Next Generation PEER Structures Performance Database

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Organization

- Existing databases
- Current work
- Needs/Priorities????

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Available Column Databases

- Early Contributions
  - Taylor and Stone (1993)
  - Taylor et al. (1997)
- PEER Structural Performance Database
  - Berry and Eberhard (2004)
  - NHERI-ACI Committee 369, Ghannoum et al., (2015)
- Databases limited to specific region (e.g., Japan, China)
  - Kawashima Database (still available??)
- Narrowly focused databases
  - high-strength rebar (Suzuki, 2015)
  - retrofit (Alvarez and Breña, 2017)]
  - steel-concrete composite member database (Denavit)
- Current PEER Effort (Abdullah/Wallace, 2021)

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Other Notable Databases

- NHERI DesignSafe
- FIB Database Project (Miguel Ruiz, Carlos Ospina)
  - Fiber-reinforced concrete
  - Concentric punching shear of concrete slabs without shear reinforcement
  - *https://www.fib-international.org/commissions/databases.html*

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Benefits of Databases

- Access data from 100s of tests of columns
- Calibration/Evaluation of design models
  - Flexural strength
  - Shear Strength
  - Stiffness
  - Damage (flexural and shear cracking, spalling, buckling)
  - Force-displacement, hysteretic models
- Development of design provisions
  - Limits on axial load
  - Spacing, development of transverse reinforcement
- Identification of tests to study in detail
- Current PEER database receives ~50 citations/year

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Limitations of Current Databases

- Partial coverage
  - Regional
  - Focused subset
- Missing key properties
- Missing more recent tests
- Attributions

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Introduction

This site provides the results of over 400 cyclic, lateral-load tests of reinforced concrete columns. The database describes tests of:

- spiral or circular hoop-reinforced columns (with circular, octagonal or rectangular cross-sections)
- rectangular reinforced columns
- columns with or without splices

For each test where the information is available, the database provides the:

- column geometry
- column material properties
- column reinforcing details
- test configuration (including P-delta configuration)
- axial load
- digital force-displacement history at the top of the column
- top displacement that preceded various damage observations
- key drawings and images (where available)
- comments (e.g., unusual characteristics)
- references and links for further information

Detailed information is available in the user manual (424K PDF).

The following websites provide additional data and details of column tests:

- Kawashima Earthquake Engineering Laboratory (Tokyo Institute of Technology)

Disclaimer

This database was assembled as a service to the research community in earthquake engineering. The University of Washington, PEER and the researchers who performed the experiments make no warranties to the accuracy of the information that has been collected. If you have any questions, comments or suggestions, please contact Marc Eberhard at the University of Washington or Debra Bartling at the University of California, Berkeley.

Acknowledgements

Our greatest thanks go to the many researchers who generously shared their test data. Wherever possible, users of this database should cite the original references for the test description, in addition to this database.

The core of the database was assembled by researchers at the National Institute of Standards and Technology (NIST), who collected data for 92 test of columns with circular spiral or hoop-reinforced columns and 107 tests of columns with rectangular reinforcement. For each test, the NIST database described the reported test geometry, material properties, top force-displacement histories and a reference. Dr. Andrew Taylor, formerly of NIST, provided invaluable assistance in developing the database.

The column data was collected and processed by University of Washington students Michael Berry, Haili Camarillo, Amit Mookerjee, Myles Parrish, and Zachary Price. Mr. Berry and Mr. Price were supported by the National Science Foundation Research Experience for Undergraduates Program.

Information Provided

- ~400 tests
- Column geometry
- Material properties
- Reinforcing details
- Test configuration (including P-delta configuration)
- Axial load
- **Digital force-displacement history at the top of the column**
- Top displacement that preceded various damage observations
- Comments
- References

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Current Work (Abdullah/Wallace)

- Data from more (recent) tests
- More properties
- Backbone Curves
- Computed properties
  - Nominal strengths
  - Neutral axis depths
  - Moment-curvature relationships
  - Provision capacities (ASCE 318, ASCE 41, Caltrans)
- References
  - PDFs of reports and theses

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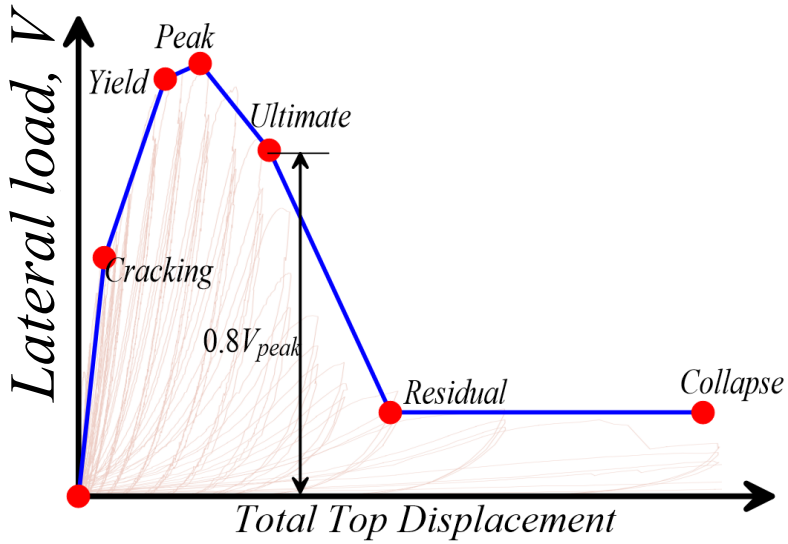
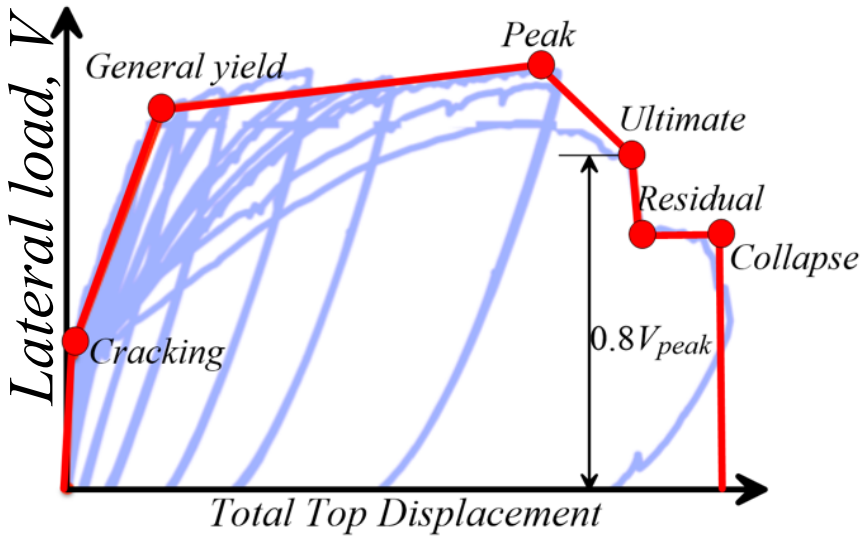
Backbone Curves





From Abdullah,Karoum, Hu, Wallace, 2020

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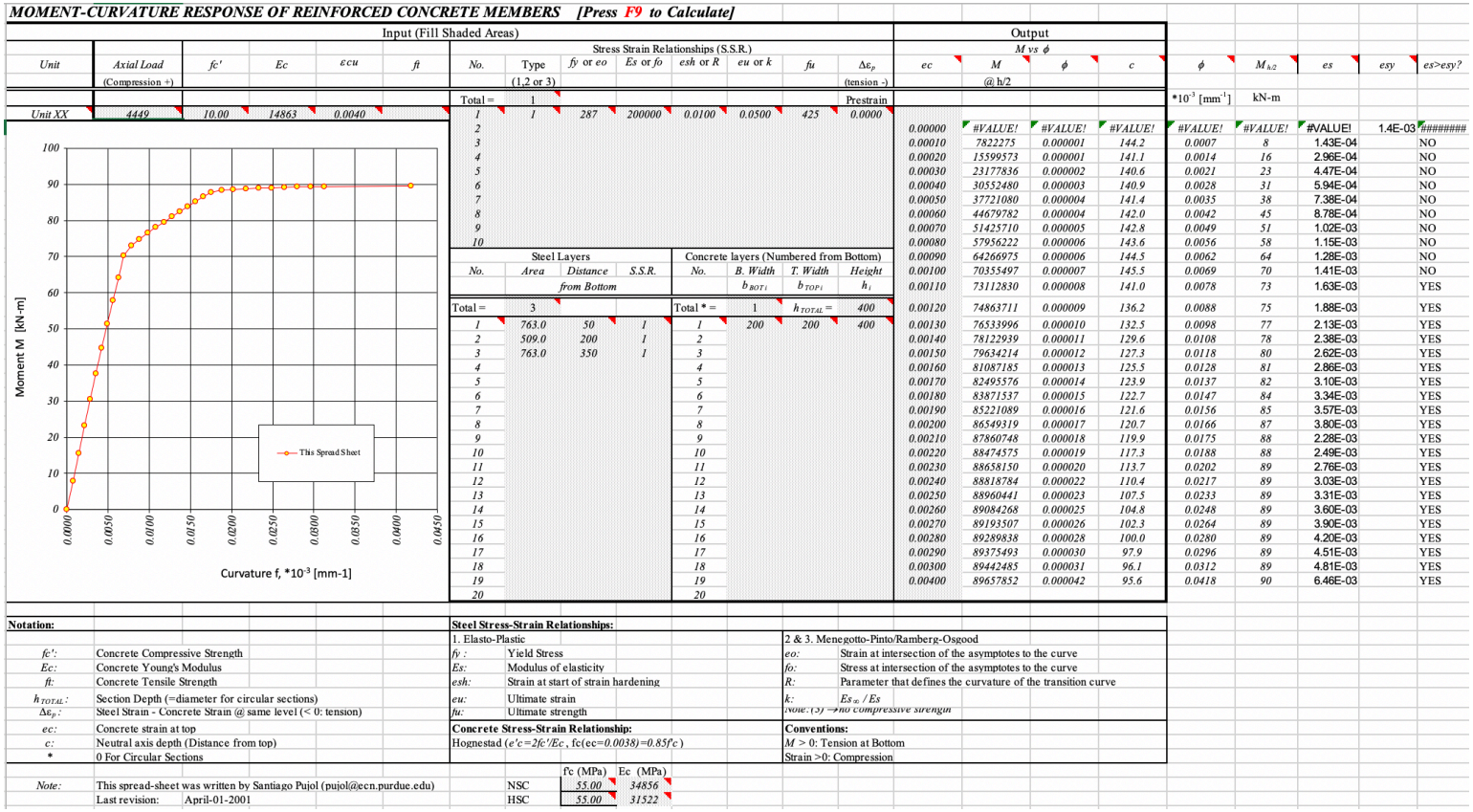
Moment-Curvature Analysis



MOMENT-CURVATURE RESPONSE OF REINFORCED CONCRETE MEMBERS [Press F9 to Calculate]

Input (Fill Shaded Areas)

Unit	Axial Load (Compression +)	fc'	Ec	εcu	ft
Unit XX	4449	10.00	14863	0.0040	

Stress Strain Relationships (S.S.R.)

No.	Type (1,2 or 3)	fy or eo	Es or fo	esh or R	eu or k	fu	Δεp (tension -)
Total =	1						Prestrain
1	1	287	200000	0.0100	0.0500	425	0.0000
2							
3							
4							
5							
6							
7							
8							
9							
10							

Steel Layers

No.	Area	Distance from Bottom	S.S.R.
Total =	3		
1	763.0	50	1
2	509.0	200	1
3	763.0	350	1
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Concrete layers (Numbered from Bottom)

No.	B. Width $b_{BOT,i}$	T. Width $b_{TOP,i}$	Height h_i
Total * =	1	h_{TOTAL} =	400
1	200	200	400
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Output

M vs ϕ

ec	M @ h/2	ϕ	c	ϕ *10⁻³ [mm⁻¹]	$M_{h/2}$ kN-m	es	esy	es>esy?
0.00000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1.4E-03	########
0.00010	7822275	0.000001	144.2	0.0007	8	1.43E-04		NO
0.00020	15599573	0.000001	141.1	0.0014	16	2.96E-04		NO
0.00030	23177836	0.000002	140.6	0.0021	23	4.47E-04		NO
0.00040	30552480	0.000003	140.9	0.0028	31	5.94E-04		NO
0.00050	37721080	0.000004	141.4	0.0035	38	7.38E-04		NO
0.00060	44679782	0.000004	142.0	0.0042	45	8.78E-04		NO
0.00070	51425710	0.000005	142.8	0.0049	51	1.02E-03		NO
0.00080	57956222	0.000006	143.6	0.0056	58	1.15E-03		NO
0.00090	64266975	0.000006	144.5	0.0062	64	1.28E-03		NO
0.00100	70355497	0.000007	145.5	0.0069	70	1.41E-03		NO
0.00110	73112830	0.000008	141.0	0.0078	73	1.63E-03		YES
0.00120	74863711	0.000009	136.2	0.0088	75	1.88E-03		YES
0.00130	76533996	0.000010	132.5	0.0098	77	2.13E-03		YES
0.00140	78122939	0.000011	129.6	0.0108	78	2.38E-03		YES
0.00150	79634214	0.000012	127.3	0.0118	80	2.62E-03		YES
0.00160	81087185	0.000013	125.5	0.0128	81	2.86E-03		YES
0.00170	82495576	0.000014	123.9	0.0137	82	3.10E-03		YES
0.00180	83871537	0.000015	122.7	0.0147	84	3.34E-03		YES
0.00190	85221089	0.000016	121.6	0.0156	85	3.57E-03		YES
0.00200	86549319	0.000017	120.7	0.0166	87	3.80E-03		YES
0.00210	87860748	0.000018	119.9	0.0175	88	2.28E-03		YES
0.00220	88474575	0.000019	117.3	0.0188	88	2.49E-03		YES
0.00230	88658150	0.000020	113.7	0.0202	89	2.76E-03		YES
0.00240	88818784	0.000022	110.4	0.0217	89	3.03E-03		YES
0.00250	88960441	0.000023	107.5	0.0233	89	3.31E-03		YES
0.00260	89084268	0.000025	104.8	0.0248	89	3.60E-03		YES
0.00270	89193507	0.000026	102.3	0.0264	89	3.90E-03		YES
0.00280	89289838	0.000028	100.0	0.0280	89	4.20E-03		YES
0.00290	89375493	0.000030	97.9	0.0296	89	4.51E-03		YES
0.00300	89442485	0.000031	96.1	0.0312	89	4.81E-03		YES
0.00400	89657852	0.000042	95.6	0.0418	90	6.46E-03		YES

Notation:

fc':	Concrete Compressive Strength
Ec:	Concrete Young's Modulus
ft:	Concrete Tensile Strength
h_{TOTAL}:	Section Depth (=diameter for circular sections)
$\Delta\varepsilon_p$:	Steel Strain - Concrete Strain @ same level (< 0: tension)
ec:	Concrete strain at top
c:	Neutral axis depth (Distance from top)
*	0 For Circular Sections

Steel Stress-Strain Relationships:

1. Elasto-Plastic

fy :	Yield Stress
Es:	Modulus of elasticity
esh:	Strain at start of strain hardening
eu:	Ultimate strain
fu:	Ultimate strength

2 & 3. Menegotto-Pinto/Ramberg-Osgood

eo:	Strain at intersection of the asymptotes to the curve
fo:	Stress at intersection of the asymptotes to the curve
R:	Parameter that defines the curvature of the transition curve
k:	Es_{∞} / Es

Note: (3) →No compressive strength

Concrete Stress-Strain Relationship:

Hognestad ($e'c=2fc'/Ec$, fc(ec=0.0038)=0.85f'c)

Conventions:

M > 0: Tension at Bottom

Strain >0: Compression

	f'c (MPa)	Ec (MPa)
NSC	55.00	34856
HSC	55.00	31522

Note: This spread-sheet was written by Santiago Pujol (pujol@ecn.purdue.edu)

Last revision: April-01-2001

From Abdullah,Karoum, Hu, Wallace, 2020

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Needs/Priorities???

- Continue to add tests
- Force-displacement histories
- Scanning of historical reports/theses
- Test images, videos, point clouds (damage)
- Coordination with other databases
  - Regional
  - Narrowly focused
  - NHERI
- Shaking Table Tests
- Beyond columns
  - Walls
  - Joints
- Support for data analysis
  - Visualization
  - Statistical analysis
  - Automatic generation of OpenSees code
- Version control
  - Code provisions
  - Papers and reports
- Community survey

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