CONSULTIN E N G I N E E R		Engineerin		n Shoot		Job No.	Sheet No.		Rev.
	NEEDS	Consulting	y Calculatio Engineers	II Sheet		iVVV		1	
ENGI	NEEKS	consulting	Engineers]^^^		T	
						Member/Locatio	n		
Job Title	Member De	esign - Rein	forced Con	crete Colun	nn BS8110	Drg. Ref.			
Member De	esign - RC (Column				Made by XX	C Date 2	2/7/2024	Chd.
									<u>BS8110</u>
Effects Fr	om Struct	ural Analys	sis						
Axial force,	, N (tensior	n -ve and co	omp +ve) (e	ensure >= (0)		100000	kN	ОК
Major plan	e shear for	ce, V _y					C	kN	
Minor plane	e shear for	ce, V _z					C	kN	
Major plan	e primary b	ending mor	ment, M _{xp}				5000	kNm	
Minor plane	e primary b	ending mor	nent, M _{yp}				1000	kNm	
Imperfectio	on deflectio	n (in h dire	ction), $e_h =$	MIN (0.05	n, 20mm)		20	mm	cl.3.8.2.4
Imperfectio	on deflectio	n (in b dire	ction), $e_b =$	MIN (0.05	o, 20mm)		20	mm	cl.3.8.2.4
Major plan	e imperfect	ion (nomina	al) moment	, M _{eh} = N.e	h		2000	kNm	cl.3.8.2.4
Minor plane	e imperfect	ion (nomina	al) moment	$M_{eb} = N.e_{b}$)		2000	kNm	cl.3.8.2.4
Major plan	e max desig	gn bending	moment, M	_× = MAX (M	I _{xp} +M _{add,x} , N	M _{eh})	5000	kNm	cl.3.8.3.2
Minor plane	e max desig	gn bending	moment, M	_y = MAX (M	l _{yp} +M _{add,y} , N	1 _{eb})	2000	kNm	cl.3.8.3.2
Material P	Properties								
							_	2	
Characteris	stic strengt	h of concret	e, f _{cu} (≤ 10	5N/mm²; F	ISC)		80	N/mm ²	OK
Yield stren	gth of long	tudinal stee	r_y				460 🔻	N/mm ²	
Yield stren	gth of shea	r link steel,	t _{yv}				460 🔻	N/mm ²	
Bracing o	r Unbrace	d Column							
D						Мајо	r Minor	l	12015
Braced or u	unbraced co		ects slende	rness limits	S Criteria Brad	ced	Braced		<i>cl.3.8.1.5</i>
Note brace	a = {coium	nn / Wall Sta	abilizea by c	other bracif	ng, snear v	valls or co	ore walls and	i outriggers	};
NOLE UNDIA	$lceu = \{con$	unni / wan :	Sladilizeu D	y benung n				les of tube	пајог ріан
Section D	imoncione								
Section D	Intensions								
Section tyr	o (affects (concrete are	a clandarr	ness steels	area rea)	Poct	l angular ▼		
Denth (lard	rer) h (rec	tangular) oi	r diameter	D (circular)		Nect		mm	
Width (sma	aller), h (ree	ctangular) (r N/A (circ	ular)			900	mm	
Area of sec	$\Delta = 1$	h h (rectand	ular) or πD	$\frac{2}{4}$ (circula	r)		2610000	mm ²	
Major plan	e clear heig	iht. Islaar v			.,		4.050	m	d 3.8.1.6
Minor plane	e clear heig	ht. Labor v					4.050	m	d 3.8.1.6
Major plan	e effective	height. L					3 443	m	d 3 8 1 6
Minor plane	e effective	height, l _{off y}					3.443	m	cl.3.8.1.6
		line group len,y							0.10101210
Longitudina	al steel rein	forcement	diameter. ø				32 🔻	mm	
Total longit	tudinal stee	l reinforcen	nent numbe	er (uniaxial	bending), r) _I	50		Note
Total longit	tudinal stee	el area provi	ided (uniaxi	al bending)	$A_{cc} = n_{i}.\pi_{i}$	$\phi^2/4$	40212	mm ²	
Total longit	tudinal stee	l reinforcen	nent numbe	er (orthogor	nal bending), n _{i+}	12		Note
Total longit	tudinal stee	el area provi	ided (ortho	aonal bendi	na), A _{sc+} =	$n_{1+},\pi,\phi^2/4$	9651	mm ²	
Total longit	tudinal stee	l area provi	ided, A _{sc} +A	sc+	577 301		49863	mm ²	
(Note A sc I	is the total	Iongitudina	l steel area	for the rele	evant uniax	ial plane o	f bending ol	nly, whilst A	sc+
is the total	longitudina	al steel area	a for bendin	g in the ort	hogonal pla	ane, exclu	ding steel co	ounted with	n A _{sc})
	-			-					
Shear link	diameter, ¢	link					12 🗸 🗸	mm	
Number of	links in a c	ross sectior	n, i.e. numb	er of legs,	n _v		6		
Area provid	ded by all li	nks in a cro	ss-section,	$A_{sv,prov} = n_v$,.π.φ _{link} ²/4		679	mm ²	
Pitch of lin	ks, S						100	mm	
Cover to al	l reinforcer	nent, cover	(usually 35	6 (C35) or 3	0 (C40) int	ernal; 40	e: 25	mm	
Cover to m	ain reinford	cement, cov	/er _{main} = co	ver + ϕ_{link}			37	mm	

C	ONS	TIL TING	Enginoori	na Calculatio		Job No. Sheet No. Rev.		Rev.			
			Consultin	ng Calculation Tendineers		iVVV		2			
	GII	I E E K S	Consulting	g Engineers]~~~		2			
						Member/Location					
Job Title	e ľ	Member D	esign - Rei	nforced Con	crete Colum	n BS8110	Drg. Ref.	1			
Member	r De	sian - RC (Column				Made by XX	Date 2	2/7/2024	Chd.	_
		-) -								BS8110	_
Iltilicat	tion	Summary	v							000110	_
otinisat		Summar	Y				Major	Minor			
		Proced or	unbracad				Broad	Proced			
		Slaceu ol	unbraceu				Бгасец	Бгасец			
							Major	Minor			
	2	Slendernes	ss (short o	r slender)			Short	Short			
		Item					UT	Remark			
	ſ	Max (brace	ed) slende	mess			10%	OK			
	ſ	Max (unbra	aced) slen	derness / he	ight		N/A	N/A			
	5	Shear ultir	nate stress	5			0%	OK			
	\$	Shear (wit	h axial loa	d) design ca	pacity		79%	OK			
	9	Shear (axi	al confiner	nent) design	capacity		89%	OK			
	ſ	Method 1 ((nominal m	noments; sle	nder colum	n Euler buc	4%	OK			
	١	Method 2 ((nominal m	noments; sh	ort column o	crushing)	101%	NOT OK			
	ſ	Method 3 ((small assเ	imed momei	nts; short co	olumn crus	115%	NOT OK	Conve	rgence	
	ſ	Method 4 (biaxial des	sign moment	ts; short col	umn crushi	93%	ОК	Conv	erged	
	5	Total utili	sation				115%	ΝΟΤ ΟΚ	Design	Column	
	5	Detailing	requirem	ents			0	K	(Itera	ative)	
	0	% Vertical	reinforcen	nent				1.91	%		_
	F	-ctimated	stool roinf	orcomont qu	antity (220	300ka/m	3	228	ka/m^3		
	-	-Sumateu 7850 [(A		$A \pm A$	$\frac{1}{(b \pm b \text{ or })}$	20)/S) / A	1: No lans	. 220	Kg/III		
			sc rA _{sc+} //			20)/3/7	$\frac{c}{3}$	210	1 / 3	ICtructE	_
	1	stimated	steel reinf	orcement qu		- 300kg/m) A 1. Lanci	319	kg/m	ISUUCLE	_
	-		$A_{sc} + A_{sc+}$	$/A_c + (A_{sv})$	$\frac{1}{3}$	1 20)/3) / 1	A_c ; Laps;				_
e, snea	rw	Note that	steel quar	ntity in kg/m	can be of	otained from	n 110.0 x %	% rebar];			
	ľ	Material co	ost:	concrete, c	250	units/m ²	steel, s	3500	units/tonn	e	
	ł	keinforcea	concrete	material cost	t = [c+(est.	rebar quai	nt).sJ.A _c	3565	units/m		_
Columr	n Eff	fective He	eight								
			·	Table 3.19 –	– Values of	β for brace	ed columns				_
	Er	nd condition	at top			End condi	ition at bottor	n			
				1	L		2		3		
1				0.75		0.80		0.90			
2				0.80		0.85		0.95			
3				0.90		0.95		1.00			
			Т	able 3.20 —	Values of β	for unbra	praced columns				
	Er	nd condition	at top			End condi	ition at bottor	n			
				1	L		2		3		
1				1.2		1.3		1.6			
2				1.3		1.5		1.8			
3				1.6		1.8		-			-
4				2.2		_					
3.8	8.1.6	.2 End con	ditions							⊢	-
Th	ne fou	ur end cond	ditions are	as follows.							-
- 4	a) Co	ondition 1.	The end of	the column i	s connected	monolithica	lly to beams	on either s	ide which ar	e at	_
	ieast	as deep as	s the overal foundation	a dimension of structure the	n in the plai of a form so	ne considere ecifically de	a. Where th	e column is		_	
	h C	ndition 9	The end of	the column is	nonolithical	ly to beame	or slahe on a	either side w	hich	_	
	are s	hallower t	han the ove	erall dimensio	umn in the p	plane consid	ered.	Since Since W		_	
	c) <i>Co</i>	ndition 3.	The end of	the column is	s connected t	o members	which, while	e not specifi	cally designe	ed to	
1	prov	ide restrain	nt to rotatio	on of the colu	mn will, nev	ertheless, p	rovide some	nominal re	straint.		
(d) Co	ondition 4.	The end of	the column i	s unrestrain	ed against k	ooth lateral	movement a	and rotation		
((e.g.	the free en	a of a cant	llever column	i in an unbra	iced structu	re).				
1			1								

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ENGI	NEEKS	consulting	Engineers			јллл		5	
						Member/Location			
Job Title	Member De	esign - Rein	forced Cond	crete Colum	n BS8110	Drg. Ref.	D .		
Member De	esign - RC C	Column					Date 2.	2/7/2024	Cha.
		147.111							<u>BS8110</u>
Effective	рертп апо	wiath							
Number of	lavers of st	eel at each	extremity	for rect cols	: n.		1	lavor(s)	
(Note n lave	affects th	e effective	h' or h' den	endina on e	equivalent s	sinale axis (of bendina.	for rect on	v)
Spacer reir	nforcement,	$s_r = MAX$ (φ, 25mm, ι	user)	150	mm	150	mm	//
Plane of be	, ending		,	,	b-plane	or	minor pla	ne	
Effective de	epth, $h' = h$	1 - cover _{mair}	- [\u00e9+(n _{layer}		2 rect	98%	2847	mm	
	=	D - cover _m	_{ain} - ¢/2 circ	cular					
Effective w	idth, b' = b	- cover _{main}	- [ϕ +(n_{layer}	_s -1)(+s _r)]/	2 rect	94%	847	mm	
	=	D - cover _m	_{iain} - ∳/2 ciro	cular					
(Note mult	iple steel la	yer for h'-	or b'- plane	bending de	epending or	n equivalent	t single axis	s of bending	i, for rect o
.									
Detailing	Instructio	ns							
					^		<u> </u>		
					+				
					+//				
			h =	2900					
				mm					
						_	~ //-		
		,			/				
	•		\rightarrow	\langle	/				
	b =	900	mm	$A_{sc} =$	50 T32 Syr	nmetrically	Distributed		
				Links =	6 legs of T	12@100mm	n pitch		
		Cover =	25 mm						
	(Concrete =	80 MPa						
		Rebars =	460 MPa						
		Links =	460 MPa						
	D!	Steel % =	1.91 %						
	Benai	ng plane =	b-plane						
		Note	1 rect column	chown for	honding in	h-nlang ng	t h-nlane)		
		(NOLE I		51101011101	benuing in	п-ріапе, по	n b-plane)		
Bendina N	1oment Sig	an Conven	tion						
	🕈 My								
	· _]								
h	▶	► Mx							
	b								
		1							
l									

CON	SUI TINC	Enginoorin	a Calculatio	n Shoot		Job No.	Sheet No.		Rev.
	NEEDS	Consulting	y Calculatio Engineers	II Sheet		iVVV		1	
ENGI	NEEKS	consulting	Linginicers]~~~	-	t	
						Member/Location			
Job Title	Member De	esign - Rein	forced Con	crete Colum	n BS8110	Drg. Ref.			
Member De	esign - RC (Column				Made by XX	Date 2	2/7/2024	Chd.
									<u>BS8110</u>
Slenderne	ess of Colu	mn (Whet	her Short	or Slender)				
Major plan	e eff. slende	erness, l _{eff,x} ,	/(h or D)			Major	1.2		
Minor plan	e eff. slende	erness, l _{eff,y} ,	/(b or D)			Minor	3.8		
Major plan	e short colu	mn limiting	eff. slende	rness (15 b	oraced; 10 u	Major	15.0		cl.3.8.1.3
Minor plane	e short colu	mn limiting	eff. slende	rness (15 b	raced; 10 u	Minor	15.0		cl.3.8.1.3
Major plan	e eff. slende	erness (sho	rt if < crite	ria, slender	if > criteria	Major	Short		cl.3.8.1.3
Minor plan	e eff. slende	erness (sho	rt if < crite	ria, slender	if > criteria	Minor	Short		cl.3.8.1.3
Major plan	e max clear	slendernes	ss l _{clear,x} /(h o	or D)		Major	1.4		cl.3.8.1.7
Minor plan	e max clear	slendernes	s I _{clear,y} /(b o	or D)		Minor	4.5		cl.3.8.1.7
Max (brace	ed or unbra	ced) clear s	lenderness	utilisation (<= 60)		8%		ОК
Major plan	e max eff. s	slenderness	l _{eff,x} /(h or [D)		Major	1.2		cl.3.9.3.7.2
Minor plan	e max eff. s	lenderness	l _{eff,y} /(b or [D)		Minor	3.8		cl.3.9.3.7.2
Max (brace	ed) eff. slen	derness uti	lisation (<=	= 40)			10%		ОК
Major plan	e max clear	[.] height l _{clear}	,x	N/A		•	4050	mm	cl.3.8.1.8
Minor plan	e max clear	height l _{clear}	,у	N/A		•	4050	mm	cl.3.8.1.8
Max (unbra	aced cant.)	clear heigh	t utilisation	(<= 60(h d	or b) or 100)(h or b)²/(l	N/A		N/A
Major plan	e max eff. s	slenderness	l _{eff,x} /(h or [D)		Major	1.2	cl.3.8	8.5, cl.3.9.:
Minor plan	e max eff. s	lenderness	l _{eff,y} /(b or [D)		Minor	3.8	cl.3.8	8.5, cl.3.9.:
Max (unbra	aced) eff. sl	enderness	utilisation (<= 30)			N/A		N/A
Note for R	C columns a	and walls, si	lenderness	limits are a	s follows:-				
	braced sho	rt (stocky)	l _{eff,x/y} /(h/b	or D)			15		cl.3.8.1.3
	braced sler	nder I _{clear,x/y}	/(h/b or D))			60		cl.3.8.1.7
	braced sler	nder I _{eff,x/y} /	(h/b or D)				40		cl.3.9.3.7.2
	unbraced s	hort (stock	y) I _{eff,x/y} /(h	/b or D)			10		cl.3.8.1.3
	unbraced s	lender I _{clear}	_{,x/y} /(h/b or	D)			60		cl.3.8.1.7
	unbraced c	ant. slende	r I _{clear,x/y}	{6	0h, 100h²,	/b} {60b,	100b²/h}		cl.3.8.1.8
	unbraced s	lender I _{eff,x,}	_{/y} /(h/b or Ľ))			30		cl.3.8.5
	unbraced s	lender I _{eff,x,}	_{/y} /(h/b or L)			30		cl.3.9.3.7.2
Note for pl	ain (unreini	forced) wall	s, slendern	ess limits a	re as follow	/s:-			
	braced sho	rt (stocky)	l _{eff} /THK				15		cl.3.8.1.3
	unbraced s	hort (stock	y) I _{eff} /THK				10		cl.3.8.1.3
	braced or ι	inbraced sle	ender I _{eff} /T	ΉК			30		cl.3.9.4.4

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			<u> </u>			Mombor/Location		-		
1.h. Title	Marahan D	acian Dai	forced Con	anata Calum	DC0110	Dra Bef	I			
Job Title Mombor D	Prember De	Sign - Keir	norcea Con	crete Colum	10 058110	Made by	Date 🤉	2/7/2024	Chd.	
	esigii - RC (Joiuiiii				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	2 ×	2/7/2024	BSS	110
Moments	From Slen	derness F	ffects						d 3.8	231
Homenes									01.0.0	
Additional	moment for	slender co	olumns, M _{ade}	d.x		().	N/A	kNm	cl.3.8	8.3.1
Additional	moment for	slender co	olumns, M _{ade}	d,y	11/1	$I_{add} = Na_{u}$	N/A	kNm	cl.3.8	8.3.1
	Major plan	e effective	height, l _{eff,x}				N/A	m	cl.3.8	8.3.1
	Minor plane	e effective	height, l _{eff,y}				N/A	m	cl.3.8	8.3.1
	Deflection	in x (h in t	his equatior	n = h or D	[$a_{11} = \beta_{2}Kh$	N/A	mm	cl.3.8	8.3.1
	Deflection	in y (h in t	his equatior	n = b or D		u i u	N/A	mm	cl.3.8	8.3.1
	Coefficient	in x (b' in	this equatio	n = h or D	β	$=\frac{1}{2}\left(\frac{l_e}{l_e}\right)^2$	N/A		cl.3.8	3.3.1
	Coefficient	in y (b' in	this equatio	n = b or D	, a	2000\b')	N/A		CI.3.8	3.3.1
	Reduction	factor due	to avial loar	10	$K = \frac{N}{N}$	$\frac{V_{uz} - N}{-N_{v_{uz}}} \le 1$	0.25		038	2 1
	Ultimate as	xial load		13	V = 0.45f	1z + 0.95f A	115750	kN	d.3.8	3.1
	Axial load a	at balanced	l failure, N _h	$= 0.25 f_{cu}$		Ic · 0.00/yrise	52200	kN	cl.3.8	8.3.1
Single Ax	is Moment	From Bia	xial Mome	nts						
Major plan	e max desig	gn bending	moment, M	l _x			5000	kNm		
Minor plan	e max desig	gn bending	moment, M	l _y			2000	kNm		
Ratio N/(b	hf _{cu}) rectan	gular or N/	(D ² f _{cu}) circu	lar			0.48		cl.3.8	8.4.5
Enhancem	ent coefficie	ent for biax	ial bending,	β			0.44		cl.3.8	8.4.5
6. /. 5. 7 .			Table 3.22	— Values o	of the coef	ficient β			-	
	0	0.1	0.5	2 0	.3	0.4	0.5	≥0.6		
bhf _{cu}										
β	1.00	0.8	8 0.	17 0	.65	0.53	0.42	0.30		
Effective d	epth, h' = ł	n or D - cov	/er _{main} - ø/2				2847	mm		
Effective w	/idth, b' = b	or D - cov	er _{main} - ø/2				847	mm		
(Note for t	he purpose	of determi	ning equiva	lent single	bending ax	ris, single s	teel layer as	sumed)		
						h'	1			
If $M_{ m x}/h'$	$\geq M_{ m y}/b'$	then in	creased ma	jor plane be	ending M	$M_{\rm x} + \beta \frac{n}{b'} M_{\rm y}$	N/A	kNm	cl.3.8	8.4.5
16 2 6 12 1	26.01					b're		1.81	120	
If $M_{\rm x}/h'$	$< M_{\rm y}/b'$	then in	creased mir	nor plane be	ending M_{3}	$\gamma + \beta \frac{\delta}{h'} M_{\rm x}$	2659	kNm	cl.3.8	8.4.5
Increased	cinalo avic l	honding m	omont M				2659	kNm	038	15
Plane of de	single axis i	nt for recta	angular colu	imns (h- or	h-)		b-plane	KINIII	d.3.8	4.5
							a prano		chore	1115

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						Member/Location			
Job Title	Member De	esign - Reir	nforced Con	crete Colum	nn BS8110	Drg. Ret.	Data		Oh d
Member D	esign - RC (Column	1			Made by XX	Date 2	2/7/2024	Cna.
									<u>BS8110</u>
Shear (W	ith Axial L	oad)							cl.3.4.5.12
Shear insig	inificant if N	1/N < 0.6 (h or b) for i	rect, 0.6 D	for circ	2/ <	- 540	mm	cl.3.8.4.6
(Note h or	b dependin	g on equiv	alent single	axis of ben	Snea	ar Insignif		1.51	<i>cl.3.8.4.</i> 6
Maximum	snear force,	$V_{d} = MAX$	(V_y, V_z)	05	2,		0	KN 2	
Ultimate s	near stress,	$v_{ult} = V_d /$	$A_{c} (< 0.8 f_{cu}$	^{0.3} & {5.0,7	'.0}N/mm*))	0.00	N/mm ²	.3.4.5.2 BC
Note the u	ltimate she	ar stress III	mit of 5.0 oi	r /.0N/mm [·]	s used fo	$or f_{cu} \le 60$	or 105N/mr	n° respecti	vely;
Ultimate s	near stress	utilisation					0%		ОК
Desian sha									
Design she	ear stress, v	$v_{\rm d} = V_{\rm d} / A_{\rm c}$					0.00	N/mm²	
(Shear cap	acity enhar	ncement by	either cal	culating v _d	at d from .	support and	i comparing	i against	
unenhance	$rd v_c$ as cla	use 3.4.5.1	<u>0 BS8110 (</u>	or calculati	ng v _d at su	ipport and o	comparing a	against	
enhanced	v_c within 20	d of the su	port as cla	use 3.4.5.8	BS8110 bc	oth not app	dicable as	described	
in clause 3	.4.5.12 BS8	3110;)						2	
Area of ter	isile steel re	einforceme	nt provided	(uniaxial be	ending), A _{s,}	$prov = A_{sc} / 2$	20106	mm²	
$\rho_w = 100A$	_{s,prov} /A _c						0.77	%	
Effective d	istance to t	ension stee	el, h' or b'				847	mm	
(Note h' oi	⁻ b' dependi	ng on equi	valent single	e axis of be	nding, for r	ect only)		2	
$v_{c} = (0.79)$	/1.25)(ρ _w f _{cu}	/25) ^{1/3} (400)/(h' or b'))'	^{/4} ; ρ _w <3; f _c	_u <80; (400)/(h' or b'))	0.85	N/mm²	.3.4.5.4 BC
				NVh —					
Including a	axial force e	ffects	$v_{\rm c}' = v_{\rm c} + 0.6$	$\overline{A_{a}M} \leq v_{a}$	$v' = v_c \sqrt{1}$	+ $N/(A_{\rm c}v_{\rm c})$ }	0.85	N/mm ²	cl.3.4.5.12
	N/A _c			C			38.3	N/mm ²	cl.3.4.5.12
	V _d (h or b)/	M or V _d D/N	1 but < 1.0				0.00		cl.3.4.5.12
(Note h or	b dependin	g on equiv	alent single	axis of ben	ding, for re	ect only)			
				2/2					
Minimum s	hear streng	$v_r = M$	AX (0.4, 0.4	$(f_{cu}/40)^{2/3}),$	f _{cu} ≤80N/m	1m²	0.63	N/mm ²	.3.4.5.3 BC
Check v _d	< 0.5v _c ' (c	olumn) (n	ninor elem	ents) or 1.	0v _c ' (wall)) for no lin	VALID	Column	<i>cl.3.8.4.6</i>
	Concrete s	hear capac	ity v _c '.(A _c)				2228	kN	
Check 0.0	v _c ' (colum	n) or 1.0v	/ _c ' (wall) <	$v_d < v_r + v_r$	v _c ' for non	ninal links	VALID	2	cl.3.4.5.3
	(A _{sv} /S) _{nom}	> v _r .(b or l	n rect, D cire	c)/(0.95f _{yv})	i.e. (A _{sv} /S)	nom >	4.21	mm²/mm	
	(Note b or	h dependir	ng on equiva	alent single	axis of ben	nding, for re	ct only)		
	$V_{cap,nom} = ($	$v_{r} + v_{c}').(A$	(c)				3886	kN	
Check v _d	> v _r + v _c ' f	or design	links				N/A		cl.3.4.5.3
	$A_{sv}/S > (b$	or h rect, l	O circ)(v _d -v _c	')/(0.95f _{yv})	i.e. $A_{sv}/S >$	>	4.21	mm²/mm	
	(Note b or	h dependir	ng on equiva	alent single	axis of ben	nding, for re	ct only)		
	$V_{cap} = (A_{sv},$	_{.prov} /S).(0.9	95f _{yv}).(h or l	o rect, D cir	$(c) + v_{c}'.(A_{c})$.)	4897	kN	
								L	
Area provi	ded by all li	nks in a cro	oss-section,	A _{sv,prov}			679	mm ²	
Tried A _{sv,pr}	$_{ov}$ / S value						6.79	mm²/mm	
Design she	ear (with ax	ial load) re	sistance util	isation			79%		ОК
Shear (A)	cial Confine	ement)			Consider for C	Columns Only	•		
				ļ					
Minimum o	confining pro	essure, f _s		Non-Seismic	Design 0.015f	fck 🔻	0.98	N/mm ²	McFarlane
									IStructE, 07
Confining	pressure, f _s	= [A _{sv,prov} /	S].f _{yv} /b _c				1.10	N/mm ²	McFarlane
	Width, $b_c =$	= [(b or h)	for rect, 0.6	D for circ]	– 2.cover –	- ¢ _{link}	2838	mm	StructE, 07
	Area provid	ded by all l	inks in a cro	ss-section,	A _{sv,prov}		679	mm ²	
	Tried Asv,pro	_{ov} / S value					6.79	mm²/mm	
Design she	ear (axial co	onfinement) resistance	utilisation			89%		ОК

CON	ISULTING	Enginoorin		n Ch	oot		Job No).	Sheet No.		Rev.
	NEEDS	Consulting	y Calculatio Engineers	11 511	eet		iXX	v	-	7	
LIGI	NEEKS	consulting	Engineers	-			JVV	^		/	
							Member/Lo	ocation			•
Job Title	Member De	esign - Rein	forced Con	crete	Colum	nn BS8110	Drg. Ref.				
Member D	esign - RC (Column					Made by	XX	Date 2	2/7/2024	Chd.
											<u>BS8110</u>
Detailing	Requirem	ents									
All detailin	g requireme	ents met ?							ОК		
By definition	on, b <= h										OK
Min dimen	sion (to faci	llitate concr	eting >= 1	25mr	n)				900	mm	OK
Min longitt		reinforceme		, n _l (2	>= 4 r	ectangular;	>=60	Ircui	50		OK
Min longitu	idinal steel	reinforceme	ent diamete	r, φ (>=121	nm column	Colu	mn	32	mm ov	OK
Percentage	e of reinford	coment A	$+A_{sc+})/A_c X$	100%	0 100/2	[0 10±0 0	1/f -6	0170	1.91	70 00/2) 7	
Longitudin	al stool roin	forcoment	$A_c \times 100\%$	nm±(.40%,	$\frac{10.40\pm0.0}{1000}$	$1(r_{cu}=0)$	-300	116	mm	R49 (1.3.1.
Longituum	Rectangula	ar col bar ni	rch = [(h or	r h)_2	φ , >10	οππτφπ 1 cdl/(n./	(2 n.	<u>ا-200</u>	116	mm	UK
	(Note h or	h denendin	$a \circ n equiv:$	alent	sinale	avis of her	dina f	rs) ⊥, ∩r re	ct only)		
	Circular co	l bar pitch =	$= \pi (D-2.co)$	ver	ه)/n			51 10	N/A	mm	
Note an al	lowance ha	s been mad	e for lans i	the	min n	itch hv incr	easina	the d	riteria hv t	he har diar	neter
Min link dia	ameter, dunk	(>=0.25¢:	>=6mm N	SC: :	>=10n	nm HSC)			12	mm	OK
Max link p	itch. S	(,					100	mm	OK
Max link p	itch, S (<=.	12 ø NSC, <	:=10 <i>φ</i> HSC	; <=.	24 Ø link	HSC, <=3	300mm	, <=	288	mm	
Require ar	overall end	closina link.	- /	, 	/ 11/16		,				
, Require ad	lditional res	training link	ks for each	alteri	nate lo	ngitudinal	bar in e	each	direction.		
No unrestr	ained bar s	hould be fu	rther than .	150m	m clea	ar distance	from a	rest	rained bar.		
		_									
- T	- ']	1									
-		-									
60		_									
2 +	_ ** **	-									
Les that 190g											
Require th	rough slab ,	/ beam dep	th column l	inks i	in edge	e and corne	er colun	nns d	due to lack	of restraint	
Max link p	itch, S								100	mm	ОК
Max link p	itch, S (<=.	10 ø.f ₁ .f ₂ .f	5₃ HSC, <=	24 ø _{li}	_{ink} .f ₁ .f	$f_2.f_3$ HSC)			149	mm	McFarlane
	Axial stres	s, N/(f _{cu} .A _c)						0.48		IStructE, 07
	Spacing fa	$ctor, f_1 = 0$	0.27(f _{cu} .A _c)/N					0.56		
	Spacing fa	$ctor, f_2 = q$	ø _{link} /12						1.00		
	Spacing fa	$ctor, f_3 = f$	_{yv} /500		_				0.92		
a		b	Alternate 90° and 138 each layer of links, b	5° bends in ut must							
			check capacity of 90	bend							
	1										
7											
,											

CONSULTIN E N G I N E E R		Engineerin	a Calculatio	n Shoot		Job No.	Sheet No.		Rev.
ENGI	NEERS	Consulting	Engineers	in Sheet		iXXX	1	3	
2			5			Manukan/Lanatian		-	
1.1. 7.1.	Marahan D	anina Daia	fauna d Cau	custo Colum	DC0110	Dra Bef			
JOD TITIE Member D	Priember De	olumn	forced Con	crete Colum	IN BS8110	Made by	Date 7	2/7/2024	Chd.
Member D							2	2/7/2024	BS8110
Method 1	(Axial For	ce; Nomin	al Moment	ts for Non-	Continuo	us (Precast	t) Floors; §	Slender Co	lumn Eule
	```								
Axial buck	ing capacity	(Euler) ma	ajor plane,	$N_{cap,Euler} = \pi$	² .E _{c,28} .I _x /I _{ef}	2 f,x	3E+07	kN	
Axial buck	ing capacity	/ (Euler) mi	nor plane,	$N_{can Euler} = \pi$	; ² .E _{c 28} .I _y /I _{eff}	2 f,y	3E+06	kN	
	Elastic mod	dulus of con	crete,	$E_{c,28} = K_0 + 0.2$	fcu,28		36.0	GPa	
	Cracked se	econd mome	ent of area	major plane	$e_{,0.5I_{x}} = 0$	$\frac{1.5b.h^3}{12}$	9.1E+11	mm ⁺	
Avial cana	Cracked se	econa mome on = N/N	ent of area	minor plane	$e, 0.5I_y = 0$	.5n.b ² /12 0	8.8E+10 40/2	mm [.]	OK
			,Euler				-170		ÖK
Method 2	(Axial For	ce; Nomin	al Moment	ts for Non-	Continuo	us (Precasi	t) Floors; s	Short Colu	mn Crushi
	`								
Percentage	e of reinforc	ement (A _{sc} -	+A _{sc+} )/A _c x	100%			1.91	%	
Axial capa	city, $N_{cap} =$	$0.40f_{cu}.A_{c} +$	(0.75f _y -0.	40f _{cu} ).(A _{sc} +	A _{sc+} )		99127	kN	cl.3.8.4.3
(Note for p	perfect axial	conditions,	$N_{cap} = 0.4$	45f _{cu} .A _c +	(0.95f _y -0.4	45f _{cu} ).(A _{sc}	+A _{sc+} ))		
Ахіаї сара		$D\Pi = N/N_{cap}$					101%		NOTOK
7									
			<u> </u>				<u> </u>		

	CON	SULTIN	G End	aineerii	ng Calcula	ation She	et		Job	No.	Sheet	No.		Rev.
<b>E N G I N E E R S</b> Consulting Engineers										jXXX			9	
		-							Memb	er/Location				
1 - 1	T:+1 -	Marahar	Decia	m Dei	nforced (	Concrete	Caluman	DC011(		lef				
JOD	D LITIE	Member		in - kei	nforcea (	Loncrete	Column	858110	Made	by <b>vv</b>	Date	2	2/7/2024	Chd.
Me		esiyii - K		111111						~ ^^		2	2/7/2024	BCQ110
Me	thod 3	A (Axial	Force	e: Sma	ll Assum	ned Mom	ents fr	or <15º	⁄₀ ∆di	iacent	Snans	Dif	ference in	<u>D30110</u> Continuou
					ASSum						opuns	0		continuou
i	Approxima mmediate	ite method ly above th	for allov e colum	ving for n in being (	noments: n considered)	nultiply the a by:	axial load	from the f	oor	-				
				1 25	-interior coli	umns								
				1.50	-edge colum	nns								
				2.00	-corner colu	Imns								
t	out keep t	he columns	s to con	stant size	e for the top	o two storey	S.		-					
Per	rcentage	e of reinf	orcem	ent (A _s	_c +A _{sc+} )/A	_c x 100%					1	1.91	%	
Axi	al capad	city, N _{cap}	= 0.3	5f _{cu} .A _c	+ (0.67f _y	,-0.35f _{cu} ).	.(A _{sc} +A	_{sc+} )			87	052	kN	cl.3.8.4.4
Axı	al capad	city utilis	ation =	= N/N _{ca}	p						11	5%		NOT OK
	ι	Iltimate res	istance	of brace	d stocky c	olumns (f _{cu}	1 = 35)							
Н							Area of	<b>r</b>				₁⊢		
Η	Co	umn size &	braced.	clear store	ey height limi	it (mm)	section	p=1% (kN)	p=2% (kN)	p=3% (kN)	p=4%* (kN)	∣⊢		
Η	< 3530	< 441	1 <	5294	< 6176	< 7059	10 ³ )	1260	1625	1004	0469	∣⊢		
H	200 x 45 200 x 52	5 250 x 3	20 30	0 x 350	250 250		105	1597	1908	2218	2168 2529			
H	200 x 61 200 x 70 200 x 70	0 250 x 4	60 30 40 30	0 x 470	350 x 350 350 x 400	400 - 400	140	2129	2543	2958 2958	2950 3372			
	200 x 80 200 x 90	0 250 x 6	40 30 20 30	0 x 540 0 x 600	350 x 460 350 x 520	400 x 400 400 x 450	180	2433	3270	3380	3854 4335			
	200 x100 200 x120	0 250 x 8 0 250 x 9	60 30 60 30	0 x 870 0 x 800	350 x 575 350 x 690	400 x 500 400 x 600	200 240	3041 3650	3633 4360	4225 5070	4817 5781			
	* Note : So	cheme desig	gn based	1 on 4 % re	bar should b	be avoided if	possible.	11.040 ·						
F	The ulti percentages	mate loads p may be ob	that can tained fro	be carried m Table 5	for $f_{cu} = 30$ N	s of different Umm ² and fy:	sizes and = 460N/m	n ² .	einforce	ment				
- 1														
			Table	5 Ultimo	ite loads fo	r stocky co	olumns							
Нſ	Column	Cross	sectional	p=	1% N	p = 2%	p = 3	%	p = 4% kN					
	mm x mm	u.	u, mm	~						_				
Ηſ	300 x 300 300 x 350		0 000	12	13	1481	1749		2016 2353					
	350 x 350 400 x 350	i i	2 500	16	51	2016 2304	2380		2745 3137					
	400 x 400	10	000 000	21	56	2633	3109		3585					
	*Provided that	t the smallest di	mension is n	not less than 2	200mm, any shap	e giving an equi	valent area m	nay be used.						
				_										
Me	thod 3	B (Axial	Force	e; Sma	II Assum	ned Mom	ents; S	Short Co	olumi	n Crusl	ning; A	rup	Scheme D	esign)
	Approxim	ate metho	od for a	llowing f	or momen	ts: multipl	y the axi	ial load fr	om the	floor		1		
ļ	immediat	ely above	the ∞l	lumn bei	ing conside	ered) by:	-							
					1.25-interio	or columns								
-					1.50-edge 2.00-corne	columns r.columns								
Η												┣─		
ΗĽ	but keep	the colun	nns to c	onstant	size for th	ie top two	storeys.					Į—		
١Ī	Minimum	column c	limensi	ons for	stocky', br	aced colur	nn = cle	ar height	/ 17.7					
	Column a	area where	e ( _{eu} = 3	35 N/mm	$n^2$ and $f_v =$	460 N/mm	² is as f	ollows (N	is axia	al force i	n			
	Newtons)	:-												
				,	1% steel :	Area = N/′	15							
				1	2% steel : . 3% steel :	Area = N/° Area = N/°	18							
					570 31001 .	Aloa - No			_					
-									_					
			_						_					
			_						_					
			_											
-														







CON	SUI TINC	Enginoorin	a Calculatio	n Shoot		Job No.	Sheet No.		Rev.
	NEEDS	Consulting	y Calculatio Engineers	in Sheet		iXXX	1	з	
LIGI	NEEKS	consulting	Lingineers			JYYY	1	.5	
						Member/Location			
Job Title	Member D	esign - Rein	forced Con	crete Colum	n BS8110	Drg. Ref.			
Member D	esign - RC (	Column				Made by XX	Date 2	2/7/2024	Chd.
									<u>BS8110</u>
Method 4	(Axial For	ce; Design	Biaxial M	oments; Sl	nort Colun	nn Crushin	g or Slend	ler Columr	Imperfec
(Note whe	re relevant	(h and h') (	or (b and b	') depending	i on equiva	lent single a	axis of ben	ding, for rea	ct only)
<b>D</b> 11 1			() ) (						
Depth to c	ompression	steel, $n_c =$	(n or d for	rect, D for	$\operatorname{circ}$ ) - $(n')$	or b')	53	2 mm	
Area of sec	ction, A _c						2610000	mm ²	
Patio (h' o	r h')/(h or k	) (roct) or	(h' h ')/D (/	circ)			0.04		
Strongth o	f concrete	f					0.94	NI /mama ²	
Viold strop	ath of longi	i _{cu} tudinal stor	l f				80 460	N/mm	
Pectangula	r ratio N/bl	h or circular	ratio N/D ²				38 31	$N/mm^2$	
Pectangula	r ratio (M/I	$h^2$ or M/bb	$\frac{1}{2}$ or circula	ar ratio M/D	3		1.13	$N/mm^2$	
Rectanguit							1110	11/11/11	
Perform ite	eration					Design	Column		
						(Itera	tive)		
Iterate dep	oth of neutr	al axis until	the two A _s	expression	equal, x		1063	mm	
Steel strain	η, $ε_s = -ε_{cu}$ (	(h' or b' - x)	)/x	-			0.00063		
Steel strain	$n, \epsilon_{sc} = \epsilon_{cu}$ (	x-h _c ')/x					0.00295		
	For f	CO N /mm	2 0.0	0.25					BC2
	FOR T _{cu} S	60 N/mm	$r_{e_{cu}} = 0.0$	035					cl.2.5.3
	For f	60 N/mm	$h^2$ , $\epsilon_{cu} = 0.0$	0035 - (f _{cu} -	60)/5000	00			cl.2.5.3
								2	
Steel desig	in yield stre	rangth = 460	)/1.05 (G46	0) or 250/1	.05 (G250)	)	438	N/mm ²	
Steel elast	ic modulus,	E _s	بنداط مليبيني	+l- )			205000	N/mm ²	
Steel stres	$S, T_s = E_s \cdot \varepsilon_s$	(< design	yield streng	tn)			129	N/mm ²	
Steel stres	$S, T_{SC} = E_S.\varepsilon$	_{sc} (< aesign	i yiela stren	igtn) - 0.451	cu		402	N/mm ⁻	
	Postanau	lar							
	Rectangu	ai							
	Concrete s	train, εο	2.4 × 10 ⁻⁴ /-	fcu			0.00175		
				7 m					
		0.45/	. /	<b>6</b> 0 \					
	Factor, $k_1$		Ξ ( ε	$(u - \frac{3}{3})$	= k1		29.2	N/mm ²	
		Ccu	`	- /					
		[(2 - )	En/ E 1	² + 2]					
	Factor, $k_2$	4 (	3-60/ 8	<u> </u>	* k ₂		0.417		
		L .,		u ' _					5.00
	For f _{cu} ≤	60 N/mm	$e^{2}, \epsilon_{cu} = 0.0$	035					BC2
									(1.2.5.3)
	For f _{cu} >	60 N/mm	$h^2$ , $\epsilon_{cu} = 0.0$	)035 - (f _{cu} -	60)/5000	00			0.2.3.5
	A _c = [N-k₁	.(b or h).x1	$/(f_{s}+f_{s})$				18708	mm ²	ОК
	$A_{s} = [M-k_{1}]$	(b or h).x.	(0.5(h or b)	)-k ₂ .x)] / [(f	-fs).((h' c	or b')-0.5(h	18691	mm ²	OK
	$A_{sc,reg} = MA$	AX (2.avera	$ge(A_s), 0.4$	$0\%A_c$ ) if sol	n; from int	eraction cha	37597	mm ²	
	100A _{sc,req} /A	A _c					1.44	%	
	Circular								
								-	
	From inter	action chart	ts, A _{sc,req}				N/A	mm ²	N/A
	100A _{sc,req} /A	۹ _c					N/A	%	
Aros of la	ت ا = منام رطنوم	ool roinfor	omont	uirod (waiau			27507		
Area of Ion	gitudinal st		ement requ		ai vending	), A _{sc,req}	3/59/	mm ²	
	ity utilicati	$\frac{1}{2} = \frac{1}{2} = \frac{1}{2}$	ament prov		ai benung	), A _{sc}	40212	ınm-	OK
Convergen	ce of intera	ction equat	ions			Conv	erged		OR
Jennergen									

	CON	SULTI	NG	Engir	neerin	n Cal	Calculation Sheet				Job No.		Sheet	No.			Rev.	
E	<b>ENGINEERS</b> Cor			Cons	ulting	Engii	neers	II One				j	xxx		1	.4		
								<u> </u>				Membe	er/Location					
lob	Title	Membe	r De	esian	- Rein	force	d Con	crete (	Colum	n BS8	3110	Drg. R	əf.					
Mer	nber D	esign - F	RC (	Colum	n							Made I	y XX	Date	2	2/7/202	<b>24</b> (	Chd.
																		<u>BS8110</u>
Sch	eme D	esign															_	
<b>—</b> [	Table	s 2.21	to i	2.23	may	be us	sed fo	or initi	al sizi	ing. T	his is	sas	umma	ary of	the	data cor	nta	ined in
	Econ	omic co	ncre	ete fra	ame e	leme	ents ^[2]	and s	hould	l be u	sed v	vith	the fo	llowin	g ca	utions:		-
	🔳 Lo	ads are	ult	imate	e load	ls in l	kN.											
	Int	ternal o	olu	mns a	are as	sume	ed to	suppo	rt sla	bs or	bear	ns o	f simil	ar spa	ns ir	i each oi	rthe	ogonal
	dir	ection.															6	. –
	Im Im	posed i	moi	ment ちのと	s on e	edge Salta	and c	orner	colun ificati	nns r ion is	nave I	beer	i assur	ned; fo	or in	iposed la	bac	IS
		lumns	are	'shor	t' and	l'bra	ceď.	ejust	incau	OTTS	requ	neu						-
	Conc	rete co	olun	nns o	can b	e co	onceal	ed w	ithin	part	itions	s by	using	gʻblaq	le' d	olumns.	. 0	ften a
	200 >	( 800 n	nm	section	on is i	used	becau	use 20	0 mn	n is a	prac	tica	l minir	num t	hick	ness and	180	00 mm
is four times the thickness, which classifies it as a wall. For fire resistance this reduces the cover requirements compared with a column										e cover								
	requi	rement	5 C(	лпра	ieu w	iui a	colur	101.										F
	Table	2.21																
	Initial sizing for internal square columns (mm)																	
	Percentage of Ultimate axial load, kN (Class C28/35 concrete)																	
reinforcement 1000 1500 2000 3000 4000 5000 6000 8000 10												10000						
	1.09	24	0	295	295 3		420	5	485		540	59	5	685	7	765		
	1.0%         240           2.0%         225			5	270	3	310	380	5	440		490	540	D	620	e	595	
	3.09	6		22	5	250	2	285	350	)	405		455	500	0	570	e	540
	4.09	6		22	5	230	2	270	330	5 C	380		425	46	5	535		595
┝╴┟			_	_		250						_					_	
	Table I Initial	2.22 sizing f	or s	ouar	e edø	e coli	umns	(mm)										
		512113	1.11+	imate				20/ 50	har c		c	9E						
			400		= axia		1200	3%10	600 C	20	00	33 (0		=)		E000	60	200
	2 - + -		400	,	205		1200		500	20	-	30	00	4000		5000	OL	
	2 sto	reys	230	,	305		380	45	10	50	5		-					
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