Slamgeesh Smolt Fence 2008

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Table of Contents

2

Abstract

In April and May 2008 we modified our Slamgeesh counting weir to support fan traps recycled from the Fulton River sockeye spawning channel. This involved construction of adapters to fit the existing weir trusses. The adapters are hinged on the downstream edge and connected by rubber gussets to the adjustable traps. Live boxes were fabricated to collect the smolts from each trap. A high-line system was constructed to move the heavy traps into place along the weir. Fishing the fan traps required raising the level of Slamgeesh Lake by 74 cm. Unfortunately the weir failed during the rapid rise of the nival flood on May 15, 2008. The failure mode is described. The weir was repaired in July 2008 and effectively used for adult enumeration. A simpler design of smolt trap was fabricated in April 2009 that functioned successfully through the snowmelt flood, one of comparable intensity to that of 2008.

Introduction

For the past decade the Gitksan Watershed Authorities (GWA) has been collecting biological data on salmon from the Slamgeesh watershed (Figure 1) in the upper Skeena about 160 km north of Hazelton. Part of this sampling involved enumerating and tagging coho and sockeye smolts from 2002 to 2005. During these years a fyke trap and an inclined plane trap (IPT) were used to collect juveniles. Between 9% and 26% of the migrating smolts were trapped successfully (Hall *et al*, 2006). However, each trap had variable efficiencies during the season. This was mitigated to some degree by the complementary behavior of the two traps as the fyke worked best at high flows and the IPT at low flows.

Channel changes on Damshilgwet Creek in 2006 and 2007 eliminated the possibility of fishing an IPT. This increased our interest in a weir-based system to trap and count smolts. The northern fund of the Pacific Salmon Commission graciously awarded us a grant in early 2008 to cover much of the expenses of this installation. The concept was to use large fan traps recycled from the Fulton River sockeye spawning channel and to modify the adult counting weir constructed in the summer of 2007 to

3

support them. The proposed activities included fabrication and installation of a set of smolt barrier panels, live boxes and connectors, adjustable jacks, adaptors for mounting the acquired traps and an improved highline system to move the heavy traps into position.

Description

Fence Structure

The foundation of the weir consists of 2 large cement piers, each about 4 m^3, and a series of 18 interlocking 0.8 m^2 concrete slabs crossing the stream. Each slab has a pair of clevises that attach aluminum trusses to form the framework of the fence. Adult fence panels can be slid into the spaces between the truss assemblies. Smolt panels were fabricated to block juvenile movement. These screens fit upright in the upstream H-beam channels of the weir trusses. They are simple screens, 36”x 72” (91 x 182 cm), made with a frame of 1½” (38 mm) aluminum channel and are filled with 1/4” (3/8” stagger) perforated 18 gauge sheeting. The bottom edge was ensured to fit closely along the cement sill. In use, the upstream panels were backwatered by a dam constructed of red cedar blocks set in the downstream channel position of the trusses (Figure 1). The height of block layers could be adjusted by 3” intervals.

Figure 1. Fence structure shows screens in upstream position and traps mounted with adaptors.

Traps and Adaptors

A set of used fan traps was acquired from the Fulton River sockeye spawning channel facility that was used on the pilot scale Spawning Channel A in the 1970s and 1980s. Three of these fan traps were adapted and mounted in the base structure of the weir (Figure 1, 2). The trap entrances were slightly wider than two of the weir units so we needed to design and fabricate adapters to fit into the double weir spacing on the upstream side (Figure 3) and to have a hinge and gusset structure on the downstream side to mount the trap and provide vertical adjustment (Figure 1). The fan traps worked by controlling flow on perforated incline planes. Stainless steel turn jacks were custom fabricated and mounted to the traps ends for altering trap slope and height (Figure 3).

5

Figure 2. Three fan traps in position mounted in the Slamgeesh Weir.

Figure 3. Screw jack mechanism to adjust downstream trap height.

6

Live Boxes and Connectors

The three fan traps were connected to separate live boxes via 6” stainless steel tubing. The tubing had adjustable sleeves and elbows to compensate for jack movement of the trap ends (Figure 4). The live boxes were made of aluminum sheeting and perforated plate, approximately 72” long, 30” high and 30” wide (Figure 4). The footings were bolted onto cement blocks which were dug into the stream bed on the up and downstream ends. Each had two aluminum lids for easy access.

Figure 4. Smolt system assembled May 7th with three separate capture units.

Installation Structures

A highline transport system was constructed with 5/8” wire rope and a chain hoist on a pulley system to move the heavy traps into position. The ends of the central span were elevated with 20 foot lengths of 2” drill pipe. This provided sufficient clearance to move trap units over the erected sections of the weir.

Development

Pre-fabrication took approximately 10 days; the on site fabrication and construction took 5 days. Design was completed by the end of March by an engineering technician, Eli Brook. Fabrication was completed with the help of three parties, Terrace Steel, Alumafix (Hazelton, BC) and Derek Kingston from Gitanyow Fisheries. Seasonal

7

field staff was used for most of the construction labor. The stream was closed off and smolt fishing begun on May 7, a few days later than in previous years but well before the ice melt on Slamgeesh Lake which occurred on May 16th. The spring peak of the sockeye smolt migration usually coincides with the ice melt timing, or follows within a few days.

Function

Mechanical Operations

During the initial trap operations from May 9th to May 15th, we were able to evaluate the trap design and function. Capture of smolts was successful, especially in the fan trap at the deeper end of the cross section on bank right. In this period we caught nearly 1000 smolts. The amount of flow to transport fish through the trap was enhanced when the bottom grooves of the trap were lined with strips of solid aluminum blocking part of the perforated screens. The jacks required some mechanical adjustments as well. Devices to trap weeds were necessary as flow was easily restricted, since the openings at the end of the traps were only 10 cm and were easily blocked.

The fan traps were designed to fish in deep rectangular concrete channels. They require about 70 cm of water depth to work well. Consequently we backed up the Slamgeesh Lake system about 74 cm with stop logs. This increased the effectiveness of both the trap and the perforated screens. Unfortunately it resulted in part of the stream flow being diverted through a swamp to the east of the weir. On May 12 this amounted to 38% of the total flow.

The cold late spring weather abruptly changed on May 14 and temperatures reached 30^{o} C. The stream level at the Slamgeesh weir responded rapidly and by May 15 the water levels were rising several cm per hour (Figure 5). The weir structure failed. At the time of failure the discharge was approximately 8 m^3 /sec. The stream stage was 0.808, a typical spring peak flow level. The stage reached its highest level of 1.099 m on May 27th, 2008. This was a high spring flood level but not extraordinarily so. It was exceeded three times in the past nine years.

8

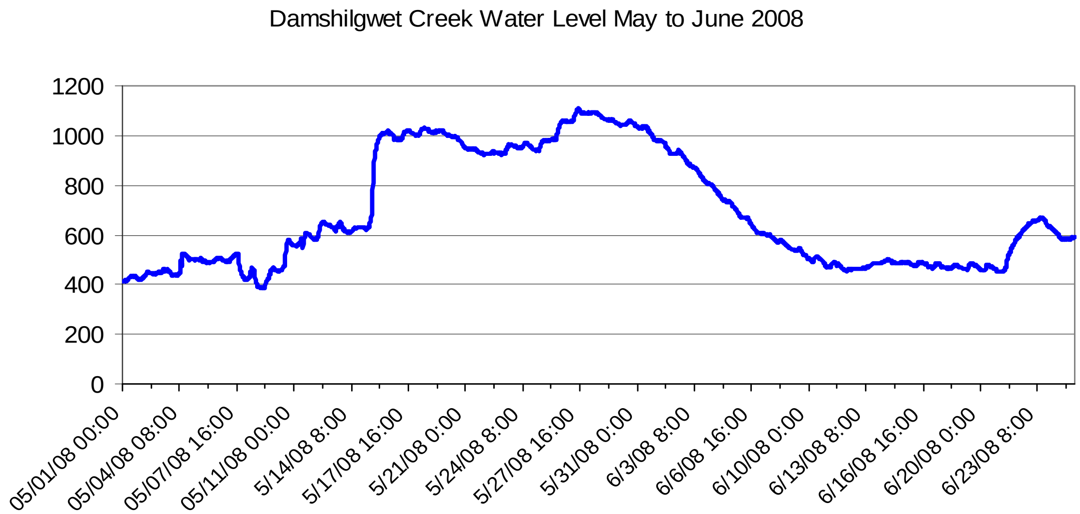


Figure 5. Damshilgwet Creek water level in mm from May 1st to June 25th, 2008. Weir failure occurred on May 15 about 15:00. The vertical scale is in millimetres.

The weir failure occurred near the top of the 200 mm vertical rise section on May 15 (Figure 5). We observed the weir structure failure. The overall structure bowed downstream over a few seconds and the weir components separated with many of them being washed downstream short distances. About 50,000 m3 of water was released by the collapse of the weir. At the time of failure, the stream flow was increasing so fast that the weir failure did not result in a drop in stream level and high stages persisted for about two weeks.

After the flood passed we were able to reconstruct the failure mode. It involved compressive failures of the concrete foundation blocks on the upstream edges and interlocking tongues which allowed the structure to bend until it failed. Since the weir is constructed out of interlocking modules, there was little damage to the component pieces.

9

Our weir reconstruction was undertaken in July 2008. We drove 1.5 m lengths of 2 inch drill pipe (63 mm ϕ) into the stream bed at the downstream edge of the weir on 30 cm spacing. (Figure 6) This provides three support points downstream of each weir block and should make translation failure of the sort we experienced on May 15 2008 much more unlikely. The weir was used to support an adult fence in August through November 2008 and performed flawlessly. No adult salmon passed the fence uncounted as verified by mark and recapture experiments.

Figure 6. Placement of steel drill pipe sections along the downstream edge of the weir, August 2008.

10

A low concrete wall was constructed August to October 2008 to block off all flow through the swamp to the east of the weir during floods. The top of the constructed weir is at a stage of about 980 mm. This is high enough that fall floods do not pass over the wall and coho do not attempt to jump the barrier. The largest spring floods will slightly exceed this level. The peak flood level in 2008 was 1050 mm.

Smolt Trap Installation in 2009

In 2009 we installed a more modest smolt fence design, one that did not require backing up the Slamgeesh Lake system nor did it attempt to filter all of the flood flows through perforated plate. This trap is a 6x6 ft fyke trap with two fykes (Figure 7). It functions in water 15 cm deep. High velocities in the intake area prevent smolts from leaving the trap. Problems with floating vegetation and debris were avoided by building a barrier upstream with 5 cm mesh that captures most of the debris. The trap was set up in the position used by the rightmost fan trap in 2008.

11

Figure 7. Fyke trap installed at Slamgeesh Weir in May 2009.

The fyke trap seems to be more efficient at catching sockeye than the traps used in previous years. Preliminary analysis suggests that the catch rate is more stable at various stages than in previous trap designs. The simple fyke trap functioned during a prolonged spring snowmelt flood with peak stage over 1000 mm for seven days. We used mark and recapture experiments to calibrate the trap. Preliminary efficiency calculations suggest the trap fishes at about 20% efficiency for sockeye and 2 to 10% for coho.

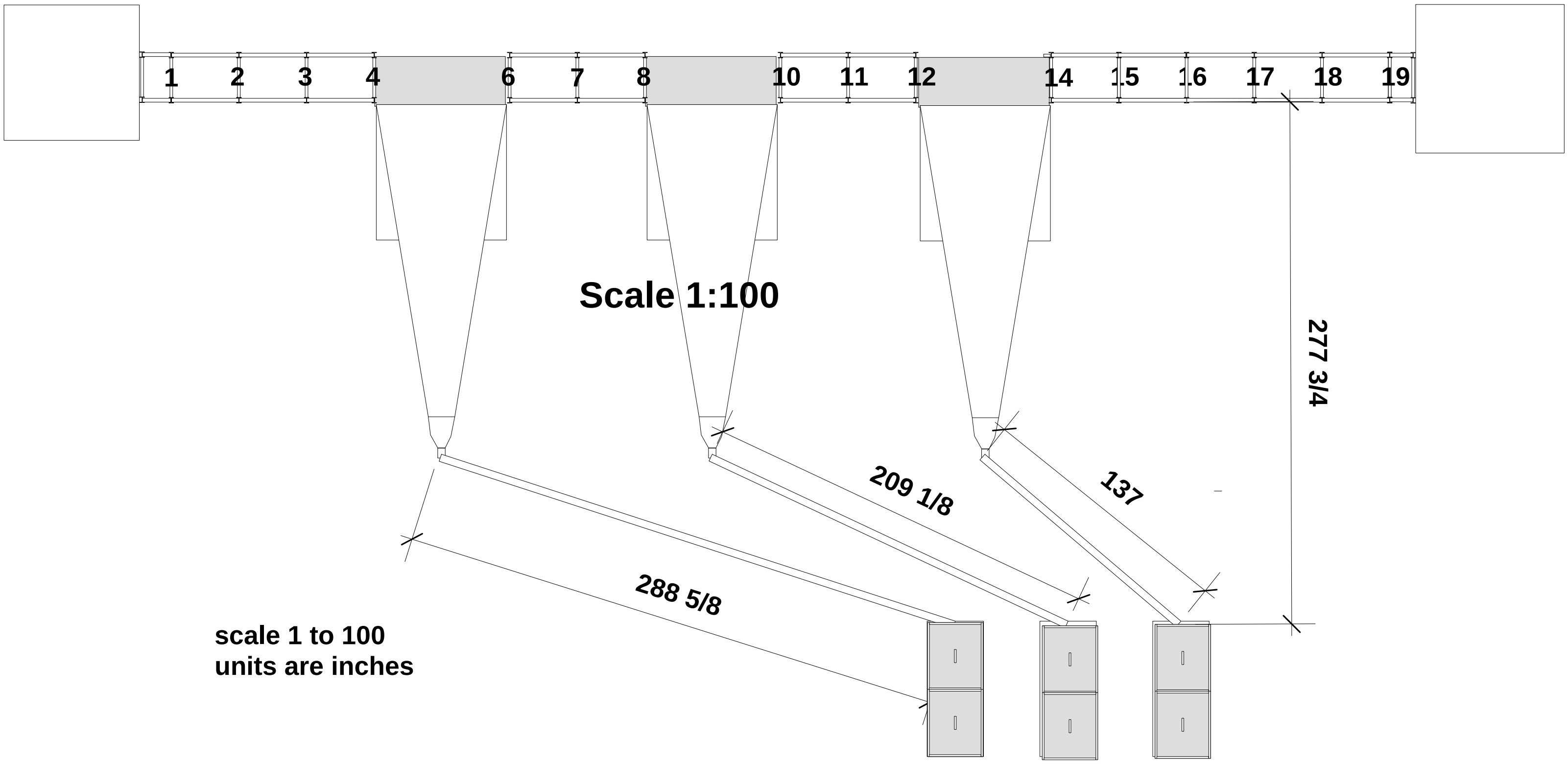
12

Appendices

Scale Drawings of 2008 Smolt Trap Components

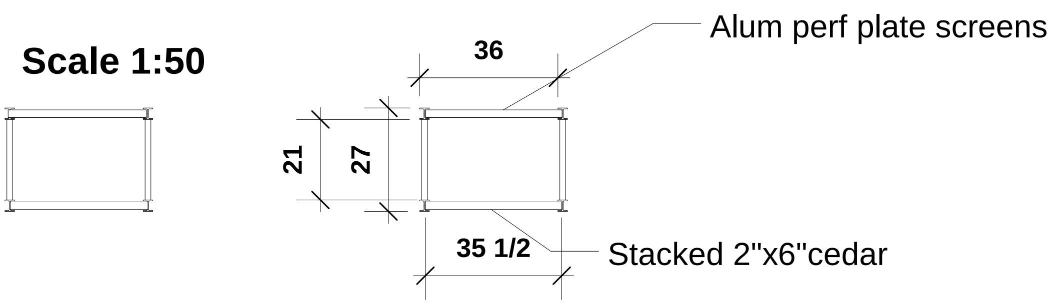
13

Scale 1:100

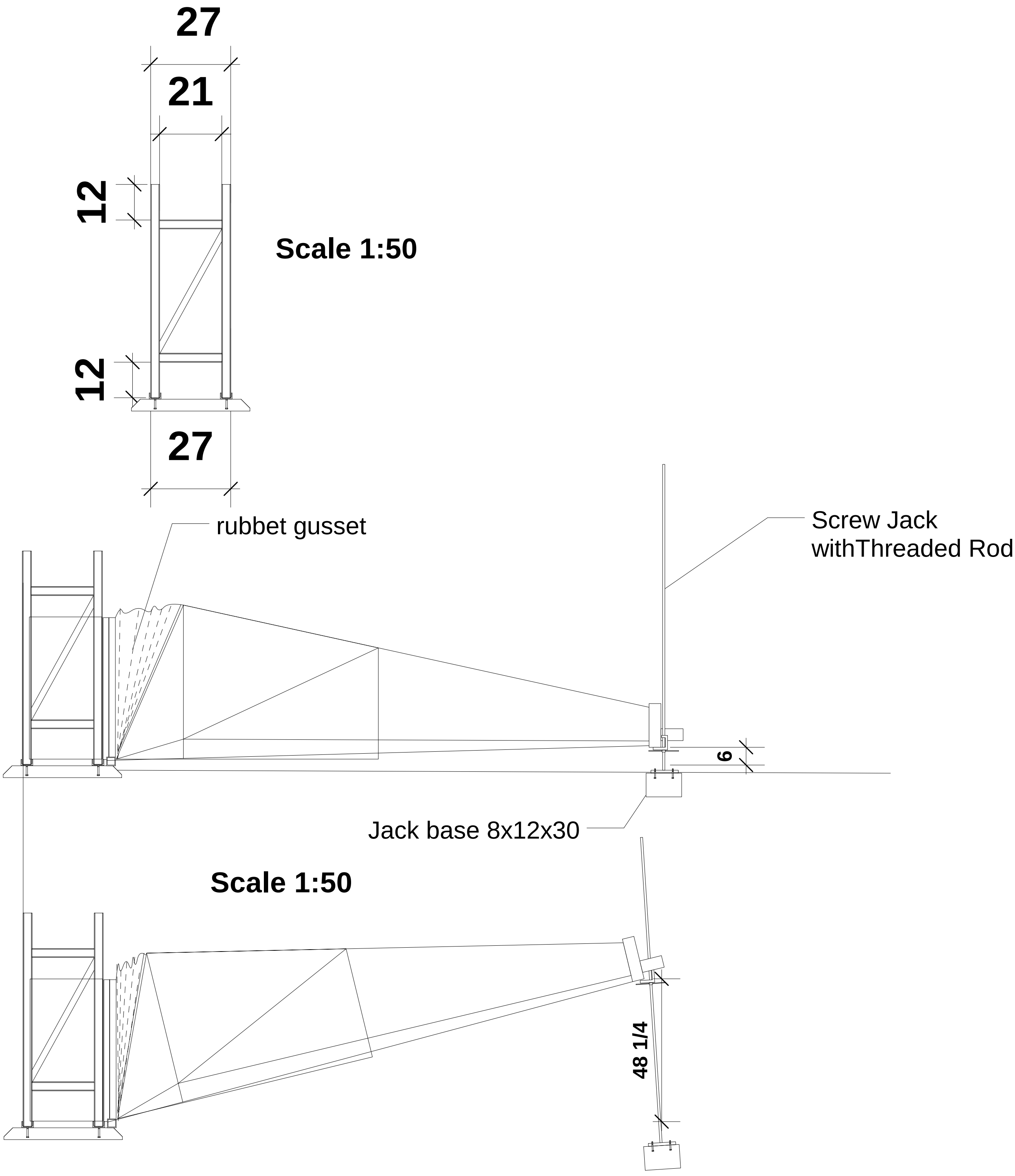


scale 1 to 100
units are inches

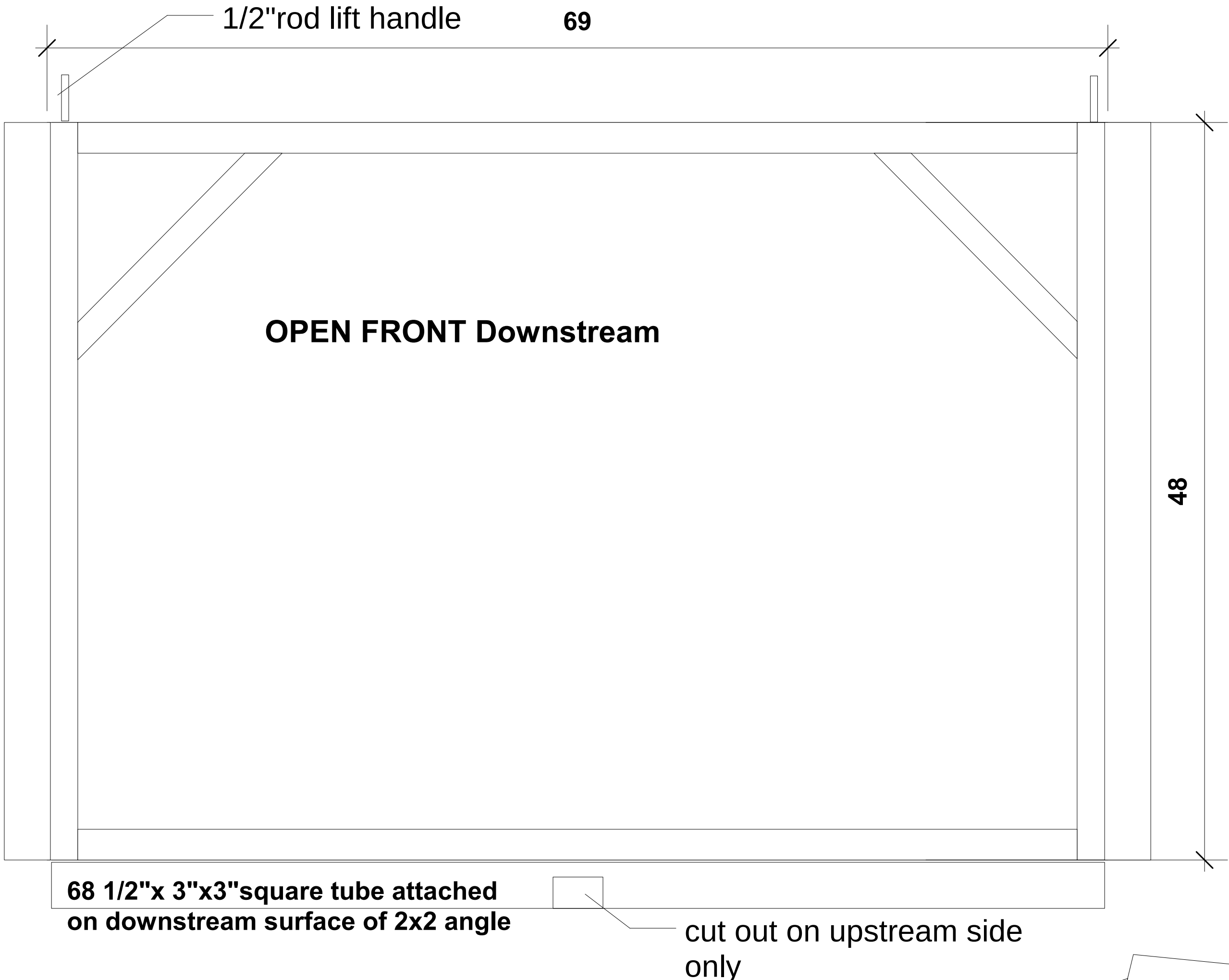
Scale 1:50

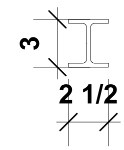


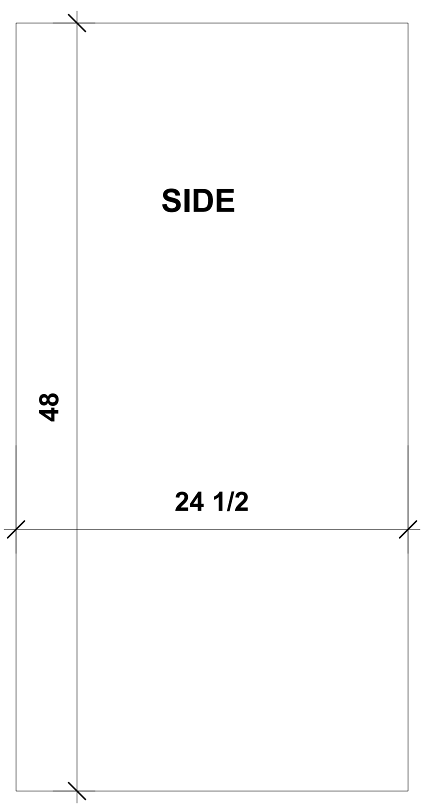
Slamgeesh Weir and Fan Traps
Page 1 of 2

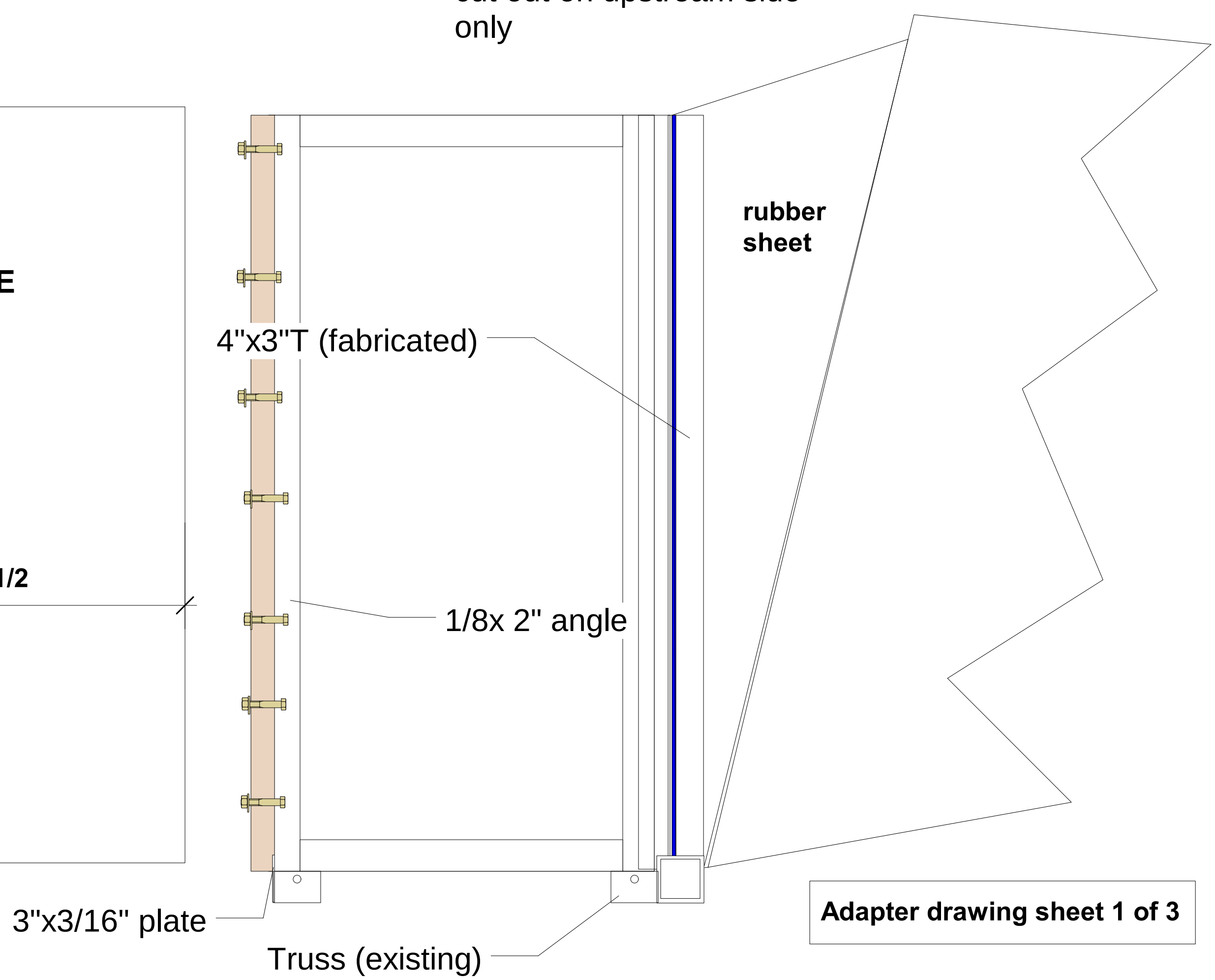


Slamgeesh Weir and Fan Traps
Page 2 of 2

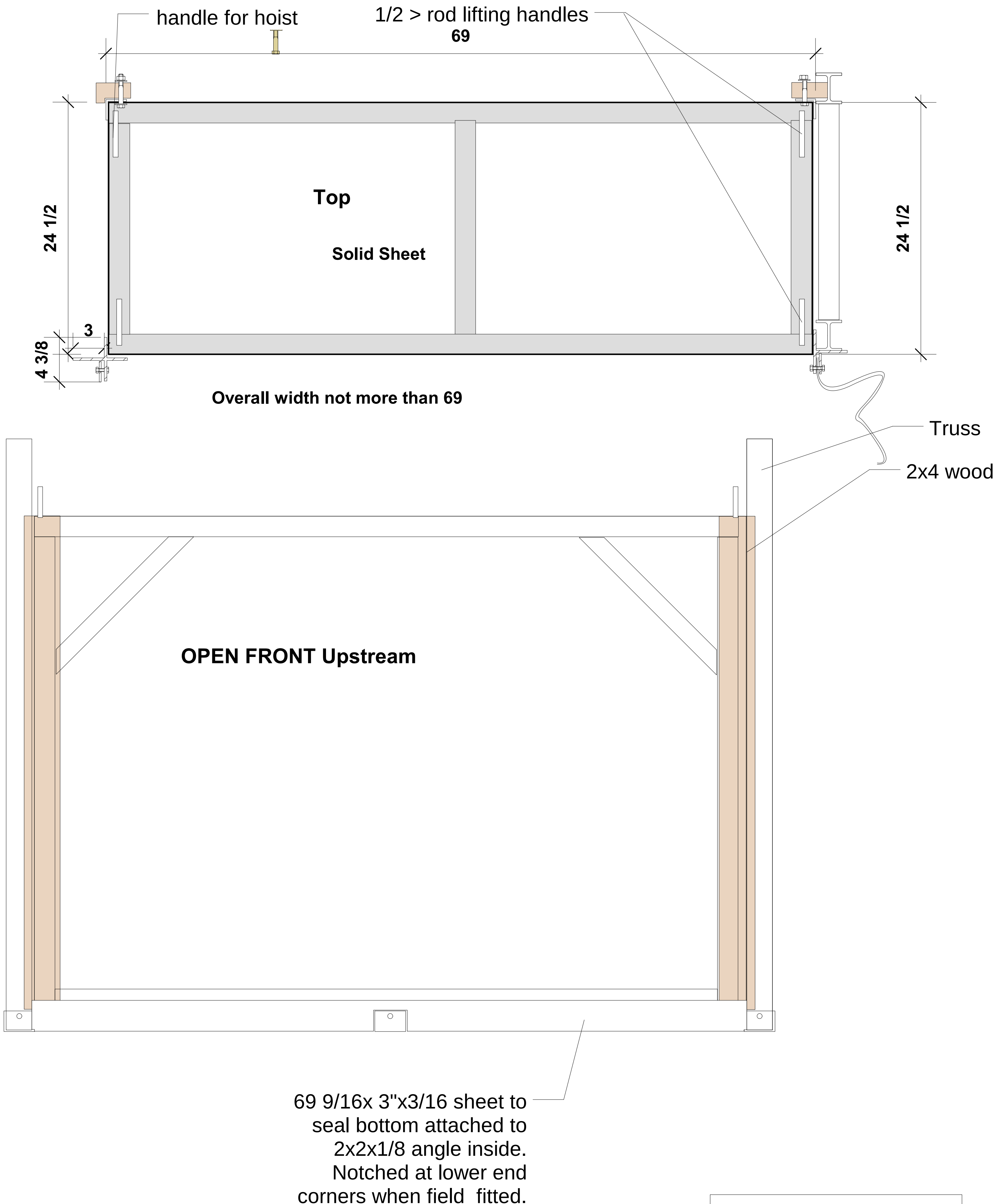




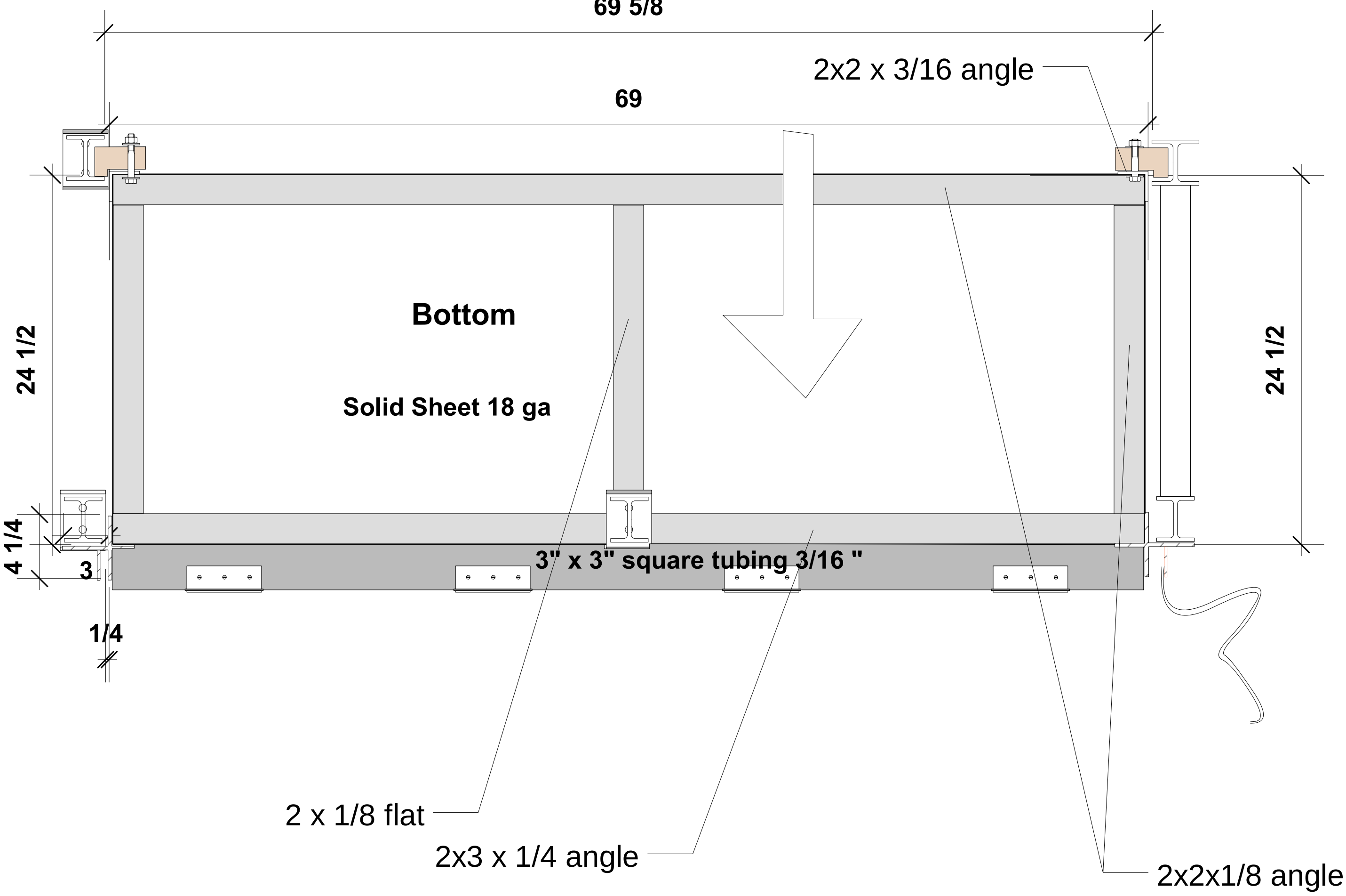




Adapter drawing sheet 1 of 3



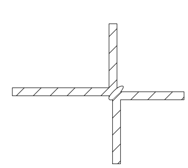
Adapter drawing sheet 2 of 3



Note the trap adapter fits in an average width of 69 11/16 (177 cm) between the trusses. Build the adapter to 69" Outside width.

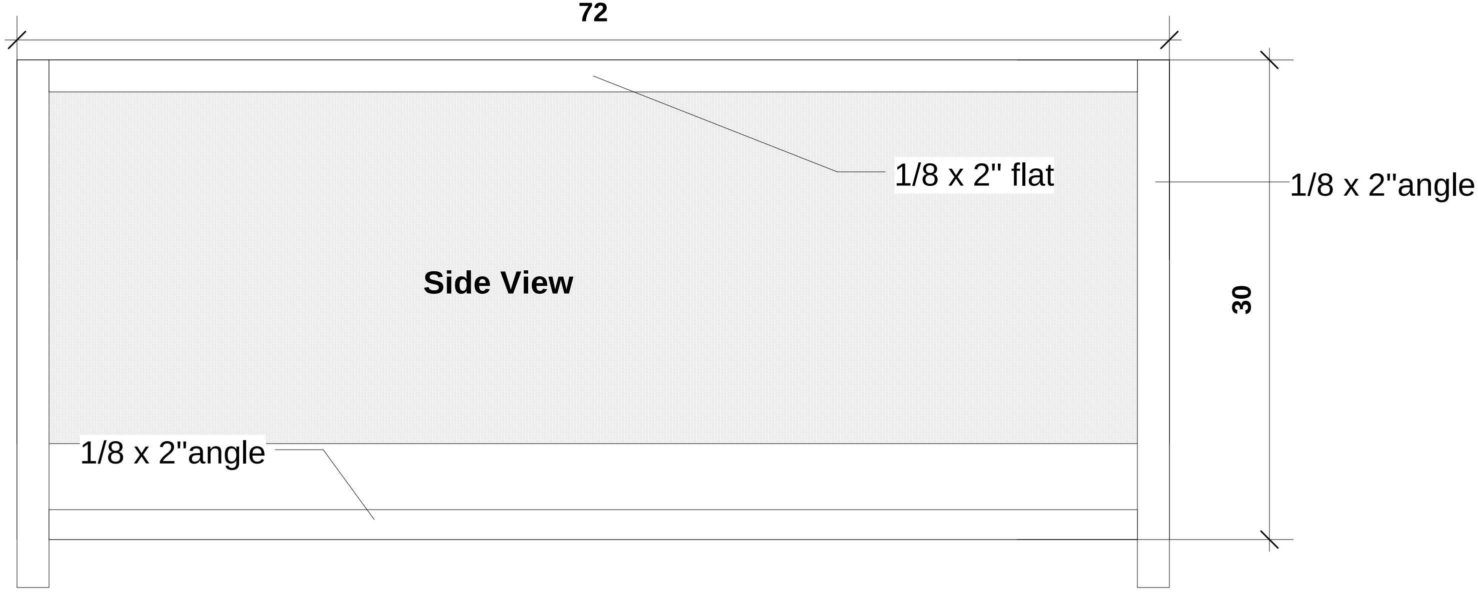
Measured openings
1 (4-6) 72" OC = 69 1/2"
2 (8-10) 72" OC = 69 1/2"
3 (12-14) 72 1/4" = 69 3/4"

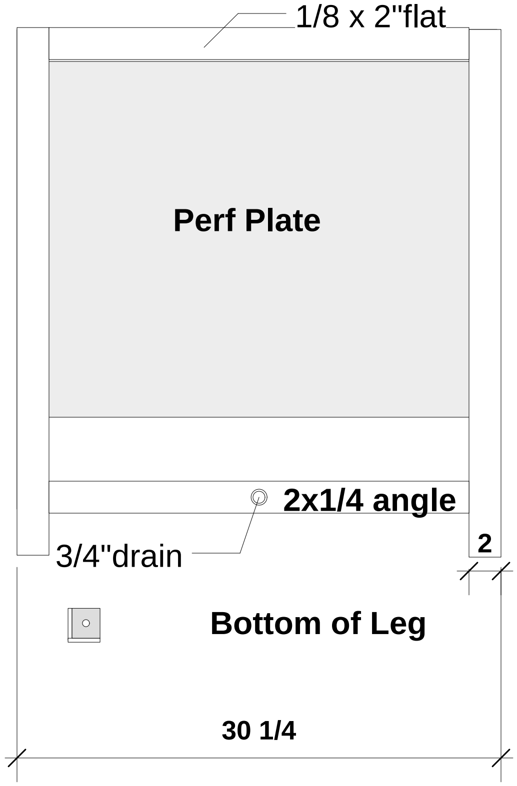
Note the trap adapter fits in an average depth of 24 1/2" between the trusses. Build the adapter to 24 1/2" Outside dimension.
Any excess will extend past the trusses and could be taken up by the wood adjustment blocks.



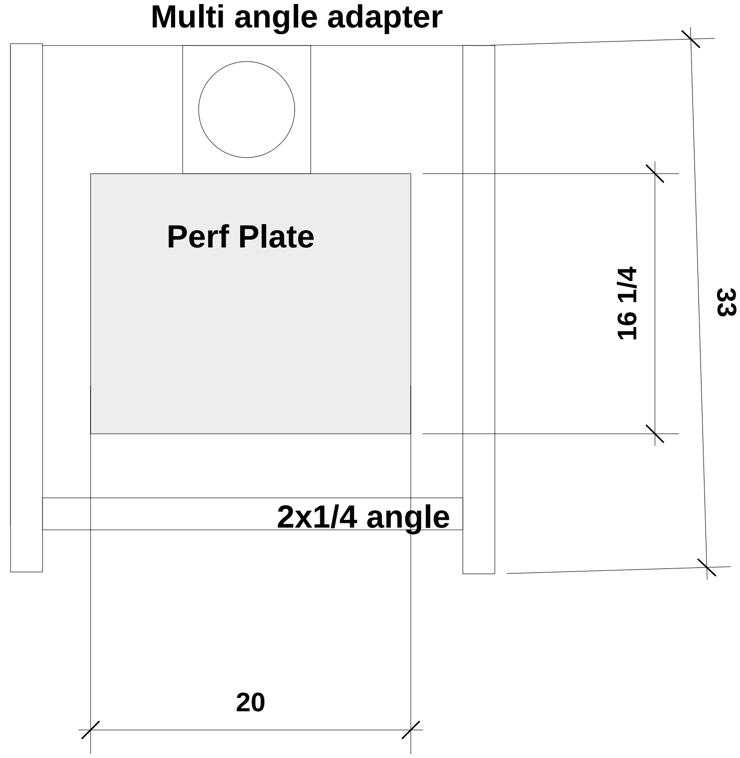
2x scale for downstream vertical corners
fabricated of one 2x3x1/4" angle and 2x2x1/4" angle.
3 inch flange trimmed 2" at base to clear clevis.

Scale 1"= 12"
units inches



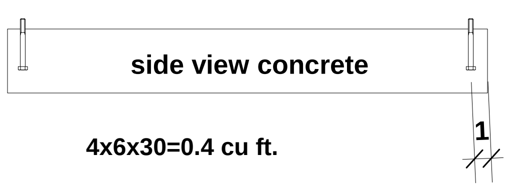


Multi angle adapter

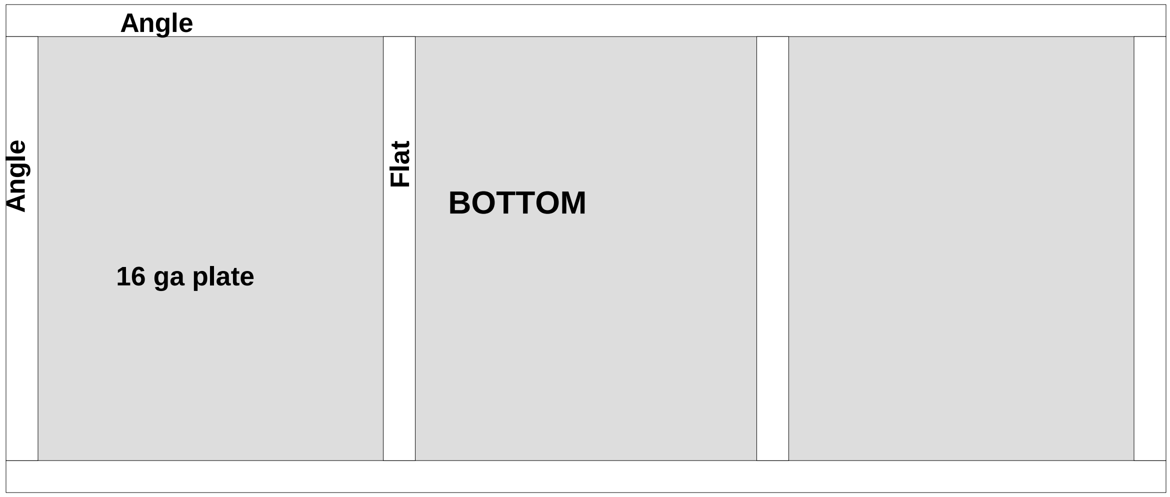


Scale 1": 12"
units inches

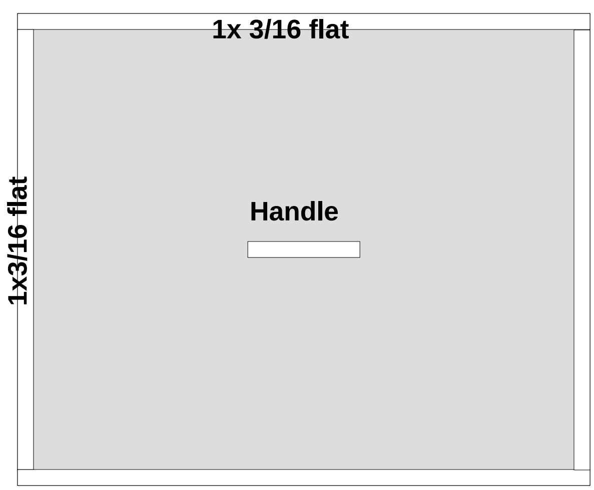
Live Box Drawing Page 1 of 2



4x6x30=0.4 cu ft.



3/4" angle x 3/16" inside 18 ga sides, 1/2"down



Live box Drawing Page 2 of 2

Add Detail of recessed lid

Scale 1"= 12"
units inches