Sheet Piling Design Calculation ("SHTPILE")

Description: "SHTPILE" (meaning "sheet pile") designs cantilever or tied-back sheet piling. It is really two programs in one, because it has two optional methods of design: (1) The "Classical" method, an established method based on empirical theories and (2) the "Finite Element Method", a newer method which models the soil using the concept of a subgrade modulus. It is recommended that the designer first design the sheet piling using the Classical Method, then check the design using the Finite Element Method.

The program is adaptable to a variety of conditions, with or without tie-backs. Care should be exercised to enter accurate soil and loading conditions. The designer must exercise engineering judgement and poise a variety of possibilities:

Can the soil be overdredged?; In the case of clay, how long will the sheetpiling be in place (too long and the cohesion of clay wil be diminished to zero)?; Will the water table fluctuated? How accurate are soil parameters?

The program makes it possible to quickly investigate a whole scenario of possibilities. It is best to be prudent with this type of structure; as the saying goes "When in doubt, make it stout". However, undue conservatism will lead to uneconomical designs, therefore the designer must try to be as realistic as possible when inputting soil parameters.

One word of note: The program does not design the tie-back, except for indicating the design force. The designer must properly locate the anchor a sufficient distance to prevent failure.

Theory: The "Classical" Method is based on theories presented in the U.S. Steel publication "Steel Sheet Piling Design Manual", although the same theories are available in almost all geotechnical textbooks. The program output describes in detail the method. The main question the designer must ask is whether to use Rankine or Coloumb theory to calculate pressures. It appears that Coloumb theory leads to more economical designs and the method is more popular with experienced designers. The program does not use Rowes method of moment reduction, but the designer can apply this method later if necessary.

The Finite Element Method models the soil using the concept of subgrade modulus. The procedure is based on a method described by J.E. Bowles, "Foundation Engineering and Design", 1988, and the publication is recommended reading. Soil pressures above the dredge line are based on Rankine theory.

Many structural engineers working on sheet pile design are not experts in the geotechnical field, and the author urges that they review fundamental soil mechanics when designing a structural of this type. In the program author's opinion, soil is not an "engineered" material - we are stuck with whatever soil we have, whose strength characteristics are largely unknown or of limited precision. Knowing this, the engineer should be forewarned that the Finite Element Method probably does not give the exact answer, but an answer that is close, say within 10%. The Finite Element Method used for sheet piling is the most rational and scientific approach, but many engineers are unfamiliar with this method and view it with apprehension.

Description of soil types (adapated from "Foundation Design", by Wayne Teng, 1962):

Granular Soil Table

	Very Loose	Loose	Medium	Dense	Very Dense
Standard Penetration N=Blows/ft	4	10	30	50	
Phi (degrees)	28	30	36	41	
Unit weight, pcf					
moist	<100	95-125	110-130	110-140	>130
saturated	<122	117-127	122-132	127-147	>137

Cohesive Soil Table

	Very Soft	Soft	Medium	Stiff	Very Stiff	Hard
qu (ksf)	.5	1	2	4	8	
N=Blows/ft	2	4	8	16	32	
Unit weight, pcf						
saturated	100-120		110-130	120-140		130+