Attachment 2.1-1:

Notation and Formulary for the ACI-DAfStb Shear Databases vuct-RC-DS for the data collection and vuct-RC-DK for the data control of r.c.-beams without stirrups subjected to point loads

Nr. (no.)	running number,
Lit. (Author)	reference: author, year
Bez. (Test specimen)	specimen as named by author

Einheiten (Units): dual input in Imperial units or SI - units; Imp. units are converted into SI-units, and all calculations in SI-units.

Querschnittswerte (section properties)

b	b	[in → mm]	width of flange
bw	b_w	[in → mm]	width of web
h	h	[in → mm]	height of beam
hf	h_f	[in → mm]	height of flange
hh,top	$h_{h,top}$	[in → mm]	height of top haunch
hw	h_w	[in → mm]	height of web
hft	h_{ft}	[in → mm]	height of tension flange
hh,bot	$h_{h,bot}$	[in → mm]	height of botton haunch
bft	b_{ft}	[in → mm]	width of tension flange
Ac	A_c	[mm²]	gross area of concrete section
zc2	z_{c2}	[mm]	distance of CGS from top fibre

Laststellung und Geometrie (loading and geometry)

aa	a_A	[in → mm]	dimension of support plate
af	a_F	[in → mm]	dimension of loading plate
ba	b_A	[in → mm]	distance between support axis and beam end
L	L	[in → mm]	span
c	c	[in → mm]	distance between point loads
a	a	[in → mm]	distance of point load from support axis
kap	a/d	[-]	moment - shear force - ratio

Längsbewehrung (Zugbewehrung) (longitudinal tension reinforcement)

cc	c_c	[in → mm]	minimum concrete cover
ds	d_s	[in → mm]	effective depth of reinforcing bars
d	d	[in → mm]	effective depth of tension chord
Stab_Z		[-]	number and diameter of bars
ns	n_s	[-]	number of bars
dst	$Ø_{st}$	[in → mm]	average diameter
fr	f_r	[-]	r = ribbed bars; 0 = plain bars
As	A_s	[in² → mm²]	area of reinforcing steel
alphaa	α_a	[-]	coefficient for anchorage (hook 0.7; straight 1.0; anchor plate 0.01)
rhos	$\rho_s = \frac{A_s}{b \cdot d} \cdot 100$	[%]	geometrical reinforcement ratio
rhosw	$\rho_{sw} = \frac{A_s}{b_w \cdot d} \cdot 100$	[%]	geom. reinforcement ratio related to web width
fsy	f_{sy}	[ksi → MPa]	yield strength of longitudinal steel

esy	$\varepsilon_{sy} = f_{sy} / E_s$	[-]	steel strain at yield (E_s = 200.000 MPa)
ftk	f_{tk}	[ksi → MPa]	characteristic tensile strength
ftk/fsy	f_{tk}/f_{sy}	[-]	ratio
euk	ε_{uk}	[-]	steel strain at tensile strength f_{tk}

Längsdruckbewehrung (longitudinal compression reinforcement)

Stab_D		[-]	number and diameter of bars
ds2	d_{s2}	[in → mm]	distance of compress. reinforc. from compress. edge
ns2		[-]	number of compr. bars
dst2	$\varnothing_{st2}$	[in → mm]	average diameter of compr. bars
As2	A_{s2}	[in² → mm²]	area of compr. Bars
rhos2		[-]	geometrical reinforcement ratio
fsy2	f_{sy2}	[ksi → MPa]	yield strength of compression bars
eps2y	$= f_{sy2/200}$	[‰]	yield strain

Betondruckfestigkeit (concrete compressive strength)

diaa	$\varnothing_a$	[in → mm]	max. diameter of aggregates
fccyl	$f_{c,cyl}$	[psi → MPa]	cylinder strength of concrete
PKcyl	Prüfkörper	[in → mm]	dimension of cylinders
dimPKcyl	Prüfkörper	[mm]	dimension of cylinders for calculation of $f_{1c,cyl}$
f1ccyl	$f_{1c,cyl}$	[ksi → MPa]	uniaxial compr. strength derived from fccyl
fccu	$f_{c,cube}$	[ksi → MPa]	cube strength of concrete
PKcu	Prüfkörper	[in → mm]	dimension of cubes
dimPKcu	Prüfkörper	[mm]	dimension of cube for calculation of $f_{1c,cu}$

f1ccu	$f_{1c,cu}$	[ksi → MPa]	uniaxial compr. strength derived from fccube
fcpr	$f_{c,prism}$	[ksi → MPa]	prism strength of concrete
PKpr	Prüfkörper	[in → mm]	dimension of prisms
f1cpr	$f_{1c,pr}$	[ksi → MPa]	uniaxial compr. strength derived from fcpr
f1c	f_{1c}	[ksi → MPa]	uniaxial compr. strength of concrete
Method		[-]	test method (cyl; cu; pr)

<u>Betonzugfestigkeit (concrete tensile strength)</u>

fctfl	$f_{ct,fl}$	[ksi → MPa]	modulus of rupture
PKfl	Prüfkörper	[in → mm]	dimension of control specimen
dimPKfl	Prüfkörper	[mm]	dimensions of control specimen
h_PK	Prüfkörper	[mm]	height of control specimen
f1ctfl	$f_{1ct,fl}$	[ksi → MPa]	axial tensile strength derived from fctfl
fctsp	$f_{ct,sp}$	[ksi → MPa]	splitting tensile strength
PKsp	Prüfkörper	[in → mm]	dimension of control specimen
f1ctsp	$f_{1ct,sp}$	[ksi → MPa]	axial tensile strength derived from fctsp
f1cttest	$f_{1ct,test}$	[ksi → MPa]	test value for axial tensile strength
Method		[-]	test method (fl; sp)
betacttest	$\beta_{ct,test} = \frac{f_{1ct,test}}{f_{1c}}$	[-]	ratio
f1ctmcal	$f_{1ct,m,cal}$	[MPa]	calculated value of axial concrete tensile strength
betactcal	$\beta_{ct,cal} = \frac{f_{1ct,m,cal}}{f_{1c}}$	[-]	ratio

<u>mechanische Bewehrungsgrade (mecahnical reinforcement ratios)</u>

oms	$\omega_s = \frac{\rho_s \cdot f_{sy}}{f_{1c} \cdot 100}$	[-]	mech. reinf. ratio of reinforcing steel
om1	$\omega_l = \omega_s$	[-]	mech. reinf. ratio of tension chord

<u>Versuchswerte (test results)</u>

g	$g = A_s \cdot 24$	[kip/in→kip/ft→kN/m]	calculated self weight
Vg	$V_g = g \cdot (0{,}5 \cdot c + (a - x_r))$	[kip → kN]	shear force due to self weight
F	F	[kip → kN]	ultimate load
Vu_gFRep	$V_{u,g+F,Rep}$	[kip → kN]	reported shear force at failure with self weight (from report)
Vu_Rep = Vu_test	$V_{u,Rep} = V_{u,test}$	[kip → kN]	shear force at failure with self weight
Vu_gF	$V_{u,g+F}$	[kip → kN]	shear force at failure with calculated self weight
betar_meas	β_r	[°]	measured angle of inclined cracks
xr_meas	$x_{r,meas}$	[in → mm]	measured distance of crack from support axis
xr	x_r	[in → mm]	distance of crack from support axis
br		[-]	type of failure
bem		[-]	remarks
oft		[-]	other failure types

<u>Control criteria</u>

contr		[-]	reference available for control
konx		[-]	relevant data are given
kon61		[-]	criterion for slenderness $\kappa = a/d \geq 2{,}40$
konsl	= konx · kon61	[-]	criterion for tests on slender beams

kon62		[-]	criterion for slenderness $\kappa = a/d < 2{,}40$
kon24	= konx · kon62	[-]	criterion for tests on non-slender beams
konrect		[-]	criterion for rectangular cross-section

Bruchschnittgrößen (forces and moments at failure)

n_	N	[kN]	axial force (< 0 for compression)
nu_		[-]	non-dimensional axial force
zcN		[mm]	distance of applied axial force from top fibre
Mu	M_u	[kNm]	maximum Moment at shear failure
muu	μ_u	[-]	non-dimensional moment
con_nu		[-]	ratio
vutest	$\upsilon_{u,\,test} = \frac{V_u}{b_w \cdot d \cdot f_{1c}}$	[-]	non-dimensional value fror ultimate shear force

Inner lever arm at shear failure

kapc	$\kappa_c = 1 - \frac{f_{1c}}{250}$	[-]	coefficient for maximum stress of stress block
Ko_a; Ko_b; Ko_c		[-]	coefficients for quadratic equation
rat_sigsl		[-]	
sigsl	σ_{sl}	[MPa]	steel stress
kon_fsy	$kon_{fsy} = \sigma_{sl}/f_{sy}$	[-]	
xsitest	$\xi_{test} = x/d$	[-]	coefficient for depth of compression zone
zetatest	$\zeta_{test} = 1 - \frac{\xi_{test}}{2}$	[-]	coefficient for inner lever arm
z_test	$z_{test} = \zeta_{test} \cdot d_s$	[mm]	inner lever arm

<u>Kontrolle Biegebruch (check of flexural capacity)</u>

epcu	$\varepsilon_{cu} = 4 - 2 \cdot \frac{f_{1,c}}{100}$	[‰]	maximum strain in compression zone
ds2_cal		[-]	calculated value for location of A_{s2} if not reported
co_A	$co\_A = \frac{\omega_1}{\varepsilon_{sy}}$	[-]	coefficient for quadratic equation
co_B	$co\_B = \frac{\varepsilon_{cu} \cdot \omega_1}{\varepsilon_{sy}}$	[-]	coefficient for quadratic equation
co_C	$co\_C = -\varepsilon_{cu} \cdot \kappa_c$	[-]	coefficient for quadratic equation
xsi_		[-]	
es	ε_s	[%]	steel strain
rat_esy		[-]	
zeta	ζ	[-]	coefficient for inner lever arm
x_	$x = \xi \cdot d_s$	[mm]	
z_	$z = \zeta \cdot d_s$	[mm]	inner lever arm
eps2_		[-]	
rat_s2		[-]	ratio
muflex = Muflex/(b·d^{2}·f$_{1c}$)	μ_{flex}	[-]	non-dimensional moment at flexural failure
betaflex = vutest / vuflex	$\beta_{flex} = \frac{\upsilon_u}{\upsilon_{u,\,flex}}$	[-]	ratio
FF			FF = flexural failure

Assumed inner lever arm

zeta_ass		[-]	assumed inner lever arm
muflex_ass		[-]	non-dimensionalflexural moment
betaflex_ass		[-]	ratio
ass/flex		[-]	ratio

Verankerung (anchorage at end support)

lbprov		[in → mm]	provided anchorage length
sslau		[-]	steel stress
lbreq	$l_{b,req} = \alpha_a \cdot d_{st} \cdot \sigma_{sla,u} / (9 \cdot f_{1ct,cal})$	[in → mm]	required anchorage length
beta1b	$\beta_{1b} = \frac{l_{b,req}}{l_{b,prov}}$	[-]	ratio
AF			remark: AF = anchorage check failed

Umrechnungsfaktoren (conversion factors)

1 inch	= 25,4 mm
1 pound	= 4,448 N
1 kip	= 4,448 kN
1 klbf ft	= 1,36 kNm
1 psi	= 1/145 * MPa
1 ksi	= 1000/ 145 * MPa
1 kp	= 9,81 N
1 kp/cm2	= 9,81/100 MPa = 9,81/100 N/mm²