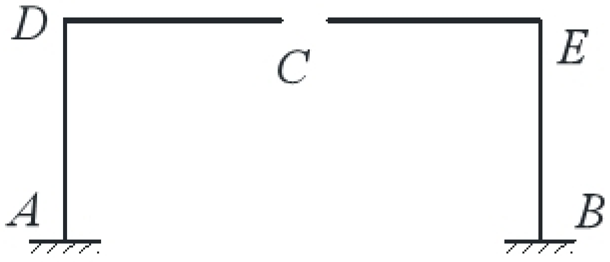
We have realised that our former structure is too complicated, so we simplify our structure and redo our project deliverables.

Structure layout

- Identify the components of the structure

Rods and hinges, the detailed information of the material of the rods will be specificated and modified in the section of probabilistic analysis.

- Draw a simplified skeleton of the structure

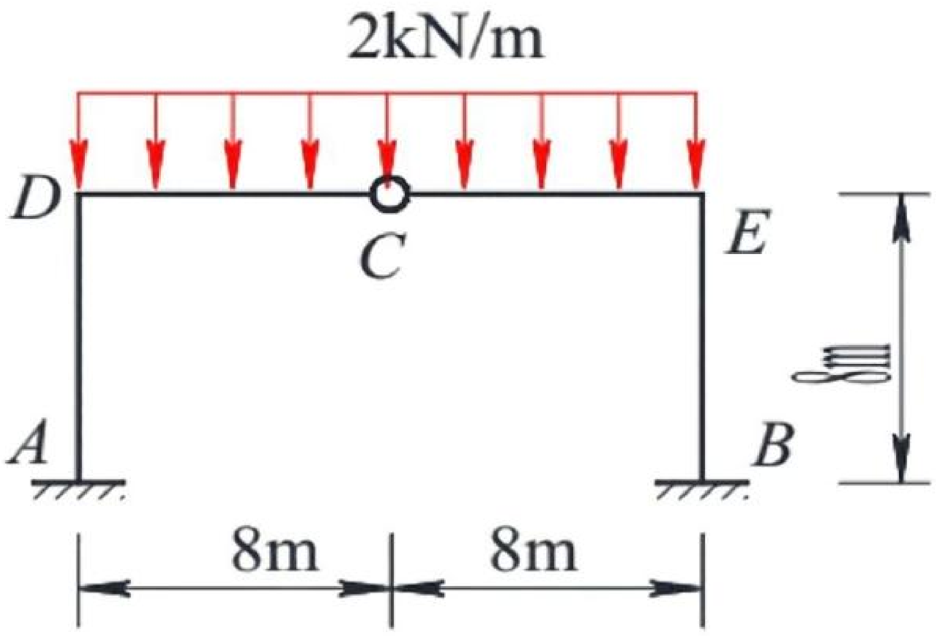


- Identify the connections among elements(boundary conditions)

The two parts of the structure are combined by a hinge point, A and B are the fixed ends.

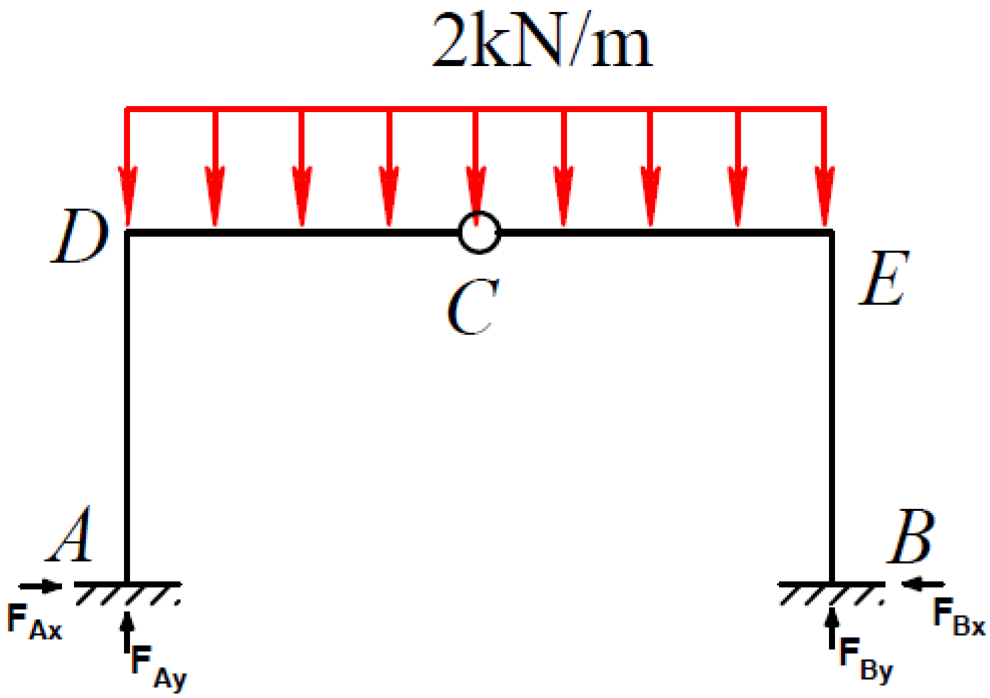
Loads

- Identify dead loads for your structure



Unit DC and unit CE are subjected to a vertically downward uniform load of 2KN/M.

- Draw the free body diagrams of components



- Identify how the load id transmitted among elements

From what I've learned in vibration mechanics, the transfer of loads in a structure can only be analyzed if dynamic loads are involved. Our structure is statically determinate, if there is any way to analyze force transfer in a statically determinate structure, please tell us in ed.

Analysis of the Structure by the Force Method

这里把吴亚桐那个word照搬过来就行，不过要把里面的中文都翻译成英文

Uncertainties

- Formulas in mechanics of materials

The normal stress at any point on the cross section of a straight beam which is only bending is:

$\sigma = \frac{My}{I_z}$

Where:

M: Bending moment in cross section.

I_z: The moment of inertia of the cross section about the neutral axis z.

y: The ordinate of the desired stress point.

When the neutral axis z is the symmetry axis of the cross section, the maximum normal stress on the cross section is:

$\sigma_{max} = \frac{My_{max}}{I_z}$

If

$W_z = \frac{I_z}{y_{max}}$

Thus

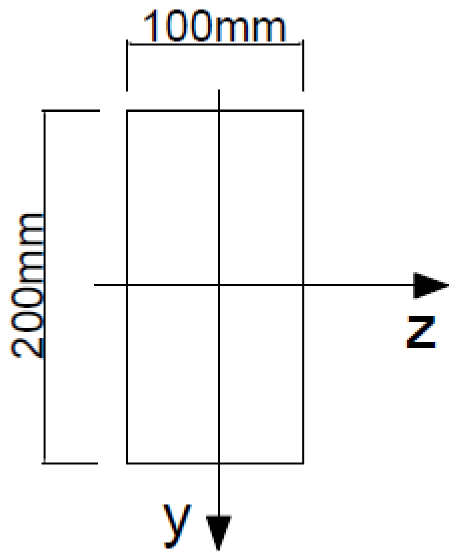
$\sigma_{max} = \frac{M}{W_z}$

In the formula, W_z is called the bending section coefficient.

As for rectangular section:

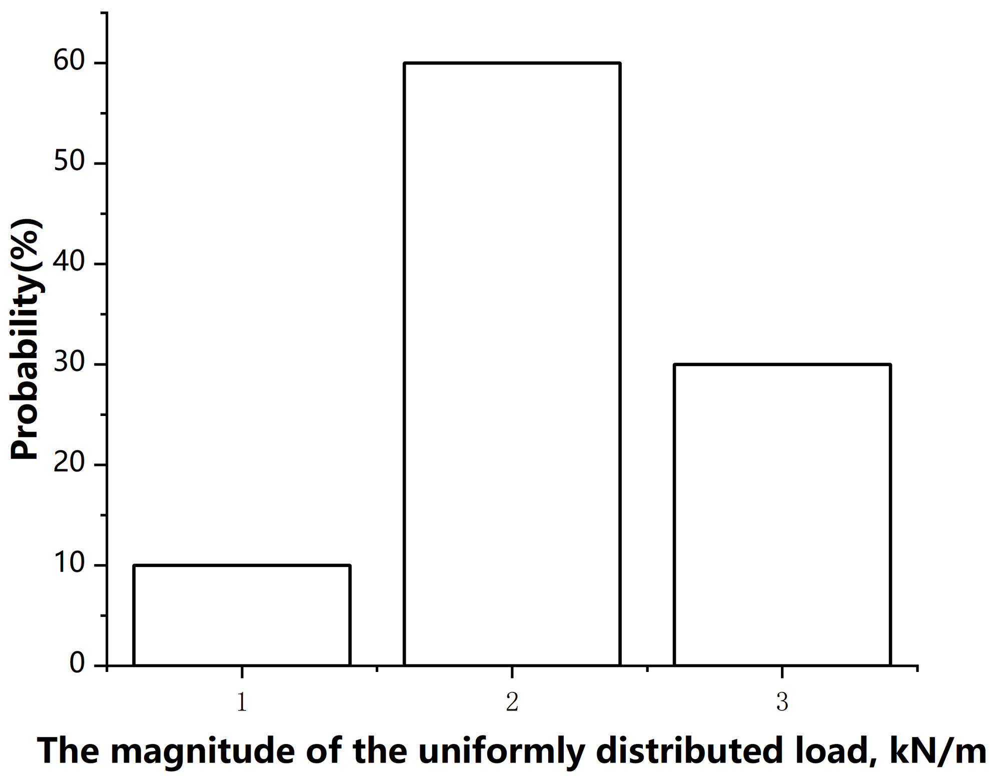
$$W_z = \frac{I_z}{h/2} = \frac{bh^3/12}{h/2} = \frac{bh^3}{6}$$

We assume that the cross-section of the structure is a rectangular section, the dimensions of which are shown in the figure below:



- Assess the variability in the loads

Loads in specific engineering problems are generally not deterministic, and often exist according to specific distributions. There are three kinds of uniformly distributed loads on the structure we analyzed, and their magnitude and probability of occurrence are shown in the following figure.



At the same time, we assume that the tensile and compressive permissible stress of the material are:

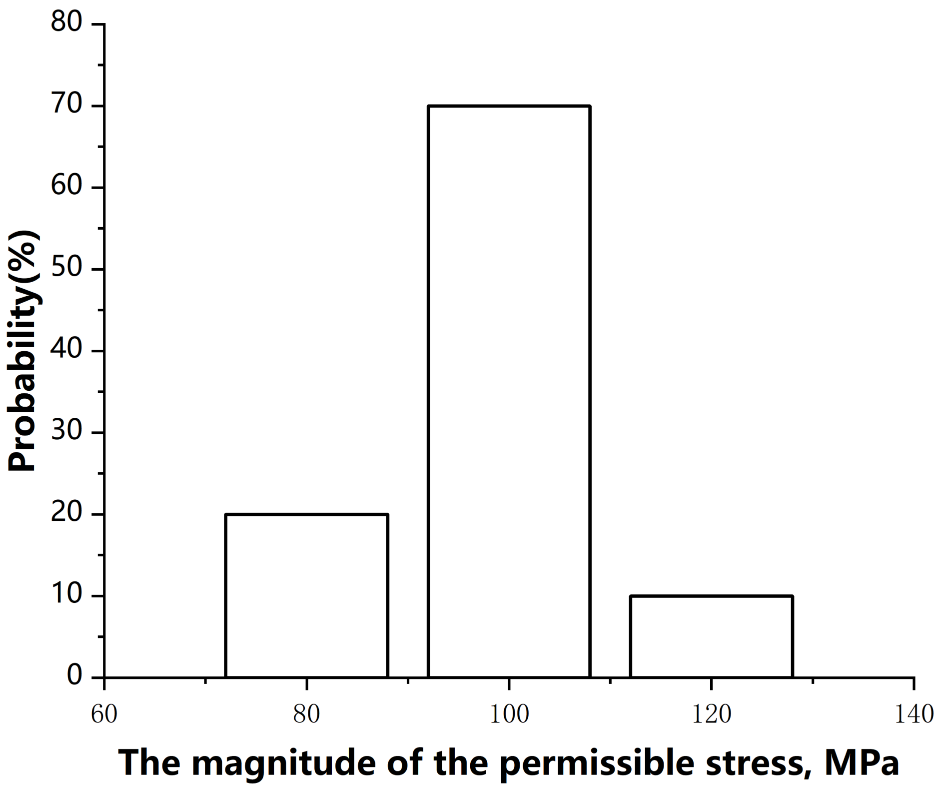
$[\sigma_t] = [\sigma_c] = 100MPa$

Therefore, we can get the safety and reliability of the structure under this load distribution through the following table.

Uniformly distributed load(kN/m)	**1**	**2**	**3**
Probability(%)	10	60	30
M_{max}(kN·m)	32	64	96
σ_{max}(kN/m)	48	96	144
Safety	Safe	Safe	Unsafe

- Assess the variability in material and geometri properties

Because of statistical and epistemic uncertainties of material, The permissible stress of a specific material is not a unique value, but should conform to a certain distribution. We assume that the uniformly distributed load $p = 2kN/m$, corresponding $\sigma_{max} = 96kN/m$The tensile and compressive permissible stress of the material conforms to the distribution shown in the figure below.



Therefore, we can get the safety and reliability of the structure under this permissible stress distribution through the following table.

Permissible stress(MPa)	**80**	**100**	**120**
Probability(%)	20	70	10
Safety	Unsafe	Safe	Safe

Conclusion

In the future, we will apply this methodology to specific materials other than hypothetical material. But we still have many questions, is our structure too simple? What other types of probabilistic analysis can we do? Are we heading in the right direction? Any advice and comment please put on ed so we can modify our structure and methodology as soon as possible.