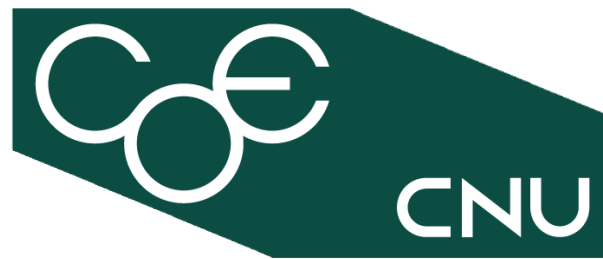


강구조설계진단연구실

Steel structures design & monitoring lab

김선후 (Supervisor)

2026.09.04



Chonnam National University
College of Engineering

Research area and interest

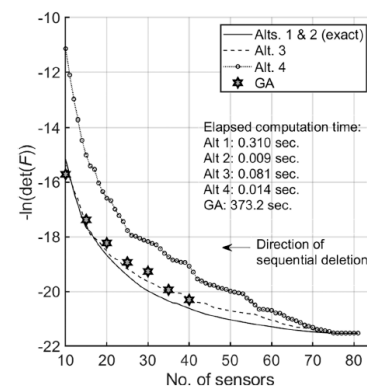


Tubular structures
(steel)

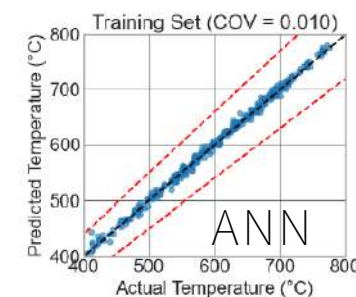
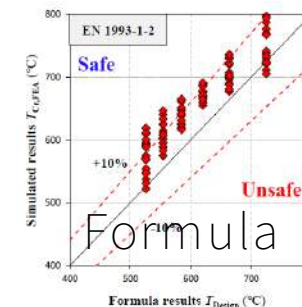
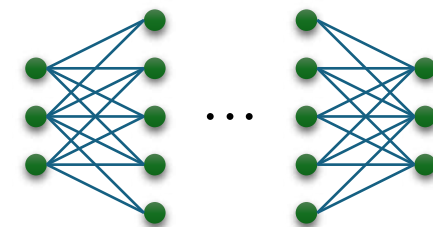
*main topic

Seismic applications
(steel)

$$\mathbf{e} = \text{diag}(\mathbf{\Sigma}^{-1} \mathbf{S} \mathbf{F}^{-1} \mathbf{S}^T \mathbf{\Sigma}^{-1}) \oslash \text{diag}(\mathbf{\Sigma}^{-1})$$



Some math and theories
(e.g.,
monitoring
optimization)



Data-driven approach
(aka ML)

Tubular structures in architecture



Longspan roof
(airport, factory, ...)



Diagrid (high-rise)



Shell (irregular)

Tubular structures in civil/mechanical



Bridge

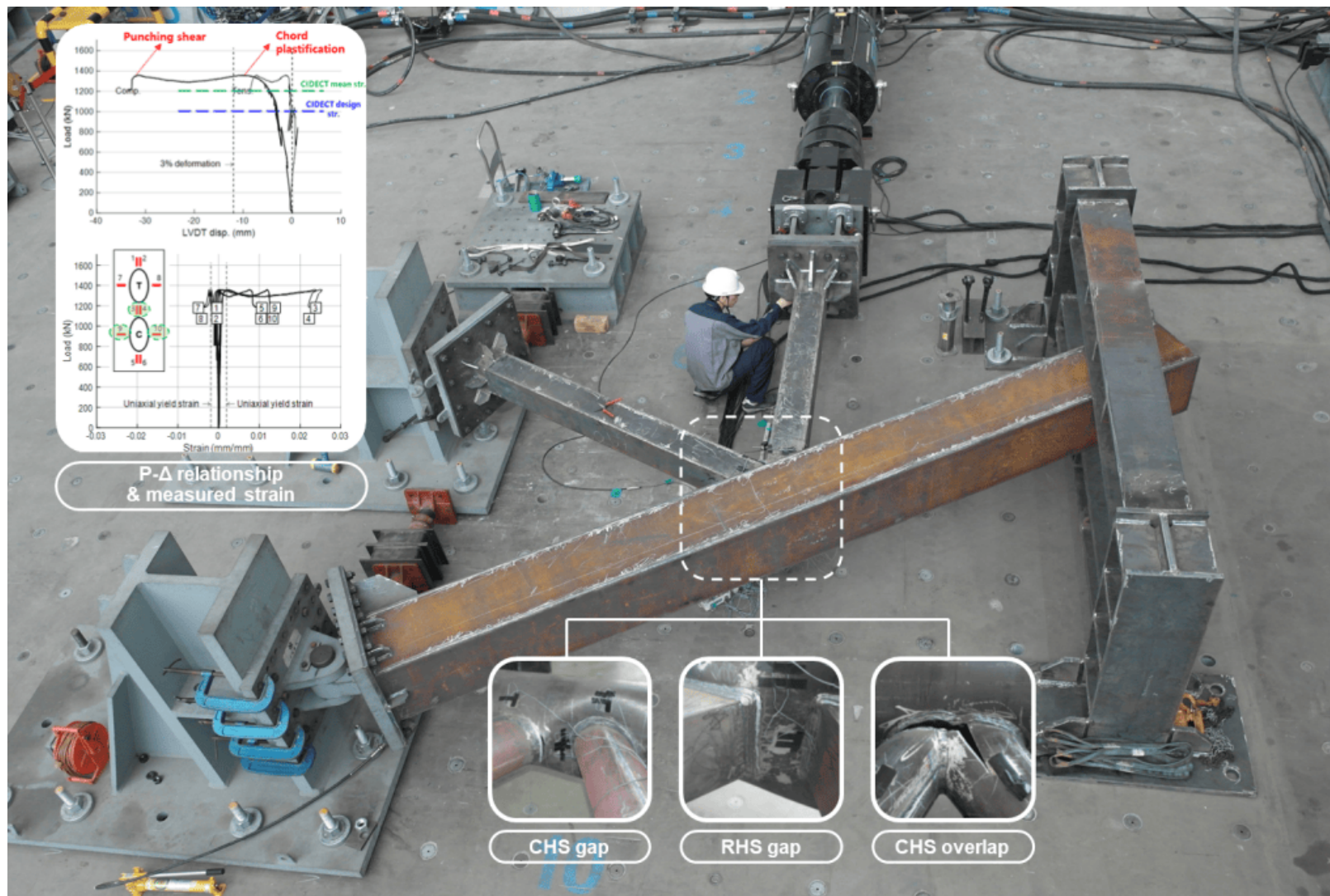


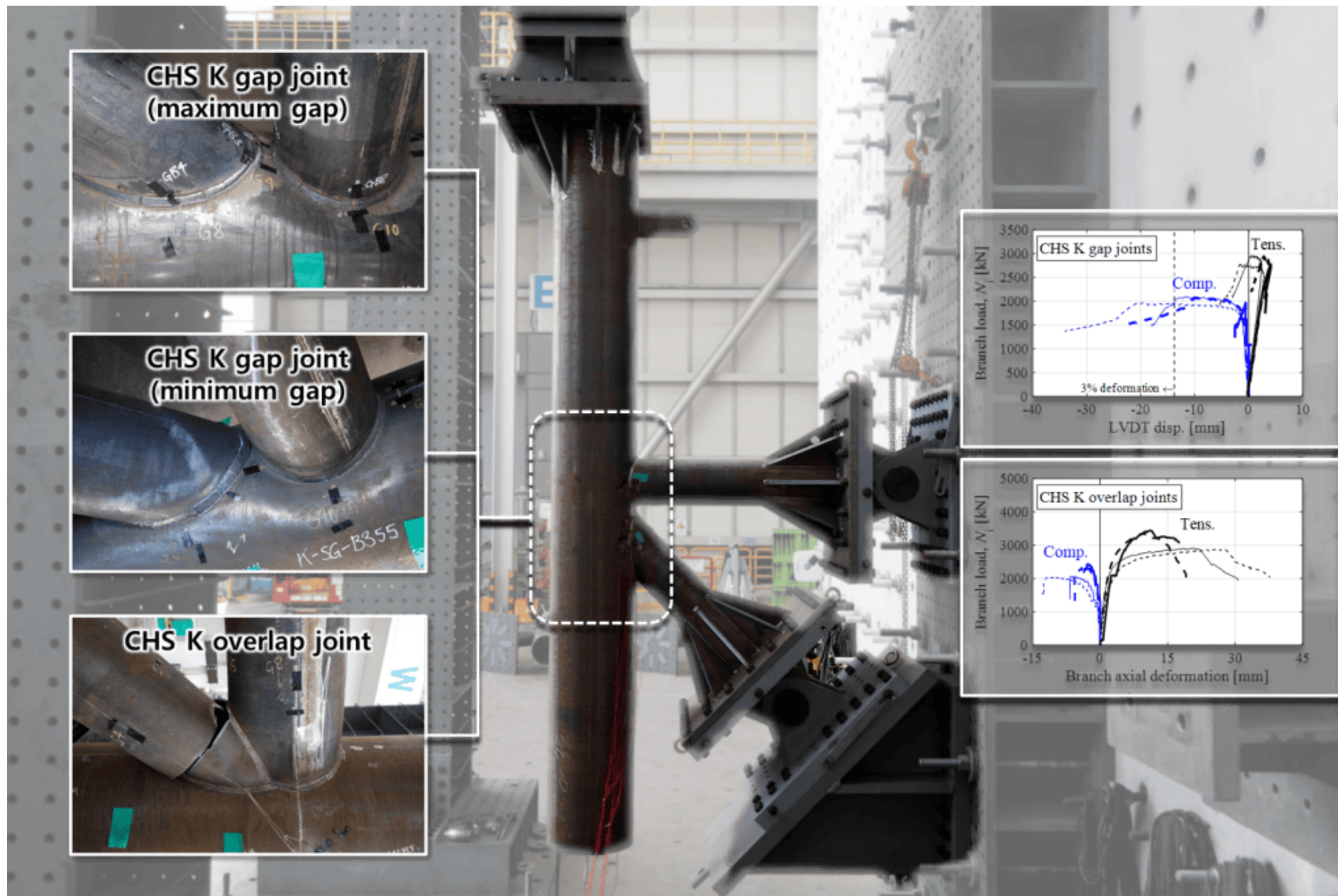
Offshore platform



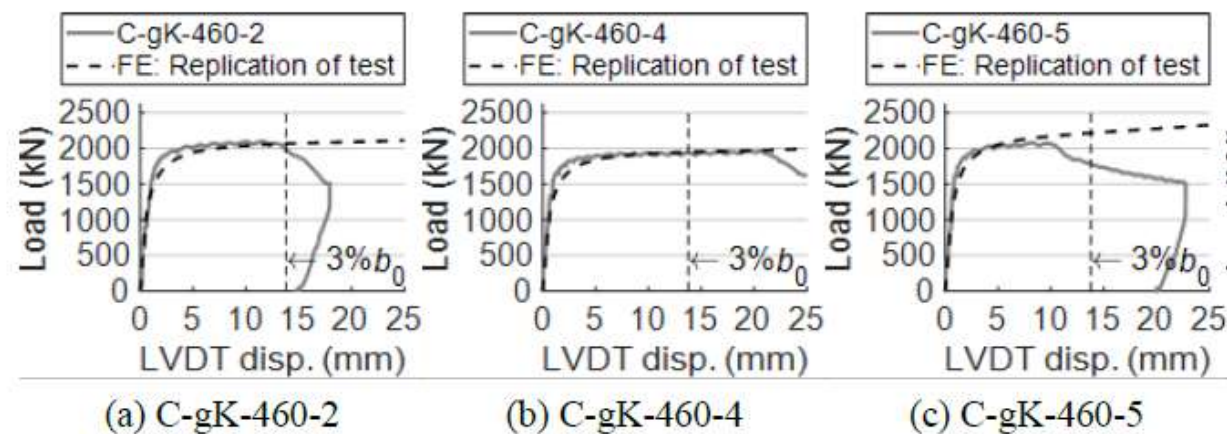
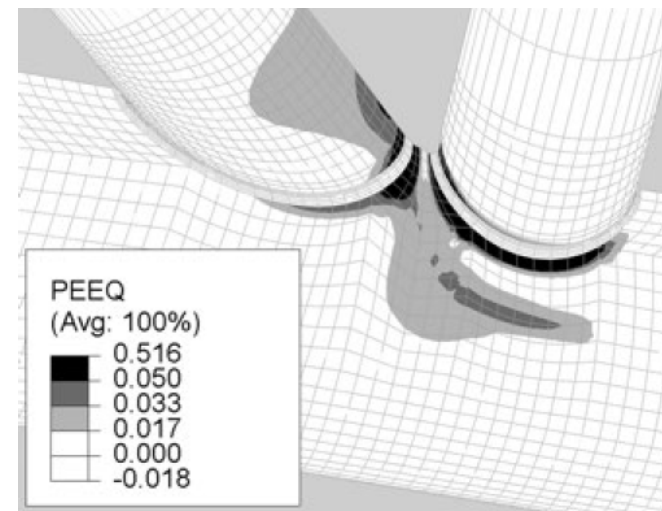
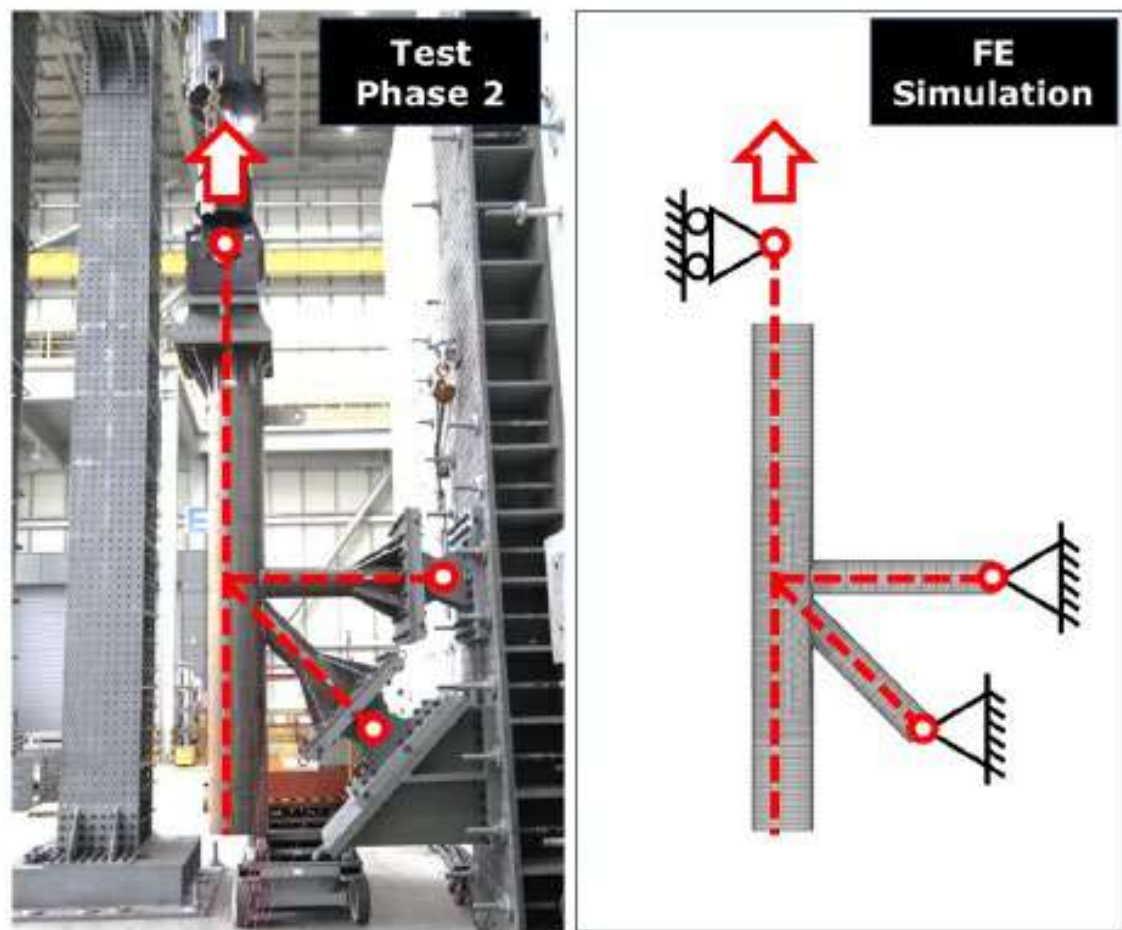
Crane

Laboratory tests (tubular joints)





Computer simulation (FEA)

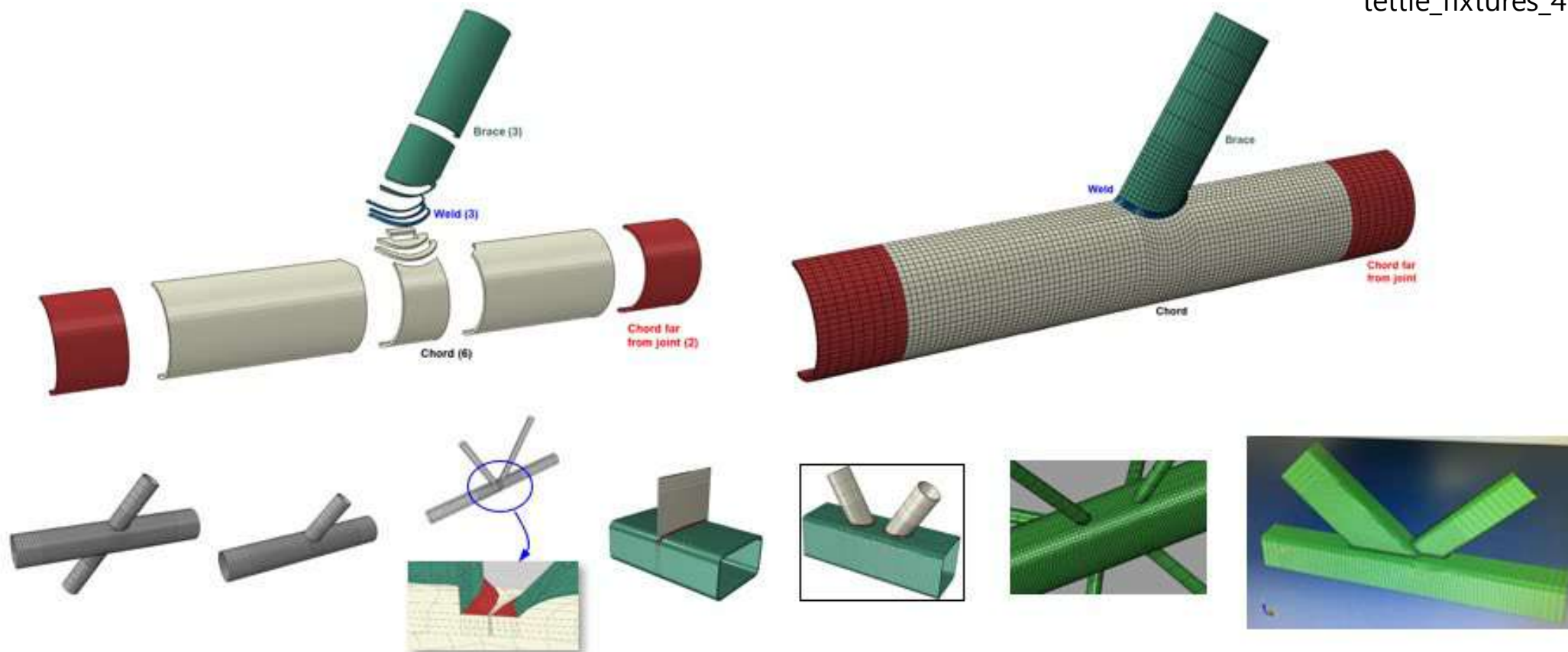


Automatic simulation tool

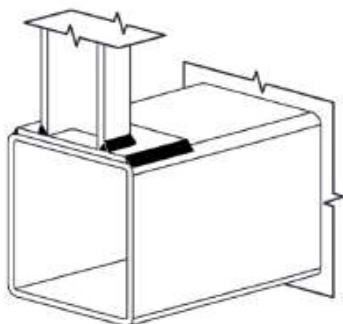
Any (hopefully) configurations and dimension proportions.



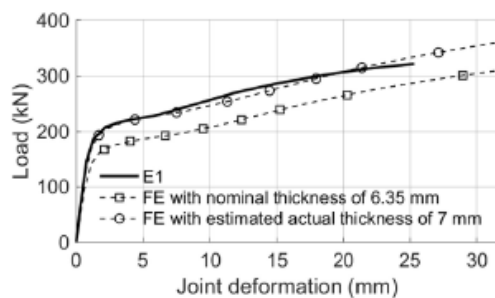
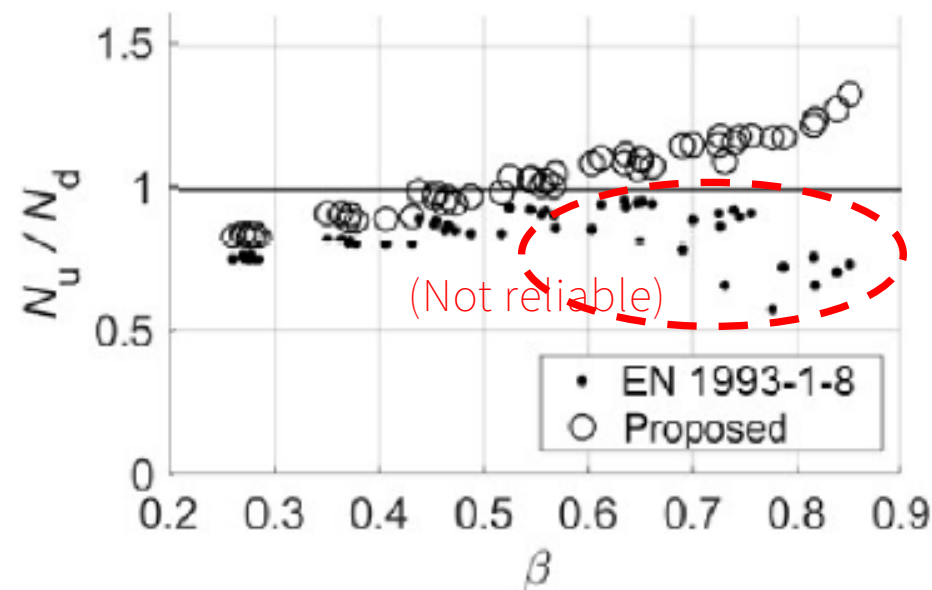
tettie_fixtures_4in1.html



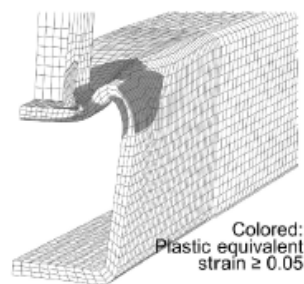
Validated + automated FEA = Large dataset



Doubler plate reinforcement



(a) Load-displacement curve



(b) FE analysis result ($t_0 = t_p = 7$ mm)

Improved design methods

Revision proposal for design codes (rules/laws of structural design)

Code revision

Implementation to real industries

*KDS 14 30 강관접합 챕터 개정 (진행중)

KDS 14 = 공통(건축+토목) 구조설계기준
KDS 14 30 = Steel

현행기준 원문(구)	개정안(신)	개정 근거
* KDS 41 31 00의 4.8항에 해당하며, KDS 41 30 10의 4.9항 또는 KDS 14 31 25의 4.3항과 본질적으로 동일함(KDS 41 31 00은 2022년 KDS 41 30 10으로 교체됨). 4.8 강관구조접합 이 접합은 균일부재의 강관접합부설계에 적용한다. 강관구조보트림접합의 부가적인 요구사항은 4.7을 참조한다.	* KDS 41 30 10(건축물 강구조 설계기준)의 4.9항은 KDS 14 31 25(강구조연결설계기준)의 4.3항에 따름. 따라서 본 개정안은 KDS 14 31 25의 4.3항에 해당하도록 작성됨. 4.3 강관접합부 4.3항은 용접 강관접합부의 설계에 적용한다. 4.3항의 구성은 아래와 같다. (1) 4.3.1 적용 범위 (2) 4.3.2 설계 절차 (3) 4.3.3 거점플레이트-강관 접합부의 설계 (4) 4.3.4 단일평면 강관-강관 접합부의 설계 (5) 4.3.5 다중평면 강관-강관 접합부의 설계 (6) 4.3.6 특수한 강관접합부의 설계 (7) 4.3.7 존재용역 용접부의 설계	4.3 관제목 수정: "구조" 불필요. 용접 접합부에만 적용됨을 언급하였음. 4.3항의 전체적인 목차를 제시하여 기준의 구성을 한눈에 알아볼 수 있도록 하였음.
(신설)	4.3.1 적용 범위 4.3항의 적용 범위는 다음 4.3.1.1 개요 (1) 접합부를 구성하는 강관에 부합하는 강관 규격	(5) 강관접합부를 구성하는 강관과 강관의 재료적 성질은 아래 ①~③의 요구조건을 만족하여야 한다. ① $F_y/F_u \leq 0.95$ ② 인장 파단 시의 변형도가 12% 이상이어야 한다. ③ 단, 설계강도 산정식에서는 4.3.2.2(5)에 따라 강종의 항복강도와 항복비의 영향을 고려해야 한다.

항복강도 상한 360 → 650 MPa 로 상향 조정
국내 최고강종 HSA650 까지 모두 포괄.

*ISO 14346 (강관접합 국제표준) 개정



Acknowledgements

The authors are grateful to Mr. Park and Dr. Kim of the Dept. of Architecture and Architectural Engineering, Seoul National University, for their support in analysing the effect of imperfections and misalignment. Appreciation is also extended to Dr. R. Yan of Delft University of Technology for making available his recent data on RHS X joints in the interaction region for brace axial tension.

RHS-to-RHS X, T and Y joints (class a)		Brace axial compression and tension loading *)
		Chord sidewall resistance
		Compression: $N_{cs} = C_s f_{cs} \sqrt{\frac{1}{\sin \alpha}}$ Tension: $N_{cs} = f_{cs}$ $C_s = 2(h_1 + 5t_1)$ but $5t_1 \leq 0.3h_1$
		Chord face plastification at β_{cs}
		$N_{fcs} = C_s f_{cs} \sqrt{\frac{1}{(1-\beta_{cs}) \sin \alpha} + \frac{4}{\sqrt{1-\beta_{cs}}}} \frac{Q_1}{\sin \alpha}$
		Interaction between chord sidewall failure and chord face plastification
		$N_{int} = N_{cs} - \left(\frac{1-\beta}{1-\beta_{cs}} \right) (N_{cs} - N_{fcs})$
		Parameters
		$\beta_{cs} = 0.65 + 0.01 \gamma \leq 0.85$
		$Q_1 = 1.1 - 0.1 f_{cs} / 355 \leq 1.0$
		$\gamma_{0.5}$ is the buckling reduction factor obtained from: $\chi_{0.5} = 1.12 - 0.012 \frac{h_1}{t_1} \sqrt{\frac{f_{cs}}{355}}$
		$Q_1 = (1 - \gamma_{0.5})$

"Revision of a classic formula having served more than 30 years"

Typical workflow summary

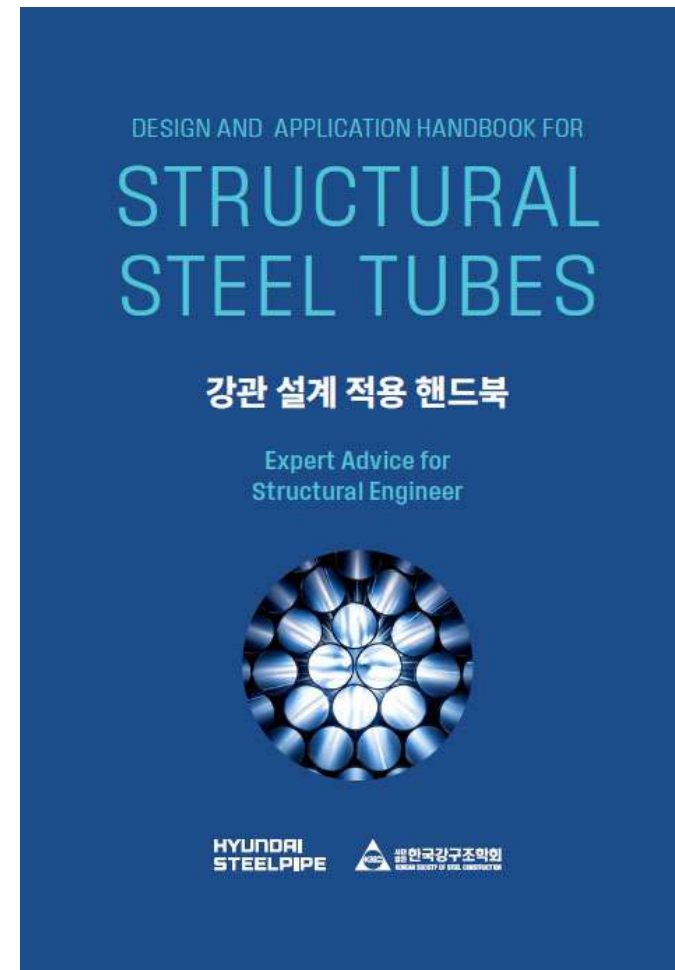
Laboratory
tests

Expanding
dataset
(validated
and
automated
FE)

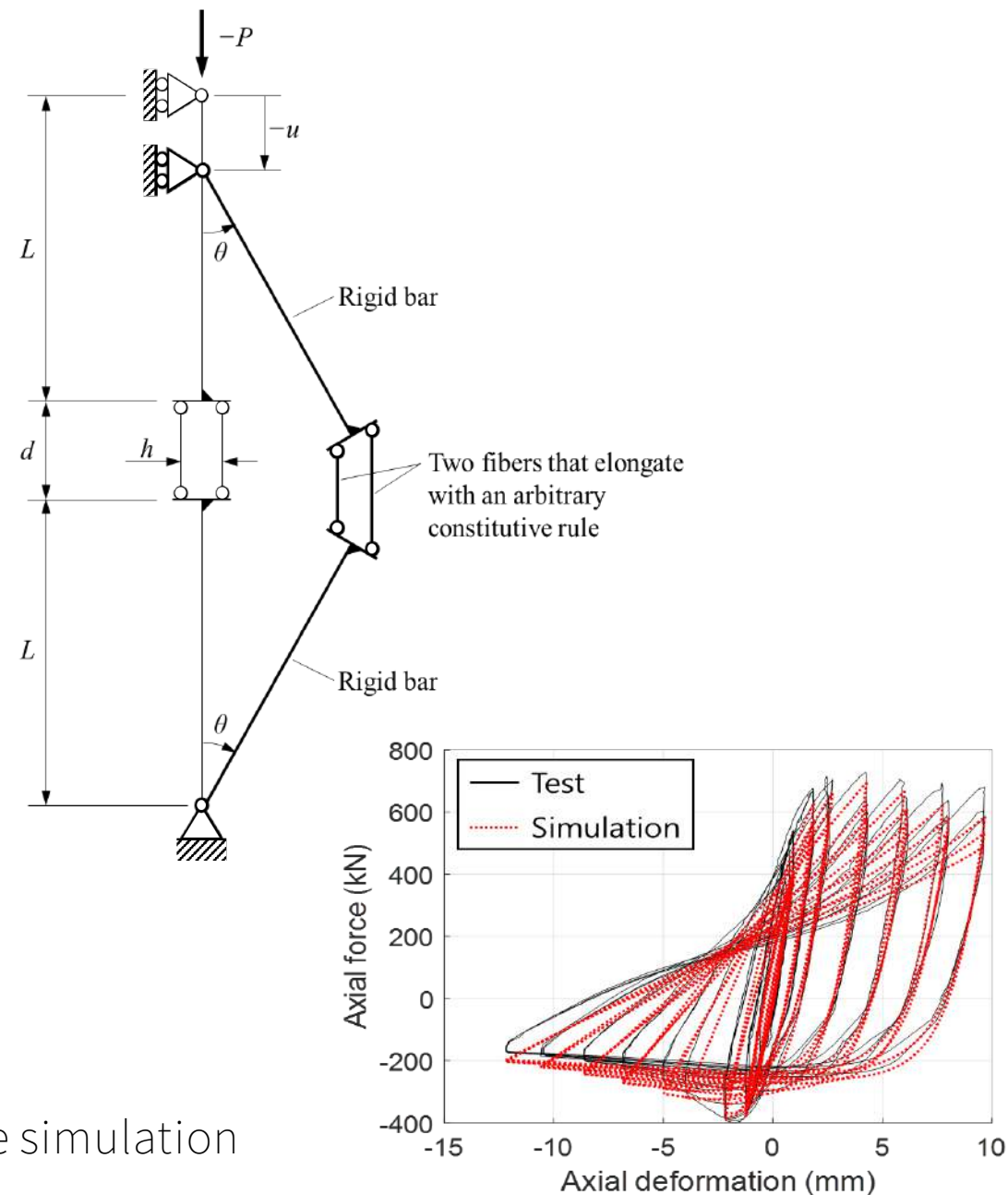
New theory
and
design
methods

Adoption
in
design
documents

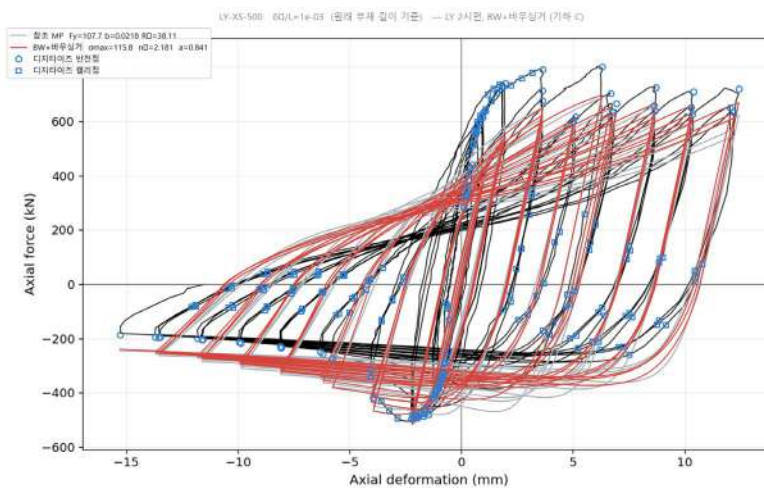
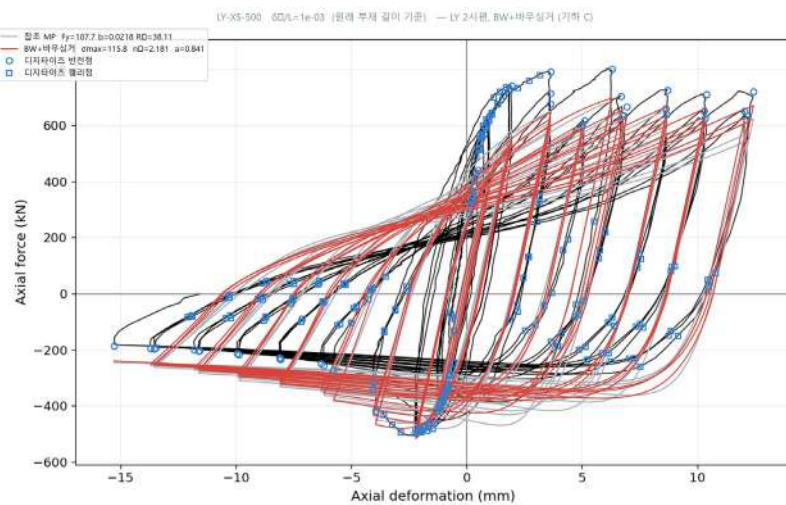
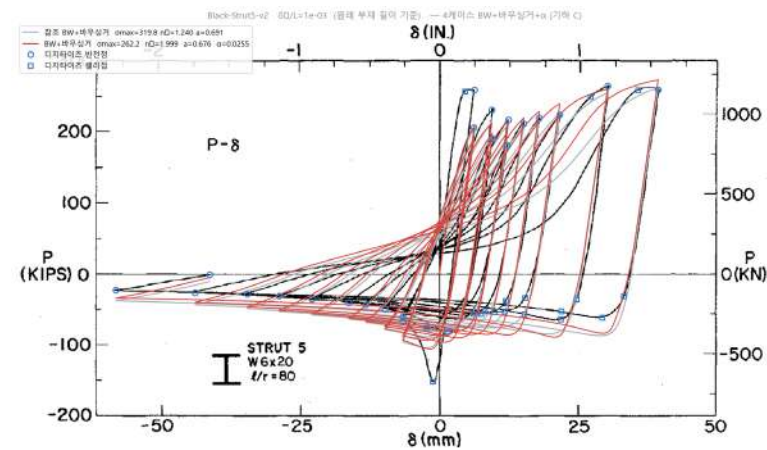
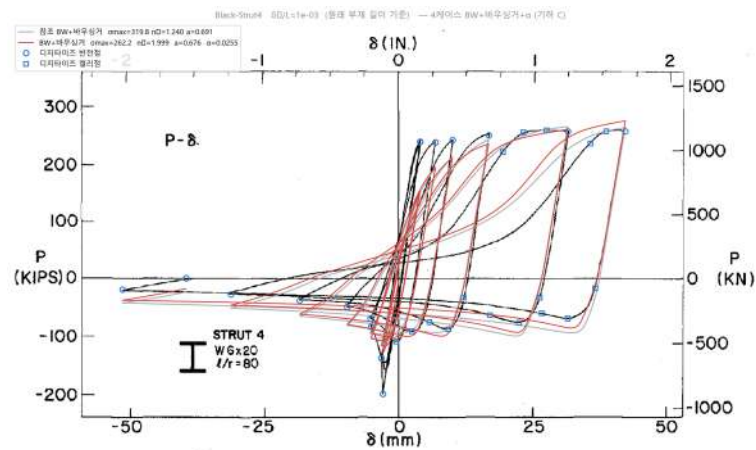
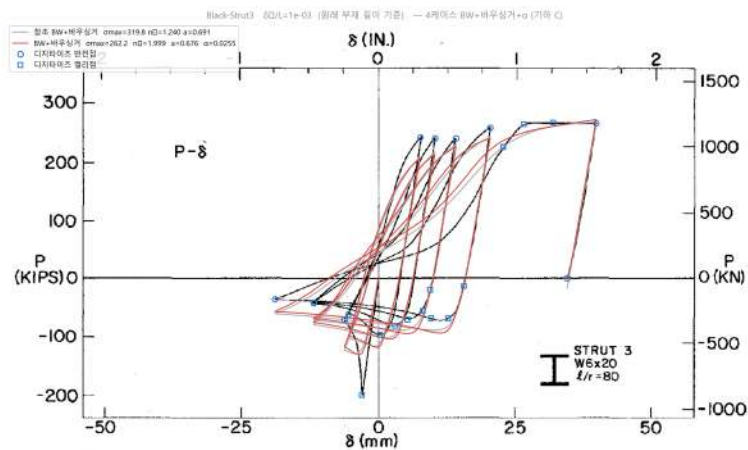
Social contribution



Seismic studies

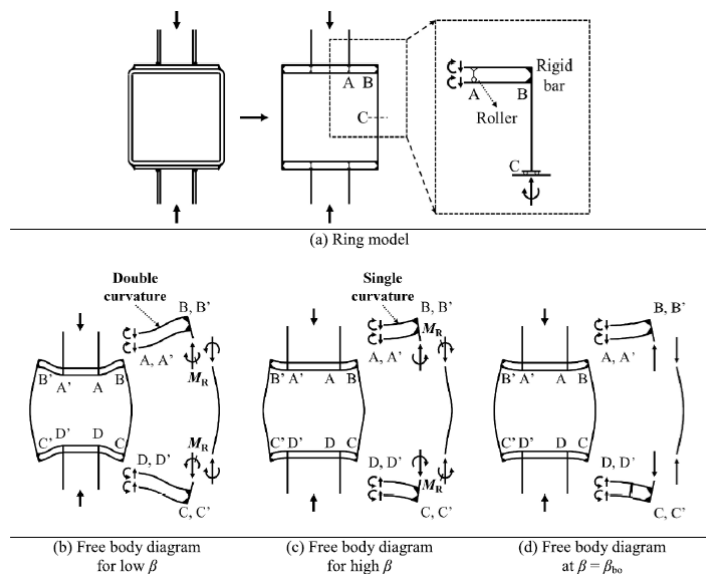


Simplified modeling for building-scale earthquake simulation

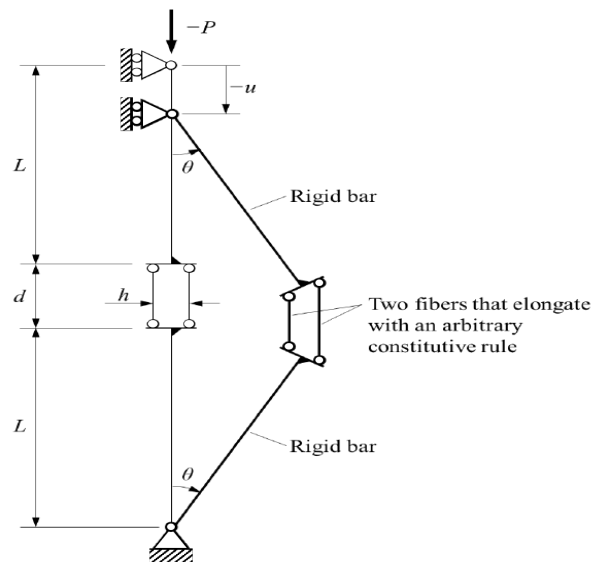


(substantially based on) Theories

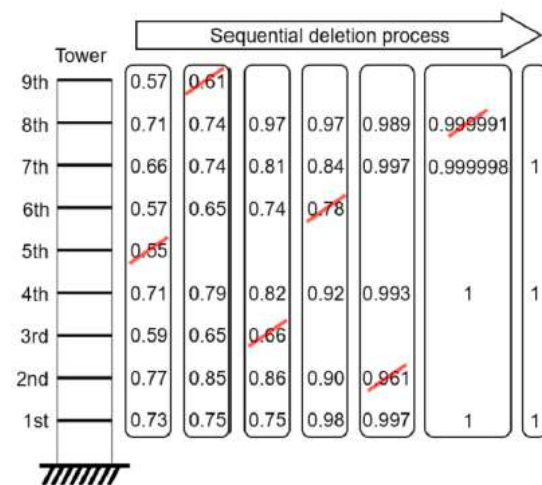
Mechanics



Dynamics



Dynamics + information theory



$$\frac{df}{de} = k_0[\alpha + (1 - \alpha)\Phi]$$

$$\Phi = 1 - \frac{1}{2}[1 + \text{sgn}(\dot{e} f_h)] \left| \frac{f_h}{f_{max}} \right|^n$$

$$n = n_0 \left[1 - a \frac{|p_{opp}|}{f_{max}} \right]$$

$$f(\eta) = \det E_\eta = \det(\Phi_\eta^T K_\eta \Phi_\eta)$$

$$\mathbf{e} = \text{diag}(\mathbf{K}_\eta \Phi_\eta \mathbf{E}_\eta^{-1} \Phi_\eta^T \mathbf{K}_\eta) \oslash \text{diag}(\mathbf{K}_\eta)$$

$$\beta_{bo} = 1 - \frac{1}{4\gamma} \left[(4 + \lambda^2) \left(1 + \frac{f_{yp} t_p^2}{f_{y0} t_0^2} \right) + 6 \right]$$