

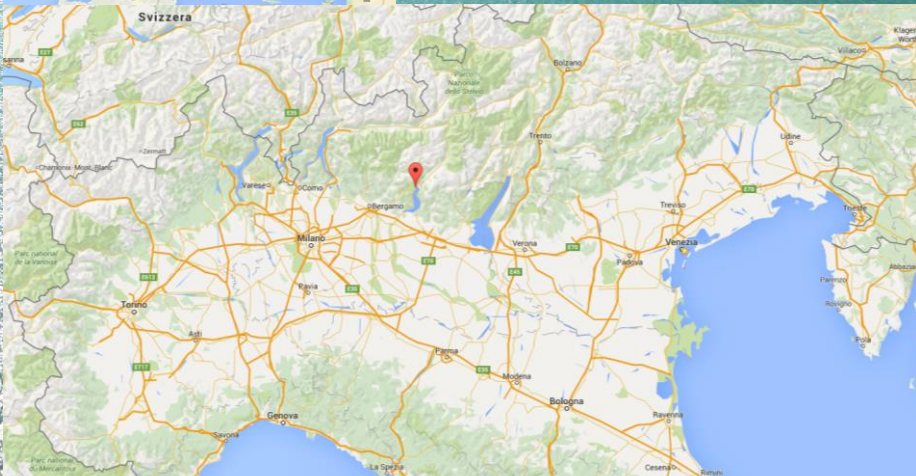
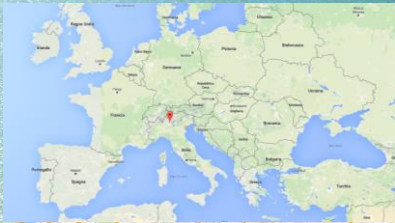
DIMENSION STONES AND ENVIRONMENTAL SUSTAINABILITY THROUGH QUARRY WASTE RECOVERY: HOW SHOULD WE PAY ATTENTION TO THE “COSTS” OF THE PROCESS? A CASE HISTORY

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CEPPO DI GRÈ

dolomitic diamicton



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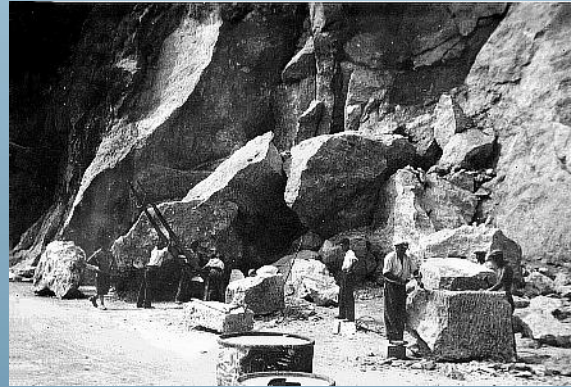
dolomitic diamicton

5÷30 cm

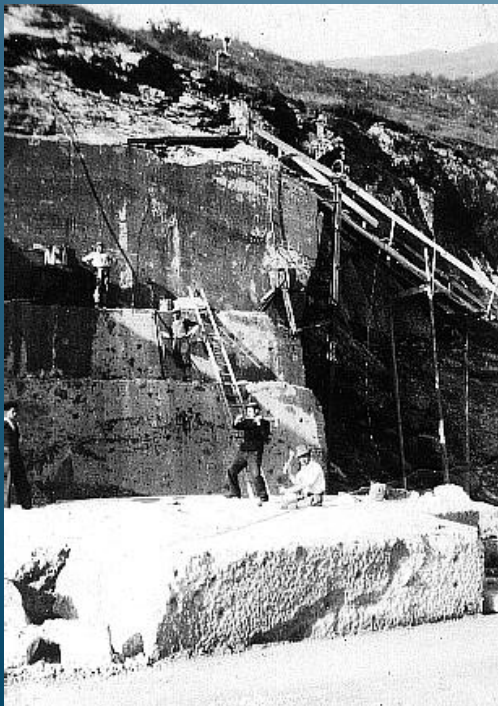
Beginning of XX century



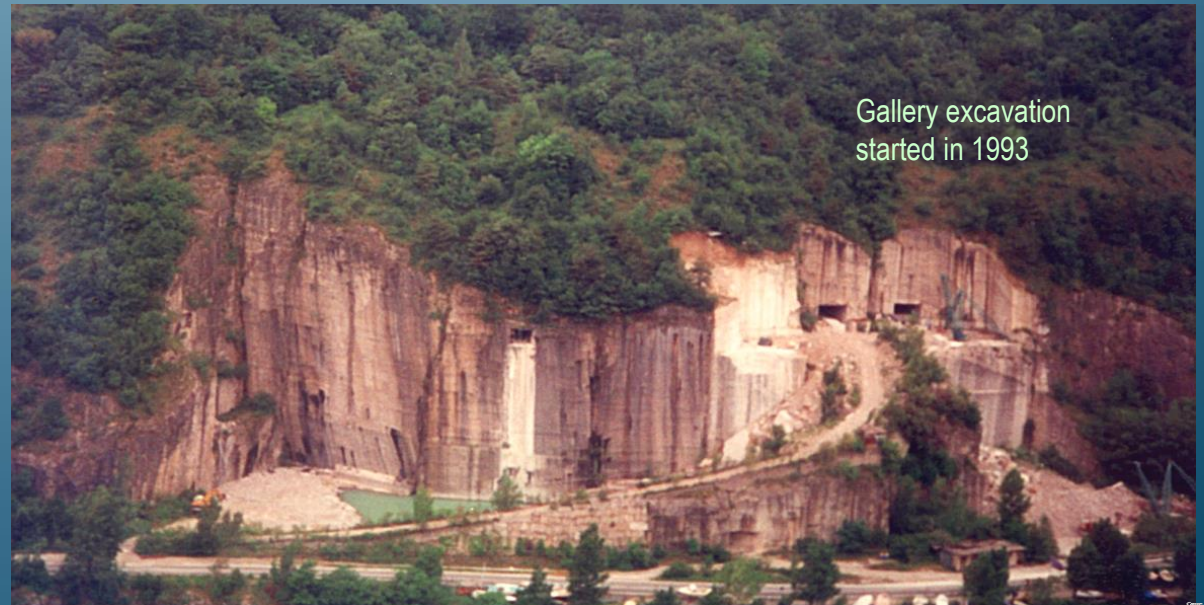
30s: blocks loaded on boats towards the railway station



The quarry from 1896 till today



60s: open air and elicoidal wire



Gallery excavation
started in 1993

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Mount Presolana: a today example of the environment where the deposit formed

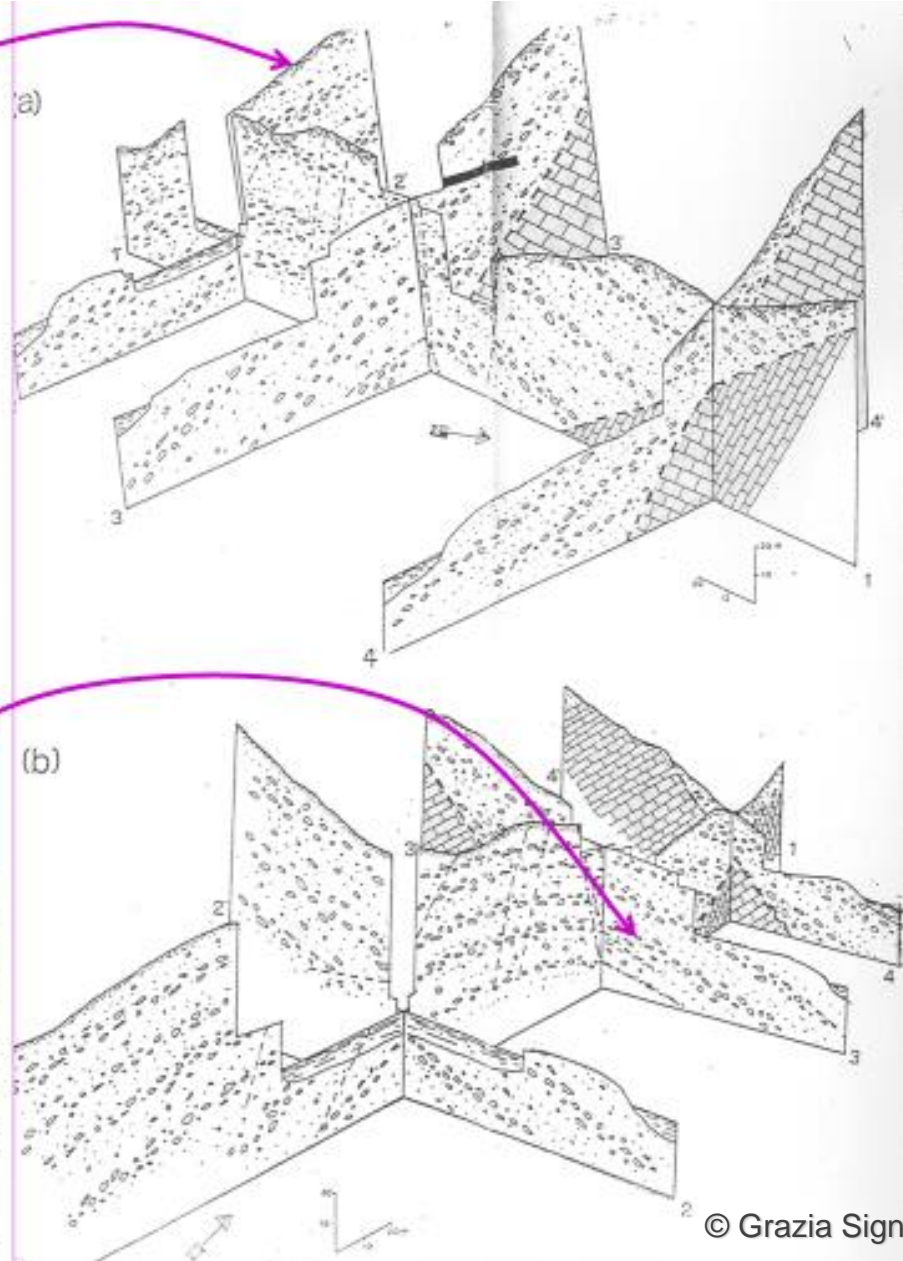
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The excavation system



sketch of the conoid with the typical buckle of the central portion and apparent dip from both sides; dip angles about $25/30^\circ$



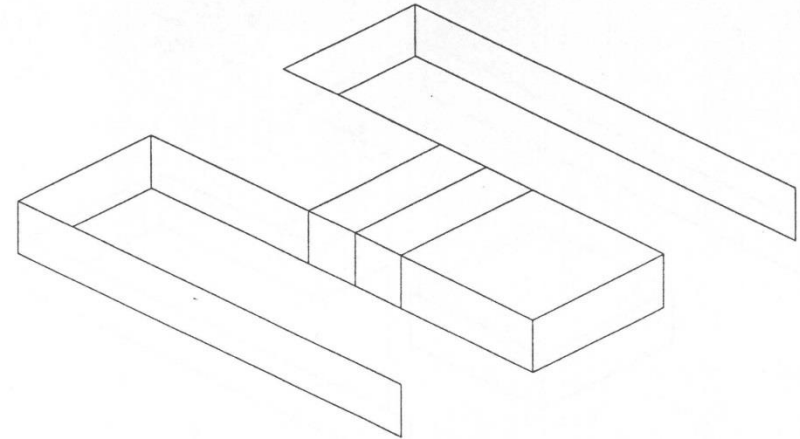
Gallery excavation chain saw



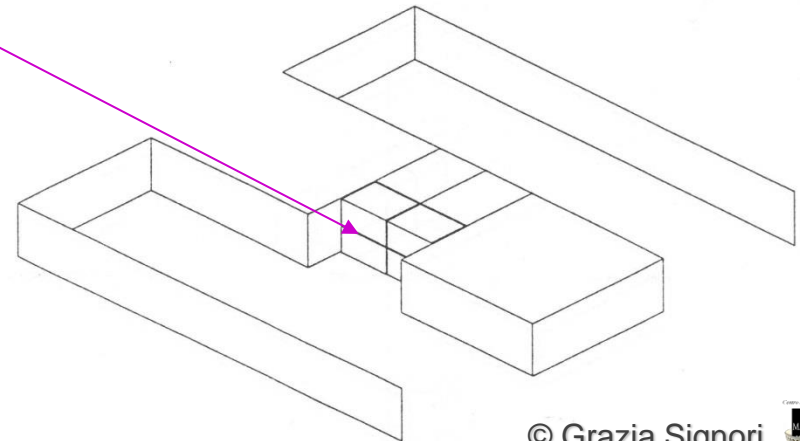
The gallery quarry on one hand led to enhancing the quality and the durability of the dimension stone, on the other hand strictly defined the pattern pillars and the galleries (i.e. exploited blocks). Thus, according to geological and mining engineering constraints, not commercial exploited blocks may more often occur due to the presence of joints or irregular textures or huge boulders

TAGLIO DEI DIAFRAMMI

A): taglio passante con filo diamantato



B): suddivisione in blocchi con tagliatrice a catena



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MACCHINE E MACCHINE
CARRARA SPA



PERC
Pavimento e Ristrutturazione
Carrara



ALFA ROMEO
Carrara



Chain-saw

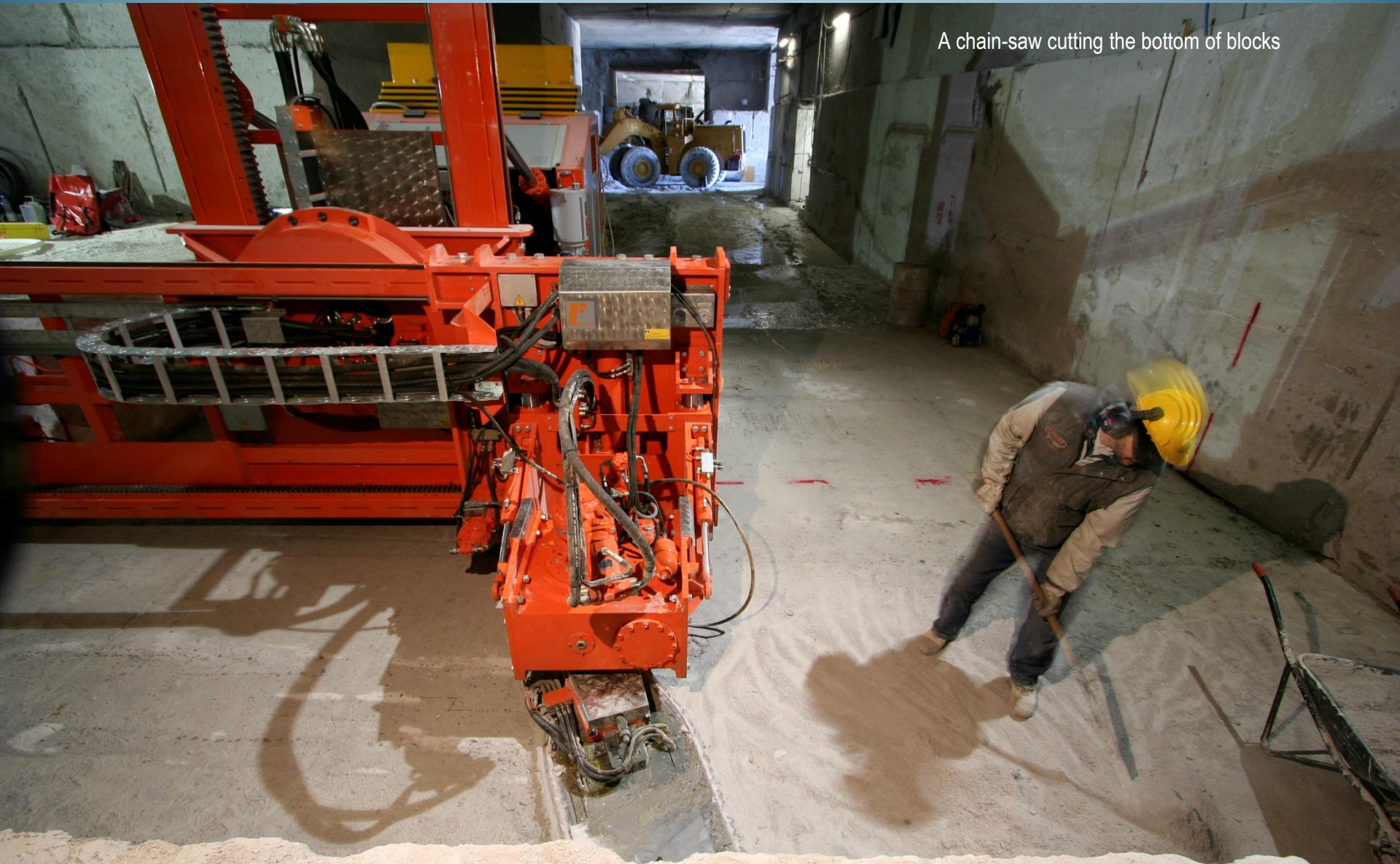


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A chain-saw cutting the bottom of blocks



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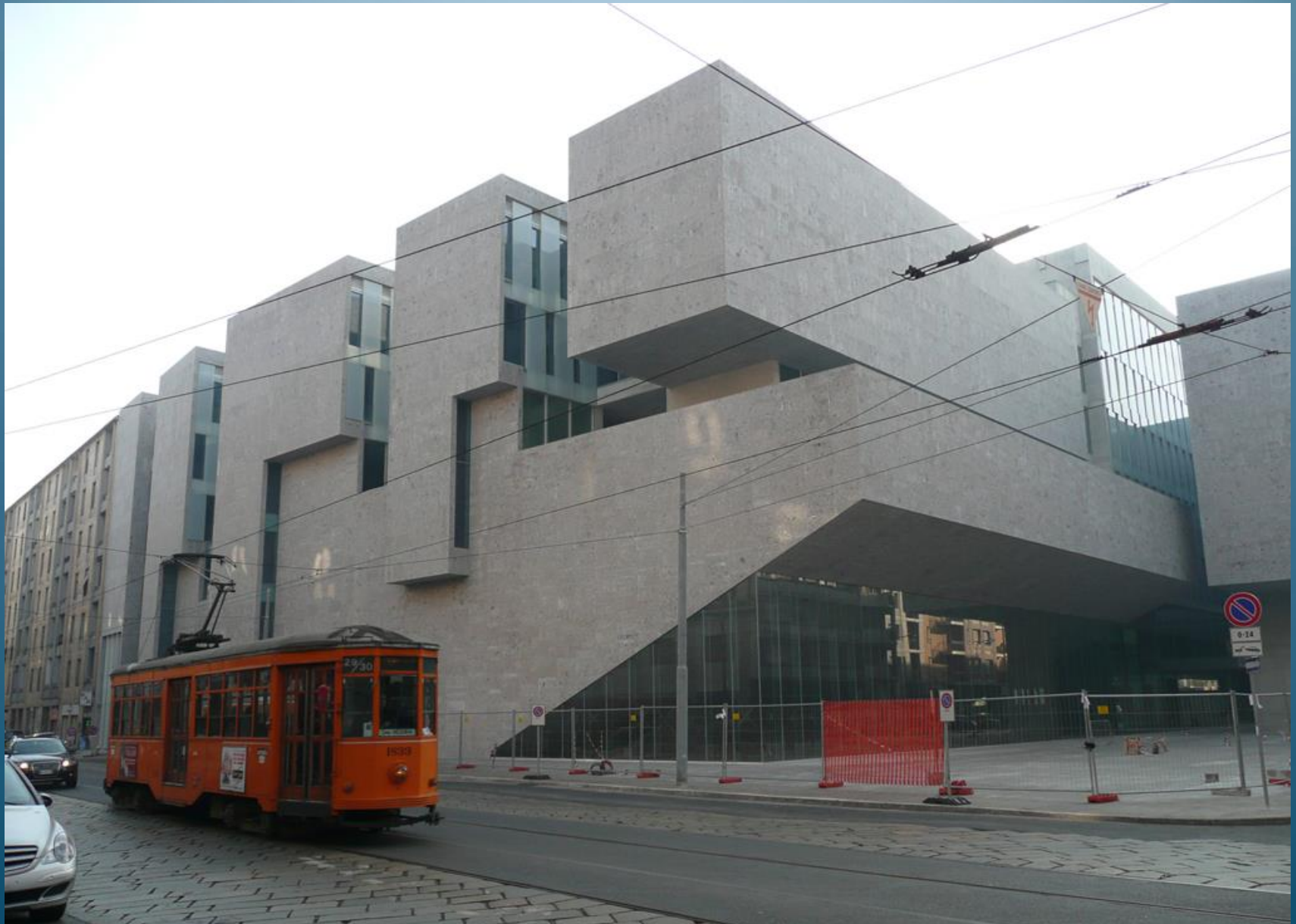
INTERNAZIONALE
MARMI E MACCHINE
CARRARA SPA



PERC
Pavimento Esterno
Rivestimento
Cimentato



ALPI
Cemento e Macchine
di Carrara



Bocconi Building, winner of the Architectural World Prize in 2009, external cladding and paving – Grafton Architects

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not commercial exploited blocks



not commercial exploited
blocks may more often
occur due to the presence
of joints or irregular
textures or huge boulders



From crushed quarry waste:
single-layered terrazzo tiles

Traditional
processing

Technological
and patented
processing



Traditional
processing

It's an homogeneous mixture obtained by mixing natural ingredients: water, inert Ceppo di Gré, and white cement, Italcementi 42.5.

The mixture is vibrated and compacted into blocks of size 180 x 40 x 130 cm.

After 28 days of curing the blocks are ready to be sawn

Technological and
patented
processing

It's an homogeneous mixture obtained by mixing natural ingredients:
water, inert Ceppo di Gré, and white cement, Italcementi 42.5.

The mixture is vibrated and vacuum compacted into blocks of size
253 x 80 x 123/142 cm.

After 28 days of curing the blocks are ready to be sawn

Traditional processing

Technological and patented processing

- Aesthetical look/appearance is quite similar
- Quarry waste used is the same

- Facility and plants are 5 km far from the quarry
- Technical properties are poor
- Production cost is much cheaper
- Very large slabs aren't available

- Facility and plants are 100 km far from the quarry
- Technical properties and durability are excellent
- Production cost is much more expensive
- Very large slabs are available

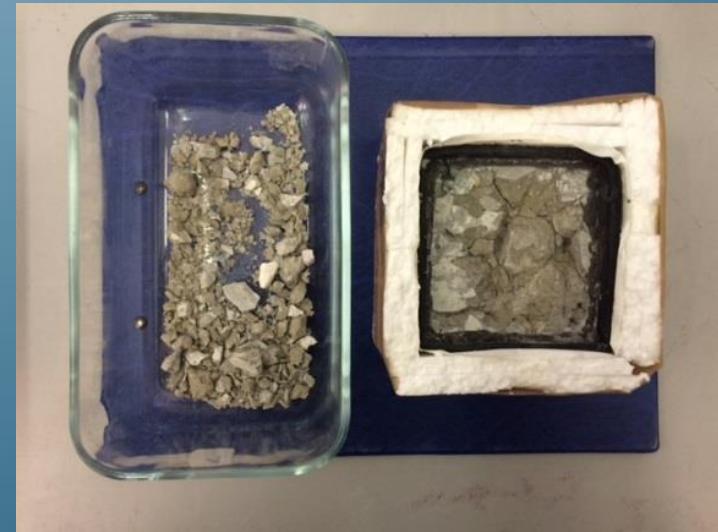
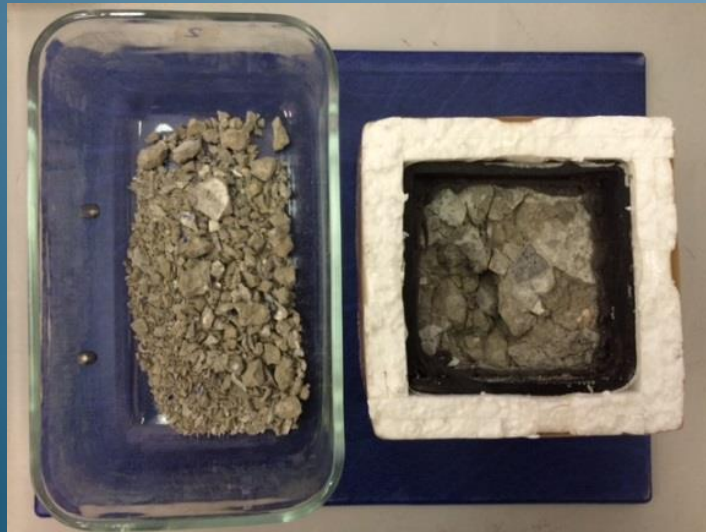
Technical properties	Standard test method	Traditional terrazzo tiles	Patented terrazzo tiles
Water absorption	EN 13748-1	6,9 %wt	5,3 %wt
Abrasion resistance	EN 13748-1	21,5 mm	21,0 mm
Flexural strenght	EN 13748-1	4,8 MPa	8,0 MPa
Compressive strenght	EN 14617-15	51 MPa	72 MPa
Freeze/thaw resistance	EN 13748-2 and 12371	failed	-7% (7,4 Mpa)

They comply with EN 13748-1 requirements (terrazzo tiles for internal use), but don't comply with EN 13748-2 requirements (terrazzo tiles for external use).

They comply both with EN 13748-1 requirements (terrazzo tiles for internal use), and with EN 13748-2 requirements (terrazzo tiles for external use).

Traditional terrazzo tiles

Freeze/thaw resistance according to EN 13748-2: detached pieces were over 100x the allowed amount

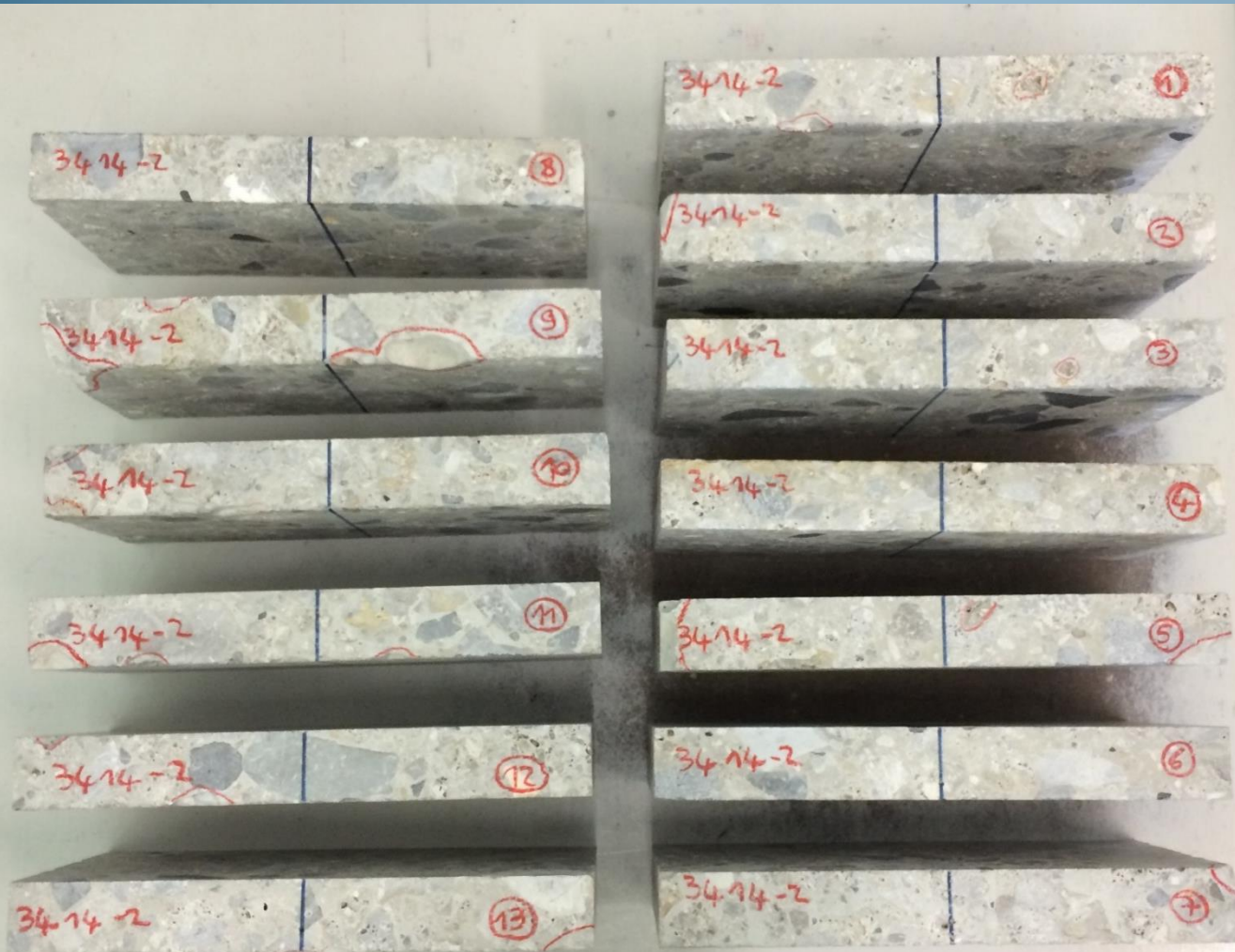


Traditional terrazzo tiles

Freeze/thaw resistance according to EN 12371:
at the 5th of 14 cycles specimens were all crushed



Patented terrazzo tiles



Freeze/thaw
resistance according
to EN 12371:
at the end of 14 cycles
specimens were well
preserved



Different manufacturing processes involve very different cost of production, not only strictly related to manufacturing, but also to

- transports
- patents
- raw materials
- production chain, etc.

As LCA should be taken into account whenever pondering the cost of production, a very **clear idea of the final use** of the product and then relevant laboratory tests are the main keys to **predict physical and durability behavior** of the product, and avoid adding waste to other money and time consuming further waste

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THANK YOU
FOR YOUR KIND ATTENTION