The Work of the UK Joint Board of Moderators. Reflections on the UK Accreditation Process, Educational Standards and the skills needed by Industry.

Dr John M Roberts - Chairman JBM
(Executive Director of Operations
Jacobs Engineering UK Limited
Manchester)

- An Overview of the work of the JBM
- Some (personal) comments on civil engineering degree courses in the UK
- My personal experience as an engineer outside academia

JBM

An overview

Dr John Roberts

JBM Chairman

The Institution of Structural Engineers

ice
Institution of Civil Engineers

IHE
INSTITUTE OF HIGHWAY ENGINEERS

THE CHARTERED INSTITUTION OF HIGHWAYS & TRANSPORTATION

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The JBM:

- Founded in 1977, now in 34th year of operation
- Set up by:- Institution of Civil Engineers and Institution of Structural Engineers
- CIBSE a member for a time (Building Services Engineering)
- More recently: CIHT and IHE have joined ICE and IStructE on the JBM.
- Other institutions from the ‘civil engineering’ sector may apply to become members of JBM.

Composition of the JBM:

- All appointments are made by the Institutions, normally for a 3 year term.
- 20 members of the Board: 10 from industry and10 academic members.
- Chairman serves 3 years and alternates between industry / academic engineer
- 30 strong panel of visiting moderators - visiting teams comprise 2 academics and 2 from industry, plus 1 secretary.

The main activities of the JBM:

- To formulate and publish guidelines agreed upon by the Institutions for the design of Civil Engineering courses for Bachelors and Masters degrees (www.jbm.org.uk).
- To undertake accreditation of the educational base both for Institution membership and the UK's "Chartered Engineer" and "Incorporated Engineer" qualifications.
- To publish on the Web a database of accredited degree courses.

The main activities of the JBM (continued) :

- The JBM accredits degrees at about 60 civil engineering departments on a 5-year cycle.

- The JBM looks for good practice during its visits

- The JBM then promotes this best practice to other departments through its Annual Report and on the web.

The JBM guidelines:

- The broad JBM definition of Civil Engineering requires significant core content. At least one third of the total curriculum should be spent on core subjects
- The required **List A** core subjects are:
  - **Materials**
  - **Structures**
  - **Geotechnics**
- A minimum of two core subjects to be chosen from **List B** :
  - Fluid Mechanics (Hydraulics)
  - Surveying (Geomatics and Measurement)
  - Transport Infrastructure Engineering
  - Public Health Engineering
  - Construction Management
  - Environmental Engineering
  - Architectural Technology

The JBM guidelines (continued):

- If fluid mechanics and surveying are not included within core subjects, the JBM would expect the fundamentals still to be covered.
- If specialist optional core subjects other than those in list B are covered their inclusion must be justified and Departments must demonstrate that there is a balance of core subjects which will provide the foundation for a career in the construction and environment sectors.

- the JBM defines three ‘**Threads**’ should be evident throughout courses:
  - Design
  - Sustainability
  - Health and Safety Risk Management
- Industrial placements
- Professionalism
- Industrial Liaison Committees
- Site Visits

Assessment of Courses

- Assessment for accreditation is based on **OUTPUT** standards.
- The JBM visiting teams review departments on the basis of Output standards evident in the coursework, project reports, examination scripts etc.
- But the JBM continues to review INPUT standards to be assured that Output standards can be achieved in departments.
- Problems arise from the declining standards in secondary education, particularly a weakness in Maths and English.
  - JBM visiting teams check that remedial courses are available in Maths where the INPUT standards are low.

The Institutions and the JBM:

- The research-driven staff appointment process in universities has led to fewer staff with industrial experience, or having an appreciation of the profession.
- Closer links between departments and the institutions are encouraged, to help both staff and students understand the professional life of a Civil and Structural Engineer.
- Strengthened links between departments and industry and the Institutions may assist.
- Industry needs to recognise the importance of the contribution that can be made within departments, helping to shape its future Civil Engineers.

<u>Further learning</u> for future Chartered Engineers:

- **MEng** degrees are seen as the 'gold standard'. **MEng** degrees are accredited as a <u>complete educational base</u> for future Chartered Engineers.
- Graduates with **BEng** degrees who to become wish to become Chartered Engineers must:-
  - Acquire a JBM accredited **MSc**, <u>or</u>
  - Undertake <u>Employer Managed Work Based Further Education</u> to Masters level, <u>or</u>
  - Submit a <u>Technical Report</u> which must demonstrate, amongst other things, equivalence to education to Masters level.
- There are also Bachelors degrees at IEng level (which the JBM prefers Universities to call **BSc** rather than BEng)

Further learning for future Chartered Engineers
(continued):

Having obtained an **MEng** degree or a **BEng** degree with Further Learning a graduate engineer has – finally – to complete his or her Initial Professional Development (**IPD**) before applying to become a Chartered Engineer with one of the professional engineering institutions.

This will typically take a further 4 or more years following on from an award of an **MEng** degree (although no minimum time period is actually stated)

A brief international perspective:

- The JBM works with civil engineering departments overseas, applying the JBM Guidelines, carrying out exactly the same accreditation visits
- Last week, for instance, a visiting team was at UWI in Port of Spain, Trinidad
- The JBM welcomes and assists with the formation of national accreditation bodies for civil engineering degrees
- Several UK universities now have an offshore campus, teaching and awarding civil engineering degrees outside the UK. This is a new role for the JBM but exactly the same standards are adopted.

In summary - the aims of the JBM:

- At a fundamental level – JBM provides an assurance of standards.
- Seeks to improve a civil engineering department's performance, where necessary.
- Helps to create a challenging student experience.
- Helps to identify and share best practice.

In summary - the aims of the JBM (continued):

- To strengthen Civil Engineering as a subject within Universities
- To encourage participation with industry.
- To encourage Institution membership amongst department staff.
- To continue to be recognised as the "pre-eminent brand" for accreditation of university Civil Engineering departments.

JBM briefing July 2011

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JOHN ROBERTS

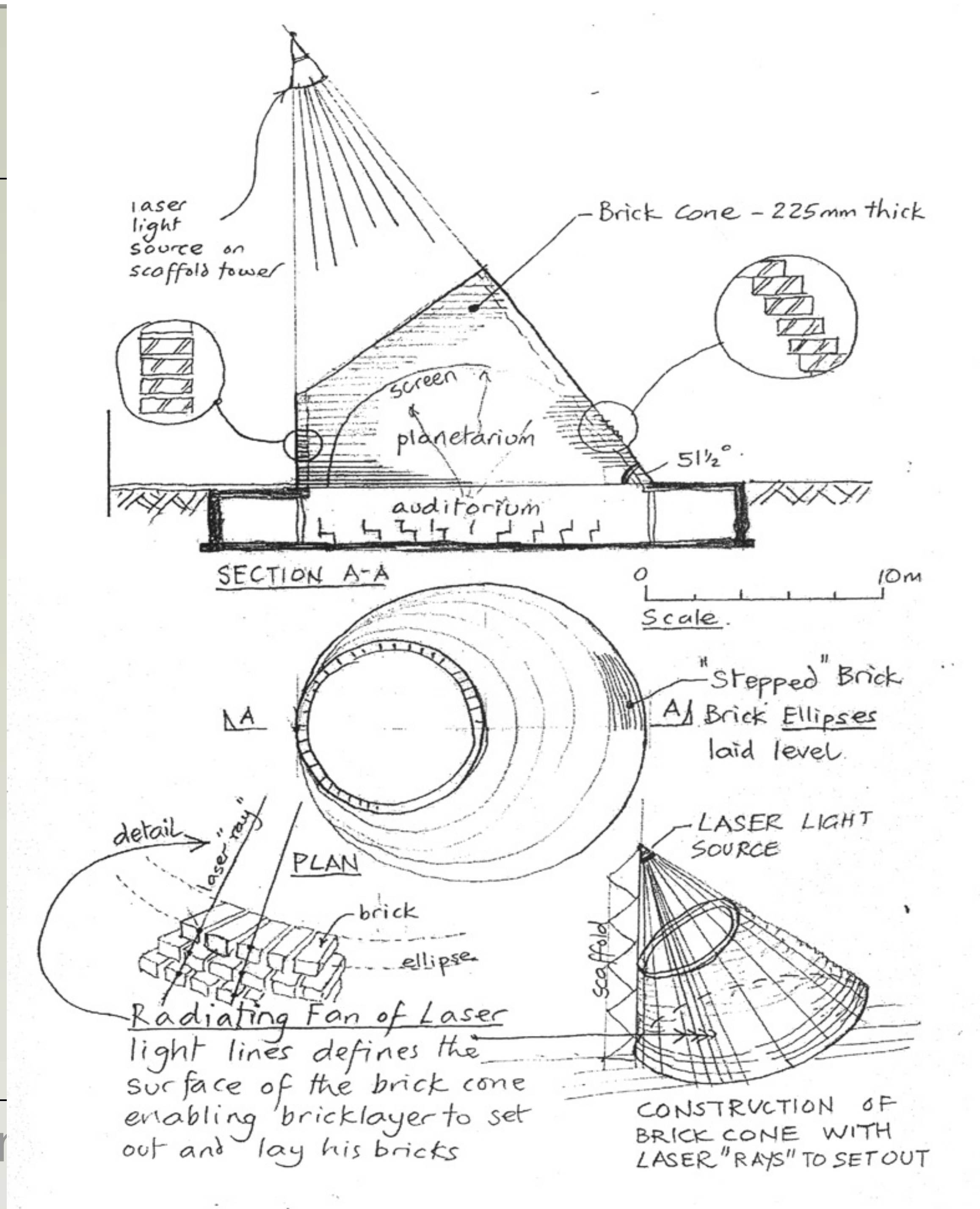
- Personal Comments on civil engineering courses in the UK
- I attended University of Sheffield for a BEng (1966 to 1969) and stayed to do a PhD (1969 to 1972)
- Since then I have worked briefly as a site engineer for McAlpines then spent the whole of my career as a Consulting Engineer

- I have taught (a little) at the University of Manchester, where I am a Visiting Professor.

- I am very aware of how difficult it is to teach structures (my own design specialisation) in a world where students expect immediate access to full computer solutions.

- I am particularly keen that physical models are used to show both material and structural shape behaviour. I am also very interested in teachers who encourage the use of hand sketches and simple hand calculations
- When we visit departments and look at exam scripts I am always looking to see if the answers give “engineering sketches” to explain what is happening, rather than just maths

uly 2011



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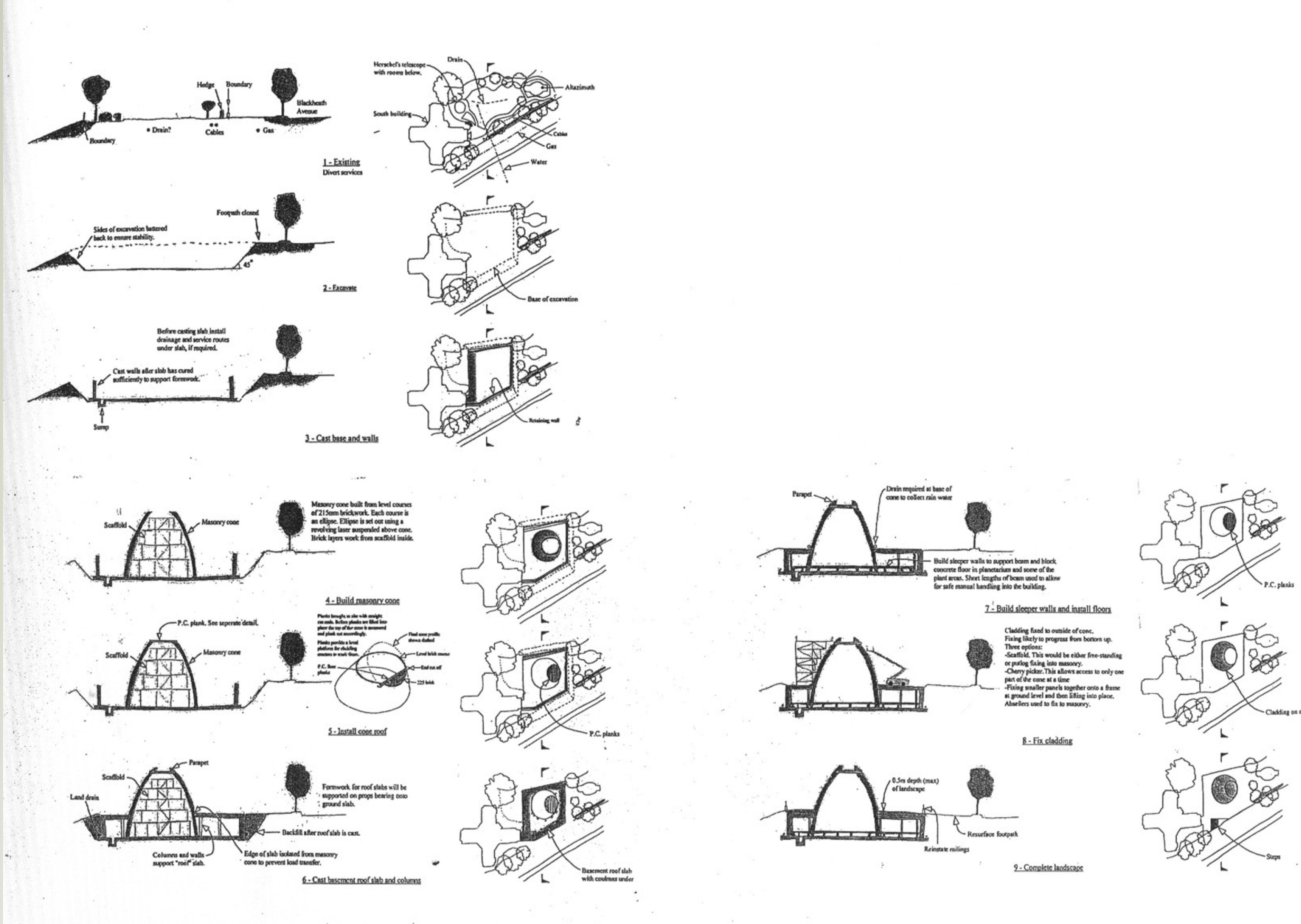

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Date

Skyhouse 250.

Concept design - calcs.

Area / leaf ~ 250 m²

175 solid slab	.175×24	= 4.2	kN/m²
75 floor finish, allow		= 1.5	kN/m²
Ceiling / services, allow		= 0.5	"
Partitions, allow		= 1.5	"
Total 'floor' dead		7.7	kN/m²
Floor imposed		1.5	kN/m²

(4.0 only in core itself, not common corridor).

Using idealized grid, as per sketch :-

~~[illegible]~~ Internal column, 5.0 × 4.0 = 20 m²
External column 5.0 × 4.0 / 2 = 10 m²

Internal column: Ultimate loads
1.6 × 7.7 × 20 = 246 kN
1.4 × 1.5 × 20 = 42 kN

Typical 'upper stories' column. (no LL reduction)
32 stories, consider 25th.
7 floors : 7×246 + 7×42 = 2016
8 columns : 8 × 7.1 = ~~[illegible]~~ 57
~~[illegible]~~ kN. 2073

Trial design 219.1 ϕ × 10mm
steel (275) column, 40 fcu concrete
(Nu = ~~[illegible]~~ kN)
2204 kN)

300 ϕ
73 kN/storey.
×1.4 = ~~[illegible]~~ 7.
$\left[\frac{0.3^2}{4}\pi \times 24\right] \times 3m$
= 5.1 kN × 1.4 = 7.1

Date

Typical "middle storeys".
32 stories consider 15th
17 floors (17×246 + 17×42) = 4896
18 self weight cols. 18 × ~~[illegible]~~ 7.1 = ~~[illegible]~~ 128
5024

323.9 ϕ × 16 mm (275 N/mm²)
40 N/mm² fcu concrete
Nu = 5078 ✓

Typical "lower" storeys
32 stories, consider 5th.
27 floors (27×246 + 27×42) = 7776
Self weight cols. 27 × 10 say 270
8046 kN

457 ϕ × 16.0 mm (275 N/mm²)
fcu = 40 N/mm² concrete
Nu = 8101 kN ✓

External columns : 50% above loads +
cladding weight 5.0×3.0×1.5 kN/m² × 1.4
per storey
= 31.5 kN/storey

Upper	2016×0.5	=	1008
	57	=	57
7×31.5	220	=	220
			1285 kN.

219.1 ϕ × 5.0mm (275 N/mm²)
fcu = 40 N/mm² concrete
Nu = 1460 kN ✓

Middle

17 floors	2448
Self weight	128
17 storeys cladding	536
	3112 kN

Date

323.9 ϕ x 8mm (275 N/mm²)
f_{cu} = 40 N/mm² concrete
N_u = 3327 kN ✓

Lower
25 floors ... 3888
25 sw. cols ... 270
25 storeys cladding 851
5009 kN.

457 ϕ x 10mm (275 N/mm²)
f_{cu} = 40 N/mm² concrete
N_u = 6214 kN ✓

Tabular: 32 storeys, Skyhome 250

External	Storey	Internal
457x10mm	5th	457x16 mm
323.9x8mm	15th	323.9x16 mm
219.1x5mm	25th	219.1x10 mm

Wind stability.

Single leaf 8 storey 'cantilever' above supercore.

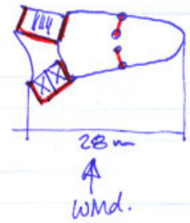
Area (side area) = 23.0x8x3.0
= 552 m²

Force C_f = 0.85 p = 1.05 kN/m²

∴ Total force = 0.85x1.05x552 = 493 kN.
O/T moment = $\left(\frac{8 \times 3.0}{2}\right) \times 493$
= 5916 kNm.

As a conservative option:– Date

Take one 2 'equal' braced/shear walls.



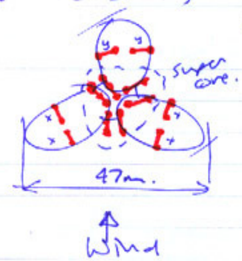
$\frac{28}{23} \times 5916$ = 7207 kNm

Per 'wall' = 3603 kNm

P = $\pm \frac{3603}{3.0}$
= 1201 kN extra ✓

easily OK on the steel/tube concrete filled columns. ✓

For 32 storeys



Take C_f = 0.85 as per 1 leaf
x1.15 for re-entrant angle (KJE advice)
0.9775 say 1.0.

storeys, storey height, width, CF
Wind force = 32x3.0x47x1.05 kN/m² x 1.0
= 4737 kN
O/T moment = $\left(\frac{32 \times 3}{2}\right) \times 4737$
= 227,376 kNm.

Assume supercore takes (say) 90% by stiffness
(10% into 4 no walls, x, x, x, x)

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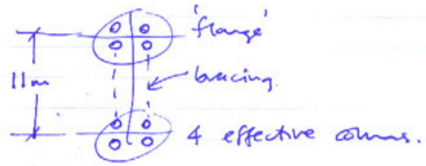
Idealise core as



$4P \times 11$ = BM capacity.

$227{,}376 \times 0.9 = 44P$

(Working) P = 4650 kN per effective colm

If these 'flange' colms are effective also as external colums with ultimate vertical load of 5009 kN.

$5009 \times \frac{1.2}{1.5} + 4650 \times 1.2$ (average – actually closer to 1.6)

= 9587 kN (ultimate, wind + dead + live)

457 φ × 25 mm (275 N/mm²)
f_{cu} = 40 N/mm² concrete fill
N_u = 10,520 kN ✓

So appears to be a feasible design.

To check out : "Bisteel" Corus

- In my opinion whilst “Structures” and “Geotechnics” are usually being taught reasonably well, the same cannot be said for “Materials” which do not seem to be well understood – in a practical sense - by many of the graduate engineers we employ at Jacobs

- Another area where new graduates are lacking in knowledge and appreciation is any sort of historical perspective
- How civil and structural engineering developed with key events in design and construction
- Learning from mistakes !

- New topics that need to be rapidly integrated into courses include:-
- a proper quantitative assessment of "low carbon" design and construction
- An updated and holistic view of sustainable developments and infrastructure

- I will finish my address by showing you for just a few minutes some of "my projects" – so that you can see what use I have made of my civil engineering degree over the last 40 years !
- (My PhD topic was on dynamic loading of steel structures)

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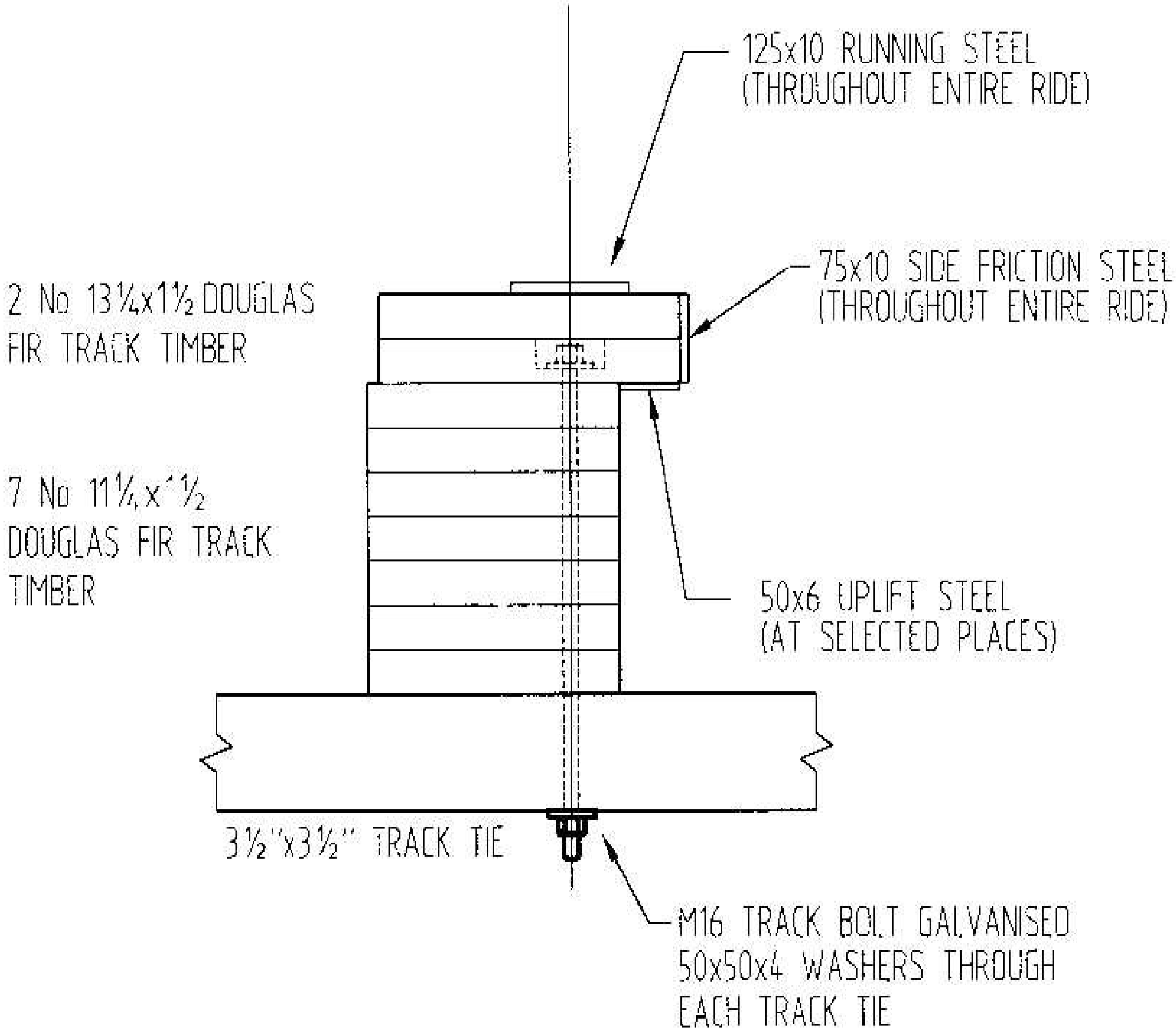

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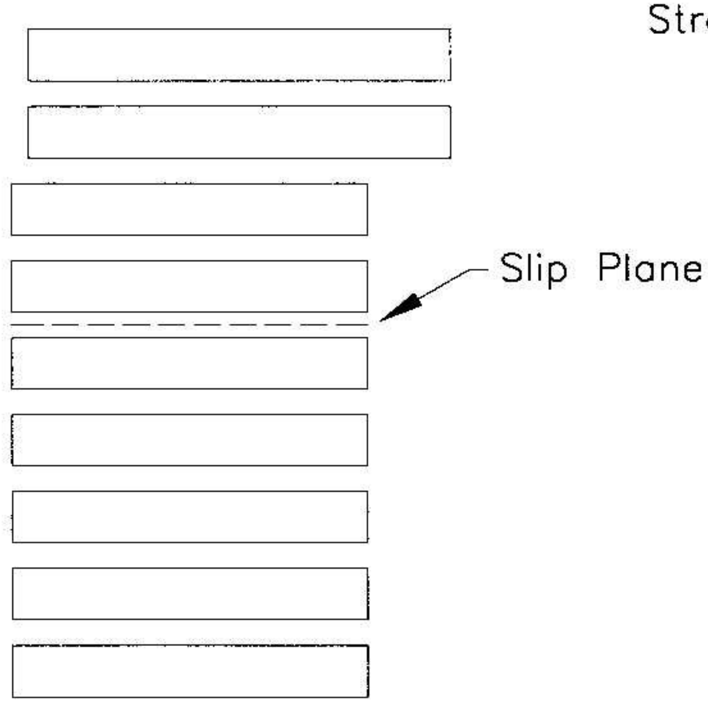
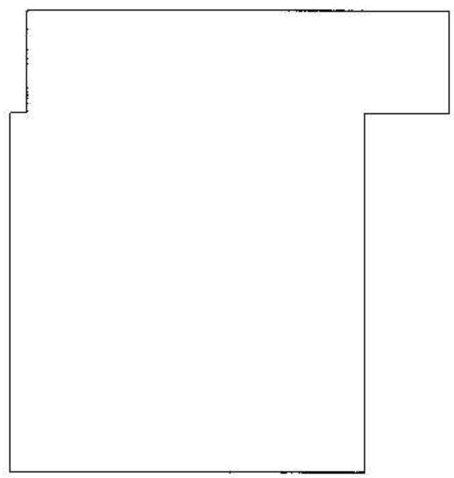
9 No. Individual pieces of timber
Strength = 1; Stiffness = 1



Single homogeneous timber member
Strength = 9; Stiffness = 81



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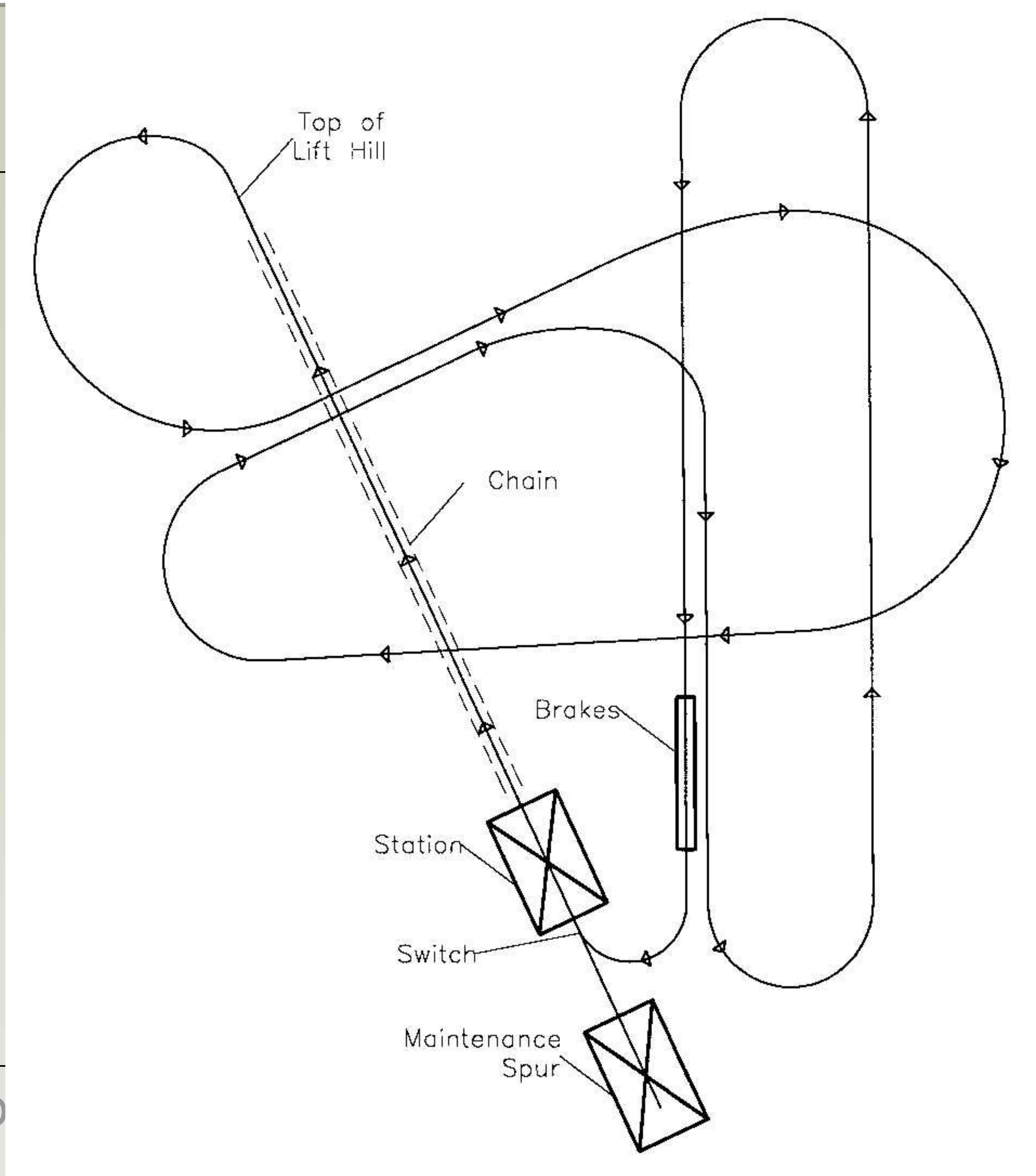

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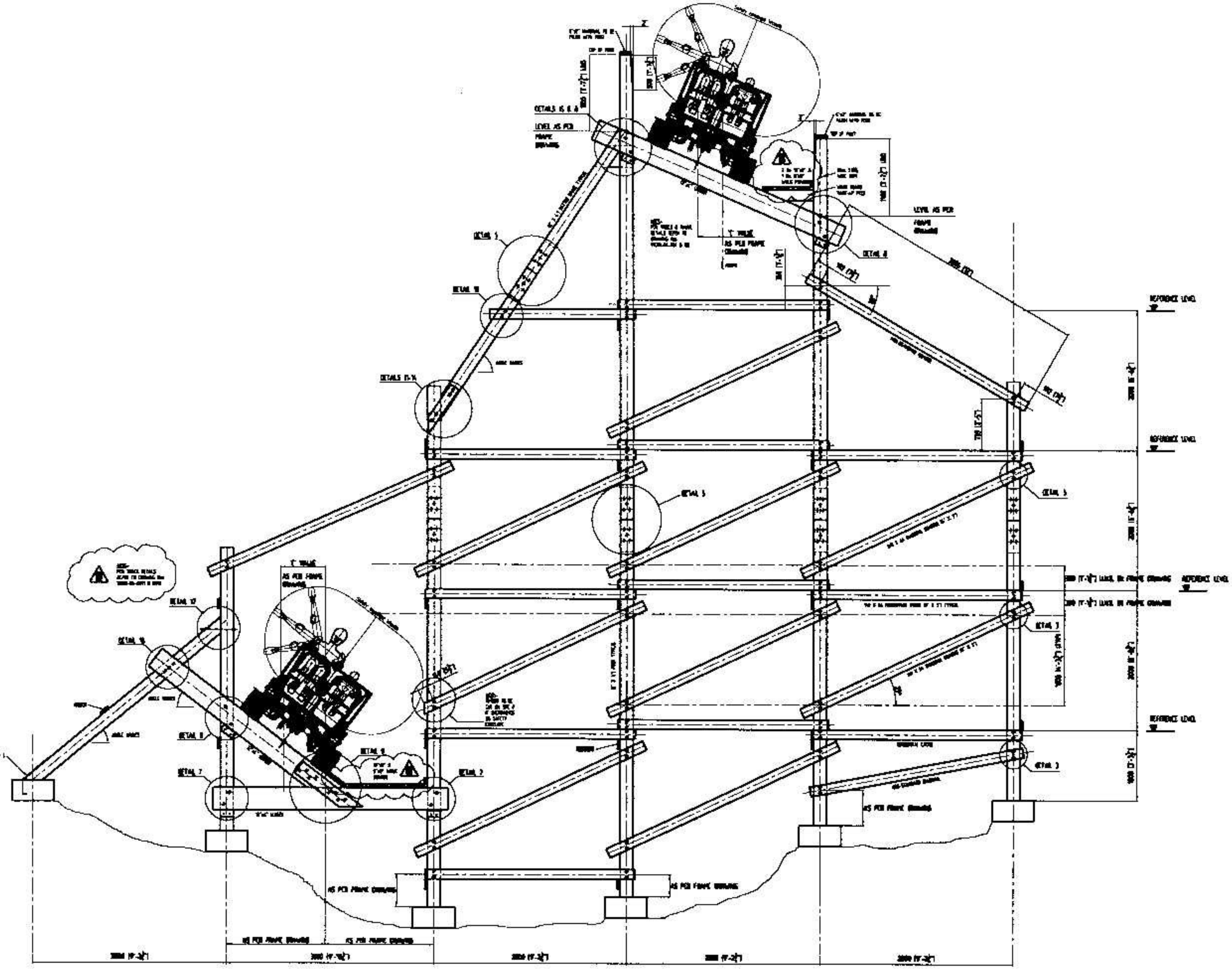

TYPICAL FRAME
LOOKING IN DIRECTION OF TRAVEL

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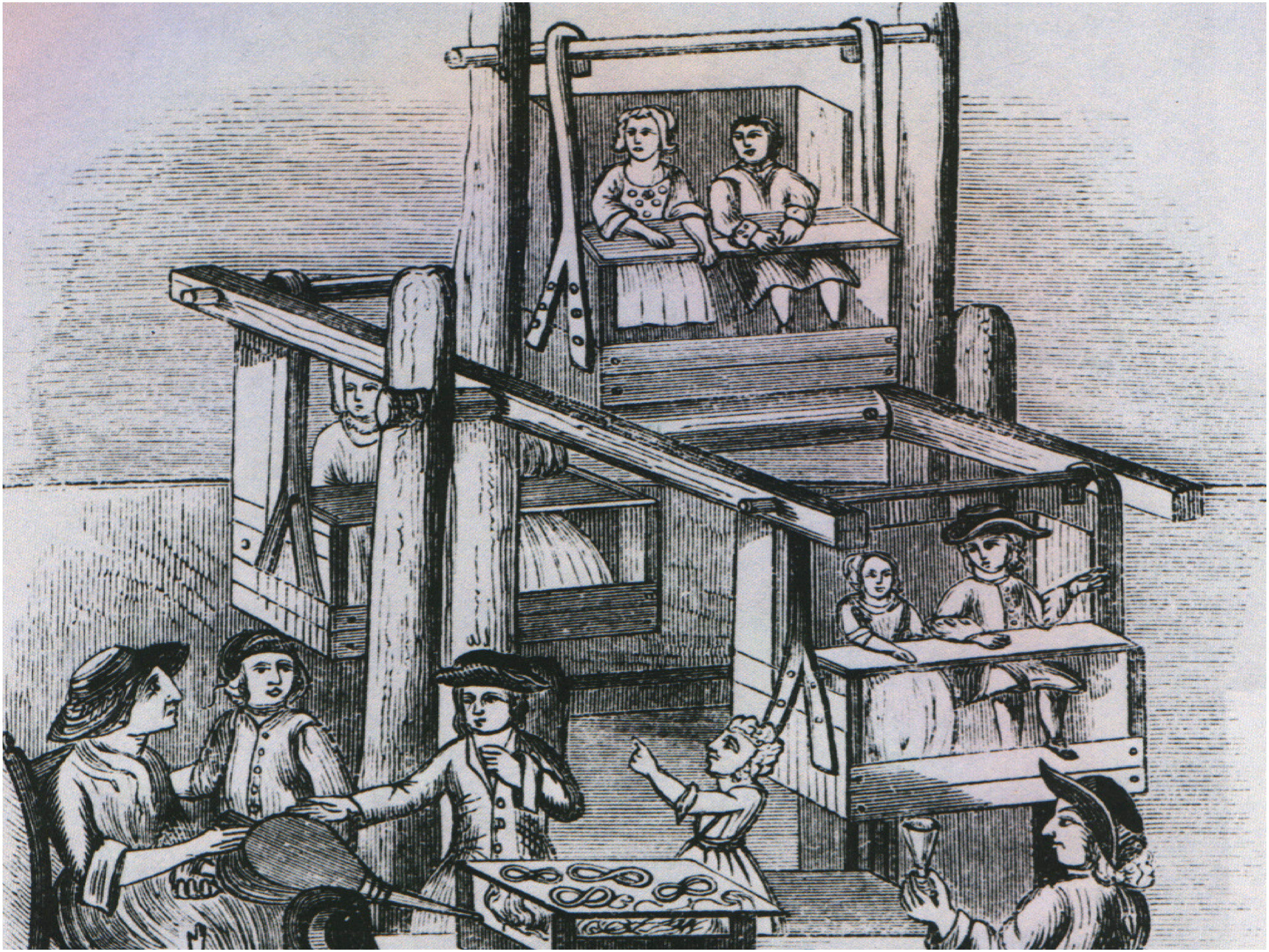

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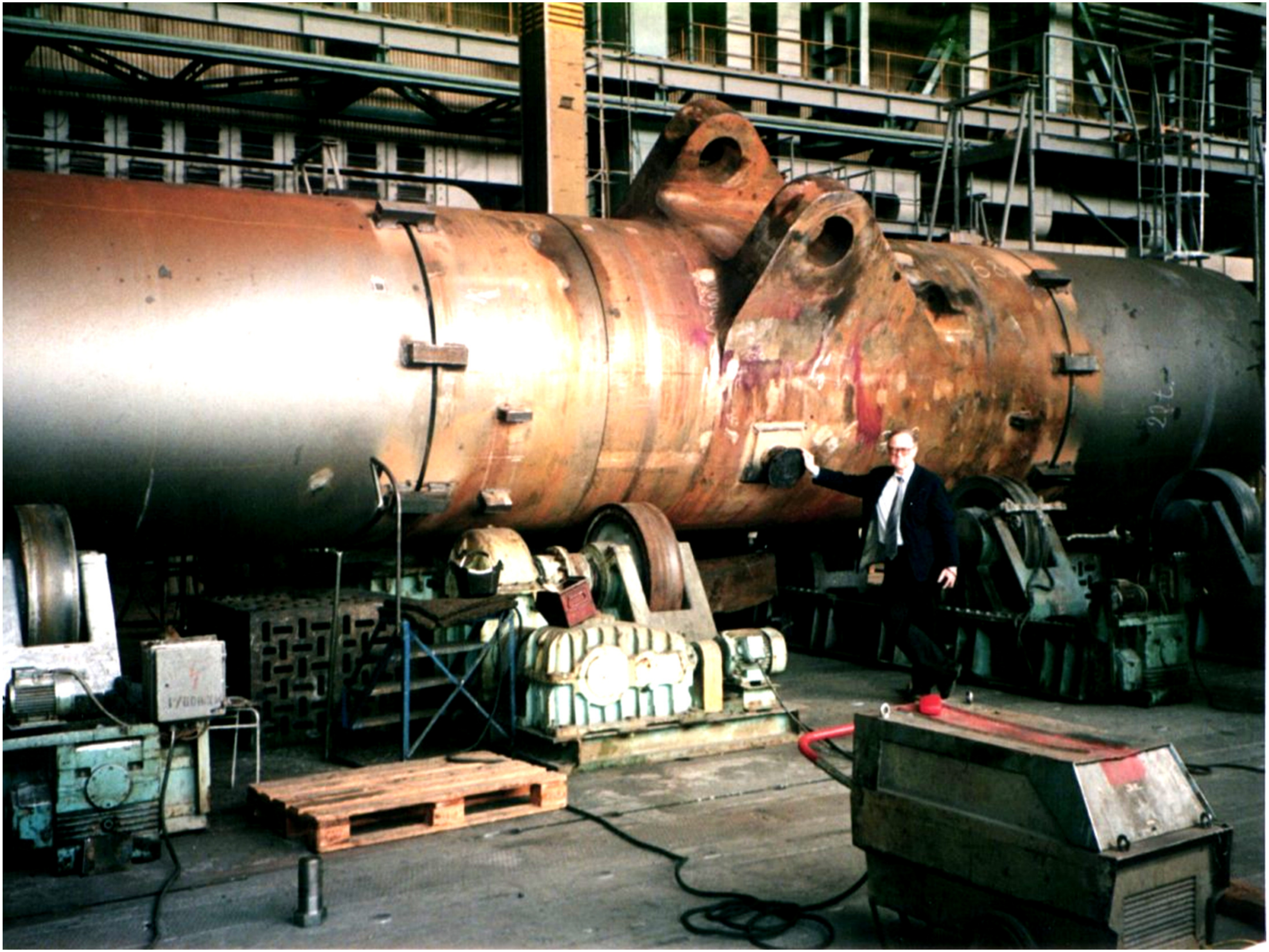

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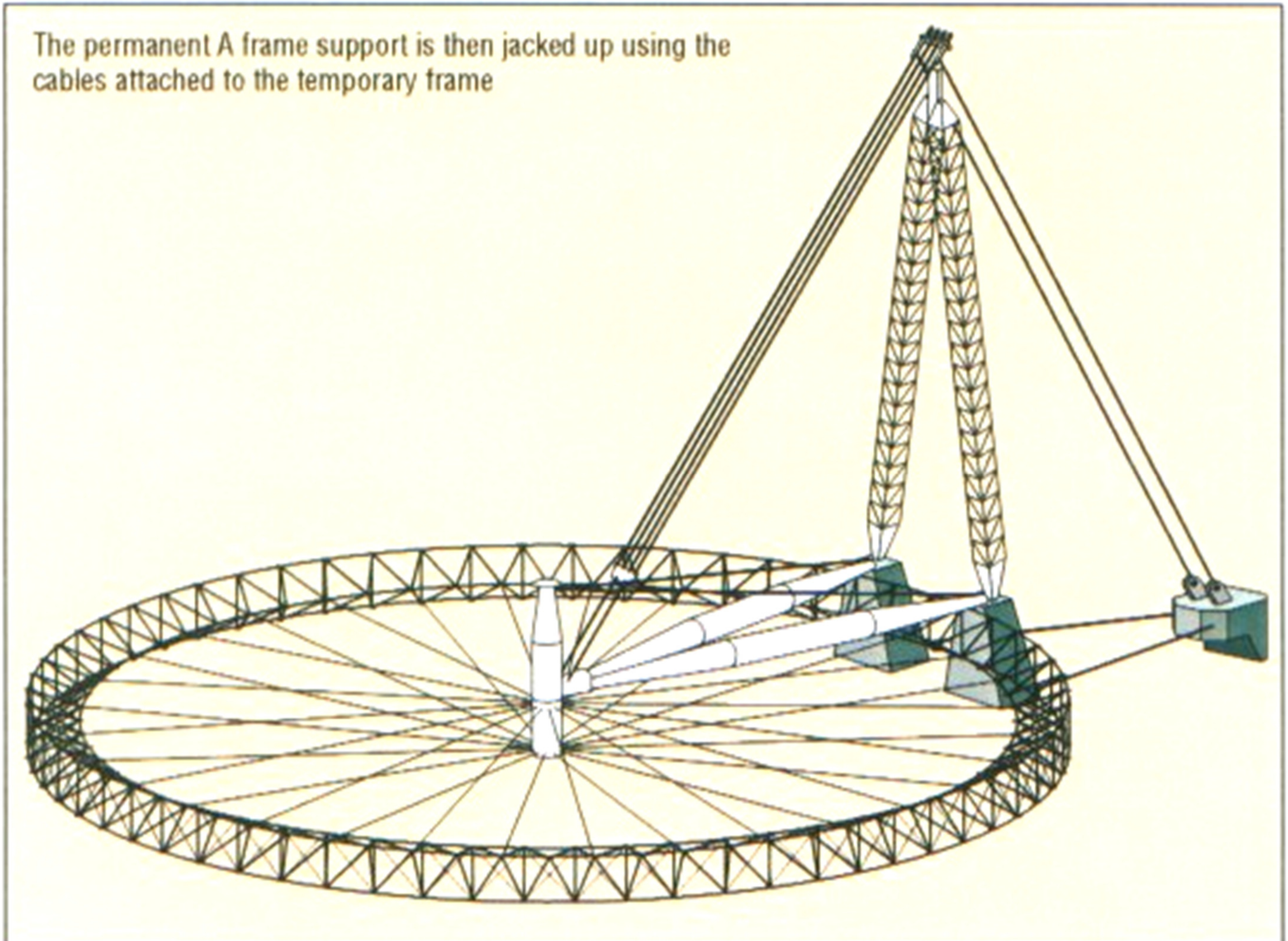

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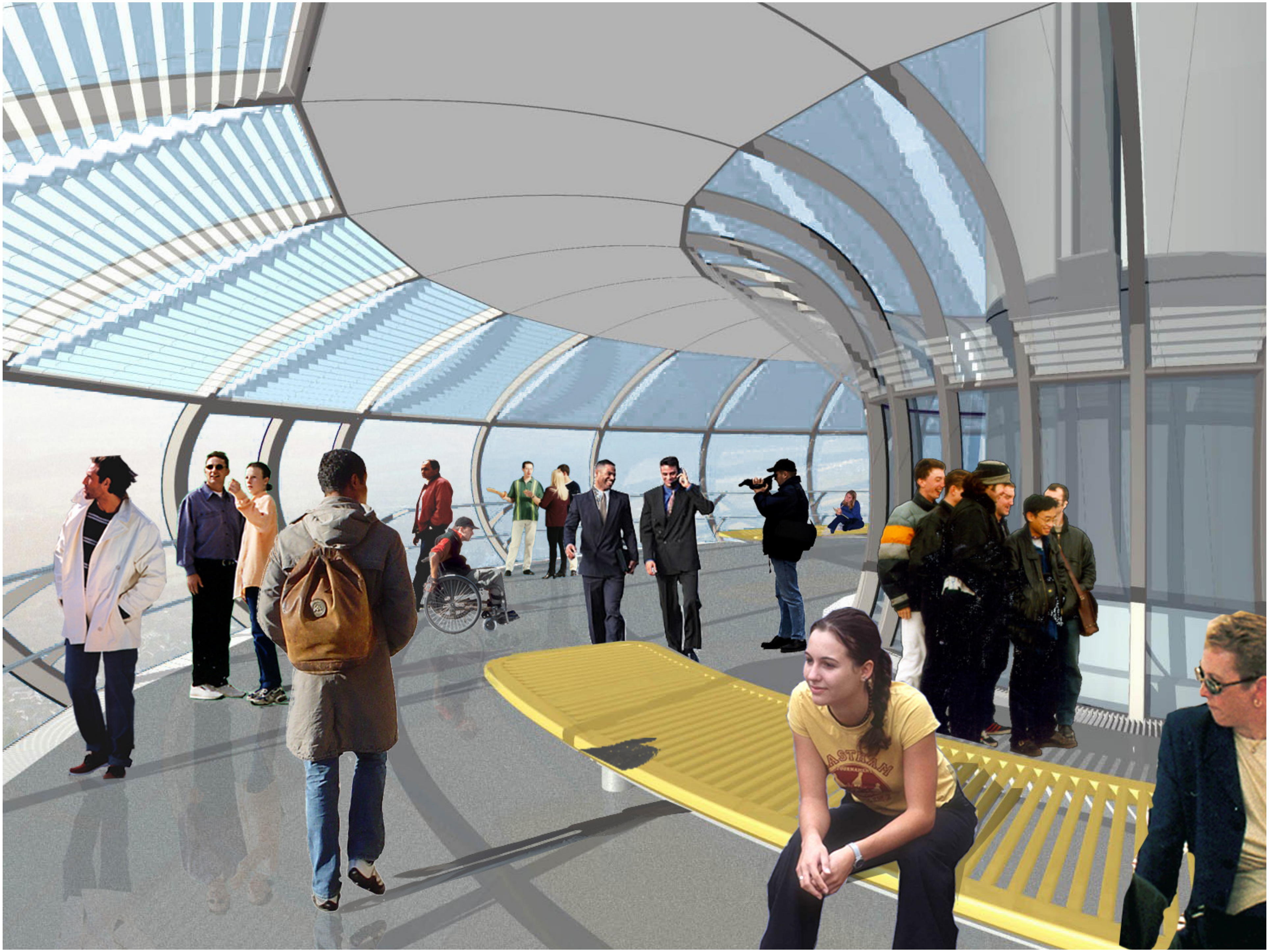

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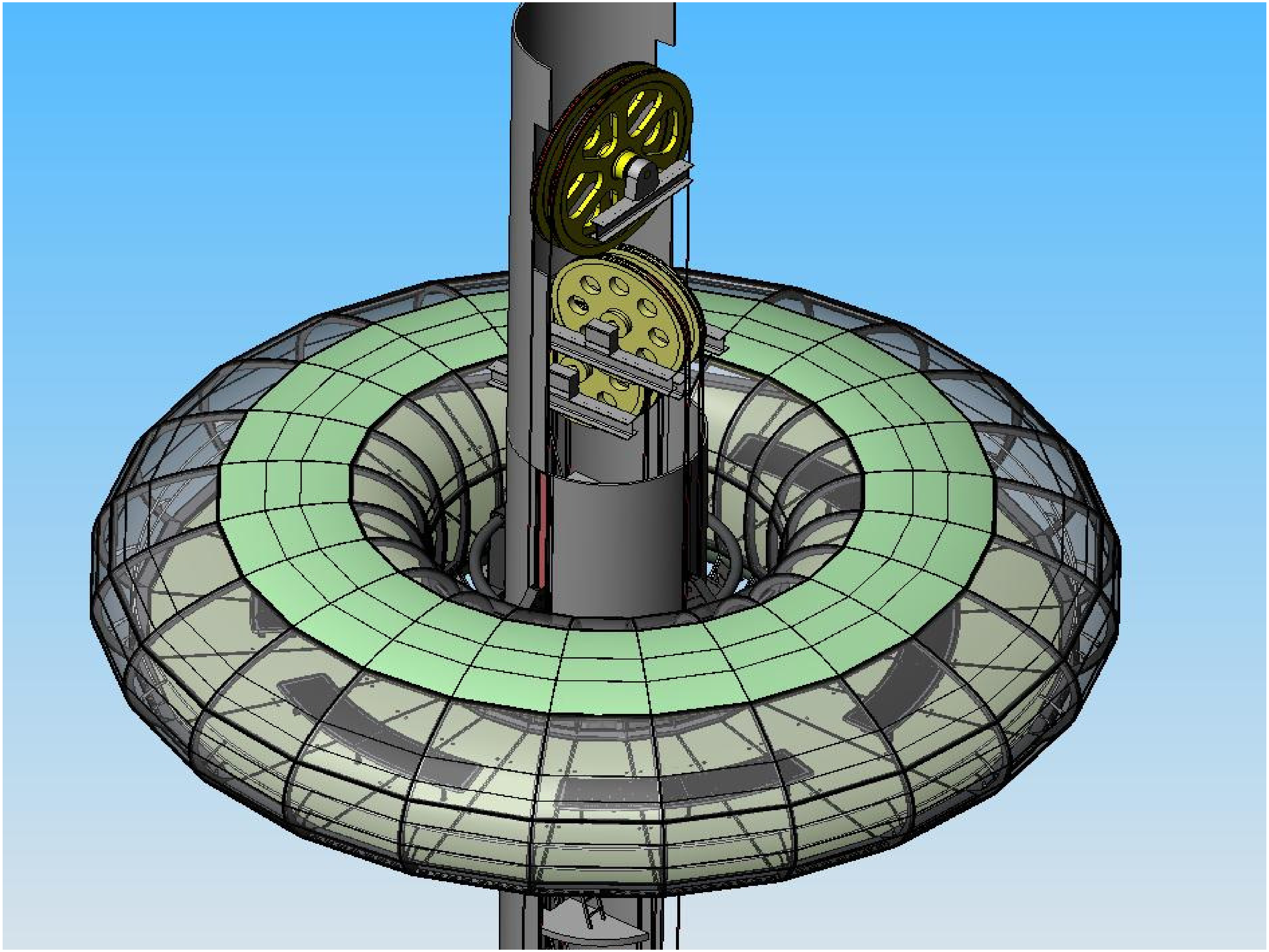

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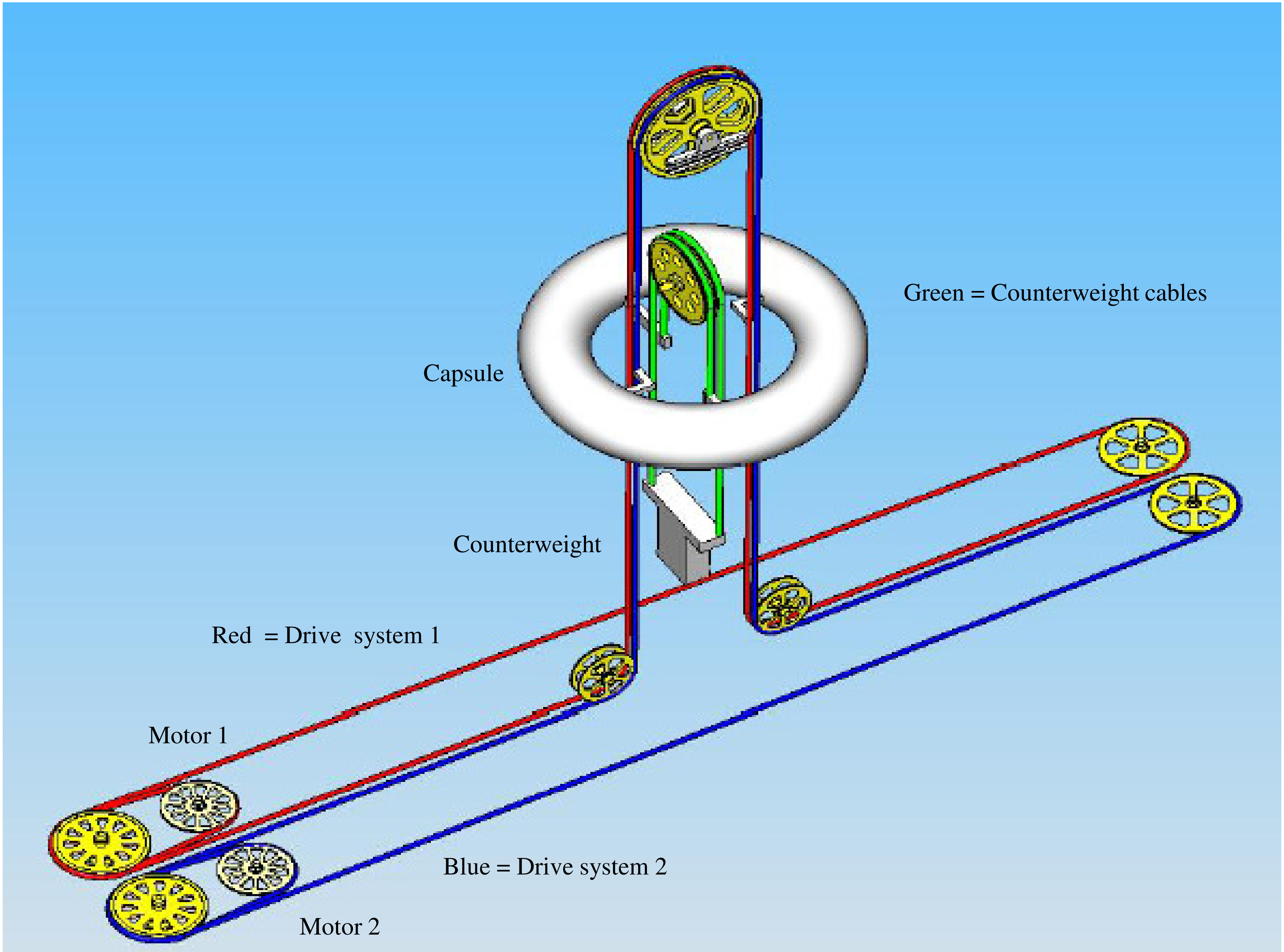

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- Thank you very much for listening.
- I would be very pleased to answer any questions about the work of the JBM
- (or even about how the London Eye was designed !)