5th International Conference
"Computational Mechanics and Virtual Engineering "
COMEC 2013
24- 25 October 2013, Braşov, Romania

THE CHECKING OF THE SEMI-PRECAST R.C. FLOORS

Cristina Chilibaru–Oprițescu[1], Amalia Țîrdea[2], Corneliu Bob[3]
[1, 2] The research institute for construction equipment and technology - ICECON S.A. Bucureşti, Research department of Timişoara, P. Râmneanțu str No.2, Romania,
opritescucristina@yahoo.com, amalia_tirdea@yahoo.com
[3] University "Politehnica" of Timişoara, Department CCI, T. Lalescu str. No 2, Romania, cbob@mail.dnttm.ro

Abstract: *The paper deals with the checking of the semi–precast R.C. floors for the technological phases: transport and mounting. A dynamic analysis is presented instead of the manual calculation. The influence of dynamic effect (F=1.5G) is proposed and the most of stresses are smaller than characteristic strength and it presents a safety calculation.*
Keywords: *semi-precast R.C. floors, transport and mounting phases, dynamic analysis, manual calculation, concrete class, concrete strength*

1. INTRODUCTION

Semi-precast slab are part of the mixed floors partly monolithic, partly precast. These are composed of a lower layer made of reinforced concrete plates precast with thickness from 30 to 100mm and an upper layer of reinforced concrete monolith with thickness from 80 to 200mm or more. The precast plate contains the reinforcement from the lower part of the plate; the layer of monolithic reinforced concrete contains the upper reinforcement for take up the negative moments in the supporting areas. The precast plate is the formwork and it must be designed for take up the efforts during all phases. [1]

The connection between the prefabricated plate and the monolith reinforced concrete is done by both adherences of the two layers of concrete, as well by some special links of reinforcement.

Lattice truss are made like a plane truss or spatial (triangular) truss, made of reinforced concrete or thin profiles. These are dimensioned so that will ensure the efforts of transport, mounting and weight of monolithic concrete layer after casting. In the same time the stiffened truss links the two layers of monolithic and prefabricated concrete. The stiffened truss can be placed near the wire that constituting the reinforcement of prefabricated plates.

Checks in mould release phases, transport and mounting on static schemes, depending on suspension system; the calculation loads for these checks are [2], [3]:

- dead load of partial prefabricated slab add uniformly distributed load for to defeat the adherence of formwork (1 – 1.5kN/m^2) to demoulding
- dead load of partial prefabricated slab increased with dynamic coefficient of 1.5 in the transport and mounting phases

The utilization of cracked semi-precast slab is not allowed for building structures

2. ANALYSIS OF SEMI-PRECAST R.C. FLOORS

The behavior of a partial prefabricated slab for the transportation and mounting is always taking into account by engineers. For usual design, there is used a static analysis for which the self weight of the slab is multiplied by a dynamic coefficient η=1.5.

For the checking of the state of stress in this design, a dynamic simulation was performed by using a computer program ANSYS LS-Dyna. [4]

The semi-precast slab has taken into account with the next characteristics: geometrical dimensions 4x2x0.1m; density 2400kg/m^3; Poisson ration 0.2 and mechanical characteristics of material are presented in Table 1.

Table 1: The mechanical concrete characteristics

Concrete classes	**Tensile concrete strength [MPa]**			**E [$\cdot 10^4$ MPa]**	**G [$\cdot 10^4$ MPa]**
	f_{tm}	**f_{tk}**	**f_{td}**		
C8/10	1.41	0.92	0.6	2.1	0.84
C10/15	1.71	1.19	0.8	2.4	0.96
C15/20	1.98	1.43	0.95	2.7	1.08
C20/25	2.24	1.65	1.1	3	1.2
C25/30	2.71	1.86	1.25	3.25	1.3
C30/35	2.94	2.03	1.35	3.45	1.38

A static analysis of the semi-precast slab was performed on the scheme given in Fig.1a with the static loads F=G and F=1.5G, where G is the weight of the slab.

For comparison of the calculated data, a dynamic simulation was made by finite elements using ANSYS LS-Dyna, Fig.1b. This dynamic analysis was performed for the forces with the intensity of G, 1.25G, 1.5G and 2G and with proper strength f_{tk} for each class.

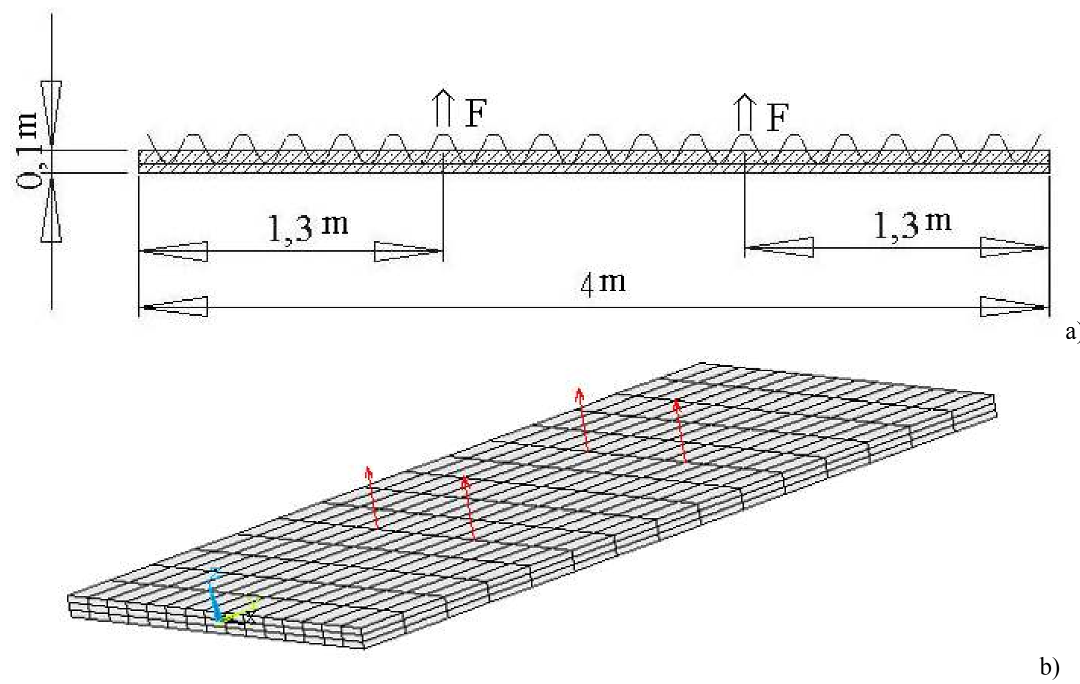

Figure 1: a)-The scheme for mounting and transport of a semi-precast R.C. floor; b)-the modeling by finite elements of a semi-precast R.C. floor

Table 1: Value of stresses from static and dynamic calculation

Concrete classes	**Stress [MPa]**					
	static analysis for the force:		**dynamic simulation for the force:**			
	F=G	**F=1.5G**	**F=G**	**F=1.25G**	**F=1.5G**	**F=2G**
C8/10	1.27	2	0.79	0.94	1.06	1.29
C10/15			0.85	1.06	1.22	1.47
C15/20			0.85	1.07	1.28	1.55
C20/25			0.93	1.16	1.39	1.78
C25/30			0.95	1.19	1.43	1.89
C30/35			0.95	1.18	1.42	1.9

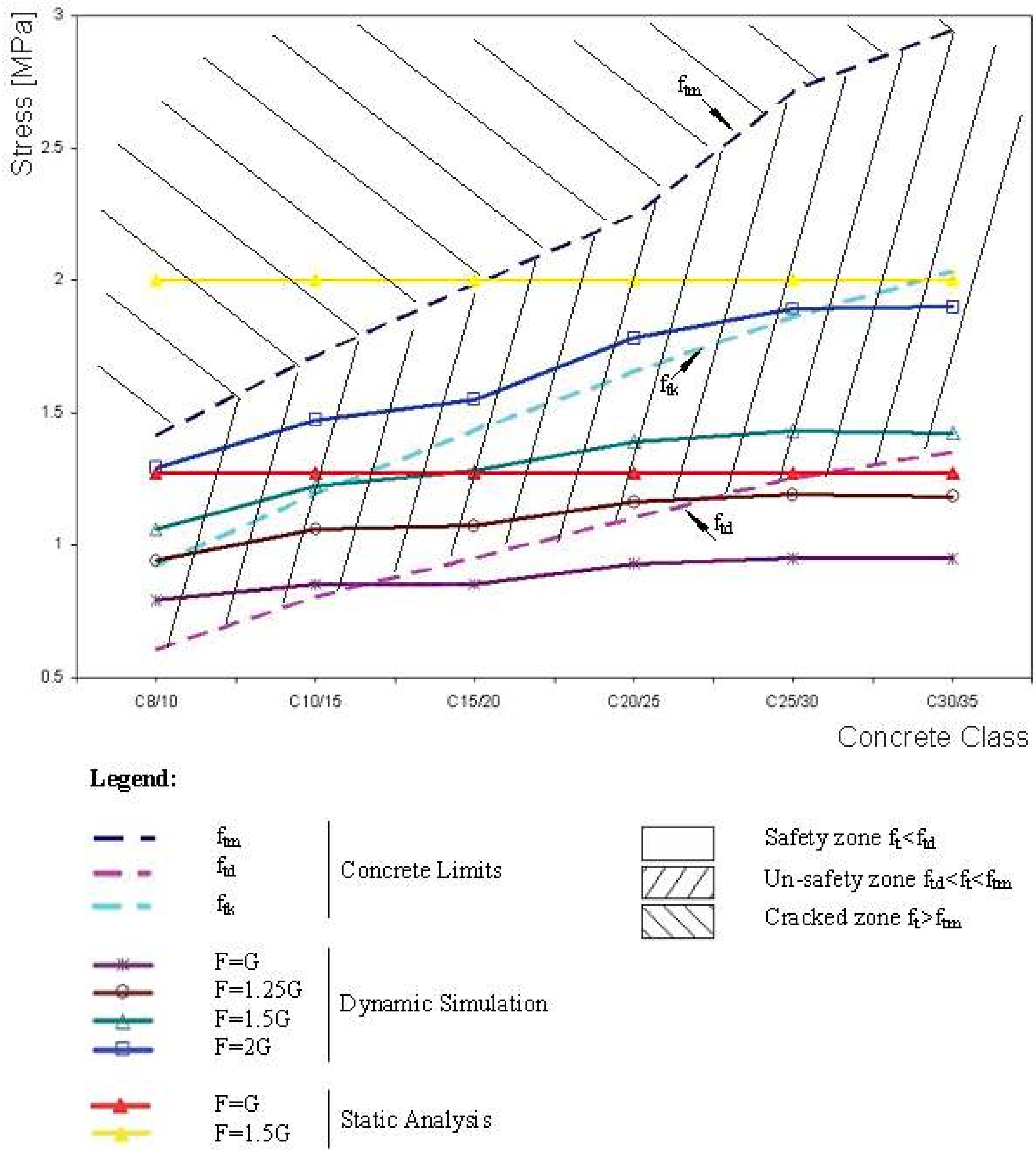

Figure 1: The stresses for concrete class from static and dynamic analysis

From the analysis presented in Fig.2 and Table 2 it can be pointed:

- The **safety zone**, where $\mathbf{f_t<f_{td}}$, is valuable only for the action without dynamic effect F=G and for the concrete class greater than C10/15 as well as for F=1.25G and concrete class C25/30 and C30/35. For the case of static calculation the safety zone will include only the concrete class C30/35 and F=G.
- The zone where $\mathbf{f_{td}<f_t<f_{tm}}$ was defined as **un-safety** due to the stress values witch are greater than designed tension stress of concrete. Most of calculated values are included in this zone, together with the characteristic strength of concrete.
- The **cracked zone** where $\mathbf{f_t>f_{tm}}$ is proper only for static calculation and for concrete classes C8/10 and C10/15.

From the data presented, the dynamic simulation for the action of F=1.5G, the values of stresses are closer to designed stress, f_{td}: for higher concrete class C30/35 – 5%, and for C8/10 – 77%. Such approach is much favorable than manual calculation which is with no security values. Taking into account the purpose of such calculation with the effect of dynamic action for transportation and mounting, the value with F=1.5G is good enough most of stresses obtained with this dynamic coefficient are smaller than characteristic strength f_{tk} which represent quite a safety calculation. A smaller value of dynamic coefficient is not indicated for design and checking.

3. CONCLUSION

Some practical conclusion, which emerge from the presented analysis are:

- For the check in the transport and mounting phase a dynamic analysis there is necessary
- The manual calculation, with a dynamic coefficient of 1.5 is not satisfactory for concrete of inferior classes
- Dynamic analysis gives good results, even the data are situated in the un-safety zone, but for such technological, short-time, stressed there are not probability of having cracked zone. On the other hand the stresses are smaller than characteristic strength which means a safety calculation.

REFERENCES

[1] Ovidiu MÎRŞU, Corneliu BOB: *Reinforced Concrete Sructures*, vo.I (in Romanian) IPT Facultatea de construcţii, Timişoara, 1990.

[2] EN 1992–*Design of Concrete structures*.

[3] Daniel BOGDĂNESCU, Corneliu BOB, Liana BOB: *Some Considerations for the Assessment of Existing RC Framed Structure*, North Atlantic University Union-Recent Advances in Engineering, Paris, 2-4 Decembrie, 2012.

[4] Cristina OPRIŢESCU, Amalia ŢÎRDEA, Corneliu BOB, Mihai Ilie TOADER: *Numerical simulation of real contact between two bodies*, The 10th International Conference "Acustică. Vibraţii.", 29-30 septembrie 2011 Petroşani, CD