COMPLETE MASTER BUILDER RESOURCE LIBRARY

This is your complete index of every free resource in the Dirt Cheap Building Series toolkit. All tools are available at empiregroup.ug/toolkit — no sign-up required.

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EMPIRE GROUP COMMUNITY + SERVICES

RESOURCE	WHAT YOU GET	URL
Free Toolkit	All 21 PDFs above, plus future additions	empiregroup.ug/toolkit
Community Forum	Connect with owner-builders; ask site-specific questions	empiregroup.ug/community
Dirt Cheap Series	Deep-dive method playbooks — Books 2 onwards	empiregroup.ug/dirt-cheap-series
Udemy Courses	Video instruction by Edward Ssewanyana, B.Arch	Search: Edward Ssewanyana on Udemy
Professional Consultancy	Paid 1-on-1 project review by Empire Group architects	empiregroup.ug/consultancy

Build Smart, Build Dirt Cheap — Dirt Cheap Building Series, Book 1

Author: Edward Ssewanyana, B.Arch (MUK) | Founder, Empire Group

1st place — Construction Exhibition Design Competition | Ministry of Works, Housing & Communications, Uganda

★ *These resources are provided free of charge as a companion to the book. They are for personal, owner-builder use only. Share the URL — empiregroup.ug/toolkit — with anyone who is planning to build.*

INTRODUCTORY METHOD COMPARISON CHART

Use the ratings below as a first-pass filter. Score = 1 (poor) to 5 (excellent). Grey out any method that scores 1 on a factor that is non-negotiable for your site.

Method	Cost Index	Skill Level	Tropical Fit	Dry Fit	Termite Resist	Flood Resist	Equip Needed	DIY Friendly
CEB								
Earthbag								
Rammed Earth								
Adobe								
Cob								
Wattle & Daub								
Bamboo								
Straw Bale								
Ferrocement								
Containers								

KEY — SCORING GUIDE

Rating	Meaning
5	Excellent — strong advantage on this factor
4	Good — performs well with minor limitations
3	Acceptable — use with caution; mitigate risks
2	Weak — not recommended unless compensated
1	Fail — eliminates this method for your site

MY SHORTLIST (AFTER SCORING)

Rank	Method	Total Score	Reason for Keeping
1st			
2nd			
3rd			

★ *Complete Chapter 4 Decision Scorecard for a full weighted analysis before making your final choice.*

PART 1 — MASTER BUILDER RESOURCE PACK

Use this pack as your navigational companion throughout the book. Tick each item as you download and use it.

#	Resource Name	Chapter	Downloaded?	Used?
1	Master Builder Resource Pack + Site Scorecard	Front Matter	☐	☐
2	Introductory Method Comparison Chart	Intro	☐	☐
3	Master Site Evaluation Sheet + Test Pit Log	Ch. 1	☐	☐
4	Climate Risk One-Pager + Termite Detailing	Ch. 2	☐	☐
5	Real Budget Planner + Soil Jar Test Log	Ch. 3	☐	☐
6	Master Decision Scorecard + Method Calculator	Ch. 4	☐	☐
7	CEB Mix Design Calculator + Production Log	Ch. 5	☐	☐
8	Earthbag Tamping Guide + Shear Calculator	Ch. 6	☐	☐
9	Rammed Earth Formwork Guide + Lift Calc	Ch. 7	☐	☐
10	Adobe Brick Casting Guide + Balance Sheet	Ch. 8	☐	☐
11	Cob Tarp Mixing Guide + Lift Tracker	Ch. 9	☐	☐
12	Wattle Weaving Grid + Daub Recipe Sheet	Ch. 10	☐	☐
13	Bamboo Joinery Template + Borate Curing Log	Ch. 11	☐	☐
14	Straw Bale Moisture Guide + Plaster Calc	Ch. 12	☐	☐
15	Ferrocement Mesh Guide + Cistern Math Sheet	Ch. 13	☐	☐
16	Container Welding Header Guide + Safety Check	Ch. 14	☐	☐
17	Hybrid Combinations Sheet + Rubble Trench Calc	Ch. 15	☐	☐
18	Roof + Drainage Checklist + Overhang Calc	Ch. 16	☐	☐
19	Room-by-Room Phasing Planner + Plaster Guide	Ch. 17	☐	☐
20	Master Safe-Build Checklist + 30-Day Plan	Ch. 18	☐	☐
21	Complete Master Builder Resource Library	Back Matter	☐	☐

PART 2 — SITE SCORECARD (QUICK PRE-BUILD ASSESSMENT)

Rate each factor 1–5. Total ≥ 30 = safe to proceed. Below 20 = pause and consult.

Factor	Your Rating (1–5)	Notes
1. Budget Adequacy		
2. Soil Suitability		
3. Climate Fit for Method		
4. Termite / Pest Risk (5=low)		
5. Flood / Drainage Risk (5=low)		
6. Skilled Labour Availability		
7. Material Source Proximity		

8. Site Access & Logistics		
TOTAL (out of 40)		

★ *Download all tools free at empiregroup.ug/toolkit — no sign-up required.*

PART 1 — MASTER SITE EVALUATION SHEET

Complete this sheet before committing to any wall system. Every answer directly affects which methods are eligible for your site.

SITE IDENTIFICATION	
Project Name / Location:	
Evaluator Name:	
Evaluation Date:	
Plot Size (m²):	

FACTOR	OBSERVED VALUE	RISK LEVEL (L/M/H)
1. Annual Rainfall (mm/yr)		
2. Humidity (avg %)		
3. Flood Zone?	[ ] Yes [ ] No	
4. Termite Activity on Site?	[ ] Yes [ ] No	
5. Soil Type	[ ] Clay [ ] Sandy [ ] Loam [ ] Gravel	
6. Expansive Clay Present?	[ ] Yes [ ] No	
7. Slope / Drainage	[ ] Flat [ ] Sloped [ ] Poor drain	
8. Road Access for Equipment?	[ ] Easy [ ] Difficult	
9. Skilled Labour Nearby?	[ ] Yes [ ] Partial [ ] No	
10. Local Material Availability		

PART 2 — TEST PIT LOG

Dig a minimum 1 m × 1 m × 1.2 m deep test pit. Record one row per pit.

Pit #	Depth (m)	Layer Description	Colour	Texture	Moisture	Stability Notes
1	0–0.3					
1	0.3–0.6					
1	0.6–0.9					
1	0.9–1.2					
2	0–0.3					
2	0.3–0.6					
2	0.6–0.9					
2	0.9–1.2					

★ *If the pit wall collapses within 30 minutes of digging, classify soil stability as LOW and select a method with shallow footings or rubble trench.*

PART 1 — CLIMATE RISK ONE-PAGER

Identify your climate zone and read the risk flags for each wall system.

MY CLIMATE ZONE (tick one)	
[ ] Tropical Wet (high rain, high humidity, termites)	
[ ] Tropical Wet/Dry (rainy + dry seasons, moderate termites)	
[ ] Semi-Arid / Savanna (low rain, hot days, cold nights)	
[ ] Arid / Desert (very low rain, extreme temp swings)	
[ ] Highland / Temperate (cool, moderate rain, frost risk)	
[ ] Coastal (salt air, humidity, cyclone/storm risk)	

Method	Tropical	Tropical W/D	Semi-Arid	Arid	Highland	Coastal
CEB	CAUTION	GOOD	EXCELLENT	GOOD	GOOD	CAUTION
Earthbag	CAUTION	GOOD	EXCELLENT	EXCELLENT	GOOD	GOOD
Rammed Earth	CAUTION	GOOD	EXCELLENT	EXCELLENT	GOOD	CAUTION
Adobe	AVOID	CAUTION	EXCELLENT	EXCELLENT	CAUTION	AVOID
Cob	AVOID	CAUTION	GOOD	GOOD	GOOD	AVOID
Wattle & Daub	CAUTION	CAUTION	GOOD	CAUTION	GOOD	CAUTION
Bamboo	GOOD	GOOD	CAUTION	AVOID	GOOD	GOOD
Straw Bale	AVOID	CAUTION	GOOD	GOOD	EXCELLENT	AVOID
Ferrocement	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
Containers	GOOD	GOOD	CAUTION	CAUTION	GOOD	CAUTION

PART 2 — TERMITE DETAILING SHEET

Complete this section for any site with confirmed or probable termite activity.

TERMITE DETAILING CHECKLIST	Done?
Physical barrier: metal termite cap on all foundations	☐
No wood-to-soil contact anywhere on the structure	☐
Treated timber only (boron or approved preservative)	☐
Treated bamboo if used (boron soak minimum 48 hrs)	☐
Inspection gap: 75 mm clearance at slab edge visible	☐
Straw bale: sealed with 50 mm plaster on all faces	☐
Cob/Adobe: lime render on exterior prevents entry	☐
Re-inspection scheduled every 12 months	☐

★ *Methods rated AVOID in your climate zone should be eliminated immediately — do not attempt to engineer around a fundamental climate incompatibility.*

PART 1 — REAL BUDGET PLANNER

List every cost category below. Use local quotes where possible. Add 20% contingency before deciding your method is affordable.

COST CATEGORY	Est. Cost (USD)	Local Quote	Final?
Land (if not yet purchased)			☐
Site clearing & earthworks			☐
Foundation / footing system			☐
Wall system materials (bulk)			☐
Wall system equipment hire			☐
Roof structure (timber/steel)			☐
Roof covering			☐
Doors & windows			☐
Plaster / render (exterior)			☐
Plaster / render (interior)			☐
Electrical rough-in			☐
Plumbing rough-in			☐
Flooring			☐
Skilled labour (total days × rate)			☐
Transport & logistics			☐
Permits & professional fees			☐
Contingency (add 20% of subtotal)			☐
TOTAL BUDGET			

PART 2 — SOIL JAR TEST LOG

Shake 1 part soil + 3 parts water in a clear jar. Let settle for 24 hours. Measure each layer and record below.

Sample #	Sample Location	Gravel Layer (mm)	Sand Layer (mm)	Silt Layer (mm)	Clay Layer (mm)	% Clay (clay÷total)
1						
2						
3						
4						

★ *Target clay content for CEB/Rammed Earth: 10–35%. Over 40% = expansive risk. Under 10% = won't bind without stabiliser.*

PART 1 — MASTER DECISION SCORECARD

Rate each method 1–5 on each weighted criterion. Multiply score × weight. The method with the highest weighted total is your recommended choice.

CRITERION	WEIGHT	CEB	Earthbag	Ram. Earth	Adobe	Cob	W&D	Bamboo	Str. Bale	Ferro	Contain.
Climate Fit	×5										
Termite Resistance	×4										
Flood Resistance	×4										
Budget Fit	×4										
Skill Required	×3										
Equipment Needed	×3										
Labour Availability	×3										
Material Proximity	×3										
Long-Term Durability	×2										
Code Compliance	×2										
WEIGHTED TOTAL	—										

PART 2 — METHOD CALCULATOR WORKSHEET

Use this worksheet to compare your top two methods on total delivered cost.

COST ITEM	Method A: _____	Method B: _____
Wall material cost per m²		
Wall area required (m²)		
Wall material subtotal		
Equipment hire		
Skilled labour (days × day rate)		
Unskilled labour (days × day rate)		
Stabiliser / treatment costs		
Finishing (plaster both sides)		
Transport		
Subtotal		
+ 20% Contingency		
TOTAL ESTIMATED WALL COST		

★ *My chosen method: _____ Reason: _____*

PART 1 — CEB MIX DESIGN CALCULATOR

Optimum CEB mix: 70–80% soil aggregate + 10–20% clay + 5–10% stabiliser. Adjust ratios based on your jar test results (Chapter 3 log).

MIX PARAMETER	YOUR VALUE	TARGET RANGE
Soil % clay (from jar test)		10 – 35%
Stabiliser type selected		Cement / Lime / Pozzolan
Stabiliser % by volume		5 – 8% (cement) / 8–12% (lime)
Water added per batch (L)		Just enough to form ball that breaks
Optimum Moisture Content (OMC %)		8 – 14%
Target dry density (kg/cu.m)		1,600 – 2,000
Block dimensions (mm)		290 × 140 × 100 (standard)
Press machine model / kN rating		≥ 30 kN for residential quality

BATCH CALCULATION	FORMULA	YOUR ANSWER
Soil volume per batch (litres)	Press capacity × 0.8	
Stabiliser volume (litres)	Soil vol × (stabiliser %/100)	
Water added (litres)	Soil vol × (OMC/100)	
Blocks per batch	Press yield (check manual)	
Blocks needed (wall area × 50)		
Batches required	Blocks needed ÷ blocks/batch	

PART 2 — BLOCK PRODUCTION LOG

Log each production session. Target quality: block must survive 7-day wet cure and ring when tapped.

Date	Mix Ratio	Batches Run	Blocks Made	Rejected	Curing Start	Pass Test?

★ *Cure CEB blocks in shade for minimum 28 days before loading. Never expose uncured blocks to rain.*

PART 1 — EARTHBAG TAMPING GUIDE

Each earthbag course must be tamped to at least 90% of its loose-fill height before the next course is laid. Use a flat-plate tamper weighing minimum 4 kg.

✔	Item	Notes
☐	Bag type confirmed: woven polypropylene (UV-stabilised), 18 kg capacity minimum	
☐	Soil fill: moistened to 'just moist' — forms ball, breaks cleanly when dropped	
☐	Bag filled to 90% only — no overfilling; sealed end tucked under	
☐	Each bag tamped until height reduces by ≥ 15% (loose to compacted)	
☐	Course is level and plumb before barbed wire is laid	
☐	Two strands of 4-point barbed wire between every course	
☐	Wire extends ≥ 150 mm beyond bag edge to overlap with next course	
☐	Courses staggered (running bond) — joints never align vertically	
☐	Buttresses / piers added every 3 m for walls > 2 m height	
☐	All bags plastered within 3 months of completion to prevent UV degradation	

TAMP QUALITY TEST	Target	Recorded
Course height after tamp (mm)	≤ 180 mm	
Width after tamp (mm)	≥ 380 mm (std bag)	
Level error per course (mm)	≤ 10 mm	
Plumb error per 1 m height	≤ 15 mm	

PART 2 — BARBED WIRE SHEAR CALCULATOR

Barbed wire between courses acts as the tensile / shear reinforcement. Calculate the number of wire rolls needed.

PARAMETER	FORMULA	YOUR VALUE
Total wall perimeter (m)	Measure on plan	
Wall height (m)	Design height	
Number of courses	Height ÷ 0.18 m per course	
Wire length per course (m)	Perimeter + 10% waste	
Total wire length (m)	Wire/course × no. of courses × 2 strands	
Roll length (m) — standard	90 m / roll (confirm with supplier)	
Rolls required	Total length ÷ 90	
Add 15% wastage; final rolls to buy		

★ *Never substitute smooth wire for barbed wire. The barbs are structural — they interlock under shear loading.*

PART 1 — RAMMED EARTH FORMWORK ENGINEERING GUIDE

Formwork must resist lateral pressure from wet soil mix. Minimum specification for residential walls below.

FORMWORK PARAMETER	MINIMUM SPEC	YOUR SPEC
Panel material	18 mm ply or 2 mm steel sheet	
Vertical waler spacing	≤ 400 mm centres	
Horizontal strongback spacing	≤ 600 mm centres	
Tie rod diameter	≥ 10 mm threaded steel	
Tie rod spacing (H × V)	≤ 400 mm × 600 mm	
Panel height (lift height)	300–500 mm per lift (500 mm max)	
Wall width (form gap)	250–350 mm typical residential	
Release agent	Diesel or commercial form oil — all faces	
Stripping time	≥ 12 hours after last compaction	

✔	Item	Notes
☐	Soil tested: PI (Plasticity Index) < 20; clay content 10–35%	
☐	Stabiliser (cement 5–8% or lime 8–12%) pre-mixed dry before water added	
☐	Moisture at Optimum Moisture Content — soil 'just damp', not wet	
☐	Compaction energy: minimum 25 blows per 150 mm layer with pneumatic rammer	
☐	Each layer ≤ 150 mm loose before ramming	
☐	Form ties removed cleanly; holes pointed with matching mix on strip	

PART 2 — LIFT CALCULATOR

Each lift is one panel-height of compacted material. Calculate total number of lifts needed.

CALCULATION STEP	FORMULA	YOUR VALUE
Design wall height (m)		
Lift height selected (m)	0.3 – 0.5 m	
Number of lifts	Wall height ÷ lift height	
Volume of wall per lift (cu.m)	Length × width × lift height	
Loose soil per lift (cu.m)	Compacted vol × 1.25	
Stabiliser mass per lift (kg)	Loose vol × density × stab%	
Labour hours per lift (estimate)	5–8 hrs for 2-person team	
Total person-hours for full wall	Hours/lift × lifts	

★ *Never ram a new lift onto a lift that has been rained on or frozen. Moisture content must be consistent throughout.*

PART 1 — ADOBE BRICK CASTING GUIDE

Follow the casting sequence below for each production run. Target: 200–300 bricks per day for a 2-person team.

✔	Item	Notes
☐	Mould prepared: 2-brick timber mould, 300 × 140 × 100 mm (std), wetted inside	
☐	Mix proportions confirmed: 65–75% soil, 20–25% sand, 5–10% straw (chopped 50 mm)	
☐	Test brick made and passed: no cracks after 3-day air cure	
☐	Mixing pit or pan ready; mix just moist — holds shape, no slump	
☐	Mould filled in two layers; each layer pressed firmly into corners	
☐	Excess mix struck off level with wire or stick	
☐	Mould lifted cleanly; brick left flat for 24 hours before turning on edge	
☐	Bricks stacked on edge after 2 days; shaded from rain and direct sun	
☐	Minimum cure time before use in wall: 28 days in dry conditions	
☐	Bricks tested: no soil scratch deeper than 3 mm with fingernail = ready	

PRODUCTION TRACKER	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
Bricks cast					
Bricks cracked / rejected					
Net bricks for use					
Running total					

PART 2 — CLAY-STRAW BALANCE SHEET

Use this to find your site's optimum clay-to-straw ratio. Run 3 test batches and score each.

BATCH #	Clay %	Sand %	Straw %	Water Added	Surface Cracks (1=bad, 5=none)	Scratch Test (mm depth)	Use?
A							☐
B							☐
C							☐

★ *Adobe mortar (for laying bricks) should be the same mix as the brick — never use cement mortar on adobe walls.*

PART 1 — COB TARP MIXING GUIDE

Tarp mixing is the most accessible method for small teams. One batch = what two people can tarp-mix and lift in 30 minutes.

STEP	ACTION	Check
1	Lay 3 m × 3 m heavy tarp on flat ground	☐
2	Pile soil (1 part), sand (1 part) on tarp	☐
3	Form hollow in centre; add water gradually	☐
4	Add chopped straw (50 mm) — approx 10% by vol	☐
5	Fold tarp over pile; walk or twist to mix	☐
6	Mix until colour is uniform; no dry streaks	☐
7	Test: roll golf-ball — no cracks after 2 min	☐
8	Transfer to wall in 30-min batches	☐

MIX RATIOS TESTED (circle or fill)	Batch A	Batch B	Batch C
Soil (parts)			
Sand (parts)			
Straw (% by volume)			
Water (approx litres per batch)			
Crack rating after 7 days (1=bad, 5=none)			
SELECTED RATIO?	☐	☐	☐

PART 2 — SCULPTURAL LIFT TRACKER

Cob walls are built in 'lifts' of 300–450 mm. Each lift must stiffen before the next.

Lift #	Date Applied	Height Reached (mm)	Width (mm)	Stiffen Time (hrs)	Surface Check (firm?)	Next Lift Date

★ *Never add a new lift to cob that moves or feels soft underfoot. Press thumb firmly — if it leaves a mark > 10 mm deep, wait 24 more hours.*

PART 1 — WATTLE WEAVING GRID GUIDE

The wattle grid is the structural skeleton for the daub. Correct spacing is essential for daub adhesion.

GRID PARAMETER	SPECIFICATION	YOUR MEASUREMENT
Upright post species	Hardwood, min 50 mm dia	
Upright spacing	400–600 mm centres	
Horizontal wattle species	Flexible: willow, reed, split bamboo	
Horizontal wattle diameter	10–25 mm	
Horizontal spacing	80–150 mm centres	
Weave pattern	Alternate sides per row (in/out/in)	
Total grid area (m²)	Wall length × height	
Wattle length (m) per m²	Area ÷ horizontal spacing × 1.2 waste	

✔	Item	Notes
☐	Posts driven or fixed securely — no movement under hand pressure	
☐	Wattles soaked in water for 1 hour before weaving if dry	
☐	Weave is tight — no gap > 30 mm between horizontals	
☐	All ends of wattle tucked behind posts or tied with natural twine	
☐	Grid checked for plumb and level before daubing begins	
☐	Daub applied while wattles are still green / damp for best bond	

PART 2 — DAUB MUD RECIPE SHEET

Three proven daub recipes. Test all three; select the one with fewest cracks after 14-day cure.

RECIPE	SOIL	SAND	FIBRE	WATER	BEST FOR
A — Standard	60%	30%	10% straw (50 mm chop)	To workability	Dry climates
B — Sandy	50%	40%	10% cattle dung (dried)	To workability	Clay-heavy soils
C — Lime finish	55% soil	30% sand	5% straw + 10% lime putty	To workability	Humid climates

APPLICATION SEQUENCE	COAT	THICKNESS	Cure Time	Done?
First coat (scratch coat)	1	10–15 mm	7–14 days	☐
Second coat (body coat)	2	8–12 mm	7–14 days	☐
Finish coat (lime or clay)	3	3–5 mm	3–7 days	☐

★ *Daub must be kept damp (not wet) during the first 3 days of curing to prevent rapid surface cracking.*

PART 1 — BAMBOO JOINERY TEMPLATE GUIDE

The joint is the weakest point in a bamboo structure. Use only the joint types below for structural applications.

JOINT TYPE	APPLICATION	Min. Bolt Ø	Pegs?	Lashing?	Structural Use
Square lashing	Non-structural, décor	—	No	Yes	Light only
Clamp joint	Secondary members	M10	Yes	No	Moderate
Fish-mouth joint	Rafter-to-beam	M12	Yes	Yes	Structural
End-to-end splice	Column extension	2 × M12	Yes	Yes	Structural
Corner knee brace	Frame corners	M12	Yes	Yes	Structural

✔	Item	Notes
☐	Bamboo culm: minimum 3 years old (check node spacing — mature = closer nodes at top)	
☐	No cracks, splits, or insect holes visible on any structural culm	
☐	All culms air-dried minimum 4 weeks before use in structure	
☐	Borate treatment completed before jointing (see Part 2)	
☐	All hollow ends filled with mortar or capped with wood plugs	
☐	Bolts installed with washers; over-tightening cracks the culm — finger-tight + 1/4 turn	
☐	No direct soil contact — bamboo elevated minimum 150 mm above finished ground	

PART 2 — BORATE CURING (TREATMENT) LOG

Boron salt treatment is essential. Treat every culm before installation regardless of species.

TREATMENT PARAMETER	SPECIFICATION	RECORDED
Solution concentration	10% borax or disodium octaborate	
Solution temperature	Min 40 deg C for absorption	
Soak method	Full submersion in tank/trough	
Minimum soak duration	48 hours (structural) / 24 hrs (non-struct.)	
Air-dry after treatment	Minimum 14 days shade-dried	

Batch #	Culm Count	Soak Start	Soak End	Solution Conc.	Air-Dry End	Ready?

★ *Untreated bamboo in humid or tropical climates will be infested within 1–3 years. Treatment is not optional.*

PART 1 — STRAW BALE MOISTURE VERIFICATION GUIDE

Moisture content is the single most critical factor in straw bale construction. Never install a bale that reads above 20% MC.

MOISTURE CHECK METHOD	PROCEDURE	PASS/FAIL
Probe meter reading	Insert 2 probes 100 mm deep, centre bale	≤ 20% = PASS
Visual check	No discolouration, no mould smell	Clean = PASS
Hand test	Grab straw — should not feel cool or damp	Dry feel = PASS
After rain exposure	Re-test every bale that was rained on	Re-test required

Bale #	Location in Wall	MC Reading %	MC Reading #2	Pass?	Date Installed

PART 2 — PLASTER MIX CALCULATOR

Straw bale walls require full plaster encasement on both faces — minimum 50 mm total. Calculate quantities for each mix below.

MY WALL AREAS	MEASUREMENT
Total exterior wall area (m²)	
Total interior wall area (m²)	
Total area to plaster (m²)	

COAT	MIX (parts)	Thickness	Volume needed (cu.m)	Bags cement / lime
Scratch coat	1 lime : 2.5 sand : 1 clay	20 mm	Area × 0.020	
Body coat	1 lime : 3 sand	20 mm	Area × 0.020	
Finish coat	1 lime : 2 sand + pigment	10 mm	Area × 0.010	

★ *Cement plaster on straw bale is NOT recommended — it traps moisture. Use lime exclusively. Lime is breathable.*

PART 1 — FERROCEMENT MESH LAYERING GUIDE

Ferrocement strength comes from mortar fully encasing many thin layers of mesh. Never skip a layer. Total wall thickness: 25–40 mm for residential panels.

LAYER	MATERIAL	Aperture	Wire Ø	Coverage Check
Frame	6 mm deformed bar @ 150 mm gri	N/A	6 mm	[ ] No bare frame ends
Mesh 1 (outer)	Chicken wire or welded mesh	25 × 25 mm	0.9–1.2 mm	[ ] Full coverage
Mortar coat 1	1 cement : 1.5 sand + plasticiser	N/A	N/A	[ ] Into mesh, 10 mm
Mesh 2 (mid)	Welded mesh or hardware cloth	12 × 12 mm	1.0 mm	[ ] Pressed into mortar
Mortar coat 2	1 cement : 1.5 sand	N/A	N/A	[ ] Full coverage 8 mm
Mesh 3 (inner)	Welded mesh	12 × 12 mm	1.0 mm	[ ] Pressed in
Final coat	1 cement : 1.5 sand (plastered)	N/A	N/A	[ ] Smooth finish 7 mm
TOTAL THICKNESS	Target 25–40 mm (check with pin)	—	—	☐

✔	Item	Notes
☐	Water/cement ratio held to 0.35–0.45 (mix is stiff, not flowing)	
☐	All mesh laps minimum 50 mm, tied with 0.8 mm wire every 200 mm	
☐	No air pockets — tap panel; hollow sound = remortar that section	
☐	Panel cured wet (covered with damp burlap) for minimum 28 days	
☐	No cracks visible at 28 days — if cracks present, investigate mix ratio	

PART 2 — CISTERN DESIGN MATH SHEET

Ferrocement cisterns are one of the highest-value applications. Use these formulas to size your tank.

PARAMETER	FORMULA	YOUR ANSWER
Daily household water use (litres)	Persons × 50 L/person/day	
Storage target (days of supply)	Suggest: 30–90 days for rain-fed	
Tank volume required (litres)	Daily use × storage days	
Tank volume (cu.m)	Litres ÷ 1,000	
Cylindrical tank diameter (m)	Choose: 1.5 m, 2.0 m, or 2.5 m	
Required tank height (m)	Volume ÷ (π × (D/2)²)	
Wall surface area (m²)	(π × D × H) + (π × (D/2)²) floor	
Mesh required (m²)	Surface area × 3 layers × 1.15 waste	
Mortar volume (cu.m)	Surface area × 0.030 m thickness	

★ *Ferrocement cisterns must have a tight-fitting lid to prevent contamination. Apply two coats of food-safe lime wash to the interior before filling.*

PART 1 — CONTAINER WELDING HEADER GUIDE

Every opening cut into a container wall requires a structural header (lintel) to redistribute load. Do not cut before fabricating the header.

OPENING TYPE	Opening Width	Min. Header Section	Weld Spec	Done?
Standard door (900 mm)	900 mm	100 × 100 × 6 mm RHS	6 mm fillet both sides	☐
Double door (1800 mm)	1,800 mm	150 × 100 × 8 mm RHS	8 mm fillet both sides	☐
Window (up to 1200 mm)	up to 1,200 mm	100 × 100 × 6 mm RHS	6 mm fillet both sides	☐
Wide opening (> 1800 mm)	> 1,800 mm	Consult structural eng.	N/A	☐
Corner panel removal	Full panel	Additional frame reqd.	Consult engineer	☐

✔	Item	Notes
☐	Container grade confirmed: cargo-grade (CSC plated) — not damaged 'as-is' grade	
☐	Corten steel verified — check with magnet (should stick) and visual rust pattern	
☐	Hazardous cargo check: request shipping history; reject any container that carried chemicals	
☐	Header pre-fabricated, fitted, and fully welded BEFORE any cutting of wall begins	
☐	All welds inspected: no pinholes, undercut, or missed sections	
☐	Cut edges ground smooth and primed within 24 hours to prevent rust spread	
☐	Stacking: never stack more than 3 containers without structural assessment	
☐	Ventilation planned: min. 10% of floor area as openings to prevent condensation	

PART 2 — PLYWOOD FLOOR SAFETY CHECK

Container floors contain chromate-based pesticides in the original plywood. Complete this check before inhabiting any container structure.

SAFETY STEP	Action Required	Done?
1. Identify floor species	Check stamping on underside — record species	☐
2. Test for pesticide treatment	Contact supplier or use test kit	☐
3. Remove and replace if positive or unknown	Replace with FSC-certified plywood	☐
4. If retaining floor — seal completely	2 coats epoxy paint, all edges sealed	☐
5. Do NOT sand original floor	Sanding releases pesticide dust — hazardous	☐
6. Ventilate during any floor work	Wear N95 mask; open all doors/windows	☐

★ *Do not lay carpet or breathable flooring directly on untreated container plywood. Seal first, always.*

PART 1 — HYBRID COMBINATIONS SHEET

This book compares 10 wall systems, but your actual home may combine 2 methods — e.g., ferrocement wet rooms + CEB living areas. Use this matrix to check compatibility.

WALL METHOD (A)	Compatible With	Watch-Out	Foundation Shared?
CEB	Rammed Earth, Adobe, Ferrocement	Avoid direct contact with Straw Bale	[ ] Yes [ ] No
Earthbag	Ferrocement (wet rooms), Cob	Must match footing depth	[ ] Yes [ ] No
Rammed Earth	CEB, Ferrocement	Formwork access between methods	[ ] Yes [ ] No
Adobe	Cob, Wattle & Daub	Keep wet-zone walls in Ferrocement	[ ] Yes [ ] No
Bamboo	Ferrocement, Wattle & Daub	Bamboo needs own footing pad	[ ] Yes [ ] No
Containers	Ferrocement (cisterns), CEB (in-fill)	Differential settlement — separate ftg	[ ] Yes [ ] No

✔	Item	Notes
☐	All methods share same finished floor level — level pegs set before any wall begins	
☐	Foundation type is compatible with both/all methods used	
☐	No capillary break missing between dissimilar materials	
☐	Differential settlement risk assessed — heavier walls on stronger footings	
☐	Structural engineer reviewed hybrid combination for buildings > 1 storey	

PART 2 — RUBBLE TRENCH CALCULATOR

Rubble trench foundations are ideal for low-cost, well-drained sites. Not suitable for expansive clay or flood zones.

PARAMETER	FORMULA	YOUR VALUE
Wall length (total, m)	Measure from plan	
Trench depth (m)	Below frost or expansive clay zone + 300 mm	
Trench width (m)	Wall width + 200 mm each side	
Volume of trench (cu.m)	Length × depth × width	
Rubble stone volume (cu.m)	Trench vol × 0.65 (65% fill factor)	
Drainage aggregate volume (cu.m)	Trench vol × 0.35	
Perforated pipe length (m)	Equal to trench length + 10% for bends	
Concrete cap thickness (mm)	Min. 150 mm reinforced; 200 mm preferred	
Concrete cap volume (cu.m)	Length × wall width × 0.15	

★ *Rubble trench works only where water can drain freely. If the bottom of the trench stays wet for >24 hrs after rain, this is not the right foundation for your site.*

PART 1 — ROOF AND DRAINAGE CHECKLIST

Roof failure is the most common cause of premature wall deterioration in low-cost buildings. Complete this checklist before the first rains arrive.

ITEM	Check
Roof pitch ≥ 15° for metal sheets; ≥ 25° for clay tiles	☐
Overhang: minimum 600 mm all sides (1,000 mm in high-rain zones)	☐
All penetrations (pipes, vents) flashed and sealed	☐
Ridge capping fixed and overlapped minimum 150 mm both sides	☐
Fascia board and barge board fixed; no exposed rafter ends	☐
Gutters pitched at 1:500 minimum toward downpipes	☐
Downpipes extend ≥ 500 mm from wall base; splash pad present	☐
No valley without underlayer or lead flashing	☐
Roof-to-wall connection: straps or anchor bolts at ≤ 1,200 mm centres	☐
All fixings: galvanised or stainless — no bare steel	☐
Ceiling batts or reflective foil insulation fitted (if climate demands)	☐
Subfloor ventilation / crawl space vented (if applicable)	☐

PART 2 — OVERHANG SOLAR ANGLE CALCULATOR

A correctly designed overhang shades the wall in summer and admits sun in winter. Use your latitude to calculate the required overhang depth.

PARAMETER	FORMULA	YOUR VALUE
Your latitude (degrees)	Look up your location (e.g. Kampala = 0.3°N)	
Window / opening height (m)	Measure your window height	
Summer solstice sun angle (°)	90 – latitude – 23.5	
Overhang depth required (m)	Window height ÷ tan(summer angle)	
Winter solstice sun angle (°)	90 – latitude + 23.5	
Shadow length in winter (m)	Overhang depth × tan(winter angle)	
Winter shadow on glass?	If shadow < window height = sun admitted	

LATITUDE REFERENCE	Summer Sun Angle	Target Overhang for 1.2 m window
0° (Equator)	66.5°	0.48 m
5°N/S	61.5°	0.56 m
10°N/S	56.5°	0.73 m
15°N/S	51.5°	0.94 m
20°N/S	46.5°	1.27 m

★ *At low latitudes (0–10°), the sun is nearly overhead. Deep overhangs may not be necessary — but rain runoff protection IS. Design for rain before solar.*

PART 1 — ROOM-BY-ROOM PHASING PLANNER

Plaster and render are critical for weather protection. Never leave walls unrendered through a rainy season. Plan your sequence below.

ROOM / ZONE	Wall Area (m²)	Method	Coat 1 Date	Coat 2 Date	Coat 3 Date	Complete?
Exterior North						☐
Exterior East						☐
Exterior South						☐
Exterior West						☐
Kitchen (interior)						☐
Bathroom / WC						☐
Living Room						☐
Bedroom 1						☐
Bedroom 2						☐
Bedroom 3						☐
Veranda / Porch						☐

PART 2 — NATURAL PLASTER RECIPE GUIDE

Match plaster recipe to wall type. Wrong plaster on wrong wall causes delamination and cracking.

RECIPE	WALL TYPE	COAT	MIX RATIO	Finish
Clay plaster	Cob, Adobe, Earthbag	1st+2nd	3 clay : 4 sand : 1 straw	Smooth or textured
Lime plaster	CEB, Rammed Earth, Adobe	Final	1 lime : 2.5 sand	Float or trowel
Lime-clay blend	All earthen walls	All coats	1 lime : 1 clay : 4 sand	Smooth
Sand-lime	Bamboo, Wattle & Daub	Final	1 lime : 3 coarse sand	Rough / rustic
Cement-lime	Ferrocement exterior only	All coats	1 cement : 1 lime : 4 sand	Smooth, waterproof

PLASTER QUANTITY CALCULATOR	FORMULA	YOUR TOTAL
Total area to plaster (m²)	From phasing planner	
Volume per coat: 12 mm thick (cu.m)	Area × 0.012	
Lime bags needed (25 kg bags)	Volume × 750 kg/cu.m × lime %	
Sand needed (cu.m)	Volume × sand fraction	

★ *Never apply a rigid cement render over an earthen wall. The wall breathes; cement doesn't. Delamination is inevitable.*

PART 1 — MASTER SAFE-BUILD CHECKLIST

Complete ALL items before occupying the building. This is not a code substitute — consult your local authority for statutory approvals.

CATEGORY	ITEM	Done?
Foundation	Foundation depth reaches stable soil; no settlement cracks	☐
Foundation	DPC (damp-proof course) at base of all walls above slab	☐
Walls	All walls plumb within 15 mm per storey	☐
Walls	All openings have lintels or headers	☐
Walls	Exterior plaster complete; no bare earthen wall facing rain	☐
Roof	Roof-to-wall straps fixed at ≤ 1,200 mm centres	☐
Roof	Ridge, hips, valleys all flashed and sealed	☐
Roof	Overhang minimum 600 mm all sides	☐
Drainage	Site graded away from building; no pooling within 3 m	☐
Drainage	Gutters and downpipes installed; splash pads in place	☐
Electrical	All wiring inside conduit; no exposed cables in wall voids	☐
Electrical	Earth leakage circuit breaker (ELCB) fitted at DB board	☐
Plumbing	All supply pipes pressure-tested before wall closure	☐
Plumbing	All waste drains to soakpit or sewer — no open discharge	☐
Fire	2 × 4.5 kg dry powder extinguishers in kitchen and store	☐
Termites	Termite barrier inspected; 75 mm inspection gap visible	☐
Occupancy	Council or permit sign-off obtained (if required locally)	☐

PART 2 — 30-DAY ACTION PLAN (POST-DECISION)

Use this plan after choosing your method in Chapter 4. Adapt dates to your actual start date.

DAY	MILESTONE	Done?
1–3	Confirm land ownership and site access	☐
3–5	Obtain site plan / topographic survey	☐
5–7	Complete Site Evaluation Sheet (Chapter 1 resource)	☐
7–9	Complete Soil Jar Test (Chapter 3 resource)	☐
9–12	Final budget drafted with 20% contingency	☐
12–14	Complete Decision Scorecard; method CONFIRMED	☐
14–16	Source and price all major materials locally	☐
16–18	Contact local authority re: building permit requirements	☐
18–21	Identify skilled labour; agree rates in writing	☐
21–23	Order equipment / tools; confirm delivery dates	☐
23–25	Prepare site: clear, peg out, dig test pits	☐

25–27	Produce or source trial batch of wall material	☐
27–30	Evaluate trial batch; adjust mix if needed	☐
Day 30	SITE START — foundation excavation begins	☐

★ *Take a photo on Day 1 and Day 30. If you are still on Day 1 after 30 days, email us — the community can help. empiregroup.ug/community*