Tech
Spotlight

Designing for Construction Productivity and Safety—In Practice

New applications for PS=Ø couplers

by Gordon H. Reigstad, Jason G. Reigstad, and Jared M. Reigstad

Since our first *Concrete International* article on gapless pour strips,[1] engineers and contractors have become more creative with the PS=Ø® Mechanical Reinforcement Splice System. In addition to using the patent-pending technology to eliminate traditional pour strips, many are using it when temporary post-tensioned (PT) stressing access is required. Engineers have also found the slotted PS=Ø coupler (Fig. 1) to be very effective at mitigating restraint to shortening (RTS) at walls, where the restraint is highest. The slotted coupler allows for restraint relief in two horizontal directions, perpendicular and parallel to the wall. All applications of the PS=Ø system allow more time for RTS relief without interrupting construction schedules as would be needed with traditional delay strips or costly temporary slab-to-wall slip details.

Slab-to-Slab Restraint Relief

PTI DC20.2-22, Section 4.1.1,[2] states that a self-supporting PT slab with a traditional pour strip can be achieved at midspan with added PT reinforcement or by enlarging the gap (that is, reducing the cantilever lengths). Self-supporting slabs are important to contractors, as they need less costly reshoring. Further, non-self-supporting slabs require more expensive backshoring.

With a typical slab-to-slab PS=Ø Relief Joint as shown in Fig. 2, slab cracking can be minimized. PS=Ø couplers have been used at both midspan and the inflection point locations. However, for best economy, the PS=Ø Relief Joint should be placed near the inflection point (1/5 span), separating stiff lateral elements in the building. At this location, the PT and mild reinforcement are optimized, and the slabs are

Fig. 1: Slotted PS=Ø Mechanical Reinforcement Splice System

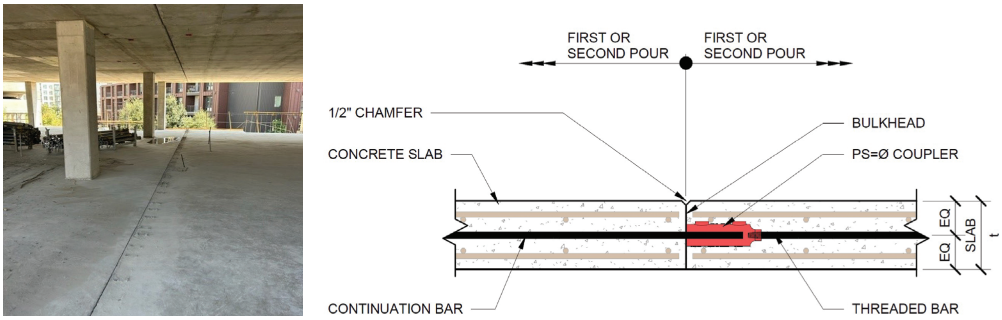

Fig. 2: Typical PS=Ø slab-to-slab restraint relief joint

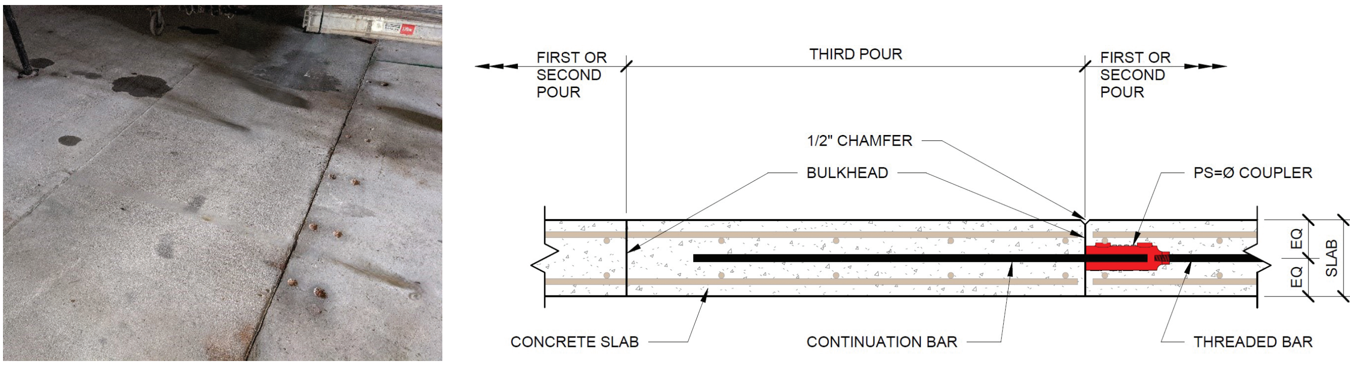

Fig. 3: Typical PS=Ø slab-to-slab restraint relief joint with a temporary stressing strip

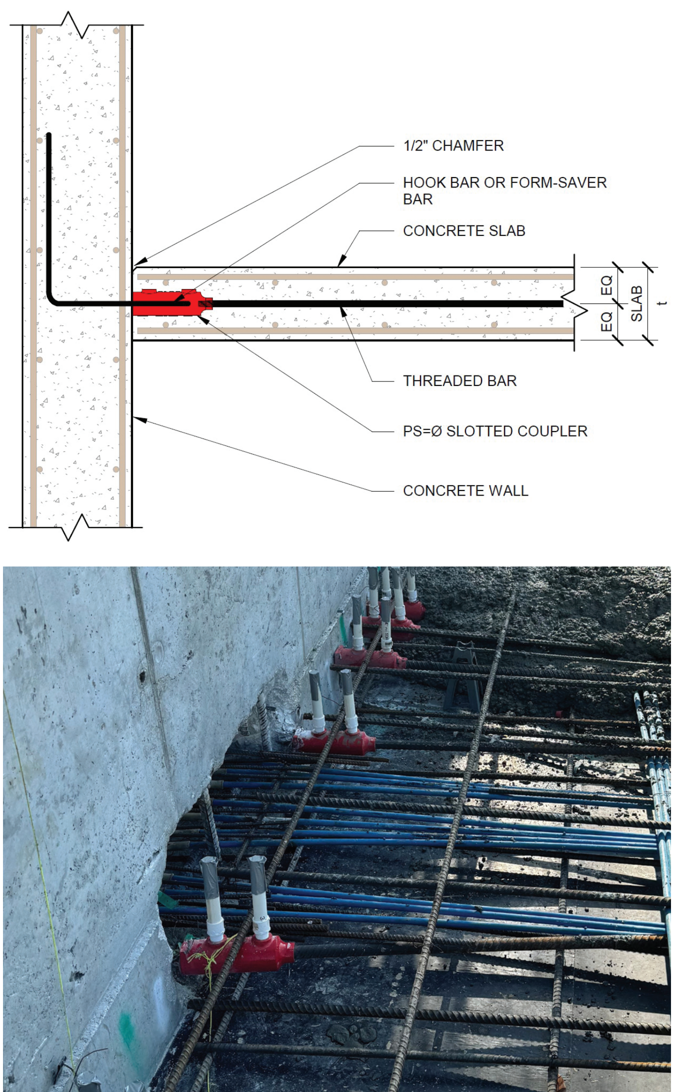

Fig. 4: PS=Ø slab-to-wall restraint relief joint

self-supporting using the shear capacity of the ungrouted PS=Ø couplers. The result: no added PT or mild reinforcement is required, no formwork or shoring is left in place, and no leave-outs remain in the floor to impede other construction trades.

Some contractors and engineers are choosing to delay the grouting of the PS=Ø couplers and joint longer, for 180 days or more, as locking the system later significantly minimizes concrete cracking and improves overall concrete quality. Delaying the grouting of the system doesn't interfere with construction schedules because the pour strip and backshoring have been eliminated.

In cases where internal PT slab stressing is needed (Fig. 3), a PS=Ø slab-to-slab joint with a temporary stressing strip can be used. The temporary stressing strip can be placed back immediately after stressing to create a typical PS=Ø slab-to-slab restraint relief joint. This allows for all slabs to be stressed, even those that can't be accessed for exterior slab edge stressing. This detail is commonly used in subterranean conditions or when stressing the exterior slab edge is difficult on elevated slabs.

Because of normal post-tensioning procedures, many engineers design subterranean elevated slabs as reinforced concrete (RC). With the PS=Ø system, many RC slabs are being converted to more economical PT systems.

Slab-to-Wall Restraint Relief

For subterranean conditions (and shear wall releases), many engineers are using a combination of PS=Ø slab-to-wall joints (Fig. 4) at exterior walls and PS=Ø slab-to-slab joints (Fig. 2) near the middle of the building. An elevated, subterranean PT slab can easily be stressed using a PS=Ø slab-to-slab joint with a temporary stressing strip (Fig. 3). The detail shown in Fig. 5 allows for both stressing and restraint relief at an exterior wall using a slotted PS=Ø coupler, with restraint relief in two horizontal directions, perpendicular and parallel to the wall. Figure 6 also allows for restraint relief in two horizontal directions and is commonly used on podiums where the slab is placed over the top of the wall.

We have also observed value engineering (VE) solutions where the original design included perimeter columns and a delayed connection to the exterior walls: two separate structural systems. These solutions have involved a slotted PS=Ø coupler to eliminate the columns as well as the costly delayed connection. This works because PS=Ø couplers can support the slab vertically while temporarily ungrouted. After grouting, the couplers can transfer gravity and lateral forces to the wall using shear friction.

Beam-to-Beam Restraint Relief

PS=Ø couplers have been used in several concrete beam (PT and RC) restraint-release applications where the pour strip passed through beams. Figure 7 photo shows concrete beams in a RC pan system supporting a large convention center exhibition floor, where PS=Ø couplers were placed at the 1/5 span. Other beam applications have included beam restraint releases in RC pan system hospitals and one-way PT systems. Contractors regularly save 2 to 4 months of construction time because mechanical, plumbing, and electrical contractors are not delayed.

Case Study

A hospital parking garage with PS=Ø couplers was completed in Texas (Fig. 8). The structure was a one-way PT system with subterranean levels. The engineers chose to have a PS=Ø gapless pour strip near the middle of the building, splitting it in the long direction. They also chose to have slotted PS=Ø couplers at all slab-to-wall connections in the subterranean levels where the maximum RTS occurs. With this being a hospital parking garage, the owner, engineer, and contractor wanted high-quality concrete slabs with minimal cracks for the best long-term performance, but they also wanted it to open on time. By using the PS=Ø system, they were able to extend the original grouting delay time from 28 days to 75 days without negatively impacting the construction schedule.

The parking garage was finished 2 months ahead of schedule with

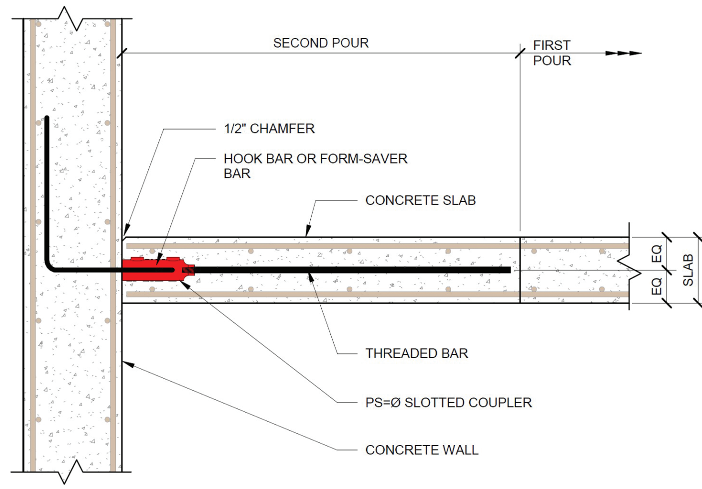

Fig. 5: PS=Ø slab-to-wall restraint relief joint with temporary stressing strip

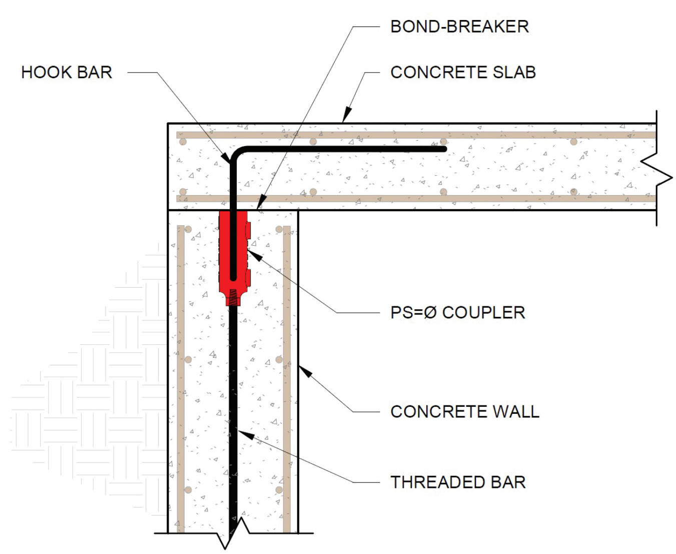

Fig. 6: PS=Ø slab-to-wall restraint relief joint over wall

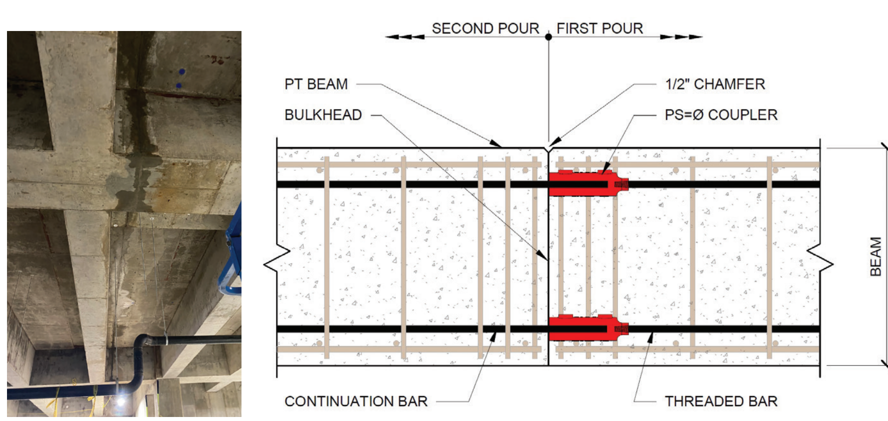

Fig. 7: PS=Ø beam-to-beam restraint relief joint

Fig. 8: Hospital parking garage in Texas with PS=Ø technology

high-quality concrete slabs. Based on visual observations, the slabs and walls, especially in the subterranean levels, are crack-free. No observable cracking has been reported since the completion of the project, even after one winter season with thermal contractions.

Summary

The PS=Ø system allows engineers to design PT and RC members with more restraint releases without the construction schedule delays of traditional pour strips. With or without temporary PT stressing strips, PS=Ø couplers can be used as restraint relief details in:

- Slab-to-slab joints;
- Slab-to-wall joints; and
- Beam-to-beam joints.

The slab-to-slab and slab-to-wall joints with temporary stressing strip details have allowed for cost-saving VE, replacing RC slabs with PT slabs for subterranean elevated slabs.

PS=Ø couplers are easy to implement and cost-effective, which allows for more use of the PTI DC20.2-22[2] temporary restraint-release details. Such detailing, with PS=Ø, results in higher-quality, more durable, and longer-lasting concrete structures, ensures code-required structural integrity reinforcement, and enables faster construction—truly a win-win for the concrete industry.

For more information, visit **www.pourstrip0.com.**

References

1. Reigstad, G.H.; Reigstad, J.G.; and Reigstad, J.M., "Designing for Construction Productivity and Safety," *Concrete International*, V. 43, No. 6, June 2021, pp. 51-55.

2. PTI DC20.2-22, "Restraint Cracks and Their Mitigation in Unbonded Post-Tensioned Building Structures," Post-Tensioning Institute, Farmington Hills, MI, 2022, 64 pp.

Selected for reader interest by the editors.

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