JP6000 HIR System

Xi'an Ring Expressway

Project Report April 30, 2025

Preface

The "14th Five-Year Plan" period marks a crucial phase for Shaanxi's expressway maintenance management. In response to emerging pavement damage and distress signs on the Ring Expressway, Shanxi Transportation Holding Group Co., Ltd. has implemented green, low-carbon, and environmentally friendly technologies, including the recycling of waste pavement materials within the road sections. These measures aim to:

1. Slow the deterioration rate of pavement performance
2. Maintain optimal road service conditions
3. Reduce lifecycle costs
4. Minimize ecological impact during construction

I Project Overview

The Xi'an Ring Expressway spans 80.35 kilometers in total, consisting of:

- Northern Section (35.686 km): Completed and opened to traffic in October 2000 (K0+000–K34+700, K79+364–K80+350)
- Southern Section (44.664 km): Completed and opened to traffic in September 2003 (K34+700–K79+364)

Both sections have significantly exceeded their designed service life.
This special maintenance project focuses on the downbound lanes from K46+000 (Hechizhai Interchange) to K7+500 (Xingyuan Interchange), covering a total length of 38.5 km, including:

- Northern Ring Section: 27.2 km (70.6%)
- Southern Ring Section: 11.3 km (29.4%)

Total Investment: 141.076 million yuan

Construction Period: ≤80 days
Centralized repair of pavement and bridge defects.
Upgrade of traffic safety facilities along the route.

The Xi'an Ring Expressway forms an elliptical loop around the central urban area, serving as a critical transportation hub for nine national expressways including Baotou-Maoming (G65), Beijing-Kunming (G5), Lianyungang-Khorgas (G30), Fuzhou-Yinchuan (G70), Xi'an-Yan'an, and Shanghai-Xi'an routes, as well as multiple provincial highways in Shaanxi. Its service level and traffic capacity directly determine the operational efficiency of the entire regional road network. The improvements will ensure more efficient traffic flow conversion between major national and provincial routes while maintaining the expressway's vital role in regional connectivity.

II Pilot Orientation and Implementation Rationale

This Ring Expressway project adopts green maintenance as its pilot direction, with implementation approaches demonstrating strong justification through the following aspects:

(1) Aligning with Green, Low-Carbon Transportation Development Goals: The project responds to China’s Transportation Power Construction Outline, which emphasizes green and low-carbon development. The northern section of the Xi'an Ring Expressway was selected as the pilot zone due to its: High traffic density; Substantial pavement maintenance demands.

(2) Breakthrough in HIR Technology Innovation & Application: The project leverages mature, proven recycling technologies previously validated on multiple Shanxi expressways, including: Integrated HIR systems; Clean HIR technology; RAP prefabricated pavement recycling.

(3) 100% Recycling of Waste Pavement Materials: Through digital smart maintenance design & construction, along with advanced recycling techniques, the project achieves:
Full-cycle utilization of waste materials via multi-mode HIR; Energy-efficient construction using next-gen recycling equipment; RAP-based prefabricated components for auxiliary structures.

II Pilot Orientation and Implementation Rationale

(4) Carbon Emission Reduction: The project establishes a solid waste recycling carbon emission assessment system to: Quantify energy-saving and emission-reduction benefits; Promote widespread adoption of reclaimed pavement material technologies; Advance ecological civilization development.

(5) Significant Economic Benefits, the recycling technology delivers: Reduced construction costs through material reuse; Enhanced project economics; Alignment with sustainable green transportation strategies

(6) Strong Demonstration Value, the pilot's success offers: A replicable model for nationwide green highway maintenance; Benchmark potential for low-carbon transportation initiatives.

(7) Optimized Construction Approach, the project employs sectional single-carriageway bidirectional construction, featuring: Coordinated multi-workzone management; Efficient cross-construction scheduling; Maximized centralized maintenance advantages: Shorter timelines; Minimized public impact; Guaranteed quality

III Technical Approach & Implementation Plan

1. Technical Approach

Adhering to the principles of "scientific planning, cost-effectiveness, precision design, and needs-based investment", the project employs the following strategies:

(1) Subgrade Section Asphalt Pavement Rehabilitation

a. Full-Surface Hot In-Place Recycling for all three traffic lanes; Existing pavement distresses are addressed before IHR implementation.

b. Pre-treat critical failures, including: Transverse/longitudinal cracks; Rutting; Pumping; Potholes; Full-depth repair based on distress severity and layer penetration.

c. For minor transverse cracks (reflective cracks): After milling, apply anti-crack tape + fiberglass grid at the lower layer's top surface. Delay upward crack reflection. For severe transverse cracks: Grooving + crack sealing + patching + backfilling.

III Technical Approach & Implementation Plan

(2) Bridge Section Asphalt Pavement Rehabilitation

Full Removal & Replacement:
The entire asphalt surface layer on bridges will be milled and repaved with new asphalt.

Concrete Leveling Layer Repair:
Dynamic treatment of distresses in the cement concrete leveling layer to ensure structural integrity.

(3) Emergency Lane Asphalt Pavement Treatment

Process:
Mill off the existing asphalt micro-surfacing.
Apply fog seal treatment to restore pavement smoothness.

Objective:
Achieve uniform elevation between the emergency lane and main traffic lanes.

III Technical Approach & Implementation Plan

2. Implementation Plan

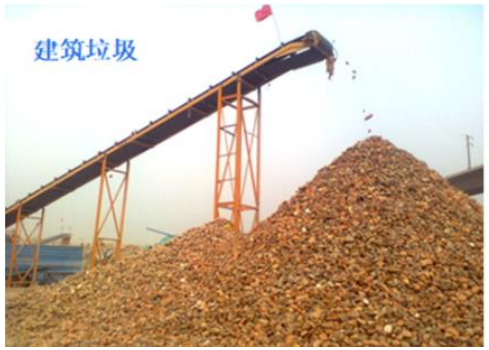
The project will be executed in 4 sequential work zones, divided by interchanges, with the following schedule:

Work Zone	Section	Length	Duration
Zone 1	Hechizhai → A'fangong	8.12 km	23 days
Zone 2	A'fangong → Liucunbao	11.04 km	21 days
Zone 3	Liucunbao → Lüxiaozhai	10.4 km	17 days
Zone 4	Lüxiaozhai → Xingyuan	10.1 km	12 days

IV Project Benefits

1. The project achieves 100% recycling of original pavement materials, effectively reducing emissions and protecting the ecological environment. For every 10,000 square meters of old asphalt pavement (4cm thick) repaired using clean in-place thermal regeneration technology, it saves 917 tons of stone aggregates, 43 tons of asphalt, 440 liters of fuel, and 7,088 kWh of electricity while reducing carbon dioxide emissions by 70 tons. It also prevents the excavation of 18 square meters of mountainous land and reduces land occupation by **36 square meters**. This project aims to achieve 100% recycling of waste pavement materials, shorten the construction period by 30%, and **save 13.75 million yuan** compared to traditional milling and repaving methods.

2. By adopting multi-mode integrated in-place thermal regeneration technology, large-scale continuous paving with energy-saving and environmentally friendly thermal regeneration equipment featuring integrated mixing and paving functions with recycled material storage capacity, the project promotes the application of clean in-place thermal regeneration technology. The air-circulating low-oxygen heating principle eliminates visible blue smoke and enables centralized emissions, causing no pollution to the surrounding environment while allowing heat energy recycling, energy conservation, and reduced greenhouse gas emissions.



3. The application of clean in-place thermal regeneration technology on Xi'an Ring Expressway will further verify, improve, and optimize the complete technical standards for in-place thermal regeneration, providing data support for its wider adoption in Shaanxi Province and accumulating practical experience for green transportation development in the region.

IV Project Benefits

(4) Through the successful implementation of this pilot project, a carbon emission model for solid waste resource utilization will be established to comprehensively evaluate the energy-saving and emission-reduction benefits of the pilot project. A set of carbon emission accounting and assessment methods for road construction solid waste recycling projects will be proposed, culminating in the compilation of one specialized pilot project energy-saving and emission-reduction evaluation report.

(5) The centralized maintenance pilot project will further explore and leverage the advantages of concentrated maintenance, identify areas requiring improvement and enhancement, and ultimately produce a standardized implementation report for centralized maintenance procedures.

(6) The implementation of this pilot project holds significant importance for strengthening Xi'an's external transportation corridors, promoting coordinated development with surrounding cities, improving the national expressway network, and enhancing the service level of national expressway transportation routes.

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Thank You