

STEEL FIBER REINFORCED CONCRETE PIPES

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American Concrete Pipe Association

NESMEA 2013

What Has Been Available



Designation: C76 – 11

**Standard Specification for
Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe¹**



Designation: C14 – 11

**Standard Specification for
Nonreinforced Concrete Sewer, Storm Drain, and Culvert
Pipe¹**

What has been available?

Standard Specification for

Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

AASHTO Designation: M 170-12¹

ASTM Designation: C 76-11a



Standard Specification for

Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe

AASHTO Designation: M 86M/M 86-09¹

ASTM Designation: C 14M-07 and C 14-07



ACPA's Preliminary Look into FRCP

Final Report

On

A Study of

FIBER-REINFORCED CONCRETE PIPE

And

FIBER-CEMENT PIPE

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Fibers Studied in 2003

Table 1. – Fiber Content in Concrete Matrix

fiber type	wt. fraction (wt.%/cu yd)	vol. fraction (vol.%/cu yd)	fiber weight (lbs./cu yd)
Type (P1) polypropylene fiber	0.12	0.35	5
	0.22	0.60	9
	0.29	0.80	12
Type (P2) polypropylene fiber	0.08	0.25	3.2
	0.12	0.35	4.8
	0.15	0.45	6.2
glass fiber	0.27	0.25	10.3
	0.37	0.35	14.4
	0.47	0.45	18.5
carbon fiber	0.85	0.70	32.7
	1.25	1.00	48.1

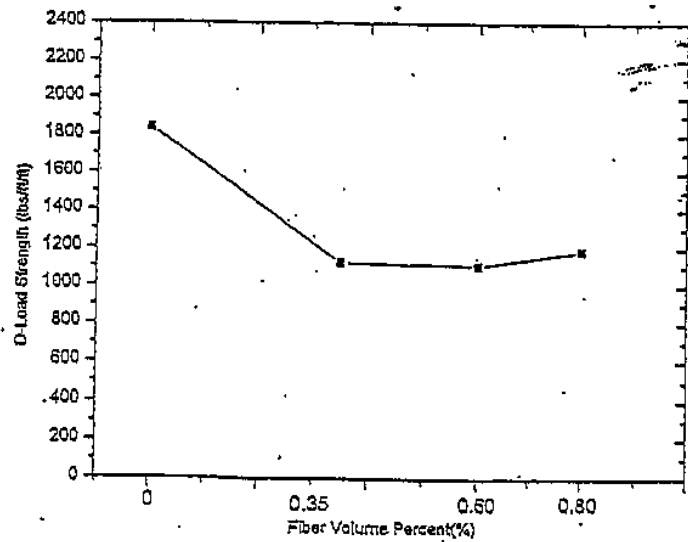


Figure 14 – D-Load Strength With (P1) Poly. Fibers

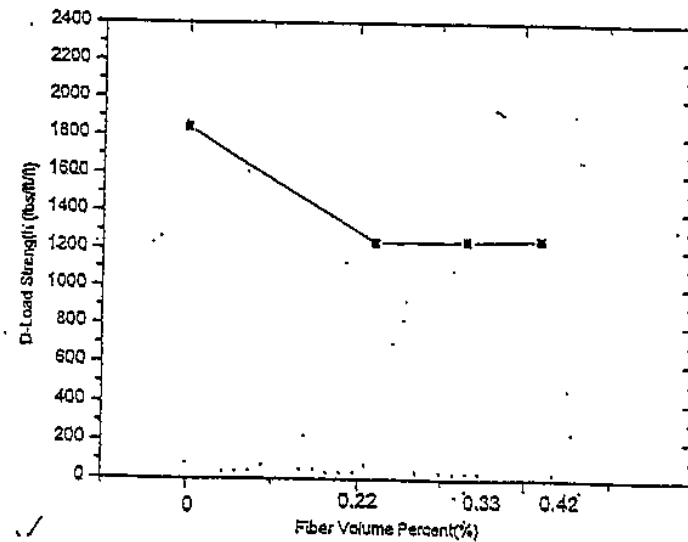


Figure 15 – D-Load Strength With (P2) Poly. Fibers

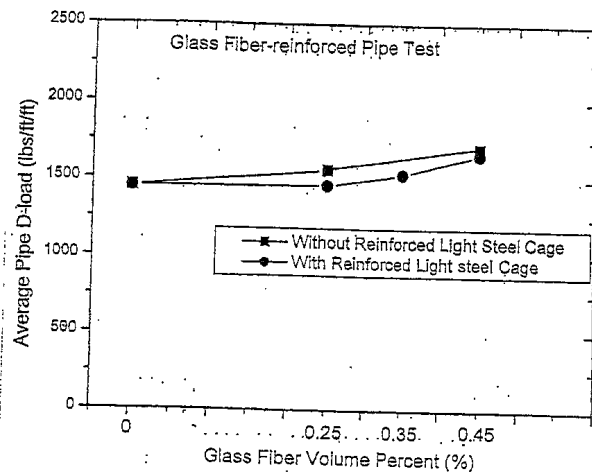


Figure 16 – Pipe D-Load Strength with Glass Fibers

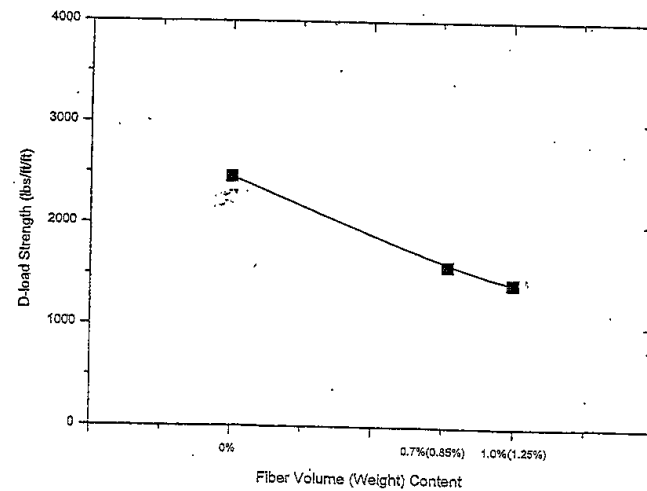


Figure 17 – Pipe D-Load Strength with Carbon Fibers

Brittle Failure

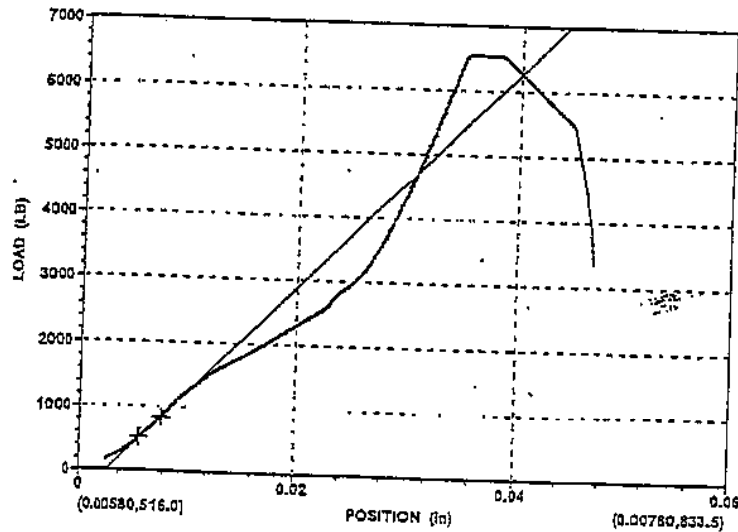


Figure (13c) 0.35% V_f

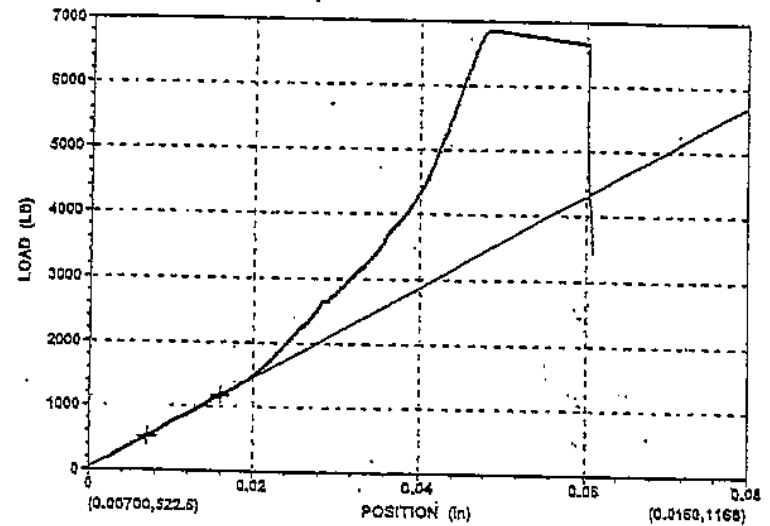


Figure (13d) 0.45% V_f

Figure 13 – Flexural Load / Deformation Relationship



European Standard for Steel Fiber Reinforced Concrete Pipe.

EUROPEAN STANDARD

EN 1916

NORME EUROPÉENNE

EUROPÄISCHE NORM

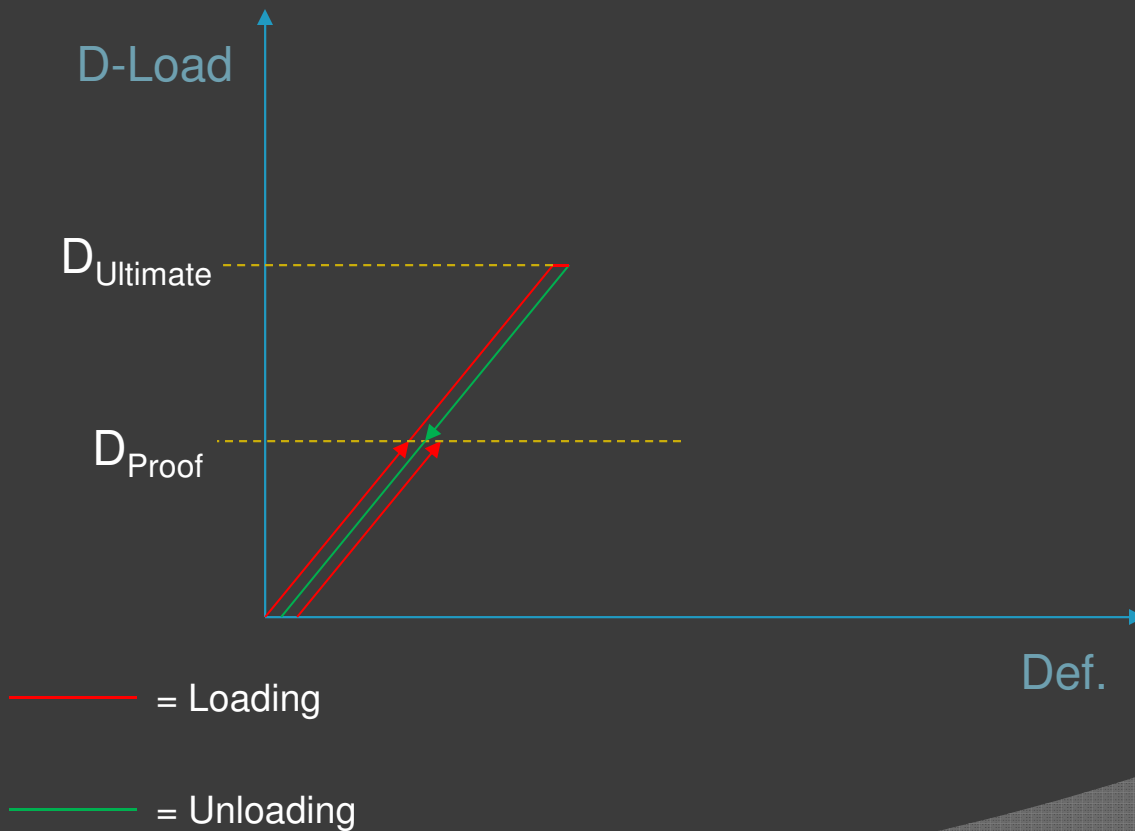
October 2002

ICS 23.040.50; 93.030

English version

Concrete pipes and fittings, unreinforced, steel fibre and
reinforced

No Brittle Failure



EXPERIMENTAL WORK AT THE UNIVERSITY OF TEXAS AT ARLINGTON

FULL SCALE PIPE

TEST

ASTM C497
THREE-EDGE
BEARING (3EBT)

ASTM C443
HYDROSTATIC JOINT

ASTM C497
JOINT SHEAR

MATERIAL

TESTING

ASTM C1609
FLEXURAL BEAM

ASTM C39
COMPR. CYLINDER

DIRECT TENSION
OF CONCRETE

PRODUCTION SITES



PRODUCTION EQUIPMENT

**HANSON
PACKERHEAD**



**NCP
HAWKEYE**



**RINKER
PETERSHAAB**



**SHERMAN DIXIE
SCHLUSSEAUFER**

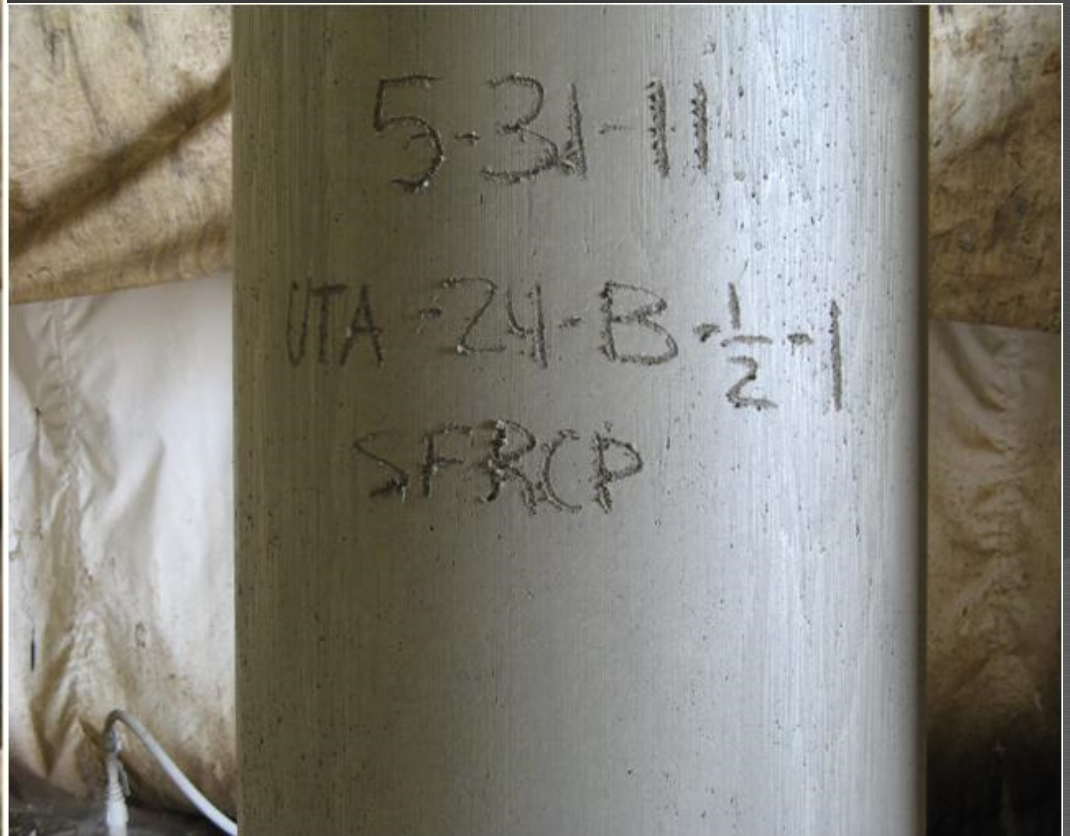
PIPE SPECIMENS AND SITES

TEST SITE	TYPE OF EQUIPMENT	NUMBER OF SPECIMENS	SIZES (in)	WALL THICKNESSES
HANSON	Packerhead	51	15,24,30,33,36,42,48	B,C
RINKER-CEMEX	Petershaab	16	24,36	B
NORTHERN CONCRETE PIPE	Hawkeye	27	24,36,48	B,C
SHERMAN DIXIE	Schlüsselbauer	16	24,36,48	B,C
	TOTAL	110		

SFRCP FINISH



48 in. SFRCP, 88 lb/cyd

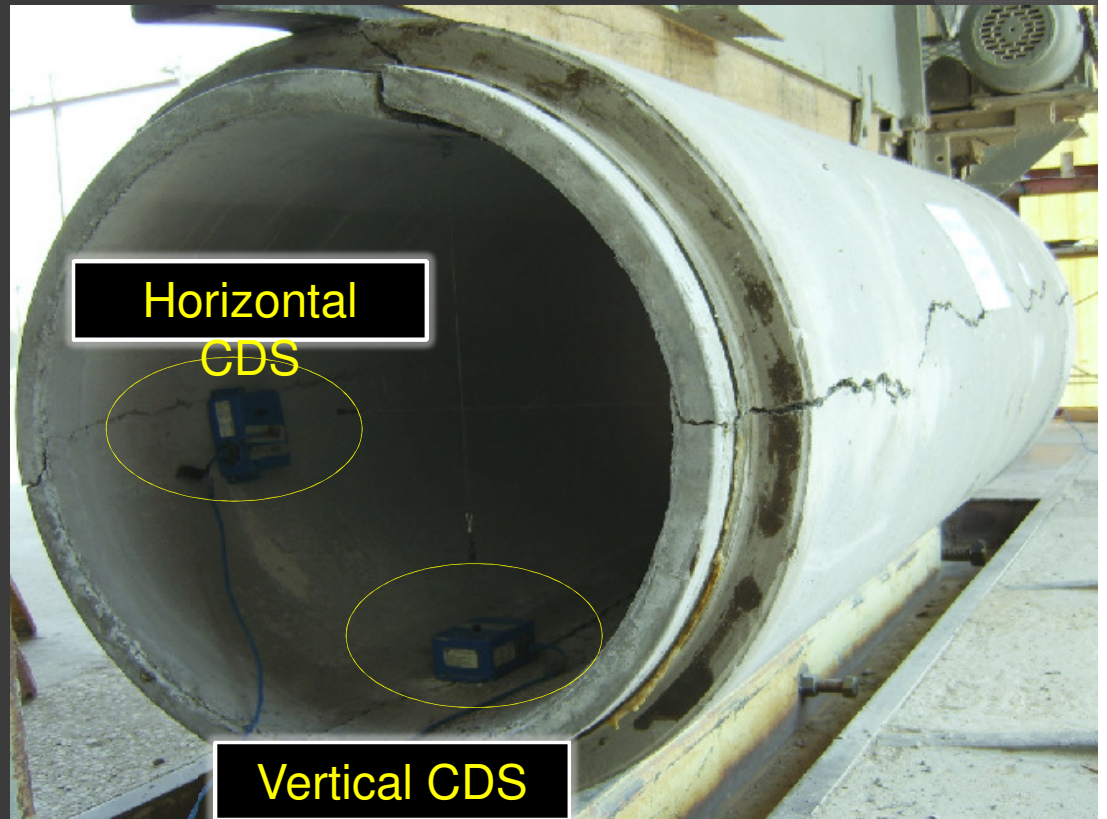


24 In. SFRCP, 22 lb/cyd

D-LOAD TEST ASTM C497



INSTRUMENTATION



TYPICAL FAILED SPECIMEN

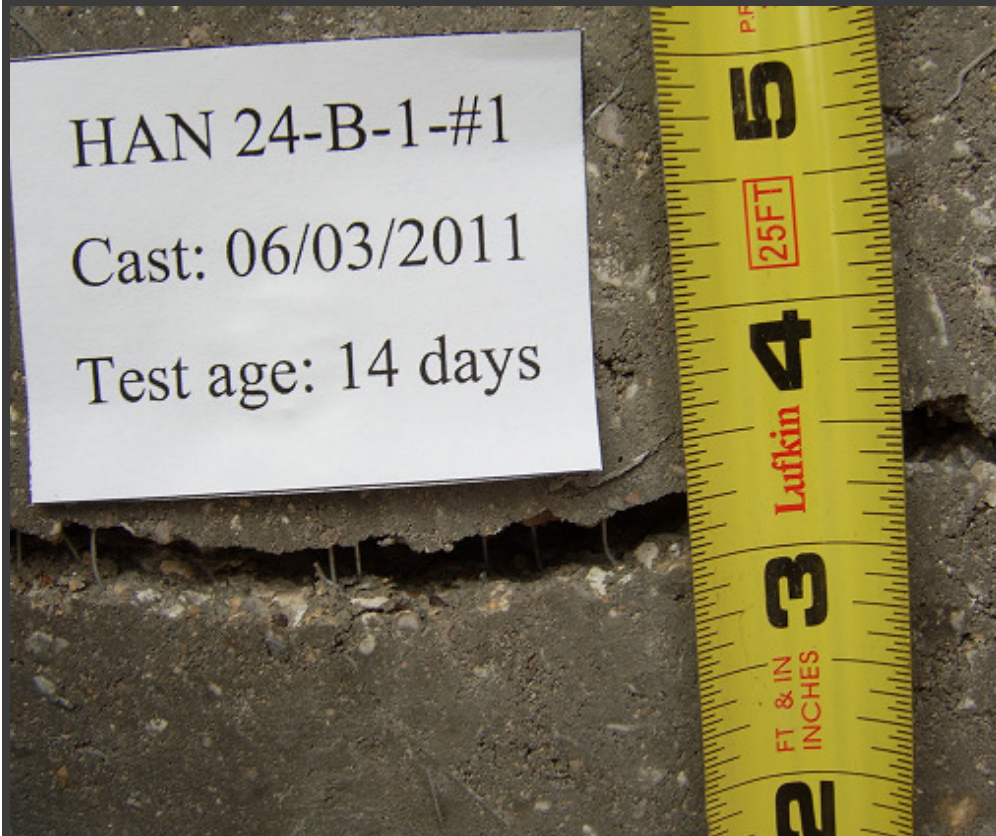


**SFRCPC
NCP-36-C-66**



**SFRCPC
NCP-24-B-44**

CRACK SIZE



SFRCPC 24-B-44

1/4 in. CRACK @ 5% DEFORMATION



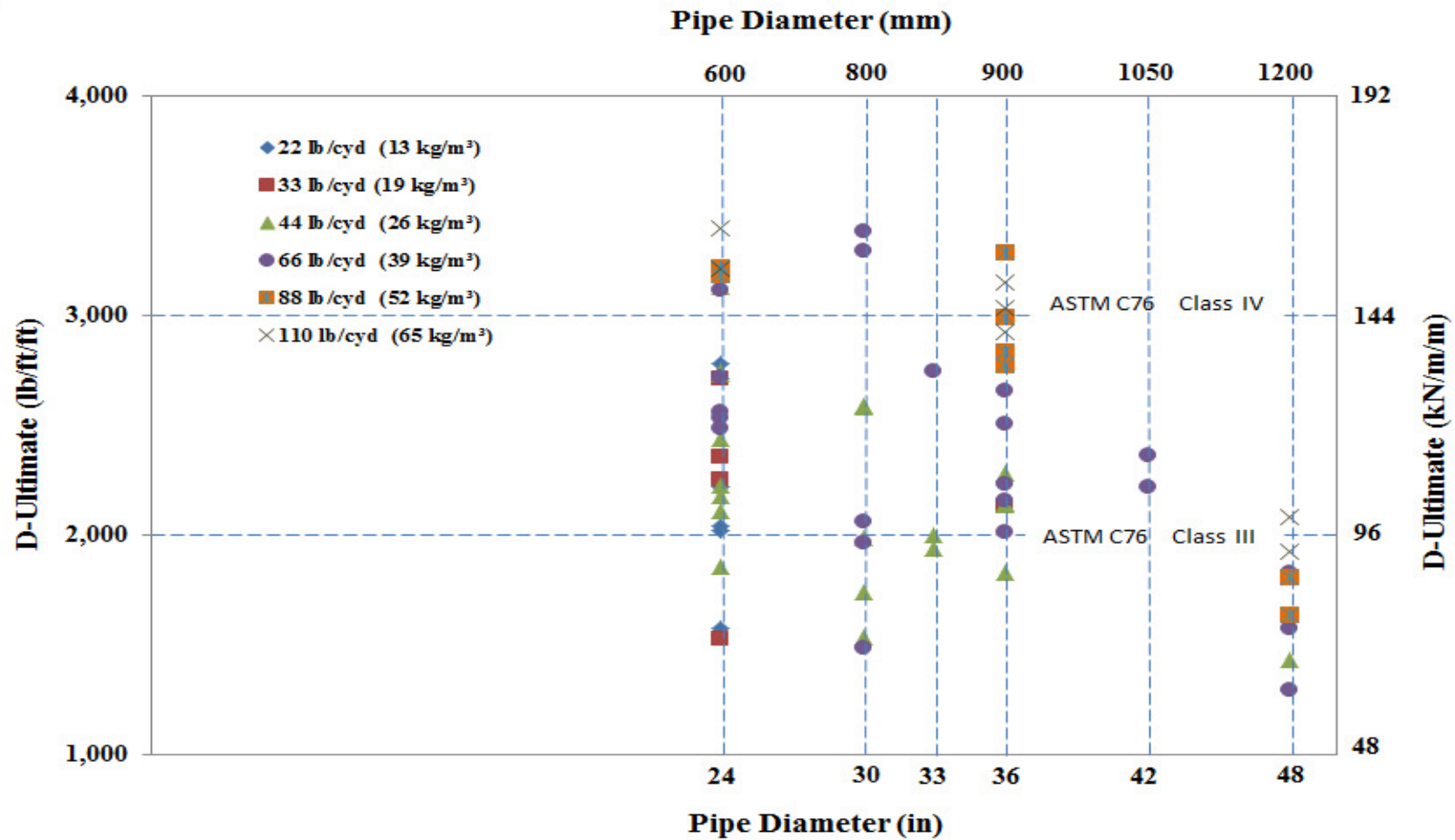
SFRCPC 36-C-66

1/2 in. CRACK @ 5% DEFORMATION

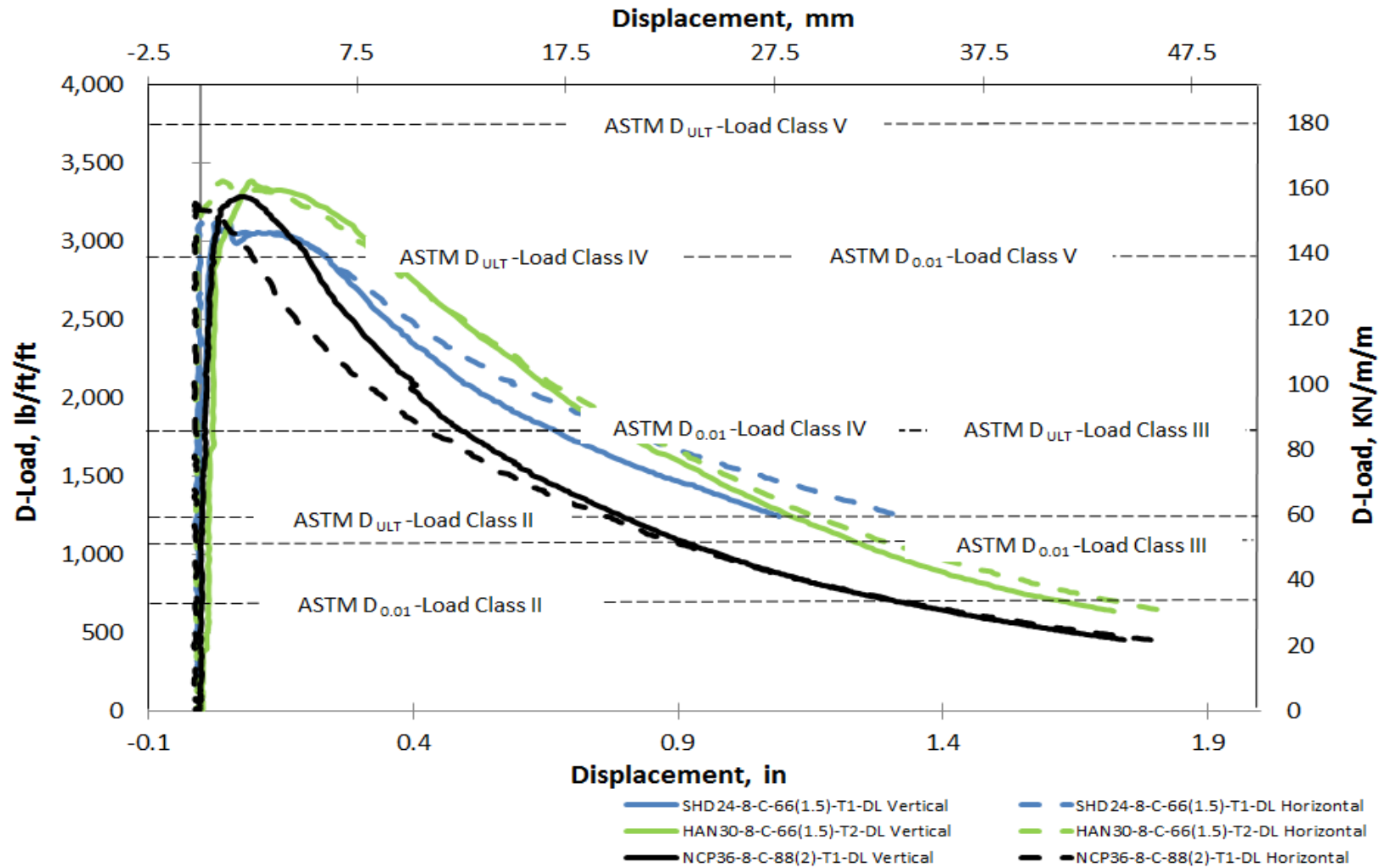
FIBERS AT LARGE CRACK



D-LOAD TEST RESULTS



D-LOAD TEST RESULTS



New ASTM Standard

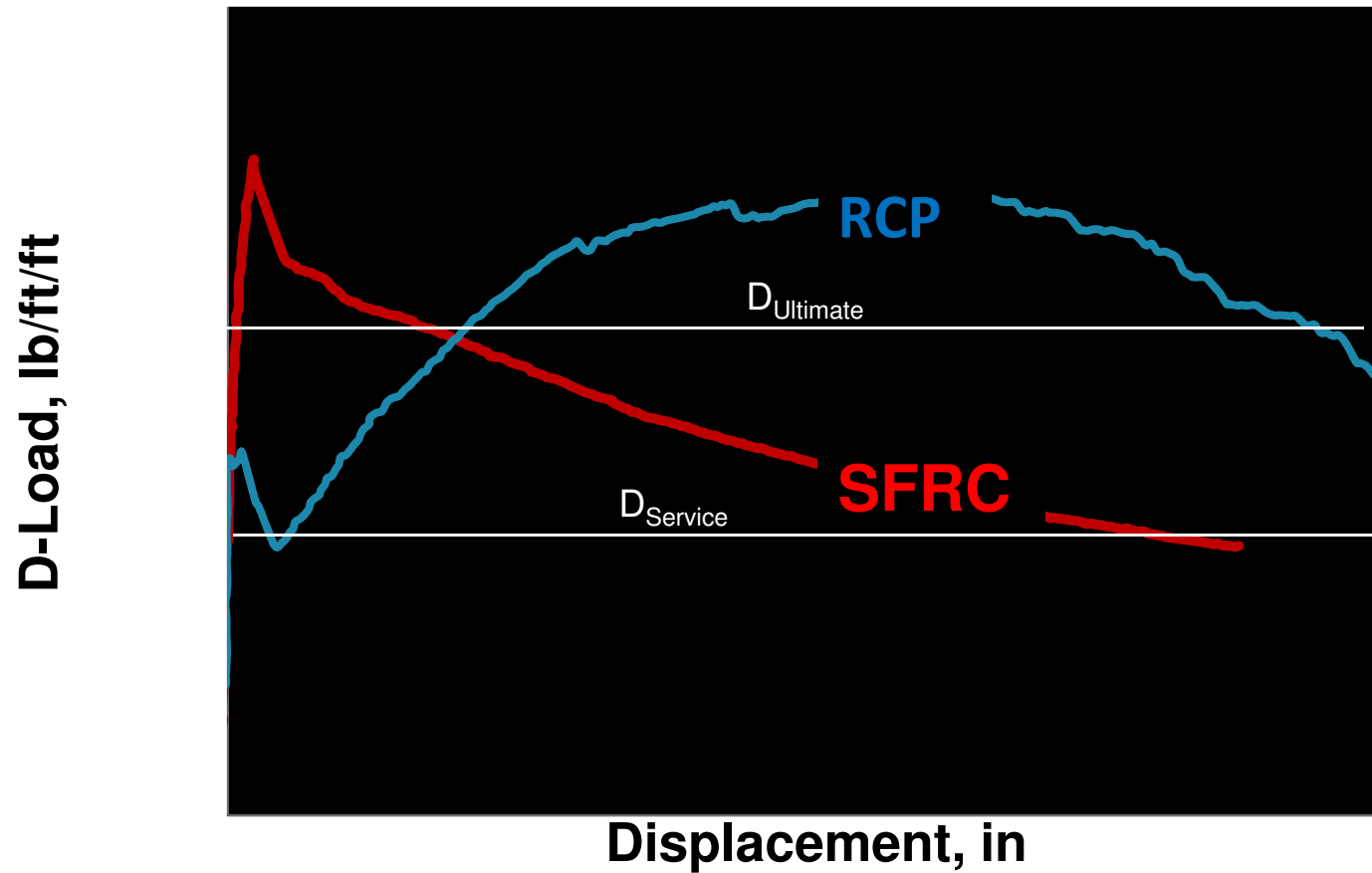


Designation: C1765 – 13

Standard Specification for Steel Fiber Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe¹

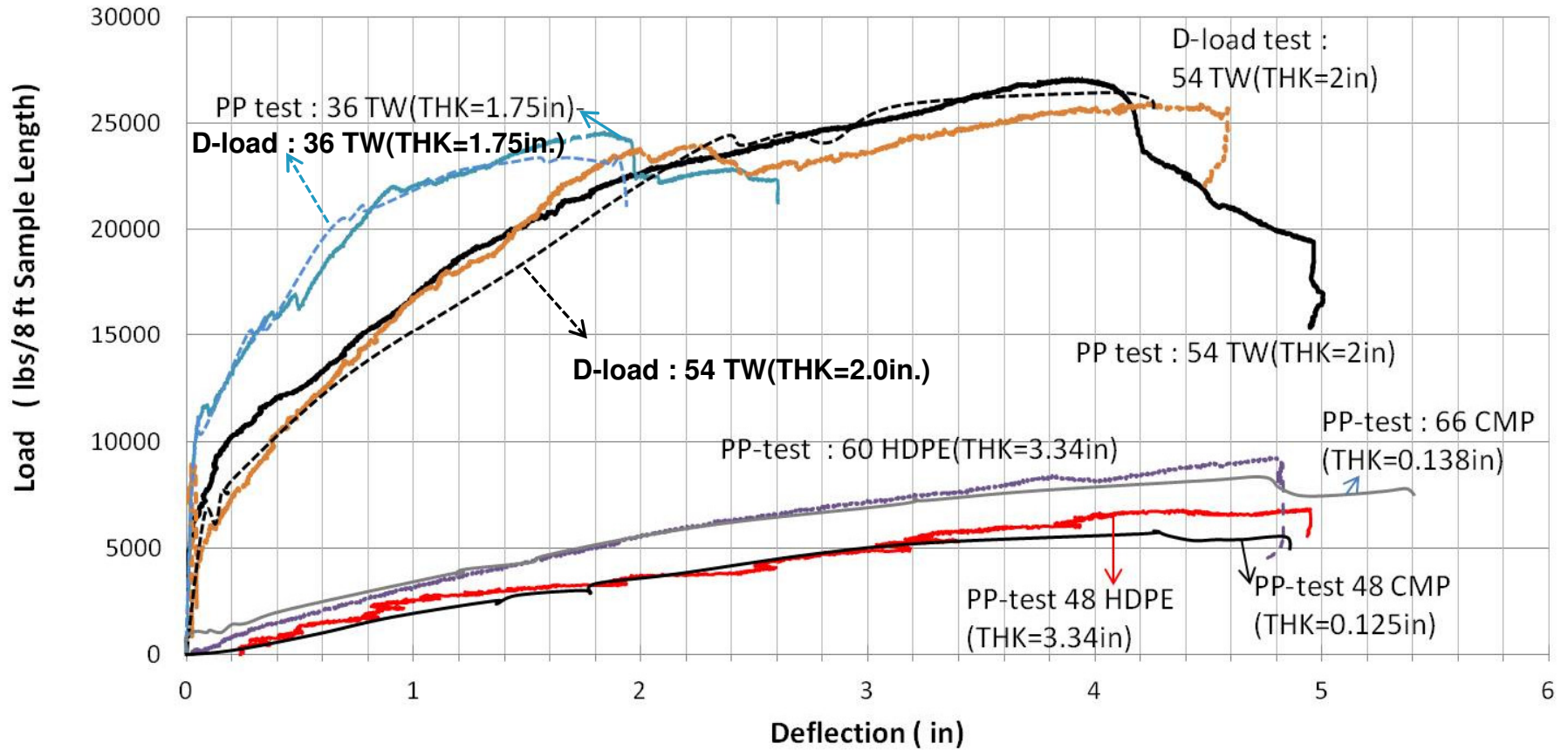
This standard is issued under the fixed designation C1765; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

CONSISTENT FACTOR OF SAFETY



Future Possibilities

D-load vs. Parallel plate test(PPT)



THE END