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Plastbau eWall

Product Technical Manual

Description

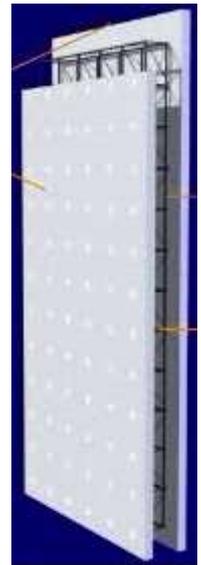
Plastbau eWall represents a form system consisting of Insulating Concrete Form (ICF) panels molded from Expanded Polystyrene (EPS) according to patented Plastbau technology that has been successfully practiced for many other application possibilities. A typical eWall panel module is 120cm wide, provides for concrete up to 35cm thick, and permits practically any storey height in single shot.

The Plastbau eWall system are manufactured and pre-reinforced with electro welded vertical steel ladders. The ladders are held between two EPS boards using self-threading screw caps fitted to steel cross ties spaced at 20cm on centers. The cavity formed between the EPS panels allows casting of various thicknesses of reinforced concrete to be formed. The reinforced concrete core provides all the structural capacity of the Plastbau eWall.

Plastbau eWall form system can be installed without difficulty under any weather condition, thus ensuring reliable schedule that meet project requirements or special situations. The outer EPS slab faces present a continuous surface ready to receive approved exterior claddings and interior finishes. Suitable covering materials include but are not limited to regular gypsum wallboard, drywall, plaster, stuccos, and brick or tile sidings.

The overall concept of their manufacture is to address major concern of cast in-situ concrete wall construction in terms of formwork rationalization and conscious strive for project constructability. Production process of the Plastbau eWall permits consistently high quality of eWall modules to be achieved with distinct material, time, cost, and lightweight benefits.

Whether used for load bearing or internal partition, Plastbau eWall system is selected for economy and the speed it provides to construction, with services concealed behind the EPS. Designed to obtain the most out of concrete wall construction, Plastbau eWall system are easily placed, assemble and finished on site without compromise to meeting superior strength, security, performance and insulation demands anticipated in today's structural wall systems.



Specifications

Production process of the Plastbau eWall permits consistently high quality of eWall modules to be achieved with distinct material, time, cost, and lightweight benefits. The outer faces of the EPS slab present a continuous surface ready to receive exterior and interior finishes.

Further to concrete, materials and specifications characterizing the Plastbau eWall components are explained in the following sections.

EPS e Wall Boards

EPS is a lightweight, inert, and organic material, which, in general, has the inherent property of being rot free, impervious to water, inert to bacteria and termite, resistant to heat and cold, and last the life of most buildings in which it is used. Plastbau eWall EPS forms are presently molded from EPS beads manufactured by SABIC, Saudi Arabia. Results of standard test conducted to evaluate the specific properties of EPS samples of the Plastbau eWall are indicated in the following table.

Physical properties

Property	Unit	EPS 550 FF	EPS 550 FF	EPS 650 FF	Test method
Density	Kg/m ³	25	30	30	
Compressive Resistance @ 10% deflection	KPa	153	158	188	DIN 53421
Flexural strength	KPa	298	316	346	DIN 53423
Flexural modulus	MPa	5.34	6.7	8.3	DIN 53423
Thermal conductivity	W/m ² K	31.1	30.6	28.9	DIN 52612
Water vapor permeation	ug/m ² .s	120	152	118	DIN 52615
Oxygen Index Flammability ¹	%	43	45	51	SABIC

¹Note: oxygen index measure s minimum oxygen required to sustain burning according to subject standard. Fire is not propagated below this level.

Fire Resistance Properties

Fire Retardance

Plastbau products are manufactured using a 550 FF Sabic EPS grade which is a fire retardant grade.

Surface Burning Characteristics

* Test Results

Property (at Full 10 min exposure)	Test Value
Flame Spread Index (FSI)	50
Smoke Development Index (SDI)	440

Based on ASTM E-84-06 classification⁵, the EPS 550 FF material meets class II surface burning characteristic of materials under building fire conditions.

⁴Test conducted for PAL according to ASTM E-84-06 method at Bodycote Materials Testing Canada Inc., Mississauga, Ontario-Canada. Bodycote report number 06-02-774.

Surface Burning Characteristics (⁵Material Classification to ASTM E-84-06)

Class	FSI	SDI
I or A	0 – 25	450 max
II or B	26 – 75	450 max
III or C	76 - 200	450 max

The tested EPS 550 FF is thus a class II building material on the ASTM E-48-06 classification scale.

Oxygen Index

The oxygen index specification helps determine that the foam is adequately modified with a flame retardant. Technically, the oxygen index is the percentage of oxygen in the atmosphere that would have to be present for the given foam to sustain combustion. If the actual atmosphere were lower in oxygen than the foam's index, the foam would not burn unless constantly exposed to an outside fuel source.

ASTM C578-95 sets the index minimum at 24 for all polystyrene foam types. Since the natural atmosphere includes less than 24 percent oxygen, foam with an index of 24 or more will not ordinarily sustain combustion.

* Oxygen Index Flammability of EPS Material used by Plastbau

	Unit	Method	EPS 550 FF	EPS 650 FF
* Oxygen index flammability	%	Sabic in house	43 45	51

* Oxygen index is a measure of minimum oxygen required to sustain the burning according to subjected standard. Below this level the fire propagation is not supported and it extinguishes.

Smoke and Dangerous Gas Emissions

As compared to other materials the burning of EPS is less harmful than burning timber and many other commonly used building materials. Gases released during combustion are predominantly carbon dioxide and carbon monoxide. Tests carried out in accordance with European Standard DIN 53436 show that the levels of dangerous gases are considerably less those occurring when burning timber.

Type of test piece	Constituents of the fire gases	Fire gas composition in ppm at a test temperature of			
		300*c	400 *c	500 *c	600 *c
Standard EPS	Carbon monoxide	50*	200*	400*	1000**
	Styrene monomer	200	300	500	50
	Other aromats	Traces	10	30	10
	Hydrogen bromide	0	0	0	0
(=) Flame Retardant EPS	Carbon monoxide	10*	50*	500*	1000**
	Styrene monomer	50*	100	500	50
	Other aromats	Traces	20	20	10
	Hydrogen bromide	10	15	12	11
Pine wood	Carbon monoxide	400*	6000**	12000**	15000**
	Aromats	-	-	-	300
Insulating Softboard	Carbon monoxide	14000**	24000**	59000**	69000**
	Aromats	Traces	300	300	1000
Expanded cork	Carbon monoxide	1000**	3000**	15000**	29000**
	Aromats	Traces	200	1000	1000

Notes :Test conditions as specified in DIN 53 436, air supply 100 l/h, test piece size in mm : 300 x 15 x 10

* Smoulding fire
 ** Flame fire
 - Not measured

(=) Plastbau EPS material is fire retardant EPS of 550 FF grade produced by Sabic.

Toxicity properties (Gases released upon burning EPS 550 FF)²

Gas Type	Lower Limit (ppm)	Detection (4 mins exp)
HCN	2 – 30	Not detected
HCl	1 – 10	Not detected
NOx	2 – 100	Not detected
SO2	0.5 – 25	Not detected
CO	10 - 3000	Not detected
HF	1.5 - 15	Not detected

²Concentration of gases determined are below the Instrument detecting capability suggesting that the gases released from EPS 550 FF burning are certainly below the lower limit indicated above.

Concrete

The Building Code Requirements for Structural Concrete (ACI 318) code outlines proportioning and performance requirements that should be considered in design. Such considerations should be additional to any supplementary requirements for a specific construction project. For the Plastbau eDeck design, normal weight concrete is assumed according to the following conditions:

- 28 days cylinder compressive strength:- 28Mpa
- Maximum aggregate size: 15 mm

Reinforcement Bars/Wires

Plastbau eWall forms are pre-reinforced with vertical steel ladder made of deformed reinforcing bars having a minimum yield strength of 410MPa (60,000 psi) according to ASTM A 615 (96) Grade 60. Steel cross ties are obtained from plain wire rods having minimum yield strength of 250Mpa conforming to ASTM specifications.

Fabrication

The Plastbau eWall units are manufactured according to patented Plastbau Insulated Concrete Forming (ICF) technology. The units are produced in the factory using specifically formulated EPS slabs or panels.



The EPS slabs are shaped from Expanded Polystyrene (EPS) beads through a process of expansion, conditioning and molding, post processing, and cutting to EPS slabs of desired density. Production process of the EPS slabs permits consistently high quality of eWall modules to be achieved with distinct material, time, cost, and lightweight benefits.



Plastbau eWall is uniquely characterized by being pre-reinforced with a steel ladder of size and spacing that automatically meet vertical reinforcement of the system. The vertical steel ladders, fitted with steel form ties, wedged by a stopper, and connected together by screw caps. The steel form ties are designed to form a regular grid points that are 20cm on centers and provides a seat for horizontal bars to be placed if desired.

Plastbau eWall are ordered for fabrication following dimensions designed for the best combination of ultimate strength, reliable scheduling, ease of assembly, and in-service capabilities. A typical Plastbau eWall unit is 120cm wide and allows a nominal concrete wall of various wall thicknesses to be ordered for fabrication.



Design Criteria

The Building Code Requirements for Structural Concrete (ACI 318) code establishes structural design requirements for reinforced concrete, Procedure described therein are adopted as a basis of design of Plastbau eWall units for structural wall applications.

Reference is also made to Portland Cement Association (PCA) publications striving to foster developments, acceptance, and implementation ICF based cast-in-place concrete wall systems. The PCA sources consulted include “Structural Design of Insulating Concrete Form Walls in residential Construction”, and “Prescriptive method for Insulating Concrete Forms in residential Construction” that serves as the source documents for building code provisions in the International residential Code (IRC).

Axial load capacity tables have been developed to permit accurate selection of reinforced concrete walls based on a combination of a wide variety of design parameters. The Plastbau eWall design table is characterized by the following material and dimension selection parameters.

EPS slab thickness, mm	50 to 150
Typical eWall height m	Building story height
Typical eWall width, mm	Prefixed to 120
Concrete core thickness	100 to 350 (to design)
Concrete strength, MPa	27 (typical)
Steel yield strength, MPa	410Mpa (typical)
Vertical bar diameters, mm	8 to 16 (to design)
Number of bars per panel	12
Tie bar diameters, mm	6 (typical)
Tie bar spacing, mm	200 c/c grid
Deflection control	To design
Support conditions	Simple (or to design)

Installation

Constructing with Plastbau eWall panels simply involve sequence of activities such as assembly and alignment, reinforcement and concreting, and finishing and de-shoring. The lightweight nature of the Plastbau eWall means that installation can be done manually with minimal shoring, increased safety, and fast assembly at the jobsite. Provisions for windows and doors are readily achieved by pre-cutting the panels to suit the opening requirements.

Plastbau eWall units are assembled and aligned to close-fit each other in position. Placement of horizontal steel, dowel and tie bars, and additional vertical steel (if any) in the inner void must be in accordance with structural design of the project. Units are shored to comply with the "Guide to Formwork for Concrete (ACI 347-03).



Concreting is done according to any requirements specific to a construction project and provisions such as ACI 301 and ACI 306 have addressed special precautions that need to be taken for structural and hot weather concrete respectively. Since the EPS form stay in place, concrete placed within the Plastbau eWall completely moist cured for the requisite 28 days. This makes it possible for the concrete to attain higher 28 days compressive strength by as much as 20 to 50%.



Upon concreting, the Plastbau eWall faces present a robust surface ready to receive approved exterior claddings and interior finishes. Applicable covering materials may include gypsum board, fiber cement, drywall, plaster, stuccos, and brick or tile sidings. The finishes are applied in accordance with manufacturing instructions to achieve requisite assembly or fire ratings.

As with all construction, the success of a concrete building project depends on strict adherence to installation documents of the building system. The completed Plastbau eWall assembly is evaluated for thermal, sound, moisture, and fire resistances.



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Further Information

You are invited to learn more by contacting Plastbau Arabia Limited, for a personal presentation, and by visiting us on the web.

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