Table S1. Calculation methods of the deformation of RSRW under static loading.

Methods	Fundamental Formula	Annotation	Assumption
FHWA [12]	$\delta_R = 11.81\left(\frac{L}{H}\right)^4 - 42.25\left(\frac{L}{H}\right)^3 + 57.16\left(\frac{L}{H}\right)^2 - 35.45\left(\frac{L}{H}\right) +$ $\delta_{max} = \frac{\delta_R H}{75}$ (Extensible reinforcement); $\delta_{max} = \frac{\delta_R H}{250}$ (Non-expandable reinforcement)	δ_R: deformation index; δ_{max}: maximum horizontal deformation; L: length of geosynthetic; H: height of the retaining wall	L/H: 0.3~1.175; rigid foundation; no external load on top; length of geosynthetic; same reinforcement spacing; relative increase in the deformation by 25% per 19.15 kPa external load (6.1 m wall height)。
GeoService [12]	$\delta_h = \frac{\varepsilon_d L}{2}$	δ_h: deformation of retaining wall; δ_d: limit strain or maximum strain per reinforcement	If the strain of the reinforcement is unknown, it is assumed that the ultimate strain is less than 10%
CTI [12]	$\delta_{\max} = \varepsilon_d\left(\frac{H}{1.25}\right)$	H: height of the retaining wall; ε_d: limit strain or maximum strain per reinforcement	Ultimate strain: 1~3% (permanent construction), within 10% (temporary structure); walls above 6.1 m; low panel stiffness; if the panel stiffness is large, the wall height is greater than 6.1 m, the deformation is reduced by 15%
Wu [12]	$\Delta_h = \left(\frac{1}{2}\right)\left(\frac{P_{rm}}{K_{reinf}}\right)(H - Z_i)\left[\tan(45° - \frac{\varphi}{2}) + \tan(90° - \phi_{ds})\right]$ $\Delta_i = \left(\frac{1}{2}\right)\left[\frac{K_h(\gamma_s Z_i + q)S_v - \gamma_b b S_v tan\delta(1 + tan\delta tan\beta)}{K_{reinf}}\right](H - Z_i)\left[\tan\left(45°\right.\right.$	Δ_h: deformation of retaining wall; P_{rm}: maximum tensile force of reinforcement at Z from top; K_{reinf}: Geogrid stiffness; φ: internal friction angle of soil; $\emptyset_{ds}$: effective internal friction angle of the soil in direct shear test; K_h: lateral earth pressure coefficient; γ_s: soil bulk density; S_v: vertical spacing of reinforcement; γ_b: module brick bulk density; b: panel width; δ: friction angle between module bricks;	L/H ≥ 0.7; panel stiffness not considered L/H ≥ 0.7; based on the modular retaining wall, considering panel stiffness

		β: friction angle between the brick and soil	
Adams [12]	$D_L = \frac{2b_{q,vol}D_v}{H}$, $\varepsilon_L = \frac{D_L}{b_{q,vol}} = \frac{2D_v}{H} = 2\varepsilon_v$	D_L: horizontal deformation of reinforced earth retaining wall abutment; D_v: vertical settlement of foundation; ε_L: horizontal strain; $b_{q,vol}$: width of the load along the top of the wall (including setback); ε_v: vertical strain on the top of the retaining wall	Volume strain 0; simultaneous deformation and strain of reinforcement and soil; horizontal strain less than 1%
	$u_{act} = \omega\gamma z(H-z) = -\omega\gamma(z^2 - Hz), \omega = \frac{tan^3\varphi}{E}\Delta H$	ε_{act}: strain of rebar in active area; F: tension in geosynthetic; E: elastic modulus of reinforcement; u_{act}: horizontal displacement of bar active area	Frictional soil; potential rupture surface is wedge surface; only free zone causes displacement
IBW PAN [13]	$u_x = u_{act} + u_{pass}$, $\omega = \frac{tan^3\varphi}{E}\Delta H$, $\beta = \sqrt{\frac{2BG}{E}}$ $u_{act} = \frac{\omega\gamma\Delta Htan\alpha}{E}\left[H(L-Htan\alpha)Z - (L-2Htan\alpha)Z^2 - \right.$ $u_{pass} = \frac{\sigma_r(1+e^{-2\beta l})}{\beta E(1-e^{-2\beta Bl})}\Delta H$, $\sigma_r = \omega\left[\gamma(L-htan\alpha)Z + \gamma Z^2 t\right.$	H: the height of retaining wall; L: length of geosynthetic; ΔH: vertical spacing of reinforcement: B: width of geosynthetic; E: elastic modulus of reinforcement;	Frictional soil; potential rupture surface is wedge surface; no external load
	$u_x = u_{act} + u_{pass}$, $\omega = \frac{tan^3\varphi}{E}\Delta H$, $\alpha = 45° - \frac{\varphi}{2}$ $u_{act} = \frac{\omega\Delta Htan\alpha}{E}\begin{cases} pH(L-Htan\alpha) + \left[p(2Htan\alpha - L) + \gamma H(L-Htan\right. \\ -\left[ptan\alpha + \gamma(L-2Htan\alpha)\right]Z^2 - Z^3\gamma tan\alpha \end{cases}$ $u_{pass} = \frac{\sigma_r(1+e^{-2\beta l})}{\beta E(1-e^{-2\beta Bl})}\Delta H$	γ: soil bulk density; φ: internal friction angle of soil; P: loading; L: length of the rebar in the anchorage zone; G: contact surface stiffness	Frictional soil: potential rupture surface is a wedge surface; there is an external load
Wang Liyan [11]	$s = s_b + s_s = \frac{k_e\gamma H^2}{10EL^2}\left(9Hz^2 - \frac{7}{2}z^3\right) + \frac{k_e\gamma}{6GL}\left(H^3 - \right.$; $E = \left[\frac{(1-t)E_s}{1-v_s^2} + \frac{tE_r}{1-v_r^2}\right](1-v^2)$, $t = \sum m / H$, $G = \frac{}{2}$ $v = \left[\frac{tv_rE_r}{1-v_r^2} + \frac{(1-t)v_sE_s}{1-v_s^2}\right] / \left[\frac{tE_r}{1-v_r^2} + \frac{(1-t)E_s}{1-v_s^2}\right]$	K_e: average of the active earth pressure coefficient and static earth pressure coefficient; γ: soil bulk density; t: geogrid thickness ratio; E_r: elastic modulus of geogrid; V_r: Poisson's ratio of geogrid; E_s : elastic modulus of the filling soil; G: shear modulus of the equivalent elastomer;	Deformation form of the retaining wall; the earth pressure behind the wall is a triangular distributed load; horizontal isotropic elastomer for a reinforced earth retaining wall

		V_s: Poisson's ratio of the fill; m: geogrid thickness	
He Wei [14]	$y = 2.5416H + 18.8848h - 0.3609E - 2.3728L - 0.3026C_1 - 0.4832\varphi_1 + 0.0574C_2 + 0.0847\varphi_2$ (Two dimensions) $y = 2.4614H + 16.7550h - 0.2935E - 2.3242L - 0.2909C_1 - 0.4483\varphi_1 + 0.0724C_2 + 0.0937\varphi_2$ (Three dimensions)	H: Height of the retaining wall; h: vertical spacing of reinforcement; E: elastic modulus of reinforcement; L: length of geosynthetic; C_1: stiffened filler cohesion; φ_1: internal friction angle of reinforced filler; φ_2: internal friction angle of the rear filler C_2: viscosity of the rear filler;	The relationship between the parameters and horizontal displacement is linear

Table S2. Reinforced soil retaining wall parameters of 10 case histories.

Case Number	H（m）	L(m)	ε_d(%)	T_y(kN/m)	φ(degree)	γ_s(kN/m3)	S_v（m）	Reinforcement Type	Measured Maximum Lateral Deformations (mm)	Reference
1	6.0	4.3	1.8	--	40	20.1	0.6–1.0	Biaxial geogrid	19.56 (P = 0), 91.44（P = 35 kPa）	Bathurst et al., (1993)
2	4.5	8–12	0.3	157.3	40	22.1	0.4	Uniaxial geogrid	7 (P = 115 kPa), 6 (P = 150 kPa)	Abu-Hejleh, et al., (2002) (Section 200)
3	5.9	8–12	0.3	157.3	40	22.1	0.4	Uniaxial geogrid	9 (P = 115 kPa), 13 (P = 150 kPa)	Abu-Hejleh, et al., (2002) (Section 400)
4	5.9	8–12	0.3	157.3	40	22.1	0.4	Uniaxial geogrid	10 (P = 115 kPa)	Abu-Hejleh, et al., (2002) (Section 800)
5	3.6	2.5	1	20.4	40	16.7	0.6	Biaxial geogrid	5.2 (P = 0), 9.3 (P = 30 kPa), 13.5 (P = 50 kPa), 31.4 (P = 70 kPa)	Hatami. K. and Bathurst (2005) Wall No.1
6	3.6	2.5	1	10.2	40	16.7	0.6	Biaxial geogrid	7.9 (P = 0), 12.0 (P = 30 kPa), 35.0 (P = 50 kPa), 58.4 (P = 70 kPa)	Hatami. K. and Bathurst (2005) and Bathurst (2009) Wall No.2
7	3.6	2.5	1	20.4	40	16.7	0.9	Biaxial geogrid	6.0 (P = 0)	Hatami. K. and Bathurst (2005) Wall No.3
8	3.6	2.5	1	7.3	40	16.7	0.6	Geogrid（PET）	10.5 (P = 30 kPa), 20.3 (P = 50 kPa), 29.6 (P = 70 kPa)	Hatami. K. and Bathurst (2006) and Bathurst (2009) Wall No.5
9	2.0	1.0	1.2	70.0	54	15.9	0.194	Biaxial woven polypropylene geotextiles	4.8(P = 200 kPa) 9.0(P = 400 kPa)	Jennifer E. Nicks (2016) 8–70–8-B

10	0.54	0.378	0.8	12.4	36.1	17.52	0.135	Biaxial geogrid	2.7(P = 100 kPa); 5.94(P = 200 kPa)	Xiao et al., (2013) D/H = 0.3

[1] H = GRS wall height, L = reinforcement length, ε_d = maximum reinforcement strain, T_y = ultimate tensile strength of reinforcement, φ = friction angle of soil, $\boldsymbol{\gamma}_s$ = unit weight of soil, S_v = vertical spacing of reinforcement, P = surcharge load.

Table S3. Measured and predicted maximum lateral deformations of GRS walls.

Case Number	Measured (mm)	Surcharge load (kPa)	Predicted(mm)						
			FHWA (F)	GeoService (G)	CTI (C)	Wu (1)	Wu (2)	Adams (A)	Wang (W)
1	19.56	0	79	38.7	86.4	--	--	--	--
	91.44	35	118.8						
2	7	115	--	18	9.2	19.5	--	14.7	--
	6	150	--						
3	9	115	--	18	12	19.5		28.5	--
	13	150	--						
4	10	115	--	18	12	19.5	--	28.5	--
5	5.2	0	48.8	12.5	24.5	10.4	--	51.4	122.7
	9.3	30	69.2				1.5		
	13.5	50	87.3				2.8		
	31.4	70	110.2				4.1		
6	7.9	0	48.8	12.5	24.5	10.4	--	51.4	122.8
	12.0	30	69.2				2.9		
	35.0	50	87.3				5.6		
	58.4	70	110.2				8.3		
7	6.0	0	48.8	12.5	24.5	10.4	--	51.4	122.7
8	10.5	30	69.2	12.5	24.5	11.6	4.6	51.4	122.9
	20.3	50	87.3				8.7		
	29.6	70	110.2				12.8		
9	4.8	200	409.4	6	16.3	--	--	--	--
	9.0	400	4209.4						
10	2.7	100	23.33	1.5	2.9	5.8	--	--	--
	5.94	200	74.6						

Notes: Wu (1) = the equation can be used for walls with flexible facing because the rigidity of the wall is not considered; Wu (2) = the equation considers the rigidity of the wall facing.

Table S4. Introduction of the yield acceleration.

Method of Calculation	Computing Formula	Annotation
C.C. Huang [34]	$k_c = 0.9797\tan\varphi - 0.1629\frac{B_w}{H} + 0.2012\frac{L}{H} + 0.128\beta - 0.4176 \cdots\cdots d = 0.3m$ $k_c = 0.896\tan\varphi + 0.0741\frac{B_w}{H} + 0.188\frac{L}{H} + 0.1857\beta - 0.4302 \cdots\cdots d = 0.6m$	k_c: threshold acceleration φ: internal friction angle of the backfill soil B_w: width of the wall H: height of the wall L: reinforcement length β: inclination of the wall d: reinforcement spacing
E.Ausilio [30]	$k_y = K\frac{\sin\Omega\sin\beta}{\sin(\beta-\Omega)} - \tan(\Omega-\varphi)$ $\Omega = \tan-1\left\{\frac{\tan\beta[-K\tan\beta\tan\varphi - \tan 2\varphi - 1 + \sqrt{K(\tan^2\varphi+1)(1+\tan\beta\tan\varphi)^2}\,]}{K\tan^2\beta\tan^2\varphi - \tan^2\varphi - 1}\right\}$	k_y: threshold acceleration; Ω: angle between the fracture surface and horizontal surface;

		D_j: reinforcement spacing;γ: unit weight of soil; φ: internal friction angle of the backfill soil K: tension strength value of the reinforcement, $K = \frac{t_j}{\gamma h_j D_j}$; t_j:reinforcement load; h_j: distance between the J-layer reinforcement and wall top
Muni [16]	$k_c = \frac{(1-k_v)\tan\delta_u - 0.5\frac{S_v}{L}\frac{\gamma_b}{\gamma_f}K_a}{(1+\frac{3}{8}\frac{S_v}{L}\frac{\gamma_b}{\gamma_f})}$	k_v: vertical acceleration coefficient; δ_u: friction coefficient of the reinforced soil section; S_v: vertical reinforcement spacing; L: reinforcement length; γ_f: filling weight of the retaining wall panel; K_a: coefficient of the active earth pressure
Cai [15]	$F_{dyn} = \frac{2(a_u + W_W(1+k_v)\tan\lambda_u)}{[0.8\Delta K_{dyn}\cos(\delta-\psi) + (K_a - 0.6\Delta K_{dyn})\cos(\delta-\psi)(\frac{z}{H} - \frac{S_v}{4H}) + k_h\frac{L_w}{H}]}$	F_{dyn}: dynamic safety factor; H: Height of the retaining wall; k_v: vertical acceleration coefficient; k_h: horizontal acceleration coefficient; S_v: module area; ΔK_{dyn}: dynamic soil pressure increment; α_u: minimum shear strength of the interface δ: interface friction angle ψ: angle between the wall back and vertical direction; W_w: panel weight; λ_u: friction coefficient between the modules; K_a: static earth pressure coefficient of the calculated Coulomb earth pressure

Table S5. Calculation method of the horizontal displacement for the retaining wall under earthquake action.

Methods	Fundamental Formula	Annotation	Hypothesis
Richard sand Elms upper bound method [31]	$d = 0.087\frac{v_m^2}{k_m g}\left(\frac{k_c}{k_m}\right)^{-4}$	v_m: horizontal peak velocity;	The landslide is rigid plastic. The peak acceleration and peak velocity are reference factors
Whitman and Liao average licit [32]	$d = 37\frac{v_m^2}{k_m g}exp\left(-9.4\frac{k_c}{k_m}\right)$	k_m: horizontal peak acceleration coefficient;	
Cai and Bathrust average upper bound method [15]	$d = 35\frac{v_m^2}{k_m g}exp\left(-6.91\frac{k_c}{k_m}\right)\left(\frac{k_c}{k_m}\right)^{-0.38}$	k_c: horizontal yield acceleration coefficient	
Newmark upper bound method [33]	$d = 9.2\frac{v_m^2}{k_m g}exp\left(-5.87\frac{k_c}{k_m}\right)\left(\frac{k_c}{k_m}\right)^{-0.49}$		