Masons, Materials, and Machinery:

Logistical Challenges in Roman Building

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The Augustan-era poet Tibullus records an episode in the life of a Republican merchant, "His fancy turns to foreign marbles, and through the trembling city his column is carried by one thousand sturdy pairs of oxen."[1] By sheathing Rome in marble during the early 1st c. A.D. Augustus essentially prefigured three centuries of colossal stone construction in the capital.[2] Subsequent emperors favored massive monolithic columns, metaphorically equating their size and distinctiveness with the might and reach of the empire. These exotic marbles, pried from quarries in peripheral locales like Egypt and Anatolia, demonstrated that Rome could bring wealth from any of its territories to showcase in the capital. Although these marble monoliths were a symbol for the supremacy of Rome, the real power was displayed in their erection.[3] Key imperial construction projects developed into major spectacles, and the convoy of marble columns and cartloads of building materials to the building site shook the ground and commanded attention. One such case study from the Tetrarchic period is the building of the great Basilica of Maxentius at the southern end of the Roman Forum.[4] In addition to its vast quantity of brick and concrete, the plans for the basilica specified eight Proconnesian marble columns that weighed in excess of 90 tons. These columns contained the perfect means to put on a dramatic show of Roman engineering and organizational expertise. The resulting parade of stone and brick to the Forum glorified the ambitious building program of the Emperor, and gave the people of Rome a spectacle that had been absent in the capital for nearly a hundred years.[5]

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[1] Tibullus, *Elegiae,* 2.3.43-44.

[2] Augustus was famously quoted in Suet. *Aug*. 28 as saying "I found Rome built of bricks; I leave her clothed in marble," insinuating that he had jump-started the imperial marble industry and used the stone extensively in the capital city. It has been noted that, at the time of Augustus, most buildings were simply decorated with marble revetments, and were not structurally composed of marble; this circumstance would be exhibited later, during the reigns of Hadrian, Trajan, and others.

[3] Adam 1994, 24. Adam states that the astonishing technical accomplishment in the handling and transporting of these marbles is only overshadowed by the rendering of such grand achievements as commonplace by the Romans.

[4] The Basilica is located on a spur of the Velian Hill, which skirts the southern end of the Roman Forum along the Via Sacra (which is variously recorded as in or out of the Forum proper); for the particulars of the Basilica of Maxentius, see the entries in Steinby 1995-2000 and in Platner and Ashby 1929; also for reference consult Giavarini 2005.

[5]The last instance of columns this size near the city center may have been the monoliths at the Pantheon and the Forum of Trajan in the 2nd c.; most of the projects after this date were based in brick or smaller decorative materials. The emperors were largely absent from Rome after 280 A.D., although Diocletian refurbished the Senate House in 283 and built a large arch, a Decennalia monument, and a large-scale bath complex (albeit outside the forum area). According to Rees 2004, the ancient scholar Aurelius Victor sees the building program in a positive

In the late 3rd c. A.D., the political circumstances of the newly-Tetrarchic Roman Empire had bred a mercurial situation for the city of Rome. The manipulation of Diocletian had reduced Rome to a regional urban center subject to taxes and devoid of a power base. Maxentius capitalized on the plebeian reaction to this demotion, swiftly resurrected the defunct Praetorian Guard, and usurped the title of Emperor in 306 A.D.[6] His main statement of power was to take the form of an aggressive architectural program. Maxentius saw the void created by the Fire of Carinus in 283 A.D. as an opportunity to make an architectural statement in the Forum, and soon formulated a plan to punctuate the Velian Hill with a series of monuments (Fig. 1). To this end, he reconstructed the Temple of Venus and Rome and built a small temple dedicated to his son Romulus. But it was the massive Basilica of Maxentius that functioned as the key piece of imperial propaganda, and provided the opportunity for vast spectacle of construction that had not been seen for decades.

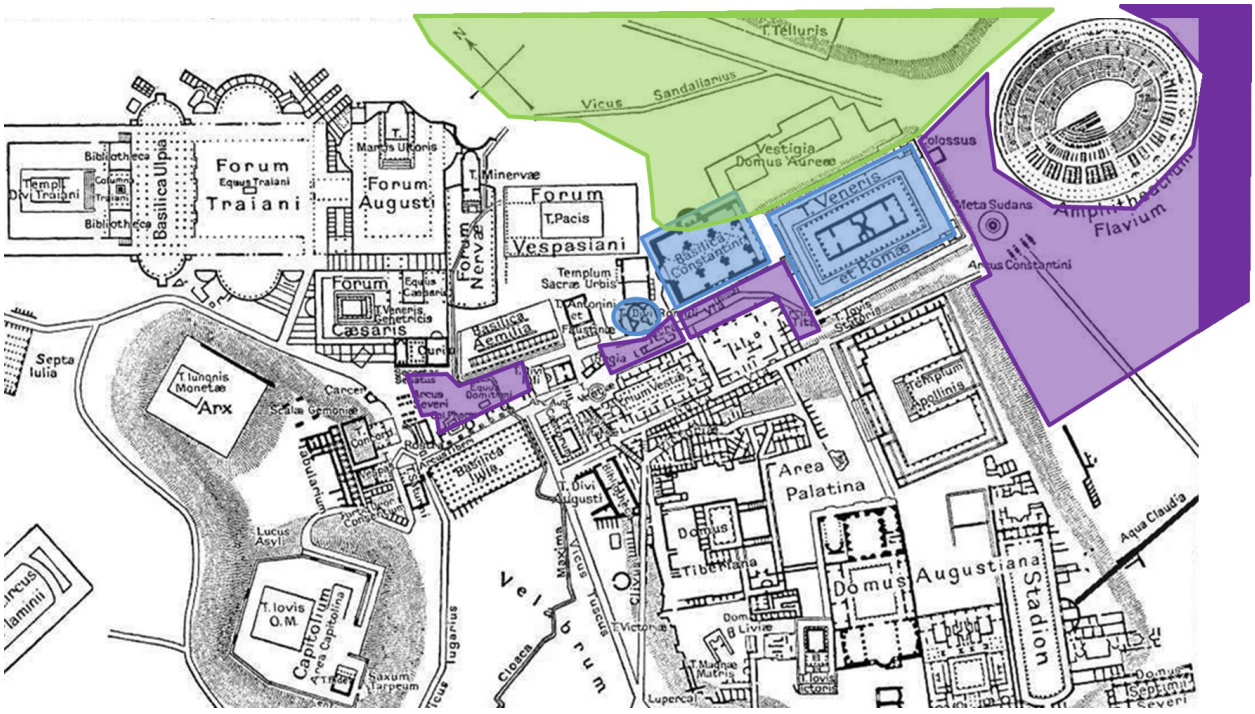

Fig. 1: Figure 1: Diagram of Roman Forum, with constructions of Maxentius in blue, extent of the Velian Hill with Flavian-Trajanic Villa in green, and possible material staging areas for the Basilica and Maxentius' other constructions in purple.

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light, whereas Lactantius sees in a negative light. Before Diocletian's small additions to the forum, the last addition of significant size was the Arch of Septimius Severus in 203 A.D. The last instance of columns this size near the city center may have been the monoliths at the Pantheon and the Forum of Trajan in the 2nd c.; most of the projects after this date were based in brick or smaller decorative materials (including the city walls of 260, the Curia of 283, and the baths of the 280s).

[6] An investigation of Maxentius policy is included in Cullhed 1991; as well as in a Master's Thesis by the author. For reference on the Tetrarchic situation, see the relevant sections (1.2. Roman Politics 284-305 and 2.2. Provincial Capitals and Rome) in Rees 2004, 5-8, 27-30.

The mobilization of materials for the basilica's towering vaults and central hall caused a great stir in central Rome and the first months of assembly quickly stimulated the construction industry.[7] Given the project's vital location, the populace could hardly be forced to ignore each new building phase. Construction crews immediately began clearing away the Velian hillside for the massive foundations of the Basilica, which included an excavation decidedly detrimental to the Flavian-Trajanic villa situated above it.[8] The size of the building site successively grew, with provisions made for the construction of temples to the north and south of the Basilica. Although the site itself was to be constrained by the existing Templum Pacis, the Via ad Carinas, the new Temple of Romulus to its north, and the Temple of Venus and Rome restoration to its south, the Basilica's staging areas most likely spilled out into the area of the Via Sacra. The plethora of materials required for the masons to construct the massive basilica far exceeded the area immediately surrounding the building site, and as a result, must have inundated the rest of the central city. The Forum and the Colosseum Valley would be likely staging areas for materials and implements, but this naturally depended on the ability to shut down these sections for a period of months or years at a time. The constant running of materials, carts, and laborers from site to staging area and back was undoubtedly a large disruption to everyday life in the business district. However, the bustle associated with clearing foundations, laying bricks, and composing concrete would pale in comparison with the rumble of stone monoliths down Rome's cobblestones. It had been 100 years since the emperor Septimius Severus had last brought colossal marble columns into the center of Rome, and this new occasion was marked on the schedule. Maxentius was thus able to link this construction spectacle to Severan, and even Hadrianic or Trajanic methods of punctuating imperial building projects with massive monoliths.

The procurement, transport, and deployment of substantial marbles had long been a source of pride for the Roman emperors, and effectively demonstrated their dominion over the areas of marble production.[9] The fact that the marble trade was able to be successfully utilized after years of stagnation speaks volumes about the organization of its infrastructure. The actual procurement of the monoliths had already been months or even years in the making. The quarries of Greece, Italy, Anatolia, Egypt, and Africa had remained in continuous use to furnish stones for the four separate provincial capitals of the Tetrarchy.[10] Shipments were constantly crisscrossing the Mediterranean, as exemplified by the nine different types of exotic marble used in the construction and decoration of the Basilica of Maxentius.[11] The eight gigantic Proconnesian monoliths were by far the grandest addition to the plans, and required some foresight to attain.

[7] For material requirements of concrete vaulting, cf. Lancaster 2005.

[8] Giavarini 2005, 21-23.

[9] Cf. Fant 1988; Ward-Perkins 1971.

[10] Cf. the relevant essays 'Geology of Greece and Turkey: Potential Marble Source Regions,' 'Quarries and the Marble Trade in Antiquity,' and 'The Roman Emperors in the Marble Business: Capitalists, Middlemen, or Philanthropists?' in Herz and Waelkens 1988.

[11] Giavarini 2005, 119-120, citing Africano, Cipollino, Numidian Yellow, Grey Granite, Pavonazzetto, Portasanta, Red Porphyry, Proconnesian, and Green Porphyry.

The storage yards in the Roman Emporium district display evidence of a large stock of decorative marbles, but eight 15 m long monoliths may have been outside the realm of possibility.[12] Columns of this specificity and grandeur may have been ordered directly from the quarries in the Sea of Marmara, in the Anatolian Hellespont.[13] If that was the case, the columns might have taken 6 months or more to arrive at Rome, inclusive of quarrying and transport.

The columns were separated from the mountainside, roughly shaped, loaded on to barges, and shipped almost 2400 km to the port of Ostia.[14] The journey was briefly waylaid at the Portus marble yards on the banks of Ostia, and the columns were likely reloaded and ferried the remaining 30 km up the Tiber River. They would then be stored at the Emporium yards, which lie between the Testaccio bend of the Tiber and the slope of the Aventine Hill.[15] The date of arrival would depend on both the season in which they were ordered and the level and navigability of the Tiber.[16] Substantial marbles like this may have been ordered well before they were needed on site to avoid any mishaps.[17] The columns likely were stored in the Emporium for months before the marble procession took place. This furlough would then allow the building foremen to plan the specific route through the city, and anticipate any problems with the haul. The oxen and drovers were hired, and the carts, pulleys, logs, and lifting apparatus were

[12] In reference to the marbles contained within the emporium, consult Fant 2001; Ward-Perkins 1992, 24; Pensabene 1995, 156-158; Fant suggests that by the Antonine period, quantities of marble shipped to Rome reached several thousand blocks per year, Ward-Perkins states that the imperial system of quarries, operating continuously rather than fulfilling orders as they arrived, had produced so much marble by the Antonine period that the rest of antiquity, and indeed later ages, never used it up, and Pensabene referred to the marble inventories as if they represented a fiscal reserve.

[13] Several famous imperial-age projects employed Proconnesian white marble, a notable example being the Arch of Trajan in Ancona, made solid in solely Proconnesian blocks. Also of note is the preference during the Antonine age for Proconnesian marble metropolitan sarcophagi; cf. Bowersock et al. 1999, 560; the authors mention that Proconessus began another sustained period of supplying white marble to the new capital of Constantinople from the 320s to the late 6th c. A.D., even remarking that Proconnesian white was the marble of choice for all new building projects.

[14] Adam 1994, 20, stating that term quarry (*carrier* in the native French) may derive from the heavy cart designed to transport stones along the tracks leading to or from the source, and see Adam 1994, 26-29 for technique and visual representations.

[15] Maischberger 1999, 325; Maischberger sites here the number of materials found at the Emporium yards, suggesting that this was, without a doubt, the largest stockpile of marble in Rome, from the Neronian age through the end of the Empire.

[16] Scholars estimate that the Mediterranean was passable by ship during about half of the year, and with such valuable cargo, the transporters must have planned their voyage accordingly. DeLaine 1997, 108 suggests that long shipping voyages across the sea were impossible from early November to early March and deemed dangerous from late September to late May. The remaining passage up 30 km of the Tiber was facilitated by oxen and guide-ropes which towed the barges against the currents. DeLaine 1997, 108, citing Casson 1995 and Eubanks 1930 among others, mentions that normal river barges on the Tiber probably consisted of 70-ton voyages with 3-man crews, needing one pair of oxen per 20 tons of portage.

[17] Wilson-Jones 2000, 199-206; Wilson-Jones and others have noted the possibilities for alterations being made to buildings based on lost or damaged materials.

arranged.[18] The streets were cleared, and the paths opened up. Planners and laborers darted in every direction, readying the route. There had been workers in the city for months constructing Maxentius' projects, but the linear and deliberate brickwork tasks were soon to be trumped by a fantastic feat of Roman power and engineering.

The veritable parade of marble began with the coordinated emergence of a train of oxen hundreds of feet long, dozens of supporting teams, and a 15 m long marble column cradled tightly on sturdy carts.[19] Each of the marble columns weighed at least 90 tons, and required over 200 oxen pairs each.[20] Assuming that oxen are at least 2.5 m long with their yokes, and run with two pairs side-by-side, this gives the train a length of over 530 m. Spectators may not have witnessed the initial emergence of this procession from the Emporium warehouses, but the gradual materialization of such a long train of equipment became visually arresting throughout the remainder of the route. The oxen train had likely been afforded the luxury of traveling during daylight hours, as the *Lex Iulia Municipalis* limiting heavy traffic during the day did not apply to imperial building projects.[21] Therefore, the peril of 400 oxen and a 90 ton stone could at least be tempered with day-lighting. Nightfall would undeniably halt the marble procession, making the streets and building angles impossible to account for.

There are many other aspects of transporting materials within the city that would require much attention by the planners, including the character and disposition of the Roman street.[22] The harsh cobblestones were shared by pedestrians, politicians, merchants, and pagan ministry alike. Public use had to be balanced with private commercial use, even in times with no construction traffic. A narrow, roughly-paved street was suitable during the normal market day, but needed to be cleared during times of large-scale construction.[23] The surface of the street was then either covered by log rollers or scuffed by the hooves of thousands of oxen. The clearing of the streets

[18] The character of the workforce would be composed of drovers needed for each pair of oxen, foremen needed to supervise the entire operation (provided by marble yards or imperial design staff), workmen to steady loads as they are transported, and miscellaneous workmen to clear areas ahead and behind; in total the workers might number in the hundreds.

[19] In antiquity, transporting loads meant pushing, pulling, or dragging materials in a pre-industrial state; the concept of using oxen is widely accepted as the standard way to move loads, see Fitchen 1986, also consult Burford 1960; the oxen might also have been employed in combination with rollers and pulleys for uphill/downhill journeys, of which we have evidence from a court case in *Dig*. 9.2.52.2, in which a loose wagon ran down a hill and killed a slave boy.

[20] The columns are 14.7 m high and 1.7 m in diameter, which gives a total volume of 33.3 m^3. Marble weighs an average of 2.82 tons per m^3; the columns weigh over 90 tons. Xen. *Cyrop.* 6.1.52 records that each oxen yoke could carry 380 kg (0.42 tons). This estimation would necessitate at least 230 oxen pairs.

[21] DeLaine 1997, 98-99 notes that the *Lex Iulia Municipalis* is our only source detailing the use of heavy cart traffic in Rome; the Law (*Tabula Heracleensis* vv. 56-61) states no heavy traffic for the 10 hours after sunrise, excepting for imperial building projects or demolition works.

[22] For Roman street traffic and the character of the Roman via, see Poehler 2003 and Van Tilburg 2007.

[23] This is an assumption based on the length of this particular oxen train, but also the number of oxcarts with standard building materials like brick, wood, and mortar that needed to traverse the same route repeatedly during the construction period.

along the route meant that storefronts and homes could not be accessed during a great deal of the day. It also meant that building facades and corners were not completely safe from damage. A large column, or even various construction materials, could easily destroy the wall of an apartment block or cause other collateral damage in the city. Although the procession of marble had the power to dictate its route, the character of the buildings along the route made a huge impact in the difficulties of transport. Sharp corners and narrow corridors had the power to affect the routing of the parade, and sometimes necessitated a change in the entire organization.

Given the severity of these factors, a column's 2 km journey from the Emporium marble yards on the Tiber to the building site was inherently difficult. The route had to utilize extant streets and avoid the physical obstacles of the Palatine and Capitoline Hills. The Palatine residences lie to the west of the building site, and the Velian Hill immediately to the east. In addition, the urban topography at both the northern and southern end of the city center was extremely dense, and

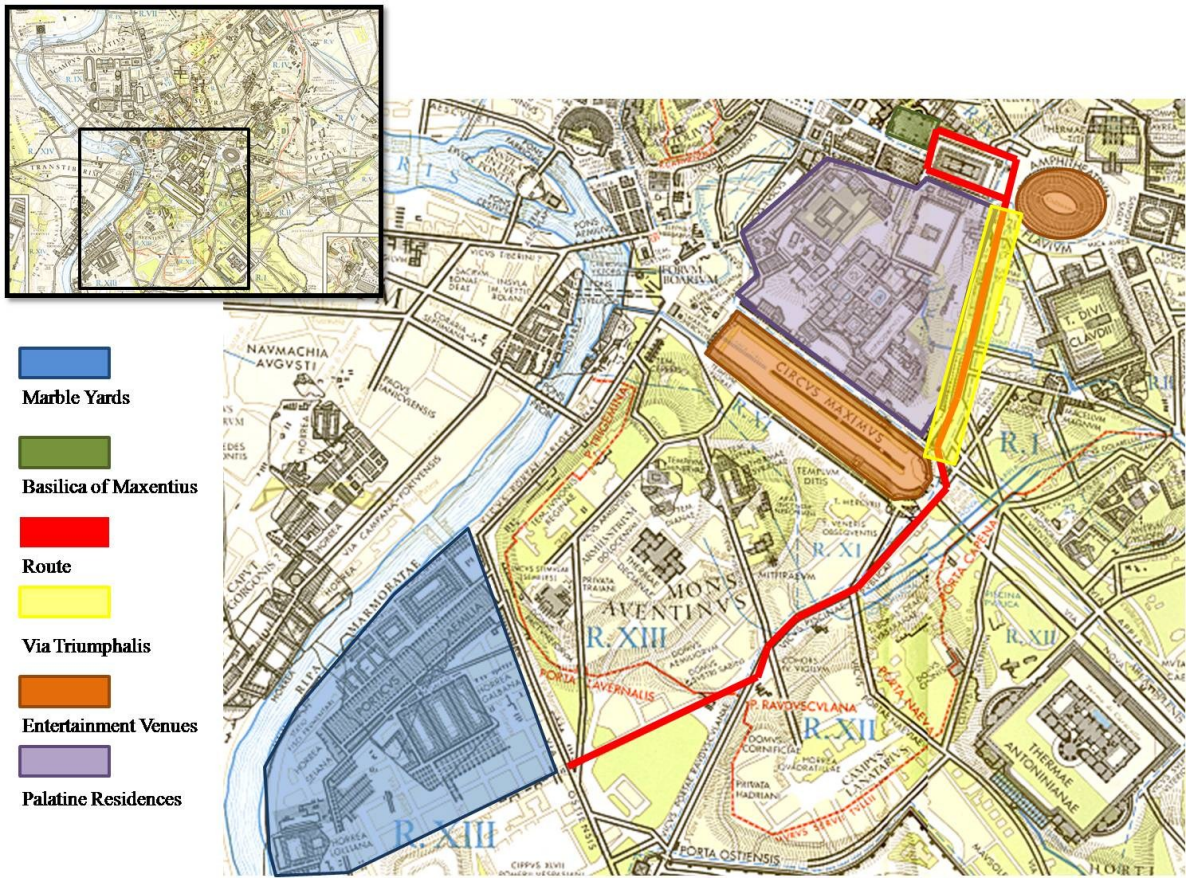

Fig. 2: Scagnetti map with the possible route from the Emporium marble yards to the Basilica of Maxentius highlighted in red.

yielded only a few avenues.[24] Maxentius was likely forced to choose from two routes, with the first following the Tiber and approaching the site from the northwest, and the second following the Via Ostiensis and approaching from the southeast. The approach via the Tiber would necessitate a conveyance along the river or the narrow streets on its banks. The columns would then need to pass through the Forum Boarium, and negotiate a series of small and winding streets to get to the Capitoline entrance of the Forum.[25] They would then need to interrupt the activity of the Forum and pass through its entire length to the building site.

Instead, the directionally opposite approach would begin by moving from the Emporium down the Via Ostiensis, turning east along the Via Piscinae Principalis, and passing the southern promenade of the Circus Maximus (Fig. 2). The columns would then enjoy a long straightaway in the so-called Via Triumphalis, entering the Colosseum Valley from the south. The columns would then turn ninety degrees and head up the Via Sacra across the Velian Hill spur to the building site. In determining the route of the marble procession, it is important to note the possibilities for ease of transport, the geographical make-up of the areas, and the political aims of the imperial client. The approach from the Via Triumphalis would be easier on the oxen train for three principal reasons: the turns are slighter, the streets are wider, and the hills are less intimidating. The Triumphal approach would also allow for a poignant connection to the other notable building that Maxentius was restoring: the Temple of Venus and Rome. In truth, the entire area from the Colosseum to the southern Forum was most likely appropriated for a variety of construction purposes. The bricks, lime, pozzolana, and other materials had been funneled into this area for months, and set up in a variety of staging areas. These areas would now either have to share or give up their position for the complicated train of colossal materials that was soon arriving.

Fig. 3: Scene of a building site, painting from Stabiae (Archaeological Museum of Castellmare, no. 282).

[24] Based on the vector from the Emporium marble yards to the building site, several of the hills of Rome would be directly in the way, and the route would move north or south around the Palatine Hill; even if there was another marble yard in the Campus Martius (an idea which Maischberger 1999, 325-334 discounts), the route from the Emporium district would still appear to be easier to traverse than moving through the area of central Rome to the Forum. Routes based on an analysis of the city of Rome in the form of the map *Roma Urbs Imperatorum Aetate* (by Fransiscus Scagnetti in 1979).

[25] The route through the Forum Boarium would not be the difficult part of this particular segment, as its use for construction material travel was attested to in Plin. *Nat.* 36.105-06.

The fact that construction was underway in the entire southern Forum area functioned as a long, sustained declaration of production activity (Fig. 3).[26] The clang of hammers and the shouts of workmen overtly signaled the construction tasks. The town crier may have made an announcement, but the disruptive rumbling of the streets would indicate that a parade of marble columns was quickly approaching.[27] It had been decades since the center of Rome was last alive with the din of construction, and the plebeians periodically stopped their work to check on the progress.[28] The populace of Rome undoubtedly missed the long-departed days of frequent spectacle in the city center. Surely the promise of eight massive marble columns for a prominent new building in the Forum was a powerful prospect for the recently demoted second-class citizens of the empire. Rome had always enjoyed a public exhibition, from speeches to feasts to ritual processions.[29] The plebeians of Rome were fanatical about spectacles, and during the days of the Empire, they turned out in great numbers whenever a procession was announced.[30] The citizenry of Rome appreciated a choreographed show, and the best staged views were habitually revered by senator and plebeian alike.[31]

The best views of the action were held at a premium, and a loose choreographing of the crowd was undoubtedly necessary for safety reasons. Spectators might randomly accumulate at pivot points for the column and oxen train, as well as any point when the monolith needed to be raised or lowered.[32] As it was, the wide, straight Via Triumphalis afforded such an area for curious onlookers. Moving down the Via Triumphalis also allowed the marble parade to fortuitously pass the two main entertainment venues of the city: the Circus Maximus and the Colosseum. Triumphal processions had a sustained history of traveling through the Circus Maximus, and it is reasonable to assume that the marble parade may have segued into the southeastern end of the massive arena to give the commoners a sustained look. Other viewers might even have stood in the outer arcades of the Colosseum to witness the turning of the columns, or near the Temple of Venus and Rome to watch the raising of the columns. In these locations, the engineering challenges are magnified, and the spectatorship is escalated. Although there were many slight

[26] See visual evidence for construction sites, *Scene of a building site*, painting from Stabiae (Archaeological Museum of Castellmare, no. 282); *Scene of a building site*, relief found at Terracina (National Museum of Rome).

[27] In Sen. *Ep.* 56, the author notes the great noise from a simple passing carriage; the noises from the many carriages rumbling along these routes would undoubtedly have the power to rouse anyone in the near vicinity, and this noise might have trumped the normal construction noises from the Forum as well.

[28] The city center here is the Forum, the Campus Martius, and the immediate housing and manufacturing areas near the Tiber; thus it was last in the 280s that Diocletian had constructed his main buildings.

[29] For a discussion of Roman interest in spectacle, cf. Carcopino 1940, 202-206.

[30] Plut. *Aem*. 32.2; "The people erected scaffolds in the forum, in the circuses, as they call their buildings for horse races, and in other parts of the city where they could best behold the show…all the temples were open, and full of garlands and perfumes."

[31] A discussion of Roman perception of festivals is contained in the 'Seeing the festival' subsection of Favro 2008, 14-22.

[32] Such an episode of spectatorship is described in Hor. *Ep.* 2.2.72-80, "A builder in heat hurries along with his mules and porters: the crane whirls aloft at one time a stone, at another a great piece of timber."

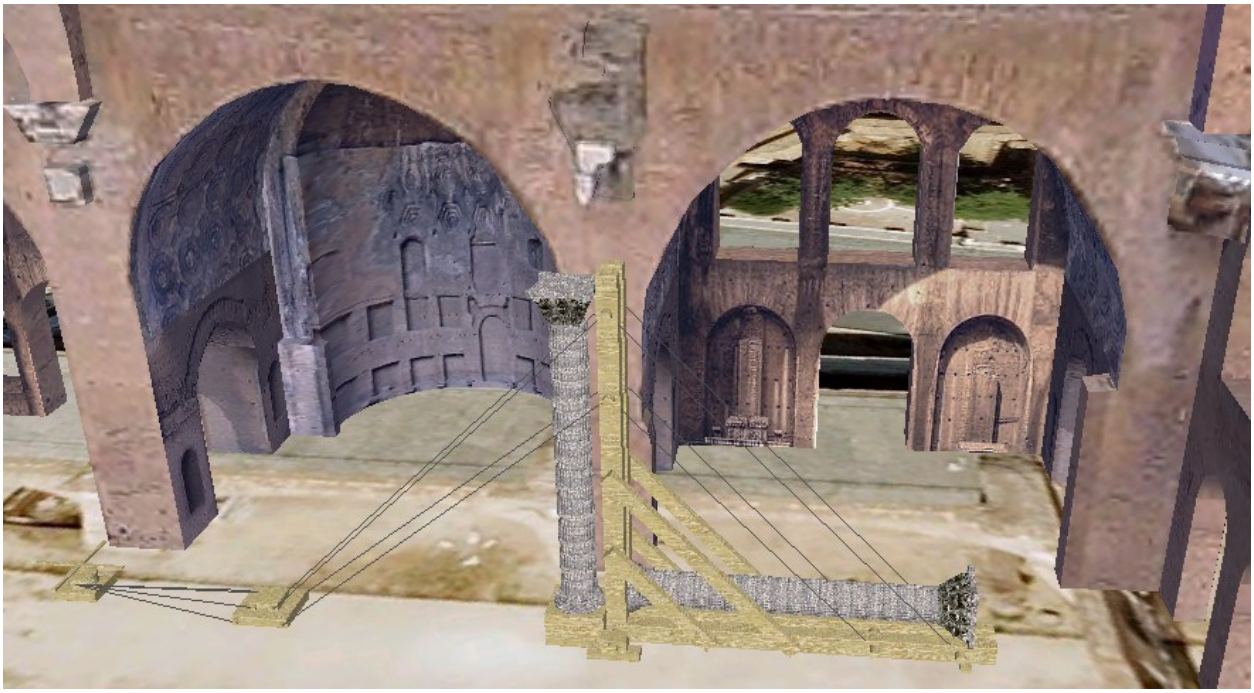

Fig. 4: Superimposition of 3D model of lifting machine by the author after the descriptions of Vitruvius and the drawing by J.-P. Adam, inserted into a GoogleEarth framework with 3D buildings enabled (including Basilica of Maxentius for scale).

turns along the meandering parade route, the primary impediment was negotiating a ninety-degree turn in the Colosseum Valley. A famous task on a similar scale has been described in the *Historia Augusta*, "and Hadrian raised the Colossus and, keeping it in an upright position, moved it away from the place in which the Temple of Rome is now, though its weight was so vast that he had to furnish for the work as many as twenty-four elephants."[33] A task similar to this, even without the aid of gargantuan exotic animals, undoubtedly drew the interest of a large crowd of spectators. As Maxentius was simultaneously renovating the Temple of Venus and Rome adjacent to the Basilica of Maxentius, it is feasible that the entire Velian spur between the Colosseum Valley and the building site might have been strewn with onlookers awaiting the climactic event in the marble parade.

As each column arrived at the building site, it was likely raised immediately into place in order to make each effort unique and rewarding to the onlookers. An interesting example of the pomp and circumstance associated with raising large marbles is recorded on the base of a column drum in Sardis, where the column itself promptly states "I am the first to rise." As the up-righting of the columns was one of the most difficult engineering tasks, it would have drawn the most interest.[34] Each event would be inherently difficult to stage on the ground level, as workers, implements, and building materials would be strewn about the site. But the assembling area could be viewed from locations on the Velian Hill to the east, the Palatine residences to the west, and the podium of the Temple of Venus and Rome on the south. The populace had a strong desire to see the columns triumphantly raised, and the spectacular mechanisms that moved them.

[33] Ael. *Sp. Had*. 19.12.

[34] For case studies on building sites and construction, cf. Taylor 2003; and Lancaster 1999.

The raising of the columns employed a variety of equipment, including cranes, lift towers, and other simple machines (Fig. 4). In Vitruvius' tenth book on machines, the author describes many cranes, and elaborates that these machines are used for hoisting heavy loads during "the completion of temples and public works," and also for loading and unloading ships.[35] He mentions that some of these machines are set upright in a stationary position, while some have revolving booms. Vitruvius also describes an instrument of laminated wood and supporting cords that resembles a fulcrum lever mechanism. Capstans at the ground level would feed the cords through pulleys to effectively tension the wood beams, and pull the column from a lying horizontal position to its vertical standing position. Large wooden cranes, which were spectacular examples of Roman ingenuity in themselves, would then lift the column into its place on each podium (see Figure 5).[36] Vitruvius illuminates this type of pulley-based machinery, which was operated by *mechanicos*, or many workers, as opposed to one skilled workman. Depending on the size of the loads, these cranes employed single or double boom arms, with trispastos or pentaspastos tackle to raise and lower the load. The largest of loads would require reduction gear, including the use of capstans to tension the boom arms. The most difficult and unwieldy of loads would be handled by treadmill cranes, as illuminated in a scene from the Haterii Relief (Fig. 6). These cranes have been depicted with up to eight workers inside the bowels of the treadmill, which provide the necessary power to manipulate the loads. The operation of a single machine might require dozens of teams, but even more impressive is the Roman technique of using these machines in tandem to achieve a singular purpose; in this case to erect a 15 m column.

Fig. 6: Digital rendering of a Roman treadmill crane, after descriptions by Vitruvius, drawings by J.-P. Adam and others, and the Haterii relief, superimposed within the digital Roman Forum (courtesy UCLA ETC).

Fig. 5: Haterii Relief (CIL VI.19151), depiction of treadmill crane at work in the construction of an unknown temple.

[35] Vitr. 10.2.1-4.

[36] Treadmill cranes are also described in Vitr. 10.2.1-4, and championed by Adam and Taylor.

The combination of the two machines would require an area over half the size of a football field. This may have been even larger depending on the desired locations for cords and capstans, and the necessary safety perimeter. For a 15 m column, the engineers must have employed at least a 25 m boom-arm treadmill crane. In order for the workers to raise the contraption and tether all the guide-wires in a circular fashion, these figures would yield an area of 2800 m^2. The fulcrum column-raising machine also takes up almost 750 m^2. If the area of the two implements is considered together with the various material staging areas and the impediment of the Basilica's outer halls, which would already have been progressively rising, the severity of this particular problem comes steadily into focus.

The 4th c. A.D. historian Ammianus Marcellinus describes the raising of such a monolith in Rome during the time of the Emperor Constantius II. "The obelisk was put on cradles and brought into the Circus Maximus. After this, there remained only the raising, which it was thought could be accomplished only with great difficulty, perhaps not at all. It was gradually drawn up on high through the empty air, and after hanging for a long time, while many thousand men turned wheels resembling millstones, it was finally placed in the middle of the circus."[37] Each successful engineering feat thus operated as a commemoration of the building's impending completion, and functioned as a testament to the power of the emperor's construction industry. The Via Triumphalis and the Via Sacra provided a successful venue for showcasing the marble monoliths as they moved into their spot in a politically-charged building project (Fig. 7). The route of the procession surely presented problems of transport, but also proffered a grand showcase for the solution of these problems.

Fig. 7: Digitally constructed image by the author, culled from still image of digital city of Rome (courtesy UCLA ETC), image of Mussolini's monolith transport, a 15-meter long Proconnesian marble column, and still images of spectators in period clothing.

[37] Amm. 17.4.14-15.

In the tradition of displaying spoils of war, the marble procession's massive oxcart train was one method of depicting the pageantry and spectacle of a triumph. The slow and deliberate movement of the marble column past the Circus Maximus and the Colosseum, up the sacred way, and into place at the Basilica loosely resembles the path of the triumphator. The penultimate act is the erection of the column, which takes the place of the ritual sacrifice. The raising acted as the climax of the procession, and delivered a final herculean feat of ingenuity and significance to the gawking spectators. As the basilica steadily rose in tandem with the addition of its columns and the erection of its vaults, the accuracy and organization of Roman construction process come into focus. Designers, engineers, and masons worked tirelessly in cooperation with each other to keep a city functioning while its construction industry displayed its relentlessly precise system of logistical planning.

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