Annex 4

A4-1 Experimental site classification of German model sites

A4-2 Experimental site classification of strong-motion recording stations in Adana (Ceyhan) province

Table A4-1	Site classification of German model sites

Overview of the different investigated sites

Map of geological subsoil classes within German earthquake regions acc. to DIN 4149 (DIN, 2002)

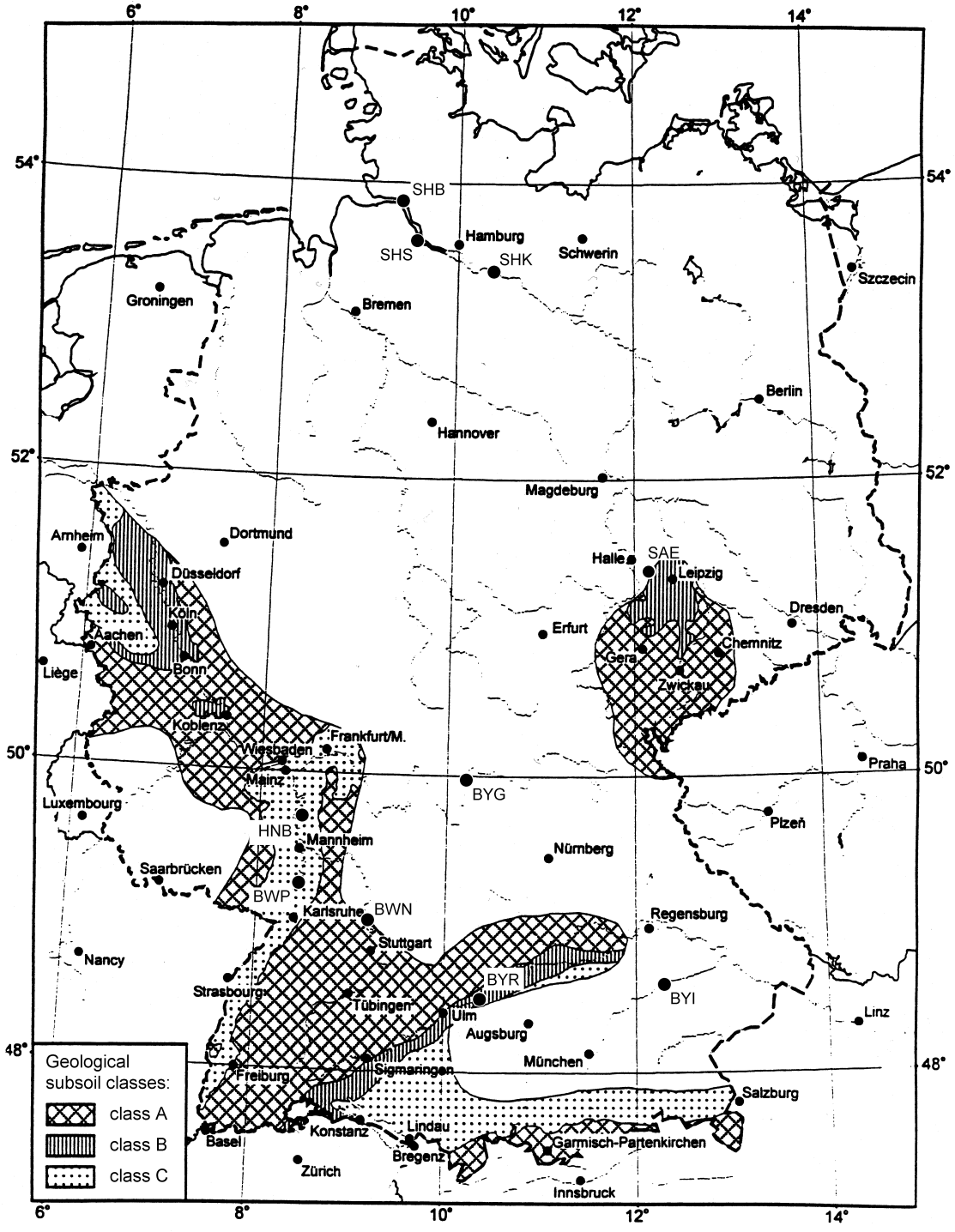


Table A4-1.1	Site classification of German model sites

Investigated site	Northern Baden-Wuerttemberg	*Index*	BWN

Idealized subsoil profile

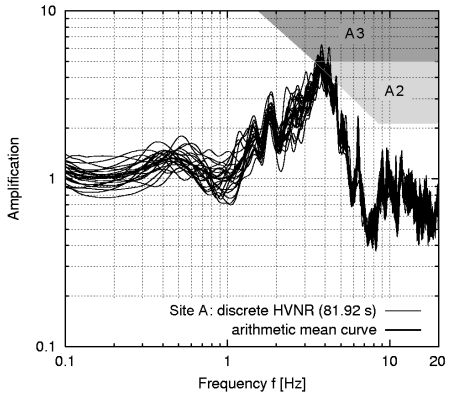
Since parts of the investigated area, which can be esteemed as an outcropping rock site, are overlaid by soft materials (soil layer 1: artificial replenishments) two model sites must be distinguished:

Site A: soft top layer over bedrock (halfspace)
Site B: pure bedrock (outcrop)

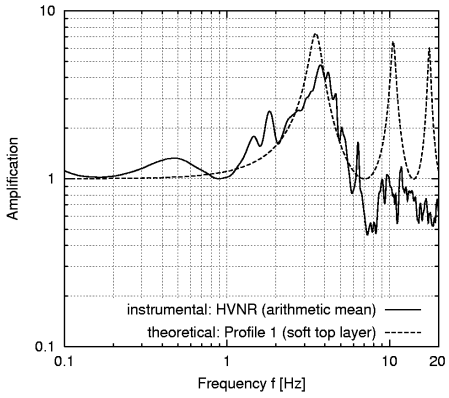
Due to the fact that pure bedrock stations will neither provide a theoretical transfer function nor an instrumental H/V-ratio on microtremors, which are of practical concern, only Site A will be further investigated:

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Soft top layer	18.5	2.00	135	260	-	5.00
	Halfspace	∞	2.70	6075	1500	0.37	5.00

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Site	Available/allocated parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1]	*MESSIAS* [2]
A	260	260	18.5	4.0	moderate/high	A3	A2-A3
B [3]	> 800	> 800	-	-	-	A1	-

[1] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H
[2] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile
[3] solution for "site B"-profile is not illustrated

Table A4-1.2	Site classification of German model sites

Investigated site	Northern Baden-Wuerttemberg	*Index*	BWP

Derived subsoil profiles

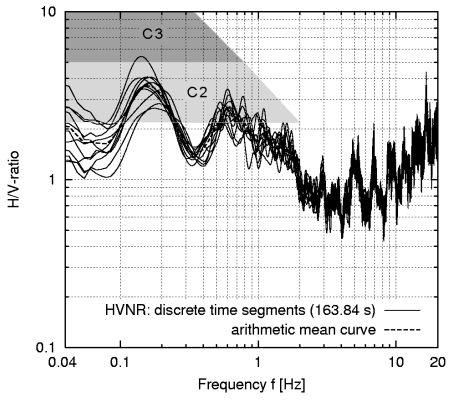
Profile 1 (G_{min}) H = 600 m

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Silty sands and gravels	3.5	1.80	46.1	160	0.44	7.00
2	Gravel, coarse-grained	2.5	1.80	46.1	160	0.21	7.00
3	Sandy gravels, partly with clayey silts (medium dense)	4.0	1.80	46.1	160	0.49	7.00
4	Silty fine to medium-grained	6.0	1.90	48.6	160	0.49	7.00
5	sands, partly with brown coal	14.0	1.90	138.5	270	0.48	7.00
6	or wooden inclusions (dense)	20.0	1.90	171.0	300	0.47	7.00
7	Sands, silts, clays and gravels	*550 (var.)*	1.90	304.0	400	0.45	3.30
	Halfspace	∞	2.70	6075	1500	0.37	0.50

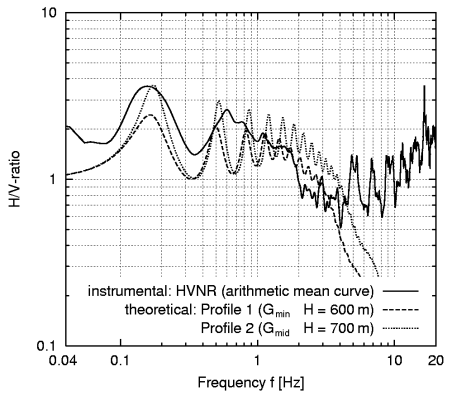
Profile 2 (G_{mid}) H = 700 m

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Silty sands and gravels	3.5	1.80	68.5	195	0.44	5.80
2	Gravel, coarse-grained	2.5	1.80	68.5	195	0.21	5.80
3	Sandy gravels, partly with clayey silts (medium dense)	4.0	1.80	68.5	195	0.49	5.80
4	Silty fine to medium-grained	6.0	1.90	72.2	195	0.49	5.80
5	sands, partly with brown coal	14.0	1.90	194.5	320	0.48	5.80
6	or wooden inclusions (dense)	20.0	1.90	260.1	370	0.47	5.80
7	Sands, silts, clays and gravels	*650.0 (var.)*	1.90	456.2	490	0.45	2.80
	Halfspace	∞	2.70	6075	1500	0.37	0.50

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
1	211	387	*600*	0.15	moderate	C3	C2
2	253	476	*700*			C3	

[1)] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H

[2)] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile

Table A4-1.3	Site classification of German model sites

Investigated site	Northern Bavaria	*Index*	BYG

Derived subsoil profiles

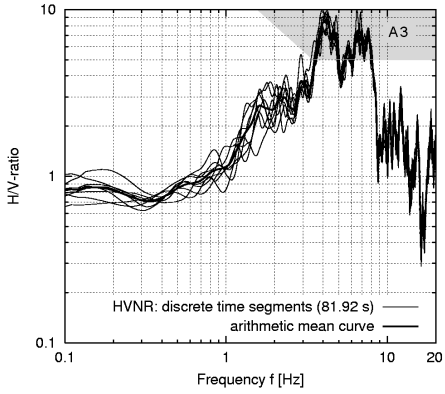
Profile 1 (2-layer-model)

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand, gravelly	7.5	2.10	64.3	175	0.46	5.00
2	Halfspace	∞	2.70	6075	1500	0.37	1.60

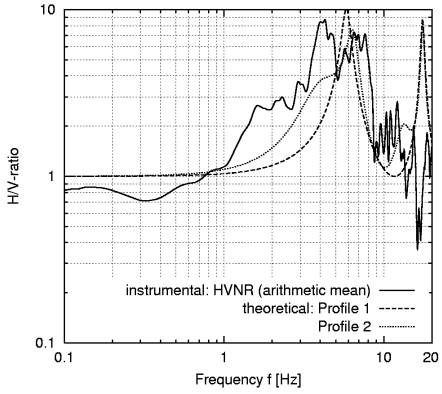
Profile 2 (3-layer-model)

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand, gravelly	7.5	2.10	64.3	175	0.46	5.00
2	Argillaceous rock	50	2.30	1830	890	0.46	2.00
3	Halfspace	∞	2.70	6075	1500	0.37	1.60

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
1	175	175	7.5	4.0-8.0	high	A3	A3
2	175	175	7.5			A3	

[1)] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H

[2)] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile

Table A4-1.4 (cont.) Site classification of German model sites

Investigated site	Southern Bavaria	*Index*	BYI

Derived subsoil profiles

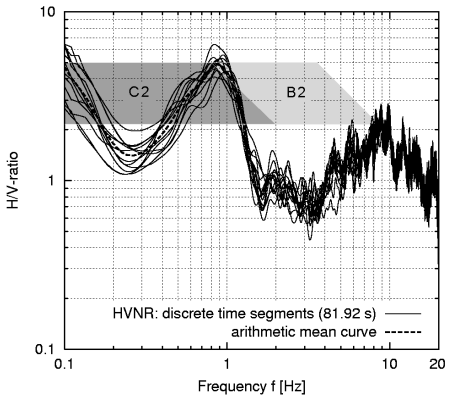
Profile 1 (85% of G_{max} , H = 100 m)

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand, gravelly	6.5	1.90	187	314	0.35	5.0
2	Sand, gravelly/silty	23.0	2.40	581	492	0.35	4.0
3	Fine sand	70.5	2.05	275	366	0.35	5.0
	Halfspace	∞	2.70	6075	1500	0.37	0.5

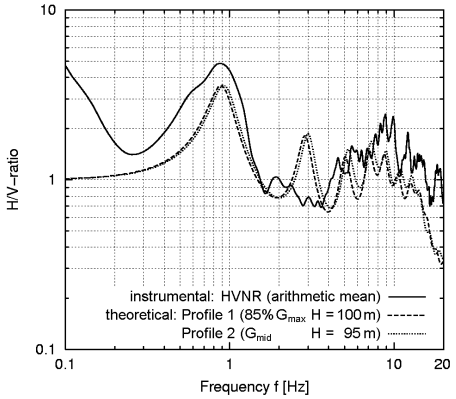
Profile 2 (G_{mid} , H = 95 m)

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand, gravelly	6.5	1.90	160	290	0.35	5.0
2	Sand, gravelly/silty	23.0	2.40	539	474	0.35	4.0
3	Fine sand	65.5	2.05	267	361	0.35	5.0
	Halfspace	∞	2.70	6075	1500	0.37	0.5

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
1	445	392	*100*	0.8-0.9	moderate	B2-C2	B2-C2
2	426	384	*95*		(high)	B2	

[1)] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H

[2)] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile

Table A4-1.5	Site classification of German model sites

Investigated site	Southern Bavaria	*Index*	BYR

Derived subsoil profiles

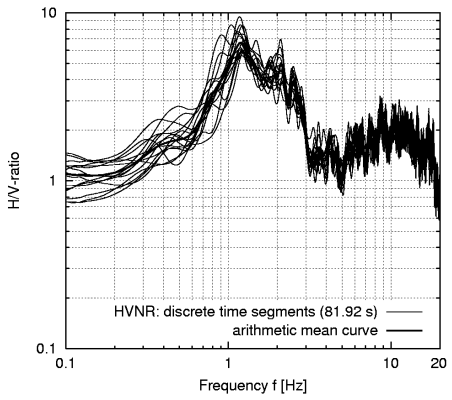
Profile 1 (H = 100m)

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Quaternary alluvium (loose sands, soft clays)	2.5	1.80	141	280	-	5.0
2	Quaternary gravels (sandy, partly silty)	5.0	1.80	221	350	-	3.0
3	Tertiary layers (dense fine-grained sands, stiff clayey to sandy silts, marls and clay marls)	72.5	2.10	388	430	-	2.0
4	Coarse-grained sands	20.0	2.10	546	510	-	2.0
	Halfspace	∞	2.70	6075	1500	0.37	0.25

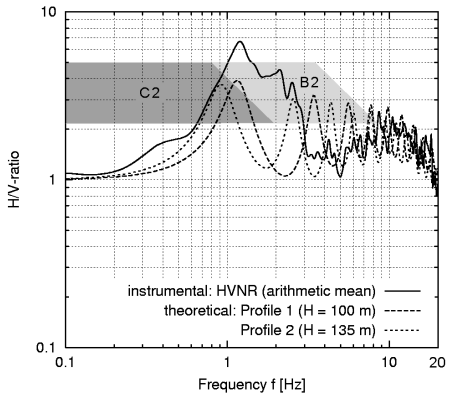
Profile 2 (H = 135m)

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Quaternary alluvium (loose sands, soft clays)	2.5	1.80	141	280	-	5.0
2	Quaternary gravels (sandy, partly silty)	5.0	1.80	221	350	-	3.0
3	Tertiary layers (dense fine-grained sands, stiff clayey to sandy silts, marls and clay marls)	62.5	2.10	388	430	-	2.0
4	Coarse-grained sands	65.0	2.10	546	510	-	2.0
	Halfspace	∞	2.70	6075	1500	0.37	0.25

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
1	404	438	*100*	1.2	moderate (high)	B2-C2	B2 (B3)
2	404	463	*135*			C2	

[1)] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H

[2)] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile

Table A4-1.6	Site classification of German model sites

Investigated site	Hesse	*Index*	HNB

Derived subsoil profiles

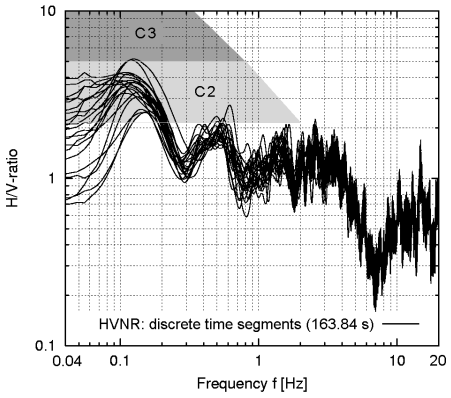
Profile 1

No.	H [m]	d [m]	ρ [t/m³]	v_s [m/s]	ξ [%]
1	-5.5	5.5	1.8	196	5.0
2	-13.0	7.5	2.0	255	2.5
3	-34.5	21.5	2.1	372	1.6
4	-62.0	27.5	2.1	400	1.25
5	-84.0	22	2.1	520	1.0
6	-108	24	2.1	430	0.83
7	-126	18	2.1	600	0.83
8	-200	74	2.1	650	0.83
9	-500	300	2.2	660	0.5
10	-1000	500	2.2	830	0.5
11	-1250	250	2.2	900	0.5
12	-1400	150	2.2	1010	0.5
13	-1500	100	2.2	930	0.5
14	-1600	100	2.2	1050	0.5
15	-1900	300	2.2	1165	0.5
16	-2200	300	2.4	1506	0.5
17	-2590	390	2.2	1360	0.5
18	-3000	410	2.5	1900	0.25
19	> -3000	∞	2.7	2000	0.25

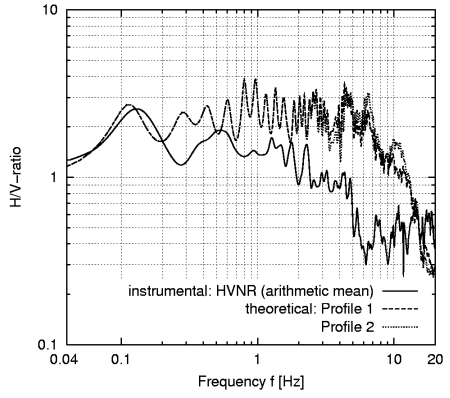
Profile 2

No.	H [m]	d [m]	ρ [t/m³]	v_s [m/s]	ξ [%]
1	-4.0	4	1.8	153	5.0
2	-13.0	9	2.0	280	2.5
3	-21.0	8	2.1	447	1.6
4	-29.0	8	2.1	387	1.6
5	-34.0	5	2.1	298	1.6
6	-62.0	28	2.1	400	1.25
7	-84.0	22	2.1	520	1.0
8	-108	24	2.1	430	0.83
9	-126	18	2.1	600	0.83
10	-200	74	2.1	650	0.83
11	-500	300	2.2	660	0.5
12	-1000	500	2.2	830	0.5
13	-1250	250	2.2	900	0.5
14	-1400	150	2.2	1010	0.5
15	-1500	100	2.2	930	0.5
16	-1600	100	2.2	1050	0.5
17	-1900	300	2.2	1165	0.5
18	-2200	300	2.4	1506	0.5
19	-2590	390	2.2	1360	0.5
20	-3000	410	2.5	1900	0.25
21	> -3000	∞	2.7	2000	0.25

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1]	*MESSIAS* [2]
1	310	-	*>> 500*	0.13	high	C3	C2-C3
2	337	-	*>> 500*		(moderate)	C3	

[1] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H

[2] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile

Table A4-1.7	Site classification of German model sites

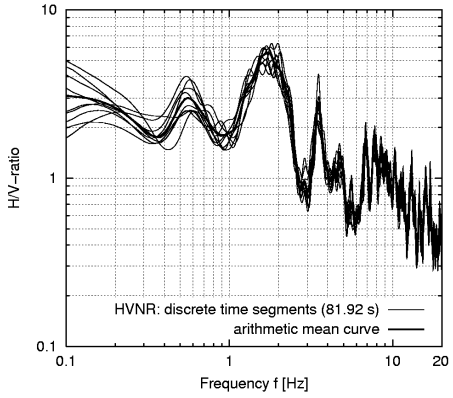
Investigated site	Schleswig-Holstein	*Index*	SHB

Derived subsoil profiles

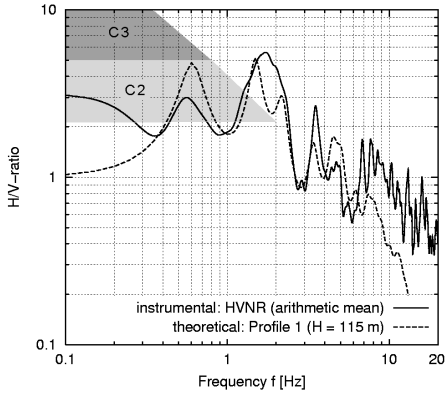
Profile 1 (maximum shear modulus G_{max})

No.	Soil material	d [m]	ρ [t/m³]	G [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand deposits	2.0	1.80	30	129	0.40	8.0
2	Mud and peat	14.0	1.40	10	104	0.49	7.0
3	Sands	7.0	2.10	110	229	0.45	6.0
4	Gravel, sandy	5.5	2.10	220	324	0.45	4.0
5	Micaceous silts	86.5	2.10	150	267	0.49	4.0
	Halfspace	25000	2.70	6075	1500	0.37	0.25

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
1	183	245	*115*	0.5-0.6	moderate	C3	C2-C3

[1)] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H

[2)] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile

Table A4-1.8	Site classification of German model sites

Investigated site	Schleswig-Holstein	*Index*	SHK

Derived subsoil profiles

Profile 1 (minimum shear modulus G_{min}; total thickness of overlying sediments 120 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{min} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Pleistocene sands	7.0	2.1	120	239	0.45	5.0
2	Tertiary muds (brown coal, peat)	2.0	1.4	80	239	0.49	7.0
3	Tertiary sands (fine-grained)	7.0	2.1	120	239	0.45	5.0
4	Tertiary muds (brown coal, peat)	2.0	1.4	80	239	0.49	7.0
5	Tertiary sands (fine-grained)	34.0	2.1	120	239	0.45	3.5
6	Silty sands	68.0	2.1	200	308	0.45	3.5
	Halfspace	∞	2.7	6075	1500	0.37	1.6

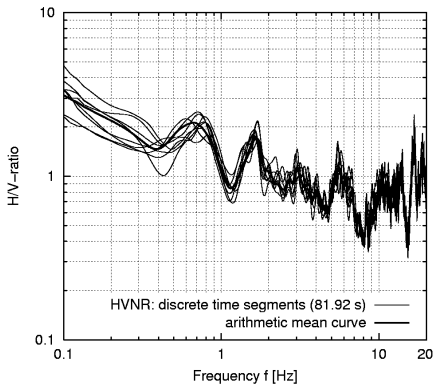
Profile 2 (medium shear modulus G_{mid}; total thickness of overlying sediments 150 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{mid} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Pleistocene sands	7.0	2.1	235	335	0.45	5.0
2	Tertiary muds (brown coal, peat)	2.0	1.4	115	287	0.49	7.0
3	Tertiary sands (fine-grained)	7.0	2.1	235	335	0.45	5.0
4	Tertiary muds (brown coal, peat)	2.0	1.4	115	287	0.49	7.0
5	Tertiary sands (fine-grained)	74.0	2.1	235	335	0.45	3.5
6	Silty sands	58.0	2.1	362	415	0.45	3.5
	Halfspace	∞	2.7	6075	1500	0.37	1.6

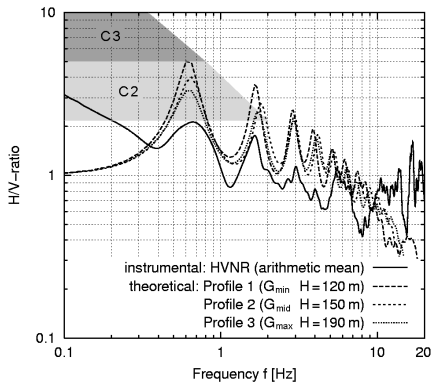
Profile 3 (maximum shear modulus G_{max}; total thickness of overlying sediments 190 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{max} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Pleistocene sands	7.0	2.1	350	408	0.45	5.0
2	Tertiary muds (brown coal, peat)	2.0	1.4	150	327	0.49	7.0
3	Tertiary sands (fine-grained)	7.0	2.1	350	408	0.45	5.0
4	Tertiary muds (brown coal, peat)	2.0	1.4	150	327	0.49	7.0
5	Tertiary sands (fine-grained)	84.0	2.1	350	408	0.45	3.5
6	Silty sands	88.0	2.1	525	500	0.45	3.5
	Halfspace	∞	2.7	6075	1500	0.37	1.6

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
1	239	278	*120*			C3	
2	329	364	*150*	0.6-0.7	moderate	C3	C2
3	397	449	*190*			C2	

Table A4-1.9	Site classification of German model sites

Investigated site	Schleswig-Holstein	*Index*	SHS

Derived subsoil profiles

Profile 1 (maximum shear modulus G_{max}; original layer thicknesses, total: 80 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{max} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand deposits	6.0	1.80	40	150	0.40	8.0
2	Mud, consolidated	2.0	1.60	15	97	0.49	8.0
3	Sand with mud involvements	14.0	1.90	80	205	0.45	6.0
4	Mud, consolidated	2.0	1.70	20	108	0.49	7.0
5	Sand, gravelly	*56.0*	2.10	200	309	0.45	4.0
	Halfspace	∞	2.70	6075	1500	0.37	0.25

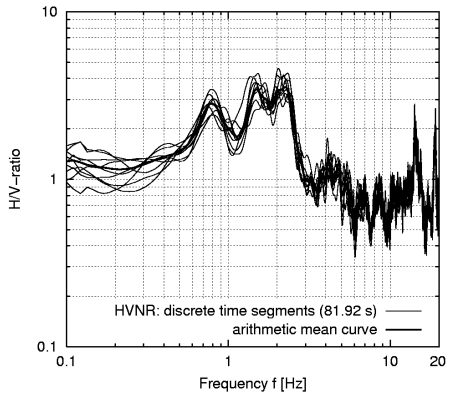
Profile 2 (maximum shear modulus G_{max}; modified thickness of layer 1 and 5, total: 80 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{max} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand deposits	*3.0*	1.80	40	150	0.40	8.0
2	Mud, consolidated	2.0	1.60	15	97	0.49	8.0
3	Sand with mud involvements	14.0	1.90	80	205	0.45	6.0
4	Mud, consolidated	2.0	1.70	20	108	0.49	7.0
5	Sand, gravelly	*59.0*	2.10	200	309	0.45	4.0
	Halfspace	∞	2.70	6075	1500	0.37	0.25

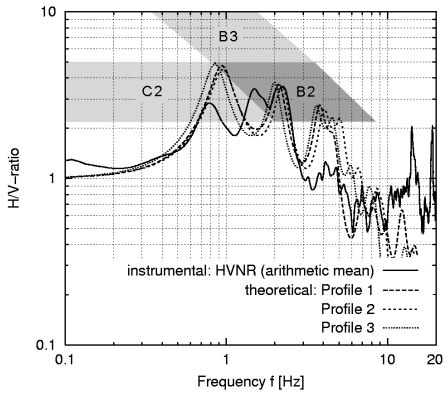
Profile 3 (20% reduced shear modulus $G_{max\text{-}20\%}$; modified thickness of layer 1 and 5, total: 80 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{max}^{*} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Sand deposits	*3.0*	1.80	32	133	0.40	8.0
2	Mud, consolidated	2.0	1.60	12	87	0.49	8.0
3	Sand with mud involvements	14.0	1.90	64	184	0.45	6.0
4	Mud, consolidated	2.0	1.70	16	97	0.49	7.0
5	Sand, gravelly	*59.0*	2.10	160	276	0.45	4.0
	Halfspace	∞	2.70	6075	1500	0.37	0.25

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [4)]	*MESSIAS* [5)]
1	201	304	*80*			B3	
2	217	274	*80*	0.8	moderate (high)	B3	B2-B3
3	194	245	*80*			B3	

Table A4-1.10	Site classification of German model sites

Investigated site	Saxony	*Index*	SAE

Derived subsoil profiles

Profile 1 $v_{s,min}$ (total thickness of sediment layers: 108 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{min} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Quaternary	35	1.80	221	350	0.45	5.0
2	Tertiary	48	1.90	304	400	0.45	5.0
3	Brown coal	8	1.40	68	220	0.49	7.0
4	Tertiary	17	2.00	320	400	0.45	5.0
5	Lower coloured sandstone	13	2.10	3282	1250	0.40	3.0
	Halfspace	∞	2.70	6075	1500	0.37	1.6

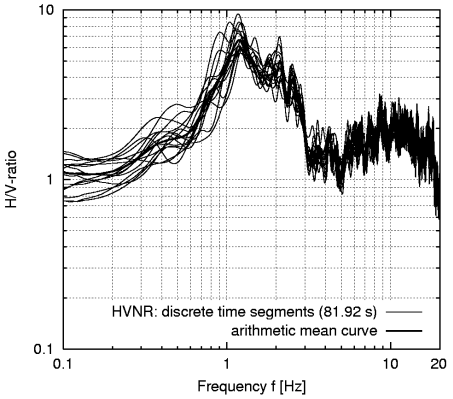
Profile 2 $v_{s,mid}$ (total thickness of sediment layers: 108 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{mid} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Quaternary	35	1.80	253	375	0.45	5.0
2	Tertiary	48	1.90	429	475	0.45	5.0
3	Brown coal	8	1.40	87	250	0.49	7.0
4	Tertiary	17	2.00	451	475	0.45	5.0
5	Lower coloured sandstone	13	2.10	3282	1250	0.40	3.0
	Halfspace	∞	2.70	6075	1500	0.37	1.6

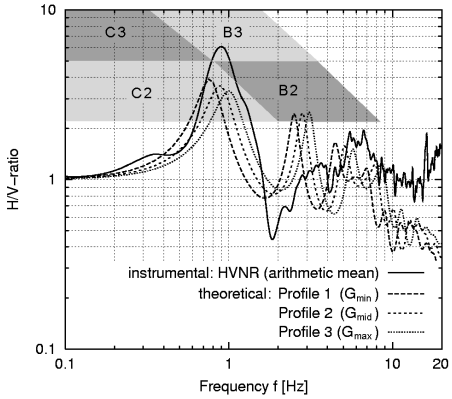
Profile 3 $v_{s,max}$ (total thickness of sediment layers: 108 m)

No.	Soil material	d [m]	ρ [t/m³]	G_{max} [MN/m²]	v_s [m/s]	ν [-]	ξ [%]
1	Quaternary	35	1.80	288	400	0.45	5.0
2	Tertiary	48	1.90	575	550	0.45	5.0
3	Brown coal	8	1.40	110	280	0.49	7.0
4	Tertiary	17	2.00	605	550	0.45	5.0
5	Lower coloured sandstone	13	2.10	3282	1250	0.40	3.0
	Halfspace	∞	2.70	6075	1500	0.37	1.6

Spectral H/V-ratios on microtremors (HVNR)



Theoretical and instrumental transfer functions



Classification of the subsoil

Profile	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
1	350	370	108			C2/C3	
2	375	426	108	0.9	high	C2	B3-C3
3	400	481	108			C2	

Table A4-2	Experimental site classification of strong-motion recording stations

Investigated region/site Adana (Ceyhan), Türkiye, province

Geological situation

The geology of the Adana-Ceyhan Basin is dominated by a Quaternary (recent Holocene) alluvial valley covered by clay and surrounded on the north by the Taurus Mountains (CELEBI, 2000). According to different authors, the geological units of the basin belong to the Upper Cretaceous, Oligo-Miocene, Miocene, Pliocene and Quaternary periods. The rock units of the Upper Cretaceous consisting of tuffs, sandstones, marls, agglomerates, and limestones are located in the south-east of the basin.

The Quaternary deposits of the basin consist of alluvial soils and travertine. Travertine outcrops can be found in the northern part of the basin between the towns Adana and Ceyhan, and also around the Cebelinur mountains in the south-east of the basin. Within the basin deposits of travertine and terrace deposits are also present with increasing thickness up to 30 m to the south.

The plain, fault-bounded Cukurova Basin is traversed by two rivers, the Ceyhan River in the east and the Seyhan River in the west. Both carried Quaternary sediments into the basin, leading to the accumulation of thick unconsolidated alluvial deposits composed of intercalated gravel, sand, silt and clay layers. The materials are generally loosely compacted due to the rapid sedimentation processes. On the basis of borehole investigations, total thickness of unconsolidated materials within the basin vary between 100 and 300 m (ULUSAY *et al.*, 2000).

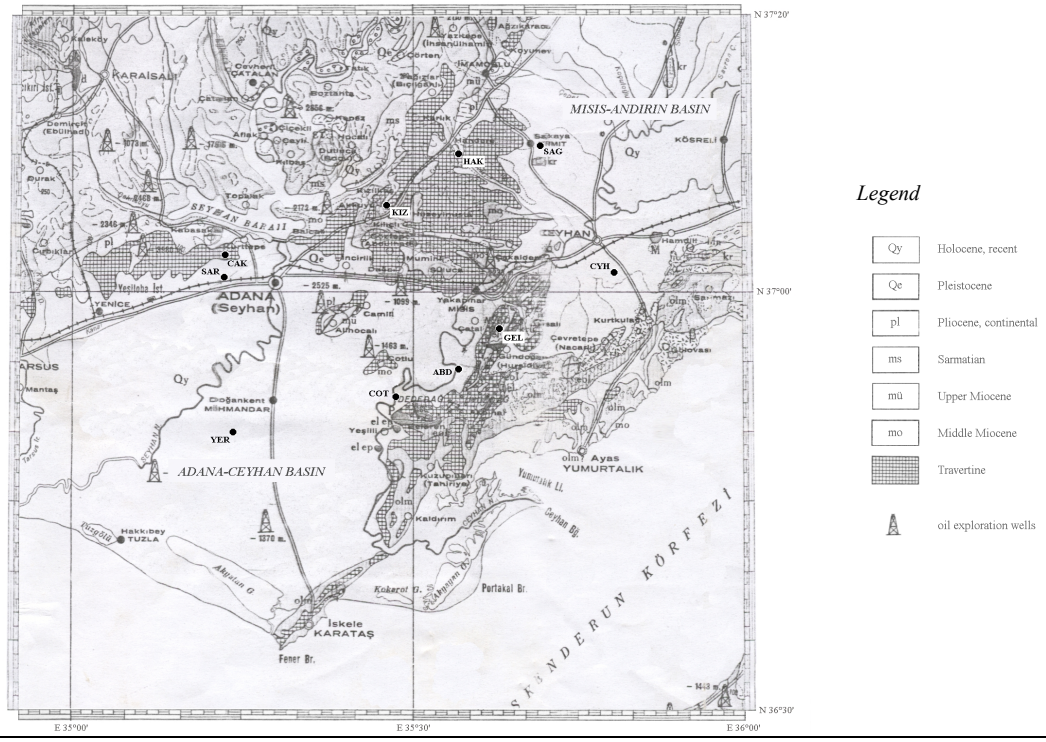
Informations of the recording sites

Station	*Index*	*Geology, topography*	*Damage extent*
Abdioğlu	ABD	eastern margin of Adana Basin at Ceyhan River, recent holocene sediments	heavy damage to all building types
Çakalkuyusu	CAK	north-west of Adana within a hilly landscape, travertine outcropping with thin layer of topsoil	only minor damage to buildings
Cotlu	COT	gentle hill on the southeastern part of Adana Basin, close to Ceyhan River, outcropping rock	only minor damage to buildings
Ceyhan	CYH	quaternary alluvial plain valley covered by clay (Misis-Andirin Basin), below loose gravelly or dense hard alluvium with pockets of (clayey-)sand	heavy damage to 7-10 story RC frame structures (collapse)
Geçitli	GEL	hillside of moderate slope, difficult estimation of geology (possibly sandy gravels)	collapse to fieldstone masonry buildings
Hakkibeyli	HAK	gentle hillside close to surrounding travertine formations, silty clays and gravelly sands visible	damage to adobe masonry buildings
Kizilkaş	KIZ	hilltop, claystone outcrops, surrounded by travertine formations	damage to fieldstone masonry buildings
Sagkaya	SAG	plain alluvial basin of holocene alluvium (Misis-Andirin Basin), sandy gravels visible	collapse of a minaret (reinforced concrete)
Sarihuğlar	SAR	west of Adana on the northern rim of Adana Basin, travertine outcrops with layers of topsoil	only minor damage to buildings
Yerdelen	YER	within the middle of Adana Basin, recent holocene sediments, high level of ground-water	only minor damage to buildings

Table A4-2	Experimental site classification of strong-motion recording stations

Investigated region/site Adana (Ceyhan), Türkiye, province

Geological map with investigated recording sites



Classification of the site/subsoil

Site	Available/*allocated* parameters			Shape of *HVNR*		Site class	
	$v_{s,30}$ [m/s]	$v_{s,av}$ [m/s]	H [m]	f_s [Hz]	*Rel. amplif.*	DIN 4149 [1)]	*MESSIAS* [2)]
ABD	< 350	*289*	*50*	1.5	high	B3	B3
CAK	> 350	*563*	*13.5*	10	moderate	A2	A2
COT	> 800	> 800	-	10	low	A1	A1
CYH	< 800	408	*100.5*	0.5	moderate (high)	C2	C2 (C3)
GEL	> 350	468	*10*	> 10	low (moderate)	A2	A2
HAK	< 350	277	*7*	6	moderate (high)	A3	A2
SAG	> 350	550	*107*	1.5	moderate	C2	B2/C2
SAR	> 350	800	-	> 10	moderate (low)	A1	A1/A2
YER	< 350	437	*50*	1.5	high (moderate)	B3	B3 (B2)

[1)] on the basis of available shear wave-velocities, $v_{s,30}$, and total sedimentary thickness, H

[2)] on the basis of *HVNR* shapes and/or parameters of calibrated subsoil profile

Table A4-2	Experimental site classification of strong-motion recording stations

Investigated region/site Adana (Ceyhan), Türkiye, province

Site response studies at the recording sites

ABD

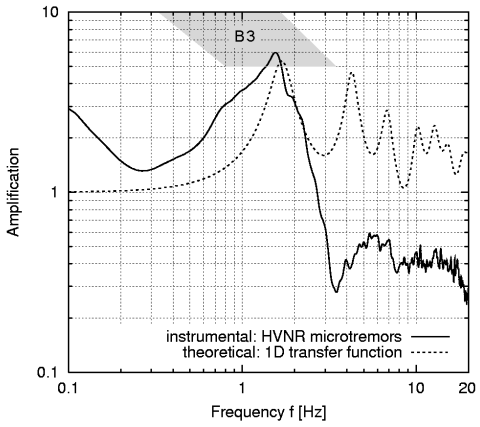
Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	1.0	261	130	river deposits (recent
2	9.5	840	171	holocene alluvium)
3	-	1455	900	

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	1.0	1.80	130		7.0	
2	9.0	1.85	171		6.0	
3	40.0	1.90	350		5.0	
4	10.0	2.10	900		1.5	
5	∞	2.70	1500		0.5	

Transfer functions of the site



CAK

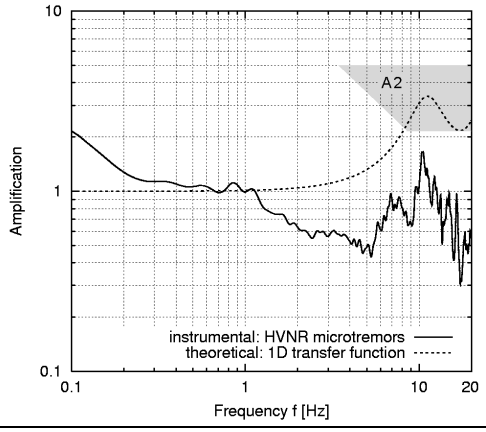
Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	1.0	262	101	topsoil and "caliche"
2	12.5	900	600	(travertine)
3	-	1525	928	

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	1.0	1.80	101		8.0	
2	12.5	2.00	600		5.0	
3	∞	2.70	1500		0.5	

Transfer functions of the site



COT

Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	1.0	250	100	topsoil and
2	12.0	1066	500	"caliche"
3	-	1835	1090	(travertine)

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	5	2.00	800		1.0	
2	∞	2.70	1500		0.5	

- recording station situated on geological outcrop
- soft surface layers are missing

Transfer functions of the site

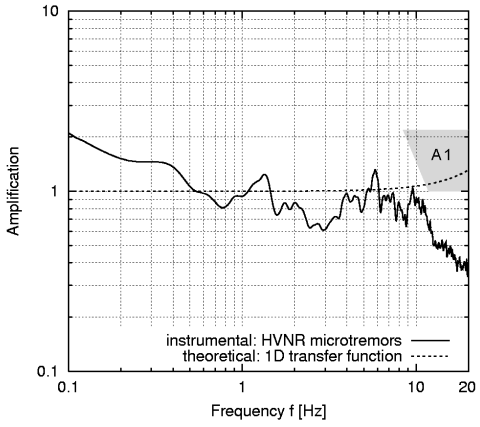


Table A4-2	Experimental site classification of strong-motion recording stations

Investigated region/site Adana (Ceyhan), Türkiye, province

Site response studies at the recording sites

CYH

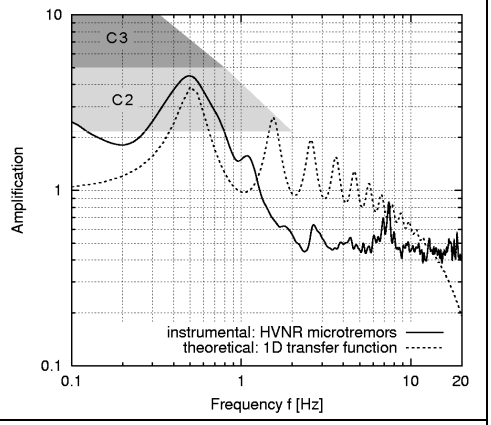
Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	4.5	295	194	river deposits (clay, gravelly/dense alluvium)
2	-	1400	412	

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	4.5	1.8	295		5.0	
2	195	1.9	412		4.0	
3	∞	2.7	1500		0.5	

Transfer functions of the site



Additional subsoil informations

"The thickness [of the alluvial sequence] is about 170 m beneath the town of Ceyhan. The depth of the clayey surface varies between 1 and 6 m. Below the clay, the alluvium is generally loose and gravelly or dense and hard with pockets of sand/clayey sand. (..) the alluvial deposits mainly consist of clayey and silty material, although sandy and gravelly layers are found at shallow depth." (ULUSAY *et al.*, 2000)

"The logs available are about 140 m in depth [at Ceyhan]. A single layer (H = 140m, v_s = 250 m/s) as well as a two layers of depth (H_1 = 80 m, v_{s1} = 200 m/s; H_2 = 60 m, v_{s2} = 300 m/s) are considered." (CELEBI, 2000)

GEL

Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	2.5	242	152	sandy gravels and "caliche" (travertine)
2	7.6	933	572	
3	-	1750	965	

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	2.5	1.80	152		7.0	
2	7.5	1.90	572		4.0	
3	10.0	2.00	965		1.0	
4	∞	2.70	1500		0.5	

Transfer functions of the site

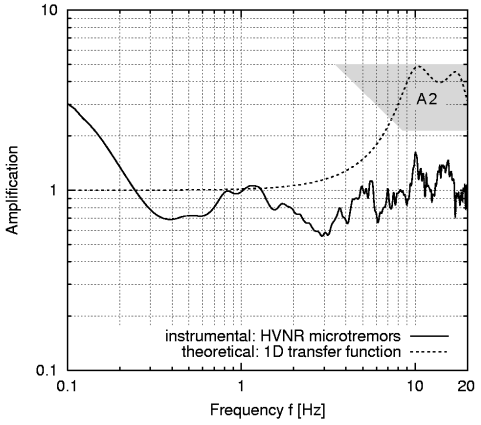


Table A4-2	Experimental site classification of strong-motion recording stations

Investigated region/site Adana (Ceyhan), Türkiye, province

Site response studies at the recording sites

HAK

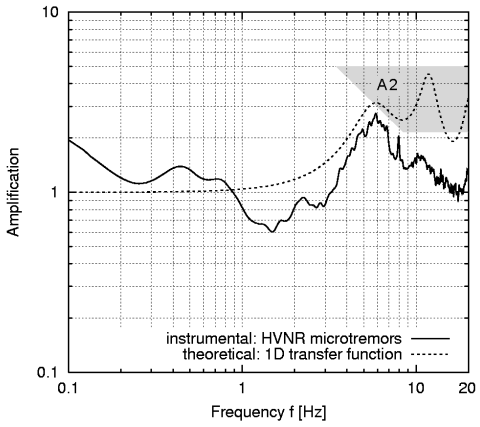
Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	1.0	226	100	silty clays and
2	6.0	815	307	"caliche" (travertine)
3	-	1250	850	

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	1.0	1.80	100		8.0	
2	6.0	1.85	307		6.0	
3	30.0	2.00	850		2.0	
4	∞	2.70	1500		0.5	

Transfer functions of the site



SAG

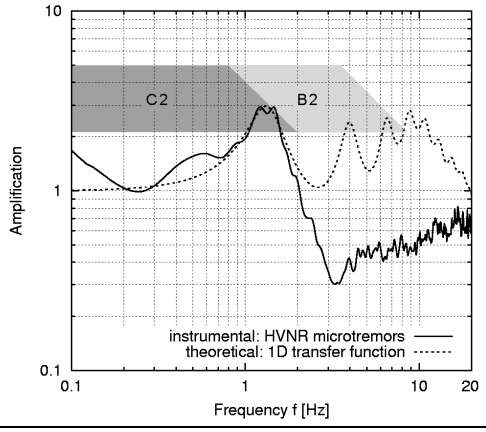
Results of seismic refraction tests

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	2.0	332	111	clayey and sandy
2	5.0	1391	295	gravels
3	-	2000	570	

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	2.0	1.80	111		8.0	
2	5.0	1.85	295		6.0	
3	100.0	1.90	570		5.0	
4	∞	2.70	1500		0.5	

Transfer functions of the site



SAR

Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	1.0	229	138	gravelly to sandy
2	8.0	831	438	clay, "caliche"
3	-	1583	842	(travertine)

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	5.0	2.00	800		1.0	
2	∞	2.70	1500		0.5	

- recording station situated on geological outcrop
- soft surface layers are missing

Transfer functions of the site

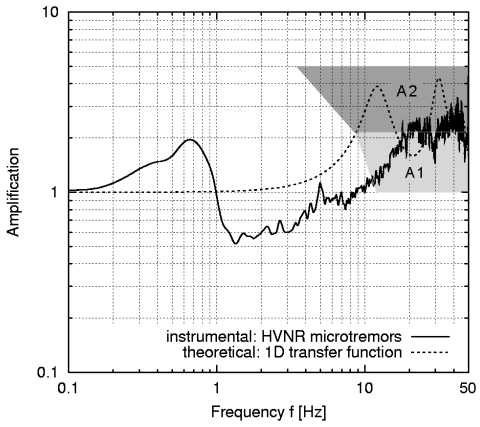


Table A4-2	Experimental site classification of strong-motion recording stations

Investigated region/site Adana (Ceyhan), Türkiye, province

Site response studies at the recording sites

YER

Results of seismic refraction tests (GÜRBÜZ & KURU, 1998)

Layer	*H [m]*	*v_p [m/s]*	*v_s [m/s]*	*Material*
1	2.0	292	109	topsoil and clayey
2	10.0	1235	165	sands (recent
3	-	1482	223	holocene)

Generation of a representative subsoil profile

Layer	*H [m]*	*ρ [t/m³]*	*v_s [m/s]*	*ν [-]*	*D [%]*	*Material*
1	2	1.8	109		8.0	
2	10	1.9	165		6.0	
3	18	2.0	223		5.0	
4	20	2.1	800		2.0	
5	∞	2.7	1500		0.5	

Transfer functions of the site