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○ General overview

Target verification technology / verification applicant	ZEROCOAT / ZEROCON CO., LTD.
Verification organization	Japan Testing Center for Construction Materials
Verification test period	September 17, 2013 to February 17, 2014

1. Overview of the target verification technology

A technology for applying sunshade coating materials to existing windowpanes

*For information about the characteristics and other factors of the technology, see 4, "Reference information (overview version, on page 9)."

2. Overview of the verification test

2.1 Efficiency to reduce air conditioning and other loads

We measured the thermooptic efficiency of sunshade coating materials for glazing, and based on the findings, we numerically calculated the effects (such as the effect to reduce air conditioning load) achieved after applying a sunshade coating materials for glazing to all windows on the indoor side of the target building under the conditions specified below.

2.1.1 Set conditions in numerical calculations

(1) Target building

1) The living/dining (LD) space on the first floor of a housing (detached wooden) model
Target floor area: 20.49 m^2; window area: 6.62 m^2; floor height: 2.7 m; construction: wooden]

2) The southern part of the clerical office of the office model
[Target floor area: 115.29 m^2; window area: 37.44 m^2; floor height: 3.6 m; construction: RC construction]

Note: No consideration is given to the shelter of sunlight due to the effects of surrounding buildings or structures.

For details of the target building, see 4.2.2 (1) 1) “Target building” in the full version of main text. (See page 15 of the full version of main text.)

(2) Operating atmospheric data

Standard year for extended AMeDAS meteorological data (1991-2000) (Tokyo and Osaka Prefecture)

(3) Setting air-conditioning equipment

Building	Temperature setting (°C)		Operating hours	Cooling COP	Heating COP
	Cooling	Heating			
Housing	26.6	21.0	6:00-9:00, 12:00-14:00, 16:00-22:00	4.67	5.14
Office	28.0	20.0	7:00-21:00 on weekdays	3.55	3.90

(4) Setting the unit prices of electric energy charges

Region	Building	Standard contractual category	Unit price of electric energy charges (yen/kWh)	
			Summer	Other season
Tokyo	Housing	Meter rate lighting B	25.19	
	Office	Industrial power	16.65	15.55
Osaka	Housing	Meter rate lighting A	26.51	
	Office	High-voltage power AS	14.83	13.81

2.2 Efficiency of environmental load and maintenance

We performed a 1,000-hour accelerated weather resistance performance test using a weather resistance tester. After the test, we measured the thermooptic efficiency, and demonstrated the changes in measurements before and after the weather resistance test.

3. Verification test results

3.1 Efficiency to reduce air conditioning and other loads and efficiency of environmental load and maintenance

(1) Test results of thermooptic efficiency and efficiency of environmental load and maintenance (averages)*1

[Verification items]

Board thickness	Item		Before weather resistance test	After weather resistance test
3 mm	Sheltering coefficient	(–)	0.67	0.76
	Heat transmission coefficient	(W/m^2•K)	6.0	6.0

[Measurement items] (reference)

Board thickness	Item		Before weather resistance test	After weather resistance test
3 mm	Visible ray transmittivity	(%)	75.9	80.3
	Solar transmission factor	(%)	39.5	52.4
	Solar reflectance	(%)	5.3	5.5

[Reference items]

Board thickness	Item		Before weather resistance test	After weather resistance test
8 mm	Sheltering coefficient	(–)	0.64	-
	Heat transmission coefficient	(W/m^2•K)	5.8	-
	Visible ray transmittivity	(%)	72.9	-
	Solar transmission factor	(%)	35.8	-
	Solar reflectance	(%)	5.1	-

*1: Before the weather resistance test, we performed measurements on three samples (n = 3). Based on the findings, we selected two samples (i.e., those with the highest and lowest solar transmission factor where n = 2) and then performed a weather resistance test.

(2) Spectral transmission factor and spectral reflectance characteristics (wavelength range: 300 nm to 2,500 nm)

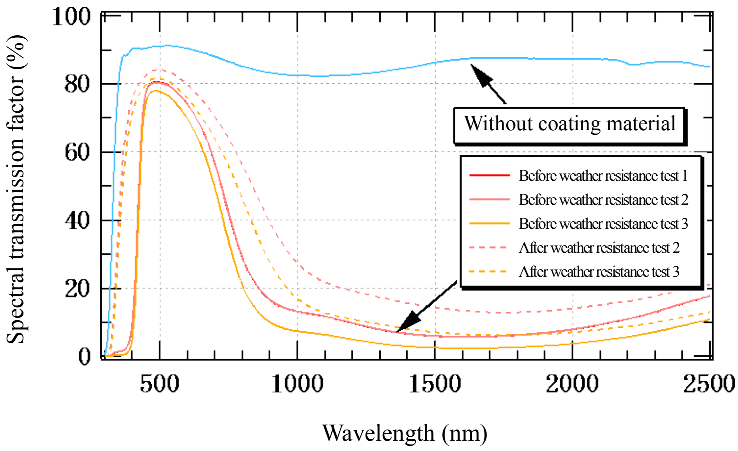

Figure 1 Measurement results of spectral transmission factor (board: float glass plate 3-mm thick)

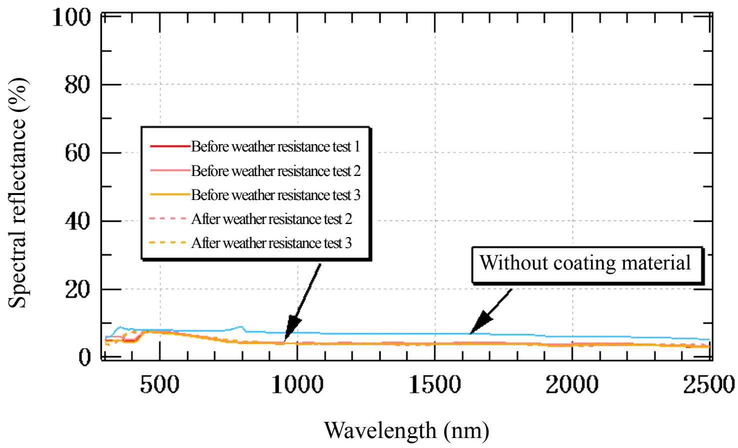

Figure 2 Measurement results of spectral reflectance (board: float glass plate 3-mm thick)

* Thermooptic efficiency was measured before the weather resistance test on three samples (n = 3) in view of the dispersions of the products. Among the samples measured, we selected two samples (n = 2), that is, those with the highest and lowest solar transmission factor, and then performed the weather resistance test. To monitor the deterioration in performance due to the weather resistance test, we performed another round of measurements on thermooptic efficiency after the weather resistance test.

[Reference information: wavelength range and definition*]
Ultraviolet region: 300-380 nm; visible light region: 380-780 nm; sunlight region: 300-2,500 nm
*Based on JIS A 5759

3.2 Verification items to be numerically calculated

(1) Calculation results of verification items

[Calculable region: Living/dining (LD) space (housing), southern part of the clerical office (office)

Control: before applying coating material

		Tokyo		Osaka	
		Housing (detached wooden construction)	Office	Housing (detached wooden construction)	Office
Effect to reduce air conditioning load[*1] (1 month in summer)	Calorific value	88 kWh/month (513 kWh/month → 425 kWh/month)	300 kWh/month (1,866 kWh/month → 1,566 kWh/month)	95 kWh/month (626 kWh/month → 531 kWh/month)	325 kWh/month (2,209 kWh/month → 1,884 kWh/month)
		Reduction of 17.2%	Reduction of 16.1%	Reduction of 15.2%	Reduction of 14.7%
	Power rate	Reduction of 475 yen	Reduction of 1,407 yen	Reduction of 540 yen	Reduction of 1,358 yen
Effect to reduce air conditioning load[*1] (June to September in summer)	Calorific value	293 kWh/4 months (1,468 kWh/4 months → 1,175 kWh/4 months)	953 kWh/4 months (5,071 kWh/4 months → 4,118 kWh/4 months)	331 kWh/4 months (1,839 kWh/4 months → 1,508 kWh/4 months)	1,101 kWh/4 months (6,440 kWh/4 months → 5,339 kWh/4 months)
		Reduction of 20.0%	Reduction of 18.8%	Reduction of 18.0%	Reduction of 17.1%
	Power rate	Reduction of 1,581 yen	Reduction of 4,411 yen	Reduction of 1,880 yen	Reduction of 4,537 yen
Effect to control rising room temperature[*2] (15:00 in summer)	Natural room temperature[*3]	2.6°C (42.1°C → 39.5°C)	2.8°C (49.2°C → 46.4°C)	2.7°C (40.6°C → 37.9°C)	3.0°C (50.2°C → 47.2°C)
	Effective temperature[*4]	3.0°C (42.6°C → 39.6°C)	2.8°C (49.2°C → 46.4°C)	3.2°C (41.3°C → 38.1°C)	3.0°C (50.3°C → 47.3°C)

*1: Effect to reduce air conditioning load after activating cooling when the indoor temperature rises above the cooling temperature setting in one summer month (August) and in summer (June to September)

*2: Effect of controlling rises in room temperature at the target region at 3 p.m. on a weekday in August when the total amount of direct solar radiation is highest (August 10 in Tokyo and August 18 in Osaka)

*3: Room temperature when no cooling is provided

*4: Temperature considering the surface temperature of indoor walls (average of air temperature and indoor wall surface temperature)

Note Numerical calculations are performed on the assumption of a model housing and office and under various preconditions, and thus differ from the actual environment where the technology is introduced.

(2) Calculation results of reference items

1) Calculation results in view of the effects of heating with regard to verification items

[Calculable region: Living/dining (LD) space (housing), southern part of the clerical office (office)]

Control: before applying coating material

		Tokyo		Osaka	
		Housing (detached wooden construction)	Office	Housing (detached wooden construction)	Office
Effect to reduce heating system load*1 (1 month in winter)	Calorific value	-75 kWh/month (293 kWh/month → 368 kWh/month)	-207 kWh/month (166 kWh/month → 373 kWh/month)	-71 kWh/month (398 kWh/month → 469 kWh/month)	-218 kWh/month (469 kWh/month → 687 kWh/month)
		Reduction of -25.6%	Reduction of -124.7%	Reduction of -17.8%	Reduction of -46.5%
	Power rate	Reduction of -367 yen	Reduction of -825 yen	Reduction of -366 yen	Reduction of -772 yen
Effect to reduce air conditioning and heating system load*2 (air-conditioning for a limited period)	Calorific value	1 kWh/year (2,901 kWh/year → 2,900 kWh/year)	251 kWh/year (5,776 kWh/year → 5,525 kWh/year)	39 kWh/year (3,389 kWh/year → 3,350 kWh/year)	382 kWh/year (7,582 kWh/year → 7,200 kWh/year)
		Reduction of 0.0%	Reduction of 4.3%	Reduction of 1.2%	Reduction of 5.0%
	Power rate	Reduction of 150 yen	Reduction of 1,611 yen	Reduction of 374 yen	Reduction of 1,990 yen

*1: Effect to reduce heating system load after activating heating when the indoor temperature drops below the heating temperature setting in one winter month (February)

*2: Effect to reduce air conditioning and heating system load after activating cooling when the indoor temperature rises above the cooling temperature setting in summer (June to September), and after activating heating when the indoor temperature drops below the heating temperature setting in winter (November to April)

Note 1: Numerical calculations are performed on the assumption of a model housing and office and under various preconditions, and thus differ from the actual environment where the technology is introduced.

2) Calculation results in view of the effects of cooling and heating throughout the year
[Calculable region: Living/dining (LD) space (housing), southern part of the clerical office (office)]
Control: before applying coating material

		Tokyo		Osaka	
		Housing (detached wooden construction)	Office	Housing (detached wooden construction)	Office
Effect to reduce air conditioning load*1 (yearly air-conditioning)	Calorific value	548 kWh/year (1,933 kWh/year → 1,385 kWh/year)	1,648 kWh/year (6,616 kWh/year → 4,968 kWh/year)	556 kWh/year (2,256 kWh/year → 1,700 kWh/year)	1,731 kWh/year (7,796 kWh/year → 6,065 kWh/year)
		Reduction of 28.3%	Reduction of 24.9%	Reduction of 24.6%	Reduction of 22.2%
	Power rate	Reduction of 2,956 yen	Reduction of 7,456 yen	Reduction of 3,157 yen	Reduction of 6,988 yen
Effect to reduce heating system load*2 (yearly air-conditioning)	Calorific value	-301 kWh/year (1,461 kWh/year → 1,762 kWh/year)	-702 kWh/year (705 kWh/year → 1,407 kWh/year)	-298 kWh/year (1,571 kWh/year → 1,869 kWh/year)	-719 kWh/year (1,142 kWh/year → 1,861 kWh/year)
		Reduction of -20.6%	Reduction of -99.6%	Reduction of -19.0%	Reduction of -63.0%
	Power rate	Reduction of -1,476 yen	Reduction of -2,800 yen	Reduction of -1,536 yen	Reduction of -2,547 yen
Effect to reduce air conditioning and heating system load*3 (yearly air-conditioning)	Calorific value	247 kWh/year (3,394 kWh/year → 3,147 kWh/year)	946 kWh/year (7,321 kWh/year → 6,375 kWh/year)	258 kWh/year (3,827 kWh/year → 3,569 kWh/year)	1,012 kWh/year (8,938 kWh/year → 7,926 kWh/year)
		Reduction of 7.3%	Reduction of 12.9%	Reduction of 6.7%	Reduction of 11.3%
	Power rate	Reduction of 1,480 yen	Reduction of 4,656 yen	Reduction of 1,621 yen	Reduction of 4,441 yen

*1: Effect to reduce air conditioning load after activating cooling when the indoor temperature rises above the cooling temperature setting at any time of the year
*2: Effect to reduce heating system load after activating heating when the indoor temperature drops below the heating temperature setting at any time of the year
*3: Sum of the yearly cooling load and yearly heating load that decline due to applied sunshade coating materials for glazing
Note 1: Numerical calculations are performed on the assumption of a model housing and office and under various preconditions, and thus differ from the actual environment where the technology is introduced.

3) Calculation results in view of the effects of cooling and heating throughout the year in an entire building or entire clerical office
[Calculable region: Entire building (housing), entire clerical office on the reference floor (office)]

Control: before applying coating material

		Tokyo		Osaka	
		Housing (detached wooden construction)	Office	Housing (detached wooden construction)	Office
Effect to reduce air conditioning load*1 (yearly air-conditioning)	Calorific value	676 kWh/year (2,550 kWh/year → 1,874 kWh/year)	6,461 kWh/year (30,583 kWh/year → 24,122 kWh/year)	708 kWh/year (3,078 kWh/year → 2,370 kWh/year)	7,005 kWh/year (36,782 kWh/year → 29,777 kWh/year)
		Reduction of 26.5%	Reduction of 21.1%	Reduction of 23.0%	Reduction of 19.0%
	Power rate	Reduction of 3,646 yen	Reduction of 29,307 yen	Reduction of 4,019 yen	Reduction of 28,315 yen
Effect to reduce heating system load*2 (yearly air-conditioning)	Calorific value	-554 kWh/year (2,535 kWh/year → 3,089 kWh/year)	-3,651 kWh/year (7,583 kWh/year → 11,234 kWh/year)	-515 kWh/year (2,690 kWh/year → 3,205 kWh/year)	-3,074 kWh/year (8,647 kWh/year → 11,721 kWh/year)
		Reduction of -21.9%	Reduction of -48.1%	Reduction of -19.1%	Reduction of -35.5%
	Power rate	Reduction of -2,713 yen	Reduction of -14,557yen	Reduction of -2,658 yen	Reduction of -10,885 yen
Effect to reduce air conditioning and heating system load*3 (yearly air-conditioning)	Calorific value	122 kWh/year (5,085 kWh/year → 4,963 kWh/year)	2,810 kWh/year (38,166 kWh/year → 35,356 kWh/year)	193 kWh/year (5,768 kWh/year → 5,575 kWh/year)	3,931 kWh/year (45,429 kWh/year → 41,498 kWh/year)
		Reduction of 2.4%	Reduction of 7.4%	Reduction of 3.3%	Reduction of 8.7%
	Power rate	Reduction of 933 yen	Reduction of 14,750 yen	Reduction of 1,361 yen	Reduction of 17,430 yen

*1: Effect to reduce air conditioning load after activating cooling when the indoor temperature rises above the cooling temperature setting at any time of the year
*2: Effect to reduce heating system load after activating heating when the indoor temperature drops below the heating temperature setting at any time of the year
*3: Sum of the yearly cooling load and yearly heating load that decline due to applied sunshade coating materials for glazing
Note 1: Numerical calculations are performed on the assumption of a model housing and office and under various preconditions, and thus differ from the actual environment where the technology is introduced.

(3) Cautions on (1) "calculation results of verification items" and (2) "calculation results of reference items"

1) Numerical calculations are performed under various preconditions on the assumption of a model housing and office. The preconditions may differ from the actual environment where the technology is introduced.
2) To represent the reduction effects of heat loads not only in calorific value units (kWh) but also in terms of the reduction effects (in yen) of power rates, we set COP and energy charge unit prices that represent the cooling and heating capacities (in kW) per kW of power consumption during a rated output run.
3) The operating periods of cooling and heating set in the numerical calculations were as follows:
   - 15:00 in summer: Tokyo: 15:00 on August 10; Osaka: 15:00 on August 18
   - One summer month: August 1-31
   - Summer (June to September): June 1 to September 30
   - One winter month: February 1 to 28
   - Air-conditioning for a limited period: Cooling from June to September and heating from November to April
   - Yearly air-conditioning: One year of cooling and heating[*1]
4) No consideration is given to the rise in heat load arising from the amount of illumination and time stemming from the sunlight sheltered and resulting darkening of the indoor space.
5) The fields of the calorific values of effect to reduce air conditioning and heating system load represent the difference in heat load before and after use of the target verification technology, and the sum of heat load before and after said use, respectively (before use → after use).
6) For power rates, these calculations consider the difference in indoor heat load depending on the presence or absence of sunshade coating materials for glazing. Therefore, we do not estimate a total amount that entails various assumptions, but only indicate the difference in air-conditioning power rates due to changes in heat load. (For the concepts of calculating power rates, see page 28 of the full version of main text in [Concepts on calculating power rates]).

*1: Cooling will be performed when room temperature is higher than the temperature setting. Heating will be performed when room temperature is lower than the temperature setting.

4. Reference information

The verification applicant has submitted the information specified in (1) "overview of the target verification technology (reference information)" and (2) "other information from the manufacturer (reference information)" on his or her own responsibility. Therefore, MoE and the verification organization assume no responsibility whatsoever for the contents thereof.

(1) Overview of the target verification technology (reference information)

Item		To be filled out by the verification applicant		
Verification applicant		ZEROCON CO., LTD.		
Company name of technology developer		–		
Product name of target verification		ZEROCOAT		
Product code of target verification		–		
Contact information	Phone	06-6492-0659		
	Fax	06-6499-3481		
	Web address	http://www.zerocon.co.jp		
	E-mail	info@zerocon.co.jp		
Characteristics of the technology		When singly applied to the surface of window glass, this material can reduce the transmittance of near-infrared rays while allowing visible light rays to pass through. In particular, as this material suppresses the transmittance of near-infrared rays, it can significantly control rises in room temperature due to the near-infrared rays, thereby letting you enjoy the sunshade effect more than that of conventional products. In addition, this inorganic glass coating material features ultrafine inorganic particles dispersed in high weather-resistant resin, allowing it to create extremely hard, high weather-resistant coating films that are difficult to deteriorate.		
Conditions for installation	Corresponding building and its region	Window glass (e.g., offices, shops, medical care facilities, schools, housing units)		
	Considerations on installation	The coated films may be thermally cracked. Therefore, the possibility of thermal cracks must be judged in advance.		
	Other constraints on the installation location, etc.	This coating material can be applied to both the indoor and outdoor surfaces of window glass.		
Need for maintenance, weather resistance, product service life, etc.		- The surface of the coated film can be cleaned by gently wiping it with a damp cloth (or towel). - When applied to the indoor side of window glass, this material can be expected to provide about 20 years of effective weather resistance.		
Rough estimate of the cost		Design and installation price (with materials and installation)	14,000 yen	per 1 m^2

(2) Other information from the manufacturer (reference information)

Additional cost may be required depending on the worksite conditions.