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INFLUENCED FACTOR OF SITE INFORMATION ON THE ENVIRONMENTAL GROUND

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ABSTRACT

The relationship between "Landform Geology Classification" factor of site information and environmental ground vibration caused by the public transportation in metropolitan was related, and considered.

INTRODUCTION

The phenomenon caused by long-period ground motion that gives the physical or human suffering in our lives, specially attracted to this phenomenon in recent years. Damage or collapse of structures due to long-distance propagation of long-period element of the seismic wave is considered as a natural disaster. Earthquake is a phenomenon that seismic generation mechanism, generate time is does not understand generate, and cannot control it, or the size and behavior that artificially. Many studies have been surface ground amplification characteristics there of generation mechanism is wave propagation path. In addition, researching with concerning prediction, such as damage, many studies have been made by the earthquake. In contrast to natural disaster, heavy damage does not occur in a moment, environmental ground vibration problem afflicts many people over a long period of time in human behavior.
It is classified as pollution, it is a Sensory Pollution that vibration caused by human life and transportation is propagated to the house through the soil, people feel a tremor in the house. Denominated external physical damage, such as cracks and crazy is called Material Pollution. Sensory Pollution has an individual variation of human sense, do not have a direct effect on the human body, and the like. Environmental ground vibration problem is Sensory Pollution, delayed resolution, to further complicate the phenomenon that is preventing the advancement prevention and phenomena.
Therefore, a characteristic of vibration pollution, and the like may be difficult to classify clearly the extent of the problem, the location is local occurrence of complaints. The energy of vibration source is not necessarily large, distance attenuation due to propagation through the ground is large, so the damage is relatively narrow area, with many cases complaints by neighbors is a reality. In this way, and the earthquake that destroys human livings and the many lives momentarily, environmental ground vibration that affects the sense of human for a long time is very different magnitude relationship and its generation mechanism of the vibration source. However, the phenomenon as a medium to transmit to life ground from the vibration source is the same in both.
On the other hand, the factors of the propagation path between base of the seismic wave to measurement position are as follows.
(a) Source characteristic by human lives.
(b) Damping characteristics of the vibration of the geophone position from the vibration source.
(c) Ground characteristics at receiving site.
In this way, the seismic wave is a pathway in the vertical direction throughout to the surface from the seismic center, environmental ground vibration wave should be a pathway of the ground surface shallow in the soil or ground surface, with a large difference between the two there.
In summary environmental ground vibration source, the characteristics of the propagation path and situation at measurement site, as follows.
(1) The source of vibration in the ground or shallow soil depth, wave emitted artificially propagated in the ground.
(2) Repeat the damping and amplification in reflection and absorption at the boundary stratum in the depth direction, is a specific component of the Ground Vibration wave propagate long distances.
Therefore, the magnitude of the environmental ground vibration is also significantly affected ground surface topography and its propagation path. It is necessary to clarify the relationship between geographical features in the

subsurface layer where the influence is large and geological features and the spread level to the spread route characteristic in an artificial vibration source against the background of these. Moreover, the study of the relation between the ground environmental vibration and geographical features and the geological features factor is indispensable to prevent it in addition to prevent occurring ground vibration problem beforehand.

PURPOSE AND METHOD

The vibration source of the environment ground vibration is including many kinds factors, they are caused by the traffic and railroad, and by the industry factory. In this paper, pays attention to the influence of the topography and the geological feature about the characteristic of the propagation pass of the environment ground vibration by the railway traffic at Two Metropolises in Japan, investigates the correlation between vibration level and three factors concerning the ground, as follows.

(a) The factor of the topography and geology feature classification, “Landform Geology Classification”.

(b) The factor of softness on the ground surface, It is concerning the seismic engineering, “Micro-Topography Classification”.

(c) The factor of the coefficient, it is the ratio of vibration levels from base to surfaces, “Base to surface Increment Value”.

Specifically, about a peak vibration level, analyzed each item, as follows.

(a) “Landform Geology Classification”, it is a relationship with the topography and the geological feature classification that judged than a past paper japan26),

(b) “Micro-Topography Classification”, it is classified in “Japan Engineering tremble Classification Map on the ground surface” by the Ministry prevention conference.

(c) “Base to surface Increment Value”, it is ditto.

And analyzed the factor that influences the vibration level specify.

The vibration level is added to the classification map that is filled address on the "Information on the surface ground", it is showed on internet in the past, and methods of analysis were compared site information and the vibration level. These information were treated as "Site information", and the relation to the vibration level was clarified. The map data was retrieved from the railway to 12.5m or the value of 25.0m position the vibration level in the address. Therefore, some error margins are included in the plot position.

About “Landform Geology Classification”, Geographical features and the geological classification were divided into the alluvial plain and the diluvial plateau, first. In more detail, the alluvial plain was classified into five kinds "Low-plain near the plateau and the hill", "Natural embankment", "Old river", "Buried valley", and "Low plain". And diluvial plateau classified into three kinds "Plateau hill", "Edge of the plateau", and "The valley lowland on the hill of the plateau". Landform Geology Classification is related with the vibration level about detail classification.

“Micro-Topography Classification” is classified into 16 kinds about the index of "soft to-stiff", most softest division is "Delta and back marsh from the river of 0.5 km or less", and hardest one is "Palaeozoic Era". The route map was displayed on the air photograph of Google Earth, each vibration level of measured point was classified by color, more specific. In addition, it overlapped with “National 1km mesh Map” of “Japan Engineering Tremble Classification Map on the ground surface”, it is classified by the micro-topography, and each lapped color was compared.

In large classification of the color is two kinds, the alluvium color was shown in the warm one, and diluvium color was shown in the cold one.

The physiographic division is shown in the order of "Soft to Hard" in “Japan Engineering tremble Classification Map on the ground surface”. However, the code number for the micro-topography to "Palaeozoic Era to Reclaimed fill" is put according to "It is a coefficient table of the Shear wave velocity (AVS30) shallower than 30m depth" of each micro-topography division classified by the Ministry prevention conference.

In this paper, after the code number for the micro-topography classification had been made a sign, it was shown to the table in large the order. However, because the comparison of site information concerning the landform geology classification are important softness of ground, and the micro-topography classification was arranged from soft to hard one.

Finally, the base to surface Increment value in “Japan Engineering tremble Classification Map on the ground surface” was related to the vibration level. The tremble easily index value was divided into seven stages. An index of "1.0-1.65" assumes most incremental value, and an index of "-0.95-0.0" is tremble not easily. The magnitude correlation of “Base to surface Increment Value” and vibration level was verified. “Base to surface Increment Value” is ratio of the inclement value on the ground to the seismic basement, and it find the easily shakes ground on the subsurface by the large value. Coloring and the arrangement of color were assumed to be similar to map of the tremble. Therefore, the vibration level was compared with site information on “Landform Geology Classification”, “Micro-topography classification”, and “Base to surface increment value”, and site information that influenced the ground environmental vibration was specified.

ENVIRONMETAL GROUND VIBRATION AND SITE INFORMATION

The geographical and the geological features factor is correlated with the vibration level, as follows data. First, railway noise and vibration investigation result of actual conditions report "Railway noise vibration investigation of actual conditions report" of 58 points that is result of the survey in Osaka Prefecture by "Osaka Prefectural Government environmental Bureau" brought together from 2001 to 2003. In addition, another one is "Railway noise and vibration investigation report" of 120 points that is the follow-up survey result brought together in Tokyo Environment Bureau until three years from 2003 to 2005.

The relationship results were analyzed. “Landform Geology Factors”, “Micro-topography Classification”, and “Base to surface Increment Value” were classified with the vibration level. However, the difference between the track structure, the transport speed, and the high-speed train or local line railway is not considered to site information.

SITE INFORMATION AND CONSIDERRATION IN OSAKA PREFECTURE

The data of the Osaka Prefecture traffic pollution section has not extracted the complaint part. The vibration level is the mean value at the peak vibration level in 12.5m from a railway. In Osaka Prefecture, the situation of the environmental ground vibration of the railway neighborhood of three years in the main route in eight company 22 routes, Landform Geology Classification, Micro-topography Classification, and Base to surface Increment Value are shown in Table 1.

(a) Landform Geology Classification and vibration level.

Figure 1 shows a colored classification of Landform Geology classification of all measurement point. Figure 2 shows a colored classification by 5dB pitch, the vibration level of the measurement point that is divided by every 5dB. The vibration measurement result of showing in Table 1 is divided into the alluvium and the diluvium, and the number of measurement points in which the vibration level in the various point with the Landform Geology Classification is divided by every 5dB is shown in Table 2.

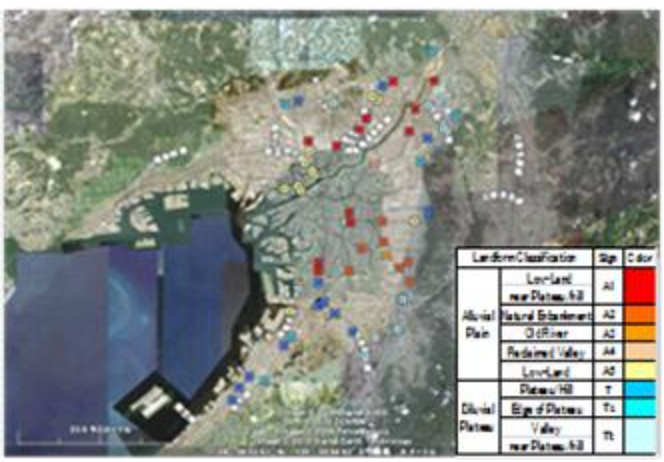

Fig. 1. Landform Geology Classification

(b) Relationship between micro-topography classification and vibration level.

Figure 3 shows the vibration level classified by every 5dB in the micro-topography classification that is souse of “Japan Engineering tremble Classification Map on the ground surface” had classified. Table 3 showed the number of measurement points within the range of the vibration level of each micro-topography classification.

(c) Relationship between the tremble easy and vibration level on surface layer

The vibration level of each measurement point is colored every 5dB, the base to surface increment value that is the index of easiness to tremble is classified, and lapped over to “Japan Engineering Tremble Classification Map on the ground surface” is shown in Figure 4. Table 4 shows the number of points of the classified increment value and measured vibration level area.

Fig. 2. Vibration Level

Table.2 Landform Geology Classification and vibration area

Landform Classification		色 (Vibration(dB))	60 over	55~59	50~54	50 under	Total
Alluvial Plain	Low-Land near Plateau/hill	A1	4	7	1	0	12
	Natural Enbankment	A2	0	4	2	1	7
	Old River	A3	0	1	0	0	1
	Reclaimed Valley	A4	1	0	0	0	1
	Low-Land	A5	0	5	3	3	11
Total			5	17	6	4	32

Landform Classification		色 (Vibration(dB))	60 over	55~59	50~54	50 under	Total
Diluvial Plateau	Plateau/Hill	T	0	1	8	4	13
	Edge of Plateau	Tc	0	6	0	0	6
	Valley near Plateau/hill	Tt	0	2	4	1	7
Total			0	9	12	5	23

Table 3 Number of measurement point and Micro-topography

Micro-Topography	Color (Vibration(dB))	60 over	55~59	50~54	50 under	Total
Delta Marsh D≦0.5Km		4	2	2	1	9
Sandbank/Sand hill		0	1	0	0	1
Natural Enbankment		0	10	2	3	15
Artificial Ground		0	0	2	1	3
Delta Marsh D>0.5Km		1	5	4	1	11
Sand Gravel Plateau		0	3	2	2	7
Alluvial Fan		0	5	5	1	11
Mesozonic Era		0	0	1	0	1
Total		5	26	18	9	58

Table.1 Measurement Result and Site Information in Osaka (2001-2003)

V.L	Num	Year	Adress	Alluvial Plain					Diluvial Prateau			Velocity	Micro-Topography Classification		Base to surface Increment	
dB	No.			A1	A2	A3	A4	A5	T	To	Tt	(km/h)	Sign	Geologic	Sign	Increment Value
64	10	2001	Ibaraki city	○								95.6	R-16	Delta marsh D≦0.5	②	0.8~10
63	8	2001	Neyagawa city	○								75.1	R-16	Delta marsh D≦0.5	④	0.4~0.6
61	11	2001	Settsu city	○								92.8	R-16	Delta marsh D≦0.5	④	0.4~0.6
60	9	2001	Hirakata city	○								67.8	R-16	Delta marsh D≦0.5	②	0.8~10
60	A4	2002	Moriguchi city				○					71.4	R-15	Delta marsh D > 0.5	③	0.6~0.8
59	21	2002	Sakai city					○				77.8	R-14	Natural Enbankment	④	0.4~0.6
59	50	2003	Takaishi city							○		85.1	R-11	Alluvial Fan	④	0.4~0.6
59	13	2001	Yodogawa ward					○				73.8	R-15	Delta marsh D > 0.5	②	0.8~10
59	7	2001	Hirakata city	○								70.2	R-11	Alluvial Fan	④	0.4~0.6
59	47	2003	Katano city							○		86.1	R-11	Alluvial Fan	④	0.4~0.6
59	–	2002	Ikuno ward	○								73.0	R-14	Natural Enbankment	②	0.8~10
58	A3 45	2003	Yao city			○						75.4	R-14	Natural Enbankment	③	0.6~0.8
58	–	2002	Takatsuki city	○								92.5	R-16	Delta marsh D≦0.5	②	0.8~10
58	49	2003	Sijyou-nawate city							○		89.0	R-11	Alluvial Fan	④	0.4~0.6
58	19	2002	Tonda-bayashi city								○	80.8	R-09	Sand Gravel Plateau	②	0.8~10
58	18	2002	Kashiwara city		○							87.8	R-14	Natural Enbankment	③	0.6~0.8
58	–	2002	Suminoe ward	○								73.6	R-12	Sandbank/Sand Hill	④	0.4~0.6
57	15	2001	Yodogawa ward					○				84.3	R-15	Delta marsh D > 0.5	②	0.8~10
57	46	2003	Hirano ward		○							80.7	R-14	Natural Enbankment	③	0.6~0.8
57	–	2002	Shimamoto town							○		101.6	R-15	Delta marsh D > 0.5	②	0.8~10
57	33	2002	Suminoe ward	○								35.5	R-14	Natural Enbankment	④	0.4~0.6
57	32	2002	Higashinari ward	○								57.8	R-14	Natural Enbankment	②	0.8~10
57	34	2003	Higashi-Osaka city		○							68.9	R-16	Delta marsh D≦0.5	③	0.6~0.8
56	23	2002	Sayama city								○	70.3	R-09	Sand Gravel Plateau	④	0.4~0.6
56	44	2003	Yao city		○							90.4	R-14	Natural Enbankment	③	0.6~0.8
56	29	2002	Kaizuka city						○			82.3	R-15	Delta marsh D > 0.5	④	0.4~0.6
56	24	2002	Suita city	○								61.5	R-14	Natural Enbankment	④	0.4~0.6
56	38	2003	Ikeda city							○		84.4	R-11	Alluvial Fan	④	0.4~0.6
55	52	2003	Kishiwada city							○		86.9	R-09	Sand Gravel Plateau	④	0.4~0.6
55	40	2003	Toyonaka city					○				70.2	R-14	Natural Enbankment	②	0.8~10
55	42	2003	Nishiyodogaw ward					○				91.2	R-15	Delta marsh D > 0.5	③	0.6~0.8
54	30	2002	Sakai city						○			73.2	R-09	Sand Gravel Plateau	④	0.4~0.6
54	51	2003	Izumi city						○			87.0	R-11	Alluvial Fan	④	0.4~0.6
54	25	2002	Suita city								○	71.2	R-17	Artificial Ground	③	0.6~0.8
54	27	2002	Hirakata city								○	60.1	R-17	Artificial Ground	④	0.4~0.6
53	–	2003	Takatsuki city						○			97.1	R-09	Sand Gravel Plateau	④	0.4~0.6
53	41	2003	Minou city						○			69.2	R-14	Natural Enbankment	④	0.4~0.6
53	43	2003	Nishiyodogaw ward					○				82.0	R-16	Delta marsh D≦0.5	③	0.6~0.8
53	14	2001	Toyonaka city					○				85.2	R-15	Delta marsh D > 0.5	③	0.6~0.8
53	12	2001	Ibaraki city					○				55.1	R-11	Alluvial Fan	④	0.4~0.6
52	16	2002	Yao city		○							77.2	R-14	Natural Enbankment	②	0.8~10
52	26	2002	Katano city								○	76.1	R-11	Alluvial Fan	④	0.4~0.6
52	39	2003	Toyonaka city	○								51.2	R-15	Delta marsh D > 0.5	④	0.4~0.6
52	6	2001	Higashi-sumiyoshi ward		○							87.7	R-16	Delta marsh D≦0.5	④	0.4~0.6
52	31	2002	Ikuno ward								○	60.3	R-15	Delta marsh D > 0.5	③	0.6~0.8
51	3	2001	Sakai city						○			78.2	R-11	Alluvial Fan	④	0.4~0.6
51	37	2003	Kishiwada city						○			66.9	R-11	Alluvial Fan	④	0.4~0.6
51	20	2002	Kishiwada city						○			71.8	R-15	Delta marsh D > 0.5	②	0.8~10
50	36	2003	Higashi-Osaka city						○			63.7	R-04	Messozonic Fan	⑥	0~0.2
49	17	2002	Yao city		○							75.8	R-14	Natural Enbankment	③	0.6~0.8
49	48	2003	Neyagawa city						○			62.0	R-17	Artificial Ground	③	0.6~0.8
48	–	2002	Ibaraki city					○				91.8	R-11	Alluvial Fan	②	0.8~10
48	53	2003	Sakai city						○			66.9	R-09	Sand Gravel Plateau	④	0.4~0.6
48	28	2002	Nishiyodogaw ward					○				68.4	R-16	Delta marsh D≦0.5	③	0.6~0.8
48	35	2003	Higashi-Osaka city					○				72.6	R-14	Natural Enbankment	③	0.6~0.8
47	2	2001	Sakai city						○			65.9	R-09	Sand Gravel Plateau	④	0.4~0.6
47	22	2002	Sakai city						○			72.5	R-15	Delta marsh D > 0.5	②	0.8~10
47	4	2001	Fujiitera city								○	67.5	R-14	Natural Enbankment	③	0.6~0.8

Landform Geology Classification

Sign	Landform Geology Classification	
A1:	Lowland near Plateau/Hill	12
A2:	Natural Enbankment	7
A3:	Old Liver	1
A4:	Reclimed Valley	1
A5:	Low-Land	11
T:	Plateau/Hill	13
To:	Edge of Plateau	6
Tt:	Valley Low-Land	7
	Total	58

Micro-Topography Classification

Sign	icro-Topography Classificatio	Number
R-21:	Volcano	-
R-18:	Reclimed Ground	-
R-17:	Artificical Ground	3
R-16:	Delta marsh D≦0.5	9
R-15:	Delta marsh D > 0.5	11
R-14:	Natural Enbankment	15
R-13:	Valley Bottom Plane	-
R-12:	Sandbank/Sand hill	1
R-11:	Alluvial Fan	11
R-10:	Loam Plateau	-
R-09:	Sand Gravel Plateau	7
R-08:	Hill Plateau	-
R-07:	Other	-
R-06:	Therd Cenozic Era	-
R-05:	Mesozonic Era	-
R-04:	Palaeozonic Era	1
D: Distance from River(km)	Total	58

Micro-Topography Classification

Increment Value	Sign	Number
1.0~1.65	①	-
0.8~1.0	②	14
0.6~0.8	③	16
0.4~0.6	④	27
0.2~0.4	⑤	-
0~0.2	⑥	1
-0.95~0	⑦	-
	Total	58

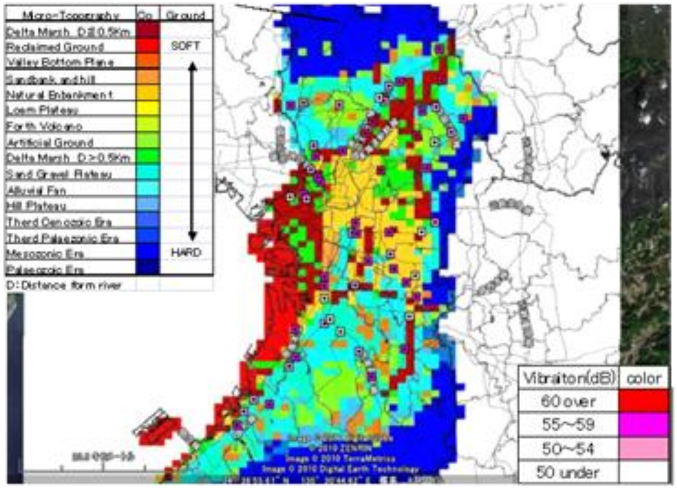

Fig.3 Relationship between Micro-topography Classification and Vibration Level

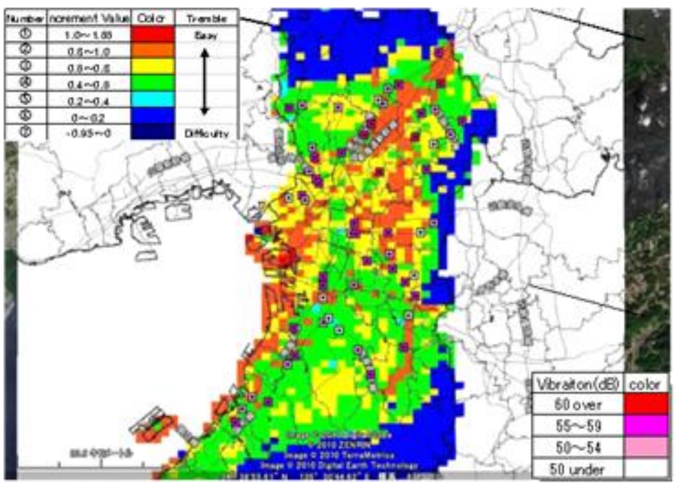

Fig.4 Surface Increment Value and Vibration Level

Table 4 Increment value and vibration level area

Vibration (dB)		60 over	55～59	50～54	50 under	Total
Increment Value	Color					
①1.0～1.65		0	0	0	0	0
②0.8～1.0		2	8	2	2	14
③0.6～0.8		1	6	4	5	16
④0.4～0.6		2	12	11	2	27
⑤0.2～0.4		0	0	0	0	0
⑥0～0.2		0	0	1	0	1
⑦-0.95～0		0	0	0	0	0
Total		5	26	18	9	58

SITE INFORMATION AND CONSIDERRATION IN TOKYO

Tokyo Environment bureau did the noise and vibration investigation. Measurement objectives were to have understood the achievement situation with the noise and the vibration by Shinkansen to the guideline value of environmental standards by "Environmental standards of Shinkansen noises" (No.46 of the Environment Agency notification in 1975), and "Shinkansen vibration measures that required on environmental preservation in emergency" (Director-General of the Environment Agency recommendation on March 12, 1976). Moreover, it investigated to understand the situation and a change with the time of the noise and vibration of the local line in Tokyo, and "Railway noise and vibration investigation report" was brought together. The investigation place was made a place that had a few influence from the surrounding, and to be able to investigate every year. Tokaido Shinkansen investigates is 11 places (33 data), Tohoku Shinkansen is 25 places (75 data), and local line is in 4 places (12 data). However, it was not searchable in all parts every year in the same point consequentially.

Basically, measured point is far away to 25m point that was not able to be measured though it measured from the track center in the direction of the perpendicular in 12.5m point. The peak level of 20 trains or more continuously passed was measured. The evaluation indicates a peak level half of high ranks values about the Shinkansen, and uses the mean value at the peak levels of all numbers about local line. The data of Tokyo was analyzed as well as Osaka Prefecture. The difference point is as follows.

(a) The Shinkansen must be included in the data of Tokyo.

(b) The method of evaluating data must be different with local line.

(c) Data from the railway to 25m position must be included in part.

(d) Monolail traffic data is included only by two place.

Table 5 shows 120 data concerning the relation between the situation, Landform Geology Classification, Micro-Topography Classification, and Base to surface Increment Value. A blue point in a address showed the place that was able to be measured for 3 years at the same position continuity, and correspondence * sign of Landform Geology Classification showed the data of 2005 degrees in blue, 2004 in red and 2003 in black. Moreover, the distance from the railway to the measurement point by blue is 25m away in the result of Shinkansen.

(a) Relationship between Landform Geology Classification and vibration level

The one that Landform Geology Classification of each measurement point was classified is shown in Figure 5, the vibration level that is classified into unit 5dB is shown in Figure 6. Table 6 shows data that classified the data of showing in Table 5 into the alluvial plain and the diluvial plateau. Each table showed the number of measurement points that corresponded to the vibration level in every 5dB. In alluvial plain, all is 39 points, the most a lot of 60dB or more is 6 points, and 15 points is less than 50dB. In diluvial plateau, all is 81 points, and the level of 60 dB or more is 14 points, and 67 points is less than 60dB. The number of points in which 60dB or more is equal by about 1/6 whole, by compared with each ground classification.

As for Landform Geology Classification, the point of 60dB or more is ""Low-plain near the plateau and the hill" and “Low plain” in alluvial plain. The measurement points in "Hill or

Table.5 Measurement Result and Site Information in Tokyo (2003-2005)

V.L dB	Num No.	Year	Adress	Shinkansen or Local Line	Alluvial Plain A1	A2	A3	A4	A5	Diluvial Plateau T	To	Tt	Velocity (km/h)	Micro-Topography Classification Sign	Geologic	Base to surface increment Sign	Increment Value
66	16	2003	Kodaira city	Local Line								○	57.0	R-10	Loam Plateau	[illegible]	0.4~0.6
65	17	2005	Kodaira city	Local Line						○			69.0	R-10	Loam Plateau	[illegible]	0.4~0.6
64	10	2003	Meguro ward	Local Line						○			94.0	R-10	Loam Plateau	[illegible]	0.6~0.8
63	15	2003	Machida city	Local Line						○			82.0	R-10	Loam Plateau	[illegible]	0.4~0.6
63	3	2005	Kita ward	Local Line								○	78.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
63	4	2005	Kunitachi city	Local Line							○		72.0	R-10	Loam Plateau	[illegible]	0.6~0.8
63	20	2005	Koutou ward	Local Line					○				51.0	R-15	Delta marsh D > 0.5	[illegible]	1.0~1.68
62	SHin11	2003	Oota ward	Shin(Tokai)	○								117.0	R-10	Loam Plateau	[illegible]	0.6~0.8
62	17	2003	Nerima ward	Local Line						○			41.0	R-10	Loam Plateau	[illegible]	0.4~0.6
62	21	2003	Katsushika ward	Local Line					○				65.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
62	SHin01	2004	Minato ward	Shin(Tokai)					○				82.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
62	SHin04	2004	Oota ward	Shin(Tokai)							○		107.0	R-10	Loam Plateau	[illegible]	0.4~0.6
62	13	2005	Fuchuu city	Local Line						○			75.0	R-17	Artificial ground	[illegible]	0.6~0.8
62	19	2005	Itabashi ward	Local Line						○			61.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
61	2	2004	Oota ward	Local Line							○		88.0	R-10	Loam Plateau	[illegible]	0.4~0.6
61	5	2004	Hino city	Local Line							○		91.0	R-10	Loam Plateau	[illegible]	0.4~0.6
60	5	2003	Kita ward	Local Line	○								76.0	R-10	Loam Plateau	[illegible]	0.8~1.0
60	6	2003	Kunitachi city	Local Line						○			70.0	R-10	Loam Plateau	[illegible]	0.4~0.6
60	6	2004	Kita ward	Local Line							○		78.0	R-15	Delta marsh D > 0.5	[illegible]	0.4~0.6
60	SHin11	2005	Oota ward	Shin(Tokai)	○								111.0	R-10	Loam Plateau	[illegible]	0.6~0.8
59	SHin02	2003	Oota ward	Shin(Tokai)							○		108.0	R-10	Loam Plateau	[illegible]	0.4~0.6
59	3	2003	Kita ward	Local Line								○	62.0	R-10	Loam Plateau	[illegible]	0.6~0.8
59	7	2003	Akiruno city	Local Line						○			75.0	R-10	Loam Plateau	[illegible]	0.4~0.6
59	12	2003	Oota ward	Local Line	○								73.0	R-11	Alluvial Fan	[illegible]	0.4~0.6
59	4	2004	Nakano ward	Local Line						○			83.0	R-10	Loam Plateau	[illegible]	0.4~0.6
59	15	2004	Machida city	Local Line						○			84.0	R-12	Valley Bottom Plane	[illegible]	0.4~0.6
59	22	2004	Itabashi ward	Local Line						○			72.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
59	15	2005	Tama city	Local Line						○			41.0	R-17	Artificial ground	[illegible]	0.6~0.8
58	SHin11	2004	Oota ward	Shin(Tokai)	○								108.0	R-10	Loam Plateau	[illegible]	0.6~0.8
58	16	2004	Setagaya ward	Local Line							○		88.0	R-10	Loam Plateau	[illegible]	0.4~0.6
58	2	2005	Adachi ward	Local Line		○							87.0	R-14	Natural Embankment	[illegible]	0.8~1.0
57	11	2003	Setagaya ward	Local Line						○			66.0	R-10	Loam Plateau	[illegible]	0.4~0.6
57	12	2003	Setagaya ward	Local Line						○			67.0	R-10	Loam Plateau	[illegible]	0.4~0.6
57	1	2004	Oota ward	Local Line					○				89.0	R-15	Delta marsh D > 0.5	[illegible]	0.8~1.0
57	17	2004	Musashino city	Local Line						○			37.0	R-10	Loam Plateau	[illegible]	0.4~0.6
57	13	2005	Hachioji city	Local Line						○			74.0	R-17	Artificial ground	[illegible]	0.6~0.8
56	3	2004	Meguro ward	Local Line								○	66.0	R-10	Loam Plateau	[illegible]	0.6~0.8
56	6	2005	Hamura city	Local Line						○			71.0	R-10	Loam Plateau	[illegible]	0.2~0.4
56	7	2005	Oota ward	Local Line					○				51.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
56	10	2005	Setagaya ward	Local Line						○			33.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
55	SHin10	2003	Oota ward	Shin(Tokai)								○	143.0	R-10	Loam Plateau	[illegible]	0.6~0.8
55	11	2004	Fussa city	Local Line						○			78.0	R-17	Artificial ground	[illegible]	0.6~0.8
55	20	2004	Nishi Tokyo city	Local Line						○			74.0	R-10	Loam Plateau	[illegible]	0.4~0.6
55	25	2004	Itabashi ward	Local Line	○								62.0	R-11	Alluvial Fan	[illegible]	0.4~0.6
55	SHin07	2005	Oota ward	Shin(Tokai)								○	154.0	R-12	Valley Bottom Plane	[illegible]	0.8~1.0
55	SHin09	2005	Oota ward	Shin(Tokai)							○		162.0	R-12	Valley Bottom Plane	[illegible]	0.8~1.0
55	SHin10	2005	Oota ward	Shin(Tokai)								○	126.0	R-10	Loam Plateau	[illegible]	0.6~0.8
55	11	2005	Suginami ward	Local Line						○			68.0	R-10	Loam Plateau	[illegible]	0.4~0.6
54	SHin09	2003	Oota ward	Shin(Tokai)							○		162.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
54	SHin09	2004	Oota ward	Shin(Tokai)							○		154.0	R-10	Loam Plateau	[illegible]	0.6~0.8
54	12	2004	Setagaya ward	Local Line							○		63.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
54	SHin03	2005	Kita ward	Shin(Tohoku)							○		102.0	R-15	Delta marsh D > 0.5	[illegible]	0.4~0.6
54	15	2005	Nishi Tokyo city	Local Line								○	80.0	R-10	Loam Plateau	[illegible]	0.4~0.6
53	SHin02	2003	Shinagawa ward	Shin(Tokai)							○		107.0	R-10	Loam Plateau	[illegible]	0.4~0.6
53	SHin03	2003	Kita ward	Shin(Tohoku)							○		101.0	R-15	Delta marsh D > 0.5	[illegible]	0.4~0.6
53	1	2003	Shinagawa ward	Local Line	○								87.0	R-19	Reclaimed Ground	[illegible]	0.6~0.8
53	8	2003	Oota ward	Local Line					○				92.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
53	19	2003	Adachi ward	Local Line					○				81.0	R-15	Delta marsh D > 0.5	[illegible]	0.8~1.0
53	23	2003	Shinagawa ward	Monorail					○				76.0	R-19	Reclaimed Ground	[illegible]	0.6~0.8
53	SHin02	2004	Shinagawa ward	Shin(Tokai)							○		106.0	R-10	Loam Plateau	[illegible]	0.6~0.8
53	SHin10	2004	Oota ward	Shin(Tokai)							○		122.0	R-10	Loam Plateau	[illegible]	0.6~0.8
53	SHin02	2004	Kita ward	Shin(Tohoku)							○		101.0	R-15	Delta marsh D > 0.5	[illegible]	0.4~0.6
52	13	2004	Oota ward	Local Line					○				79.0	R-15	Delta marsh D > 0.5	[illegible]	0.8~1.0
52	24	2004	Katsushika ward	Local Line					○				65.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
52	8	2005	Meguro ward	Local Line						○			66.0	R-10	Loam Plateau	[illegible]	0.4~0.6
52	9	2003	Oota ward	Local Line					○				54.0	R-15	Delta marsh D > 0.5	[illegible]	0.8~1.0
51	SHin07	2003	Oota ward	Shin(Tokai)								○	160.0	R-10	Loam Plateau	[illegible]	0.6~0.8
51	SHin03	2003	Itabashi ward	Shin(Tohoku)					○				106.0	R-11	Alluvial Fan	[illegible]	0.8~1.0
51	SHin06	2004	Oota ward	Shin(Tokai)								○	153.0	R-10	Loam Plateau	[illegible]	0.6~0.8
51	SHin07	2004	Oota ward	Shin(Tokai)								○	145.0	R-10	Loam Plateau	[illegible]	0.8~1.0
51	15	2004	Oota ward	Local Line						○			81.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
51	21	2004	Adachi ward	Local Line					○				85.0	R-15	Delta marsh D > 0.5	[illegible]	0.6~0.8
51	SHin02	2005	Oota ward	Shin(Tokai)							○		106.0	R-10	Loam Plateau	[illegible]	0.4~0.6
51	1	2004	Kita ward	Local Line							○		71.0	R-10	Loam Plateau	[illegible]	0.6~0.8
51	12	2005	Hachioji city	Local Line								○	101.0	R-08	Hill Plateau	[illegible]	0.4~0.6
51	21	2005	Katsushika ward	Local Line		○							57.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.6~0.8
50	4	2003	Shinjuku ward	Local Line								○	81.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
50	14	2003	Hino city	Local Line						○			46.0	R-17	Artificial ground	[illegible]	0.6~0.8
50	22	2003	Toshima ward	Local Line								○	29.0	R-10	Loam Plateau	[illegible]	0.4~0.6
50	9	2004	Edogawa ward	Local Line					○				79.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
50	22	2004	Katsushika ward	Local Line					○				76.0	R-15	Delta marsh D > 0.5	[illegible]	0.6~0.8
50	SHin02	2005	Shinagawa ward	Shin(Tokai)							○		102.0	R-10	Loam Plateau	[illegible]	0.6~0.8
49	SHin01	2003	Shinagawa ward	Shin(Tokai)							○		105.0	R-12	Valley Bottom Plane	[illegible]	0.4~0.6
49	SHin05	2003	Oota ward	Shin(Tokai)								○	146.0	R-10	Loam Plateau	[illegible]	0.6~0.8
49	10	2004	Machida city	Local Line						○			77.0	R-17	Artificial ground	[illegible]	0.6~0.8
49	14	2004	Shinagawa ward	Local Line								○	56.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
49	19	2004	Nerima ward	Local Line								○	95.0	R-10	Loam Plateau	[illegible]	0.4~0.6
49	SHin05	2005	Oota ward	Shin(Tokai)								○	142.0	R-10	Loam Plateau	[illegible]	0.6~0.8
49	22	2005	Adachi ward	Subway ground					○				47.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
48	SHin04	2003	Itabashi ward	Shin(Tohoku)		○							104.0	R-14	Natural Embankment	[illegible]	0.8~1.0
48	2	2003	Shinagawa ward	Local Line								○	69.0	R-17	Artificial ground	[illegible]	0.6~0.8
48	22	2003	Edogawa ward	Subway ground						○			81.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.8~1.0
48	SHin02	2004	Itabashi ward	Shin(Tohoku)					○				107.0	R-11	Alluvial Fan	[illegible]	0.8~1.0
48	SHin04	2004	Itabashi ward	Shin(Tohoku)		○							104.0	R-14	Natural Embankment	[illegible]	0.8~1.0
48	SHin05	2005	Oota ward	Shin(Tokai)								○	152.0	R-10	Loam Plateau	[illegible]	0.8~1.0
48	SHin01	2005	Kita ward	Shin(Tohoku)	○								107.0	R-17	Artificial ground	[illegible]	0.6~0.8
48	SHin04	2005	Itabashi ward	Shin(Tohoku)					○				106.0	R-11	Alluvial Fan	[illegible]	0.8~1.0
48	5	2005	Kiyose city	Local Line								○	87.0	R-10	Loam Plateau	[illegible]	0.4~0.6
48	14	2005	Komae city	Local Line								○	85.0	R-10	Loam Plateau	[illegible]	0.6~0.8
48	25	2005	Hachioji city	Monorail						○			46.0	R-12	Valley Bottom Plane	[illegible]	0.6~0.8
47	SHin06	2003	Oota ward	Shin(Tokai)								○	150.0	R-10	Loam Plateau	[illegible]	0.8~1.0
47	20	2003	Katsushika ward	Local Line					○				69.0	R-16	Delta marsh D ≦ 0.5	[illegible]	0.6~0.8
47	SHin01	2005	Shinagawa ward	Shin(Tokai)							○		104.0	R-12	Valley Bottom Plane	[illegible]	0.4~0.6
47	22	2005	Edogawa ward	Subway ground				○					69.0	R-14	Natural Embankment	[illegible]	0.8~1.0
46	24	2003	Katsushika ward	Local Line					○				52.0	R-15	Delta marsh D > 0.5	[illegible]	0.8~1.0
46	8	2004	Adachi ward	Local Line					○				94.0	R-14	Natural Embankment	[illegible]	0.8~1.0
45	SHin04	2003	Oota ward	Shin(Tokai)							○		108.0	R-10	Loam Plateau	[illegible]	0.4~0.6
44	16	2003	Higashi kurume city	Local Line								○	87.0	R-10	Loam Plateau	[illegible]	0.4~0.6
44	SHin02	2004	Shinagawa ward	Shin(Tokai)								○	100.0	R-12	Valley Bottom Plane	[illegible]	0.4~0.6
44	SHin05	2004	Oota ward	Shin(Tokai)							○		107.0	R-10	Loam Plateau	[illegible]	0.4~0.6
44	SHin04	2005	Oota ward	Shin(Tokai)							○		107.0	R-10	Loam Plateau	[illegible]	0.4~0.6
44	24	2005	Katsushika ward	Local Line		○							72.0	R-15	Delta marsh D > 0.5	[illegible]	0.8~1.0
42	SHin06	2003	Oota ward	Shin(Tokai)								○	158.0	R-12	Valley Bottom Plane	[illegible]	0.8~1.0
42	9	2005	Machida city	Local Line								○	98.0	R-09	Sand Gravel Plateau	[illegible]	0.4~0.6
42	SHin09	2004	Oota ward	Shin(Tokai)								○	155.0	R-12	Valley Bottom Plane	[illegible]	0.8~1.0
41	SHin01	2003	Kita ward	Shin(Tohoku)	○								101.0	R-15	Delta marsh D > 0.5	[illegible]	0.4~0.6
41	7	2004	Kita ward	Local Line					○				81.0	R-08	Hill Plateau	[illegible]	1.0~1.68
41	SHin06	2005	Oota ward	Shin(Tokai)								○	149.0	R-12	Valley Bottom Plane	[illegible]	0.8~1.0
40	SHin01	2004	Kita ward	Shin(Tohoku)	○								104.0	R-15	Delta marsh D > 0.5	[illegible]	0.4~0.6
39	SHin02	2005	Kita ward	Shin(Tohoku)	○								104.0	R-15	Delta marsh D > 0.5	[illegible]	0.4~0.6

Same point(3 years) 12

Landform Geology Classification

Sign	Landform Geology Classification	Number
A1:	Lowland near Plateau/Hill	11
A2:	Natural Embankment	5
A3:	Old River	-
A4:	Reclaimed Valley	1
A5:	Low-Land	22
T:	Plateau/Hill	27
To:	Edge of Plateau	25
Tt:	Valley Low-Land	29
	Total	120

Micro-Topography Classification

Sign	Micro-Topography Classification	Number
R-21:	Volcano	-
R-19:	Reclaimed Ground	2
R-17:	Artificial Ground	8
R-16:	Delta marsh D ≦ 0.5	10
R-15:	Delta marsh D > 0.5	16
R-14:	Natural Embankment	5
R-12:	Valley Bottom Plane	19
R-12:	Sandbank/Sand hill	-
R-11:	Alluvial Fan	5
R-10:	Loam Plateau	52
R-09:	Sand Gravel Plateau	1
R-08:	Hill Plateau	2
R-07:	Other	-
R-06:	Third Cenozoic Era	-
R-05:	Mesozoic Era	-
R-04:	Paleozoic Era	-
D: Distance from River(km)	Total	120

Base to surface increment

Increment Value	Sign	Number
1.0~1.68	[illegible]	2
0.8~1.0	[illegible]	30
0.6~0.8	[illegible]	45
0.4~0.6	[illegible]	42
0.2~0.4	[illegible]	1
0~0.2	[illegible]	-
-0.25~0	[illegible]	-
	Total	120

Vibration level Blue 25m, Black 12.5m

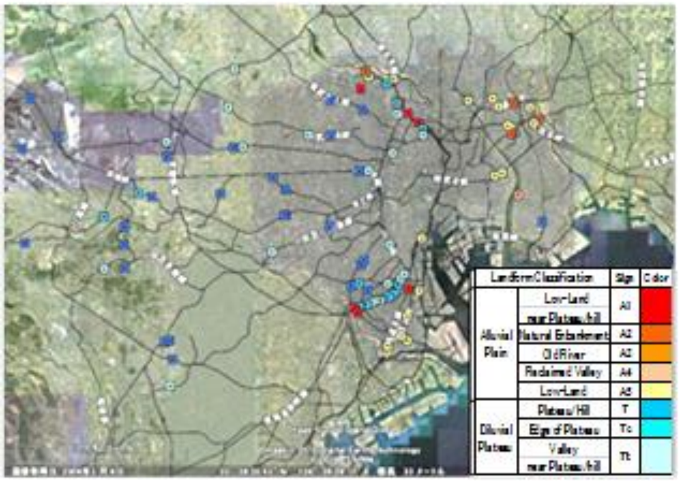

Fig.5 Landform Geology Classification

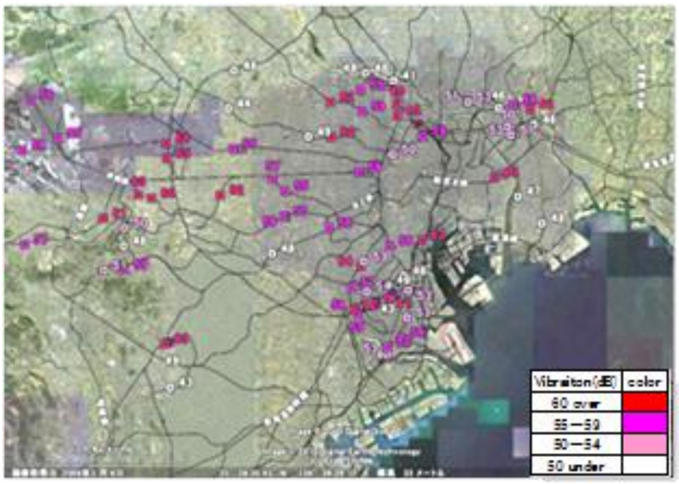

Fig.6 Vibration Level

Table.6 Landform Geology Classification and vibration area

Landform Classification		Color	60 over	55～59	50～54	50 under	Total
Alluvial Plain	Low-Land near Plateau/hill	A1	3	3	1	4	11
	Natural Enbankment	A2	0	1	1	3	5
	Old River	A3	0	0	0	0	0
	Reclaimed Valley	A4	0	0	0	1	1
	Low-Land	A5	3	2	10	7	22
Total			6	6	12	15	39

Landform Classification		Color	60 over	55～59	50～54	50 under	Total
Diluvial Plateau	Plateau/Hill	T	7	14	3	3	27
	Edge of Plateau	Tc	5	3	12	5	25
	Valley near Plateau/hill	Tt	2	5	7	15	29
Total			14	22	22	23	81

Plateau" is 7 points that is most large number, "Edge of the plateau" is at 5 points following. It is almost same number of measuring points which is 25 points to 29 points in the diluvial plateau, "Plateau hill", "Edge of the plateau", "The valley lowland on the hill of the plateau". However, 21 points are 55dB or more in 27 points of "Plateau hill", and the vibration level is large. Moreover, 50dB~54dB level data is half of 12 points, and 60dB or more is about 20 percent in "Edge of the plateau" per five point. In "The valley lowland on the hill of the plateau", the more than half is less than 50dB, and there are only 2 points of 60dB or more. The vibration level is 15% per 6 points/39 points in the alluvial plain, the ratio of the point where 60dB or more is shown, and accounts for 17% in 14 points/81 points in the diluvial plateau, and is almost equal. It is understood that the point of 60dB or more is "Plateau hill" widely distributed in the west of Tokyo and "Plateau hill", "Edge of the plateau" in the diluvial plateau, by Figure 7.

(b) Relationship between Micro-topography Classification and vibration level

The vibration level is classified by every 5dB to examine the relationship of the Micro-topography classification and the vibration level and it shows in Figure 7. The number of points within the range of the vibration level of each classification is shown in Table 7. In the micro-topography that shows the vibration level of 60dB or more from Figure 7, a lot of "Loam plateau" that accounts for 40 percent or more of all the measurement points is 13 points. Next, they are 2 points in "Delta back Marsh", and "Valley Bottom Plains" is 2 point where 60dB or more is shown "Delta back Marsh". Moreover, the measuring points are distributed in various parts of Tokyo, and contain stiff ground comparatively. The vibration level in the most softness ground, "Delta Back Marsh" in the Micro-Topography Classification is not large, and the correlation of the Micro-Topography Classification and the vibration level is not found. In other Micro-Topography Classification, the vibration level in the soft ground is not larger than the stiff ground. A great difference cannot be confirmed to the vibration level by data according to fiscal year. However, it is understood that the vibration level changes every fiscal year, to the data of the same position of Shinkansen in Table 5 carefully, according to fiscal year.

(c) Relationship between Base to surface Increment Value and vibration level

Figure 8 shows the colored measurement point every 5dB on the map where the Base to surface Increment Value was classified. The Base to surface Increment Value was classified into Table 8, and the number of measurement points was shown. The point number data is shown in Table 8, where measurement Base to surface Increment Value is "1.0-1.65", which the ground surface is amplified easily. For three years, more than 60dB over and to less than 50dB data is 1 point respectively. Moreover, there is one point 55dB-59dB within the range of "0.2-0.4". There are 45 points in ranges of "0.6-0.8", and 42 points in ranges of "0.4-0.6", 30 points in the range of "0.8-1.0". Therefore, the measurement seismic intensity increment value of 117 points of the point inside in 120 measurement points is distributed in "0.4-1.0". Therefore, it is easy to admit no tendency and the correlation of neither Base to surface Increment Value nor the vibration level in each fiscal year.

The vibration level in an excellent, stiff ground is not smaller than these, and "Plateau", "Edge", and "Bottom plain" are key words.

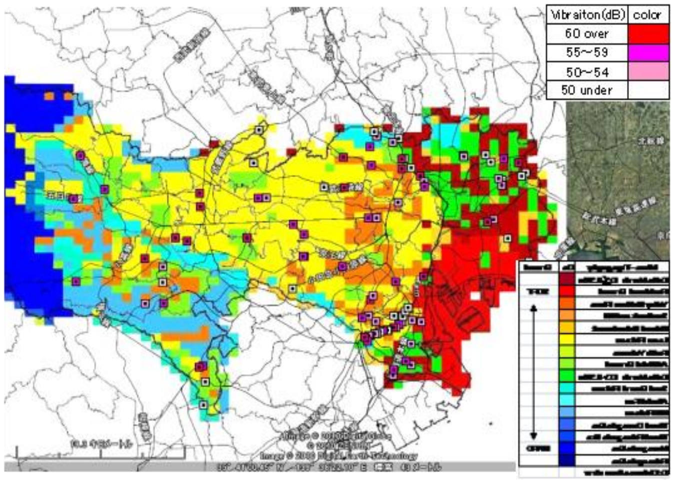

Fig.7 Relationship between Micro-Topography Classification and Vibration Level

Table 7 Measurement point Number and Micro-Topography

Micro-Topography \ Vibration(dB)	Color	60over	55~59	50~54	50under	Total
Delta Marsh(D≦0.5)		2	1	4	3	10
Reclaimed Ground		0	0	2	0	2
Valley Bottom Plane		2	5	4	8	19
Natural Enbankment		0	1	0	4	5
Loam Plateau		13	15	13	11	52
Artificial Ground		1	3	1	3	8
Delta Marsh(D＞0.5)		2	1	8	5	16
Sand Gravel Plateau		0	0	0	1	1
Affuvial Fan		0	2	1	2	5
Hill Plateau		0	0	1	1	2
Total		20	28	34	38	120

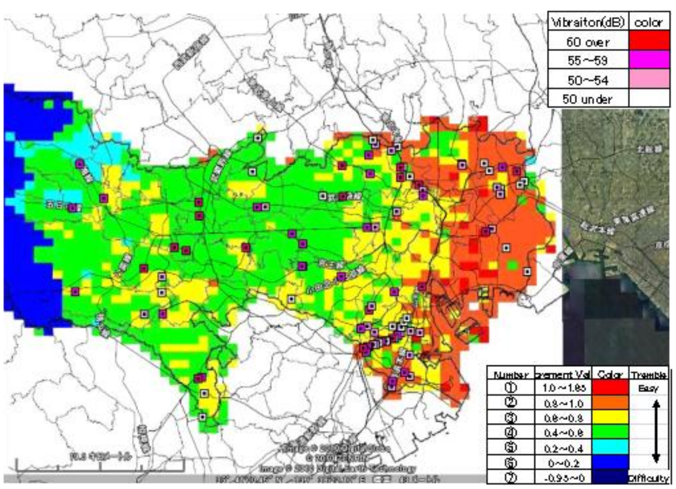

Fig.8 Surface Increment Value and Vibration Level

CONCLUSION

In this paper, to relate the ground vibration level to the landform geology factor, the relativity of vibration level and site information was analyzed and considered. First of all, the relationship of vibration level with the "Landform Geology Classification", "Micro-Topography classification", in addition to "Base to surface Increment Value" was analyzed and considered for the measurement result of the railway vibration in Osaka Prefecture. A similar analysis was done and considered continuously about the data of Tokyo.

As a result, the tendency whose vibration level on the alluvial plain is larger than the diluvial plateau one was shown in the data of Osaka Prefecture. However, thought to be some the tendencies different in tokyo,there are some "Landform Geology classification" with large vibration level on the dilluvial plateau. Comparatively excellent, and it has been understood that the correlativity of vibration level, at hard ground level is larger than at the soft ground with the environmental ground vibration problem.

Therefore, the ground environmental vibration level should cannot be judged only ground softness, and be deliberated including landform geology classification factor. Especially, it is thought that the classification method for matching landform geology classification factor concerning the site information with the environmental ground vibration problem.

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