TECHNICAL INSTRUCTIONS

ON

LAYOUT, PLANNING, EXECUTION, OPERATION AND MAINTENENCE OF SWIMMING POOL

BY

DTE OF WORKS
ENGINEER-IN-CHIEF’S BRANCH
MILITARY ENGINEER SERVICES
INTEGRATED HQ OF MOD (ARMY)
The swimming pool technology has been subjected to a sea of new technological advances all over the world. Construction, planning as well as operation and maintenance of today’s swimming pools to the superior water quality and utmost hygienic environments are essential to be maintained. It’s our endeavour to remain updated with technological development. These technical instructions (TI) are issued to update Engineers in far flanged areas with advancements in technologies.

This TI is written for those involved with designing, planning, execution as well as operation and maintenance of new as well as old swimming pools to equip them with the latest technological improvisations in the field of swimming pools. The TI gives precise inputs right from selection of suitable site till completion of pool facility. Various tried and tested circulation diagrams of circulation system, diving facilities are described clearly with diagrams. Important precautions and measures for ensuring leakage free construction of swimming pools are highlighted. Operational methods including chemical dosing, water testing, water quality standards, recording log sheets are new systematic ways of maintaining consistent water quality in the swimming pools which are very well conveyed.

This would help in our ‘QUEST FOR EXCELLENCE’ and “to develop MES into the most competent, efficient, responsive, cost effective and technologically advanced construction agency for the Defence Forces and the National construction Effort”. I am glad this TI has been drafted with the latest provisions covered under various codes.

New Delhi
Sep 10

(A K NANDA)
Lt Gen
E-in-C
Training and recreation are the two important aspects of troop’s fitness; therefore, training and recreational facilities are the important features of any military station. Swimming pool covers both these important aspects. A well designed and executed swimming pool in any military station is, therefore, a great asset to boost the morale of the troops. This is also one place which is widely used by all ranks and their family and requires utmost attention.

TI 03/2010 has been drafted to provide information in regard to the planning, design, execution and maintenance of swimming pool system covering all expects of this field. The main objective has been to convey information to various engineers with a view to improve quality of execution and also update the information and role of MES and users. The TI has also covered all aspects of swimming pool and the latest development in the field. Overall this TI is an informative compendium and will be helpful and useful to the planners and ground engineers to maintain the system efficiently.

I am sanguine that this TI would guide all executives and staff in achieving enhanced standards. I expect its contents to be followed explicitly, to serve our ongoing thrust towards providing better services to users.

New Delhi
Sep 10

(Brajesh Kumar)
Maj Gen
DG (Works)
## INDEX

<table>
<thead>
<tr>
<th>Ser No.</th>
<th>Description</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GENERAL</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>AUTHERISATION / SCALES</td>
<td>5-6</td>
</tr>
<tr>
<td>3</td>
<td>SELECTION OF SITE</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>FOUNDATION</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>DESIGN PHILOSOPHY AND PLANNING</td>
<td>6-8</td>
</tr>
<tr>
<td>6</td>
<td>DIVING REQUIREMENTS</td>
<td>8-11</td>
</tr>
<tr>
<td>7</td>
<td>OTHER POOL FITMENTS</td>
<td>11-12</td>
</tr>
<tr>
<td>8</td>
<td>CONSTRUCTION OF POOL</td>
<td>12-14</td>
</tr>
<tr>
<td>9</td>
<td>WATER CIRCULATION SYSTEM</td>
<td>14-16</td>
</tr>
<tr>
<td>10</td>
<td>FILTRATION PLANT</td>
<td>16-17</td>
</tr>
<tr>
<td>11</td>
<td>POOL DRAIN SYSTEM</td>
<td>18-19</td>
</tr>
<tr>
<td>12</td>
<td>POOL CLEANING SYSTEM</td>
<td>19-20</td>
</tr>
<tr>
<td>13</td>
<td>POOL WATER PURIFICATION</td>
<td>20-22</td>
</tr>
<tr>
<td>14</td>
<td>DAILY OPERATION OF POOL</td>
<td>22</td>
</tr>
<tr>
<td>15</td>
<td>DAILY CHEMICAL TREATMENT</td>
<td>22-23</td>
</tr>
<tr>
<td>16</td>
<td>POOL WATER QUALITY AND STANDARDS</td>
<td>23</td>
</tr>
<tr>
<td>17</td>
<td>ANNEX A - LAYOUT OF 25 M POOL</td>
<td>24</td>
</tr>
<tr>
<td>18</td>
<td>ANNEX B - LAYOUT OF 50 M POOL</td>
<td>25</td>
</tr>
<tr>
<td>19</td>
<td>ANNEX C – LANE MARKINGS</td>
<td>26</td>
</tr>
<tr>
<td>20</td>
<td>ANNEX D - POOL LOG SHEET</td>
<td>27-28</td>
</tr>
<tr>
<td>21</td>
<td>ANNEX E – LIST OF RELATED IS STANDARDS</td>
<td>28</td>
</tr>
</tbody>
</table>
1. GENERAL

- Swimming Pools are considered today as a topmost physical training as well as Recreation Centers and their construction represent a major cash investment.
- Creation of modern Swimming Pool Facility requires top class designing, planning and careful execution by experienced construction team under expert supervision.
- Requires elaborate understanding of various water treatment techniques for maintaining sparkling clear water quality, hygiene and safety to swimmers as well operating personnel.
- The aim of this Technical Instruction is to provide guidelines for layout and planning, design, construction, operation and maintenance of modern swimming pools.

2. AUTHORISATION / SCALES

Scales of Accommodation for Defence Services, 2009, Chapter 8, Training and Recreational Facilities, deals with the provision of swimming pools, which will invariably be followed when planning swimming pools. Para 8.8 and Table 8 VIII give details of the sizes and the number of swimming pools and diving pools that are authorized for a Station depending upon its strength. The salient provisions of the Scales are given below as a guide and to provide a link of the Scales with the standard plans developed as Types A, B, C and D:

TYPES OF SWIMMING POOLS IN MIL STATIONS

- Type A - 50 m x 21 m Main Swimming Pool with a separate Diving Pool of 16 m x 16 m. The main pool has water depth of 1.0 m at both ends and increasing to 2.5 m in the center. The diving pool has a uniform depth to 5.0 m.
- Type B - 50 m x 21 m Main Swimming Pool with a separate Diving Pool of 16 m x 16 m. The main pool has a uniform water depth of 1.8 m throughout. The diving pool has a uniform water depth to 5.0 m.
- Type C - 50 m x 21 m Swimming Pool without a separate diving pool. The water depth is 1.0 m at shallow end increasing to 5.0 m at deep end.
- Type D - 25 m x 13.5 m Swimming Pool with water depth of 1.0 m at shallow end increasing to 4.0 m at deep end with maximum 3.0 m height diving facilities.

SELECTION CRITERIA FOR MIL STATIONS

a. No swimming pool is authorized for less than strength of 1000.
b. The type and no. of pools authorized for any MIL station are as under:

<table>
<thead>
<tr>
<th>Strength of MIL Stn</th>
<th>Authorized Pools</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. 1000 to 5000</td>
<td>Type D - One pool</td>
</tr>
<tr>
<td>ii. 5000 to 8000</td>
<td>Type C - One pool</td>
</tr>
<tr>
<td>iii. 8001 to 14000</td>
<td>Type C - One pool + Type D – One pool</td>
</tr>
</tbody>
</table>
iv. 14000 to 20000 Type C One pool + Type D - Two pools
    or Type C - Two pools

v. More than 20000 Type A or Type B only – Max. three pools.

The choice of the Type (A, B, C or D) of swimming pool for a first pool in a station or as an additional pool required due to increased strength must be made in accordance with the dictates of the Scales and Accommodation and the requirement of the user keeping in mind the type descriptions given above. Special attention is drawn to Paras 8.8.3 through 8.8.6 the Scales for incorporation at the board stage.

3. SELECTION OF SITE

The general area of locating a swimming pool facility may often be determined from Cantonment planning considerations. Other important consideration for pool site selection:

- Soil investigation must be carried out preferably before the final selection of the site and definitely before the preparation of the AE.
- Soil investigation should be carried out to such depths below the deepest part of the pool by boreholes (IS 1892:1979) as to provide adequate data for structural design.
- The sub-soil water should be chemically analyzed to check for possible deleterious effects on structural concrete.
- Soil properties must be such as to provide good foundation
- Water table must be sufficiently low for ease of construction. In case the water table is high or the ground is rocky and it is not possible to relocate the pool, possibility of constructing the pool partly or wholly above the ground level should be explored.
- The choice of the site may also be influenced by the availability of water, power, easy sewerage disposal and access to the users.

4. FOUNDATION

The choice of foundation will be dictated by the soil condition.

- In case of ‘Black Cotton’ soil condition, piling should be done for the raft of pool as well as adjoining building portion.
- In case of ‘Sandy’ soil condition either piling or granite stone rubble soling of adequate depth should be adopted.
- For ‘Murrum’ type soil condition, stone soling is not required.

5. DESIGN PHILOSOPHY AND PLANNING
Depending upon type of pool, whether A, B, C or D planned at a particular site, the next step is preparation of architectural layout drawing and designing of actual pool and related infra-structure. Important guidelines for preparing architectural design of pool facility –

- It is must that longer side of pool is aligned as close as possible to North –South direction.
- The basis of design is that the pool floor and pool walls must form a “Monolithic” structure such a way that the pool floor and wall are acting together to resist the water load.
- Proper seismic reinforcements are a must as per seismic zonal code requirements.
- Minimum M 25 grade concrete must be planned for the pool floor and walls.
- Shallow end water depth required is 1.0 m and reverse slope at other end is a must for easy drainage of dirt and dust.
- The floor profile of the pools must be as per Fig. 1 and Table 1.
- There must be a reverse slope at deep end side, so that the deepest point in the pool is situated fairly inside the deep end pool edge and easily accessible for pool cleaner.
- Deck design ….. Wet Deck of min. 1.0 m width all round periphery of pool and Dry Deck of min. 3 m width all round and min. 6 m width behind diving structure is a must. Dry Deck to have an outward slope of 1:300 for proper drainage of rain water.
- A storm drain gutter is must at the periphery of dry deck preferably at the edge of compound wall.
- A Balancing Tank of 10% volume of pool water capacity is a must and should be located closer to filter room and deeper area of pool so that pipeline required and the friction losses are minimum. A round or rectangular shape is OK, only requisite is, it should be at or below pool water level.
- Design of change room block depends on bathing capacity of pool. The International Standards are –
  - 1 bather per 2.5 sq. M of pool area having depth of 1 to 1.5 m
  - 1 bather per 3.5 sq. M of pool area having depth of more than 1.5 m
- The other compulsory requisites of any well planned swimming pool facility are as follows –
  a. Filtration Plant Room of adequate size and height.
  b. Two Store Rooms …. One for pool chemicals and one for pool accessories
  c. Entrance Lobby of adequate size and suitable design.
  d. Gents Change Room and Shower Block of adequate size. Open Outdoor Shower towers are more and more preferred for Gents now-a- days as they have been found to improve hygiene of pool water.
  e. Ladies Change Room and Shower Block of adequate size.
  f. Minimum 2 Nos Entrance Gates with well designed lockable gates.
  g. External water supply arrangement for make up of lost water in the pool.
h. There must be proper sewage disposal arrangement of filter wash water as well as deck and change room and shower block water.

i. Preferably separate Electrical Transformer with minimum 2 Nos of earthing pits.

j. Spectator Gallery with separate entrance (not from pool deck area). The spectator gallery must be constructed min. 1 m above water level for proper visibility and it should cover entire length of long side of pool.

k. The level of the spectators gallery and other connected levels should be based upon the level of the water in the swimming pool. In cases where for technical reasons, the bottom of the pool has been raised, the space below the spectators gallery may be utilized for providing change rooms, stores etc.

l. Compound wall of min. 3 m height all around periphery of swimming pool complex.

New pool designs have ruled out use of fountains or cascades as they help in losing chlorine to atmosphere very fast as well as they slow down the circulation rate. It is therefore recommended to demolish the existing cascades wherever present in pools. If at all cascade is required for beatification purposes it can planned near the pool, however it must be with separate water storage sump and pumping system and no way connected with pool circulation system. Footbaths have also become outdated now a days since occurrence of athletes foot decease is nil all over world.

6. DIVING REQUIREMENTS

GENERAL

- The height of the springboards and each platform above the water level may vary by plus 0.05 m from the heights prescribed in Table 1.
- In outdoor pools, springboards and platforms are recommended to face north in the northern hemisphere and south in the southern hemisphere.
- The minimum illumination at a level of one meter above the water surface shall be 500 Lux.
- Mechanical surface agitation may be installed under the diving facilities to aid the divers in their visual perception of the surface of the water.
- The water temperature in the diving pool shall be not less than 26°C (79°F).
- The minimum distance separating the diving pool from the swimming pool shall be 5.0 m.

SPRINGBOARD DIVING

- Diving Springboards are permitted from 1m and 3 m height from water level only.
- The boards shall be at least 4.8 m long and 0.5 m wide.
- The boards shall be provided with a satisfactory slip-resistant surface.
The springboards shall be provided with movable fulcrum, easily adjustable, by the diver.

PLATFORM DIVING

- Diving Platforms are permitted only from 5.0 m, 7.5 m and 10.0 m height from water level only. Each platform shall be rigid.
- The minimum dimensions of the platform are:
  
  a. 5.0 m platform - 1.5 m width x 6.0 m length  
  b. 7.5 m platform - 1.5 m width x 6.0 m length  
  c. 10.0 m platform - 2.0 m width x 6.0 m length  

- The thickness of the front edge of the platform shall be maximum of 0.02 m.
- The surface and the front edge of the platform shall be covered throughout with a resilient non-slip surface.
- The front of 10 m and 7.5 m platforms shall project at least 1.5 m beyond the edge of the pool and that of 5.0 m platform should project by 1.25 m.
- The back side of each platform shall be surrounded by handrails with a minimum clearance of 1.80 m between pairs.
- Each platform shall be accessible by suitable stairs (not ladders).
### Figure 1: Diving Board Table 1: Dimensions for Diving Facilities

<table>
<thead>
<tr>
<th>NO.</th>
<th>DIMENSIONS OF DIVING FACILITIES IN METERS</th>
<th>SPRINGBOARD IN METERS</th>
<th>PLATFORMS IN METERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>LENGTH</td>
<td>4.80</td>
<td>4.80</td>
</tr>
<tr>
<td></td>
<td>WIDTH</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>HEIGHT</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>---</td>
<td>--------------------------------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>A</td>
<td>From plummet back to pool wall</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>B</td>
<td>From plummet to Pool wall at side</td>
<td>2.50</td>
<td>3.50</td>
</tr>
<tr>
<td>C</td>
<td>From plummet to Adjacent plummet</td>
<td>2.00</td>
<td>2.20</td>
</tr>
<tr>
<td>D</td>
<td>From plummet to Pool wall ahead</td>
<td>9.00</td>
<td>10.25</td>
</tr>
<tr>
<td>H</td>
<td>Depth of water At plummet</td>
<td>3.50</td>
<td>4.00</td>
</tr>
<tr>
<td>J</td>
<td>Distance and depth</td>
<td>5.00</td>
<td>6.00</td>
</tr>
<tr>
<td>K</td>
<td>Ahead of plummet</td>
<td>3.30</td>
<td>3.60</td>
</tr>
<tr>
<td>L</td>
<td>Distance and depth</td>
<td>1.50</td>
<td>2.00</td>
</tr>
<tr>
<td>M</td>
<td>Each side of plummet</td>
<td>3.30</td>
<td>3.60</td>
</tr>
</tbody>
</table>

7. OTHER POOL FITMENTS

Other important fitments compulsorily required for completion of pool facility are as follows-

- **Starting Blocks – Starting Platforms** as per International standards are required for all sports pools. They are made of stainless steel and grouted in position at both ends of pool. Each starting platform must have a proper handrail for back-stroke racing.

- **Ladders** – Anti-corrosive stainless steel material are a must for any pool. Minimum three ladders must be fitted on each longer side of pool. No ladders to be fitted on short side of the pools.

- **Hand Rails** – Handrails are compulsory for any sports pool all round periphery of pool. They act as an important exercise aid as well as resting points in the pool. They must be made from minimum 38 mm dia. stainless steel tubes. Hand Rails should be fitted in the center of free board region above water level.

- **Safety Equipments** – Important safety equipments are also a must for any sports pool. They have to be placed on the pool at strategic locations such that they can be quickly provided to the problematic swimmer whenever required.

They include following –
a. Safety Lifebuoys Rings, 500 mm dia – 6 Nos
b. Safety Rope – 2 Nos
c. Safety Pole – 2 Nos
d. First Aid Boxes – 2 Nos
e. Stretcher - 2 Nos

8. CONSTRUCTION OF POOL

Following important facts must be carefully observed during construction stages of any Swimming Pool -

- A mix of at least M 25 grade concrete as per IS: 6494 -1988 is recommended.
- The workability of the design mix should be suited to the conditions in the forms and the w/c ratio maintained as low as possible for strength requirements.
- The use of plasticizers in the mix should be considered depending upon the levels of supervision enforceable at the construction site.
- Aim of concreting should be to achieve an impermeable, dense concrete avoiding any honey-combing.
- Any uplift pressure on the slab of the main / diving pool due to a high ground water table should be avoided as far as possible.
- While doing construction of the swimming pool, practically, entire casting of the pool shell is not possible in one go. But most important point to note is to cast entire floor and 30 cm height of wall in one go to avoid any subsequent leakage problems in the floor.
- No construction or expansion joints should be permitted in the floor of pool.
- Remaining portion of wall can be cast in subsequent batches by allowing proper construction joints.
- Use of water stoppers of PVC or rubber material has become outdated in construction joints. Use of aluminum sheet strips of 16 gauge thickness and 150 mm or 200 mm width are recommended.
- The RCC work of swimming pool must be followed by two 20 mm thickness screed bed layers for making proper leveled surface for tiling.
- Waterproofing treatment for swimming pool construction is three fold as follows –
  i. Use admixtures during concreting of floor and walls.
  ii. Use waterproofing compounds in the two screed bed plaster layers.
  iii Use tile adhesive for tiling of the pool.

- Before commencing the work of tiling in the pool, a no-leakage test should be carried out. The fixing of pipes to be embedded in the concrete should be provided with puddle flange or collars for ensuring water tightness.
- Following piping materials are recommended for filtration plant and circulation system of swimming pools –
i. For pump suction piping - HDPE pipes of 10Kg/sq.cm are advised against old C.I pipes for ease of handling, laying and maintenance.

ii. For pump to filter section - Mild Steel pipes in heavy gauge are advised for ease of fabrication and sturdiness.

iii. For filter to pool entry point section - HDPE pipes of 10Kg/sq.cm are advised against old C.I pipes for ease of handling, laying and maintenance.

iv. For pool jet piping which is concealed in concrete, UPVC piping in 10 Kg/sq.cm rating are advised.

- Following valves types and materials are recommended for filtration and circulation system:

  i. C.I. Valves of sluice type require more repairs and maintenance compared to other valves and hence should be used preferentially.

  ii. C.I. Butterfly Valves with neoprene coating work better and can be used for pool systems.

  iii. C.I. Diaphragm valves, rubber lined can be used for filter piping as they are simple and quick to repair and maintain.

  iv. Polypropylene Valves are corrosion free, easy to handle and require very little maintenance and hence preferred as first choice.

**9. WATER CIRCULATION SYSTEM**

The water in the swimming pool must be circulated through filtration plant continuously for purification and for this reason an efficiently designed circulation system should be integrally installed as part of the pool structure. The circulation in any pool should follow a “laminar flow” pattern which means every drop of pool water should go to filter and come back to pool in one turn over cycle. The circulation system can be divided into two parts –

- Pool Supply System – The water from the balancing tank is sucked by pumps and passed through filtration plant and supplied to pool at floor level. This is a pressure line controlled by pumps.
The old system of constructing a central channel from cascade to the other end of pool along the floor and then covering it with pre-cast slabs is outdated. The various inspection chambers created in this channel always leak causing most of the filtered water and disinfectants to spread in shallow area only. The deep end gets starved of disinfectants and filtered water. Secondly the vertical nozzles fitted equi-distant on this channel simply push the filtered water to the surface of pool where the disinfectants are easily lost to atmosphere. Such pools consume high amounts of pool chemicals and are difficult to maintain easily.

In new system, as cascade as well as central channel, is absent, the filtered water is directly led to pool floor through pipes. On these pipes, horizontal flow type pool jets are fitted which spread the water horizontally and uniformly in all direction along the floor hitting the pollutants head-on. The horizontal flow pool jets ensure that the disinfectants are not lost to atmosphere but remain in the bottom portion of pool water thus effectively destroying pollutants. For ensuring uniform spread of filtered water and disinfectants in the pool more than one line of pool jet piping is done in the pool floor.
• Also the quantity of jets is adjusted according to the quantum of water in different sections of pool i.e. more pool jets in deeper side for supplying more water in deep area and lesser jets in shallow area. This ensures that the filtered water and chemicals are supplied very effectively and uniformly throughout the entire pool area.

Pool Return System - The pool water returns from surface of pool by gravity to the balancing tank through a channel constructed along the periphery of the pool. There are three types of return systems in use now-a-days viz. Conventional Overflow Gutter, Open Channel Method and Skimmer Channel Method.

• The Conventional Overflow Gutter is an old system of in which a U shaped open gutter is constructed all along the periphery at the top edge of pool walls. This is now an outdated concept since it is difficult to construct and finish. Because of narrow size, tiling cannot be done. So it is finished only by plastering. The algae and fungus anchors very easily to the plastered surfaces which breed colonies of fungus and microorganisms and eat away lot of chlorine everyday. It also provides a pet hiding place for snakes, frogs, etc. It is not recommended for new pools. For old pools wherever such gutters are present, they should be suitably converted to skimmer channel concept.

• The Open Channel Method is used for “Level Pool” type pools which are swimming pools where water is filled upto brim level and there in no freeboard area (Freeboard is vacant area between water level and top surface of pool deck). Here the channel is constructed in wet deck and covered by plastic or metal gratings. The water spills over the top edge of pool into this channel through gratings. This type channel design is accident-prone as in the event of breaking or misplacing some of the grating segments can cause serious injuries to swimmers. Also as there is no freeboard area, the handrails can not be fitted in such pools.

• In Skimmer Channel Method, an open channel of sufficient cross section is constructed along the periphery of the pool and skimmer windows are created in the pool wall at water level line. This channel is simple to construct and finish by tiling. Each skimmer window is fitted with a sturdy skimmer frame and a safety grill so that nothing can hide in the channel. Also 6 to 8” freeboard area is available above water level and deck top surface in which handrail can be fitted conveniently. Thus finishing, hygiene and safety is effectively achieved in skimmer channel and hence recommended for all pools. The No. of skimmers and their strategic locations are decided such a way that all floating scum is uniformly skimmed to balancing tank.

10. FILTRATION PLANT
Filtration plant is heart of any swimming pool. Sturdy, well designed and manufactured filtration plant is of vital importance for maintaining the swimming pools in excellent order for years.

• Design or capacity of filtration plant is based on total water capacity of pool and Turnover Period (it is a time in hours required for passing the entire pool water through the filtration plant). Generally turn over period for sports pools recommended is 7 to 8 hours.

• Filtration plant of swimming pool consists of –
  a. Pumps
Filters

- Electric pumps of centrifugal design and self-priming type are recommended as they work independent of foot valves and avoid frequent priming difficulties.

- Pressure type filters fabricated out of thick mild steel sheets are sturdy devices and last longer.
- Horizontal filters are much less effective since the depth of filter media is small and hence the contact time of water in the filter media is small.
- Vertical filters are most effective since the depth of filter media is more and hence the filtration is more effective.
- The filter media of brown colored sand is a poor quality media. This is normally collected on sea shores or riverbeds. This is a weather beaten sand, brittle in nature, and hence becomes mud in the filter due to repeated water hammering effects.
- The best filter media is white quartz sand, which is normally quarried and crushed to proper sizes and grades. Quartz is hardest in nature and so does not have any wear and tear and form no mud.

Electric Control Panel - A well designed control panel must be provided in the filtration plant room for housing all electrical starting devices for the pumps. An ELCB is a must for avoiding any electrical short-circuit accidents.
Figure 3: Comparison of Filters

- **Chemical Dozers** - Automatic dozers are recommended for dozing chlorine and alum solutions directly into flowing pipelines of filter plant. One dozer for chlorine and one dozer for alum is a must for any pool.
- Now-a days special on-line devices for improving pool water quality are popularly used which include Chloronomes, Ultra-violet, Ozone and Ionisers.
- Chloronomes release chlorine gas for disinfection. This is economical and simple device but handling and operation is very risky and can cause serious accidents and hence should be discontinued or avoided as far as possible.
- Ultra-violet or Ozone disinfection is instantaneous and their effect does not carry further in the pool and provide no residual disinfection protection.
- Ionisers provide copper and silver ionic treatment to pool water along with 60% lesser amount of chlorine. This is superior, non-toxic disinfection method which provides long term residual protection for pool water and hence highly recommended.
11. POOL DRAIN SYSTEM

Every pool must have an in-built water drainage system for draining the water in the pool for any reasons.

- Two types of drainage methods are being adopted viz. conventional drain and power drain.

![Diagram of Conventional Drain System]

Figure 4: Old Drain System

- In conventional drain system, a drain chamber is constructed in the pool floor at deepest point and from this piping is lead to balancing tank. Another drain pit is created between balancing tank and pool for housing the control valve for drainage. This valve is provided with a long handle upto deck surface. In this system, the pool water is drained by gravity to balancing tank by opening the control valve and running main circulation pump. The disadvantage of this method is that if the control valve is malfunctioning or leaking, the pool circulation process become unbalanced causing slow purification.
In power drain system, there are two drain chambers strategically located at the deepest points of the pool and they are connected by suitable piping to the main circulation pump direct. There is no control valve or long handle and hence no damage to circulation process. Another advantage with this system is that the balancing tank need not be constructed more deeper than the pool.

12. POOL CLEANING SYSTEM

The dirt and dust is continuously coming into pool from atmosphere or bodies of swimmers and heavier particles always settle on the floor of the pool which are not possible to remove alone by filtration process. For this purpose a vacuum type pool cleaning system is a must for any pool.

- Two types of such systems are popular viz. Trolley Type and In-built Type.

- In Trolley Type System, a pump and motor is fitted on a trolley that is kept on the deck. A suction head device is moving on the pool floor in the water and is connected to the pump on the trolley by flexible pipe. The movement of suction head is manual by pulling ropes at either end of pool. In this system, the water drawn through suction head, is thrown to drain and hence in one cleaning cycle almost 8 to 12 inches of pool water is lost every time cleaning is done and pool circulation cannot be started unless substantial water quantity is added to pool.
In In-built Pool Cleaning System, no separate pump and trolley is used but the suction head is connected to main circulation pumps by in-built underground piping through vacuum points. In this system the water sucked through the suction head is passed through the filter and put back to pool and so no water lost at all. Also separate pump and trolley is not required. This is a latest concept now and recommended for pools.

13. POOL WATER PURIFICATION

It is impractical to change the water in the swimming pool everyday and hence the water stays in the pool for long periods & can get dirty and polluted unless it is purified everyday by filtration plant with the aid of various chemicals.

- Pool water gets invariably polluted continuously, day and night, due to the following reasons –
  - Dust and dirt from atmosphere due to wind effects. Leaves, foliage, plastics and other flying matters also come into pool depending upon the surroundings of pool.
  - Algae – Algae is either green, black or yellow in color, though green and black types are more prominent in Indian sub-continent. As algae mars clarity of pool and hence it must be completely absent from a well maintained pool.
  - Bacteria and Viruses – from bodies of swimmers
  - Organic pollution – This is from the bodies of bathers include mucus from the nose, saliva, sweat and skin scales, urine and fecal matter.

- The above types of pollutions are continuously bombarding the pool day and night and hence it is most important to purify the water by eliminating these pollutions everyday by the filtration and circulation system with the aid of various chemicals.

- Science of sparkling clear blue water in the pool - The pool water in a well maintained pool looks sparkling and blue unlike water in open pond, lake or dam because the pool water is repeatedly & every day purified. However this purification is possible only with the use of chemicals like alum, chlorine, copper sulphate, etc. A well designed chemical treatment is a must for filtration process to become really effective.

- Only filtration process or only chemical treatment will not be sufficient to make any pool water in sparkling clear status. A proper combination of both filtration process and chemical treatment must be adopted for any pool purification plans.

- Coagulation is one important process of water purification.- When water becomes turbid and loses shine and clarity, use of alum as coagulant, is a must. Alum does action of coagulation by which very fine dust particles come together to make a bigger size particle which are easily trapped in the filter media. The usual dose is 3 to 5 ppm depending upon turbidity in the water.
  - There are two types of alum available viz. ferric and potash.
• Ferric alum is a yellowish muddish slabs or lumps. This is a very fast acting and forms heavier floc which can be picked up by pool cleaner easily. This is highly recommended for pools.
• Potash alum is in the form of white crystals. This is slow acting and floc is lighter and not generally recommended.

Disinfection is a most important process of water purification for destroying algae, bacteria, viruses as well as organic matter.

• Chlorine is mainly used as popular disinfectant but it is unstable in water and escapes to atmosphere in three to four hours and hence repeated chlorination is required whole day to have some residual or free chlorine in the pool.
• However excess chlorine is dangerous to human bodies.
• Insufficient chlorine reacts with organic matter to produce trichloromethanes which are carcinogenic and imparts urine like pungent smell to pool water.

Chlorine is commercially available in four forms as follows –

a. As Chlorine Gas…. it is highly acidic and very dangerous to use as it can cause instant death to persons inhaling it. It will eat away metals of filtration equipments, tiles or cement of pool structure. Needs utmost care for handling and dosing. Therefore it is not recommended for swimming pools. Available chlorine in gas form is 100%.

b. As Sodium Hypochlorite…. This is in liquid form and very unstable in nature and produced as a by-product in certain chemical companies so not easily available in all places. Not usually recommended for swimming pool. Available chlorine in this form is only 10%.

c. As Stable Bleaching Powder….It is alkaline in nature, safe to handle and use and easily available everywhere and recommended for swimming pools. The only disadvantage is that it has lime sludge residue which should not be allowed to mix in pool water as it tends to increase the hardness and pH. Available chlorine in this form is 35%.

d. As Calcium Hypochlorite …This is a better version of bleaching powder as it completely dissolves in water leaving no residue. This is best type disinfectant and recommended for swimming pools. Available chlorine in this form is 70%.

Other purification process is pH correction. Ideal pH to be maintained in the pool water is between 7.4 to 7.6 and if it varies, it is must to corrected.

• Use of Soda Ash - When chlorine gas is used for disinfection, pH is lowered and it can be raised to desired level by using soda ash. The dose of soda ash depends upon the correction level of pH.
• Use of Hydrochloric Acid – When bleaching powder is used as a disinfectant, there is tendency of pH to rise. Use of dilute hydrochloric acid is recommended to bring down the pH. The dose of hydrochloric acid depends upon the correction level of pH.
14. DAILY OPERATION OF POOL

Detailed operating instructions as provided by the plant suppliers shall be displayed in the plant room with circulation and valve identification diagrams. The plant shall be operated daily as per these instructions and a daily log sheet as per Annex D to be maintained by the operators, recording all relevant information like flow rate, chlorine content, pH value, time of backwashing and weight of each chemical consumed maintained.

Following additional points be carefully observed for day to day operation of pool –

- The filtration plant must run for minimum one turn over period i.e. 7 to 8 hours every day irrespective of the fact whether there is any swimming activity or not in the pool.
- If swimming activity is continued beyond 8 hours, then it is must to run the filtration plant beyond 8 hours & as long as swimming activity continues.
- The water level in the balancing tank must be maintained between half and ¾ marks. The upper ¼ portion must be always empty to accommodate the excess volume of water displaced temporarily from the pool because of swimmers bodies.
- The water in the pool is lost due to back-washing, evaporation and body drips etc and it is must to make up for lost water in the balancing tank everyday.
- Backwashing is a must after every 8 hours of filtration plant running and must be done using the balancing tank water only.
- Daily, at least once, the pool floor must be cleaned using pool cleaner.
- Pre-showers by swimmers before entry into the pool is a must.

15. DAILY CHEMICAL TREATMENT

Daily Chemical Treatment of the swimming pool water is compulsory and should be done as follows-

- All chemical additions are to be done to balancing tank only. Direct additions of chemicals to pool are prohibited as it may cause serious health hazards to the swimmers.
- No any two chemicals should be added simultaneously. There must be a time gap of minimum 30 minute between two chemical additions. Also the storage of different chemicals should be done separately.
- At the start of the filtration plant in the day, first backwashing should be done followed by rinsing and pool cleaning. Chemical additions should be done after backwashing.
- 2 to 3 mg/ltr of chlorine must be added to pool water daily.
- 3 to 5 mg/ltr of alum must be added to pool water daily depending upon the pool environment and usage.
- pH correction chemicals also required to be added to pool water daily after assessing their correct requirements.
- Super-chlorination should be done once in a fortnight to clear out all residual organic matter.
16. POOL WATER QUALITY AND STANDARDS

As per International Standards the water in the pool must be maintained to following quality parameters -

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.4 to 7.6</td>
</tr>
<tr>
<td>Free Chlorine</td>
<td>0.5 to 1.0 ppm</td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>75 ppm minimum</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>200 ppm minimum</td>
</tr>
<tr>
<td>TDS</td>
<td>500 ppm minimum</td>
</tr>
</tbody>
</table>

Other Standards are as follows –

- **Bacteriological standards** –
  E Coli and Coli form bacteria must be absent from pool water. The quality of water in the swimming pool is judged on the results of the tests for coli form organisms and E coli. With adequate filtration and disinfection, coli forms and E Coli should be absent in a 100 ml sample of water. This is usually achieved when a free chlorine residual is maintained between 0.5 to 1.0 mg/l.

- **Chemical Standards** –
  Water used for drinking is considered suitable for pools as well. The pH of pool water should be maintained as near as possible to 7.5 and always within the range of 7.2 to 8.0.

- **Physical Standards** –
  In a swimming pool, at times of design swimming load but not short peak loads, a clarity of 12 m visibility should be maintained. The bottom of the pool at the deepest point must be visible at all times.
Figure 6: **ANNEX A - LAYOUT OF 25M POOL**
Figure 7: **ANNEX B: LAYOUT OF 50M POOL**
ANNEX C – LANE MARKINGS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WIDTH OF LANE MARKINGS, END LINES, TARGETS</td>
<td>A 0.25 m ± 0.05</td>
</tr>
<tr>
<td>LENGTH OF END WALL TARGETS</td>
<td>B 0.50 m ± 0.05</td>
</tr>
<tr>
<td>DEPTH TO CENTER OF END WALL TARGETS</td>
<td>C 0.60 m ± 0.05</td>
</tr>
<tr>
<td>LENGTH OF LANE MARKER CROSS LINE</td>
<td>D 1.00 m ± 0.05</td>
</tr>
<tr>
<td>WIDTH OF RACING Lanes</td>
<td>E 2.50 m</td>
</tr>
<tr>
<td>DISTANCE FROM LANE CROSS LINE TO END WALL</td>
<td>F 2.00 m ± 0.05</td>
</tr>
<tr>
<td>TOUCH PAD</td>
<td>G 2.40 m ± 0.05</td>
</tr>
</tbody>
</table>

END WALL

PLAN

START

2.40 m x 0.90 m x 0.01 m

Electronic Touch Pad

A

D

E

F

G

21.00 m
# ANNEX D - POOL LOG SHEET

**NAME OF THE POOL:**

<table>
<thead>
<tr>
<th></th>
<th>MON</th>
<th>TUE</th>
<th>WED</th>
<th>THUR</th>
<th>FRI</th>
<th>SAT</th>
<th>SUN</th>
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<tbody>
<tr>
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<td></td>
<td></td>
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</tr>
<tr>
<td>START TIME</td>
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</tr>
<tr>
<td>STOP TIME</td>
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<tr>
<td><strong>PRESSURE</strong></td>
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<td></td>
</tr>
<tr>
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<tr>
<td>VOLTAGE</td>
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<tr>
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<td></td>
</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td><strong>ADD</strong></td>
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## ANNEX E – IS STANDARDS

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<thead>
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<th>DOCUMENT NO.</th>
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<tbody>
<tr>
<td>IS : 3328-1965</td>
<td>QUALITY TOLERANCES FOR WATER FOR SWIMMING POOLS</td>
</tr>
<tr>
<td>IS : 6494-1988</td>
<td>CODE OF PRACTICE FOR WATER PROOFING OF UNDERGROUND WATER RESERVOIRS AND SWIMMING POOLS</td>
</tr>
<tr>
<td>IS : 10500-1991</td>
<td>DRINKING WATER- SPECIFICATIONS</td>
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