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Concrete Pavement: A Larger Number of Advantages such as a Long Span Negligible Maintenance

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Abstract

The transportation by road is the only road which gives maximum service to one and all. This mode had also the maximum flexibility for travel and with reference to route, direction, time and speed of travel. It is possible to provide door to door service only by road transport. Concrete pavement has a larger number of advantages such as a long span negligible maintenance, user and environmental friendly and lower cost.

Key Words: Concrete pavement, Advantages, Maintenance, National Highway

Introduction

Rigid pavements are rigid as they do not deflect under loading like flexible pavements. They are constructed using cement concrete. The design of rigid pavement is based on providing a structural cement concrete slab of sufficient strength to resist the loads from traffic. The rigid pavement has rigidity and high modulus of elasticity of slab to distribute the load over a relatively wide area of soil.

- Rigid pavements have a structure composed of hydraulic cement concrete surface course with an underlying base and sometimes a sub-base course. The surface layer is the stiffest of all the layers. This layer is a concrete slab that provides the majority of the strength to the pavement. In order to reduce thermal stresses or eliminate joints and maintain tight crack widths.
- The major portion of the load carrying capacity of the rigid pavement is derived from the concrete slab as the modulus of elasticity of concrete slab is much greater than that of the base or sub base materials; Wheel loads, temperature changes, changes in moisture and changes in volumes of base, sub base and sub grade are the causes for the stresses in the rigid pavements.

- Rigid pavements are associated with rigidity or flexural strength or slab action so the load is distributed over a wide area of sub grade soil. Rigid pavement is plain or unreinforced concrete slabs having high flexural strength.

Advantage of Rigid Pavement

Rigid pavements have high compressive strength, which tends to distribute the load over a relatively wide area. There are several advantages of properly constructed rigid pavements-

- It can bear heavy static and dynamic load.
- Adequate coefficient of friction to prevent skidding of vehicles.
- These roads are durable and practically not so much affected by weather agencies.
- Concrete roads have long life than any other roads.
- It provides a smooth and level surface for driving irrespective of the undulations on the sub grade.
- It requires less maintenance compared to flexible pavement, results in less traffic disruption, minimum congestion time.
- Resistance to rutting
- Good night visibility because of its better light reflecting characteristics than bituminous pavement.
- Use of waste products like fly ash and slag.
- They do not develop corrugations.
- High abrasion durability.
- Meet environmental and aesthetics requirement.
- No damage from oils and greases.
- Lower life-cycle cost.

Disadvantage of Rigid Pavement

- ❖ The initial cost of rigid pavement is high.
- ❖ May lose frictional properties overtime.
- ❖ Energy consumed in manufacturing of construction materials.
- ❖ On average, it takes more time to lay a rigid pavement as compared to flexible pavement.
- ❖ Flexible pavement provides better riding than rigid pavement because of its rigidity.

- ❖ Set up cost are significant.
- ❖ Difficult to do the underground works.
- ❖ Temperature changes induce stresses.
- ❖ Increase tire pressure.
- ❖ The green house gas emissions during manufacturing of cement.
- ❖ Energy consumed in construction of road and transport of material.
- ❖ Skilled supervision and labour are required for construction.
- ❖ Generally rough riding quality
- ❖ One site batch plants is essential for slip forming.
- ❖ The joints between the slabs can be considered as a resource for failure.
- ❖ Threat to safety because of bursting of tire
- ❖ The process of manufacturing cement concrete contributes to a significantly higher carbon footprint.

Design Approach for Rigid Pavement

The design of pavement varies with soil conditions and amount of traffic expected to be carried its design life. Rigid pavements are designed for a period of 30-40 years.

Factors for design of rigid pavements are:

- Design Wheel Load
- Design period
- Contact pressure or Tire pressure
- Vehicle Speed
- Climatic Factors, temperature, precipitation
- Design Traffic Characteristics and loading
- Sub grade conditions
- Concept of equivalent single wheel load.
- Structural models
- Axle load

Types of Rigid Pavement

Rigid pavements can be classified into four types:

- Jointed plain concrete pavement
- Continuously reinforced concrete pavements
- Jointed reinforced concrete pavement
- Pre-stressed concrete pavement

Materials for Construction of Rigid Pavement

Concrete is widely used in domestic, commercial, recreational, rural and educational construction. Materials are used for sequential construction of sub grade, sub base and concrete slab etc.

Cement:

Cement is a binder, a surface that sets and hardens by reacting chemically with water, and can bind other materials together. During the reaction, called hydration, cement combines with water to form calcium silica hydrates paste.

The most important uses of cement are as an ingredient in the production of mortar in masonry, and of concrete and an aggregate to form a strong building material.

The type of cement that may be used for the preparation of PQC and DLC are :

1. Portland Cement

- i) Ordinary Portland cement of Grade 33
- ii) Ordinary Portland cement of Grade 43
- iii) Ordinary Portland cement of Grade 53

2. Portland Pozzolana cement with Fly ash content up to 20%

3. Portland Slag Cement

Quality Control during construction

- Coarse aggregate samples collected should be tested to specified tests in the laboratory to decide suitability.
- Grading of coarse aggregate and fine aggregate for mix is checked and compared with specified gradation.

- Samples of fresh cement concrete mix are collected, cube and beam specimen prepared and tested according to standard test and checked with acceptance criteria.
- Side slabs of pavements is checked to find honeycombed surface, such surface are finished with cement mortar.

The quality control process will include the three activities listed below:

1. The checking and review of pavement designs for compliance with procedures, standards and good engineering practices.
2. The checking and review of plans to insure that the approved pavement designs and correctly incorporated.
3. Documentation of the Quality control process.

Protection of Work

The contractor shall protect the work from the rain damage and shall provide detailed proposals for procedures and equipment to be used for such protection.

Neither traffic nor construction equipment, other than that associated with testing, groove cleaning or joint sealing, shall be allowed on the finished base until the joints have been permanently sealed and at least 10 days have elapsed since placing concrete, and the concrete has reached its average compressive strength.

No traffic will be permitted on the pavement until curing is completed.

Opening to Traffic

The entire surface of newly laid pavement is carefully examined for:

- Fine cracks have developed on surface
- Non-uniform settlement of cement concrete slabs has taken place or not. If any such defects are noticed, then corrective measures may be taken up.

A newly constructed pavement quality concrete pavement stretch shall be opened to traffic only after 28 days of curing and in the presence of all parties; any possible cracks have been recorded.

Conclusion

India, is economical growth plan of over 6% per annum for the next 20 years will, to a great extent, depend on an efficient road infrastructure, not only national highways but other roads too, which can provide fast movement of goods and people with safety and economical cost to the user.

Current trends show that concrete pavements are the prime choice as compared to flexible pavements. Cement concrete roads offer many advantages like long life of more than 30 years, minimum maintenance requirement, and lower life-cycle costs when compared with bituminous overlay. In concrete pavement we can utilize the waste products like fly ash and slag.

Oil that leaks from vehicles and water logging usually causing faster deterioration of the asphalt or bituminous roads, does not affect the concrete pavement. Now, concrete overlays have been used to rehabilitates the existing bituminous (flexible) pavement.

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