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THE FRAME CONCRETE STRUCTURE

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ABSTRACT

This work shows the influence of characteristics of the alternating load and its intensity on state strain deformations of critical sections in frame structures.

The development of a methodology for assessing the ultimate bearing capacity and deformability of reinforced concrete frame structures under the action of alternating dynamic loads is presented.

Analysis in elastic hyperstatic frame structures corresponds to rather weak stresses not involving crack and non-elastic deformation of concrete and steel. Therefore, for a greater level of stresses, such as the seismic action, the distribution of efforts is totally different from the static study.

***Key Words*: *Concrete*, Static, Dynamic, Seismic.**

1 INTRODUCTION

In frame concrete structure, collapse is directly linked to the failure of the various critical sections. In steel structures, they are manifested by excessive deformation of the parts and the whole. Currently, concrete frame structures are widely applied in the construction of complex building.

Therefore, systems of frame structures are considered as a major problem in increasing the efficiency of the primary structure and which is achieved by the use of sophisticated methods of calculation more or less accurate.

Because of the properties of steel, there is a work hardening of the material and the steel structure is capable of transmitting increased loads, but due to excessive deformation, it becomes in the meantime in the same way that a reinforced concrete structure becomes unusable due to the spalling of concrete.

However, the calculation of the resistance elements of structures in reinforced concrete frames is generated by maximum efforts appeared and led out of the elastic design of the system due to the worst case of possible load combinations.

In addition, "experimental theory" research of hyperstatic structures shows that the non-elastic deformation of the elements will be reduced with the redistribution of effort across their critical sections [1].

For example, Bischoff and Perry [2] show, as corroborated by a significant bibliographical synthesis in figure1, that there is an increase of the concrete compressive strength at higher deformation rate. Moreover they point out that we can distinguish two different modes (see Figure1) producing the relative increase of the resistance in compression.

For the simple tension test must also be adapted to dynamic. In particular, by using a modified version of the Hopkinson bar test, Klepaczko and Brara [3] obtained experimental results in which the rate of deformation is about 100 s-1 (see figure 2). They also collected the results presented in the literature as shown in fig.2. We can see from this figure that just like in compression, two distinct modes appear in the increase of the tensile strength due to the high rate of deformation.

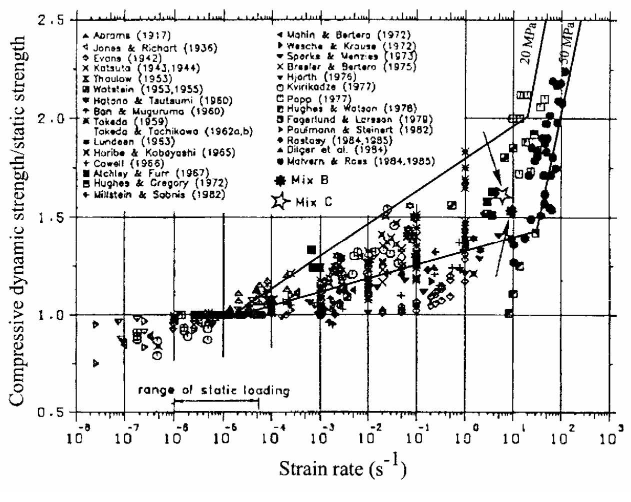

Figure 1 : Compressive strength increase versus strain rate (from [10]).

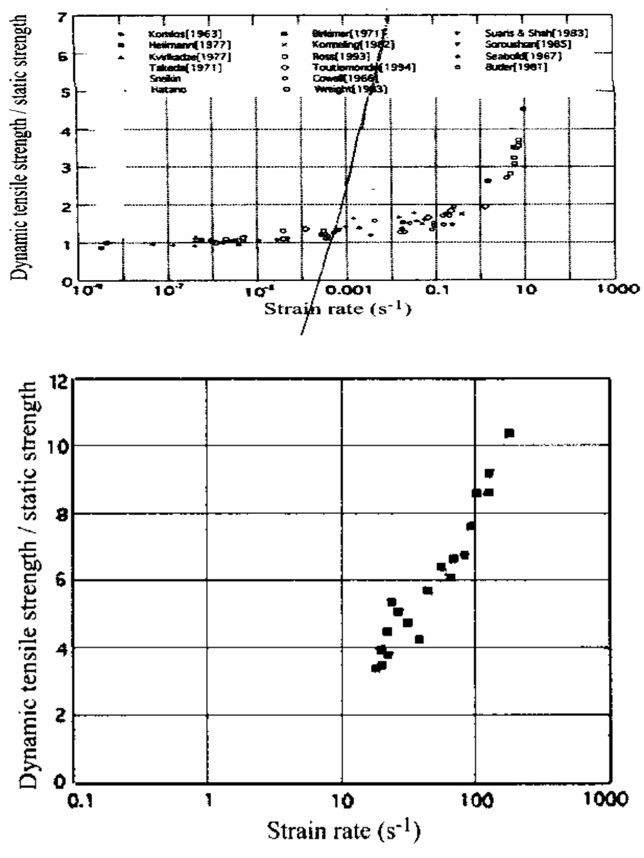

Figure 2 : Tensile strength increase versus strain rate (from [19])

Schemes of loading of reinforced concrete frames influence the state (σ,ε) elements in the process. The action of dynamic load is considered as one of the flow loading in a moment of intense vibrations of seismic vibrations of structures; seismic stability of structures in reinforced concrete frames "hyperstatic systems" is developed by experience.

There are several proposals for calculating the strain and deformation systems in reinforced concrete frames under the action of dynamic loading of a mono multiple non repeated cyclical and based on diagrams of ideal elastoplastic deformation of materials, but problems of alternate dynamic loading dynamic alternate characters are not yet treated. Under the action of alternate dynamic loading (where there asymmetry of cycles is close to 1) [4].

2 SPECIMEN OF TESTS

The experimental study of the resistance, deformability and the redistribution of load is being carried on 9 specimens of frames with two spans as part of a fragment of a reinforced concrete structure with multiple floors cut at null points of columns. The test specimens are prepared in a scale 1/4 of natural values (3 sets with 3 specimens per set) of a heavy concrete class B25 and B30 and armed with steel class A-III (mark 35) (figure 3). In comparison with earlier experimental studies, the test specimens have an increased difference in the longitudinal reinforcement of the support sections and sections of the spans of the beams in comparison with those given by an elastic calculation.

Specimens of the first series of double spans frames are to study the specificity of work elements critical sections bars armed by an elastic design (figure 3). The ratio of longitudinal reinforcement of the extreme sections of support of reinforced concrete frames of the section spans is (Aap/ Atr= 1.64).

The second set of specimens is different from the first by a reduction in reinforcement of columns and sections of the support beams. Indeed, the ratio of longitudinal reinforcement sections support beams to the frame sections spans is (Aap/Atr =1) (figure 3).

The third set of specimens was prepared with a high reinforcement on spans of beams for a medium percentage of reinforcement of columns. Which shed light on the redistribution of forces in specimens at maximum difference of frames that required by an elastic design (Aa / Atr = 0.49).

Transverse reinforcement of the reinforced concrete is a class AI diameter 6. Prisms of dimensions 15×15×60 and 10×10×40 and edges 15cm cubes were prepared to determine the strain and deformability of concrete (figure 4 and figure 5).

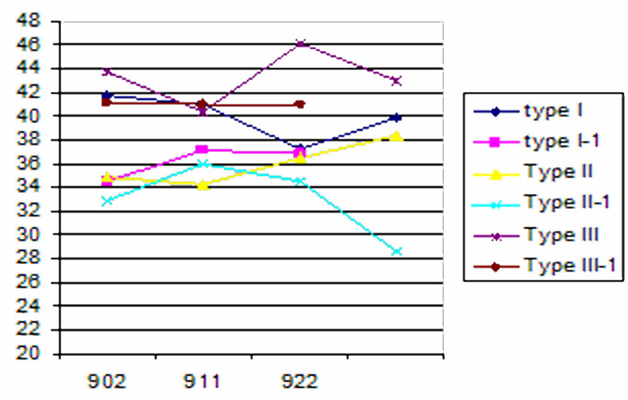

Figure 3 : Resistances of the cubic concrete test tubes under static loading.

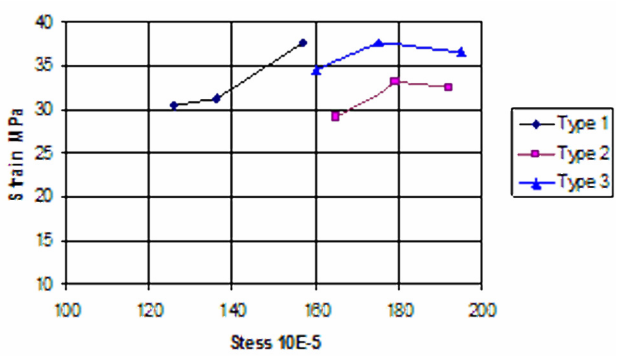

Figure 4 : Resistance characteristics of concrete prismatic specimens of dimensions 10 × 10 × 40 cm under static compression.

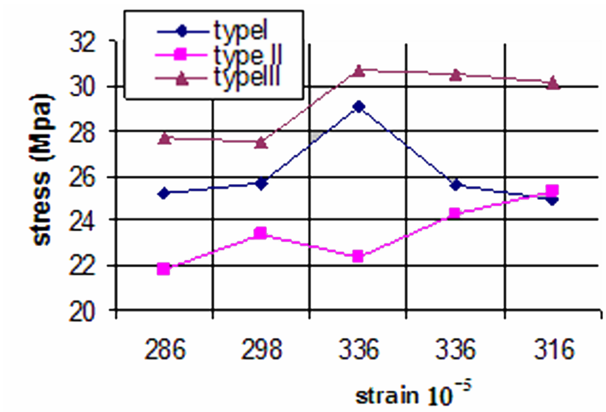

Figure 5 : Characteristics of concrete prisms of dimensions (10 × 10 × 40) under dynamic cyclic loading with φ = 0 asymmetric coefficient.

3 ANALYSIS OF RESULTS

The theoretical analysis of experiments on a series of models of reinforced concrete frames subjected to static and dynamic loads taking into account the redistribution of efforts in sections of the frame (the spans and support) in to evaluate the ultimate bearing capacity of reinforced concrete structures (table1 and table2).

The work summarizes some essential points which are as follows:

- Vertical live loads are constant and do not produce any redistribution of forces in the calculation of frame.
- Stresses in the elements of the frame are determined by:
  - An elastic design “method of forces”
  - A plastic design “method of limit equilibrium”
- The redistribution based on change and loading product of dynamic forces applied to the upper extremities of the uprights of the frame, which showed a degradation of stiffness in support critical sections of beams and columns.
- The influence of the rate of reinforcement of the sections with the flow loading producing the redistribution of efforts in the critical sections in bending composed requested “support spans”.
- The 50th cycle of alternate dynamic horizontal loading causes degradation in strength from 22 to 25 %.

4 CONCLUSION

It is significant to summarize this work by the following conclusions:

The specimens of frame designed or built for a distribution rubber bands of the efforts give rise to a limiting redistribution of efforts which is at the stage of ruin under some repetitive cycles of loading does not exceed 5% but under 50 cycles of loadings arrive 10%.

The analysis of the theoretical calculation of resistance and deformation of the critical sections of the elements of the reinforced concrete gantries show the states of (of these elements for different the levels from loadings alternate and repeated following developed deteriorations and accumulated

- Change of the diagrams of the stresses in the compressed concrete areas.
- Change of the diagrams of the deformations and working conditions.

The horizontal loads cause an accelerated degradation of the rigidity of the sections of supports of the beams and posts, which imposes a need for change of the report/ratio of reinforcement of the critical sections in comparison with that obtained by the elastic design of the system.

Reduction in reinforcement of the nodal areas (post-beams) of 25-46 % in comparison with the elastic design of the system.

The stresses with ruptures into dynamic are higher than those, which one finds in static’s the variation is approximately 26 %.

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