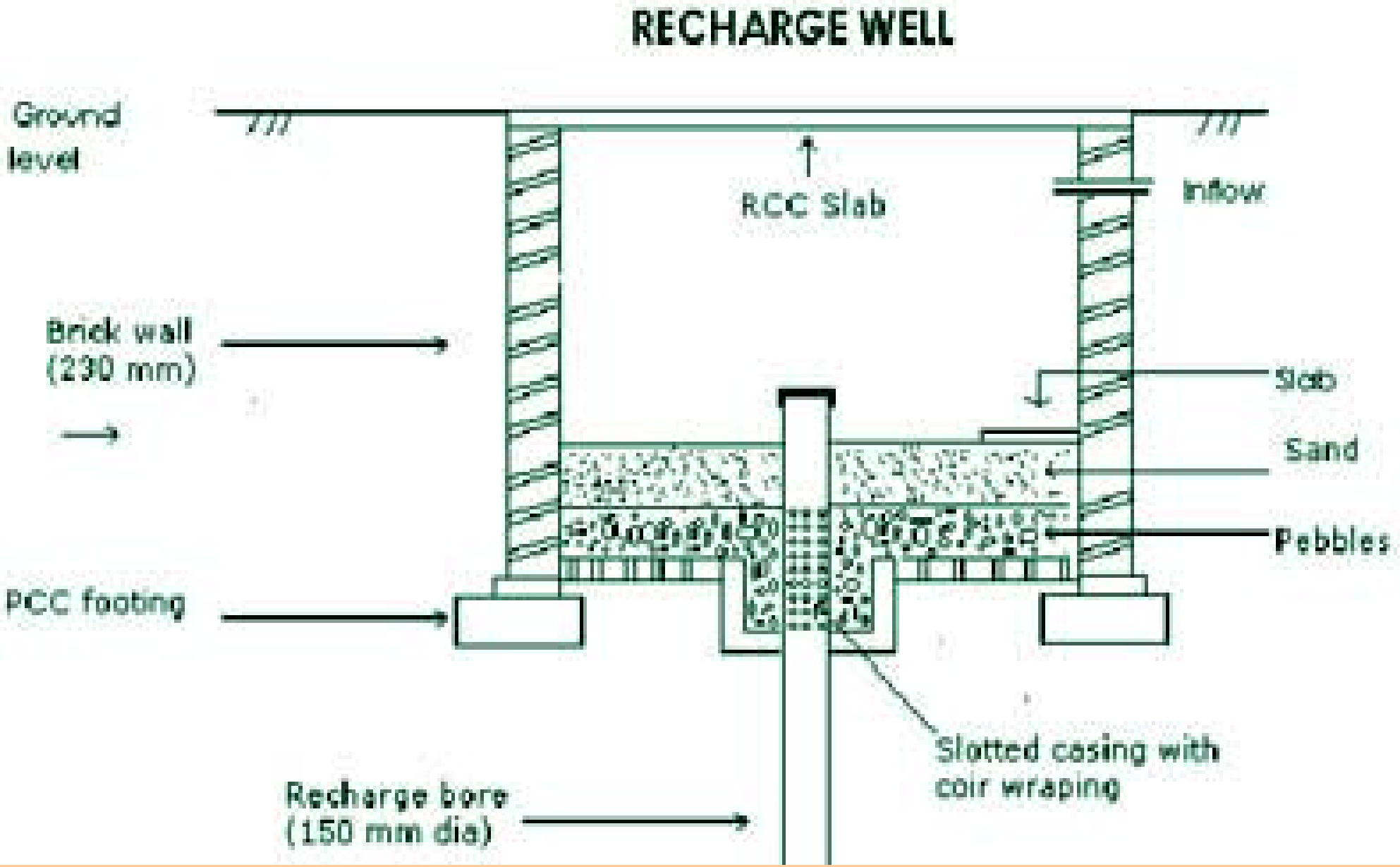
Rain Water Harvesting System



Elements of Rain Water Harvesting System



Recharge Well Structure



Rain Water Harvesting Tank

Shortcomings/deficiencies noticed during various inspections in Engineering Works

Common Shortcomings/deficiencies noticed during various inspections at various terminals

1. **Pavement-** Improper laying, shallow depressions, potholes, broken blocks, cracks, improper slope etc.
2. **Boundary Wall-** improper painting, deflected walls, seepage along walls etc.
3. **Drainage-** Blocked with garbage, improper slope etc.
4. **Ramp of Warehouse-** Improper height of ramp.

Contd…

Common Shortcomings/deficiencies noticed during various inspections at various terminals

4. Curing -

- Insufficient curing, improper methods etc.

Contd…

What is Curing??

Curing is the process of controlling the rate and extent of moisture loss from concrete during cement hydration.

Curing may be defined as the process of maintaining satisfactory moisture and temperature conditions for freshly placed concrete for some specified time for proper hardening of concrete. Curing in the early ages of concrete is more important. If curing is not done properly, the strength of concrete reduces. Cracks develop due to shrinkage. The durability of concrete structure reduces. Curing for a minimum period of 28 days should be ensured in areas of high temperature like Delhi, Ahmedabad, Kolkata. Only in areas of heavy rainfall the period of curing can be decreased from 28 days. The following curing methods are employed:

Contd...

(a) Spraying of water

(b) Covering the surface with wet gunny bags, straw etc.

(C) Ponding

(d) Steam curing and

Contd…

CURING OF PAVEMENT

1) BANKING WATER BUNDS

Curing by using sprinklers

2) Curing using gunny bags

Curing using gunny bags

Curing using gunny bags

Curing by using plastic sheets

Curing of blocks by keeping the blocks in water tank

Ponding i.e.Curing by making water bunds

Improper curing leads to early degradation of the structure and reduces the effective life of the structure.

Defects arising due to improper curing and other reasons as improper content of cement, improper mix of concrete, water cement ratio etc.

Cracks appearing on surface of pavement

Defects arising due to improper curing and other reasons as improper content of cement, improper mix of concrete, water cement ratio etc.

Honeycombing

Defects arising due to improper curing and other reasons as improper content of cement, improper mix of concrete, water cement ratio etc.

Cracks leads to complete deterioration of structure

Common Shortcomings/deficiencies noticed during various inspections at various terminals

5. Mandatory Testing -

- Ø **Less number of tests conducted than required.**

List of Mandatory Tests to be conducted

Contd…

Common Shortcomings/deficiencies noticed during various inspections at various terminals

- **System Improvement has been issued w.r.t. selection of laboratory for outside testing. The same has been found not followed at a number of sites.**

The following system improvements had been issued by Engineering Division

Contd…

Common Shortcomings/deficiencies noticed during various inspections at various terminals

6. Cement Storage -

- Improper storage of cement observed.

Contd…

Common Shortcomings/deficiencies noticed during various inspections at various terminals

7. **Registers-** **Register like Site Order Book, Hindrance Register etc. not filled properly.**

List of Registers to be maintained at site is given below:-

Contd…

Common Shortcomings/deficiencies noticed during various inspections at various terminals

8. Improper maintenance of CONCOR assets.

a) Rain Water Harvesting system not maintained properly.
b) Maintenance of Admin Building not done properly.
c) Warehouse.
d) Lightening System not maintained properly.
e) Rail Sidings not maintained properly.

Deficiencies Observed during various inspections in execution of works

Work not done as per Specifications

M-50 grade CC Block Work

- Out of 14000 sqm area paved with M-50 CC blocks, about 5400 sqm area found not meeting the required strength of M-50 Grade and found with lower strength of M-40/M-35 Grade.
- This area was rejected, recovery made and contractor banned for future business with CONCOR, site engineer removed from the service.

Work not done as per Specifications

- Cement Concrete base with 1:3:6

- Core samples extracted from the hardened concrete found not meeting the compressive strength requirements for the base concrete 1:3:6, i.e. equivalent Cube Strength of some core samples found about 4 to 6 N/mm^2 against 7.5N/mm^2.

Thickness of base concrete 1:3:6 not maintained

- Ø Thickness of base concrete is generally 300mm.
- Ø In one of the projects, thickness of base concrete 1:3:6 found about 240-270mm at some of the locations against 300mm.
- Ø Contractor tries to save in concrete work as the same is costlier than , Earth, GSBC and WBM.
- Ø Checks required at interim design levels to achieve final design level.

Site records not maintained properly

- Hindrance Register
- MTC: Manufacturer's Test Certificate not obtained for cement & steel.
- Registers for maintaining site records not signed & issued by Competent Authority.
- Compliance in site order book not recorded by the site engineer.
- Record of receipt & consumption of chemicals used in hardener in VDC not found maintained.

General deficiencies observed

- Broken CC blocks found in use.
- Top level of Gully chambers, inspection pits, found higher than finished level of PQC/CC block pavement area.
- Tolerance limits w.r.t levels in laying of CC blocks found not as per technical specifications.
- Kerb wall found not in straight line
- Mandatory testing not being conducted as per CPWD/MORTH/ technical specifications of contract.
- Materials extracted from earth i.e. stones etc, used materials but intact – not accounted for.

Sites Engineer Deployment

- Site Supervisors/Engineers deployed on contract basis for supervising construction activities found not aware of maintaining proper site records such as, test records, issue & consumption of cement and also found not knowing testing procedures for conducting field test.

- At one of the sites frequents shifting of site Engineers have been noted.

Testing problems in CONCOR

- Mandatory tests on various materials not conducted as per the prescribed frequency in the contract document/BIS codes.
- Deficiencies in appropriate sampling and proper documentation test results.
- Test results obtained from outside lab not properly recorded in the test registers ensuring that the results obtained passes the acceptability criteria.
- Dependability for lab testing on contractor for testing charges, transportation etc, since the quoted rate of contractor includes testing charges, transportation etc.

Monitoring of Testing

Ø Checkpoints:

(i) Name of the test

(ii) Stages at which tests are required to be carried out .

(iii) No. of samples and frequency of testing.

(iv) Reference of IS codes or any other specification.

(v) Quantity of sample material required per each test.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works: *Contd…*

1) All proposals of existing terminals are initiated by region and forwarded to GGM/SP. As such, regional heads should ensure association of terminal managers, if considered necessary by them.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works:

Contd…

2) A copy of the agreement is made available to the Regional Heads wherein the scope of the work is given. Terminal Manager should see that the work is broadly in accordance with the plans.

   The copy of the agreement should also be provided to Terminal Manager. The plan for the construction activities should be given to TM from either the consultant or Project-In-Charge right after the award of the work and taking over of site.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works: *Contd…*

3) A joint survey of Contractor, Project Management Consultant, Project Executives and Terminal Manager will be held to earmark the phase-wise handing over of site for starting of works in time bound manner. Joint survey shall be carried out immediately after awarding of contract on prefixed date so that contractor can mobilize his resources early. Delay of starting of works on this ground, if any, shall be recorded in the hindrance register/site order book.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works:

Contd…

Planning of handing over of site and taking over should be decided in joint survey conducted presence of contractor, consultant, Project-in-charge and Terminal Manager, bar chart submitted by contractor should be seen during this meeting and this should be formed in the minutes of the meeting held with contractor, consultant, Project-in-charge and Terminal Manager and placed in file of terminal, for records.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works:

Contd…

4) TM shall issue or facilitate issue of Form-V which is mandatory requirement for obtaining labour license by the contractor. Delay in issue of form-v resulting in delayed starting of works shall be recorded in the hindrance register.

5) TM shall check proper storage of cement in presence of PMC and inform about deficiency, if any, to project executive of co and record the same in the site order book.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works: *Contd…*

6) TM should check that there is no major water stagnation on the surface. In case, any major water stagnation is observed, the same should be recorded in the site engineer's register and brought to the notice of the consulting engineer and the Project-in-charge.

The checking of stagnation of water should be done after the completion of work in that specific area.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works: *Contd…*

7) During the annual maintenance contract, repair & maintenance works which is under the control of regional heads, TM shall check presence of helper/assistant along with electrician while undertaking electrical works in running installations during execution. TM will inform DGM/electrical or Sr. Manager/electrical if adequate staff is missing in case of contracts awarded by the CO and working with live installations.

Duties and Responsibilities of Terminal Managers with regards to Civil & Electrical Works: *Contd…*

8) It needs to be ensured that proper curing in ongoing construction is done. When curing is required in the repairs in the existing terminal where there is TM, the TM should see that it is done in proper manner for adequate duration. In the case of new locations, consulting engineer should certify that curing has been done in prescribed manner. The appropriate engineer from CONCOR should make surprise check and record findings TM.

Container Corporation of India Ltd.

THANK YOU