3. Advice for Method of Fund Raising

3.1 Basic Idea of Selection for Concrete Plan

The method of fund raising is examined with an emphasis on the following three points.

Loan condition	Long terms of repayment and low interest rate
Realization	Realization of speedy fund raising
Vietnamese policy	Joint venture is not considered

3.2 Result of Study on Fund Raising

The result of the study on each fund raising method is shown in Table VI-3-1.

TableVI-3-1 Study on Method of Fund Raising

Method of fund raising	Concrete plan	Result of study					
		Condition of fund raising		recommendation loan condition	Realization	Total	Reason for selection
Introduction of foreign capital	Joint venture	-	-	○	×	×	Not studied according to the policy of Viet Nam
Fullness of domestic capital	VSC and / or other national facilities buy the stock of new mill	-	-	◎	◎	◎	Strong source of fund from specific stockholder
	Subsidy from national facilities	-	-	◎	×	×	Unknown about subsidy for steel industry
Loan from international public banking facilities	Loan from World Bank Group, Asian Development Bank (ex. Using ODA)	The loan is possible only for infrastructure	Preferable loan condition because of governmental assistance	○	×	×	Depends on governmental negotiation
Loan from export finance	Supplier's credit	Loan for equipment only Payment of trade insurance required	Interest rate :7.27% Insurance required during the period of repayment	△	△	△	Ambiguous due to the dependence on the negotiation
	Buyer's credit	Loan for equipment only Sovereign guarantee required	Maximum loan period is 10 years Interest rate is 10.2%	△	○	○	Possible by sovereign guarantee
Loan from domestic banking facilities	Loan from Development funds in Viet Nam		Interest rate :Minimum 7.5% Loan period : for 10 years	◎	◎	◎	Preferable conditions compared to the fund raising in foreign countries
	Loan from Commercial bank		Interest rate is 0.85% per month (p.a. 10.2%)	○	○	○	Possibility of Less interest rate, for example 7.5% per year.

Notes) ◎ : Recommended ○ : Possible △ : Ambiguity or possibly with worse condition × : Not possible

3.2.1 Selection of Fund Raising Methods

The following three fund raising methods are considered as the possible ones in this feasibility study.

	Contents of fund raising	Reason for selection
Case1	All fund is raised in Viet Nam	Most advantageous of all in terms of the loan condition and realization.
Case2	Fund for equipment is raised in buyer's credit. The remain is raised in Viet Nam.	To evaluate the fund raising from foreign countries.
Case3	10 mil. US$ is invested as equity capital. The remain is raised in Viet Nam.	To improve the inadequate capital situation

3.2.2 Recommendation

As the financial deficit occurs for all the above three cases, it is indispensable that VSC and the government of Viet Nam improve the conditions of funds as follows.

(1) Investment to the new mill by VSC and other governmental facilities

In this study, all sources of the fund for the initial investment in the base case is the borrowing. As is mentioned in ChapterVI-1, however, a financial deficit happens every year for the first 10 years. The fragile financial situation which is caused by the extremely large amount of loan is to be improved by equity from VSC and/or other governmental facilities. More than ten million US$ as the equity capital is strongly recommended.

(2) Fund raising by using the governmental financial system and the commercial banking facilities in Viet Nam.

Export financing is a reasonable method of fund raising from foreign countries. In reality, however, it is better to use the governmental development funds for the initial investment because the loan condition from foreign countries is stricter than that of the domestic loan. It is important that the government gives the first priority of development funds to this project, and secures the source of development funds considering the large amount of around 130 million US$ required. Furthermore, an extension of the loan period up to 12 years is strongly recommended.

Chapter VII Proposals for Environmental Countermeasures

1. Policy and Regulation with regard to Environmental Protection in Viet Nam

1.1 Law and Standards of Environment Control Concerning the Project

There are following Law and Standards in Viet Nam with regard to the construction of the new cold rolling mill.

(1) Law on Environment Protection
National Assembly of the Socialist Republic of Viet Nam 9 Legislation, 4th Session
(from 06 to 30 December 1993)

(2) Standards
1) TCVN 5937-1995: Air Quality Ambient Air Quality Standards
2) TCVN 5939-1995: Air Quality Industrial Emission Standards Inorganic Substances and Dust
3) TCVN 5942-1995: Water Quality Surface Water Quality Standards
4) TCNV 5943-1995: Water Quality Coastal Water Quality Standards
5) TCVN 5945-1995: Industrial Waste Water Discharge Standards
6) TCVN 5949-1995: Acoustics Noise in Public and Residential Areas Maximum Permitted Noise Level
7) TCVN 5501-1991: Drinking Water Standards
8) TCVN 5502-1991: Domestic Water Standards
9) The Decision No.505 BYT/QD (Ministry of Health) : Drinking and Domestic water standards

The content of those standards are described later.

(3) Environmental Impact Assessment
1) Government Decree No.175/CP
2) Instruction No. 1420/MTg
3) Decision No. 1806/QD-MTg
4) Decision No.1807/QD-MTg
5) Introduction No. 1100/TT-MTg
6) Government Decree No.26/CP
7) Circular No.490/1998/TT-BKHCNMT

In accordance with those Decrees, Instructions, Decisions and Circulars the following documents should be submitted to MOSTE and DOSTE to get an approval for the construction of the new cold rolling mill.

(A) Stage of Investment License Application
A part or a certain chapter of the project documents must provide an initial description of the potential environmental impacts.

(B) Stage of design and construction

One of the following documents is to be submitted to MOSTE and DOSTE to get an approval.

a) Environment Impact Assessment report (EIA report)
b) Application for registration for securing environmental standards

The production amount of the new cold rolling mill is 250,000 ton/year, more than 100,000 ton/year, so that this project belongs to "Category 1" in the Circular No.490/1998/TT-BKHCNMT. Usually a project which belongs to "Category 1" is required to submit an EIA report. According to Notes of the Circular, however, if a project belonging to "Category 1" is implemented in a certain industrial zone approved by the government, it is not required to submit the EIA report. The new cold rolling mill complex is to be constructed in an industrial zone, and therefore this project is required to submit only the "Application for registration for securing environmental standards".

2. Present Environmental Standards around Sites for New Cold Rolling Mill Complex

2.1 Emission Standards of Waste Gas in Viet Nam

"B" standards of TCVN5939-1995 are applied to all of the three industrial zones. (Refer to Table VII-2-1). Although MOSTE has no concrete plan to change the standards in the near future, the total volume regulation is being considered, which may lead to a change of the standards.

Table VII-2-1 Emission Standard

No	Parameter	Unit	Industrial Zone			Viet Nam Standards TCVN5939-1995	
			AMATA	Nhon Trach	Phu My	A	B
1	Particulate in smoke of ;						
	other sources	mg/m^3	Same as [B] standards of TCVN5939-1995	Same as [B] standards of TCVN5939-1995	Same as [B] standards of TCVN5939-1995	600	400
2	Dust ;						
	containing silica	mg/m^3				100	50
	containing asbestos	mg/m^3				none	none
3	Antimony	mg/m^3				40	25
4	Arsenic	mg/m^3				30	10
5	Cadmium	mg/m^3				20	1
6	Lead	mg/m^3				30	10
7	Copper	mg/m^3				150	20
8	Zinc	mg/m^3				150	30
9	Chloride	mg/m^3				250	20
10	HCl	mg/m^3				500	200
11	Fluoride, HF(any source)	mg/m^3				100	10
12	H_2S	mg/m^3				6	2
13	CO	mg/m^3				1,500	500
14	SO_2	mg/m^3				1,500	500
15	NOx (other source)	mg/m^3				2,500	1,000
17	H_2SO_4 (any source)	mg/m^3				300	35
18	HNO_3	mg/m^3				2,000	70
19	Ammonia	mg/m^3				300	100

2.2 Waste Water Discharge Standards in Viet Nam

AMATA Industrial Zone has its own standards because the final treatment plant for the waste water has already been installed. On the other hand, "B" standards of TCVN5945-1995 are applied to Nhon Trach and "C" standards of TCVN5945-1995 to Phu My Industrial Zone. (Refer to Table VII-2-3). Although MOSTE has no concrete plan to change the above mentioned standards in the near future, there is a possibility to increase parameters and substances.

The waste water from AMATA Industrial Zone is discharged to Dong Nai River, the water of which is used as the sources of domestic water supply for HCM city. Accordingly, the waste water from AMATA Industrial Zone should comply with "A" standards, which are the most strict in TCVN5945-1995. As AMATA Industrial Zone has the final treatment plant for the waste water, the standards of the discharged water from each factory might be eased from "A" standards. However, "A" standards are applied to almost all the items even inside AMATA Industrial Zone.

The waste water from Nhon Trach Industrial Zone is discharged to Dong Tranh River, the water of which is not used as sources of domestic water supply. The industrial zone does not have a final treatment plant for the waste water, so that "B" standards in TCVN5945-1995 are to be applied. There exists a plan to construct a final treatment plant of the waste water in the near future (Refer to Table VII-2-2), and the standards might be eased after the installation.

The waste water from Phu My Industrial Zone is discharged to Thi Vai River, the water of which is not used as sources of domestic water supply. In addition, Phu My Industrial Zone has a plan to install a final treatment plant for waste water. Accordingly, "C" standards in TCVN5945-1995 are applied.

Phu My Industrial Zone is located about 20 km near to the sea compared to Nhon Trach Industrial Zone. In case the water of Dong Tranh River and Thi Vai River is used as sources of domestic water supply, Phu My Industrial Zone has less possibility to be affected by tightened standards than Nhon Trach Industrial Zone.

Table VII-2-2 Final Treatment Plant for Waste Water

	AMATA	Nhon Trach	Phu My
Capacity at present	1,000 m^3/day	-	-
Consumption at present	500 m^3/day	-	-
Capacity in near future	4,000 m^3/day	4,000 m^3/day (June 2000)	-
Capacity in Future	according to demand	12,000 m^3/day	18,000 m^3/day (2002)

Table VII-2-3 Industrial Waste Water Discharge Standards

No	Parameters & substance	Unit	Industrial Zone			Viet Nam Standards TCVN5945-1995		
			AMATA	Nhon Trach	Phu My	A	B	C
1	Temperature	C	40			40	40	45
2	pH value	-	5-9			6-9	5.5-9	5-9
3	BOD_5(20C)	mg/l	500	Same as [B] standards of TCVN5945-1995	Same as [C] standards of TCVN5945-1995	20	50	100
4	COD	mg/l	530			50	100	400
5	Suspended Solid	mg/l	200			50	100	200
6	Arsenic	mg/l	0.05			0.05	0.1	0.5
7	Cadmium	mg/l	0.01			0.01	0.02	0.5
8	Lead	mg/l	0.1			0.1	0.5	1
9	Residual Chlorine	mg/l	5			1	2	2
10	Chromium(6)	mg/l	0.05			0.05	0.1	0.5
11	Chromium(3)	mg/l	0.2			0.2	1	2
12	Mineral oil and fat	mg/l	10			Not	1	5
13	Animal-vegetable fat and oil	mg/l	10			5	10	30
14	Copper	mg/l	0.2			0.2	1	5
15	Zinc	mg/l	1.0			1	2	5
16	Manganese	mg/l	0.2			0.2	1	5
17	Nickel	mg/l	0.2			0.2	1	2
18	Organic phosphorous	mg/l	0.2			0.2	0.5	1
19	Total phosphorous	mg/l	4.0			4	6	8
20	Iron	mg/l	1.0			1	5	10
21	Tetrachloroethylene	mg/l	0.02			0.02	0.1	0.1
22	Tin	mg/l	0.2			0.2	1	5
23	Mercury	mg/l	0.005			0.005	0.005	0.01
24	Total nitrogen	mg/l	30			30	60	60
25	Trichloroethylene	mg/l	0.05			0.05	0.3	0.3
26	Ammonia (as N)	mg/l	0.1			0.1	1	10
27	Fluoride	mg/l	1.0			1	2	5

28	Phenol	mg/l	0.001			0.001	0.05	1
29	Sulfide	mg/l	0.2			0.2	0.5	1
30	Cyanide	mg/l	0.2			0.05	0.1	0.2
31	Coliform	MPN/ml	5,000			5,000	10,000	-
32	Gross Alpha activity	Bq/l	0.1			0.1	0.1	-
33	Gross Beta activity	Bq/l	1.0			1.0	1.0	-
34	Chloride(Cl^-)	mg/l	300					
35	Detergent(Synthetic)	mg/l	30					
36	Formaldehyde	mg/l	2.0					

2.3 Noise Standards in Viet Nam

Noise limit from 22h to 6h AM in No. 4 area of TCVN5949-1995 is as stringent as 50 dB(A), which is a very strict limit value. 50 dB(A) at night time is the same as the limit value applied to residential areas in Japan. In general many factories in the industrial zone operate 24 hours a day, and the noise at night time in industrial zones is limited to 65 dB(A) in Japan. (Refer to Table VII-2-4).

In Viet Nam there are no noise standards for industrial zones at present. According to MOSTE's instruction, Japanese standards for industrial zones are to be used for this FS.

Table VII-2-4 Maximum Permitted Noise Level in Public and Residential Areas - dB(A)

No.	Area	Period of time		
		From 6h AM to 18h	From 18h to 22h	From 22h to 6h AM
1	Quiet areas	50	45	40
2	Residential area	60	55	45
3	Commercial and service areas and mix	70	70	50
4	Small industrial factories intermingling in residential areas	75	70	**50**
Japan (Industrial Zone)		70	70	65

Viet Nam : VIET NAM STANDARD (TCVN5949-1995)
JAPAN : Noise Control Law

2.4 Generated Substances from New Cold Rolling Mill

The generated substances from the new cold rolling mill and the treatment methods are shown in Table VII-2-5, and the measures in each industrial zone are shown in the tables from VII-2-6 to VII-2-8. As is shown in the tables, measures for generated substances are not so different from one industrial

zone to the other. However, one point should be noted, Vina Kyoei, which is located in Phu My Industrial Zone, has a plan to install an Electric Arc Furnace (EAF). After the installation of EAF, the scale and sludge from the new cold rolling mill might be recycled as the raw materials for the EAF.

With regard to the waste acid, there is a company in HCM city which performs the treatment. The company, named VIETPAM Environmental Co., Ltd., can treat the waste acid by using only the neutralizing method which is useful for weak acid, and the capacity is limited to 5,000 litters/day and already in full operation. The waste acid from the pickling line is strong, and the regeneration method is better than neutralizing method for the waste acid from the pickling line. Considering the said conditions, the said company is considered inappropriate to be used and Acid Regeneration Plant, ARP is required to be installed beside the pickling line.

Table VII-2-5 Treatment of Generated Substances

No	Generated substances		Treatment
1	Sludge		-----
	(1)	Water treatment sludge	-----
		a. Treatment sludge of source water	Landfill disposal (each industrial zone)
		b. Treatment sludge of weak acid	Landfill disposal
		c. Treatment sludge of oil and alkali	Landfill disposal or Incineration disposal
	(2)	Rolling sludge	Landfill disposal or Incineration disposal
	(3)	Pickling sludge (scale)	Sell to EAF works (Electric Arc Furnace) or Landfill disposal
	(4)	Roll grinding sludge (scale)	Sell to EAF works (Electric Arc Furnace) or Landfill disposal
2	Waste acid (Strong acid)		ARP recycling (Acid Regeneration Plant)
3	Waste oil		Incineration disposal
4	Waste dust from shot equipment		Sell to EAF works (Electric Arc Furnace) or Landfill disposal
5	Others		-----
	(1)	Rubber debris	Incineration disposal
	(2)	Waste plastics	Incineration disposal
	(3)	Radioactive waste	Return back to the device manufactures
	(4)	Others	

Table VII-2-6 Landfill Disposal Area in Each Industrial Zone

	AMATA	Nhon Trach	Phu My
Existing at present	No	Yes	No
Possibility in future	Yes	Yes	Yes

Table VII-2-7 Incineration Plant

	AMATA	Nhon Trach	Phu My
Existing at present	No	No	No
Remarks	Use outside company	Use outside company	Use outside company

Table VII-2-8 Scale & Sludge Treatment (EAF Plant)

	AMATA	Nhon Trach	Phu My
At present	No	No	No
In future	No	No	Yes Vina Kyoei(2003)

3. Environmental Impacts on Phu My Industrial Zone

3.1 Environmental Standards in Viet Nam

3.1.1 Ambient Air Quality Standards

Ambient air quality is described in TCVN5937-1995 as shown in Table VII-3-1. The new cold rolling mill complex has a pickling line which uses much HCl, and HCl has to be considered, too. However, HCl is not mentioned in TCVN5937-1995. In Japan, Japan Industrial Health Academy recommends the permitted concentration of "HCl" as 5 PPM. This value is used for this FS and is shown in Table VII-3-1 with parenthesis.

Table VII-3-1 Ambient Air Quality Standards (TCVN5937-1995)

Items	Unit	1 hour average	8 hours average	24 hours average
CO	mg/m^3	40	10	5
NO_2	mg/m^3	0.4	*	0.1
SO_2	mg/m^3	0.5	*	0.3
Lead	mg/m^3	*	*	0.005
O_3	mg/m^3	0.2	*	0.06
Suspended particulate matter	mg/m^3	0.3	*	0.2
(HCl)	(PPM)	(5)		

Note : "*" mark means "Not defined in the standard".

3.1.2 Surface Water Quality Standards

Surface water quality is described in TCVN5942-1995 as shown in Table VII-3-2. Thi Vai River is not used as source of domestic water supply, so that "B" standard of TCVN5942-1995 is to be applied.

Table VII-3-2 Surface Water Quality Standards (TCVN5942-1995)

No	Parameters & substance	Unit	Viet Nam Standards	
			A	B
1	pH value	-	6-8.5	5.5-9
2	BOD_5(20C)	mg/l	< 4	< 25
3	COD	mg/l	< 10	< 35
4	Dissolved oxygen	mg/l	>= 6	>= 2
5	Suspended Solid	mg/l	20	80
6	Arsenic	mg/l	0.05	0.1
7	Barium	mg/l	1	4
8	Cadmium	mg/l	0.01	0.02
9	Lead	mg/l	0.05	0.1
10	Chromium, Hexavalent	mg/l	0.05	0.05
11	Chromium, Trivalent	mg/l	0.1	1
12	Copper	mg/l	0.1	1
13	Zinc	mg/l	1	2
14	Manganese	mg/l	0.1	0.8
15	Nickel	mg/l	0.1	1
16	Iron	mg/l	1	2
17	Mercury	mg/l	0.001	0.002
18	Tin	mg/l	1	2
19	Ammonia (as N)	mg/l	0.05	1
20	Fluoride	mg/l	1	1.5
21	Nitrate (as N)	mg/l	10	15
22	Nitrite (as N)	mg/l	0.01	0.05
23	Cyanide	mg/l	0.01	0.05
24	Phenol compounds	mg/l	0.001	0.02
25	Oil and grease	mg/l	not detectable	0.3
26	Detergent	mg/l	0.5	0.5
27	Coliform	MPN/ml	5,000	10,000
28	Total pesticides (except item No.29)	mg/l	0.15	0.15
29	Dichloro Diphenyl Trichloro ethane	mg/l	0.01	0.01
30	Gross Alpha activity	Bq/l	0.1	0.1
31	Gross Beta activity	Bq/l	1.0	1.0

Note 1: Values in the column A are applied to the surface water being used as source of domestic water supply with appropriate treatments.

Note 2: Values in the column B are applied to the surface water being used for the purposes other than domestic water supply.

3.1.3 Permitted Noise Level

Refer to the section 2.3 in Chapter VII. (Table VII-2-4).

3.2 Present Environmental Condition of Phu My Industrial Zone

The following data were collected during the second site survey to compare the present condition to that expected after the construction of the new cold rolling mill complex.

(1) Present air quality in Phu My Industrial Zone
(2) Present water quality of the Thi Vai River
(3) Present noise level near the site

3.2.1 Present Air Quality in Phu My Industrial Zone

Table VII-3-3 shows the air quality in Phu My Industrial Zone. Those results are obtained from one bottle of air sample, and strictly speaking it is not easy to evaluate the present air quality in comparison to TCVN5937-1995. In addition, the suspended particulate matter generally means particles with sizes of less than 10 μ m, and is included in the dust in the table. In this study the dust is considered same as the suspended particulate matter.

With the said preconditions the measured values of the dust (the suspended particulate matter), CO and ozone obviously stay around the limit. However, those are the items which are not affected by the construction of the new cold rolling mill complex. Accordingly, those items except the dust are not studied in this report, but have to be investigated more deeply later.

Table VII-3-3 Air Quality in Phu My Industrial Zone

Parameters	Unit	Results	TCVN5937-1995	
			1hr-averaging	24hrs-averaging
Dust	mg/m^3	**0.33**	*	*
Suspended particulate matter	mg/m^3	-	0.3	0.2
SO_2	mg/m^3	0.083	0.5	0.3
NO_2	mg/m^3	0.048	0.4	0.1
CO	mg/m^3	**4.2**	40	5
Lead	mg/m^3	$2.5x10^{-4}$	*	0.05
Cl_2	mg/m^3	none	*	*
Ozone	mg/m^3	**0.063**	0.2	0.06
HCl	PPM	none	(5)	

Note 1 : "*" mark means "Not defined in the standard"
Note 2 : "-" mark means "Not mentioned in the report".

3.2.2 Present Water Quality of Thi Vai River

The water quality of Thi Vai River is shown in Table VII-3-4. The value of the mineral oil and fat is over the standard value of TCVN5942-1995 even at present. The reason for this over limit has to be investigated immediately and countermeasure has to be executed.

The value of the mercury is not so accurate for evaluation, and it has to be measured in a more accurate manner again. The construction of the new cold rolling mill complex will by no means affects the value of mercury, so that the detailed study is not required in this report.

The new cold rolling mill complex is to be designed to match the Industrial Waste Water Discharge Standards of TCVN5945-1995. In addition, Phu My Industrial Zone has a plan to install a final treatment plant for the waste water. Accordingly, the construction of the new cold rolling mill complex will not be the cause of water pollution of Thi Vai River.

Table VII-3-4 Water Quality of Thi Vai River

Parameters	Unit	Results		"B" standards in TCVN5942-1995
		Surface Water at Thi Vai River	Ground water at Phu My IZ	
Temperature	°C	29.1	28.5	*
pH value	-	6.9	5.6	5.5-9
BOD_5(20C)	mg/l	7	-	< 25
COD	mg/l	15	-	< 35
Suspended Solid	mg/l	15	0	80
Copper	mg/l	<0.01	<0.01	1
Lead	mg/l	<0.01	<0.01	0.1
Zinc	mg/l	<0.01	<0.01	2
Mercury	mg/l	**<0.2**	**<0.2**	0.002
Cadmium	mg/l	<0.01	<0.01	0.02
Chromium	mg/l	<0.01	<0.01	0.05
Total Coliform	MPN/100ml	900	0	10,000
Mineral oil and fat	mg/l	**0.32**	none	0.3
Animal-Vegetable fat and oil	mg/l	Trace	none	*
Total Nitrogen	mg/l	1.9	<0.03	15
Ammonia (as N)	mg/l	0.05	<0.03	1
Total phosphorous	mg/l	0.16	<0.03	*

Note 1 : "*" mark means " Not defined in the standard"

Note 2 : "-" mark means " Not mentioned in the analysis reports"

3.2.3 Present Noise Level near the Site

The results of the noise level measurement near the site are shown in Appendices. The maximum noise level was 46 dB(A), which is considered to be a very low level. Accordingly, the noise simulation was executed without those results measured.

3.3 Environmental Impact Simulation after the Construction of New Cold Rolling Mill Complex

As mentioned before Phu My Industrial Zone has a plan to install a final treatment plant for the waste water. The waste water from all the factories in the industrial zone is to be treated at the final treatment plant and then discharged to Thi Vai River. It is impossible and meaningless to differentiate the environmental impacts on Thi Vai River of the new cold rolling mill complex from others. It is more appropriate for the environmental impact on Thi Vai River to be examined by Phu My Industrial Zone each time new factory is constructed.

Accordingly, the following environmental impact simulations are made in this report ;

(1) Environmental Impact Simulation of Air

(2) Environmental Impact Simulation of Noise

3.3.1 Air

(1) Outline

The impact of the operation of new cold rolling mill complex on air quality of the surrounding area is discussed. The objective substances are NO_2, SO_2, suspended particulate matter and HCl. A Simulation was made for the following items :

- Annual average concentration
- One-hour concentration by the most frequent weather condition
- One-hour concentration by the weather condition that gives the highest ground-level concentration

(2) Simulation area

The simulation was made for a 2 km square area with the new cold rolling mill complex in the center. The simulation area is shown in Fig. VII-3-1.

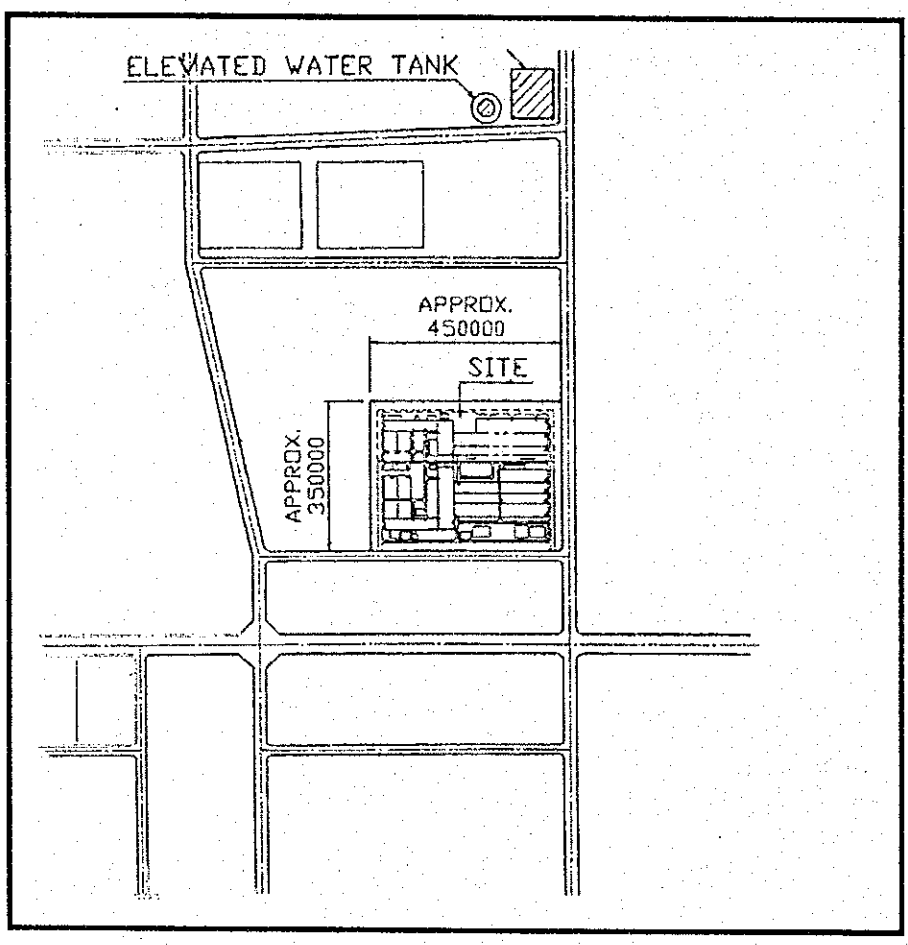


Fig. VII-3-1 Simulation Area

(3) Simulation conditions

1) Emission sources

(a) Emission quantity

Emission sources and their emission quantities are shown in Table VII-3-5. All are assumed to be point sources. The location of the stacks are shown in Fig.VII-3-2.

Table VII-3-5 Emission Specification of the New Cold Rolling Mill Complex

No.	Source equipment	Stack height (m)	Stack diameter (m)	Gas flow rate (m^3_N/h)	Gas temperature (℃)	Substance	Concentration	Unit
1	PL fume scrubber	12	0.8	18,000	70	HCl	33	mg/m^3_N
2	ARP	20	0.5	3,500	95	HCl	20	mg/m^3_N
						NOx	228	mg/m^3_N
3	BAF	18	20× 2×2sides	400	100	NOx	415	mg/m^3_N
4	Boiler	20	0.8	11,500	280	NOx	295	mg/m^3_N
						SPM	0.1	g/m^3_N
						SO_2	715	mg/m^3_N

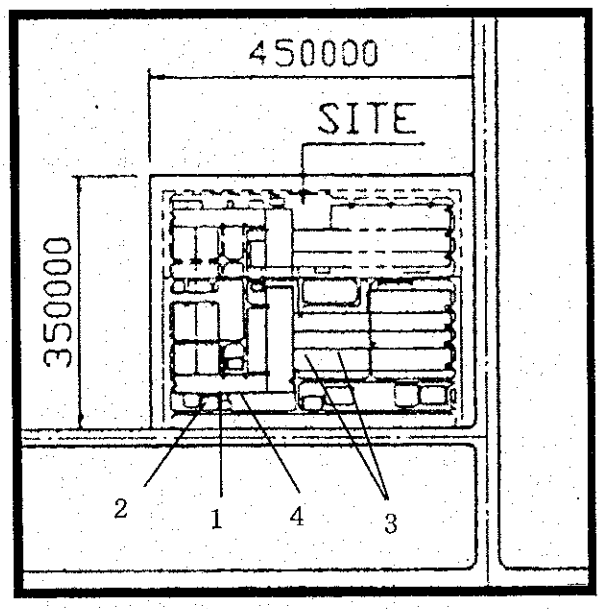


Fig. VII-3-2 Location of Gas Emission Sources

(b) Effective stack height

Effective stack heights were calculated according to "Manual for Areawide Total Pollutant Load Control of Nitrogen Oxide" (Japanese Environment Agency).

Windy condition:

CONCAWE equation

$$\triangle H = 0.175 \cdot Q_H^{1/2} \cdot u^{-3/4}$$

Calm condition:

Briggs equation

$$\triangle H = 1.4 \cdot Q_H^{1/4} \cdot (d\theta/dz)^{-3/8}$$

where,

$\triangle H$	:	Rise of exhaust gas (m)
Q_H	:	Exhausted heat (cal/s)
U	:	Wind speed at stack top (m/s)
$d\theta/dz$	:	Adiabatic thermal gradient (℃/m)

$$Q_H = \rho \cdot C_P \cdot Q \cdot \Delta T$$

where,

ρ	:	Density of exhaust gas at 0℃ ($1.293 \times 10^3 g/m^3$)
C_P	:	Isobaric specific heat (0.24cal/K/g)
Q	:	Quantity of exhaust gas per unit time (Nm^3/s)
$\triangle T$	:	Difference (TG-TA) between exhaust gas temperature (TG) and mean air temperature (TA)

Effective stack heights were modified by the following equations to incorporate the influence of neighboring buildings.

Huber equations

if $H_0/H_b \leqq 1.2$,

$\varDelta H' = 0.333 \varDelta H$

if $1.2 < H_0/H_b \leqq 2.5$,

$\varDelta H' = 0.333 \varDelta H - ((H_0/H_b - 1.2) \cdot (0.2563 \varDelta H))$

if $2.5 < H_0/H_b$,

$\varDelta H' = 0$

where,

$\varDelta H$	:	Fall of plume axis caused by building (m)
H_b	:	Building height (m)

2) Weather condition

(a) Division of time zones

Daytime and nighttime was divided according to the Pasquill's classification of atmospheric stability shown in "Manual for Areawide Total Pollutant Load Control of Nitrogen Oxide", and the division is shown in Table VII-3-6.

Table VII-3-6 Time Zone

Daytime	Nighttime
6～19 o'clock	19 o'clock～6 o'clock next morning

Note) Division between daytime and nighttime is based on sunrise time and sunset time. Nighttime starts at one hour before sunset and ends at one hour after sunrise.

(b) Classification of wind

- Wind direction classification

16 directions and calm class (less than 1.0 m/s wind speed)

- Wind speed classification

7 classes as shown in Table VII-3-7

Table VII-3-7 Wind Speed Classes

	Wind speed (m/s)	Representative speed (m/s)
Calm	0.0～0.9	0.0
Windy	1.0～1.9	1.5
	2.0～2.9	2.5
	3.0～3.9	3.5
	4.0～5.9	5.0
	6.0～8.0	7.0
	8.0～	9.0

(c) Classification of atmospheric stability

Atmospheric stability was classified in accordance with Pasquill's method of classification as shown in Table VII-3-8.

Table VII-3-8 Pasquill's Classification of Atmospheric Stability

Wind speed (u) m/s	Daytime Actinometry (T) kW/m²				Nighttime Cloud cover		
	T≧0.60	0.60>T≧0.30	0.30>T≧0.15	0.15>T	Overcast (8～10)	Upper layer cloud (5～10) Middle/Lower layer cloud (5～7)	Cloud cover (0～4)
u<2	A	A-B	B	D	D	G	G
2≦u<3	A-B	B	C	D	D	E	F
3≦u<4	B	B-C	C	D	D	D	E
4≦u<6	C	C-D	D	D	D	D	D
6≦u<8	C	D	D	D	D	D	D
8≦u	C	D	D	D	D	D	D

(d) Weather frequency

Weather data measured throughout the year were used, and weather frequency table by wind speed class, wind direction and atmospheric stability was calculated, the result of which is shown in Table VII-3-9

Table VII-3-9 Weather Frequency by Wind Speed Class, Wind Direction and Atmospheric Stability

WV	STB	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CAL	TOTAL
0～	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.69	0.69
	AB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.85	1.85
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.76	0.76
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4.6	4.6
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.37	1.37
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.27	9.27
1～	A	0.01	0.04	0.04	0.08	0.03	0	0	0	0	0	0	0	0.04	0.12	0.08	0.16	0	0.62
	AB	0.03	0.08	0.03	0	0.01	0.04	0.01	0	0	0	0	0	0.01	0.04	0.04	0.11	0	0.41
	B	0.01	0.04	0.01	0	0	0	0	0	0	0	0	0	0	0	0.08	0.05	0	0.21
	D	0	0	0.01	0.04	0.03	0.04	0.03	0.04	0.05	0.12	0.04	0	0.01	0.04	0.07	0.22	0	0.76
	G	0	0	0	0	0	0	0.01	0.04	0.01	0	0	0	0	0	0.01	0.05	0	0.14
	TOTAL	0.05	0.16	0.1	0.12	0.07	0.08	0.05	0.08	0.07	0.12	0.04	0	0.07	0.21	0.29	0.6	0	2.13
2～	AB	0.11	0.12	0.1	0.16	0.14	0.25	0.11	0.08	0.14	0.33	0.23	0.37	0.26	0.41	0.43	0.33	0	3.57
	B	0.15	0.25	0.16	0.25	0.12	0.12	0.14	0.08	0.07	0.12	0.1	0.16	0.16	0.33	0.43	0.44	0	3.09
	C	0.18	0.12	0.16	0.16	0.08	0.08	0.1	0	0.01	0.04	0.01	0	0	0	0.04	0.16	0	1.17
	D	0.44	0.7	0.62	0.74	0.6	0.66	0.45	0.08	0.19	0.29	0.33	0.7	0.73	0.66	0.48	0.77	0	8.45
	E	0.01	0.04	0.04	0.08	0.03	0	0	0	0	0	0	0	0	0	0.07	0	0	0.27
	F	0.03	0.08	0.11	0.25	0.16	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.05	0	1.03
	TOTAL	0.92	1.32	1.2	1.65	1.14	1.15	0.82	0.29	0.44	0.82	0.7	1.28	1.18	1.44	1.47	1.76	0	17.58
3～	B	0.1	0.08	0.18	0.45	0.3	0.45	0.41	0.58	0.7	1.52	0.88	0.91	0.63	0.99	0.37	0.16	0	8.72
	BC	0.04	0.12	0.11	0.21	0.29	0.04	0.03	0.04	0.15	0.41	0.19	0.16	0.23	0.54	0.38	0.27	0	3.23
	C	0.03	0.08	0.12	0.08	0.12	0.08	0.1	0	0.05	0.16	0.05	0	0.04	0.12	0.07	0.11	0	1.24
	D	0.29	0.45	0.62	1.2	1.13	1.36	0.88	0.45	0.7	1.44	0.7	0.66	0.54	0.95	0.44	0.49	0	12.29
	E	0.03	0.08	0.12	0.29	0.37	0.41	0.22	0.04	0.07	0.16	0.05	0	0.01	0.04	0.01	0	0	1.92
	TOTAL	0.48	0.82	1.15	2.23	2.21	2.35	1.63	1.11	1.68	3.71	1.88	1.73	1.46	2.64	1.28	1.04	0	27.4
4～	C	0.05	0.16	0.51	1.36	1.21	1.65	1.52	1.07	0.99	1.9	1.03	0.99	0.69	1.07	0.38	0.11	0	14.7
	CD	0.03	0.08	0.07	0.12	0.07	0.08	0.07	0.12	0.21	0.49	0.27	0.33	0.18	0.21	0.11	0.16	0	2.61
	D	0.1	0.29	0.96	2.39	1.7	1.07	0.98	0.82	1.24	2.88	1.55	1.57	0.81	0.87	0.32	0.11	0	17.65
	TOTAL	0.18	0.54	1.54	3.87	2.98	2.8	2.57	2.02	2.43	5.27	2.86	2.88	1.68	2.14	0.81	0.38	0	34.96
6～	C	0	0	0.23	0.7	0.66	0.66	0.4	0.12	0.16	0.37	0.14	0.04	0.04	0.08	0.03	0	0	3.64
	D	0.01	0.04	0.21	0.58	0.3	0.12	0.05	0.04	0.34	0.99	0.47	0.41	0.19	0.16	0.07	0.05	0	4.05
	TOTAL	0.01	0.04	0.44	1.28	0.96	0.78	0.45	0.16	0.51	1.36	0.6	0.45	0.23	0.25	0.1	0.05	0	7.69
8～	C	0	0	0.04	0.12	0.12	0.04	0.01	0	0.03	0.08	0.03	0	0.01	0.04	0.01	0	0	0.55
	D	0	0	0.01	0.04	0.01	0	0	0	0.01	0.04	0.03	0.04	0.05	0.12	0.04	0	0	0.41
	TOTAL	0	0	0.05	0.16	0.14	0.04	0.01	0	0.04	0.12	0.05	0.04	0.07	0.16	0.05	0	0	0.96
TOTAL		1.65	2.88	4.48	9.31	7.5	7.21	5.55	3.67	5.16	11.41	6.14	6.39	4.68	6.84	4	3.85	9.27	100

3) Diffusion equations

Diffusion equations are based on those shown in "Manual for Areawide Total Pollutant Load Control of Nitrogen Oxide". Plume model is used for windy condition (1.0 m/s or more), and puff model for calm condition (less than 1.0 m/s). All the smoke sources are assumed to be point sources.

Plume equation expresses concentration in a plume streamed leeward by wind, and puff equation expresses concentration in a puff which is released at a point of time and gradually diffuses in the air.

- Plume equation

$$C(R,\ z)=\sqrt{\frac{1}{2\pi}}\ \frac{Q_P}{\frac{\pi}{8}R\,\sigma_z\,u}\left\{\exp\left\{-\frac{(z-He)^2}{2\sigma_z^2}\right\}+\exp\left\{-\frac{(z+He)^2}{2\sigma_z^2}\right\}\right\}$$

C(R, z) : Concentration at point (R, z)
R : Leeward horizontal distance (m)
z : Height from the ground (m)
Q_P : Emission strength of point source (Nm^3/s)
u : Wind speed at stack height (m/s)
H_e : Effective stack height (m)
σ_z : Diffusion width in vertical direction (m)

- Puff equation

$$C(R,\ z)=\frac{Q_P}{(2\pi)^{3/2}\gamma}\left\{\frac{1}{R^2+\frac{\alpha^2}{\gamma^2}(He-z)^2}+\frac{1}{R^2+\frac{\alpha^2}{\gamma^2}(He+z)^2}\right\}$$

C(R, z) : Concentration at point (R, z)
R : Leeward horizontal distance (m)
z : Height from the ground (m)
Q_P : Emission strength of point source (Nm^3/s)
H_e : Effective stack height (m)
α : Diffusion parameter in horizontal direction (m/s)
γ : Diffusion parameter in vertical direction (m/s)

4) Background concentration
Present background concentration obtained by the field measurement as shown in Table VII-3-3 was used as the background concentration for the simulation.

5) NO_2 conversion equation
To convert NO_X concentration to NO_2 concentration, exponent approximation model shown in "Manual for Areawide Total Pollutant Load Control of Nitrogen Oxide" was used.

$$NO_2=NO_X\cdot(1-\alpha/(1+\beta)\cdot(\exp(-K\cdot t)+\beta))$$

$$K=0.208\cdot u\cdot[O_3]_B$$

NO_2 : NO_2 concentration
NO_X : NO_X concentration
α : NO/NO_X ratio near emission source (=0.83[fixed source])
β : Equilibrium constant (=0.3[daytime]、=0.0[nighttime])
t : Diffusion time
u : Wind speed
$[O_3]_B$: Background concentration of ozone

(4) Simulation results
The simulated air quality for annual average concentrations around the new cold rolling mill complex at 1.5 m height from the ground after the commencement of the mill operation is shown in Fig.VII-3-3 to Fig.VII-3-6 , that for one-hour concentrations for the most frequent weather condition in Fig.VII-3-7 to Fig.VII-3-10 and that for one-hour concentrations for the weather condition giving the highest ground-level concentration in Fig.VII-3-11 to Fig.VII-3-14. The maximum ground-level concentration and its contribution ratio for each result are shown in Table VII-3-10.

Table VII-3-10 Maximum Ground-Level Concentration and Contribution Ratio

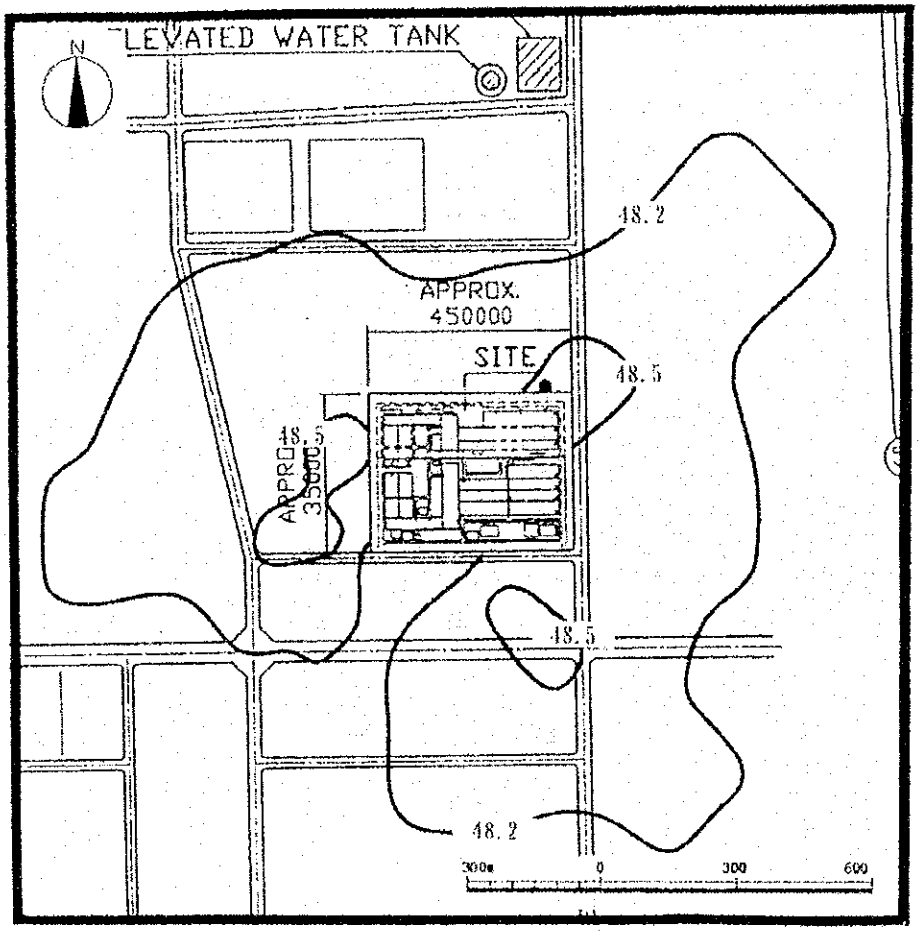
	Annual average concentration		One-hour concentration (Most frequent weather condition)※1		One-hour concentration (Weather condition for highest concentration)※2		Unit of concentration
	Maximum Ground-Level Concentration	Contribution Ratio	Maximum Ground-Level Concentration	Contribution Ratio	Maximum Ground-Level Concentration	Contribution Ratio	
NO_2	0.0487	1.4%	0.0568	15.5%	0.0574	16.4%	mg/m^3
SO_2	0.0896	7.4%	0.1588	47.7%	0.1685	50.7%	mg/m^3
SPM	0.3309	0.3%	0.3406	3.1%	0.3420	3.5%	mg/m^3
HCl	0.0015	-	0.0146	-	0.0134	-	mg/m^3

(Note) For NO_2, SO_2, SPM, the shown concentration is the sum of the complex contribution and the background; for HCl, the shown concentration is the contribution only, because background concentration has not been obtained.

※1…Wind direction: SW, Wind speed: 4m/s, Stability: D

※2…Wind direction: WSW, Wind speed: 6m/s, Stability: D

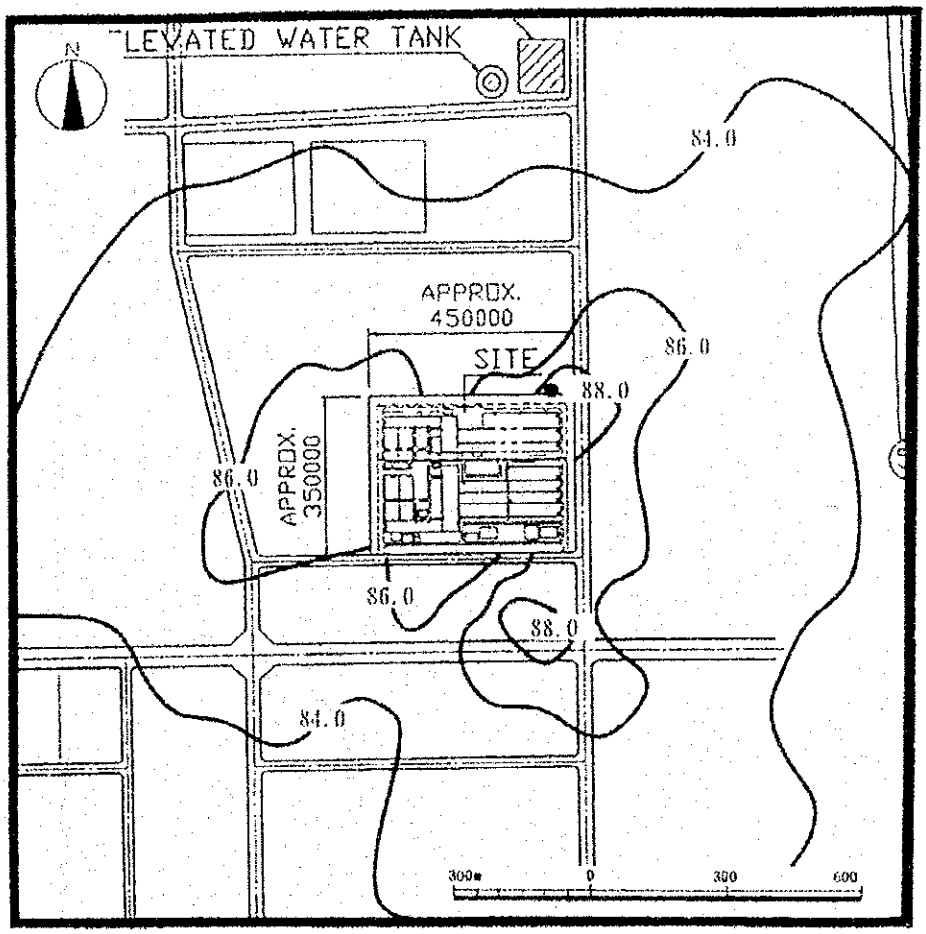
(unit: μg/m^3)



●: Point of maximum ground-level concentration (48.7 μg/m^3)

Fig. VII-3-3 NO_2 Concentration Contours (Annual Average)

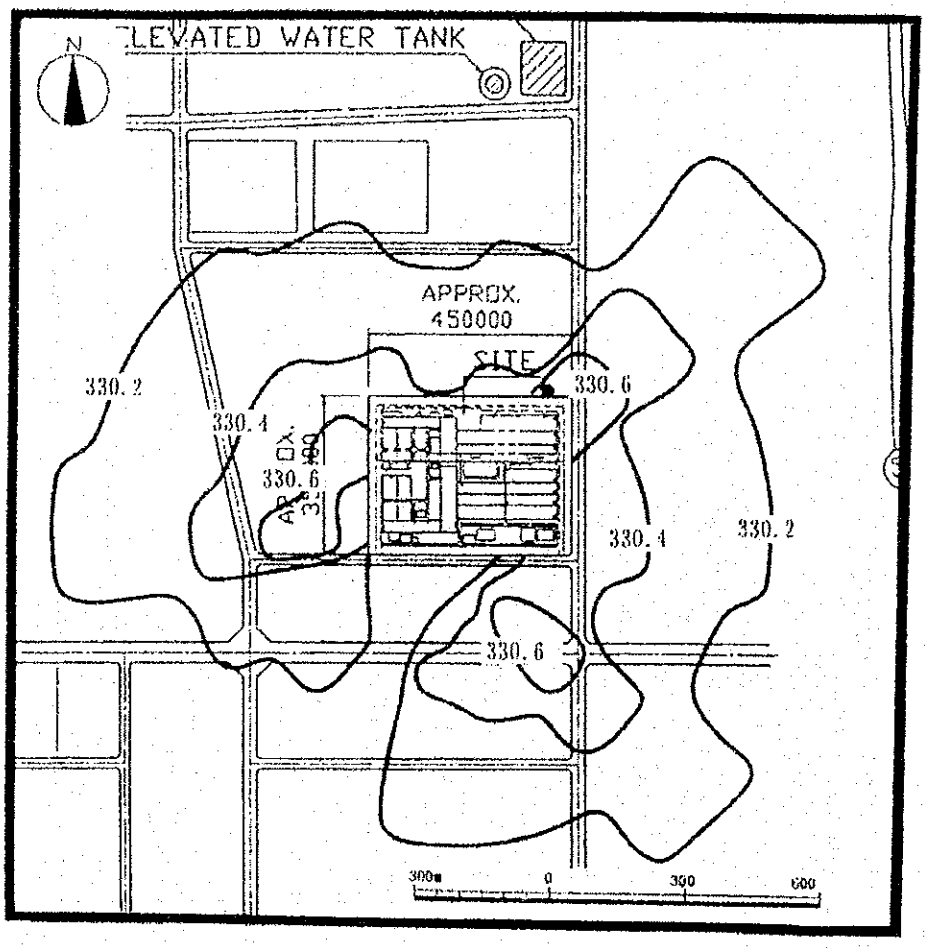
(unit: μg/m^3)



●: Point of maximum ground-level concentration (89.6 μg/m^3)

Fig. VII-3-4 SO_2 Concentration Contours (Annual Average)

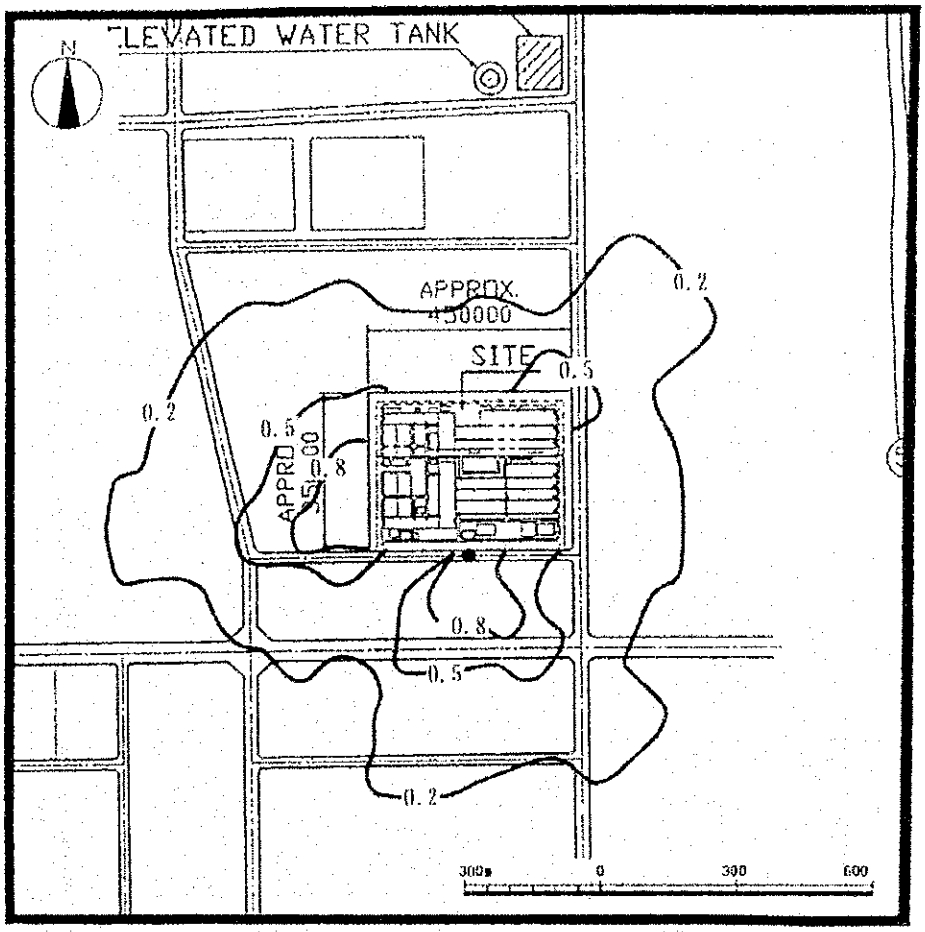
(unit: μg/m³)



●: Point of maximum ground-level concentration (330.9 μg/m³)

Fig. VII-3-5 Suspended Particulate Matter Concentration Contours (Annual Average)

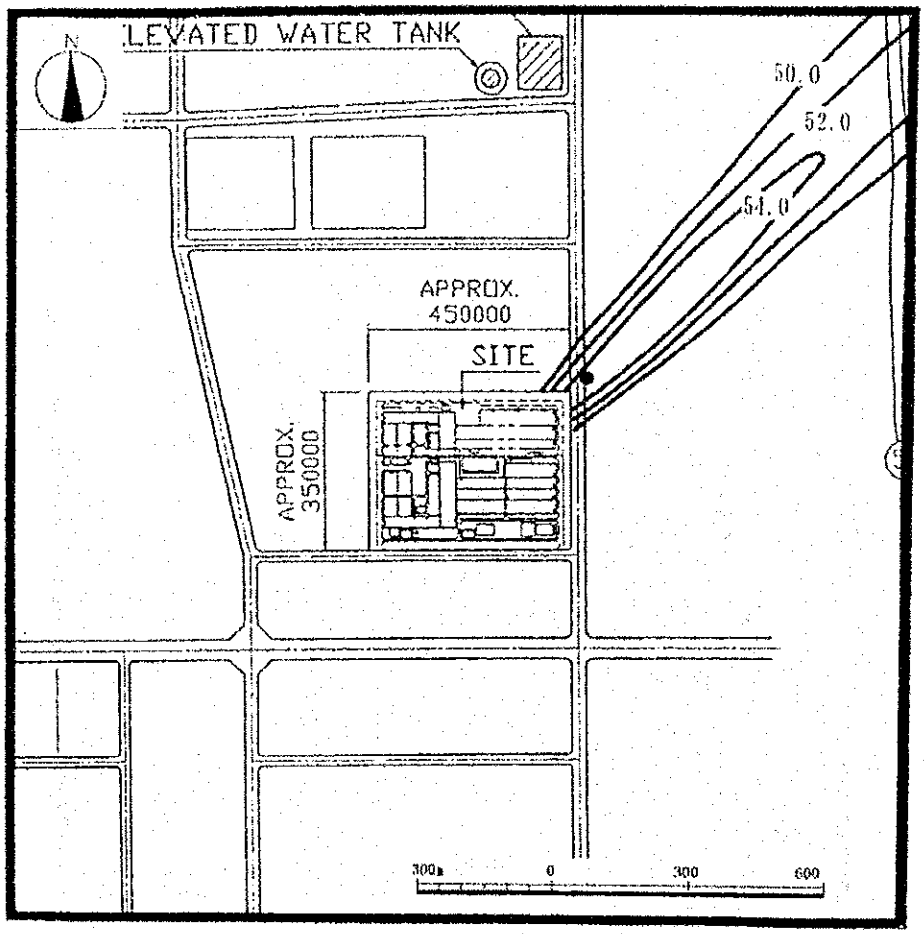
(unit: μg/m^3)



●: Point of maximum ground-level concentration (0.9 μg/m^3)
※HCl concentration comprises the Complex contribution only.

Fig. VII-3-6 HCl Concentration Contours (Annual Average)

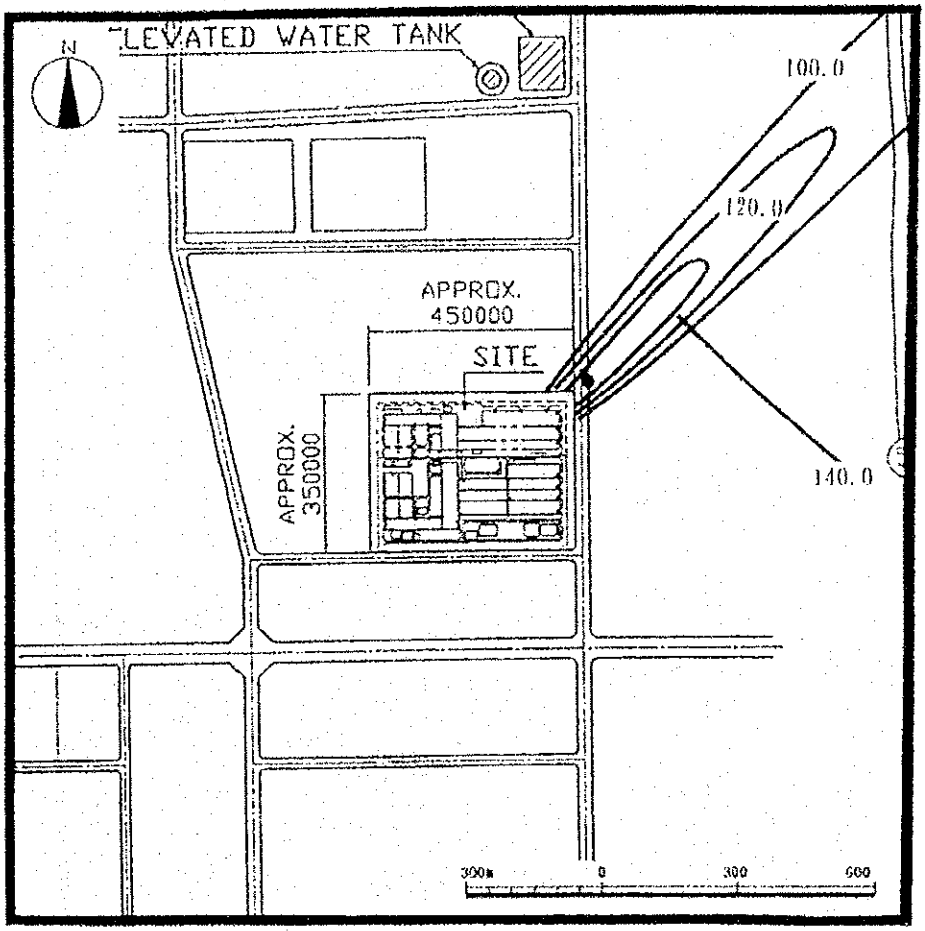
(unit: μg/m^3)



●: Point of maximum ground-level concentration (56.8 μg/m^3)

Fig. VII-3-7 NO_2 Concentration Contours (One-hour [Most Frequent Condition])

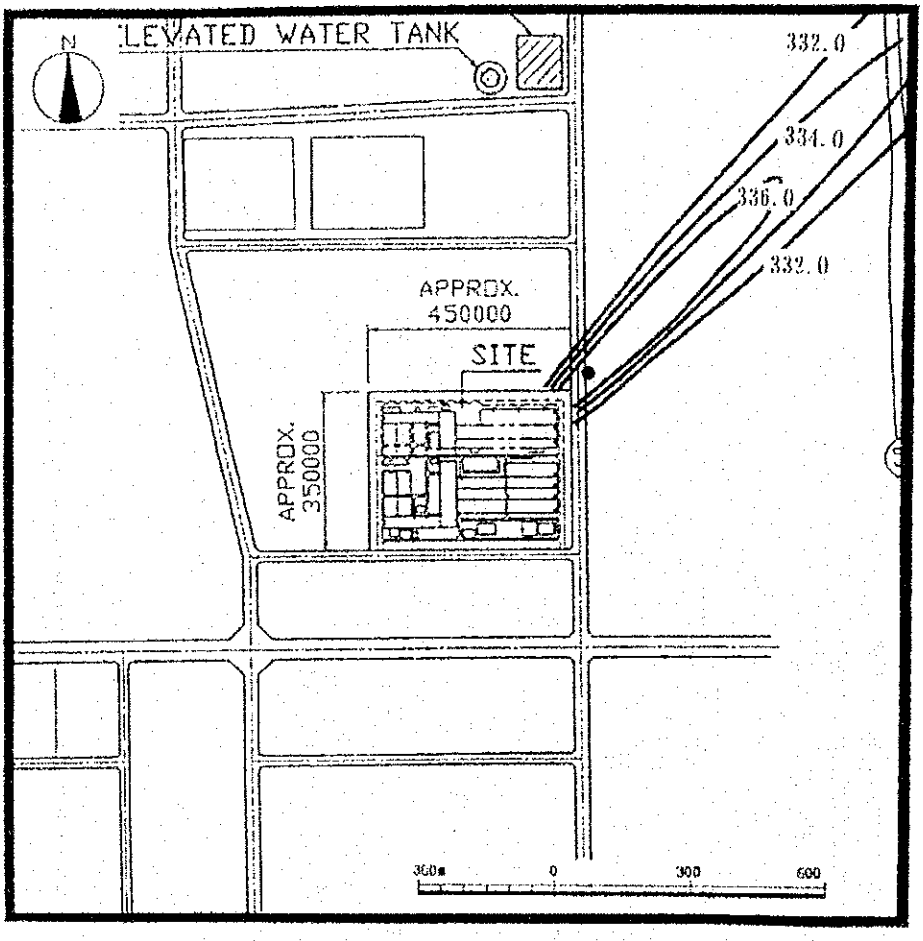
(unit: $\mu g/m^3$)



●: Point of maximum ground-level concentration (158.8 $\mu g/m^3$)

Fig. VII-3-8 SO_2 Concentration Contours (One-hour [Most Frequent Condition])

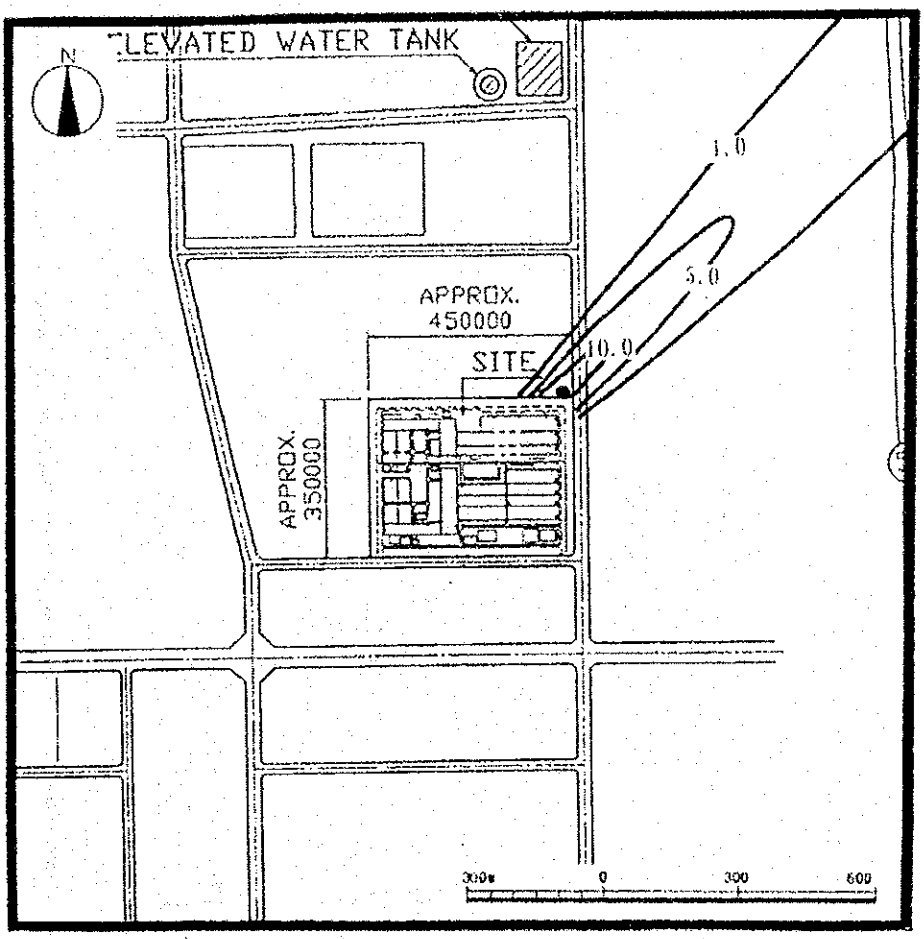
(unit: μg/m^3)



●: Point of maximum ground-level concentration (340.6 μg/m^3)

Fig. VII-3-9 Suspended Particulate Matter Concentration Contours (One-hour [Most Frequent Condition])

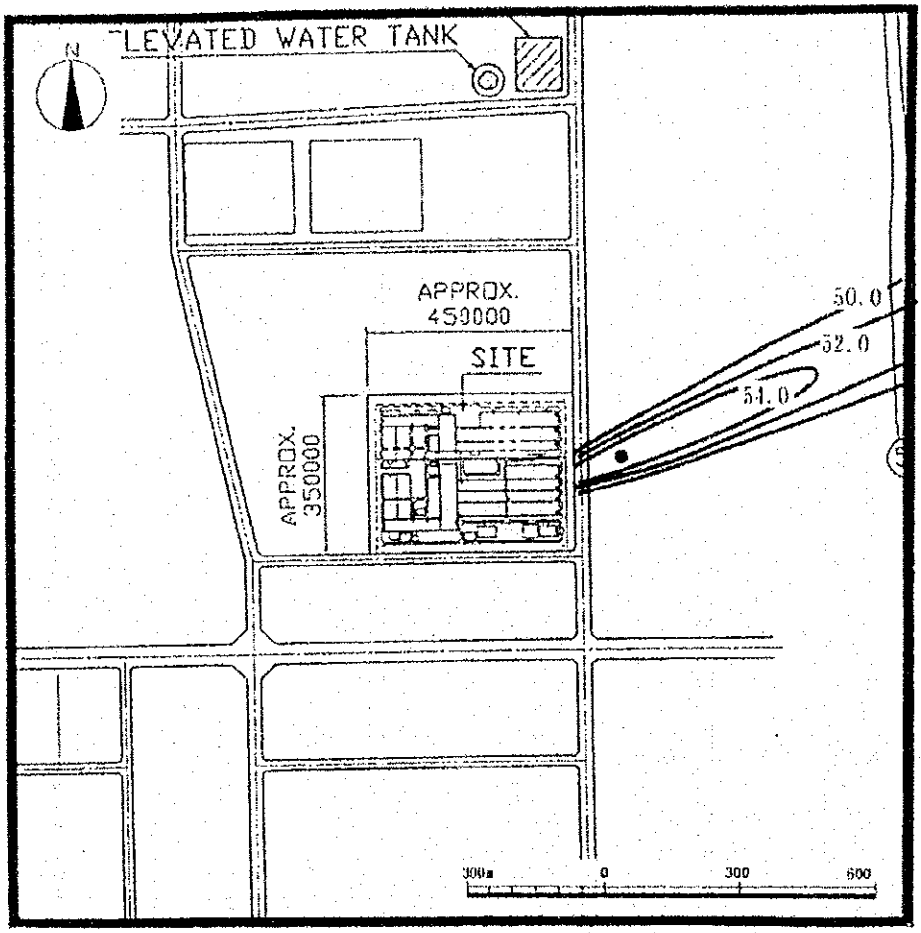
01(unit: μg/m^3)



●: Point of maximum ground-level concentration (9.0 μg/m^3)
※HCl concentration comprises the mill complex contribution only.

Fig. VII-3-10 HCl Concentration Contours (One-hour [Most Frequent Condition])

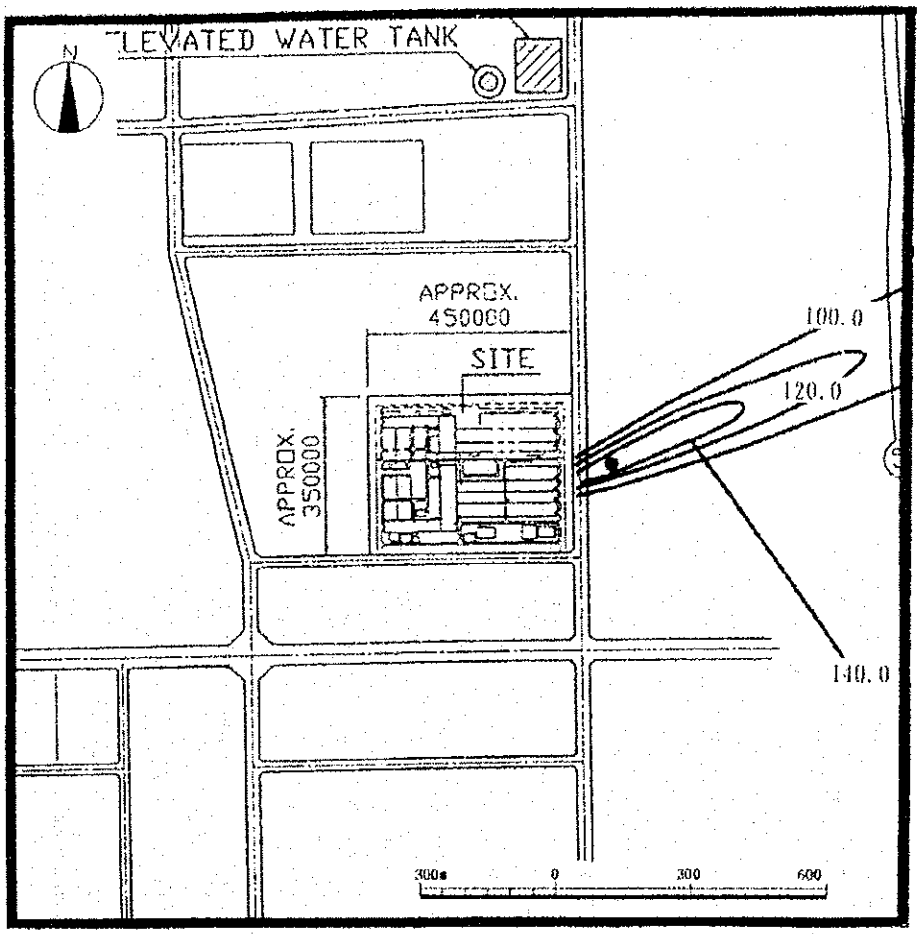
(unit: $\mu g/m^3$)



●: Point of maximum ground-level concentration (57.4 $\mu g/m^3$)

Fig. VII-3-11 NO_2 Concentration Contours (One-hour [Highest Concentration Condition])

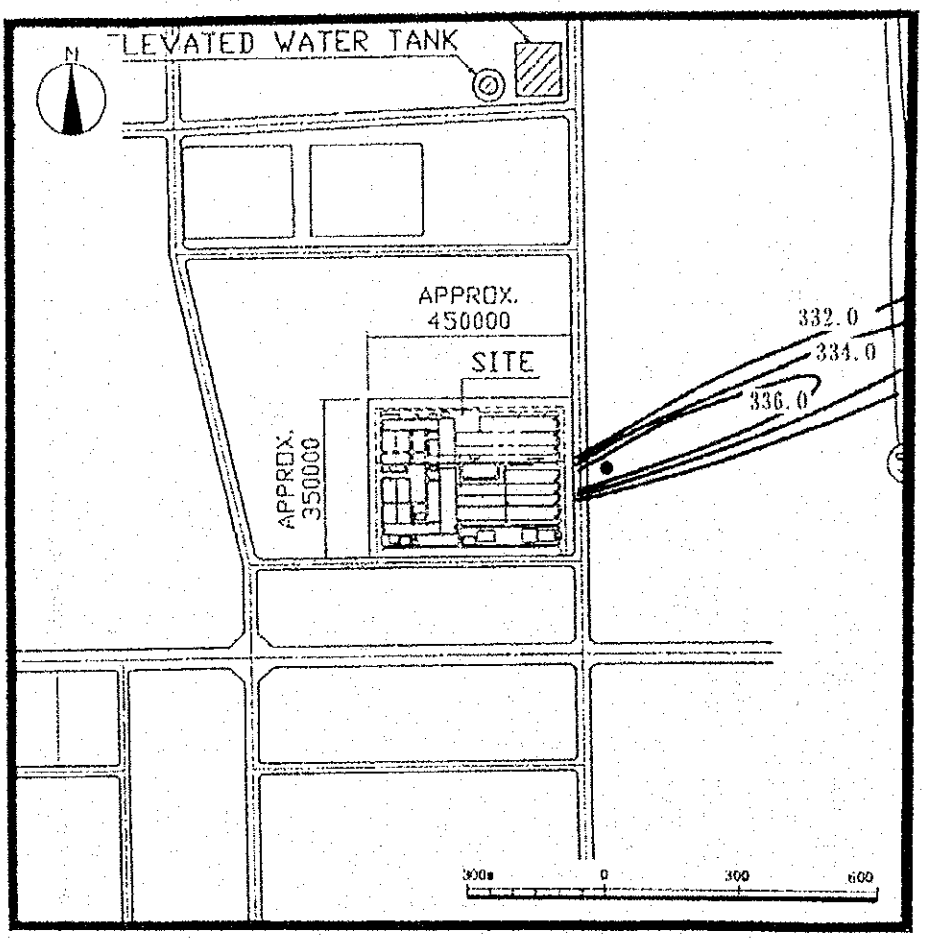
(unit: μg/m^3)



●: Point of maximum ground-level concentration (168.5 μg/m^3)

Fig. VII-3-12 SO_2 Concentration Contours (One-hour [Highest Concentration Condition])

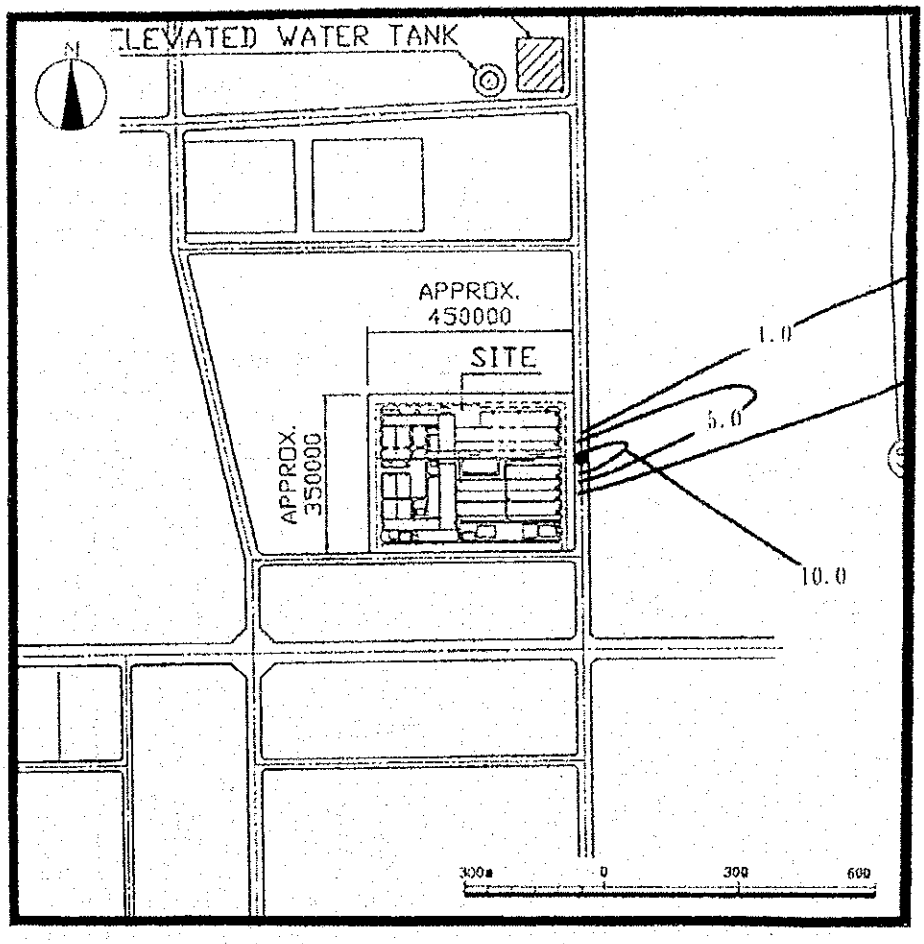
(unit: μg/m^3)



●: Point of maximum ground-level concentration (342.0 μg/m^3)

Fig. VII-3-13 Suspended Particulate Matter Concentration Contours (One-hour [Highest Concentration Condition])

(unit: μg/m^3)



●: Point of maximum ground-level concentration (8.2 μg/m^3)
※HCl concentration comprises the Complex contribution only.

Fig. VII-3-14 HCl Concentration Contours (One-hour [Highest Concentration Condition])

(5) Evaluation

The maximum ground-level concentrations in the above simulation and the environmental standard values are shown in Table VII-3-11.

As for NO_2, SO_2, and HCl, the annual average concentration and one-hour concentration are less than the standard values. But those of Suspended Particulate Matter (SPM) exceed the standard values, since the SPM background concentration (0.33 mg/m^3) already exceeds the standard value by itself. The contribution ratio of the new cold rolling mill complex, however, is 0.3% for the annual average concentration, and is 3 to 4 % for one-hour concentrations for both the most frequent weather condition and the highest concentration condition, thus it is considered that the impact on the air environment of the surrounding area is limited .

Table VII-3-11 Evaluation of Air Quality Impact of the New Cold Rolling Mill Complex

	Annual average concentration			One-hour concentration (Most frequent condition)※1			One-hour concentration (Highest concentration condition)※2			Unit of concentration
	Maximum ground-level concentration	Standard value	Decision	Maximum ground-level concentration	Standard value	Decision	Maximum ground-level concentration	Standard value	Decision	
NO_2	0.0487	0.1000	○	0.0568	0.4000	○	0.0574	0.4000	○	mg/m^3
SO_2	0.0896	0.3000	○	0.1588	0.5000	○	0.1685	0.5000	○	mg/m^3
SPM	0.3309 (0.3%)	0.2000	×	0.3406 (3.1%)	0.3000	×	0.3420 (3.5%)	0.3000	×	mg/m^3
HCl	0.0015	3.2589	○	0.0146	3.2589	○	0.0134	3.2589	○	mg/m^3

(Note) For NO_2, SO_2, Suspended Particulate Matter (SPM), the shown concentration is the sum of the Complex contribution and the background; for HCl, the shown concentration is the contribution only, because background concentration has not been obtained.

※1…Wind direction: SW, Wind speed: 4m/s, Stability: D

※2…Wind direction: WSW, Wind speed: 6m/s, Stability: D

3.3.2 Noise

(1) Outline

The impact of the noise emitted from the new cold rolling mill complex on the surrounding environment is studied.

(2) Environmental standard

The limited noise value at the boundary of the new cold rolling mill complex is set at 65 dB(A).

(3) Simulation

1) Simulated items

The noise emitted by the new cold rolling mill complex is simulated for the following two cases ;

Case 1: ARP exhaust fan is placed close to the site boundary (original layout),
Case 2: ARP exhaust fan is placed away from the site boundary (alternative layout).

2) Simulation method

(a) Area of simulation

The objective area of noise level simulation is the area which is 800 m long in east-west direction and 700m long in north-south direction, including the mill site. The east-west direction of this area is divided into 32 equal elements, and the north-south direction into 28 equal elements. The calculations are carried out on each grid point at 1.2 m height from the ground.

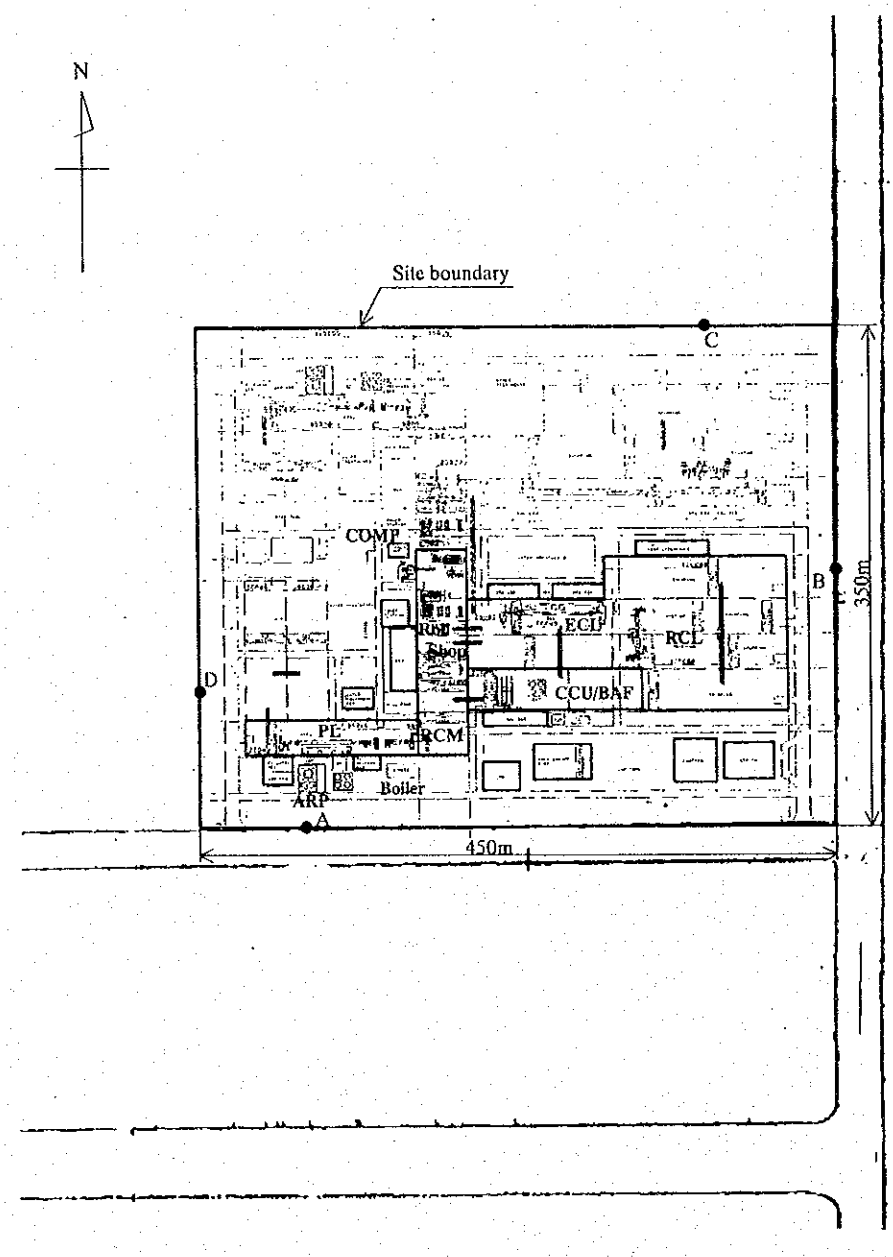


Fig. VII-3-15 Simulation Area for Noise

(b) Simulation condition

a) Noise sources

Noise sources of the new cold rolling mill complex are shown in Table VII-3-12. The locations of noise sources are shown in Fig. VII-3-16 and Fig. VII-3-17.

Table VII-3-12 Noise Data of the New Cold Rolling Mill Complex

unit : dB(A)

No.	Large group of equipment	Small group of equipment	O.A.	1/1 octave band middle frequency (Hz)								Literature
				63	125	250	500	1k	2k	4k	8k	
1	PL	Oil hydraulic pumps (2 points)	95	64	74	82	87	90	90	85	76	A
2		Dryer	95	66	74	83	87	86	85	89	89	B
3		Side trimmer	95	57	69	79	87	89	90	86	86	B
4		Fume exhaust fan	95	74	82	85	91	90	85	79	79	B
5	ARP	Exhaust gas fan	90	69	77	80	86	85	80	74	74	B
6	RCM	Oil hydraulic pump	95	64	74	82	87	90	90	85	76	A
7		Fume exhaust fan	95	74	82	85	91	90	85	79	79	B
8		Air wiper	95	66	74	83	87	86	85	89	89	B
9	Roll Shop	Shot dull machine	90	40	56	65	73	79	87	86	75	A
10	Compressor	Compressor	95	75	82	83	86	90	91	81	81	B
11	ECL	Oil hydraulic pump (2 points)	95	64	74	82	87	90	90	85	76	A
12		Fume exhaust fan	95	74	82	85	91	90	85	79	79	B
13		Dryer	95	66	74	83	87	86	85	89	89	B
14	BAF	Blower (4 points)	85	56	64	73	77	76	75	79	79	B
15	CCU	Blower	95	66	74	83	87	86	85	89	89	B
16	RCL	Oil hydraulic pump	95	64	74	82	87	90	90	85	76	A
17		Tension Leveler	95	61	74	86	91	87	86	84	84	B
18		Side Trimmer	95	57	69	79	87	89	90	86	86	B
19	Boiler	Exhaust gas fan	90	69	77	80	86	85	80	74	74	B

Note : Literature A: Society of Noise Control Engineering, Japan, "Plans for Regional Sound Environment",
Literature B: Japan Materials Association, "Handbook for Controlling Noise and Vibration"

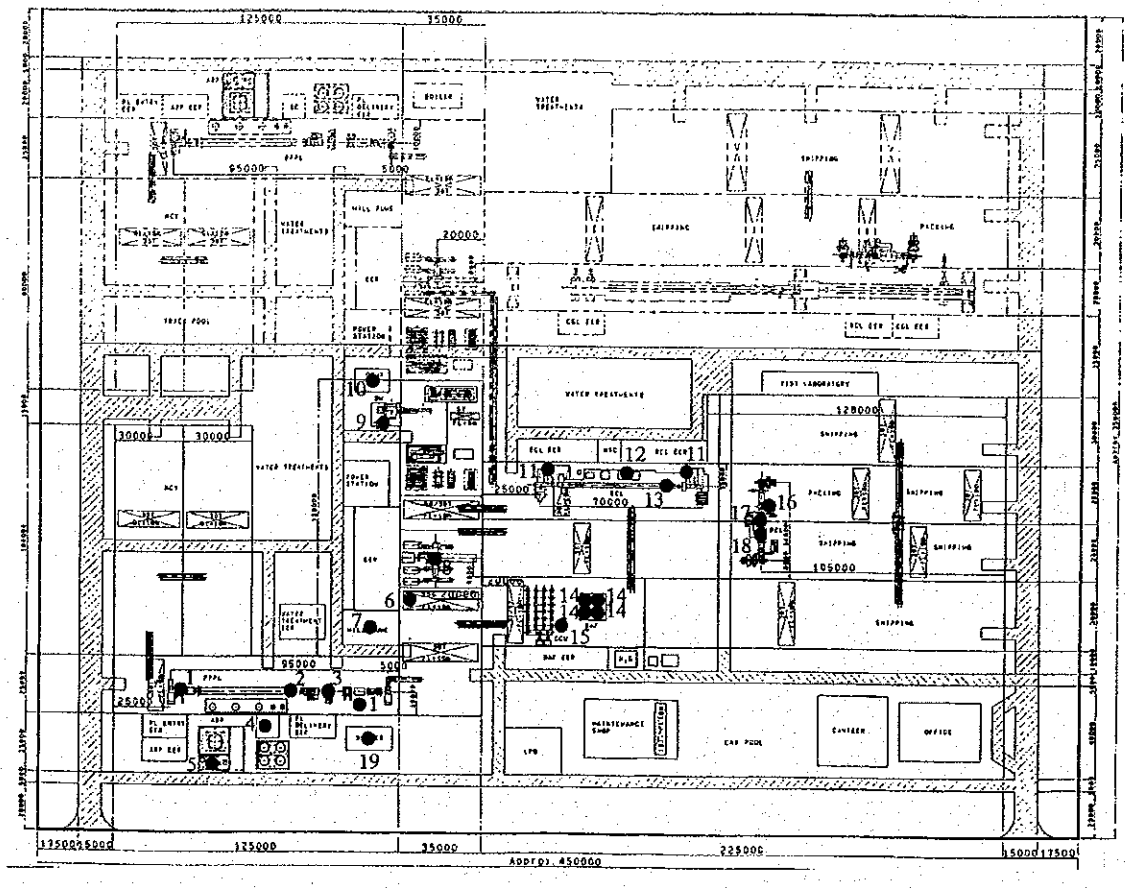


Fig. VII-3-16 Location of Noise Source Equipment (Case 1)

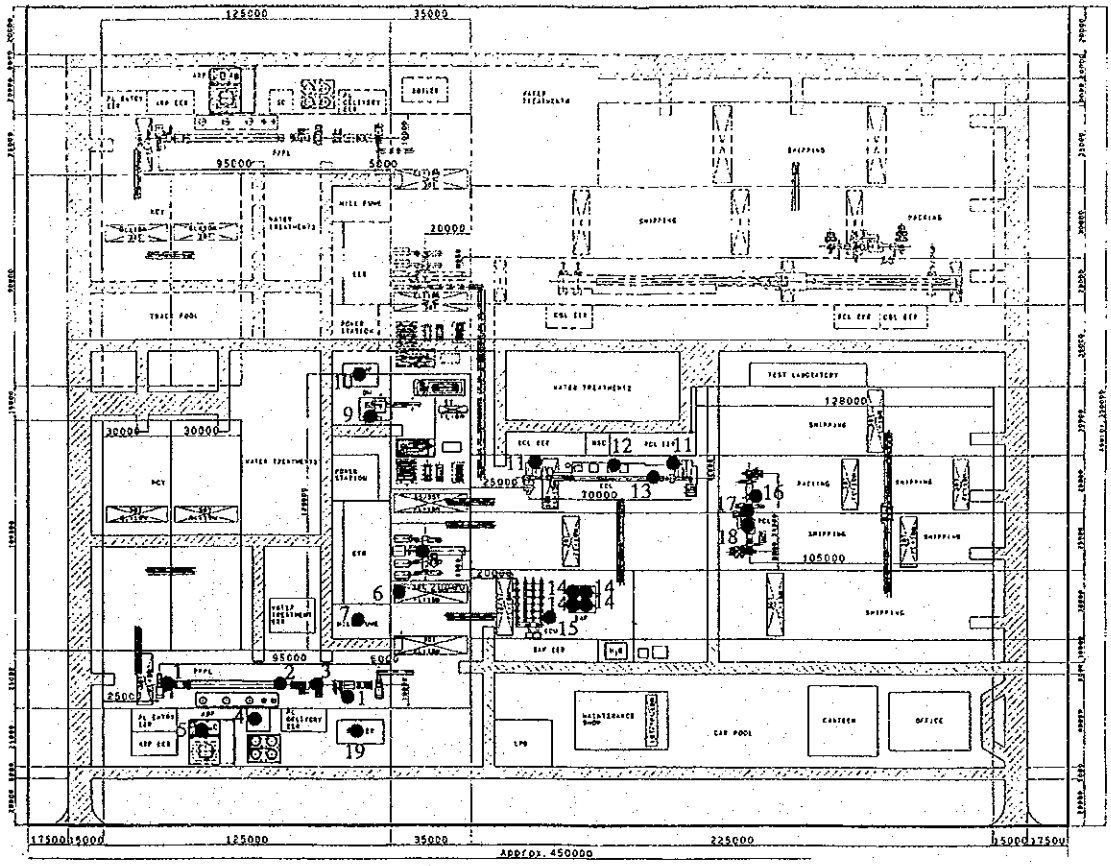


Fig. VII-3-17 Location of Noise Source Equipment (Case 2)

b) Structure and materials of the building

The building structure of the new cold rolling mill complex is assumed such that the outer wall is made of small-pitch wavy colored steel sheet, the ceiling of large-pitch wavy colored steel sheet and the floor of concrete. Acoustic properties of each structural members are shown in Table VII-3-13 and Table VII-3-14. Transmission loss of the monitors fitted to the ceiling is assumed zero.

Table VII-3-13 Sound Absorption Coefficient of Materials

Member	1/1 octave band (Hz)							
	63	125	250	500	1k	2k	4k	8k
Colored steel sheet	0.04	0.04	0.04	0.05	0.05	0.05	0.07	0.07
Concrete	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03

Note : Cited from manufacturer's data (Sasakura)

Table VII-3-14 Sound Transmission Loss of Materials

unit : dB

Member		1/1 octave band (Hz)							
		63	125	250	500	1k	2k	4k	8k
Small-pitch wavy colored steel sheet	0.4mm	11	16	14	18	23	25	26	26
Large-pitch wavy colored steel sheet	0.6mm	3	8	12	15	23	20	28	28

Note1 : Reference: Japan Society of Architects, "Practical guide for noise control"
Note2 : Transmission loss is reduced to 80% for simulation.

Heights of the buildings of the new cold rolling mill complex and other facilities are shown in Table VII-3-15..

Table VII-3-15 Height of Buildings

Building name		Height (m)
PL		14.3
RCM		19.5
Compressor		5.0
ECL		17.8
CCU/BAF		24.5
RCL		19.0
Electricity chamber	ARP	5.0
	PL ENTRY	5.5
	PL DELIVERY	5.0
	RCM	6.5
	BAF	6.5
	ECL	6.0
	RCL	6.0
TEST LABORATORY		5.0
MAINTENANCE SHOP		10.0
CANTEEN		5.0
OFFICE		10.0

(c) Simulation method

Simulation of noise emitted by the new cold rolling mill complex is performed in such a way that indoor noise level is calculated based on the sound power level of the noise sources, and transmitted noise level at outside of the wall based on the level at inside of the wall, and then outdoor noise propagation is calculated based on the noise level at outside of the wall.

a) Calculation of indoor noise level

$$Lp_{(in)} = Lw + 10\log\left(\frac{Q}{4\pi r^2} + \frac{4}{R}\right)$$

$$R = \frac{S \cdot \alpha}{(1-\alpha)}$$

where,

$Lp_{(in)}$: Noise level at inner side of the wall (dB(A))
Lw : Sound power level of sound source equipmnt (dB(A))
r : Distance from sound source equipment to the wall (m)
R : Room constant (m^2)
Q : Directivity factor of sound source equipment (= 2)
S : Total area of the room (m^2)
α : Mean sound absorption coefficient (-)

b) Calculation of transmitted noise level at outside of the wall

$$Lp_{(out)} = Lp_{(in)} - TL - 6$$

where,

$Lp_{(out)}$: Noise level transmitted to outside of the wall (dB(A))
$Lp_{(in)}$: Noise level at inner side of the wall (dB(A))
TL : Transmission loss of the wall (dB)

c) Calculation of outdoor distribution

$$L_r = L_w - 10\log(2\pi r^2) - \alpha_d$$

where,

L_r : Noise level at distance r(m) from sound source (dB(A))
L_w : Power level of sound source (dB(A))
α_d : Diffraction attenuation (dB)

For equations for diffraction attenuation, refer to 3.3.2 (5).

Calculation is performed for each of the middle frequency of 1/1 octave band, and noise level at any point is obtained by its energy-based summation.

3) Results of simulation

Noise level distribution when all of the equipment is in operation is shown in Fig.VII-3-18 and Fig.VII-3-19. Noise level distribution around Point A is shown in Fig. VII-3-20 and Fig. VII-3-21. Noise levels at representative points on the site boundary are shown in Table VII-3-16. The maximum noise level on the site boundary were predicted at point A as 65.1dB(A) for Case 1, and 64.1dB(A) for Case 2.

Table VII-3-16 Results of Noise Simulation

unit : dB(A)

Sound source			Case 1				Case 2			
			South	East	North	West	South	East	North	West
No.	Larger group of equipment	Small group of equipment	A	B	C	D	A	B	C	D
-	Main works building		54.8	60.9	55.1	54.7	54.8	60.9	55.1	54.7
4	PL	Fume exhaust fan	61.8	0.0	0.0	0.0	61.8	0.0	0.0	0.0
5	ARP	Exhaust gas fan	61.1	0.0	0.0	20.3	58.2	0.0	0.0	0.0
7	RCM	Fume exhaust fan	32.4	0.0	0.0	44.9	32.4	0.0	0.0	44.9
9	Roll Shop	Shot dull machine	0.0	0.0	8.8	43.3	0.0	0.0	8.8	43.3
10	COMP	Compressor	0.0	21.9	41.3	47.8	0.0	21.9	41.3	47.8
19	BOILER	Exhaust gas fan	50.5	0.0	0.0	0.0	50.5	0.0	0.0	0.0
Total			65.1	60.9	55.2	56.1	64.1	60.9	55.2	56.1

Note 1 : Case 1: ARP exhaust gas fan is placed close to the site boundary.

Note 2 : Case 2: ARP exhaust gas fan is placed away from the site boundary.

(4) Evaluation

If ARP exhaust gas fan is placed close to the site boundary (Case 1), the maximum noise level is estimated to be 65.1dB(A) on the southern boundary, thus exceeding the regulated value of 65dB(A). On the other hand, if ARP exhaust gas fan is placed away from the site boundary (Case 2), the maximum is estimated to be 64.1dB(A) on the southern boundary, thus falling below the regulated value.

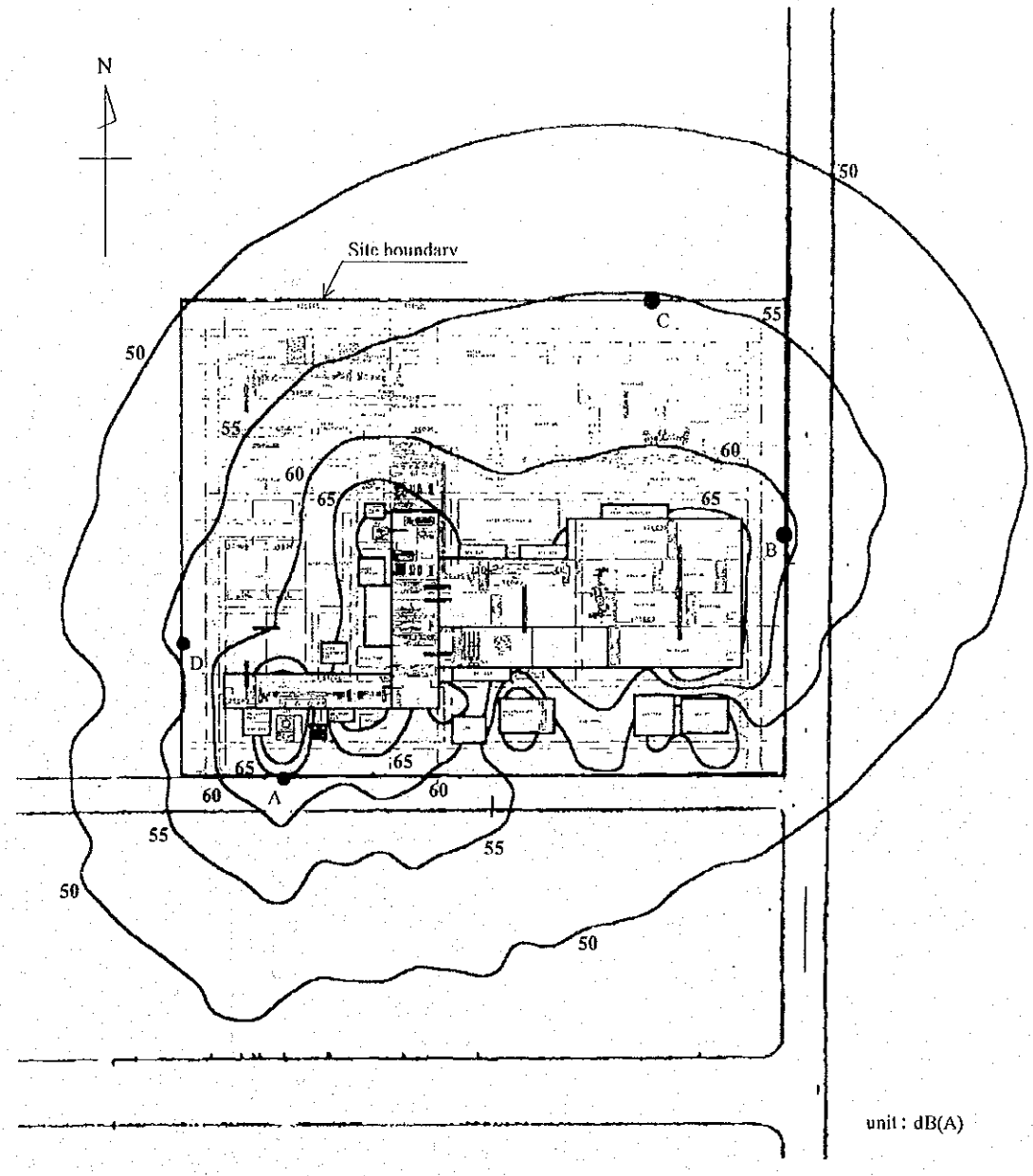


Fig. VII-3-18 Noise Level Contours (Case 1)

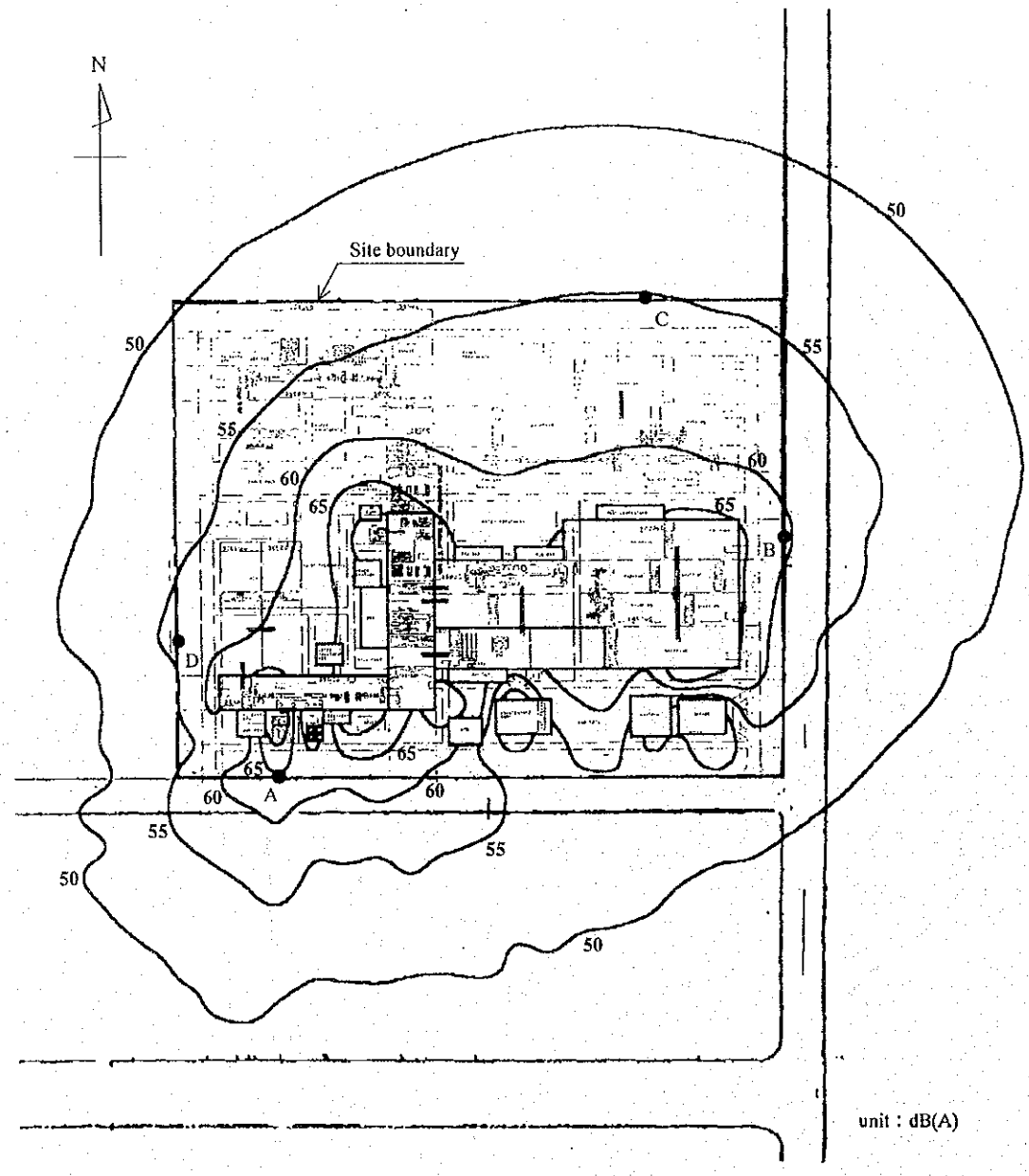


Fig. VII-3-19 Noise Level Contours (Case 2)

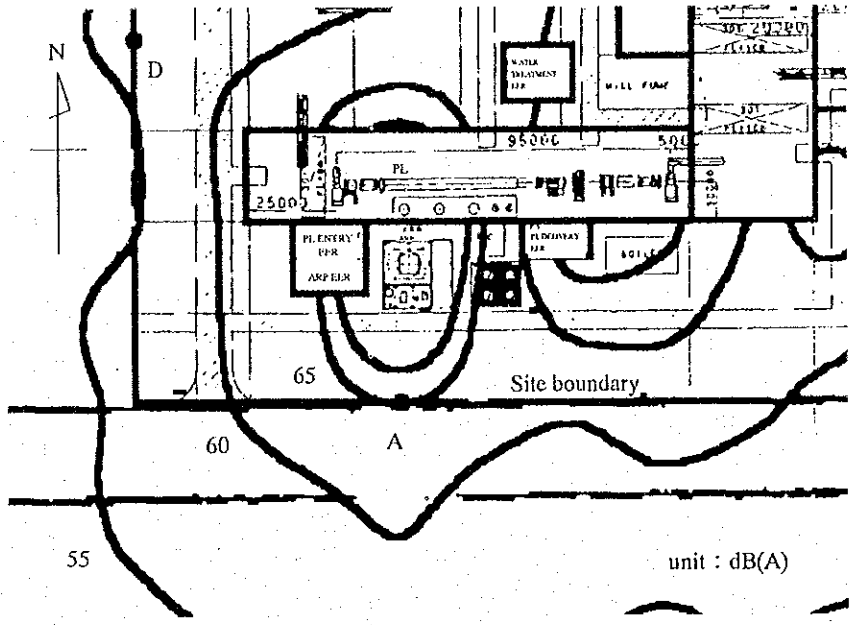


Fig. VII-3-20 Detailed Noise Level Contours around Point A (Case 1)

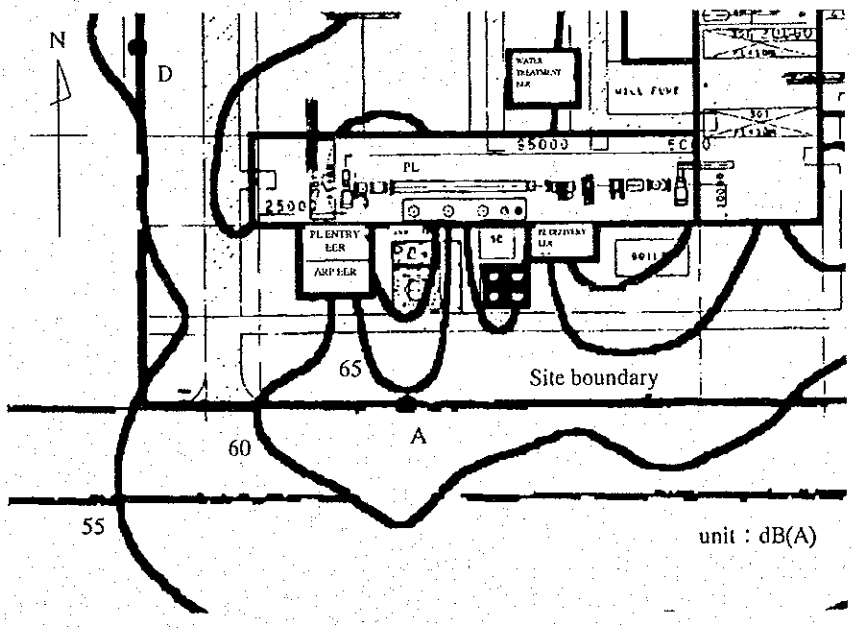


Fig. VII-3-21 Detailed Noise Level Contours around Point A (Case 2)

(5) Others

How to deal with diffraction attenuation is discussed here.

Diffraction attenuation is expressed as

$$\Delta L = \log_{10}\left|\frac{P}{P_{atL}}\right|$$

To deal with diffraction attenuation, we used Pierce's first approximation equation, which yields good accuracy and is easy to treat. It is as follows:

$$\left|\frac{P}{P_{atL}}\right|^2 = \frac{1}{2}\left\{f(X_+) + f(X_-)\right]^2 + \left[g(X_+) + g(X_-)\right]^2\right\}$$

where,

ΔL : Attenuation due to diffraction (dB)

P : Sound pressure level at receiving point (dB)

$PatL$: Sound pressure level at L(m) from sound source where there are no obstacles (dB)

f(X) and g(X) in the above equation are auxiliary functions of Fresnel integration, which are

$$f(X) = \left[\frac{1}{2} - S(X)\right]\cos\left(\frac{1}{2}\pi X^2\right) - \left[\frac{1}{2} - C(X)\right]\sin\left(\frac{1}{2}\pi X^2\right)$$

$$g(X) = \left[\frac{1}{2} - C(X)\right]\cos\left(\frac{1}{2}\pi X^2\right) + \left[\frac{1}{2} - S(X)\right]\sin\left(\frac{1}{2}\pi X^2\right)$$

where, S(X) and C(X) are Fresnel integration, which are

$$C(X) = \int_0^X \cos\left(\frac{1}{2}\pi t^2\right)dt$$

$$S(X) = \int_0^X \sin\left(\frac{1}{2}\pi t^2\right)dt$$

$X_\pm$ is expressed as follows:

$$X_\pm = \sqrt{\frac{2rr_0}{\lambda L}}\left|\frac{\cos\left(\pi^2/\beta\right) - \cos\left[(\pi/\beta)(\theta \pm \theta_0)\right]}{(\pi/\beta)\sin\left(\pi^2/\beta\right)}\right|$$

The Notation in the above equation are as follows:

L : Distance from sound source to receiving point via diffraction point (m)

r : Length of perpendicular drawn from receiving point to diffraction edge (m)

ro : Length of perpendicular drawn from sound source to diffraction edge (m)

4. Proposals for Environmental Countermeasures

The new cold rolling mill complex is considered not to affect the surrounding environment much. When the new cold rolling mill complex is constructed, the following points and comments are recommended to be confirmed from environmental point of view ;

4.1 Air Quality

According to the results of the air quality simulation, the annual average concentration and one-hour concentration of NO_2, SO_2 and HCl are less than the standard values. On the other hand those of the suspended particulate matter exceed the standard values and this is simply because the background concentration of the suspended particulate matter (0.33 mg/m^3) already exceeds the standard value by itself. The contribution ratio by the new cold rolling mill complex is 0.3% for the annual average concentration, and 3 to 4 % for one-hour concentrations for both the most frequent weather condition and the highest concentration condition. Thus it is considered that the impact of the new cold rolling mill complex on the air environment of the surrounding area is small. The present condition of the suspended particulate matter, namely the excessive amount of the suspended particulate matter has to be investigated deeply before the construction of the new cold rolling mill complex.

According to the results of the investigation on air quality in Phu My Industrial Zone, it seems appropriate for CO and ozone to be investigated deeply although the construction of the new cold rolling mill complex by no means affects them.

4.2 Water Quality

Phu My Industrial Zone has a plan to install a final treatment plant for the waste water, and "C" standards of TCVN5945-1995 are applied. Accordingly, the new cold rolling mill complex is to be designed to satisfy the "C" standards first. Furthermore, the capacity and specification of the final treatment plant for the waste water is to be designed to meet the "B" standards of TCVN5945-1995.

According to the results of the water quality of Thi Vai River, it seems appropriate for the mercury and the mineral oil and fat to be investigated deeply although the construction of the new cold rolling mill complex by no means affects them.

4.3 Noise

According to the results of noise simulation, the maximum noise level for the original layout of the new cold rolling mill complex exceeds the limit value. The most strict point is south boundary near the ARP, and the original layout seems to require some alteration. One of the possibile countermeasures is to remove the ARP fan as far as possible from the south site boundary.

4.4 Others

When Vina Kyoei, which is located in Phu My Industrial Zone, installs an EAF, the scale and sludge from the new cold rolling mill complex can be recycled as the raw materials for the EAF.

With regard to the waste acid, there is a company in HCM city which performs the treatment. After the necessary investigation, however, it has been found that the company is not appropriate for the treatment of the waste acid from the new cold rolling mill complex due to its treatment method and treatment capacity. Accordingly, the outside contractor shall not be used and Acid Regeneration Plant, ARP is required to be installed beside the Pickling Line.