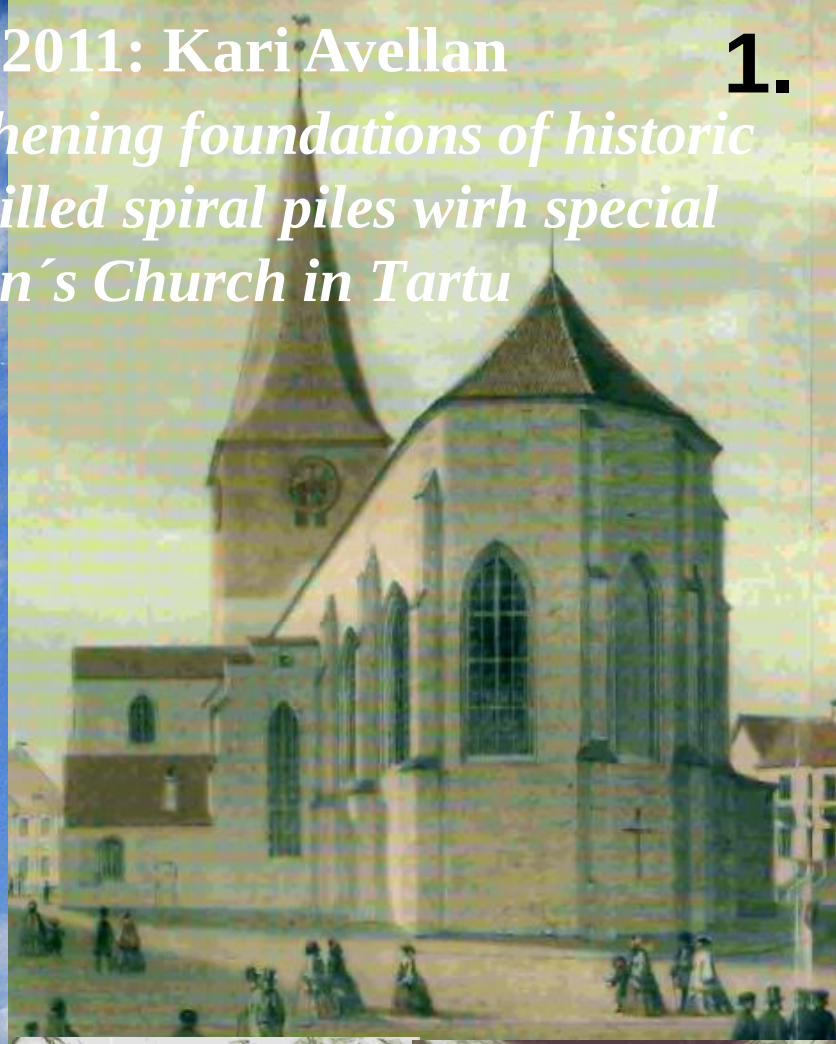
Lectio praecursoria 12.11.2011: Kari Avellan

1.

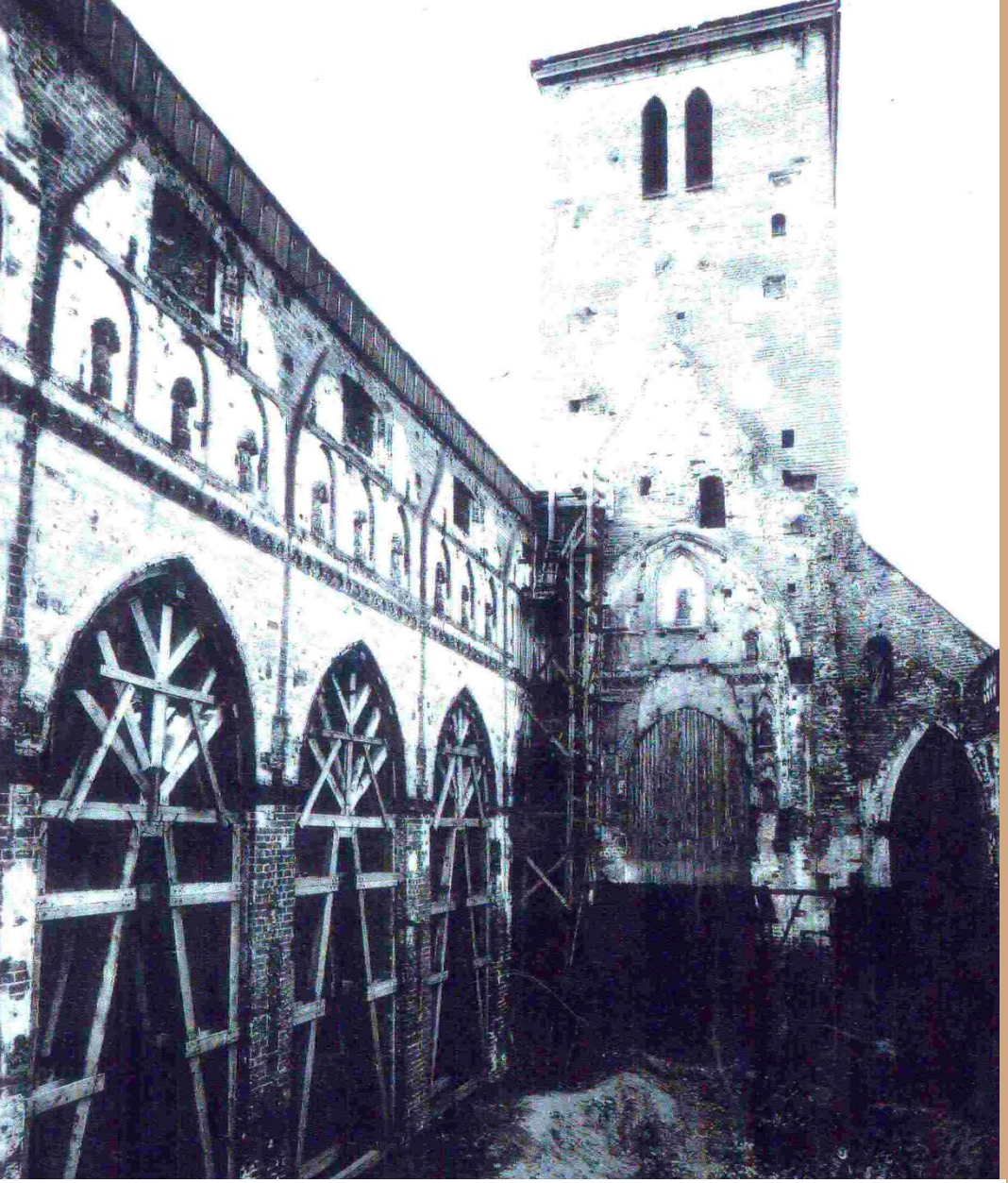
Limit state design for strengthening foundations of historic buildings using pretested drilled spiral piles wirh special reference to St. John´s Church in Tartu



St. John´s Church, Tartu Estonia

2.

Picture: Tiina Viirelaid

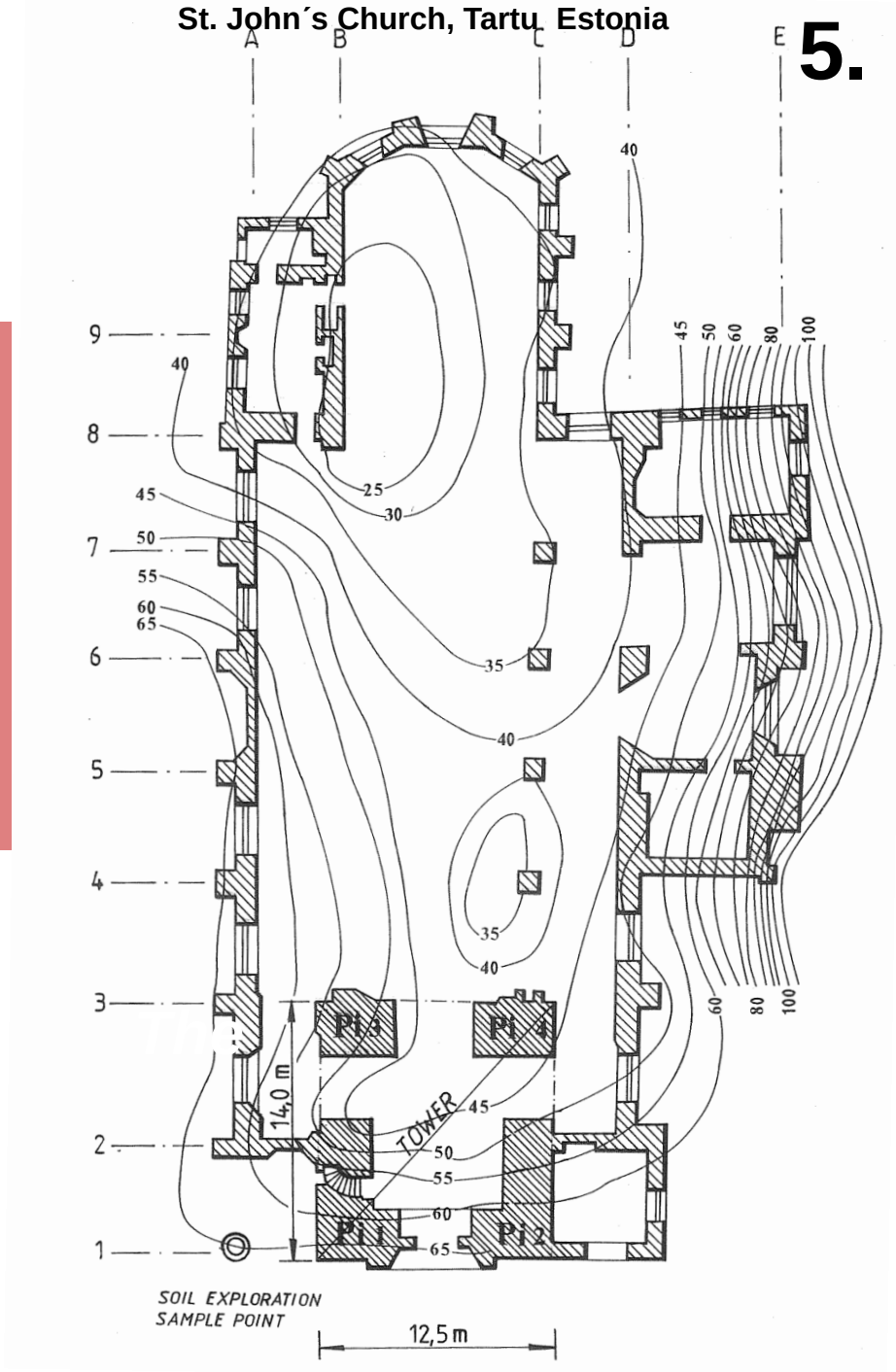


Church before the strengthening work, line A is on the right-side with-out roof, columns on line B had to be entirely rebuilt.

The orgin of the church can be traced back to second half of the 12th century or the 13th century at the latest. In 1323 the church, or, to be more precise, a congregation existed. Among the many examples of medieval architecture in Estonia, church remains an outstanding piece of art within the European context.

Strengthening the foundations was done between years 1993 - 96. One innovate pilling technique employed extensively in response to the difficult circumstances at site was developed and employed extensively in response to the difficult circumstances at site: pretested "end jacked" drilled spiral piles. Special working method and equipment were conceived to install these drilled spiral piles.

Contour lines of settlement (mm) in the area of St. John’s Church during the years 1963 - 87. The line A is on the left-side without roof, columns on the line B had to be entirely rebuilt.



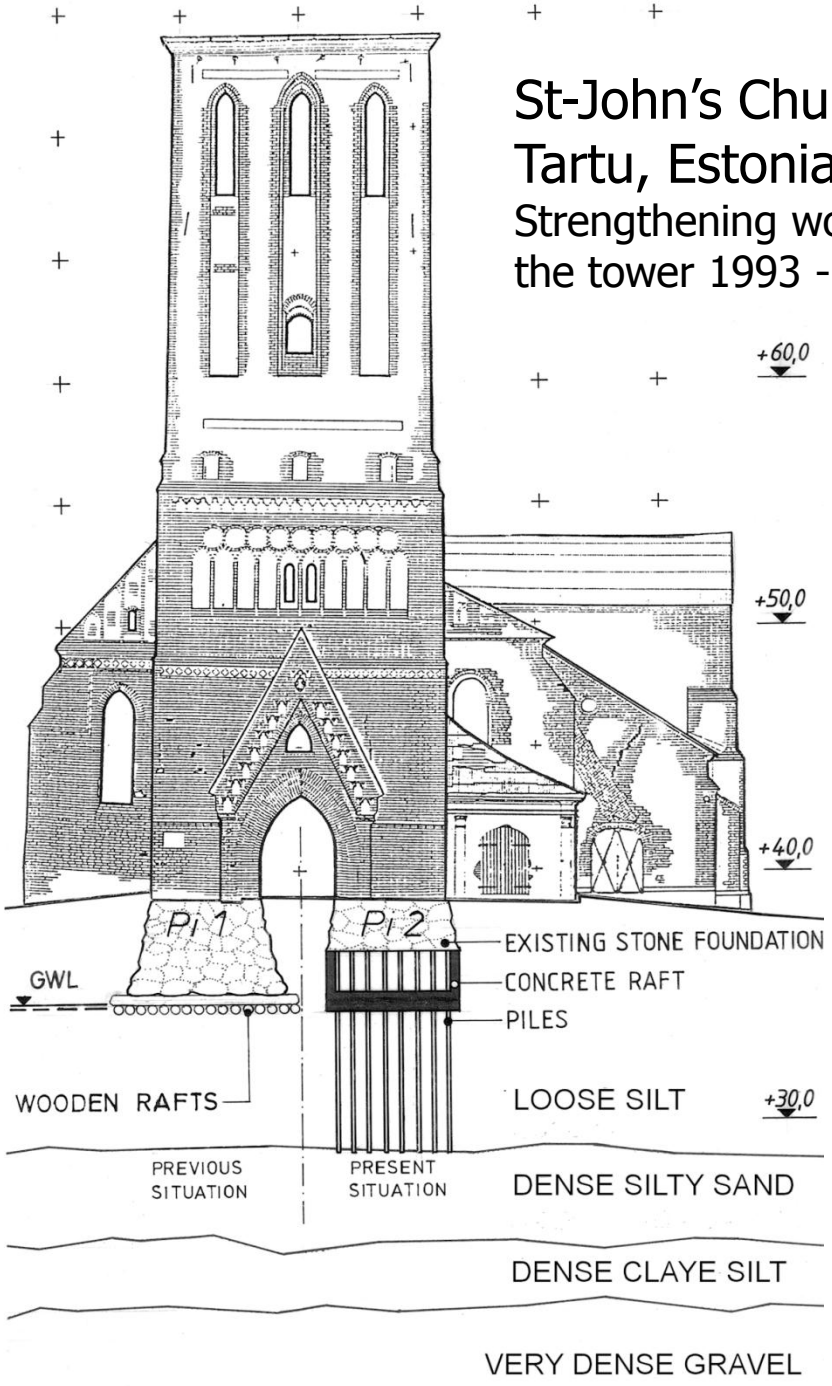
St. John´s Church, Tartu Estonia

6.

Simple screw driving equipment for drilled spiral piles. KAREG also trained local workmen.

St-John's Church, Tartu, Estonia

Strengthening work of the tower 1993 - 1994

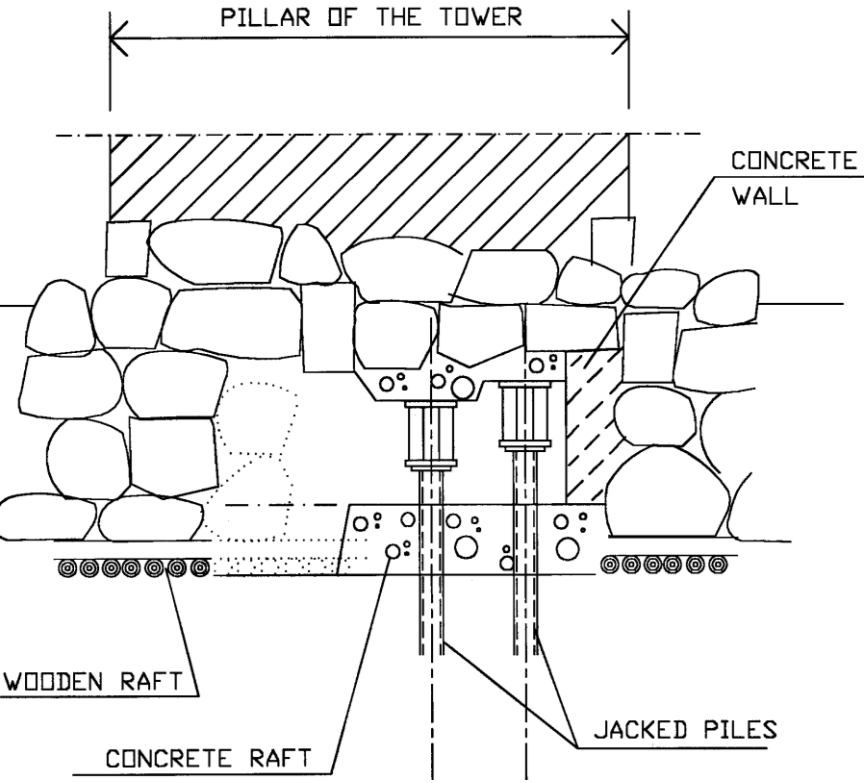


• The tower lies on four pillars which rest on wooden rafts. The foundations of pillars were strengthened by method of underpinning using jacked steel tube piles. Piling of pillars was done gradually, demolishing partly stone composition and piling the demolished part at the same time. Reinforced concrete raft foundation d = 600 mm thick was cast part by part with piling work.

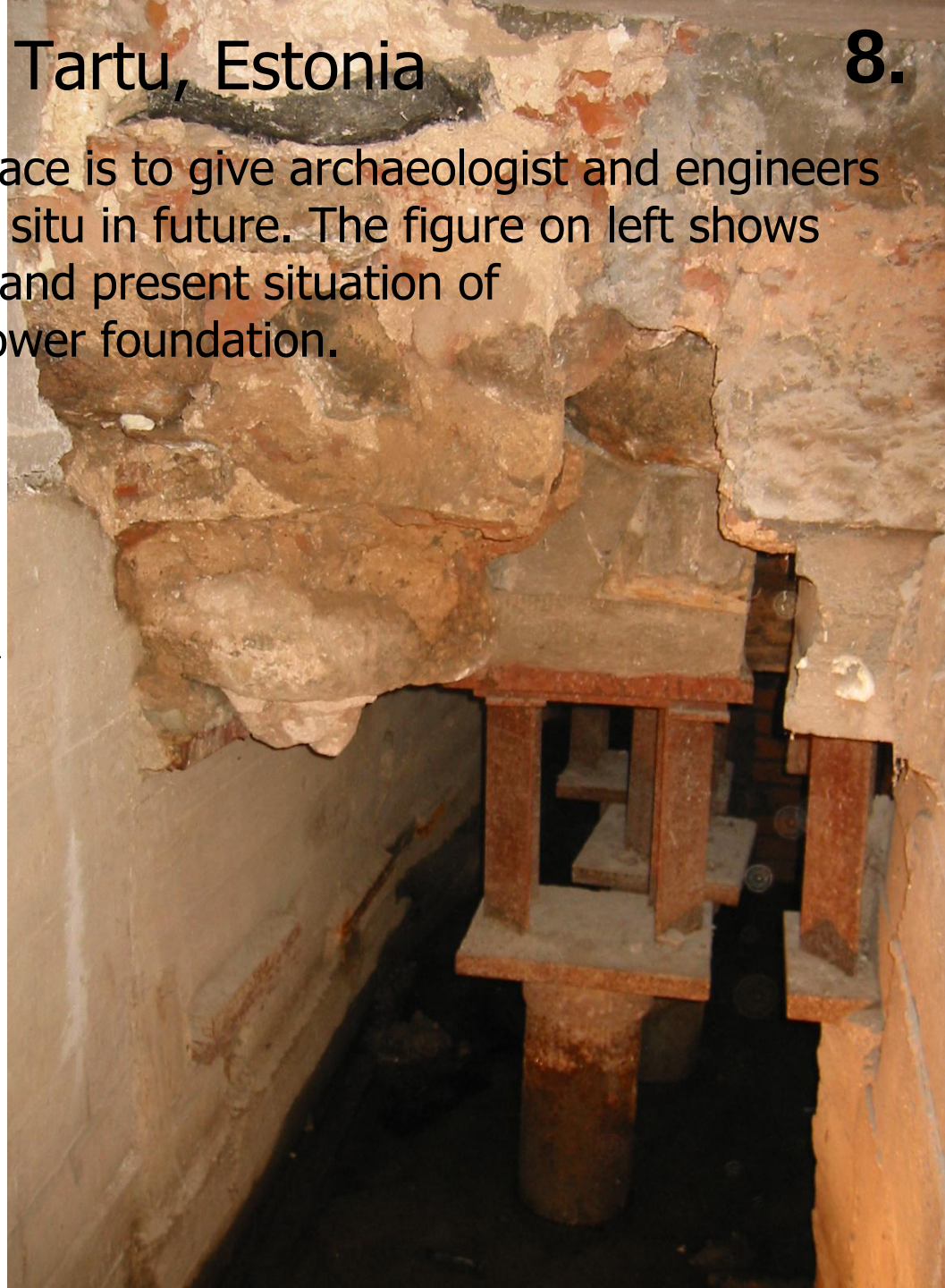
• All four tower pillars were strengthened simultaneously. The piling order was designed during the work according to geotehnical and structural stability. Movements of the tower were measured continuously during the work. In total 138 pc. of piles were installed under the pillars of the tower, approximately 0.8 m c/c.

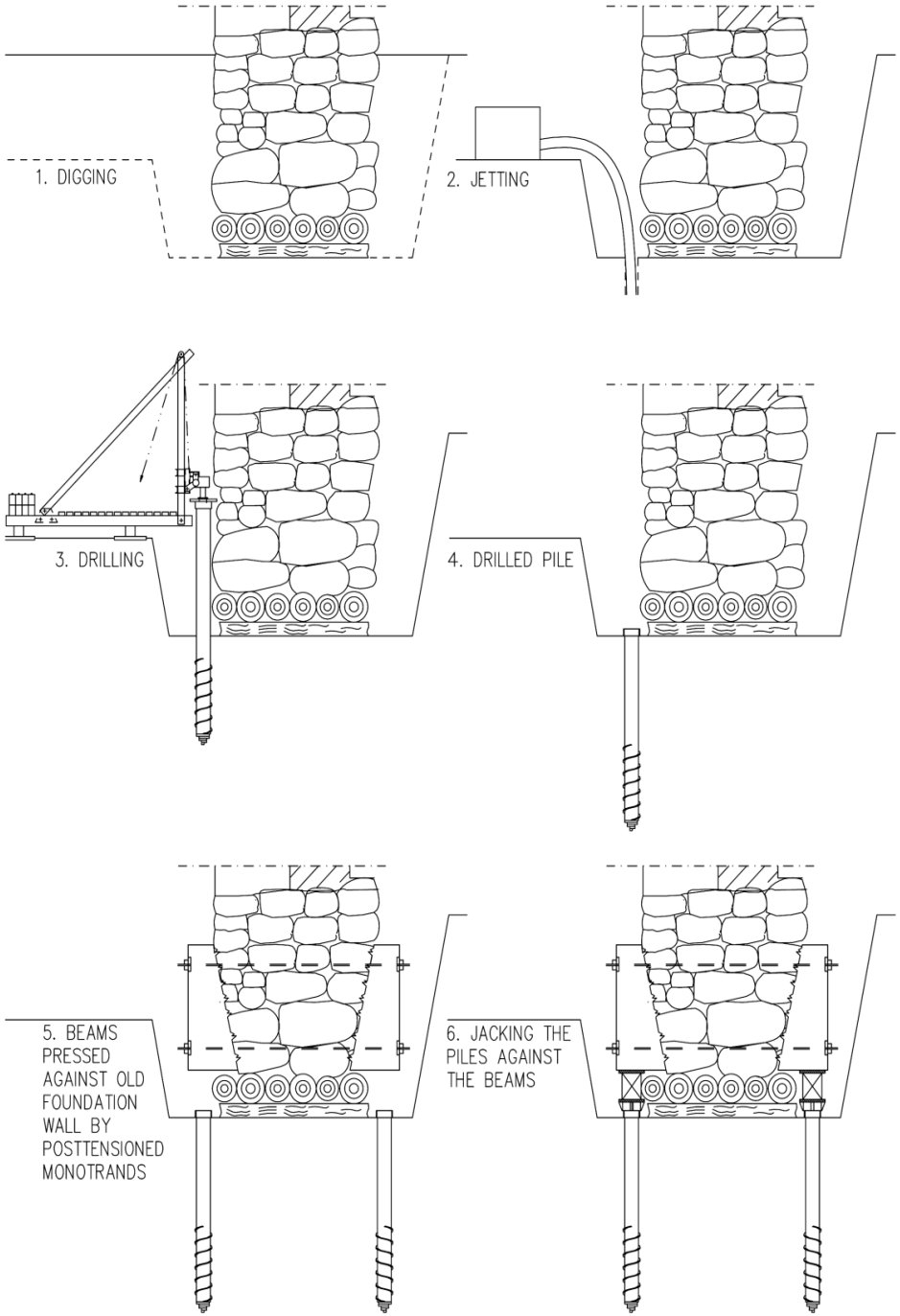
St-John's Church, Tartu, Estonia

The purpose of the empty space is to give archaeologist and engineers chance to study the place in situ in future. The figure on left shows the previous and present situation of the tower foundation.



St. John´s Church, Tartu Estonia

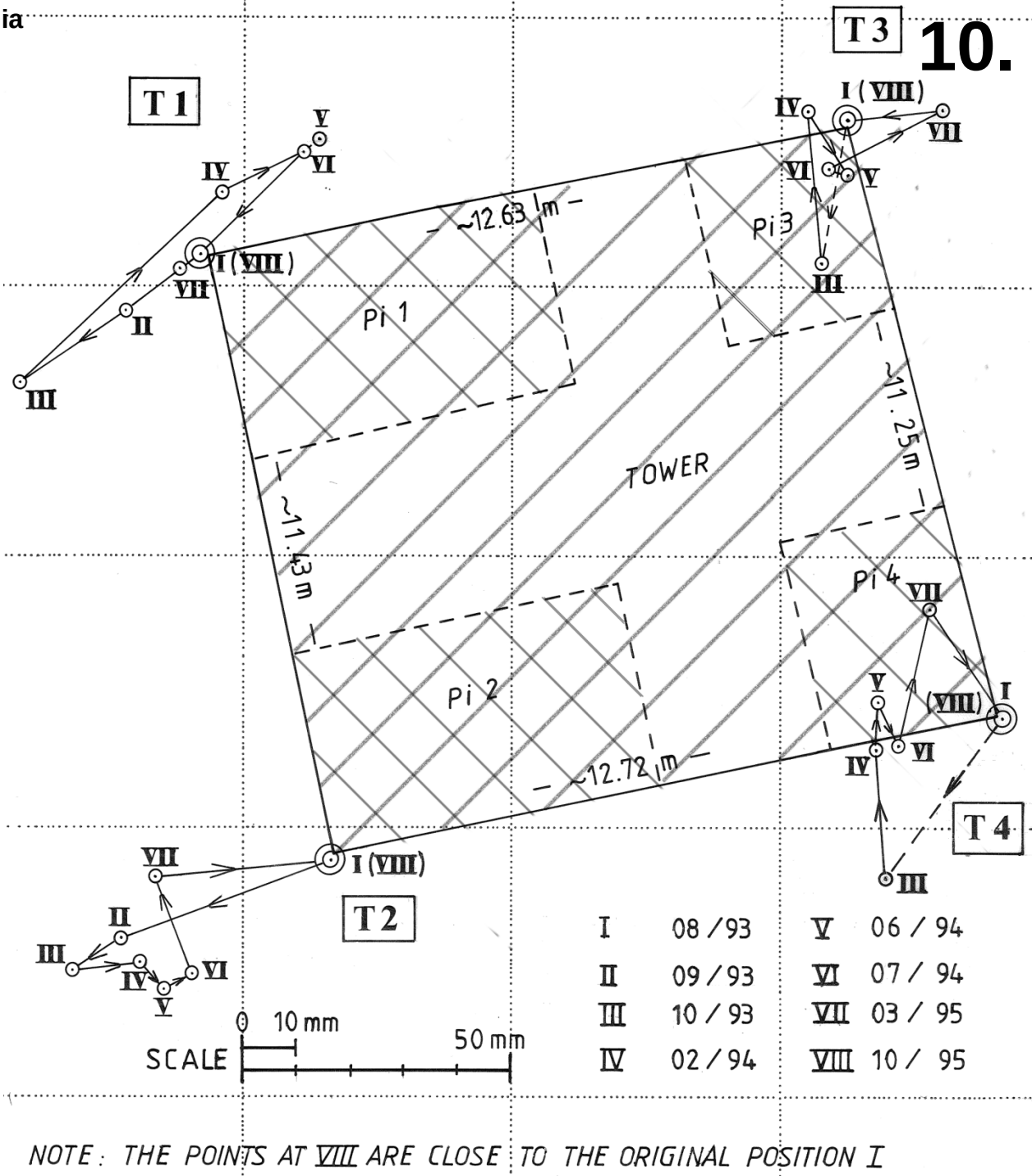




The sequence of the work on the line A is described as following steps (part of the works could be done simultaneously)

1. Digging, first outside, then inside
2. Injection of wall
   - day 1: erection of pipes and shotcreting by hand, day 2: waiting for shotcreting to mature, day 3: injection of lower part day injection of upper part
3. Preparation of piles locations and cutting
4. Jetting of pile locations and installation of piles
5. Torquering the pile step by step
6. Boring of openings for anchors
7. Chiselling of the old stone foundation
8. Casting of concrete beams
9. Prestressing of the concrete beams together
10. Jacking the piles with special pretesti procedure in line A in incremental loading steps at 15 minutes intervals
11. End jacking procedure

Horizontal displacements of the tower.



Church was opened for visitors in May 2005 and the reopening ceremony of the Church was held on 29.6.2005

Sources of the pictures

Dia 1. Louis Höflinger 1860. Johanneksen kirkko. Johanneksen kirkon esite. (L. Höflinger 1860. St. John´s Church. A Brochure of St. John´s Church). Wikipedia. < http://en.wikipedia.org/wiki/St. John´s Church.>

Dia 2. From Juhani Jaeger. St. John´s Church and Photographer Tiina Viireland

Dia 3. Johanneksen kirkon esite. (A Brochure of St. John´s Church)

Others from KAREG Consulting Engineers