

The Impact of Cognitive Biases on Decision Making

Evelyn L. Brooks, Julian A. Thompson

University of Cognitive Sciences, New York, USA

Abstract 7KLVVWXG\LQYHVWLDJWHVWVKHPFKDQLVPR ID*\UDWRU\
FUXVKHUORFDWHG LQ *ROJRKDU PLQLQJ DQG LQGXVWULDO &R VSHFLILFDOO\
ZLWKDIRFXVRQVWUHVHVGVLWULEXWLRQDQGIDWL JXHIDLOXUHRILWVPDLQ
VKDIW\$WILUVVWVH\$WKFURVVVHFWLRQRIWKHIUD FWXUHGVKDIWLVVWXGLHG
DQGWKHFUDFNJURZWKLVDQDO\JHG7KHQWKHURWDW LRQDOPRWRQRIWKH VKDIW DQG WKH RLO
WHPSHUDWXUH RI RLO FLUFXLW RI HTXLSPHQW DUH PRQLWRUHG &RQGLWLRQ PRQLWRULQJ LV XVHG WR
KHOS ILQGLQJ D EHWWHU PRGLILFDWLRQ%DVHGRQWKHUHVXOWVRIWKLWVWX
G\WKHPDLQFDXVHVRI VKDIW IDLOXUH DUH LGHQWLILHG DQG FRUHFVLYH VROXWLRQ LV
RIIHUHG WR LQFUHDVH FUXVKHU SHUIRUPDQFH HVSHFLDOO\ LWV PDLQ VKDIW OLIH 7R SUHGLFW WKH
HIILFLHQF\ RI WKH SURSRVHG PRGLILFDWLRQ ILQLWH HOHPHQW
VLPXODWLRQLVSHUIRUPHGQDGLWVUHVXOWVDUHFR PSDUHGLZLWKWKHVLPLODU PRGLILHG FDVHV 7KH
FRPSDULVRQ DQG LQWUSUHWDWLRQ RI VLPXODWLRQ
UHVVXOWFRQILUPWKHHIILFLHQF\ RISURSRVHGFRUHFV WLYHFWKRG

Keywords 2)DWLJXH IDLOXUH ILQLWH HOHPHQW PHWKRJ \UDWRU\ FUXVKHUFRQGLWLRQPRQLWRULQJ

.,1752'8&7,21

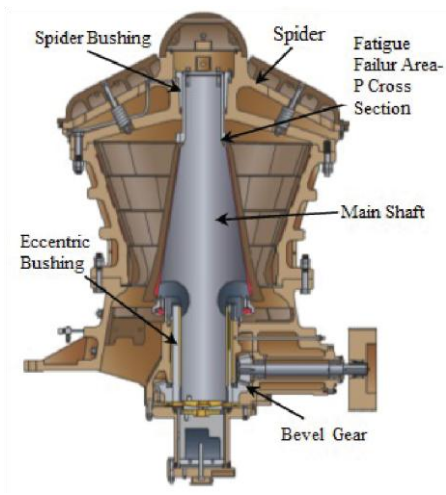
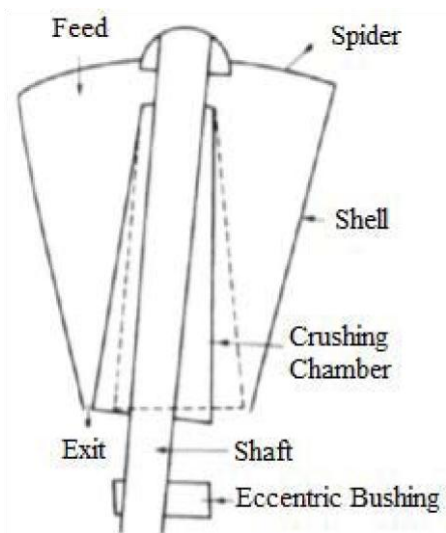
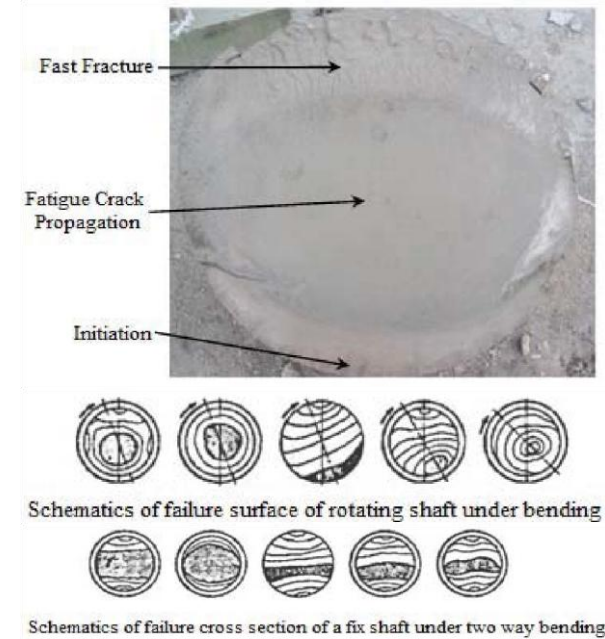
) \$7,*8(IDLOXUHLVDYHU\FRPPRQHYHQWIRUPHFKDQL FDO
VWXG\RIGHVLJQDQGDQDO\VLVRLWVFRPSRQHQWV LVVFLHQWLILFDOO\ DQG SUDFWLFDQO\ YHU\
LPSRUWDQW *\UDWRU\ &UXVKHU DV DQ HVVHQWLDO HTXLSPHQW LQ *ROJRKDU PLQLQJ DQG
LQGXVWULDO
FRPSDQLVSODFHGDIWHUWKHLURQRUHH[WUDFWL RQDUHDDQGDQFW
DVSULPDU\PLOORWFUXVKHGXONLURQRUH7KHP D[LXPVL]H
RIRXWSXWRUHIURPWKLVFUXVKHULVDERXWFHQW LPHWHUVZKLFK
LVVXLWDEOHIRUXSZDUGPLOOV'LIHUUHQWV\SHVRI FUXVKHUVDUH

XVHGLQPLQLQJLQGXVWU\%XWZRW\SHVRI-DZDQG*\UDWRU\
56%DKUHLQLLVZLWKWKH&RQGLWLRQORQLWRULQJ\HSDUW PHQWRI*ROJRKDU 0LQLQJ DQG ,QGXVWULDO &R 6LUMDQ
,UDQSKRQH ID[HPDLODKLPVRWRXGKH#JPDLOFRP \$)HPDWROODKL LV ZLWK WKH &RQGLWLRQ 0RQLWRULQJ
'HSDUWPHQW RI *ROJRKDU 0LQLQJ DQG ,QGXVWULDO &R 6LUMDQ ,UDQ HPDLO DIRURXJKL#JPDLOFRP
\$-DIDULLVZLWKWKH0HFKDQLFDO (QJLQHHULQJ\HSDUWPHQW 8QLYHUVLW\RI
7HFKQRORJ\6LUMDQ,UDQHPDLOMDIDUL#VLUMDQWHFKDFLU SHQGXOXPOLNHDWWKHFHQWHURIFRQLFDOVKHOO
7KLVUHFLSURFDWLQJ PRYHPHQWFDXVHVFKDQJHVLQVL]HRIWKHH[LWDU
HDRIFUXVKHU WKHUHIRUHRUHFUXVKLQJSURFHVVLVGRQHE\WKL
VPHFKDQLV,Q IDFWWKLWV\SHRIFUXVKHUFDQEHVVXPHGDVLQIL
QLWHQXPEHURI YHU\VPDOOMDZVUXVKHUVORFDWHGRQWKHFLUX
PIHUHQFHRID FLUFOH5HJDUGLQJWKLVGHVFULSWLRQLWFDQEHFR
QFOXGHGWKDWWKH HIILFLHQF\ RI *\UDWRU\ FUXVKHU LV PXFK KLJKHU WKDQ MDZ
FUXVKHU\$OWKRXJKWKHUHLVQRH[DFWHTXDWLRQI RUFDOFXODWLQJ
WKHFDSDFLW\RIWKHFUXVKHUVLWFDQEHHP\$SLULF DOO\VDLQWGDWLQJ
WKHVDPHFRQGLWLRQRIRXWSXWVL]HFDSDFLW\RI\ UDWRU\W\SHLV DERXWWKUHHLVPHVRIWKH-
DZVUXVKHU\$OVR*\UDWRU\W\SHLV UHFRPPHQGHGZKHQWKHFDSDFLW\RISURGXFWLRQO
LQHLVPRUH WKDQWK,QDGLWLRQLQDVLPLODUFDSDFLW\GXH
WRWKH FLUXODUVKDSHWKHUHTXLUHGVSDFHIRU*\UDWR U\W\SHLVOHVV
WKDQMDZVUXVKHU0RUHRYHUGXHWRVHYHUHIOXF WXDWLRQRIVWUHV
GXULQJWKHRSHUDWLRQDVWURQJHUIRXQGDWLRQ DQGVXSSRUWVUHV QHHGHG IRU -DZ FUXVKHU >@
\$FRUGLQJ WR WKH VSHFLDO WHFKQRORJIRIFUXVKHUYHU\VPDOOQXPEHUVRIQDQ
XIDFWXUHV DUHDEOHWRPDQXIDFWXUHDQGPDLQWDLQWKHHT
XLSPHQW\$OVR SURYLGLQJ VSDUH SDUWV OHQGV WR KLJK FRVW RI UHSDLU DQG
PDLQWHQDQFH7KXVLWLVQHFFHVVDU\DQGLQHYLW

DEOHWRVWXG\
GHV LJQRSWLP LJDWLRQLPSURYHHPHQWRIHTXLSPHQ
WDQGKRZWR
RSHUDWHLWEHWWHU/LWHUDWXUHUHYLHZLQGLF
DWHVWVKDWIRFXVHVRI
UHVHDFKZRUNVDUHEDVHGRQHPSLULFDODQDO\
LVSDUWLFXODUO\
GHDOLQJZLWKLQWHUQDOIUFWLRQDQGDEUDVLR
QRIFRPSRQHQQVRI
WKLWV\SHRIHTXLSPHQW>@>@\$FRUGLQJO\DJRGRS
URILOHRI
WKHFHQWUDOVKDIWKDVEHHQSURSRVHGIRUEHWW
HUFUXVKLQJ>@
)XUWKHUPRUHEHFDXVHRIKLJKHQHUJ\FRQVXPSWLR
QRIWKLW
HTXLSPHQWVKHRSWLPDOFKRLFHRIWKDWKDEHH
QLQYHVWLJDWHG

+HUHWKHUHDUHWZRDSSURDFKHVHPSLULFDODQ
GILQLWHHOHPHQW
DQDO\VLVWRVWXG\DQGDQDO\JHWKHLVVXH,QWKH
HPSLULFDODQ
PHWKRGWKHREVVHUYDWLRQDQGLQWHUSUHWDWL
RQRIWKHIUDFWXUH
VXUIDFHFDSWXULQJWKHPRWLRQRIWKHVKDIWDWG
LIIHUHQWZRNLQJ
FRQGLWLRQVDQGKHPURJUDSK\DQDO\VLVRIOXEU
LFDWLRQV\VVHP DUH IROORZHG ,Q ILQLWH
HOHPHQW PHWKRG WKH FRPPHUFDO
VRIWZDUH\$%\$486LVXVHG

A. Investigating the Fatigue Fracture Surface



.,352%/(0')1,7,21

VXSSRUWVDQGEXVKLQJV

,,, 0(7+2'62)5(6(\$5&+

)LJ'LIIHUHQWUHLRQVRIIUDFWXUHGVHFWLRQRIWKH
FUXVKHUVKDIWDQGDQ
FRPSDULVRQZLWKVWDQGDUGVFKHPDWLFRIDWLJX
HIDLOXUH

IRZWKHTXHVWLRQLV³ZKDWNLQGRIRDGLQJFRQ
GLWLRQLV
H[SRVHGWRWKHVKDIW'DQG³ZKLFKVKHPDWLFLVW
KHQDWXUHRI IUDFWXUHGVXUIDFH'" 0LVPDWFK RI
IUDFWXUHGVHFWLRQZLWK
VWDQGDUGVFKHPDWLFLVWQGLFDWHVWVKDWVWKHQ
DWXUHRIWKDIWORDGLQJ LV FRPSRXQG DQG GRHV
QRW PDWFK VWDQGDUG VFKHPDWLFLV +RZHYHU

WKH FUDFN JURZWK VKRZV WKDW EHQGLQJ
DURXQG
GLUHFWRQZKLFKLVSHUSHQGLFXODUWRWKHGLU
HFWRQRIFUDFN
JURZWKFRXOGHEHWKHPDLQFDXVHRIIDLOXUH%FRP
SDULQJWKH
UDWLRRIWKHDUHDZKHUHUSLGLJURZWKRRFXUUH
GZLWKWKHDUHD
ZKHUHFUDFNJUDGXDOO\JURZVWKHDUHDOLNHEHD
FKPDUNVLW
FDQEHFRQFOXGHGWKDWKIDLOXUHLVIDWLJXH
W\SH,QDGGWLWRQLW
LVREVHUYHGWKDFUDFNQLWLDOO\WVWUWVUIUR
PVKDIWFLUFXPIHUHQFH
DQGJUDGXDOO\JURZWKWRZDUGRQHVLGH7KHUHIR
UHEHIRUHVKDIW
IDLOV WKRURXJKO\ LW ZDV SRVVLEOH WR
GLVFRYHU LW E\ QRQ
GHVWUXFWLYHWHVWV6RLIWKHUHH[LVWVDSHUPD
QHQPWRQLWRULQJLW
ZRXOGESRVVLEOHWRSUHGLFWWKIDLOXUH6XFK
DQDSSURDFKFDQ GHWHUPLQH WKH DSSUR[LPDWH
WLPH RI XOWLPDWH IDLOXUH
\$FFRUGLQJO\HTXLSPHQWFDQEHVWRSSHGEHIRUHH[
SHQVLYH
GDPDJHV\$WOHDVWLWFRXOGESRVVLEOHWRSUHY
HQWGDPDJHWKH
RWKHUFRPSRQHQW2QWKHRWKHUKDQGE\WVXG\RIF
UXVKHU
PHFKDQLVPLWFDQEHFRQFOXGHGWKDWLQFDVHWK
DWWKHUHLVRQO\ JUDWRU\ PRYHPHQW DQG VSLQ
URWDWLRQ LV DEVHQW DW DQ\
PRPHQWGLUHFWRQRIVKDIWEHQGLQJFKDQJHVGX
HWRHFFHQWULF
PRYHPHQWRIORZHUEXVKLQJ\$OVRORDGLQJGXHWRF

W\SHRIORDGLQJWKDWVVKDIWURWDWHVDQGGORDGL
VIL[HG7KXVWKH
JURZWKRIUDFNVKRXOGHEHVLPLODUWRWKHVFKHP
DWLFRVRIUDFWXUH
RIURWDWLRQDOVXUIDFHXQGHUEHQGLQJORDGZKH
UHDVLWLVRW
7KXVLWLHVWLPDWHGWKDWKLVW\SHRIPRYHPH
QWGRHVQRW
KDSSHQLQUHDOFRQGLWLRQ7RLQWHUSUHWKHRF
FXUUHQFHRIWKLV
VLWXDWLRQWKHVVKDIWPHFKDQLVPZLOOEHVWXGL
HGSUHFVHO\$V
DOUHDGPHQWLRQHGLQDGGWLWRQRJUDWRU\PRY
HPHQWRWKH
PDLQVVDWLRQWKHVSHHG□WKHUHLVDQRWKHU
W\SHRIURWDWLRQ
DURXQGWKHD[LVRIWKHVVKDIWVSLQURWDWLRQ\$
V)LJ
LOOXVWUDWHVWLQWKHVLWXDWLRQWKDWVSLQPR
YHPHQWLVJHWLQJ
V\FKURQLJHGZLWKJ\UDWRU\URWDWLRQEHQGLQJD
OZD\VRFFXUV
DURXQGDIL[HGD(LV)RUH[DPSOHSRLQWV\$DQG%DUH
DOZD\V
XQGHUPD[LPXPVWUDLQDQGVWUHVVDQGSRLQWV&
DQGDUH
ORFDWHGRQWKHXWUDOD[LV,QIDFWZKLOHWKH
VKDIWURWDWHVWKH
SRLQWRIDSSOLFDRQRRIORDGURWDWHVWRR,QWK
HRWKHUZRUGVWKL
LVOLNHDIL[HGVKDIWXQGHUHQHVD\EHQGLQJORD
G7KLV
FRQGLWLRQKRZHYHUGRHRVQRWFRPSO\ZLWKWKHFU
RVVVFWRQ VFKHPDWLF RI IDLOHG VKDIW %XW
FRPSDULQJ ZLWK SUHYLRXV
FRQGLWLRQURWDWLRQVKDIWFRQGLWLRQVKRZVPR

UXVKLQJ
SURFHVFKDQJHVDVGHSLFWHGLQJLJ,QWKLVDVH
DWLPH
GHSHQGHQWEHQGLQJORDGLPSRVHGWRWKHVVKDIW
LVVLPLODUWRWKH

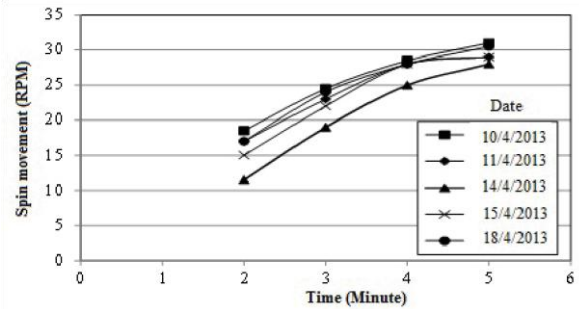
UHVLPLODULW7R
HYDOXDWHWKLWKHRSHUDWLRQRWKHHTXLSPH
QWLVPRQLWRUHGWD
GLIHHUHQWVPHVDQGWKHUHVXOWVZLOOEHLQW
HUSUHWHGDIROORZV

B. Condition Monitoring of Equipment

7RMXVWLI\RXUSUHGLFWLRQRQVSLQURWDWLRQ
HIIHFWRUDZKLOH
VKDIWPRYHPHQWDQGIHHGLQJRIFUXVKHUZDVVKR
WLQGLIIHUHQW
ZRUNLQJFRQGLWLRQ\$OVRRLLOWHPSHUDWXUHLVVK
RWE\WKHUPR
YLVLRQFDPHUDLQFULWLFDOSRLQVVDWGLIIHUHQ
W\WLPHV)LJVKRZV
KRZWKHFUXVKHULVFKDUJHGE\LURQ2UH,QWKLVV
WXG\LWZDV
IRXQG\WKDWWKHZKHQFUXVKHULVFKDUJHGWKHS
LQURWDWLRQVWRSV
DQGGXULQJWKHSHULRGRIFUXVKLQJ\DOPRVWJUDW
RU\PRYHPHQW
GRPLQDWHV+RZHYHUJUDGXDOO\E\SDVVLQJWKHFU
XVKHG2UH
WRZDUGRXWSXWDQGFUXVKHUXQORDGVVSLQURW
DWLRQLQFUHDVHV
JUDGXDOO,Q)LJGLDJUDPVRIVKDIWVSLQURWDWLR
QDOVSHHG
YHUVHVGLIIHUHQW\WLPHV\DUHSORWWHG7KHPHQW
LRQHGVSHHGLV
UHFRUGHGDERXWWZRPLQXWHVDIWHUFKDUJHRIRU
HVLXPXOWDQHRXV
ZLWKWKHFRPSOHWHH[LWRIRUH,WFDQEHVHHQZKH
QLURQRUH
FRPSOHWHO\OHDYHVWKHFUXVKLQJDUHDVSLQURW
DWLRQDOVSHHG
YDULHVEHWZHHQWRUSPRQGLIIHUHQWGDWHV7KL
VVSHHG
DSSURDFKHVLWVDV\PSWRWLFYDOXHDERXWUSPWK
UHHPLQXWHV
DIWHUH[LWRIRUH,WLVLQWHUHVWLQJWKDWWKLV
YDOXHLVDSURSHU
IUDFWLRQRIRJUDWRU\VSHHGUSP7KHUHIRUH\WFDQ
EH
FRQFOXGHGWKDW\SUREDEO\DGLUHFWRQWDFWKD
SSHQVEHWZHHQ
VKDIWDQGERWWRPHFFHQWULFEXVKLQJRURLOVKH
DUVWUHQJWK
EHWZHHQFRQWDFVXUIDFHVIRUPVIULFWLRQDOW
RUTXHZKLFKOHDGV
WRVSLQURWDWLRQDORIVKDIW2EMHFWLYHREVHU
YDWLRQRIVXUIDFHRI
EXVKLQJDQGVKDIWFLUFXPVWDQFHLQGLFDWHVGD
PDJHVLQWKHVH
DUHDVZKLFKFRQILUPVDERYHPHQWLRQHGGK\SRWKH
VLV



)LJ\$YLHZRILQ\$SXWRIFUXVKHULQZKLFKFKDUJHGLZLW
KLURQRUH

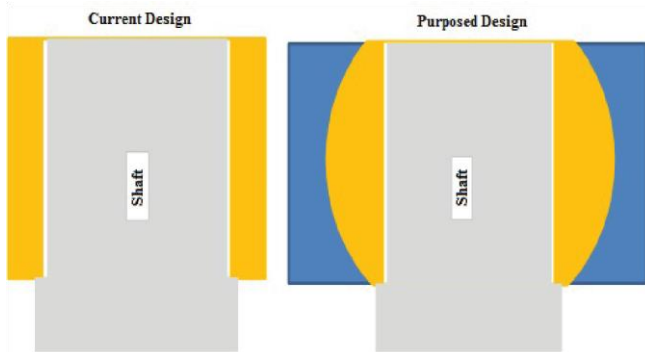


)LJ&KDJHVIRIVKDIWVSLQVSHHGGRYHUWKHWLPHDIW
HUFKDUJLQJRUH

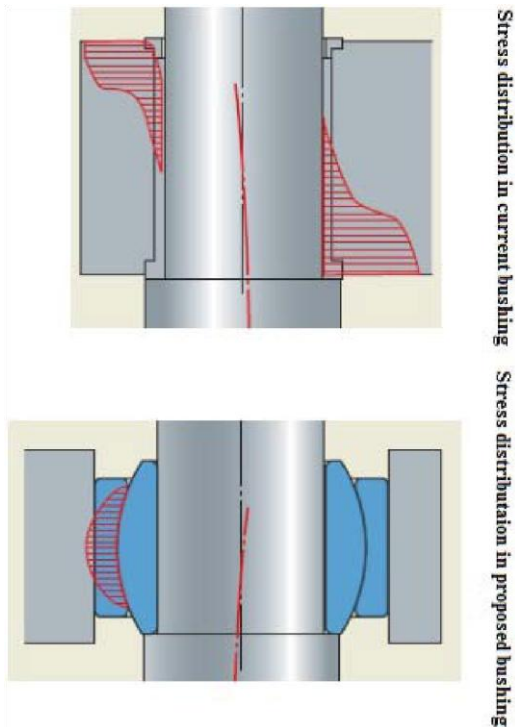
C. Finite Element Simulation

5HJDUGLQJILQLWHHOHPHQWSRLQWRILHZWKHH
QGSUWRIVKDIW ORFDWHG LQ HFFHQWULF
EXVKLQJ LV PRGHOHG DV D FRQVWDQW
GLVSODFHPHQW DSSOLHG LQWR WKH VXSSRUW
7KLV GLVSODFHPHQW
HTXDOPPDQGOHDGVWRDEHQGLQJPRPHQWRQVKDI
W7KLV
PRPHQWPD[LPL]HVDWVSLGHUEXVKLQJ7KHUHIRUH3
VHFWRQLQ
)LJLVWKHPRVWFULWLFDOSRLQWRIVKDIW,Q)LJPRUH
GHWDLOV
RIVFKHPDWLFDQGWROHUDQFHVIRIVSLGHUEXVKLQJ
DWSSSHUSDUWRI VKDIW LV VKRZQ LQGHHG WKL
LV ZKHUH IDLOXUH KDSSHQH
'LDPHWHURIVSLGHUEXVKLQJ' PPDQGLWVOHQJWK O
PP WKUHIRUH /' 7KLV DFWV DV D VXSSRUW
HGXULQJQGLQJPRPHQW2QWKHRWKHUKDQGLW
KDVEHHQ
VKRZQSUHYLRXVO\WKDWVSLQPRYHPHQWSUHYHQ
WVDXQLRUP
VWUHVGLVWULEXWLRQRQDURXQGVKDIWFLUFXP
IHUHQFH
\$FFRUGLQJWRWKHEHIRUHPPHQWLRQHGGHVFULSW
LRQWRLPSURYH
WKHOLIHRIWKLVLWDOHTXLSPHQWUHVWUXFWXU
LQJLWVWRSEVVKLQJDV
VKRZQLQJLJLVUHFPPHQGHG%\WKLQVHZEXVKLQJ
PHFKDQLVPWKHXSSHUVXSSRUWDFWV\NNDVSKH
ULFDOMRLQWDQGLQ
SUHYHQWVRRFFXUHQFHRIHQGLQJPRPHQWLQWKL

VDUHDRIVKDIW
&RQVHTXHQWO\QRUPDOVWUHVVFDXVHGE\EHQGLQ
JGRHVQRW
RFFXU



)LJ&XUUHQWDQGSURSRVHG VFKHPDWLFRIVSLGHUEXV
KLQJ

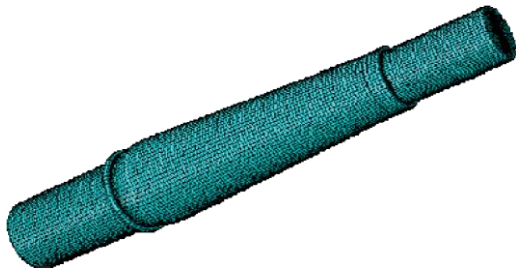


)LJ7KHGLIIHUHQFHEHWZHHQVWUHVVGLVWULEXWLR
QLQFXUUHQWDQG
SURSRVHGEXVKLQJ

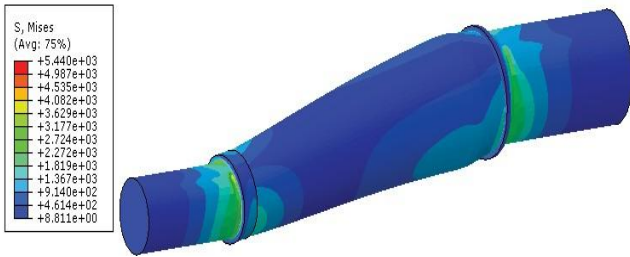
)LJVKRZVVWUHVVGLVWULEXWLRQLQWKHFUHQ
WDQGVXJHVVHG EXVKLQJ ,Q WKH FXUUHQW
EXVKLQJ VWUHVV GLVWULEXWLRQ LV
PD[LPXPDPWHGJHVZKLOHLQWKHRIIHUHGWA\SHLWL
PLQLPL]HG WKHUH 2Q WKH RWKHU KDQG
FRQVXOWDWLRQ ZLWK VRPH
PDQXIDFWXUHUPDNHVLWVXUHWKDPDQXIDFW
XULQJWKHRIIHUHG EXVKLQJLVSRVVLEOH

7RLQYHVWLJDWHHHIHFWRIQHZGHVVLJQRQVWUHV
VGLVWULEXWLRQLQ VKDIW ILQLWH HOHPHQW
PRGHOLQJ LV SHUIRUPHG E\ XVLQJ
\$\$486DQGWKHUHVXOWVZLOOEHLVFXVVHGLQEU
LHIDV
IROORZV)LJVKRZVWKHPRGHORIPDLQVKDIWPHVKH
GZLWK
OLQHDKH(DJRQDOHOHPHQW)RUPRGHOLQJHODVW
LFPFKDQLFDO

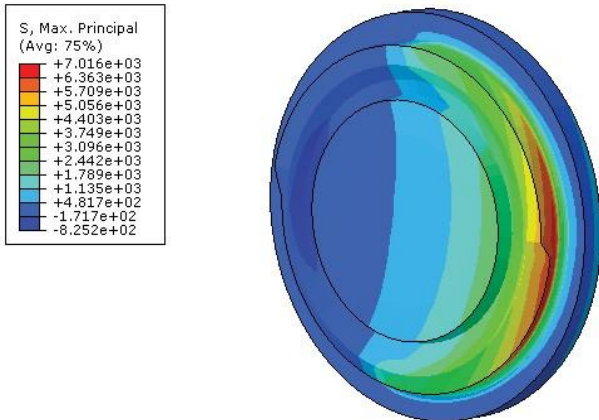
VRWKUHLVD
KLJKVLPLQDULWEHWZHHQOLQHVIRFRQRXUVRIIL
UVWSULQFLSDO
VWUHVVDQGLQHVRIERXQGDULHVRIFUDFNJURZW
KDUHDVRQ
IUDFWXUHG VHFVLRQ



) LJ0DLQVKDIWRIFUXVKHUPRGHOHGE\ILQLWHHOHPHQW

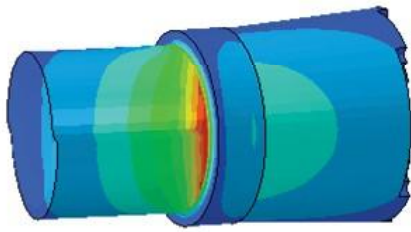
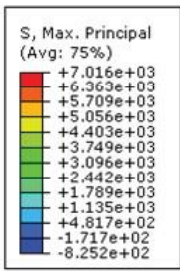


) LJ9RQ0LVHVWUHVVFQRWRXUVLQVLPXODWHGVKDI

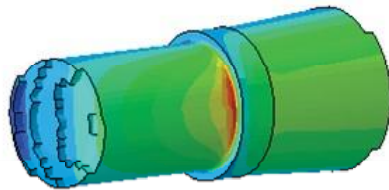
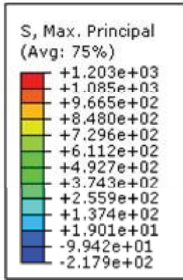


)LJ)LUVWSULQFLSDOVWUHVVFQRWRXULQFULWLFDOV
HFVLRQRIVKDIW VHFVLRQ3

SURSHUWLHVPHQWLRQHGLQPDQXDORIFUXVKHUD
UHDSSOLHG9RQ
0LVHVWUHVVFQRWRXUVVDWGLIIHUHQWSDUWVRI
VKDIWDUHVKRZQLQ
)LJEDVHGRQFXUUHQWEXVKLQJWUXFWXUH,WFDQ
EHVHHQWKDW WKH PD[LXP DPRXQW RI VWUHV
RFFXUV ZKHUH WKH VKDIW
GLDPHWHUFKDQJHVXQGHUWKHVS LGHUEXVKLQJ\$O



&XUUHQWGHVLJQ
EXVKLQJ

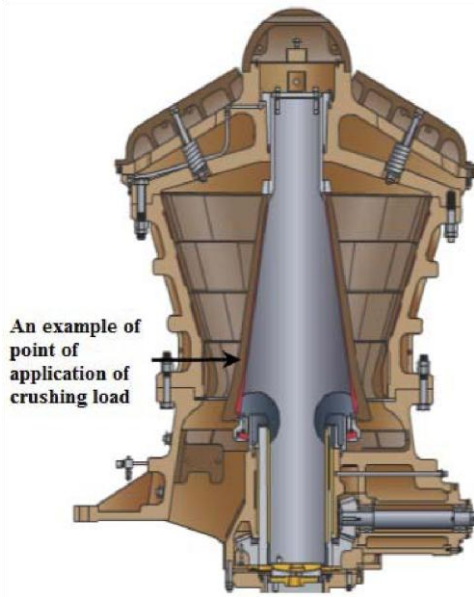


URSRVHGGHVLJQRI
EXVKLQJ

)LJ)LUVWSULQFLSDOVWUHVFRQRXUVRIFXUUHQW
VLWXDWLRQDQGDWHU FKDQJLQJEXVKLQJW\SH

IRZ E\ DSSO\LQJ SURSRVHG FRUUHFWLRQ ILQLWH
HOHPHQW
VLPXODWLRQVZLWKWKHVDPHORDGLQJFRQGLWLR
QDVWKHSUHYLRXV
VLPXODWLRQFDUULHGRXWDQGWKHUHVXOWVDUH
FRPSDUHGZLWKWKH
FRUUHVSROGLQJYDOXHVRUH[DPSOHLQ)LJILUVWSU
LQFLSDO
VWUHVFRQRXUVDUHVVRZQIRUWKHVHWZRVLPX
ODWLRQV
&RPSDULQJQXPHULFDUHVXOWVVRZVWGDWE\
DSSO\LQJWKH
QHZFRQGLWLRQVWKHSULQFLSDOVWUHVZKLFKL
DOPRVWHTXLYDOHQW
WRWKQRUPDOVWUHVVGXHWREHQGLQJRIWKHV
DIWLUVHGXFHG7KH
PD[LXPYDOXHRIWKLVLVWUHVUHGXFHVIURPDERX
WWRDERXW
UHDFKLQJDERXWRIWKHSUHYLRXVYDOXHIRZORDG
LQJ
GXHWFUXVKLQJRILURQRUHVVRXOGEHLPSRVHGW
RWKHPRGHO
WKHQFRUUHVSRQGLQJWUHVVRQWKHFUXUHQWE
XVKLQJPRGHODQG
WKHVXJHVVHGRGHOLVFRPSDUHG7KHIDFWLWVK
DWWKHUHFWRQ ORDG LPSRVHG IURP RUH ZKLFK
LV FUXVKHG FRXOG QRW EH
GHWUPLQHGHDVLO\,VVDFWXDODPRXQWDQGVLV
XDWLRQGHSHQGVRQ
VWUHQJWKDQGORFDWLRQRILURQRUHLQVLGHVKH
FUXVKHU+RZHYHU
WRGHWUPLQHZKHUWKHORDGLPSRVHGWWRWKHV

KDIWWKHFUXVKHU
LVPRQLWRUHGIRUDZKLOHDQGLWLVLOPHG2EVHUY
DWLRQVFRQILUP
WKDWWKHPDMRUSDUWRIFUXVKLQJRFFXUVQHDUW
KHH[LWDUHDI
FUXVKLQJDUHDZKHUHWKHRSHQLQJLVYHU\QDUURZ
,VVKRXOGEH
QRWHGIRUODUJHVL]HRIVWRQHVFUXVKLQJORDGDF
WVRQXSSHUUDH
RIVKDIW+RZHYHUWKHSRVVLELOLW\RIDFFXUDWHP
RGHOLQJRIWKH
DFWXDOORDGRQWKHVKDIWLVQRWSRVVLEOH<HWL
QWKLVSKDVIHRI
VWXGDQDVVXPHGIORDGLVFRQVLGHUHGQGLPSR
VHGW
WKHPRGHODWVZRLIHHUHQWSRLQWVRQVKDIWOH
QJWKRIWKDIW IURPERWWRPDQGOHQJWKRIWKDIW
SHVXOWVRIWZRPGRHOLQJFXUUHQWDQGVXJHVV
WHGEXVKLQJDUH
FRPSDUHGZLVOEHPHQWLRQHG&RQVHTXHQWO\
RDGUHDFWLRQ PRPHQV DQG VWUHVHGH
FUHDWHG LQ HDFK XSSHU DQG ORZHU
EXVKLQJIRUPHQWLRQHGORDGLQJDUHHYDOXDWH
GDQGFRRPSDUH
&RPSDULQJWUHVYDOXHVVVRZVWGDWE\WKH
LPSOHPHQWDWLRQ
RIWKHSURSRVHGPHWKRGVWUHVHVHFDXVHGE\FUX
VKLQJORDG
VLJQLILFDQWO\UHGXFHVVLPLODUWRVWUHVHVH
DXVHGEHFFHQWULF
PRYHPHQWDWVSSHUEXVKLQJ+RZHYHULWLVIRXQG
WKDWVWUHV
GRHVQRWGHVFUHDVHDWVKHORZHUEHDULQJHYHQ
LQFUHDVHV2I
FRXUVHWKLVDPRXQWRILQFUHDVHGHSHQGVQRZK
HUHFUXVKLQJ
ORDGDFWVRQ,QIDFWZKDWHYHUFUXVKLQJORDGLV
FORVHUWR ERWWRP WKLVLQFUHDVH EHFRRPHV
PRUH LQVHGVLEOH DW ORZHU
EXVKLQJ)RUH[DPSOHZKHQWKHFUXVKLQJIRUFHLVD
SSOLHGWD
IURPWKHERWWRPRIWKHVKDIWVWUHVVDWORZHUE
XVKLQJ
ZKHUWKHVKDIWVHWWOHVIRUWKHVXJHVVHGH
RGHOLVWLVPHVRI
WKHFUXUHQWRQH



An example of point of application of crushing load

3 3 SRVDULR 5 \$ +DOO DQG ' 0 0DLMHU /LQHU ZHDU DQG SHUIRUPDQFH LQYHVWLJDWLRQ RI SULPDU\ JUDWRU\ FUXVKHUV *Minerals Engineering*, YROSS
 3 3 SRVDULR 5 \$ +DOO DQG ' 0 0DLMHU ,PSURYHG JUDWRU\ FUXVKLQJRSHUDWLRQE\WKHDVVHVVPHQWRIOLQHUZHUDUQ GPDQWOHSURILOH
 UHGHVLJQ*Minerals Engineering*, YROSS
 0 /LQGTYLW (QHUV\ FRQVLGHUDWLRQV LQ FRPSUHVVLYH DQG LPSDFW
 FUXVKLQJRIURFN*Minerals Engineering*, YROSS
 *ROH**RKDUGRFXPHQDWLRQ*\UDWRU\FUXVKHUPDQXDOHG*
 (LJKWK(GLWLRQ0F*UDZi+LOO3ULPLV

)LJ\$YLHZRISODFHRIORDGFDXVHGE\FUXVKLQJRILURQR UHRQ PDLQVKDIW

,9&21&/86,21

W\SH RI IUDFWXUHG VXUIDFH WKDW LV PRQLWRUHG ZLWK QRQ GHVWUXFWLYHPHWKRGOLNHHGHWHUPLQLQJFUDFN VE\SHQHWDWLQJWHVW FRXOGSURYLGHXVHIXOLQIRUPDWRQDERXWFUDF NJURZWK:LWK WKLVPHWKRGGLWFDQEHSUHGLFWHGZKHQXOWLPD WHIDLOXUHKDSSHQV 7KHUHIRUH EHIRUH UHDFKLQJWR XOWLPDWH IDLOXUH HTXLSPHQW FRXOGEHVWRSSHGWRSUHYHQWRWKHUFRRSRQHQW GDPDJHV

\$&.12:/(*0(17

\$XWKRUVZRZOGOLNHWDRDSSUHFLDWHPDQDJHUD QGH[SHUWVRI SURFHVVVLQJGHSUWPHQWRI*ROJRKDUPLQLQJDQG LQGXVWULDO&R DQG**RKDU5DYHVK&RIRUWKHLUFRRSHUDWLRQWR SHUIRUPWKL V WXG*

5()5(1&(6

' %URHN *Elementary Engineering Fracture Mechanics* &OXZHU \$FDGHPDF3XEOLVKHUV
 % \$:LOOV DQG 7 IDSLHU0XQQ &UXVKHUV *Mineral Processing Technology*" (Seventh Edition) HG 2[IRUG
 %XWWHUZRUK+HLQHPDQQ
 SS
 KWWSSZZH[FHOIRXQGUFRP
 5\$%HDUPDQDQG&\$%ULJJV7KHDFWLYHXVHRIFUXVKHUVWRFR QWURO SURGXFW UHTXLUHPHQWV *Minerals Engineering*, YRO SS
 0 /LQGTYLW DQG & 0 (YHUWVRQ 'HYHORSPHQW RI ZHDU PRGHO IRU FRQHFUXVKHUV*Wear*, YROSS