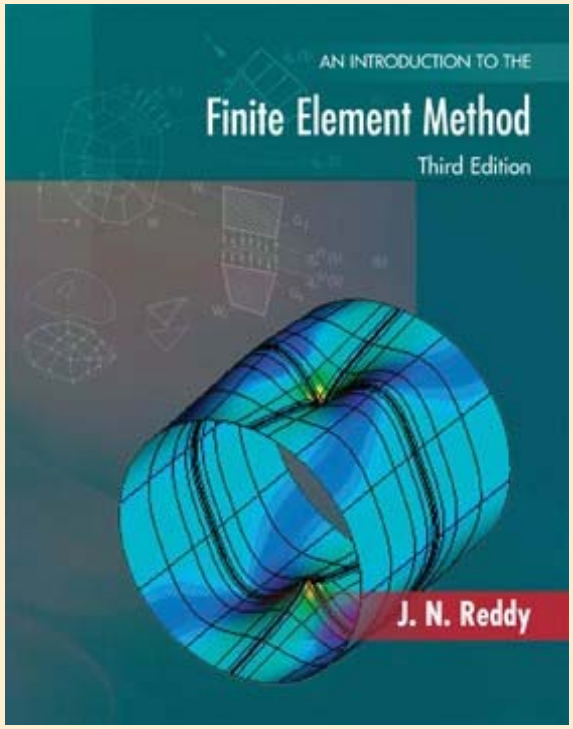
The Finite Element Method

Modeling Considerations: General Remarks

Read: Chapter 9



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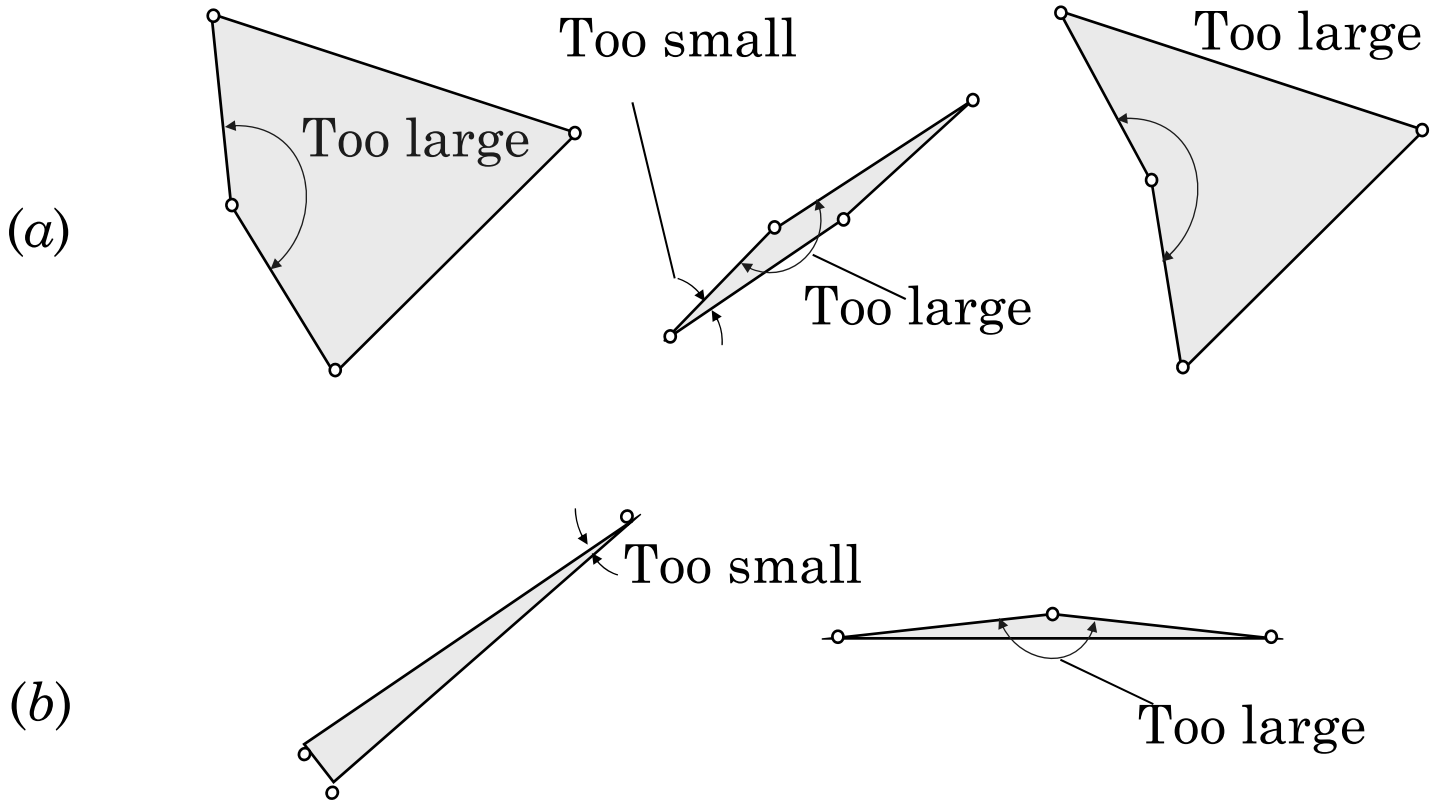
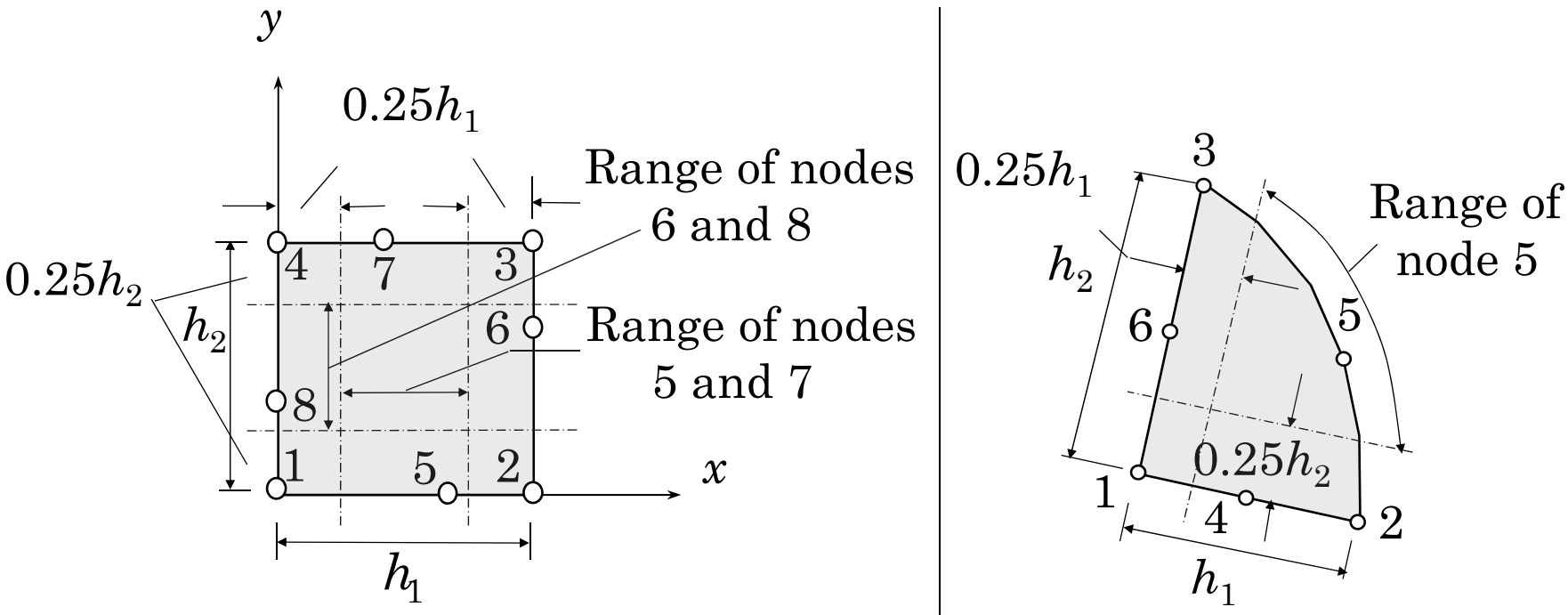
- Elements with unacceptable vertex angles
- Range of acceptable location of the `midside' nodes
- Compatible and incompatible element connections
- *Mesh refinements; h* and *p* refinements, and acceptable, and unacceptable mesh refinements
- Transition elements and multipoint constraints
- Conflicts in boundary conditions

Unacceptable Vertex Angles



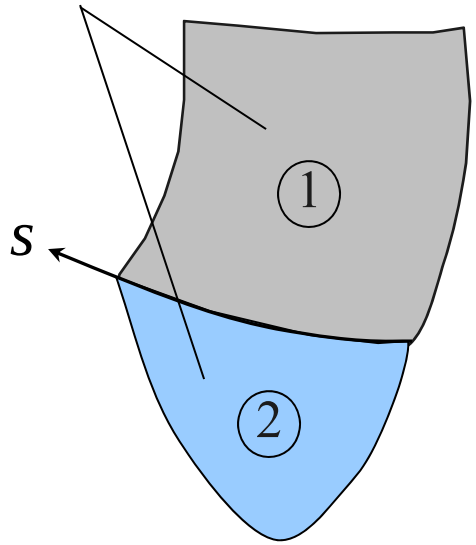
Range of Acceptable Locations of Midside Nodes for Quadratic Elements

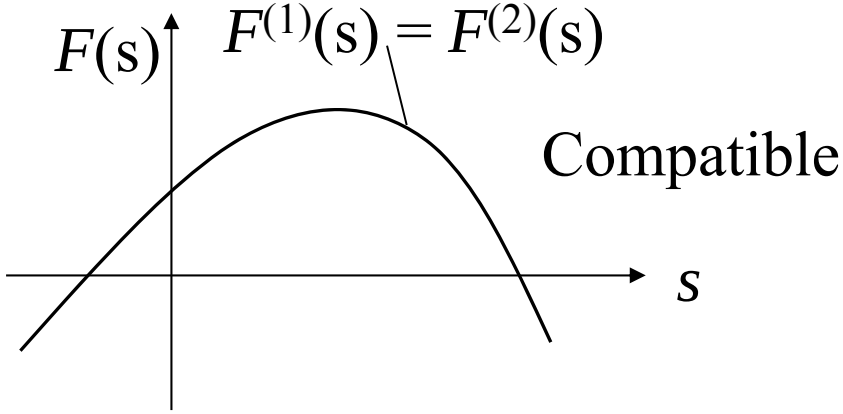


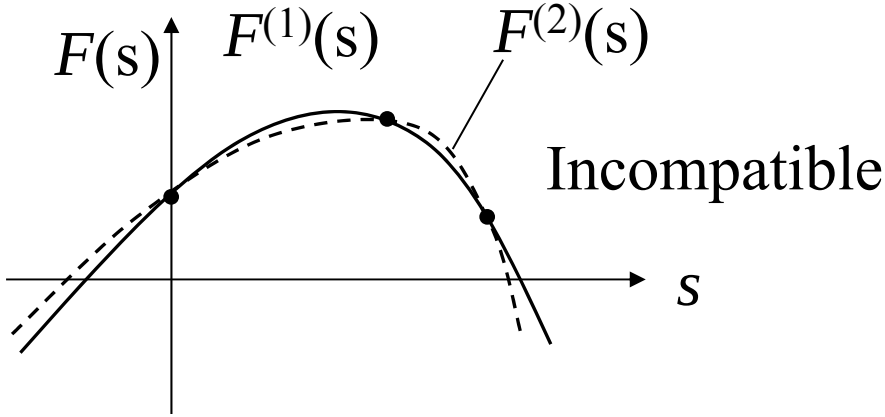
COMPATIBLE ELEMENT CONNECTIONS

A connection between two elements is said to be *compatible* if the primary variables are continuous along the entire boundary between the elements.

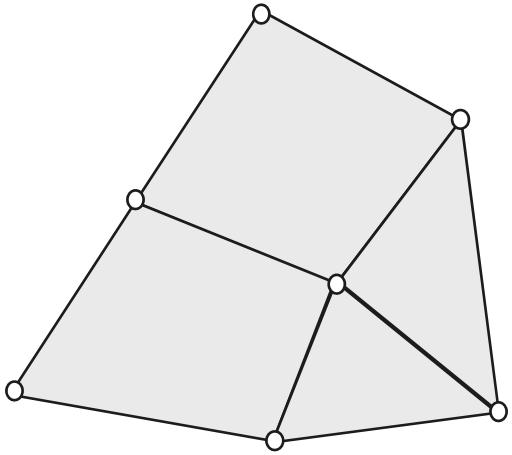
Arbitrary elements



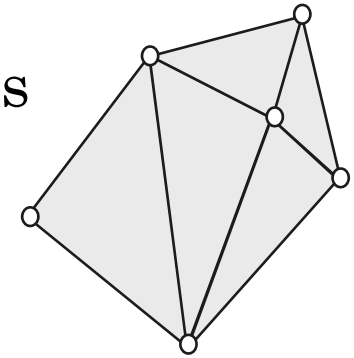


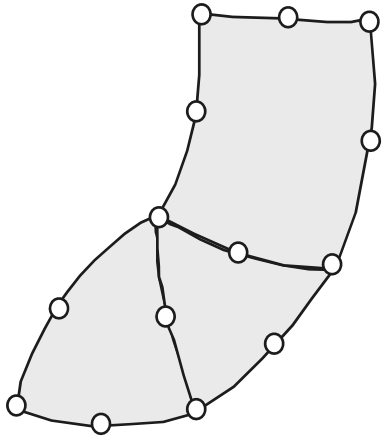


COMPATIBLE ELEMENT CONNECTIONS
(continued)

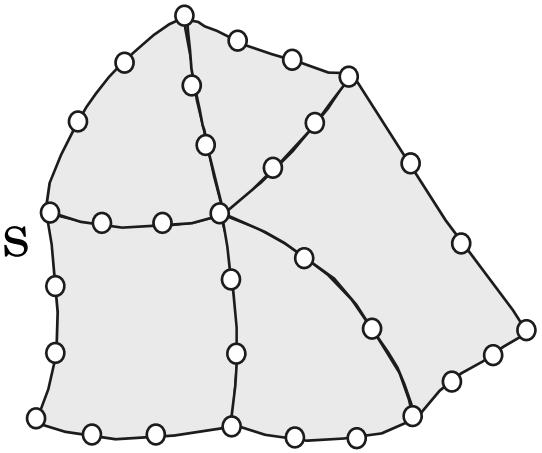


Linear elements



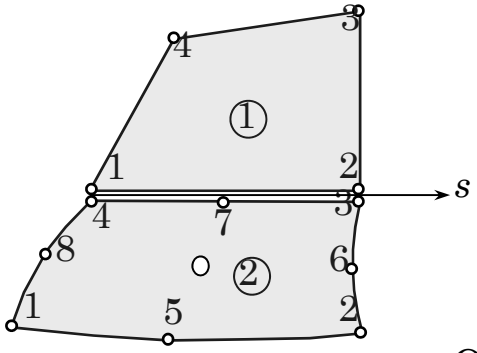


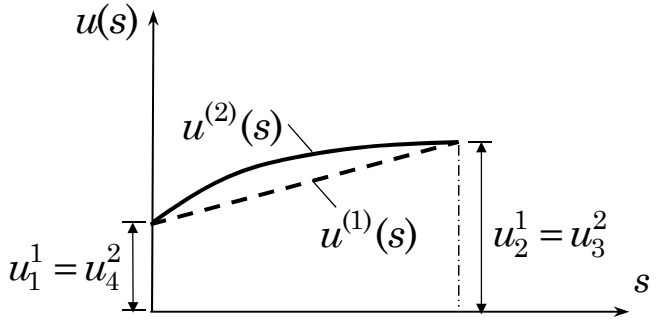
Quadratic elements



Incompatible Connections

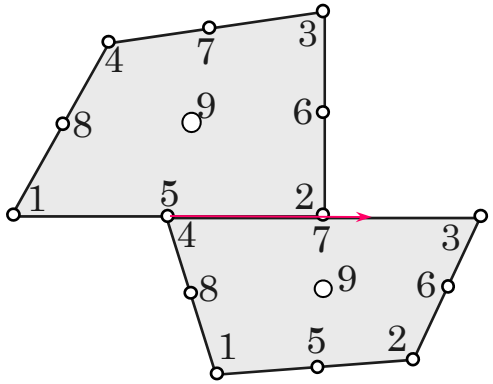
(a)

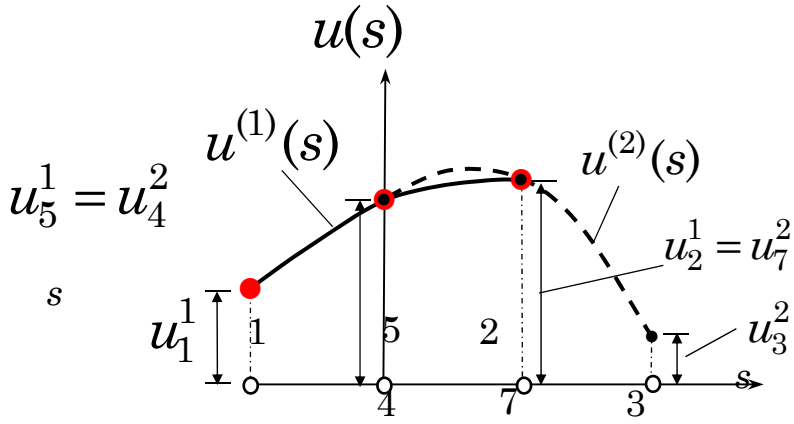




Constraint condition: $u_7^2 = \frac{1}{2}\left(u_1^1 + u_2^1\right)$

(b)

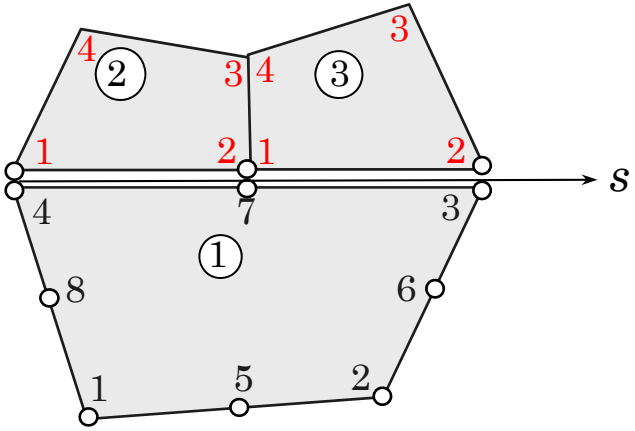


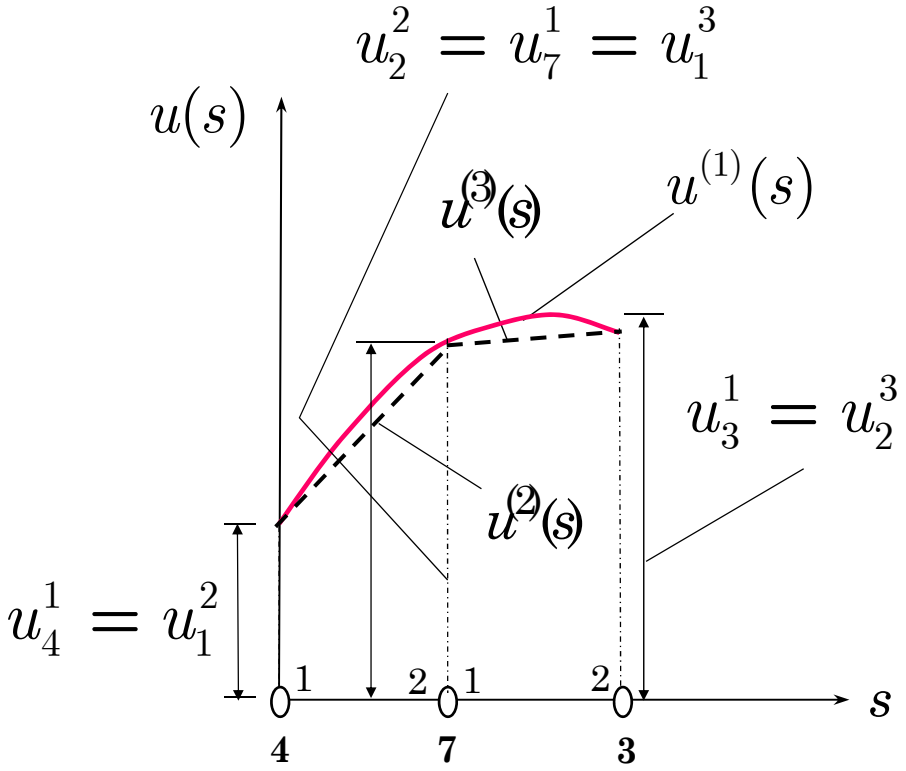


Incompatible Connections

(continued)

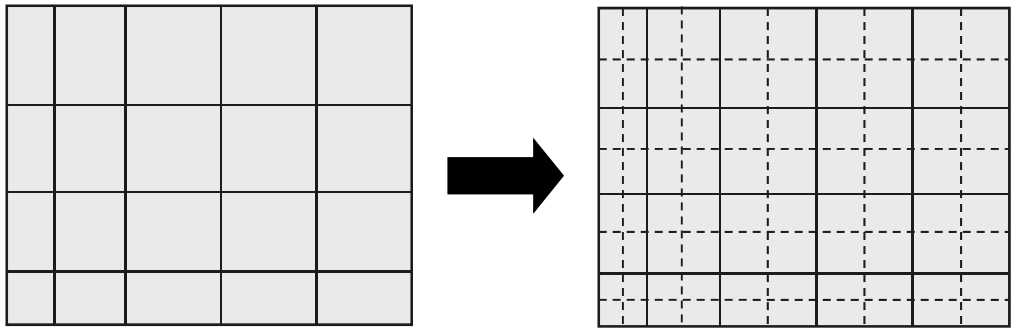
(c)



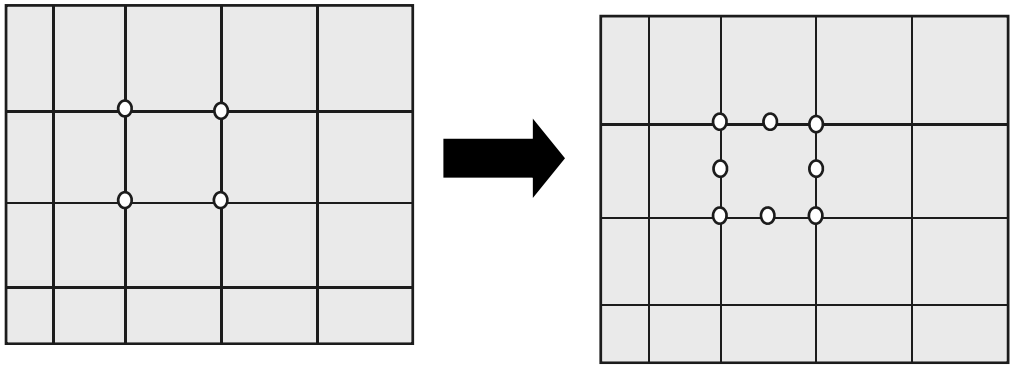


h and *p* Mesh Refinements

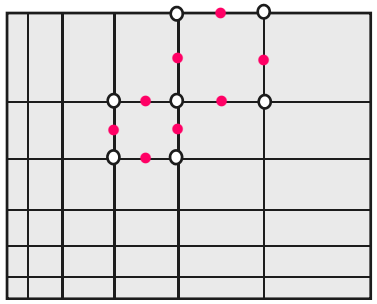
***h*-refinement:** Refined mesh contains the same type of elements as in the previous mesh.



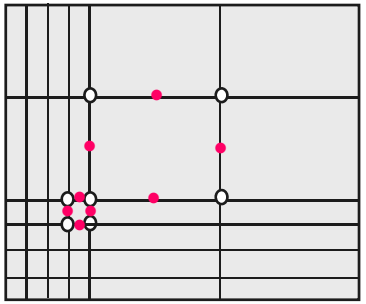
***p*-refinement:** Refined mesh contains higher-order elements than in the previous mesh.



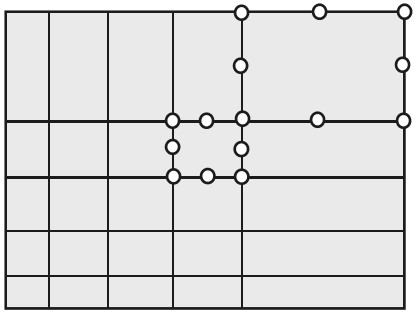
Mesh Refinements



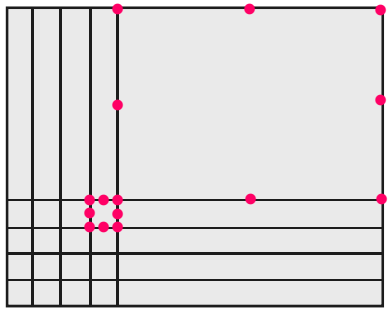
Preferred



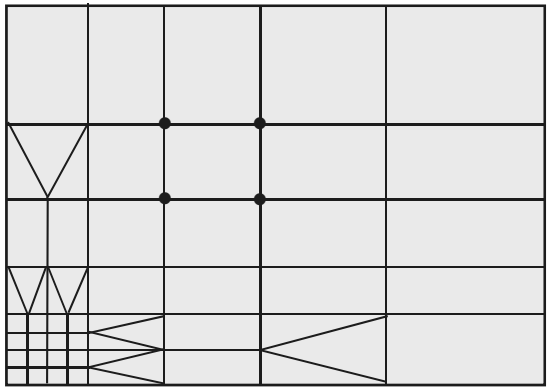
Not preferred



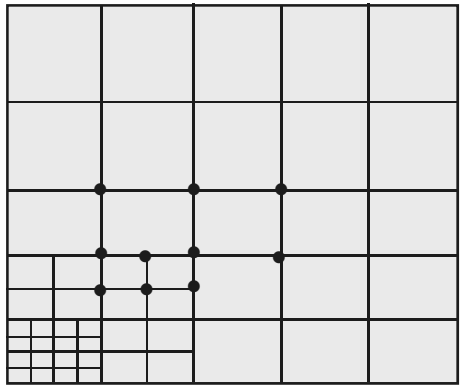
Preferred

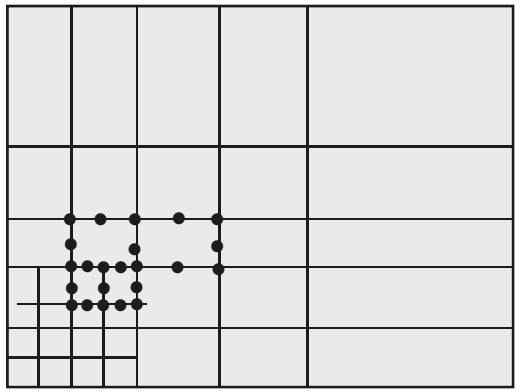


Not preferred



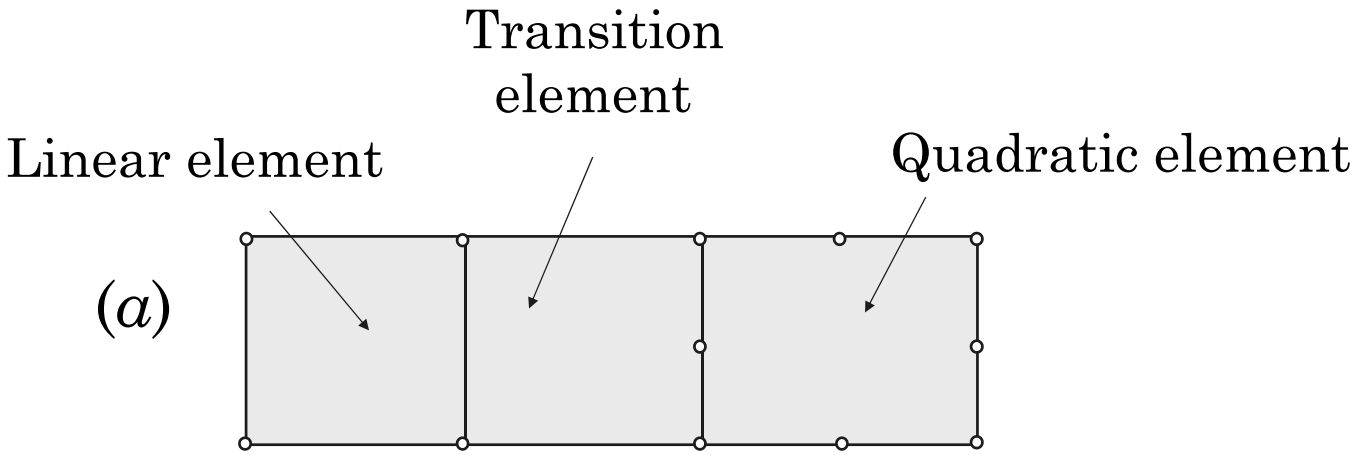
Compatible connection



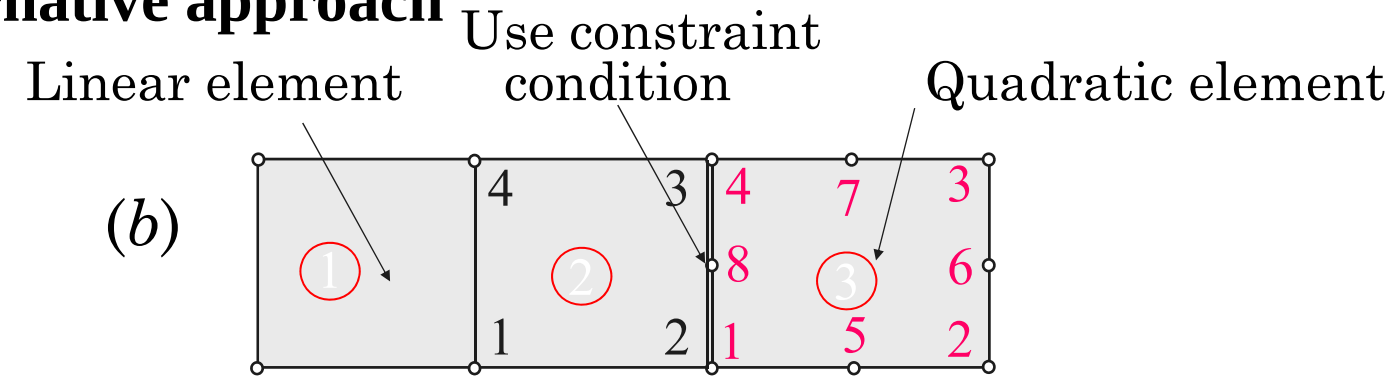


Incompatible connections

Transition Element and Multipoint Constraints



Alternative approach



Constraint condition: $u_8^3 = \frac{1}{2}\left(u_2^2 + u_3^2\right)$

RESOLVING THE CONFLICTS IN THE IMPOSITION OF BOUNDARY CONDITIONS