Cement-free tyre foundations for public buildings

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Straw WORKS
bale buildings

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Outline

1. The story of tyre foundations
2. The story of tyre foundations at Tulse Hill
3. Principle (intermezzo)
4. Technical Details
5. Resources

Picture by Richard Dormandy

Tyre retaining walls

- on the M62 near Bradford
- 1982 by West Yorkshire Metropolitan County Council
- Low cost (tyres for free) £46/m2, 1/4 of conventional retaining wall
- Speed of Construction (70m long and 5m high) under 2 weeks

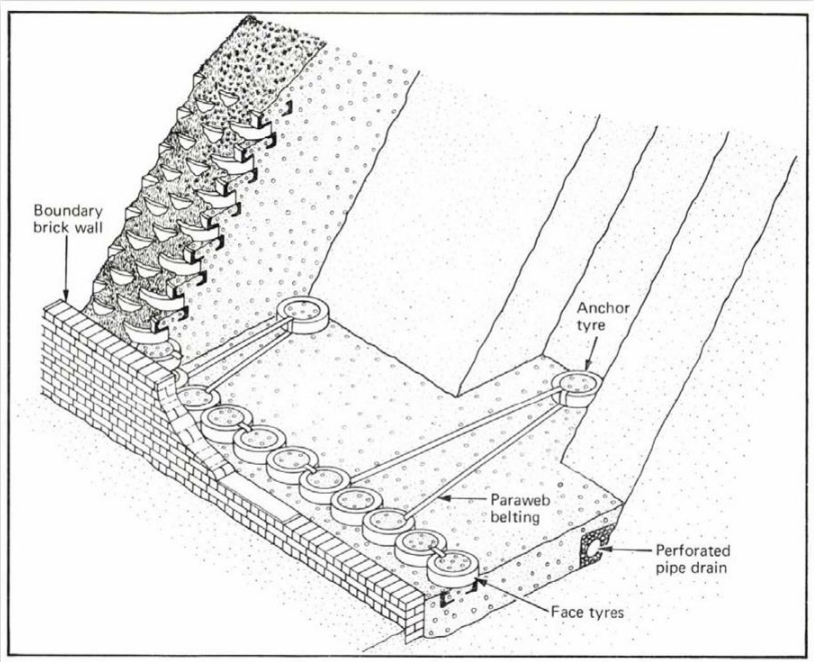

Fig. 3. Cutaway view showing face tyres, anchor tyres and Paraweb belting. (The boundary wall is free standing and non-structural)

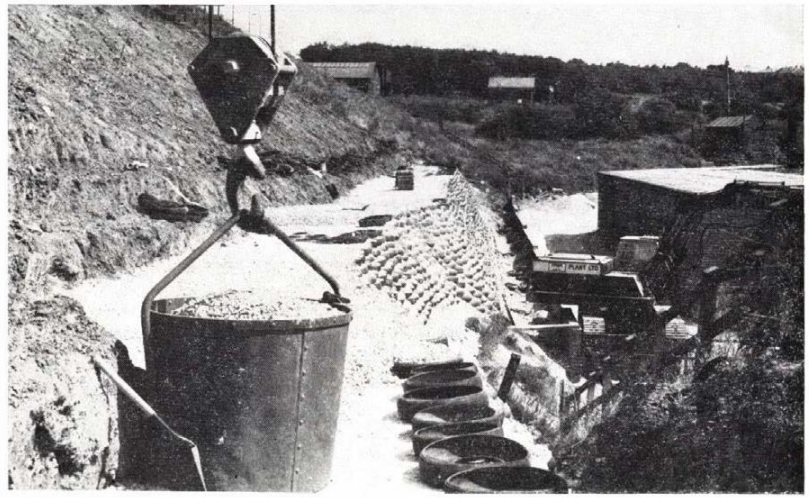

Fig. 4. During construction. Crusher run had to be treble handled using the Poclain for the lower section and the skip for the upper section. Final placing was by hand shovel

by DONALD C. DALTON (1982)

The story of tyre foundations..

- Start
- Barbara's brain
- 1996 proposed under SB **sauna in Hebden Bridge** - received full B. Regs. approval **- NEVER BUILT -**

Barbara @ Skipsea (2008)

..versus my own journey

2002

.

approx. 30 buildings

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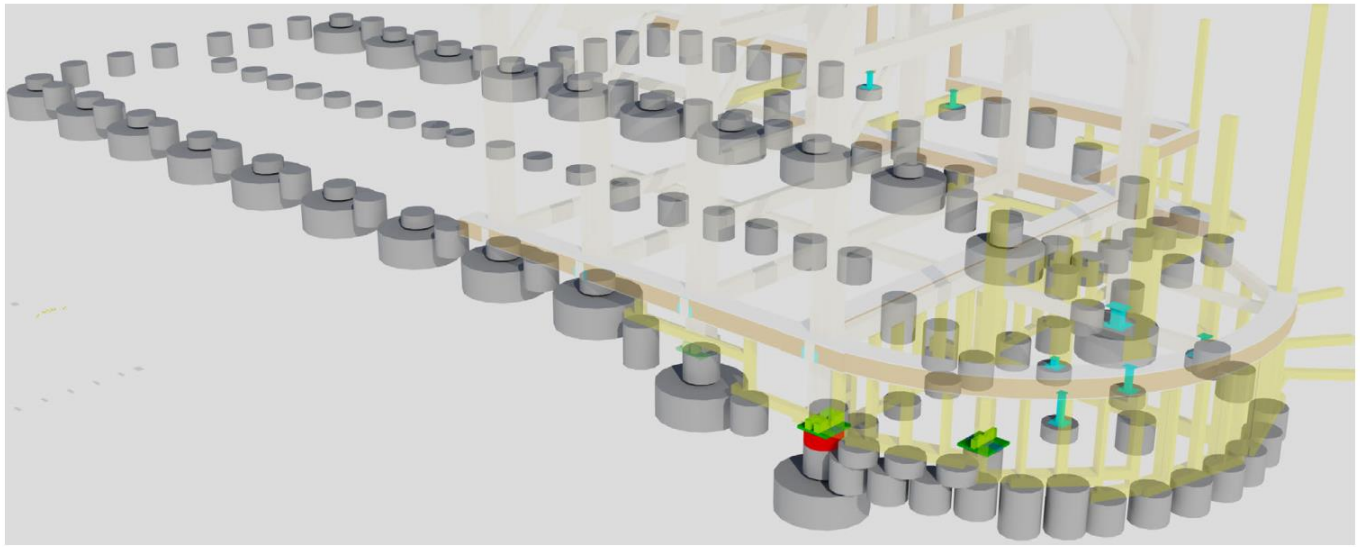


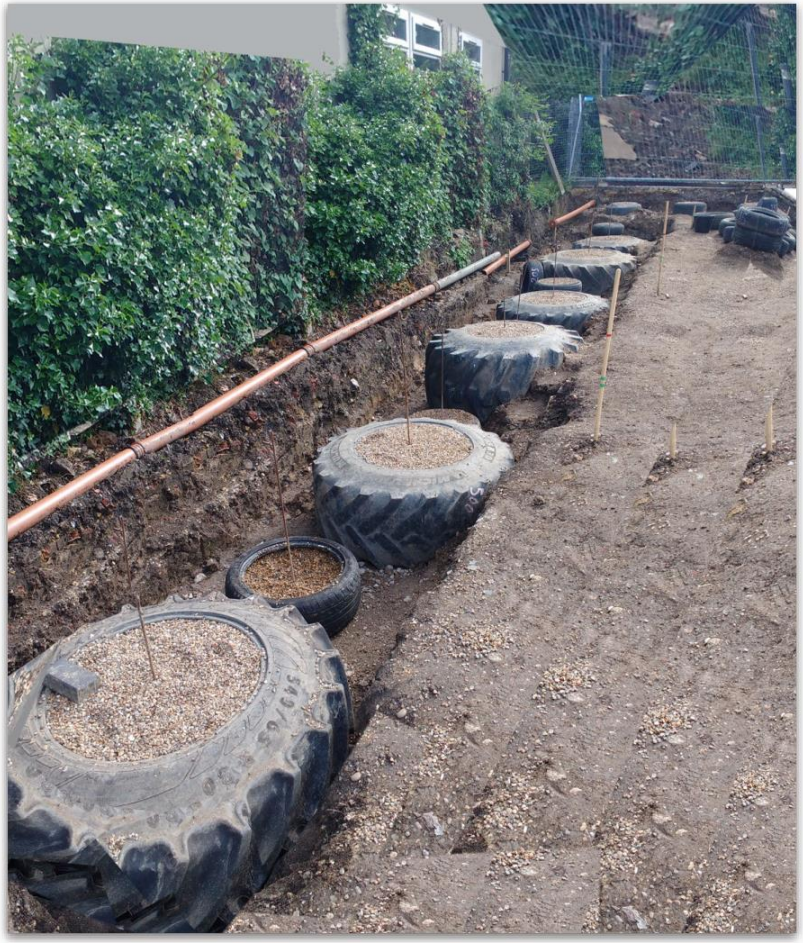
2019

The story of tyre foundations at Tulse Hill

vicar Richard Dormandy picture possibly by Nicole Lyon? (2018)

from article by Timber Trade Federation (2019)

The story of tyre foundations at Tulse Hill



Opportunity

- for sharing unique experience
- for demonstration on how Straw Works design team works and how it implements it's ethos in practice

pictures by Richard (2017)

Principle

- Pillars or pier foundations - raising construction above ground level

Gabion basket

- Pea shingle infill - draining, strong
- Construction above protected from damp **without any DPC**

Richard & Rachel, Suffolk Straw Bale Cottage (2015)
Self-build inspired by Barbara's book

Why?

- **Environmental impact** - reusing waste difficult to dispose of

- Free & durable if away from UV
- Low embodied energy
- Simple and accessible to work with
  - Volunteer & self-build friendly
  - Safe
- **Ideal as a community activity**

Community building at Tulse Hill by Richard Dormandy (2017)

What is under pillars?

- Nothing

  ideally - majority sites -

  - good bearing subsoil as natural foundation

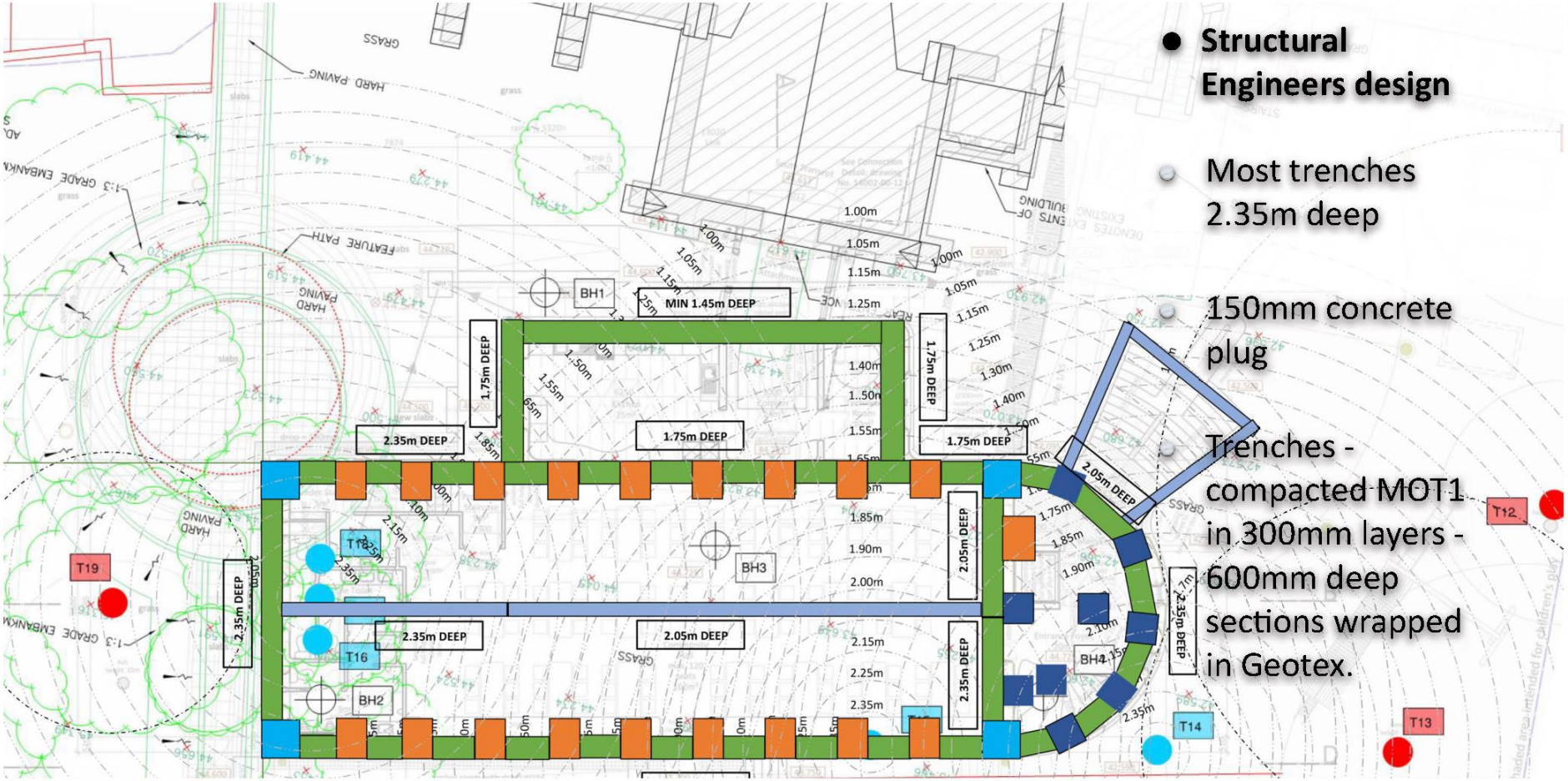
- Hole filled with compacted MOT1, pea shingle, or gravel

  less ideally -

  - heavy clay soils
  - made-up ground
  - wet soils
  - moving sand

Community building at Tulse Hill by Richard Dormandy (2017)

The story of tyre foundations at Tulse Hill

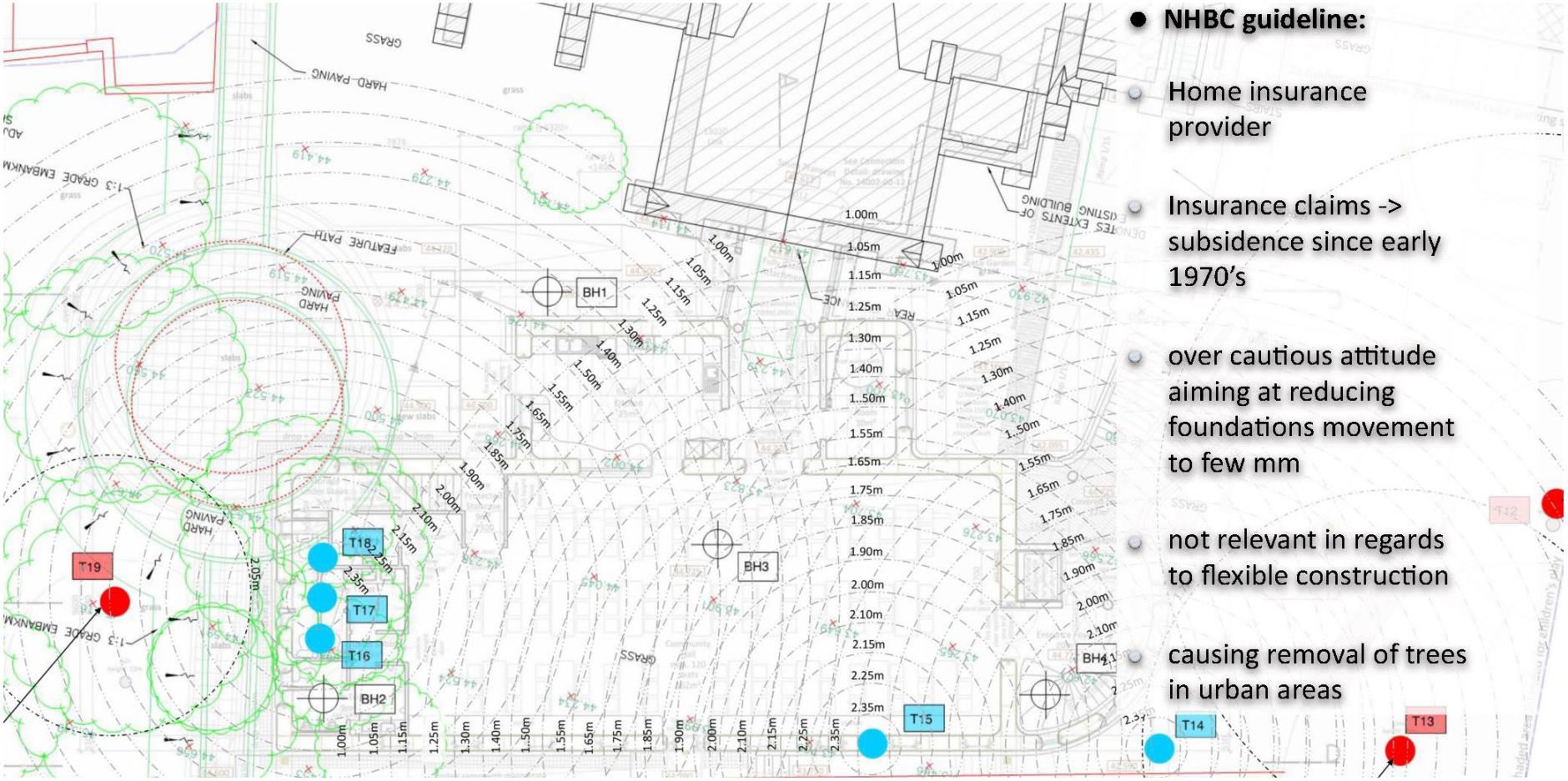


- **Structural Engineers design**
- Most trenches 2.35m deep
- 150mm concrete plug
- Trenches - compacted MOT1 in 300mm layers - 600mm deep sections wrapped in Geotex.

Tyre foundation - trenches - designed by Renaissance Structural Engineers (May 2016)

NOTE: * THE DEPTH OF FOUNDATION HAS BEEN TAKEN FROM CHART 1 OF NHBC CHAPTER 4, SECTION 4.2

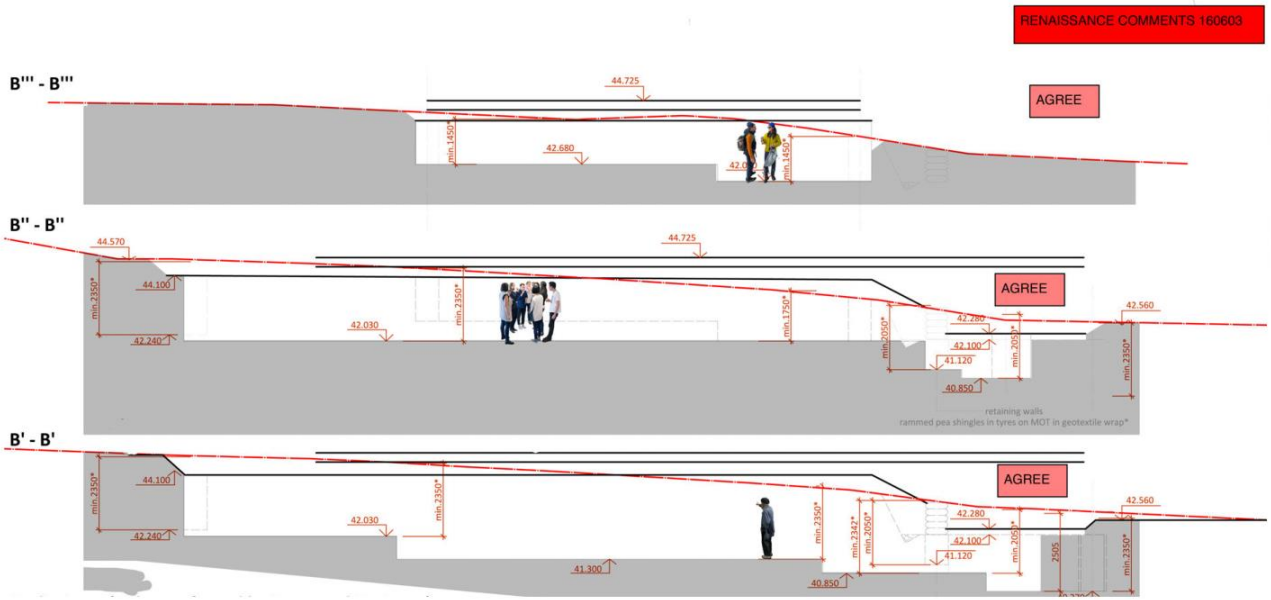
The story of tyre foundations at Tulse Hill



- **NHBC guideline:**
- Home insurance provider
- Insurance claims -> subsidence since early 1970's
- over cautious attitude aiming at reducing foundations movement to few mm
- not relevant in regards to flexible construction
- causing removal of trees in urban areas

Blue dots indicate trees removed in February 2015 (drawing by Renaissnace, May 2016)

The story of tyre foundations at Tulse Hill



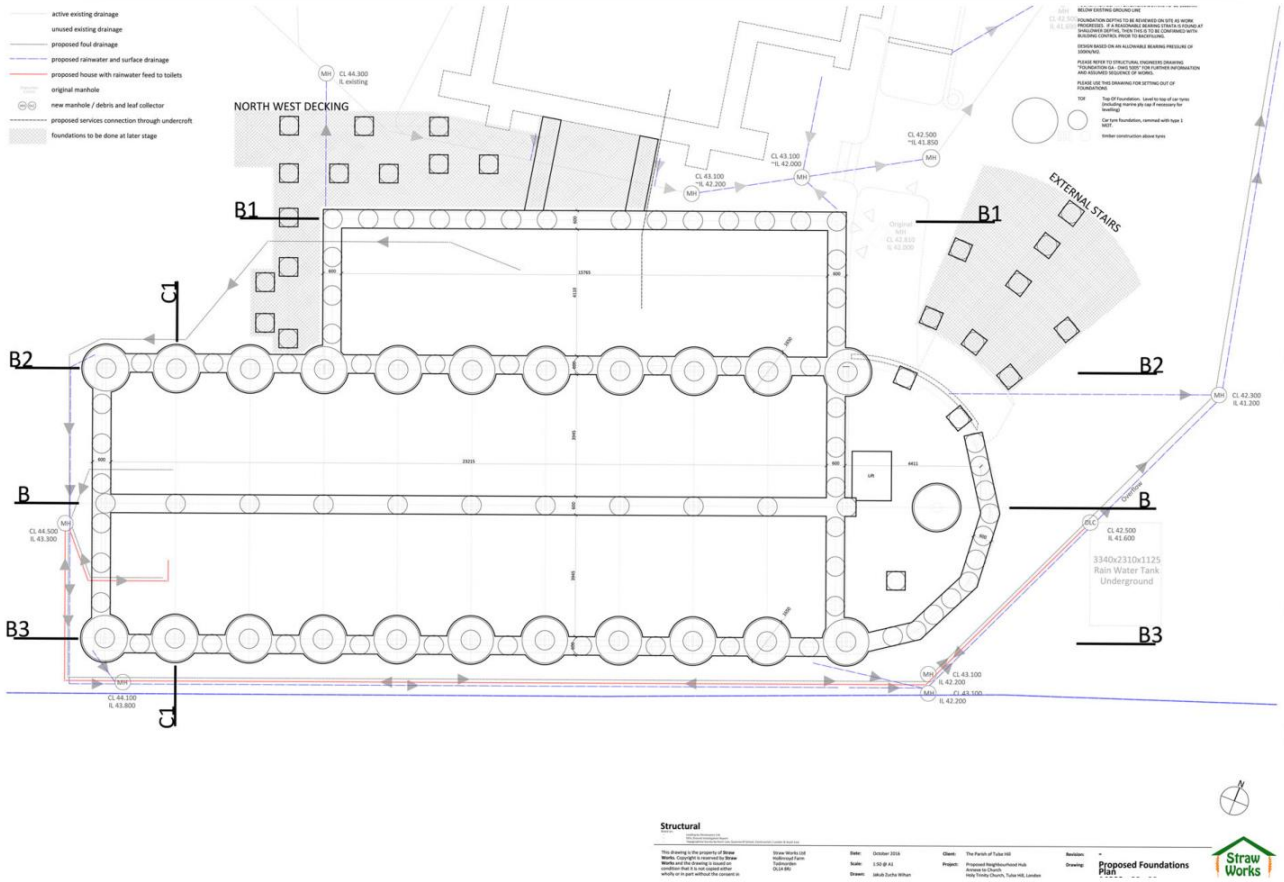
Tyre foundation - trenches designed by Renaissance Structural Engineers (May 2016)

- **Estimate by Tony:**
  - >1.5m - shoring
  - no volunteers
  - 2m layer of MOT1 - labour intensive - if half filled with concrete - cheaper:

    ~ £134,000

The story of tyre foundations at Tulse Hill

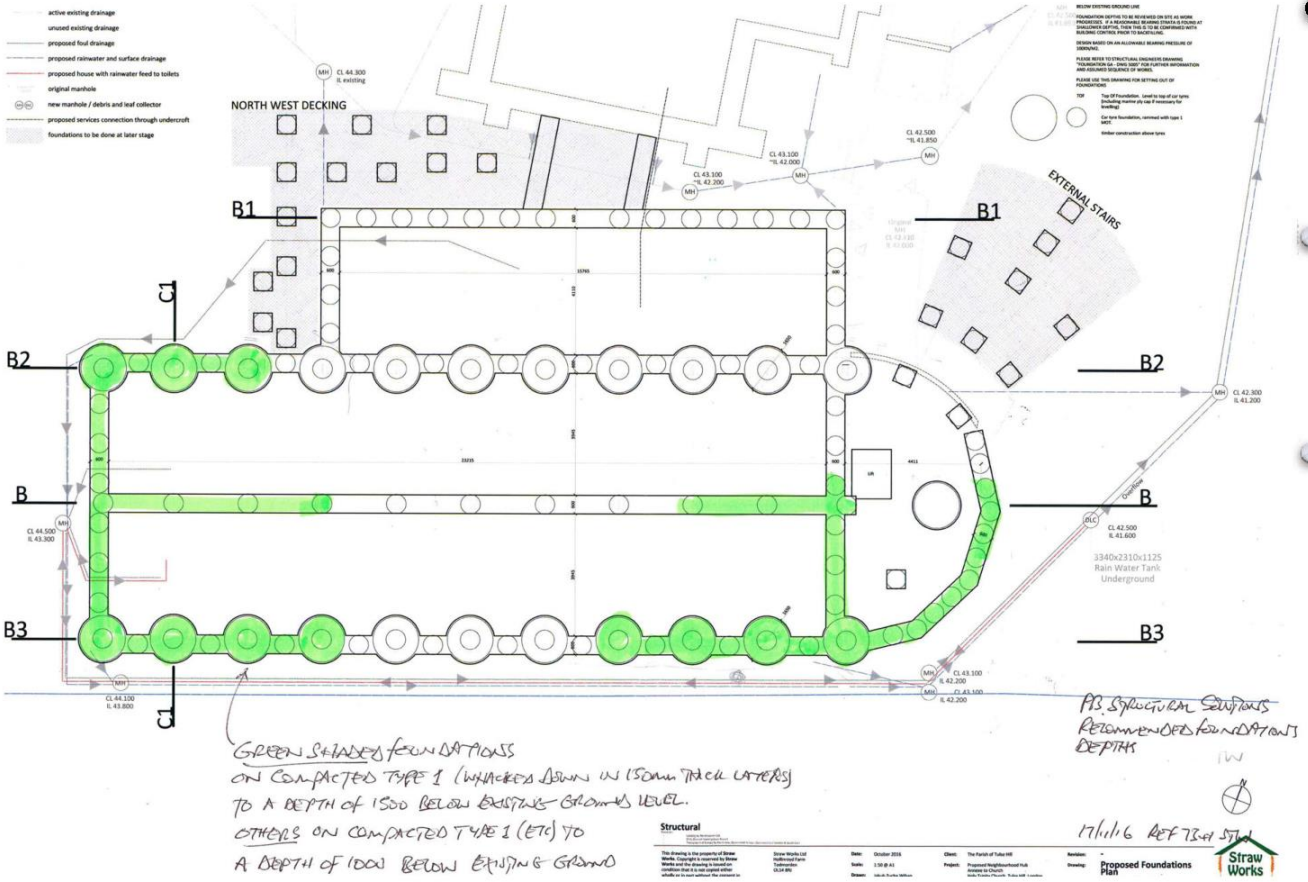
Our remit: affordable, easily buildable, user friendly, without cement



Tyre foundation- trenches designed by Straw Works (October 2016)

- **Redesign**:
  - evidence showing irrelevance of NHBC report
  - Investigation of existing Church foundation
  - Loading by S.E.
  - GIR

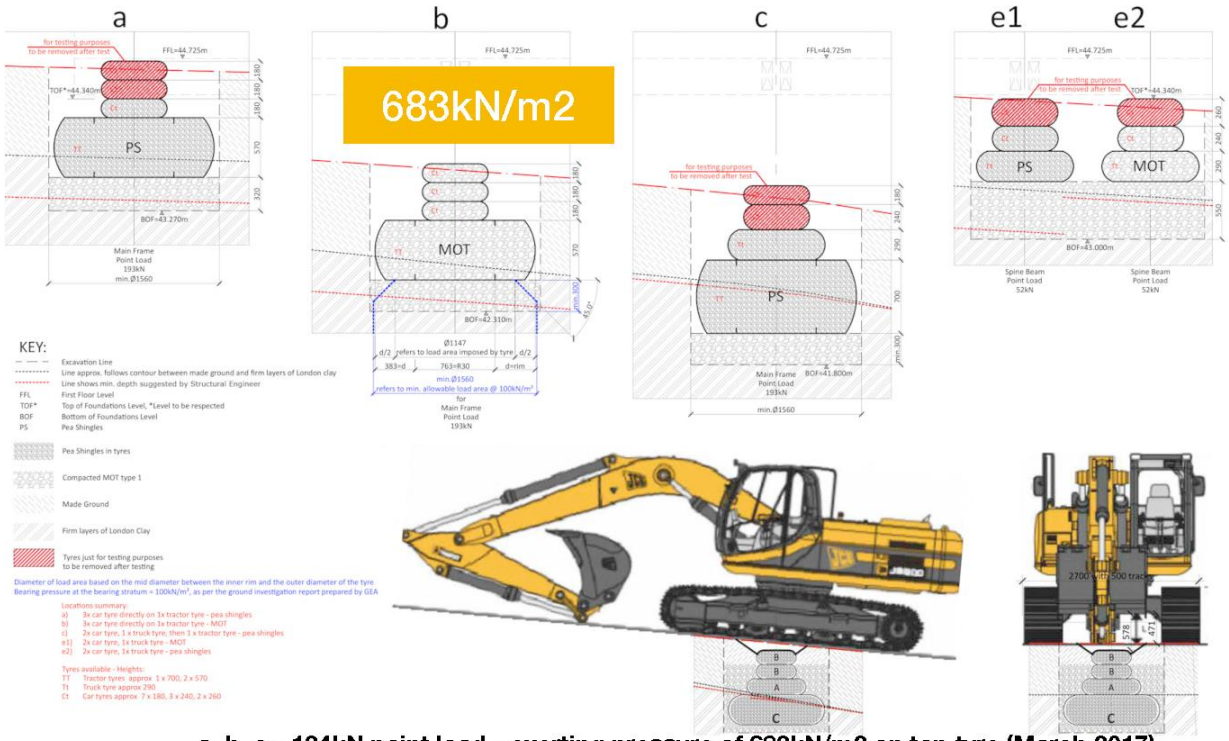
The story of tyre foundations at Tulse Hill



Tyre foundation- trenches depth by Structural Solutions (October 2016)

- **Redesign by Straw Works - checked by other S. E.**
- realistic assessment of dead trees impact on subsoil movement
- understanding nature of flexible building
  - green trenches - depth **1250mm**
  - all others - depth **900mm**

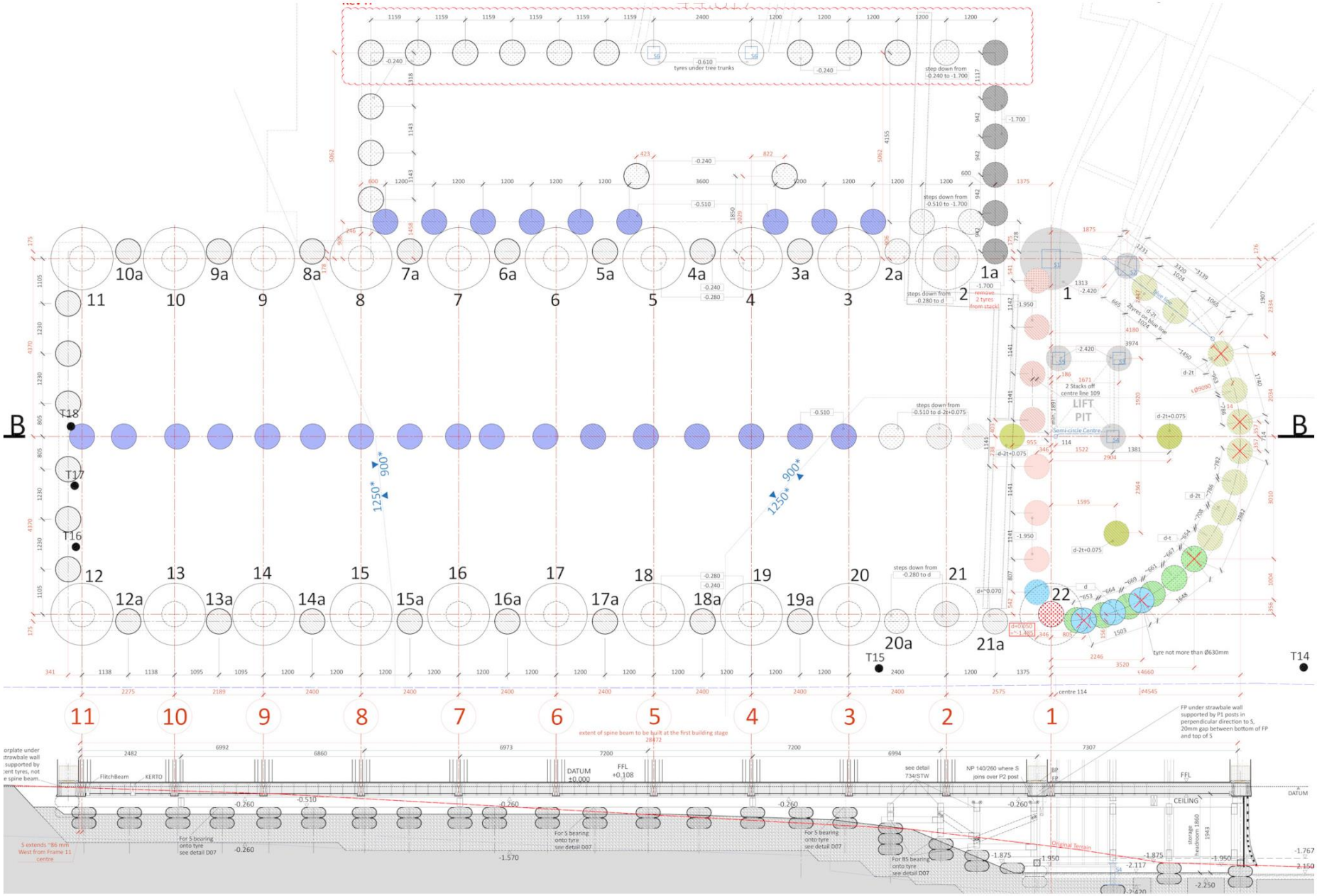
The story of tyre foundations at Tulse Hill



a, b, c - 134kN point load - exerting pressure of 683kN/m2 on top tyre (March 2017)

.pdf document: RESULTS OF PLATE LOAD TESTING ON FOUNDATIONS MADE FROM TYRES RAM FILLED WITH EITHER MOT TYPE 1 OR 10MM PEA SHINGLE **by Barbara Jones - available upon request**

- **Building Inspector**
- **Plate load testing required**
  - Plate diameter - **450mm**
  - Max. exerted pressure - **1000 kN/m2**
  - Max. settlement MOT1 - **7.95mm,** Pea Shingle - **5.45mm**



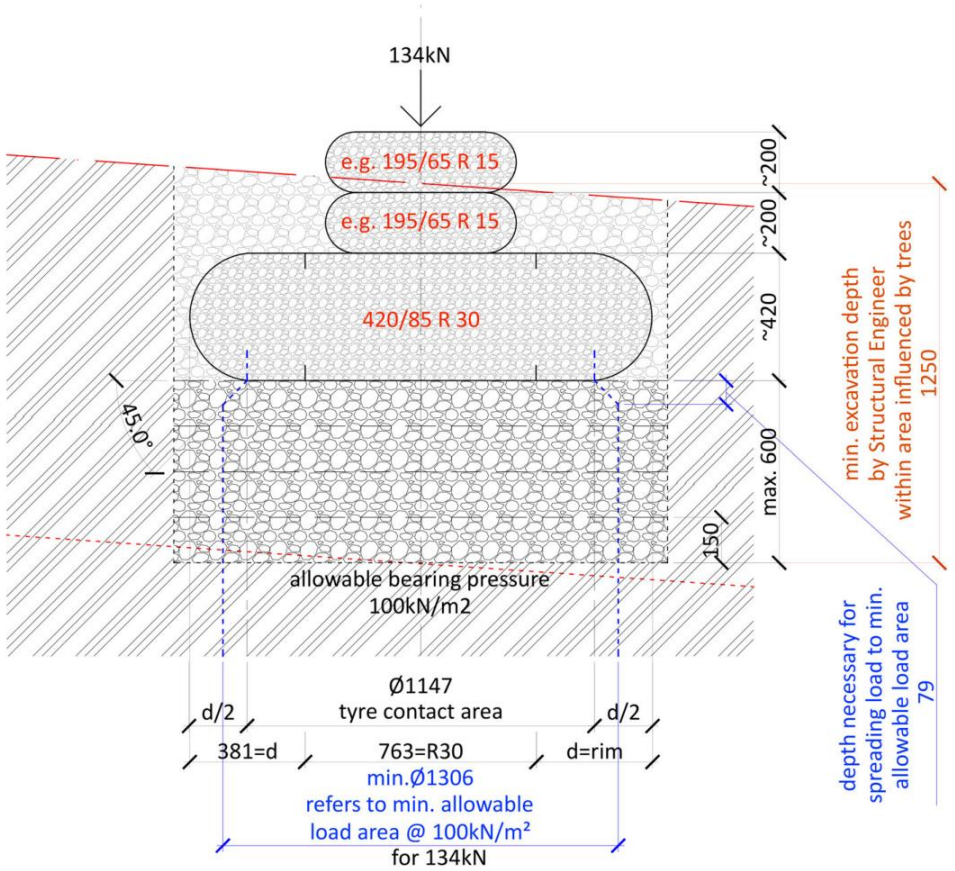
Construction drawing - Foundation layout at Tulse Hill (Rev.H June 2019)

The story of tyre foundations at Tulse Hill

picture by Richard Dormandy

- **Cost so far:**
  - Tyres for free
  - £125 transport of tractor tyres
  - £60 transport of car tyres
  - 4 x £350 load of pea shingle
  - 4 x £320 load of MOT1
  - £350 excavated soil disposal
  - £2,500 digger
  - £500 plate test
  - £5,000 digger operators & paid labour
  - £500 compactors and breakers hire
- **Total £11,715**
  excluding fees for drawings and design

Technical Details



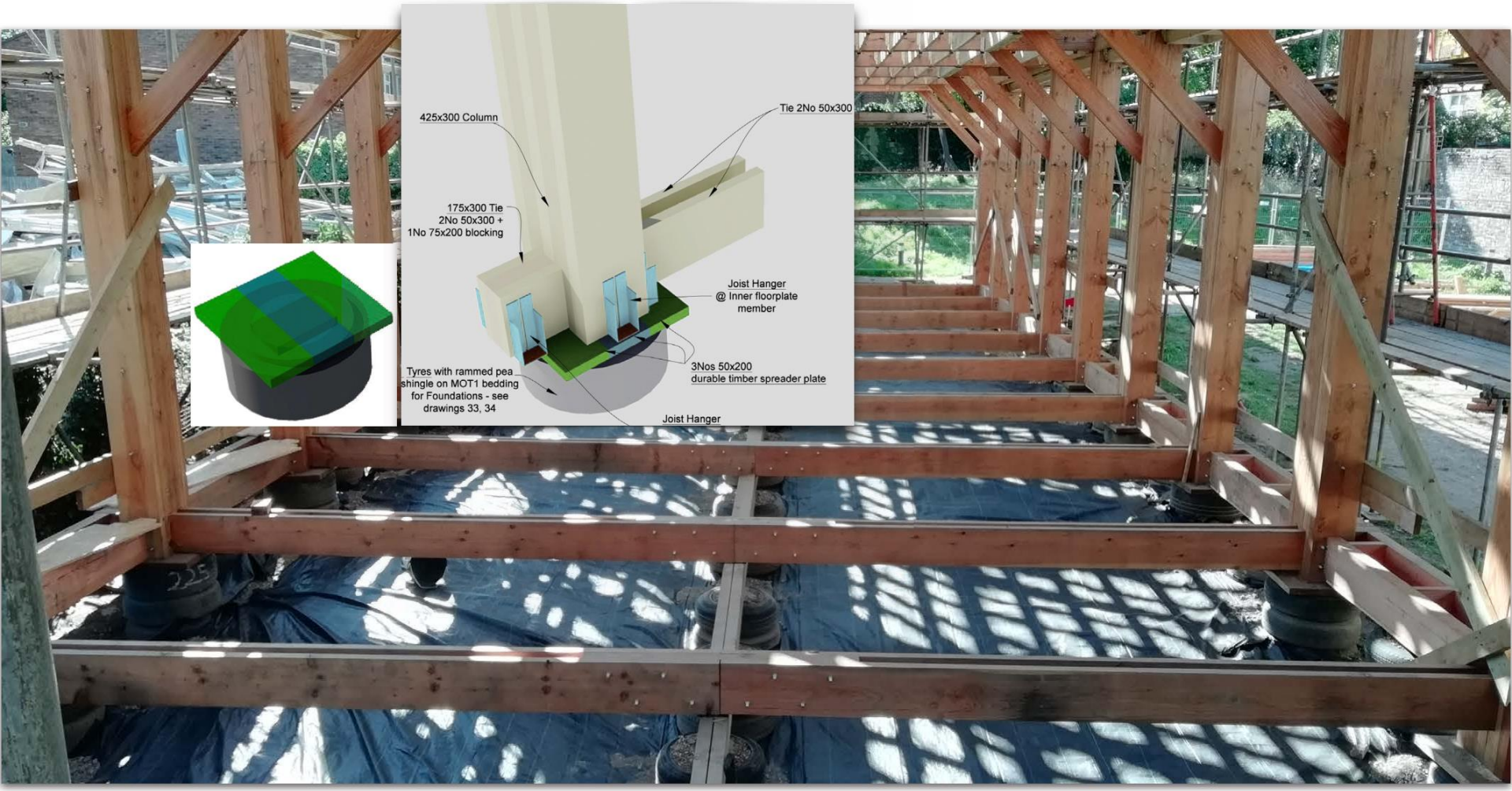
Tyre foundation under frames at Tulse Hill - setting depth, min. load area and No. of tyres

- Excavation depth 1250mm under existing ground level
- Nominal bed - compacted MOT1 **100mm** - no more than **600mm** (compacted in 150mm layers)
- Tyre contact area [m2]
- Min. allowable load area [m2] = Load [kN] / Allowable bearing pressure [kN/m2]
- No. of tyres in stack - to arrive at safe level above ground
- Compacted MOT1 fill around tyres

Technical Details

Pictures by Richard Dormandy

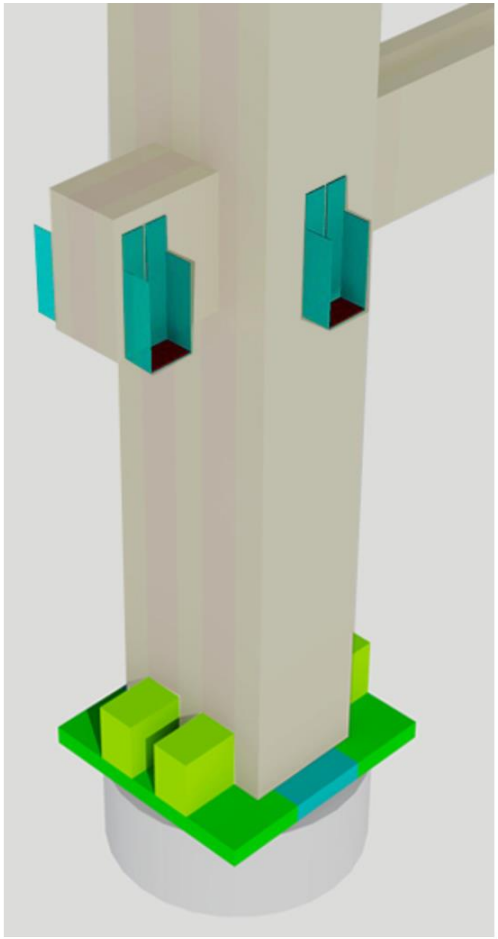
Technical Details



Picture by Richard Dormandy

Technical Details

Picture by Nicole Lyon



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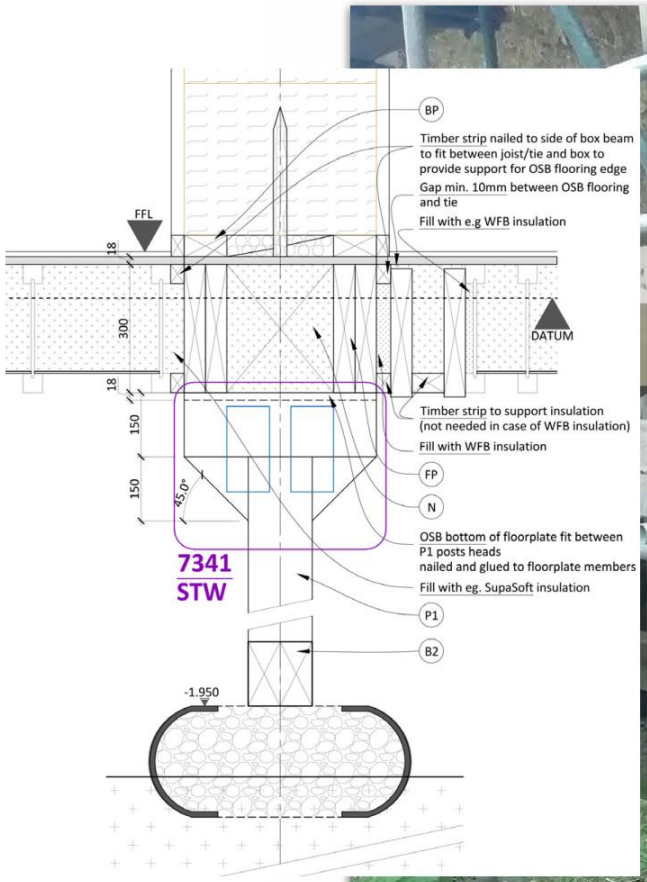

Picture by Richard Dormandy

Resources:

Picture by Barbara Jones

- **Book by Barbara Jones** BUILDING WITH STRAW BALES - appendix
- **strawworks.co.uk** .pdf TECHNICAL DETAIL
- **Document .pdf by Barbara Jones** RESULTS OF PLATE LOAD TESTING ON FOUNDATIONS MADE FROM TYRES RAM FILLED WITH EITHER MOT TYPE 1 OR 10MM PEA SHINGLE
- **Youtube video guides by Richard Dormandy**
  - Plate test on car tyre foundations
  - How to make row of tyres perfectly level
  - Choosing your tyres
  - Filling tyres
  - Packing & levelling tyres to arrive at level


Concrete: the most destructive material on Earth | Cities | The Guardian
Guardian concrete week
Concrete: the most destructive material on Earth
▲ Limestone quarries and cement factories are often sources of air pollution. Photograph: Zoonar GmbH/Alamy

Who profits?

Guardian