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EXPERT SYSTEM FOR SOIL SLOPE STABILITY ANALYSIS

[illegible]

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[illegible]

[illegible] 15 [illegible] 800 [illegible] USCS [illegible] Expert shell [illegible] RAISON [illegible]

ABSTRACT: Soil slope stability analysis requires understanding and the more than 15 internal and external factors may effect the slope failure. There is a need to have the specialize in geotechnical engineering, so the expert system for soil slope stability analysis is wanted to help the civil engineer in analysis. In this paper, it is to build the expert system concerning the internal factors. The system is to give the guideline for slope failure type, including the stability status of soil slope, the strength of soil as classified in the USCS and the Bangkok Clay characteristic, including the seismic intensity of area in Thailand. The stability status is determined from the analysis on the more than 800 sections of soil slope. The system is operated by the way of the expert shell program named RAISON, which represents the knowledge in the production rule based type. Later development on the system will be done to improve the communication between the user and the system by linking the system to the two parts. Those are database for landslide in Thailand and program for slope stability analysis. The system is therefore to improve the slope stability analysis. And also, the standard design for earth slope will be improved and the landslide case will be reduced after the publication is done.

KEYWORDS: Expert system, Soil slope stability analysis, Production rule based type

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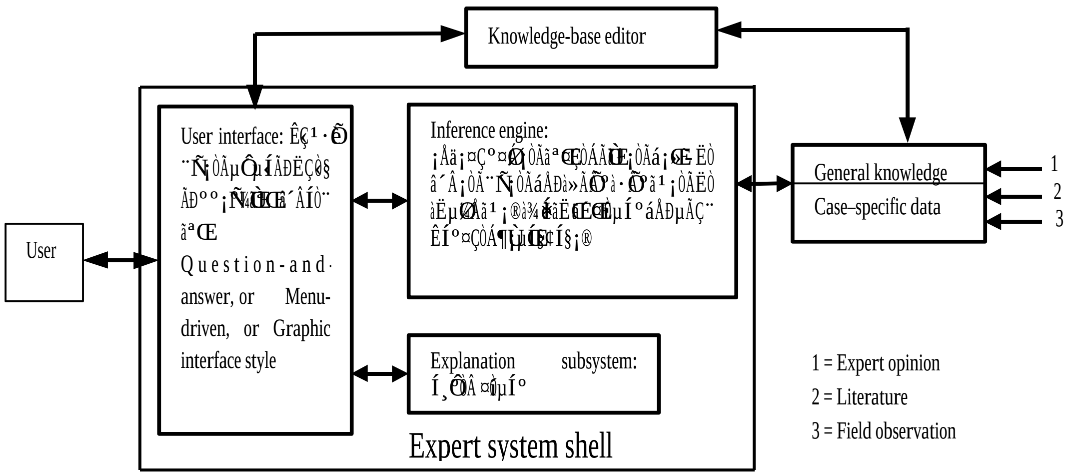
1. º·¹Ó

ã¹ËÅÒÂ¡Ã³ÕÍ§¤ìÃÇÁ¤ÇÒÁÃÙé ¤ÇÒÁàªÕèÂÇªÒ¢Í§¼Ùé·Õè¶Ù¡ÁÍºËÁÒÂ§Ò¹ã¹ÅÑ¡É³Ðà©¾ÒÐ »ÃÐÊº¡ÒÃ³ì áµè¡çÁÕ¤ÇÒÁÊÓ¤ÑÞµèÍ¡ÒÃ´Óà¹Ô¹§Ò¹ ã¹»ÃÐà·Èä·Â ¡ÒÃà¡çº¢éÍÁÙÅ¢Í§¼ÙéàªÕèÂÇªÒ ·Õè»ÃÐÊº¡ÒÃ³ì ÁÕ»ÃÐÁÒ³ 1,000 ÅéÒ¹ºÒ· ã¹¡ÒÃ á¡éä¢»ÑËÒ ... ËÅÒÂ¡Ã³Õ ... 80% ã¹µèÒ§ »ÃÐà·È ...

2. §Ò¹ÇÔ¨ÑÂ·Õèà¡ÕèÂÇ¢éÍ§

ÃÐººÙéàªÕèÂÇªÒ à»ç¹â»Ãá¡ÃÁ¤ÍÁ¾ÔÇàµÍÃì ... »ÃÐ¡Íº´éÇÂÊèÇ¹ËÅÑ¡ 2 ÊèÇ¹ ¤×Í °Ò¹¤ÇÒÁÃÙé (Knowledge base) áÅÐà»Å×Í¡ÃÐººÙéàªÕèÂÇªÒ (Expert system shell) ´Ñ§áÊ´§ã¹ÃÙ»·Õè 1 «Öè§¨Ð¡ÅèÒÇ¶Ö§ ... ÃÐººÙéàªÕèÂÇªÒ ...



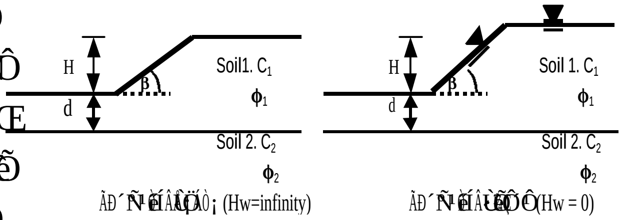
ÃÙ»·Õè 1 â¤Ã§ÊÃéÒ§¢Í§ÃÐººÙéàªÕèÂÇªÒ

¡ÒÃ¹ÓàÍÒÃÐºº¼ÙéàªÕèÂÇªÒ–ÁÒ»ÃÐÂØ¡µìãªé¡ÑºÃÐºº¡ÒÃÊ¹Ñº Ê¹Ø¹¡ÒÃµÑ´ÊÔ¹ã¨ã¹§Ò¹´éÒ¹¡ÒÃÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´ ÁÕÁÒ¡ÇèÒ 10 »Õ áÅéÇ â´Â·Õè§Ò¹ÇÔ¨ÑÂã¹ÂØ¤áÃ¡æ ¨ÐÁØè§à¹é¹¡ÒÃ¾Ñ²¹ÒÃÐºº¼ÙéàªÕèÂÇªÒ–·Õè¤Ó¹Ç³¤èÒÍÑµÃÒÊèÇ¹»ÅÍ´ÀÑÂâ´Â¤Ó¹Ç³ â»Ãá¡ÃÁ XPENT ã¹»ÃÐà·È½ÃÑè§àÈÊ ¨Ñ´·Óâ´Â Faure áÅÐ¤³Ð [1] à»ç¹ÃÐºº¼ÙéàªÕèÂÇªÒ–·Õè¹ÓÁÒª èÇÂ¾ÔÊÙ¨¹ì¼Å¡ÒÃÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹ â´Â¤Ó¹Ç³¼Å¡ÒÃ¤Ó¹Ç³¢Í§¡ÒÃ¾Ñ§·ÅÒÂ¢Í§ÅÒ´´Ô¹ áÅÐÃÐºº Knowledge-based approach to slope stability analysis ã¹»ÃÐà·ÈÁÒàÅà«ÕÂ ¨Ñ´·Óâ´Â Z’Aba [2] à»ç¹ÃÐºº¼ÙéàªÕèÂÇªÒ–·Õè¾Ñ²¹Ò¢Öé¹à¾×èÍ¡ÒÃÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´à»ç¹µé¹

3. á¹Ç¤Ô´¢Í§¡ÒÃÊÃéÒ§°Ò¹¤ÇÒÁÃÙé¢Í§ÃÐºº¼ÙéàªÕèÂÇªÒ–à¾×èÍ¡ÒÃÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹

°Ò¹¤ÇÒÁÃÙéà»ç¹ÊèÇ¹»ÃÐ¡Íº·ÕèÊÓ¤ÑÞ·ÕèÊØ´¢Í§ÃÐºº¼ÙéàªÕèÂÇªÒ– à¹×èÍ§¨Ò¡ÃÐºº¨Ð·Ó§Ò¹ä´é´Õ ËÃ×Í äÁè¢Öé¹ÍÂÙè¡Ñº»ÃÔÁÒ³¤ÇÒÁÃÙé áÅÐ¤Ø³ÀÒ¾¢Í§°Ò¹¤ÇÒÁÃÙé ´Ñ§¹Ñé¹¡ÒÃÃÇºÃÇÁ¤ÇÒÁÃÙé¨Ò¡¼ÙéàªÕèÂÇªÒ¨Ö§à»ç¹¢Ñé¹µÍ¹·ÕèÊÓ¤ÑÞ ã¹°Ò¹¤ÇÒÁÃÙé¢Í§ÃÐºº¼ÙéàªÕèÂÇªÒ–à¾×èÍ¡ÒÃÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹ ÁÕ¢éÍÁÙÅ·Õè¨Ðµéͧ¾Ô¨ÒÃ³Ò à¾×èÍ¹ÓÁÒ¡Ó˹´ÊÀÒ¾¤ÇÒÁà»ç¹¨ÃÔ§¢Í§¡ÒÃÇÔà¤ÃÒÐËì·Ò§´éÒ¹µèÒ§æ ´Ñ§ÃÙ»·Õè 2 °Ò¹¤ÇÒÁÃÙé

1. à¾×èÍÇÔà¤ÃÒÐËì¼Å¡ÒÃÇÔàÅ×èÍ¹µÑÇ¢Í§ÅÒ´´Ô¹ ¨Ðµéͧ¾Ô¨ÒÃ³Ò¼Å¢Í§¹éÓã µé´Ô¹ à¾×èÍ¨ÐÁÕ¼Åµè͵¹ÂÑº¢Í§´Ô¹ ¢Í§Ë¹èÇÂ¹éÓË¹Ñ¡¢Í§´Ô¹ áÅÐáç´Ñ¹¹éÓã¹ªèÍ§ÇèÒ§ ´Ô¹ «Öè§¨Ð·ÓãËéä´é¼Å¡ÒÃÇÔà¤ÃÒÐËì·Õè ãËé¼ÅÃÐ´Ñº¤ÇÒÁàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹ â´ÂÁÕÃÙ»áºº¢Í§ÅÒ´´Ô¹·Õèãªé



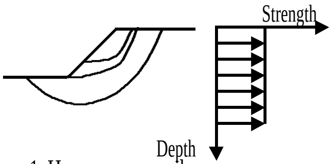
ÃÙ»·Õè 2 ÃÙ»áºº¢Í§ÅÒ´´Ô¹·Õèãªé ÃÐºº

ÃÐºº´Ñ§áÊ´§ã¹ÃÙ»·Õè 2 àÁ×èÍÃÙ»áºº¡ÒÃà¤Å×èÍ¹¾Ñ§¢Í§ÅÒ´´Ô¹ÁÕ¤ÇÒÁá µ¡µèÒ§¡Ñ¹ 3 ÃÙ»áºº¤×Í Homogeneous soil, Nonhomogeneous soil - strength varies with depth, áÅÐ Stratified soil ´Ñ§áÊ´§ã¹ÃÙ»·Õè 3

2. à¾×èÍµÃÇ¨ÊÍºã¹¡ÒÃàÅ×Í¡ãªé¤ÇÒÁá¢ç§áÃ§¢Í§´Ô¹ «Öè§¨ÐÍéÒ§ÍÔ§¨Ò¡ÃÐºº USCS áÅÐ¡ÒÃ¨Ó á¹¡¢Í§´Ô¹àË¹ÕÂÇ¡ÃØ§à·¾ (Bangkok clay) «Öè§¨Ðä´éãªé¡ÒÃÇÔàà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹ã¹ÊÀÒ¾·Õè ¤ÇÒÁ´Ñ¹ ¹éÓ¤ÒÃÒ§ÊÙ§ÊØ´áÅÐ¤ÇÒÁ´Ñ¹¹éÓ¤ÒÃÒ§µèÓÊØ´ â´Âáº§à»ç¹ 2 ¡ÅØèÁ ¡ÅØèÁáÃ¡¤×Í·Õè¤ÇÒÁ´Ñ¹¹éÓ¤ÒÃÒ§ÊÙ§ ÊØ´¨ÐÁÕ¡ÒÃ¨Óá¹¡ ÃÐ´Ñº¢Í§ªÑé¹´Ô¹ à»ç¹ªÑé¹´Ô¹àË¹ÕÂÇ¡ÃØ§à·¾ «Öè§ÁÕ¤èÒ Undrained shear strength à»ç¹ä»µÒÁÊÁ¡ÒÃ¢Í§ SHANSEP ·Õèä´é ¤ÇÒÁá¢ç§áÃ§äÁè§·Õè¤ÇÒÁÅÖ¡ áÅÐ¡ÅØèÁ·Õè Ê Í§ ¤×Í «Öè§¨ÐµéÍ§ª ¤ÇÒÁá¢ç§áÃ§¢Í§´Ô¹µèÍ »ÃÐàÀ· áÅÐá¹Ç¡ÒÃÁÕ¤èÒ¤ÇÒÁàÊ¶ÕÂÃ ¢Í§á¼è¹´Ô¹äËÇà»ç¹¤èÒ Coefficient of earthquake (A) àÁ×èÍ¾Ô¨ÒÃ³Ò¨Ò¡ µÓáË¹è§¢Í§¾×é¹·Õè»ÃÐà·Èä·Â·Õè¨ÐÁÕ¼ÅµèÍ

áËÅè§¢Í§¤ÇÒÁÃÙé·Õèãªé¨Ò¡¡ÒÃÈÖ¡ÉÒ¨Ò¡Ë¹Ñ§Ê×Í àÍ¡ÊÒÃ ºÑ¹·Ö¡¤ÇÒÁ·Ã§¨Ó¢Í§¡ÒÃ ÇÒ§áÅÐ »ÃÐÊº¡ÒÃ³ì ¢Í§¼ÙéàªÕèÂÇªÒ–¨Ò¡¡ÒÃÊÑÁÀÒÉ³ì áÅÐ¢éÍÁÙÅ¨Ò¡ÃÒ¡ÒÃ¨Ò¡¼Å¡ÒÃµÃÇ¨ã¹ÊÀÒ¾¨ÃÔ§¨Ò¡ ÁÒ¡ÇèÒ 50 àÊé¹ ·Ò§ÃÇ§¢Í§¡ÒÃÇÔàà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹¨Ó¹Ç¹ÁÒ¡¡ÇèÒ 800 Ë¹éÒ ·ÓãËéÅÐàÍÕÂ´¢Í§¢éÍÁÙÅ ¤ÇÒÁá¢ç§áÃ§¢Í§´Ô¹ ¢¹Ò´Ë¹èÇÂ¹éÓË¹Ñ¡áÅÐáç´Ñ¹¹éÓ

ºÒ¹¤ÇÒÁÃÙéà¡ÕèÂÇ¡Ñº¡ÒÃà¤Å×è͹¾Ñ§¢Í§ÅÒ´´Ô¹áÅÐÅÒ´ËÔ¹ÃÔÁ¶¹¹ºÃÔàÇ³·Ò§ËÅÇ§



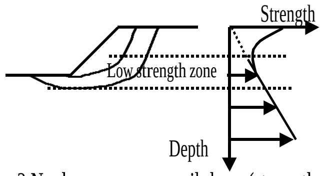
1. Homogeneous soil

Application to: Embankment, Uniform soil layer, Weathered granitic soil

Failure type: Rotational slide

Position of surface failure: base or toe slide for soft to medium stiff clay and plastic silt (ϕ ~0); surface slide for cohesionless soil (c ~ 0); base or toe or slope slide for stiff clay, nonplastic silt, coarse grained soil

Stability status(1): Guideline for stable to unstable slope



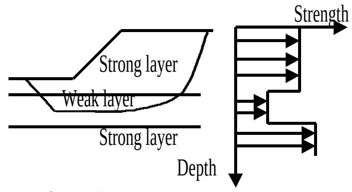
2.Nonhomogeneous soil layer(strength varies with depth)

Application to: Bangkok clay, Chao Phraya delta, Quaternary sediments

Failure type: Rotational slide

Position of surface failure: base or toe slide

Stability status(1): Guideline for stable to unstable slope

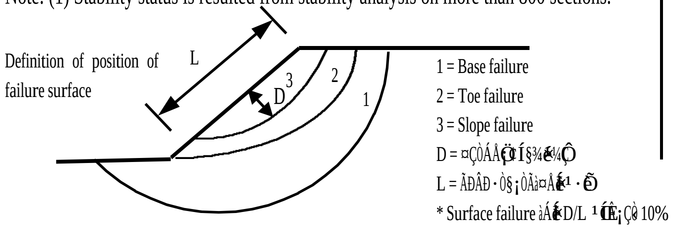


3. Stratified soil layer

Application to: Nonuniform soil layer, Slope underlain by thin layer of very soft clay, Old Alluvial deposit, Weathered sedimentary rock

Failure type: infinite slope or surface rotational slide for upper cohesionless soil layer (c ~ 0); toe to base rotational slide for two or more than two soil layers , with upper soft to medium stiff clay layer (ϕ ~ 0) on firm layer; rotational slide for two or more than two soil layers, with upper soft to medium stiff clay layer (ϕ ~ 0) on weaker layer or stronger layer; rotational slide or translational slide for two soil layer, with upper c - ϕ soil layer, stability analysis must be done

Note: (1) Stability status is resulted from stability analysis on more than 800 sections.



ÃÙ»·Õè 4 á¹Ç¤Ô´¡ÒÃÊÃéÒ§°Ò¹¤ÇÒÁÃÙéà¡ÕèÂÇ¡Ñº¡ÒÃà¤Å×è͹¾Ñ§¢Í§ÅÒ´´Ô¹áÅÐÅÒ´ËÔ¹ÃÔÁ¶¹¹ºÃÔàÇ³·Ò§ËÅÇ§

4. ¡ÒÃÊÃéÒ§ÃÐºº¼ÙéàªèÕÂÇªÒÞ-à¾×èÍ¡ÒÃÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹

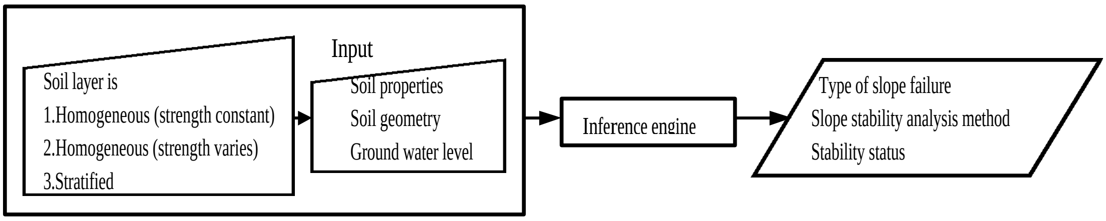
ÃÐºº¶Ù¡¾Ñ²¹Ò¢Öé¹â´ÂãªéExpert system shell ª×èÍ RAISON ªÖè§ã¹¡ÒÃÊÃéÒ§àÁ×èÍ RAISON ·Ó§Ò¹º¹ Windows áÅÐáÊ´§¤ÇÒÁÃÙéáºº Production rule based type ã¹°Ò¹¤ÇÒÁÃÙé§ÃÐºº «Öè§»ÃÐ¡Íº´éÇÂ 2 °Ò¹¤ÇÒÁÃÙé¤×Í °Ò¹¤ÇÒÁÃÙéà¡ÕèÂÇ¡Ñº¡ÒÃà¤Å×è͹¾Ñ§¢Í§ÅÒ´´Ô¹áÅÐÅÒ´ËÔ¹ÃÔÁ¶¹¹ºÃÔàÇ³·Ò§ËÅÇ§ áÅÐ°Ò¹¤ÇÒÁÃÙéà¡ÕèÂÇ¡ÑºµÑÇá»Ã·Õè㪠ã¹¡ÒÃ àÅ×Í¡¤èÒ¤ÇÒÁá¢ç§áÃ§¢Í§´Ô¹ º¹¡ÅØèÁ¢Í§´Ô¹ËÅÑ¡ã¹¡ÃØ§à·¾ áÅÐá¹Ð¹ÓÊÀÒ¾¤ÇÒÁà¢éÁ¢Í§á¼è¹´Ô¹äËÇ µÑÇ ÍÂèÒ§¢Í§¡®áÊ´§ã¹ µÒÃÒ§·Õè

µÒÃÒ§·Õè µÑÇÍÂèÒ§¢Í§¡®ã¹ÃÐºº

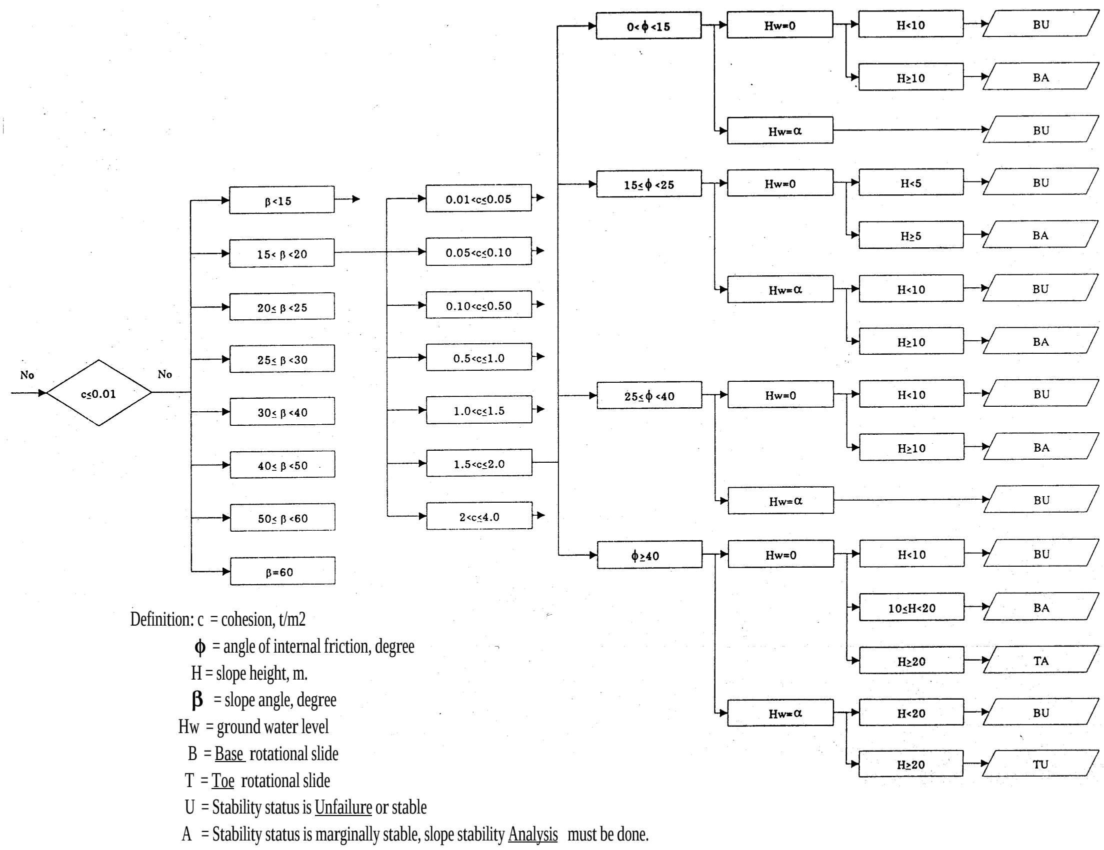
Knowledge base	Condition	Result
KB1	If the soil layer = homogeneous soil layer (strength varies with depth) and beta ≥ 20 and 2 < H ≥ 5,	Then Result = BFX When BFX = Base rotational slide in Bangkok Clay, Failure
KB2	If part = Central part and province = Bangkok,	Then Result = BKKC A = 0 010g to 0 025g When BKKC = Bangkok Clay, A = 0.01g to 0.025g

4.1 °Ò¹¤ÇÒÁÃÙéà¡ÕèÂÇ¡Ñº¡ÒÃà¤Å×è͹¾Ñ§¢Í§ÅÒ´´Ô¹áÅÐÅÒ´ËÔ¹ÃÔÁ¶¹¹ºÃÔàÇ³·Ò§ËÅÇ§ (KB1)

¡ÒÃ¾Ô¨ÒÃ³ÒÅÑ¡É³Ð¡ÒÃà¤Å×è͹¾Ñ§¢Í§ÅÒ´´Ô¹áÅÐÅÒ´ËÔ¹ÃÔÁ¶¹¹ºÃÔàÇ³·Ò§ËÅÇ§ áÊ´§ÍÂèÒ§ÂèÍã¹¡Ò÷´ÊÍº¨Ó¹Ç¹·Ñé§ ËÁ´ 1,083 ¡Ã³Õ â´ÂÁÕ¨Ó¹Ç¹¢Í§¤èÒµÑÇá»Ã¨Ó¹Ç¹ 29 ¤èÒ «Öè§¾ºÇèÒ¨Ó¹Ç¹¢Í§¡ÒÃ»ÃÐàÁÔ¹¼Å¢éÍÁÙÅáÅÐ¨ÓµÑÇ´Ñ§áÊ´§ ã¹ÃÙ»·Õè áÅÐµÑÇÍÂèÒ§¢Í§ Chart áÊ´§àÊé¹ä¢è·Õè¹èÒ áÅÐ¨ÓµÑº¢Í§ Homogeneous soil ¤èÒËÅÑ¡ ¤×Í ¤èÒ c áÅÐ ϕ ÁÒ¡¡ÇèÒ ËÃ×Íà·èÒ¡Ñº



ÃÙ»·Õè 4 ¼Ñ§áÊ´§¡ÒÃä»Ë¢Í§ Input áÅÐ Output ¢Í§°Ò¹¤ÇÒÁÃÙé KB1


No
c≤0.01
No
β<15
15<β<20
20≤β<25
25≤β<30
30≤β<40
40≤β<50
50≤β<60
β=60
0.01<c≤0.05
0.05<c≤0.10
0.10<c≤0.50
0.5<c≤1.0
1.0<c≤1.5
1.5<c≤2.0
2<c≤4.0
0<φ<15
15≤φ<25
25≤φ<40
φ≥40
Hw=0
Hw=α
H<10
H≥10
H<5
H≥5
10≤H<20
H≥20
H<20
BU
BA
TA
TU
Definition: c = cohesion, t/m2
φ = angle of internal friction, degree
H = slope height, m.
β = slope angle, degree
Hw = ground water level
B = Base rotational slide
T = Toe rotational slide
U = Stability status is Unfailure or stable
A = Stability status is marginally stable, slope stability Analysis must be done.

ÃÙ»·Õè 5 µÑÇÍÂèÒ§¢Í§ Chart ÊÓËÃÑº´Ô¹ Homogeneous soil àÁ×èÍ»ÃÐàÀ·´Ô¹ c áÅÐ φ ÁÕ¤èÒ¤§·Õè

4.2 °Ò¹¤ÇÒÁÃÙéà¡ÕèÂÇ¡Ñº¡ÒÃÇÔà¤ÃÒÐËì¤ÇÒÁÁÑè¹¤§¢Í§ÅÒ´´Ô¹ ÀÒÂãµéáÃ§á¼è¹´Ô¹äËÇ, áÅÐá¹Ð¹ÓÇÔ¸Õ¡ÒÃá¡éä¢ (KB2)

ÃÐ´Ñº¤ÇÒÁÃØ¹áÃ§¢Í§á¼è¹´Ô¹äËÇ (Coefficient of earthquake, A) µÒÁ Modified mercalli scale áÅÐ¤èÒÊÑÁ»ÃÐÊÔ·¸Ô¢Í§áÃ§á¼è¹´Ô¹äËÇ ¡®¨Ò¡¡ÒÃ·´ÊÍº 113 ¡® â´Â¨Ñ´á¼¹¡ÒÃ ¤Ó¹Ç³ 8 ÃÙ»áºº

5. ¡ÒÃ·´ÊÍº°Ò¹¤ÇÒÁÃÙéáÅÐ¡ÒÃ»ÃÐàÁÔ¹¼Å

¡®µèÒ§æã¹°Ò¹¤ÇÒÁÃÙé¨Ð¶Ù¡¹ÓÁÒãªé»ÃÐàÁÔ¹¼Åâ´Â¡ÒÃãªéà¤Ã×èÍ§Á×Í ä´éÃÑºàÅ×Í¡âÁ´ÙÅ â´Â RAISON ã¹ÃÙ»áºº·Õè¡ÒÃµÑ´ÊÔ¹ã¨ä»¢éÒ§Ë¹éÒ (Forward chaining) ¹Ñè¹¤×ÍàÃÔèÁ¨Ò¡¢éÍÁÙÅ¢Í§¼Ùéãªé¨Ð¶Ù¡ ä»ËÒ¤ÓµÍº â´Âà¤Ã×èÍ§¨Ñ¡Ã¡ÒÃ ËÒ¤ÓµÍº (Inference engine) ¹Í¡¨Ò¡¹Õé¼ÙéÇÔ¨ÑÂä´éÍÍ¡áºº¡ÒÃàª×èÍÁµèÍ User interface ÊÓËÃÑºËÅÑ§¨Ò¡¼Ùé¤Ó¹Ç³ áÅÐáÊ´§¼Å¡ÒÃ¤Ó¹Ç³ â´ÂÁÕ¤ÇÒÁÊÑÁ¾Ñ¹¸ì¡Ñº¡ÒÃ¾Ô¨ÒÃ³Ò¤ÇÒÁ¶Ù¡µéÍ§

ÃÐºº¨ÐÁÕ¡ÒÃµÃÇ¨ÊÍºËÅÑ¡·Ô´ÊÍºâ´Â¾Ô¨ÒÃ³Ò¨Ò¡ÊÀÒ¾ÀÙÁÔ»ÃÐà·È áÅÐ¨Ò¡¼Å¡ÒÃÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹ à§×èÍ¹ä¢µèÒ§æ ·Õè¡ÓË¹´äÇé ÃÐººÁÒ·Ó¡ÒÃ·´ÊÍº ´Ñ§áÊ´§µÑÇÍÂèÒ§¢Í§¡ÒÃàÃÕÂ¡ãªé§Ò¹¢Í§ÃÐºº¼ÙéàªÕèÂÇªÒÞ·Õè¾Ñ²¹Ò¢Ö¹ã¹µÒÃÒ§·Õè 6

µÒÃÒ§·Õè 6 µÑÇÍÂèÒ§¢Í§¡ÒÃ·´ÊÍºÃÐºº ¨Ò¡ÊÀÒ¾¡ÒÃ¾Ñ§·ÅÒÂ¢Í§¶¹¹ã¹à¢µËÅÇ§¨Ò¡

Knowledge base	Input	Result	Fact
KB2	Part = Central Province = Bangkok	BKKC A = 0.010g to 0. 025g Explanation: The upper soil layer is soft clay (Bangkok clay), with shear strength varies with depth and Su = (0.22 to 0.26)*σ'_{vo}, σ'_{vo} is the effective overburden pressure, and also it should be normally consolidated clay. * This is for guideline only. The soil investigation must be done*	ÅÑ¡É³Ð´Ô¹ºÃÔàÇ³ ªÑé¹º¹à»ç¹´Ô¹àË¹ÕÂÇÍè͹ ·ÕèàÃÕÂ¡ÇèÒ Bangkok clay Ë¹Ò»ÃÐÁÒ³ 12 àÁµÃ «Öè§ÁÕ ϕ à»ç¹ÈÙ¹Âì áÅÐ¤èÒ Su â´Âà©ÅÕèÂ»ÃÐÁÒ³ 0.90 t/m^2  ÊÀÒ¾¡ÒÃ¾Ñ§·ÅÒÂ¢Í§¤Ñ¹¡Ñé¹¶¹¹ Å§ÁÒ»ÃÐÁÒ³ 0.50 àÁµÃ ÃÙ»áºº ¢Í§¡ÒÃà¤Å×èÍ¹¾Ñ§à»ç¹ Base rotational slide áÅÐÁÕ Tension crack Å¡»ÃÐÁÒ³ 0.50 àÁµÃ ¤Ò´ÇèÒ à¡Ô´¨Ò¡¡ÒÃ¢Ø´ÅÍ¡¤Å Í§ áÅÐ¡ÒÃÅ´ÃÐ´Ñº¹éÓÍÂèÒ§ÃÇ´àÃçÇ (Rapid drawdown)
KB1	Soil layer = Homogeneous soil (strength varies with depth) Beta = Slope angle = 35 degree H = Slope height = 2.50 m.	BFX Explanation: Type of movement; Base rotational slide in Bangkok clay using Simplified Bishop or Fellenius method. Stability status; Failure, it should be stabilized. Analysis method for strength test; Total strength analysis (ϕ = 0) for very soft to medium stiff clay. * This is for guideline only. Slope stability analysis should be done. Stability status is resulted from soil around Ruam Pattana road, Amphor Nongchok, Bangkok.*	

6. ÊÃØ»¼Å

¡ÒÃ¹ÓÃÐºº¼ÙéàªÕèÂÇªÒÞ·Ò§´éÒ¹»ÑÞÒÁÒ»ÃÐÂØ¡µìãªé§Ò¹¡Ñº§Ò¹ÅÒ´´Ô¹ (Earth slope) ä´é¶Ù¡¾Ñ²¹ÒÁÒà»ç¹ãªé§Ò¹â´Â¾Ô¨ÒÃ³ÒÊÀÒ¾ÀÙÁÔ»ÃÐà·È ÊÀÒ¾ËÔ¹áÅÐ´Ô¹¢Í§»ÃÐà·Èä·Â ÃÐºº¼ÙéàªÕèÂÇªÒÞ·Õè¾Ñ²¹Ò¢Ö¹»ÃÐ¡ÍºäÇéÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´´Ô¹ ¨ÐªèÇÂã¹¡ÒÃ»ÃÐàÁÔ¹ã¹¢Ñé¹µé¹ã¹¡ÒÃÇÔà¤ÃÒÐËì¤ÇÒÁÁÑè¹¤§¢Í§ÅÒ´´Ô¹ (KB1), áÅÐ¹Í¡¨Ò¡¹Õé¢éÍÁÙÅ·Ò§ã¹´é¹¡ÒÃÊÓÃÇ¨¢Í§áÃ§Ê¡ÃÐà·×Í¹ÍÂèÒ§Ë¹èÒÂ¹ËÃ×Í¢éÍÁÙÅ¨Ò¡ÊÀÒ¾áÅÐÊÀÒ¾¤ÇÒÁà¢é Á¢Í§¼Å ´Ô¹ËÇ¢Í§áµèÅÐ¾×é¹·Õè»ÃÐà·Èä·Â (KB2) «Öè§ÇÑÁ¶Ø»ÃÐÊ§¤ì¢Í§¡ÒÃÈÖ¡ÉÒáÅÐ·´ÊÍº¤ÇÒÁ·Ò§ÇÔ¶Õ¡ÒÃ·Õè¶Ù¡µéÍ§ »ÃÐÊº¡ÒÃ³ì¢Í§¼ÙéàªÕèÂÇªÒ , áÅÐÊÀÒ¾¡ÒÃ¾Ñ§·ÅÒÂ¨ÃÔ§¨Ó¹Ç¹ÁÒ¡¡ÇèÒ 50 áËè§ ÃÐºº¶Ù¡¾Ñ²¹Òº¹ Expert shell ª×èÍ RAISON «Öè§ÁÕÃÐºº¡ÒÃ¨Ñ´¡ÒÃ¡®·ÕèÁÕ»ÃÐÊÔ·¸ÔÀÒ¾ãªéËÅÑ¡¡ÒÃµÑ´ÊÔ¹ã¨áºº Forward chaining áÅÐÁÕ¡®·Ñé§ËÁ´ 1196 ¡® ¤×Í¹ KB1 ¨Ó¹Ç¹ 1083 ¡® áÅÐã¹ KB2 ¨Ó¹Ç¹ 113 ¡® ¡ÒÃ·´ÊÍº¢Í§ÃÐºº¨Ò¡ÊÀÒ¾¨ÃÔ§¾ºÇèÒ¼ÅÅÑ¾¸ì·Õè ä´éÁÕ¤ÇÒÁ¶Ù¡µéÍ§ã¡Åéà¤Õ§¡Ñº¼Å¡ÒÃÇÔà¤ÃÒÐËì·Ò§ÇÔÈÇ¡ÃÃÁ·Õèä´é¾Ñ²¹Òâ´Â¹Ñ¡ÇÔªÒ¡ÒÃ¢Í§»ÃÐà·ÈáÅÐµèÒ§»ÃÐà·È ÇÔà¤ÃÒÐËìàÊ¶ÕÂÃÀÒ¾¢Í§ÅÒ´ áÅÐ¹Í¡¨Ò¡¹Õé ÃÐºº¨ÐÁÕ¡ÒÃ¾Ñ²¹ÒµèÍä»â´Â¡ÒÃà¾ÔèÁ¢éÍÁÙÅ ·Ò§´éÒ¹¾ÅÇÑµ¡ÃÃÁ Dynamic factors ÁÒÊÃéÒ§¡®à¾ÔèÁàµÔÁ

àÍ¡ÊÒÃÍéÒ§ÍÔ§

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