



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 12, December 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com



Rigid Pavement Construction in Kashmir and its Environmental Aspects

Hishma Zahoor¹, Aaqib Farooq², Tasaduq Rouf³, Muhammad Yameen Bhat⁴, Tajamul Islam⁵

B.E Student, Department of Civil Engineering, SSM College of Engineering, Kashmir, India^{1,2,3,4}

Assistant Professor, Department of Civil Engineering, SSM College of Engineering, Kashmir, India⁵

ABSTRACT : The primary focus of our study is to identify the challenges and difficulties that we face and to find some feasible solutions while constructing and maintaining roads in the state of Jammu and Kashmir. The roads pass through the swaths, that are mostly frost prone, located at high altitudes and we experience sub-zero temperature there. Apart from its mountainous nature, the climatic conditions are very harsh for most part of the year, in which the precipitation is more, mostly in the form of snow that covers the whole of the land including roads. In this paper, we introduce some of its materials and some of the improved methods in road construction in order to overcome the challenges that we encounter during construction and maintenance of roads in Kashmir.

KEYWORDS: Roads; Frost; Construction; Landslides; Snow; shear strength

I. INTRODUCTION

Rigid pavement can be defined as the one, constructed from cement concrete or reinforced concrete slabs. 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 possesses very high flexural strength or flexural rigidity and high modulus of elasticity to distribute load over a relatively wide area of soil. Generally, pavement quality concrete (PQC) is used as the most common material for

the design and construction of rigid pavements.

➤ Properties of Cement Concrete Pavement.

- Rigid pavement can be used successfully in wet weather conditions.
- Rigid pavement, though costly in initial investment, are cheap in long run because of low maintenance costs.
- No such phenomenon of grain to grain load transfer exists.
- Life span is more as compared to flexible pavement.
- Good visibility.
- Requires less aggregate.

➤ Components of rigid pavement.

1. Concrete slab or surface course.

- It is the top most layer of rigid pavement which is in direct contact with vehicular loads. The thickness of concrete slab is kept between 150 to 300 mm. The slab prevents the infiltration of excess surface water into sub base course. It offers friction to the vehicles to provide skid resistance.

2. Granular base or stabilized base course.

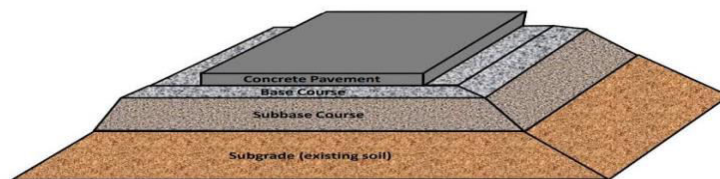
- It is the second layer from top and is constructed using crushed aggregates. The base course thickness should be minimum 100mm. This course helps surface course to take additional loads. It is also useful to provide sub surface drainage system.

3. Granular sub-base(GSB) or stabilized sub-base course.

- It is the third layer from top and is in contact with sub grade soil and base course. It is constructed by using low quality aggregates than the base course, but should be better quality than sub grade. The GSB course has to serve as an effective drainage layer of the rigid pavement to prevent early failures due to excessive moisture content in the sub grade soil.

4. Sub grade soil.

- The soil sub grade is the lower most layer of the pavement structure which ultimately supports all other pavement layer and traffic loads. A good soil sub grade and prepared soil sub grade gives long service life to the pavement.



➤ **Rigid Concrete Pavement in Kashmir.**

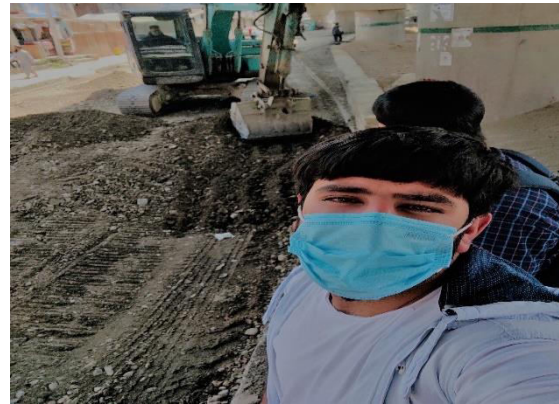
As the name implies, rigid pavements are rigid that is they do not flex much under loading like flexible pavements. They are constructed using cement concrete. In this case the load carrying capacity is mainly due to the rigidity and high modulus of elasticity of the slab (slab action). H.M Westergaard is considered the pioneer in providing the rational treatment of rigid pavement analysis.

Modulus of sub-grade reaction:- Westergaard considered the rigid pavement slab as a thin elastic plate resting on soil sub-grade, which is assumed as a dense liquid. The upward reaction is assumed to be proportional to the deflection. Based on this assumption, Westergaard defined a modulus of sub-grade reaction K in kg/cm^3 given by $k=p/\Delta$ where Δ is the displacement level taken as 0.125cm and p is the pressure sustained by the rigid plate of 75cm dia at a deflection of 0.125cm.

Critical load positions:- since the pavement slab has finite length and width, either the character or the intensity of maximum stress induced by the application of a given traffic load is dependent on the location of the load on the pavement surface. There are 3 typical namely the interior, edge, and corner, where differing conditions of slab continuity exist. These locations are termed as critical load positions.

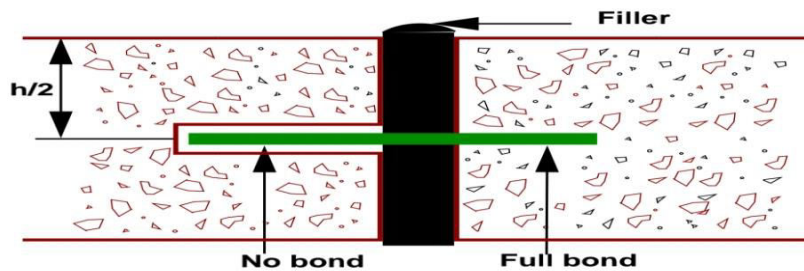
Wheel load stress (Westergaards equation):- The cement concrete slab is assumed to be homogeneous and to have uniform elastic properties with vertical sub-grade reaction being proportional to the deflection. Westergaard developed relationships for the stress at interior, edge and corner regions, denoted as σ_i , σ_e , σ_c in kg/cm^2 respectively. And other stresses like Temperature stresses, Warping stress and Frictional stresses are also calculated.

The J&K Economic Reconstruction Agency (ERA) started work on Rs 9.16 crore Rigid Concrete Pavement of civil secretariat to Rambagh Chowk road in August 2020. The project has a timeline of 12 months and will directly benefit thousands of people living on both the sides of the road which include Rambagh, Solina, Allochibagh, TulsiBagh, HazuriBagh, MagarmalBagh, Shaheedgunj, Natipora, Bakshi Stadium, Batmaloo etc.

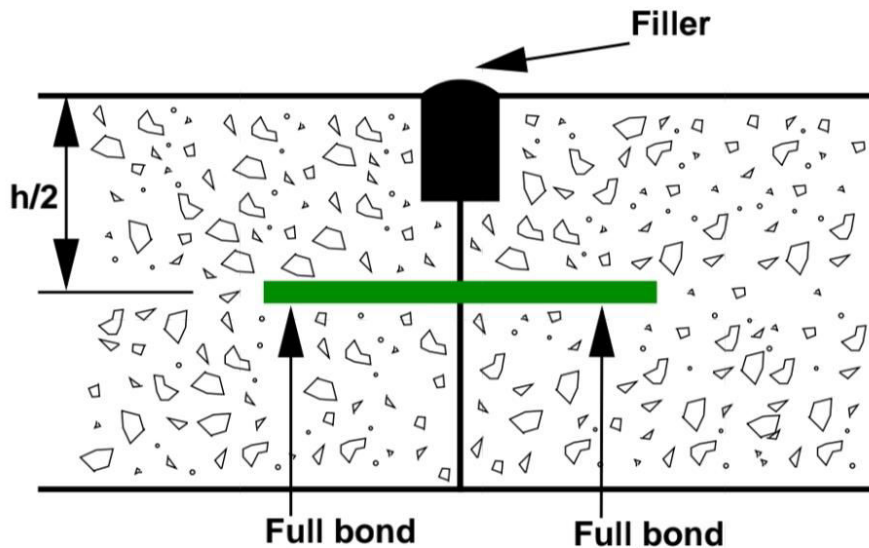


Design of joints

- **Expansion joint:**-The purpose of extension joint is to allow the expansion of the pavement due to rise in temperature with respect to construction temperature. The design considerations are:
 - Provided along the longitudinal direction.
 - Design involves finding the joint spacing for a given expansion joint thickness (say 2.5 cm specified by IRC) subjected to some maximum spacing (say 140 as per IRC)



- **Contraction joints:**-The purpose of the contraction joint is to allow the contraction of the slab due to fall in slab temperature below the construction temperature. The design considerations are:
 - The movement is restricted by the sub-grade friction.
 - Steel reinforcement can be use, however with a maximum spacing of 4.5 m as per IRC.



➤ **Environmental Aspects of Rigid Pavement in Kashmir.**

- A lot of work has been done to identify construction and maintenance challenges in cold and hilly areas. A data were arranged about how to prevent the rigid pavements or roads in cold and hilly areas(in Kashmir). The information regarding various aspects and challenges such as,
 - A. Regarding the formation, Checking and prevention of frost formation due to surface and sub surface water.
 - B. Construction methods and errors in designing and planning of roads leads to formation of Frost formation.
 - C. The no. of landslides in particular area depending upon the gradient of slope and its distance from epicentre.
 - D. Various challenges such as , Floods, Snow drift, Drainage problem, Material transportation issues and Earth quake and land slides etc. All are discussed in this paper and the solution to these environmental aspects.

II. CHALLENGES/ENVIRONMENTAL ASPECTS

Floods:-The internal roads connecting various districts within the Kashmir valley are both hilly roads as well as plain roads. The roads situated in plain area including the national highway that divides Kashmir into two parts stretching from north of Kashmir valley to the extreme south. This road lacks drainage system and is more prone to flooding, because it moves parallel to the river Jhelum whenever there are heavy rains during summers, it receives large water from catchment area including various tributaries like Lidder, Vaisho, Sind etc. due to which it over flows and inundates the National highway and other district roads. There is no flood channel to drain away the water, although there was one channel constructed in Srinagar city but that does not work properly now due to encroachments and solid waste disposals there. The recent flood of 2014 obstructs the inundation of the whole area.

The area surrounding river Jhelum has a soil that remains mostly saturated and thus retains more water. Since the area has mainly flexible pavements, a lot of settlements occur there even at lesser loads. There is not much impact on the rigid and semi-rigid pavements, although there may be reflection cracking due to differential settlements in the subgrade. Thus flood mainly affects the pavement and hinders the construction work.

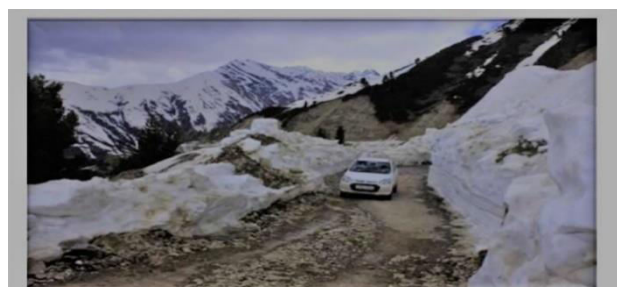


Ground frost:- In the hilly area of Kashmir, the temperature goes below minus 15 degree centi-grade in winter and never exceeds 15 degree even in summer months. In winter months these roads remain covered by snow and the frost action takes place. The sediments of glacial and glaciolacustrine origin are most frost sensitive. Frost depth is dependent on annual frost sum the green size of the soil and snow depth.

The frozen ground is considered to be stabilized soil and it cannot create any problem unless it remains frozen. As the temperature increase, thaw starts and its carrying capacity is lost, all this process delays the drainage of melt waters. Due to this, the water move along the road surface instead of drainage system constructed, resulting in the formation of longitudinal cracks on the embankment sites. This causes the deterioration of pavement, transverse cracks and potholes. If ground frost remains for longer periods, it will lead to accidents due to slippery condition on the roads.



Snow drift:- The whole Kashmir remains under snow cover for most part of the year and the major prone to snow storm includes Banihal top and Patni top on national highway, Sinthan top on anantnag-kishtiwar road and Peer-ki-gali on Mughal road. The frost so formed and the continues freezing and thawing action, deteriorates the wearing course and it scraps off the upper layer of the road when we try to clear the frost off the roads.



Earth quake and landslides:- The Kashmir valley lies in the zone 5 of earthquake zoning, which is considered to be the earth prone zone, we often experience big earthquakes causing the loosening of soil and ultimately the huge mass moment of earth. The Srinagar – jammu National highway passes through these Himalayan ranges that are prone to landslides. There are heavy rains and snow during winter months because of high RL of the place that has resulted in deep weathering profiles, on slopes that are hardly stable. This accumulation of water in soil molecules develops pressure that leads to the shear failure of soil and thus the mass moment of the soil, resulting landslides and snow avalanches rolling the hill slope at very high speed destroys the roads located beneath the hill.



Material transportation issue:- The special attention in treatment for roadway construction in extremely cold weather conditions starts from mobilization of resources. Carrying pavement construction materials to such a high altitude is very difficult where temperature is very low and can be very uneconomical. It is difficult to maintain the high temperature of bitumen that is essential for the success and long life of any pavement. Apart from this, working in sub zero temperature lead to the deterioration of health, productivity, masons and engineers working at the site. The machinery planted at the site face the problems like freezing of fuels and lubricants, thus reduce the efficiency of mechanics, resulting in uneconomical design and construction of pavements.

Solutions:-

- The cement mainly Chunam and Ferro-cement used in construction of rigid pavements should have the initial curing time of less than 2.5h and final setting time of not less than 5.2h. The aggregates of granite and carbonate rocks can be used.
- The construction of toe walls mainly the mass gabion walls to prevent the low amount landslide debris from entering the road that may damage road pavement and drainage.
- The cut off drains with trapezoidal cross section should be provided at numerous places for better drainage.
- To prevent individual cracking caused due to penetration of moisture because of prolonged rainfall, crack sealing comprising of jute fibre mixed with cut-back bitumen can be used.
- Increasing vegetation is the effective method to prevent soil erosion, snow drifting and weathering.
- To prevent snow drifting, the snow fences can be constructed and the roads have to be placed parallel to the wind direction.
- The insulated multiply-drainage outlets, snow walls and culvert can be used. the wall height should not be less than 3.7m.



III. CONCLUSION

Thus from our study we conclude that it is much more difficult to construct and maintain road in the cold and hilly regions like that of Kashmir valley. We identified the challenges and found some suitable challenges to counter them. It was found that the major construction and maintenance challenge is to construct roads in the frost covered regions. Other challenges like earthquakes, landslides and mass moment of earth leading to the closure of roads, causing damage to the roads and danger to the travellers due to heavy traffic jams.

The best solutions were identified which are discussed, to overcome these challenges that are economical, feasible and easy available.

REFERENCES

1. <https://thelegitimateneews.com/jk-era-starts-work-on-rs-9.16-crore-rigid-concrete-pavement-of-civil-secretariat-rambagh-road/>
2. <http://thekashmirimages.com/2020/08/20/jkera-starts-work-on-rigid-concrete-pavement-of-civil-secretariat-rambagh-roads/>
3. Dr.C.E.G. Justo-Formerly-Professor-of-Civil (Highway) Engineering Bangalore University, Bangalore



**Impact Factor:
7.569**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details