HP-35s Calculator Program –

Calculation of Cracked Moment of Inertia and Deflection on Reinforced Concrete Beam subjected to Uniformly Distributed Load and single Point Load

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Line	Instruction	Process	User Instruction
D001	LBL D	Establishing the library	
D002	CLSTK		Press Clear 5
D003	FS? 10		Press FLAGS etc
D004	SF 1		
D005	SF 10		
D006	CF 1		
D007	EFF I + DEFL	Calculation of Effective Moment of Inertia and Deflection	Key in using EQN, RCL E, RCL F, etc
D008	BEAM BASE	You input the base width in inches	Same method as above
D009	INPUT B	Store bw in variable “B”	
D010	Clx		
D011	BEAM HEIGHT	Determine height of the beam (top to bottom) in inches	Key in using EQN, RCL E, RCL F, etc
D012	INPUT H	Store h in “variable “H”	
D013	CLSTK	Clearing Stack	
D014	RCL H	Calculating Moment of Inertia of Concrete alone and store in variable “G”.	
D015	3		
D016	y^x		
D017	RCL B		
D018	×		
D019	12		
D020	÷		
D021	STO G		
D022	AREA STEEL TOP	Determine the Area of Top Steel in sq. inches	Key in using EQN, RCL E, RCL F, etc
D023	INPUT T	Store A' in variable “T”	
D024	Clx		
D025	AREA STEEL BOTTOM	Determine the Area of Bottom Steel in sq. inches	Key in using EQN, RCL E, RCL F, etc
D026	INPUT A	Store A in variable “A”	
D027	Clx		
D028	CONC PSI	You determine the strength of Concrete in psi units	
D029	INPUT C	Store f'c in variable “C”	
D030	Clx		
D031	29000000	Modulus of Elasticity of Steel in psi	
D032	57000	Value from ACI 318 – 8.5.1 for Modulus of Elasticity	
D033	RCL C		
D034	√x		
D035	×		
D036	STO E	Establishing Value of Concrete's Modulus of Elasticity	
D037	÷	Establishing the N ratio of Elasticity Moduli	
D038	STO N	Store “n” ratio of Elasticity Moduli	
D039	Clx	Clear Mantissa	
D040	COVER	You determine the distance given for cover	
D041	INPUT V	Store cover in variable “V”	
D042	Clx		
D043	TIME FCTR	Determine the time factor according to which you solve for deflection	
D044	1.0 FOR 3 MONTHS		
D045	1.2 FOR 6 MONTHS		
D046	1.4 FOR 1 YEAR		
D047	2.0 FOR 5 YEARS		
D048	INPUT J	Variable “J” is set for the time factor	
D049	Clx		
D050	BEAM L (FT)		
D051	PSE	Determine the length of the beam in feet	
D052	INPUT L	Store Length of beam in variable “L”	
D053	12		
D054	×		
D055	STO L	Length is transformed form feet to inches	
D056	UNIF LOAD K÷FT	Determine Uniformly Distributed Load in Kips per foot	
D057	INPUT W	Store Uniformly Distributed Load variable in “W”	

D058	83.333333333	Transforming w to lbf/inch	
D059	×		
D060	STO W		
D061	RCL L	Solving for Moment due to Uniformly Distributed Load	
D062	ENTER		
D063	×		
D064	×		
D065	8		
D066	÷		
D067	STO M	Storing Moment value due to Uniformly Distributed Load	
D068	CLSTK		
D069	PT LOAD	Determine the Point Load in Kips	
D070	PSE		
D071	INPUT P	Storing Point Load in Variable “P”	
D072	1000		
D073	×	Transforming Point Load to lbf	
D074	STO P		
D075	CLSTK		
D076	DISTANCE	Locate distance (in Feet) from L to R for Point Load	
D077	PSE		
D078	INPUT X	Enter Distance of Point Load in variable “X” in Feet	
D079	12	Transform distance X to inches	
D080	×		
D081	STO X	Storing Distance of Point Load in variable “X” in inches	
D082	CLSTK		
D083	RCL L	Calculating Moment due to Point Load	
D084	RCL X		
D085	-		
D086	RCL X		
D087	×		
D088	RCL P		
D089	×		
D090	RCL L		
D091	÷		
D092	RCL M		
D093	+	Adding Moments	
D094	STO M		
D095	CLSTK		
D096	RCL B	Calculating $\bar{Y}$ distance	
D097	RCL H		
D098	×		
D099	RCL N		
D100	1		
D101	-		
D102	RCL A		
D103	×		
D104	+		
D105	RCL T		
D106	RCL N		
D107	1		
D108	-		
D109	×		
D110	+		
D111	1/x		
D112	STO Y		
D113	RCL T		
D114	RCL N		
D115	1		
D116	-		
D117	×		
D118	RCL V		
D119	×		
D120	RCL A		
D121	RCL N		
D122	1		

D123	-		
D124	×		
D125	RCL H		
D126	RCL V		
D127	-		
D128	×		
D129	+		
D130	RCL B		
D131	RCL H		
D132	x^2		
D133	×		
D134	2		
D135	÷		
D136	+		
D137	RCL Y		
D138	×		
D139	STO Y	Storing temp $\bar{Y}$ value to “Y” variable	
D140	CLSTK		
D141	RCL T		
D142	RCL B		
D143	÷		
D144	RCL H	Calculating ρ'	
D145	RCL V		
D146	-		
D147	÷		
D148	STO R	Storing ρ' in variable “R”	
D149	CLSTK		
D150	7.5		
D151	RCL J		
D152	×		
D153	RCL C		
D154	√x		
D155	×	Calculating fr (modulus of rupture) ACI 318 - 9-10	
D156	50		
D157	RCL R		
D158	×		
D159	1		
D160	+		
D161	÷		
D162	STO F	Storing fr in variable “F”	
D163	CLSTK		
D164	RCL F		
D165	RCL G		
D166	×	Calculating Critical Moment ACI 318 – 9-9	
D167	RCL Y		
D168	÷		
D169	STO K	Storing Mcr in variable “K”	
D170	CLSTK		
D171	RCL N		
D172	RCL A		
D173	×		
D174	RCL B		
D175	÷		
D176	RCL H		
D177	÷		
D178	STO S		
D179	1/x		
D180	2		
D181	×	Calculating distance “cs” of cracked section	
D182	1		
D183	+		
D184	√x		
D185	1		
D186	-		
D187	RCL H		

D188	RCL V		
D189	-		
D190	×		
D191	RCL S		
D192	×		
D193	STO S	Store cs as variable “S”	
D194	CLSTK	Calculating Cracked Moment of Inertia (See Lindeburg 50.45)	
D195	RCL B		
D196	RCL S		
D197	3		
D198	y^x		
D199	×		
D200	3		
D201	÷		
D202	STO Q		
D203	RCL H		
D204	RCL V		
D205	-		
D206	RCL S		
D207	-		
D208	x^2		
D209	RCL A		
D210	×		
D211	RCL N		
D212	×		
D213	RCLQ		
D214	+		
D215	STO Q	Storing Icr as variable “Q”	
D216	CLSTK	Calculating the Effective Moment of Inertia	
D217	RCL K		
D218	RCL M		
D219	÷		
D220	3		
D221	y^x		
D222	STO Z		
D223	CLSTK		
D224	RCL Z		
D225	RCL G		
D226	×		
D227	RCL Z		
D228	+/-		
D229	1		
D230	+		
D231	RCL Q		
D232	×		
D233	+		
D234	STO I	Storing Ie as variable “I”	
D235	Clx		
D236	RCL N	Calculating Transformed Moment of Inertia (which may be totally unnecessary for this process anyway, but the user may want to have it)	
D237	1		
D238	-		
D239	RCL A		
D240	RCL T		
D241	+		
D242	×		
D243	STO O		
D244	RCL H		
D245	2		
D246	÷		
D247	RCL V		
D248	-		
D249	x^2		
D250	×		
D251	RCL H		
D252	3		

D253	y^x		
D254	RCL B		
D255	×		
D256	12		
D257	÷		
D258	+		
D259	STO U	Storing Transformed Moment of Inertia as variable “U”	
D260	Clx		
D261	I TRANSFORMED	Viewing values of Moment of Inertia (Transformed, Cracked, and Effective)	
D262	PSE		
D263	VIEW U		
D264	I CRACKED		
D265	PSE		
D266	VIEW Q		
D267	I EFFECTIVE		
D268	PSE		
D269	VIEW I		
D270	CLSTK		
D271	DIST FOR DEFL	Determine distance Z for Deflection calculation	
D272	PSE		
D273	RCL X		
D274	INPUT Z	Enter distance from left for calculation of deflection	
D275	12	Transforming distance from feet to inches	
D276	×		
D277	STO Z		
D278	x≠y?	Verifying that routine for automatic selection of formula x>a or x<a shall not generate a 0 value on denominator	Note: The command GTO (Go To) to a line that does not exist will cause issues.Verify the command of this line once all the lines are in
D279	GTO D283		
D280	0.000001		
D281	+		
D282	STO Z		
D283	CLSTK		
D284	RCL Z		
D285	3		
D286	y^x		
D287	RCL L		
D288	x^2		
D289	+/-		
D290	RCL Z		
D291	×		
D292	+		
D293	RCL L		
D294	RCL X		
D295	-		
D296	x^2		
D297	RCL Z		
D298	×		
D299	+		
D300	RCL X		
D301	RCL Z		
D302	-		
D303	x^2		
D304	√x		
D305	2		
D306	×		
D307	1/x		
D308	RCL X		
D309	RCL Z		
D310	-		
D311	×		
D312	0.5		
D313	+		
D314	×		
D315	RCL L		
D316	RCL X		
D317	-		

D318	RCL P
D319	×
D320	×
D321	STO D
D322	RCL X
D323	RCL Z
D324	-
D325	3
D326	y^x
D327	RCL L
D328	×
D329	RCL L
D330	RCL X
D331	-
D332	÷
D333	RCL L
D334	x^2
D335	RCL L
D336	RCL X
D337	-
D338	x^2
D339	-
D340	RCL Z
D341	×
D342	-
D343	RCL Z
D344	3
D345	y^x
D346	+
D347	RCL X
D348	RCL Z
D349	-
D350	2
D351	÷
D352	RCL X
D353	RCL Z
D354	-
D355	x^2
D356	√x
D357	÷
D358	0.5
D359	-
D360	×
D361	RCL L
D362	RCL X
D363	-
D364	×
D365	RCL P
D366	×
D367	RCL D
D368	-
D369	6
D370	÷
D371	RCL E
D372	÷
D373	RCL I
D374	÷
D375	RCL L
D376	÷
D377	STO D
D378	CLSTK
D379	RCL L
D380	3
D381	y^x
D382	RCL Z

Process for combined deflection using point load at specific location and uniformly distributed load throughout the beam. Location of Point load and location for deflection measurement are independent of course.

D383	×		
D384	RCL Z		
D385	3		
D386	y^x		
D387	RCL L		
D388	×		
D389	2		
D390	×		
D391	-		
D392	RCL Z		
D393	4		
D394	y^x		
D395	+		
D396	RCL W		
D397	×		
D398	24		
D399	÷		
D400	RCL E		
D401	÷		
D402	RCL I		
D403	÷		
D404	RCL D		
D405	+		A = A - Area of bottom Steel
D406	STO D		B = bw - base width
D407	RCL Z		C = f'c Strength of Concrete
D408	12		D = Deflection
D409	÷		E = Ec – Mudulus of Elasticity of Concrete
D410	STO Z		F = fr – Rupture Stress
D411	Clx		G = Ig – Gross Moment of Inertia
D412	R↓		H = h – height of section
D413	DEFLECTION IS	Visualization of deflection value (in inches) at specified location along the length of the beam (in feet)	I = Ie – Effective Moment of Inertia
D414	PSE		J = ξ – Time factor for deflection
D415	VIEW D		K = Mcr – Moment Critical
D416	AT LOCATION	Verification/reminder of location that deflection was calculated (in feet along the length of the beam)	M = Ma – Maximum Moment
D417	PSE		N = n – Ratio of Elastic moduli
D418	VIEW Z		O = Unused
D419	CLSTK		P = P – Point Load
D420	STO Z		Q = Icr – Cracked Moment of Inertia
D421	OTHER LOCATION	Option to calculate deflection at a different spot. By allowing the 0 value the process closes. Any value given will loop the process Values should remain within the length of the beam – unless you're really nuts!	R = ρ' – Ratio of Top Steel
D422	PSE		S = Cs – Critical Section distance from Extreme fiber to Neutral Axis after Cracking
D423	INPUT Z		
D424	X=0?		T = A' – Area of top Steel
D425	GTO D431		U = Itrans – Transformed Section Moment of Inertia
D426	RCL X	Precaution for zero division	V = Cover
D427	12		W = w – Uniformly distributed load
D428	×		X = Location of Pt. Load (Left to right in ft)
D429	x<>y		Y = Ȳ of section
D430	GTO D275		Z = Temporarily used variable for (Mcr/Ma)^3
D431	RCL D	Defl value remains on stack when process is finished	
D432	FS? 1		
D433	CF 10		
D434	STOP		
D435	RTN		