Residual stress analysis is commonly achieved through curvature measurement with the help of Stoney's formula. However, this conventional approach is inadequate for multi-layer thin film systems, which are widely used in today's microelectronics. Also, for the thin film case, the residual stress is composed of thermal stress and intrinsic stress. Measuring the wafer curvature at room temperature provides a value for the average stresses in the layer, the two components cannot be distinguished by the existing methodologies of curvature measurement. To alleviate these problems, a modified curvature method combining finite element (FE) modelling is proposed to study the stress distribution in a Pt/USG/Si structure. A 2D FE model is firstly built in order to calculate the thermal stress in the multilayer structure, the obtained thermal stresses in respective films are verified by an analytical model. Then, we calculate the warpage of the multilayer structure by considering the intrinsic stress in the respective films. The residual stresses in the films are determined by minimizing the difference between the simulated warpage and that of experimental measurement. The proposed approach can be used to calculate not only the average residual stress but also thermal and intrinsic stress components in the USG and Platinum films. The obtained residual and intrinsic stresses from a numerical model are compared with the values of other studies. There is no limitation for the application of our methodologies regarding the number of the layers in the stack.