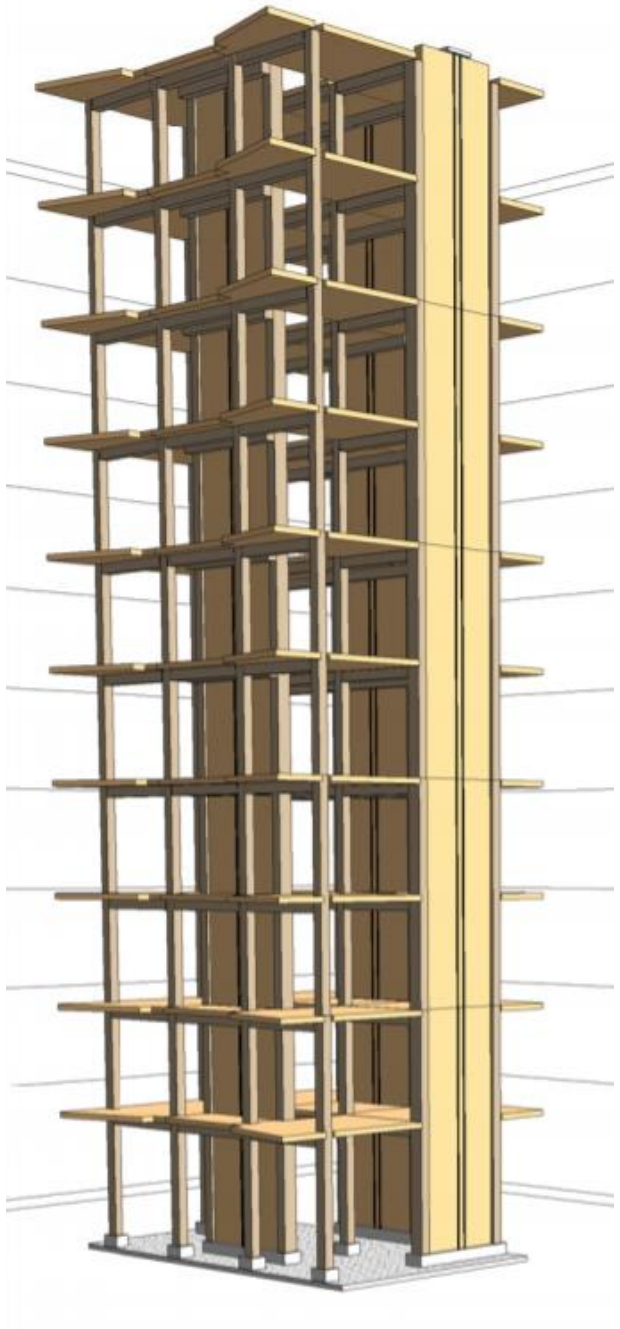
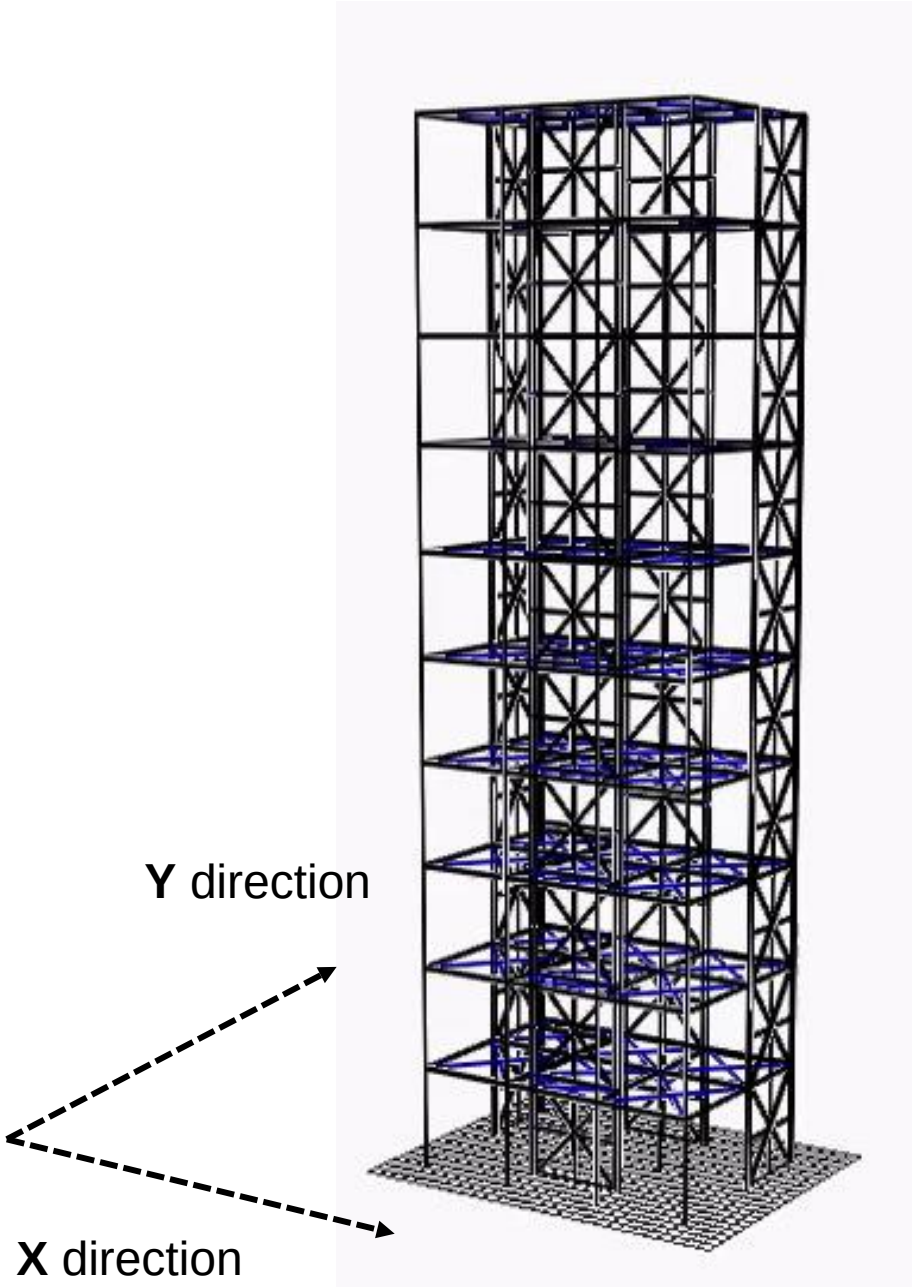


TallWood 10-story building numerical analysis(Kyoto)

○Tomoya FURUSAWA
Hiroshi ISODA
Takafumi NAKAGAWA

Numerical Analysis Method

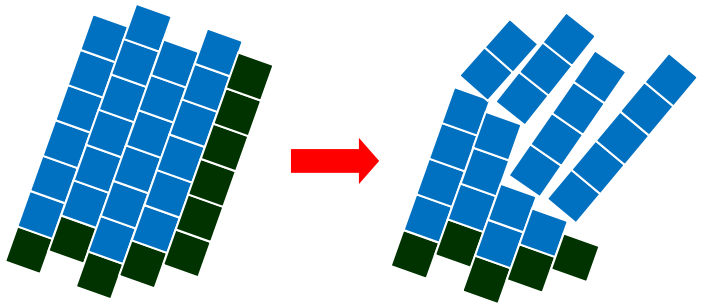
- The numerical analysis program used here is "***wallstat***"
- It has been originally developed for research by Mr.Nakagawa in Kyoto university
- By using it, it is possible to understand visually the deformation, damage state, and whether or not collapse



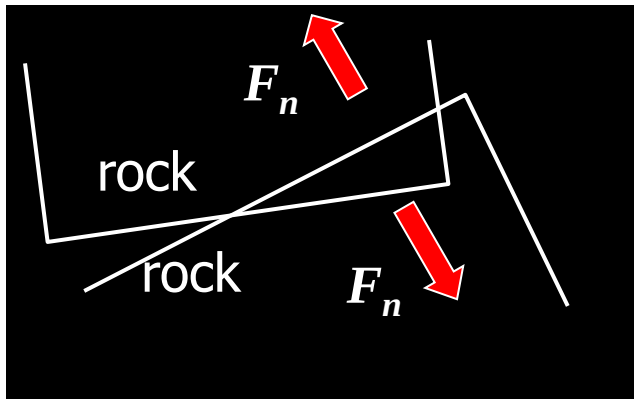
Theory of Numerical Analysis

- Distinct Element Method is used as fundamental theory

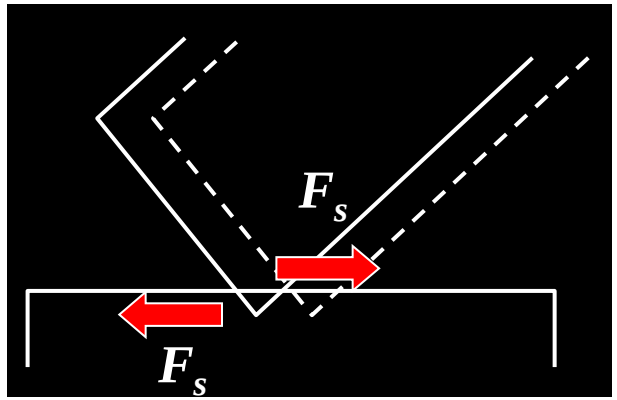
- DEM is Non-continuum analysis explicit method, so it is suitable for large deformation and collapsing analysis



Normal force

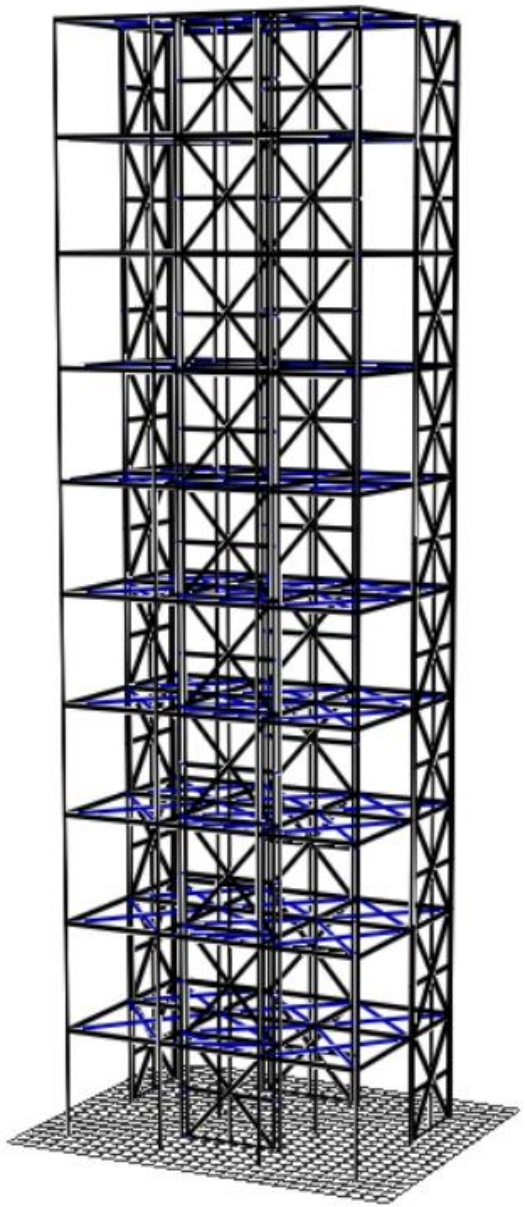


Shear force



Analysis Model

- CLT, MPP walls and floors
→truss element (brace substitution)
- Tie rods
→rigid body
- Columns
→pin-pin connections at every story
- UFPs
→bilinear type hysteretic rule
- 2% viscous damping

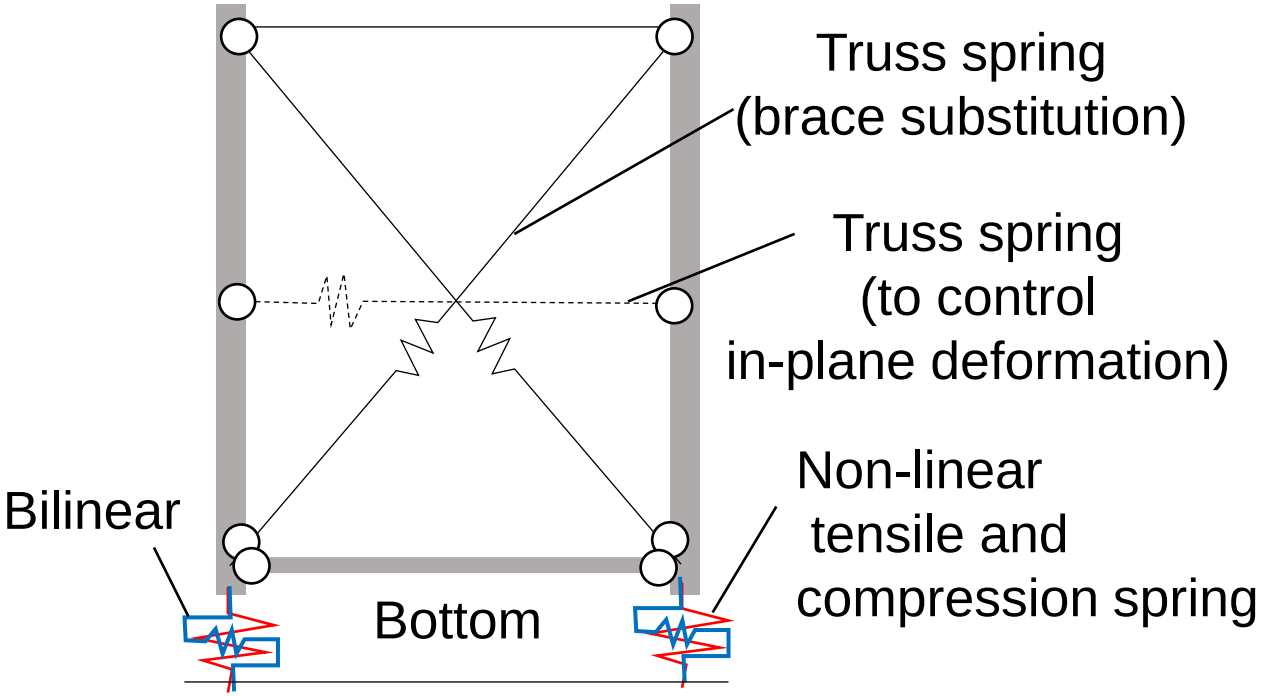


Floor weight

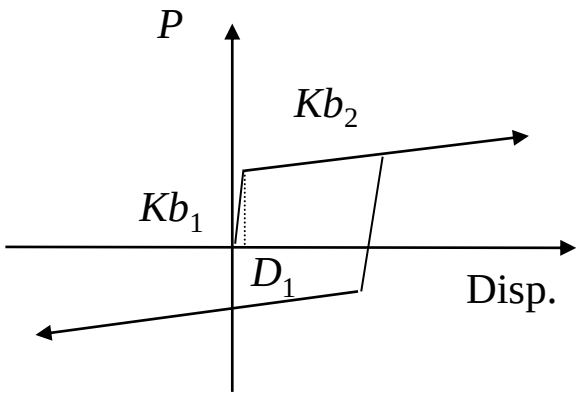
Roof (k/floor)	43.59
Floor 8-10 (k/floor)	54.43
Floor 7 (k/floor)	54.55
Floor 4-6 (k/floor)	54.67
Floor 3 (k/floor)	54.79
Floor 2 (k/floor)	56.50

Modeling of CLT and MPP walls

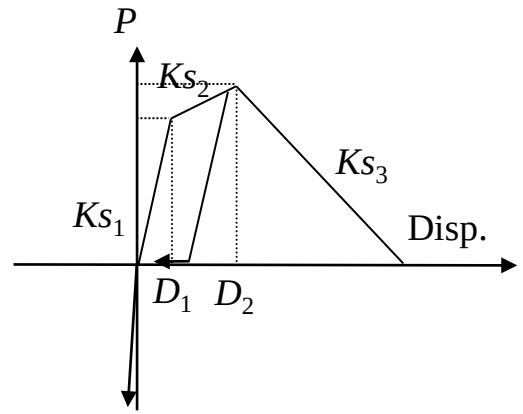
- CLT and MPP walls were modeled by truss spring(brace substitution)
- They are connected at the middle of every story by truss spring to control in-plane deformation
- They are connected at the bottom by two kind of spring



Bilinear

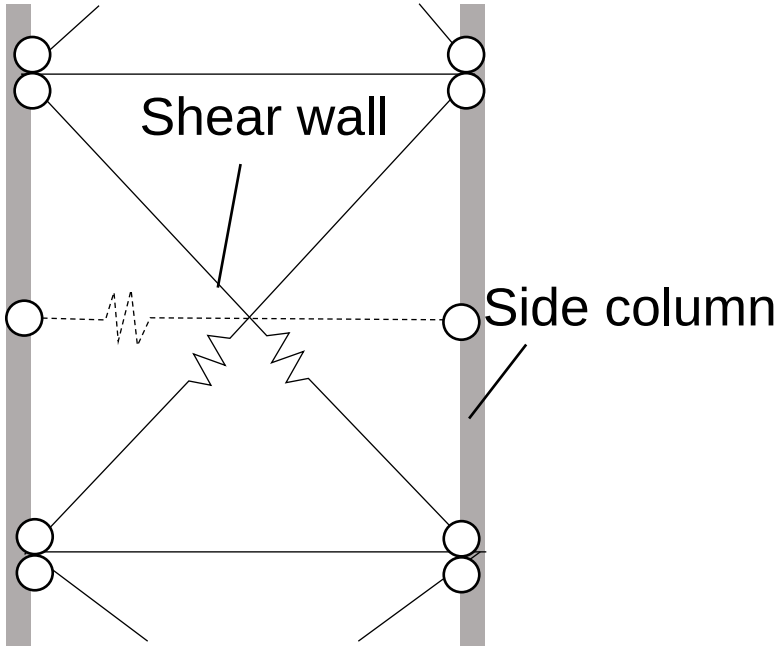


Non-linear tensile and compression spring

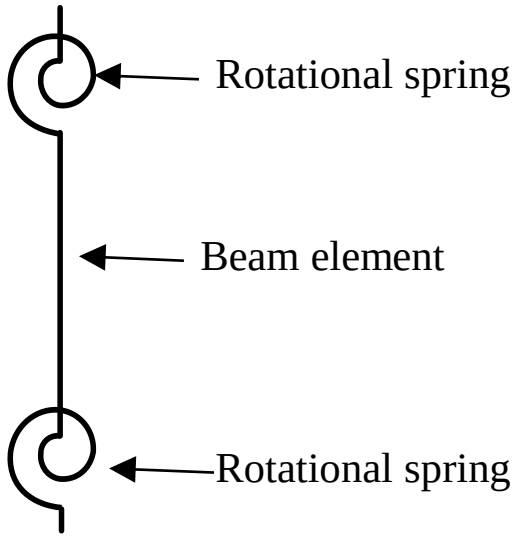


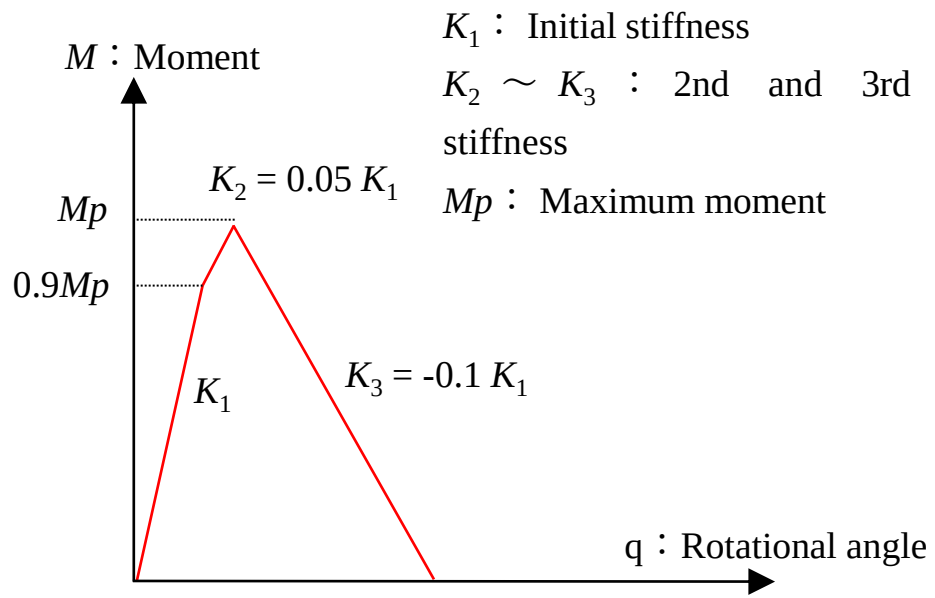
Modeling of CLT and MPP walls

- Side columns of shear walls were modeled by beam element
- Maximum bending moment Mp
- If the bending moment exceed Mp, the rotational spring of beam element become pin connection.



Schema and skeleton curve of the beam element



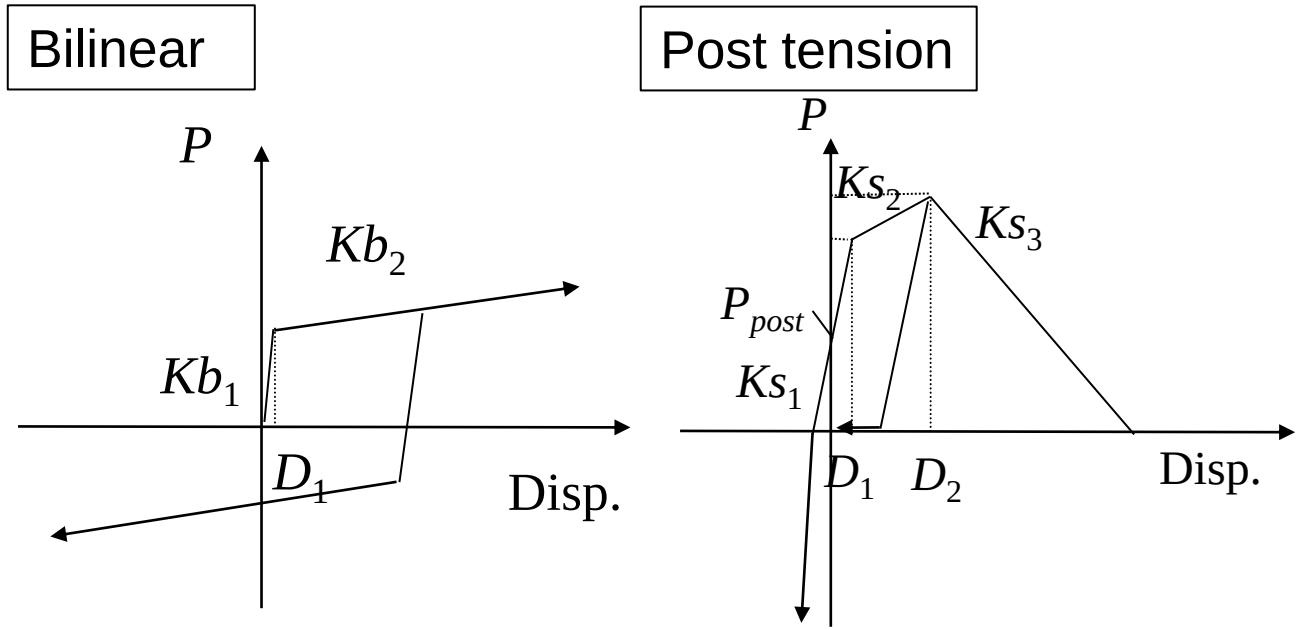


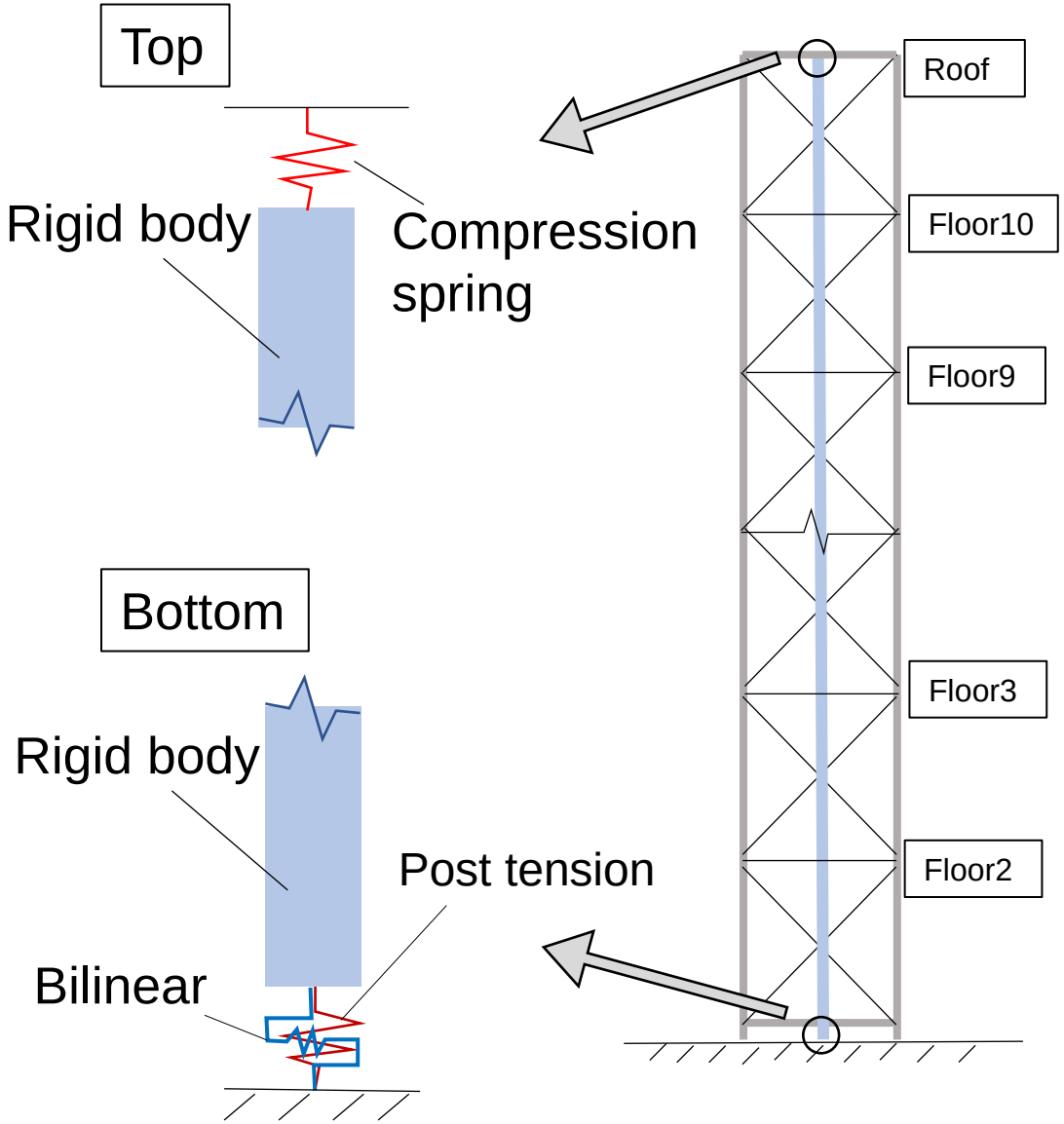
Modeling of Tie rod

- Tie rod was modeled by rigid body
- It connected by three kind of spring
- At the bottom

→Post tension and Bilinear type hysteretic rule

- On the top→Only compression spring





Modeling of UFP

- UFP→Bilinear type hysteretic rule
- Kb_1=23.8 [kip/in]
- Kb_2=0.357 [kip/in]
- D_1=0.30 [in]
- P_y=7.14 [kip]

Bilinear