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Novel Methodology for Precast Methods of Highway Drainage System in Heavily Built up Areas and Major National Highways

Abstract

This is an invention relating to highways drainage system. During the author's practice as a highway Structural Engineer in NHAI's projects and world bank projects, he has noticed extreme delays in the construction of highway drainage work. Highway Drainage is very important and sometimes cost as much as 10%of project cost depending upon the place. Without proper drainage highway pavement and sub grade detoriates very fast. The Drainage sidewall also acts like a retaining wall in urban areas thus preventing movement of soil and water entering from outside. But drainage construction by cast- in situ method involves much delay (sometimes even 5 years in congested areas and due to point to point variation of cross section of drainage structures) and hence there is a need for modification in construction methodology and novel methods of design and construction. This invention speeds up the major side drainage construction (RCC Drainage of more than 1.5m×1.5m size) so that time and cost delays are avoided.It will be a boon for all NHAI and BOT projects if this method is adopted

Keywords: Highway Drainage system, Precast RCC construction Design and methods.

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Introduction

Major Highways Drainage system in major congested areas and in major National Highways Projects is a problematic issue. The Drainage involving more than 1.5m ×1.5m RCC longitudinal Drainage system creates considerable technical difficulties even though looks simple because the height h (see fig 3) varies from point to point. This is because the longitudinal Bed level of Major RCC Drainage is different from longitudinal F.R.L (Finished Road Level) profile of Highways. As such the height variess longitudinally at every point making it difficult for precast construction. Cast- insitu construction with variable bar bending schedule involves much wastage of time and labor force with required skill and hence construction goes at snails pace and particularly at heavily congested areas. Also this results in much wastage of concrete since the drainage height varies from 1.5m to 2.5m or more height depending upon t he location of place and cross culverts (see fig 3).

Needless to say there are heavy wastage of labor forces , checking time and bad quality of concreting.

In order to facilitate quick execution and precast concreting methods we have separated the drainage Design and construction in 2 parts as shown in Fig 1 and Fig 2.

Fig 1-HighwayDrainage (where space is restricted)
Fig 2-Highway Drainage (where space is available)
Fig 3-Highway Drainage (General Cross Section}

The precast part shown in figure 1 and 2 [Part A] can be mass produced in the casting yard with highest quality (Please note the cross section is identical for precast partsl) and with the highest speed. There are huge savings in labour force and material. The Design also can save quantities of concrete wherever possible , Cast- insitu portion is very small and easy to construct at site since the portion is in the form of slab Only

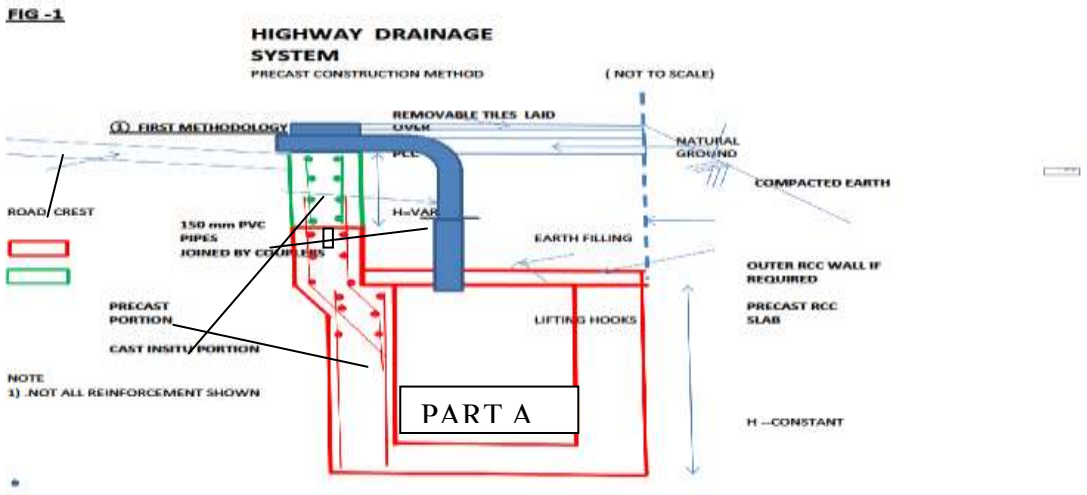
over lapping reinforcement or loops of reinforcements of precast walls will be projecting in cast-insitu portion. (Part B).

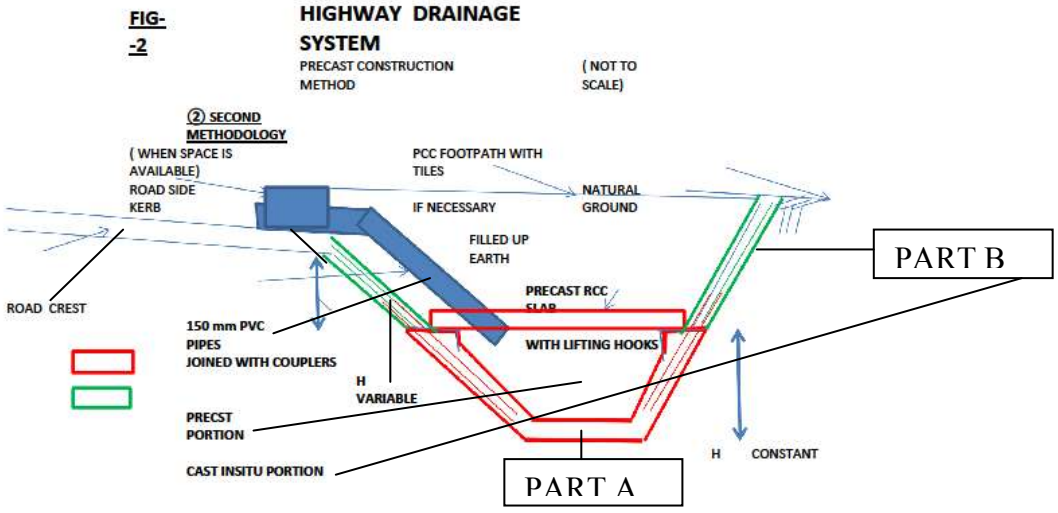
In this connection it is informed that the sides of drainage wall particularly in consented areas acts like a retaining wall and water in subgrade.As such this portion has to be designed as a retaining wall is vertical due to look of space. Weep holes need Nat e provided since in section of water into sugared is very rare.

But when there is sufficient transverse space is available it is …….. to provide V shaped drain since wall thickness can e reduced and the action of dispersed vehicle wheel load is minimized.

The method consist of following

Insert Fig 1,2,3





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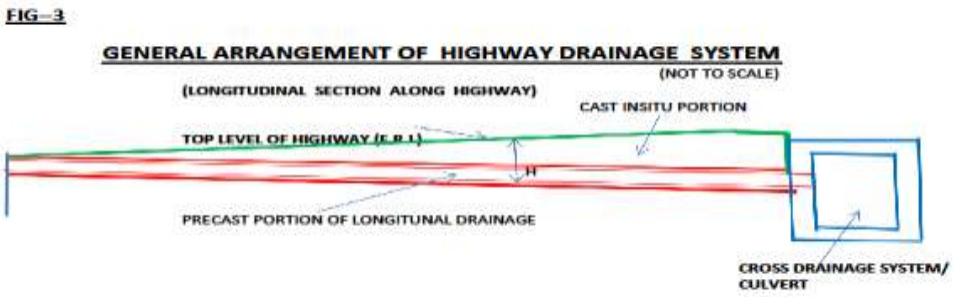

The following steps are involved in Box shaped drainage construction

A. Box shaped drain with vertical walls

1. The height of Box drain varies depending upon the location when the drainage invert levels varies longitudinally. Please see Fig 3).
2. Make a construction plan section so that which part of height is precast and which part of wall is cast- insitu (Fig1,Fig 2,Fig 3).
3. Manufacture precast drainage parts with constant height (Say 1.5m) near batching. Plant (with lifting hooks).
4. Manufacture precast cover slab as per Design in manufacturing plant.
5. Standard Joining grove has to be provided in precast drainage parts.
6. Excavate the drainage with required width and height at site.
7. Provide leveling course of minimum thickness at site.(M 10/ M 15) with required level and slope.
8. Immediately place the precast drainage part over the leveling course and seal the bottom joint and vertical joints with cement mortar to make it water tight. If necessary standard water sealing rubber sheets can be pasted in joints on the road side (to prevent water seeping into embankment and damaging the road embankments).
9. Tie cast-insitu portion of reinforcement is overlapped with reinforcement projecting from precast drainage walls.
10. The cast- insitu drainage slab part should be cast up to top of road side kerb (say 225mm above FRL) with holes for 150 mm PVC drainage pipe at 6m interval (say).
11. Cover the top of precast drain with precast slabs with lifting hooks (for maintenance purpose)
12. Construct outer vertical wall only If necessary (on the outer side of embankment).This can be avoided if space is available for embankment and slope.
13. Seal the cover slab joints with mortar to make it water tight.
14. Fill up with earth over cover slab up top of Road side kerb.
15. Provide cement mortar/concrete over filled up earth for footpath slabs.
16. Provide small size footpath tiles over cement mortar so that pedestrian can walk over foot path.
17. For maintenance purpose footpath tiles have to be removed earth work excavated and drainage cover slab should be lifted for cleaning purpose.

II Drainage with V shaped RCC

The same method as above is adopted except that there is a change in supporting arrangement for cover slab and side wall arrangement.

Advantages of precast & cast in situ Method

1. Construction is very fast so that related construction such as service road can be accelerated.
2. Labour cost is minimized.
3. Centering material/shuttering material is saved and damages avoided.
4. Proper concrete quality can be assured by proper Design/planning.
5. Removal of top slab by local people and throwing thrashes,plastics and wastage material into drainage and thus blocking the same is avoided.Misuse of Drainage system is avoided.Pilfirage is reduced.

6. People can walk safely over footpaths since at present drainage slabs are displaced/removed resulting in accidents/children falling into the pit.
7. Overall construction time is reduced.
8. Overall construction cost is reduced.
9. Overall quality/functioning of drainage is improved.

Disadvantages

Nil…….

Conclusion

The above methodology of highway drainage system will be a boon to highway construction in the country.

The above methodology cannot be copied by contractor or Government agencies, and BOT Designer, Designers of Highway without the author's permission.

It is proposed to patent the above methodology after publication, after reviews and comments by Highway Engineers

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