

Product Technical Manual

Description

Plastbau eDeck is a stay-in-place insulating concrete forming system for joisted concrete floors. The system is pre-engineered to address major concern of cast in-situ concrete construction, that of formwork rationalization and conscious strive for project constructability.

Invented by Piero Cretti, the system consists of a core of Expanded Polystyrene (EPS) through which a continuous pair of z-metal strips is embedded to confer self-supporting ability when the eDeck is finally laid in place for concreting. The EPS core is molded according to a patented Plastbau technology that has been successfully practiced over the past decades amid many other application possibilities. The reinforced concrete joist system embraced in and around the EPS form provides all the structural capacity of the Plastbau eDeck.



Plastbau production process permits consistently high quality of eDeck modules to be achieved with distinct material, time, cost, and lightweight benefits. The Plastbau eDeck system can be installed without difficulty under any weather condition, thus ensuring reliable schedule that meet project requirements or special situations.

Construction built with Plastbau eDeck ensures the rigidity of monolithic cast-in-situ concrete and the durability of EPS-encapsulated concrete. These are factors that increasingly make Plastbau eDeck a system of first choice in severe weather and seismic conditions. To experts in the field of structural and building material performance, Plastbau eDeck is a revolutionary system that maximizes the life cycle of buildings.

Specifications

The Plastbau eDeck units are produced in the factory using specifically formulated EPS block fitted with a pair of long Metal Furring Strips. When assembled, reinforcement placed, and concrete cast, the EPS block allow a single-tee shaped joists spaced 600mm on centers to form. With regard to the complete system, the Plastbau eDeck consists of three principal components, comprising the EPS Core, reinforcement bars, and the Concrete. Material and specifications characterizing these components are explained in the following sections.

EPS e Deck Forms

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 classification ⁵ , 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

With regard to reinforcement, premium quality deformed reinforcing bars having minimum yield strength of 410MPa (60,000 psi) comparable to ASTM A 615 (96) Grade 60 is specified for Plastbau eDeck. In compliance, concreted units are reinforced with the deformed reinforcing bars according to design calculations and subject to any supplementary requirements for a specific construction project.

Fabrication

The Plastbau eDeck is manufactured according to patented Plastbau Insulated Concrete Forming (ICF) technology.

The forms are shaped from Expanded Polystyrene (EPS) grains processed to a desired density in a molding chamber subjected to external and internal steam treatments. Internal heat treatment is achieved by means of tubular steam pipes connected to the rear end of the molding chamber. At the end of the process, it is the spaces vacated by the tubular steam pipes that are left to serve as conduits for utility lines.



Production process of the Plastbau eDeck is uniquely characterized by Z-shaped and perforated metal furring strips that are continuously fed into the mold. The holes deliberately punched into the strips allow both the EPS and the strips to fuse and bond around each other as the EPS expands to create a self-supporting formwork system.



Overall, the Plastbau eDeck is a product that fuses a foam core, made of EPS, between and around Z-metal furring strips (ZFS) to create a robust shuttering system for construction of reinforced concrete roofs, ceiling, and floors. Plastbau eDeck are ordered for fabrication following dimensions designed for the best combination of ultimate strength, reliable scheduling, ease of assembly, and in-service capabilities.

Design Criteria

The internationally recognized standard for design of reinforced concrete structures is the “Building Code Requirements for Structural Concrete (ACI 318)”. The ACI 318 code establishes structural design requirements for reinforced concrete, and thus provides the design basis adopted for design of Plastbau eDeck.

Span-load tables have been developed to permit accurate selection of reinforced concrete joists based on a combination of a wide variety of designs. The Plastbau eDeck design table is characterized by the following material and dimension selection parameters.

Service dead load, kg/m ²	upto 250
Service live load, kg/m ²	upto 500
Flange thickness, mm	40 to 100
Flange width, mm	Prefixed to 600
Rib depth, mm	100 to 290
Rib width, mm	110 to 130
Concrete strength, MPa	27 (typical)
Steel yield strength, MPa	410Mpa (typical)
Main bar diameters, mm	8 to 16
Main bar layers	1 to 2
Number of bars per layer	1 to 2
Stirrup bar diameter, mm	8 (typical)
Stirrup spacing, mm	to design
Clear spans, m	to design (upto12m for roofs)
Deflection controls	L/(180, 360, 240, or480)
Support conditions	Simple (or to design)

Installation



shoring.

During installation, Plastbau eDeck units should be shored in accordance with the “Guide to Formwork for Concrete (ACI 347-03). With continuous shoring and bracing in place, the Plastbau eDeck units are easily assembled and aligned to close-fit each other in position.

Actual placement of reinforcement steel in the joist cavity must be in accordance with structural design of the project with precaution taken to address dowel requirements, transverse stiffening ribs, and other inserts to be concreted.

Relevant code provisions such as ACI 301 and ACI 306 have addressed special precautions that need to be taken for structural and hot weather concrete respectively. Concreting should also be pursued to meet any requirements specific to a construction project.

As with all construction, the success of a concrete building project depends on strict adherence to installation documents of the building system. The lightweight nature of the Plastbau panels means that installation can be done manually with increased safety, minimal shoring, and fast execution at the jobsite.

Achieving reinforced concrete floors/roofs with Plastbau eDeck panels simply involve sequence of activities such as shoring and bracing, assembly and alignment, reinforcement and concreting, and finishing and de-

