SMALL DISPLACEMENTS IN STRUCTURAL ANALYSIS

2.2.1 Introduction

In structural analysis we will often make the assumption that displacements are *small*. This allows us to use approximations for displacements that greatly simplify analysis.

What do we mean by small displacements?

We take small displacements to be such that the arc and chord length are approximately equal. This will be explained further on.

Is it realistic?

Yes – most definitely. Real structures deflect very small amounts. For example, sways are usually limited to storey height over 500. Thus the arc or chord length is of the order 1/500th of the radius (or length of the member which is the storey height). As will be seen further on, such a small rotation allows the use of the approximation of small displacement.

Lastly, but importantly, in the analysis of flexural members, we ignore any changes in lengths of members due to axial loads. That is:

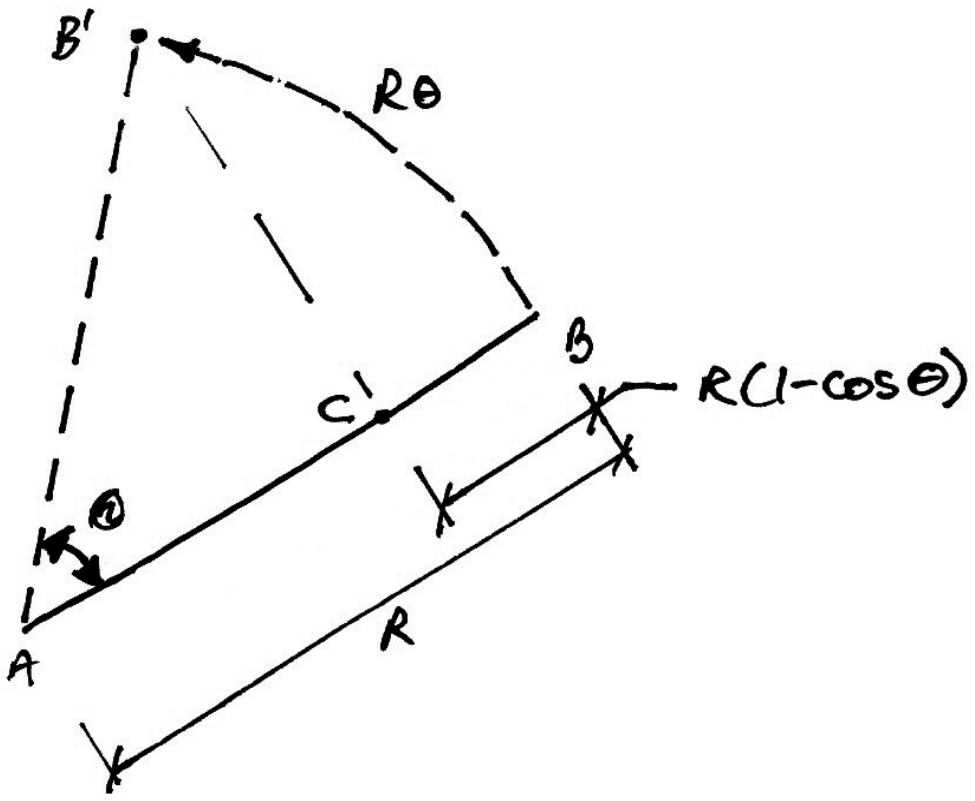
We neglect axial deformations – **members do not change length**.

This is because such members have large areas (as required for bending resistance) and so have negligible elastic shortening.

2.2.2 Derivation

Remember – all angles are in radians.

Consider a member AB, of length R, that rotates about A, an amount θ, to a new position B' as shown:



The total distance travelled by the point B is the length of the arc BB', which is $R\theta$.

There is also the 'perpendicular distance' travelled by B: CB'. Obviously:

$$CB' < BB'$$

Source : http://www.nprcet.org/e%20content/Misc/e-Learning/CIVIL/VI%20SEMESTER/10111CE602%20-%20Structural%20Analysis%20II.pdf