Significant efforts have centered in the last decade or so on the construction of reduced order models (ROMs) of structures undergoing “large” deformations, i.e. exhibiting geometric nonlinearity, from finite element models generated using commercial codes (e.g. Nastran, Abaqus, ANSYS). Using these codes enables the straightforward consideration of complex models, allows a broad ensemble of possible elements and capabilities, but also permits a direct transition to the industrial setting where these codes are routinely used. The counterparts of these advantages are the unavailability of certain information and the uncertainty on the formulation implemented in the finite element modeling and response computation. A general methodology, successfully validated in recent years on simpler beam and plate structures, will be presented by: (i) developing a novel identification strategy of the reduced order model parameters that enables the consideration of the large number of modes (> 50 say) that would be needed for complex structures, and (ii) extending an automatic strategy for the selection of the basis functions used to represent accurately the displacement field. The above novel developments are successfully validated on the nonlinear static response of a 9-bay panel structure modeled with 96,000 degrees of freedom within Nastran.