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Modern materials and methodologies for road maintenance and construction

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Abstract
The primary focus of this study is to identify the challenges and difficulties that we face and to find some feasible solutions while constructing and maintenance of roads in the state of India. A road is a thoroughfare, route, or way on land between two places that has been paved or otherwise improved to allow travel by foot or some form of conveyance, including a motor vehicle, cart, bicycle, or horse. In this paper, we introduce some of the 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 India.

Keywords: roads, strength, construction, maintenance, concrete, methods

Introduction
The Road Construction and Maintenance Section is in charge of routine assessment and upkeep of streets, spans, walkways, checks, unpaved streets and tempest water offices as indicated by built up state execution and wellbeing gauges. This segment facilitates and deals with the Comprehensive Preventive Maintenance Program (CPMP), Service Management, Project Development and Quality Management Programs. Extra duties incorporate keeping up the administration and administration framework which screens and calendars work, hardware, materials and work orders for development and upkeep work exercises. Street Construction and support is basic keeping in mind the end goal to (1) save the street in its initially developed condition, (2) secure adjoining assets and client wellbeing, and (3) give proficient, helpful go along the course. Tragically, support is frequently disregarded or disgracefully performed bringing about quick decay of the street and inevitable disappointment from both climatic and vehicle utilize impacts. It takes after that it is difficult to construct and utilize a street that requires no upkeep.

With a specific end goal to get ready for street upkeep needs, it is critical to keep a total arrangement of "as assembled" plans and records of all support operations and perceptions. The as fabricated arrangement ought to contain the accompanying:

- Complete job index
- Complete history of project from planning stage to construction
- Photographic records
- Exact location and observations of any unstable conditions in relation to the road location
- Exact location of culverts and other drainage features
- Wet areas that may have required additional excavation and replacement with more suitable ballast backfield materials
- All major changes made to the original plan

Probably the most valuable tool for any maintenance program is the knowledge and experience gained by individuals performing the maintenance. Every effort should be made to retain competent, knowledgeable, and experienced individuals in these positions not only from the standpoint of instituting and executing a good maintenance program, but for future road planning needs as well.

India in its past did not allot enough assets to fabricate or keep up its street organize. This has changed since 1995, with significant endeavors right now in progress to modernize the nation's street framework. As of May 2017, India had finished and set being used more than 28,900 kilometers of as of late assembled 4 or 6-path expressways interfacing a considerable lot of its significant assembling focuses, business and social focuses. As per the CIA World Factbook, starting at 2015, India had around 96,000 kilometers of national roadways and freeways, in addition to another 147,800 kilometers of state parkways. Real ventures are being actualized under the National Highways Development Project, an administration activity. Private manufacturers and parkway administrators are likewise executing real tasks - for instance, the Yamuna Expressway amongst Delhi and Agra was finished in front of calendar and inside spending plan, while the KMP Expressway began in 2006 is a long ways behind timetable, over spending plan and deficient. As per 2009 gauges by Goldman Sachs, India should contribute US$1.7 trillion on foundation extends before 2020 to meet its financial needs, a piece of which would be in updating India's street organize. The Government of India is endeavoring to advance outside interest in street ventures.

Field Identification Procedure
As a guide to recognize the expansive soil sorts in the field with no lab testing, a visual arrangement is prescribed. For visual order, the accompanying classes of soils are proposed:

Gravels: These are coarse materials with molecule estimate

more than 4.75 mm. These may have practically zero fines adding to union of the material.

Moorums: These are unmistakably unique materials from rock and are results of disintegration and weathering of the parent shake. The properties of these materials normally rely upon the parent shake and the way toward weathering and disintegration. Outwardly they look like rock with the exception of the distinction that the percent fines is generally significantly higher.

Sands: These fluctuate in surface from coarse to fine however show no union. They enable water to penetrate promptly through them.

Residues: These are better than sands in surface; lighter in shading contrasted with muds and show little union. Dilatancy is a particular property of residues. At the point when a chunk of silty soil blended with water is on the other hand crushed and tapped, a glossy surface shows up.

Dirts: These are better than sediments and are a definitive result of weathering and disintegration of parent shake. Mud and clayey soils display stickiness, high quality when dry and demonstrate no dilatancy. Dark cotton soils and other far reaching sorts of dirts display swelling and shrinkage and are portrayed by an ordinary shrinkage design. A glue of mud with water when rubbed in the middle of fingers leaves a stain which is not watched for residues.

Modern Road Construction Materials

Road construction requires the creation of an engineered continuous right-of-way or roadbed, vercoming geographic obstacles and having grades low enough to permit vehicle or foot travel. and may be required to meet standards set by law or official guidelines. The process is often begun with the removal of earth and rock by digging or blasting, construction of embankments, bridges and tunnels, and removal of vegetation (this may involve deforestation) and followed by the laying of pavement material. A variety of road building equipment is employed in road building.

Fig 1: Surveyor at work with a leveling instrument

After design, approval, planning, legal and environmental considerations have been addressed alignment of the road is set out by a surveyor. The radii and gradient are designed and staked out to best suit the natural ground levels and minimize the amount of cut and fill. Great care is taken to preserve reference Benchmarks. Roads are designed and built for primary use by vehicular and pedestrian traffic. Storm drainage and environmental considerations are a major concern. Erosion and sediment controls are constructed to prevent detrimental effects. Drainage lines are laid with sealed joints in the road easement with runoff coefficients and characteristics adequate for the land zoning and storm water system. Drainage systems must be capable of carrying the ultimate design flow from the upstream catchment with approval for the outfall from the appropriate authority to a watercourse, creek, river or the sea for drainage discharge.

Asphalt

Asphalt (specifically, asphalt concrete), sometimes called flexible pavement due to the nature in which it distributes loads, has been widely used since the 1920s. The viscous nature of the bitumen binder allows asphalt concrete to sustain significant plastic deformation, although fatigue from repeated loading over time is the most common failure mechanism. Most asphalt surfaces are laid on a gravel base, which is generally at least as thick as the asphalt layer, although some 'full depth' asphalt surfaces are laid directly on the native subgrade. In areas with very soft or expansive subgrades such as clay or peat, thick gravel bases or stabilization of the subgrade with Portland cement or limemay be required. Polypropylene and polyester geosynthetics have also been used for this purpose and in some northern countries, a layer of polystyrene boards have been used to delay and minimize frost penetration into the subgrade. Advantages of asphalt roadways include relatively low noise, relatively low cost compared with other paving methods, and perceived ease of repair. Disadvantages include less durability than other paving methods, less tensile strength than concrete, the tendency to become slick and soft in hot weather and a certain amount of hydrocarbon pollution to soil and groundwater or waterways.

Fig 2: Asphalt layer and Hamm road roller

Concrete

Concrete surfaces (specifically, Portland cement concrete) are created using a concrete mix of Portland cement, coarse aggregate, sandand water. In virtually all modern mixes there

will also be various admixtures added to increase workability, reduce the required amount of water, mitigate harmful chemical reactions and for other beneficial purposes. In many cases there will also be Portland cement substitutes added, such as fly ash. This can reduce the cost of the concrete and improve its physical properties. The material is applied in a freshly mixed slurry, and worked mechanically to compact the interior and force some of the cement slurry to the surface to produce a smoother, denser surface free from honeycombing. The water allows the mix to combine molecularly in a chemical reaction called hydration.

One of the major advantages of concrete pavements is they are typically stronger and more durable than asphalt roadways. They also can be grooved to provide a durable skid-resistant surface. A notable disadvantage is that they typically can have a higher initial cost, and can be more time-consuming to construct. This cost can typically be offset through the long life cycle of the pavement. Concrete pavement can be maintained over time utilizing a series of methods known as concrete pavement restoration which include diamond grinding, dowel bar retrofits, joint and crack sealing, cross-stitching, etc. Diamond grinding is also useful in reducing noise and restoring skid resistance in older concrete pavement.

Bituminous Surface Treatment (BST)

Bituminous surface treatment (BST) or chipseal is used mainly on low-traffic roads, but also as a sealing coat to rejuvenate an asphalt concrete pavement. It generally consists of aggregate spread over a sprayed-on asphalt emulsion or cut-back asphalt cement. The aggregate is then embedded into the asphalt by rolling it, typically with a rubber-tired roller. This type of surface is described by a wide variety of regional terms including "chip seal", "tar and chip", "oil and stone", "seal coat", "sprayed seal or "surface dressing" or as simply "bitumin." BST is used on hundreds of miles of the Alaska Highway and other similar roadways in Alaska, the Yukon Territory, and northern British Columbia. The ease of application of BST is one reason for its popularity, but another is its flexibility, which is important when roadways are laid down over unstable terrain that thaws and softens in the spring. Other types of BSTs include micropaving, slurry seals and Novachip. These are laid down using specialized and proprietary equipment. They are most often used in urban areas where the roughness and loose stone associated with chip seals is considered undesirable.

Road Maintenance Methodologies

Like all structures, roads deteriorate over time. Deterioration is primarily due to accumulated damage from vehicles, however environmental effects such as frost heaves, thermal cracking and oxidation often contribute. According to a series of experiments carried out in the late 1950s, called the AASHO Road Test, it was empirically determined that the effective damage done to the road is roughly proportional to the Fourth power of axle weight. A typical tractor-trailer weighing 80,000 pounds (36.287 t) with 8,000 pounds (3.629 t) on the steer axle and 36,000 pounds (16.329 t) on both of the tandem axle groups is expected to do 7,800 times more damage than a passenger vehicle with 2,000 pounds (0.907 t) on each axle. Potholes on roads are caused by rain damage and vehicle braking or related construction works.

Fig 3: Manual road repair taking place on rural roads

Pavements are designed for an expected service life or design life. In some parts of the United Kingdom the standard design life is 40 years for new bitumen and concrete pavement. Maintenance is considered in the whole life cost of the road with service at 10, 20 and 30 year milestones. Roads can be and are designed for a variety of lives (8-, 15-, 30-, and 60-year designs). When pavement lasts longer than its intended life, it may have been overbuilt, and the original costs may have been too high. When a pavement fails before its intended design life, the owner may have excessive repair and rehabilitation costs. Some asphalt pavements are designed as perpetual pavements with an expected structural life in excess of 50 years.

Fig 4: Line marking in rural India

Many asphalt pavements built over 35 years ago, despite not being specifically designed as a perpetual pavement, have remained in good condition long past their design life. Many concrete pavements built since the 1950s have significantly

outlived their intended design lives.

Virtually all roads require some form of maintenance before they come to the end of their service life. Pro-active agencies use pavement management techniques to continually monitor road conditions and schedule preventive maintenance treatments as needed to prolong the lifespan of their roads. Technically advanced agencies monitor the road network surface condition with sophisticated equipment such as laser/inertial Profilometers. These measurements include road curvature, cross

slope, asperity, roughness, rutting and texture. This data is fed into a pavement management system, which recommends the best maintenance or construction treatment to correct the damage that has occurred.

Maintenance treatments for asphalt concrete generally include thin asphalt overlays, crack sealing, surface rejuvenating, fog sealing, micro milling or diamond grinding and surface treatments. Thin surfacing preserves, protects and improves the functional condition of the road while reducing the need for routing maintenance, leading to extended service life without increasing structural capacity. Maintenance for the older concrete pavements that develop faults includes the technique called dowel bar retrofit. This involves cutting slots in the pavement at each joint, placing dowel bars in the slots, then filling them with concrete patching material. This method can extend the life of the concrete pavement for another 15 years. Failure to maintain roads properly can create significant costs to society, in a 2009 report.

Conclusion

Road are the fundamental methods for travel and transportation and of building ties and advancing exchange, streets have developed significantly since their presentation in the early piece of the twentieth century. Today, clients, nearby inhabitants, and administrators need enduring framework that realizes genuine solace, better stream, less annoyances, more prominent wellbeing, and a more drawn out valuable life. Road surfaces ought to be revised just as important to give a smooth running surface and a decent crown or slant for waste. All-season streets will require persistent observing for surface and subgrade wear or disintegration. Rutting and loss of stabilizer frequently happen amid blustery season utilize. Snow expulsion hardware can likewise wreck the street surface by evacuating or modifying the crown and expelling weight. An arrangement ought to be set up to give weight when important to keep up proceeded with utilization of the road.

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