

"Walking Castle": concept of a walking dome house on 4 legs

| All calculations are conceptual, without FEM strength analysis.

Stage: concept / feasibility study. All figures below were obtained with simplified formulas and serve to choose the layout and the class of components. This is not a detailed design calculation. The frame, leg frame, column and joints must later be checked with FEM (FreeCAD FEM / ANSYS), and the components must be selected from manufacturers' catalogues.

The calculation is reproduced by a script: `calc/calc.py` takes the masses and centres of mass from the model (`cad/mass_*.json`) and writes the results to `calc/results.json` and the figures to `renders/`.

1. Summary in one paragraph

I recommend **scheme B, the "walking excavator"**. It has 4 legs on a common sliding frame and a central Ø2.0 m support plate under the column. The plate sits on a slewing ring. - **Only 6 actuators in total**. Each leg has 1 lift actuator with a 300 mm stroke. There are two shared actuators: 1 shuttle actuator (600 mm stroke) and 1 slewing-ring rotation drive. - **Stability**. The house always stands either on 4 legs or on the Ø2 m plate. It never stands on three legs. - **Speed**: 0.92 m/min (a 600 mm step in 39 s). - **Turning**: in place, to any angle. - **Levelling**: by the leg lift actuators.

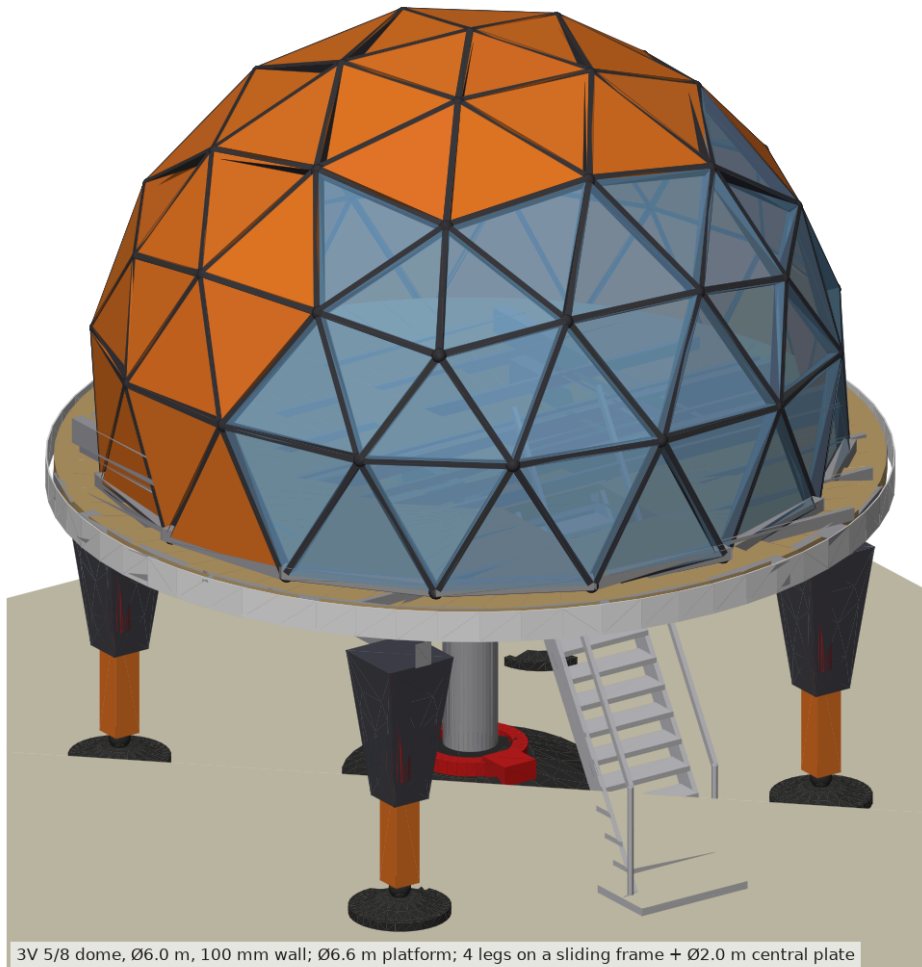
Scheme A, proposed originally (each leg has its own lift and its own stroke, 8 actuators in total), is workable. But it is half as fast (0.47 m/min) and has a small stability margin on three legs: 113 mm. The sequence "swing 4 legs, then move the body" is outright **unstable**: the CoG leaves the support triangle by 217 mm. Details in section 3.

Recommended drive: **electromechanical** (servo motor or induction motor with VFD and brake, ball screw or planetary roller screw, or a 10 t screw jack). Rationale and the hydraulic alternative are in section 6.

Parameter	Value
Dome	geodesic 3V, 5/8 truncation. Sphere Ø6.0 m, base Ø5.91 m, height above floor 3.56 m
Dome frame	165 struts, 100×50×2 tube, 198 m in total
Envelope	105 triangular panels: 74 solid sandwich panels "0.7 steel + 100 XPS (Penoplex) + 12 plywood" (46 m²) and 31 double-glazed units (19 m², front sector ±65°)
Platform	ring-shaped, Ø6.6 m. 200 mm floor frame, finished floor at +2.76 m
Clearance under the house	≈2.1 m under the leg frame, ≈2.45 m under the floor frame (a car fits underneath, as in the photo)
Overall height	6.3 m
Mass	structure with interior ≈11.3 t; walking with 4 people ≈11.6 t (W = 113 kN); parked with snow ≈16.8 t
Supports	4 legs on a 3.8 × 4.0 m plan (centre to centre), Ø800 foot pads on ball joints; Ø2.0 m plate

Parameter	Value
Actuators (scheme B)	4 lift actuators (60 kN dynamic / 100 kN static, 300 stroke, 15...40 mm/s), 1 shuttle (15 kN, 600 stroke, 40...75 mm/s), 1 rotation drive (slewing ring $\approx \varnothing 0.9$ m, tilting moment ≥ 66 kN·m)
Speed	0.92 m/min in the base setting. Up to ~ 1.3 m/min with an 800 mm step and a faster shuttle
Power	peak ≈ 3 kW (4 lifts at once) + 0.4 kW (shuttle); 380 V / 7–10 kVA supply or a battery. Energy ≈ 0.9 kWh per 100 m

Walking Castle, scheme B (recommended): parked on 4 legs, stair deployed



2. Input data and assumptions

- Geometry as in the Capsule Castle photo: a dome on a ring platform, 4 inclined conical legs, a folding stair underneath. The inclined look of the legs is kept in the model (a welded truncated pyramid). The lifting telescope inside each leg is **vertical**, so the actuator works in compression only, without bending.
- 100 mm wall: 100×50 mm frame struts with 100 mm Penoplex laid flush between them.
- Unit masses:
- solid panel 18.2 kg/m² (0.7 mm steel 5.5 + 100 mm XPS at 35 kg/m³ 3.5 + 12 mm plywood 7.2 + fixings and membranes 2);
- 6-16-6 double-glazed unit (tempered or laminated glass) with frame 35 kg/m²;
- floor 39 kg/m² (100 XPS + 2×18 plywood + finish + 1 mm bottom skin);

- steel 7850 kg/m³; rectangular hollow sections are calculated by the GOST section: $A = 2t(h+b) - 4t^2$.
- Interior and building services: 1500 kg at +0.8 m above the floor. People while walking: 4 × 80 kg. +5% of the steel mass is added for welds, fasteners and paint.
- Snow: snow region III, $S_g = 1.5$ kPa, $\mu = 1$ (conservative) over the Ø6.6 m plan, 5.2 t in total. **No walking with snow on the roof**: snow is considered for parking only.
- Wind: $q = \frac{1}{2} \cdot \rho \cdot v^2$, $\rho = 1.225$ kg/m³. Dome: $C_f = 0.6$ on a projected area of 17.5 m². Platform, legs and column: $C_f = 1.5$. Total $C_f \cdot A \approx 20.6$ m², lever arm ≈ 2.95 m above ground.

2.1 Mass (from the FreeCAD model + allowances)

Group	kg
Dome: frame (struts + hubs + base ring)	1238
Dome: sandwich panels	837
Dome: glazing	668
Floor: steel frame (ring 200×150×5, beams 200×100×6, joists 100×50×3)	1512
Floor: sandwich deck + edge cladding	1359
Running gear: legs, telescopes, foot pads, leg frame, guides, carriages	2347
Actuators (4 lifts + shuttle)	415
Central support: Ø426×8 column, braces, slewing ring, Ø2.0 m plate	899
Stair	170
Welds, fasteners, paint (+5%)	308
Interior and building services	1500
Dead weight	11 253
People while walking	320
Operating mass while walking, W	11 573 kg = 113.5 kN
Snow when parked	5 231
Parked with snow	16 804 kg = 165 kN

Centre of gravity while walking: $X \approx +80$ mm (shifted forward, towards the glazing), $Z \approx 2.76$ m above ground.

Weight-saving reserve ≈ 1.5 –2 t: a glulam or aluminium dome frame (as in the interior photo), 100×40×2 struts, a lighter floor. The floor frame and the running gear will remain steel in any case.

3. Choice of kinematics

3.1 Options considered

Scheme	Actuators	Stability	Speed (600 step)	Pros	Cons
A : 4 legs × (lift + stroke)	8	3 legs, margin 113	0.47 m/min	No "fifth support", copes well with	8 actuators; small stability margin;

Scheme	Actuators	Stability	Speed (600 step)	Pros	Cons
		mm		uneven ground, "real" walking	turning only by differential stepping using the carriages' lateral play; complex control
A, sequence "4 swings, then the body"	8	unstable (–217 mm)	—	—	The CoG leaves the support triangle
Twin-frame: inner frame with 4 legs + outer frame with 4 legs + 1-2 horizontal actuators	9-10	always 4 legs	≈1 m/min	Maximum stability	8 legs (contradicts the brief), the most actuators
B (recommended): 4 legs on a common frame + central plate (like an ESh walking dragline)	6 (5 without rotation)	4 legs or the Ø2 m plate (margin ≥690 mm)	0.92 m/min	1 actuator per leg; simple control (4 synchronous Z axes + X + C); turning in place to any angle; low ground pressures	A central column under the house; in the "on the plate" phase the body tilts with the ground under the plate, so the route must be graded (slope ≤3%)
Klann/Jansen linkage, 1 motor per leg	4	statically unstable with 4 legs (≥6 legs needed)	—	Minimum number of actuators	No levelling, no stability

3.2 Why the original scheme A is weaker

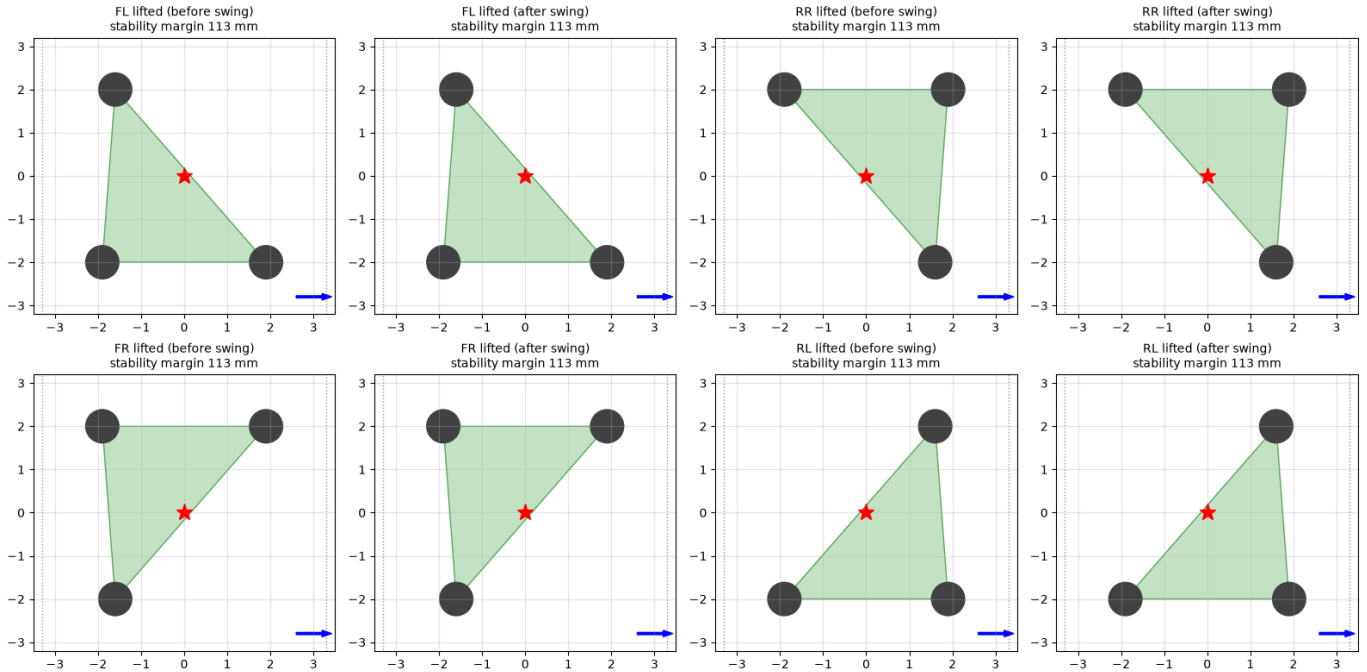
With 4 legs standing in a rectangle, the diagonal passes through the centre. Lift one leg and you get a support triangle whose hypotenuse runs almost through the CoG. A positive margin exists only if the remaining legs are favourably offset along the direction of travel. Brute-forcing all 24 sequences and body shifts (script calc.py) gives:

- "Swing 4 legs, then all 4 stroke actuators move the body at once": margin **–217 mm**, the house tips over when a front leg is swung.
- Best sequence: **body shift S/2 → RR → FR → body shift S/2 → RL → FL** (rear leg, then the front leg on the same side). Margin **113 mm** in all 8 phases. Formula: $\text{margin} \approx (S/4) \cdot 2b / \sqrt{((2a - S/2)^2 + (2b)^2)}$. Notation: S is the step, $2a \times 2b$ is the leg base.
- 113 mm for a 10.5 t house with the CoG at 3 m means the following:
 - a 2° ground slope shifts the CoG by ≈100 mm;
 - two people moving to a wall shift the CoG by ≈40 mm;
 - a 12.5 m/s wind uses up half of the margin.

It can work, but it is "on the edge". The margin can be increased: * by lengthening the step (800 mm gives a ≈150 mm margin); * by tilting the body with the lift actuators by 1.5–2° towards the support triangle, which adds another ≈80–100 mm. But this is noticeable inside the house. * The maximum reaction of one leg on three supports is $\approx W/2 = 52\text{--}57\text{ kN}$, so the lift actuator must be rated for 80 kN.

Leg designations: FL – front left, FR – front right, RL – rear left, RR – rear right.

Scheme A: support triangles for the optimal sequence FL → RR → FR → RL with body shifts of 0/300/0/300 mm before the swings
(★ - CoG projection, blue arrow - direction of travel; with "4 swings, then the body" the margin = -217 mm)

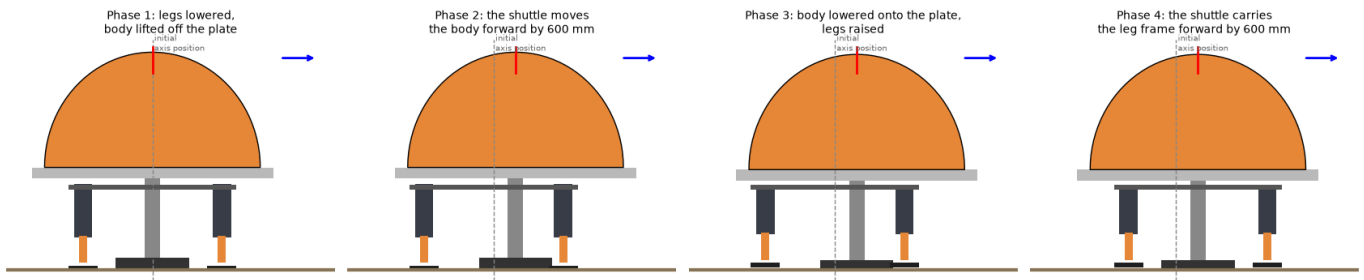


3.3 Scheme B: how it walks

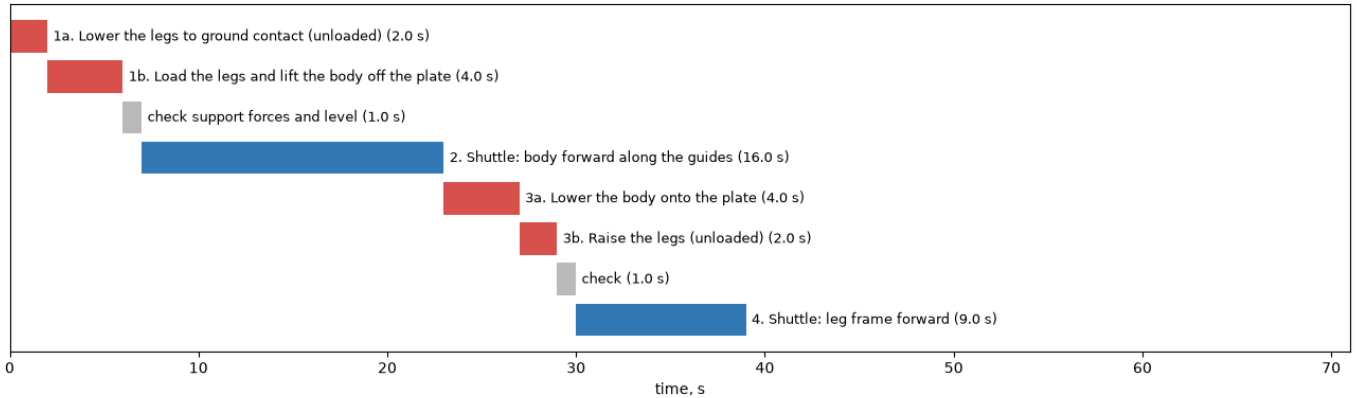
The body (dome + platform + column with plate) and the leg frame are connected by two linear guides along the X axis, at $Y = \pm 2.0$ m. The carriages sit directly above the legs, so the vertical load follows a straight path. The shuttle actuator (1 pc.) moves the leg frame relative to the body by ± 300 mm.

Phase	What happens	Support	Time, s
1a	The legs are lowered to ground contact, unloaded, 80 mm at 40 mm/s	plate	2.0
1b	The legs are loaded and lift the body: the plate rises 60 mm at 15 mm/s. Levelling by inclinometer	4 legs	4.0
—	Check of the forces in the 4 supports and of the level	4 legs	1.0
2	The shuttle moves the body forward by 600 mm at 40 mm/s	4 legs	16.0
3a	The body is lowered onto the plate, 60 mm at 15 mm/s	4 legs → plate	4.0
3b	The legs are raised by 80 mm at 40 mm/s	plate	2.0
—	Check: force on the plate $\approx W$	plate	1.0
4	The shuttle carries the leg frame forward by 600 mm at 75 mm/s	plate	9.0
	Total per 600 mm step		39 s → 0.92 m/min

Scheme B (recommended): 600 mm step cycle ≈ 39 s $\rightarrow 0.92$ m/min. Always supported on 4 legs OR on the $\varnothing 2.0$ m plate

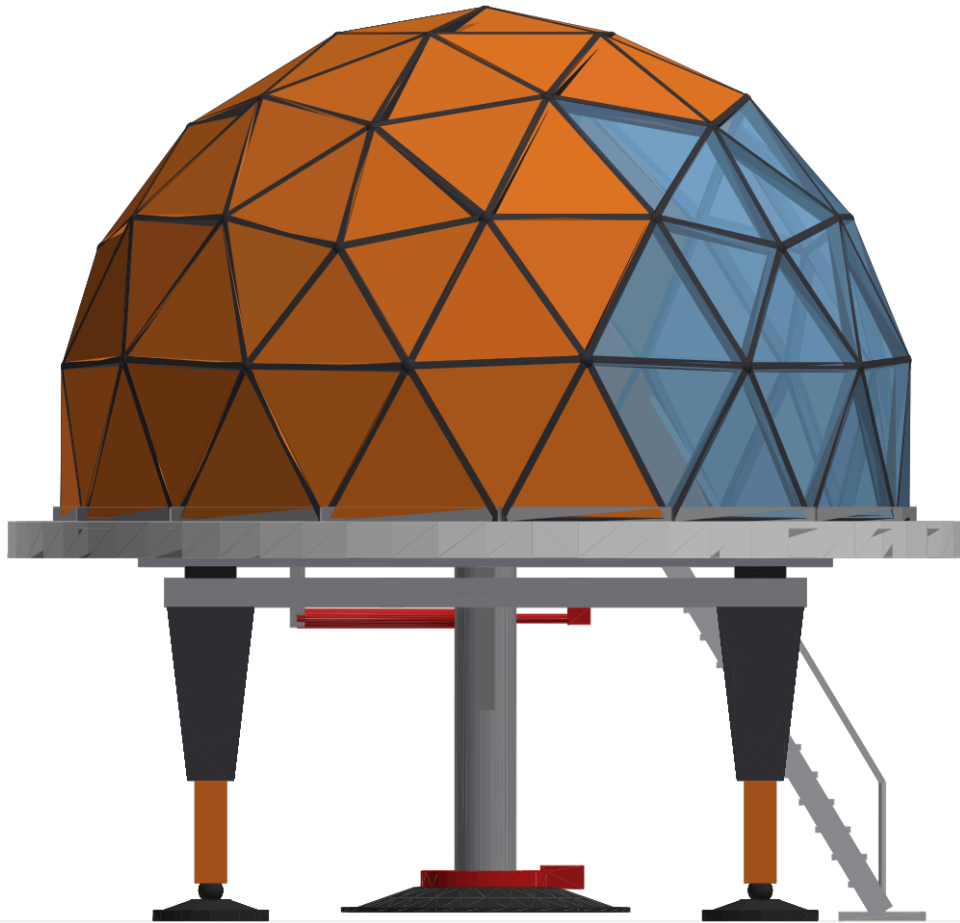


Scheme B step timing chart: red - 4 lift actuators (synchronous), blue - shuttle drive. Total 39 s per 600 mm = 0.92 m/min



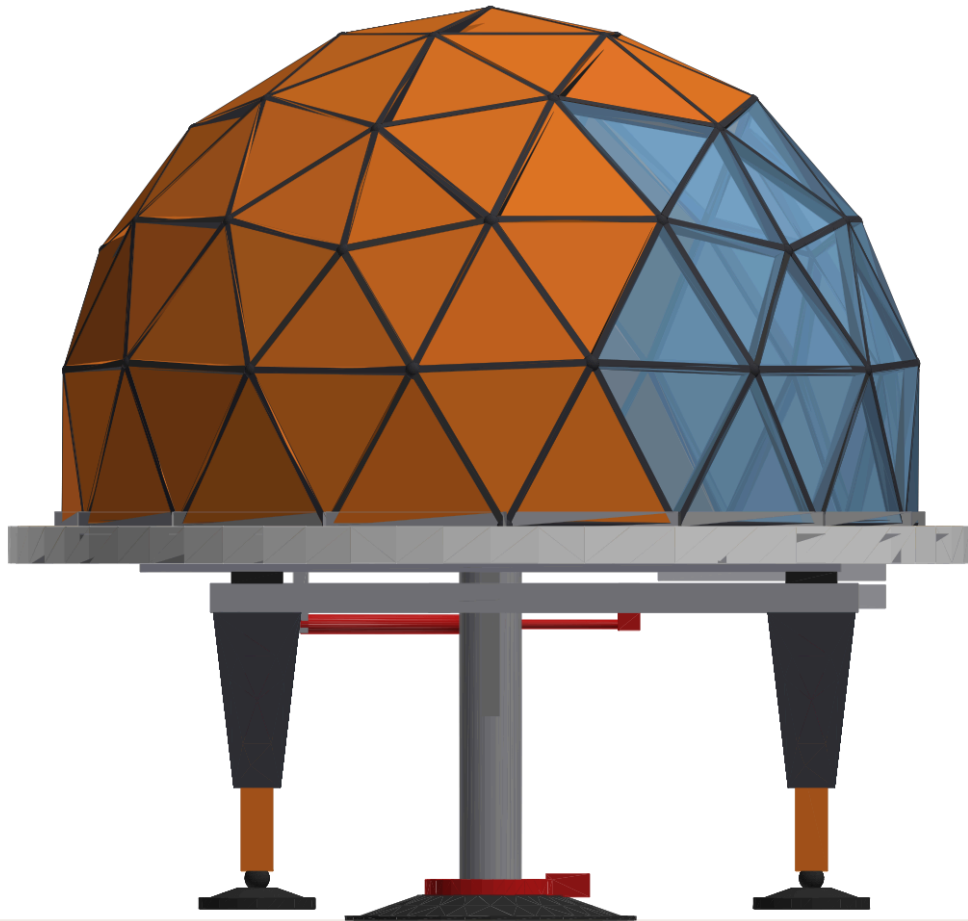
- **Turning.** In the "on the plate" phase (legs raised) the slewing-ring drive rotates the body together with the leg frame about the plate axis. Speed $\approx 0.5^\circ/\text{s}$, any angle. The legs sweep a circle of $R \approx 3.4$ m, which must be kept clear.
- **Reversing:** the same cycle in reverse order.
- **Levelling.** On the legs, the 4 lift actuators level the body by inclinometer. Stroke reserve: $300 - 60 - 80 \approx 160$ mm, i.e. ± 80 mm over a 3.8–4 m base, roughly $\pm 1.2^\circ$. On the plate, the body tilts with the ground under the plate, so the route needs a slope of $\leq 3\%$ and preparation: crushed stone or compacted soil, a strip ≈ 4.8 m wide. If the ground is more difficult, increase the stroke to 400–500 mm.
- **Parking:** the house stands on 4 legs **and** on the plate (5 supports), the legs are preloaded to a set force, the screws are held by brakes and mechanical locks. This way the house withstands snow and storms, and the actuators are not permanently loaded.

Scheme B, side view (forward = right): body on the legs, plate raised by 60 mm



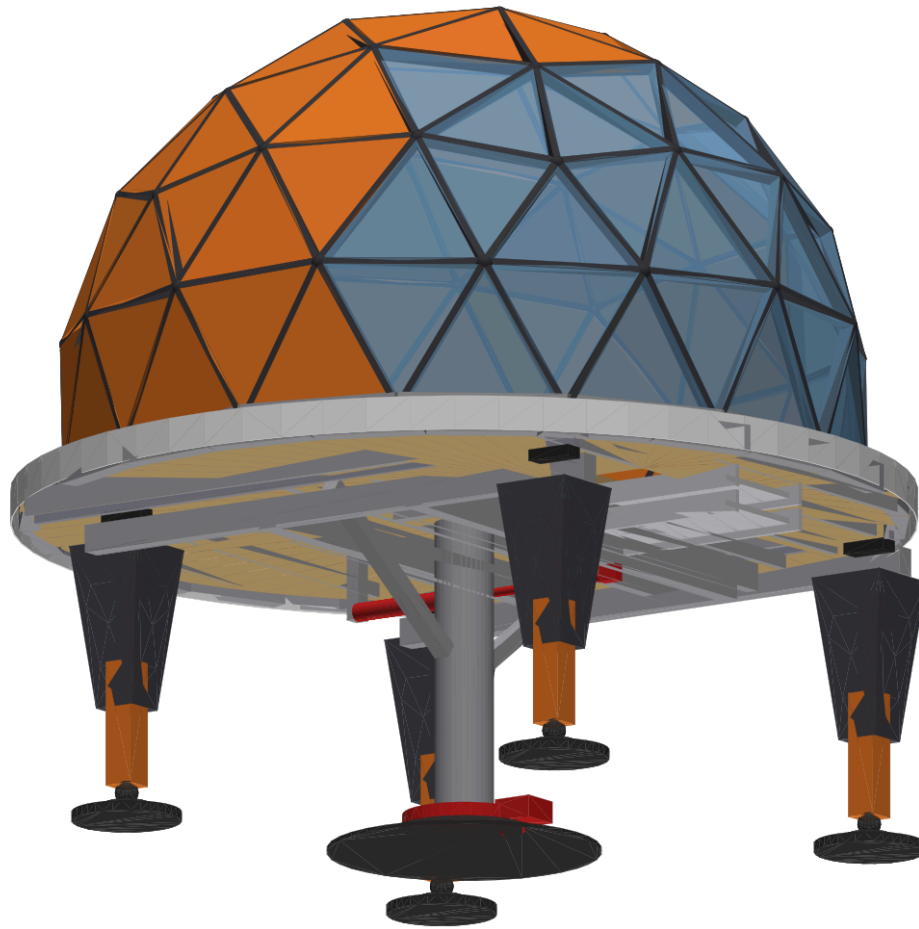
Phases 1-2: the legs carry the body, the shuttle drive moves the body forward by 600 mm

Scheme B, side view: body lowered onto the plate, legs raised by 80 mm and moved 300 mm forward



Phases 3-4: the body stands on the central plate, the leg frame is carried forward (stair folded)

Scheme B, view from below: leg frame, guides, shuttle drive, column, slewing ring and plate



Red - actuators: 4 leg lifts + 1 shuttle + 1 rotation (slewing ring) = 6 in total

4. Support loads, ground and stability

4.1 Scheme B

Case	Formula	Load
Leg, 4 supports, nominal	$W/4$	28.4 kN
Leg, 4 supports, unevenness $k = 1.3$ (force-sensor control)	$1.3 \cdot W/4$	36.9 kN
Leg, control failure: support on 2 diagonal legs	$W/2$	56.8 kN → actuator rating 60 kN
Leg, parked with snow (without the plate)	$1.3 \cdot 165/4$	53.6 kN → actuator static rating ≥100 kN ($k \approx 1.9$)
Plate	W	113.5 kN

Ground pressure, $p = F/A$:

Support	Mode	Pressure
Ø800 foot pad (0.50 m ²)	nominal	73 kPa
Ø800 foot pad	worst case	113 kPa
Ø800 foot pad	snow	107 kPa

Support	Mode	Pressure
Ø2.0 plate (3.14 m²)	—	36 kPa

Bearing capacity guide values: compacted crushed stone or sand 150–250 kPa, loam 100–150 kPa, weak wet soil 50 kPa. On weak ground, removable 1×1 m "skis" or road slabs along the route are needed.

Stability. Wind force $F = q \cdot C_f \cdot A$, overturning moment $M = F \cdot 2.95 \text{ m}$:

Wind	q	F	M
10 m/s	61 Pa	1.3 kN	3.7 kN·m
15 m/s	138 Pa	2.9 kN	8.4 kN·m
30 m/s (parked)	551 Pa	11.4 kN	33.6 kN·m

- Parked on 4 legs: restoring moment = dead weight × min(a, b) = 110 × 1.9 ≈210 kN·m. At 30 m/s the safety factor is **K = 6.2**. Suction on the dome is not included: for a storm-prone area, anchors (screw piles) under the foot pads are recommended.
- "On the plate" phase: restoring moment = $W \cdot (R_{\text{plate}} - e)$, where $e = 0.17 + 2.7 \cdot \tan 3^\circ \approx 0.31 \text{ m}$ (CoG offset plus a 3° slope). This gives ≈78 kN·m. At 15 m/s, **K = 9.3**.
- "On the legs" phase: 3.8×4.0 m support rectangle, margin ≥1.8 m.
- **Walking limit:** wind up to 12 m/s, gusts up to 15 m/s (by anemometer, with an interlock). Scheme A has K = 3.1 at 10 m/s, with a limit of about 12.5 m/s.
- Inertia: accelerating 0 → 40 mm/s in 0.5 s gives $a = 0.08 \text{ m/s}^2$ and $F = 0.9 \text{ kN}$. This is negligible compared with wind.

4.2 Structural notes (conceptual)

- **Main floor beams 200×100×6** with a 3.8 m span between the carriages: $\sigma \approx M/W \approx 26.7 \text{ kN·m} / 179 \text{ cm}^3 \approx 150 \text{ MPa}$. I recommend **250×150×8** or a truss 300–400 mm deep.
- **"On the plate" phase: the whole body hangs on the column.** A "capital" with braces is needed. The model shows 2 braces in the YZ plane. The leg frame travels in the XZ plane, so braces there must run above the leg frame, or a stiff 1.2×1.2 m hub is needed.
- Ø2.0 m plate: 12 mm plate with radial ribs, with a rubber or polymer anti-slip "shoe" underneath.
- Slewing ring: four-point contact ball type (as on loader cranes), raceway diameter ≈0.8–0.9 m, tilting moment ≥66 kN·m (1.5 × 43.8). Drive: a gearmotor with a pinion on the gear ring.

5. Actuators: forces, strokes, speeds, power

Actuator	Qty	Force (nom. / max.)	Stroke	Speed	Power
Leg lift (B)	4	37 / 60 kN, static 100 kN	300 mm	15 mm/s under load, 40 mm/s unloaded	0.74 kW useful → 2–3 kW servo with brake
Shuttle (B)	1	8 / 15 kN	600 mm	40–75 mm/s	0.43 kW → 1–1.5 kW
Slewing-ring rotation (B)	1	≈0.6 kN·m (friction) + wind reserve → 3–5 kN·m drive	360°	≈0.5°/s	0.5–0.75 kW

Actuator	Qty	Force (nom. / max.)	Stroke	Speed	Power
Leg lift (A)	4	52 / 80 kN	300 mm	as B	3 kW servo
Step drive (A)	4	8 / 10 kN	600 mm	100 mm/s	1 kW

How the figures were obtained: * Shuttle: $F = W \cdot (\mu_{\text{guides}} + i) + F_{\text{wind}} = 113.5 \cdot (0.01 + 0.05) + 1.3 \approx 8 \text{ kN}$. Here $i = 5\%$ is a conservative slope. * Lift, ball screw with a 10 mm lead: $M_{\text{screw}} = F \cdot P / (2\pi \cdot \eta) = 60\,000 \cdot 0.010 / (2\pi \cdot 0.9) \approx 106 \text{ N}\cdot\text{m}$. Through an $i = 5$ gearbox the motor sees $\approx 22 \text{ N}\cdot\text{m}$ peak and $\approx 14 \text{ N}\cdot\text{m}$ nominal, 1200 rpm. * Ball screw life with $C_a \approx 100 \text{ kN}$: $L_{10} = (C_a / F_m)^3 \cdot 10^6$ rev. At $F_m = 37 \text{ kN}$ this is $\approx 20 \cdot 10^6$ rev, i.e. on the order of 1000 km of travel. A huge margin. * Energy per 600 mm step: $(W \cdot 0.06 \text{ m} + F_{\text{shuttle}} \cdot 0.6 \text{ m}) / 0.6 \approx 19 \text{ kJ}$, i.e. **$\approx 0.9 \text{ kWh per 100 m}$** .

Screw type. * **Planetary roller screw.** The best fit for lifting. Static load capacity 2–3 times that of a ball screw of the same diameter, handles shock and long-term static load well (no brinelling of the raceways). Guide: $\varnothing 36\text{--}48 \times 5\text{--}10$, $C_a \approx 130\text{--}200 \text{ kN}$. This is the class of Exlar FTX, Tolomatic RSX, Ewellix (SKF) SRSA electric cylinders and equivalents; check the specific model against the catalogue. Downside: 2–3 times the price of a ball screw. * **Ball screw.** $\varnothing 50\text{--}63 \times 10$, $C_a \approx 80\text{--}110 \text{ kN}$ (check against the catalogue). Cheaper, but must be unloaded when parked: brake, lock and support on the plate. * **Budget, "workshop" option: a 10 t screw jack** (worm gearbox + screw) from a lifting-equipment catalogue, e.g. ZIMM Z, Pfaff-silberblau SHE or Chinese 10 t series. Options: * *trapezoidal screw*, **self-locking**: parking without a brake, no brinelling issues. Efficiency $\approx 25\text{--}30\%$, so a $\approx 2.2\text{--}3 \text{ kW}$ motor per leg. Speed 1–2.5 m/min suits our 15–40 mm/s; * *ball screw* in the same housing: efficiency $\approx 70\%$, a brake is required.

For a workshop with CNC and welding this is the simplest: the jack is built into the welded leg, the telescope takes the bending, and the jack carries axial force only.

Lift recommendation (B): a 10 t ball-screw jack or a 60–100 kN planetary roller screw electric cylinder. In both cases: motor with brake, absolute encoder, load cell in the foot pad, mechanical lock when parked. **Shuttle:** ball screw $\varnothing 32\text{--}40 \times 20$ or rack and pinion, 15–20 kN.

6. Electromechanical or hydraulic

Criterion	Electromechanical (servo + screw)	Hydraulic
Lift cylinder	see section 5	$\varnothing 80/45$: 80 kN at 160 bar, working pressure $\approx 73 \text{ bar}$
Pump / power	4x2...3 kW servos	18 L/min under load, 33 L/min when raising the legs; pump $\approx 4 \text{ kW}$ + accumulator
Noise in a dwelling	quiet	the power unit is noisy, sound insulation needed
Synchronising 4 legs, positioning	precise, "like CNC", with electronic gearing	proportional valves, position sensors in the cylinders and leakage compensation are needed
Load holding	brake + lock (a trapezoidal jack is self-locking)	load-holding and counterbalance valves; creep over time
Frost $-30 \text{ }^\circ\text{C}$	no problem	winter oil, tank heating
Environment / fire	no oil	oil leaks under a dwelling, high-pressure hoses

Criterion	Electromechanical (servo + screw)	Hydraulic
Shock loads, overload	needs a C_0 reserve (planetary roller screw)	good, there is a relief valve
Cost	actuators are more expensive	cylinders are cheap, but a hydraulic circuit for 5 axes is no cheaper
Maintenance	minimal	filters, oil, hoses

Recommendation: electromechanical. The loads are moderate (≤ 60 kN per leg), the speeds are low, quiet operation, precise synchronisation of 4 axes and long-term holding when parked are needed, and it will have to work through a Russian winter. Hydraulics make sense only if the house grows to 20+ t or shock overload becomes a problem. A compromise is **electro-hydrostatic actuators (EHA)**: a dedicated pump on each leg, without shared lines.

7. Control and safety

- **Controller.** Any of these will do:
 - a PLC with motion functions (CODESYS + EtherCAT servo drives);
 - **LinuxCNC** with Mesa boards: axes Z1-Z4 (legs), X (shuttle), C (rotation). The step cycle is written as G-code or as a HAL state machine.
- **Sensors:**
 - a 10 t load cell in each foot pad (or a strain-gauge bridge on the telescope) and a contact switch; a force and contact sensor on the plate;
 - a 2-axis inclinometer on the floor frame (0.05° accuracy), tilt limit $1.5^\circ \rightarrow$ stop;
 - absolute encoders, limit switches and "hard stops" on all axes;
 - an anemometer (walking interlock above 12 m/s);
 - a "stair folded" sensor and a door-closed sensor;
 - lidar or ultrasonic obstacle sensors around the perimeter and in the leg swing zone.
- **Leg control:** hybrid position/force. After contact, each leg is loaded to $W/4 \pm 10\%$, then the 4 axes move synchronously with force equalisation. For scheme A this is mandatory: if a force sensor fails, the house ends up on 2 diagonal legs.
- **State machine** with checks before each phase:
 - sum of support forces $\approx W$;
 - tilt within tolerance;
 - CoG (from the force distribution) inside the support polygon with a margin;
 - wind within limits.
- **Manual control:** a radio remote with a dead-man button (as in the photo), emergency stops inside and outside.
- **On power loss** all brakes close and the house stays in its current phase. Both phases are stable.
- **Power supply:** a 380 V cable on a reel (7–10 kVA) or a LiFePO4 battery of ≈ 10 kWh + inverters. Walking takes little energy, 0.9 kWh per 100 m.
- **Utilities:** water, sewage and electricity via flexible quick-disconnect connections, or an off-grid house (tanks, septic tank). Disconnect them before walking.

8. FreeCAD model

The files are in `cad/`.

The walking_castle.py script is a parametric model: * run: `freecadcmd walking_castle.py [KEY=VALUE ...]`, or in FreeCAD via "Macro → Execute"; * parameters are set at the top of the file, in `params.json` next to the script, or on the command line. A copy of the parameters is written to the "Parameters" spreadsheet inside the `.FCStd`; * main parameters: `DOME_D`, `DOME_FREQ` (2/3/4), `DOME_CUT`, `WALL`, `FLOOR_D`, `LEG_X`, `LEG_Y`, `STRIDE`, `LIFT_STROKE`, `FOOT_D`, `PAD_D`, `SCHEME` (A/B), `POSE` (stand / pad / leg_swing), `STAIR_FOLDED`.

Model contents. Objects are grouped and named in Russian; each has a `Massa_kg` property: * dome: 100×50 struts, spherical hubs, 100 mm sandwich panels, glazing units, base ring; * platform: ring, main beams, joists, floor with hatch, edge cladding; * running gear: guides, carriages, leg frame, 4 legs (casing post, 220×220 telescope, lift actuator, Ø800 foot pad on a ball joint), shuttle actuator (A: 4 step drives); * central support: column, braces, slewing ring with drive, plate; * folding stair (deployed or folded).

Output files: * `walking_castle_<scheme>_<pose>.FCStd` / `.step`; * `mass_*.json`: mass and CoG; * `mesh_*/*.stl`: for rendering.

Renders are produced by `render_mpl.py`: matplotlib from the STL meshes. FreeCAD's GUI renderer gave blank frames on a headless server.

The model is conceptual. Welded joints, chamfers, fasteners, panel seals and joint preparation are not modelled. Bodies intersect at the joints. For detailed design documentation it must be rebuilt in PartDesign/Assembly based on these parameters.

9. Open questions for you

1. **Purpose and scenario.** How often and how far should it walk? Is it an attraction with a "show step" in place, or relocation around a plot? What ground and route slope?
 2. Do you accept the **central column with a plate** (scheme B)? Or is "pure" 4-legged walking essential (scheme A: 8 actuators, half the speed, stability margin ~0.1 m)?
 3. Dimensions: are the Ø6 m dome and a 2.1–2.4 m clearance (a car under the house, as in the photo) suitable? Can the house be lowered to bring the CoG down?
 4. Are people inside while it walks? What tilt is acceptable (I suggest $\leq 1^\circ$)?
 5. Climate: snow region, minimum temperature. This affects the glazing, thermal design and the choice of hydraulics.
 6. Actuator budget: planetary roller screw electric cylinders (expensive, premium) or 10 t screw jacks (cheap, DIY)?
 7. Power: a 380 V cable or off-grid on batteries?
 8. Dome frame: steel, as in the brief, or timber/aluminium to save 1.5–2 t?
 9. Turning: is turning in place needed (slewing ring), or is walking in a straight line enough (then 5 actuators)?
 10. Legal status: a non-permanent structure, a mobile building or a vehicle. This determines the requirements for calculations and approvals.
 11. Utilities: off-grid house or connection via flexible lines?
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10. Caveats

- All estimates are conceptual: simplified schemes, conservative coefficients, no FEM and no dynamics.

- Catalogue actuator models are given as a guide to the class; they must be checked against current catalogues.
- Loads per SP 20.13330 (snow, wind) are taken in simplified form. A specific site requires a code-compliant calculation and a ground survey.
- In scheme B the main risk is the quality of the route under the plate. In scheme A it is the small stability margin on three legs.