

Roll Pass Design

RAILS

Standard and Special

Steel of West Virginia, Inc.



By: Joe Schenk

Design: More like a Map than a Recipe.

3 Stages of Design



Establish overall concept and requirements, challenges, constraints, answering specific questions.

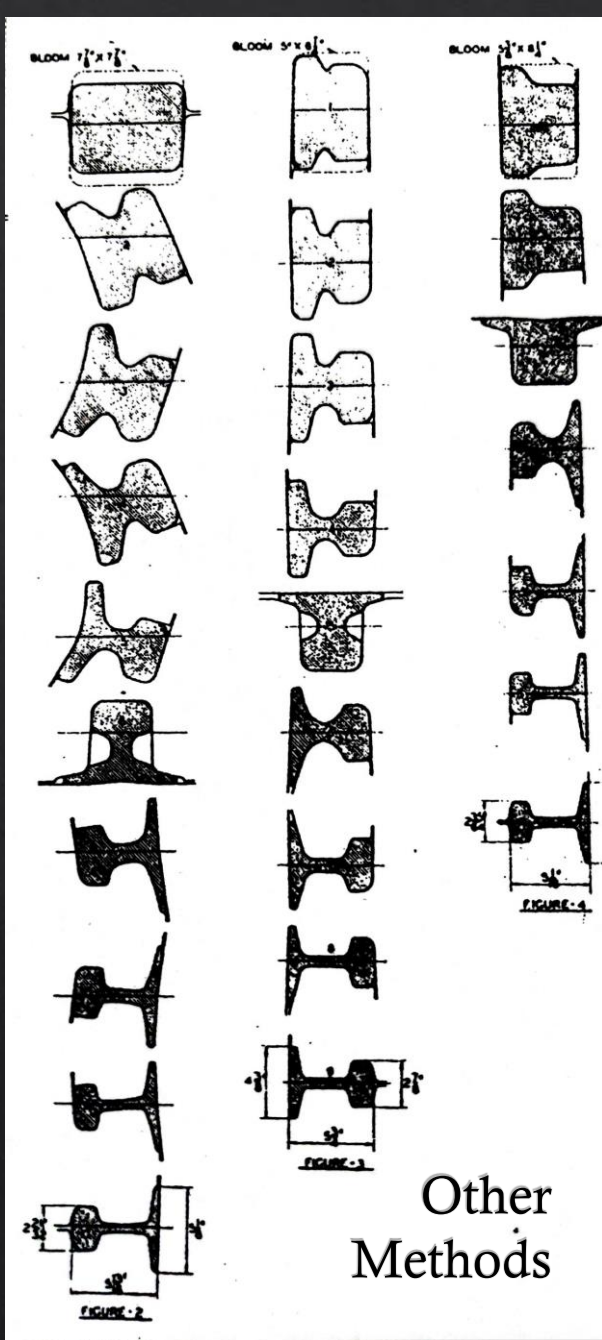
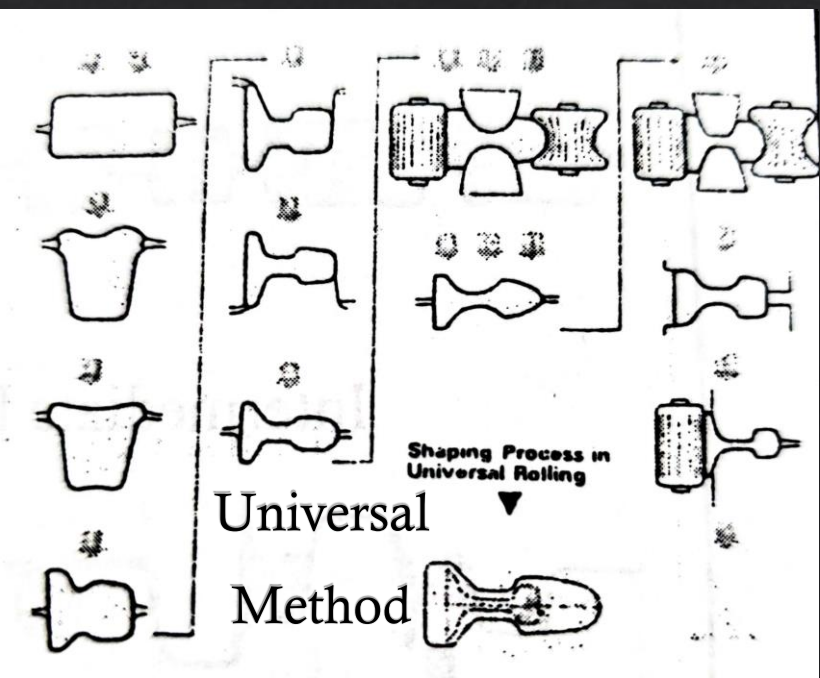
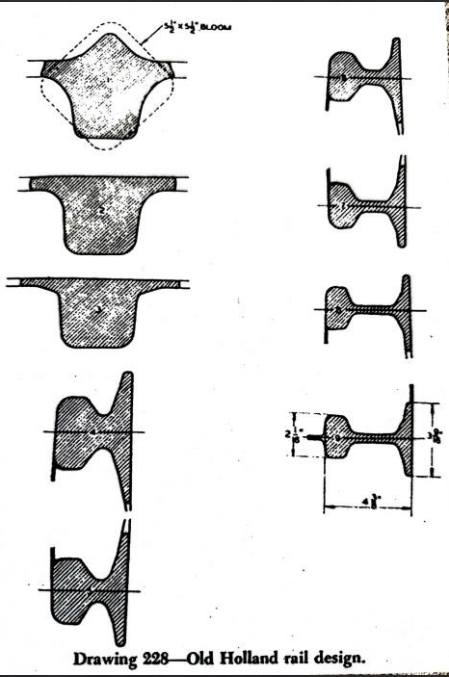
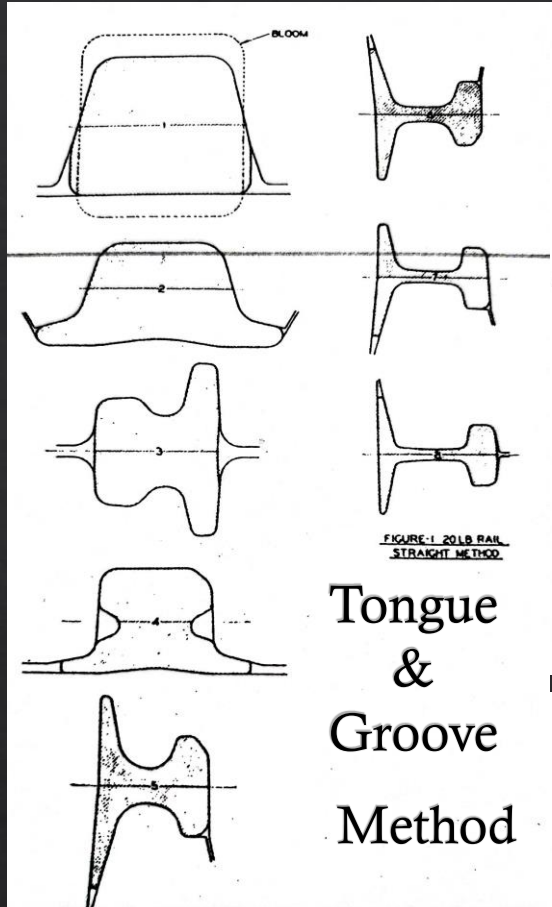
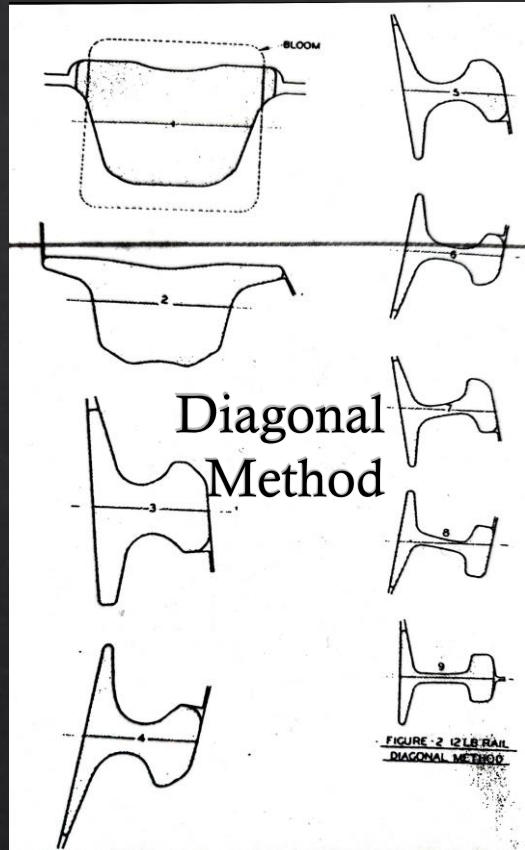
- Tolerances
- Reduction Ratio, # of passes, Avg. Reduction %
- Mill limits,
- Elongations, limits on Mill, Thru put, Cost/Profit
- Special equipment needs
- Ect.

Playing with the possibilities that fit inside the defined envelope. Take basic design concepts and build structure or composition.

- Quick sketches
- Imagining different possibilities (*Diagonal, T&G, Universal, Slab, Edger, Combo*)
- Start small and quick, move to full size
- Start with KNOWN and Move toward UNKNOWN

Refining our design to make it balanced and sing.

- Trail and error, adjusting angles, radii, balancing parts of a pass, tracking
- Each Design has a “Money Pass” i.e. A stupid pass if it makes it through here we’ll be fine. Earlier the better!
- Lots of back and forth between Explore and Refine Phases.

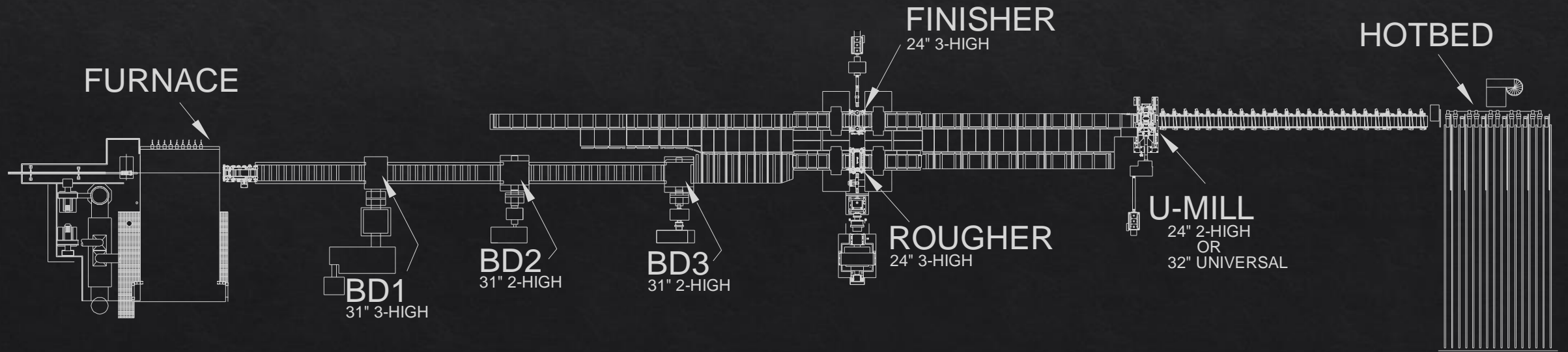
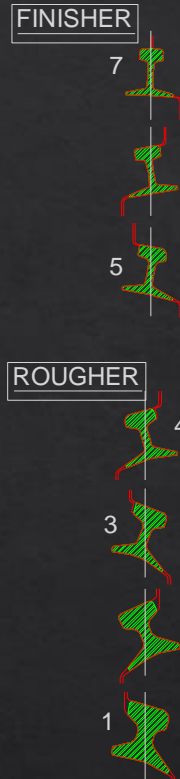


Various Rail Designs

#85 Crane Rail

SWVA #1 Mill

- ◇ Bricmont pusher furnace
- ◇ BD1 3 high; 3000 HP 37.1 rpm; 31" Pitch x 68" barrel
- ◇ BD2 2 high; 2000 HP 39.8 rpm; 31" Pitch x 68" barrel
- ◇ BD3 2 high; 2000 HP 39.8 rpm; 31" Pitch x 68" barrel
- ◇ Rougher 3 high; 4000 HP 0-120 rpm; 24" Pitch x 66" barrel
- ◇ Finisher 3 high; 2000 HP 0-120 rpm 24" Pitch x 56" barrel
- ◇ U-mill 2 high or universal; 1750 HP 87.5 rpm 24" pitch x 46.5" barrel or 32" dia. donuts

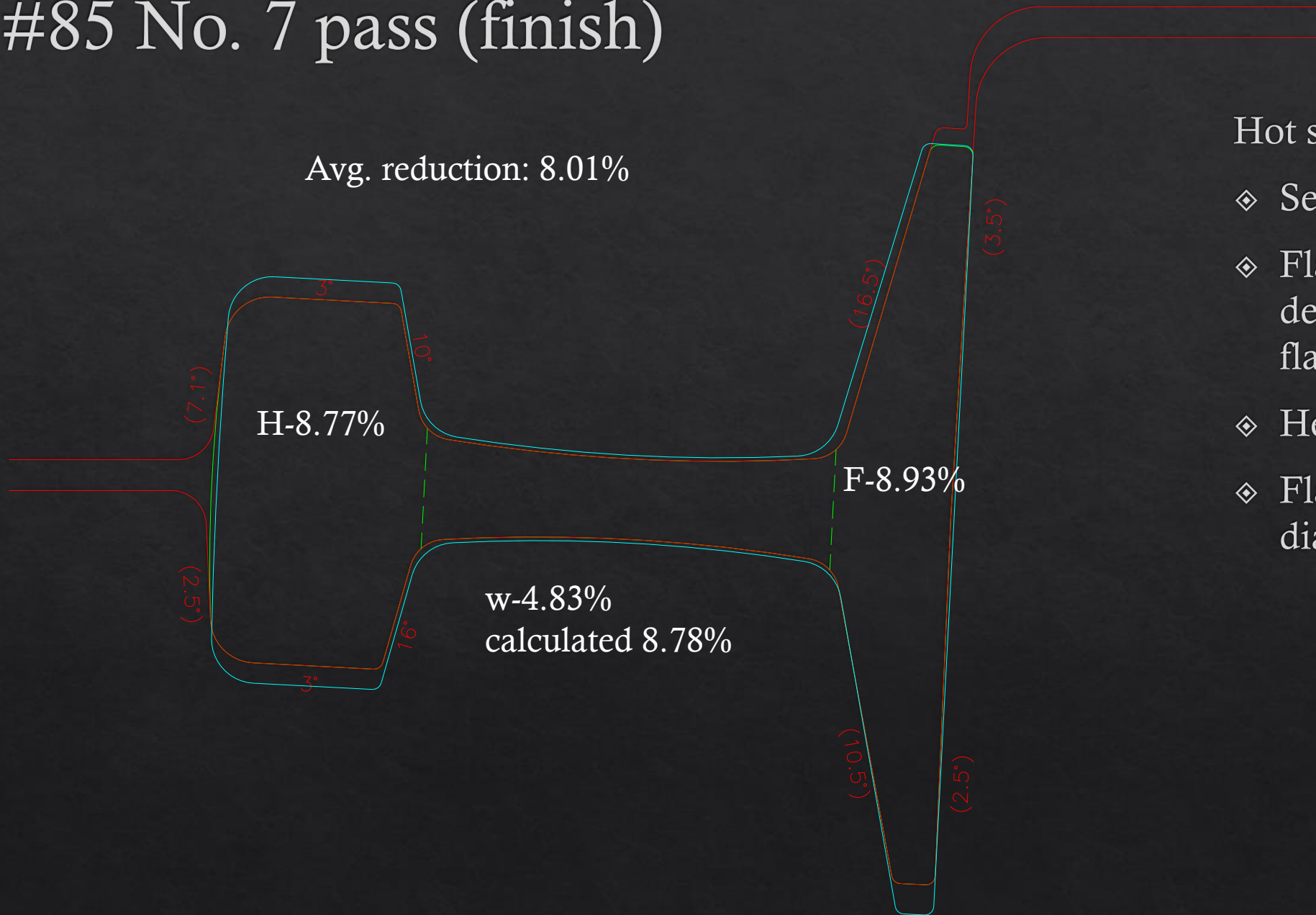


85# pass design overview



#85 No. 7 pass (finish)

Avg. reduction: 8.01%



Hot size

- ◇ Set @ 3 degrees
- ◇ Flanges rotated 0.5 degrees to ensure flatness
- ◇ Head worked as edger
- ◇ Flanges worked as diagonal

#85 No. 6 pass (leader)

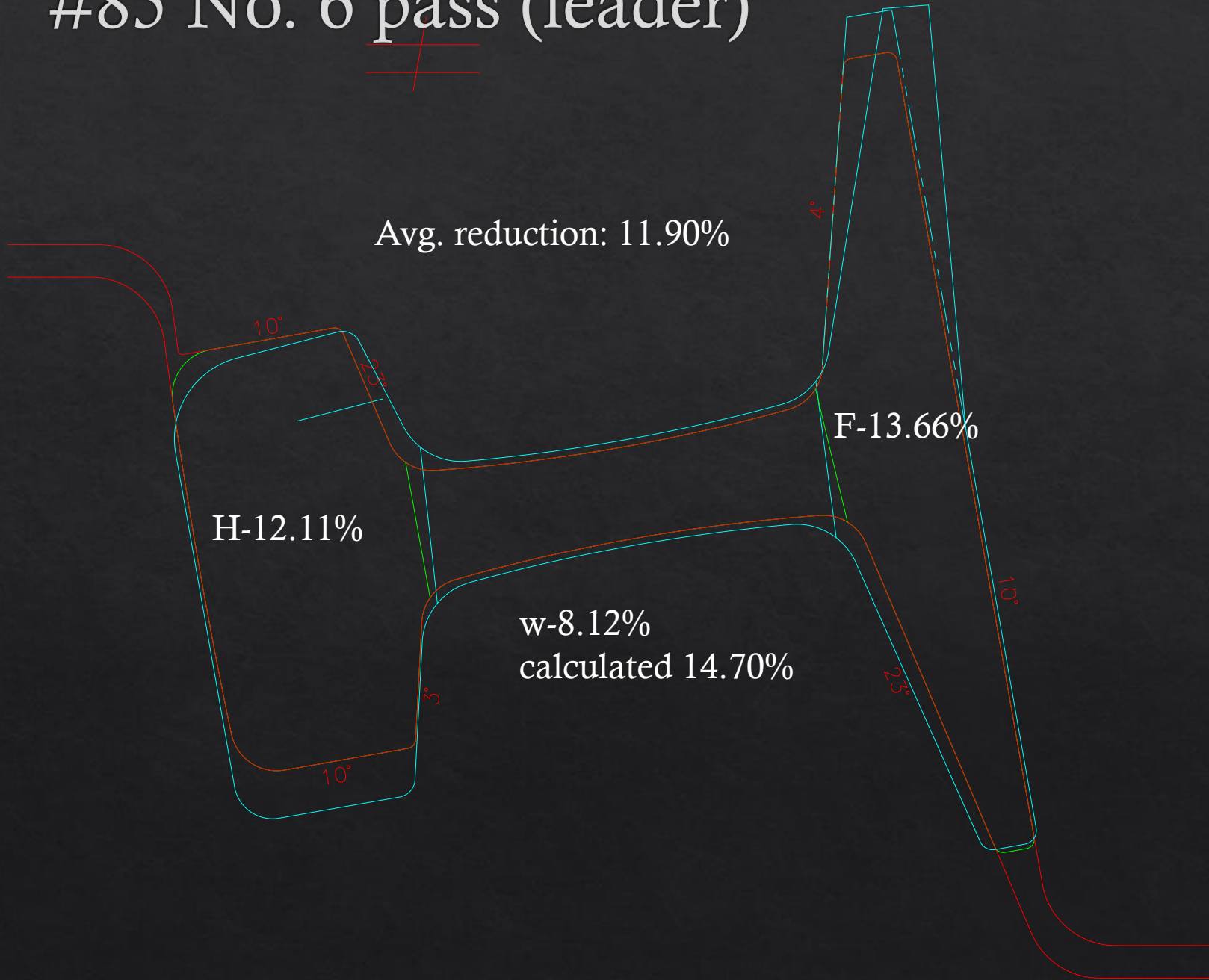
Avg. reduction: 11.90%

H-12.11%

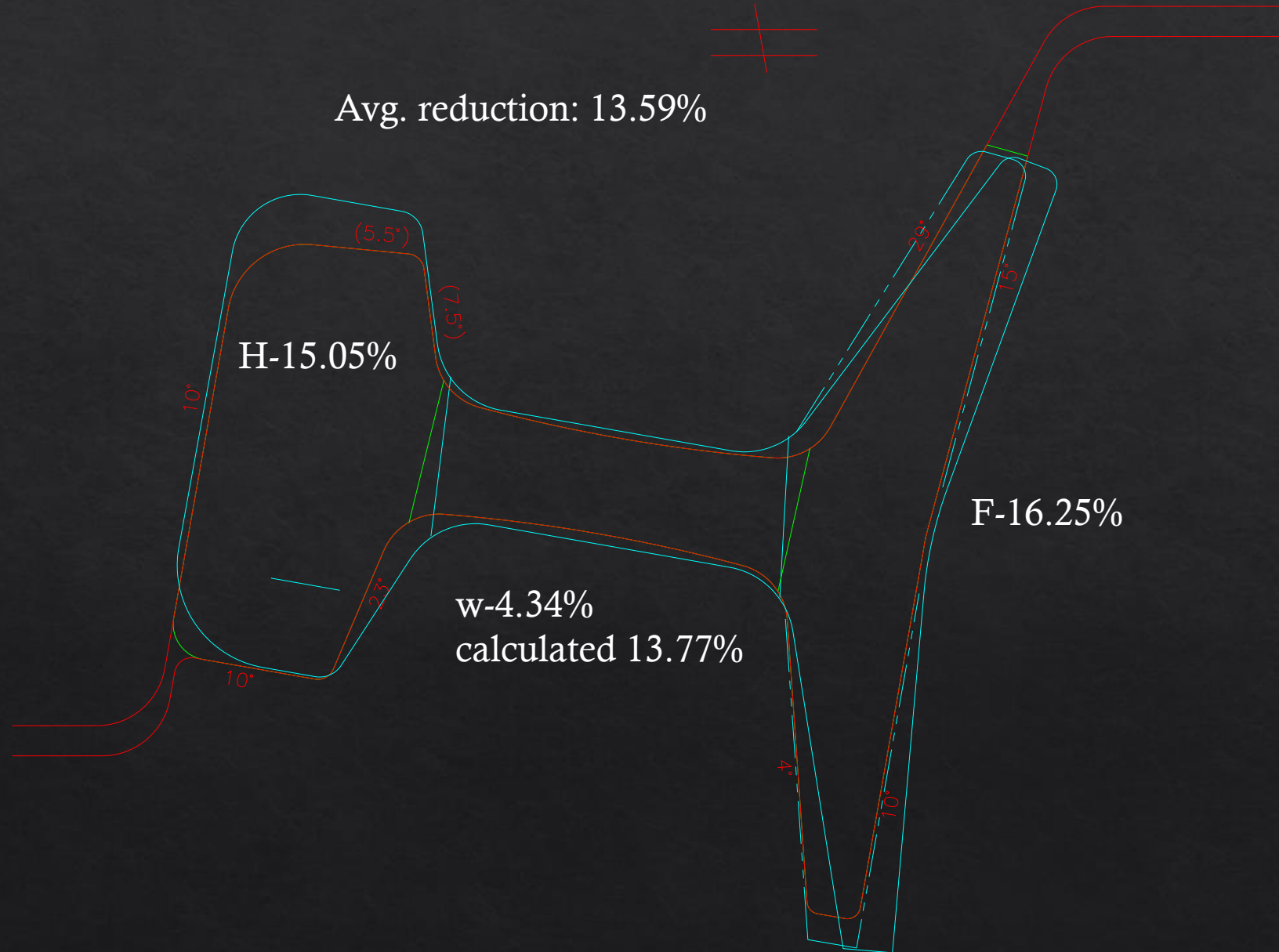
w-8.12%
calculated 14.70%

F-13.66%

- ◇ Set at 10 degrees
- ◇ Dead legs at 3 & 4 degrees
- ◇ Head radii at 36" prep. for finish edger
- ◇ Flange dead leg rotates into position, protects against vacancy on backside of base

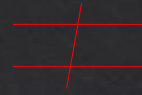


#85 No. 5 pass (former)

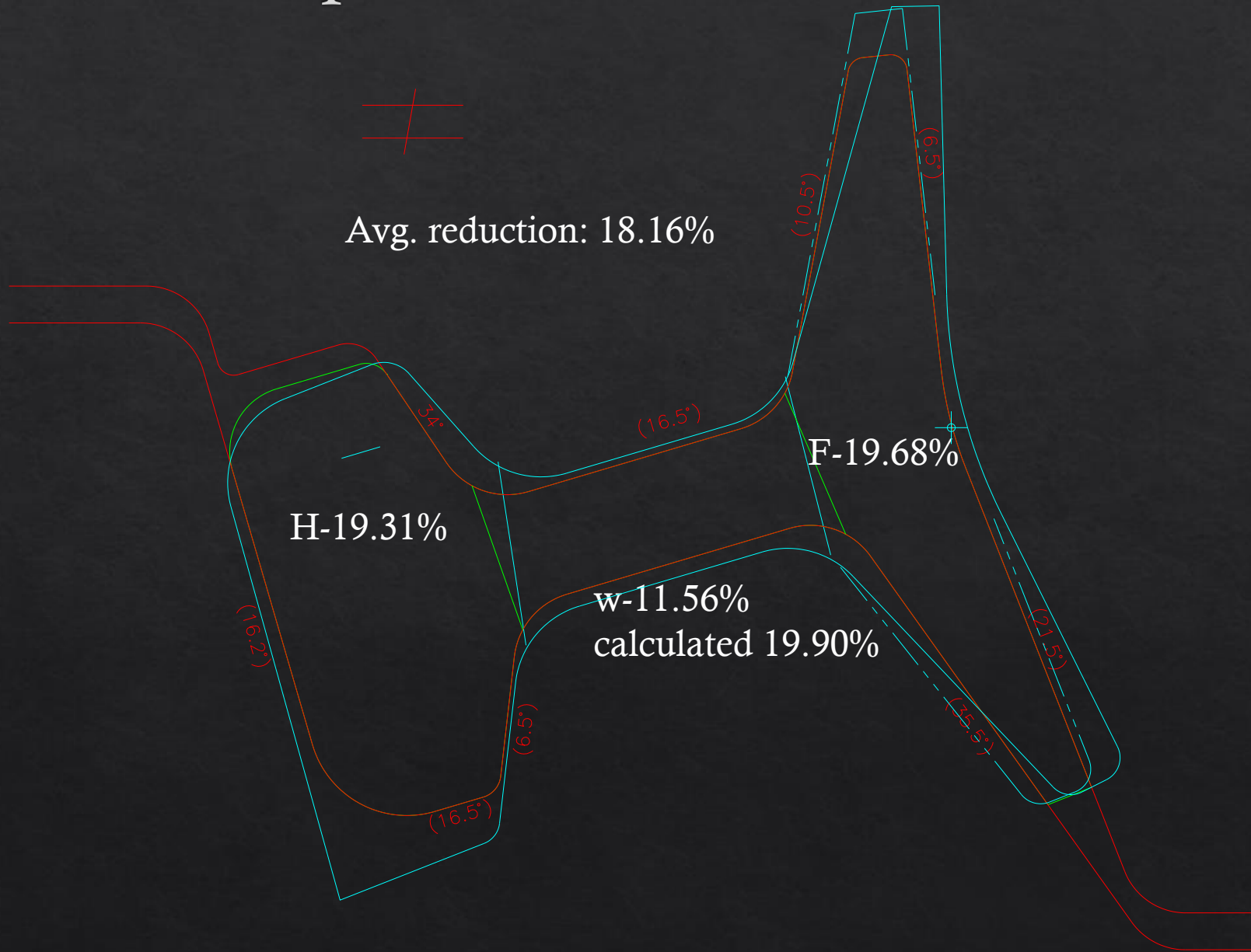


- ◇ Set at -10 degrees
- ◇ Dead legs at 7.5 & 4 degrees
- ◇ Web radii started here, avg. web thickness used for calculation
- ◇ Flange dead leg rotates into position, protects against vacancy on backside of base
- ◇ Flange live leg rotates into position, counteracts dead leg force as well as reduce direct wear on live leg

#85 No. 4 pass

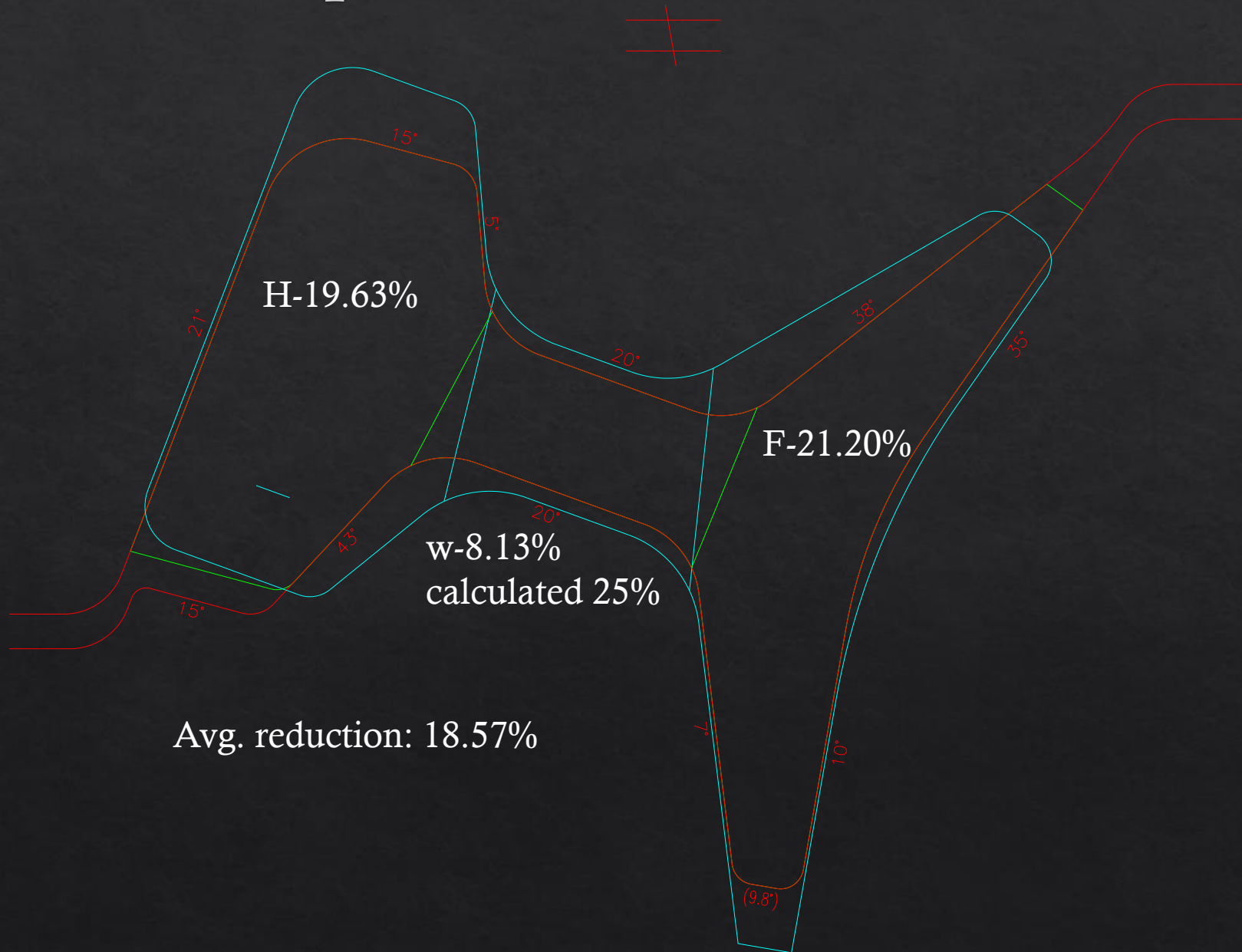


Avg. reduction: 18.16%



- ◇ Set at 16.5 degrees
- ◇ Dead legs at 6.5 degrees
- ◇ Flange rotated in position, maintains flange individuality and increased direct rolling contact for live legs

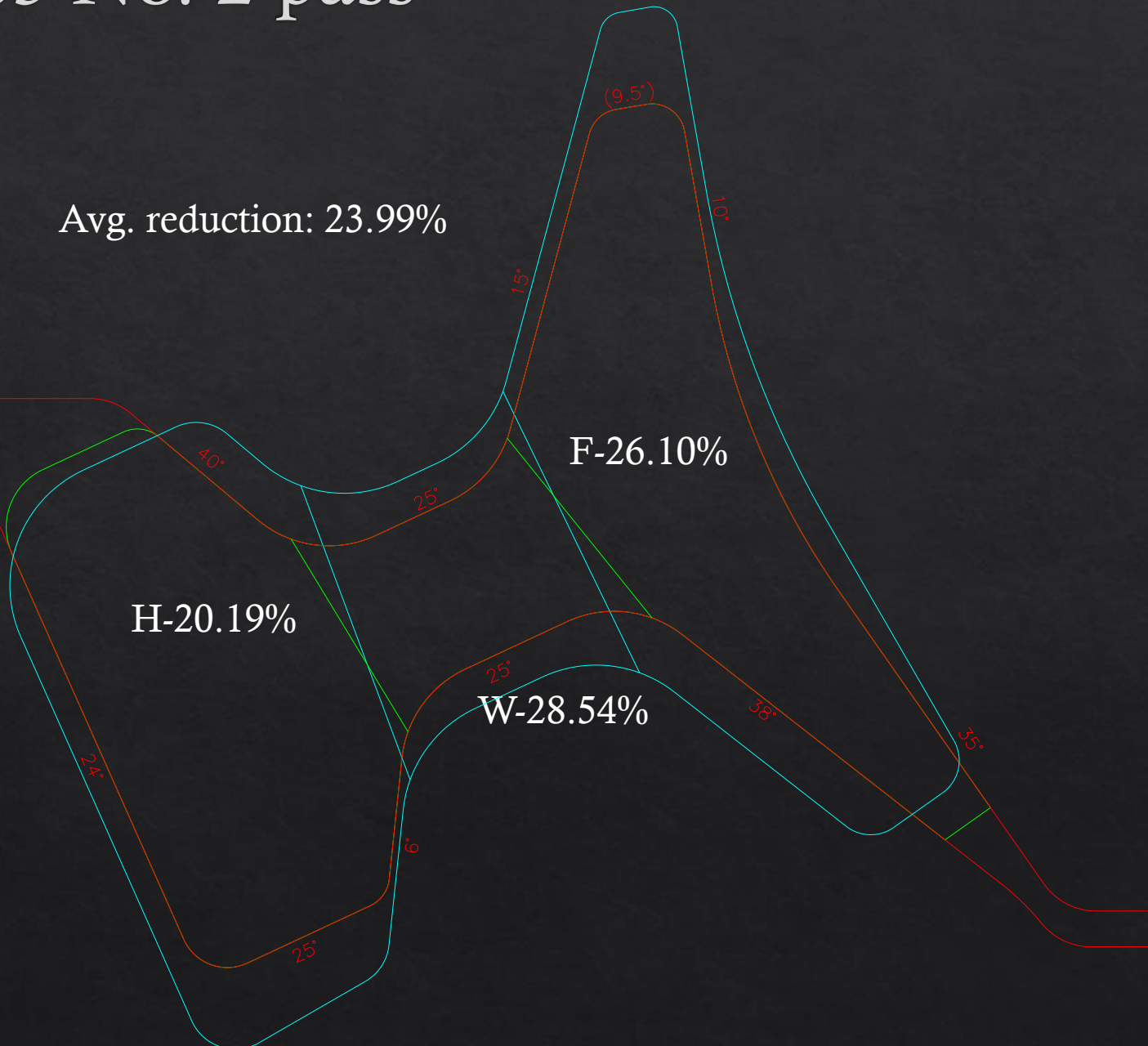
#85 No. 3 pass



- ◇ Set at -20 degrees
- ◇ Dead legs at 5 and 7 degrees
- ◇ Flange rotation no longer necessary, live leg sufficient length to contact stop in 4, not dependent upon spread
- ◇ Aggressive thinning of live legs, balanced with equal dead leg work

#85 No. 2 pass

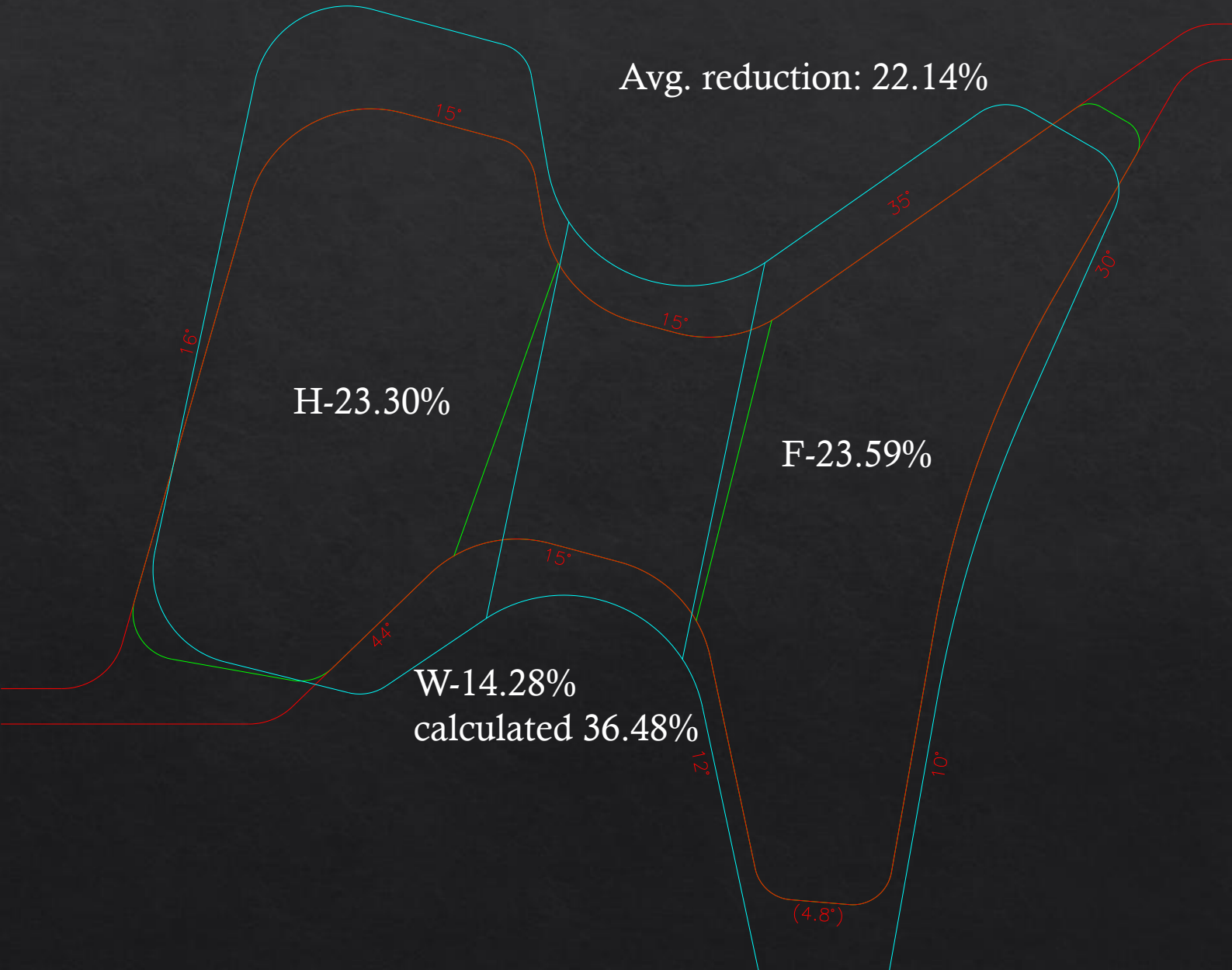
Avg. reduction: 23.99%



- ◇ Set at 25 degrees
- ◇ Entry bar similar profile, primarily reducing thickness
- ◇ Flanges seat before web

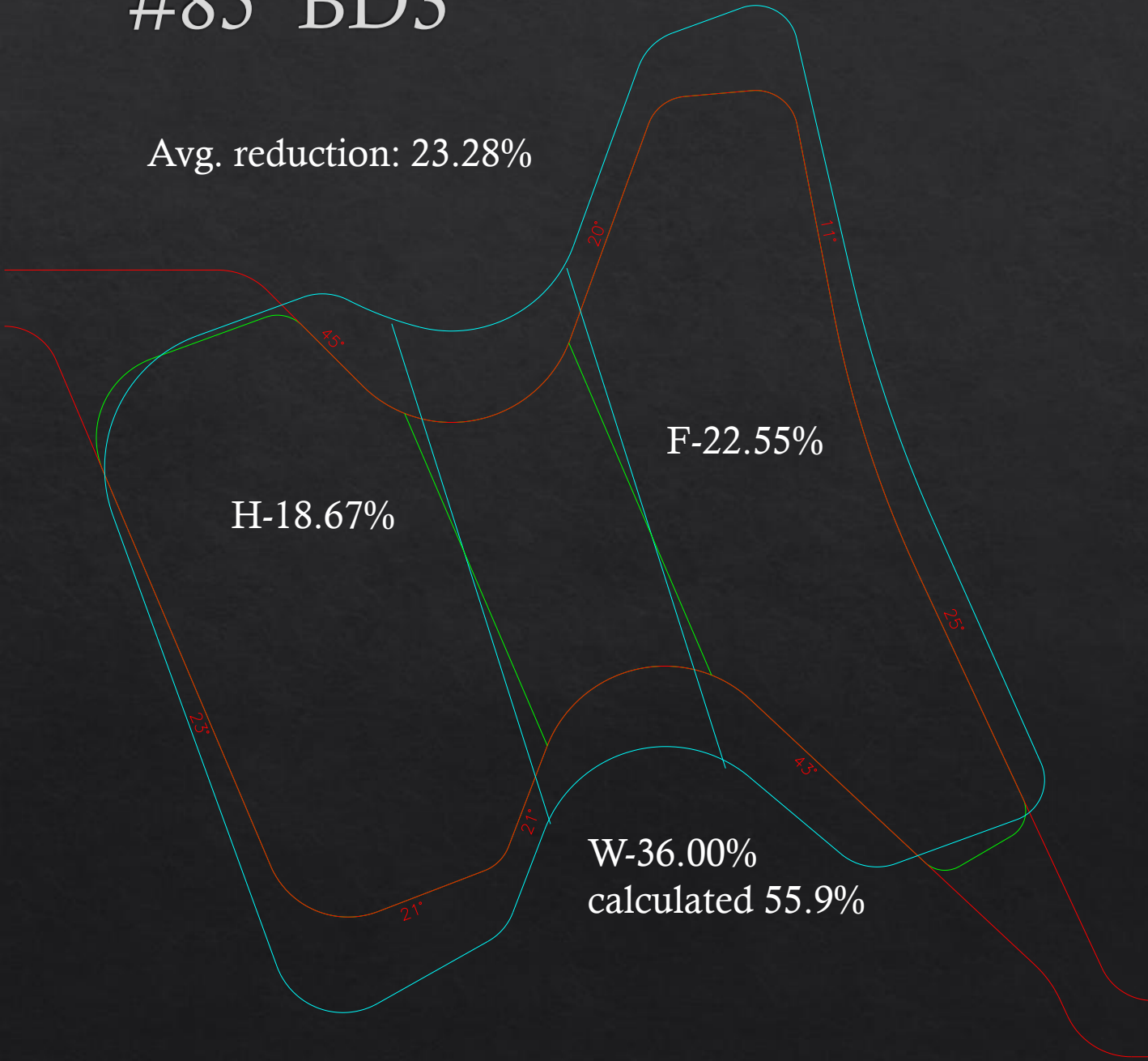
#85 No. 1 pass

- ◇ Set at -15 degrees
- ◇ Reducing head, while growing flanges



#85 BD3

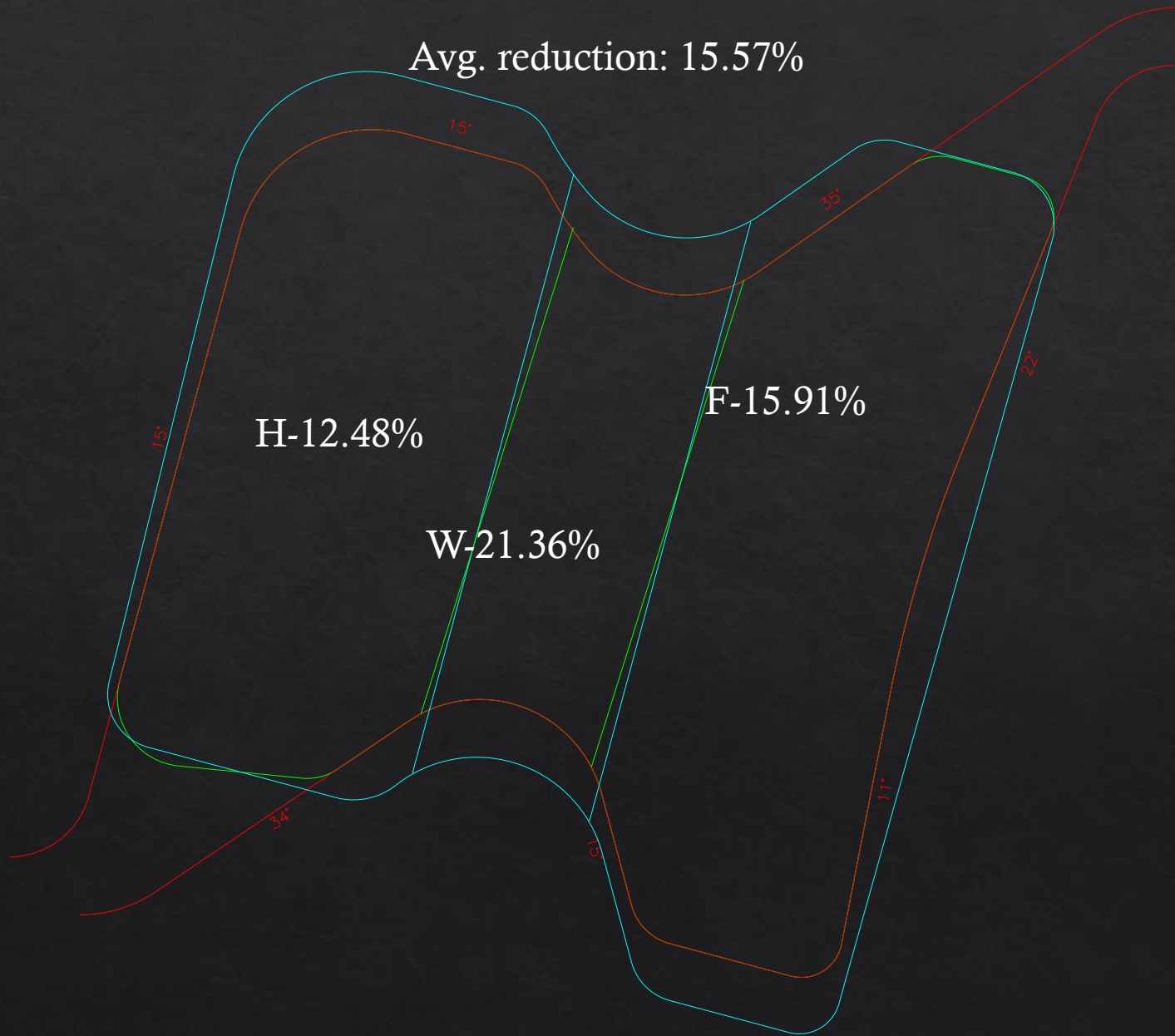
Avg. reduction: 23.28%



- ◇ Set at 20 degrees
- ◇ Knifing web
- ◇ High web work, short dead legs on head side, squeezing action on flanges maintain flange length, while reducing head

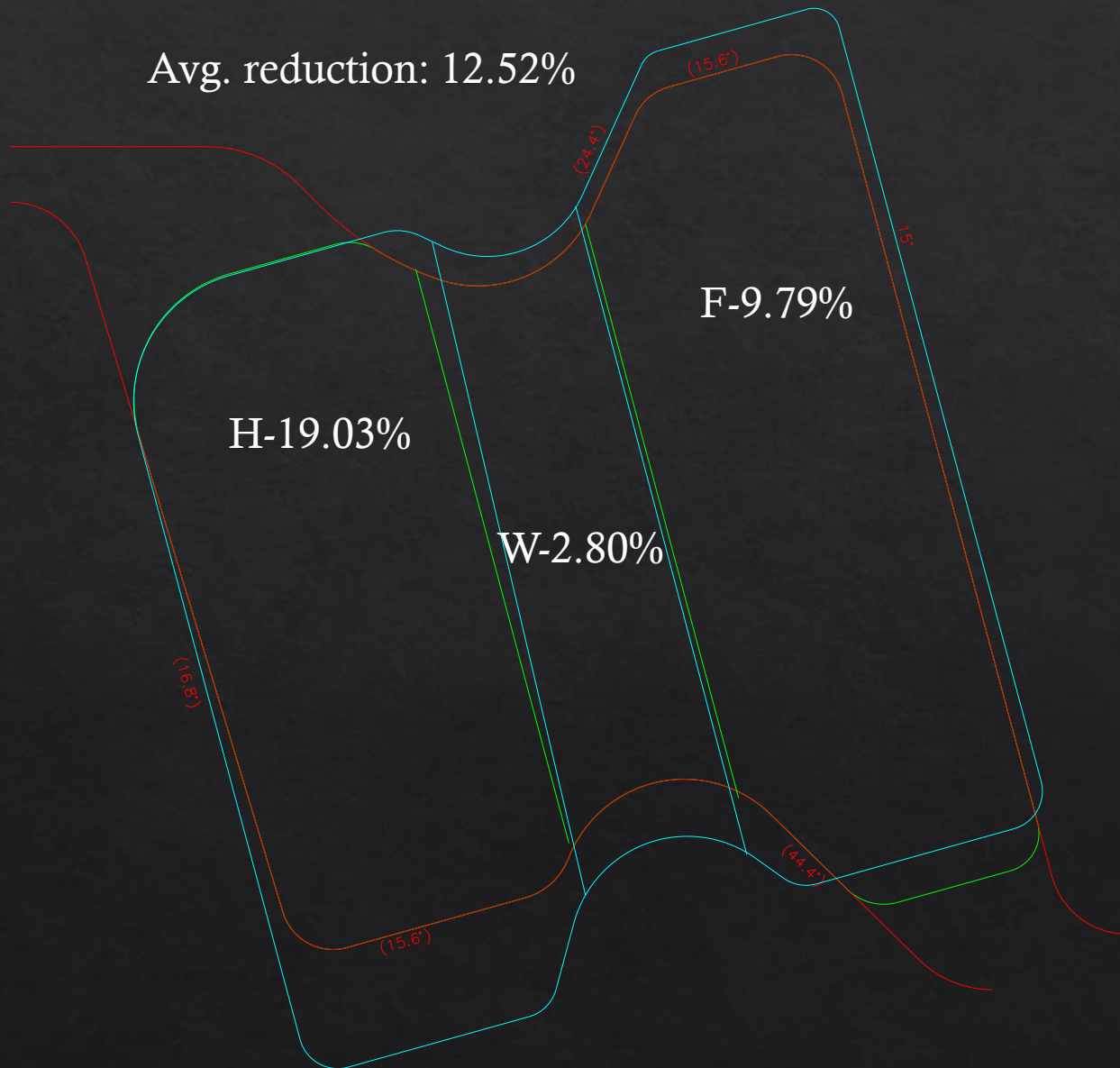
#85 BD1-3

Avg. reduction: 15.57%



- ◇ Set at -15 degrees
- ◇ Flanges begin basic division
- ◇ Reduction of thickness web and overall width

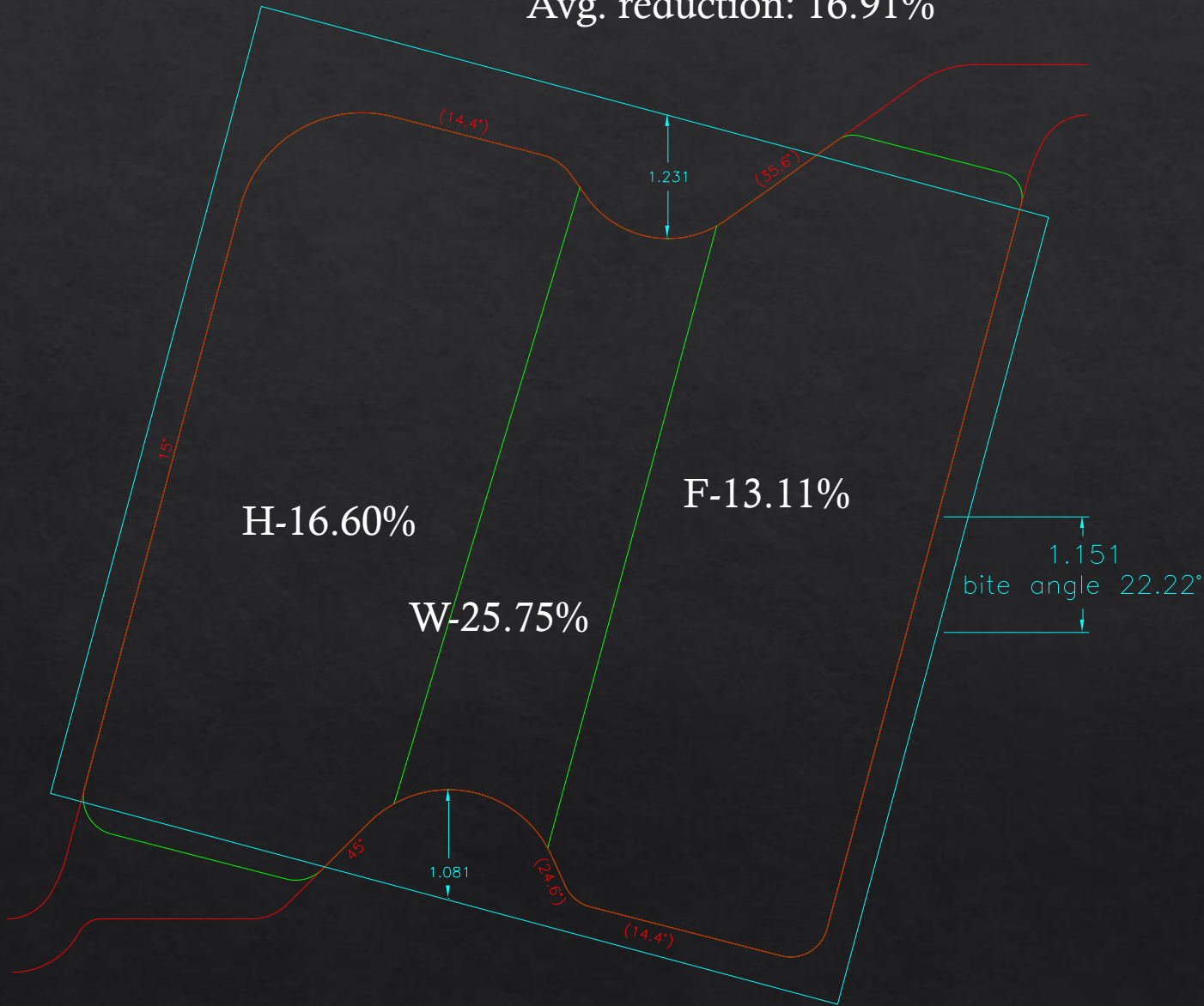
#85 BD1-2



- ◇ Set at 15 degrees
- ◇ Flanges floating maintain work via outside
- ◇ Dead leg on head reducing height, minimal spread in opposing live leg due to mass in between

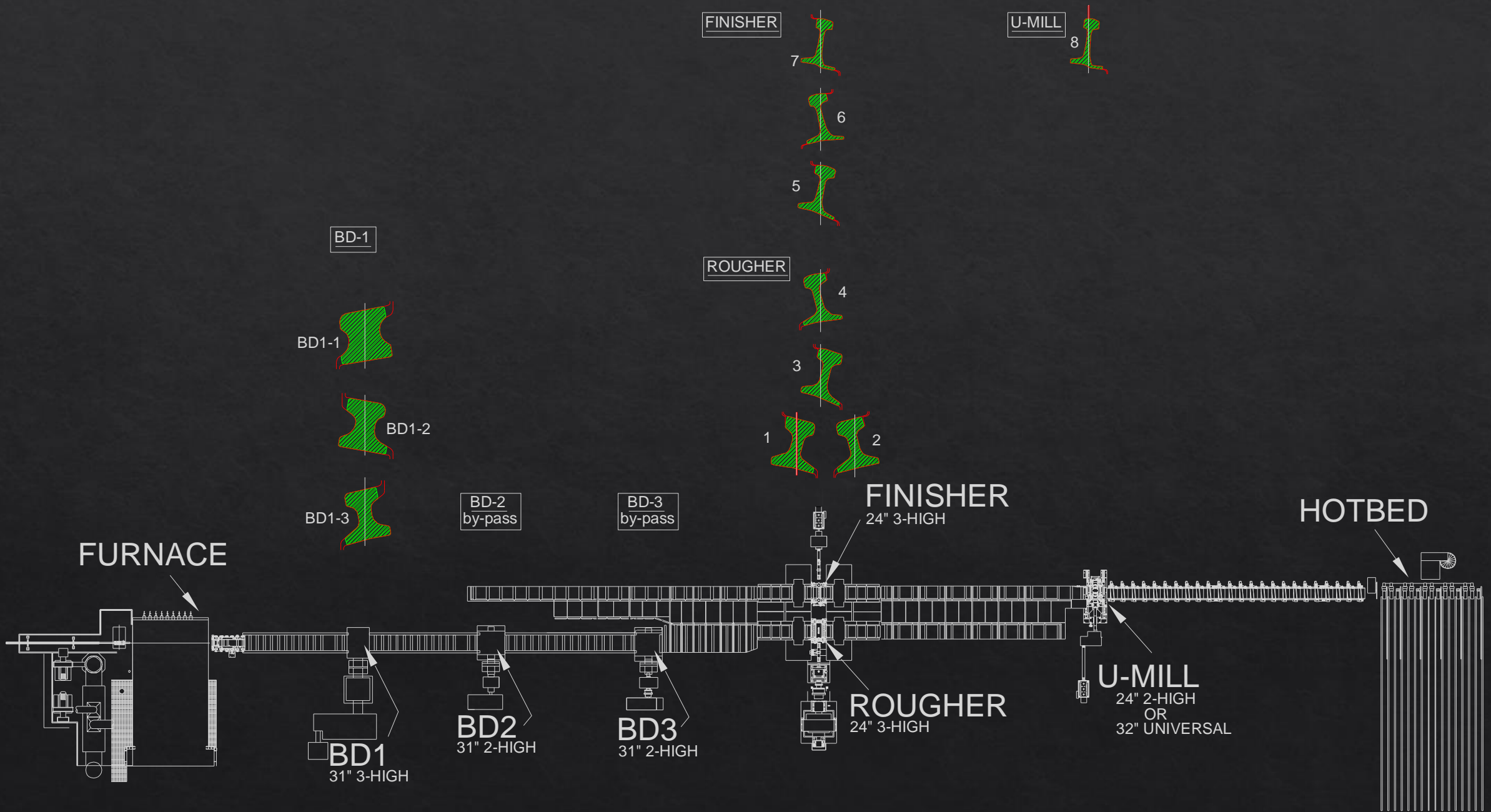
#85 BD1-1

Avg. reduction: 16.91%



- ◇ Set at -15 degrees
- ◇ Bite angle 22.2 degrees
- ◇ Dividing head from flanges, piercing web
- ◇ Web hits bar at same time as adjacent side wall

#140 Hook Flange Rail



FINISHER

U-MILL

BD-1

ROUGHER

FINISHER

HOTBED

FURNACE

BD1-1

BD1-2

BD1-3

BD-2
by-pass

BD-3
by-pass

24" 3-HIGH

ROUGHER

U-MILL

24" 2-HIGH
OR
32" UNIVERSAL

BD2
31" 2-HIGH

BD3
31" 2-HIGH

BD1
31" 3-HIGH

7

8

6

5

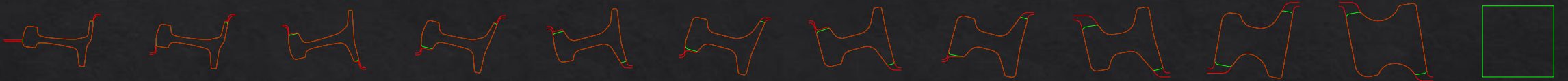
4

3

1

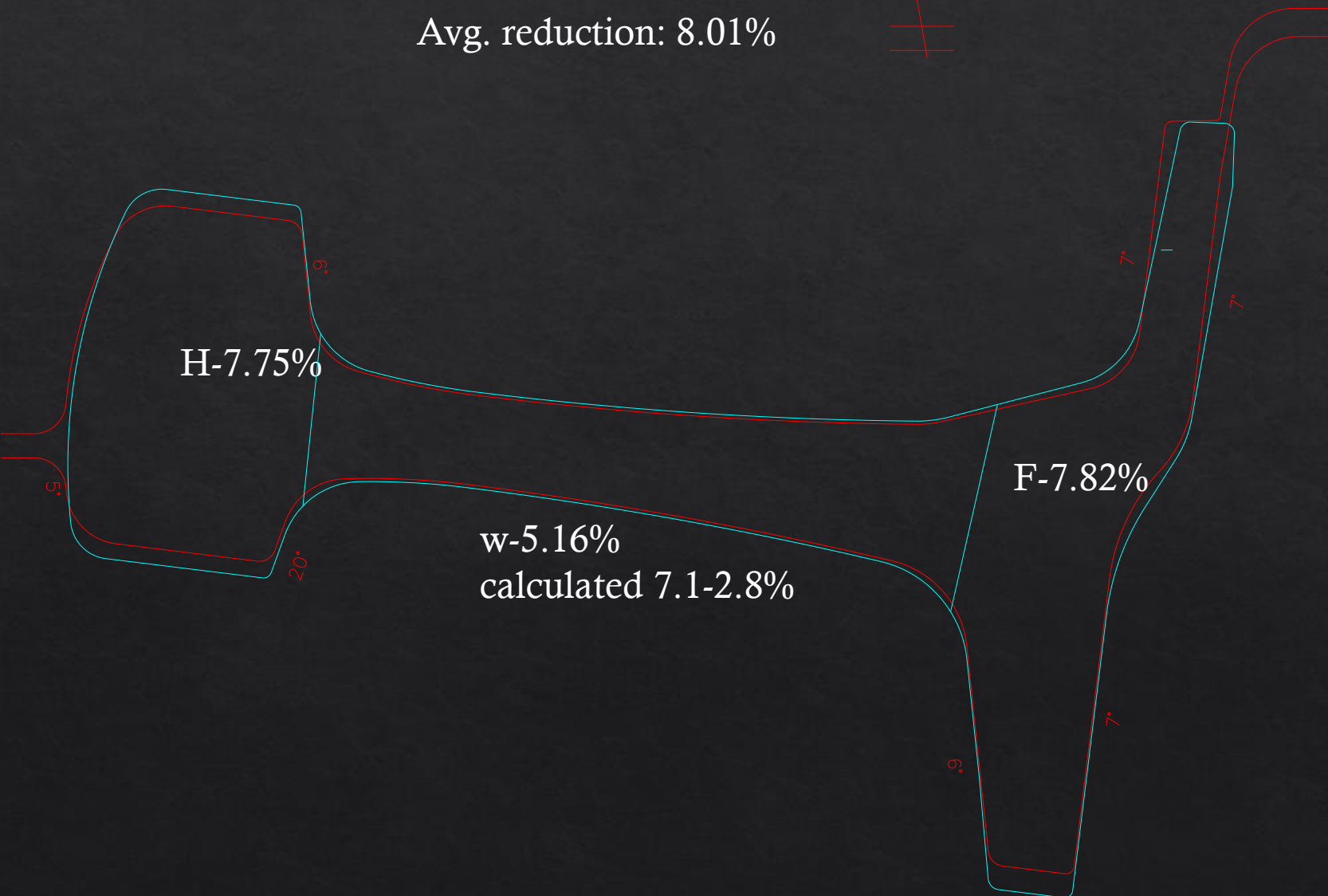
2

#140 Hook Flange pass design overview



#140 Hook Flange No. 8 pass (u-mill)

Avg. reduction: 8.01%

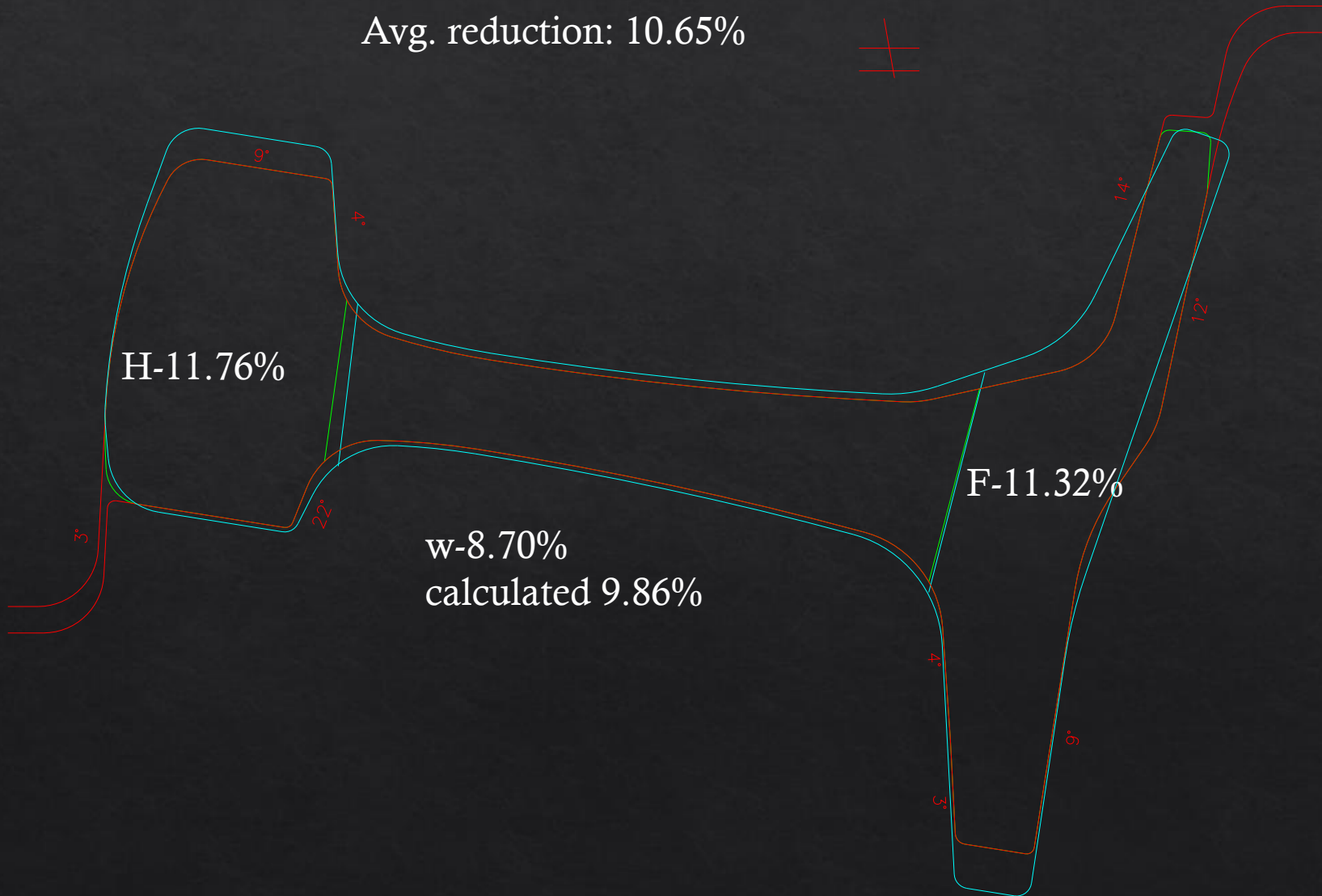


Hot size

- ◇ Set @ -7 degrees
- ◇ Hook flange rotated 3 degrees
- ◇ Head worked with edger joint but treated as diagonal
- ◇ Flanges worked as diagonal, some folding action

#140 Hook Flange No. 7 pass (pre-finish)

Avg. reduction: 10.65%

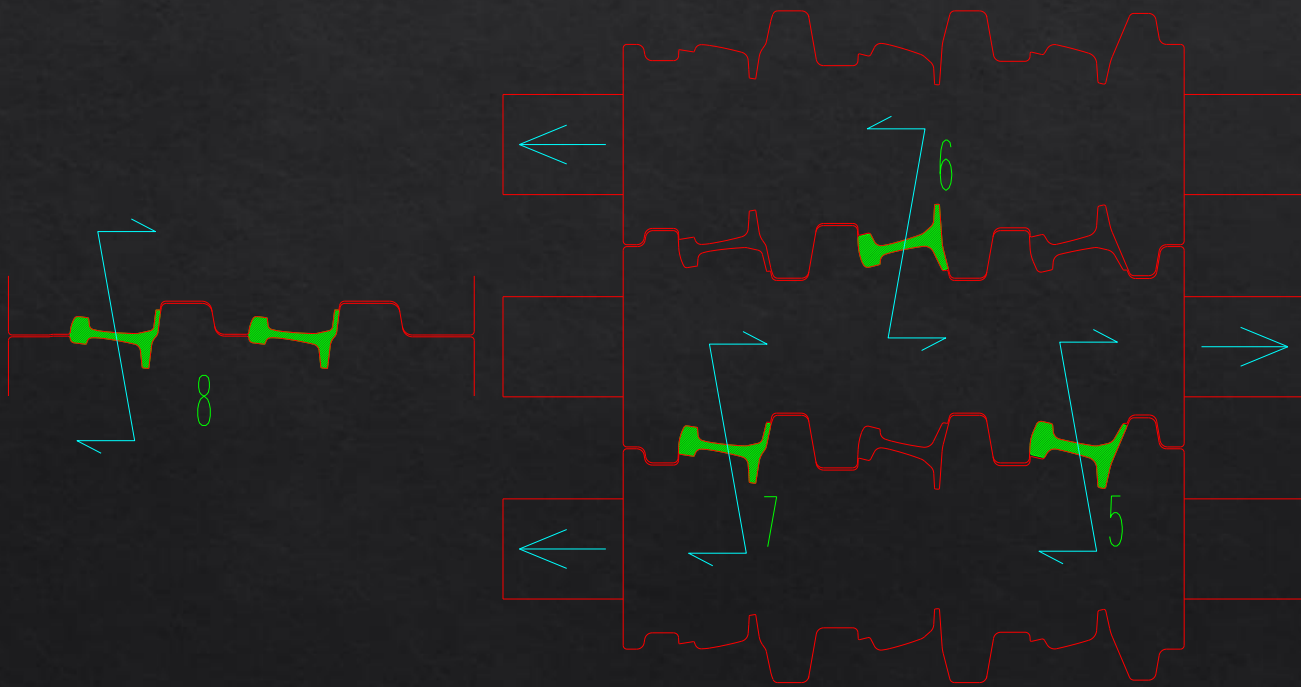


- ◇ Set @ -9 degrees
- ◇ Hook flange rotated 7 degrees
- ◇ Back to back live joints, head worked as diagonal with stop
- ◇ Flanges worked as diagonal, greater folding action, dog leg introduced
- ◇ Finish pass had to move to u-mill different roll set 8 and 7 passes set at negative

#140 Hook Flange No. 8 & 7 must be in different roll sets

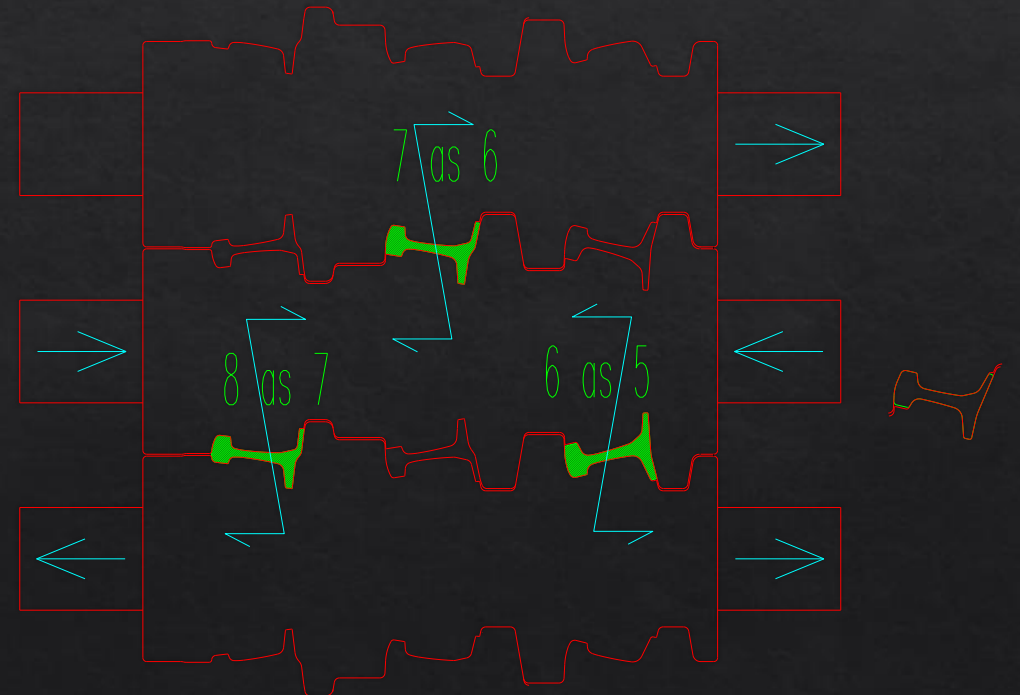
Correct bearing collars

Counteracting axial separating forces



Incorrect bearing collars

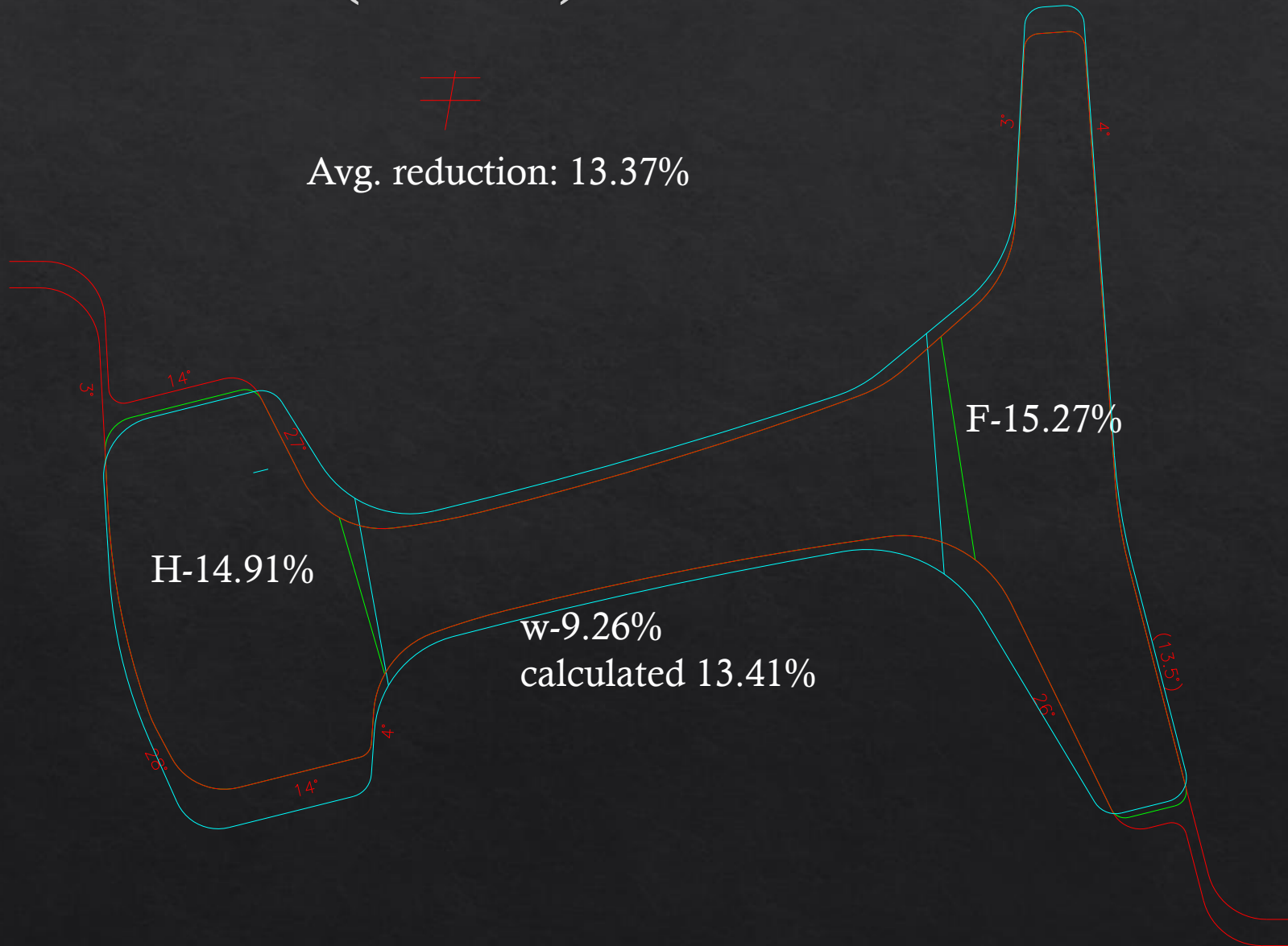
Bearing collars only work for some passes
But 5 & 7 passes will never BOTH work



#140 Hook Flange No. 6 pass (leader)

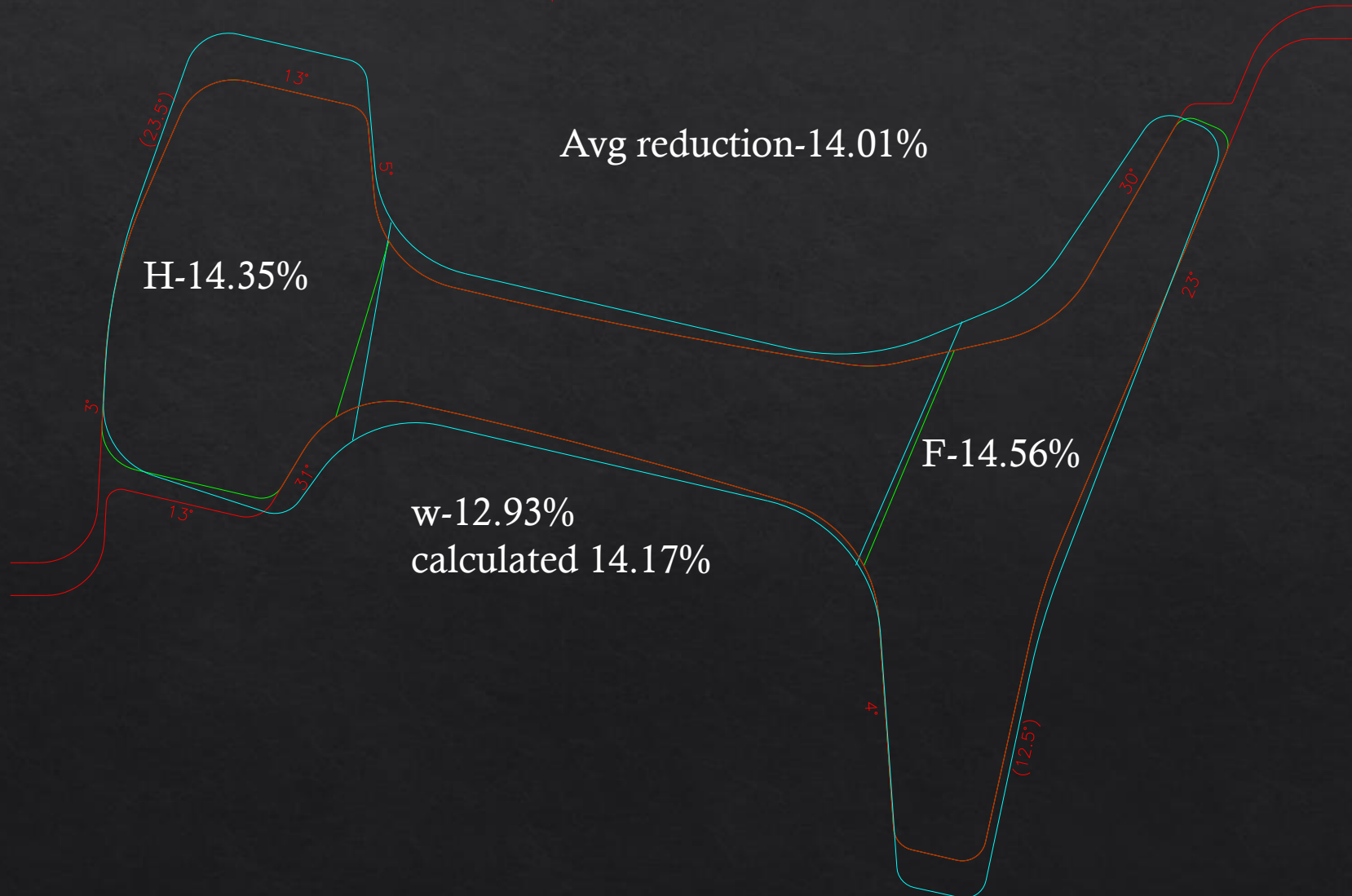


Avg. reduction: 13.37%



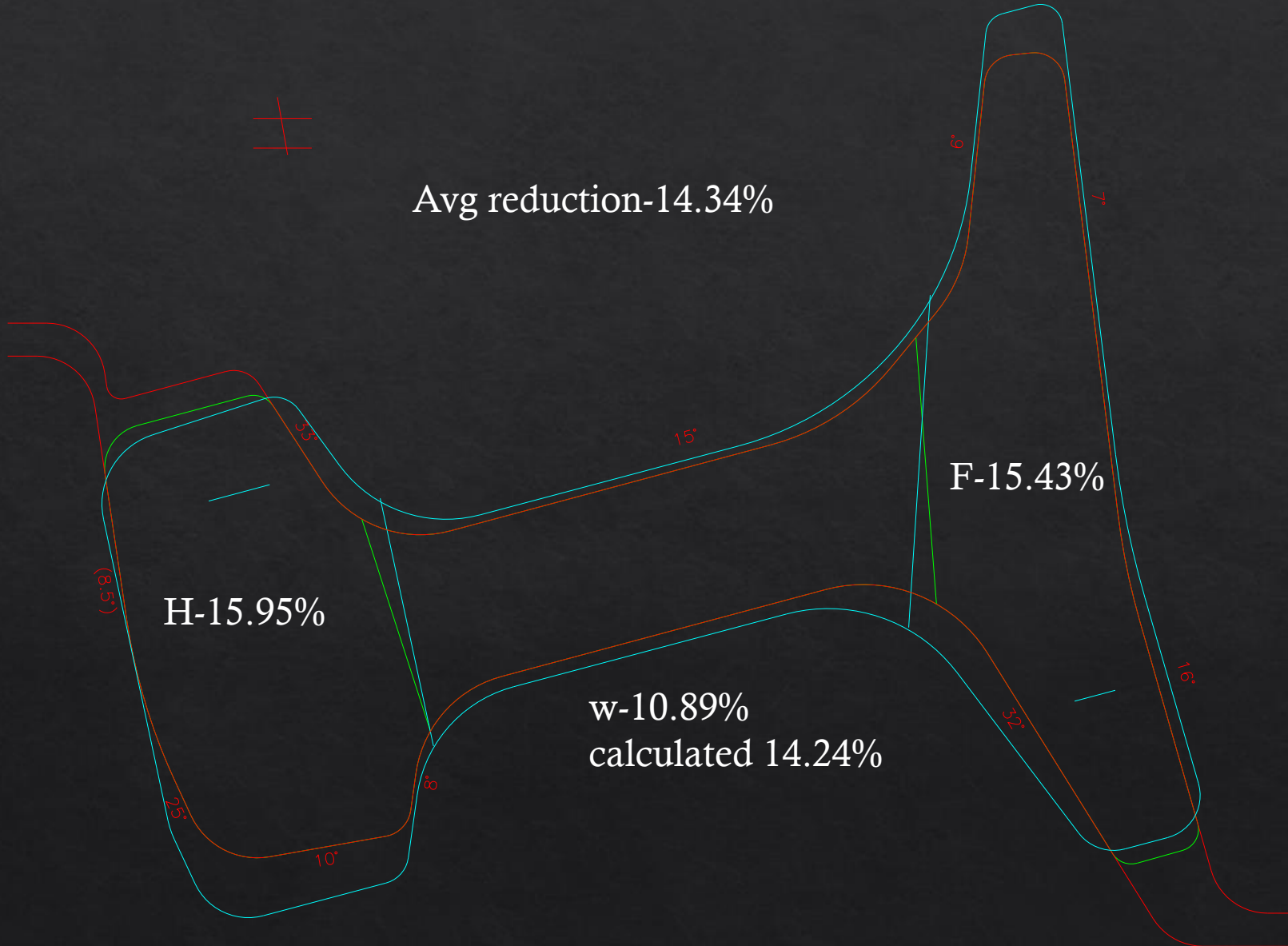
- ◇ Set @ 14 degrees
- ◇ Hook flange rotated 7 degrees
- ◇ Last pass to control hook leg length

#140 Hook Flange No. 5 pass (former)



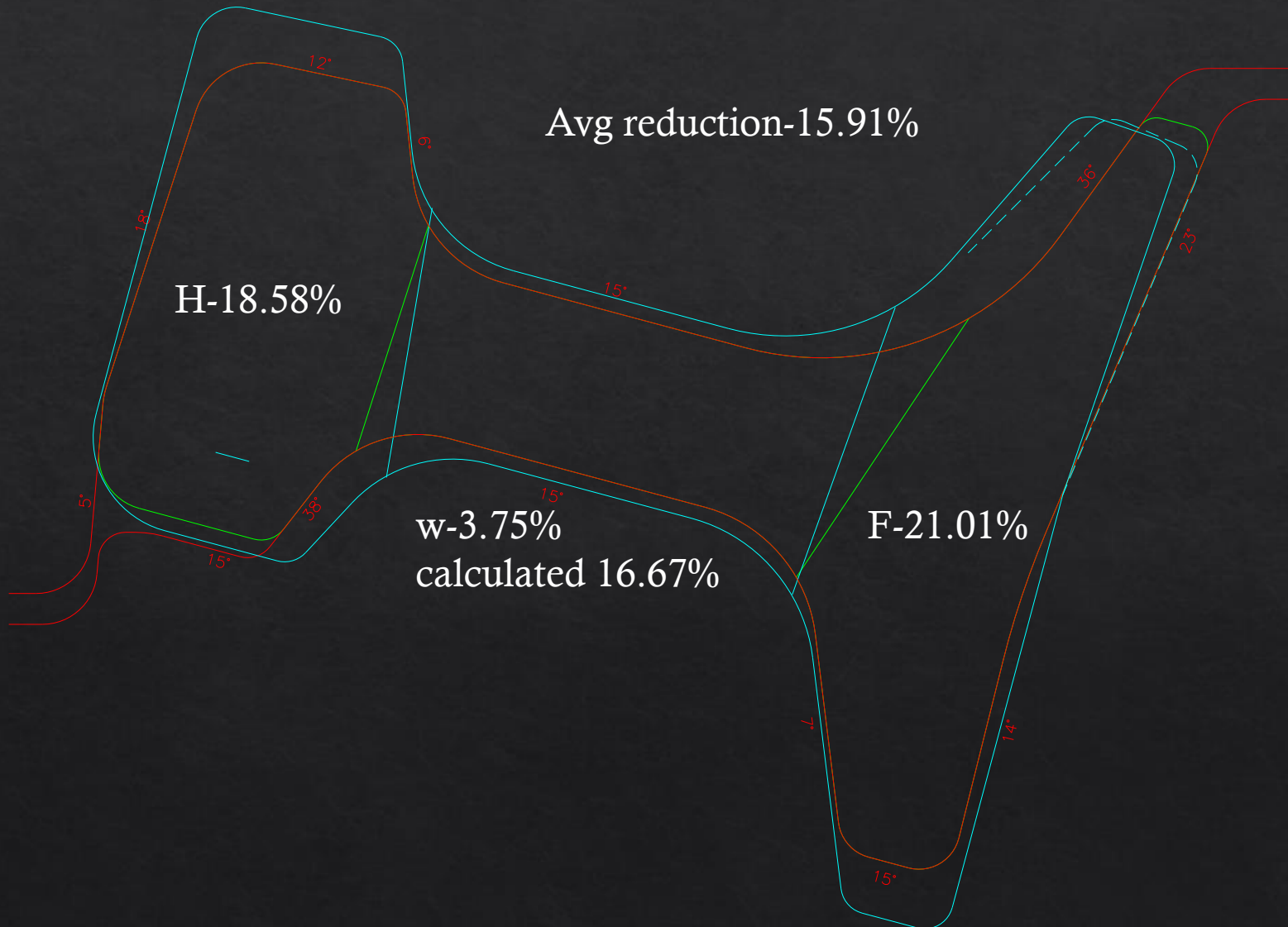
- ◇ Set @ -13 degrees
- ◇ Web tapered radius introduced
- ◇ Angles are sufficient to start and form the bar

#140 Hook Flange No. 4 pass



- ◇ Set @ 15 degrees
- ◇ Pitch adjusted to increase top roll diameter at dead leg

#140 Hook Flange No. 3 pass

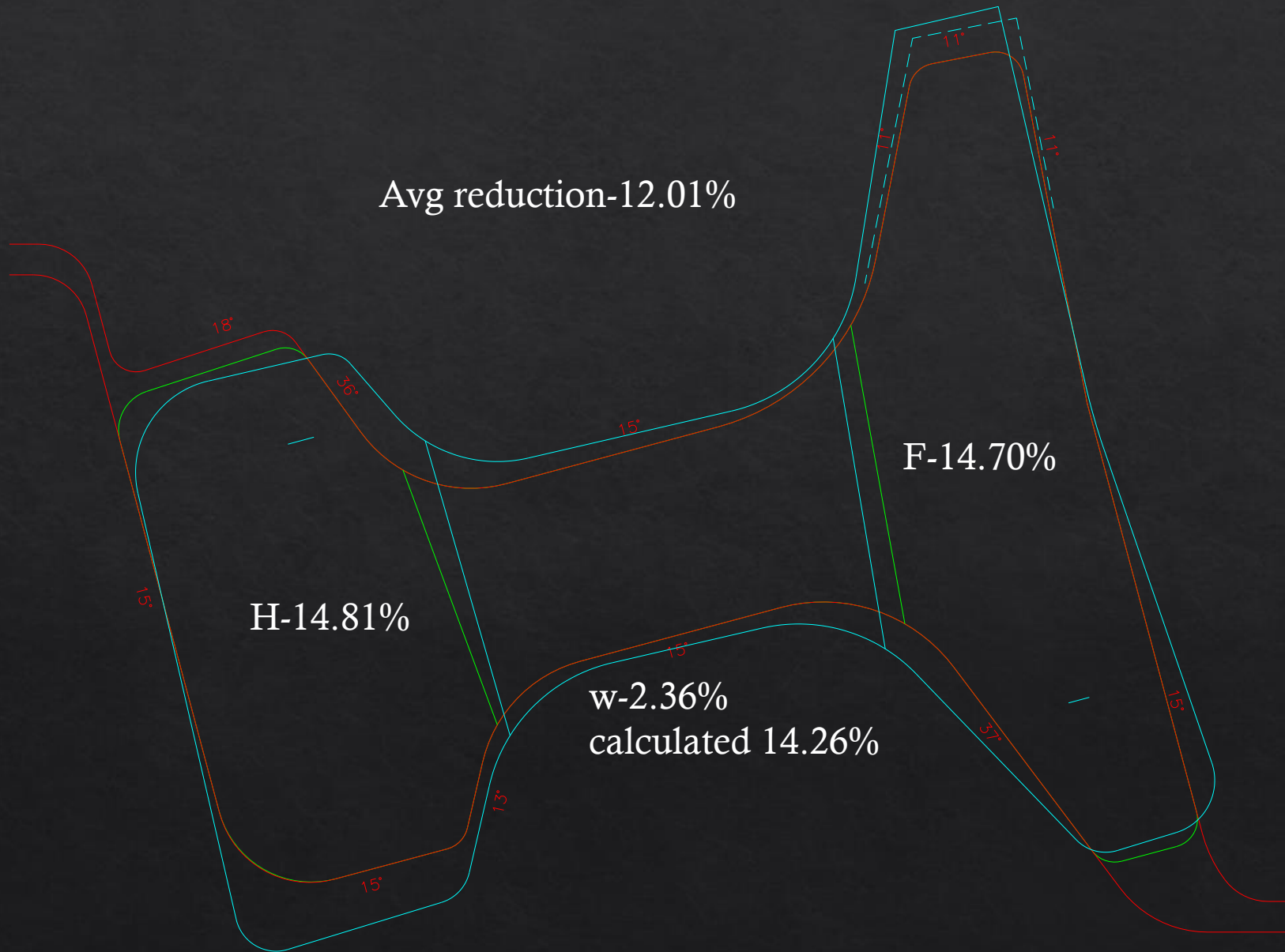


- ◇ Set @ -15 degrees
- ◇ Pitch adjusted to increase bott. roll diameter at dead leg
- ◇ flange live leg opening up and thinning
- ◇ Over/under passes (1&2) are interdependent with this pass.

#140 HF Rougher roll



#140 Hook Flange No. 2 pass



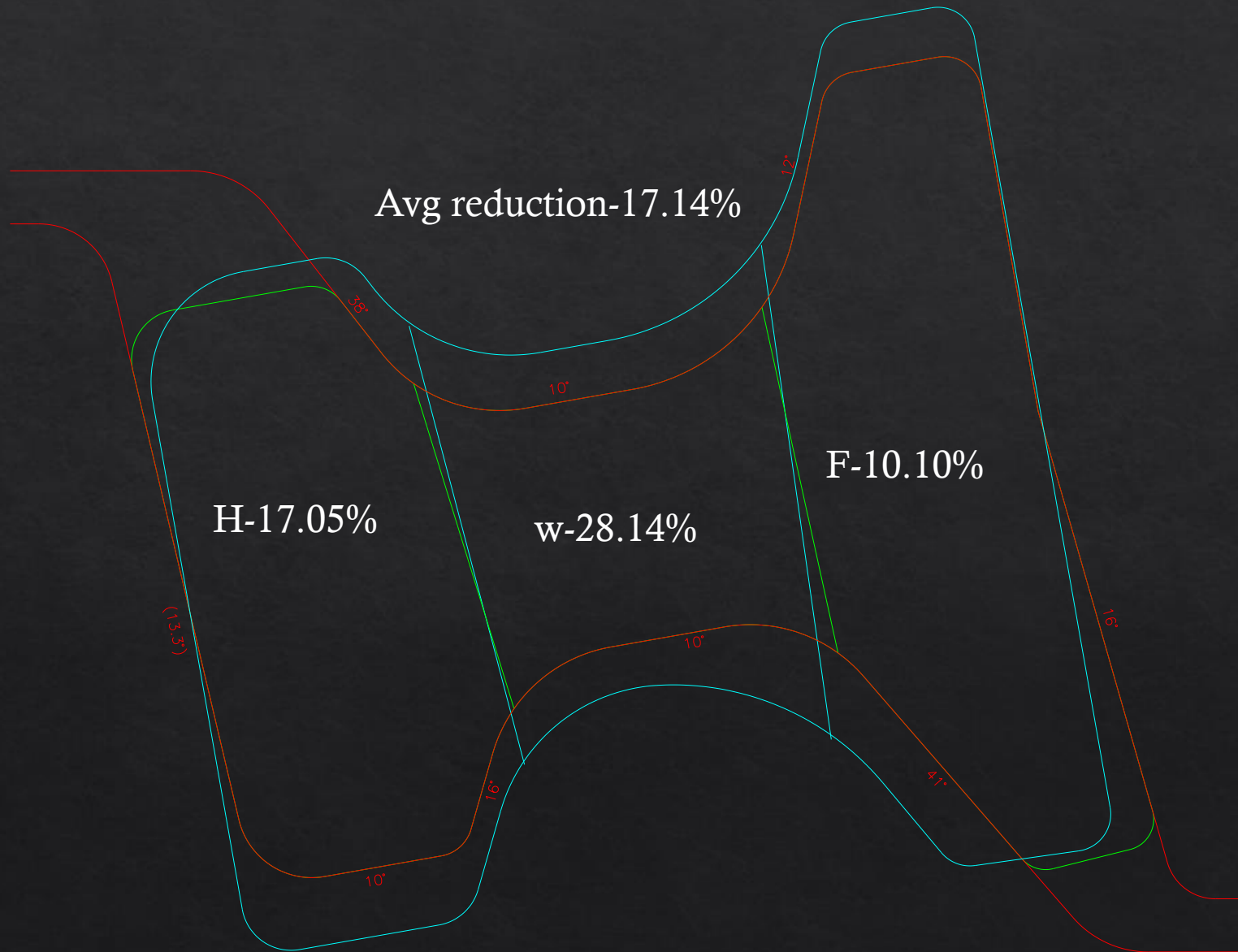
- ◇ Set @ 15 degrees
- ◇ 1 pass enters @ Approx. 13 degrees, i.e. self centers with tracking distances; and aids opening of dead leg flange, while retarding growth of live leg head
- ◇ Heads dead leg matches 1 pass dead which must fit No. 2 passes live leg, similar relationship with all other parts between 1,2 3 passes.

#140 Hook Flange No. 1 pass



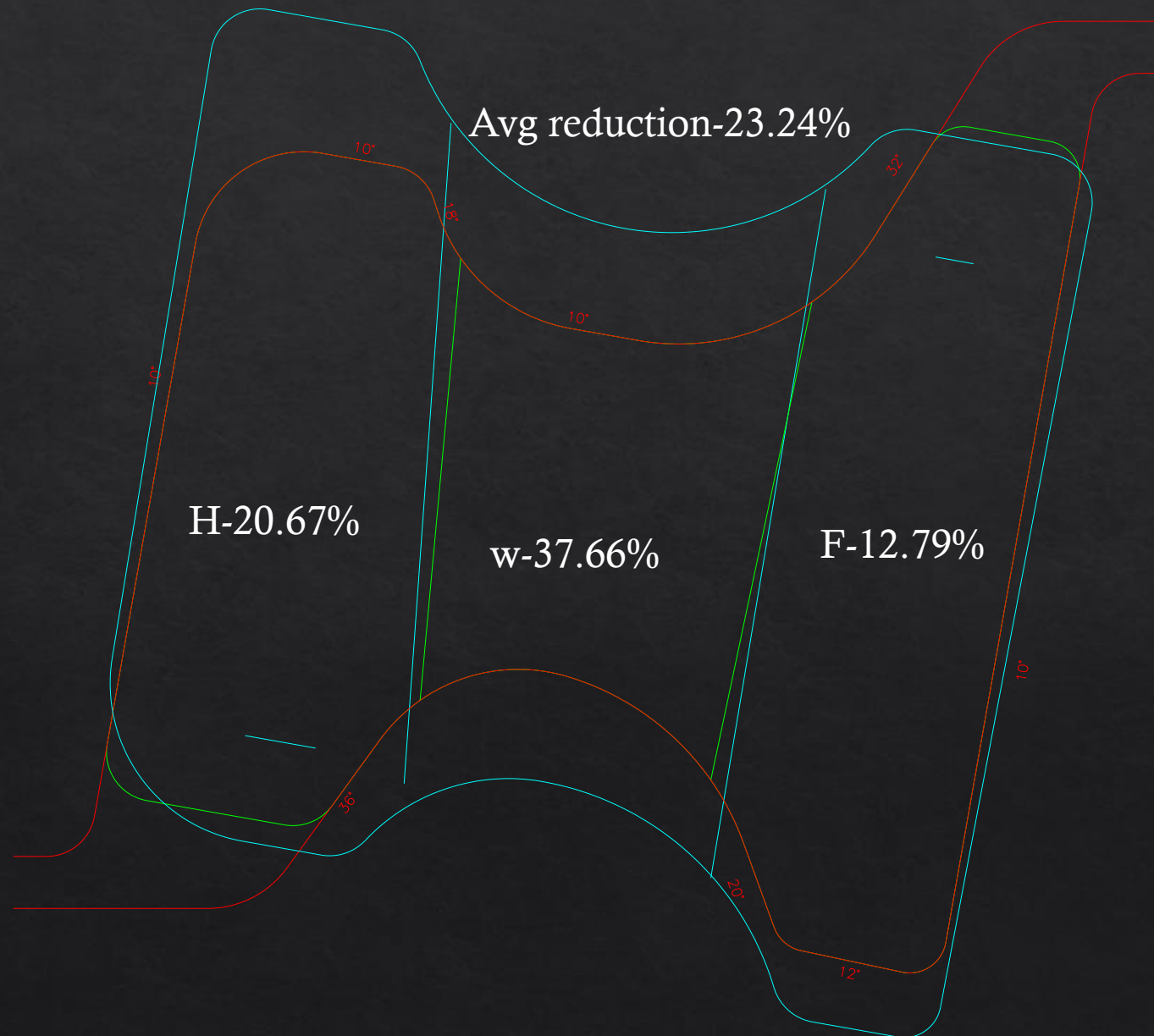
- ◇ Set @ -15 degrees
- ◇ Primarily thinning flanges, prepping for No. 2 and 3 passes
- ◇ Flanges track before web contacts

#140 Hook Flange BD1-3 pass



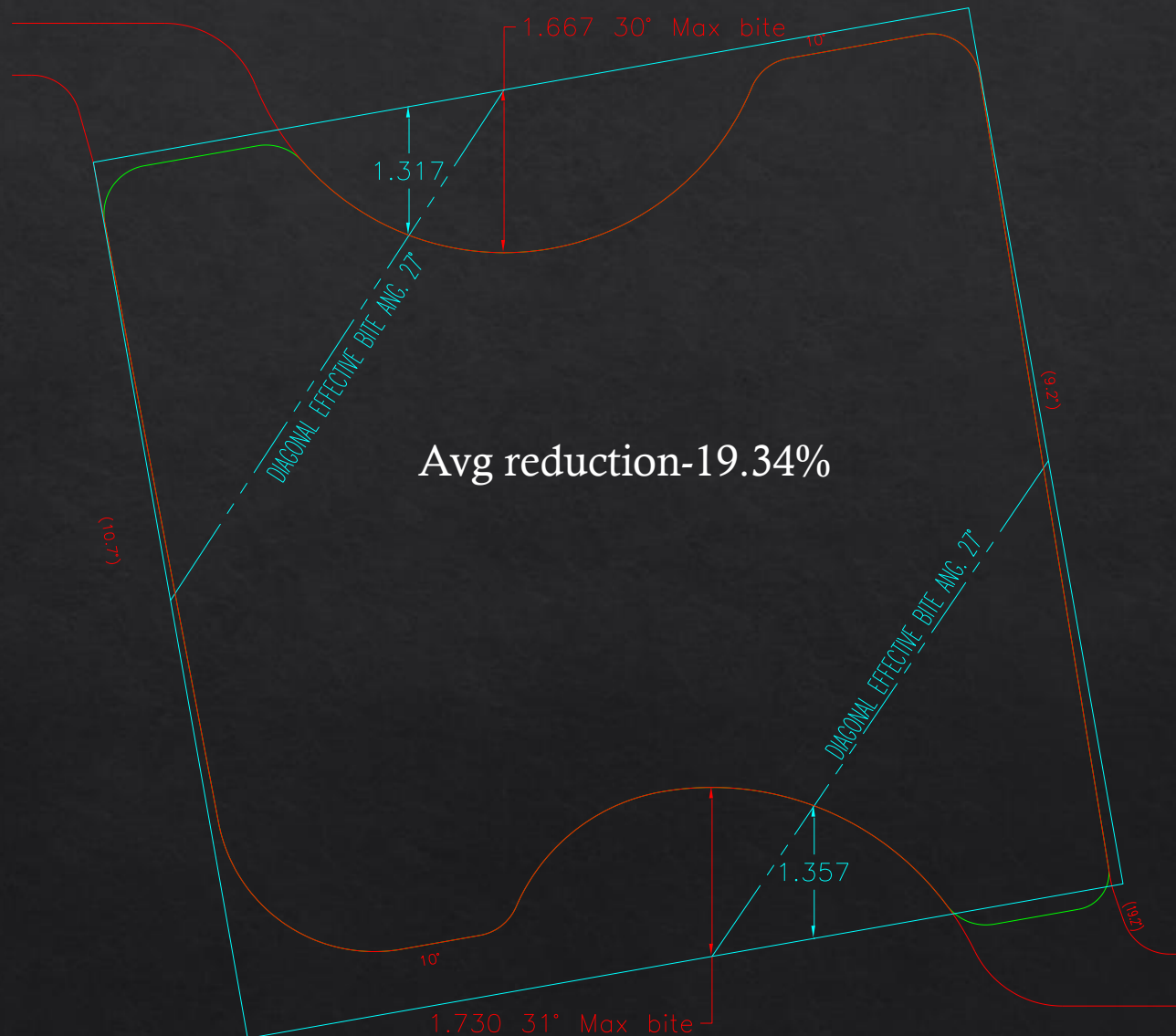
- ◇ Set @ 10 degrees
- ◇ Primarily thinning web, flanges are maintained
- ◇ Flange live leg is bent out with tongue of roll
- ◇ Flanges and web track nearly at same time

#140 Hook Flange BD1-2 pass



- ◇ Set @ -10 degrees
- ◇ Primarily creating web, and reducing head height, while flanges are maintained
- ◇ Crazy work is done early to upset ratios, while steel is most plastic and hot

#140 Hook Flange BD1-1 pass



- ◇ Set @ 10 degrees
- ◇ Enters w/ 9x9 Billet
- ◇ Primarily piercing billet, creating head and flange sides
- ◇ Some extra work on dead leg of head, reducing head height and large radius to retard future growth
- ◇ Diagonals side walls help aid in bite angle.

Thank You

Any Questions or Comments?