PALIKHE's BEAM ANALYSIS PROGRAM PBAP 2016

Software Manual

Palikhe's BAP is a structural beam analysis software that can be used by Civil, Mechanical and Structural Engineers, Beam designers and Engineering students for both professional and academic purposes.

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Further information about the software may be obtained from

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DISCLAIMER

CONSIDERABLE TIME AND EFFORT HAVE GONE INTO THE DEVELOPMENT AND TESTING OF THIS SOFTWARE. THE DEVELOPER HAS GONE THROUGH MORE THAN **THREE YEARS** CONTINUOUS **PROGRAMMING EXPERIENCE IN BEAM ANALYSIS** AND MORE **THAN A YEAR'S MODIFIED RESEARCH** ON **MACAULAY'S METHOD** IN ORDER TO PROVIDE THE **MORE ACCURATE ALGORITHM FOR THIS SOFTWARE**. THIS SOFTWARE IS THE FOURTH EDITION AND SIXTH VERSION ON BEAM ANALYSIS. HOWEVER, THE USER ACCEPTS AND UNDERSTANDS THAT NO WARRANTY IS EXPRESSED OR IMPLIED BY THE DEVELOPER OR THE DISTRIBUTOR ON THE ACCURACY OR THE RELIABILITY OF THIS PRODUCT.

THIS PRODUCT IS A PRACTICAL, POWERFUL, FAST AND EASY TOOL FOR STRUCTURAL BEAM ANALYSIS. HOWEVER, THE USER MUST EXPLICITLY UNDERSTAND THE BASIC ASSUMPTIONS OF THE SOFTWARE MODELING AND ANALYSIS ALGORITHMS AND COMPENSATE FOR THE ASPECTS THAT ARE NOT ADDRESSED.

THE INFORMATION PRODUCED BY THE SOFTWARE MUST BE CHECKED BY A QUALIFIED AND EXPERIENCED ENGINEER AS THERE MAY OCCURS SOME TECHNICAL ERRORS LIKE RUN TIME MEMORY ERRORS. THE ENGINEER MUST INDEPENDENTLY VERIFY THE RESULTS AND TAKE PROFESSIONAL RESPONSIBILITY FOR THE INFORMATION THAT IS USED.

Overview of the Program / About

Palikhe's BAP is a structural beam analysis software that can be used by Civil, Mechanical and Structural Engineers, Beam designers and Engineering students for both professional and academic purposes.

Palikhe's BAP 2016 which stands for **Palikhe's BEAM ANALYSIS PROGRAM 2016** is a stand-alone structural program for the analysis of structural beams. This package is efficient, powerful, and easy to use and the most important feature is that it is more accurate as it uses conventional approach instead of approximated FEM.

PBAP 2016 is object oriented program developed in C++ platform, meaning that the models are created using members that represent the physical reality i.e. real world problems. Multiple members like supports, loads, spans, and flexural stiffness are framed into a single model of beam object, just as it exists in real world.

In the development phase of this program, the developer had to do a modified research on "**Macaulay's Method solving multi-EI segmented Euler-Bernoulli's Beam and its Computational Approach: Load's Effect Method**" so this program is a first successful implementation of that research.

The program has interactive console mode menu options system to enter data through files and window, setting out model, run analysis, display output and further interpretation on output data. The program is relatively very fast as input is directly given through Ms-Excel files and the console mode itself is too fast to response. The output can be plotted in the same Ms-Excel file.

Credits / Developer

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CONTENTS

Chapter 1

Introduction

1.1) Palikhe's BAP 2016

Palikhe's BAP 2016 software package runs under console mode platform. All the executive modules are programmed in C++. This encompasses of storing, processing data to model a beam object so that further analyzing is done and finally output is saved for user interpretation. The program imports Input Data from Ms-Excel file filled up by Users.

It is very convenient, efficient and easy to add, delete or edit for User to Input Data as everything is supplied through Ms-Excel files. Every imported file has associated fixed name and format inside it; Users are compelled to enter within the format as the program extracts the data in the same format. After extraction of the Input Data, then a beam model is created from the Data which is then analyzed by Load's Effect Method to get Support Reactions, Shear Force, Bending Moment, Slope and Deflection.

Along with the output in Ms-Excel file, User can get analysis at fixed sections of his/her choice. Output file is left for user for his/her further interpretation like plotting to get values at sections and more.

1.2) Installation and Software Initialization

a) Copy the zip folder "**Palikhe's BAP 2016.zip**" and Extract it into a specified location.
b) Inside the extracted folder "**Palikhe's BAP 2016**" Run **PBAP 2016.exe.**

Make sure that your software package contains at least these six files:

a) PBAP 2016.exe : Main executive file to run
b) LOAD.jpg : Shows loads and their codes
c) SUPPORT.jpg : Shows supports and their codes
d) MANUAL.pdf : Documentation for Users (this manual)
e) CREDITS.jpg : Shows Developer

Besides them you might see:

a) EI.csv : Shows EI contents to be entered.
b) LOAD.csv : Shows LOAD contents to be entered.
c) SUPPORT.csv : Shows SUPPORT contents to be entered.
d) OUTPUT.csv : Shows OUTPUT contents.

Note: These above four files are automatically initially generated by the software.

Chapter 2

Sign conventions and Units

2.1) Sign Conventions

The program does beam analysis by analyzing from left side of beam and it too uses our general convention (sagging means +ve and hogging means -ve) so

a) Supply upward directed **(against of gravity) Loads as +ve** values and supply downward directed **(gravity directed) Loads as -ve** values.
b) Supply **clockwise pt_moments** as **+ve** values.
c) Supply **anti-clockwise pt_moments** as **-ve** values.
d) For **Equation Load** Supply signs as if the **Equation Load** is **acting on beam** but **not as if acting from the beam**.
e) Supply **Clockwise Rotation** positive and vice-versa.
f) Supply **Downward Deflection** negative and vice-versa.
g) **UNITS: [kN, m, rad].**

Note: In output file, everything follows above conventions like up +ve, down –ve, clockwise +ve and anticlockwise –ve, but the output slope clockwise means -ve and vice-versa.

2.2) Units

Length	:	meter (m)
Load	:	kN
Angle	:	rad
Moment	:	kNm
E	:	kN/m^2
I	:	m^4

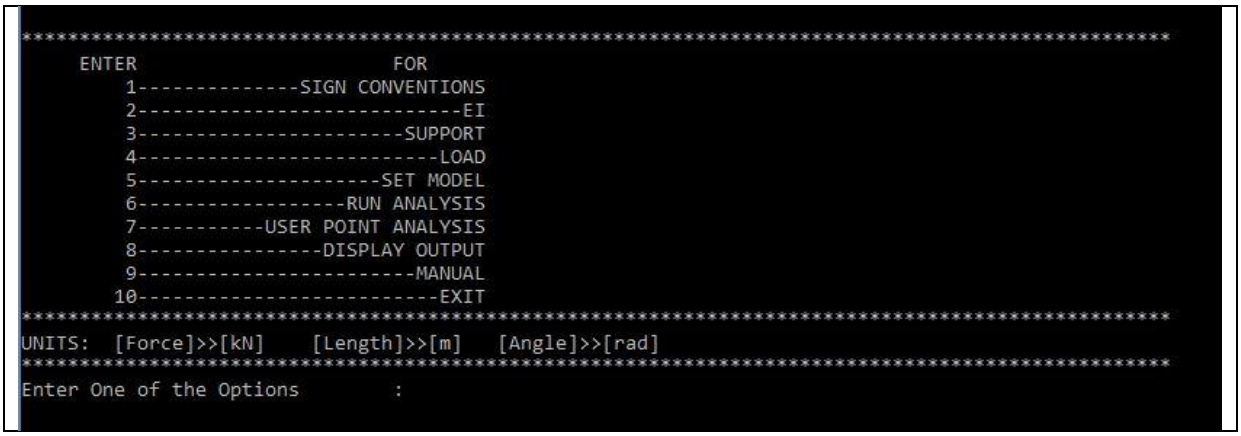
Note: The program makes no **unit conversion** i.e. follows the consistent units so if user give inputs in varying units then he/she needs to be careful for it. Either user need to enter in above units or in his/her unit system. If he/she uses his/her unit system, then he must be aware of units that the program displays don't actually represent them; just read values.

Chapter 3

Step-wise Procedure

3.1) Run PBAP 2016.exe

Main Option Menu is displayed as you run **PBAP 2016.exe**



Here, in order to facilitate for User, step-wise oriented options procedure need to be followed. But, if you become more familiar with the software, you can override steps for example, if you have previous input files then you may directly set model instead of entering inputs at first and so on.

ENTER	FOR	REMARK
1	SIGN CONVENTIONS	Displays Sign Conventions (Refer Chapter-2)
2	EI	Displays EI file for INPUT
3	SUPPORT	Displays SUPPORT file for INPUT
4	LOAD	Displays LOAD file for INPUT
5	SET MODEL	Set BEAM model using all the INPUTS
6	RUN ANALYSIS	Analyzes the BEAM model
7	USER POINT ANALYSIS	To find analysis at specific sections
8	DISPLAY OUTPUT	To display OUTPUT file
9	MANUAL	To get help and other details of this software
10	EXIT	To exit the software

3.2) OPTION 1>>Sign Conventions

(Refer Chapter-2.1)

3.3) OPTION 2>>EI

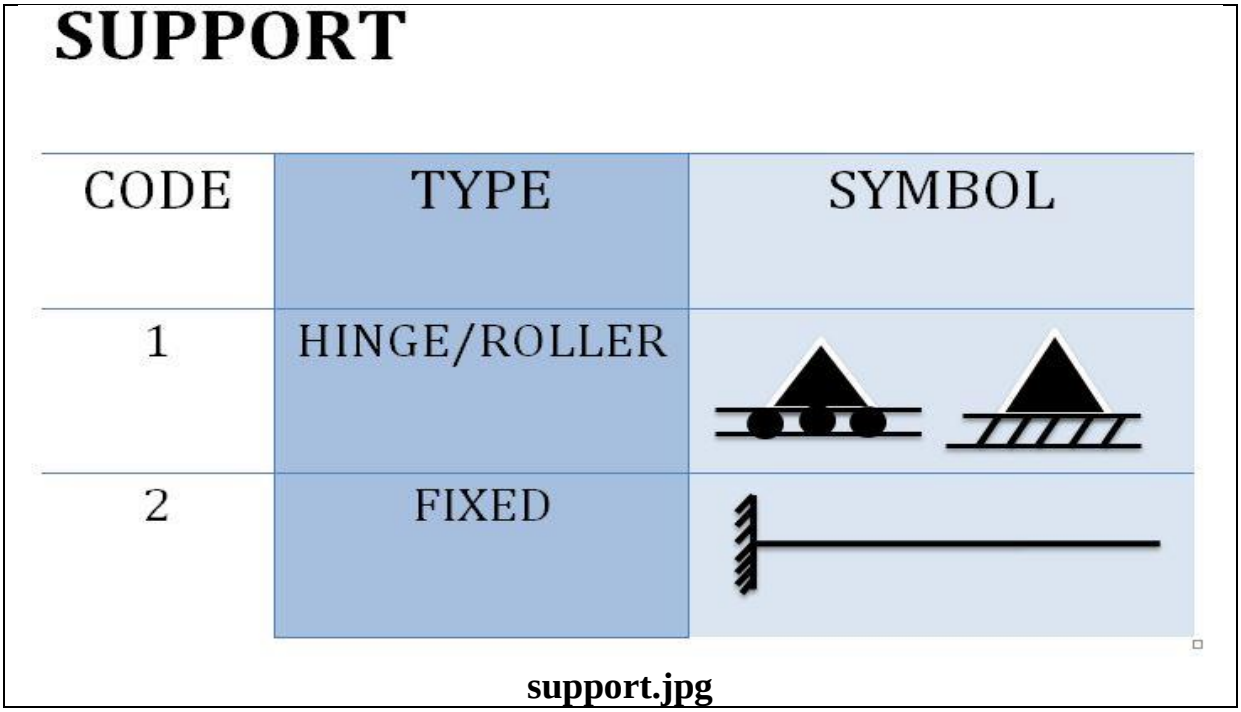
	A	B	C
1	E		
2	I		
3	S.N.	EI_Range	Rel_EI
4			
5			
6			
7			
8			

EI.csv

1) Here user gives value of **E in B1cell** and **I in B2 cell**.
2) Similarly, **S.N. as per the no of spans** of the beam based on flexural stiffness EI segmented.
3) **EI_range** stands for **length of each EI** segmented span.
4) **Rel_EI** stands for **Relative Value** of EI for the span.
5) All the data must be entered in **sequence order** of span from **left end to right end** of beam.

3.4) OPTION 3>>SUPPORT

It will display two files- "support.jpg" and "SUPPORT.csv" respectively as below:



support.jpg

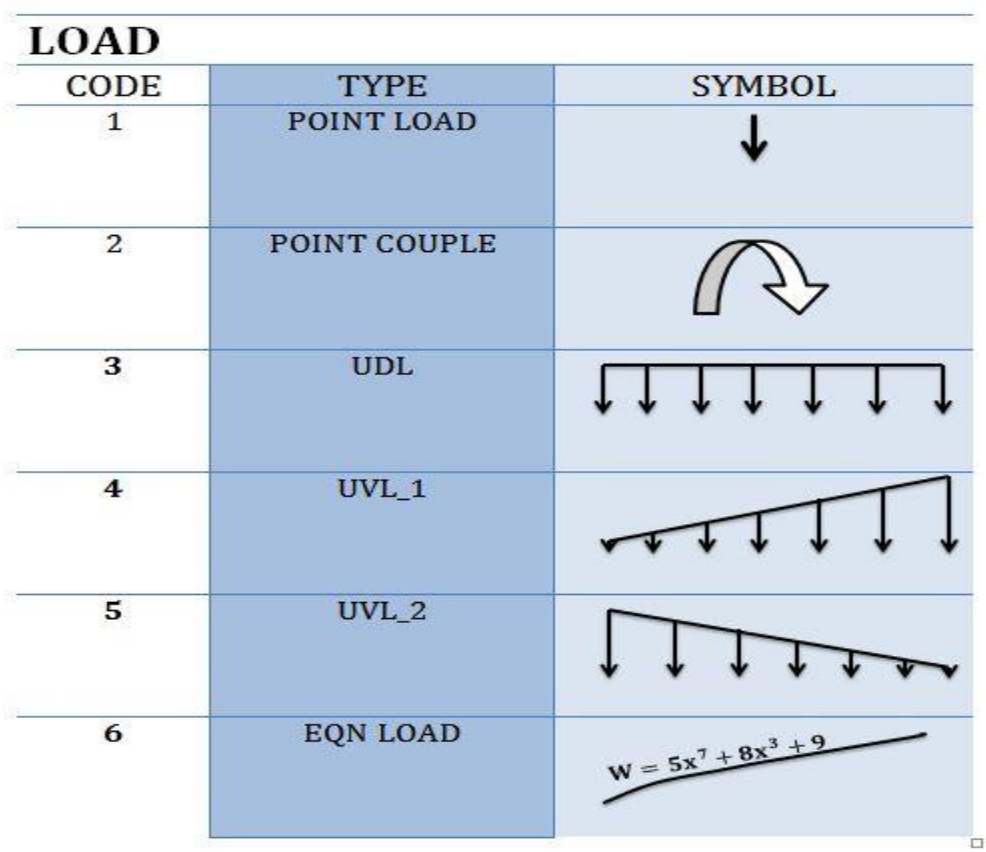
	A	B	C	D	E	F	G
1	S.N.	CODE	POSITION	SUP_ROT	SUP_DIS	F_RXN	M_RXN
2							
3							
4							
5							
6							

SUPPORT.csv

1) Here for the **CODE** in the csv file, refer the "support.jpg".
2) **POSTION** stands for location of support from left end of the beam.
3) Supply **SUP_ROT** as +ve for clockwise and **SUP_DIS** as –ve for downward support displacement; all as per the sign conventions (Chapter-2.1).
4) User need not to fill **F_RXN** and **M_RXN** as they are filled up after Reaction Calculation automatically.

3.5) OPTION 4>>LOAD

It will display two files- "load.jpg" and "LOAD.csv" respectively as below:



load.jpg

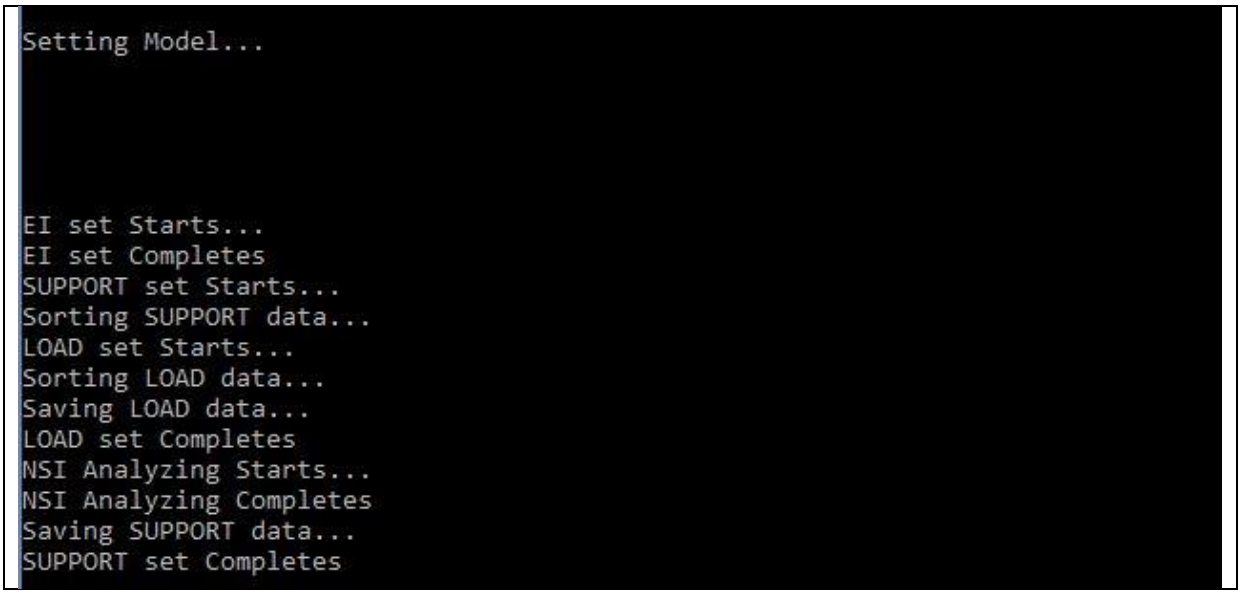
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	S.N.	CODE	ST_POINT	RANGE	END_POINT	VAL	NET_VALUE	APPLY_PT	DEGREE	coeff x^0	coeff x^1	coeff x^2	coeff x^3
2													
3													
4													
5													

LOAD.csv

1) Here for the **CODE** in the csv file, refer the "load.jpg".
2) **ST_POINT** stands for starting section of the load from left end of the beam.
3) **RANGE** stands for length of that load.
4) **END_POINT** stands for ending section of that load from left end of the beam.
5) **VAL** represents for value of load, refer Sign-conventions (Chapter-2.1).
6) **NET_VALUE** is automatically filled by program so do nothing.
7) **APPLY_PT** stands for cg location which is automatically filled by program.
8) **DEGREE** stands for degree of **Eqn Load** so use this for eqn load only.
9) Similarly user needs to fill **coefficients** for **Eqn Load** only.

NOTE: Save, **Replace** and **Close** the above "**csv**" files from the above 2, 3, 4 options.

3.6) OPTION 5>>SET MODEL



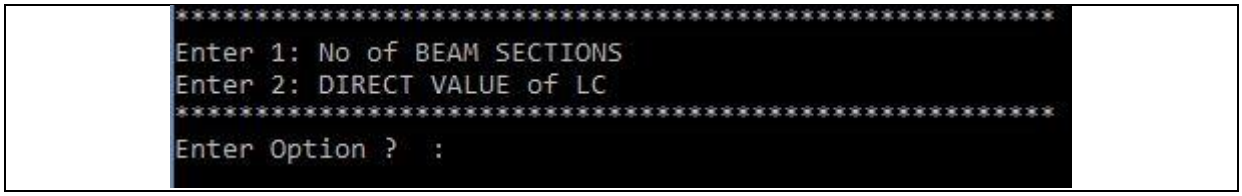
This option sets a model of beam using all the INPUT DATA given by user. Each time you make some edit to the above files- "EI.csv", "SUPPORT.csv" or "LOAD.csv", you need to run this option so that new changes in the above files are implemented to make the new model of beam.

3.7) OPTION 6>>RUN ANALYSIS

Leastcount is the multiple for sections of the beam; the program would analyze for graph plotting data.

The default **leastcount** is $\frac{1}{1000} of\ beam\ length$ i.e. by default program can have 1000 sections for beam analysis.

If you change default; you will have two options:



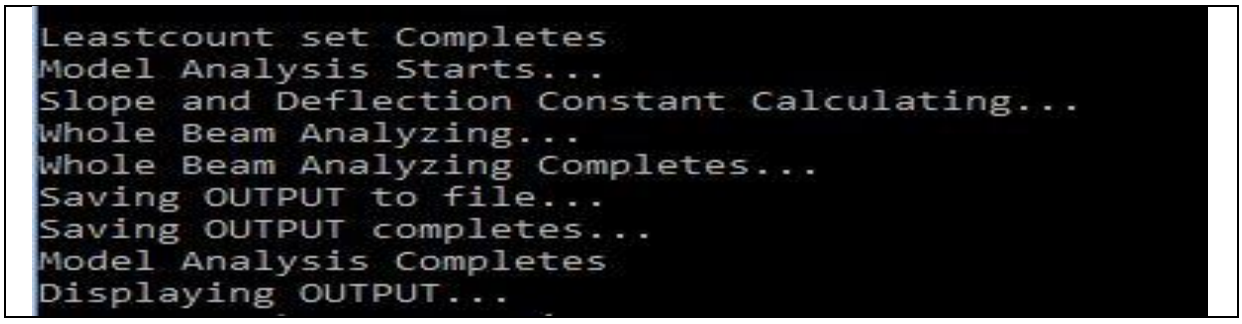
1) No of BEAM SECTIONS ?

   Means how many sections you want to be analyzed.

2) DIRECT VALUE of LC?
   Means what value of **leastcount** you want to give.

   For e.g. if the beam is 12m and you want 12 sections then following option_1 input "12" or following option_2 input "1" because here 12 means "12" sections for 12m each @ 1m and "1" means 1m leastcount i.e. 12 sections for 12m.

After that the beam model will be analyzed and output will be displayed.



S.N.	POSITION	SF LEFT	SF RIGHT	BM LEFT	BM RIGHT	SLOPE	DELECTION
0	0	0	24.3557	0	-38.7672	-2.86E-06	0
1	1	19.3557	19.3557	-16.9115	-16.9115	-13.7113	-7.76632
2	2	14.3557	14.3557	-0.05584	-0.05584	-17.7448	-24.1967
3	3	9.35567	9.35567	11.7998	11.7998	-14.6005	-40.8634
4	4	4.35567	4.35567	18.6555	18.6555	-6.77835	-51.8385
5	5	-0.64433	-0.64433	20.5112	20.5112	3.22165	-53.6942
6	6	-5.64433	-5.64433	17.3668	17.3668	9.67354	-47.1592
7	7	-10.6443	-10.6443	9.2225	9.2225	14.244	-34.9742
8	8	-15.6443	-15.6443	-3.92183	-3.92183	15.2663	-19.854
9	9	-20.6443	-20.6443	-22.0662	-22.0662	11.0739	-6.17984
10	10	-25.6443	0	-45.2105	0	-1.43E-06	0

By using Excel commands and menus plot the graph of your requirement.

3.8) OPTION 7>>USER'S POINT ANALYSIS

This option of main screen has two purposes specially

a) To get exact values at exact locations in significant digits that may not be clear from graph accurately to few decimals.
b) To work it simultaneously and side by side with graph analysis.

Note: This additional facility has nothing to do with program output; it is independent of outputs of program. So users may run analysis after this option too.

3.9) OPTION 8>>DISPLAY OUTPUT

This option displays the OUTPUT file. So this option works only if model is analyzed.

3.10) OPTION 9>>MANUAL

This option displays User's Guide; the same this pdf.

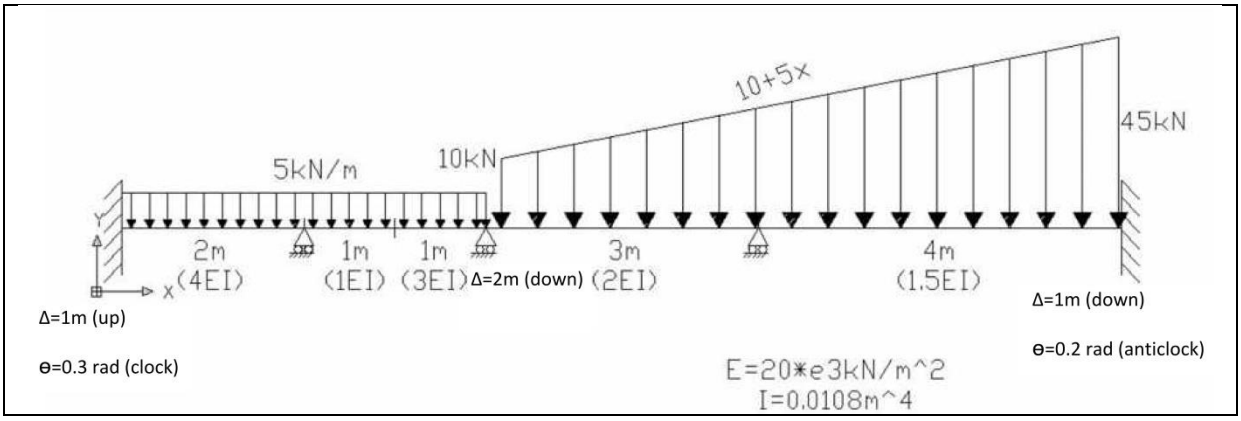
3.11) OPTION 10>>EXIT

This option exits the program giving Credits at last.

Chapter 4

Tutorial

4.1) A Problem



4.2) Solution

After you run the exe file you will get this option menu

```
**********************************************************************************************************
     ENTER                    FOR
         1--------------SIGN CONVENTIONS
         2----------------------------EI
         3-----------------------SUPPORT
         4--------------------------LOAD
         5---------------------SET MODEL
         6------------------RUN ANALYSIS
         7-----------USER POINT ANALYSIS
         8---------------DISPLAY OUTPUT
         9-----------------------MANUAL
        10--------------------------EXIT
**********************************************************************************************************
UNITS:  [Force]>>[kN]    [Length]>>[m]   [Angle]>>[rad]
**********************************************************************************************************
Enter One of the Options        :2
```

Enter option 2 to Fill the **"EI.csv"** file as below:

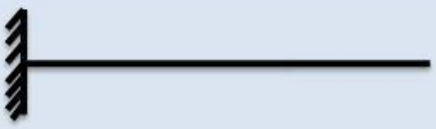
	A	B	C	D	E	F	G
1	E	20000					
2	I	0.0108					
3	S.N.	EI_Range	Rel_EI				
4	1	2	4				
5	2	1	1				
6	3	1	3				
7	4	3	2				
8	5	4	1.5				

Then again in the main menu enter option 3:

```
**********************************************************************************************************
     ENTER                    FOR
         1-------------SIGN CONVENTIONS
         2---------------------------EI
         3-----------------------SUPPORT
         4-------------------------LOAD
         5--------------------SET MODEL
         6------------------RUN ANALYSIS
         7-----------USER POINT ANALYSIS
         8---------------DISPLAY OUTPUT
         9-----------------------MANUAL
        10---------------------------EXIT
**********************************************************************************************************
UNITS:  [Force]>>[kN]    [Length]>>[m]   [Angle]>>[rad]
**********************************************************************************************************
Enter One of the Options        :3
```

Take help of "**SUPPORT.jpg"** to Fill the **"SUPPORT.csv"** file.

SUPPORT

CODE	TYPE	SYMBOL
1	HINGE/ROLLER	
2	FIXED	

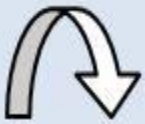
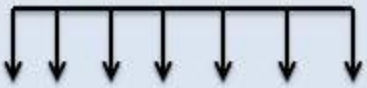
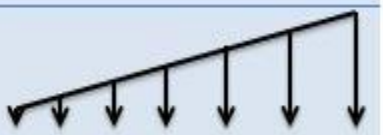
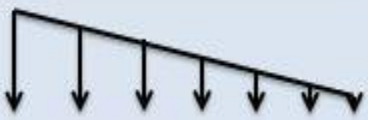
	A	B	C	D	E	F	G	H	I	J	K
1	S.N.	CODE	POSITION	SUP_ROT	SUP_DIS	F_RXN	M_RXN				
2	1	2	0	0.3	1						
3	2	1	2	0	0						
4	3	1	4	0	-2						
5	4	1	7	0	0						
6	5	2	11	-0.2	-1						
7											
8											
9											
10											

Then again in the main menu enter option 4:

```
**********************************************************************************************************
     ENTER                    FOR
         1-------------SIGN CONVENTIONS
         2---------------------------EI
         3-----------------------SUPPORT
         4-------------------------LOAD
         5--------------------SET MODEL
         6-----------------RUN ANALYSIS
         7-----------USER POINT ANALYSIS
         8---------------DISPLAY OUTPUT
         9-----------------------MANUAL
        10--------------------------EXIT
**********************************************************************************************************
UNITS:  [Force]>>[kN]    [Length]>>[m]   [Angle]>>[rad]
**********************************************************************************************************
Enter One of the Options        :4
```

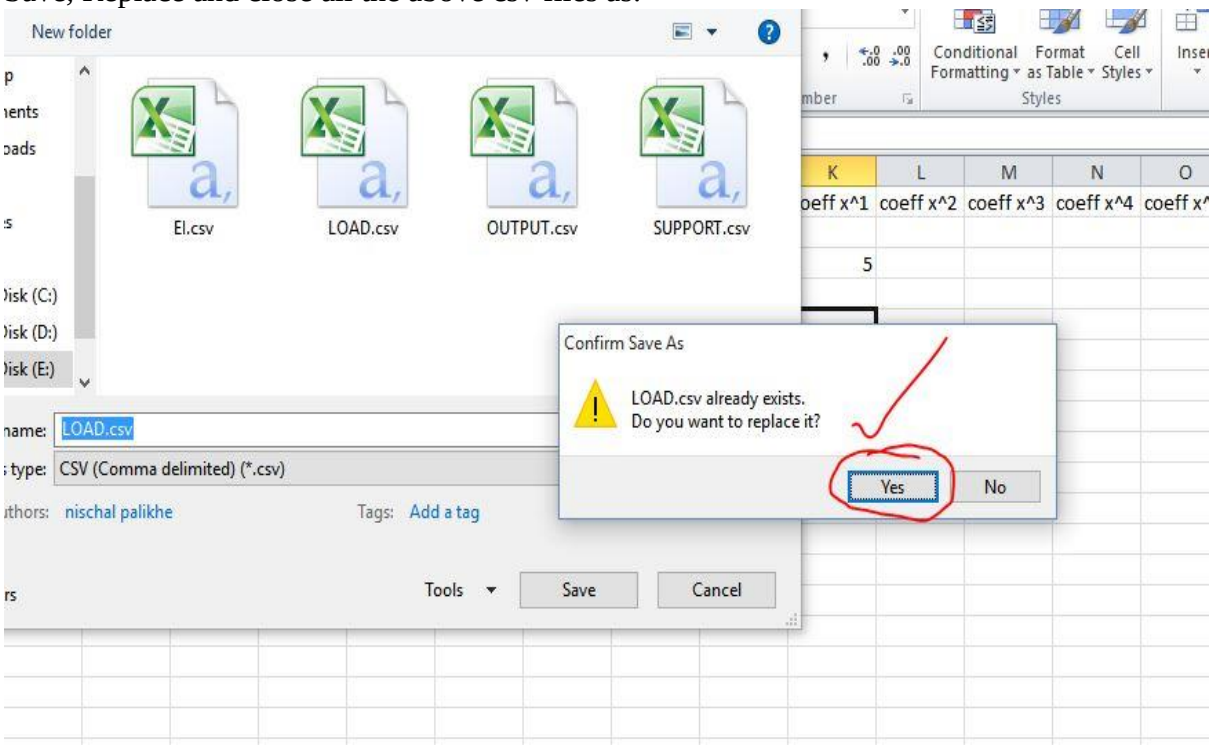
Take help of "**LOAD.jpg"** to Fill the **"LOAD.csv"** file.

LOAD

CODE	TYPE	SYMBOL
1	POINT LOAD	
2	POINT COUPLE	
3	UDL	
4	UVL_1	
5	UVL_2	
6	EQN LOAD	$W = 5x^7 + 8x^3 + 9$

S.N.	CODE	ST_POINT	RANGE	END_POIN	VAL	NET_VALU	APPLY_PT	DEGREE	coeff x^0	coeff x^1	coeff x^2	coeff x^3	coeff x^4	coe
1	3	0	4	4	-5									
2	6	4	7	11				1	10	5				

Save, Replace and close all the above csv files as:



Then **SET MODEL** and **RUN ANALYSIS using OPTION 5 and OPTION 6** respectively

```
Leastcount setting...
Change default leastcount        <1:1000> (y/n) ?         :n
```

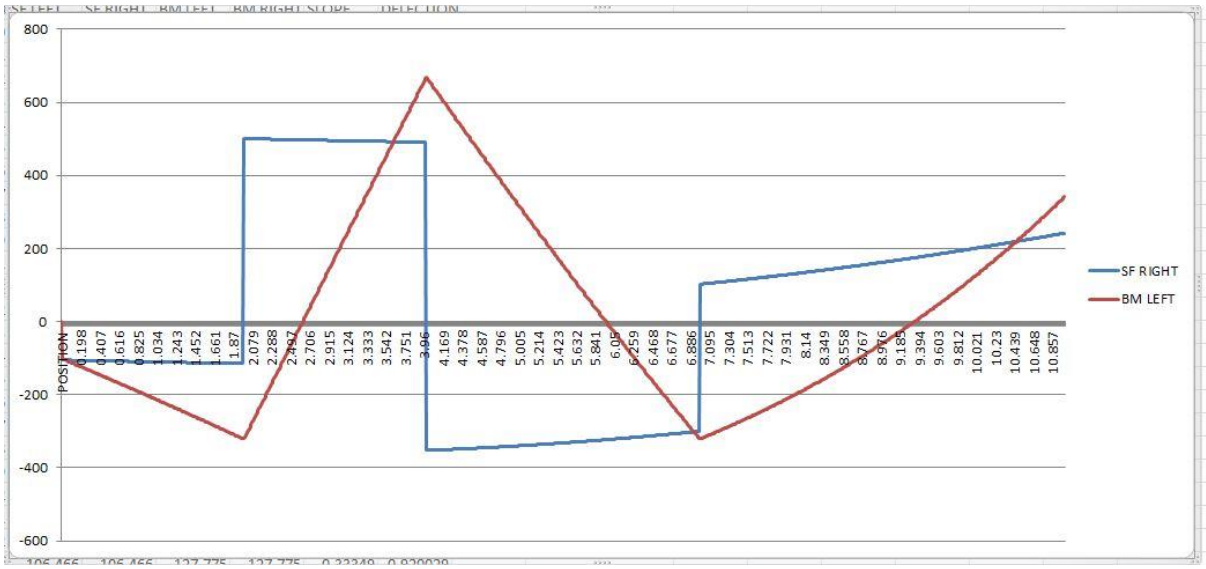
Then displays the **output**:

S.N.	POSITION	SF LEFT	SF RIGHT	BM LEFT	BM RIGHT	SLOPE	DELECTION
0	0	0	-105.201	0	-100.999	-0.3	1
1	0.011	-105.256	-105.256	-102.156	-102.156	-0.30129	0.996693
2	0.022	-105.311	-105.311	-103.314	-103.314	-0.3026	0.993371
3	0.033	-105.366	-105.366	-104.473	-104.473	-0.30392	0.990036
4	0.044	-105.421	-105.421	-105.632	-105.632	-0.30526	0.986685
5	0.055	-105.476	-105.476	-106.792	-106.792	-0.30661	0.98332
6	0.066	-105.531	-105.531	-107.953	-107.953	-0.30798	0.97994
7	0.077	-105.586	-105.586	-109.114	-109.114	-0.30936	0.976544
8	0.088	-105.641	-105.641	-110.276	-110.276	-0.31076	0.973134
9	0.099	-105.696	-105.696	-111.438	-111.438	-0.31217	0.969707
10	0.11	-105.751	-105.751	-112.601	-112.601	-0.3136	0.966266
11	0.121	-105.806	-105.806	-113.765	-113.765	-0.31504	0.962808
12	0.132	-105.861	-105.861	-114.929	-114.929	-0.31649	0.959335
13	0.143	-105.916	-105.916	-116.094	-116.094	-0.31796	0.955845
14	0.154	-105.971	-105.971	-117.259	-117.259	-0.31945	0.95234
15	0.165	-106.026	-106.026	-118.425	-118.425	-0.32095	0.948817
16	0.176	-106.081	-106.081	-119.592	-119.592	-0.32246	0.945279
17	0.187	-106.136	-106.136	-120.759	-120.759	-0.32399	0.941723
18	0.198	-106.191	-106.191	-121.927	-121.927	-0.32554	0.938151
19	0.209	-106.246	-106.246	-123.095	-123.095	-0.3271	0.934561
20	0.22	-106.301	-106.301	-124.264	-124.264	-0.32867	0.930955

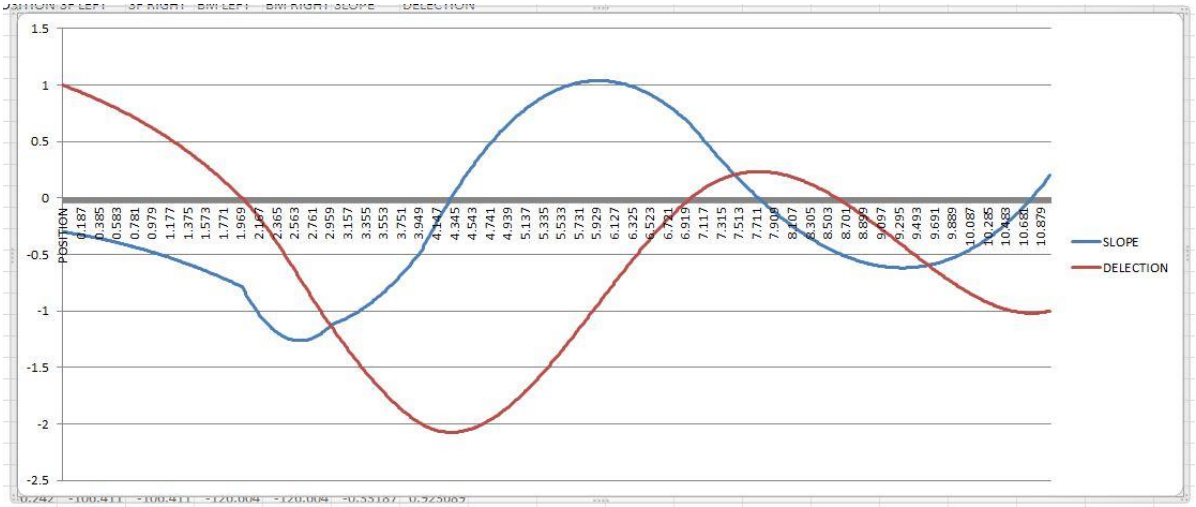
Note: Enter **SUPPORT option 2** to view support reactions.

Then plot your requirement

V and M:



θand Δ:



Note:

Professional decision is the primary decision of an Engineer than the analysis output given by any software.