
PSP unsustainable ceiling blocks
PSP is the first specialized designer and executor of Waffle ceilings in south Iran
PARS
STRUCTURE
PREFAB
WAFFLE SLAB SERVICES
Strong ■ beautiful ■ economical

Introduction

Pars Structure Prefab Company was founded in Shiraz in 1996 and has been active in the design and implementation of concrete and metal buildings with joist and block ceilings, simple concrete slab prefabricated and waffle slabs

Nowadays, due to the increasing development of civil engineering knowledge in the country and the use of new technologies with the aim of optimal use of materials and manpower and prolonging the life of the building, the waffle slabs are the right option for most residential buildings, offices, multi-storey car parks, etc

PARS STRUCTURE PREFAB

History

The idea of two-sided waffles was introduced in the first decade of the twentieth century, and various studies were carried out on it. Finally, this method has been used since the 1920 in various structural fields in the United States, and due to its proper functioning in roofs with large spans, and even in .the foundations, its application grew rapidly

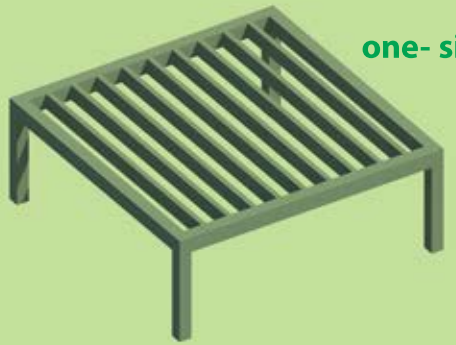
The introduction and performance of the waffle slab

Double-sided waffle slabs are called ceilings, which make it lighter by creating hollows in the ceiling, and the remaining concrete cross section, which is lighter than the full concrete cross section, has to withstand internal stresses and has the necessary stiffness to control the roof deflection in the short .and long term

This type of ceiling is in the category of double-sided slabs, which, with light weight and less thickness, high rigidity and uniform load distribution, helps in the implementation of long span, as well as the division and transfer of earthquake forces into bending frames and shear walls, so that by reducing the overall weight of the building, significant savings will be made on the total building materials con- .sumption

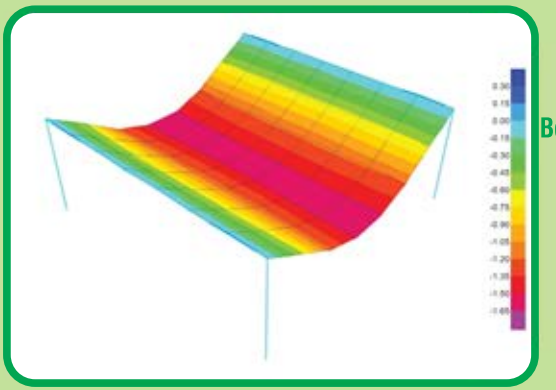
Comparison of two-sided and one-sided slab with equal span and similar loading

one- sided slab



two- sided slab

the ceiling with more thickness



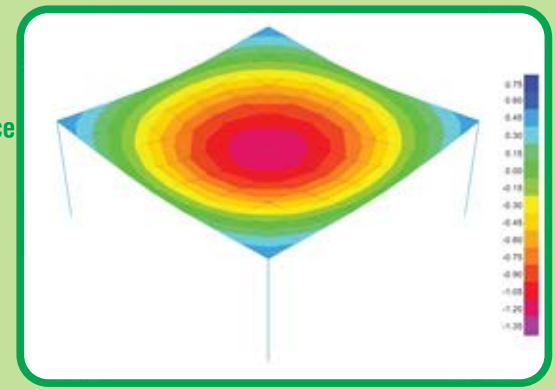
» Better seismic performance

» Uniform load distribution

» Lower ceiling thickness

» No vertical beam ceiling spacing

the ceiling with less thickness



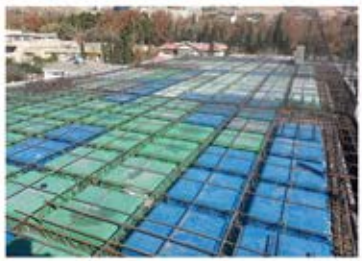
The process of waffle slab implementation

Molding under the ceiling

In this system, the PSP ceiling molds are designed in such a way that the moldings under the ceiling are similar to the joist and block ceiling, and unlike other slabs, the ceiling should not be completely floored. So, molding is done with minimal time and cost. Proper negative deflection is also applied to the ceiling before concreting of the ceiling as fitted to the spans

Installing the PSP molds

After the roof is molded, the installation of non sustainable PSP blocks is executed according to the execution plan



Rebar tying

The design of the main slabs is included in the design of this company, which does not require SPACER during execution, and after installing the PSP molds, these trusses will be installed

Concreting

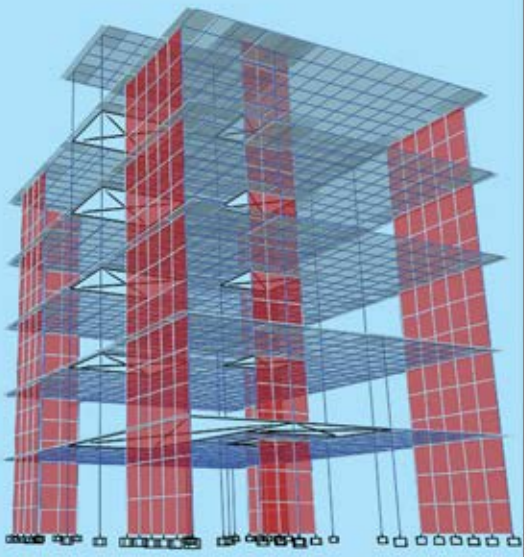
Concreting is done after closing the rebar tying and placing it on the ceiling. At this stage, as usual, the vibration of the concrete in the coils and around the columns should be carefully applied

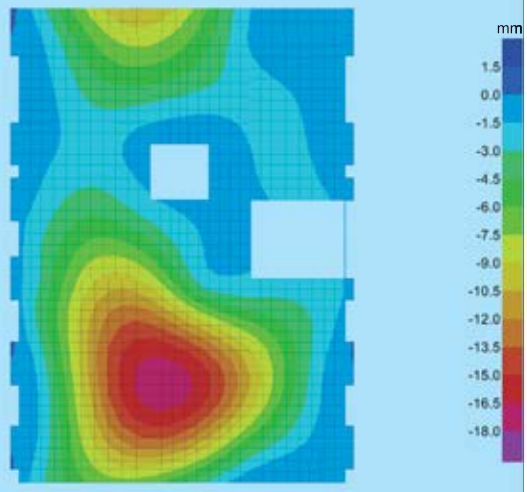
opening of PSP templates

after concreting and elapse of the time required, the forming below the ceiling is opened and then the psp templates are removed from inside the ceiling to get prepared for reuse

PSP Ceiling Technical Implications and Computations

Manual waffle slab computations are carried out according to the ACI regulations as a simple concrete slab and can be performed using ETABS and SAFE software.Both short and long term bending, shear and deflection behavior of ceilings, as well as one-sided and two-sided shear (puncturing) control and other technical requirements are computable and controllable in both .manual and software modes





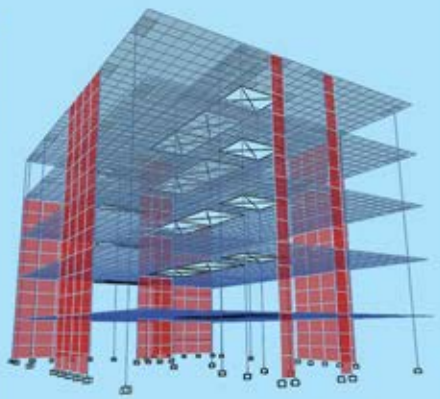
PSP Ceiling Technical Implications and Computations

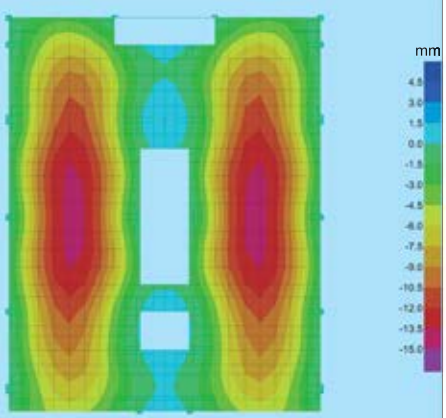
In the seismic design of the ceiling, two things are critical:

Firstly, the degree of rigidity of the roof aperture should be determined by code ACI

Secondly, due to proper seismic performance in the transfer of earthquake shear force from the ceiling aperture to the lateral elements of the load, it should be predicted in the aperture, collector elements and chord elements

Double-sided slabs are bilaterally loaded, these membrane templates are modeled and the ETABS software can only assist in the transmission of slab forces to bending frames and will not be able to analyze the slab So, finally, we will design the slab with the transfer of forces to the SAFE software





Technical advantages of waffle ceiling

Less absorption of earthquake forces and improvement of seismic performance due to lightness and full diaphragm continuity of the PSP waffle ceiling

Lower deflection of psp ceiling than other similar ceilings in the long run due to its integrity and lightness

Soundproof and fire proof due to the non-use of any . durable plastic and polystyrene materials in the ceiling

Possibility to implement and install false ceiling in a new way on the psp ceiling with %60 lower false ceiling cost

Possibility to pass the installations from under the roof

Possibility to implement on steel frames

Benefits of PSP Waffle Ceiling Architecture

Implementation of high spans up to more than 12 meters due to the lightness of the PSP waffles ceiling
Console execution with further progress due to the lightness of the PSP Waffle
Removal of the pendant of the center beams of the structure
Elevation of the floor to the floor height of the ceiling due to the reduction in the thickness of each ceiling with respect (to the various spans of the structure (the thickness of each ceiling is 22 to 25 cm
Possibility to create more quantities and more effective space between the parking columns for parking 4 and 5 cars due to the implementation of large spans
possibility for Irregular column spacing
Removing diagonal beams and unnecessary columns corresponding to the PSP ceiling
Removing a potential reset in parking lot ramps due to reduced thickness of the PPS ceilings
Allows you to use the unique design inside the waffle holes and the beautiful lighting inside them and the lack of false ceilings implementation
Easy to implement and install Knauf car-o-liner on a psp ceiling.




Unique Benefits of PSP Templates

1-Considerable thickness reduction due to the shape and dimensions of the psp templates

2-the possibility of vibrating the concrete around the templates and all the ceiling points according to the shape of the PSP templates

3-Non-slipping of the concrete and non wasting of it due to locking of the margins of psp molds into each other

4-Non changing the appearance of the templates during grouting due to the bracing of the surface of the PSP templates

5-Non Shifting the templates with respect to each other during grouting and maintaining the effective width of the joist due to the locking of the psp templates into each other

6-Concentrated load capability up to 240kg during implementation

7-Fast and economical loading and unloading of templates in the lowest volume possible

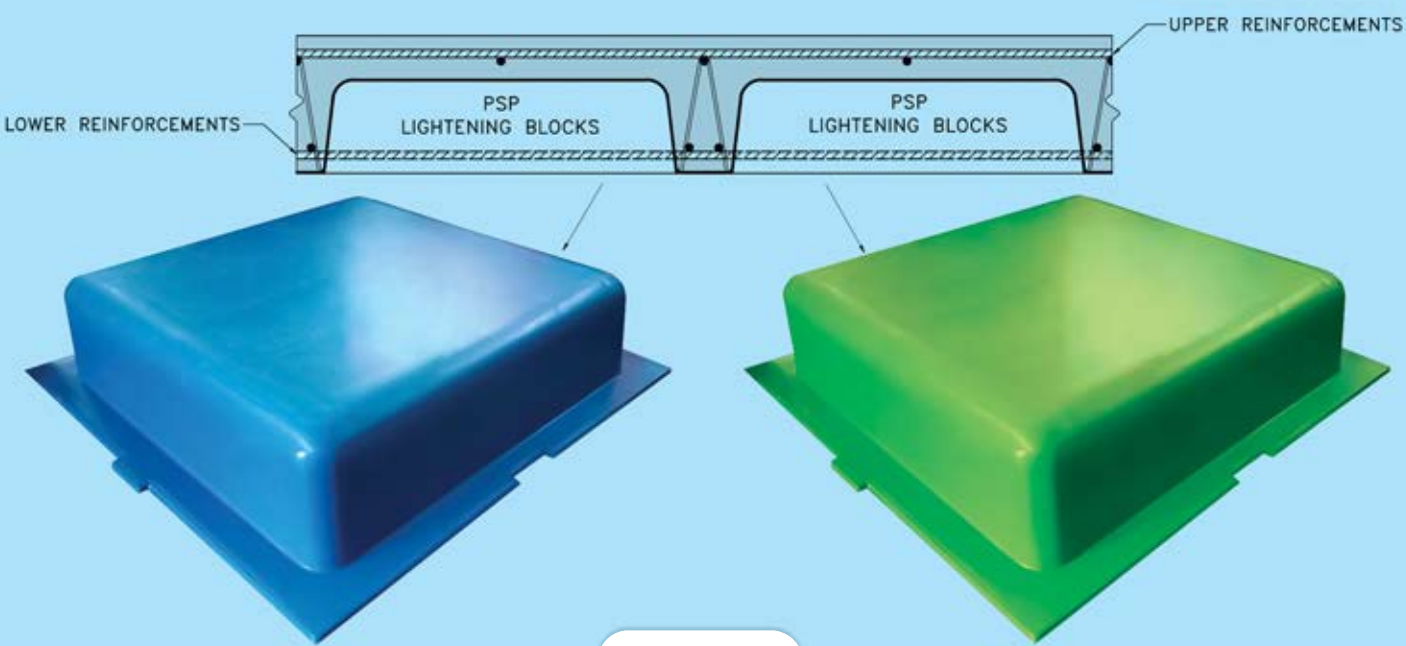
8-without complete flooring under the ceiling due to the special design of psp templates

9-The possibility of using each template over multiple times due to unsustainable PSP templates being used

10-Not trapping the gas inside the slab during a fire due to the unsustainability of the psp templates

11-Increasing the ultimate strength of the psp ceiling concrete due to moisture holding in the concrete setting period

12-calculations in accordance with the ACI Interior Design Code



Economic benefits of PSP waffle ceiling

1-Reduction in the overall weight of the building

2-Reducing the amount of foundation rebar and concrete

3-Reducing the thickness and volume of all shear walls

4-Reducing the size and dimensions of all columns and beams

5-Reduction of building materials, which is equivalent to reducing all costs by up to 30% compared with other concrete frames

6-Increasing the implementation speed due to the lack of perfect flooring compared with other similar ceilings

7-Increased implementation speed due to the lack of carrying heavy joists for each ceiling relative to the joist-block ceiling

8-Increase in the number of floors in high-rise buildings due to the building's elevation limit due to the decrease in the thickness of the PSP ceilings

9-Decrease in overall building height due to lower ceiling thickness

Economic comparison of the PSP ceiling with similar ceilings

comparison of the slab weight, and the concrete and rebar consumption for a 10×10 M ceiling

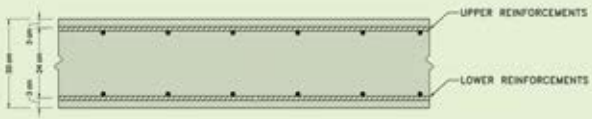
concrete slab Simple

30 cm

2500 kg/m³ X 0.3 m X 1m X 1m = 750 kg per square meter

0.3 m X 1m X 1m = 0.3 m³ per square meter

Ø12@20 cm Top & Bot = 17.5 kg per square meter



- Slab thickness
- Slab weight
- Concrete consumption
- Rebar weight

Concrete slab with sustainable cubic template

32 cm

(0.32 m X 0.7m X 0.7m) - (0.18m X 0.52m X 0.52m) = 0.1081 m³

full slab volume — empty slab volume — Actual slab volume

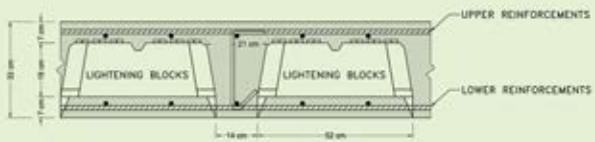
2500 kg/m³ X 0.1081 m³ = 270 kg

270 kg / (0.7m X 0.7m) = 550 kg per square meter

(0.32 m X 0.7m X 0.7m) - (0.18m X 0.52m X 0.52m) = 0.1081 m³

0.1081 m³ / (0.49) = 0.22 m³ per square meter

Ø12@32 cm Top & Bot = 12.5 kg per square meter



- Slab thickness
- Slab weight
- Concrete consumption
- Rebar weight

Concrete slab with sustainable spherical template

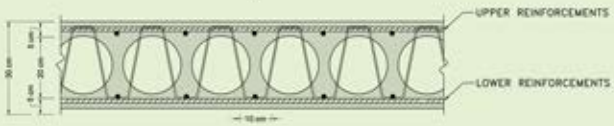
30 cm

(0.30m X 1m X 1m) - 16 X ($\frac{4}{3}$ X π X 0.1^3) m³ = 0.232 m³

2500 kg/m³ X 0.232 m³ / 1m² = 580 kg/m² per square meter

(0.30m X 1m X 1m) - 16 X ($\frac{4}{3}$ X π X 0.1^3) m³ = 0.232 m³ per square meter

Ø10@20 cm , Ø12@20 cm Top & Bot = 15.8 kg per square meter



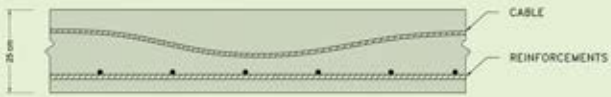
- Slab thickness
- Slab weight
- Concrete consumption
- Rebar weight

Economic comparison of the PSP ceiling with

comparison of the slab weight, and the concrete and rebar consumption for a 10×10 m ceiling

Prefabricated concrete slab

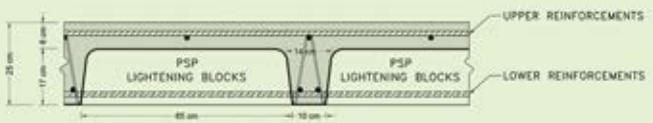
Slab thickness	25 cm	
Slab weight	(0.25 m × 1m × 1m) = 0.25 m³	
	2500 kg/m³ × 0.25 m³ / 1m² = 625 kg	per square meter
Concrete consumption	(0.25 m × 1m × 1m) = 0.25 m³	per square meter
Rebar weight	Ø 10 @ 20 cm = 7 kg	
Cable weight	5.5 kg	



Concrete slab with T-form beam and PSP block

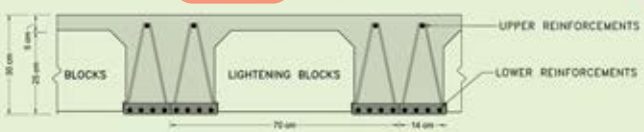
	25 cm	
	(0.25 m × 0.75 m × 0.75m) - (0.17 m × 0.65 m × 0.65 m) = 0.0688 m³	
	2500 kg/m³ × 0.0688 m³ = 170 kg 170 kg / (0.75 m × 0.75m) = 305 kg	per square meter
	(0.25 m × 0.75 m × 0.75m) - (0.17 m × 0.65 m × 0.65 m) = 0.0688 m³	
	0.0688 m³ / (0.75 m × 0.75m) = 0.122 m³	per square meter
	Ø 14 @ 75 cm Top & Bot = 8.3 kg	per square meter

- Slab thickness
- Slab weight
- Concrete consumption
- Rebar weight

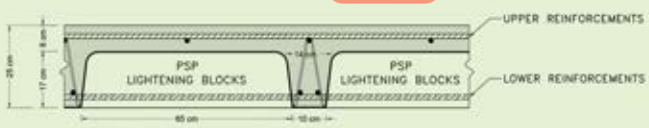


Comparison of the PSP ceiling and the joist-block ceiling with a 7.5 m span

Slab thickness	30 cm	
Slab weight	330 kg	per square meter
Concrete consumption	0.135 m³	per square meter
Rebar weight	15.5 kg	per square meter



Slab thickness	23 cm	
Slab weight	260 kg	per square meter
Concrete consumption	0.103 m³	per square meter
Rebar weight	7.1 kg	per square meter



Comparison between PSP slab and similar slabs in the present marketplace
For spans over 10 m long

% of increase in building material used for other types of ceilings as compared with PSP ceiling	Rebar consumed	Concrete consumed	Ceiling weight	Ceiling thickness	Types of two-sided slab
%60	17.5 kg/m²	0.3 m³/m²	750 kg/m²	30 cm	Simple concrete slab
%45	12.5 kg/m²	0.22 m³/m²	550 kg/m²	32 cm	Concrete slab with sustainable cubic template
%48	15.8 kg/m²	0.232 m³/m²	580 kg/m²	30 cm	Concrete slab with sustainable spherical template
%50	7 kg/m²	0.25 m³/m²	625 kg/m²	25 cm	Prefabricated slab
%0	8.3 kg/m²	0.122 m³/m²	305 kg/m²	25 cm	PSP slab with non sustainable templates

Comparison between the joist-block ceiling and the two-sided PSP slab
for spans up to 7.5 m

% of increase in building material used for other types of ceilings as compared with PSP ceiling	Rebar consumed	Concrete consumed	Ceiling weight	Ceiling thickness	Types of slab
%25	15.5 kg/m²	0.135 m³/m²	330 kg/m²	30 cm	joist-block
%0	7.2 kg/m²	0.103 m³/m²	260 kg/m²	23 cm	Two-sided PSP slab

According to the calculations done, the roof weight and the consumption of concrete and rebars in a square meter of two-sided slab with a psp system has been reduced by between 45 and 60 percent compared with other similar roofs with an average span of 10 meters, as in comparison with a roof of the joist and block with a 7.5 m span, we also had 25 percent weight reduction and reduction in construction materials used. Therefore, the buildings computed and constructed in this way, in addition to the implementation of large spans and the removal of beam pendants in the building, significantly reduce the consumption of concrete and rebars in the beams, shear walls and foundations

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