Embedded Inserts Add Up to Big Savings on Minneapolis Bridge

by Doug Knapp, BrandSafway

Constructed in 1929 and listed on the National Register of Historic Places, the Tenth Avenue Bridge in Minneapolis, Minn., features seven iconic arches (**Fig. 1**). Designed by noted Norwegian-American engineer Kristoffer Olsen Oustad, it is typical of the reinforced concrete bridges built in Minneapolis–St. Paul in the early 20th century to span the high Mississippi River bluffs.

Today, the bridge should also be known for its use of embedded concrete inserts (**Fig. 2** and **3**) to provide a connection point for suspended work platforms. Such platforms are currently being used for the bridge rehabilitation, and they may also be used for future maintenance or bridge inspections, a concern that bridge owners are now being encouraged to consider in design. Concrete embeds are not new; however, using embeds for attaching a proprietary rotating-suspension-point (RSP) assembly is. In 2019, RSP assemblies proved their value for bridge renovation, construction, inspection, maintenance, and repair activities on a railway viaduct rehabilitation project (also a concrete arch) in Romania (**Fig. 4**).

Embedded inserts are used in the precast concrete industry for many applications: structural connections, securing handling hardware, anchoring formwork, or for pipe or other supports. For the Tenth Avenue Bridge, the embedded insert is a low-cost, proprietary item (available from several manufacturers) consisting of a 1¼-in.-diameter NC-threaded ferrule welded to struts, which are then welded to a coiled wire to create a shear cone for improved concrete tension and shear capacities (**Fig. 5**). The proprietary RSP assembly is secured to the NC-threaded embedment using a 1¼-in.-diameter all-thread rod (**Fig. 6**). The threaded rod material must be specified to meet the required loading criteria. The rotating assemblies on the Tenth Avenue Bridge will be removed after the project, but the embedded anchors will remain for future use when access is needed on the bridge for inspection, maintenance, repair, refurbishment, or fall arrest. It is recommended that anchors intended for reuse be plugged with a metal or plastic fastener when not in use to prevent corrosion or fouling.

Establishing the capacities of the concrete embed and all-thread rod can be challenging. Multiple uses require compliance with multiple codes.[1–4] For example, the factor of safety and loading criteria requirements for a construction work platform are different from those for a formwork connection, fall-arrest system, railing (permanent or temporary), or pipe support. Other factors that must be considered are concrete strength, insert capacities of a particular manufacturer, spacing of inserts, and edge distance. It is paramount that a licensed engineer design and specify the shear and tensile capacities and intended use of the embedded concrete inserts. These capacities and uses must be a part of project documentation (plans and specifications) and, in some cases, may require labeling per the applicable Occupational Safety and Health Administration standard.

In the spring of 2020, the City of Minneapolis initiated the restoration project on the Tenth Avenue Bridge, which included replacing the bridge deck and concrete railing, patching piers and arches, replacing and patching deteriorated beams and spandrel columns, and applying corrosion-prevention treatment of the arch ribs and a new surface finish.

Figure 1. View of spans 3 to 6 of the Tenth Avenue Bridge in Minneapolis, Minn., looking north. Suspended platforms were used as debris shields on span 4 and for work access on span 5. Photo: Doug Knapp.

The contractor initially asked BrandSafway to engineer the work platforms for spans 4 and 5 using their proprietary suspended access system. Because of the access system's load capacity, the contractor was able to simultaneously place up to 30 people working on multiple levels. As a result of this efficiency, the scope of the project was expanded to include access platforms for three additional spans.

Because of construction schedule constraints, the existing bridge deck remained in place on span 5. In this instance, holes were drilled through the deck to allow suspension chains to drop through. Because concrete for the new deck in spans 3 and 4 was placed before the arch repair, the contractor was able to install 320 concrete embeds without having to drill holes for post-installed anchors in the new deck or in the spandrel caps. After the deck was complete, the RSP assemblies were attached to threaded rods installed in the embedments. The RSP assemblies and threaded rods were removed after work was complete, but the embedded inserts remain in the underside of the bridge deck for future access needs.

Figure 2. Embedded concrete inserts (indicated with arrows) are secured to the deck slab reinforcement with wire ties before placement of the new Tenth Avenue Bridge deck. Photo: Doug Knapp.

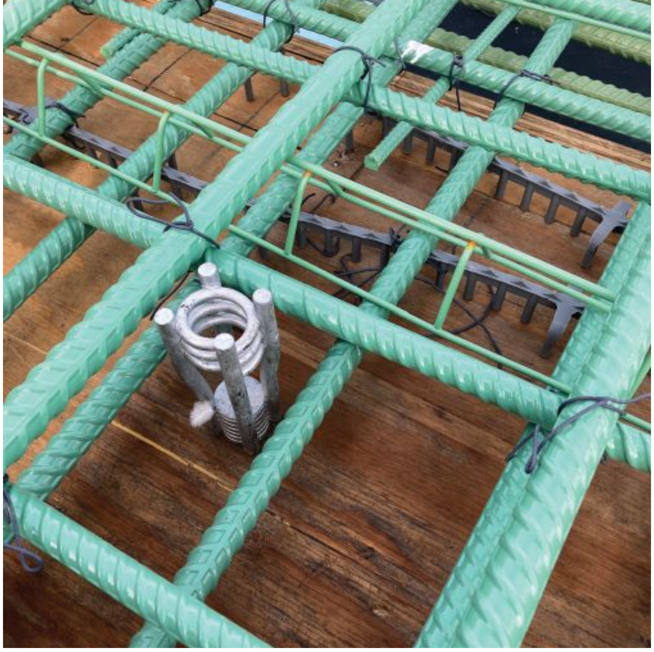

Figure 3. Using hundreds of embedded concrete inserts in the cast-in-place bridge deck eliminated hundreds of hours of labor to drill holes for post-installed anchors. Photo: Doug Knapp.

Figure 4. An innovative proprietary rotating-suspension-point assembly was used for the rehabilitation of the Caracău Viaduct in Romania. Photo: Doug Knapp.

Figure 5. Proprietary concrete ferrule inserts are available from several manufacturers. Consult the specific manufacturer for capacities and installation requirements. For the Tenth Avenue Bridge project, the insert was threaded for 1¼-in.-diameter NC threads and had four struts instead of the two shown in this representative photo. Photo: Dayton Superior.

The concrete embeds add a small amount to material costs, take only minutes to install, and avoid issues such as interference with reinforcement and certain elements of supervised installation and inspection required for post-installed anchors (see the four-part series on post-installed anchors that started in the Summer 2020 issue of *ASPIRE*®). In this situation, by eliminating the time to drill and patch holes (about an hour per hole), the use of 320 concrete embeds translated to a savings of about $250,000 for the project and accelerated the work schedule.

With the demonstrated advantages of the concrete embeds on this project, a similar solution is being implemented just seven blocks away on the Third Avenue Bridge, another iconic arched bridge.

References

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EDITOR'S NOTE

This article reports on a successful solution for the Tenth Avenue Bridge that also has potential use for future rehabilitation or maintenance activities. If and when the embedded inserts are reused, the condition of the embedded inserts and their available capacity should be confirmed before use.

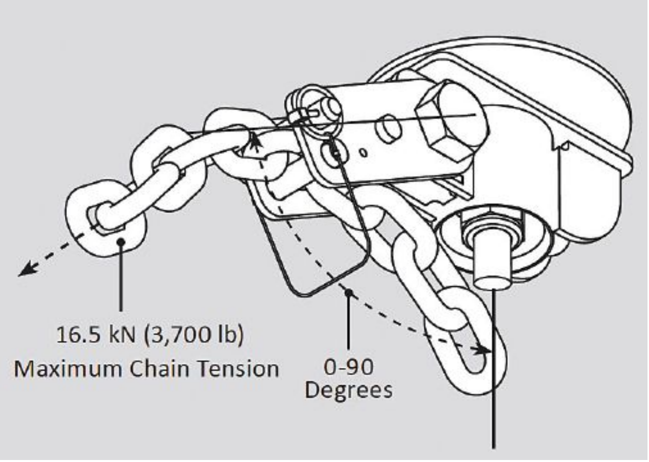

Figure 6. The design of this proprietary rotating-suspension-point assembly ensures the load pulls in a straight line. Each assembly is rated for 3700 lb. The capacities of the all-thread rod and the concrete insert are not part of the assembly and must be designed by a licensed engineer according to the appropriate codes. Figure: Doug Knapp.