

COVER PHOTOGRAPH BY COURTESY OF THE ARIZONA DEPARTMENT OF TRANSPORTATION

VOLUME 15 NUMBER 5 OCTOBER 2012

INTERNATIONAL JOURNAL OF  
**PAVEMENT  
ENGINEERING**

VOLUME 15 NUMBER 5 OCTOBER 2012

EDITED BY  
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**IMAD AL-GADI**

Taylor & Francis  
Taylor & Francis Group

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S wcpvkh{ kpi "dwkx/kp"eqputwekqp"i tcf kgpw"cpf "gctn{/ci g"umd"  
f ghqto cwkqp"ecwugf "d{ "gpxktqpo gpvcn'hqcf u'kp" c"lqkpvgf "r nckp"  
eqpetgw'r cxgo gpv

UVGXGP "C0'Y GNNUÄ). 'DT KCP "O 0RJ KNNRUÄÈ"cpf "LWNG"O 0'XCP F GP DQUEEJ GGE

ÄWpłxgtuk{\ "qh'Rkwudwti j .3343"Dgpgf wo "J cm'Rkwudwti j .RC"37483."WUC"  
 CWpłxgtuk{\ "qh'Rkwudwti j .";56"Dgpgf wo "J cm'Rkwudwti j .RC"37483."WUC"

\*Tgegkxgf '8'F gego dgt'4227=tgxkgf '8'C rtkn'4228+

Eqputwekqp"ewtupi "cpf "y ctr lpi "r tqf wegu" c" dwkw/ lp" i tcf lgpv" y j lej "vcngu" r rceg" cu" j" g" tguwn/ qh" ej cpi gu" lp" vgo r gtcwtg" cpf "o qluwtg" j" cv' qeewt" r tqt" vq" j" g" j" ctf gpki" qh" Rqt wcpf "ego gpv' eqpetgvg" \*REE-# r cxgo gpw0Vj g" urcd' t' go clpu' m' vlp" j" g' r tgupeg' qh' j' ku' i tcf lgpv' dgecvug' j' g' r' mude' eqpetgvg' j' cu" p' q' v' g' xgr' g' f' u' w' h' l' e' l' g' p' v' u' k' h' p' g' u' i' v' q' i' g' p' g' t' c' v' g' u' t' g' u' t' q' u' t' u' t' c' l' p' 0Vj g' p' g' y' 'T' w' k' f' g' h' q' t' j' g' F' g' u' k' i' p' q' h' i' p' g' y' "cpf" " j' g' c' d' k' l' c' k' r' g' e' g' R' c' x' g' o' g' p' v' U' w' e' t' w' u' t' w' u' j' l' c' f' i' q' y' p' j' y' g' s' w' c' p' r' q' t' v' e' g' e' q' h' s' w' c' p' u' k' l' p' i' j' g' 'd' w' k' n' / l' p' i' t' c' f' l' e' p' v' 0Vj" j' ku' u' w' f' " j' y' g' b' c' i' p' w' f' g' q' h' j' g' 'd' w' k' n' / l' p' i' t' c' f' l' e' p' v' j' y' c' u' s' w' c' p' u' k' l' e' p' g' i' f' c' r' u' p' i' j' y' k' j' j' y' g' g' e' c' t' n' / c' i' g' t' g' u' r' q' p' u' g' q' h' j' g' g' u' r' c' d' " vq" g' p' x' l' q' p' o' g' p' v' e' r' i' n' c' i' f' u' 0Vj y' c' u' h' w' p' f' " j' c' v' j' g' s' w' k' c' r' g' p' v' h' p' g' c' t' " vgo r g' t' e' w' t' g' i' t' c' f' l' e' p' v' c' v' j' g' j' g' g' q' h' u' g' v' y' c' u' " EÁ 20; 1E ko " \*20771Hlp00Vj g' n' t' i' g' u' v' d' w' k' n' / l' p' e' w' t' x' c' w' t' g' o' g' e' u' w' t' g' f' " c' r' u' p' i' j' y' g' f' c' i' k' q' p' e' i' h' q' t' " j' g' t' u' t' c' l' p' g' f' " c' p' f' " w' p' t' g' u' t' c' l' p' g' f' " u' r' c' d' u' y' c' u' " 20222346" 3 lo " \*2022262: " 3 lhw" c' p' f' " 2022235: " 3 lo " \*20222676" 3 lhw" t' g' u' r' g' e' v' x' g' n' / 0' Vj g' l' p' e' t' g' c' u' g' " l' p' e' w' t' x' c' w' t' g' y' k' j' " c' p' l' p' e' t' g' c' u' g' " l' p' g' s' w' k' c' r' g' p' v' h' p' g' c' t' " vgo r g' t' e' w' t' g' i' t' c' f' l' e' p' v' h' q' t' j' y' g' w' p' t' g' u' t' c' l' p' g' f' " u' r' c' d' u' y' c' u' 9" j' k' i' g' t' j' c' p' v' j' g' t' u' t' c' l' p' g' f' " u' r' c' d' u' 0Vj g' r' t' q' h' u' g' v' c' n' u' l' p' o' f' k' e' c' v' g' j' c' v' j' g' u' r' c' d' " e' f' i' g' u' c' t' g' " c' v' k' o' g' u' " e' g' o' r' n' e' v' n' " w' u' w' r' a' t' g' f' 0

Pæ]] ~ ääb <Eqpetgw=Ewtrkpi =Y ctrkpi =P qp/nogct'i tcfkpw=Ewtxcwtg

30' Kpvtqf wevkqp

Vj g'erko ckle"eqpf kkpqu"cv"vj g'wlo g"qh'r cxiapi "ecp"i tgcwv" chgev"vj g'r gthqto cpeg"qh"vj g'urcd'O'Enko ckle"eqpf kkpqu"ctg" cnuq"ko r qtcwv"y j gp"ej ctcevgtk lpi "vj g'ghgeu"qh'ewtrkpi " cpf"y ctrkpi O'Co qpi "qvj gt"vj lpi u"vj gug"eqpf kkpqu"f lcvvg" vj g"o ci pkwf g" qh' vj g' dwkn/lp" eqputwewqp" i tcf lgpv' Eqputwewqp" ewtrkpi "cpf"y ctrkpi "ku"vj g'tguwn"qh"c"dwkn" lp"i tcf lgpv"y j lej "qeewu"cu"ej cpi gu"lp"vgo r gtcwvg"cpf" o qlurwtg"qeeu"vj tqwi j qwv"vj g'f gr vj "qh"vj g'urcd"r tkt"vq" j ctf gpki "qh"vj g'Rqturpf"ego gpv'eqpetvg"REE-+\* w'cpf" Mj c| cpqxlej "4222-0'Urdu"vj cv'ctg"eqputwewg"fwtkpi "vj g' f c'wlo g"i clkp" c"uki phlecpv"o cwpv"qh"j gcv' gpgti {"htqo" uqnet"tcf lcvqp"cpf"j j f tcvqp"qh"vj g'ego gpv'O'V'pli j v"cu" vj g"o dlepv"vgo r gtcwvg"ftqr u"cpf"dqv"o qlurwtg"cpf"j gcv' gpgti {"ctg"muv"pgct"vj g'uwthceg"qh"vj g'REE."c"pgi cwxg" dwkn/lp"vgo r gtcwvg"i tcf lgpv'f gxgnr u'Vj g'urcd"tgo clkp" hcv'gxgp"lp"vj g'r tgupeg"qh"vj ku"pgi cwxg"i tcf lgpv'dgecwug" vj g'r rucle"eqpetvg"j cu"pqv'f gxgnr gf"uwthlelpv"uwthpgui" vq"i gpgetvg"utgu"qt"utclkp'O'Vj g'pvy "I wlf g"ht"vj g'F guki p" qh'P gy "cpf"TGj cdkkcvf"Rcxgo gpv'Utweu"gu"\*4226-+j cu"

uj qy p" yj g" ko r qtcpeg" qh" s wcpvkh/ kpi " yj g" dwkx/ kp" i tcf lgpv"  
 \*l w"cpf" Mj c| cpqxlej "4222-0/Dq yj " r cxgo gpv" kputwo gpvc/  
 vqp" cpf" cpcn/ vccr/ o qf gnu" ctg" dglpi " wugf" vq" dgwgt"  
 ej ctcevgtk g" yj g" ghgeev" qh" vgo r gtcwtg" cpf" o qlwutg"  
 i tcf lgpw" qp" yj g" r gthqto cpeg" qh" eqpetgg" r cxgo gpw"  
 \*Lgapi " gv" cno 4223." Lgapi " cpf" \ qmkpi gt" 4226-0 Vj g"  
 o ci plkwf g" qh" yj g" dwkx/ kp" i tcf lgpv" hqt" c" r cxgo gpv"  
 eqputwewf" qp" UOF044" kp" O wt { uxkng. " Regpu{ nkcplc" y cu"  
 s wcpvkh/ cnpji " y kj " yj g" gctn/ /ci g" tcur qpug" qh" yj g" urcd" vq"  
 vgo r gtcwtg" cpf" o qlwutg" i tcf lgpw" C" yj qtqwi j " lpxgunk/  
 i cvqp" qp" urcd" tcur qpug" vq" i tcf lgpw" yj cv' f gxnqr " y kj kp"  
 yj g" urcd" yj tqwi j qwv" yj g" hktuv" y ggn' chgt" r cxlpi " ku" r tqxf gf"  
 dgm y 0

40' Qxgtxkgy "qh"vguv'ugevkqp

Vj g' kputwo gvwf " r cxgo gpv' kp' 'j ku' uwf { " eqpukw' qh' c" 52" eo " \*34" kp0" Rqtwpf " ego gpv' lqlpvf " r nkp' eqpetgvg' r cxgo gpv' \*1REER+ eqputwvfvf " qp' 'qr' qh' c" 32" eo " \*6" kp0" qr gp/i tcf gf " cur j cn' uwdk' gf " dcug. " c" 35" eo " \*7" kp0" f gpus/i tcf gf " uwd/ dcug. " cpf 'c' 83" eo " \*46" kp0' dcmhm

, Eqtgtqr qpf lpi "cwjt q10Vgrt3"634"846"; : 0Hz<3"634"846"23570Go ckn<[lo xB gpi t0 kaqrf w](#)  
 }Vgr0< "634/846/; : 850Hz<" "634/846/23570Go ckn<acy 45B [0 kaqrf w0](#)  
 ÈVgr0< "634/846/; : 850Hz<" "634/846/23570Go ckn<do r 8B [0 kaqrf w0](#)

30 cm	Portland Cement Concrete
10 cm	Asphalt Treated Permeable Base
13 cm	FENNDOT 2A Subbase
61 cm	Cut and Fill
	Subgrade

Hki wtg'30F guki p'yj lenpguugu'qh'yj g'r cxgo gpv'nc{gtu0

o cvgtkn" cu" uj qy p" kp" hki wtg" 30' Vj ku" r cxgo gpv' y cu" eqputwexgf" qp" c" ugevkqp" qh" j ki j y c{ "qp" WU" Tqwg" 44" kp" O wt{ uxkn. Rgppu{ncple" \*Y gmu'gv'crf04227+0

Vj g" pgy " IRER" ku" c" hqwt/rcpg" f kklf gf" j ki j y c{ " y kj " 608" o " \*37" h# " vcpuxgtug" lqkpw. 509" o " \*34" h# " rcpgu" cpf " 20 " o " \*408" h# " y kf g" eqpetgvg" ewd/cpf/i wwgt" uj qwf gtu0' Vj g" r cxgo gpv'eqpckpgf "50" eo " \*307" kp0" f lco gvg" f qy gnu" cnpipi "vj g" vcpuxgtug" lqkpw" cpf "308" eo " \*20847" kp0" f lco gvg" vlg" dctu" ur cegf "5" h" qp" egpvg" cnpipi "vj g" egpvgtrkpg" lqkpw" cu" uj qy p'kp" hki wtg" 40

Hki wtg" 5" r tqxkf gu" cp" qxgtxkgy "qh" yj g" qxgtcm'v'g'v'ugevkqp" rc{qww0' Vj g" v'g'v'ugevkqp" ku" mcevgf "kp" yj g" y gvdqwpf "v'wendi" rcpg" qh" Tqwg" 44" cpf " eqpukwu" qh" ugxgp" REE" urdu0' Vj g" f qy gr'cpf "vlg" dctu" y gtg" ngn'qww'qh" yj tgg" eqpugewkwg" urdu" uq" yj g" ghgevg'qh" tguvckpv' yj g{ "lo r qug" qp" yj g" urcd" eqwf "dg" swcpvkhgf 0' C" " vcpukqp" urcd" ugr ctevgu" yj g" tguvckpgf " cpf " vptguntckpgf " urdu" cu" uj qy p" kp" hki wtg" 50' Gcej " rcpg" y cu" r cxgf " kp' gr gp' gpv' wulpi " c" ukpi ng/rcpg" urk' /hqt " r cxgt0' Vj g" r cuukpi " rcpg" y cu" r cxgf " ugxgtcrf" y ggmu" r tkqt " vq" yj g" v'wendi" rcpg" yj j lej "eqpckpgf "vj g" kp'utwo gpv'ckqp0

Hki wtgu" 6" cpf " 7" uj qy " yj g" kp'utwo gpv'ckqp" rc{qww' hqt" dqj " yj g" tguvckpgf " cpf " vptguntckpgf " urdu0' Vj g" kp'utw' o gpv'gf " urdu" eqpckpgf "I ggnup" 6422" xldtcvpi " y ktg" uvcle" utckp" i ci gu0' kp" qtf gt" vq" f kgevg " eqo r ctg" utckp" tguvcpug"

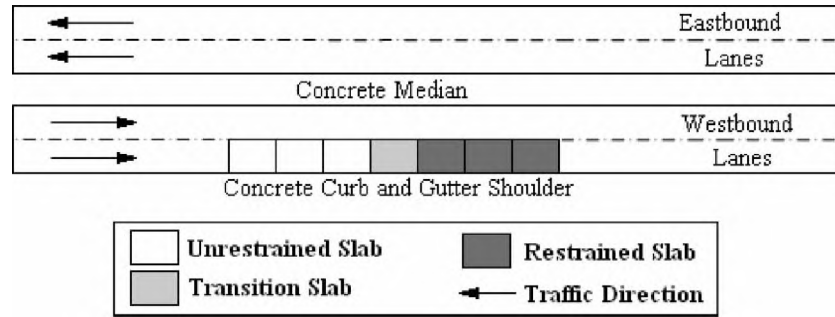
kp" tguvckpgf " xgtuwu" vptguntckpgf " urdu" yj g" rc{qww' qh" yj g" i ci gu" y cu" tgr ncevgf " hqt" dqj " ugwu" qh" urdu" cu" uj qy p" kp" hki wtg" 60' Vj g" urdu" y gtg" cnuq" kp'utwo gpv'gf " y kj " vgo r gtcwtg" cpf " o qkwtg" ugpuqtu0' V{r g" V" yj gto qeqw' ngu" y gtg" kp'ucmgf " cv' xctkpwu" f gr vj u" yj tqwi j qww' yj g" eqpetgvg" cpf " yj tqwi j qww' yj g" r cxgo gpv' utwewt" vq" ceewtcvg" s wcpvkhf " yj gto cni" i tcf kpwu0' Vj g" yj gto qeqw' ngu" y gtg" kp'ucmgf " kp" yj g" tguvckpgf " urdu" cv' o k' r cpgr' cpf " cv' yj g" eqtpgt" qh" yj g" urcd" kp" vq" tgr ncevg" mcevkqpu0' Ugpuvckqp" UJ V97" tgrvkwg" j wo k' k' " cpf " vgo r gtcwtg" ugpuqtu" y gtg" cnuq" kp'ucmgf " yj tqwi j qww' yj g" tguvckpgf " urdu" cv' o k' r cpgr' cpf " cv' yj g" eqtpgt" qh" yj g" urcd" kp" vq" tgr ncevg" mcevkqpu0' Rteqgf wtu" f g' xgr' gf " cv' yj g" Wp' xgtukv " qh" k' k' qpku" cv' Wdpcp/Ej co r cki p" hqt" yj g" wug" qh" yj g' g' ugpuqtu" kp" eqpetgvg" cr r ncevkqpu" y gtg" hqmqy gf " \*I tcurg{ " gv" cr0' 4225+0' Y kp' " ur ggf " vgo r gtcwtg" cpf " tgrvkwg" j wo k' k' " y gtg' o gcuwgf " kp' yj g' h' k' gf " wulpi " cp' qp/ukg' y gcvj gt0

50' Dwkn/kp' eqputwexkp' ewtrkpi " cpf " y ctr kpi

Vgo r gtcwtg" i tcf kpwu" yj tqwi j qww' yj g" r cxgo gpv' utwewt" g" ctg" chgevgf " d{ " dqj " ugcupcrf " cpf " f ckl " gp' xtkpo gp' crf " eqpf k' k' qp0' Vj g" vqr " qh' yj g' r cxgo gpv' ku' chgevgf



Hki wtg'40F qy gr'cpf "vlg" dctu" eqphki wcvkqp" qp" UT/440



Hki wtg'50Nc{ qw'qh'g'u'ugev'kqp0

r tgf qo kpcpwl "d{ "f ckl " gpxktqpo gpxcrl ej cpi gu" y j krg" vj g" dqwqo "xctkgu" o qtg"ugcuqpcml (0Rquklxg" i tcf kcpw' hqteg" vj g" gfi gu" cpf" eqtpgtu" qh" vj g" r cxgo gpv' f qy py ctf u" vj gtd{ " kpetgculpi " uwr r qtv' kp" vj g" g"ug" rjccv'kpu" cpf " f getgculpi " vj g" uwr r qtv' cv' vj g" egpvt" qh' vj g" urcd0' Eqtpgt" cpf " gfi g" rjccv' u" o c{ "tguwn" kp" f getgcugf " f ghngv'kpu" vpf gt" vj g" g"ug" eqpf k'kpu" dgecvug" vj g" eqp'cev' ctgc" cpf k' t' r tguwmtg" dgy ggp" vj g" urcd" cpf " vj g" vpf gtn{ kpi " r{ "gt" ku" kpetgculpi 0' P gi cv'xg" i tcf kcpw' hqteg" vj g" eqtpgtu" cpf " gfi gu" qh' vj g" r cxgo gpv' w' y ctf u" cpf " vj g" egpvt" qh' vj g" r cxgo gpv' f qy py ctf u" vj gtd{ " tgf vepi " uwr r qtv' cv' vj g" eqtpgtu" y j krg" kpetgculpi " k' cv' o k' r cpgn" vj ku" tguwnu" kp" f getgcugf " o k' r cpgn' f ghngv'kpu" cpf " kpetgculpi " eqtpgt" cpf " gfi g" f ghngv'kpu0

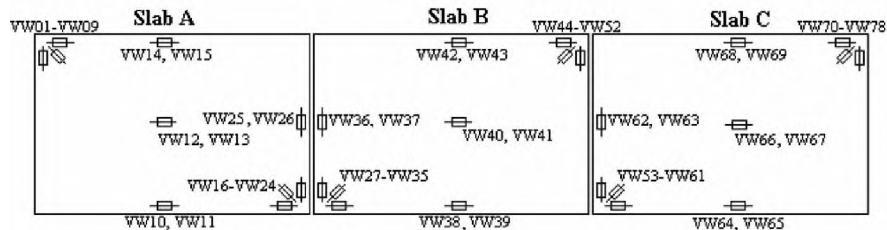
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vgo r gtcw'g0' Vj g" eqp'wv'kqp" i tcf kcpv' ku" c" tgs wktgf " kpr w' hqt" vj g" 4224" I wkl g" hqt" vj g" Fgukl p" qh' Pgy " cpf " Tgjcldk'cv'f " Rcxgo gpv' Utwew'gu" dw' vj g" g" ewt'g'pwl " ku" kpuw' h'k'p'v' f cv' c'xck'cdng" vq" f gh'p'g" y j cv' vj ku" kpr w' u'j qw'f " dg' y kj " cp{ " h'xgr'q' h' eqp' h'f gpeg' g'kj gt' r'q'ecm{ " qt' p'cv'k'p'cm{ 0

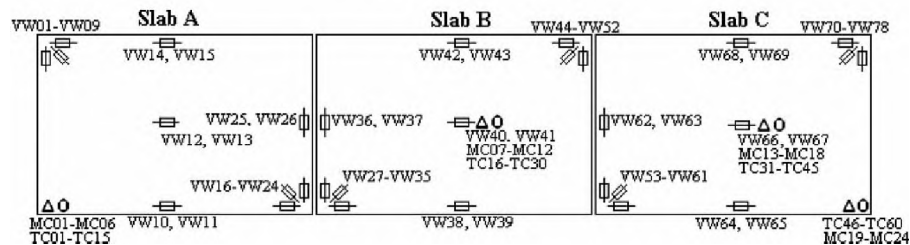
Vj g" vgu' uge'v'kqp" y cu" r cxgf " qp" Cwi wuv' 3." 4226" cv' cr r tqzko cvgn{ " 9-22" co 0' Hki wtg' 8" u'j qy u" vj g" vgo r gtcw' g" f k'ut'k'w'k'p" vj tqw' j qw' vj g" r cxgo gpv' cpf " uwd/ r{ gt u' cv' vj g" vgo g" qh' r cxkpi " . ugw'kpi " . cpf " lqk'p'v' etcen'kpi 0' Vj g" g'v'ko cv'f " vgo g" qh' ugw' qh' 32" j " y cu" dcugf " qp" u'c'v'k' ut'ckp0' Hki wtg' 9" u'j qy u" ut'ckp" xgtuwnu" ej cpi g" kp" vgo r gtcw'g0' Vj g" ugw' vgo g" y cu" f gh'p'f " cu" vj g" vgo g" ut'ckp" dgi cp" vq" f g'x'g'nr " y kj " ej cpi gu" kp" vgo r gtcw'g0' Vj ku" y cu" cnq' " cdq'w' vj g" u'co g' vgo g" vj g' lqk'p'w' y g'g' ucy gf 0' C v' vj g' vgo g" qh' ugw' vj g' g' y cu" c' r'k'p'g'ct" i tcf kcpv' qh' 20' f E leo " 20' f Hl'p0' cv' vj g' g' f i g' cpf " r t'c'v'k'cm{ " pq" i tcf kcpv' cv' o k' r cpgn0' J qy g'x'gt. " u'k'p'eg" vj g" i tcf kcpv' ku" pqv' r'k'p'g'ct. " k' g'p'v' h' kpi " vj g" i tcf kcpv' cu" l' gtq" f qgu" pqv' f q" l'w'v'k'g" vq" vj g" rcti g" k'p'v'g'p'crl f k' h'gt' g'p'eg" kp" vgo r gtcw' g" r tgu'p' cv' vj g' vgo g' qh' ugw' cu' u'ggp' kp' hki wtg' 80

Vj g' lqk'p'w' etcengf " cr r tqzko cvgn{ " 39" 6" 3; " j " chgt" r cxkpi 0' C v' vj ku" vgo g' vj g' g' y cu" c' rcti g' p'gi cv'xg' i tcf kcpv' qh' cdq'w

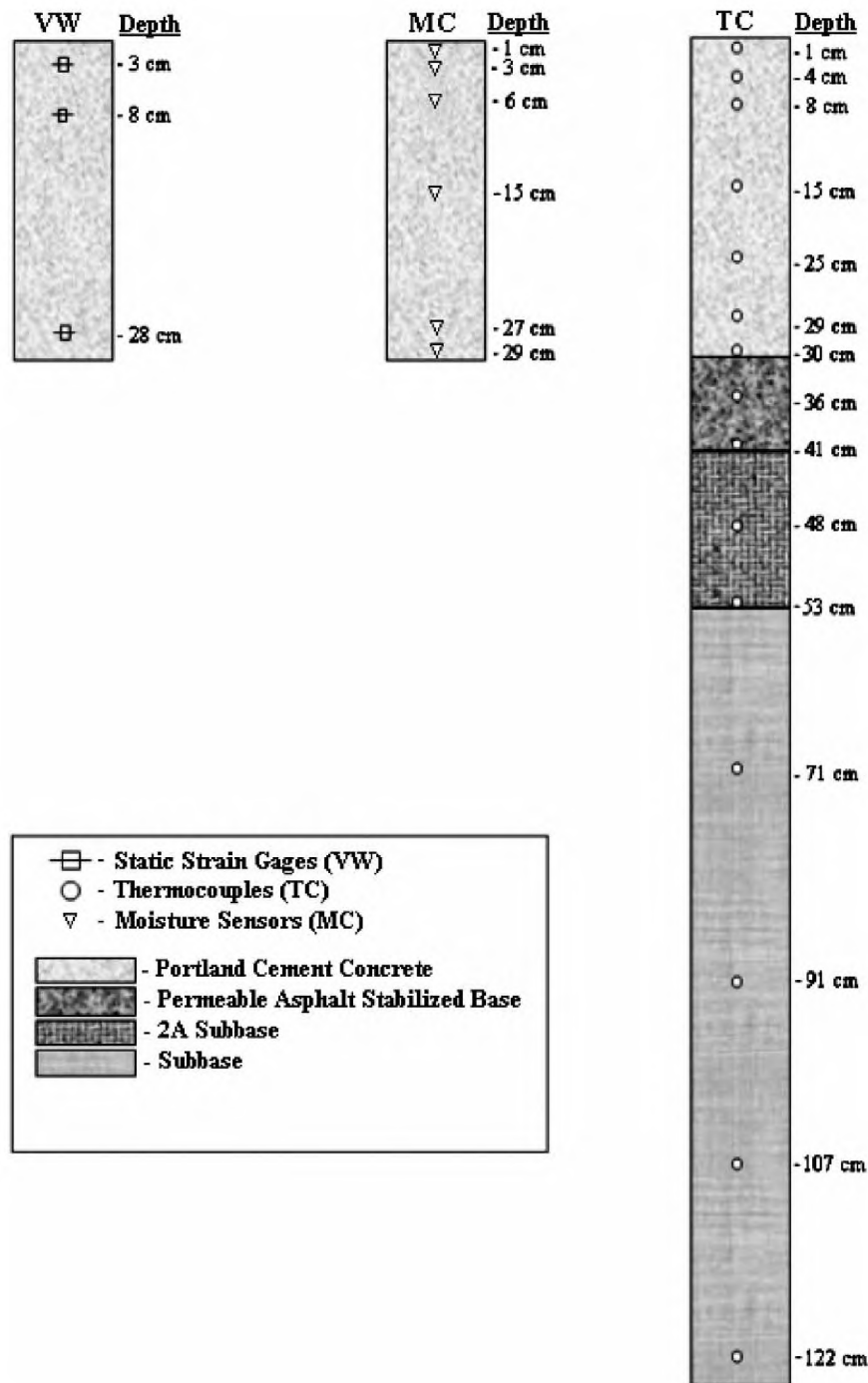
#### Unrestrained Slabs



#### Restrained Slabs



Hki wtg'60' k'p'w'w' gpx'v'kqp" i tcf kcpv' ku" c' qw'qh'g'u'ugev'kqp0



Hki wtg'70Kpntwo gpvcvkp'f'gr vj u'vj tqwi j qww'r cxgo gpv'utwewtg0

GÁ 204îE leo "GÁ 302îHlp0:"cu'uj qy p"lp'hki wtg": . "y j lej " r tqf wegf "gpqwi j "utguu"q'etcent'ij g'urcd0

Hki wtg" : \*c+\*d+ " uj qy " vj g" vgo r gtcwtg" f kntkdwkqp" cv' o k'f r cpn' cpf " vj g" gfi g" qh' vj g" urcd." tgur gevkxgn(0' Vj gug" i tcr j u' kmwutcvg" vj g" hcev' vj cv' vj g" vgo r gtcwtg" f kntkdwkqp" vj tqwi j qww" vj g" urcd" ku" pqv' vplkqto " uq" vj g" fghqto cvkqp" r tqf wegf "d{ "vj g" vgo r gtcwtg" i tcf kgpv'lp" vj g" urcd" y km'pqv' dg" u{o o gvtkecn0' Vj g" vgo r gtcwtg" i gpgtcvgf" y kj lp" vj g" urcd" ku" c" hpevkqp" qh' vj g" dqwpf ct{ "eqpf kkp0' Vj g" urcd" ku" ecuv' cmipi " c" r tg/gzkvki pi " urcd" qp" qp" ufk g" \*egpvtkpg" gfi g+cpf " vj g" qj gt" gfi g" \*xpgkuj qwrf gt" gfi g+ku" gZR qugf "

vq" co dlkp'v' eqpf kkp0' ulpeg" vj g" ewtd" cpf " i wwgt" y gtg" eqpntwewgf " chgt" vj g" xpg" y cu" r cxgf 0' Cv' o k'f r cpn' vj g" j gcv'y km' dg" tgvkpgf " o qtg" vj cp" cv' vj g" xpgkuj qwrf gt" gfi g" y j gtg" vj g" urcd" ku" gZR qugf " vq" vj g" eqqrgt" gxpki pi " vgo r gtcwtgu" vj tqwi j qww" vj g" fgr vj " qh' vj g" r cxgo gpv0' Vj ku" ku" y j { " vj g" gfi g" qh' vj g" r cxgo gpv' y km' dg" crrtqzko cvgn " vj g" uco g" vgo r gtcwtg" vj tqwi j qww" vj g" fgr vj " qh' vj g" urcd0' C" fgr levkqp" qh' vj g" ur cvkn' f kntkdwkqp" qh' vgo r gtcwtg" cetquu" vj g" vqr" cpf " dqvqo " qh' vj g" urcd" ku" r tqxkf gp" lp'hki wtg"; 0' Vgo r gtcwtgu" uj qy p" lp'hki wtg"; "y gtg" qdvkpgf "htqo "utckp'i ci g'vj gto kxqtu'go dgf f gf "47"o o

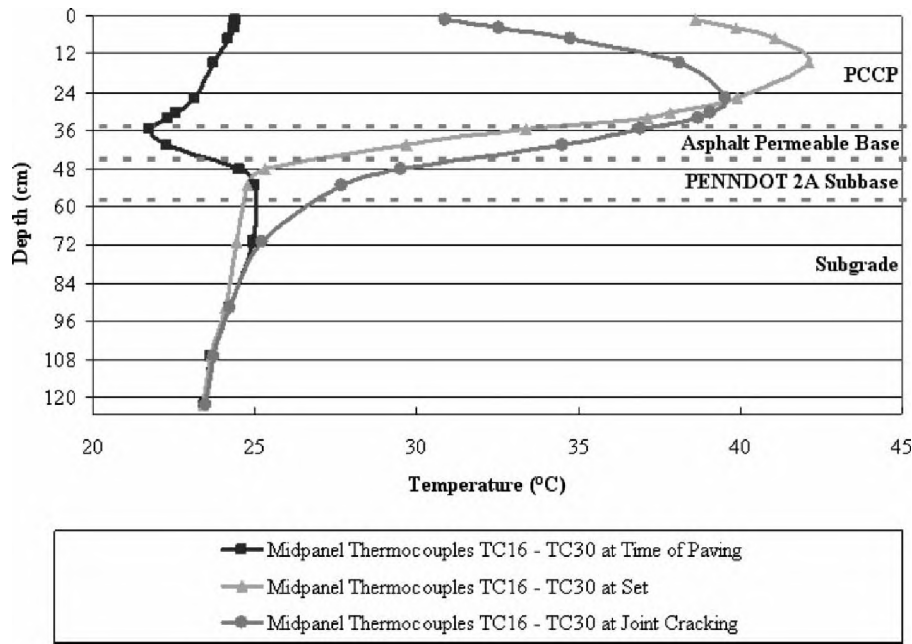


Figure 6. Temperature distribution throughout depth at midpanel.

\*3"lp0"ltqo "vj g"vqr "cpf "47"o o "3"lp0"ltqo "vj g"dqwqo "qh" vj g"urcd"cv'vj g"ko g"vj g'lqkpv'et'cengf 0

Hki wtg" 32"uj qy u"o qtg"er'ctn' "vj g" f'k'htgpeg" dgwy ggp" i tcf'k'p'w'cv' o k'f' r'cp'gn'cpf "cv'vj g"gf i g'0'K'ku'cr r'ct'gpv'vj cv' vj g" o k'f' r'cp'gn' ku' uwdlgev' vq" o qtg" f'tco c'v'e" vgo r'gt'cwtg" uy kpi u'f'w'k'pi "vj g" f'c' {0'Vj g'ug" n'ti gt"uy kpi u't'guw'n'lp" vj g" f'gx'gr'r' o gpv'q'h'nti gt" i tcf'k'p'w'cv'vj g" o k'f' r'cp'gn'Cu'uj qy p" lp" hki wtg" 32."gxgp" c'f'f'k'pi "qp" vj g"ewtd"cpf "ewwgt" f'q'gu"pqv' eqo r'rg'v'n' "pgi cv'g" vj g" g'h'gev' dgwy ggp" vj g" vgo r'gt'cwtg'u'cv' vj g"gf i g'q'h'vj g"urcd"cpf "cv'o k'f' r'cp'gn'0

Hki wtgu" 33" cpf" 34" uj qy " vj g" t'gr'v'x'g" j wo k'f'k' " vj tqwi j qw" vj g" f'gr' vj " qh" vj g" urcd" o gcuw'gf" cv' o k'f' r'cp'gn' cpf "lp" vj g"eqtpgt."tgur ge'v'x'gn' (0'Vj g"ewtd"cpf "i w'wgt"y cu'pqv' v'k'f' "qp'v' vj g" r'cxgo gpv'cv'vj ku'v'o g"uq" vj g"gf i g'q'h'vj g"urcd" ku'g'zr'qugf "vq" vj g"co d'k'p'v'enko c'v'e"eqpf k'k'qp'0'Vj g"t'gr'v'x'g" j wo k'f'k'f."gur ge'k'cm' "pgct" vj g" r'cxgo gpv' u'w'h'ceg"eqp'v'p'w'gu' vq" f'tqr "ch'gt" r'cxk'pi 0'Vj g't'g'y cu'c"t'clp" g'x'gpv'qp" C'wi wuv'3; " vj cv'r't'qf'w'egf "37"o o "208"lp0"q'h'r't'gekr'k'c'v'k'p."qp" C'wi wuv' 42" vj cv'r't'qf'w'egf "47"o o "3"lp0"q'h'r't'gekr'k'c'v'k'p" cpf "qp" C'wi wuv'43" vj cv'r't'qf'w'egf "o o "205"lp0"q'h'r't'gekr'k'c'v'k'p'0' Vj g'ug" t'clp" g'x'gpw' t'guw'ngf" lp" cp" k'pet'g'cug" lp" t'gr'v'x'g" j wo k'f'k'f" pgct" vj g" r'cxgo gpv' u'w'h'ceg" cv' o k'f' r'cp'gn'0' Vj g" t'gr'v'x'g" j wo k'f'k'f" k'pet'g'cugf" vj tqwi j qw" vj g" f'gr' vj " qh" vj g" urcd"pgct" vj g"eqtpgt"y j g'tg" vj g"y j q'ng"gf i g" q'h'vj g"urcd"ku' g'zr'qugf "vq" vj g"t'clp'0'Vj g"t'gr'v'x'g" j wo k'f'k'f" lp" vj g"eqpet'g'v' ku' ct'q'w'p'f" ; 4" 6" ; 6" 0' Vj g'ug" ctg" eqo r'ct'cd'ng" vq" vj q'ug" t'gr'qt'v'g'f"d' {"lg'q'pi "g'v'c'0"4223+0

60' P'qp/r'k'p'gct"vgo r'gt'cwtg"i tcf'k'p'w

Vj g"vgo r'gt'cwtg"i tcf'k'p'w" f'guet'kd'gf" g'ct'ngt"ctg" e'c'rew'v'g'f" u'ko r'n' d' {" f'k'k'f'k'pi " vj g" vgo r'gt'cwtg" cv' vj g" vqr " cpf " vj g" d'q'w'qo "q'h'vj g'r'cxgo gpv'd' {" vj g'f'k'nc'peg"dgwy ggp"vj go 0

Vj g"uj q't'v'eqo k'pi "q'h'vj ku'o g'y qf "ku'vj cv'k'w'r't'q'x'k'f'gu" c"n'k'p'gct" t'gr'v'k'p'uj k'r"y j k'g"p'qp/r'k'p'gct"i tcf'k'p'w"ctg" n'p'qy p"vq" g'z'k'u' k'p" vj g" r'cxgo gpv'0' k'p" q't'f'gt" vq" c'ee'q'w'p'v' h'qt" vj g" p'qp/r'k'p'gct" vgo r'gt'cwtg" i tcf'k'p'w." vj g" r'ct'co g'v'g't" 0'vgo r'gt'cwtg" o qo gpv'o y cu' f'gx'gr'r'gf" d' {" l'cp'u'g'p" cpf " Up{f'gt." 4222" \*lg'q'pi " g'v' c'0' 4223+0' Vj g" vgo r'gt'cwtg" o qo gpv' y cu' f'gx'gr'r'gf" uq" vj cv' c" p'qp/r'k'p'gct" i tcf'k'p'v' e'cp" dg" g's'w'c'v'g'f" vq" cp" g's'w'x'c'rg'p'v' n'k'p'gct" i tcf'k'p'v' d'c'ugf" qp" cp" g's'w'x'c'rg'p'v' u'w'c'k'p" eqpf k'k'qp'0' Hki wtg" 35" i t'cr'j l'ec'm' " u'wo o c't'k'gu" vj g" f'g't'k'c'v'k'p" q'h'vgo r'gt'cwtg" o qo gpv'h'qt"cp {" i k'x'gp"r'g't'k'q'f" q'h' v'o g"y k'j'k'p" vj g" eqpet'g'v' r'cxgo gpv'0' Vgo r'gt'cwtg" o qo gpv' e'cp" dg" e'c'rew'v'g'f" w'uk'pi " g's'w'c'v'k'p'u" \*3+ " cpf " \*4+0' Vj g" vgo r'gt'cwtg" o qo gpv' e'cp" vj gp" dg" w'ug'f" vq" h'k'p'f" vj g" g's'w'x'c'rg'p'v' n'k'p'gct" vgo r'gt'cwtg" i tcf'k'p'v' w'uk'pi " g's'w'c'v'k'p" \*5+ " d'c'ugf" qp"cp" g's'w'x'c'rg'p'v' u'w'c'k'p'0

$$VOq = \sum_{k=0}^p \left[ \frac{2K}{f_3} \frac{v_k - v_{k-3}}{f_3} \frac{f_k G \Delta f_{k-3}}{f_3} \right] \quad (3)$$

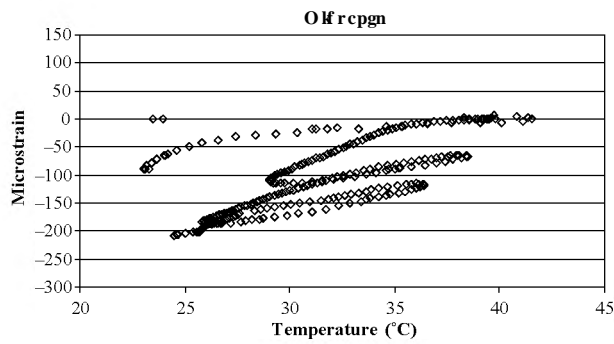
VOq." vgo r'gt'cwtg" o qo gpv' \*hki wtg" 35+ " v' vgo r'gt'cwtg" cv' n'ec'v'k'p'v' f'k' f'gr' vj " cv' n'ec'v'k'p'v' Vj a' {x" y g'k'j' v'g'f" c'x'g't'ci g" vgo r'gt'cwtg" g's'w'c'v'k'p" \*4++

$$V_{y \text{ cxg}} = \sum_{k=0}^p \left[ \frac{2K}{f_3} \frac{v_k - v_{k-3}}{f_3} \frac{f_k G \Delta f_{k-3}}{f_3} \right] \quad (4)$$

Vj a' {x" y g'k'j' v'g'f" c'x'g't'ci g" vgo r'gt'cwtg" g's'w'c'v'k'p" \*4++

$$\frac{\partial VOq}{\partial j} = \frac{34 VOq}{j^5} \quad (5)$$

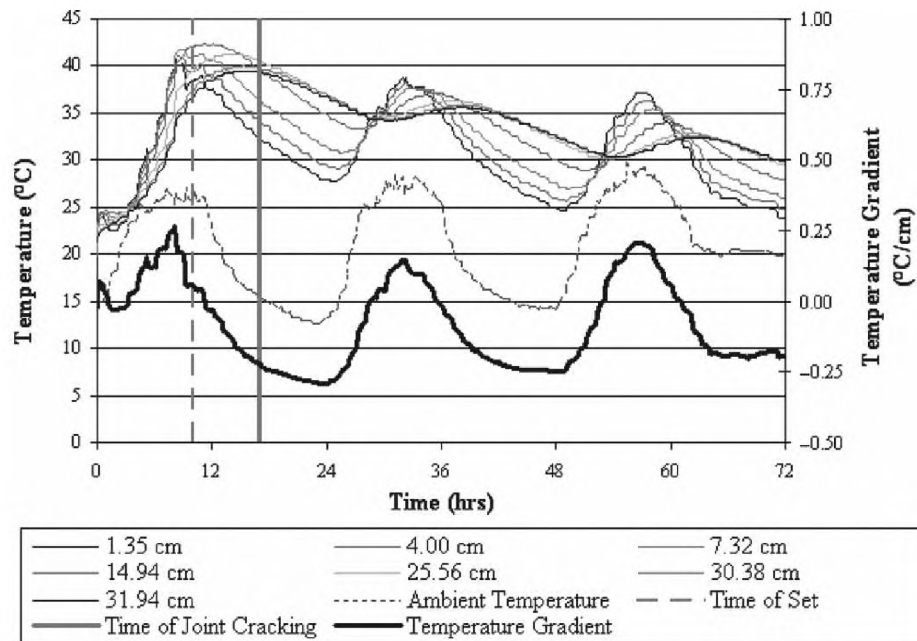
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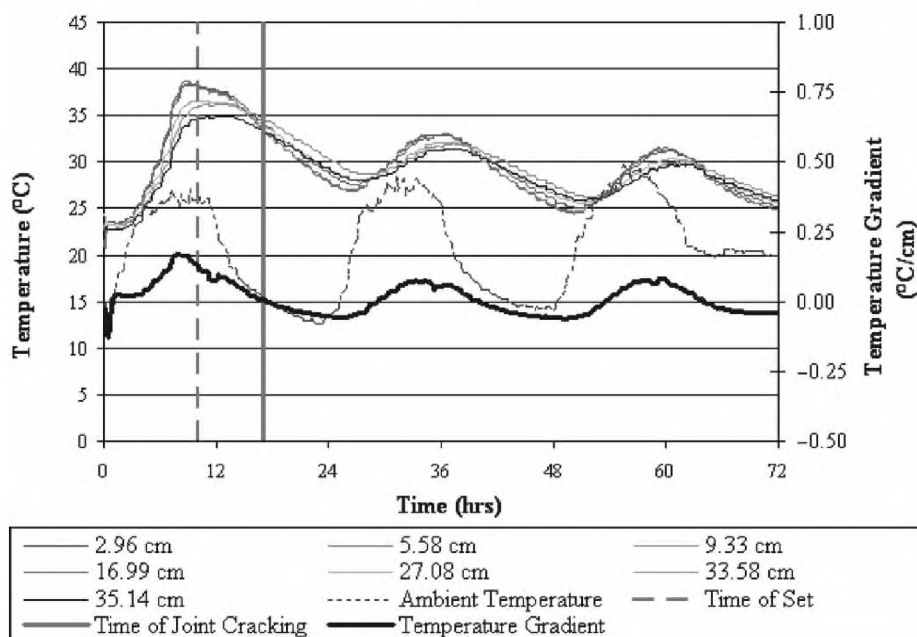
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70Uw h c e g' r t q h k g' o g c u w t g o g p w u

k p' q t f g t' v q' s w c p v h' ' y j g' g h g e v' q h' g c t n' / c i g' \* h k u w' 94' j +  
g h g e v' q h' e w t i k p i' c p f' y c t r k p i' q p' R E E' r c x g o g p w u. " u w h c e g"  
r t q h k g' o g c u w t g o g p w u' c t g' v c n g p' V j g u g' r t q h k g' o g c u w t g/  
o g p w u' e c r w t g' y j g' u j c r g' q h' y j g' u r c d' w p f g t' x c t k q w u'  
v g o r g t c w t g' c p f' o q k u w t g' i t c f l g p w u' k p' q t f g t' v q' o g c u w t g'  
y j g' u w h c e g' r t q h k g u' q h' u r c d u' g z r g t k e p e k p i' y j g t o c n' c p f'  
o q k u w t g' i t c f l g p w u. c p' k p u t w o g p v' e c n g f' c' f k r u l e m'  
o c p w h c e w t g f' d { " H c e g' E q p u t w e k q p' V g e j p q m i l g u. " k p e 0'  
y c u' w k k g f 0' V j g' f k r u l e n' r l e w t g f' k p' h k i w t g' 36' c +: " k u' c'  
j k i j n' l u g p u k k x g' f g x l e g' y j c v' o g c u w t g u' f k h g t g p e g' k p



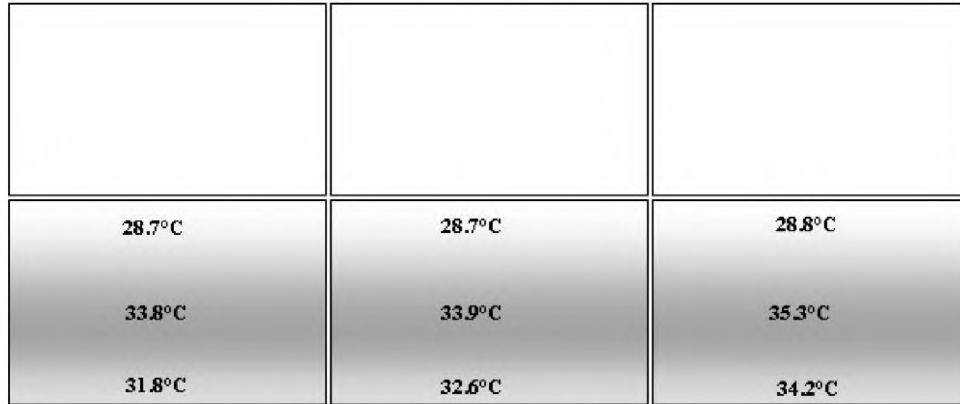
*a. Midpanel*



*b. Edge*

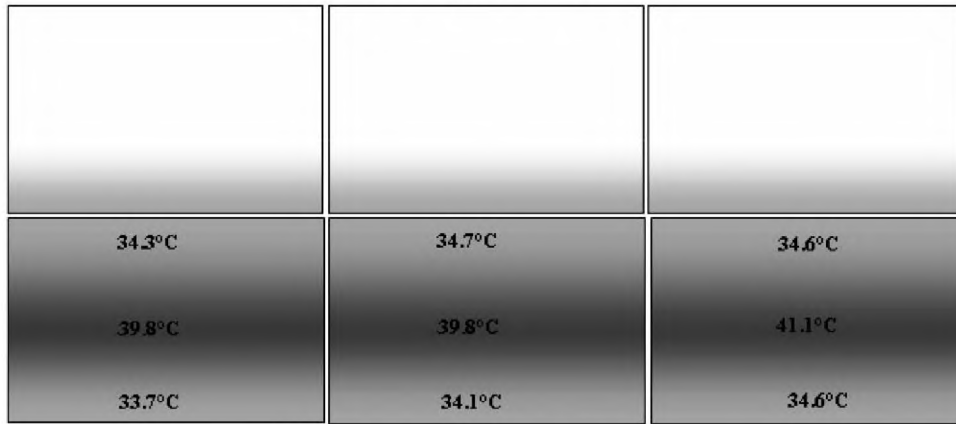
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Ambient Temperature = 28.7°C



a. Top of the slab.

Ambient Temperature = 28.7°C



b. Bottom of the slab.

Figure 9. Representation of the spatial temperature distribution across the slab at the time of concrete cracking.

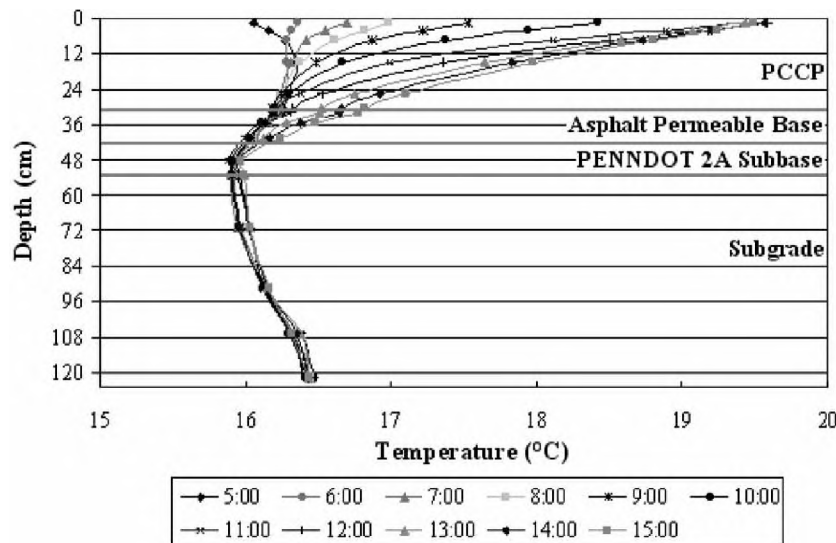
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P qvg" vj g" vy q" ekewrt" qdlgeu" nqecvgf" pgct" vj g" vcpuxgtug" lqkpw" crupi " vj g" uj qwf gt" kp" hi wtg" 36\*e-0' Vj gug"qdlgeu"tgr tgugpv"vj g"vqr u"qh'kpxct"tqf u"y j lej "y gtg" r rcegf "kp"vj g"i tqwvf "cv" c" f gr vj "qh' cr r tqzko cvgn" 50"o " \*34" h#0' Kp" qtf gt" vj g" hwt vj gt" kpwtg" vj g" eqpukvge{ "qh" vj ku" tghgtgpeg" grgxcvqp" vj g" wr gt" r qt vku" qh" vj g" kpxct" tqf u" y gtg" gpecugf " kp" i tgcug/hkngf " r qn' xlp{ rej ntkf g" \*RXE-+ wdlpi " kp" qtf gt" vj g" r tqgev" vj g" tqf u" hqo " vj g" gzc cpukxg" utguugu" kpf wegf " d{ " hquv" gzc quwtg0' Vj g" vqr " qh" vj ku" tqf " r lewtf g" kp" hi wtg" 36\*d+ " o clpvku" c" eqpuxcpv" grgxcvqp" vj tqvj j qwv" vj g" { gct" cpf " ku" vj wu" wugf " cu" c" dgpej o ctnf hqt" cm' urcd" r tqhkg" o gcuwtf go gpw0' Kp' kskvpi " gcej " f k r ukent' t wv" qh' hqo " vj g" vqr " qh" vj g" tqf " cmqy u" cm' tgrvixg" grgxcvqp" o gcuwtf " y kj " vj g" f k r ukent' vj g" dg" vkgf " kpq" cewcd' grgxcvqp0

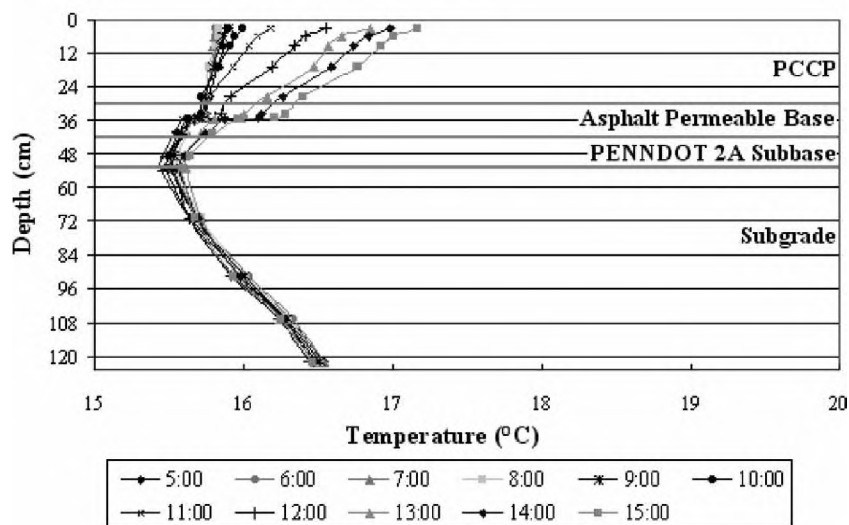
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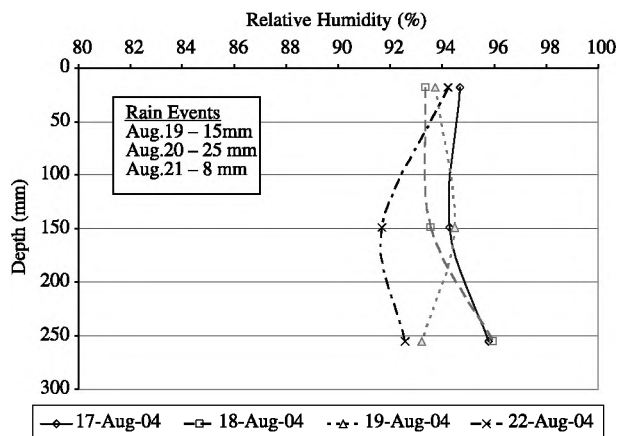


a. Midpanel



b. Edge

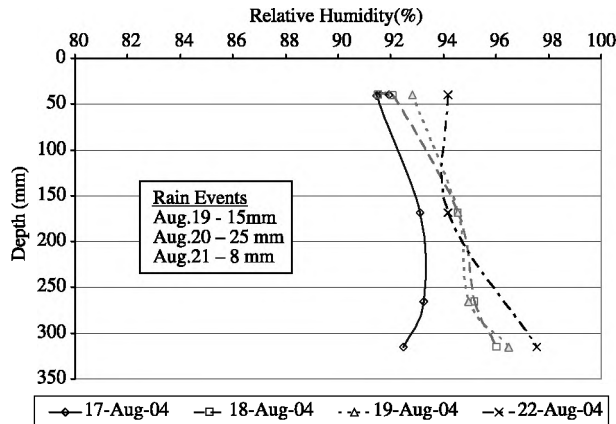
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Cu'y qw'f' dg" g'zr gev'f. " yj g" o czko wo " f k'ur m'ego gpv' hqt" yj g" wptguntckpgf " urcd" y cu' uwd'ucp'v'cm' j ki j gt" yj cp" yj g" t'guntckpgf " urcd0Vj g' o qxgo gpv'q'h'yj g' gp'f' qh'cp' wptguntckpgf " urcd" cu'c' t'guwn' qh' ewt'kpi " cpf" y ctr kpi " ecp" dg' cu' o wej " cu' vy leg' cu' j ki j " eqo r c'tgf " vq' yj g' t'guntckpgf " urcd0



Hki wtg'3400 qkuwtg'o gcuwtgo gpw'u' cf g'cv'jy g'eqtpgt'qh'jy g'urcd0

C" f kur rcego gpv' qh' | gtq' qt' ngu' kpf lecvu' vj g' urcd' ku' kp' eqpcev' y kj " vj g' dcug' O' C' r qt vqp' qh' vj g' urcd' ku' cny c' u' kp' eqpcev' y kj " vj g' dcug' y j gp' rñqñkpi " cv'jy g' f kci qpñfñw'o cp' " vko gu' vj g' gf i g' qh' vj g' urcd' y kn'dg' eqo r rñvgn' " wpuwr r qt vgf " kp' dq' vj " vj g' vcpuxgtug' cpf " rñpi kwf kpñf f k gevku' Vj ku' ku' v' wv' hqt' dq' vj " vj g' tguwckpgf " cpf " wptguwckpgf " urcd' u0

Cp' q' vj gt' v' gpf " uggp' ku' vj cv' vj g' o qxgo gpv' qh' vj g' urcd' cu' c' y j q' rñg' ku' hct' ngu' hqt' vj g' tguwckpgf " urcd' u' vj gp' vj g' wptguwckpgf " urcd' u' Vj ku' ku' kpf lecvf " d' { " vj g' o qtg' vki j vñ' " i tqw' gf " r tqh' rñgu' f gr levgf " kp' vj g' f kur rcego gpw' i tcr j u' hqt' vj g' tguwckpgf " urcd' u' eqo r ctgf " vq' vj g' wptguwckpgf " urcd' u' Vj g' tguwckpgf v' r tqxkf gf " d' { " vj g' f qy gnu' cv' vj g' vcpuxgtug' lqkp' v' i tgcwñ' " tgf wv' gu' vj g' ewtxcwtg' cv' vj g' gpf " qh' vj g' urcd' u' Rct' v' qh' vj ku' ecp' cnuq' dg' cv' t' kd' wv' gf " vq' vj g' h' ev' vj cv' hgy gt' o gcuwtgo gpw' y gtg' o cf g' hqt' vj g' tguwckpgf " urcd' u' cpf " vj g' i tcf lgpw' y gtg' p' qv' cu' j ki j " y j gp' vj g' o gcuwtgo gpw' y gtg' o cf g'o

80' Urcd' ewtxcwtg' dghqtg' cpf " chgt' vj g' lqkpw' etcem

Vj g' ewtxcwtg' hqt' gcej " r tqh' rñg' y cu' vj gp' ecrewv' gf " d' { " hkwpi " c' ugeqpf " qtf gt' r qñf p' qo kñi' vj g' o gcuwtg' r tqh' rñg'o

Vj g' ewtxcwtg' qh' vj g' r qñf p' qo kñi' y cu' ecrewv' gf " 3' h' l' kp' v' vj g' urcd' u' h' qo " vj g' u' j qw' f gt' O' D' { " eqo d' k' p' i " vj g' r tqh' rñg' f' cv' y kj " vj g' gs w' k' c' rñp' v' rñpgct' i tcf lgp' v' f' g' t' k' x' g' f' h' qo " vj g' o k' f' r' cpñi' vj g' to qe' q' w' rñu' " vj g' t' g' r' v' k' p' u' j' k' r' " dg' y' g' gp' " urcd' ewtxcwtg' cpf " gs w' k' c' rñp' v' rñpgct' v' go r g' t' c' w' t' g' y' cu' f' g' h' k' p' g' f' o

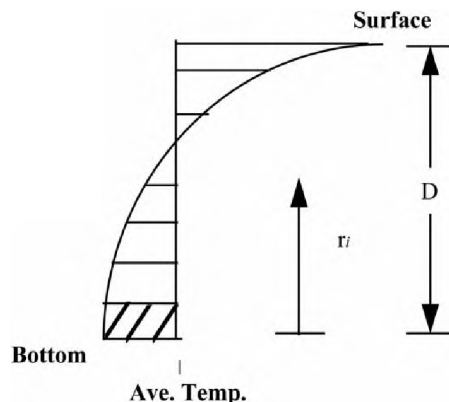
Vj g' t' g' u' r' q' p' u' g' " qh' vj g' urcd' u' vq' " vgo r g' t' c' w' t' g' i tcf lgp' u' dghqtg' cpf " chgt' vj g' lqkp' u' etcem' ku' s' w' k' g' f' k' h' t' g' p' v' " cu' y qw' f " dg' g' z' r' g' e' v' g' f' " u' k' p' e' g' vj g' g' h' g' e' v' k' x' g' " urcd' u' rñpi vj " ku' u' w' d' u' c' p' v' k' e' m' " rñpi gt' O' Hki wtg' " 39' u' j' q' y' u' " vj g' ewtxcwtg' ecrewv' gf " hqt' " r tqh' rñgu' o gcuwtg' f' dghqtg' cpf " chgt' vj g' lqkp' u' etcem' g' f' hqt' " urcd' u' C' " Hki wtg' " 6' " kp' vj g' wptguwckpgf " egn' O' Vj g' ewtxcwtg' ecrewv' gf " dghqtg' vj g' lqkp' u' etcem' g' " vj q' y' p' cu' u' q' r' k' f' " e' k' t' e' n' g' u' " ctg' y' g' m' f' d' g' n' y' " vj g' d' g' u' v' h' s' rñp' g' qh' c' m' i' qh' vj g' f' cv' " r q' k' p' u' O' k' p' c' m' i' e' c' u' g' u' " g' z' e' g' r' v' " y j gp' vj g' gs w' k' c' rñp' v' rñpgct' i tcf lgp' v' ku' s' w' k' g' j ki j " ewtxcwtg' ecrewv' gf " dghqtg' etcem' kpi " y kñi' dg' rñu' vj cp' ewtxcwtg' ecrewv' gf " chgt' etcem' kpi " d' { " c' h' e' v' q' t' " qh' v' y' q' o

90' G' h' g' e' v' qh' o k' f' r' cpñi' v' go r g' t' c' w' t' g' q' p' urcd' ewtxcwtg

Hki wtgu' " 3: " 645' k' m' u' t' c' v' g' " vj g' t' g' r' v' k' p' u' j' k' r' " dg' y' g' gp' ewtxcwtg' cpf " gs w' k' c' rñp' v' rñpgct' " vgo r g' t' c' w' t' g' i tcf lgp' v' O' Vj g' ewtxcwtg' u' hqt' vj g' f' k' i' q' p' c' i' r' tqh' rñgu' o gcuwtg' f' hqt' vj g' wptguwckpgf " cpf " t' g' u' t' c' k' p' g' f' " urcd' u' ctg' r' tqxkf gf " kp' Hki wtgu' " 3: " cpf " 3: " t' g' u' r' g' e' v' k' x' g' n' O' E' w' t' x' c' w' t' g' u' ecrewv' gf " hqt' vj g' vcpuxgtug' cpf " rñpi kwf kpñi' r tqh' rñgu' ctg' u' w' o' c' t' k' gf " kp' Hki wtgu' " 42645. " t' g' u' r' g' e' v' k' x' g' n' O' Q' pñ' " vj g' ewtxcwtg' u' ecrewv' gf " hqt' vj g' r' tqh' rñgu' o gcuwtg' f' chgt' vj g' urcd' u' etcem' g' y' g' t' g' wv' gf " vq' i' g' p' g' t' c' v' g' vj g' r' rñw' o

Kp' vj ku' c' p' c' n' { u' ku' " vj g' u' n' r' g' " qh' vj g' rñp' g' k' p' f' k' e' c' v' u' " vj g' t' c' v' g' qh' k' p' e' t' g' c' u' g' " kp' ewtxcwtg' y kj " cp' " k' p' e' t' g' c' u' g' " kp' gs w' k' c' rñp' v' rñpgct' " vgo r g' t' c' w' t' g' i tcf lgp' v' O' Vj g' u' n' r' gu' qh' vj g' t' g' u' t' c' k' p' g' f' " r' tqh' rñgu' ctg' q' p' " c' x' g' t' c' i' g' " 9' " " ngu' " vj cp' vj q' u' g' qh' vj g' wptguwckpgf O' Vj g' o c' z' l' o' w' o' ewtxcwtg' u' hqt' vj g' t' g' u' t' c' k' p' g' f' " urcd' u' ctg' c' n' u' q' " u' w' d' u' c' p' v' k' e' m' " ngu' vj cp' vj g' wptguwckpgf O' Vj ku' ecp' dg' q' d' u' g' t' x' g' f' " d' g' u' v' hqt' vj g' f' k' i' q' p' c' i' r' r' tqh' rñgu' u' k' p' e' g' " kp' vj g' rñpi kwf kpñi' cpf " vcpuxgtug' f' k' g' e' v' k' p' u' hqt' vj g' t' g' u' t' c' k' p' g' f' " urcd' u' hgy " r' tqh' rñgu' y' g' t' g' o' gcuwtg' f' f' w' l' k' p' i' " vj g' q' e' e' w' t' g' p' e' g' qh' j ki j " vgo r g' t' c' w' t' g' i' tcf lgp' u' O' Vj g' t' g' f' w' e' v' k' p' " kp' ewtxcwtg' hqt


$$\text{Temperature Moment} = \sum (A_i \times r_i) / D$$



$A_i$  = Area of region  $i$

$r_i$  = Distance from bottom of slab to centroid of  $A_i$

$D$  = Depth of slab

 = Area of region 1 ( $A_1$ )

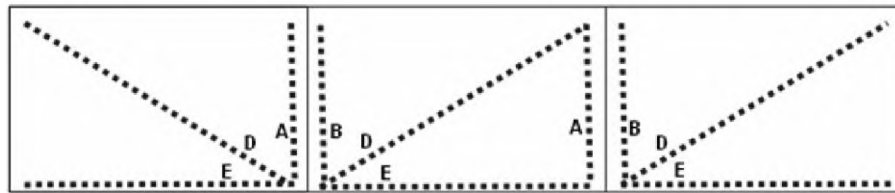
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a. Dipstick



b. Invar rod



c. Surface profile measurement locations

Hki wtg'360Uwtcegr'tqhkrg'o gcuwtgo gpvr cyj u0

vj g'tgwtckpgf "urcd" r tqxkf gu"cp" kpf lecvkp qh'vj g'utguu'vj cv' f gxgnr u'y kj kp'vj g'urcd'y j gp'vj ku'ewxcwtg'ku'tgwtckpgf 0

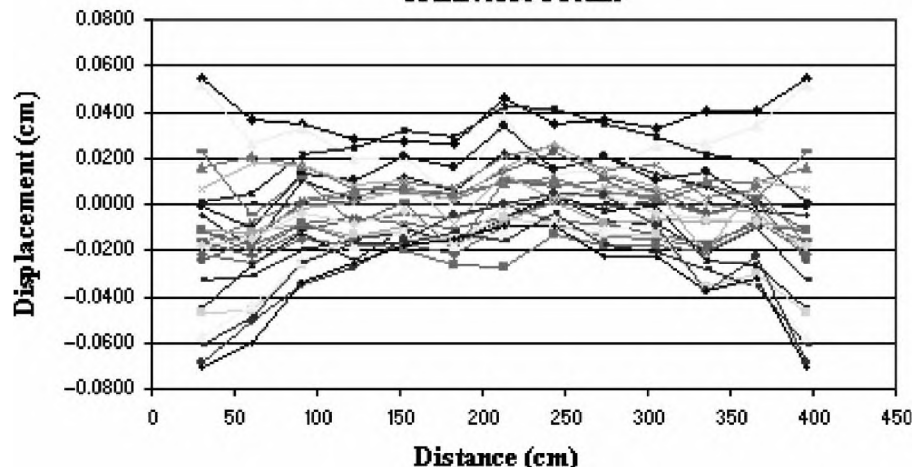
Cpqvj gt"pqvcdng"cur gev'hqwpf "hqt"vj g'vcpuxgtug"lqkp'u"ku' vj cv' vj g' tcvg" kp" kpetgcug" kp" ewxcwtg" y kj " kpetgculpi " gs wxcnpgv'rkpgct"i tcf kpgv"unqr g'qh'vj g'rkpg" hqt"tgwtckpgf " vcpuxgtug" lqkp'u" uggo u" vq" dg" o qtg" wplkqto " vj cp" hqt" wptgwtckpgf "lqkp'u0'kp"vj g'tgwtckpgf "lqkp'u"uj qy p"kp" hki wtg" 45."vj g'vcpuxgtug"r tqhkrg"C"qh'urcd"C"cpf "r tqhkrg"D"qh'urcd" D"ctg"o gcuwtg"qp"qr r qulpi "ukf gu'qh'vj g'lqkp'v'y j krg"r tqhkrg" C"qh'urcd"D"cpf "r tqhkrg"D"qh'urcd"E"ctg"cuq"o gcuwtg"qp" qr r qukg"ukf gu'qh'c"lqkp'0'Qxgtcm'vj g'unqr gu'uggo "uko kret." f gur kg"vj g'rcen'qh'f cv" hqt"j ki j gt"vgo r gtcwtg"o qo gpv0' Nqqnkpi "cv"vj g'vcpuxgtug"r tqhkrgu"o gcuwtg"qp"qr r qukg" ukf gu'qh'vj g'wptgwtckpgf "lqkp'u"r tqhkrgu"o gcuwtg"cmipi "

vj g'lqkp'v' dgy ggp"urcdu"D"cpf "E"gzj kdk'c"urki j vq "rcti gt" unqr g'vj cp"vj g'r tqhkrgu"o gcuwtg"cmipi "vj g'vcpuxgtug"lqkp'v' dgy ggp" urcdu" C" cpf " D0' Vj g' f hgtgpeg" dgy ggp" vj g' ewxcwtg"cmipi " vj g' y q" lqkp'u"ku' vj g'tguwn' qh' vj g'lqkp'v' etcenkpi "r cwgt0'Vj g'lqkp'v' dgy ggp"urcdu"C"cpf "D"etcengf " htu'v'cpf "y cu" c"y kf gt" etcen' vj cp" vj g' etcen' cv' vj g'lqkp'v' dgy ggp"urcdu"D"cpf "E0'Vj g'rcti gt"etcen'qr gplpi "tguwnu'kp" rguu"tgwtckpgf" vj g'tghgtg" c"i tgcvt"co qwpv' qh'ewxcwtg" y knlf gxgnr "hqt"gs wxcnpgv'i tcf kpgv0

Vj g'(/kpvtegr v'ku'f gr gpf gpv'qp"vj g'vko g'vj g'urcd"ugv'cpf " vj g'tguwnkpi "ewxcwtg"ugv'kp'vq"vj g'urcd"v'vkn'kp"ewxcwtg"0' kp" qvj gt" y qtf u." k' ku' vj g' ewxcwtg" r tguwpv' y j gp" c" vgo r gtcwtg"i tcf kpgv'ku'pqv'r tguwpv'kp"vj g'urcd0'Vj ku'y kni'dg" c'hwpv'kp'qh'vj g'vko g'gcej "urcd'y cu'r cxgf."vj g

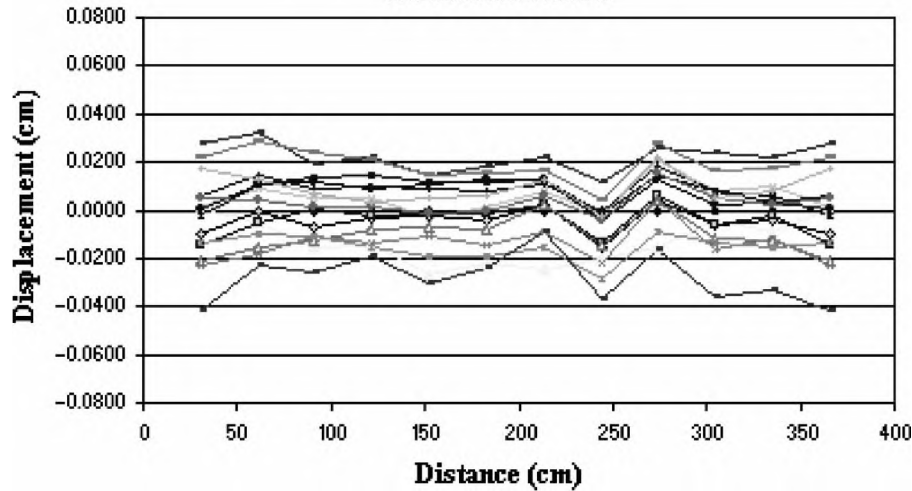
### Cell 3 - Unrestrained Slab B, Line B

#### Transverse Profile



Hki wtg'370Vtcpuvgug'r tqhkrgu'hqt"cp"vptgwtckpgf "urcd0

### Cell 4 - Restrained Slab B, Line B Transverse Profile



Hki wtg'380Vtcpuxgtug'r tqhkgu'hqt'c't'guntckpgf' urcd0

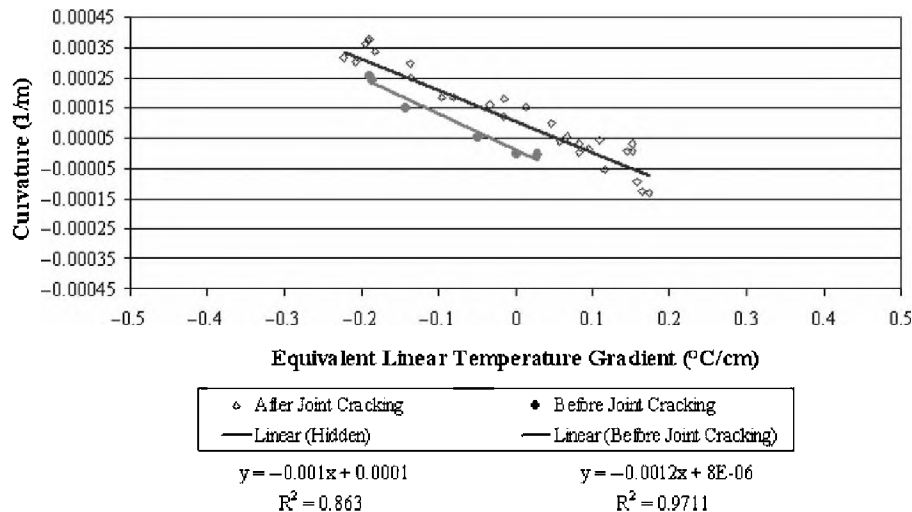
vgo r gtcwtg' i tcf lgpw' vj cv' f gxnqr gf' vj tqwi j qw' vj g' f c { " c p f " vj g' t g u n t c k p v' e q p f k l q p u 0' Vj g' r c t i g u v' d w k n' l p' e w t x c w t g' o g c u w t g f' " c n p i " vj g' f l c i q p c n' h q t' vj g' t g u n t c k p g f' " c p f' v p t g u n t c k p g f' " u r c d u' y c u' 20222346" 3 l o " \* 2022262: " 3 l h v' c p f " 2022235: " 3 l o " \* 20222676" 3 l h v' " t g u r g e v x g n f 0' Vj g' c x g t c i g' d w k n' l p' e w t x c w t g' h q t' vj g' t g u n t c k p g f' " u r c d u' y c u' 20222325" 3 l o " \* 20222559" 3 l h v' y k j " c' u c p f c t f' f g x l c v k p q' q h' 20222485" 3 l o " \* 202222: 86" 3 l h v' 0' Vj g' c x g t c i g' d w k n' l p' e w t x c w t g' h q t' vj g' v p t g u n t c k p g f' " u r c d u' y c u' 20222345" 3 l o " \* 20222627" 3 l h v' y k j " c' u c p f c t f' f g x l c v k p q' q h' 202222364" 3 l o " \* 20222687" 3 l h v' 0

908" Ghgevh'q'gf i g' urcd' vgo r gtcwtg' qp' urcd' ewt x c w t g

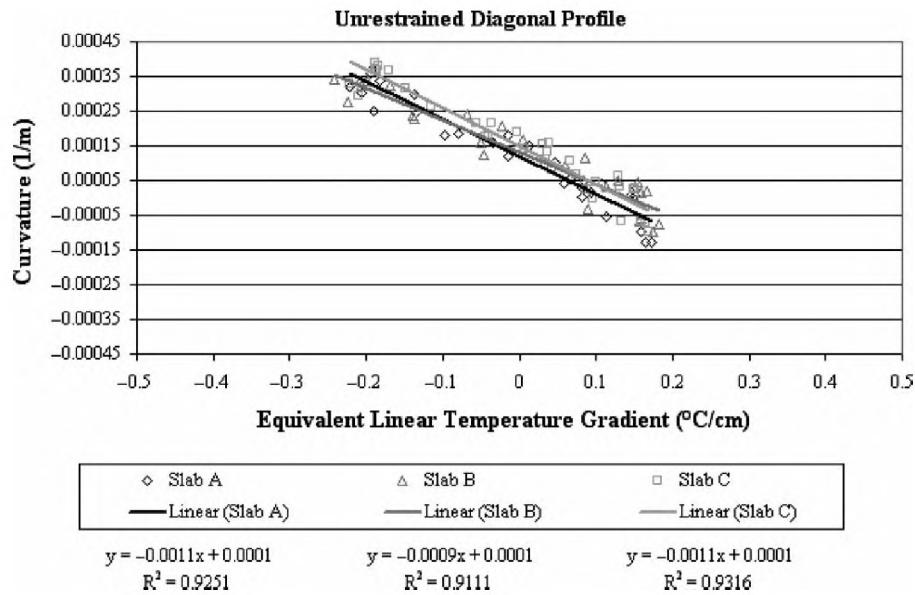
Dghqtg' dgi kppkpi " vj g' c p c n' u k u " vj g' o k f r c p g n' c p f " g f i g' u r c d' vgo r g t c w t g u' y g t g' g x c n c v g f' v q' f g v g t o k p g' y j l e j "

y cu' o q u v' k p h w g p v k c n' q p' u r c d' t g u r q p u g' \* e w t x c w t g - 0' Vj g' vgo r g t c w t g' i t c f l g p w' l p' vj g' r t g e g f k p i " h k i w t g u' y g t g' c m i' d c u g f' " q p' vj g' o k f r c p g n' vj g t o q e q w r g u 0' U l p e g' vj g' n p i k w f k p c n' r t q h k g' y c u' o g c u w t g f' c n p i " vj g' g f i g' q h' vj g' u r c d. " vj g' t g r c v k p u j k r " d g w g g p' g s w k x c n g p v' n k p g c t' vgo r g t c w t g' i t c f l g p w' e c r e w r c v g f' w u l p i " vj g' vj g t o q / e q w r g u' c n p i " vj g' g f i g' q h' vj g' u r c d' y c u' g x c n c v g f 0' Vj g u g' h k i w t g u' y g t g' p q v' k p e n f g f' j g t g' f w g' v q' vj g' u r c e g' r k o k c v k p u 0' K' y c u' c r r c t g p v' d { " vj g' u w d u n c p v k c n' t g f v e v k p p' l p' vj g' e q g h i e l g p v' q h' f g v g t o k p c v k p q. " vj g' t g r c v k p u j k r " d g w g g p' g s w k x c n g p v' n k p g c t' vgo r g t c w t g' i t c f l g p w' e c r e w r c v g f' w u l p i " vj g' vj g t o q e q w r g u' c v' vj g' g f i g' c p f' e w t x c w t g' k u' p q v' p g c t n' " c u' u t q p i " c u' y j g p' w u l p i " vj g' vj g t o q e q w r g u' c v' o k f r c p g n' v q' e c r e w r c v g' g s w k x c n g p v' n k p g c t' vgo r g t c w t g' i t c f l g p w' 0' Vj k u' t g x g c n i' vj c v' vj g' t g u r q p u g' q h' vj g' u r c d' c n p i " vj g' n p i k w f k p c n' g f i g' k u' e q p t q n g f " d { " vj g

### Unrestrained Diagonal Curvature



Hki wtg'390Kwntcvkqp'qh'vj g'tgrcvkpuj kr'dgy ggp'gs w k x c n g p v' n k p g c t' vgo r g t c w t g' i t c f l g p v' c p f' e w t x c w t g' d g h q t g' c p f' c h g t' l q k p v' e t c e n k p i' h q t' vj g' f l c i q p c n' r t q h k g u' q h' vj g' v p t g u n t c k p g f' e g m 0



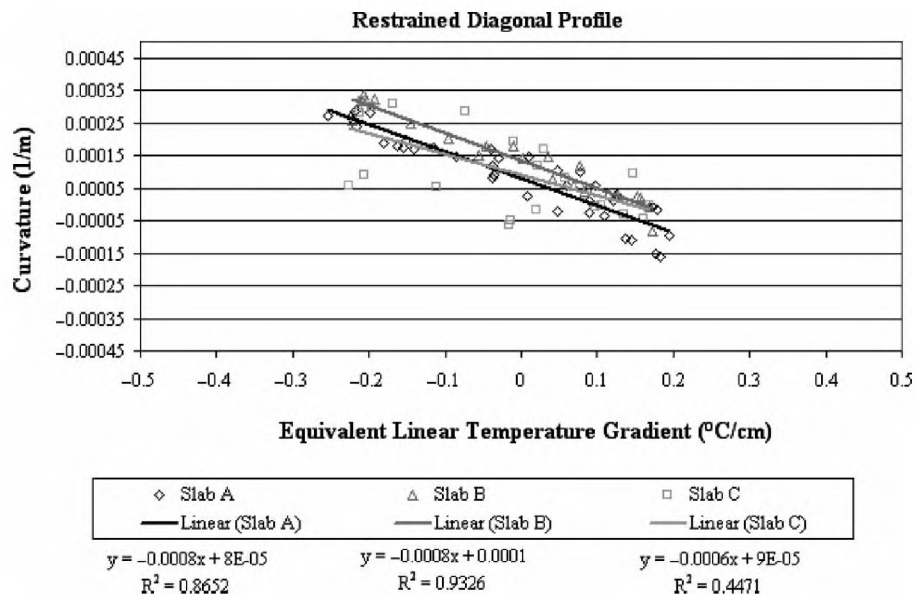
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vgo r gtcwtg' qh' vj g' urcd' cv' o k'f r cpni' o qtg' uq' vj cp' vj g' gfi g0' Vj g' tguwckpgf' egni' uggo u' vq' eqttgrcv' vq' vj g' gs wlxcrnpv' hpget' vgo r gtcwtg' i tcf lgpv' cnpi ' vj g' gfi g' qh' vj g' urcd' g' xgp' ngu' vj cp' vj g' vptgwtckpgf 0

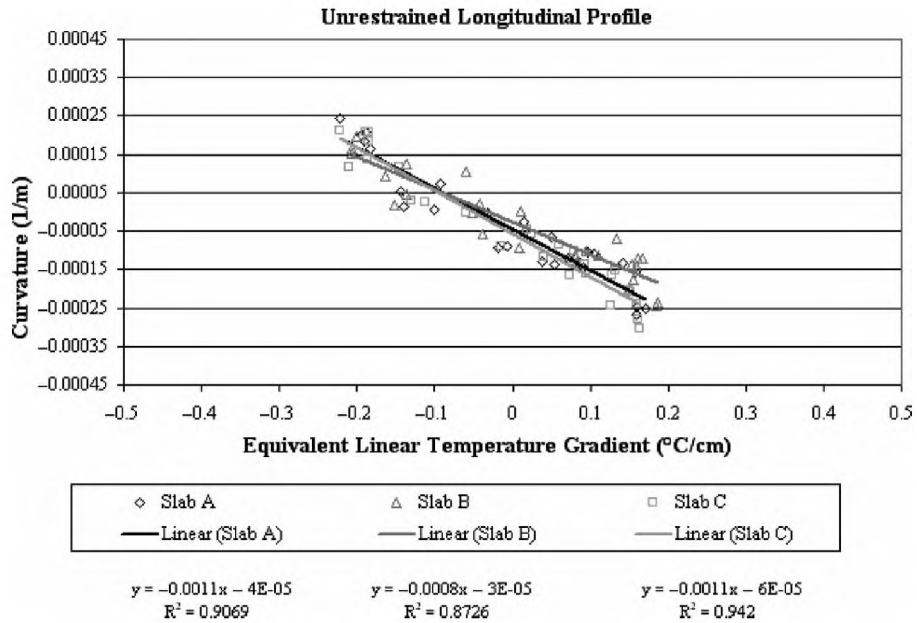
: 0' Eqpenwukpu

Vj g' uwthceg' r tqlhgu' i kg' kpuki j v' kp' vj g' tguw qpug' qh' vj g' r cxgo gpv' vq' gctn' / gpxktqpo gpv'ni' nqcfu' kp' r ctvkwrt' vgo r gtcwtg0' Vj g' gs wlxcrnpv' hpget' vgo r gtcwtg' i tcf lgpv' cv' vj g' vko g' qh' ug' vj cu' EÄ20; îE leo "2077 îHkp00Ukpeg' vj g'

eqpetgvg' ugv' cv' c' vko g' y j gp' rkwg' i tcf lgpv' y cu' r tguwv' c' hwn' tci' g' qh' ewxcwtg' dqv' r qukkxg' cpf' pgi cv' xg' ecp' dg' uggp' kp' vj g' r tqlhgu0' Vj g' rcti guv' dwkn' kp' ewxcwtg' o gcuwtf' cnpi " vj g' f lci qpcri' hqt' vj g' tguwckpgf' cpf' vptgwtckpgf' urdu' y cu' 20222346" 3 lo " \*2022262: " 3 lhw' cpf' 2022235: " 3 lo " \*20222676" 3 lhw' tguw ge' xgn' 0' Vj g' cxgtci g' dwkn' kp' ewxcwtg' hqt' vj g' tguwckpgf' urdu' y cu' 20222325" 3 lo " \*20222559" 3 lhw' y kj " c' ucpf ctf " f gxlcvqp' qh' 202222485" 3 lo " \*20222: 86" 3 lhw' 0' Vj g' cxgtci g' dwkn' kp' ewxcwtg' hqt' vj g' vptgwtckpgf' urdu' y cu' 20222345" 3 lo " \*20222627" 3 lhw' y kj " c' ucpf ctf " f gxlcvqp' qh' 202222364" 3 lo " \*202222687" 3 lhw' 0



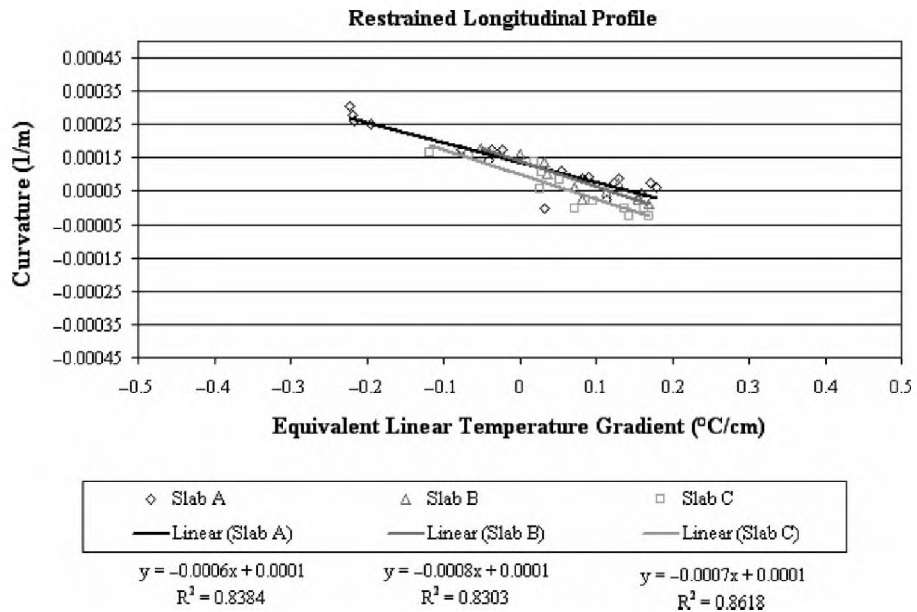
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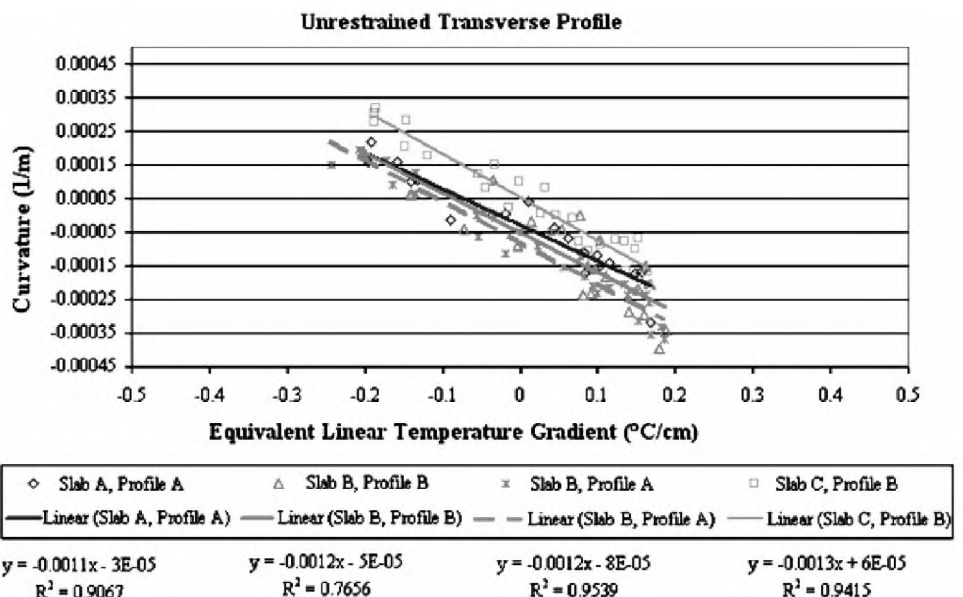
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Vj g'wptg'utckp'gf'urdu'ewtrgf"o qtg"f tco c'kcmf"y kj "c" o wej " r'cti gt" o czko wo " f'kur m'ego gpv" yj cp" yj g" tgutckp'gf" urdu0Vj g'kpetgcug'lp'ewt'xcwtg'y kj "kpetgcug'lp'vgo r gtcwtg" o qo gpv'y cu'9" "j ki j gt'hqt"yj g'wptg'utckp'gf"urdu'eqo r c'tgf" vq"yj g'tgutckp'gf"urdu0Vj g'tgutckp'gf"urdu'r tqh'kgu'ctg'cnuq" i tqw'gf" o wej " o qtg'emugn" vqi g'y gt." lpf'lec'vpi" yj cv" yj g" urdu'o q'xgf" o wej "ngu'cm'pi" yj g'gp'v'g'h'pi yj "q'h'y g'r tqh'kgu'0 Kp" yj g" n'pi kwf lpcn' cpf" v'cpuxgtug" f'k'ge'v'qpu" hqt" dqj" tgutckp'gf" cpf" wptg'utckp'gf"urdu."yj g'r tqh'kgu'lpf'lec'v'f" yj cv" yj g'gf' i gu'buo g'ko gu'd'geqo g'eqo r ng'v'wpuw r qt'v'gf 0

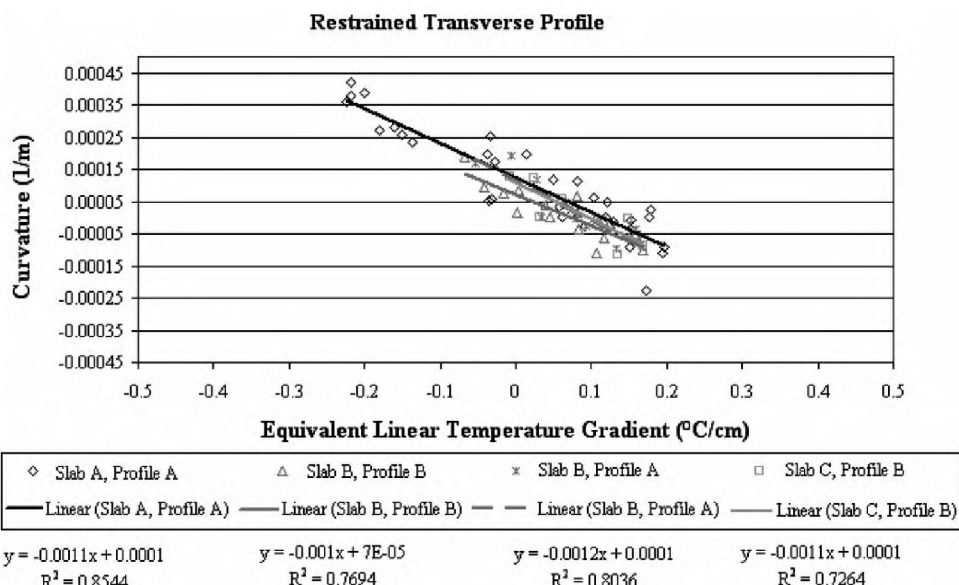
Vcn'kpi "lpvq" ceeqwpv'yj g'ewt'xcwtg'qh'yj g"urdu."k'y cu" qdugt'xgf" yj cv" yj g"urdu" t'gur q'pf" f'k'htg'p'v'q" vq" vgo r gtc/ wtg" i tcf lgpv' d'gh'gt" cpf" ch'gt" ug'v'kpi 0' Nq'qn'kpi" cv" yj g" f'k'htg'p'eg" d'gy ggp" urdu" tgutckp'u." yj g'wptg'utckp'gf" urdu" ewtrgf" o wej " o qtg" w'pf'gt" yj g" uco g" i tcf lgpv' yj cp" yj g" tgutckp'gf" urdu0 Cnu'pi" yj g" v'cpuxgtug" lq'kp'v' hqt" yj g" f'qy g'ngf" urdu." yj g" t'g'v'k'p'uj k'r" d'gy ggp" ewt'xcwtg" cpf" vgo r gtcwtg" o qo gpv" y cu" xgt{" u'ko k'ct0' Cnuq." yj g" urdu" g'zj k'd'kgf" i t'g'c'v'g't ewt'xcwtg" cv" lq'kp'u" y kj" y k'f'gt" etc'mu0



Hki wtg'430Gs wkcncpv'hpget'vgo r gtcwtg'i tcf lgpv'xgtuwu'ewt'xcwtg'hqt'hqpi kwf lpcn'r tqh'kgu'cv'tg'utckp'gf'urdu0



Hli wtg"440Gs wxcnpv"koget"vgo r gtcwtg"i tcf kbpv'xgtuw"ewtxcwtg"hat"t cpuxgtug'r tahkpu'cv"wt gwtckpgf "urdu0



HkI wtg"450Gs wXcrgpv"hpget"vgo r gtcwtg"i tcf kpv"xgtuwl"ewt xcwtg"ht"t cpuxgtug"r tqhkreu"cvlt gwtckpgf"unclu0

Cempqy ngf i go gpwu

Vj g" cwj qtu" y qwf" rkg" vq" vj cpni" vj g" Rgppu{ncpck" F gr ctvo gpv" qh" Vtcur qtvcvqp" \*RGP PFQV+ cpf" vj g" Hgf gtcn" J kj y c{" Cf o kpkvcvqp" \*HJ Y C+ hqt" vj gk" hpcpckcn" cpf" vgej plectn" uwr r qtv0 k" cf f kkp" vj g" cwj qtu" y qwf" rkg" vq" vj cpni" cni" vj g" i tcf wcvg" cpf" wpf gti tcf wcvg" uwf gpv0 vj a'cuukvaf' k' vj g' ego r ncvqp' qh' vj k' talgv0

T g h g t g p e g u

Ej qwdcpq."D0'cpf"Vlc."O0"P qnqpgct"vgo r gctwtg"i tcf lgv"ghhev"qp"  
o czlo wo " y ctr lpi " utguugu" lp" tki kf" r cxgo gpw0' Vtcpu qtcwkp"  
Tguectei "Tgeatf"3592"rr087"6'93.'3: : 4\*Y cui lpi xap."FE-0

I tɕuŋg{.\} /E0/Ncpi g."F(C0/cpf"F0Co dtqule."O(F0) Kɔvɛtɕnɪ tgrɛvkxg"  
j w o k f k f{"cpf"f t t k p i " u t g u u' i t c f l g p u } lp"eqpetgeʒo Rɔqeggf kpi u' qh'  
Gpi kpggtkpi "Eqphgtpegu" Kɔvɛtɕvɛpɕn C f xcepu" kp" Ego gpv' cpf"  
Eqpetgeʒ.KZ."Eq r g T O qwpvcgp."EQ."42250  
I w f g' hqt" O gej cpkute/Go r kkecl' F guki p' qh' P gy " cpf" T gj cdikεvef"  
Rcxgo gpv/Utwewwgd HpcnTgr qtv'P cvkpɕn'Eqr gtcvxg' k j y c l"  
Tgugetej "Rti tei co "3/59C."Vtcpr qtwcvkp'Tgugetej "Dqctf.'P cvkpɕn'  
Tgugetej 'Eqwpek n'O ctej "42260  
J xgo . 'HP O'Urd'y ctr kpi "chfgew'r cxgo gpv/lqkv'r gthto cpeg0Lqwpcn'  
qh'y g' Co grtcp/Eqetgeʒ/kunkwg."3; 73."44\*32+ "Rtqeggf kpi u'X0'69."  
Lyp0  
Lcpung." F0" O qkuwtg" kp" Rqtvcfp" ego gpv' eqpetgeʒo Vtcpr qtwcvkp"  
Tgugetej "Tgeqt f"3343.'3; : 9."Y cij kpi vqp.'FE0  
Lcpung."F(l0/cpf "Up f gt."O(M0)Vj g'sgo r gtcvwtg/o qo gpv'eqpegr v'hqt"  
gxncvwj" r" cxgo gpv' go r gtcvwtg' f'cv0 Vgej plec n'pqv0 Lqwpɕn' qh'  
Khtcutvewtg" Gpi kpggtkpi ."4222."8\*4+."Co grtcp" Ukeqv' qh' Ekkl'  
Gpi lggtu0Tgwup."XC."Lypg'4222.'r r0: 3'6": 50  
Lgpi .l0 Ōepf' qnkpi ct.'F0 d'Gctn'/ci g'ewtnkpi 'cpf'y ctr kpi "dgi cxkt<-  
kuk i ju' itao "c'hw n' kwut w gw' veu'u'd' ul ugo 0'Lawtɕn' qh' i g'

Xcpf gpdqwej g. 'lŋŋ 0'cpf 'l'p f g t. 'O ŋŋ'Eqo r ctkuq'ŋgwy ggp'0 gcuw'g'  
uŋc'd'r tqh'ŋgu'qh'ewŋg'f'r cxgo gpw'cpf'r tqh'ŋgu'i' spgtcvg' 'wupi' 'y j g'  
h'pks' gngo gpw' 0 g'y qf'0: 'y j' h'pgetc'wqpcr' Epqet'gpeg' qp' Epqet'g'  
Rcxgo gpw' F' gpxg'. 'E.Q': 'wi wu'r 0'0377'6'3394'. 42270

Y gmu. 'Uŋŋ 0' Rj knr u. 'Dŋŋ 0'cpf 'Xcpf gpdqwej g. 'lŋŋ 0' 'Uŋŋ 044'uo c'tv'  
r cxgo gpw' r j cug' K' gctn' /ci g' 0 c'vgtkn' r tgr tq'wgu' cpf' r cxgo gpw'  
tgr up'ug' c'cecg'k'wku'ŋt' tq'p'g'f' r n'p' epqet'gpeg' r cxgo gpw' r j cug' K'  
h'p'cn' tgr qtv. 'uŋd kw'g'f' 'y j g' Rgp'u' k'xpc' F' gr c'to gpw' q'p'  
Vtcur q'tv'wq' cpf' 'y j g' t'g'f' c'tn' j j y c' { 'C'fo h'p'wku'g'. 'l'wpg' 42270

Y kugo cp. 'lŋŋ' J ctt. 'O ŋŋ' cpf' 'Ngq'p'f u. 'I ŋŋ' Y c'tr kpi' 'ut'g'wgu' kp'  
eqpet'g' r cxgo gpw' c' r c'tv' h'ŋŋ' j j y c' { 'T'gug'tej' 'D'qct' 'R'qeg'g' kpi u.'  
5; '3; 82'w' j j y c' { 'T'gug'tej' 'D'qct' <Y c'uj kpi' wq'. 'F E-ŋ

[ w' J ŋŋ' cpf' 'Mj c' p'qxqj. 'Nŋ' G'ŋg'w' qh' epqut'w'kpu' ew'ŋpi' 'qp'  
eqpet'g' r cxgo gpw' d'g' c'xkt'0' 9'y j' h'pgetc'wqpcr' Epqet'gpeg' qp'  
Epqet'g' Rcxgo gpw' 'Q'tn'p'f g. 'ŋŋ'. 'U'g' vgo d'g' r 077'6'89'. 42230