

# JOINT TRANSPORTATION RESEARCH PROGRAM

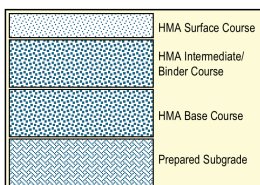
INDIANA DEPARTMENT OF TRANSPORTATION  
AND PURDUE UNIVERSITY



## User Manual for Digital Inspection Training System

### Construction Process Involved in Pay Item 401-000004 QC/QA-HMA, 2, 58H, SURFACE, 9.5 mm

Click on the construction process for which you want to find applicable check items:



Design



Mixing



Loading Mixture onto Truck



Transport



Preparing Subgrade



Sealant Application



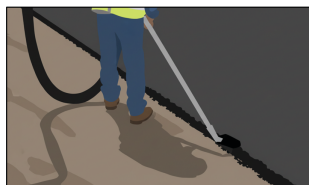
Loading Mixture onto Paver



Paving



Compaction



Joint Adhesive Application

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Hubo Cai, and Dulcy M. Abraham**

## RECOMMENDED CITATION

Hong, Y., Zhang, Y., Hong, Z., Zheng, R., Cai, H., & Abraham, D. M. (2025). *User manual for digital inspection training system* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2025/28). West Lafayette, IN: Purdue University. <https://doi.org/10.5703/1288284318594>

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## JOINT TRANSPORTATION RESEARCH PROGRAM

The Joint Transportation Research Program serves as a vehicle for INDOT collaboration with higher education institutions and industry in Indiana to facilitate innovation that results in continuous improvement in the planning, design, construction, operation, management and economic efficiency of the Indiana transportation infrastructure. Learn more at [engineering.purdue.edu/JTRP](http://engineering.purdue.edu/JTRP).

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## TECHNICAL REPORT DOCUMENTATION PAGE

<b>1. Report No.</b> FHWA/IN/JTRP-2025/28	<b>2. Government Accession No.</b>	<b>3. Recipient's Catalog No.</b>	
<b>4. Title and Subtitle</b> User manual for digital inspection training system	<b>5. Report Date</b> October 23, 2025		<b>6. Performing Organization Code</b>
	<b>8. Performing Organization Report No.</b> FHWA/IN/JTRP-2025/28		
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		<b>11. Contract or Grant No.</b> SPR-4832	
<b>12. Sponsoring Agency Name and Address</b> Indiana Department of Transportation (SPR) State Office Building 100 North Senate Avenue Indianapolis, IN 46204		<b>13. Type of Report and Period Covered</b> Final Report	
		<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Notes</b> Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.			
<b>16. Abstract</b> Construction inspection plays a pivotal role in ensuring the quality and long-term performance of infrastructure products. INDOT is currently facing the challenge to effectively train novice inspectors and update experienced inspectors with the latest versions of quality requirements to perform construction inspection effectively and more efficiently. This project developed a digital inspection training system to train INDOT inspectors to inspect asphalt pavement construction. Inspectors can access the inspection instructions through a construction process-based approach or a pay item-based approach. The inspection guidance is developed using data and information from INDOT's Standard Specification (2024), <i>Manual for Frequency of Sampling and Testing and Basis for Use of Materials</i> , General Instructions to Field Employees, Standard Drawings, risk-based check items developed in previous JTRP projects (SPR-4002 and SPR-4422), INDOT training materials, and relevant external references from Federal Highway Administration, state transportation agencies, and reports of National Cooperative Highway Research Program (NCHRP) projects. The system is implemented through a Web platform. It serves as a training tool for novice inspectors and a quick reference for experienced inspectors seeking update-to-date specifications and guidelines.			
<b>17. Key Words</b> construction inspection, digital training system, construction risks and pitfalls, inspector training		<b>18. Distribution Statement</b> No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161.	
<b>19. Security Classif. (of this report)</b> Unclassified	<b>20. Security Classif. (of this page)</b> Unclassified	<b>21. No. of Pages</b> 10	<b>22. Price</b>

## 1. INTRODUCTION

This digital inspection training system aims to train Indiana Department of Transportation (INDOT) inspectors to inspect asphalt pavement construction. Inspectors can access the inspection instructions through a construction process-based approach or a pay item-based approach. The inspection guidance is developed using data and information from INDOT's Standard Specification (INDOT, 2024b), Manual for Frequency of Sampling and Testing and Basis for Use of Materials (INDOT, 2025), General Instructions to Field Employees (INDOT, n.d.), Standard Drawings (INDOT, 2024a), risk-based check items developed in previous JTRP projects (SPR 4002 [Xu et al., 2019] and SPR 4422 [Cai et al., 2020]), INDOT training materials, and relevant external references from Federal Highway Administration (FHWA), state transportation agencies, and reports of National Cooperative Highway Research Program (NCHRP) projects.

The system is implemented through a Web platform. It serves as a training tool for novice inspectors and a quick reference for experienced inspectors seeking up-to-date specifications and guidelines. It contains many features as follows.

### 1.1 Feature #1: Check Items

This feature offers Web pages that guide users on **what to inspect, why to inspect, and how to inspect**. These web pages are:

- Linked to two complementary views:
  - **Pay item**, following inspection practices that ensure contractor work is inspected and compensated per pay items and standards.
  - **Construction process**, reflecting the typical sequence of field operations that align with inspection workflows.
- Enhanced with **hyperlinks to source references** and **figures** to improve user's understanding and comprehension.

### 1.2 Feature #2: Pay Item-Based Approach and Construction Process-Based Approach

This feature provides two search approaches that guide users to access the check item pages. Both approaches use a cascade search structure as follows:

- **Pay Item-Based Approach:** Pay Item → Construction Process → Check Items
- **Construction Process-Based Approach:** Construction Process → Pay Item → Check Items

### 1.3 Feature #3: Material Requirements and Frequency for Sampling and Testing

This feature provides interactive buttons that link check items to relevant documents, including:

- **Material requirement subsections of the *Standard Specifications (INDOT, 2024b)***, specifying required materials and the corresponding acceptance criteria
- **Selected pages from the *Manual for Frequency of Sampling and Testing and Basis for Use of Materials (INDOT, 2025)***,

outlining the minimum schedule necessary to satisfy the requirements for acceptance samples and tests

### 1.4 Feature #4: Construction Pitfalls and Remedies

This feature links check items to construction pitfalls and remedies to address them in asphalt pavement projects. Information of construction pitfalls is organized into **pitfall description, preventive actions, quality indicators, corrective actions, consequences of noncompliance, and pavement performance issues**. Construction pitfalls:

- Include the **riskiest areas** identified by INDOT engineers, including surface preparation, milling, tack coat application, temperature control for hot-mix asphalt (HMA) course placement, paving, compaction, and smoothness.
- Are enhanced with **hyperlinks to source references** and **figures** to improve user's understanding and comprehension.

### 1.5 Feature #5: Calculator

This feature provides an easy-to-access tool for field calculations.

## 2. USE GUIDE

This section provides guidance for users to use the training system.

To access the application, open a modern Web browser on a desktop, laptop, or mobile device, and navigate to <https://indot-digital-inspection-system.netlify.app/> (*the website is subject to change when INDOT implements the system*).

The homepage is shown in Figure 2.1. It highlights the system's core functions—Pay Item-Based Approach and Construction Process-Based Approach (Feature #2) and Material Requirements and Frequency for Sampling and Testing (Feature #3)—organized under each *Standard Specification (INDOT, 2024b)* section.

Each page has a top navigation bar that includes three buttons: Home, Construction Pitfalls and Remedies, and Tools (Calculator), along with a Search Box for quick Check Item lookup.

The subsections will first present two approaches for accessing check item pages followed by an explanation of how to navigate information related to construction pitfalls and remedies, search check items by keyword, access material requirements in the *Standard Specifications (INDOT, 2024b)*, and locate relevant information in the *Manual for Frequency of Sampling and Testing and Basis for Use of Materials (INDOT, 2025)*. Links to external references and the calculator feature will also be introduced.

### 2.1 Pay Item-Based Approach

This method uses a cascade search structure: **Pay Item → Construction Process → Check Items**. It is best used when you already know the pay item associated with the check items of interest.

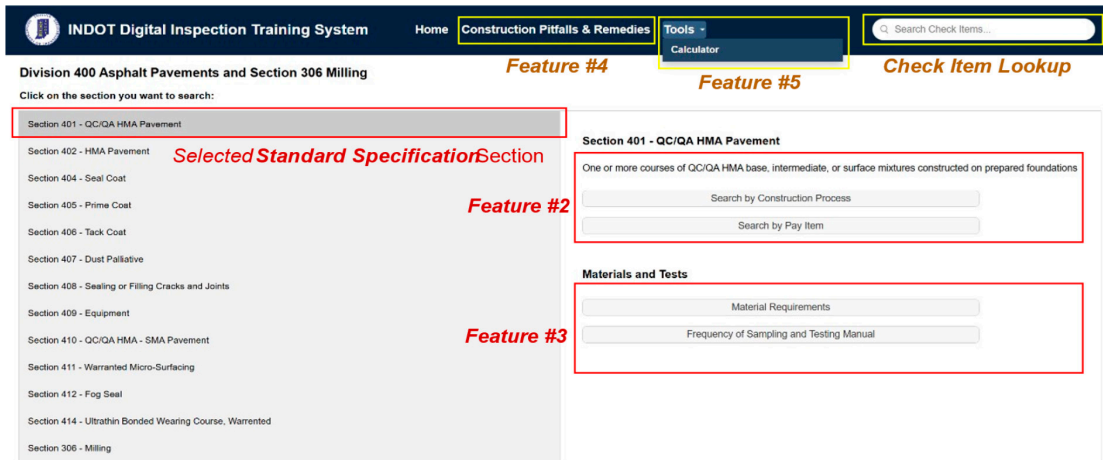


Figure 2.1 Home Page and Top Navigation Bar.

**Step-by-step instructions:**

**Step 1.** Open the **Home Page** (Figure 2.1).

**Step 2.** Locate the **Standard Specification Section** (INDOT, 2024b; e.g., Section 401—QC/QA HMA Pavement) the pay item belongs to.

**Step 3.** Click the **“Search by Pay Item”** button (Figure 2.2).

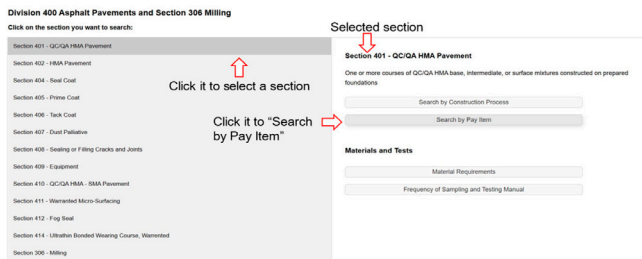


Figure 2.2 Selection of Section 401 and Use of the “Search by Pay Item” Button.

**Step 4.** Select the **pay item** (e.g., 401-000004 QC/QA-HMA, 2, 58H, SURFACE, 9.5 mm (TON)) and click the **“Submit”** button (Figure 2.3).

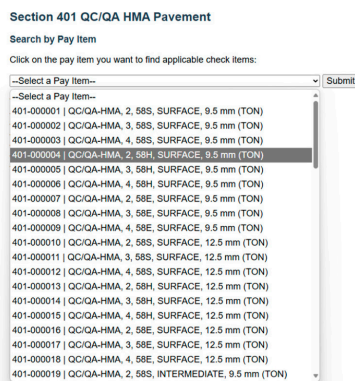


Figure 2.3 Selection of a Pay Item Under Section 401.

**Step 5.** Select the **construction process** (e.g., Paving) you want to view (Figure 2.4). (Note: The image is clickable.)



Figure 2.4 Selection of a Construction Process Involved in Pay Item 401-000004.

**Step 6.** A list of **applicable check items** will appear (Figure 2.5). Click the **check item** (e.g., 401-013 Weather Limitations) you wish to view.

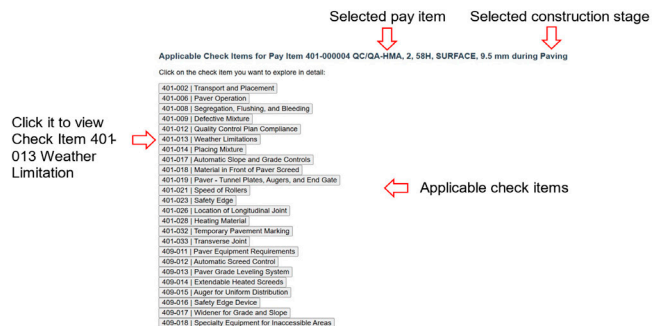
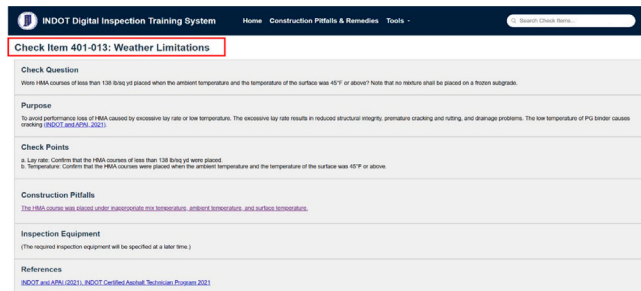


Figure 2.5 Selection of a Check Item for Pay Item 401-000004 During Paving.

**Step 7.** The selected **Check Item Page** will open (Figure 2.6).

Note: To view check items for a different pay item, repeat the process starting from Step 4 by selecting a new pay item and construction process.



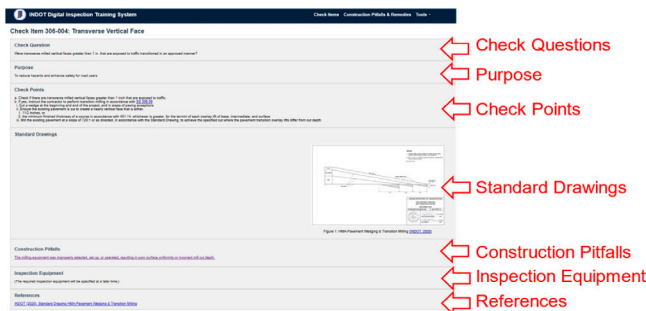
**Figure 2.6** Check Item 401-013: Weather Limitations.

### 2.1.1 Check Item Page

The content of the Check Item Page includes:

- **Check question:** Explains what to check
- **Purpose:** Explains why to check
- **Check points:** Explains how to check
- **Standard drawings** (if applicable)
- **Construction pitfalls** (if applicable)
- **Inspection equipment** (*Planned for future extension*)
- **References** (if applicable)

Check Item 306-004 (Transverse Vertical Face) serves as an example that contains all the sections, and the screenshot of the page is shown in Figure 2.7.



**Figure 2.7** Check Item 306-004: Transverse Vertical Face.

## 2.2 Construction Process-Based Approach

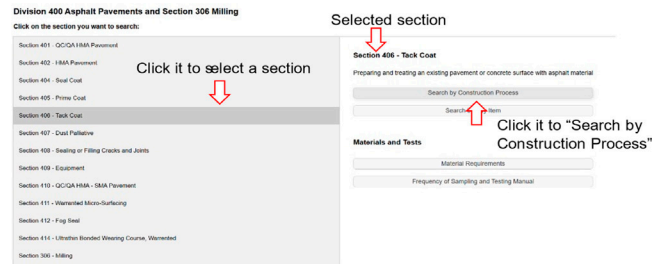
This method uses a cascade search structure: **Construction Process** → **Pay Item** → **Check Items**. It is best used when you are sure about the construction process associated with the check items of interest.

**Step-by-step instructions:**

**Step 1.** Open the **Home Page**.

**Step 2.** Locate the **Standard Specification Section** (e.g., Section 406—Tack Coat) the pay item belongs to.

**Step 3.** Click the “**Search by Construction Process**” button (Figure 2.8).



**Figure 2.8** Selection of Section 406 and Use of the “Search by Construction Process” Button.

**Step 4.** Select the **construction process** (e.g., Surface Preparation) you want to view (Figure 2.9). (Note: The image is clickable.)

### Section 406 Tack Coat

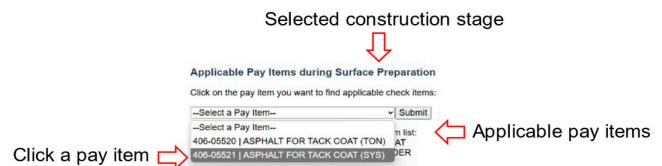
#### Search by Construction Process

Click on a construction process to find applicable pay items.



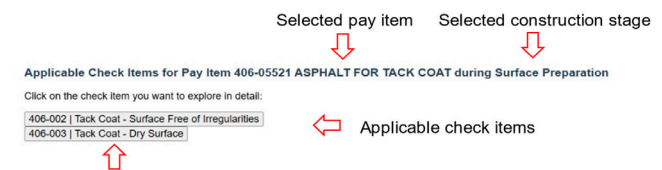
**Figure 2.9** Selection of a Construction Process Under Section 406.

**Step 5.** Select the **pay item** (e.g., 406-05521 ASPHALT FOR TACK COAT (SYS)) and click the “**Submit**” button (Figure 2.10).



**Figure 2.10** Selection of a Pay Item During Surface Preparation.

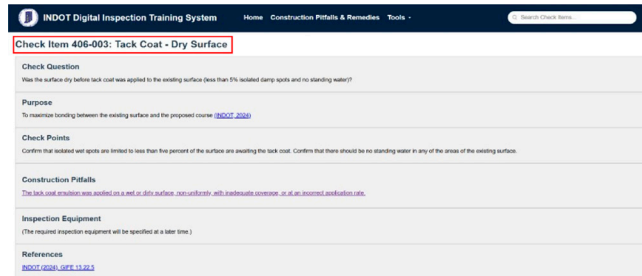
**Step 6.** A list of applicable **check items** will appear (Figure 2.11). Click the check item (e.g., Check Item 406-003 Tack Coat – Dry Surface) you wish to view.



Click it to view Check Item 406-003 Tack Coat – Dry Surface

**Figure 2.11** Selection of a Check Item for Pay Item 406-05521 During Surface Preparation.

**Step 7.** The selected **Check Item Page** will open (Figure 2.12).  
 Note: To view check items for a different construction process, repeat the process starting from Step 4 by selecting a new construction process and pay item.



**Figure 2.12** Check Item 406-003: Tack Coat—Dry Surface.

### 2.3 Construction Pitfalls and Remedies

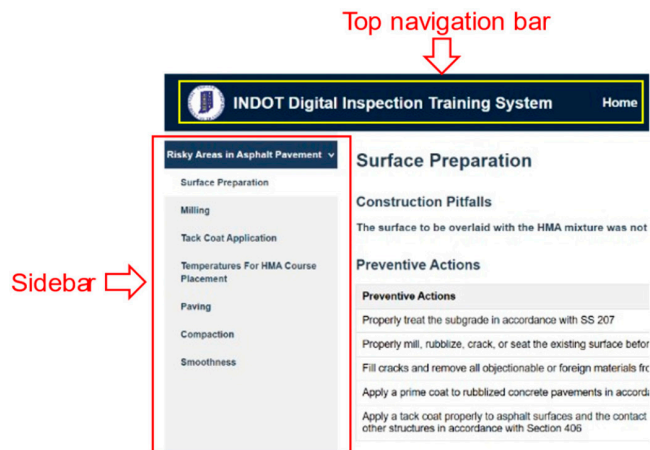
This subsection describes how to access the information related to construction pitfalls and remedies, followed by an overview of the construction pitfalls page.

#### 2.3.1 Risky Areas Navigation

The following instructions guide you in navigating information related to construction pitfalls and remedies for various risky areas using the sidebar on the left side of the page.

#### Step-by-step instructions:

- Step 1.** Open the **Home Page**.
- Step 2.** Click the “**Construction Pitfalls & Remedies**” button in the top navigation bar.
- Step 3.** The default page (Figure 2.13) displays information on **surface preparation**. You can navigate different risky areas using the sidebar, for example, **tack coat application**.



**Figure 2.13** Risky Areas Navigation Using the Sidebar.

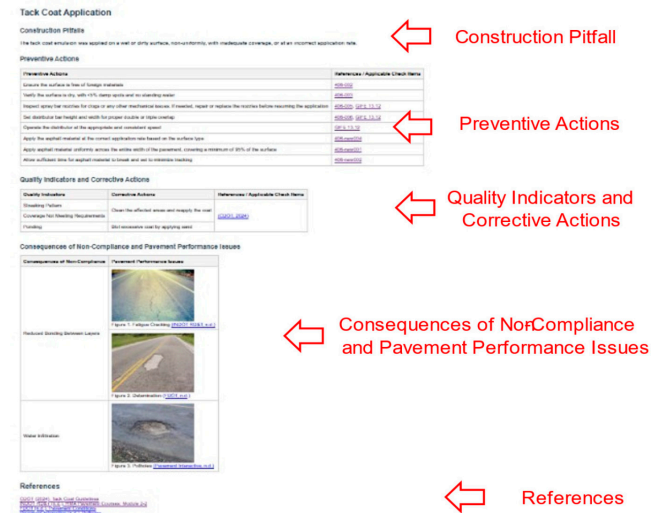
#### 2.3.2 Construction Pitfalls Page

The Construction Pitfalls Page includes the following contents:

- **Preventive actions:** Explains measures to avoid the pitfall.

- **Quality indicators and corrective actions:** Describes how to identify signs of deficient construction work and take corrective actions to prevent issues.
- **Consequences of non-compliance and pavement performance issues:** Explains potential impacts on pavement performance.
- **References** (if applicable)

Construction Pitfalls Page - Tack Coat Application serves as an example, shown in Figure 2.14.



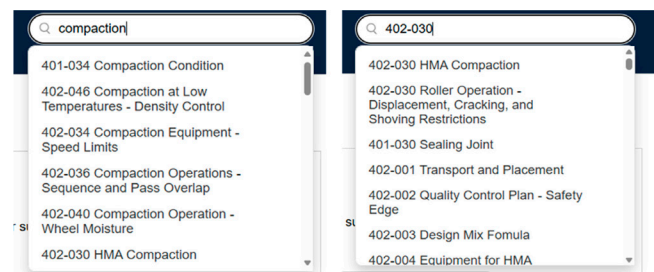
**Figure 2.14** Construction Pitfall: Tack Coat Application.

### 2.4 Search by Keyword

This method uses keyword matching across the check item ID, title, and content to help you locate specific check items. It is best used when you know the check item ID or have an approximate keyword.

#### Step-by-step instructions:

- Step 1.** Open the **Home Page**.
- Step 2.** Click the **search box** in the top navigation bar.
- Step 3.** Enter a **keyword**, term (e.g., compaction), or check item ID (e.g., 402-030) into the search box.
- Step 4.** A list of **matching check items** will appear (Figure 2.15). Click the check item you wish to view.



**Figure 2.15** A List of Matching Check Items Using “Search by Keyword” Method.



## 2.8 Calculator

This subsection provides basic instructions for using the built-in calculator, which supports simple arithmetic operations for inspection.

### 2.8.1 Example: Estimating the Amount of Asphalt Needed for a Patch Repair

You're inspecting a patch repair area and need to estimate the amount of asphalt (in ton) required. The formula is:

$$\text{Volume (ft}^3\text{)} = \text{Length (ft)} \times \text{Width (ft)} \times \text{Thickness (ft)}$$

Then multiply by the **unit weight** of asphalt (e.g., 145 lb/ft<sup>3</sup>) and divide by 2,000 to convert to tons.

#### Given:

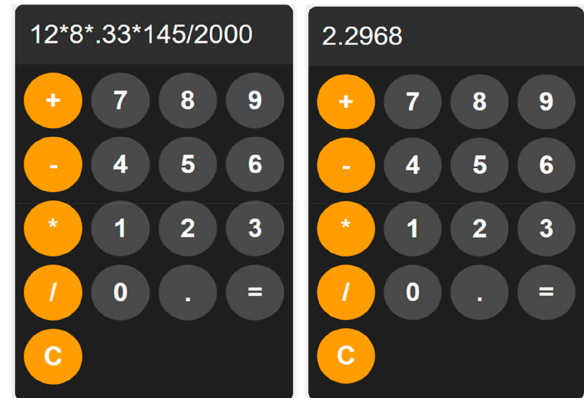
- Length = 12 ft
- Width = 8 ft
- Thickness = 0.33 ft (4 in.)
- Unit weight of asphalt = 145 lb/ft<sup>3</sup>
- 1 ton = 2,000 lb

#### Steps using the calculator:

- Press **12**
- Press **\***
- Press **8**
- Press **\***
- Press **0.33**
- Press **=** → Result: **31.68** (cubic feet of asphalt)
- Press **\***
- Press **145**
- Press **=** → Result: **4593.6** (pounds)
- Press **/**
- Press **2000**
- Press **=** → Final result: **2.3 tons**

#### Result:

Approximately **2.3 tons** of asphalt are needed for this patch repair (Figure 2.21).



**Figure 2.21** Calculation Example (Intermediate Results are Omitted).

## REFERENCES

- Cai, H., Jeon, J., Xu, X., Zhang, Y., & Yang, L. (2020). *Automating the generation of construction checklists* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2020/23). Purdue University. <https://doi.org/10.5703/1288284317273>
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## About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1 — evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at [docs.lib.purdue.edu/jtrp/](https://docs.lib.purdue.edu/jtrp/).

Further information about JTRP and its current research program is available at [engineering.purdue.edu/JTRP](https://engineering.purdue.edu/JTRP).

## About This Report

An open access version of this publication is available online. See the URL in the citation below.

Hong, Y., Zhang, Y., Hong, Z., Zheng, R., Cai, H., & Abraham, D. M. (2025). *User manual for digital inspection training system* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2025/28). West Lafayette, IN: Purdue University. <https://doi.org/10.5703/1288284318594>