

# Design Tip: Staged Girder Tensioning

Establish a “staged” post-tensioned (PT) cable tensioning sequence for the girders that carry a long-span beam load.

## WHY USE STAGED GIRDER TENSIONING

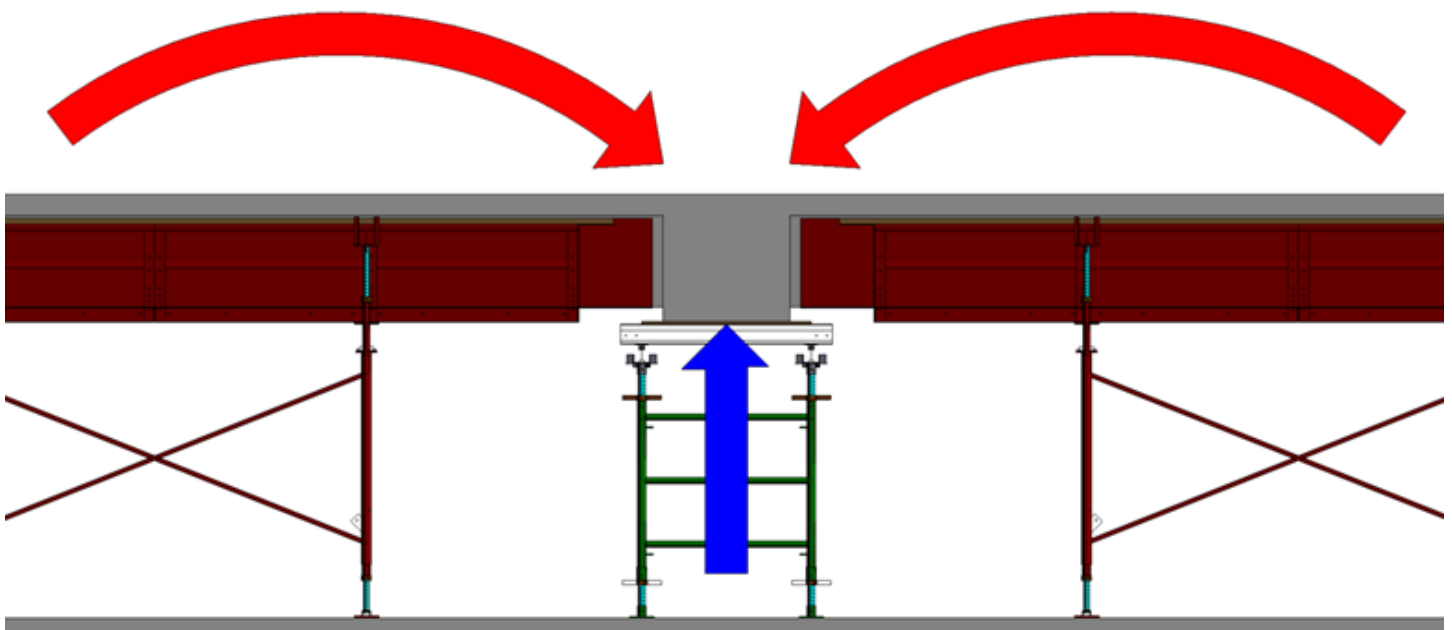
Beams are typically tensioned prior to girders. Tensioning all beam cables prior to partially tensioning girder cables results in beam-and-slab loads transferred to the girder before capacity is established. The transferred beam load requires significant temporary shoring/reshoring materials and labor for a short period of time. The shoring required is an unnecessary expense and can become a barrier for finish trades on the reshoring levels. As a result, it can extend the project schedule and delay final completion while increasing costs.

## WHEN TO USE STAGED GIRDER TENSIONING

- *For turning bays that direct vehicles from one long-span parking isle to another.* In these locations, columns are eliminated to accommodate vehicles' turning radius.
- *Garage bays designed 25 feet or wider.* The turning bay girders are often not required as columns and can be located at all beam ends. Wider bays throughout a garage are also recommended. When the slab cables of wider bays are tensioned, the transfer of the slab load onto the beams result in additional shoring and reshoring under the beams. While the magnitude of additional shoring will be significantly less than for the beam-to-girder transfer condition, it should be avoided.

## UNIQUE FEATURES OR CHALLENGES

- *Typically, the girder structural design will require PT tendons of 400+ Kips—approximately 15 PT cables for combined live and dead loads.* A portion of the PT cables should be stressed prior to the load-bearing beam to sufficiently carry the dead loads.
- *Ensure stress reversal is within acceptable limits.* Stress reversal can result from pre-tensioning the girder before dead loads are applied. To prevent this, preload the girder by pre-tensioning a portion of the beam and slab cables prior to tensioning the girder cables. Staged girder tensioning remains advantageous if additional top steel is required for the short-term girder's top-side tension force.



Load transfer from beams onto girders during tensioning.