

● STANDARD SPECIFICATION

DONG SHIN

"LOVELY" WALL Architectural Porcelain
(Vitreous) Enameled Honeycomb Panel

DONG SHIN ENGINEERING CORP., KOREA

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A. INTRODUCTION OF PORCELAIN ENAMELED (P.E.) HONEYCOMB PANEL

A.1. PREFACE

The steel, as one of the common building materials, is being used in various construction fields such as foundation, structure, panel production, and so on. One of the main problems of the steel, however, is that the steel corrodes easily. But, thanks to the current advanced anti-corrosion treatment, the use of the steel as the building material has been steadily increased.

In order to meet the construction requirements, especially for exterior construction, the steel plate has to fulfill various factors and be able to meet the high standard specification as well as to maximize the factor of decorative function.

In the present time, the only steel plate that can meet all of those high requirements including the decorative function is the PORCELAIN ENAMELED PANEL. It is one of the most convenient materials for curtain wall system and can be easily applied in renovating the old building as well as constructing the new building.

We, **DONGSHIN**, the pioneer and the leading producer of PORCELAIN ENAMELED PANEL in Korea with our own brand name "**LOVELY WALL**" believe that we can fully meet the modern construction needs and answer to the modern architects by developing a new sphere in the design and creativity.

A.2. SUPERIORITY OF PORCELAIN ENAMELED HONEYCOMB PANEL

The porcelain enameled honeycomb panel is superior to any other exterior panels because of the following characteristics :

A.2.1. It is **rustproof** due to the absence of pores on the enameling.

A.2.2. It is **weather resistance** with respect to heat, cold, humidity, because the coloring process is carried out by means of metal oxidation at high temperature. On that account, its color will not fade. Moreover, its gloss can be conserved over 80% of the original gloss after 30 years (90% after 20 years).

The PE panel can guarantee for **over 15 years** against discoloration, warping, surface blemish, scaling, cracks, and other defects to the product.

A.2.3. The porcelain enamel is a type of material similar to glass with a surface hardness of more than 5.5 Mohs' scale, thus keeps **outstanding scratchproof**. Aluminum, on the contrary, is the soft material which can be easily damaged by scratch. In general, the aluminum cannot resist the severe weather condition and its color fades easily.

A.2.4. It is **fire resistance** and maintains its **non-combustibility** up to the melting point. of 1490°C. Meantime, the aluminium has a lower melting point of 660°C.

A.2.5. It has the **wide variation of design** and is very economical.

A.2.6. It has the **wide range of color selection**. The stainless steel has monotonous colors. Aluminum has a limited color choice, its color consistency is unstable.

A.2.7. The **cost of maintenance for P.E. panels is economical** because the porcelain enameled steel panels do not turn dirty easily and they can be simply cleaned by water cleaning.

A.2.8. The porcelain enameled panel is **hygienic and resistant to bacteria**.

A.2.9. The **short installation period** can save the construction cost.

A.2.10. **Resistant to acid and other chemicals**.

B. GENERAL CHARACTERISTICS OF PORCELAIN ENAMELED HONEYCOMB PANEL

B.1. STANDARD SIZE

B.1.1 The standard size and shape of Dongshin PE panel is regulated under the JIS as shown in the following table ; * JIS(Japan Industrial Standard)

Standard Size of PE panel :

Length \ Width	867mm	1,170mm	1,450mm
867mm	867 x 867	1170 x 867	1450 x 867
1,170mm	867 x 1170	1170 x 1170	1450 x 1170
1,470mm	867 x 1470	1170 x 1470	*1450 x 1470
1,780mm	867 x 1780	1170 x 1780	*1450 x 1780
2,080mm	867 x 2080	1170 x 2080	*1450 x 2080
2,250mm	867 x 2250	1170 x 2250	*1450 x 2250
2,500mm	867 x 2500	1170 x 2500	*1450 x 2500
2,800mm	867 x 2800	1170 x 2800	*1450 x 2800

Note : * Special Order size : It needs 90-120 days of delivery time in order to procure raw-materials without any price increasing.

B.1.2. The size of PE panel is limited under the following conditions :

B.1.2.1. "L" type : - One side width shall be under 300mm

- The other side width shall be under 1500mm.

B.1.2.2. "□" type : - One side width shall be under 300mm

- The other side width shall be under 1500mm.

B.1.2.3. Round type : - Available R = Max 40,000 mm, Min 200 mm

- In case of $\Theta < 180^\circ$, The "R" of round panel shall be from 250mm to 450mm.

B.2. GENERAL CHARACTERISTICS

B.2.1. GLOSS

In general, the porcelain enamel products have the gloss to some extent due to the characteristics of the used raw materials. As a the result of measurement by 60 degree gloss meter, our porcelain enameled panel turns out to maintain 90 % gloss in case of the light color. However, the half and non-glossy products are possible in case of special color.

B.2.2. COLOR

The color of PE panel can be chosen among 70 colors of Dongshin Standard Color Chart and the special colors are also available according to the requirement by the architect. **The color is strictly controlled within the range of $\Delta E < 2$ and the color consistency and stability can be maintained semi-permanently as the pigment consists of 100% metal oxidation material.**

B2.3. CHEMICAL RESISTANCE

As the porcelain is a kind of glass containing SiO₂ & Al₂O₃, it is very strong to Alkali and Acid.

Chemical resistance of PE panel

No.	Chemicals	Result
1	H ₂ SO ₄ 98 %	Slight Pollution
2	H ₂ SO ₄ 12.8 %	"
3	HCL 37 %	No change
4	HCL 18.5 %	"
5	HNO ₃ 60 %	"
6	Salt Water 5 %	"
7	NaOH 30 %	"
8	NaOH 10 %	"

B.2.4. STRENGTH & IMPACT RESISTANCE

As the result of pendulum impact test, our P.E. panel proves to resist the impact upto 100 kg/cm². This impact is equivalent to almost 2 times of the impact that the common people imposes by wielding a spade.

B.2.5. HARDNESS

Generally, the hardness of porcelain enamel panel is described as Mohs' Scale. The Mohs' scale of porcelain enameled panel is approximately 5.5. It means that the PE is much harder than Aluminum panel (2.9) and Steel panel(4.5).

Mohs' scale of some materials is as follows :

Materials	Steatite	Gypsum	Zn	Aluminum	Calcite	Fluorite
Moh's scale	1	2	2.5	2.9	3	4

Materials	Fe	<i>PE</i>	Felspar	Crystal	Topaz	Emery	Diamond
Moh's scale	4.5	5.5	6	7	8	9	10

B.2.6. HEAT RESISTANCE, TRANSMISSION-RESISTANCE, AND SPECIFIC HEAT

There is no change on PE panel surface when the P.E. panel heated up to 170. C cools down to 0. C in 20 minutes, and when the P.E. panel is heated from 0. C to 300°C in 20 minutes. The heat transmission and specific heat of P.E. panel is as follows, compared with other materials.

Heat transmission and Specific Heat :

Classification	Heat transmission(kcal/m ² h°C)	Specific heat(cal/g°C)
Porcelain Enamel	0.68	0.174
Aluminum	190	0.214
Fe	61	0.108
Cu	340	0.0915

B.3. PROPERTIES OF PORCELAIN ENAMEL PANEL

Hardness	5.5-6.0 Mohs' scale
Chemical properties	A) Resistance to oil
	B) Resistance to alkali
	C) Resistance to acid
Heat Resistance	700°C (30 minutes)
Flatness	Less than 0.5% (JIS : Less than 1.0%)
Test of loading Strength	Loading strength 183 kg/m ² (JIS : Loading strength 125 kg/m ²)
Mechanical properties	1) Yield point 16 kg/mm ²
	2) Tensile strength 32 kg/mm ²
	3) Erichson 11.6 mm
Weather resistance	JIS A 1415 Acid resistance grades not affected by severe conditions. No change after 4000 hrs by weather meter test. No change after 8 year of outdoor exposure test
Resistance to salt	JIS Z 2371 (Spraying salt solution) Place the sample into 5 % salt solution for 48 hours. No corrosion.
Gloss conservation	JIS 5400 Conservation over 80% of original gloss after 30 years.
Resistance to impact	JIS 6516 No scale and crack after dropping a steel ball of 200g from a height of 1 m onto the P.E. panel
Thermal conductivity	0.68 kcal/mh °C
Specific heat	0.174 cal/g. C
Resistance to heat	Melting point 1490 °C

C. MANUFACTURING PROCESS OF PORCELAIN ENAMELED STEEL PANELS

Before starting the manufacturing process of a particular project, the intensive discussion should be held among the buyer, the project implementation party and the manufacturer regarding the preparation of shop drawing, installation plan, and panel design drawing, and so on.

C.1. FORMING AND WELDING :

In this process, the panel is prepared in conformity with the agreed drawings. As the porcelain enameled steel panels are produced by pre-forming and after-coating procedure, the panel design should be fully completed before commencing the enameling process.

The steel plate is sheared according to the required size by using the shearing machine. After shearing, all sides are bent by using a press machine for flat type and a rolling machine for round type. The angle where the bent sides meet is to be welded with GAS, TIG or ARC and the hanging clip on the panel are SPOT welded. Finally, the entire surface which is uneven or has welding marks should be polished to a smooth finish.

C.2. PRE-TREATMENT

To obtain a good enameling, the surface of the steel plate should be totally free from grease or corrosion. The purpose of this pre-treatment process is to remove the grease, oil, corrosion, to rinse with water, and to neutralize the surface.

C.3. COMPOUNDING ENAMEL

The basic enameling material is the frit, while the auxiliary materials are calcium oxides and etc. These components are mixed with water and milled to the desired fineness. The fineness, density, viscosity, and color of the enamel clay is tested before applying the coats.

C.4. APPLYING COATS AND BAKING

C.4.1. This consists of a series of production process; spraying the enamel clay, drying and baking.

C.4.2. The enamel clay milled with frit, auxiliary materials, color oxides, and water is sprayed onto the surface of steel sheet by the spraying gun at the air pressure of 2.8 - 3.5 bar.

C.4.3. The panels which have been enameled should be dried first to remove the water contained in the clay. Water, in this case, is only used as a medium in the enamel milling and spraying process.

C.4.4. After the drying process, the enamelled panel is fired and baked in the furnace at the temperature of 800. C - 830. C to obtain a good adhesion between steel plate and enamel.

C.4.5. Coating thickness

Layer \ Surface Finish	Coating Thickness (μ)		Remark
	Flat type	Stipple Type	
Ground coat	80 - 120 or more	Max 400	
Ground coat +1 cover coat	160 - 240 or more	Max 500	
Ground coat +2 cover coat	240 - 360 or more	Max 600	Special Color

Color tone : 70 standard colors & special color ordered

Gloss : Shiny, Semi dull, Dull

Surface finish : Flat type or Stipple type

C.4.6. BONDING THE BACK SIDE MATERIAL

C.4.6.1. In case of flat panel, the 15.5mm thick Aluminium honeycomb core board shall be bonded at the back side with sheet type adhesive to obtain the superb flatness of the PE panel. Its cell size is 3/4" or 1/2".

C.4.6.2. However, in case of bent panel, the calcium silicate board can be partially applied as a back side material. However, the round panel has no back side materials.

C.5. QUALITY CONTROL

C.5.1. After the baking process, the enameled steel panel has to pass through very strict Quality Inspection. At the time of inspection, the enamel coated surface should be free from any small holes/pores, cracks, air bubbles, scale or even specific spots.

C.5.2. Apart from the above, there should be no deviation in the color of the entire panel surface from the standard color spectrum which has been previously agreed on. After the inspection, the protective film should be placed onto the panel surface to prevent from any damage and scratch which may be caused during the transportation and installation.

C.5.3. Quality Control Method and Test Result (equivalent to BS 1344)

TEST	METHOD	RESULT
1. Resistance to chemical materials	Spot Test : Drop 2 cc of test chemicals on the surface of the item to be tested. Leave in the test laboratory for 48 hours. Clean the surface. Dry and observe the outcome. Chemicals used : 12.8% H ₂ SO ₄ , 60% HNO ₃ , 18.5% HCL, 10% NaOH	No spots AA class
2. Resistance to acid	Drop 2cc of 10% citric acid and leave for 48 hours. DIN 51.150	No spots AA class
3. Resistance to salt	Place the sample to be tested into a 5% salt solution for 48hours.	No corrosion
4. Cooling and Heating	Repeat cooling process 5 times at 20°C for 8 hours and heat to 300 °C	No breakage and no chipping

D. STANDARD SPECIFICATION OF PORCELAIN ENAMEL HONEY-COMB PANEL

D.1. GENERAL INTRODUCTION AND INSTALLATION METHOD

D.1.1. The Component materials of P.E. curtain wall system

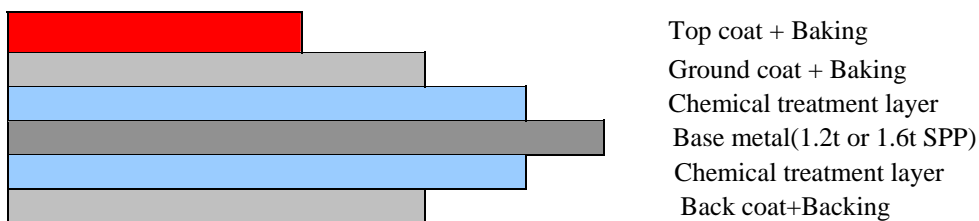
- Porcelain Enamel Honey-Comb Panel (" Lovely Wall")
- Set Anchor and other ancillary accessories
- Caulking material and other ancillary accessories for installation

D.1.2. The design Criteria

- The design shall consider the applicable wind load so that there should be no deformation, twist and damage on the P.E. panel.
- The color should be decided subject to approval by the owner or architect.

D.1.3. The composition of porcelain enameled honeycomb panel

D.3.1. The P. E Panel has an excellent chemical resistance and weather resistance property. Its base metal is 1.2(or 1.6)mm thick decarbonized steel sheet. And both surfaces are firstly sprayed with inorganic ceramic glass powder for the ground coating and baked in the furnace (800-830 °C). And then, the 2nd coating is sprayed on both surfaces of the panel for the top finish coating and again baked in furnace(800-830 °C) for the top finish coating.



D.1.3.2.. Substrate steel sheet

The substrate steel sheet is 1.2mm (or 1.6mm) thick decarbonized steel sheet. Its chemical and mechanical property is as follows :

* Chemical Composition of P.E Panel

Chemical element	C	Si	Mn	P	S
Base metal					
SPP steel sheet	0.005% (JIS G3133: Max 0.008)	0.003%	0.040%	0.030%	0.030%
Cold roll steel sheet	0.060	0.020	0.300	0.015	0.020

* Mechanical Property of P.E Panel

Yield Point (kg/mm ²)	Tensile Strength (kg/mm ²)	Elongation(%)	Erichson value (mm)
17.5	30.5	49 (JIS G3133: Min 39)	12.7

D.1.3.3. Chemical Treatment Layer

This is a slim layer which is formed by chemical treatment in order to increase the anti-acid and adhesive properties of P.E Panel's surface.

D.1.3.4. Ground coating

This is a layer mixed with inorganic glass powder, special elements, and pigment which has the strong weather resistance and adhesive property. Its coating thickness shall be 80-120 μ or more.

D.1.3.5. Top finish coating

This is a layer mixed with inorganic enamel having ultra-durability property. The various and beautiful colors are applied in this top finish coating process. Its coating thickness shall be 80 - 120 μ or more.

D.1.3.6. Back Coating

This is the same as ground coating. Its thickness is 80 - 120 μ or more.

D.1.4. Backing Material

D.1.4.1. Backing material for flat type (Aluminum Honeycomb)

15.5mm thick Aluminum Honey-comb Core (cell size of 3/4" or 1/2")
+ 0.5mm thick color coated steel sheet.

D.1.4.2. Backing material for bent type (Calcium Silicate Board)

12mm thick calcium silicate board. (However, in case that one side length of bent type panel is shorter than 400mm, this backing material **is not applicable**)

MATERIAL	Thickness(mm)	PROPERTIES
Calcium Silicate Board	12	Density : 0.88G/cm ³ Thermal Conductivity : 0.1212kcal/m. h. °C Bending Strength : 128 kg/cm ²

* The test report of Calcium Silicate Material (Backing Material)

Item Description	Thick-ness (mm)	Noncombustible Test				
		Surface Test				Material
		Melting, Cracking, Harmful Transformation	Flame Remained	Calorific Value per Unit Area	Temperature Time, Area (°C min)	The Difference of Tem(°C)
Calcium Silicate Board	12.0mm	None	None	0	0	+10
		None	None	0	0	+9
		None	None	0	0	+7

Description	Result
Bulk Density	0.88gr/cm ³
Water Content(%)	9.65
Moisture Extension (Dry To Saturated) (%)	0.06
Destruction Strength (kgf)	128
Thickness (mm)	12.00

D.1.4.3. Weight

The thickness and weight of the Panel is as follows :

MATERIAL	THICKNESS(mm)	WEIGHT(kg/m ²)
Flat type (Al. Honeycomb backed)	18	14
Bent type (Calcium Silicate Board)	27	25

D.1.5. ERECTION ACCESSORIES

D.1.5.1. Set Anchor

- Material : Galvanized steel (SS41) or stainless steel anchor
- Size : 3/8" x 100mm L

D.1.5.2. Back Frame

- Material : Galvanized steel sheet(SS41)
- Shape : C-Channel , L-Bar or Steel Square Pipe
- Size : C-75 x 45 x 15 x 2.3t / L-40 x 40 x 6t
Steel Square Pipe - 40 x 40 x 1.6t
- Painting on welding area : In case of steel, red-oxide primer coating (2 times) and in case of G.I, zinc-primer.

D.1.5.3. Bits

- Materials : General structural Steel (SS41) or Galvanized steel
- Size : L-80 x 80 x 6T, L-100 x 100 x 6T

D.1.6. INSTALLATION (ERECTION)

D.1.6.1. Installation of Back Frame

- To check the horizontal and vertical status of the building structure.
- To set the base line with ink-pot string
- To fix the set anchor in an interval of 1500mm on the concrete.
- To set the piano string vertically.
- To fix the back frame

D.1.6.2. P.E. Panel Installation

- To install the panel onto the back frame.
- The space of bits shall be within 300-400mm.
- When the welding job is executed in the area adjacent to panel installation area, not only the panel surface but also other materials (aluminum frame, shelter, rail, ceiling, moulding, and etc) should be carefully protected from welding spot.
- When handling and installing the P.E Panel, the installer shall pay the careful attention for the P.E. panel not to be damaged.

D.1.7. Cleaning, Maintenance and Repairing

- The defected panel area shall be repaired with touch-up paint.
- The stain on the P.E Panel shall be washed with thinner and cleaned with dry-towel.
- The impact on the P.E Panel from outside is strictly prohibited.

D.1.8. Transportation and Storing of P.E Panel

- The finished P.E. panel shall be packed and delivered to jobsite in wooden box or container in accordance with the international standard.
- The panel surface shall be properly protected not to be damaged by mis-handling or bad weather.
- The P.E Panel and its accessories shall be stored in warehouse free from rain.

D.1.9. Test and Inspection

- To measure the dimension (W x H x L) with random sample.
- To check the crack, pin hole, groove, air bubble, color, stain, shape deformation, and the surface finishing. Any defected panels inferior to the standard inspection criteria shall be eliminated.
- The allowable value is as follows :
 - (-) The length and width : Below +/- 2.0mm
 - (-) The thickness : Below +/-1.5mm
 - (-) Radius : +/-1mm
 - (-) Width if Flange : +/-1mm
 - (-) Deviation across the face of the panel in any 2 m lengths +/-1mm
 - (-) The dimension gap of diagonal line : Below 4.0mm
 - (-) The coating thickness : Below 600 μ

D.2. UNIT WALL INSTALLATION SYSTEM

- To check the and horizontal status of the building structure by using the piano string vertically.
- To mark the base line onto the building structure by using the ink-pot.
- To fabricate the unit frame in accordance with the decided horizontal and vertical line and to fix the P.E. panel onto the fabricated unit frame.
- To fix the set anchor, 1st fastener, and 2nd fastener at position specified in the drawing.
- To remove the scaffolds before installing the unit.
- To lift up the P.E unit from the ground by using the heavy equipment (tower crane, chain block, and etc.) and fix the P.E. unit to the 2nd fastener.

- The joint space between unit and unit shall conform to the approved drawing. The allowable discrepancy is +/-2.5mm.
- After setting the P.E. unit, the steel plate is additionally welded to the unit frame between unit and unit in order to reinforce the earth-quake resistant property, if necessary.

E. COMPARISON OF P.E. PANEL WITH ALUMINIUM SHEET

E.1. PROPERTIES

SECTION	AL. SHEET	P.E PANEL	REMARKS
Weight	8kg/m ²	14kg/m ² (Including Al. Honeycomb board)	
Color Choice	Free	Free	
Gloss conservation	15-20 years	Conservation over than 80% of original gloss after 30 years	
Resistance to impact	A CLASS	A CLASS, 133kg/cm ²	
Thermal expansion	140x10 ⁻⁷ /°C	260-320x10 ⁻⁷ /°C	
Twist	None	None	
Design	Easy	Free	
Max. Panel size	1500×3000mm	1170×2250mm	Special order size is possible
Resistance to rust	A CLASS	A CLASS	
Repairing of surface	By air drying touch-up		
Panel replace	Easy	Easy	
Delivery	1 Month after contract	1 Month after contract	
Flatness		Less than 1% (JIS)	
Resistance to fire	Melting point 660°C	Melting point 1490°C	
Resistance to pollution	Disadvantageous	None	

Weather resistance	Thin surface, weak to acid	Excellent	
Hardness of surface	4H	5.5 Mohs' hardness	
Maintenance	Uneasy to maintain the cleaning for pollution	Advantageous to resistance to pollution and cleanliness	
Color consistency	Unstable Thick : 20-40 μ	Stable Thick : 160-240 μ	
Resistance to abrasion	Unchanged within 1000 hours, but the surface destroyed after 5000 hours.	Unchanged within 5000 hours	
Guarantee for surface	15-20 years (PVDF)	40 years	

E.2. USED MATERIALS

SECTION	AL SHEET	P. E. PANEL
Base material	2.5-3.0mm AL Sheet	1.2(1.6)mm decarbonized steel sheet for porcelain enameling (SPP)
Coating methods	Electrostatic coating used PVDF	Firing inorganic ceramic glass powder in 800 - 830°C furnace. Coating thickness : 160-240 μ or More
Fixing accessories	Steel anchor, screw	Steel frame, set anchor, bits, Screw
Caulking material	Silicone sealant	Silicone sealant polysulfide Sealant

E.3. QUALITY COMPARISON WITH OTHER FINISHING MATERIALS

MAIN QUALITIES	PORCELAIN ENAMEL	ALUMINIUM PANEL	STAINLESS STEEL	VINYL CHLORINIZE SHEET	ALC PANEL	PC, GRC PANEL	TILE
DESIGN	AA	A - B	C	B - C	B	B	AA
COLOR	AA	B	C	B	B	B	AA
SHAPE	AA	A	C	C	B	B	AA
FIXING METHOD	A	AA	A	A	A	A	B
DELIVERY	A	A	A	A	A	A	B
WETHER RESISTANCE	AA	B	AA	B	B	B	B
RESISTANCE TO RUST	AA	B	A	B	AA	AA	A
INSULATION	A	A	A	A	A	A	A
NOISE PROOF	A	A	A	A	A	A	A
RESISTANCE TO HEAT	AA	C	A	B	A	A	B
RESISTANCE TO IMPACT	B	B	A	B	B	A	B
MAINTENANCE	A	C	B	B	B	B	B

* AA : EXCELLENT

* A : GOOD

* B : MEDIUM

* C : BAD

F. STANDARD MAINTENANCE MANUAL

F.1. GENERAL MAINTENANCE

F.1.1. Panel Handling

- 1) Another way to minimize damages of P.E. panels is the proper way of handling/storing prior installation.
- 2) The panel delivered should be stacked on pallet with the back of the PE panel facing upwards and having a 30-60 mm t polystyrene separator before placing the next, so as to minimize damages.
- 3) All completed panels upon delivered should also be protected with PVC protection film before completion of construction.
- 4) The recommended stacking quantities per pallet should not be more than 65 pcs which is equivalent to approximately 3,000kg, so as unloading by the aid of forklift is possible.
- 5) All panels prior installation should be store in a shelter area, if not covered with canvas.

F.1.2. Panel Touch-up

- 1) Any minor chipping on the PE panel which is visible at 1 liner meter distance can be repaired as per below two methods:
 - * Touch-up with paint
 - a) When base coating is exposed less than 10mm : Touch-up paint
 - * Touch-up with putty powder & paint
 - b) when base coating is exposed more than 10mm : Touch-up with putty powder and paint over.
- 2) When a panel requires minor touch-up as per item F.1.2.1-a), the following procedures must be adhered to.
 - a) Rub the damaged part horizontally/vertically(which ever is suitable) by grade #200 fine sand paper to remove the rust or any other contaminated materials.
 - b) Using a 1" wide paint brush, clear away the dust and clean with thinner or alcohol and leave dry.
 - c) Touch-up the affected area horizontally/vertically with a clean brush, with the desired paint and leave dry.

- 3) When a panel is severely or chipped as mentioned in F.1.2.2-b), the following procedures must be adhered to.
 - a) Rub the damaged part horizontally/vertically by using grade #80 sand paper or, higher grade to remove rust or angled edges.
 - b) Using a 1" wide brush and clear away the dust and clean with thinner or alcohol and leave dry.
 - c) Mix the putty powder with the hardener by the ratio of 10:1 within 10 minutes, as the hardening starts after 10 minutes of mixing and the practical hardness can be achieved after 3 hours.
 - d) Apply the mixed putty with a putty tool on the damaged part, and make sure that the affected area are patched up evenly. Tooling application should always follow the direction of sanding.
 - e) Await putty to dry for half hour prior sanding down with a fine sand paper grade #200 in the similar direction.
 - f) Brush away the dust and clear the surface before touch-up with the desired paint and leave dry.

F.1.3. Panel Replacement

- 1) One of the main advantage of P.E. Panel system is that any damaged panels can be easily replaced.
- 2) Lift panel up to the underside of the above panel with the aid of wooden tool and remove.
- 3) Check all existing fixing panels on the steel members are in order.
- 4) Slot in the new panel.
- 5) Check panel alignment, position & remove protection tape.
- 6) Use a wet cloth to clean the surface of the new panel.
- 7) Recommended facilities for the replacement job is as follows;
 - a) Gondola
 - b) Pump lift
 - c) Scaffolding

F.2. CLEANING & MAINTENANCE OF PORCELAIN ENAMEL PANEL

F.2.1. Cleansing & Washing

- 1) The coating system on the PE panels is a highly durable and decorative finish. Simple maintenance with regular washing with water & suitable cleansing agents will not only enhance the life but also maintain attractiveness for longer period thus protecting your assets.
- 2) The frequency with which cleaning is to be carried out and the choice of a suitable cleansing agent, depend mainly on the position of the building being located and the degree of contamination. Washing should be done at least every 12 months and more frequently in coastal areas where marine salt spray is prevalent and also in areas where high levels of industrial fallout occur.
- 3) The cleaning operation should be carried out in stages starting from the top and working downwards. It can be carried out either manually or with the aid of special cleaning apparatus, such as high pressure spray gun or foam brush appliances etc and also the addition of suitable cleansing agents and water.
- 4) The final round of the cleaning operation should also followed by a thorough rinse with clean water to ensure the removal of all remnant of the cleansing agents, and wipe down is necessary to avoid any water stains.
- 5) Avoid using both strongly alkaline agents and acid products. Try to use cleansing products as neutral cleansing agents or soft alkaline soap.

G. PRODUCTION PROCESS OF ART WORK PANEL(MASKING TAPE METHOD)

G.1. Base panel Process

- 1) According to the panel fabrication drawings, the base(1.6T SPP) metal should be cut, curved and welded.
- 2) The pre-fabricated base panel should be treated in the pre-treatment chemical bucket in order to get rid of oil, grease and others

G.2. Enamel Spray & Heating Process

- 1) Ground spray coating should be done on vitreous enamel panel with coordinated enamel.
- 2) The ground coated VE panel should be put into the furnace by hanger and conveyor at temperature of 850°C in order to dry the panel.
- 3) Top(Cover) spray coating should be done on ground coated vitreous enamel panel with pigments and coordinated enamel.
- 4) The top coated VE panel should be also put into the furnace by hanger and conveyor at temperature of 850°C in order to dry the panel.

G.3. Masking Tape Adhesion Process

- 1) Panel protection masking tape should be adhered on top coated VE Panel .
- 2)The masking tape should be cut and eliminated depending on the Artwork Drawing supplied by Client
- 3) The art-work spray coating should be done on masking tape eliminated area of VE panel.
- 4) The art-work spray coated VE panel should be put into the furnace by hanger and conveyor at temperature of 850°C in order to make finished Art-work VE panel.

G.4. Inspection & Protection PE film Process

- 1) After inspection of Art-work VE panel, if there is no fault, the protection film shall be adhered on Art-work panel for packing.