

STEEL COLUMN DESIGN WITH 'C++' PROGRAMME

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Abstract This software is developed to generalize the design of steel column within a short period of time. By using this software the designer can determine the design load, length, lightest section, cross section dimensions and slenderness ratio of the column in both SI and FPS unit. Here we considered W-section, rectangular section and solid circular section for the solution.

INTRODUCTION

Now a days it is very important for the Mechanical engineers to make the mechanical use easier for the general people and to reduce the time of operation. So that a person who is not an engineer or expert can handle the machine easily. To achieve this goal computerization is one of the easiest way. In the modern country they are trying to control all the machine by computer program. This software is also developed as one of the steps to achieve this goal. Many software company developed this type of software for the world wide demand of steel column design. But those are not so general form.

USE OF STEEL COLUMN

Steel column are used available all over the world for its unlimited advantages over other design. Following are some example of the use of steel column.

Some Significant Construction Using Steel Column

We found thousands of construction made by steel column, which are available in the internet. Most of these are building, some of these are industry, airport, sports stadium and railway station etc. steel column construction is popular because it has more than thirty advantages over RCC construction. Some significant constructions using steel column are shown below.

- World Trade Center ,US.
- Liverpool Street station ,London ,GB.
- French institute for polar research and tech.
- Beximco permacutical industry, Bangladesh.
- Ponds porge international sports center. GB.
- Etc.

TYPES OF STEEL COLUMN

We included four types of sections for the design by this software which are as follows

1. W-Shape section.
2. Rectangular section.
3. Circular section.
4. C-section.

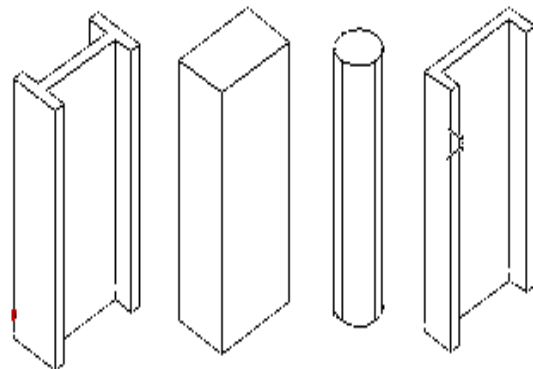


Fig. 1 Different types of section

SALIENT FEATURES OF THE S/W

This software provides mainly the design of the steel column. It also contains one file named 'Theory' containing necessary theoretical knowledge and another one is "help" file containing all types of information about the software for the user its also like a user manual. The menu bar contains 'Theory' , ' Problem solution' and 'Help' command to enter into the software.

Theory

It include the definition of the different types of column. Derivation of the formulas. figure of the different types of column for different section.

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Problem solution

This command is linked with the general program of the column design. It contains many path of commands for the selection of appropriate design parameter. After selecting the command the program will seek to entry the data in the **input** box. After entry the input data click **ok** then it will display the **out put** box.

Help

It includes the details about the software. General procedure to use the software that is described bellow. Some standard data. Material properties, values of N for different end gripping condition etc.

DESIGN PROCEDURE

Following steps should be followed to the problem with the help of the software designed.

- Summarize the Question
- Command selection .
- Data input style.
- Visual display of the output.

Summarize the Question

The purpose of the ‘summarize the question’ is to find out the all the parameters from the question and to arrange those parameters in tabular form. It will help to entry input data appropriately . It is very important for the new designers whose are not expert in design and not necessary for the expert designer. This can be done as shown below.

Tabular form.

Loading condition	
Axial Loaded	Slender column
	AISC column
Eccentric Loaded	
Section Type	
W- Shape section	
Rectangular Shape	
Circular Shape	
C-Shape	
Design Parameter	
Lightest Section	
Maximum Load	
Length	
Cross Section Dimension	
Max. Eccentric Load	
Max. Eccentricity	
Slenderness ratio	

Data Arrange Style				
Variable	Symb	Qty	Unit	
Length	LI		Meter	Feet
Section	SEC			
Axial load	PI		KN	Ksi
Safety factor	FS			
End cond ⁿ	EC			
Elasticity	E		GPa	Msi
P.stress	SIGP		Mpa	Ksi
Y.stress	SIGY		MPa	Ksi
Breadth	B		mm	Inch
Width	H		Mm	Inch
Area	A		Mm ²	Inch ²
Radius of gyration	R		Mm	Inch
E. load 1	P1		KN	Kips
E .load 3	P2		KN	Kips
E load 2	P3		KN	Kips
Eccentricity 1	E1		mm	Inch
Eccentricity 2	E2		mm	Inch
Eccentricity 3	E3		mm	Inch
Load Axis	axis			

Command Selection

There are three command in the menu bar. To find the design parameter must select the “**PROBLEM SOLUTION**” button in the menu. Then it will show all the options of command of the program that is shown in the fig: 2. By using key board or mouse any body can select the appropriate command. There are four steps of the selection.

First step First step is the loading condition. The load may be axial or eccentric. If the load is axial the column may either slender column or AISC.

Second step Second step is the section type. The cross section of the column may three types in this program for the solution. Cross section may be W-shape or Rectangular shape or circular shape.

Third step Third step is to select the design parameter. In this software there are maximum seven options to select the design parameter. The options are Lightest section, Maximum load, Length, Slender ratio, Cross section dimensions, Maximum eccentric load and Maximum eccentricity. So one of the above parameters can be found by using this software and can repeat the program to find another parameter.

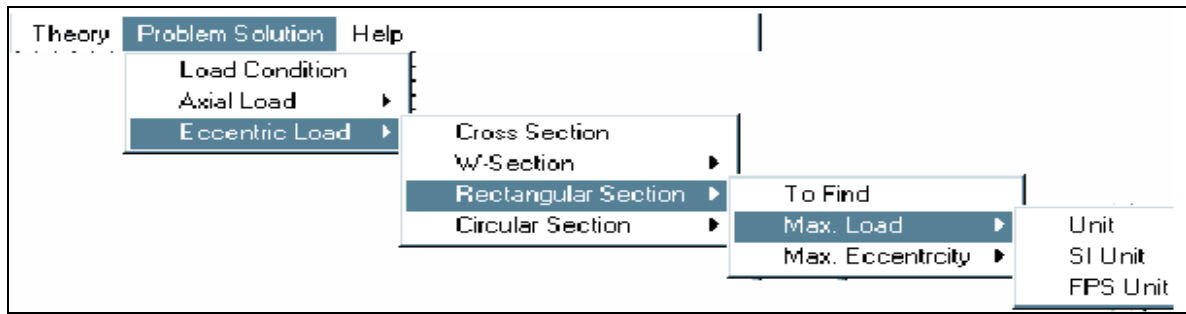
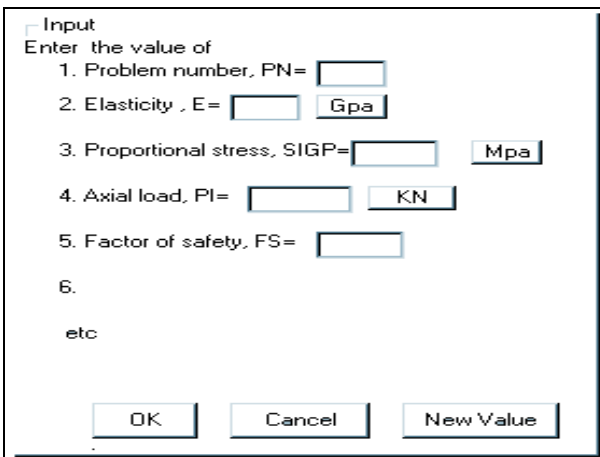


Fig. 2 Command Selection Menu

Fourth step This step is to select the unit (SI or FPS) of the solution. This option is available at the end of each option of the third step.

Data Entry

After selecting the command for the design parameter from the menu the program will display **input** box for the entry of the corresponding required data. The input box is like as follows.



Out put style

After entry the data, required for the design, it will display the output dialog box containing maximum possible design information with the figure of the designed column, levelled by the dimensions. The out put will be shown as follows.

<p>Problem number: Serial number Problem to find: Design parameter. Given parameter: All necessary input data .</p> <p>Design parameter: All necessary design parameters .</p>	Fig. 3D
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EXAMPLE

Question

1108: Select the lightest W-Shape that will act as a slender column of 8 meter long with hinged ends and support an axial load of 270 KN with a factor of safety 2.5 Assume that the proportional limit as 200 Mpa and modulus of elasticity , E=200 Gpa.

Summarization Of The Question

The parameters of this question are arranged in the table. Loading condition is 'Axial loaded slender' column. Section type is 'W-shape', design parameter is 'Lightest section', value of length, axial load, factor of safety, end condition, modulus of elasticity and proportional stress are given.

Loading condition				
Axial Loaded column	Slender			✓
	AISC			
Eccentrically Loaded column.				
Section Type.				
W- Shape section				✓
Rectangular Shape				
Circular Shape				
C-Shape				
Design Parameter				
Lightest Section				✓
Maximum Load				
Length				
Slender ratio				
Cross Section Dimension				
Max. Eccentric Load				
Max. Eccentricity				
Data Arrange Style				
Variable	Symb	qty	Unit	
Length	LI	8	Meter	Feet
Section	SEC	W	--	--

Axial load	PI	270	KN	Ksi
Safety factor	FS	2.5	--	--
End cond ⁿ	EC	2 H	--	--
Elasticity	E	200	GPa	Msi
P.stress	SIGP	200	Mpa	Ksi
Y.stress	SIGY	--	MPa	Ksi
Breadth	B	--	mm	Inch
Width	H	--	Mm	Inch
Area	A	--	Mm ²	Inch ²
Radius of gyration	R	--	Mm	Inch
E. load 1	P1	--	KN	Kips
E .load 3	P2	--	KN	Kips
E load 2	P3	--	KN	Kips
Eccentricity 1	E1	--	mm	Inch
Eccentricity 2	E2	--	mm	Inch
Eccentricity 3	E3	--	mm	Inch
Load Axis	Axis	--		

Command Selection

There are three command in the menu bar. To find the design parameter must select the “**Problem Solution**” button in the menu .Then it will appear as shown in fig 4. By using key board or mouse any body can select the appropriate path of command. In this question axial loaded slender column as loading condition, lightest W-shape section as the design parameter and SI unit as the unit of solution.

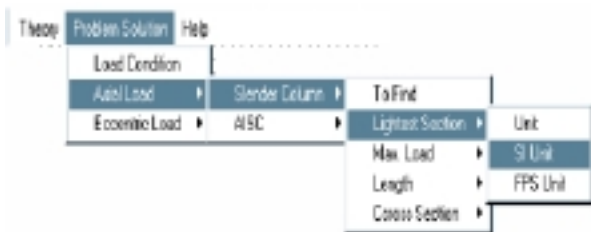


Fig. 4 Command Selection

Data Entry

After selecting the command the program will display the input box shown in fig. 5 for entry the data. In this question we put the question number 1108 as problem number and the value of elasticity, proportional stress, axial load, factor of safety, length and end condition according to unit given in the right of the box.

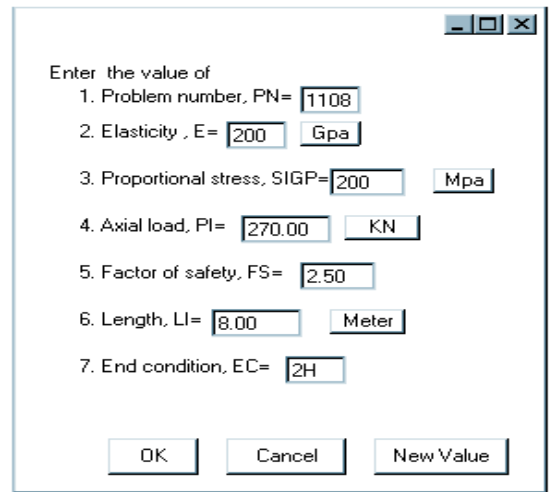


Fig. 5 Input of this example

Out Put

After entry the data in the data input box select OK to get the design parameters. In this problem the out put dialog box is shown in fig. 6.

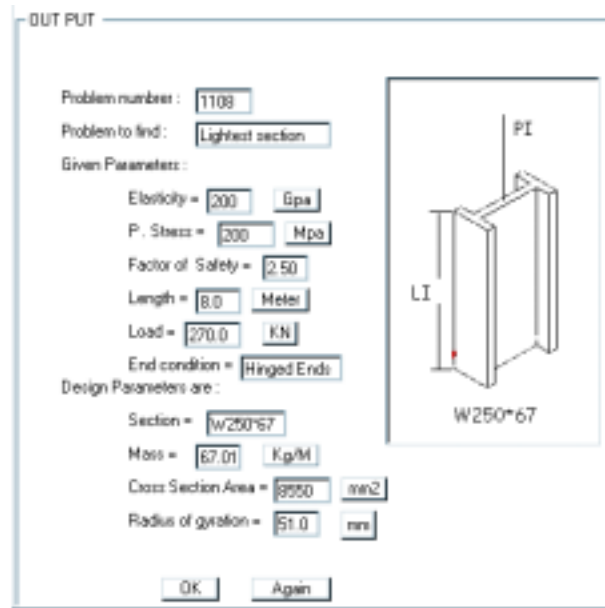


Fig. 6 Out put of the solution

CONCLUSION

In this software we generalized the design of the steel column of w-shape, rectangular shape and circular shape cross section. Solution for the c-shape and hollow circular column can be included in the next modification of the software. We hoop it’s use will be commercial.

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