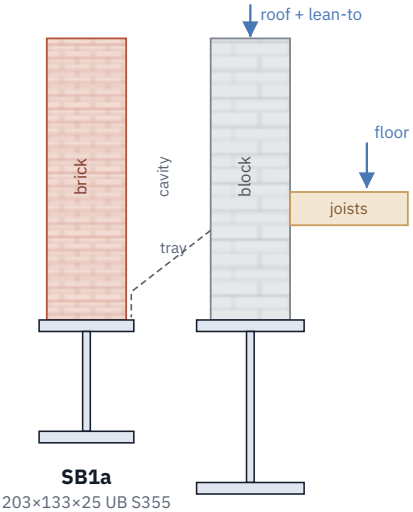
PROJECT	JOB NO.	DATE
Example House 3 bed detached house · new build (example project)	LTD-EX-001	29 Oct 2026
SUBJECT	**CALC BY**	**CHECKED BY**
Steelwork SB1	LoadTakedown (auto)	

REFERENCES

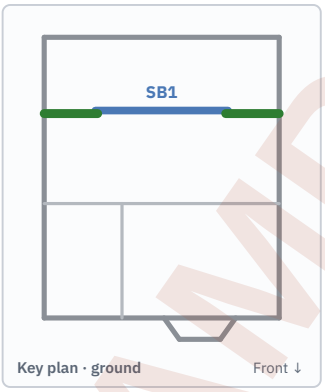
SB1: ONE BEAM PER LEAF

SB1 carries the first floor rear wall over the opening below. The cavity wall is supported on **two beams, one under each leaf**, so each leaf sits on its own flange and neither beam is loaded in torsion. Each beam is designed for its own leaf only.



SB1a
203×133×25 UB S355

SB1b
254×146×31 UB S355



Rear return walls (green) either side of the 4195 mm clear opening; each beam bears on its own leaf of the returns.

Clear opening, design span	4195 mm clear + 2 × 150 bearings → L	**4.345** m
Returns, length to jamb	1902 mm from the outside corner; 1600 mm past the side wall	sheet 8

Load split between leaves

BEAM	LEAF	CARRIES	SECTION	w_{Ed} KN/M	UTIL.
SB1a	outer	First floor rear wall outer leaf over the opening, First floor rear wall outer leaf lintel reactions, Lean-to roof dead, Beam self weight, Lean-to snow drift (persistent)	203×133×25 UB	9.93	0.86
SB1b	inner	First floor rear wall inner leaf over the opening, First floor rear wall inner leaf lintel reactions, First floor + partitions, Beam self weight	254×146×31 UB	16.94	0.82

Differential deflection, total load $|\delta_{inner} - \delta_{outer}| = |7.2 - 7.5|$ **0.3** mm — SCI P385; engineering practice

Schemes considered

SCHEME	SB1A	SB1B	DEPTH MM	UTIL.	OUTCOME
UB pair within the wall width	203×133×25 UB	254×146×31 UB	251.4	0.86	PASS **adopted**

engineer's decision

Adopted pair: downstand 91 mm below the ceiling, boxed in. UB pair between the rear return walls, 4.195 m clear opening, 4.345 m span, no post (engineer's scheme); each beam bears on its own leaf of the returns; downstand below the rear-bay ceiling boxed in

Detailing

1. M16 grade 8.8 bolts through tube spacers at both bearings and at 600 c/c, tying the pair to transfer the racking shear; not relied on to share vertical load (each beam carries its own leaf).
2. Cavity tray with stop ends and weeps over SB1a; close the cavity at the bearings.
3. Both beams fire protected to R30; SB1a also galvanised (in the cavity).

PASS – Each leaf supported on its own beam; no torsion

DRAFT SAMPLE

PROJECT	JOB NO.	DATE
Example House 3 bed detached house · new build (example project)	LTD-EX-001	29 Oct 2026
SUBJECT	**CALC BY**	**CHECKED BY**
Steelwork SB1a · 203×133×25 UB S355	LoadTakedown (auto)	

BEAM SB1A – TO SUPPORT OUTER LEAF OF FIRST FLOOR REAR WALL

Design span	*L* (centre to centre of bearings)	**4345** mm
Section, grade	203×133×25 UB S355	
Supports	simply supported on the rear return walls	
Restraint	fork restraint at bearings; flange unrestrained	
Combination	eq. 6.10 roof leading	
Deflection limits	imposed *L*/360; total *L*/500	

Carries the brick outer leaf of rearFirst and the lean-to roof ledger; bears in the plane of the rear return walls on their outer block leaf, on a padstone.

REFERENCES



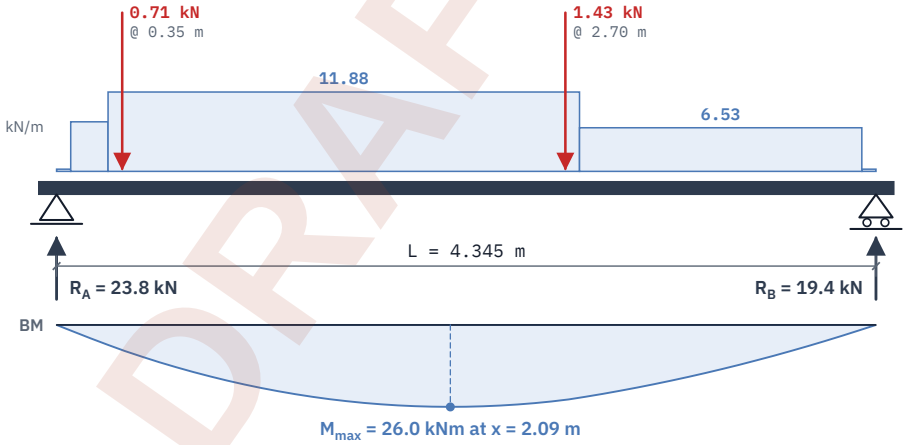
Loading, as it acts

SOURCE	FORM AND POSITION (X FROM BEARING A)	CHAR. KN	γ	ULS KN
Outer leaf over the opening (DL)	2.64 kN/m 0.07-0.27 m; 5.94 kN/m 0.27-2.77 m; 1.98 kN/m 2.77-4.27 m	18.34	1.35	24.75
Outer leaf lintel reactions (DL)	0.53 kN at 0.35 m; 1.06 kN at 2.70 m	1.58	1.35	2.14
Lean-to roof dead (DL)	1.28 kN/m 0.07-4.27 m	5.38	1.35	7.27
Beam self weight (DL)	0.25 kN/m full span	1.07	1.35	1.44
Lean-to snow drift (persistent) (LL)	1.20 kN/m 0.07-4.27 m	5.02	1.50	7.53
Total on the span	**eq. 6.10 roof leading: γ_G 1.35, floor 1.05, roof 1.50**	**31.39**		**43.13**

Loading schedule, sheet 1; takedown

Characteristic, per m of span	$g_k = 6.07$, $q_{k,floor} = 0.00$, $q_{k,roof} = 1.16$	kN/m
Equivalent UDL (information only)	$w_{eq} = (1.35 \times 6.07 + 1.50 \times 1.16)$	**9.93** kN/m

= 43.13 / 4.345; BS EN 1990 eq. 6.10; UK NA Table NA.A1.2(B)



ULS load diagram, governing combination: part UDLs in kN/m, point loads (red) at their positions; R and M_{max} from this diagram.

Supports and bearings

END	R_{Ed} KN ULS	R_k KN SLS	BEARS ON	BEARING
A	23.8	17.3	outer leaf, left return	PS1 440×215×100
B	19.4	14.1	outer leaf, right return	PS2 440×215×100

Padstones: sheet 25; foundations: sheet 32

DRAFT SAMPLE

PROJECT	JOB NO.	DATE
Example House 3 bed detached house · new build (example project)	LTD-EX-001	29 Oct 2026
SUBJECT	**CALC BY**	**CHECKED BY**
Steelwork SB1a · 203×133×25 UB S355	LoadTakedown (auto)	

BEAM SB1A (CONTINUED) – 203×133×25 UB S355

Section classification

REFERENCES: BS EN 1993-1-1 5.5, Table 5.2

Section class in bending	f_y = 355 N/mm², $\varepsilon = \sqrt{(235/f_y)}$	**Class 1**

Bending resistance

REFERENCES: BS EN 1993-1-1 6.2.5; sheet 21

Design bending moment	$M_{Ed} = M_{max}$ from the load diagram, at x = 2.09 m	**26.0** kNm
Bending resistance	$M_{c,Rd} = W_{pl,y} f_y / \gamma_{M0}$ = 258 × 355 / 10^3	**91.6** kNm

***PASS** – Design bending resistance exceeds design bending moment*

Shear resistance and web bearing

REFERENCES: BS EN 1993-1-1 6.2.6

Design shear force	$V_{Ed} = \max(R_A, R_B) = \max(23.8, 19.4)$	**23.8** kN
Shear resistance	$V_{pl,Rd} = A_v (f_y/\sqrt{3}) / \gamma_{M0}$	**263.4** kN
Bending and shear	$V_{Ed} < 0.5\ V_{pl,Rd}$: no reduction	6.2.8(2)
Web bearing at support	F_{Rd} (100 mm stiff bearing)	**272.1** kN — BS EN 1993-1-5 6

***PASS** – Design shear and web bearing resistances exceed design forces*

Lateral torsional buckling

REFERENCES: BS EN 1993-1-1 6.3.2.3; UK NA NA.2.17; masonry not taken as restraint

Effective length	$L_{LT} = L$ (unrestrained)	**4.345** m
Equivalent moment factor	C_1 (UDL, simply supported)	**1.13**
Destabilising load	masonry on the top flange: $z_g = +h/2$ = 101.6 mm, C_2 = 0.454.	SN003 / NCCI; masonry not restraint
Elastic critical moment	M_{cr} (C_1, C_2 method, load at top flange)	**43.9** kNm — SN003; C_1 method
Buckling curve	h/b = 203.2 / 133.2 = 1.53	**curve b** — UK NA NA.2.17
Non-dimensional slenderness	$\bar{\lambda}_{LT} = \sqrt{(W_{pl,y} f_y / M_{cr})}$ ($\bar{\lambda}_{LT,0}$ = 0.4, β = 0.75)	**1.444** — 6.3.2.3(1)
Reduction factor	χ_{LT}	**0.454** — eq. 6.57
Buckling resistance moment	$M_{b,Rd} = \chi_{LT} W_{pl,y} f_y / \gamma_{M1}$	**41.6** kNm — eq. 6.55
	$M_{Ed} / M_{b,Rd}$ = 26.00 / 41.60	**0.62**

***PASS** – Buckling resistance moment exceeds design bending moment*

Deflection

REFERENCES: BS EN 1993-1-1 7.2; UK NA NA.2.23 (imposed); E = 210 kN/mm²

Second moment of area	I_y	**2340** cm⁴
Imposed load	$\delta_Q \le$ 12.1 mm (L/360)	**1.1** mm
Total load	$\delta_{total} \le L$/500 = 8.7 mm	**7.5** mm — L/500: practice for beams carrying masonry
Span / deflection		**L/582**

***PASS** – Deflection within limits*

Summary of checks

Bending	0.28	LTB	0.62	Shear	0.09	Web bearing	0.09
Defl. imposed	0.09	Defl. total	0.86				

∴ PROVIDE 203×133×25 UB S355

Utilisation governed by deflection — **0.86** **PASS**

DRAFT SAMPLE

PROJECT	JOB NO.	DATE
Example House 3 bed detached house · new build (example project)	LTD-EX-001	29 Oct 2026
SUBJECT	**CALC BY**	**CHECKED BY**
Steelwork SB1b · 254×146×31 UB S355	LoadTakedown (auto)	

BEAM SB1B – TO SUPPORT INNER LEAF OF FIRST FLOOR REAR WALL

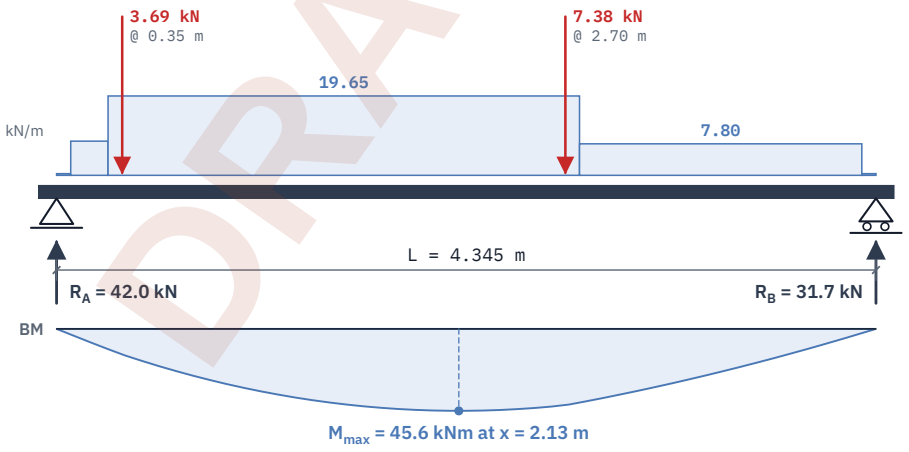
Design span	*L* (centre to centre of bearings)	**4345** mm
Section, grade	254×146×31 UB S355	
Supports	simply supported on the rear return walls	
Restraint	fork restraint at bearings; flange unrestrained	
Combination	eq. 6.10 floor leading	
Deflection limits	imposed *L*/360; total *L*/500	

Carries the block inner leaf of rearFirst, the main roof eaves and the first floor rear bay; bears in the plane of the rear return walls on their block leaf (padstone where needed).

Loading, as it acts

SOURCE	FORM AND POSITION (X FROM BEARING A)	CHAR. KN	γ	ULS KN
Inner leaf over the opening (DL)	1.95 kN/m 0.07-0.27 m; 8.29 kN/m 0.27-2.77 m; 1.46 kN/m 2.77-4.27 m	23.28	1.35	31.43
Inner leaf lintel reactions (DL)	1.95 kN at 0.35 m; 3.90 kN at 2.70 m	5.85	1.35	7.90
First floor + partitions (DL)	0.74 kN/m 0.07-0.87 m; 0.74 kN/m 0.87-4.27 m	3.09	1.35	4.17
Beam self weight (DL)	0.31 kN/m full span	1.33	1.35	1.79
Inner leaf over the opening (LL)	2.51 kN/m 0.27-2.77 m	6.28	1.05	6.59
Inner leaf lintel reactions (LL)	1.00 kN at 0.35 m; 2.01 kN at 2.70 m	3.01	1.05	3.16
First floor + partitions (LL)	2.95 kN/m 0.07-0.87 m; 2.95 kN/m 0.87-4.27 m	12.37	1.50	18.56
Total on the span	**eq. 6.10 floor leading: γ_G 1.35, floor 1.50, roof 1.05**	**55.21**		**73.60**

Characteristic, per m of span	$g_k = 7.72$, $q_{k,floor} = 2.85$, $q_{k,roof} = 2.14$	kN/m
Equivalent UDL (information only)	$w_{eq} = (1.35 \times 7.72 + 1.50 \times 2.85 + 1.05 \times 2.14)$	**16.94** kN/m



ULS load diagram, governing combination: part UDLs in kN/m, point loads (red) at their positions; R and M_{max} from this diagram.

Supports and bearings

END	R_{Ed} KN ULS	R_k KN SLS	BEARS ON	BEARING
A	42.0	31.7	inner leaf, left return	PS3 440×215×100
B	31.7	23.6	inner leaf, right return	PS4 440×215×100

REFERENCES



Loading schedule, sheet 1; takedown

= 73.60 / 4.345; BS EN 1990 eq. 6.10; UK NA Table NA.A1.2(B)

Padstones: sheet 25; foundations: sheet 32

DRAFT SAMPLE

PROJECT	JOB NO.	DATE
Example House 3 bed detached house · new build (example project)	LTD-EX-001	29 Oct 2026
SUBJECT	**CALC BY**	**CHECKED BY**
Steelwork SB1b · 254×146×31 UB S355	LoadTakedown (auto)	

BEAM SB1B (CONTINUED) – 254×146×31 UB S355

Section classification

			REFERENCES
Section class in bending	f_y = 355 N/mm², $\varepsilon = \sqrt{(235/f_y)}$	**Class 1**	BS EN 1993-1-1 5.5, Table 5.2

Bending resistance

Design bending moment	$M_{Ed} = M_{max}$ from the load diagram, at x = 2.13 m	**45.6** kNm	BS EN 1993-1-1 6.2.5 sheet 23
Bending resistance	$M_{c,Rd} = W_{pl,y} f_y / \gamma_{M0}$ = 393 × 355 / 10³	**139.5** kNm	

***PASS** – Design bending resistance exceeds design bending moment*

Shear resistance and web bearing

Design shear force	$V_{Ed} = \max(R_A, R_B) = \max(42.0, 31.7)$	**42.0** kN	BS EN 1993-1-1 6.2.6
Shear resistance	$V_{pl,Rd} = A_v (f_y/\sqrt{3}) / \gamma_{M0}$	**336.0** kN	
Bending and shear	$V_{Ed} < 0.5\ V_{pl,Rd}$: no reduction		6.2.8(2)
Web bearing at support	F_{Rd} (100 mm stiff bearing)	**255.2** kN	BS EN 1993-1-5 6

***PASS** – Design shear and web bearing resistances exceed design forces*

Lateral torsional buckling

Effective length	$L_{LT} = L$ (unrestrained)	**4.345** m	BS EN 1993-1-1 6.3.2.3; UK NA NA.2.17 masonry not taken as restraint
Equivalent moment factor	C_1 (UDL, simply supported)	**1.13**	
Destabilising load	masonry on the top flange: $z_g = +h/2$ = 125.7 mm, C_2 = 0.454.		SN003 / NCCI; masonry not restraint
Elastic critical moment	M_{cr} (C_1, C_2 method, load at top flange)	**67.8** kNm	SN003; C_1 method
Buckling curve	h/b = 251.4 / 146.1 = 1.72	**curve b**	UK NA NA.2.17
Non-dimensional slenderness	$\bar{\lambda}_{LT} = \sqrt{(W_{pl,y} f_y / M_{cr})}$ ($\bar{\lambda}_{LT,0}$ = 0.4, β = 0.75)	**1.434**	6.3.2.3(1)
Reduction factor	χ_{LT}	**0.459**	eq. 6.57
Buckling resistance moment	$M_{b,Rd} = \chi_{LT} W_{pl,y} f_y / \gamma_{M1}$	**64.1** kNm	eq. 6.55
	$M_{Ed} / M_{b,Rd}$ = 45.60 / 64.10	**0.71**	

***PASS** – Buckling resistance moment exceeds design bending moment*

Deflection

Second moment of area	I_y	**4410** cm⁴	BS EN 1993-1-1 7.2; UK NA NA.2.23 (imposed) E = 210 kN/mm²
Imposed load	$\delta_Q \le$ 12.1 mm (L/360)	**2.7** mm	
Total load	$\delta_{total} \le L$/500 = 8.7 mm	**7.2** mm	L/500: practice for beams carrying masonry
Span / deflection		**L/607**	

***PASS** – Deflection within limits*

Summary of checks

Bending	0.33	LTB	0.71	Shear	0.13	Web bearing	0.16
Defl. imposed	0.23	Defl. total	0.82				

∴ PROVIDE 254×146×31 UB S355

Utilisation governed by deflection **0.82** PASS

DRAFT SAMPLE

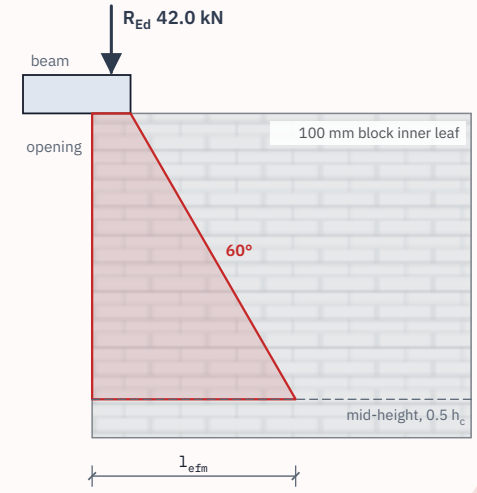
PROJECT	JOB NO.	DATE
Example House 3 bed detached house · new build (example project)	LTD-EX-001	29 Oct 2026
SUBJECT	**CALC BY**	**CHECKED BY**
Padstones PS3 · SB1b	LoadTakedown (auto)	

PADSTONE PS3 – SB1B BEARING ON INNER LEAF

REFERENCES

Design reaction	R_{Ed} from *SB1b* (sheet 23)	**42.0** kN	
Masonry	medium-density aggregate concrete block, Group 1, 7.3 N/mm2		
Characteristic strength	$f_k = K f_b^{0.7} f_m^{0.3}$	**4.20** N/mm²	BS EN 1996-1-1 3.6.1.2 eq. 3.1; UK NA
Design strength	$f_d = f_k / \gamma_M = 4.20 / 2.7$	**1.555** N/mm²	UK NA to BS EN 1996-1-1 Table NA.1
Height to bearing, end distance	h_c = 2234 mm, a_1 = 0 mm (bearing at the wall end)		Fig. 6.2

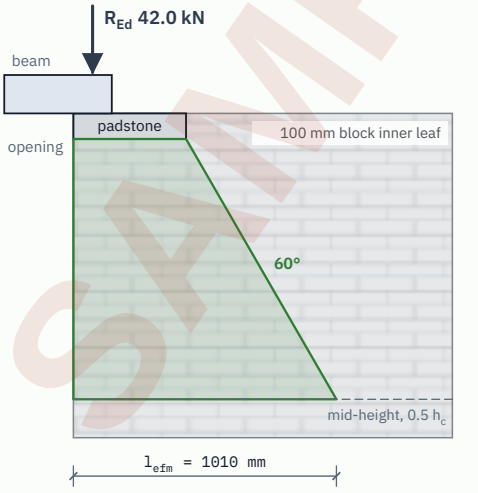
1 Beam directly on the block



A_b 15000 mm² · β 1.250 · N_{Rdc} 29.2 kN

Utilisation **1.44** FAIL

2 On 440×215×100 padstone



A_b 36500 mm² · β 1.102 · N_{Rdc} 62.6 kN

Utilisation **0.67** PASS

1 · Bearing without padstone

BS EN 1996-1-1 6.1.3, eq. 6.9 / 6.10

Bearing area (flange on leaf)	A_b	**15000** mm²	
Enhancement factor	$\beta = (1 + 0.3\,a_1/h_c)(1.5 - 1.1\,A_b/A_{ef})$	**1.250**	eq. 6.10
Resistance	$N_{Rdc} = \beta\,A_b\,f_d$	**29.2** kN	eq. 6.9

FAIL – Resistance 29.2 kN < reaction 42.0 kN (utilisation 1.44): padstone required

2 · Bearing on 440×215×100 padstone

BS EN 1996-1-1 6.1.3, eq. 6.9 / 6.10

Padstone	precast concrete C30/37, 440 long x 215 deep x leaf width		
Bearing area (padstone in leaf)	A_b	**36500** mm²	
Effective length at mid-height	l_{efm} (60° spread)	**1010** mm	Fig. 6.2
Effective area	$A_{ef} = l_{efm}\,t$	**100978** mm²	
Enhancement factor	β (cap 1.250 = min(1.25 + $a_1/2h_c$, 1.5))	**1.102**	eq. 6.10
Resistance	$N_{Rdc} = \beta\,A_b\,f_d$	**62.6** kN	eq. 6.9

PASS – Concentrated load resistance exceeds design reaction

∴ PROVIDE 440×215×100 PRECAST CONCRETE PADSTONE

Utilisation **0.67** PASS

DRAFT SAMPLE

PROJECT	JOB NO.	DATE
Example House 3 bed detached house · new build (example project)	LTD-EX-001	29 Oct 2026
SUBJECT	**CALC BY**	**CHECKED BY**
Padstones	LoadTakedown (auto)	

PADSTONE SCHEDULE

Every beam bearing is checked for concentrated load on the masonry (BS EN 1996-1-1 6.1.3). Where the bare bearing fails, a precast padstone is specified and the check repeated.

REF	BEAM	LEAF	R_{Ed} KN	β BARE	BARE UTIL.	PADSTONE	UTIL.	
PS1	SB1a	outer	23.8	1.25	0.82	440×215×100	0.38	PASS
PS2	SB1a	outer	19.4	1.25	0.66	440×215×100	0.31	PASS
PS3	SB1b	inner	42.0	1.25	1.44	440×215×100	0.67	PASS
PS4	SB1b	inner	31.7	1.25	1.09	440×215×100	0.51	PASS

Padstones precast concrete, bedded in M12 mortar, full width of the leaf. Beam bearing on padstone 150 mm minimum along the beam. The wall below is checked under the spread load in the takedown.

Governing bearing utilisation **0.67** PASS

REFERENCES

BS EN 1996-1-1 6.1.3, eq. 6.9 / 6.10

DRAFT SAMPLE