

Appendix 7 Solar Panel Reflection Simulation

Solar Panel Reflection Simulation (Tbilisi International Airport: Parking)

Panel Direction: 223.3 ° (South West)

Panel Slope: 25 °

※True North (0 degree), True South (180 degree)

1. March

Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
8:00	99.8	8.36	–	–	No reflection up to 133° in direction or 25° in altitude
9:00	110	19.2	–	–	No reflection up to 133° in direction or 25° in altitude
10:00	122	29.4	302.0	-20.6	Reflection might affect driving cars
11:00	137	38.1	310.0	88.1	
12:00	155	44.4	292.0	85.6	
13:00	176	47.1	271.0	82.9	
14:00	198	45.6	249.0	84.4	
15:00	217	40.3	229.0	89.7	
16:00	233	32.2	213.0	82.2	
17:00	246	22.4	200.0	72.4	
18:00	257	11.7	189.0	61.7	
19:00	267	0.52	179.0	50.5	

2. June

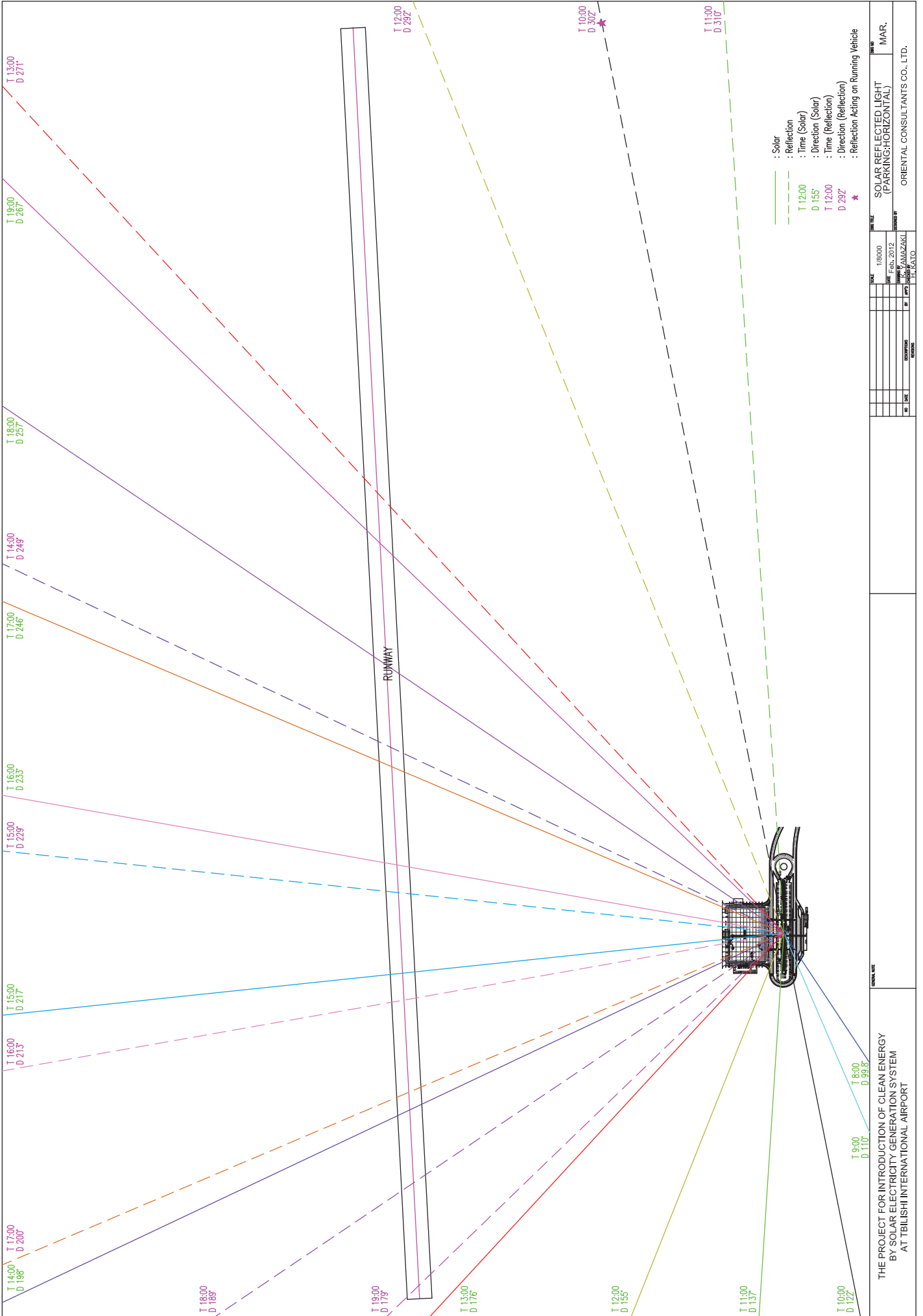
Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
6:00	63.1	4.51	–	–	No reflection up to 133° in direction or 25° in altitude
7:00	72.2	14.9	–	–	No reflection up to 133° in direction or 25° in altitude
8:00	81.1	25.9	261.1	-24.1	Reflection might affect driving cars
9:00	90.9	37.2	270.9	-12.8	Reflection might affect driving cars
10:00	101	48.5	281.0	-1.5	Reflection might affect airplanes
11:00	116	59.2	296.0	9.2	Reflection might affect airplanes
12:00	140	68.1	307.0	61.9	
13:00	180	72.0	267.0	58.0	
14:00	219	68.0	228.0	62.0	
15:00	243	59.0	203.0	71.0	
16:00	258	48.3	188.0	81.7	
17:00	269	37.1	177.0	87.1	
18:00	279	25.8	167.0	75.8	
19:00	287	14.8	159.0	64.8	
20:00	297	4.38	149.0	54.4	

3. December

Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
9:00	128	6.42	308.0	–	No reflection up to 133° in direction or 25° in altitude
10:00	139	14.6	295.0	64.60	
11:00	152	20.9	281.0	70.90	
12:00	166	24.9	266.0	74.90	
13:00	181	26.0	250.0	76.00	
14:00	197	24.2	235.0	74.20	
15:00	211	19.5	234.0	69.50	
16:00	223	12.7	212.0	62.70	
17:00	234	4.1	392.6	54.10	

* Solar light direction and altitude are given by NASA

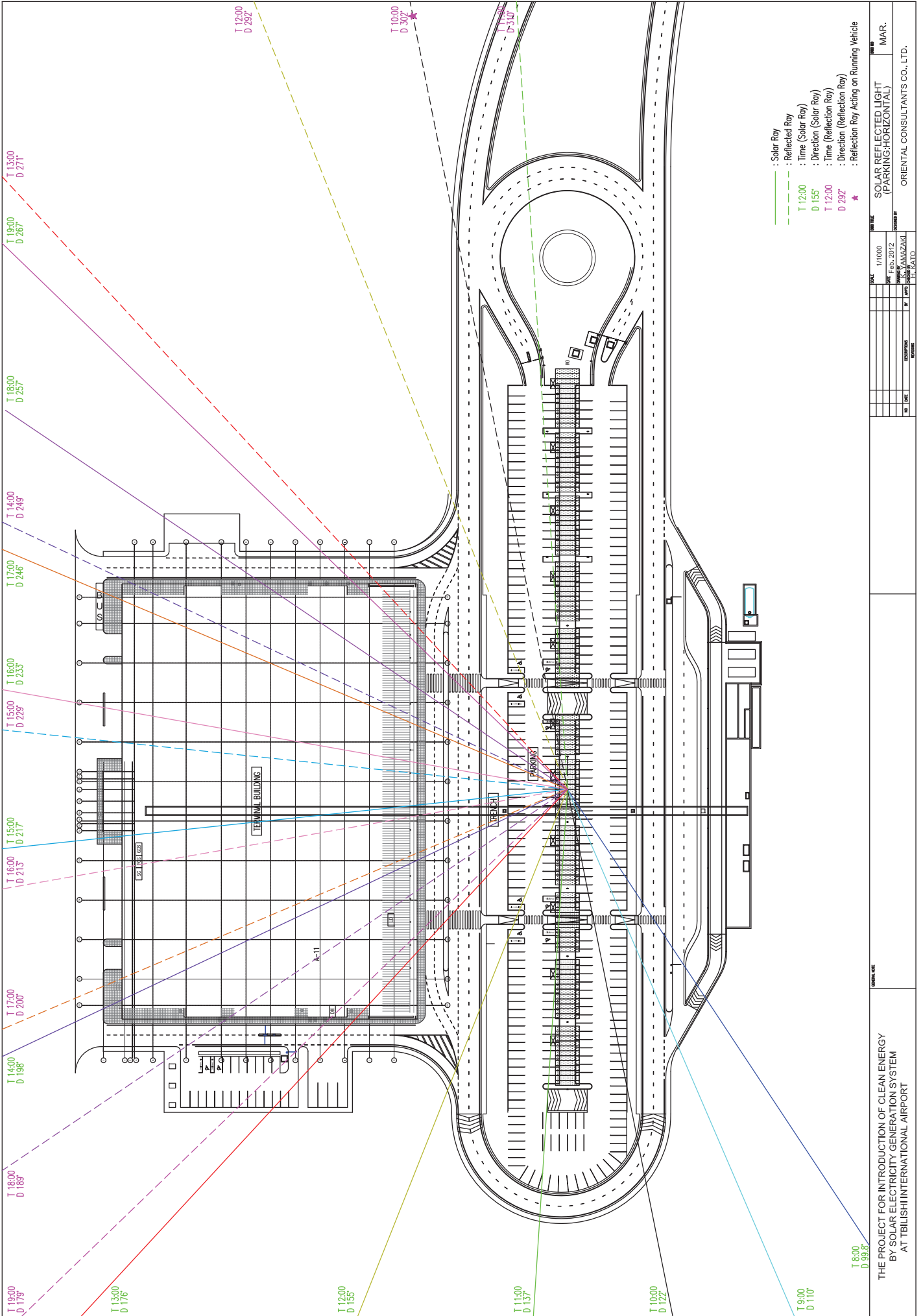
7. Solar Panel Reflection Simulation



SCALE		1:8000
DATE		Feb. 2012
DRAWN BY		YOSHIOKAWA
CHECKED BY		H. SATO
PROJECT NAME		SOLAR REFLECTED LIGHT (PARKING: HORIZONTAL)
CLIENT		ORIENTAL CONSULTANTS CO., LTD.
PROJECT NO.		MAR.

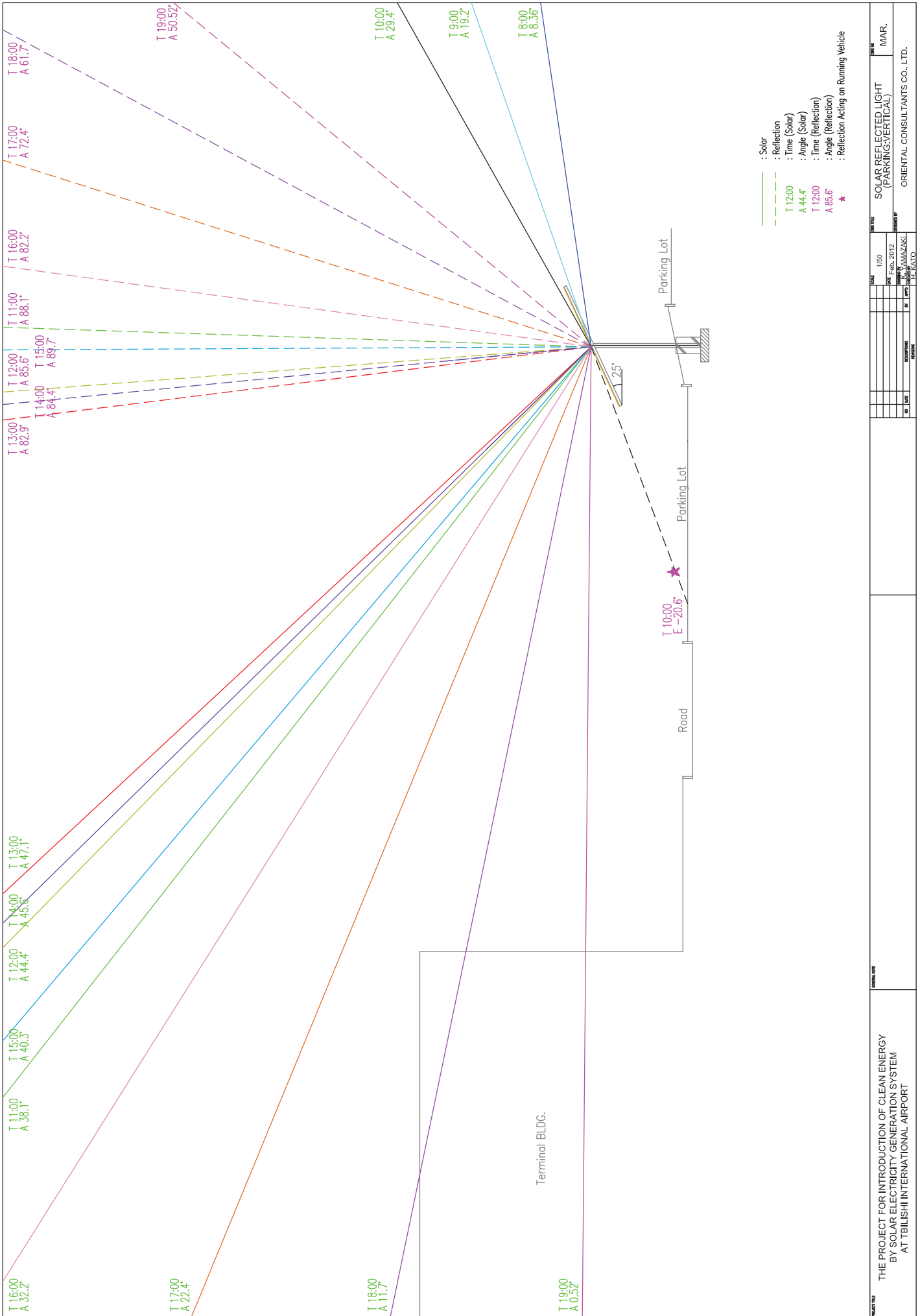
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT

7. Solar Panel Reflection Simulation



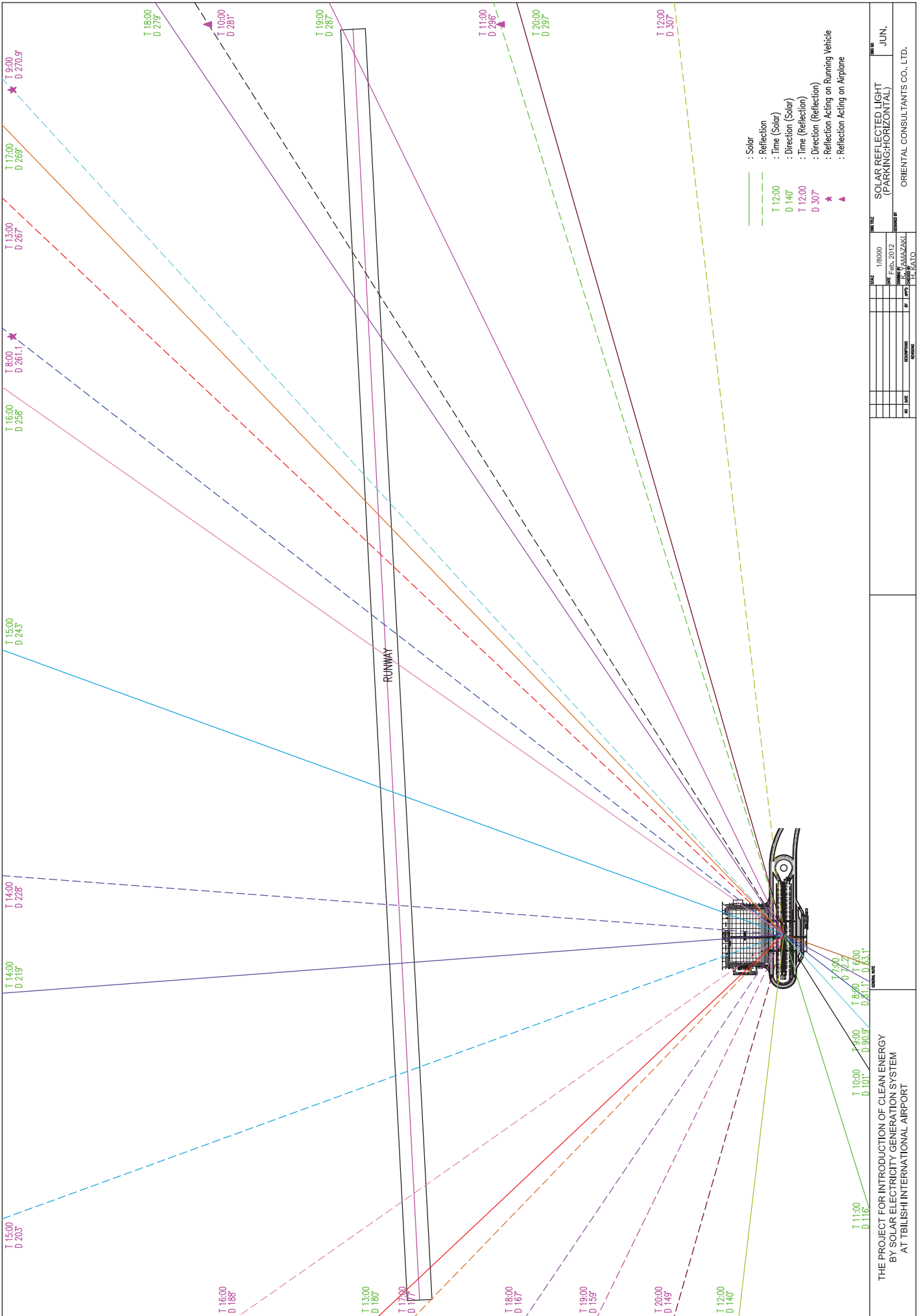
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THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT		1:1000		FEB. 2012		SOLAR REFLECTED LIGHT (PARKING-HORIZONTAL)		MAR.																			
ORIENTAL CONSULTANTS CO., LTD.																											

7. Solar Panel Reflection Simulation



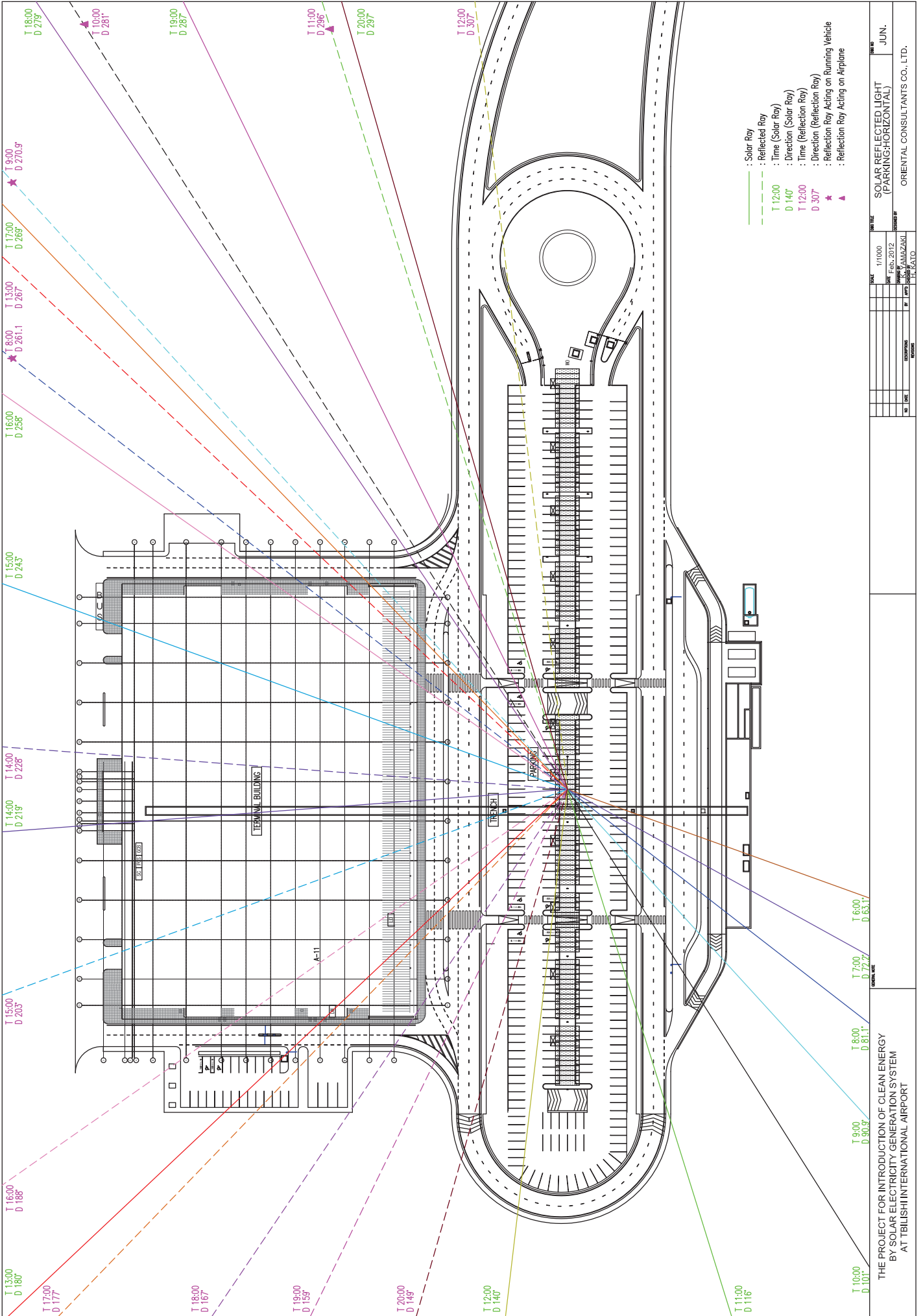
PROJECT TITLE		THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT	
DATE	1/50	DATE	Feb. 2012
SCALE	1/50	SCALE	1/50
DESIGNER	ORIENTAL CONSULTANTS CO., LTD.	DESIGNER	ORIENTAL CONSULTANTS CO., LTD.
CHECKER		CHECKER	
APPROVER		APPROVER	
DATE		DATE	
SOLAR REFLECTED LIGHT (PARKING/VERTICAL)		MAR.	

7. Solar Panel Reflection Simulation



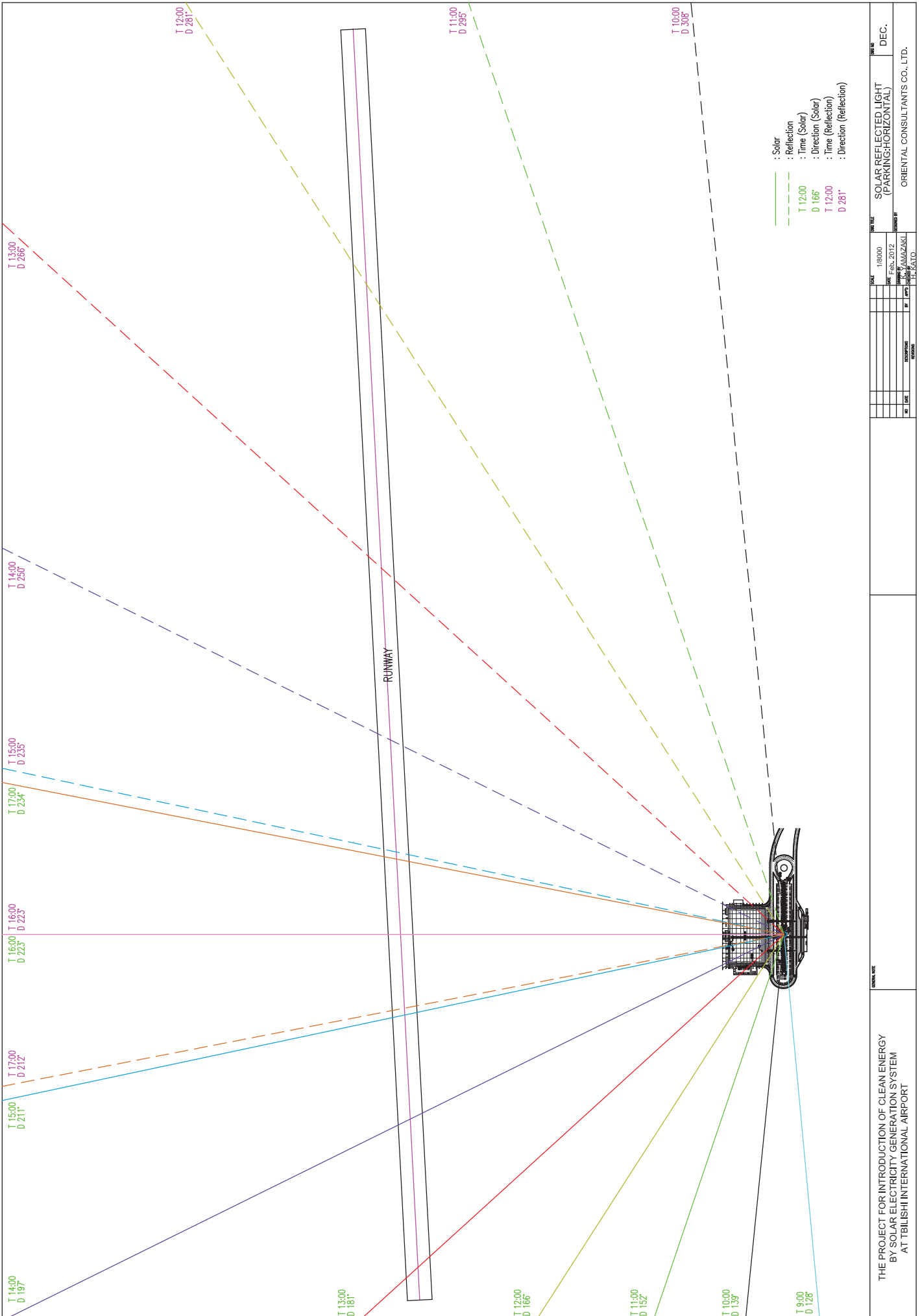
SCALE 1:8000		DATE JUN. 2012	PROJECT SOLAR REFLECTED LIGHT (PARKING-HORIZONTAL)	NO. JUN.
BY H. KATO	BY H. KATO	BY H. KATO	BY H. KATO	BY H. KATO
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT				
ORIENTAL CONSULTANTS CO., LTD.				

7. Solar Panel Reflection Simulation



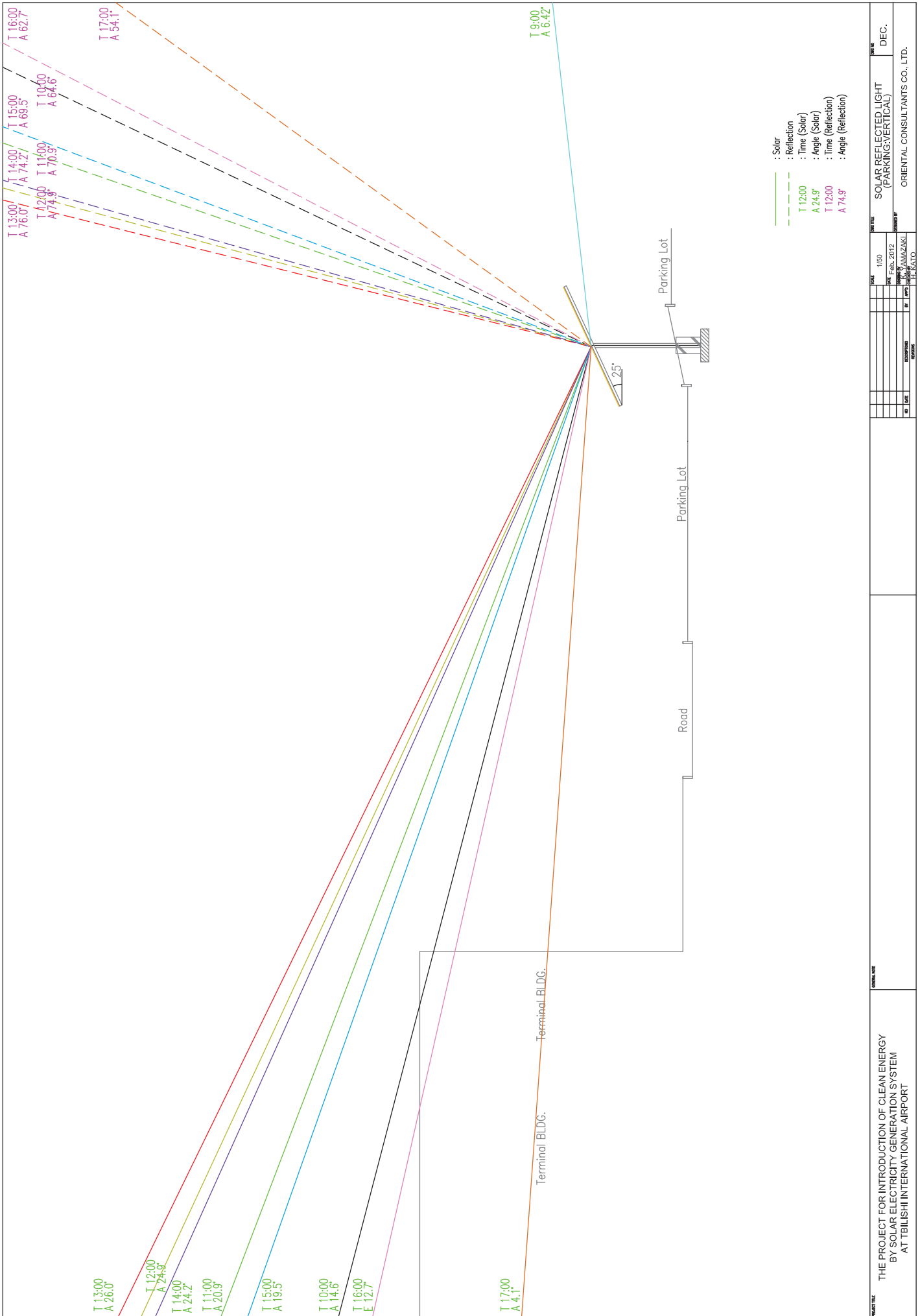
DATE		SCALE	DATE	BY	CHECKED	DATE	BY	DATE	BY
11/10/2012		1/1000	11/10/2012	Y. KATO	Y. KATO	11/10/2012	Y. KATO	11/10/2012	Y. KATO
PROJECT		CLIENT	DATE	BY	CHECKED	DATE	BY	DATE	BY
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISI INTERNATIONAL AIRPORT		ORIENTAL CONSULTANTS CO., LTD.	11/10/2012	Y. KATO	Y. KATO	11/10/2012	Y. KATO	11/10/2012	Y. KATO
SHEET		TITLE	SOLAR REFLECTED LIGHT (PARKING-HORIZONTAL)						
11/10/2012		11/10/2012	JUN.						

7. Solar Panel Reflection Simulation



SCALE 1:8000		DATE FEB. 2012		PROJECT TBILISHI INTERNATIONAL AIRPORT		SHEET NO. 1		SHEET TOTAL 1		SHEET TITLE SOLAR REFLECTED LIGHT (PARKING-HORIZONTAL)		DATE DEC.	
DRAWN BY		CHECKED BY		DESIGNED BY		APPROVED BY		DRAWING NO.		PROJECT NO.		CLIENT ORIENTAL CONSULTANTS CO., LTD.	

7. Solar Panel Reflection Simulation



PROJECT TITLE		THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT	
SCALE	1/50	DATE	Feb. 2012
DESIGNER	ORIENTAL CONSULTANTS CO., LTD.	CHECKER	
APPROVED BY		DATE	
REVISION			
PROJECT TITLE		SOLAR REFLECTED LIGHT (PARKING:VERTICAL)	
DATE		DEC.	
ORIENTAL CONSULTANTS CO., LTD.			

Solar Panel Reflection Simulation (Tbilisi International Airport: Open Space)

Panel Direction: 180 ° (South West)

Panel Slope: 30 °

※True North (0 degree), True South (180 degree)

1. March

Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
8:00	99.8	8.36	260.2	68.36	
9:00	110	19.2	250	72.9	
10:00	122	29.4	238	89.4	
11:00	137	38.1	223	81.9	
12:00	155	44.4	205	75.6	
13:00	176	47.1	184	72.9	
14:00	198	45.6	162	74.4	
15:00	217	40.3	143	79.4	
16:00	233	32.2	127	87.8	
17:00	246	22.4	114	82.4	
18:00	257	11.7	103	71.7	
19:00	267	0.52	93	60.52	

2. June

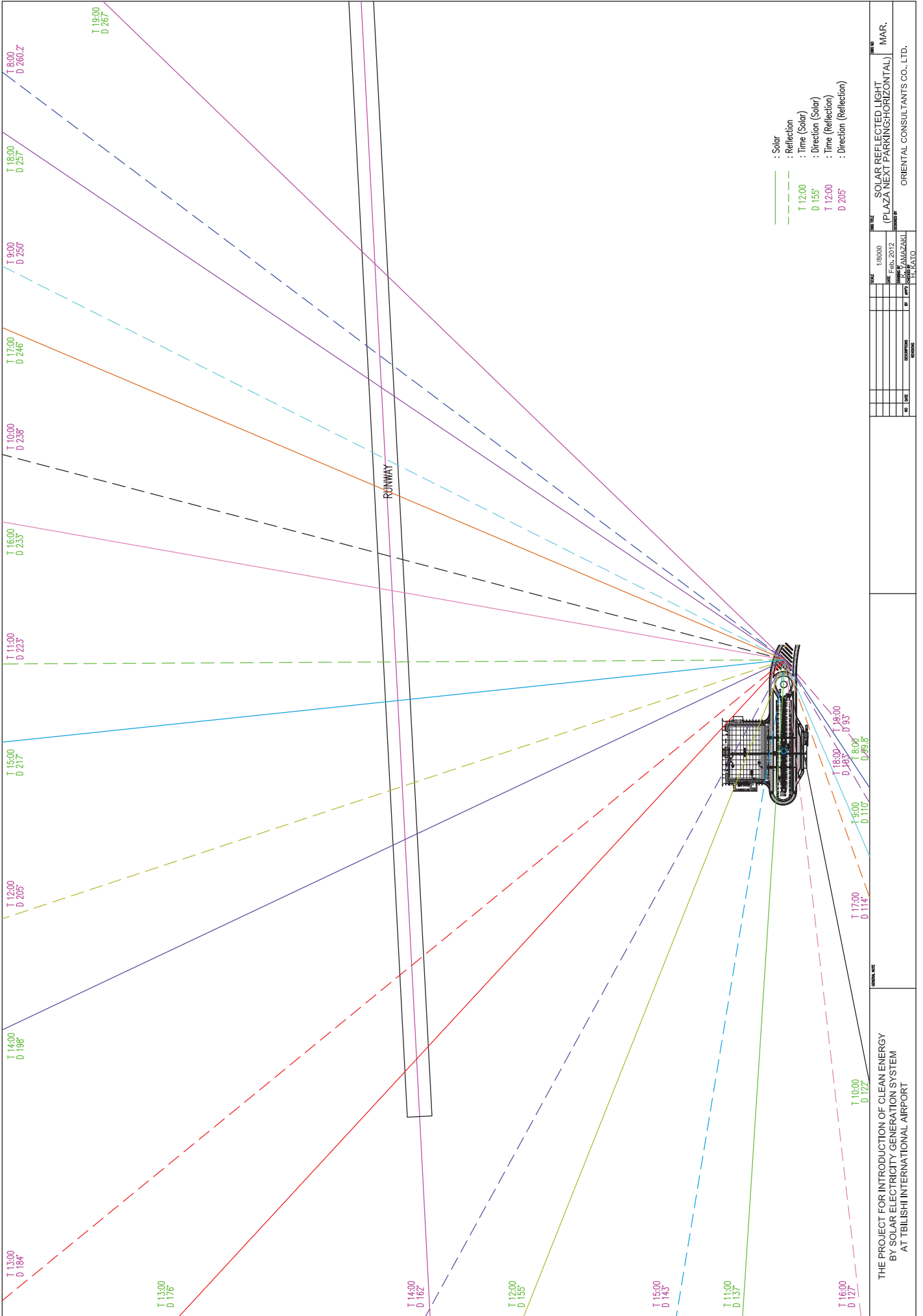
Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
6:00	63.1	4.51	-	-	No reflection up to 90° in direction or 30° in altitude
7:00	72.2	14.9	-	-	No reflection up to 90° in direction or 30° in altitude
8:00	81.1	25.9	-	-	No reflection up to 90° in direction or 30° in altitude
9:00	90.9	37.2	269.1	82.8	
10:00	101	48.5	259	71.5	
11:00	116	59.2	244	60.8	
12:00	140	68.1	220	51.9	
13:00	180	72.0	180	48.0	
14:00	219	68.0	141	52.0	
15:00	243	59.0	117	61.0	
16:00	258	48.3	102	71.7	
17:00	269	37.1	91	82.9	
18:00	279	25.8	-	-	No reflection up to 90° in direction or 30° in altitude
19:00	287	14.8	-	-	No reflection up to 90° in direction or 30° in altitude
20:00	297	4.38	-	-	No reflection up to 90° in direction or 30° in altitude

3. December

Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
9:00	128	6.42	232	66.42	
10:00	139	14.6	221	74.6	
11:00	152	20.9	208	80.9	
12:00	166	24.9	194	84.9	
13:00	181	26.0	179	86.0	
14:00	197	24.2	163	84.2	
15:00	211	19.5	149	79.5	
16:00	223	12.7	137	72.7	
17:00	234	4.1	126	64.1	

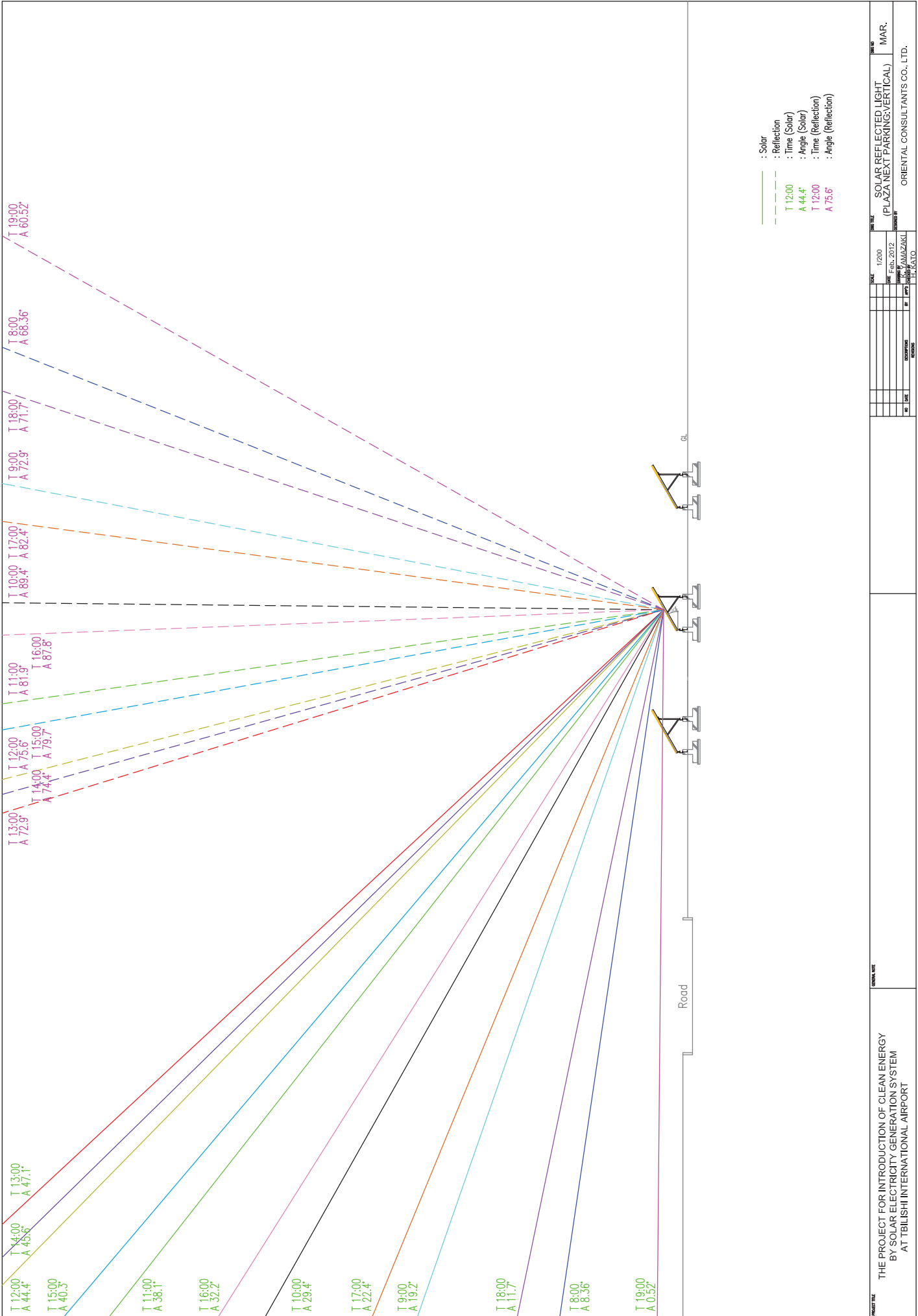
* Solar light direction and altitude are given by NASA

7. Solar Panel Reflection Simulation



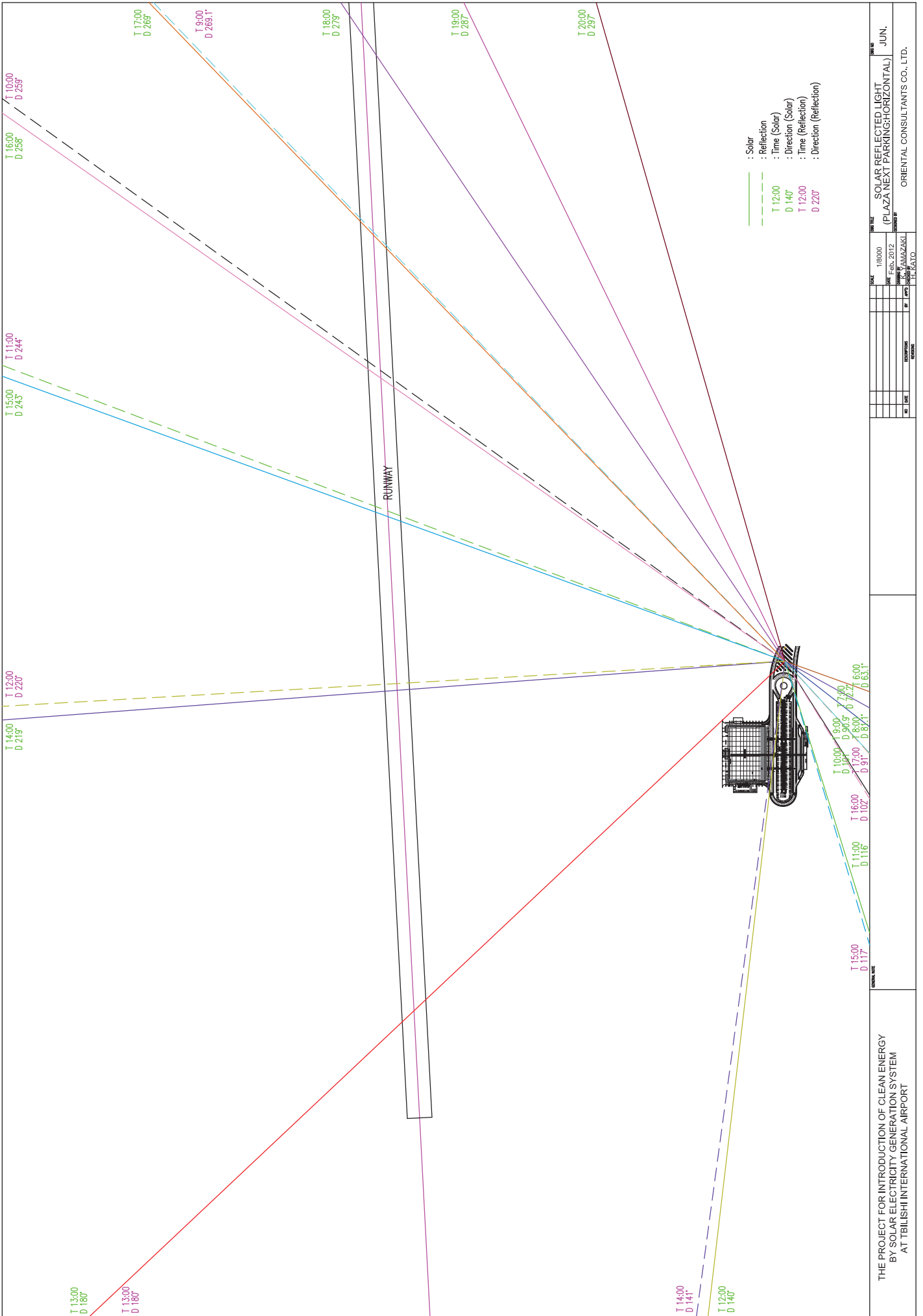
SCALE 1:8000		DATE 18/08/2012	PROJECT SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING: HORIZONTAL) MAR.
DATE 18/08/2012		PROJECT SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING: HORIZONTAL) MAR.	ORIENTAL CONSULTANTS CO., LTD.
DRAWN BY [Name]		CHECKED BY [Name]	DATE [Date]
DESIGNED BY [Name]		APPROVED BY [Name]	DATE [Date]
PROJECT NO. [Number]		CLIENT [Name]	LOCATION [Location]

7. Solar Panel Reflection Simulation



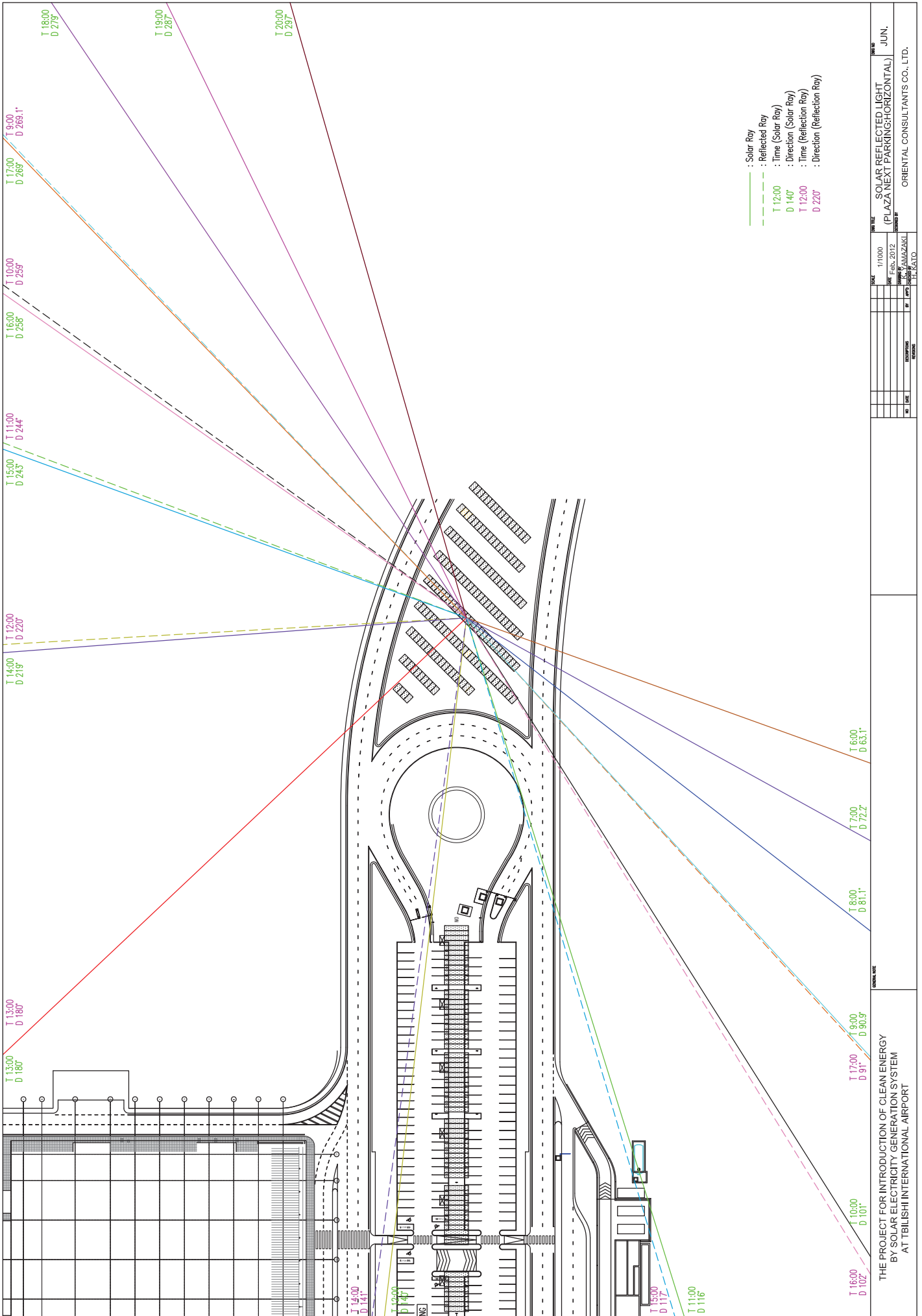
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SCALE	DATE	SCALE	DATE
1:200	12/00	1:200	Feb. 2012
DESIGNER	DATE	DESIGNER	DATE
Y. YAMAZAKI	2012.02.01	Y. YAMAZAKI	2012.02.01
CHECKER	DATE	CHECKER	DATE
H. KATO	2012.02.01	H. KATO	2012.02.01
DRAWING TITLE		SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING:VERTICAL)	
DRAWING NO.		MAR.	
ORIENTAL CONSULTANTS CO., LTD.			

7. Solar Panel Reflection Simulation



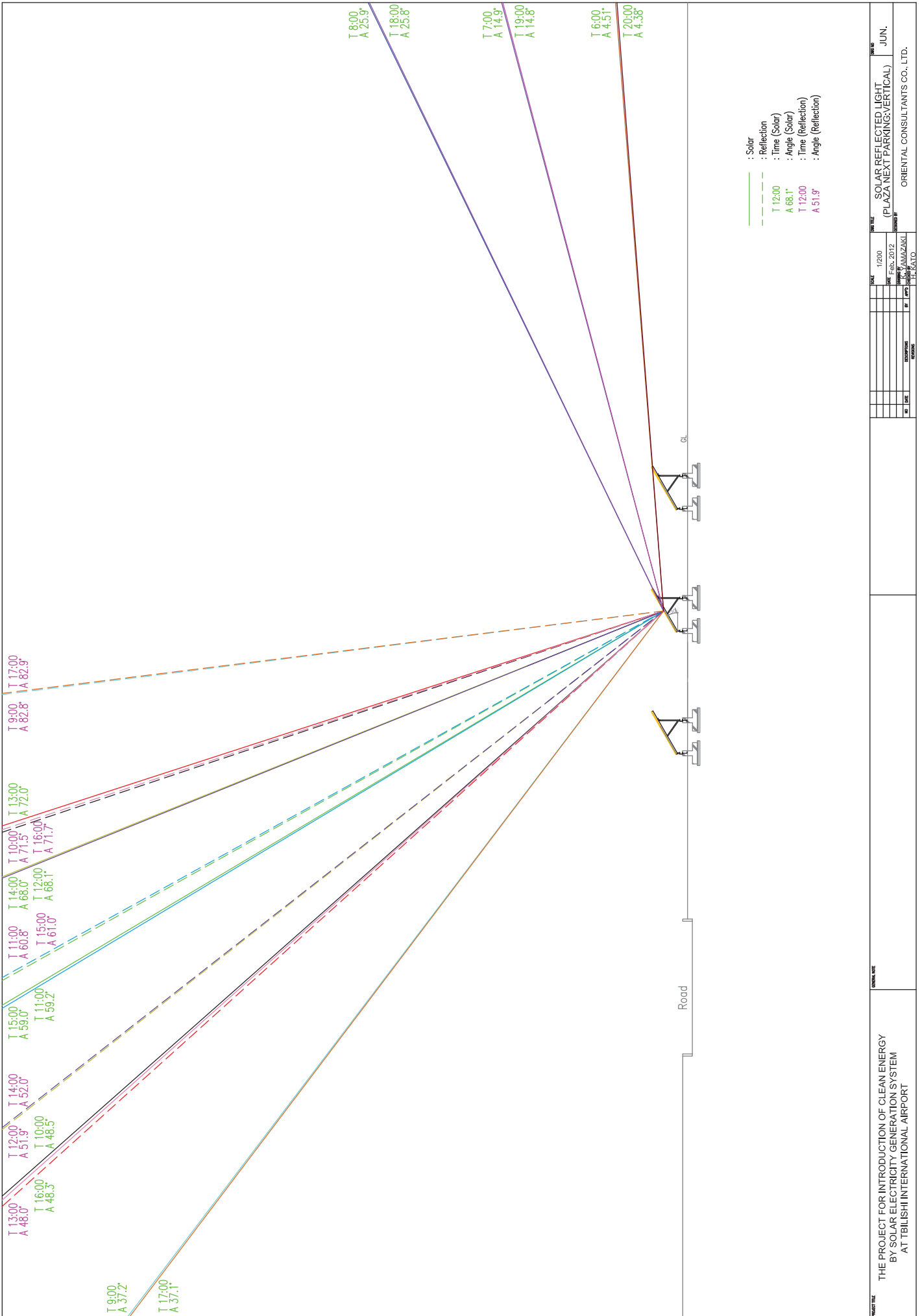
PROJECT TITLE		SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING: HORIZONTAL) JUN.	
SCALE	1:8000	DATE	Feb. 2012
DESIGNER	ORIENTAL CONSULTANTS CO., LTD.	CLIENT	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT
DATE		BY	
NO.		REVISION	

7. Solar Panel Reflection Simulation



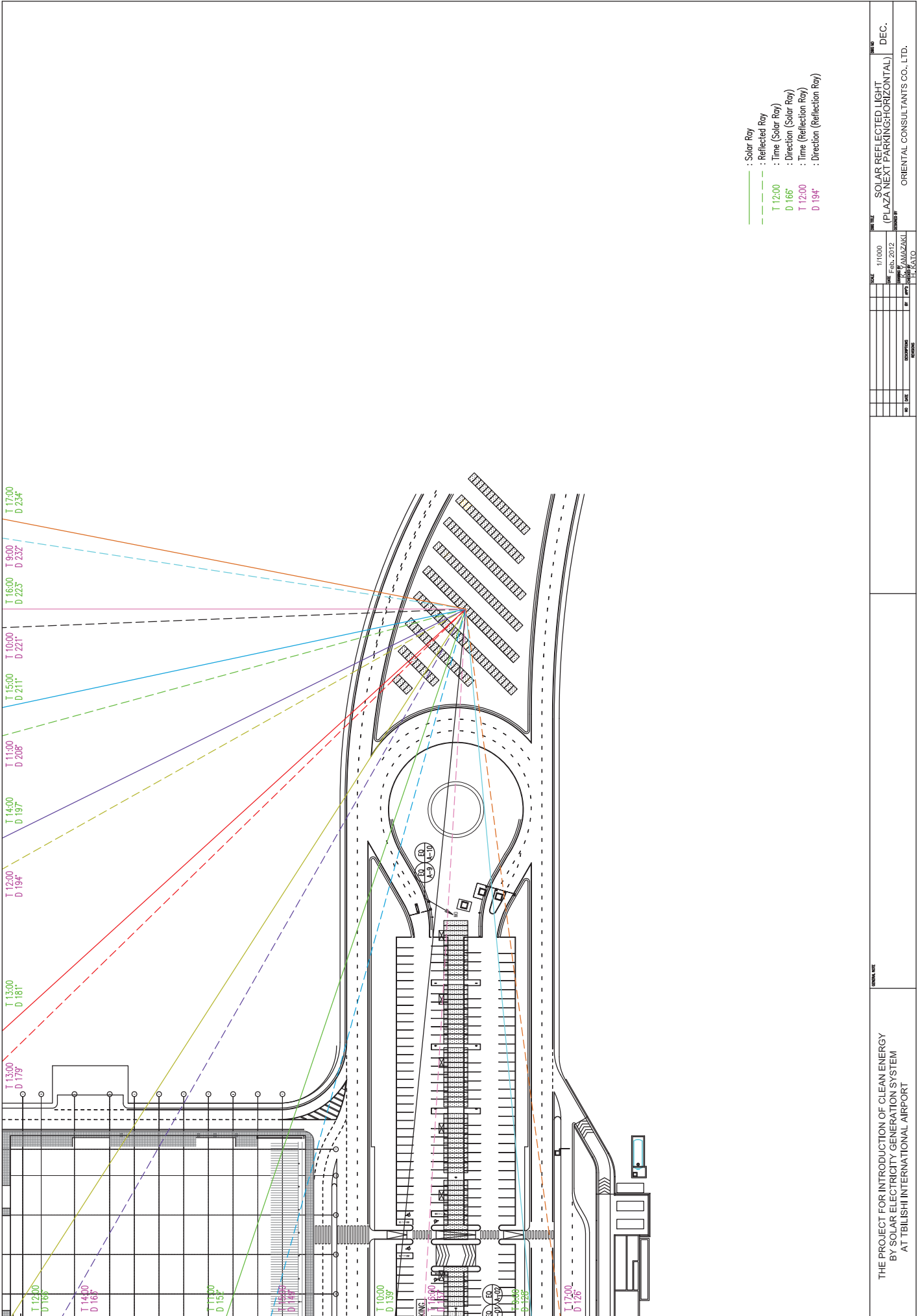
NO.	DATE	SCALE	PROJECT TITLE	DATE OF ISSUE
1	1/10/00	1/1000	SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING: HORIZONTAL)	JUN.
2	Feb. 2012			
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7. Solar Panel Reflection Simulation



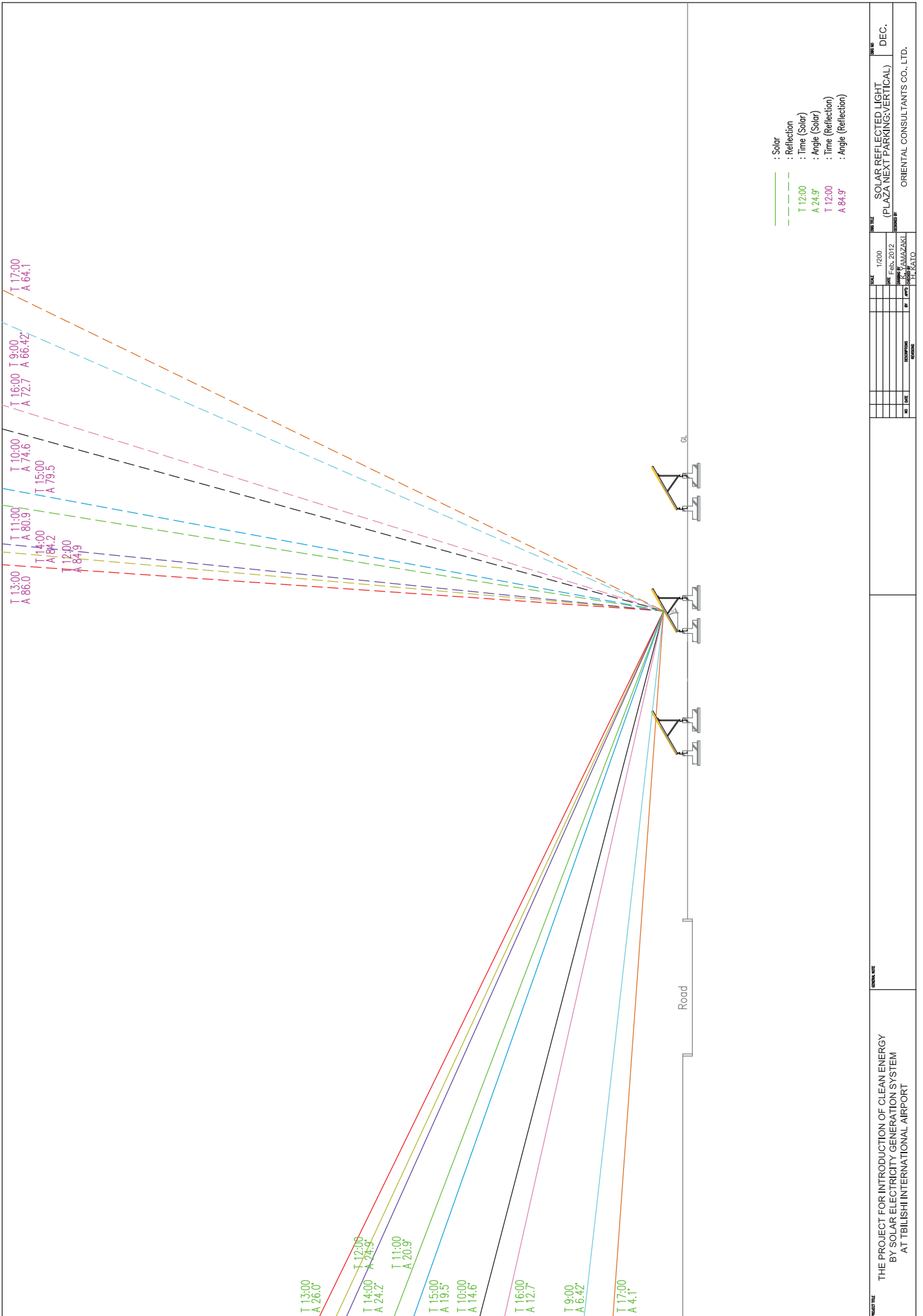
PROJECT TITLE		THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT	
SCALE		1:2000	
DATE		FEB. 2012	
DRAWN BY		S. YAMAGUCHI	
CHECKED BY		H. KATO	
DATE			
REVISION			
DRAWING NO.		SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING:VERTICAL)	
DATE OF		JUN.	
ORIENTAL CONSULTANTS CO., LTD.			

7. Solar Panel Reflection Simulation



PROJECT TITLE		SCALE		DATE		DRAWN BY		CHECKED BY		DATE	
SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING; HORIZONTAL)		1/1000		FEB. 2012		H. KATO		H. KATO		DEC.	
PROJECT NO.		DRAWING NO.		SHEET NO.		TOTAL SHEETS		SCALE		DATE	
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT											
ORIENTAL CONSULTANTS CO., LTD.											

7. Solar Panel Reflection Simulation



PROJECT TITLE		THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT TBILISHI INTERNATIONAL AIRPORT	
DATE	1/2000	DATE	Feb. 2012
NO.	00000000000000000000	NO.	00000000000000000000
BY	00000000000000000000	BY	00000000000000000000
CHECKED BY	00000000000000000000	CHECKED BY	00000000000000000000
DATE		DATE	
DRAWN TITLE		SOLAR REFLECTED LIGHT (PLAZA NEXT PARKING:VERTICAL)	
DRAWN NO.		DEC.	
DRAWN BY		ORIENTAL CONSULTANTS CO., LTD.	

Solar Panel Reflection Simulation (Ilia State University)

Panel Direction: 179 ° (South West)

Panel Slope: 10 ° ※True North (0 degree), True South (180 degree)

1. March

Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
8:00	99.8	8.36	258	28.3	
9:00	110	19.2	248	39.2	
10:00	122	29.4	236	49.4	
11:00	137	38.1	221	58.1	
12:00	155	44.4	203	64.4	
13:00	176	47.1	182	67.1	
14:00	198	45.6	160	65.6	
15:00	217	40.3	141	60.3	
16:00	233	32.2	125	52.2	
17:00	246	22.4	112	42.4	
18:00	257	11.7	101	31.7	
19:00	267	0.52	91	20.5	

2. June

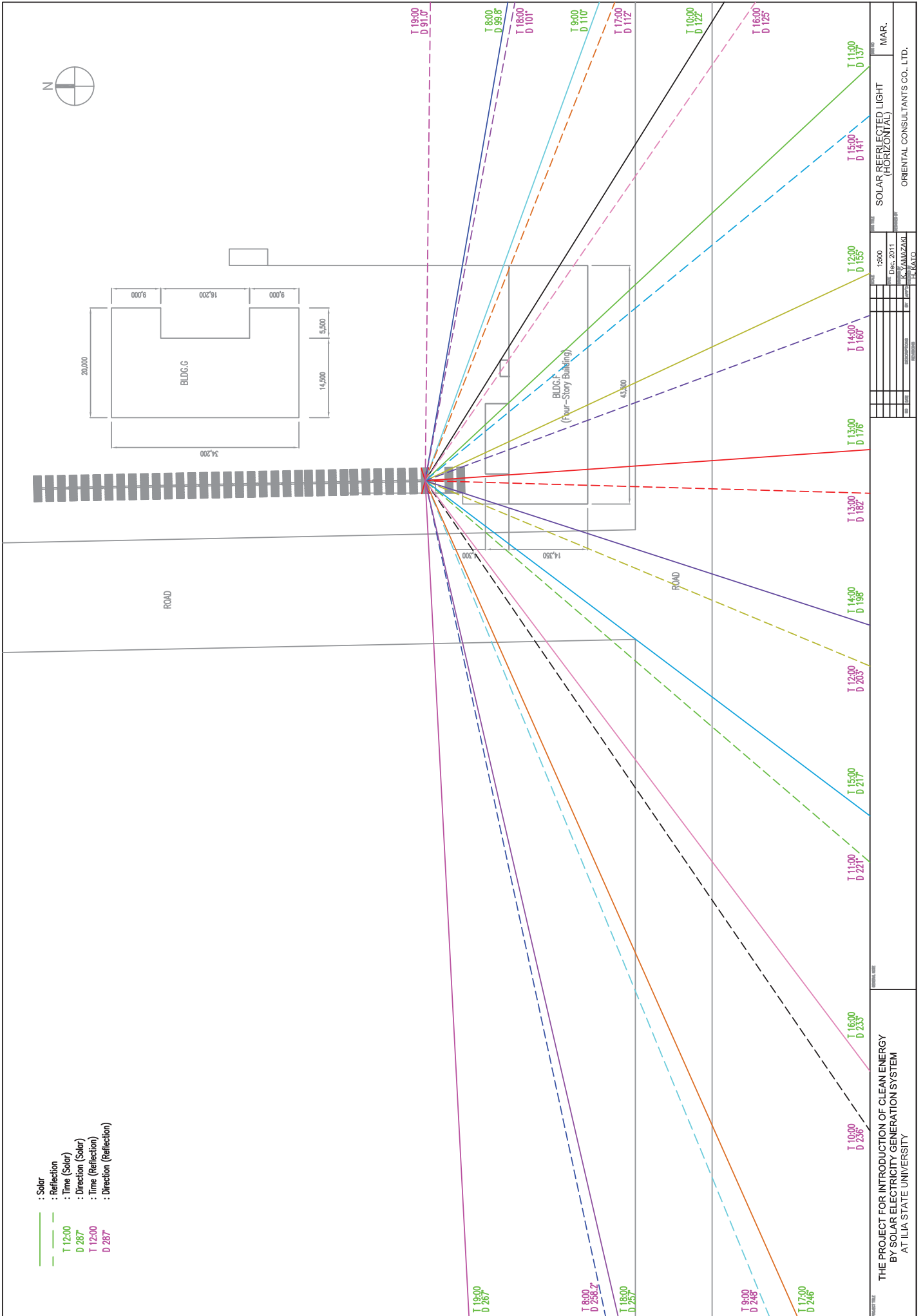
Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
6:00	63.1	4.51	-	-	No reflection up to 89° in direction or 10° in altitude
7:00	72.2	14.9	252	-5.1	Reflection might affect driving cars
8:00	81.1	25.9	261	5.9	
9:00	90.9	37.2	267	57.2	
10:00	101	48.5	257	68.5	
11:00	116	59.2	242	79.2	
12:00	140	68.1	218	88.1	
13:00	180	72.0	178	88.0	
14:00	219	68.0	138	88.0	
15:00	243	59.0	115	79.0	
16:00	258	48.3	100	68.3	
17:00	269	37.1	89	57.1	
18:00	279	25.8	99	5.8	
19:00	287	14.8	107	-5.2	
20:00	297	4.38	-	-	No reflection at 269° or more in direction or up to 10° in altitude

3. Devenber

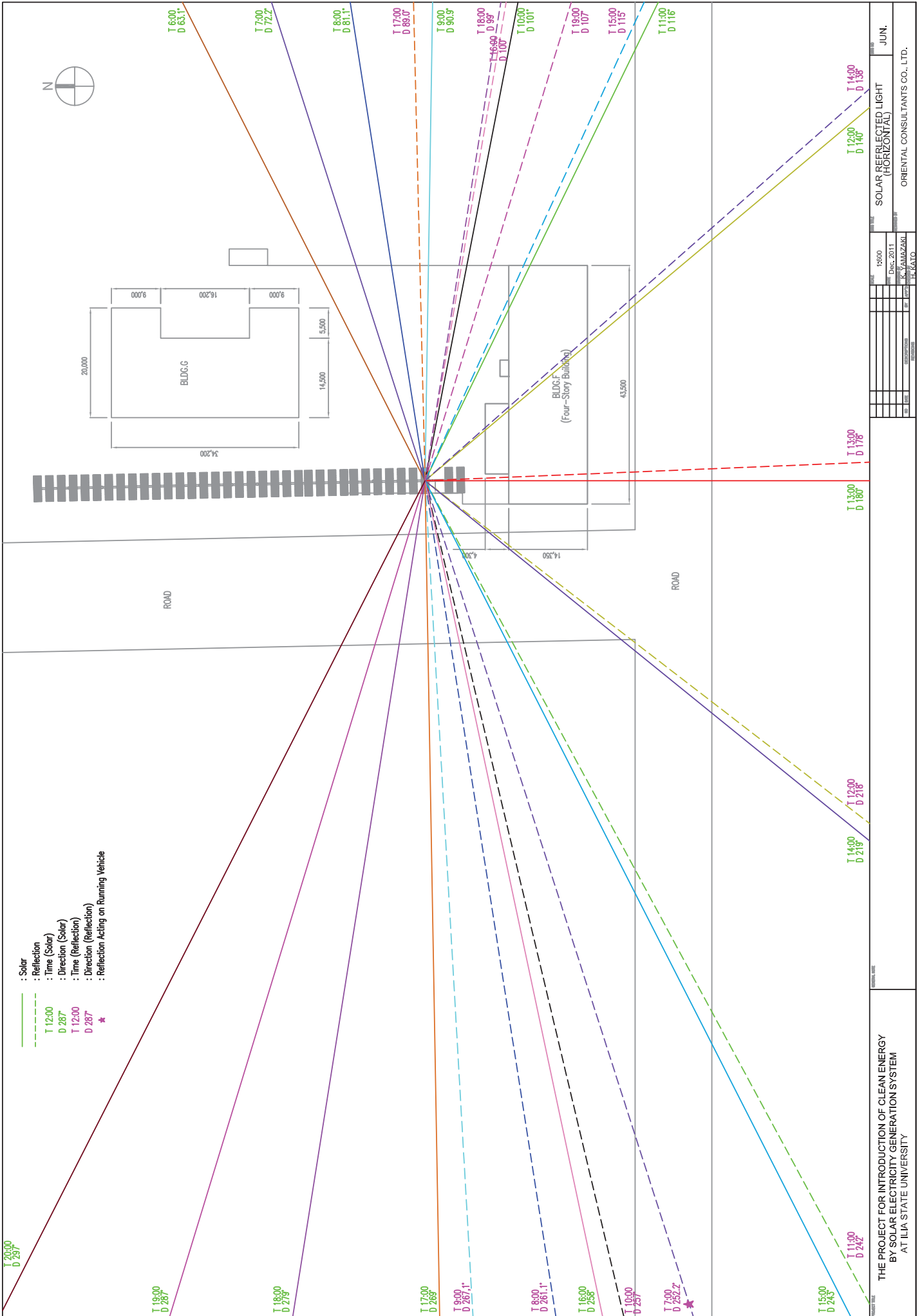
Time	Solar light		Reflection		Remark
	Direction (degree)	Altitude (degree)	Direction (degree)	Altitude (degree)	
9:00	128	6.42	230	26.4	
10:00	139	14.6	219	34.6	
11:00	152	20.9	206	40.9	
12:00	166	24.9	192	44.9	
13:00	181	26.0	179	46.0	
14:00	197	24.2	161	44.2	
15:00	211	19.5	147	39.5	
16:00	223	12.7	135	32.7	
17:00	234	4.1	124	24.1	

* Solar light direction and altitude are given by NASA

7. Solar Panel Reflection Simulation

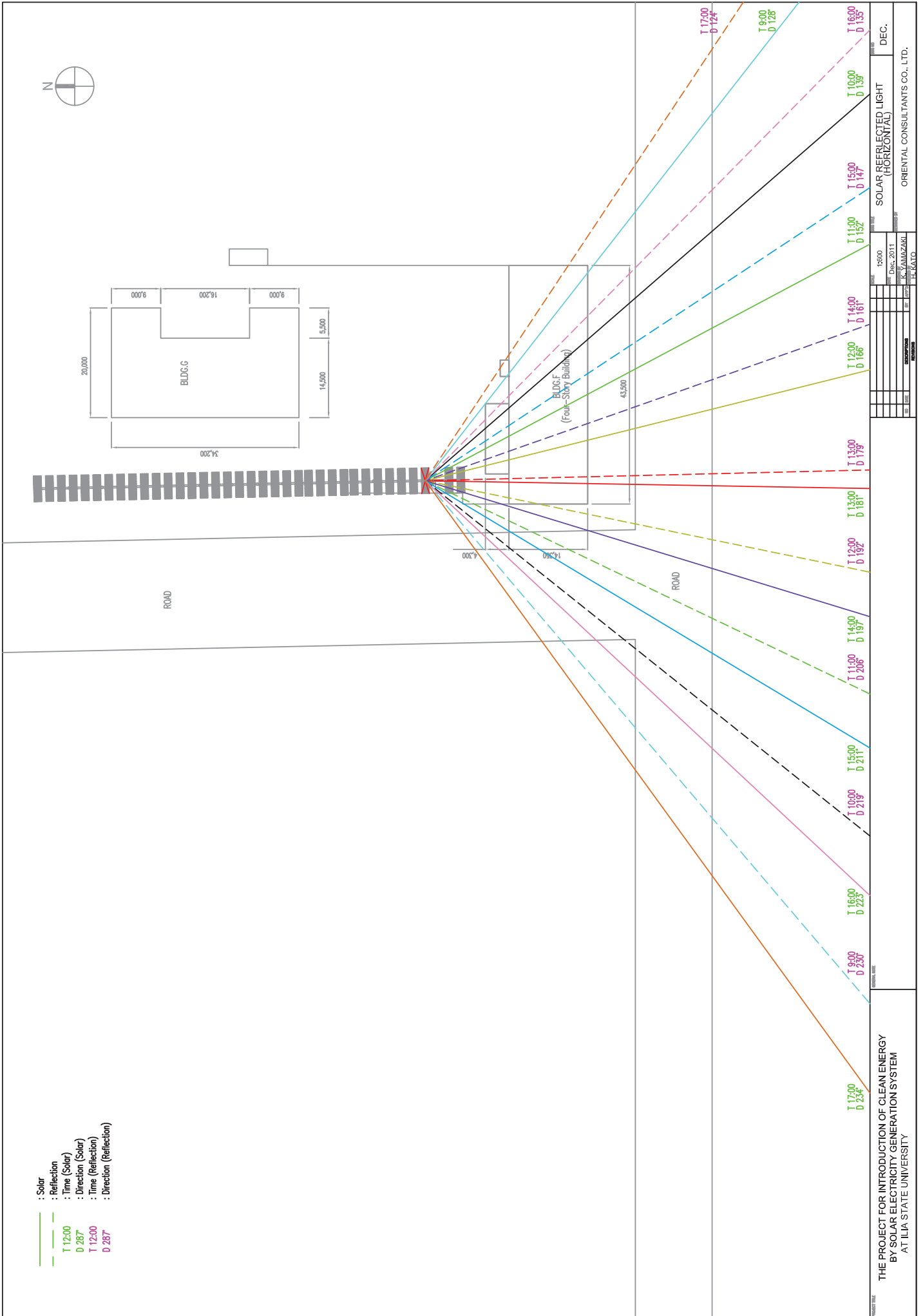


7. Solar Panel Reflection Simulation



PROJECT TITLE		THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM AT ILIA STATE UNIVERSITY	
DATE	15/06	DATE	JUN.
DESIGNER	K. YAMAZAKI	DATE	Dec. 2011
CHECKER	H. KATO	DATE	
APPROVER		DATE	
REVISION		DATE	
NO.		DATE	
PROJECT NAME		SOLAR REFLECTED LIGHT (HORIZONTAL)	
CONSULTANT NAME		ORIENTAL CONSULTANTS CO., LTD.	

7. Solar Panel Reflection Simulation



Appendix 8 References

The Preparatory Survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System in Georgia

No.	NAME	FORM	Original or Copy	Issuing Institution	Date of Publication
1	Georgia's Second National Communication to the UNFCCC	Book	Copy	Ministry of Environment Protection and Natural Resources	2009
2	Third National Report of Georgia	Book	Copy	Ministry of Environment Protection and Natural Resources	2006
3	Budget of Ministry of Environment Protection and Natural Resources	Book	Copy	Ministry of Environment Protection and Natural Resources	2009
4	The electricity sector in Georgia - A risk assessment	Book	Copy	Ministry of Energy	2007
5	Unique Investment Opportunity in the Georgian Hydro Power Generation Sector	Book	Copy	Ministry of Energy	2009
6	Low of Georgia On the Investment Activity Promotion and Guarantees	Book	Copy	Ministry of Energy	1996
7	Georgian Law on Electricity and Natural gas	Book	Copy	Ministry of Energy	1997
8	Resolution Government of Georgia	Book	Copy	Ministry of Energy	
9	List of Potential Hydro Power Projects in Georgia	Book	Copy	Ministry of Energy	
10	CDM potential of the proposal Hydro power plants	Book	Copy	Ministry of Energy	
11	RENEWABLE ENERGY RESOURCES OF GEORGIA	Book	Copy	Leningrad Hydrometeoizdat	1984
12	Energy policy Framework Conditions for Electricity Markets and Renewable Energies	Book	Copy	Federal Ministry for Economic Cooperation and Development	2004
13	Promoting Clean Energy Technologies in Mountainous Regions of Georgia on the Example of Oni Region	Book	Copy	United Nations Development Programme	2007