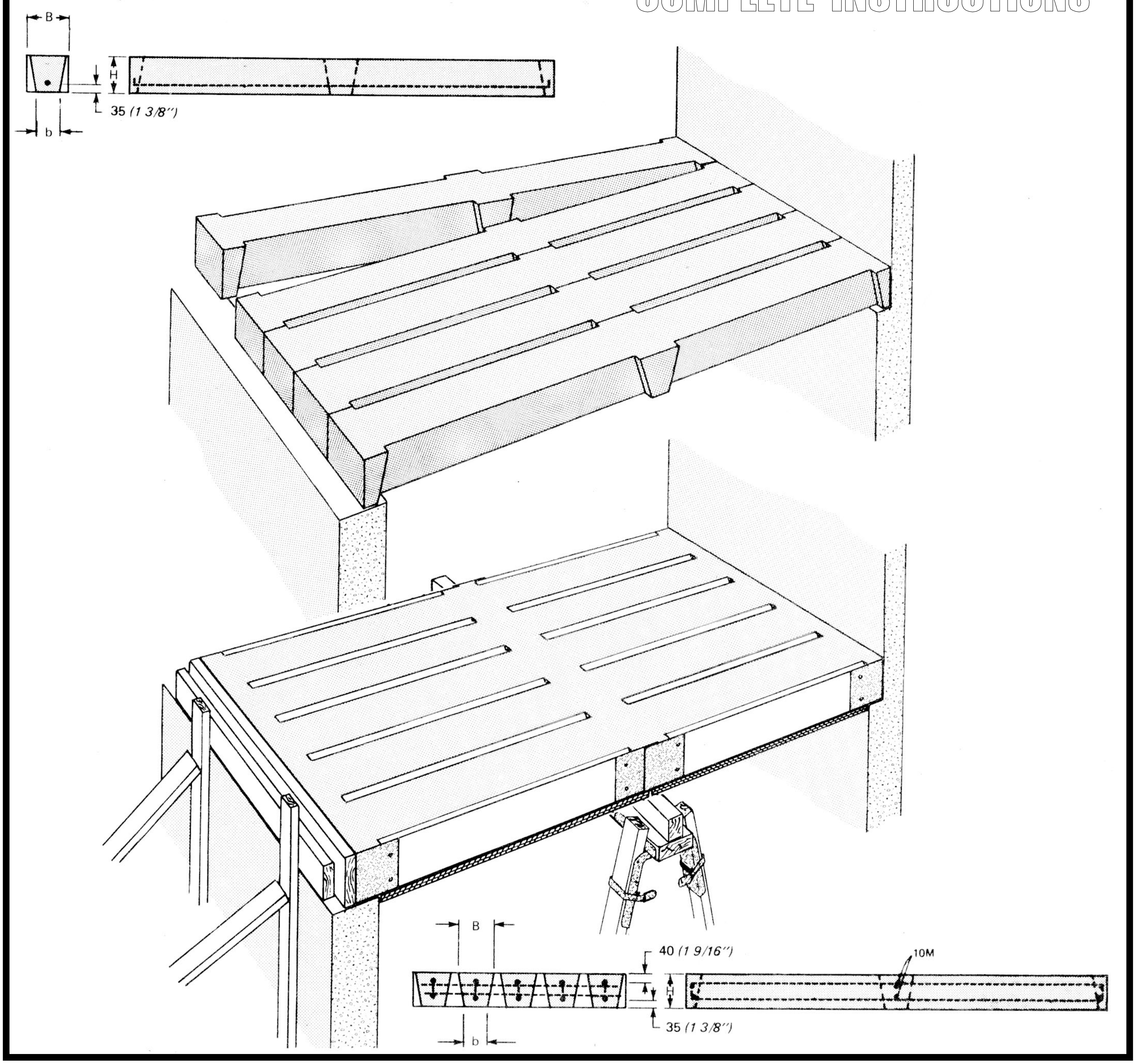
# CAST – IN – PLACE CONCRETE SLOTTED FLOORS FOR SWINE

COMPLETE INSTRUCTIONS

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# CAST-IN-PLACE CONCRETE SLOTTED FLOORS FOR SWINE

**CPS**
**PLAN M-3701 NEW 86:05**

This leaflet shows how to make cast-in place concrete slats or slotted-floor grids for swine. The same procedure could be used to precast slats or grids in the farm shop or small precasting plant, except that for mass production you should use steel instead of wood forms.

## DESIGN REQUIREMENTS

Poorly-made or overloaded concrete slats can develop hairline cracks at points of overstress. At first, these are almost invisible and seem harmless, but in time they can expose the steel reinforcing to penetrating *and* highly corrosive manure gases. Over several years, expanding scaly rust causes chunks of concrete to separate from the steel, the exposed bars pull through the concrete and the slats break. To prevent this, concrete must be top quality, and the bars must be accurately positioned to provide enough concrete cover to protect the steel from corrosion.

**LOADS** These slotted floors have been designed for the dead load of the reinforced concrete (2.4t/m$^3$) plus the live loads due to either breeder pigs (2.5 kN/m of slat) or feeder pigs (1.5 kN/m of slat) as specified in the *Canadian Farm Building Code 1983)*.

## SLAT AND SLAT GRID SELECTION

See Tables 1 to 2 for selection of slat or slat grid dimensions respectively, including steel reinforcement to suit different gutter spans. Use 35 MPa concrete and 400 MPa (grade 400) steel. The tables also indicate which limit (shear, bending or deflection) determines the maximum length. Limiting deflections are based on 1/360 of the span.

The tables also give the maximum concentrated load that a slat of given span can carry, and whether bending, shear or deflection is the limiting factor.

## USING THE DESIGN TABLES

**EXAMPLE 1** Select a slat design for sows and boars, to span a gutter 2400 mm (8 ft) wide.

Use Table 1 to select the slat. Any combination of slat cross-section and reinforcement good for a span of at least 2400 mm (8 ft) can be used. One option would be slat depth 150 mm (6 in.), top width 100 mm (4 in.), bottom width 75 mm (3 in.), 15M bottom rebar and 10M top rebar. Where single slats are cast-in-place the top rebars are not necessary.

## MAKING SLATS AND SLAT GRIDS

Good workmanship and construction procedures are necessary to build durable slats and slat grids. A good forming system will ease the fabrication and reduce the possibility of making construction mistakes.

Slats can be made either in the shop, or they can be cast-in-place using removable steel or wood forms (Step 1). Casting-in-place has several advantages:

- It eliminates slat handling.
- Slats are self-spacing (T-shaped at the ends) and cannot wobble or slide.
- The number of forms used for each pour can be adjusted to any convenient size batch of concrete.
- For single slats, top reinforcement is not needed.

Slats cast-in-place can be made as single units by inserting sheet-steel dividers. If slats with only bottom reinforcement have to be lifted later for any reason, they must be lifted at the ends, not near mid-span.

**SLAT GRIDS** These consist of several slats connected in the middle and at both ends. Step 1 and 2 show slat grid details and a forming system for casting-in-place. This form can be built by using 18.5 mm ( ¾ in.) plywood for the bottom of the form and smooth dressed lumber to space and shape the slots. Grids should not be made more than six slats wide, in case they have to be lifted out sometime later.

For both slats and slat grids, fix the reinforcement exactly in place while placing the concrete. If the rebars are not centered horizontally and supported vertically to maintain at least 35 mm ( $1^3/_8$ in.) concrete cover, or if they move when the concrete is placed, slat serviceability and strength will be reduced. The bottom rebars are hooked upward at both ends to increase bond with the concrete.

Oil the forms each time before placing concrete. This makes it easy to strip the forms later, and helps prevent the concrete from cracking while curing in the forms. Non-detergent motor oil is appropriate. Used motor oil is not recommended; it contains contaminants that may damage the concrete.

## CONCRETE

See the cement, aggregate and water mix proportions in Tables 3 to achieve the required concrete strength of 35 MPa. The water used in the mixture should be good enough to drink and should not have pronounced taste or odor.

The aggregates (sand and stone), representing about 75% of the volume of the concrete, must be of good quality. The aggregates should be hard, strong and free of silt and organic matter to get a good bond with the cement paste. The size of the aggregates should never be uniform, but should range from fine sand to a maximum stone of 20 mm ( ¾ in.). The cement should be type 10 (normal), a general purpose cement suitable for slat and slat grid construction.

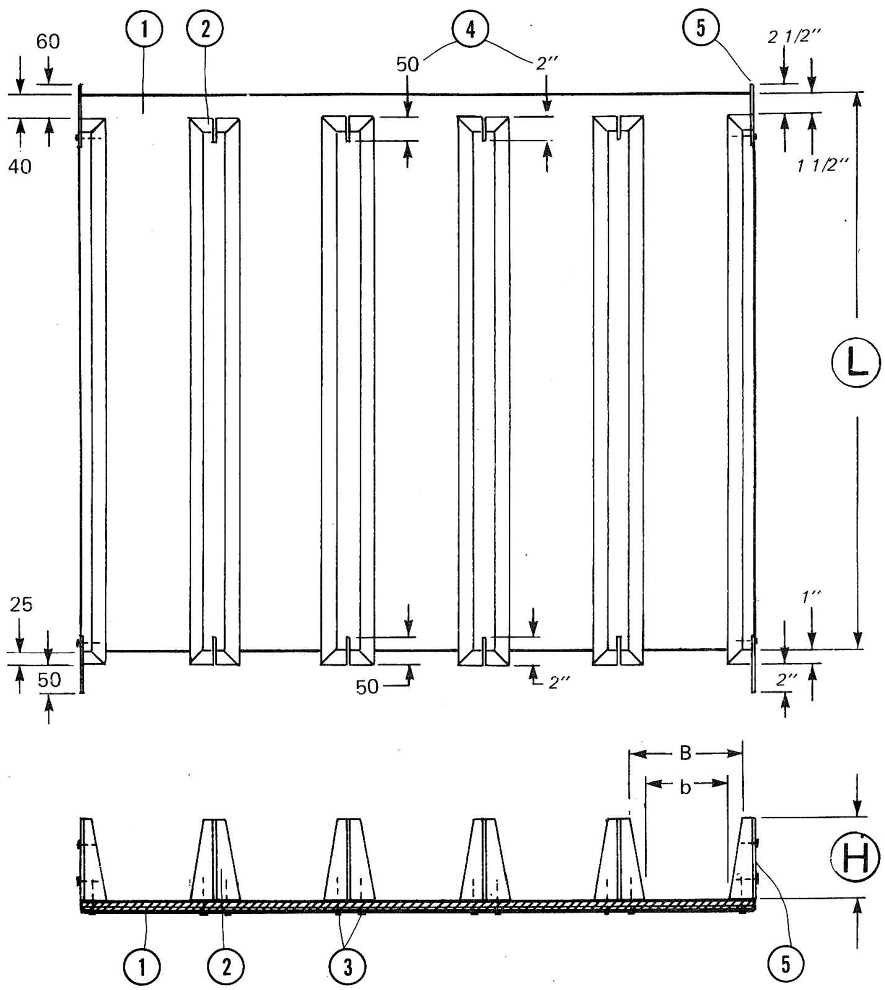
Mix cement and aggregates in the proportion specified in Table 3; the resulting concrete should be just plastic enough to be rammed or vibrated to perfectly fill the forms (neither fluid nor dry and crumbly). Immediately after filling, use a wood float to level the top surface.

After the concrete has set for 30 to 45 minutes, work the surface again to get a normal wood float surface finish which is appropriate for grower, finisher, sow and boar pens. The wood float finish is too rough for baby pigs; if these slats are used in farrowing pens, a magnesium float finish is better, especially in the creep and nursing areas frequented by the baby pigs.

Use a sidewalk-edger to round the top edges. This prevents later chipping that can widen the slots enough to catch a toe and cause serious foot injuries. Some concrete finishers omit the edger, but wait until the concrete has hardened and the forms are stripped. They then grind the top edges to a smooth radius, about the size of a lead pencil.

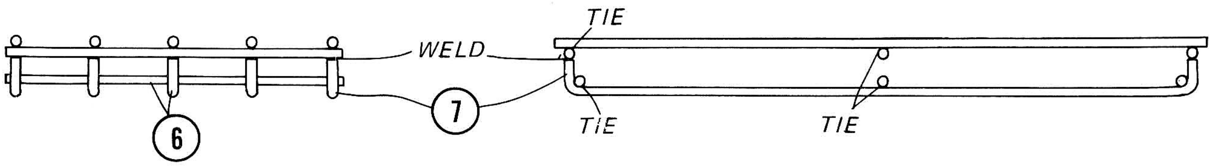
Concrete hardens and becomes durable due to a chemical reaction between water and cement. Therefore, the concrete should not be allowed to dry out for a period of about 1 week. Prevent evaporation by covering with plastic sheeting or wet straw or by frequent water sprinkling.

In warm weather (20°C or above) the forms can be stripped after 72 hours, but the slats should not be loaded before 7 days. If a high early strength cement (type 30) is used, the forms can be stripped after 24 hours and the slats can be loaded after 3 days. After the forms are removed continue to keep the concrete wet for at least a week.

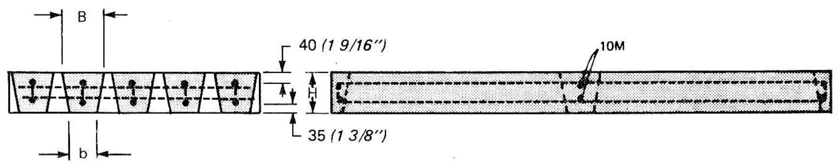



Step 1 Build Pairs of forms.

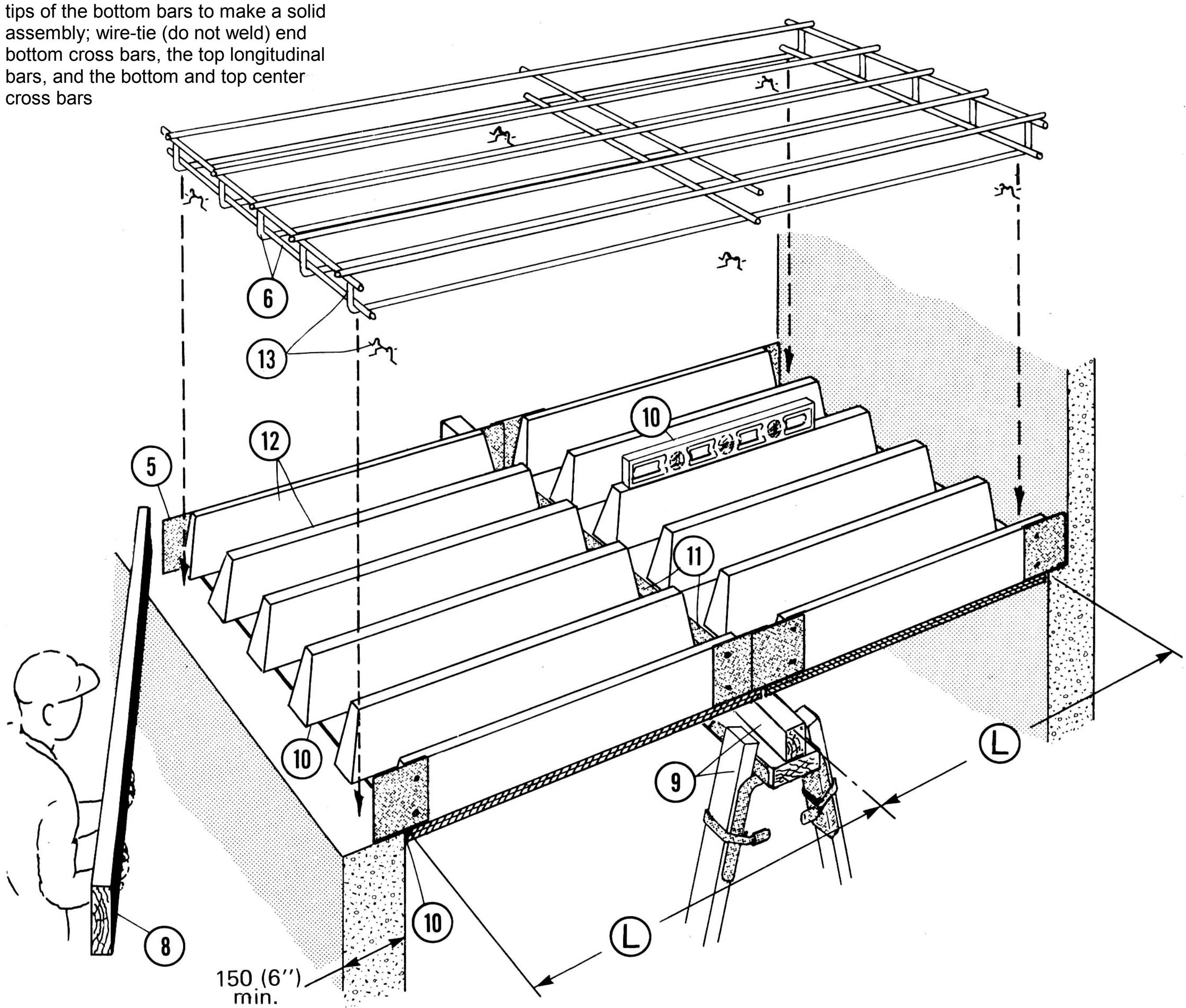
1. slat grid form (make two), 18.5 mm (3/4 in.) plywood, length L is 1/2 of trench span (see Step 3) less 10 mm (3/8 in.) gap at midspan; see Table 1 or 2 for maximum spans
2. wood slot formers, sawn and dressed; see Tables 1 to 2 for slat height H slat width B and bottom width b; see Table 4 to select slot widths recommended for growers, finishers, sows and boars
3. screw slot formers from underside, two rows of no. 8 x 2 1/2 in. flat socket head plate wood screws spaced at 200 mm (8 in.)
4. if form is to be used to precast single slats in the shop, add saw cuts at both ends of slot formers to hold 20 gauge galvanized steel insert dividers (see 16 of optional instructions)
5. 0.91 mm (20 gauge) x 150 mm (6 in.) long galvanized steel corners and outside mid-span dividers (make eight); screw flush to 2




## Step 2 Make steel grids

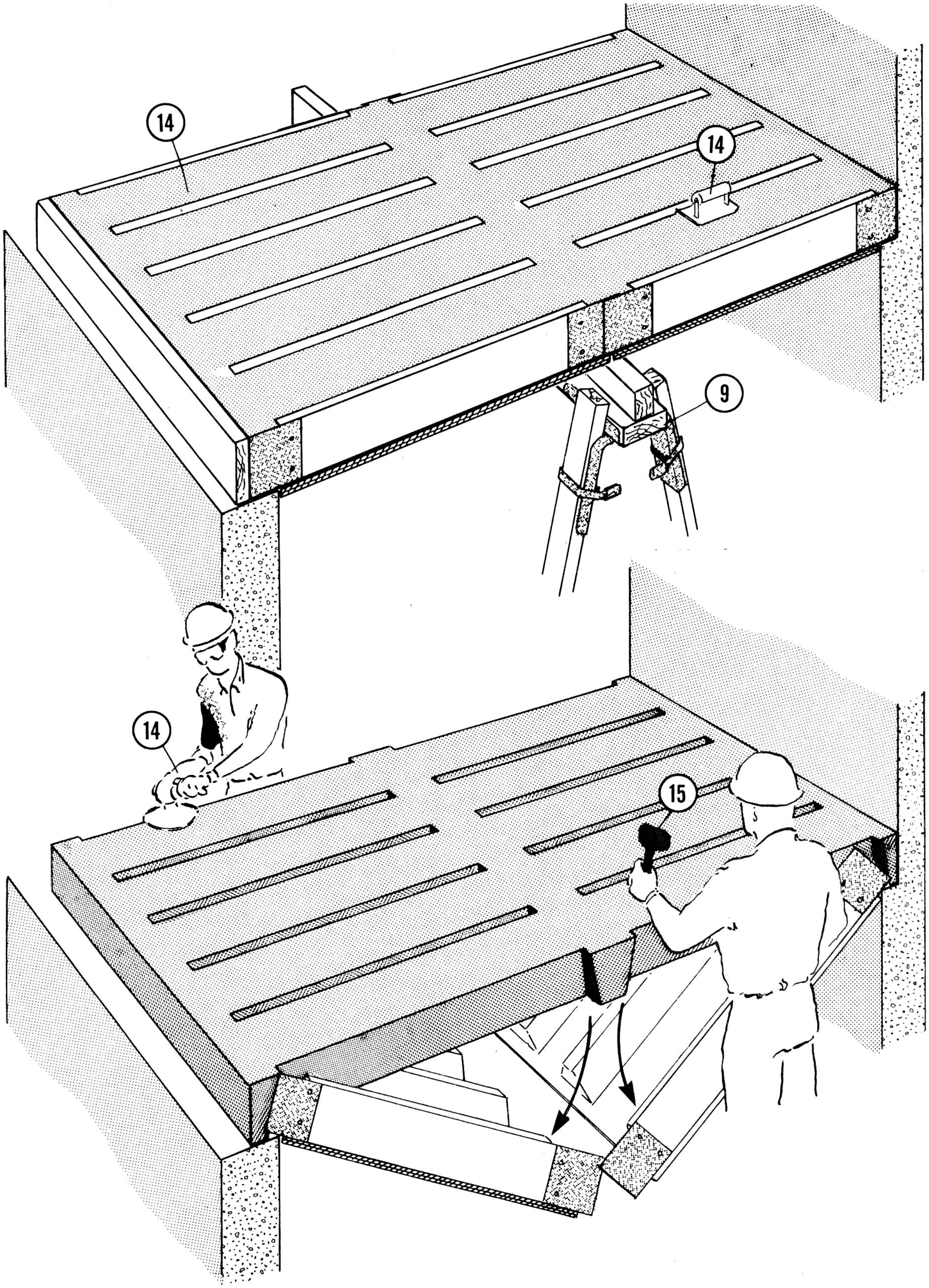



6. reinforcing steel grid preassembled in farm shop; use a completed slat form assembly as a jig; see Table 2
7. bend longitudinal rebars upwards at both ends; weld end top cross bars to bent-up tips of the bottom bars to make a solid assembly; wire-tie (do not weld) end bottom cross bars, the top longitudinal bars, and the bottom and top center cross bars



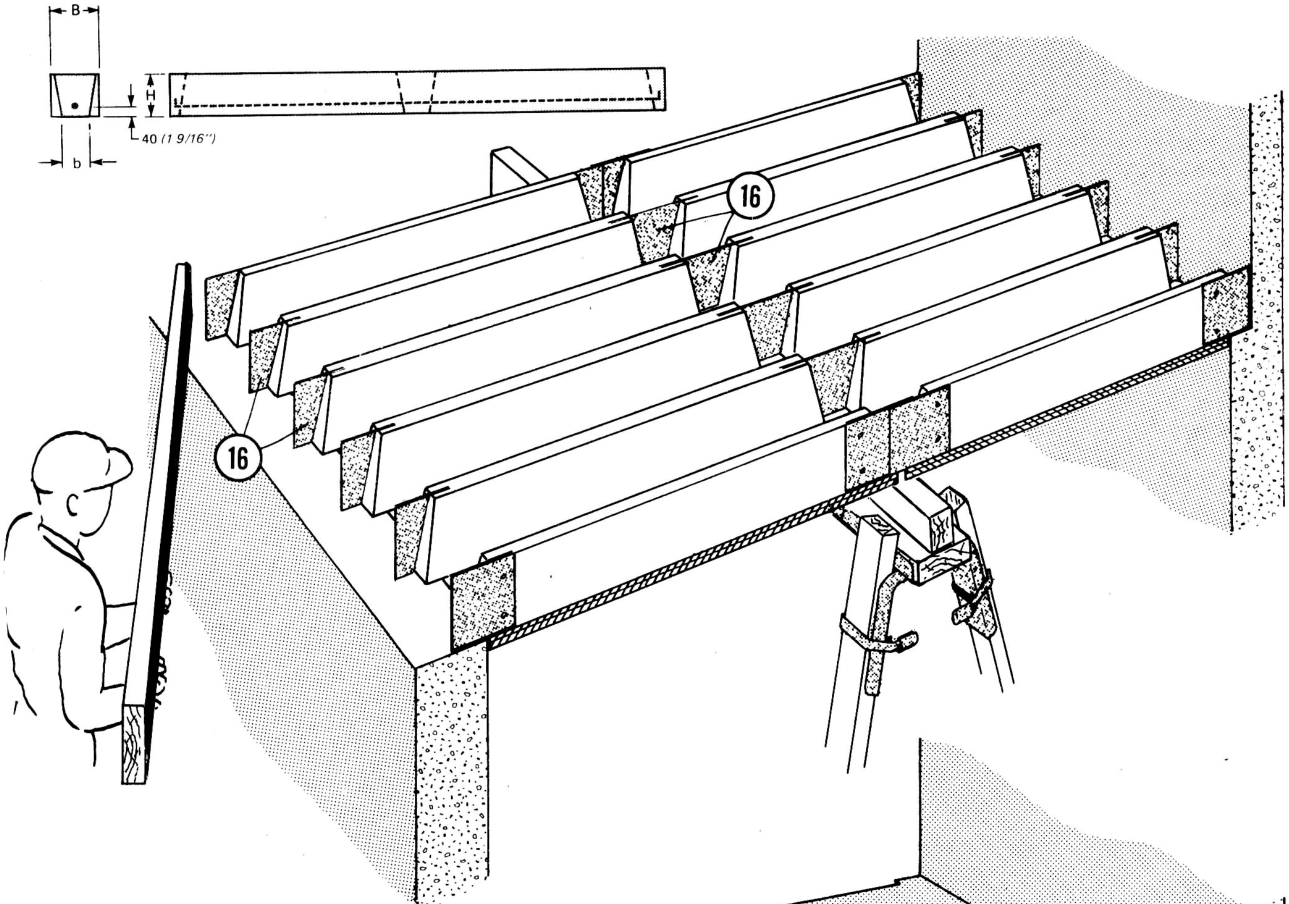

## Step 3 Set and level the forms

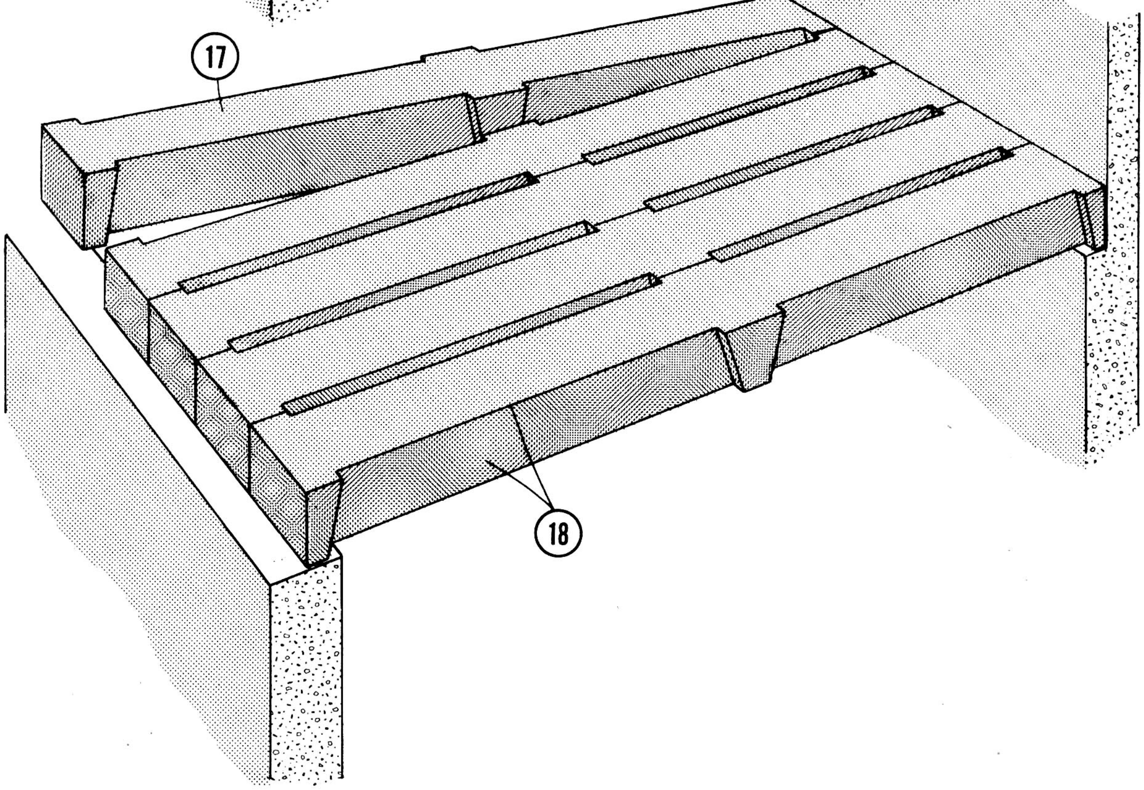
8. form end of slat grid at center of bearing wall with a 38 mm (2 in.) plank secured on edge to wall (keep free from 5, see cover page)
9. install 89 x 140 mm (4 x 6) center support with 38 x 89 mm (2 x 4) legs at 1200 mm (4 ft) spacing, adjusted to level (Black & Decker Workhorse or equivalent)
10. place and level slat grid forms 1; plywood form butts walls, slot formers 2 rest on walls; minimum bearing width is 50 mm (2 in.) of concrete at walls
11. 0.91 mm (20 ga.) x 75 mm (3 in.) galvanized steel strip screwed to one form only, to cover gap between forms
12. oil forms before placing concrete
13. set reinforcing steel grid assembly (Step 2) on chairs; maintain 35 mm (1 3/8 in.) concrete cover




## Step 4 Place and finish the concrete

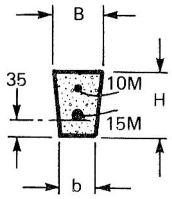
14. when concrete is partially set, level and texture the top surfaces (see text); round the top edges with a sidewalk edger, or grind them round after stripping forms
15. after concrete has cured for at least 3 days, remove center support 9, tap top of slat grid at ends and midspan with a rubber hammer; forms will drop free




## Making individual slats (optional)

16. see Step 1, note 4; add 0.91 mm (20 gauge) galvanized steel inserts 100 mm (4 in.) long at ends, 150 mm (6 in.) long at center
17. reinforcing, see Table 1; sit steel on chairs
18. place concrete and finish edges as in Step 4



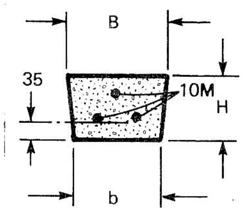
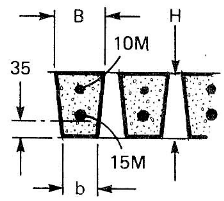




**TABLE 1 MAXIMUM SINGLE SLAT SPAN FOR SOWS AND BOARS (UP TO 225 kg) AND FEEDER PIGS (UP TO 100 kg), OR MAXIMUM CONCENTRATED LOAD ON ONE SLAT**

| Slat | | | | | | Concrete compres-sive strength | Steel yield strength | Maximum slat span | | | | Maximum concentrated load | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth H | | Top width B | | Bottom width b | | | | Sows & boars up to 225 kg | | Feeder pigs up to 100 kg | | | |
| mm | (in.) | mm | (in.) | mm | (in.) | MPa | MPa | mm | (ft) | mm | (ft) | N | (lb) |
| 100 | (4) | 100 | (4) | 75 | (3) | 35 | 400 | 1200 | (4) | 2100 | (7) | 1700 | (380) |
| 125 | (5) | “ | “ | “ | “ | “ | “ | 1800 | (6) | 2700 | (9)* | 2300 | (520) |
| 150 | (6) | “ | “ | “ | “ | “ | “ | 2400 | (8) | 3000 | (10)* | 3000 | (675) |
| 100 | (4) | 150 | (6) | 125 | (5) | 35 | 400 | 1800 | (6) | 2400 | (8)* | 2100 | (470)* |
| | | 200 | (8) | 175 | (7) | “ | “ | 2100 | (7)* | 2700 | (9)* | 2400 | (540)* |
| 125 | (5) | 150 | (6) | 125 | (5) | 35 | 400 | 2400 | (8)* | 3000 | (10)* | 2800 | (630)* |
| | | 200 | (8) | 175 | (7) | “ | “ | 2700 | (9)* | 3000 | (10)* | 3600 | (810)* |
| 150 | (6) | 150 | (6) | 125 | (5) | 35 | 400 | 3000 | (10)* | 3000 | (10)* | 4900 | (1100)* |
| | | 200 | (8) | 175 | (7) | “ | “ | 3000 | (10)* | 3000 | (10)* | 5900 | (1300)* |

*Slat length and concentrated load (self-feeder, etc.) limited by deflection; all other cases limited by shear



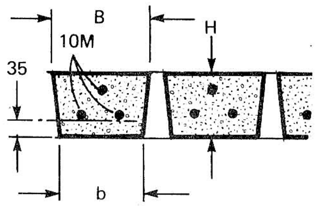




**TABLE 2 MAXIMUM SLAT GRID SPAN FOR SOWS AND BOARS (UP TO 225 kg) AND FEEDER PIGS (UP TO 100 kg), OR MAXIMUM CONCENTRATED LOAD ON ONE SLAT**

| Slat | | | | | | Concrete compres-sive strength | Steel yield strength | Maximum slat span | | | | Maximum concentrated load | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth H | | Top width B | | Bottom width b | | | | Sows & boars up to 225 kg | | Feeder pigs up to 100 kg | | | |
| mm | (in.) | mm | (in.) | mm | (in.) | MPa | MPa | mm | (ft) | mm | (ft) | N | (lb) |
| 100 | (4) | 100 | (4) | 75 | (3) | 35 | 400 | 1500 | (5) | 2100 | (7)* | 1800 | (400) |
| 125 | (5) | “ | “ | “ | “ | “ | “ | 2100 | (7) | 2700 | (9)* | 2500 | (560) |
| 150 | (6) | “ | “ | “ | “ | “ | “ | 2700 | (9) | 3000 | (10)* | 3200 | (700) |
| 100 | (4) | 150 | (6) | 125 | (5) | 35 | 400 | 2100 | (7) | 2700 | (9)* | 2400 | (540) |
| | | 200 | (8) | 175 | (7) | “ | “ | 2400 | (8)* | 3000 | (10)* | 2500 | (560)* |
| 125 | (5) | 150 | (6) | 125 | (5) | 35 | 400 | 2700 | (9)* | 3000 | (10)* | 3400 | (760)* |
| | | 200 | (8) | 175 | (7) | “ | “ | 3000 | (10)* | 3000 | (10)* | 4400 | (1000)* |
| 150 | (6) | 150 | (6) | 125 | (5) | 35 | 400 | 3000 | (10)* | 3000 | (10)* | 4900 | (1100)* |
| | | 200 | (8) | 175 | (7) | “ | “ | 3000 | (10)* | 3000 | (10)* | 5900 | (1300)* |

*slat length and concentrated load (self-feeder, etc.) limited by deflection; all other cases limited by shear

**TABLE 3 RECOMMENDED CONCRETE MIXES FOR SLATS AND SLAT GRIDS FOR EACH 40 kg (88 lb) BAG OF CEMENT**

| Water to add when sand is: | | | | | | | | Aggregate | | | | Approximate Yield | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dry | | Damp[a] | | Wet[b] | | Very wet[c] | | Sand[d] | | Gravel[e] | | | |
| L | (gal) | L | (gal) | L | (gal) | L | (gal) | L | (cu ft) | L | (cu ft) | L | (cu ft) |
| 16 | (3 1/2) | 15 | (3 1/4) | 12 1/2 | (2 3/4) | 11 | (2 1/2) | 50 | (1 3/4) | 57 | (2) | 88 | (3.1) |

[a] Damp sand will fall apart after being squeezed in the palm of the hand.
[b] Wet sand will ball in the hand when squeezed, but leaves no moisture in the palm.
[c] Very wet sand has been subjected to a recent rain or recently pumped.
[d] Sand with particle size up to 6 mm (1/4 in.)
[e] Gravel with particle size up to 20 mm (3/4 in.).

NOTE: Increasing the proportion of water to cement reduces the strength and durability of concrete. Adjust the proportion of trial batches without changing the water-cement ratio.

**TABLE 4 SLOT WIDTH FOR DIFFERENT ANIMAL SIZES**

| | Slot Width | |
|---|---|---|
| | mm | (in.) |
| Growers (20 to 50 kg)(45 to 110 lb) | 22 | (7/8) |
| Finishers (50 to 100 kg)(110 to 220 lb) | 25 | (1) |
| Sows and boars | 25-32 | (1-11/4) |