In this study the aim is to demonstrate the capabilities of a finite element program for the simulation of experimental rock deformation in axisymmetric extension. In a real experimental situation (Rutter, 1995) a temperature gradient exists along the deformed sample, although the aim is to minimize this effect through profiling of a hollow Al₂O₃ dummy sample at the apparatus calibration stage. In this modelling approach the effect of a temperature gradient in the visco-plastic behaviour of a cylindrical marble rock sample of 10 mm diameter and 20 mm length in extension has been studied. After incorporating necessary relationships in the main program and related subroutines, the program was run for temperature gradients of 10° and 20°. The calculated results in terms of deformed shape for axisymmetric extension up to 20% bulk strain are demonstrated. The obtained results of these applications show that: (a) increasing the temperature gradient enhances the necking tendency and (b) the specimen shape is always concave outwards. Outward convexity is an observed characteristic (Rutter, 1997) of real deformed specimens that display extreme necking.

In the next stage to consider the effect of temperature gradient in the formation of neck instability at higher strain, the program was run with temperature gradients of 10° in axisymmetric extension up to 40% bulk strain. The calculated results of this application illustrate that deformation becomes more concentrated at the centre of the sample, but the shape of elements at the specimen surface implies the existence of significant shear stress component.