

National Technical Approval

Approval office for construction
products

Structural Testing Office

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Business sign:

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Approval Number:

N-17-17740

Applicant:

Contruss engineering company
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Subject of approval:

Contruss voided slab system

Validity

From: 2017 Dec 5

Until: 2022 Dec 5

The above-mentioned approval subject is hereby permitted general building inspection. This national technical approval comprises 15 pages.

General provisions

1. The national technical approval proves the usability or applicability of the object of approval according to the state building regulations.
2. If in the national technical approval requirements for the special expertise and experience of the persons entrusted with the production of construction products and types according to the model building code corresponding country regulations are provided, it is to be noted that this expertise and experience is also by equivalent evidence of others member states of the Canadian Union. This also applies, if applicable, to equivalent evidence provided under the Agreement on the Canadian Economic Area (CEA) or other bilateral agreements.
3. The national technical approval does not replace the legally required permits, consents and certificates for the execution of construction projects.
4. The national technical approval is granted without prejudice to the rights of third parties, in particular private property rights.
5. Without prejudice to further provisions in the "Special Provisions", the manufacturer and distributor of the object of approval must provide the user or user of the approval subject with copies of the general building approval and must point out that the national technical approval must be available at the place of use. Upon request, the participating authorities are to be provided with copies of the national technical approval.
6. The general construction supervisory approval may only be completely reproduced. A partial publication requires the approval of Canadian institute of building material and technology. Texts and drawings of advertising brochures may not contradict the national technical approval.
7. The national technical approval is revocable. The provisions of general building approval can be supplemented and amended later in particular, when new technical insights are needed.

Specific provisions

1- Subject of approval and scope

1.1 Subject of approval:

With the "Contruss voided slab" system, a voided reinforced concrete ceiling system with mutually ribs by the use of Contruss permanent fillers is created.

1.2 Scope:

Within the framework of this approval, the application of the approval object for the production of flat, non - inclined reinforced concrete roofs of normal concrete of the strength classes C25 to C55 according to ACI 318-14.

The Contruss filler installation elements should only be used in in-situ concrete areas and in individual room-sized prefab ceilings.

The installation in or on semi-finished parts as well as the use in cover composed of prefabricated parts are not regulated in the context of this general construction approval.

Planned pulling or pushing forces should not be introduced into the hollow body areas of the cover.

A pre-stressing of the hollow body area is not regulated within the scope of this approval.

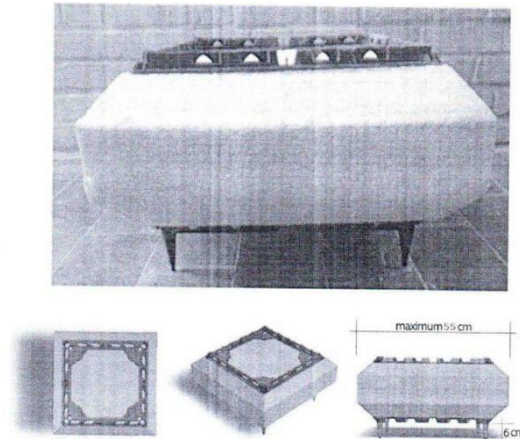
2-regulations for the construction project

2.1 Properties and composition

2.1.1 Solid filler:

The Contruss filler is included expanded polystyrene block that is remained stable by means of upper and lower trays made of polypropylene material. The filler is rested on 4 piles that are 6-cm-high as maintaining in determined distance by use of polypropylene belts positioned on trays.

The longitudinal, transversal dimensions and thickness of the polystyrene block is determined according to design requirements; the maximum dimensions are restricted to 60cm. The minimum density of polystyrene is as much as 8 kg/m³.



2.1.2 concrete:

The application is limited to normal concrete of strength class C25 to C55 according to ACI 318-14. The consistency of the fresh concrete must have a spreading strength of class F3 to F4, but may not be higher than F4, the grading curve and the grain size (maximum size 16 mm) are to be determined taking into account the smallest permissible distance of the Contruss filler installation elements.

2.1.3 Reinforcement:

The reinforcement used is ribbed steel according to ACI 318-11. R3.5 or general construction approval. The diameter of the reinforcement area of the Contruss fillers must not be greater than 16mm.

2.2 Manufacture, transport, storage and marking

2.2.1 Production

For the production of the concrete, CSA A23.1-14/A23.2-14 criteria must have to be considered. For the production of the reinforcement of the Contruss filler installation elements, CSA G30.5-M1983 must have to be considered.

2.2.2 Transportation and storage

Damage to the Contruss filler installation elements is the responsibility of the transport and the Storage segment.

2.2.3 Marking

The Contruss filler components must be marked with the manufacturer's mark of conformity (0-mark) in accordance with the Lander's conformity mark regulations. The marking may only be made if the requirement according to section 2.3 has been met.

The Contruss filler installation elements are to be marked prior to delivery in such a way that mistakes during installation are excluded.

On top of the Contruss filler installation element must be durable and legible:

- the solid body height and
- The axial distance of solid body be given before the concreting in the transverse direction.

2.3 Proof of conformity

2.3.1 General

(1) Confirmation of compliance of the Contruss filler installation element with the provisions of this national technical approval shall be provided for each manufacturing facility with a certificate of conformity based on a factory production control and regular external inspection including initial testing of the Contruss filler installation element in accordance with the following provisions respectively.

(2) The manufacturer of the Contruss filler installation element must appoint a certification body recognized by the manufacturer as well as a recognized monitoring body for issuing the certificate of conformity and external monitoring including the product inspections to be carried out.

(3) The manufacturer has to declare that a certificate of conformity has been issued by marking the construction products with the sign of conformity (0-mark) with reference to the intended use.

(4) The certification body must notify the Canadian institute of building material and technology of a copy of its certificate of conformity.

2.3.2 Factory production control

(1) Factory production control shall be understood as the continuous monitoring of production by the manufacturer to ensure that the Contruss filler components manufactured by him comply with the provisions of this national technical approval.

(2) The results of the factory production control shall be recorded and evaluated. The records must contain at least the following information:

- Designation of the Contruss filler installation element, including the starting materials, and the ingredients
- Type of control or examination
- Date of manufacture and test of the Contruss filler quality or of the starting material or components
- Result of checks or tests and comparison with the requirements
- Signature of the person responsible for the factory production control.

(3) The records must be kept for at least five years and submitted to the monitoring body involved in surveillance. They are to be submitted to the Canadian institute of building material and technology and the relevant supreme building inspectorate on request.

(4) If the test result is unsatisfactory, the manufacturer must immediately take the necessary measures to remedy the defect. Construction products that do not comply with the requirements must be handled in such a way that confusion with those in the agreement is excluded. Once the defect has been corrected, the relevant test must be repeated as soon as technically possible and to prove that the defect has been remedied.

2.3.3 External monitoring

- (1) In each production plant, the factory production control must regularly be inspected by external monitoring, but at least twice a year. For each Contruss filler installation element, the tests must be carried out on ten components and Contruss filler installation elements.
- (2) In the context of external monitoring, an initial test of each Contruss filler installation element shall be carried out and samples shall be taken and tested for the tests. Sampling and testing are each the responsibility of the recognized surveillance body.
- (3) The results of certification and external monitoring must be retained for at least five years. They shall be submitted by the certification body or the surveillance office to the Canadian institute of building material and technology and to the relevant supreme building inspectorate on request.

3 Determination for design and dimensioning

3.1 General

- (1) For the design and dimensioning, ACI 318-14 applies unless otherwise specified below. A mixture of both technical building regulations is not allowed.
- (2) For the determination of the hollow bodies, the methods according to plasticity theory and nonlinear methods should not be applied.
- (3) In this ceiling system, permanent fillers are used to construct two-way voided reinforced concrete ceilings. The permanent fillers are positioned between the upper and lower reinforcement meshes; in addition, the ceiling section can be considered as composed of perpendicular ribs, from structural view.
- (4) The shear design of ribs created between the permanent fillers must be determined according to ACI 318-11 chapter 11. When stirrups are required in any direction in correspondence of design, adequate numbers of pin stirrups must be positioned relying on the upper and lower reinforcement bars in the ribs.
- (5) Connections of this ceiling system to structural frames must be in a manner that the ceiling bear gravity and lateral loads simply and transfer it to structural frames.
- (6) Providing chords and collectors are necessary in the ceiling diaphragm. Seismic design of the diaphragm and sufficiency control of chords and collectors must be accomplished according to valid international codes such as ACI 318-14 and ASCE 7-10. All components involved in transfer of loads to the lateral load resisting systems must have enough strength when subjected to lateral forces. Providing concrete beams is necessary in the place of collectors; therefore, the ceiling must be performed as solid in a determined transverse according to the calculations, along with longitudinal reinforcement bars and stirrups practiced in solid section (buried beam).

- (7) The diameter of the rebar in the area of the filler must not be greater than 16 mm.
- (8) When planning, a grading curve adjusted to the minimum axial distance of the solid bodies as well as the grain size {maximum grain 16 mm) must be selected and indicated on the formwork and reinforcement cover.

3.2 design

3.2.1 Dimensions:

- (1) The minimum distance between the permanent fillers is restricted to 10 cm in each direction, and the maximum proportion of ceiling thickness to the mentioned distance must be restricted to 3/5.
- (2) Necessary measures must be considered in concrete pouring of the ceiling in order to flowing of concrete toward the bottom of fillers as well as providing high quality concrete. The minimum thickness of the upper and lower concrete layers is as much as 5 cm.

3.2.2 supports:

Above the supports of the ceiling to be created, no fillers are to be arranged. The size of the massive areas is defined by the shear force proof. Constructively, a solid strip in the width of at least the center distance of the filler is provided laterally of the support edge.

3.2.3 Concrete cover:

- (1) The upper and lower reinforcement meshes must be positioned in a manner that the provided clear cover between the reinforcement and surface of permanent fillers gets equal to minimum numbers between 20 mm and four-thirds of nominal maximum aggregate size.
- (2) The concrete cover of the reinforcing steel reinforcement for the solid body surface must comply according to ACI 318-11, section 7.7.
- (3) The concrete cover regarding the component surfaces depends on the existing ones exposure classes.

(4) A sufficient concrete cover for securing the composite is also for solid body surface to comply.

(5) The reason for the concrete cover must be taken into account in the planning. The parameter must be increased by the actual displacement of the Contruss filler installation elements and indicated on the reinforcement cover, if the value is exceeded.

(6) The required concrete cover • also for securing the composite - is also in the anchoring and upper grip area of the reinforcement.

3.2.4 margins:

Required edge distances of the Contruss filler installation elements to any other components, installation parts etc. must be taken into account in the design and execution of the design.

3.2.5 Attached loads in the area of the solid body:

Planned loads in the area of the lower plate mirror must be adequately anchored. Only the actual existing concrete cross-section may be used for the verification. Possibly, by dispensing with the arrangement of individual solid bodies, a sufficiently large solid area is to be provided.

3.2.6 recesses and plate edges:

Recesses shall be evidenced separately in accordance with Section 3.3.5 of this approval. Recesses and plate edges are circumferentially with an area in the size of plate thickness h massive form.

3.3 Dimensioning

3.3.1 Bending:

(1) Approximately, in compliance with the provisions of this National technical approval, it may be assumed that the drill stiffness of the hollow slab is reduced in comparison to the rigidity of a solid slab in the same ratio.

(2) The inclusion of the transverse tensile stresses in the concrete in the anchoring and upper gripping area of the reinforcement caused by an explosive effect must also be ensured in the area of the solid bodies in accordance with ACI 318-11, Therefore required transverse reinforcement is placed between the longitudinal reinforcement and the concrete surface - even to solid body surface -.

3.3.2 Punching:

Necessary measures must be considered in order to control shear punch according to ACI 318-14 in this system, particularly for structures including large spans as well as existence of considerable gravity forces.

3.3.3 Proof of serviceability:

- (1) The proof of the limitation of the crack widths is to be found according to ACI 224R-01.
- (2) The minimum reinforcement for limiting the crack width shall be determined and inserted in accordance with ACI 224R-01. The structured or profiled cross-sectional shape of the Contruss ceiling must be observed. The increase of the first load through the massive sections of the ceiling with full cross section has to be taken into account when determining the minimum reinforcement.
- (3) A limitation on the crack width without direct calculation according to ACI 224R-01 is only possible if the full cross section of the ceiling is used, without consideration of the solid bodies.
- (4) The proof of the limitation of the deformation shall be in accordance with ACI 318-14. The reduced bending stiffness of the solid body has to be considered.

3.3.4 compound joint:

Concrete pouring of the whole ceiling section must be performed continuously to avoid from creating cold joints between the layers. In order to achieve such goal, suitable measures must be considered to prevent the reinforcement mesh from displacing subjected to floating force applied by the fillers.

3.3.5 Ceiling openings and recesses:

Observance of dimension restriction in ceiling openings as well as necessary measures upon the vicinity of openings must be considered according to ACI 318-14, section 13.4. Providing boundary elements in the vicinity of openings and edge of slab must be determined according to the case.

3.4 Fire protection:

The structural behavior of the Contruss ceiling system under the effects of fire is not regulated within the scope of this general building inspectorate approval.

3.5 Heat and sound insulation:

The evidence of thermal insulation and sound insulation is not subject to this general building inspectorate approval.

4 provisions for the execution

4.1 General

(1) For the execution of Contruss ceiling system, CSA-A23-314 applies in conjunction with ACI 318-14 with the following supplementation in accordance with section 4.2 and 4.3 of this approval.

(2) In order to ensure the quality of the construction and the stability of the Contruss system ceiling, the conditions for execution in section 4 of the approval must be observed and complied for each design.

4.2 Regulations for installation and concreting

(1) Necessary measures must be considered in concrete pouring of the ceiling in order to flowing of concrete toward the bottom of fillers as well as providing high quality concrete. The minimum thickness of the upper and lower concrete layers is as much as 5 cm.

(2) The upper and lower reinforcement meshes must be positioned in a manner that the provided clearance between the reinforcement and surface of permanent fillers gets equal to minimum numbers between 20 mm and four-thirds of nominal maximum aggregate size.

(3) Props and piles practiced in formwork performance of this ceiling must be capable of applying adequate camber before concrete pouring.

(4) Loads acting during installation must be considered in use of this filler. The permanent fillers must be placed perpendicularly in two directions as well as necessary measures considered to keep them stable in concrete pouring.

(5) Concrete pouring of the whole ceiling section must be performed continuously to avoid from creating cold joints between the layers. In order to achieve such goal, suitable measures must be considered to prevent the reinforcement mesh from displacing subjected to floating force applied by the fillers.

(6) Necessary measure is required for concrete durability consideration in accordance with various environmental conditions.

(7) Accurate details for positioning of electrical and mechanical systems installation must be considered in design and construction phases.

(8) Damaged Contruss fillers installation components may not be used. The dimensional stability of the fillers must be checked and ensured before concreting - in particular at summer temperatures.

(9) During the execution, care must be taken to ensure that the Contruss filler elements are carefully installed and secured according to the design plan. For this purpose, you must provide a layout sheet with corresponding descriptions and details.

This concerns in particular:

- compliance with the concrete cover of the reinforcement
- the axial distances
- the height of the ceiling cross section
- the required guidance when arranging the Contruss filler elements

(10) The installation, the concrete coverings and the center distances of the fillers are in front of the concreting - if necessary with distance control - from the site supervisor.

(11) The consistency of the fresh concrete shall be of a spread type F3 to F4 but not higher than F4. The grading curve and the grain size (maximum size 16 mm) are to be determined taking into account the smallest permissible distance of the Contruss filler elements. In special cases (for example, with dense reinforcement), the fresh concrete properties required for this purpose must be specifically planned and monitored in terms of concrete technology.

(12) During the concreting process, the Contruss fillers are in each use case by appropriate measures against lift and lateral drift to secure.

(13) When executing a horizontal construction joint, the concrete quantities of the first concrete layer, the concreting heights and the compliance with the axial distances of the fillers shall be checked and documented in the construction files. It is important to ensure a uniform and flat concrete distribution while complying with the concrete heights. Concrete accumulations are to be avoided. Furthermore, it is important to ensure a sufficient compression of the first concrete layer, so that the areas under the Contruss fillers are filled without concrete.

(14) The necessary anchoring of the reinforcement on both sides of the contact surface shall be ensured during execution and shall be checked and documented after the first concreting section.

(15) If the distance between the axes and the concrete height is not maintained, the planner must be switched on Possibly. In this case, the load-bearing capacity of the ceiling must be subjected to an expert assessment. This also applies if the required anchoring of the composite reinforcement is undershot.

4.3 Additional provisions for the user and manufacturer

- (1) Prior to the first concreting of a construction project with the Contruss ceiling system, instructions for the construction management of the executing company (user) must be given by the manufacturer of the Contruss filler installation elements. In this case, the provisions of the approval, in particular the provisions for the execution and the assembly instructions, must be explained.
- (2) The proof of this instruction must be submitted to the client in writing and in any case in writing and taken to the construction files.
- (3) The user of this type (for example the executing company) must confirm in writing that the ceiling construction complies with the special provisions of this general building approval.
- (4) The certificate of conformity must be presented to the client in any case and without request and taken to the construction files.

Installation instruction for the Contruss ceiling system

Installation and use:

The Contruss filler elements are placed on site between the reinforcement layers of a reinforced concrete ceiling installed to reduce material consumption and dead load.

For a flawless, yet practical execution of fillers are the provisions of the general type approval- especially section 4 as well as these installation instructions must be observed at every execution and to fulfill.

Installation sequence:

Analogous to a conventional solid ceiling, the lower reinforcement is installed first, followed by the fillers according to the installation plan in the next step. Then the upper reinforcement laid. In this assembly, the following points urgently:

- 1) The distance between the load-bearing reinforcement and the hollow body must be observed in accordance with the specifications of the approval. If necessary, additional spacers or constructive rebar are to be used.
- 2) The axial distances of the solid core modules must not be reduced. By using an appropriate installation aid (template), compliance with the axial distance must be ensured.
- 3) The installation of the solid body modules must be painted, take the given grid in the laying plan. The installation of the solid body module with an offset is inadmissible.
- 4) Damage to the solid core modules must be excluded during transport, storage and installation. Only unshielded solid body modules may be used. The dimensional stability of the solid body must be checked and ensured before concreting - in particular at summer temperatures.

Concreting:

- 1) During the concreting process, a buoyancy force acts on the solid body modules due to the fillers. These are therefore to be fixed by appropriate measures in their position. If these safety measures are not sufficient for a concrete work without interruption, two concreting sections with controlled working joints are required in the areas with solid bodies.
- 2) In order to ensure the bonding of the two concrete layers, if necessary, a computationally proven composite reinforcement is to be installed. The required anchoring length must be ensured according to the design plan on both sides of the contact surfaces.

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- 3) The consistency of the fresh concrete must have a spreading class of classes F3 to F4, but must not be higher than F4. The grading curve and the grain size (maximum size 16 mm) shall be determined taking into account the minimum permissible spacing of the Contruss filler elements. In special cases (for example, with dense reinforcement), the fresh concrete properties demanded in this case must be specifically planned in terms of concrete technology and monitored
- 4) Practical concrete compaction determines the quality of the finish. The concrete must be carefully introduced and compacted so that the reinforcement as well as the solid bodies are positioned tightly with concrete. Optionally, the solid body is to be compacted in each intermediate region.
- 5) The concrete quantities of the first concrete layer and the concreting heights are to be planned, checked and documented in the construction files. It is important to ensure even and flat concrete distribution while maintaining the concrete height. Concrete accumulations are absolutely to be avoided. Furthermore, it is important to ensure sufficient compression of the first concrete layer, so that the areas under the flat ceiling are filled without air inclusion with concrete. For controlling the concrete height and the solid body layer, e.g. the use of a marked auxiliary rod in the concreting process serve. The markings are based on the information given in the installation plan.
- 6) It must be ensured that the fillers have no water accumulation before or during concreting.