KORELASI ANTARA CBR, PI DAN KUAT GESER TANAH LEMPUNG

Mego Purnomo

[illegible]

Abstract: [illegible]

Keywords: [illegible]

Abstrak: [illegible]

Kata kunci: [illegible]

PENDAHULUAN

[illegible]

Klasifikasi Tanah

Batu Kerikil dan Pasir

Lempung

Lanau

Q4n,nOT hnOn T jn mT (ksrlnin T lksn,SOn Tn UnsnT,k(lr mT4n TlnaSST On,ra8T 5rsn mTl,naUShT4n T,khSOT(r4nOT4SSk(hraTnSST 4nsSTln4nT,k(lr mT4n T(k(lks,SOnUin TaSnUT 4S,n UnaSTjn mTUS4niTUks4nlnUTn4nT,k(lr m8T

cS,n UnaST SST (kr /riin T mk/n,nT lksrhnOn T SaST nlnhS,nT ,n nrT SUT 4SrhnOT

Tabel 1. TRnUnan yhnUnan Tirsn Tmb,b mn TUn nOT

gn(nTdb,b mn T	virsn TRrUSn TE((GT			
	5ksSS,T	wnaST	Mh nrT	Mk(lr mT
≥naanoOrakUhaT=aUSUUkTb-TekoO b,bmjTE≥=eGT	<9T	9Ty282–T	282–Ty28229T	W28229T
v8p8TcklnsUk(k Ub-TQmsSSr,UskTEvpcQGT	<9T	9Ty2820T	2820y28229T	W28229T
Q(ksSSn TQaaboSnUSb T-TpUnUkTLSnOCnjTn 4T esn albsUnUSb T–SSSn,aTEQQppLef GT	6–89Ty9T	9y28260T	28260Ty28229T	W28229T
v SSk4TpbS,TB,naaSSSnUSb TpjaUk(TEv8p8TQs(jTBbslaT b-T) mSkksaFTv8p8TRrsknrTb-TkonO,n(nUSb GT	6–89yK8660T	K8660Ty28260T	Ln,raTEjnSUTn nrT4n T ,k(lr mGTW28226OT	

pk,nSThnUnan yhnUnan Trirsn TaklksUST 4SUnaFT4Sk n,T/rmnThnUnan yhnUnan Trirsn T hrUSn TaklksUST4SnCnOTSSTjn mT/rmnT4SniinST akhnmnSTUSSSTUb,niTrirsTr UiTi,naSSnaSTUki SaT 4nsSTUn nO8T

Tabel 2. RnUnayhnUnaTirsn ThrUSn TUn nOT

≥non(Ten nOT	RnUnayRnUnaTvirsn T
Rksn min,TExmbgwdcGT	<1TSoOTE92Tb(GT
5ksnin,TEBmxxgdoimadGT	7TSoOTy1TSoOTE1Ty92Tb(GT
RnUTksSS,TEKqp(dgGT	9T((Ty17TSoOTE9T((Ty11o(G
wnaSTnansT EBmbcodlopaw,GT	28–T((Ty9T((T
wnaSTak4n mT EVdwlbe lopawGT	289T((Ty28–T((T
wnaSTOn,raTEkladlopawG	289T((Ty28–T((T
Mh nrTE,lgiGT	28229T((Ty282–T((T
Mk(lr mTEB,njGT	W28229T((T

pr(hksTTc8F8TMc8Z kaa,kjFE≥kin SnTen nOFT Rn4n Twk kshSTwFD.66T

Sistem KlasIfIkasI Tanah yang Diunifikasi (USCS)

pSaUk(T i,naSSnaST Un nOT jn mT 4S SSnaSn TEeCkTv SSk4TpbS,TB,naaSSSnUSb T pjaUk(GTjn mT4Snr nin Tb,kOTBbslaTVk ST Q minUn TcnsnUTQ(ksSSnFTRSbTlki,n(naST4n T ,nSy,nS8TpSaUk(TSSThksnan,T4nsSTQ8TBnanmsn 4kFT (kk(lnUin TUn nOT4n,n(TD0Tik,b(lbiTjn mT 4SS4k USSnaSn T4k mn T,n(hn mT n(nT4n T Orsr-8T

hk Ui jn8T urmnT ,n nrT nin T(k r /riin T mk/n,nTr UiT(k /n4ST>rSSiTEOS4rlGTnlnhS,nT 4Snr on mnhUnrT4SnkUnsin 8T

wn4nTUnhk,T4SThnCnOTSST4SU /riin T hnUnan yhnUnan Trirsn Tmb,b mn T/k SaTUn nOT jn mT Uk,nOT 4Sk(hn min T b,kOT hkhksnlnT bsmn SanaSTjnSUT4nsST≥=eFTvpcQFTQQpLef T4n T vpBp8T

en nOyUn nOT hkshrUST 4S4k-SSaSSn T akhnmnSTUn nOT4k mn T,khSOT4nsST02Tlksak T hnOn Tjn mT,khSOThkansT4nsSTansSmn Tgb89228T en nOThkshrUSTOn,raT4SnmS(k /n4STUn nOyUn nOT 4k mn Tib(lskaSS,SSnaTsk 4nOTEMGTnUnrTUSmmST EL GST

Sistem Klasifikasi AASHO

≥kUb4kTQQpLf T4SksSn Tb,kOTnabaSnaST lnsaTlk/nhnUT/n,n TsnjnT kmnsnThnmSb TQ(ksSnT EeCkTQ(ksSn TQaaboSnUSb Tb-TpUnUkTLSnOCnjT f–SSSn,aGTc n,n(TpSaUk(TSSFTUn nOT4k mn T4njaT 4rir mT hkhn T jn mT iSnyiSnT an(nT 4S,naSSnaSn T4n,n(TUr/rOTik,b(lbiT4nansFT 4SakhrUakhnmnSTQyDTan(lnS4k mn TQy68T

en nOTUkshnSTr UiTUn nOT4nansT/n,n T snjnT4S,naSSnaSn TakhnmnSTQyDTEjn mTUkshnSGFT ak,n /rUjnTakhnmnSTQTy9T4n TakUksra jn8T

Klasifikasi Tanah dengan Referensi Terhadap Pemampatan

pr,SST r UiT (k mmr nin T aSaUk(T i,naSSnaST Un nOT ib Nk aSb n,T r UiT (kk Uin T(kUb4kTlk(n(lnUn Tjn mTln,SmT akarnST4n T/k SaTlksn,nUn Tlk(n(lnUn 8TpnUT n,nan TI k USmTSh,nOThnOCnT,$ SSTi b aSaUk aST E,$ SSTonSn T4n T,nSy,nS GTj n mT4Sm nin T4n,n(T hkhksnI nT aSaUk(T i,naSSnaST j n mT US4niT hksOrhr mm T ,n mar mT 4k mm T ik(n(I rn T I k(n(I nUh 8T

≥ k rsrUaSaUk(TS SHmsno,naSUh nOT4ST k,b(I bi T=FT =T 4n T ==T 4SUk Ur in 8T v Ur i T ik,b(I bi T≐ FT ikirnUh TUh nOTOnsraT4S irsT(San, jnT4k mm T r/ST,nhbsnUbsS(T(k mk nSTikirnUh TUkin TUS4niT UkshnUha8T 5kirnUh T SUT OnsraT 4S irsT I n4nT in 4r mm TnSTjn mTnin T 4nI nUT 4Sm nin T ak,n(nT k(n(I nUh 8T

Tabel 3. T p SaUk(Ti,naSSnaSTUh nOT4k mm Tsk-ksk aST UksOn4nI T k(n(I nUh T

5k,b(I bi	v snSh T
=T	v sr i n ThnUr n T4n TUh nOThrUSn T4k mm hnUr T4n Tmr,SmThkans[*] T wnaST4n T5ksS S,T[**] T
==T	n8Tc Smn4naShnS T h8Tc Smn4naSF SbS(T M(I rsFUh nOThks,r(I rsFT4,,8T n8Twna ST hksS(I rsFiksS S,T hks,r(I rsF (bsnSkT h8TM(I rsT4n T,r(I rsThks I naSFI naS hks,k(I r mFTksS S,Thks,k(I r mT en nOT,ShUT
≐ T	n8Ten nOT,ShUT4k mm Tikirn Uh Tsk 4nO nUhrTak4n mT[***] T h8Ten nOT,ShUT4k mm Tikirn Uh TUSmmS[****] T

5kUksn mm TOT

[*] ck mm Trsn mT4nsSOTyD2T≤ T4nsUhnOn Tjn mT =kh=OT koS,T4nsS2F2–T((T

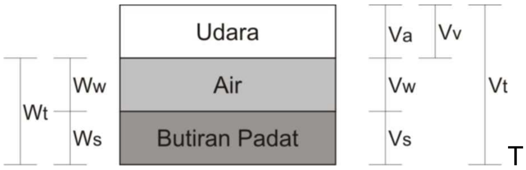
[**] 5kirnUh TUkin TUS4niTUkshnUhaTW2F9T≥ I nT

[***] 5kirnUh TUkin TUS4niTUkshnUhaT<T2F9T≥ I nT

5k,b(I bi T=T4n T=FTj n mTUks4SST4nsTh,bi T EhnUr mr,SmGTThnUr TEEksni n,GTTiksS S,TnUhr TI naST n4n,nOTUh nOyUh nOT b Ti bOkaST4n ThkhnaTnS8T 5k,b(I bi TSSThShan jnTakhnmmSThnOn Trsrin T 4n Tsk,nUST(r4nOT4$ n(I nUn 8Tpk/r(,nOTi koST hrUSn T On,raT E,r(I rsT 4n T ,k(I r mGT 4nI nUT 4SUks$ nT4n,n(TUh nOyUh nOT j n mTUks(nari Tn4nT ik,b(I bi TFT4n T=8T

Sifat-Sifat Umum Tanah

en nOT Uks4SST4nsT 4rnT hnmSh FTjnSUT hnmSh Tl n4nUT4n Thnm Sh Tsb mmnTEbsSSTRnmSh T jn mTn4nUTUks4SST4nsShkhksnI nTnsUSk,yI nsUSk,T I n4nUFTak4n min Thnm Sh Tsb mmnTUks4SST4nsST hnm Sh TonST4n Thnm Sh Tr 4nsn8T



Gambar 1. T r hr mm Th UhsnThksnU4n TNb,r(kT n4nT ib(I baSaSUh nOT

v Ur i T(k(hrnUOrhr mm TNb,r(kyhksnUT nmskmnUUh nOTUSmT-nakTEn4nUFTnST4n Tr4nsnGFT k,k(k TUh nOT4$ SanOin TakI ksUSmn(hnsT4SnUha8T *b,r(kTUbUh,TUh nOT4S jnUhin Tak hnmmShks SrUOT

$$
\begin{aligned}
W &= W_b + W_(\\
&= W_b + W_h + W_p
\end{aligned}
$$

ikUksn mm TOT

Wbl 1lWmgbe dlxbilcpalr pwpil
W(ll 1lWmgbe dlr mdl
Whll 1lWmgbe dlpldwpgpe lr mdl
Wpll 1lWmgbe dlbwpcplwpgpe r mdl

QI nhS,nT r 4nsnT 4Sh mmnI T US4niT (k(I r j nSThksnUFT(ninThksnUTUbUh,T4nsSTob UbOT Uh nOTn4n,nOTOT

$$\%i = \%o + \%h$$

ikUksn mm TOT

%il 1lRdcpilimipgxbildipap. l
%oll 1lRdcpilxbilcpalipap. l
%h ll1lRdcpilpld

l

Angka Pori (*e*)

Q4n,nOTI kshn 4Sm TNb,r(kTsb mmnTW(T UksOn4nI TNb,r(kThr USTUh nOTWbT I n4nTar nUr T Nb,r(kTUksUk Ur 8T

$$d = \frac{W(}{Wb}$$

Kadar Air (*w*)

Q4n,nOTI kshn 4Sm Tn UhsnThksnUTnST Z CTUksOn4nI ThksnU4nsShrUSTUh nOT%o8T

$$d = \frac{\%h}{\%o} \times 344j$$

$$\% = Ko =) \times d$$

i kUktsn mn TOT

Kol 1lRdqpilor dold/ lxbilqpalr pwpil
) l 1lHdqplpil/ dLdab. pal

l

Derajat Kejenuhan (*S*)/

Q4n,nOTI kshn 4Smn Tn UnsnThkans jnT Nb,r(kTnSSTCTUksOn4nlTNb,r(kTsb mmnTW(8T

$$) = \frac{Wh}{W6} \times 344j$$ T

T

Berat Volume Kering (*pd*)

Q4n,nOT OnsmnT I kshn 4Smn T n UnsnT hksnUT i ksSmT 4nsSThrUSn TUn nOTIksTanUn T Nb,r(kTUn nO8T

$$vw = \frac{W(}{W6}$$ T

T

Batas-Batas Konsistensi

en nOThkshrUSSTjn mT4Sn(I rsTnSST4nlnUT 4Sk(naysk(naTUn InT(k $ hr,in T skUnin 8T pSnUT i bOkaST SST 4nlnUT 4Sakhnhin T insk nT n4n jnThSSTjn mTUksaksnIT4Sakik,SSmT ks(rinn T InsUSk,T,k(Ir m8T5k(r4Sn T/SnTon(Irsn TSST 4$kshb,kOin T(k /n4STiksSmTi k(hn,STakonsnT ak4$SST4k(STak4$SSFUn nOTSSTnin T(k,n,rST hkhksnInTUnOnITikn4nn T4nsSTikn4nn TonSST an(InSTikn4nn TiksnaST 5kn4nn yikn4nn T Uksakhr UT4Sn(hnsin T4n,n(Thnmn T4SThnCnOT SSST

T

Gambar 2. RnUnaynnUnaTb aSUk aST

n8TRnUnaTBn=ST *lublwl' ge liP'* GT

≥ ksrInin Tin4nsTnSSTUn nOTn UnsnTikn4nn T onSST4n Tkn4nn T,naUSa8T

h8TRnUnaTw,naUSaTEw,naUSaTM(SSRwMGT

≥ ksrInin Tin4nsTnSSTIn4nThnUnaThnCnOT 4nksnOT,naUSa8T

o8TRnUnaTMk mikUTEpUSaij TM$ SSGT

5n4nsTnSST4$ n nTUn nOTikOSn mn TaSnUT n4OkaSjnT4n TUS4niT4nlnUT,k mikUT,nmSTn4nT hk 4nT,nS jnTaklksUST/nsSTnUnrTIks(rinn T jn mTOn,raT4nsST,bmn(8TRnUnaTSSThksmr nT In4nTIkiks/nn ylkiks/nn TUn nOFTinsk nT UnOn n TTn4nTn,nUTk mmnsrTnin ThksUn(hnOT nInhSnTUn nOTorirIThnanOTr UriT(k /n4ST ,k mikUST

48TRnUnaT5bOkaSEBbOkaSb TM$ SSGT

5n4nsTnSST4$ n nThrUSn TUn nOTUS4niT4nlnUT (k,kinUT ,nmSFTjnSST4$ n nTIk mn(hSn T Un nOTUS4niT4nlnUT(k mOnaSIn T,k(Ik mn y ,k(Ik mn TJn mThksanUn8T

k8T= 4kiaTw,naUSaTEw,naUSaSSJT= 4kqPw=GT

pk,SaSOTn UnsnThnUnaTonSST4n ThnUnaTI,naUSaT n4n,nOT4nksnOT4$ n nTUn nOTUksakhrUT4n,n(T ikn4nn T,naUSa8T

$vr = '' - v'$ T

-8T = 4kiaT5konSn TEMSYr S4SSJT= 4kqPM=GT

5n4nsTnSSTUn nOT4n,n(Tikn4nn Tna,SjnT hSan jnTUks,kUniTn UnsnThnUnaTI,naUSaT4n T hnUnaTonSS8T

$$'n = \frac{\% - v'}{'' - v'} = \frac{\% - v'}{rv}$$ T

gSnSTM=Thksi SansTn UnsnT2TyTD8Tpk(ni SThkansT SnST M=TUn nOTnin Tak(niST,r niT4n T akhn,$ jnTak(niSTikoST SnSTM=TUn nOTnin T ak(niSTnirPk jn,8T

m8T= 4kiaT5b aSUk aSE=BGT

gSnSTS4kiaTib aSUk aSThksi SansTn UnsnT2T an(InST4k mn TD8Tg SnSTS4kiaTSST4S4nlnUT 4nsSSr(raTakhnmnShksSr UTJnSST

$$rt = \frac{m - \%}{rv}$$ T

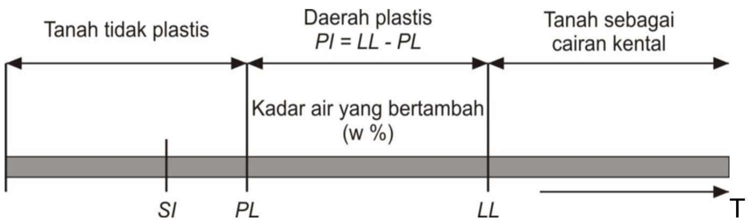
Tabel 4. Tenhk,Tb aSUk aS4n,n(T*qpasdlr goilt* T

5b aSUk aST 4n,n(Tsn mkT I,naUSaT	MST	=oT	5kUktsn mn T
pn mnUT,r ni¯	D8xTyT28T	2TyT28T	xRnUnaTBnSST
Mr niT	28TyT28T	28TyT26T	xxRnUnaTw,naUS¯
5nirPk jn,T	28TyT2T	26TyTD8xx¯	T

C8TRnUhaTwk mksr Uh TEpCsS i nmkTM$ S$PpMGT

en nOT nin T (k jrar UT nI nh$nT nS$T jn mT 4$n 4r m jnTakonsnTI ks,nCh y,nCh TC$h m8T ck mn TC$h m jnTnS$Takonsn TUksr aT(k ksr aFT Uh nOT nin T (k onI nST arnUrT U$minUT ikak$ hn mn T 4$ n nT I k n(hnCh T ikC$h mn T nS$T U$ni T nin T (k jkhnhin T I ksr hnCh T Nb,r (k8T 5n4nsT nS$T 4Sj nUhin T 4n,n(TI ksak FT4$ n nTI ksr hnCh T Nb,r (kT arnUrT Uh nOT hksCk U$T 5n4nsT nS$FT jn mT 4$4k-S$a$n T I n4nT 4ksn/nUT ik/k r Ch T 3T D22≤ FT4$ n nTr UrI T hy hT4$nCnO jnT U$ni Tni n TUks4nI nUTI ksr hnCh TNb,r (kTUh nOT

h$nT 4$ksSmin T Uksr a8T RnUhaT S$T orirIT I k U$mT4$T4nksnOTjn mTiksSmT4n Tr UrI T Uh nOT /k S$T UksUk UrT jn mT (k mn,n(ST I ksr hnCh TNb,r (kTjn mTorirI Thkans T4k mn T hksr hnO jnT in4nsT nS$T LnsraT 4$kUhCr,T hnCCnTnI nh$nThnUhaTar ar UTS ST(ni STi koSFT (ninTUh nOTnin T,kh$OT(r4nOT(k mn,n(ST I ksr hnCh TNb,r (kFTjn$UTak(ni STi koSTpMFT ak(ni STak4STnS$Tjn mT4$r UrCi n Tr UrI T 4nI nUT (k mr hnOT Nb,r (k8T Rks$r UT n4n,nOT ,bina$,bi naStk,nU$T4nsS$MFTwMT4n TpMT n4nT ar nUrTpi n,nTn4nsTnS$8T



Gambar 3. RnUhaT k mksr Uh T

RnUhaTar ar UT4Sj nUhin T4k mn TonsnTakhnmnST hks$r UTT

$) ' = h rI\$ \ J - h I\$ \ J$ T

i kUksn mn TT

C=T3Tn4nsTnS$TUh nOT(r,ny(r,nTI n4nTannUT 4$Uk(I nUn T4n,n(T(n mibi Tr/SThnUhaT ar ar U8T

CT3TksrhnCh Tin4nsTnST,nUTn UhsnTin4nsT nS$T(r,ny(r,nT4k mn Tin4nsTnS$TI n4nT annUTar ar U8T

$$h rI\$ \ J = \frac{V_3 - V_0}{V_0} \times 344j \quad T$$

i kUksn mn TT

$$) ' \emptyset = \frac{S V_3 - V_0 J \times , \%}{V_0} \times 344j \quad - \frac{S V_3 - V_0 J \times , \%}{V_0} \times 344j \quad T$$

V_3T3T naanTUh nOThnanOT4n,n(TonCn ThkaST I n4nTannUTks(r,nn T k mr/S$ TEmsn(GT

V_0T3T naanT Uh nOT ikjSmT 4n,n(T onCn T akUk,nOT4$Nk TEmsn(GT

$$h I\$ \ J = \frac{S Wh - Wq J \times , \%}{V_0} \times 344j \quad T$$

i kUksn mn TT

WT 3T b,r (kT f b UbOT Uh nOT hnanOT I n4nT aknUT I ks(r,nn Tob UbOTI k mr/S$ T3T Nb,r (kTonCn TEooGT

WqT 3T b,r (kTUh nOTi ksSmTakUk,nOT4$Nk T EooGT

$, \%$T3T5ksnI nUh TnS$T3TDTmsPoo8T

≥ ni nT4$4nI nUTr UrI TI ksC$U mn ThnUhaTar4r UT EaCsS i nmkT$ S$PpMGT

S$T Qi U$S$haT

ekI $UkI ST (Sksn,T ,k(I r mT (k(I r jnST (rnUh T kmnU$T kUbb8T = ST (k mni $nUn T Uks/n4SjnT ranCnT r UrI T (k jk$ hn min T

(rnUh T4k mn TUh(hnCh TnU$ 8TQi UShaTS ST h$nT4$r (rai n Takhnmnhksr UT

$$C/il(lipoll = \frac{vn}{v \, \text{cmodaipodl'} \, de \, r \, bas} \quad T$$

= 4$ nUbsTni U$$UhaTj n mT,khSOTI sni U$aTn4n,nOT hnUhaTar ar U8TRnUhaTar ar UTn4n,nOThnUhaTi n4nsT n$Takhk,r (TUks/n4S j nTI ksr hnOn TNb,r (k8T Qi U$$UhaT4n,n(Ti nSUh j nT4k mn TI ksr hnOn T Nb,r (kT (ksr I nin T I ksU$ hn mn T r Uh(nT 4n,n(T (k mkNh,r naST Uh nOT j n mT nin T 4$ ni nS4n,n(TI ki ks/nn TUh nOT4k Tl b 4naS8T pkhnmSh Thkans T,k(I r mThin T(k mk(hn mT hS,nT/k r O8T

Kekuatan Geser Tanah

5ki r nUh TmkaksTUh nOT4$ ks,r i n Tr Ui T (k mOSU mT 4nj nT 4ri r mT Uh nOT EhknsS mT onI naS$JGFT Ukmn mn T Uh nOT UksOn4nI T 4S 4S mT I k nOn T EknsUOT I skaar skGFT 4n T i kakUhhS,n T ,ksk mTEa,bI kTaUhhS$JG8T5ki r nUh TmkaksTUh nOT Uks4S$4nsS4r nT nsn(kUksFTj nSUTOT

D8TRnmSh T j n mT hksaSnUT i bOkaST EBGFT j n mT Uksmn Ur mT I n4nT (non(T Uh nOT 4n T i kI n4nUh j n8T

98TRnmSh T j n mT (k(I r j nST aSnUT mkaki n PsSbUS n,T j n mT akhn 4S mT4k mn T Ukmn mn T k-ki U$T EsGT j n mT hki ks/nT I n4nT 4S 4S mTmkaks8T5ki r nUh TmkaksTUh nOT4nI nUT 4S j nUhi n T4k mn Tsr (raTakhnmnShks$r UTOT

$) = t\emptyset Sv - bJipa\phi\emptyset T$

i kUksn mn TOT

) II 1Dd/ bpipalsdodd
v II 1f dspaspal imipgl r pwpl wlawlasl sdodd bl idspaspalpldr mdgl
t Ø 1Dm dollipap. l
' dl1) bwbilr dqph papalsdodd

l

Teori Daya Dukung Terzaghi

wn4nTr (r (j nTI ksan(nn TUkbsS4nj nT 4ri r mT eksAnmOST 4Sr nin T r Ui T I b 4naST 4n mi n,FT4$ n nTc TWTR8Tekbs$TS ST4S4nansi n T I n4nTn mmI n ThnOCnTi ki r nUh TmkaksTUh nOT 4nI nU4S j nUhi n T4k mn Tsr (raTOT

$) = t\emptyset\alpha ipa\phi T$

i kUksn mn TOT

) II 1V d/ bpipalsdoddipap. l
NI 1f dspaspalamce pqlr pwplxlwpaslsdodd
t dl 1Dm doll
+ II 1) bwbilr dqph papalsdodd

ekbsSTUksAnmOSTS ST(k mOnaS,n TakhrnOT sr (raT4nj nT4ri r mTUh nOTakhnmnShks$r UTOT

$u = t\,Yt + HYu + \frac{3}{0}, RY,\ ipa\,\phi\ T$

i kUksn mn TOT

ul 1wp, pl wb/ basl ipap. l SMgle pidl Rdpdasl Bpr pt li, JIRI1I' dxpdr mawpoll
HII 1Ddwpgpe palr mawpoll
, II 1Rdqpilnollipap. l
t II 1Dm dogl

gOFTgYFT4n TgjTn4n,nOT-niUbsT4njnT 4ri r mTj n mTUksmn Ur mTI n4nThkans j nTar 4r UT I ks,nCn n Tmkaks8T

c nsSTsr (raTUksakhrUTaSnUTUh nOTj n mT I ks,r T4$ kUhOr STr Ui T(k k Ui n T4nj nT4ri r mT Uh nOT n4n,nOT hksnUT SaST Ej,GFT 4n T i b aUh UhT i ki r nUh TmkaksToT4n T28TRksUh(hnO j nTOnsmnFT (ni nT 4nj nT 4ri r mT Uh nOT hksUh(hnOT I r,n8T wksan(nn TSU T4nI nUTr mnT4Sr nin Tr Ui TnaST I n4nUFTksnin,T4n T,k(I r mTksna8T

METODOLOGI PENELITIAN

T ≥ kUb4kT j n mT 4Sr nin T j nSUT I k 4ki nUh Tr aUhi nT4n T(kUb4kTarsNkj8T

n8T5n/Sh Twr aUhi nT

wk 4ki nUh Tj n mT4Sh mmI Tak4rnST4n,n(T (k mn n,SnT4nj nT4ri r mTUh nOFTaUhhS$UhaT ,ksk mT4n TI k(konOn j n8Twr aUhi nTj n mT 4$ ni nSn4n,nOT,$UksnUr sT(k mk nST≥ ki n $nT en nOFTun,n TI nj nFTpUhhS$anaSTUh nOT4n T ,nS y,nS 8T

h8T≥ kUb4kTpr sNkj T

pr sNkj T j n mT 4S,ni r i n T n4n,nOT ar sNkj T ,nI n mn 8Tc nUhTj n mT4$ ksb,kOThksr I nT4nUhT I s$ ksT4n Takir 4ks8T

D8Tc nUhTws$ ksT

n mTUks(nar i T4nUhTI s$ ksT4SaS STn4n,nOT

4nUhT(k mk nST ib 4SaSFT aSnUyaSnUT aksUhT /k SaT Uh nOT I n4nT ,bi naST I k jk,S4Sn FT jn mT 4S4nI nUT (k,n,rST I k jk,S4Sn T 4ShI n mn T 4n T 4ST ,nhbsnUbsS(8T wk jk,S4Sn TSSTni n T(k(hn UT r UiT (k mn n,SanTaUhh,SShaT,ksk mT4n T4njnT 4ri r mT Uh nO8T Mbi naST I k k,SSh Tjn mT 4Sh(hSTn4n,nOT,$ nT,bi naSBTMbi naSy,bi naST Uksakhr UT wr on mT d n4S mT Epk(nsn mGFT un,n T wk4rsr mn ydk ri T Epk(nsn mGFT 5nsn mnCk T Eck(ni GFT d rhr mT EwrsCb4n4SSFd b4b mEwrsCb4n4SSST

98Tc nUhTpki r 4ksT

cnUhT aki r 4ksT (ksrI ni n T 4nUhT I k 4ri r mT4nsST4nUhTI s$ ks8Tc nsST4nUhT aki r 4ksTSST4nI nUT4S kUhOr SThkans jnT hkhn T 4n T -niUbsT ,nST jn mT (k(I k mnsr OST4njnT4ri r mTUh nOT4n T aUhh,SSanaSTksk m8T

HASIL PENELITIAN

T ck mn T(k,niri n TI k jk,S4Sn T4n T n n,SanT4nUhFThnST4ST ,nI n mn T(nrI r T4ST ,nhbsnUbsS(T (k mk nST insni UksSaUST Uh nOFT (ni nT4SOnsnI i n Tni n T4Sksb,kOT4nUhTjn mT ni rsnUT UiTkI ks,rn TarnUTksk on nn 8T

T Z n,nrI r T akhk ns jnT I k k Un T insnaUksSaUST Uh nOTakonsnTI naUSTori rI Tar,SSFT (k mSmnUThkhksnI nTi n 4r mn ThnOn TUh nOT an mnUTari nsT4SUk Uin T4n Tsr(SSTgn(r T akonsnTUki SaTFTI k jk,S4Sn TT4n TI k mr/Sh T Uh nOThnST4ST,nI n mn T(nrI r T4ST,nhbsnUbsS(T ori rI T4nI nUT4Sr ni n TakhnmnSTnorn Tr Ui(T i kI ks,rn TarnUTksk on nn 8Tc ShnCnOTSSTOnaST I k k,SSh T,nhbsnUbsS(T(k mk nST inski UksSaUST Uh nOTPT

Tabel 5. LnaSTwksobhnn TpbSTekaUT nUhyI nUhT

v arsTjn mT 4SUk,SST	cnksnOTwk k,SSh T				
	wrsCb4n4ST		pk(nsn mT		ck(ni T
	d b4b mT	d rhr mT	dk ri T	wo8Td n4S m1	5s8TQCk T
5n4nsTh SEECGE T	7K80KT	9686. T	9080T	77809T	79890T
pI kaSSTd sn-SJT	9870T	98K9T	98KKT	980–T	980–T
v SCk ShnOUTmsP([7]T	D8K1T	D871T	D8K6T	D802T	D8K6T
Z kUTc k aSJTmsP([7]T	28-7T	28-KT	28-. T	28-1T	28-1T
csjTc k aSJTmsP([7T]	D8D2T	D82. T	D8D6T	D8D9T	D8DDT
wbsbaShaTE T	0789DT	00826T	0D8 0T	0–826T	0–8-7T
Q mi nTwbsST	D8DKT	D897T	D821T	D891T	D87DT

T

Tabel 6. TLnaSTwksobhnn TQUkshksmTM$ SUT nUhysnUhT

v arsTjn mT 4SUk,SST	cnksnOTwk k,SSh T				
	wrsCb4n4ST		pk(nsn mT		ck(ni T
	d b4b mT	d rhr mT	dk ri T	wo8Td n4S m1	5s8TQCk T
w,naUSTE 4kqTE T	–D8DKT	K–827T	7. 87KT	778620T	0982–T

T

Tabel 7. TLnaSTwksobhnn TBRI TekaUT nUhysnUhT

v arsTjn mT 4SUk,SST	cnksnOTwk k,SSh T				
	wrsCb4n4ST		pk(nsn mT		ck(ni T
	d b4b mT	d rhr mT	dk ri T	wo8Td n4S m1	5s8TQCk T
BRI TED2Twri r,n GT	K80K7T	K8120T	K89–0T	K81660T	081T
BRI TE90Twri r,n GT	6861T	6810T	1861T	18600T	68K6T
BRI TED0Twri r,n GT	D2861T	D28KK0T	98770T	D781D0T	18 K0T

T

Tabel 8. TLnaSTwksobhnn TBRI Tc kaSh T nUhysnUhT

v arsTjn mT 4SUk,SST	cnksnOTwk k,SSh T				
	wrsCb4n4ST		pk(nsn mT		ck(ni T
	d b4b mT	d rhr mT	dk ri T	wo8Td n4S m1	5s8TQCk T
BRI T4kaSh T	18K0T	18660T	68090T	. 81T	. 8-T

Tabel 9.TL naSTwksobhnn Tc SkoUTp CknsTekaUT nUhysnUhThkhn TFT

v ar sTj n mT 4SUk,SSST	cnksnOTwk k,SSSh T				
	wr sCb4n4ST		pk(nsn mT		ck(ni T
	d b4b mT	d r hr mT	d k ri T	wo8Td n4S m1	5 s8TQCk T
5 bCkaSTEB GT mPo(9T	28760T	28K60T	28KDT	28KK0T	28DKT
pr 4r UTd kaksTc n,n(TE+ 2G	9780T	99T	9280T	97T	97T

T

Tabel 10.TL naSTwksobhnn Tc SkoUTp CknsTekaUT nUhysnUhThkhn TFFT

v ar sTj n mT 4SUk,SSST	cnksnOTwk k,SSSh T				
	wr sCb4n4ST		pk(nsn mT		ck(ni T
	d b4b mT	d r hr mT	d k ri T	wo8Td n4S m1	5 s8TQCk T
5 bCkaSTEB GT mPo(9T	2810T	2810T	28 7T	28 90T	2869T
pr 4r UTd kaksTc n,n(TE+ 2G	9980T	9–890T	9180T	9. T	96T

T

Tabel 6.11.TL naSTwksobhnn Tc SkoUTp CknsTekaUT nUhysnUhThkhn TFFFT

v ar sTj n mT 4SUk,SSST	cnksnOTwk k,SSSh T				
	wr sCb4n4ST		pk(nsn mT		ck(ni T
	d b4b mT	d r hr mT	d k ri T	wo8Td n4S m1	5 s8TQCk T
5 bCkaSTEB GT mPo(9T	D8790T	D890T	D869T	D8 T	D8260T
pr 4r UTd kaksTc n,n(TE+ 2G	7D80T	79T	77T	70T	9–T

T

cnsT OnaST l k k,SSSh T UksakhrUT 4SnUhaT Uh nOT ,k(l r mT Uksmb,b mT 4n,n(T i k,b(l bi T ,k(l r mT j n mT (k(l r j nST l bUk aST l ksr hnOn T Nb,r (kT j n mT or i r l T USmmST insk nT snUhysnUhT (k(l r j nST w,naUSST = 4kqT Ew=G928T en nOT ,k(l r mT ni n T(k mn,n(ST l k(r nSh Ti k$nTnSST hksUh(hnOT4nsSSk-ksk aSj n8Twk j r ar Uh TUks/n4ST i kUSnTn4nsTnSThksi r sn mT4nsST $nSSk-ksk aSj nT an(l nST hnUhaT ar ar US8T en nOT ,k(l r mT SST (k(l r j nST l ksr hnOn T Nb,r (kT j n mT hkansT Eki al n aSG8T

cnsTOnaST l k k,SSSh T4nl nUT4Sa$ l r ,i n T hnOCnTak(ni S TUh nOT,k(l r mT4$n4nUn T $nST BRl Tak(ni S ThkansT4n Ti ki r nUh Tmkaks j nT ak(ni S ThkansTr ,n8T

cn,n(Tl k k,SSSh TSSTw,naUSST= 4kqTEw=GT (k(l k mnsr OSTOnaSTBRl FTak(ni S ThkansTw=T (ni nT $nST BRl T ak(ni S T i koST 4n T hkmSUT akhn,$ j n8Tpk,nS TSUTw=T(k(l k mnsr OSTaSnUT (k mk(hn mT 4n T (k j r ar UT 4nsST Uh nOT ,k(l r m8TRS$nTUh nOT,k(l r mTUksakhrUTUks4nl nUT (Sksn,T,nSTT(San, j nTn,n nr TnUhr l r TnaSThi n T (k j khnhi n T Uh nOT UksakhrUT (k(l r j nST w,naUSST = 4kqT ak(i nST i koST 4n T $nST BRl T

hksUh(hnOT hkansT /$nT 4$n 4S m i n T4k mn T Uh nOT,k(l r mThna,SST

cn,n(T aUhh,SSanaST Uh nOT ,k(l r mFT i Orara j nTUh nOT,k(l r mTkial n aSTUr/r n j nT j nSUTak,nS T(k S mi nUn T4nj nT4r i r mTUh nOT n4n,nOT(k r sr i n Tw,naUSST= 4kq j nT4k mn T (k on(l r sThnOn Tj n mTk-ki USST4n Tki b b(SaT j nSUT (San, j nT ФT l k n(hnOl n T hnOn T l k on(l r sTakl ksUST mn(l S mT j n mT UksOS4snaST E(nUSSST RSan j nT l k n(hnOn T akhn j ni T 9T an(l nSTKTl ksak Tni n T(k mr sn mSTw=Tan(l nST i r sn mT 4nsST 928T c k mn Thksi r sn m j nT $nST w,naUSST= 4kqTSSTni n T(k mr sn mSTl r ,nTaSnUT (k mk(hn mT4n T(k j r ar UjnTj n mTUks,n,r T hkansFTakOS mmmTUh nOT4n,n(Tkn4nn TaUhh,S8T

cnsSTOnaST l k k,SSSh T4$ksb,kOT $nSTar 4r UT mkaksTUh nOT,k(l r mT4nksnOTd b4b mFTd r hr mFT 5nsn mnCk FT wr on mmm4S mFT 4n T d k ri T hksi SansTn UhsnTD. 2Tan(l nST76[2]8TT

pk(ni S T(k S mi nUj nT w,naUSST = 4kqT ni n T(k j khnhi n Tar 4r UT mkaksT 4n,n(T4nsST Uh nOT ,k(l r mT ni n T ak(ni S T i koS8T wn4nT l k k,SSSh Ti ki r nUh TmkaksTr Ur i TUh nOT,k(l r mT j n mT4$n4nUn Tar 4r UTmkaks j nThksn4nTl n4nT ar 4r UT mkaksT (ni a$ r(T /SnT 4$n 4S mi n T 4k mn T I ksobhnn T 5k kjT r UiT Un nOT ,k(I r mTna,STEr 4SUshk4GT4n TUn nOT,k(I r mT Uksk(naTEsk(b,4k4GTun4STUn nOT,k(I r mTjn mT 4$n4nUn Tni n T(k(I r jnSTar 4r UTmkaksTjn mT ,kh$OThkansT4n Thkm$UTI r ,nT $nSTBRI jnTni n T (k SminUTI r ,nTOn,TS S4nI nUT4$ri U$n T4k mn T (k SminUjnT $nST BRI T r UiT hn jni jnT I r i r ,n Tjn mThkshk4nTjn$UTOBRI TD2qTI r i r ,n T $nS jnT,kh$OTi koS,T4nsSTBRI T90qTI r i r ,n T4n T hkm$UTI r ,nT $nSTi k4r nTBRI TS S,kh$OTi koS,T4nsST BRI T00qTwr i r ,n 8T

cnsSTOnaS,TI k k,$$ Tjn mT4$rnUT4n,n(T hk UiTmsn-$T4nI nUT4$k Uin TarnUTsr(raT I k 4kinUn TOr hr mn Tn UnsnTBRI T4k mn Tw=FT BRI T4k mn Tpr 4r UTd kaksT4n,n(FBRI T4k mn T i bOka$T4n Tw,naU$T= 4kqT4k mn Tar 4r UTmkaksT 4n,n(T4k mn T(kUb4kTMknaUTp Yr nskaTakhnmnST hks$r UT

n8TLr hr mn TBRI T4k mn Tw=T

$\square_p = 378T69 - 9T82y$

$\square_x = 24T64 - 5T.8y$

i kUksn mn T

$\square_p$T3ThnUnaThUnaTw,naU$T= 4kqT≤ GT

$\square_x$T3ThnUnaTRnCnOTw,naU$T= 4kqT≤ GT

yT 3Tg $nSBRI T≤ GT

h8TLr hr mn TBRI T4k mn Tpr 4r UTmkaksT4n,n(T

$\square_p = 36T76 - 3T39y$

$\square_x = 34T.4 - 3T83y$

i kUksn mn T

$\square_{pT}$3ThnUnaThUnaTpr 4r UTd kaksT4n,n(T≤^{2}GT

$\square_x$T3ThnUnaTRnCnOTpr 4r UTd kaksT4n,n(T≤^{2}GT

yT 3Tg $nSBRI T≤ GT

o8TLr hr mn TBRI T4k mn T5 bsk,naST

$\square_p = 4T39{:}\ y - 4T06$

$\square_x = 4T385y - 4T.9$

i kUksn mn T

$\square_p$T3ThnUnaThUnaT5 bOkaSTEmP(^{9}GT

$\square_x$T3ThnUnaTRnCnOT5 bOkaSTEmP(^{9}GT

yT 3Tg $nSBRI T≤ GT

48TLr hr mn Tw=T4k mn Tar 4r UTmkaksT4n,n(T

$\phi = 52T239 - 4T5lvnl$

QUnr T

$ola\,\phi = 4T829{:}\ 99 - 4T44{:}\ 26lvn$T

i kUksn mn T

+ T3Tpr 4r UTmkaksT4n,n(T≤^{2}GT

vnT3Tw,naU$T= 4kqT≤ GT

T

KESIMPULAN

D8Ten nOT,k(I r mTI n4nTI k k,$$ TUksmb,b mT 4n,n(Ti k,b(I bi T,k(I r mTjn mT(k(I r jnST I bUk aSTI ksr hnOn TNb,r (kTjn mTorirI TU$mmST insk nTsnUnysnUnT(k(I r jnSTw,naU$T= 4kqT Ew=G928

98Tak(ni S T Un nOT ,k(I r mT 4$n4nUn T $nST BRI Tak(ni S Thkans T4n Ti ki r nUn Tmkaks jnT ak(ni S Thkans T r ,n8

78Tak(ni S Thkans Tw=T(ni nT $nSTBRI Tak(ni S T i koS,T4n Thkm$UTakhn,$ jn

K8Tpk(ni S T(k SminUjnTw,naU$T= 4kqTni n T (k jkhnhi n Tar 4r UTmkaksT4n,n(T4nsSTUn nOT ,k(I r mThi n Tak(ni S T koS,

DAFTAR PUSTAKA

Q(ks$n T pbo$kUjT -bsT ekaU$ mT n 4T (nUks$,FT *Caabpgj Rmm/I mj C) f V I) ipawpol Bmaoidbt ilma*FD. 1. T

Rsn/nT ≥ 8T c naFT gr sT) 4nOFT = 4snT pr sj nT R8T ≥ r oOUnsFT *Vd/pal/pl f pap.* FT) s,n mmFT uni nsUnT

c kI nsUk(k T wki ks/nn T v(r(FT *vpawbpal vdasbUpalBR=I' pxmqpimdbe* FD. 16T

=$NS mTp8Tc r FTMbsk TI 8TQ 4ksab FTt sk4TZ 8T 5$-ksFT *kbawpe daipgpl mj Kdmid/t. alt pg Capgolo*FUbO TZ $kj Tn 4Tpb FD. 12T

pr 4/n nF≥ QF≥ poFTwsb-8Tc sFT*Vdimwdl) ipiloil/p*FT ensa$bTRn 4r mFD. . 9T

pr j b bTpbasb4nsab bFT=8T5 nar UbTg ni nAnCnFT *Vd/pal/plf pap. Iwpalf d/al/Iv mawpol*FTwe 8T wsn4 j nTwnsn($nFTuni nsUnFD. 12T