Sub: Construction Management System: Circular – 14
Ref: Guidelines for execution of sewerage works.

It has been observed during various site inspections that certain inadequacies & disarray are there in execution of work. Care should be taken during construction process to ensure that the works are strictly carried out & tested according to standard specifications and prevailing sound engineer’s practice. It is therefore directed that PSC/PMDSC/PIU shall ensure the followings but not limiting to:

A. Priority in Sewer Construction Program –

1. As per procedure, as far as possible first of all outfall sewer should be laid, tested and commissioned and in follow up main/branch sewer of zone adjacent to downstream side of outfall should be taken and commissioned, then & then only street lanes should be taken in hand so the segment of the town be commissioned without delay.
   - Priority should be in such a way that the system can be commissioned as soon as possible and early benefits can be delivered to the public.
   - Works should be generally started at the downstream end of the systems.
   - Engineers shall develop a program for construction and commissioning according to the priorities.
   - Contractors should not be permitted to take up the construction program in an arbitrary manner. The following order of priorities may be assigned:
     a. City wise priority:
        i. Outfall sewer
        ii. Trunk sewers
        iii. Main sewers
        iv. Branch sewers
        v. Lateral sewers
     b. Priorities in Lateral sewers shall be followed in the following order:
        i. Laterals which can be commissioned earlier and those areas covering maximum population from downstream to upstream
        ii. Priority to the areas in order of their population
        iii. Sparsely populated areas
        iv. Laterals in the areas where there is presently no water supply but distribution system is proposed in the contract and quantities for sewer network is available.

Circular 14: Guidelines for execution of sewerage works
It should be ensured and make all out efforts that no incomplete work of main sewers, Branch sewers, Trunk sewers & outfall sewers are left in the sewer works taken up under RUIDP.

B. **Execution sequence:**

2. It should be ensured that complete construction material for a section has been procured before excavation and the work of manhole, roadside chamber & laying of pipe in that section should be taken up simultaneously.

3. Transfer the temporary bench mark (TBM) in lanes where sewer is to be laid. It will help in quickly transferring of levels for laying of lines, excavation depth, slope to be provided which requires to be checked at multiple times till the laying is not completed.

4. Locate the underground utilities as per report of underground utility survey or a sectional cutting of road throughout the width be made for ensuring position of underground utilities.

5. Mark the alignment for laying of sewer keeping in mind the excavation width / diameter required for construction of manhole chamber.

6. Fix the location of manhole chambers by reconnaissance survey so that the maximum outlets from dwellings can be joined as well as distance between two manhole chambers be ensured with respect to maximum / minimum distance between two consecutives manholes chambers.

7. **Location and alignment of property chamber (inspection chamber) shall be marked on site; alignment of chambers should be straight. If there is any change in alignment of inspection chamber, the reason should be recorded from it. It is to be ensured by PIU & Consultant to install the chambers near the compound wall to the maximum possible extent and reason for each chamber shall be recorded in case chambers are installed away from compound wall. In case, IC chamber is away from compound wall, a piece of PVC pipe should also be laid upto compound wall so as to avoid the further road cutting during property connection.**

Calculate top width of trench for cutting as per depth of invert and mark with white powder.

8. **Barricading & caution boards:** It should be ensured that the barricading has been carried out properly and display boards for diversion, warning, work in progress, schedule of completion of activity in the area are displayed at required places and proper lighting arrangement at work sites are made during night for convenience & safety of the public.

9. **Alignment** – L section for each lateral, branch, main and trunk/outfall sewer should be checked and be signed by Engineer in charge/ Employers representative, so that any short coming can be checked and rectified before execution. The alignment and bed level of trench should be checked before laying of granular base for pipes. Laying of pipes as per design gradient is the most important factor for successful working of sewerage networks. Therefore, all concerned Engineers should ensure that the pipes have been laid as per the designed gradient in all sections of sewer line. The alignment and gradient of the pipes, once laid in trench should be checked regularly.
and this fact should be recorded every day in the site instruction book. Any defect in the alignment and gradient should be pointed out and corrected immediately.

10. Type of road to be recorded before execution- During excavation record the thickness of BT, granular pavement, CC etc.

11. Proper safety arrangements like barricading, timbering in trenches, access to trench, proper stacking of construction material, immediate disposal of surplus excavated material should be ensured during construction. Proper planning & arrangement for shifting of utilities i.e. water supply lines/ telephone cable/ electric cable /optical fiber cable etc. which may encounter during excavation, timely correspondence and follow up with concern line agencies and shifting be ensured timely.

12. Shoring: As far as possible, the installation of shores should be done from the surface. The trench jack or horizontal braces should never be used as a ladder for getting in or out of a trench as they are not designed to take vertical load.

13. The excavator machine operator / supervisor be instructed that how much depth, excavation be taken out, which should be approximately upto invert depth, rest depth for bedding should be carried out manually with smooth dressing.

14. H-Frame & Boning Rod: For sight rail (H-frame) and boning road for transferring and checking of the levels in trench shall be as per procedure mentioned in 3.56 of Manual of Sewerage & Sewage Treatment System by CPHEEO.

15. Bedding: As per CPHEEO manual, proper placement (i.e., bedding) has to be there for each pipe section that is laid. Sieve analysis of the bedding material should be carried out in site laboratory for every lot of material received. The alignment and bed level of trench should be checked before laying of granular base for pipes. Laying of pipes as per design gradient is the most important factor for successful working of sewer network. The thickness of granular bedding (once laid) should be physically checked by field staff.

Four classes, A, B, C and D type of bedding used for pipes in trenches. Most often A & B type of bedding is recommended to use for pipes in trenches.

   i. Class A bedding may be either concrete cradle or concrete arch.
   ii. Class B is bedding having compacted granular bedding with a carefully compacted backfill.
   iii. Class C is an ordinary bedding having a shaped bottom or compacted granular bedding but with a lightly compacted backfill.
   iv. Class D is one with flat bottom trench with no care being taken to secure compaction of backfill at the sides and immediately over the pipe and hence is not recommended.

Class B bedding with compacted granular bedding is generally recommended. Shaped bottom is impracticable and costly and hence is not recommended.

It should also be ensured that the bedding shall be in accordance with nomenclature mentioned in BOQ.

16. Laying & Jointing of Sewer lines:

   a) All the sewer lines are to be laid perfectly true both in alignment and to gradient specified. In case of spigot and socket pipe, the socket end of the pipe shall face upstream.
b) Sewer pipe laying and jointing shall be started and completed only section wise as per the instruction of the Engineer. The sections shall be chosen manhole to manhole. The work of sewer line laying, manhole construction and house sewer connections shall be done simultaneously so that all the necessary testing can be done efficiently and effectively.

c) All the pipe joints shall be flexible with Rubber gasket joints (EPDM/SBR rings be used for jointing).

d) After bedding & laying of pipe line the trench shall be filled up to top of pipe with compaction of soil.

e) The posts and rails shall in no case be removed until the trench is excavated, the pipes are laid and Engineer gives permission to proceed with the backfilling.

f) No trench shall be filled in unless the sewer stretches have been tested and approved for water tightness of the joints. However, partial filling may be done keeping the joints open to avoid any disturbance. The refilling shall proceed around and above the pipes.

g) Soft material screened free from stones or hard substances shall first be used and hand pressed under and around the pipes to half their height. Similar soft material shall then be put up to a height of 30 cm above the top of the pipe and this will be moistened with water and well rammed. The remainder of the trench can be filled with hard material, in stages, each not exceeding 15 cm. At each stage, the filling shall be well rammed, consolidated and completely saturated with water and then only further filling shall be continued.

h) It should be ensured that open ends of the pipes are suitably plugged to prevent entry of sand/soil and other construction material in the sewers at the end of the day.

i) Where sewers having cover less than 1.0 m, before execution take place it is to be ensured / verified with ground realities that property connections from building premise to inspection/property chamber and from property chamber to proposed street manhole chamber (cover less than 1.0 m) is feasible to join.

j) Protection of Water Mains: The maximum possibility of pollution in water supply lines is when these lines pass through manholes of sewers. Therefore, this condition should be totally avoided and during construction of manhole/ laying of water supply pipe line it should be ensured that no water pipe line passes through Manhole. In these circumstances either location of manhole should be changed or pipe line should be shifted to lay it outside the manhole. This should be strictly followed.

k) A minimum offset of equal to half the width of the manhole plus 30 cm shall be the lateral offset between water mains and sewer lines. (Ref. section 3.54.2 Manual of Sewerage & Sewage Treatment System by CPHEEO) or as specified in Contract document.

17. Hydrostatic Test:

a) The laying of pipes and further trench filling should be taken up only after satisfactory sectional hydraulic testing of the laid pipe line. In no case a section should be back filled without satisfactory hydraulic testing. Expendable balloons / dummy shall be preferred for plugging of pipe ends instead of masonry packing.

b) Entire section of the sewer shall be proved by water tight by filling in pipes with water to the level of 1.50 m, above the top of the highest pipe in the stretch and heading the water up for the period of one hour. As per standard specification of
RUIDP, the loss of water over a period of 30 minutes should be measured by adding water from a measuring vessel at regular 10 minute intervals and noting the quantity required to maintain the original water level. For water tightness, the average quantity added should not exceed 1 litre / hour / 100 linear meters / 10 mm nominal internal diameter. Pipe size wise water loss allowable in 1 hour & \( \frac{1}{2} \) an hour in 100 mtr length is summarized in table below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Pipe dia (internal) (in mm)</th>
<th>volume of water loss allowed in 1 hour in 100 mtr length (in litre)</th>
<th>volume of water loss allowed in 1/2 an hour in 100 mtr length (in litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150</td>
<td>15.00</td>
<td>7.50</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>20.00</td>
<td>10.00</td>
</tr>
<tr>
<td>3</td>
<td>250</td>
<td>25.00</td>
<td>12.50</td>
</tr>
<tr>
<td>4</td>
<td>300</td>
<td>30.00</td>
<td>15.00</td>
</tr>
<tr>
<td>5</td>
<td>350</td>
<td>35.00</td>
<td>17.50</td>
</tr>
<tr>
<td>6</td>
<td>400</td>
<td>40.00</td>
<td>20.00</td>
</tr>
<tr>
<td>7</td>
<td>450</td>
<td>45.00</td>
<td>22.50</td>
</tr>
<tr>
<td>8</td>
<td>500</td>
<td>50.00</td>
<td>25.00</td>
</tr>
<tr>
<td>9</td>
<td>600</td>
<td>60.00</td>
<td>30.00</td>
</tr>
<tr>
<td>10</td>
<td>700</td>
<td>70.00</td>
<td>35.00</td>
</tr>
<tr>
<td>11</td>
<td>800</td>
<td>80.00</td>
<td>40.00</td>
</tr>
<tr>
<td>12</td>
<td>900</td>
<td>90.00</td>
<td>45.00</td>
</tr>
<tr>
<td>13</td>
<td>1000</td>
<td>100.00</td>
<td>50.00</td>
</tr>
<tr>
<td>14</td>
<td>1100</td>
<td>110.00</td>
<td>55.00</td>
</tr>
<tr>
<td>15</td>
<td>1200</td>
<td>120.00</td>
<td>60.00</td>
</tr>
<tr>
<td>16</td>
<td>1400</td>
<td>140.00</td>
<td>70.00</td>
</tr>
</tbody>
</table>

18. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good.

19. It is noticed that at times quality of road restoration works is not of desired standards and this aspect of sewer works is easily noticeable by common man. Therefore, in order to gain confidence of public, it is essential that road restoration works are strongly monitored for high quality.

20. Connectivity from house to the sewer line should be encouraged & ensured to all consumers as soon as line is commissioned, so that the consumers are benefited without delay.

**C. Construction of Manhole Chambers:**

21. Manholes should be built at every change of alignment, gradient or diameter, at the head of all sewers and branches, at every junction of two or more sewers. The maximum distance between manholes should be 30 m for sewers which are to be cleaned manually or which cannot be entered for cleaning or inspection.

22. The channel at bottom of manhole should be in curve shape when the flow takes bend.

23. **Depth of Manhole**- The vertical distance from the top of the manhole cover to the outgoing invert of the Sewer. The circular manholes be provided for all depths starting from 0.9 m. Circular manholes are straight down in lower portion and slanting in top portion so as to narrow down the top opening equal to internal dia. of manhole cover.
Depending upon the depth of manhole, the diameter of manhole changes. The internal diameter of circular manholes may be kept as following for varying depths:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Depth Range (m)</th>
<th>Internal diameter of Manhole</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>For depths above 0.90 m and up to 1.65 m</td>
<td>900 / 1000 mm</td>
</tr>
<tr>
<td>2</td>
<td>For depths above 1.65 m and up to 2.50 m</td>
<td>1200 mm</td>
</tr>
<tr>
<td>3</td>
<td>For depths above 2.50 m and up to 9.0 m</td>
<td>1500 mm</td>
</tr>
<tr>
<td>4</td>
<td>For depths above 9.0 m and up to 14.0 m</td>
<td>1800 mm</td>
</tr>
</tbody>
</table>

Calculate the invert depth for selection of category of Manhole chamber to be provided from above table and in line of nomenclature of respective BOQ item.

24. After proper ramming & curing of PCC, the construction of chamber first be completed upto crown of the laid pipe with benching concreting so that the monolithic structure can be made with outer walls. Proper slope in benching i.e. 1 in 12 be given from outward to inward.

25. It should be ensured that the manhole top is flushed with road level.

26. No house sewer connections shall be made in conical piece of RCC precast manholes. It should be in ring portion beneath the conical piece.

D. **Water Tightness test for Manhole:**

27. The entire height of the manhole shall be tested for water tightness as per CPHEEO Manual, by closing both the incoming and outgoing ends of the sewer and filling the manhole with water and the drop in water level not more than 50 mm per 24 hours shall be permitted.

E. **Deflection test:**

28. “Deflection test” shall be performed on all flexible gravity sewer pipe. The test shall be conducted after the sewer trench has been backfilled to the desired finished grade for a minimum of 30 days, in light of guidelines issued by RUIDP vide CMS circular-7 dated 19.01.2018.

F. **Drop Manholes:**

29. When a sewer connects with another sewer, where the difference in level between peak flow levels of main line and the invert level of branch line is more than 600 mm or a drop of more than 600 mm is required to be given in the same sewer line, a drop connection shall be provided for which a manhole may be built incorporating a vertical or nearly vertical drop pipe from the higher sewer to the lower one.

30. In the case of sewers over 450 mm in diameter, instead of providing the total drop required at the junction manhole, the same may be achieved by giving smaller drops in successive manholes preceding the junction manhole. Thus, for example, if a total drop of 2.4 m is required to be given, 0.6 m drops may be given in each of the previous three manholes and the last 0.6 m drop may be given at the junction manhole.

31. As far as possible drops in manholes should be avoided and it should be utilized for providing steeper slopes in the sewers to generate better velocity of flow in sewers. Any such modification may be incorporated while issuing construction drawings.
G. Inspection Chambers:

32. Inspection chamber is an intermediate chamber for joining sewer plumbing of dwelling to street manhole chamber. The Inspection chamber is used to facilitate cleaning of sewer pipe from chamber to street manhole as well as to accommodate change of alignment of sewer pipe coming out from property. Generally, RCC precast or Brick/Stone masonry chambers are provided with an opening of 450 mm dia with depth ranging from 450 to 900 mm for suitably capturing the sewer line coming out from dwellings.

33. The chamber shall be suitably placed in such a manner it can be utmost utilized by joining two or three house connections, it should also be ensured that the planning of using these chambers should be in line of BOQ provisions, however if it is felt that the numbers can be exceeded, then before execution the matter should be placed for approval from competent authority with proper justification and cost implications.

H. Flow test:

34. After successful completion of sewer network and all allied works, before commissioning flow test shall be carried out for entire network to ensure following that:
   
a) During construction there is no obstruction remain in due to debris or any foreign material which causes obstruction in flow.
   
b) There is no missing gap in the sewer line.
   
c) The flow is smooth without any turbulence & gradients provided are practically good.

These are the guidelines for ease in execution; however relevant BIS / CPHEEO manual and Contract Agreement shall be strictly followed for detailed specifications.

This circular shall be strictly abided by all the members of PMU, PIU, PMDSC, PSC & Contractor.

(Dr. Preetam B. Yashvant)
Project Director

No. F3 (201)(57)/RUIDP/PMU/PH-III/CMS/ 3\& 12-6 - 3\& 12

Date: 07.07.2018

Copy to following for information and necessary action:
1. PA to PD/Addl. PD/ FA/ CE/ ACE/SE-I/SE-II/SE-III/ POs/APOs, PMU, RUIDP, Jaipur
2. SE, PIU, Pali/Tonk/Sriganganagar/Jhunjhunu/Bhilwara/Hanumangarh/Kota
3. EE, PIU, Sawai Madhopur/ Bikaner/ Udaipur/ Jhalawar/ Mt. Abu/Banswara
4. Team Leader/ Project Coordinator/CM/ Dy. CM/ACM, PMDSC/ PSC, Jaipur, Pali/ Tonk/ Sriganganagar/ Jhunjhunu/ Bhilwara/ Hanumangarh/ Kota/ Sawai Madhopur/ Bikaner/ Udaipur/ Jhalawar/ Mt. Abu/Banswara
5. ACP, RUIDP, Jaipur to send by e-mail and put up the Guidelines on the website.

Addl. Chief Engineer

Circular 14: Guidelines for execution of sewerage works