

VALIDATION OF FIXED-END BEAM ANALYSIS WITH UNIFORM LOADS USING ANDROID- BASED APPLICATIONS

ABSTRACT

The beam structure is an essential structural element to construction professionals, and most engineers must be familiar with beams. The type of beam structure discussed in this article is a fixed-end beam structure with uniform loads. Calculating the forces and structural deformations manually takes longer and requires good accuracy. Various software and applications can be installed easily in this increasingly sophisticated era. The Easy Beam Analysis Application is one application that can be used to obtain internal forces and structural deformations quickly and accurately. Easy Beam Analysis is an Android-based application that can be installed via the Play Store. In this article, fixed-end beam structures with uniform loads are modelled and analyzed using the Easy Beam Analysis Application. This article aims to validate the results of manual calculations according to the static equilibrium requirements, especially fixed-end beams with uniform loads. This article will also validate it by manual accounting according to static equilibrium requirements. Furthermore, the analysis results with the Easy Beam Analysis Application and manual calculations have been obtained and validated. It can be seen that the results of the analysis do not have a significant difference. So, it can be concluded that structural analysis with the Easy Beam Analysis Application can be a fast and accurate solution.

Keywords: fixed-end beam, Easy Beam Analysis, uniform loads

1. INTRODUCTION

[The beam structure is an important structural element to construction professionals, and most engineers must be familiar with beams. These structures play an important role in how weight is transferred and ensure that the foundation of the building is firmly anchored in the ground. The most common types of beam structures include simple beams, cantilever beams, fixed-ended beams, continuous beams, and so on. Beam structure is very important to understand in construction and structural engineering because beams are the first to carry the weight of a building. The type of beam structure discussed in this article is a fixed-end beam structure with uniform loads. The structural analysis of fixed-end beams includes a scientific discipline that studies the forces and shifts in a system due to loads acting on the structure [1]. The fulcrum is where the construction rests and the reaction works. The type of support influences the type of construction because each style has its characteristics. In the structural analysis, it is known that there are three types of supports, namely pin supports, roll supports, and fixed supports. Beams with fixed ends (tightly anchored) are constructed to resist translation and rotation. The ends of the beam are locked so tightly that they do not move or rotate due to the moment. In terms of static equilibrium [2] 3 equations are available, namely $\Sigma F_x = 0$, $\Sigma F_y = 0$, and $\Sigma M_z = 0$. Static equilibrium equations can calculate support reactions if the structure belongs to a specific static system. In general, the calculation of support reactions on a structure is necessary and must be carried out before calculating the forces and deformation of the structure.

35 Calculating the forces and structural deformations numerically takes longer and requires
36 good accuracy. Various software and applications can be installed easily in this increasingly
37 sophisticated era. One application [3] that can quickly and accurately obtain internal forces
38 and structural deformations is the Easy Beam Analysis Application. Easy Beam Analysis is
39 an Android-based application that can be installed for free via the play store. The Easy
40 Beam Analysis application can be used to obtain internal forces and structural deformations
41 quickly and accurately. The Easy Beam Analysis application can easily and quickly calculate
42 reaction forces, shear forces and bending moments, slope, deflection and stress diagrams
43 for beam analysis. The Easy Beam Analysis application follows the principles of statics and
44 dynamics, materials mechanics, and solids mechanics and is thus highly applicable to
45 structural engineering and mechanical engineering. Easy Beam Analysis is the perfect App
46 for engineering students to accompany homework problems and check solutions to statics,
47 materials mechanics or solids mechanics. It is also very useful for professionals in structural
48 and mechanical engineering to make quick calculations regarding beam calculations. Easy
49 Beam Analysis supports two modes: Statically Determined Beam and Continuous Beam [4]-
50 [7]. This article aims to validate the results of manual calculations according to the static
51 equilibrium requirements, especially beams with uniform loads. This article will also validate
52 it by manual analysis according to static equilibrium requirements.]

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2. METHODOLOGY

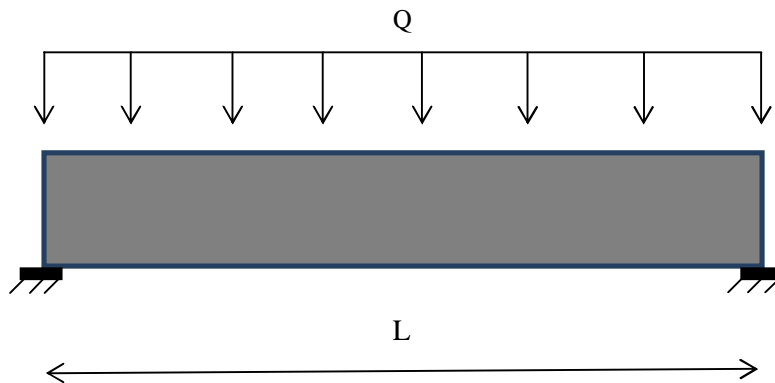
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[The fixed-end beam structure is modelled and analyzed in this article using the Easy Beam
56 Analysis Application [8]-[11]. Then the case studies to be completed are shown in Figure 1.
57 The steps for modelling and analysis with the Easy Beam Analysis Application are shown as
58 a flowchart in Figure 2. The data used in the modelling and analysis are as follows:

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- a. Distributed loads (q) = 7 t/m;
- 60 b. Lengths (L) = 5 m;
- 61 c. Frame element = default software.

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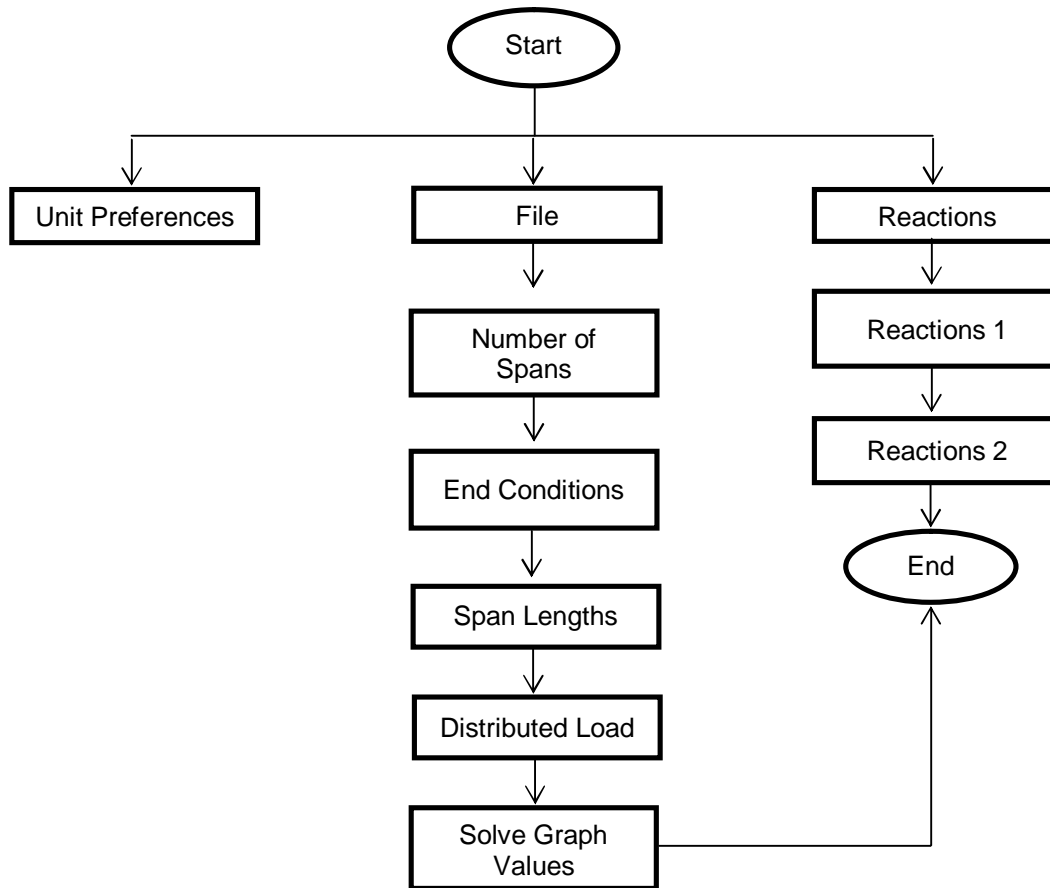


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Fig. 1. Case study

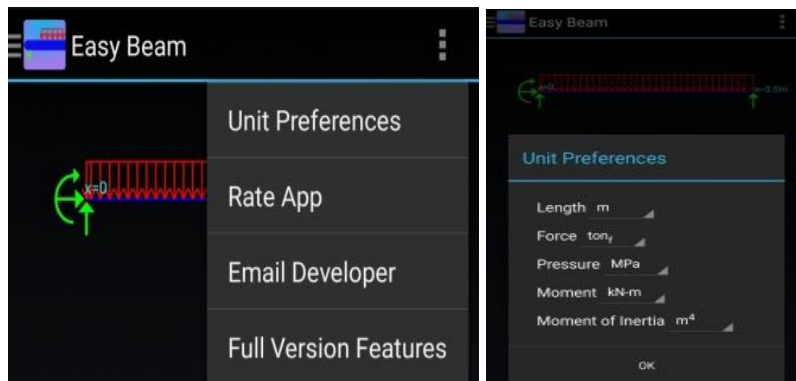


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Fig. 2. Flow chart

Next, the steps for running the Easy Beam Analysis Application are shown to analyse fixed-end beam structures with uniform loads.

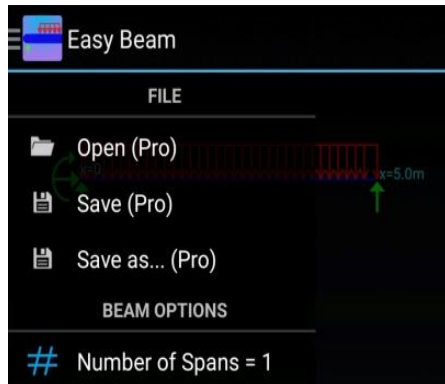
- a. Select settings (top right three dots) > unit preferences > input units to be used (Figure 3)



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Fig. 3. Unit preferences

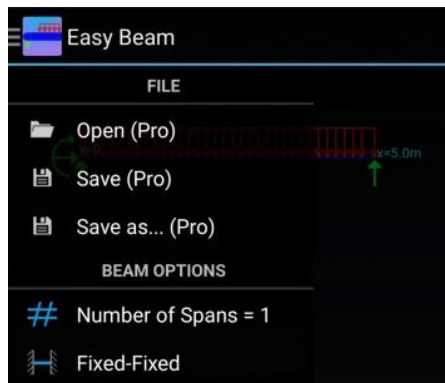
- b. Select file (top left) > number of spans > fill in the number of spans (Figure 4)



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Fig. 4. Number of spans

- c. Select file (top left) > end condition > select pinpoint base (Figure 5)



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Fig. 5. End condition

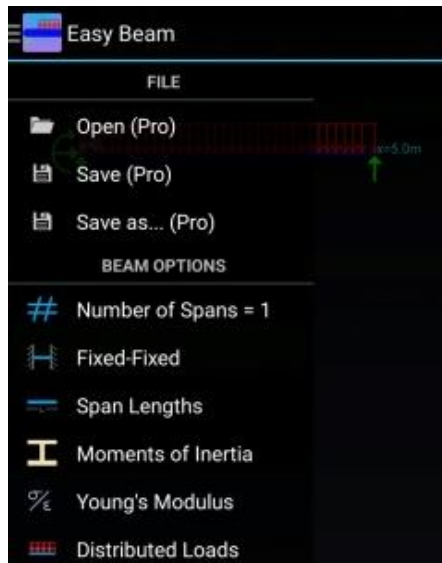
- d. Select file (top left) > span length > input beam span (Figure 6)



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Fig. 6. Span lengths

- e. Select file (top left) > distributed loads > input distributed loads (Figure 7)



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Fig. 7. Distributed loads

- f. Select the file (top left) > solve for the graph value > see the output of the internal force (Figure 8)



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Fig. 8. output internal force]

3. RESULTS AND DISCUSSION

Results

[Analysis of fixed-end beam structures with the Easy Beam Analysis Application has been obtained. The analysis results are shown as shear force diagrams and bending moment

113 diagrams. Furthermore, the results obtained from the Easy Beam Analysis Application are
 114 recapitulated and validated with the results of manual calculations that have been adjusted
 115 to the static equilibrium requirements (Table 1).
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117 **Table 1. Validation of result**

	SFD		BMD	
	Max (ton-m)	Min (ton-m)	Max (ton-m)	Min (ton-m)
Easy Beam Analysis	17,5	17,5	6,6	13,3
Manual	17,5	17,5	7,3	14,5

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119 **Discussion**

120 The validation of the analysis results using the Easy Beam Analysis Application and the
 121 manual shows a difference in the value, but it is insignificant. In Figure 8, the moment is
 122 shown in kN-m units, so it needs to be converted to ton-m units.]
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124 **4. CONCLUSION**

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126 [In this article, manual calculations have discussed and validated the results of the analysis
 127 of fixed-end beam structures with the Easy Beam Analysis Application. It can be seen that
 128 the analysis results obtained did not have a significant difference. So, it can be concluded
 129 that structural analysis with the Easy Beam Analysis Application can be a fast and accurate
 130 solution.]
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