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	Machine	1000	11		~~~	1000		~~~~	~~^		~~~	~~~~	~~~	~~~	~~~	~~~~	~~~~	~~~	~~~
Category	Туре						~~~~	~~~~					~~~~		~~~~		~~~·	~~~	~~
	Open Shield		Оре	n shie	lds ar	e fo	vou	red	whe	re	the	gre	ound	is	fre	e st	and	ling	~~
İ	Mechanical Supported Closed Shield		Clos	ed sh	ields a	re 1	favo	urec	d wh	ere	: th	e g	rour	d i	s ve	ry I	wea	k,	~~
	Mechanical Supported Open Shield		such	as s	oft cla	ıy, s	ilt (or r	unni	ng	san	d.							
les	Compressed Air Closed Shield	1																	~~~
Machin	Compressed Air Open Shield]		~~~~~				~~~~				~~~~				~~~	~~~-	~~~~	~~~
round	Close Slurry Shield – Slurry Shield –		Slur	ry sh	ields a	ire f	avo	urec	d foi	r w	ate	r sa	tur	atec	d sa	ndy	so	ls	~~
Soft G	SS-Hydroshield Open Slurry Shield –		and	grave	ls (<1	0%	clay	anc	l silt	t ce	onte	nt;	e.g	. r	Inni	ng s	sanc) .	
	Special Open - Slurry Shields																		~~~
	Earth Pressure Balance Shield - EPBS Special]←	EPB	shiel	ds are	fav	oure	ed f	or n	vate	er s	atu	rate	d s	ilty	soi	ls (>7%	
	EPBS		clay	and	silt co	nten	t; <	709	6 gr	ave	l co	nte	nt).						~~~
	Combined Shield - Mix Shield Polishield																	_	
	Sincid - Fonsineld]															ب 		
								~~~~				~~~~					~~~~		~~~
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	Su	pport		E	xcavation			Machine				
Location	Cavity	Sys	tem Face	Method	Tool	Reaction Force	Category	Туре				
				PFM	Rod header/ Back hoe/ Manual excavation	Thrust Jacks		Open Shield				
			/lechanical	TBM	Cutting bits/ Cutting knives & teeth			Mechanical Supported Closed Shield Mechanical Supported Open Shield				
	eld			PFM	Road header/Back hoe							
	Shi		Compressed	TBM	Cutting bits/Cutting knives & teeth		les	Compressed Air Closed Shield				
I cavity			Air	PFM	Road header/ Back hoe/ Manual excavation	2	l Machii	Compressed Air Open Shield				
Face and		luid	~1	TBM	Cutting disk/ Cutting bits/ Cutting knives & teeth	rust Jack	t Ground	Close Slurry Shield – Slurry Shield – SS-Hydroshield				
			Slurry	PFM	Road header/Back hoe	Ę	Sof	Open Slurry Shield – Special Open - Slurry Shields Earth Pressure Balance Shield - EPBS Special EPBS				
			Earth Pres- sure Balance		Cutting disk/							
	None or fluid	Nor Earth	ne or slurry or Press. Balance	IBM	Cutting knives & teeth			Combined Shield - Mix Shield - Polishield				



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Babende	rerde	. <b>s</b> ,	Hoek	ς, Ε,	Mar	inos	, P	9 &	Ca	rdos	0,	AS	(20	05).	-"El	PB-"	ГВЛ	Fa	ce s	Supr	ort	Col	ntro	l in
the Met Seattle	ro do	Port	o Pro	ject,	Por	tuga	l"	In:	Pro	cee	ding	s R	apic	Ex	cav	atio	n ai	nd T	Tunr	elin	g C	onfe	eren	ce,
Barla, G	; & Pe	elizza	, <b>s</b>	(2000	)). 1	гвм	Т	Inne	ling	in	dif	ficu	lt d	ond	itio	ns.	In	Geo	Eng	200	0, 1	Mell	bour	ne.
Technon	nic Pub	olishir	ng Coi	mpany	: Lo	inca	ste	r, pl	p. 3	29-3	354	~~~~				~~~~					~~~		~~~~	~~~1
Harding	, н (	1981	<b>)</b> . "T	unnel	ling	His	tor	yа	nd	My	Ow	ηI	nvo	lven	nent	". 6	Solo	er	Ass	ocio	ites	Т	oron	to,
258pp.			~~~~		~~~~	~~~			~~~~	~~~	~~~~	~~~~	~~~~			~~~~	~~~~					~~~~	~~~~	
Hudson, ". Elsevi	JA & er Scie	Hari	rison Oxfo	, <b>JP</b> ( ord, 4	(199 44pp	<b>7)</b> . ).	"Er	igine	eeri	ng F	Rock	( Me	cho	nics	- /	An I	ntro	oduo	tio	n to	the	Pri	ncip	les
Maidl, E	3, Her	renki	necht	F, M	& A1	nhei	Isei	$\overline{\mathbf{v}}$	(1	996	). "	Med	har	ised	l SI	nielo	ΓT	inne	Ilin	a". I	Erns	t 8	50	hn:
Berlin, 4	28pp.						~~~~			~~~~	~~~	~~~~	~~~			~~~~	~~~					~~~		
NTNU	(1995	), "1	unne	l: Blo	ist	Des	ign	":C	Depo	artn	nent	0	F B	uild	ing	and	l c	ons	ruc	tior	E	ngin	eeri	ng,
Norwegi	an Uni	versi	ty of	Scier	ice a	ind	Tec	hno	loġy	(N	τηι	J), 1	ror	dhe	im,	Pro	ect	Re	oort	2A	-95			
NTNU-	Anlegg	sdrif	t (19	998).	"Har	rd R	ock	Tu	nne	Во	ring	: Tł	ie B	orir	ig Pi	roce	ss"	No	rwe	giar	Un	iver	sity	of
Science	and To	echno	logy	(NTN	U),	Tro	ıdh	eim,	Pro	jec	t Re	por	† 1F	-98	Ē					[				
Rysdahl	BN	loone	<u>у</u> , М	& Gr	asm	ick,	J	(20	15)	"С	alcu	lati	on d	of v	olun	ne le	555	usir	ig n	ach	ine	dat	a fr	om
two slu	ry Tl	BMs	durir	ng th	e ex	kcav	atio	on d	of '	the	Qu	een	s B	ore	d t	unne	els".	In	: Pi	roce	edi	ngs,	Ra	pid
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Thuro,	K&F	linnir	nger,	RJ	(200	)3).	Ho	rd	roc	k t	unne	el b	orir	1 <u>g</u> ,	cutt	ing	dr	illin	g a	nd	blas	ting	i: re	ock
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