

# Bead Clamp

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# Project Background

- Current method of operations and equipment
  - Operators hold the beads in their hands to drill
  - The drills are run by one motor
  - Drills are mounted and do not move



Acai

Brazilian  
Redwood



Oblong Palm

Round Palm



# Project Objectives

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Improve Safety

Operators

- Design for one operator/unit

Efficiency

- Improve from 7.5s/large bead

Simplicity

- Easily machined moving parts

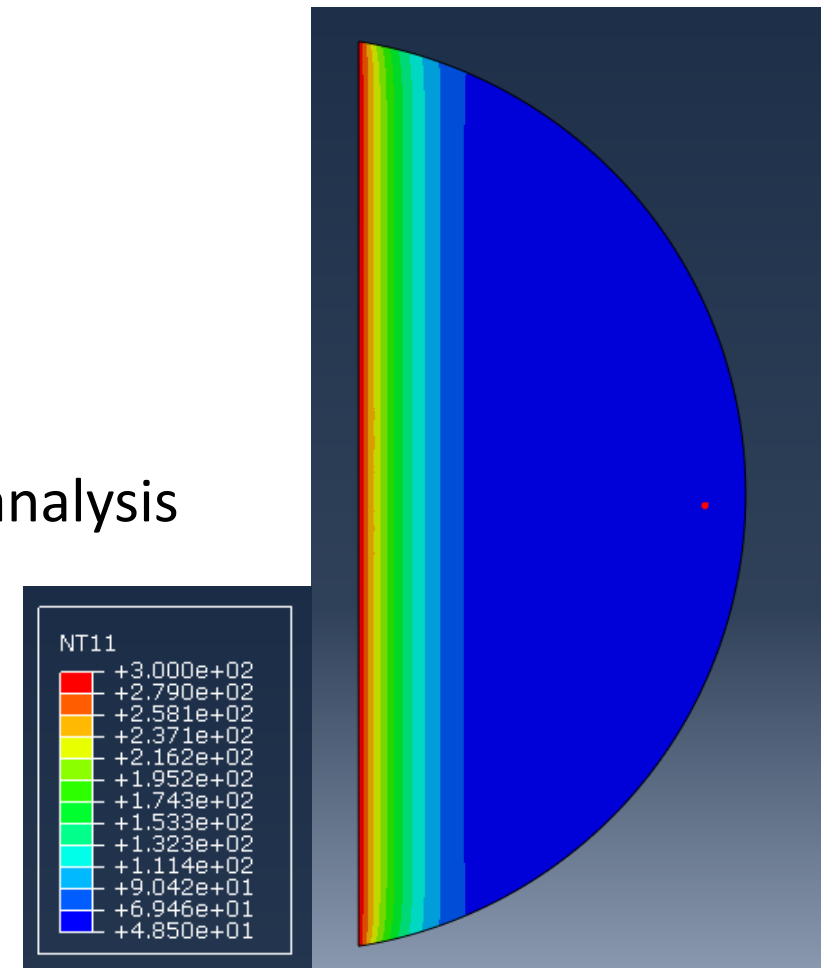
Product Quality

- Holes drilled through the soft spot
- Avoid fracture on the back of the bead



# Safety Concerns

- Fingers contacting the drill bit
- Beads getting hot, smoking
  - Biot number
    - Greater than 100 for plausible scenarios
    - Requires more advanced transient heat flow analysis
  - FEA Modelling
    - Seed gets hot near drill holes
    - Contact zone stays relatively cool



7<sup>th</sup> second of transient heat flow through seed with Oak properties



# Initial Test Results

Redwood/Acai - did it smoke?						
RPM	Trial 1	Trial 2	Trial 3	Trail 4	Trial 5	Trial 6
370	no	no	no	no	no	no
500	no	no	no	no	no	no
830	no	no	no	no	no	no
1000	no	no	no	no	no	no
1200	no	no	no	no	no	no

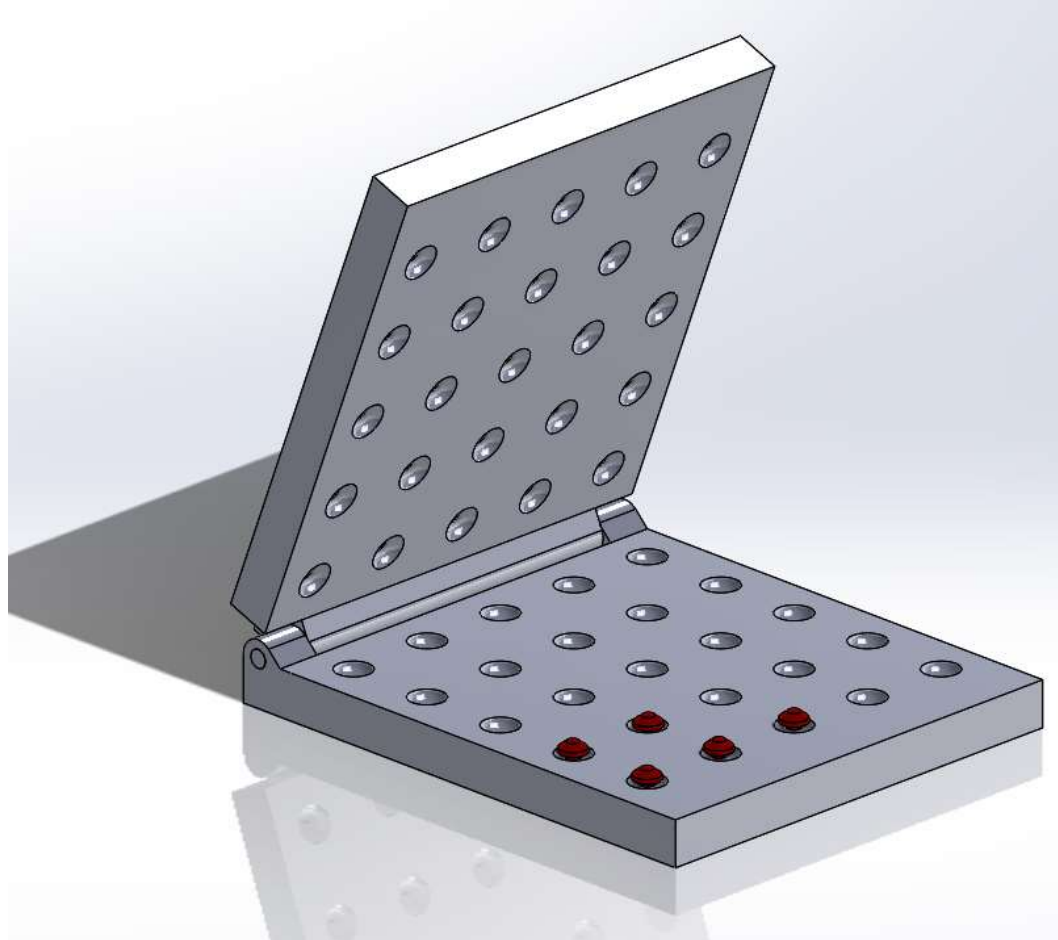
Palm Seeds - did it smoke?						
RPM	Trial 1	Trial 2	Trial 3	Trail 4	Trial 5	Trial 6
370	yes	yes	yes	yes	yes	yes
500	yes	yes	yes	yes	yes	yes
830	yes	yes	yes	yes	yes	yes
1000	yes	yes	yes	yes	yes	yes
1200	yes	yes	yes	yes	yes	yes

- Redwood seeds were difficult to hold
- All seeds difficult to drill below 830 RPMs
- Small seeds did not smoke
- Large seeds did smoke
- Seeds don't crush easily



# Initial Design Ideas

- Current Method
- Book
- Clamp



# Prototype

- Made primarily of readily available parts
- Used to test viability of the initial design



# Testing With Prototype

- Difficult to place the Brazilian Redwood beads in the jaws.
- Jaws work well for the larger round beads.
- Jaws of the prototype do not support drill exit well.
- It required practice to get the time down to 7.5 seconds per bead





# Final Clamp

- All complex parts can be cut with a water jet
- Improved jaw design
  - Provides support to drill exit surface
  - Easier to place small seeds



# Testing with Final Clamp

Seed Type	Number of Seeds Drilled	Time to drill (sec/bead)	Standard Deviation
Brazilian Redwood	41	7.42	1.10
Acai	55	9.89	1.26
Oblong Palm	75	6.65	0.12
Spherical Palm	75	6.21	0.74

- A trial of 300 Brazilian Redwood seed were drilled in about 20 minutes (about 4.1 sec/bead)



# Design Failure Analysis

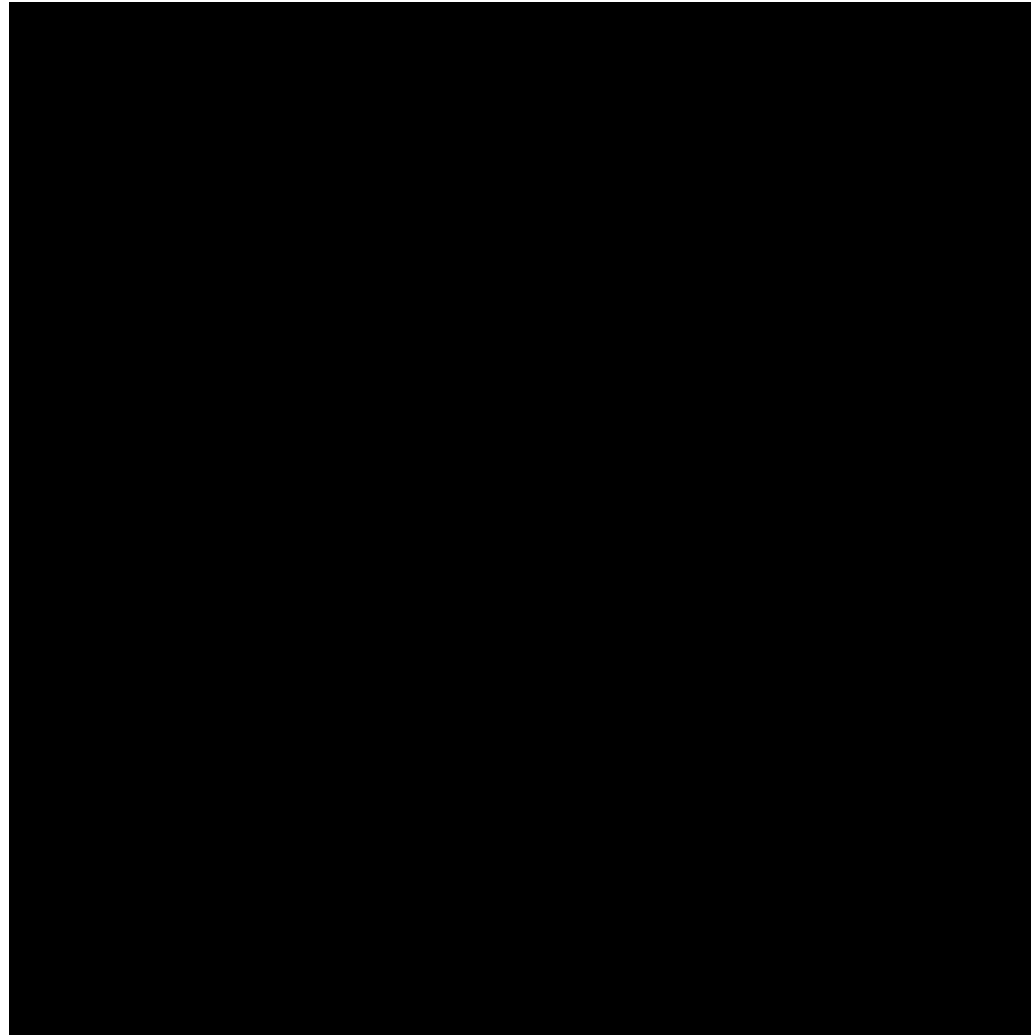
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- Spring will fatigue with use
  - Pull spring can be easily replaced
- Slide pin will wear with use
  - Slide pin can be easily replaced
- Jaws can bind against the guide plates
  - Oil prevents binding



# Video of Clamp

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# Conclusion

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- Fingers are further from drill bit
- One operator required
- Less than 7.5 sec/bead
- Clamp is made from easily machined parts
- Beads are drilled consistently

