



American Concrete Institute®
Advancing concrete knowledge

The Art of Designing Ductile Concrete in the Past 50 Years: The Impact of the PCA Book and Mete A. Sozen, Part 2

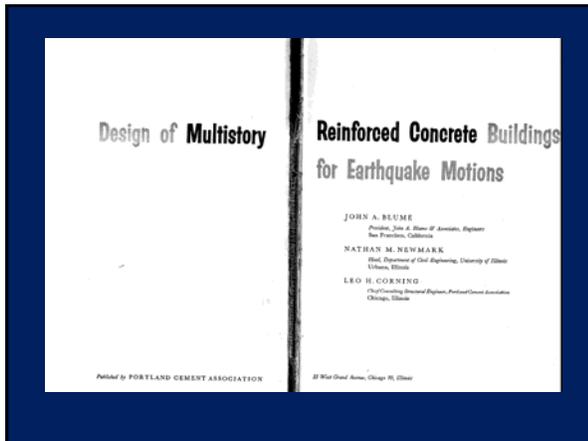
ACI Fall 2012 Convention
 October 21 – 24, Toronto, ON

ACI WEB SESSIONS



Mete Sozen, a graduate (BSc in Civil Engineering) of Robert College (now Bogazici University) in Istanbul Turkey, obtained his MS at the University of Illinois and, after working as a structural designer with Kaiser Engineers (Oakland, CA) and Hardesty and Hanover (New York, NY), returned to obtain his PhD degree in Civil Engineering at the University of Illinois, Urbana. He joined the faculty at Urbana in 1963 where he served until 1993 when he moved to Purdue University as the Kettelhut Distinguished Professor of Structural Engineering. Sozen has served on the Building Code Committee of the American Concrete Institute. He was a member of the four-person committee that produced the Veterans Administration Code for Earthquake Resistant Design of Hospitals in 1972. He has served on technical committees of the American Concrete Institute, the American Society of Civil Engineers, the European Concrete Committee, the Prestressed Concrete Institute, and the Earthquake Engineering Research Institute. Sozen has been elected to membership in the U.S. National Academy of Engineers and the Royal Swedish Academy of Engineering Sciences. He has been granted honorary doctorates by Bogazici University (Turkey), Pannonius University (Hungary), and the Georgian Technical University (Tbilisi), and honorary membership by the Assoc. of Turkish Eng. (NY), the American Society of Civil Engineers, Japan Society of Architectural Engineers, and the American Concrete Institute. Engineering News Record and The Applied Technical Council included him in the list of ten top earthquake engineers of the 20th century.

ACI WEB SESSIONS

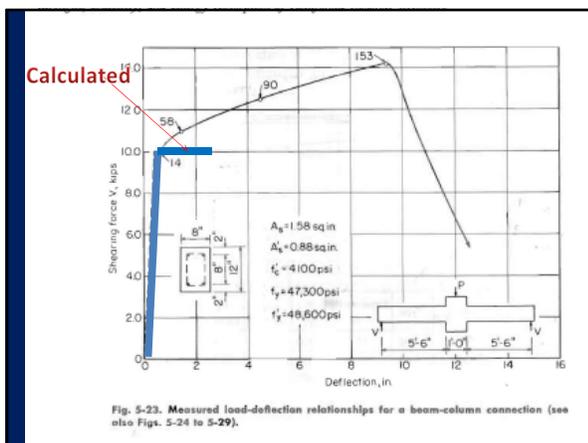
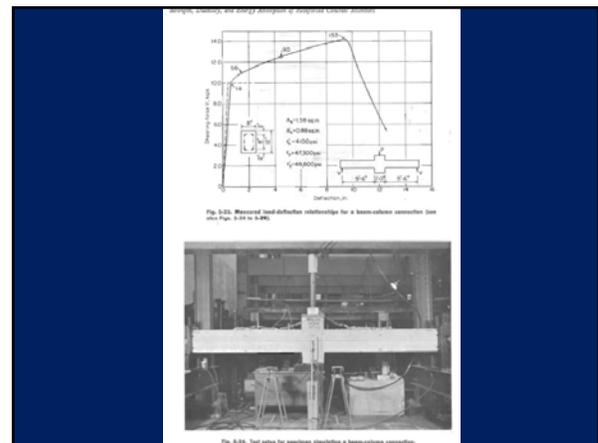
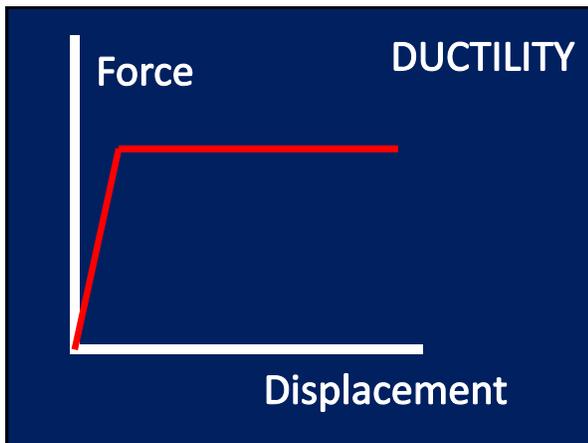
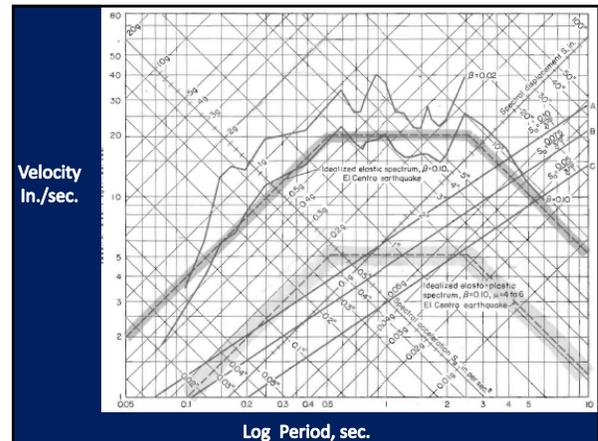


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Linear Strain Distribution?

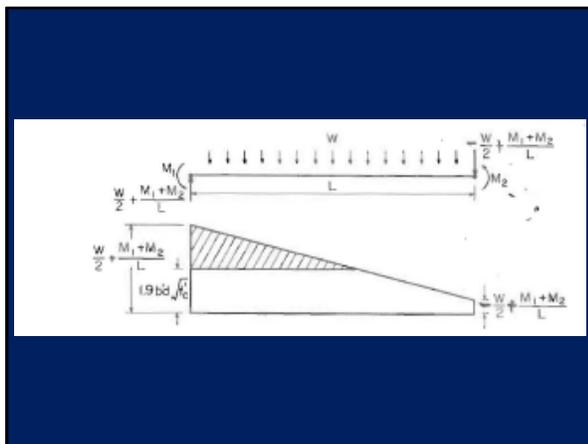
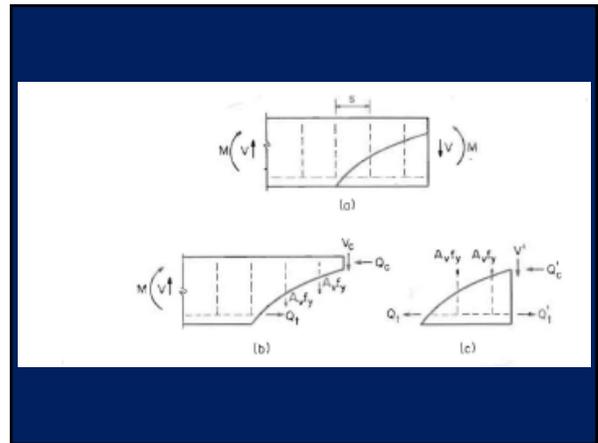
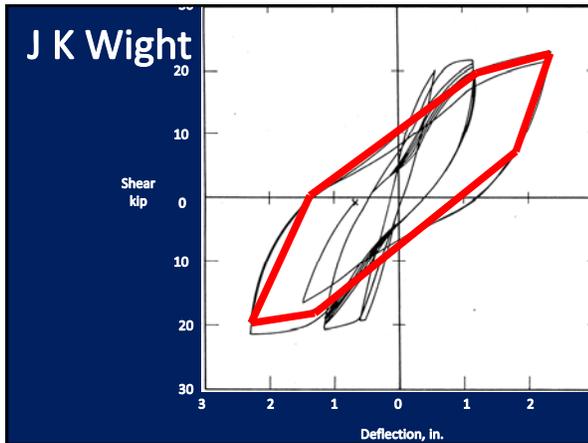
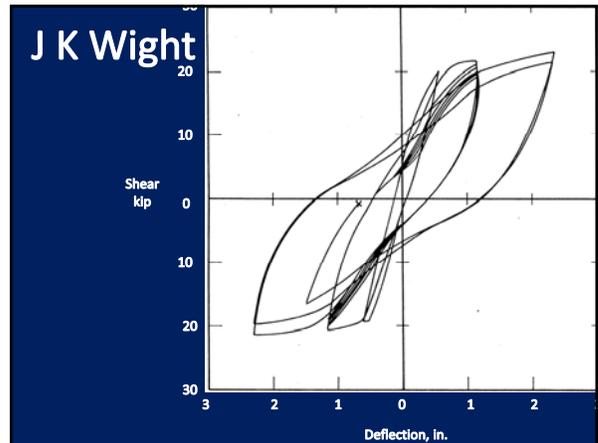
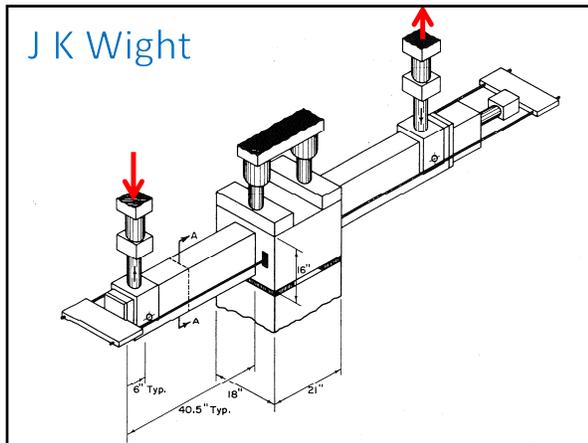
Is Unit Curvature a Measure of Ductility?

Does RC Respond "Elasto-Plastically"?

Is Rotation Ductility Critical?

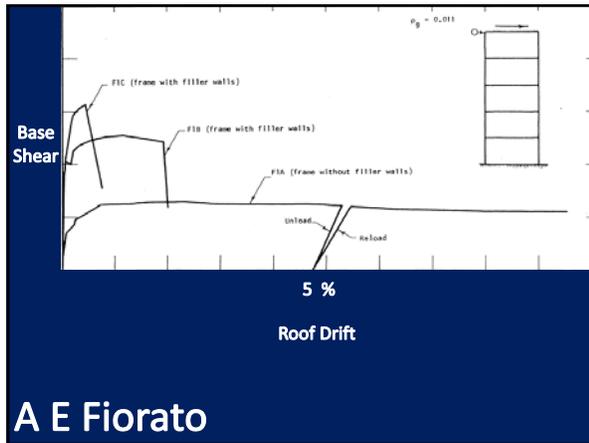
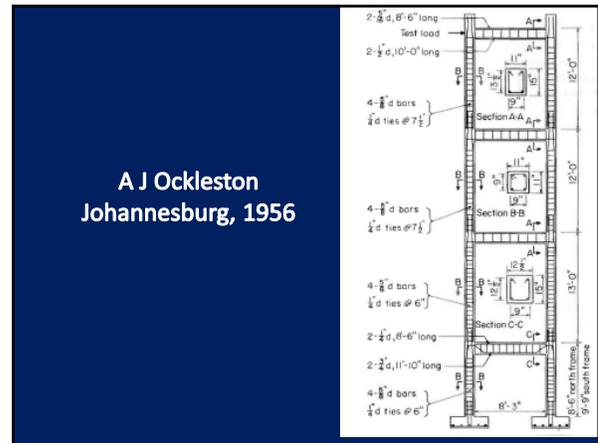
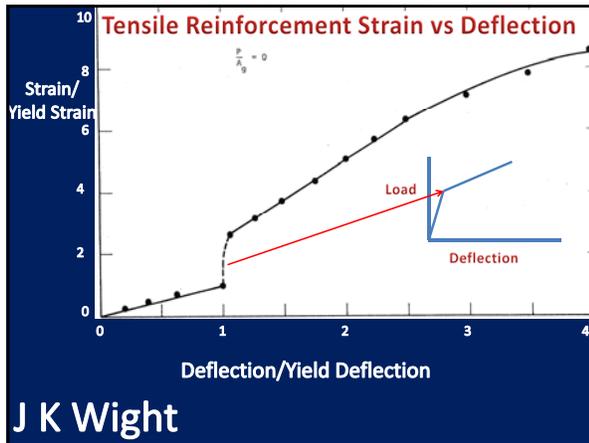
Is Concrete Compressive Strain Limited to ~ 0.004 ?

Is strength in shear under load reversals to be treated as monotonically increasing shear?



J. K. Wight

- Linear Strain Distribution? No
- Is Unit Curvature a Measure of Ductility? No
- Does RC Respond "Elasto-Plastically"? No
- Is Rotation Ductility The Limiting Factor? No
- Is Concrete Compressive Strain Limited to ~ 0.004 ? No
- Is strength in shear under load reversals to be treated as monotonically increasing shear? No



Drift?

Discussion in 1959, SEA/SC

What is good engineering practice related to drift?

Broken glass or wall pieces falling is within engineering concern but protection of nonstructural elements and problem of motion sickness borders on excessive paternalism.

Drift

..... even though drift is seldom critical in a multi-story reinforced concrete building ...

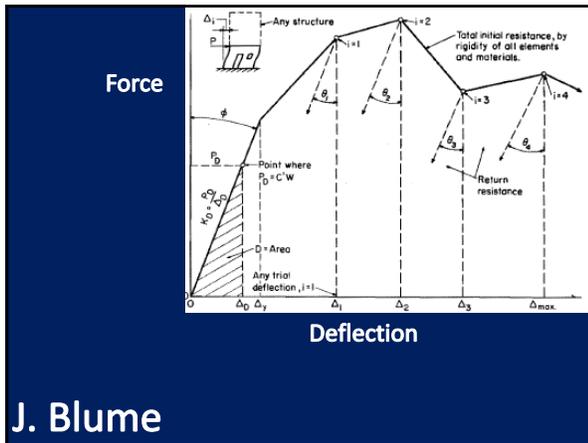
A less rigorous .. rule ..that may be more accurate ... is to sum story drifts corresponding to yield deflection and amplifying the yield deflections of the first two stories by two?

J. Blume

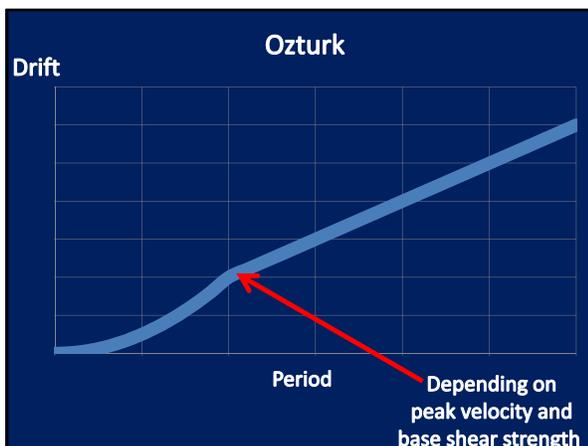
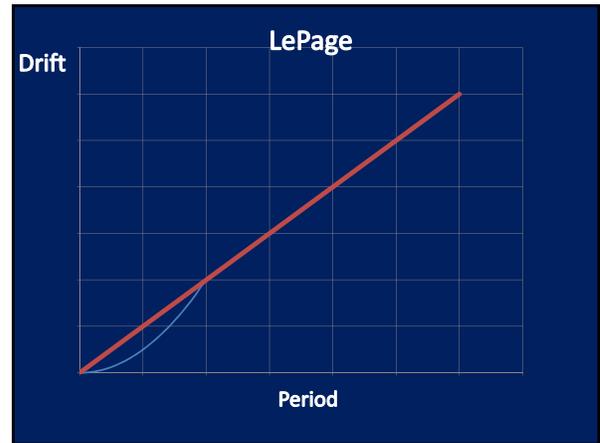
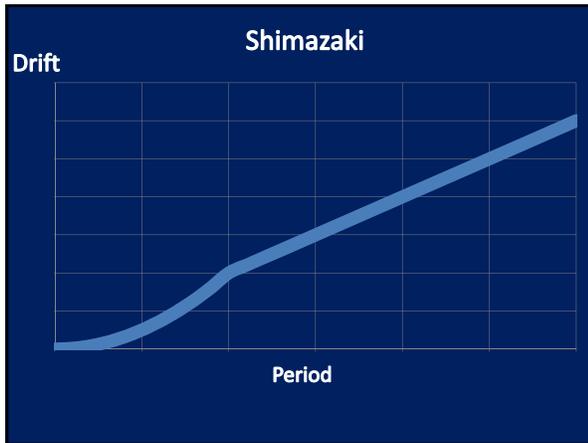
Reserve-Energy Technique

Current design methods

1. fall short of estimating drift,
2. are not sensitive to damage caused by drift,
3. ignore changes in natural period
4. do not recognize effect of repeated loading
5. insensitive to nonstructural elements
6. Do not consider (a) energy, (b) max. drift, (c) permanent set, and (d) damage.



J. P. Moehle
 S. L. Wood
 H. Cecen
 J. Lybas
 D. Aristizabal
 J. Bonacci
 B. Algan → Drift Based
 M. Eberhard → Behavior Based



William Stafford
 Every war has two losers !

**A Trade War
Has Many Winners !**