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Classifications (and Recommendations) for Prefabricated Structures

Classification (et recommendations) pour les ouvrages préfabriquées

Klassifikation (und Empfehlungen) für vorfabrizierte Bauwerke

1 - Foreword

1.1 - Definition of prefabricated elements in concrete

Prefabrication means manufacturing on an industrial scale, away from the building site, structural elements necessary for a structure to be built.

The prefabricated elements, made of plain or reinforced concrete, shall prevalently be installed by using mechanical means of assembling.

1.2 - Degree of prefabrication

For every structure it will be expedient first to define the degree of prefabrication of a given type of prefabricated element [1]).

The degree of prefabrication of an element will be the higher the smaller the number of traditional building operations (for instance, placing the concrete) that are necessary for erecting and completing the structure.

2 - Classifications

2.1 - Classification of prefabricated members according to their statical function

2.1.1 - Floors and beams
2.1.2 - Shells
2.1.3 - Columns and load- bearing walls
2.1.4 - Prefabricated stairs
2.1.5 - Large pipes
2.1.6 - Foundations

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[1]) For example, a slab floor possesses a higher degree of prefabrication than a floor consisting of separate prefabricated beams.

2.2 - Classification of prefabricated members according to their materials and strength characteristics

2.2.1 - Reinforced concrete:
— Mass production elements (for instance, pipes, beams, floors).
— Special elements, i.e., those pertaining to a particular job or building site.

2.2.2 - Prestressed concrete:
— Mass production elements (see above).
— Special elements (see above).

2.2.3 - Mixed structural elements:
— Reinforced concrete and brick.
— Prestressed concrete and brick.

2.2.4 - Special concrete elements:
— Pumice concrete.
— Lightweight concrete.

3 - Production characteristics

3.1 - Production technology

Prefabricated elements may be manufactured without special procedures or subjected to vibration, heat curing (possibly steam curing), vacuum process for excess water removal, etc.

3.2 - Conveyance and stock-piling practices of prefabricated elements

3.3 - Quality characteristics of prefabricated elements

— Heat insulation coefficients.
— Sound insulation coefficients.

4 - Assembly systems and joints

Connection between prefabricated elements shall meet the following requirements [1]):

4.1 - Ability to take stresses

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[1]) According to the Lewicki Paper at the VI IABSE Congress.

4.2 - Plain assembly, particularly keeping clear of temporary supports

4.3 - Stability also at assembly

4.4 - Rapid transmission of stresses so as to speed up the assembly process, and hence to increase the availability of the machinery employed

The connection systems generally used are as follows:

4.5 - Connections unable to take bending moments

4.5.1 - Friction.
4.5.2 - Dowels.
4.5.3 - Screw fastening using steel screw bolts.

4.6 - Connections able to take bending moments

4.6.1 - Fastening by means of reinforced concrete bolts.
4.6.2 - Projecting reinforcing loops.
4.6.3 - Overlapping of projecting reinforcing bars and subsequent embedding of these bars in concrete.
4.6.4 - Welding together of projecting steel parts, viz.:
4.6.4.1 - Reinforcing bars.
4.6.4.2 - Structural steel or sheet metal parts which are fastened to the reinforcement by welding.
4.6.5 - Screw fastenings for projecting steel parts connected to the reinforcement by welding.
4.6.6 - Wedging.
4.6.7 - Prestressing.

A distinction should be drawn between the above-listed connections and those which are used in the assembly of slabs and walls made of prefabricated elements. For instance, it may be required that connections be able to transmit shearing stresses acting perpendicularly to the joint or such that are parallel to its longitudinal direction. Furthermore, it may be required that the joints be air-and gas-proof (impervious to air-borne sound), and that they form no alarming cracks.

5 - Phenomena influencing the static behavior of prefabricatcd elements after their incorporation into a structure and producing a redistribution of stresses

5.1 - Effect of creep and shrinkage

5.2 - Effect of age difference

5.3 - Effect of variation of Young's modulus

6 - Defects and imperfections of prefabricated structures

6.1 - Defects due to imperfections of the prefabricated elements

6.1.1 - Defects in the raw materials (steel, cement, etc.) or component parts (brick or concrete blocks, etc.) that are used in making the prefabricated elements.

6.1.2 - Defects in the production of the prefabricated elements (for example, imperfect layout of the clocks, inadequate vibration of the concrete, nonuniform tensioning of the prestressed elements, etc.).

6.2 - Defects due to imperfect assembly and setting of the prefabricated elements in the structure

6.2.1 - Geometrical errors in setting and alignment.

6.2.2 - Insufficient care in the field completion work (assembling the different parts).

7 - Factors of safety and static controls

7.1. - A prefabricated structure on a mass scale characterized by a higher degree of prefabrication (which means that its factor of safety is not greatly affected by installation and completion practices) may dispense with the design specifications of reinforced or prestressed concrete if an accurate laboratory investigation had been carried out on its prototype.

In this case, the factor of safety for failure (or cracking) could be set even smaller than the prescribed one, since a large part of the safety factor is due to the possibility of poor construction of the structure (which in this case can be verified experimentally).

7.2 - Provision shall be made for a transportation and execution factor of safety; it shall be related to the curing period, for which a minimum shall be assumed.

Likewise, the suspension chains, hooks, etc., needed to hoist the structural members shall be checked, as well as the means of transporting and setting up the members in place; these precautions serve to prevent buckling and accidents. The formwork for prefabricated elements shall be more accurate, exact and rigid than the usual one.

7.3 - Prefabricated structures are probably more sensitive to vibration effects because they are less monolithic. The specifications should take this fact into consideration.

8 - Existing specifications and recommendations for prefabricated structures

8.1 - Criteria for setting up specifications of prefabricated structures

8.1.1 - Comparison of the stresses of the materials.
8.1.2 - Comparison of the manufacturing and placing specifications.

8.2 - Comparison with specifications for non-prefabricated structures (see also point 7)

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