

The Novel SnapLocX Column Splice

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INTRODUCTION

Research on an innovative, rapid-assembly column splice is highlighted. The research is led by Dr. Jeffrey Berman and Dr. Dawn Lehman, professors in civil and environmental engineering at the University of Washington, and by Reid Zimmerman, Technical Director at KPFF in Portland, Oregon. Dr. Berman and Dr. Lehman share interests in seismic performance and design of steel structures, performance-based seismic design, and innovative structural systems. Both are recognized for their expertise in large-scale experimental testing, analytical investigations, and synthesis of experimental-analytical research to advance the state of the art and of the practice. Their honors include distinguished teaching and outstanding paper awards from multiple organizations, including the American Society of Civil Engineers (ASCE). Mr. Zimmerman is active in code development for ASCE 7 and ASCE 41, including helping to lead efforts in resilient seismic design and functional recovery. An AISC grant supports this column splice research. The SnaplocX connection is introduced, and highlights from work to date are presented.

MOTIVATION AND RESEARCH OBJECTIVES

This project arose from AISC's Need for Speed initiative. AISC has supported research that aligns with the Need for Speed goal to "increase the speed of designing, fabricating, and erecting steel buildings and bridges by 50%" (AISC, n.d.). In 2022, AISC hosted a SpeedConnection competition and selected a few projects, including the SnapLocX research (Huber and Colsia, 2025).

The basic concept of the proposed column splice is to save construction time and labor with a "snap-and-lock" operation. The SnapLocX connection provides an alternative to the conventional bolted column-to-column splice (Figure 1). Columns arrive on site with snap-and-lock components attached and do not require any field welding or field bolting. Locking plates are shop welded to the upper columns, and snapping plates are shop bolted to the lower

columns (Figure 2). Shear keys in the snapping plates align with corresponding slots in the locking plates. With this initial condition, the upper column is lowered toward the lower column. In the intermediate condition, the snapping plates bend outward as the upper column is placed into position. In the final condition, the connection snaps into place, the snapping plates and shear keys then engage with the locking plates and shear key slots (Figure 3). The connection idea was conceived by Reid Zimmerman, who serves as a co-investigator and industry advisor to the project.

The primary objectives of this first phase of the multi-phase project were to demonstrate the feasibility of the SnapLocX splice and to provide a design methodology for an industry-ready connection. The research team fully developed the snap-and-lock connection using selected wide-flange sections. Considering the appropriate demands for column splices in gravity framing, including AISC *Seismic Provisions for Structural Steel Buildings* (2022a) requirements for gravity frame columns, they created design procedures utilizing mechanics principles, structural steel specifications (AISC, 2022b), OSHA's Safety Standards for Steel Erection (OSHA, 2001), and ASCE/SEI 7-22 design loads (2022). The team considered a range of column sizes, outlined the relative geometric requirements of the components, and demonstrated the procedure with an example design. They took the SpeedConnection concept a step further with sets of standardized designs and tabular design aids facilitating quick selection of SnapLocX components for different pairings of column sections. In this manner, the research team has reduced design time as well as construction time.

THE SNAPLOCX CONNECTION

The SnapLocX connection's snapping and locking plate assemblies and shear keys transfer shear and moment while compression is transferred through bearing of the column ends. Each assembly consists of multiple plates. The shear key, plates, bolts, and welds are sized to enable the snap-and-lock action of the connection and to resist the design loading, the latter being often controlled by the shear strength requirements from the AISC *Seismic Provisions* (2022a) for column splices that are not part of the seismic force-resisting system. By satisfying those shear strength requirements, the connection can be used in gravity framing in any part of the country.

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Fig. 1. Bolted column splice example.

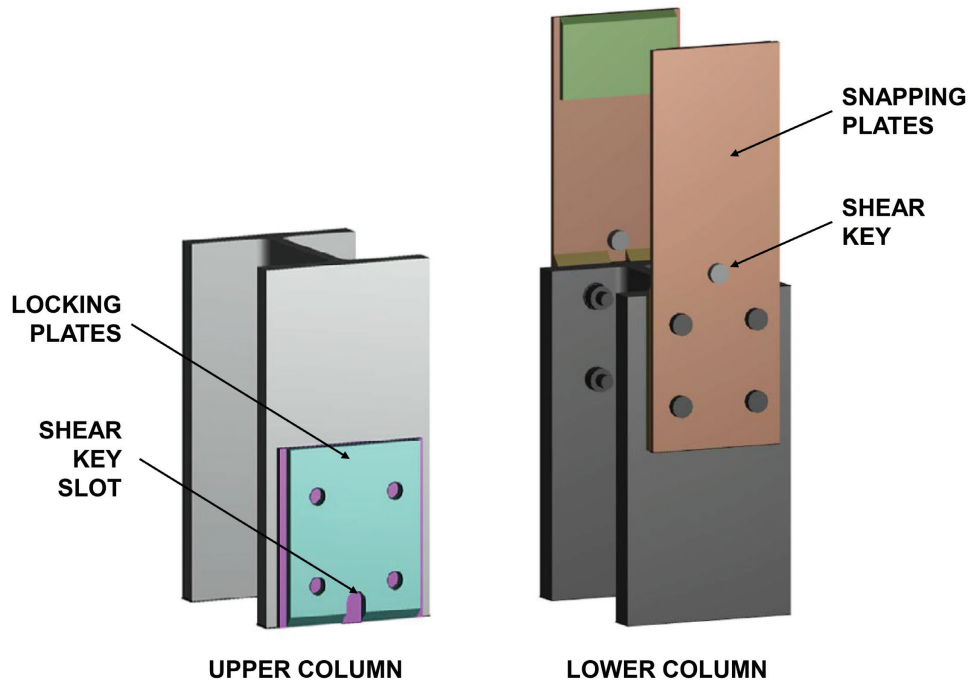


Fig. 2. Upper and lower columns with shop-attached connection plates.

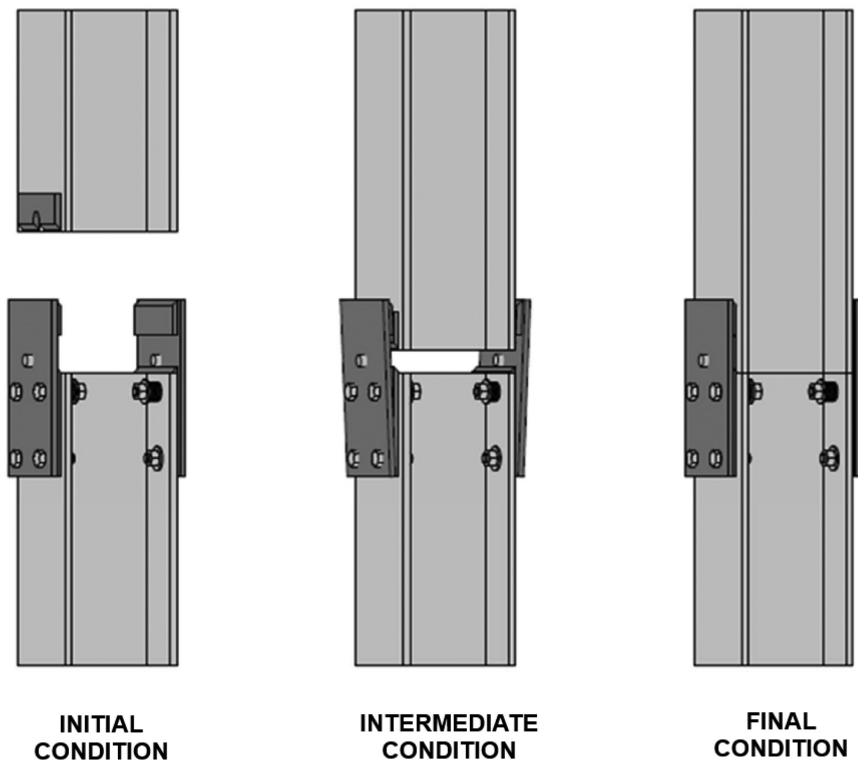


Fig. 3. Initial, intermediate, and final conditions for the snap-and-lock assembly.

The snapping plate assembly consists of an outer plate (OP), upper lock plate (ULP), inner plate (IP), bolts with disc springs, and a shear key (SK) (Figure 4). The ULP and shear key (SK) are welded to the OP (Figure 2). The top of the ULP is beveled at a 45° angle to help align the upper and lower columns and then push the OP outward for the snapping mechanism. An IP is welded to the lower column and sandwiched between the OP and lower column flange in a four-bolt connection. The upper pair of bolts utilizes disc springs—that is, Belleville washers—and are installed with a specified pretension. The disc springs work with the OP for the “snapping” mechanism. Additional details of the washers and other components are provided in Hinaus (2024).

The locking plate assembly consists of a lower lock plate (LLP) and a shim plate (SP) (Figure 4). The LLP is welded to the SP, which is directly welded to the upper column (Figure 2). The LLP has a slot for the shear key and a 45°

angle bevel that bears on the matching bevel on the lower column IP.

COMPONENT DESIGN

SnapLocX connection design may be considered in two stages: (1) column splice component design and detailing and (2) snapping assembly design. A brief overview of the component design and detailing is followed by highlights of the snapping assembly design. Additional details and an example design can be found in Hinaus (2024) and Berman et al. (2025).

Component design and detailing includes sizing of plates, bolts, and welds for demands and geometry. The shim plate thickness is determined by the difference in column depths. A minimum upper column depth is recommended to ensure sufficient contact area with the lower column for bearing capacity (Berman et al., 2025). The SnapLocX is currently

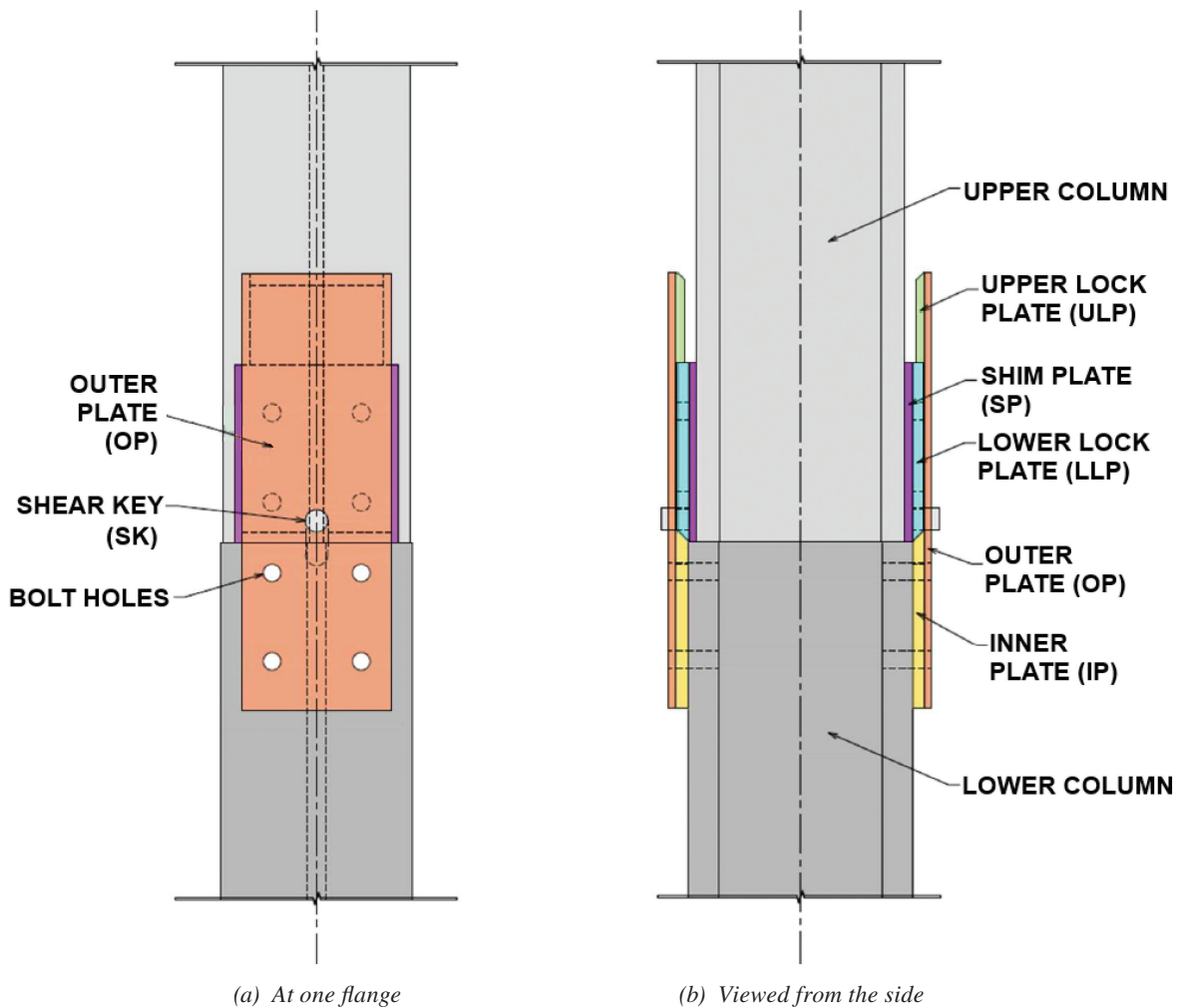


Fig. 4. SnapLocX column splice components.

to be used for splicing columns of the same rolled series (e.g., W14× to a W14×). The inner plates (IPs) transfer the major axis column shear forces. The 45° angle bevel and bearing prevent relative movement of the IP and upper lock plate (ULP); the IP therefore resists the shear through its thickness. The minor axis shear is transferred from the upper column to the lower column through the shear key (SK), bearing on the shear key slot in the lower lock plate (LLP) and the bolts connecting the outer plate (OP) to the lower column. Bolts and welds are designed for the resulting demands. For example, the shear key force imposes an eccentric loading on the lower column bolt group. Meanwhile, major-axis flexural demands are resisted by a combination of column flange bearing in compression and transfer of tensile forces through the upper and lower column plates,

welds, and bolts. Details of the load path and limit states are provided in Hinaus (2024).

The OPs are designed to accommodate the deformations during assembly. As the upper column is lowered into place, the outer plate bends and must be checked for yielding. The curvature in the outer plate is the largest when the upper lock plate (ULP) is at the leading edge of the lower lock plate (LLP) (Figure 5). The nonlinear elastic load-deformation behavior of the disc springs must also be considered. The research team developed a MatLab script to calculate the resulting moment, shear, and deformation demands along the outer plate (Hinaus, 2024).

Another unique consideration for the SnapLocX connection is the snapping friction. During assembly, the normal force between the ULP and LLP creates a frictional

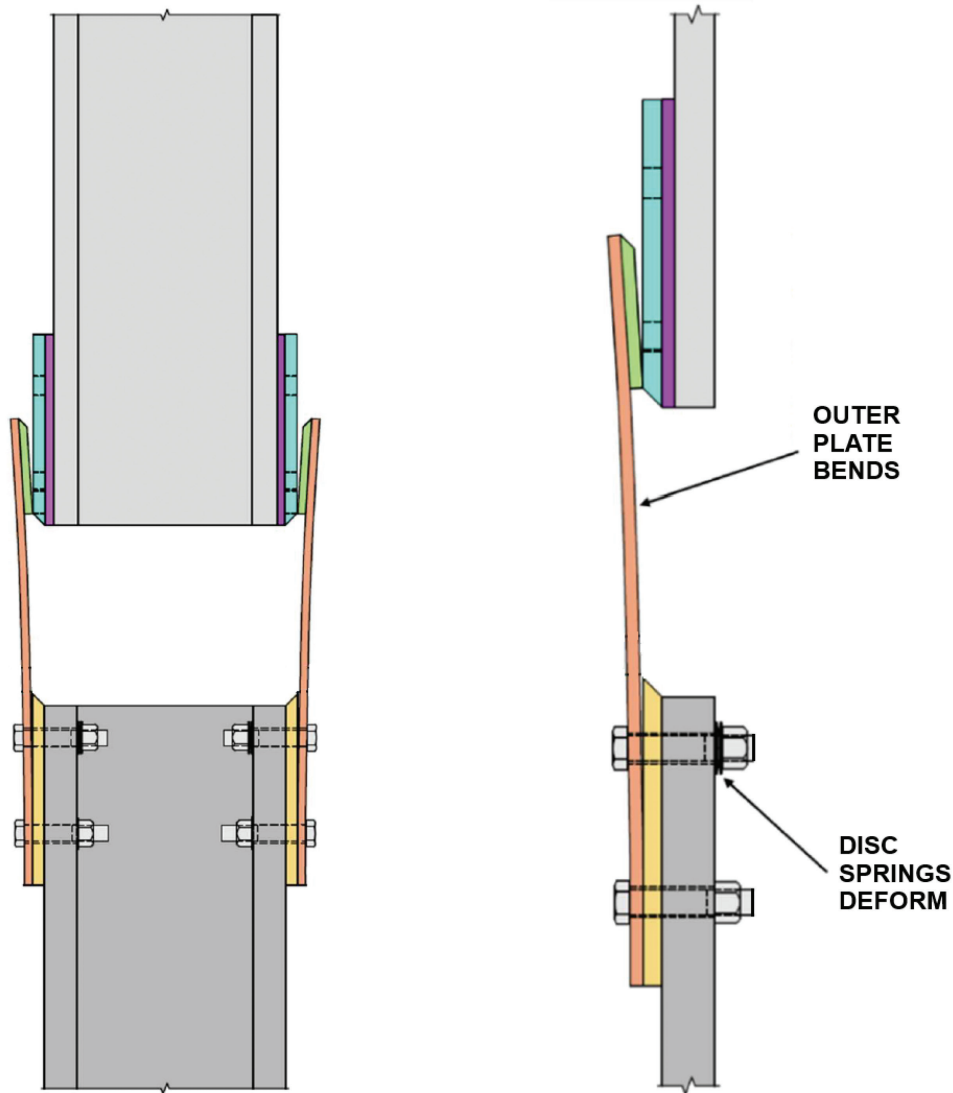


Fig. 5. Intermediate condition of column assembly with bending of the outer plates and deformation of the disc springs.

resistance. The weight of the upper column should be large enough to overcome the friction so that it can drop and snap into place. The research team assumed a friction coefficient of 0.3 in their designs (Berman et al., 2025).

STANDARDIZED DESIGNS

The team has created a tabular process to facilitate design and fabrication of the SnapLocX column splices. The tables are based on sets of standardized splices for a range of potential W10, W12, and W14 sections. The column sizes were partitioned into groups corresponding to specific plate designs. Further refinement produced a selected number of plate designs that satisfy requirements for most potential column splices. This approach limits the number of unique plate designs needed for a building project, aiding in design and fabrication. The approach also allows for potential mass production of certain components that could reduce costs.

This tabular design process provides quick determination of plate combinations and properties for given column sections. First, the upper and lower column sizes are used to determine the plate combination and shim plate (SP) thickness. In Figure 6, the column pairing points to a cell with the SP thickness and a color corresponding to the plate combination (color key at the upper right). For example, a W14x132 upper column with a W14x211 lower column requires plate combination D-5-5 and a 1/2-in.-thick shim plate. Figure 7 then provides plate design information, including SP width. If the shim plate thickness from

Figure 6 is marked with an *, the (*) SP width is used. There is no * in this case, and the SP width is 11 in. Plate D is to be used for the outer plate (OP), and Plate 5 will be used for the inner plate (IP) and lower lock plate (LLP). Additional tables (not shown here) provide the dimensions, as shown in Figure 8 for the LLP, for each plate letter or number (Hinaus, 2024; Berman et al., 2025).

SUMMARY AND FUTURE WORK

Phase 1 of the research has demonstrated feasibility and produced a design methodology for the rapid-assembly SnapLocX column splice. The “snap-and-lock” procedure saves construction time and labor at the acknowledged expense of additional fabrication cost. The designs satisfy requirements for gravity frame column splices. Standardized designs limit the number of unique assemblies needed and reduce design time as well. With this first phase complete, AISC notes that “this connection shows great promise in increasing the speed of steel construction” (Huber and Colsia, 2025).

Phase 2 research plans include SnapLocX mockups, experimental testing, and finite element modeling. The team will design and practice assembly of the column splices. Tests of full-scale specimens will be evaluated for strong- and weak-axis shear and flexural strengths. The experimental results, together with finite element analyses, will be used to support the proposed design methodology and identify any gaps in the procedure.

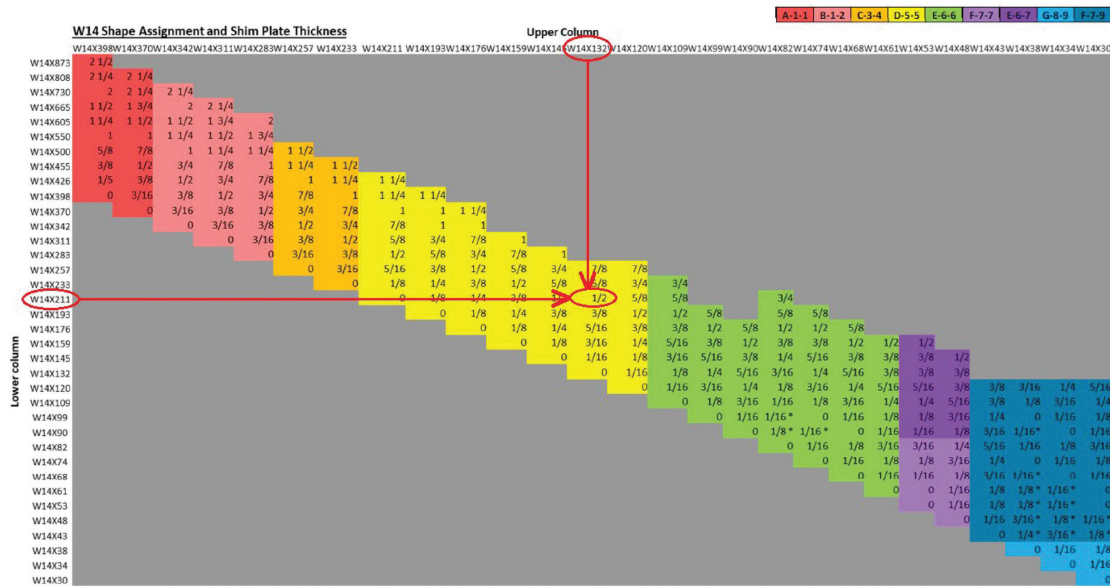


Fig. 6. Sample SnapLocX design and shim plate assignment for W14 column combination.

Phase 2 work may address questions about costs, tolerances, and alternative details. The savings in construction time might be offset by fabrication costs. The proposed mockups and collaborations with steel fabricators and erectors may help to answer questions about the tradeoff between fabrication cost and erection time saved. The mockups for assembly and structural testing could also be used to investigate the impact of tolerances (e.g., for flange thickness and tilt) on construction and structural performance. Meanwhile, alternatives for the shear key could also be explored with consideration for fabrication costs and erection speed.

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Outer Plate	Inner Plate	Lower Lock Plate	SP Width	(*) SP Width
A	1	1	15 in.	-
B	1	2	13 in.	-
C	3	4	11 in.	-
D	5	5	11 in.	-
E	6	6	9 in.	9 in.
F	7	7	7 in.	-
E	6	7	7 in.	-
G	8	9	5 in.	6 in.
F	7	9	5 in.	7 in.

Fig. 7. Sample plate combination and shim plate width.

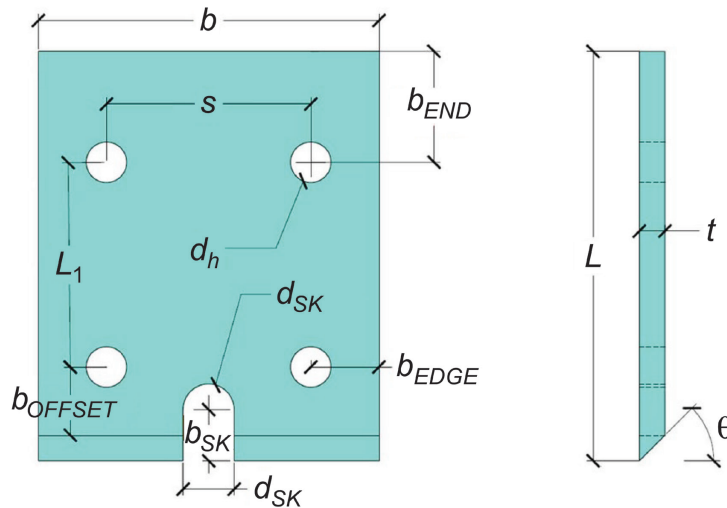


Fig. 8. Design dimensions for the lower lock plate.

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