

Guide to Using ILLISLAB15 and ILLIGUI Programs

Armen Amirkhanian

March 4, 2015

Contents

1	Introduction	3
2	Getting Started	4
2.1	General Setup	4
2.2	Layer Setup	5
2.3	Node Setup	6
2.4	Aircraft Selection	7
2.5	Generate Input File	8
2.6	Save/Load Session	9
3	Running ILLISLAB15	10
4	Known Errors/Bugs	11
4.1	Application Does Not Close Properly	11
4.2	Application Does Not Generate Correct Input File . .	11
4.3	Single Axle Case Does Not Generate Correct Coordinates	11
5	ILLIGUI Change Log	12
6	ILLISLAB15 Change Log	14

Disclaimer

This software is for educational use only and should not be used in design calculations where public safety is a factor.

Both ILLISLAB15 and ILLIGUI are provided as is and with all faults. The author makes no representations or warranties of any kind concerning the safety, suitability, lack of viruses, inaccuracies, typographical errors, or other harmful components of ILLISLAB15 and ILLIGUI. You are solely responsible for the proper use of ILLISLAB15 and ILLIGUI. The programs ILLISLAB15 and ILLIGUI should not be used for actual design calculations and is provided only for educational use.

The aircraft data provided in ILLIGUI may contain errors. It is up to the user to confirm the data is correct. Some aircraft have up to 30 weight variants and it is impossible to know how a particular airline will further modify the airframe. Unless specified otherwise, the data presented as loads and tire pressures is from the heaviest or most common weight variant.

This software has no brain, use yours.

1 Introduction

ILLIGUI was created to facilitate the easy creation of input files for the newly compiled ILLISLAB15 program. ILLIGUI's stand out feature is that it contains a near complete database of commercial aircraft produced by Boeing and Airbus. Another notable feature is the ability to save model setups and load them at later times to make modifications.

ILLISLAB15 is a recompiled version of the slightly modified IISL94 Fortran code. Code editing was performed by M. Scot Breitenfeld and due to his expertise in Fortran, the following modifications include:

- Compilation of 64-bit and 32-bit versions to enhance memory utilization on the desired systems

- Main node array was reconfigured to be any size allowing for the node spacing to be extremely small even for large slab/multiple slab systems

- Several DO and GOTO statement blocks have been reconfigured to allow for better optimization

- One loop has been reconfigured to prevent a non-initialized variable issue under certain cases

- Recompilation was done with -O3 to ensure fastest running code

2 Getting Started

ILLIGUI requires the Section31.mdb file to be in the same directory as the ILLIGUI executable. This database contains the aircraft data and is designed to allow for updating of the aircraft data without having to update the ILLIGUI code. Any modifications to the Section31.mdb file will corrupt the database and ILLIGUI will not run properly.

2.1 General Setup

Figure 2.1 shows the opening screen for ILLIGUI. The File Name: box is where you enter the desired file name for the input file. Do not add any extensions. A .inp extension will automatically be added to the filename upon creation. The Project Name: box is purely for your reference. It will be present in line 2 of the input file as well as near the beginning of the output file. The next three number change boxes will change meaning depending on the subgrade type selected. Please take note of any warnings that may pop up, especially with the first set of subgrade types. The Max Iterations: box is currently disabled as it is not used at this time.

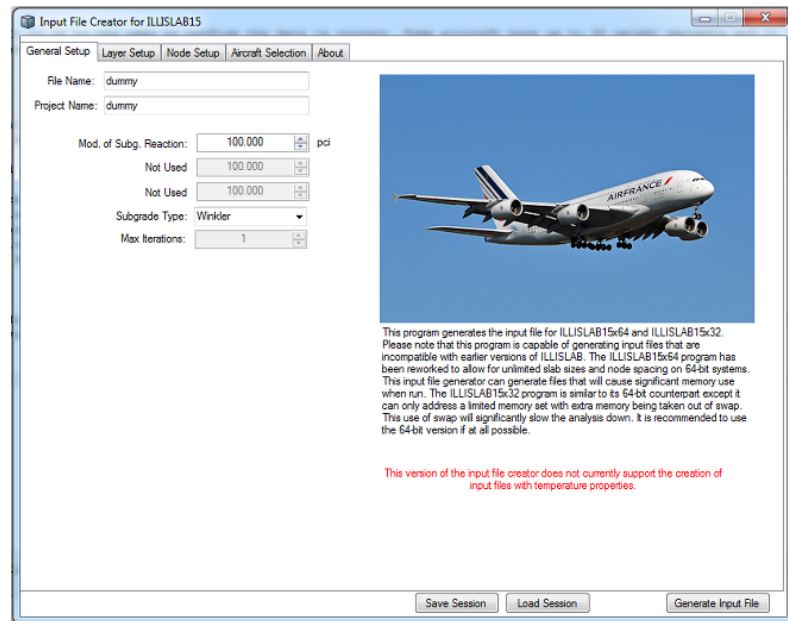


Figure 2.1: Opening screen of ILLIGUI.

2.2 Layer Setup

Figure 2.2 shows the next screen in the input file creation process. Most of the options are self-explanatory. Please note that at this time the temperature modeling capabilities have been disabled. The one property of note is the Composite Action Factor. At this time, it is not recommended to choose the Totsky model due to the uncertainty of proper implementation in ILLIGUI.

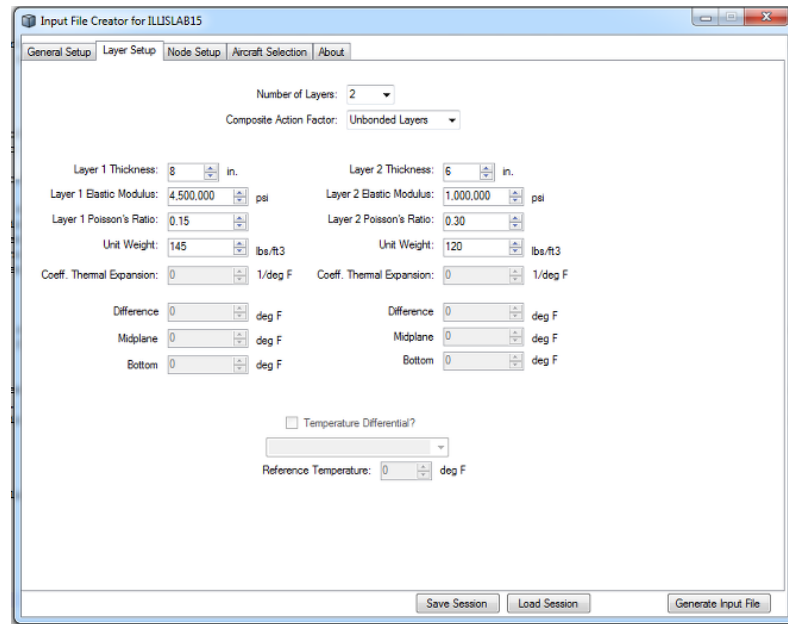


Figure 2.2: Layer setup screen of ILLIGUI.

2.3 Node Setup

Figure 2.3 shows the next screen in the input file creation process. The two inputs for the number of slabs in the X and Y direction are pretty self explanatory. At this time, only uniformly spaced nodes are allowed to be inputted (the Total X-Nodes per slab: and Total Y-Nodes per slab: boxes). For example, if you had 2 slabs in the X direction and 3 slabs in the Y direction as well as 50 nodes in the X direction and 60 nodes in the Y direction, each of the six slabs modeled would have a total of 3000 nodes (50 nodes by 60 nodes). Keep this in mind with larger slab and node system as the simulation will require large amounts of memory to store all of the calculations.

The length of the X and Y slab should be self-explanatory. There are buttons to activate aggregate interlock in the X and Y directions. You can enter a load transfer efficiency percentage and this will be converted to a stress value using Eq. 2.1. Note that this approximation is only valid for Winkler and Springs subgrade models.

Generally, this application is designed to model aircraft loads. Thus, the default load type is a selection from the aircraft database. You can change this at anytime. The Select Symmetry option has been disabled. The most important and easiest step to mess up is se-

lection of the load reference point. This X and Y coordinate specifies where the load will go in the global coordinate system. For example, in Fig. 2.3, the X,Y coordinate of (0,0) would be the point shown by the checked circle in the lower left of the tire layout diagram. This means the tire will “grow” up and to the right as the footprint is calculated from the load and tire pressure.

You should always perform a check to make sure your gear will not end up outside of the model. This check should be performed after the load, tire pressure, load reference point, and X,Y coordinates have been chosen. Changing any of these values will affect the tire dimensions.

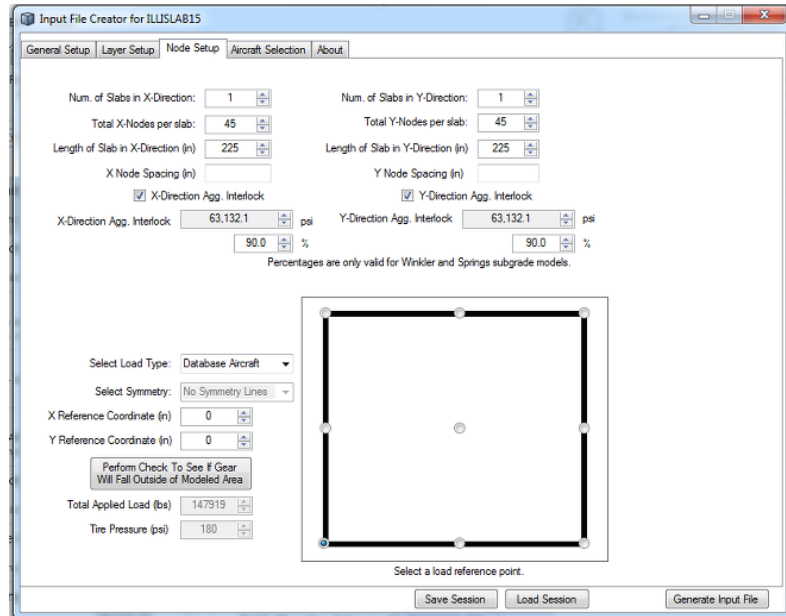


Figure 2.3: Node setup screen of ILLIGUI.

$$A_{x,y} = \left[\frac{\frac{1}{LTE_{x,y}} - 0.01}{0.012} \right]^{\frac{-1}{0.849}} k l_{\text{eff}} \quad (2.1)$$

2.4 Aircraft Selection

Figure 2.4 shows the crowning achievement of this input file generator. Using the data in the Section31.mdb file, the selected aircraft information is displayed. All of the properties that affect the

simulation can be altered from their default values. As noted in the various disclaimers, the information presented is accurate but not guaranteed to be error free. Some aircraft versions (e.g. B747-400) have up to 30 different weight variants. Generally, the heaviest weight variant is chosen unless another variant is more commonly deployed. It is up to the user to determine if the weight shown is the desired variant. As long as the Database Aircraft option is selected on the Node Setup page, all of the values here will transfer to the Node Setup page.

The A/C Terminology button provides a brief description of some of the terms and the View A/C Info button shows a picture of the selected plane along with a brief description from the manufacturer.

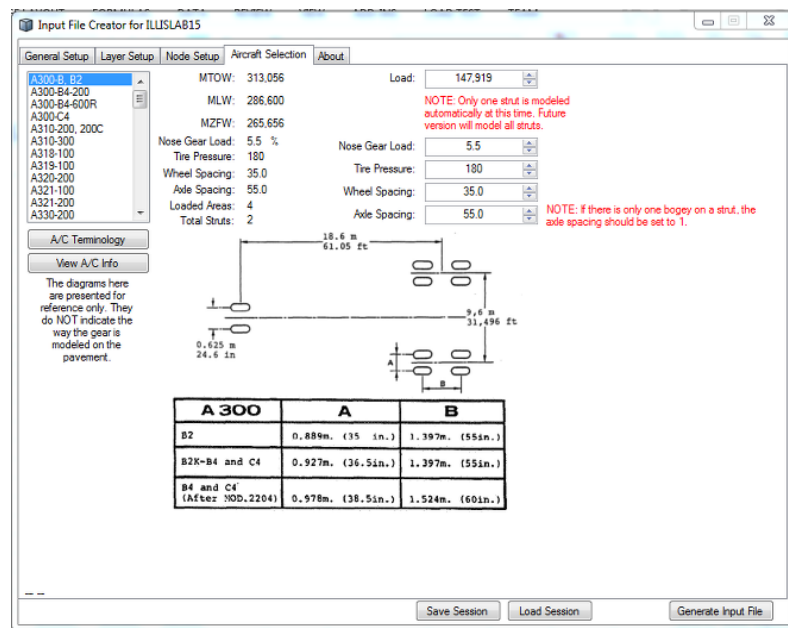


Figure 2.4: A/C selection setup screen of ILLIGUI.

2.5 Generate Input File

Clicking the Generate Input File button will immediately generate an input file with the file name specified in the General Setup tab. This file will be created in the same directory as the ILLIGUI program and will overwrite any file with the same name without warning.

2.6 Save/Load Session

These buttons allow you to save the current state of ILLIGUI or load an existing state to quickly continue your work. It also aids in troubleshooting as the saved sessions can be opened by any version of ILLIGUI. These saved sessions cannot be used as input files for ILLISLAB15.

3 Running ILLISLAB15

ILLISLAB15 is a console application that can only be run from the command line. It is recommended to keep ILLISLAB15 in the same folder as ILLIGUI so that the generated input files from ILLIGUI will be immediately and readily accessible to ILLISLAB15.

First, you will need to open the command prompt. In Windows 7 and 8 you can type in Command Prompt into the search bar. You will then need to change the directory to the one that contains ILLISLAB15 and your input file. You can use the `cd` command for this. For example:

```
cd C:\Users\Default\Documents\Slabs
```

This will change the directory to the Slabs folder, where for purposes of this example, the ILLISLAB15x64 executable and input file `test1.inp`. Once in the correct folder type the following command:

```
ILLISLAB15x64.exe < test1.inp > test1.out
```

The file `test1.out` is created upon execution and can be named anything. However, it is best to name it the same as the input file so that the two will always be paired. ILLISLAB15 has very little in the way of exception handling. It is up to the user to look at the output to determine if something went wrong and the perform a reasonableness check on the final values.

4 Known Errors/Bugs

4.1 Application Does Not Close Properly

This occurs when ILLIGUI is started and the aircraft selection is never changed. Upon trying to exit the program without ever selecting a different aircraft, you will get an unhandled string exception error. This is nonsense because the author has handled string exception errors. You can either hit Continue or Quit. This error does not affect the operation of the program and is only a nuisance. Upon trying to exit the program a second time, it will successfully terminate.

4.2 Application Does Not Generate Correct Input File

This occurs when ILLIGUI tries to generate an input file for a one slab system. This will be fixed in future versions. The solution is not to use one slab systems.

This has been fixed since Version 0.9.984

4.3 Single Axle Case Does Not Generate Correct Coordinates

This occurs when the single axle load type is selected either through the menu or via selection of certain aircraft.

This has been fixed since Version 1.0.4

5 ILLIGUI Change Log

Version 0.9.501

Initial release version.

Version 0.9.902

Added unit labels

Added X,Y direction indicators

Added 4Gb 64-bit warning message due to possible segfaults

Version 0.9.957

Fixed thickness input boxes not displaying decimal values

Version 0.9.959

Fixed issue with single load area not allowing for a change in tire pressure

Version 0.9.984

Fixed issue when trying to generate input file with agg. interlock in singleton slab directions

Version 1.0.4

Fixed coordinate generation for single axle cases

Added memory display to alert user to model size and available memory

Version 1.0.7

Fixed issue with single load area not being square

Version 1.1.2

Fixed issue with single axle area not be calculated correctly in the Y-direction

Added ability to change X/Y load ratio for tire footprints

Version 1.1.9

Fixed issue of LTE not always updating when layer properties were changed

Version 1.2.4

Fixed issue of a cast error in modulo operation for calculating node coordinates. This caused some nodes to not be duplicated.

6 ILLISLAB15 Change Log

Version 15.1.0

Initial release version.

Version 15.2.0

Reconfigured several arrays and GOTO statements

Updated TITLEPG subroutine