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Flexible Composite Construction Types for Urban Expressways

Souplesse des constructions mixtes pour les routes urbaines surélevées

Flexible Verbundlösungen für Hochstrassen

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1 - INTRODUCTION

The construction of modern expressways in large urban areas pose some important questions on the structural solution and design.

In order to solve traffic flow problems in densely constructed and populated areas, elevated expressways must be built through existing streets or avenues and partly through expropriated areas.

The basic requirement for such a construction, besides the one of keeping costs as low as possible on account of heavy public investments, is that it must not interfere with the normal flow of traffic.

Most frequently, changes of design must be made during the process of construction, on account of unpredictable hindrances, such as existing pipelines, old foundations and so on.

Sometimes, the structural solution must be flexible enough, in order to allow removal and use in other sites. Normaly, provisional supporting structures and scafolding are not compatible with local traffic requirements.

The above conditions are determinant for the choice of the structural solution.

The characteristics for the adequacy of a solution, in order to comply with the above requirements,is that:

a) the structural solution be flexible enough, in order to allow a local change of design, without affecting considerably the overall conception;
b) the structural solution rests mainly on independent and possibly self-supporting constitutive elements.

We shall in the sequel outline a solution, which has been proposed for expressways through Rio de Janeiro and São Paulo, Brazil.

This line of solution has been adopted, in many instances, in Rio de Janeiro, where it is under construction.

2 - FLEXIBLE COMPOSITE SOLUTION

A flexible type of composite construction, in order to comply with the previous requirements could be designed with the following main features:

1) a composite superstructure, with steel beams and precast or cast "in situ" roadway slab;
2) prestressed concrete traverses, in order to convey the loads from the superstructure to the columns;
3) reinforced concrete columns.

The solution is illustrated in Fig. 1

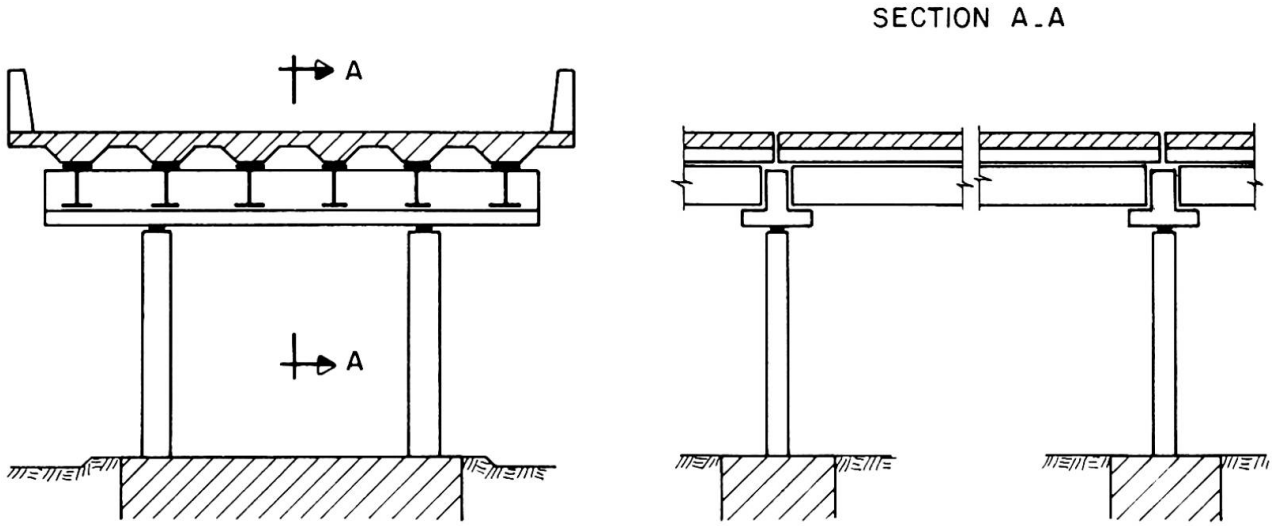
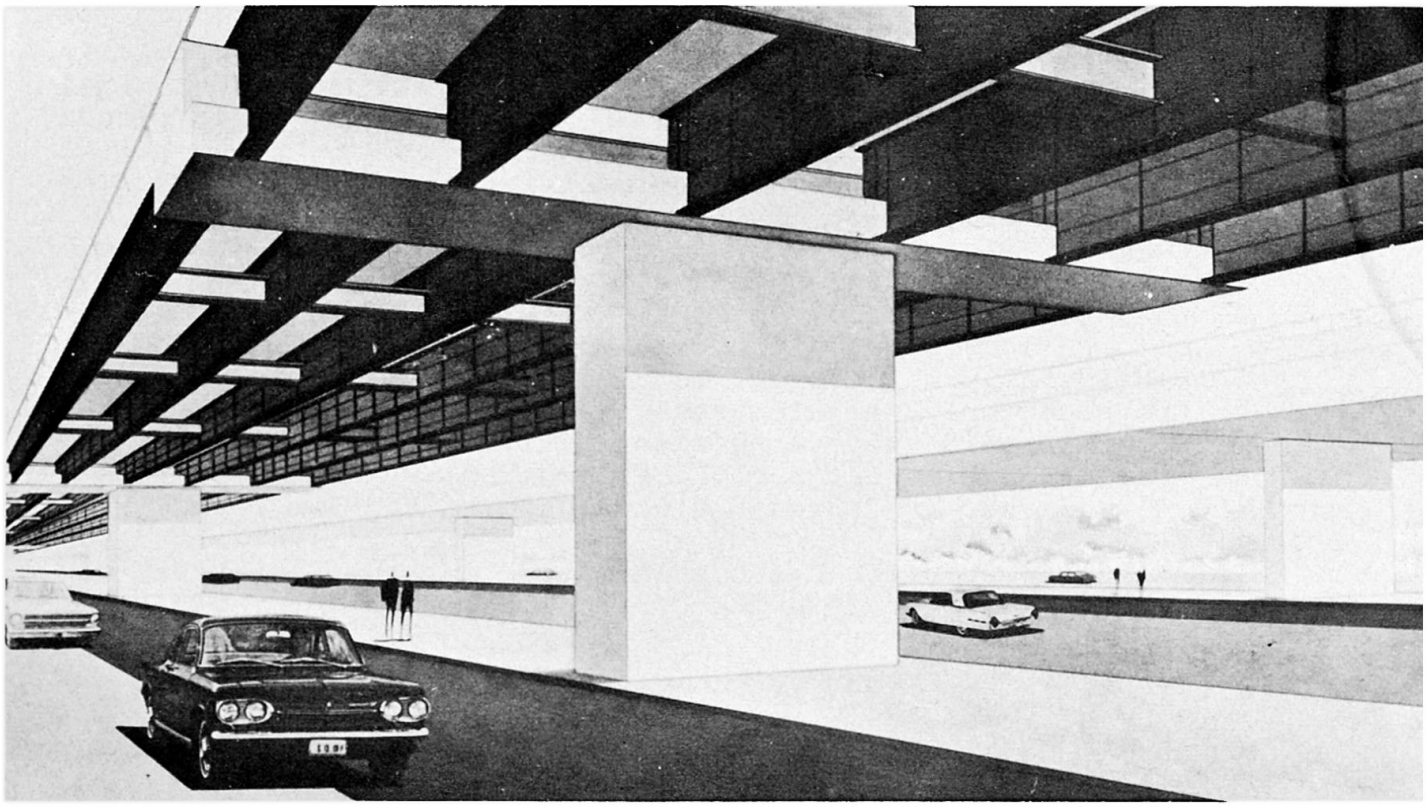
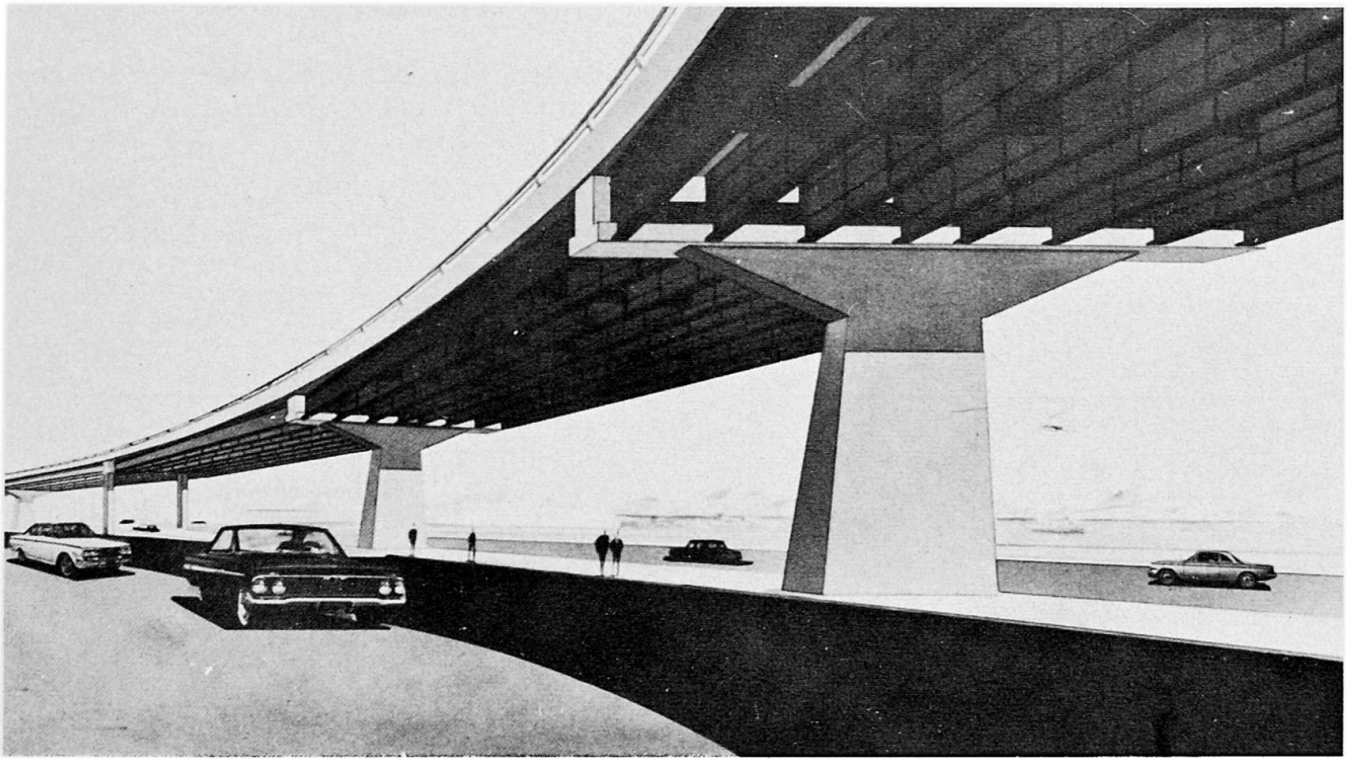


FIG. 1

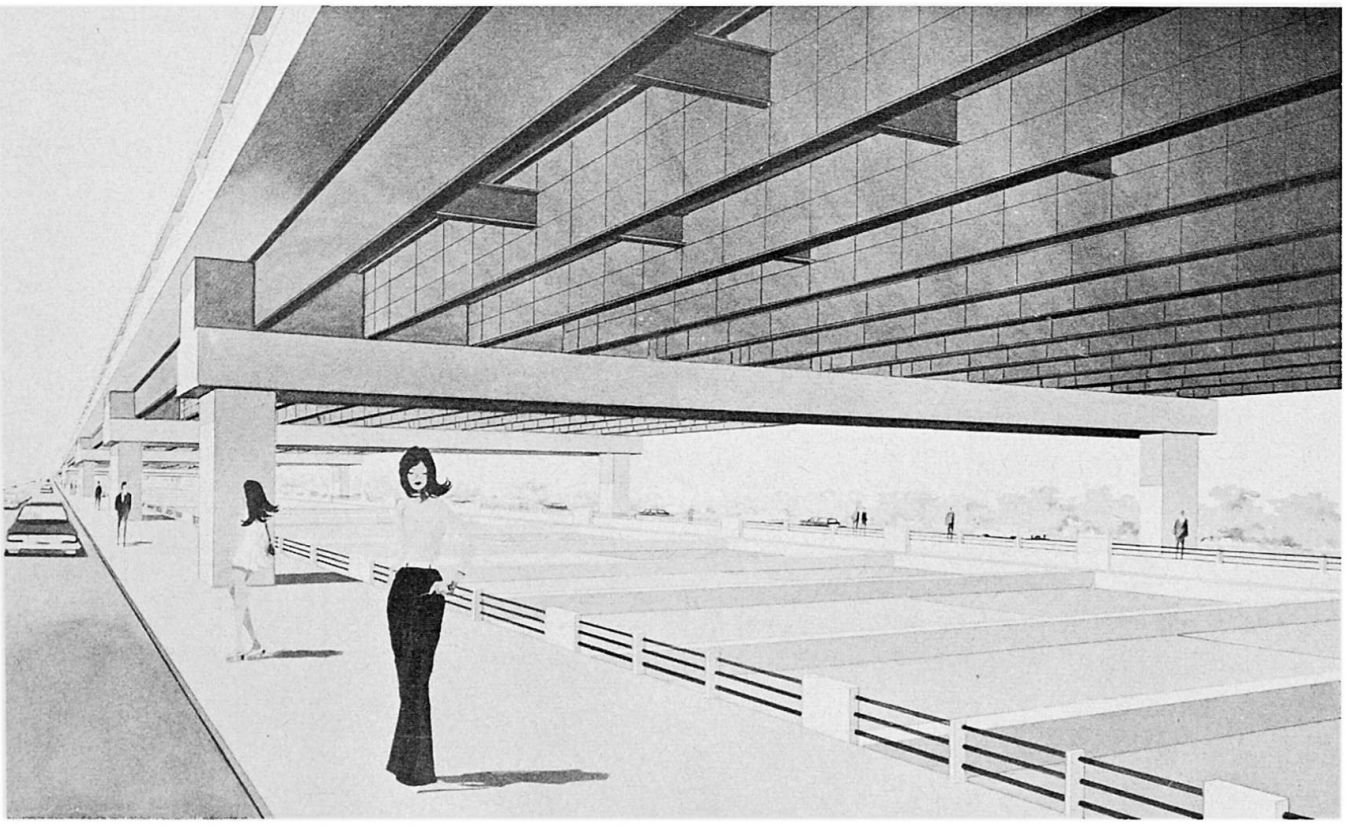
The photographs included illustrate additionally the aspects of the structural solution.





The above photographs refer to solutions with spans close to 40m and a width of the roadway of 20m.

The next photograph refers to a solution with both spans and roadway width of 40m.



It covers a river inside the town, in order to avoid expropriations.

In order to satisfy the requirements stated in the previous item, the superstructure consists of simply supported spans.

The roadway slab, according to the particular situation of the span under consideration, can be cast "in situ" or precast in sections of dimensions compatible with the handling equipment.

In such a case, holes will be left in the slab for positioning the connectors, after the slab is brought to position. These holes can be filled with concrete or epoxy (Fig. 2,a).

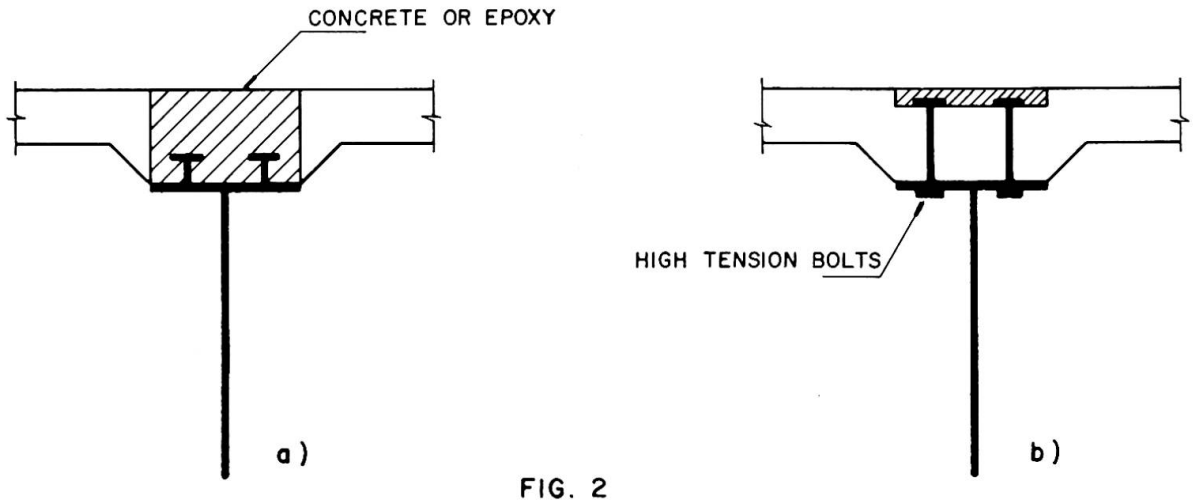


FIG. 2

In order to allow for a possible removal of the roadway slab at a later stage, the connectors could be replaced by high tension bolts, as suggested in Fig. 2,b.

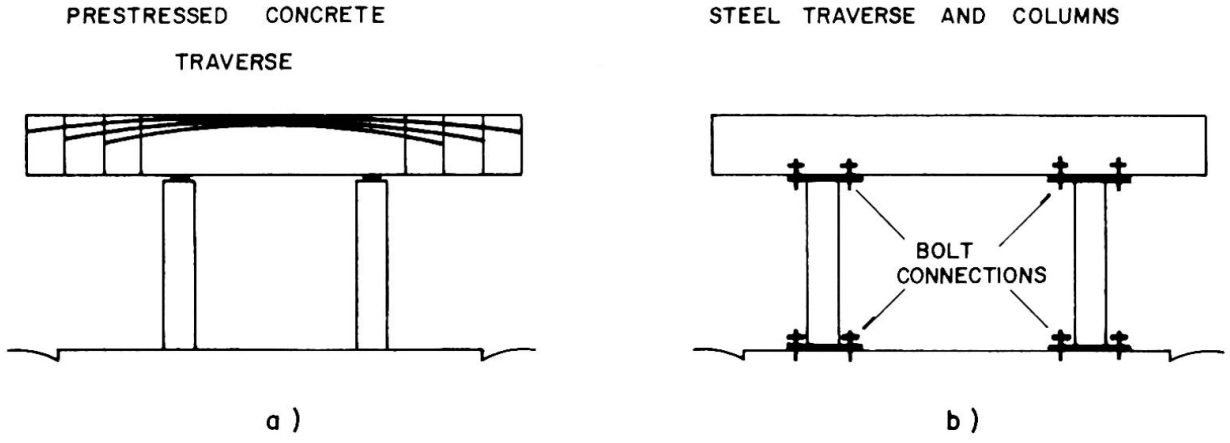


FIG. 3

Figure 3 illustrates the structural solution for the traverses. In case "a", the traverses are prestressed by segments. In case "b", both columns and traverses are in steel, with bolt connections, in order to make removal possible.

In order to reduce the weight of steel in the main beams, a movable truss can be used in order to support the steel beams,during casting of the roadway slab (Fig. 4).

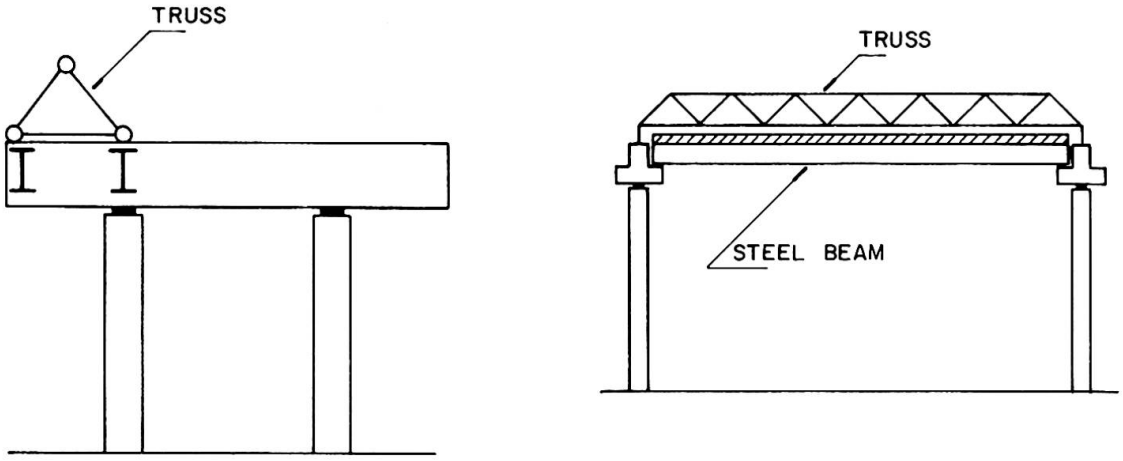


FIG. 4

In this case, the dead load would also be carried by the composite structure.

3 - CONCLUDING REMARKS

The solution discussed was compared economically with several other alternatives and proved to be very advantageous.

A particular advantage of the system, besides the previous ones already mentioned, is that large construction sites are avoided, an important fact for urban areas.

The steel beams and the precast elements are taken to the site only at the time of erection.

SUMMARY

A flexible system of composite construction for urban expressways is discussed. The main features of the structural solution are presented, as well as some remarks on the construction method.

RESUME

Un système de constructions mixtes est présenté pour la construction de routes urbaines surélevées. Les caractéristiques et les procédés de construction sont présentés brièvement.

ZUSAMMENFASSUNG

Eine flexible Verbundlösung für Hochstrassen in städtischen Bereichen wird erörtert. Die massgebenden Eigenschaften der Lösung, sowie das Konstruktionsverfahren, werden kurz dargelegt.