

Table 6a – Description of Crack Cases

Through Cracks:	
TC01:	Through crack at center of plate
TC02:	Through crack at edge of plate
TC03:	Through crack from an offset hole in a plate
TC04:	Through crack from hole in a lug
TC05:	Through crack from hole in a plate with a row of holes
TC06:	Through crack in a sphere
TC07:	Through crack in a cylinder (longitudinal direction)
TC08:	Through crack in a thin cylinder (circumferential direction)
TC09:	Through crack from hole in a plate under combined loading
TC10:	Through crack from hole in a cylinder (circumferential direction)
TC11:	Through crack in center of plate – weight function solution
TC12:	Through crack at edge of plate – weight function solution
TC13:	Through crack(s) from hole in a plate (nonlinear stress)
TC14:	Through crack at edge of plate – remote displacement loading
TC15:	Through crack at edge of variable thickness plate – weight function solution
TC16:	Through crack in curved panel with bulging
TC17:	Through crack at angled or elliptical edge notch
TC18:	Through crack at embedded slot or elliptical hole
TC19:	Through crack at hole with broken ligament
TC23:	Through crack(s) (of equal or unequal length) at a hole
TC24:	Through crack at plate center – Displacement control
TC25:	Through crack at edge rectangular cutout with rounded corners
TC26:	Through crack at offset internal rectangular cutout with rounded corners
TC27:	Through crack at hole in lug – univariant weight function solution
TC28:	Curved through crack at edge of plate
TC30:	Through crack at hole in obliquely loaded and tapered lug (in short or in long ligament)
TC31:	Through crack (pre-corner) in L-section
TC32:	Through crack (post-corner) in L-section
TC33:	Through crack approaching a hole
TC34:	Two collinear through cracks of unequal length
TC35:	Through crack in plate with single symmetric step change in thickness
TC37:	Through crack in C-section under remote loading
Embedded Cracks:	
EC01:	Embedded crack in a plate
EC02:	Embedded crack, offset, in a plate
EC04:	Embedded crack, offset, in a plate subjected to bivariant stress
EC05:	Embedded crack, offset, in a plate subjected to univariant stress
Corner Cracks:	
CC01:	Corner crack in a rectangular plate
CC02:	Corner crack from offset hole in a plate
CC03:	Corner crack from hole in a lug
CC04:	Corner crack from hole in a plate (one or two cracks)
CC05:	Corner crack in a rectangular plate subjected to bivariant stress
CC07:	Corner crack from hole in a plate (new soln for one crack, tension and pin loads)
CC08:	Corner crack(s) from hole in a plate subjected to nonlinear stress
CC09:	Corner crack in a rectangular plate subjected to bivariant stress – new SwRI solution
CC10:	Corner crack from hole in a plate subjected to bivariant stress
CC11:	Corner crack in a plate subjected to univariant stress
CC12:	Corner crack from chamfered edge of plate subjected to bivariant stress
CC13:	Corner crack at elliptical or angled edge notch
CC14:	Corner crack at embedded slot or elliptical hole
CC15:	Corner crack at round hole with broken ligament
CC16:	Corner crack at hole (offset) / Two symmetric corner cracks at central hole in plate
CC17:	Two unequal corner cracks at hole (offset) in plate
CC18:	Part-elliptical Corner Crack at Angled Corner – Bivariant WF
CC19:	Corner crack at hole in lug – univariant weight function solution

CC20:	Corner crack at hole in lug – displacement control
CC21:	Corner crack at rectangular cutout at edge of plate
CC22:	Corner crack at internal (offset) rectangular cutout in plate
CC23:	Corner crack at hole in obliquely loaded and tapered lug (in short or in long ligament)
Surface Cracks:	
SC01:	Surface crack in a rectangular plate – tension and/or bending
SC02:	Surface crack in a rectangular plate – nonlinear stress
SC03:	Surface crack in a spherical pressure vessel
SC04:	Longitudinal surface crack in a hollow cylinder – nonlinear stress
SC05:	Thumbnail crack in a hollow cylinder
SC06:	Circumferential crack in a hollow cylinder – nonlinear stress
SC07:	Thumbnail crack in a solid cylinder
SC08:	Semi-elliptical surface crack (circumferential) in threaded solid cylinder
SC09:	Constant-depth surface crack (circumferential) in threaded solid cylinder
SC10:	Constant-depth surface crack (circumferential) in threaded hollow cylinder
SC11:	Surface crack from hole in a plate (one or two cracks)
SC12:	Surface crack from hole in a lug (one or two cracks)
SC13:	Surface crack in bolt head fillet - Shear bolt
SC14:	Surface crack in bolt head fillet - Tension bolt
SC15:	Surface crack in a plate subjected to bivariate stress
SC17:	Surface crack in a rectangular plate – nonlinear stress
SC18:	Surface crack(s) from hole in a plate – nonlinear stress
SC19:	Surface crack in a plate, bivariate weight function solution
SC26:	Surface crack at elliptical or angled edge notch
SC27:	Surface crack at embedded slot or elliptical hole
SC28:	Surface crack at round hole with broken ligament
SC29:	Surface crack at off-center hole in plate - bivariate weight function solution
SC30:	Surface crack (offset) in plate – univariate weight function
SC31:	Surface crack (offset) in a plate – bivariate weight function solution
SC32:	Surface crack at hole in lug – univariate weight function solution
SC33:	Semi-elliptical surface crack at center of plate subjected to remote bivariate displacement
SC34:	External surface crack in a hollow cylinder – univariate WF
SC35:	Semi-elliptical surface crack in a solid cylinder – univariate WF
Standard Specimens:	
SS01:	Center-cracked tension specimen M(T)
SS02:	Compact tension specimen C(T)
SS03:	Disc-shaped compact tension specimen DC(T)
SS04:	Arc-shaped tension specimen A(T)
SS05:	Three-point bend specimen SE(B)
SS06:	Edge cracked tension specimen SE(T) – constrained ends
SS07:	Notched round bar specimen R-bar(T) – circumferential crack
SS08:	Notched plate with a surface crack
SS09:	Notched plate with a corner crack
SS10:	Notched plate with a through crack
SS11:	Corner crack in a plate from symmetric hole
SS12:	Eccentrically-loaded single edge crack tension specimen ESE(T)
SS13:	Same as SC01, for use by NASMAT only
SS14:	Same as SC17, for use by NASMAT only
Data Tables:	
DT01:	One-dimensional data table for a through crack (one tip)
DT02:	Two-dimensional data table for a through crack (one tip)
DT03:	Two-dimensional data table for part-through cracks (two tips)
DT04:	Two-dimensional data table for one or two through cracks (two tips)
Stress-Intensity Factor Data Tables:	
KT01:	One-dimensional stress intensity factor table for a through crack (one tip)
KT02:	Two-dimensional stress intensity factor table for a through crack (one tip)
KT03:	Two-dimensional stress intensity factor table for part-through cracks (two tips)
KT04:	Two-dimensional stress intensity factor table for one or two through cracks (two tips)
Polynomial Series:	

PS01:	$F_0 = C_0 + C_1u + C_2u^2 + \dots + C_5u^5$ where $u = \left(\frac{a}{D}\right)^m$
Boundary Element Models:	
BE02:	Two through cracks from either side of an offset hole in a plate
BE03:	One through crack, one corner crack on either side of an offset hole in a plate
Hybrid Cracks	
HC01	Corner crack and Through crack at (offset) hole in plate

Table 6b – Transition Relationship between Crack Cases (Details in Appendix D)

From	To	Condition/Comment
TC03	TC02	
TC11	TC12	Either crack tip can set off the transition
TC23	TC19	Either crack tip can set off the transition
TC31	TC32	
CC01	TC02 (or TC28)	
CC02	TC03	
CC03	TC04	
CC04	TC03	Occurs only if number of cracks=1
CC05	TC12	Uses averaged unvariant stresses in TC12
CC07	TC03	Occurs only if number of cracks=1
CC08	TC13	
CC09	TC12 (or TC28)	
CC10	TC13	
CC11	TC12 (or TC28)	Either crack tip can set off the transition
CC12	TC12	
CC13	TC17	
CC14	TC18	
CC15	TC19	
CC16	TC03 or TC23	
CC17	HC01 or TC23	
CC21	TC25	
CC22	TC26	
CC23	TC30	
SC01	TC01	
SC02	TC01	Uses equivalent stresses in TC01
SC03	TC06	S_1 should be zero
SC04	TC07	Uses equivalent stresses in TC07
SC05	TC08	Both external & internal cracks undergo transition
SC11	TC03	Occurs only if number of cracks=1
SC12	TC04	Occurs only if number of cracks=1
SC15	TC11	
SC17	CC11, TC11 or TC12	
SC18	CC08 or TC13	
SC19	CC09, TC11 or TC12	
SC26	CC13 or TC17	

SC27	CC14 or TC18	
SC28	CC15 or TC19	
SC30	CC11, TC11 or TC12	
SC31	CC09, TC11 or TC12	
SC32	CC19 or TC27	
EC01	TC01	
EC02	SC30	
EC04	SC31, CC09, TC11 or TC12	Either crack tip can set off the transition
EC05	SC30, CC11, TC11 or TC12	Either crack tip can set off the transition
SS08	SS10	
SS09	SS10	
SS11	TC03	
HC01	CC15 or TC23	

Whenever nonlinear stresses are present in a part-through crack model, the statically equivalent tension and bending loads are computed and the corresponding nominal stresses S_0 , S_1 are obtained for use in the through crack model to which the part-through crack transitions. Numerical integration is performed over the cross section of the geometry in use. In some cases such as CC05 to TC12, the bivariant stress field is integrated across the thickness but the variation along width is preserved.

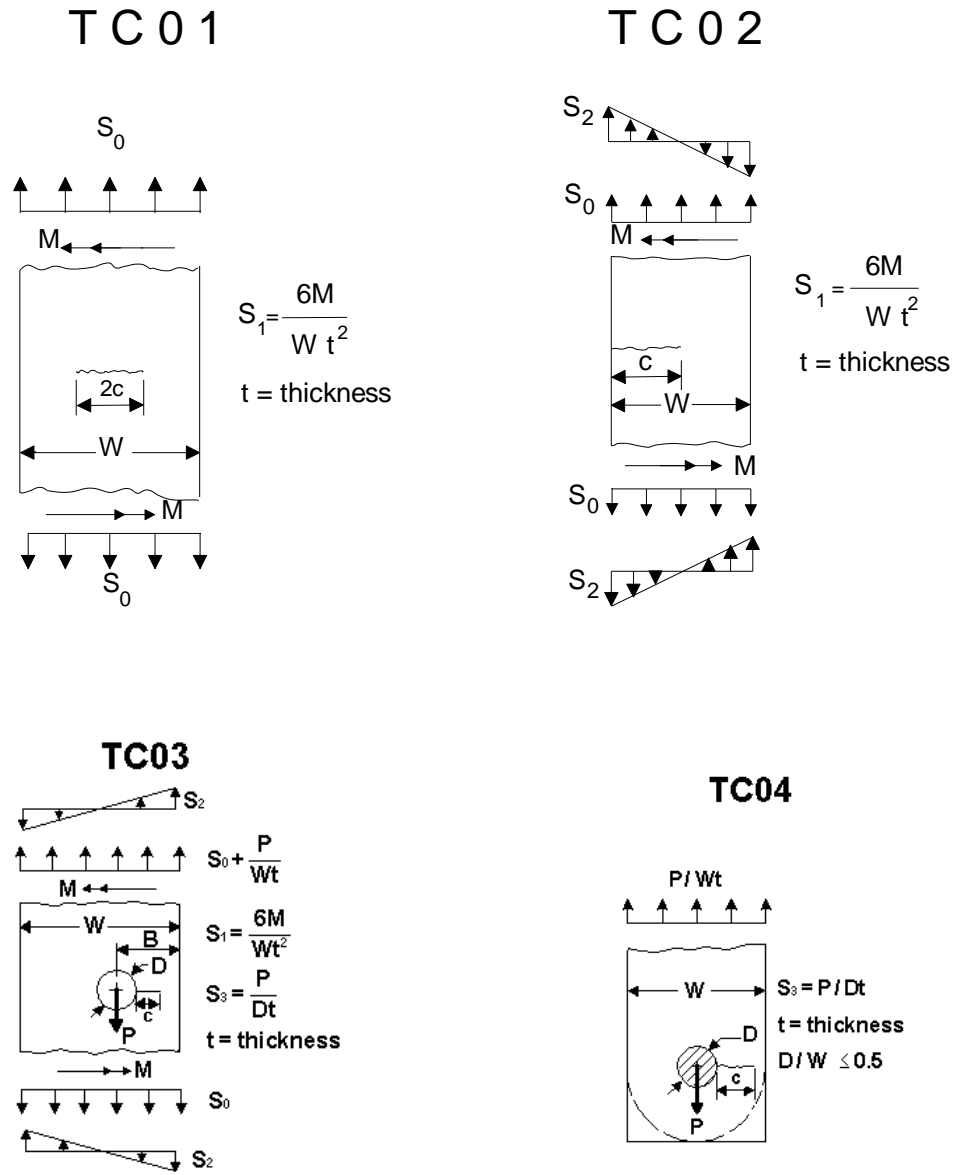


Figure 16 – Through crack cases 1, 2, 3 & 4

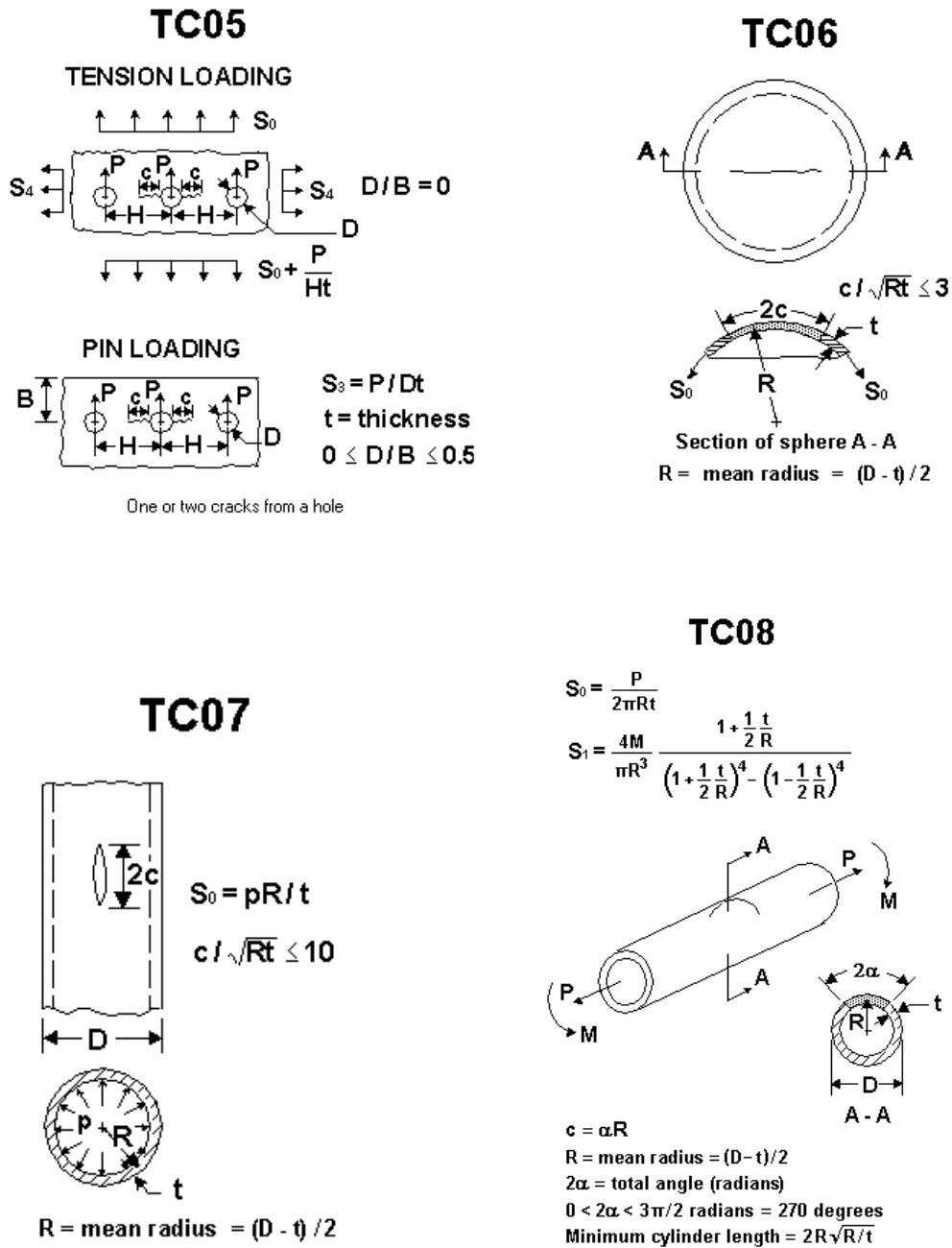


Figure 17 – Through crack cases 5, 6, 7 & 8

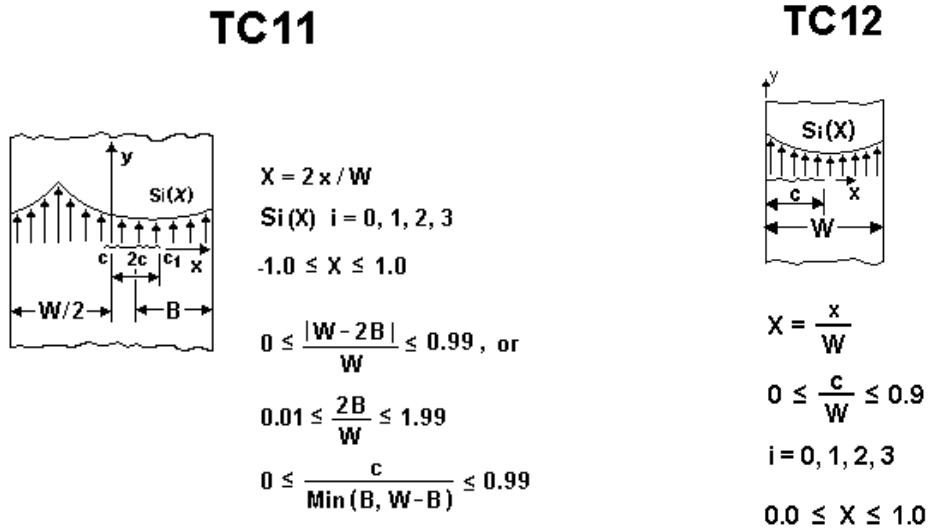
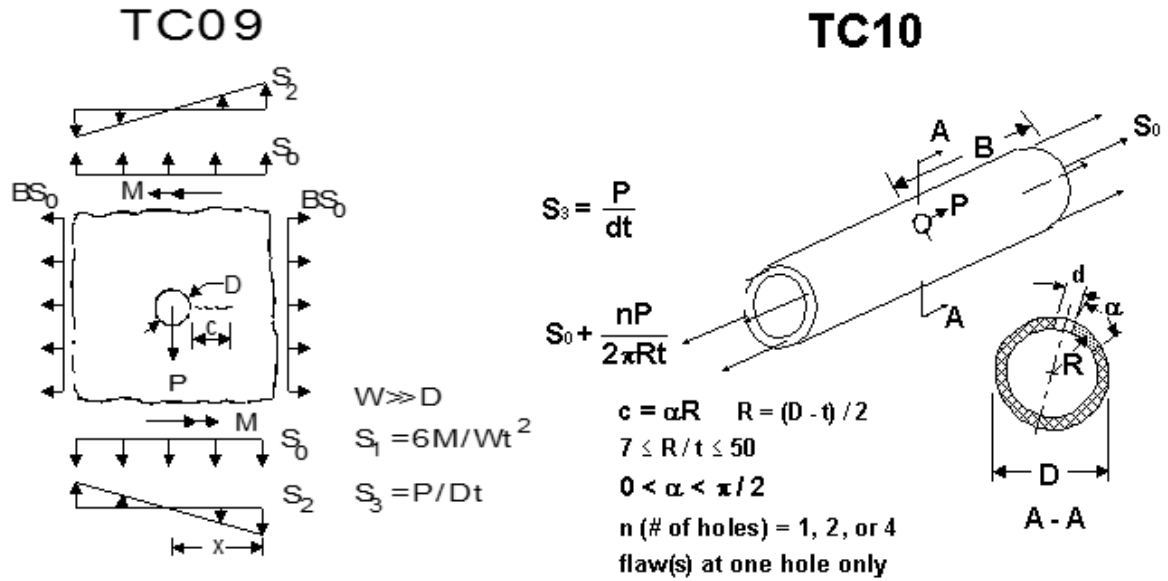


Figure 18 – Through crack cases 9, 10, 11 & 12

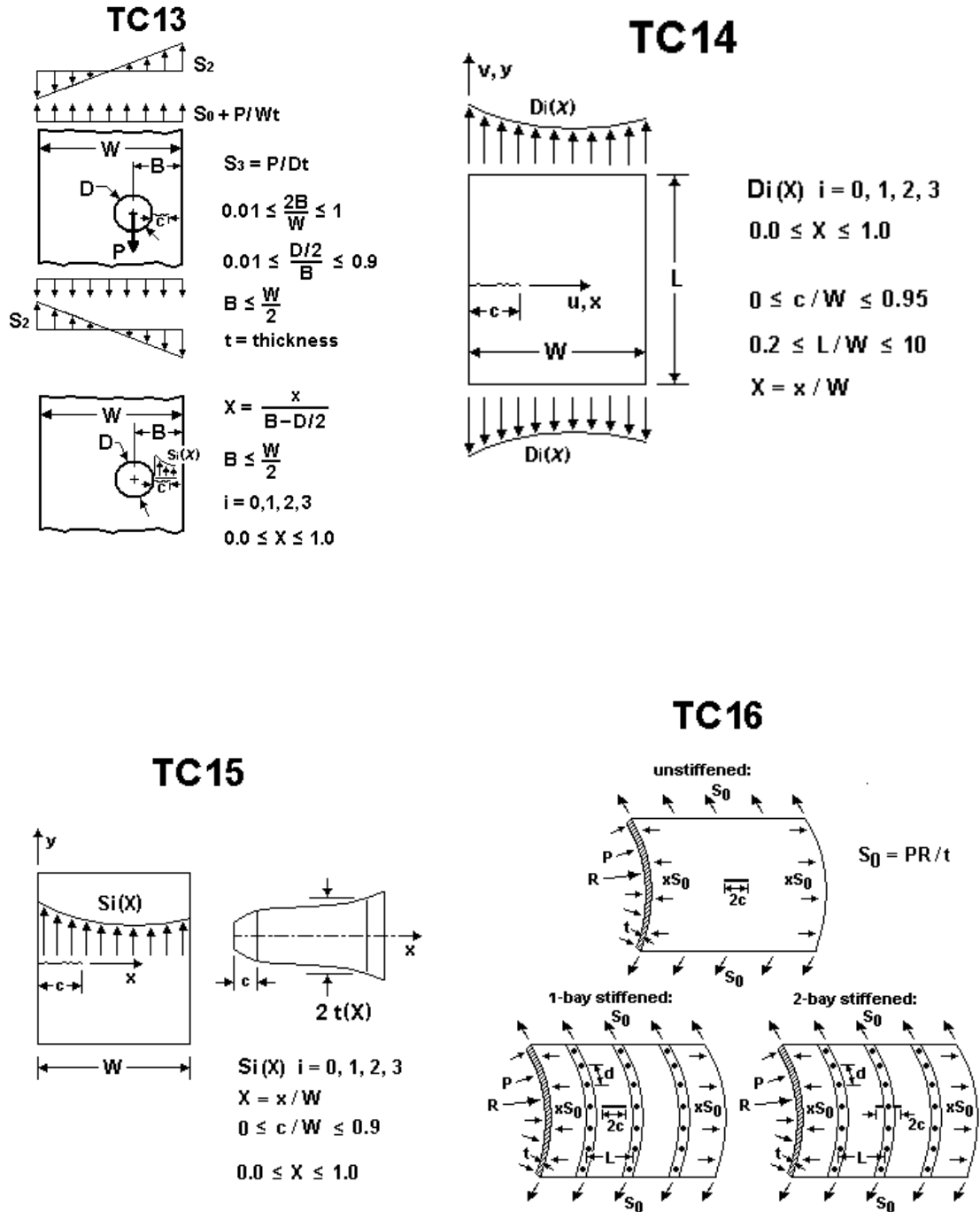


Figure 19 – Through crack cases 13, 14, 15 & 16

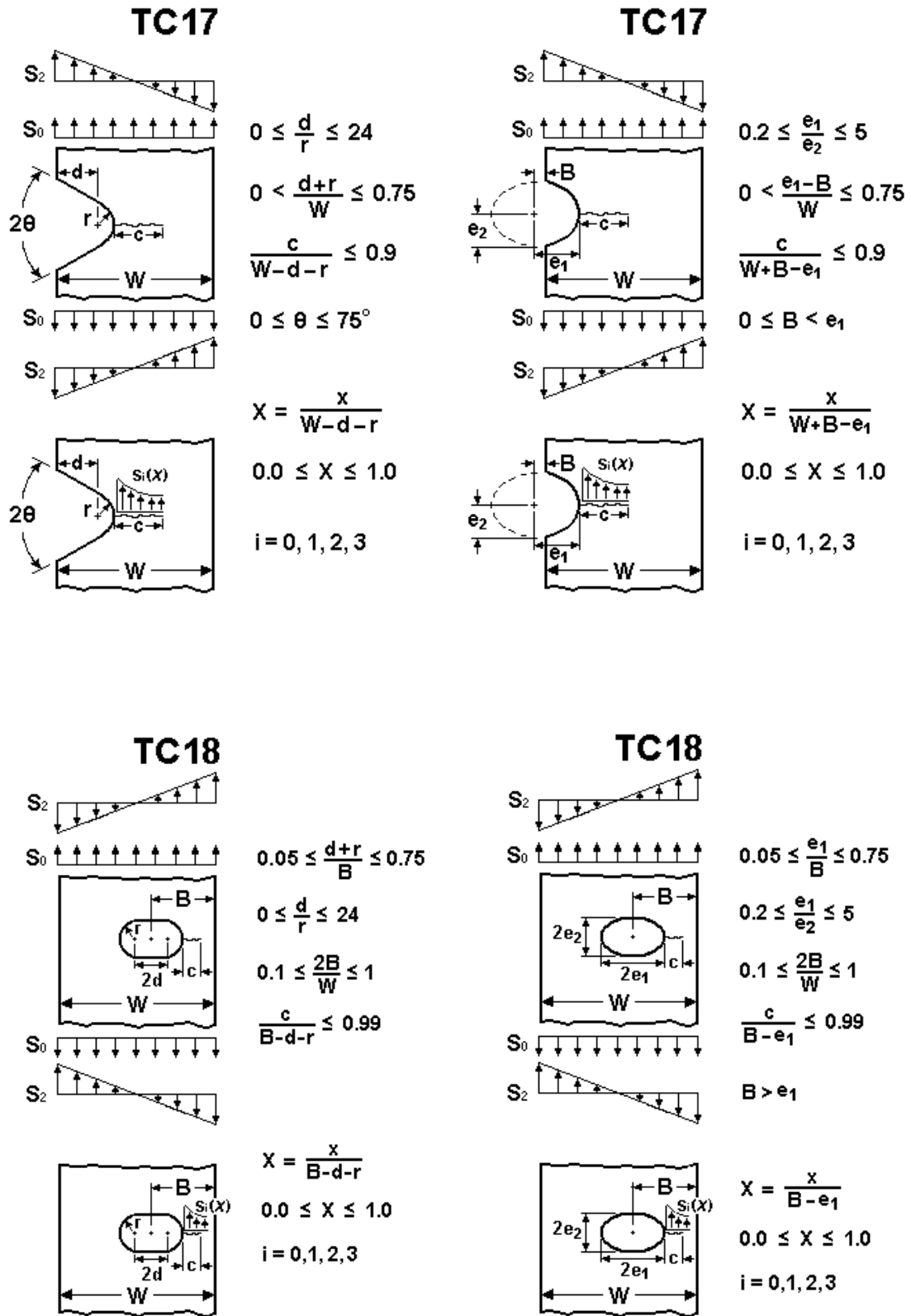


Figure 20 – Through crack cases 17 & 18

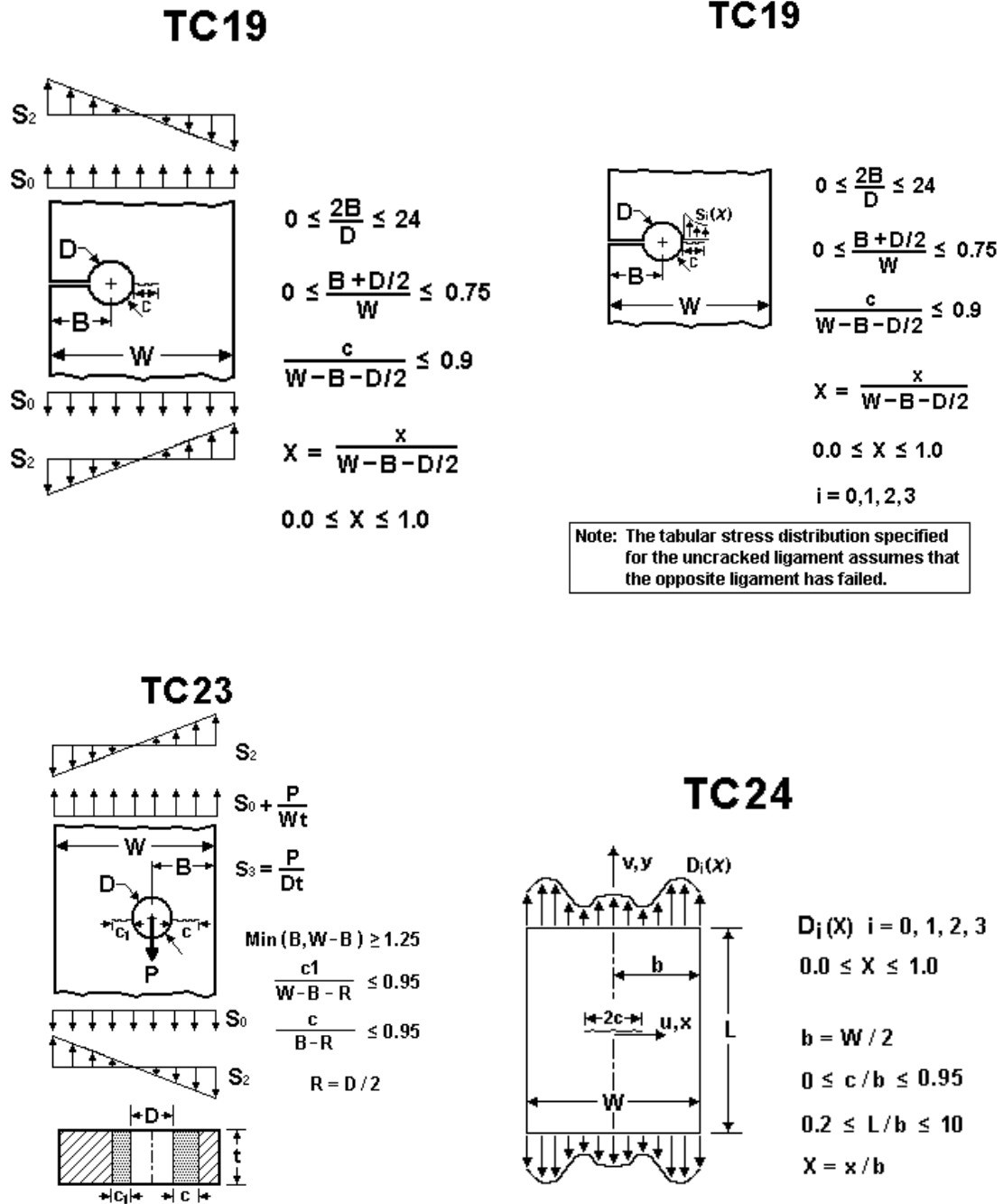
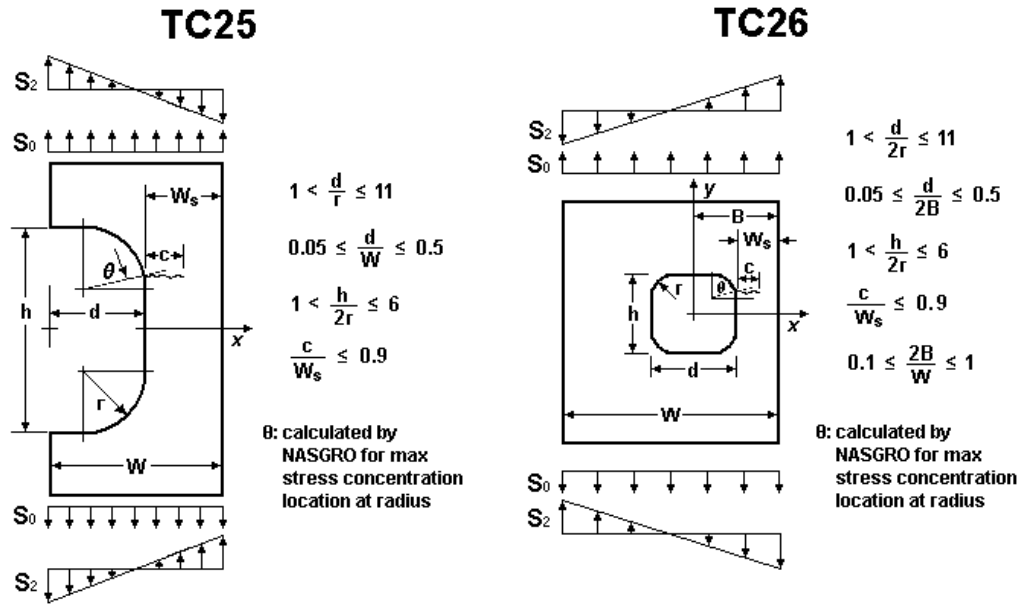
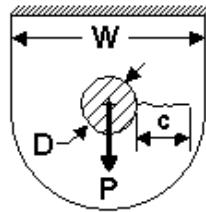


Figure 21 – Through crack cases 19, 23 & 24



TC27



$S_3 = P/Dt$
 $t = \text{thickness}$
 $1.25 \leq W/D \leq 10$
 $0 \leq c/(W-D) \leq 0.4995$

Figure 22 – Through crack cases 25, 26 & 27

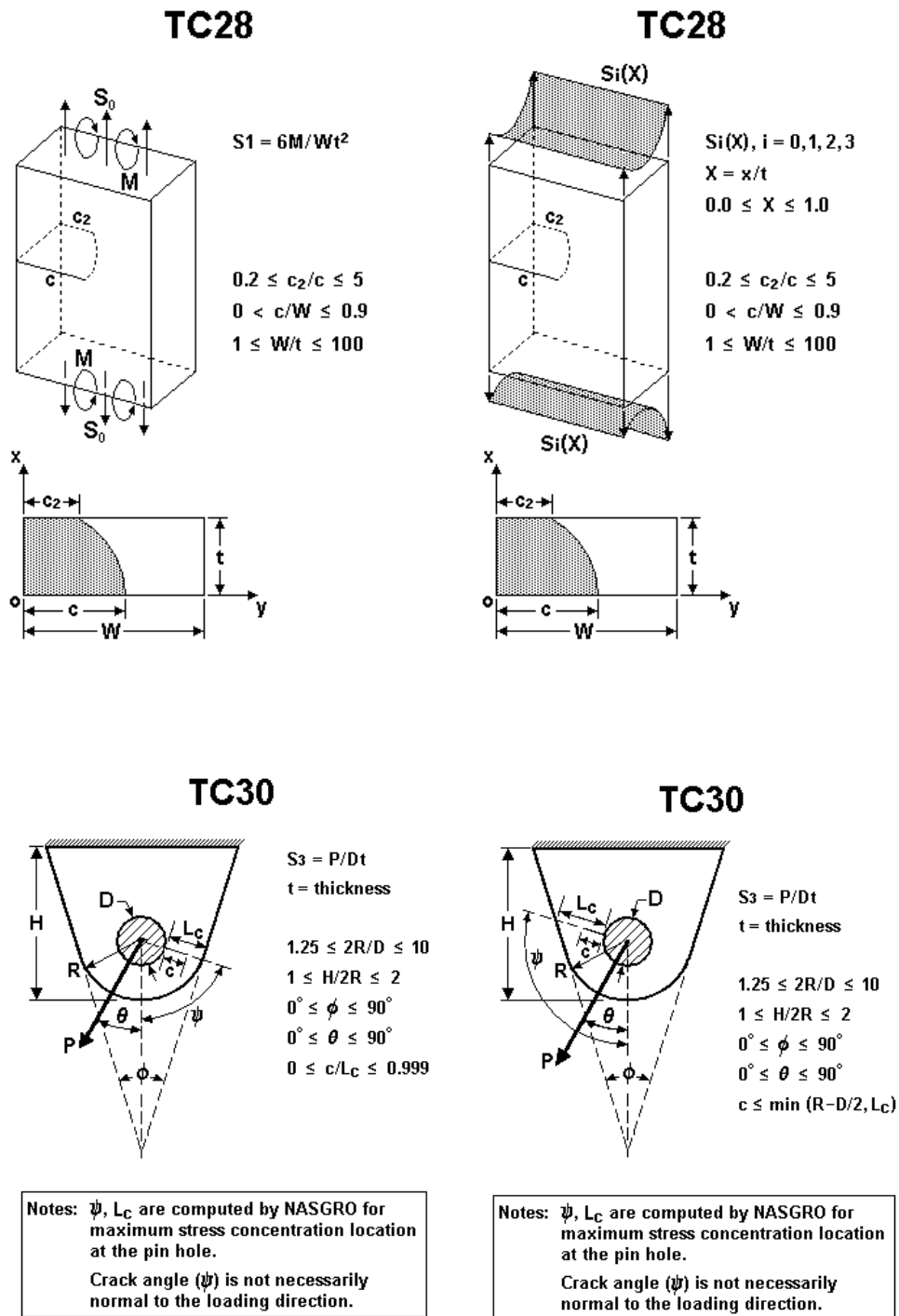


Figure 23a – Through crack cases 28 & 30

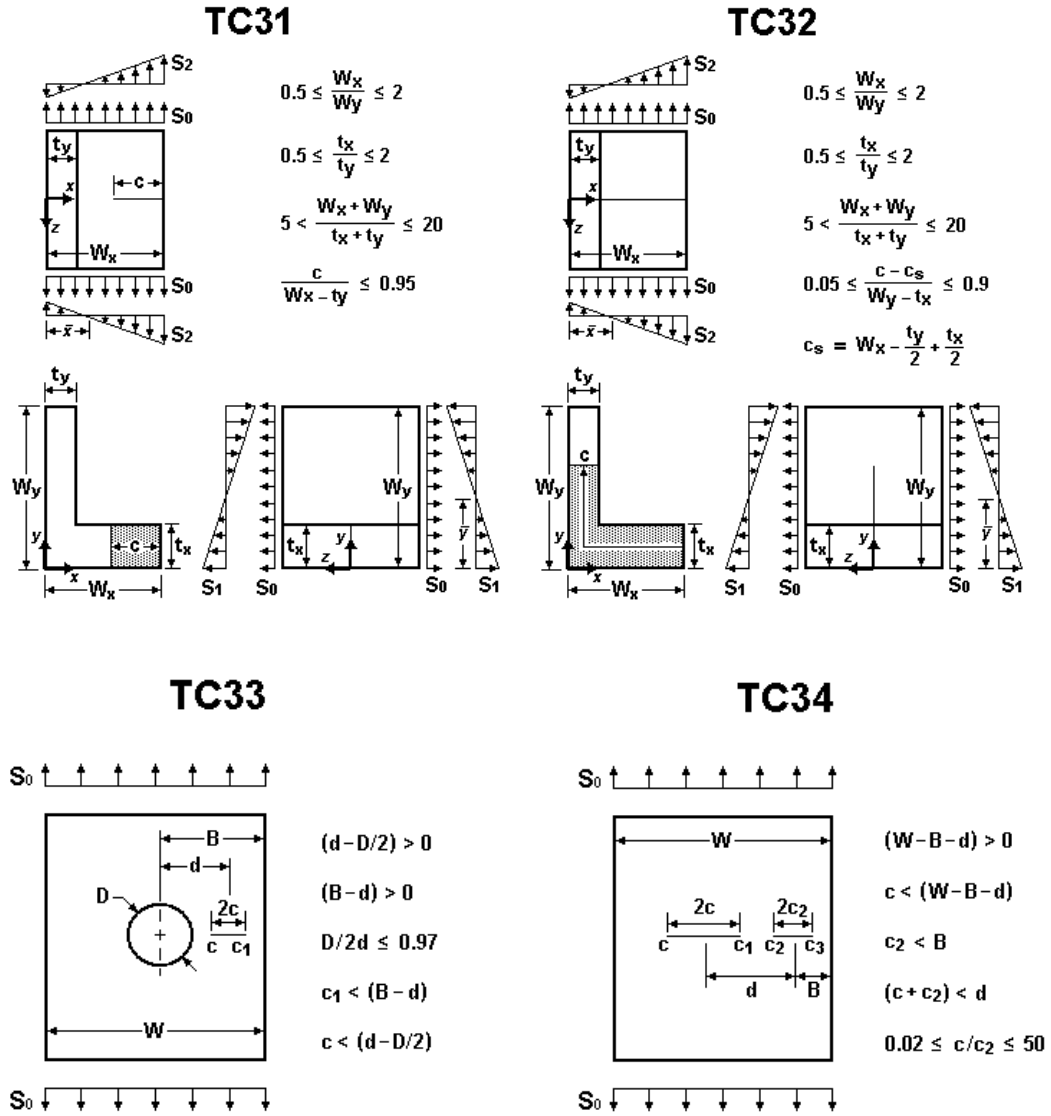
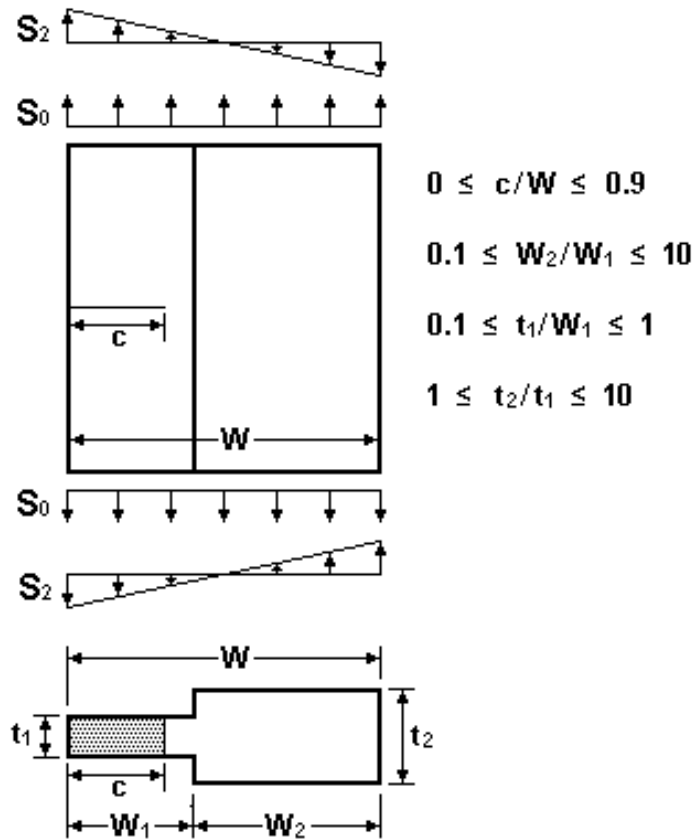


Figure 23b – Through crack cases 31, 32, 33 & 34

TC35



Note: Crack front is assumed to remain straight during transition from thickness t_1 to thickness t_2 .

Figure 23c – Through crack cases 35

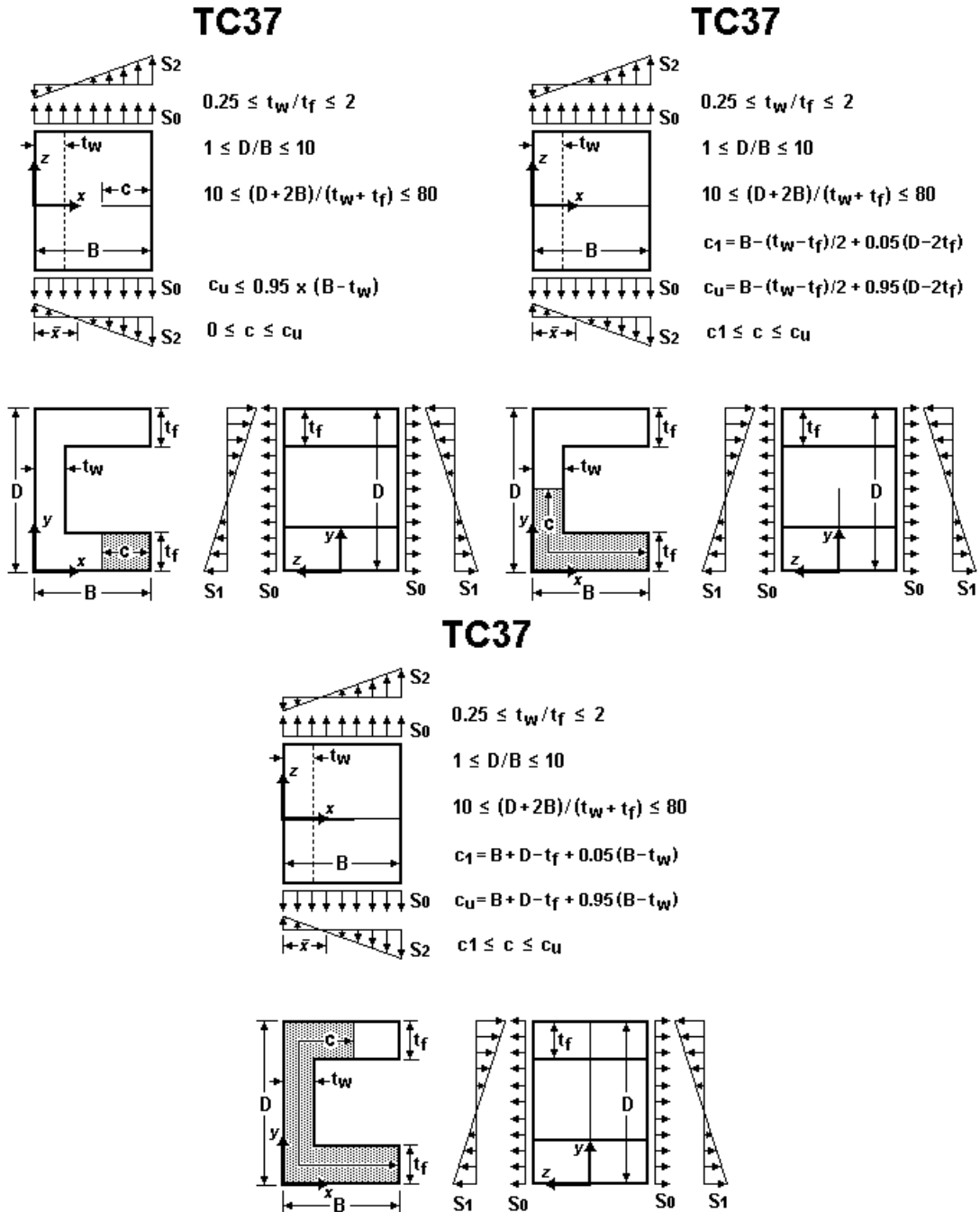
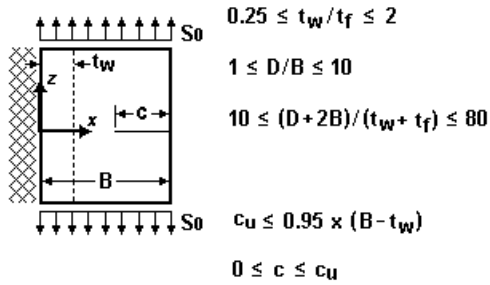
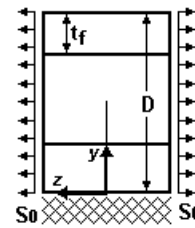
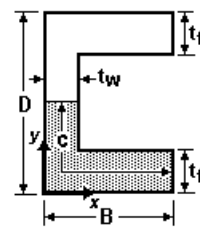
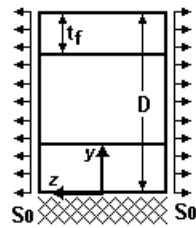
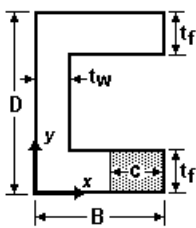
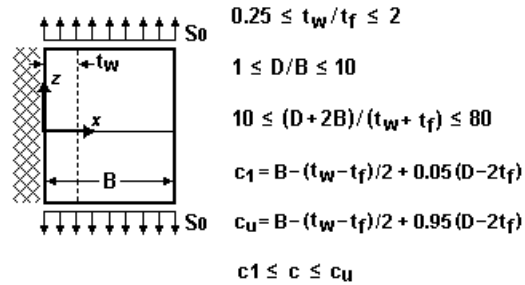


Figure 24 – Through crack 37, unrestrained cases

TC37



TC37



TC37

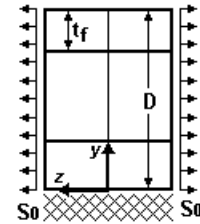
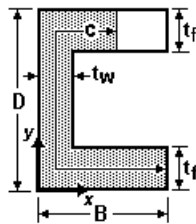
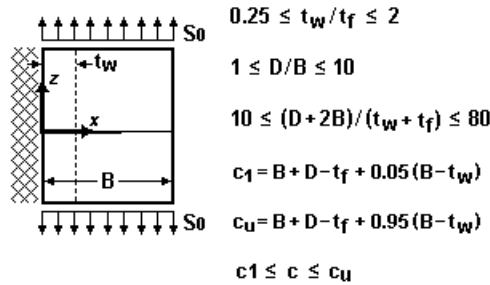
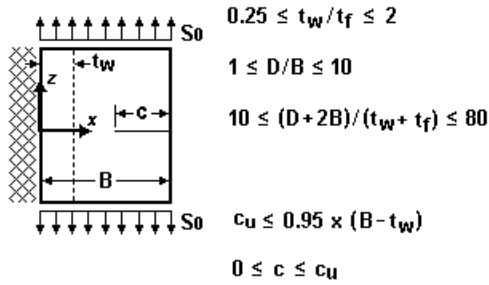
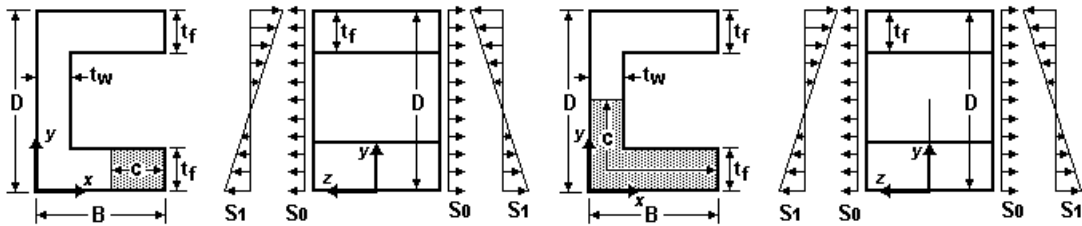
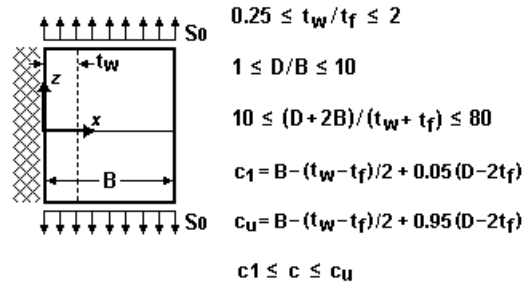


Figure 25a – Through crack 37, restrained cases

TC37



TC37



TC37

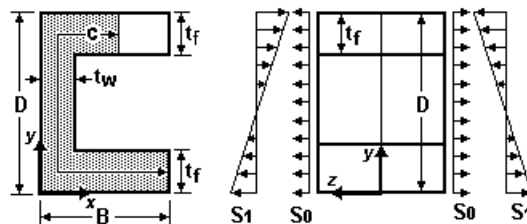
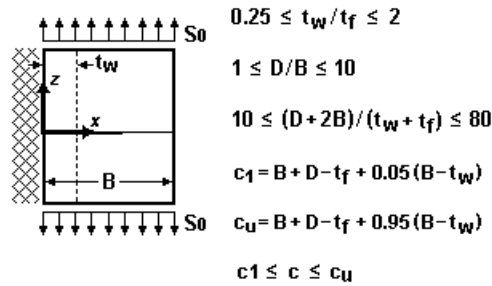


Figure 25b – Through crack 37, partially restrained cases

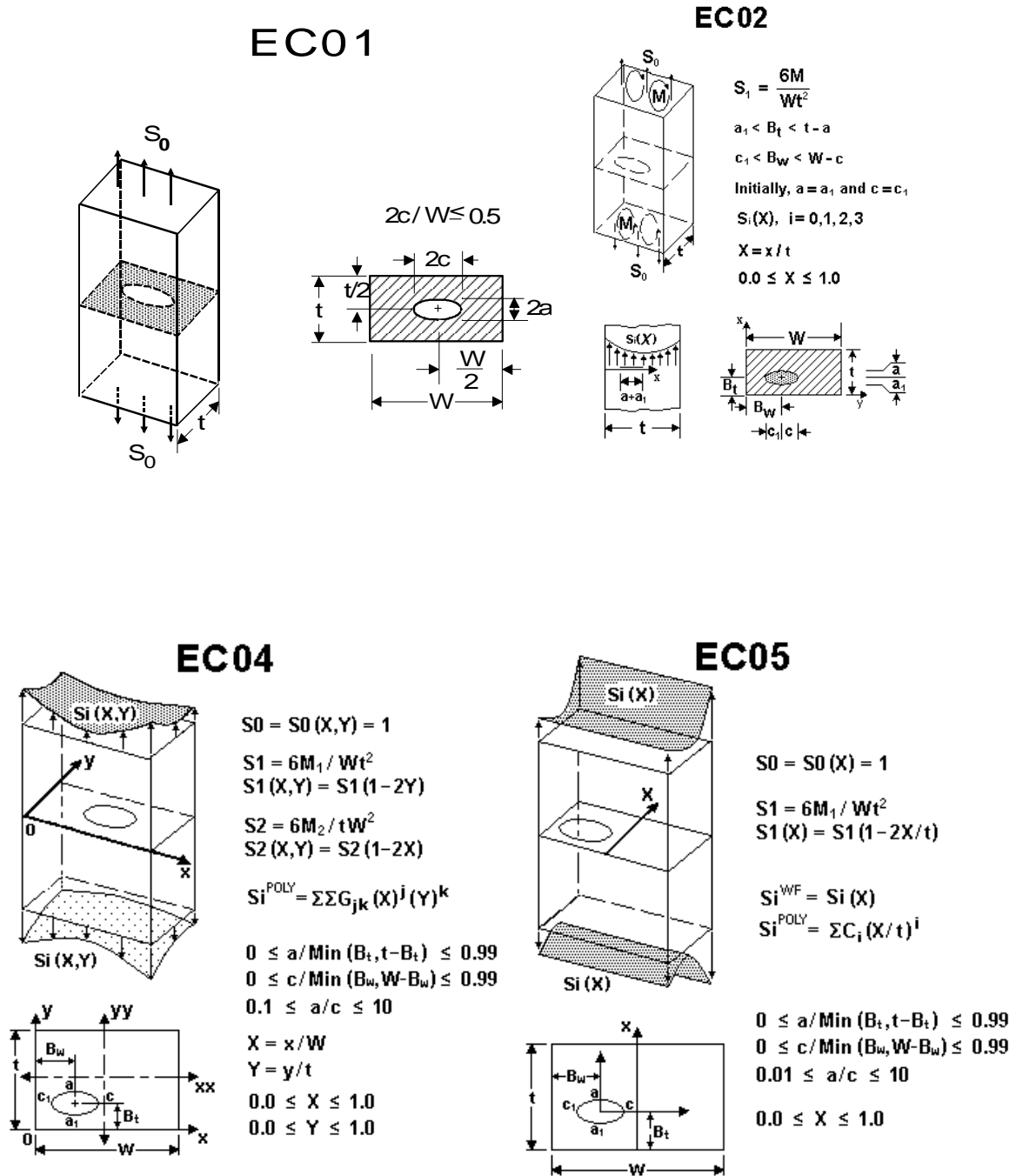
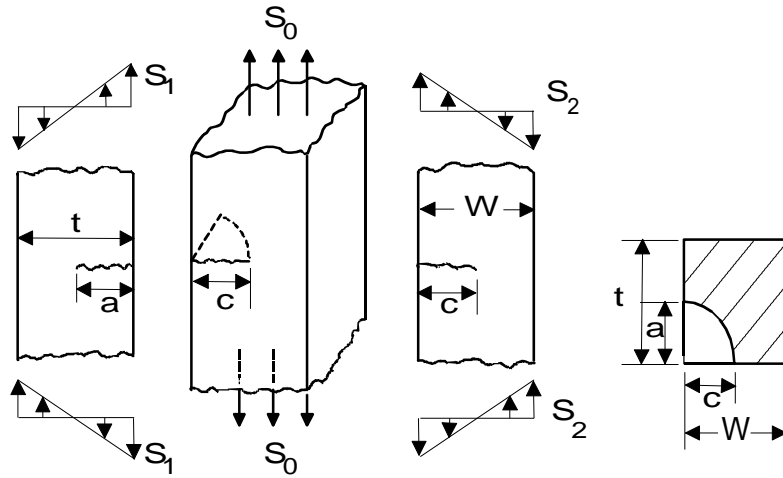
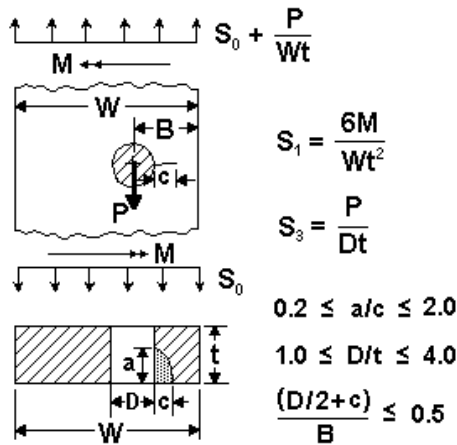


Figure 26 – Embedded crack cases 1, 2, 4 & 5

CC01



CC02



CC03

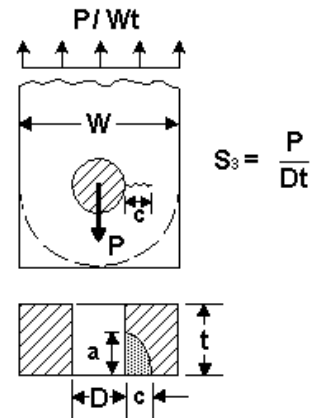
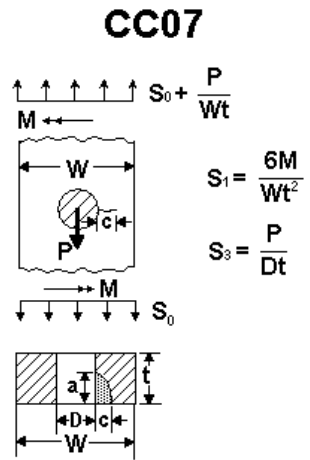
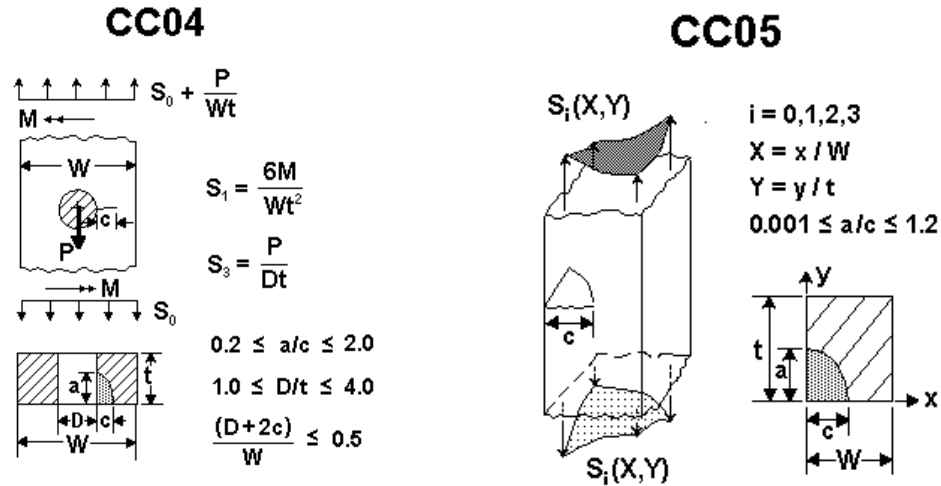


Figure 27 – Corner crack cases 1, 2 & 3



For one corner crack under tension (S_0) and/or pin load (S_3) only:

$0.1 \leq a/c \leq 2.0$
 $0.5 \leq D/t \leq 4.0$

For one corner crack under bending (S_1), or two corner cracks (all load conditions):

$0.2 \leq a/c \leq 2.0$
 $1.0 \leq D/t \leq 4.0$
 $\frac{(D+2c)}{W} \leq 0.5$

Figure 28a – Corner crack cases 4, 5, 7

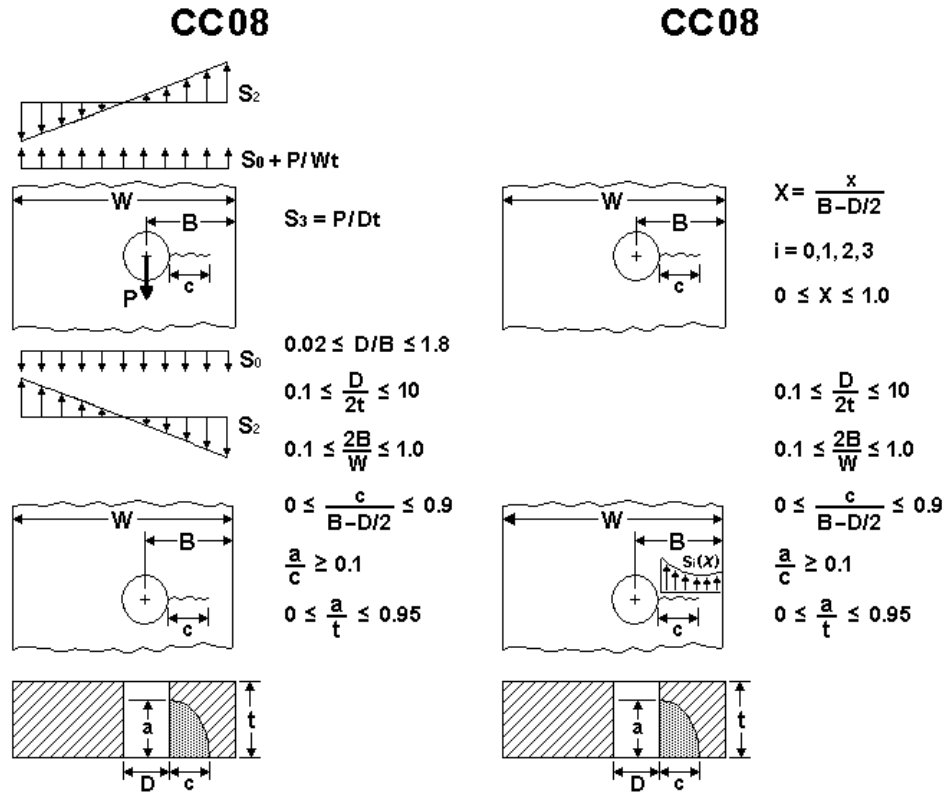


Figure 28b – Corner crack case 8

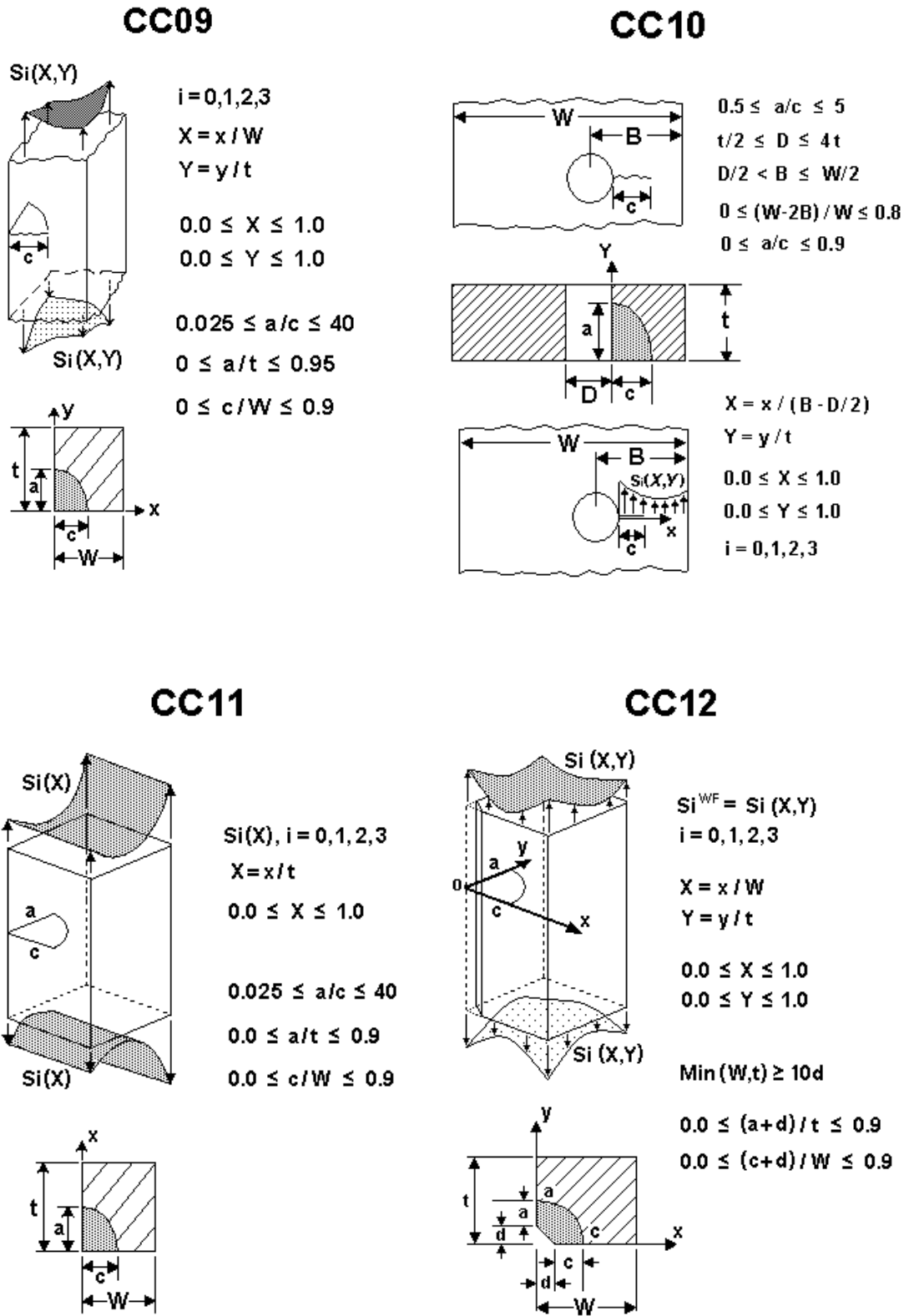


Figure 29 – Corner crack cases 9, 10, 11 & 12

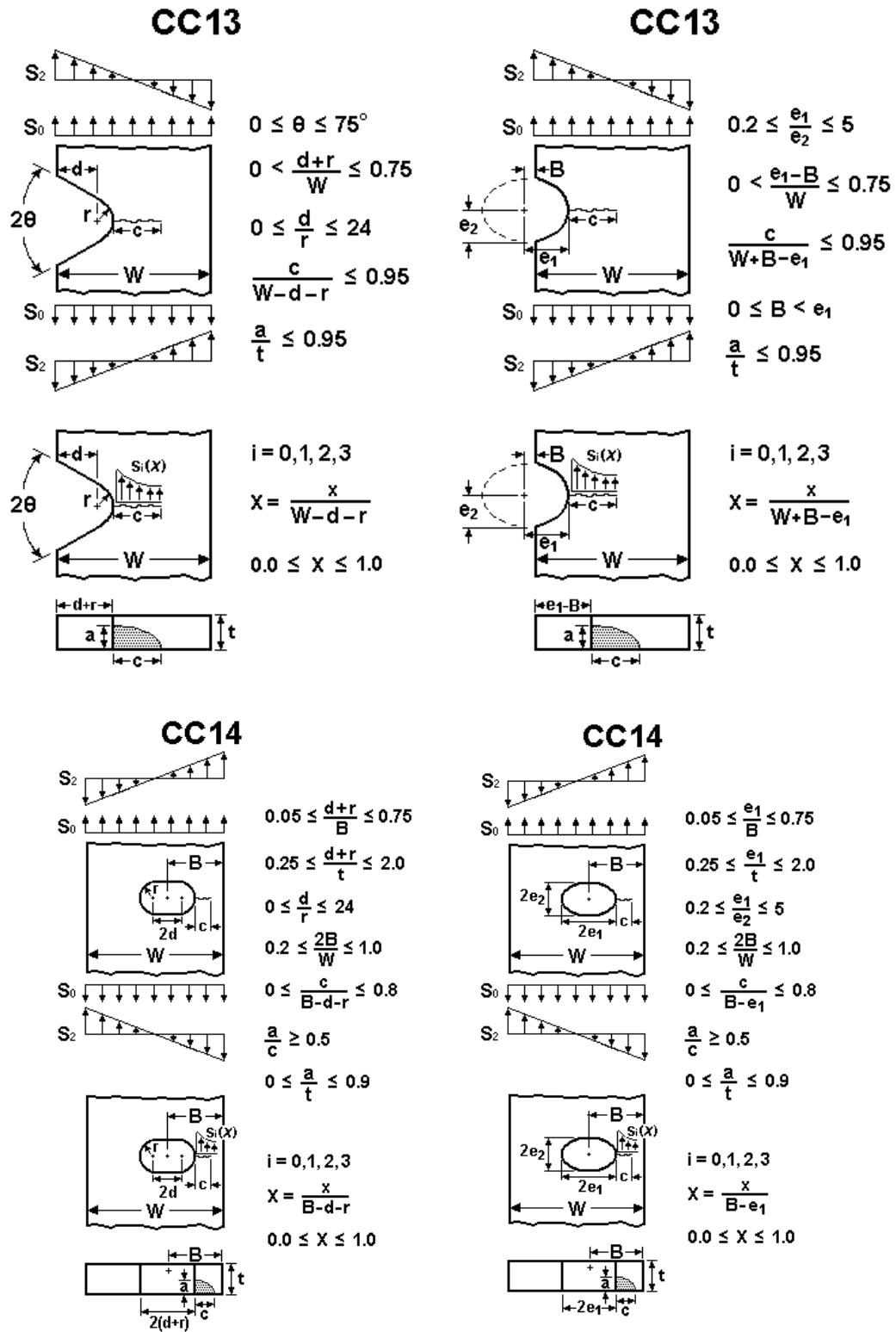


Figure 30 – Corner crack cases 13 & 14

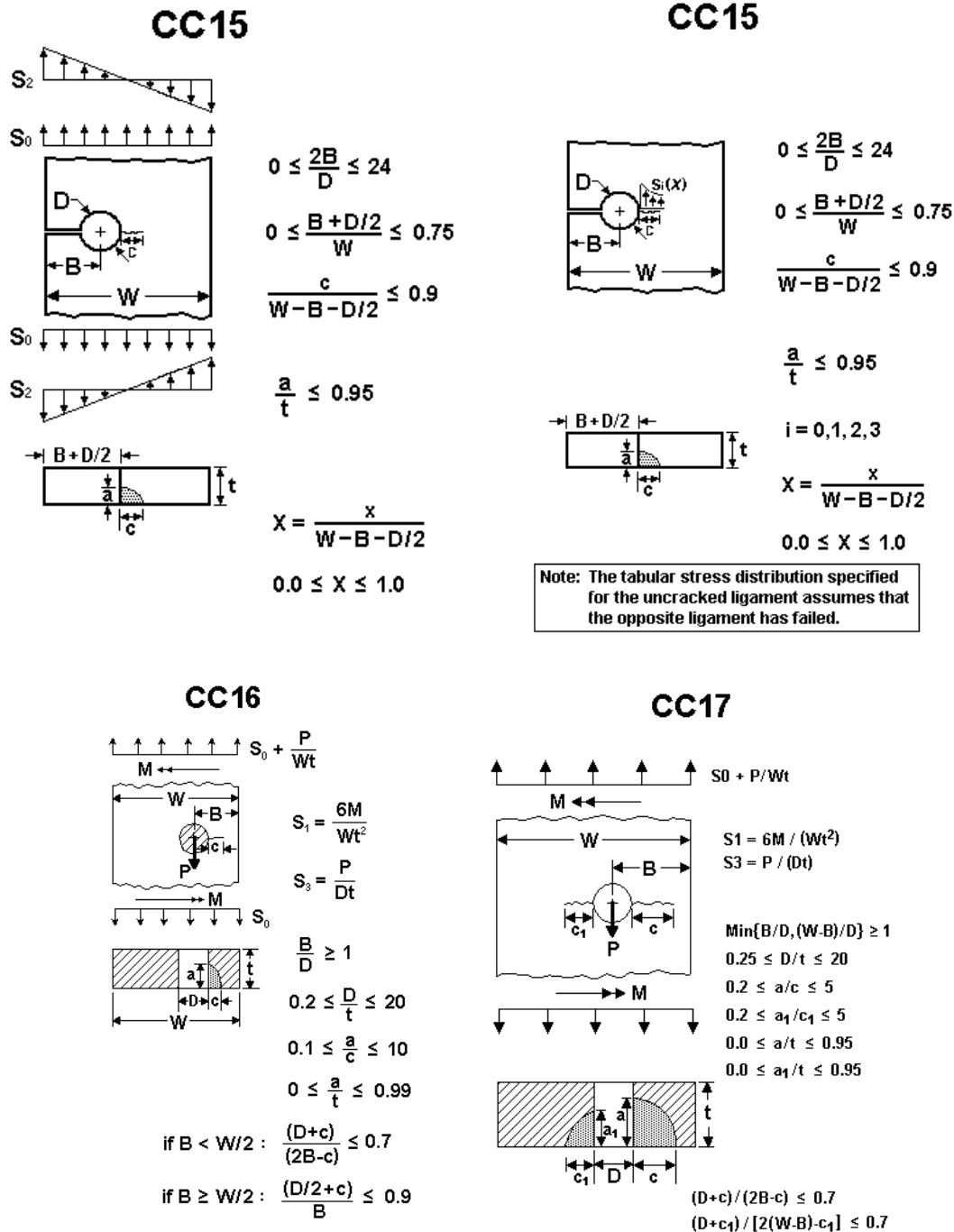


Figure 31a – Corner crack cases 15, 16 & 17

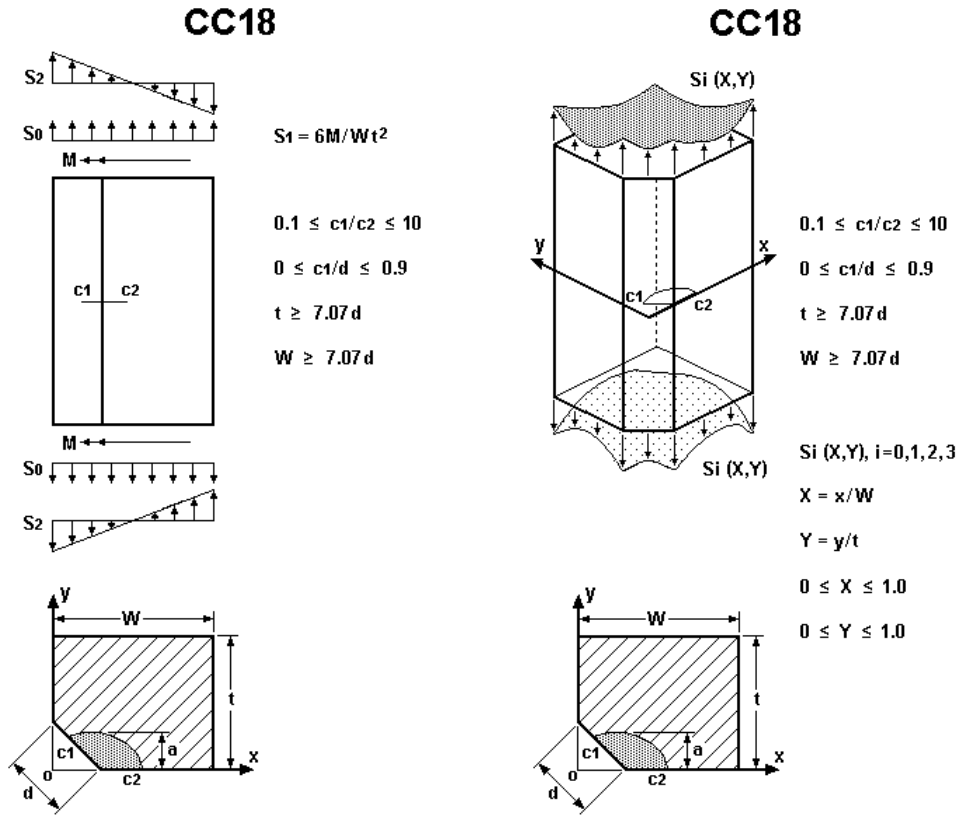


Figure 31b – Corner crack case 18

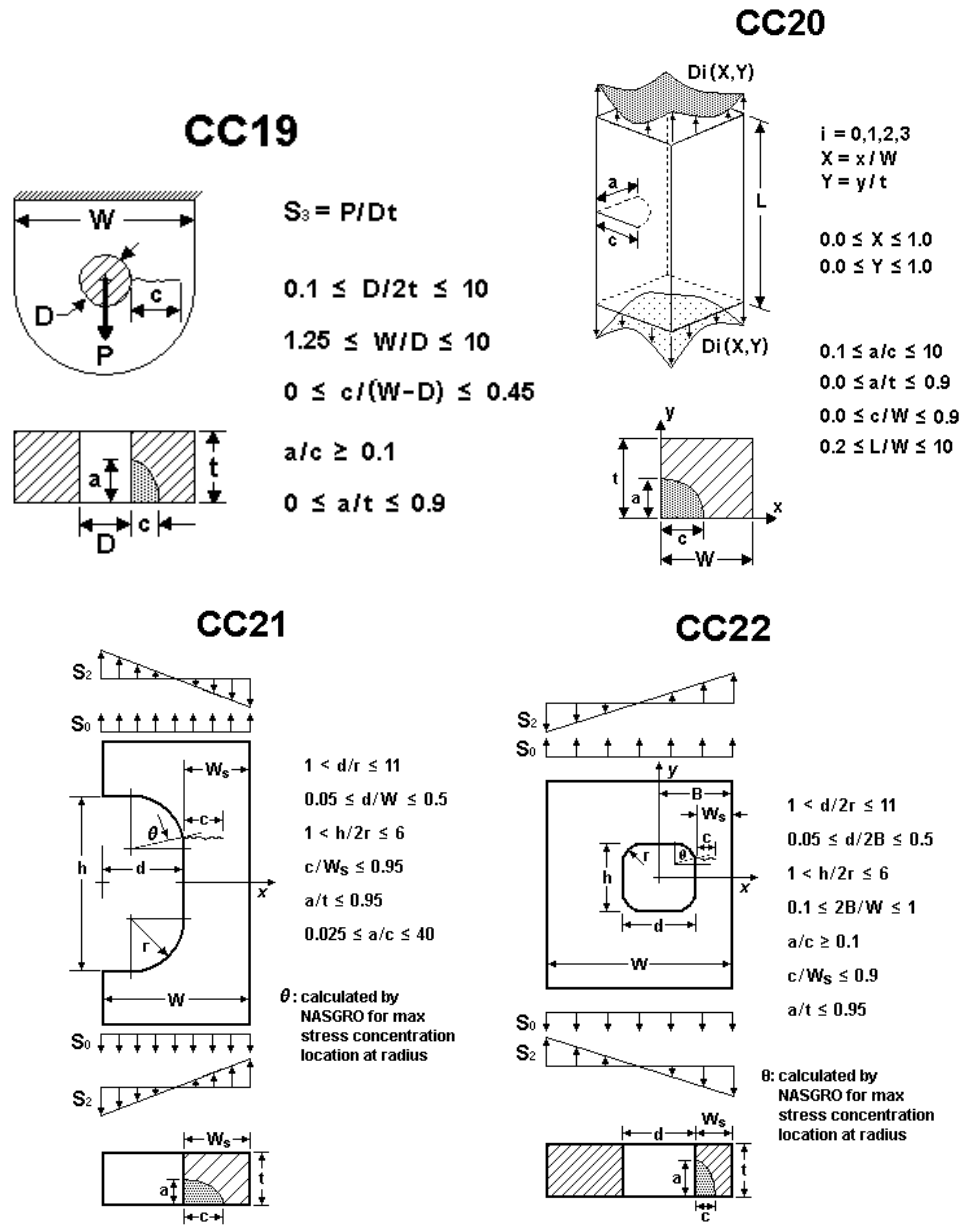


Figure 32a – Corner crack cases 19, 20, 21 & 22

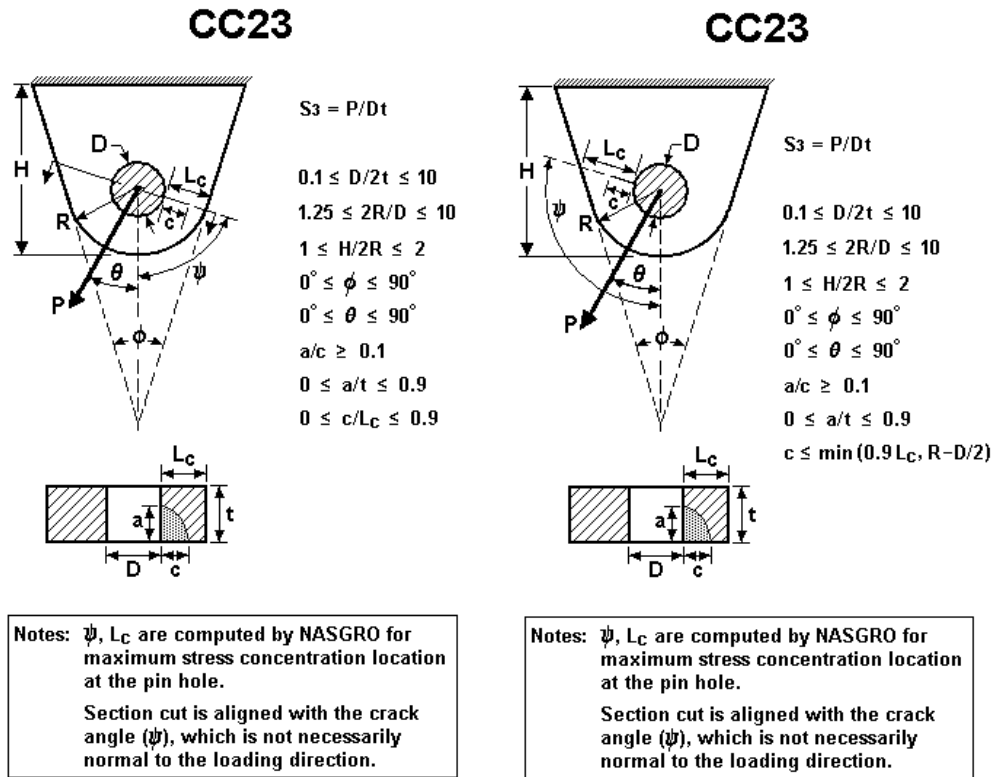


Figure 32b – Corner crack case 23

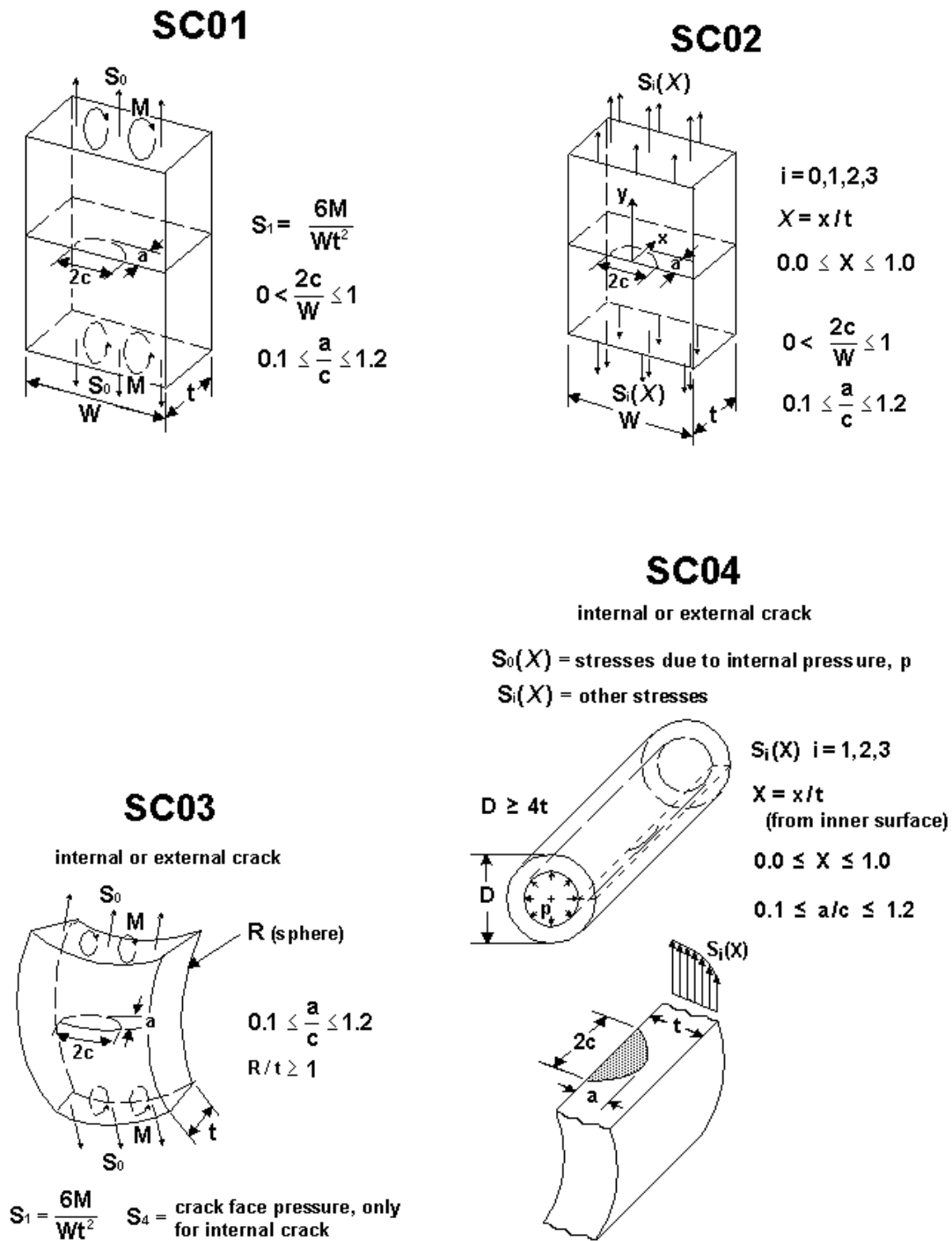


Figure 33 – Surface crack cases 1, 2, 3 & 4

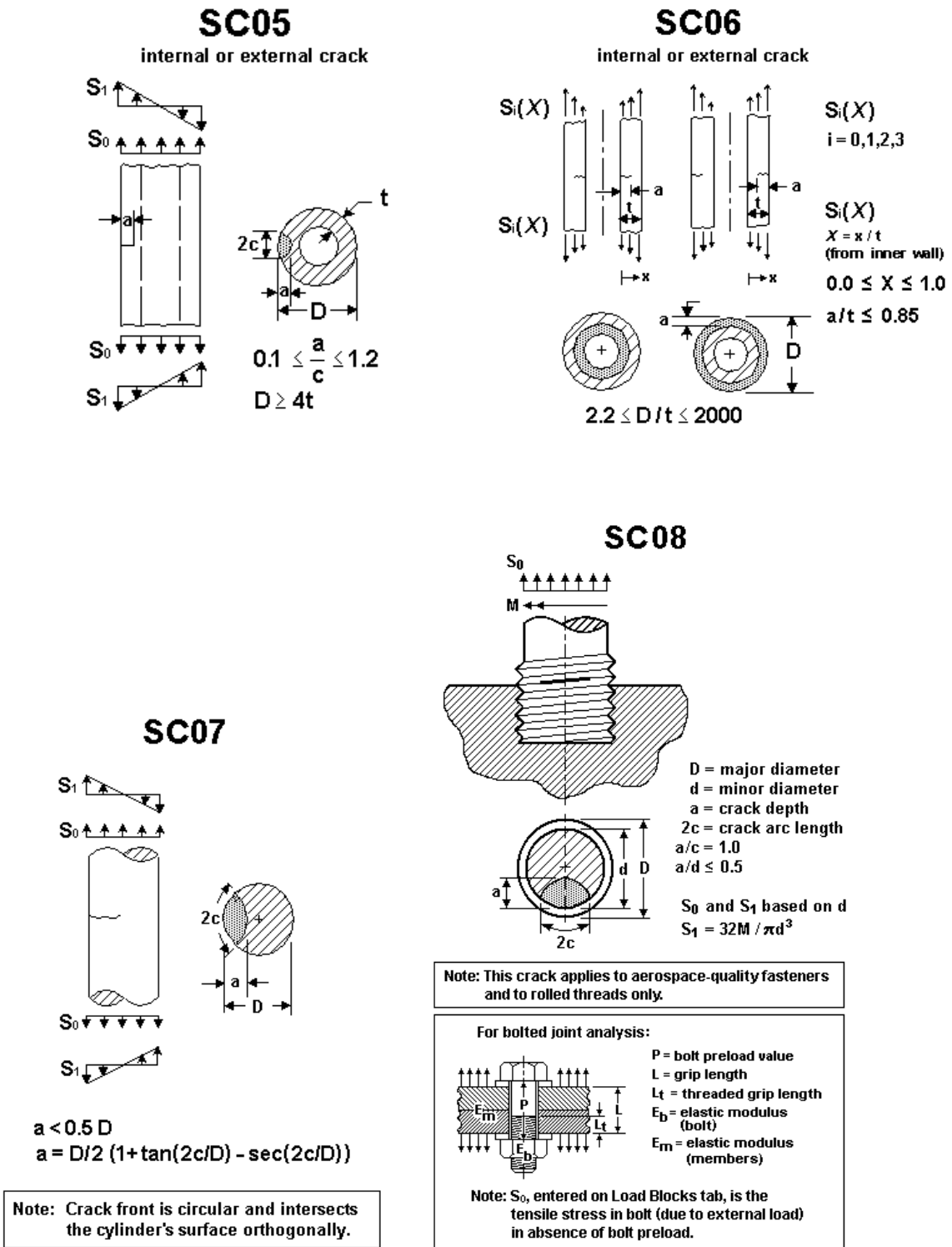


Figure 34 – Surface crack cases 5, 6, 7 & 8

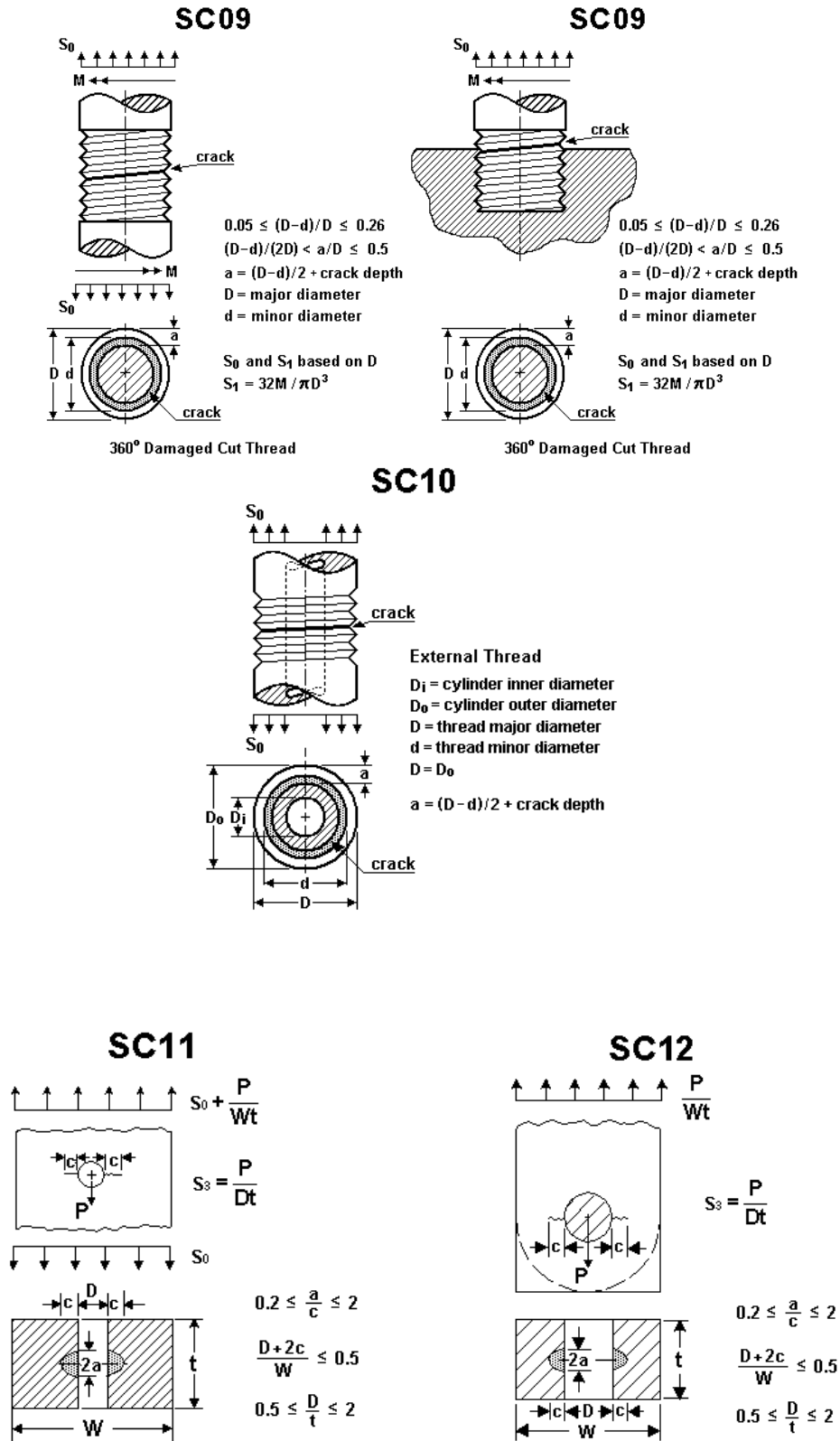
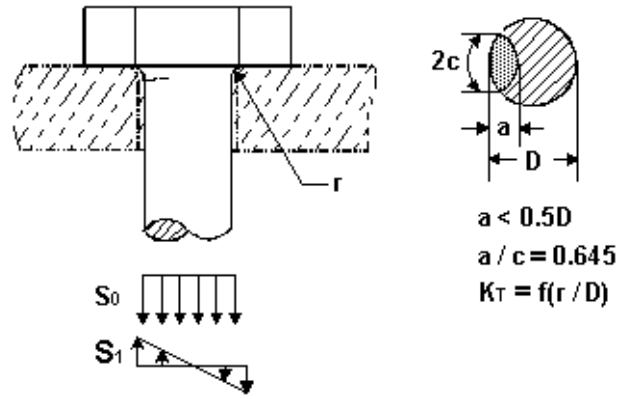


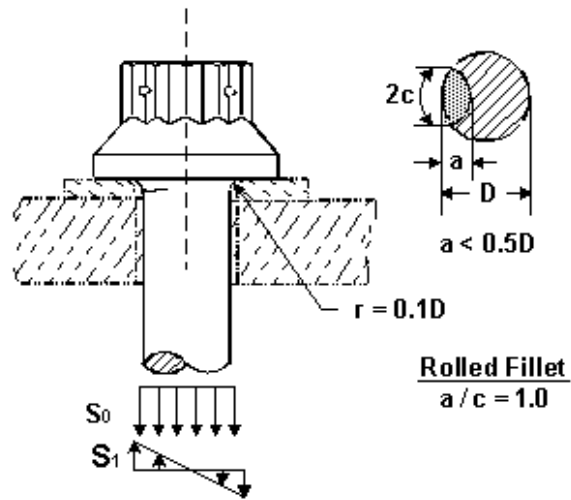
Figure 35 – Surface crack cases 9, 10, 11 & 12

SC13



Shear or Machine Bolt - Machined Fillet

SC14



Crack in Bolt Head Fillet

Figure 36 – Surface crack case 13 & 14

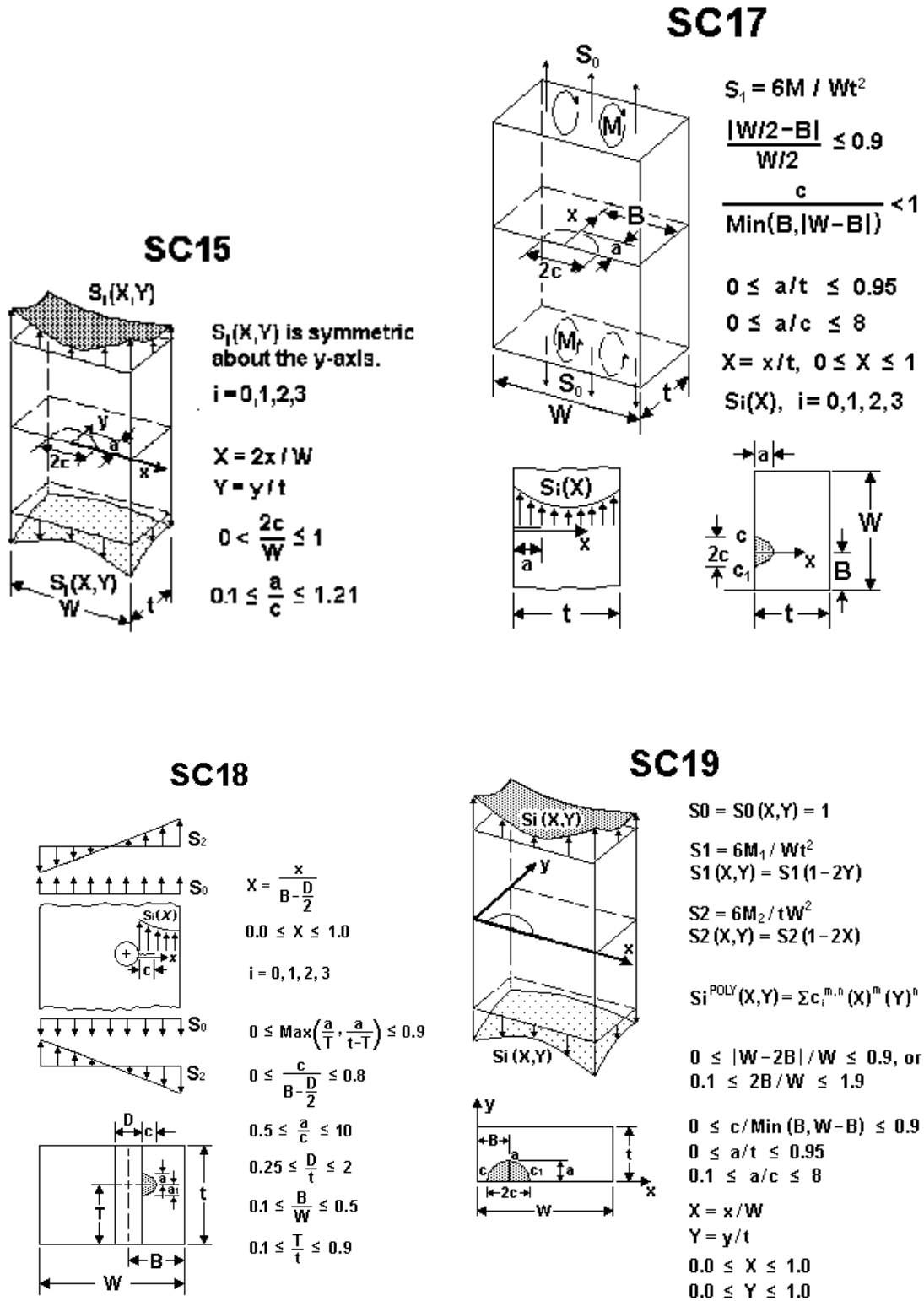


Figure 37 – Surface crack cases 15, 17, 18 & 19

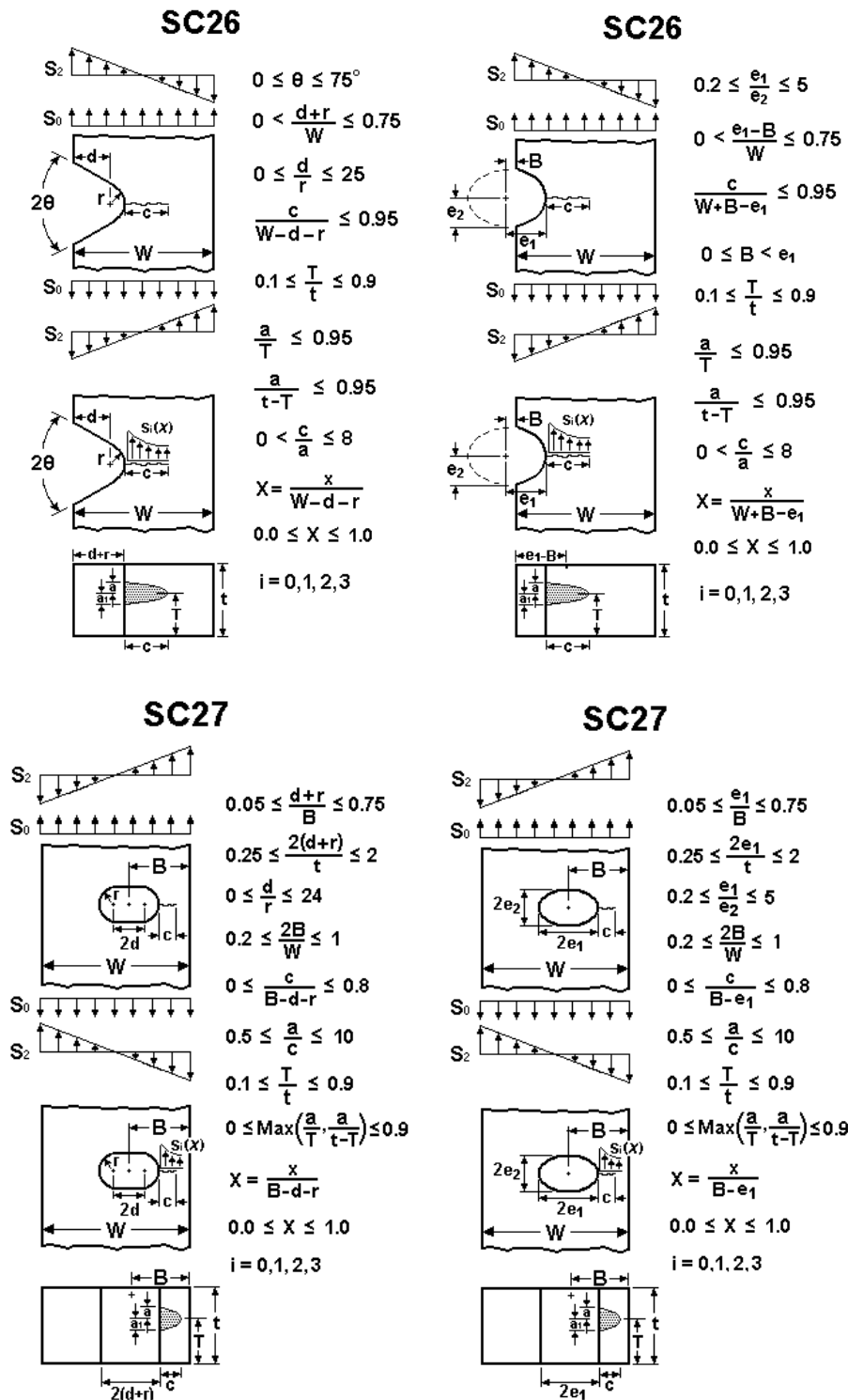
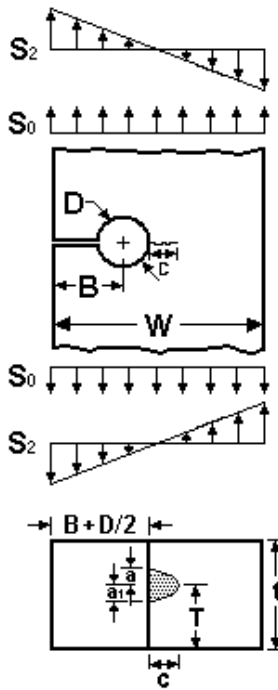


Figure 38 – Surface crack cases 26 & 27

SC28



$$0 \leq \frac{2B}{D} \leq 24$$

$$0 \leq \frac{B+D/2}{W} \leq 0.75$$

$$\frac{c}{W-B-D/2} \leq 0.9$$

$$0.1 \leq \frac{T}{t} \leq 0.9$$

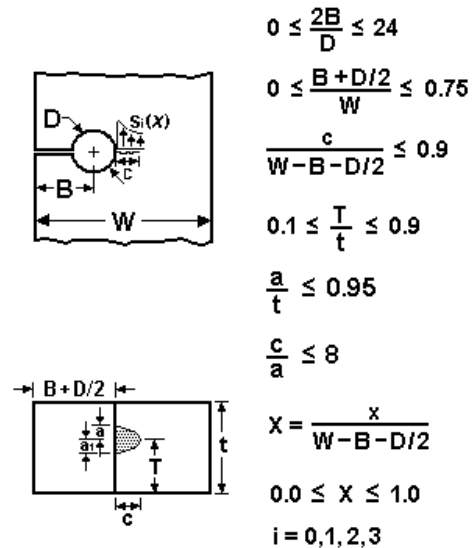
$$\frac{a}{t} \leq 0.95$$

$$\frac{c}{a} \leq 8$$

$$X = \frac{x}{W-B-D/2}$$

$$0.0 \leq X \leq 1.0$$

SC28



$$0 \leq \frac{2B}{D} \leq 24$$

$$0 \leq \frac{B+D/2}{W} \leq 0.75$$

$$\frac{c}{W-B-D/2} \leq 0.9$$

$$0.1 \leq \frac{T}{t} \leq 0.9$$

$$\frac{a}{t} \leq 0.95$$

$$\frac{c}{a} \leq 8$$

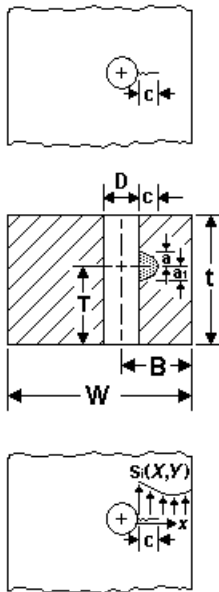
$$X = \frac{x}{W-B-D/2}$$

$$0.0 \leq X \leq 1.0$$

$$i = 0, 1, 2, 3$$

Note: The tabular stress distribution specified for the uncracked ligament assumes that the opposite ligament has failed.

SC29



$$0.25 \leq D/t \leq 2$$

$$0.5 \leq a/c \leq 5$$

$$0.1 \leq B/W \leq 0.5$$

$$0 \leq c/(B-D/2) \leq 0.8$$

$$0.05 \leq 2T/t \leq 1.95$$

$$a/\min(T, t-T) \leq 0.95$$

$$X = x/(B-D/2)$$

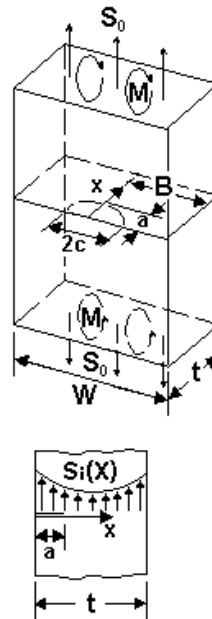
$$Y = y/t$$

$$0.0 \leq X \leq 1.0$$

$$0.0 \leq Y \leq 1.0$$

$$i = 0, 1, 2, 3$$

SC30



$$S_1 = 6M / Wt^2$$

$$\frac{|W/2-B|}{W/2} \leq 0.9$$

$$\frac{c}{\min(B, |W-B|)} < 1$$

$$0 \leq a/t \leq 0.95$$

$$0 \leq a/c \leq 8$$

$$X = x/t, 0 \leq X \leq 1$$

$$S_i(X), i = 0, 1, 2, 3$$

Figure 39 – Surface crack cases 28, 29 & 30

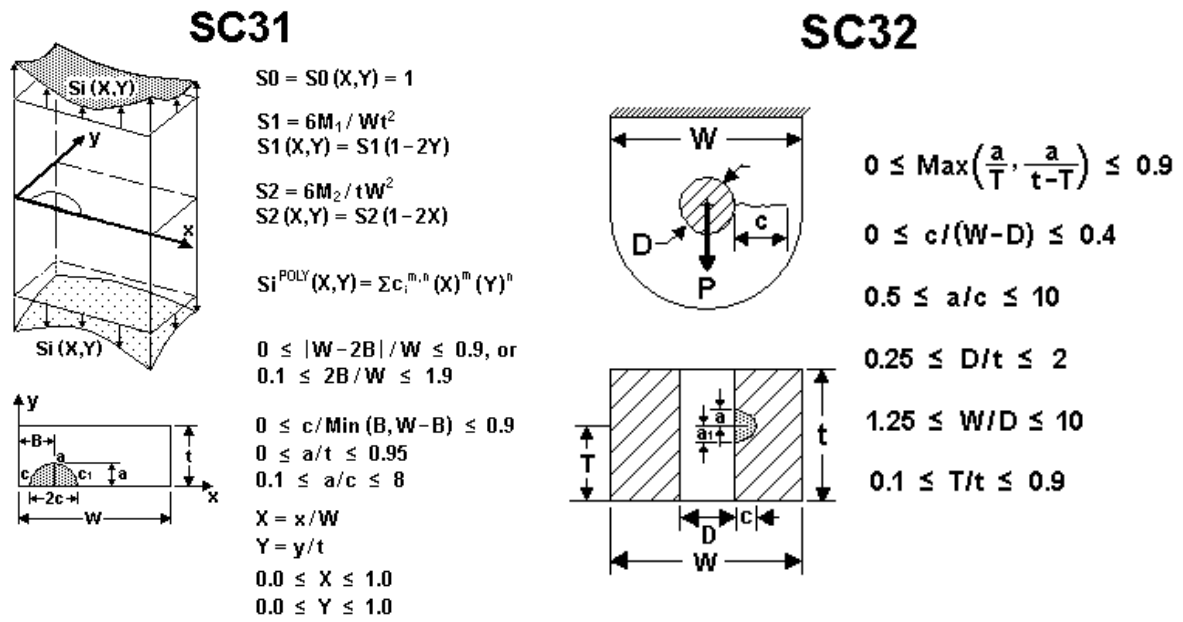


Figure 40 – Surface crack case 31 & 32

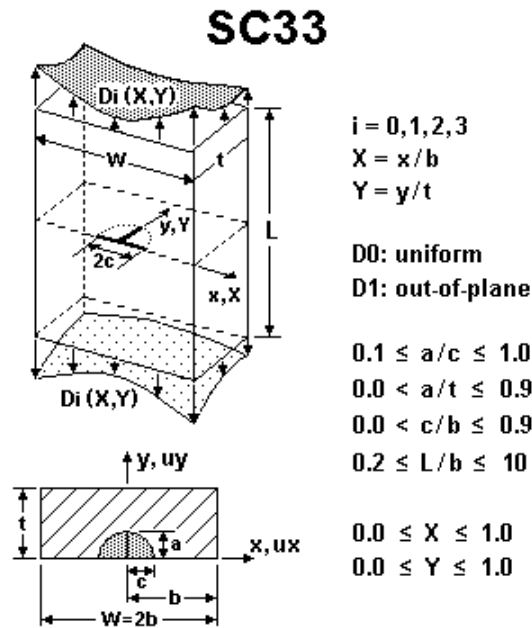


Figure 41a – Surface crack case 33

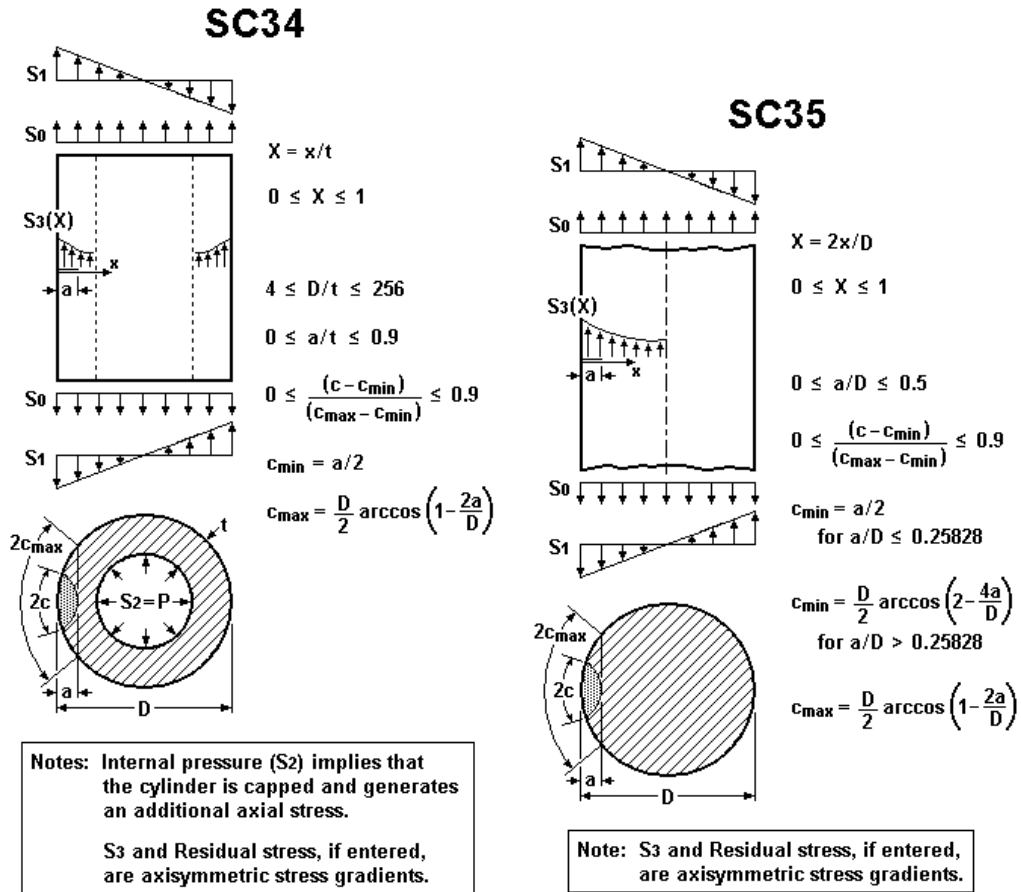
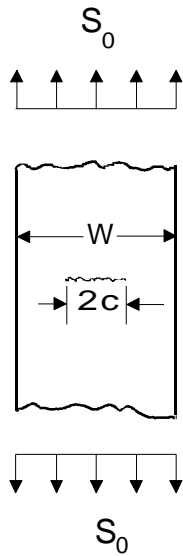
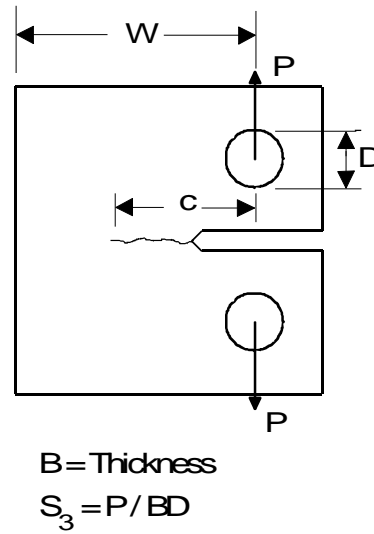


Figure 41b – Surface crack cases 34 & 35

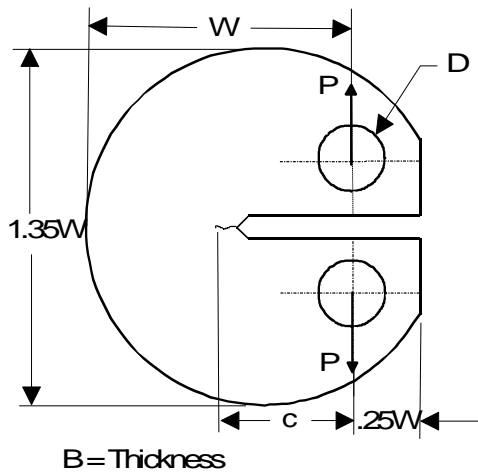
SS01



SS02



SS03



SS04

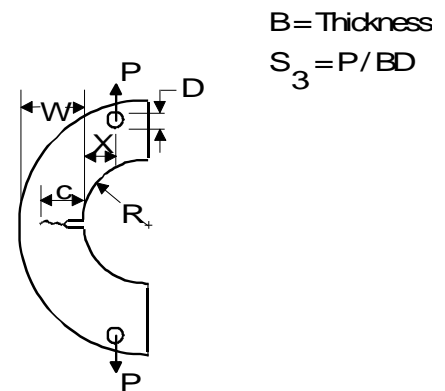


Figure 42 – Standard specimen crack cases 1, 2, 3 & 4

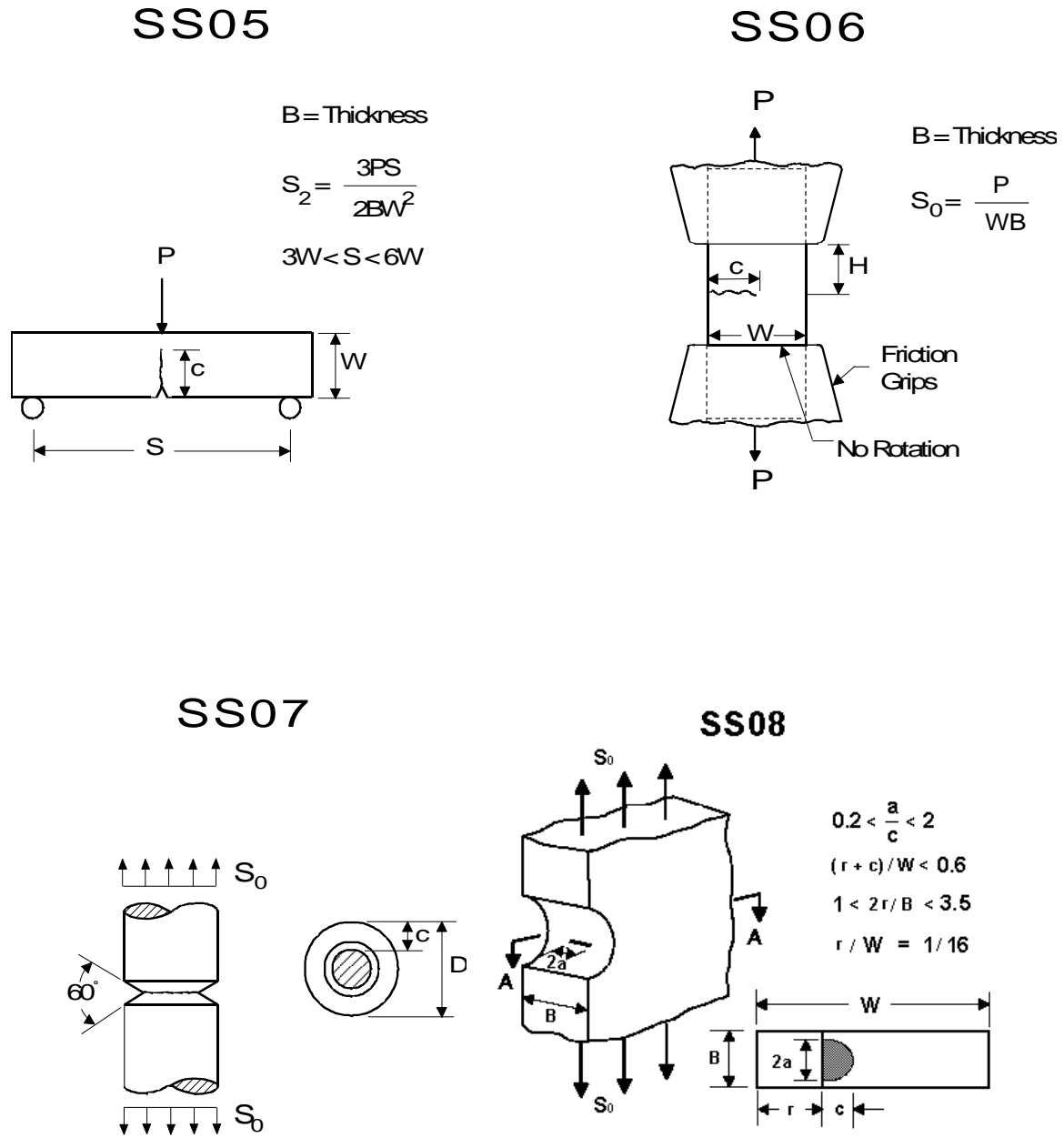


Figure 43 – Standard specimen crack cases 5, 6, 7 & 8

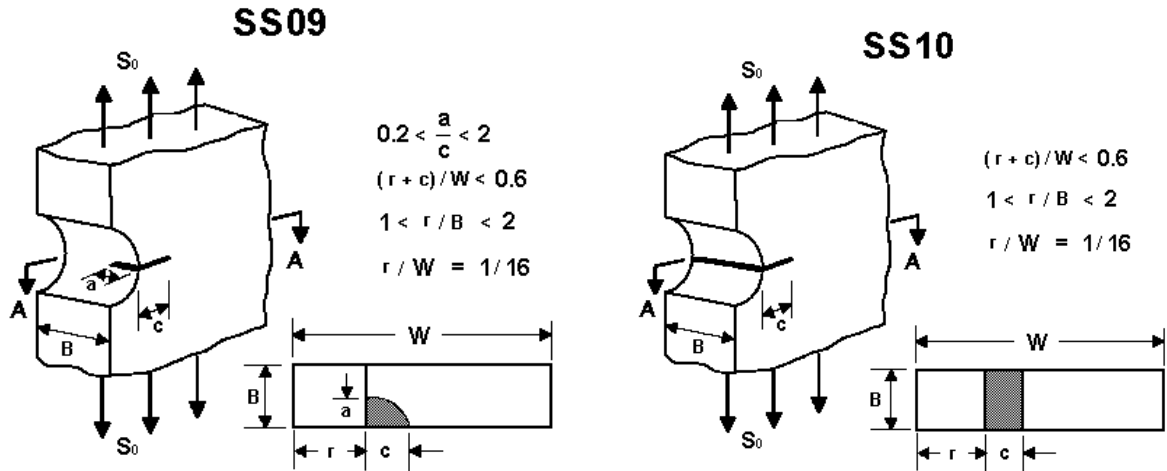


Figure 44 – Standard specimen crack cases 9 & 10

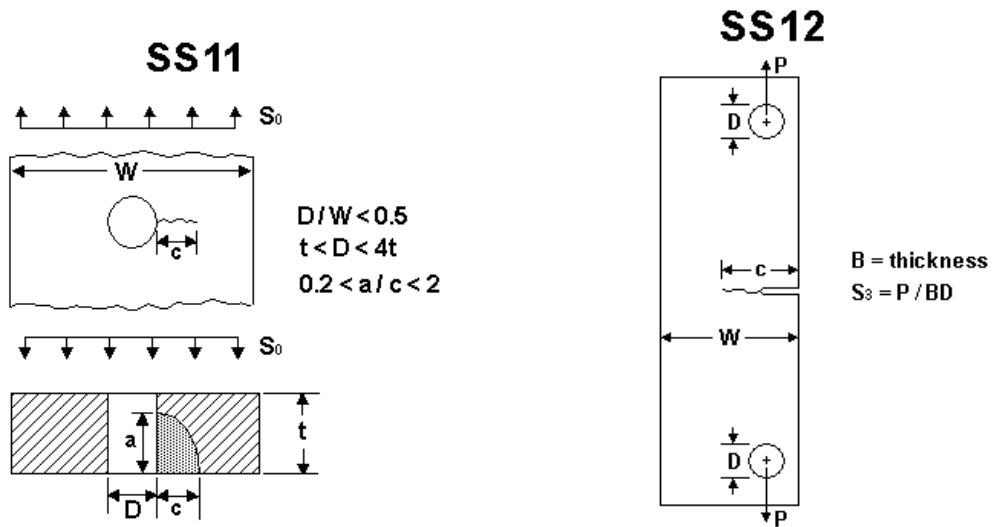


Figure 45 – Standard specimen crack cases 11 & 12

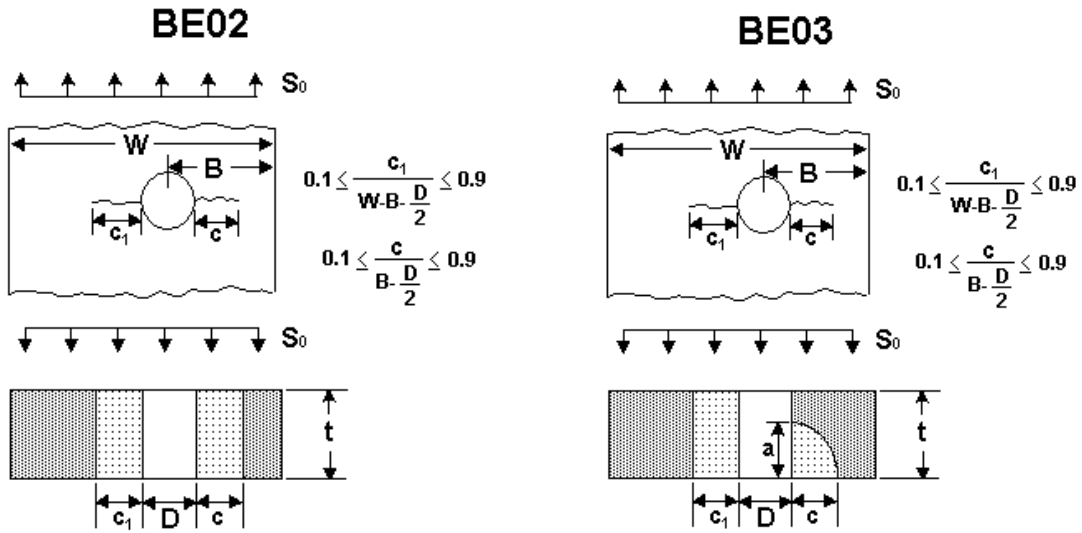


Figure 46 – Boundary Element crack cases 2 & 3

HC01

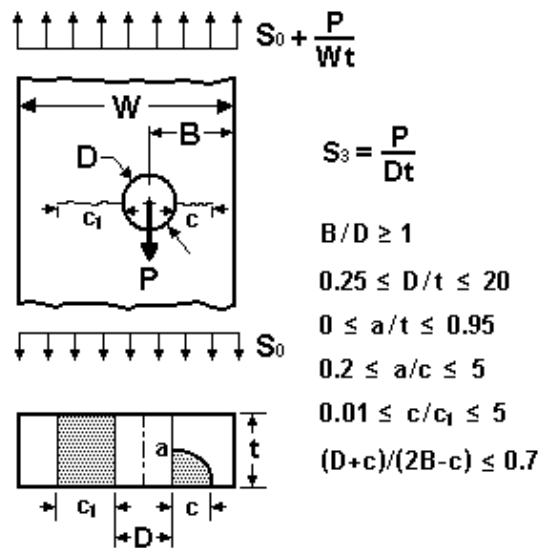


Figure 47 – Hybrid crack case 1