



INDOT SEAL COAT DESIGN SOFTWARE MANUAL

Version 1.0.1

May 2011

DISCLAIMER

The contents of this manual do not necessarily reflect the official views or policies of the Indiana Department of Transportation (INDOT). The details in this manual are intended for reference only, not as specifications or design guidance. In the event that any information presented herein conflicts with the Indiana Design Manual, INDOT Standard Specifications or other INDOT policy, said policy will take precedence.

TABLE OF CONTENTS

1	INTRODUCTION	1
2	INSTALLATION GUIDE	2
2.1	BEFORE INSTALLING	2
2.2	INSTALLING iSeal	3
3	OVERVIEW	5
3.1	APPLICATION MENU.....	5
3.1.1	FILE.....	5
3.1.2	VIEW	6
3.1.3	HELP	6
3.2	MULTIPLE SHEETS.....	7
3.3	STATUS INDICATOR.....	8
3.4	TAB	9
3.4.1	GENERAL.....	9
3.4.2	AAR.....	10
3.4.3	EAR	11
3.4.4	SUMMARY.....	12
3.4.5	ATTACHMENTS.....	13
4	GETTING STARTED.....	14
4.1	LAUNCHING iSeal.....	14
4.2	DESIGN EXAMPLE	15
4.2.1	STEP 1	15
4.2.2	STEP 2.....	16
4.2.3	STEP 3.....	17
4.2.4	STEP 4.....	18
4.2.5	STEP 5.....	20
4.2.6	STEP 6.....	21
4.2.7	STEP 7.....	22
4.2.8	STEP 8.....	22
4.2.9	STEP 9.....	23
4.2.10	STEP 10.....	24
4.2.11	STEP 11.....	25
4.2.12	STEP 12.....	26
4.2.13	STEP 13.....	27
4.2.14	STEP 14.....	28
4.2.15	STEP 15.....	29
4.2.16	STEP 16.....	32

5 REFERENCES33

1 INTRODUCTION

The design software “INDOT SEAL COAT DESIGN (iSeal)” was developed as part of the JTRP/SPR-3087: Performance Evaluation of Seal Coat Materials and Designs to aid the seal coat design process and incorporate INDOT seal coat practice. The software is largely based on the McLeod design method. Furthermore, one additional factor, an equipment factor, was implemented into the design process to resolve issues due to discrepancies between the designed rate and the applied rate.

During development, engineers emphasized intuitiveness in using the software, thus providing more user-friendly software. In addition, the software provides various options when inputting values, namely “User-Defined”, “Typical” and “Measured”. “User-defined” allows a user to manually input desired values while “Typical” provides selection of generally accepted values for a given factor. “Measured” accepts experiment data and then converts this into a corresponding value.

2 INSTALLATION GUIDE

2.1 BEFORE INSTALLING

iSeal was developed using ADOBE Flex technology and requires ADOBE AIR 2.6 to run the application. You can download ADOBE AIR 2.6 or newer version from <http://get.adobe.com/air/>.

In addition, you need to check that your computer has the following minimum requirements to run iSeal:

Windows

- Intel® Pentium® 4 processor
- Microsoft® Windows® XP Home, Professional, or Tablet PC Edition with Service Pack 2 or 3, Windows Server® 2003 or later
- 512MB of RAM

Apple

- Intel® Core® Duo
- Mac OS X v.10.4.9 or later
- 512MB of RAM

Linux

- Intel® Pentium® 4 processor
- Fedora® Core 12, Ubuntu® v. 9 or later, or openSUSE® v.11.2 or later
- 512MB of RAM

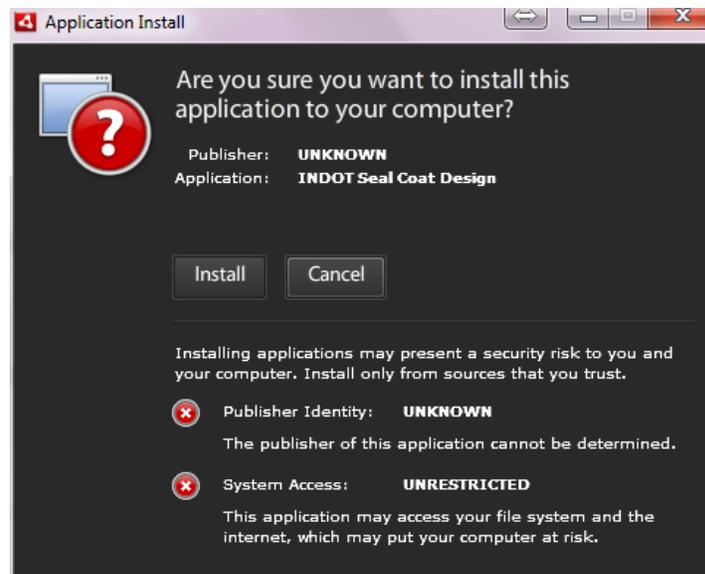
2.2 INSTALLING ISEAL

To install iSeal, follow these steps:

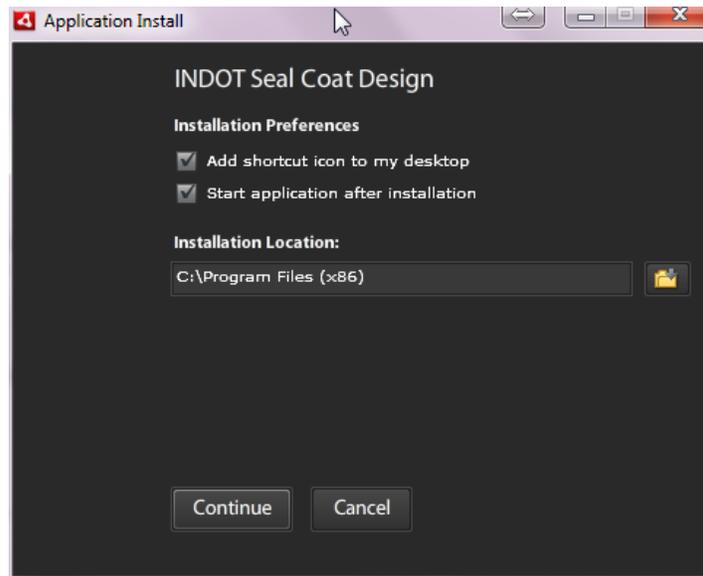
1. Before you can install iSeal, you will need to download ADOBE AIR 2.6 or newer version and install it. If you have already done this, you can skip this step.
2. Download iSeal installer from **TBD**. The iSeal installer icon should appear on your desktop, similar to the one below:



3. Run iSeal by double-clicking on the iSeal icon on your desktop or in your Windows start menu. An application install window should appear. Click the **Install** button to continue.



4. You will then have to specify the installation location and click the **Continue** button.



5. You have finished installing iSeal and an iSeal icon shown below should now appear on your Windows desktop.

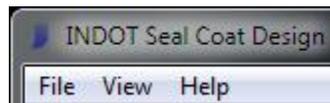


3 OVERVIEW

iSeal consists of five tabs, namely **General**, **AAR**, **EAR**, **Summary** and **Attachments**. In addition, iSeal features a status indicator and application menus.

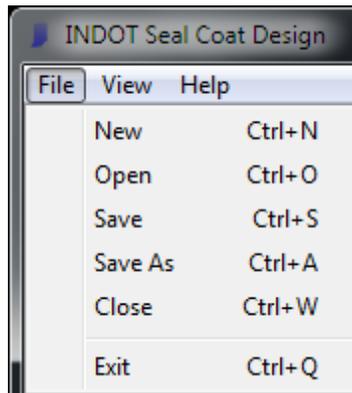
3.1 APPLICATION MENU

Application menus are located in the upper left corner of the window and consist of **File**, **View** and **Help**.



3.1.1 FILE

The figure below illustrates the **File** menu.



- **New:** Opens a new sheet. Up to five sheets can be opened at the same time (Keyboard shortcut CTRL + N).
- **Open:** Opens the selected file (Keyboard shortcut CTRL + O).
- **Save:** Saves the current work to a folder on your hard disk. The name of the file is automatically generated as Date_Time.indot and the default file save location is set to your computer's desktop. Once the file is saved, it saves the current work to a existing saved file (Keyboard shortcut CTRL + S).
- **Save As:** Saves the current work to a folder on your hard disk. The name of the file is automatically generated as Date_Time.indot and the default file save location is set to your computer's desktop (Keyboard shortcut CTRL + A).
- **Save As:** Closes the current sheet. (Keyboard shortcut CTRL + W)

- **Exit:** Closes the entire program. If there are multiple sheets, it closes them all at the same time (Keyboard shortcut CTRL + Q).

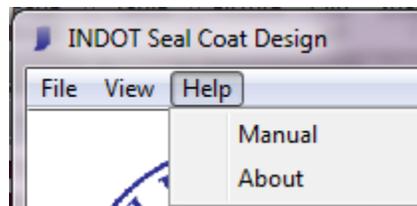
3.1.2 VIEW

The figure below illustrates the **View** menu. This allows a user to switch between different tabs and displays the keyboard shortcuts designated for each tab.



3.1.3 HELP

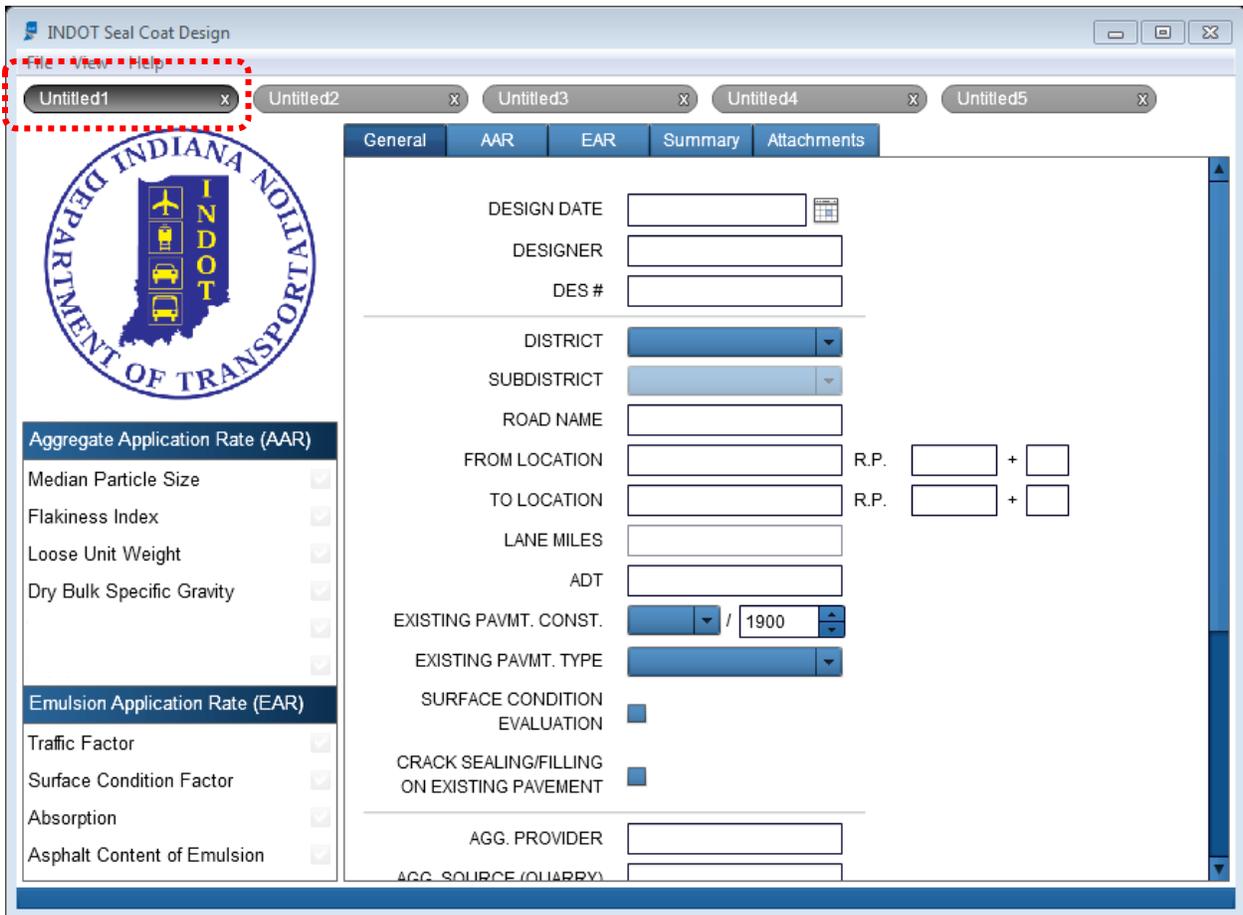
The figure below illustrates the **Help** menu. This provides the manual and software version information.



3.2 MULTIPLE SHEETS

iSeal allows a user work with a number of sheets (up to five). And a user can easily switch between sheets in iSeal using either their keyboard shortcut (CTRL + Tab) or mouse by clicking on an individual sheet.

The figure below illustrates how multiple sheets are shown in iSeal along with their file name. The current sheet is indicated by darker color.



3.3 STATUS INDICATOR

The status indicator is located in the lower left corner of the window and provides an overview of required inputs. The figure below illustrates how the status indicator displays once any change in the values of each required input is detected. It is advised that a user verify their inputs on the “Summary” tab since the status indicator does not check the validity of the input value.

Aggregate Application Rate (AAR)		Aggregate Application Rate (AAR)	
Median Particle Size	<input type="checkbox"/>	Median Particle Size	<input checked="" type="checkbox"/>
Flakiness Index	<input type="checkbox"/>	Flakiness Index	<input type="checkbox"/>
Loose Unit Weight	<input type="checkbox"/>	Loose Unit Weight	<input type="checkbox"/>
Dry Bulk Specific Gravity	<input type="checkbox"/>	Dry Bulk Specific Gravity	<input type="checkbox"/>
Emulsion Application Rate (EAR)		Emulsion Application Rate (EAR)	
Traffic Factor	<input type="checkbox"/>	Traffic Factor	<input type="checkbox"/>
Surface Condition Factor	<input type="checkbox"/>	Surface Condition Factor	<input type="checkbox"/>
Absorption	<input type="checkbox"/>	Absorption	<input type="checkbox"/>
Asphalt Content of Emulsion	<input type="checkbox"/>	Asphalt Content of Emulsion	<input checked="" type="checkbox"/>

3.4 TAB

3.4.1 GENERAL

The “General” tab is the default screen when the software is launched. This allows a user to input general information regarding specific seal coat design, including designer information and location along with existing pavement condition and material type and source. The District and Sub-district features are Indiana’s, and existing pavement type selections are constructed based on the Indiana Design Manual Chapter 52 (1).

The screenshot displays the 'INDOT Seal Coat Design' software window. The title bar includes 'File View Help' and standard window controls. The main interface features a navigation bar with tabs for 'General', 'AAR', 'EAR', 'Summary', and 'Attachments'. The 'General' tab is active, showing a form with the following fields:

- DESIGN DATE:** 02/08/2011 (with a calendar icon)
- DESIGNER:** [Text Input]
- DES #:** [Text Input]
- DISTRICT:** [Dropdown Menu]
- SUBDISTRICT:** [Dropdown Menu]
- ROAD NAME:** [Text Input]
- FROM LOCATION:** [Text Input] R.P. [] + []
- TO LOCATION:** [Text Input] R.P. [] + []
- LANE MILES:** [Text Input]
- ADT:** [Text Input]
- EXISTING PAVMT. CONST.:** [Dropdown Menu] / 2011 [Dropdown Menu]
- EXISTING PAVMT. TYPE:** [Dropdown Menu]
- SURFACE CONDITION EVALUATION:** [Blue Selection Box]
- CRACK SEALING/FILLING ON EXISTING PAVEMENT:** [Blue Selection Box]
- AGG. PROVIDER:** [Text Input]
- AGG. SOURCE (QUARRY):** [Text Input]

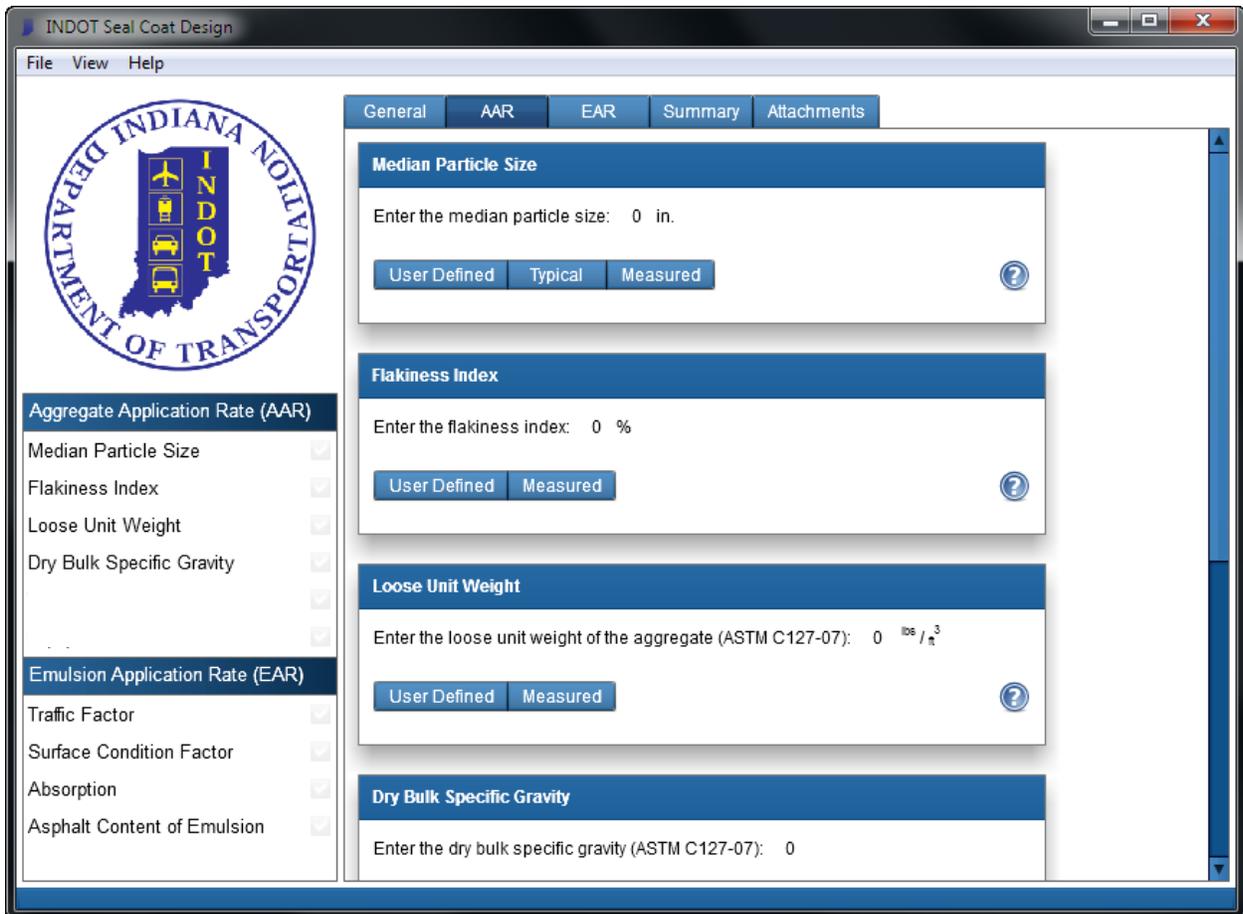
On the left side, there are two sections with checkboxes:

- Aggregate Application Rate (AAR):**
 - Median Particle Size
 - Flakiness Index
 - Loose Unit Weight
 - Dry Bulk Specific Gravity
- Emulsion Application Rate (EAR):**
 - Traffic Factor
 - Surface Condition Factor
 - Absorption
 - Asphalt Content of Emulsion

The top left corner features the Indiana Department of Transportation logo.

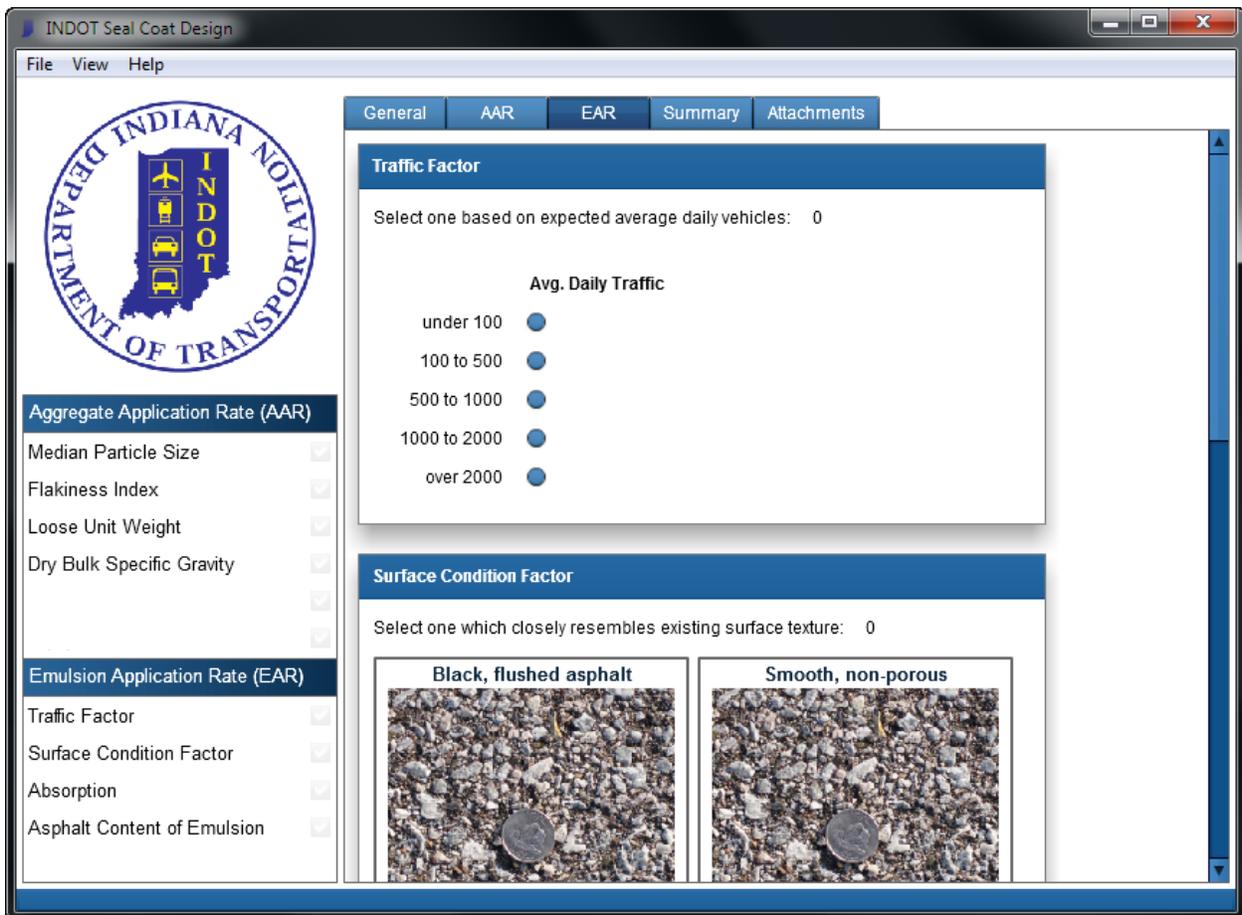
3.4.2 AAR

The “AAR” tab presents a user to input values required to calculate the aggregate application rate, including Median Particle Size, Flakiness Index, Loose Unit Weight, Dry Bulk Specific Gravity, Wastage Factor and Equipment Correction Factor. The “Typical” input option in the median particle size box allows a user to select among widely used sizes of aggregates, such as Indiana aggregates No. 11, No. 12 and SC-16. Upon selection, the software inputs the median particle size accordingly; values are based on INDOT Standard Specification (2). The values for Flakiness Index generally range from 10 to 25 %. Loose Unit Weight and Dry Bulk Specific Gravity should be obtained under ASTM C 127-07 (3). Although the last two factors, which are a wastage factor and an equipment correction factor, are optional, it is strongly advised that the user apply these factors.



3.4.3 EAR

The “EAR” tab allows a user to input values required to calculate the emulsion application rate, including Traffic Factor, Surface Condition Factor, Absorption and Asphalt Content of Emulsion. Traffic factor is calculated based on the average daily traffic of the road. The Traffic Factor contributes significantly in designing EAR since it determines the average embedment depth, which ranges from 60 to 85 % of the average least dimension of aggregates. The Surface Condition Factor features five pictures to help a user determine the existing pavement condition and improve objectivity when selecting categories. The input value for Absorption is the water absorption of aggregates, although aggregate is mixed with emulsion in a seal coat application. This is mainly due to lack of testing methods that can measure the actual amount of emulsion absorbed by aggregates. The “Typical” input option is also available under the Asphalt Content of Emulsion box, which allows a user to select among widely used types of emulsion, namely RS-2, RS-2P, AE-90S and HFRS-2. Upon selection, the software inputs the asphalt content of the emulsion accordingly; values are based on INDOT Standard Specification (2).



3.4.4 SUMMARY

The “Summary” tab presents all input values as a summary and instantly updates as any changes occurs in selected values. A small box featured in the right side of each line displays which type of value is used for each type of factor. AAR and EAR are also automatically calculated and displayed once the required data are defined in the software and update once any change in the value of each factor is detected. The “Summary” tab also features a “Print Report” option button in the left lower corner of the window, which allows a user to print detailed report. A detailed report shows every value input by a user and step-by-step calculation of the AAR and EAR in PDF format. The figures below illustrate how “Summary” tab displays type of factor as well as AAR and EAR.

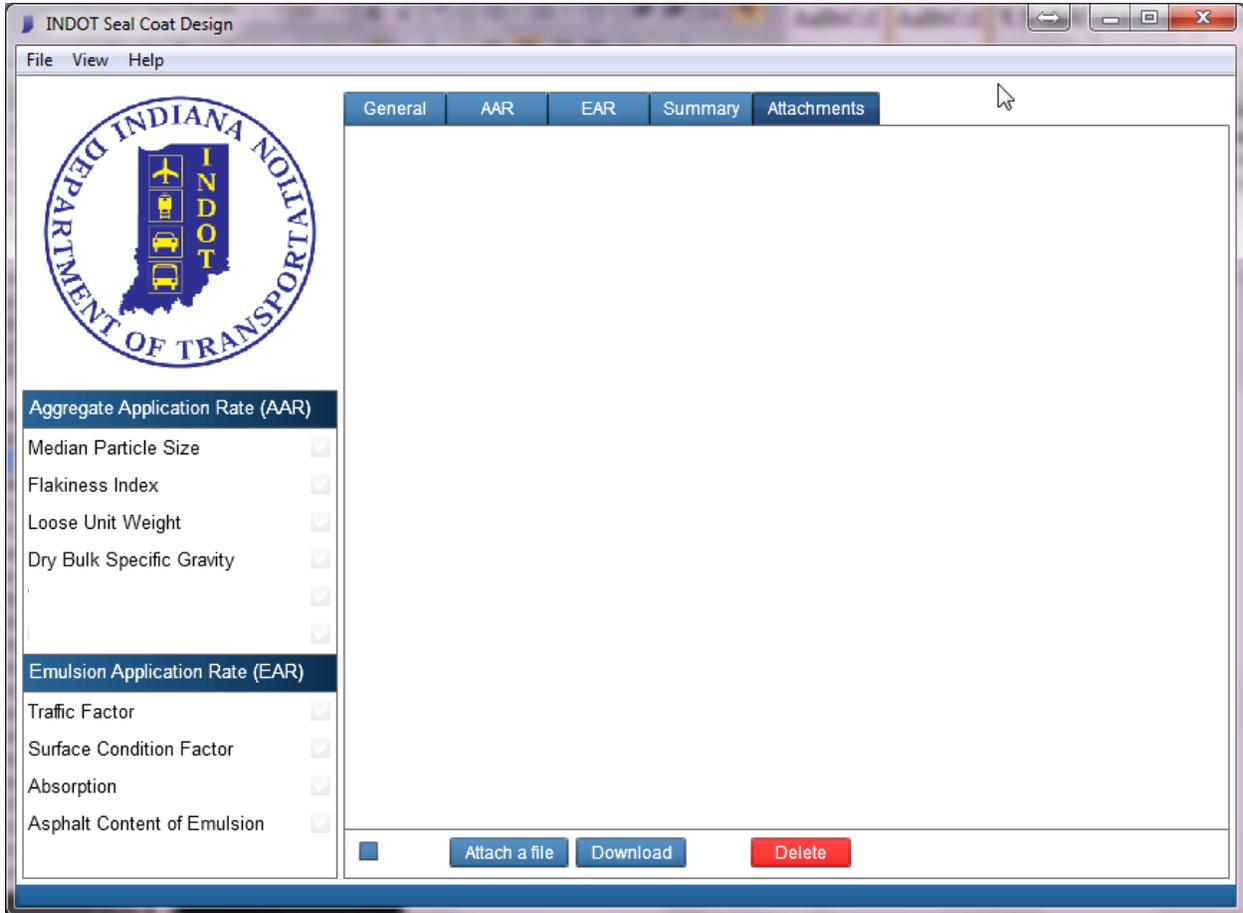
General	AAR	EAR	Summary	Attachments
Median Particle Size	0	in.	Default	
Flakiness Index	0	%	Default	
Loose Unit Weight	0	lbs / ft ³	Default	
Dry Bulk Specific Gravity	0		Default	
Wastage Factor	0		Default	
Equipment Correction Factor	0		Default	
<hr/>				
Traffic Factor	0		Default	
Surface Condition Factor	0		Default	
Absorption	0	%	Default	
Asphalt Content of Emulsion	50	%	Default	
<hr/>				
Aggregate Application Rate (AAR)	Not enough data!	lbs / yd ²		
Emulsion Application Rate (EAR)	Not enough data!	gal / yd ²		



Summary	Attachments
0.22	in.
2.2	%
90	lbs / ft ³
2.71	
Yes	
Yes	
<hr/>	
0.7	Typical
0	Typical
0.31	%
65	%
<hr/>	
24.39	lbs / yd ²
0.25	gal / yd ²

3.4.5 ATTACHMENTS

The “Attachments” tab displays a list of attached files. This feature essentially works the same way as attaching a file to an email. Furthermore, it provides a drag and drop function, which allows a user to simply drag any file to a software window and automatically the file in that location. This feature also provides options to manage multiple files at once by selecting the check box located in the lower left corner of the window.



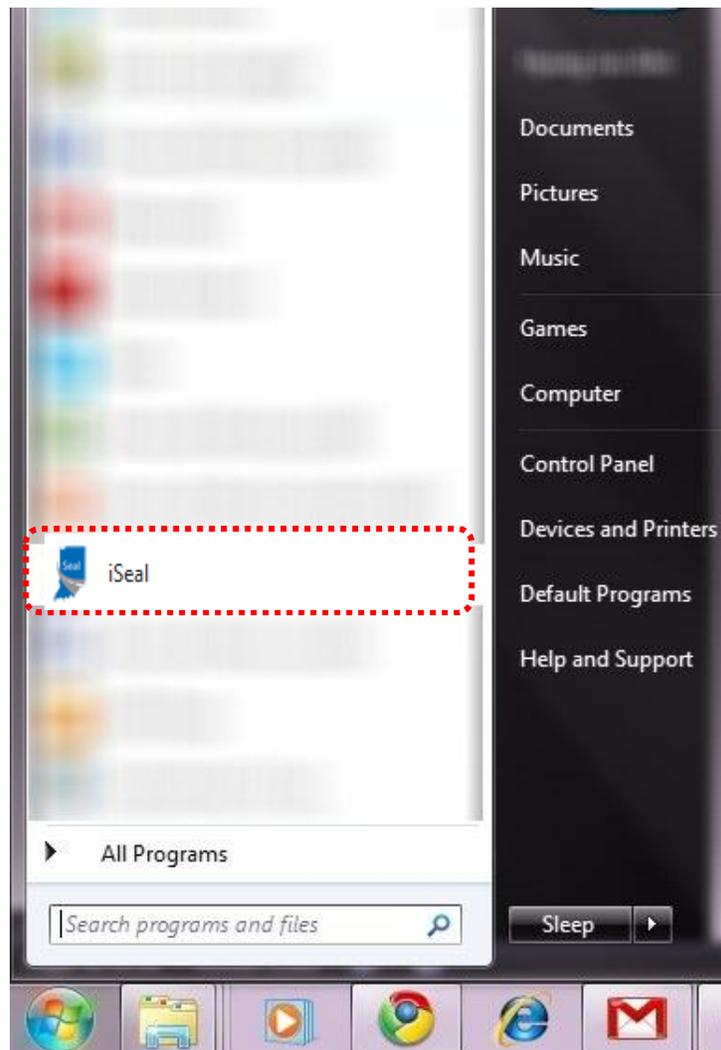
4 GETTING STARTED

4.1 LAUNCHING iSeal

Run iSeal by double-clicking on the iSeal icon on your desktop or



in your Windows **Start** menu.



4.2 DESIGN EXAMPLE

The following example illustrates how to design AAR and EAR using iSeal step by step. Procedures presented in this example are designed to help the first-time user to become more familiar with iSeal, but hereafter a user may enter and edit values for each required input in any order.

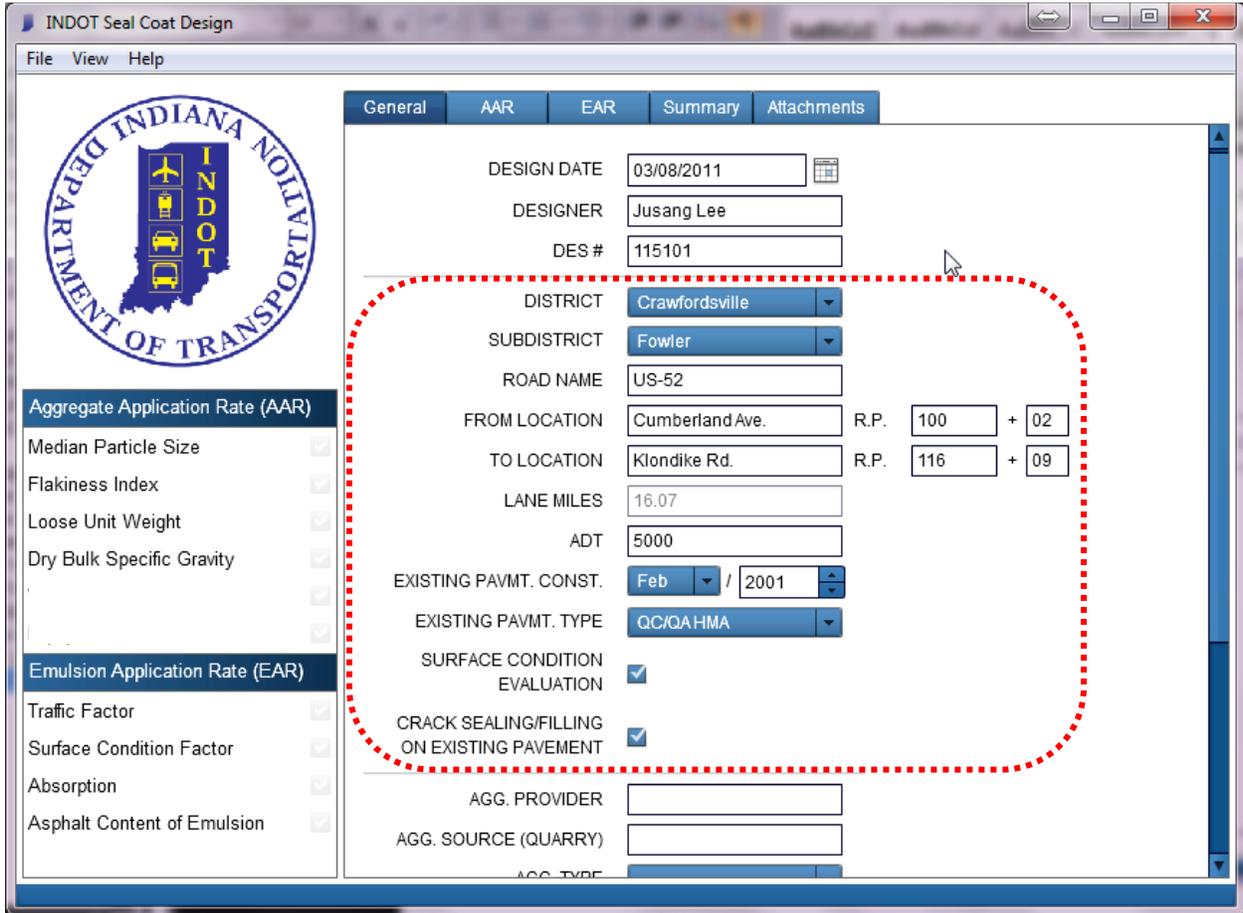
4.2.1 STEP 1

Enter designer name along with design date and DES number.

The screenshot shows the 'INDOT Seal Coat Design' software window. The 'General' tab is active, and the 'AAR' sub-tab is selected. A red dashed box highlights the 'DESIGN DATE' (03/08/2011), 'DESIGNER' (Jusang Lee), and 'DES #' (115101) fields. The left sidebar contains sections for 'Aggregate Application Rate (AAR)' and 'Emulsion Application Rate (EAR)' with various input options. The main form area includes fields for 'DISTRICT', 'SUBDISTRICT', 'ROAD NAME', 'FROM LOCATION', 'TO LOCATION', 'LANE MILES', 'ADT', 'EXISTING PAVMT. CONST.', 'EXISTING PAVMT. TYPE', 'SURFACE CONDITION EVALUATION', 'CRACK SEALING/FILLING ON EXISTING PAVEMENT', 'AGG. PROVIDER', and 'AGG. SOURCE (QUARRY)'. There are also 'R.P.' (Right of Way) input fields for 'FROM LOCATION' and 'TO LOCATION'.

4.2.2 STEP 2

Enter location information, including existing pavement type and condition. Lane miles are automatically calculated once reference points are presented.



For district selection, the user can choose from one of six districts of Indiana. Once a district is selected, a list of subdistricts corresponding to the selected district becomes available.



4.2.3 STEP 3

Enter material information and additional comments in the blank space provided.

For aggregate and emulsion type selection, a user can only choose from the list provided, based on INDOT Standard Specification (2). Indiana aggregate No. 11 and AE-90S are selected in this example.

The screenshot shows the 'INDOT Seal Coat Design' software window. The 'Summary' tab is active, displaying the following fields:

- TO LOCATION: Klondike Rd. R.P. 116 + 09
- LANE MILES: 16.07
- ADT: 5000
- EXISTING PAVMT. CONST.: Feb / 2001
- EXISTING PAVMT. TYPE: QC/QA/HMA
- SURFACE CONDITION EVALUATION:
- CRACK SEALING/FILLING ON EXISTING PAVEMENT:
- AGG. PROVIDER: Aggregate Provider Name
- AGG. SOURCE (QUARRY): Quarry Name
- AGG. TYPE: 11
- EMULSION PROVIDER: Emulsion Provider Name
- EMULSION TYPE: AE-90
- NOTE: INDOT Seal Coat Design Example

A red dashed box highlights the material selection fields (AGG. PROVIDER, AGG. SOURCE, AGG. TYPE, EMULSION PROVIDER, EMULSION TYPE, and NOTE).

4.2.4 STEP 4

Enter the median particle size of aggregates used for the seal coat application using one of three input options.

Option 1: **User Defined**

Input median particle size by typing in values in the box or using arrows.

The screenshot shows a dialog box titled "Median Particle Size". At the top, it says "Enter the median particle size: 0.24 in.". Below this are three tabs: "User Defined" (which is selected and highlighted in blue), "Typical", and "Measured". To the right of the tabs is a question mark icon. Below the tabs is an input field containing the text "0.24" followed by a spin button (a blue box with left and right arrows) and the text "in.". A mouse cursor is pointing at the spin button.

Option 2: **Typical**

Input median particle size by selecting one of five types of aggregate size.

The screenshot shows a dialog box titled "Median Particle Size". At the top, it says "Enter the median particle size: 0 in.". Below this are three tabs: "User Defined", "Typical" (which is selected and highlighted in blue), and "Measured". Below the tabs is a section titled "Aggregate Size" with three radio button options: "11", "12", and "SC 16". All radio buttons are currently unselected.

Option 3: **Measured**

Input median particle size by providing the sieve analysis result.

Median Particle Size

Enter the median particle size: 0.21 in.

User Defined
Typical
Measured

	% Passing
1"	<input type="text"/>
3/4"	<input type="text"/>
1/2"	<input type="text" value="100"/>
3/8"	<input type="text" value="90"/>
1/4"	<input type="text" value="80"/>
No. 4	<input type="text" value="30"/>
No. 8	<input type="text" value="20"/>
No. 16	<input type="text" value="0"/>
No. 30	<input type="text"/>
No. 50	<input type="text"/>

4.2.5 STEP 5

Enter Flakiness Index of aggregates used for seal coat application using one of two input options.

Option 1: **User Defined**

Input Flakiness Index by typing values in the box or using arrows.

Flakiness Index

Enter the flakiness index: 2.2 %

User Defined Measured

2.2 %

Option 2: **Measured**

Input Flakiness Index by providing the test result.

Flakiness Index

Enter the flakiness index: 2.2 %

User Defined Measured

Total Mass(g)

900

Mass of Passing Particle (g)

3/4" 0

1/2" 0

3/8" 0

1/4" 20

No. 4 0

4.2.6 STEP 6

Enter loose unit weight of aggregates used for seal coat application using one of two input options.

Option 1: **User Defined**

Input loose unit weight by typing in values in the box or using arrows.

The screenshot shows a dialog box titled "Loose Unit Weight". At the top, it says "Enter the loose unit weight of the aggregate (ASTM C29): 90 lbs / ft³". Below this, there are two buttons: "User Defined" (which is selected) and "Measured". Under the "User Defined" button, there is a text input field containing the number "90" and a small spinner control to its right. To the right of the spinner is the unit label "lbs / ft³".

Option 2: **Measured**

Input loose unit weight by providing the test result specified by ASTM C29 (4).

The screenshot shows the same "Loose Unit Weight" dialog box. The "Measured" button is now selected, and a mouse cursor is pointing at it. Below the buttons, there are two input fields. The first is labeled "Weight of Aggregate [lbs]" and contains the value "45". The second is labeled "Volume of Cylinder [ft^3]" and contains the value "0.5".

4.2.7 STEP 7

Enter the bulk specific gravity of aggregates used for seal coat application. ASTM C127 covers determination of the specific gravity of coarse aggregate (3).

Dry Bulk Specific Gravity

Enter the dry bulk specific gravity (ASTM C127-07): 2.71

User Defined 

2.71 

4.2.8 STEP 8

Choose whether the wastage factor or equipment correction factor is used in the seal coat design. Findings from the study SPR-3087 recommend using both factors.

Wastage Factor

It is advised that a wastage factor is applied for all size of aggregates.

Check to apply a wastage factor (10%).

Equipment Correction Factor

It is advised that an equipment correction factor is applied for No. 12.

Check to apply an equipment correction factor .

4.2.9 STEP 9

Select one of five categories of average daily traffic for road segments on which the seal coat will be applied.

Traffic Factor

Select one based on expected average daily vehicles: 0.7

Avg. Daily Traffic

under 100

100 to 500

500 to 1000

1000 to 2000

over 2000

4.2.10 STEP 10

Select one of five categories of surface condition for road segments on which the seal coat will be applied.

Surface Condition Factor

Select one which closely resembles existing surface texture: 0

<p>Black, flushed asphalt</p> 	<p>Smooth, non-porous</p> 
<p>Slightly porous, oxidized</p> 	<p>Slightly pocked, porous, oxidized</p> 
<p>Badly pocked, porous, oxidized</p> 	



4.2.11 STEP 11

Enter the water absorption of aggregates used for the seal coat application. ASTM C127 covers determination of water absorption of coarse aggregate (3).

Absorption

Enter the water absorption in percentage (ASTM C127-07): 0.31 %

User Defined

0.31 %

4.2.12 STEP 12

Enter the asphalt content of the emulsion used for the seal coat application using one of two input options.

Option 1: **User Defined**

Input the asphalt content of the emulsion by typing values in the box or using arrows.

The screenshot shows a dialog box titled "Asphalt Content of Emulsion". At the top, it says "Enter the residual asphalt content of binder in percentage: 65 %". Below this are two buttons: "User Defined" (which is highlighted) and "Typical". To the right of these buttons is a question mark icon. Below the buttons is an input field containing the number "65" followed by a percentage sign "%". A mouse cursor is positioned over the arrow controls of the input field.

Option 2: **Typical**

Input the asphalt content of the emulsion by selecting one of four types of emulsions specified in the INDOT Specification.

The screenshot shows the same dialog box titled "Asphalt Content of Emulsion". The "Typical" button is now selected. Below the buttons, there is a section titled "Emulsion Type" with four radio button options: "RS-2", "AE-90", "AE-90S" (which is selected and has a mouse cursor over it), and "HFRS-2". The top text "Enter the residual asphalt content of binder in percentage: 65 %" remains the same.

4.2.13 STEP 13

Review the input values. iSeal generates the AAR and EAR once the necessary input values are presented.

The screenshot shows the 'iSeal' software interface for 'INDOT Seal Coat Design'. The window title is 'INDOT Seal Coat Design [C:\Users\Hyung Jun Ahn\Desktop\Sealcoatexample.indot]'. The interface includes a menu bar (File, View, Help) and a logo for the Indiana Department of Transportation (INDOT). The main area is divided into several sections:

- General**: Contains input parameters for Median Particle Size (0.22 in.), Flakiness Index (2.2 %), Loose Unit Weight (90 lbs/ft³), Dry Bulk Specific Gravity (2.71), Wastage Factor (Yes), and Equipment Correction Factor (Yes). Buttons for 'Default' and 'Measured' are next to the Flakiness Index and Loose Unit Weight values.
- AAR**: Contains input parameters for Traffic Factor (0.7), Surface Condition Factor (0), Absorption (0.31 %), and Asphalt Content of Emulsion (65 %). Buttons for 'Typical' are next to the Traffic Factor, Surface Condition Factor, and Asphalt Content of Emulsion values.
- Summary**: Displays the calculated results:
 - Aggregate Application Rate (AAR)**: 24.39 lbs / yd²
 - Emulsion Application Rate (EAR)**: 0.25 gal / yd²
- Attachments**: A section for additional files or reports.

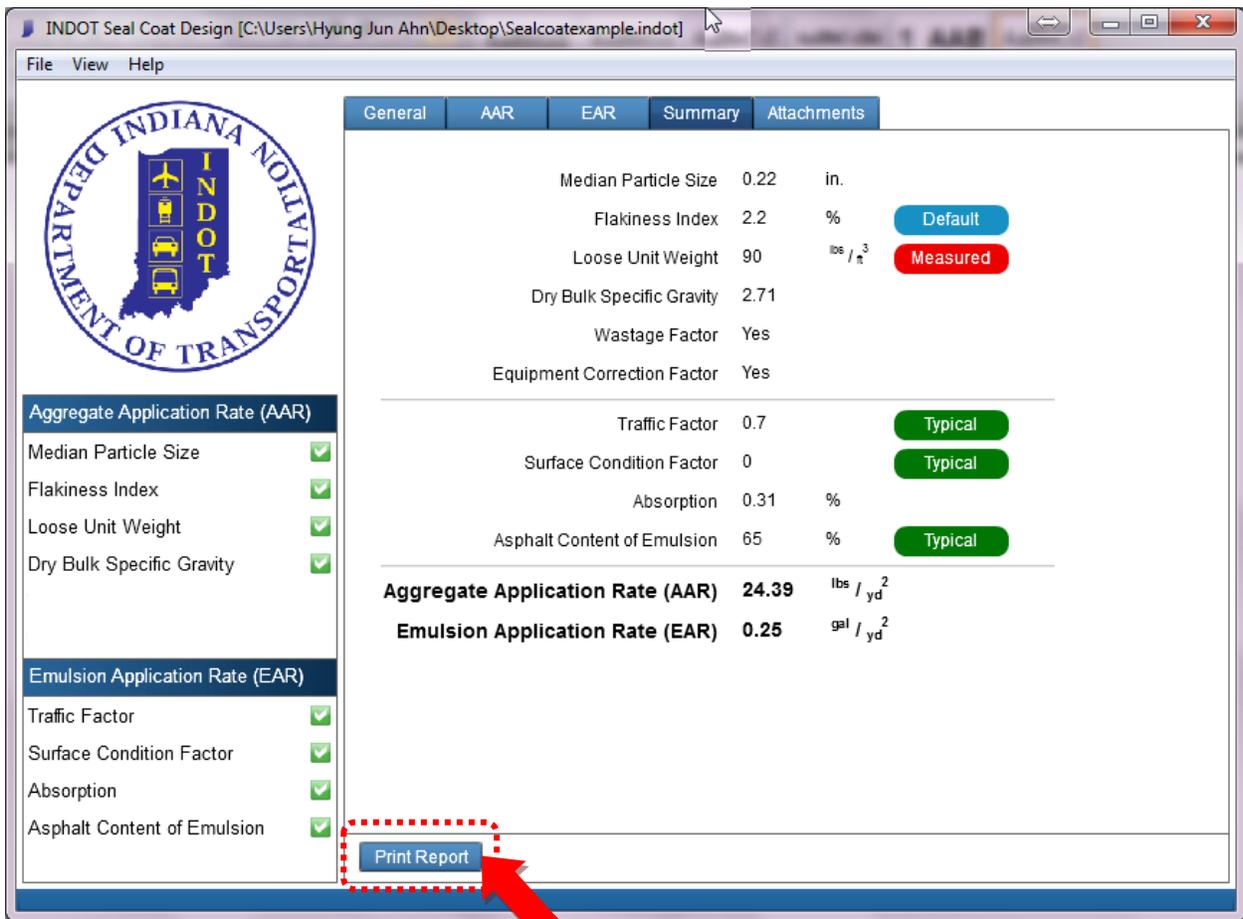
On the left side, there are two sections with checkmarks indicating that all input values are present:

- Aggregate Application Rate (AAR)**: Median Particle Size, Flakiness Index, Loose Unit Weight, Dry Bulk Specific Gravity.
- Emulsion Application Rate (EAR)**: Traffic Factor, Surface Condition Factor, Absorption, Asphalt Content of Emulsion.

A 'Print Report' button is located at the bottom left of the main content area.

4.2.14 STEP 14

If you would like to print a detailed report that contains general information as well as each step of the seal coat design calculation, click the **Print Report** button located at the bottom of the window. iSeal will generate a report in PDF format.

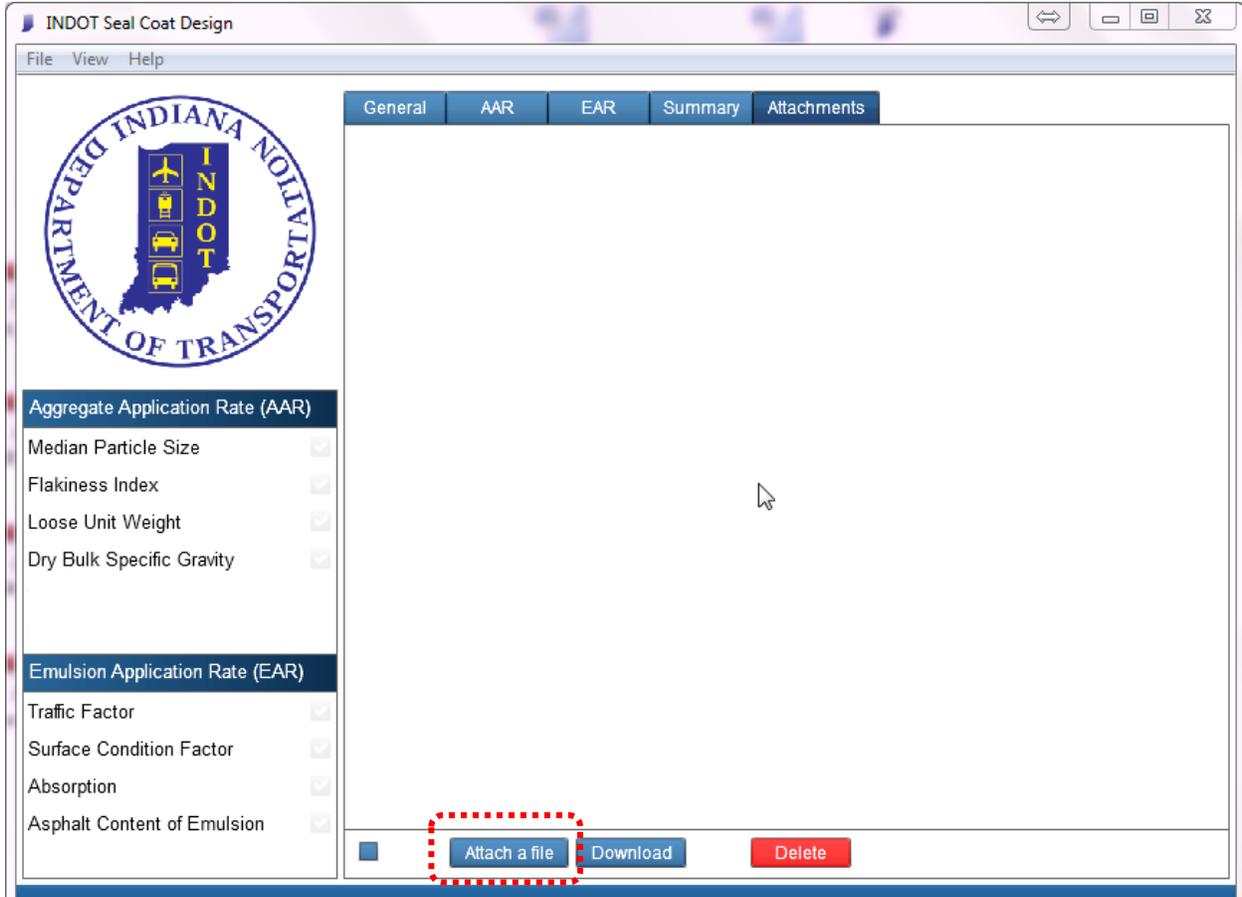


4.2.15 STEP 15

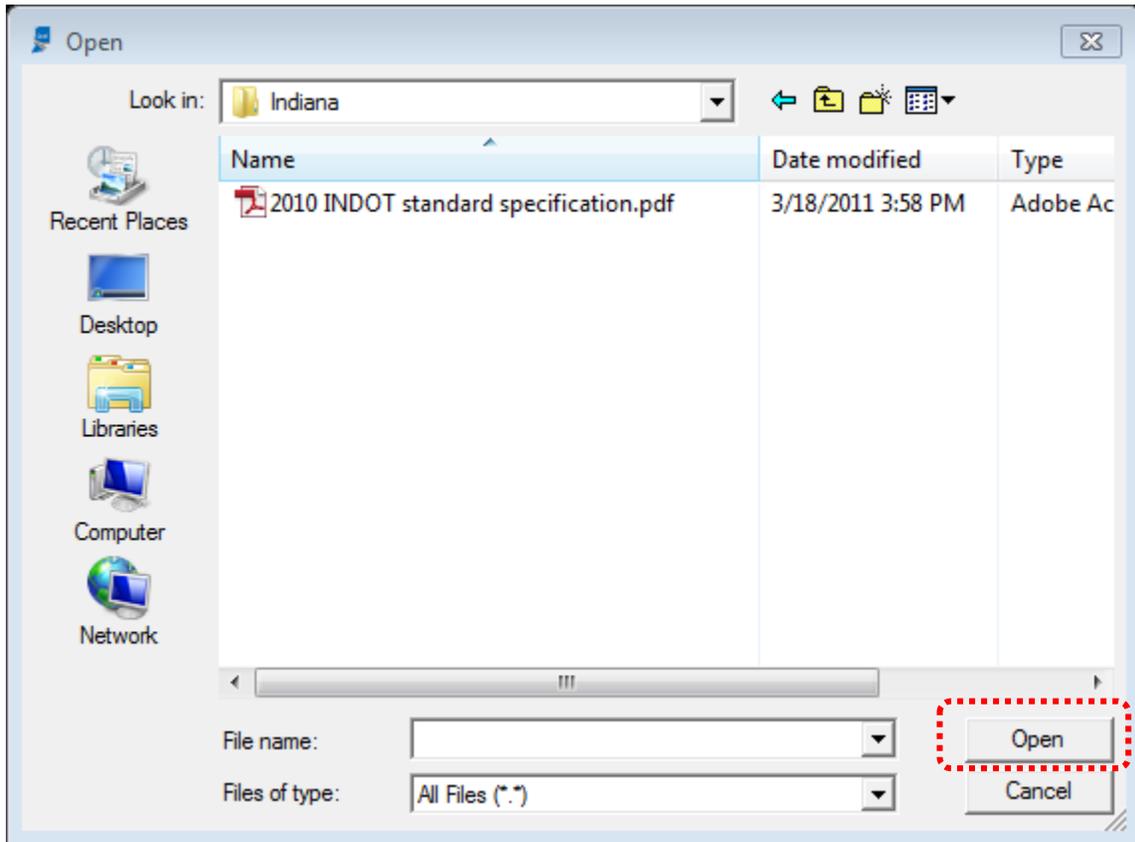
The user can attach any type of file with no size limit. The figure below illustrates how to add or delete attached files.

To add files, follow these steps:

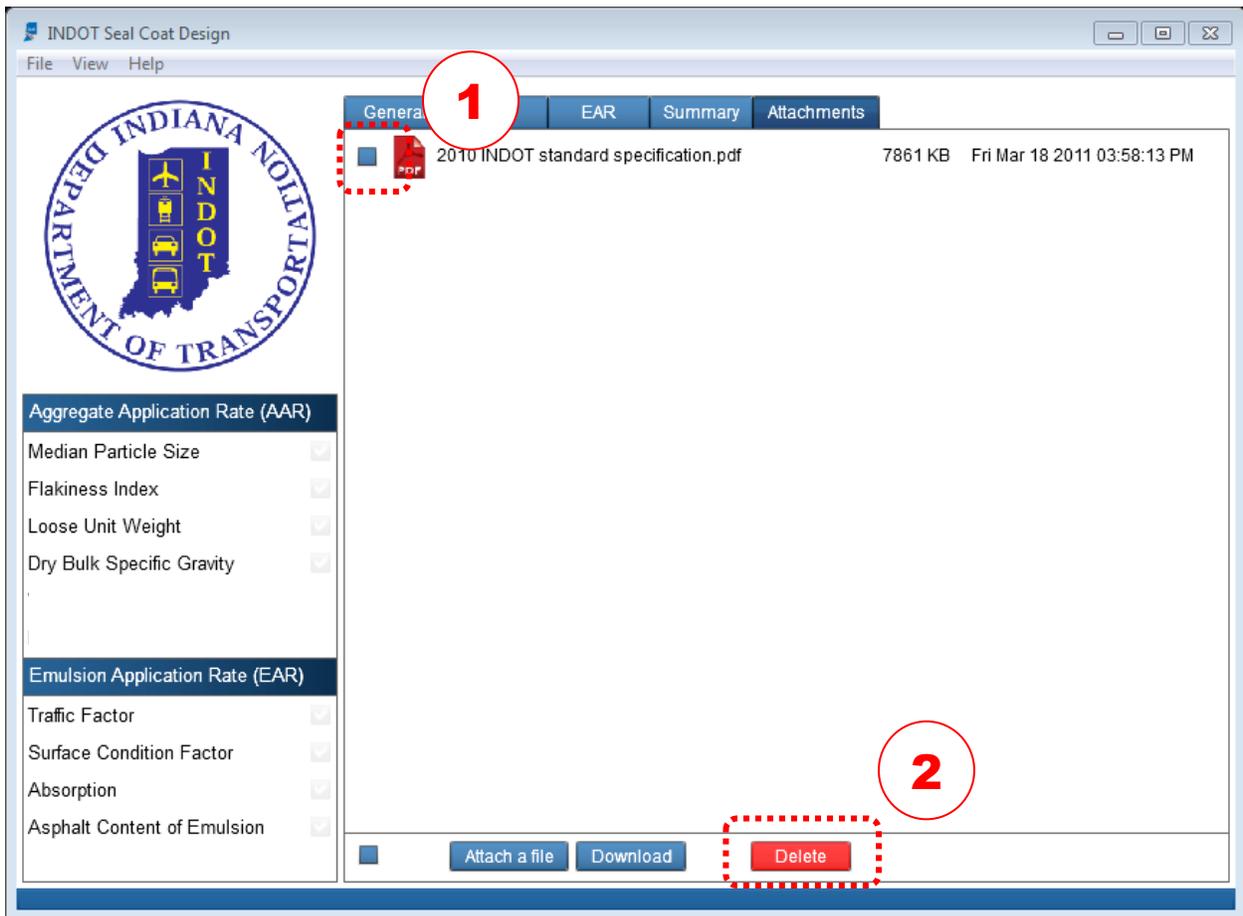
1. Click the **Attach a File** button.



2. Select a file and then click **Open**.



To delete files, select files by clicking the box, then click the **Delete** button

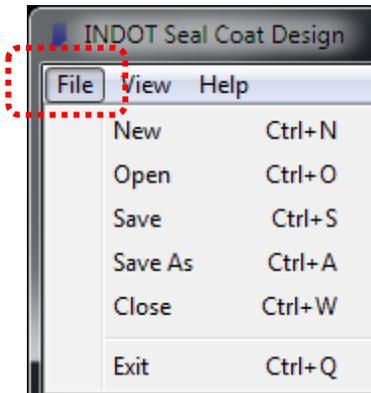


4.2.16 STEP 16

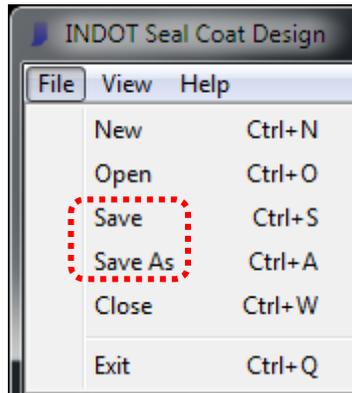
The last step is to save your work. You can save your work at anytime by typing the keyboard shortcut CTRL + S.

To save your work, follow these steps:

1. Click the **File** button.



2. Click either the **Save** or the **Save As**.



5 REFERENCES

1. **Indiana Department of Transportation.** The Indiana Design Manual 2010. *Indiana Department of Transportation*. [Online] Indiana Department of Transportation, January 21, 2010. <http://www.in.gov/dot/div/contracts/standards/dm/>.
2. —. *INDOT Standard Specifications*. s.l. : Indiana Department of Transportation, 2010.
3. **ASTM.** Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate. s.l. : American Society for Testing and Materials. ASTM C 127.
4. —. Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate. s.l. : American Society for Testing and Materials. ASTM C29.