2.2.3 Choosing the Crack Geometry

The next few pages provide a "catalog" of currently available crack cases in NASGRO, organized by crack category. The summary Table 2.2.1 provides a listing of all crack cases for each crack type, followed by groups of figures in Fig. 2.2.4 through Fig. 2.2.78 that provide schematic diagrams of each SIF model and supplementary information about nomenclature, loading, and geometry limits. These diagrams are taken directly from the NASFLA GUI. The GUI allows the user to export the diagrams as bitmap files that can be integrated into user reports. The following is a grouped list of the figures according to crack type:

- Through crack (TC) geometries are shown in Fig. 2.2.4 through Fig. 2.2.37
- Corner crack (CC) geometries are shown in Fig. 2.2.38 through Fig. 2.2.53
- Surface-crack (SC) geometries are shown in Fig. 2.2.54 through Fig. 2.2.73
- Embedded crack (EC) geometries are shown in Fig. 2.2.74
- Hybrid crack (HC) geometries are shown in Fig. 2.2.75
- Standard specimen (SS) geometries are shown in Fig. 2.2.76 through Fig. 2.2.77
- Boundary element (BE) crack cases are shown in Fig. 2.2.78

Besides the crack geometries listed above, four data table (DT) cases, four SIF table (KT) cases, and one polynomial solution (PS01) are also available for use.

The user selects the desired crack geometry by clicking on the **Show crack case library** button in the **Geometry** tab of the GUI and then using selection boxes in the pop-up window. After selecting the appropriate crack case, the figure is displayed in the **Geometry** tab and the user can enter dimensional information such as width, thickness, diameter, etc. in the text boxes provided.

The majority of the crack cases come with standard loading types such as uniform tension, bending, and bearing stresses where applicable. To provide a consistent approach, S0 is reserved for tension and compression, S1 and S2 are bending stresses in through-the-thickness (out of plane) and width (in-plane) directions, S3 is the bearing stress, and S4 is reserved for the second tension/compression stress for cases that have biaxial loading. Besides the standard loading types, all weight function based crack cases also offer general non-linear loading capability. In Table 2.2.1, such weight function based SIF models can be identified by their case names, which end with either "univariant WF" or "bivariant WF". There are a few special crack cases in the NASGRO library that are designed to work with remote displacement profiles instead of stress. The names of these particular cases end with the designation "displacement control".

Additional information regarding the SIF models may be found in Section 4 and Appendices C and D. The details of nonlinear stress input through tabular, polynomial, and external stress files are given in the "Weight Function Solution Options" section in Appendix C.

Table 2.2.1:	Description	of Crack	${\rm Cases}$
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ID	Name
	Through Cracks
TC01	Through crack at center of plate
TC02	Through crack at edge of plate
TC03	Through crack at hole (offset) in plate
TC05	Through crack(s) at hole in plate with row of holes
TC06	Through crack in hollow sphere

	Table 2.2.1: Description of Crack Cases (cont.)
ID	Name
TC07	Through crack (axial) in hollow cylinder
TC08	Through crack (circumferential) in thin cylinder
TC09	Through crack at hole in plate under biaxial loading
TC10	Through crack (circumferential) at hole in hollow cylinder
TC11	Through crack (offset) in plate – univariant WF
TC12	Through crack at edge of plate – univariant WF
TC13	Through crack(s) at hole (offset) in plate, univariant WF
TC14	Through crack at edge of plate – displacement control
TC15	Through crack at edge of variable thickness plate – univariant WF
TC16	Through crack in thin curved stiffened panel with bulging
TC17	Through crack at edge notch in plate – univariant WF
TC18	Through crack(s) at (offset) embedded slot or elliptical hole in plate – univariant WF
TC19	Through crack at hole (offset) in plate with broken ligament – univariant WF
TC23	Two unequal through cracks at offset hole
TC24	Through crack (offset) in plate – 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 WF
TC28	Curved through crack at edge of plate – univariant WF
TC29	Offset curved through crack in plate – univariant WF
TC30	Through crack at hole in obliquely loaded and tapered lug – univariant WF
TC31	Through crack in L-section under remote loading – pre-corner
TC32	Through crack in L-section under remote loading – post-corner
TC33	Through crack growing toward a hole
TC34	Two collinear through cracks of unequal lengths
TC35	Through crack at edge of plate with one symmetric step change in thickness
TC37	Through crack in C-section under remote loading
TC38	Through crack at an interference fit hole
TC39	Through crack in T-section under remote loading
TC40	Through crack between two unequal holes (offset) in plate
TC43	Through crack(s) at hole (offset) in plate – univariant WF
TC44	Curved through crack(s) at hole(s) in plate with row of holes
TC45	Curved through crack at edge of plate – bivariant WF
TC46	Through crack (circumferential) in thin cylinder with finite length
TC47	Curved through crack at edge of plate – univariant WF
TC48	Through crack growing toward a hole
	Corner Cracks
CC01	Quarter elliptical corner crack in plate
CC08	Quarter elliptical corner crack(s) at hole (offset) in plate – univariant WF
CC09	Quarter elliptical corner crack in plate – bivariant WF
CC10	Quarter elliptical corner crack at hole (offset) in plate – bivariant WF
CC11	Quarter elliptical corner crack in plate – univariant WF

Table 2.2.1: Description of Crack Cases (cont.)

ID	Name	
CC12	Quarter elliptical corner crack at chamfer in plate – bivariant WF	
CC13	Quarter elliptical corner crack at edge notch in plate	
CC14	Quarter elliptical corner crack at (offset) embedded slot or elliptical hole in plate	
$\rm CC15$	Quarter elliptical corner crack at (offset) hole in plate with broken ligament	
CC16	Corner crack(s) at a hole based on Fawaz-Anderson solution	
$\rm CC17$	Two unequal corner cracks at a hole in a finite plate	
CC18	Part elliptical corner crack at angled corner – bivariant WF	
CC19	Quarter elliptical corner crack at hole in lug – univariant WF	
CC20	Quarter elliptical corner crack in plate – displacement control	
CC21	Corner crack at edge rectangular cutout with rounded corners	
CC22	Corner crack at offset internal rectangular cutout with rounded corners	
CC23	Corner crack at hole in obliquely loaded and tapered lug – univariant WF	
CC24	Corner crack(s) at hole(s) in plate with row of holes	
CC25	Corner crack at countersunk hole in infinite plate (Cronenberger solution)	
CC26	Quarter elliptical corner crack at hole (offset) in plate – bivariant WF	
CC27	Corner crack at nozzle from API 579 (KNCC1)	
CC28	Corner crack at pressure vessel nozzle – bivariant WF	
CC29	Corner crack in T-section under remote loading	
	Surface Cracks	
SC01	Semi-elliptical surface crack in plate	
SC02	Semi-elliptical surface crack in plate – univariant WF	
SC03	Semi-elliptical surface crack in pressurized sphere	
SC04	Semi-elliptical surface crack (axial) in hollow cylinder – univariant WF	
SC05	Semi-elliptical surface crack (circumferential) in hollow cylinder	
SC06	Constant-depth surface crack (circumferential) in hollow cylinder – univariant WF	
SC07	Semi-elliptical surface crack (circumferential) in 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	Semi-elliptical surface crack(s) at hole in plate	
SC13	Semi-elliptical surface crack in bolt head fillet – shear bolt	
SC14	Semi-elliptical surface crack in bolt head fillet – tension bolt	
SC18	Semi-elliptical surface crack(s) (offset) at hole (offset) in plate – univariant WF	
SC26	Surface crack at edge notch in plate	
SC27	Surface crack at (offset) embedded slot or elliptical hole in plate	
SC28	Surface crack at (offset) hole in plate with broken ligament	
SC29	Semi-elliptical surface crack (offset) at hole (offset) in plate – bivariant WF	
SC30	Semi-elliptical surface crack (offset) in plate – univariant WF	
SC31	Semi-elliptical surface crack (offset) in plate – bivariant WF	
SC32	Semi-elliptical surface crack at hole in lug – univariant WF	
SC33	Semi-elliptical surface crack at center of plate – displacement control	
SC34	External surface crack in a hollow cylinder – univariant WF	

Table 2.2.1: Description of Crack Cases (cont.)

ID	Name		
SC35	Semi-elliptical surface crack in a solid cylinder – univariant WF		
SC36	Semi-elliptical surface crack (external circumferential) in sphere – univariant WF		
SC37	Semi-elliptical surface crack(s) (offset) at hole (offset) in plate – univariant WF		
SC38	Semi-elliptical surface crack (offset) at hole (offset) in plate – bivariant WF		
SC39	Semi-elliptical surface crack in a round notched bar		
	Embedded Cracks		
EC04	Elliptical embedded crack (offset) in plate – bivariant WF		
EC05	Elliptical embedded crack (offset) in plate – univariant WF		
	Hybrid Cracks		
HC01	HC01 - corner crack and through crack at hole (offset)		
	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 a part-through crack (two tips)		
DT04	Two-dimensional data table for one or two through-cracks (two tips)		
	Stress Intensity Factor 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 a part-through crack (two tips)		
KT04	Two-dimensional stress intensity factor table for one or two through-cracks (two tips)		
	Polynomial Series		
PS01	Polynomial series		
	Standard Specimens		
SS01	Middle crack 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	Single edge crack bend specimen $SE(B)$ – three-point bend		
SS06	Single edge crack tension specimen $SE(T)$ – constrained ends		
SS07	Notched round bar specimen R-bar(T) – circumferential crack		
SS08	Single edge notch tension specimen $SEN(T)$ with semi-elliptical surface crack		
SS09	Single edge notch tension specimen $SEN(T)$ with quarter-elliptical corner crack		
SS10	Single edge notch tension specimen SEN(T) with through crack		
SS11	Quarter-elliptical corner crack at centered hole in plate		
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		
	Superseded Solutions		

Table 2.2.1: Description of Crack Cases (cont.)

ID	Name
TC04	Through crack at hole in lug
CC02	Quarter elliptical corner crack at hole (offset) in plate
CC03	Quarter elliptical corner crack at hole in lug
CC04	Quarter elliptical corner crack(s) at hole in plate
$\rm CC05$	Corner crack in rectangular plate subjected to bivariant stress
$\rm CC07$	Quarter elliptical corner crack at hole in plate
SC12	Semi-elliptical surface crack(s) at hole in lug
SC15	Surface crack in plate subjected to bivariant stress
SC17	Semi-elliptical surface crack (offset) in plate – univariant WF
SC19	Semi-elliptical surface crack (offset) in plate – bivariant WF
EC01	Elliptical embedded crack in plate
EC02	Elliptical embedded crack (offset) in plate – univariant WF
BE02	Two through cracks of unequal length at opposite sides of hole (offset) in plate
BE03	Through crack and corner crack at opposite sides of hole (offset) in plate

Table 2.2.1: Description of Crack Cases (cont.)

2.2.4 Transition of Crack Geometry

Crack growth analysis is usually conducted on part-through cracks, such as surface or corner crack in a plate. As the crack grows, the depth of the crack may exceed the thickness before the crack becomes unstable. In such instances, growth will continue using the corresponding through crack and then the crack will grow some more before becoming critical. Table 2.2.2 shows the transition relation between crack cases (with details given in Appendix D).

From	То	Condition/Comment
TC03	TC02	
TC11	TC12	Either crack tip can set off the transition
TC23	TC19	Either crack tip can set off the transition
TC24	TC14	
TC29	TC47	
TC31	TC32	
TC33	TC13	
TC34	TC11	
TC37	TC37	From first flange to web and to second flange
TC39	TC39	From flange to flange & web
CC01	TC02 or TC47	
CC02	TC03	
CC03	TC04	

Table 2.2.2: Transition Relationship between Crack Cases

	Table 2.2.2: Transition Relationship between Crack Cases (cont.)			
From	То	Condition/Comment		
CC04	TC03	Occurs only if number of cracks=1		
$\rm CC05$	TC12	Uses averaged unvariant stresses in TC12		
$\rm CC07$	TC03	Occurs only if number of cracks=1		
CC08	TC13 or TC43			
CC09	TC12 or TC47			
CC10	TC13			
CC11	TC12 or TC47	Either crack tip can set off the transition		
CC12	TC12			
CC13	TC17			
CC14	TC18			
CC15	TC19			
CC16	TC03 or TC23			
$\rm CC17$	HC01 or TC23			
CC18	CC12			
CC19	TC27			
CC20	TC14			
CC21	TC25			
CC22	TC26			
CC23	TC30			
CC24	TC05			
CC26	TC13			
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			
SC29	CC10 or TC13			
SC30	CC11, TC11, TC12			
	TC29, or $TC47$			
SC31	CC09, TC11, TC12, or TC29			
SC32	CC19 or TC27			
SC37	CC08 or TC43			
SC38	CC26 or TC43			

Table 2.2.2: Transition Relationship between Crack Cases (cont.)

From	То	Condition/Comment	
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	
HC01	CC15 or TC23		
SS08	SS10		
SS09	SS10		
SS11	TC03		

Table 2.2.2: Transition Relationship between Crack Cases (cont.)

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 S0, S1 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.

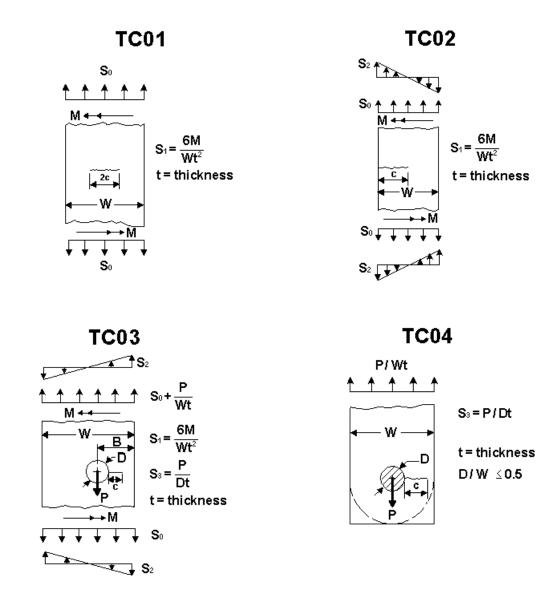
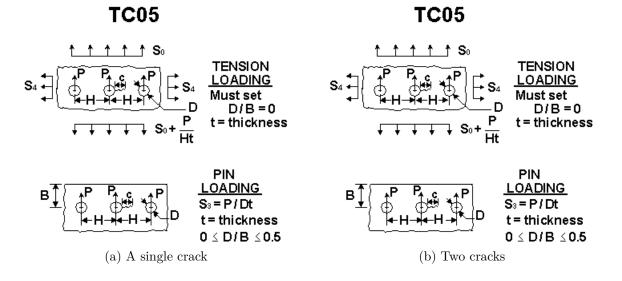
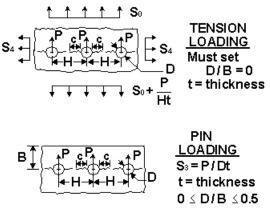
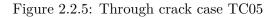


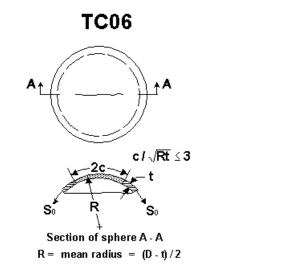
Figure 2.2.4: Through crack cases TC01, TC02, TC03, and TC04

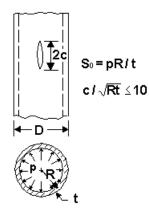




(c) Two cracks at each hole







R = mean radius = (D - t)/2

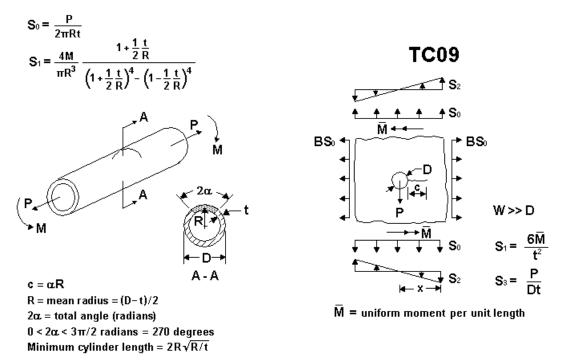


Figure 2.2.6: Through crack cases TC06, TC07, TC08, and TC09

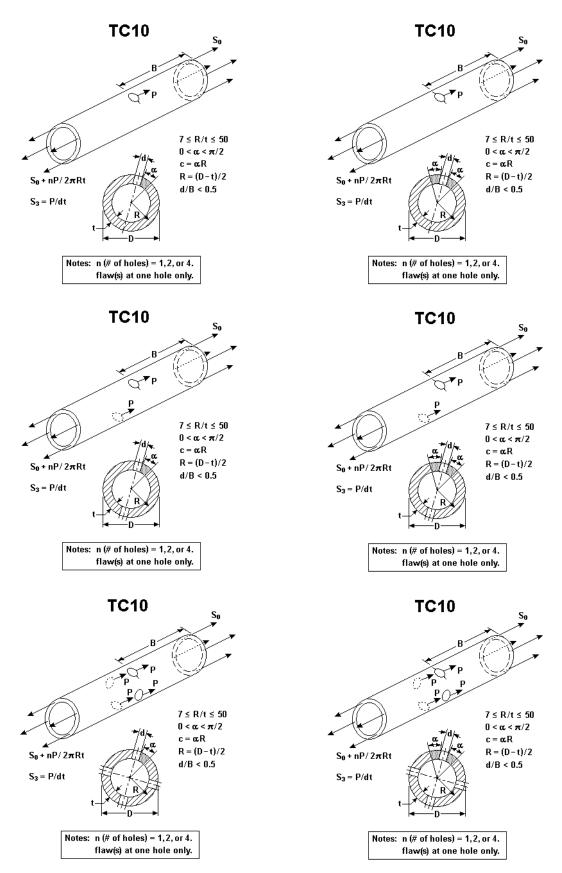
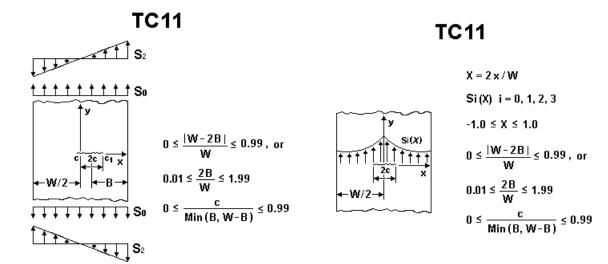


Figure 2.2.7: Through crack case TC10





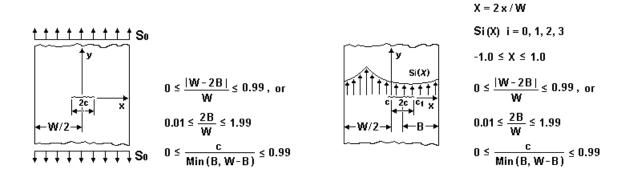
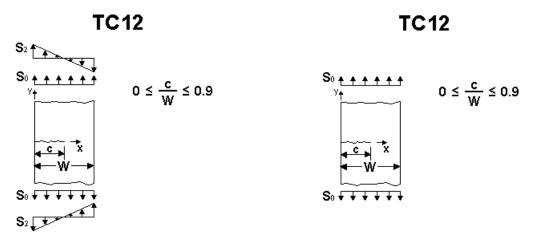


Figure 2.2.8: Through crack case TC11





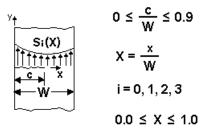


Figure 2.2.9: Through crack case TC12

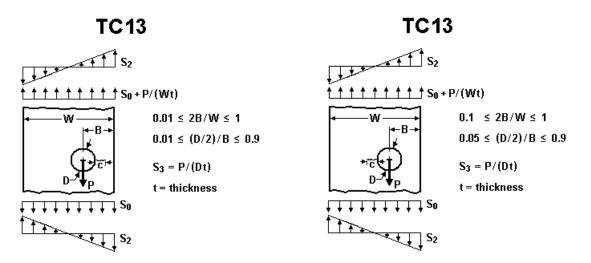
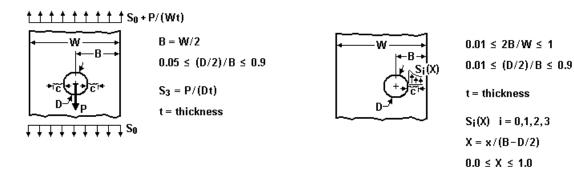


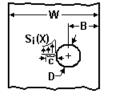
Figure 2.2.10: Through crack case TC13

TC13

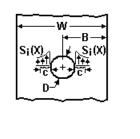




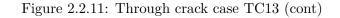


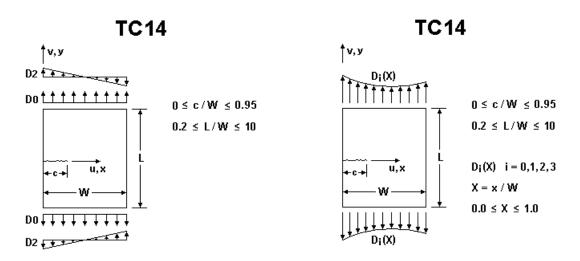


 $0.1 \le 2B/W \le 1$ $0.05 \le (D/2)/B \le 0.9$ t = thickness $S_i(X) \quad i = 0,1,2,3$ X = x/(W-B-D/2) $0.0 \le X \le 1.0$



B = W/20.05 ≤ (D/2)/B ≤ 0.9 t = thickness S_i(X) i = 0,1,2,3 X = x/(B-D/2) 0.0 ≤ X ≤ 1.0







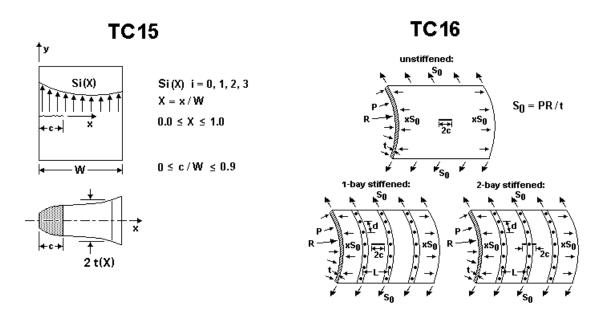


Figure 2.2.13: Through crack cases TC15 and TC16

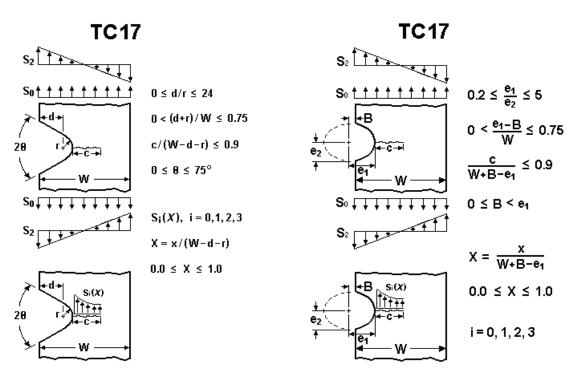
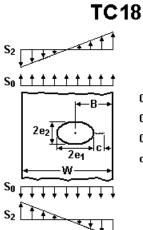
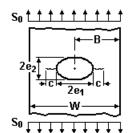


Figure 2.2.14: Through crack case TC17

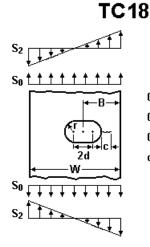


 $0.05 \le e_1/B \le 0.75$ $0.2 \leq e_1/e_2 \leq 5$ $0.01 \leq 2B/W \leq 1$ $c/(B-e_1) \le 0.99$

TC18



 $0.05 \le e_1/B \le 0.75$ $0.2 \leq e_1/e_2 \leq 5$ B = W/2 $c/(B{-}e_1) \leq 0.99$



 $0.05 \le (d+r)/B \le 0.75$ $0 \leq d/r \leq 24$ $0.01 \leq 2B/W \leq 1$ $c/(B-d-r) \le 0.99$

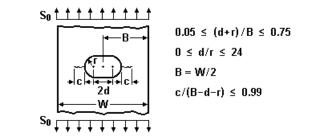
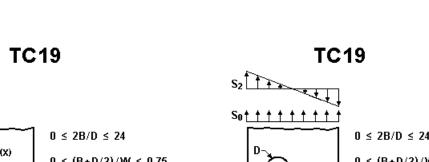
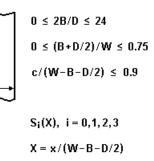


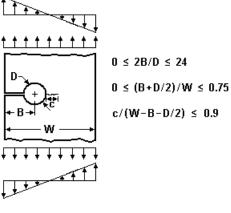
Figure 2.2.15: Through crack case TC18







 $0.0 \leq X \leq 1.0$



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

Figure 2.2.16: Through crack case TC19

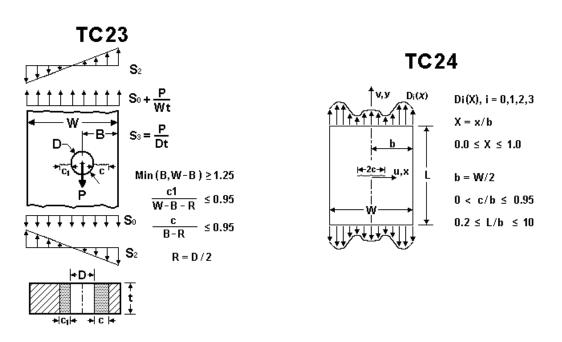


Figure 2.2.17: Through crack cases TC23 and TC24

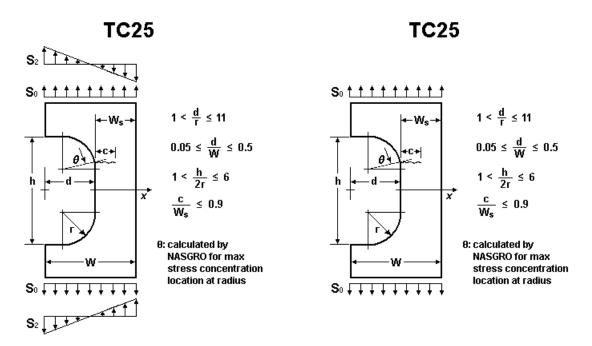


Figure 2.2.18: Through crack case TC25

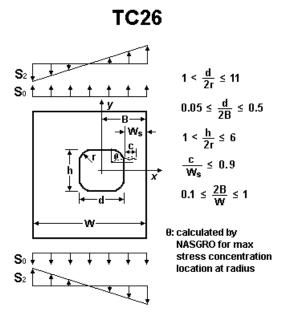


Figure 2.2.19: Through crack case TC26

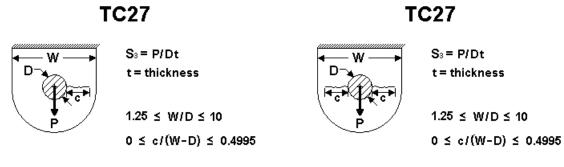


Figure 2.2.20: Through crack case TC27

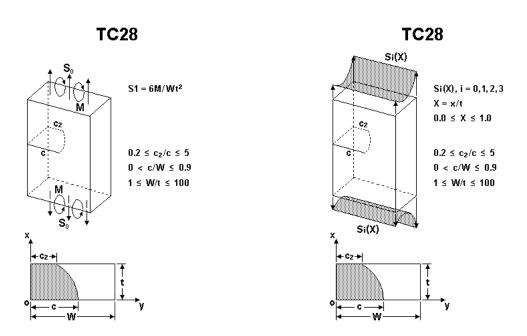


Figure 2.2.21: Through crack case TC28

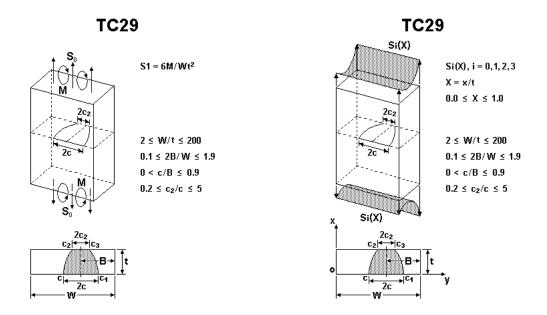


Figure 2.2.22: Through crack case TC29

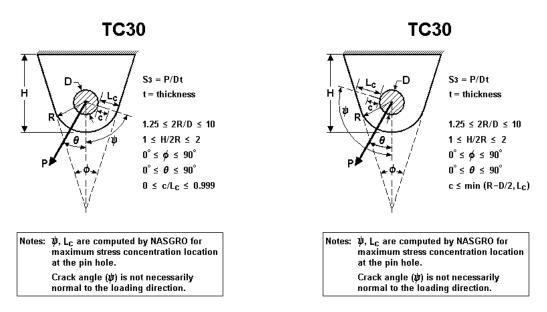
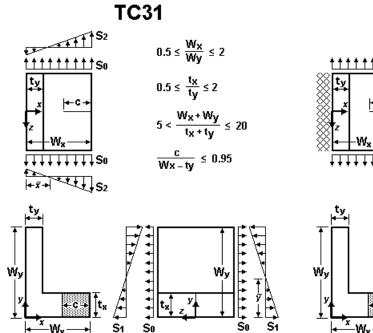
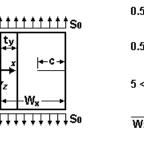
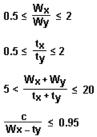
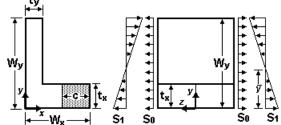


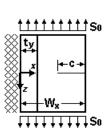
Figure 2.2.23: Through crack case TC30

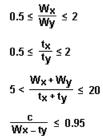












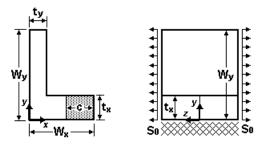
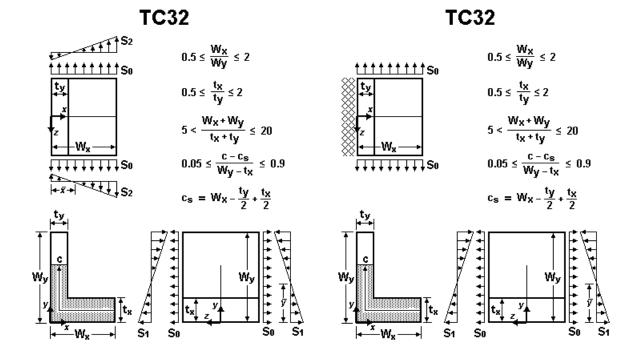


Figure 2.2.24: Through crack case TC31



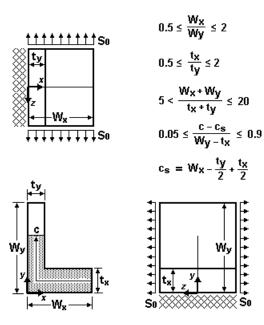


Figure 2.2.25: Through crack case TC32

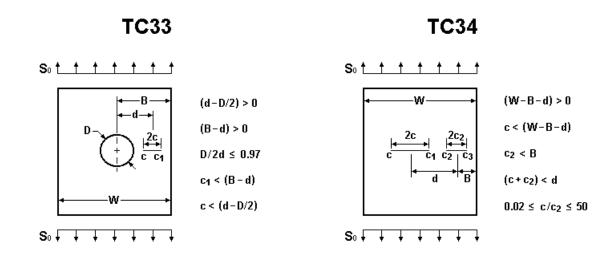


Figure 2.2.26: Through crack cases TC33 and TC34





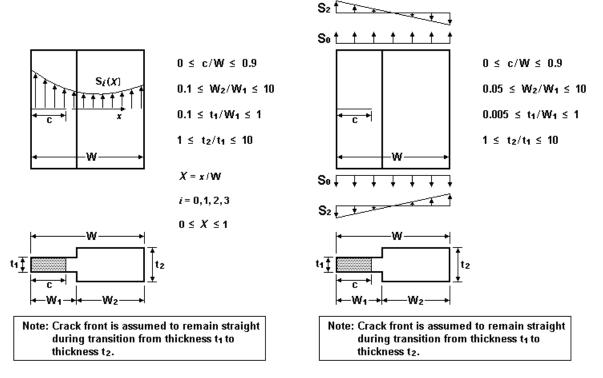


Figure 2.2.27: Through crack cases TC35

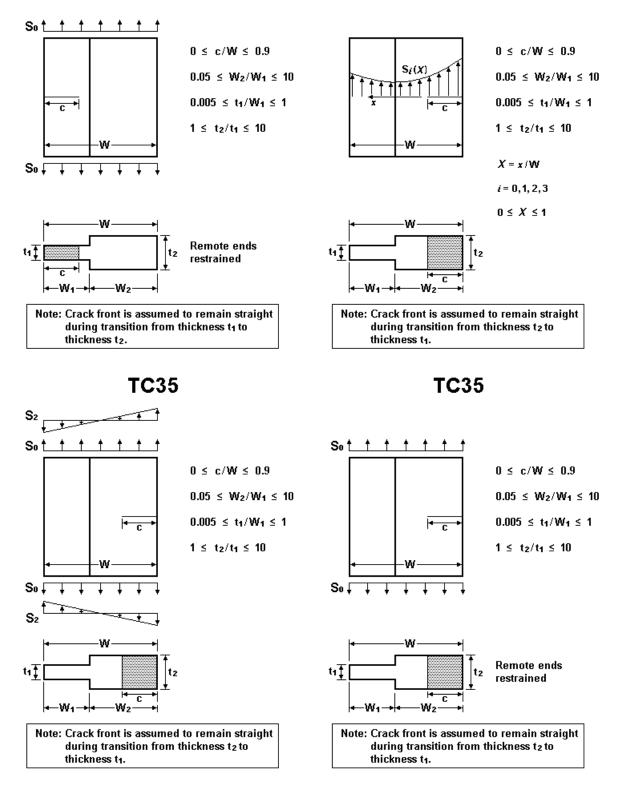


Figure 2.2.28: Through crack case TC35 (cont)

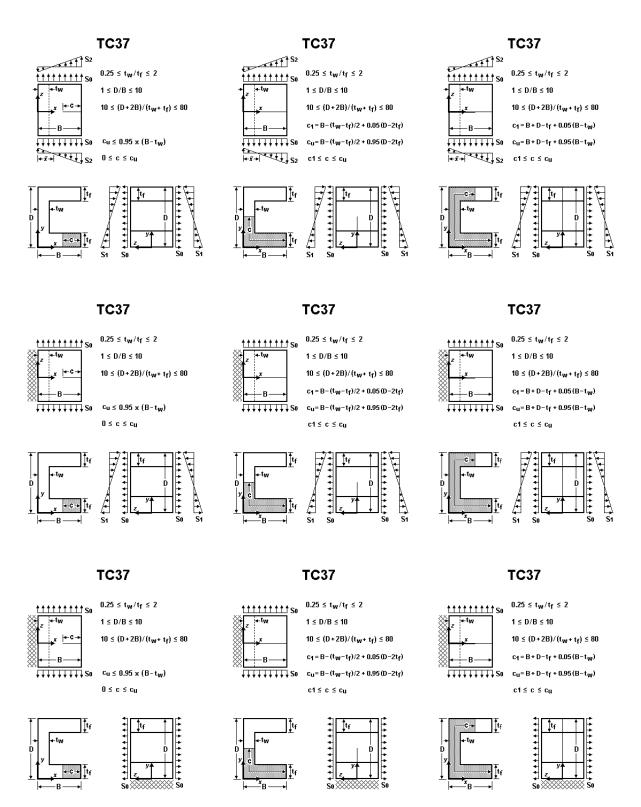


Figure 2.2.29: Through crack case TC37

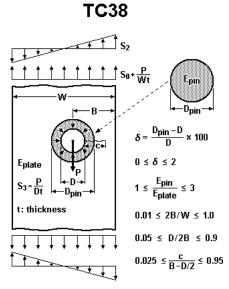


Figure 2.2.30: Through crack case TC38

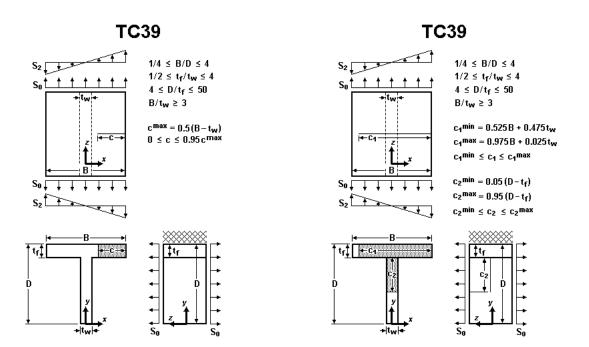
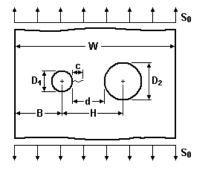


Figure 2.2.31: Through crack case TC39

68

TC40



 $\begin{array}{l} 1/64 \, \leq \, D_4/D_2 \, \leq \, 64 \\ d = H - (D_4 + D_2)/2 \\ 1/25 \, \leq \, d/(D_4 + D_2) \, \leq \, 5 \\ 1 \, \leq \, B/D_4 \\ 1 \, \leq \, (W - B - H)/D_2 \\ 0 \, \leq \, c/d \, \leq \, 0.99 \end{array}$



TC40

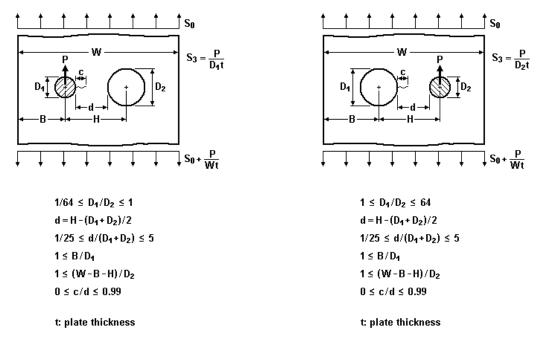
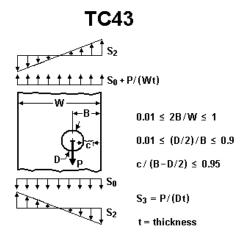


Figure 2.2.32: Through crack case TC40



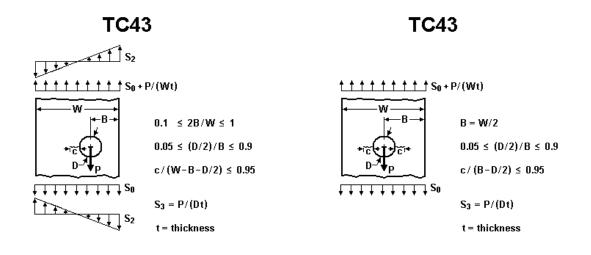
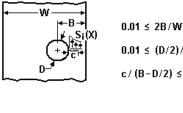


Figure 2.2.33: Through crack case TC43

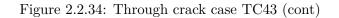
TC43





$0.01 \le 2B/W \le 1$ $0.01 \le (D/2)/B \le 0.9$ $c/(B-D/2) \le 0.95$	$W \rightarrow B \rightarrow $	0.1 ≤ 2B/W ≤ 1 0.05 ≤ (D/2)/B ≤ 0.9 c/(W-B-D/2) ≤ 0.95
t = thickness		t = thickness
S _i (X) i = 0,1,2,3		S _i (X) i = 0,1,2,3
X = x/(B-D/2)		X = x/(W-B-D/2)
$0.0 \le X \le 1.0$		$0.0 \le X \le 1.0$

• W -



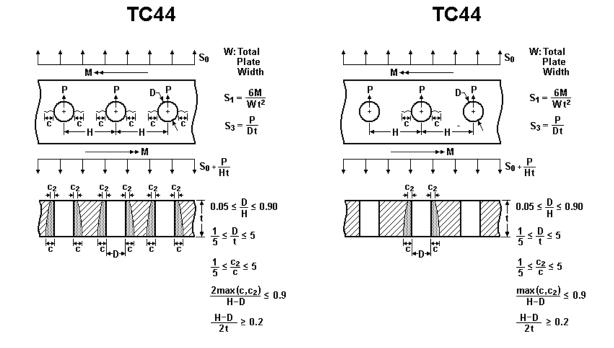
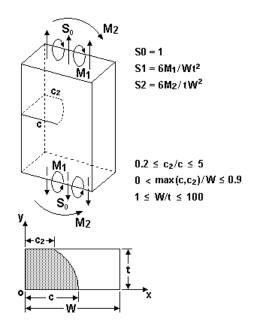


Figure 2.2.35: Through crack case TC44



TC45

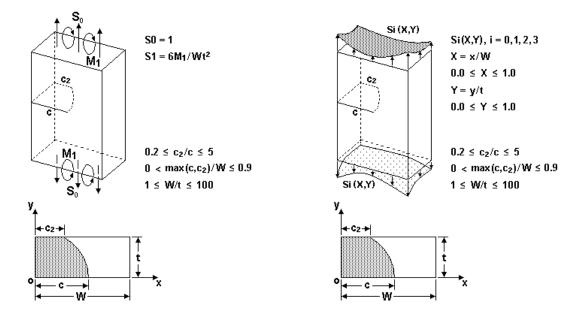
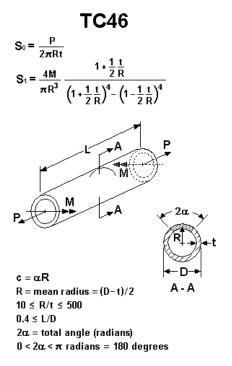
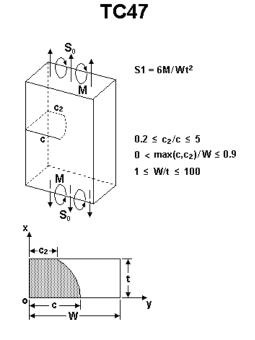


Figure 2.2.36: Through crack case TC45





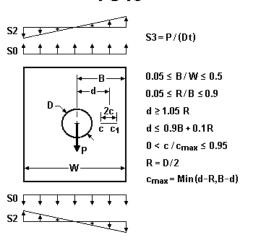


Figure 2.2.37: Through crack cases TC46, TC47, and TC48

73

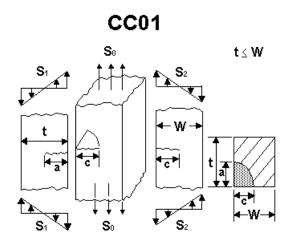


Figure 2.2.38: Corner crack case CC01

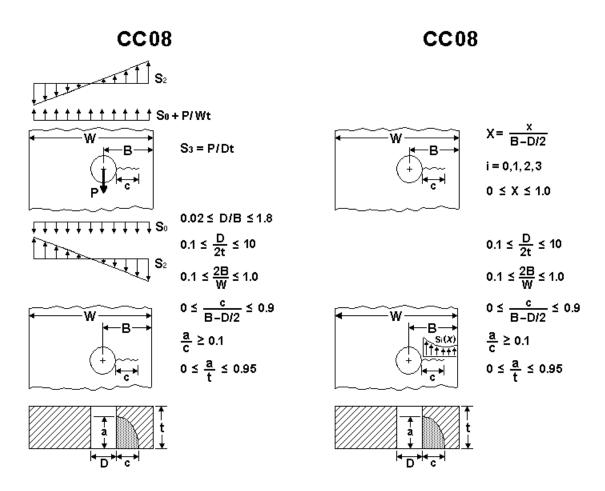
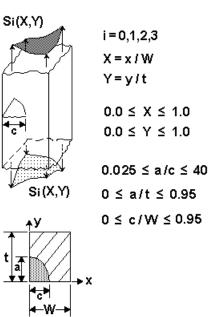
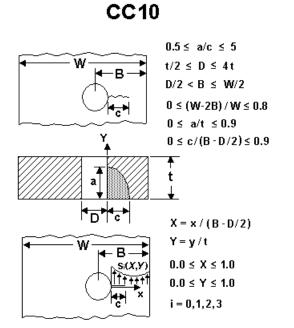


Figure 2.2.39: Corner crack case CC08

CC09





CC11

CC11

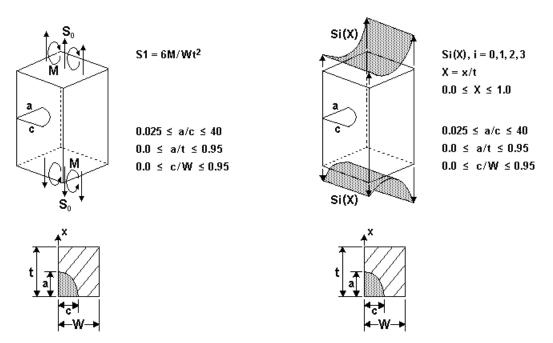
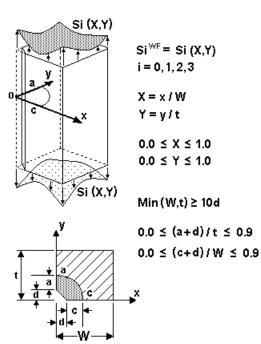
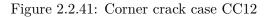
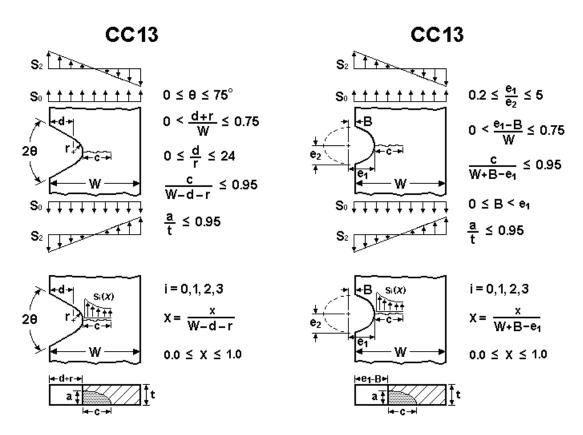


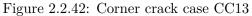
Figure 2.2.40: Corner crack cases CC09, CC10, and CC11



CC12







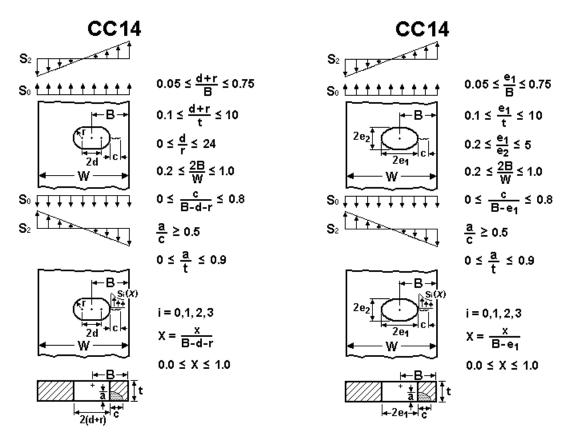
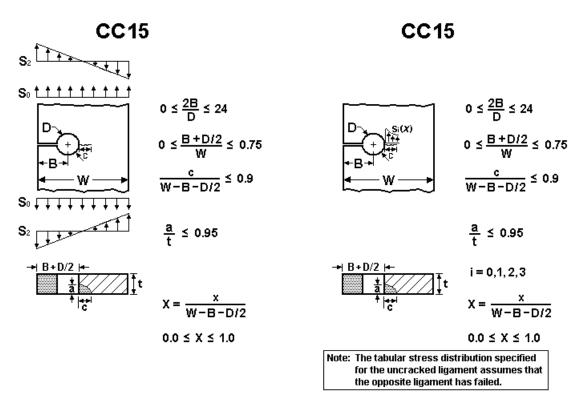
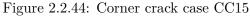


Figure 2.2.43: Corner crack case CC14





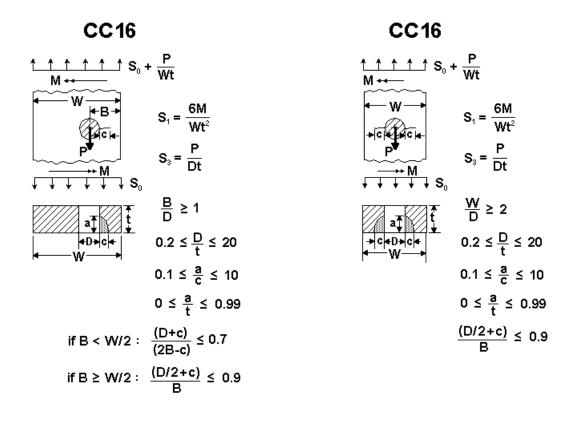


Figure 2.2.45: Corner crack case CC16

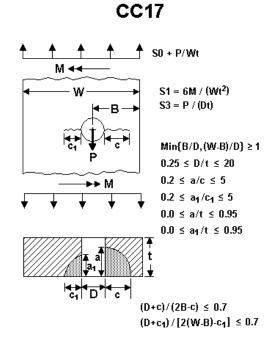


Figure 2.2.46: Corner crack case CC17

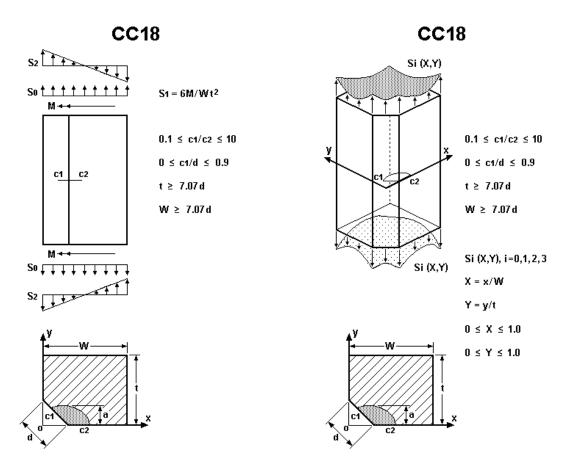
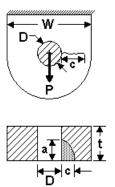
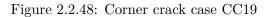


Figure 2.2.47: Corner crack case CC18

CC19



19	CC19	
S₃= P/Dt	► W →	S₃= P/Dt
0.1 ≤ D/2t ≤ 10		$0.1 \leq D/2t \leq 10$
1.25 ≤ W/D ≤ 10		1.25 ≤ W/D ≤ 10
$0 \le c/(W-D) \le 0.45$		$0 \le c/(W-D) \le 0.45$
a/c ≥ 0.1		a/c ≥ 0.1
$0 \leq a/t \leq 0.9$	─>>< <u>+</u> →< D	0 ≤ a/t ≤ 0.9



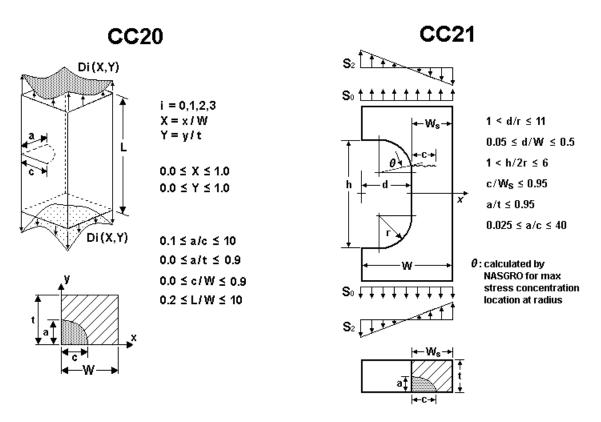


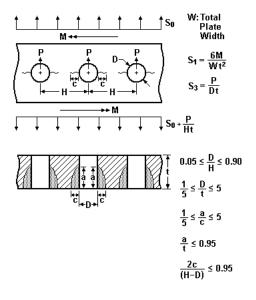
Figure 2.2.49: Corner crack cases CC20 and CC21

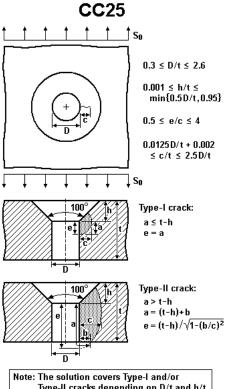
CC22

S₂ S₀ t $1 \leq d/2r \leq 11$ v в $0.05 \le d/2B \le 0.5$ ы w. $1 \le h/2r \le 6$ $0.1 \le 2B/W \le 1$ Y $0.1 \le d/(2t) \le 10.0$ a/c ≥ 0.1 $c/W_S \leq 0.9$ a/t ≤ 0.95 S₀ S_2 **8: calculated by** NASGRO for max stress concentration location at radius **CC23 CC23** $S_3 = P/Dt$ S3 = P/Dtн н $0.1 \le D/2t \le 10$ $0.1 \le D/2t \le 10$ $1.25 \le 2R/D \le 10$ $1.25 \le 2R/D \le 10$ $1 \leq H/2R \leq 2$ $1 \leq H/2R \leq 2$ $0^{\circ} \le \phi \le 90^{\circ}$ $0^{\circ} \leq \phi \leq 90^{\circ}$ Ρ Р $0^{\circ} \leq \theta \leq 90^{\circ}$ $0^{\circ} < \theta \le 90^{\circ}$ a/c ≥ 0.1 a/c ≥ 0.1 $0 \leq a/t \leq 0.9$ $0 \leq a/t \leq 0.9$ $0 \leq c/L_C \leq 0.9$ $c \leq \min\left(0.9\,L_C,\,R\text{-}D/2\right)$ n n Notes: Ø, Lc are computed by NASGRO for Notes: 🖞, Lc are computed by NASGRO for maximum stress concentration location maximum stress concentration location at the pin hole. at the pin hole. Section cut is aligned with the crack Section cut is aligned with the crack angle (ψ), which is not necessarily angle (ψ), which is not necessarily normal to the loading direction. normal to the loading direction.

Figure 2.2.50: Corner crack cases CC22 and CC23







Type-II cracks depending on D/t and h/t.

CC26

CC26

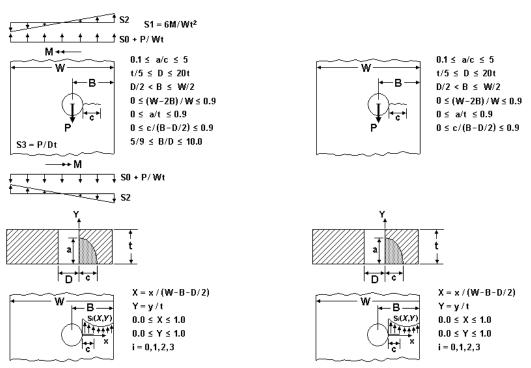
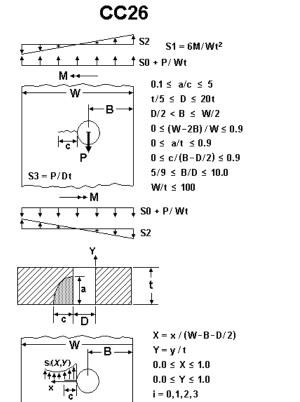
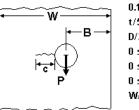
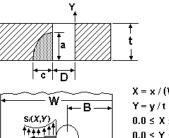


Figure 2.2.51: Corner crack cases CC24, CC25, and CC26



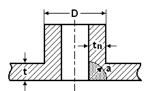
CC26





$$\begin{split} X &= x / (W - B - D / 2) \\ Y &= y / t \\ 0.0 &\leq X \leq 1.0 \\ 0.0 &\leq Y \leq 1.0 \\ i &= 0, 1, 2, 3 \end{split}$$

CC27



S0: internal pressure for cylindrical and spherical shell configurations, or nominal membrane stress for plate configuration ktn: theoretical stress concentration factor

CC28

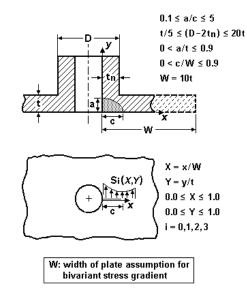


Figure 2.2.52: Corner crack cases CC26 (cont), CC27 and CC28

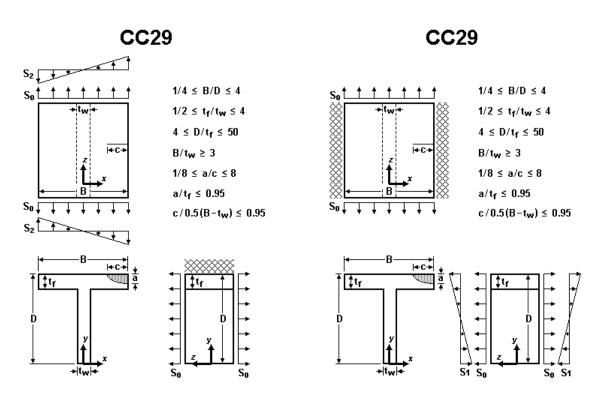


Figure 2.2.53: Corner crack case CC29

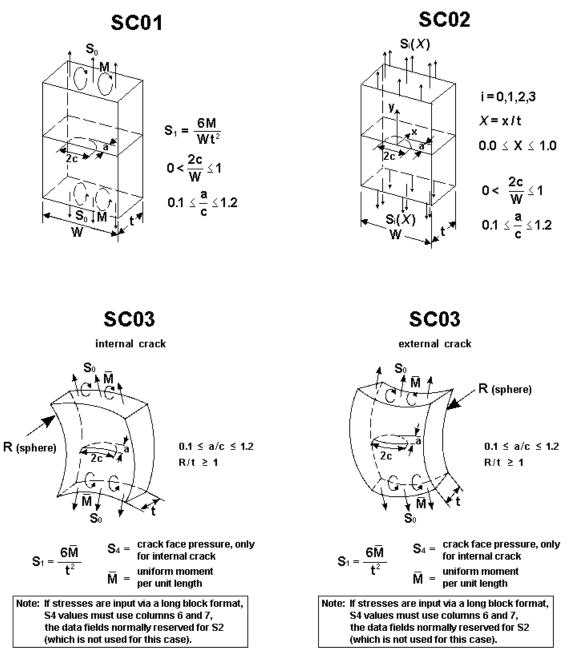


Figure 2.2.54: Surface crack cases SC01, SC02, and SC03

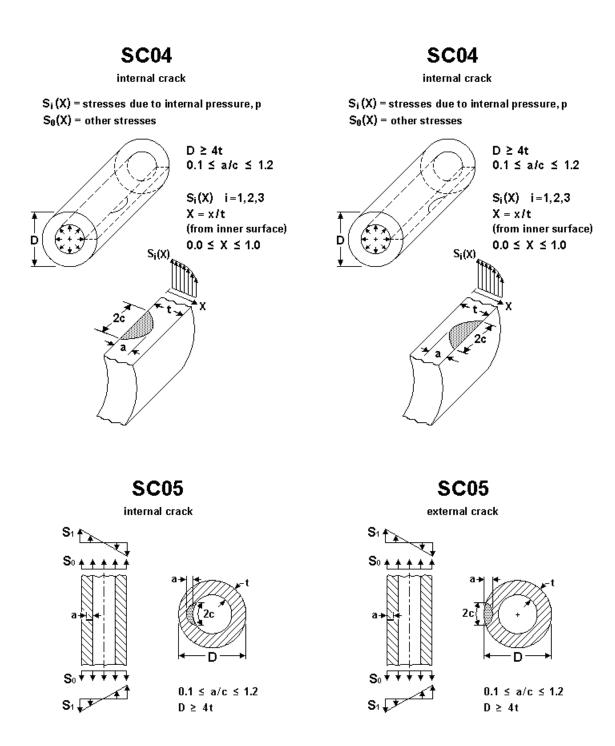


Figure 2.2.55: Surface crack cases SC04 and SC05

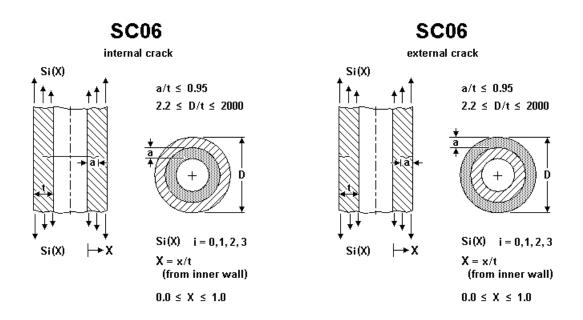


Figure 2.2.56: Surface crack case SC06

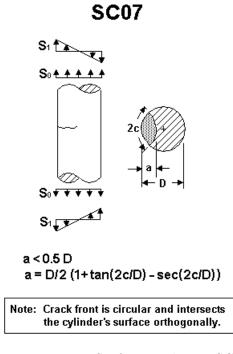


Figure 2.2.57: Surface crack case SC07

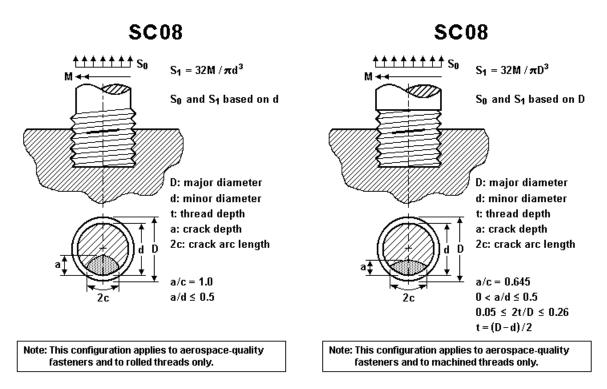


Figure 2.2.58: Surface crack case SC08

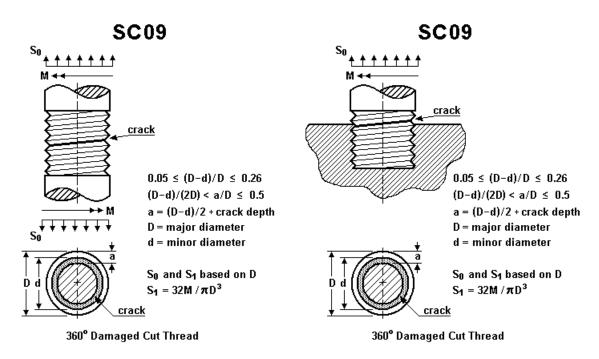


Figure 2.2.59: Surface crack case SC09

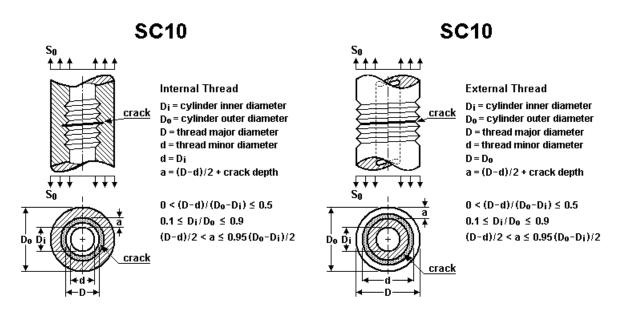


Figure 2.2.60: Surface crack case SC10

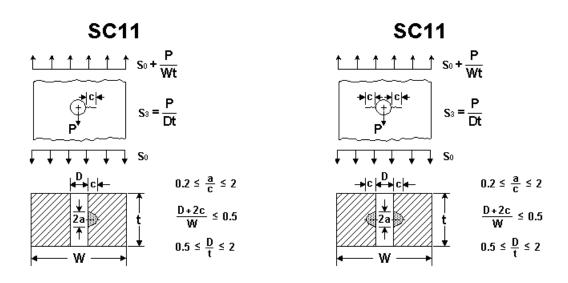
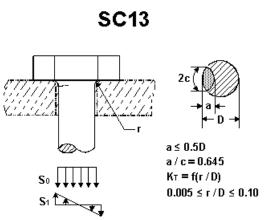


Figure 2.2.61: Surface crack case SC11



Shear or Machine Bolt - Machined Fillet

Figure 2.2.62: Surface crack case SC13

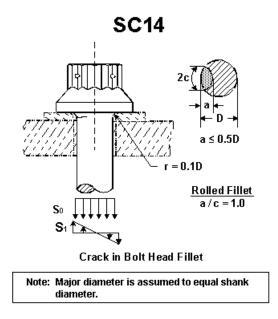
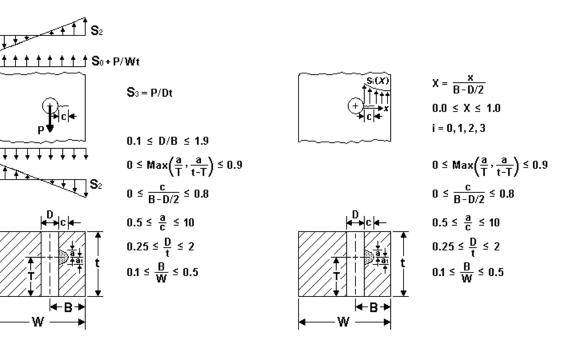


Figure 2.2.63: Surface crack case SC14





SC18

SC18

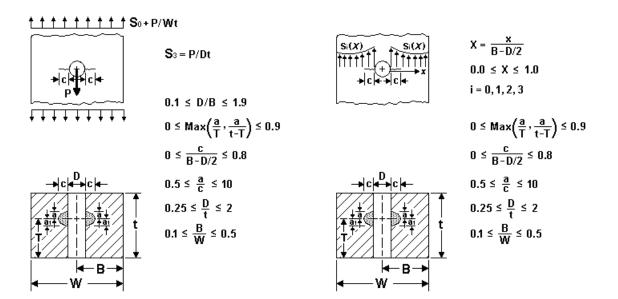


Figure 2.2.64: Surface crack case SC18

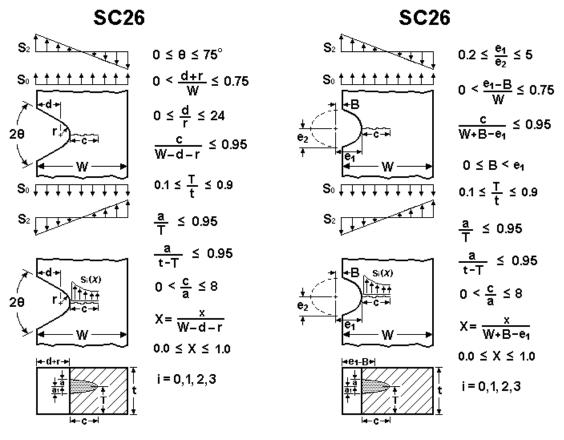
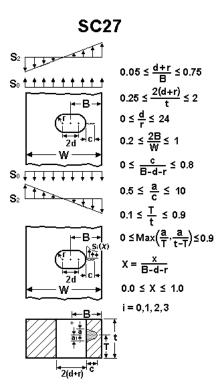
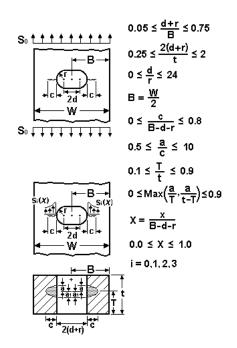


Figure 2.2.65: Surface crack case SC26







SC27

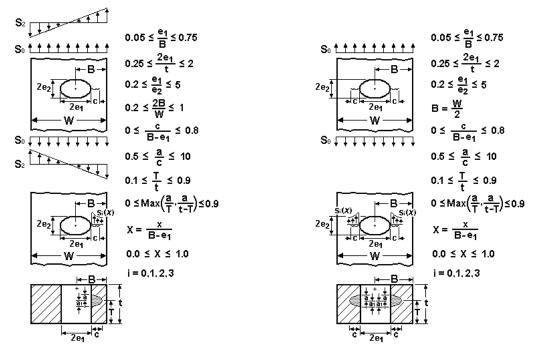


Figure 2.2.66: Surface crack case SC27

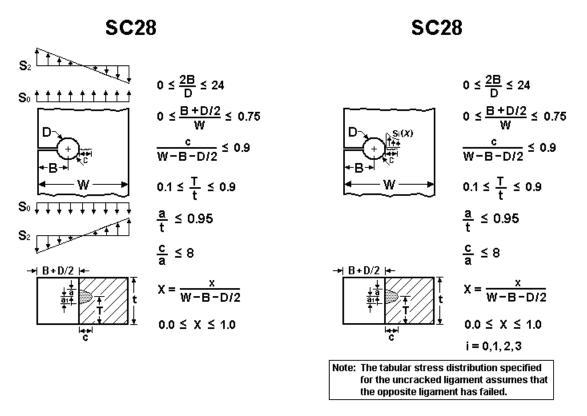


Figure 2.2.67: Surface crack case SC28

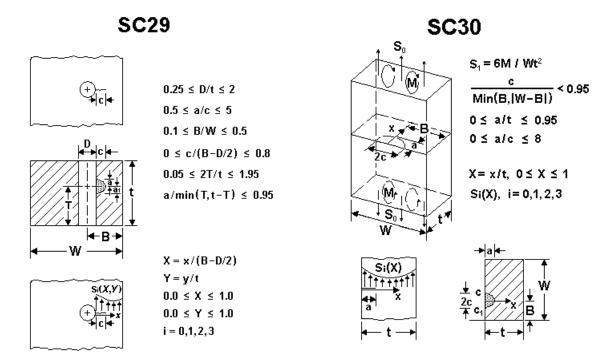


Figure 2.2.68: Surface crack cases SC29 and SC30

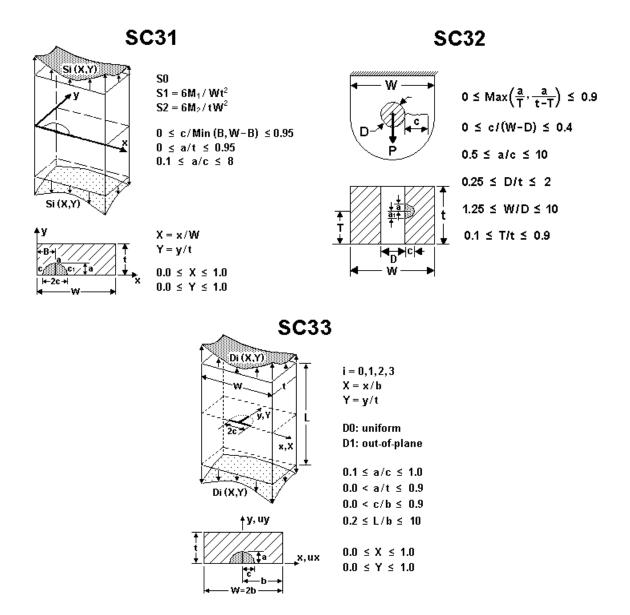


Figure 2.2.69: Surface crack cases SC31, SC32, and SC33

95

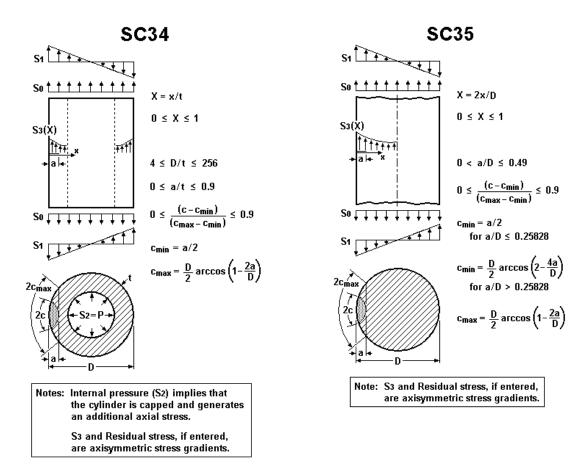


Figure 2.2.70: Surface crack cases SC34 and SC35

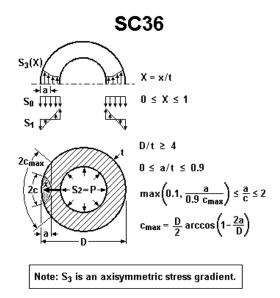
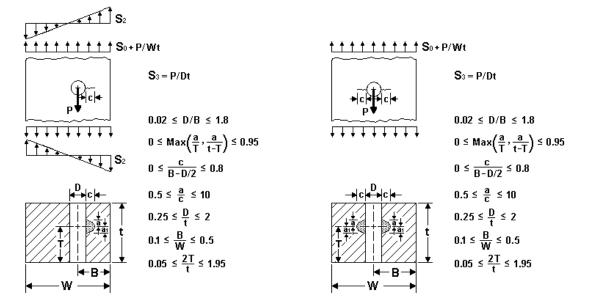


Figure 2.2.71: Surface crack case SC36





SC37



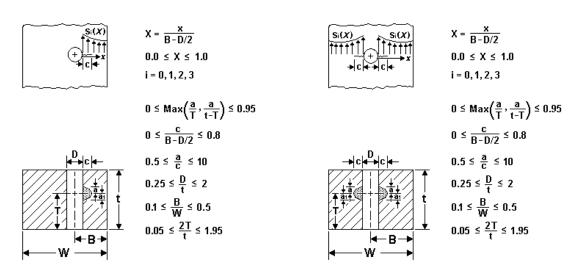
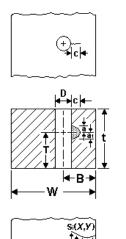
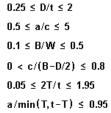


Figure 2.2.72: Surface crack case SC37







X = x/(B-D/2) Y = y/t $0.0 \le X \le 1.0$ $0.0 \le Y \le 1.0$

i = 0,1,2,3

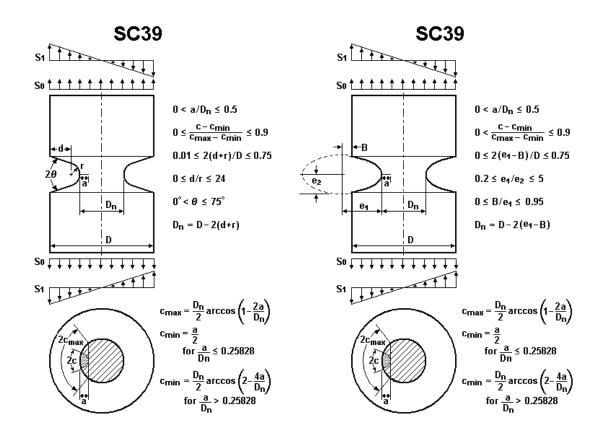


Figure 2.2.73: Surface crack cases SC38 and SC39

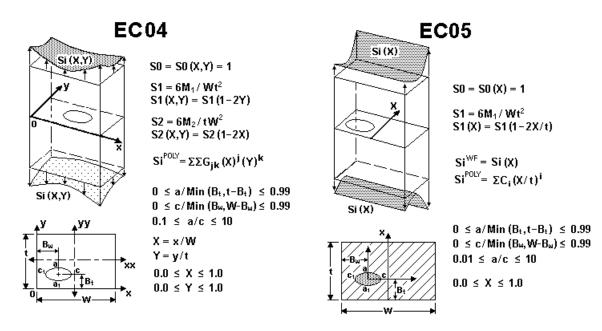


Figure 2.2.74: Embedded crack cases EC04 and EC05 $\,$

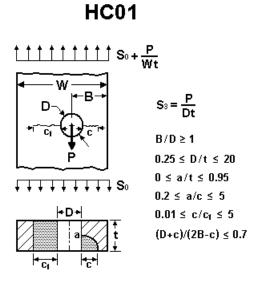
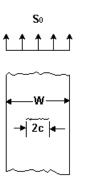


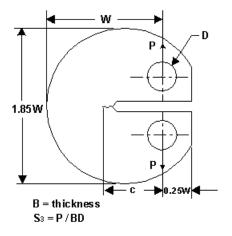
Figure 2.2.75: Hybrid crack case HC01



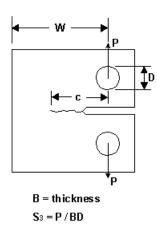


50

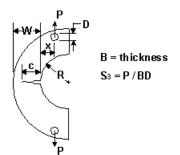




SS02



SS04



SS05

SS06

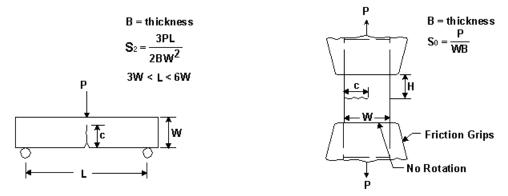
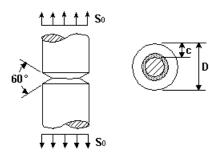
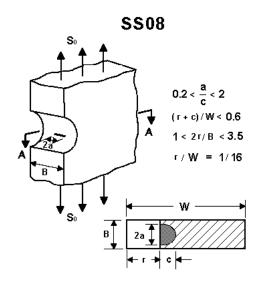


Figure 2.2.76: Standard specimen crack cases SS01, SS02, SS03, SS04, SS05, and SS06

SS07





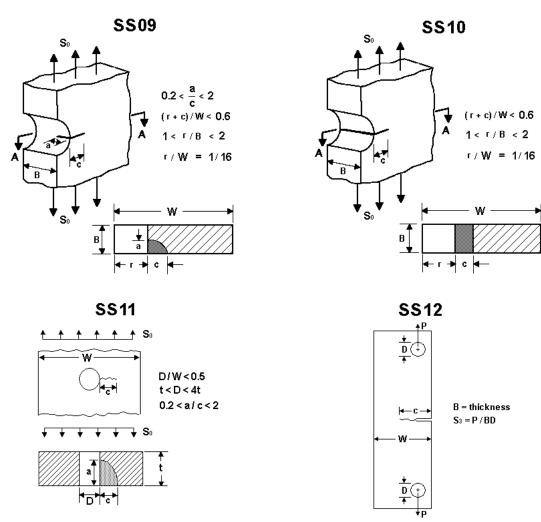


Figure 2.2.77: Standard specimen crack cases SS07, SS08, SS09, SS10, SS11, and SS12

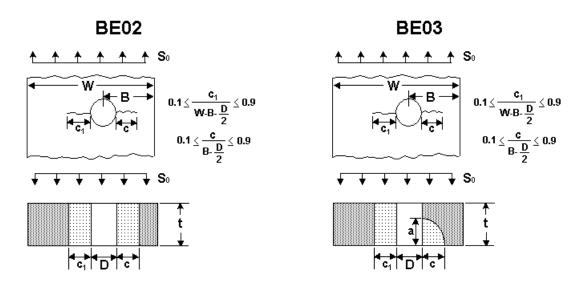


Figure 2.2.78: Boundary element crack cases BE02 and BE03