Technical News Bulletin

Enfield, 7 July, 2005

AC Servo Multi-Cam Feeder

1. Introduction

The AC Servo Multi-Cam Feeder permits the simultaneous production of different weight containers on different sections of the same NIS or AIS machine. This new, software-controlled feeder facilitates the mixing of electronic feeder cams, together with a corresponding height and stroke, on a per-section basis. When using the Multi-Cam Feeder, operators are not limited to running the same Cam/Height/Stroke combination for each running section. In a multi-cam configuration, each section's cam/height/stroke combination is referred as a sub-cam. Multi-Cam jobs can be created, controlled, and monitored from a single screen. The feeder software also permits merging two existing job files.

2. Creating a Multi-Cam Job

The primary task in creating a multi-cam job is to determine the cam/height/stroke (a sub-cam) that is required for each section. Feeder and fluid-dynamic constraints determine how much each adjoining gob can differ. Next, the configuration of how the sub-cams are to be joined is determined. Even if all gobs will be created with the same cam profile, the joining of sub-cams is still an important issue. Examples and information on available options are described in Section 4 of this bulletin.

3. Joining Sub-Cams

3.1. Joining Cams at Top vs. Joining Cams at Bottom

Sub-cams can be connected at the bottom, or at the top.

Joining sub-cams at bottom means putting them next to each other at their zero points. If the cam doesn't start at zero position, it is shifted first. The connection then can be further edited, if necessary. Figures 1 and 2 show the cams EX1 and 4 BRICK being joined at the bottom.

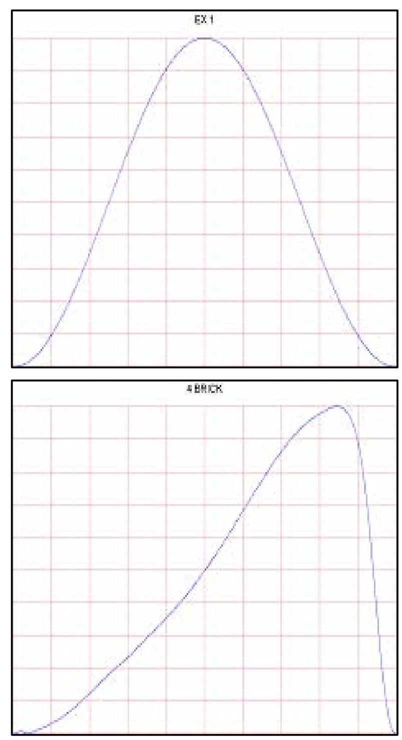


Figure 1: Cams EX 1 and 4 BRICK

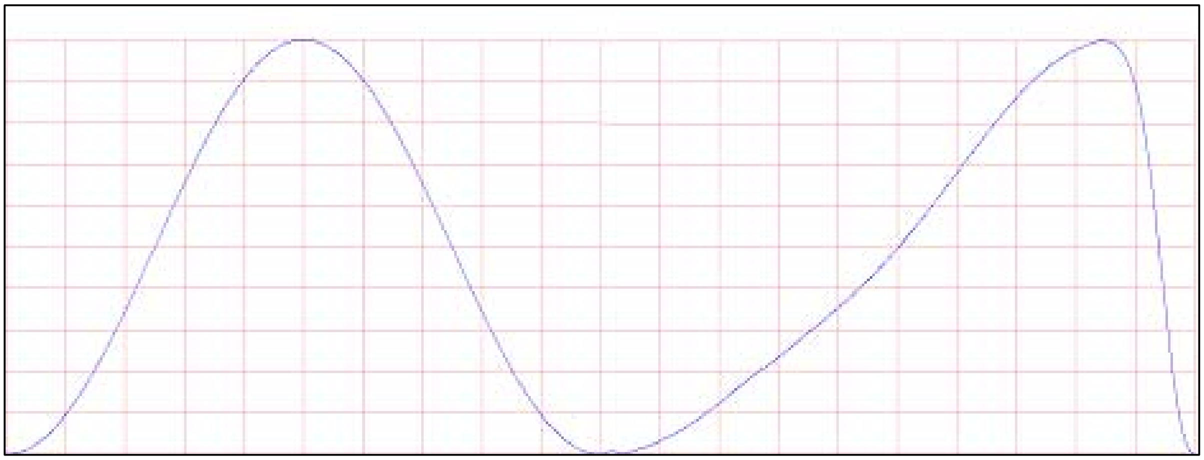


Figure 2: Cams EX 1 and 4 BRICK connected at bottom

Note that at the “peaks”, the original cam shapes are retained. But at the bottom, where EX1 and 4 BRICK meet, the “valley” is formed half from EX1 and half from 4 BRICK, so it would not actually match either shape accurately. The actual shapes of the valleys for these two cams can be seen in Figure 3. EX 1 has a symmetrical smooth valley, whereas 4 BRICK has a bumpy asymmetrical valley. The joined cam matches neither, but has a valley that has the left half of EX 1 and right half of 4 BRICK. This can be a problem if the plunger movement at the bottom is important (techniques for resolving this problem are discussed in Section 5).

Joining cams at the top means shifting the cams, so they start at the top instead of at zero, and then joining them. Again, the connection can be further edited.

Shifted EX1 and 4 BRICK cams are shown in Figures 3 and 4.

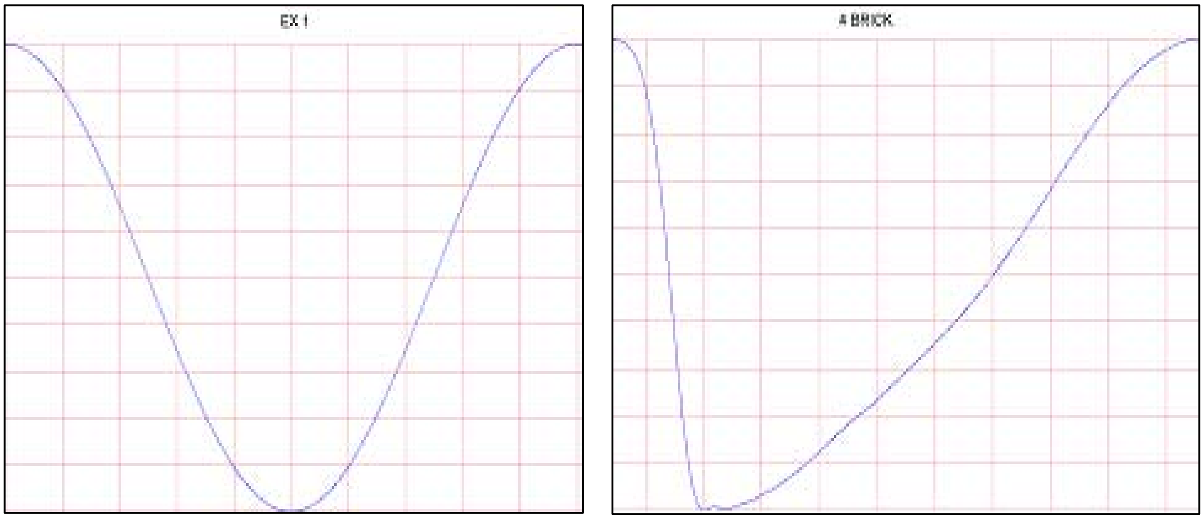


Figure 3: Cams EX 1 and 4 BRICK shifted for joining at top

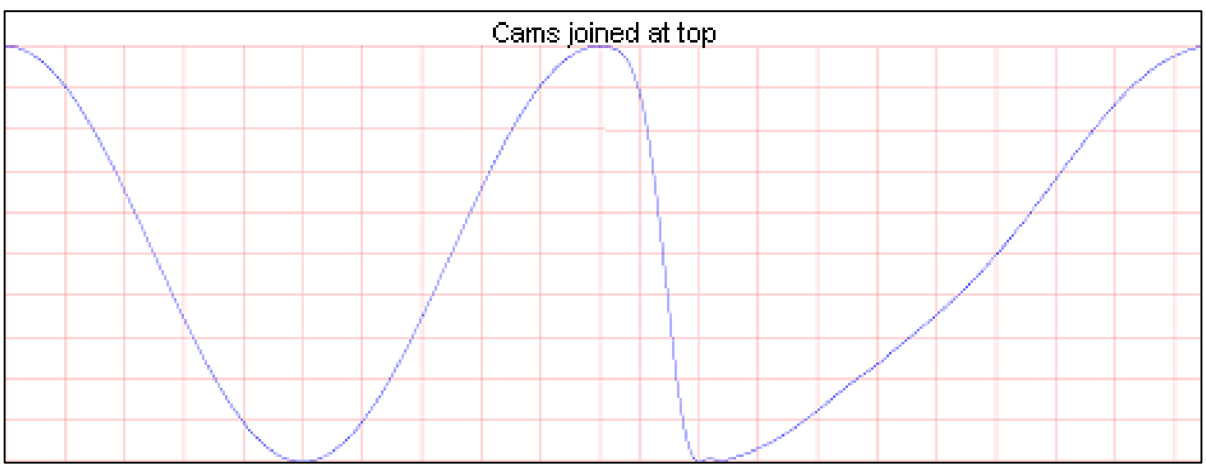


Figure 4: Cams EX 1 and 4 BRICK joined at top

Note than in Figures 3 and 4, the “valleys” have the correct shape. But the “peak” is formed half from EX 1 and half from 4 BRICK, so it would not match the correct peak shape for either cam. If the plunger movement at the peak is important (techniques for resolving this problem are discussed in Section 3).

4. Adjusting for Heights and Strokes

If adjacent sub-cams do not have the same height and/or stroke, they must be adjusted further. For example, if the cam on the left has a height of 2” [50.8mm] but the cam on the right has a height of 0”, then the cams cannot be simply joined.

For bottom-joined cams, if the heights/strokes do not match, the down-stroke (right side) of the cams is changed to make sure the plunger is positioned at the correct position at the end of the cam.

Figure 5 shows an example of bottom-joined cams. The numbers used in this example are for illustration only and may not be suitable for production operation. The cam on the left has a height of 0” but the cam on the right has a height of 2” [50.8mm]. Both cams have a stroke of 8” [203.2mm]. The cam on the left starts at 0” and finishes its upward movement as normal. But its downward movement is shortened, so that it can meet the required height of 2” [50.8mm] for the next cam. The actual downward stroke of the cam on the left, is only 6” [152.4mm].

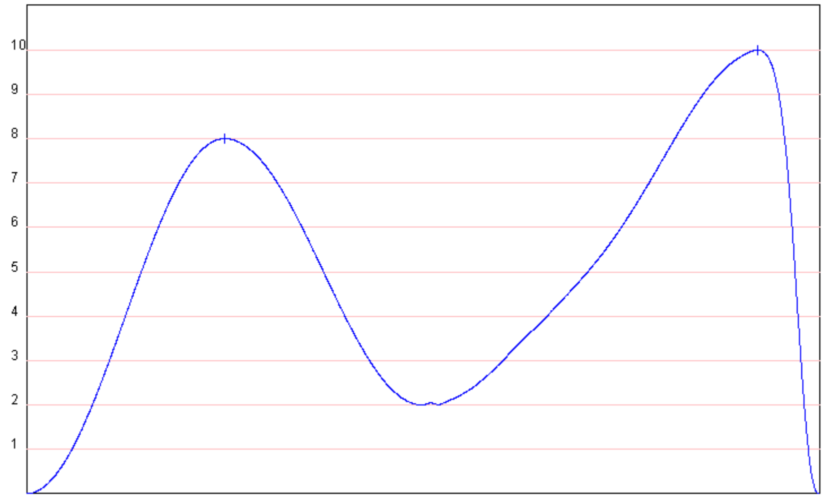


Figure 5: Height adjustment for bottom-joined cams

The cam on the right has a height of 2” [50.8mm], but it must leave the plunger positioned at 0” for the next cam. So its upstroke is normal, but its down-stroke is 2” [50.8mm] longer than normal, i.e. it has a 10” [250.4mm] down-stroke so that plunger can be positioned back at 0”.

In joining at the bottom, The shape and size of the cam upstroke is preserved. If the cams do not have same stroke/height, the down-stroke of one cam will be compressed or stretched so it meets the next cam correctly.

In joining at the top, the shape and size of the cam down-stroke is preserved. If the cams do not have same stroke/height, the upstroke of one cam will be compressed or stretched so it meets the previous cam correctly. The shape of the cam bottom also is preserved. In other words, the way the plunger moves when it is at the bottom of the stroke will remain the same. Each section uses the upstroke of the previous section’s cam to get the plunger to move to the right place for the down-stroke.

Figure 6 shows an example of top-joined cams. As with Figure 5 (above), the numbers used in this example are for illustration only and may not be suitable for production operation. The cam on the left has a height of 0” and the cam on the right has a height of 2” [50.8mm]. They both have a stroke of 8” [203.2mm]. The cam on the left has the normal down-stroke. But its upstroke is made 2” [50.8mm] longer, thus allowing the next cam to have a normal down-stroke. Similarly, the second cam’s upstroke is made 2” [50.8mm] shorter, allowing the next cam to have a normal down-stroke.

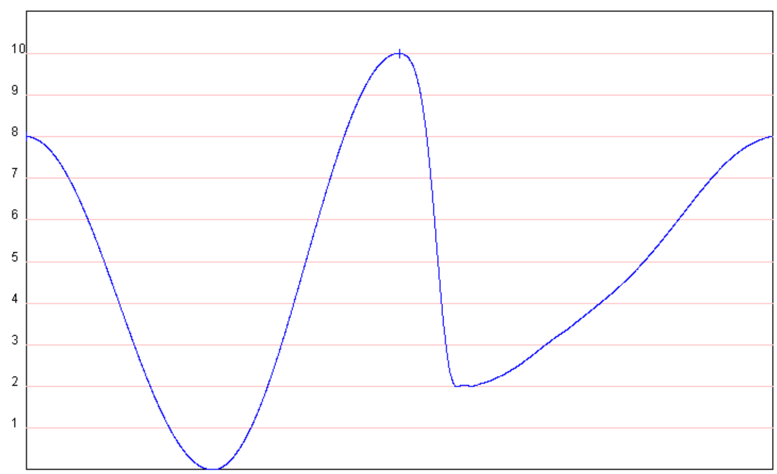


Figure 6: Height adjustment for top-joined cams

Note that in top-joined cams, every cam actually uses the previous cam’s upstroke for positioning the plunger at the expected location. (Figure 5 will be shifted by about half a cam, so the complete joined cam starts at 0.) This can be acceptable if the upstroke is not critically important in the cam, and if the job of the upstroke is only to get the plunger positioned correctly for the down-stroke. If the shape of the upstroke is critical, the join must be further edited.

5. Multi-section examples

Figure 7 shows bottom-joined cams, where all cams have a height or 0" and a stroke of 4" [101.6mm], but section 6 has a height of 2" [50.8mm] and a stroke of 3" [76.2mm]. Note that the upstroke for section 6 starts at 2" [50.8mm], and has the stroke of 3" [76.2mm]. The down-stroke for section 6 uses a stroke of 5" [127mm] to reach the height of 0" for the next cam. Notice that because of the height of section 6, the down-stroke for section 3 had to be modified. It has only a 2" [50.8mm] stroke.

NOTE:

The combination of sub-cams used in the following examples are examples only and are not necessarily representative of actual jobs.

The peaks of all cams maintain accuracy with bottom-joined cams.

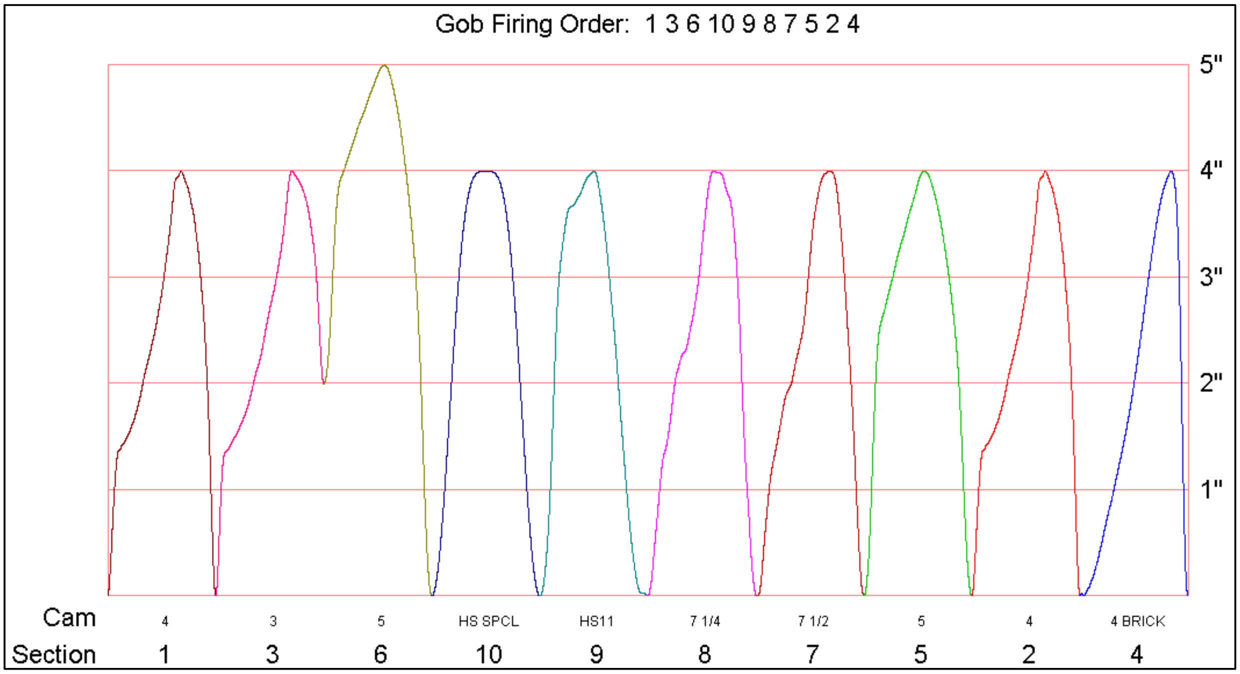


Figure 7: Cam arrangement for a 10-section feeder with bottom-joined cams

Figure 8 shows the same cams as in Figure 7, but in a top-joined configuration. Note that section 1 uses the upstroke from 4 BRICK, the cam on the last section in the firing order (section 4.)

Section 6 also has a down-stroke that starts at the correct place (2" [50.8mm] + 3" [76.2mm] = 5" [127mm]) and finishes at the correct height of 2" [50.8mm] using the correct stroke of 3" [76.2mm]. However, the upstroke for section 6 is actually 5" [127mm]. Similarly, the upstroke for section 10 is reduced by 2" [50.8mm], but its down-stroke remains accurate.

The valleys for all cams maintain accuracy in a top-joined configuration.

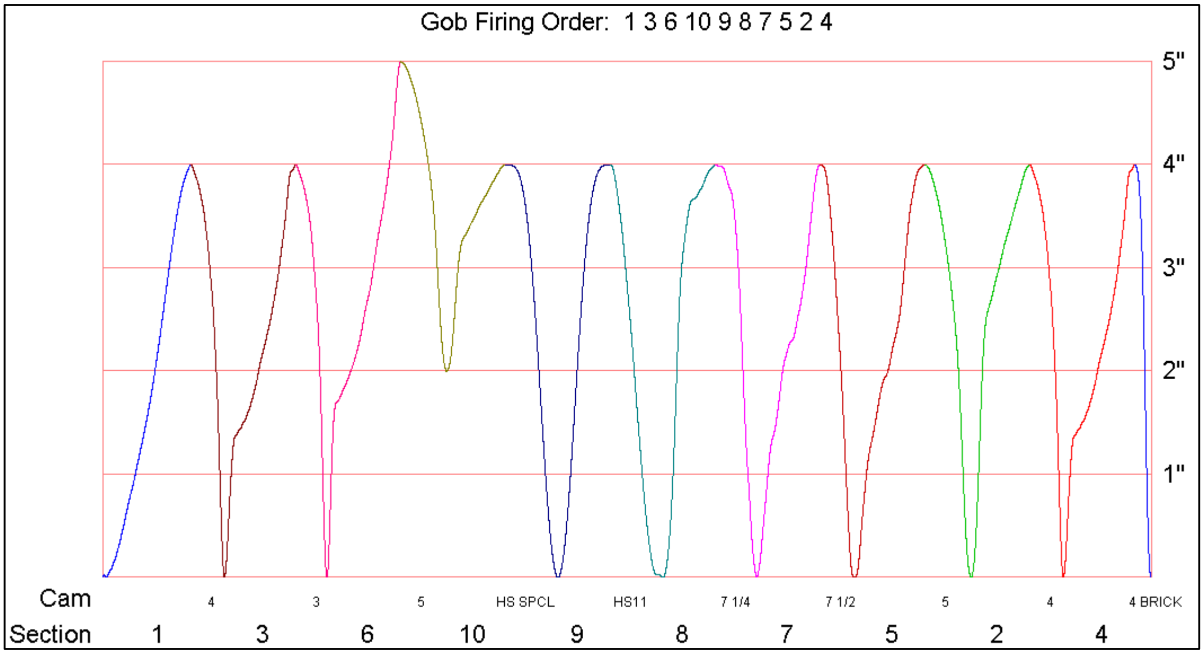


Figure 8: Cam arrangement for a 10-section feeder with top-joined cams

6. Editing the joins

The Multi-Cam software provides three kinds of connections, both for top-joined and bottom-joined cams:

- Direct Connection. Cams are placed together without any editing of the joins.
- Morph. A smoothing function is used to preserve the valley of one cam and the peak of the next cam, slowly morphing from one to the other.
- Smooth Join. In this configuration, the user decides how much to preserve of the valley of one cam and the peak of the next cam. The Multi-Cam software then joins the two sides smoothly.

The difference between "morph" and "smooth join" is that "morph" considers the original shape of the cams – what the cam *would* have done – and it slowly changes from one cam to the next. "Smooth Join" simply joins the two end points smoothly, and ignores what the cams *would* have done.

Both "morph" and "smooth join" use a "window" that extends from the valley of one cam to the peak of the next cam. The user can make this window shorter by moving its left and right sides closer together.

Normally, "morph" works well on the full window. For "smooth join", the user should make the window shorter to preserve enough of the valley and peak shapes, then let "smooth join" connect the valley and the peak using a smooth curve.

"Smooth Join" also has a "curve" control that decides how curvy the join can get. If the "curve" control is moved all the way to the left, the cams are joined almost in a straight line. If it is moved all the way to the right, the join will usually be too curvy. A middle position usually is the best smooth path, and can be fine-tuned by the user.

Figure 9 shows the EX 1 and 4 BRICK cams with a Direct Connection.

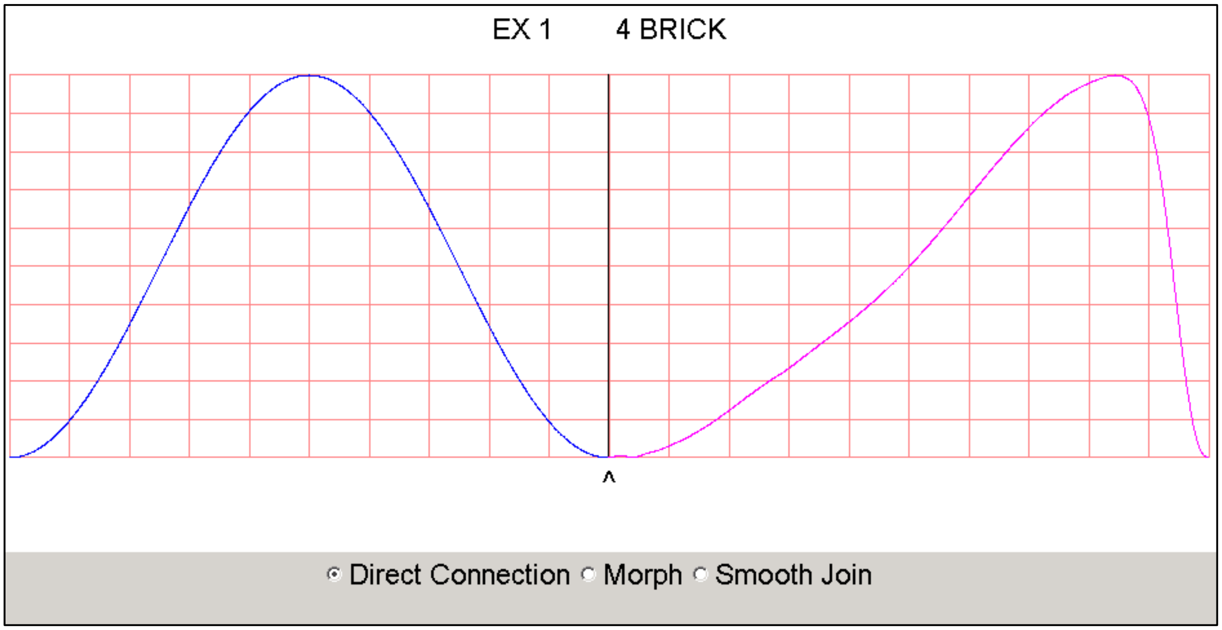


Figure 9: Cams EX 1 and 4 BRICK connected at bottom with Direct Connection

Figure 10 shows the cams with a Morph. Morph usually works well for most cases, but in this example (EX 1 and 4 BRICK), it is adding unnecessary curves in the cam, even though it is preserving the valley of EX 1 and the peak of 4 BRICK.

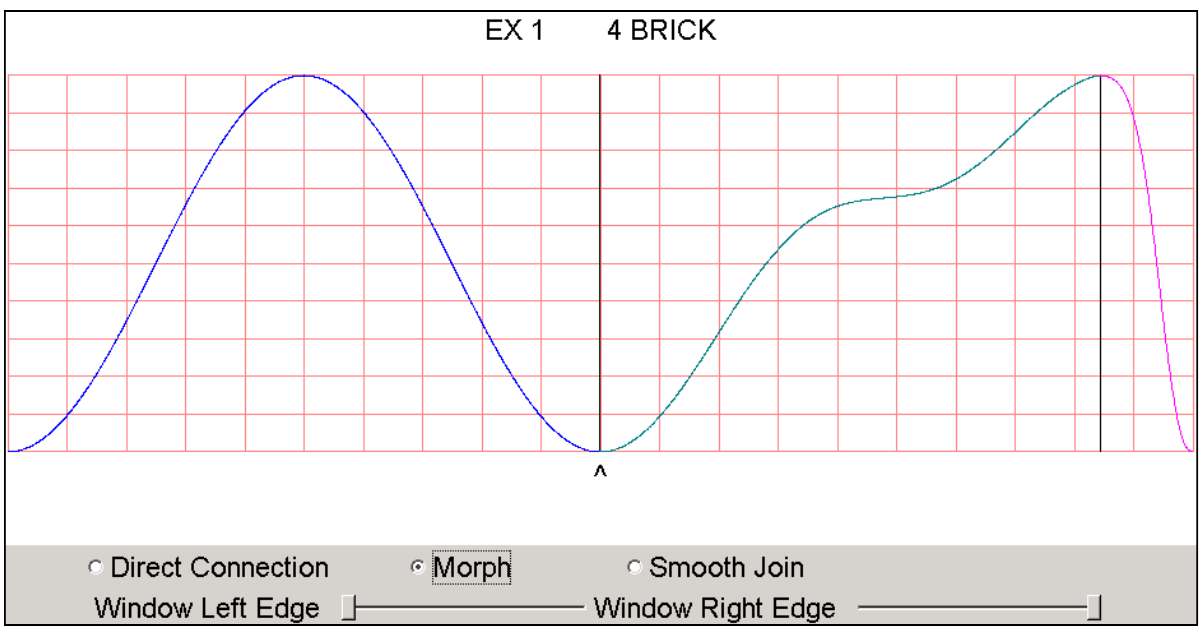


Figure 10: Cams EX 1 and 4 BRICK connected at bottom with Morph over full window

Figure 11 shows the cams with a Smooth Join. Note that the smooth join over the full window preserves neither the valley of EX 1 nor the peak of 4 BRICK.

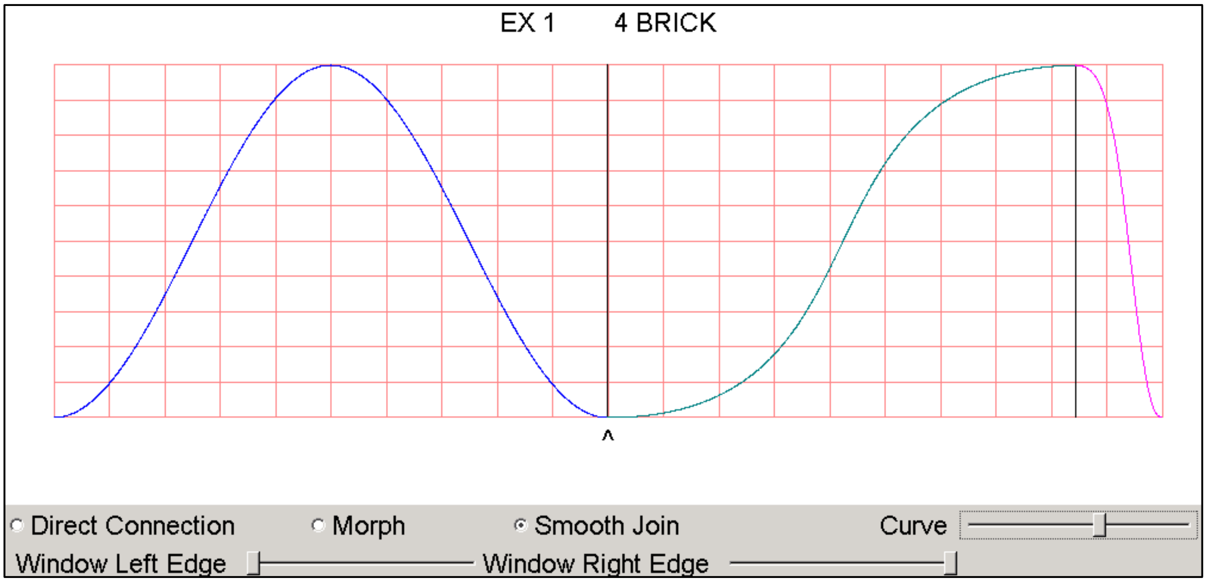


Figure 11: Cams EX 1 and 4 BRICK connected at bottom with Smooth Join over full window

Figure 12 shows the cams with a Smooth Join, but with an appropriately reduced window and an appropriate setting for "Curve". In this example, the cams are joined smoothly, with both the valley of EX 1 and the peak of 4 BRICK being preserved correctly. In this case, a Smooth Join with reduced window appears to be the best, but in other cases, a morph or a direct connection may be the best.

Figure 12: Cams EX 1 and 4 BRICK connected at bottom with Smooth Join over a reduced window

7. General System Requirements

Machine Cycle Signal (MCS) must be connected to the Index input of the AC Feeder Controller. The MCS determines when Gob #1 is formed.

7.1 Software Requirements:

AC Feeder:	Ver. 4.28K or later
PLC:	Ver. 8.09 or later
Universal Console:	Ver. 2.53_4 or later

8. Multi-Cam Screen Examples

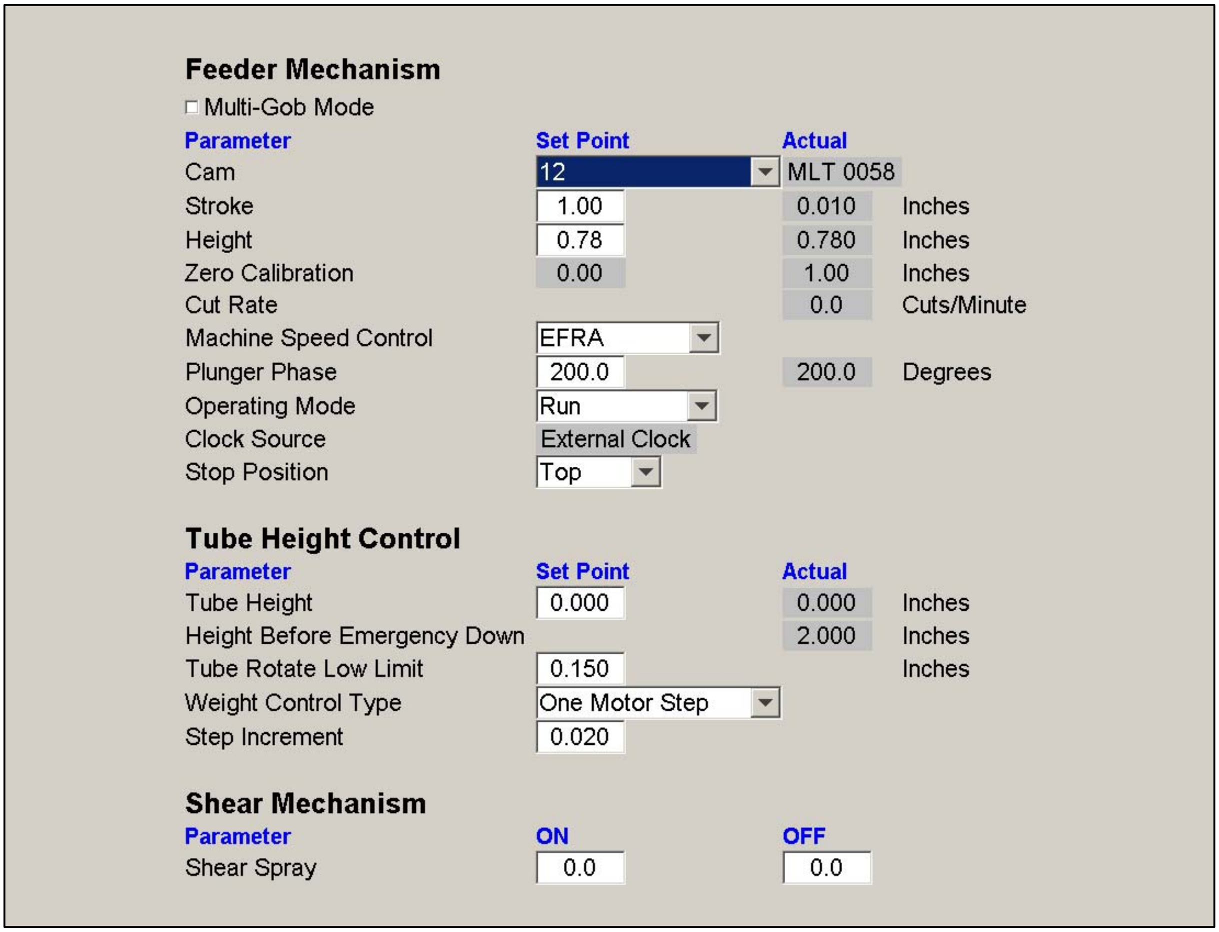
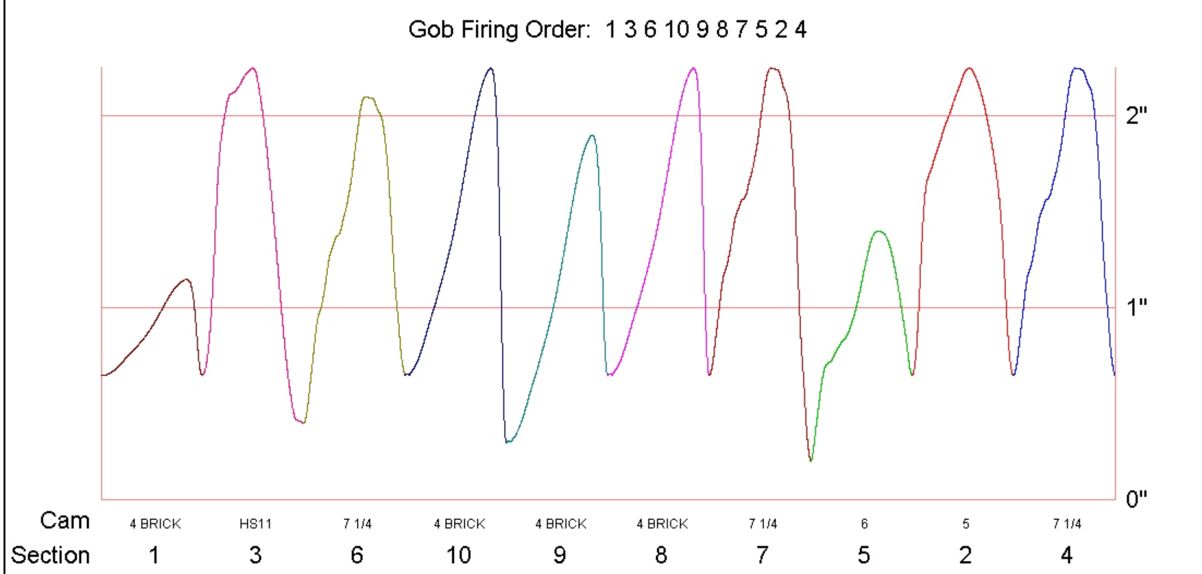


Figure 13: Universal Console screen showing Multi-Cam mode check box

	Section 1	Section 2	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Sectio
Cam	4 BRICK	5	HS11	7 1/4	6	7 1/4	7 1/4	4 BRICK	4 BRICK	4 BR
Height Setpoint	0.650	0.650	0.650	0.650	0.200	0.400	0.650	0.650	0.300	0.65
Height Actual	0.650	0.650	0.650	0.650	0.200	0.400	0.650	0.650	0.300	0.65
Stroke Setpoint	0.500	1.600	1.600	1.600	1.200	1.700	1.600	1.600	1.600	1.60
Stroke Actual	0.500	1.600	1.600	1.600	1.200	1.700	1.600	1.600	1.600	1.60

Join At ○ Top ◉ Bottom



HOME | Load Cams | Edit Cam Joins | Feeder Setup Page

Figure 14: Once check box for Multi-Cam mode is checked, this screen appears, allowing input of sub cams.