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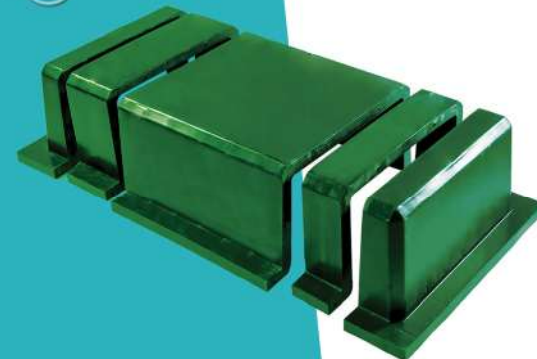
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Green Waffle Ceiling System ...

GREEN WAFFLE



Environment Friendly  
**GREEN  
WAFFLE**  
Green waffle ceiling mold  
Safe, Lightweight, Economical  
Today's choice, Tomorrow engineering



At 2010 with the purpose of creating job and optimized use of water sources and avoiding water waste and responding to the increased demand and supplying public demands for using different kinds of drip irrigation products, Abfeshan Sahel Shiraz industrial producing complex started its activity in agricultural segment according to the designs and implantation of irrigation systems through buying the required machinery and employing skilled and updated knowledge forces and believing that the quality is the guaranty of our economic security. This company has started its activity with two production lines with nominal capacity of 6000 MT per year and tried to increase and improve the qualitative and quantitative level of its products by using technology and knowledge of the day and employing talented and skilled forces.

### Green Waffle Ceiling System

This industrial complex acted to produce polymer removable ceiling mold with the backup of its knowledge and experience. "Green Waffle" ceiling system has entered into the country's construction field after several years of research on the needs of country's construction industry and considering the traditional conventional ceiling and with regards to the provisions of building regulations. Actually this kind of ceiling is the update of common methods which are implemented with molds with the same name which avoids the burial of expensive materials such as joist, bar, concrete, pottery, polystyrene (foam) and material waste and national resources by modifying the pattern of material consumption and procedure and without disturbing existing tools and methods and imposing heavy costs.

Today unlike the past not so long ago, the variety of structural systems and molds has increased and for selecting the best ceiling option we have to consider different parameters including quality, quickness, skeleton type, price,.... And choose the best option for implementing structural ceiling.

The ceiling system of about 75 percent of the country's constructions is unilateral slab of block joist or Styro-foam joist type. Unfortunately this outdated method in the world is still used in Iran despite its numerous weaknesses. Green waffle ceiling is an appropriate alternative for the common construction methods in Iran. The following are the significant features of this type of ceiling:

Industrialization of concrete ceilings performance, weight and cost decrease, environment protection, increased safety and resistance against earthquake and fire, decrease of fuel and raw material consumption, increase the life of structures, implementation quality control, speed increase, removing construction phase, removing production and transportation of any type of joists and blocks.



This complex stepped into production field at 1995 and was honored for being the first producer of green pipe in Iran. In this regards and with the progress of building industry, this complex started the production of new generation of building water pipes-Pex-Al Pex five layer pipes- under the license of England Safe Building Technology. Due to the fact that piping with 5-layer pipes was more expensive than green pipes and considering the quality of 5-layer pipe, a.s industrial group proceeded to produce pipes which named the new generation of 5-layer pipes. PP-Al-Pex pipe includes all of 5-layer pipe capabilities and can use "green" PP fittings at building piping system. In this way, the used pipes at building piping system are of 5-layer type and its charge is equal to the charge of piping with "green" PP pipes. With growing progress at building industry, a.s producing group proceeded to produce aluminum composite panel with symbolic name a.s bond and again became the first producer of this kind of panel at the south of Iran.

To complete the package of building installations products, a.s industrial group proceeded producing of PVC pipes in black and grey color and these pipes were produced and arrived the installations market of all over the country according to standards explained and now a.s industrial group has started to produce fittings for five layer Pex-Al-Pex pipes (PPA fittings) which unveiled at March 2009 for the first time in Iran and again by a.s industrial group so the production ability of Iranian craftsmen proves to everyone. These fittings are produced with noteworthy price and considerable quality which can also be used in hot water piping system.

In another step a.s industrial group will produce PVC fittings in a short time program to supply the demand of building installations and add the name of the greatest Iranian installations industrial group to its past honors.



Traditional construction methods in country which includes considerable statistics too have many disadvantages which some of them are mentioned below.

#### Using types of constant blocks:

It's been a long time at building industry especially at the implementation of common ceilings that constant blocks are used on ceilings. Blocks of cement, polystyrene (foam) ..... which using each kind of these molds is the waste of national resources. Kinds of building ceiling blocks are used merely as a concrete mold and have no interference at building structure and strength after ceiling concreting and even removing the blocks from the ceiling is recommended because of the decrease of debris risk at the time if earthquake although it is almost never done because of the difficulty of this work and also the fire danger of polystyrene blocks always exists either before building operation or at the time of using it.

#### Problems of using prefabricated joists:

Production of prefabricated joists has many problems such as disability to control the quality of all of the joists at the time of production, restrictions on the use of armature, the difficulty of carrying joist to the location, the possibility of joist vulnerability at the time of installation, creation of technical problems at the time of joist installation (stirrups relocation, break of the concrete on the head of joist, ....), using extra armature at joist production: some of the joist armatures are merely responsible for bearing the weight of joist at the time of movement and are practically useless after installation in place and concreting.

#### Safety problems:

The possibility of block breaking or dislocation while workers' passing is high because of the material of cement blocks. It is also true about polystyrene blocks. Of course we don't have to ignore the fire danger of polystyrene blocks at construction workshops and the evaporation of its dangerous gases. The mentioned items increase danger while ceiling implementation and to eliminate it we have to turn to block removal methods.

#### High cost:

Today the implementation of types of flat slabs in different projects has been welcomed less because of the high cost of its implementation and high consumption of materials such as concrete and its best alternative is waffle slabs with removable molds.

Above mentioned items such as avoiding national capital waste, improving building technical quality, safety increase and construction total cost decrease caused the design of a special kind of ceiling removable mold got on the agenda.

## General Specifications of Green Waffle Mold

This mold is a kind of removable ceiling mold. It means it can be removed after ceiling concreting and again be used in next ceilings or projects. With this feature, all of ceiling blocks can be removed from building and in addition to national resources protection it will help to the strength, lightening and more safety for buildings at the time of earthquake. Due to the shape of the mold, all of the prefabricated joists along with their installation problems on the ceiling will be removed and technically it will be implemented more easily due to the implementation of joist resident. Also due to the mold strength at the time of ceiling implementation, executive workers can easily move on the molds without being worried about mold break or dislocation and it will help the safety of workers' life.

Another feature of this kind of ceiling is its easy implementation by executive workers. Due to the main construction of the country for ceiling infrastructure, common tools for ceiling implementation such as squared timber, hollow-square section, scaffolding tube and common ceiling jacks can be used. The implementation of this ceiling is very similar to the joist block ceiling and doesn't need professional labors with special trainings.

#### Mold Material:

Mold is made of recyclable polymer materials and its polished surface and material makes it known as a suitable mold for concrete which is removed from concrete easily. Usually the implementation of polystyrene ceilings and cement blocks makes the ceiling dirty by crushed blocks but this problem will be removed by using this mold.

#### Mold Weight:

Because of the light weight of the mold, workers can carry it easily. The weight of each square meter of mold is about 11kg and a worker can carry it. This weight is less than the maximum permitted load each worker can carry.

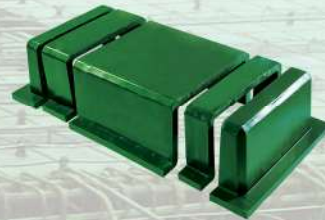
#### Mold Dimensions:

Center-to-center of the joist is 60cm, mold height is 25cm and its lengths are 10, 15 and 50 cm. Each mold is assembled to the next one by bolts and nuts and the end of each segment is closed by a cap mold with different lengths. Total length of ceiling with counting 5cm of concrete on the mold is 30cm. In total the concrete weight of this ceiling is about 250kg which is minimum amount of concrete between similar ceilings.



## Advantages of green waffle ceiling

1. Because of the mold non-durability and possibility of resumption, it can be environment and national capital protective.
2. According to the possibility of assembling in diverse sizes, unilateral and bilateral slabs can be implemented.
3. Green Waffle does not need to be lubricated, and the utilization minimum frequency is 50 times, where in the case of proper use and care it can be duplicated.
4. It can be easily washed and cleaned with water.
5. The mold is lightweight so that it is portable by one person in manufactory.
6. Two year replacement warranty in case of damage during the roof implementation.



The average of green waffle ceiling consumable materials per square meter (ceiling)

| One Way Slab                                |      |                     |
|---|------|---------------------|
| Item  | Unit | Average Consumption |
| Main and reinforcement round bar of ceiling | kg   | 5                   |
| Thermal round bar                           | kg   | 1.6                 |
| Tie beam                                    | kg   | 0.4                 |
| Total used round bat at ceiling             | kg   | 7                   |
| Consumed concrete at ceiling                | kg   | 230-250             |

| Two Way Slabs(Wide Openings)    |      |                     |
|---------------------------------|------|---------------------|
| Item                            | Unit | Average Consumption |
| Main Round Bar                  | kg   | 8                   |
| Top Reticule                    | kg   | 4                   |
| Total used round bat at ceiling | kg   | 12                  |
| Consumed concrete at ceiling    | kg   | 320-400             |

## Advantages of green waffle ceiling

1. Removal of all kinds of blocks and prefabricated joist
2. Removal of double joist due to joist resident implementation and no limitation in the usage of bar size in joist.
3. Removal of stages and costs of prefabricated joist manufacturing, transportation, stocking and transfer to floors.
4. No need to stirrup replacement and breaking of joist concrete head coverings, and ease of ceiling bar investment.
5. Possibility of sheet installation for facility supports in bar floor before concreting.
6. Applicable in different concrete and metal skeletons
7. Reducing the consumption of concrete and bar due to the ceiling weight reduction compared to other current roofs.
8. Simple substructure, low cost, faster implementation and higher quality compared to current ceilings, because of being lightweight and modular.
9. By changing the assembling method, the ceiling can be implemented unilateral or bilateral.
10. Using structural ceiling as exposed roof and removal of joinery in joints and parking.
11. Safety in implementation, fire and earthquake
12. Possibility of passing Installations through the ceiling, and, consequently, reduction of flooring cost and ceiling dead load, along with profitable space increase.
13. Economic performance of large openings
14. High rigidity and moment of inertia due to roof integrated concreting which in turn leads to significant decrease in roof vibration
15. Careful monitoring of bar consumption and arrangement before concreting
16. Due to the Green Waffle mold material, no concrete water absorption occurs, while the vibration is completely performed, and high concrete resistance processing and attainment until the mold undoing can be ensured
17. The ceiling concrete weight is at least 250 kg/m<sup>2</sup>
18. In accordance with Iran and international regulations
19. One of the best and the most economic methods of industrial waffle ceilings implementation

### Suggested loading

|   |   |
|---|---|
| Ceramics and mortar                                 | $0.03 \times 2100 = 63 \text{ kg/m}^2$  |
| Light Concrete for flooring                         | $0.07 \times 500 = 35 \text{ kg/m}^2$   |
| Slab Concrete on the joist                          | $0.05 \times 2500 = 125 \text{ kg/m}^2$ |
| joist concrete with a width of 10 cm                | 105 kg/m <sup>2</sup>                   |
| False ceilings with knauf plaster panels            | 22 kg/m <sup>2</sup>                    |
| Maximum ceiling dead load for medium-sized openings | 350 kg/m <sup>2</sup>                   |

Concrete weight of the roof 250 kg/m<sup>2</sup>

# GREEN WAFFLE



↩ No Need to stirrup Relocation While Joist Implementation ↪

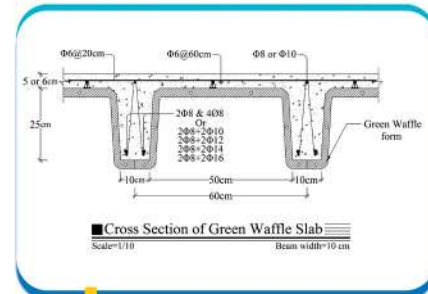
↙ High Rigidity ↘



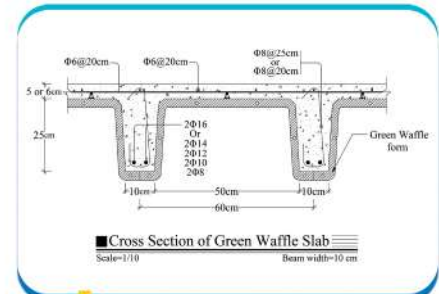
↙ Possibility to use raw truss ↘



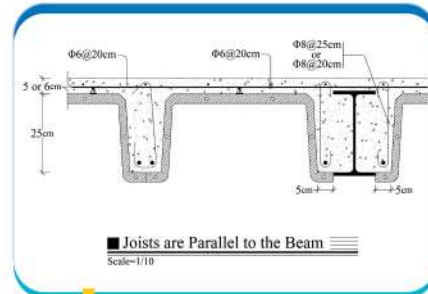
## Ceiling Details



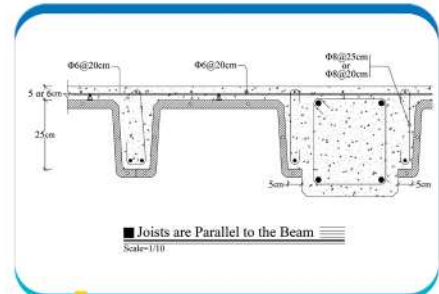
General Details with the Use of Truss



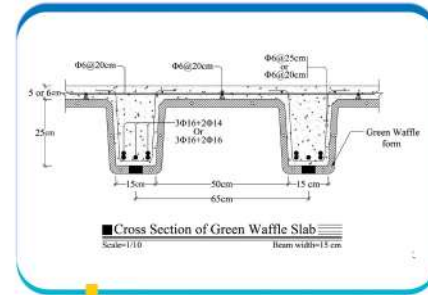
General Details



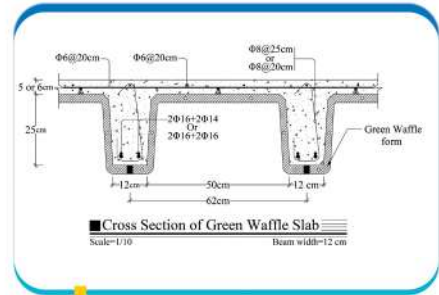
Ceiling Details in Metal Structure



Ceiling Details in Concrete Structure



Details of Joist Implementation with 15 cm Width



Details of Joist Implementation with 12 cm Width

GREENWAFFLE

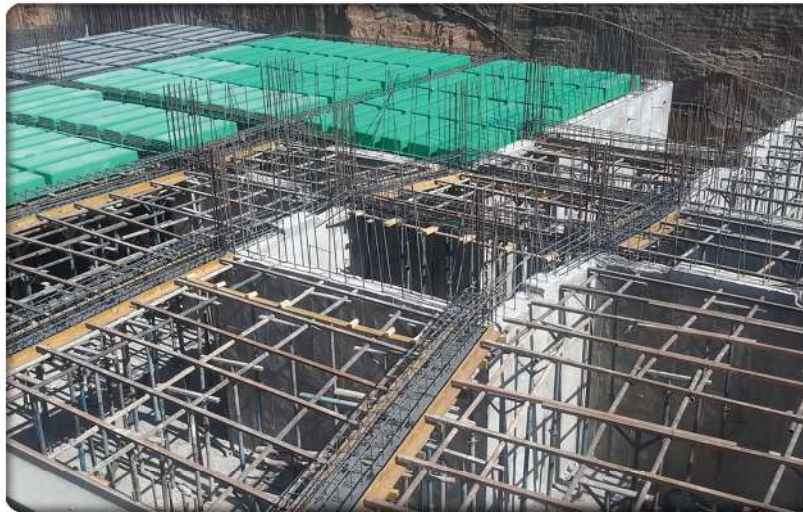
GREENWAFFLE



Simple substructure similar to block joist ceiling



Simple and low costs substructure



Applicable in all types of concrete and metal skeleton



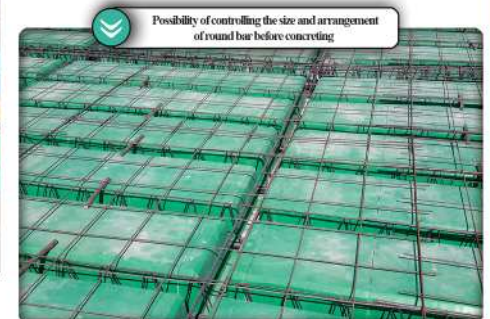
Possibility of two way slab implementation by changing mold assembling method



Possibility of passing installations through the ceiling



The view below the ceiling



Possibility of controlling the size and arrangement of round bar before concreting

## Ceiling implementation stages

### Mold Arrangement:

After substructure, pre-assembled molds are put together according to the drawings.

"Green Waffle" mold can be used in kinds of concrete and metal skeleton. Ceiling can also be implemented as one way or two way slab by changing the method of assembling the molds. The point to be mentioned is that molds are assembled to the desired size by bolts and nuts due to the different openings of a load and at the end of the mold, a piece as a cap is closed and while separating or carrying there is no need to open bolts and nuts and then mold can be carried seamlessly in different lengths. In this method the width of joists and tie beams will be performed exactly and there is no need for width control in this ceiling. Also crossing the mold is easy due to its strength. This mold does not need to be lubricated for separation and due to its material we can be sure about concrete processing until the mold is opened.



### Placing Round Bar:

Due to the special design of the mold, joist is implemented as resident. With this method all of the problems of joist manufacturing and carrying will be removed. Of other advantages of resident joist implementation is that there is no need to move stirrup in main bars while closing armature joist. Concrete continuity and ceiling rigidity is well observed in resident joist implementation which causes the shaking of the ceiling decreases at the time of operation. Also exact monitoring and control over the size of armature and its arrangement can be done before the time of concreting.



## Ceiling implementation stages

### Mold assembling:

Molds can be assembled by using bolts and nuts as much as you like and as one way or two way slab according to the ceiling design. Molds' assembling is done at the beginning of the project and for the first ceiling and usually there is no need to open bolts and nuts during the project.



### Ceiling substructure:

Substructure of this kind of ceiling is almost similar to block joist ceilings and can be used with commonly used equipment in construction workshops such as squared timber, hollow-square section, scaffolding tube or other similar equipment. The substructure is such that at first it is being placed vertically on joists, hollow-square section or scaffolding tube or squared timber with appropriate distance. Then special jacks for ceiling will be placed under it and the required negative deflection is applied according to regulations.





# Projects

## Ceiling implementation stages

### Possibility of passing Installations through the ceiling:

Due to the shape of ceiling (waffle slab), we can consider some places for passing installations in the existing space under the ceiling with regards to code of ethics. Passing installations through or under the ceiling causes the weight of floorboard and as a result the weight of dead load decreases. Also increase of ceiling useful height and convenient facility repairs at the time of operation can be mentioned.



### Mold Removing:

After the end of the allowed time for removing the mold of ceiling, molds can be easily removed from the ceiling in one side by a small metal lever and can be used again after transferring to next ceiling. The façade under the ceiling is totally exposed and we can operate this façade on the ceiling of parking and joints without need to joinery. Also due to the prohibition of the use of polystyrene blocks on the ceiling of parking, schools..., "green waffle" ceiling will be the best alternative both in terms of implementation quality and lower cost.



### General Specifications:

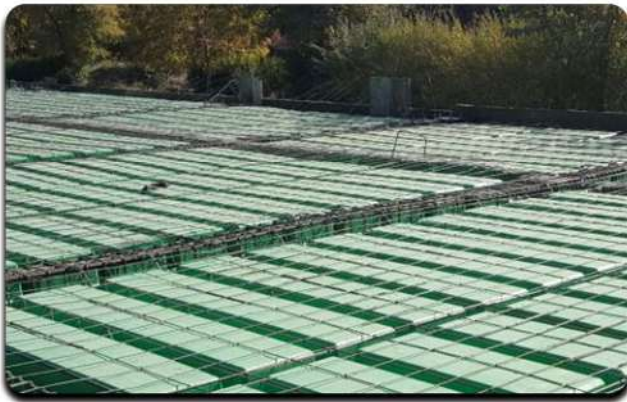
**Employer:** Mashhad Faculty of Medical Sciences

**Contractor:** Pishgaman Noavari Saman Co.

**Location:** Pardis of Ferdowsi University of Mashhad

**Area:** 2500 sqm

Parking of Pharmacy Faculty of Ferdowsi University of Mashhad has been designed and executed in two ceilings with green waffle system besides of Mashhad Pharmacy Faculty according to concrete structure.



Parking of Pharmacy Faculty of Ferdowsi University of Mashhad



### General Specifications:

**Location:** Argentina Square, Tehran

**Area:** 49000 sqm

**Number of Ceilings:** 7

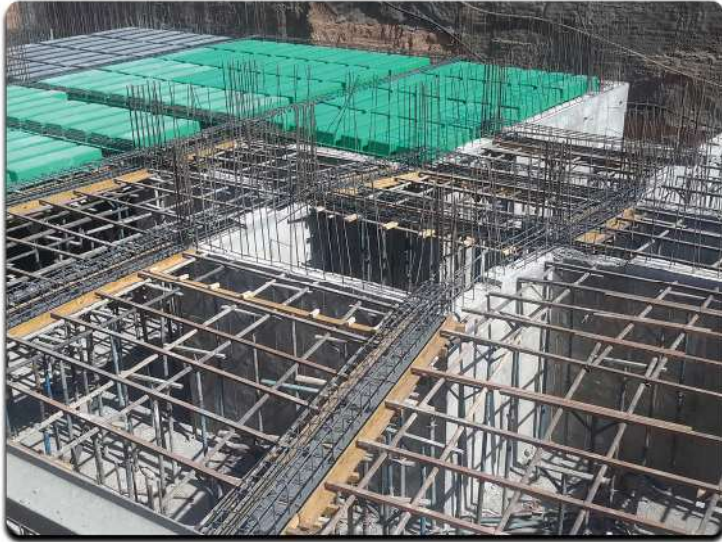
Main reasons for using green waffle in this project have been ceiling vibration reduction, polystyrene block removal and more safety for parking against fire.



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### Vertical Parking





#### General Specifications:

**Employer:** Shiraz Municipality Housing Cooperative

**Contractor:** Abadgarane Asre Asia Co.

**Biggest Aperture:** 7.80 m

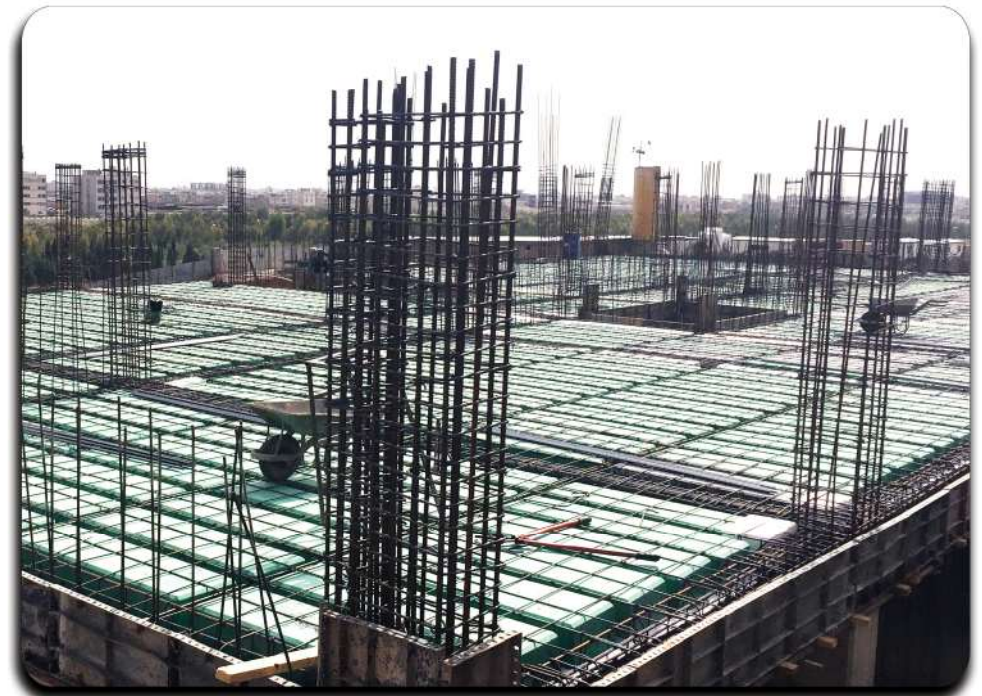
**Location:** Shiraz

**Foundation:** 50,000 sqm



416-unit Zeytun Project of Shiraz

This residential project is of concrete skeleton type and consists of 7 blocks with 11 floors which is designed and executed according to green waffle ceiling. Some of the reasons of using green waffle in this project are higher speed and quality, cost reduction, joists workshop remove and reduction of between workshops transportation.



### General Specifications:

**Employer:** tosee va omrane Kouhsar Co.

**Contractor:** Pishgamane Noavariye Saman Co.

**Location:** Hashemiyeh 62, Mashhad

**Area:** 16500 sqm

**Number of ceilings:** 11

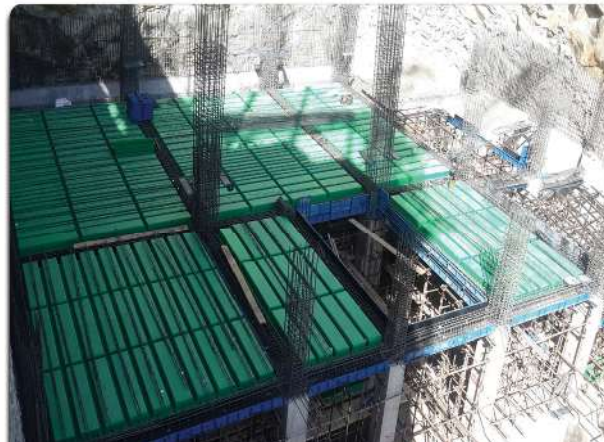
**Biggest Aperture:** 8 m

Using green waffle ceiling in concrete structure of bending frame of Kouhsar vertical parking project is selected because of light weight, performance speed, beauty of structural ceiling, economic optimization and as a result.



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### Parking of Mashhad Kouhsar Shopping Center





**General Specifications:**

**Employer:** Shiraz Municipality Housing Cooperative

**Contractor:** Abadgarane Asre Asia Co.

**Location:** Shiraz, Fars Province

**Foundation:** 34,000 sqm

**Number of Ceilings:** 17



At first this project was designed according to joist block (polystyrene) ceiling but after technical and economical consideration by employer it was again designed and implemented according to green waffle ceiling. This project has two blocks and it is of concrete skeleton type.

**Shiraz Sahand Project**



General Specifications:

**Employer:** Abadgarane Asre Asia Co.

**Area:** 3600 sqm

**Number of Ceilings:** 5

**Type of Skeleton:** Metal



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New Project of Sadra City

### General Specifications:

**Employer:** Hampa Energy Engineering and Designing Co. (HEDCO)

**Contractor:** Sakhre Sakhteman Shahre Raz Co.

**Location:** Shiraz, Fars Province

**Area:** 17,000 sqm

**Usage:** Residential



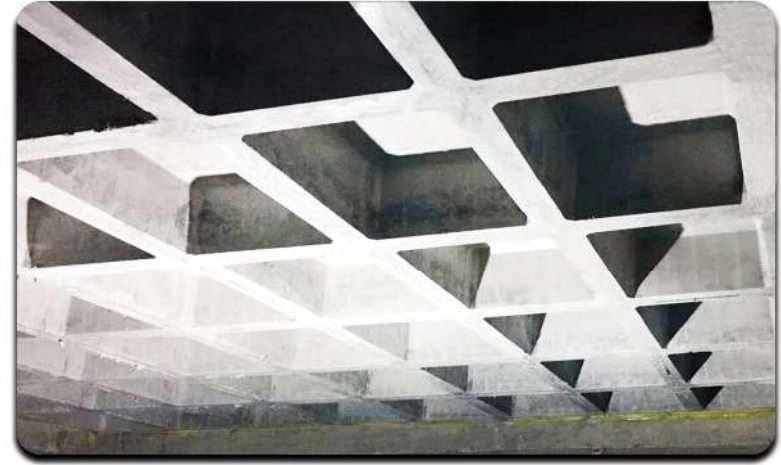
In this project green waffle mold is used instead of polystyrene block and no change has been made on the structure design. Reasons for using green waffle are improving the quality of ceiling implementation, increasing speed, block removal and removing joist workshop due to the lack of project space. The project skeleton was finally finished two months earlier than the schedule.



Shiraz Vahdat Project







#### General Specifications:

**Employer:** Mr. Abbas Anvari

**Location:** Tehran

**Area:** 28000 sqm

**Number of ceilings:** 14

**Usage:** commercial, official and parking

**Type of skeleton:** concrete



Merdas Center Project



#### General Specifications:

**Location:** Azimiyeh, Karaj, Alborz Province

**Area:** 17,500 sqm

**Number of ceiling:** 7



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## Iran Zamin Commercial Building



Green waffle mold has merely replaced prefabricated joist and polystyrene in this project and in addition to the ease of implementation it has resulted in the removal of joinery.



#### General Specifications:

**Employer:** Engineer Rajabi

**Location:** Saadat Abbad, Tehran

**Area:** 8,000 sqm

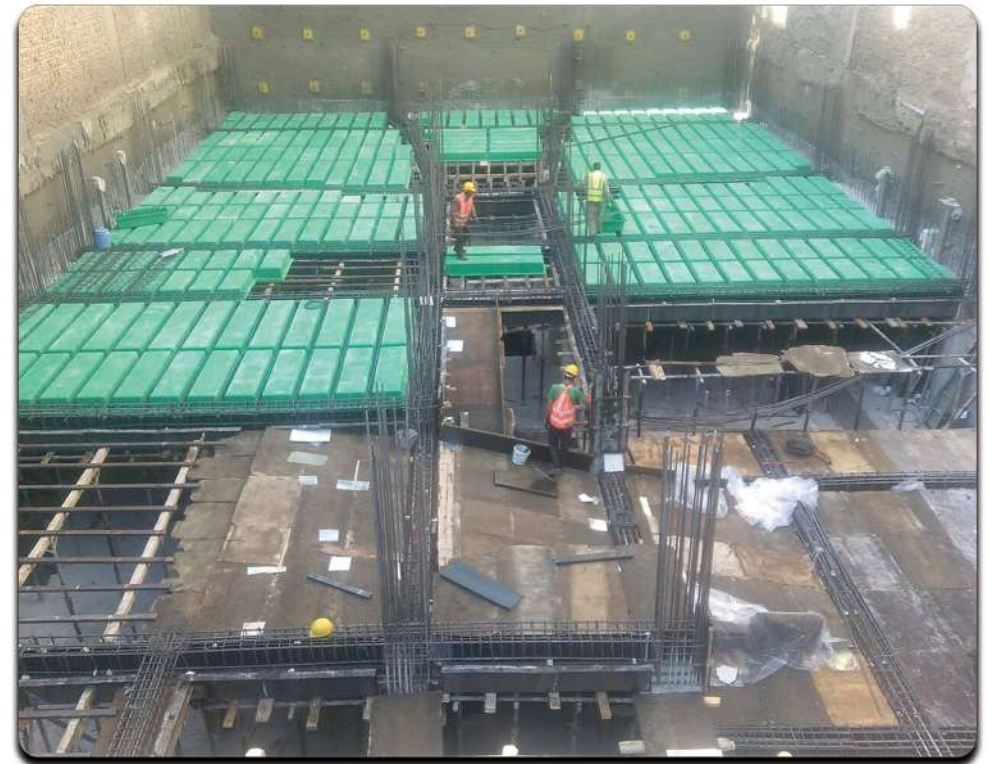
**Number of ceiling:** 11

**Usage:** Residential

**Type of Skeleton:** Concrete



### Royal Classic Morvarid Project



In this project green waffle mold has replaced polystyrene and prefabricated joist and no change has been made at the structure calculations. Reasons for using green waffle in this project are construction quality improve, removal of fire hazard of polystyrene blocks and implementation speed increase and also optimizing construction cost.



General Specifications:

**Location:** Tehran

**Area:** 35,000 sqm

**Number of ceilings:** 10

**Usage:** Commercial

**Type of skeleton:** 5 floors concrete, 5 floors metal



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Tehranpars Cultural-Commercial Project



General Specifications:

Location: Najaf, Iraq

Usage: Commercial, Vertical Parking

Area: 36000 sqm

Number of ceilings: 6

Optimization, structure design and the implementation of this project is done by green waffle technical and executive team.



Alhoda Commercial Building and Vertical Parking

## General Specifications:

**Location:** Al-Kut city, Iraq

**Usage:** Commercial

**Area:** 8000 sqm

**Number of ceilings:** 4

Optimization, structure design and the implementation of this project is done by green waffle technical and executive team.



## Sir William Shopping Center



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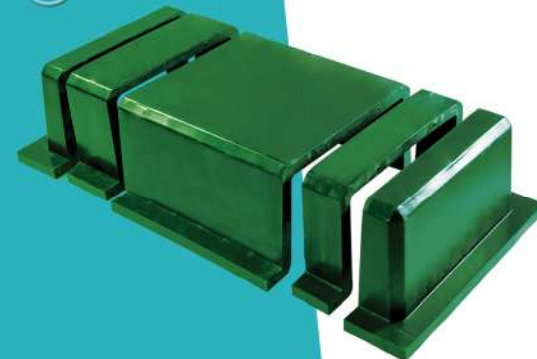
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Green Waffle Ceiling System ...

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Today's choice, Tomorrow engineering