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An Investigation on the Advantages and Disadvantages of Chromite and Styrofoam (EPS) Ceilings in Concrete Structures

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ABSTRACT

The present paper tends to investigate the merits and demerits of chromite and Styrofoam ceilings in concrete structures. Since in lots of buildings and structures chromite and Styrofoam used in ceilings, there are problems with their implementation cause a bunch of advantages and disadvantages. Generally, precast beams or in short joist with blocks including both chromite and concrete, if properly designed, calculate and implemented have less tremble than the in situ concrete ceilings and composite due to the thickness of the ceiling blocks. But this is a general issue and it varies in different circumstances and conditions. For example, the vibration of the composite ceilings will be much less in the cases of underpinning both of the primary and secondary beams during concreting. The tremble of ceilings with old style blocks I mean Concrete masonry unit (concrete zigzag slab) and Composite steel concrete precast beams is also less than others of this kind Because of the underpinning during execution Polymer Styrofoam is white in color, and moisture, heat and sound insulation which is produced in petrochemical plants. This material is available in very small volumetric volumes (1.04 to 1.09 g / cm3) in different gradation of tiny and big can be found in form of granules, sheets, and blocks of various sizes and thicknesses. Cutting it off with cutting machines or by hot wire is easy to do. In this study, the chromite and Styrofoam ceilings are examined and their advantages and disadvantages of them in concrete structures are investigated.

***Keywords*:** chromite, Styrofoam, disadvantages and advantages, block, composite

1. INTRODUCTION

Today, variety of materials used for building construction, some of them are in the form of iron skeleton buildings and others in concrete. There are different ways to execute the ceilings such as Composite steel concrete precast beams with chromite and beam with Styrofoam, and each with advantages and disadvantages, thorough this article they'll be mentioned and related discussions will be presented. The quality of materials plays an important role in pre said structures that we'll refer to later. First, it is said that in the process of chromite beams production specially welding process is of the most important issues that is visible in sight inspection. In addition to welding, there are various issues affect their quality, such as zigzag overlap, welding dimension and welding intervals, zigzagging steps based on calculations, environmental temperature control and regular welding checks, all worth to note.

So one of the most important threatening factors for beams is their improper welding. The use of single-phase welder in many unauthorized workshops is very common, which causes weld instability. Also, the excessive increase in welding amperage causes melting down of the welded items and noticeable decrease in the strength of the welded beams. the other most common problem during chromite beams preparation is the inadequacy in welds intervals, inappropriate overlap of zigzags, lack of weld ability of the zigzag hinge on the upper corners, or the inadequacy of the zigzag weld length, inappropriate patching of the parts, non-compliance with the zigzagging step and even inaccuracy during the reinforcement. due to the greater width of Styrofoam blocks The possibility of their In the chromite roof is more plausible, as well due to the concreting of several building ceilings at the same time, with a breakage of a block in higher flats the number of subsequent breakage in lower floors increases respectively, which requires more foam to be provided. In Fig. 1, the ceiling of the block is shown, and beams are shown in Fig. 2.

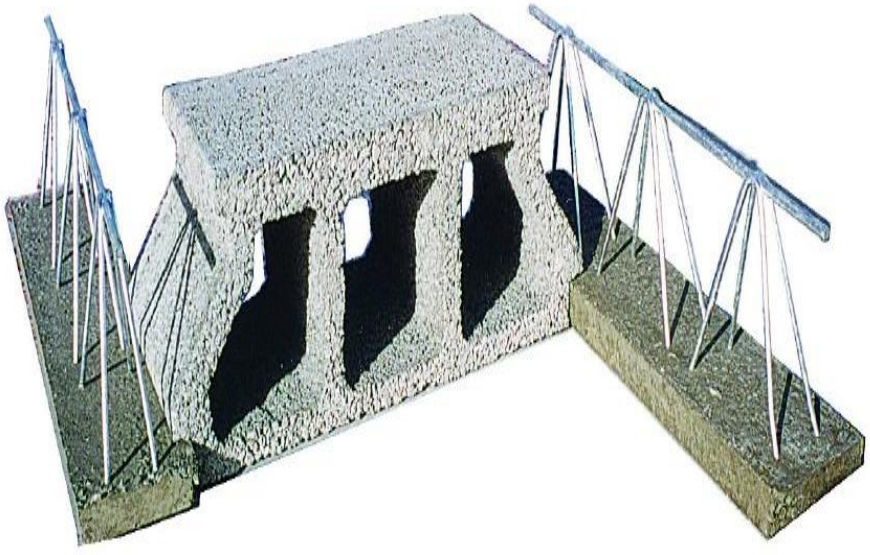

Figure 1. Block Joist (chromite)

Figure 2. Unillated joints (beams)

2. STATEMENT OF THE PROBLEM

We all know that there is no construction material which can tolerate the tensile forces except steel. In this case, the presence of concrete or any other of this kind doesn't reinforce the tolerance burden but rather increases the dead burden of ceiling or deltoid so to do this there is no way other than the enhancement of steel, by the way in steel concrete precast beam ceiling the concrete removed from the tensile zone and just the amount of concrete that should hold tensile steel is kept (concrete in the heel of the joist). The removal of concrete in the joist block ceilings which has been replaced by the block makes this The types of roofs economically very affordable and the it's use is growing, currently the pre- tied joists are the cheapest with the highest quality of this type that can be run for the spans of up to 12 meters. It is worth to note that the use of this pre-tied beam is permitted if its manufacturer provides a standard certificate, otherwise it is not recommended.

Depending on the method of their production, the two types of composites are distinguished: artificial and natural. In artificial composites the strengthening disperse phase is either introduced artificially from the outside or is formed when matrix melt interacts with artificially introduced agents. Natural composites include the alloys, in which the disperse phases are formed under the natural processes of primary, in particular – oriented crystallization. Typical natural composites are graphitized cast irons. The properties of natural composites can also be improved using the technologies typical to artificial composites. However, artificial composites are regarded as the prospective materials with unique Properties (Kosnikov et al, 2014).

The existing challenges in the composite fabrication are to obtain uniform filler dispersion and to introduce strong chemical bonding between the micro size particles and the polymer matrix, which are necessary to provide a high tensile strength due to local stress within the composite. The interfacial interactions between fillers and polymer matrix play a

crucial role in determining the quality and properties of the composites (Amarababu & Pandu Rangadu, 2014).

Vinyl-ester resin, as a structural polymer, was chosen as a polymer matrix in current study due to the fact that the cured resins are thermosetting with a network structure possessing high resistance to the moisture and chemicals, and good mechanical properties (Myshkin et al, 2005). Thus the resultant composites have the potential applications in fabrication and building materials such as electrode position tanks, automotive parts and marine vessels which require superior mechanical properties and/or high resistance to harsh environments such as strong acid or base. Furthermore, the functional groups of the polymer surrounding the nanoparticles enable these nanocomposites as good candidates (Sampathkumaran et al, 1999).

Majority of cases of non-power destruction of reinforced concrete structures, specifically in conditions of aggressive media, is related to corrosion of reinforcement. In order to improve reliability and durability of reinforced concrete structures and at the same time to protect reinforcement against aggressive media, we suggest the use of rubcon in extended zone of flexural members, thus generating double-ply rubcon-concrete structures (Figovsky et al, 2014).

An Iranian company named *Tirche Pish Tanideh Iran* is the standard and approved manufacturer of these joints. In short, the ceiling of the steel concrete precast beams is a number of T-shaped beams that lie side by side and The components of the block ceilings are block-top blocks or top-mounted blocks that integrates all the joints in monolith way. The concrete is also used in the compressed of the roof (Wikipedia). In concrete structures and by having view to the used materials and the selected roof type, it can be said that there are some merits and demerits which can be affected by different factors. Therefore, according to the mentioned issues, it is important to first examine both types of ceilings and remind about the related items. Styrofoam roofs, are better sound absorption than concrete but they are not as good as concrete in sound insulation (Bakhtiari et al, 2012). Laboratory results showed the acoustic behavior of the ceiling with polystyrene blocks shows the same equivalency of thump sound to the ceiling of both joints block roofs and roof with ceramic blocks (Kalat Jari & Mansourian, 2008). Styrofoam alone doesn't have any sound loss effects, and some expert's idea and perceptions about positive effect of impact and sound because of unmonolithity and inconsistency is not true and even sometimes found to be vice versa and they are effective in sound enhancement, by the increase in their width this defect is exacerbated and multiplied (Bakhtiari et al, 2012).

But in the Chromite ceiling, they are ceilings made by steel concrete precast beams with open webs combined with concrete. The use of block ceilings in conventional, customary buildings is very common. Due to the omission of concrete and substituting it with hollow blocks in tensile area concrete consumption reduced significantly and because of prefabricatedness of joists and blocks, the ceiling installation process is very quick and easy to do, so there is no need for specialist workmen. The ceiling of steel concrete precast beams executed with joist and block is of the ceilings with concrete buttress, which tolerates the pressure of high concrete with a thickness of at least five centimeters, and the tensile tolerated by the joints of the joists (the staddle rebar of the joist). Even The high concrete also, tolerates the local bending between the two joists like a thin slab with a span equal to the distance between two joists. In this type of roof, the joists are placed at a distance of up to 70 cm (from axis to axis) side by side and along with more narrow openings of roof, and with a

covering concrete in the area with thickness of at least five centimeters, T shaped beams formed the monolith surface, to fill the gap between the joists, various elements, such as hollow bricks, concrete blocks, and even plastics and other things applied but they are just the fillers and do not tolerate the ceiling burden.

Aims and Necessities of Subject

In order to highlight and in reminding the importance of concrete structures in which ferroconcrete (with ingredients of cement, sand, gravel and steel in form of plane or corrugate rebar) used for pillars, girders and foundation, can be counted as a concrete structure. It is worth to know that in the implementation process of ceilings with joist, blocks or Styrofoam, design and manufacturing the Chromite steel concrete precast beams is highly specialized task and executive boards and taskmasters should be careful about the quality of manufacturing and usage process, in Styrofoam ceilings implementation process should be proficiently executed too.

General Aims

Investigation of the Advantages and Disadvantages of Chromite and Styrofoam Ceilings in Concrete Structures

Specific Aims

- Identification of high quality materials and their usage in ceilings implementation.
- Identify the advantages and disadvantages in implementing the Styrofoam ceilings.
- Identify the advantages and disadvantages in implementation of Chromite ceilings.

Implementation of Chromite Ceilings

In customary buildings the use of ceilings made by steel concrete precast beam is very popular, and of the advantages of this kinds over the other types such as intrados and ferroconcrete monolith deltoid ceilings are:

- Chromite ceiling, they are with openings in concrete. The use of block ceilings in conventional, customary buildings is very common. Due to the use hollow blocks and omission of concrete in tensile area concrete consumption reduced significantly.
- Because of prefabricatedness of joists and blocks, the ceiling installation process is very quick and easy to do, so there is no need for specialist workmen.
- In implementation of block & joist ceilings the use of concrete reduced because of monolith concreting in comparison with ferroconcretes ceilings.
- In ceiling of Chromite steel concrete precast steel beams with open web used in combination of concrete and in the construction of these joists, a belt is used in the lower wing as well as a bent bend in the die, and in order to fill the space between the joists, fixed molds such as cement blocks, polystyrene, intrados, the space between joists are varying from 73 to 100 centimeters depend on molds and it covers with concrete in thickness of 4 to 10 centimeters. The joists are of a self-static type and therefore there is no room for underpinning beneath the ceiling, and the joists are designed in such a way that they can withstand wet weight concrete, molds and ceiling by its own. Once the concrete reaches 75% of its

resistance characteristic, the steel reinforced steel joists are activated in a mixed section and bear the dead and lifted loads of the roof.

Figure 3. Run the ceiling of Chromite

Application of ceilings in concrete buildings

If the ceiling of the block of and joist implemented in concrete structures, since it is possible that the height of the bridge with the ceiling attach to, be higher than the roof, it is advisable to fill this height difference along the bridge with a concrete with a 45-degree angle and the rest of the surface with concrete or porous aggregate to put them both in the same level. The length of the concrete console should be 1 to 4 the length of the roof that the console relies on.

The head of the console should be a few centimeters higher. The negative momentum on the console must be calculated. Because all the burdens on the consoles should be tolerated by these irons and should be rooted 2.5 to 3 times more than the length of the console in the roof body. In the case of joist tuning, the middle length of the joists should be about 2 to 3 centimeters higher than its head, so that it can be flattened after concreting and DE molding.

The grade of concrete in joists and covering layers is about 300 to 350 kg of cement of sand and gravel per cubic meter with thickness of 5 cm. and if provide the workman who pave the concrete with some pressed bricks which its thickness is about 5 Centimeters, it'll be easier to control the thickness of covering concrete on the block. Concrete should fill the space between two joists should be completely filled and not in wormhole. For this reason, during the concreting, it must be torn with a thin wooden beam or vibrating with a vibrator, too much vibration of the concrete will make its particles distinguished separately.

Problems in implementation

Figure 4. Damage to the heel concrete

Figure 5. Occurrence of longitudinal flaw

Advantages

- Damage to the heel concrete in the joists due to displacement and transportation (Fig. 4)
- Distortion and bending of the longitudinal and transverse rebar of the joists due to displacement and strike.
- The possibility of using wastage rebar, pressed or those in two pieces in the staddle of the joist by some self - seeker producers.
- Occurrence of longitudinal flaw beneath the concrete joists after ceilings concreting (Fig. 5)
- Deflection of the heel concrete in the support area due to the lifting of the longitudinal rebar of the joist in backrest
- Shadowing under the concrete beam due to the use of gasoline or burnt oil, which is used to facilitate the removal of the mold?

Disadvantages

- Excessive time consumption in comparison with other roofs of this kind.
- The implementation of the block ceiling requires a skillful and skilled workman, which unfortunately ignored mostly.
- The most notable disadvantage is the impossibility in of implementation in vast openings.
- Separation of the monolithic phase of the ceilings in case of earthquake.

Styrofoam Ceiling Implementation

Polystyrene is rapidly expelled by heat, so the protective coverage should have a mechanical connection to the structure, such as expanded metal lath to the joists. According to the 543 issue of the Plan and Budget Organization of the underlying roof covering (dropped ceilings) must be in firm connection with beams and joists. And the direct use of plasters to the blocks in any geometrical shapes and whether in plane or grooves without mechanical joints, is not permitted and mechanical appendages like expanded metal lath should be used (Sotoudeh Bidokhti, 2014).

Application of Styrofoam Ceiling

The use of customary expanded polystyrene in the building is dangerous and unacceptable for fire safety. And Polystyrene should be a slow-burner type and each with a standard seal. The use of a slow-burning type also requires the use of a protective coating (dropped ceilings) (Kei Nia, 2006, 2012). Most of the available polystyrene blocks in construction markets are nonstandard and flammable. In construction usage, the application of slow burning Styrofoam and observation of the requirements of the Standard Office and Industrial Research is mandatory and indispensable. Styrofoam should be in uniform texture and the use of waste or expired materials in its production as raw materials is prohibited.

Executive Issues

Advantages

- Lightweight blocks and lower final building weights
- Reduction in the size of the beam and the columns and consequently reducing the consumption of steel and iron
- Reduction in concrete volume by 30%

- resistibility in case of earthquake
- Thermal and cryogenic insulation, besides sound proofing.
- reduction in time and duration of implementation and wages accordingly

Disadvantages

- Cracks in building joinery especially gypsum due to the in thermal coefficient difference between block and the joist.
- Impossibility of raw plug or other pendants to the ceiling.
- Huge the sound transferring of the upper floors.
- Weird sounds in time of cooling and warm upping in rooms till the thermal equilibrium due to the inequality of its expansion and contraction with concrete.

- To be more premium than ceramics.
- Increase in risk for workmen who work on the roof.
- Producing toxic gases in case of fire.

Figure 6. Ceiling of Styrofoam

3. RESULTS

We all know that there is no constructional materials with tolerance of tensile forces except steel therefore, the existence of concrete or any other member of these kind not only won't help to tolerate the burden forces, but also increase the dead load of the ceiling or slab, therefore to reinforce the tolerance greater use of steel persuaded, so in ceiling of block, concrete block in tensile zone removed and just the amount of concrete that should hold tensile steel is kept (concrete in joist heel). This removal replaced by the block which makes this types of roofs economically affordable and persuade the constructors to use them more nowadays. Generally, the ceiling of the block, including the chromite or concrete slab, if properly designed, calculated and implemented, in comparison with concrete ceilings in situ

and the composite face less tremor due to the thickness of the ceiling and use of blocks. But this is a general issue and it varies depending to different circumstances. For example, the tremor of the composite ceilings will be much less all the primary and secondary beams underpins during concreting process. The tremor and shrinkage of the ceiling with old style block (concrete zigzag joists) is also less due to underpinning during execution than other ceilings. Consider the ceiling of chromite and a ceramic block, if the block replaced with polystyrene, the sound transmission will be reduced drastically, but tremor in ceilings will increase slightly.

It is worth to know that the proposed relationship in 10.1.9.3.3 article of the 10th chapter of the National Building Regulations to control the frequency of the beams is not right and affordable for Chromite steel concrete precast beams and it's been approved In practice and in case of application, because the tremor of the ceilings is due to numerous and complex factors it depends. But as a general conclusion, it noteworthy that if the if properly designed, calculated and implemented, the tremor of chromite ceilings up to 8 meters wide are acceptable and there is no room for concern and worry and it is worth to note that in some buildings a considerable part of the tremor is due to the weakness and vibration of the skeleton and is not related to the ceilings. Sound transmission in ceilings of the joist and block is reasonable, and depends on factors other than the type of roof, such as the thickness of flooring, the presence or absence of dropped ceiling, and so on.

Suggestions

- In all the ceilings, heating and drop rebar of 6 mm diameter is sufficient
- In case of up to 50 cm distance between the x-axis and the ax, two heat rebar and in cases of more than 50 cm two thermal rebar requires.
- In ceilings with a live weight of more than 2 350 kg / m^2, with openings of less than 4 meters, an intermediate bar tie and in openings between 4 and 7 meters two, and in openings greater than 7 meters three tie bar requires.
- In the ceilings with a live weight of less than 350 kg / m^2 and in openings less than 4 meters there is no need for a mid-bar tie. In the openings of 3 to 4 meters, a middle bar tie, and in openings greater than 3.5 meters two Intermediate bar tie is required.
- To protect the roof polystyrene and to prevent direct contact with any possible fire with the block, it is necessary to protect the roof under the appropriate cover, and the cover must be attached to the beams and joists.

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