Project Title	:	**WELLS ARE MADE CIRCULAR, RESOLVING THE MYSTERY**
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TITLE OF THE PROJECT: "Circular wells are stronger, safer and more material-efficient because a circle evenly distributes soil and water pressure and avoids weak corners."

INTRODUCTION

Wells are circular because a circle (cylinder) spreads earth pressure evenly around its walls. That makes the structure stronger and less likely to collapse. Other reasons:

No corners = no stress concentration. Square or rectangular wells have corners where soil pressure concentrates and cracks can start.

Efficient use of material. For a given inside area, a circle uses less wall material than a square — cheaper and lighter to build.

Arch action. A circular wall works like a continuous arch; the load is transferred smoothly around the ring into the ground.

Easier to dig & line. Digging a round hole and putting in circular lining (bricks, concrete rings, metal casing) is easier and stronger.

Hydraulic and mechanical fit. Pumps, pipes and casings are cylindrical, so circular shape fits equipment well.

BACKGROUND OF THE STUDY

The background of studying circular wells primarily revolves around their superior structural integrity, efficiency in construction, and ease of maintenance, reasons that have made them a universal design choice across centuries and civilizations.

Historical Context
For millennia, wells have served as vital lifelines for communities, from ancient India to medieval Europe. Early human-dug wells were often made in a circular shape because this form could be achieved more naturally with basic digging tools and was easier to line with available materials like curved bricks or stones. This design choice evolved from practical experience, as builders observed that square or rectangular wells were prone to failure.

Durability and Stability: The enhanced strength and even load distribution contribute to the long-term stability and longevity of circular wells, allowing them to remain intact for decades with less risk of structural damage or tilting.
Practical and Economic Advantages:
Beyond structural benefits, the circular design offers practical advantages:
Ease of Construction: Modern drilling equipment naturally creates cylindrical holes. Even historically, hand-digging a round bore was simpler and more efficient than carving out precise corners, requiring less specialized labor and materials.
Cost-Effectiveness: Building and lining a circular well requires fewer materials and less labor for a given capacity, making it a more economical option.
Engineering and scientific principles: This principle, known as "hoop stress," ensures that no single point bears more load than another.

Structural Strength: The uniform pressure distribution makes the circular shape inherently stronger and more resistant to collapse compared to shapes with corners. In a square well, stress concentrates at the corners, leading to weak points where cracks are likely to form and the structure could fail.

AIM

To investigate why wells are commonly built circular by comparing structural stability, ease of construction, and resistance to earth pressure between circular and non-circular (square/rectangular/hexagonal) well shapes using scale models.

OBJECTIVE AND HYPOTHESIS

To find out which well shape (circular, square, or rectangular) is strongest under soil pressure and to understand why most wells are circular.

The circular well will resist more soil pressure and collapse later than square or rectangular wells, because its shape distributes pressure evenly in all directions.

Circular wells resist inward earth pressure better than square wells of the same cross-sectional area.

Circular shapes distribute stress evenly, so they bear more load before collapsing.

Circular wells are easier to line (brick/stone) without weak corners, reducing leakage and failure.

Materials (simple, low-cost)

- Fine sand or packing soil (large tray or sandbox)
- Modelling clay or damp sand (for compacted soil layer)
- 2 rectangular shaped cement moulds for building model well
- 2 round shaped cement moulds for building model well
- 10 watts motor
- Electricity

VARIABLES

Independent Variables: shape of the well

Dependent Variable: load (mass) of which the collapse occurs.

Controlled Variable: Wall thickness, internal area, packaging density, soil type and depth of the soil.

Shape	Load test(trial 1)	Trial 2
Circular	20 kg	18 kg
Rectangular	16 kg	15 kg

EXPERIMENTAL DESIGN — 3 SIMPLE TESTS

Experiment 1 — Load test (vertical load on top of well mouth)
Compare how much vertical load a lined circular vs square well opening can carry before deformation or collapse of the lining by filling sand.

Experiment 2 — Side pressure test (simulate earth pressure)
Place identical hollow shapes in compacted sand and apply uniform lateral pressure (by piling sand to a certain height around them) or press inward with a plate to see when walls deform.

Experiment 3 — Ease of lining & leakage (practical build test)
Simulate lining with bricks/coins around circular vs square forms and test how well they maintain shape when soil is removed and when water is poured in (observe leaks and corner gaps) by creating water pressure.

EXPERIMENT 1 — VERTICAL LOAD TEST

Diameter of the circular well 30 cm, height 40cm weight of the mould is 12 kg

Length of the rectangular well is 36 cm, breadth is 15 cm

1. Prepare three identical cement forms open at top: circular , rectangular . Dig a temporary well with 20 cm hollow and place the moulds.

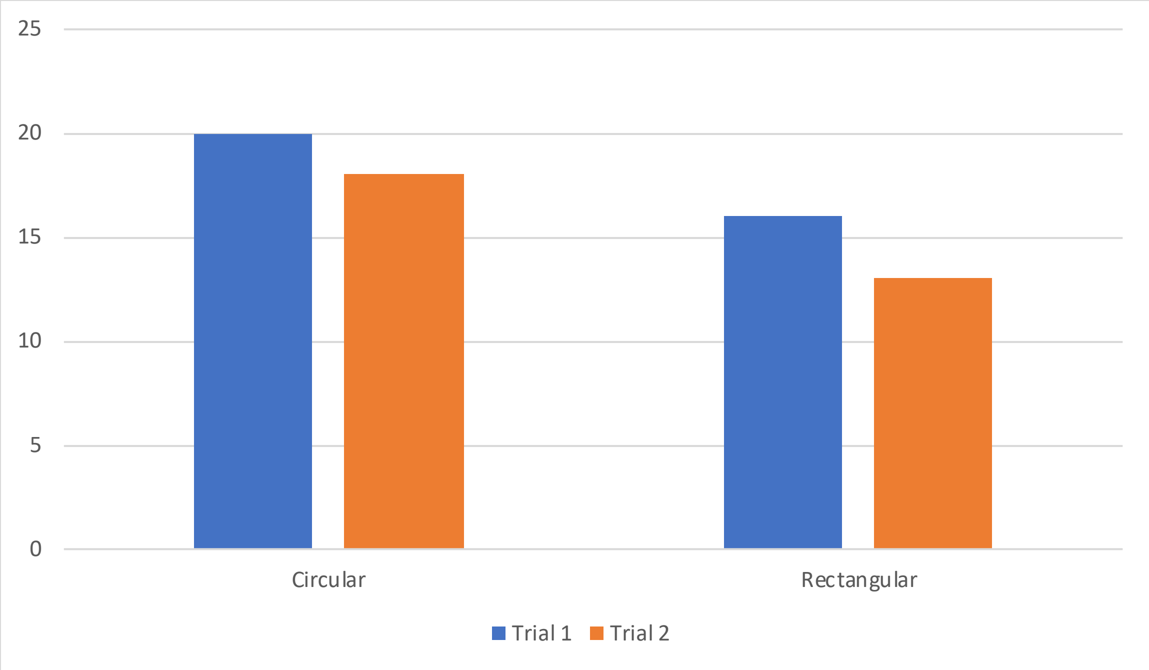
2. Line each with the same “lining” (stack coins, lego ring, or tape-reinforced cardboard rings) to simulate stone lining.

3. Slowly add weight centrally on top of the tube (use a small rigid plate to distribute load) in increments (e.g., 0.5 kg). After each increment, observe any deformation, cracking of lining, or collapse. Record maximum load before failure (if any). Repeat 3 times per shape.

4. Photograph deformation pattern; note whether failure begins at corners (square) or uniformly (circle).

DATA TABULATION

Shape	Load test(trial 1)	Trial 2
Circular	20 kg	18 kg
Rectangular	16 kg	13 kg



EXPERIMENT 2 — LATERAL PRESSURE (EARTH PRESSURE) TEST

1. Use a shallow tray and compact a layer of sand or soil about 10–12 cm deep. Cut holes and insert the shaped forms so that their outside is surrounded by soil up to the top.

2. Slowly add a regulated amount of sand in a separate container to apply lateral pressure — or use a wooden plank with clamps to press inward uniformly on opposite sides with a known force (spring scale if available). Alternatively, pile extra sand to a set height to increase lateral pressure.

3. For each shape, increase lateral pressure and record the pressure at which the wall buckles/inward displacement is observed. Measure maximum inward displacement (with ruler) before failure. Repeat 3 times.

DATA TABLE EXAMPLE — EXPERIMENT 2

Trial	Shape(mm)	Soil height (cm)	Lateral force (N)	Displacement at failure
1	**Circle**	**12**	**10**	2 mm
2	**Square**	**12**	**10**	8 mm

EXPERIMENT 3 — LINING & LEAKAGE TEST

1. Create lining rings of small bricks (Lego/stacked coins) around each shape inside the soil. Carefully remove soil from inside the lined shape, leaving lining standing (simulate well excavation).

2. Pour a measured quantity of water into the lined well (e.g., 500 mL). Observe leakage paths (where water seeps through gaps). Compare circular vs square: corners in square may produce larger gaps. Measure time taken for water level to drop by a fixed amount (or measure leaked volume). Repeat 3 times.

Yes — Leakage at 4 corners

DATA TABLE EXAMPLE — EXPERIMENT 3

SN No:	Shape	Initial water (L)	Time to lose 100 mL .	Visible leakage points (yes/no)
1	Circle	10	420s	No
2	Square	10	210s	Yes — 4 corners

ANALYSIS — HOW TO INTERPRET RESULTS

Compare mean failure loads and lateral displacement for all shapes. If circle shows higher failure load and lower displacement .

For leakage test: longer retention time for circular lining indicates better sealing and fewer stress concentration gaps.

INFERENCES:

Corners in square wells concentrate stress and provide weak points where fractures start. A circle distributes pressure evenly around its circumference — there are no corners to begin a crack.

Circular lining also fits well with stacked circular rings (bricks/stone), simplifying construction and sealing.

DISCUSSION & RESULTS

Circular wells will generally withstand larger loads and show less localized deformation. Square wells are more likely to fail at corners and leak at corner joints. Circular shapes are historically chosen for these mechanical and practical advantages.

SAFETY & ETHICS

Use adult supervision when lifting heavy weights or cutting cardboard.

Be careful when using water near electrical equipment. Clean up wet sand/soil to avoid slips.

TIMELINE (1–2 WEEKS)

Day 1: Build forms, prepare sandbox and linings.

Days 2–4: Run Experiments 1–3 (replicates).

Days 5–6: Data analysis and graphs, photos for poster.

Day 7: Prepare poster and presentation notes.

BUDGET (LOW)

Most supplies are cheap or available at school: cardboard tubes/boxes, sand, small weights, lego/coins, ruler, camera. Estimated cost: ₹200–₹2000 depending on materials (or $5–$30).

BIBLIOGRAPHY

https://www.envirodesignproducts.com/blogs/news/the-scientific-reason-why-wells-are-round?srsltid=AfmBOoqgD7klsCPZFkX2zHO36qS-YqFHYDkHYNLaWjKM5acb9W21RTfK

https://thebrighterworld.com/detail/Why-Wells-Are-Always-Round-The-Simple-Science-Behind-a-Timeless-Design/ODgxOQ