Table NA 4 - Design Values of Actions (STR/GEO) (Set B)

Persistent and transient design situations	Permanent Actions		Leading Variable Action (*)	Accompanying variable Actions (*)	
	Unfavourable	Favourable		Main (if any)	Others
(Eq 6.10)	$\gamma_{Gj,sup} G_{kj,sup}$	$\gamma_{Gj,inf} G_{kj,inf}$	$\gamma_{Q,1} Q_{k,1}$		$\gamma_{Q,i} \psi_{0,i} Q_{k,i}$
(Eq 6.10a)	$\gamma_{Gj,sup} G_{kj,sup}$	$\gamma_{Gj,inf} G_{kj,inf}$		$\gamma_{Q,1} \psi_{0,1} Q_{k,1}$	$\gamma_{Q,i} \psi_{0,i} Q_{k,i}$
(Eq 6.10b)	$\xi \gamma_{Gj,sup} G_{kj,sup}$	$\gamma_{Gj,inf} G_{kj,inf}$	$\gamma_{Q,1} Q_{k,1}$		$\gamma_{Q,i} \psi_{0,i} Q_{k,i}$

(*) Variable actions are those considered in Table A1.1

NOTE 1: Equation 6.10 shall normally be used. Alternatively the less favourable of Eqs 6.10 a + 6.10 b should be used.

NOTE 2: The recommended values for γ are as follows:

$\gamma_{Gj,sup} = 1,35$

$\gamma_{Gj,inf} = 1,00$

$\gamma_{Q,1} = 1,5$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,5$ where unfavourable (0 where favourable)

$\xi = 0,85$ (so that $\gamma_{Gj,sup} = 0,85 \times 1,35 \cong 1,15$)

See also EN 1991 to EN 1999 for γ values to be used for imposed deformations.

NOTE 3: The characteristic values of all permanent actions from one source are multiplied by $\gamma_{G,sup}$ if the resulting action effect is unfavourable and $\gamma_{G,inf}$ if the resulting action effect is favourable. For example, all actions originating from the self-weight of the structure may be considered as coming from one source; this also applies if different materials are involved.

NOTE 4: For particular verifications, the values for γ_G and γ_Q may be subdivided into γ_g and γ_q and the model uncertainty factor γ_{sd}. A value of $\gamma_{sd} = 1,15$ can be used in most common cases.

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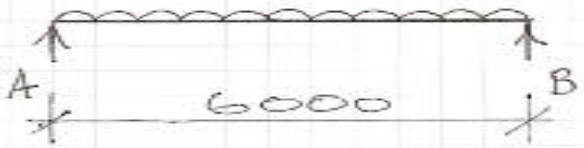
Project: Engineers Ireland · Eurocode			Course & Year:
Part of structure: Actions 1			Calc. Sheet No.: 1
Drawing Ref.	Calculations by: BOR	Checked by	Date: 23/9/09.

REFERENCE	CALCULATIONS	OUTPUT

$q_K = 18$ KN/M
$g_K = 20$ KN/M



Eurocode EXP. 6.10 TD. A.1.2 Set B

Design Load

$$E_d = \gamma_{G,j,sup} G_{k,j,sup} + \gamma_{Q,1} Q_{k,1}$$

$$= 1.35 \times 20 + 1.5 \times 18$$

$$= 54 \text{ KN/M}$$

$$M_{Ed} = 54 \times \frac{6^2}{8} = 243 \text{ KNM}$$

$$V_{Ed} = 54 \times \frac{6}{2} = 162 \text{ KN}$$

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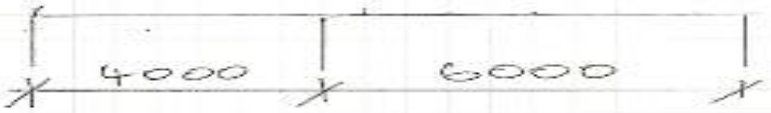
Project: Engineers Ireland Eurocode		Course & Year:
Part of structure: Actions 2		Calc. Sheet No.: 2
Drawing Ref.	Calculations by: BOK / Checked by	Date: 23/9/09

REFERENCE	CALCULATIONS	OUTPUT
	q_k = 22 KN/M offices g_k = 40 KN/M	
		
Eurocode Table A·1·2 Set B		
EXP6·10	Unfavourable $E_d = \gamma_{G,j,sup} G_{k,j,sup} + \gamma_{Q,1} Q_{k,1}$ $= 1.35 \times 40 + 1.5 \times 22$ $= 87$ KN/M	
	Favourable $E_d = \gamma_{G,j,inf} G_{k,j,inf}$ $= 1.0 \times 40$ $= 40$ KN/M	
EXP6·10a	Unfavourable $E_d = \gamma_{G,j,sup} G_{k,j,sup} + \gamma_{Q,1} \psi_{0,1} Q_{k,1}$	
Table NA·2	$= 1.35 \times 40 + 1.5 \times 0.7 \times 22$ $= 77.1$ KN/M	

Project: Engineers Ireland Eurocode.		Course & Year:
Part of structure: Actions 2		Calc. Sheet No.: 3
Drawing Ref.	Calculations by: Ror	Checked by:
		Date: 23/9/09

REFERENCE	CALCULATIONS	OUTPUT

Favourable

$E_d = \gamma_{G\,j,inf}\, G_{kj,inf}$

$= 1.0 \times 40$

$= 40\ kN/m$.

EXP 6.10b Unfavourable

$E_d = \sum \gamma_{Gj,sup} G_{kj,sup} + \gamma_{Q,1} Q_{k,1}$

$= 0.85 \times 1.35 \times 40 + 1.5 \times 22$

$= 78.9\ kN/M$

Favourable

$E_d = \gamma_{G\,j,inf}\, G_{kj,inf}$

$= 1.0 \times 40$

$= 40\ kN/M$.

Choose

EXP 6.10 $E_d = 87\ kN/m$

OR

EXP 6.10b $E_d = 78.9\ kN/m$.

Table NA.2 Values of ψ factors for buildings

Action	ψ_0	ψ_1	ψ_2
Imposed loads in buildings, category (see EN 1991-1-1)			
Category A: domestic, residential areas	0.7	0.5	0.3
Category B: office areas	0.7	0.5	0.3
Category C: congregation areas	0.7	0.7	0.6
Category D: shopping areas	0.7	0.7	0.6
Category E: storage areas	1.0	0.9	0.8
Category F: traffic area, Vehicle weight < or = 30 kN	0.7	0.7	0.6
Category G: traffic area, 30 kN < vehicle weight < or = 160 kN	0.7	0.5	0.3
Category H: roofs	0.6	0.0	0.0
Snow loads on buildings (see EN 1991-1-3)	0.5	0.2	0.0
Wind loads on buildings (see EN 1991-1-4)	0.6	0.2	0.0
Temperature (non-fire) in buildings (see EN 1991-1-5)	0.6	0.5	0.0

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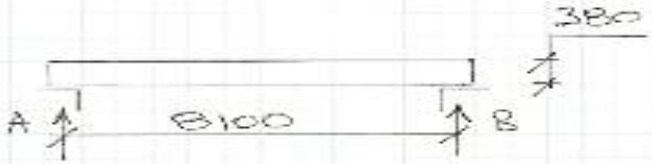
Project: Engineers Ireland Eurocode		Course & Year
Part of Structure: Actions 3		Calc. Sheet No. 4
Drawing Ref.	Calculations by: BOR / Checked by	Date: 23/9/09

REFERENCE	CALCULATIONS	OUTPUT

Museum Gallery Slab



Permanent Actions

EC 1 Table A.1 — Unit weight of normal density

R.C. = 25 kN/m³

	kN/m²
Slab Self-Weight	= 0.38 × 25 = 9.5
50 mm finish Screed	= 0.05 × 24 = 1.2
Finishes	= 1.0
	g_k = 11.7

$g_k = 11.7$ kN/m²

Variable Actions

EC 1 Table 6.1 & 6.2 — Museum Gallery ⇒ Category C3

∴ q_k = 5.0 kN/m²

$q_k = 5.0$ kN/m²

Eurocode Exp 6.10

$E_d = \gamma_{G1,sup} G_{k1,sup} + \gamma_{Q,1} Q_{k,1}$

$= 1.35 \times 11.7 + 1.5 \times 5.0$

$= 23.3$ kN/m²

$E_d = 23.3$ kN/m²

Annex A
(informative)
Tables for nominal density of construction materials, and nominal density and angles of repose for stored materials

Table A.1 - Construction materials-concrete and mortar

Materials	Density γ [kN/m^3]
concrete (see EN 206)	
lightweight	
density class LC 1,0	9,0 to 10,0 [1)2)]
density class LC 1,2	10,0 to 12,0 [1)2)]
density class LC 1,4	12,0 to 14,0 [1)2)]
density class LC 1,6	14,0 to 16,0 [1)2)]
density class LC 1,8	16,0 to 18,0 [1)2)]
density class LC 2,0	18,0 to 20,0 [1)2)]
normal weight	24,0 [1)2)]
heavy weight	> [1)2)]
mortar	
cement mortar	19,0 to 23,0
gypsum mortar	12,0 to 18,0
lime-cement mortar	18,0 to 20,0
lime mortar	12,0 to 18,0
[1)] Increase by 1kN/m^3 for normal percentage of reinforcing and pre-stressing steel [2)] Increase by 1kN/m^3 for unhardened concrete	
NOTE See Section 4	

Table 6.1 - Categories of use

Category	Specific Use	Example
A	Areas for domestic and residential activities	Rooms in residential buildings and houses; bedrooms and wards in hospitals; bedrooms in hotels and hostels kitchens and toilets.
B	Office areas	
C	Areas where people may congregate (with the exception of areas defined under category A, B, and D[1)])	**C1**: Areas with tables, etc. e.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions. **C2**: Areas with fixed seats, e.g. areas in churches, theatres or cinemas, conference rooms, lecture halls, assembly halls, waiting rooms, railway waiting rooms. **C3**: Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms, etc. and access areas in public and administration buildings, hotels, hospitals, railway station forecourts. **C4**: Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages. **C5**: Areas susceptible to large crowds, e.g. in buildings for public events like concert halls, sports halls including stands, terraces and access areas and railway platforms.
D	Shopping areas	**D1**: Areas in general retail shops **D2**: Areas in department stores

[1)] Attention is drawn to 6.3.1.1(2), in particular for C4 and C5. See EN 1990 when dynamic effects need to be considered. For Category E, see Table 6.3

NOTE 1 Depending on their anticipated uses, areas likely to be categorised as C2, C3, C4 may be categorised as C5 by decision of the client and/or National annex.

NOTE 2 The National annex may provide sub categories to A, B, C1 to C5, D1 and D2

NOTE 3 See 6.3.2 for storage or industrial activity

Table 6.2/ NA.2 - Imposed loads on floors, balconies and stairs in buildings

Categories of loaded areas	***q*k [kN/m^2]**	***Q*k [kN]**
Category A1		
- Floors	1,5	2,0
- Stairs	2,0	2,0
- Balconies	2,5	2,0
Category A2		
- Floors	2,0	2,0
- Stairs	2,0	2,0
- Balconies	2,5	2,0
Category B	3,0	4,5
Category C		
- C1	3,0	4,0
- C2	4,0	4,0
- C3	5,0	4,0
- C4	5,0	7,0
- C5	5,0	4,5
Category D		
- D1	4,0	4,0
- D2	5,0	7,0

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	Project: Engineers Ireland · Eurocode		Course & Year:
	Part of structure: Actions 4		Calc. Sheet No.: 5
	Drawing Ref.	Calculations by: Boik / Checked by	Date: 23/9/09

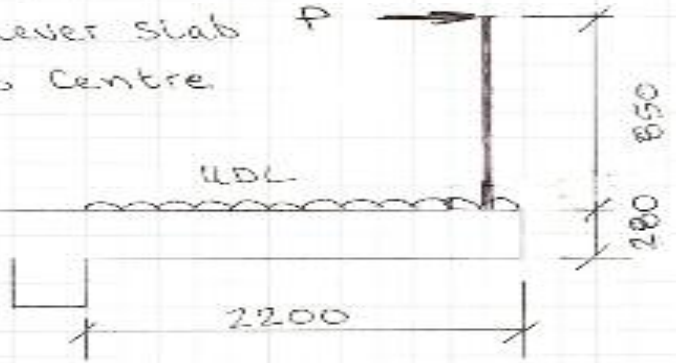
REFERENCE	CALCULATIONS	OUTPUT
	Cantilever Slab Sports Centre  	
EC1 Table A.1	Characteristic Permanent Action Slab Self Weight = 0·28 x 25 = 7·0	kN/m² = g_k
Table 6.1/6.2	Characteristic Variable Action Assume category C5 ∴ q_k = 50 kN/m² nnn	
Table 6.12	Point Load = 3·0 kN/M →	
Eurocode Table A.1.2 SET B	Design Value of actions	
EXP6.10	$E_d = \gamma_{G,sup} G_{k,sup}$ " + " $\gamma_{Q,1} Q_{k,1}$ " + " $\gamma_{Q,i}$	$\psi_{0,i} Q_{k,i}$
	= 1·35 x 7 + 1·5 x 5 " + " 1·5 x	0·7 x 3
	= 16·95 kN/m² " + " 3·15 kN/M	
	Is this the critical arrangement of actions ? – No	

Table 6.12 of EN 1991-1-1:2002 shall be implemented nationally by use means of the values given in Table NA.5

Table NA.5 - Horizontal loads on partitions, walls and parapets

Loaded areas	q_k **(kN/m)**
Categories A1 and A2	0,5
Categories B and C1	0,5
Categories C2, C3, C4 and D	1,0
Category C5	3,0
Category E	1,0
Category F	See Annex B
Category G	See Annex B
NOTE 1: For areas of Category E the horizontal loads depend on the occupancy. The value of q_k is defined as a minimum value and should be checked for the specific occupancy. NOTE 2: For grandstands and stadia the requirements of the regulatory authorities shall be complied with.	

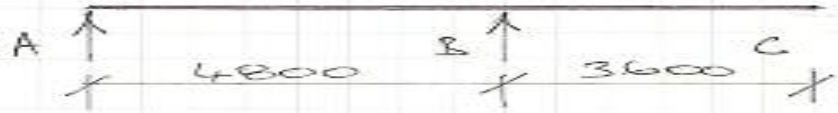
Project: Engineers Ireland. Eurocode		Course & Year
Part of structure: Actions 5		Calc. Sheet No. 6
Drawing Ref.	Calculations by: BOR / Checked by	Date: 23/9/09

REFERENCE	CALCULATIONS	OUTPUT

Equilibrium of Structure.

$q_{rk} = 8$ KN/M

$g_k = 14$ KN/M.



Eurocode Table A.1.2(a) SET B EQU

EXP 6.10

Favourable Actions

$E_d = \gamma_{G,j,inf} G_{k,j,inf} + \gamma_{Q,1} Q_{k,1}$

$= 0.9 \times 14 + 0 \times 8$

$= 12.6$ KN/M

Unfavourable Actions

$E_d = \gamma_{G,j,sup} G_{k,j,sup} \quad \gamma_{Q,1} Q_{k,1}$

$= 1.1 \times 14 + 1.5 \times 8$

$= 27.4$ KN/M

{ Support A = 6.75 KN ↓
No option of 6.10a / 6.10b }

Table NA 3. - Design Values of Actions (EQU) (Set A)

Persistent and transient design situations	Permanent Actions		Leading Variable Action (*)	Accompanying variable Actions (*)	
	Unfavourable	Favourable		Main (if any)	Others
(Eq 6.10)	$\gamma_{Gj,sup}G_{kj,sup}$	$\gamma_{Gj,inf}G_{kj,inf}$	$\gamma_{Q,1}Q_{k,1}$		$\gamma_{Q,i}\psi_{0,i}Q_{k,i}$

(*) Variable actions are those considered in Table A1.1

NOTE 1: The recommended values for γ are as follows:

$\gamma_{Gj,sup} = 1,10$

$\gamma_{Gj,inf} = 0,90$

$\gamma_{Q,1} = 1,5$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,5$ where unfavourable (0 where favourable)

NOTE 2: In cases where the verification of static equilibrium also involves the resistance of structural members, as an alternative to two separate verifications based on Table A1.2(A) and A1.2(B), a combined verification, based on Table A1.2(A), should be adopted, with the following set of values:

$\gamma_{Gj,sup} = 1,35$

$\gamma_{Gj,inf} = 1..$

$\gamma_{Q,1} = 1,5$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,5$ where unfavourable (0 where favourable)

provided that applying $\gamma_{Gj,inf} = 1,0$ both to the favourable part and to the unfavourable part of permanent actions does not give a more unfavourable effect.

Table NA 5 - Design Values of Actions (STR/GEO) (Set C)

Persistent and transient design situations	Permanent Actions		Leading Variable Action (*)	Accompanying variable Actions (*)	
	Unfavourable	Favourable		Main (if any)	Others
(Eq 6.10)	$\gamma_{Gj,sup} G_{kj,sup}$	$\gamma_{Gj,inf} G_{kj,inf}$	$\gamma_{Q,1} Q_{k,1}$		$\gamma_{Q,i} \Psi_{0,i} Q_{k,i}$

(*) Variable actions are those considered in Table A1.1

Note : The recommended values for γ are as follows:

$\gamma_{Gj,sup} = 1,00$

$\gamma_{Gj,inf} = 1,00$

$\gamma_{Q,1} = 1,30$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,30$ where unfavourable (0 where favourable)

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Project: Engineers Ireland Eurocode			Course & Year
Part of structure: Wind Load			Calc. Sheet No. 1
Drawing Ref.	Calculations by: JM	Checked by	Date 29/9/09

REFERENCE	CALCULATIONS	OUTPUT
1.1 (2)	Building < 200m	
4.2(1)	$v_{b0} = 25 m/s$ (say)	
4.2(2)	$C_{dir} = C_{season} = 1.0$ (recommended)	
	$v_b = C_{dir} \times C_{season} \times v_{b0} = 25 m/s$	
4.3.1	$v_m(z) = C_r(z) \times C_o(z) \times v_b$	
	$C_o(z) = 1$	
Table 4.1	Terrain category II $z_0 = 0.05m$, $z_{min} = 2m$, $z_{max} = 200m$	
4.3.2	$z_{min} \leq z \leq z_{max}$	
Eqn 4.5	$k_r = 0.19 \left(\frac{0.05}{0.05}\right)^{0.07} = 0.19$	
Eqn 4.4	$C_r(z) = k_r \ln \frac{z}{z_0} = 0.19 \ln \frac{15}{0.05} = 1.084$	
4.3.1	$v_m(z) = 1.084 \times 1.0 \times 25 = 27.1 m/s$	$v_m(z) = 27.1 m/s$
4.4	Turbulence intensity	
Eqn 4.7	$I_v(z) = \frac{k_1}{C_o(z) \times \ln \frac{z}{z_0}} = \frac{1.0}{1.0 \times \ln \frac{15}{0.05}} = 0.1753$	
	$(k_1 = 1.0)$	
4.5	$q_p(z) = (1 + 7 I_v) \times \frac{1}{2} \rho v_m^2(z) =$	
	$(1 + 7(.1753)) \times \frac{1}{2} \times \frac{1.25}{1000} \times 27.1^2 = 1.022 kN/m^2$	$q_p(z) = 1.022 kN/m^2$

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	Project: Engineers Ireland Eurocode		Course & Year:
	Part of structure: Wind Load		Calc. Sheet No.: 2
	Drawing Ref.	Calculations by: CM / Checked by	Date: 29/9/09

REFERENCE	CALCULATIONS	OUTPUT
Table 7.1	Zone D, $\frac{h}{d} = 1.5$ $C_{pe,10} = 0.8$	
	Zone E $C_{pe,10} = -0.525$	
6.2.1 (a), (c)	$C_s C_d = 1.0$	
7.2.2(3)	$\frac{h}{d} = 1.5$ Multiply by 0.869	
Eqn 5.5	'Nett pressure' $= 1.022(0.8 - (+0.525))v^2 \times 0.869$ $= 1.176 kN/m^2$	Nett Pressure $= 1.176 kN/m^2$