

## Handling of Precast Grid Reinforced Concrete Panels

Grid reinforced concrete decks are modular in nature which supports accelerated bridge construction methods that have become popular with many bridge owners. Installation rates of precast panels exceed that of cast-in-place construction and are ideal for projects which can accommodate only nighttime or weekend lane closures. A high degree of control is ordinarily expected from precasting operations which ensures the delivery of a quality product. There are however several features of precast construction that require consideration for satisfactory results that are summarized below.

### Planning

The most economical panel size is generally the largest that can be fabricated, transported and erected. Traditionally, the maximum panel size is 8'-6" wide by approximately 40 to 45 feet in length, which is restricted by both the maximum non-permitted shipping width and maximum length of galvanization tanks respectively. Larger precast panels can be considered if the precasting of multiple bare grid panels is performed near the project site. Available crane capacity, position and site restrictions should be examined.



*Robert C. Beach Memorial Bridge - Precast Exodermic™ Deck.*

### Precasting and Handling

Concrete should have reached adequate compressive and tensile strength before forms are stripped and panels are moved. In general, the greater of 3.5 ksi or 75% of the design compressive strength should be considered a minimum before panels are handled. Allowing the concrete to achieve full compressive strength can have a positive effect on minimizing cracking during early age handling. Even after adequate strengths are developed for handling, extended wet curing (saturated cover,

low pressure steam, etc.) for precast concrete deck systems helps to minimize shrinkage cracking and provide durable concrete. A one to two week minimum wet cure depending on the type of aggregate and overall mix design is preferred.



*WT shape lifting device (circled).*



*Lifting device made from WT shape.*

Analyzing the stresses in the panel involves calculation of section properties in the “strong” (main bar) and “weak” (cross bar) directions using the transformed area method, deducting for all holes and slots in the grid bars, and ignoring any concrete in tension. The modular ratio ( $n$ ) (*AASHTO LRFD Bridge Design Specifications, Article 6.10.1.1*) shall be based upon the specified weight of concrete and the minimum allowable

concrete compressive strength at the time of handling. The sacrificial depth for grinding, grooving and wear need not be subtracted for these calculations and any overcast thickness intended for final milling can be included. Dead load moments can be calculated by hand, or by using any one of a number of analysis programs. Dead load moments should be multiplied by a factor of safety (1.5 minimum suggested) to allow for dynamic effects of panel handling and transportation.

Rigid spreader beams and lifting frames are recommended whenever precast panels are handled. Check for acceptable levels of stress in the steel and concrete members, paying particular attention to controlling concrete tensile stresses to avoid cracking. Proposed lifting locations must be positioned to minimize bending in the panel and limit the actual concrete tensile stress to the concrete modulus of rupture ( $f_r$ ) (AASHTO LRFD Bridge Design Specifications, Article 5.4.2.6) based on the allowed compressive strength at the time of



handling. Consideration must also be given to deflection of the lifting frame. Analyses are generally based on supports being stationary; however, settlement of supports induces additional negative moment that must be considered. Steps should be taken to avoid twisting of the panel. Preferably, panels are picked from beneath the main bars of the grid, through the blockouts where precast concrete is omitted. Lifting devices should be attached to the panels in such a way that only vertical forces are applied to the panel. Considering the above recommendations, it is the responsibility of all parties handling panels to complete their own analysis to ensure safety and prevent damage to panels.



*Left and Above: Examples of Rigid Lifting Frames.*

## **Transportation**

Precast panels shall be stored and shipped right side up, and wood blocking shall be used (with due regard to built-in panel camber) to prevent steel, concrete, sheet metal, or galvanized coating damage. At a minimum, lagging shall be placed immediately adjacent to the proposed lifting locations and at the ends of the panel. Preferably, blocking should be placed at all support (stringer, floor beam, etc.) block-outs and at the ends of the panel. Blocking between stacked panels must be in vertical alignment across the panel width and stack no more than four precast panels high.



*Stacked Panels on Trailer.*



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