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Crack Leveling Material Spreader

CITY: Dickinson, ND

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PROBLEM STATEMENT:

Leveling depressed cracks with a hot mastic material involved pushing a steel box along the crack to level the mastic. This is a very labor-intensive operation and especially for the wider boxes required for wider cracks. The work is physically exhausting for the person pushing the steel box.

DISCUSSION OF SOLUTION:

We came up with the idea of using an underutilized 4-wheeler to do the hard work of pushing the steel boxes. We built a mount on the 4-wheeler that could accommodate different width boxes. We also built 12", 18", 24", and 36" steel material boxes. The width of the depressed crack determines which material box is used. The operator on the 4-wheeler is able to use the crack-seal-leveling apparatus to fill the crack depressions and very little muscle power is needed. The weight of the material box provides sufficient down-pressure for most cracks. When we need to put a large amount of material in the box the operator pushes down on the handle to apply a bit more pressure. (The boxes are compatible with a Mini-Mac crack-leveling machine.)

The spreader consists of a push frame mounted to the 4-wheeler. The section of the push frame that attaches to the underside of the 4-wheeler frame is custom-fabricated to fit the individual machine. The push frame is hinged so the material box can be raised for transport or lowered for use. The material box mounts to the push frame using a $\frac{3}{4}$ " rod and a ball mount. A rope with a snap hook attaches to the outer end of the push frame. The rope enables the driver to raise and secure the push frame and material box in the raised position for transport, by hooking the snap hook to the front basket of the 4-wheeler.

The operator uses the handle made from pipe to raise and lower the material box. The operator uses the handle to angle the material box from side to side, or tilt it forward or backward to aid in placing the mastic into the crack. First, the operator drives to the discharge chute of the mastic machine and lowers the material box to the ground. Once the material box is filled with mastic sealant, the operator drives either forward or reverse while

the box releases and depresses the sealant into the crack. The leveling apparatus expedites seal cracking and leaves no bumps.

LABOR, EQUIPMENT, AND MATERIALS:

Equipment Used: welder, drill press, chop saw, grinder, 4-wheeler

Material:

4 wheeler (already owned by the public works department, but underutilized)

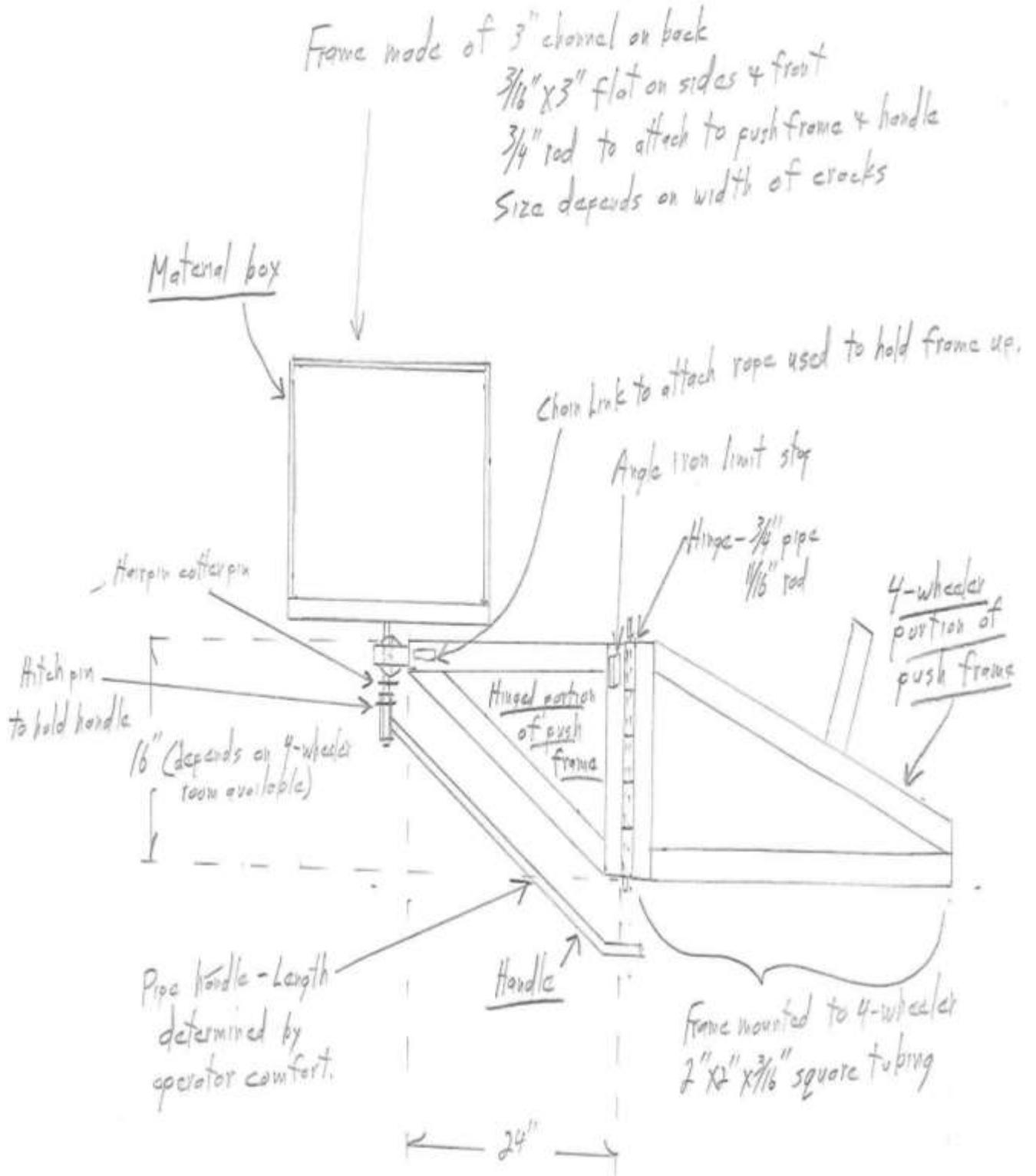
- Push Frame: (Material requirements may change depending on the specific 4-wheeler)
 - 8' of 2" x 2" x 3/16" square tubing
 - Scrap pieces of flat iron
 - 4 – 1/2" bolts, washers, nuts
 - 3 pieces of 3/4" pipe, about 3" long
- Hinge section of Push Frame:
 - 6' of 2" x 2" x 3/16" square tubing
 - 3" scrap of 1 x 1 x 1/8" angle iron
 - 2 pieces of 3/4" pipe, about 3" long
 - Chain link from side chain of a tire chain
 - Tractor drawbar ball mount with a 3/4" hole
 - 5' of 1/4" rope
 - 2 snap hooks for the rope
 - 18" piece of 11/16" cold-rolled rod with holes drilled in each end for cotter keys
 - 2 hairpin cotter keys
- Material Box: (This material list is for an 18" box. To make different width boxes, change the length of the front and back pieces.)
 - 18" piece of 3" channel iron for the back (we also used 3" x 2" rectangular tubing for a couple of the boxes, depending on what we could find in the scrap pile.)
 - 2 - 18" pieces of 3" x 3/16" flat iron for the sides
 - 1 - 18" piece of 3" x 3/16" flat iron for the front
 - 9" x 3/4" cold rolled rod
 - 1 hairpin cotter key
- Handle:
 - 4" of 3/4" pipe to mount to the material box
 - 5/16" hitch pin to hold the handle to the material box pin
 - 4' of 3/4" pipe to make the handle
 - 4" of heat-shrink tubing to make the grip on the handle

Total Labor Hours:

Total number of persons: 4 worked on the design, construction, and testing.

Total hours: 40, for the design and construction

DRAWING (SCHEMATIC) WITH DETAILS:



COST SUMMARY:

Salvage Material: Most of the steel was either on hand on our iron rack or scraps in the recycling bin.

New Material:

Steel – \$50

Drawbar ball mount - \$16

Rope, bolts, nuts - \$20

Total Cost: \$86 plus labor

SAVINGS AND BENEFITS:

The crack leveling material spreader has increased production making our operation more effective and efficient. We have experienced fewer muscle injuries that were the result of pushing the material box. Work crew efficiencies have increased, resulting in less time needed to complete a project. We have experienced a savings in time and money.

ANNUAL OPERATING COSTS:

Prior to using the innovation: Applying a 44,000-pound load of mastic material took 6 days using a 6-person crew. The frames were pushed by hand, causing muscle soreness and exhaustion. As a result, more rest breaks were necessary.

After using the innovation: Applying a 44,000-pound load of mastic material took 4 days using a 6-person crew. Employees are able to work continuously. The savings comes in added daily production. Employee compensation averages around \$45 per hour. This equates to \$5,400 in savings for a 6-person crew for 2 days, plus \$650 in machine rental. A total savings of approximately \$6,050 for this project.

Manual material box (old method).



Crack Leveling Material Spreader (new method).



Push frame mounted to 4-wheeler frame.



Push frame hinge.



Material box attachment to push frame.



Rearview of material box in working position.



Front view of material box in working position.



Filling box with mastic material.



Spreading and leveling mastic.



Material box partially raised for short transport.



Video Link

https://drive.google.com/open?id=1medFc3JMxtkpr1Hyx_-dEJf5Voeo2Ta1