



SAPIENZA
UNIVERSITÀ DI ROMA



The engineering of ancient Roman roads

29th of September 2015 - h. 17,30 BRUSSELS



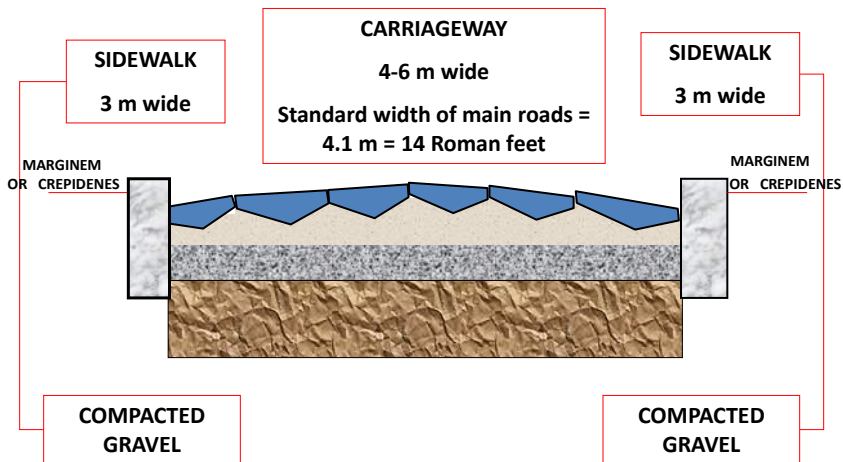
Roman Roads

Paola Di Mascio

"Sapienza University of Rome"

- 1 armilla
- 2 volta
- 3 spalla
- 4 rifianco
- 5 cappa
- 6 riempimento
- 7 parapetto
- 8 pavimentazione

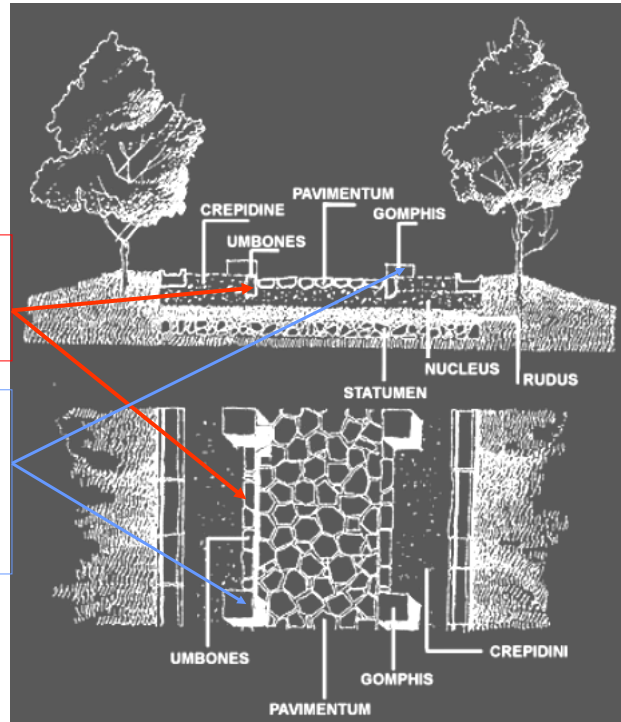
ROAD STRUCTURE



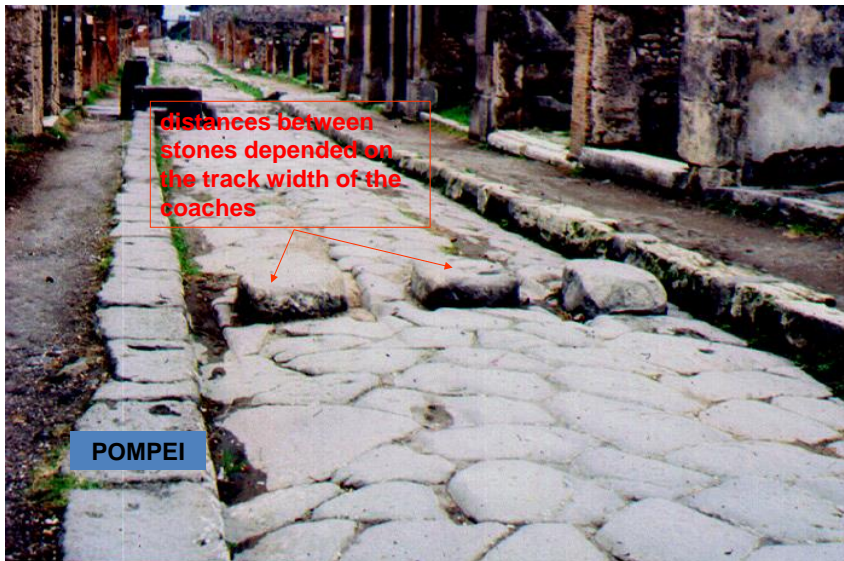
ROAD STRUCTURE

Umbones: Large stones stuck vertically in the ground to delimit the sidewalks and to contain the road pavement

Gomphs: Parallelepipedal stone blocks wedged at regular distances along the roadsides, to facilitate the riders' remounting into the saddle without aid.



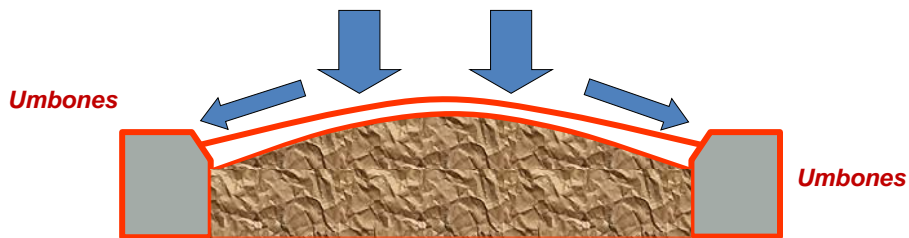
ROAD STRUCTURE



ROAD STRUCTURE

The road cross section was slightly convex, so as to facilitate the flow-off of rainwater.

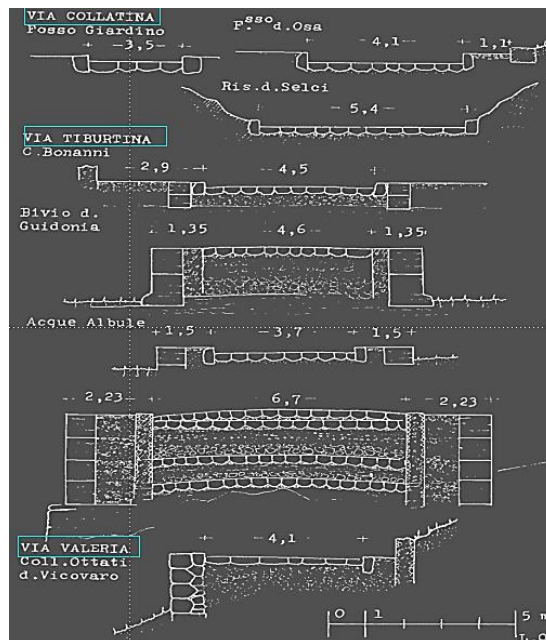
In addition, the convex form of the road distributed the loads over the “*umbones*” without charging the soil too much



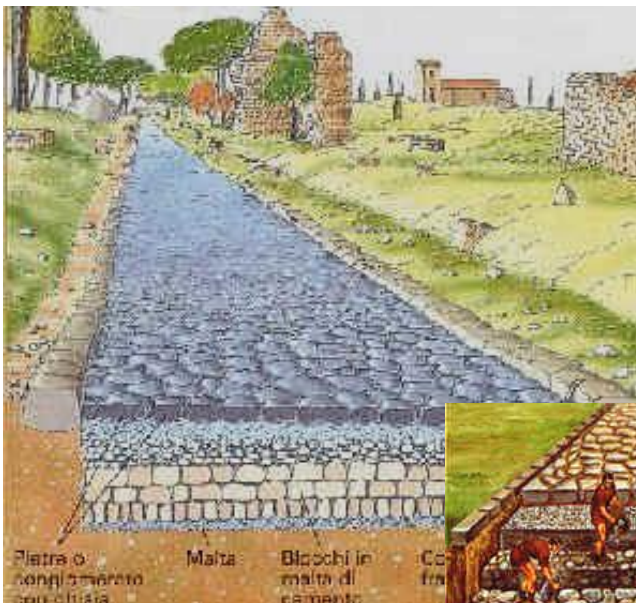
Sections by “*Istituto di topografia di Roma antica*”

Romans very often constructed roads on embankment to avoid:

- flood
- enemy attacks from above



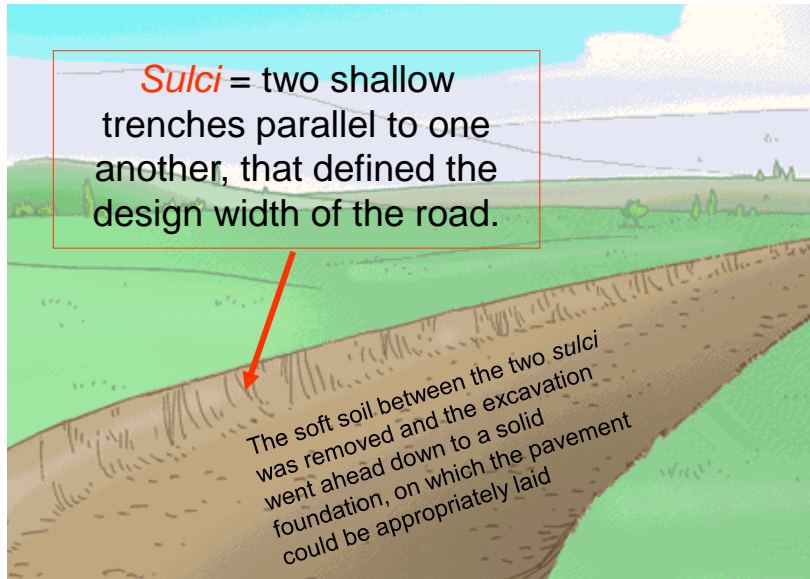
ROAD STRUCTURE



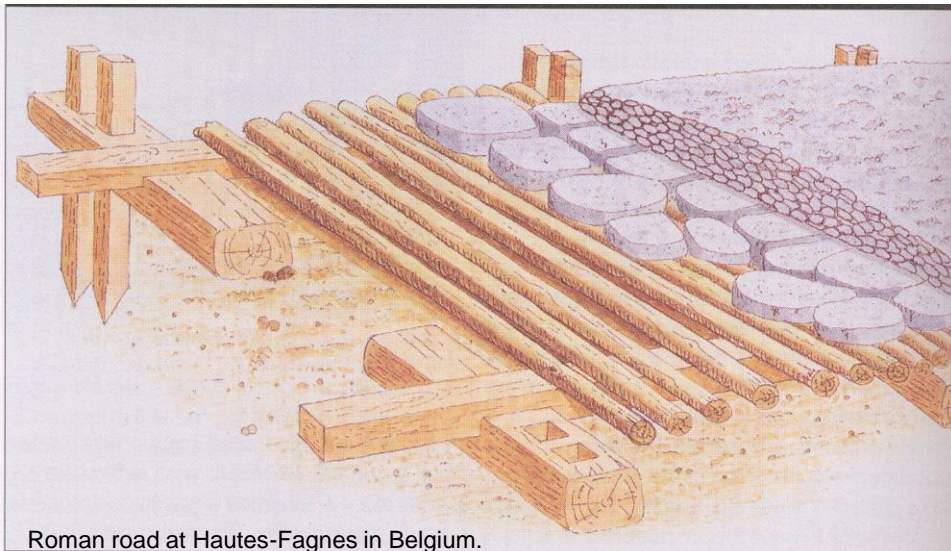
Slaves, war prisoners as well as soldiers, were employed in road construction. We know that many times the harsh working conditions provoked rebellions, which were crushed violently.



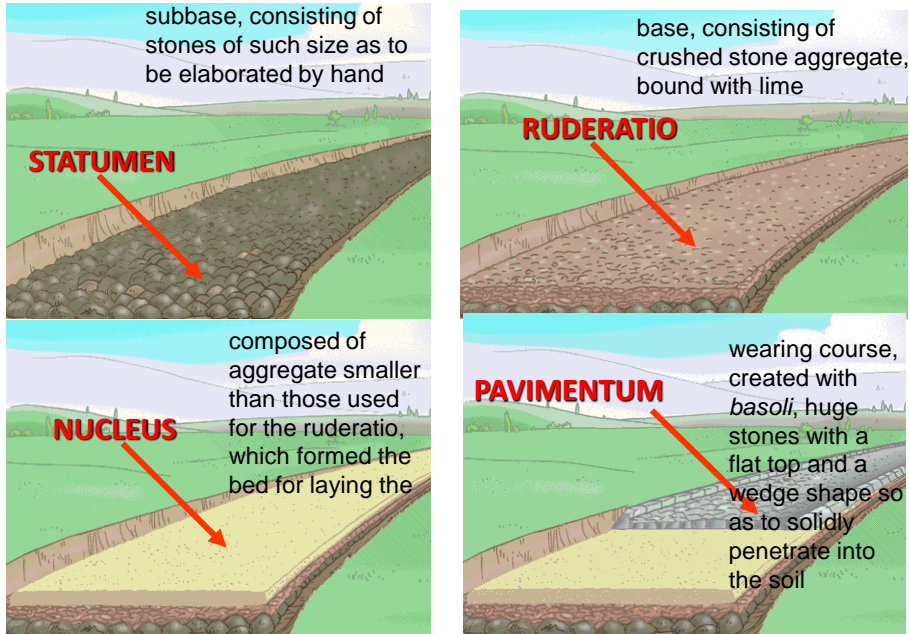
ROAD CONSTRUCTION



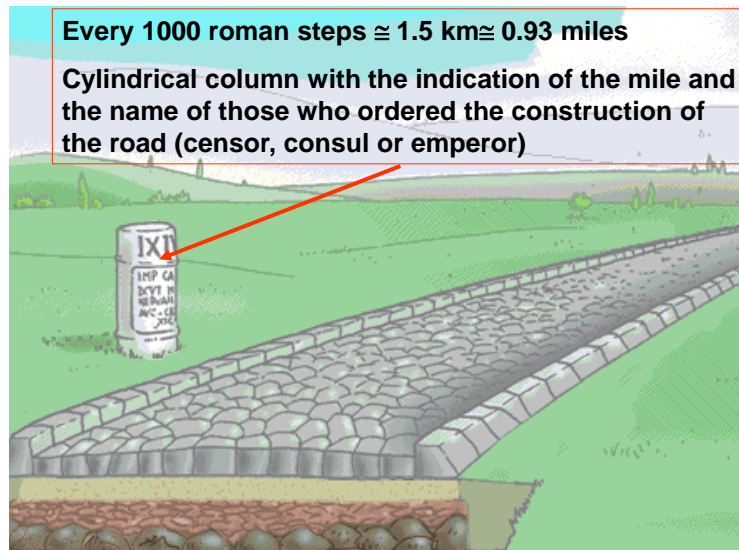
ROAD CONSTRUCTION



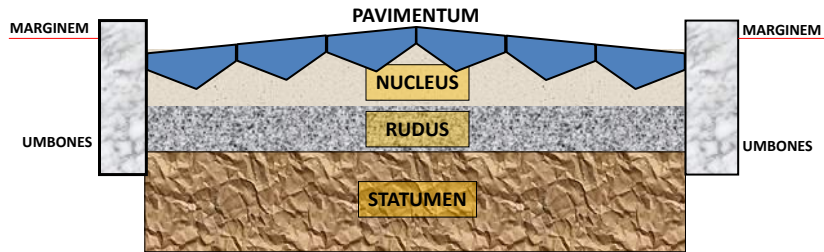
ROAD CONSTRUCTION



ROAD CONSTRUCTION



PAVEMENT STRUCTURE



VIAE LAPIDIBUS STRATAE o VIAE STRATAE

LAPIDIBUS STRATAE = PAVED WITH STONES

STRATAE = PAVED

Urban roads and main rural roads

Roman troops covered up to 38 kilometers a day.

The *Cursus Velox*, could make up to 120 kilometers a day

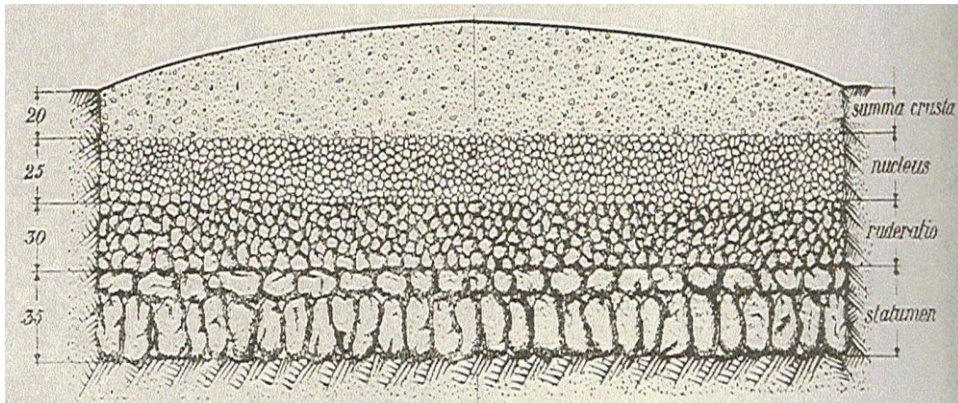


PAVEMENT STRUCTURE

VIAE GLAREA STRATAE o VIA GLAREATAE

Glarea = ghiaia = gravel

Rural roads



PAVEMENT STRUCTURE

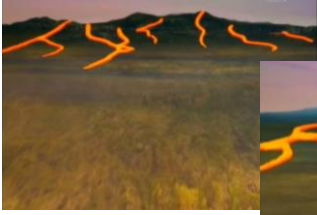
VIAE TERRENAE

no pavement at all

probably built by compacting the
natural soil in situ.

Minor roads

VOLCANIC ACTIVITY IN LATIUM



MUDFLOW RICH OF POTASSIUM = LEUCITITE

USED BY ROMANS TO
PAVE VIA APPIA AND
OTHER ROADS

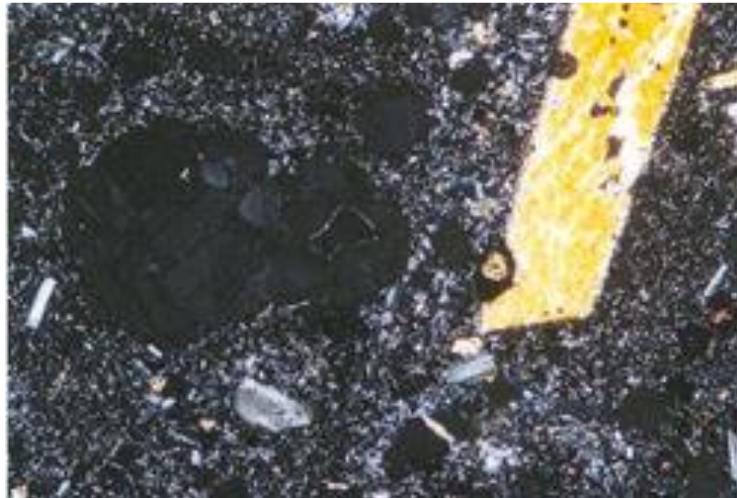
One of the most important **effusive** phases was 270,000 years ago: the flow of lava reached a depth of 7 or 8 meters and traveled numerous kilometers before stopping nearby the current Caffarella valley.

MATERIAL FOR PAVIMENTUM

LEUCITITE

Basaltic **magmatic effusive** rock coming from lava of Latium Volcano

Very resistant and hard material . It wears out very slowly



MATERIAL FOR PAVIMENTUM



MATERIAL FOR PAVIMENTUM



TUFF

*TUFUM
(in urban areas)*

Tuff is produced by the volcano during the explosive phases.

Very common material in the Center and in the South of Italy. It is actually used in the sub-base course of road pavements

SELF-CEMENTING MATERIAL :

Under compactors, fine materials is produced. This material has bounding properties due to iron or alluminium sesquioxide or chalky compounds. This capacity gives cohesion to the aggregate mix and stability to the finished layer.

MECCANICAL STABILIZATION

MATERIAL FOR PAVIMENTUM

TRAVERTINO

(in urban areas)

sedimentary rocks of chemical nature formed by the precipitation of CaCO_3



CHEMICAL ANALYSIS

(Weight %)

CaO	55.00	K ₂ O	0.03
MgO	0.18	Na ₂ O	0.03
SiO ₂	0.50	MnO	0.00
Fe ₂ O ₃	0.16	CO ₂	43.50
Al ₂ O ₃	0.05		

APPARENT SPECIFIC WEIGHT = 2480 Kg/m³

ABSORPTION COEFFICIENT (%) = 0.7

COMPRESSIVE STRENGTH = 360 Kg/cm²

MODULUS OF RUPTURE = 72 Kg/cm²

MATERIAL FOR NUCLEUS

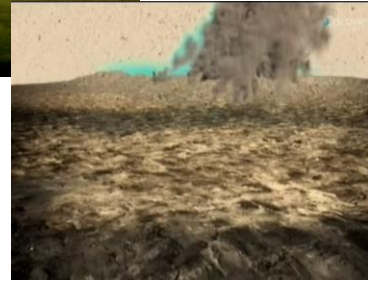
COARSE
GRAVEL
CRUSHED
BRICKS AND
POTTERY
SAND AND
POZZOLANA



MATERIAL FOR NUCLEUS

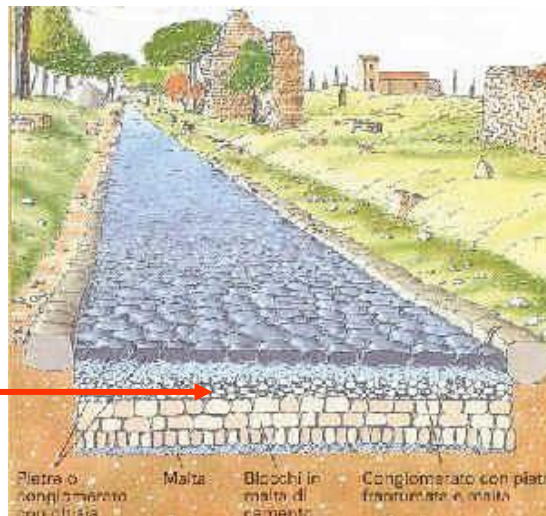
POZZOLANA

Puteolanu(m) (pulverem) = ash of Pozzuoli



Components	Roman pozzolana(%)	Neapolitan pozzolana (%)
SiO ₂	45-47	53-64
Al ₂ O ₃	15-23	17-20
Fe ₂ O ₃	6-12	4-6
CaO	8-9	3-4
MgO	1-3	1-2
K ₂ O ₃ } Na ₂ O }	3-4	5-13

MATERIAL FOR RUDERATIO



STONES BOUND WITH LIME

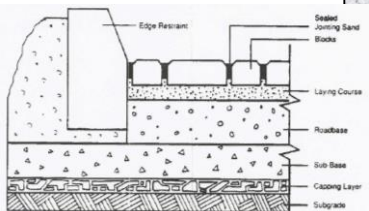
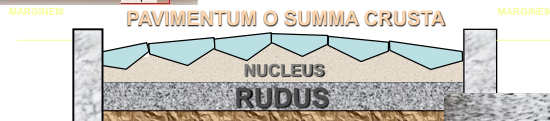
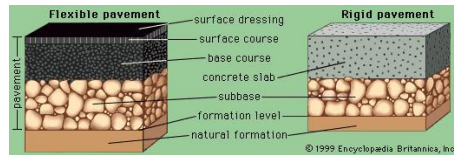
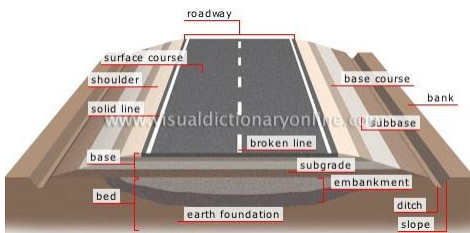


MATERIAL FOR STATUMEN

BALLAST 30 cm THICK WITH VERY LARGE STONES



THE ROMAN HERITAGE



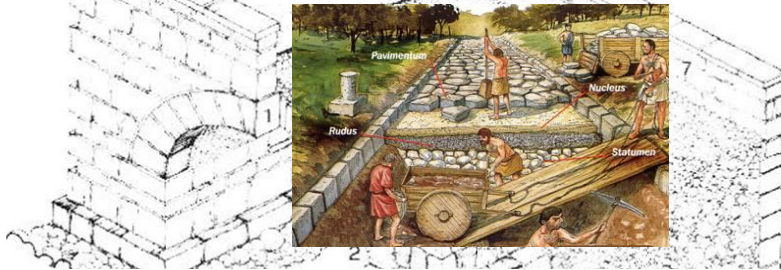


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Thank you! Gratias vobis! Grazie!

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