Site:	Hafod Landfill	
Sample No.:	C1	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		317	g
Mass of dried soil + tray (m_2)	=		278	g
Mass of empty tray (m_3)	=		7	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	310	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	271	g
Mass of moisture (m_6)	=	$m_4 - m_5$	39	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.4%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3308	g
Mass of empty core (M_2)	=		1072	g
Mass of soil (M)	=	$M_1 - M_2$	2236	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.189	Mg m^3
Water Content (w)	=		14.4%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.914	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.37	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	-0.3%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C2	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		309	g
Mass of dried soil + tray (m_2)	=		272	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	304	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	267	g
Mass of moisture (m_6)	=	$m_4 - m_5$	37	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.9%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3267	g
Mass of empty core (M_2)	=		1068	g
Mass of soil (M)	=	$M_1 - M_2$	2199	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.153	Mg m^3
Water Content (w)	=		13.9%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.891	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.39	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	1.9%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C3	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		308	g
Mass of dried soil + tray (m_2)	=		272	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	303	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	267	g
Mass of moisture (m_6)	=	$m_4 - m_5$	36	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.5%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3280	g
Mass of empty core (M_2)	=		1058	g
Mass of soil (M)	=	$M_1 - M_2$	2222	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.175	Mg m^3
Water Content (w)	=		13.5%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.917	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.37	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	1.3%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C4	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		326	g
Mass of dried soil + tray (m_2)	=		288	g
Mass of empty tray (m_3)	=		7	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	319	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	281	g
Mass of moisture (m_6)	=	$m_4 - m_5$	38	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.5%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3323	g
Mass of empty core (M_2)	=		1072	g
Mass of soil (M)	=	$M_1 - M_2$	2251	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.204	Mg m^3
Water Content (w)	=		13.5%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.941	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.35	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	-0.1%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C5	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		333	g
Mass of dried soil + tray (m_2)	=		296	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	328	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	291	g
Mass of moisture (m_6)	=	$m_4 - m_5$	37	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.7%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3256	g
Mass of empty core (M_2)	=		1058	g
Mass of soil (M)	=	$M_1 - M_2$	2198	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.152	Mg m^3
Water Content (w)	=		12.7%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.909	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.38	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	3.1%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C6	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		301	g
Mass of dried soil + tray (m_2)	=		260	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	296	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	255	g
Mass of moisture (m_6)	=	$m_4 - m_5$	41	g
Water Content (w)	=	$\frac{m_6}{m_5}$	16.1%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3249	g
Mass of empty core (M_2)	=		1068	g
Mass of soil (M)	=	$M_1 - M_2$	2181	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.135	Mg m^3
Water Content (w)	=		16.1%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.840	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1 \ -1}{\rho_d}$	0.43	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	0.5%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C7	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		289	g
Mass of dried soil + tray (m_2)	=		258	g
Mass of empty tray (m_3)	=		7	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	282	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	251	g
Mass of moisture (m_6)	=	$m_4 - m_5$	31	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.4%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3277	g
Mass of empty core (M_2)	=		1072	g
Mass of soil (M)	=	$M_1 - M_2$	2205	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.159	Mg m^3
Water Content (w)	=		12.4%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.921	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.37	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	3.2%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C8	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		340	g
Mass of dried soil + tray (m_2)	=		301	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	335	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	296	g
Mass of moisture (m_6)	=	$m_4 - m_5$	39	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.2%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3318	g
Mass of empty core (M_2)	=		1068	g
Mass of soil (M)	=	$M_1 - M_2$	2250	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.203	Mg m^3
Water Content (w)	=		13.2%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.946	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.35	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	0.3%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C9	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		322	g
Mass of dried soil + tray (m_2)	=		282	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	317	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	277	g
Mass of moisture (m_6)	=	$m_4 - m_5$	40	g
Water Content (w)	=	$\frac{m_6}{m_5}$	14.4%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3294	g
Mass of empty core (M_2)	=		1058	g
Mass of soil (M)	=	$M_1 - M_2$	2236	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.189	Mg m^3
Water Content (w)	=		14.4%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.913	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.37	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	-0.4%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C10	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		297	g
Mass of dried soil + tray (m_2)	=		262	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	292	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	257	g
Mass of moisture (m_6)	=	$m_4 - m_5$	35	g
Water Content (w)	=	$\frac{m_6}{m_5}$	13.6%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3271	g
Mass of empty core (M_2)	=		1068	g
Mass of soil (M)	=	$M_1 - M_2$	2203	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.157	Mg m^3
Water Content (w)	=		13.6%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.898	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.39	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	2.0%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C11	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		320	g
Mass of dried soil + tray (m_2)	=		279	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	315	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	274	g
Mass of moisture (m_6)	=	$m_4 - m_5$	41	g
Water Content (w)	=	$\frac{m_6}{m_5}$	15.0%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3194	g
Mass of empty core (M_2)	=		1058	g
Mass of soil (M)	=	$M_1 - M_2$	2136	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.091	Mg m^3
Water Content (w)	=		15.0%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.819	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1 \ -1}{\rho_d}$	0.45	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	3.6%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod Landfill	
Sample No.:	C12	**FTC-1012**
		Site Determination of Compaction

(1) Determination of Water Content				
Mass of damp soil + tray (m_1)	=		337	g
Mass of dried soil + tray (m_2)	=		300	g
Mass of empty tray (m_3)	=		5	g
Mass of damp soil (m_4)	=	$m_1 - m_3$	332	g
Mass of dried soil (m_5)	=	$m_2 - m_3$	295	g
Mass of moisture (m_6)	=	$m_4 - m_5$	37	g
Water Content (w)	=	$\frac{m_6}{m_5}$	12.5%	
(2) Determination of Dry Density				
Mass of core plus soil (M_1)	=		3269	g
Mass of empty core (M_2)	=		1072	g
Mass of soil (M)	=	$M_1 - M_2$	2197	g
Height of core (h)	=		125	mm
Internal diameter of core (d)	=		102	mm
Internal volume of core (V)	=	$\frac{\Pi \times d^2 \times h}{4}$	1021410.31	mm^3
Bulk density (ρ) (see Note 4)	=	$\frac{M \times 1000}{V}$	2.151	Mg m^3
Water Content (w)	=		12.5%	
Dry density (ρ_d) (see Note 4)	=	$\frac{\rho}{(1+w)}$	1.911	Mg m^3
Average Particle Density (laboratory determination, G_s) =			2.63	Mg m^3
Void Ratio (e)	=	$\frac{G_s * 1}{\rho_d} - 1$	0.38	
Air Voids (Av)	=	$\frac{e - (wG_s)}{1 + e}$	3.4%	

Notes:

(1) Before weighing, ensure balance is zeroed and plate is free from debris;

(2) Ensure steel core is trimmed flush, and any small depressions in soil surface are filled, prior to weighing and knocking out into tray;

(3) BS 1377 Test method requires 24 hours at 105^{0}C to ensure complete drying of samples; site determinations will yield conservative results after 12-16 hrs, although the longer the time, the more accurate the determination. Cohesive samples must be diced and spread out across tray before drying; granular samples similarly should be spread.

(4) Bulk and dry density should be expressed to three places of decimals. All formulae are adjusted for different measurement units, no further conversion factors are required.

Revision Index

i		03/11/2010	Richard C
ii	Renumbered	21/07/2011	Richard C
iii	Air Voids Calculation added	04/06/2014	Richard C
iv	Text amemded	19/06/2014	Richard C

Site:	Hafod	Sheet No:	1 of 2
CQA Engineer:	A White	CQA Plan Ref:	

Date	Location	Material Tested	Vane Reading (kPa)	Pass/ Fail
9/3/15	B8, layer 3	Engineered clay	98	Pass
"	"	Engineered clay	112	Pass
"	"	Engineered clay	87	Pass
"	"	Engineered clay	102	Pass
"	B5, layer 3	Engineered clay	93	Pass
"	"	Engineered clay	90	Pass
"	"	Engineered clay	102	Pass
"	"	Engineered clay	108	Pass
"	B7, layer 4	Engineered clay	120	Pass
"	"	Engineered clay	118	Pass
"	"	Engineered clay	99	Pass
"	"	Engineered clay	107	Pass
"	A4, layer 4	Engineered clay	101	Pass
"	"	Engineered clay	89	Pass
"	"	Engineered clay	92	Pass
"	"	Engineered clay	113	Pass
10/3/15	A6, layer 5	Engineered clay	120	Pass
"	"	Engineered clay	108	Pass
"	"	Engineered clay	120	Pass
"	"	Engineered clay	106	Pass
"	B2, layer 5	Engineered clay	93	Pass
"	"	Engineered clay	97	Pass
"	"	Engineered clay	85	Pass
"	"	Engineered clay	101	Pass
12/3/15	B6, layer 6	Engineered clay	120	Pass
"	"	Engineered clay	120	Pass
"	"	Engineered clay	106	Pass

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C

Site:	Hafod	Sheet No:	2 of 2
CQA Engineer:	A White	CQA Plan Ref:	

Date	Location	Material Tested	Vane Reading (kPa)	Pass/ Fail
12/3/15	B6, layer 6	Engineered clay	113	Pass
"	A3, layer 6	Engineered clay	104	Pass
"	"	Engineered clay	111	Pass
"	"	Engineered clay	120	Pass
"	"	Engineered clay	120	Pass
16/3/15	A5, layer 7	Engineered clay	95	Pass
"	"	Engineered clay	104	Pass
"	"	Engineered clay	97	Pass
"	"	Engineered clay	100	Pass
17/3/15	B3, layer 7	Engineered clay	104	Pass
"	"	Engineered clay	96	Pass
"	"	Engineered clay	120	Pass
"	"	Engineered clay	102	Pass
18/3/15	B4, layer 8	Engineered clay	87	Pass
"	"	Engineered clay	89	Pass
"	"	Engineered clay	94	Pass
"	"	Engineered clay	99	Pass
19/3/15	A2, layer 8	Engineered clay	112	Pass
"	"	Engineered clay	120	Pass
"	"	Engineered clay	116	Pass
"	"	Engineered clay	113	Pass

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C

Site:	HAFOD	Sheet No:	1 of 2
CQA Engineer:	J Gibson	CQA Plan Ref:	

Date	Location	Material Tested	Vane Reading (kPa)	Pass/ Fail
4/2/2015	A2	Formation to GDL	68	Pass
5/2/2015	A3	Formation to GDL	+120	Pass
5/2/2015	A4	Formation to GDL	98	Pass
5/2/2015	A5	Formation to GDL	+120	Pass
5/2/2015	A6	Formation to GDL	104	Pass
6/2/2015	A6L1	Eng fill	110	Pass
6/2/2015	B6L1	Eng fill	94	Pass
6/2/2015	A5L1	Eng fill	+120	Pass
6/2/2015	B5L1	Eng fill	+120	Pass
9/2/2015	A4L1	Eng fill	112	Pass
9/2/2015	B4L1	Eng fill	+120	Pass
9/2/2015	A3L1	Eng fill	+120	Pass
9/2/2015	B3L1	Eng fill	+120	Pass
10/2/2015	A3L2	Eng fill	+120	Pass
10/2/2015	A4L2	Eng fill	110	Pass
10/2/2015	A5L2	Eng fill	+120	Pass
10/2/2015	A6L2	Eng fill	94	Pass
10/2/2015	A4L3	Eng fill	+120	Pass
10/2/2015	A5L3	Eng fill	106	Pass
10/2/2015	A6L3	Eng fill	86	Pass
10/2/2015	A5L4	Eng fill	+120	Pass
10/2/2015	A6L4	Eng fill	+120	Pass
10/2/2015	A5L5	Eng fill	110	Pass
10/2/2015	A6L6	Eng fill	+120	Pass
11/2/2015	A5L7	Eng fill	90	Pass
11/2/2015	A6L7	Eng fill	86	Pass
11/2/2015	A5L8	Eng fill	96	Pass

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C

Site:	HAFOD	Sheet No:	2 of 3
CQA Engineer:	J Gibson	CQA Plan Ref:	

Date	Location	Material Tested	Vane Reading (kPa)	Pass/ Fail
11/2/2015	A6L8	Eng fill	94	Pass
12/2/2015	A5L9	Eng fill	78	Pass
12/2/2015	A6L9	Eng fill	82	Pass
12/2/2015	A6L10	Eng fill	90	Pass
12/2/2015	A5L10	Eng fill	94	Pass
13/2/2015	A6L11	Eng fill	110	Pass
18/2/2015	Layer 1	Trial pad	86	Pass
18/2/2015	Layer 1	Trial pad	+120	Pass
18/2/2015	Layer 1	Trial pad	92	Pass
18/2/2015	Layer 1	Trial pad	98	Pass
18/2/2015	Layer 1	Trial pad	106	Pass
18/2/2015	Layer 1	Trial pad	78	Pass
18/2/2015	Layer 2	Trial pad	98	Pass
18/2/2015	Layer 2	Trial pad	76	Pass
18/2/2015	Layer 2	Trial pad	84	Pass
18/2/2015	Layer 2	Trial pad	110	Pass
18/2/2015	Layer 2	Trial pad	102	Pass
18/2/2015	Layer 2	Trial pad	+120	Pass
18/2/2015	Layer 2	Trial pad	98	Pass
19/2/2015	B2, layer 1	AEGB	112	Pass
"	A3, layer 1	AEGB	+120	Pass
"	B4, layer 1	AEGB	+120	Pass
"	B4,layer 1	AEGB	76	Pass
"	A4, layer 1	AEGB	64	Pass
"	B5, layer 1	AEGB	84	Pass
"	A5, layer 1	AEGB	78	Pass
"	A5, layer 1	AEGB	110	Pass

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C

Site:	HAFOD	Sheet No:	3 of 3
CQA Engineer:	J Gibson	CQA Plan Ref:	

Date	Location	Material Tested	Vane Reading (kPa)	Pass/ Fail
"	A6, layer 1	AEGB	+120	Pass
"	B6, layer 1	AEGB	102	Pass
"	B7, layer 1	AEGB	84	Pass
"	B8, layer 1	AEGB	+120	Pass
"	B3, layer 2	AEGB	+120	Pass
"	A4, layer 2	AEGB	92	Pass
"	A4, layer 2	AEGB	68	Pass
23/2/2015	B6, layer 2	AEGB	76	Pass
"	A6, layer 2	AEGB	94	Pass
"	B7, layer 2	AEGB	96	Pass
"	A7, layer 2	AEGB	80	Pass
"	B7, layer 2	AEGB	108	Pass
"	B7, layer 2	AEGB	90	Pass

Revision Index

i	31/08/10	Draft for comment	Richard C
ii	22/7/11	Renumbered	Richard C