

FIELD INSPECTIONS OF ONE AND TWO-STAGE
JOINT SAWING PROCEDURES

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JOINT SAWING PROCEDURES

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This report covers field inspections of transverse contraction joint sawing procedures on several concrete paving projects during the 1972 construction season. These field inspections were in answer to a request by D. L. Wickham, of the Construction Division, to inspect one-stage and two-stage sawing procedures.

Purpose

The purpose of this study was to compare finished transverse pavement joint grooves sawed in one stage with those sawed in two stages. The definitions of the two procedures are:

1) One-stage sawing - The transverse joint groove shall be sawed to the specified depth and width in one operation after the concrete has hardened, but before any transverse cracking develops.

2) Two-stage sawing - The first stage shall be a relief cut 1/8 to 1/4 in. in width and 2-1/2 in. deep. This stage shall be completed after the concrete has sufficiently hardened so that no excess spalling or raveling occurs, but before any transverse cracking develops. The second stage shall not start until the concrete has obtained 30 percent of its design strength. After the required 30 percent strength has been obtained, the second cut shall be centered over the relief cut and sawed to the specified dimensions.

A list of several projects to be inspected was compiled by the Construction Division. An investigation of the proposals for these projects indicated that all of the transverse joints were to be sawed in two stages. Since there were no projects on which the transverse joints were to be sawed in one stage, we proposed to investigate the new projects and compare the percent of patching on these projects to the percent of patching on previous jobs which had been sawed in one stage. Although this approach was not completely satisfactory, it appeared to be the only solution possible. In the process of investigating the projects, however, it was observed that in some cases the contractor was sawing in one stage or sawing the second stage before the required time between stages had been reached. We were, therefore, able to obtain sufficient data to make an actual comparison between one-stage and two-stage pavement joint sawing.

Field Inspection Procedure

The field inspections consisted of investigating eleven projects totaling approximately 30.5 miles of four-lane divided highway. The number of

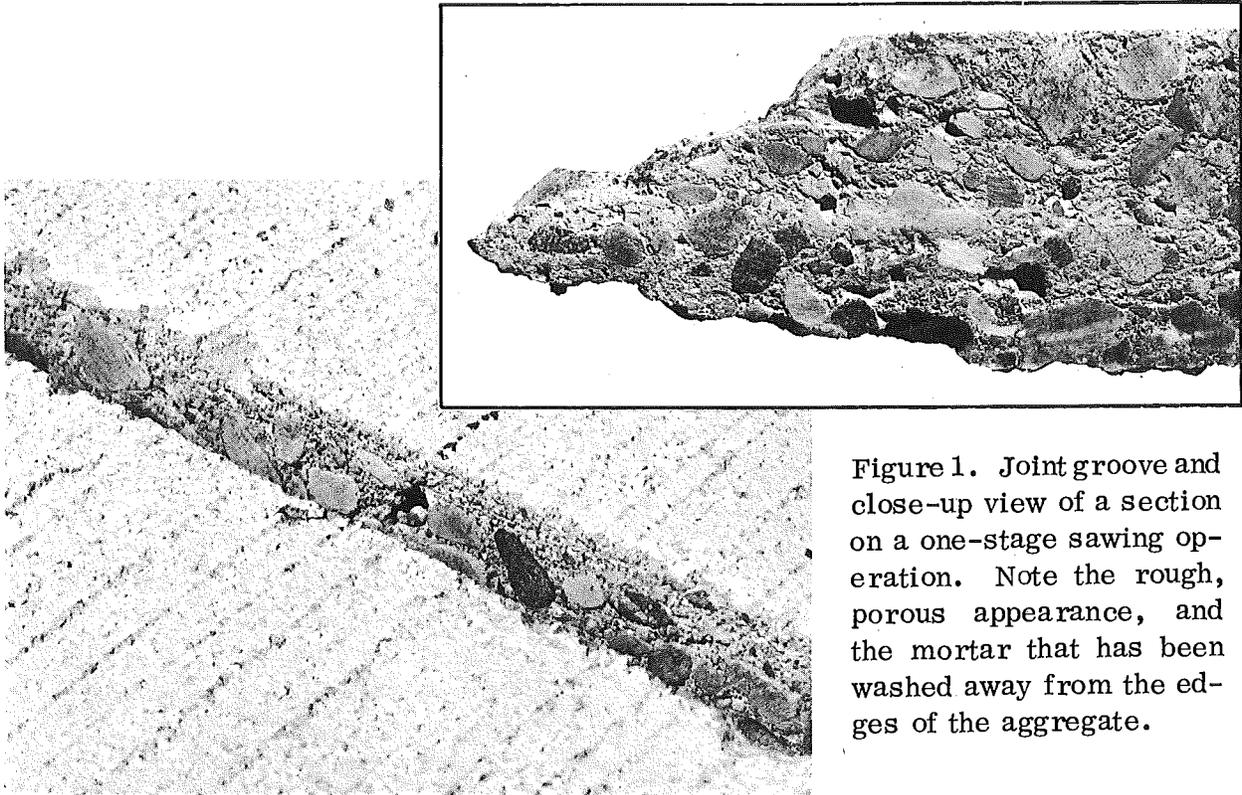


Figure 1. Joint groove and close-up view of a section on a one-stage sawing operation. Note the rough, porous appearance, and the mortar that has been washed away from the edges of the aggregate.

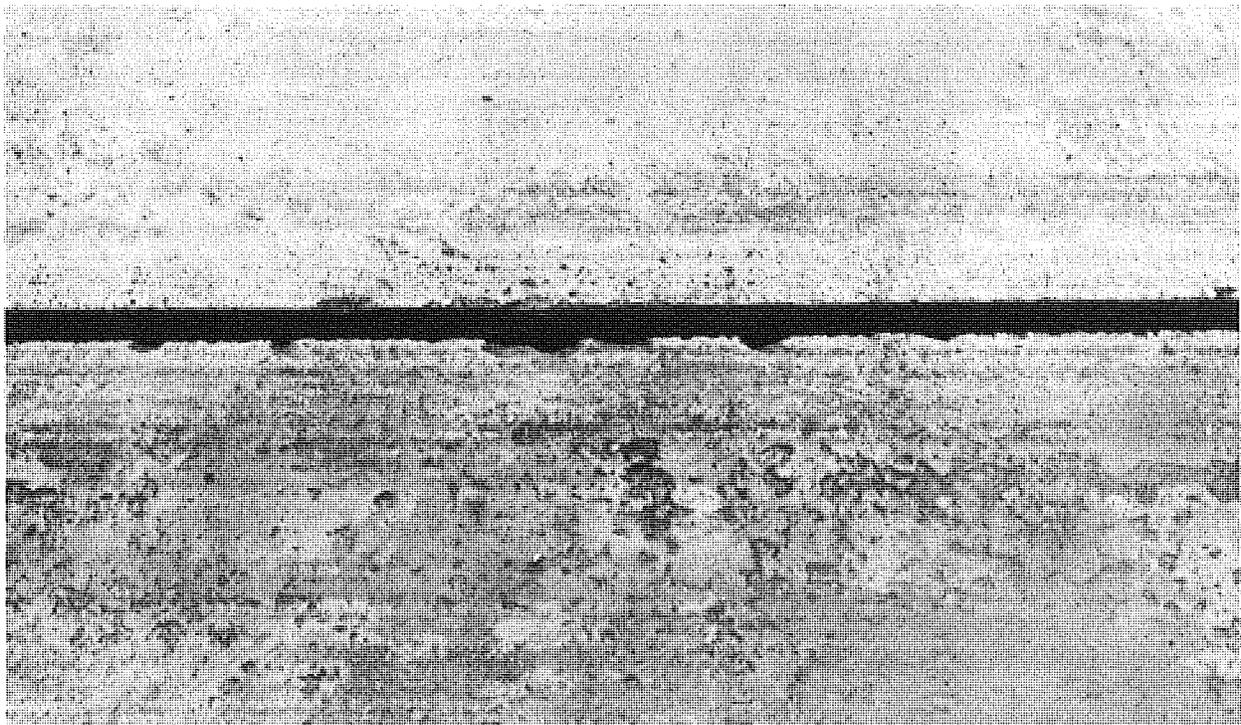


Figure 2. Spalling and aggregate pull-out on a joint groove where the second cut was made too soon.

joints inspected on each project varied from one day's pour length to three day's pour length, depending on the length of the project.

In most cases the relief cutting operation was not observed, but an inspection of the cut was made before the second stage to determine the extent of raveling and spalling. The second stage sawing was inspected to observe the sawing speed, operator technique, and practicality of centering the second saw cut over the relief cut. After the joint grooves were cleaned, the joint faces and edges were inspected to determine the amount of spalling, raveling, and aggregate pull-outs. The joint faces were also checked to determine the texture of the surface.

Observations

Three of the projects surveyed used slag in the concrete in place of natural aggregate. The characteristics of this concrete are different than those of concrete using natural aggregate, therefore these projects are not included in this section but will be discussed in the summary.

Inspection of the joint grooves that were sawed in one stage showed some raveling, moderate spalling, extensive aggregate pull-out, and extremely rough and porous joint faces (Fig. 1).

Inspection of the two-stage sawed grooves, on which the second stage was performed before 30 percent of design strength was obtained, indicated moderate raveling and spalling, a considerable number of pull-outs, and a rough and porous textured joint face (Fig. 2).

Figure 3 shows the extent of time consuming patching that is necessary when raveling or aggregate pull-out occurs.

The joint grooves that were sawed in two stages (as defined in the Standard Specifications) had little spalling or raveling (Fig. 4), very few pull-outs, and the joint faces were smooth (Fig. 5). A joint groove such as this allows the neoprene compression seal to keep dirt and water out of the joint.

Summary

The three items which appeared to affect the condition of the joint faces and edges the most were:

- 1) The strength of the concrete at the time of sawing
- 2) The stiffness of the saw blades
- 3) The rate of forward movement of the saw.

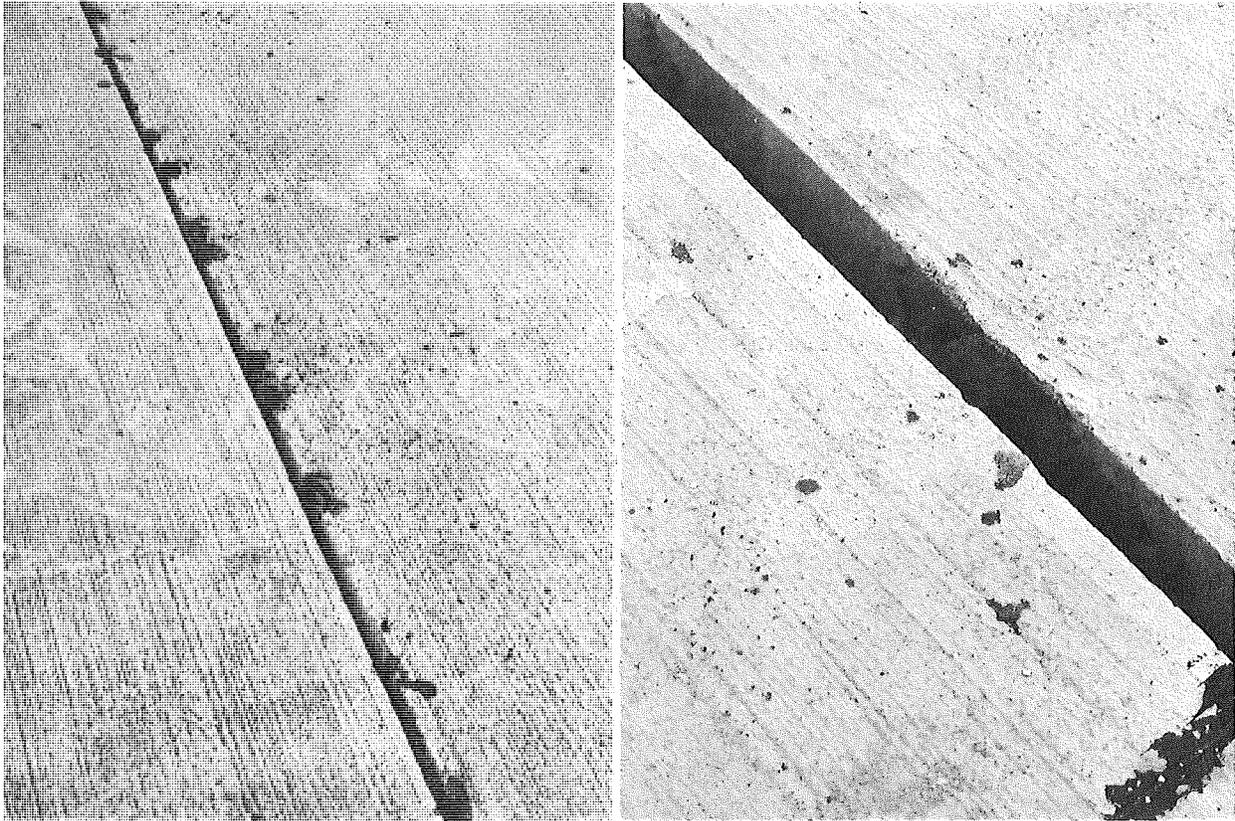


Figure 3. Patching required to repair prematurely sawed joints.

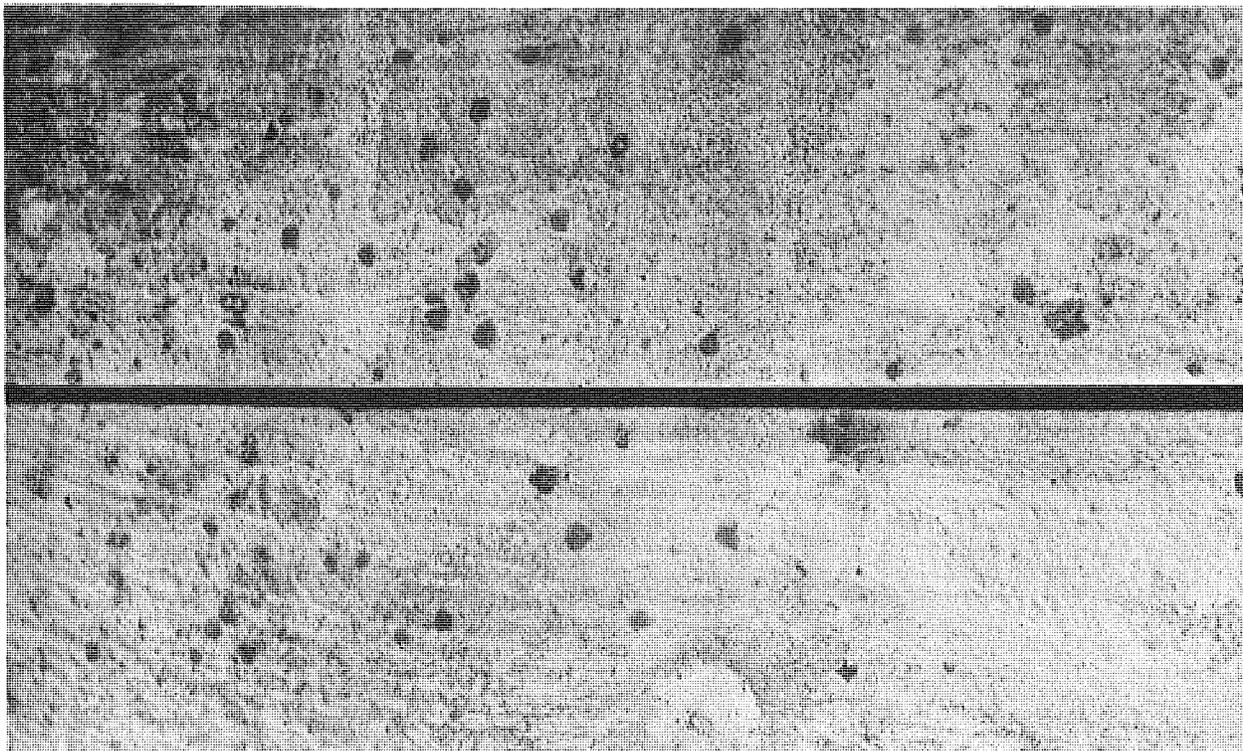


Figure 4. A correctly sawed two stage joint groove with no raveling or spalling.

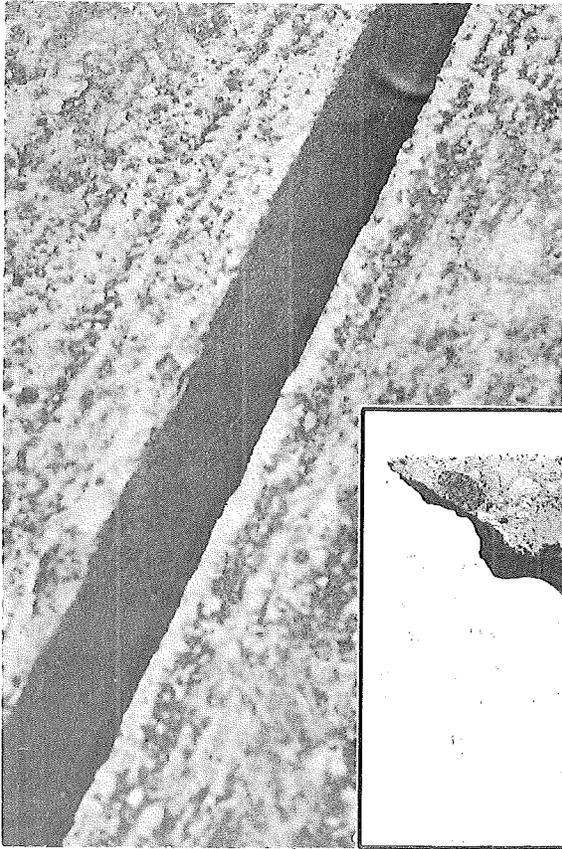


Figure 5. Joint groove and close-up view of a section on a two stage sawing operation. Note the smooth appearance, with no evidence of the mortar washing away when proper sawing techniques are used.

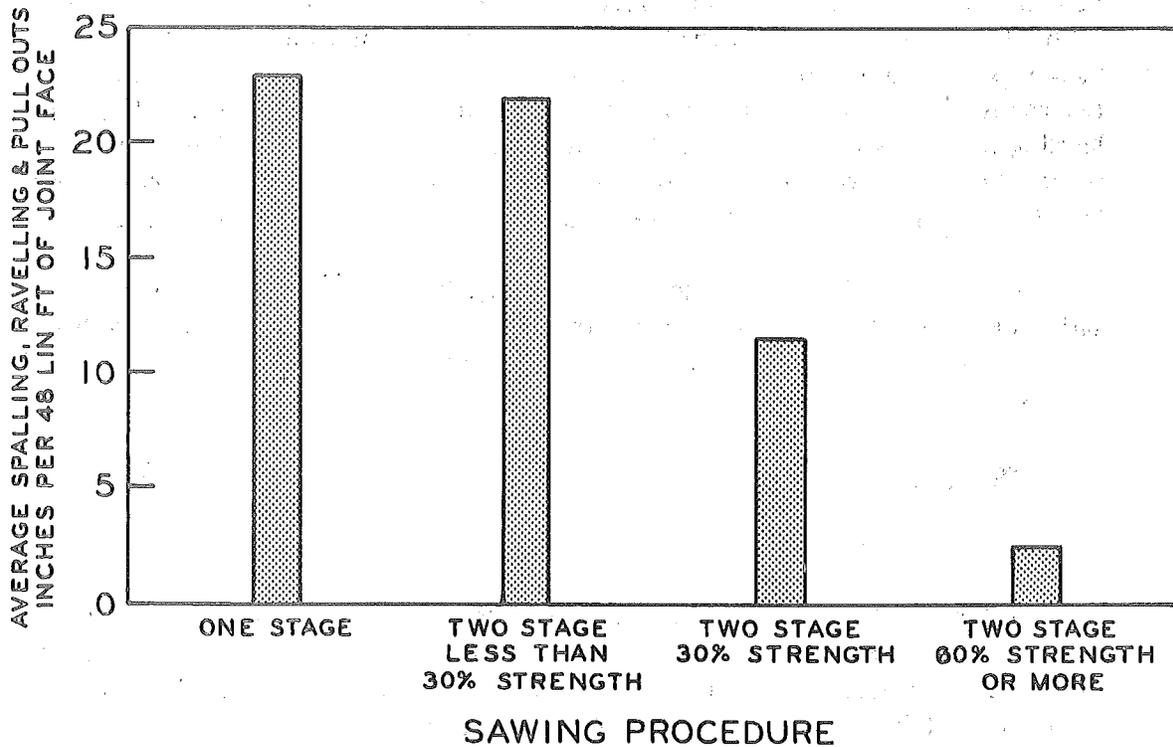


Figure 6. Effect of sawing procedure on joint groove quality.

The strength of the concrete at the time of sawing appears to be the most critical factor for producing a good joint. When the concrete is cut too soon after the initial set, the faces have a rough and porous appearance, there can be considerable raveling and spalling of the joint edges, and the water used in the sawing operation washes away the mortar around the aggregate. In a single-stage cut this would be the finished condition of the groove; and, if the second cut in a two-stage operation is not centered over the relief cut, this would be the condition of one side of the joint. Our observations indicate that a better joint is obtained when the concrete is allowed to cure beyond the 30 percent minimum before the second stage is performed (Fig. 6).

A thick, stiff sawblade tends to produce a groove with a more uniform width and fewer aggregate pull-outs than a joint groove sawed with a thin blade. The thin blade has more wobble which pulls the aggregate and the two blades are more easily compressed together at the outer edge causing the groove width variation. One of the best set-ups observed consisted of two 1/4-in. blades with a large diameter spacer between the blades to obtain the specified width. This produced a stiff blade combination and removed all the concrete from the groove.

The forward movement of the saw on the projects varied from 2-1/2 ft/minute on eleven day old concrete to 7 ft/minute on two day old concrete. When the forward movement is too great, the joint width varies because there is a tendency for the blades to flex when they cut into a large piece of aggregate. The depth also varies as the saw has a tendency to lift over hard aggregate without cutting. The majority of the sawyers that we talked to preferred the two-stage sawing method as it enabled them to produce the best joint. Two types of second-stage saw set-ups are shown in Figure 7.

Our limited data on projects using slag in place of natural aggregate indicates that this concrete may conform to single-stage sawing natural aggregate concrete. The absence of hard aggregate lessens the problem of pull-outs.

Recommendations

Based upon the field surveys we recommend the following.

- 1) That a two-stage sawing method be used. The relief cut shall be made as soon after the initial set as possible without causing excessive raveling, but before any cracking occurs. The second stage shall not be started until the concrete has reached at least 30 percent (preferably more)

of its design strength. The second stage shall be centered over the relief cut to insure that both faces of the completed joint were made with the second stage cut. The blade combination shall be such that all the concrete is removed with the second cut, thus eliminating the ridge of concrete that is presently removed with an air chisel. When a spacer is used, it shall be of the largest diameter possible and still allow the saw to cut to the specified depth.

2) That all specifications for sawing, cleaning, and epoxy patching be vigorously enforced to insure the best possible joint.

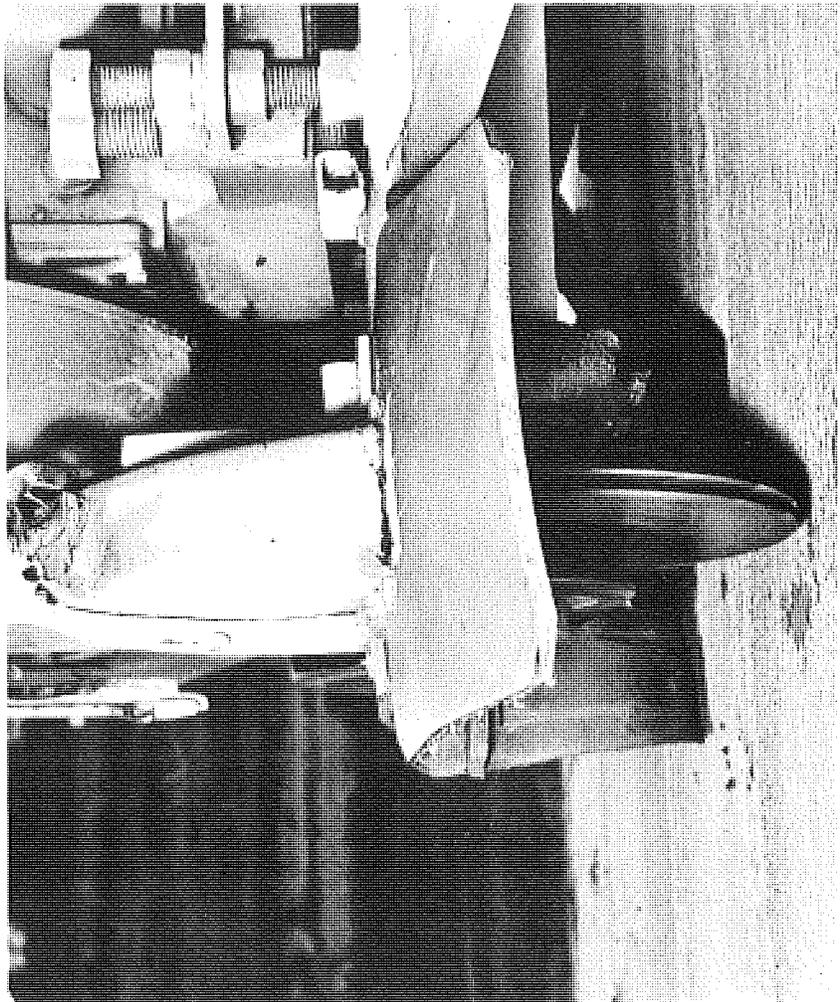
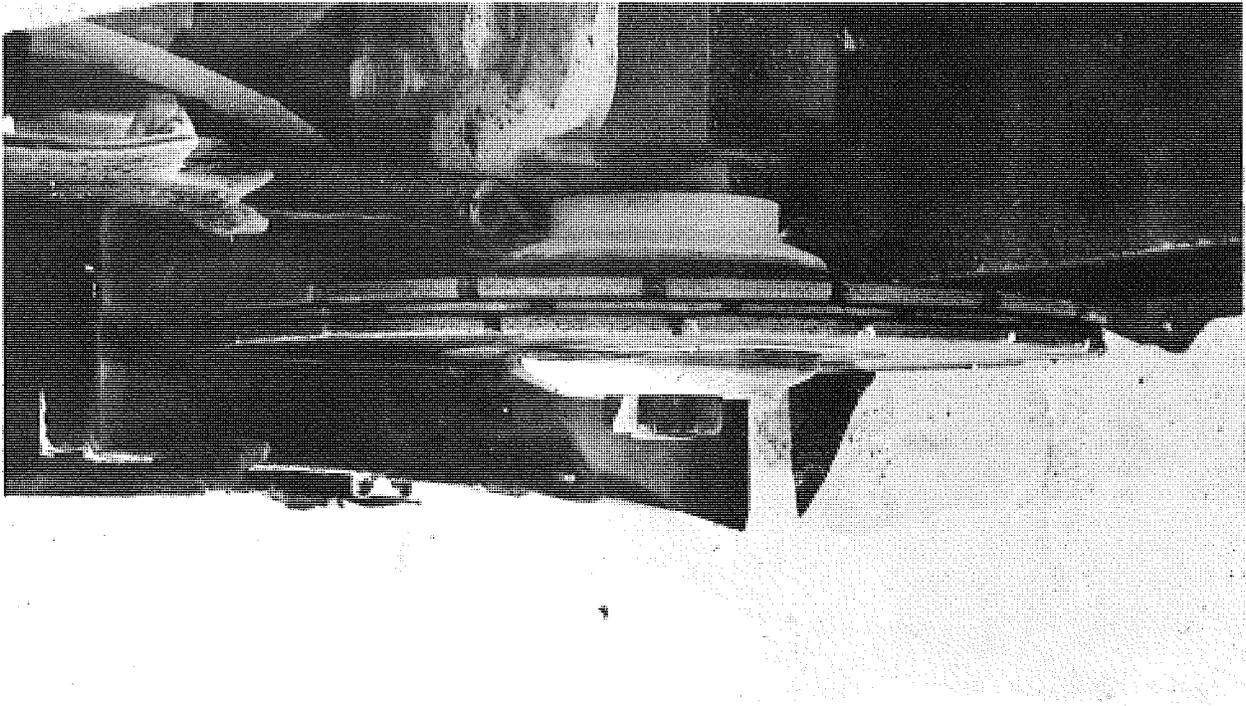


Figure 7. Two types of saw set-ups for a second stage cut utilizing a spacer (above) and more than two blades (right).