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Software for Load Distribution on Low-Fill Box Culverts: User's Manual

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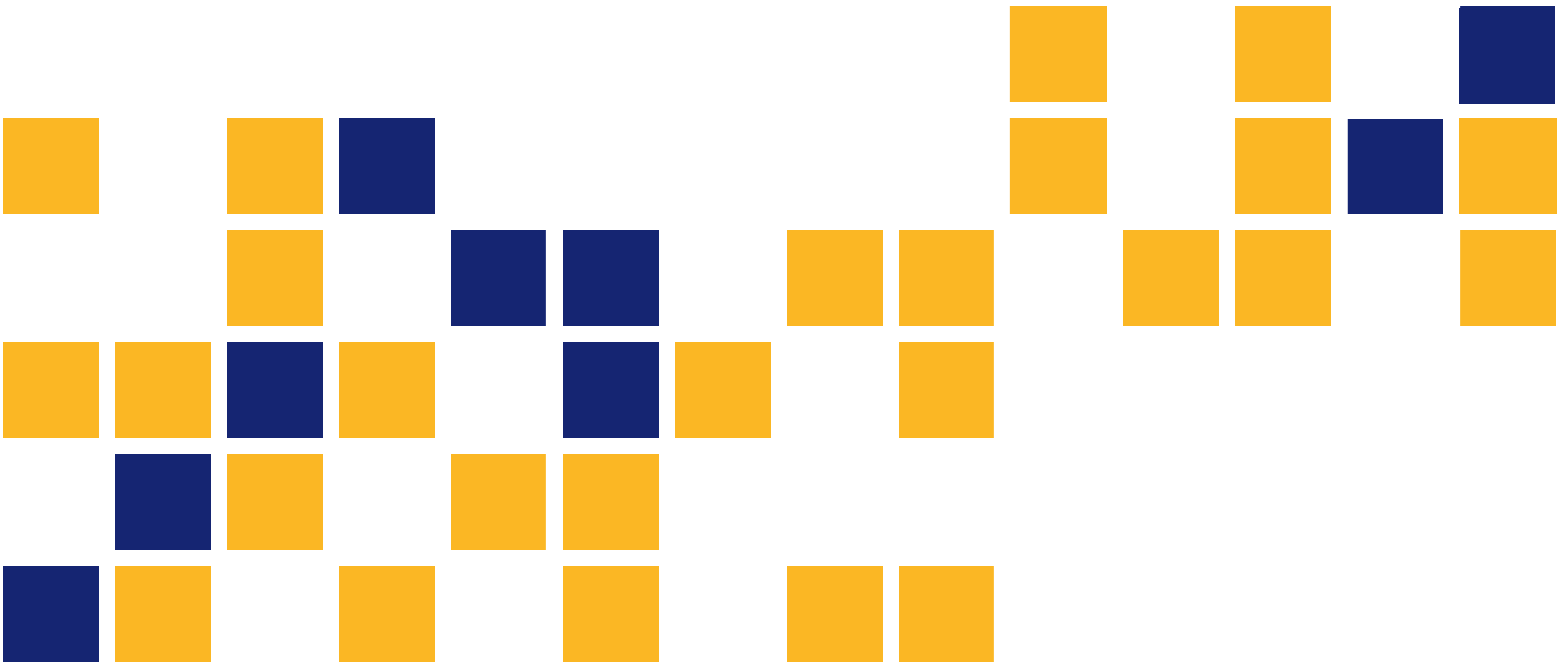

Kansas Department of Transportation

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Reinforced concrete box culverts have mostly been installed at shallow depths under roadways for drainage. The effect of traffic loads on the shallowly buried culverts is more significant than that on culverts at greater depths. The distribution of traffic loads onto the culverts is used to determine the rating factors of these structures. The American Association of State Highway and Transportation Officials (AASHTO) provides three methods of load rating: 1. Allowable Stress Rating (ASR); 2. Load Factor Rating (LFR); and 3. Load and Resistance Factor Rating (LRFR). The Load Factor Design (LFD) method and the Load and Resistance Factor Design (LRFD) method have been mostly used by Departments of Transportation (DOTs) to load rate the buried culverts. The LFD method considers the wheel load acting as a point load on fill, which is distributed onto a square area on the culvert with a width of 1.75 times the fill depth above the culvert. The LRFD method suggests the wheel load be applied on a rectangular area as a tire footprint and distributed onto the culvert by increasing the tire footprint by 1.15 times the fill depth.

The stress distribution program developed in this project used an improved load distribution method proposed by Han, Acharya, Parsons, and Khatri (2013). This method considers the effect of pavement type and pavement layers on the load distribution. This method was used to calculate the Equivalent Live Load Distribution Factor (ELLDF) based on the LFD and LRFD methods. This program considers the type of pavement, thicknesses, and elastic moduli of pavement layers, and 16 types of design trucks. This program computes the ELLDF for distributed loads, the distributed stress, and the distributed area on the buried box structure, which can be input into the current AASHTO design software and enable the software to consider the pavement effect on the live load distribution onto the buried box culvert.

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PREFACE

The Kansas Department of Transportation's (KDOT) Kansas Transportation Research and New-Developments (K-TRAN) Research Program funded this research project. It is an ongoing, cooperative and comprehensive research program addressing transportation needs of the state of Kansas utilizing academic and research resources from KDOT, Kansas State University and the University of Kansas. Transportation professionals in KDOT and the universities jointly develop the projects included in the research program.

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Abstract

Reinforced concrete box culverts have mostly been installed at shallow depths under roadways for drainage. The effect of traffic loads on the shallowly buried culverts is more significant than that on culverts at greater depths. The distribution of traffic loads onto the culverts is used to determine the rating factors of these structures. The American Association of State Highway and Transportation Officials (AASHTO) provides three methods of load rating: 1. Allowable Stress Rating (ASR); 2. Load Factor Rating (LFR); and 3. Load and Resistance Factor Rating (LRFR). The Load Factor Design (LFD) method and the Load and Resistance Factor Design (LRFD) method have been mostly used by Departments of Transportation (DOTs) to load rate the buried culverts. The LFD method considers the wheel load acting as a point load on fill, which is distributed onto a square area on the culvert with a width of 1.75 times the fill depth above the culvert. The LRFD method suggests the wheel load be applied on a rectangular area as a tire footprint and distributed onto the culvert by increasing the tire footprint by 1.15 times the fill depth.

The stress distribution program developed in this project used an improved load distribution method proposed by Han, Acharya, Parsons, and Khatri (2013). This method considers the effect of pavement type and pavement layers on the load distribution. This method was used to calculate the Equivalent Live Load Distribution Factor (ELLDF) based on the LFD and LRFD methods. This program considers the type of pavement, thicknesses, and elastic moduli of pavement layers, and 16 types of design trucks. This program computes the ELLDF for distributed loads, the distributed stress, and the distributed area on the buried box structure, which can be input into the current AASHTO design software and enable the software to consider the pavement effect on the live load distribution onto the buried box culvert.

Acknowledgements

This research was financially supported by the Kansas Department of Transportation (KDOT) through the Kansas Transportation Research and New-Developments (K-TRAN) Program. John Culbertson, Bridge Management Engineer in the KDOT Bureau of Structures and Geotechnical Services, was the Project Monitor for this project. John Jones, Assistant Bureau Chief, and Dean Teal, Engineering Associate III, also with the KDOT Bureau of Structures and Geotechnical Services, have provided great technical assistance in this research project. The truck information included in this software was provided by KDOT. The IT Support Technician, Tim Miller, in the Technology Services Center at School of Engineering and the former graduate student, Babak Mardan Doost, at the University of Kansas provided technical support during the programming of this software. All the above support is greatly appreciated.

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Chapter 1: Introduction

Culverts are infrastructure assets under highways and railways to provide drainage of water and access for animals to cross. The opening size of a culvert is selected based on design flood, while the thickness of the culvert section is designed based on applied loads, including the weights of backfill materials over the culvert and vehicles. A variety of materials, such as reinforced-concrete, steel, and thermal plastic, have been used for the construction of culverts. Based on the type of culvert material, the load carrying system, and the surrounding soil condition, culverts can be categorized as rigid, semi-rigid, or flexible. Many factors, such as the type and age of the culvert material, the size and shape of the culvert, and the surrounding supporting materials, affect the load carrying capacity of a culvert. The capacity of a culvert decreases with time due to aging and degradation of the materials after repeated loading by heavy trucks. Culverts can be placed at different depths. When they are placed at shallow depths, the effects of the live loads by heavy trucks become more significant.

Reinforced-concrete box culverts are the most prevalent type of culverts that are placed at shallow depths. The AASHTO (1992) *Standard Specifications for Highway Bridges* suggested a wheel load as a point load above the backfill, distributed onto a square area on the culvert, which has a width of 1.75 times the backfill depth above the culvert. The AASHTO (2007) *LRFD Bridge Design Specifications* suggested that the footprint of the wheel load be rectangular above the backfill and be distributed onto the culvert by increasing the rectangular area. The width of the rectangular area above the culvert is equal to 1.15 times the backfill depth depending on the backfill material. Most culverts have been constructed under flexible or rigid pavements. However, neither the AASHTO (2007) *LRFD Bridge Design Specifications* nor the AASHTO (1992) *Standard Specifications for Highway Bridges* considered the effects of the type of the pavement above the backfill on the live load distribution. The methods suggested by the 1992 and 2007 AASHTO specifications are valid for the culvert without any pavement above the backfill, which often happens during construction. However, when a rigid or flexible pavement exists above the backfill, the distributed wheel load through a pavement might be different from that calculated

using the AASHTO specifications. Moreover, the backfill depth and its modulus may affect the distributed load.

Han, Acharya, Parsons, and Khatri (2013) conducted two field tests to investigate the effects of rigid and flexible pavements on the load distribution and the deflections of the reinforced concrete boxes under truck loading. These field test results were used to calibrate three-dimensional numerical models. The calibrated numerical models were used to perform parametric studies further investigating the effects of pavements on the load distribution on box culverts under different pavement and backfill thickness. These numerical results were used to verify the simplified methods for load distribution considering pavement effects proposed by Han et al. (2013). In these methods, different approaches were proposed to handle the load distribution for rigid and flexible pavements due to their rigidity differences. Han et al. found that the 2007 *AASHTO LRFD Bridge Design Specifications* and the 1992 AASHTO *Standard Specifications for Highway Bridges* overestimated the distributed stresses above the box culverts since these methods do not consider the effect of the pavement.

This User's Manual describes the software developed based on the simplified methods for load distribution considering pavement effects proposed by Han et al. (2013). This software is to help the user calculate the magnitude and dimension of the distributed stress on the top of the culvert due to truck loading on a pavement. To be compatible with the current design methods suggested by AASHTO, this software calculates an equivalent live load distribution factor by considering the effects of pavement type (i.e., rigid pavement, flexible pavement, and no pavement), pavement thickness, backfill depth, and their elastic moduli. In addition, the software built in most of the trucks (i.e., type of axles, axle load, axle arrangement, and wheel size) available in the AASHTO specifications.

Chapter 2: Simplified Methods for Load Distribution

Giroud and Han (2004) simplified the Burmister theoretical solution (Burmister, 1958) into an approximate formula to estimate the vertical stress distribution angle from a base course to a subgrade as follows:

$$tan\,\alpha_1 = tan\,\alpha_2\left[1 + 0.204\left(\frac{E_{bc}}{E_{sg}} - 1\right)\right] \quad \textbf{Equation 2.1}$$

Where: α_1 = the stress distribution angle in the base course, α_2 = the reference stress distribution angle for a uniform medium defined by $E_{bc}=E_{sg}$, E_{bc} = the elastic modulus of the base course, and E_{sg} = the elastic modulus of the subgrade.

Han et al. (2013) adopted this simplified method to estimate the vertical stresses under the rigid and flexible pavements. In this simplified method, Equation 2.2 is used to estimate the stress distribution angle between the upper and lower layers, which is re-written from Equation 2.1:

$$tan\,\alpha_1 = tan\,\alpha_0\left[1 + 0.204\left(\frac{E_1}{E_2} - 1\right)\right] \quad \textbf{Equation 2.2}$$

Where: E_1 = the elastic modulus of the upper layer, E_2 = the elastic modulus of the lower layer, and α_0 = the reference stress distribution angle for a uniform medium.

In the computation of the distribution angle between pavement layers based on the LRFD method, α_0 can be selected as 30°, which corresponds to the live load distribution factor of 1.15 as suggested by the AASHTO (2016) interim LRFD specifications. However, in the LFD method, the reference stress distribution angle, α_0, can be taken as 41°. Therefore, in the computation of the distribution angle between pavement layers based on the LFD method, α_0 can be selected as 41°, which corresponds to the live load distribution factor of 1.75 as suggested by the AASHTO (2002) *Standard Specifications for Highway Bridges*. Moreover, in the computation of the distribution angle between two adjacent layers, when tan α_1 is greater than 3.0, tan α_1 is limited to 3.0 because the simplified methods proposed by Han et al. (2013) were verified with this limit. The vertical stress distribution and its distribution area on the culvert under a rigid pavement are

shown in Figure 2.1. In this figure, the length of the rectangular distribution area, a, on the top of the culvert along the culvert axis due to a single wheel load can be calculated as follows (assuming four layers):

$$a = t_l + 2\,(h_1 \tan\alpha_1 + h_2 \tan\alpha_2 + h_3 \tan\alpha_3 + h_4 \tan\alpha_4) \qquad \textbf{Equation 2.3}$$

Where: a = the length of the distribution area by one single wheel load, t_l = the length of the tire footprint, h_1, h_2, h_3, and h_4 = the thicknesses of the four layers, and α_1, α_2, α_3, and α_4 = the distribution angles between the layers.

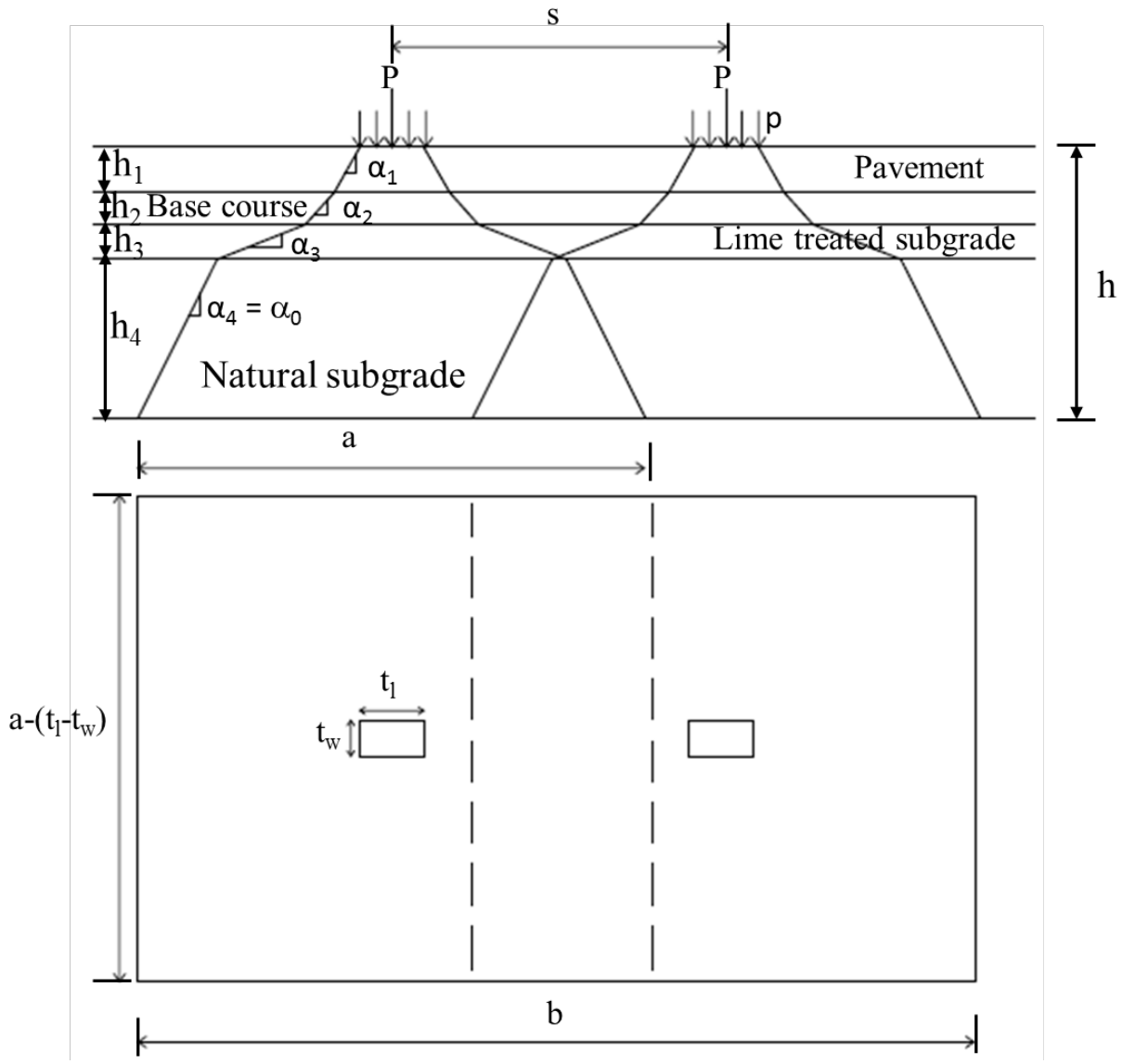

Figure 2.1: Vertical Stress Distribution under a Rigid Pavement (after Han et al., 2013)

Since the same distribution angles are used in both the culvert axis direction and the perpendicular direction to the culvert axis, the width of the distribution area in the perpendicular direction is: a - (t_l - t_w), where t_w is the width of the tire footprint. Therefore, the total length of the distribution area by two wheel loads can be calculated as follows:

$$b = a + s \qquad \textbf{Equation 2.4}$$

Where: b = the total length of the distribution area, and s = the spacing of the two wheel loads.

Under the rigid pavement, the magnitude of the distributed vertical stress can be calculated by dividing the axle load by the total distribution area as follows:

$$p_c = \frac{2 \times P}{b(a - t_l + t_w)} \qquad \textbf{Equation 2.5}$$

Where: p_c = the distributed stress above the culvert.

Consequently, the proposed distributed vertical stress above the culvert under the rigid pavement is shown in Figure 2.2.

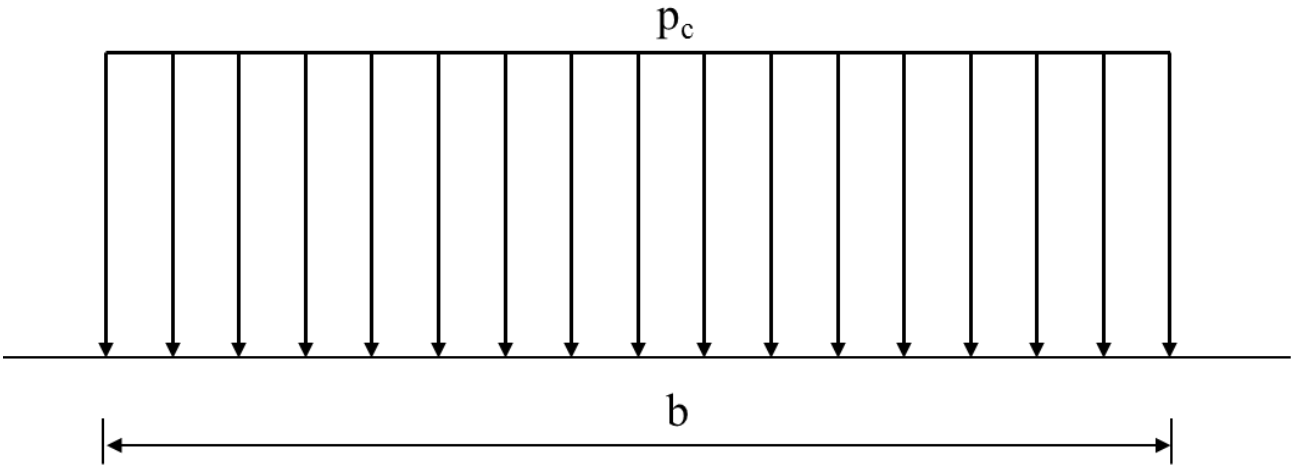

Figure 2.2: Distributed Vertical Stress above the Culvert under a Rigid Pavement

The vertical stress distribution and the distribution area above the culvert under a flexible pavement are shown in Figure 2.3. In this figure, the length of the rectangular distribution area, a,

on the top of the culvert along the culvert axis due to a single wheel load can be calculated as follows (assuming three layers):

$$a = t_l + 2\,(h_1\,tan\,\alpha_1 + h_2\,tan\,\alpha_2 + h_3\,tan\,\alpha_3) \qquad \textbf{Equation 2.6}$$

Where: a = the length of the distributed area by one single wheel load, t_l = the length of the tire footprint, h_1, h_2, and h_3 = the thicknesses of the layers, and α_1, α_2, and α_3 = the distribution angles between the layers.

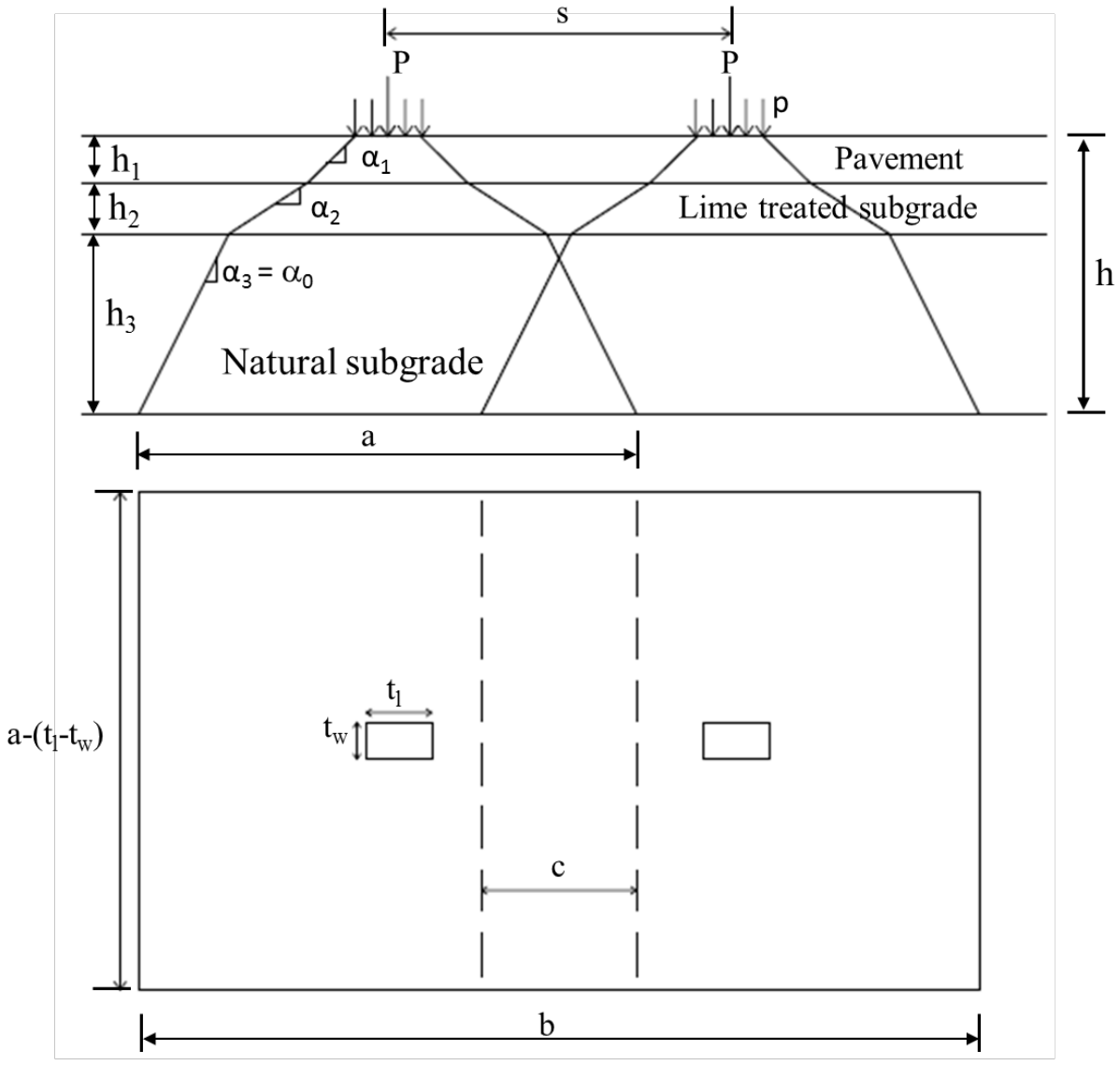

Figure 2.3: Vertical Stress Distribution under a Flexible Pavement (after Han et al., 2013)

Considering the flexibility of the flexible pavement, it is assumed that a uniform vertical stress under a wheel load is distributed independently onto the culvert. The uniform vertical stress is:

$$p_{c1} = \frac{\mathrm{P}}{a(a - t_l + t_w)} \qquad \textbf{Equation 2.7}$$

Where: p_{c1} = the distributed vertical stress on the top of the culvert from an individual wheel load.

Within the overlapped area, the vertical stress above the culvert can be calculated by the superposition of the stresses due to two individual wheels as follows:

$$p_{c2} = 2 \times p_{c2} \qquad \textbf{Equation 2.8}$$

Where: p_{c2} = the distributed vertical stress within the overlapped area.

Moreover, the width of the overlapped area is:

$$c = \frac{2\,a - b}{2} = \frac{a - s}{2} \qquad \textbf{Equation 2.9}$$

Where: c = the width of the overlapped distribution area by two wheel loads.

Even though the two-zone distribution is more accurate to represent the actual stress distribution, the AASHTO (2016) LRFD specifications only allow one uniform stress distribution. Therefore, an approximation is taken to calculate the average vertical stress using Equation 2.5. Since rigid pavements have much higher modulus than flexible pavements, the distributed areas for rigid pavements are larger than those for flexible pavements. As a result, the vertical stresses under the flexible pavements are higher than those under the rigid pavements.

Consequently, the proposed distributed vertical stress above the culvert under the flexible pavement is shown in Figure 2.4.

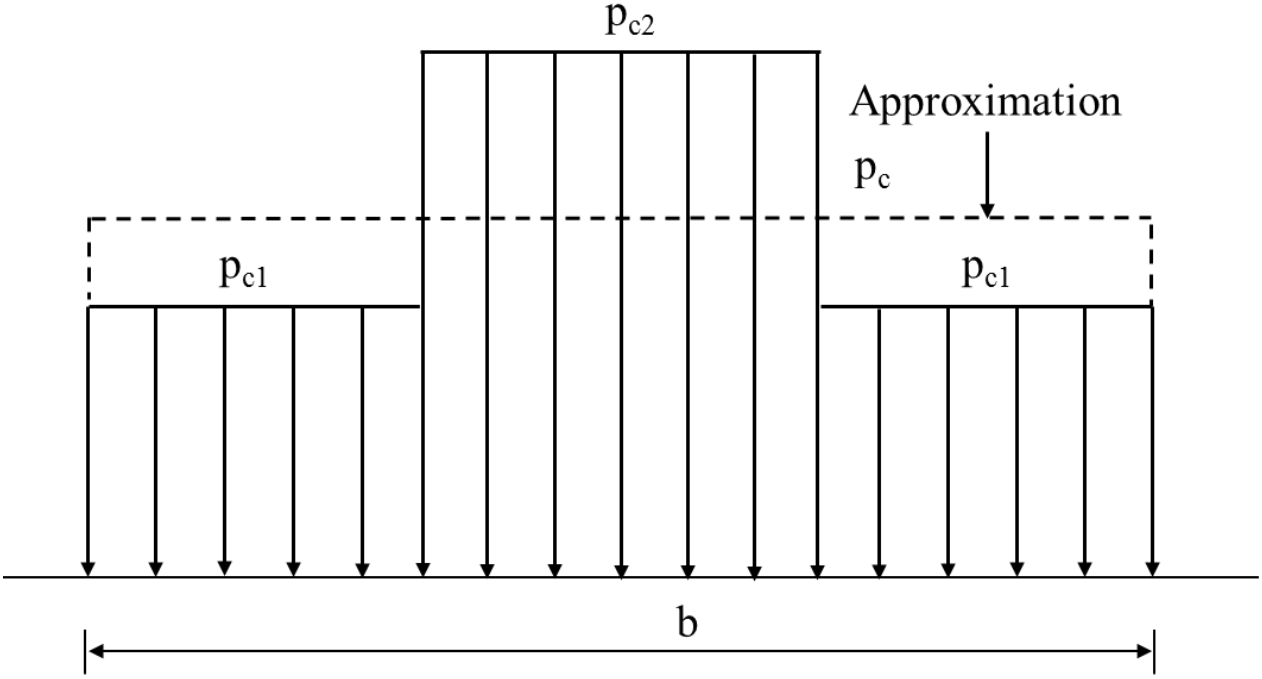

Figure 2.4: Distributed Vertical Stress above the Culvert under a Flexible Pavement (modified from Han et al., 2013)

The simplified methods presented above were incorporated in this software to calculate the vertical stresses on the top of the box culvert under rigid and flexible pavements.

Chapter 3: Design Vehicular Live Load

Based on the AASHTO (2014) *LRFD Bridge Design Specifications*, the live load vertical crown pressure should be determined as:

$$P_L = \frac{P\left(1+\frac{IM}{100}\right)(m)}{A_{LL}} \qquad \textbf{Equation 3.1}$$

Where: P_L = the live load vertical crown pressure (ksf), P = the live load applied on all interacting wheels on the pavement surface (kip), IM = the dynamic load allowance, m = the multiple presence factor, and A_{LL} = the rectangular area at depth h (ft^2).

The *IM* for culverts and other buried structures should be taken as:

$$IM = 33\,(1.0 - 0.125\,D_E) \geq 0\% \qquad \textbf{Equation 3.2}$$

Where: D_E = the minimum depth of the earth cover above the box culvert (ft).

Moreover, the *m* factor may be selected according to Table 3.1.

Table 3.1: Multiple Presence Factor, *m*

Number of Loaded Lanes	Multiple Presence Factor, *m*
1	1.20
2	1.00
3	0.85
> 3	0.65

Chapter 4: Equivalent Live Load Distribution Factor

The AASHTO (2016) interim LRFD specifications suggested the use of a live load distribution factor (LLDF) to calculate the vertical stresses on the top of the culvert. To adjust the LLDF in the AASHTO specifications, an equivalent live load distribution factor (ELLDF) is proposed herein and adopted in the software. The concept of the equivalent stress distribution angle is illustrated in Figure 4.1 and the ELLDF can be calculated using the following equation:

$$ELLDF = 2tan\alpha = \frac{a-t1}{h}$$ **Equation 4.1**

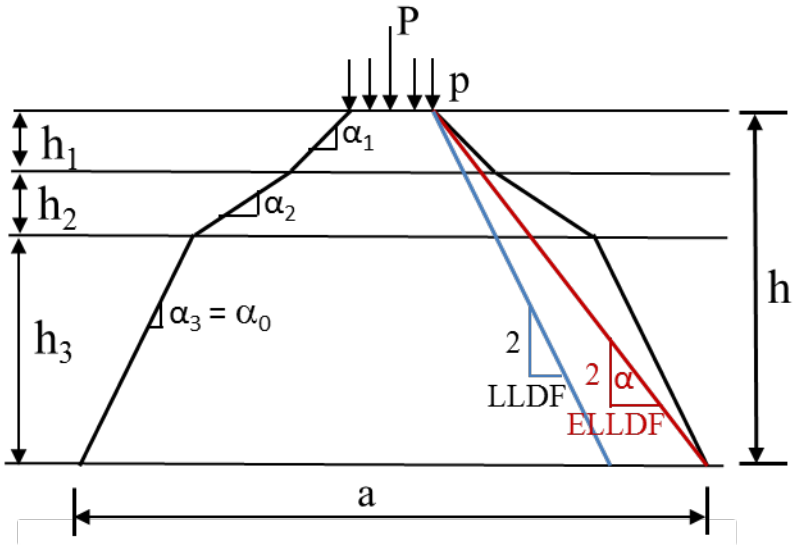

Figure 4.1: Equivalent Live Load Distribution Angle, α

Chapter 5: Use of the Software

5.1 Getting Started

To start the program, click the “Stress Distribution above Culvert” icon. Figure 5.1 shows the software window for the Live Load Distribution on Low-Fill Box Culverts.

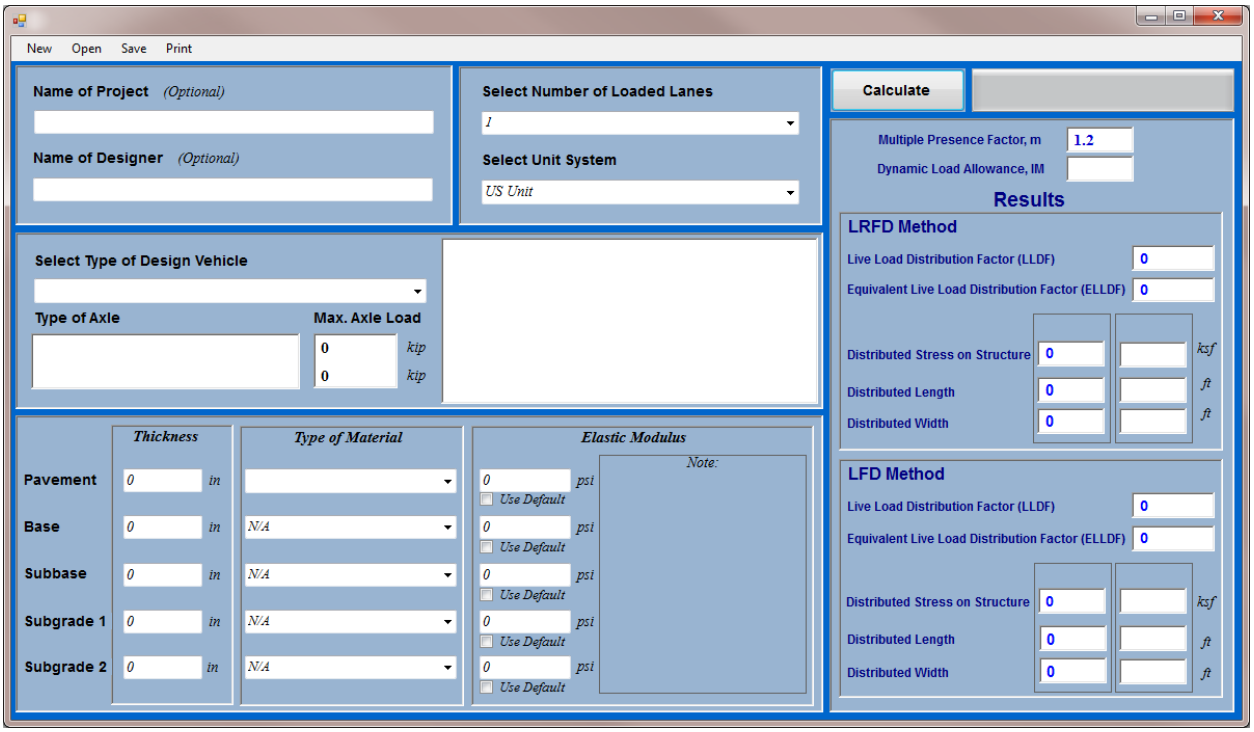

Figure 5.1: Software Window for Live Load Distribution on Low-Fill Box Culverts

On this screen, the user can enter the name of a project and the name of a designer in the “Name of Project” and “Name of Designer” textboxes, respectively. Alternatively, these textboxes can be left blank.

5.2 Type of Pavement

Click the “Select Type of Pavement” combobox and select one of the following three types of pavements: Rigid Pavement, Flexible Pavement, and No Pavement, as shown in Figure 5.2. The type “No Pavement” is also referred to as an unpaved road.

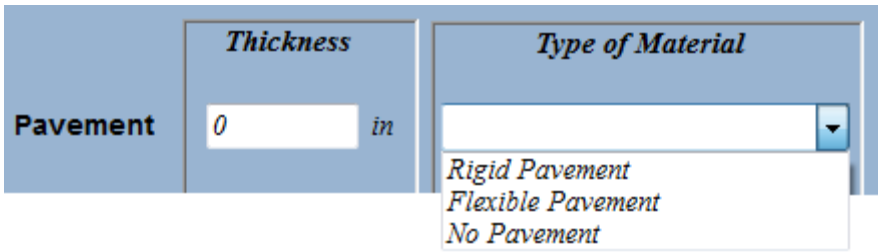

Figure 5.2: Selection of the Type of Pavement

5.3 Number of Loaded Lanes and Unit System

Click the "Select Number of Loaded Lanes" combobox and select one of the following four types of loaded lanes: 1, 2, 3, and >3.

The default unit for this software is the US unit. The user may change the unit by clicking the "Select Unit System" combobox. Two types of units are available in this software: US Unit and SI Unit, as shown in Figure 5.3.

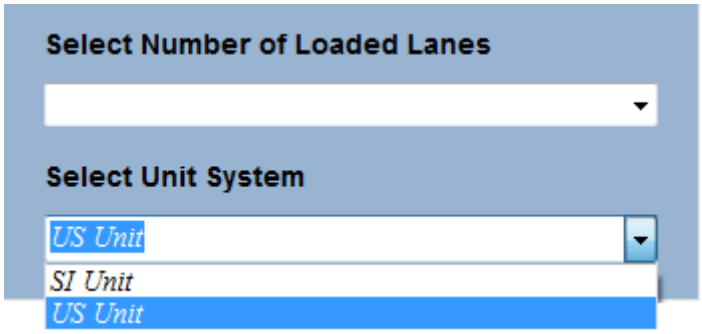

Figure 5.3: Selection of the Unit System

5.4 Type of Vehicle

This software includes 16 types of vehicles, which are used by KDOT as rating trucks. Table 5.1 shows the specifications of these vehicles. For each axle of the vehicle, the load is defined based on the AASHTO suite of trucks. The size of the wheel contact area and the distance between wheels for each vehicle are defined. Click the "Select Type of Design Vehicle" combobox to select the type of vehicle for analysis from the list as shown in Figure 5.4.

Table 5.1: Vehicle Specifications

Vehicles	Type of Axles and Tires	Number of Axles	Max. Load on Axles, kip		Tire Footprint Width, in		Tire Footprint Length, in		wheels Distance, ft	Axles Distance, ft
			Dual Tiers	Single Tires	Dual Tiers	Single Tires	Dual Tiers	Single Tires		
HL-93	Single Axle with Dual Tires	3	32		20		14.4		6	14
H 20-44	Single Axle with Dual Tires	2	32		20		14.4		6	14
HS 20-44 K	Single Axle with Dual Tires	3	32		20		14.4		6	14
Type 3	Tandem Dual Axle with Dual Tires	3	17		14.57		10.5		6	4
Type 3S2	Tandem Dual Axle with Dual Tires	5	15.5		13.92		10.0		6	4
Type T130	Tandem Dual Axle with Dual Tires	7	20		13.92		10.0		6	4
Type 3-3	Single Axle with Dual Tires	6	16		14.14		10.2		6	15
	Tandem Dual Axle with Dual Tires		14		13.23		9.5		6	4
Type T170	Tandem Dual Axle with Dual Tires	9	20		13.92		10.0		6	4
	Tandem Triple Axle with Dual Tires		18		13.92		10.0		6	4
Heavy Equipment	Tandem Triple Axle with Dual Tires	9	21.35		17		12.2		6	5
	Penta Axle with Dual Tires		25.39		14		10.1		6	5.95
SU4	Triple Axle with Dual and single Tires	4	17	8	10.62	5	7.65	3.6	6	4
SU5	Quad Axle with Dual and single Tires	5	17	8	10.62	5	7.65	3.6	6	4
SU6	Penta Axle with Dual and single Tires	6	17	8	10.62	5	7.65	3.6	6	4
SU7	Hexa Axle with Dual and single Tires	7	17	8	10.62	5	7.65	3.6	6	4
NRL	Hepta Axle with Dual and single Tires	8	17	8	10.62	5	7.65	3.6	6	4
EV 2	Single Axle with Dual Tires	2	33.5		20		14.4		6	15
EV 3	Tandem Dual Axle with Dual Tires	3	31		20		14.4		6	4

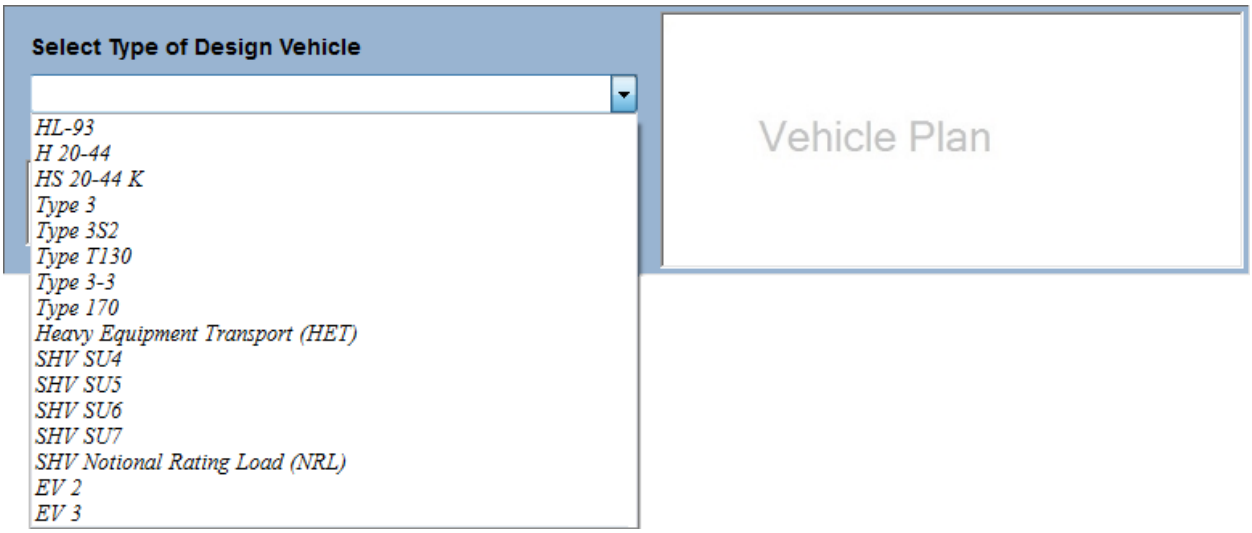

Figure 5.4: Selection of the Type of Vehicle

After the selection, the schematic layout of the wheels for this vehicle is shown in the picture box. Figure 5.5 shows the type of axles, the maximum axle load, and the vehicle plan for the truck Type 3-3 as an example. Two maximum axle loads for this vehicle are shown in Figure 5.6. However, other vehicles may have only one maximum axle load (Figure 5.7).

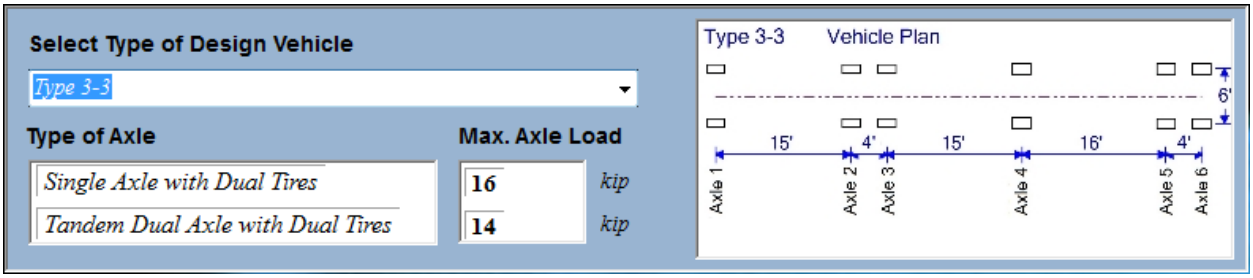

Figure 5.5: Type of Axle, Maximum Axle Load, and Vehicle Plan in the Truck Type 3-3

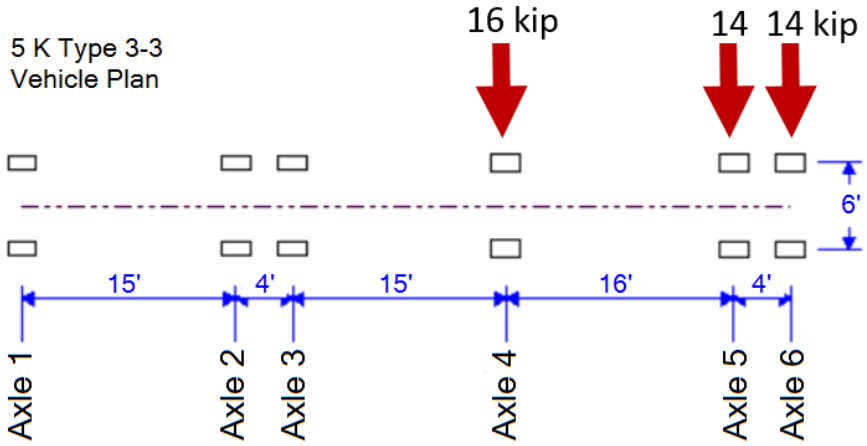

Figure 5.6: Arrangement of the Axles and their Maximum Loads for the Truck Type 3-3

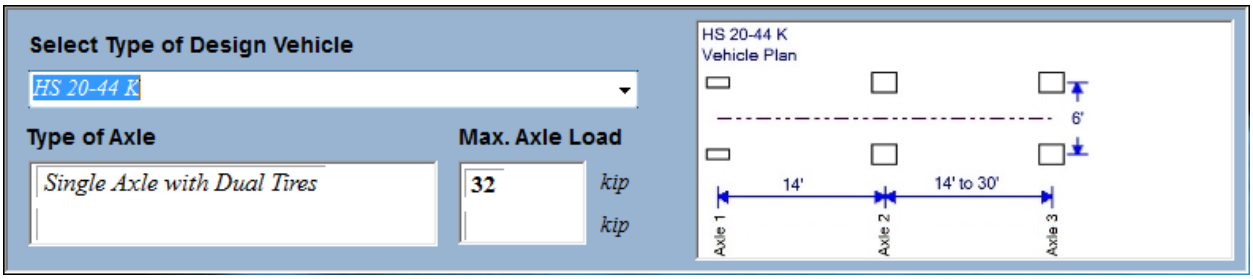

Figure 5.7: Type of Axle, Maximum Axle Load, and Vehicle Plan for the Truck HS 20-44 K

In addition, five vehicles (SU4, SU5, SU6, SU7, and NRL) have both single and dual tires. For one of these vehicles, only the maximum load of the axle with dual tires will appear and the software will consider the maximum load of both single and dual tires during the calculation. For example, Figure 5.8 shows the type of axle, the maximum axle load, and the vehicle plan for the truck SHV SU7.

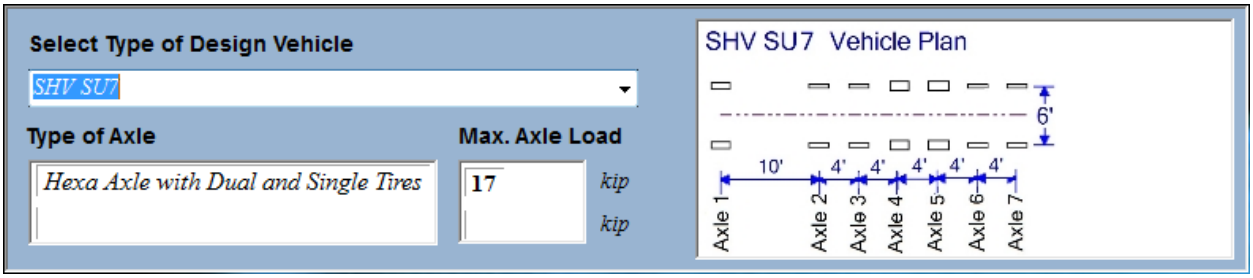

Figure 5.8: Type of Axle, Maximum Axle Load, and Vehicle Plan for the Truck SHV SU7

5.5 Pavement Layers

The user is allowed to input the number of pavement layers (two layers as minimum and five layers as maximum). Figure 5.9 shows five pavement layers: Pavement, Base, Subbase, Subgrade 1, and Subgrade 2. The user needs to input the thickness and elastic modulus for each layer. If "No Pavement" is selected as the type of pavement, the textboxes of the thickness and elastic modulus of the pavement surface would be set to zero automatically. If a pavement layer is not available in a project, the thickness of that layer must be set zero. To use the default value for each layer, the "Use Default" checkbox should be checked.

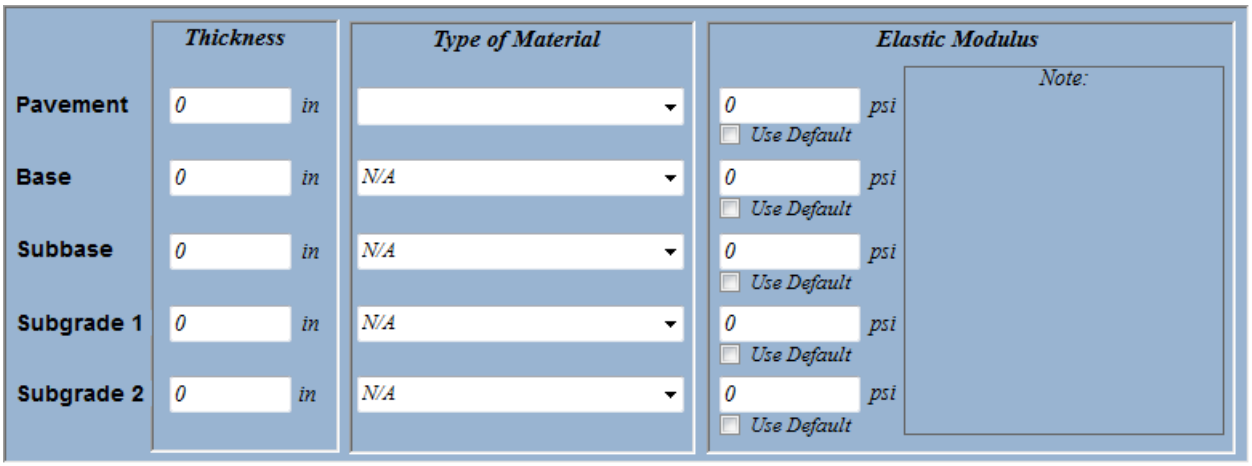

Figure 5.9: Input for Thicknesses and Elastic Moduli of Pavement Layers

5.6 Running and Results

To run the calculations, click the "Calculate" button. The software computes the live load distribution factor (LLDF), the equivalent live load distribution factor (ELLDF), the distributed vertical stress on the structure, and the distributed area based on the LRFD and LFD methods. Figure 5.10 shows the Calculate button and the calculated Results box.

There are two “Distributed Vertical Stress on Structure” textboxes in the result box. Three vehicles (Type 3-3, Type T170, and Heavy Equipment Transport) have two critical axles. Therefore, the first “Distributed Vertical Stress on Structure” textbox is referred to as the first type of axle and the second textbox is referred to as the second type of axle. However, other vehicles with one type of the critical axle have only one distributed vertical stress on the culvert in the output.

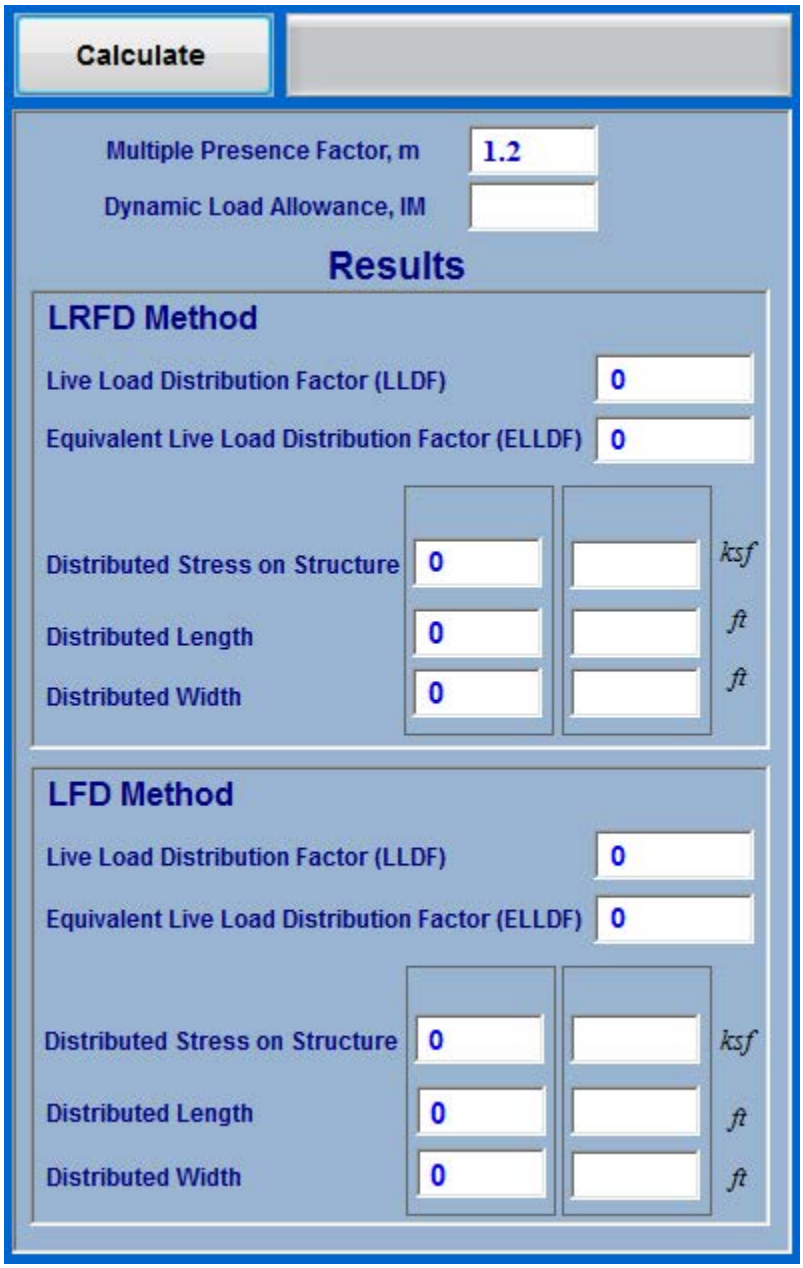

Figure 5.10: Calculate Button and the Calculated Results

5.7 Error Messages

The software has included a few error messages, which are used to prevent crashing of the program due to missing inputs or mistyped characters. For example, if the user does not select the type of the pavement and then clicks the “Calculate” button, an error message window will appear, showing “Error: Select Type of the Pavement!”; Figure 5.11 shows this error message window. To continue, the user should close this error message window and select the type of pavement.

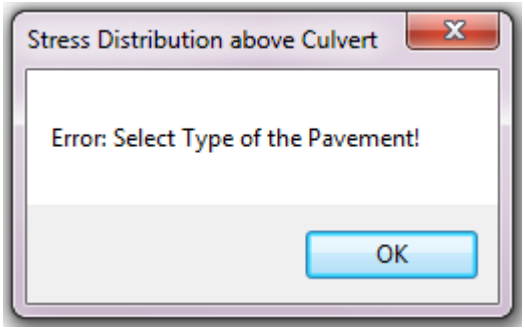

Figure 5.11: Error Message of the Type of Pavement Selection

If the user does not select the type of vehicle and then clicks the “Calculate” button, an error message window will appear, showing the message “Error: Select Type of the Design Vehicle!” as shown in Figure 5.12. To continue, the user should close this error message window and select the type of vehicle.

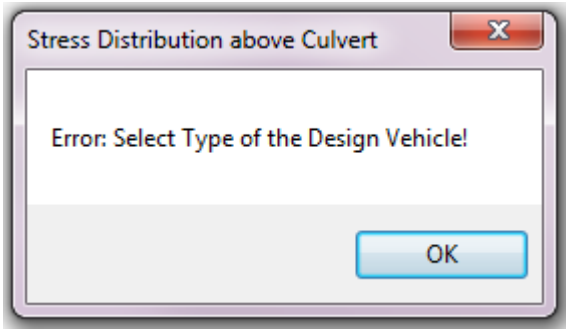

Figure 5.12: Error Message of the Type of Vehicle Selection

If the user does not enter the values for the thickness and/or the elastic modulus of a pavement layer or enters a non-numeric text and then clicks the “Calculate” button, an error message window will appear, showing the message “Error: Not Numeric or Missing Value!” as

shown in Figure 5.13. To continue, the user should close this error message window and enter or correct the values for the thickness and/or the elastic modulus of that layer.

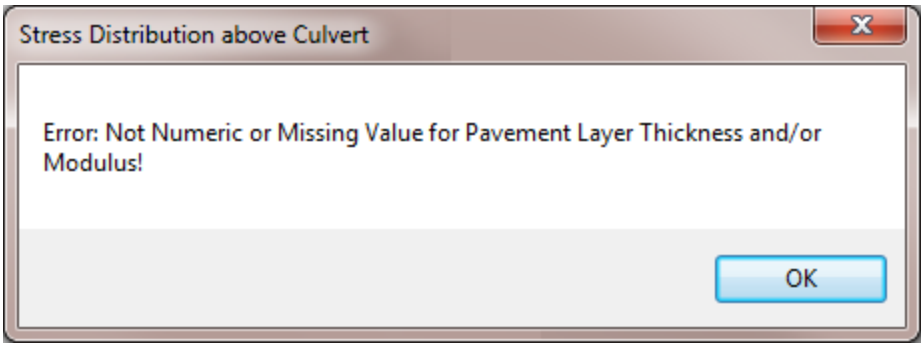

Figure 5.13: Error Message of the Entered Thickness and/or Elastic Modulus of Pavement Layer

5.8 New, Open, Save, and Print

The software includes the following items in the menu bar: New, Open, Save, and Print, as shown in Figure 5.14. By clicking the "New" item, all entered data will be cleared and the user can enter the information for a new project.

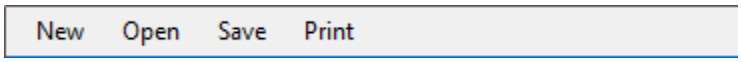

Figure 5.14: The Menu Bar of the Software

If the user would like to open an existing project file, click "Open" on the menu bar. A window will pop out and the user can select the file by clicking the paths to the directory where the file is stored.

To save the entered information and data for a project, click the "Save" item. All the entered information and data will be saved as a text file (*.txt). The user should enter a file name and chose a proper directory to store this file.

To print the input information, data, and the calculated results, click the "Print" item. A Print window will appear for selections. The entered information and data as well as the calculated results can be saved as a PDF file or sent to a printer. Time and date will be saved and printed automatically.

Chapter 6: Examples

6.1 Example 1

Figure 6.1 shows a rigid pavement section with one loaded lane for the Q721 project that is located above a concrete box culvert. The truck type T170 is designed to load the pavement. The concrete pavement has a thickness of 8 inches and an elastic modulus of 3,470,000 psi; the base course has a thickness of 5 inches and an elastic modulus of 694,000 psi; the lime-treated subgrade has a thickness of 6 inches and unknown elastic modulus; and the natural subgrade has a thickness of 26 inches and an elastic modulus of 2,082 psi. Determine the equivalent live load distribution factor and the distributed vertical stress on the structure. Save the input data and results as a PDF file.

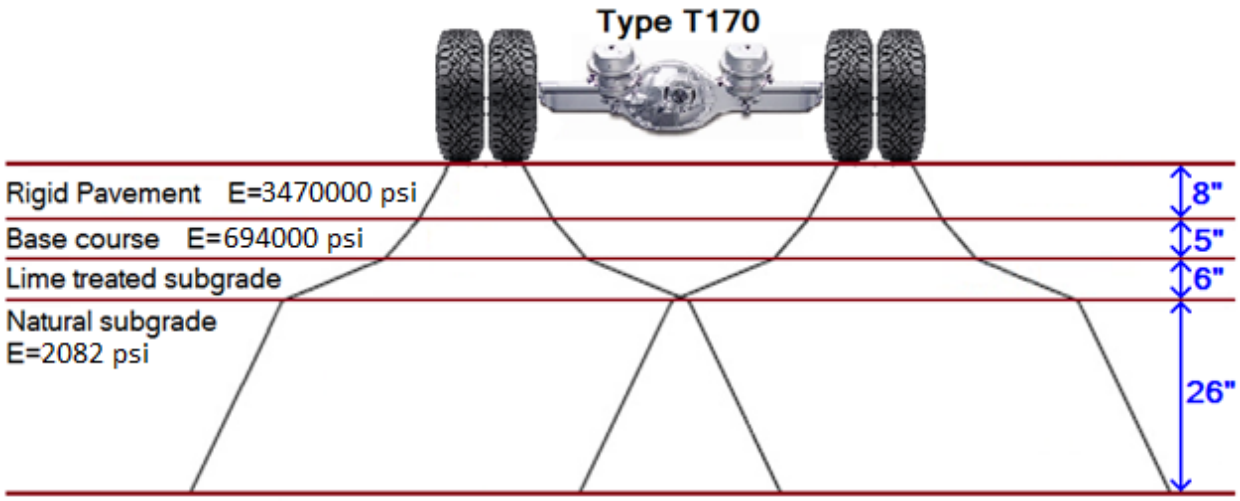

Figure 6.1: Pavement Layers

The name of the project is Q721. Because a concrete pavement is used, the rigid pavement is selected. The type of the vehicle is Type 170, which has two types of axles. Because the elastic modulus of the lime-treated subgrade is not available, the default value is used. After completing the input, click the “Calculate” button and then the calculated results will appear in the window as shown in Figure 6.2.

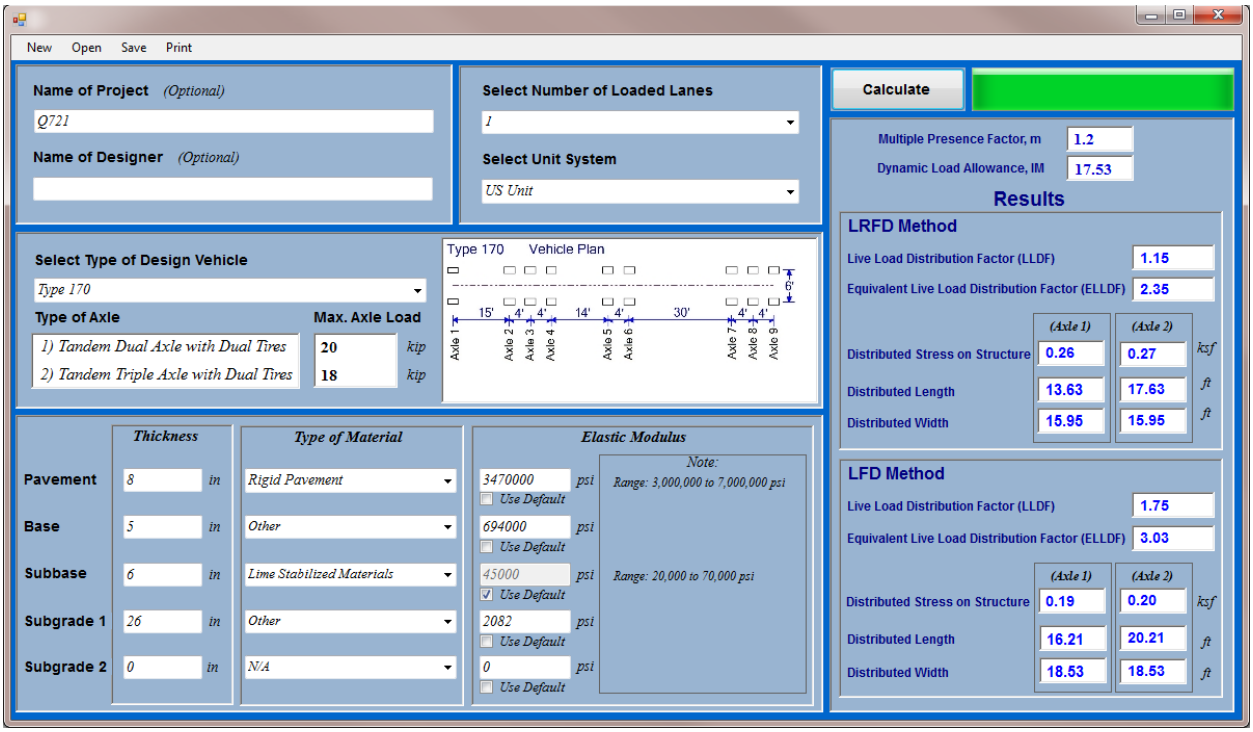

Figure 6.2: Software Window Displaying the Input and Output

By clicking the “Print” menu and selecting the printer as “Adobe PDF,” all the input and output are saved as a PDF file as shown in Figure 6.3.

01/13/2018 11:34:21

Name of Project : Q721
Designer :

Type of Pavement : Rigid Pavement Number of Lanes : 1
Type of Design Vehicle : Type 170
Type of Axle : 1) Tandem Dual Axle with Dual Tires
2) Tandem Triple Axle with Dual Tires

Desin Axle Load =	20	18	kip
Thickness of Pavement =	8		ft
Elastic Modulus of Pavement =	3470000		psi
Thickness of Bace =	5		ft
Elastic Modulus of Base =	694000		psi
Thickness of Subbase =	6		ft
Elastic Modulus of Subbase =	45000		psi
Thickness of Subgrade 1 =	26		ft
Elastic Modulus Subgrade 1 =	2082		psi
Thickness of Subgrade 2 =	0		ft
Elastic Modulus of Subgrade 2 =	0		psi

==========

Multiple Presence Factor, m =	1.2		
Dynamic Load Allowance, IM =	17.53		
LRFD Method:			
Live Load Distribution Factor (LLDF) =	1.15		
Equivalent Live Load Distribution Factor (ELLDF) =	2.35		
Distributed Stress on Structure =	0.26	0.27	ksf
Distributed Length =	13.63	17.63	ft
Distributed Width =	15.95	15.95	ft
LFD Method:			
Live Load Distribution Factor (LLDF) =	1.75		
Equivalent Live Load Distribution Factor (ELLDF) =	3.03		
Distributed Stress on Structure =	0.19	0.20	ksf
Distributed Length =	16.21	20.21	ft
Distributed Width =	18.53	18.53	ft

Figure 6.3: Input and Output in the PDF File

6.1.1 Hand Calculation

Distance between two tires of an axle = 6 ft

Distance between two axles = 4 ft

$$h = h_{pavement} + h_{base} + h_{l.t.subgrade} + h_{n.subgrade} = 8 + 5 + 6 + 26 = 45\ in = 3.75\ ft$$

(1) Calculation based on the LRFD method

For the pavement layer:

$$\tan\alpha_{pavement} = \tan 30\left[1 + 0.204\left(\frac{E_{pavement}}{E_{base}} - 1\right)\right] = 0.58 \times \left[1 + 0.204\left(\frac{3470000}{694000} - 1\right)\right] = 1.05$$

For the base course layer:

$$\tan\alpha_{base} = \tan 30\left[1 + 0.204\left(\frac{E_{base}}{E_{l.t.subgrade}} - 1\right)\right] = 0.58 \times \left[1 + 0.204\left(\frac{694000}{45000} - 1\right)\right] = 2.27$$

For the lime treated subgrade:

$$\tan\alpha_{l.t.subgrade} = \tan 30\left[1 + 0.204\left(\frac{E_{l.t.subgrade}}{E_{n.subgrade}} - 1\right)\right] = 0.58\left[1 + 0.204\left(\frac{45000}{2082} - 1\right)\right] = 3.00$$

For the natural subgrade:

$$\tan\alpha_{l.t.subgrade} = \tan 30 = 0.58$$

$$h\ \tan\alpha_{equivalent} = h_{pavement}\tan\alpha_{pavement} + h_{base}\tan\alpha_{base} + h_{l.t.subgrade}\tan\alpha_{l.t.subgrade} + h_{n.subgrade}\tan 30 = 4.40\ ft$$

Because h $\tan\alpha_{equivalent}$ is larger than half of the distance between two consecutive tires of the tandem ($\frac{4}{2}$), there will be bi-directional overlapping on the distributed load areas.

$$ELLDF = 2 \times \tan\alpha_{equivalent} = 2 \times \frac{h\tan\alpha_{equivalent}}{h} = 2 \times \frac{4.40}{3.75} = 2.35$$

For a tandem dual axle with dual tires:

Length of the wheel contact area = 0.83 ft

Width of the wheel contact area = 1.16 ft

$$Distributed\ length\ above\ the\ culvert = 2 \times 4.40 + 0.83 + 4 = 13.62\ ft$$

$$Distributed\ width\ above\ the\ culvert = 2 \times 4.40 + 1.16 + 6 = 15.96\ ft$$

$$P_l = \frac{2P\left(1+\frac{IM}{100}\right)m}{Distributed\ Area} = \frac{2\times20\left(1+\frac{17.53}{100}\right)1.2}{13.62\times15.96} = 0.26\ ksf$$

Where: P = the live axle load = 20 kips (two axles for this distributed area)

IM = the dynamic load allowance

$IM = 33(1.0 - 0.125 \times h) = 33(1 - 0.125 \times 3.75) = 17.53$

m = multiple presence factor for one loaded lane = 1.2.

For the tandem triple axle with dual tires:

Length of the wheel contact area = 0.83 ft

Width of the wheel contact area = 1.16 ft

$$Distributed\ length\ above\ the\ culvert = 2 \times 4.40 + 0.83 + 2\ \times 4 = 17.62\ ft$$

$$Distributed\ width\ above\ the\ culvert = 2 \times 4.40 + 1.16 + 6 = 15.96\ ft$$

$$P_l = \frac{3P\left(1+\frac{IM}{100}\right)m}{Distributed\ Area} = \frac{3\times18\times\left(1+\frac{17.53}{100}\right)\times1.2}{17.62\times15.96} = 0.27\ ksf$$

Where: P = the live axle load = 18 kips (three axles for this distributed area).

(2) Calculation based on the LFD method

For the pavement layer:

$$\tan\alpha_{pavement} = \tan 41\left[1 + 0.204\left(\frac{E_{pavement}}{E_{base}} - 1\right)\right] = 0.87 \times \left[1 + 0.204\left(\frac{3470000}{694000} - 1\right)\right] = 1.58$$

For the base course layer:

$$\tan\alpha_{base} = \tan 41\left[1 + 0.204\left(\frac{E_{base}}{E_{l.t.subgrade}} - 1\right)\right] = 0.87 \times \left[1 + 0.204\left(\frac{694000}{45000} - 1\right)\right] = 3.43 > 3.0$$

Since $\tan\alpha_{base}$ is greater 3.0, 3.0 should be used.

For the lime treated subgrade:

$$\tan\alpha_{l.t.subgrade} = \tan 41\left[1 + 0.204\,(\frac{E_{l.t.subgrade}}{E_{n.subgrade}} - 1)\right] = 0.87\,\left[1 + 0.204\,(\frac{45000}{2082} - 1)\right] = 4.52 > 3$$

Since $\tan\alpha_{l.t.subgrade}$ is greater 3.0, 3.0 should be used.

For the natural subgrade:

$$\tan\alpha_{l.t.subgrade} = \tan 41 = 0.87$$

$$h\ \tan\alpha_{equivalent} = h_{pavement}\tan\alpha_{pavement} + h_{base}\tan\alpha_{base} + h_{l.t.subgrade}\tan\alpha_{l.t.subgrade} + h_{n.subgrade}\tan 41 = 5.68\,ft$$

$$ELLDF = 2 \times \tan\alpha_{equivalent} = 2 \times \frac{h\tan\alpha_{equivalent}}{h} = 2 \times \frac{5.68}{3.75} = 3.03$$

For tandem dual axle with dual tires:

$$Distributed\ length\ above\ the\ culvert = 2 \times 5.68 + 0.83 + 4 = 16.20\,ft$$

$$Distributed\ width\ above\ the\ culvert = 2 \times 5.68 + 1.16 + 6 = 18.53\,ft$$

$$P_l = \frac{2P\left(1+\frac{IM}{100}\right)m}{Distributed\ Area} = \frac{2\times 20\left(1+\frac{17.53}{100}\right)\times 1.2}{16.20\times 18.53} = 0.19\,ksf$$

For tandem triple axle with dual tires:

$$Distributed\ length\ above\ the\ culvert = 2 \times 5.68 + 0.83 + 2\ \times 4 = 20.20\,ft$$

$$Distributed\ width\ above\ the\ culvert = 2 \times 5.68 + 1.16 + 6 = 18.53\,ft$$

$$P_l = \frac{3P\left(1+\frac{IM}{100}\right)m}{Distributed\ Area} = \frac{3\times 18\left(1+\frac{17.53}{100}\right)\times 1.2}{20.20\times 18.53} = 0.20\,ksf$$

6.2 Example 2

Figure 6.4 shows a pavement with one loaded lanes section for the R32-21 project that is located above a concrete box culvert. The design truck used to load the pavement is Type HL-93. The concrete pavement has a thickness of 6 inches and an elastic modulus of 3,650,000 psi; the cement-treated granular base has a thickness of 10 inches with an elastic modulus of E=1,510,000 psi; and the bituminous stabilized mixture has a thickness of 10 inches. The designer is Mr. John Smith. Determine the equivalent live load distribution factor and the distributed vertical stress on the box culvert. Save the input data and calculated results as a PDF file.

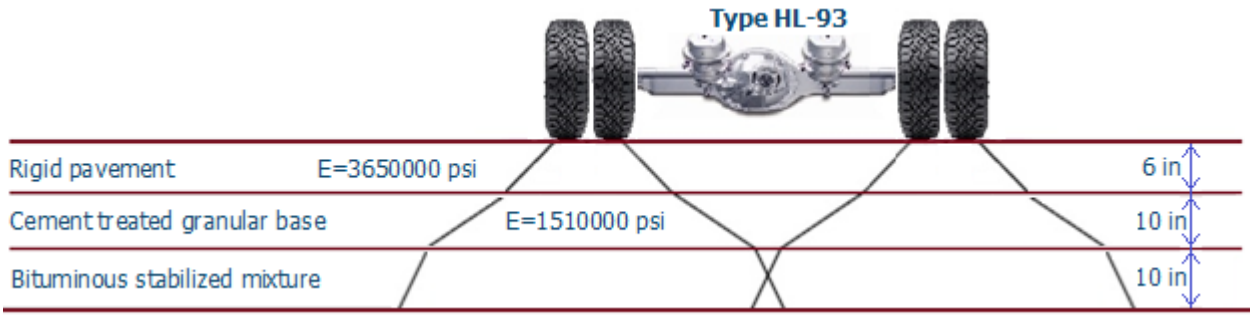

Figure 6.4: Pavement Layers

Solution:

The names of the project and the designer are R32-21 and John Smith, respectively. Because a concrete pavement is used, the rigid pavement is selected. The unit system for this project is the US unit. The vehicle type is Type HL-93, which has one type of axle. This pavement has three layers. Therefore, the thicknesses and elastic moduli of two layers are set to zero. Since the elastic modulus of the bituminous stabilized mixture is not available, the default value for this layer is used. After completing the input, click the “Calculate” button, and then the calculated results will appear in the window as shown in Figure 6.5.

By clicking on the “Print” menu and selecting the printer as “Adobe PDF,” the entered data and the calculated results are saved as a PDF file as shown in Figure 6.6.

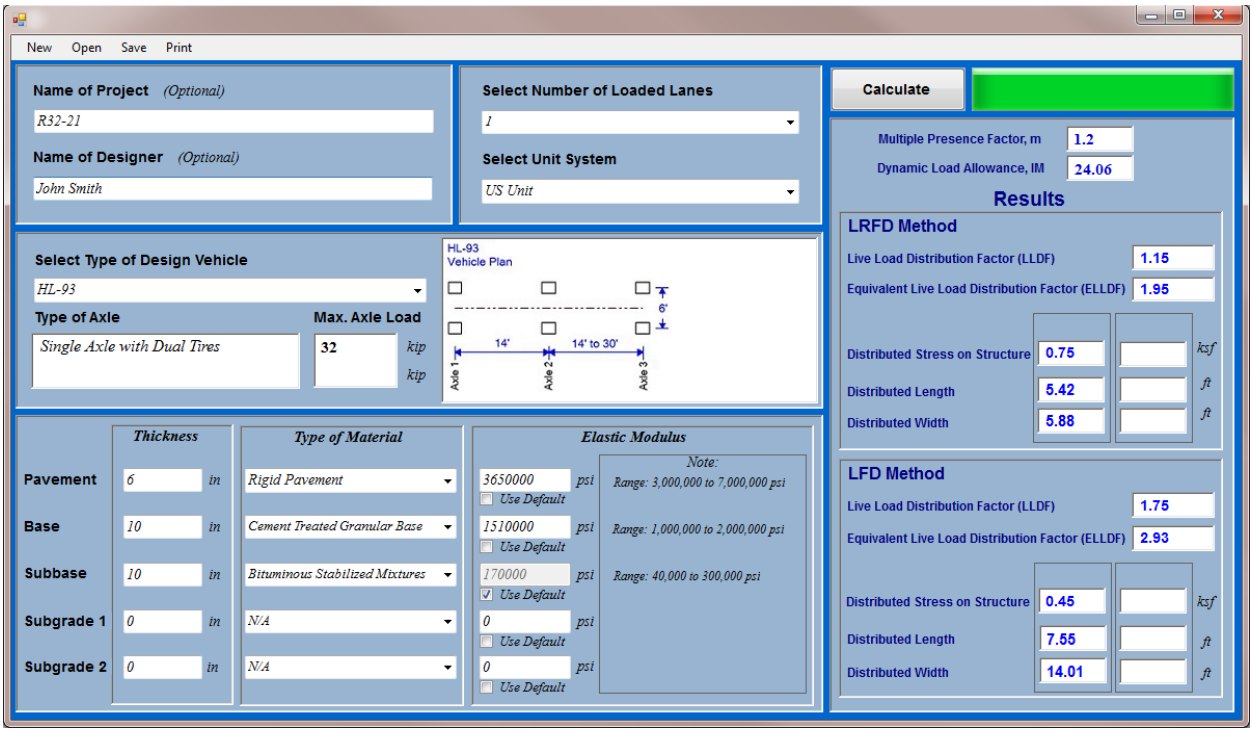

Figure 6.5: Software Window for the Input and Output

01/13/2018 01:32:38

Name of Project :	R32-21		
Designer :	John Smith		
Type of Pavement :	Rigid Pavement	Number of Lanes :	1
Type of Design Vehicle :	HL-93		
Type of Axle :	Single Axle with Dual Tires		

Desin Axle Load =	32	kip
Thickness of Pavement =	6	ft
Elastic Modulus of Pavement =	3650000	psi
Thickness of Bace =	10	ft
Elastic Modulus of Base =	1510000	psi
Thickness of Subbase =	10	ft
Elastic Modulus of Subbase =	170000	psi
Thickness of Subgrade 1 =	0	ft
Elastic Modulus Subgrade 1 =	0	psi
Thickness of Subgrade 2 =	0	ft
Elastic Modulus of Subgrade 2 =	0	psi

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Multiple Presence Factor, m =	1.2	
Dynamic Load Allowance, IM =	24.06	
LRFD Method:		
Live Load Distribution Factor (LLDF) =	1.15	
Equivalent Live Load Distribution Factor (ELLDF) =	1.95	
Distributed Stress on Structure =	0.75	ksf
Distributed Length =	5.42	ft
Distributed Width =	5.88	ft
LFD Method:		
Live Load Distribution Factor (LLDF) =	1.75	
Equivalent Live Load Distribution Factor (ELLDF) =	2.93	
Distributed Stress on Structure =	0.45	ksf
Distributed Length =	7.55	ft
Distributed Width =	14.01	ft

Figure 6.6: Input and Output in the PDF File

6.2.1 Hand Calculation

Distance between two tires of an axle = 6 ft

$$h = h_{pavement} + h_{base} + h_{subbase} = 6 + 10 + 10 = 26\ in = 2.17\ ft$$

(1) Calculation based on the LRFD method

For the pavement layer:

$$\tan\alpha_{pavement} = \tan 30\ \left[1 + 0.204\ (\frac{E_{pavement}}{E_{base}} - 1)\right] = 0.58\ \times \left[1 + 0.204\ (\frac{3650000}{1510000} - 1)\right] = 0.74$$

For the base:

$$\tan\alpha_{base} = \tan 30 \left[1 + 0.204\ (\frac{E_{base}}{E_{subbase}} - 1)\right] = 0.58\ \times \left[1 + 0.204\ (\frac{1510000}{170000} - 1)\right] = 1.50$$

For the subbase:

$$\tan\alpha_{subbase} = \tan 30 = 0.58$$

$$h\ \tan\alpha_{equivalent} = h_{pavement} \tan\alpha_{pavement} + h_{base} \tan\alpha_{base} + h_{subbase} \tan\alpha_{subbase} = 2.11$$

Because h $\tan\alpha_{equivalent}$ is less than half of the distance between two tires of the axle ($\frac{6}{2}$), there will be no overlapping.

$$ELLDF = 2 \times \tan\alpha_{equivalent} = 2 \times \frac{h \tan\alpha_{equivalent}}{h} = 2 \times \frac{2.11}{2.17} = 1.95$$

For single axle with dual tires:

Length of the wheel contact area = 1.2 ft

Width of the wheel contact area = 1.66 ft

$$Distributed\ length\ above\ the\ culvert = 2 \times 2.11 + 1.2 = 5.41\ ft$$

$$Distributed\ width\ above\ the\ culvert = 2 \times 2.11 + 1.66 = 5.87\ ft$$

$$P_l = \frac{P\left(1+\frac{IM}{100}\right)m}{Distributed\ Area} = \frac{32\left(1+\frac{24.06}{100}\right)1.2}{5.41\times4.87} = 0.75\ ksf$$

Where: P = the live axle load = 32 kip

IM = dynamic load allowance

$IM = 33(1.0 - 0.125 \times h) = 33(1 - 0.125 \times 2.17) = 24.06$

m = multiple presence factor for one loaded lane = 1.2

(2) Calculation based on the LFD method

For the pavement layer:

$$\tan\alpha_{pavement} = \tan 41\ \left[1 + 0.204\ (\frac{E_{pavement}}{E_{base}} - 1)\right] = 0.87\ \times \left[1 + 0.204\ (\frac{3650000}{1510000} - 1)\right] = 1.11$$

For the base:

$$\tan\alpha_{base} = \tan 30 \left[1 + 0.204\ (\frac{E_{base}}{E_{subbase}} - 1)\right] = 0.58\ \times \left[1 + 0.204\ (\frac{1510000}{170000} - 1)\right] = 2.27$$

For the subbase:

$$\tan\alpha_{subbase} = \tan 41 = 0.87$$

$$h\ \tan\alpha_{equivalent} = h_{pavement} \tan\alpha_{pavement} + h_{base} \tan\alpha_{base} + h_{subbase} \tan\alpha_{subbase} = 3.17$$

Since h $\tan\alpha_{equivalent}$ is more than half of the distance between two consecutive tires of the tandem ($\frac{6}{2}$), there will be unilateral overlapping on the distributed load areas.

$$ELLDF = 2 \times \tan\alpha_{equivalent} = 2 \times \frac{h \tan\alpha_{equivalent}}{h} = 2 \times \frac{3.17}{2.17} = 2.93$$

$$Distributed\ length\ above\ the\ culvert = 2 \times 3.17 + 1.2 = 7.54\ ft$$

$$Distributed\ width\ above\ the\ culvert = 2 \times 3.17 + 1.66 + 6 = 14\ ft$$

$$P_l = \frac{P\left(1+\frac{IM}{100}\right)m}{Distributed\ Area} = \frac{32\times\left(1+\frac{24.06}{100}\right)\times1.2}{7.54\times14} = 0.45\ ksf$$

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Appendix: Program Source Code

```
Imports System
Imports System.IO
Imports System.Text
Public Class Form1
    Public Const pi As Decimal = 0.0017453292
    'set the dimension of the wheel
    Dim L As Decimal 'Length of the tire
    Dim L2 As Decimal 'Length of the tire
    Dim I As Decimal 'Length of the tire
    Dim W As Decimal 'Width of the primary tire
    Dim W2 As Decimal 'Width of the primary tire
    Dim V As Decimal 'Width of the secondary tire
    Dim s As Decimal 'Distance of two tires of an axle
    Dim B As Decimal 'Distance of two tires of a tandem
    Dim B2 As Decimal 'Distance of two tires of a tandem
    Dim F As Double 'primary axle load
    Dim D As Double 'primary axle load
    Dim T As Double 'primary axle load
    Dim A As Decimal 'a LRFD
    Dim A2 As Decimal 'a LFD
    'define the default elastic moduli
    Public Const Edrp As Integer = 520000 'default elastic modulus of rigid pavement (ksf
or kPa)
    Public Const Edfp As Integer = 38000 'default elastic modulus of flexible pavement
(ksf or kPa)
    Public Const Edsb As Integer = 200000 'default elastic modulus of subbase (ksf or
kPa)
    Public Const Edbc As Integer = 100000 'default elastic modulus of base course (ksf or
kPa)
    Public Const Edls As Integer = 6500 'default elastic modulus of lime-treated subgrade
(ksf or kPa)
    Public Const Edns As Integer = 270 'default elastic modulus of natural subgrade (ksf
or kPa)
    'define parameters
    Dim Ep As Double 'elastic modulus of pavement (ksf or kPa)
    Dim Es As Double 'elastic modulus of base (ksf or kPa)
    Dim Eb As Double 'elastic modulus of subbase course (ksf or kPa)
    Dim Els As Double 'elastic modulus of lime-treated subgrade (ksf or kPa)
    Dim Ens As Double 'elastic modulus of natural subgrade (ksf or kPa)
    Dim Ecc As Double 'elastic modulus of culvert concrete (ksf or kPa)
    Dim Hp As Double 'thickness of pavement (ft or m)
    Dim Hp1 As Double 'thickness of pavement (ft or m)
    Dim Hs As Double 'thickness of subbase (ft or m)
    Dim Hs1 As Double 'thickness of subbase (ft or m)
    Dim Hb As Double 'thickness of base course (ft or m)
    Dim Hb1 As Double 'thickness of base course (ft or m)
    Dim Hls As Double 'thickness of lime-treated subgrade (ft or m)
    Dim Hls1 As Double 'thickness of lime-treated subgrade (ft or m)
    Dim Hns As Double 'thickness of natural subgrade (ft or m)
    Dim Hns1 As Double 'thickness of natural subgrade (ft or m)
    Dim H As Double 'total thickness of soil cover (ft or m)
    Dim ar2 As Double 'distribution angle
    Dim ap As Double 'distribution angle of pavement (deg.)
    Dim asu As Double 'distribution angle of base (deg.)
    Dim ab As Double 'distribution angle of subbase course (deg.)
```

```
    Dim als As Double 'distribution angle of subgrade 1 (deg.)
    Dim ans As Double 'distribution angle of subgrade 2(deg.)
    Dim ap2 As Double 'distribution angle of pavement (deg.)  LFD
    Dim asu2 As Double 'distribution angle of base (deg.)   LFD
    Dim ab2 As Double 'distribution angle of subbase  (deg.)    LFD
    Dim als2 As Double 'distribution angle of subgrade 1 (deg.) LFD
    Dim ans2 As Double 'distribution angle of subgrade 2 (deg.) LFD
    Dim peq As Double
    Dim Lu As Double
    Dim Wu As Double
    Dim m As Double 'Multiple presence factors, m
    Dim IM As Double 'Dynamic Load Allowance, IM
    Dim ELLDF As Double



    'select truck type
    Private Sub ComboBox3_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox3.SelectedIndexChanged

        If ComboBox3.Text = ("US Unit") Then
            Label30.Text = "in"
            Label31.Text = "in"
            Label32.Text = "in"
            Label33.Text = "in"
            Label34.Text = "in"
            Label16.Text = "ft"
            Label41.Text = "ft"
            Label81.Text = "ft"
            Label80.Text = "ft"
            Label35.Text = "psi"
            Label36.Text = "psi"
            Label37.Text = "psi"
            Label38.Text = "psi"
            Label39.Text = "psi"
            Label40.Text = "kip"
            Label46.Text = "kip"
            Label42.Text = "ksf"
            Label79.Text = "ksf"
        End If
        If ComboBox3.Text = ("SI Unit") Then
            Label30.Text = "mm"
            Label31.Text = "mm"
            Label32.Text = "mm"
            Label33.Text = "mm"
            Label34.Text = "mm"
            Label16.Text = "m"
            Label41.Text = "m"
            Label35.Text = "MPa"
            Label36.Text = "MPa"
            Label37.Text = "MPa"
            Label38.Text = "MPa"
            Label39.Text = "MPa"
            Label40.Text = "kN"
            Label46.Text = "kN"
            Label42.Text = "kPa"
            Label79.Text = "kPa"
            Label81.Text = "m"
```

```
            Label80.Text = "m"

        End If


    End Sub
    Private Sub ComboBox2_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox2.SelectedIndexChanged

        If ComboBox2.Text = ("No Pavement") Then
            CheckBox1.Checked = False
            TextBox1.Text = "0"
            TextBox2.Text = "0"
            TextBox1.Enabled = False
            TextBox2.Enabled = False
            CheckBox1.Enabled = False
        Else
            TextBox1.Enabled = True
            TextBox2.Enabled = True
            CheckBox1.Enabled = True
        End If


        'Pavement

        If ComboBox3.Text = ("US Unit") Then

            If ComboBox2.Text = ("Rigid Pavement") Then
                Label83.Text = ("Range: 3,000,000 to 7,000,000 psi")
            ElseIf ComboBox2.Text = ("Flexible Pavement") Then
                Label83.Text = ("Range: 110,000 to 450,000 psi")
            ElseIf ComboBox2.Text = ("No Pavement") Then
                Label83.Text = ("")
            End If

        ElseIf ComboBox3.Text = ("SI Unit") Then

            If ComboBox2.Text = ("Rigid Pavement") Then
                Label83.Text = ("Range: 20,700 to 48,000 MPa") 'new
            ElseIf ComboBox2.Text = ("Flexible Pavement") Then
                Label83.Text = ("Range: 760 to 3,100 MPa")
            ElseIf ComboBox2.Text = ("No Pavement") Then
                Label83.Text = ("")
            End If

        End If
    End Sub



    Private Sub ComboBox5_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox5.SelectedIndexChanged
        'New



        'Base Elastic Modulus
```

```
        If ComboBox3.Text = ("US Unit") Then

            If ComboBox5.Text = ("Cement Treated Granular Base") Then
                Label25.Text = ("Range: 1,000,000 to 2,000,000 psi")
            ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
                Label25.Text = ("Range: 500,000 to 1,000,000 psi")
            ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
                Label25.Text = ("Range: 350,000 to 1,000,000 psi")
            ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
                Label25.Text = ("Range: 40,000 to 300,000 psi")
            ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
                Label25.Text = ("Range: 20,000 to 70,000 psi")
            ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
                Label25.Text = ("Range: 15,000 to 45,000 psi")
            ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
                Label25.Text = ("Range: 3,000 to 40,000 psi")
            ElseIf ComboBox5.Text = ("Other") Then
                Label25.Text = ("")
            ElseIf ComboBox5.Text = ("N/A") Then
                Label25.Text = ("")
            End If

        ElseIf ComboBox3.Text = ("SI Unit") Then


            If ComboBox5.Text = ("Cement Treated Granular Base") Then
                Label25.Text = ("Range: 6,900 to 13,800 MPa")
            ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
                Label25.Text = ("Range: 3,450 to 6,900 MPa")
            ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
                Label25.Text = ("Range: 2,400 to 6,900 MPa")
            ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
                Label25.Text = ("Range: 280 to  2,000 MPa")
            ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
                Label25.Text = ("Range: 140 to 480 MPa")
            ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
                Label25.Text = ("Range: 100 to 310 MPa")
            ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
                Label25.Text = ("Range: 20 to 280 MPa")
            ElseIf ComboBox5.Text = ("Other") Then
                Label25.Text = ("")
            ElseIf ComboBox5.Text = ("N/A") Then
                Label25.Text = ("")
            End If

        End If




    End Sub
    Private Sub ComboBox6_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox6.SelectedIndexChanged
```

```
        'New
        'subBase Elastic Modulus

        If ComboBox3.Text = ("US Unit") Then

            If ComboBox6.Text = ("Cement Treated Granular Base") Then
                Label51.Text = ("Range: 1,000,000 to 2,000,000 psi")
            ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
                Label51.Text = ("Range: 500,000 to 1,000,000 psi")
            ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
                Label51.Text = ("Range: 350,000 to 1,000,000 psi")
            ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
                Label51.Text = ("Range: 40,000 to 300,000 psi")
            ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
                Label51.Text = ("Range: 20,000 to 70,000 psi")
            ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
                Label51.Text = ("Range: 15,000 to 45,000 psi")
            ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
                Label51.Text = ("Range: 3,000 to 40,000 psi")
            ElseIf ComboBox6.Text = ("Other") Then
                Label51.Text = ("")
            ElseIf ComboBox6.Text = ("N/A") Then
                Label51.Text = ("")
            End If

        ElseIf ComboBox3.Text = ("SI Unit") Then


            If ComboBox6.Text = ("Cement Treated Granular Base") Then
                Label51.Text = ("Range: 6,900 to 13,800 MPa")
            ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
                Label51.Text = ("Range: 3,450 to 6,900 MPa")
            ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
                Label51.Text = ("Range: 2,400 to 6,900 MPa")
            ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
                Label51.Text = ("Range: 280 to  2,000 MPa")
            ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
                Label51.Text = ("Range: 140 to 480 MPa")
            ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
                Label51.Text = ("Range: 100 to 310 MPa")
            ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
                Label51.Text = ("Range: 20 to 280 MPa")
            ElseIf ComboBox6.Text = ("Other") Then
                Label51.Text = ("")
            ElseIf ComboBox6.Text = ("N/A") Then
                Label51.Text = ("")
            End If

        End If



    End Sub


    Private Sub ComboBox7_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox7.SelectedIndexChanged
```

```
    'New
    'Subgrade 1 Elastic Modulus


    If ComboBox3.Text = ("US Unit") Then

        If ComboBox7.Text = ("Cement Treated Granular Base") Then
            Label52.Text = ("Range: 1,000,000 to 2,000,000 psi")
        ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
            Label52.Text = ("Range: 500,000 to 1,000,000 psi")
        ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
            Label52.Text = ("Range: 350,000 to 1,000,000 psi")
        ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
            Label52.Text = ("Range: 40,000 to 300,000 psi")
        ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
            Label52.Text = ("Range: 20,000 to 70,000 psi")
        ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
            Label52.Text = ("Range: 15,000 to 45,000 psi")
        ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
            Label52.Text = ("Range: 3,000 to 40,000 psi")
        ElseIf ComboBox7.Text = ("Other") Then
            Label52.Text = ("")
        ElseIf ComboBox7.Text = ("N/A") Then
            Label52.Text = ("")
        End If

    ElseIf ComboBox3.Text = ("SI Unit") Then


        If ComboBox7.Text = ("Cement Treated Granular Base") Then
            Label52.Text = ("Range: 6,900 to 13,800 MPa")
        ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
            Label52.Text = ("Range: 3,450 to 6,900 MPa")
        ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
            Label52.Text = ("Range: 2,400 to 6,900 MPa")
        ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
            Label52.Text = ("Range: 280 to  2,000 MPa")
        ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
            Label52.Text = ("Range: 140 to 480 MPa")
        ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
            Label52.Text = ("Range: 100 to 310 MPa")
        ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
            Label52.Text = ("Range: 20 to 280 MPa")
        ElseIf ComboBox7.Text = ("Other") Then
            Label52.Text = ("")
        ElseIf ComboBox7.Text = ("N/A") Then
            Label52.Text = ("")
        End If

    End If



End Sub
```

```
    Private Sub ComboBox8_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox8.SelectedIndexChanged

        'New
        'Subgrade 2 Elastic Modulus


        If ComboBox3.Text = ("US Unit") Then

            If ComboBox8.Text = ("Cement Treated Granular Base") Then
                Label53.Text = ("Range: 1,000,000 to 2,000,000 psi")
            ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
                Label53.Text = ("Range: 500,000 to 1,000,000 psi")
            ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
                Label53.Text = ("Range: 350,000 to 1,000,000 psi")
            ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
                Label53.Text = ("Range: 40,000 to 300,000 psi")
            ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
                Label53.Text = ("Range: 20,000 to 70,000 psi")
            ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
                Label53.Text = ("Range: 15,000 to 45,000 psi")
            ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
                Label53.Text = ("Range: 3,000 to 40,000 psi")
            ElseIf ComboBox8.Text = ("Other") Then
                Label53.Text = ("")
            ElseIf ComboBox8.Text = ("N/A") Then
                Label53.Text = ("")
            End If

        ElseIf ComboBox3.Text = ("SI Unit") Then


            If ComboBox8.Text = ("Cement Treated Granular Base") Then
                Label53.Text = ("Range: 6,900 to 13,800 MPa")
            ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
                Label53.Text = ("Range: 3,450 to 6,900 MPa")
            ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
                Label53.Text = ("Range: 2,400 to 6,900 MPa")
            ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
                Label53.Text = ("Range: 280 to  2,000 MPa")
            ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
                Label53.Text = ("Range: 140 to 480 MPa")
            ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
                Label53.Text = ("Range: 100 to 310 MPa")
            ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
                Label53.Text = ("Range: 20 to 280 MPa")
            ElseIf ComboBox8.Text = ("Other") Then
                Label53.Text = ("")
            ElseIf ComboBox8.Text = ("N/A") Then
                Label53.Text = ("")
            End If

        End If


    End Sub
```

```
    Private Sub PictureBox4_Click(sender As Object, e As EventArgs) Handles
PictureBox4.Click
        PictureBox4.Image = My.Resources.NA
    End Sub




    Private Sub ComboBox1_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox1.SelectedIndexChanged



        'HL-93 & H 20-44 & HS 20-44 K
        If ComboBox1.Text = ("HL-93") Or ComboBox1.Text = ("H 20-44") Or ComboBox1.Text =
("HS 20-44 K") Then



            If ComboBox1.Text = ("HL-93") Then
                PictureBox4.Image = My.Resources.HL_93
            ElseIf ComboBox1.Text = ("H 20-44") Then
                PictureBox4.Image = My.Resources.H_20_44
            ElseIf ComboBox1.Text = ("HS 20-44 K") Then
                PictureBox4.Image = My.Resources.HS_20_44_K
            End If


            Label28.Text = ("")
            Label45.Text = ("")

            Label70.Text = ("")
            Label72.Text = ("")
            Label71.Text = ("")
            Label73.Text = ("")

            Label43.Text = ("Single Axle with Dual Tires")
            Label44.Text = ("")

            If ComboBox3.Text = ("US Unit") Then
                L = 1.2
                W = 1.66
                s = 6.0
                B = 0
                F = 32
                Label28.Text = "32"
                Label45.Text = ("")
            End If
            If ComboBox3.Text = ("SI Unit") Then
                L = 0.37
                W = 0.51
                s = 1.83
                B = 0
                F = 142.4
                Label28.Text = "142.4"
                Label45.Text = ("")
```

```
    End If

    'EV 2

ElseIf ComboBox1.Text = ("EV 2") Then



    If ComboBox1.Text = ("EV 2") Then
        PictureBox4.Image = My.Resources.EV_2
    End If


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Single Axle with Dual Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        L = 1.2
        W = 1.66
        s = 6.0
        B = 0
        F = 33.5
        Label28.Text = "33.5"
        Label45.Text = ("")
    End If
    If ComboBox3.Text = ("SI Unit") Then
        L = 0.37
        W = 0.51
        s = 1.83
        B = 0
        F = 149
        Label28.Text = "149"
        Label45.Text = ("")
    End If


    'Type 3

ElseIf ComboBox1.Text = ("Type 3") Then



    PictureBox4.Image = My.Resources.Type_3


    Label28.Text = ("")
    Label45.Text = ("")


    Label70.Text = ("")
```

```
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")


    Label43.Text = ("Tandem Dual Axle with Dual Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        L = 0.876
        W = 1.215
        s = 6.0
        B = 4.0
        F = 17
        Label28.Text = "17"
        Label45.Text = ("")
    End If
    If ComboBox3.Text = ("SI Unit") Then
        L = 0.267
        W = 0.37
        s = 1.83
        B = 1.22
        F = 75.7
        Label28.Text = "75.7"
        Label45.Text = ("")
    End If



    ' EV 3


ElseIf ComboBox1.Text = ("EV 3") Then



    PictureBox4.Image = My.Resources.EV_3


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Tandem Dual Axle with Dual Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        L = 0.876
        W = 1.215
        s = 6.0
        B = 4.0
        F = 31
        Label28.Text = "31"
        Label45.Text = ("")
```

```
    End If
    If ComboBox3.Text = ("SI Unit") Then
        L = 0.267
        W = 0.37
        s = 1.83
        B = 1.22
        F = 138
        Label28.Text = "138"
        Label45.Text = ("")
    End If


    'Type 3S2
ElseIf ComboBox1.Text = ("Type 3S2") Then


    PictureBox4.Image = My.Resources.Type_3S2


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Tandem Dual Axle with Dual Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        L = 0.836
        W = 1.16
        s = 6.0
        B = 4.0
        F = 15.5
        Label28.Text = "15.5"
        Label45.Text = ("")
    End If
    If ComboBox3.Text = ("SI Unit") Then
        L = 0.255
        W = 0.354
        s = 1.83
        B = 1.22
        F = 69
        Label28.Text = "69"
        Label45.Text = ("")
    End If



    'Type T130
ElseIf ComboBox1.Text = ("Type T130") Then


    PictureBox4.Image = My.Resources.Type_T130

    Label28.Text = ("")
```

```
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Tandem Dual Axle with Dual Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        L = 0.836
        W = 1.16
        s = 6.0
        B = 4.0
        F = 20
        Label28.Text = "20"
        Label45.Text = ("")
    ElseIf ComboBox3.Text = ("SI Unit") Then
        L = 0.255
        W = 0.354
        s = 1.83
        B = 1.22
        F = 89
        Label28.Text = "89"
        Label45.Text = ("")
    End If



    'Type 3-3
ElseIf ComboBox1.Text = ("Type 3-3") Then


    PictureBox4.Image = My.Resources.Type_3_3

    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("(Axle 1)")
    Label72.Text = ("(Axle 1)")
    Label71.Text = ("(Axle 2)")
    Label73.Text = ("(Axle 2)")

    Label43.Text = ("1) Single Axle with Dual Tires")
    Label44.Text = ("2) Tandem Dual Axle with Dual Tires")

    If ComboBox3.Text = ("US Unit") Then
        s = 6.0
        B = 4.0
        F = 16
        Label28.Text = "16"
        D = 14
        Label45.Text = "14"
        W = 1.17
        W2 = 1.1
        L = 0.85
        L2 = 0.79
```

```
    ElseIf ComboBox3.Text = ("SI Unit") Then
        s = 1.83
        B = 1.22
        F = 71.2
        Label28.Text = "71.2"
        D = 62.3
        Label45.Text = "62.3"
        W = 0.36
        W2 = 0.34
        L = 0.25
        L2 = 0.25
    End If




    'Type 170
ElseIf ComboBox1.Text = ("Type 170") Then


    PictureBox4.Image = My.Resources.Type_170


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("(Axle 1)")
    Label72.Text = ("(Axle 1)")
    Label71.Text = ("(Axle 2)")
    Label73.Text = ("(Axle 2)")

    Label43.Text = ("1) Tandem Dual Axle with Dual Tires")
    Label44.Text = ("2) Tandem Triple Axle with Dual Tires")


    If ComboBox3.Text = ("US Unit") Then
        L = 0.836
        W = 1.16
        s = 6.0
        B = 4.0
        F = 20
        Label28.Text = "20"
        D = 18
        Label45.Text = "18"
    ElseIf ComboBox3.Text = ("SI Unit") Then
        L = 0.255
        W = 0.354
        s = 1.83
        B = 1.22
        F = 89
        Label28.Text = "89"
        D = 80.1
        Label45.Text = "80.1"
    End If
```

```
    'Heavy Equipment Transport (HET)
ElseIf ComboBox1.Text = ("Heavy Equipment Transport (HET)") Then


    PictureBox4.Image = My.Resources.HET


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("(Axle 1)")
    Label72.Text = ("(Axle 1)")
    Label71.Text = ("(Axle 2)")
    Label73.Text = ("(Axle 2)")

    Label43.Text = ("1) Tandem Dual Axle with Dual Tires")
    Label44.Text = ("2) Penta Axle with Dual Tires")

    If ComboBox3.Text = ("US Unit") Then
        s = 6.0
        F = 21.35
        Label28.Text = "21.35"
        D = 25.39
        Label45.Text = "25.39"
    ElseIf ComboBox3.Text = ("SI Unit") Then
        s = 1.83
        F = 95
        Label28.Text = "95"
        D = 113
        Label45.Text = "113"
    End If




    'SHV SU4
ElseIf ComboBox1.Text = ("SHV SU4") Then


    PictureBox4.Image = My.Resources.SU4


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Triple Axle with Dual and Single Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        s = 6.0
        B = 4.0
        W = 0.88
```

```
        V = 0.42
        L = 0.63
        I = 0.3
        F = 17
        T = 8
        Label28.Text = "17"
        Label45.Text = ("")
    ElseIf ComboBox3.Text = ("SI Unit") Then
        s = 1.83
        B = 1.22
        W = 0.27
        V = 0.13
        L = 0.19
        I = 0.09
        F = 75.7
        T = 35.6
        Label28.Text = "75.7"
        Label45.Text = ("")
    End If




    'SHV SU5
ElseIf ComboBox1.Text = ("SHV SU5") Then


    PictureBox4.Image = My.Resources.SU5


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Quad Axle with Dual and Single Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        s = 6.0
        B = 4.0
        W = 0.88
        V = 0.42
        L = 0.63
        I = 0.3
        F = 17
        T = 8
        Label28.Text = "17"
        Label45.Text = ("")
    ElseIf ComboBox3.Text = ("SI Unit") Then
        s = 1.83
        B = 1.22
        W = 0.27
```

```
        V = 0.13
        L = 0.19
        I = 0.09
        F = 75.7
        T = 35.6
        Label28.Text = "75.7"
        Label45.Text = ("")
    End If


    'SHV SU6
ElseIf ComboBox1.Text = ("SHV SU6") Then


    PictureBox4.Image = My.Resources.SU6


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Penta Axle with Dual and Single Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        s = 6.0
        B = 4.0
        W = 0.88
        V = 0.42
        L = 0.63
        I = 0.3
        F = 17
        T = 8
        Label28.Text = "17"
        Label45.Text = ("")
    ElseIf ComboBox3.Text = ("SI Unit") Then
        s = 1.83
        B = 1.22
        W = 0.27
        V = 0.13
        L = 0.19
        I = 0.09
        F = 75.7
        T = 35.6
        Label28.Text = "75.7"
        Label45.Text = ("")
    End If


    'SHV SU7
ElseIf ComboBox1.Text = ("SHV SU7") Then


    PictureBox4.Image = My.Resources.SU7
```

```
    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Hexa Axle with Dual and Single Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        s = 6.0
        B = 4.0
        W = 0.88
        V = 0.42
        L = 0.63
        I = 0.3
        F = 17
        T = 8
        Label28.Text = "17"
        Label45.Text = ("")
    ElseIf ComboBox3.Text = ("SI Unit") Then
        s = 1.83
        B = 1.22
        W = 0.27
        V = 0.13
        L = 0.19
        I = 0.09
        F = 75.7
        T = 35.6
        Label28.Text = "75.7"
        Label45.Text = ("")
    End If


    'SHV Notional Rating Load (NRL)
ElseIf ComboBox1.Text = ("SHV Notional Rating Load (NRL)") Then


    PictureBox4.Image = My.Resources.NRL


    Label28.Text = ("")
    Label45.Text = ("")

    Label70.Text = ("")
    Label72.Text = ("")
    Label71.Text = ("")
    Label73.Text = ("")

    Label43.Text = ("Hepta Axle with Dual and Single Tires")
    Label44.Text = ("")

    If ComboBox3.Text = ("US Unit") Then
        s = 6.0
```

```
            B = 4.0
            W = 0.88
            V = 0.42
            L = 0.63
            I = 0.3
            F = 17
            T = 8
            Label28.Text = "17"
            Label45.Text = ("")
        ElseIf ComboBox3.Text = ("SI Unit") Then
            s = 1.83
            B = 1.22
            W = 0.27
            V = 0.13
            L = 0.19
            I = 0.09
            F = 75.7
            T = 35.6
            Label28.Text = "75.7"
            Label45.Text = ("")
        End If

    End If


End Sub



' Multiple Presence Factor, m, from Number of Loaded Lanes
Private Sub ComboBox4_SelectedIndexChanged(sender As Object, e As EventArgs) Handles
ComboBox4.SelectedIndexChanged

    If ComboBox4.Text = ("1") Then
        m = 1.2
        Label60.Text = "1.2"
    ElseIf ComboBox4.Text = ("2") Then
        m = 1
        Label60.Text = "1"
    ElseIf ComboBox4.Text = ("3") Then
        m = 0.85
        Label60.Text = "0.85"
    ElseIf ComboBox4.Text = (">3") Then
        m = 0.65
        Label60.Text = "0.65"
    End If

End Sub







'calculate
Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
```

```
        'define the elastic modulus of pavement

        If IsNumeric(TextBox1.Text) = False Or IsNumeric(TextBox2.Text) = False Or
IsNumeric(TextBox3.Text) = False Or IsNumeric(TextBox4.Text) = False Or
IsNumeric(TextBox5.Text) = False Or IsNumeric(TextBox6.Text) = False Or
IsNumeric(TextBox7.Text) = False Or IsNumeric(TextBox8.Text) = False Or
IsNumeric(TextBox9.Text) = False Or IsNumeric(TextBox10.Text) = False Then
            MsgBox("Error: Not Numeric or Missing Value for Pavement Layer Thickness
and/or Modulus!")
            Exit Sub
        ElseIf ComboBox2.Text = ("") Then

            MsgBox("Error: Select Type of the Pavement!")
            Exit Sub
            End If

            If ComboBox3.Text = ("") Then
                MsgBox("Error: Select the Unit System!")
                Exit Sub
            End If

            If ComboBox1.Text = ("") Then
                MsgBox("Error: Select Type of the Design Vehicle!")
                Exit Sub
            End If

            If CheckBox1.Checked = True Then  'new
                If ComboBox2.Text = ("Rigid Pavement") Then
                    If ComboBox3.Text = ("US Unit") Then
                    Ep = 5000000 'psi 'it was 520000 ksf   '520000 ksf *6.94 = 3608800
psi
                    'New 3000000-7000000psi  ave=5000000psi
                ElseIf ComboBox3.Text = ("SI Unit") Then
                    Ep = 34500 'New MPa was 24600000
                    'New 20700-48000Mpa   ave 34500 MPa
                    End If
            ElseIf ComboBox2.Text = ("Flexible Pavement") Then  'new
                If ComboBox3.Text = ("US Unit") Then
                    Ep = 280000 'psi 'it was 38000 ksf '38000 ksf *6.94 = 263720 psi
                    'new 110,000 to 450,000 psi ave 280000
                ElseIf ComboBox3.Text = ("SI Unit") Then
                    Ep = 1930 'New MPa was 18200000
                    'new 760-3100 Mpa
                End If
                End If
            ElseIf TextBox2.Text = "" Then
                Ep = 0
            Else
                Ep = TextBox2.Text
            End If

            If Ep < 0 Then
                MsgBox("Error: Correct the Elastic Modulus of Pavement!")
```

```
                Exit Sub
            End If

            If CheckBox1.Checked = True Then
                If ComboBox2.Text = ("Rigid Pavement") Then
                    If ComboBox3.Text = ("US Unit") Then
                    If TextBox2.Text <> "5000000" Then 'was 520000 'new new
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Pavement!")
                        Exit Sub
                    End If
                    End If
                    If ComboBox3.Text = ("SI Unit") Then
                        If Val(TextBox2.Text) = 0 Then
                            MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Pavement!")
                        End If
                    If TextBox2.Text <> "34500" Then 'was 24900000 'new new
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Pavement!")
                        Exit Sub
                    End If
                    End If
                ElseIf ComboBox2.Text = ("Flexible Pavement") Then
                    If ComboBox3.Text = ("US Unit") Then
                    If TextBox2.Text <> "280000" Then 'was 38000 new new
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Pavement!")
                        Exit Sub
                    End If
                    End If
                    If ComboBox3.Text = ("SI Unit") Then
                    If TextBox2.Text <> "1930" Then 'was 18200000 new new
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Pavement!")
                        Exit Sub
                    End If
                    End If
                End If
            End If

            'define the elastic modulus of base


        If CheckBox2.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then 'new
                If ComboBox5.Text = ("Cement Treated Granular Base") Then
                    Es = 1500000
                ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
                    Es = 750000
                ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
                    Es = 675000
                ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
                    Es = 170000
                ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
                    Es = 45000
                ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
                    Es = 30000
```

```
        ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
            Es = 21500
        ElseIf ComboBox5.Text = ("N/A") Then
            Es = 0
        End If
    End If
    If ComboBox3.Text = ("SI Unit") Then 'new
        If ComboBox5.Text = ("Cement Treated Granular Base") Then
            Es = 10350
        ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
            Es = 5175
        ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
            Es = 4650
        ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
            Es = 1140
        ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
            Es = 310
        ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
            Es = 205
        ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
            Es = 150
        ElseIf ComboBox5.Text = ("N/A") Then
            Es = 0
        End If
    End If
ElseIf CheckBox2.Checked = False Then
    If IsNumeric(TextBox4.Text) Then
        Es = TextBox4.Text
    ElseIf TextBox4.Text = "" Then
        Es = 0
    End If
End If


'old
'If CheckBox2.Checked = True Then
' If ComboBox3.Text = ("US Unit") Then
'   Es = 200000
'End If
' If ComboBox3.Text = ("SI Unit") Then
'     Es = 9600000
' End If
' End If
' If CheckBox2.Checked = False Then
'  If IsNumeric(TextBox4.Text) Then
'     Es = TextBox4.Text
'   ElseIf TextBox4.Text = "" Then
'      Es = 0
'    End If
'End If

If Es < 0 Then
    MsgBox("Error: Correct the Elastic Modulus of Base!")
    Exit Sub
End If

If CheckBox2.Checked = True Then
    If ComboBox3.Text = ("US Unit") Then
```

```
                If ComboBox5.Text = ("Cement Treated Granular Base") Then
                    If TextBox4.Text <> "1500000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
                    If TextBox4.Text <> "750000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
                    If TextBox4.Text <> "675000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
                    If TextBox4.Text <> "170000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
                    If TextBox4.Text <> "45000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
                    If TextBox4.Text <> "30000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
                    If TextBox4.Text <> "21500" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("N/A") Then
                    If TextBox4.Text <> "0" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                End If

        ElseIf ComboBox3.Text = ("SI Unit") Then

                If ComboBox5.Text = ("Cement Treated Granular Base") Then
                    If TextBox4.Text <> "10350" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
```

```
                ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
                    If TextBox4.Text <> "5175" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
                    If TextBox4.Text <> "4650" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
                    If TextBox4.Text <> "1140" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
                ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
                    If TextBox4.Text <> "310" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
            ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
                    If TextBox4.Text <> "205" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
            ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
                    If TextBox4.Text <> "150" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
            ElseIf ComboBox5.Text = ("N/A") Then
                    If TextBox4.Text <> "0" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Base!")
                        Exit Sub
                    End If
            End If


        End If
        End If

        'define the elastic modulus of subbase

        'New


        If CheckBox3.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then 'new
                If ComboBox6.Text = ("Cement Treated Granular Base") Then
                    Eb = 1500000
                ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
```

```
            Eb = 750000
        ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
            Eb = 675000
        ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
            Eb = 170000
        ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
            Eb = 45000
        ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
            Eb = 30000
        ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
            Eb = 21500
        ElseIf ComboBox6.Text = ("N/A") Then
            Eb = 0
        End If
    End If
    If ComboBox3.Text = ("SI Unit") Then 'new
        If ComboBox6.Text = ("Cement Treated Granular Base") Then
            Eb = 10350
        ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
            Eb = 5175
        ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
            Eb = 4650
        ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
            Eb = 1140
        ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
            Eb = 310
        ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
            Eb = 205
        ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
            Eb = 150
        ElseIf ComboBox6.Text = ("N/A") Then
            Eb = 0
        End If
    End If
ElseIf CheckBox3.Checked = False Then
    If IsNumeric(TextBox7.Text) Then
        Eb = TextBox7.Text
    ElseIf TextBox7.Text = "" Then
        Eb = 0
    End If
End If



'old

'  If CheckBox3.Checked = True Then
'   If ComboBox3.Text = ("US Unit") Then
'       Eb = 100000
'   End If
'   If ComboBox3.Text = ("SI Unit") Then
'      Eb = 4800000
'   End If
'  ElseIf TextBox7.Text = "" Then
'     Eb = 0
'  Else
'   Eb = TextBox7.Text
```

```
        'End If

        If Eb < 0 Then
            MsgBox("Error: Correct the Elastic Modulus of Subbase!")
            Exit Sub
        End If

        'new
        If CheckBox3.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then
                If ComboBox6.Text = ("Cement Treated Granular Base") Then
                    If TextBox7.Text <> "1500000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
                    If TextBox7.Text <> "750000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
                    If TextBox7.Text <> "675000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
                    If TextBox7.Text <> "170000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
                    If TextBox7.Text <> "45000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
                    If TextBox7.Text <> "30000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
                    If TextBox7.Text <> "21500" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("N/A") Then
                    If TextBox7.Text <> "0" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
```

```
                End If

            ElseIf ComboBox3.Text = ("SI Unit") Then

                If ComboBox6.Text = ("Cement Treated Granular Base") Then
                    If TextBox7.Text <> "10350" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
                    If TextBox7.Text <> "5175" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
                    If TextBox7.Text <> "4650" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
                    If TextBox7.Text <> "1140" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
                    If TextBox7.Text <> "310" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
                    If TextBox7.Text <> "205" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
                    If TextBox7.Text <> "150" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                ElseIf ComboBox6.Text = ("N/A") Then
                    If TextBox7.Text <> "0" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                        Exit Sub
                    End If
                End If


            End If
        End If
        'old
```

```
        ' If CheckBox3.Checked = True Then
        '  If ComboBox3.Text = ("US Unit") Then
        '    If TextBox7.Text <> "100000" Then
        '        MsgBox("Error: Check the Defult Box of the Elastic Modulus of Base
Course!")
        '        Exit Sub
        '     End If
        '  End If
        '  If ComboBox3.Text = ("SI Unit") Then
        '      If TextBox7.Text <> "4800000" Then
        '          MsgBox("Error: Check the Defult Box of the Elastic Modulus of Base
Course!")
        '          Exit Sub
        '       End If
        '    End If
        ' End If



        'define the elastic modulus of subgrade 1


        'New


        If CheckBox4.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then 'new
                If ComboBox7.Text = ("Cement Treated Granular Base") Then
                    Els = 1500000
                ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
                    Els = 750000
                ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
                    Els = 675000
                ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
                    Els = 170000
                ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
                    Els = 45000
                ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
                    Els = 30000
                ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
                    Els = 21500
                ElseIf ComboBox7.Text = ("N/A") Then
                    Els = 0
                End If
            End If
            If ComboBox3.Text = ("SI Unit") Then 'new
                If ComboBox7.Text = ("Cement Treated Granular Base") Then
                    Els = 10350
                ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
                    Els = 5175
                ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
                    Els = 4650
                ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
                    Els = 1140
                ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
                    Els = 310
```

```
            ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
                Els = 205
            ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
                Els = 150
            ElseIf ComboBox7.Text = ("N/A") Then
                Els = 0
            End If
        End If
    ElseIf CheckBox4.Checked = False Then
        If IsNumeric(TextBox8.Text) Then
            Els = TextBox8.Text
        ElseIf TextBox8.Text = "" Then
            Els = 0
        End If
    End If

    'old

    ' If CheckBox4.Checked = True Then
    ' If ComboBox3.Text = ("US Unit") Then
    '     Els = 6500
    '  End If
    '  If ComboBox3.Text = ("SI Unit") Then
    '      Els = 310000
    '   End If
    'ElseIf TextBox8.Text = "" Then
    '    Els = 0
    ' Else
    '     Els = TextBox8.Text
    ' End If

    If Els < 0 Then
        MsgBox("Error: Correct the Elastic Modulus of Subgrade 1!")
        Exit Sub
    End If

    'new


    If CheckBox4.Checked = True Then
        If ComboBox3.Text = ("US Unit") Then
            If ComboBox7.Text = ("Cement Treated Granular Base") Then
                If TextBox8.Text <> "1500000" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
                If TextBox8.Text <> "750000" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
                If TextBox8.Text <> "675000" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
```

```
                End If
            ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
                If TextBox8.Text <> "170000" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
                If TextBox8.Text <> "45000" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
                If TextBox8.Text <> "30000" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
                If TextBox8.Text <> "21500" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("N/A") Then
                If TextBox8.Text <> "0" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            End If

        ElseIf ComboBox3.Text = ("SI Unit") Then

            If ComboBox7.Text = ("Cement Treated Granular Base") Then
                If TextBox8.Text <> "10350" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
                If TextBox8.Text <> "5175" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
                If TextBox8.Text <> "4650" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
                If TextBox8.Text <> "1140" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
```

```
                End If
            ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
                If TextBox8.Text <> "310" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
                If TextBox8.Text <> "205" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
                If TextBox8.Text <> "150" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            ElseIf ComboBox7.Text = ("N/A") Then
                If TextBox8.Text <> "0" Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            End If


        End If
    End If

    'old
    ' If CheckBox4.Checked = True Then
    ' If ComboBox3.Text = ("US Unit") Then
    '  If TextBox8.Text <> "6500" Then
    '   MsgBox("Error: Check the Defult Box of the Elastic Modulus of Lime-Treated
Subgrade!")
    '   Exit Sub
    ' End If
    ' End If
    'If ComboBox3.Text = ("SI Unit") Then
    '   If TextBox8.Text <> "310000" Then
    '          MsgBox("Error: Check the Defult Box of the Elastic Modulus of Lime-
Treated Subgrade!")
    '           Exit Sub
    '        End If
    '    End If
    '   End If



    'define the elastic modulus of subgrade 2


    'new
```

```
If CheckBox5.Checked = True Then
    If ComboBox3.Text = ("US Unit") Then 'new
        If ComboBox8.Text = ("Cement Treated Granular Base") Then
            Ens = 1500000
        ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
            Ens = 750000
        ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
            Ens = 675000
        ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
            Ens = 170000
        ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
            Ens = 45000
        ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
            Ens = 30000
        ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
            Ens = 21500
        ElseIf ComboBox8.Text = ("N/A") Then
            Ens = 0
        End If
    End If
    If ComboBox3.Text = ("SI Unit") Then 'new
        If ComboBox8.Text = ("Cement Treated Granular Base") Then
            Ens = 10350
        ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
            Ens = 5175
        ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
            Ens = 4650
        ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
            Ens = 1140
        ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
            Ens = 310
        ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
            Ens = 205
        ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
            Ens = 150
        ElseIf ComboBox8.Text = ("N/A") Then
            Ens = 0
        End If
    End If
ElseIf CheckBox5.Checked = False Then
    If IsNumeric(TextBox10.Text) Then
        Ens = TextBox10.Text
    ElseIf TextBox10.Text = "" Then
        Ens = 0
    End If
End If



'old

'If CheckBox5.Checked = True Then
' If ComboBox3.Text = ("US Unit") Then
'    Ens = 270
' End If
' If ComboBox3.Text = ("SI Unit") Then
```

```
        '     Ens = 13000
        '  End If
        'ElseIf TextBox10.Text = "" Then
        '   Ens = 0
        ' Else
        '   Ens = TextBox10.Text
        'End If

        If Ens < 0 Then
            MsgBox("Error: Correct the Elastic Modulus of Subgrade 2!")
            Exit Sub
        End If
        'new

        If CheckBox5.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then
                If ComboBox8.Text = ("Cement Treated Granular Base") Then
                    If TextBox10.Text <> "1500000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
                    If TextBox10.Text <> "750000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
                    If TextBox10.Text <> "675000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
                    If TextBox10.Text <> "170000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
                    If TextBox10.Text <> "45000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
                    If TextBox10.Text <> "30000" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
                    If TextBox10.Text <> "21500" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
```

```
                ElseIf ComboBox8.Text = ("N/A") Then
                    If TextBox10.Text <> "0" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                End If

            ElseIf ComboBox3.Text = ("SI Unit") Then

                If ComboBox8.Text = ("Cement Treated Granular Base") Then
                    If TextBox10.Text <> "10350" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
                    If TextBox10.Text <> "5175" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
                    If TextBox10.Text <> "4650" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
                    If TextBox10.Text <> "1140" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
                    If TextBox10.Text <> "310" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
                    If TextBox10.Text <> "205" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
                    If TextBox10.Text <> "150" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
                ElseIf ComboBox8.Text = ("N/A") Then
                    If TextBox10.Text <> "0" Then
                        MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                        Exit Sub
                    End If
```

```
            End If


        End If
    End If


    'old
    ' If CheckBox5.Checked = True Then
    ' If ComboBox3.Text = ("US Unit") Then
    '   If TextBox10.Text <> "270" Then
    '       MsgBox("Error: Check the Defult Box of the Elastic Modulus of Natural
Subgrade!")
    '        Exit Sub
    '    End If
    ' End If
    '  If ComboBox3.Text = ("SI Unit") Then
    '     If TextBox10.Text <> "13000" Then
    '         MsgBox("Error: Check the Defult Box of the Elastic Modulus of Natural
Subgrade!")
    '          Exit Sub
    '     End If
    '  End If
    'End If


    'define the elastic modulus of Culvert concrete


    If ComboBox3.Text = ("US Unit") Then
        Ecc = 570000
    End If
    If ComboBox3.Text = ("SI Unit") Then
        Ecc = 27500000
    End If









    'load design

    If F < 0 Then
        MsgBox("Error: Check the Design Axle Load!")
        Exit Sub
    End If

    'define heigth of layers

    Hp1 = TextBox1.Text
    Hs1 = TextBox3.Text
    Hb1 = TextBox5.Text
    Hls1 = TextBox6.Text
    Hns1 = TextBox9.Text
```

```
        If ComboBox3.Text = ("US Unit") Then
            Hp = Hp1 / 12
            Hs = Hs1 / 12
            Hb = Hb1 / 12
            Hls = Hls1 / 12
            Hns = Hns1 / 12
        ElseIf ComboBox3.Text = ("SI Unit") Then
            Hp = Hp1 / 1000
            Hs = Hs1 / 1000
            Hb = Hb1 / 1000
            Hls = Hls1 / 1000
            Hns = Hns1 / 1000
        End If


        If Hp < 0 Then
            MsgBox("Error: Check the Thickness of Pavement!")
            Exit Sub
        ElseIf Hs < 0 Then
            MsgBox("Error: Check the Thickness of Base!")
            Exit Sub
        ElseIf Hb < 0 Then
            MsgBox("Error: Check the Thickness of Subbase!")
            Exit Sub
        ElseIf Hls < 0 Then
            MsgBox("Error: Check the Thickness of Subgrade 1!")
            Exit Sub
        ElseIf Hns < 0 Then
            MsgBox("Error: Check the Thickness of Subgrade 2!")
            Exit Sub
        End If

        H = (Hp + Hs + Hb + Hls + Hns)




        'Error: Define at least Thickness of One Layer...

        'Traditionally, the effect of fills less than 2.0 ft deep on live load has been
ignored.

        'If H = 0 Then
        'MsgBox("!")
        ' Exit Sub
        ' ElseIf ComboBox3.Text = ("US Unit") Then
        ' If H < 2 Then
        '    MsgBox("The Effect of Fills Less than 2.0 ft Deep Can be Ignored!")
        '    Exit Sub
        ' End If
        ' ElseIf ComboBox3.Text = ("SI Unit") Then
        ' If H < 0.6096 Then
        ' MsgBox("The Effect of Fills Less than 0.61 m Deep Can be Ignored!")
        '  Exit Sub
        'End If
        'End If
```

```
        ' comparing the elastic modulus of each layer
        ' checking N/A
        ' checking Other

        If Hp > 0 Then 'Pavement
            If Ep < Es Or Ep < Eb Or Ep < Els Or Ep < Ens Then
                MsgBox("Error: Check the Elastic Modulus of Each Layer!")
                Exit Sub
            End If
        End If


        If Hs > 0 Then 'base
            If Es < Eb Or Es < Els Or Es < Ens Then
                MsgBox("Error: Check the Elastic Modulus of Each Layer!")
                Exit Sub
            End If
            If ComboBox5.Text = ("N/A") Then
                MsgBox("Error: Check the Type of the Material of Base!")
                Exit Sub
            End If
            If ComboBox5.Text = ("Other") Then
                If CheckBox2.Checked = True Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of Base!")
                    Exit Sub
                End If
            End If
        End If


        If Hb > 0 Then 'subbase
            If Eb < Els Or Eb < Ens Then
                MsgBox("Error: Check the Elastic Modulus of Each Layer!")
                Exit Sub
            End If
            If ComboBox6.Text = ("N/A") Then
                MsgBox("Error: Check the Type of the Material of Subbase!")
                Exit Sub
            End If
            If ComboBox6.Text = ("Other") Then
                If CheckBox3.Checked = True Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subbase!")
                    Exit Sub
                End If
            End If
        End If

        If Hls > 0 Then 'subgrade 1
            If Els < Ens Then
                MsgBox("Error: Check the Elastic Modulus of Each Layer!")
                Exit Sub
            End If
            If ComboBox7.Text = ("N/A") Then
                MsgBox("Error: Check the Type of the Material of Subgrade 1!")
                Exit Sub
```

```
            End If
            If ComboBox7.Text = ("Other") Then
                If CheckBox4.Checked = True Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 1!")
                    Exit Sub
                End If
            End If
        End If

        If Hns > 0 Then 'subgrade 2
            If ComboBox8.Text = ("N/A") Then
                MsgBox("Error: Check the Type of the Material of Subgrade 2!")
                Exit Sub
            End If
            If ComboBox8.Text = ("Other") Then
                If CheckBox5.Checked = True Then
                    MsgBox("Error: Check the Defult Box of the Elastic Modulus of
Subgrade 2!")
                    Exit Sub
                End If
            End If
        End If


        'Dynamic Load Allowance, IM

        If ComboBox3.Text = ("US Unit") Then
            If H < 8 Then
                IM = 33 * (1 - 0.125 * H)
            Else
                IM = 0
            End If
        ElseIf ComboBox3.Text = ("SI Unit") Then
            If H < 2.4384 Then
                IM = 33 * (1.0 - 0.41 * H)
            Else
                IM = 0
            End If
        End If

        Label63.Text = Format(IM, "####0.00")

        ProgressBar1.Value = 5
        Const ar As Decimal = 0.5773 'tan 27 deg. it was 0.5095 but it was changed to 30
deg. for 0.5773            LRFD
        'Const ar1 As Decimal = 0.5773 'tan 30 deg.

        ar2 = 0.869             'LFD Method

        'determine distribution angle for the pavement layer      LRFD

        If Hp = 0 Then
            ap = 0
        End If

        If Hp <> 0 And Hs <> 0 Then
            ap = ar * (1 + 0.204 * (Ep / Es - 1))
```

```
ElseIf Hp <> 0 And Hs = 0 And Hb <> 0 Then
    ap = ar * (1 + 0.204 * (Ep / Eb - 1))
ElseIf Hp <> 0 And Hs = 0 And Hb = 0 And Hls <> 0 Then
    ap = ar * (1 + 0.204 * (Ep / Els - 1))
ElseIf Hp <> 0 And Hs = 0 And Hb = 0 And Hls = 0 And Hns <> 0 Then
    ap = ar * (1 + 0.204 * (Ep / Ens - 1))
ElseIf Hp <> 0 And Hs = 0 And Hb = 0 And Hls = 0 And Hns = 0 Then
    ap = 0.577 'new it was = ar
Else
    ap = 0
End If

If ap > 3 Then
    ap = 3
End If

ProgressBar1.Value = 15

'determine distribution angle for the pavement layer      LFD
'New
If Hp = 0 Then
    ap2 = 0
End If

If Hp <> 0 And Hs <> 0 Then
    ap2 = ar2 * (1 + 0.204 * (Ep / Es - 1))
ElseIf Hp <> 0 And Hs = 0 And Hb <> 0 Then
    ap2 = ar2 * (1 + 0.204 * (Ep / Eb - 1))
ElseIf Hp <> 0 And Hs = 0 And Hb = 0 And Hls <> 0 Then
    ap2 = ar2 * (1 + 0.204 * (Ep / Els - 1))
ElseIf Hp <> 0 And Hs = 0 And Hb = 0 And Hls = 0 And Hns <> 0 Then
    ap2 = ar2 * (1 + 0.204 * (Ep / Ens - 1))
ElseIf Hp <> 0 And Hs = 0 And Hb = 0 And Hls = 0 And Hns = 0 Then
    ap2 = 0.869 'new it was = ar2
Else
    ap2 = 0
End If

If ap2 > 3 Then
    ap2 = 3
End If




'determine distribution angle for the base layer                LRFD

If Hs <> 0 And Hb <> 0 Then
    asu = ar * (1 + 0.204 * (Es / Eb - 1))
ElseIf Hs <> 0 And Hb = 0 And Hls <> 0 Then
    asu = ar * (1 + 0.204 * (Es / Els - 1))
ElseIf Hs <> 0 And Hb = 0 And Hls = 0 And Hns <> 0 Then
    asu = ar * (1 + 0.204 * (Es / Ens - 1))
ElseIf Hs <> 0 And Hb = 0 And Hls = 0 And Hns = 0 Then
    asu = 0.577 'new
Else
    asu = 0
End If
```

```
If asu > 3 Then
    asu = 3
End If

ProgressBar1.Value = 25



'determine distribution angle for the base layer                LFD

If Hs <> 0 And Hb <> 0 Then
    asu2 = ar2 * (1 + 0.204 * (Es / Eb - 1))
ElseIf Hs <> 0 And Hb = 0 And Hls <> 0 Then
    asu2 = ar2 * (1 + 0.204 * (Es / Els - 1))
ElseIf Hs <> 0 And Hb = 0 And Hls = 0 And Hns <> 0 Then
    asu2 = ar2 * (1 + 0.204 * (Es / Ens - 1))
ElseIf Hs <> 0 And Hb = 0 And Hls = 0 And Hns = 0 Then
    asu2 = 0.869 'new
Else
    asu2 = 0
End If

If asu2 > 3 Then
    asu2 = 3
End If


'determine distribution angle for the subbase layer             LRFD

If Hb <> 0 And Hls <> 0 Then
    ab = ar * (1 + 0.204 * (Eb / Els - 1))
ElseIf Hb <> 0 And Hls = 0 And Hns <> 0 Then
    ab = ar * (1 + 0.204 * (Eb / Ens - 1))
ElseIf Hb <> 0 And Hls = 0 And Hns = 0 Then
    ab = 0.577 'new
Else
    ab = 0
End If

If ab > 3 Then
    ab = 3
End If


ProgressBar1.Value = 35


'determine distribution angle for the subbase layer             LFD

If Hb <> 0 And Hls <> 0 Then
    ab2 = ar2 * (1 + 0.204 * (Eb / Els - 1))
ElseIf Hb <> 0 And Hls = 0 And Hns <> 0 Then
    ab2 = ar2 * (1 + 0.204 * (Eb / Ens - 1))
ElseIf Hb <> 0 And Hls = 0 And Hns = 0 Then
    ab2 = 0.869 'new
Else
    ab2 = 0
```

```
End If

If ab2 > 3 Then
    ab2 = 3
End If


'determine distribution angle for the subgrade1 layer           LRFD
If Hls <> 0 And Hns <> 0 Then
    als = ar * (1 + 0.204 * (Els / Ens - 1))
ElseIf Hls <> 0 And Hns = 0 Then
    als = 0.577 'new
Else
    als = 0
End If

If als > 3 Then
    als = 3
End If


'determine distribution angle for the subgrade1 layer           LFD
If Hls <> 0 And Hns <> 0 Then
    als2 = ar2 * (1 + 0.204 * (Els / Ens - 1))
ElseIf Hls <> 0 And Hns = 0 Then
    als2 = 0.869 'new
Else
    als2 = 0
End If

If als2 > 3 Then
    als2 = 3
End If


'determine distribution angle for the subgrade2 layer           LRFD
If Hns <> 0 Then
    ans = 0.577 'new
Else
    ans = 0
End If
ProgressBar1.Value = 55


'determine distribution angle for the subgrade2 layer           LFD
If Hns <> 0 Then
    ans2 = 0.869 'new
Else
    ans2 = 0
End If
ProgressBar1.Value = 55


'calculate the equivalent distribution angle        LRFD

A = (ap * Hp + asu * Hs + ab * Hb + als * Hls + ans * Hns)

Dim aeq As Double = A / H
```

```
        Dim agleq As Double = Math.Atan(aeq)
        'Label22.Text = Format(agleq * 57.35, "####0.00") 'return the equivalent
distribution angle

        'ELLDF
        Label22.Text = Format(2 * aeq, "####0.00") 'ELLDF
        ProgressBar1.Value = 70



        'calculate the equivalent distribution angle        LFD

        A2 = (ap2 * Hp + asu2 * Hs + ab2 * Hb + als2 * Hls + ans2 * Hns)

        Dim aeq2 As Double = A2 / H
        Dim agleq2 As Double = Math.Atan(aeq2)


        'ELLDF          LFD
        Label78.Text = Format(2 * aeq2, "####0.00") 'ELLDF
        ProgressBar1.Value = 70


'Calculation


        'Calculate the distributed pressure


        'Type HL-93 & H 20-44 & HS 20-44 K
        'New



        If ComboBox1.Text = ("HL-93") Or ComboBox1.Text = ("H 20-44") Or ComboBox1.Text =
("HS 20-44 K") Or ComboBox1.Text = ("EV 2") Then

            ' LRDF

            If aeq * H <= s / 2 Then
'No Overlap
                Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) * ((W
+ 2 * A))), "####0.00")

                Label6.Text = Format(L + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")


                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            Else
                Label23.Text = Format((F * (1 + IM / 100) * m) / ((s + W + 2 * A) * ((L +
2 * A))), "####0.00") 'overlap along width

                Label6.Text = Format(L + 2 * A, "####0.00")
```

```
                Label9.Text = Format(s + W + 2 * A, "####0.00")

                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width


            End If

            'LFD

            If aeq2 * H <= s / 2 Then
'No Overlap
                Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label65.Text = Format(L + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")


                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            Else
                Label64.Text = Format((F * (1 + IM / 100) * m) / ((s + W + 2 * A2) * ((L
+ 2 * A2))), "####0.00") 'overlap along width

                Label65.Text = Format(L + 2 * A2, "####0.00")
                Label66.Text = Format(s + W + 2 * A2, "####0.00")

                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width


            End If



        End If



        'Type 3 & Type 3S2 & Type T130
        'new

        If ComboBox1.Text = ("Type 3") Or ComboBox1.Text = ("Type 3S2") Or ComboBox1.Text
= ("Type T130") Or ComboBox1.Text = ("EV 3") Then


            'LRFD


            If aeq * H <= B / 2 Then    'Not any overlap
```

```
                Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) * ((W
+ 2 * A))), "####0.00")

                Label6.Text = Format(L + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")


                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label23.Text = Format((F * (1 + IM / 100) * m) / ((B + L + 2 * A) * ((W +
2 * A))), "####0.00")

                Label6.Text = Format(B + L + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")


                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            Else   'general overlap

                Label23.Text = Format((2 * F * (1 + IM / 100) * m) / ((2 * A + W + s) *
((L + 2 * A + B))), "####0.00") 'Stress overlap

                Label6.Text = Format(B + L + 2 * A, "####0.00")
                Label9.Text = Format(W + s + 2 * A, "####0.00")


                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            End If



            'LFD

            If aeq2 * H <= B / 2 Then    'Not any overlap

                Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label65.Text = Format(L + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")


                Label67.Text = ("")
```

```
                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label64.Text = Format((F * (1 + IM / 100) * m) / ((B + L + 2 * A2) * ((W
+ 2 * A2))), "####0.00")

                Label65.Text = Format(B + L + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")


                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            Else   'general overlap

                Label64.Text = Format((2 * F * (1 + IM / 100) * m) / ((2 * A2 + W + s) *
((L + 2 * A2 + B))), "####0.00") 'Stress overlap

                Label65.Text = Format(B + L + 2 * A2, "####0.00")
                Label66.Text = Format(W + s + 2 * A2, "####0.00")


                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            End If



        End If







        'Type 3-3
        If ComboBox1.Text = ("Type 3-3") Then


            'single axle with dual tires

            'LRDF

            ' If aeq * H <= s / 2 Then
            'Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
            ' Else
            ' Label23.Text = Format(F / (((L + 2 * A) - L + W + s) * ((L + 2 * A))),
"####0.00") 'Lateral Stress overlap
            'End If
```

```
            If aeq * H <= s / 2 Then
'No Overlap
                Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) * ((W
+ 2 * A))), "####0.00")

                Label6.Text = Format(L + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")
            Else
                Label23.Text = Format((F * (1 + IM / 100) * m) / ((s + W + 2 * A) * ((L +
2 * A))), "####0.00") 'overlap along width

                Label6.Text = Format(L + 2 * A, "####0.00")
                Label9.Text = Format(s + W + 2 * A, "####0.00")
            End If

            'LDF

            If aeq2 * H <= s / 2 Then
'No Overlap
                Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label65.Text = Format(L + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")
            Else
                Label64.Text = Format((F * (1 + IM / 100) * m) / ((s + W + 2 * A2) * ((L
+ 2 * A2))), "####0.00") 'overlap along width

                Label65.Text = Format(L + 2 * A2, "####0.00")
                Label66.Text = Format(s + W + 2 * A2, "####0.00")
            End If




            'Tandem Dual axle with dual tires

            'LRFD

            If aeq * H <= B / 2 Then    'Not any overlap

                Label47.Text = Format((0.5 * D * (1 + IM / 100) * m) / ((L2 + 2 * A) *
((W2 + 2 * A))), "####0.00")

                Label11.Text = Format(L2 + 2 * A, "####0.00")
                Label12.Text = Format(W2 + 2 * A, "####0.00")

            ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label47.Text = Format((D * (1 + IM / 100) * m) / ((B + L2 + 2 * A) * ((W2
+ 2 * A))), "####0.00")

                Label11.Text = Format(B + L2 + 2 * A, "####0.00")
                Label12.Text = Format(W2 + 2 * A, "####0.00")

            Else   'general overlap
```

```
                Label47.Text = Format((2 * D * (1 + IM / 100) * m) / ((2 * A + W2 + s) *
((L2 + 2 * A + B))), "####0.00") 'Stress overlap

                Label11.Text = Format(B + L2 + 2 * A, "####0.00")
                Label12.Text = Format(W2 + s + 2 * A, "####0.00")

            End If

            'LFD

            If aeq2 * H <= B / 2 Then    'Not any overlap

                Label67.Text = Format((0.5 * D * (1 + IM / 100) * m) / ((L2 + 2 * A2) *
((W2 + 2 * A2))), "####0.00")

                Label68.Text = Format(L2 + 2 * A2, "####0.00")
                Label69.Text = Format(W2 + 2 * A2, "####0.00")

            ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label67.Text = Format((D * (1 + IM / 100) * m) / ((B + L2 + 2 * A2) *
((W2 + 2 * A2))), "####0.00")

                Label68.Text = Format(B + L2 + 2 * A2, "####0.00")
                Label69.Text = Format(W2 + 2 * A2, "####0.00")

            Else   'general overlap

                Label67.Text = Format((2 * D * (1 + IM / 100) * m) / ((2 * A2 + W2 + s) *
((L2 + 2 * A2 + B))), "####0.00") 'Stress overlap

                Label68.Text = Format(B + L2 + 2 * A2, "####0.00")
                Label69.Text = Format(W2 + s + 2 * A2, "####0.00")

            End If


            ' If ComboBox2.Text = ("Rigid Pavement") Then
            '  If aeq * H <= s / 2 Then
            '   If aeq * H <= B / 2 Then
            '     Label47.Text = Format(0.5 * D / (((L + 2 * A) - L + W) * ((L + 2 *
A))), "####0.00")
            '  Else
            '      Label47.Text = Format(D / (((L + 2 * A) - L + W) * ((L + 2 * A + B))),
"####0.00") 'Stress overlap
            '  End If
            ' Else
            '   If aeq * H <= B / 2 Then
            '       Label47.Text = Format(D / (((L + 2 * A) - L + W + s) * ((L + 2 *
A))), "####0.00") 'Stress overlap
            '   Else
            '       Label47.Text = Format(2 * D / (((L + 2 * A) - L + W + s) * ((L + 2 *
A + B))), "####0.00") 'Stress overlap
            '     End If
            '     End If
            '  Else ' flexible
            '    If aeq * H <= s / 2 Then
            '     If aeq * H <= B / 2 Then
```

```
            '       Label47.Text = Format(0.5 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
            '    Else
            '        Label47.Text = Format(D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '     End If
            '    Else
            '       If aeq * H <= B / 2 Then
            '      Label47.Text = Format(D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '    Else
            '       Label47.Text = Format(2 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '   End If

            '   End If
            ' End If


        End If


        'Type 170
        If ComboBox1.Text = ("Type 170") Then


            'Tandem Dual axle with dual tires
            'New

            'LRFD

            If aeq * H <= B / 2 Then    'Not any overlap

                Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) * ((W
+ 2 * A))), "####0.00")

                Label6.Text = Format(L + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")

            ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label23.Text = Format((F * (1 + IM / 100) * m) / ((B + L + 2 * A) * ((W +
2 * A))), "####0.00")

                Label6.Text = Format(B + L + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")

            Else   'general overlap

                Label23.Text = Format((2 * F * (1 + IM / 100) * m) / ((2 * A + W + s) *
((L + 2 * A + B))), "####0.00") 'Stress overlap

                Label6.Text = Format(B + L + 2 * A, "####0.00")
                Label9.Text = Format(W + s + 2 * A, "####0.00")

            End If
```

```
            'LFD

            If aeq2 * H <= B / 2 Then    'Not any overlap

                Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label65.Text = Format(L + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")

            ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label64.Text = Format((F * (1 + IM / 100) * m) / ((B + L + 2 * A2) * ((W
+ 2 * A2))), "####0.00")

                Label65.Text = Format(B + L + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")

            Else   'general overlap

                Label64.Text = Format((2 * F * (1 + IM / 100) * m) / ((2 * A2 + W + s) *
((L + 2 * A2 + B))), "####0.00") 'Stress overlap

                Label65.Text = Format(B + L + 2 * A2, "####0.00")
                Label66.Text = Format(W + s + 2 * A2, "####0.00")

            End If


            'If ComboBox2.Text = ("Rigid Pavement") Then
            '  If aeq * H <= s / 2 Then
            '  If aeq * H <= B / 2 Then
            '      Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 *
A))), "####0.00")
            '  Else
            '     Label23.Text = Format(F / (((L + 2 * A) - L + W) * ((L + 2 * A + B))),
"####0.00") 'Stress overlap
            '  End If
            '  Else
            '  If aeq * H <= B / 2 Then
            '      Label23.Text = Format(F / (((L + 2 * A) - L + W + s) * ((L + 2 * A))),
"####0.00") 'Stress overlap
            '  Else
            '       Label23.Text = Format(2 * F / (((L + 2 * A) - L + W + s) * ((L + 2 *
A + B))), "####0.00") 'Stress overlap
            '  End If
            '  End If
            ' Else ' flexible
            '  If aeq * H <= s / 2 Then
            '  If aeq * H <= B / 2 Then
            '     Label23.Text = Format(0.5 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
            '  Else
            '     Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '  End If
            ' Else
            ' If aeq * H <= B / 2 Then
```

```
            '  Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)), "####0.00")
'Stress overlap
            '  Else
            '  Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            ' End If

            'End If
            'End If


            'Tandem Triple axle with dual tires

            'New

            'LRFD

            If aeq * H <= B / 2 Then    'Not any overlap

                Label47.Text = Format((0.5 * D * (1 + IM / 100) * m) / ((L + 2 * A) * ((W
+ 2 * A))), "####0.00")

                Label11.Text = Format(L + 2 * A, "####0.00") 'length
                Label12.Text = Format(W + 2 * A, "####0.00")    'width

            ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label47.Text = Format((1.5 * D * (1 + IM / 100) * m) / ((2 * B + L + 2 *
A) * ((W + 2 * A))), "####0.00")

                Label11.Text = Format(2 * B + L + 2 * A, "####0.00")
                Label12.Text = Format(W + 2 * A, "####0.00")

            Else   'general overlap

                Label47.Text = Format((3 * D * (1 + IM / 100) * m) / ((2 * A + W + s) *
((L + 2 * A + 2 * B))), "####0.00") 'Stress overlap

                Label11.Text = Format(2 * B + L + 2 * A, "####0.00")
                Label12.Text = Format(W + s + 2 * A, "####0.00")

            End If


            'LFD

            If aeq2 * H <= B / 2 Then    'Not any overlap

                Label67.Text = Format((0.5 * D * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label68.Text = Format(L + 2 * A2, "####0.00") 'length
                Label69.Text = Format(W + 2 * A2, "####0.00")    'width

            ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label67.Text = Format((1.5 * D * (1 + IM / 100) * m) / ((2 * B + L + 2 *
A2) * ((W + 2 * A2))), "####0.00")
```

```
                Label68.Text = Format(2 * B + L + 2 * A2, "####0.00")
                Label69.Text = Format(W + 2 * A2, "####0.00")

            Else   'general overlap

                Label67.Text = Format((3 * D * (1 + IM / 100) * m) / ((2 * A2 + W + s) *
((L + 2 * A2 + 2 * B))), "####0.00") 'Stress overlap

                Label68.Text = Format(2 * B + L + 2 * A2, "####0.00")
                Label69.Text = Format(W + s + 2 * A2, "####0.00")
            End If

            'If ComboBox2.Text = ("Rigid Pavement") Then
            '   If aeq * H <= s / 2 Then
            'If aeq * H <= B / 2 Then
            'Label47.Text = Format(0.5 * D / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
            ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '       Label47.Text = Format(D / (((L + 2 * A) - L + W) * ((L + 2 * A +
B))), "####0.00") 'Stress overlap
            '   Else
            '       Label47.Text = Format(1.5 * D / (((L + 2 * A) - L + W) * ((L + 2 * A
+ 2 * B))), "####0.00") 'More Stress overlap
            '   End If
            '  Else
            'If aeq * H <= B / 2 Then
            'Label47.Text = Format(D / (((L + 2 * A) - L + W + s) * ((L + 2 * A))),
"####0.00")
            '  ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '     Label47.Text = Format(2 * D / (((L + 2 * A) - L + W + s) * ((L + 2 * A
+ B))), "####0.00") 'Stress overlap
            '  Else
            '     Label47.Text = Format(3 * D / (((L + 2 * A) - L + W + s) * ((L + 2 * A
+ 2 * B))), "####0.00") 'More Stress overlap
            '  End If
            '   End If
            '     Else 'flexible
            'If aeq * H <= s / 2 Then
            'If aeq * H <= B / 2 Then
            'Label47.Text = Format(0.5 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
            '  ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '       Label47.Text = Format(D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '  Else
            '      Label47.Text = Format(1.5 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            '   End If
            '  Else
            'If aeq * H <= B / 2 Then
            'Label47.Text = Format(1 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
            '  ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '     Label47.Text = Format(2 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '  Else
```

```
            '      Label47.Text = Format(3 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            '   End If
            ' End If
            'End If



        End If


            'Heavy Equipment Transport (HET)

        If ComboBox1.Text = ("Heavy Equipment Transport (HET)") Then


            If ComboBox3.Text = ("US Unit") Then
                W = 1.41
                L = 1.02
                B = 5
                W2 = 1.16
                L2 = 0.84
                B2 = 5.95
            ElseIf ComboBox3.Text = ("SI Unit") Then
                W = 0.43
                L = 0.31
                B = 1.52
                W2 = 0.36
                L2 = 0.26
                B2 = 1.81
            End If

            'If ComboBox3.Text = ("US Unit") Then
            'W2 = 1.16
            ' L2 = 0.84
            ' B2 = 5.95
            ' ElseIf ComboBox3.Text = ("SI Unit") Then
            ' W2 = 0.36
            ' L2 = 0.26
            '  B2 = 1.81
            ' End If

            'Tandem Triple Axle with Dual Tires

            'LRDF

            If aeq * H <= B / 2 Then    'Not any overlap

                Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) * ((W
+ 2 * A))), "####0.00")

                Label6.Text = Format(L + 2 * A, "####0.00") 'length
                Label9.Text = Format(W + 2 * A, "####0.00")    'width

            ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label23.Text = Format((1.5 * F * (1 + IM / 100) * m) / ((2 * B + L + 2 *
A) * ((W + 2 * A))), "####0.00")
```

```
                Label6.Text = Format(2 * B + L + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")

            Else   'general overlap

                Label23.Text = Format((3 * F * (1 + IM / 100) * m) / ((2 * A + W + s) *
((L + 2 * A + 2 * B))), "####0.00") 'Stress overlap

                Label6.Text = Format(2 * B + L + 2 * A, "####0.00")
                Label9.Text = Format(W + s + 2 * A, "####0.00")

            End If

            'LDF

            If aeq2 * H <= B / 2 Then    'Not any overlap

                Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label65.Text = Format(L + 2 * A2, "####0.00") 'length
                Label66.Text = Format(W + 2 * A2, "####0.00")    'width

            ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label64.Text = Format((1.5 * F * (1 + IM / 100) * m) / ((2 * B + L + 2 *
A2) * ((W + 2 * A2))), "####0.00")

                Label65.Text = Format(2 * B + L + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")

            Else   'general overlap

                Label64.Text = Format((3 * F * (1 + IM / 100) * m) / ((2 * A2 + W + s) *
((L + 2 * A2 + 2 * B))), "####0.00") 'Stress overlap

                Label65.Text = Format(2 * B + L + 2 * A2, "####0.00")
                Label66.Text = Format(W + s + 2 * A2, "####0.00")

            End If


            '                If ComboBox2.Text = ("Rigid Pavement") Then
            'If ComboBox3.Text = ("US Unit") Then
            '                W = 1.41
            '                L = 1.02
            '                B = 5
            '            ElseIf ComboBox3.Text = ("SI Unit") Then
            '                W = 0.43
            '               L = 0.31
            '               B = 1.52
            '            End If
            'If aeq * H <= s / 2 Then
            'If aeq * H <= B / 2 Then
            'Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
            '            ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
```

```
            '                Label23.Text = Format(F / (((L + 2 * A) - L + W) * ((L + 2 *
A + B))), "####0.00") 'Stress overlap
            '            Else
            '                Label23.Text = Format(1.5 * F / (((L + 2 * A) - L + W) * ((L
+ 2 * A + 2 * B))), "####0.00") 'More Stress overlap
            '            End If
            '            Else
            'If aeq * H <= B / 2 Then
            'Label23.Text = Format(F / (((L + 2 * A) - L + W + s) * ((L + 2 * A))),
"####0.00")
            '            ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '               Label23.Text = Format(2 * F / (((L + 2 * A) - L + W + s) *
((L + 2 * A + B))), "####0.00") 'Stress overlap
            '            Else
            '               Label23.Text = Format(3 * F / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 2 * B))), "####0.00") 'More Stress overlap
            '           End If
            '       End If
            '           Else 'flexible
            'If ComboBox3.Text = ("US Unit") Then
            'W = 1.41
            '               L = 1.02
            '               B = 5
            '          ElseIf ComboBox3.Text = ("SI Unit") Then
            '              W = 0.43
            '             L = 0.31
            '             B = 1.52
            '         End If
            'If aeq * H <= s / 2 Then
            'If aeq * H <= B / 2 Then
            '             Label23.Text = Format(0.5 * F / ((L + 2 * A) * (L + 2 * A - L -
W)), "####0.00")
            'ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '              Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '          Else
            '             Label23.Text = Format(1.5 * F / ((L + 2 * A) * (L + 2 * A - L -
W)), "####0.00") 'More Stress overlap
            '         End If
            '         Else
            '         If aeq * H <= B / 2 Then
            '             Label23.Text = Format(1 * F / ((L + 2 * A) * (L + 2 * A - L -
W)), "####0.00")
            '        ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '            Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L -
W)), "####0.00") 'Stress overlap
            '        Else
            '            Label23.Text = Format(3 * F / ((L + 2 * A) * (L + 2 * A - L -
W)), "####0.00") 'More Stress overlap
            '        End If
            '    End If
            '                End If


            'Penta Axle with Dual Tires


            'LRDF
```

```
            If aeq * H <= B2 / 2 Then    'Not any overlap

                Label47.Text = Format((0.5 * D * (1 + IM / 100) * m) / ((L2 + 2 * A) *
((W2 + 2 * A))), "####0.00")

                Label11.Text = Format(L2 + 2 * A, "####0.00") 'length
                Label12.Text = Format(W2 + 2 * A, "####0.00")    'width

            ElseIf aeq * H > B2 / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label47.Text = Format((2.5 * D * (1 + IM / 100) * m) / ((4 * B2 + L2 + 2
* A) * ((W2 + 2 * A))), "####0.00")

                Label11.Text = Format(4 * B2 + L2 + 2 * A, "####0.00")
                Label12.Text = Format(W2 + 2 * A, "####0.00")

            Else   'general overlap

                Label47.Text = Format((5 * D * (1 + IM / 100) * m) / ((2 * A + W2 + s) *
((L2 + 2 * A + 4 * B2))), "####0.00") 'Stress overlap

                Label11.Text = Format(4 * B2 + L2 + 2 * A, "####0.00")
                Label12.Text = Format(W2 + s + 2 * A, "####0.00")

            End If

            'LFD

            If aeq2 * H <= B2 / 2 Then    'Not any overlap

                Label67.Text = Format((0.5 * D * (1 + IM / 100) * m) / ((L2 + 2 * A2) *
((W2 + 2 * A2))), "####0.00")

                Label68.Text = Format(L2 + 2 * A2, "####0.00") 'length
                Label69.Text = Format(W2 + 2 * A2, "####0.00")    'width

            ElseIf aeq2 * H > B2 / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label67.Text = Format((2.5 * D * (1 + IM / 100) * m) / ((4 * B2 + L2 + 2
* A2) * ((W2 + 2 * A2))), "####0.00")

                Label68.Text = Format(4 * B2 + L2 + 2 * A2, "####0.00")
                Label69.Text = Format(W2 + 2 * A2, "####0.00")

            Else   'general overlap

                Label67.Text = Format((5 * D * (1 + IM / 100) * m) / ((2 * A2 + W2 + s) *
((L2 + 2 * A2 + 4 * B2))), "####0.00") 'Stress overlap

                Label68.Text = Format(4 * B2 + L2 + 2 * A2, "####0.00")
                Label69.Text = Format(W2 + s + 2 * A2, "####0.00")

            End If



            'If ComboBox2.Text = ("Rigid Pavement") Then
```

```
            'If ComboBox3.Text = ("US Unit") Then
            'W = 1.16
            ' L = 0.84
            ' B = 5.95
            ' ElseIf ComboBox3.Text = ("SI Unit") Then
            ' W = 0.36
            ' L = 0.26
            '  B = 1.81
            ' End If
            'If aeq * H <= s / 2 Then
            'If aeq * H <= B / 2 Then
            'Label47.Text = Format(0.5 * D / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
            'ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            'Label47.Text = Format(1 * D / (((L + 2 * A) - L + W) * ((L + 2 * A + B))),
"####0.00") 'Stress overlap
            ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            'Label47.Text = Format(1.5 * D / (((L + 2 * A) - L + W) * ((L + 2 * A + 2 *
B))), "####0.00") 'More Stress overlap
            ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (3 * W / 2 + 2 * B) Then
            ' Label47.Text = Format(2 * D / (((L + 2 * A) - L + W) * ((L + 2 * A + 3 *
B))), "####0.00") 'More Stress overlap
            ' Else
            ' Label47.Text = Format(2.5 * D / (((L + 2 * A) - L + W) * ((L + 2 * A + 4 *
B))), "####0.00") 'More Stress overlap
            ' End If
            ' Else
            '    If aeq * H <= B / 2 Then
            'Label47.Text = Format(1 * D / (((L + 2 * A) - L + W + s) * ((L + 2 * A))),
"####0.00")
            '  ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            ' Label47.Text = Format(2 * D / (((L + 2 * A) - L + W + s) * ((L + 2 * A +
B))), "####0.00") 'Stress overlap
            ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            ' Label47.Text = Format(3 * D / (((L + 2 * A) - L + W + s) * ((L + 2 * A + 2
* B))), "####0.00") 'More Stress overlap
            ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (3 * W / 2 + 2 * B) Then
            'Label47.Text = Format(4 * D / (((L + 2 * A) - L + W + s) * ((L + 2 * A + 3 *
B))), "####0.00") 'More Stress overlap
            ' Else
            ' Label47.Text = Format(5 * D / (((L + 2 * A) - L + W + s) * ((L + 2 * A + 4
* B))), "####0.00") 'More Stress overlap
            ' End If
            'End If
            ' Else 'flexible
            '     If ComboBox3.Text = ("US Unit") Then
            '  W = 1.16
            'L = 0.84
            '  B = 5.95
            '  ElseIf ComboBox3.Text = ("SI Unit") Then
            '  W = 0.36
            ' L = 0.26
            ' B = 1.81
            ' End If
            'If aeq * H <= s / 2 Then
            'If aeq * H <= B / 2 Then
            'Label47.Text = Format(0.5 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
```

```
            ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            ' Label47.Text = Format(1 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            '  Label47.Text = Format(1.5 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            '  ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (3 * W / 2 + 2 * B) Then
            '  Label47.Text = Format(2 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            '  Else
            '  Label47.Text = Format(2.5 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            '    End If
            'Else
            '       If aeq * H <= B / 2 Then
            'Label47.Text = Format(1 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
            '   ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '   Label47.Text = Format(2 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '   ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            '  Label47.Text = Format(3 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            '  ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (3 * W / 2 + 2 * B) Then
            ' Label47.Text = Format(4 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            '  Else
            '  Label47.Text = Format(5 * D / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'More Stress overlap
            ' End If
            'End If
            'End If


        End If




            'SHV SU4
            If ComboBox1.Text = ("SHV SU4") Then


            'LRFD

                'New
                If aeq * H <= B / 2 Then    'Not any overlap

                    Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) *
((W + 2 * A))), "####0.00")

                    Label6.Text = Format(L + 2 * A, "####0.00") 'length
                    Label9.Text = Format(W + 2 * A, "####0.00")    'width

                    Label47.Text = ("")

                    Label11.Text = ("") 'length
```

```
                Label12.Text = ("")    'width

            ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label23.Text = Format(((0.5 * T + F) * (1 + IM / 100) * m) / ((2 * B
+ (L / 2) + (I / 2) + 2 * A) * ((W + 2 * A))), "####0.00")

                Label6.Text = Format(2 * B + (L / 2) + (I / 2) + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")



                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            Else   'general overlap

                Label23.Text = Format(((2 * F + T) * (1 + IM / 100) * m) / ((2 * A +
W + s) * ((2 * B + (L / 2) + (I / 2) + 2 * A))), "####0.00") 'Stress overlap

                Label6.Text = Format(2 * B + (L / 2) + (I / 2) + 2 * A, "####0.00")
                Label9.Text = Format(W + s + 2 * A, "####0.00")



                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            End If


        'LFD

        If aeq2 * H <= B / 2 Then    'Not any overlap

            Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

            Label65.Text = Format(L + 2 * A2, "####0.00") 'length
            Label66.Text = Format(W + 2 * A2, "####0.00")    'width

            Label67.Text = ("")

            Label68.Text = ("") 'length
            Label69.Text = ("")    'width

        ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

            Label64.Text = Format(((0.5 * T + F) * (1 + IM / 100) * m) / ((2 * B + (L
/ 2) + (I / 2) + 2 * A2) * ((W + 2 * A2))), "####0.00")

            Label65.Text = Format(2 * B + (L / 2) + (I / 2) + 2 * A2, "####0.00")
            Label66.Text = Format(W + 2 * A2, "####0.00")
```

```
                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            Else   'general overlap

                Label64.Text = Format(((2 * F + T) * (1 + IM / 100) * m) / ((2 * A2 + W +
s) * ((2 * B + (L / 2) + (I / 2) + 2 * A2))), "####0.00") 'Stress overlap

                Label65.Text = Format(2 * B + (L / 2) + (I / 2) + 2 * A2, "####0.00")
                Label66.Text = Format(W + s + 2 * A2, "####0.00")



                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            End If


                'old

                ' If ComboBox2.Text = ("Rigid Pavement") Then
                'If aeq * H <= s / 2 Then
                'If aeq * H <= B / 2 Then
                'Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
                'ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '  Label23.Text = Format(F / (((L + 2 * A) - L + W) * ((L + 2 * A + B))),
"####0.00") 'Stress overlap
                ' Else
                '  Label23.Text = Format((F + 0.5 * T) / (((L + 2 * A) - L + W) * ((L + 2
* A + 2 * B))), "####0.00") 'Stress overlap
                ' End If
                'Else
                '  If aeq * H <= B / 2 Then
                'Label23.Text = Format(1 * F / (((L + 2 * A) - L + W + s) * ((L + 2 *
A))), "####0.00")
                'ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '   Label23.Text = Format(2 * F / (((L + 2 * A) - L + W + s) * ((L + 2 *
A + B))), "####0.00") 'Stress overlap
                ' Else
                '    Label23.Text = Format((2 * F + T) / (((L + 2 * A) - L + W + s) * ((L
+ 2 * A + 2 * B))), "####0.00") 'Stress overlap
                '  End If
                'End If
                'Else 'flexible
                'If aeq * H <= s / 2 Then
                'If aeq * H <= B / 2 Then
                'Label23.Text = Format(0.5 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
```

```
                '  Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                ' Else
                '    Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (0.5
* T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'Stress overlap
                '  End If
                'Else
                ' If aeq * H <= B / 2 Then
                'Label23.Text = Format(1 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                ' Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                'Else
                '   Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'Stress overlap End If
                ' End If
                'End If
                'End If

            End If




            'SHV SU5
            If ComboBox1.Text = ("SHV SU5") Then

            'LRFD

                'New
                If aeq * H <= B / 2 Then    'Not any overlap

                    Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) *
((W + 2 * A))), "####0.00")

                    Label6.Text = Format(L + 2 * A, "####0.00") 'length
                    Label9.Text = Format(W + 2 * A, "####0.00")    'width


                    Label47.Text = ("")

                    Label11.Text = ("") 'length
                    Label12.Text = ("")    'width

                ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                    Label23.Text = Format(((T + F) * (1 + IM / 100) * m) / ((3 * B + I +
2 * A) * ((W + 2 * A))), "####0.00")

                    Label6.Text = Format(3 * B + I + 2 * A, "####0.00")
                    Label9.Text = Format(W + 2 * A, "####0.00")


                    Label47.Text = ("")

                    Label11.Text = ("") 'length
```

```
                Label12.Text = ("")    'width

            Else   'general overlap

                Label23.Text = Format(((2 * F + 2 * T) * (1 + IM / 100) * m) / ((2 *
A + W + s) * ((3 * B + I + 2 * A))), "####0.00") 'Stress overlap

                Label6.Text = Format(3 * B + I + 2 * A, "####0.00")
                Label9.Text = Format(W + s + 2 * A, "####0.00")

                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            End If

        'LFD

        If aeq2 * H <= B / 2 Then    'Not any overlap

            Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

            Label65.Text = Format(L + 2 * A2, "####0.00") 'length
            Label66.Text = Format(W + 2 * A2, "####0.00")    'width


            Label67.Text = ("")

            Label68.Text = ("") 'length
            Label69.Text = ("")    'width

        ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

            Label64.Text = Format(((T + F) * (1 + IM / 100) * m) / ((3 * B + I + 2 *
A2) * ((W + 2 * A2))), "####0.00")

            Label65.Text = Format(3 * B + I + 2 * A2, "####0.00")
            Label66.Text = Format(W + 2 * A2, "####0.00")


            Label67.Text = ("")

            Label68.Text = ("") 'length
            Label69.Text = ("")    'width

        Else   'general overlap

            Label64.Text = Format(((2 * F + 2 * T) * (1 + IM / 100) * m) / ((2 * A2 +
W + s) * ((3 * B + I + 2 * A2))), "####0.00") 'Stress overlap

            Label65.Text = Format(3 * B + I + 2 * A2, "####0.00")
            Label66.Text = Format(W + s + 2 * A2, "####0.00")

            Label67.Text = ("")

            Label68.Text = ("") 'length
```

```
                Label69.Text = ("")    'width

            End If




                'old

                'If ComboBox2.Text = ("Rigid Pavement") Then
                'If aeq * H <= s / 2 Then
                'If aeq * H <= B / 2 Then
                'Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '    Label23.Text = Format(F / (((L + 2 * A) - L + W) * ((L + 2 * A +
B))), "####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '     Label23.Text = Format((F + 0.5 * T) / (((L + 2 * A) - L + W) * ((L
+ 2 * A + 2 * B))), "####0.00") 'More Stress overlap
                ' Else
                '    Label23.Text = Format((F + T) / (((L + 2 * A) - L + W) * ((L + 2 * A
+ 3 * B))), "####0.00") 'More Stress overlap
                '  End If
                'Else
                '  If aeq * H <= B / 2 Then
                'Label23.Text = Format(1 * F / (((L + 2 * A) - L + W + s) * ((L + 2 *
A))), "####0.00")
                'ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '  Label23.Text = Format(2 * F / (((L + 2 * A) - L + W + s) * ((L + 2 * A
+ B))), "####0.00") 'Stress overlap
                'ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '   Label23.Text = Format((2 * F + T) / (((L + 2 * A) - L + W + s) * ((L
+ 2 * A + 2 * B))), "####0.00") 'More Stress overlap
                ' Else
                '    Label23.Text = Format((2 * F + 2 * T) / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 3 * B))), "####0.00") 'More Stress overlap
                'End If
                'End If
                'Else 'flexible
                'If aeq * H <= s / 2 Then
                'If aeq * H <= B / 2 Then
                'Label23.Text = Format(0.5 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '    Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '    Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (0.5
* T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' Else
                '     Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (T
/ ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' End If
                'Else
                ' If aeq * H <= B / 2 Then
```

```
                'Label23.Text = Format(1 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '  Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '   Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' Else
                '   Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(2 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                'End If
                'End If
                'End If


            End If


            'SHV SU6

            If ComboBox1.Text = ("SHV SU6") Then

            'LRFD

                'New
                If aeq * H <= B / 2 Then    'Not any overlap

                    Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) *
((W + 2 * A))), "####0.00")

                    Label6.Text = Format(L + 2 * A, "####0.00") 'length
                    Label9.Text = Format(W + 2 * A, "####0.00")    'width


                    Label47.Text = ("")

                    Label11.Text = ("") 'length
                    Label12.Text = ("")    'width

                ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                    Label23.Text = Format(((1.5 * T + F) * (1 + IM / 100) * m) / ((4 * B
+ I + 2 * A) * ((W + 2 * A))), "####0.00")

                    Label6.Text = Format(4 * B + I + 2 * A, "####0.00")
                    Label9.Text = Format(W + 2 * A, "####0.00")


                    Label47.Text = ("")

                    Label11.Text = ("") 'length
                    Label12.Text = ("")    'width

                Else   'general overlap

                    Label23.Text = Format(((2 * F + 3 * T) * (1 + IM / 100) * m) / ((2 *
A + W + s) * ((4 * B + I + 2 * A))), "####0.00") 'Stress overlap
```

```
                Label6.Text = Format(4 * B + I + 2 * A, "####0.00")
                Label9.Text = Format(W + s + 2 * A, "####0.00")

                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            End If

        'LFD

        If aeq2 * H <= B / 2 Then    'Not any overlap

            Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

            Label65.Text = Format(L + 2 * A2, "####0.00") 'length
            Label66.Text = Format(W + 2 * A2, "####0.00")    'width


            Label67.Text = ("")

            Label68.Text = ("") 'length
            Label69.Text = ("")    'width

        ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

            Label64.Text = Format(((1.5 * T + F) * (1 + IM / 100) * m) / ((4 * B + I
+ 2 * A2) * ((W + 2 * A2))), "####0.00")

            Label65.Text = Format(4 * B + I + 2 * A2, "####0.00")
            Label66.Text = Format(W + 2 * A2, "####0.00")


            Label67.Text = ("")

            Label68.Text = ("") 'length
            Label69.Text = ("")    'width

        Else   'general overlap

            Label64.Text = Format(((2 * F + 3 * T) * (1 + IM / 100) * m) / ((2 * A2 +
W + s) * ((4 * B + I + 2 * A2))), "####0.00") 'Stress overlap

            Label65.Text = Format(4 * B + I + 2 * A2, "####0.00")
            Label66.Text = Format(W + s + 2 * A2, "####0.00")

            Label67.Text = ("")

            Label68.Text = ("") 'length
            Label69.Text = ("")    'width

        End If


            'old
```

```
                ' If ComboBox2.Text = ("Rigid Pavement") Then
                'If aeq * H <= s / 2 Then
                'If aeq * H <= B / 2 Then
                'Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '  Label23.Text = Format(F / (((L + 2 * A) - L + W) * ((L + 2 * A + B))),
"####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '  Label23.Text = Format((F + 0.5 * T) / (((L + 2 * A) - L + W) * ((L + 2
* A + 2 * B))), "####0.00") 'More Stress overlap
                ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B)
Then
                '  Label23.Text = Format((F + T) / (((L + 2 * A) - L + W) * ((L + 2 * A +
3 * B))), "####0.00") 'More Stress overlap
                '  Else
                '  Label23.Text = Format((F + 1.5 * T) / (((L + 2 * A) - L + W) * ((L + 2
* A + 4 * B))), "####0.00") 'More Stress overlap
                '  End If
                'Else
                ' If aeq * H <= B / 2 Then
                'Label23.Text = Format(1 * F / (((L + 2 * A) - L + W + s) * ((L + 2 *
A))), "####0.00")
                'ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '  Label23.Text = Format(2 * F / (((L + 2 * A) - L + W + s) * ((L + 2 * A
+ B))), "####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                ' Label23.Text = Format((2 * F + T) / (((L + 2 * A) - L + W + s) * ((L +
2 * A + 2 * B))), "####0.00") 'More Stress overlap
                ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B)
Then
                ' Label23.Text = Format((2 * F + 2 * T) / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 3 * B))), "####0.00") 'More Stress overlap
                'Else
                ' Label23.Text = Format((2 * F + 3 * T) / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 4 * B))), "####0.00") 'More Stress overlap
                'End If
                'End If

                'Else 'flexible
                ' If aeq * H <= s / 2 Then
                'If aeq * H <= B / 2 Then
                'Label23.Text = Format(0.5 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '  Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                ' Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (0.5 *
T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                'ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B) Then
                '  Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (T /
((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' Else
                ' Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (1.5 *
T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' End If
```

```
                'Else
                '  If aeq * H <= B / 2 Then
                'Label23.Text = Format(1 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
                '  ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '   Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '   Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                'ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B) Then
                '   Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(2 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' Else
                '   Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(3 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' End If
                'End If
                ' End If
            End If




            'SHV SU7
            If ComboBox1.Text = ("SHV SU7") Then

            'LRDF

                'New
                If aeq * H <= B / 2 Then    'Not any overlap

                    Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) *
((W + 2 * A))), "####0.00")

                    Label6.Text = Format(L + 2 * A, "####0.00") 'length
                    Label9.Text = Format(W + 2 * A, "####0.00")    'width


                    Label47.Text = ("")

                    Label11.Text = ("") 'length
                    Label12.Text = ("")    'width

                ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                    Label23.Text = Format(((2 * T + F) * (1 + IM / 100) * m) / ((5 * B +
I + 2 * A) * ((W + 2 * A))), "####0.00")

                    Label6.Text = Format(5 * B + I + 2 * A, "####0.00")
                    Label9.Text = Format(W + 2 * A, "####0.00")


                    Label47.Text = ("")

                    Label11.Text = ("") 'length
                    Label12.Text = ("")    'width
```

```
                Else   'general overlap

                    Label23.Text = Format(((2 * F + 4 * T) * (1 + IM / 100) * m) / ((2 *
A + W + s) * ((5 * B + I + 2 * A))), "####0.00") 'Stress overlap

                    Label6.Text = Format(5 * B + I + 2 * A, "####0.00")
                    Label9.Text = Format(W + s + 2 * A, "####0.00")

                    Label47.Text = ("")

                    Label11.Text = ("") 'length
                    Label12.Text = ("")    'width

                End If


            'LDF


            If aeq2 * H <= B / 2 Then    'Not any overlap

                Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label65.Text = Format(L + 2 * A2, "####0.00") 'length
                Label66.Text = Format(W + 2 * A2, "####0.00")    'width


                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label64.Text = Format(((2 * T + F) * (1 + IM / 100) * m) / ((5 * B + I +
2 * A2) * ((W + 2 * A2))), "####0.00")

                Label65.Text = Format(5 * B + I + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")


                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            Else   'general overlap

                Label64.Text = Format(((2 * F + 4 * T) * (1 + IM / 100) * m) / ((2 * A2 +
W + s) * ((5 * B + I + 2 * A2))), "####0.00") 'Stress overlap

                Label65.Text = Format(5 * B + I + 2 * A2, "####0.00")
                Label66.Text = Format(W + s + 2 * A2, "####0.00")

                Label67.Text = ("")

                Label68.Text = ("") 'length
```

```
                Label69.Text = ("")    'width

            End If

                'old

                ' If ComboBox2.Text = ("Rigid Pavement") Then
                'If aeq * H <= s / 2 Then
                'If aeq * H <= B / 2 Then
                'Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
                'ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '  Label23.Text = Format(F / (((L + 2 * A) - L + W) * ((L + 2 * A + B))),
"####0.00") 'Stress overlap
                'ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                ' Label23.Text = Format((F + 0.5 * T) / (((L + 2 * A) - L + W) * ((L + 2
* A + 2 * B))), "####0.00") 'More Stress overlap
                ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B)
Then
                ' Label23.Text = Format((F + T) / (((L + 2 * A) - L + W) * ((L + 2 * A +
3 * B))), "####0.00") 'More Stress overlap
                'ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B / 2)
Then
                '  Label23.Text = Format((F + 1.5 * T) / (((L + 2 * A) - L + W) * ((L + 2
* A + 4 * B))), "####0.00") 'More Stress
                'Else
                '  Label23.Text = Format((F + 2 * T) / (((L + 2 * A) - L + W) * ((L + 2 *
A + 5 * B))), "####0.00") 'More Stress overlap
                ' End If
                ' Else
                '  If aeq * H <= B / 2 Then
                '   Label23.Text = Format(1 * F / (((L + 2 * A) - L + W + s) * ((L + 2 *
A))), "####0.00")
                '  ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '     Label23.Text = Format(2 * F / (((L + 2 * A) - L + W + s) * ((L + 2
* A + B))), "####0.00") 'Stress overlap
                '  ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '     Label23.Text = Format((2 * F + T) / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 2 * B))), "####0.00") 'More Stress overlap
                '  ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B)
Then
                '     Label23.Text = Format((2 * F + 2 * T) / (((L + 2 * A) - L + W + s)
* ((L + 2 * A + 3 * B))), "####0.00") 'More Stress overlap
                '  ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B /
2) Then
                '      Label23.Text = Format((2 * F + 3 * T) / (((L + 2 * A) - L + W + s)
* ((L + 2 * A + 4 * B))), "####0.00") 'More Stres
                '  Else
                '      Label23.Text = Format((2 * F + 4 * T) / (((L + 2 * A) - L + W + s)
* ((L + 2 * A + 5 * B))), "####0.00") 'More Stress overlap
                '   End If
                '  End If

                '  Else 'flexible
                ' If aeq * H <= s / 2 Then
                '   If aeq * H <= B / 2 Then
                '     Label23.Text = Format(0.5 * F / ((L + 2 * A) * (L + 2 * A - L -
W)), "####0.00")
```

```
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '   Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                ' ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '    Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (0.5
* T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B)
Then
                '     Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (T
/ ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                '  ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B /
2) Then
                '    Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (1.5
* T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overla
                ' Else
                '      Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (2
* T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                '   End If
                '  Else
                ' If aeq * H <= B / 2 Then
                '   Label23.Text = Format(1 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
                ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
                '     Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
                '  ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
                '    Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                '  ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B)
Then
                '     Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(2 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                '  ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B /
2) Then
                '     Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(3 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                ' Else
                '     Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(4 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
                '   End If
                ' End If
                'End If
            End If




        'SHV Notional Rating Load (NRL)


        If ComboBox1.Text = ("SHV Notional Rating Load (NRL)") Then


            'LRDF

            'New
            If aeq * H <= B / 2 Then    'Not any overlap
```

```
                Label23.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A) * ((W
+ 2 * A))), "####0.00")

                Label6.Text = Format(L + 2 * A, "####0.00") 'length
                Label9.Text = Format(W + 2 * A, "####0.00")    'width


                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            ElseIf aeq * H > B / 2 And aeq * H <= s / 2 Then 'overlap along length

                Label23.Text = Format(((2.5 * T + F) * (1 + IM / 100) * m) / ((6 * B + I
+ 2 * A) * ((W + 2 * A))), "####0.00")

                Label6.Text = Format(6 * B + I + 2 * A, "####0.00")
                Label9.Text = Format(W + 2 * A, "####0.00")


                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            Else   'general overlap

                Label23.Text = Format(((2 * F + 5 * T) * (1 + IM / 100) * m) / ((2 * A +
W + s) * ((6 * B + I + 2 * A))), "####0.00") 'Stress overlap

                Label6.Text = Format(6 * B + I + 2 * A, "####0.00")
                Label9.Text = Format(W + s + 2 * A, "####0.00")

                Label47.Text = ("")

                Label11.Text = ("") 'length
                Label12.Text = ("")    'width

            End If


            'LDF

            If aeq2 * H <= B / 2 Then    'Not any overlap

                Label64.Text = Format((0.5 * F * (1 + IM / 100) * m) / ((L + 2 * A2) *
((W + 2 * A2))), "####0.00")

                Label65.Text = Format(L + 2 * A2, "####0.00") 'length
                Label66.Text = Format(W + 2 * A2, "####0.00")    'width


                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width
```

```
            ElseIf aeq2 * H > B / 2 And aeq2 * H <= s / 2 Then 'overlap along length

                Label64.Text = Format(((2.5 * T + F) * (1 + IM / 100) * m) / ((6 * B + I
+ 2 * A2) * ((W + 2 * A2))), "####0.00")

                Label65.Text = Format(6 * B + I + 2 * A2, "####0.00")
                Label66.Text = Format(W + 2 * A2, "####0.00")


                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            Else   'general overlap

                Label64.Text = Format(((2 * F + 5 * T) * (1 + IM / 100) * m) / ((2 * A2 +
W + s) * ((6 * B + I + 2 * A2))), "####0.00") 'Stress overlap

                Label65.Text = Format(6 * B + I + 2 * A2, "####0.00")
                Label66.Text = Format(W + s + 2 * A2, "####0.00")

                Label67.Text = ("")

                Label68.Text = ("") 'length
                Label69.Text = ("")    'width

            End If



            'old
            ' If ComboBox2.Text = ("Rigid Pavement") Then
            ' If aeq * H <= s / 2 Then
            ' If aeq * H <= B / 2 Then
            '    Label23.Text = Format(0.5 * F / (((L + 2 * A) - L + W) * ((L + 2 * A))),
"####0.00")
            ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '    Label23.Text = Format(F / (((L + 2 * A) - L + W) * ((L + 2 * A + B))),
"####0.00") 'Stress overlap
            'ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            '    Label23.Text = Format((F + 0.5 * T) / (((L + 2 * A) - L + W) * ((L + 2 *
A + 2 * B))), "####0.00") 'More Stress overlap
            ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B) Then
            '     Label23.Text = Format((F + T) / (((L + 2 * A) - L + W) * ((L + 2 * A +
3 * B))), "####0.00") 'More Stress overlap
            '  ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B / 2)
Then
            '    Label23.Text = Format((F + 1.5 * T) / (((L + 2 * A) - L + W) * ((L + 2 *
A + 4 * B))), "####0.00") 'More Stress
            '  ElseIf aeq * H > (W + V + 5 * B / 2) And aeq * H <= (W + 3 * V / 2 + 3 *
B) Then
            '      Label23.Text = Format((F + 2 * T) / (((L + 2 * A) - L + W) * ((L + 2 *
A + 5 * B))), "####0.00") 'Mo
            '   Else
```

```
            '       Label23.Text = Format((F + 2.5 * T) / (((L + 2 * A) - L + W) * ((L +
2 * A + 6 * B))), "####0.00") 'More Stress overlap
            '   End If
            '  Else
            '  If aeq * H <= B / 2 Then
            '    Label23.Text = Format(1 * F / (((L + 2 * A) - L + W + s) * ((L + 2 *
A))), "####0.00")
            ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '     Label23.Text = Format(2 * F / (((L + 2 * A) - L + W + s) * ((L + 2 * A
+ B))), "####0.00") 'Stress overlap
            '  ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            '     Label23.Text = Format((2 * F + T) / (((L + 2 * A) - L + W + s) * ((L +
2 * A + 2 * B))), "####0.00") 'More Stress overlap
            ' ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B) Then
            '     Label23.Text = Format((2 * F + 2 * T) / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 3 * B))), "####0.00") 'More Stress overlap
            ' ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B / 2)
Then
            '    Label23.Text = Format((2 * F + 3 * T) / (((L + 2 * A) - L + W + s) * ((L
+ 2 * A + 4 * B))), "####0.00") 'More Stres
            ' ElseIf aeq * H > (W + V + 5 * B / 2) And aeq * H <= (W + 3 * V / 2 + 3 * B)
Then
            '     Label23.Text = Format((2 * F + 4 * T) / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 5 * B))), "####0.00") 'Mor
            '  Else
            '      Label23.Text = Format((2 * F + 5 * T) / (((L + 2 * A) - L + W + s) *
((L + 2 * A + 6 * B))), "####0.00") 'More Stress overlap
            '  End If
            ' End If

            ' Else 'flexible
            'If aeq * H <= s / 2 Then
            ' If aeq * H <= B / 2 Then
            '    Label23.Text = Format(0.5 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
            ' ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '     Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '  ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            '      Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (0.5 *
T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '  ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B) Then
            '      Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (T /
((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '  ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B / 2)
Then
            '      Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (1.5 *
T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overla
            '   ElseIf aeq * H > (W + V + 5 * B / 2) And aeq * H <= (W + 3 * V / 2 + 3 *
B) Then
            '       Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (2 *
T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '   Else
            '       Label23.Text = Format(F / ((L + 2 * A) * (L + 2 * A - L - W)) + (2.5
* T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '    End If
            ' Else
            '    If aeq * H <= B / 2 Then
```

```
            '        Label23.Text = Format(1 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00")
            '     ElseIf aeq * H > B / 2 And aeq * H <= (B + W / 2) Then
            '         Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)),
"####0.00") 'Stress overlap
            '     ElseIf aeq * H > (B + W / 2) And aeq * H <= (W + 3 * B / 2) Then
            '         Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '     ElseIf aeq * H > (W + 3 * B / 2) And aeq * H <= (W + V / 2 + 2 * B)
Then
            '         Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(2 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '     ElseIf aeq * H > (W + V / 2 + 2 * B) And aeq * H <= (W + V + 5 * B / 2)
Then
            '         Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W)) +
(3 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '      ElseIf aeq * H > (W + V + 5 * B / 2) And aeq * H <= (W + 3 * V / 2 + 3
* B) Then
            '          Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L - W))
+ (4 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '       Else
            '           Label23.Text = Format(2 * F / ((L + 2 * A) * (L + 2 * A - L -
W)) + (5 * T / ((I + 2 * A) * (I + 2 * A - I - V))), "####0.00") 'More Stress overlap
            '        End If
            '
            'End If
        End If



            peq = Label23.Text
            ProgressBar1.Value = 80

            'return the distributed pressure
            ProgressBar1.Value = 90

            'LLDF'calculate equivalent distribution factor   LRFD
            Label21.Text = "1.15" 'LLDF
            ProgressBar1.Value = 100

            'LLDF'calculate equivalent distribution factor   LFD
            Label77.Text = "1.75" 'LLDF


    End Sub


    Private Sub CheckBox1_CheckedChanged(sender As Object, e As EventArgs) Handles
CheckBox1.CheckedChanged
        If CheckBox1.Checked = True Then
            If ComboBox2.Text = ("Rigid Pavement") Then
                If ComboBox3.Text = ("US Unit") Then
                    TextBox2.Text = "5000000" 'was 520000
                    TextBox2.Enabled = False
                End If
                If ComboBox3.Text = ("SI Unit") Then
                    TextBox2.Text = "34500"  'was 24900000
```

```
                TextBox2.Enabled = False
            End If
        ElseIf ComboBox2.Text = ("Flexible Pavement") Then
            If ComboBox3.Text = ("US Unit") Then
                TextBox2.Text = "280000" 'was 38000
                TextBox2.Enabled = False
            End If
            If ComboBox3.Text = ("SI Unit") Then
                TextBox2.Text = "1930" 'was 18200000
                TextBox2.Enabled = False
            End If
        ElseIf ComboBox2.Text = ("No Pavement") Then
            TextBox2.Text = "0"
            TextBox1.Text = "0"
        End If
    Else
        TextBox2.Enabled = True
    End If
End Sub

    Private Sub CheckBox2_CheckedChanged(sender As Object, e As EventArgs) Handles
CheckBox2.CheckedChanged
        If CheckBox2.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then
                'Base

                'new

                If ComboBox5.Text = ("Cement Treated Granular Base") Then
                    TextBox4.Text = "1500000"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
                    TextBox4.Text = "750000"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
                    TextBox4.Text = "675000"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
                    TextBox4.Text = "170000"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
                    TextBox4.Text = "45000"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
                    TextBox4.Text = "30000"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
                    TextBox4.Text = "21500"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("N/A") Then
                    TextBox4.Text = "0"
                    TextBox4.Enabled = False
                End If

            ElseIf ComboBox3.Text = ("SI Unit") Then
                If ComboBox5.Text = ("Cement Treated Granular Base") Then
                    TextBox4.Text = "10350"
                    TextBox4.Enabled = False
```

```
                ElseIf ComboBox5.Text = ("Cement Aggregate Mixture") Then
                    TextBox4.Text = "5175"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Asphalt Treated Base") Then
                    TextBox4.Text = "4650"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Bituminous Stabilized Mixtures") Then
                    TextBox4.Text = "1140"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Lime Stabilized Materials") Then
                    TextBox4.Text = "310"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Unbound Granular Materals") Then
                    TextBox4.Text = "205"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("Fine Grained Subgrade Materials") Then
                    TextBox4.Text = "150"
                    TextBox4.Enabled = False
                ElseIf ComboBox5.Text = ("N/A") Then
                    TextBox4.Text = "0"
                    TextBox4.Enabled = False
                End If



            End If
        Else
            TextBox4.Enabled = True
        End If
    End Sub

    Private Sub CheckBox3_CheckedChanged(sender As Object, e As EventArgs) Handles
CheckBox3.CheckedChanged
        If CheckBox3.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then

                'new
                If ComboBox6.Text = ("Cement Treated Granular Base") Then
                    TextBox7.Text = "1500000"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
                    TextBox7.Text = "750000"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
                    TextBox7.Text = "675000"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
                    TextBox7.Text = "170000"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
                    TextBox7.Text = "45000"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
                    TextBox7.Text = "30000"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
                    TextBox7.Text = "21500"
                    TextBox7.Enabled = False
```

```
                ElseIf ComboBox6.Text = ("N/A") Then
                    TextBox7.Text = "0"
                    TextBox7.Enabled = False
                End If

            ElseIf ComboBox3.Text = ("SI Unit") Then

                'new
                If ComboBox6.Text = ("Cement Treated Granular Base") Then
                    TextBox7.Text = "10350"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Cement Aggregate Mixture") Then
                    TextBox7.Text = "5175"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Asphalt Treated Base") Then
                    TextBox7.Text = "4650"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Bituminous Stabilized Mixtures") Then
                    TextBox7.Text = "1140"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Lime Stabilized Materials") Then
                    TextBox7.Text = "310"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Unbound Granular Materals") Then
                    TextBox7.Text = "205"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("Fine Grained Subgrade Materials") Then
                    TextBox7.Text = "150"
                    TextBox7.Enabled = False
                ElseIf ComboBox6.Text = ("N/A") Then
                    TextBox7.Text = "0"
                    TextBox7.Enabled = False
                End If

            End If
        Else
            TextBox7.Enabled = True
        End If
    End Sub

    Private Sub CheckBox4_CheckedChanged(sender As Object, e As EventArgs) Handles
CheckBox4.CheckedChanged
        If CheckBox4.Checked = True Then
            If ComboBox3.Text = ("US Unit") Then


                'new
                If ComboBox7.Text = ("Cement Treated Granular Base") Then
                    TextBox8.Text = "1500000"
                    TextBox8.Enabled = False
                ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
                    TextBox8.Text = "750000"
                    TextBox8.Enabled = False
                ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
                    TextBox8.Text = "675000"
                    TextBox8.Enabled = False
                ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
                    TextBox8.Text = "170000"
```

```
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
                TextBox8.Text = "45000"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
                TextBox8.Text = "30000"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
                TextBox8.Text = "21500"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("N/A") Then
                TextBox8.Text = "0"
                TextBox8.Enabled = False
            End If


        End If
        If ComboBox3.Text = ("SI Unit") Then
            TextBox8.Text = "310000"
            TextBox8.Enabled = False

            'new
            If ComboBox7.Text = ("Cement Treated Granular Base") Then
                TextBox8.Text = "10350"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Cement Aggregate Mixture") Then
                TextBox8.Text = "5175"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Asphalt Treated Base") Then
                TextBox8.Text = "4650"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Bituminous Stabilized Mixtures") Then
                TextBox8.Text = "1140"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Lime Stabilized Materials") Then
                TextBox8.Text = "310"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Unbound Granular Materals") Then
                TextBox8.Text = "205"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("Fine Grained Subgrade Materials") Then
                TextBox8.Text = "150"
                TextBox8.Enabled = False
            ElseIf ComboBox7.Text = ("N/A") Then
                TextBox8.Text = "0"
                TextBox8.Enabled = False
            End If


        End If
    Else
        TextBox8.Enabled = True
    End If
End Sub

    Private Sub CheckBox5_CheckedChanged(sender As Object, e As EventArgs) Handles
CheckBox5.CheckedChanged
        If CheckBox5.Checked = True Then
```

```
If ComboBox3.Text = ("US Unit") Then
    TextBox10.Text = "270"
    TextBox10.Enabled = False

    'new
    If ComboBox8.Text = ("Cement Treated Granular Base") Then
        TextBox10.Text = "1500000"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
        TextBox10.Text = "750000"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
        TextBox10.Text = "675000"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
        TextBox10.Text = "170000"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
        TextBox10.Text = "45000"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
        TextBox10.Text = "30000"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
        TextBox10.Text = "21500"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("N/A") Then
        TextBox10.Text = "0"
        TextBox10.Enabled = False
    End If



ElseIf ComboBox3.Text = ("SI Unit") Then
    TextBox10.Text = "13000"
    TextBox10.Enabled = False


    'new
    If ComboBox8.Text = ("Cement Treated Granular Base") Then
        TextBox10.Text = "10350"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Cement Aggregate Mixture") Then
        TextBox10.Text = "5175"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Asphalt Treated Base") Then
        TextBox10.Text = "4650"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Bituminous Stabilized Mixtures") Then
        TextBox10.Text = "1140"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Lime Stabilized Materials") Then
        TextBox10.Text = "310"
        TextBox10.Enabled = False
    ElseIf ComboBox8.Text = ("Unbound Granular Materals") Then
        TextBox10.Text = "205"
        TextBox10.Enabled = False
```

```
                ElseIf ComboBox8.Text = ("Fine Grained Subgrade Materials") Then
                    TextBox10.Text = "150"
                    TextBox10.Enabled = False
                ElseIf ComboBox8.Text = ("N/A") Then
                    TextBox10.Text = "0"
                    TextBox10.Enabled = False
                End If


            End If
        Else
            TextBox10.Enabled = True
        End If
    End Sub

    Private Sub NewToolStripMenuItem_Click(sender As Object, e As EventArgs) Handles
NewToolStripMenuItem.Click
        ComboBox2.Text = ""
        ComboBox4.Text = ""
        ComboBox5.Text = "N/A"
        ComboBox6.Text = "N/A"
        ComboBox7.Text = "N/A"
        ComboBox8.Text = "N/A"
        ComboBox3.Text = ""
        ComboBox1.Text = ""
        TextBox1.Text = "0"
        TextBox2.Text = "0"
        TextBox3.Text = "0"
        TextBox4.Text = "0"
        TextBox5.Text = "0"
        TextBox6.Text = "0"
        TextBox7.Text = "0"
        TextBox8.Text = "0"
        TextBox9.Text = "0"
        TextBox10.Text = "0"
        TextBox11.Text = ""
        TextBox12.Text = ""
        Label21.Text = "0"
        Label22.Text = "0"
        Label23.Text = "0"
        Label47.Text = ""
        Label6.Text = "0"
        Label11.Text = ""
        Label9.Text = "0"
        Label12.Text = ""
        Label28.Text = "0"
        Label45.Text = ""
        Label43.Text = ""
        Label44.Text = ""
        Label45.Text = ""
        Label70.Text = ""
        Label72.Text = ""
        Label71.Text = ""
        Label73.Text = ""
        Label64.Text = "0"
        Label65.Text = "0"
        Label66.Text = "0"
        Label67.Text = ""
```

```
        Label68.Text = ""
        Label69.Text = ""
        Label77.Text = "0"
        Label78.Text = "0"
        Label63.Text = "0"
        Label60.Text = ""
        Label83.Text = ""
        CheckBox1.Checked = False
        CheckBox2.Checked = False
        CheckBox3.Checked = False
        CheckBox4.Checked = False
        CheckBox5.Checked = False
        TextBox1.Enabled = True
        TextBox2.Enabled = True
        CheckBox1.Enabled = True



        PictureBox4.Image = My.Resources.NA
    End Sub

    Private Sub Timer1_Tick(sender As Object, e As EventArgs) Handles Timer1.Tick
        Timer1.Enabled = True
    End Sub
    Private Sub PrintToolStripMenuItem_Click(sender As Object, e As EventArgs) Handles
PrintToolStripMenuItem.Click
        PrintDocument1.Print()
    End Sub

    Private Sub PrintDocument1_PrintPage(sender As Object, e As
Printing.PrintPageEventArgs) Handles PrintDocument1.PrintPage
        Dim font As New Font("Arial", 10, FontStyle.Regular)

        'Time and Date
        e.Graphics.DrawString(Date.Now.ToString("MM/dd/yyyy      hh:mm:ss"), font,
Brushes.Black, 100, 100)

        'Name
        e.Graphics.DrawString("Name of Project :", font, Brushes.Black, 100, 150)
        e.Graphics.DrawString(TextBox12.Text, font, Brushes.Black, 300, 150)

        'Designer
        e.Graphics.DrawString("Designer :", font, Brushes.Black, 100, 170)
        e.Graphics.DrawString(TextBox11.Text, font, Brushes.Black, 300, 170)

        'Type of Pavement
        e.Graphics.DrawString("Type of Pavement :", font, Brushes.Black, 100, 210)
        e.Graphics.DrawString(ComboBox2.Text, font, Brushes.Black, 300, 210)

        'Number of Lanes
        e.Graphics.DrawString("Number of Lanes :", font, Brushes.Black, 475, 210)
        e.Graphics.DrawString(ComboBox4.Text, font, Brushes.Black, 625, 210)

        'Type of Vehicle
        e.Graphics.DrawString("Type of Design Vehicle :", font, Brushes.Black, 100, 230)
        e.Graphics.DrawString(ComboBox1.Text, font, Brushes.Black, 300, 230)

        'Type of Axle
```

```
        e.Graphics.DrawString("Type of Axle :", font, Brushes.Black, 100, 250) '260 to
250
        e.Graphics.DrawString(Label43.Text, font, Brushes.Black, 300, 250)
        e.Graphics.DrawString(Label44.Text, font, Brushes.Black, 300, 270) '280 to 270

        'Desin Axle Load
        e.Graphics.DrawString("Desin Axle Load =", font, Brushes.Black, 100, 300)
        e.Graphics.DrawString(Label28.Text, font, Brushes.Black, 450, 300)
        e.Graphics.DrawString(Label45.Text, font, Brushes.Black, 500, 300)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("kip", font, Brushes.Black, 600, 300)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("kN", font, Brushes.Black, 600, 300)
        End If

        'Pavement
        e.Graphics.DrawString("Thickness of Pavement =", font, Brushes.Black, 100, 320)
        e.Graphics.DrawString(TextBox1.Text, font, Brushes.Black, 450, 320)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 320)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("mm", font, Brushes.Black, 600, 320)
        End If

        e.Graphics.DrawString("Elastic Modulus of Pavement =", font, Brushes.Black, 100,
340) '360 to 340
        e.Graphics.DrawString(TextBox2.Text, font, Brushes.Black, 450, 340)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("psi", font, Brushes.Black, 600, 340)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("MPa", font, Brushes.Black, 600, 340)
        End If

        'Subbase
        e.Graphics.DrawString("Thickness of Bace =", font, Brushes.Black, 100, 370) '390
to 370
        e.Graphics.DrawString(TextBox3.Text, font, Brushes.Black, 450, 370)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 370)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("mm", font, Brushes.Black, 600, 370)
        End If

        e.Graphics.DrawString("Elastic Modulus of Base =", font, Brushes.Black, 100, 390)
'420 to 390
        e.Graphics.DrawString(TextBox4.Text, font, Brushes.Black, 450, 390)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("psi", font, Brushes.Black, 600, 390)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("MPa", font, Brushes.Black, 600, 390)
        End If

        'Base Course
```

```
        e.Graphics.DrawString("Thickness of Subbase =", font, Brushes.Black, 100, 420)
'450 to 420
        e.Graphics.DrawString(TextBox5.Text, font, Brushes.Black, 450, 420)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 420)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("mm", font, Brushes.Black, 600, 420)
        End If

        e.Graphics.DrawString("Elastic Modulus of Subbase =", font, Brushes.Black, 100,
440)  '480 to 440
        e.Graphics.DrawString(TextBox7.Text, font, Brushes.Black, 450, 440)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("psi", font, Brushes.Black, 600, 440)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("MPa", font, Brushes.Black, 600, 440)
        End If

        ' Subgrade1
        e.Graphics.DrawString("Thickness of Subgrade 1 =", font, Brushes.Black, 100, 470)
'510 to 470
        e.Graphics.DrawString(TextBox6.Text, font, Brushes.Black, 450, 470)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 470)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("mm", font, Brushes.Black, 600, 470)
        End If

        e.Graphics.DrawString("Elastic Modulus Subgrade 1 =", font, Brushes.Black, 100,
490)  '540 to 490
        e.Graphics.DrawString(TextBox8.Text, font, Brushes.Black, 450, 490)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("psi", font, Brushes.Black, 600, 490)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("MPa", font, Brushes.Black, 600, 490)
        End If

        'Subgrade 2
        e.Graphics.DrawString("Thickness of Subgrade 2 =", font, Brushes.Black, 100, 520)
'570 to 520
        e.Graphics.DrawString(TextBox9.Text, font, Brushes.Black, 450, 520)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 520)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("mm", font, Brushes.Black, 600, 520)
        End If

        e.Graphics.DrawString("Elastic Modulus of Subgrade 2 =", font, Brushes.Black,
100, 540)   '600 to 540
        e.Graphics.DrawString(TextBox10.Text, font, Brushes.Black, 450, 540)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("psi", font, Brushes.Black, 600, 540)
```

```
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("MPa", font, Brushes.Black, 600, 540)
        End If


e.Graphics.DrawString("================================================================
=============", font, Brushes.Black, 100, 580)

        'Results

        'm
        e.Graphics.DrawString("Multiple Presence Factor, m =", font, Brushes.Black, 100,
610)
        e.Graphics.DrawString(Label60.Text, font, Brushes.Black, 450, 610)

        'IM
        e.Graphics.DrawString("Dynamic Load Allowance, IM =", font, Brushes.Black, 100,
630)
        e.Graphics.DrawString(Label63.Text, font, Brushes.Black, 450, 630)


        'LRFD Method
        e.Graphics.DrawString("LRFD Method:", font, Brushes.Black, 100, 670)

        e.Graphics.DrawString("Live Load Distribution Factor (LLDF) =", font,
Brushes.Black, 100, 700) '680+20=700
        e.Graphics.DrawString(Label21.Text, font, Brushes.Black, 450, 700)

        e.Graphics.DrawString("Equivalent Live Load Distribution Factor (ELLDF) =", font,
Brushes.Black, 100, 730)  '710+20=730
        e.Graphics.DrawString(Label22.Text, font, Brushes.Black, 450, 730)
        'e.Graphics.DrawString("deg", font, Brushes.Black, 600, 730)

        e.Graphics.DrawString("Distributed Stress on Structure =", font, Brushes.Black,
100, 760)  '740+20=760
        e.Graphics.DrawString(Label23.Text, font, Brushes.Black, 450, 760)
        e.Graphics.DrawString(Label47.Text, font, Brushes.Black, 510, 760)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ksf", font, Brushes.Black, 600, 760)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("kPa", font, Brushes.Black, 600, 760)
        End If

        e.Graphics.DrawString("Distributed Length =", font, Brushes.Black, 100, 790)
'770+20=790
        e.Graphics.DrawString(Label6.Text, font, Brushes.Black, 450, 790)
        e.Graphics.DrawString(Label11.Text, font, Brushes.Black, 510, 790)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 790)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("m", font, Brushes.Black, 600, 790)
        End If

        e.Graphics.DrawString("Distributed Width =", font, Brushes.Black, 100, 820)
'800+20=820
        e.Graphics.DrawString(Label9.Text, font, Brushes.Black, 450, 820)
```

```
        e.Graphics.DrawString(Label12.Text, font, Brushes.Black, 510, 820)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 820)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("m", font, Brushes.Black, 600, 820)
        End If


        'LFD Method
        e.Graphics.DrawString("LFD Method:", font, Brushes.Black, 100, 850)

        e.Graphics.DrawString("Live Load Distribution Factor (LLDF) =", font,
Brushes.Black, 100, 880)
        e.Graphics.DrawString(Label77.Text, font, Brushes.Black, 450, 880)

        e.Graphics.DrawString("Equivalent Live Load Distribution Factor (ELLDF) =", font,
Brushes.Black, 100, 910)
        e.Graphics.DrawString(Label78.Text, font, Brushes.Black, 450, 910)

        e.Graphics.DrawString("Distributed Stress on Structure =", font, Brushes.Black,
100, 940)
        e.Graphics.DrawString(Label64.Text, font, Brushes.Black, 450, 940)
        e.Graphics.DrawString(Label67.Text, font, Brushes.Black, 510, 940)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ksf", font, Brushes.Black, 600, 940)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("kPa", font, Brushes.Black, 600, 940)
        End If

        e.Graphics.DrawString("Distributed Length =", font, Brushes.Black, 100, 970)
        e.Graphics.DrawString(Label65.Text, font, Brushes.Black, 450, 970)
        e.Graphics.DrawString(Label68.Text, font, Brushes.Black, 510, 970)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 970)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("m", font, Brushes.Black, 600, 970)
        End If

        e.Graphics.DrawString("Distributed Width =", font, Brushes.Black, 100, 1000)
'800+20=820
        e.Graphics.DrawString(Label66.Text, font, Brushes.Black, 450, 1000)
        e.Graphics.DrawString(Label69.Text, font, Brushes.Black, 510, 1000)

        If ComboBox3.Text = ("US Unit") Then
            e.Graphics.DrawString("ft", font, Brushes.Black, 600, 1000)
        ElseIf ComboBox3.Text = ("SI Unit") Then
            e.Graphics.DrawString("m", font, Brushes.Black, 600, 1000)
        End If

    End Sub

    Private Sub OpenToolStripMenuItem_Click(sender As Object, e As EventArgs) Handles
OpenToolStripMenuItem.Click
        'Open file dialog
        Dim FileReader As StreamReader
```

```
        Dim results As DialogResult

        OpenFileDialog1.CheckFileExists = True
        OpenFileDialog1.CheckPathExists = True
        OpenFileDialog1.DefaultExt = "txt"
        OpenFileDialog1.FileName = ""
        OpenFileDialog1.Filter = "Text Files (*.txt)|*.txt|All Files (*.*)|*.*"
        OpenFileDialog1.Multiselect = False

        results = OpenFileDialog1.ShowDialog


        If results = DialogResult.OK Then
            FileReader = New StreamReader(OpenFileDialog1.FileName)


            TextBox12.Text = FileReader.ReadLine
            TextBox11.Text = FileReader.ReadLine
            ComboBox2.Text = FileReader.ReadLine
            ComboBox3.Text = FileReader.ReadLine
            ComboBox1.Text = FileReader.ReadLine
            Label43.Text = FileReader.ReadLine
            Label44.Text = FileReader.ReadLine
            Label28.Text = FileReader.ReadLine
            Label45.Text = FileReader.ReadLine
            TextBox1.Text = FileReader.ReadLine
            TextBox2.Text = FileReader.ReadLine
            TextBox3.Text = FileReader.ReadLine
            TextBox4.Text = FileReader.ReadLine
            TextBox5.Text = FileReader.ReadLine
            TextBox7.Text = FileReader.ReadLine
            TextBox6.Text = FileReader.ReadLine
            TextBox8.Text = FileReader.ReadLine
            TextBox9.Text = FileReader.ReadLine
            TextBox10.Text = FileReader.ReadLine
            ComboBox4.Text = FileReader.ReadLine
            ComboBox5.Text = FileReader.ReadLine
            ComboBox6.Text = FileReader.ReadLine
            ComboBox7.Text = FileReader.ReadLine
            ComboBox8.Text = FileReader.ReadLine

            FileReader.Close()
        End If

    End Sub

    Private Sub SaveToolStripMenuItem_Click(sender As Object, e As EventArgs) Handles
SaveToolStripMenuItem.Click
        'save file dialog
        Dim FileWriter As StreamWriter
        Dim results As DialogResult

        SaveFileDialog1.DefaultExt = "txt"
        SaveFileDialog1.FileName = ""
        SaveFileDialog1.Filter = "Text Files (*.txt)|*.txt|All Files (*.*)|*.*"

        results = SaveFileDialog1.ShowDialog
```

```
        If results = DialogResult.OK Then
            FileWriter = New StreamWriter(SaveFileDialog1.FileName, False)
            FileWriter.WriteLine(TextBox12.Text)
            FileWriter.WriteLine(TextBox11.Text)
            FileWriter.WriteLine(ComboBox2.Text)
            FileWriter.WriteLine(ComboBox3.Text)
            FileWriter.WriteLine(ComboBox1.Text)
            FileWriter.WriteLine(Label43.Text)
            FileWriter.WriteLine(Label44.Text)
            FileWriter.WriteLine(Label28.Text)
            FileWriter.WriteLine(Label45.Text)
            FileWriter.WriteLine(TextBox1.Text)
            FileWriter.WriteLine(TextBox2.Text)
            FileWriter.WriteLine(TextBox3.Text)
            FileWriter.WriteLine(TextBox4.Text)
            FileWriter.WriteLine(TextBox5.Text)
            FileWriter.WriteLine(TextBox7.Text)
            FileWriter.WriteLine(TextBox6.Text)
            FileWriter.WriteLine(TextBox8.Text)
            FileWriter.WriteLine(TextBox9.Text)
            FileWriter.WriteLine(TextBox10.Text)
            FileWriter.WriteLine(ComboBox4.Text)
            FileWriter.WriteLine(ComboBox5.Text)
            FileWriter.WriteLine(ComboBox6.Text)
            FileWriter.WriteLine(ComboBox7.Text)
            FileWriter.WriteLine(ComboBox8.Text)

            FileWriter.Close()
        End If

    End Sub




    Private Sub VScrollBar1_Scroll(sender As Object, e As ScrollEventArgs)

    End Sub

End Class
```

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