Structural design of buried pipelines under various conditions of loading

Environmental Provida

Landfill basal drainage system
Pipe Modelled: " 180mm SDR11 perf"
Date Modelled:

Calculations based upon BS EN 1295 -1: 1998

NA.2 Symbols used in this calculation

B_c	Outside diameter of pipe
B_d	Effective width of trench
C_c	Soil load coefficient in embankment conditions
C_d	Soil load coefficient in trench conditions
C_L	Soil modulus adjustment factor
C_w	Water load coefficient
D	Mean diameter of pipe
D_f	Strain factor
D_L	Deflection lag factor
E_L	Long term modulus of elasticity of pipe material
E_s	Short term modulus of elasticity of pipe material
E'_2	Modulus of soil reaction
E'_3	Modulus of native soil reaction
E'	Overall modulus of soil reaction
F_s	Factor of safety
H	Depth of cover to top of pipe
I	Second moment of area of unit length of pipe wall
P	Vertical pressure due to soil and surcharge combined
P_{cr}	Critical pressure for buckling of flexible pipes
P_{crl}	Long term critical pressure
P_{crs}	Short term critical pressure
P_e	Vertical soil pressure
P_i	Pipe internal pressure
P^s	Surcharge pressure
t	Pipe wall thickness
γ	Unit weight of soil
γ_w	Unit weight of water
Δ	Pipe diameter change

Figure NA.2 Flowchart for pipeline design with thermoplastic pipes

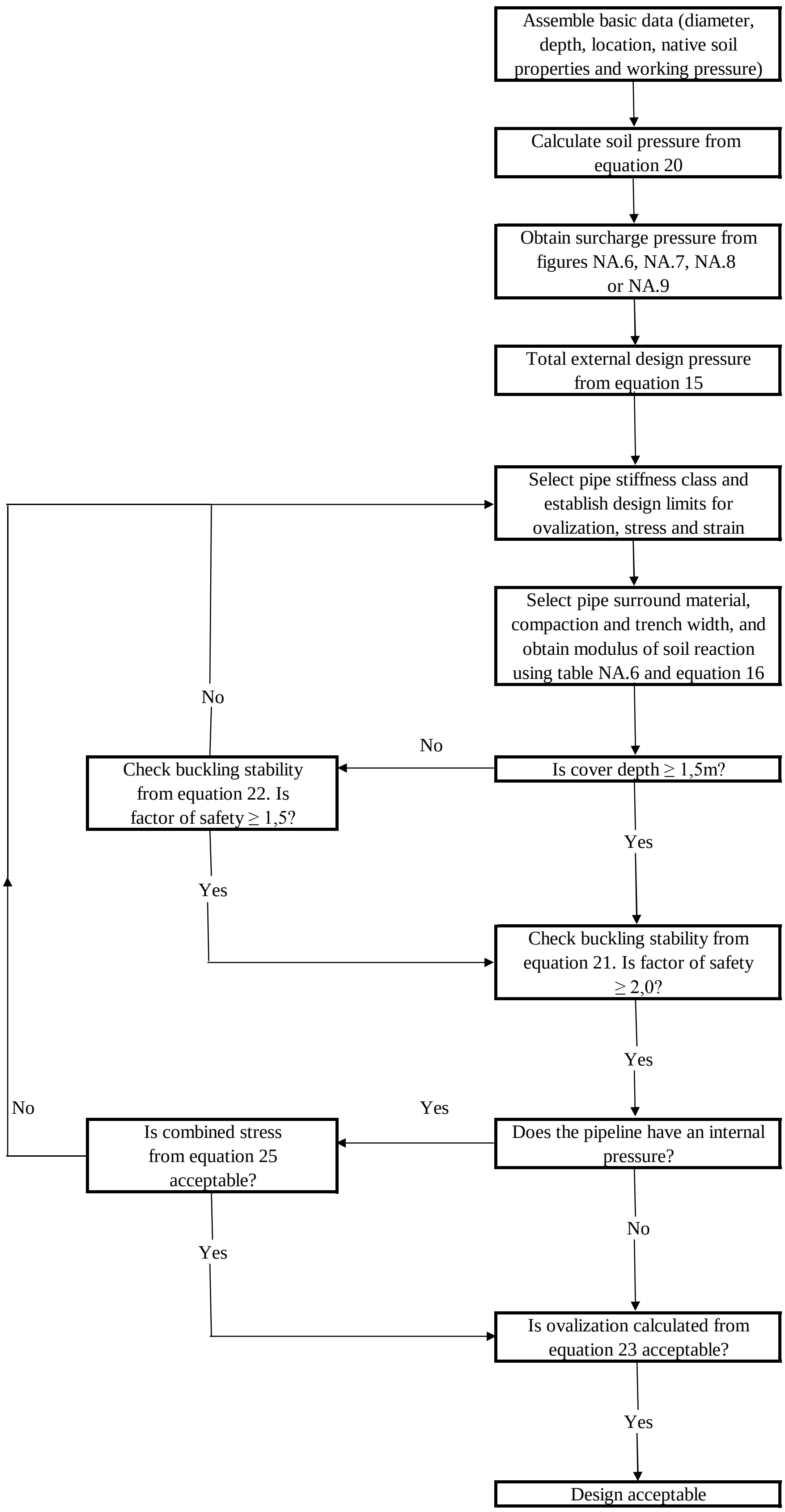


Table NA.1 Guide values of Spangler modulus for native soils					
Soil type	**Spangler modulus for soils in various conditions (MN/m²)**				
	Very dense	**Dense**	**Medium dense**	**Loose**	**Very loose**
Gravel	Over 40	15 to 40	9 to 15	5 to 9	3 to 5
Sand	15 to 20	9 to 15	4 to 9	2 to 4	1 to 2
Clayey, silty sand	10 to 15	6 to 10	2.5 to 6	1.5 to 2.5	0.5 to 1.5
Clay	Very hard	11 to 14			
	Hard	10 to 11			
	Very Stiff	6 to 10			
	Stiff	4 to 6			
	Firm	3 to 4			
	Soft	1.5 to 3			
	Very soft	0 to 1.5			

Table NA.6 Flexible and semi-rigid pipe embedment properties

Embedment class as table NA.8 deflection coefficient K_x	Compaction M_p %	Modulus of soil reaction E'_2 MN/m^2	Deflection lag factor D_L [2)]	Strain factor Df for various pipe stiffnesses - see (1 KN/m^2					
				1.25	2.5	5	10	15	30 or more
Class S1	Uncompacted	5	1.5	4.7	4.5	4.3	4	3.75	3
K_x=0.083	80	7	1.25	4.7	4.5	4.3	4	3.75	3
	85	7	1	4.7	4.5	4.3	4	3.75	3.25
	90	10	1	4.7	4.5	4.3	4	3.75	3.5
	95	14	1	-	-	-	-	3.75	3.5
Class S2	Uncompacted	3	1.5	4.7	4.5	4.3	4	3.75	3
K_x=0.083	80	5	1.25	4.7	4.5	4.3	4	3.75	3
	85	7	1	4.7	4.5	4.3	4	3.75	3.25
	90	10	1	4.7	4.5	4.3	4	3.75	3.5
	95	20	1	-	-	-	-	-	3.5
Class S3	85	5	1.5	6.2	5.5	4.75	4.25	4	3.25
K_x=0.100	90	7	1.25	7.75	6.6	5.5	4.7	4.25	3.5
	95	14	1	-	-	-	-	4.75	3.5
Class S4	85	3	1.5	6.2	5.5	4.75	4.25	4	3.5
K_x=0.100	90	5	1.25	7.75	6.6	5.5	4.7	4.25	3.5
	95	10	1	-	-	-	-	4.75	3.5
Class S5	85	1	3	-	-	-	-	4	3.5
K_x=0.100	90	3	2	-	-	-	-	4.25	3.5
	95	7	1.25	-	-	-	-	4.5	3.5
Class B1	85	5	1.5	-	-	-	5	4	3.5
K_x=0.083	90	7	1.25	-	-	-	5.5	4.25	3.5
Class B2	85	3	2	-	-	-	5.5	4.25	3.5
K_x=0.083	90	5	1.75	-	-	-	6	5	3.5

[1)] Pipe stiffnesses referred to in this table are initial values

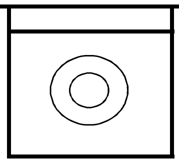
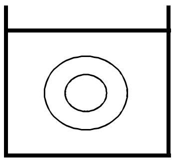
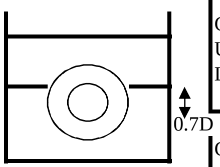
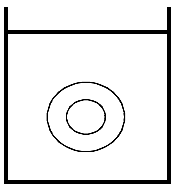
[2)] Where the designer can be certain that initial pressurisation will take place within one year of backfilling, a value of 1.0 may be taken for the deflection lag factor

Note 1. - For construction details of embedment classes see table NA.8

Note 2. - Quated values for E'2 assume the pipeline will be installed below groundwater

Note 3. - Mp indicates modified Proctor density and corresponds to the heavy compaction test in BS 1377

Note 4. - For Landfill it is assumed that most plastic basal drainage pipes will be surrounded by cell drainage blanket stone which is normally processed granular material of a single size (minimum fines), therefore embedment class most appropriate is Class S1

Table NA.8 Semi-rigid and flexible pipe embedments			
Embedment class	**Embedment configuration**	**Bed and sidefill materials**	**Notes**
S1 and S2		Class S1 : Gravel (single sized) Class S2 : Gravel (graded)	Normally processed granular material
S3 - S5		Class S3 : Sand and coarse grained soil with more than 12% fines	These represent 'as dug' soils, and require particularly close control when used with low stiffness pipe
		Class S4 : Coarse grained soil with more than 12% fines OR Fine grained soil, liquid limit less than 50%, medium to no plasticity and more than 25% coarse grained material	
		Class S5 : Fine grained soil, liquid limit less than 50%, medium to no plasticity and more than 25% coarse grained material	Class S5 only recommended for use with semi-rigid pipes
B1 and B2		Class B1: Upper surround as for S3 or S4 Lower surround as for S1 or S2	Class B embedments not recommended for use with pipes of less than 10 kN/m2 stiffness
		Class B2: Upper surround as for S5 Lower surround as for S1 or S2	
D		As for S3, S4 or S5	Only suitable for semi-rigid pipes with high beam strength Soil properties from table NA.6, except Kx=0.110
Note 1.	See Table NA.6 for design parameters for embedment classes		

Note 1. - For Landfill it is assumed that most plastic basal drainage pipes will be surrounded by cell drainage blanket stone which is normally processed granular material of a single size (minimum fines), therefore embedment class most appropriate is Class S1

Project specific assumptions		Value	Units	Notes
Pipe product description		" 180mm SDR11 perf"		Provided by Environmental Provida
No of Slots/Holes per metre length	SL_{num}	25	No	Provided by Environmental Provida
Slot/Holes Width	SL_w	0.012	m	Provided by Environmental Provida
Embankment / Trench Class		S1	dimensionless	From Table NA.8 for a pipe surrounded by single sized drainage blanket material
Outside diameter of pipe	B_c	0.18	m	Project Specific Input provided by Client
Effective width of trench or embankment	B_d	1	m	Width assumed to have a minimum of 2 x diameter of pipe either side of pipe
Mean diameter of pipe	D	0.1636	m	Provided by Environmental Provida
Strain factor	D_f	3.5	dimensionless	From Table NA.6 Class S1
Deflection lag factor	D_L	1.5	dimensionless	From Table NA.6 Class S1
Short term modulus of elasticity of pipe material	E_s	800	MN/m^2	PE80
Long term modulus of elasticity of pipe material	E_L	160	MN/m^2	PE80
Modulus of soil reaction	E'_2	14	MN/m^2	From Table NA.6 Class S1 for gravel drainage blanket surround self-compacted to 95% Proctor by wei
Modulus of native soil reaction	E'_3	14	MN/m^2	As Modulus of Soil Reaction due to continuous stone drainage blanket
Deflection coefficient	K_x	0.083	dimensionless	From Table NA.6 Class S1
Depth of Waste	H	55	m	Project Specific Input provided by Client
Pipe internal pressure	P_i	0	kN/m^2	No internal pressure within pipe
Surcharge pressure	P_s	0	kN/m^2	No Significant Traffic Loads
Transient surge vacuum pressure	P_v	0	kN/m^2	No surges of pressure in basal drainage
Pipe wall thickness	t	0.0164	m	DIN8074
Unit weight of waste	γ	10	kN/m^2	Typical Unit weight of waste insitu long term (10yr plus)

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Results

Description	Formulae	Eqn No	Result	Units
Second moment of area of unit length of pipe wall	$I_{pipe} = t^3/12$		0.0000003676	m^4/m
Second moment of area of slots per unit length of pipe	$I_{slots} = (SL_{num} * SL_{w*} t)^3/12$		0.0000000099	m^4/m
Total second moment of area of unit length of pipe wall	$I = I_{pipe} - I_{slots}$		0.0000003577	m^4/m
Initial Pipe Ring Stiffness	$S_r = E_s.I/D^3$		65.34362555	KN/m^2
Vertical soil pressure	$P_e = \gamma H$	(20)	0.5500	MN/m^2
Total external pressure	$P = P_e + P_s$	(15)	0.5500	MN/m^2
Soil modulus adjustment factor	$C_L = (0.985+(0.544.B_d/B_c)) / \{1.985-0.456(B_d/B_c)\}(E'_2/E'_3)-\{1-(B_d/B_c)\}$	(17)	1.0000	
Overall modulus of soil reaction	$E' = E'_2.C_L$	(16)	14.0000	MN/m^2
Short term critical pressure	$P_{crshort} = 0.6(E_s.I/D^3)^{0.33} . (E')^{0.67}$	(21a)	1.4291	MN/m^2
Long term critical pressure	$P_{crlong} = 0.6(E_L.I/D^3)^{0.33} . (E')^{0.67}$	(21a)	0.8403	MN/m^2
Factor of safety against collapse (short term)	$F_{sshort} = 1/\{(P_e/P_{crshort}) + (P_s + P_v)/P_{crshort}\}$	(21)	2.6	
Factor of safety against collapse (long term)	$F_{slong} = 1/\{(P_e/P_{crlong}) + (P_s/P_{crlong}\}$	(21)	1.5	
Ovalization (short term)	$\Delta/D = K_x.\{(1.0*P_e)+P_s\} / \{8.E_s.I/D^3 + 0.061.E'\}$	(23)	3.32%	
Ovalization (long term)	$\Delta/D_L = K_x.\{(D_L.P_e)+P_s\} / \{8.E_L.I/D^3 + 0.061.E'\}$	(23)	7.14%	
Combined stress in pipe wall	$\sigma_c = ((P_i - P).D/2t) + E_L.D_f(\Delta/D)_R.(t/D)$	(25)	-0.8819	MN/m^2

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Client Worksheet

Project Name: ____________________

Date: ____________

Project specific assumptions		Value	Units	Preffered Units
Pipe product description				
No of Slots per metre length	SL_{num}			
Slot Width	SL_w			m
Outside diameter of pipe	B_c			m
Effective width of trench or embankment	B_d			m
Mean diameter of pipe	D			m
Strain factor	D_f			dimensionless
Deflection lag factor	D_L			dimensionless
Short term modulus of elasticity of pipe material	E_s			MN/m^2
Long term modulus of elasticity of pipe material	E_L			MN/m^2
Modulus of soil reaction	E'_2			MN/m^2
Modulus of native soil reaction	E'_3			MN/m^2
Deflection coefficient	K_x			dimensionless
Depth of Waste	H			m
Pipe internal pressure	P_i			kN/m^2
Surcharge pressure	P_s			kN/m^2
Transient surge vacuum pressure	P_v			kN/m^2
Pipe wall thickness	t			m
Unit weight of waste	γ			kN/m^2

Structural design of buried pipelines under various conditions of loading

Environmental Provida

Landfill basal drainage system
Pipe Modelled: " 450mm SDR17.6 Plain Pipe "
Date Modelled:

Calculations based upon BS EN 1295 -1: 1998

NA.2 Symbols used in this calculation

B_c	Outside diameter of pipe
B_d	Effective width of trench
C_c	Soil load coefficient in embankment conditions
C_d	Soil load coefficient in trench conditions
C_L	Soil modulus adjustment factor
C_w	Water load coefficient
D	Mean diameter of pipe
D_f	Strain factor
D_L	Deflection lag factor
E_L	Long term modulus of elasticity of pipe material
E_s	Short term modulus of elasticity of pipe material
E'_2	Modulus of soil reaction
E'_3	Modulus of native soil reaction
E'	Overall modulus of soil reaction
F_s	Factor of safety
H	Depth of cover to top of pipe
I	Second moment of area of unit length of pipe wall
P	Vertical pressure due to soil and surcharge combined
P_{cr}	Critical pressure for buckling of flexible pipes
P_{crl}	Long term critical pressure
P_{crs}	Short term critical pressure
P_e	Vertical soil pressure
P_i	Pipe internal pressure
P^s	Surcharge pressure
t	Pipe wall thickness
γ	Unit weight of soil
γ_w	Unit weight of water
Δ	Pipe diameter change

Figure NA.2 Flowchart for pipeline design with thermoplastic pipes

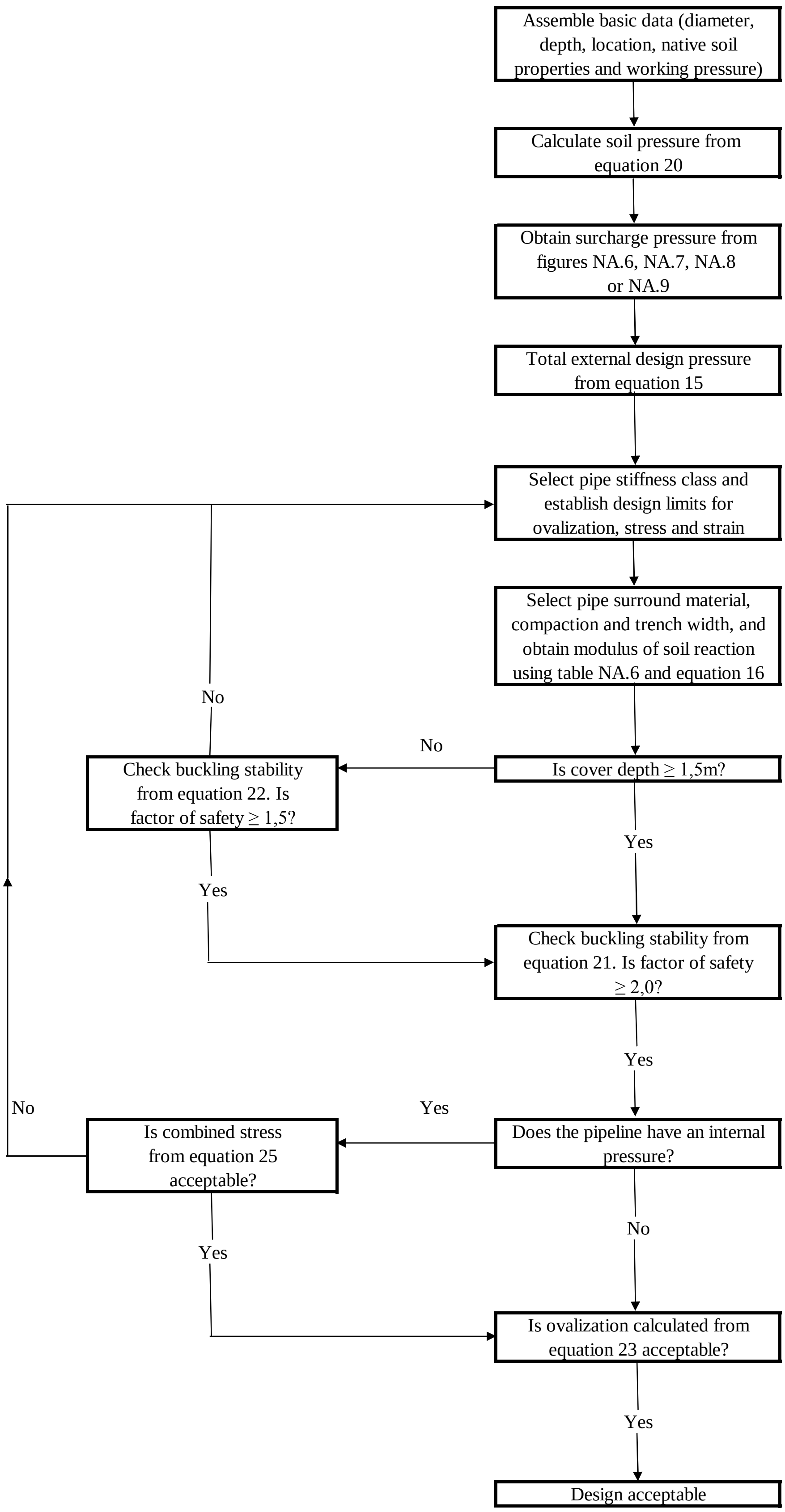


Table NA.1 Guide values of Spangler modulus for native soils					
Soil type	**Spangler modulus for soils in various conditions (MN/m^2)**				
	Very dense	**Dense**	**Medium dense**	**Loose**	**Very loose**
Gravel	Over 40	15 to 40	9 to 15	5 to 9	3 to 5
Sand	15 to 20	9 to 15	4 to 9	2 to 4	1 to 2
Clayey, silty sand	10 to 15	6 to 10	2.5 to 6	1.5 to 2.5	0.5 to 1.5
Clay	Very hard	11 to 14			
	Hard	10 to 11			
	Very Stiff	6 to 10			
	Stiff	4 to 6			
	Firm	3 to 4			
	Soft	1.5 to 3			
	Very soft	0 to 1.5			

Table NA.6 Flexible and semi-rigid pipe embedment properties

Embedment class as table NA.8 deflection coefficient K_x	Compaction M_p %	Modulus of soil reaction E'_2 MN/m²	Deflection lag factor D_L [2)]	Strain factor Df for various pipe stiffnesses - see (1 KN/m²					
				1.25	2.5	5	10	15	30 or more
Class S1	Uncompacted	5	1.5	4.7	4.5	4.3	4	3.75	3
K_x=0.083	80	7	1.25	4.7	4.5	4.3	4	3.75	3
	85	7	1	4.7	4.5	4.3	4	3.75	3.25
	90	10	1	4.7	4.5	4.3	4	3.75	3.5
	95	14	1	-	-	-	-	3.75	3.5
Class S2	Uncompacted	3	1.5	4.7	4.5	4.3	4	3.75	3
K_x=0.083	80	5	1.25	4.7	4.5	4.3	4	3.75	3
	85	7	1	4.7	4.5	4.3	4	3.75	3.25
	90	10	1	4.7	4.5	4.3	4	3.75	3.5
	95	20	1	-	-	-	-	-	3.5
Class S3	85	5	1.5	6.2	5.5	4.75	4.25	4	3.25
K_x=0.100	90	7	1.25	7.75	6.6	5.5	4.7	4.25	3.5
	95	14	1	-	-	-	-	4.75	3.5
Class S4	85	3	1.5	6.2	5.5	4.75	4.25	4	3.5
K_x=0.100	90	5	1.25	7.75	6.6	5.5	4.7	4.25	3.5
	95	10	1	-	-	-	-	4.75	3.5
Class S5	85	1	3	-	-	-	-	4	3.5
K_x=0.100	90	3	2	-	-	-	-	4.25	3.5
	95	7	1.25	-	-	-	-	4.5	3.5
Class B1	85	5	1.5	-	-	-	5	4	3.5
K_x=0.083	90	7	1.25	-	-	-	5.5	4.25	3.5
Class B2	85	3	2	-	-	-	5.5	4.25	3.5
K_x=0.083	90	5	1.75	-	-	-	6	5	3.5

1) Pipe stiffnesses referred to in this table are initial values

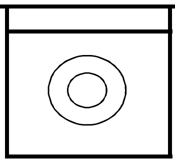
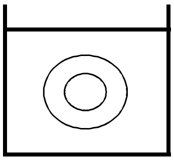
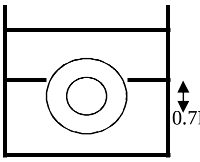
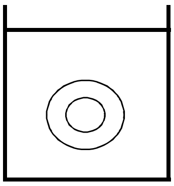
2) Where the designer can be certain that initial pressurisation will take place within one year of backfilling, a value of 1.0 may be taken for the deflection lag factor

Note 1. - For construction details of embedment classes see table NA.8

Note 2. - Quated values for E'2 assume the pipeline will be installed below groundwater

Note 3. - Mp indicates modified Proctor density and corresponds to the heavy compaction test in BS 1377

Note 4. - For Landfill it is assumed that most plastic basal drainage pipes will be surrounded by cell drainage blanket stone which is normally processed granular material of a single size (minimum fines), therefore embedment class most appropriate is Class S1

Table NA.8 Semi-rigid and flexible pipe embedments			
Embedment class	**Embedment configuration**	**Bed and sidefill materials**	**Notes**
S1 and S2		Class S1 : Gravel (single sized) Class S2 : Gravel (graded)	Normally processed granular material
S3 - S5		Class S3 : Sand and coarse grained soil with more than 12% fines	These represent 'as dug' soils, and require particularly close control when used with low stiffness pipe
		Class S4 : Coarse grained soil with more than 12% fines OR Fine grained soil, liquid limit less than 50%, medium to no plasticity and more than 25% coarse grained material	
		Class S5 : Fine grained soil, liquid limit less than 50%, medium to no plasticity and more than 25% coarse grained material	Class S5 only recommended for use with semi-rigid pipes
B1 and B2		Class B1: Upper surround as for S3 or S4 Lower surround as for S1 or S2	Class B embedments not recommended for use with pipes of less than 10 kN/m2 stiffness
		Class B2: Upper surround as for S5 Lower surround as for S1 or S2	
D		As for S3, S4 or S5	Only suitable for semi-rigid pipes with high beam strength Soil properties from table NA.6, except Kx=0.110
Note 1.	See Table NA.6 for design parameters for embedment classes		

Note 1. - For Landfill it is assumed that most plastic basal drainage pipes will be surrounded by cell drainage blanket stone which is normally processed granular material of a single size (minimum fines), therefore embedment class most appropriate is Class S1

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Project specific assumptions		Value	Units	Notes
Pipe product description		" 450mm SDR17.6 Plain Pipe "		Provided by Environmental Provida
No of Slots/Holes per metre length	SL_{num}	0	No	Provided by Environmental Provida
Slot/Holes Width	SL_w	0	m	Provided by Environmental Provida
Embankment / Trench Class		S1	dimensionless	From Table NA.8 for a pipe surrounded by single sized drainage blanket material
Outside diameter of pipe	B_c	0.45	m	Project Specific Input provided by Client
Effective width of trench or embankment	B_d	1.5	m	Width assumed to have a minimum of 2 x diameter of pipe either side of pipe
Mean diameter of pipe	D	0.145	m	Provided by Environmental Provida
Strain factor	D_f	3.5	dimensionless	From Table NA.6 Class S1
Deflection lag factor	D_L	1.5	dimensionless	From Table NA.6 Class S1
Short term modulus of elasticity of pipe material	E_s	800	MN/m^2	PE80
Long term modulus of elasticity of pipe material	E_L	160	MN/m^2	PE80
Modulus of soil reaction	E'_2	14	MN/m^2	From Table NA.6 Class S1 for gravel drainage blanket surround self-compacted to 95% Proctor by wei
Modulus of native soil reaction	E'_3	14	MN/m^2	As Modulus of Soil Reaction due to continuous stone drainage blanket
Deflection coefficient	K_x	0.083	dimensionless	From Table NA.6 Class S1
Depth of Waste	H	58	m	Project Specific Input provided by Client
Pipe internal pressure	P_i	0	kN/m^2	No internal pressure within pipe
Surcharge pressure	P_s	0	kN/m^2	No Significant Traffic Loads
Transient surge vacuum pressure	P_v	0	kN/m^2	No surges of pressure in basal drainage
Pipe wall thickness	t	0.0266	m	DIN8074
Unit weight of waste	γ	10	kN/m^2	Typical Unit weight of waste insitu long term (10yr plus)

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Results

Description	Formulae	Eqn No	Result	Units
Second moment of area of unit length of pipe wall	$I_{pipe} = t^3/12$		0.0000015684	m^4/m
Second moment of area of slots per unit length of pipe	$I_{slots} = (SL_{num} * SL_{w*} t)^3/12$		0.0000000000	m^4/m
Total second moment of area of unit length of pipe wall	$I = I_{pipe} - I_{slots}$		0.0000015684	m^4/m
Initial Pipe Ring Stiffness	$S_r = E_s.I/D^3$		411.5756229	KN/m^2
Vertical soil pressure	$P_e = \gamma H$	(20)	0.5800	MN/m^2
Total external pressure	$P = P_e + P_s$	(15)	0.5800	MN/m^2
Soil modulus adjustment factor	$C_L = (0.985+(0.544.B_d/B_c)) / \{1.985-0.456(B_d/B_c)\}(E'_2/E'_3)-\{1-(B_d/B_c)\}$	(17)	1.0000	
Overall modulus of soil reaction	$E' = E'_2.C_L$	(16)	14.0000	MN/m^2
Short term critical pressure	$P_{crshort} = 0.6(E_s.I/D^3)^{0.33} . (E')^{0.67}$	(21a)	2.6232	MN/m^2
Long term critical pressure	$P_{crlong} = 0.6(E_L.I/D^3)^{0.33} . (E')^{0.67}$	(21a)	1.5423	MN/m^2
Factor of safety against collapse (short term)	$F_{sshort} = 1/\{(P_e/P_{crshort}) + (P_s+P_v)/P_{crshort}\}$	(21)	4.5	
Factor of safety against collapse (long term)	$F_{slong} = 1/\{(P_e/P_{crlong}) + (P_s/P_{crlong}\}$	(21)	2.7	
Ovalization (short term)	$\Delta/D = K_x.\{(1.0*P_e)+P_s\} / \{8.E_s.I/D^3 + 0.061.E'\}$	(23)	1.16%	
Ovalization (long term)	$\Delta/D_L = K_x.\{(D_L.P_e)+P_s\} / \{8.E_L.I/D^3 + 0.061.E'\}$	(23)	4.77%	
Combined stress in pipe wall	$\sigma_c = ((P_i - P).D/2t) + E_L.D_f(\Delta/D)_R.(t/D)$	(25)	-0.3882	MN/m^2

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Client Worksheet

Project Name: ____________________

Date: __________

Project specific assumptions	Symbol	Value	Units	Preffered Units
Pipe product description				
No of Slots per metre length	SL_{num}			
Slot Width	SL_w			m
Outside diameter of pipe	B_c			m
Effective width of trench or embankment	B_d			m
Mean diameter of pipe	D			m
Strain factor	D_f			dimensionless
Deflection lag factor	D_L			dimensionless
Short term modulus of elasticity of pipe material	E_s			MN/m^2
Long term modulus of elasticity of pipe material	E_L			MN/m^2
Modulus of soil reaction	E'_2			MN/m^2
Modulus of native soil reaction	E'_3			MN/m^2
Deflection coefficient	K_x			dimensionless
Depth of Waste	H			m
Pipe internal pressure	P_i			kN/m^2
Surcharge pressure	P_s			kN/m^2
Transient surge vacuum pressure	P_v			kN/m^2
Pipe wall thickness	t			m
Unit weight of waste	γ			kN/m^2

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CQA Engineer:	Kay Adedotun	CQA Plan Ref:	Hafod/C4/P1

Date	Weld Number	String Reference	Pipe Diameter (mm)	Length of Pipe (m)	Machine Operator	Machine Serial Numbers				Comments
						Cutting Head	Clamps	Heating Pad	Control Box	
25/08/2015	Dummy	1A	450	6	J Davies	112008	T5002610	PS5014H	090860041	n/a
25/08/2015	2	1A	450	6	J Davies	112008	T5002610	PS5014H	090860041	Pass
25/08/2015	3	1A	450	6	J Davies	112008	T5002610	PS5014H	090860041	Pass
27/08/2015	Dummy	1A	450	3	J Davies	112008	T5002610	PS5014H	081080011	n/a
27/08/2015	195	1A	450	3	J Davies	112008	T5002610	PS5014H	081080011	Pass
27/08/2015	196	1A	450	6	J Davies	112008	T5002610	PS5014H	081080011	Pass
27/08/2015	197	1A	450	6	J Davies	112008	T5002610	PS5014H	081080011	Fail
27/08/2015	198	1A	450	6	J Davies	112008	T5002610	PS5014H	081080011	Pass
01/09/2015	Dummy	1B	450	6	J Davies	112008	T5002610	PS5014H	081080011	n/a
01/09/2015	200	1B	450	6	J Davies	112008	T5002610	PS5014H	081080011	Fail
02/09/2015	201	1B	450	6	J Davies	112008	T5002610	PS5014H	081080011	Fail
03/09/2015	202	1B	450	6	J Davies	112008	T5002610	PS5014H	081080011	Fail
03/09/2015	203	1B	450	6	J Davies	112008	T5002610	PS5014H	081080011	Fail

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CQA Engineer:	Kay Adedotun	**CQA Plan Ref:**	Hafod/C4/P1

Date	Weld Number	String Reference	Pipe Diameter (mm)	Length of Pipe (m)	Machine Operator	Machine Serial Numbers				Comments
						Cutting Head	Clamps	Heating Pad	Control Box	
03/09/2015	204	1B	450	6	J Davies	T5008802	T5004207	EC1321	081080011	Fail
03/09/2015	1	1B	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
03/09/2015	2	1B	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
03/09/2015	3	1B	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	Dummy	1B	450	6	J Davies	T5008802	T5004207	EC1321	090860041	n/a
04/09/2015	4	1B	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	5	1B	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	6	1B	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	6	2	450	3	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	7	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	8	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	9	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	10	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass

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Site:	Hafod Landfill	**Sheet No:**	3 of 5
CQA Engineer:	Kay Adedotun	**CQA Plan Ref:**	Hafod/C4/P1

Date	Weld Number	String Reference	Pipe Diameter (mm)	Length of Pipe (m)	Machine Operator	Machine Serial Numbers				Comments
						Cutting Head	Clamps	Heating Pad	Control Box	
04/09/2015	11	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	12	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	13	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	14	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	15	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass
04/09/2015	16	2	450	6	J Davies	T5008802	T5004207	EC1321	090860041	Pass

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Site:	Hafod Landfill	**Sheet No:**	4 of 5
CQA Engineer:	Kay Adedotun	**CQA Plan Ref:**	Hafod/C4/P1

Date	Weld Number	String Reference	Pipe Diameter (mm)	Length of Pipe (m)	Machine Operator	Machine Serial Numbers				Comments
						Cutting Head	Clamps	Heating Pad	Control Box	
07/10/2015	Dummy	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	Dummy weld
07/10/2015	Joint2	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
07/10/2015	Joint3	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint4	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	Dummy weld
08/10/2015	Joint5	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint6	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint7	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint8	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint9	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint10	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint11	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint12	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint13	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	

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Site:	Hafod Landfill	**Sheet No:**	5 of 5
CQA Engineer:	Kay Adedotun	**CQA Plan Ref:**	Hafod/C4/P1

Date	Weld Number	String Reference	Pipe Diameter (mm)	Length of Pipe (m)	Machine Operator	Machine Serial Numbers				Comments
						Cutting Head	Clamps	Heating Pad	Control Box	
08/10/2015	Joint14	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint15	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint16	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	
08/10/2015	Joint17	1	180	6	J Davies	G250/62	G250/14	G250/54	G250/123	

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Electrofusion Pipe Welding Record

Site:	Hafod	**Sheet No:**	1 of 1
CQA Engineer:	Kay Adedotun	**CQA Plan Ref:**	Hafod/c4/p1

Date	Location	Joint No.	Pipe Diameter (mm)	Scraped?	Wiped?	Fitting Type					Operator	Machine No. Fusion Qbox Fusmatic	Status	
						Coupler	Tee	Reducer	Saddle	Elbow			Pass	Fail
07/09/15	Between Jnt 198 and Jnt 5 string 1A and 1B , 450mm siderisers	580	450	Y	Y	Y					J Davies	Box11235		x
07/09/15	Between Jnt 198 and Jnt 5 string 1A and 1B	581	450	Y	Y	Y					J Davies	Box11235		x
07/09/15	Between Jnt 198 and Jnt 5 string 1A and 1B	582	450	Y	Y	Y					J Davies	Box11235	x	

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