APPENDIX E

COMPARISON OF DANISH CODE AND JAKY EQUATIONS FOR AT-REST COEFFICIENT WITH COULOMB COEFFICIENT FOUND USING REDUCED SHEAR STRENGTH PARAMETER ϕ_d

$$\phi_d = \tan^{-1}\left(\frac{2}{3}\tan\phi\right)$$

Jaky, Equation 3-4 Danish Code, Equation 3-6 Coulomb, Equation 3-14

Table E-1

At-Rest Earth Pressure Coefficients for Comparison of Coulomb's Equation with an SMF of 2/3 to the Danish Code and Jaky Equations

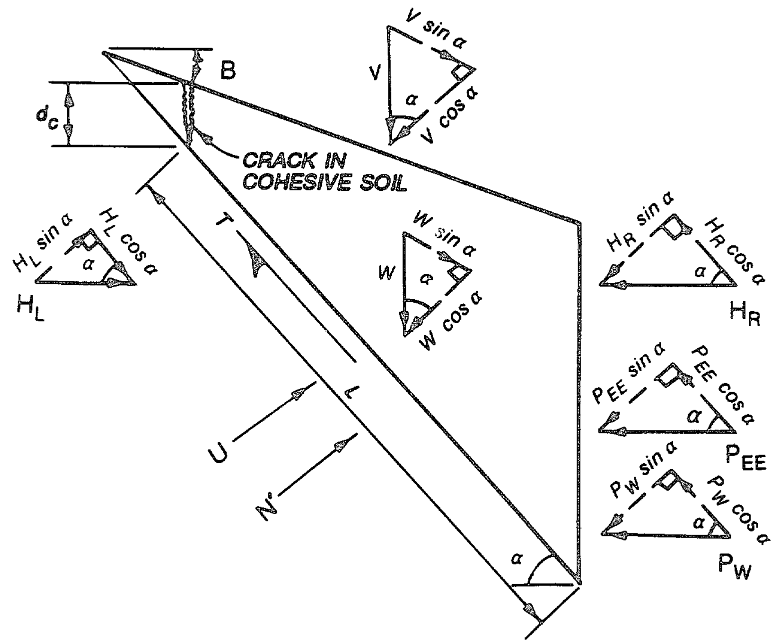
		Horizontal Backfill		Inclined Backfill							
				$\beta = -10°$		$\beta = 0°$		$\beta = 10°$		$\beta = 20°$	
ϕ (deg)	ϕ (rad)	K_o (Jaky)	K_o (SMF = 2/3)	$K_{o\beta}$ (Danish)	K_o (SMF = 2/3)	$K_{o\beta}$ (Danish)	K_o (SMF = 2/3)	$K_{o\beta}$ (Danish)	K_o (SMF = 2/3)	$K_{o\beta}$ (Danish)	K_o (SMF = 2/3)
10	0.175	0.826	0.791	0.683	0.703	0.826	0.791	0.970			
11	0.192	0.809	0.772	0.669	0.686	0.809	0.772	0.950			
12	0.209	0.792	0.754	0.655	0.669	0.792	0.754	0.930			
13	0.227	0.775	0.736	0.640	0.653	0.775	0.736	0.910			
14	0.244	0.758	0.718	0.626	0.638	0.758	0.718	0.890			
15	0.262	0.741	0.701	0.612	0.622	0.741	0.701	0.870	0.931		
16	0.279	0.724	0.684	0.599	0.607	0.724	0.684	0.850	0.871		
17	0.297	0.708	0.667	0.585	0.593	0.708	0.667	0.831	0.833		
18	0.314	0.691	0.651	0.571	0.578	0.691	0.651	0.811	0.802		
19	0.332	0.674	0.634	0.557	0.564	0.674	0.634	0.792	0.774		
20	0.349	0.658	0.618	0.544	0.550	0.658	0.618	0.772	0.748	0.883	
21	0.367	0.642	0.603	0.530	0.537	0.642	0.603	0.753	0.724	0.861	
22	0.384	0.625	0.587	0.517	0.523	0.625	0.587	0.734	0.702	0.839	
23	0.401	0.609	0.572	0.503	0.510	0.609	0.572	0.715	0.680	0.818	
24	0.419	0.593	0.557	0.490	0.497	0.593	0.557	0.696	0.659	0.796	
25	0.436	0.577	0.542	0.477	0.485	0.577	0.542	0.678	0.638	0.775	
26	0.454	0.562	0.528	0.464	0.472	0.562	0.528	0.659	0.619	0.754	
27	0.471	0.546	0.513	0.451	0.460	0.546	0.513	0.641	0.599	0.733	
28	0.489	0.531	0.499	0.438	0.448	0.531	0.499	0.623	0.581	0.712	
29	0.506	0.515	0.485	0.426	0.436	0.515	0.485	0.605	0.563	0.691	0.809
30	0.524	0.500	0.471	0.413	0.424	0.500	0.471	0.587	0.545	0.671	0.742
31	0.541	0.485	0.458	0.401	0.412	0.485	0.458	0.569	0.527	0.651	0.696
32	0.559	0.470	0.445	0.388	0.400	0.470	0.445	0.552	0.510	0.631	0.660
33	0.576	0.455	0.431	0.376	0.389	0.455	0.431	0.534	0.494	0.611	0.627
34	0.593	0.441	0.418	0.364	0.378	0.441	0.418	0.517	0.478	0.592	0.598
35	0.611	0.426	0.405	0.352	0.367	0.426	0.405	0.500	0.462	0.572	0.572
36	0.628	0.412	0.393	0.341	0.356	0.412	0.393	0.484	0.446	0.553	0.547
37	0.646	0.398	0.380	0.329	0.345	0.398	0.380	0.467	0.431	0.534	0.523
38	0.663	0.384	0.368	0.318	0.334	0.384	0.368	0.451	0.416	0.516	0.501
39	0.681	0.371	0.356	0.306	0.323	0.371	0.356	0.435	0.401	0.497	0.479
40	0.698	0.357	0.344	0.295	0.313	0.357	0.344	0.419	0.386	0.479	0.459
41	0.716	0.344	0.332	0.284	0.303	0.344	0.332	0.404	0.372	0.462	0.439
42	0.733	0.331	0.320	0.273	0.292	0.331	0.320	0.388	0.358	0.444	0.420
43	0.750	0.318	0.309	0.263	0.282	0.318	0.309	0.373	0.345	0.427	0.402
44	0.768	0.305	0.298	0.252	0.272	0.305	0.298	0.358	0.331	0.410	0.384
45	0.785	0.293	0.286	0.242	0.263	0.293	0.286	0.344	0.318	0.393	0.367

Note: A blank entry in the table denotes where $\beta > \phi_d$.

APPENDIX F

DERIVATION OF GENERAL WEDGE EQUATION FOR SINGLE WEDGE ANALYSIS (EQUATION 3-23)

F-1. Effective horizontal earth force. Given the following driving wedge, an equation for P_{EE} , the effective horizontal earth force, will be derived.



Summing forces normal to the slip plane yields,

$$H_L \sin\alpha + U + N' - V\cos\alpha - H_R \sin\alpha - P_{EE}\sin\alpha - P_W \sin\alpha - W\cos\alpha = 0$$

Solving for N' yields,

$$N' = (-H_L + H_R + P_{EE} + P_W)\sin\alpha - U + (V + W)\cos\alpha \qquad [F-1]$$

According to the Mohr-Coulomb failure criterion,

$$T = N' \tan\phi + cL \qquad [F-2]$$

Inserting Equation F-1 into Equation F-2 yields,

$$T = \left[(-H_L + H_R + P_{EE} + P_W) \sin \alpha - U + (V + W) \cos \alpha \right] \tan \phi + cL$$

Setting the summation of forces parallel to the slip plane equal to zero yields

$$H_L \cos \alpha + V \sin \alpha + W \sin \alpha - H_R \cos \alpha - P_{EE} \cos \alpha - P_W \cos \alpha - T = 0 \quad \text{[F-3]}$$

Solving for T from Equation F-3 and substituting this expression into Equation F-2 yields,

$$(H_L - H_R - P_{EE} - P_W) \cos \alpha + (V + W) \sin \alpha$$

$$+ \Big[(H_L - H_R - P_{EE} - P_W) \sin \alpha + U - (V + W) \cos \alpha \Big] \tan \phi - cL = 0$$

Simplifying and solving for P_{EE} yields,

$$P_{EE} = (V + W) \frac{(\sin \alpha - \cos \alpha \tan \phi)}{(\cos \alpha + \sin \alpha \tan \phi)} + \frac{U \tan \phi - cL}{\cos \alpha + \sin \alpha \tan \phi} + H_L - H_R - P_W$$

$$P_{EE} = (V + W) \frac{(1 - \cot \alpha \tan \phi) \tan \alpha}{(1 + \tan \alpha \tan \phi)} + \frac{U \tan \phi - cL}{(1 + \tan \alpha \tan \phi) \cos \alpha}$$

$$+ H_L - H_R - P_W \quad \text{[F-4]}$$

F-2. <u>Soil parameters</u>. For a particular SMF , the corresponding factored parameters ϕ_d and c_d can be inserted into Equation F-4 to yield soil

$$P_{EE} = (V + W) \frac{(1 - \cot \alpha \tan \phi_d) \tan \alpha}{(1 + \tan \alpha \tan \phi_d)} + \frac{U \tan \phi_d - c_d L}{(1 + \tan \alpha \tan \phi_d) \cos \alpha}$$

$$+ H_L - H_R - P_W$$

F-3. <u>Resisting wedge</u>. The same procedure can be applied to a resisting wedge to yield the following equation for P_{EE} .

$$P_{EE} = (W + V)\,\frac{(1 + \tan\phi_d \cot\alpha)\tan\alpha}{(1 - \tan\phi_d \tan\alpha)} - \frac{U\tan\phi_d - c_d L}{\cos\alpha\,(1 - \tan\phi_d \tan\alpha)} - H_L + H_R - P_W$$

If more than one driving or resisting wedge exists, the value of P_{EE} will equal the difference of the earth forces applied to the wedge.