# THESIS INFORMATION

## INTRODUCTION

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| Thesis title: | **Nonlinear analysis of space semi-rigid steel frames under static and dynamic loads using plastic-zone method** |
| Major: | Civil Engineering |
| Major code: | 62580208 |
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## ABSTRACT

A new hybrid finite element based on plastic-zone method for nonlinear inelastic analysis of space semi-rigid steel frames subjected to static and dynamic loads is proposed in this dissertation. The element stiffness matrix is formulated by using the updated Lagrangian context which can consider geometric nonlinear effects including large-displacement behavior.

The spread of plasticity over element cross section and along element length is investigated through the Newton-Cotes numerical integration points using von Mises yield criteria. The nonlinear rotational springs are added to the beam ends to model both in and out-of-bending-plane connection rotational flexibility and hysteresis loop behavior with appropriate semi-rigid connection models. The hybrid element comprised of the finite element and connection springs is formulated by using the static condensation procedure to eliminate interior degree-of-freedoms between both hybrid element ends.

For the nonlinear static analysis, the modified generalized displacement control method combined with minimum residual displacement criteria are applied to solve the static equilibrium equations of structures. For the nonlinear dynamic analysis, the Newmark method is applied to solve the equilibrium equations of motion with the error of unbalanced residual force eliminated by the iterative Newton-Raphson algorithm in each time step.

Many numerical examples are investigated and compared with previous studies to demonstrate the reliability and efficiency of the proposed hybrid element. Furthermore, the yielding diagram of spatial steel frames with consideration of all key nonlinear factors is also presented to provide a comprehensive understanding on the limit states of structures under the static and dynamic load actions.

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