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# Production, Transport, and Socio-ecological Impact of Building Materials in the Roman Empire

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## Résumé

The process of construction essentially depends on the availability of suitable building materials. For the Roman Empire, a large number of large-scale building projects are attested, which created an immense demand for stone blocks in various formats, mortar, bricks, and timber. This need led to the exploitation of natural resources as well as the establishment of production sites where bricks were made or lime was burned. The choice of materials was influenced on the one hand by the regional availability of mineral and biological raw materials, and on the other hand by extensive networks of transportation. In many cases, this caused a major impact on the natural environment. For example, quarries and the extraction of building or firewood could permanently change entire landscapes.

Quarries were developed to satisfy the need for suitable stone blocks. To minimise transport costs, these were extracted in the vicinity of the towns and military camps, if possible. If no suitable deposits were available, the stones had to be transported over long distances. Riverine networks played an important role for this type of logistics because of the relatively low transport costs. Due to their different geological characteristics, the origin of stone materials used in Roman buildings can be well determined by means of archaeometry.

Ceramic building material (CBM) plays a special role in the assessment of Roman construction projects. Brick and tile are often discovered during excavations. Although they were also recycled secondarily, this did not take place to the same extent as with stone ash-lars. Producers can be distinguished by the practice of stamping, which was widespread in large parts of the Roman Empire. In the frontier provinces, military stamps are also common. This opens up the possibility of in-depth studies on military involvement in state and public building projects. Archaeometric analyses can also be used to locate production sites. Last but not least, due to modern firing tests, the process and effort of brick production also offers great potential for empirical tests and quantification.

For a long time, timber has been underestimated as a building material in archaeological research. Yet it was an indispensable part of almost all Roman buildings, in particular for roofs, which are usually not preserved. In addition, timber was also a sought-after building material for half-timbered walls in various regions of the Roman Empire. Dendroarchaeological investigations can help to determine the type, dating, and origin of the trees used in Roman building projects. Recent investigations indicate that some of these trees were transported over very long distances. In addition, archaeometric results also allow conclusions about the environmental conditions in the immediate surroundings of the respective construction site.

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\*Intervenant

Lime was also needed in large quantities for numerous buildings. This applies to the production of mortar for joints, but also in particular to the production of *opus caementicium*, which was an essential building material in the Roman Imperial period. The production of lime required a large amount of energy, which had to be covered mainly by firewood and other types of fuel. In addition, kilns had to be built for burning lime.

This panel aims at bringing together papers from various disciplines, such as Archaeology, Roman History, Archaeometry, that use quantitative and qualitative methods in order to assess the four building materials (stone, CBM, timber, and lime) with respect to the effort, organisation, costs, and consequences of their provision. Case studies may come from both the Mediterranean and the Empire's frontiers, thus contributing to ongoing discussions about the dimensions of the demand for building materials, their production, and distribution across the Roman world.

**Mots-Clés:** Roman Empire, architecture, construction, building materials, society, ecology