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Structural Engineering and Materials

SURVEY RELATED TO EDGE DETAILS IN CONCRETE-FILLED STEEL DECK SLABS

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Report No. CE/VPI-ST-24/01
March 2024

EXECUTIVE SUMMARY

The aim of this survey is to gain insight into the common practices employed by structural engineers regarding the typical edge detail in concrete-filled steel deck floor systems.

The survey content, which included questions and figures, was developed based on feedback from design engineers and the AISC Task Committee 5 on composite structures. The survey was advertised to the structural engineering industry through the AISC weekly bulletin email and was open from May to August 2023.

The survey results provided valuable perspectives on different practices and typical edge details of structural engineering design firms across the United States from 34 respondents. It showed large scatter in typical edge details related to minimum slab overhang distance, pour stop type used, steel deck termination, pour stop connection and more.

ACKNOWLEDGEMENTS

The American Institute of Steel Construction (AISC) assisted with the distribution and advertising of the survey. The AISC Task Committee 5 on composite design provided feedback and guidance on the content and logistics of the survey.

TABLE OF CONTENTS

1. INTRODUCTION

In composite beams and collectors in steel buildings, headed shear studs transfer load between the steel beam and the concrete-filled steel deck slab. Headed shear studs that are not near the edge of the slab exhibit failure modes such as stud shearing, concrete cone pullout, and deck punching. When the headed shear studs are near the edge of the slab with the deck ribs oriented perpendicular to the beam, a failure mode called rib shear failure, such as shown in Figure 1, can occur and result in a significant reduction in shear strength (Avellaneda-Ramirez et al. 2023)

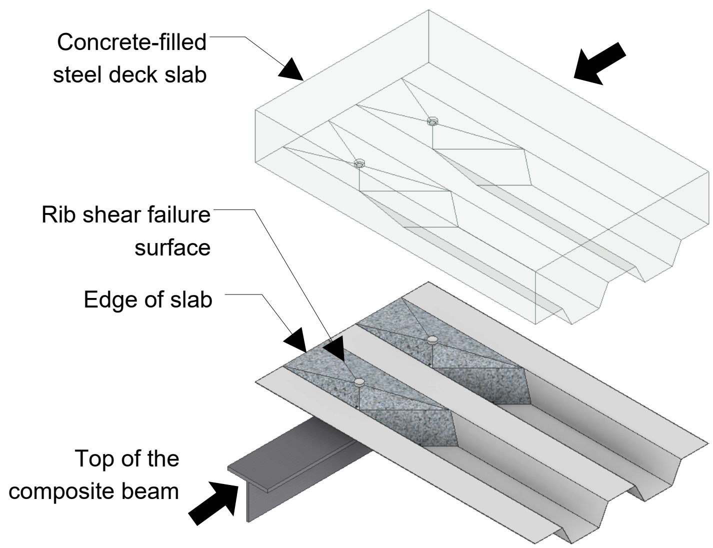

Figure 1. Schematic diagram showing rib shear failure which occurs with small edge distance.

The shear strength of a headed shear stud embedded in a concrete-filled steel deck is calculated using the *AISC Specification* (AISC 2022) Equation I8-1. However, the *AISC Specification* currently gives no limit on the edge distance (perpendicular to the direction of shear) for headed shear studs installed in the ribs of concrete-filled steel deck. Based on available test data, rib shear failure can happen with edge distance of 12 in. or less (Lloyd and Wright 1990 and Avellaneda-Ramirez et al. 2023). In some cases, the equation in the *AISC Specification* overpredicted the experimental strength by as much as two times when there was no pour stop or bent plate at the edge (Hawkins and Mitchell, 1987).

While it is possible that a pour stop, cell closure, or bent plate at the edge of the concrete-filled steel deck slab may help mitigate rib shear failure, there is no data available to support this theory, and little published information about typical slab edge detailing. For that reason, a survey was executed to collect information about typical slab edge detailing for concrete-filled steel deck slabs in structural steel buildings. The survey results were also used to inform a companion experimental program, not described here.

The survey, which consisted of 14 questions, was circulated to structural engineers across the United States, and a total of 34 responses were collected. This report describes the survey, the approach to distribution, and the results.

2. METHODOLOGY

The survey content, including related questions and figures, was developed in early 2023 based on a preliminary review of structural drawings from several design engineers, feedback from several design engineers, and feedback from the AISC Task Committee 5 (TC 5) on composite design. The survey was designed to collect information regarding typical design and construction practice for slab edges expected to be most susceptible to rib shear failure, namely slab edges that (1) overhang beyond the centerline of the edge beam by 12 in. or less, and (2) are formed by steel decking with ribs oriented perpendicular to the edge beam. Further, the primary survey content was focused on slab edges that are not designed to support façade or other edge loads, to solicit responses regarding the most lightly reinforced, and thus expected to be the most critical, edge conditions that may be susceptible to rib shear failure. These criteria are illustrated in Figure 2, which shows the schematic detail that was provided at the beginning of the survey.

The survey was created as a Google Form to facilitate the process of administering the survey and collecting data. The full survey is included in Appendix A. The answer fields for each question were text fields, which allowed the respondents to provide explanatory or qualified responses, as appropriate. This approach was used instead of multiple choice or numeric answer fields to put the least constraints on the responses.

In May 2023, the survey was advertised on the AISC weekly bulletin email, which is sent to all subscribed AISC professional members. The survey was closed in August 2023.

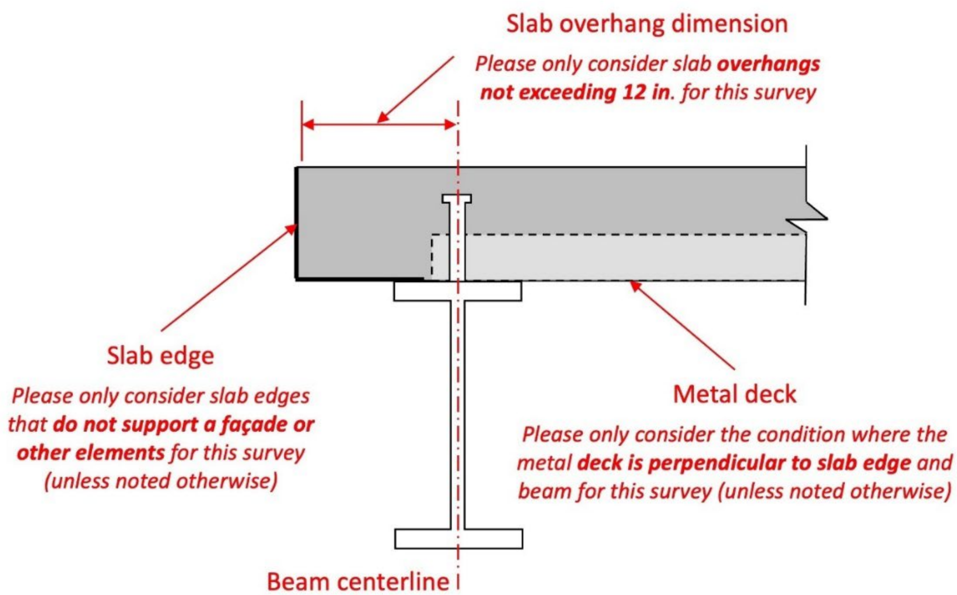

Figure 2. Schematic edge detail with notation, description and limitations as to what conditions should be considered in this survey.

A total of 34 responses were received from engineers that design composite floor systems across the United States, with some respondents noting they also design projects located outside the U.S. Many of the respondents provided more than one answer associated with different specific scenarios of the slab edge condition. If a respondent provided more than one answer to a question, it was counted as more than one response in the survey results. The presented results only consider responses pertaining to cases of short slab overhangs (12 in. or less) and slab edges that do not support façade or other loads, unless specifically noted otherwise in the question.

Chapter 3 of this report summarizes the responses to the survey. Appendix B includes all the raw data in the form of individual responses to each question.

3. SURVEY RESULTS

This section summarizes the results from the survey. For each of the 14 questions, first the question is given, and then the responses are summarized. The individual responses to each question are included in Appendix B.

Question 1: What is the minimum distance from the slab edge to the beam centerline (slab overhang dimension) that you have seen or used in a project?

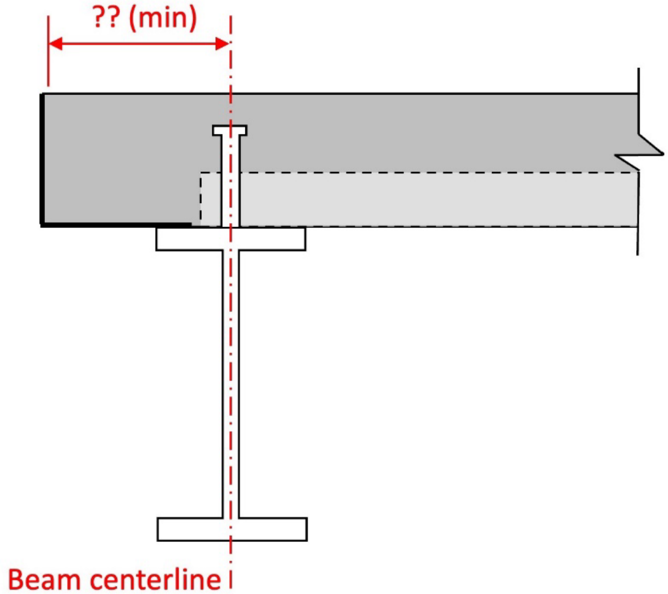

Figure 3. Drawing associated with Question 1 related to minimum edge distance.

Most respondents (91%) replied that the minimum edge distance illustrated in Figure 3 to be 6 in. or less. The answers were scattered as described in Figure 4. Nearly half said the minimum overhang is 4 in. or less. A typical edge distance equal to half of the flange width of the beam, $\frac{b_f}{2}$ was specified by 18%. One respondent said the minimum overhang was not less than $\frac{b_f}{2}$ or thickness of the slab.

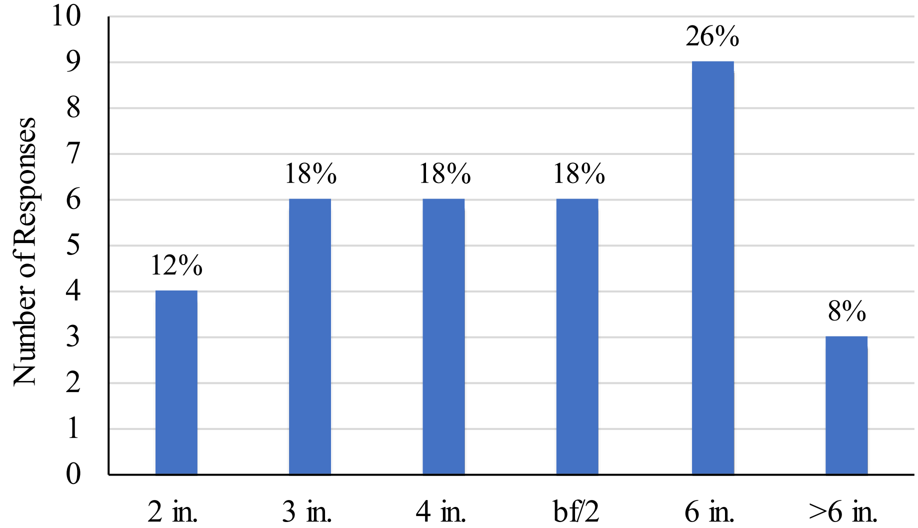

Figure 4. Minimum edge distance responses.

Question 2: How far does the metal deck typically extend (examples shown below)? If this may vary, please describe the condition(s) for which different deck extensions would be used.

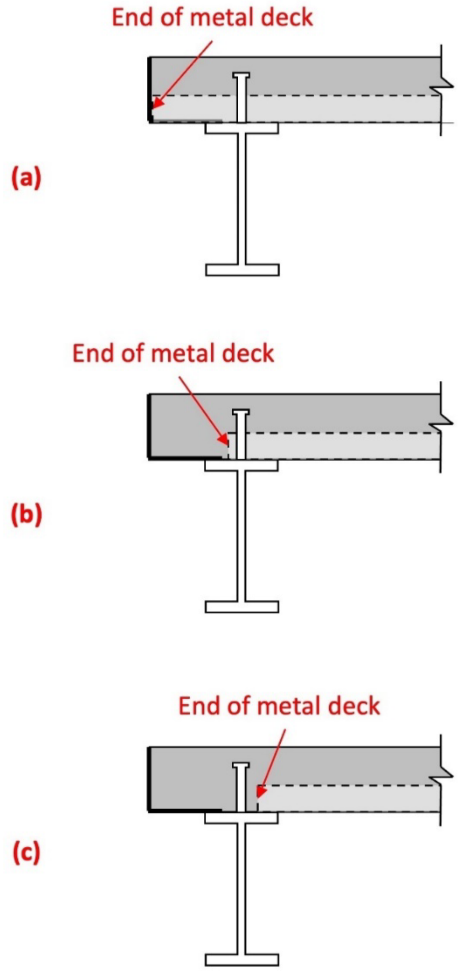

Figure 5. Drawing associated with Question 2 related to deck termination.

Some respondents answered that they typically use more than one of the details described Figure 5 depending on the conditions, such as overhang length, flange width, demands on the steel deck, and deck orientation. However, as shown Figure 6, Detail (a) in Figure 5 is not commonly used, with some respondents explaining that they often do not use nor have seen it used for overhang lengths of 12 in. or less and deck ribs perpendicular to the beam. However, a few respondents indicated that they use Detail (a) exclusively. Detail (c) was the most common deck termination detail and is used by 53% of the respondents, followed by Detail (b) with 33%.

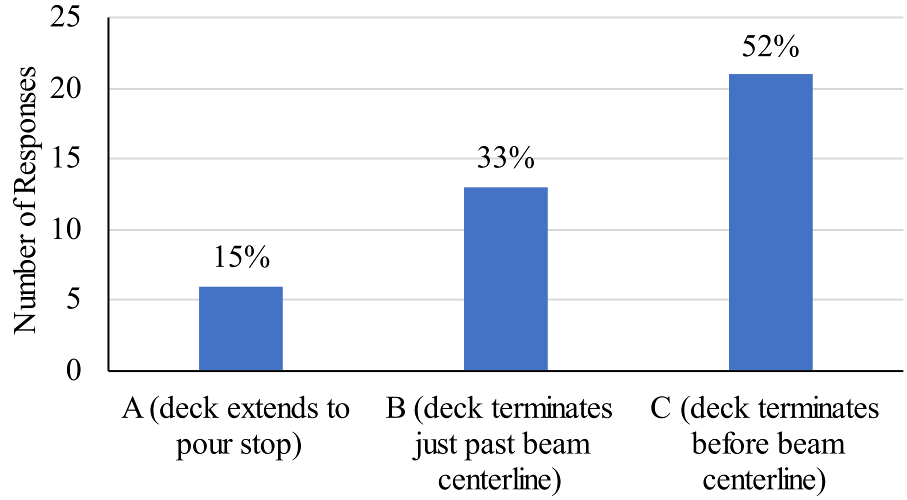

Figure 6. Responses related to deck termination in Question 2.

Question 3: What type of pour stop is typically used? (e.g., bent plate, light gauge, wood form, etc.) If more than one type may be used, please describe the conditions(s) for which each type would be used.

Many respondents said that they use both light gauge and bent plate pour stops. The respondents noted that the decision between bent plates and light gauge pour stops depends on various factors, with bent plates being used when attachments to the deck edge are necessary (e.g., handrail, façade, mechanical system at elevator openings), when the edge is "loaded," for exterior or exposed conditions, and for longer overhangs. Some respondents leave the decision of the type of pour stop up to the contractor. Based on the survey responses, key observations are as follows:

- Bent plates are typically preferred for exterior edges, longer overhangs, exterior conditions, or when supporting loads from cladding, stair stringers, handrails, or façade.

- Light gauge pour stops are commonly used for shorter overhangs when there is no load on the edge. However, the classification of short and long overhang distance was observed to be subjective in the responses. Some said light gauge pour stops are favored for overhang dimensions up to 4 in. or 8 in., while others said up to 12 inches. If the overhang length exceeds the engineers limit for light gauge, bent plates are used as default.

Figure 7 below shows that the light gauge pour stop option is favored over the bent plate option for overhangs 12 in. or less and when the slab edge is not loaded.

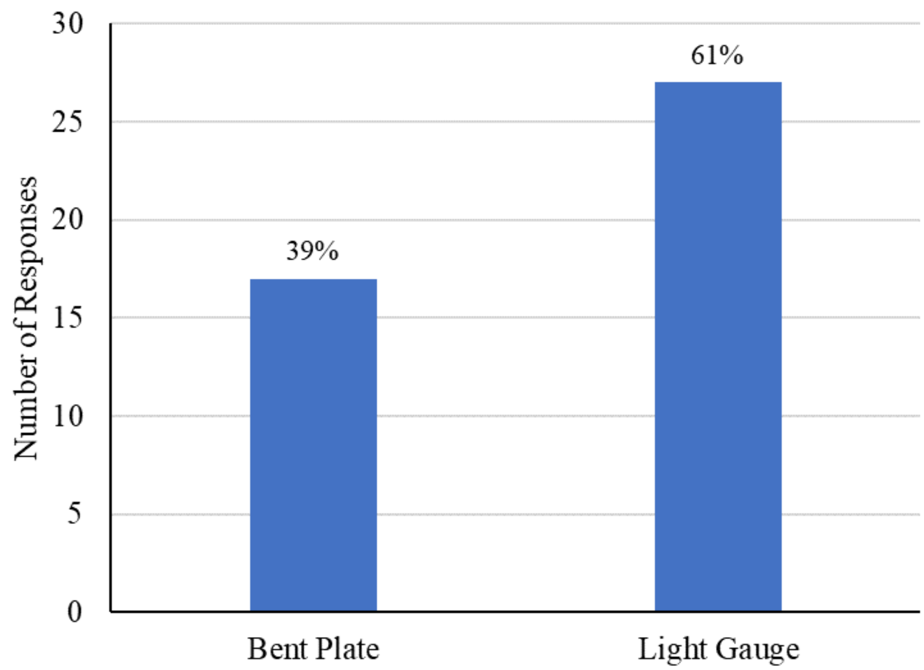

Figure 7. Responses related to the typical pour stop used.

Question 4: Is a cell closure typically used? If the use of a cell closure may vary, please describe the condition(s) for which a cell closure would or would not be used.

Nearly all respondents indicated that cell closures are typically used. Some explicitly specify the cell closure in their details. Others noted that cell closures are typically selected and installed by the deck provider.

One respondent mentioned that sometimes wire mesh or spray foam is specified as an alternative to a cell closure, and the method is selected by the contractor. Another said that in the past, when a paper or rubber dam was specified at each open flute, the contractor always requested to use a continuous light gauge closure instead. In that case, the engineer specified that a 1 in. cover to the side of the stud must be maintained by the installer.

Question 5: How thick is the pour stop typically? If the thickness may vary, please describe the condition(s) for which different thicknesses would be used.

For bent plates, 76% of respondents use a standard thickness of 1/4 inch. Others specify the bent plate thickness as per loading, overhang, and concrete depth, or how it is supported at the edge of slab. Some respondents mentioned that the thickness of the bent plate in the case of heavy cladding supports could increase up to 3/8 inch.

For light gauge pour stops, respondents indicated the thickness might range from 20 gauge to 10 gauge, depending on edge distance and slab thickness. Nearly 60% refer to the Steel Deck Institute (SDI) recommendations or the deck manufacturer table to specify the light gauge. Three respondents said they do not use a pour stop thinner than 16 gauge.

Question 6: If a cell closure is used, how thick is the cell closure typically? If the thickness may vary, please describe the condition(s) for which different thicknesses would be used.

The thickness of the cell closure is typically determined by the manufacturer, the deck provider, or contractor, as indicated by 75% of respondents. Several respondents expressed uncertainty about the specific thickness, acknowledging that they had never specified it and leave it up to the contractor. It was reported by 10% of the respondents that the pour stop thickness should match the deck thickness, and the remaining 15% of respondents specify a thickness between 16 and 22 gauge. Overall, the decision-making responsibility for cell closure thickness is often determined by the deck supplier.

Question 7: How is the pour stop typically connected? For example, is the pour stop typically connected to the beam flange or the metal deck? If a welded connection, what is the typical weld size, length, and spacing? If a fastener connection, what is the typical fastener type, size, and spacing? If the connection may vary, please describe the condition(s) for which different connections would be used.

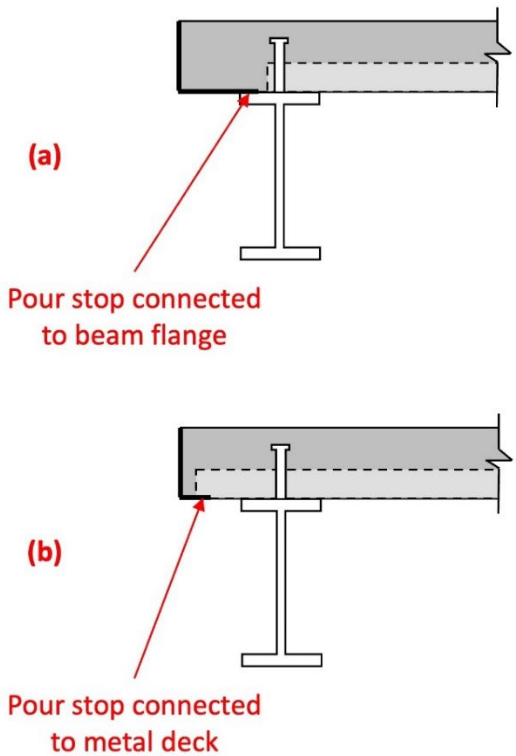

Figure 8. Drawing associated with Question 7 on how the pour stop is typically connected.

The preferred detail is Detail (a) shown in Figure 8, which is used by 89% of the respondents. This trend is consistent with the responses to Question 2, which indicate that the steel deck typically does not extend beyond the edge beam. The pour stop is typically connected to the beam flange with welding methods such as fillet weld, arc spot weld and tack weld. Or, as mentioned by three respondents, bent plate pour stops are shop bolted with slotted holes for adjustment during erection, then field welded in place. In some cases, when light gauge pour stops are used, the connection method is left to the deck supplier or manufacturer.

For Detail (a) in Figure 8, the connection details are described by respondents as:

- Intermittent fillet weld: Over 50% of the respondents indicating Detail (a) connections use fillet welds to connect the pour stop to the beam flange. The size and length of the weld varies depending on the pour stop type and overhang length. The most common responses for bent plate pour stops were (1) a 3/16 in. fillet weld, 2 in. long at 12 in. on center and (2) a 3/16 in. fillet weld, 3 in. long at 12 in. on center. Some respondents did not include the weld size or details in their response. For light gauge pour stops, smaller weld sizes are typically used, such as 1/8 in. fillet weld, 2 in. or 1 in. long at 12 in on center. A couple of respondents left the weld details to the deck supplier. Others did not include the weld size or details in their response.
- Arc spot welds (puddle welds) were mentioned by a couple respondents for light gauge pour stops.
- Tack weld at 12 in. was mentioned by one respondent for light gauge pour stops.
- Shop bolted with slotted holes for bent plates as described above.
- Left to the supplier for light gauge pour stops as described above.

One respondent said that they used a detail different than Details (a) and (b) in Figure 8, with light gauge pour stops placed on top of and screwed to c-shaped cell closures.

The remaining 11% (four respondents) use Detail (b) in Figure 8. Three of these respondents also specify their deck to extend all the way to the pour stop as described in Detail (a) in Figure 5 for Question 2. One said that although Detail (b) in Figure 8 was their typical detail, some contractors preferred Detail (a) to allow field adjustment of the slab edge location. No respondents provided information about how the pour stop is connected to the deck in Detail (b).

Question 8: Is there typically additional slab reinforcement perpendicular to the edge beam and slab edge (in addition to the normal slab reinforcement present away from the slab edge)? If so, please describe reinforcement (i.e., diameter, spacing, length, how it is developed at the slab edge) and condition(s) when it would be used. If the reinforcement may vary, please describe the condition(s) for which different reinforcement (if any) would be used. Note: Assume this slab edge is not part of a diaphragm chord designed to resist lateral loads.

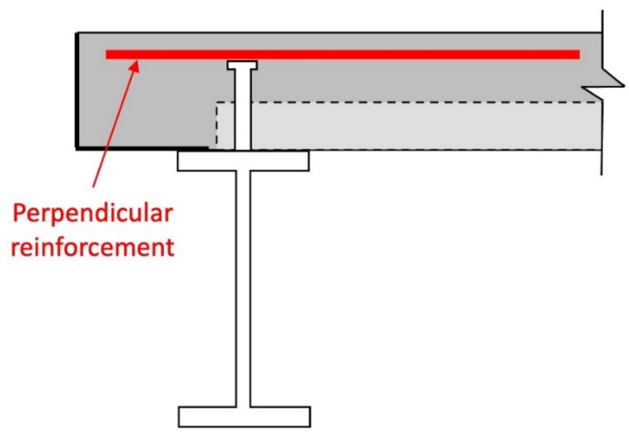

Figure 9. Drawing associated with Question 8 on whether additional slab reinforcement perpendicular to the slab is typically used.

Figure 10 shows that the responses in terms of whether additional perpendicular reinforcement is used as described in Figure 9 were almost equally divided between yes and no. Some respondents clarified that they don't add reinforcement perpendicular to the edge beam and slab edge for short overhangs (defined as 6 in. or 9 in.) or if the edge is not loaded. When additional perpendicular reinforcement is used, it is specified as follows:

- The most common bar size used is #4. Also, some respondents mentioned they use #3 bars with a smaller spacing than what is used with #4 bars, as described below.
- Spacing between reinforcement varies. A 12 in. spacing was the most common response, while 16 in., 18 in., and 24 in. spacings are used less commonly.
- Development length or reinforcement length: Only a few respondents answered this portion of the question. Additional reinforcement 2 ft long was the most common response. One respondent noted that the bars are detailed to extend their development length past the beam center line. Another respondent noted that they specify #4 bars, 5 ft long at 12 in. on center when three or more studs per foot are used on the edge beam.
- Several respondents indicated the additional bars have 180° hooks at the slab edge. Others indicated that the bars are welded to the bent plate or that deformed bar anchors are used (see Question 10).

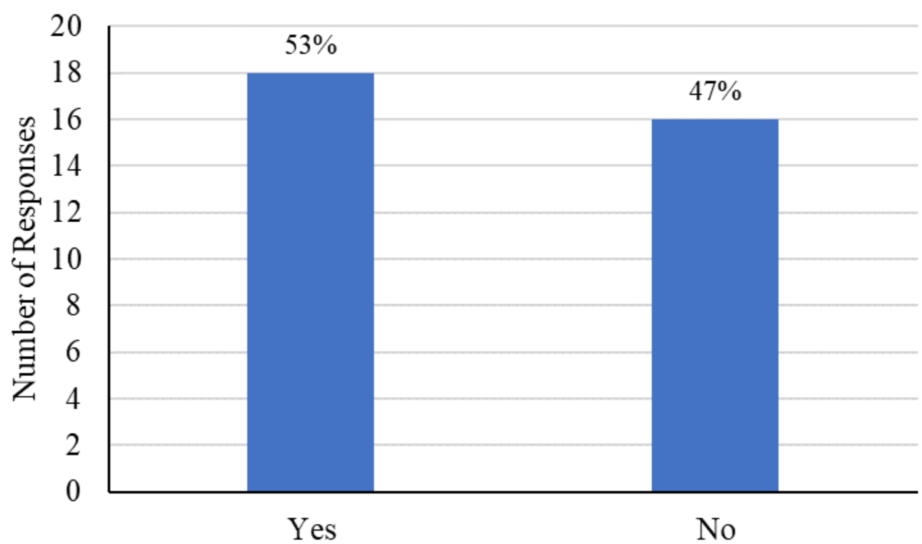

Figure 10. Responses to Question 8 on whether additional slab reinforcement is typically used.

Question 9: Is there typically additional slab reinforcement parallel to the edge beam and slab edge (in addition to the normal slab reinforcement present away from the slab edge)? If so, please describe the reinforcement (i.e., diameter, number of bars, distance from edge). If the reinforcement may vary, please describe the condition(s) for which different reinforcement (if any) would be used. Note: Assume this slab edge is not part of a diaphragm chord designed to resist lateral loads.

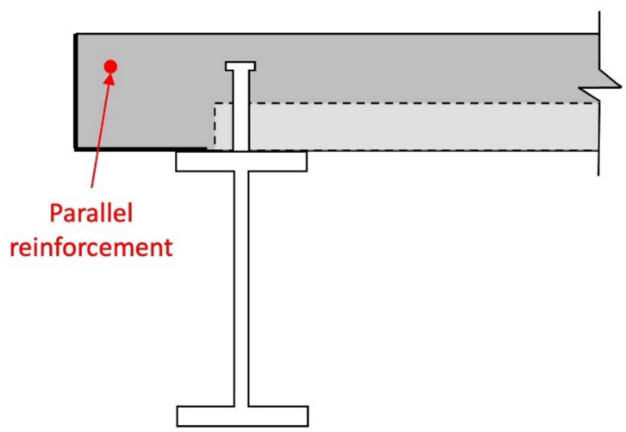

Figure 11. Drawing associated with Question 9 on whether additional slab reinforcement perpendicular to the slab is typically used.

Figure 12 shows that 38% of respondents said no, they do not require additional slab reinforcement parallel to the edge of the slab as shown in Figure 11 above if the slab edge is not part of the diaphragm chord. The remaining 62% responded with yes, they do specify additional parallel slab reinforcement. It was observed that 1-#4 continuous bar is the most common additional reinforcement used. Other responses were 1-#5 continuous bar, 2-#5 continuous bars, 2-#4 continuous bars, and 2-#3 continuous bars.

Some respondents noted that the additional parallel reinforcement would match the slab reinforcement. Also, it was noted by one respondent that if the slab edge is a steel bent plate with headed studs, usually 2-#4 continuous bars along the slab edge are used. The same respondent indicated that for a light gauge pour stop, a #3 or #4 bar to match the slab reinforcement is added.

In conclusion, 62% of the respondents typically provide at least one additional continuous bar parallel to the slab edge, while 38% of the respondents do not add reinforcement unless required for diaphragm reasons.

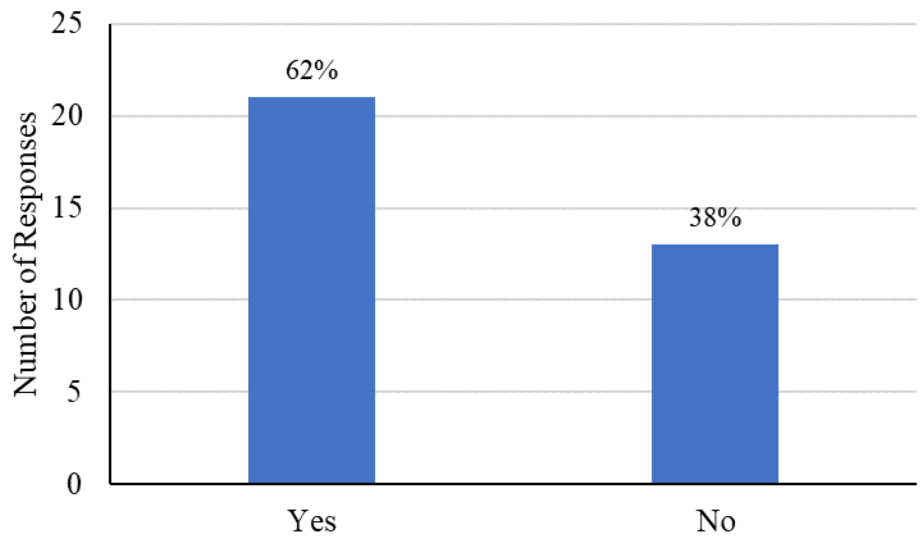

Figure 12. Responses to Question 8 on whether additional slab reinforcement was typically used.

Question 10: Are there horizontal studs, deformed bar anchors, or other anchors welded to the bent plate? If so, please describe the studs or anchors (i.e., diameter, length, spacing). If the studs or anchors may vary, please describe the condition(s) for which different types of studs or anchors (if any) would be used. Note: Assume this slab edge is not part of a diaphragm chord designed to resist lateral loads.

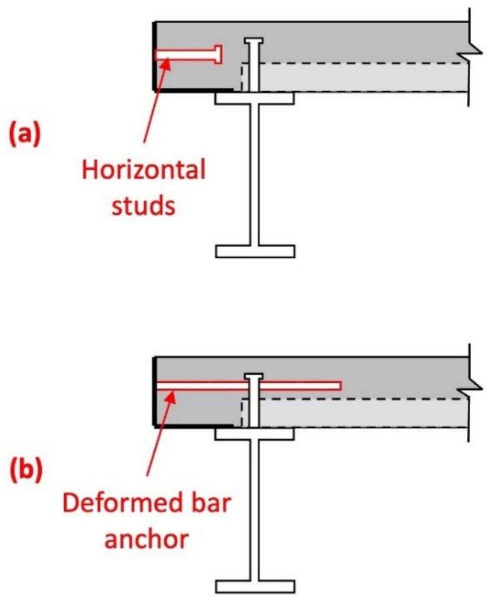

Figure 13. Drawing associated with Question 10 on if there were horizonal studs or deformed bar anchors welded to the bent plate.

Figure 14 illustrates that 71% of the respondents said that they do not add studs or deformed bar anchors (DBA) welded to the bent plate similar to Figure 13 if the slab edge is not loaded. However, when used, the most common attachment is DBAs with the following typical details: 18 in. or 24 in. long #4 bars at 12 in., 18 in., or 24 in. on center. Headed studs are less commonly used compared to DBAs. When used, headed studs are typically detailed to be 1/2 in. diameter and 4 in. or 8 in. long.

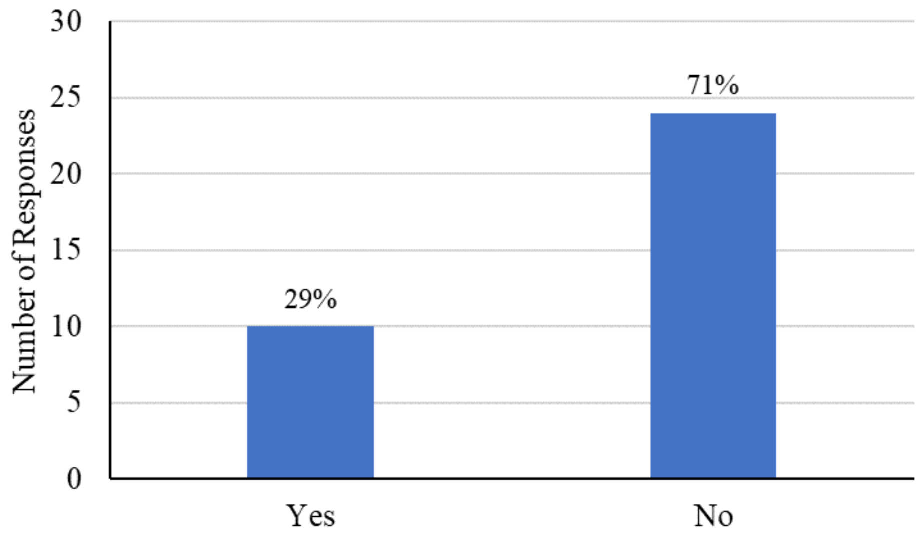

Figure 14. Responses to Question 10 on if there were horizontal studs or deformed bar anchors welded to the bent plate.

Question 11: Do your responses to questions 1 through 10 change for the case where the metal deck is oriented parallel to the edge beam and slab edge? If so, please describe how your responses would differ for each applicable question.

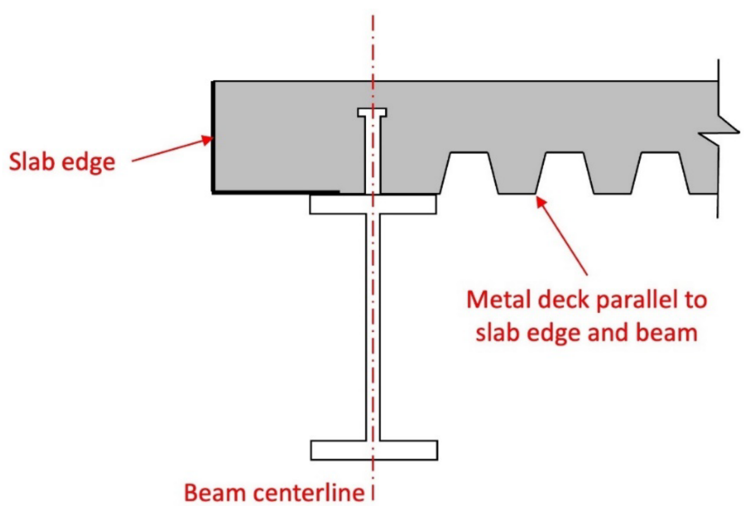

Figure 15. Drawing associated with Question 11 on whether the responses to questions 1 through 10 would change for the case where the steel deck is parallel to the edge beam and slab edge, or not.

The responses as shown in Figure 16 indicated that 77% of respondents would not change their responses to questions 1 through 10 if the deck is oriented parallel to the edge beam. For respondents that would change their responses, key observations on the differences are described as follows:

- A thicker light gauge pour stop gauge would be used, or a light gauge pour stop would be replaced with a bent plate.
- Less additional reinforcement would be used, or no DBAs would be welded to the vertical leg of the bent plate.
- Detail (a) in Figure 5 would not be used.

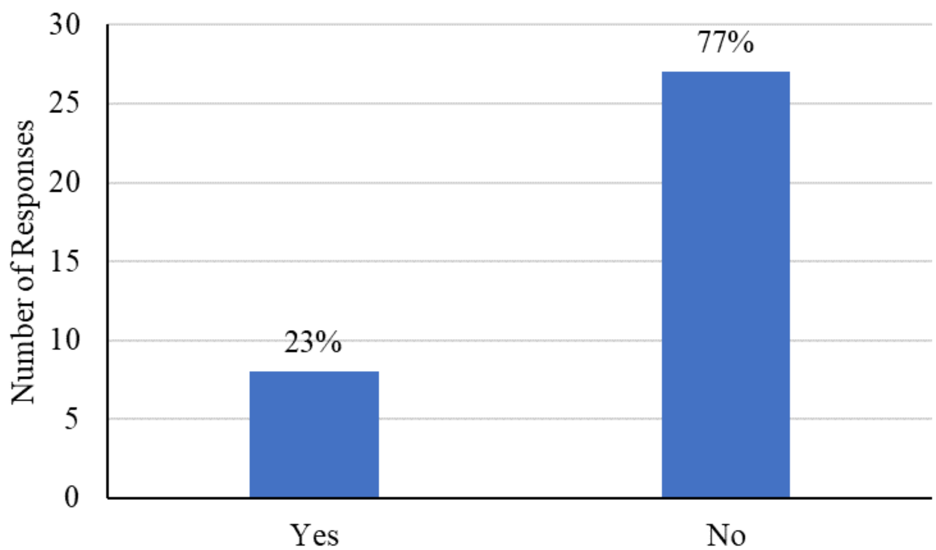

Figure 16. Responses to Question 11 on if responses to questions 1 through 10 would change for the case where the steel deck is parallel to the edge beam and slab edge, or not.

Question 12: Do your responses to questions 1 through 10 change for the case where the slab edge supports the facade or other elements?

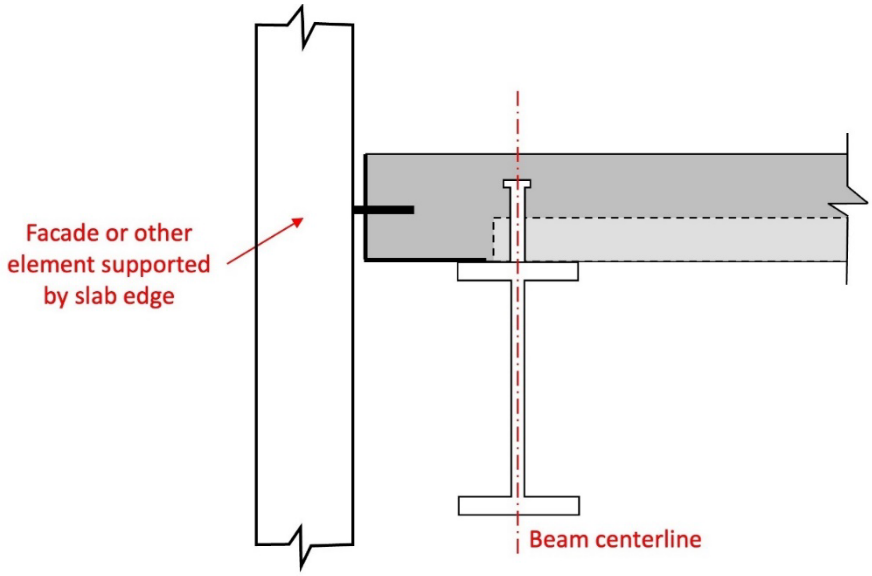

Figure 17. Drawing associated with Question 12 on whether the responses to questions 1 through 10 would change in the scenario where the slab edge supports the facade or other elements.

The respondents' answers would change in the following ways for the case where the slab supports the façade or other elements as described in Figure 17:

- Light gauge pour stops would not be used. Bent plates would be used on slab edges that support a façade or other elements.
- Determining the slab edge details would require a more detailed design and engineering solution, rather than using typical details. That includes using thicker bent plates, analyzing the vertical loads and designing the DBAs to transfer the imposed load in the cantilevered slab edge, and adding horizontal anchors welded to the bent plate.

Question 13: What geographic region(s) in the U.S. are you typically designing for? (Select all that apply).

All respondents indicated they design projects in the U.S., with a few respondents also indicating they design projects outside the U.S. The geographic distribution is presented in Figure 18 below.

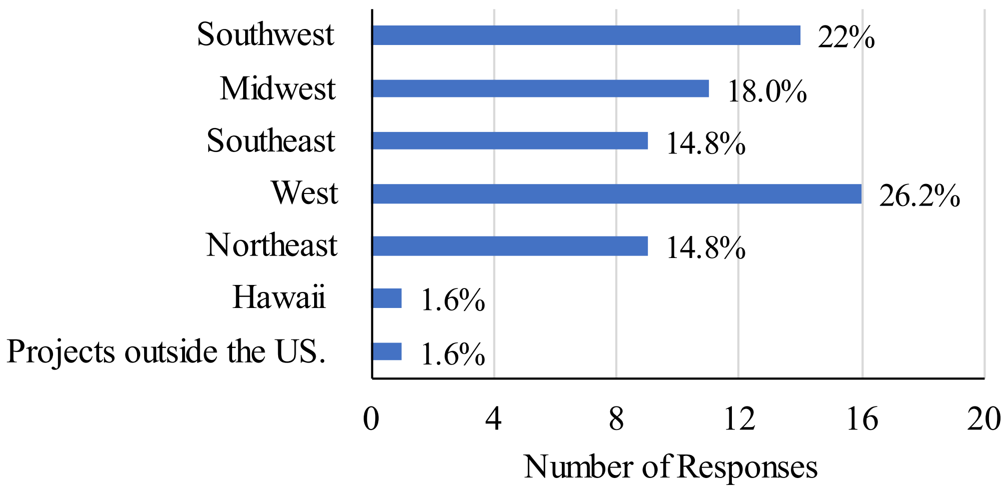

Figure 18. Responses to Question 13 about the geographic region of projects designed by the survey participants.

Question 14: (Optional) Please provide any additional comments, description, clarifications, or other information you would like to share.

Only nine responded to this question. Answers are listed in Appendix B.

4. CONCLUSIONS AND RECOMMENDATIONS

A total of 34 practicing structural engineers across the U.S. participated in a survey to provide feedback regarding design and detailing of composite slab edges. This survey focused on slab edges with short overhangs, steel decking oriented perpendicular to the edge, and without significant edge loads. Some participants provided multiple answers depending on the edge condition.

The responses to the survey showed a large scatter in practices and details used by engineering firms in terms of overhang distance, pour stop type, deck termination, pour stop connection, pour stop type, and use of additional reinforcement. Selected key results of the survey are summarized as follows:

- Slab overhangs less than 4 in. beyond the centerline of the edge beam are used by nearly half of the survey respondents. Slab overhangs less than 6 in. are used by nearly all of the respondents.
- The slab edge is most commonly detailed so that the steel deck does not extend beyond the flange of the edge beam.
- Light gauge pour stops (typically 16 gauge or thicker) are more commonly used for slab edges with 6 in. or smaller overhangs where the deck terminates before the beam centerline. The selection and detailing of light gauge pour stops is typically in accordance with the deck manufacturer's recommendations or left to the contractor.
- Bent plates (typically 1/4 in. thick) are more commonly used for longer overhangs and at loaded edges.

- The typical method of connecting the pour stop is by intermittent fillet welding or arc spot welds to the beam flange, but the size and lengths of weld varies. A 3/16 in. intermittent fillet weld, 2 in. or 3 in. long, at a 12 in. pitch appears to be fairly typical.
- Cell closures are typically used, with their design and detailing left to the deck supplier or contractor.
- Approximately half of the respondents include additional reinforcement perpendicular to the slab edge, even if the slab edge is not being used as a diaphragm chord. This additional reinforcement is less likely to be used for overhangs 6 in. or shorter. While the details of additional perpendicular reinforcement varies, typical practice appears to be hooked #4 bars that are 2 ft long spaced at 12 in. or more on center. Some engineers use deformed bar anchors (DBA) welded to a bent plate pour stop as additional perpendicular reinforcement.
- Approximately two-thirds of the respondents include at least one additional continuous reinforcing bar, typically a #4 bar, parallel to the slab edge, even if the slab edge is not being used as a diaphragm chord.
- In the absence of edge loads and for short overhangs, most engineers do not specify headed studs welded to the bent plates.
- Most engineers also use similar slab edge details as those described above for cases where the steel decking is oriented parallel to the slab edge.
- For cases where the slab edge supports a façade or other elements, light gauge pour stops would typically not be used, and the engineer would design the slab edge for the imposed load on the edge, instead of using a typical detail.

The responses to this survey will help code committees such as AISC TC 5 understand typical composite slab edge detailing. The insight gained by this survey will also inform a companion experimental program to test and evaluate the effect of lateral edge distance on the strength of headed shear studs in composite beams and collectors. The results of that testing, along with the survey responses described in this report, will be used by AISC TC 5 to evaluate the current shear connector lateral cover requirements in the *AISC Specification* (AISC 2022).

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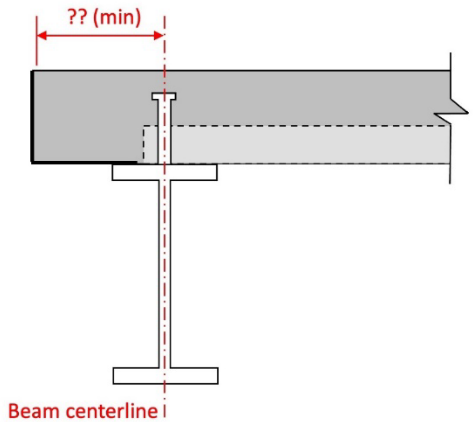
APPENDIX A – SURVEY QUESTIONS

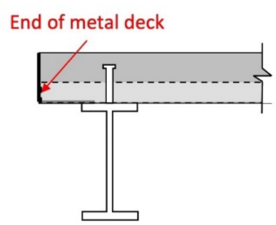
All questions are listed with their figures in this appendix.

1. What is the minimum distance from the slab edge to the beam centerline (slab overhang dimension) that you have seen or used in a project?

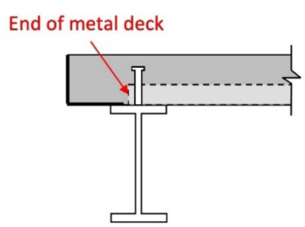


2. How far does the metal deck typically extend (examples shown below)? If this may vary, please describe the condition(s) for which different deck extensions would be used.

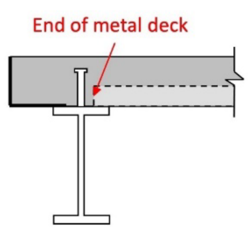
(a)



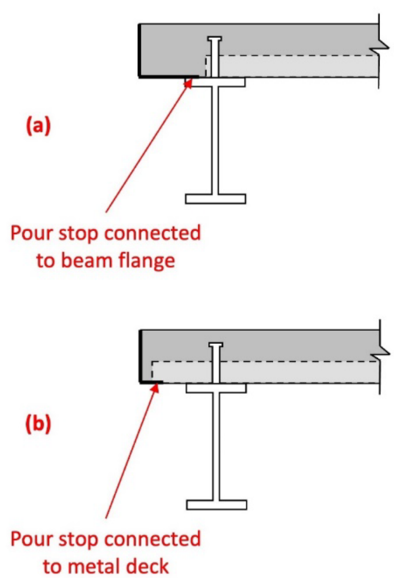
(b)



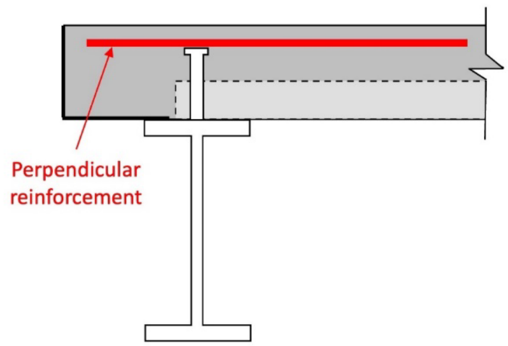
(c)



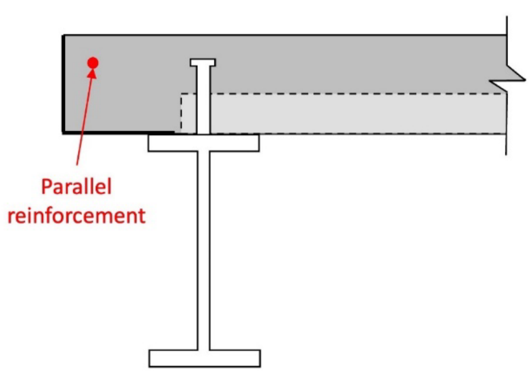
3. What type of pour stop is typically used? (e.g., bent plate, light gauge, wood form, etc.) If more than one type may be used, please describe the conditions(s) for which each type would be used.
4. Is a cell closure typically used? If the use of a cell closure may vary, please describe the condition(s) for which a cell closure would or would not be used.
5. How thick is the pour stop typically? If the thickness may vary, please describe the condition(s) for which different thicknesses would be used.
6. If a cell closure is used, how thick is the cell closure typically? If the thickness may vary, please describe the condition(s) for which different thicknesses would be used.
7. How is the pour stop typically connected? For example, is the pour stop typically connected to the beam flange or the metal deck? If a welded connection, what is the typical weld size, length, and spacing? If a fastener connection, what is the typical fastener type, size, and spacing? If the connection may vary, please describe the condition(s) for which different connections would be used.



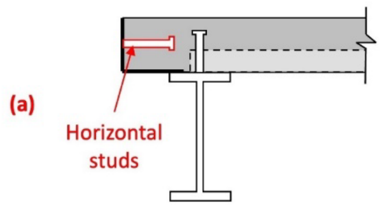
8. Is there typically additional slab reinforcement perpendicular to the edge beam and slab edge (in addition to the normal slab reinforcement present away from the slab edge)? If so, please describe reinforcement (i.e., diameter, spacing, length, how it is developed at the slab edge) and condition(s) when it would be used. If the reinforcement may vary, please describe the condition(s) for which different reinforcement (if any) would be used. Note: Assume this slab edge is not part of a diaphragm chord designed to resist lateral loads.

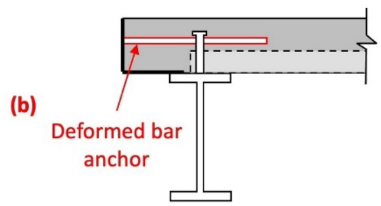


9. Is there typically additional slab reinforcement parallel to the edge beam and slab edge (in addition to the normal slab reinforcement present away from the slab edge)? If so, please describe the reinforcement (i.e., diameter, number of bars, distance from edge). If the reinforcement may vary, please describe the condition(s) for which different reinforcement (if any) would be used. Note: Assume this slab edge is not part of a diaphragm chord designed to resist lateral loads. Figure was attached to the question.

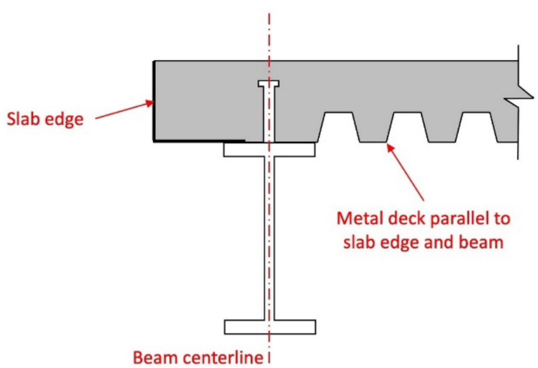


10. Are there horizontal studs, deformed bar anchors, or other anchors welded to the bent plate? If so, please describe the studs or anchors (i.e., diameter, length, spacing). If the studs or anchors may vary, please describe the condition(s) for which different types of studs or anchors (if any) would be used. Note: Assume this slab edge is not part of a diaphragm chord designed to resist lateral loads.

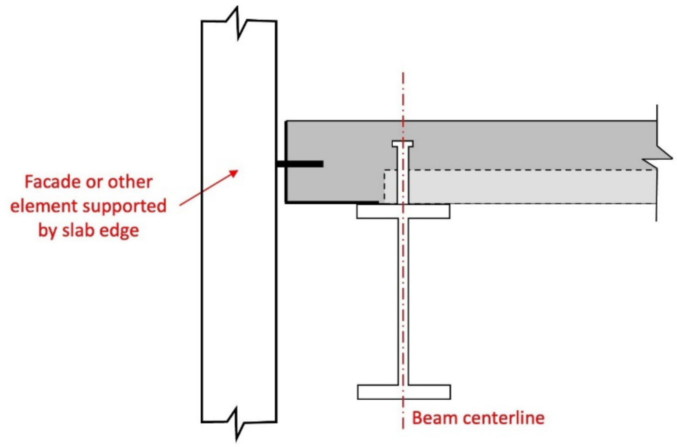




11. Do your responses to questions 1 through 10 change for the case where the metal deck is oriented parallel to the edge beam and slab edge? If so, please describe how your responses would differ for each applicable question.



12. Do your responses to questions 1 through 10 change for the case where the slab edge supports the facade or other elements?



13. What geographic region(s) in the U.S. are you typically designing for? (Select all that apply). The geographic regions provided for selection in the survey were as follows:

    a. Northeast

    b. Southeast

    c. Midwest

    d. Southwest

    e. West

    f. Washington

    g. Hawaii

    h. Typically not in CA

    i. Projects outside the US.

14. (Optional) Please provide any additional comments, description, clarifications, or other information you would like to share.

    Only 9 responded to this question. Answers are listed in Appendix B.

15. (Optional) Please provide your email address for any follow up items.

APPENDIX B – SURVEY RESPONSES

This appendix provides all the responses for every question listed in the survey in their raw form. If an answer is left blank, it means that the related question was not answered. If part of an answer shows XXXXX, it means that personally identifying information was redacted.

1. Overhang Distance

1) 6"
2) b_f/2
3) 3 inches
4) 6"
5) 2 inches
6) 3"
7) 1/2 flange width, so usually 3-4".
8) width of flange divided by two (just enough to cover the flange)
9) 3
10) 4 inches nominally
11) 4 inches
12) Not specified on typical detail, but would typically not want to be less than bf/2 or thickness of the slab.
13) 2". However, for beams will multiple studs per rib (a common condition), the distance from edge to center of stud is often as small as 1 1/4", as permitted by ACI.
14) 3 inches
15) 2"
16) 3 inches minimum
17) 6"
18) Very rare case of 2-inches past the edge of the beam flange
19) 4"
20) 6"
21) 6 inches
22) 4", however, it's normally more than that. 7" is our typical.
23) 3 inches has been used in a bind, but we typically try and use 6 inches.
24) 4"
25) 1/2 inches past edge of beam flange else we do not consider composite action.
26) 6 in
27) 12"±
28) 8in ish
29) 2 inches
30) 8-in.
31) 4 inches
32) Edge of beam flange
33) 6.5"
34) 6 in

2. Deck Termination

1) We detail it to terminate just past the stud but before the edge angle/plate. It often gets installed on top of the angle/plate, though.
2) b is as-detailed typically
3) a
4) c
5) Typically similar to Detail (c) with a minimum end bearing of 1 1/2".
6) a if deck is spanning to beam, b if a girder where deck span is parallel to beam
7) a) we don't use this very often, but I've seen up to 1'-6" from beam centerline, b&c) 1'-0" max without added supports, 2'-6" max with added supports (Lx, Cx, etc)
8) Depends on the overhang. If short, then (B), Longer overhangs where deck is needed to support wet concrete then (a)
9) (a) If the metal deck is strong enough to act as a cantilever for the floor load. (b) If I am going to use the pour stop as the floor support.
10) Typically C, sometimes A for large cantilevers.
11) similar to condition (c), 1 1/2" inches on to the inside flange to permit stud placement.
12) (c)
13) I never see (a) used for slab overhangs of 12" or less. (b) and (c) are equally common.
14) Condition B nearly always. Condition c occasionally. I have not observed condition a.
15) b
16) condition (b)
17) 2"
18) Typically "b" - it has differed for slab extensions over 12"
19) b and c. at b it is typically 2" beyond CL. if c it has been 1" min short of CL
20) C
21) Both b and c are allowed by our details, depending on flange width.
22) c
23) c
24) (b)
25) C
26) c. 2" minimum bearing
27) (c)
28) C
29) c
30) (c)
31) c
32) a
33) c
34) a

3. Pour Stop Type

1) Bent plate or angle (depending on condition) with deformed bar anchors welded to the vertical leg and spanning back into the slab.

2) bent plate if used at rail, stair stringer, or stud attachment. Light-ga pour stop at MEP penetrations or similar conditions where no attachments made to deck edge/pour stop.
3) light gauge if not exposed Bent plate if exposed.
4) bent plate, light gauge for short overhang
5) Typically use light guage pour stop for overhang dimensions up to 4". Anything greater than 4" we use a bent plate.
6) light gauge pour stop if nothing loading edge, bent plate or angle if something loading edge or overhang is larger than 12"
7) 1/4" bent plate at exterior edges, gage plate at interior edges
8) Light gage unless bent plate is required at elevator openings.
9) Light gauge If I just need to hold back the concrete. Bent plate if I am supporting the floor with weak axis bending of the pour stop.
10) LG pour stop for smaller edges up to about 8" when there is no load on the edge. For loaded edges or larger edge distance, either a bent plate or a flat plate supporting a LG pour stop.
11) bent plate
12) bent plate w/ 1/2" studs at 2' o/c
13) For overhangs of 12" or less, the pour stop is nearly always gage metal unless the slab is extremely thick (greater than 5" concrete above the flutes).
14) light gauge
15) Light gauge at interior openings and edges; bent plate or steel angle where supporting stair or handrail connection.
16) Typical condition is light gauge pour stop.
17) bent plate or light gauge
18) Typically 1/4-inch bent plate
19) Bent plate or light gauge is typical.
20) light gage
21) Bent plate or light gauge. Bent plate if edge resists horizontal loads from cladding or other system.
22) 1/4" bent plate with a DBA that extends beyond the beam CL into the slab 1'-6".
23) Bent plate
24) Bent plate typically. Light gauge may be used for interior floor penetrations.
25) Light-gauge as allowed by SDI and bent plate elsewhere.
26) Bent plate
27) For internal shafts I usually specify bent plate to allow for mechanical system attachments, but for non-facade external usually flat plate with a light gage pour stop.
28) Bent plate for large dimension and for facade attachment/ Light gauge for smaller dimensions with facade not attached to face of slab edge
29) We (EOR) would spec a steel bent plate, but we would also allow light gage pour stops if the contractor wants to deal with that.
30) bent-plate
31) light gauge
32) light gage pour stop with detail "a"
33) 16 GA Bent plate with outrigger stiffeners every 24" OC
34) edge form by the metal deck supplier at typ conditions. if the slab edge is load bearing (like at a stair) a bent PL with D2Ls is used or more

4. Cell Closure Practices

1)
2) Cell closures not typically detailed but specified in specs. Steel deck supplier coordinates detailing, quantities, etc.
3) no, because deck will extend to edge of slab.
4) yes
5) Yes, typically a cell closure would be specified in the detail.
6) light gauge deck closure by deck supplier
7) no
8) No
9) Yes.
10) It is specified, but not always installed.
11) cell closures typically provided at every location where deck span is terminated.
12) Yes, by deck provider. Not indicated on typical structural detail though.
13) Cell closures are sometimes used. Other times, wire mesh or spray-foam are used to seal the cells. the method is selected by the contractor.
14) light gauge as established by the deck detailer
15) Yes
16) Cell closure is typically used.
17) intermittent cell closure
18) yes
19) Yes
20) per deck supplier
21) Yes
22) yes
23) Yes but we often do not call it out on the detail and let the deck supplier pick this up.
24) Yes, cell closure typically used.
25) As required by the deck manufacturer. We do not specifically detail.
26) closure angle on high flutes (i.e. not continuous)
27) I have tried to specify a paper or rubber dam at each open flute but always get push back to change to a continuous light gage closure. If they use a continuous closure I make sure the installer maintains 1" cover to the side of the stud.
28) yes
29) yes (how would you do it without a closure cell? concrete would flow through those open flutes)
30) We leave that to the metal deck supplier
31) yes
32) cell closure is used in with detail "a" when closure is placed on top of the deck.
33) N/A
34) not typically

5. Pour Stop Thickness

1) 1/4"
2) We use a table derived from ANSI/SDI-C-1.0Attachment C2 SDI Pour Stop Selection Table (ref. 2008 Vulcraft steel deck catalog, P. 63)
3) Select the thickness from SDI table based on slab thickness and a 1-2" cantilever. We generally leave to the deck supplier.
4) 12 gauge for short overhangs, 1/4" for longer overhangs
5) Not thinner than 16 gauge if cold-formed is used. 1/4" typically if a bent plate is used.
6) i use vulcrafts guide based on slab thickness and overhand dimension
7) 1/4" bent plate at exterior edges, gage plate at interior edges
8) 12-14 gage. Or 1/4" bent plate.
9) It varies with the overhang. For short overhangs, I often use the charts in deck catalogs to determine thickness. If specifying bent plate, that will act as a bending member, I choose the thickness based on bending strength and deflection. Even if I use the strength of the slab to support the cantilever, I will design the thickness based on a man standing on the edge of the pour stop.
10) Per the deck catalog depending on edge distance and slab thickness when LG. For bent plate, usually 1/4".
11) For 12" or less cantilever, bent plate thickness is typically 1/4" thick, unless there are heavy cladding supports. For heavy cladding thickness increased to 5/16" or 3/8" depending on loads.
12) 0.25 inches
13) For overhangs of 12" or less, the pourstop is gagemetal, and varies in thickness based on overhang and slab thickness. Minimum thickness is 20 gage; max thickness is 10 gage.
14) gauge metal, generally assessed by the deck detailer, but not thinner than 20 gauge.
15) 16 ga
16) Pour stop thickness varies based on the overhang length.
17) varies, upto 10 Ga
18) Depends on the thickness of composite deck desired- most cases it is 5 1/4 inch
19) Varies. Light gage is per MFR. If not light gage 1/4" is typical for mounting reasons.
20) 43mil min
21) 10ga. However, our details are usually sized larger for conditions beyond the limitations above.
22) We call for a 1/4" bent plate. Thickness does not vary. If the cantilever gets to be large we provide angle bracing and change from a bent plate to a L5x5x5/16 and extend the deck to the angle. That would be for cantilevers beyond 1'-2".
23) It is usually a steel bent plate. If a pour stop is used it would be 16 gage minimum.
24) 1/4"
25) See #3 above.
26) 1/4" up to 12".
27) Thickness of steel or light gage pour stop varies depending on overhang and concrete depth. For steel generally between 3/16" and 3/8" and for light gage generally between 10 and 18 gage.

28) 1/4 to 3/8" if facade attached to face of slab... 10 to 12 gage if facade does not attach to face and dimension is small
29) I (EOR) would spec 1/4 inch bent plate. If the GC wants to provide light gage material, then whatever they want. It's non structural, I wouldn't care.
30) 3/16 or 1/4 depending on the veneer and how it is supported at the edge of slab
31) 16 to 10 gage, depending if greater or less than 6 inches
32) for detail "a" pour stop is left to supplier and we call out 14 gage minimum.
33) 16GA
34) gage bent plate. if a steel one is required, it is usually 1/4"

6. Cell Closure Thickness

1)
2) Unknown, this is by metal deck supplier
3) We would generally leave the cell closure selection up to the contractor.
4) same gauge as deck
5) Typically 16 gauge
6) i dont know/care usually
7) n/a
8) NA
9) I don't usually specify a thickness.
10) Whatever the deck supplier specifies, usually 18-24 ga. It's not something we design, it's considered more like formwork, not really structural.
11) 20 gage
12) Specified by deck provider, but probably matches deck thickness.
13) Closure thickness is determined by the manufacturer.
14) gauge metal, generally assessed by the deck detailer
15) 20 ga
16) Thickness by contractor.
17) varies
18) Typically let the vendor of the deck spec out cell thickness based on conditions
19) Match the thickness of the deck.
20) per deck supplier
21) Unknown, supplied by deck subcontractor.
22) Up to the contractor.
23) As required by the deck supplier.
24) Typically gauge steel that matches the deck thickness.
25) See #4 above.
26) 22 gage
27) I have never specified a thickness or gage for a closure and leave it to the metal deck supplier/installer.
28) 20 gage
29) no idea. Probably whatever the thinnest light gage material they can get? Minimal force on the cell closure.
30) We leave that to the metal deck supplier

31) Not specified. Other details specify 20 gage.
32) We do not specify the thickness of the cell closure, we leave it up to the deck supplier. Deck suppliers usually provide a 20 gage closure
33) N/A
34) n/a see #4

7. Pour Stop Connection

1) 3/16" 3-12 welds.
2) (a) is how detailed. Welded via fillet weld at 2-12 pitch
3) b
4) a
5) Typically detail a weld of the pour stop to the top flange of the beam. Size and length of weld varies depending upon the overhang distance, but typically a minimum of 3" of 3/16" fillet weld.
6) b
7) connected to beam flange. our typical detail has it shop bolted with slotted holes for adjustment, then field welded in place.
8) B is the typical detail but some contractors prefer a to allow field adjustment of the EOS.
9) Typically, I connect the pour stop to the beam flange with a fillet weld. I typically specify 2"@12" o.c.
10) A. Connection typically welded to the beam, usually per the deck supplier's details for an LG pour stop. For bent plate, usually a periodic weld as designed depending on the loads at the edge.
11) Bent plate connected with 3/16" fillet weld 2" long - 12" on center. larger welds used if cladding is connected and bent plate is thicker
12) Stitch-welded to beam flange. 3/16" fillet weld, 3" long at 12" o/c.
13) pour stop is usually attached to the beam flange (a), not the deck. Attachment is most commonly a weld, 1/8"x1.5"@12" on center.
14) Condition a) is what we indicate in our structural drawings.
15) a - tack weld at 12" oc for light ga
16) Typically welded to the beam flange with 1" long fillet at 12" spacing
17) pour stop connected to beam flange, seen both welded and bolted
18) Typically use "a"
19) a - light gage puddle welded per mfr. a - at bent pl stitch weld 3/16 @ 3-12 ns & fs
20) weld to beam flange per deck supplier
21) Connected to beam flange, typically with 2-12 fillet weld. Occasionally bolted if needed for erection tolerances (on design-build jobs where contractor requests)
22) We use a bent plate for cantilevers up to 1'-2" and it is welded to the beam with a 3" long 3/16" weld at 12" OC. Anything over 1'-2" we switch to a L5x5x5/16 that is supported by angle bracing below. The angle is still welded to the steel framing in the same way.
23) a
24) (a)

25) A
26) a. fillet welded to beam flange
27) (a): 2-12 minimum fillet for lightgage otherwise 1/4" fillet 4-12.
28) A
29) always welded to the beam flange. For non-loading bent plate... I would say 2 inches on 16 weld. I've never seen condition b.
30) we weld the bent-plate to the top flange of the beam
31) 3/4-inch-diameter puddle weld every 12 inches.
32) Pour stop is connected with screws. The pour stop does not look like "a" or "b" in sketch's above. Pour stop is placed on top of the metal deck over the "c" shaped cell closure and then screwed to the top of the cell closure. We do not specify screw spacing, but typical there is one screw in the high hat down to the deck closure and screw is typically a number 10 tek screw.
33) Pour stop connected to beam flange
34) b

8. Additional Reinforcements Perpendicular to The Edge Beam and Slab Edge

1) We decrease the spacing from #3 bars at 12" on center to 6" on center at girders, but nothing specifically for an edge condition.
2) If there is a stair stringer or other appreciable gravity load supported by the slab or a cantilever > 12" (nominally) we would place bars over the support with 3/4" clear cover. The bar would extend into the backspan to either (1) adjacent purlin, or (2) a distance that creates an equilibrium on either side of the edge beam (i.e. when the idealized moment diagram crosses the x-axis). Typically a #4 or #5 bar is used. If we need the bar developed "instantly", we would weld a 30" deformed bar anchor (DBA), or A706 bar, usually #5 to a hot-rolled angle/bent plate, steel attached to deck similar to detail (b) of question 7, and lap the DBA/A706 with a longer piece of rebar as described above.
3) Would generally not provide top reinforcing for overhangs less than 6". Over6" would review plain concrete bending to see if reinforcing is appropriate.
4) For long overhangs, add #4's x 48"L @ 12" O/C
5) No
6) depends on if edge is loaded. reinforcing would vary based on loads.
7) not added steel, but usually a hook on the #3 or #4 typical bar.
8) Yes, typically #4 U bars at 12" OC (leg spacing)
9) For larger overhangs (>9"), I will use rebar aligned with the deck low rips. Usually I will weld it off to pour stop.
10) Only if there is load at the edge, and it depends on the pour stop. If the load is small and a bent plate pour stop can handle it, then usually no rebar. If the load is larger or a LG pour stop is used, then a hooked bar, usually #5 or smaller at 48" or less depending on loads is used at the edge, going back into the slab enough to have development length past the beam centerline. For some situations, the rebar may be welded to the bent plate pour stop, directly or via a coupler, instead of hooking the bar.

11) #3 U-bars @ 24" on center, #4 U-Bbars at a closer spacing if there are heavy cladding supports
12) Yes. We use a #4 bar w/ standard hook, tied to the studs on the bent plate pour stop.
13) For slab overhangs up to 9", no additional rebar is provided. For overhangs 9"-12", #4@18" top bars are provided.
14) we call out #4x5'-0"@12" reinforcing when 3 or more studs are on the beam per foot. reinforcing is centered on the beam, and has a hook when the slab edge is closer than 2'-8".
    We also call out reinforcing akin to this example for cladding loads, but cladding loads are not considered in this question.
15) Yes - depends on overhang dimension and the load on the cantilever edge.
16) Additional #3 bar perp. to the edge typically at 18" spacing. Bar is developed by hooking around a continuous edge rebar.
17) #4 at varying spacing based on cantilever span
18) Yes, typically have crack mitigation steel at the edges- since this example is not to consider attached facade- it would be roughly #4 @18" with 180 hooks.
19) yes. typically #4 @ 16"oc if we do bent plate over 10" long we do DBA's at 24"oc that are 48"l.
20) for 6" overhang, no added reinf
21) Only the typical slab bars, we usually use #4 @ 12".
22) No additional reinforcement beside the typical slab reinforcement.
23) Yes. For slab edges 6" or less, it is a 1/2" diameter x 2'-0" DBA @18" on center, For slab edge longer than 6 inches there is the above mentioned DBA plus a #3 @18" on center that extend 3'-0" back from the beam centerline and lapped with the DBA.
24) For short slab overhangs, additional reinforcement is not typically required. For larger overhangs, and if the slab edge is not supported otherwise (kickers or outriggers), then may use up to #4's as required to design slab edge as cantilever. Often will use DBA's welded to the slab edge in these cases.
25) 1/2" DBA extending one development length past beam centerline at 12" OC or matching slab reinforcement locations (whichever is more stringent) or as required for progressive collapse.
26) Deformed bar anchors (DBA) welded to the bent plate.
27) Perpendicular to the slab edge I provide a 180-degree candy cane bar to match the spacing and size of the basic slab reinforcement. Usually ends up being #3@12" or #4@15".
28) Yes. Depends on slab edge dimension and facade type. #4 or #5 @ 12" is common
29) no.
30) #4 @ 12 with a 180 degree hook
31) No. Not with edges less than 12 inches.
32) Yes, A #4 with a 180 degree hook perpendicular to the beam. Bar extends past the beam a distance equal to the cantilever length plus the bar lap length minimum, but not further than the adjacent beam (to resist the slab live load moment and superimposed dead load)
33) #4 @12OC

34) if it is not at a stair, or other large load bearing edge, the usual reinforcement is a #3 hook around a #4 horizontal bar. reinforcement is not used if the slab edge distance is less than 6in

9. Additional Reinforcements Parallel to The Edge Beam and Slab Edge

1) We don't require anything beyond the general slab reinforcement specifically for the edge. We do have them provide an additional bar at the beam along the studs, though.
2) If not part of a diaphragm, typically not. If this was subject to out-of-plane wind loading and headed studs (attached to vertical leg of angle) were embedded into the slab, this bar may be provided for "higher" loadings. "Higher" loadings would probably be >500 plf strength.
3) Would provide parallel reinforcing if perpendicular reinforcing is required.
4) #4 continuous
5) No
6) only for diaphragm reasons
7) we show (2) continuous vertically stacked bars parallel to the beam.
8) Yes, continuous #4
9) No
10) No
11) 1-#4 continuous minimum, if chord reinforcement is required that is added to this quantity
12) Yes. We specify a continuous #4 bar either along the edge beam studs or as indicated in the example detail above.
13) Yes, a #4 nosing bar is provided.
14) For good practice we call for a continuous #4 parallel reinforcing in the location illustrated.
15) No
16) Typically a #4 continuous edge bar is provided.
17) 2-#4 cont.
18) Assuming non diaphragm condition- typically we have 2-#5 continuous
19) Yes #4 @ 16"oc and our typical chord bar is min 2-#5 regardless of lateral loads.
20) (1) cont #4, location from edge not explicitly called out
21) Yes, to match slab bars. #4 @ 12" typical.
22) No
23) No we typically do not specify this.
24) For the stated case of 12" or less overhang, additional parallel reinforcing is not typically used. If overhang is longer and slab edge is cantilevered, then will add 1-#4 at edge to hook perpendicular bars around.
25) Continuous #5 bar around the perimeter or as required for progressive collapse.
26) Yes. #5 continuous
27) If the slab edge is a steel bent plate with headed studs usually (2) #4 continuous along the slab edge. For a light gage pour stop just a #3 or #4 to match the slab reinforcement.
28) 1 # 5 cont

29) The answer to your question is No. However, we almost always have a bar there for diaphragm reinf (Your note is unrealistic... when is the composite slab not a diaphragm?)
30) 1 - #4 continuous under the 180 degree hook of the orthogonal bar
31) #3 continuous, 1 inch clear
32) Yes, A #4 continuous bar (minimum) that is placed in the 180 degree hook (see previous detail for hook bar). When parallel bar is a diaphragm chord bar, the bar may be larger and there may be multiped bars. Pending column locations, the parallel bars may be shown on the drawings as placed on the right side of the beam in the detail above so that the chord bars are not interrupted by the column that is supporting the beam.
33) If the overhang is more than 6" 2-#4 cont.
34) #4 bar if the hooks are there. see #8

10. Horizonal Studs, Dba or Other Anchors Connected to The Bent Plate

1) Not headed studs, but 1/2" diameter deformed bar anchors that are 1'-6" long minimum but require them to span 1'-0" past the beam center line and are spaced at 12" on center.
2) Typically we would use (a), studs would be 18"-36" OC typically. We would use (b) at unique conditions, such as supporting veneer or stair stringers. If the concrete above the flutes was "small" (2.5" or less) we would probably use (b) at railing connections where the deck is parallel with the edge beam.
3) Would not provide headed studs or DBA's.
4) b, only for long overhangs
5) Yes, typically we detail a 1/2" dia X 2'-0" long deformed bar anchor be attached to the vertical leg of the bent plate spaced at 18" on-center.
6) only if edge is loaded
7) only if there is an attachment of the exterior wall to the bent plate.
8) Only if bent plate is being used and there are external loads applied to the BPL
9) For larger (>9") overhangs, I will specify rebar (or deformed bar anchors) to be welded to pour stop.
10) Only if it is a loaded edge, and particularly if the load is horizontal pulling on the pour stop, such as wind suction from a curtain wall attachment. Stud or bar size or spacing depends on the load.
11) 1/2" diameter studs, 8" long at 24" on center. Spacing of studs and thickness of bent plate may be increased if there are heavy cladding support.
12) (a) horizontal studs, 1/2" diameter x 4" long, spaced at 2'-0" o/c.
13) Such studs or welds would only be used for a direct attachment (such as a railing or a facade anchor) to the exterior face of a bent plate. Absent those conditions, these lateral anchors would not occur.
14) We would show studs or DBA at condition a) or b) only in cases of resisting cladding loads that apply loads to the bent plate.
15) a - size and spacing depends on loading on the bent plate
16) We only use a DBA where we expect concentrated loads at the slab edge.
17) no

18) Typically we do not use this type for non facade conditions. When we have curtain wall, or brick we have transitioned to "b" with DBA's. Typically #4's and length is developed passed the CL of the beam
19) yes. typically DBA at 24"oc but not always. sometimes studs.
20) for 6" overhang, no added anchor
21) Only if needed for lateral loading applied to face of bent plate. (Or longer conditions excluded by the 12" assumption above.)
22) Yes, we require a 1/2" DBA at 2'-0" OC that extends 1'-6" past the beam CL.
23) b. 1/2" diameter x 2'-0" DBA @18" on center
24) Additional studs or DBA's are not typically added to edge bent plate unless they are supporting specific additional load (curtain wall, brick supports, exterior cladding, etc.).
25) B (see #8 above).
26) b. 1/2" diameter DBA x 2'-0" at 1'-0" oc.
27) With steel bent plate for interior slab openings I provide 3/4"x10" stud under the assumption that someone will want to connect to it at some point. If the slab edge is exterior and we know nothing needs to connect to the slab edge then no.
28) Sometimes. Depends on facade attachment. We sometimes weld deformed bar with heavy facade connection welded to face of slab
29) No (I understand in your example, the slab edge is not supporting exterior wall). However, exterior slab edges are almost always supporting exterior wall, and we (EOR) commonly specify DAS (b) in those cases. Sometimes studs (a), but then we would be lapping on some candy-cane rebar.
30) We use horizontal studs only if the brick shelf angle is to be welded to the bent plate. The studs are typically 1/2 or 5/8, and the spacing depends on the height of the brick supported.
31) No. Not for edges that don't support additional loads, such as facades.
32) no.
33) No
34) D2Ls if it's a large load bearing edge, like at a stair

11. Change In Responses for The Case Where The Metal Deck Is Oriented Parallel to The Edge Beam And Slab Edge

1) No
2) If we are trying to put a point-moment at the slab edge we would rely on only the concrete above the flutes as the flexural member cross-section. In those cases, we would often rely on the DBA anchored to the slab edge, lapped with a longer rebar in the slab.
3) Pour stop gage will vary based on SDI table - possibly more likely to use a bent plate. Cantilevers more than 2" or so past the beam flange will generate check for plain concrete bending.
4) same responses
5) No. Typically use the same details.

6) yes, as noted in above answers
7) no. we use the same detail for both conditions with the deck stopping at the beam.
8) Overhang cannot be handled with deck.
9) I would likely not use rebar welded to the pour stop.
10) No. The edge beyond the beam is treated as its own condition independent of what the deck is doing. The only time it would matter what the deck direction is would be for a large cantilevered slab, and in that case the deck would be turned as needed so that it can cantilever over the beam out to the cantilevered edge.
11) No, same bent plate used.
12) No, except that a cell closure would likely not be present.
13) Answers are the same.
14) No
15) No
16) Typical cases are the same for this condition.
17) no
18) No change here for small slab extension
19) answers are very similar if not the same.
20) no
21) Not significantly.
22) No
23) They are treated the same,
24) No. Details are generally the same for both conditions.
25) We treat condition as the same.
26) No change.
27) No
28) yes. Less d for reinforcement. Need to adjust accordingly
29) I don't think that changes anything...
30) Same
31) No
32) yes nearly all of the responses change (beam as shown above is typically a girder beam). When the metal deck is parallel to the beam, we have multiple details that vary based on the length of the cantilever. For short cantilevers (less than 12"), there is a bent plate that is 16 gage minimum bent plate up to a 3/16" bent plate at 12" cantilever. Bent plate is welded to the beam flange with a 3/16" by 1-1/2" long fillet weld at 6 inches spacing. For larger cantilevers we place a section of metal deck that spans between angle kicker frames to support the deck (and live loads). In all cases the is slab top bar (1" cover) with a 180 degree hook that is perpendicular to the beam and there is a #4 bar in the corner of the hook parallel to the beam.
33) No
34) 1: max is 15". 2: b. 3 through 6: same answers. 7: a. 8: same answer except reinforcement is not provided if the edge distance is <4.5". 9 and 10: same answers

12. Change In Responses for The Case Where The Slab Edge Supports The Facade or Other Elements

1) No, not generally. If it's going to support vertical load we will analyze the slab edge and deformed bar anchor to verify its capacity and then provide bracing as required.
2) Yes, answers provided in above questions
3) Would likely not use a light gauge pour stop but rather a bent plate. Bent plate would likely have headed studs or deformed bar anchors. If wind load is high enough, might use welded reinforcing bar to resist tension. More likely to have top reinforcing especially if supporting facade weight.
4) The answers for 8, 9 and 10 would depend on analysis of the loads imposed by the facade. Longer anchors or tighter additional rebar spacing may be required
5) Yes. If the slab edge is supporting facade, only a bent plate will be used for the pour stop.
6) would likely be bent plate/angle with welded on das or headed anchor stud, potentially also added reinforcing based on overhang length and loads
7) yes. added reinforcement as required for the loads imposed. depends if it's curtain wall, light gage stud, etc., but usually welded rebar.
8) Yes
9) I would not use light gauge pour stops, and I would be more likely to include rebar.
10) Yes, as described in those answers. Generally this would trigger a more detailed design of the edge and could mean switching from an LG pour stop to a bent plate and/or adding reinforcing to the slab or attached to the pour stop, or adding kickers to support the edge.
11) Yes, thicker bent plate (5/16" or 3/8"), closer spaced studs (12" or 8"), heavier weld to beam (1/4" or 5/16" fillet weld 3 @ 12) if required.
12) If providing out-of-plane support only, we would prefer to make the connection above the top of slab for easier access (as opposed to what is shown in the example detail). In this case, an embed would be provided in the top of the slab for the facade/wall supplier to connect to, typically some sort of angle or proprietary system involving vertical and maybe in-plane slots to allow relative movement between the facade and slab. ACI provisions would be used to check the slab edge for the out-of-plane forces, typically neglecting any stiffening or confining contribution from the bent plate pour stop.

    If providing vertical support, the slab edge would be checked as an RC section to determine added reinforcement, or else regularly-spaced gusset plates would be added below the slab edge and designed using AISC provisions. Additional bracing for the end beam would be provided if necessary to resist the twisting from the eccentric loading.

    Another condition would be if a handrail were attached to the bent plate pour stop around a large opening. In this case, the bent plate would either be thickened or added horizontal studs provided to enable the load transfer from the handrail post into the slab.

13) See response to question 10 for what occurs in this case.
14) Yes, in the case of supported cladding there woudl be reinforcing perpendicular to the beam to handle the downward bending upon the cantilever. We delegate the cladding attachment, so the connection (black horizontal line in the image) would be by others.... but commonly ends up being a 1/4 inch steel plate with a couple studs, normally on the top surface of the slab.
15) No, however bent plate is used for some types of cladding connection details.
16) If connecting to an architectural element, we change the edge form to a bent plate or rolled angle with welded orthogonal reinforcement.
17) yes
18) Yes, depending on the system we would have DBA to the bent plate. Additionally, with slab edge greater than 8", we would introduce a gusset plate beneath the bent plate at 4'-0" max spacing.
19) it would always be 1/4" bent plate with DBA's then.
20) yes, depending on weight of facade (precast?) element; thicker edge form with horizontal anchors welded to edge form.
21) Assuming lateral-only support -- we change to a bent plate and often add studs or DBAs to carry loads into the slab. May also require additional slab rebar. For vertical support, it depends on the magnitude of loads but likely includes bent plate, DBAs, and/or additional rebar.
22) No, but if loads are heavy we will do a check of the cantilevered slab edge design to verify it is enough for the specific load and reduce the DBA spacing as needed.
23) Not really except we show a clip for metal studs.
24) Yes. For conditions where the slab edge is supporting exterior cladding or components, DBA's would generally be used to prevent the edge angle from pulling away and to ensure direct load transfer to the slab.
25) Depending on the facade and attachment requirements, we would size the deck edge thickness to receive required fasteners from facade attachment. Additional beam bracing may be required.
26) Yes. DBA designed to transfer load and reinforce cantilevered slab edge.
27) The answers change only in that the slab edge is specifically engineered as opposed to a "typical" detail condition. Generally the answers above are applicable but the slab edge will default to steel bent plate.
28) Yes... May need thicker plate or more reinforcement. Be careful on the details
29) Yes - this completely changes everything. And this is the most common condition. AND the engineering solution is super complicated. It's a huge challenge for us to design for the many slab edge loading conditions that occur on a project. Especially if we strive to provide an economical solution. We have thicker bent plates. We may have kickers. We probably have 30" DAS. And we probably have 8 foot rebar lapped back into the slab.
30) Yes, as noted in responses above
31) Use 1/4-inch bent plate with deck stiffener (if extension greater than 9 inches) welded with 1/4 fillets both sides 2 inches every 12 inches.
32) Yes. When slab edge supports the exterior wall, then we always use a bent plate (5/16" or 3/8" thick) with #4 or #5 deformed anchor studs (or A706 bars) welded to the top of the bent plate with 1" of concrete cover. Spacing of deformed anchor stud varies based

on the load being applied and location of load (at curtain wall mullions there may be multiple bars centered on a mullion). The deformed anchor stud length is set based on the lap length need to lap the bar welded to the plate to the slab reinforcing top bars. Slab reinforcement length varies but often extends as far as the adjacent beam.

33) Case by case
34) usually, facade attachment is not done to the slab edge. we try to use the beam for that where possible

13. Geographic Regions The Participants Typically Design For

1) Southwest
2) Midwest
3) Midwest
4) Southeast
5) Midwest
6) Southeast, Midwest, Southwest, West
7) West
8) Southwest
9) Northeast
10) Northeast
11) Midwest
12) Southeast
13) Northeast, Southeast, Midwest, Southwest, West
14) Northeast, Southeast, Midwest, Southwest, West, Hawaii
15) Northeast, Southeast, Southwest
16) Southwest
17) Northeast
18) Southeast, Midwest, Southwest, West, Typically not in CA
19) West
20) West
21) West
22) Southwest
23) Southwest
24) Southwest
25) Northeast, Southeast, Midwest, Southwest, West, Projects outside the US.
26) West
27) Northeast
28) Northeast
29) West
30) Southeast, Midwest, Southwest, West
31) West
32) Midwest, Southwest, West
33) West
34) West, Washington

14. Additional Comments, Description, Clarifications, or Other Information

1)
2)
3) For questions 1-11 I also assumed that the edge does not support a railing. If a railing is present, the answers would have changed similar to question 12.
4)
5)
6)
7)
8)
9)
10)
11) Typically provide steel bent plates at the slab edges and follow the design procedures outlined in AISC Design Guide 22.
12)
13) It is strongly encouraged that the minimum lateral dimension of 1.25", not 4", be used in these tests. Also, if a significant capacity reduction is found, is there extra rebar in the flutes (or taller studs) that would resolve the issue?
14)
15)
16)
17)
18)
19) We typically have even more bar for lateral around the studs. But what is said is the minimum regardless of lateral loads.
20)
21)
22) These responses are all based on the typical slab configuration we use. 99% of the time we have a 2 VLI 20 gauge deck with 3" concrete over the flutes (5" total). We rarely use a 3" deck.
23)
24) 1. If possible, standard size angles will often be used as edge closures to reduce fabrication costs of a bent plate.
2. 12" from cl of beam is generally beyond the limits of just a bent plate edge angle. Typically a bent plate can be effectively used for up to 6-8" from cl of beam. Beyond this, (shop welded) outriggers would often be used to provide additional support, both during construction and post-installation, to limit deflection at the edge.
25)
26)
27)
28) I would be interested in seeing the results of this survey.
29)
30)

31) XXXXX US standard detail
32) At interior mechanical openings in the floor slab we provide a 5/16" bent plate with #4 deformed bars spaced at 12 inches on center (top) on all sides of the opening so that mechanical supports can be welded to the plate
33)
34)