

14 YEARS EXPERIENCE OF “SUTSTRUCTOR” THE IN-HOUSE 2D STRUCTURE ANALYSIS SOFTWARE

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ABSTRACT

The SUTstructor is a program for the analysis and design structures. The in house software is originally developed for the teaching class at School of Civil Engineering, Suranaree University of Technology (SUT). The “structor” is the short brief from “Structural Mentor”, and it has capability to analyze 2D structures with rigid or pin joints. Since 2001, the SUTstructor has been freely downloaded by Thai engineers and widely known, because it is simple using and save time in complicate structure analysis works and with reliability results. Among the others similar license software, such as ETAB, STAAD pro, the SUTstructor is competent, easily self-learning, in the 2D analysis of structures, such as Frame, Truss, and Beam. The graphics results, Shear and Bending Moment Diagram are also presented. This paper presents the experience of using this in house software in both class room and in real life civil engineering works. The Software is introduced to second year engineering students after they passed the basic class of “Engineering Statics”. And motivate of using the students to get familiar the program, in order to, helping themselves to check their own home work, comparing the results with hand calculation. With 14 years experiences, since then, the software has been downloaded and used by numbers of engineers in government agencies and private companies. This widely use is due to the simplicity and performance of the software itself. However, it is a bit long time already and the software need to be upgraded, therefore, this paper is to discover, in order upgrade the SUTstructor, the requirements to fit hi-tech future use.

saving even lots of time. Those mentions are powerful, 3D provided, and for professionally applications. Each program has different characteristics, and familiar to user accordingly, however, they are required quite expensive registration licenses to run them. The limitations for numbers of students in classes were occurred due to their costly installation fees which were not suitable for small class works. The structural engineering software was essential for students, in order for them to use, with free of charge, legally acceptance, without any restrictions, especially, in class with large number of students. The SUTstructor, in-house software, by School of Civil Engineering, Suranaree university of Technology(SUT), has been developed, originally for teaching assistance. Since 2001, the SUTstructor has been introduced to students and with absolutely a free downloaded software. The in-class students are assigned and with intension to work with the program, in comparison to the results to their hand calculations. Civil Students from SUT are familiar with this program, which it is easy to use and returned accuracy results. Since then, the SUTstructor is well-known, stayed on those users to the real professional engineering life. With 14 years experiences, the program has been used in structural analysis in many applications, and in many organization, including companies, privates, and government agencies. Despite the fact, the program still be running, it is required to be up-grade to suite the future usage for hi-tech computer. This paper makes the demonstration of the application in structural analysis of SUTstructor and evaluation of the experiences from the users, in order to find out how to up-grade

1. INTRODUCTION

In Civil Engineering practicing, a structural analysis programs such as SAP2000, STAAD.Pro, ETABS, Autodesk, and etc., are normally used, in which they are allowed for quick and easy analysis of the structure,

2. MATERIAL AND METHODS

The investigation for the 14-year SUTstructor usages were carried out using focus group interview methods. Three groups, eight person per group, are from 1) Professor inside the School of Civil Engineering at SUT, 2) Civil Engineering students (Senior) and 3) Engineers in

Practice. This paragraph will explain the basic background of the SUTstructor program and the follows by the results from the focus group interview.

2.1 The SUTstructor Software

Refer to Alongkorn L.(2000), who developed this program during his master degree at School of Civil Engineering, Suranaree University of Technology, under the supervision of Dr. Thanongsak Phisarnsilp, the program has the aims attention as a computer-assisted instruction-CAI. The SUTstructor stands for SUT structural Mentor, which will be able to display the intermediate results steps by steps, in both in graphic and tabulation results. The 2D program is able to analyze Frame and Truss, and the display graphically detail of Loads, Reactions, Bending Moment/Shear/Axial Force Diagrams, and Deflection.

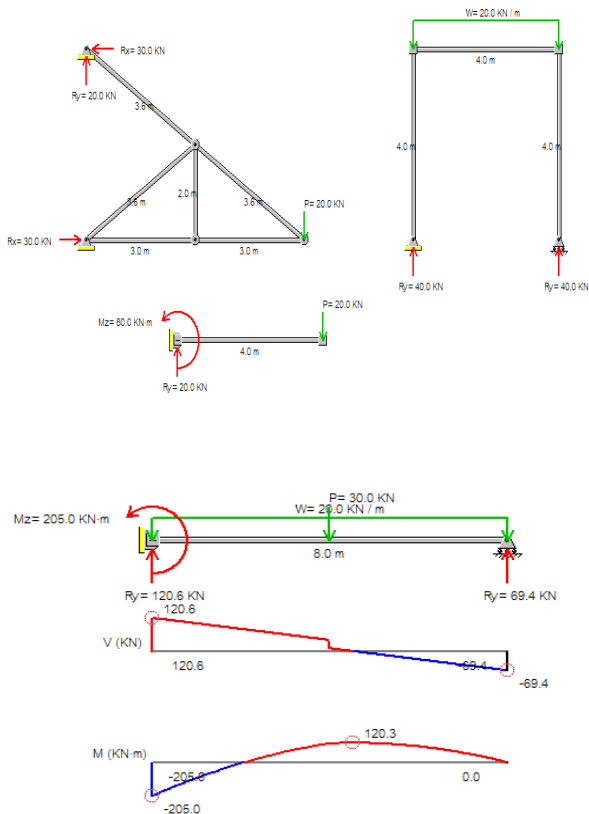


Figure 1. Loaded Structures solved by SUTstructure

The following in figure 1 and 2 show the problem of the loaded beam solved by the SUTstructor.

As shown followed, the 15 meters continuous beam (3@5 meters), has pinned supports at both ends. And the beam was loaded with moment, point load and distributed loads. The SUTstructor will automatically analyzed and provided the results of free body diagram with support reaction, shear diagram, and bending moment diagram.

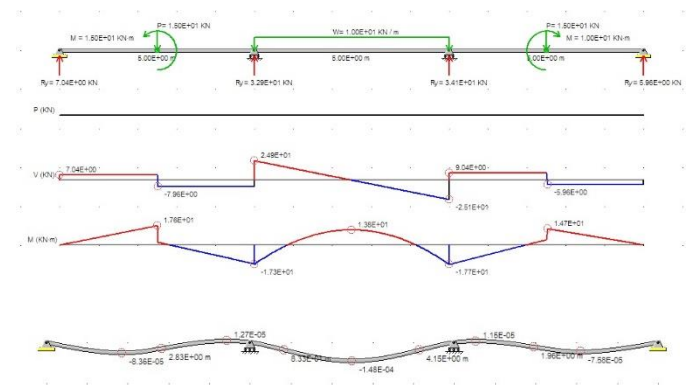
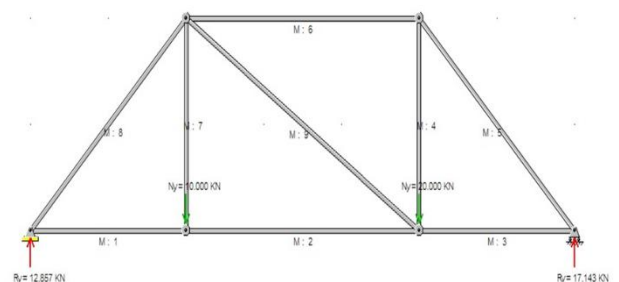


Figure 2. Given A, I, and E value to the program, the Elastic curve was also plot out.

The following in figure 3 and 4 show the problems of the loaded truss solved by the SUTstructor.

As shown followed, three spans of truss, with the lengths of 2, 3 and 2 meters, and with 2 meters height, is input and the loads are applied at the nodes as showed. The SUTstructor will promptly runs and displays the reaction force at both supports.



Member	F _{x,i}	F _{y,i}	M _{z,i}	F _{x,j}	F _{y,j}	M _{z,j}
1	-12.86	0.00	0.00	12.86	0.00	0.00
2	-12.86	0.00	0.00	12.86	0.00	0.00
3	-17.14	0.00	0.00	17.14	0.00	0.00
4	-17.14	0.00	0.00	17.14	0.00	0.00
5	24.24	0.00	0.00	-24.24	0.00	0.00
6	-10.00	0.00	0.00	10.00	0.00	0.00
7	17.14	0.00	0.00	-17.14	0.00	0.00
8	18.18	0.00	0.00	-18.18	0.00	0.00
9	-5.15	0.00	0.00	5.15	0.00	0.00

Figure 3 & 4 Truss support reactions, the axial forces of each member will be showed in table

2.2 Program accuracy and limitations

The method of Direct Stiffness Matrix Method is the basic calculation for the structural analysis and used in the SUTstructor program. The integration procedures in the program development for the display are result into graphic part. The development engines included, “Visual Basic 6.0 service pack 4” and with the “Wise Installer”. The menu icons were developed by ‘Icon Forge 4.5’, and all graphics were developed for the display using” Photoshop and Visio 5”. The input mode is ready for the input graphically using mouse on the screen data page, and able to add texts from keyboard. With automatically program calculation, the output is consequently displayed at the same input page, such as, reactions at all supports. The diagram of results forces, i.e. axial forces, shear forces, and bending moment are display graphically. The SUTstructor provides a very high accuracy of the results output. The output numbers resulted from the program are in the scientific format (i.e. 2.37E-10). Many good test runs results from SUTstructor were compared to the results from hands calculations, and from other software. However, the program has some limitation as it could not determine the shear deformation under any circumstances. Which means that, the analysis of structure are under the linear elasticity condition. The program did not include the print command. The results, graphically, could be save as a screen capture and print out later by other utilities software, such as Words or Excel.

2.3 End Users responses

The interview to focus group method has been used to investigate the usage of SUTstructor usages. Three groups, eight person per group, have been focused separately they were 1) Professors inside the School of Civil Engineering at SUT, 2) Civil Engineering students (Senior) and 3) Engineers in Practice. The confirmation of the interview results has been done only in group 1 and 2. But in group 3, the interview was carried out only those who response through social media (Facebook) only.

3. RESULTS AND DISCUSSION

The interviews were done in order to find, how often of using the program and whether or not the program should be up-date. Those results from each group could be summarized as follows. In group 1, the professors in school of Civil Engineering, at SUT, the SUTstructor is always encourage to students for their own homework checking. Totally 8 lecturers from school of Civil Engineering agreed to assigned students to use the program in order to compare result from hand calculation. And it will make students has more confident in hand calculation during the examination. Meanwhile, some of lectures in structural classes, reported that, the higher professional program such as, STAADpro, SAPs, and ETABS, are using in the class room. Same comments from all lectures, that, the program is very appropriated

for class work because it offers the very basic solutions that provide good engineering sense students. And make the comment that the program is suitable, fit all requirement for class work, no need to be up date.

From the civil engineering students focus group, the SUTstructor is usually announced to new civil students by senior students. The introduction of the program was always carried out in the student club, that the SUTstructor was a free download, developed in-house of SUT that all civil engineering students should recognized. The foremost application of the program were for the class works. As such, the students need to run the program to valid their hand calculations. And more frequently use, the program were for the project assignment in the class of Reinforce Concrete Design. The analyzing part in this assignment was worthy, because the graphic results could capture and very beneficial for the report. Fit the requirement, the students could create the professional jobs out from this in-house free ware, and no need any software up-grade. However, for foreigner students who were not familiar with Thai language, have been made request for English using menu bar and manual.

And similar comment from the engineers in practice, the program was applied in their work mainly in small structural works. The program help them to create good report which mainly from the graphic could be captured as the attachment in the others utilities soft wares, Word or Excel. The comments were that the classic method of the software was convenient enough, fit to structural engineering work, especially simply 2D structural analysis. This high accuracy SUTstructor has not required to be upgrade. However, the comment were that, this program is not suitable for the complicate structure or high stories building which 3D works were more applicable.

4. CONCLUSION

This paper reports some results of users of the in-house SUTstructor, a structural analysis software. The 14 years old free-ware, which can be download from: <http://www.sut.ac.th/sutstructor/>. The program is developed, originally for teaching assistance, but however, it has been one of the good choice for the 2D structural analysis for engineers in practice. The small powerful SUTstructor are still familiar to engineers because it returns good and accurate results fit to 2D structural analysis of structure. The graphically results this old program could be easily capture and then attach to report, with to date, considerable appearing.

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