STUDY OF PLASTIC CELL-FILLED CONCRETE BLOCK PAVEMENT FOR RURAL ROAD (PCCBP)

Avinash B. Kokare
Assistant professor Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

Dr. M. G. Dheshmukh
Associate professor Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

Priydarshni Deshmukh
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

Mayuri Takmoghe
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

Esha Bagwan
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

Snehal Borade
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

Shivani Ghaytidak
UG Student Department of Civil engineering,
SVERI's College of Engineering Pandharpur Maharashtra

ABSTRACT
One of the innovative ways by which the Government of India is addressing the challenges of rural Road development is the use of plastic waste as an alternative material for road construction. Under the Pradhan Mantri Gram Sadak Yojana (PMGSY), or the Prime Minister's Rural Road Program, several Implementing state level agencies have utilized plastic waste as alternative road construction materials in various ways, even though still on a pilot basis. It is expected that India will not only reduce the amount of plastic waste that goes to its landfills or incinerators, but also benefit from more efficient rural road Development. The aim is to carry out a review of Plastic Cell-Filled block pavement by the study of Previous experimental studies carried to satisfy the need of sustainable all-weather roads with accessible riding quality in rural areas with satisfactory life span and maintenance cost.

1.Introduction

India has a total of 4.2 million kilometres (km) of rural roads in addition to 114,158 km of national highways, 761,217 km of state highways, and district roads. Only half of the network's roadways are surfaced. There are over 6 lakh villages spread throughout a variety of landscapes, including plains, hilly and mountainous regions, deserts, marshes, and coastal areas. Without a system of decent roads, the rural masses cannot access employment opportunities and basic services like health and education. Seventy percent of India's population lives in rural areas, many of which can only be reached via dirt roads that are unsuitable for motor vehicles and become inaccessible during the rainy season.

New, cutting-edge technology must be generated through research and development initiatives (R & D). The use of concrete pavement with embedded cells has shown to be a very effective remedy for the aforementioned problems. It offers reasonably priced, nearly maintenance-free long-lasting concrete pavements (permanent assets). Additionally, it creates job chances in rural areas.

Concrete blocks are enclosed in PCCBP by heat-welded plastic cells in the shape of diamonds. It should be noted that this kind of plastic cell formwork has been utilised successfully for reinforced earth treatment, canal lining, etc. Concrete is poured into the cells, which have been stretched throughout the foundation layer and tensioned. When compacted, the cell walls bend, causing neighbouring individual concrete blocks to connect. Cement-bound (rigid) surfaces are made flexible, and some people refer to these pavements as "Flexible Concrete Pavements."

2. Plastic Cell Filled Concrete Block Pavement (PCCBP)

A formwork made of plastic cells is used to cover the compacted subgrade or subbase in this method. To keep the plastic form work taut, iron spikes are pushed into the corners of the cells and the form work is stretched. When concrete or stones are being placed within the cells, nylon ropes inserted through the cell walls prevent the cells from collapsing. The cells are filled with several types of concrete, such as conventional concrete and zero slump concrete, each with a minimum 28-day characteristic strength of 32 MPa. The top of the cells will have the same camber as the subgrade/subbase since they have the correct camber. A vibratory/static road roller with a 6- to 8-ton capacity may be used to compact the concrete after it has been levelled. The required compaction will be achieved with one or two static passes, one or two vibratory passes, and then one or two static passes once more. During construction, the cell walls are coiled both vertically and horizontally to create the three-dimensional interlocking of the concrete blocks.

Figure.1: Peddle machine preparation of plastic cell formwork

3. Materials used for the construction of PCCB

3.1 Plastic cells

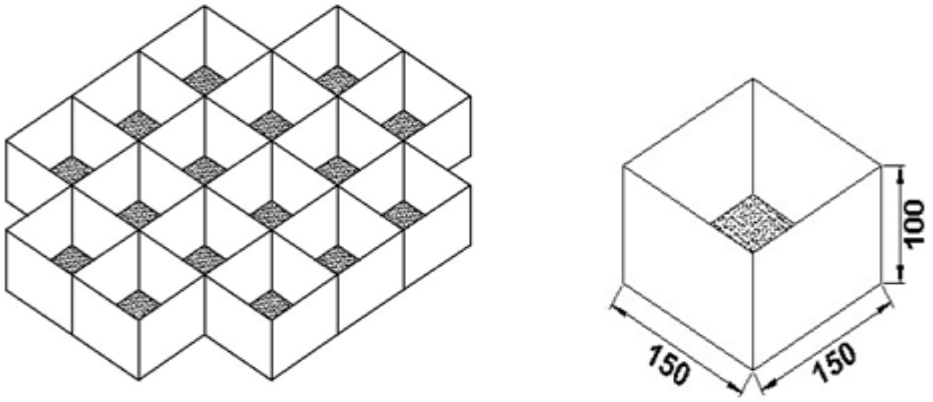

Figure.2- Plastic Cell

Recycled high-density polyethylene (HDPE) sheets with a thickness ranging from 0.22 mm to 0.25 mm can be used to create the form work for plastic cells. Depending on the required depth, plastic sheet manufacturers can provide rolls of strips 50mm to 100mm wide.

3.2. Cement

Fly ash-based Portland pozzolana cement (PPC) conforming to IS 1489 (1991), was used for casting concrete blocks.

3.3. Stone dust

For the casting of concrete blocks, fine aggregates are made from stone dust gathered from a stone crusher facility.

3.4. Coarse Aggregate

The crusher run coarse aggregates were obtained from the same stone crusher factory from where the stone dust was collected. These coarse aggregates were crushed from hilly stone boulders.

4. Construction

4.1. Formwork:

It is possible to lay a plastic cell formwork over the compacted subbase and strain it with iron spikes so that the cells are roughly square in shape.

Figure.3.- Application of plastic cells during road construction

4.2. Joints

No seams are required because the concrete is in the shape of 150 mm x 150 mm blocks with plastic sheets on the vertical interface. The aggregates should be removed from the cells before work starts the following day, and concrete should then be poured into the plastic cells after spreading a fresh roll of cells.

Figure.4 Wet paddy straw and ponding used to cure concrete

4.3. Curing

Wet jute/coir mats and wet paddy straw (figure 10) provide a superior water curing option due to the camber of around 3 to 3.5 percent stipulated for rural roads, allowing light traffic to move on the surface.

5. Cost Analysis of Roads made of PCCB and rigid pavement

5.1. Costing of PCCB pavement

For 150 MM Thickness Plastic Cell Filled Concrete Block Pavement (PCCBP), an abstract of costs is provided (SSR 20-21)

Cost of plastic 3750 Sqm area = Rs 2,24,848.49

cost of man-days @ Rs 80 per day (80X505) = Rs 40400.00

Cost of electrically operated paddle sealing machine = Rs 10000.00

Therefore, total cost for preparation of cell forms made of plastic for 3750Sqm area, (2,24,848.49 + 40400.00 + 10000.00) = Rs 2,75248.49

Cost of Concreting

Cement Cost @ 400 per bag (400 X 4646.25) = Rs 18,58,500/-

Cost of coarse aggregates @ Rs 900/ m3 (900 X 658.125) = Rs 5,92,312.5/-

Total cost (18,58,500+5,92,312.5+2,72,475) = Rs 27,23,287.5/-

Add 5% transportation charges = Rs 1,36,164.375/-

Grand Total cost of concrete for 3750 Sqm area = Rs 28,59,451.875/-

Therefore, concrete cost per Sqm area = Rs 762.52/-

Total cost for PCCB pavement = RS 37,27,012.865/-

5.2.Rigid Pavement costing

Abstract of cost for 150 MM Thickness Concrete Pavement (SSR 20-21)

Cement Cost @ 400 per bag (400X 5856) = Rs 23,42,400 /-

Cost of coarse aggregates @ Rs 900/ m3 (900 X 331.32) = Rs 2,98,181.25/-

Cost of stone dust @ Rs 700/ m^3 (700X254.81) = Rs 1,78,367

Total cost (23,42,400+2,98,181.25+1,78,367) = Rs 28,18,948.25/-

Add 5% transportation charges = Rs 1,40,947.41/-

Grand Total cost of concrete for 3750 Sqm area = Rs 29,59,895.66/-

Therefore, Concrete cost per Sqm area = RS 789.30/-

Total cost for rigid pavement = RS 56,00,476.96/-

5.3.Comparative Study

Total cost of rigid pavement = RS 56,00,476.96/-

Total cost of PCCB pavement = RS 37,27,012.865/-

Difference between cost of rigid and PCCB pavement = RS 18,73,464.095/-

6.Conclusion

1. Concrete with plastic cell filling roads could be a Solution for the rural roads because of the lifeof Concrete roads is much more. It's beneficial to use cell filled in low Volume traffic condition.
2. The cost of switching from river sand to stone dust in concrete was discovered. Cutting without noticeably affecting the concrete's strength. As a result, PCCBP can be a good substitute for the traditional rigid and PCCBP for building rural roads.
3. Compared to PCCBP, the entire cost, which includes the cost of stiff pavements, is 14 percent more.
4. No guidelines have been created Such as codes or manuals as yet for the Construction and evaluation of Pavement condition index for different Types of distress that PCCBP may Have. All work done in this respect is of experimental nature.
5. Compared to conventional materials, using road materials that include plastic waste has the following benefits:
    i. Reduces whole life cost
    ii. Longer service life
    iii. Preserves natural resources
    iv. Reduces plastic waste in landfills.
6. Hypothetical flexible–rigid pavement structure utilising plastic waste elements, PCCBP has been theoretically assessed for its potential to offer:
    i. Good serviceability (durability, weather resilience, and riding quality)

ii. Improved sustainability (higher recyclability and waste contents)

iii. Cost savings

iv. Positive socioeconomic impacts.

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