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Building the Medieval Trebuchet: Assembling a Half-Scale Historical Machine

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In the Middle Ages, armies built trebuchets to destroy enemy castles. The trebuchet is a type of catapult that uses a falling counterweight to throw projectiles. Many trebuchets were huge machines over 60 feet tall and their construction was complex. The methods used to erect a trebuchet in history are not widely known.

My Research Question:
How were trebuchets designed and assembled in the Middle Ages?

Through experimental history, I used primary sources to design a trebuchet. This machine is half-scale: 30 feet tall.

I built this trebuchet with medieval techniques, assembled it with an ancient type of crane hoist, and tested it with up to 1,500lb of counterweight.

Building Methods
Trebuchets were designed with ratios.

Components rotated on wooden axles.

Parts were connected with wood joints and made to fit together without nails.

The machine is assembled in stages:
1. Piece together the ground frame.
2. Assemble the sides on the ground.
3. Tilt up the sides like raising a barn.
4. Lift the throwing arm into the blocks.
5. Attach the counterweight box.

Results of Testing
Assembly methods worked well. A full-scale trebuchet could be made by generally using these same methods.

Wooden axles performed better than expected. The main axle held 1,500lbs.

The historical windlass loading system allowed two people to lift this weight.

Historically-based wood joints are sturdy.

The machine threw a 16lb ball 300 yards.

Figures 1 – 4: From primary sources to the siege.

Far Left: A ground plan of a trebuchet from the notebook of Villard de Honnecourt, 13th century.

Left: One of the side frames, or “bents.” It has just been tilted up into position by hand with three people.

Right: Climbing the machine ladder to grease the axle with olive oil, used around the Mediterranean.

Far Right: A frame capture from a launch. The sling slips open and the bowling ball heads downrange.

Figures 5 – 6: Raising the Throwing Arm

Using Shear Legs to hoist the throwing arm. Photo by John Zsiray, Herald Journal.

Conclusions
When made properly, wooden axles can hold as much weight as metal ones.

Trebuchets can operate outside longbow range. A typical bow distance is 240 yards.

A loading system, such as a medieval windlass, is needed at large-scale.

This project helps us to understand that medieval technology and engineering was complex, elegant, and sophisticated.

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