In this study, a new apparatus which have new jaw clutch mechanism is designed to determine the direct tensile strength of rocks. The determination of the direct (with new apparatus) and indirect tensile strength as Brazilian test method of travertine rock was carried out in compliance with related standard test methods. In order to analyse rock tensile strength between direct and indirect test methods was conducted and obtained results were compared between them. Dumbbell shape samples were used in direct tensile tests and cylindrical specimens were used in Brazilian test. Stress distribution and the stress intensity within the sample were analysed with Finite Elements Method and numerical modelling techniques using ANSYS R.14 software. The direct tensile test yielded lower strength values than the indirect test. Direct tensile test is affected to a greater degree by the presence of microfractures and microfissures in the rock. For the specimens tested in direct tensile test, failure occurred near the radius of the dumbbell shape sample due to stress intensity factor. Therefore, direct tensile stress should be re-calculated by considering stress intensity factor. Since Brazilian disc test strain value in the diametrical line of the specimen has been found higher than nominal strain value according to FEM, tensile strength value which should be re-calculated by using proposed the coefficient.