# Effect of Shear Deformation on Convergability of Simple Contact Analysis with Large Displacement

***Z.M. Nizam[1], H. Obiya[2], K. Ijima[3], R. Tokubuchi[4], and K. Ishibashi[5]**

[1,4] School of Environmental Science and Engineering, Saga University, Japan.
[2,3,5] Department of Civil Engineering and Architecture, Saga University, Japan.
Saga University, Honjo 1, Saga City, Saga Prefecture, 840-8502, Japan.

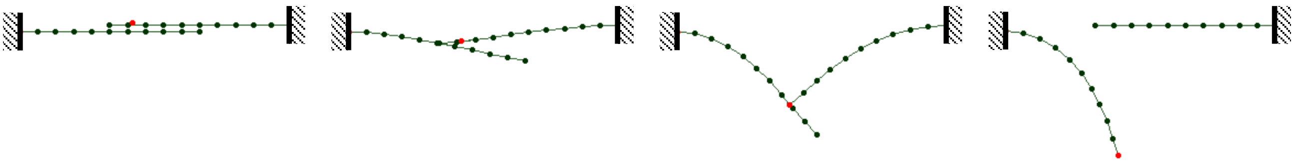
*Corresponding author: mnizam@uthm.edu.my

A common problem encountered in the study of frictionless contact is the failure to obtain stable and accurate convergence result when the contact node is close to the element edge, which is referred as “critical area”. In previous studies, we modified the element force equation to apply it to frictionless node-element contact problem using the Euler-Bernoulli beam theory (Tsutsui, Obiya and Ijima, 2009). A simple single-element consists two edges and a contact point was used to simulate contact phenomenon of a plane frame. The modification was proven to be effective by the convergability of the unbalanced force at the tip of element edge, which enabled the contact node to “pass-through”, resulting in precise results. However, in another recent study, we discovered that, if the shear deformation based on Timoshenko beam theory is taken into consideration, a basic simply supported beam coordinate afforded a much simpler and more efficient technique for avoiding the divergence of the unbalanced force in the “critical area”. Using our unique and robust Tangent Stiffness Method, the improved equation can be used to overcome any geometrically nonlinear analyses, including those involving extremely large displacements.

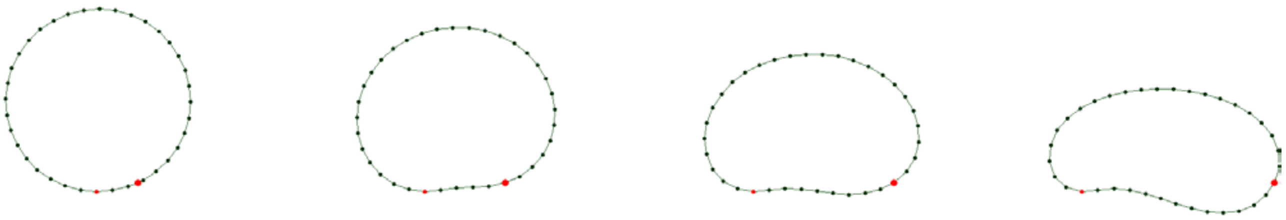
**Key Words:** *Frictionless Contact Problem, Node-Element Contact, Critical Area, Shear Deformation, Tangent Stiffness Method, Pass-Through*

## Numerical Examples of Frictionless Node to Element Contact

**Example 1 : Contact between Two Cantilever Beams**



**Example 2 : Contact of Circular Shape Beam**



### Reference

(1) T. Tsutsui, H. Obiya and K. Ijima (2009), An algorithm for contact problem with large deformation of plane frame structures. *Advances in Computational Engineering & Sciences*.