Innovative Measures to Reduce Road Construction Time- A case study: Dasna Hapur Road Project

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Abstract - Construction operations inevitably require work forces to occupy the roadway. There is need to provide sufficient space to perform construction and maintenance operations, while reducing the impact of these operations on the travelling public. Many road projects are delayed on account of such factors. In urban areas there is a restriction of the available width and to spread the road horizontally, hence in such areas the better option is to go for elevated grade separators, so that both surface level as well as elevated road can be fully utilised for traffic movement. This eliminates cost of land acquisition or displacement of local habitants which results in overall reduction in the cost of the project and also helps in segregating the local and fast moving highway traffic. Construction of such elevated structures poses many challenges due to restricted work space. Keeping in mind "Every Day Counts", an aim to shorten the overall project delivery time, enhance safety, and protect the environment both on and around construction projects is the pivot of this case study. Using innovative planning, design, and construction methods, construction techniques were improvised in Dasna Hapur Road Project of NH 9 in Pilakua Township of district Hapur, India, thereby reducing the construction time and in situ construction hindrances in town area.

Key Words - Modern construction management, innovative design, transport space, value engineering.

I. Introduction

Rapid urbanization is demanding for more urban space and finding out new and innovative techniques for elevated highways in transport planning and development with two tier of traffic movement. Construction of long elevated transport corridors in urban areas has its own challenges and constraints. The superstructure in old times used to be supported on twin/multiple piers, covering the major part underneath, and surface level is kept outside flyover width, however in recent times there has been a shift in the planning of these structures with single pier in the centre. This allows the wider surface level road.
The in situ construction of such roads in habitation areas poses many difficulties both for the construction managers and for habitats. Since the highway segment is located in major urban corridors, there are often critical links for local and through traffic, and serve high traffic volumes throughout the day. Thus, there cannot be shut down for extended periods of time without considerable inconvenience and increased delays for road users, major community disruption, and significant economic loss.

An innovative planning, design, and construction methods, were evolved in construction of viaduct in Dasna Hapur Road Project of NH 9, India for reducing construction time by selection of materials, technology and sequence of operations. It results in:

- Minimizing traffic disruption during in situ bridge construction;
- Maintaining and/or improving construction quality;
- Reducing the costs and environmental impacts.

II. Challenges

The safe and efficient flow of traffic approaching andtravelling through work zones is a major concern to highwayusers and those involved in maintaining and improvingroadways. More frequently, the travelling public is demanding increased mobility, while displaying less tolerance for delays, increased travel time, and inconvenience because of congestion, especially congestion caused by highway facility construction and maintenance operations.
Construction operations inevitably require work forces to occupy the roadway. There is a need to provide for sufficient space to perform construction operations, while reducing the impact of these operations on the travelling public. The six lane elevated highway of length 4.680 Km with restricted width of 32 m, has to be constructed, with a constraint of both side dense shopping habitation.

III. Approach

The area and road network was studied and found that there were neither proper service roads nor alternative routes where traffic can be diverted. Since there was no option, the 25.65 m wide deck construction has to be taken up with traffic plying in market place for a length of 4680 m, with a restricted width of 32 m. The construction scheme was very difficult with present day in

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situ working. It was discussed in long sessions with the NHAI, district administration, designers, construction managers and an innovative scheme was evolved.

It believes that achieving dramatic reduction in highway construction project time requires a broader and more comprehensive approach to the problem than looking for marginal improvements in existing techniques. Re-conceptualization of the problem during the planning phase, lead to alternative designs or approaches to construction that could yield greater benefits in terms of reduced delay and disruption.

The scheme was discussed at large for possible structural solutions, with all stakeholders and the most optimal working solution was thus obtained.

IV. Materials and Methods

Six lane elevated highway (25.65 m width), has to be constructed in 32 m wide restricted width, with both side dense shopping habitation, for a length of 4.680 Km. The structural scheme was evolved looking to the traffic congestion, and was decided that maximum off site activities shall be promoted such as:

- Precast pre-stressed I-girders (28.1 m x 1.9 m high) in casting yard,
- Precast pier caps in two parts7.6 m each (cantilever length of 8.4 m). Section sizes were selected for ease of construction, handling and erection (mostly weight governed).
- The segmental construction was ruled out, for huge setup and transportation & erection of wide and heavy segments in restricted carriage way of busy market road.
- .A module of continuous integrated span totalling to 90m,(3 x 30 m) module, has intermediate piers are monolithic with the deck and the deck is made to rest on free bearing only on expansion joints. The foundation pile cap required to support the elevated viaduct structure is of 7.3 x 7.3 m, accommodating 8 piles of 1000 mm dia., at every 30 m centre to centre. The size of pier is 1.6 x 6 m, with a pier cap of 22.8 m long. The top deck slab of 25.65 m is having a base of seven no. I-shaped PSC girders, stationed on the pier cap.

V. Construction Methodology

The viaduct part of the project involved construction of 1097 precast pre-stressed I-girders of 1.9 m high, 310 precast post-stressed pier caps 7.6 m x 3.0 m, 1148 piles (cast in situ) of 1000 mm x 24 m deep, pile cap (cast in situ) 157nos 7.3 m x 7.3 m, piers (cast in situ) 157 nos1.6 m x 6 m (i/c abutment), deck slab (cast in situ) 156 nos x 30 m x 25.65 m, 120042 sqm, pot bearing 416 & 104 guided bearing, single strip seal expansion joint 53 nos.
The structural scheme developed mainly considered maximum off site activities, and assembling it in-place. It was decided to construct girder 'precast casting yard' of 12000 sqm, having 12 bed, for 3 girders casting at a time at one bed. The expected production is 108 girders per month and staking capacity of 220 nos. It was arrived at that in case of reduction of cycle time the girder production can be increased to 180 nos. per month, by using early setting admixture or application of steam curing. Accordingly 4 no boilers (600 kg) were also commissioned for steam/hot water curing. The precast pier cap casting unit was also developed with 25 beds, for a production cycle of 25 nos per month. A steel cutting bending & binding automatic yard was conceived 50 m x 18 m, accommodating a shear line, a bend line, a straightening machine, three automatic stirrup benders, spiral etc,
The key construction activities are as under:

- Casting of precast pre-tensioned girders,
- Casting of precast post-stressed pier caps,
- Drilling for piles,
- Fabrication of cages,
- Casting of piles,
- Casting of pile caps,
- Casting of piers,
- Stitching &cast in situ pier cap in flange over pier,
- Stitching & casting of precast pier cap in web portion,
- Post stressing three stage of pier caps,
- Erection of Girders by gantries,
- Erection of precast pier cap by gantries,
- Girder stitching with pier cap,
- Casting of Deck slab, and
- Finishing.

All the above mentioned activities are in series, but by selecting two major activities as precast activities (I-Girders & Pier caps), the activities are operational on parallel basis. By these two precast activities the working width on actual road reduced to 8.5 m in the road centre, with free flowing traffic on either side. The construction atrocities to the neighbourhood were minimal and there was no critical objection by the commuters and the market stakeholders. The erection of precast I-girders and pier caps are been done with the help of gantries (tracks at 30 m centre to centre) instead of crane launching, thereby reducing the stoppage of traffic.

VI. BENEFITS

The primary benefits of reducing highway construction project are to reduce traffic delay and associated costs like:

- Travel time,
- Vehicle operating Cost, and
- Maintenance cost.
- Improving work zone safety;

It decrease the number of collisions and injuries associated with construction-related accidents, and lowers the capital cost of maintaining traffic associated with highway construction project.

VII. CONCLUSION

Adoption of innovative technologies shortens project time, primarily by overlapping the design and construction phases so that concurrent activity is possible, and construction starts and ends sooner. The overall project schedule is construction-driven, with construction sequencing driving the production of engineering information packages that support construction activities. An additional benefit of the design-build approach is single-source responsibility for design and construction, which can result in consolidated risk management, quick decisions and fewer change orders. Opportunity exists to reduce highway construction time by adopting innovative contracting techniques, such as incentives and disincentives for expediting construction and the design-build approach. The innovative construction technologies, such as those using large amounts of off-site high-strength pre-casting help to shorten project times. It has been identified that how construction could yield improvements to existing methods and procedures and provides the basis for materials, and methods to achieve revolutionary changes in construction industry.

VIII. ACKNOWLEDGEMENTS

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